SIEMENS

SIMATIC

ET 200S Positioning

Operating Instructions

05/2007
A5E00124871-04

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING
This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Ordernumber: A5E00124871-04
℗ 05/2007

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1 Overview

How the Manual is Structured

This manual complements the manual *Distributed I/O System ET 200S*.

It contains descriptions of the ET-200S modules that can be used for serial communication.

How to Find Your Way Around

At the beginning of each chapter you will find a Product Overview, which lists the features and applications of the module described. You will also find the order number of the module and the name and release of the software required. For the current GSD file, go to:

http://support.automation.siemens.com

In each chapter you will then find a section with the heading Brief Instructions on Commissioning followed by the name of the relevant module. These brief instructions tell you in a series of short steps how to install and configure the module, how to integrate it in your use program, and how to test it in your user program.

Index

The index contains keywords that come up in the manual.

Further Support

Should you have any questions on the products described which are not answered in this documentation, please contact your local Siemens partner.

Your partner can be found under:

http://www.siemens.com/automation/partner

Your guide to the technical documentation for the individual SIMATIC products and systems can be found under:

http://www.siemens.com/simatic-tech-doku-portal

The online catalog and the online order system can be founder under:

http://mall.automation.siemens.com/

Training Center

We offer corresponding courses to help familiarize you with the SIMATIC S7 automation system. Please contact your regional training center or the central training center in D 90327 Nuremberg, Germany.

Phone: +49 (911) 895-3200

Internet: http://www.sitrain.com

Technical Support

The Technical Support for all the A&D products can be contacted

- Via the Web form for support request

  http://www.siemens.de/automation/support-request
- Phone: + 49 180 5050 222
- Fax:+ 49 180 5050 223

Further information about our Technical Support can be found on the Internet under http://www.siemens.com/automation/service.

Service & Support on the Internet

In addition to our documentation online we also offer you our complete knowledge online on the Internet.

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There you can find:

- The newsletter that constantly provides you with up-to-date information on your products.
- The right documents via our Search function in Service & Support.
- A forum, where users and experts from all over the world exchange their experiences.
- Your local partner for Automation & Drives.
- Information on service on site, repairs, and spare parts. You will also find much more under “Services”.

1STEP 5V/204kHz 2

2.1 Product overview

Order number

6ES7138-4DC00-0AB0

Features

The 1STEP 5V/204kHz generates pulses for the power units of stepping motors. The number of pulses emitted determines the distance traversed. The pulse frequency determines the velocity.

A stepping motor shaft turns by a certain angle with every pulse. During rapid pulse sequences, this stepping movement becomes a continuous turning motion.

The 1STEP 5V/204kHz has the following features:

- Digital input as reference cam
- Digital input as external STOP or external pulse enable
- Interface to commonly available stepping motor power units with differential signals for pulses and direction to RS 422
- Maximum output frequency 204 kHz
- Distance up to 1 048 575 pulses

Configuration

You can use either of the following to configure the 1STEP 5V/204kHz:

- A DDB file (http://www.ad.siemens.de/csi/gsd) or
- STEP7 as of version V5.0 SP3

2.2 Example: Commissioning 1STEP 5V/204kHz

Task

The task of the 1STEP 5V/204kHz is to position a drive on certain predefined destinations.

Using the example of an incremental run, it guides you to a functioning application in which you get to know and check a positioning operation (both hardware and software) of your 1STEP 5V/204kHz.

Note

The power unit used in this example and the stepping motor can be replaced by products from other manufacturers.

Note that the power unit must process signals for pulses and direction in accordance with RS 422. Make sure you also adapt the wiring to the products you have chosen.

Requirements

The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You must have:
  - A TM-E15S24-01 terminal module
  - A 1STEP 5V/204kHz
  - An FM STEPDRIVE

    (Order Number: 6SN1 227-2ED10-0HA0, Catalog ST 70)
  - A 3-phase stepping motor in the SIMOSTEP range

    (for example, order number: 1FL3 041-0AC31-0BG0; Catalog ST 70)
  - A motor cable (for example, order number: 6FX5008-5AA00-1BA0; Catalog ST 70)
  - A network filter

    (Order Number: B84113-C-BGO, Catalog ST 70)
  - The necessary wiring material

Installation, Wiring, and Fitting

1. Install and wire the TM-E15S24-01 terminal module (see the following figure).
2. Connect the 1STEP 5V/204kHz to the terminal module (you will find detailed instructions on how to do this in the *Distributed I/O Device* manual).

You can find out how to wire the power unit and the stepping motor in the relevant product manuals.

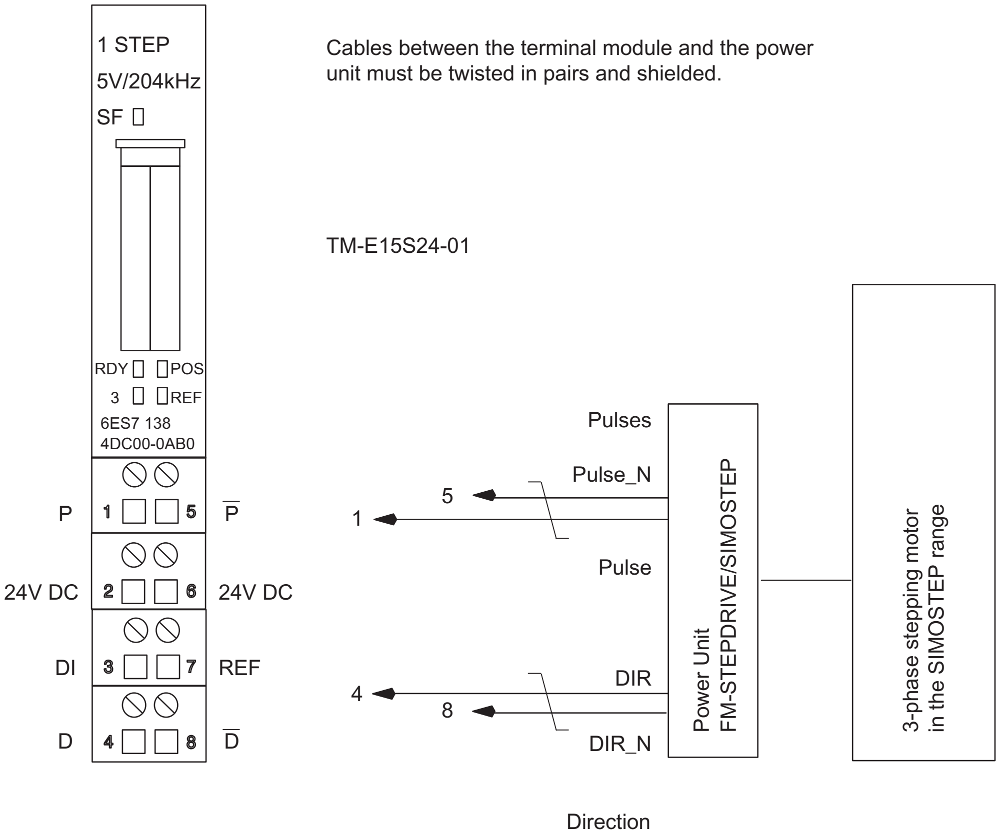


Figure 2-1 Terminal Assignment for the Example

Configuring STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. Select 1STEP from the hardware catalog. The number 6ES7 138-4DC00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1STEP 5V/204kHz.
4. Double-click this number to open the DP Slave Properties dialog box.
5. On the Addresses tab, you will find the addresses of the slot to which you have dragged the 1STEP 5V/204kHz. Make a note of these addresses for subsequent programming.
6. On the Parameters tab, you will find the default settings for the 1STEP 5V/204kHz.
   Set the DI function as "external STOP". You must set the "external STOP, limit switch" parameter as a normally open contact.
7. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Integrating the FC 101 Block into the User Program

Integrate block FC101 in your user program (for example, in OB1).

This block requires the DB1 data block with a length of 16 bytes. In the following example, the start is triggered by setting the memory bit 30.0 with the programming device.

WARNING
You may damage your system at the start of a run (4800 pulses forwards). It may therefore be necessary to adjust the distance.

```
STL                                             Explanation
Block:      FC101
                                                //Initialize control interface

            L       L#4800;                     //Distance 4800 pulses
            T       DB1.DBD     0;
            L       1;                          //Multiplier 1 for output frequency
            T       DB1.DBB     0;

            L       0;                          //Delete limit switch etc.
            T       DB1.DBB     5;
            T       DB1.DBW     6;

            SET;

            S       DB1.DBX     5.2;            //Set pulse enable DRV_EN
            R       DB1.DBX     4.0;            //Set incremental mode
            R       DB1.DBX     4.1;            //Reserve bit = 0
            R       DB1.DBX     4.2;            //Reserve bit = 0
            R       DB1.DBX     4.3;            //Reserve bit = 0
            R       DB1.DBX     4.5;            //Delete backward start DIR_M
            R       DB1.DBX     4.6;            //Delete STOP
            R       DB1.DBX     4.7;            //Delete reduction factor R

            L       DB1.DBD0                    //Write 8 bytes to 1STEP 5V/204kHz
            T       PAD 256
            L       DB1.DBD4
            T       PAD 256

            L       PID 256                     //Read 8 bytes from 1STEP 5V/204kHz
            T       DB1.DBD4
            L       PID 260
            T       DB1.DB12

            A       M           30.0;           //Detect the edge on start initiation and set start
            AN      DB1.DBX     12.0            //DIR_P if STS_JOB is deleted.
            S       DB1.DBX     4.4

            A       DB1.DBX     12.0            //Wait for STS_JOB and
            R       DB1.DBX     4.4             //Reset start DIR_P; the run begins
            R       M           30.0            //Delete start initiation
```

Testing the Configuration

Start an incremental run and monitor the associated feedback.

1. Using "Monitor/Modify Variables", check the residual distance and the status bits POS (positioning in operation) and STS_DRV_EN (pulse enable).
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table" menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   – DB1.DBD8 (residual distance)
   – DB1.DBX13.7 (POS, positioning in operation)
   – DB1.DBX13.0 (STS_DRV_EN, pulse enable)
   – M30.0 Start by means of the programming device
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor" to switch to monitoring.
6. Switch the CPU to RUN mode.

Result

When you switch the CPU to RUN, the following results are obtained:

- The RDY LED lights up.
- The POS status bit is deleted.
- The STS_DRV_EN status bit is set.

Start the run by setting memory bit 30.0 ("Variable > Modify >").

The following result is obtained during the run:

- The POS status bit is set (you can see this by monitoring the variable); that is, the POS LED lights up.
- The residual distance is continuously updated.
- The STS_DRV_EN status bit (pulse enable) is set.

The following result is obtained after the run has been completed:

- The POS status bit is deleted (you can see this by monitoring the variable); that is, the POS LED is no longer illuminated.
- The residual distance is 0.
- The STS_DRV_EN status bit (pulse enable) is set.

2.3 Terminal Assignment Diagram

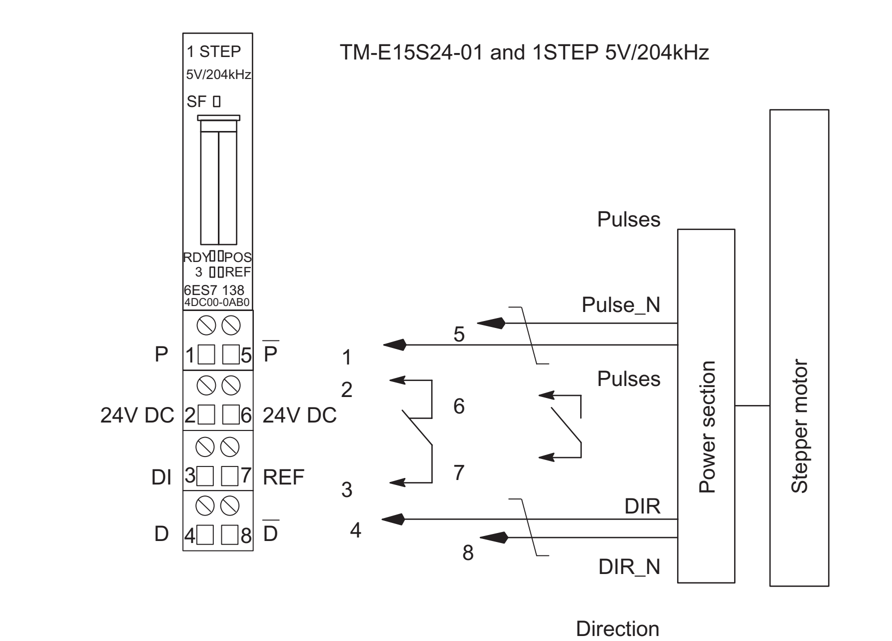
Wiring rules

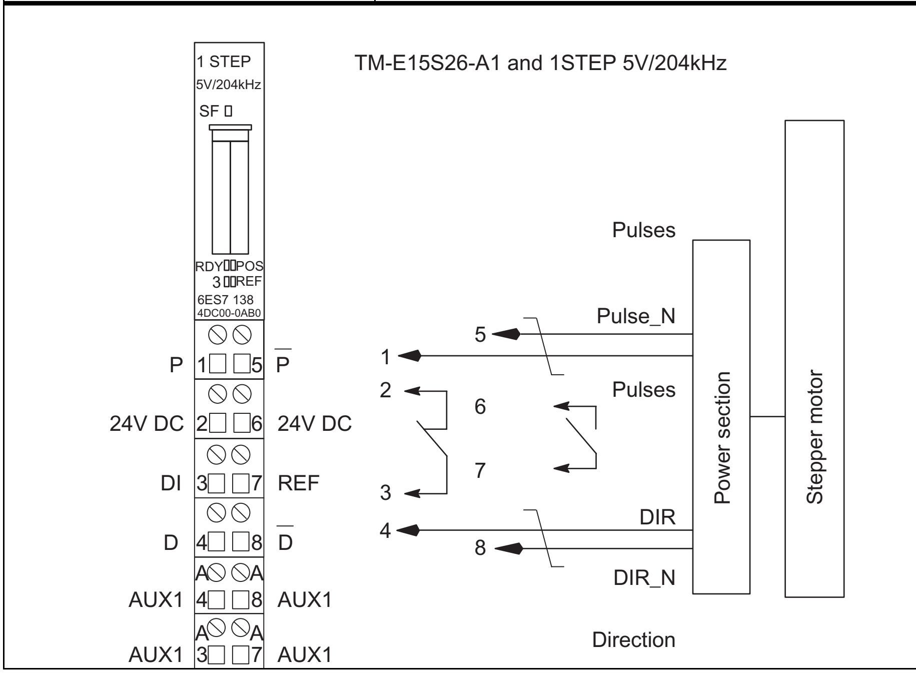
The cables (terminals 1 and 5 and terminals 4 and 8) to the power unit must be shielded, twisted-pair cables. The shield must be supported at both ends. You use the shield contact element (Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal assignment

The following table shows the terminal assignment for the 1STEP 5V/204kHz.

Table 2-1 Terminal Assignment of the 1STEP 5V/204kHz

View	Terminal assignment	Remarks
		The cables between the terminal module and power unit must be shielded and twisted in pairs. P, /P and D, /D are signals to RS 422.

View	Terminal assignment	Remarks
		The cables between the terminal module and power unit must be shielded and twisted in pairs. P, /P and D, /D are signals to RS 422.

2.4 Safety concept

Safety Measures

The following measures are imperative for the safety concept of the system. Install the items carefully, and ensure they meet the system's requirements.

WARNING
To avoid injury and damage to property, make sure you adhere to the following: • Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.). • Make sure that no one has access to areas of the system with moving parts. • Install hardware limit switches for the end positions of the axes that switch off the power control system directly. • Install devices and take steps to protect motors and power electronics, as described for example in the installation guidelines for the FM STEPDRIVE/SIMOSTEP.

Setting up a positioning control

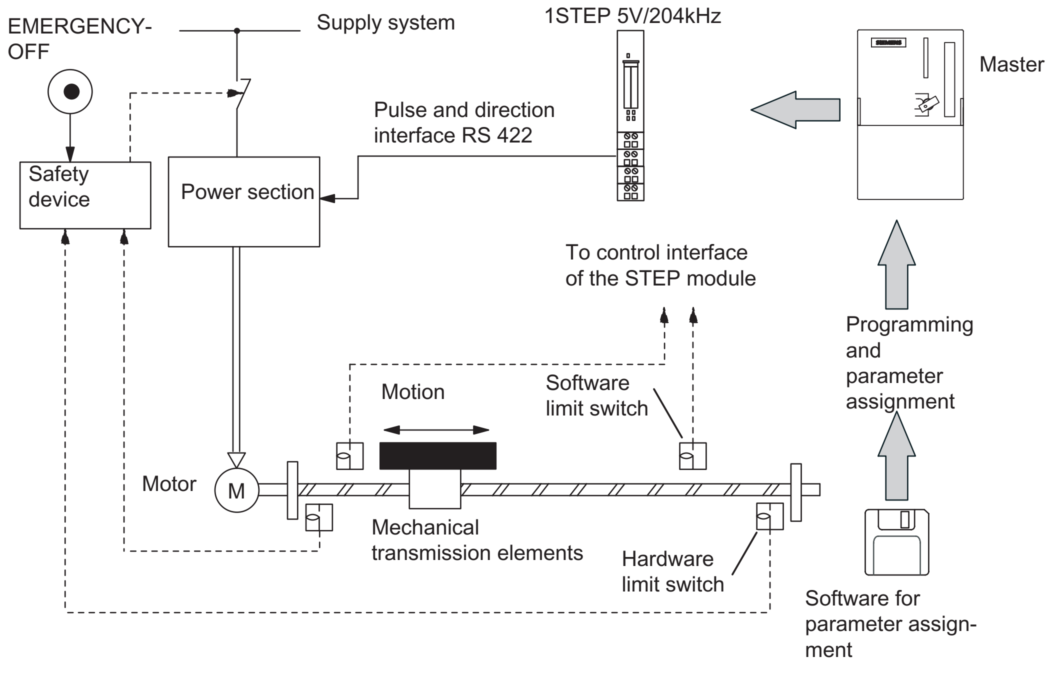


Figure 2-2 Design of a Positioning System with a Stepping Motor (Example)

The 1STEP 5V/204kHz generates the control frequency and the directional signal for the power unit. The power unit processes the control signals and supplies the motor with power. The motor is connected directly or by means of mechanical transmission elements to the machine part that is to be moved.

2.5 Fundamentals of Positioning

2.5.1 Overview

Introduction

Below you will find out how the individual components - the electronic module, the power unit, and the motor - affect each other.

Stepping motors

Stepping motors are used to position axes. They represent the simple and cost-effective solution for precision positioning tasks in wide performance ranges.

A stepping motor shaft turns by a certain angle with every pulse. During rapid pulse sequences, this stepping movement becomes a continuous turning motion.

You can, for example, select one of the SIMOSTEP stepping motors (see *Catalog ST 70*).

Power unit for stepping motors

The power unit is the connecting link between the 1STEP 5V/204kHz and the stepping motor. The 1STEP 5V/204kHz sends 5 V differential signals for frequency and direction. These signals are converted in the power unit into motor currents that control the movements of the motor with a very high degree of precision.

You can, for example, use FM STEPDRIVE (see *Catalog ST 70*), which is suitable for SIMOSTEP stepping motors.

1STEP 5V/204kHz

The 1STEP 5V/204kHz generates pulses and a directional signal for the power units of stepping motors. The number of pulses emitted determines the distance traversed. The pulse frequency determines the velocity. The way the 1STEP 5V/204kHz works depends on its parameters and settings.

2.5.2 Parameters and Settings

Required Information

To ensure optimum interplay between the individual components, you must provide the 1STEP 5V/204kHz with information:

- **One time: during parameter configuration using your configuration software**
  - Base Frequency $F_{b:}$
  - Multiplier n for setting the start-stop frequency F_{ss}
  - Multiplier i for setting the acceleration/delay in steps
- **In operation: movement of the motor by means of a positioning job in your user program**
  - Multiplier G for the velocity/output frequency F_a
  - Reduction factor R for the assigned parameters base frequency F_b
  - Distance (number of pulses to be emitted)
  - Mode and
  - Direction selection as start
- **In operation: to adjust to different load conditions as a parameter assignment request in your user program**
  - Base Frequency $F_{b:}$
  - Multiplier n for setting the start-stop frequency F_{ss}
  - Multiplier i for setting the acceleration/delay in steps

See also

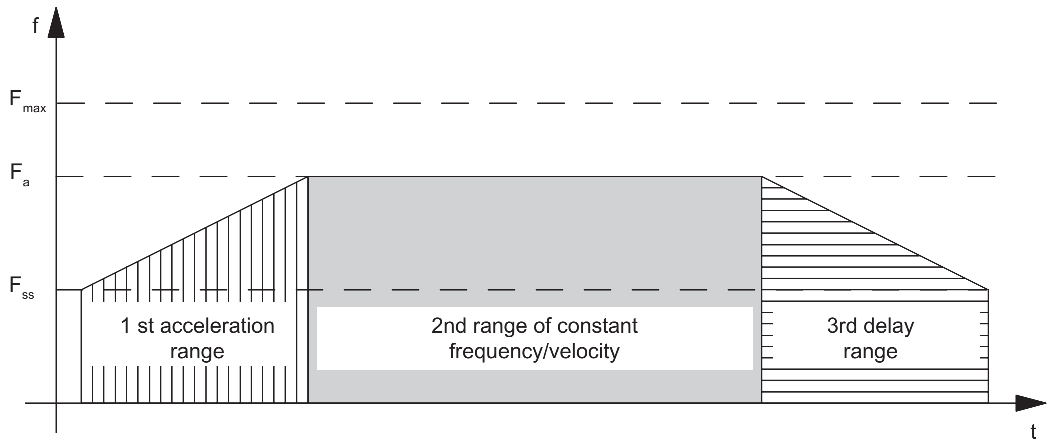
Traversal Curve of the 1STEP 5V/204kHz (Page 26)

Setting the Base Frequency (Page 29)

2.5.3 Traversal Curve of the 1STEP 5V/204kHz

Introduction

Each movement of the stepping motor is executed by the 1STEP 5V/204kHz in accordance with the following traversal curve. The 1STEP 5V/204kHz forms the fundamental parameters (start-stop frequency, output frequency, and acceleration/delay) of the traversal curve with a base frequency that you select.



F_{ss} = start-stop frequency
F_a = output frequency
F_{max} = maximum frequency of the stepping motor

Figure 2-3 Traversal Curve of the 1STEP 5V/204kHz

Start-Stop Frequency F_{ss}

The start-stop frequency F_{ss} is the frequency to which the motor can be accelerated under load from a standstill. If the selected start-stop frequency F_{ss} is too high, the motor may stop.

The size of F_{ss} depends on the load inertia. The best way to work out the load inertia is by trial and error.

The start-stop frequency F_{ss} is simultaneously the minimum output frequency F_a needed to move the stepping motor.

Setting the Start-Stop Frequency F_{ss}

Through parameter assignment, the 1STEP 5V/204kHz permits the start-stop frequency F_{ss} to be set in steps. To do this, select the multiplier n between 1 and 255, which is multiplied with the base frequency F_b. You can lower the start-stop frequency F_{ss} again with the reduction factor R (1 or 0.1) in the positioning job.

$F_{ss} = F_b * n * R$	min. F_{ss}	max. F_{ss}
Reduction factor R=1	4 Hz	204 kHz
Reduction factor R=0.1	0.4 Hz	20.4 kHz

Maximum Frequency/Velocity of the Axis F_{max}

When you choose a stepping motor, remember the following:

The maximum frequency/velocity is determined by your application. At this frequency, the motor must reach a torque high enough to move its load.

Note this does not mean the highest possible frequency that the motor or the power unit can tolerate.

You can work out the maximum frequency F_{max} with the corresponding characteristic curve.

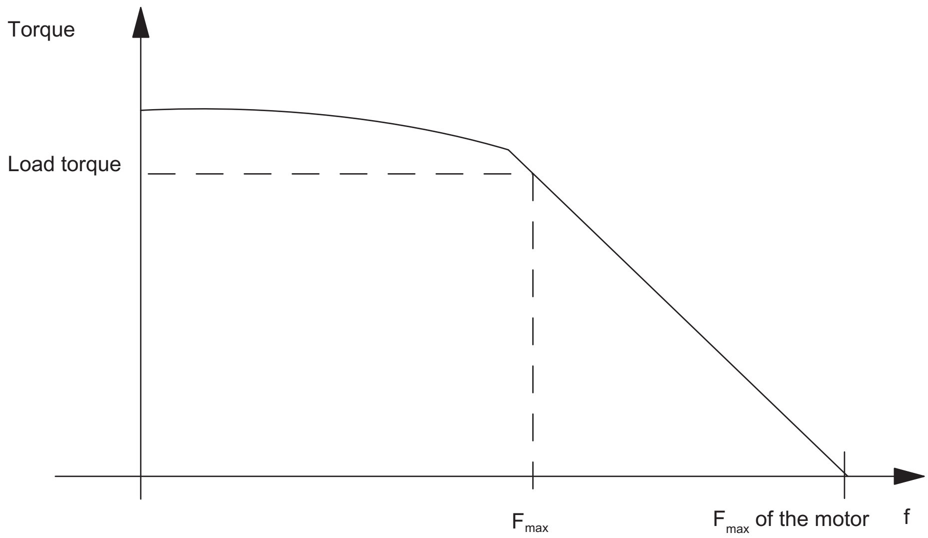


Figure 2-4 Torque Characteristic Curve of a Stepping Motor

Output Frequency/Velocity (F_a)

The output frequency can be set differently for each run.

When you select the output frequency, take the minimum pulse duration of your power unit into consideration (see the following table).

If the selected output frequency is lower than the set start-stop frequency F_{ss}, the 1STEP 5V/204kHz output frequency is set to the start-stop frequency F_{ss}.

F_a must always be smaller than F_{max}.

Setting of the Output Frequency/Velocity (F_a)

The 1STEP 5V/204kHz permits the output frequency F_a to be set in steps. To do this, select the multiplier G between 1 and 255, which is multiplied with the base frequency F_b. You can lower the output frequency F_a again with the reduction factor R (1 or 0.1) in the positioning job.

$F_a = F_b \cdot G \cdot R$	Min. Fa	Max. Fa
Reduction factor R=1	4 Hz	204 kHz
Reduction factor R=0.1	0.4 Hz	20.4 kHz

Acceleration/delay a

The maximum permitted acceleration/delay depends on the load to be moved.

The motor must reach a torque high enough to accelerate or delay the load without loss of step.

Depending on the application, you must also take into account additional criteria for setting the acceleration/delay, such as smooth starting and stopping.

Setting the Acceleration/Delay a

Through parameter assignment, the 1STEP 5V/204kHz permits the acceleration/delay to be set in steps by means of the multiplier i.

During the acceleration phase, the frequency is increased in steps starting from the start-stop frequency F_{ss} until the output frequency F_a has been reached.

The time interval for the gradual increase in frequency can be set in steps. To do this, select the multiplier i between 1 and 255, which is multiplied with the fixed period of 0.032 ms. After each time interval, the frequency is increased by one quarter of the base frequency F_b.

In the delay phase, the output frequency is reduced in the same way.

You can lower the acceleration/delay a again with the reduction factor R (1 or 0.1) in the positioning job.

$a = F_b \cdot R / (i \cdot 0.128\ ms)$	Min. a	Max. a
Reduction factor R=1	0.12 Hz/ms	6250 Hz/ms
Reduction factor R=0.1	0.012 Hz/ms	625 Hz/ms

See also

Setting the Base Frequency (Page 29)

2.5.4 Setting the Base Frequency

Introduction

Through parameter assignment, the 1STEP 5V/204kHz permits the base frequency to be set in steps.

The base frequency sets the range for the start-stop frequency, the output frequency, and the acceleration.

Procedure

1. Depending on the priority of your request, select one of the three columns from the following table:
   - Range for the start-stop frequency F_{ss},
     for example, for starting and stopping as soon as possible
   - Range for the output frequency F_a,
     for example, for a velocity setting that is as precise as possible
   - Range for the maximum acceleration a,
     for example, for the fastest possible positioning operations
2. Use the table to determine the base frequency F_b.
   To optimize the base frequency F_b proceed as follows:
3. Check whether the other corresponding values meet your requirements. If necessary, select another base frequency F_b, which meets your requirements better.
4. Define the multipliers required to set the output frequency F_a, the acceleration/delay a, and the start-stop frequency F_{ss}.

The values in the table are based on reduction factor 1. If you use the reduction factor 0.1, you can reduce the range of the values without changing the parameters.

Table 2-2 Ranges for the Start-Stop Frequency, Output Frequency, and Acceleration

Base frequency F_b in Hz	Range Start-Stop frequency F_{ss} in Hz	Range Output Frequency F_a in Hz	Range Max. Acceleration a in Hz/ms	Minimum pulse duration in µs
	Formula: $F_{ss}= F_b*n*R$	Formula: $F_a= F_b*G*R$	Formula: $a= F_b* R / (i*0.128)$	
4	4...1020	4...1020	0.12...31.2	255
8	8...2040	8...2040	0.25...62.5	127
20	20...5100	20...5100	0.61...156	63
40	40...10200	40...10200	1.22...312	31
80	80...20400	80...20400	2.45...625	15
200	200...51000	200...51000	6.12...1560	7
400	400...102000	400...102000	12.25...3125	3
800	800...204000	800...204000	24.5...6250	2

F_b = Base frequency
F_{ss} = Start-Stop frequency
F_a = Output frequency
a = Acceleration/delay
R = Reduction factor
n = Multiplier for setting the start-stop frequency in steps
G = Multiplier for setting the output frequency in steps
i = Multiplier for setting the acceleration/delay in steps

2.6 Functions of the 1STEP 5V/204kHz

2.6.1 Overview

Introduction

The task of the 1STEP 5V/204kHz is to position a drive on certain predefined destinations.

The following functions are available to you to this purpose:

- Search for Reference. The axis is synchronized.
- Incremental Run: The axis is moved by a predefined distance.
- Stopping the Stepping Motor
- Changing Parameters during Operation

See also

Assignment of the Feedback and Control Interfaces (Page 44)

2.6.2 Search for Reference

Functional Description

The reference point marks the point of reference of your drive system (reference cam) for the following positioning jobs. You can find out the reference point by installing an initiator on the reference cam and connecting its normally open contact to the REF digital input.

The 1STEP 5V/204kHz ensures the reference point can be reproduced accurately in that it is always approached from the same direction. You can specify this direction by always starting the search for reference in the same direction.

Positioning Job for the Search for Reference

The job contains the following information:

- Multiplier G for the velocity/output frequency F_a
- Reduction factor R for the assigned parameters base frequency F_b
- Mode = 1 for search for reference
- Direction selection as start
- STOP at the Reference Cam

SYNC Status Bit

The SYNC status bit informs you that the axis has been synchronized, that is, after the correct search for reference, this status bit is set and deleted during the run.

The SYNC status bit is deleted

- After parameter assignment of your ET 200S station
- After deletion of the pulse enable
- After a CPU-/Master-STOP

In these cases it is advisable to carry out a search for reference.

Status Bits POS and POS_RCD

While search for reference is active, it is indicated by the POS feedback bit.

On completion of a correct search for reference, the POS_RCD feedback bit indicates that the position has been reached.

If the search for reference is interrupted, the feedback bit POS_RCD is not displayed.

Residual distance

The residual distance reported is irrelevant during the search for reference.

Note

To ensure that the 1STEP 5V/204kHz can reproduce reference points accurately, the period of the start-stop frequency must be longer than the signal delay of the REF digital input. You must therefore approach the reference points with start-stop frequencies lower than 100 Hz. In the case of start-stop frequencies F_{ss} greater than 100 Hz, you can do this using the reduction factor R in the relevant positioning job; this enables you to reach the corresponding start-stop frequency without changing the parameters.

If you stop at the reference cam or limit switch during the acceleration phase, the 1STEP 5V/204kHz continues to send pulses for 50 ms at the frequency already reached before it starts braking. This avoids abrupt changes in frequency, which can lead to step losses.

See also

Assignment of the Feedback and Control Interfaces (Page 44)

Stopping the Stepping Motor (Page 37)

2.6.3 Sequence of Execution of the Search for Reference

Steps of the Search for Reference

A search for reference consists of a maximum of three sections.

In the **first section** (1) and **second section** (2), the system ensures that the reference cam is found.

Both these sections are executed at the defined output frequency F_a.

In the **third section** (3), the reference cam is approached with start-stop frequency F_{ss} in the selected direction up to the reference point ⊕ with reproducible accuracy.

Note

Each section can have a maximum of only 1048575 pulses.

Different Execution Sequences

Depending on the position Ⓟ at the start of the search for reference, there are different execution patterns for the run (REF is the reference cam, which is wired to the REF digital input). The illustration applies to the forward starting direction (DIR_P).

Start before REF or at Limit Switch LIMIT_M

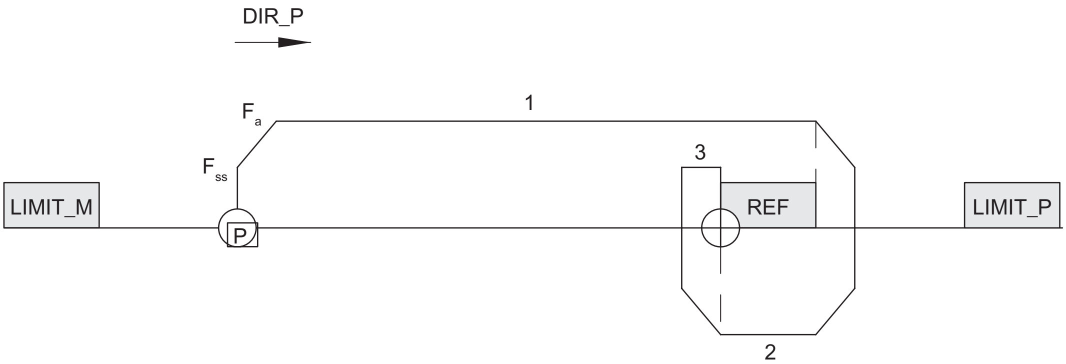


Figure 2-5 Search for Reference, Start before REF

Start after REF

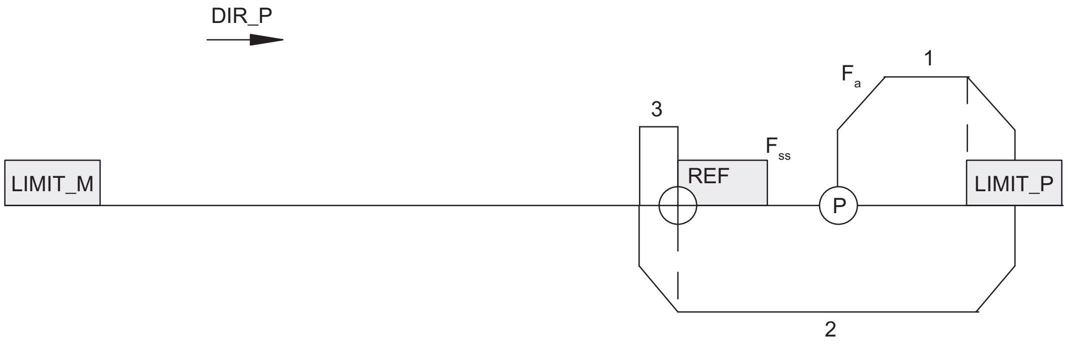


Figure 2-6 Search for Reference, Start after REF

Start at REF

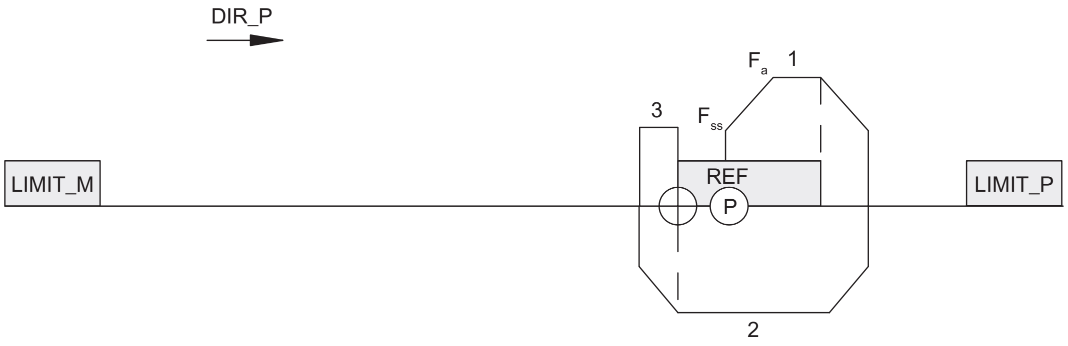


Figure 2-7 Search for Reference, Start at REF

Start at the Limit Switch in Start Direction

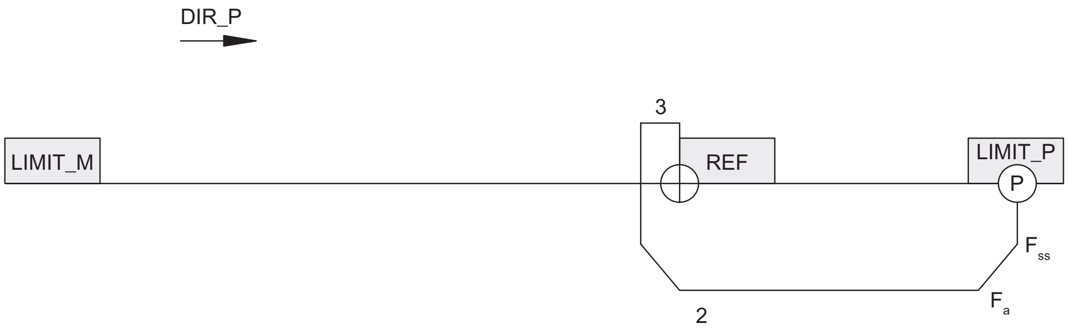


Figure 2-8 Start at the Limit Switch in Start Direction

Behavior: Defective Reference Cam with Limit Switch (Interruption of Search)

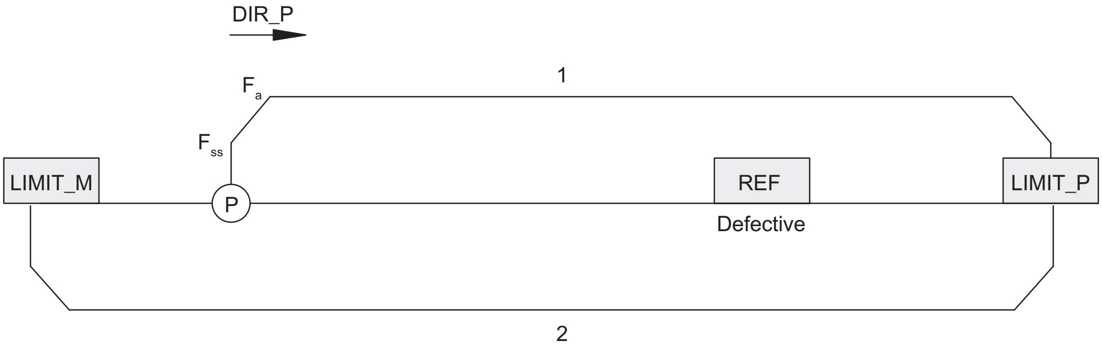


Figure 2-9 Defective Reference Cam, Start before REF

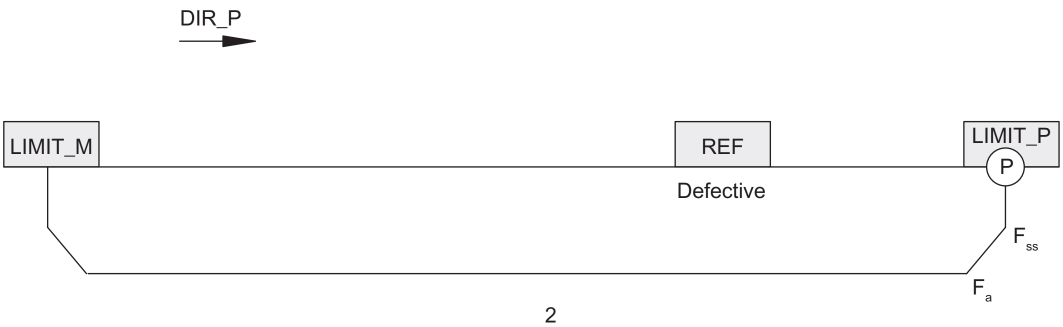


Figure 2-10 Defective Reference Cam, start at LIMIT_P

Behavior in the Case of a Constantly Set Reference Cam without Limit Switch

At the end of the first section, after 1048575 pulses have been output, the search is terminated with a cleared SYNC and POS_RCD status bit.

Behavior in the Case of Failure of the Reference Cam without Limit Switch

All three sections of the search are executed, each with output of 1048575 pulses. Afterwards, the search is interrupted with a cleared SYNC and POS_RCD status bit.

See also

Search for Reference (Page 31)

Assignment of the Feedback and Control Interfaces (Page 44)

2.6.4 Incremental Mode, Relative

Functional Description

The incremental run (incremental mode) is the main function of the 1STEP 5V/204kHz. You can use it to move the stepping motor a defined distance and so approach a set position.

You can determine the direction of the run and the velocity at the start.

The Positioning Job for Incremental Mode, Relative

The job contains the following information:

- Distance (number of pulses to be emitted)
- Multiplier G for the velocity/output frequency F_a
- Reduction factor R for the assigned parameters base frequency F_b
- Mode = 0 for incremental mode, relative
- Direction selection as start
- STOP at the Reference Cam

Note

The 1STEP 5V/204kHz checks the set distance for limit values (minimum 1 pulse and maximum 1 048 575 pulses). The distance to the limit switch is not checked by the 1STEP 5V/204kHz. The run is stopped at the latest when the limit switch is reached.

Feedback Messages

Incremental mode is indicated by the POS feedback bit.

On completion of a correct incremental mode run, the POS_RCD feedback bit indicates that the position has been reached.

If the incremental run is interrupted, the feedback bit POS_RCD is not displayed. If the incremental run is stopped, the path still left to traverse is displayed.

See also

Stopping the Stepping Motor (Page 37)

Assignment of the Feedback and Control Interfaces (Page 44)

2.6.5 Stopping the Stepping Motor

How the Stepping Motor Is Stopped

- Caused by	Displayed by Feedback Bit
STOP by control bit	-
External STOP at digital input	STOP_EXT
Limit switch LIMIT_P reached	STOP_LIMIT_P
Limit switch LIMIT_M reached	STOP_LIMIT_M
STOP at the Reference Cam	STOP_REF

Note

Remember that the LIMIT_P and LIMIT_M limit switches are used in the search for reference mode to search for the reference cam.

STOP at the Reference Cam

If the STOP function at the reference cam is selected (the control bit STOP_REF_EN is set) at the start of a run and the reference cam is detected during a run, the stepping motor is stopped and the run terminated.

Stopping the Stepping Motor in Exceptional Circumstances

The stepping motor is also stopped in the following cases:

- Incorrect operation in the control interface during a run
- External error ERR_24V caused by short circuit
- CPU-master STOP

Effects

If one of the above things occurs and the current positioning operation has to be canceled, it is terminated by a delay ramp.

The residual distance is updated. This enables you to traverse the residual distance after stopping by means of a new positioning job in the relative incremental mode.

Limit Switches and External STOP

By assigning parameters, you can choose to wire normally open or normally closed contacts for the external STOP and the limit switches.

- Normally closed contact means: The external STOP is tripped by a 0 signal. When the limit switches are reached, delete the associated control bit.
- Normally open contact means: The external STOP is tripped by a 1 signal. When the limit switches are reached, set the associated control bit.

Note

If it stops during the acceleration phase, before it starts braking the electronic module 1STEP 5V/204kHz still sends pulses for 50 ms at the frequency already reached. This avoids abrupt changes in frequency, which can lead to step losses.

If it stops during the acceleration phase, the 1STEP 5V/204kHz electronic module will emit more pulses than expected in the following circumstances:

– If 33% to 37.5% of the total number of pulses have already been emitted
– If the velocity reached at stopping was so high that as many pulses were emitted in 50 ms as during the acceleration phase

Since just as many pulses are emitted during the delay phase as during the acceleration phase, the 1STEP 5V/204kHz emits a maximum 112.5% of the defined pulses. The residual distance in this case has a negative sign, and the DIS_NEG feedback bit is set.

2.6.6 Pulse Enable

Functional Description

Pulse enable permits the output of pulses from the 1STEP 5V/204kHz to the power unit. A run is not possible without pulse enable.

Activating Pulse Enable

You can activate pulse enable by one of the following methods:

- By means of the digital input DI 3
  (parameter assignment: digital input DI = external pulse enable) or
- By means of the control bit DRV_EN
  (parameter assignment: digital input DI = external STOP)

You can tell that pulse enable has been activated by the following:

- The RDY LED on the 1STEP 5V/204kHz lights up, given correct parameter assignment and pulse enable.
- The STS_DRV_EN feedback bit is set

Deleting the Pulse Enable

Deleting the pulse enable during a run terminates the run immediately because no more pulses are emitted to the power unit. Without pulses, the stepping motor comes to a standstill. The residual distance is then no longer valid. The synchronization of the axis by means of the reference point is lost. The SYNC feedback bit and the RDY LED are deleted.

Deleting the pulse enable when the motor is at standstill deletes the SYNC feedback bit and the RDY LED.

In these cases it is advisable to carry out a search for reference.

2.6.7 Changing Parameters during Operation

Introduction

You can change several of the 1STEP 5V/204kHz parameters during operation without having to reassign the parameters of the whole ET 200S station.

This is only necessary if the areas you require for start-stop frequency F_{ss}, output frequency F_a, and acceleration/delay cannot be covered in the positioning job because of a change to the reduction factor and to the multiplier for the output frequency.

Parameters That Can Be Changed

The parameters

- Base Frequency $F_{b:}$
- Multiplier n for start-stop frequency F_{ss}
- Multiplier i for acceleration/delay

can be changed.

When you start changing parameters by means of the C_PAR control bit, the parameters are checked for permitted limit values. If you do not adhere to the limit values, the ERR_JOB feedback bit is set.

Only the feedback bits for the ERR_JOB and STS_JOB job processing are affected when you change the parameters.

All the other feedback messages are not affected by this job.

See also

Parameter assignment (Page 43)

2.6.8 Behavior of the Digital Inputs

Digital Input DI 3

You can assign parameters to the digital input DI 3 as one of the following:

- External pulse enable
- External STOP

Digital Input DI 3 as External Pulse Enable

The input must be put into operation. If the input is set and the parameter assignment correct, the 1STEP 5V/204kHz is ready for operation.

Digital Input DI 3 as External STOP

Using this input, you can stop current positioning operations by means of an external signal.

REF Digital Input

Wire a normally open contact to this input for the reference cam.

You need a reference cam for the following:

- For a search for reference
- For an incremental run with STOP on the reference cam.

See also

Stopping the Stepping Motor (Page 37)

Pulse Enable (Page 39)

2.6.9 Behavior at CPU-Master-STOP

Introduction

The 1STEP 5V/204kHz detects the CPU-master STOP. It responds by canceling the current positioning operation.

Exiting the CPU-Master-STOP Status

ET 200 S Station	1STEP 5V/204kHz
Without reassigning the parameters of the ET 200 station	• The feedback interface of the 1STEP 5V/204kHz remains current. • The values changed by means of parameter assignment job are maintained. • If a control bit was set (DIR_P, DIR_M, C_PAR) when the CPU-Master-STOP occurred, the bits STS_JOB and ERR_JOB are set when the CPU-Master- STOP status is exited. Delete the control bit. The run/parameter job is not executed. You can then start a new search by means of the control bit. • After the delay ramp, the pulse enable, the RDY LED, and the SYNC status bit are deleted.
With reassignment of the parameters of the ET 200 station	• Information on previous searches and parameter assignment jobs is reset. • If pulse enable was activated by means of the control bit DRV_EN at the time of the CPU-Master-STOP, the pulse enable, the RDY LED, and the SYNC status bit are deleted after the delay ramp.

Parameter Reassignment at the ET 200S Station

A new parameter assignment of the ET 200S station by means of your CPU/ DP master takes place:

- Upon power on of the CPU/DP master
- Upon power on of the IM 151/IM 151 FO
- After failure of the DP transmission
- After loading an altered parameter assignment or configuration of the ET 200S station into the CPU/DP master
- When the 1STEP 5V/204kHz is inserted
- Upon power on or inserting of the appropriate power module

See also

Stopping the Stepping Motor (Page 37)

Pulse Enable (Page 39)

2.7 Parameter assignment

Setting the Parameters

You set the parameters for the 1STEP 5V/204kHz by means of the device database file for the ET 200S using the *STEP 7* or COM PROFIBUS parameter assignment software.

Parameter List

You can enter the following parameters (default **bold**):

Parameters	Value range	Explanation
Enable		
Group diagnostics	**Disable**/enable	The sensor supply short circuit error or a parameter assignment error results in a channel-specific diagnostics if you have enabled group diagnostics.
Traversal Frequency		
Base Frequency $F_{b:}$ in Hz	**800**/400/200/80/40/20/8/4	It is the base value for setting the start-stop frequency, the output frequency, and the acceleration/delay.
Multiplier n: $F_{ss}= F_b$*n	**1**...255	Using the multiplier, you can set the start-stop frequency in steps.
Acceleration/Delay		
Time interval i: a= F_b/(i* 0.128ms)	**1**...255	Using the multiplier, you can set the acceleration/delay in steps.
Digital Inputs		
DI function	**External pulse enable**/ external STOP	-
External STOP, limit switches	**Normally closed contact**/ normally open contact	-

Causes of Parameter Assignment Errors

- Multiplier n = 0
- Multiplier i = 0

2.8 Feedback and Control Interface

2.8.1 Assignment of the Feedback and Control Interfaces

Interface Assignment

Note

For the electronic module, the following data of the control and feedback interface are consistent:

- Bytes 0 to 3
- Bytes 4 to 7

Use the access or addressing mode for data consistency over the entire control and feedback interface on your DP master (only for configuration using the DDB file).

You can see the assignment of the inputs and outputs in the following tables:

Table 2-3 Assignment of the Inputs (I): Feedback interface

Address	Assignment
Bytes 0 to 3	Residual distance (bits 19 to 0)
Byte 4	Bit 7: Short circuit of the ERR_24V sensor supply Bit 6: Reserve = 0 Bit 5: Parameter assignment error ERR_PARA Bit 4: Reference point determines SYNC Bit 3: Residual value < 0 DIS_NEG Bit 2: Position reached POS_RCD Bit 1: Error during job transfer ERR_JOB Bit 0: Job transfer currently running STS_JOB
Byte 5	Bit 7: Positioning in operation POS Bit 6: Cause of STOP: Limit switch STOP_LIMIT_P Bit 5: Cause of STOP: Limit switch STOP_LIMIT_M Bit 4: Cause of STOP: External STOP STOP_EXT Bit 3: Cause of STOP: Reference cam STOP_REF Bit 2: Status DI STS_DI Bit 1: Status reference input STS_REF Bit 0: Status pulse enable active STS_DRV_EN
Byte 6	Reserve = 0
Byte 7	Reserve = 0

Table 2-4 Assignment of the Outputs (O): Control interface

Address	Assignment
Bytes 0 to 3	**Positioning job**
	Byte 0: Multiplier G; $F_a = F_b * R * G$ (value range 1 to 255) Byte 1: Distance (bit 19 to bit 16) Byte 2: Distance (bit 15 to bit 8) Byte 3: Distance (bit 7 to bit 0) (Value range for bytes 1 to 3 is 1 to 1 048 575)
	Parameter Assignment Request
	Byte 0: Reserve = 0 Byte 1: Multiplier i: $a= F_b * R / (i*0.128ms)$ (value range 1 to 255) Byte 2: Multiplier n: $F_{ss}=F_b * n * R$ (value range 1 to 255) Byte 3: Base frequency F_b: • 0 = 800Hz; • 1 = 400Hz; • 2 = 200Hz; • 3 = 80Hz; • 4 = 40Hz; • 5 = 20Hz; • 6 = 8Hz; • 7 = 4Hz
Byte 4	Bit 7: Reduction factor R Bit 6: STOP Bit 5: Backward start DIR_M Bit 4: Forward start DIR_P Bit 3: Mode = 0 Bit 2: Mode = 0 Bit 1: Mode = 0 Bit 0: Mode: 0 = Incremental run mode / 1 = Search for reference mode
Byte 5	Bit 7: Diagnostic error acknowledgment - EXTF_ACK Bit 6: Parameter assignment job change parameter C_PAR Bit 5: Reserve = 0 Bit 4: Reserve = 0 Bit 3: Stop at the reference cam STOP_REF_EN Bit 2: Pulse enable DRV_EN (only relevant if you assigned parameters to the digital input as external STOP) Bit 1: Limit switch in forward direction LIMIT_P Bit 0: Limit switch in backward direction LIMIT_M
Bytes 6 to 7	Reserve = 0

Notes on the Feedback Bits

Feedback Bits	Notes
DIS_NEG	Shows whether the residual distance is negative when the positioning job is stopped during acceleration. More pulses were emitted during this positioning job than were defined.
ERR_JOB	This bit is set if the job is not clear or not possible. Possible causes of error during a positioning job are as follows: • More than one control bit is set (DIR_P, DIR_M, C_PAR) • Start incremental mode, relative with DIR_P set at LIMIT_P • Start incremental mode, relative with DIR_M set at LIMIT_M • Start, although the STOP bit is set • Start, although external STOP is present • Start, although pulse enable is missing • Start, although multiplier G for velocity = 0 • Start with STOP_REF_EN set, if REF digital input is set • Start with diagnostic error present • The mode is not known • The distance is 0 or larger than 1 048 575 (only for incremental mode) • A requested start was interrupted by CPU-Master-STOP Possible causes of error during a parameter assignment request are as follows: • More than one control bit is set (DIR_P, DIR_M, C_PAR) • The multiplier n = 0 for the start-stop frequency • The multiplier i = 0 for acceleration/delay
ERR_PARA	Incorrect parameter assignment for the ET 200S station. Cause: Multiplier n of the start-stop frequency = 0 or the multiplier i for acceleration/delay = 0. The parameter error bit is deleted when a correct parameter assignment is transmitted.
ERR_24V	The sensor supply was short-circuited and is now switched off. ERR_24V is reset if it was acknowledged with the EXTF_ACK control bit. After the short circuit has been eliminated, the sensor supply is switched on again and ERR_24V remains deleted.
POS	Positioning is in operation: This bit is set during incremental mode or a search for reference.
POS_RCD	POS_RCD is deleted at the start of an incremental run or a search for reference. After a correct run, the residual distance = 0, that is, the defined position is reached and POS_RCD is thus set. If the run was interrupted (if the stepping motor stops or the pulse enable is deleted), POS_RCD remains deleted.
Residual distance	A 20-bit value that contains the pulses that still have to be traversed (without signs).
STOP_EXT	Cause of STOP: External STOP
STOP_LIMIT_M	Cause of STOP: Limit switch reached LIMIT_M
STOP_LIMIT_P	Cause of STOP: Limit switch reached LIMIT_P
STOP_REF	Cause of STOP: Reference cam reached
STS_DI	The bit displays the status of the DI 3 digital input.
STS_DRV_EN	This bit is set when one of the following occurs, depending on the assigned parameter function of the digital input: • The external pulse enable is set. • The DRV_EN control bit is set for the pulse enable.
STS_JOB	This bit is set as a feedback message when a job request for a positioning or parameter assignment job is detected and then reset when the job has been executed.
STS_REF	The bit displays the status of the REF digital input.

Feedback Bits	Notes
SYNC	This bit is set after a correct search for reference. The SYNC bit is deleted after parameter assignment with new ET 200S station parameters or after deletion of the pulse enable.

Notes on the Control Bits

Control Bits	Notes
Base Frequency F_b:	To set the base frequency in steps
Mode	Mode = 0 incremental mode, relative Mode = 1 search for reference
C_PAR	Start of parameter changing
DIR_M	This bit requests and starts a positioning job in the backward direction.
DIR_P	This bit requests and starts a positioning job in the forward direction.
DRV_EN	If you use the DI 3 digital input as external stop, this bit is interpreted as a pulse enable.
Limit switch LIMIT_M	This limit switch limits the travel range in the backward direction. You set or delete this bit in your user program.
Limit switch LIMIT_P	This limit switch limits the travel range in the forward direction. You set or delete this bit in your user program.
EXTF_ACK	Acknowledgment bit for diagnostic message
Multiplier G	To set the velocity/output frequency in steps
Multiplier n	To set the start-stop frequency in steps
Reduction factor R	The base frequency F_b is multiplied by 0.1 if the bit is set. This reduces the output frequency F_a, the start-stop frequency F_{ss}, and the acceleration/delay a by the same amount.
STOP	With this bit, you can stop a positioning job with a delay ramp at any time.
STOP_REF_EN	When the bit is set, the STOP function is active on the reference cam. When the reference cam is detected, the positioning job is stopped with a delay ramp.
Distance	A 20-bit value that contains (without signs) the pulses that still have to be traversed.
Multiplier i	To set the acceleration/delay in steps

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file1 (hardware catalog\PROFIBUS DP\Other Field Devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
[1]Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

See also

Stopping the Stepping Motor (Page 37)

Pulse Enable (Page 39)

Starting the Positioning Job (Page 48)

2.8.2 Starting the Positioning Job

Sequence for Starting a Positioning Job

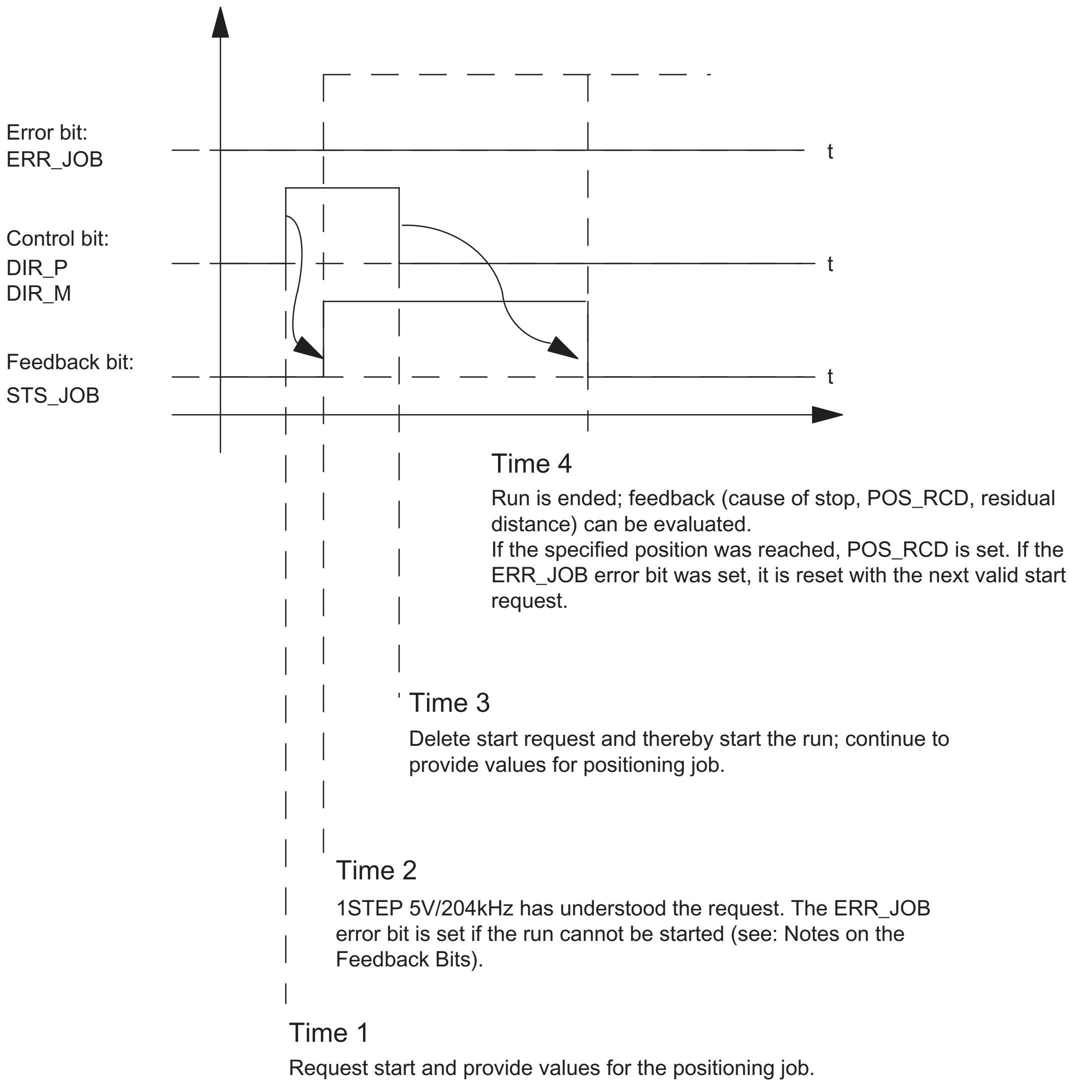


Figure 2-11 Starting the Positioning Job

Evaluating the ERR_JOB Error Bit

As soon as the STS_JOB feedback bit is deleted at time stamp 4, evaluate the ERR_JOB error bit. Note that the STS_JOB feedback bit is only deleted if the DIR_P, DIR_M, and C_PAR control bits are deleted.

Carrying Out a Parameter Change

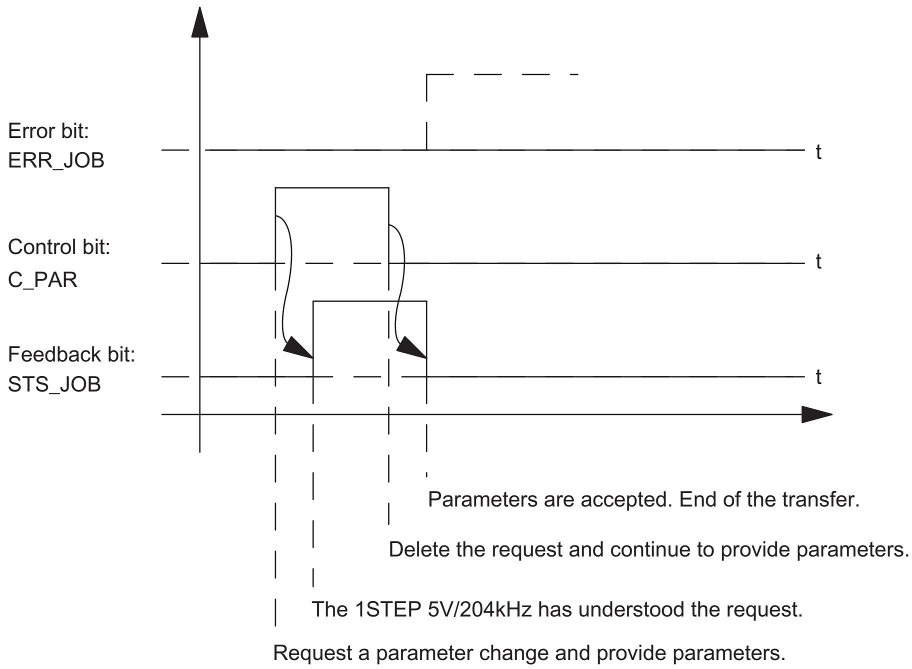


Figure 2-12 Carrying Out a Parameter Change

Note

Only one of the following control bits can be set at a particular time:

DIR_P or DIR_M or C_PAR.

Otherwise, the ERR_JOB error is reported. The job error message is deleted by the start of the next job.

Application Example Error Detection

The sensor supply short circuit error must be acknowledged. It was detected by the 1STEP 5 /204 kHz and displayed in the feedback interface. Channel-specific diagnostics are executed if you enabled group diagnostics when you assigned parameters.

The parameter assignment error bit is acknowledged by means of correct parameter assignment.

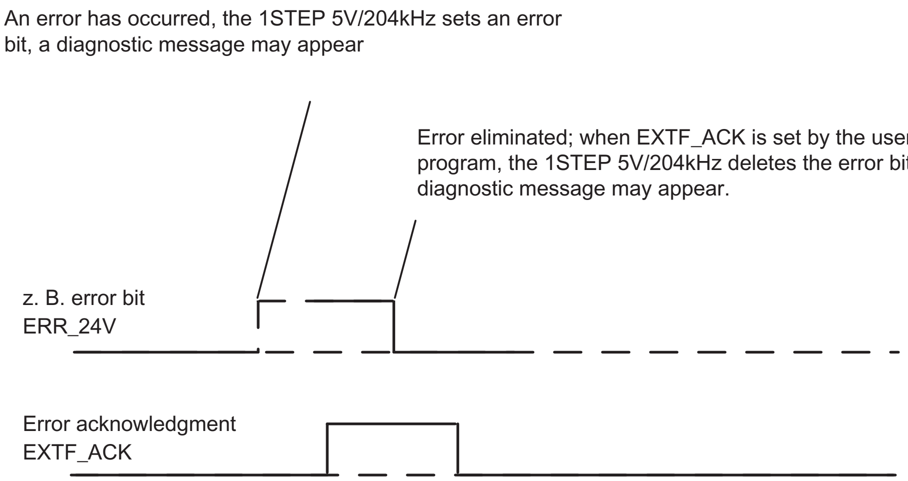


Figure 2-13 Error Acknowledgment

In the case of constant error acknowledgment (EXTF_ACK = 1) or in CPU-/Master-STOP mode, the 1STEP 5V/204kHz reports the error as soon as it is detected and clears the error as soon as it is eliminated.

See also

Parameter assignment (Page 43)

2.9 Technical specifications

Technical specifications

Technical data 1STEP5V/204khZ	
Dimensions and weight	
Dimensions W × H × D (mm)	15 × 81 × 52
Weight	Approx. 40 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
• Rated load voltage L+	24 VDC
• Range	20,4 ... 28.8 V
• P1	Yes, as of Version 2
Isolation	
• Between the backplane bus and the positioning function	Yes
• Between the positioning function and load voltage	No
Sensor supply	
• Output voltage	L+ (-0.8 V)
• Output current	Maximum 500 mA, short-circuit proof
Current consumption	
• From the backplane bus	Max. 10 mA
• From the load voltage L+ (no load)	Typ. 40 mA
Power dissipation of the 1STEP 5V/204kHz	Typ. 1.5 W
Data for the digital inputs	
Isolation	No, from shield only
Input voltage	
• Rated value	24 VDC
• 0 signal	-30 ... 5 V
• 1 signal	11 ... 30 V
Input current	
• 0 signal	Max. 2 mA (bias current)
• 1 signal	9 mA (typically)
Input delay	Typically 4 ms
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	
• Shielded	Max. 1000 m
• Unshielded	Max. 600 m

Technical data 1STEP5V/204khZ	
Connection to the power unit (data to the outputs)	
The cables to the power unit must be twisted in pairs and shielded.	Max. 100 m
Differential signals for pulses and direction	To RS 422
Status, interrupts, diagnostics	
Digital input status display for STOP or pulse enable	LED 3 (green)
Status display for digital input REF	LED REF (green)
Status display ready for operation	LED RDY (green)
Status display positioning in operation	LED POS (green)
Malfunction indication on the 1STEP 5V/204kHz	SF LED (red)
Diagnostic information	Yes
Response Times	
Update rate of the feedback interface	2 ms
Deletion of the start request until pulse output	Response time DP master + response time ET 200S + 2 ms + 1 / (2* F_{ss})

1PosInc/Digital 3

3.1 Product overview

Order number

6ES7138-4DG00-0AB0

Features

- Positioning module for controlled positioning by means of rapid/creep feed
  – Switchover and switch-off difference can be set using your control program
- Incremental encoder with 5 V differential signals
  – With or without zero mark
  – Quadruple evaluation of the encoder signals
- Usable axis types:
  – Linear axis
  – Rotary axis
- Operating range: 0 - 16 777 215 steps
- The drive can be controlled via 3 digital outputs:
  – Travel minus
  – Travel plus
  – Rapid/creep feed
- 3 digital inputs can be used for the following:
  – Minus hardware limit switch
  – Plus hardware limit switch
  – Reducing cam/latch input
- Diagnostics
  – Encoder monitoring
  – Load voltage monitoring

Configuration

You can use either of the following to configure the 1PosInc/Digital:

- A DDB file (http://www.ad.siemens.de/csi/gsd) or
- STEP 7 as of V5.1 SP2.

3.2 Brief Introduction to Commissioning the 1PosInc/Digital

Introduction

Using the example of inching mode, this brief introduction shows you a functioning application in which you get to know and check the hardware and software involved in a positioning operation of your 1PosInc/Digital.

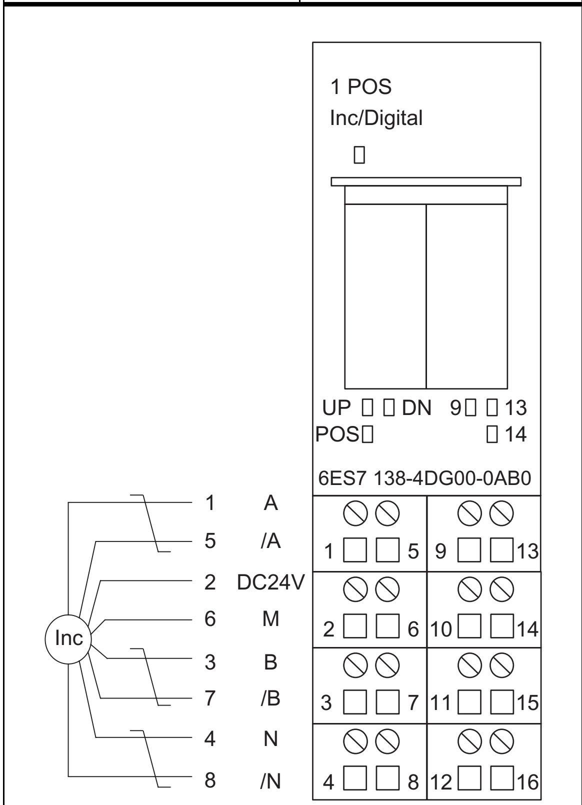
Prerequisites for the Example

The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You must have:
  - A TM-E30S44-01 terminal module (6ES7 193-4CG20-0AA0 or 6ES7 193-4CG30-0AA0)
  - A 1PosInc/Digital
  - An incremental encoder with 5V differential signals and a 24 V encoder supply
  - A drive with power control (e.g. a pole-changing motor with contactor switching)
  - A 24 VDC power supply
  - The necessary wiring material

Installation, Wiring, and Fitting

Install and wire the TM-E30S44-01 terminal module. Insert the 1PosInc/Digital in the terminal module (you can find detailed instructions in the *Distributed I/O Device* manual).

Terminal assignment	View	Remarks			
		**Connection of the Incremental Encoder with 5 V Differential Signals: Terminals 1-8**		**Connection of the Switches and the Drive: Terminals 9-16**	
		1: A	Track A	9: IN0	Minus limit switch
		5: /A		13: IN1	Plus limit switch
		3: B	Track B	14: IN2	Reducing cam; latch signal
		7: /B		10: DC24	Encoder supply for the switches
		2: DC24	Voltage supply for incremental encoder	11: OUT0	Travel minus or rapid feed
		6: M		12: OUT1	Travel plus or creep feed
		4: N	Track N; optional zero mark	16: OUT2	Rapid/creep feed and travel plus/minus
		8: /N		15: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2

Configuring STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. Select 1PosInc/Digital from the hardware catalog. The number 6ES7 138-4DG00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1PosInc/Digital.
4. Double-click this number to open the properties dialog box for the 1PosInc/Digital.
5. On the "Addresses" tab, you will find the addresses of the slot to which you have dragged the 1PosInc/Digital. Make a note of these addresses for subsequent programming.
6. On the "Parameters" tab, you will find the default settings for the 1PosInc/Digital. If you are not connecting any limit switches to the 1PosInc/Digital, set the DI0 limit switch minus and DI1 limit switch plus parameters to "make contact".
7. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Creating Blocks and Integrating Them Into The User Program

Integrate the following FC 101 block in your user program (in OB 1, for example). This block requires the DB1 data block with a length of 16 bytes. In the example below, the start is initiated by setting memory bit 30.0 (in the plus direction) or 30.1 (in the minus direction) with the programming device. You select rapid or creep feed using memory bit 30.2.

STL			Explanation
Block: FC101			
	L	PID 256	//Load feedback values from 1PosInc/Digital
	T	DB1.DBD8	
	L	PID 260	
	T	DB1.DBD12	
	L	DB1.DBB8	//Display status bits
	T	MB8	
	L	DB1.DBB12	
	T	MB9	
	L	DB1.DBD8	//Display actual value
	UD	DW#16#FFFFFF	
	T	MD12	
	AN	M30.0	
	SPB	DIRM	
	L	B#16#13	//Travel in plus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
	SPA	CTRL	
DIRM:	AN	M30.1	
	SPB	STOP	
	L	B#16#15	//Travel in minus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
	SPA	CTRL	
STOP:	L	B#16#0	//Stop
	T	DB1.DBB0	
	A	DB1.DBX8.2	
	SPB	CTRL	
	AN	DB1.DBX8.0	//Set/delete START depending on POS_ACK
	=	DB1.DBX0.0	

STL			Explanation
CTRL:	A	M30.2	//Set SPEED
	=	DB1.DBX0.3	
	L	DB1.DBD0	//Transfer control values to the 1PosInc/Digital
	T	PAD256	
	L	DB1.DBD4	
	T	PAD260	

Test

Start inching mode, and monitor the associated feedback.

1. Using "Monitor/Modify Variables", check the actual value and the status bits POS_ACK, POS_ERR, POS_DONE, ERR_ENCODER and ERR_2L+.
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   - MD12 (actual value)
   - M8.0 (POS_ACK)
   - M8.1 (POS_ERR)
   - M8.2 (POS_DONE)
   - M8.7 (ERR_ENCODER)
   - M9.7 (ERR_2L+)
   - M30.0 (inching in plus direction)
   - M30.1 (inching in minus direction)
   - M30.2 (SPEED; 0= creep feed; 1=rapid feed)
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor to switch to monitoring".
6. Switch the CPU to RUN mode.

Result

The following table shows you which activity triggers which result.

Activity	Result
Switch the CPU to RUN mode.	• The POS_ACK status bit is deleted • The POS_ERR status bit is deleted • The POS_DONE status bit is set
Check the wiring of the load voltage 2L+	
Check the feedback bit ERR_2L+	• If ERR_2L+ = 1, correct the wiring of the load voltage 2L+
Check the encoder wiring	
Check the feedback bit ERR_ENCODER	• If ERR_ENCODER = 1, correct the wiring of the encoder
Inching in the plus direction:	
Start inching mode in the plus direction by setting memory marker 30.0 ("Variable > Modify >")	**The status bit POS_ERR = 0, the UP LED lights up** • The POS_ACK status bit is set • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the DN LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the plus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct
Inching in the minus direction:	
Start inching mode in the plus direction by setting memory marker 30.1 ("Variable > Modify >")	**The status bit POS_ERR = 0, the DN LED lights up** • The POS_ACK status bit is set • The POS_ERR status bit is deleted • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the UP LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the minus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct

3.3 Terminal Assignment Diagram

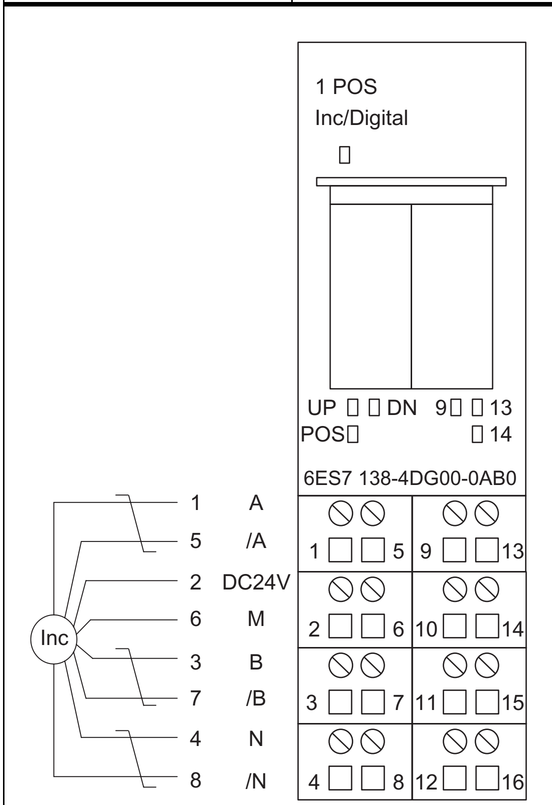
Wiring rules

The wires to the incremental encoder (terminals 1 and 5, 3 and 7 and 4 and 8) have to be in twisted pairs and shielded. The shield must be supported at both ends. You use the shield contact element (Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal assignment

The following figure shows you the terminal assignment for the 1PosInc/Digital:

Terminal assignment	View



Remarks			
Connection of the Incremental Encoder with 5 V Differential Signals: Terminals 1-8		**Connection of the Switches and the Drive: Terminals 9-16**	
1: A	Track A	9: IN0	Minus limit switch
5: /A		13: IN1	Plus limit switch
3: B	Track B	14: IN2	Reducing cam; latch signal
7: /B		10: DC24	Encoder supply for the switches
2: DC24	Voltage supply for incremental encoder	11: OUT0	Travel minus or rapid feed
6: M		12: OUT1	Travel plus or creep feed
4: N	Track N; optional zero mark	16: OUT2	Rapid/creep feed and travel plus/minus
8: /N		15: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2

Connection of Relays and Contactors to the Digital Outputs

Note

Direct connection of inductivities (such as relays and contactors) is possible without external circuiting.

If SIMATIC output circuits can be deactivated by additionally installed contacts (for example relay contacts), you have to provide additional overvoltage protection devices at inductivities (see the following example for overvoltage protection).

Overvoltage Protection Example

The following figure shows an output circuit that requires additional overvoltage protection devices. Direct-current coils are wired with diodes or Zener diodes.

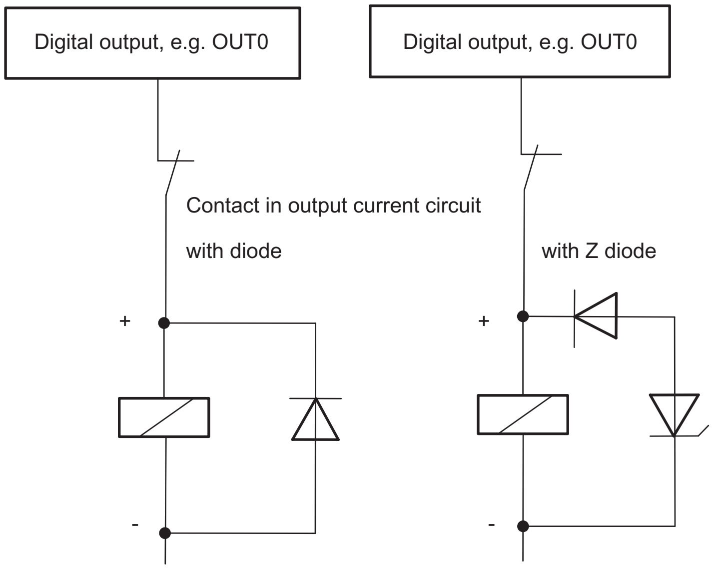


Figure 3-1 Relay contact in the output circuit

3.4 Safety concept

Safety Measures

The following measures are vital to the safety of the system. Install them with particular care, and adapt them to meet the requirements of the system.

Check the measures are effective before the first run.

> **WARNING**
>
> To avoid injury and damage to property, make sure you adhere to the following:
> - Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.).
> - Make sure that no one has access to areas of the system with moving parts.
> - Install, for example, safety limit switches for the end positions of the axes that switch off the power control system directly.
> - Install devices and take steps to protect motors and power electronics.

Setting up a positioning control

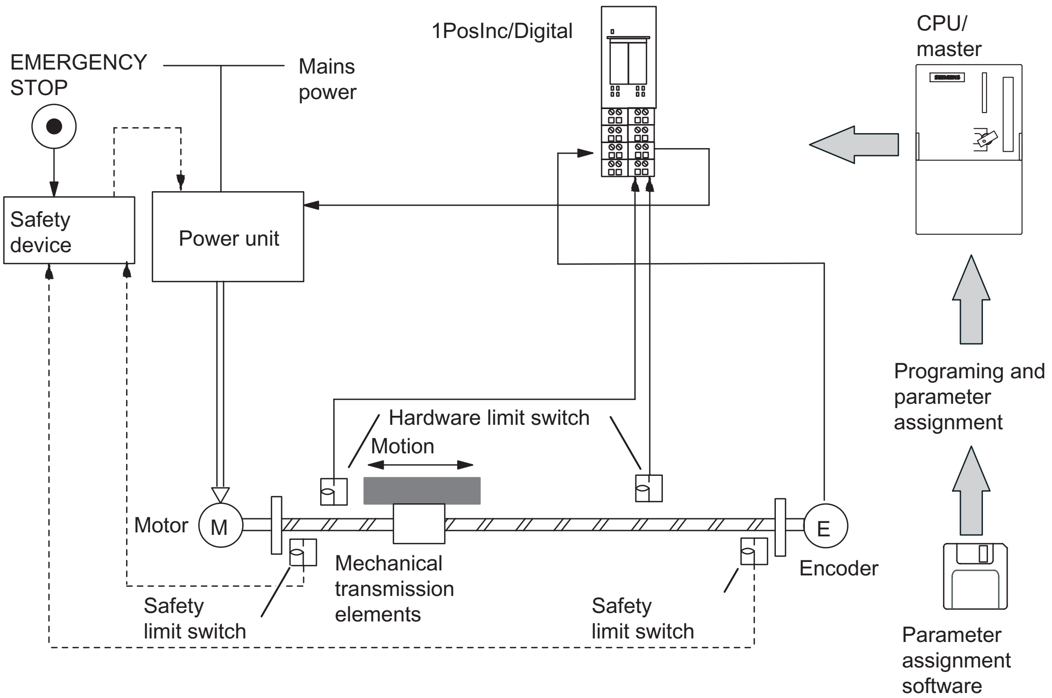


Figure 3-2 Design of a Positioning Control System (Example)

3.5 Fundamentals of Controlled Positioning Using Rapid/Creep Feed

Positioning Operation

From the start position, the target is approached at high speed (rapid feed). At a preset distance from the target (switchover point), there is a change to a lower speed (creep feed). Shortly before the axis reaches the target, again at a preset distance from the target, the drive is switched off (switch-off point).

The drive is controlled via digital outputs for rapid feed or creep feed and the appropriate direction.

To facilitate understanding, the change in speed is illustrated over the path traversed.

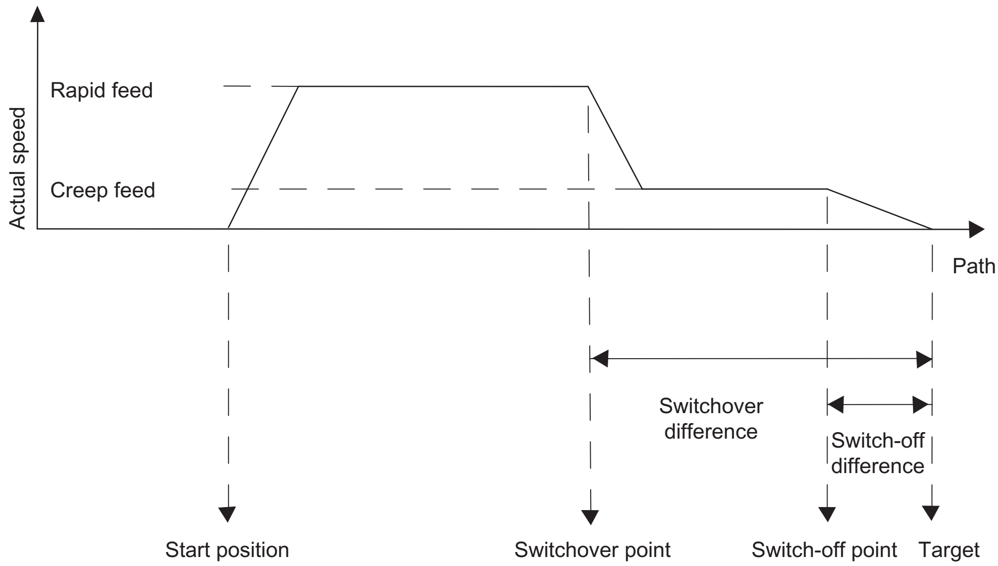


Figure 3-3 Switching points and switching differences

Definitions

Term	Explanation
Operating range	Defines the range, which you set for a particular task by means of the hardware limit switches. Maximum operating range: • Linear axis - max. 0 to 16,777,215 increments • Rotary axis - from 0 to the assigned parameter end of the rotary axis
Switchover difference	Defines the distance from the destination at which the drive is switched over from rapid feed to creep feed.
Switchover point	Defines the position at which the drive is switched over from rapid feed to creep feed.
Switch-off difference	Defines the distance from the destination at which the drive is switched off. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no change from rapid feed to creep feed.
Switch-off point	Defines the position at which the drive is switched off. The 1PosInc/Digital reports the end of the run at this point.
Start position	Defines the position of the drive within the operating range from which the run is started. If the start position is within the switch-off difference, the drive is not triggered. The 1PosInc/Digital reports the end of the run at this point. If the start position is within the switchover difference, the run is only executed in creep feed mode.
Target	Defines the absolute or relative position of the axis approached during positioning. The destination is the position to be reached on an axis during a run. In the case of an absolute run, you specify the destination directly by means of your control program. In the case of a relative run, the destination is calculated from the start position and the path specified in the control program. If you want to find out how accurately you have reached the destination, you have to compare the actual value with the position specified.
Linear axis	Defines the axis type with a limited operating range. It is limited by the following: • The numeric range that can be represented (0 to 16 777 215 increments) • The hardware limit switch
Rotary axis	Defines the axis type with an infinite operating range. This includes resetting the axis position to 0 after one rotation (assigned parameter rotary axis end).
Minus direction	If the drive moves in the minus direction, the actual value displayed is decreased.
Plus direction	If the drive moves in the plus direction, the actual value displayed is increased.

3.6 Functions of the 1PosInc/Digital

3.6.1 Overview of the Functions

Overview

The 1PosInc/Digital offers you the following functions for moving your axis:

- Stop
- Search for Reference
- Inching
- Absolute Positioning
- Relative Positioning

In addition to the different types of motion, the 1PosInc/Digital also offers functions for:

- Setting of Actual Value
- Change Switch-Off Difference
- Change Switchover Difference
- Reference Signal Evaluation
- Latch Function
- Setting the Monitoring of the Direction of Rotation
- Display Current Values
- Error Detection/Diagnostics
- Behavior at CPU-Master-STOP

Parameters: Define the variables that depend on the drive, axis, and encoder uniquely in the parameters.

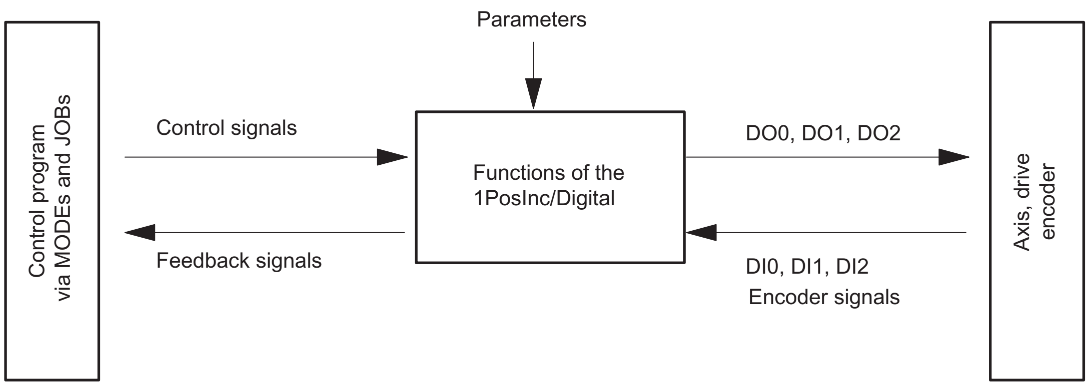


Figure 3-4 How the 1PosInc/Digital Works

Interfaces to the Control Program and the Axis

To execute the function, the 1PosInc/Digital has digital inputs as an interface to the axis, encoder signals for the connection to an encoder and digital outputs to control the drive.

You can modify and monitor the types of motion (MODES) and functions (JOBs) with your control program using control signals and feedback signals.

See also

Parameter List (Page 105)

Principle

What You Do	Response of the 1PosInc/Digital
Provide the control interface with data depending on the MODE. Check the POS_ACK feedback bit is at 0	
Switch the START control bit from 0 to 1	The 1PosInc/Digital sets the feedback bits POS_ACK = 1 and POS_DONE = 0. This indicates that the start of the 1PosInc/Digital has been detected and that the MODE is executed when POS_ERR = 0 . The MODE is not executed when POS_ERR = 1.
Switch the START control bit from 1 to 0	The 1PosInc/Digital sets the feedback bit POS_ACK = 0
	In the case of stopping, the reference point run, absolute and relative positioning, the 1PosInc/Digital sets the feedback bit POS_DONE = 1 when the MODE is terminated without errors. When POS_ERR = 1 the MODE is terminated with an error.
Only when POS_ACK = 0 can you start a new MODE. If you start when a MODE is running, the 1PosInc/Digital takes on the new motion and executes a change of direction, if necessary.	

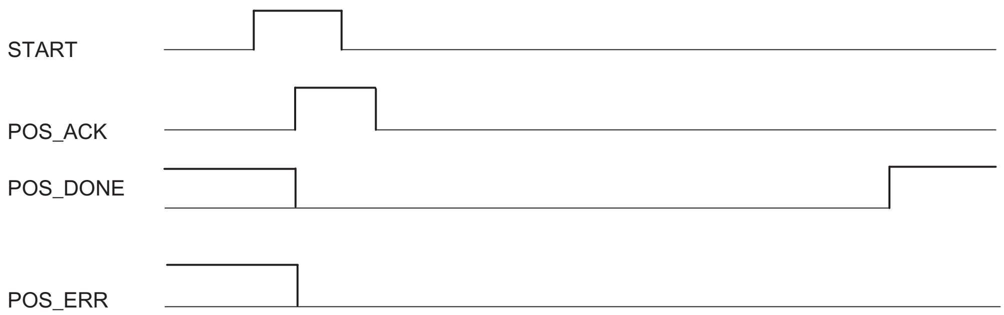


Figure 3-5 Control and Feedback Signals with MODEs

Principle

What You Do	Response of the 1PosInc/Digital
Provide the control interface with data corresponding to the JOB. Check the JOB_ACK feedback bit is at 0	
Switch the JOB_REQ control bit from 1 to 0	The 1PosInc/Digital sets the feedback bit JOB_ACK = 1 This indicates that the initiation of the 1PosInc/Digital has been detected and that the JOB will be executed when JOB_ERR = 0. • In the case of the function for evaluating a reference signal, the 1PosInc/Digital sets the SYNC = 0 feedback bit at the same time. • In the case of the latch function, the 1PosInc/Digital sets the feedback bit LATCH_DONE = 0 at the same time. • All the other JOBs are thus executed. The JOB is not executed when JOB_ERR = 1.
Switch the JOB_REQ control bit from 1 to 0	The 1PosInc/Digital sets the feedback bit JOB_ACK = 0
	In the case of the function for evaluating a reference signal, the 1PosInc/Digital sets the feedback bit SYNC = 1 when the function has been executed. In the case of the latch function, the 1PosInc/Digital sets the feedback bit LATCH_DONE = 1 when the function has been executed.
Only when JOB_ACK=0 can you activate a new JOB again.	

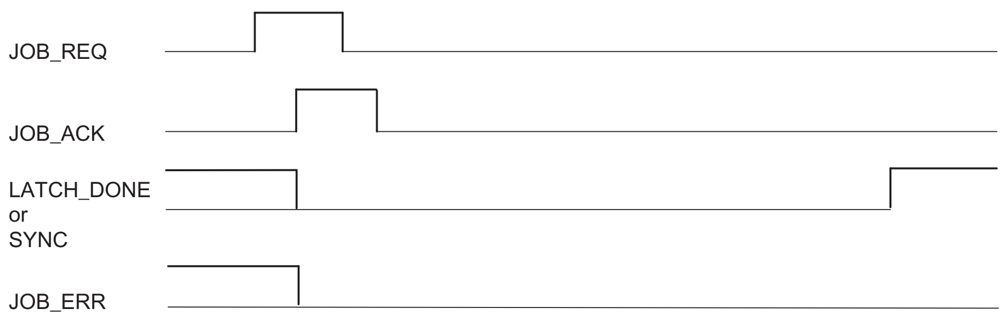


Figure 3-6 Control and Feedback Signals with JOBs

3.6.2 Axis, Drive and Encoder

Quadruple evaluation of the encoder signals

The 1PosInc/Digital evaluates the pulses delivered by the incremental encoder four times and adds them up to form the actual value. You must take the quadruple evaluation into account when you make settings for paths in the parameters and in the control and feedback interfaces:

1 pulse of the incremental encoder corresponds to 4 increments of the 1PosInc/Digital.

The current value is in the operating range 0 - 16 777 215 increments. The 1PosInc/Digital generates an overrun or underrun of the actual value at the limits of the operating range.

Reversal of the Direction of Rotation of the Encoder Signals

You can use the parameter for the reversal of the direction of rotation to adapt the direction of rotation of the encoder to that of the drive and the axis.

Controlling the Drive

The drive is controlled using the 3 digital outputs of the 1PosInc/Digital.

You can select the speed with the SPEED control bit (SPEED=0 is creep feed; SPEED=1 is rapid feed). You can also change the speed during the run.

You can bring about a change in direction with the T_{min} direction change parameter.

You can read the status of each output from the feedback interface (DO0, DO1 and DO2).

The function of the digital outputs depends on the control mode.

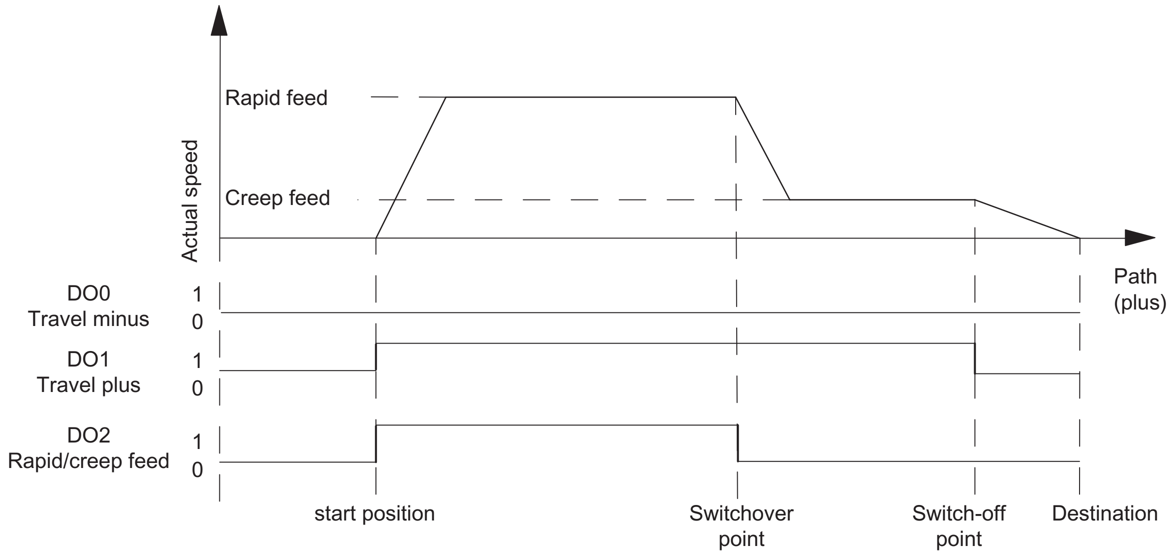


Figure 3-7 Digital Outputs with Control Mode 0

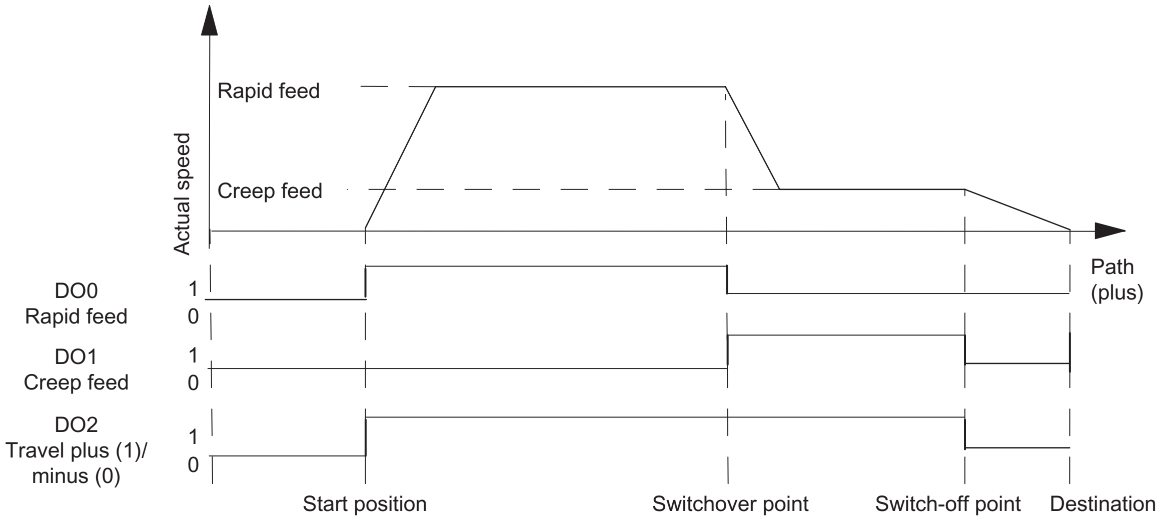


Figure 3-8 Digital Outputs with Control Mode 1

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

Effect of the Hardware Limit Switches

The two digital inputs (DI0 and DI1) are evaluated by the 1PosInc/Digital as limit switches:

- DI0 is the minus limit switch and limits the operating range in the minus direction.
- DI1 is the plus limit switch and limits the operating range in the plus direction.

You can assign parameters to the hardware limit switches separately as break contacts or make contacts.

The hardware limit switches are evaluated with linear axes and rotary axes.

Only the hardware limit switch that lies in the direction in which the drive is being moved is evaluated.

This enables you to move away from a hardware limit switch without additional error acknowledgment by moving in the other direction if you reach or overrun a hardware limit switch.

The current signal level of the digital inputs is displayed in the feedback interface, delayed by the update rate.

You can see from the following table what effect the hardware limit switches have in the individual MODEs:

MODE	Effect of the Hardware Limit Switches
Search for Reference	The 1PosInc/Digital executes an automatic reversal of direction on the hardware limit switch.
Inching	The motion of the axis is halted on the hardware limit switch, all 3 digital outputs are set to 0, and the POS_ERR feedback bit is reported.
Absolute Positioning	
Relative Positioning	

Starting on the hardware limit switch

Direction	Response of the 1PosInc/Digital
Starting into the operating range	The 1PosInc/Digital starts the preset MODE.
Starting away from the operating range	The POS_ERR=1 feedback bit is set.

3.6.3 Effect of the Directional Enables

Description

You enable the digital outputs directionally using the DIR_M and DIR_P control bits.

- With DIR_M = 1 you can move in the minus direction.
- With DIR_P = 1 you can move in the plus direction.

Interrupting and Continuing the Run

If you reset the relevant directional enable during a run, the motion of the axis is halted, all 3 digital outputs are set to 0, and the run is interrupted.

If you set the relevant directional enable again, the run is continued.

3.6.4 Stop (MODE 0)

Definition

If you activate MODE 0, the 1PosInc/Digital stops the current run, all 3 digital outputs are set to 0, and the run is terminated (POS_ERR = 0, POS_DONE = 1).

A run terminated with MODE 0 cannot be continued. To put the axis into motion again, you start a new MODE.

Control Signals: Stop

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
</table>

Feedback Signals: Stop

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK

3.6.5 Reference Point Run (MODE 3)

Definition

You can use the reference point run to synchronize the axis on the basis of an external reference signal. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch) and DI1 (plus limit switch) and DI2 (reducing cam) as break or make contacts.

Provide the control interface with the reference point coordinates, and start MODE 3. The 1PosInc/Digital sets the SYNC = 0 feedback signal and moves the drive at the preset speed (SPEED control bit) in the assigned parameter start direction and searches for the reference signal. The 1PosInc/Digital automatically executes the required change of direction at the limit switches and the reducing cam.

Set the necessary directional enables (DIR_M, DIR_P) to ensure that the drive is controlled.

If the 1PosInc/Digital detects the parameterized reference signal, it controls the drive in creep feed mode in the referencing direction. This is controlled by the reference signal and reference switch parameters.

<table>
<tr><th></th><th>Reference switch: Reduction cam towards minus</th><th>Reference switch: Reduction cam towards plus</th><th>Reference switch: Limit switch minus</th><th>Reference switch: Limit switch plus</th></tr>
<tr><td>Reference signal: Reference switch and zero mark</td><td rowspan="2">Minus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Minus referencing direction</td></tr>
<tr><td>Reference signal: Reference switch</td></tr>
<tr><td>Reference signal: Zero mark</td><td colspan="4">The referencing direction is not defined. The axis is synchronized at the next zero mark.</td></tr>
</table>

After the reference signal has been traversed, the axis is synchronized. The 1PosInc/Digital sets the feedback signal SYNC = 1 and assigns the reference point coordinates to the actual value.

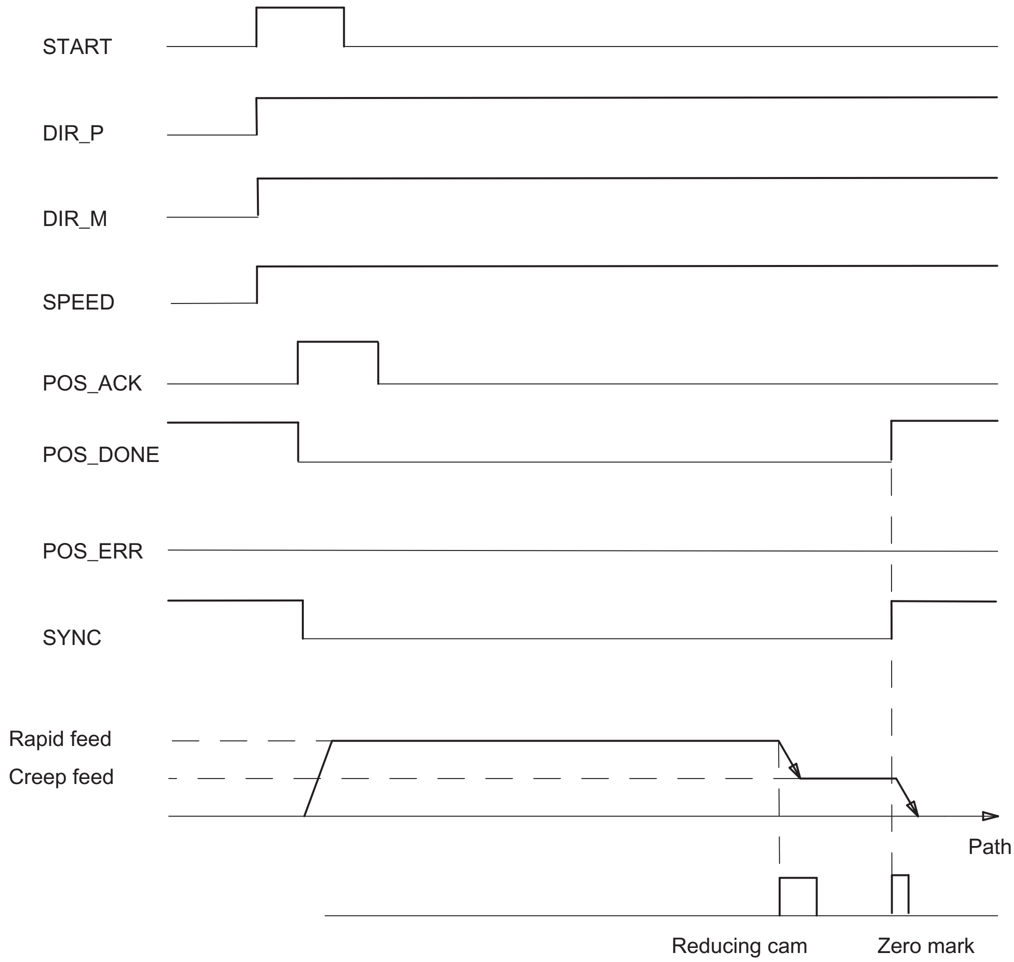


Figure 3-9 Sequence of Execution of the Search for Reference

Control Signals: Search for Reference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="7">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 3 = Reference Point Run</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)</td></tr>
<tr><td colspan="6">Bit 2: DIR_M</td></tr>
<tr><td colspan="6">Bit 1: DIR_P</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Search for Reference

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Search for Reference

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the relevant switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus

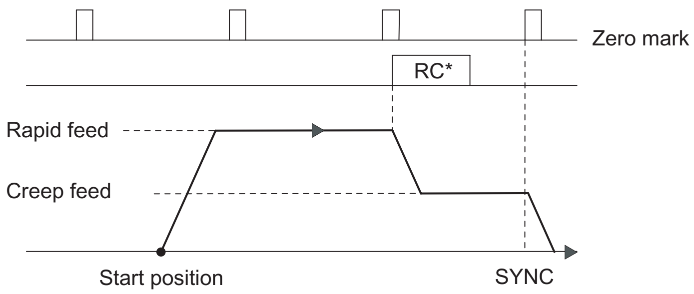
Execution of a Reference Point Run Depending on Parameterization and Start Position

In a reference point run, you have to distinguish between different cases that depend on the following:

- The start position of the drive at the start of the reference point run
- The assigned parameter start direction
- The assigned parameter reference signal
- The assigned parameter reference switch.

Example 1: Search for Reference Point Run with Reducing Cam and Zero Mark

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus



*RC = reducing cam

Figure 3-10 Search for Reference Point Run with Reducing Cam and Zero Mark

You can also carry out synchronization using the reducing cam without a zero mark.

If the start position is on the reducing cam, the 1PosInc/Digital controls the drive directly in creep feed mode in the referencing direction.

Example 2: Reference Point Run with Minus Limit Switch

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Reference switch
- Reference switch: Minus limit switch

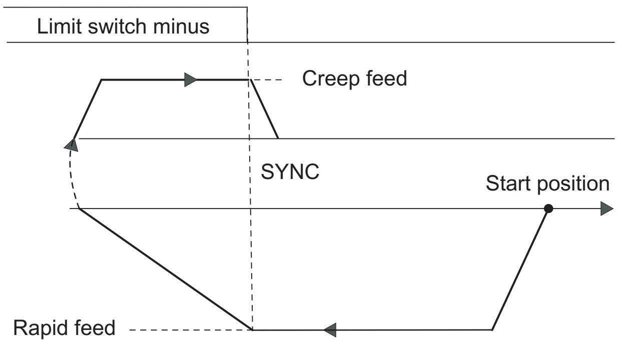


Figure 3-11 Reference Point Run with Minus Limit Switch

You can also carry out synchronization at the limit switch with the following zero mark.

If the start position is at the limit switch, the 1PosInc/Digital controls the drive directly in creep feed in the referencing direction.

Example 3: Reference Point Run with Reversal of Direction at the Plus Limit Switch

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus

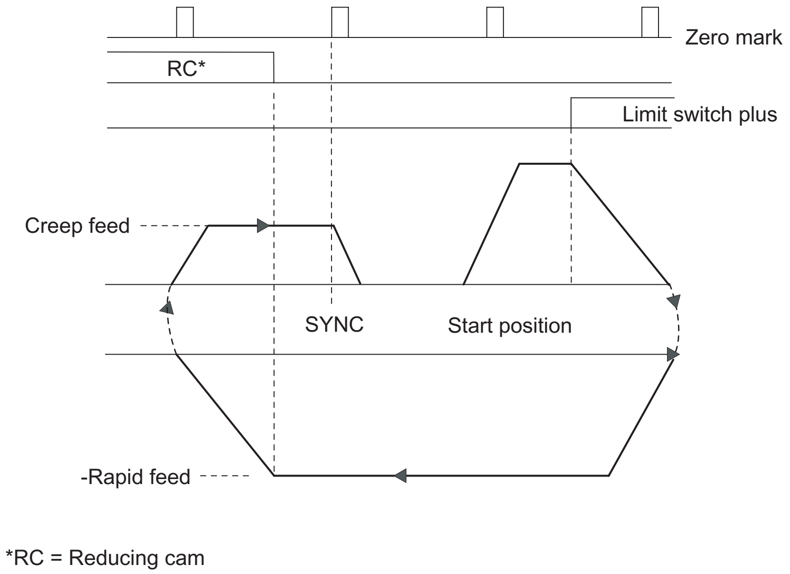


Figure 3-12 Reference Point Run with Reversal of Direction at the Plus Limit Switch

If the start position is at the plus limit switch, the 1PosInc/Digital controls directly the drive in rapid feed in the opposite direction to the assigned parameter start direction.

Example 4: Reference Point Run Only with Zero Mark

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Zero mark
- Reference switch: irrelevant

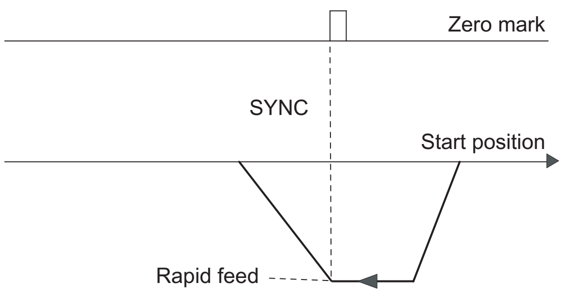


Figure 3-13 Reference Point Run Only with Zero Mark

Search for reference: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	Search for reference: No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

3.6.6 Inching (MODE 1)

Definition

You use inching mode to control the drive directly in a particular direction using the DIR_M or DIR_P control bits.

If you start MODE 1, the 1PosInc/Digital moves the drive at the preset speed (SPEED control bit) in the specified direction (control bit DIR_M or DIR_P).

You stop the drive by setting the control bits DIR_P = 0 and DIR_M = 0.

A change of direction is executed after the time T_{min} elapses.

You can also activate inching on an unsynchronized axis (feedback bit SYNC = 0) or when there is a pending encoder error (feedback bit ERR_ENCODER = 1) or without an encoder connected.

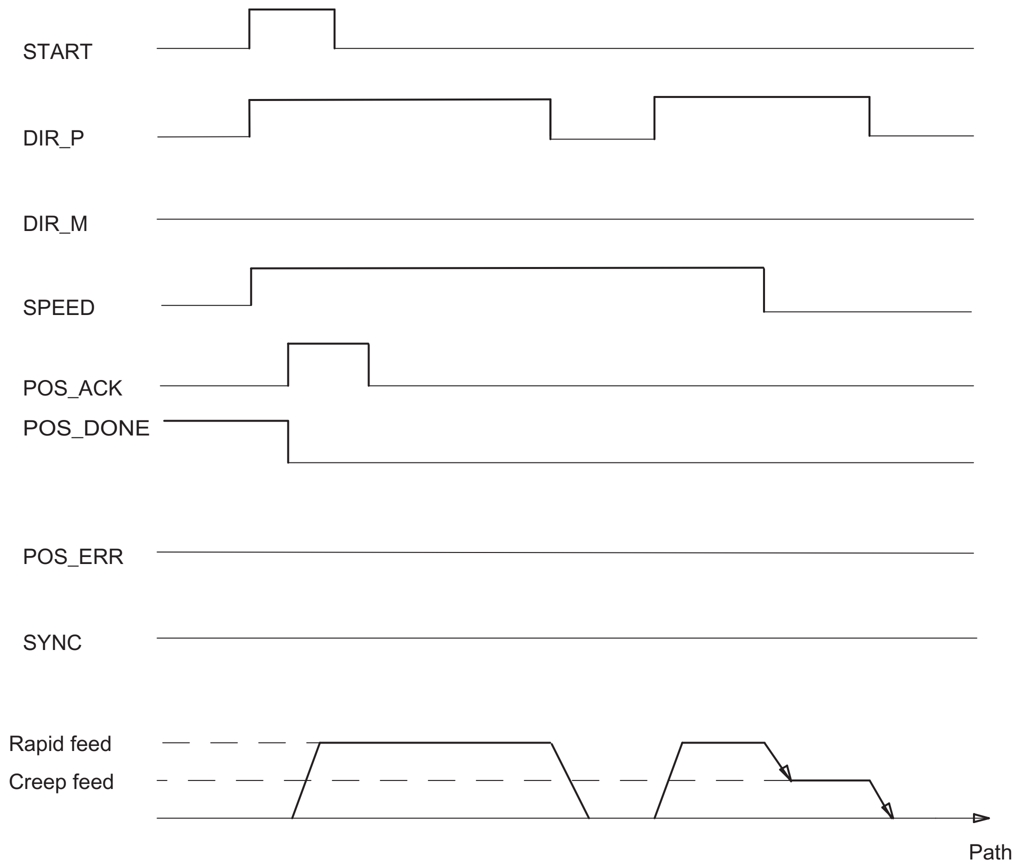


Figure 3-14 Execution of Inching

Control Signals: Inching

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
</table>

Feedback Signals: Inching

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Inching: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

3.6.7 Absolute Positioning (MODE 5)

Definition

With absolute positioning, the 1PosInc/Digital moves the drive toward absolute destinations. To do this, the axis must be synchronized.

Supply the control interface with the destination, and start MODE 5 with the necessary directional enable (DIR_M, DIR_P). The 1PosInc/Digital moves the drive at the preset speed (control bit SPEED) toward the destination. At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

If you start during an active run, the 1PosInc/Digital executes the necessary change in direction after the time T_{min} has elapsed.

Linear axis

The 1PosInc/Digital works out the direction in which the destination is approached. You must set the necessary directional enable (DIR_M, DIR_P) to start. You can also set both enables.

Rotary axis

You determine the direction in which the destination is approached by selecting the directional enable (DIR_M, DIR_P):

Control bits DIR_P and DIR_M	Direction
DIR_P = 1 DIR_M = 0	The destination is approached in the plus direction.
DIR_P = 0 DIR_M = 1	The destination is approached in the minus direction.
DIR_P = 1 DIR_M = 1	The destination is approached by the shortest route. The 1PosInc/Digital works out the direction in which the destination is approached.

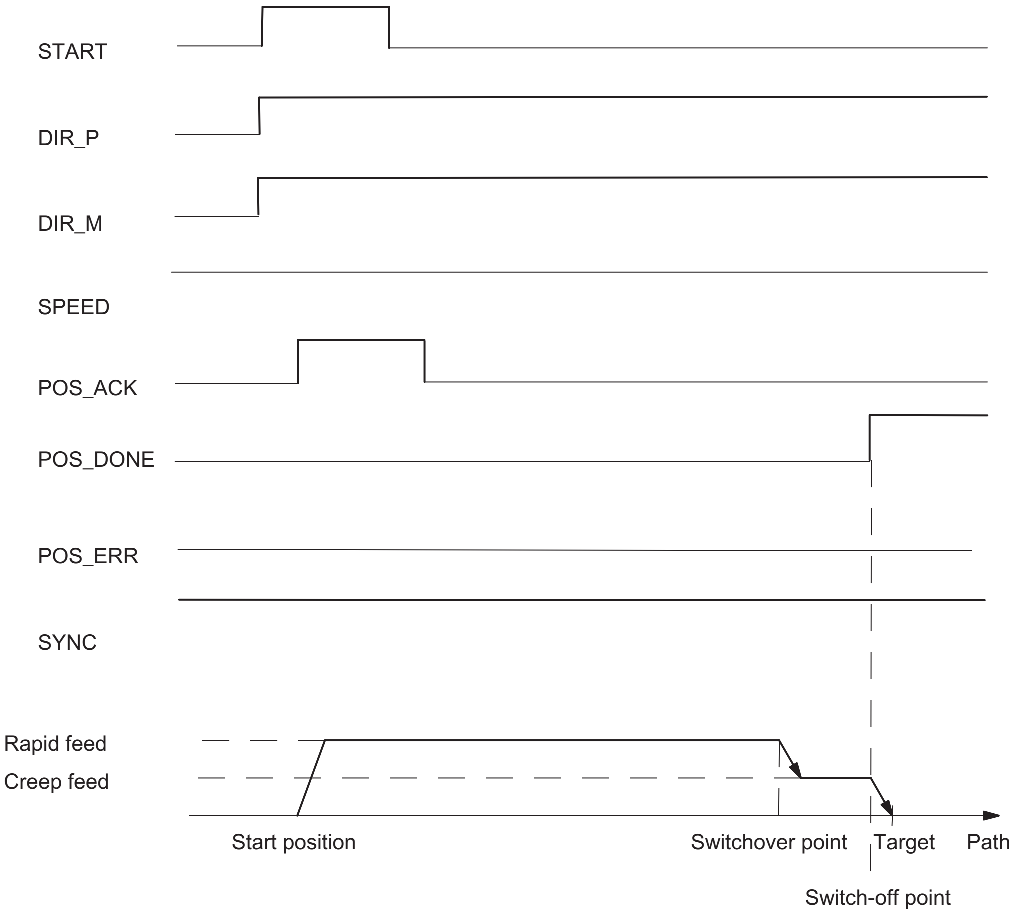


Figure 3-15 Execution of Absolute Positioning

Control Signals: Absolute Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="7">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)</td></tr>
<tr><td colspan="6">Bit 2: DIR_M</td></tr>
<tr><td colspan="6">Bit 1: DIR_P</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Destination
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Absolute Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Absolute Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Absolute positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0	
8	Absolute positioning: destination ≥ end of rotary axis	
9	Absolute positioning was terminated because JOB 9 was initiated	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

3.6.8 Relative Positioning (MODE 4)

Definition

In relative positioning the 1PosInc/Digital moves the drive from the start position in a specified direction for a certain preset distance.

Supply the control interface with the distance to be traveled, and start MODE 4, specifying the direction (DIR_M or DIR_P). The 1PosInc/Digital moves the drive at the preset speed (SPEED control bit) for that distance. At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

If you start during an active run, the 1PosInc/Digital executes the necessary change in direction after the time T_{min} has elapsed.

The preset distance is not checked by the 1PosInc/Digital. This means that more than one revolution may be involved with rotary axes.

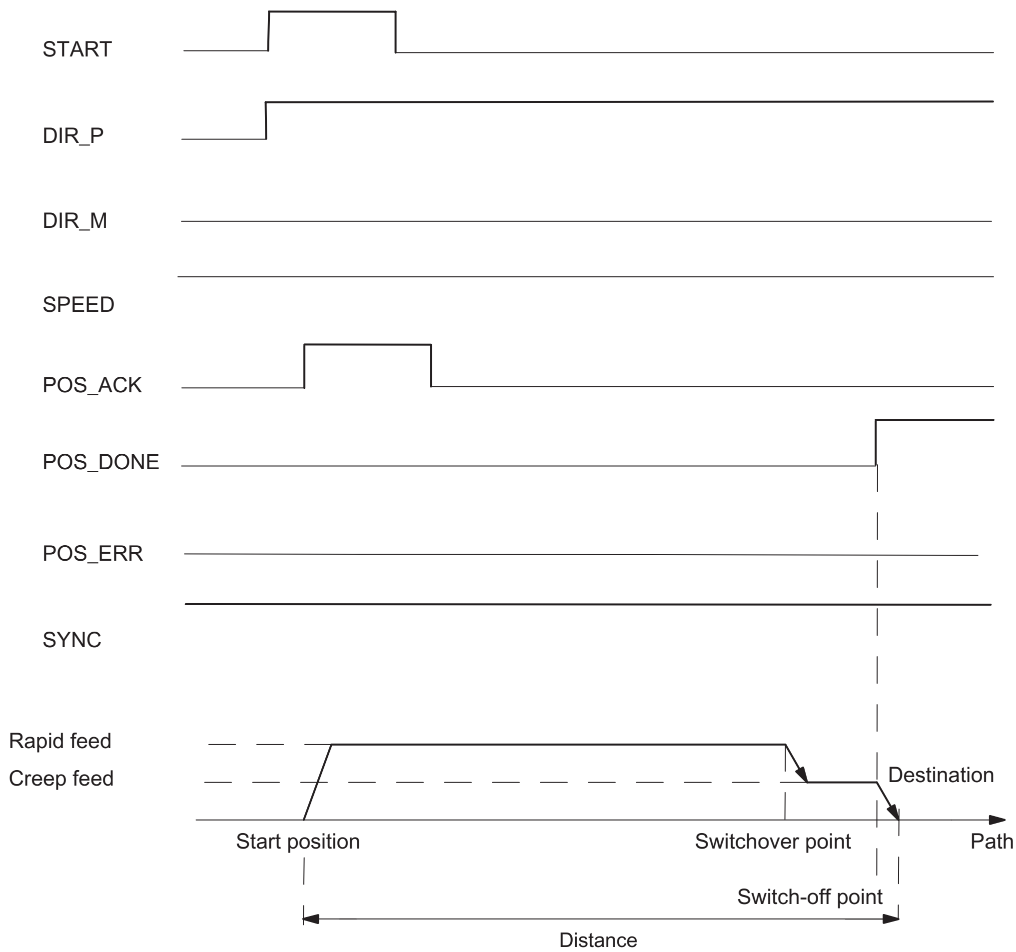


Figure 3-16 Execution of Relative Positioning

Control Signals: Relative Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Distance
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Relative Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Relative Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Relative Positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

3.6.9 Canceling JOB Processing (JOB 0)

Definition

If you activate JOB 0, the 1PosInc/Digital responds in the following way:

- It cancels the current JOB 9 (reference signal evaluation)
- It cancels the current JOB 10 (latch function)
- It sets a pending JOB_ERR = 0.

You can activate JOB 0 whatever the state of the axis.

Effect on the MODEs

MODEs are not affected by JOB 0.

Control Signals: Canceling JOB processing

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
</table>

Feedback Signals: Canceling JOB processing

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

3.6.10 Setting the Actual Value (JOB 1)

Definition

Setting an actual value assigns new coordinates to the actual value displayed. This moves the operating range to a different range on the axis and synchronizes the axis.

Provide the control interface with the new actual value coordinates and activate JOB 1.

The 1PosInc/Digital sets the specified actual value coordinates on the actual value displayed in the feedback interface and sets the feedback bit SYNC = 1.

Effect on the MODEs

MODE	What Happens
Search for Reference	Make sure when the reference point run is evaluated that the feedback bit SYNC = 1 is set immediately. The reference point run still continues to run.
Inching	–
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ switch-off difference. The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot. • Distance to the destination ≤ the switchover difference. The switchover point is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > the switchover difference The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.
Relative Positioning	The preset distance continues to be traversed.

Control Signals: Setting of Actual Value

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Actual value coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Setting of Actual Value

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting an Actual Value: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
34	Setting an Actual Value: actual value coordinates ≥ end of rotary axis	

3.6.11 Changing the Switch-Off Difference (JOB 3)

Definition

Changing the switch-off difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switch-off difference, and activate JOB 3.

The 1PosInc/Digital accepts the specified switch-off difference.

The switch-off difference remains valid until the parameter assignment of the 1PosInc/Digital is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td rowspan="2">-</td></tr>
<tr><td>Inching</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">Distance to the destination ≤ switch-off difference
The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switch-Off Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switch-off difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switch-Off Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 104)

3.6.12 Changing the Switchover Difference (JOB 4)

Definition

Changing the switchover difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switchover difference, and activate JOB 4.

The 1PosInc/Digital accepts the specified switchover difference. The switchover difference remains valid until the parameter assignment of the 1PosInc/Digital is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td rowspan="2">–</td></tr>
<tr><td>Inching</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">The following responses are possible:
• Distance to the destination ≤ the switchover difference
is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference).
• Distance to the destination > the switchover difference
The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switchover Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 4 = Change the switchover difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switchover difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switchover Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 104)

3.6.13 Evaluating the Reference Signal (JOB 9)

Definition

By evaluating the reference signal you can synchronize the axis using an external reference signal during a current run in inching or relative positioning mode. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch) and DI1 (plus limit switch) and DI2 (reducing cam) as break or make contacts.

Supply the control interface with the reference point coordinates, and activate JOB 9. The 1PosInc/Digital sets the feedback signal SYNC = 0.

If the 1PosInc/Digital detects the overrunning of the assigned parameter reference signal in the referencing direction, the axis is synchronized. The 1PosInc/Digital sets the feedback signal SYNC = 1 and assigns the reference point coordinates to the actual value.

The referencing direction is determined by the reference signal and reference switch parameters.

<table>
<tr><th></th><th>Reference switch: Reduction cam towards minus</th><th>Reference switch: Reduction cam towards plus</th><th>Reference switch: Limit switch minus</th><th>Reference switch: Limit switch plus</th></tr>
<tr><td>Reference signal: Reference switch and zero mark</td><td rowspan="2">Minus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Minus referencing direction</td></tr>
<tr><td>Reference signal: Reference switch</td></tr>
<tr><td>Reference signal: Zero mark</td><td colspan="4">The referencing direction is not defined. The axis is synchronized at the next zero mark.</td></tr>
</table>

Effect on the MODEs

MODE	What Happens
Search for Reference	The reference coordinates transferred with JOB 9 are valid
Inching	-
Absolute Positioning	Run canceled with POS_ERR = 1 because SYNC is deleted
Relative Positioning	-

Control Signals: Reference Signal Evaluation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 9 = Evaluate the reference signal</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Reference Signal Evaluation

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Parameters: Reference Signal Evaluation

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus

Evaluating the Reference Signal: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
30	Evaluating the Reference Signal: Reference point coordinates ≥ end of rotary axis	

3.6.14 Latch Function (JOB 10)

Definition

The latch function allows you to store the actual value at an edge at the DI2 digital input. You can use this function, for example, to detect edges or measure lengths.

Supply the control interface with the desired edge, and activate JOB 10.

If the 1PosInc/Digital detects the preset edge at the DI2 digital input, it stores the associated actual value, displays it as a feedback value and sets the feedback bit LATCH_DONE = 1.

You can then activate the latch function again.

Latch Function and Reference Point Run or Reference Signal

If the 1PosInc/Digital synchronizes at the same edge, it stores the actual value before it assigns the reference point coordinates.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Latch Function

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">Bit 1: Latch at negative edge at DI2
Bit 0: Latch at positive edge at DI2</td></tr>
</table>

Feedback Signals: Latch Function

Address	Assignment
Byte 4	Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value: Actual value at the edge at DI2 (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Latch Function: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
36	Latch Function: Edge selection unknown	

3.6.15 Setting the Monitoring of the Direction of Rotation (JOB 11)

Definition

By setting monitoring of the direction of rotation you can adjust the monitoring of the direction of rotation of the 1PosInc/Digital to suit your load and mechanical conditions.

Monitoring of the direction of rotation is always active. The 1PosInc/Digital detects whether the direction of rotation of the drive and the encoder is the same. Direction of rotation monitoring will tolerate different directions for the drive and the encoder up to the preset path difference. If the preset path difference is exceeded, the 1PosInc/Digital reports POS_ERR =1.

Unless you have activated JOB 11, double the switch-off difference is used from the parameters as the path difference. JOB 3 (which changes the switch-off difference) does not affect the path difference for the purpose of monitoring of the direction of rotation.

Supply the control interface with the new path difference, and activate JOB 11.

The 1PosInc/Digital accepts the preset path difference for the monitoring of the direction of rotation.

The preset path difference for the monitoring of the direction of rotation remains valid until the parameter assignment of the 1PosInc/Digital is changed.

Disabling the Monitoring of the Direction of Rotation

Monitoring of the direction of rotation is disabled when the path difference is 0.

Effect on the MODEs

MODEs are not affected by JOB 11.

Control Signals: Setting the Monitoring of the Direction of Rotation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0</td></tr>
<tr><td>Byte 6,7</td><td colspan="6">Path difference for monitoring of the direction of rotation
(0...65 535)</td></tr>
</table>

Feedback Signals: Setting the Monitoring of the Direction of Rotation

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting the Monitoring of the Direction of Rotation: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
38	Monitoring of the direction of rotation Path difference > 65 535	

See also

CPU/Master Stop and RESET State (Page 104)

Error Detection/Diagnostics (Page 99)

3.6.16 Displaying Current Values (JOB 15)

Definition

You can display the following values in the feedback interface as feedback values:

- Residual distance
- Actual speed
- Causes of errors for POS_ERR and JOB_ERR

The residual distance is set by the 1PosInc/Digital as the default for the feedback value.

The 1PosInc/Analog continuously displays the actual value in the feedback interface irrespective of the selected feedback value.

Supply the control interface with the desired feedback value and activate JOB 15.

The selected feedback value remains valid until the parameter assignment of the 1PosInc/Digital is changed.

Displaying Current Values and the Latch Function

If you activate the latch function, the 1PosInc/Digital sets a feedback value of 0 and displays the actual value at the edge at the DI2 digital input.

You can only activate JOB 15 again after the latch function has terminated.

Residual distance

The 1PosInc/Digital calculates the distance to the destination as the residual distance in the absolute positioning and relative positioning MODEs. As long as the actual value is before the destination, the residual distance remains positive. It becomes negative once the destination is overshot. The residual distance is 0 in the other MODEs.

The 1PosInc/Analog displays the residual distance with a sign between -8 388 608 and 8 388 607 increments. Negative values are displayed in twos complement. If the actual residual distance is beyond these limits, the limit value is displayed.

Actual speed

The 1PosInc/Digital calculates the actual speed as an encoder value change in increments per 10 ms. It displays these between 0 and 16 777 215.

Causes of errors for POS_ERR and JOB_ERR

The 1PosInc/Digital displays the causes of errors for POS_ERR and JOB_ERR as well as the MODE and JOB entered in the control interface.

Effect on the MODEs

MODEs are not affected by JOB 15.

Control Signals: Display Current Values

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 15 = Display current values</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0: Residual distance
1: Actual speed
2: Causes of errors for POS_ERR and JOB_ERR</td></tr>
</table>

Feedback Signals: Display Current Values

<table>
<tr><th>Address</th><th>Assignment</th></tr>
<tr><td>Byte 4</td><td>Bit 1: JOB_ERR
Bit 0: JOB_ACK</td></tr>
<tr><td>Bytes 5 to 7</td><td>In accordance with the selected feedback value:
• With a residual distance of: - 8 388 608...8 388 607
• With an actual speed of: 0...16 777 215
• With causes of errors for POS_ERR and JOB_ERR
– Byte 5: Causes of Errors for POS_ERR
– Byte 6: Causes of Errors for JOB_ERR
– Bits 7.3 to 7.0: MODE (= bits 0.7 to 0.4 from the control signals)
– Bits 7.7 to 7.4: JOB (= bits 4.7 to 4.4 from the control signals)</td></tr>
</table>

Display current values: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
35	Display current values: Selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	

See also

CPU/Master Stop and RESET State (Page 104)

Error Detection/Diagnostics (Page 99)

3.6.17 Error Detection/Diagnostics

Parameter assignment error

Parameter assignment error	Response of the 1PosInc/Digital
Causes: • The 1PosInc/Digital cannot identify parameters that exist as its own. • The 1PosInc/Digital slot you configured does not match the physical setup. What to Do: • Check the configuration and setup	• The 1PosInc/Digital is not assigned parameters and cannot execute its functions. • Generate channel-specific diagnostics

External Errors

Load Voltage 2L+ Missing	Response of the 1PosInc/Digital
Causes: • Load voltage 2L+ not present or too low at terminal 15 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current run is halted; it is not possible to start a new run. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_2L+ = 1 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK
Short circuit of the sensor supply	**Response of the 1PosInc/Digital**
Causes: • Short circuit of the encoder supply made available at terminals 2 and 10 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current MODEs reference point run, relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER = 1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error. • The current JOB (reference signal evaluation) is canceled.

Load Voltage 2L+ Missing	Response of the 1PosInc/Digital
Wire Break/Short Circuit of the Encoder Signals	**Response of the 1PosInc/Digital**
Prerequisite: • You must enable the encoder signal diagnostics parameter in order to allow error recognition for the signals A, /A and B, /B. • You must enable the zero marker diagnostics parameter in order to allow error recognition for the signals N, /N. If you use an encoder without a zero mark, switch off error detection. Causes: • Wire break or short circuit of the encoder signals at terminals 1, 5 or 3, 7 or 4, 8. What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current reference point run, relative positioning, and absolute positioning modes are stopped; it is not possible to start a new run in these modes. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER = 1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error. • The current JOB (reference signal evaluation) is canceled.

Errors in the Control of MODEs and JOBs

POS_ERR	Response of the 1PosInc/Digital
Causes: • Certain requirements or conditions have not been met at the start of a MODE	• The MODE started is not executed. • The current run is stopped. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0
JOB_ERR	**Response of the 1PosInc/Digital**
Causes: • Certain requirements or conditions have not been met at the activation of a JOB	• The activated JOB is not executed. – Feedback bit JOB_ERR = 1

Generating a Channel-Specific Diagnostics

In the event of a parameter assignment error, the absence of 2L+ load voltage, a short circuit of the sensor supply or a wire break/short circuit of the encoder signals, the 1PosInc/Digital generates a channel-specific diagnostics on the connected CPU/master. To do this, you must enable the Group Diagnostics parameter (see the *Distributed I/O Device* manual).

Error Acknowledgment EXTF_ACK

You must acknowledge the corrected errors (load voltage missing, short circuit of the sensor supply and open circuit/short circuit of the sensor signals).

What You Do	Response of the 1PosInc/Digital
	Feedback bit ERR_2L+ = 1and/or feedback bit ERR_ENCODER=1
Your control program detects the set feedback bit ERR_2L+ or ERR_ENCODER. Execute your application-specific error response. Eliminate the cause of the error.	
Switch the EXTF_ACK control bit from 0 to 1	The 1PosInc/Digital sets the feedback bits ERR_2L+ = 0 and ERR_ENCODER = 0. This tells you that the cause has been eliminated and acknowledged. If ERR_2L+ is still 1 and/or ERR_ENCODER = 1, the cause of the error is not yet eliminated.
Switch the EXTF_ACK control bit from 1 to 0	
In the case of constant error acknowledgment (EXTF_ACK = 1) or at CPU/Master Stop, the 1PosInc/Digital reports the errors as soon as they are detected and deletes them as soon as they have been eliminated.	

Parameters

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B are monitored for short circuit and wire break.	• On • Off	On
Zero marker diagnostics	Zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On

Feedback Messages

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Byte 4	Bit 7: ERR_2L+ Bit 1: JOB_ERR Bit 0: JOB_ACK

Causes of Errors for POS_ERR

Table 3-1 Causes of Errors for POS_ERR

Error Number	Cause	Remedy
1	MODE unknown	Permissible MODEs are: • MODE 0 • MODE 1 • MODE 3 • MODE 4 • MODE 5
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1 Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0 Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
8	Absolute positioning: destination ≥ end of rotary axis	
9	Absolute positioning was terminated because JOB 9 was initiated	
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	Search for reference: No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

Causes of Errors for JOB_ERR

Table 3-2 Causes of Errors for JOB_ERR

Error Number	Meaning	Remedy
21	JOB unknown	Permissible JOBs are: • JOB 0 • JOB 1 • JOB 3 • JOB 4 • JOB 9 • JOB 10 • JOB 11 • JOB 15
23	ERR_ENCODER is displayed	Check the encoder wiring
30	Evaluating the Reference Signal: Reference point coordinates ≥ end of rotary axis	
34	Setting an Actual Value: actual value coordinates ≥ end of rotary axis	
35	Display current values: Selection unknown	
36	Latch Function: Edge selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	
38	Monitoring of the direction of rotation Path difference > 65 535	

3.7 CPU/Master Stop and RESET State

Behavior at CPU-Master-STOP

Behavior at CPU-Master-STOP	Response of the 1PosInc/Digital
• Due to power-off of the CPU/DP master or • Due to power-off of the IM 151/ IM 151 FO or • Due to failure of DP transmission or • Due to change from RUN to STOP	• The current run is stopped. • All 3 digital outputs are set to 0. • Feedback bit POS_ERR = 0 • Feedback bit POS_DONE = 1

Exiting the CPU-Master-STOP Status

Exiting the CPU-Master-STOP Status	Response of the 1PosInc/Digital
• At power-on of the CPU/DP master or • At power-on of the IM 151/ IM 151 FO or • After failure of the DP transmission or • After a change from STOP to RUN	• The feedback interface of the 1PosInc/Digital remains current. • The axis remains synchronized, and the actual value is current. • The changed switch-off and switchover differences and the path difference for the monitoring of the direction of rotation remain valid. • An initiated JOB 9: Evaluating the reference signal and JOB 10: Latch function remains active. • The feedback bit selected with JOB 15 is current.

RESET state of the 1PosInc/Digital

RESET Status of the 1PosInc/Digital and Modification of the Parameters of the 1PosInc/Digital	Response of the 1PosInc/Digital
• By changing the parameters of the 1PosInc/Digital and downloading the parameter assignment and configuration of the ET 200S station to the CPU/ DP master or • As a result of power-on of the power module of the 1PosInc/Digital or • Inserting the 1PosInc/Digital in an energized state	• The axis is not synchronized and the actual value = 0. • The switch-off and switchover difference is accepted from the parameters. • The path difference for the monitoring of the direction of rotation is set at double the switch-off difference. • JOB 9: Evaluating the reference signal and JOB 10: Latch function are not active. • The residual distance is displayed as a feedback value.

3.8 Parameter List

Overview

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B are monitored for short circuit and wire break.	• On • Off	On
Zero marker diagnostics	Zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On
Axis			
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder	• Off • On	Off
Axis type	Selection of linear axis without limitation or rotary axis with overrun/underrun at end of rotary axis	• Linear • Rotary	Linear
End of rotary axis	Only relevant for rotary axis type: Underrun: 0 to end of rotary axis - 1 Overrun: End of rotary axis - 1 to 0 Parameter assignment error at 0	1 - 16 777 215	36 000
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 reducing cam	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed. You can change the switchover difference with JOB 4.	0 - 65 535	1000
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

3.9 Control and Feedback Signals

Assignment of the Control Interface

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="8">Byte 0</td><td colspan="6">Bits 0.7 to 0.4 stand for the MODEs</td></tr>
<tr><td rowspan="6">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td></td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>MODE 3 = Reference Point Run</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>MODE 5 = Absolute Positioning</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">With MODE 3 = reference point run: reference point coordinates
at MODE 4 = Relative positioning: distance
at MODE 5 = Absolute positioning: target</td></tr>
<tr><td rowspan="11">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 stand for the MODEs</td></tr>
<tr><td rowspan="9">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td></td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>JOB 4 = Change the switchover difference</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>JOB 9 = Evaluate the reference signal</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>JOB 15 = Display current values</td></tr>
<tr><td colspan="6">Bit 3: EXTF_ACK
Bit 2: Reserve = 0
Bit 1: Reserve = 0
Bit 0: JOB_REQ</td></tr>
</table>

Address	Assignment
Bytes 5 to 7	Corresponding to the selected JOB: • With JOB 1= actual value coordinates • With JOB 3 = switch-off difference • With JOB 4 = switchover difference • With JOB 9 = reference point coordinates • With JOB 10 – Byte 5: Bit 0 = latch at positive edge at DI2 – Byte 5: Bit 1 = latch at negative edge at DI2 • With JOB 11= path difference for direction of rotation monitoring • With JOB 15 – Byte 5: 0 = Residual distance – Byte 5: 1 = actual speed – Byte 5: 2 = error information

Assignment of the Feedback Interface

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 6: STATUS DO 2 Bit 5: STATUS DO 1 Bit 4: STATUS DO 0 Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value
Byte 4	Bit 7: ERR_2L+ Bit 6: STATUS DI 2 reduction cams Bit 5: STATUS DI 1 limit switch plus Bit 4: STATUS DI 0 limit switch minus Bit 3: Reserve Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file 1) (hardware catalog\PROFIBUS DP\Other Field Devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
1)Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

3.10 Technical Specifications

Overview

Technical Data of the 1PosInc/Digital	
Dimensions and weight	
Dimension W x H x D (mm)	30 x 81 x 52
Weight	Approx. 65 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
Rated load voltage L+ • Range • P1	24 VDC 20.4 ... 28.8 V Yes
Isolation • Between the backplane bus and the I/O	 Yes
Sensor supply • Output voltage • Output current	 L+ -0.8 V Maximum 500 mA, short-circuit proof
Current consumption • From the backplane bus • From the load voltage L+ (no load)	 Max. 10 mA Max. 50 mA
Power dissipation	Typ. 2 W
Data for the digital inputs	
Input voltage • Rated value • 0 signal • 1 signal	 24 V DC -30 V to 5 V DC 11 V to 30 V
Input current • 0 signal • 1 signal	 ≤ 2 mA (perm. leakage current) 9 mA (typ.)
Minimum pulse width	500 μs
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	50 m
Data for the Digital Outputs	
Output voltage • Rated value • 0 signal • 1 signal	 DC 24 V ≤ 3 V ≥ L+ -1 V

Technical Data of the 1PosInc/Digital	
Output current • 0 signal (leakage current) • 1 signal – Rated value – Permitted range	 ≤ 0.3 mA 0.5 A 7 mA to 0.6 A
Switch rate • Resistive load • Inductive load • Lamp load	 100 Hz 2 Hz ≤ 10 Hz
Lamp load	≤5 W
Output delay (resistive load, output current 0.5 A) • At 0 to 1 • At 1 to 0	 typ. 150 µs typ. 150 µs
Short-circuit protection of the output	Yes
Threshold on	0.7 A to 1.8 A
Inductive extinction	Yes; L+ -(55 to 60 V)
Digital input control	Yes
Cable lengths • Unshielded • Shielded	 600 m 1000 m
Encoder signals	
• Level • Terminating resistance • Differential input voltage • Max. frequency • Galvanic isolation from ET200S bus	After RS 422 330 Ω min. 1 V 500 kHz Yes
Length of cable • Shielded	 Max. 50 m
Status, Diagnostics	
Change in actual value (up) Change in actual value (down) Status display positioning in operation Status display DI0 (minus hardware limit switch) Status display DI1 (plus hardware limit switch) Status display DI2 (reducing cam) Group error on 1PosInc/Digital Diagnostic information	UP LED (green) DN LED (green) LED POS (green) LED 9 (green) LED 13 (green) LED 14 (green) SF LED (red) Yes
Response Times	
Update rate for feedback messages Response time at the switchover or switch-off point Latch response time	2 ms Output delay + 30 µs Typ. 400 µs

1PosInc/Analog

4

4.1 Product overview

Order number

6ES7138-4DJ00-0AB0

Features

- **Positioning module for controlled positioning using the analog output**
  - Switchover and switch-off difference can be set using your control program
  - The voltage for rapid and creep feed, acceleration, and deceleration can be set using your control program
- **Incremental encoder with 5 V differential signals**
  - With or without zero mark
  - Quadruple evaluation of the encoder signals
- **Usable axis types**
  - Linear axis
  - Rotary axis
- **Operating range: 0 - 16 777 215 steps**
- **The drive is controlled using the analog output**
  - ± 10 V, digital output DO can be controlled freely
  - 0 V to 10 V, direction using digital output DO
- **3 digital inputs can be used for the following:**
  - Minus hardware limit switch
  - Plus hardware limit switch
  - Reducing cam/latch input
- **Diagnostics**
  - Encoder monitoring

Configuration

To configure the 1PosInc/Analog, you can use either

- A DDB file (http://www.ad.siemens.de/csi/gsd) or
- STEP 7 as of V5.1 SP2.

4.2 Brief Instructions on Commissioning the 1PosInc/Analog

Introduction

Using the example of inching mode, this brief introduction shows you a functioning application in which you get to know and check the hardware and software involved in a positioning operation of your 1PosInc/Analog.

Prerequisites for the Example

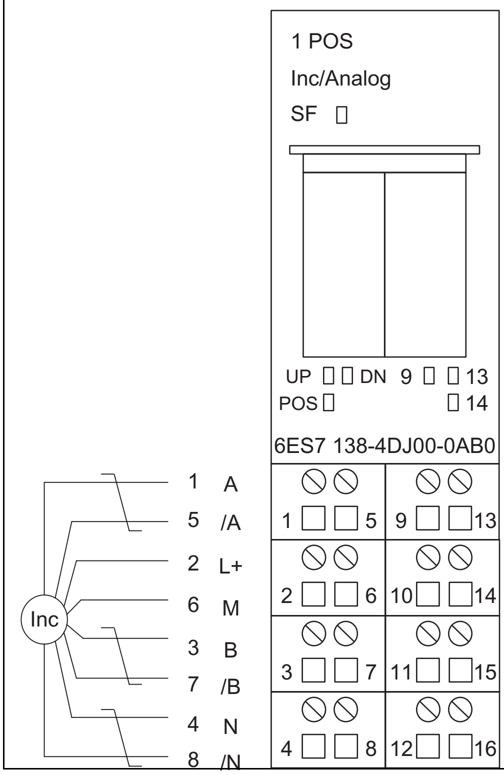
The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You must have:
  - A TM-E30S44-01 terminal module (6ES7 193-4CG20-0AA0 or 6ES7 193-4CG30-0AA0)
  - A 1PosInc/Analog
  - An incremental encoder with 5V differential signals and a 24 V encoder supply
  - A drive with a power control system (a frequency converter with ±10 V analog input for speed control, for example)
  - A 24 VDC power supply
  - The necessary wiring material

Installation, Wiring, and Fitting

Install and wire the TM-E30S44-01 terminal module. Insert the 1PosInc/Analog in the terminal module (you can find detailed instructions in the *Distributed I/O Device* manual).

Table 4-1 Terminal assignment of the 1PosInc/Analog

Terminal assignment	View	Remarks			
		**Connection of the Incremental Encoder with 5 V Differential Signals: Terminals 1-8**		**Connection of the Switches and the Drive: Terminals 9-16**	
		1: A	Track A	9: IN0	Minus limit switch
		5: /A		13: IN1	Plus limit switch
		3: B	Track B	14: IN2	Reducing cam; latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 VDC	Voltage supply for incremental encoder	12: QV+	Analog output ± 10 or 0 V to 10 V to connect the drive
		6: M		16: M_{ana}	
		4: N	Track N; optional zero mark	11: OUT	Digital output DO for direct control or as a directional signal for the drive
		8:/N		15: M	

Configured with STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. Select "1PosInc/Analog" from the hardware catalog. The number 6ES7 138-4DJ00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1PosInc/Analog.
4. Double-click this number to open the "Properties for the 1PosInc/Analog" dialog box.

   On the "Addresses" tab, you will find the addresses of the slot to which you have dragged the 1PosInc/Analog. Make a note of these addresses for subsequent programming.

   On the "Parameters" tab, you will find the default settings for the 1PosInc/Analog. If you are not connecting any limit switches to the 1PosInc/Analog, set the DI0 limit switch minus and DI1 limit switch plus parameters to "make contact". Adapt the "DO function" parameter to the drive interface.
5. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Creating Blocks and Integrating Them Into The User Program

Integrate the following FC 101 block in your user program (in OB 1, for example). This block requires the DB1 data block with a length of 16 bytes. In the example below, the start is initiated by setting memory bit 30.0 (in the plus direction) or 30.1 (in the minus direction) with the programming device. Select the speed for inching mode using memory word 32.

STL			Explanation
Block: FC101			
	L	PID 256	//Load feedback values from the 1PosInc/Analog
	T	DB1.DBD8	
	L	PID 260	
	T	DB1.DBD12	
	L	DB1.DBB8	//Display status bits
	T	MB8	
	L	DB1.DBB12	
	T	MB9	
	L	DB1.DBD8	//Display actual value
	UD	DW#16#FFFFFF	
	T	MD12	
	AN	M30.0	
	SPB	DIRM	
	L	B#16#13	//Travel in plus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, CTRL_DO=1, INCH=1)
	SPA	CTRL	
DIRM:	AN	M30.1	
	SPB	STOP	
	L	B#16#15	//Travel in minus direction
	T	DB1.DBB0	//(START=1, DIR_P=0, DIR_M=1, CTRL_DO=1, INCH=1)
	SPA	CTRL	
STOP:	L	B#16#0	//Stop
	T	DB1.DBB0	
	A	DB1.DBX8.2	
	SPB	CTRL	
	AN	DB1.DBX8.0	//Set/delete START depending on POS_ACK
	=	DB1.DBX0.0	
CTRL:	L	MW32	//Speed for inching mode
	T	DB1.DBW23	
	L	B#16#0	
	T	DB1.DBB1	
	L	DB1.DBD0	//Transfer control values to the 1PosInc/Analog
	T	PAD256	
	L	DB1.DBD4	
	T	PAD260	

Test

Start inching mode, and monitor the associated feedback.

1. Use "Monitor/Modify Variables" to check the actual value and the status bits POS_ACK, POS_ERR, POS_DONE, ERR_ENCODER.
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   - MD12 (actual value)
   - M8.0 (POS_ACK)
   - M8.1 (POS_ERR)
   - M8.2 (POS_DONE)
   - M8.7 (ERR_ENCODER)
   - M30.0 (inching in plus direction)
   - M30.1 (inching in minus direction)
   - MW32 (speed for inching mode; as S7 analog value 0-7EFFH)
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor" to switch to monitoring.
6. Switch the CPU to RUN mode.

Result

The following table shows you which activity triggers which result.

Activity	Result
Switch the CPU to RUN mode.	• The POS_ACK status bit is deleted • The POS_ERR status bit is deleted • The POS_DONE status bit is set
Check the encoder wiring	
Check the feedback bit ERR_ENCODER	• If ERR_ENCODER = 1, correct the wiring of the encoder
Inching in the plus direction:	
Start inching mode in the plus direction by setting memory marker 30.0 ("Variable > Modify >")	**The status bit POS_ERR = 0, the UP LED lights up** • The POS_ACK status bit is set • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the DN LED lights up** Check the assigned parameter reversal of the direction of rotation and directional adjustment, and the wiring of the encoder and drive

Activity	Result
Check the speed of the drive in the plus direction	
Control the speed using memory marker word 32 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct
Inching in the minus direction:	
Start inching mode in the minus direction by setting memory marker 30.1 ("Variable > Modify >")	**The status bit POS_ERR = 0, the DN LED lights up** • The POS_ACK status bit is set • The POS_ERR status bit is deleted • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the UP LED lights up** Check the assigned parameter reversal of the direction of rotation and directional adjustment, and the wiring of the encoder and drive
Check the speed of the drive in the minus direction	
Control the speed using memory marker word 32 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct

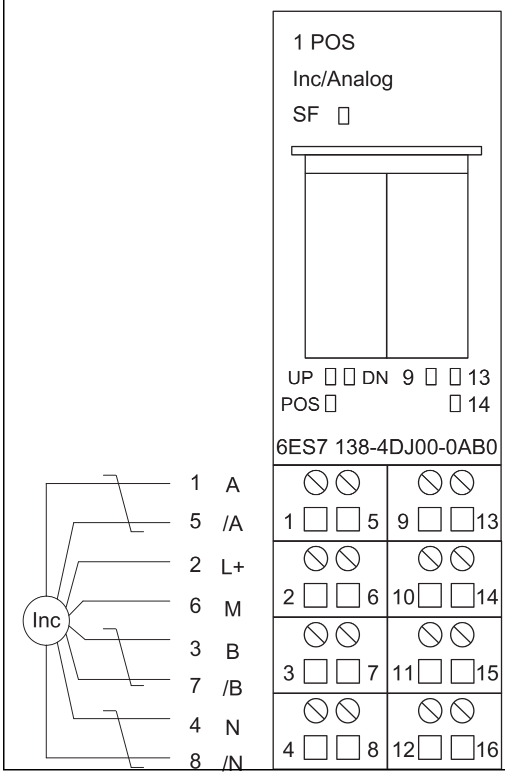
4.3 Terminal Assignment Diagram

Wiring rules

The wires to the incremental encoder (terminals 1 and 5, 3 and 7 and 4 and 8) have to be in twisted pairs and shielded. The shield must be supported at both ends. You use the shield contact element (Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal assignment

Table 4-2 Terminal assignment of the 1PosInc/Analog

Terminal assignment	View	Remarks			
		**Connection of the Incremental Encoder with 5 V Differential Signals: Terminals 1-8**		**Connection of the Switches and the Drive: Terminals 9-16**	
		1: A	Track A	9: IN0	Minus limit switch
		5: /A		13: IN1	Plus limit switch
		3: B	Track B	14: IN2	Reducing cam; latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 VDC	Voltage supply for incremental encoder	12: QV+	Analog output ± 10 or 0 V to 10 V to connect the drive
		6: M		16: M_{ana}	
		4: N	Track N; optional zero mark	11: OUT	Digital output DO for direct control or as a directional signal for the drive
		8:/N		15: M	

Connection of Relays and Contactors to the Digital Output

Note

Direct connection of inductivities (such as relays and contactors) is possible without external circuiting.

If SIMATIC output circuits can be deactivated by additionally installed contacts (for example relay contacts), you have to provide additional overvoltage protection devices at inductivities (see the following example for overvoltage protection).

Overvoltage Protection Example

The following figure shows an output circuit that requires additional overvoltage protection devices. Direct-current coils are wired with diodes or Zener diodes.

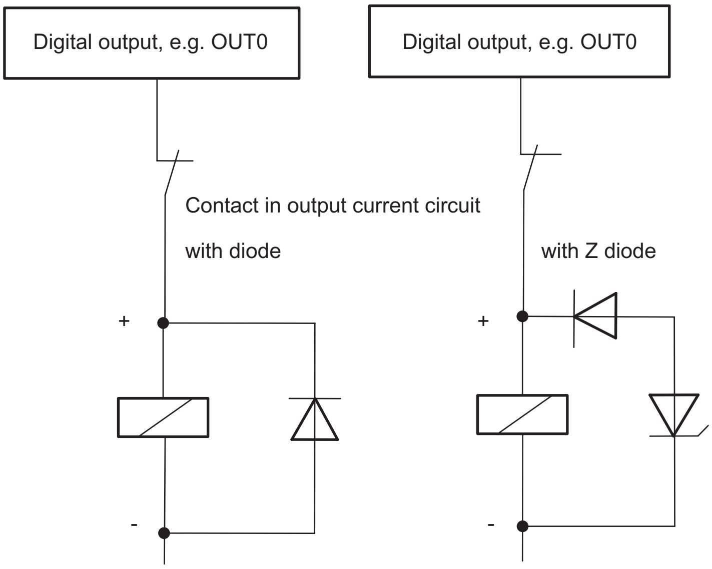


Figure 4-1 Relay contact in the output circuit

4.4 Safety concept

Principle

The following measures are vital to the safety of the system. Install them with particular care, and adapt them to meet the requirements of the system.

Check the measures are effective before the first run.

> **⚠ WARNING**
>
> To avoid injury and damage to property, make sure you adhere to the following:
> - Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.).
> - Make sure that no one has access to areas of the system with moving parts.
> - Install, for example, safety limit switches for the end positions of the axes that switch off the power control system directly.
> - Install devices and take steps to protect motors and power electronics.

Setting up a positioning control

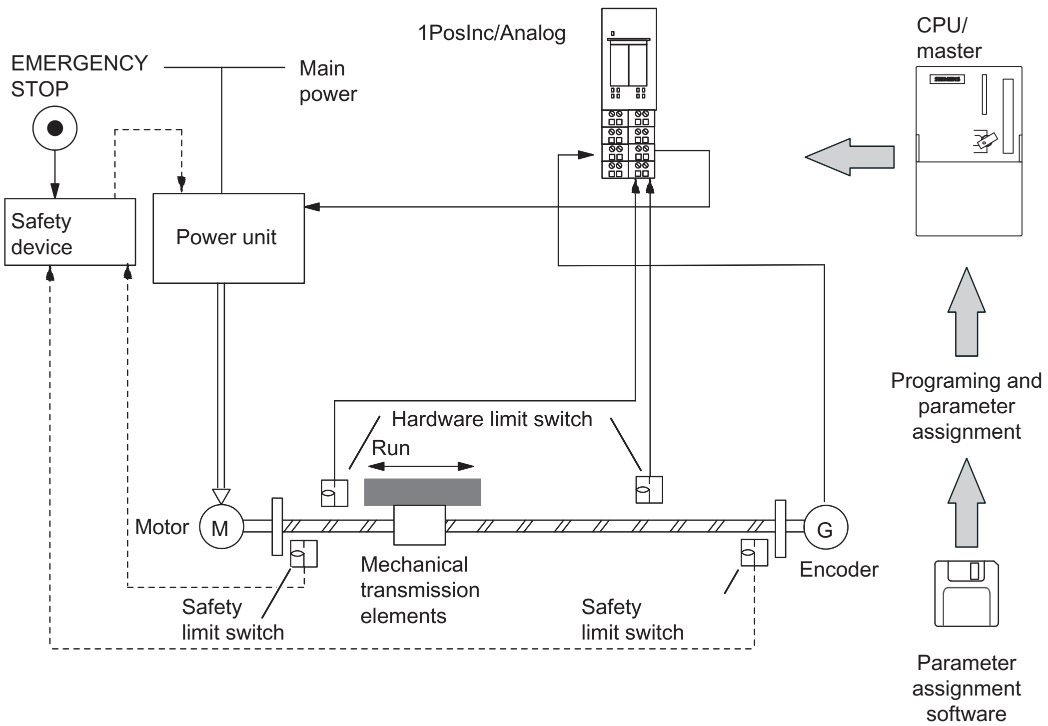


Figure 4-2 Design of a Positioning Control System (Example)

4.5 Fundamentals of Controlled Positioning Using the Analog Output

Positioning Operation

From the start position, the speed is increased (rapid feed) and the destination is approached at this speed. At a preset distance from the destination (switchover point), there is a change to a lower speed (creep feed).

Shortly before the axis reaches the destination and also at a preset distance to the destination, the drive can either be switched off (switch-off point) or be slowed down from creep feed to 0.

To facilitate understanding, the change in speed is illustrated over the path traversed.

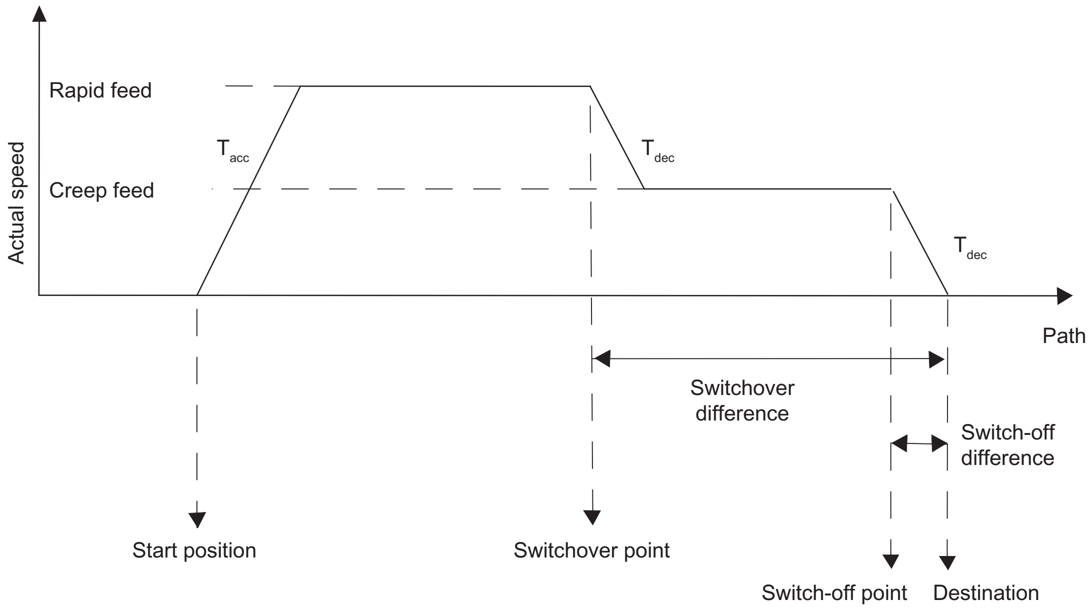


Figure 4-3 Switching points and switching differences

Definitions

Term	Explanation
Operating range	Defines the range, which you set for a particular task by means of the hardware limit switches. Maximum operating range: • Linear axis - max. 0 to 16,777,215 increments • Rotary axis - from 0 to the assigned parameter end of the rotary axis
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.
Switchover point	Defines the position at which the drive is slowed down from rapid feed to creep feed.
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.
Switch-off point	Defines the position at which the drive is switched off. The 1PosInc/Analog reports the end of the run at this point.
Start position	Defines the position of the drive within the operating range from which the run is started. If the start position is within the switch-off difference, the drive is not triggered. The 1PosInc/Analog reports the end of the run at this point. If the start position is within the switchover difference, the run is only executed in creep feed mode.
Target	Defines the absolute or relative position of the axis approached during positioning. The destination is the position to be reached on an axis during a run. In the case of an absolute run, you specify the destination directly by means of your control program. In the case of a relative run, the destination is calculated from the start position and the distance specified in the control program. If you want to find out how accurately you have reached the destination, you have to compare the actual value with the position specified.
Linear axis	Defines the axis type with a limited operating range. It is limited by the following: • The numeric range that can be represented (0 to 16 777 215 increments) • The hardware limit switch
Rotary axis	Defines the axis type with an infinite operating range. This includes resetting the axis position to 0 after one rotation (assigned parameter rotary axis end).
Minus direction	If the drive moves in the minus direction, the actual value displayed is decreased.
Plus direction	If the drive moves in the plus direction, the actual value displayed is increased.

4.6 Functions of the 1PosInc/Analog

4.6.1 Overview of the Functions

Overview

The 1PosInc/Analog offers you the following functions for moving your axis:

- Stop
- Search for Reference
- Inching
- Absolute Positioning
- Relative Positioning

In addition to the different types of motion, the 1PosInc/Analog also offers functions for:

- Setting of Actual Value
- Change Switch-Off Difference
- Change Switchover Difference
- Changing the Voltage for Rapid Feed
- Changing the Voltage for Creep Feed
- Changing the acceleration (T_{acc})
- Changing the deceleration (T_{dec})
- Reference Signal Evaluation
- Latch Function
- Setting the Monitoring of the Direction of Rotation
- Display Current Values
- Error Detection/Diagnostics
- Behavior at CPU-Master-STOP

Parameters: Define the variables that depend on the drive, axis, and encoder uniquely in the parameters.

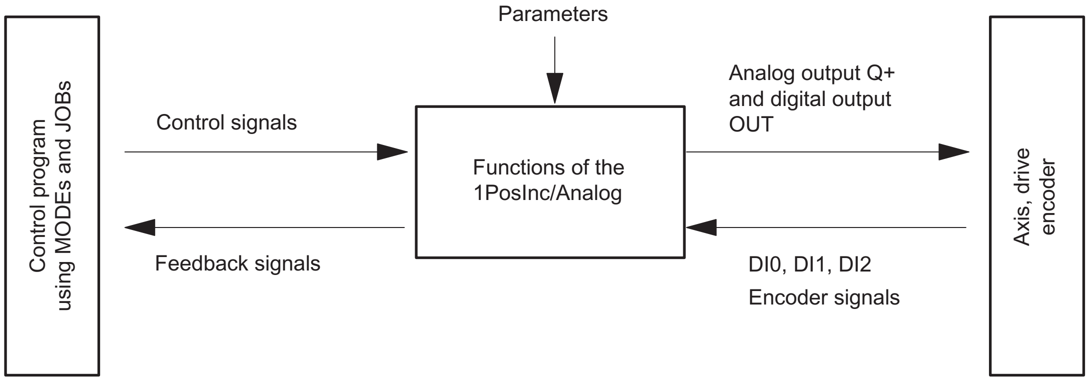


Figure 4-4 How the 1PosInc/Analog Works

Interfaces to the Control Program and the Axis

To execute the function, the 1PosInc/Analog has digital inputs as an interface to the axis, encoder signals for the connection of an incremental encoder, and an analog and a digital output to control the drive.

You can modify and monitor the types of motion (MODEs) and other functions (JOBs) with your control program using control signals and feedback signals.

See also

Parameter List (Page 178)

Principle

What You Do	Response of the 1PosInc/Analog
Provide the control interface with data depending on the MODE. Check the POS_ACK feedback bit is at 0	
Switch the START control bit from 0 to 1	The 1PosInc/Analog sets the feedback bit POS_ACK = 1 and POS_DONE = 0. You can tell by this that the start has been detected by 1PosInc/Analog and when POS_ERR = 0, the MODE is executed. The MODE is not executed when POS_ERR = 1.
Switch the START control bit from 1 to 0	The 1PosInc/Analog sets the feedback bit POS_ACK = 0
	In the case of a stop, the reference point run, and absolute and relative positioning, the 1PosInc/Analog sets the feedback bit POS_DONE = 1 when the MODE is completed without errors. When POS_ERR = 1 the MODE is terminated with an error.
Only when POS_ACK=0 can you start a new MODE. If you start when a MODE is running, the 1PosInc/Analog takes on the new motion and executes a change of direction, if necessary.	

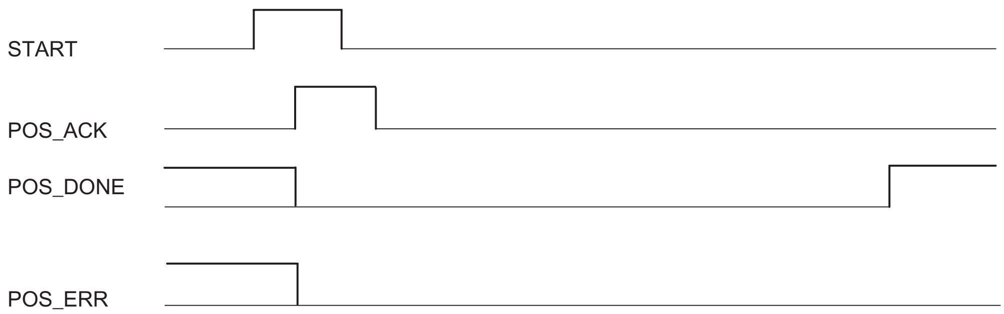


Figure 4-5 Control and Feedback Signals with MODEs

Principle

What You Do	Response of the 1PosInc/Analog
Provide the control interface with data corresponding to the JOB. Check the JOB_ACK feedback bit is at 0	
Switch the JOB_REQ control bit from 1 to 0	The 1PosInc/Analog sets the feedback bit JOB_ACK = 1 You can tell by this that activation has been detected by 1PosInc/Analog and when JOB_ERR = 0, the JOB is executed. • When a reference signal is evaluated, the 1PosInc/Analog sets the SYNC = 0 feedback bit at the same time. • In the case of the latch function, the 1PosInc/Analog sets the feedback bit LATCH_DONE = 0 at the same time. • All the other JOBs are thus executed. The JOB is not executed when JOB_ERR = 1.
Switch the JOB_REQ control bit from 1 to 0	The 1PosInc/Analog sets the feedback bit JOB_ACK = 0
	When a reference signal is evaluated, the 1PosInc/Analog sets the feedback bit SYNC = 1 when the function has been executed. In the case of the latch function, the 1PosInc/Analog sets the feedback bit LATCH_DONE = 1 when the function has been executed.
Only when JOB_ACK=0 can you activate a new JOB again.	

Figure 4-6 Control and Feedback Signals with JOBs

4.6.2 Axis, Drive and Encoder

Quadruple evaluation of the encoder signals

The 1PosInc/Analog evaluates the pulses supplied by the incremental encoder and adds them together to obtain the actual value. You must take the quadruple evaluation into account when you make settings for paths in the parameters and in the control and feedback interfaces:

1 pulse of the incremental encoder corresponds to 4 increments of the 1PosInc/Analog.

The current value is in the operating range 0 - 16 777 215 increments. The 1PosInc/Analog generates an overflow or underflow of the actual value in the operating range at the limits of the operating range.

Reversal of the Direction of Rotation of the Encoder Signals

You can use the parameter for the reversal of the direction of rotation to adapt the direction of rotation of the encoder to that of the drive and the axis.

Controlling the Drive

You assign parameters how the drive is to be controlled using the Function DO parameter.

If you select Output, the following applies: The control is bipolar. The drive is controlled using the analog output QV+/M_{ana} ±10 V to +10 V. You can use the digital output OUT as you wish. You can read the status of the OUT digital output from the feedback interface, with a delay that corresponds to the updating rate.

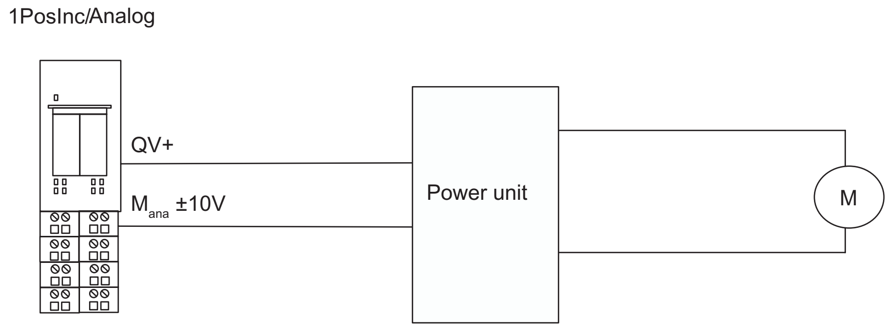


Figure 4-7 Schematic Diagram of the Bipolar Control of a Drive

If you select Direction, the following applies: The control is unipolar. The drive is controlled using the analog output QV+/M_{ana} with 0 V to +10 V.

The 1PosInc/Analog controls the direction using the OUT digital output.

You can read the status of the OUT digital output from the feedback interface, with a delay that corresponds to the updating rate.

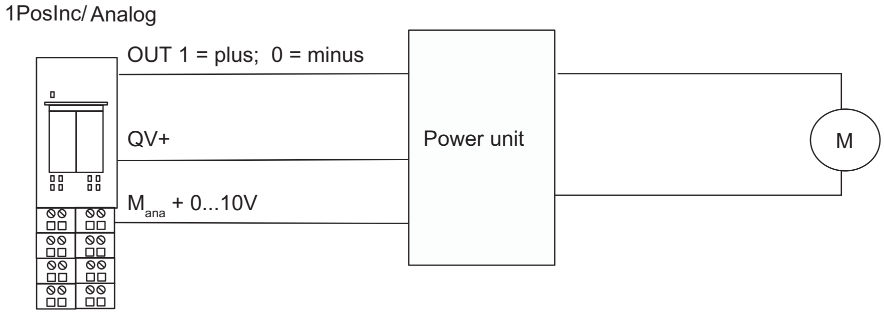


Figure 4-8 Schematic Diagram of the Unipolar Control of a Drive

Changing the Voltage for Rapid Feed and Creep Feed

The default setting for rapid feed is 10 V and the default setting for creep feed is 1 V. You can only change these settings using JOBs 5 and 6.

After the 1PosInc/Analog starts up or after parameter assignment with changed parameters, the values are accepted from the parameters.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

If you have selected a greater voltage for creep feed than for rapid feed, there will be acceleration at the switchover point from rapid feed to creep feed.

Parameters	Meaning	Value range	Default setting
Drive			
Adapt direction	If you adjust the direction, this results in the polarity reversal of your drive	• Off • On	Off
Function DO	**Output:** Your drive is controlled by the analog output using ±10 V. You control the DO digital output using the CTRL_DO control bit. **Direction:** Your drive is controlled by the analog output using 0 V to 10 V. The direction for your drive is specified by the 1PosInc/Analog via the DO digital output. Plus direction: DO=1 Minus direction: DO=0	• Output • Direction	Output

Parameters	Meaning	Value range	Default setting
Switch-off	Use this parameter to determine the course of the voltage after the switch-off point. It is only effective in the relative and absolute positioning modes. Directly: The voltage is set directly to 0 V at switch-off point. Ramp: As of switch-off point, voltage is reduced to 0 V using the ramp.	• Directly • Ramp	Directly
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000
Acceleration T_{acc} in ms	Time required for a change in voltage via a ramp from 0 V to10 V. At 0 ms acceleration is without a ramp.	0 - 65535	10000
Deceleration T_{dec} in ms	Time required for a change in voltage via a ramp from 10 V to 0 V. At 0 ms deceleration is without a ramp.	0 - 65535	10000

Displaying the Status of the Run

You can read the status of the run from the feedback interface from byte 0, bits 5 and 6. This status display is possible in the reference point run and absolute and relative positioning MODEs.

Table 4-3 Interpretation of Bits 5 and 6

Bit 5	Bit 6	Meaning	Corresponding Number in Figure
0	0	Quiet state or run completed	0
0	1	Acceleration to rapid feed or run with rapid feed	1
1	0	Deceleration to creep feed or run with creep feed	2
1	1	Deceleration to 0 V	3

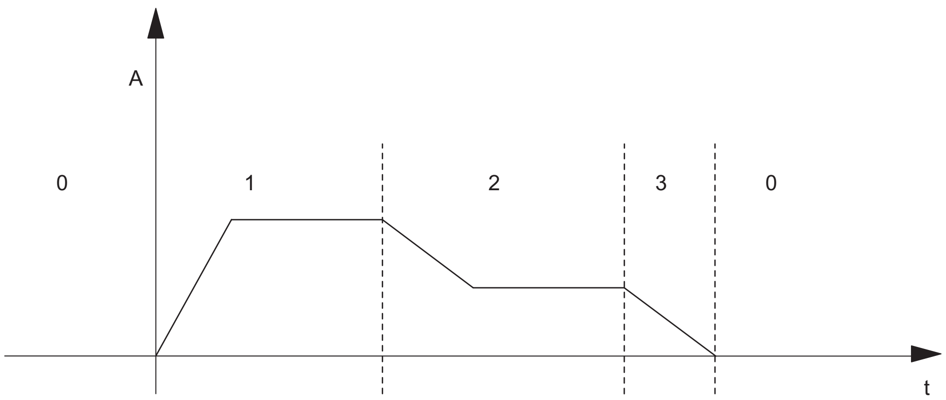


Figure 4-9 Schematic Diagram of the Status of the Run

Effect of the Hardware Limit Switches

The two digital inputs (DI0 and DI1) are evaluated by the 1PosInc/Analog as hardware limit switches:

- DI0 is the minus limit switch and limits the operating range in the minus direction.
- DI1 is the plus limit switch and limits the operating range in the plus direction.

You can assign parameters to the hardware limit switches separately as break contacts or make contacts.

The hardware limit switches are evaluated with linear axes and rotary axes.

This enables you to move away from a hardware limit switch without additional error acknowledgment by moving in the other direction if you reach or overrun a hardware limit switch.

Only the hardware limit switch that lies in the direction in which the drive is being moved is evaluated.

The current signal level of the digital inputs is displayed in the feedback interface, delayed by the update rate.

You can see from the following table what effect the hardware limit switches have in the individual MODEs:

<table>
<tr><th>MODE</th><th>Effect of the Hardware Limit Switches</th></tr>
<tr><td>Search for Reference</td><td>The 1PosInc/Analog automatically reverses the direction using deceleration and acceleration when a hardware limit switch is reached.</td></tr>
<tr><td>Inching</td><td rowspan="3">The motion of the axis is halted at the hardware limit switch with the output of 0 V on the analog output, and the feedback bit POS_ERR is reported.</td></tr>
<tr><td>Absolute Positioning</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Starting on the hardware limit switch

Direction	Response of the 1PosInc/Analog
Starting into the operating range	The 1PosInc/Analog starts the specified MODE.
Starting away from the operating range	The POS_ERR=1 feedback bit is set.

4.6.3 Effect of the Directional Enables

Definition

Using control bits DIR_M and DIR_P, you can enable control of the drive in the corresponding direction:

- With DIR_M = 1 you can move in the minus direction.
- With DIR_P = 1 you can move in the plus direction.

Interrupting and Continuing the Run

If you reset the relevant directional enable during a run, the motion of the axis is halted by deceleration to 0 V at the analog output, and the run is interrupted.

If you set the relevant directional enable again, the run is continued.

4.6.4 Stop (MODE 0)

Definition

If you start MODE 0, the 1PosInc/Analog stops the current run by deceleration to 0 V at the analog output and the run is completed (POS_ERR = 0, POS_DONE = 1).

A run terminated with MODE 0 cannot be continued. To put the axis into motion again, you start a new MODE.

Control Signals: Stop

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
</table>

Feedback Signals: Stop

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK

Completing/Interrupting a Run

If you parameterized directly at switch-off and activate MODE 0

Figure 4-10 Interrupting the Run by Switching Off: Directly

If you parameterized ramp at switch-off and activate MODE 0

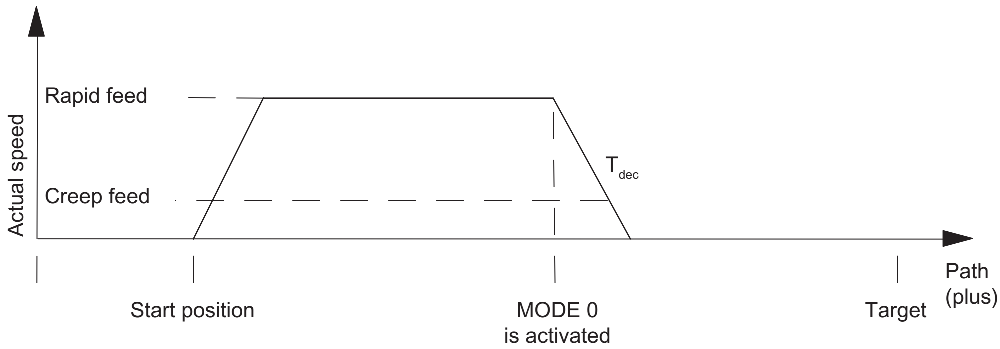


Figure 4-11 Interrupting the Run by Switching Off: Ramp

4.6.5 Reference Point Run (MODE 3)

Definition

You can use the reference point run to synchronize the axis on the basis of an external reference signal. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch) and DI1 (plus limit switch) and DI2 (reducing cam) as break or make contacts.

Provide the control interface with the reference point coordinates, and start MODE 3. The 1PosInc/Analog sets the feedback signal SYNC = 0 and moves the drive with the voltage set for rapid feed in the assigned parameter start direction and searches for the reference signal. To do this, the 1PosInc/Analog automatically makes the necessary change in direction at the limit switches and the reducing cam using deceleration and acceleration.

Set the necessary directional enables (DIR_M, DIR_P) to ensure that the drive is controlled.

If the 1PosInc/Analog detects the parameterized reference signal, it controls the drive at the set voltage for creep feed mode in the assigned parameter referencing direction. This is controlled by the reference signal and reference switch parameters.

<table>
<tr><th></th><th>Reference switch: Reduction cam towards minus</th><th>Reference switch: Reduction cam towards plus</th><th>Reference switch: Minus limit switch</th><th>Reference switch: Plus limit switch</th></tr>
<tr><td>Reference signal: Reference switch and zero mark</td><td rowspan="2">Minus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Minus referencing direction</td></tr>
<tr><td>Reference signal: Reference switch</td></tr>
<tr><td>Reference signal: Zero mark</td><td colspan="4">The referencing direction is not defined. The axis is synchronized at the next zero mark.</td></tr>
</table>

When the assigned parameter conditions are met, the axis is synchronized. The 1PosInc/Analog sets the feedback signal SYNC = 1, assigns the reference point coordinates to the actual value, and decelerates to 0 V.

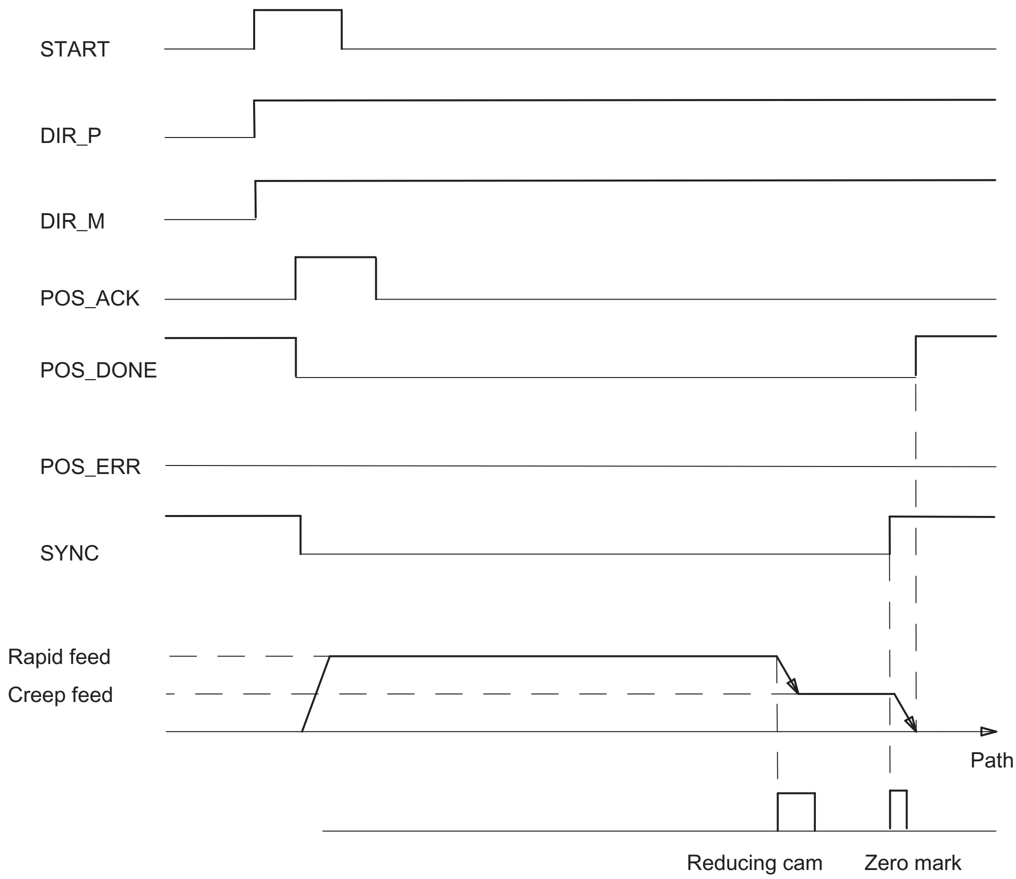


Figure 4-12 Sequence of Execution of the Search for Reference

Control Signals: Search for Reference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="6">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 3 = Reference Point Run</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 2: DIR_M</td></tr>
<tr><td colspan="6">Bit 1: DIR_P</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Search for Reference

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Search for Reference

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the relevant switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus
Acceleration T_{acc} in ms	Time required for a change in voltage via a ramp from 0 V to10 V. At 0 ms acceleration is without a ramp. You can change the acceleration using Job 7.	0 - 65535	10000
Deceleration T_{dec} in ms	Time required for a change in voltage via a ramp from 10 V to 0 V. At 0 ms deceleration is without a ramp. You can change the deceleration using Job 8.	0 - 65535	10000

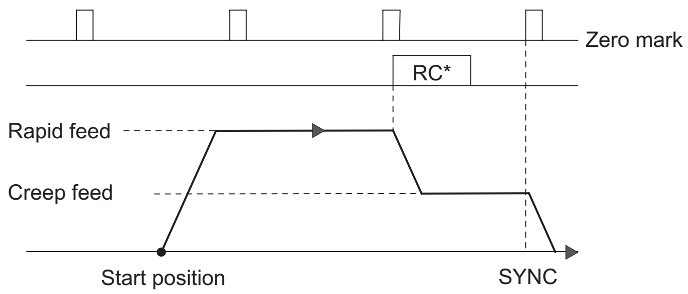
Execution of a Reference Point Run Depending on Parameterization and Start Position

In a reference point run, you have to distinguish between different cases that depend on the following:

- The start position of the drive at the start of the reference point run
- The assigned parameter start direction
- The assigned parameter reference signal
- The assigned parameter reference switch.

Example 1: Search for Reference Point Run with Reducing Cam and Zero Mark

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus



*RC = reducing cam

Figure 4-13 Search for Reference Point Run with Reducing Cam and Zero Mark

You can also carry out synchronization using the reducing cam without a zero mark.

If the start position is on the reducing cam, the 1PosInc/Analog controls the drive directly in creep feed mode in the referencing direction.

Example 2: Reference Point Run with Minus Limit Switch

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Reference switch
- Reference switch: Minus limit switch

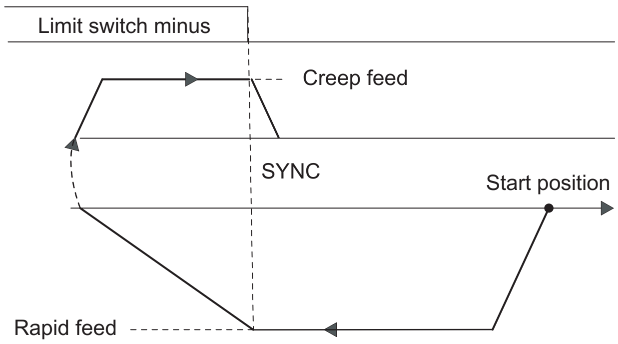


Figure 4-14 Reference Point Run with Minus Limit Switch

You can also carry out synchronization at the limit switch with the following zero mark.

If the start position is at the limit switch, the 1PosInc/Analog controls the drive directly with creep feed in the referencing direction.

Example 3: Reference Point Run with Reversal of Direction at the Plus Limit Switch

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus

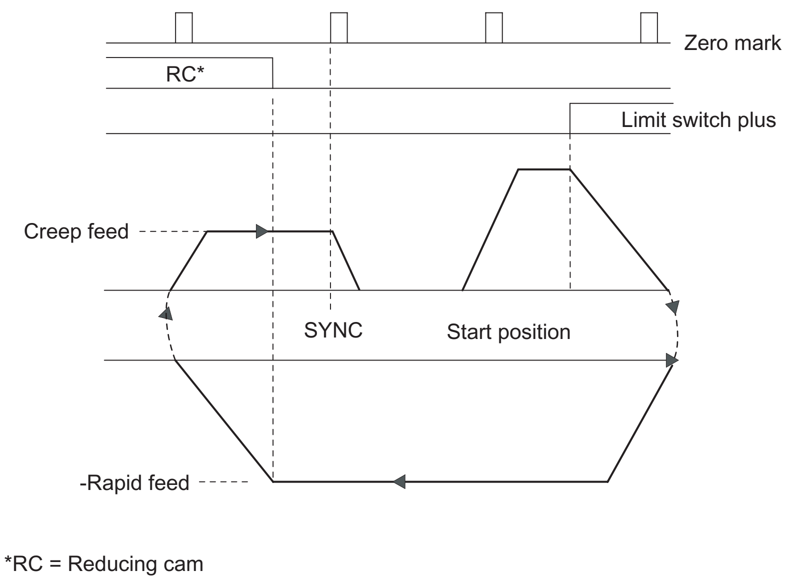


Figure 4-15 Reference Point Run with Reversal of Direction at the Plus Limit Switch

If the start position is at the plus limit switch, the 1PosInc/Analog moves the drive with rapid feed directly in the opposite direction to the assigned parameter start direction.

Example 4: Reference Point Run Only with Zero Mark

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Zero mark
- Reference switch: irrelevant

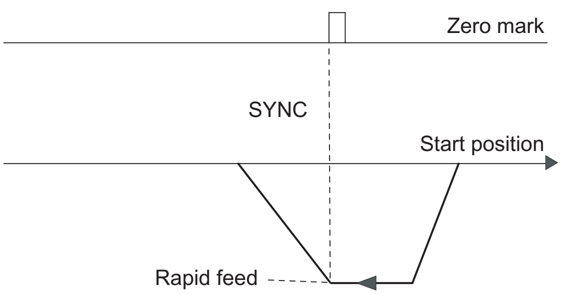


Figure 4-16 Reference Point Run Only with Zero Mark

Search for reference: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
3	ERR_ENCODER is displayed	Check the encoder wiring
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	Search for reference: No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the parameters for the reversal of the direction of rotation and adapting the direction of the drive.

4.6.6 Inching (MODE 1)

Definition

You use inching mode to control the drive directly in a particular direction using the DIR_M or DIR_P control bits.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

When you start MODE 1, the 1PosInc/Analog moves the drive with the set voltage for inching mode (from the control interface) in the specified direction (control bits DIR_M or DIR_P).

You stop the drive by decelerating to 0 V by setting the control bits DIR_P = 0 and DIR_M = 0.

You can change direction using deceleration or acceleration.

You can also activate inching on an unsynchronized axis (feedback bit SYNC = 0) or when there is a pending encoder error (feedback bit ERR_ENCODER = 1) or without an encoder connected.

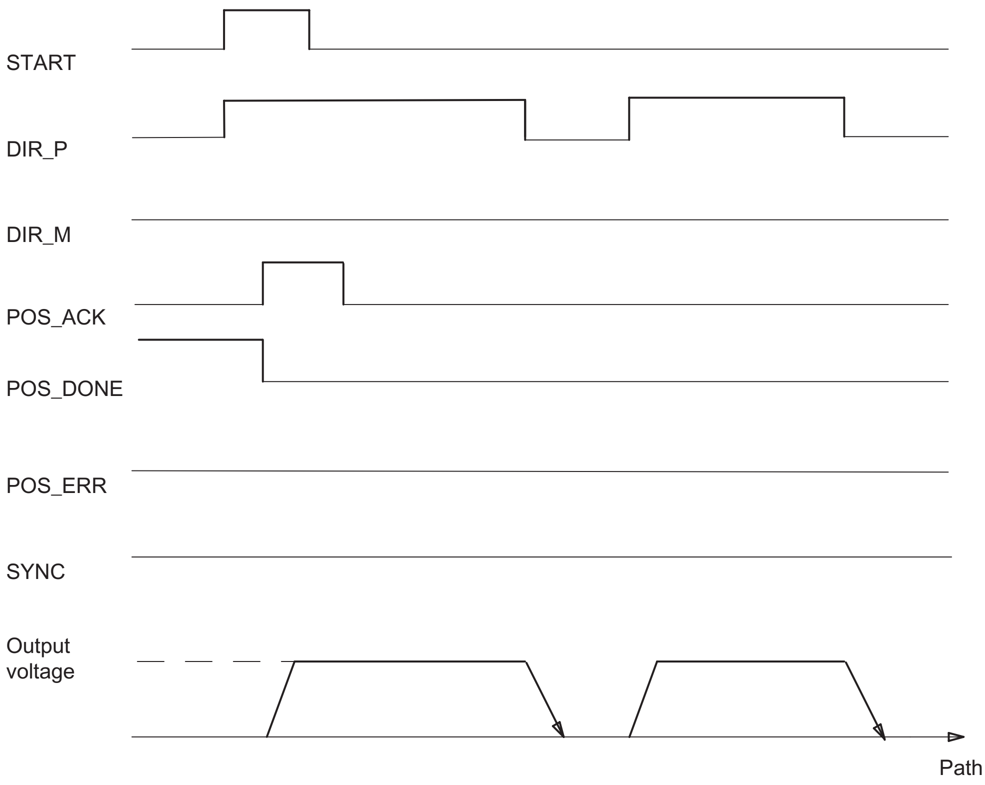


Figure 4-17 Execution of Inching

Control Signals: Inching

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Voltage for inching
(0 to 32 511)</td></tr>
</table>

Feedback Signals: Inching

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Inching: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the parameter for the reversal of the direction of rotation and adapting the direction of the drive.
	Voltage for inching >32 511 or < 0	

4.6.7 Absolute Positioning (MODE 5)

Definition

Using absolute positioning, the 1PosInc/Analog moves the drive towards absolute destinations. To do this, the axis must be synchronized.

Supply the control interface with the destination, and start MODE 5 with the necessary directional enable (DIR_M, DIR_P). The 1PosInc/Analog moves the drive towards the destination with the set voltage for rapid feed. At the switchover point, the 1PosInc/Analog decelerates from rapid to creep feed. At the switch-off point, the 1PosInc/Analog completes the run either directly or via the ramp depending on the parameter assignment.

If you start during a current run, the 1PosInc/Analog executes any required change in direction using deceleration or acceleration.

Linear axis

The 1PosInc/Analog determines the direction the destination is to be approached from. You must set the necessary directional enable (DIR_M, DIR_P) to start. You can also set both enables.

Rotary axis

You determine the direction in which the destination is approached by selecting the directional enable (DIR_M, DIR_P):

Control bits DIR_P and DIR_M	Direction
DIR_P = 1 DIR_M = 0	The destination is approached in the plus direction.
DIR_P = 0 DIR_M = 1	The destination is approached in the minus direction.
DIR_P = 1 DIR_M = 1	The destination is approached by the shortest route. The 1PosInc/Analog determines the direction the destination is to be approached from.

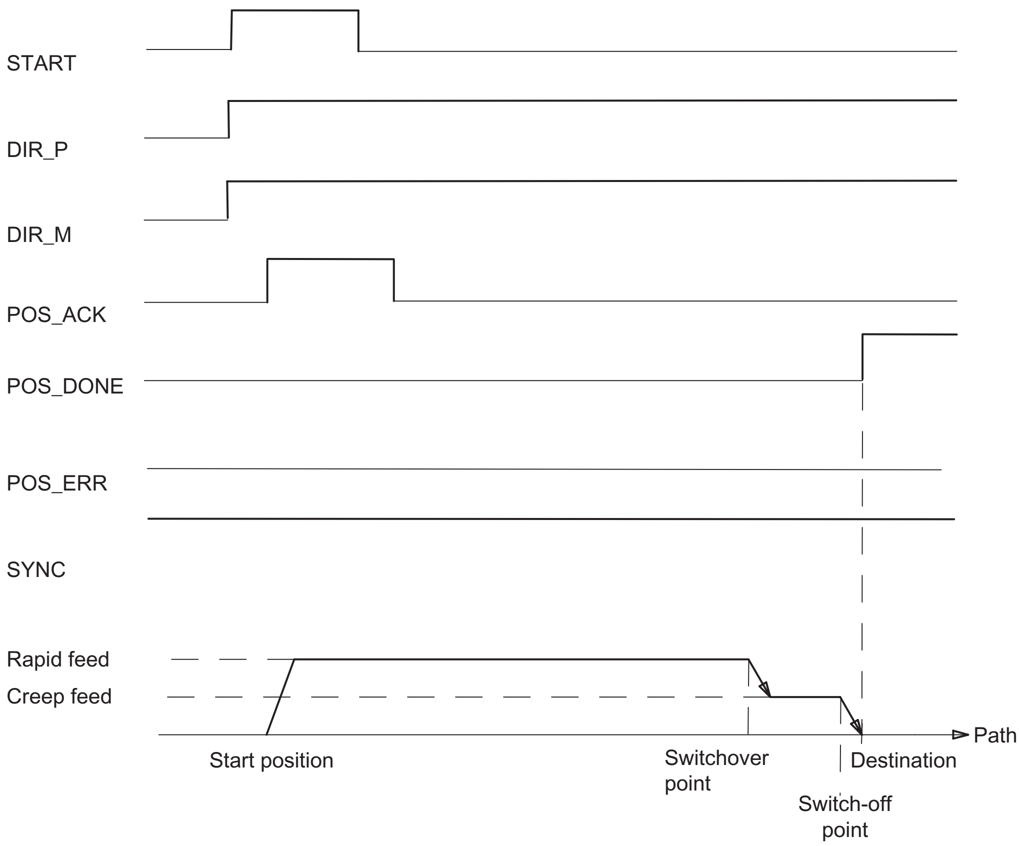


Figure 4-18 Execution of Absolute Positioning (Switch-Off Parameter: Ramp)

Control Signals: Absolute Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Destination
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Absolute Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Absolute Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000

Absolute positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0	
8	Absolute positioning: destination ≥ end of rotary axis	
9	Absolute positioning was terminated because JOB 9 (evaluate referencing signal) was initiated	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

4.6.8 Relative Positioning (MODE 4)

Definition

With relative positioning, the 1PosInc/Analog moves the drive from the start position for a set distance in the specified direction.

Supply the control interface with the distance to be traveled, and start MODE 4, specifying the direction (DIR_M or DIR_P). The 1PosInc/Analog moves the drive towards the destination for a certain distance with the set voltage for rapid feed. At the switchover point, the 1PosInc/Analog switches from rapid to creep feed. At the switch-off point, the 1PosInc/Analog completes the run either directly or via the ramp depending on the parameter assignment.

If you start during a current run, the 1PosInc/Analog executes any required change in direction using deceleration or acceleration.

The set distance is not checked by the 1PosInc/Analog. This means that more than one revolution may be involved with rotary axes.

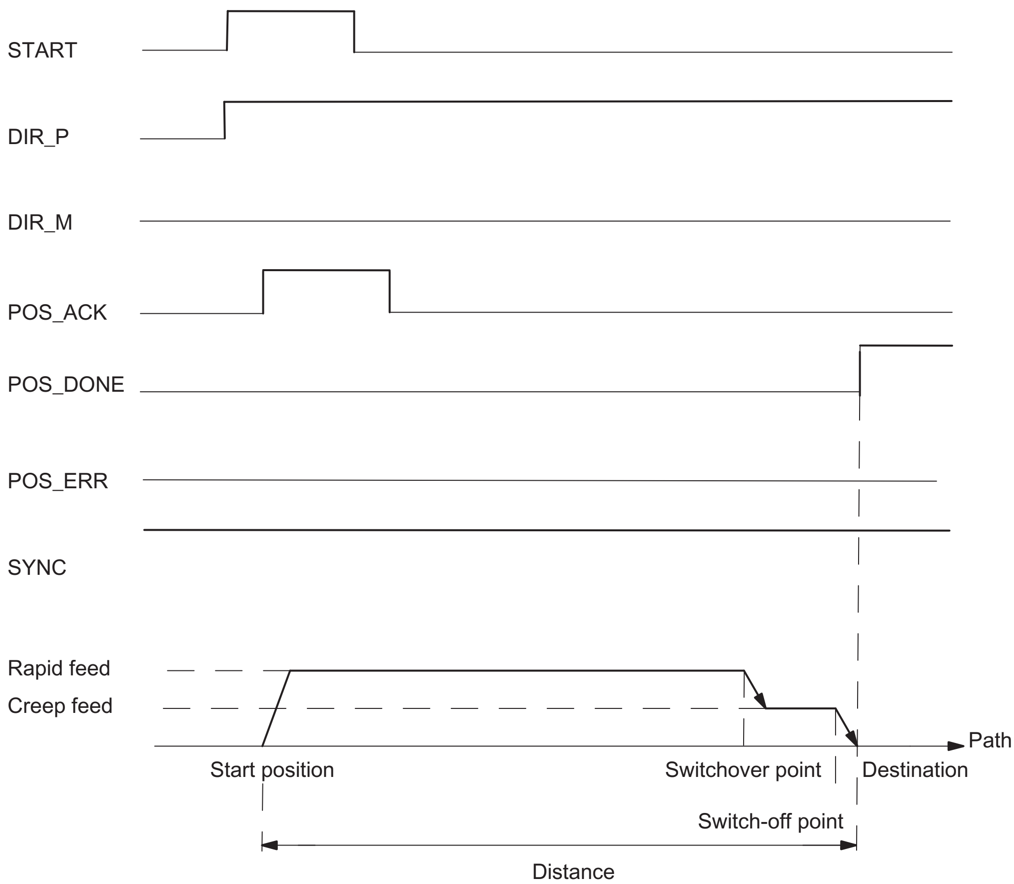


Figure 4-19 Execution of Relative Positioning

Control Signals: Relative Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Distance
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Relative Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Relative Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000

Relative Positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
3	ERR_ENCODER is displayed	Check the encoder wiring
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

4.6.9 Canceling JOB Processing (JOB 0)

Definition

If you activate JOB 0, the 1PosInc/Analog responds as follows:

- It cancels the current JOB 9 (reference signal evaluation)
- It cancels the current JOB 10 (latch function)
- It sets a pending JOB_ERR = 0.

You can activate JOB 0 whatever the state of the axis.

Effect on the MODEs

MODEs are not affected by JOB 0.

Control Signals: Canceling JOB processing

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
</table>

Feedback Signals: Canceling JOB processing

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

4.6.10 Setting the Actual Value (JOB 1)

Definition

Setting an actual value assigns new coordinates to the actual value displayed. This moves the operating range to a different range on the axis and synchronizes the axis.

At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

The 1PosInc/Analog sets the preset actual value coordinates to the actual value displayed in the feedback interface and sets the feedback bit SYNC = 1.

Effect on the MODEs

MODE	What Happens
Search for Reference	Make sure when the reference point run is evaluated that the feedback bit SYNC = 1 is set immediately. The reference point run still continues to run.
Inching	-
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ switch-off difference The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot. • Distance to the destination ≤ the switchover difference The switchover point is reached or overshot; there is an immediate deceleration from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > switchover difference The drive is accelerated again up to the voltage for rapid feed.
Relative Positioning	The preset distance continues to be traversed.

Control Signals: Setting of Actual Value

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Actual value coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Setting of Actual Value

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting an Actual Value: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
34	Setting an Actual Value: actual value coordinates ≥ end of rotary axis	

4.6.11 Changing the Switch-Off Difference (JOB 3)

Definition

Changing the switch-off difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switch-off difference, and activate JOB 3.

The 1PosInc/Analog accepts the preset switch-off difference.

The switch-off difference remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Effect on the MODEs

MODE	What Happens
Search for Reference	-
Inching	
Absolute Positioning	Distance to the destination ≤ switch-off difference The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot.
Relative Positioning	

Control Signals: Change Switch-Off Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switch-off difference
0 to 16 777 215</td></tr>
</table>

Feedback Signals: Change Switch-Off Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 176)

4.6.12 Changing the Switchover Difference (JOB 4)

Definition

Changing the switchover difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switchover difference, and activate JOB 4.

The 1PosInc/Analog accepts the preset switchover difference. The switchover difference remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td rowspan="2">-</td></tr>
<tr><td>Inching</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">The following responses are possible:
• Distance to the destination ≤ the switchover difference
Switchover difference is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference).
• Distance to the destination > the switchover difference
The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switchover Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 4 = Change the switchover difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switchover difference
0 to 16 777 215</td></tr>
</table>

Feedback Signals: Change Switchover Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 176)

4.6.13 Changing the Voltage for Rapid Feed (JOB 5)

Definition

By changing the voltage for rapid feed (JOB 5) you can adjust the speed for rapid feed.

Supply the control interface with the new rapid feed voltage and activate JOB 5.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

The 1PosInc/Analog accepts the preset voltage. When the drive runs in rapid feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new rapid feed voltage. The voltage remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td>When the drive runs in rapid feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new rapid feed voltage.</td></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">When the drive runs in rapid feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new rapid feed voltage.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Changing the Voltage for Rapid Feed

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 5 = Change the voltage for rapid feed</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Voltage for rapid feed
0 to 32 511 in S7 analog value format</td></tr>
</table>

Feedback Signals: Voltage for rapid feed

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Voltage for Rapid Feed: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
40	Voltage setting Rapid feed speed > 32 511	

See also

CPU/Master Stop and RESET State (Page 176)

4.6.14 Changing the Voltage for Creep Feed (JOB 6)

Definition

By changing the voltage for creep feed (JOB 6) you can adjust the speed for creep feed.

Supply the control interface with the new creep feed voltage and activate JOB 6.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

The 1PosInc/Analog accepts the preset voltage. The voltage remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td>When the drive runs in creep feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new creep feed voltage.</td></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">When the drive runs in creep feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new creep feed voltage.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Changing the Voltage for Creep Feed

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 6 = Change the voltage for creep feed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Voltage for creep feed
0 to 32 511 in S7 analog value format</td></tr>
</table>

Feedback Signals: Voltage for creep feed

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Voltage for Creep Feed: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
41	Voltage setting creep feed speed > 32 511	

See also

CPU/Master Stop and RESET State (Page 176)

4.6.15 Changing the Acceleration Tacc (JOB 7)

Definition

By changing T_{acc} (JOB 7) you can adjust the acceleration.

Supply the control interface with the new acceleration value and activate JOB 7.

The 1PosInc/Analog accepts the new acceleration value. The acceleration remains valid until the parameter assignment of the 1PosInc/Analog is changed.

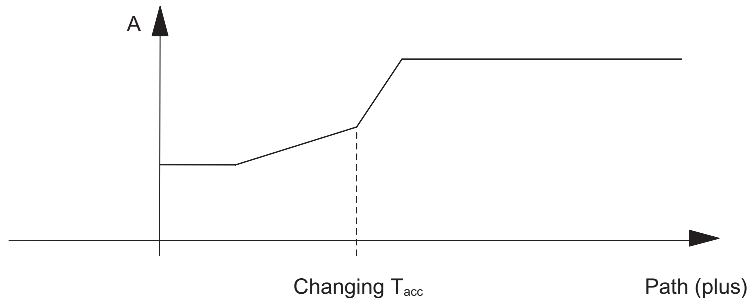


Figure 4-20 Changing the Acceleration T_{acc} During Acceleration

Effect on the MODEs

MODE	What Happens
Search for Reference	The currently valid acceleration is replaced by the new value. The new acceleration is immediately effective.
Inching	
Absolute Positioning	
Relative Positioning	

Control Signals: Changing the acceleration (T_{acc})

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 7 = Changing the acceleration T_{acc}</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Acceleration T_{acc} in ms (0 to 65 535)</td></tr>
</table>

Feedback Signals: Changing the acceleration (T_{acc})

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Changing the acceleration T_{acc}: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
42	Changing the acceleration T_{acc} > 65 535	

See also

CPU/Master Stop and RESET State (Page 176)

4.6.16 Changing the Deceleration Tdec (JOB 8)

Definition

By changing T_{dec} (JOB 8) you can adjust the deceleration.

Supply the control interface with the new deceleration value and activate JOB 8.

The 1PosInc/Analog accepts the new deceleration value. The acceleration remains valid until the parameter assignment of the 1PosInc/Analog is changed.

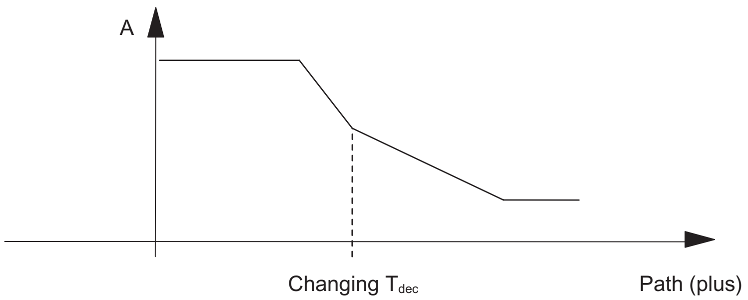


Figure 4-21 Changing the Deceleration T_{dec} During Deceleration

Effect on the MODEs

MODE	What Happens
Search for Reference	The currently valid deceleration is replaced by the new value. The new deceleration is immediately effective.
Inching	
Absolute Positioning	
Relative Positioning	

Control Signals: Changing the deceleration (T_{dec})

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 8 = Changing the Deceleration T_{dec}</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Deceleration T_{dec} in ms (0 to 65 535)</td></tr>
</table>

Feedback Signals: Changing the deceleration (T_{dec})

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Changing the deceleration T_{dec}: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
43	Deceleration T_{dec} > 65 535	

See also

CPU/Master Stop and RESET State (Page 176)

4.6.17 Evaluating the Reference Signal (JOB 9)

Definition

By evaluating the reference signal you can synchronize the axis using an external reference signal during a current run in inching or relative positioning mode. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch), DI1 (plus limit switch) and DI2 (reducing cam) as normally closed or normally open contacts.

Supply the control interface with the new actual value coordinates and activate JOB 9. The 1PosInc/Analog sets the feedback signal SYNC = 0.

If the 1PosInc/Analog detects the overrunning of the assigned parameter reference signal in the referencing direction, the axis is synchronized. The 1PosInc/Analog sets the feedback signal SYNC = 1 and assigns the reference point coordinates to the actual value.

The referencing direction is determined by the reference signal and reference switch parameters.

<table>
<tr><th></th><th>Reference switch: Reduction cam towards minus</th><th>Reference switch: Reduction cam towards plus</th><th>Reference switch: Minus limit switch</th><th>Reference switch: Plus limit switch</th></tr>
<tr><td>Reference signal: Reference switch and zero mark</td><td rowspan="2">Minus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Minus referencing direction</td></tr>
<tr><td>Reference signal: Reference switch</td></tr>
<tr><td>Reference signal: Zero mark</td><td colspan="4">The referencing direction is not defined. The axis is synchronized at the next zero mark.</td></tr>
</table>

Effect on the MODEs

MODE	What Happens
Search for Reference	The reference coordinates transferred with JOB 9 are valid
Inching	-
Absolute Positioning	Run canceled with POS_ERR = 1 because SYNC is deleted
Relative Positioning	-

Control Signals: Reference Signal Evaluation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 9 = Evaluate the reference signal</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Reference Signal Evaluation

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Parameters: Reference Signal Evaluation

<table>
<tr><th>Parameters</th><th>Meaning</th><th>Value range</th><th>Default setting</th></tr>
<tr><td colspan="4">Reference point run and evaluation of the reference signal</td></tr>
<tr><td>Reference signal</td><td>This parameter defines the relevant switch or the combination of switch and zero mark.</td><td>• Reference switch and zero mark
• Reference switch
• Zero mark</td><td>Reference switch and zero mark</td></tr>
<tr><td>Reference switch</td><td>Relevant in the case of reference signal:
• Reference switch and zero mark
• Reference switch
This parameter defines the referencing direction in which the switch must be traversed.</td><td>• Reduction cam towards minus
• Reduction cam towards plus
• Minus limit switch
• Plus limit switch</td><td>Reduction cam towards minus</td></tr>
</table>

Evaluating the Reference Signal: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
30	Evaluating the Reference Signal: Reference point coordinates ≥ end of rotary axis	

4.6.18 Latch Function (JOB 10)

Definition

The latch function allows you to store the actual value at an edge at the DI2 digital input. You can use this function, for example, to detect edges or measure lengths.

Supply the control interface with the desired edge, and activate JOB 10.

If the 1PosInc/Analog detects the preset edge at the D12 digital input, it stores the associated actual value, displays it as the feedback value and sets the feedback bit LATCH_DONE=1.

You can then activate the latch function again.

Latch Function and Reference Point Run or Reference Signal

If the 1PosInc/Analog synchronizes at the same edge, it stores the actual value before it assigns the reference point coordinates.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Latch Function

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">Bit 1: Latch at negative edge at DI2
Bit 0: Latch at positive edge at DI2</td></tr>
</table>

Feedback Signals: Latch Function

Address	Assignment
Byte 4	Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value: Actual value at the edge at DI2 (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Latch Function: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
36	Latch Function: Edge selection unknown	

4.6.19 Setting the Monitoring of the Direction of Rotation (JOB 11)

Definition

You can set the direction of rotation monitoring of the 1PosInc/Analog to suit the load and mechanical conditions.

Monitoring of the direction of rotation is always active. The 1PosInc/Analog recognizes whether the drive and encoder have the same direction of rotation. Direction of rotation monitoring will tolerate different directions for the drive and the encoder up to the preset path difference. If the preset path difference is exceeded, the 1PosInc/Analog POS_ERR =1.

Unless you have activated JOB 11, double the switch-off difference is used from the parameters as the path difference. JOB 3 (which changes the switch-off difference) does not affect the path difference for the purpose of monitoring of the direction of rotation.

Supply the control interface with the new path difference, and activate JOB 11.

The 1PosInc/Analog accepts the preset path difference for the monitoring of the direction of rotation.

The preset path difference for the monitoring of the direction of rotation remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Disabling the Monitoring of the Direction of Rotation

Monitoring of the direction of rotation is disabled when the path difference is 0.

Effect on the MODEs

MODEs are not affected by JOB 11.

Control Signals: Setting the Monitoring of the Direction of Rotation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0</td></tr>
<tr><td>Bytes 6, 7</td><td colspan="6">Path difference for monitoring of the direction of rotation
(0 to 65 535)</td></tr>
</table>

Feedback Signals: Setting the Monitoring of the Direction of Rotation

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting the Monitoring of the Direction of Rotation: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
38	Monitoring of the direction of rotation Path difference > 65 535	

See also

CPU/Master Stop and RESET State (Page 176)

Error Detection/Diagnostics (Page 171)

4.6.20 Displaying Current Values (JOB 15)

Definition

You can display the following values in the feedback interface as feedback values:

- Residual distance
- Actual speed
- Causes of errors for POS_ERR and JOB_ERR

The 1PosInc/Analog presets the residual distance as a feedback value.

The 1PosInc/Analog continuously displays the actual value in the feedback interface irrespective of the selected feedback value.

This moves the operating range to another part of the axis and synchronizes the axis.

The selected feedback value remains valid until the parameter assignment of the 1PosInc/Analog is changed.

Displaying Current Values and the Latch Function

If you activate the latch function, the 1PosInc/Analog sets a feedback value of 0 and displays the actual value at the edge at the D12 digital input.

You can only activate JOB 15 again after the latch function has terminated.

Residual distance

In absolute positioning and relative positioning modes, the 1PosInc/Analog calculates the distance to the destination as the residual distance. As long as the actual value is before the destination, the residual distance remains positive. It becomes negative once the destination is overshot. The residual distance is 0 in the other MODEs.

The 1PosInc/Analog displays the residual distance with a sign between -8 388 608 and 8 388 607 increments. Negative values are displayed in twos complement. If the actual residual distance is beyond these limits, the limit value is displayed.

Actual speed

The 1PosInc/Analog calculates the actual speed as an encoder value change in increments per 10 ms. It displays these between 0 and 16 777 215.

Causes of errors for POS_ERR and JOB_ERR

The 1PosInc/Analog displays the causes of errors for POS_ERR and JOB_ERR as well as the MODE and JOB entered in the control interface.

Effect on the MODEs

MODEs are not affected by JOB 15.

Control Signals: Display Current Values

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 15 = Display current values</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0: Residual distance
1: Actual speed
2: Causes of errors for POS_ERR and JOB_ERR</td></tr>
</table>

Feedback Signals: Display Current Values

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	In accordance with the selected feedback value: • With a residual distance of: - 8 388 608...8 388 607 • With an actual speed of: 0...16 777 215 • With causes of errors for POS_ERR and JOB_ERR – Byte 5: Causes of Errors for POS_ERR – Byte 6: Causes of Errors for JOB_ERR – Bits 7.3 to 7.0: MODE (= bits 0.7 to 0.4 from the control signals) – Bits 7.7 to 7.4: JOB (= bits 4.7 to 4.4 from the control signals)

Display current values: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
35	Display current values: Selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	

See also

Error Detection/Diagnostics (Page 171)

CPU/Master Stop and RESET State (Page 176)

4.6.21 Error Detection/Diagnostics

Parameter assignment error

<table>
<tr><th>Parameter assignment error</th><th>Response of the 1PosInc/Analog</th></tr>
<tr><td>Causes:
• The 1PosInc/Analog cannot identify existing parameters as its own.
• The slot of the 1PosInc/Analog you have configured does not match the setup.
What to Do:
• Check the configuration and setup</td><td>• The 1PosInc/Analog is not assigned parameters and cannot execute its functions.
• Generate channel-specific diagnostics</td></tr>
</table>

External Errors

<table>
<tr><th>Short circuit of the sensor supply</th><th>Response of the 1PosInc/Analog</th></tr>
<tr><td>Causes:
• Short circuit of the encoder supply made available at terminals 2 and 10
What to Do:
• Check the wiring and correct the short circuit.
• Acknowledge the error with the EXTF_ACK control bit.</td><td>• The current reference point run, relative positioning, and absolute positioning modes are stopped; it is not possible to start a new run in these modes.
– Analog output QV+ is set to 0 V
– Digital output OUT:
If the direction is assigned parameters for the DO function, the digital output OUT=0 is set
– Feedback bit POS_ERR = 1
– Feedback bit POS_DONE = 0
• Feedback bit ERR_ENCODER = 1
• Feedback bit SYNC = 0
• Generate channel-specific diagnostics
• Waits for error acknowledgment EXTF_ACK
• Inching MODE is not affected by this error.
• The current JOB (reference signal evaluation) is canceled.</td></tr>
<tr><td>Wire Break/Short Circuit of the Encoder Signals</td><td>Response of the 1PosInc/Analog</td></tr>
<tr><td>Prerequisite:
• You must enable the encoder signal diagnostics parameter in order to allow error recognition for the signals A, /A and B, /B.
• You must enable the zero marker diagnostics parameter in order to allow error recognition for the signals N, /N. If you use an encoder without a zero mark, switch off error detection.
Causes:
• Wire break or short circuit of the encoder signals at terminals 1, 5 or 3, 7 or 4, 8.
What to Do:
• Check the wiring and correct the short circuit.
• Acknowledge the error with the EXTF_ACK control bit.</td><td>• The current reference point run, relative positioning, and absolute positioning modes are stopped; it is not possible to start a new run in these modes.
– Analog output QV+ is set to 0 V
– Digital output:
if the direction is assigned parameters with the DO function, the digital output OUT=0 is set
– Feedback bit POS_ERR = 1
– Feedback bit POS_DONE = 0
• Feedback bit ERR_ENCODER = 1
• Feedback bit SYNC = 0
• Generate channel-specific diagnostics
• Waits for error acknowledgment EXTF_ACK
• Inching MODE is not affected by this error.
• The current JOB (reference signal evaluation) is canceled.</td></tr>
</table>

Errors in the Control of MODEs and JOBs

POS_ERR	Response of the 1PosInc/Analog
Causes: • Certain requirements or conditions have not been met at the start of a MODE	• The MODE started is not executed. • The current run is stopped. – Analog output is slowed down to 0 V using the ramp. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0

JOB_ERR	Response of the 1PosInc/Analog
Causes: • Certain requirements or conditions have not been met at the activation of a JOB	• The activated JOB is not executed. – Feedback bit JOB_ERR = 1

Generating a Channel-Specific Diagnostics

In the event of parameter assignment errors (short circuit of the sensor supply or open circuit/short circuit of the sensor signals), the 1PosInc/Analog generates a channel-specific diagnostics for the connected CPU/master. To do this, you must enable the Group Diagnostics parameter (see the *Distributed I/O Device* manual).

Error Acknowledgment EXTF_ACK

You must acknowledge the corrected errors (short circuit of the sensor supply and open circuit/short circuit of the sensor signals).

What You Do	Response of the 1PosInc/Analog
	Feedback bit ERR_ENCODER = 1
Your control program detects the set feedback bit ERR_ENCODER. Execute your application-specific error response. Eliminate the cause of the error.	
Switch the EXTF_ACK control bit from 0 to 1	The 1PosInc/Analog sets the feedback bit ERR_ENCODER = 0. This tells you that the cause has been eliminated and acknowledged. If ERR_ENCODER = 1, the cause of the error is not yet eliminated.
Switch the EXTF_ACK control bit from 1 to 0	
In the case of constant error acknowledgment (EXTF_ACK = 1) or at CPU/Master Stop, the 1PosInc/Analog reports the errors as soon as they are detected and deletes them as soon as they have been eliminated.	

Parameters

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	An encoder error (ERR_ENCODER) or parameter assignment error results in a channel-specific diagnostics if group diagnostics is enabled.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B are monitored for short circuit and wire break.	• On • Off	On
Zero marker diagnostics	Zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On

Feedback Messages

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Causes of Errors for POS_ERR

Table 4-4 Causes of Errors for POS_ERR

Error Number	Cause	Remedy
1	MODE unknown	Permissible MODEs are: • MODE 0 • MODE 1 • MODE 3 • MODE 4 • MODE 5
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1 Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0 Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
8	Absolute positioning: destination ≥ end of rotary axis	
9	Absolute positioning was terminated because JOB 9 was initiated	
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	Search for reference: No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

Causes of Errors for JOB_ERR

Table 4-5 Causes of Errors for JOB_ERR

Error Number	Meaning	Remedy
21	JOB unknown	Permissible JOBs are: • JOB 0 • JOB 1 • JOB 3 • JOB 4 • JOB 9 • JOB 10 • JOB 11 • JOB 15
23	ERR_ENCODER is displayed	Check the encoder wiring
30	Evaluating the Reference Signal: Reference point coordinates ≥ end of rotary axis	
34	Setting an Actual Value: actual value coordinates ≥ end of rotary axis	
35	Display current values: Selection unknown	
36	Latch Function: Edge selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	
38	Monitoring of the direction of rotation Path difference > 65 535	
40	Voltage setting Rapid feed speed > 32 511	
41	Voltage setting creep feed speed > 32 511	
42	Changing the acceleration T_{acc} > 65 535	
43	Deceleration T_{dec} > 65 535	

4.7 CPU/Master Stop and RESET State

Behavior at CPU-Master-STOP

Behavior at CPU-Master-STOP	Response of the 1PosInc/Analog
• Due to power-off of the CPU/DP master or • Due to power-off of the IM 151/ IM 151 FO or • Due to failure of DP transmission or • Due to change from RUN to STOP	• The current run is stopped. – Analog output QV+ is set to 0 V – Digital output: if the direction is assigned parameters for the DO function, the digital output OUT=0 is set • Feedback bit POS_ERR = 0 • Feedback bit POS_DONE = 1

Exiting the CPU-Master-STOP Status

Exiting the CPU-Master-STOP Status	Response of the 1PosInc/Analog
• At power-on of the CPU/DP master or • At power-on of the IM 151/ IM 151 FO or • After failure of the DP transmission or • After a change from STOP to RUN	• The feedback interface of the 1PosInc/Analog remains current. • The axis remains synchronized, and the actual value is current. • The following changed values remain valid: – Voltage for rapid feed – Voltage for creep feed – Acceleration (T_{acc}) – Deceleration T_{dec} – Switch-off and switchover difference – The path difference for the monitoring of the direction of rotation remains valid. • An initiated JOB 9: Evaluating the Reference Signal and JOB 10: Latch function remains active. • The feedback bit selected with JOB 15 is current.

RESET State of the 1PosInc/Analog

RESET Status of the 1PosInc/Analog and Changing the Parameters of the 1PosInc/Analog	Response of the 1PosInc/Analog
• Changing the parameters of the 1PosInc/Analog and downloading the parameter assignment and configuration of the ET 200S station to the CPU/DP master or • Power-on at the power module of the 1PosInc/Analog or • Inserting the 1PosInc/Analog in an energized state	• The axis is not synchronized and the actual value = 0. • The voltage for rapid feed is set to 10 V. • The voltage for creep feed is set to 1 V. • Acceleration (T_{acc}) and deceleration (T_{dec}) are transferred from the parameters. • The switch-off and switchover difference is accepted from the parameters. • The path difference for the monitoring of the direction of rotation is set at double the switch-off difference. • JOB 9: Evaluating the Reference Signal and JOB 10: Latch function are not active. • The residual distance is displayed as a feedback value.

4.8 Parameter List

Overview

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	An encoder error (ERR_ENCODER) or parameter assignment error results in a channel-specific diagnostics if group diagnostics is enabled.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B are monitored for short circuit and wire break.	• On • Off	On
Zero marker diagnostics	Zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On
Axis			
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder	• Off • On	Off
Axis type	Selection of linear axis without limitation or rotary axis with overrun/underrun at end of rotary axis	• Linear • Rotary	Linear
End of rotary axis	Only relevant for rotary axis type: Underrun: 0 to end of rotary axis - 1 Overrun: End of rotary axis - 1 to 0 Parameter assignment error at 0	1 - 16 777 215	36000
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 reducing cam	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus
Drive			
Adapt direction	If you adjust the direction, this results in the polarity reversal of your drive	• Off • On	Off
Function DO	**Output:** Your drive is controlled by the analog output using ±10 V. You control the DO digital output using the CTRL_DO control bit. **Direction:** Your drive is controlled by the analog output using 0 V to 10 V. The direction for your drive is specified by the 1PosInc/Analog via the DO digital output. Plus direction: DO = 1 Minus direction: DO = 0	• Output • Direction	Output
Switch-off	Use this parameter to determine the course of the voltage after the switch-off point. Directly: The voltage is set directly to 0 V at switch-off point. Ramp: As of switch-off point, voltage is reduced to 0 V using the ramp.	• Directly • Ramp	Directly
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000

Parameters	Meaning	Value range	Default setting
Acceleration T_{acc} in ms	Time required for a change in voltage via a ramp from 0 V to10 V. At 0 ms acceleration is without a ramp.	0 - 65535	10000
Deceleration T_{dec} in ms	Time required for a change in voltage via a ramp from 10 V to 0 V. At 0 ms deceleration is without a ramp.	0 - 65535	10000

4.9 Control and Feedback Signals

Assignment of the Control Interface

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="8">Byte 0</td><td colspan="6">Bits 0.7 to 0.4 stand for the MODEs</td></tr>
<tr><td rowspan="6">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="6">MODE 0 = Stop
MODE 1 = Inching
MODE 3 = Reference Point Run
MODE 4 = Relative Positioning
MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: CTRL_DO
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">In MODE 1= inching: voltage for inching
With MODE 3 = reference point run: reference point coordinates
at MODE 4 = Relative positioning: distance
at MODE 5 = Absolute positioning: target</td></tr>
<tr><td rowspan="15">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 stand for the MODEs</td></tr>
<tr><td rowspan="13">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="13">JOB 0 = Cancel JOB processing
JOB 1 = Set the actual value
JOB 3 = Change the switch-off difference
JOB 4 = Change the switchover difference
JOB 5 = Change the voltage for rapid feed
JOB 6 = Change the voltage for creep feed
JOB 7 = Changing the acceleration T_{acc}
JOB 8 = Changing the Deceleration T_{dec}
JOB 9 = Evaluate the reference signal
JOB 10 = Latch function
JOB 11 = Set the monitoring of the direction of rotation
JOB 15 = Display current values</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td></tr>
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<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: EXTF_ACK
Bit 2:Reserve = 0
Bit 1: Reserve = 0
Bit 0: JOB_REQ</td></tr>
</table>

Address	Assignment
Bytes 5 to 7	Corresponding to the selected JOB:
	• With JOB 1= actual value coordinates • With JOB 3 = switch-off difference • With JOB 4 = switchover difference • With JOB 5 = voltage for rapid feed • With JOB 6= voltage for creep feed • With JOB 7 = acceleration T_{acc} • With JOB 8 = deceleration T_{dec} • With JOB 9 = reference point coordinates • With JOB 10 – Byte 5: Bit 0 = latch at positive edge at DI2 – Byte 5: Bit 1 = latch at negative edge at DI2 • With JOB 11 = path difference for direction of rotation monitoring • With JOB 15 – Byte 5: 0 = Residual distance – Byte 5: 1 = Actual speed – Byte 5: 2 = error information

Assignment of the Feedback Interface

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bits 6 and 5: Status phase of the run Bit 4: STATUS DO Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value
Byte 4	Bit 7: Reserve Bit 6: STATUS DI 2 reduction cams Bit 5: STATUS DI 1 limit switch plus Bit 4: STATUS DI 0 limit switch minus Bit 3: Reserve Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file [1)] (hardware catalog\PROFIBUS DP\ other field devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
[1]Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

4.10 Technical Specifications for the 1PosInc/Analog

Overview

Technical Data of the 1PosInc/Analog	
Dimensions and weight	
Dimension W x H x D (mm)	30 x 81 x 52
Weight	Approx. 65 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
Rated load voltage L+ • Range • P1	24 VDC 20.4 ... 28.8 V Yes
Isolation • Between the backplane bus and the I/O • Between analog output and load voltage L+	 Yes Yes
Permissible potential difference between M_{ANA} and the central grounding point U_{iso}	75 V DC/60 V AC
Insulation tested	500 VDC
Sensor supply • Output voltage • Output current	 L+ -0.8 V Maximum 500 mA, short-circuit proof
Current consumption • From the backplane bus • From the load voltage L+ (no load)	 Max. 10 mA Max. 50 mA
Power dissipation	Typ. 2 W
Data for the digital inputs	
Input voltage • Rated value • 0 signal • 1 signal	 24 VDC -30 V to 5 V 11 V to 30 V
Input current • 0 signal • 1 signal	 ≤ 2 mA (perm. leakage current) 9 mA (typ.)
Minimum pulse width	500 µs
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	50 m

Technical Data of the 1PosInc/Analog	
Data on the Digital Output	
Output voltage • Rated value • 0 signal • 1 signal	 24 VDC ≤ 3 V ≥ L+ -1 V
Output current • 0 signal (leakage current) • 1 signal – Rated value – Permitted range	 ≤ 0.3 mA 0.5 A 7 mA to 0.6 A
Switch rate • Resistive load • Inductive load • Lamp load	 100 Hz 2 Hz ≤ 10 Hz
Lamp load	≤5 W
Output delay (resistive load, output current 0.5 A) • At 0 to 1 • At 1 to 0	 typ. 150 µs typ. 150 µs
Short-circuit protection of the output	Yes
Threshold on	0.7 A to 1.8 A
Inductive extinction	Yes; L+ -(55 to 60 V)
Digital input control	Yes
Cable lengths • Unshielded • Shielded	 600 m 1000 m
Data for the Analog Output	
Resolution (including overrange)	± 10 V/13 bits + sign
Settling time • For resistive load • For capacitive load • For inductive load	 0,1 ms 0.5 ms 0.5 ms
Length of cable • Shielded	 Max. 100 m

Technical Data of the 1PosInc/Analog	
Suppression of interference, limits of error	
Operational limit (in the entire temperature range, with reference to the output range)	± 0.4 %
Basic error limit (operational limit at 25°C with reference to output range)	± 0.2 %
Temperature error (with reference to the output range)	± 0.01 %/K
Linearity error (with reference to the output range)	± 0.02 %
Repeatability (in steady state at 25°C with reference to output range)	± 0.05 %
Output ripple (with reference to output range, bandwidth 0 to 50 kHz)	± 0.02 %
Data for selecting an actuator	
Output range (rated value)	±10 V
Load resistance • For capacitive load • Short-circuit protection • Short-circuit current	Min. 1.0 kΩ Max. 1 µF Yes Approx. 25 mA
Destruction limit against voltages/currents applied from outside • Voltage at the outputs to M_{ANA} • Current	 Max. 15 V continuous; 75 V for max. 1 s (pulse duty factor 1/20) Max. DC 50 mA
Connection of actuators	
• 2-conductor connection	No compensation for surge impedance
Encoder signals	
Level • Terminating resistance • Differential input voltage • Max. frequency	To RS 422 330 Ω Min. 1 V 500 kHz
Length of cable	
• Shielded	Max. 50 m
Status, Diagnostics	
Change in actual value (up)	UP LED (green)
Change in actual value (down)	DN LED (green)
Status display positioning in operation	LED POS (green)
Status display DI0 (minus hardware limit switch)	LED 9 (green)
Status display DI1 (plus hardware limit switch)	LED 13 (green)
Status display DI2 (reducing cam)	LED 14 (green)
Group error on the 1PosInc/Analog	SF LED (red)
Diagnostic information	Yes

Technical Data of the 1PosInc/Analog	
Response Times	
Update rate for feedback messages	2 ms
Response time at the switchover or switch-off point	0.1 ms - 2 ms
Latch response time	Typ. 400 µs

1PosSSI/Digital

5

5.1 Product overview

Order number

6ES7138-4DH00-0AB0

Features

- Positioning module for controlled positioning by means of rapid/creep feed
  - Switchover and switch-off difference can be set using your control program
- SSI Encoder
  - 13-bit Singleturn
  - 25-bit Multiturn
- Usable axis types:
  - Linear axis
  - Rotary axis
- Operating range: 0 - 16 777 215 steps
- The drive can be controlled via 3 digital outputs:
  - Travel minus
  - Travel plus
  - Rapid/creep feed
- 3 digital inputs can be used for the following:
  - Minus hardware limit switch
  - Plus hardware limit switch
  - Latch signal
- Diagnostics
  - Encoder monitoring
  - Load voltage monitoring

Configuration

You can use either of the following to configure the 1PosSSI/Digital:

- A DDB file (http://www.ad.siemens.de/csi/gsd) or
- STEP 7 as of V5.1 SP2.

5.2 Brief Introduction to Commissioning the 1PosSSI/Digital

Introduction

Using the example of inching mode, this brief introduction shows you a functioning application in which you get to know and check the hardware and software involved in a positioning operation of your 1PosSSI/Digital.

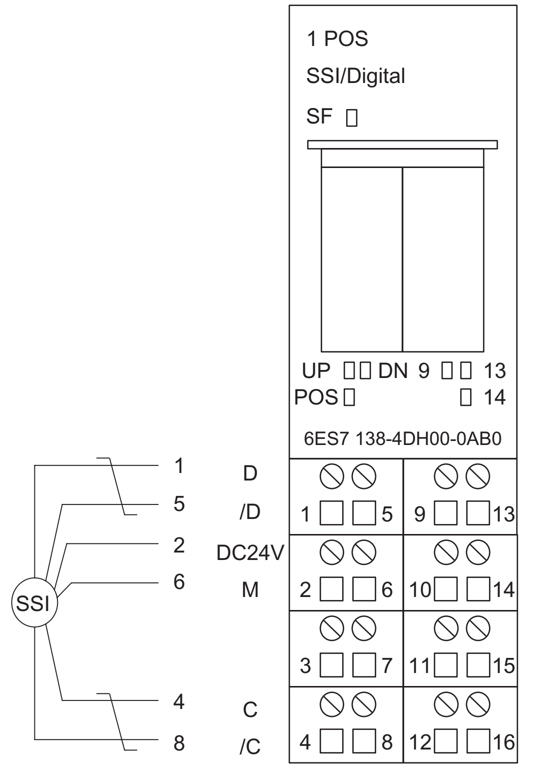
Prerequisites for the Example

The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You must have:
  - A TM-E30S44-01 terminal module (6ES7 193-4CG20-0AA0 or 6ES7 193-4CG30-0AA0)
  - A 1PosSSI/Digital
  - An SSI encoder
  - A drive with power control (e.g. a pole-changing motor with contactor switching)
  - A 24 VDC power supply
  - The necessary wiring material

Installation, Wiring, and Fitting

Install and wire the TM-E30S44-01 terminal module. Insert the 1PosSSI/Digital in the terminal module (you can find detailed instructions in the *Distributed I/O Device* manual).

Terminal assignment	View	Remarks			
		**Connection of the SSI Encoder: Terminals 1-8**		**Connection of the Switches and the Drive: Terminals 9-16**	
		1: D	Data from the SSI encoder	9: IN0	Minus limit switch
		5: /D		13: IN1	Plus limit switch
		3: B	Unused terminals	14: IN2	Latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 V DC	Power supply for SSI encoder	11: OUT0	Travel minus or rapid feed
		6: M		12: OUT1	Travel plus or creep feed
		4: C	SSI clock (clock line)	16: OUT2	Rapid/creep feed and travel plus/minus
		8:/C		15: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2

Configured with STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. Select "1PosSSI/Digital" from the hardware catalog. The number 6ES7 138-4DH00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1PosSSI/Digital.
4. Double-click this number to open the properties dialog box for the 1PosSSI/Digital.

   On the "Addresses" tab, you will find the addresses of the slot to which you have dragged the 1PosSSI/Digital. Make a note of these addresses for subsequent programming.

   On the "Parameters" tab, you will find the default settings for the 1PosSSI/Digital. If you are not connecting any limit switches to the 1PosSSI/Digital, set the DI0 limit switch minus and DI1 limit switch plus parameters to "make contact". Depending on the SSI encoder that is connected, select SSI-13 Bit or SSI-25 Bit, and enter the number of increments and the number of rotations.
5. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Integrating into the user program

Integrate the following FC 101 block in your user program (in OB 1, for example). This block requires the DB1 data block with a length of 16 bytes. In the example below, the start is initiated by setting memory bit 30.0 (in the plus direction) or 30.1 (in the minus direction) with the programming device. You select rapid or creep feed using memory bit 30.2.

STL			Explanation
Block: FC101			
	L	PID 256	//Load feedback values from 1PosSSI/Digital
	T	DB1.DBD8	
	L	PID 260	
	T	DB1.DBD12	
	L	DB1.DBB8	//Display status bits
	T	MB8	
	L	DB1.DBB12	
	T	MB9	
	L	DB1.DBD8	//Display actual value
	DU	DW#16#FFFFFF	
	T	MD12	
	AN	M30.0	
	SPB	DIRM	
	L	B#16#13	//Travel in plus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
	SPA	CTRL	
DIRM:	AN	M30.1	
	SPB	STOP	
	L	B#16#15	//Travel in minus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
	SPA	CTRL	
STOP:	L	B#16#0	//Stop
	T	DB1.DBB0	
	A	DB1.DBX8.2	
	SPB	CTRL	
	AN	DB1.DBX8.0	//Set/delete START depending on POS_ACK
	=	DB1.DBX0.0	
CTRL:	A	M30.2	//Set SPEED
	=	DB1.DBX0.3	
	L	DB1.DBD0	//Transfer control values to the 1PosSSI/Digital
	T	PAD256	
	L	DB1.DBD4	
	T	PAD260	

Test

Start inching mode, and monitor the associated feedback.

1. Using "Monitor/Modify Variables", check the actual value and the status bits POS_ACK, POS_ERR, POS_DONE, ERR_ENCODER and ERR_2L+.
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   - MD12 (actual value)
   - M8.0 (POS_ACK)
   - M8.1 (POS_ERR)
   - M8.2 (POS_DONE)
   - M8.7 (ERR_ENCODER)
   - M9.7 (ERR_2L+)
   - M30.0 (inching in plus direction)
   - M30.1 (inching in minus direction)
   - M30.2 (SPEED; 0 = creep feed; 1 = rapid feed)
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor" to switch to monitoring.
6. Switch the CPU to RUN mode.

Result

The following table shows you which activity triggers which result.

Activity	Result
Switch the CPU to RUN mode.	• The POS_ACK status bit is deleted • The POS_ERR status bit is deleted • The POS_DONE status bit is set
Check the wiring of the load voltage 2L+	
Check the feedback bit ERR_2L+	• If ERR_2L+ = 1, correct the wiring of the load voltage 2L+
Check the encoder wiring	
Check the feedback bit ERR_ENCODER	• If ERR_ENCODER = 1, correct the wiring of the encoder
Inching in the plus direction:	
Start inching mode in the plus direction by setting memory marker 30.0 ("Variable > Modify >")	**The status bit POS_ERR = 0, the UP LED lights up** • The POS_ACK status bit is set • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the DN LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the plus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct
Inching in the minus direction:	
Start inching mode in the plus direction by setting memory marker 30.1 ("Variable > Modify >")	**The status bit POS_ERR = 0, the DN LED lights up** • The POS_ACK status bit is set • The POS_ERR status bit is deleted • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the UP LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the minus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct

See also

Parameter List (Page 234)

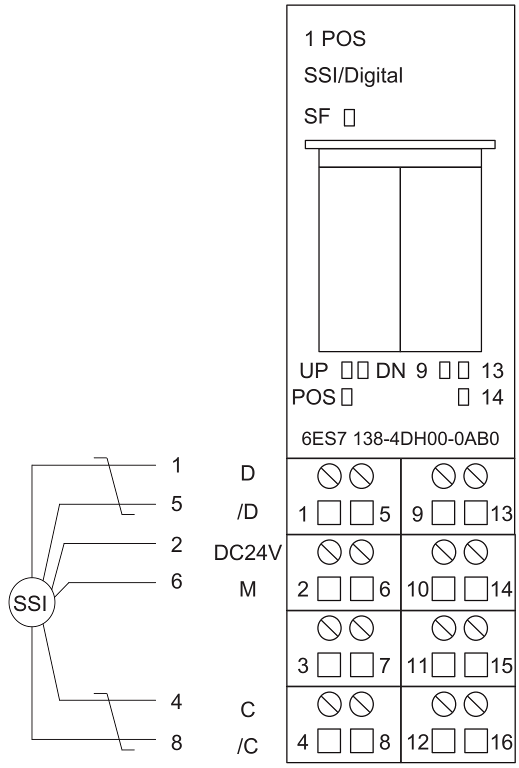
5.3 Terminal Assignment Diagram

Wiring rules

The wires (terminals 1 and 5, 4 and 8) must be in twisted pairs and shielded. The shield must be supported at both ends. You use the shield contact element
(Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal assignment

The following table shows you the terminal assignment for the 1PosSSI/Digital:



Terminal assignment	View	Remarks			
		Connection of the SSI Encoder: Terminals 1-8		Connection of the Switches and the Drive: Terminals 9-16	
		1: D	Data from the SSI encoder	9: IN0	Minus limit switch
		5: /D		13: IN1	Plus limit switch
		3: B	Unused terminals	14: IN2	Latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 V DC	Power supply for SSI encoder	11: OUT0	Travel minus or rapid feed
		6: M		12: OUT1	Travel plus or creep feed
		4: C	SSI clock (clock line)	16: OUT2	Rapid/creep feed and travel plus/minus
		8:/C		15: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2

Connection of Relays and Contactors to the Digital Outputs

Note

Direct connection of inductivities (such as relays and contactors) is possible without external circuiting.

If SIMATIC output circuits can be deactivated by additionally installed contacts (for example relay contacts), you have to provide additional overvoltage protection devices at inductivities (see the following example for overvoltage protection).

Overvoltage Protection Example

The following figure shows an output circuit that requires additional overvoltage protection devices. Direct-current coils are wired with diodes or Zener diodes.

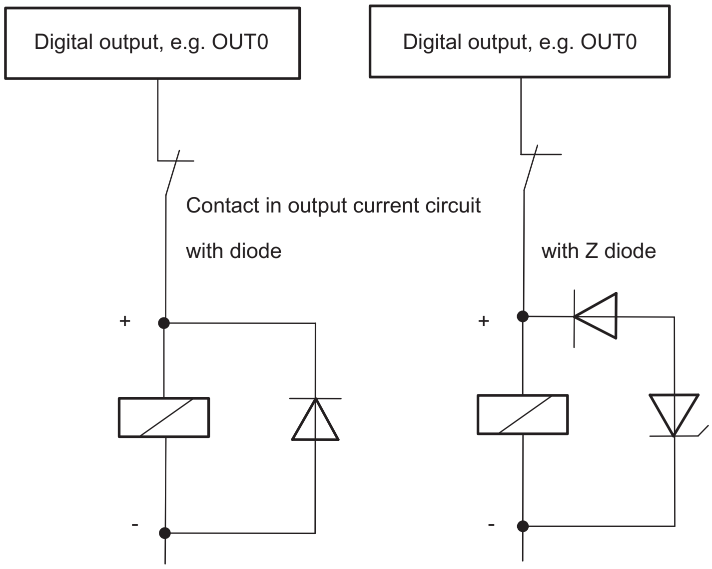


Figure 5-1 Relay contact in the output circuit

5.4 Safety concept

Principle

The following measures are vital to the safety of the system. Install them with particular care, and adapt them to meet the requirements of the system.

Check the measures are effective before the first run.

> **⚠ WARNING**
>
> To avoid injury and damage to property, make sure you adhere to the following:
> - Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.).
> - Make sure that no one has access to areas of the system with moving parts.
> - Install, for example, safety limit switches for the end positions of the axes that switch off the power control system directly.
> - Install devices and take steps to protect motors and power electronics.

Example: Setting up a positioning control

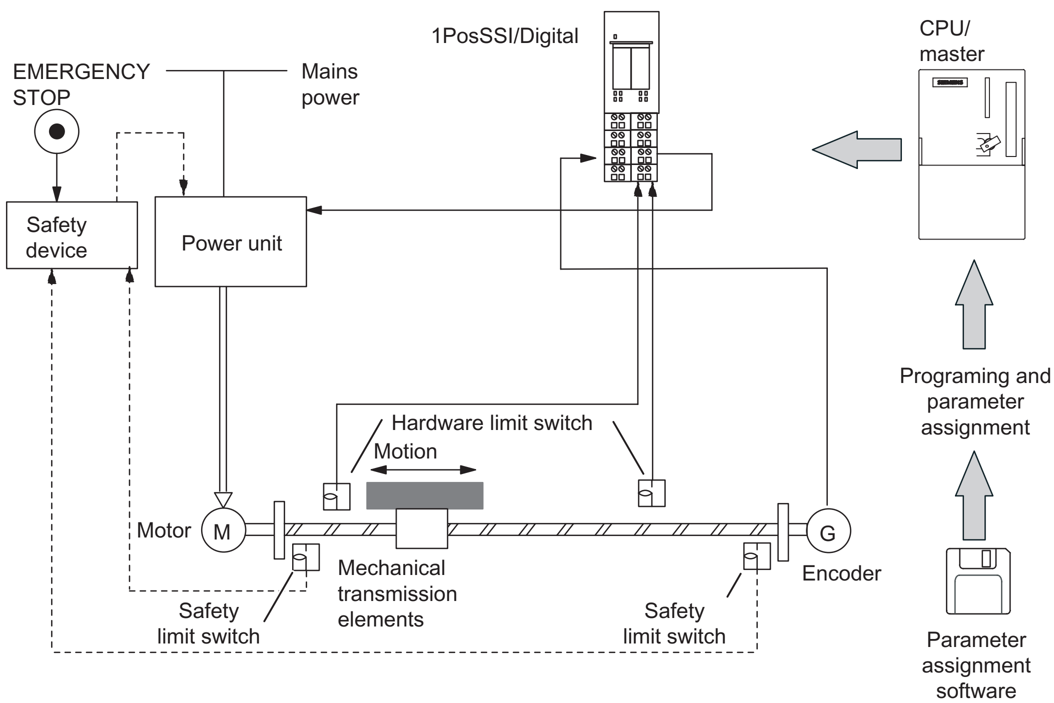


Figure 5-2 Design of a Positioning Control System (Example)

5.5 Fundamentals of Controlled Positioning Using Rapid/Creep Feed

Positioning Operation

From the start position, the target is approached at high speed (rapid feed). At a preset distance from the target (switchover point), there is a change to a lower speed (creep feed). Shortly before the axis reaches the target, again at a preset distance from the target, the drive is switched off (switch-off point).

The drive is controlled via digital outputs for rapid feed or creep feed and the appropriate direction.

To facilitate understanding, the change in speed is illustrated over the path traversed.

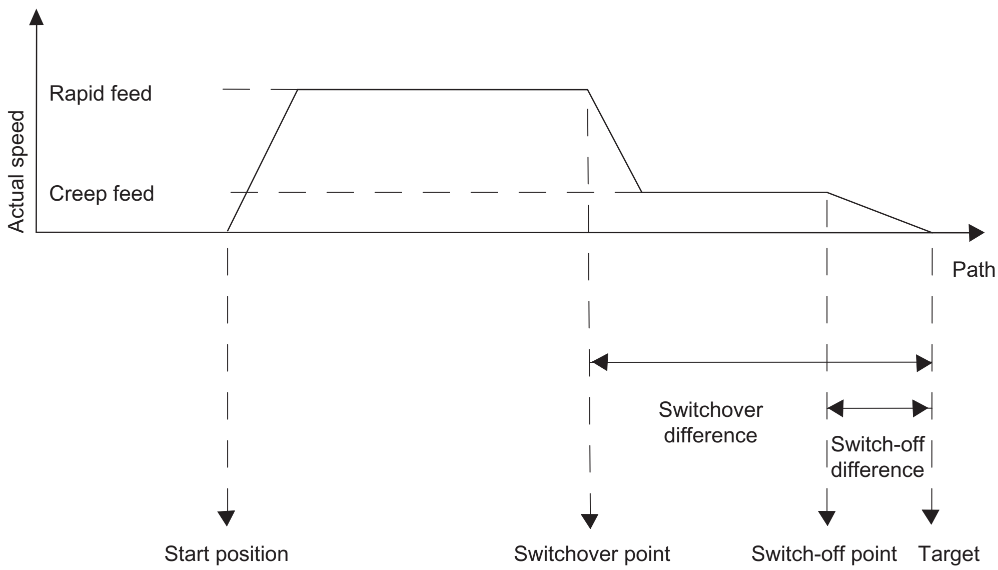


Figure 5-3 Switching points and switching differences

Definitions

Term	Explanation
Operating range	Defines the range, which you set for a particular task by means of the hardware limit switches. In addition, the operating range is also restricted by the range covered by the SSI encoder. You enter the encoder range in the parameters for: • Number of increments • Number of rotations Encoder range = number of rotations * number of increments Maximum operating range: • Linear axis - max. 0 to (encoder range -1) • Rotary axis from 0 to (encoder range - 1)
Switchover difference	Defines the distance from the destination at which the drive is switched over from rapid feed to creep feed.
Switchover point	Defines the position at which the drive is switched over from rapid feed to creep feed.
Switch-off difference	Defines the distance from the destination at which the drive is switched off. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no change from rapid feed to creep feed.
Switch-off point	Defines the position at which the drive is switched off. The 1PosSSI/Digital reports the end of the run at this point.
Start position	Defines the position of the drive within the operating range from which the run is started. If the start position is within the switch-off difference, the drive is not triggered. The 1PosSSI/Digital reports the end of the run at this point. If the start position is within the switchover difference, the run is only executed in creep feed mode.
Target XE "Target"	Defines the absolute or relative position of the axis approached during positioning. The destination is the position to be reached on an axis during a run. In the case of an absolute run, you specify the destination directly by means of your control program. In the case of a relative run, the destination is calculated from the start position and the path specified in the control program. If you want to find out how accurately you have reached the destination, you have to compare the actual value with the position specified.
Linear axis XE "Linear axis"	Defines the axis type with a limited operating range. It is limited by the following: • The encoder range • The numeric range that can be represented (0 to 16 777 215 increments) • The hardware limit switch
Rotary axis	Defines the axis type with an infinite operating range. This includes resetting the axis position to 0 after one rotation (assigned parameter encoder range).
Minus direction	If the drive moves in the minus direction, the actual value displayed is decreased.
Plus direction	If the drive moves in the plus direction, the actual value displayed is increased.

5.6 Functions of the 1PosSSI/Digital

5.6.1 Overview of the Functions

Overview

The 1PosSSI/Digital offers you the following functions for moving your axis:

- Stop
- Inching
- Absolute Positioning
- Relative Positioning

In addition to the different types of motion, the 1PosSSI/Digital also offers functions for:

- Setting of Actual Value
- Move Encoder Range
- Change Switch-Off Difference
- Change Switchover Difference
- Latch Function
- Setting the Monitoring of the Direction of Rotation
- Display Current Values
- Error Detection/Diagnostics
- Behavior at CPU-Master-STOP

Parameters: Define the variables that depend on the drive, axis, and encoder uniquely in the parameters.

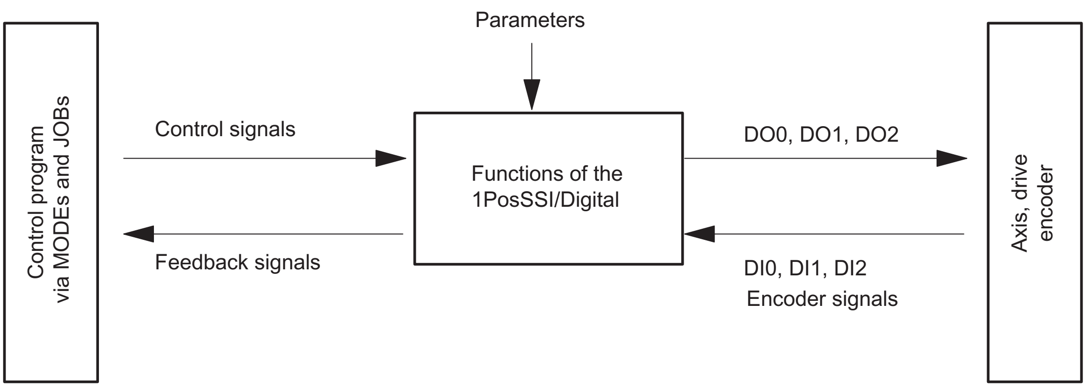


Figure 5-4 How the 1PosSSI/Digital Works

Interfaces to the Control Program and the Axis

To execute the function, the 1PosSSI/Digital has digital inputs as an interface to the axis, encoder signals for the connection to an encoder and digital outputs to control the drive.

You can modify and monitor the types of motion (MODES) and functions (JOBs) with your control program using control signals and feedback signals.

See also

Parameter List (Page 234)

Principle

What You Do	Response of the 1PosSSI/Digital
Provide the control interface with data depending on the MODE. Check the POS_ACK feedback bit is at 0	
Switch the START control bit from 0 to 1	The 1PosSSI/Digital sets the feedback bits POS_ACK = 1 and POS_DONE = 0. This indicates that the start of the 1PosSSI/Digital has been detected and that the MODE is executed when POS_ERR = 0. The MODE is not executed when POS_ERR = 1.
Switch the START control bit from 1 to 0	The 1PosSSI/Digital sets the feedback bit POS_ACK = 0
	In the case of stopping, absolute and relative positioning, the 1PosSSI/Digital sets the feedback bit POS_DONE = 1 when the MODE it terminated without errors. When POS_ERR = 1 the MODE is terminated with an error.
Only when POS_ACK=0 can you start a new MODE. If you start when a MODE is running, the 1PosSSI/Digital takes on the new motion and executes a change of direction, if necessary.	

Figure 5-5 Control and Feedback Signals with MODEs

Principle

What You Do	Response of the 1PosSSI/Digital
Provide the control interface with data corresponding to the JOB. Check the JOB_ACK feedback bit is at 0	
Switch the JOB_REQ control bit from 1 to 0	The 1PosSSI/Digital sets the feedback bit JOB_ACK = 1 This indicates that the initiation of the 1PosSSI/Digital has been detected and that the JOB will be executed when JOB_ERR = 0. • In the case of the latch function, the 1PosSSI/Digital sets the feedback bit LATCH_DONE = 0 at the same time. • All the other JOBs are thus executed. The JOB is not executed when JOB_ERR = 1.
Switch the JOB_REQ control bit from 1 to 0	The 1PosSSI/Digital sets the feedback bit JOB_ACK = 0
	In the case of the latch function, the 1PosSSI/Digital sets the feedback bit LATCH_DONE = 1 when the function has been executed.
Only when JOB_ACK=0 can you activate a new JOB again.	

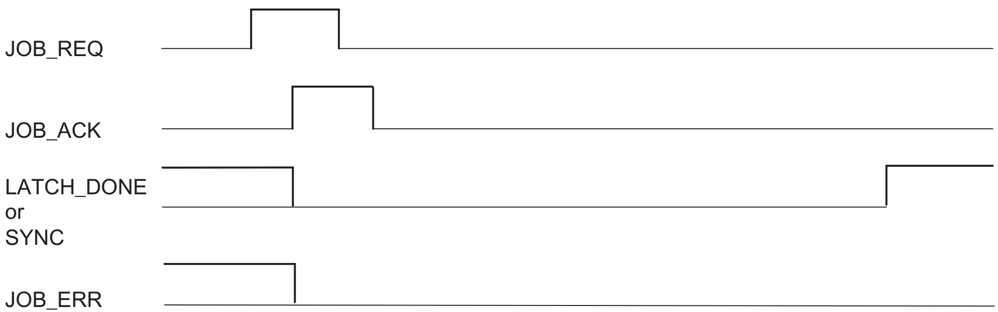


Figure 5-6 Control and Feedback Signals with JOBs

5.6.2 Axis, Drive and Encoder

Evaluation of the Encoder Signals

The 1PosSSI/Digital evaluates the encoder value supplied by the SSI encoder directly in increments and forms the actual value in increments (actual value = encoder value).

The actual value lies in the encoder range from 0-(number of rotations * number of increments)-1. The 1PosSSI/Digital generates an overrun or underrun of the actual value at the limits of the operating range.

Reversal of the direction of rotation

You can use the parameter for the reversal of the direction of rotation to adapt the direction of rotation of the encoder to that of the drive and the axis.

Controlling the Drive

The drive is controlled using the 3 digital outputs of the 1PosSSI/Digital.

You can select the speed with the SPEED control bit (SPEED=0 is creep feed; SPEED=1 is rapid feed). You can also change the speed during the run.

You can bring about a change in direction with the T_{min} direction change parameter.

You can read the status of each output from the feedback interface (DO0, DO1 and DO2).

The function of the digital outputs depends on the control mode.

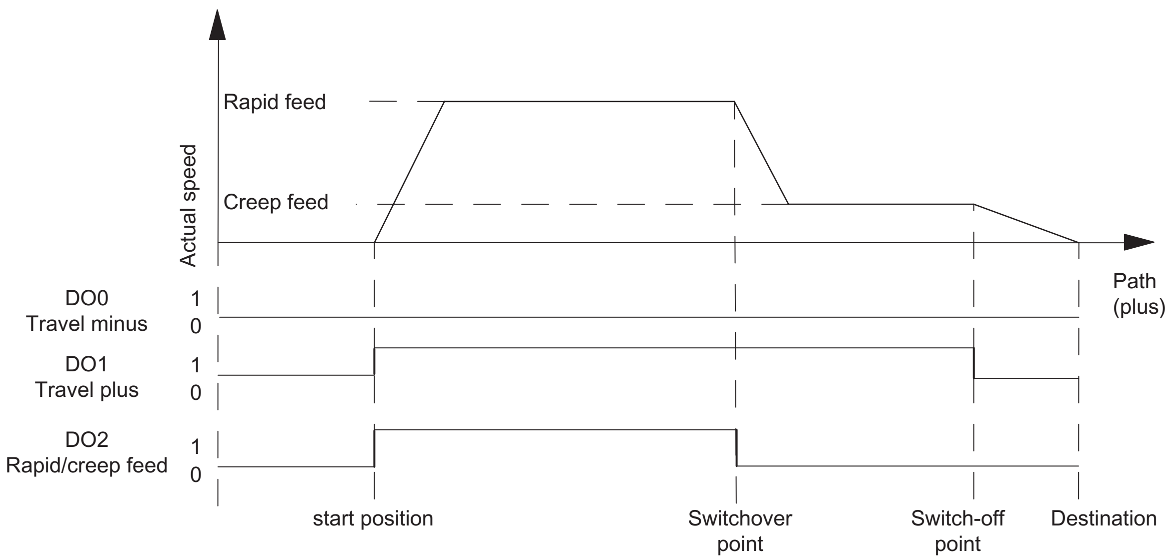


Figure 5-7 Digital Outputs with Control Mode 0

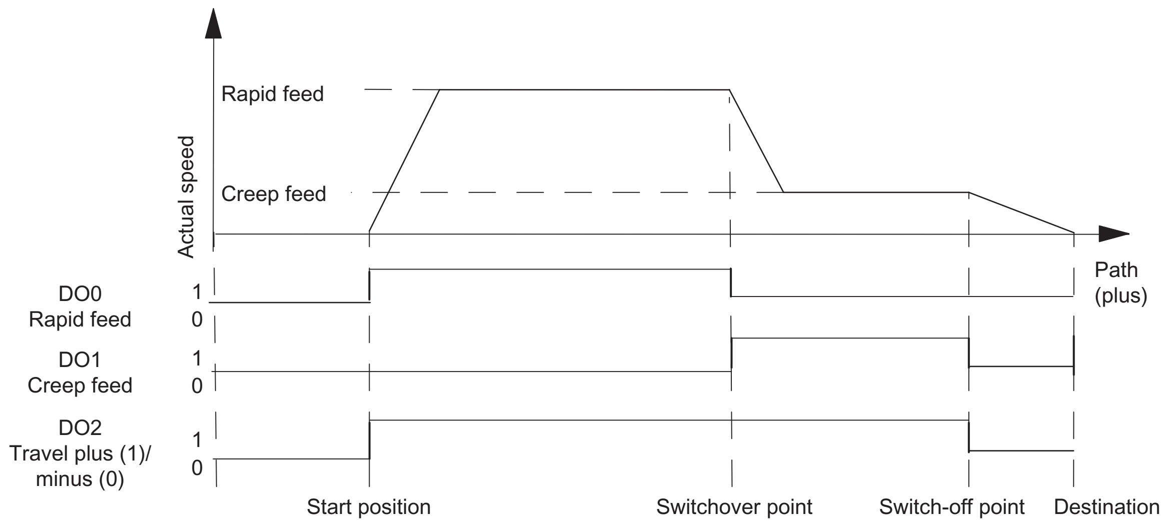


Figure 5-8 Digital Outputs with Control Mode 1

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

Effect of the Hardware Limit Switches

The two digital inputs (DI0 and DI1) are evaluated by the 1PosSSI/Digital as limit switches:

- DI0 is the minus limit switch and limits the operating range in the minus direction.
- DI1 is the plus limit switch and limits the operating range in the plus direction.

You can assign parameters to the hardware limit switches separately as break contacts or make contacts.

The hardware limit switches are evaluated with linear axes and rotary axes.

Only the hardware limit switch that lies in the direction in which the drive is being moved is evaluated.

This enables you to move away from a hardware limit switch without additional error acknowledgment by moving in the other direction if you reach or overrun a hardware limit switch.

The current signal level of the digital inputs is displayed in the feedback interface, delayed by the update rate.

You can see from the following table what effect the hardware limit switches have in the individual MODEs:

MODE	Effect of the Hardware Limit Switches
Inching	The motion of the axis is halted on the hardware limit switch, all 3 digital outputs are set to 0, and the POS_ERR feedback bit is reported.
Absolute Positioning	
Relative Positioning	

Starting on the hardware limit switch

Direction	Response of the 1PosSSI/Digital
Starting into the operating range	The 1PosSSI/Digital starts the preset MODE.
Starting away from the operating range	The POS_ERR=1 feedback bit is set.

5.6.3 Effect of the Directional Enables

Description

You enable the digital outputs directionally using the DIR_M and DIR_P control bits.

- With DIR_M = 1 you can move in the minus direction.
- With DIR_P = 1 you can move in the plus direction.

Interrupting and Continuing the Run

If you reset the relevant directional enable during a run, the motion of the axis is halted, all 3 digital outputs are set to 0, and the run is interrupted.

If you set the relevant directional enable again, the run is continued.

5.6.4 Stop (MODE 0)

Definition

If you activate MODE 0, the 1PosSSI/Digital stops the current run, all 3 digital outputs are set to 0, and the run is terminated (POS_ERR = 0, POS_DONE = 1).

A run terminated with MODE 0 cannot be continued. To put the axis into motion again, you start a new MODE.

Control Signals: Stop

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
</table>

Feedback Signals: Stop

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK

5.6.5 Inching (MODE 1)

Definition

You use inching mode to control the drive directly in a particular direction using the DIR_M or DIR_P control bits.

If you start MODE 1, the 1PosSSI/Digital moves the drive at the preset speed (SPEED control bit) in the specified direction (control bit DIR_M or DIR_P).

You stop the drive by setting the control bits DIR_P=0 and DIR_M=0.

A change of direction is executed after the time T_{min} elapses.

You can also activate inching on an unsynchronized axis (feedback bit SYNC = 0) or when there is a pending encoder error (feedback bit ERR_ENCODER = 1) or without an encoder connected.

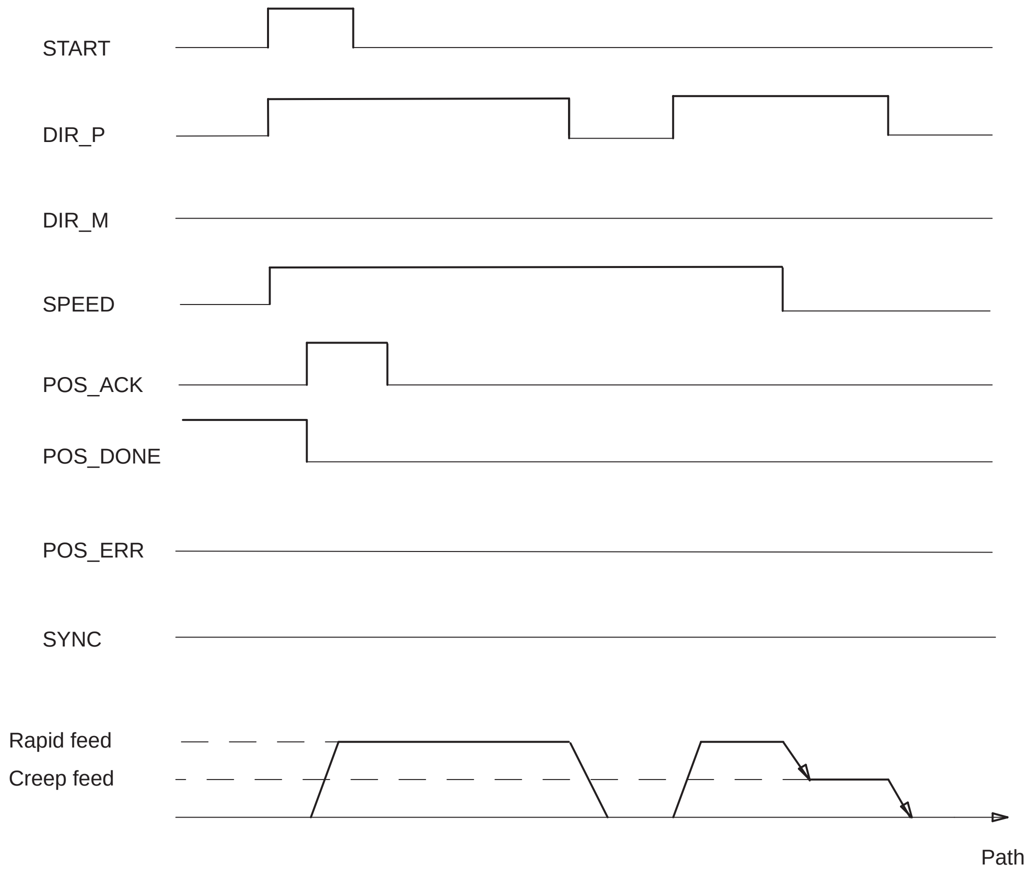


Figure 5-9 Execution of Inching

Control Signals: Inching

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
</table>

Feedback Signals: Inching

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Inching: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

5.6.6 Absolute Positioning (MODE 5)

Definition

With absolute positioning, the 1PosSSI/Digital moves the drive toward absolute destinations. To do this, the axis must be synchronized.

Supply the control interface with the destination, and start MODE 5 with the necessary directional enable (DIR_M, DIR_P). The 1PosSSI/Digital moves the drive at the preset speed (control bit SPEED) toward the destination. At the switchover point the 1PosSSI/Digital switches from rapid feed to creep feed, and at the switch-off point it terminates the run.

If you start during an active run, the 1PosSSI/Digital executes the necessary change in direction after the time T_{min} has elapsed.

Linear axis

The 1PosSSI/Digital works out the direction in which the destination is approached. You must set the necessary directional enable (DIR_M, DIR_P) to start. You can also set both enables.

Rotary axis

You determine the direction in which the destination is approached by selecting the directional enable (DIR_M, DIR_P):

Control bits DIR_P and DIR_M	Direction
DIR_P = 1 DIR_M = 0	The destination is approached in the plus direction.
DIR_P = 0 DIR_M = 1	The destination is approached in the minus direction.
DIR_P = 1 DIR_M = 1	The destination is approached by the shortest route. The 1PosSSI/Digital works out the direction in which the destination is approached.

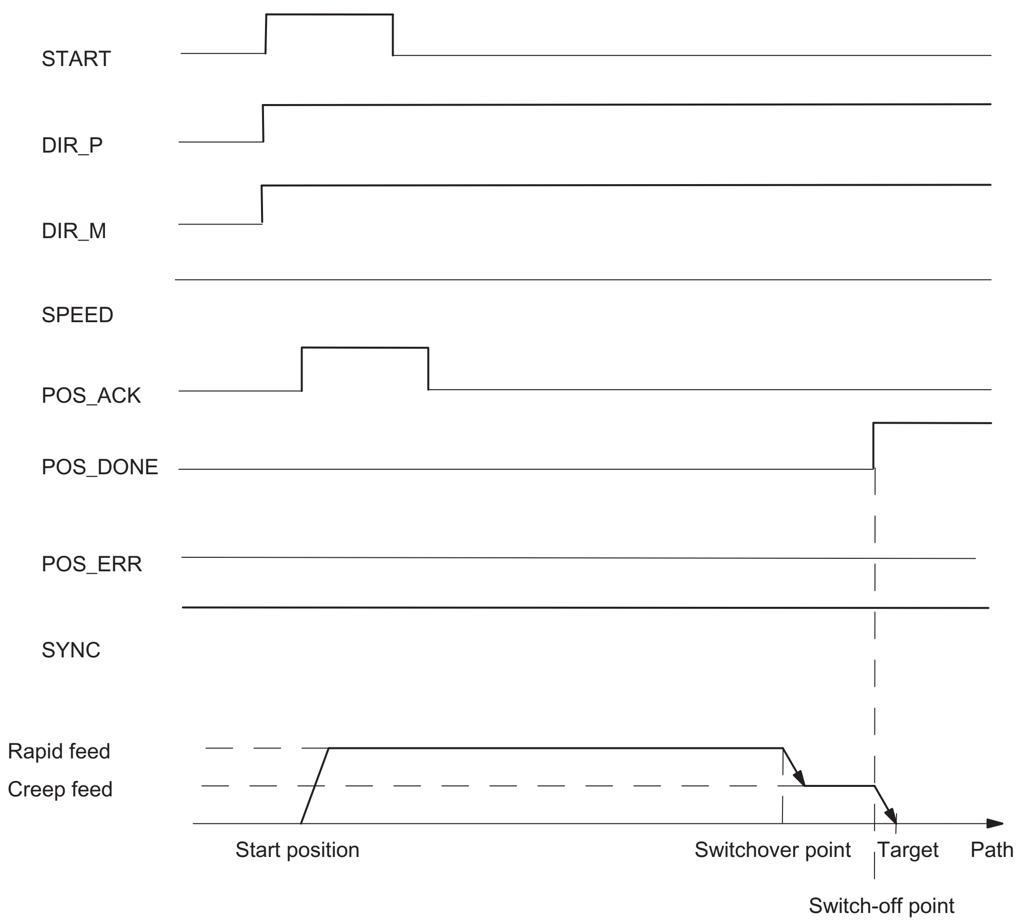


Figure 5-10 Execution of Absolute Positioning

Control Signals: Absolute Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="7">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED=0 is creep feed; SPEED=1 is rapid feed)</td></tr>
<tr><td colspan="6">Bit 2: DIR_M</td></tr>
<tr><td colspan="6">Bit 1: DIR_P</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Destination
(0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Absolute Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Parameters: Absolute Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Absolute positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	Eliminate the encoder error.
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0	
8	Absolute positioning: Destination ≥ encoder range	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

5.6.7 Relative Positioning (MODE 4)

Description

In relative positioning the 1PosSSI/Digital moves the drive from the start position in a specified direction for a certain preset distance.

Supply the control interface with the distance to be traveled, and start MODE 4, specifying the direction (DIR_M or DIR_P). The 1PosSSI/Digital moves the drive at the preset speed (SPEED control bit) for that distance. At the switchover point the 1PosSSI/Digital switches from rapid feed to creep feed, and at the switch-off point it terminates the run.

If you start during an active run, the 1PosSSI/Digital executes the necessary change in direction after the time T_{min} has elapsed.

The preset distance is not checked by the 1PosSSI/Digital. This means that more than one revolution may be involved with rotary axes.

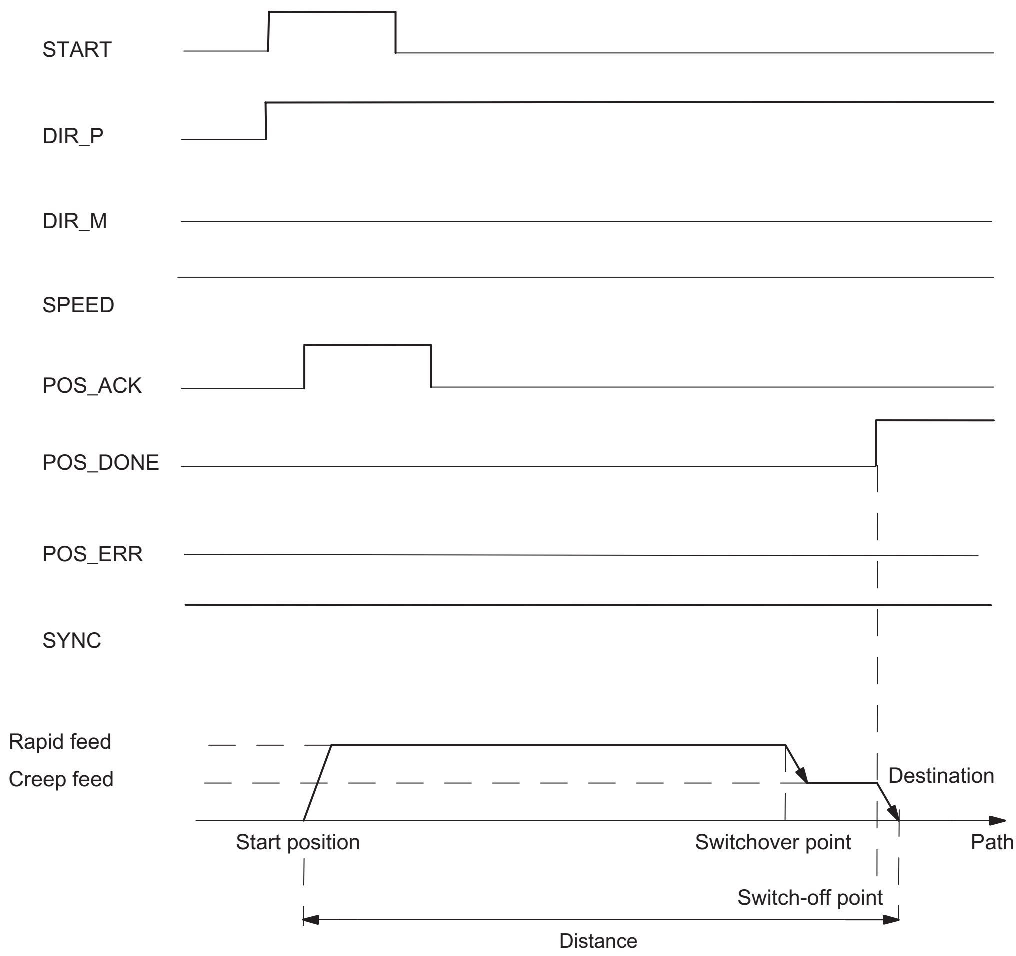


Figure 5-11 Execution of Relative Positioning

Control Signals: Relative Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED=0 is creep feed; SPEED=1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Distance
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Relative Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Parameters: Relative Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Relative Positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

5.6.8 Canceling JOB Processing (JOB 0)

Definition

If you activate JOB 0, the 1PosSSI/Digital responds in the following way:

- It cancels the current JOB 10 (latch function)
- It sets a pending JOB_ERR = 0.

You can activate JOB 0 whatever the state of the axis.

Effect on the MODEs

MODEs are not affected by JOB 0.

Control Signals: Canceling JOB processing

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
</table>

Feedback Signals: Canceling JOB processing

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

5.6.9 Setting the Actual Value (JOB 1)

Definition

Setting an actual value assigns new coordinates to the actual value displayed. This moves the operating range to another part of the axis.

At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

The 1PosSSI/Digital sets the specified actual value coordinates on the actual value displayed in the feedback interface and sets the feedback bit SYNC = 1.

Effect on the MODEs

MODE	What Happens
Inching	-
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ switch-off difference The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot. • Distance to the destination ≤ the switchover difference The switchover point is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > the switchover difference The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.
Relative Positioning	The preset distance continues to be traversed.

Control Signals: Setting of Actual Value

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Actual value coordinates
(0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Setting of Actual Value

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting an Actual Value: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
34	Setting an Actual Value: Actual value coordinates ≥ encoder range	

5.6.10 Moving the Encoder Range (JOB 2)

Definition

When the encoder range is moved, the encoder value is adjusted so that the actual value displayed corresponds to the real actual value. Before this can be done, any active run must be terminated.

Supply the control interface with the offset, and activate JOB 2.

You calculate the offset as follows:

- Offset = displayed actual value - real actual value

If the offset is negative, proceed as follows:

- Offset = displayed actual value - real actual value+
  (number of rotations * number of increments)

The 1PosSSI/Digital accepts the preset offset and displays the real actual value coordinates at the feedback interface.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Move Encoder Range

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 2 = Move encoder range</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Offset
(0 to encoder range)</td></tr>
</table>

Feedback Signals: Move Encoder Range

Address	Assignment
Bytes 1 to 3	Actual value (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Move Encoder Range: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	
33	With JOB 2: Offset not in encoder range	

5.6.11 Changing the Switch-Off Difference (JOB 3)

Definition

Changing the switch-off difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switch-off difference, and activate JOB 3.

The 1PosSSI/Digital accepts the specified switch-off difference.

The switch-off difference remains valid until the parameter assignment of the 1PosSSI/Digital is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">Distance to the destination ≤ switch-off difference
The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switch-Off Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switch-off difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switch-Off Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 233)

5.6.12 Changing the Switchover Difference (JOB 4)

Definition

Changing the switchover difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switchover difference, and activate JOB 4.

The 1PosSSI/Digital accepts the specified switchover difference.

The switchover difference remains valid until the parameter assignment of the 1PosSSI/Digital is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">The following responses are possible:
• Distance to the destination ≤ the switchover difference
is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference).
• Distance to the destination > the switchover difference
The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switchover Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 4 = Change the switchover difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switchover difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switchover Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 233)

5.6.13 Latch Function (JOB 10)

Definition

The latch function allows you to store the actual value at an edge at the DI2 digital input. You can use this function, for example, to detect edges or measure lengths.

Supply the control interface with the desired edge, and activate JOB 10.

If the 1PosSSI/Digital detects the preset edge at the DI2 digital input, it stores the associated actual value, displays it as a feedback value and sets the feedback bit LATCH_DONE=1.

You can then activate the latch function again.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Latch Function

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">Bit 1: Latch at negative edge at DI2
Bit 0: Latch at positive edge at DI2</td></tr>
</table>

Feedback Signals: Latch Function

Address	Assignment
Byte 4	Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value: Actual value at edge at DI2 (0 to encoder range-1)

Latch Function: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
36	Latch Function: Edge selection unknown	

5.6.14 Setting the Monitoring of the Direction of Rotation (JOB 11)

Definition

By setting monitoring of the direction of rotation you can adjust the monitoring of the direction of rotation of the 1PosSSI/Digital to suit your load and mechanical conditions.

Monitoring of the direction of rotation is always active. The 1PosSSI/Digital detects whether the direction of rotation of the drive and the encoder is the same. Direction of rotation monitoring will tolerate different directions for the drive and the encoder up to the preset path difference. If the preset path difference is exceeded, the 1PosSSI/Digital reports POS_ERR =1.

Unless you have activated JOB 11, double the switch-off difference is used from the parameters as the path difference. JOB 3 (which changes the switch-off difference) does not affect the path difference for the purpose of monitoring of the direction of rotation.

Supply the control interface with the new path difference, and activate JOB 11.

The 1PosSSI/Digital accepts the preset path difference for the monitoring of the direction of rotation.

The preset path difference for the monitoring of the direction of rotation remains valid until the parameter assignment of the PosSSI/Digital is changed.

Disabling the Monitoring of the Direction of Rotation

Monitoring of the direction of rotation is disabled when the path difference is 0.

Effect on the MODEs

MODEs are not affected by JOB 11.

Control Signals: Setting the Monitoring of the Direction of Rotation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0</td></tr>
<tr><td>Bytes 6, 7</td><td colspan="6">Path difference for monitoring of the direction of rotation
(0 to 65 535)</td></tr>
</table>

Feedback Signals: Setting the Monitoring of the Direction of Rotation

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting the Monitoring of the Direction of Rotation: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
38	Monitoring of the direction of rotation Path difference > 65 535	

See also

CPU/Master Stop and RESET State (Page 233)

Error Detection/Diagnostics (Page 228)

5.6.15 Displaying Current Values (JOB 15)

Definition

You can display the following values in the feedback interface as feedback values:

- Residual distance
- Actual speed
- Causes of errors for POS_ERR and JOB_ERR

The residual distance is set by the 1PosSSI/Digital as the default for the feedback value.

The 1PosInc/Digital continuously displays the actual value in the feedback interface irrespective of the selected feedback value.

This moves the operating range to another part of the axis and synchronizes the axis.

The selected feedback value remains valid until the parameter assignment of the 1PosSSI/Digital is changed.

Displaying Current Values and the Latch Function

If you activate the latch function, the 1PosSSI/Digital sets a feedback value of 0 and displays the actual value at the edge at the DI2 digital input.

You can only activate JOB 15 again after the latch function has terminated.

Residual distance

The 1PosSSI/Digital calculates the distance to the destination as the residual distance in the absolute positioning and relative positioning MODEs. As long as the actual value is before the destination, the residual distance remains positive. It becomes negative once the destination is overshot. The residual distance is 0 in the other MODEs.

The 1PosInc/Digital displays the residual distance with a sign between -8 388 608 and 8 388 607 increments. Negative values are displayed in twos complement. If the actual residual distance is beyond these limits, the limit value is displayed.

Actual speed

The 1PosSSI/Digital calculates the actual speed as an encoder value change in increments per 10 ms. It displays these between 0 and 16 777 215.

Causes of errors for POS_ERR and JOB_ERR

The 1PosSSI/Digital displays the causes of errors for POS_ERR and JOB_ERR as well as the MODE and JOB entered in the control interface.

Effect on the MODEs

MODEs are not affected by JOB 15.

Control Signals: Display Current Values

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 15 = Display current values</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0: Residual distance
1: Actual speed
2: Causes of errors for POS_ERR and JOB_ERR</td></tr>
</table>

Feedback Signals: Display Current Values

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	In accordance with the selected feedback value: • With a residual distance of: - 8 388 608...8 388 607 • With an actual speed of: 0...16 777 215 • With causes of errors for POS_ERR and JOB_ERR – Byte 5: Causes of Errors for POS_ERR – Byte 6: Causes of Errors for JOB_ERR – Bits 7.3 to 7.0: MODE (= bits 0.7 to 0.4 from the control signals) – Bits 7.7 to 7.4: JOB (= bits 4.7 to 4.4 from the control signals)

Display current values: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
35	Display current values: Selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	

See also

CPU/Master Stop and RESET State (Page 233)

Error Detection/Diagnostics (Page 228)

5.6.16 Error Detection/Diagnostics

Parameter assignment error

Parameter assignment error	Response of the 1PosSSI/Digital
Causes: • The 1PosSSI/Digital cannot identify parameters that exist as its own. • The 1PosSSI/Digital slot you configured does not match the physical setup. • Impermissible value for parameter for number of increments. • Impermissible value for parameter for number of rotations. • Number of increments * number of rotations is greater than 4096x4096. What to Do: • Check the configuration, physical setup and parameter assignment.	• The 1PosSSI/Digital is not assigned parameters and cannot execute its functions. • Generate channel-specific diagnostics

External Errors

Load Voltage 2L+ Missing	Response of the 1PosSSI/Digital
Causes: • Load voltage 2L+ not present or too low at terminal 15 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current run is halted; it is not possible to start a new run. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_2L+=1 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK
Short circuit of the sensor supply	**Response of the 1PosSSI/Digital**
Causes: • Short circuit of the encoder supply made available at terminals 2 and 10 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER=1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error.

<table>
<tr><th>Wire Break/Short Circuit of the Encoder Signals</th><th>Response of the 1PosSSI/Digital</th></tr>
<tr><td>Prerequisite:
• To detect errors of the encoder signals, you must enable the "Encoder signal diagnostics" parameter.
Causes:
• Wire break or short circuit of the encoder signals at terminals 1, 5 or 4, 8.
• The parameters for the SSI encoder do not correspond to the encoder connected.
What to Do:
• Check the wiring and correct the short circuit.
• Compare the parameter assignment with the technical specifications of the encoder.
• Acknowledge the error with the EXTF_ACK control bit.</td><td>• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs.
– All 3 digital outputs are set to 0.
– Feedback bit POS_ERR = 1
– Feedback bit POS_DONE = 0
• Feedback bit ERR_ENCODER=1
• Feedback bit SYNC = 0
• Generate channel-specific diagnostics
• Waits for error acknowledgment EXTF_ACK
• Inching MODE is not affected by this error.</td></tr>
</table>

Errors in the Control of MODEs and JOBs

<table>
<tr><th>POS_ERR</th><th>Response of the 1PosSSI/Digital</th></tr>
<tr><td>Causes:
• Certain requirements or conditions have not been met at the start of a MODE</td><td>• The MODE started is not executed.
• The current run is stopped.
– All 3 digital outputs are set to 0.
– Feedback bit POS_ERR = 1
– Feedback bit POS_DONE = 0</td></tr>
<tr><th>JOB_ERR</th><th>Response of the 1PosSSI/Digital</th></tr>
<tr><td>Causes:
• Certain requirements or conditions have not been met at the activation of a JOB</td><td>• The activated JOB is not executed.
– Feedback bit JOB_ERR = 1</td></tr>
</table>

Generating a Channel-Specific Diagnostics

In the event of a parameter assignment error, the absence of load voltage, a short circuit of the sensor supply or a wire break/short circuit of the encoder signals, the 1PosSSI/Digital generates a channel-specific diagnostics on the connected CPU/master. To do this, you must enable the Group Diagnostics parameter (see the *Distributed I/O Device* manual).

Error Acknowledgment EXTF_ACK

You must acknowledge the corrected errors (load voltage missing, short circuit of the sensor supply and open circuit/short circuit of the sensor signals).

What You Do	Response of the 1PosSSI/Digital
	Feedback bit ERR_2L+ = 1 and/or feedback bit ERR_ENCODER=1
Your control program detects the set feedback bit ERR_2L+ or ERR_ENCODER. Execute your application-specific error response. Eliminate the cause of the error.	
Switch the EXTF_ACK control bit from 0 to 1	The 1PosSSI/Digital sets the feedback bits ERR_2L+ = 0 and ERR_ENCODER = 0. This tells you that the cause has been eliminated and acknowledged. If ERR_2L+ = 1 and/or ERR_ENCODER = 1, the cause of the error is not yet eliminated.
Switch the EXTF_ACK control bit from 1 to 0	
In the case of constant error acknowledgment (EXTF_ACK=1) or at CPU/Master Stop, the 1PosSSI/Digital reports the errors as soon as they are detected and deletes them as soon as they have been eliminated.	

Parameters

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals D, /D and C, /C are monitored for short circuit and wire break.	• On • Off	On

Feedback Messages

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Byte 4	Bit 7: ERR_2L+ Bit 1: JOB_ERR Bit 0: JOB_ACK

Causes of Errors for POS_ERR

Table 5-1 Causes of Errors for POS_ERR

Error Number	Cause	Remedy
1	MODE unknown	Permissible MODEs are: • MODE 0 • MODE 1 • MODE 3 • MODE 4 • MODE 5
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 15
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	Eliminate the encoder error.
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1 Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0 Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
8	Absolute positioning: Destination ≥ encoder range	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

Causes of Errors for JOB_ERR

Table 5-2 Causes of Errors for JOB_ERR

Error Number	Meaning	Remedy
21	JOB unknown	Permissible JOBs are: • JOB 0 • JOB 1 • JOB 3 • JOB 4 • JOB 9 • JOB 10 • JOB 11 • JOB 15
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	
33	With JOB 2: Offset not in encoder range	
34	Setting an Actual Value: Actual value coordinates ≥ encoder range	
35	Display current values: Selection unknown	
36	Latch Function: Edge selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	
38	Monitoring of the direction of rotation Path difference > 65 535	

5.7 CPU/Master Stop and RESET State

Behavior at CPU-Master-STOP

Behavior at CPU-Master-STOP	Response of the 1PosSSI/Digital
• Due to power-off of the CPU/DP master or • Due to power-off of the IM 151/ IM 151 FO or • Due to failure of DP transmission or • Due to change from RUN to STOP	• The current run is stopped. • All 3 digital outputs are set to 0. • Feedback bit POS_ERR = 0 • Feedback bit POS_DONE = 1

Exiting the CPU-Master-STOP Status

Exiting the CPU-Master-STOP Status	Response of the 1PosSSI/Digital
• At power-on of the CPU/DP master or • At power-on of the IM 151/ IM 151 FO or • After failure of the DP transmission or • After a change from STOP to RUN	• The feedback interface of the 1PosSSI/Digital remains current. • The axis remains synchronized, and the actual value is current. • The moved encoder range remains valid. • The changed switch-off and switchover differences and the path difference for the monitoring of the direction of rotation remain valid. • An initiated JOB 10: Latch function remains active. • The feedback bit selected with JOB 15 is current.

RESET State of the 1PosSSI/Digital

RESET Status of the 1PosSSI/Digital and Modification of the Parameters of the 1PosSSI/Digital	Response of the 1PosSSI/Digital
• By changing the parameters of the 1PosSSI/Digital and downloading the parameter assignment and configuration of the ET 200S station to the CPU/ DP master or • As a result of power-on of the power module of the 1PosSSI/Digital or • Inserting the 1PosSSI/Digital in an energized state	• The axis is synchronized, and the actual value corresponds to the current encoder value. • The encoder range has not been moved. • The switch-off and switchover difference is accepted from the parameters. • The path difference for the monitoring of the direction of rotation is set at double the switch-off difference. • JOB 10: Latch function is not active. • The residual distance is displayed as a feedback value.

5.8 Parameter List

Overview

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals D, /D and C, /C are checked for short circuit and wire break.	• On • Off	On
Encoder and Axis			
Encoder	Selection of single-turn encoder (SSI 13 bit) or multiturn encoder (SSI 25 bit)	• SSI-13Bit • SSI-25Bit	SSI-13Bit
Transmission rate		• 125 kHz • 250 kHz • 500 kHz • 1 MHz	125 kHz
Number of increments		4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192	4096
Number of rotations	Only relevant in the case of multiturn encoders. In the case of single-turn encoders, the 1PosSSI/Digital sets the number of rotations to 1.	4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096	4096
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder	• Off • On	Off
Axis type	Selection of linear axis without limits or rotary axis with overrun/underrun with encoder range	• Linear • Rotary	Linear
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 latch signal	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed. You can change the switchover difference with JOB 4.	0 - 65 535	1000
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

5.9 Control and Feedback Signals

Assignment of the Control Interface

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="8">Byte 0</td><td colspan="6">Bits 0.7 to 0.4 stand for the MODEs</td></tr>
<tr><td rowspan="6">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td></td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>MODE 3 = Reference Point Run</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>MODE 5 = Absolute Positioning</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td rowspan="2">Bytes 1 to 3</td><td></td><td colspan="5">at MODE 4 = Relative positioning: distance</td></tr>
<tr><td></td><td colspan="5">at MODE 5 = Absolute positioning: target</td></tr>
<tr><td rowspan="11">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 stand for the MODEs</td></tr>
<tr><td rowspan="9">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td></td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>JOB 2 = Move encoder range</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>JOB 4 = Change the switchover difference</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>JOB 15 = Display current values</td></tr>
<tr><td colspan="6">Bit 3: EXTF_ACK
Bit 2:Reserve = 0
Bit 1: Reserve = 0
Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Corresponding to the selected JOB:
• With JOB 1= actual value coordinates
• With JOB 3 = switch-off difference
• With JOB 4 = switchover difference
• With JOB 10
– Byte 5: Bit 0 = latch at positive edge at DI2
– Byte 5: Bit 1 = latch at negative edge at DI2
• With JOB 11 = path difference for direction of rotation monitoring
• With JOB 15
– Byte 5: 0 = Residual distance
– Byte 5: 1 = Actual speed
– Byte 5: 2 = error information</td></tr>
</table>

Assignment of the Feedback Interface

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 6: STATUS DO 2 Bit 5: STATUS DO 1 Bit 4: STATUS DO 0 Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value
Byte 4	Bit 7: ERR_2L+ Bit 6: STATUS DI 2 Latch signal Bit 5: STATUS DI 1 limit switch plus Bit 4: STATUS DI 0 limit switch minus Bit 3: Reserve Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file [1)] (hardware catalog\PROFIBUS DP\ other field devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
[1)]Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

5.10 Technical specifications

Overview

Technical Data of the 1PosSSI/Digital	
Dimensions and weight	
Dimension W x H x D (mm)	30 x 81 x 52
Weight	Approx. 65 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
Rated load voltage L+ • Range • P1	24 VDC 20,4 ... 28.8 V Yes
Isolation	
• Between the backplane bus and the I/O	Yes
Sensor supply • Output voltage • Output current	 L+ -0.8 V Maximum 500 mA, short-circuit proof
Current consumption • From the backplane bus • From the load voltage L+ (no load)	 Max. 10 mA Max. 50 mA
Power dissipation	Typ. 2 W
Data for the digital inputs	
Input voltage • Rated value • 0 signal • 1 signal	 24 VDC -30 V to 5 V 11 V to 30 V
Input current • 0 signal • 1 signal	 ≤ 2 mA (perm. leakage current) 9 mA (typ.)
Minimum pulse width	500 µs
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	50 m

Technical Data of the 1PosSSI/Digital		
Data for the Digital Outputs		
Output voltage • Rated value • 0 signal • 1 signal	 DC 24 V ≤ 3 V ≥ L+ -1 V	
Output current • 0 signal (leakage current) • 1 signal – Rated value – Permitted range	 ≤ 0.3 mA 0.5 A 7 mA to 0.6 A	
Switch rate • Resistive load • Inductive load • Lamp load	 100 Hz 2 Hz ≤ 10 Hz	
Lamp load	≤5 W	
Output delay (resistive load, output current 0.5 A) • At 0 to 1 • At 1 to 0	 typ. 150 µs typ. 150 µs	
Short-circuit protection of the output	Yes	
Threshold on	0.7 A to 1.8 A	
Inductive extinction	Yes; L+ -(55 to 60 V)	
Digital input control	Yes	
Cable lengths • Unshielded • Shielded	 600 m 1000 m	
Encoder input SSI		
Position detection	Absolute	
Differential signals for SSI data and SSI clock	According to RS422	
Data transmission rate and line length with absolute encoders (twisted pair and shielded)	• 125 kHz max. 320 m • 250 kHz max. 160 m • 500 kHz max. 60 m • 1 MHz max. 20 m • 2 MHz max. 8 m	
Age of the encoder value • Max. (2 * frame runtime) + 64 µs • Min. frame runtime		
Frame runtime • 125 kHz • 250 kHz • 500 kHz • 1 MHz • 2 MHz Monoflop time [1]	13 Bit 112 µs 56 µs 28 µs 14 µs 7 µs 64 µs	25 Bit 208 µs 104 µs 52 µs 26 µs 13 µs

Technical Data of the 1PosSSI/Digital	
Status, Diagnostics	
Change in actual value (up)	UP LED (green)
Change in actual value (down)	DN LED (green)
Status display positioning in operation	LED POS (green)
Status display DI0 (minus hardware limit switch)	LED 9 (green)
Status display DI1 (plus hardware limit switch)	LED 13 (green)
Status display DI2 (latch signal)	LED 14 (green)
Group error on the 1PosSSI/Digital	SF LED (red)
Diagnostic information	Yes
Response Times	
Update rate for feedback messages	2 ms
Response time at the switchover or switch-off point	Output delay + Frame runtime + 30 µs
Latch response time	Typ. 400 µs + age of encoder value
[1]Encoders with a monoflop time greater than 64 µs, cannot be used with the 1PosSSI/Digital.	

1PosSSI/Analog

6

6.1 Product Overview

Order number

6ES7138-4DK00-0AB0

Features

- Positioning module for controlled positioning using the analog output
  – Switchover and switch-off difference can be set using your control program
  – The voltage for rapid and creep feed, acceleration, and deceleration can be set using your control program
- SSI Encoder
  – 13-bit Singleturn
  – 25-bit Multiturn
- Usable axis types
  – Linear axis
  – Rotary axis
- Operating range: 0 - 16 777 215 steps
- The drive is controlled using the analog output
  – ± 10 V, digital output DO can be controlled freely
  – 0 V to 10 V, direction using digital output DO
- 3 digital inputs can be used for the following:
  – Minus hardware limit switch
  – Plus hardware limit switch
  – Reducing cam/latch input
- Diagnostics
  – Encoder monitoring

Configuration

To configure the 1PosSSI/Analog, you can use either

A DDB file (http://www.ad.siemens.de/csi/gsd) or

- STEP 7 as of V5.1 SP2.

6.2 Brief Instructions on Commissioning the 1PosSSI/Analog

Introduction

Using the example of inching mode, this brief introduction shows you a functioning application in which you get to know and check the hardware and software involved in a positioning operation of your 1PosSSI/Analog.

Prerequisites for the Example

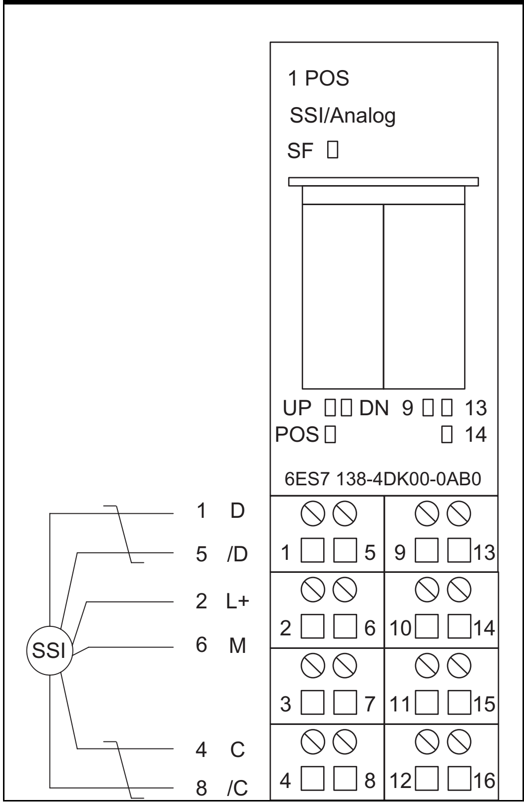
The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You must have:
  - A TM-E30S44-01 terminal module
    (6ES7 193-4CG20-0AA0 or 6ES7 193-4CG30-0AA0)
  - A 1PosSSI/Analog
  - An SSI encoder
  - A drive with a power control system (a frequency converter with ±10 V analog input for speed control, for example)
  - A 24 VDC power supply
  - The necessary wiring material

Installation, Wiring, and Fitting

Install and wire the TM-E30S44-01 terminal module. Insert the 1PosSSI/Analog in the terminal module (you can find detailed instructions in the *Distributed I/O Device* manual).

Table 6-1 Terminal assignment of the 1PosSSI/Analog



Terminal assignment	View	Remarks			
(see figure)	(see figure)	**Connection of the SSI Encoder: Terminals 1-8**		**Connection of the Switches and the Drive: Terminals 9-16**	
		1: D	Data from the SSI encoder	9: IN0	Minus limit switch
		5: /D		13: IN1	Plus limit switch
		3: B	Unused terminals	14: IN2	Reducing cam; latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 V DC	Power supply for SSI encoder	12: QV+	Analog output ± 10 or 0 V to 10 V to connect the drive
		6: M		16: M_{ana}	
		4: C	SSI clock (clock line)	11: OUT	Digital output for direct control or as a directional signal for the drive
		8:/C		15: M	

Configured with STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. Select "1PosSSI/Analog" from the hardware catalog. The number 6ES7 138-4DK00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1PosSSI/Analog.
4. Double-click this number to open the "Properties for the 1PosSSI/Analog" dialog box.

   On the "Addresses" tab, you will find the addresses of the slot to which you have dragged the 1PosSSI/Analog. Make a note of these addresses for subsequent programming.

   On the "Parameters" tab, you will find the default settings for the 1PosSSI/Analog. If you are not connecting any limit switches to the 1PosSSI/Analog, set the DI0 limit switch minus and DI1 limit switch plus parameters to "make contact". Adapt the "DO function" parameter to the drive interface. Depending on the SSI encoder that is connected, select SSI-13 Bit or SSI-25 Bit, and enter the number of increments and the number of rotations.
5. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Creating Blocks and Integrating Them Into The User Program

Integrate the following FC 101 block in your user program (in OB 1, for example). This block requires the DB1 data block with a length of 16 bytes. In the example below, the start is initiated by setting memory bit 30.0 (in the plus direction) or 30.1 (in the minus direction) with the programming device. Select the speed for inching mode using memory word 32.

STL			Explanation
Block: FC101			
	L	PID 256	//Load feedback values from the 1PosSSI/Analog
	T	DB1.DBD8	
	L	PID 260	
	T	DB1.DBD12	
	L	DB1.DBB8	//Display status bits
	T	MB8	
	L	DB1.DBB12	
	T	MB9	
	L	DB1.DBD8	//Display actual value
	DU	DW#16#FFFFFF	
	T	MD12	
	AN	M30.0	
	SPB	DIRM	
	L	B#16#13	//Travel in plus direction
	T	DB1.DBB0	//(START=1, DIR_P=1, DIR_M=0, CTRL_DO=1, INCH=1)
	SPA	CTRL	
DIRM:	AN	M30.1	
	SPB	STOP	
	L	B#16#15	//Travel in minus direction
	T	DB1.DBB0	//(START=1, DIR_P=0, DIR_M=1, CTRL_DO=1, INCH=1)
	SPA	CTRL	
STOP:	L	B#16#0	//Stop
	T	DB1.DBB0	
	A	DB1.DBX8.2	
	SPB	CTRL	
	AN	DB1.DBX8.0	//Set/delete START depending on POS_ACK
	=	DB1.DBX0.0	
CTRL:	L	MW32	//Speed for inching mode
	T	DB1.DBW23	
	L	B#16#0	
	T	DB1.DBB1	
	L	DB1.DBD0	//Transfer control values to the 1PosSSI/Analog
	T	PAD256	
	L	DB1.DBD4	
	T	PAD260	

Test

Start inching mode, and monitor the associated feedback.

1. Use "Monitor/Modify Variables" to check the actual value and the status bits POS_ACK, POS_ERR, POS_DONE, ERR_ENCODER.
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   – MD12 (actual value)
   – M8.0 (POS_ACK)
   – M8.1 (POS_ERR)
   – M8.2 (POS_DONE)
   – M8.7 (ERR_ENCODER)
   – M30.0 (inching in plus direction)
   – M30.1 (inching in minus direction)
   – MW32 (speed for inching mode; as S7 analog value 0-7EFFH)
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor" to switch to monitoring.
6. Switch the CPU to RUN mode.

Result

The following table shows you which activity triggers which result.

Activity	Result
Switch the CPU to RUN mode.	• The POS_ACK status bit is deleted • The POS_ERR status bit is deleted • The POS_DONE status bit is set
Check the encoder wiring	
Check the feedback bit ERR_ENCODER	• If ERR_ENCODER = 1, correct the wiring of the encoder
Inching in the plus direction:	
Start inching mode in the plus direction by setting memory marker 30.0 ("Variable > Modify >")	**The status bit POS_ERR = 0, the UP LED lights up** • The POS_ACK status bit is set • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the DN LED lights up** Check the assigned parameter reversal of the direction of rotation and directional adjustment, and the wiring of the encoder and drive
Check the speed of the drive in the plus direction	
Control the speed using memory marker word 32 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct
Inching in the minus direction:	
Start inching mode in the minus direction by setting memory marker 30.1 ("Variable > Modify >")	**The status bit POS_ERR = 0, the DN LED lights up** • The POS_ACK status bit is set • The POS_ERR status bit is deleted • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the UP LED lights up** Check the assigned parameter reversal of the direction of rotation and directional adjustment, and the wiring of the encoder and drive
Check the speed of the drive in the minus direction	
Control the speed using memory marker word 32 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct

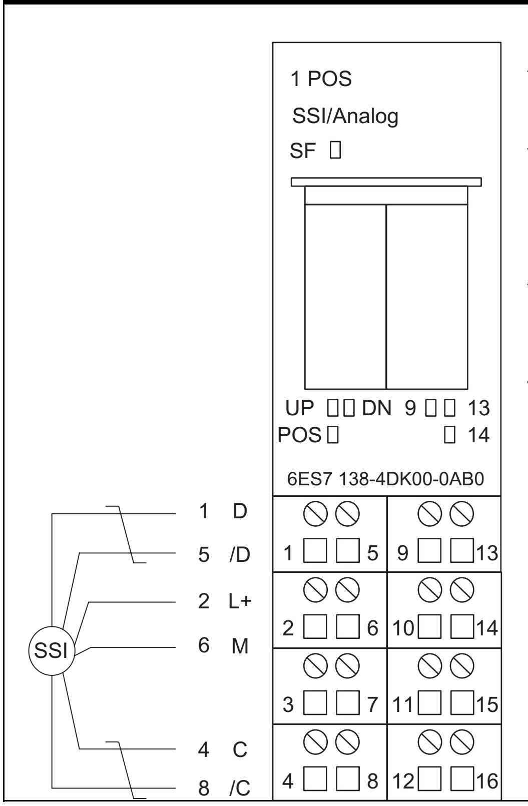
6.3 Terminal Assignment Diagram

Wiring rules

The wires (terminals 1 and 5, 4 and 8) must be in twisted pairs and shielded. The shield must be supported at both ends. You use the shield contact element
(Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal assignment

Table 6-2 Terminal assignment of the 1PosSSI/Analog

Terminal assignment	View	Remarks			
		Connection of the SSI Encoder: Terminals 1-8		Connection of the Switches and the Drive: Terminals 9-16	
		1: D	Data from the SSI encoder	9: IN0	Minus limit switch
		5: /D		13: IN1	Plus limit switch
		3: B	Unused terminals	14: IN2	Reducing cam; latch signal
		7: /B		10: 24 VDC	Encoder supply for the switches
		2: 24 V DC	Power supply for SSI encoder	12: QV+	Analog output ± 10 or 0 V to 10 V to connect the drive
		6: M		16: M_{ana}	
		4: C	SSI clock (clock line)	11: OUT	Digital output for direct control or as a directional signal for the drive
		8:/C		15: M	

Connection of Relays and Contactors to the Digital Output

Note

Direct connection of inductivities (such as relays and contactors) is possible without external circuiting.

If SIMATIC output circuits can be deactivated by additionally installed contacts (for example relay contacts), you have to provide additional overvoltage protection devices at inductivities (see the following example for overvoltage protection).

Overvoltage Protection Example

The following figure shows an output circuit that requires additional overvoltage protection devices. Direct-current coils are wired with diodes or Zener diodes.

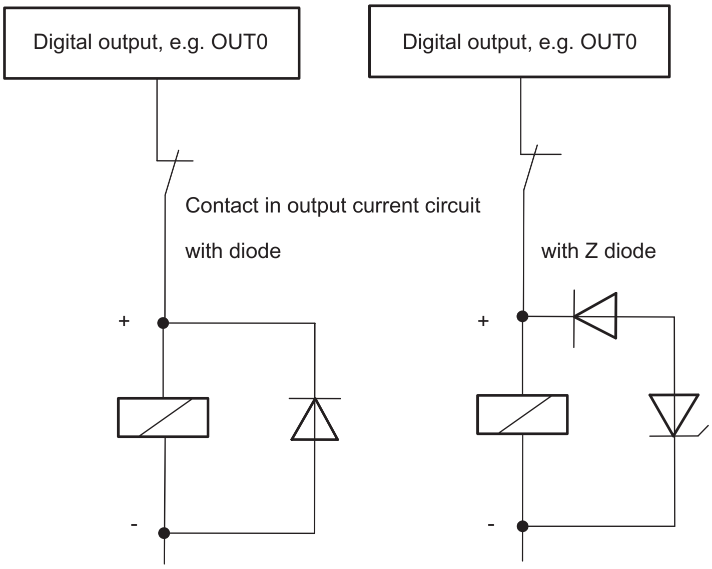


Figure 6-1 Relay contact in the output circuit

6.4 Safety concept

Principle

The following measures are vital to the safety of the system. Install them with particular care, and adapt them to meet the requirements of the system.

Check the measures are effective before the first run.

WARNING

To avoid injury and damage to property, make sure you adhere to the following:

- Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.).
- Make sure that no one has access to areas of the system with moving parts.
- Install, for example, safety limit switches for the end positions of the axes that switch off the power control system directly.
- Install devices and take steps to protect motors and power electronics.

Setting up a positioning control

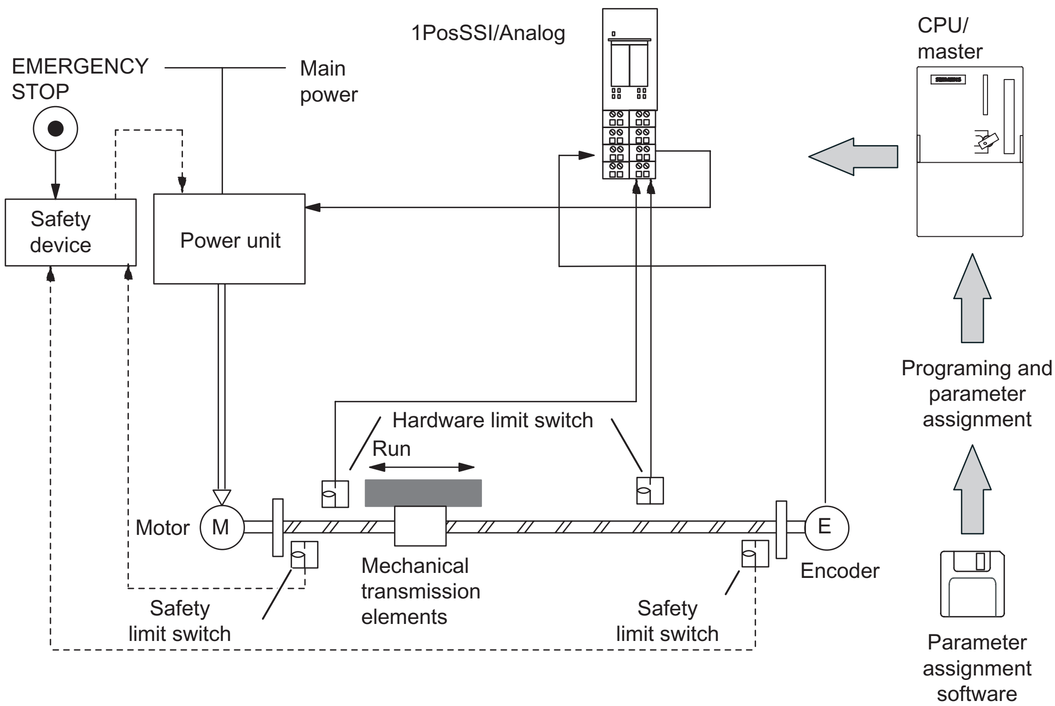


Figure 6-2 Design of a Positioning Control System (Example)

6.5 Fundamentals of Controlled Positioning Using the Analog Output

Positioning Operation

From the start position, the speed is increased (rapid feed) and the destination is approached at this speed. At a preset distance from the destination (switchover point), there is a change to a lower speed (creep feed).

Shortly before the axis reaches the destination and also at a preset distance to the destination, the drive can either be switched off (switch-off point) or be slowed down from creep feed to 0.

To facilitate understanding, the change in speed is illustrated over the path traversed.

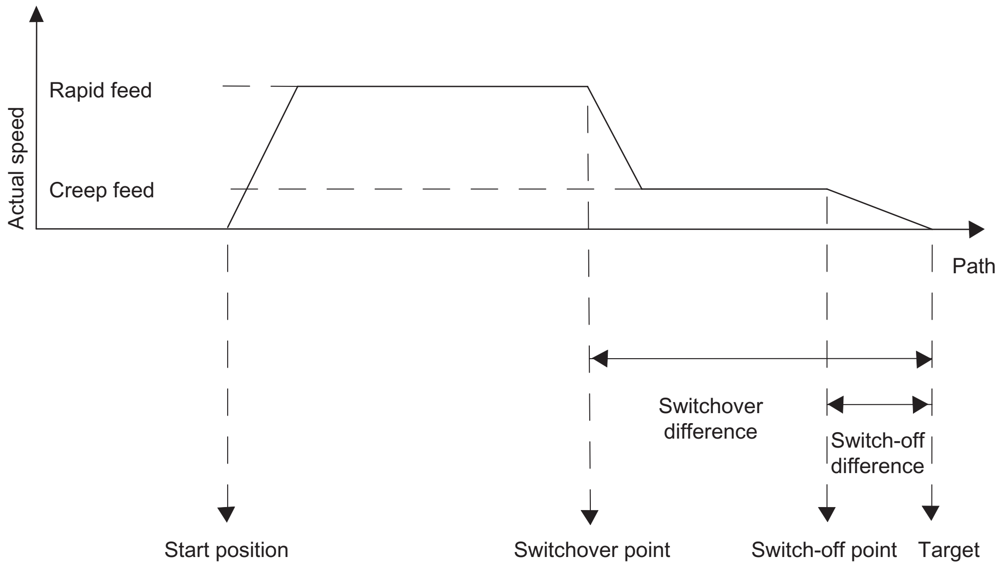


Figure 6-3 Switching points and switching differences

Definitions

Term	Explanation
Operating range	Defines the range, which you set for a particular task by means of the hardware limit switches. In addition, the operating range is also restricted by the range covered by the SSI encoder. You enter the encoder range in the parameters for: • Number of increments • Number of rotations Encoder range = number of rotations * number of increments Maximum operating range: • Linear axis - max. 0 to (encoder range-1) • Rotary axis from 0 to (encoder range - 1)
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.
Switchover point	Defines the position at which the drive is slowed down from rapid feed to creep feed.
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.
Switch-off point	Defines the position at which the drive is switched off. The 1PosSSI/Analog reports the end of the run at this point.
Start position	Defines the position of the drive within the operating range from which the run is started. If the start position is within the switch-off difference, the drive is not triggered. The 1PosSSI/Analog reports the end of the run at this point. If the start position is within the switchover difference, the run is only executed in creep feed mode.
Target	Defines the absolute or relative position of the axis approached during positioning. The destination is the position to be reached on an axis during a run. In the case of an absolute run, you specify the destination directly by means of your control program. In the case of a relative run, the destination is calculated from the start position and the distance specified in the control program. If you want to find out how accurately you have reached the destination, you have to compare the actual value with the position specified.
Linear axis	Defines the axis type with a limited operating range. It is limited by the following: • The encoder range • The numeric range that can be represented (0 to 16 777 215 increments) • The hardware limit switch
Rotary axis	Defines the axis type with an infinite operating range. This includes resetting the axis position to 0 after one rotation (assigned parameter encoder range).
Minus direction	If the drive moves in the minus direction, the actual value displayed is decreased.
Plus direction	If the drive moves in the plus direction, the actual value displayed is increased.

6.6 Functions of the 1PosSSI/Analog

6.6.1 Overview of the Functions

Overview

The 1PosSSI/Analog offers you the following functions for moving your axis:

- Stop
- Inching
- Absolute Positioning
- Relative Positioning

In addition to the different types of motion, the 1PosSSI/Analog also offers functions for:

- Setting of Actual Value
- Move Encoder Range
- Change Switch-Off Difference
- Change Switchover Difference
- Changing the Voltage for Rapid Feed
- Changing the Voltage for Creep Feed
- Changing the acceleration (T_{acc})
- Changing the deceleration (T_{dec})
- Latch Function
- Setting the Monitoring of the Direction of Rotation
- Display Current Values
- Error Detection/Diagnostics
- Behavior at CPU-Master-STOP

Parameters: Define the variables that depend on the drive, axis, and encoder uniquely in the parameters.

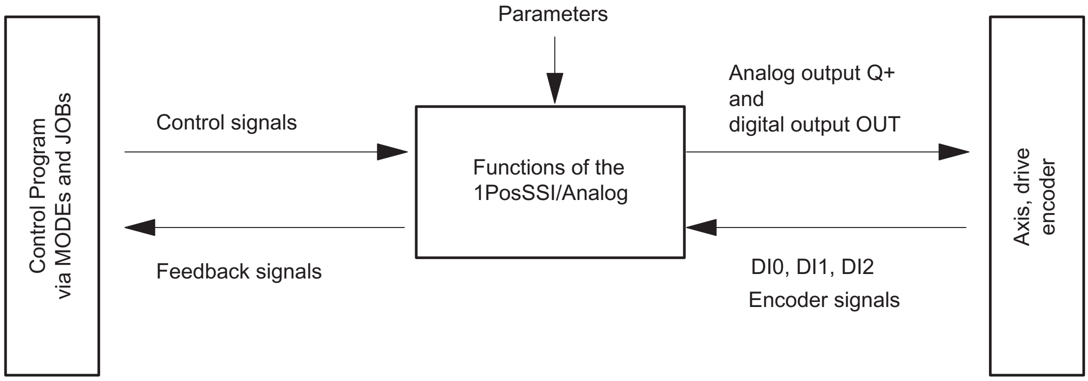


Figure 6-4 How the 1PosSSI/Analog Works

Interfaces to the Control Program and the Axis

To execute the function, the 1PosSSI/Analog has digital inputs as an interface to the axis, encoder signals for the connection of an encoder, and an analog and a digital output to control the drive.

You can modify and monitor the types of motion (MODES) and functions (JOBs) with your control program using control signals and feedback signals.

See also

Parameter List (Page 298)

Principle

What You Do	Response of the 1PosSSI/Analog
Provide the control interface with data depending on the MODE. Check the POS_ACK feedback bit is at 0	
Switch the START control bit from 0 to 1	The 1PosSSI/Analog sets the feedback bit POS_ACK = 1 and POS_DONE = 0. You can tell from this that the start has been detected by the 1PosSSI/Analog and when POS_ERR = 0, the MODE is executed. The MODE is not executed when POS_ERR = 1.
Switch the START control bit from 1 to 0	The 1PosSSI/Analog sets the feedback bit POS_ACK = 0
	In the case of a stop, the reference point run, and absolute and relative positioning, 1PosSSI/Analog sets the feedback bit POS_DONE = 1 when the MODE is completed without errors. When POS_ERR = 1 the MODE is terminated with an error.
Only when POS_ACK=0 can you start a new MODE. If you start when a MODE is running, the 1PosSSI/Analog takes on the new motion and executes a change of direction, if necessary.	

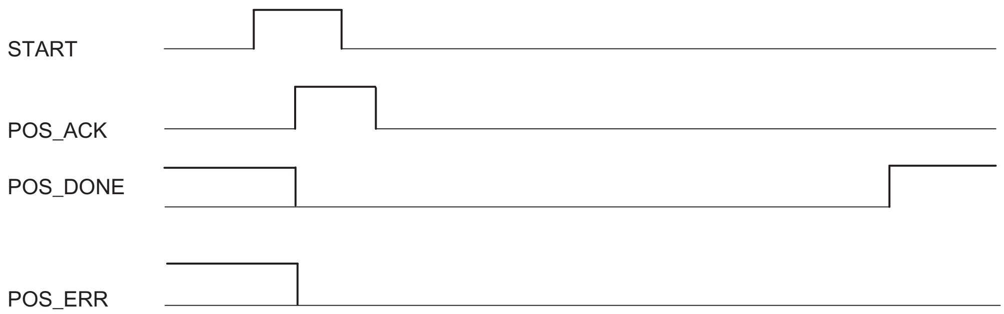


Figure 6-5 Control and Feedback Signals with MODEs

Principle

What You Do	Response of the 1PosSSI/Analog
Provide the control interface with data corresponding to the JOB. Check the JOB_ACK feedback bit is at 0	
Switch the JOB_REQ control bit from 1 to 0	The 1PosSSI/Analog sets the feedback bit JOB_ACK = 1 You can tell from this that activation has been detected by the 1PosSSI/Analog and when JOB_ERR = 0, the JOB is executed. • When a reference signal is evaluated, the 1PosSSI/Analog sets the SYNC = 0 feedback bit at the same time. • In the case of the latch function, the 1PosSSI/Analog sets the feedback bit LATCH_DONE = 0 at the same time. • All the other JOBs are thus executed. The JOB is not executed when JOB_ERR = 1.
Switch the JOB_REQ control bit from 1 to 0	The 1PosSSI/Analog sets the feedback bit JOB_ACK = 0
	When a reference signal is evaluated, the 1PosSSI/Analog sets the feedback bit SYNC = 1 when the function has been executed. In the case of the latch function, the 1PosSSI/Analog sets the feedback bit LATCH_DONE = 1 when the function has been executed.
Only when JOB_ACK=0 can you activate a new JOB again.	

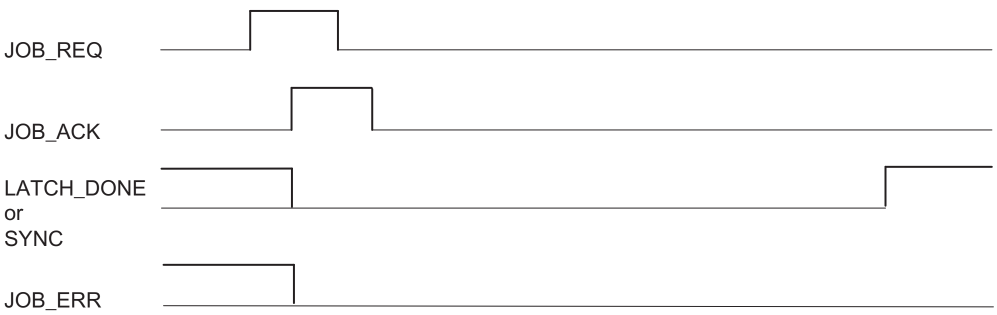


Figure 6-6 Control and Feedback Signals with JOBs

6.6.2 Axis, Drive and Encoder

Evaluation of the Encoder Signals

The 1PosSSI/Analog evaluates the encoder value supplied by the SSI encoder directly in increments and forms the actual value in increments (actual value = encoder value).

The actual value lies in the encoder range from
0 to (number of rotations * number of increments) -1.

The 1PosSSI/Analog generates an overrun or underrun of the actual value at the limits of the operating range. You specify the encoder range with the parameters for the number of rotations and number of increments. The maximum encoder range is 4096x4096 increments.

Reversal of the direction of rotation

You can use the parameter for the reversal of the direction of rotation to adapt the direction of rotation of the encoder to that of the drive and the axis.

Controlling the Drive

You assign parameters how the drive is to be controlled using the Function DO parameter.

If you select Output, the following applies: The control is bipolar. The drive is controlled using the analog output QV+/M_{ana} ±10 V to +10 V. You can use the digital output OUT as you wish. You can read the status of the OUT digital output from the feedback interface, with a delay that corresponds to the updating rate.

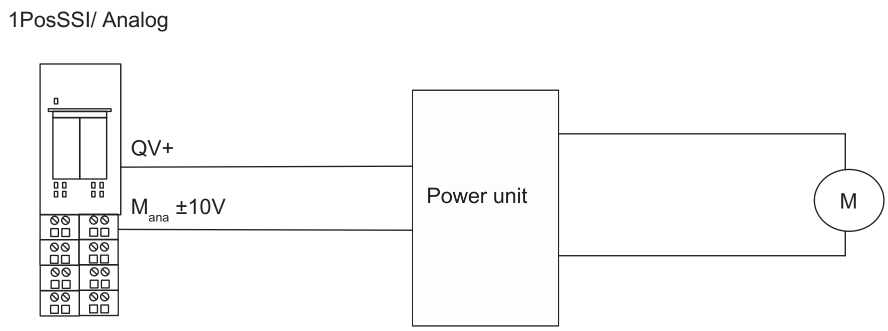


Figure 6-7 Schematic Diagram of the Bipolar Control of a Drive

If you select **Direction**, the following applies: The control is **unipolar**. The drive is controlled using the analog output QV+/M_{ana} with 0 V to +10 V.

The 1PosSSI/Analog controls the direction using the OUT digital output.

You can read the status of the OUT digital output from the feedback interface, with a delay that corresponds to the updating rate.

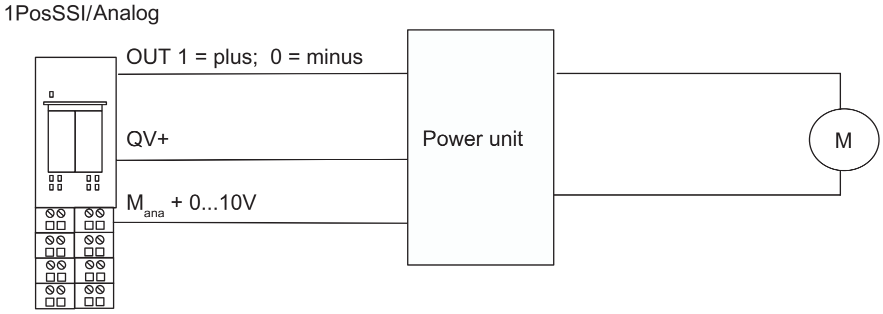


Figure 6-8 Schematic Diagram of the Unipolar Control of a Drive

Changing the Voltage for Rapid Feed and Creep Feed

The default setting for rapid feed is 10 V and the default setting for creep feed is 1 V. You can only change these settings using JOBs 5 and 6.

After the 1PosInc/Analog starts up or after parameter assignment with changed parameters, the values are accepted from the parameters.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

If you have selected a greater voltage for creep feed than for rapid feed, there will be acceleration at the switchover point from rapid feed to creep feed.

Parameters	Meaning	Value range	Default setting
Drive			
Adapt direction	If you adjust the direction, this results in the polarity reversal of your drive	• Off • On	Off
Function DO	**Output:** Your drive is controlled by the analog output using ±10 V. You control the OUT digital output using the CTRL_DO control bit. **Direction:** Your drive is controlled by the analog output using 0 V to +10 V. The direction for your drive is set by the 1PosSSI/Analog using the OUT digital output. Plus direction: OUT = 1 Minus direction: OUT = 0	• Output • Direction	Output
Switch-off	Use this parameter to determine the course of the voltage after the switch-off point. It is only effective in the relative and absolute positioning modes. Directly: The voltage is set directly to 0 V at switch-off point. Ramp: As of switch-off point, voltage is reduced to 0 V using the ramp.	• Directly • Ramp	Directly
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100

Parameters	Meaning	Value range	Default setting
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000
Acceleration T_{acc} in ms	Time required for a change in voltage via a ramp from 0 V to10 V. At 0 ms acceleration is without a ramp.	0 - 65 535	10000
Deceleration T_{dec} in ms	Time required for a change in voltage via a ramp from 10 V to 0 V. At 0 ms deceleration is without a ramp.	0 - 65 535	10000

Displaying the Status of the Run

You can read the status of the run from the feedback interface from byte 0, bits 5 and 6. This status display is possible in the absolute and relative positioning MODEs.

Table 6-3 Interpretation of Bits 5 and 6

Bit 5	Bit 6	Meaning	Corresponding Number in Figure
0	0	Quiet state or run completed	0
0	1	Acceleration to rapid feed or run with rapid feed	1
1	0	Deceleration to creep feed or run with creep feed	2
1	1	Deceleration to 0 V	3

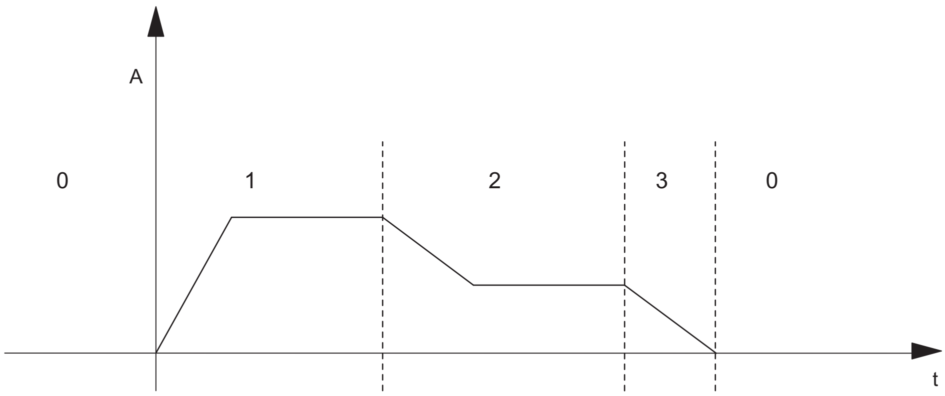


Figure 6-9 Schematic Diagram of the Status of the Run

Effect of the Hardware Limit Switches

The two digital inputs (DI0 and DI1) are evaluated by the 1PosSSI/Analog as hardware limit switches:

- DI0 is the minus limit switch and limits the operating range in the minus direction.
- DI1 is the plus limit switch and limits the operating range in the plus direction.

You can assign parameters to the hardware limit switches separately as break contacts or make contacts.

The hardware limit switches are evaluated with linear axes and rotary axes.

Only the hardware limit switch that lies in the direction in which the drive is being moved is evaluated.

This enables you to move away from a hardware limit switch without additional error acknowledgment by moving in the other direction if you reach or overrun a hardware limit switch.

The current signal level of the digital inputs is displayed in the feedback interface, delayed by the update rate.

You can see from the following table what effect the hardware limit switches have in the individual MODEs:

<table>
<tr><th>MODE</th><th>Effect of the Hardware Limit Switches</th></tr>
<tr><td>Search for Reference</td><td>The 1PosSSI/Analog automatically reverses the direction using deceleration and acceleration when a hardware limit switch is reached.</td></tr>
<tr><td>Inching</td><td rowspan="3">The motion of the axis is halted at the hardware limit switch with the output of 0 V on the analog output, and the feedback bit POS_ERR is reported.</td></tr>
<tr><td>Absolute Positioning</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Starting on the hardware limit switch

Direction	Response of the 1PosSSI/Analog
Starting into the operating range	The 1PosSSI/Analog starts the specified MODE.
Starting away from the operating range	The POS_ERR=1 feedback bit is set.

6.6.3 Effect of the Directional Enables

Description

Using control bits DIR_M and DIR_P, you can enable control of the drive in the corresponding direction:

- With DIR_M = 1 you can move in the minus direction.
- With DIR_P = 1 you can move in the plus direction.

Interrupting and Continuing the Run

If you reset the relevant directional enable during a run, the motion of the axis is halted by deceleration to 0 V at the analog output, and the run is interrupted.

If you set the relevant directional enable again, the run is continued.

6.6.4 Stop (MODE 0)

Definition

If you start MODE 0, the 1PosSSI/Analog stops the current run by deceleration to 0 V at the analog output, and the run is completed (POS_ERR = 0, POS_DONE = 1).

A run terminated with MODE 0 cannot be continued. To put the axis into motion again, you start a new MODE.

Control Signals: Stop

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
</table>

Feedback Signals: Stop

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK

Completing/Interrupting a Run

If you parameterized and activate MODE 0

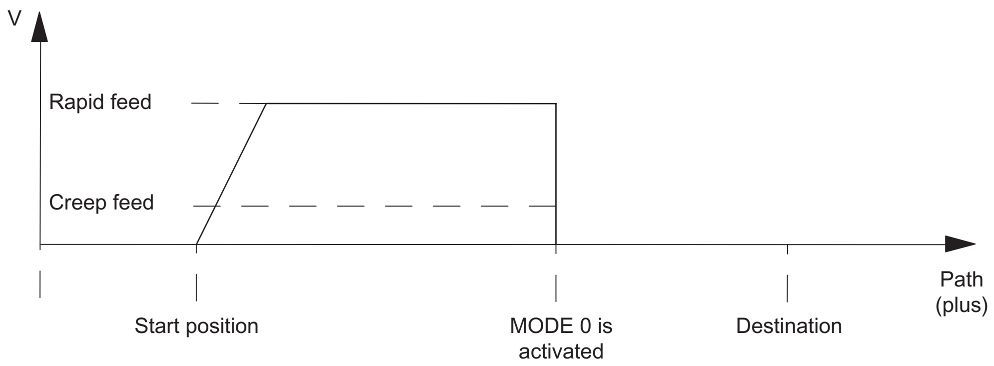


Figure 6-10 Interrupting the Run by Switching Off: Directly

If you parameterized "Ramp" at switch-off and activate MODE 0

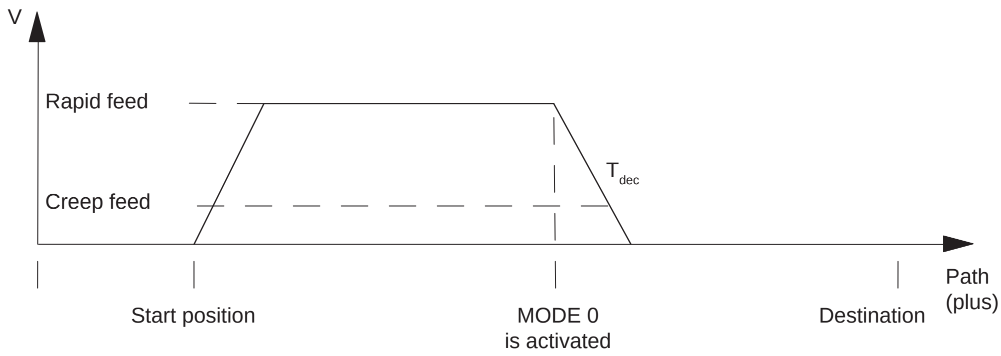


Figure 6-11 Interrupting the Run by Switching Off: Ramp

6.6.5 Inching (MODE 1)

Definition

You use inching mode to control the drive directly in a particular direction using the DIR_M or DIR_P control bits.

When you start MODE 1, the 1PosSSI/Analog moves the drive with the set voltage for inching mode (from the control interface) in the specified direction (control bits DIR_M or DIR_P).

You stop the drive by decelerating to 0 V by setting the control bits DIR_P = 0 and DIR_M = 0.

You can change direction using deceleration or acceleration.

You can also activate inching on an unsynchronized axis (feedback bit SYNC = 0) or when there is a pending encoder error (feedback bit ERR_ENCODER = 1) or without an encoder connected.

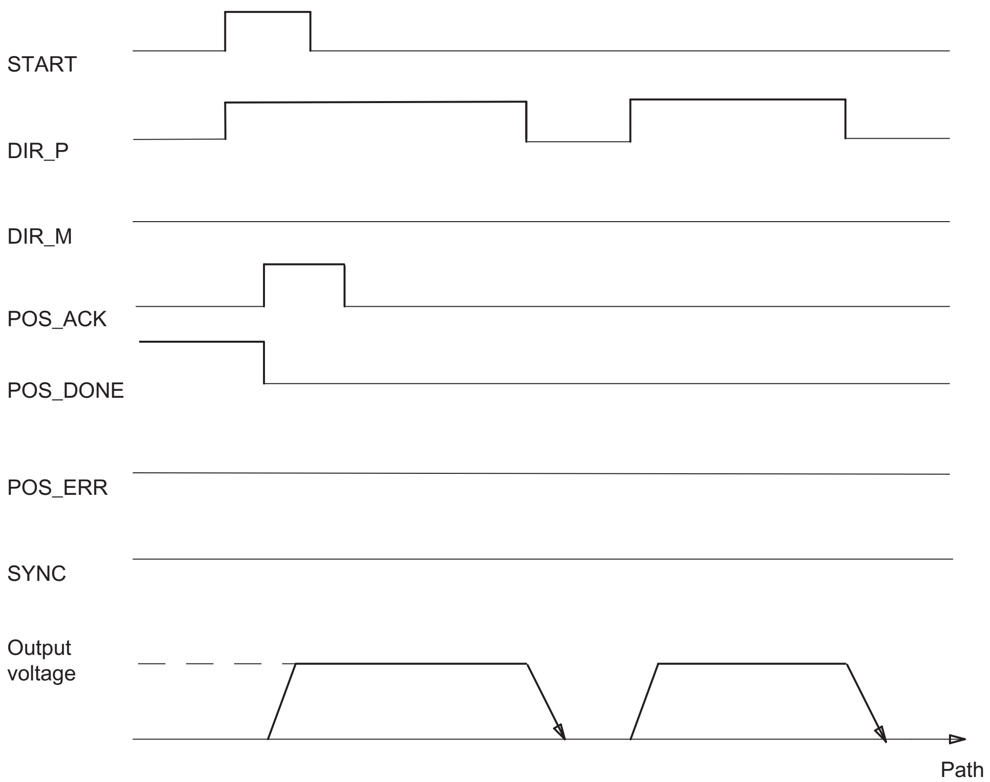


Figure 6-12 Execution of Inching

Control Signals: Inching

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Voltage for inching
(0 to 32 511)</td></tr>
</table>

Feedback Signals: Inching

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Inching: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the parameter for the reversal of the direction of rotation and adapting the direction of the drive.
	Voltage for inching >32 511 or < 0	

6.6.6 Absolute Positioning (MODE 5)

Definition

With absolute positioning, the 1PosSSI/Analog moves the drive toward absolute destinations. To do this, the axis must be synchronized.

Supply the control interface with the destination, and start MODE 5 with the necessary directional enable (DIR_M, DIR_P). The 1PosSSI/Analog moves the drive towards the destination with the set voltage for rapid feed. At the switchover point, the 1PosSSI/Analog decelerates from rapid to creep feed. At the switch-off point, the 1PosSSI/Analog completes the run either directly or via the ramp depending on the parameter assignment.

If you start during a current run, the 1PosSSI/Analog executes any required change in direction using deceleration or acceleration.

Linear axis

The 1PosSSI/Analog determines the direction from which the destination is to be approached. You must set the necessary directional enable (DIR_M, DIR_P) to start. You can also set both enables.

Rotary axis

You determine the direction in which the destination is approached by selecting the directional enable (DIR_M, DIR_P):

Control bits DIR_P and DIR_M	Direction
DIR_P = 1 DIR_M = 0	The destination is approached in the plus direction.
DIR_P = 0 DIR_M = 1	The destination is approached in the minus direction.
DIR_P = 1 DIR_M = 1	The destination is approached by the shortest route. The 1PosSSI/Analog determines the direction from which the destination is to be approached.

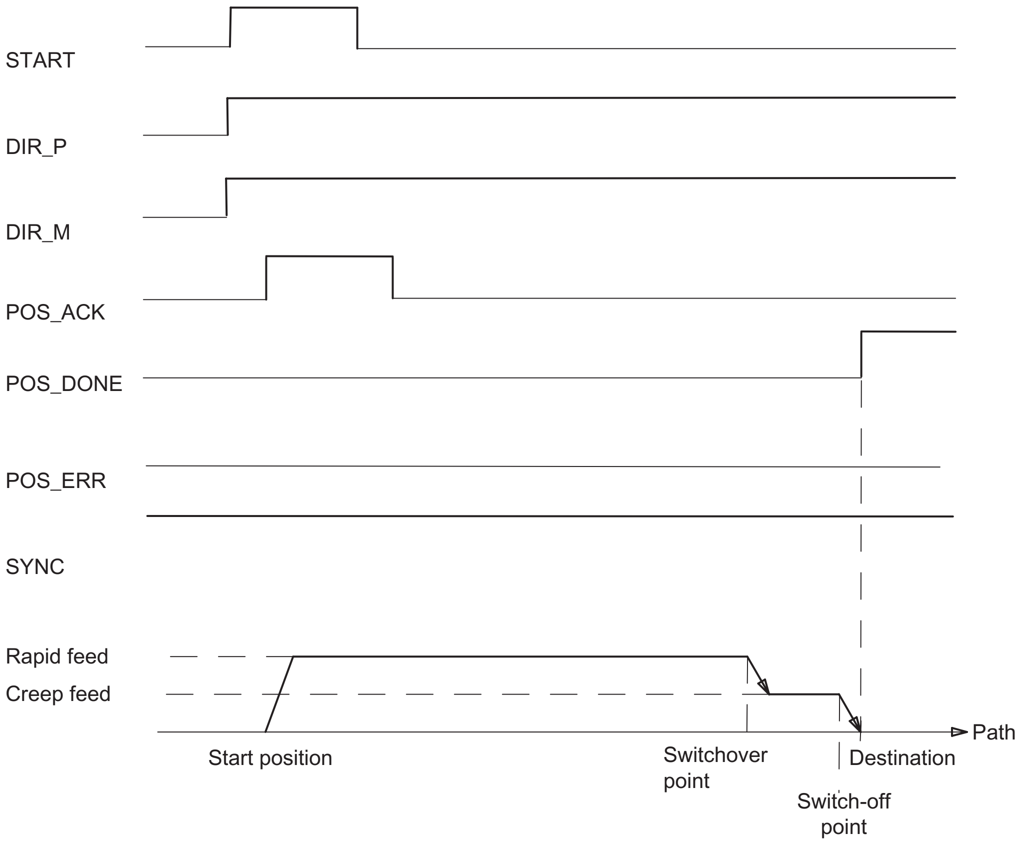


Figure 6-13 Execution of Absolute Positioning (Switch-Off Parameter: Ramp)

Control Signals: Absolute Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Destination
(0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Absolute Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Parameters: Absolute Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000

Absolute positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0	
8	Absolute positioning: destination ≥ end of rotary axis	
9	Absolute positioning was terminated because JOB 9 was initiated	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

6.6.7 Relative Positioning (MODE 4)

Definition

In relative positioning the 1PosSSI/Analog moves the drive from the start position in a specified direction for a certain preset distance.

Supply the control interface with the distance to be traveled, and start MODE 4, specifying the direction (DIR_M or DIR_P). The 1PosSSI/Analog moves the drive towards the destination for a certain distance with the set voltage for rapid feed. At the switchover point, the 1PosSSI/Analog switches from rapid to creep feed. At the switch-off point, the 1PosSSI/Analog completes the run either directly or via the ramp depending on the parameter assignment.

If you start during a current run, the 1PosSSI/Analog executes any required change in direction using deceleration or acceleration.

The preset distance is not checked by the 1PosSSI/Analog. This means that more than one revolution may be involved with rotary axes.

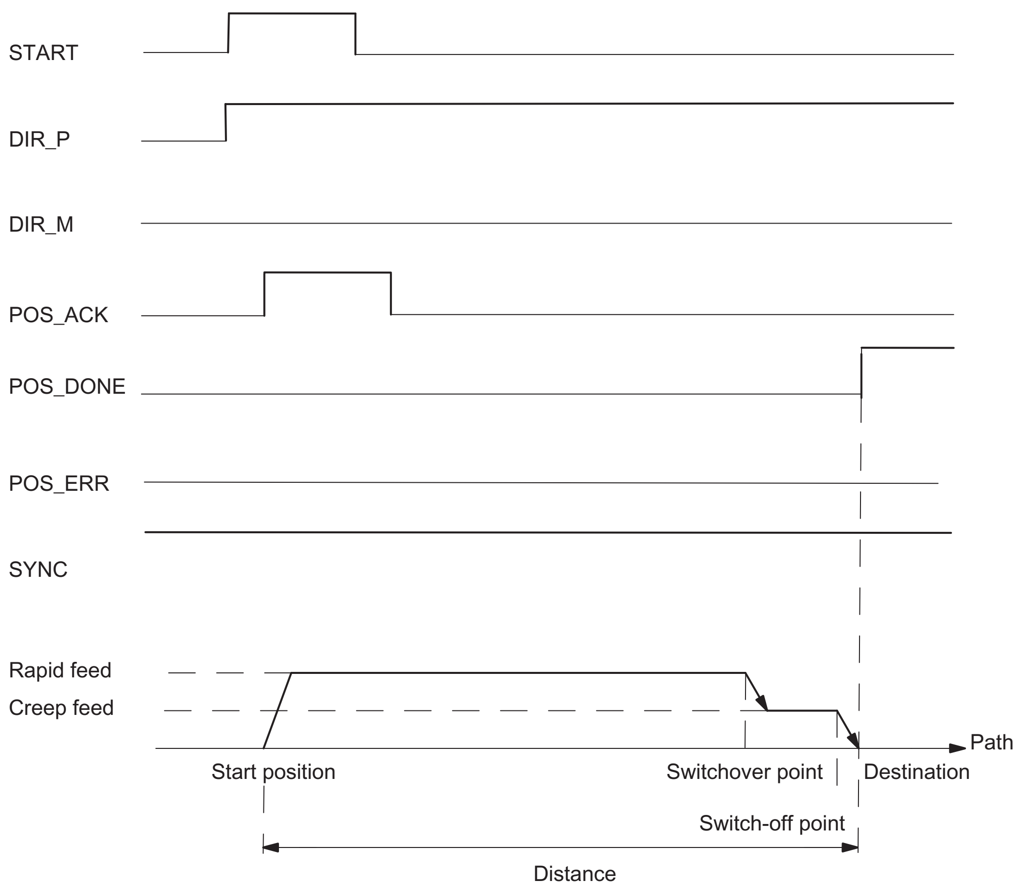


Figure 6-14 Execution of Relative Positioning

Control Signals: Relative Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Distance
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Relative Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (0 to encoder range - 1)

Parameters: Relative Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	It defines the distance to the destination at which the drive decelerates from creep feed to 0. If the switch-off difference ≥ switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000

Relative Positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
3	ERR_ENCODER is displayed	Check the encoder wiring
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

6.6.8 Canceling JOB Processing (JOB 0)

Definition

If you activate JOB 0, the 1PosSSI/Analog responds as follows:

- It cancels the current JOB 9 (reference signal evaluation)
- It cancels the current JOB 10 (latch function)
- It sets a pending JOB_ERR = 0.

You can activate JOB 0 whatever the state of the axis.

Effect on the MODEs

MODEs are not affected by JOB 0.

Control Signals: Canceling JOB processing

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
</table>

Feedback Signals: Canceling JOB processing

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

6.6.9 Setting the Actual Value (JOB 1)

Definition

Setting an actual value assigns new coordinates to the actual value displayed. This moves the operating range to a different range on the axis and synchronizes the axis.

At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

The 1PosSSI/Analog sets the preset actual value coordinates to the actual value displayed in the feedback interface and sets the feedback bit SYNC = 1.

Effect on the MODEs

MODE	What Happens
Inching	-
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ switch-off difference The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot. • Distance to the destination ≤ the switchover difference The switchover point is reached or overshot; there is an immediate deceleration from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > switchover difference The drive is accelerated again up to the voltage for rapid feed.
Relative Positioning	The preset distance continues to be traversed.

Control Signals: Setting of Actual Value

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Actual value coordinates
(0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Setting of Actual Value

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting an Actual Value: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
34	Setting an Actual Value: actual value coordinates ≥ end of rotary axis	

6.6.10 Moving the Encoder Range (JOB 2)

Definition

When the encoder range is moved, the encoder value is adjusted so that the actual value displayed corresponds to the real actual value. Before this can be done, any active run must be terminated.

Supply the control interface with the offset, and activate JOB 2.

You calculate the offset as follows:

Offset = displayed actual value - real actual value

If the offset is negative, proceed as follows:

Offset = displayed actual value - real actual value+ (number of rotations * number of increments)

The 1PosSSI/Analog accepts the preset offset and displays the real actual value coordinates at the feedback interface.

Effect on the MODEs

MODEs are not affected by JOB 2.

Control Signals: Move Encoder Range

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 2 = Move encoder range</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Offset
(0 to encoder range)</td></tr>
</table>

Feedback Signals: Move Encoder Range

Address	Assignment
Bytes 1 to 3	Actual value (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Move Encoder Range: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	
33	With JOB 2: Offset not in encoder range	

6.6.11 Changing the Switch-Off Difference (JOB 3)

Definition

Changing the switch-off difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switch-off difference, and activate JOB 3.

The 1PosSSI/Analog accepts the preset switch-off difference.

The switch-off difference remains valid until the parameter assignment of the PosSSI/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">Distance to the destination ≤ switch-off difference
The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switch-Off Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switch-off difference
0 to 16 777 215</td></tr>
</table>

Feedback Signals: Change Switch-Off Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 296)

6.6.12 Changing the Switchover Difference (JOB 4)

Definition

Changing the switchover difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switchover difference, and activate JOB 4.

The 1PosSSI/Analog accepts the preset switchover difference. The switchover difference remains valid until the parameter assignment of the PosSSI/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>–</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">The following responses are possible:
• Distance to the destination ≤ the switchover difference
Switchover difference is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference).
• Distance to the destination > the switchover difference
The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switchover Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 4 = Change the switchover difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switchover difference
0 to 16 777 215</td></tr>
</table>

Feedback Signals: Change Switchover Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 296)

6.6.13 Changing the Voltage for Rapid Feed (JOB 5)

Definition

By changing the voltage for rapid feed (JOB 5) you can adjust the speed for rapid feed.

Supply the control interface with the new rapid feed voltage and activate JOB 5.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

The 1PosSSI/Analog accepts the preset voltage. When the drive runs in rapid feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new rapid feed voltage. The voltage remains valid until the parameter assignment of the PosSSI/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">When the drive runs in rapid feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new rapid feed voltage.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Changing the Voltage for Rapid Feed

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 5 = Change the voltage for rapid feed</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Voltage for rapid feed
0 to 32 511 in S7 analog value format</td></tr>
</table>

Feedback Signals: Changing the Voltage for Rapid Feed

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Changing the Voltage for Rapid Feed: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
40	Voltage setting Rapid feed speed > 32 511	

See also

CPU/Master Stop and RESET State (Page 296)

6.6.14 Changing the Voltage for Creep Feed (JOB 6)

Definition

By changing the voltage for creep feed (JOB 6) you can adjust the speed for creep feed.

Supply the control interface with the new creep feed voltage and activate JOB 6.

You can set a voltage between 0 V and 11.7589 V (including overrange) in S7 analog value format (you will find a detailed explanation in the *Distributed I/O Device* manual).

The 1PosSSI/Analog accepts the preset voltage. The voltage remains valid until the parameter assignment of the PosSSI/Analog is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Inching</td><td>-</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">When the drive runs in creep feed, it accelerates/decelerates at the set acceleration/deceleration rate to the new creep feed voltage.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Changing the Voltage for Creep Feed

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 6 = Change the voltage for creep feed</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Voltage for creep feed
0 to 32 511 in S7 analog value format</td></tr>
</table>

Feedback Signals: Voltage for creep feed

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Voltage for Creep Feed: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
41	Voltage setting creep feed speed > 32 511	

See also

CPU/Master Stop and RESET State (Page 296)

6.6.15 Changing the Acceleration Tacc (JOB 7)

Definition

By changing T_{acc} (JOB 7) you can adjust the acceleration.

Supply the control interface with the new acceleration value and activate JOB 7.

The 1PosSSI/Analog accepts the new acceleration value. The acceleration remains valid until the parameter assignment of the 1PosSSI/Analog is changed.

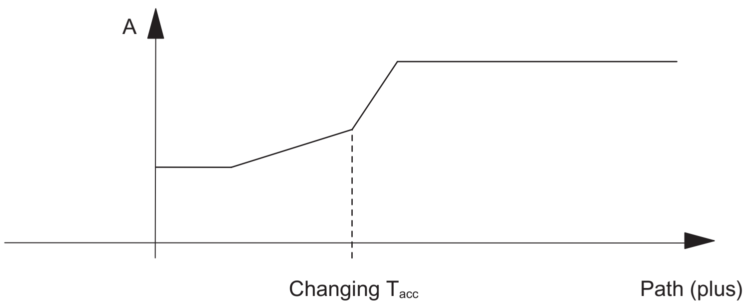


Figure 6-15 Changing the Acceleration T_{acc} During Acceleration

Effect on the MODEs

MODE	What Happens
Inching	-
Absolute Positioning	The currently valid acceleration is replaced by the new value. The new acceleration is immediately effective.
Relative Positioning	

Control Signals: Changing the acceleration (T_{acc})

Address	Assignment					
Byte 4	Bits 4.7 to 4.4 :					
	Bit	7	6	5	4	JOB 7 = Changing the acceleration T_{acc}
		0	1	1	1	
	Bit 0: JOB_REQ					
Bytes 5 to 7	Acceleration T_{acc} in ms (65 535)					

Feedback Signals: Changing the acceleration (T_{acc})

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Changing the acceleration T_{acc}: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
42	Changing the acceleration T_{acc} > 65 535	

See also

CPU/Master Stop and RESET State (Page 296)

6.6.16 Changing the Deceleration Tdec (JOB 8)

Definition

By changing T_{dec} (JOB 8) you can adjust the deceleration.

Supply the control interface with the new deceleration value and activate JOB 8.

The 1PosSSI/Analog accepts the new deceleration value. The acceleration remains valid until the parameter assignment of the 1PosSSI/Analog is changed.

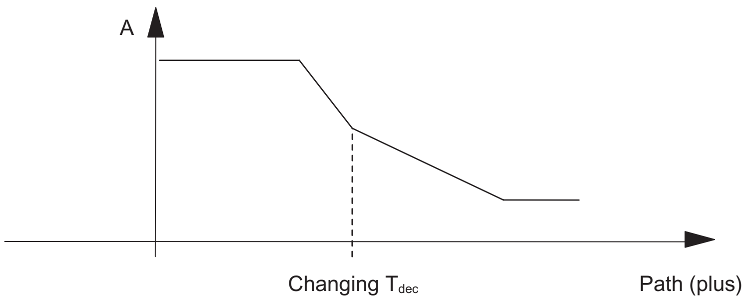


Figure 6-16 Changing the Deceleration T_{dec} During Deceleration

Effect on the MODEs

MODE	What Happens
Inching	The currently valid deceleration is replaced by the new value. The new deceleration is immediately effective.
Absolute Positioning	
Relative Positioning	

Control Signals: Changing the deceleration (T_{dec})

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 8 = Changing the Deceleration T_{dec}</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Deceleration T_{dec} in ms (0 to 65 535)</td></tr>
</table>

Feedback Signals: Changing the deceleration (T_{dec})

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Changing the deceleration T_{dec}: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
43	Deceleration T_{dec} > 65 535	

See also

CPU/Master Stop and RESET State (Page 296)

6.6.17 Latch Function (JOB 10)

Definition

The latch function allows you to store the actual value at an edge at the DI2 digital input. You can use this function, for example, to detect edges or measure lengths.

Supply the control interface with the desired edge, and activate JOB 10.

If the 1PosSSI/Analog detects the preset edge at the DI2 digital input, it stores the associated actual value, displays it as a feedback value and sets the feedback bit LATCH_DONE = 1.

You can then activate the latch function again.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Latch Function

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">Bit 1: Latch at negative edge at DI2
Bit 0: Latch at positive edge at DI2</td></tr>
</table>

Feedback Signals: Latch Function

Address	Assignment
Byte 4	Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value: Actual value at the edge at DI2 (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Latch Function: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
36	Latch Function: Edge selection unknown	

6.6.18 Setting the Monitoring of the Direction of Rotation (JOB 11)

Definition

By setting monitoring of the direction of rotation you can adjust the monitoring of the direction of rotation of the 1PosSSI/Analog to suit the load and mechanical conditions.

Monitoring of the direction of rotation is always active. The 1PosSSI/Analog detects whether the direction of rotation of the drive and the encoder is the same. Direction of rotation monitoring will tolerate different directions for the drive and the encoder up to the preset path difference. If the preset path difference is exceeded, the 1PosSSI/Analog POS_ERR =1.

Unless you have activated JOB 11, double the switch-off difference is used from the parameters as the path difference. JOB 3 (which changes the switch-off difference) does not affect the path difference for the purpose of monitoring of the direction of rotation.

Supply the control interface with the new path difference, and activate JOB 11.

The 1PosSSI/Analog accepts the preset path difference for the monitoring of the direction of rotation.

The preset path difference for the monitoring of the direction of rotation remains valid until the parameter assignment of the 1PosSSI/Analog is changed.

Disabling the Monitoring of the Direction of Rotation

Monitoring of the direction of rotation is disabled when the path difference is 0.

Effect on the MODEs

MODEs are not affected by JOB 11.

Control Signals: Setting the Monitoring of the Direction of Rotation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0</td></tr>
<tr><td>Bytes 6, 7</td><td colspan="6">Path difference for monitoring of the direction of rotation
(0 to 65 535)</td></tr>
</table>

Feedback Signals: Setting the Monitoring of the Direction of Rotation

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting the Monitoring of the Direction of Rotation: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
38	Monitoring of the direction of rotation Path difference > 65 535	

See also

CPU/Master Stop and RESET State (Page 296)

Error Detection/Diagnostics (Page 291)

6.6.19 Displaying Current Values (JOB 15)

Definition

You can display the following values in the feedback interface as feedback values:

- Residual distance
- Actual speed
- Causes of errors for POS_ERR and JOB_ERR

The 1PosSSI/Analog presets the residual distance as a feedback value.

The 1PosInc/Analog continuously displays the actual value in the feedback interface irrespective of the selected feedback value.

This moves the operating range to another part of the axis and synchronizes the axis.

The selected feedback value remains valid until the parameter assignment of the 1PosSSI/Analog is changed.

Displaying Current Values and the Latch Function

If you activate the latch function, the 1PosSSI/Analog sets a feedback value of 0 and displays the actual value at the edge at the DI2 digital input.

You can only activate JOB 15 again after the latch function has terminated.

Residual distance

The 1PosSSI/Analog calculates the distance to the destination as the residual distance in the absolute positioning and relative positioning MODEs. As long as the actual value is before the destination, the residual distance remains positive. It becomes negative once the destination is overshot. The residual distance is 0 in the other MODEs.

The 1PosInc/Analog displays the residual distance with a sign between -8 388 608 and 8 388 607 increments. Negative values are displayed in twos complement. If the actual residual distance is beyond these limits, the limit value is displayed.

Actual speed

The 1PosSSI/Analog calculates the actual speed as an encoder value change in increments per 10 ms. It displays these between 0 and 16 777 215.

Causes of errors for POS_ERR and JOB_ERR

The 1PosSSI/Analog displays the causes of errors for POS_ERR and JOB_ERR as well as the MODE and JOB entered in the control interface.

Effect on the MODEs

MODEs are not affected by JOB 15.

Control Signals: Display Current Values

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 15 = Display current values</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0: Residual distance
1: Actual speed
2: Causes of errors for POS_ERR and JOB_ERR</td></tr>
</table>

Feedback Signals: Display Current Values

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	In accordance with the selected feedback value: • With a residual distance of: - 8 388 608...8 388 607 • With an actual speed of: 0...16 777 215 • With causes of errors for POS_ERR and JOB_ERR – Byte 5: Causes of Errors for POS_ERR – Byte 6: Causes of Errors for JOB_ERR – Bits 7.3 to 7.0: MODE (= bits 0.7 to 0.4 from the control signals) – Bits 7.7 to 7.4: JOB (= bits 4.7 to 4.4 from the control signals)

Display current values: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
35	Display current values: Selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	

See also

CPU/Master Stop and RESET State (Page 296)

Error Detection/Diagnostics (Page 291)

6.6.20 Error Detection/Diagnostics

Parameter assignment error

Parameter assignment error	Response of the 1PosSSI/Analog
Causes: • The 1PosSSI/Analog cannot identify existing parameters as its own. • The slot of the 1PosSSI/Analog you have configured does not match the setup. • Impermissible value for parameter for number of increments. • Impermissible value for parameter for number of rotations. • Number of increments * number of rotations is greater than 4096x4096. What to Do: • Check the configuration, physical setup and parameter assignment.	• The 1PosSSI/Analog is not assigned parameters and cannot execute its functions. • Generate channel-specific diagnostics

External Errors

Short circuit of the sensor supply	Response of the 1PosSSI/Analog

Causes:
• Short circuit of the encoder supply made available at terminals 2 and 10
What to Do:
• Check the wiring and correct the short circuit.
• Acknowledge the error with the EXTF_ACK control bit.
	• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs.
	  – Analog output QV+ is set to 0 V
	  – Digital output OUT:
	  If the direction is assigned parameters for the DO function, the digital output OUT=0 is set
	  – Feedback bit POS_ERR = 1
	  – Feedback bit POS_DONE = 0
	• Feedback bit ERR_ENCODER=1
	• Feedback bit SYNC = 0
	• Generate channel-specific diagnostics
	• Waits for error acknowledgment EXTF_ACK
	• Inching MODE is not affected by this error.

Wire Break/Short Circuit of the Encoder Signals	Response of the 1PosSSI/Analog
Prerequisite: • To detect errors of the encoder signals, you must enable the "Encoder signal diagnostics" parameter. Causes: • Wire break or short circuit of the encoder signals at terminals 1, 5 or 4, 8. • The parameters for the SSI encoder do not correspond to the encoder connected. What to Do: • Check the wiring and correct the short circuit. • Compare the parameter assignment with the technical specifications of the encoder. • Acknowledge the error with the EXTF_ACK control bit.	• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs. – Analog output QV+ is set to 0 V – Digital output: if the direction is assigned parameters for the DO function, the digital output OUT=0 is set – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER = 1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error.

Errors in the Control of MODEs and JOBs

POS_ERR	Response of the 1PosSSI/Analog
Causes: • Certain requirements or conditions have not been met at the start of a MODE	• The MODE started is not executed. • The current run is stopped. – Analog output is slowed down to 0 V using the ramp. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0
JOB_ERR	**Response of the 1PosSSI/Analog**
Causes: • Certain requirements or conditions have not been met at the activation of a JOB	• The activated JOB is not executed. – Feedback bit JOB_ERR = 1

Generating a Channel-Specific Diagnostics

In the event of parameter assignment errors (short circuit of the sensor supply or open circuit/short circuit of the sensor signals), the 1PosSSI/Analog generates a channel-specific diagnostics for the connected CPU/master. To do this, you must enable the Group Diagnostics parameter (see the *Distributed I/O Device* manual).

Error Acknowledgment EXTF_ACK

You must acknowledge the corrected errors (short circuit of the sensor supply and open circuit/short circuit of the sensor signals).

What You Do	Response of the 1PosSSI/Analog
	Feedback bit ERR_ENCODER=1
Your control program detects the set feedback bit ERR_ENCODER. Execute your application-specific error response. Eliminate the cause of the error.	
Switch the EXTF_ACK control bit from 0 to 1	The 1PosSSI/Analog sets the feedback bit ERR_ENCODER = 0. This tells you that the cause has been eliminated and acknowledged. If ERR_ENCODER = 1, the cause of the error is not yet eliminated.
Switch the EXTF_ACK control bit from 1 to 0	
In the case of constant error acknowledgment (EXTF_ACK = 1) or at CPU/Master Stop, the 1PosSSI/Analog reports the errors as soon as they are detected and deletes them as soon as they have been eliminated.	

Parameters

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	An encoder error (ERR_ENCODER) or parameter assignment error results in a channel-specific diagnostics if group diagnostics is enabled.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals D, /D and C, /C are monitored for short circuit and wire break.	• On • Off	On

Feedback Messages

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Causes of Errors for POS_ERR

Table 6-4 Causes of Errors for POS_ERR

Error Number	Cause	Remedy
1	MODE unknown	Permissible MODEs are: • MODE 0 • MODE 1 • MODE 4 • MODE 5
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	Eliminate the encoder error.
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1 Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0 Relative Positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
8	Absolute positioning: Destination ≥ encoder range	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the parameters for the reversal of the direction of rotation and adaptation of the direction.

Causes of Errors for JOB_ERR

Table 6-5 Causes of Errors for JOB_ERR

Error Number	Meaning	Remedy
21	JOB unknown	Permissible JOBs are: • JOB 0 • JOB 1 • JOB 2 • JOB 3 • JOB 4 • JOB 5 • JOB 6 • JOB 7 • JOB 8 • JOB 10 • JOB 11 • JOB 15
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	

Error Number	Meaning	Remedy
33	With JOB 2: Offset not in encoder range	
34	Setting an Actual Value: Actual value coordinates ≥ encoder range	
35	Display current values: Selection unknown	
36	Latch Function: Edge selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	
38	Monitoring of the direction of rotation Path difference > 65 535	
40	Voltage setting Rapid feed speed > 32 511	
41	Voltage setting creep feed speed > 32 511	
42	Changing the acceleration T_{acc} > 65 535	
43	Deceleration T_{dec} > 65 535	

6.7 CPU/Master Stop and RESET State

Behavior at CPU-Master-STOP

Behavior at CPU-Master-STOP	Response of the 1PosSSI/Analog
• Due to power-off of the CPU/DP master or • Due to power-off of the IM 151/ IM 151 FO or • Due to failure of DP transmission or • Due to change from RUN to STOP	• The current run is stopped. – Analog output QV+ is set to 0 V – Digital output: if the direction is assigned parameters for the DO function, the digital output OUT=0 is set • Feedback bit POS_ERR = 0 • Feedback bit POS_DONE = 1

Exiting the CPU-Master-STOP Status

Exiting the CPU-Master-STOP Status	Response of the 1PosSSI/Analog
• At power-on of the CPU/DP master or • At power-on of the IM 151/ IM 151 FO or • After failure of the DP transmission or • After a change from STOP to RUN	• The feedback interface of the 1PosSSI/Analog remains current. • The axis remains synchronized, and the actual value is current. • The following changed values remain valid: – Voltage for rapid feed – Voltage for creep feed – Acceleration (T_{acc}) – Deceleration T_{dec} – Switch-off and switchover difference – The path difference for the monitoring of the direction of rotation remains valid. • An initiated JOB 10: Latch function remains active. • The feedback bit selected with JOB 15 is current.

RESET State of the 1PosSSI/Analog

RESET Status of the 1PosSSI/Analog and Changing the Parameters of the 1PosSSI/Analog	Response of the 1PosSSI/Analog
• Changing the parameters of the 1PosSSI/Analog and downloading the parameter assignment and configuration of the ET 200S station to the CPU/DP master or • Power-on at the power module of the 1PosSSI/Analog or • Inserting the 1PosSSI/Analog in an energized state	• The axis is not synchronized and the actual value = 0. • The voltage for rapid feed is set to 10 V. • The voltage for creep feed is set to 1 V. • Acceleration (T_{acc}) and deceleration (T_{dec}) are transferred from the parameters. • The switch-off and switchover differences are applied from the parameters. • The path difference for the monitoring of the direction of rotation is set at double the switch-off difference. • JOB 10: Latch function is not active. • The residual distance is displayed as a feedback value.

6.8 Parameter List

Overview

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	An encoder error (ERR_ENCODER) or parameter assignment error results in a channel-specific diagnostics if group diagnostics is enabled.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals D, /D and C, /C are checked for short circuit and wire break.	• On • Off	On
Encoder and Axis			
Encoder	Selection of single-turn encoder (SSI 13 bit) or multiturn encoder (SSI 25 bit)	• SSI-13Bit • SSI-25Bit	SSI-13Bit
Transmission rate		• 125 kHz • 250 kHz • 500 kHz • 1 MHz	125 kHz
Number of increments		4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192	4096
Number of rotations	Only relevant in the case of multiturn encoders. In the case of single-turn encoders, the 1PosSSI/Analog sets the number of rotations to 1.	4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096	4096
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder	• Off • On	Off
Axis type	Selection of linear axis without limits or rotary axis with overrun/underrun with encoder range	• Linear • Rotary	Linear
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 reducing cam	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact

Parameters	Meaning	Value range	Default setting
Drive			
Adapt direction	If you adjust the direction, this results in the polarity reversal of your drive	• Off • On	Off
Function DO	**Output:** Your drive is controlled by the analog output using ±10 V. You control the OUT digital output using the CTRL_DO control bit. **Direction:** Your drive is controlled by the analog output using 0 V to +10 V. The direction for your drive is set by the 1PosSSI/Analog using the OUT digital output. Plus direction: OUT=1 Minus direction: OUT=0	• Output • Direction	Output
Switch-off	Use this parameter to determine the course of the voltage after the switch-off point. Directly: The voltage is set directly to 0 V at switch-off point. Ramp: As of switch-off point, voltage is reduced to 0 V using the ramp.	• Directly • Ramp	Directly
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no slowdown from rapid feed to creep feed.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed.	0 - 65 535	1000
Acceleration T_{acc} in ms	Time required for a change in voltage via a ramp from 0 V to10 V. At 0 ms acceleration is without a ramp.	0 - 65 535	10000
Deceleration T_{dec} in ms	Time required for a change in voltage via a ramp from 10 V to 0 V. At 0 ms deceleration is without a ramp.	0 - 65 535	10000

6.9 Control and Feedback Signals

Assignment of the Control Interface

Address	Assignment					
Byte 0	Bits 0.7 to 0.4 stand for the MODEs					
	Bit	7	6	5	4	
		0	0	0	0	MODE 0 = Stop
		0	0	0	1	MODE 1 = Inching
		0	1	0	0	MODE 4 = Relative Positioning
		0	1	0	1	MODE 5 = Absolute Positioning
	Bit 3: CTRL_DO Bit 2: DIR_M Bit 1: DIR_P Bit 0: START					
Bytes 1 to 3						
		In MODE 1= inching: voltage for inching				
		at MODE 4 = Relative positioning: distance				
		at MODE 5 = Absolute positioning: target				
Byte 4	Bits 4.7 to 4.4 stand for the MODEs					
	Bit	7	6	5	4	
		0	0	0	0	JOB 0 = Cancel JOB processing
		0	0	0	1	JOB 1 = Set the actual value
		0	0	1	0	JOB 2 = Move encoder range
		0	0	1	1	JOB 3 = Change the switch-off difference
		0	1	0	0	JOB 4 = Change the switchover difference
		0	1	0	1	JOB 5 = Change the voltage for rapid feed
		0	1	1	0	JOB 6 = Change the voltage for creep feed
		0	1	1	1	JOB 7 = Changing the acceleration T_{acc}
		1	0	0	0	JOB 8 = Changing the Deceleration T_{dec}
		1	0	1	0	JOB 10 = Latch function
		1	0	1	1	JOB 11 = Set the monitoring of the direction of rotation
		1	1	1	1	JOB 15 = Display current values
	Bit 3: EXTF_ACK Bit 2: Reserve = 0 Bit 1: Reserve = 0 Bit 0: JOB_REQ					

Address	Assignment

Bytes 5 to 7	Corresponding to the selected JOB:
	• With JOB 1= actual value coordinates
	• With JOB 2= encoder range
	• With JOB 3 = switch-off difference
	• With JOB 4 = switchover difference
	• With JOB 5 = voltage for rapid feed
	• With JOB 6= voltage for creep feed
	• With JOB 7 = acceleration T_{acc}
	• With JOB 8 = deceleration T_{dec}
	• With JOB 10
	  – Byte 5: Bit 0 = latch at positive edge at DI2
	  – Byte 5: Bit 1 = latch at negative edge at DI2
	• With JOB 11 = path difference for direction of rotation monitoring
	• With JOB 15
	  – Byte 5: 0 = Residual distance
	  – Byte 5: 1 = Actual speed
	  – Byte 5: 2 = error information

Assignment of the Feedback Interface

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bits 6 and 5: Status phase of the run Bit 4: STATUS DO Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value
Byte 4	Bit 7: Reserve Bit 6: STATUS DI 2 reduction cams Bit 5: STATUS DI 1 limit switch plus Bit 4: STATUS DI 0 limit switch minus Bit 3: Reserve Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file [1)] (hardware catalog\PROFIBUS DP\ other field devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
[1]Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

6.10 Technical Specifications of the 1PosSSI/Analog

Overview

Technical Data of the 1PosSSI/Analog	
Dimensions and weight	
Dimension W x H x D (mm)	30 x 81 x 52
Weight	Approx. 65 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
Rated load voltage L+ • Range • P1	24 VDC 20,4 ... 28.8 V Yes
Isolation • Between the backplane bus and the I/O	 Yes
Sensor supply • Output voltage • Output current	 L+ -0.8 V Maximum 500 mA, short-circuit proof
Current consumption • From the backplane bus • From the load voltage L+ (no load)	 Max. 10 mA Max. 50 mA
Power dissipation	Typ. 2 W
Data for the digital inputs	
Input voltage • Rated value • 0 signal • 1 signal	 24 V DC -30 V to 5 V DC 11 V to 30 V
Input current • 0 signal • 1 signal	 ≤ 2 mA (perm. leakage current) 9 mA (typ.)
Minimum pulse width	500 μs
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	50 m

Technical Data of the 1PosSSI/Analog	
Data on the Digital Output	
Output voltage • Rated value • 0 signal • 1 signal	 DC 24 V ≤ 3 V ≥ L+ -1 V
Output current • 0 signal (leakage current) • 1 signal – Rated value – Permitted range	 ≤ 0.3 mA 0.5 A 7 mA to 0.6 A
Switch rate • Resistive load • Inductive load • Lamp load	 100 Hz 2 Hz ≤ 10 Hz
Lamp load	≤5 W
Output delay (resistive load, output current 0.5 A) • At 0 to 1 • At 1 to 0	 typ. 150 µs typ. 150 µs
Short-circuit protection of the output	Yes
Threshold on	0.7 A to 1.8 A
Inductive extinction	Yes; L+ -(55 to 60 V)
Digital input control	Yes
Cable lengths • Unshielded • Shielded	 600 m 1000 m
Data for the Analog Output	
Resolution (including overrange)	± 10 V/13 bits + sign
Settling time • For resistive load • For capacitive load • For inductive load	 0.1 ms 0.5 ms 0.5 ms
Length of cable	
• Shielded	Max. 100 m
Suppression of interference, limits of error	
Operational limit (in the entire temperature range, with reference to the output range)	± 0.4 %
Basic error limit (operational limit at 25°C with reference to output range)	± 0.2 %
Temperature error (with reference to the output range)	± 0.01 %/K
Linearity error (with reference to the output range)	± 0.02 %
Repeatability (in settled state at 25 °C, with reference to the output range)	± 0.05 %
Output ripple (with reference to output range, bandwidth 0 to 50 kHz)	± 0.02 %

Technical Data of the 1PosSSI/Analog		
Data for selecting an actuator		
Output range (rated value)	±10 V	
Load resistance • For capacitive load • Short-circuit protection • Short-circuit current	Min. 1.0 kΩ max. 1 µF yes ca. 25 mA	
Destruction limit against voltages/currents applied from outside • Voltage to the outputs against MANA • Current	 Max. 15 V continuous; 75 V for max. 1 s (pulse duty factor 1/20) Max. DC 50 mA	
Connection of actuators • 2-conductor connection	 No compensation for surge impedance	
Encoder input SSI		
Position detection	Absolute	
Differential signals for SSI data and SSI clock	According to RS422	
Data transmission rate and cable lengths for absolute encoders (twisted-pair and shielded)	• 125 kHz max. 320 m • 250 kHz max. 160 m • 500 kHz max. 60 m • 1 MHz max. 20 m • 2 MHz max. 8 m	
Age of the encoder value • Max. (2 * frame runtime) + 64 µs • Min. frame runtime		
Frame runtime • 125 kHz • 250 kHz • 500 kHz • 1 MHz • 2 MHz Monoflop time [1]	13 Bit 112 µs 56 µs 28 µs 14 µs 7 µs 64 µs	25 Bit 208 µs 104 µs 52 µs 26 µs 13 µs
Status, Diagnostics		
Change in actual value (up)	UP LED (green)	
Change in actual value (down)	DN LED (green)	
Status display positioning in operation	LED POS (green)	
Status display DI0 (minus hardware limit switch)	LED 9 (green)	
Status display DI1 (plus hardware limit switch)	LED 13 (green)	
Status display DI2 (reducing cam)	LED 14 (green)	
Group error on the 1PosSSI/Analog	SF LED (red)	
Diagnostic information	Yes	
Response Times		
Update rate for feedback messages Response time at the switchover or switch-off point Latch response time	2 ms Output delay + Frame runtime + 30 µs Typ. 400 µs + age of encoder value	
[1]Encoders with a monoflop time greater than 64 µs, cannot be used with the 1PosSSI/Analog.		

1PosUniversal/Digital 7

7.1 Product overview

Order number

6ES7 138-4DL00-0AB0

Features

- Positioning module 1 Pos Universal (1 Pos U) for controlled positioning by means of rapid/creep feed
  - Switchover and switch-off difference can be set using your control program
- An incremental encoder with 5 V differential signals or 24 V signals
  - With or without zero mark
  - Quadruple evaluation of the encoder signals
  - Dosing operation (1-fold evaluation only of the encoder signal A)
- SSI Encoder
  - 13-bit Singleturn
  - 25-bit Multiturn
- Usable axis types
  - Linear axis
  - Rotary axis
- Operating range: 0 - 16 777 215 steps
- The drive can be controlled via 3 digital outputs:
  - Travel minus / rapid feed
  - Travel plus / creep feed
  - Rapid/creep feed or travel plus/minus
- 3 digital inputs can be used for the following:
  - Minus hardware limit switch
  - Plus hardware limit switch
  - Reducing cam/latch input

- **Diagnostics**
  - Encoder monitoring
  - Load voltage monitoring
- **Firmware update** 1)
  - In order to extend the functionality and eliminate errors, firmware updates can be downloaded to the operating system memory of the 1PosU by means of the STEP 7 HW Config software.

Note

Caution

When the firmware update is started, the old firmware is deleted. If the firmware update is interrupted or aborted for any reason, the 1PosU can subsequently no longer function. Start the firmware update again and wait until it has been completed successfully.

- **Information function** 1)
  - Hardware version
  - Firmware version
  - Serial number

1) The function is only possible if the used header module supports the required system services

Configuration

In order to configure the 1PosU use one of the following

- A DDB file (http://www.ad.siemens.de/csi/gsd) or
- STEP 7 as from Version V5.3 SP 2 or with the HSP (hardware support package from the Internet) as from STEP 7 Version V5.2 SP 1

7.2 Brief Instructions on Commissioning the 1PosU

Introduction

Using the example of inching mode, this brief introduction shows you a functioning application in which you get to know and check the hardware software involved in a positioning operation of your 1PosU.

Prerequisites for the Example

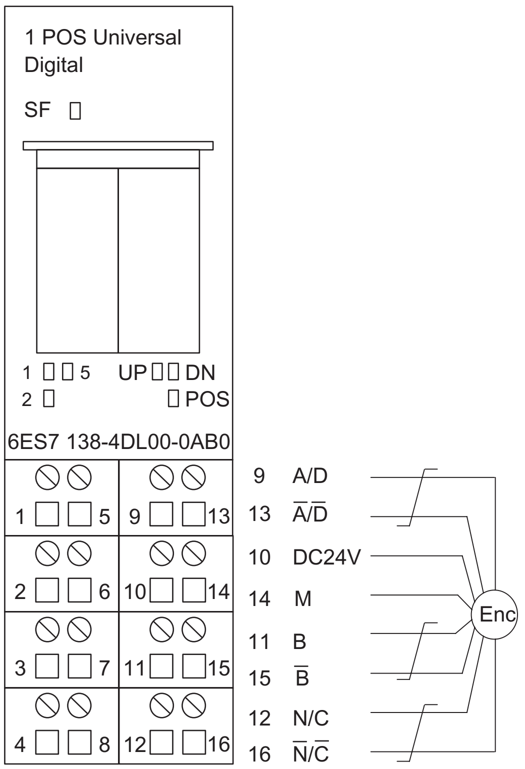
The following prerequisites must be fulfilled:

- You must have put an ET 200S station on an S7 station with a DP master into operation.
- You have a TM-E30S44-01 terminal module (6ES7 193-4CG20-0AA0 or 6ES7 193-4CG30-0AA0)
  - A 1PosU
  - A position encoder (incremental encoder with 5 V differential signals, incremental encoder with 24 V signals or SSI encoder)
  - A drive with power control (e.g. a pole-changing motor with contactor switching)
  - A 24 VDC power supply
  - The necessary wiring material

Installation, Wiring, and Fitting

Install and wire the TM-E30S44-01 terminal module. Insert the 1PosU in the terminal module (you can find detailed instructions in the *Distributed I/O Device* manual).

Table 7-1 Terminal assignment of the 1PosU

Terminal assignment	View
	

Remarks			
Connection of the Switches and the Drive: Terminals 1-8		**Connection of the Position Encoder with 5 V Differential Signals or 24 V Signals: Terminals 9-16**	
1: IN0	Minus limit switch	9: A / D	Track A / Data from the SSI encoder
5: IN1	Plus limit switch	13: /A / /D	
2: IN2	Reducing cam; latch signal	10: 24 V DC	Power supply for the position encoder
6: 24 V DC	Supply for the switches	14: M	
3: OUT0	Travel minus or rapid feed	11: B	Track B
7: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2	15: /B	
4: OUT1	Travel plus or creep feed	12: N / C	Track N / SSI clock (clock line)
8: OUT2	Rapid/creep feed and travel plus/minus	16: /N / /C	

Configured with STEP 7 via HW Config

You begin by adapting the hardware configuration to your existing ET 200S station.

1. Open the relevant project in SIMATIC Manager.
2. Call the HWConfig configuration table in your project.
3. From the hardware catalog select the entry 1Pos Universal (1 PosU) in accordance with the position encoder (incremental encoder with 5 V differential signals, incremental encoder with 24 V signals or SSI encoder) used by you. The number 6ES7 138-4DL00-0AB0 appears in the info text. Drag the entry to the slot at which you have installed your 1PosU.
4. Double-click this number to open the "Properties for the 1PosU" dialog box.

   On the Addresses tab, you will find the addresses of the slot to which you have dragged the 1PosU. Make a note of these addresses for subsequent programming.

   On the Parameters tab, you will find the default settings for the 1PosU in accordance with the position encoder type selected by you. If you are not connecting any limit switches to the 1PosU, set the DI0 limit switch minus and DI1 limit switch plus parameters to "make contact".
5. Save and compile your configuration, and download the configuration in STOP mode of the CPU by choosing "PLC -> Download to Module".

Note

Ensure that the configured position encoder type agrees with the position encoder really wired to your module and that it has been wired in accordance with the previous figure.

If this is not observed, the module can be damaged.

Integrating into the user program

Integrate the following FC 101 block in your user program (in OB 1, for example). This block requires the DB1 data block with a length of 16 bytes. In the example below, the start is initiated by setting memory bit 30.0 (in the plus direction) or 30.1 (in the minus direction) with the programming device. You select rapid or creep feed using memory bit 30.2.

```
STL                                         Explanation
Block: FC101
         L          PID 256                 //Load feedback values from the 1PosU
         T          DB1.DBD8
         L          PID 260
         T          DB1.DBD12
         L          DB1.DBB8                //Display status bits
         T          MB8
         L          DB1.DBB12
         T          MB9
         L          DB1.DBD8                //Display actual value
         DU         DW#16#FFFFFF
         T          MD12
         AN         M30.0
         SPB        DIRM
         L          B#16#13                 //Travel in plus direction
         T          DB1.DBB0                //(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
         SPA        CTRL
DIRM:    AN         M30.1
         SPB        STOP
         L          B#16#15                 //Travel in minus direction
         T          DB1.DBB0                //(START=1, DIR_P=1, DIR_M=0, SPEED=0, TIPPEN=1)
         SPA        CTRL
STOP:    L          B#16#0                  //Stop
         T          DB1.DBB0
         A          DB1.DBX8.2
         SPB        CTRL
CTRL:    AN         DB1.DBX8.0              //Set/delete START depending on POS_ACK
         =          DB1.DBX0.0
         A          M30.2                   //Set SPEED
         =          DB1.DBX0.3
         L          DB1.DBD0                //Transfer control values to the 1PosSSI/Digital
         T          PAD256
         L          DB1.DBD4
         T          PAD260
```

Test

Start inching mode, and monitor the associated feedback.

1. Using "Monitor/Modify Variables", check the actual value and the status bits POS_ACK, POS_ERR, POS_DONE, ERR_ENCODER and ERR_2L+.
2. Select the "Block" folder in your project. Choose the "Insert > S7 Block > Variable Table menu command to insert the VAT 1 variable table, and then confirm with OK.
3. Open the VAT 1 variable table, and enter the following variables in the "Address" column:
   – MD12 (actual value)
   – M8.0 (POS_ACK)
   – M8.1 (POS_ERR)
   – M8.2 (POS_DONE)
   – M8.7 (ERR_ENCODER)
   – M9.7 (ERR_2L+)
   – M30.0 (inching in plus direction)
   – M30.1 (inching in minus direction)
   – M30.2 (SPEED; 0 = creep feed; 1 = rapid feed)
4. Choose "PLC > File Connect To > Configured CPU" to switch to online.
5. Choose "Variable > Monitor" to switch to monitoring.
6. Switch the CPU to RUN mode.

Result

The following table shows you which activity triggers which result.

Activity	Result
Switch the CPU to RUN mode.	• The POS_ACK status bit is deleted • The POS_ERR status bit is deleted • The POS_DONE status bit is set
Check the wiring of the load voltage 2L+	
Check the feedback bit ERR_2L+	• If ERR_2L+ = 1, correct the wiring of the load voltage 2L+
Check the encoder wiring	
Check the feedback bit ERR_ENCODER	• If ERR_ENCODER = 1, correct the wiring of the encoder
Inching in the plus direction:	
Start inching mode in the plus direction by setting memory marker 30.0 ("Variable > Modify >")	**The status bit POS_ERR = 0, the UP LED lights up** • The POS_ACK status bit is set • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the DN LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the plus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct
Inching in the minus direction:	
Start inching mode in the plus direction by setting memory marker 30.1 ("Variable > Modify >")	**The status bit POS_ERR = 0, the DN LED lights up** • The POS_ACK status bit is set • The POS_ERR status bit is deleted • The POS_DONE status bit is deleted • The actual value is continuously updated • The POS LED lights up • The reversal of the direction of rotation you have parameterized and the wiring of the encoder and drive are correct **The status bit POS_ERR = 1, the UP LED lights up** Check the reversal of the direction of rotation you have parameterized and the wiring of the encoder and the drive
Check the speed of the drive in the minus direction	
Control the speed using memory marker 30.2 ("Variable > Modify >")	• If the drive moves at the correct speed, your wiring is correct

7.3 Terminal Assignment Diagram

Wiring Rules

If a position encoder with 5 V differential signals is used, the wires to the terminals 9 and 13, the terminals 12 and 16, as well as at incremental encoders the wires to the terminals 11 and 15 have to be in twisted pairs and shielded.

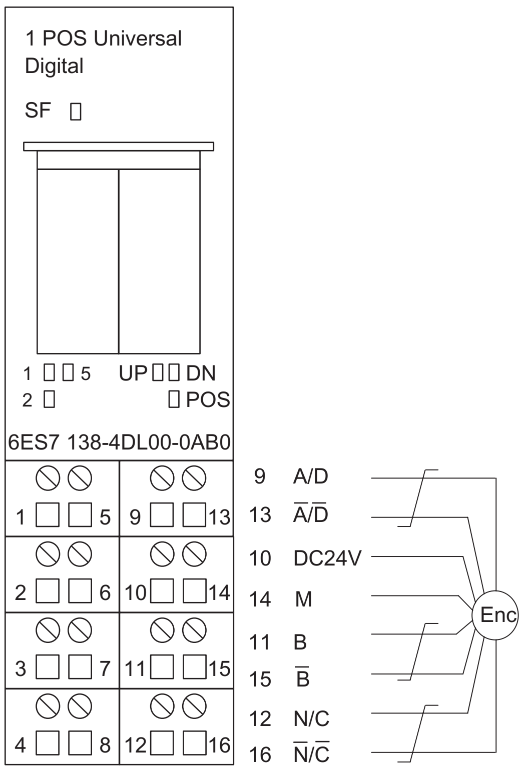
If an incremental encoder with 24 V signal is used, the wires to the terminals 9, 11 and 12 have to be shielded.

The shield must be supported at both ends. You use the shield contact element (Order Number: 6ES7 390-5AA00-0AA0) as a shield support.

Terminal Assignment

The following table shows you the terminal assignment for the 1PosU:

Table 7-2 Terminal Assignment of the 1PosU

Terminal Assignment	View	Remarks			
		**Connection of the Switches and the Drive: Terminals 1-8**		**Connection of the Position Encoder with 5 V Differential Signals or 24 V Signals: Terminals 9-16**	
		1: IN0	Minus limit switch	9: A / D	Track A / Data from the SSI encoder
		5: IN1	Limit switch plus	13: /A / /D	
		2: IN2	Reducing cam; latch signal	10: 24 V DC	Power supply for the position encoder
		6: 24 V DC	Supply for the switches	14: M	
		3: OUT0	Travel minus or rapid feed	11: B	Track B
		7: 2L+	Load voltage infeed for OUT0, OUT1 and OUT2	15: /B	
		4: OUT1	Travel plus or creep feed	12: N / C	Track N / SSI clock (clock line)
		8: OUT2	Rapid/creep feed and travel plus/minus	16: /N / /C	

Connection of Relays and Contactors to the Digital Outputs

Note

Direct connection of inductivities (such as relays and contactors) is possible without external circuiting. If SIMATIC output circuits can be deactivated by additionally installed contacts (for example relay contacts), you have to provide additional overvoltage protection devices at inductivities (see the following example for overvoltage protection).

Overvoltage Protection Example

The following figure shows an output circuit that requires additional overvoltage protection devices. Direct-current coils are wired with diodes or Zener diodes.

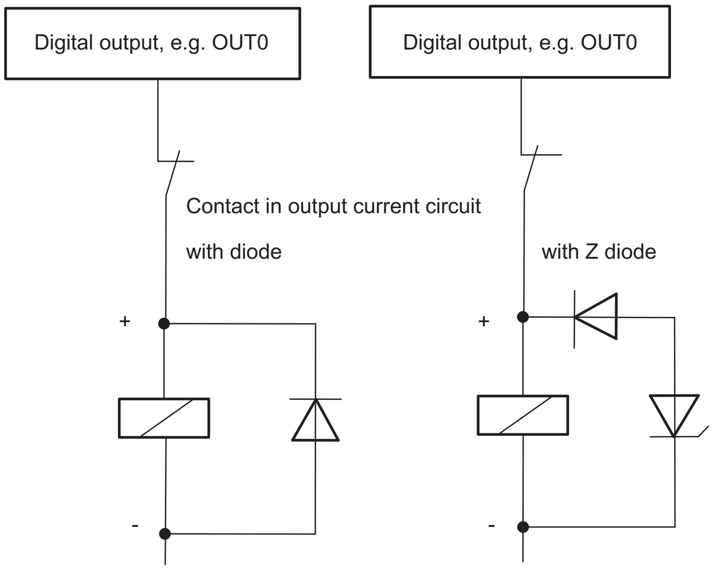


Figure 7-1 Relay Contact in the Output Circuit

7.4 Safety concept

Principle

The following measures are vital to the safety of the system. Install them with particular care, and adapt them to meet the requirements of the system.

Check the measures are effective before the first run.

WARNING

To avoid injury and damage to property, make sure you adhere to the following:

- Install an emergency stop system in keeping with current technical standards (for example, EN 60204, EN 418, etc.).
- Make sure that no one has access to areas of the system with moving parts.
- Install, for example, safety limit switches for the end positions of the axes that switch off the power control system directly.
- Install devices and take steps to protect motors and power electronics.

Setting up a positioning control

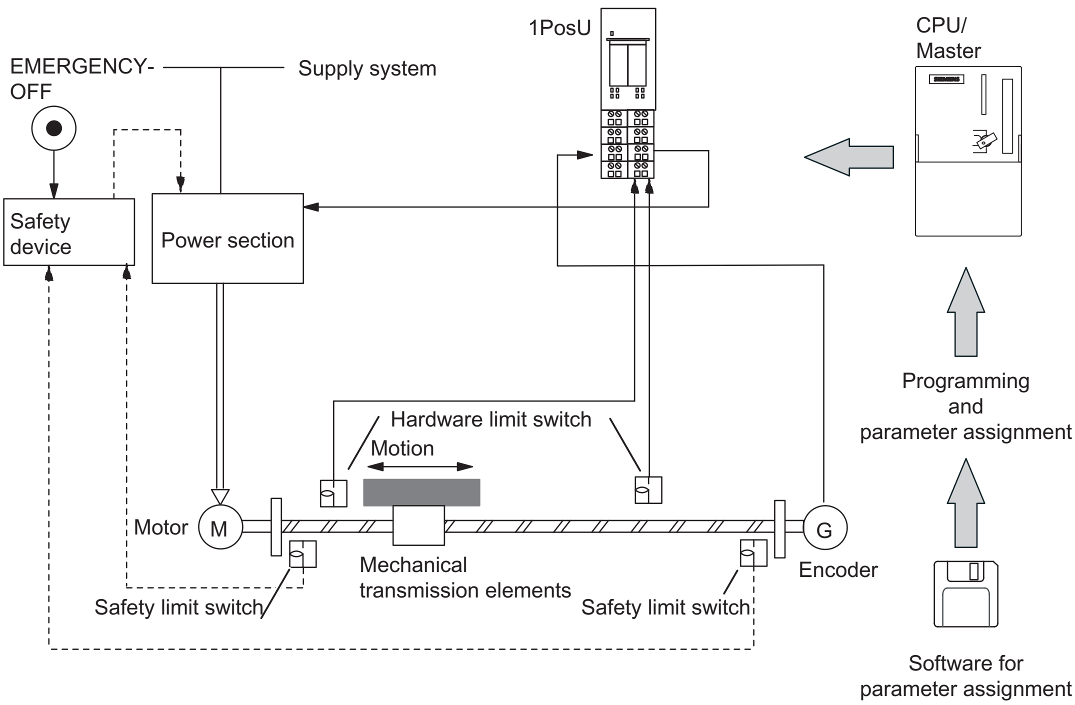


Figure 7-2 Design of a Positioning Control System (Example)

7.5 Fundamentals of Controlled Positioning Using Rapid/Creep Feed

Positioning Operation

From the start position, the target is approached at high speed (rapid feed). At a preset distance from the target (switchover point), there is a change to a lower speed (creep feed). Shortly before the axis reaches the target, again at a preset distance from the target, the drive is switched off (switch-off point).

The drive is controlled via digital outputs for rapid feed or creep feed and the appropriate direction.

To facilitate understanding, the change in speed is illustrated over the path traversed.

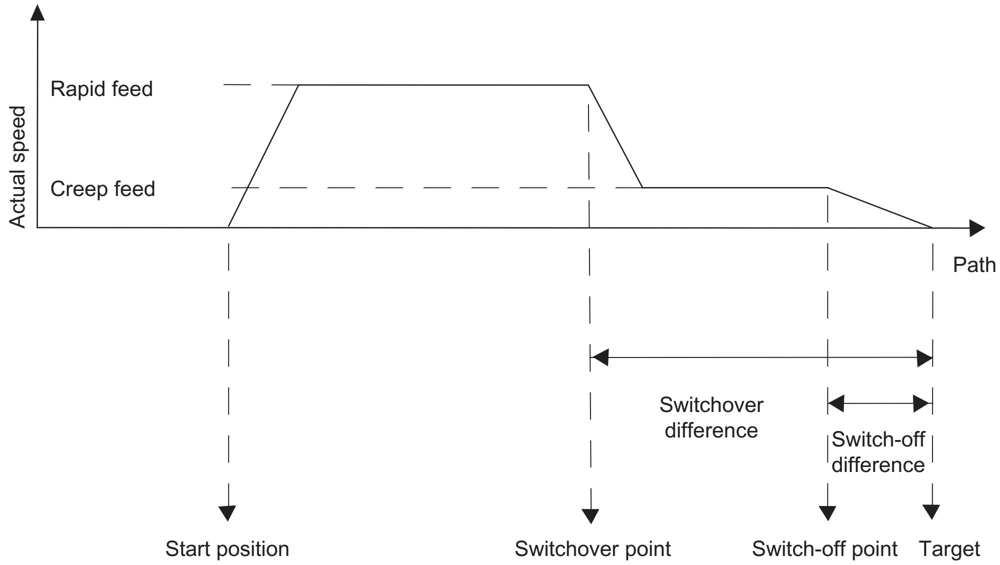


Figure 7-3 Switching points and switching differences

Definitions

Term	Explanation
Operating range	Defines the range, which you set for a particular task by means of the hardware limit switches. At an SSI encoder the operating range is limited additionally by the range covered by the SSI encoder. You enter the encoder range in the parameters for: • Number of increments • Number of rotations Encoder range = Number of rotations * Number of increments Maximum operating range: • Linear axis - max. 0 to (encoder range -1) • Rotary axis from 0 to (encoder range - 1) At an incremental encoder the operating range is limited to: • Max. 0 to 16,777,215 increments at a linear axis • 0 to the assigned parameter end of a rotary axis at a rotary axis
Switchover difference	Defines the distance from the destination at which the drive is switched over from rapid feed to creep feed.
Switchover point	Defines the position at which the drive is switched over from rapid feed to creep feed.
Switch-off difference	Defines the distance from the destination at which the drive is switched off. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no change from rapid feed to creep feed.
Switch-off point	Defines the position at which the drive is switched off. The 1PosU reports the end of the run at this point.
Start position	Defines the position of the drive within the operating range from which the run is started. If the start position is within the switch-off difference, the drive is not triggered. The 1PosU reports the end of the run at this point. If the start position is within the switchover difference, the run is only executed in creep feed mode.
Target XE "Target"	Defines the absolute or relative position of the axis approached during positioning. The destination is the position to be reached on an axis during a run. In the case of an absolute run, you specify the destination directly by means of your control program. In the case of a relative run, the destination is calculated from the start position and the path specified in the control program. If you want to find out how accurately you have reached the destination, you have to compare the actual value with the position specified.
Linear axis XE "Linear axis"	Defines the axis type with a limited operating range. It is limited by the following: • The encoder range • The numeric range that can be represented (0 to 16 777 215 increments) • The hardware limit switch
Rotary axis	Defines the axis type with an infinite operating range. This includes resetting the axis position to 0 after one rotation (assigned parameter end of a rotary axis at an incremental encoder or parameterized encoder range at an SSI encoder).
Minus direction	If the drive moves in the minus direction, the actual value displayed is decreased.
Plus direction	If the drive moves in the plus direction, the actual value displayed is increased.

7.6 Functions of the 1PosU

7.6.1 Overview of the Functions

Overview

The 1PosU offers you the following functions for moving your axis:

- Stop
- Search for Reference
- Inching
- Absolute Positioning
- Relative Positioning

In addition to the different types of motion, the 1PosU also offers functions for:

- Setting of Actual Value
- Move Encoder Range
- Change Switch-Off Difference
- Change Switchover Difference
- Latch Function
- Setting the Monitoring of the Direction of Rotation
- Display Current Values
- Error Detection/Diagnostics
- Behavior at CPU-Master-STOP

Parameters:

Define the variables that depend on the drive, axis, and encoder uniquely in the parameters.

Dosing operation:

If incremental encoders are used, the 1PosU can be used for dosing. Dosing operation is set once in the parameters. In dosing operation the 1PosU only evaluates the encoder signal A (/A). The actual value is incremented at each rising edge.

In dosing operation only the functions inching and relative positioning are available for controlling the digital outputs.

The dosing function itself is triggered by means of the relative positioning function. The dosing quantity is specified during starting by means of the control signals (distance).

At every start the actual value is set to 0 and the digital outputs are controlled as a function of the switchover and switch-off difference.

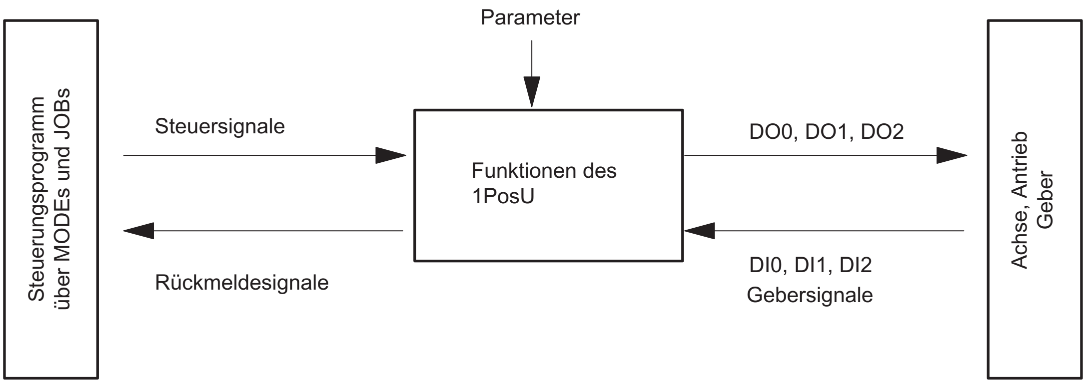


Figure 7-4 How the 1PosU Works

Interfaces to the Control Program and the Axis

To execute the function, the 1PosU has digital inputs as an interface to the axis, encoder signals for the connection to an encoder and digital outputs to control the drive.

You can modify and monitor the types of motion (MODES) and functions (JOBs) with your control program using control signals and feedback signals.

See also

Parameter List (Page 368)

Principle

What You Do	Response of the 1PosU
Provide the control interface with data depending on the MODE. Check the POS_ACK feedback bit is at 0	
Switch the START control bit from 0 to 1	The 1PosU sets the feedback bits POS_ACK = 1 and POS_DONE = 0. You can tell by this that the start has been detected by 1PosU and when POS_ERR = 0, the MODE is executed. The MODE is not executed when POS_ERR = 1.
Switch the START control bit from 1 to 0	The 1PosU sets the feedback bit POS_ACK = 0
	In the case of stopping, the reference point run, absolute and relative positioning, the 1PosU sets the feedback bit POS_DONE = 1 when the MODE is terminated without errors. When POS_ERR = 1 the MODE is terminated with an error.
Only when POS_ACK=0 can you start a new MODE. If you start when a MODE is running, the 1PosU takes on the new motion and executes a change of direction, if necessary.	

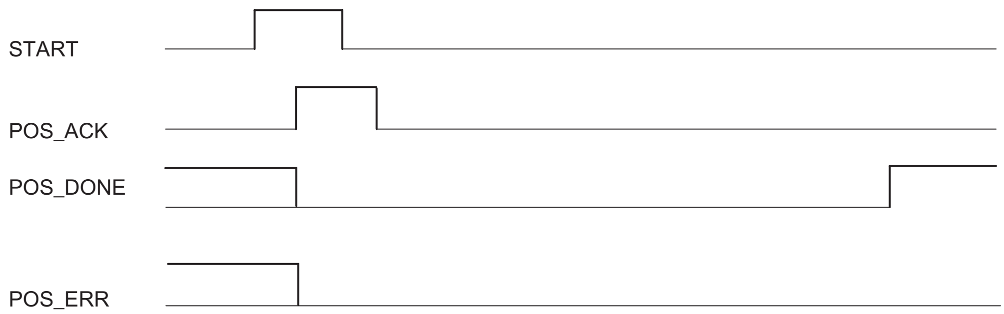


Figure 7-5 Control and Feedback Signals with MODEs

Principle

What You Do	Response of the 1PosU
Provide the control interface with data corresponding to the JOB. Check the JOB_ACK feedback bit is at 0	
Switch the JOB_REQ control bit from 1 to 0	The 1PosU sets the feedback bit JOB_ACK = 1 This indicates that the initiation of the 1PosU has been detected and that the JOB will be executed when JOB_ERR = 0. • In the case of the function for evaluating a reference signal, the 1PosU sets the SYNC = 0 feedback bit at the same time. • In the case of the latch function, the 1PosU sets the feedback bit LATCH_DONE = 0 at the same time. • All the other JOBs are thus executed. The JOB is not executed when JOB_ERR = 1.
Switch the JOB_REQ control bit from 1 to 0	The 1PosU sets the feedback bit JOB_ACK = 0
	When a reference signal is evaluated, the 1PosU sets the feedback bit SYNC = 1 when the function has been executed. In the case of the latch function, the 1PosU sets the feedback bit LATCH_DONE = 1 when the function has been executed.
Only when JOB_ACK = 0 can you activate a new JOB again.	

Figure 7-6 Control and Feedback Signals with JOBs

7.6.2 Axis, Drive and Encoder

Evaluation of the Encoder Signals

The 1PosU evaluates the signals supplied by the position encoder differently depending on the position encoder type:

SSI encoder:

The 1PosU evaluates the encoder value supplied by the SSI encoder directly in increments and forms the actual value in increments (actual value = encoder value).

The actual value lies in the encoder range from 0-(number of rotations * number of increments)-1. The 1PosU generates an overrun or underrun of the actual value at the limits of the operating range.

Incremental encoder:

The 1PosU evaluates the pulses supplied by the position encoder four times and adds them up direction-specifically to form the actual value. You must take the quadruple evaluation into account when you make settings for paths in the parameters and in the control and feedback interfaces:

1 pulse of the incremental encoder corresponds to 4 increments of the 1PosU.

The current value is in the operating range 0 - 16 777 215 increments. The 1PosU generates an overrun or underrun of the actual value at the limits of the operating range.

Incremental encoder at dosing operation:

The 1PosU only evaluates the rising edges of the "Track A" signal and adds them up to form the actual value.

The current value is in the operating range 0 - 16 777 215 increments. The 1PosU creates an overflow of the actual value at the upper limit of the operating range.

Reversal of the direction of rotation

You can use the parameter for the reversal of the direction of rotation to adapt the direction of rotation of the encoder to that of the drive and the axis.

In dosing operation reversal of the direction of rotation is not possible.

Controlling the Drive

The drive is controlled using the 3 digital outputs of the 1PosU.

You can select the speed with the SPEED control bit (SPEED=0 is creep feed; SPEED=1 is rapid feed). You can also change the speed during the run.

You can bring about a change in direction with the T_{min} direction change parameter.

You can read the status of each output from the feedback interface (DO0, DO1 and DO2).

The function of the digital outputs depends on the control mode.

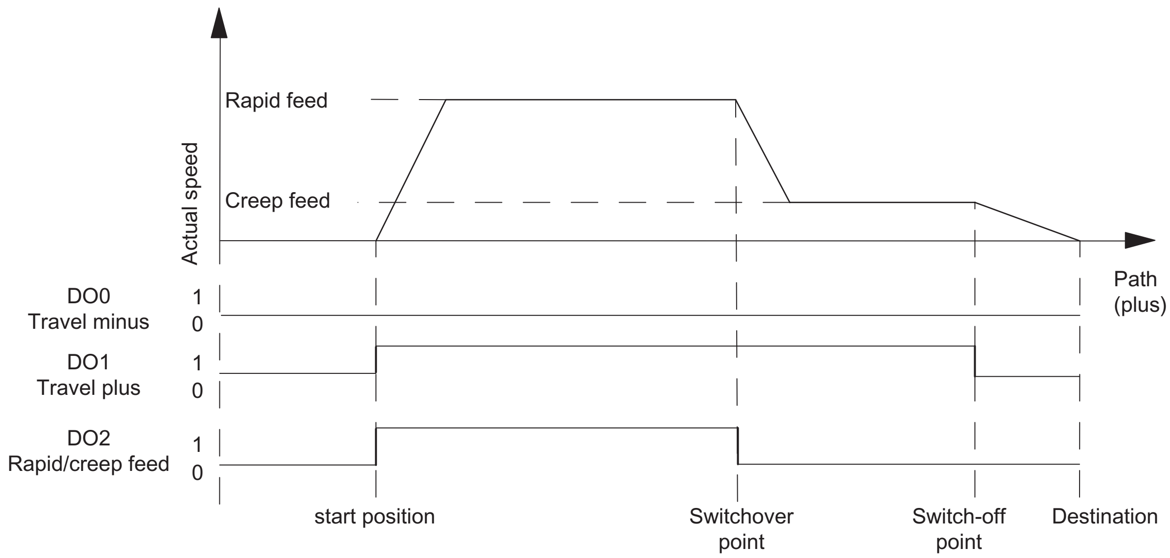


Figure 7-7 Digital Outputs with Control Mode 0

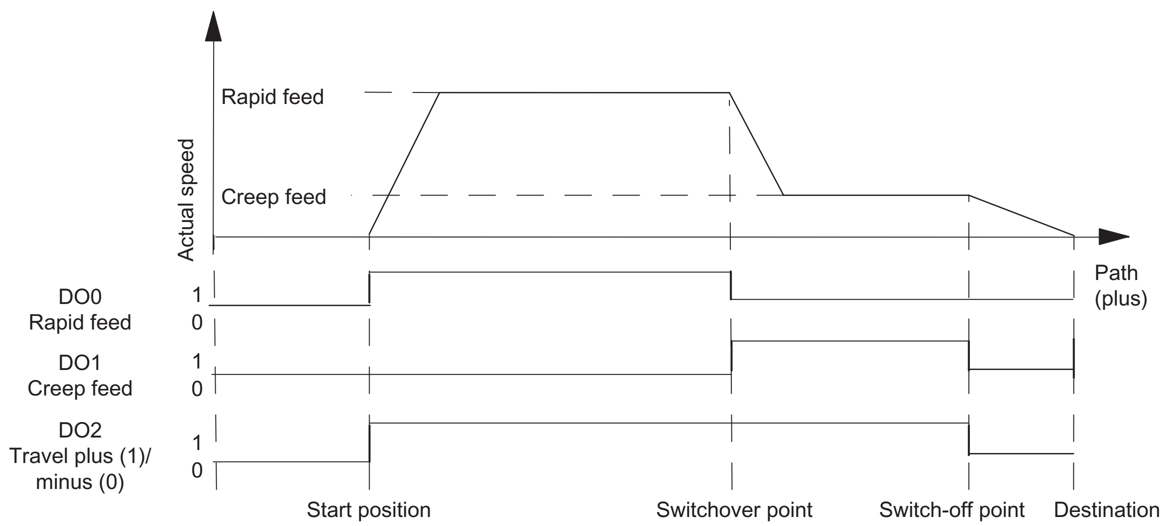


Figure 7-8 Digital Outputs with Control Mode 1

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

Effect of the Hardware Limit Switches

The two digital inputs (DI0 and DI1) are evaluated by the 1PosU as limit switches:

- DI0 is the minus limit switch and limits the operating range in the minus direction.
- DI1 is the plus limit switch and limits the operating range in the plus direction.

You can assign parameters to the hardware limit switches separately as break contacts or make contacts.

The hardware limit switches are evaluated with linear axes and rotary axes.

Only the hardware limit switch that lies in the direction in which the drive is being moved is evaluated.

This enables you to move away from a hardware limit switch without additional error acknowledgment by moving in the other direction if you reach or overrun a hardware limit switch.

The current signal level of the digital inputs is displayed in the feedback interface, delayed by the update rate.

You can see from the following table what effect the hardware limit switches have in the individual MODEs:

MODE	Effect of the Hardware Limit Switches
Search for Reference	The 1PosU executes an automatic reversal of direction on the hardware limit switch.
Inching	The motion of the axis is halted on the hardware limit switch, all 3 digital outputs are set to 0, and the POS_ERR feedback bit is reported.
Absolute Positioning	
Relative Positioning	

Starting on the hardware limit switch

Direction	Response of the 1PosU
Starting into the operating range	The 1PosU starts the specified MODE.
Starting away from the operating range	The POS_ERR=1 feedback bit is set.

7.6.3 Effect of the Directional Enables

Description

You enable the digital outputs directionally using the DIR_M and DIR_P control bits.

- With DIR_M = 1 you can move in the minus direction.
- With DIR_P = 1 you can move in the plus direction.

Interrupting and Continuing the Run

If you reset the relevant directional enable during a run, the motion of the axis is halted, all 3 digital outputs are set to 0, and the run is interrupted.

If you set the relevant directional enable again, the run is continued.

7.6.4 Stop (MODE 0)

Definition

If you activate MODE 0, the 1PosU stops the current run, all 3 digital outputs are set to 0, and the run is terminated (POS_ERR = 0, POS_DONE = 1).

A run terminated with MODE 0 cannot be continued. To put the axis into motion again, you start a new MODE.

Control Signals: Stop

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 0 = Stop</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
</table>

Feedback Signals: Stop

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK

7.6.5 Inching (MODE 1)

Definition

You use inching mode to control the drive directly in a particular direction using the DIR_M or DIR_P control bits.

If you start MODE 1, the 1PosU moves the drive at the preset speed (SPEED control bit) in the specified direction (control bit DIR_M or DIR_P).

You stop the drive by setting the control bits DIR_P = 0 and DIR_M = 0.

A change of direction is executed after the time T_{min} elapses.

You can also activate inching on an unsynchronized axis (feedback bit SYNC = 0) or when there is a pending encoder error (feedback bit ERR_ENCODER = 1) or without an encoder connected.

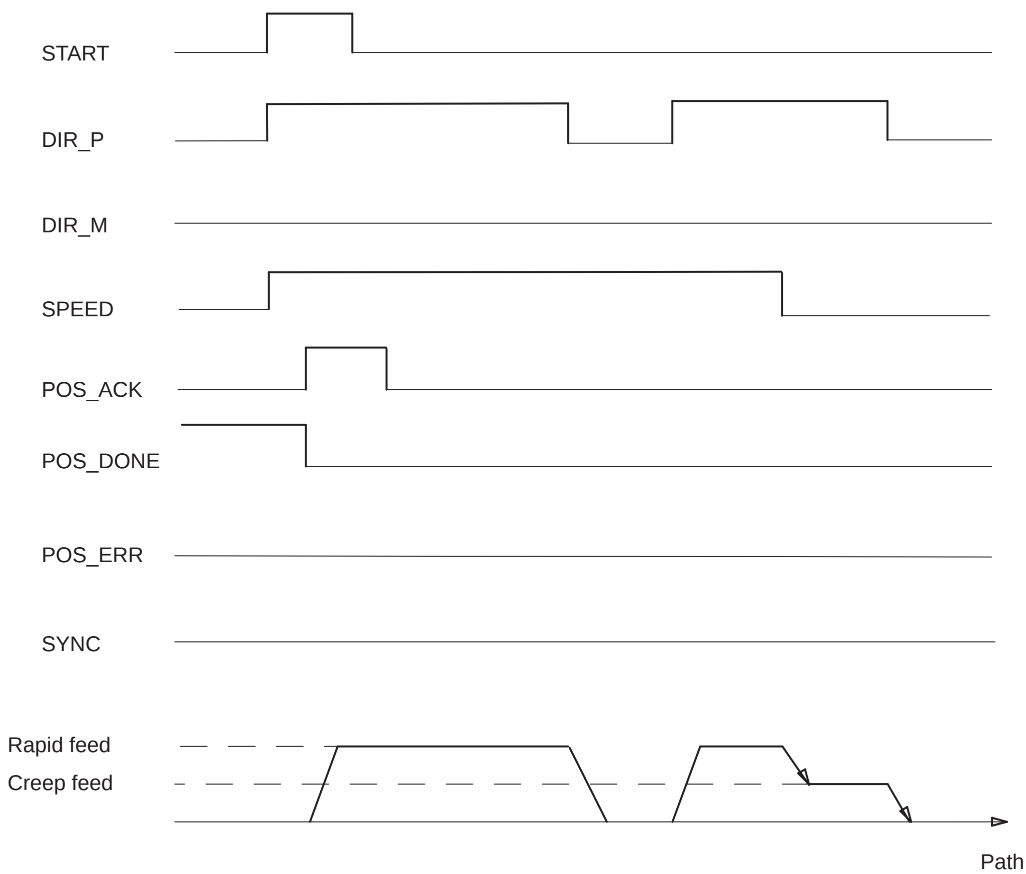


Figure 7-9 Execution of Inching

Control Signals: Inching

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 1 = Inching</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
</table>

Feedback Signals: Inching

Address	Assignment
Byte 0	Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1) at SSI encoder (0 to encoder range - 1)

Inching: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 7
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter
15	In dosing operation DIR_M = 1	

7.6.6 Reference Point Run (MODE 3)

Definition

A reference point run can only be started at incremental encoders and non-activated dosing operation.

You can use the reference point run to synchronize the axis on the basis of an external reference signal. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch) and DI1 (plus limit switch) and DI2 (reducing cam) as break or make contacts.

Provide the control interface with the reference point coordinates, and start MODE 3. The 1PosInc/Digital sets the SYNC = 0 feedback signal and moves the drive at the preset speed (SPEED control bit) in the assigned parameter start direction and searches for the reference signal. The 1PosU automatically executes the required change of direction at the limit switches and the reducing cam.

Set the necessary directional enables (DIR_M, DIR_P) to ensure that the drive is controlled.

If the 1PosU detects the assigned parameter reference signal, it controls the drive in creep feed mode in the referencing direction. This is controlled by the reference signal and reference switch parameters.

	Reference switch: Reduction cam towards minus	Reference switch: Reduction cam towards plus	Reference switch: Limit switch minus	Reference switch: Limit switch plus
Reference signal: Reference switch and zero mark	Minus referencing direction	Plus referencing direction	Plus referencing direction	Minus referencing direction
Reference signal: Reference switch				
Reference signal: Zero mark	The referencing direction is not defined. The axis is synchronized at the next zero mark.			

After the reference signal has been traversed, the axis is synchronized. The 1PosU sets the feedback signal SYNC = 1 and assigns the reference point coordinates to the actual value.

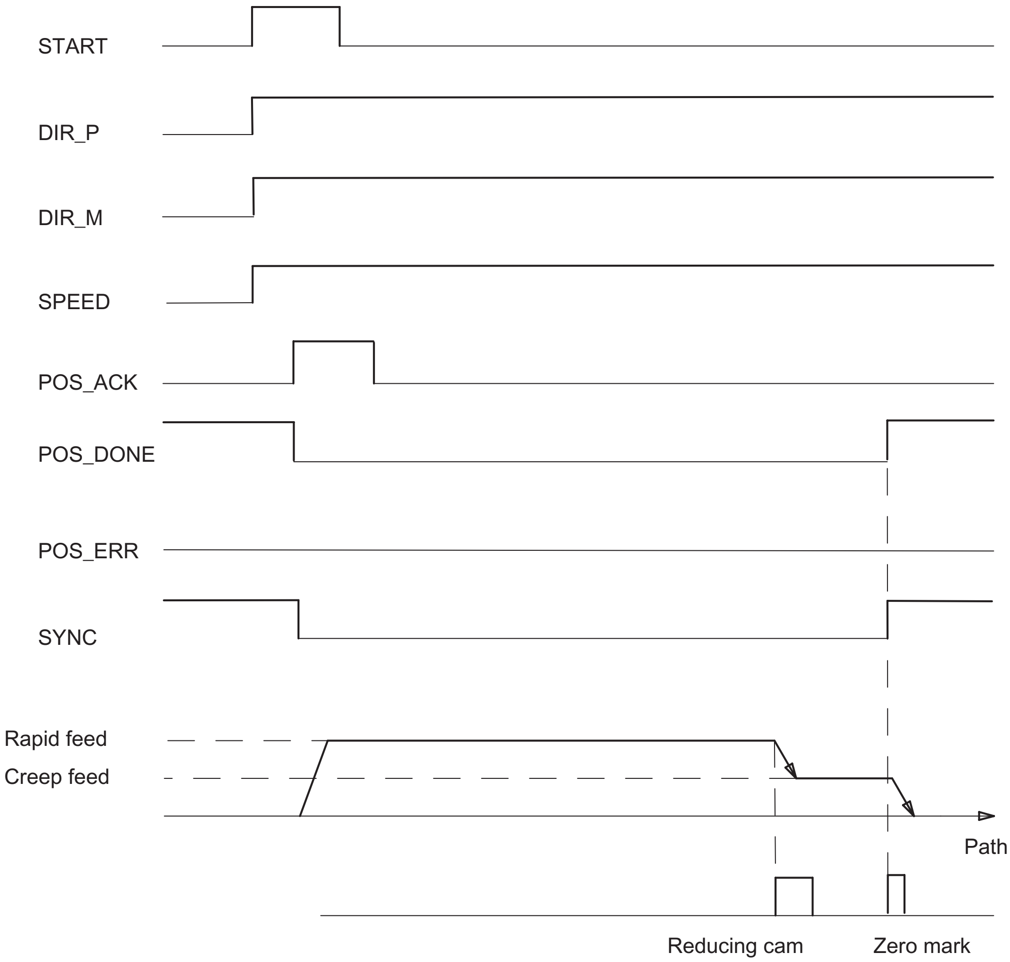


Figure 7-10 Sequence of Execution of the Search for Reference

Control Signals: Search for Reference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td></td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>MODE 3 = Reference Point Run</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Search for Reference

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)

Parameters: Search for Reference

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the relevant switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus

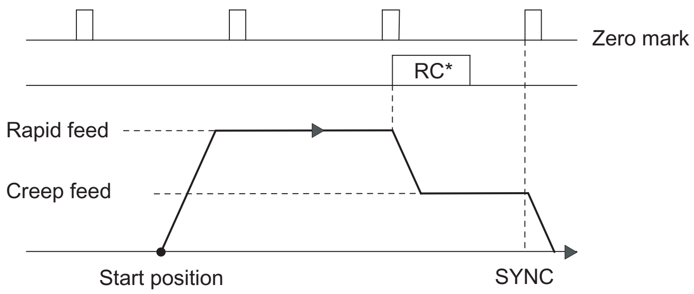
Execution of a Reference Point Run Depending on Parameterization and Start Position

In a reference point run, you have to distinguish between different cases that depend on the following:

- The start position of the drive at the start of the reference point run
- The assigned parameter start direction
- The assigned parameter reference signal
- The assigned parameter reference switch.

Example 1: Search for Reference Point Run with Reducing Cam and Zero Mark

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus



*RC = reducing cam

Figure 7-11 Search for Reference Point Run with Reducing Cam and Zero Mark

You can also carry out synchronization using the reducing cam without a zero mark.

If the start position is on the reducing cam, the 1PosU controls the drive directly in creep feed mode in the referencing direction.

Example 2: Reference Point Run with Minus Limit Switch

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Reference switch
- Reference switch: Minus limit switch

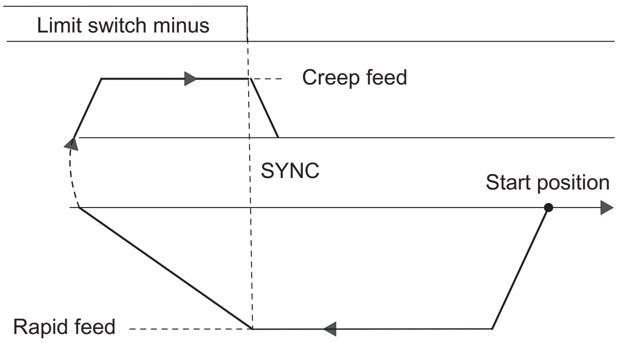


Figure 7-12 Reference Point Run with Minus Limit Switch

You can also carry out synchronization at the limit switch with the following zero mark.

If the start position is on the limit switch, the 1PosU controls the drive directly in creep feed mode in the referencing direction.

Example 3: Reference Point Run with Reversal of Direction at the Plus Limit Switch

- Start position: between the minus limit switch and the reducing cam
- Start direction: Plus
- Reference signal: Reference switch and zero mark
- Reference switch: Reduction cam towards plus

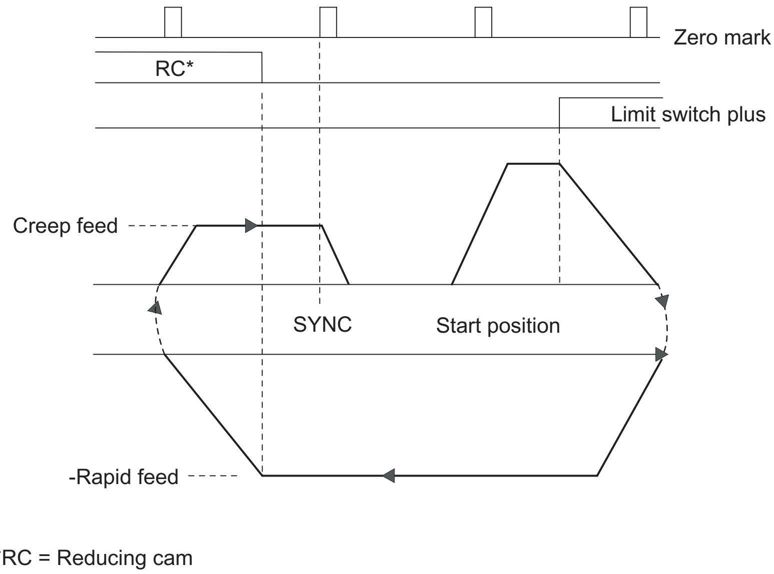


Figure 7-13 Reference Point Run with Reversal of Direction at the Plus Limit Switch

If the start position is at the plus limit switch, the 1PosInc/Digital controls directly the drive in rapid feed in the opposite direction to the assigned parameter start direction.

Example 4: Reference Point Run Only with Zero Mark

- Start position: between the minus limit switch and the plus limit switch
- Start direction: Minus
- Reference signal: Zero mark
- Reference switch: irrelevant

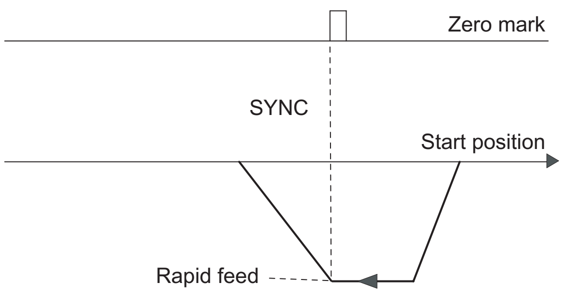


Figure 7-14 Reference Point Run Only with Zero Mark

Search for reference: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
1	Impermissible MODE in dosing operation	
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 7
3	ERR_ENCODER is displayed	Check the encoder wiring
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

7.6.7 Relative Positioning (MODE 4)

Definition

In relative positioning the 1PosU moves the drive from the start position in a specified direction for a certain preset distance.

Supply the control interface with the distance to be traveled, and start MODE 4, specifying the direction (DIR_M or DIR_P). The 1PosU moves the drive at the preset speed (SPEED control bit) for that distance. At the switchover point the 1PosU switches from rapid feed to creep feed, and at the switch-off it terminates the run.

If you start during an active run, the 1PosU executes the necessary change in direction after the time T_{min} has elapsed.

The preset distance is not checked by the 1PosU. This means that more than one revolution may be involved with rotary axes.

In dosing operation relative positioning is only possible in the plus direction. The actual value is set to 0 at every start.

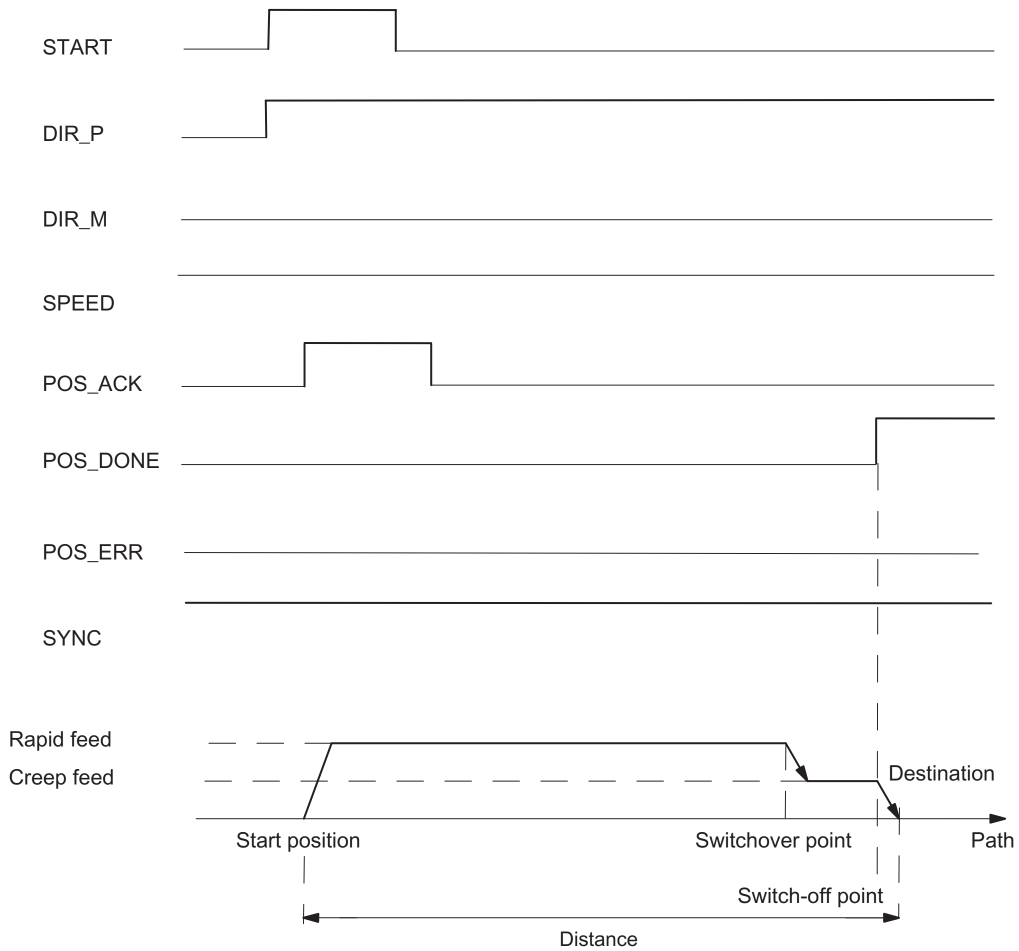


Figure 7-15 Execution of Relative Positioning

Control Signals: Relative Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="7">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 4 = Relative Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED=0 is creep feed; SPEED=1 is rapid feed)</td></tr>
<tr><td colspan="6">Bit 2: DIR_M</td></tr>
<tr><td colspan="6">Bit 1: DIR_P</td></tr>
<tr><td colspan="6">Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">Distance
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Relative Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)

Parameters: Relative Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Relative Positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 7
3	ERR_ENCODER is displayed	Check the encoder wiring
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter
15	In dosing operation DIR_M = 1	

7.6.8 Absolute Positioning (MODE 5)

Definition

With absolute positioning, the 1PosU moves the drive toward absolute destinations. To do this, the axis must be synchronized.

Absolute positioning is not possible at activated dosing operation.

Supply the control interface with the destination, and start MODE 5 with the necessary directional enable (DIR_M, DIR_P). The 1PosU moves the drive at the preset speed (control bit SPEED) toward the destination. At the switchover point the 1PosU switches from rapid feed to creep feed, and at the switch-off it terminates the run.

If you start during an active run, the 1PosU executes the necessary change in direction after the time T_{min} has elapsed.

Linear axis

The 1PosU determines the direction the destination is to be approached from. You must set the necessary directional enable (DIR_M, DIR_P) to start. You can also set both enables.

Rotary axis

You determine the direction in which the destination is approached by selecting the directional enable (DIR_M, DIR_P):

Control bits DIR_P and DIR_M	Direction
DIR_P = 1 DIR_M = 0	The destination is approached in the plus direction.
DIR_P = 0 DIR_M = 1	The destination is approached in the minus direction.
DIR_P = 1 DIR_M = 1	The destination is approached by the shortest route. The 1PosU determines the direction the destination is to be approached from. If the resulting distance to be traveled is smaller than the switch-off difference, no run is started (POS_DONE = 1).

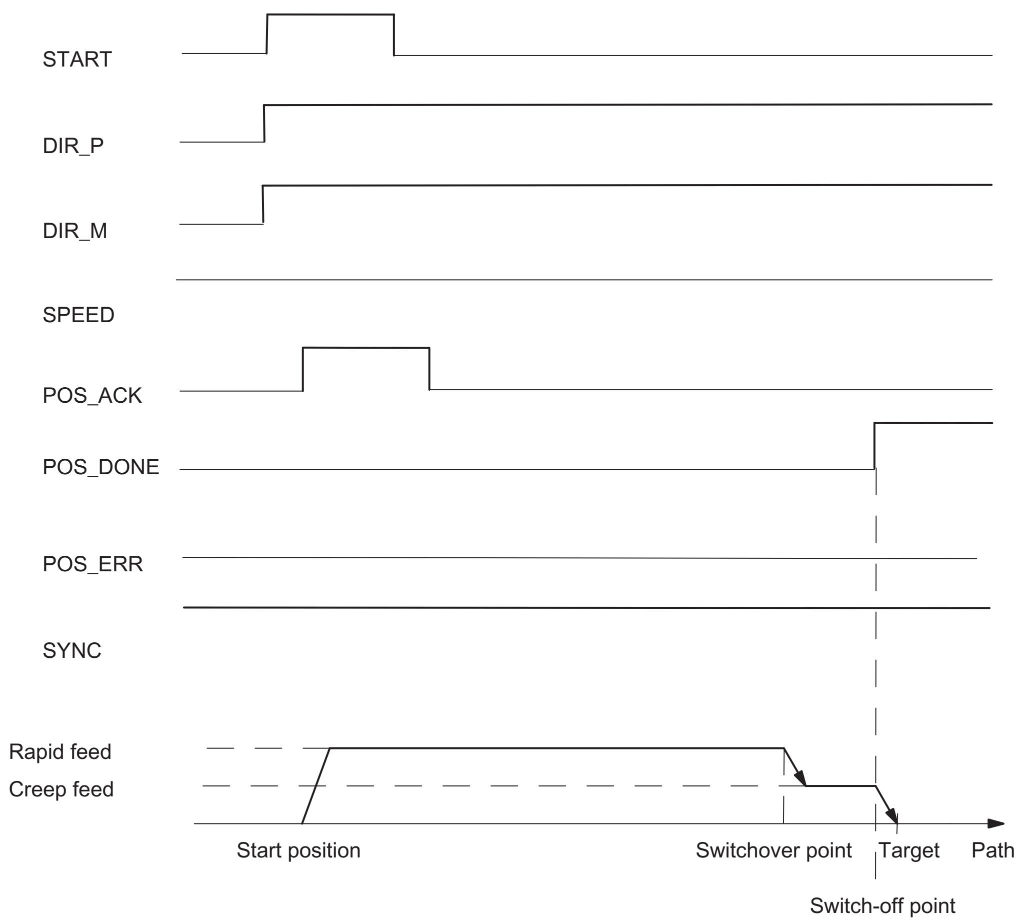


Figure 7-16 Execution of Absolute Positioning

Control Signals: Absolute Positioning

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 0</td><td colspan="6">Bits 0.7 to 0.4:</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">MODE 5 = Absolute Positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed)
Bit 2: DIR_M
Bit 1: DIR_P
Bit 0: START</td></tr>
<tr><td>Bytes 1 to 3</td><td colspan="6">target
at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Absolute Positioning

Address	Assignment
Byte 0	Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)

Parameters: Absolute Positioning

Parameters	Meaning	Value range	Default setting
Drive			
Switch-off difference	You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	You can change the switchover difference with JOB 4.	0 - 65 535	1000

Absolute positioning: Causes of Errors for POS_ERR

You must find out the causes of errors with JOB 15 (displays current values).

Error Number	Cause	What to Do
1	Impermissible MODE in dosing operation	
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 7
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	You can synchronize the axis with: • Reference point run • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0	
8	Destination ≥ end of rotary axis (at incremental encoders) or destination ≥ encoder range (at SSI encoders)	
9	Absolute positioning was terminated because JOB 9 was initiated (only at incremental encoders)	
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter

7.6.9 Canceling JOB Processing (JOB 0)

Definition

If you activate JOB 0, the 1PosU responds as follows:

- It cancels the current JOB 9 (reference signal evaluation)
- It cancels the current JOB 10 (latch function)
- It sets a pending JOB_ERR = 0.

You can activate JOB 0 whatever the state of the axis.

Effect on the MODEs

MODEs are not affected by JOB 0.

Control Signals: Canceling JOB processing

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 0 = Cancel JOB processing</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
</table>

Feedback Signals: Canceling JOB processing

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

7.6.10 Setting the Actual Value (JOB 1)

Definition

Setting an actual value assigns new coordinates to the actual value displayed. This moves the operating range to another part of the axis.

The axis is synchronized at incremental encoders and non-activated dosing operation.

At the switchover point the 1PosInc/Digital switches from rapid feed to creep feed, and at the switch-off it terminates the run.

The 1PosU sets the preset actual value coordinates to the actual value displayed in the feedback interface and sets the feedback bit SYNC = 1.

Effect on the MODEs

MODE	What Happens
Search for Reference	At incremental encoders and non-activated dosing operation ensure when the reference point run is evaluated that the feedback bit SYNC = 1 is set immediately. The reference point run still continues to run.
Inching	-
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ switch-off difference The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot. • Distance to the destination ≤ the switchover difference The switchover point is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > the switchover difference The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.
Relative Positioning	The preset distance continues to be traversed.

Control Signals: Setting of Actual Value

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 1 = Set the actual value</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Actual value coordinates
at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)</td></tr>
</table>

Feedback Signals: Setting of Actual Value

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value at incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting an Actual Value: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
34	Actual-value coordinates ≥ end of rotary axis (at incremental encoders) or actual-value coordinates ≥ encoder range (at SSI encoders)	

7.6.11 Moving the Encoder Range (JOB 2)

Definition

The move encoder range function can only be executed at SSI encoders.

When the encoder range is moved, the encoder value is adjusted so that the actual value displayed corresponds to the real actual value. Before this can be done, any active run must be terminated.

Supply the control interface with the offset, and activate JOB 2.

You calculate the offset as follows:

- Offset = displayed actual value – real actual value

If the offset is negative, proceed as follows:

- Offset = displayed actual value - real actual value +
  (number of rotations * number of increments)

The 1PosU accepts the preset offset and displays the real actual value coordinates at the feedback interface.

Effect on the MODEs

MODEs are not affected by JOB 2.

Control Signals: Move Encoder Range

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 2 = Move encoder range</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Offset
(0 to encoder range)</td></tr>
</table>

Feedback Signals: Move Encoder Range

Address	Assignment
Bytes 1 to 3	Actual value (0 to encoder range - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Move Encoder Range: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
21	Invalid JOB at incremental encoder	
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	
33	With JOB 2: Offset not in encoder range	

7.6.12 Changing the Switch-Off Difference (JOB 3)

Definition

Changing the switch-off difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switch-off difference, and activate JOB 3.

The 1PosU accepts the specified switch-off difference.

The switch-off difference remains valid until the parameter assignment of the 1PosU is changed.

Effect on the MODEs

<table>
<tr><th>MODE</th><th>What Happens</th></tr>
<tr><td>Search for Reference</td><td rowspan="2">-</td></tr>
<tr><td>Inching</td></tr>
<tr><td>Absolute Positioning</td><td rowspan="2">Distance to the destination ≤ switch-off difference
The switch-off point is reached or overshot; positioning is switched off immediately, and the run is terminated with POS_DONE = 1. In this case, the destination is sometimes overshot.</td></tr>
<tr><td>Relative Positioning</td></tr>
</table>

Control Signals: Change Switch-Off Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 3 = Change the switch-off difference</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switch-off difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switch-Off Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 367)

7.6.13 Changing the Switchover Difference (JOB 4)

Definition

Changing the switchover difference allows you to adjust the drive control to adapt to any changes in the load and mechanical conditions.

Supply the control interface with the new switchover difference, and activate JOB 4.

The 1PosU accepts the specified switchover difference.

The switchover difference remains valid until the parameter assignment of the 1PosU is changed.

Effect on the MODEs

MODE	What Happens
Search for Reference	-
Inching	
Absolute Positioning	The following responses are possible: • Distance to the destination ≤ the switchover difference. The switchover point is reached or overshot; there is an immediate reduction from rapid feed to creep feed. In this case the distance covered in creep feed is less than (switchover difference - switch-off difference). • Distance to the destination > the switchover difference. The drive is moved using rapid feed, even if it was switched over to creep feed beforehand.
Relative Positioning	

Control Signals: Change Switchover Difference

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 4 = Change the switchover difference</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Switchover difference
(linear axis: 0 to 16 777 215; rotary axis: 0...16 777 215)</td></tr>
</table>

Feedback Signals: Change Switchover Difference

Address	Assignment
Byte 4	Bit 0: JOB_ACK

See also

CPU/Master Stop and RESET State (Page 367)

7.6.14 Evaluating the Reference Signal (JOB 9)

Definition

The evaluate reference signal function is only available at incremental encoders and non-active dosing operation.

By evaluating the reference signal you can synchronize the axis using an external reference signal during a current run in inching or relative positioning mode. You can use either the 3 digital inputs or the zero mark as a reference signal.

You can assign parameters to the digital inputs DI0 (minus limit switch) and DI1 (plus limit switch) and DI2 (reducing cam) as break or make contacts.

Supply the control interface with the reference point coordinates, and activate JOB 9. The 1PosU sets the feedback signal SYNC = 0.

If the 1PosInc/Digital detects the overrunning of the assigned parameter reference signal in the referencing direction, the axis is synchronized. The 1PosU sets the feedback signal SYNC = 1 and assigns the reference point coordinates to the actual value.

The referencing direction is determined by the reference signal and reference switch parameters.

<table>
<tr><th></th><th>Reference switch: Reduction cam towards minus</th><th>Reference switch: Reduction cam towards plus</th><th>Reference switch: Limit switch minus</th><th>Reference switch: Limit switch plus</th></tr>
<tr><td>Reference signal: Reference switch and zero mark</td><td rowspan="2">Minus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Plus referencing direction</td><td rowspan="2">Minus referencing direction</td></tr>
<tr><td>Reference signal: Reference switch</td></tr>
<tr><td>Reference signal: Zero mark</td><td colspan="4">The referencing direction is not defined. The axis is synchronized at the next zero mark.</td></tr>
</table>

Effect on the MODEs

MODE	What Happens
Search for Reference	The reference coordinates transferred with JOB 9 are valid
Inching	-
Absolute Positioning	Run canceled with POS_ERR = 1 because SYNC is deleted
Relative Positioning	-

Control Signals: Reference Signal Evaluation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 9 = Evaluate the reference signal</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Bytes 5 to 7</td><td colspan="6">Reference point coordinates
(linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)</td></tr>
</table>

Feedback Signals: Reference Signal Evaluation

Address	Assignment
Byte 0	Bit 3: SYNC
Bytes 1 to 3	Actual value (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis - 1)
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Parameters: Reference Signal Evaluation

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus

Evaluating the Reference Signal: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
21	Impermissible JOB at SSI encoders or in dosing operation	
23	ERR_ENCODER is displayed	Check the encoder wiring
30	Reference point coordinates ≥ end of rotary axis	

7.6.15 Latch Function (JOB 10)

Definition

The latch function allows you to store the actual value at an edge at the DI2 digital input. You can use this function, for example, to detect edges or measure lengths.

Supply the control interface with the desired edge, and activate JOB 10.

If the 1PosU detects the preset edge at the DI2 digital input, it stores the associated actual value, displays it as a feedback value and sets the feedback bit LATCH_DONE = 1.

You can then activate the latch function again.

Latch Function and Reference Point Run or Reference Signal

If the 1PosU synchronizes at the same edge, it stores the actual value before it assigns the reference point coordinates.

Effect on the MODEs

MODEs are not affected by JOB 10.

Control Signals: Latch Function

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 10 = Latch function</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">Bit 1: Latch at negative edge at DI2
Bit 0: Latch at positive edge at DI2</td></tr>
</table>

Feedback Signals: Latch Function

Address	Assignment
Byte 4	Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value: Actual value at the edge at DI2 for incremental encoder (linear axis: 0 to 16 777 215; rotary axis: 0 to end of rotary axis-1), at SSI encoder (0 to encoder range - 1)

Latch Function: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
23	ERR_ENCODER is displayed	Check the encoder wiring
36	Edge selection unknown	

See also

CPU/Master Stop and RESET State (Page 367)
Displaying Current Values (JOB 15) (Page 358)

7.6.16 Setting the Monitoring of the Direction of Rotation (JOB 11)

Definition

The monitoring of the direction of rotation function is not available in dosing operation.

By setting monitoring of the direction of rotation you can adjust the monitoring of the direction of rotation of the 1PosU to suit your load and mechanical conditions.

Monitoring of the direction of rotation is always active. The 1PosU detects whether the direction of rotation of the drive and the encoder is the same. Direction of rotation monitoring will tolerate different directions for the drive and the encoder up to the preset path difference. If the preset path difference is exceeded, the 1PosU signals POS_ERR =1.

Unless you have activated JOB 11, double the switch-off difference is used from the parameters as the path difference. JOB 3 (which changes the switch-off difference) does not affect the path difference for the purpose of monitoring of the direction of rotation.

Supply the control interface with the new path difference, and activate JOB 11.

The 1PosU accepts the preset path difference for the monitoring of the direction of rotation.

The preset path difference for the monitoring of the direction of rotation remains valid until the parameter assignment of the PosU is changed.

Disabling the Monitoring of the Direction of Rotation

Monitoring of the direction of rotation is disabled when the path difference is 0.

Effect on the MODEs

MODEs are not affected by JOB 11.

Control Signals: Setting the Monitoring of the Direction of Rotation

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 11 = Set the monitoring of the direction of rotation</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0</td></tr>
<tr><td>Bytes 6, 7</td><td colspan="6">Path difference for monitoring of the direction of rotation
(0 to 65 535)</td></tr>
</table>

Feedback Signals: Setting the Monitoring of the Direction of Rotation

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK

Setting the Monitoring of the Direction of Rotation: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
21	Impermissible JOB in dosing operation	
38	Monitoring of the direction of rotation Path difference > 65 535	

See also

CPU/Master Stop and RESET State (Page 367)

Displaying Current Values (JOB 15) (Page 358)

7.6.17 Displaying Current Values (JOB 15)

Definition

You can display the following values in the feedback interface as feedback values:

- Residual distance
- Actual speed
- Causes of errors for POS_ERR and JOB_ERR

The residual distance is set by the 1PosU as the default for the feedback value.

The 1PosU continuously displays the actual value in the feedback interface irrespective of the selected feedback value.

This moves the operating range to another part of the axis and synchronizes the axis.

The selected feedback value remains valid until the parameter assignment of the 1PosU is changed.

Displaying Current Values and the Latch Function

If you activate the latch function, the 1PosU sets a feedback value of 0 and displays the actual value at the edge at the D12 digital input.

You can only activate JOB 15 again after the latch function has terminated.

Residual distance

The 1PosU calculates the distance to the destination as the residual distance in the absolute positioning and relative positioning MODEs. As long as the actual value is before the destination, the residual distance remains positive. It becomes negative once the destination is overshot. The residual distance is 0 in the other MODEs.

The 1PosU displays the residual distance with a sign between -8 388 608 and 8 388 607 increments. Negative values are displayed in twos complement. If the actual residual distance is beyond these limits, the limit value is displayed.

Actual speed

The 1PosU calculates the actual speed as an encoder value change in increments per 10 ms. It displays these between 0 and 16 777 215.

Causes of errors for POS_ERR and JOB_ERR

The 1PosU displays the causes of errors for POS_ERR and JOB_ERR as well as the MODE and JOB entered in the control interface.

Effect on the MODEs

MODEs are not affected by JOB 15.

Control Signals: Display Current Values

<table>
<tr><th>Address</th><th colspan="6">Assignment</th></tr>
<tr><td rowspan="4">Byte 4</td><td colspan="6">Bits 4.7 to 4.4 :</td></tr>
<tr><td rowspan="2">Bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td rowspan="2">JOB 15 = Display current values</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td colspan="6">Bit 0: JOB_REQ</td></tr>
<tr><td>Byte 5</td><td colspan="6">0: Residual distance
1: Actual speed
2: Causes of errors for POS_ERR and JOB_ERR</td></tr>
</table>

Feedback Signals: Display Current Values

Address	Assignment
Byte 4	Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	In accordance with the selected feedback value: • With a residual distance of: - 8 388 608...8 388 607 • With an actual speed of: 0...16 777 215 • With causes of errors for POS_ERR and JOB_ERR – Byte 5: Causes of Errors for POS_ERR – Byte 6: Causes of Errors for JOB_ERR – Bits 7.3 to 7.0: MODE (= bits 0.7 to 0.4 from the control signals) – Bits 7.7 to 7.4: JOB (= bits 4.7 to 4.4 from the control signals)

Display current values: Causes of Errors for JOB_ERR

Error Number	Meaning	What to Do
35	Display current values: Selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	

7.6.18 Error Detection/Diagnostics

Parameter assignment error

Parameter assignment error	Response of the 1PosU
Causes: • The 1PosU cannot identify existing parameters as its own. • The slot of the 1PosU you have configured does not match the setup. Only at SSI encoder: • Impermissible value for parameter for number of increments. • Impermissible value for parameter for number of rotations. • Number of increments * number of rotations is greater than 4096x4096. Only at SSI encoder: • Activated "Encoder signal" diagnostics • Activated "Reversal of the direction of rotation" What to Do: • Check the configuration and setup	• The 1PosU is not assigned parameters and cannot execute its functions. • Generate channel-specific diagnostics

External Errors

Load Voltage 2L+ Missing	Response of the 1PosU
Causes: • Load voltage 2L+ not present or too low at terminal 7 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current run is halted; it is not possible to start a new run. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_2L+ = 1 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK
Short circuit of the sensor supply	**Response of the 1PosU**
Causes: • Short circuit of the encoder supply made available at terminals 6 and 10 What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER=1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error. • The current JOB (reference signal evaluation) is canceled.

Wire Break/Short Circuit of the Encoder Signals	Response of the 1PosU
If an SSI encoder is used: Prerequisite: • To detect errors of the encoder signals, you must enable the "Encoder signal diagnostics" parameter. Causes: • Wire break or short circuit of the encoder signals at terminals 9 and 13 or 12 and 16. • The parameters for the SSI encoder do not correspond to the encoder connected. What to Do: • Check the wiring and correct the short circuit. • Compare the parameter assignment with the technical specifications of the encoder. • Acknowledge the error with the EXTF_ACK control bit. **If an incremental encoder is used:** Prerequisite: • The encoder signal diagnostics parameter must be enabled in order to allow error recognition for the signals A, /A and B, /B at 5 V differential signals or for the signals A and B at 24 V signals. • The zero marker diagnostics parameter must be enabled in order to allow error recognition for the signals N, /N at 5 V differential signals. If you use an encoder without a zero mark, switch off error detection. If dosing operation is activated, zero marker signal diagnostics is not possible. Causes: • For 5V differential signals only: Wire break or short circuit of the encoder signals at terminals 9 and 13 or 11 and 15 or 12 and 16. • Edge error of the encoder signals recognized so that 1PosU cannot carry out clear direction recognition. What to Do: • Check the wiring and correct the short circuit. • Acknowledge the error with the EXTF_ACK control bit.	• The current MODEs relative positioning and absolute positioning are stopped; it is not possible to start a new run in these MODEs. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0 • Feedback bit ERR_ENCODER=1 • Feedback bit SYNC = 0 • Generate channel-specific diagnostics • Waits for error acknowledgment EXTF_ACK • Inching MODE is not affected by this error. • The current JOB (reference signal evaluation) is canceled.

Errors in the Control of MODEs and JOBs

POS_ERR	Response of the 1PosU
Causes: • Certain requirements or conditions have not been met at the start of a MODE	• The MODE started is not executed. • The current run is stopped. – All 3 digital outputs are set to 0. – Feedback bit POS_ERR = 1 – Feedback bit POS_DONE = 0
JOB_ERR	**Response of the 1PosU**
Causes: • Certain requirements or conditions have not been met at the activation of a JOB	• The activated JOB is not executed. – Feedback bit JOB_ERR = 1

Generating a Channel-Specific Diagnostics

In the event of a parameter assignment error, the absence of 2L+ load voltage, a short circuit of the sensor supply or a wire break/short circuit of the encoder signals, the 1PosU generates a channel-specific diagnostics on the connected CPU/master. To do this, you must enable the Group Diagnostics parameter (see the *Distributed I/O Device* manual).

Error Acknowledgment EXTF_ACK

You must acknowledge the corrected errors (load voltage missing, short circuit of the sensor supply and open circuit/short circuit of the sensor signals).

What You Do	Response of the 1PosU
	Feedback bit ERR_2L+ = 1 and/or feedback bit ERR_ENCODER = 1
Your control program detects the set feedback bit ERR_2L+ or ERR_ENCODER. Execute your application-specific error response. Eliminate the cause of the error.	
Switch the EXTF_ACK control bit from 0 to 1	The 1PosU sets the feedback bits ERR_2L+ = 0 and ERR_ENCODER = 0. This tells you that the cause has been eliminated and acknowledged. If ERR_2L+ is still 1 and/or ERR_ENCODER = 1, the cause of the error is not yet eliminated.
Switch the EXTF_ACK control bit from 1 to 0	
In the case of constant error acknowledgment (EXTF_ACK = 1) or at CPU/Master Stop, the 1PosU reports the errors as soon as they are detected and deletes them as soon as they have been eliminated.	

Parameters

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B or D, /D are monitored for short circuit and wire break at 5 V differential signals. At incremental position encoders and non-activated dosing operation monitoring of the signal sequence is also carried out. A simultaneous edge change at Signals A and B causes an error. At an SSI encoder monitoring of the frame is carried out additionally (start bit and stop bit)	• On • Off	On
Zero marker diagnostics	At incremental encoders with 5 V differential signals the zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On

Feedback Messages

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Byte 4	Bit 7: ERR_2L+ Bit 1: JOB_ERR Bit 0: JOB_ACK

Causes of Errors for POS_ERR

Table 7-3 Causes of Errors for POS_ERR

Error Number	Cause	Remedy
1	MODE unknown	Permissible MODEs are: • MODE 0 • MODE 1 • MODE 3 (not possible at SSI encoders or in dosing operation) • MODE 4 • MODE 5 (not possible in dosing operation)
2	ERR_2L+ is displayed	Check the load voltage (2L+) at terminal 7
3	ERR_ENCODER is displayed	Check the encoder wiring
4	The axis is not synchronized (SYNC=0)	SSI encoder: • Eliminate the encoder error. The axis can be synchronized at incremental encoders and non-activated dosing operation with: • Search for Reference • Reference Signal Evaluation • Setting of Actual Value
5	The limit switch that lies in the direction in which the drive is moved is active	Check your switches and the wiring as well as the DI0 limit switch minus and DI1 limit switch plus parameters
7	Inching: DIR_P and DIR_M = 1 Absolute positioning: Start with DIR_P and DIR_M = 0 or relevant control bit DIR_P or DIR_M = 0 Relative positioning: Start with DIR_P and DIR_M = 0 or DIR_P and DIR_M = 1	
8	Absolute positioning : Destination ≥ end of rotary axis at incremental encoders or destination ≥ encoder range at SSI encoders	
9	Absolute positioning was terminated because JOB 9 was initiated	
10	Search for reference: Reference point coordinates ≥ end of rotary axis	
11	Search for reference: No reference signal found up to the limit switch or between the limit switches	Check your switches, the encoder and the wiring
13	Direction of rotation of the drive and the encoder varies	Check the wiring of the drive and the encoder as well as the reversal of the direction of rotation parameter
15	Inching, relative positioning: In dosing operation DIR_M = 1	

Causes of Errors for JOB_ERR

Table 7-4 Causes of Errors for JOB_ERR

Error Number	Meaning	Remedy
21	JOB unknown or impermissible	Permissible JOBs are: • JOB 0 • JOB 1 • JOB 2 (only possible at SSI encoders) • JOB 3 • JOB 4 • JOB 9 (not possible at SSI encoders or in dosing operation) • JOB 10 • JOB 11 (not possible in dosing operation) • JOB 15
23	ERR_ENCODER is displayed	Check the encoder wiring
26	JOB 2 (move encoder range) cannot be initiated because there is an active run	
29	Evaluating the Reference Signal: Reference point coordinates ≥ end of rotary axis	
34	Setting an Actual Value: Actual value coordinates ≥ encoder range	
35	Display current values: Selection unknown	
36	Latch Function: Edge selection unknown	
37	Display current values: JOB 15 cannot be activated with the latch function running.	
38	Monitoring of the direction of rotation Path difference > 65 535	

7.7 CPU/Master Stop and RESET State

Behavior at CPU-Master-STOP

Behavior at CPU-Master-STOP	Response of the 1PosU
• Due to power-off of the CPU/DP master or • Due to power-off of the IM 151/ IM 151 FO or • Due to failure of DP transmission or • Due to change from RUN to STOP	• The current run is stopped. • All 3 digital outputs are set to 0. • Feedback bit POS_ERR = 0 • Feedback bit POS_DONE = 1

Exiting the CPU-Master-STOP Status

Exiting the CPU-Master-STOP Status	Response of the 1PosU
• At power-on of the CPU/DP master or • At power-on of the IM 151/ IM 151 FO or • After failure of the DP transmission or • After a change from STOP to RUN	• The feedback interface of the 1PosU remains current. • The axis remains synchronized, and the actual value is current. • The moved encoder range remains valid. • The changed switch-off and switchover differences and the path difference for the monitoring of the direction of rotation remain valid. • An initiated JOB 9: Evaluating the Reference Signal and JOB 10: Latch function remains active. • The feedback bit selected with JOB 15 is current.

RESET State of the 1PosU

RESET State of the 1PosU and Changing the Parameters of the 1PosU	Response of the 1PosU
• Changing the parameters of the 1PosU and downloading the parameter assignment and configuration of the ET 200S station to the CPU/DP master or • Power-on at the power module of the 1PosU or • Inserting the 1PosU in an energized state	• The axis is synchronized, and the actual value corresponds to the current encoder value. • The encoder range has not been moved. • The switch-off and switchover difference is accepted from the parameters. • The path difference for the monitoring of the direction of rotation is set at double the switch-off difference. • JOB 9: Evaluating the Reference Signal and JOB 10: Latch function are not active. • The residual distance is displayed as a feedback value.

7.8 Parameter List

Overview

Parameter List at Incremental Encoders with 5 V Differential Signals

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals A, /A and B, /B are monitored for short circuit and wire break. In addition the signal sequence is monitored. A simultaneous edge change at Signals A and B causes an error.	• On • Off	On
Zero marker diagnostics	Zero marker signals N, /N are monitored for short circuit and wire break.	• On • Off	On
Axis			
Dosing operation	Only the encoder signals A and /A are evaluated. This means that only a path change in the positive direction is possible.	• Off • On	Off
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder A reversal of the direction of rotation is only possible if no dosing operation is set.	• Off • On	Off
Axis type	Selection of linear axis without limits or rotary axis with overrun/underrun with encoder range	• Linear • Rotary	Linear
End of rotary axis	Only relevant for rotary axis type: Underrun: 0 to end of rotary axis - 1 End of rotary axis - 1 to 0	1 - 16 777 215	36 000
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 reducing cam	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact

Parameters	Meaning	Value range	Default setting
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed. You can change the switchover difference with JOB 4.	0 - 65 535	1000
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

Parameter List at Incremental Encoders with 24 V Signals

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	A simultaneous edge change at Signals A and B causes an error.	• On • Off	On
Axis			
Dosing operation	Only the encoder signal A is evaluated. This means that only a path change in the positive direction is possible.	• Off • On	Off
Sensor	Selection of the output circuit of the encoder for the signals A, B and N	• Current-sourcing switch, push-pull • Mono-switch	Current-sourcing switch, push-pull
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder A reversal of the direction of rotation is only possible if no dosing operation is set.	• Off • On	Off
Axis type	Selection of linear axis without limits or rotary axis with overrun/underrun with encoder range	• Linear • Rotary	Linear
End of rotary axis	Only relevant for rotary axis type: Underrun: 0 to end of rotary axis - 1 End of rotary axis - 1 to 0	1 - 16 777 215	36 000
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 reducing cam	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact
Reference point run and evaluation of the reference signal			
Reference signal	This parameter defines the relevant switch or the combination of switch and zero mark.	• Reference switch and zero mark • Reference switch • Zero mark	Reference switch and zero mark
Reference switch	Relevant in the case of reference signal: • Reference switch and zero mark • Reference switch This parameter defines the referencing direction in which the switch must be traversed.	• Reduction cam towards minus • Reduction cam towards plus • Minus limit switch • Plus limit switch	Reduction cam towards minus
Start direction of the reference point run		• Plus • Minus	Plus

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed. You can change the switchover difference with JOB 4.	0 - 65 535	1000
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

Parameter List at SSI Encoder:

Parameters	Meaning	Value range	Default setting
Enables			
Group diagnostics	When group diagnostics is enabled, an encoder error (ERR_ENCODER), no load voltage (ERR_2L+) or a parameter assignment error will result in a channel-specific diagnostics.	• Disable • Enable	Disable
Encoder signal diagnostics	Encoder signals D, /D are checked for short circuit and wire break. Monitoring of the frame is carried out additionally (start bit and stop bit)	• On • Off	On
Encoder and Axis			
Encoder	Selection of single-turn encoder (SSI 13 bit) or multiturn encoder (SSI 25 bit)	• SSI-13Bit • SSI-25Bit	SSI-13Bit
Transmission rate		• 125 kHz • 250 kHz • 500 kHz • 1 MHz	125 kHz
Number of increments		4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192	4096
Number of rotations	Only relevant in the case of multiturn encoders. In the case of single-turn encoders, the 1PosU sets the number of rotations to 1.	4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096,	4096
Reversal of the direction of rotation	Adjustment of the direction of rotation of the encoder	• Off • On	Off
Axis type	Selection of linear axis without limits or rotary axis with overrun/underrun with encoder range	• Linear • Rotary	Linear
Digital Inputs			
DI0 limit switch minus	Switch on the DI0 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI1 limit switch plus	Switch on the DI1 digital input is a break or make contact	• Break contact • Make contact	Break contact
DI2 latch signal	Switch on the DI2 digital input is a break or make contact	• Break contact • Make contact	Make contact

Parameters	Meaning	Value range	Default setting
Drive			
Control mode	Type 0 means: • DO0 travel minus • DO1 travel plus • DO2 rapid/creep feed Type 1 means: • DO0 rapid feed • DO1 creep feed (rapid feed is 0) • DO2 travel plus (1)/minus (0)	• 0 • 1	0
Switch-off difference	Defines the distance from the destination at which the drive is slowed down from creep feed to 0. If the switch-off difference ≥ the switchover difference, there is no switchover point. There is no deceleration from rapid to creep feed, and instead the response is executed directly at the switch-off point. You can change the switch-off difference with JOB 3.	0 - 65 535	100
Switchover difference	Defines the distance from the destination at which the drive is slowed down from rapid feed to creep feed. You can change the switchover difference with JOB 4.	0 - 65 535	1000
T_{min} direction change	The digital outputs are switched off, and a change of direction by T_{min} is executed with a delay. T_{min} is effective at each change of direction during a run. T_{min} is not effective at startup after POS_DONE = 1 or POS_ERR = 1. Your input value is multiplied by 10. You thus specify T_{min} in increments of 10 ms (for example, 0 ms, 10 ms or 2550 ms)	0 - 255	0

7.9 Control and Feedback Signals

Assignment of the Control Interface

Address	Assignment					
Byte 0	Bits 0.7 to 0.4 stand for the MODEs					
	Bit	7	6	5	4	
		0	0	0	0	MODE 0 = Stop
		0	0	0	1	MODE 1 = Inching
		0	0	1	1	MODE 3 = Reference Point Run
		0	1	0	0	MODE 4 = Relative Positioning
		0	1	0	1	MODE 5 = Absolute Positioning
	Bit 3: SPEED (SPEED = 0 is creep feed; SPEED = 1 is rapid feed) Bit 2: DIR_M Bit 1: DIR_P Bit 0: START					
Bytes 1 to 3		With MODE 3 = reference point run: reference point coordinates				
		at MODE 4 = Relative positioning: distance				
		at MODE 5 = Absolute positioning: target				
Byte 4	Bits 4.7 to 4.4 stand for the MODEs					
	Bit	7	6	5	4	
		0	0	0	0	JOB 0 = Cancel JOB processing
		0	0	0	1	JOB 1 = Set the actual value
		0	0	1	0	JOB 2 = Move encoder range (only at SSI encoders)
		0	0	1	1	JOB 3 = Change the switch-off difference
		0	1	0	0	JOB 4 = Change the switchover difference
		1	0	0	1	JOB 9 = Evaluate the reference signal
		1	0	1	0	JOB 10 = Latch function
		1	0	1	1	JOB 11 = Set the monitoring of the direction of rotation
		1	1	1	1	JOB 15 = Display current values
	Bit 3: EXTF_ACK Bit 2: Reserve = 0 Bit 1: Reserve = 0 Bit 0: JOB_REQ					

Address	Assignment
Bytes 5 to 7	Corresponding to the selected JOB: • With JOB 1= actual value coordinates • With JOB 3 = switch-off difference • With JOB 4 = switchover difference • With JOB 9 = reference point coordinates • With JOB 10 – Byte 5: Bit 0 = latch at positive edge at DI2 – Byte 5: Bit 1 = latch at negative edge at DI2 • With JOB 11 = path difference for direction of rotation monitoring • With JOB 15 – Byte 5: 0 = Residual distance – Byte 5: 1 = Actual speed – Byte 5: 2 = error information

Assignment of the Feedback Interface

Address	Assignment
Byte 0	Bit 7: ERR_ENCODER Bit 6: STATUS DO 2 Bit 5: STATUS DO 1 Bit 4: STATUS DO 0 Bit 3: SYNC Bit 2: POS_ DONE Bit 1: POS_ERR Bit 0: POS_ACK
Bytes 1 to 3	Actual value
Byte 4	Bit 7: ERR_2L+ Bit 6: STATUS DI 2 reduction cams Bit 5: STATUS DI 1 limit switch plus Bit 4: STATUS DI 0 limit switch minus Bit 3: Reserve Bit 2: LATCH_DONE Bit 1: JOB_ERR Bit 0: JOB_ACK
Bytes 5 to 7	Feedback value

Access to Control and Feedback Interface in STEP 7 Programming

	Configured with STEP 7 via GSD file [1)] (hardware catalog\PROFIBUS DP\ other field devices\ET 200S)	Configured with STEP 7 via HW Config (hardware catalog\PROFIBUS DP\ET 200S)
Feedback interface	Read with SFC 14 "DPRD_DAT"	Load command e.g. L PED
Control interface	Write with SFC 15 "DPWR_DAT"	Transfer command e.g. T PAD
[1)]Load and transfer commands are also possible with CPU 3xxC, CPU 318-2 (as of V3.0), CPU 4xx (as of V3.0)		

7.10 Technical specifications

Overview

Technical specifications 1PosU	
Dimensions and weight	
Dimension W x H x D (mm)	30 x 81 x 52
Weight	Approx. 65 g
Data for specific modules	
Number of channels	1
Voltages, currents, potentials	
Rated load voltage L+ • Range • P1	24 VDC 20.4 ... 28.8 V Yes
Isolation	
• Between the backplane bus and the I/O	Yes
Sensor supply • Output voltage • Output current	 L+ -0.8 V Maximum 500 mA, short-circuit proof
Current consumption • From the backplane bus • From the load voltage L+ (no load)	 Max. 10 mA Max. 50 mA
Power dissipation	Typ. 2 W
Data for the digital inputs	
Input voltage • Rated value • 0 signal • 1 signal	 24 V DC -30 V to 5 V DC 11 V to 30 V
Input current • 0 signal • 1 signal	 ≤ 2 mA (perm. leakage current) 9 mA (typ.)
Minimum pulse width	500 μs
Connection of a two-wire BERO Type 2	Possible
Input characteristic curve	To IEC 1131, Part 2, Type 2
Length of cable	50 m
Data for the Digital Outputs	
Output voltage • Rated value • 0 signal • 1 signal	 DC 24 V ≤ 3 V ≥ L+ -1 V

Technical specifications 1PosU	
Output current • 0 signal (leakage current) • 1 signal – Rated value – Permitted range	 ≤ 0.3 mA 0.5 A 7 mA to 0.6 A
Switch rate • Resistive load • Inductive load • Lamp load	 100 Hz 2 Hz ≤ 10 Hz
Lamp load	≤5 W
Output delay (resistive load, output current 0.5 A) • At 0 to 1 • At 1 to 0	 typ. 150 μs typ. 150 μs
Short-circuit protection of the output	Yes
Threshold on	0.7 A to 1.8 A
Inductive extinction	Yes; L+ -(55 to 60 V)
Digital input control	Yes
Cable lengths • Unshielded • Shielded	 600 m 1000 m
Encoder Connection at Incremental Encoders with 5 V Differential Signals	
Level	To RS 422
Terminating resistance	330 Ω
Differential input voltage	Min. 1 V
Max. frequency	500 kHz
Galvanic isolation from ET200S bus	Yes
Length of cable: • Shielded	 Max. 50 m
Encoder Connection at Incremental Encoders with 24 V Signals	
Galvanic isolation from ET200S bus	Yes
Max. frequency	100 kHz
Length of cable shielded	Max. 50 m
Input voltage • Rated value • 0 signal • 1 signal	 DC24V -30 to 5V 11V to 30V
Input current • 0 signal • 1 signal	 ≤ 2mA (bias current) 9 mA (typ.)
Connection of a two-wire BERO Type 2	Yes
Input characteristic curve	To IEC 1131, Part 2, Type 2

<table>
<tr><th colspan="3">Technical specifications 1PosU</th></tr>
<tr><td colspan="3">Encoder connection SSI</td></tr>
<tr><td>Position detection</td><td colspan="2">Absolute</td></tr>
<tr><td>Differential signals for SSI data and SSI clock</td><td colspan="2">According to RS422</td></tr>
<tr><td>Data transmission rate and line length with absolute encoders (twisted pair and shielded)</td><td colspan="2">• 125 kHz max. 320 m
• 250 kHz max. 160 m
• 500 kHz max. 60 m
• 1 MHz max. 20 m
• 2 MHz max. 8 m</td></tr>
<tr><td colspan="3">Age of the encoder value
• Max. (2 * frame runtime) + 64 µs
• Min. frame runtime</td></tr>
<tr><td>Frame runtime
• 125 kHz
• 250 kHz
• 500 kHz
• 1 MHz
• 2 MHz
Monoflop time [1]</td><td>13 Bit
112 µs
56 µs
28 µs
14 µs
7 µs
64 µs</td><td>25 Bit
208 µs
104 µs
52 µs
26 µs
13 µs</td></tr>
<tr><td colspan="3">Status, Diagnostics</td></tr>
<tr><td>Change in actual value (up)
Change in actual value (down)
Status display positioning in operation
Status display DI0 (minus hardware limit switch)
Status display DI1 (plus hardware limit switch)
Status display DI2 (reducing cam)
Group error on the 1PosU
Diagnostic information</td><td colspan="2">UP LED (green)
DN LED (green)
LED POS (green)
LED 1 (green)
LED 5 (green)
LED 2 (green)
SF LED (red)
Yes</td></tr>
<tr><td colspan="3">Response Times</td></tr>
<tr><td>Update rate for feedback messages</td><td colspan="2">2 ms</td></tr>
<tr><td>Response time at the switchover or switch-off point</td><td colspan="2">At incremental encoder:
Output delay + 30 µs
For SSI encoder:
Output delay + Frame runtime + 30 µs</td></tr>
<tr><td>Latch response time</td><td colspan="2">For incremental encoder:
Typ. 400 µs
For SSI encoder:
Typ. 400 µs + age of encoder value</td></tr>
<tr><td colspan="3">[1]Encoders with a monoflop time greater than 64 µs, cannot be used with the 1PosU.</td></tr>
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