SIEMENS

SIMATIC S5

IP 264
Cam Controller

Equipment Manual

Release 01
Order No: 6ES5 998–5SL21

Contents

Notes on Safety ESD Guidelines	
Foreword Introduction	
System Overview	1
Technical Description of the IP 264	2
Setup Guidelines	3
Functions of the IP 264	4
Communication of the CPU with the IP 264	5
Commissioning	6
Sample Program	7
Error Treatment	8
Definition of Terms	9
Index	10

SIMATIC is a trade mark of Siemens.

Subject to change without prior notice. Siemens Aktiengesellschaft

Although the contents of this publication have been checked for agreement with the hardware and software described, we do not accept liability for total agreement since differences cannot be completely excluded. The information in this publication is checked at regular intervals and necessary corrections included in the next release. Your suggestions for improving this publication are welcome.

© Copyright Siemens AG 1992 All Rights Reserved

Passing on and reproduction of these documents, and utilization and disclosure of their contents is prohibited unless specifically authorized. Violations shall be cause for damage liability.
All rights reserved, particularly in the event a patent is issued or a utility model patent is registered.

Foreword

Intelligent I/O module IP 264 is an electronic cam controller. It is designed for use in programmable controllers S5–90U, S5–95U and S5–100U, and in decentral I/O device ET 200U. When used in the S5–100U, the IP 264 can be operated with the CPUs listed below.

- CPU 100 (only 6ES5 100–8MA02)
- CPU 102 (no restrictions)
- CPU 103 (no restrictions)

The IP 264 controls up to 64 cams on a maximum of 16 cam tracks for a linear or rotary axis with great precision. Cam program processing is automatically performed by the module within a very short cycle time which relieves the SIMATIC S5.

After cam processing has been triggered, the PLC–CPU can execute your control program parallel to cam processing. Despite this, the S5 can still access the IP 264 at all times. For example, it can scan the status of the cam tracks, or use the output ports to monitor and control the status of digital outputs.

If required, cascading with additional modules can be used to address more than 16 cam tracks of one axis (one encoder).

Since this module can be used in programmable controllers S5–90U, S–95U and S5–100U, and the ET 200U, we assume that you are familiar with the manual of your device. The basics of STEP5 program processing will not be covered here.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Introduction

The following information is provided to simplify working with this manual.

Material covered by this manual
The material covered by this manual is divided into individual blocks as shown below.

Hardware Description

Section 1 "System Overview" and section 2 "Technical Description" contain information on the components of the cam controller and their integration in the PLCs. You will find detailed information on the connection assignment of the individual interfaces and their location on the IP 264 module and an explanation of the available I/O connections listed below.

- Encoder types
- Digital inputs/outputs

Setup Guidelines

Section 3 "Setup Guidelines" contains all information required for the setup.

- Safety guidelines
- Shielding
- Mounting/demounting of modules

Functions of the IP 264

Section 4 provides information on the method of operation of the cam controller, presents the types of cams available, and shows the principal setup of a cam program.

The supply of the module with the data required for cam processing (parameterization) is described. The registers of the module and their contents are discussed. Information is provided on the setup of a cam data record and its storage in the module RAM.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Communication of the CPU with the IP 264

Data transmission via the bus interface is performed with fixed addressing telegrams. You must be familiar with these telegrams if you want to control the IP 264 with a STEP5 program.

Commissioning

This section describes how to install and start the IP 264.

This section assumes that you are familiar with the contents of section 4.

Sample Program

This section explains the setup of the sample program included on the floppy disk and provides information on handling this program.

Error Treatment

This section tells you how to handle errors. A list of errors and remedies is provided here.

Definition of Terms

This section explains terms applicable to the modules and controls.

Index

The index makes it easier to find selected text passages.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Available Courses

Siemens offers extensive schooling for the SIMATIC S5 system. Contact your Siemens office for detailed information.

Available Literature

This manual provides a complete description of the IP 264 positioning module. Other subject areas related to SIMATIC®S5 devices are only mentioned.

The following books contain detailed information.

- **Programming the SIMATIC S5–100U**
  Practical exercises with the PG 615 programmer

  Siemens AG, Berlin and Munich, 1988

  Contents:
  - Setup and installation of PLC S5–100U
  - Introduction to programming with the PG 615

  Order no: ISBN 3–8009–1500–6

- **SPS Memory Programmable Controllers**
  Volume 1: Link and Processing Controls; from the control tasks to the control program

  Günter Wellenreuther, Dieter Zastrow
  Braunschweig 1987

  Contents:
  - Method of operation of a memory programmable controller
  - Theory of control technology using the STEP5 programming lanauge for SIMATIC S5 pro grammable controllers.

  Order no: ISBN 3–528–04464–0

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Understood Stipulations

The manual uses tables of contents to make it easier to use the manual. This includes the following.

- Sections 1 to 7 are prefaced by individual tables of contents.
- The pages, figures and tables are numbered separately. Lists of the figures and tables included in the respective section are provided on the back each sections's table of contents.

Definite terms are used in this manual. Below you will find a list of these terms.

- Characteristic abbreviations are used for certain terms. These are explained the first time they are used in the manual.
  Example: Programmable controller (PLC)
- Cross references are handled as follows.
  "(→ section 4.3.2)" references section 4.3.2.
  References to individual pages are not used.
- Value ranges are presented as follows: 17 to 21.
- Required actions are preceded with an arrow (▶).

Emphasis of safety precautions

In this manual, information which, when not adhered to, can present a danger to persons or equipment is presented as shown below.



Warning

Indicates that loss of life, severe personal injury or substantial property damage **can** result if proper precautions are not taken.



Caution

Indicates that minor personal injury or property damage can result if proper precautions are not taken.



Important information on the product or the respective portion of the manual which requires particular attention.

Equipment manuals can only describe the current release status of the device. When changes or supplements become necessary over time, the manual is provided with a supplement which is then incorporated in the manual the next time it is updated. The respective release status of the manual is indicated on the cover sheet. The release status is incremented by "1" each time the manual is updated.

© Siemens AG 1992, Order No: 6ES5 998-5SL21

Table of Contents

1	**System Overview**	**1 – 1**
1.1	Possible Uses	1 – 2
1.2	Types of Axes	1 – 2
1.3	Integration of the IP 264 in the SIMATIC S5 System	1 – 4
2	**Technical Description of the IP 264**	**2 – 1**
2.1	Hardware Setup	2 – 1
2.2	Interfaces to the Encoders	2 – 3
2.3	Interfaces for Digital Inputs and Outputs	2 – 11
2.4	Indication LEDs	2 – 13
2.5	Monitoring	2 – 14
2.6	Technical Specifications	2 – 15
3	**Setup Guidelines**	**3 – 1**
3.1	Safety	3 – 1
3.2	EMC Measures	3 – 2
3.3	Mounting/Demounting the Module	3 – 4
3.4	Changing the Encoder	3 – 5
4	**Functions of the IP 264**	**4 – 1**
4.1	Method of Operation of the Cam Controller	4 – 1
4.2	Parameterization	4 – 18
4.3	Operation of the Module	4 – 40
5	**Communication of the CPU with the IP 264**	**5 – 1**
5.1	Output Telegram (PLC–CPU → IP 264)	5 – 3
5.2	Input Telegram (IP 264 → PLC–CPU)	5 – 9
5.3	Special Operating States	5 – 13
6	**Commissioning**	**6 – 1**
6.1	Programming the System	6 – 1
6.2	Parameterization of the IP 264	6 – 3

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7	**Sample Program**	**7 – 1**
7.1	Startup Behavior	7 – 3
7.2	Cyclic Program	7 – 4
7.3	Parameterization Data Block	7 – 6
7.4	Data Block for Cam Data Records	7 – 7
8	**Error Treatment**	**8 – 1**
9	**Definition of Terms**	**9 – 1**
10	**Index**	**10 – 1**

© Siemens AG 1992, Order No: 6ES5 998–5SL21

1 System Overview

1.1 Possible Uses ..... 1 – 2

1.2 Types of Axes ..... 1 – 2

1.3 Integration of the IP 264 in the SIMATIC S5 System ..... 1 – 4

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Figures

Figure 1.1 Diagram of an hydraulic press (via relay valve) ..... 1 – 2

Figure 1.2 Diagram of an eccentric press ..... 1 – 3

Figure 1.3 The IP 264 in the SIMATIC S5 system ..... 1 – 4

IP 264 Equipment Manual

© Siemens AG 1992, Order No: 6ES5 998–5SL21

1 System Overview

Functions of module

The IP 264 intelligent I/O module provides an electronic cam controller for one axis for the module series available for programmable controllers (PLCs) S5–90U, S5–95U and S5–100U, and for the ET 200U decentral I/O device. It automatically controls up to 64 cams on a maximum of 16 cam tracks with great precision. After the CPU of the PLC has triggered a job, the IP 264 places no further requirements on CPU time. Cam processing runs parallel to the program processing of your STEP5 program.

The pulses/absolute value of the connected encoder are acquired by the IP 264. This is then used to determine the current position, which is continuously compared to the switching points of the cam. The corresponding cam track is switched on/off when a switching point is reached.

Features

The IP 264 offers the following features.

- Serial bus interface to the programmable controller
- Digital inputs and outputs
- Status indications for various operating states
- Interface for the connection of a 24–V initiator, an incremental encoder or SSI encoder for acquisition of the current position
- Interface for cascading the module

Cam characteristics

- All cams are dynamic. Each cam has its own dynamics factor. This function is also known by the term "dead time offset". It is used to dynamically offset reaction times (dead times) of the addressed units (based on the clock pulse number).
- All cams can be programmed as either position cams or time cams. In addition, two special functions (counting cams and braking cams) are available.
- All cams can be assigned as desired to one of the 16 cam tracks of the module. Each cam track is assigned to one digital output. This permits the connected units to be addressed directly and without time loss.

Access by the S5

The SIMATIC S5 can scan the status of the cam tracks at all times and monitor and even control the status of the output ports if this should become necessary (e.g., during commissioning or for the function test of a unit).

The data record of each individual cam can be changed by the SIMATIC S5 at all times. This makes it simple to perform optimizations on the running machine during setup, for example.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

1.1 Possible Uses

Applications

Typical applications for the IP 264 module

- Mechanical and hydraulic presses
- Revolving machines
- Transfer systems
- Packaging machines

1.2 Types of Axes

Selection

The IP 264 can be operated on one of the following.

- Rotary axis
- Linear axis

Linear axis

A linear axis is an axis with a restricted travel range. The travel range is restricted by the following factors.

- Switches on the axis
- Geometry of the machine (e.g., hydraulic press)

Up to 64 cams can be set anywhere within the travel range.

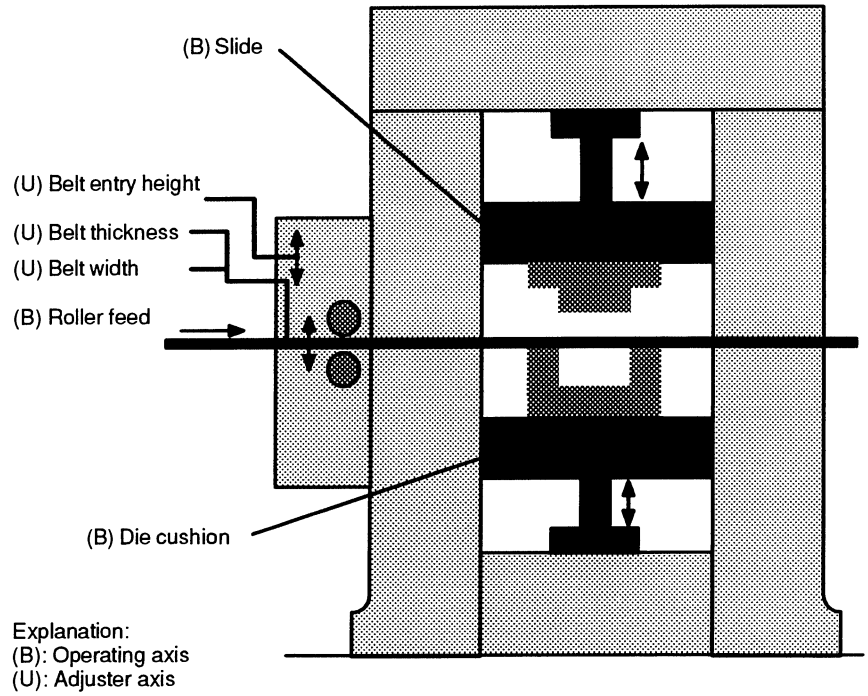


Figure 1.1 Diagram of an hydraulic press (via relay valve)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Rotary axis

A rotary axis is an axis without restrictions. Some example are listed below.

- A round table
- A continuous belt
- An eccentric

Range start and range end on a rotary axis are the same point physically on the axis.
Only the actual value is switched over when travel range start or travel range is reached.

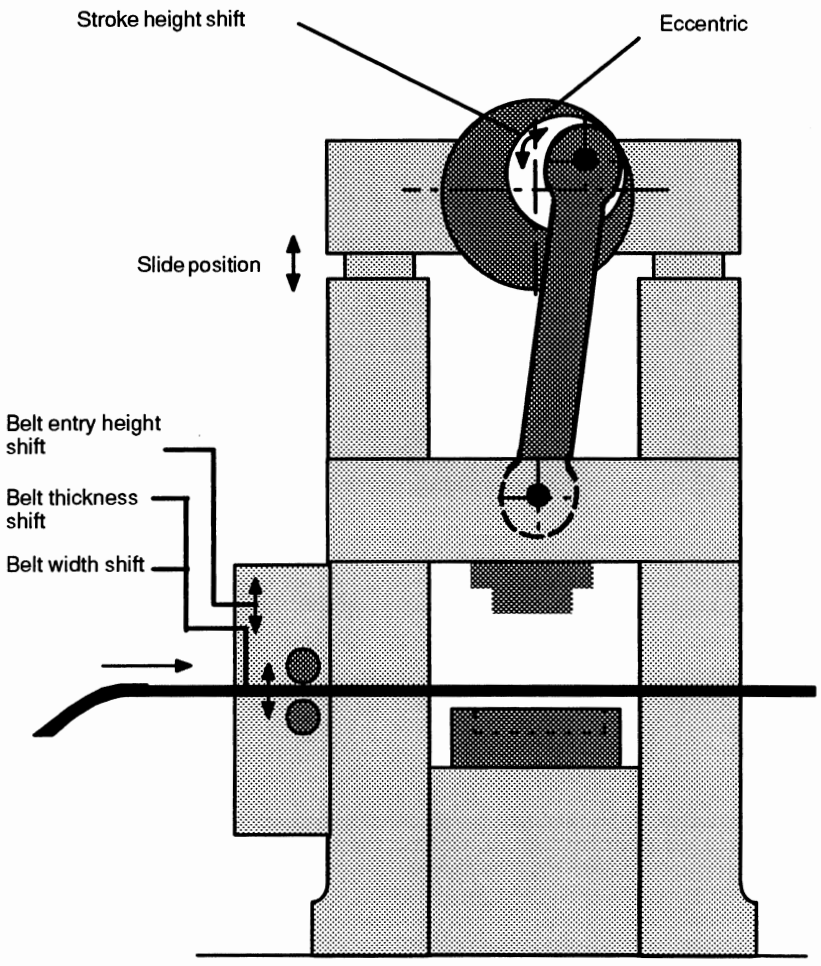


Figure 1.2 Diagram of an eccentric press

© Siemens AG 1992, Order No: 6ES5 998–5SL21

1.3 Integration of the IP 264 in the SIMATIC S5 System

Diagram of the principle

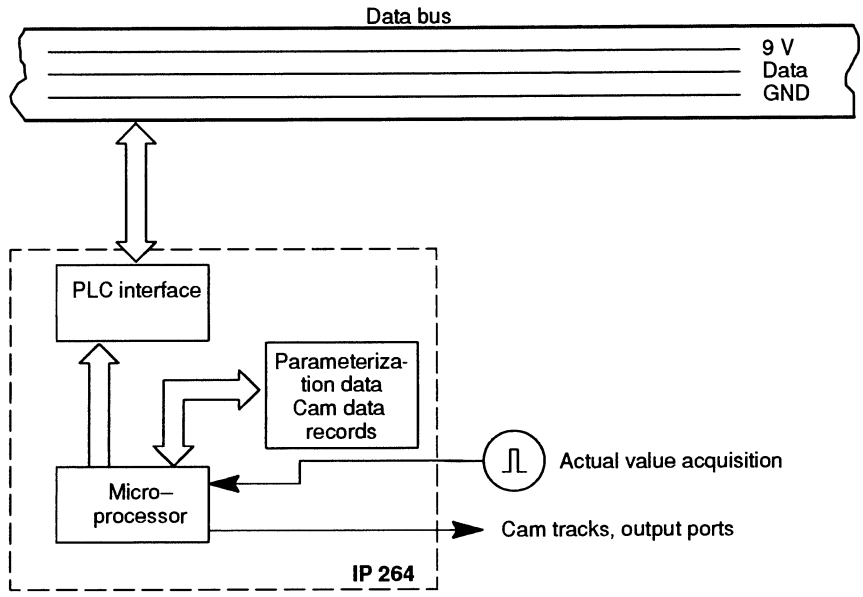


Figure 1.3 The IP 264 in the SIMATIC S5 system

The IP 264 can be installed on a bus submodule slot for analog modules (slots 0 to 7). In addition to the back bus connection, the IP 264 is equipped with additional interfaces for the following components.

- Connection of 1 encoder (incremental or SSI)
- Cascading with additional IP 264 modules
- 2 digital inputs for synchronization and brake enable
- 16 digital outputs for cam tracks/output ports

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2 Technical Description of the IP 264

2.1	Hardware Setup	2 – 1
2.2	Interfaces to the Encoders	2 – 3
2.2.1	Initiator with 24–V Signal (Proximity Switch)	2 – 3
2.2.2	Incremental Encoders	2 – 3
2.2.3	Absolute Value Encoder with SSI Interface	2 – 8
2.2.4	Cascading Plug Connector	2 – 10
2.3	Interfaces for Digital Inputs and Outputs	2 – 11
2.3.1	Digital Inputs	2 – 11
2.3.2	Digital Outputs	2 – 12
2.4	Indication LEDs	2 – 13
2.5	Monitoring	2 – 14
2.5.1	Encoder Monitoring	2 – 14
2.5.2	Supply Voltage	2 – 14
2.6	Technical Specifications	2 – 15

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Figures

Figure 2.1 Diagram of the IP 264 with interfaces ..... 2 – 1

Figure 2.2 Elements on the front plate ..... 2 – 2

Figure 2.3 Encoder signals ..... 2 – 3

Figure 2.4 Pin allocation for the connection of incremental encoders ..... 2 – 4

Figure 2.5 Connection of asymmetrical encoders with totem pole output (counter clock pulse circuit) ..... 2 – 5

Figure 2.6 Connection of asymmetrical encoders with open collector (p–switching) .. 2 – 5

Figure 2.7 Connection of asymmetrical encoders with open collector (n–switching) .. 2 – 5

Figure 2.8 Pin allocation for the connection of SSI encoders ..... 2 – 9

Figure 2.9 Pin allocation of the cascading plug connector ..... 2 – 10

Figure 2.10 Allocation of the terminal block ..... 2 – 11

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2 Technical Description of the IP 264

Tasks of the module

The IP 264 is an electronic cam controller. The required data are supplied by the PLC via the bus interface. The actual position of the axis is acquired by an incremental encoder or an absolute SSI encoder and cyclically compared with the cam data stored in the RAM of the module.

The results of the comparison are output on the cam tracks. The corresponding cam is switched on or off when a switching point is reached.

Cascading with additional IP 264 modules allows more than 16 cam tracks to be addressed by one encoder.

2.1 Hardware Setup

Components

The housing of the IP 264 is twice as wide as a standard model. Its primary components are shown in the diagram below.

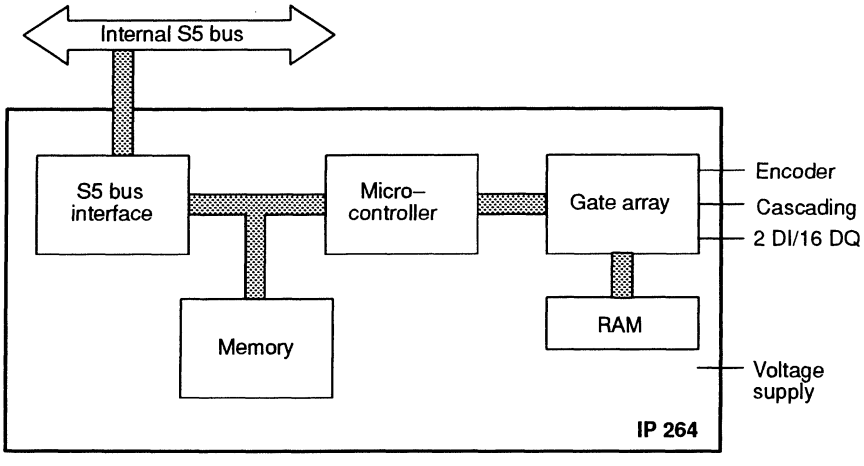
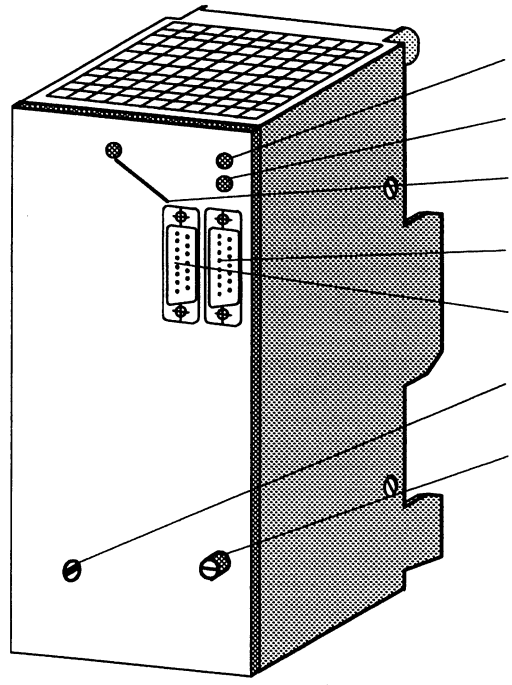


Figure 2.1 Diagram of the IP 264 with interfaces

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Connection elements, indications

The encoder is connected to the lefthand, sub D, plug connector on the front plate of the IP 264. The righthand, sub D, plug connector is used for cascading.



Cam Processing	Green LED
Error indication	Red LED
Ready indication	Green LED
Cascading	15–way, sub D plug connector
Encoder	15–way, sub D plug connector
Mounting screw	For mounting on the bus submodule
Fuse	6 A, fast action

Figure 2.2 Elements on the front plate

The IP 264 also requires the circuitry of the digital inputs and outputs on the terminal block of the bus submodule.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.2 Interfaces to the Encoders

Types of encoders The following can be used to acquire the actual position.

- Initiator with 24–V signal (proximity switch)
- Incremental encoder with zero marking pulse
- Absolute value encoder with SSI interface

2.2.1 Initiator with 24–V Signal (Proximity Switch)

Method of operation An initiator (proximity switch) can be connected to the IP 264 as a simple type of encoder. The initiator scans a toothed wheel, for example, to supply position information.

The encoder signal does not contain direction information. This must be provided by the S5 on the interface.

2.2.2 Incremental Encoders

Signal forms The IP 264 requires two signals (A and B) displaced by 90° for acquisition of the position and direction of rotation. These signals and an additional zero marking pulse signal N must be supplied by an incremental encoder.

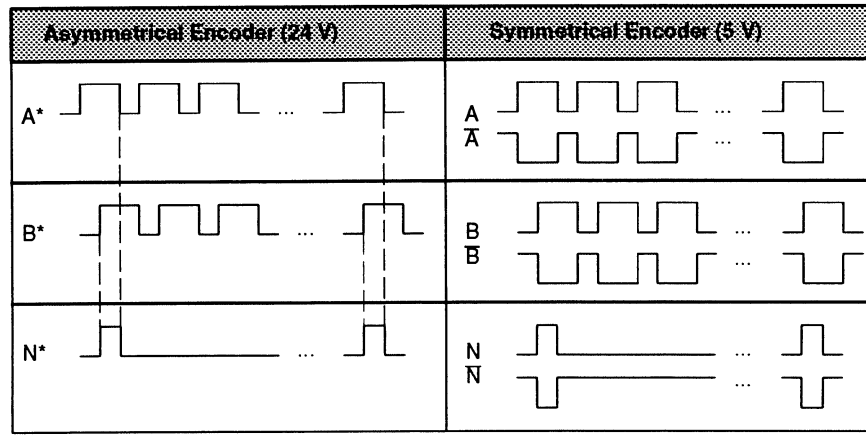


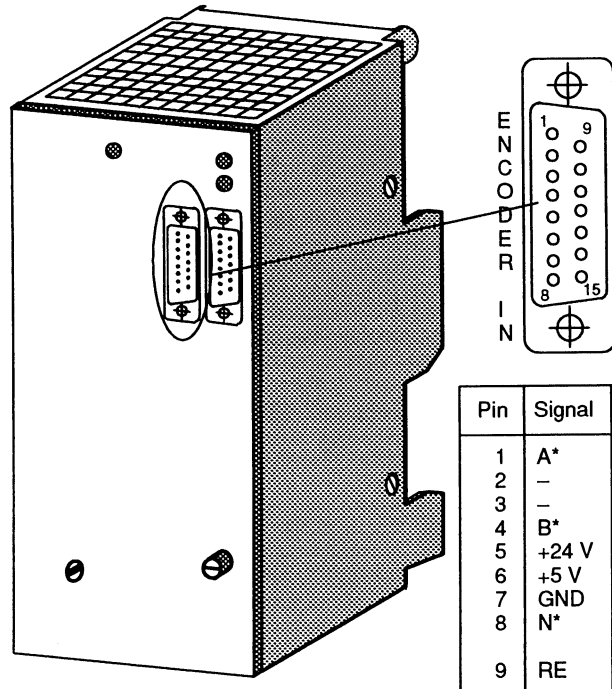
Figure 2.3 Encoder signals

Either encoders with 5–V signals or encoders with 24–V signals can be connected.

The 5–V model must also supply the inverted signals $\overline{A}$, $\overline{B}$ and $\overline{N}$. The 15–way, sub D socket on the front of the module contains all supply and signal lines for both types of encoders.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Pin allocation of the encoder connection



Pin	Signal	Meaning
1	A*	Signal A (24 V)
2	–	–
3	–	–
4	B*	Signal B (24 V)
5	+24 V	Encoder supply
6	+5 V	Encoder supply
7	GND	Ground
8	N*	Zero marking pulse signal (24 V)
9	RE	Load resistance for 24–V encoder signals
10	N	Zero marking pulse signal (5 V)
11	$\overline{N}$	Zero marking pulse signal, inverse (5 V)
12	$\overline{B}$	Signal B, inverse (5 V)
13	B	Signal B (5 V)
14	$\overline{A}$	Signal A, inverse (5 V)
15	A	Signal A (5 V)

Figure 2.4 Pin allocation for the connection of incremental encoders

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Encoder selection

The type of encoder is selected in register 10 (→ section 4.2.1.12) during parameterization of the IP 264.

When incremental encoders with 24–V signals, or 24–V initiators are used, pin 9 (RE) must be connected with GND (totem pole and p–switching) or 24 V (n–switching), depending on the type of encoder.

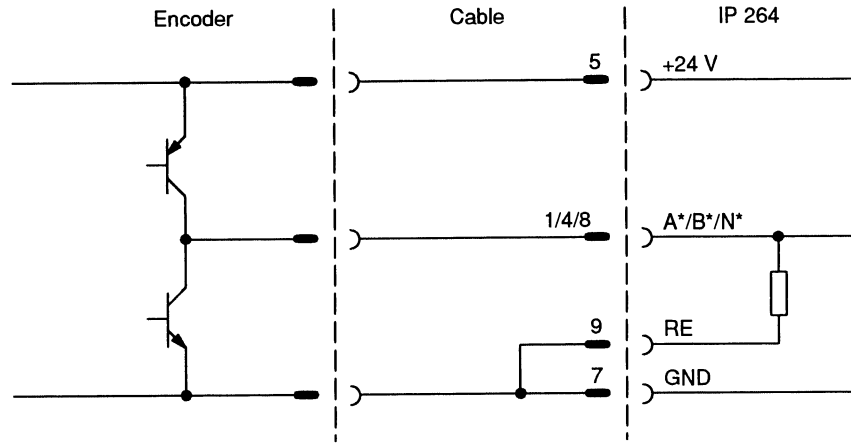


Figure 2.5 Connection of asymmetrical encoders with totem pole output (counter clock pulse circuit)

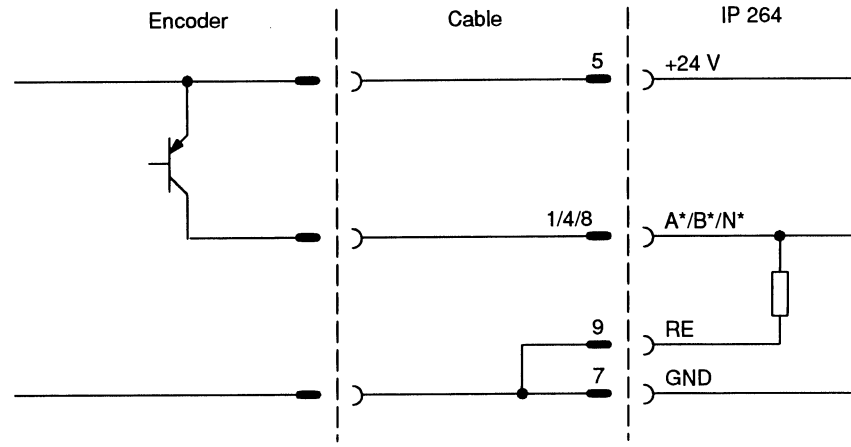


Figure 2.6 Connection of asymmetrical encoders with open collector (p–switching)

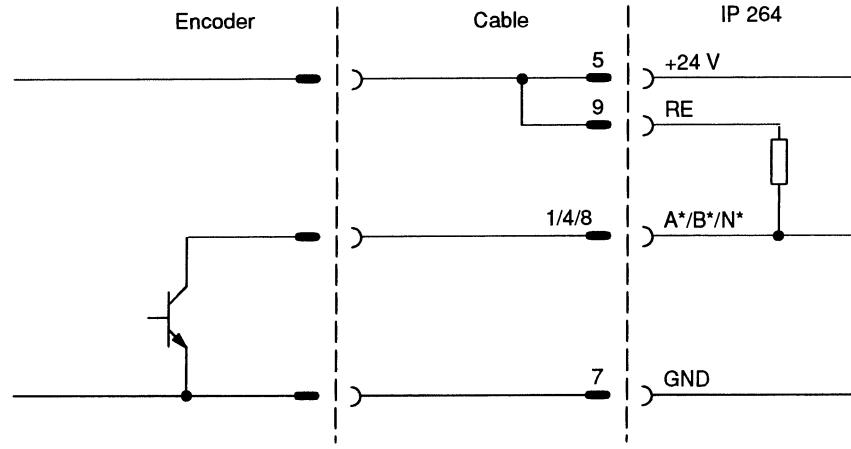


Figure 2.7 Connection of asymmetrical encoders with open collector (n–switching)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Technical specifications for incremental encoders

Incremental encoders must meet the following technical specifications.

Voltage supply:	5 V or 24 V
Output signals:	
– Symmetrical encoders (5–V, RS 422 signals)	Signal A Signal B Zero marking pulse signal N Signal $\overline{A}$ Signal $\overline{B}$ Zero marking pulse signal $\overline{N}$
– Asymmetrical encoders (24–V encoder)	Signal A* Signal B* Zero marking pulse signal N*
Upper limit frequency	
– 5–V encoder	200 kHz
– 24–V encoder	100 kHz for 25–m line length

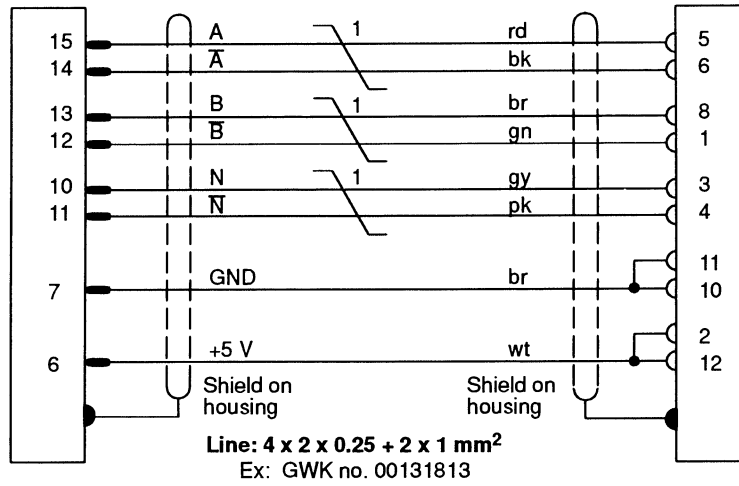
When a Siemens encoder (6FC9 320) for 5–V signals is used, we recommend the following plug–in line for the connection to the IP 264.

Order no: 6ES5 703–1□□□□

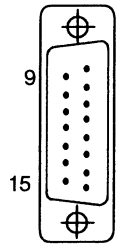
The first three boxes in the order number stand for the three–digit length key which you will find in the ST 52.1 catalog. The last box stands for the cable termination (see below).

Plug–in lines

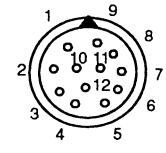
Plug–in line for Siemens encoder 6FC9 320



Line: 4 x 2 x 0.25 + 2 x 1 mm²
Ex: GWK no. 00131813



15–way, sub D pin plug connector
Connection side metallized housing with screw lock
6FC9 341–1HC



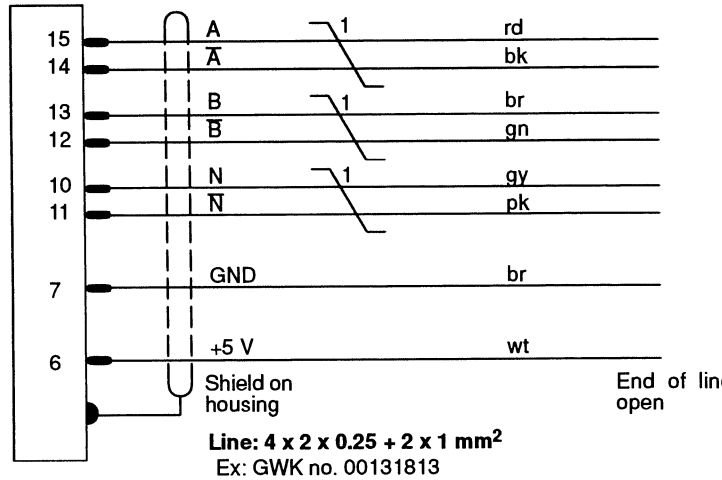
Round plug connector, 12–way socket
Connection side
SIEMENS
6FC9 431–1FD

Length:	Maximum 32 m	
Order no:	6ES5 703–1□□□0	Cable termination, top
	6ES5 703–1□□□1	Cable termination, bottom

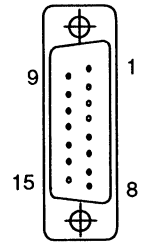
1 Lines twisted in pairs

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Plug–in line for incremental encoder (5–V signals, 5–V encoder supply)



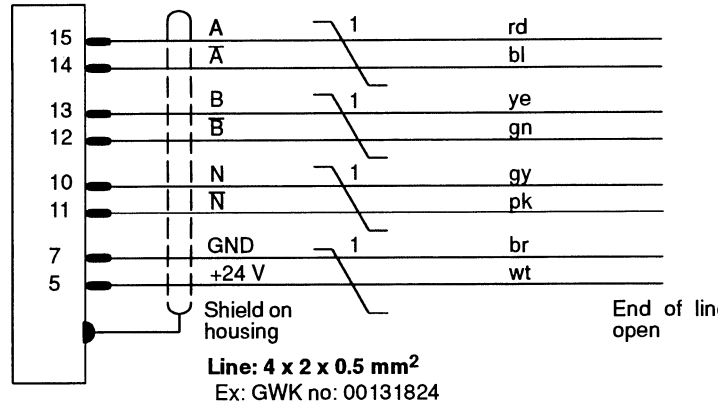
Line: 4 x 2 x 0.25 + 2 x 1 mm²
Ex: GWK no. 00131813



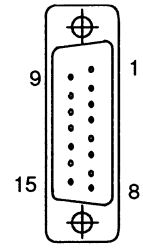
15–way, sub D pin plug connector
Connection side metallized housing with screw lock
6FC9 341–1HC

Length: Maximum 32 m
Order no: 6ES5 703–2□□□0 Cable termination, top
6ES5 703–2□□□1 Cable termination, bottom

Plug–in line for incremental encoder (5–V signals, 24–V encoder supply)



Line: 4 x 2 x 0.5 mm²
Ex: GWK no: 00131824



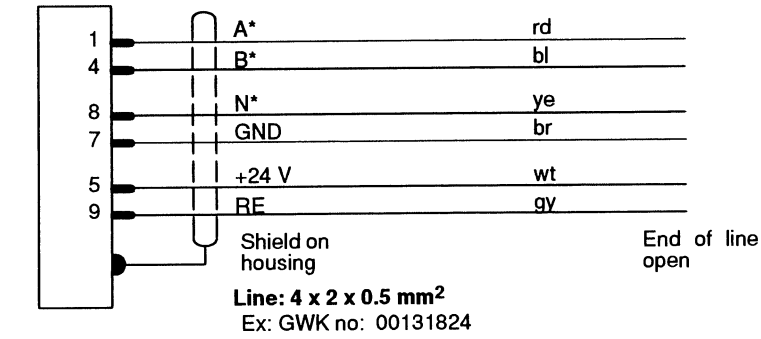
15–way, sub D pin plug connector
Connection side metallized housing with screw lock
6FC9 341–1HC

Length: Maximum 100 m
Order no: 6ES5 703–3□□□0 Cable termination, top
6ES5 703–3□□□1 Cable termination, bottom

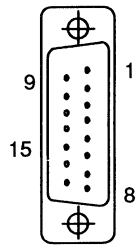
1 Lines twisted in pairs

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Plug–in line for incremental encoder (24–V signals, 24–V encoder supply)



Line: 4 x 2 x 0.5 mm²
Ex: GWK no: 00131824



15–way, sub D pin plug connector
Connection side metallized housing with screw lock
6FC9 341–1HC

Length:	Maximum 100 m	
Order no:	6ES5 703–4□□□0	Cable termination, top
	6ES5 703–4□□□1	Cable termination, bottom

2.2.3 Absolute Value Encoder with SSI Interface

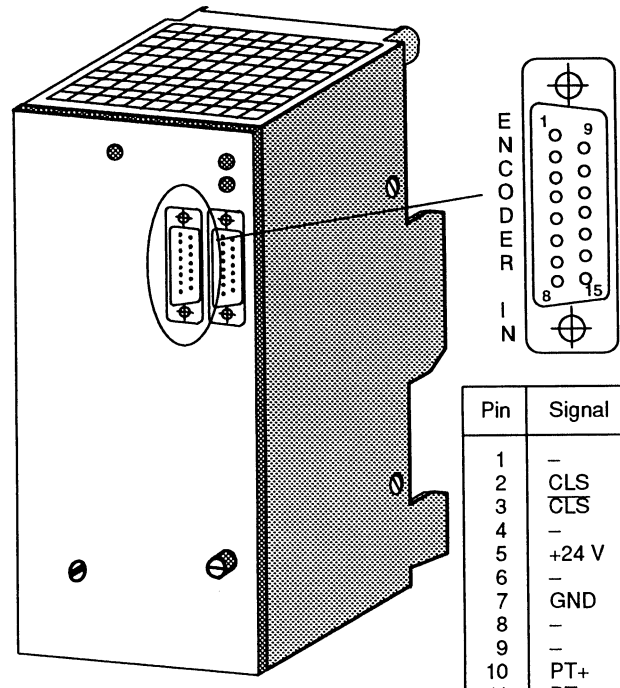
Method of operation

The position of the axis is continuously scanned by a code disk. The actual value of the position encoder is requested by the IP 264 by sending a clock pulse train to the clock pulse input of the encoder.

During parameterization, all required settings are performed in register 10 (→ section 4.2.1.12) for your type of encoder.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Pin allocation of the encoder connection

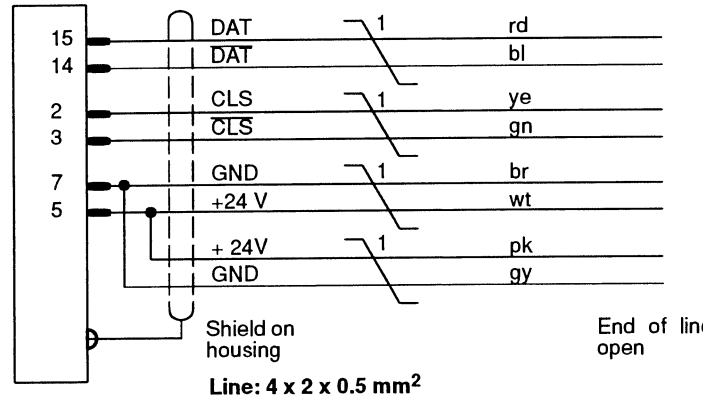


Pin	Signal	Meaning
1	–	
2	CLS	SSI clock pulse
3	$\overline{\text{CLS}}$	SSI clock pulse, inverse
4	–	
5	+24 V	Encoder supply
6	–	
7	GND	Ground
8	–	
9	–	
10	PT+	Programming signals for T+R encoders
11	PT–	
12	–	
13	–	
14	$\overline{\text{DAT}}$	SSI data, inverse
15	DAT	SSI data

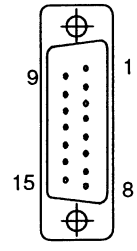
Figure 2.8 Pin allocation for the connection of SSI encoders

Plug–in line

Plug–in line for SSI encoder (cannot be programmed) [2]



Line: 4 x 2 x 0.5 mm²
Ex:GWK no: 00131824



15–way, sub D pin plug connector
Connection side metallized housing with screw lock
6FC9 341–1HC

Length:	Maximum 320 m	
Order no:	6ES5 703–5□□□0	Cable termination, top
	6ES5 703–5□□□1	Cable termination, bottom

1 Lines twisted in pairs
2 Plug–in lines with programming capability must be ordered directly from the maker of the encoder (T+R).

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.2.4 Cascading Plug Connector

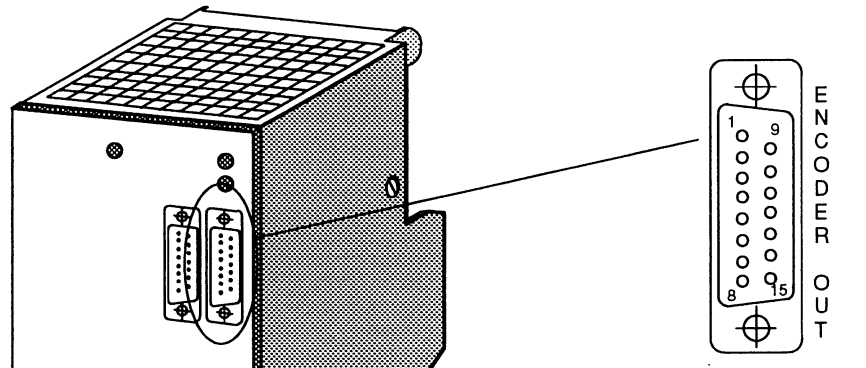
Use

The IP 264 module can be cascaded to increase the number of cam tracks to more than 16. This requires that the encoder signals be led to additional IP 264 modules using the cascading plug connector. Cascading can be used with incremental and absolute value encoders.

When an SSI absolute value encoder is used, "listen in operation" must be parameterized for the slave IP 264 modules.

☞ Since the 24–V signals of the encoders are looped through, each cascading places an extra load of up to 5 mA on the output signal of the encoder.

Pin allocation of the cascading plug connector



Pin	Signal	Meaning
1	A*	Signal A (24 V)
2	CLS	SSI clock pulse
3	$\overline{\text{CLS}}$	SSI clock pulse, inverse
4	B*	Signal A (24 V)
5	–	–
6	–	–
7	GND	Ground
8	N*	Zero marking pulse signal (24 V)
9	RE	Load resistance for 24–V encoder signals
10	N	Zero marking pulse signal (5 V)
11	$\overline{\text{N}}$	Zero marking pulse signal, inverse (5 V)
12	$\overline{\text{B}}$	Signal B, inverse (5 V)
13	B	Signal B (5 V)
14	$\overline{\text{A/DAT}}$	Signal A, inverse (5 V)/ SSI data, inverse
15	A/DAT	Signal A (5 V)/ SSI data

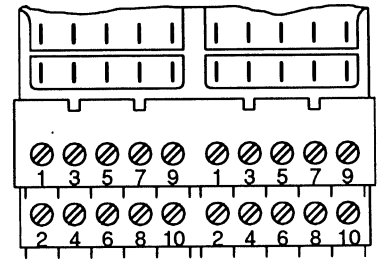
Figure 2:9 Pin allocation of the cascading plug connector

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.3 Interfaces for Digital Inputs and Outputs

Terminal block

The IP 264 is equipped with two digital inputs and 16 digital outputs (cam tracks). They can be accessed via the terminal block of the bus submodule.



	Terminal	Allocation	DI	DQ
Left block under IP 264	1	Synchronization	x	
	2	Braking enable	x	
	3	Cam track 0/port 0		x
	4	Cam track 1/port 1		x
	5	Cam track 2/port 2		x
	6	Cam track 3/port 3		x
	7	Cam track 4/port 4		x
	8	Cam track 5/port 5		x
	9	Cam track 6/port 6		x
	10	Cam track 7/port 7		x
Right block under IP 264	1	+24 V		
	2	GND		
	3	Cam track 8/port 8		x
	4	Cam track 9/port 9		x
	5	Cam track 10/port 10		x
	6	Cam track 11/port 11		x
	7	Cam track 12/port 12		x
	8	Cam track 13/port 13		x
	9	Cam track 14/port 14		x
	10	Cam track 15/port 15		x

Figure 2.10 Allocation of the terminal block

The ground potential (GND; terminal 2 of the right hand block) must always be connected to device ground of the PLC. This is the only way to ensure correct functioning of the module.

2.3.1 Digital Inputs

The synchronization signal and the switch for the braking enable are connected to the digital inputs.

Synchronization

The synchronization event with which the module is to operate is specified during parameterization.
Digital input DI 1 must be circuited if you have selected "external SYNC signal".

Braking enable (upper/lower dead point)

Digital input DI 2 is connected with the switch for the braking enable. If the corresponding command bit is set, cam track 1 is controlled with this.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.3.2 Digital Outputs

Cam tracks

The cam tracks are switched on or off at the start and end values of the cam. Several cams can be assigned to one track.

☞ If inductive loads (e.g., contactors) are to be circuited with digital outputs (cam tracks/output ports), additional free–wheeling diodes must be provided directly on these loads.

Stop of the PLC CPU

When the PLC CPU passes from RUN to STOP status, the IP 264 uses a command bit to determine whether the cam tracks are to be inhibited immediately or whether the module is to continue functioning unchanged but without communication with the PLC (→ section 4.2.1.3).

RESET

A RESET (e.g., after return of power) resets all outputs.

Output loads

All 16 outputs can be simultaneously loaded with 0.3 A each.

The outputs can be loaded with 0.4 A when a simultaneity factor of 0.5 is maintained for each group (see "Parameterization Port" below).

☞ For safety reasons, all outputs of the module are switched off starting with a voltage of approximately 35 V.

Depending on the parameterization in register 7 (→ section 4.2.1.9), the outputs switch off under the following conditions.

"Cam Track" Parameterization:
Overload, short circuit or excess temperature causes *all* outputs parameterized as cam tracks to be switched off.

"Port" Parameterization:
- Overload or short circuit causes *only the affected output* to be switched off.
- Excess temperature causes *all outputs of the affected group* (one group consists of four outputs: 0 to 3, 4 to 7, etc.) to be switched off.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.4 Indication LEDs

Number and location

The module is equipped with three LEDs for indication of the operating states. They are located above the plug connectors for the sensors.

RUN LED (ready)

This green LED is set (lights up) by the firmware as soon as the CPU (ready) exits the RESET status (startup and internal initialization concluded) and operates as planned.

A HW reset causes the module to be reset and the green LED goes off.

ERROR LED

The red LED indicates error states of the IP 264.

The following malfunctions cause it to go on.

- RESET
- SYNC bit not set
- Cable break (only for 5–V incremental encoders and SSI encoders)
- Error message of the outputs

OK LED (Cam processing)

The green LED goes on when **all** the following conditions are met.

- The SYNC bit is set.
- The cam program is being processed.
- The bit for inhibiting the digital outputs parameterized as cam tracks is not set.
- No error message from the outputs is queued.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.5 Monitoring

The IP 264 is equipped with monitoring functions to check the I/O devices and execution of the program.

2.5.1 Encoder Monitoring

Cable break monitoring

Cable break monitoring is provided for the connection of encoders with 5–V signals in accordance with RS 422.

The following errors are detected.

- Interruption of one wire
- Interruption of both wires
- Short circuit of one wire to ground or +5 V
- Short circuit of both wires to ground or +5 V
- Short circuit between both wires

To ensure reliable cable break monitoring, the difference of the complementary input signals must be at least 1.7 V.

☞ Encoders with 24–V signals are not monitored.

Activation

Cable break monitoring is activated during parameterization (→ section 4.2) by writing the command register.

Behavior during cable break

When a cable break occurs, the outputs parameterized as cam tracks are immediately inhibited. The outputs parameterized as port retain their function.

Start/stop bit error

For SSI encoders only

Edge error

For incremental encoders only

2.5.2 Supply Voltage

Function

The internal supply voltage is generated from the +24–V supply for the module. A HW reset is triggered as soon as this internal supply voltage drops below a certain value.

This causes a defined initial state to be set after voltage drops or after switch–on.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

2.6 Technical Specifications

Microprocessor	
Type	80C32
Processor clock pulse	16 MHz
Memory	
EPROM	64 kbytes
RAM	32 kbytes
EEPROM	1 kbits
Encoder Inputs	
Actual value acquisition	Incremental, absolute (SSI interface)
Maximum travel range	
With incremental encoders	Increments of 2^{16}
With absolute value encoders	2^{16} encoder steps
Signal voltages	
Differential inputs	5 V in accordance with RS 422
Asymmetrical inputs	24 V (incremental encoders only)
Supply voltage for the encoders (short circuit proof, no overload)	5 V/300 mA 24 V/300 mA
Input frequency and line length	
Symmetrical encoders (5–V signals)	
With 5–V encoder supply	Max. 200 kHz for 32–m line, shielded
With 24–V encoder supply	Max. 200 kHz for 100–m line, shielded
Asymmetrical encoders (24–V signals)	Max. 100 kHz for 25–m line, shielded Max. 25 kHz for 100–m line, shielded
Data transmission rate and line length for absolute value encoders	62.5 kHz (selectable in steps) 125 kHz 160 m, shielded 250 kHz 500 kHz 1 MHz 32 m, shielded
Input signals	
Incremental	2 pulse trains, displaced by 90 degrees, 1 zero marking pulse
24–V initiator (proximity switch)	1 pulse sequence
SSI	Absolute value
Input currents	
5 V	In accordance with RS 422
24 V	5 mA, average
Digital Inputs	
Input voltage range	–3 V to +30 V
Potential isolation	No
0–signal	–3 V to +5 V
1–signal	+13 V to +30 V
Permissible idling current for 0–signal	1.1 mA
Input current for 24 V	5 mA, average
Other	When the digital inputs are used, they must always be connected to defined potential (0 V, 24 V) and may not remain open.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Digital Outputs	
Output voltage range	+20 V to +30 V
Potential isolation	No
Output current for 1–signal	Max. 300 mA
Short circuit protection	Short circuit proof output
Line length, shielded	Max. 100 m
Supply Voltage	
Logic voltage generated from ext. 24 V with switching power-pack	4.9 V to +5.1 V
Current consumption from 24 V without outputs and encoder	120 mA, average
Undervoltage monitoring	U_{intern} < 4.65 V → HW reset
Power Loss	
	4 W, average (for inactive outputs)
Cycle Time of the Module	
Separate cam programs with a maximum of 32 cams each for forward and backward (including dead time offset)	57.6 µsec
"Common" cam program with a maximum of 32/64 cams for forward and backward	57.6/115.2 µsec
Environmental Requirements **Electromagnetic Compatibility** **Interference Immunity** **IEC/VDE Safety Regulations**	
The module meets the "General Technical Specifications" of the module series (see manual of the PLC).	

IP 264 Equipment Manual
© Siemens AG 1992, Order No: 6ES5 998–5SL21

3 Setup Guidelines

3.1 Safety ..... 3 – 1

3.2 EMC Measures ..... 3 – 2

3.3 Mounting/Demounting the Module ..... 3 – 4

3.4 Changing the Encoder ..... 3 – 5

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Figures

Figure 3.1 Shielding of the cables to the IP 264 in a switching cabinet ..... 3 – 3

Figure 3.2 Two–sided shielding ..... 3 – 3

© Siemens AG 1992, Order No: 6ES5 998–5SL21

3 Setup Guidelines

3.1 Safety

Required switching elements

The safety concept of the system makes it mandatory that emergency off switches be installed which are capable of switching off the entire system.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

3.2 EMC Measures

> **Caution**
>
> Interference immunity requires that all connections on the IP 264 (inputs, outputs and the 24–V supply) be designed as shielded cables.

The values specified for interference immunity in the technical specifications (→ section 2.6) maintained when the following protective measures are taken.

Shielding

- The shields of the connection cables must be applied to a shield bar. If a switching cabinet is present, the shield bar must be mounted in the vicinity of the cable lead–through.
- Braided shields must be secured to the shield bar over as much surface as possible (e.g., with metallic cable shoes which extend around the shield).
- The shield supplemental wire carried on cables with foil shields must be connected to the shield bar with the shortest possible distance (less than 3 cm).
- The shielding must be led from the shield bar up to but not applied to the module.
- The shielding bar must be connected (good conducting) to the carrying piece, the cabinet housing (if present) and the central grounding point.
- The use of a switching cabinet is required to meet the degree of protection. A metal cabinet is recommended to obtain good electrical conducting (shielding).

© Siemens AG 1992, Order No: 6ES5 998–5SL21

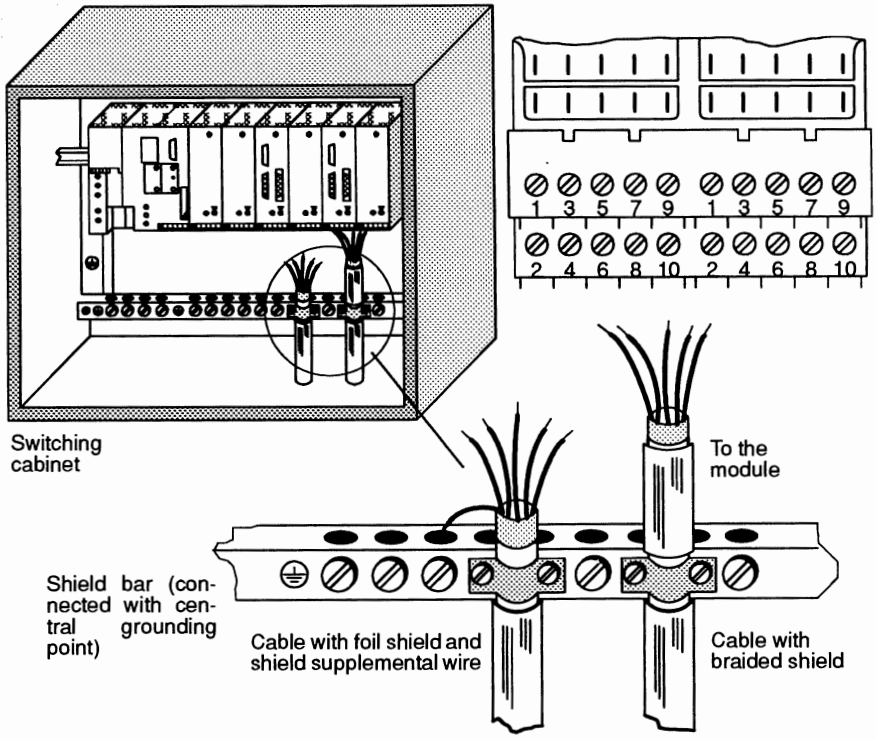


Figure 3.1 Shielding of the cables to the IP 264 in a switching cabinet

Grounding

Interference–free operation makes it mandatory to ground all cables on both sides (i.e., the shield must be applied both to the shield bar on the PLC and in the connection plug connector of the I/O device).

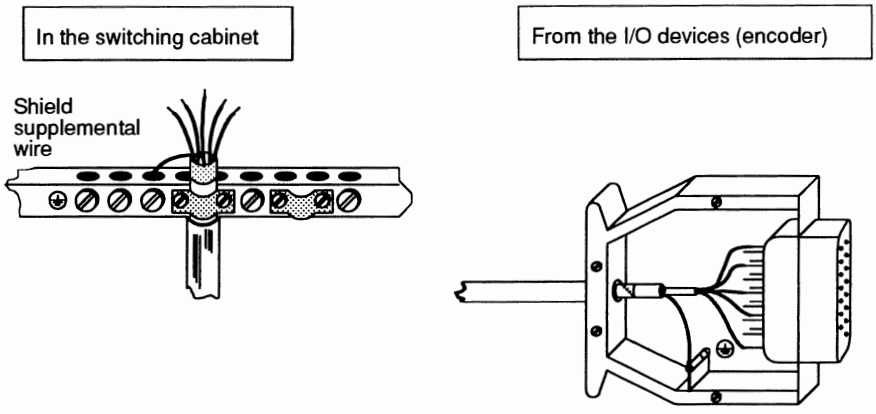


Figure 3.2 Two–sided shielding

© Siemens AG 1992, Order No: 6ES5 998–5SL21

3.3 Mounting/Demounting the Module

Coding element

The coding element of the bus submodule must be set to the type of module before you mount an I/O module.

Setting the coding element:

> **Caution**
>
> Switch off the PLC before you install a new bus submodule element or change the coding element.

An identification number (module ID) is printed on the front plate of each I/O module. A white coding pin is located on the back of the module as the "key". Its location varies with the module but is fixed. The bus submodule is equipped with the matching piece (a white, turnable coding element as the "lock") for each slot. Use a screwdriver to set the "lock" on the bus submodule to the module ID.

The IP 264 is addressed on slots 0 to 7 like an analog module.

Mounting

Two free bus submodule slots in the area from 0 to 7 are required to mount the module.

- ▶ Switch off the 24–V supply for the IP 264.
- ▶ Hang the module in the top part of the bus submodule.
- ▶ Swing the module toward the bus submodule.
- ▶ Press it in.
- ▶ Screw the module to the bus submodule.

Demounting

- ▶ Switch the PLC to stop status.
- ▶ Switch off the 24–V supply for the IP 264.
- ▶ Switch off the motor control.
- ▶ Remove the lines of the encoder and the cascading from the encoder interfaces.
- ▶ Unscrew the mounting screw for the module.
- ▶ Remove the module from the programmable controller.

All data in the RAM of the module are lost when the +24–V supply voltage is switched off and the module is demounted. Data which you want to retain must be saved before the supply voltage is switched off.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

3.4 Changing the Encoder

Changing the encoder

A change in encoder or encoder repairs may be necessary for maintenance purposes or during commissioning.

Proceed as described below. Observance is mandatory.

How to proceed

Proceed as follows to remove the encoder.

- ▶ Switch off the 24–V supply for the module.
- ▶ Remove the encoder line from the module.
- ▶ You can now make the necessary repairs or change the encoder.
- ▶ Reconnect the encoder and switch on the 24–V supply of the module again.



Caution

To avoid damage to the module or the encoder, it is absolutely necessary that the 24–V supply of the module be switched off before changing or repairing the encoder.

The IP 264 module is switched off when the supply voltage is switched off, and acknowledgement delay causes the PLC to go into stop status. The RAM data on the module are lost (→ section 3.3).

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4 Functions of the IP 264

4.1	Method of Operation of the Cam Controller	4 – 1
4.1.1	Actual Value Acquisition	4 – 2
4.1.1.1	24–V Initiator (Proximity Switch)	4 – 2
4.1.1.2	Incremental Encoder	4 – 3
4.1.1.3	SSI Absolute Encoders	4 – 5
4.1.1.4	Encoder Simulator	4 – 7
4.1.2	Types of Cams	4 – 8
4.1.2.1	Position Cams	4 – 9
4.1.2.2	Time Cam	4 – 10
4.1.2.3	Counting Cam	4 – 11
4.1.2.4	Braking Cams	4 – 12
4.1.3	Cam Dynamics	4 – 13
4.1.4	Cam Program	4 – 14
4.1.4.1	Rotary Axes	4 – 14
4.1.4.2	Linear Axes	4 – 15
4.2	Parameterization	4 – 18
4.2.1	Register Data	4 – 19
4.2.1.1	Register Overview	4 – 21
4.2.1.2	Cyclic Response Telegram (REG0)	4 – 21
4.2.1.3	Command Register (REG1)	4 – 22
4.2.1.4	Maximum Number of Strokes (REG2)	4 – 23
4.2.1.5	Upper Counting Value (REG3)	4 – 23
4.2.1.6	Encoder Simulator (REG4)	4 – 24
4.2.1.7	RAM Address (REG5)	4 – 24
4.2.1.8	Output Ports (REG6)	4 – 25
4.2.1.9	Output Selection (REG7)	4 – 26
4.2.1.10	Maximum Derivative Time (REG8)	4 – 26
4.2.1.11	RAM Data (REG9)	4 – 27
4.2.1.12	Encoder Parameterization (REG10)	4 – 27
4.2.1.13	Steps per Stroke (Modulo Value) (REG11)	4 – 31
4.2.1.14	Current Counting Value (REG12)	4 – 31
4.2.1.15	Zero Marking Pulse Value (REG13)	4 – 31
4.2.1.16	States of the Digital Outputs (REG14)	4 – 32
4.2.1.17	Firmware Release Status (REG31)	4 – 32
4.2.2	Cam Data Records	4 – 34
4.2.2.1	Position Cams	4 – 38
4.2.2.2	Time Cams	4 – 39
4.3	Operation of the Module	4 – 40
4.3.1	Activation of Cam Processing	4 – 40
4.3.2	Response Messages	4 – 41

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Figures

Figure 4.1	Table of formats for SSI encoders with allocation of the counting width	4 – 6
Figure 4.2	Cam signals	4 – 8
Figure 4.3	Overlapping cams	4 – 8
Figure 4.4	Position cams	4 – 9
Figure 4.5	Time cams	4 – 10
Figure 4.6	Counting cam	4 – 11
Figure 4.7	Braking cam	4 – 12
Figure 4.8	Dynamic cam shift	4 – 13
Figure 4.9	Example of cam switching points	4 – 15
Figure 4.10	Example of mirroring backward cams	4 – 16
Figure 4.11	Example of mirroring forward cams	4 – 17

Tables

Table 4.1	Default values for the registers	4 – 19
Table 4.2	Register overview	4 – 21
Table 4.3	Structure of a cam data record	4 – 34
Table 4.4	Addresses of the cam data records in the RAM	4 – 35
Table 4.5	Telegram for position–controlled cams	4 – 38
Table 4.6	Telegram for time–controlled cams	4 – 39
Table 4.7	Actual values and cams based on the operating status	4 – 40
Table 4.8	Errors during operation of the module	4 – 41
Table 4.9	Response message telegram	4 – 41

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4 Functions of the IP 264

4.1 Method of Operation of the Cam Controller

Principle

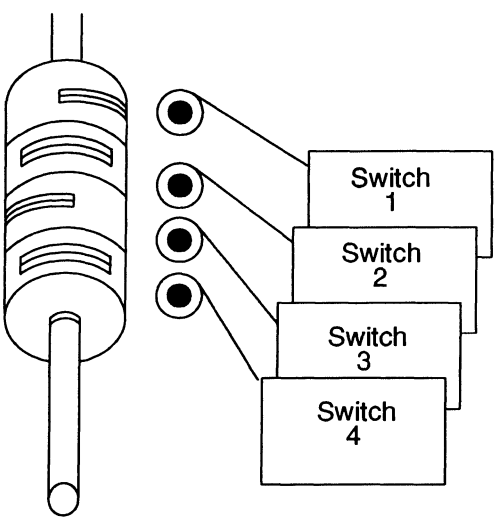
The IP 264 module is an electronic cam controller. The following input data are required for the functions.

- Actual values
- Machine data (register data)
- Cam program

The actual values are supplied by an encoder on the axis of the machine. The SIMATIC S5 transfers the machine data and the cam program to the IP 264. If the start conditions are met (→ section 4.3.1), processing and the output of the cam tracks begins.

Depending on the current actual position and the speed of the axis, up to 16 cam tracks can be addressed. The corresponding cam track is switched on or off when a switching value is reached.

(Electro) mechanical cam controller



IP 264 = electronic cam controller

Each switch corresponds to a cam track for the IP 264.

Cam number:

32 For separate cam programs in both directions of rotation

32/64 For a "common" cam program in both directions of rotation

Each cam is an electronic cam for the IP 264 whose position and size is specified by the respective cam data record.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.1 Actual Value Acquisition

Encoder types

The actual values of the axis are acquired by an encoder. The following encoders can be used.

- 24–V initiators (proximity switch encoders)
- Incremental encoders
- Absolute value encoders with SSI interface

When incremental encoders or initiators are used, the actual value on the module must be synchronized with the encoder on the machine. The actual value is not valid until this is performed.

Synchronization is not required for SSI absolute value encoders. The actual value becomes valid after the first successful SSI transmission.

4.1.1.1 24–V Initiator (Proximity Switch)

Encoder signals

Since the initiator only provides encoder signal A*, the direction cannot be recognized. The direction is specified by the S5.

> **Warning**
>
> Incorrect specification of the direction can lead to serious errors on the system (e.g., erroneous addressing of units caused by changed switching positions of time cams). Use exact specification of the direction to prevent this from happening.

Synchronization

Synchronization of the actual value with the initiator can be performed by one of the following.

- External synchronization signal
- Setting the SYNC bit via software

The rising edge of the external synchronization signal triggers the synchronization procedure in the forward direction; the falling edge of the external synchronization signal triggers the synchronization procedure in the backward direction.

The current actual value becomes valid after the SYNC bit has been set by the software.

Actual value

Actual value acquisition is performed up to the value specified in the "steps per stroke" register in the forward direction, or up to "0" in the backward direction.

An error message is triggered when a synchronization signal still does not occur after an additional 64 steps.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.1.2 Incremental Encoder

Encoder signals

Incremental encoders can be used which supply two signals (A and B) displaced by 90°, and one zero marking pulse signal (N). 5–V encoders must also supply the inverted signals $\overline{A}$, $\overline{B}$ and $\overline{N}$.

Since each edge is evaluated, pulse quadruplication is used. Up to 65,535 pulses (steps) can be counted per machine clock pulse (stroke). Several encoder revolutions are permitted per machine clock pulse.

The direction of travel (is of particular interest for linear axes) is automatically recognized and then used to select the forward or backward cam program. The direction can be inverted by the S5 (during encoder parameterization).

Synchronization

Synchronization of the axis with the incremental encoder can be performed by the following.

- Zero marking pulse of the encoder
- External synchronization signal
- Zero marking pulse of the encoder **and** external synchronization signal

(Selection is performed during the parameterization of the encoder.)

Synchronization is performed with the rising edge of the selected signal.

- Forward run: The actual value is set to "0".
- Backward run: The actual value is set to the value of the "steps per stroke" register.

The following applies to external synchronization.

- Forward run: The actual value is stopped at the "steps per stroke" value until the synchronization pulse arrives.
- Backward run: The actual value is stopped at the value "0" until the synchronization pulse arrives.

When working without external synchronization, the actual value moves from 0 to the "steps per stroke" value, or vice versa.

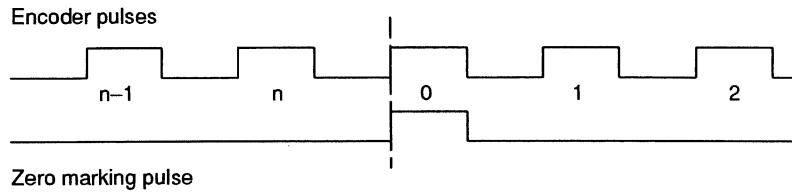


When linear axes with incremental encoders are used, **only one zero marking pulse** (or one SYNC signal) may be present for the entire travel path.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Zero marking pulse register

The zero marking pulse register accepts the actual value which was current immediately before synchronization.



Depending on the synchronization event, the actual value is accepted in the zero marking pulse register with the signal specified in the table below.

Synchronization Event	Acceptance Signal
Zero marking pulse of the encoder	Zero marking pulse
External signal	External SYNC signal
Zero marking pulse of the encoder and external signal	Zero marking pulse

Errors

An error message is generated (edge error) when the signal edges follow each other so closely that the direction of rotation cannot be recognized.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.1.3 SSI Absolute Encoders

Encoder signals

The IP 264 can also process signals from absolute measuring systems. The prerequisites are listed below.

- The absolute measuring system must operate in gray or dual code.
- The measuring signals must be transferred to the IP 264 in 13–bit or 25–bit SSI format.

The SSI encoder uses a serial data driver to transfer the absolute position measuring value to the IP 264. This has the advantage that only four lines are required for the measuring value transmission regardless of the resolution (13 or 25–bit).

The transmission rate must be specified during parameterization of the encoder. The following speeds can be selected.

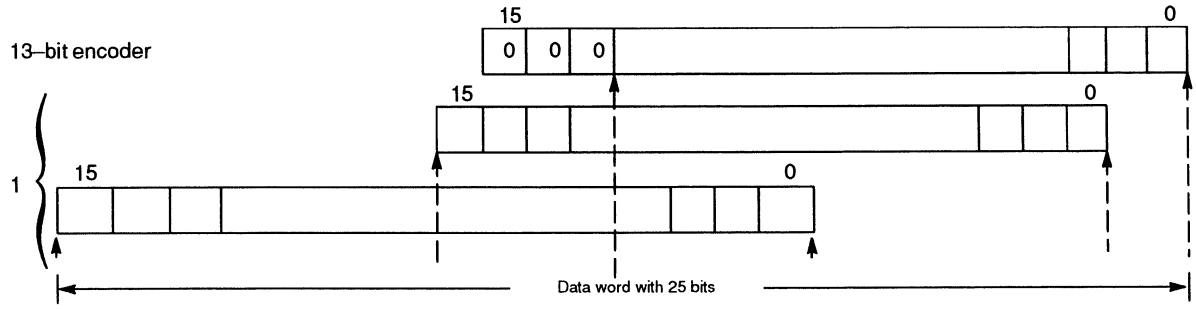
- 125 kB/sec
- 250 kB/sec
- 500 kB/sec
- 1 MB/sec

The IP 264 has an internal reaction time of less than 60 µsec between the recognition of actual value = setpoint and the output of the cams. This reaction time does not guarantee the greatest switching accuracy of the cams unless SSI transmission is performed at 1 MB/sec. If not, the delayed actual value message affects the switching accuracy.

Data format

The internal actual value area contains 16 bits. When 13–bit SSI format is used, bits 2^{13} to 2^{15} are automatically set to 0. When 25–bit SSI format is used, it can be specified during parameterization of the encoder which consecutive 16–bit block of the 25 existing bits is to be evaluated (see figure 4.1). This can affect the maximum travel path or the resolution which can be achieved.

© Siemens AG 1992, Order No: 6ES5 998–5SL21



		MSB												Bit Number in the Data Word												LSB		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
4096	12	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	8192	13
2048	11	0	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	0	4096	12
1024	10	0	0	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	0	0	2048	11
512	9	0	0	0	M9	M8	M7	M6	M5	M4	M3	M2	M1	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	0	0	0	1024	10
256	8	0	0	0	0	M8	M7	M6	M5	M4	M3	M2	M1	S9	S8	S7	S6	S5	S4	S3	S2	S1	0	0	0	0	512	9
128	7	0	0	0	0	0	M7	M6	M5	M4	M3	M2	M1	S8	S7	S6	S5	S4	S3	S2	S1	0	0	0	0	0	256	8
64	6	0	0	0	0	0	0	M6	M5	M4	M3	M2	M1	S7	S6	S5	S4	S3	S2	S1	0	0	0	0	0	0	128	7
32	5	0	0	0	0	0	0	0	M5	M4	M3	M2	M1	S6	S5	S4	S3	S2	S1	0	0	0	0	0	0	0	64	6
16	4	0	0	0	0	0	0	0	0	M4	M3	M2	M1	S5	S4	S3	S2	S1	0	0	0	0	0	0	0	0	32	5
8	3	0	0	0	0	0	0	0	0	0	M3	M2	M1	S4	S3	S2	S1	0	0	0	0	0	0	0	0	0	16	4
4	2	0	0	0	0	0	0	0	0	0	0	M2	M1	S3	S2	S1	0	0	0	0	0	0	0	0	0	0	8	3
2	1	0	0	0	0	0	0	0	0	0	0	0	M1	S2	S1	0	0	0	0	0	0	0	0	0	0	0	4	2
No. of rev.	Bit/rev.	Multi–turn bits												Single–turn bits													Steps/ rev.	Bit/rev.

1 25–bit encoder: highest bit between 2^{16} and 2^{24} can be selected.

Figure 4.1 Table of formats for SSI encoders with allocation of the counting width

Synchronization

Synchronization is not required when SSI absolute value encoders are used.

Recognition of direction of rotation

The direction of rotation/travel can be determined automatically. The following restrictions apply.

Linear axes: Direction recognition functions when the zero point is outside the travel path.

Rotary axes: Direction recognition does not function unless the zero point is not travelled over.

Because of these restrictions, the direction of rotation must be specified for rotary axes with absolute value encoders.

During parameterization of the encoder, you can specify whether the rotation direction recognition is to be performed automatically with an absolute value encoder, or the rotation direction is to be specified by the S5.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Errors

The following is monitored during the SSI transmission.

- A monoflop error is reported when the monoflop time of the transmission protocol exceeds 64 transmission clock pulses.
- A start/stop bit error is reported if the stop bit is not 0, or the start bit is not 1, and one or both of these errors occurs during three consecutive transmissions.

Up to this time, the old (previous) actual value is used for processing.

4.1.1.4 Encoder Simulator

Purpose

The external position encoder can be simulated to allow a cam program to be executed when the drive is not running. This is done by selecting "encoder simulator" for the "encoder type". The actual value is then generated by an internal timer.

Encoder clock pulse

The simulated encoder clock pulse is determined by the scaling number entered in register 4.

Example:

Scaling Number	Encoder Clock Pulse
65 535 (max.)	15.3 Hz
10 000	100 Hz
100	10 kHz
1	1 MHz
0 (min.)	Encoder is "stationary".

Direction of rotation

The direction of rotation (= actual value direction) must be specified for the encoder simulator.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.2 Types of Cams

Definition

The SIMATIC S5 transfers the cam program to the IP 264 module. When the start conditions are met, the IP 264 module supplies internal control signals which are switched on and off depending on the distance and speed, or are switched off depending on the time.
These internal control signals are called cams. Each cam is assigned to one cam track. Several cams can also influence a common cam track. Each cam track is assigned to a digital output.

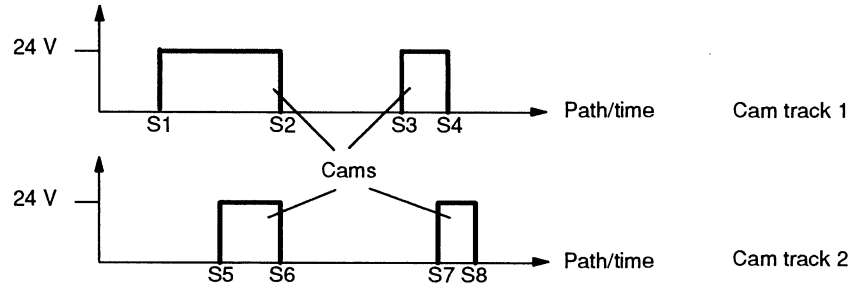


Figure 4.2 Cam signals

When several cams influence the same cam track, the output signal is an OR link of the individual cams.

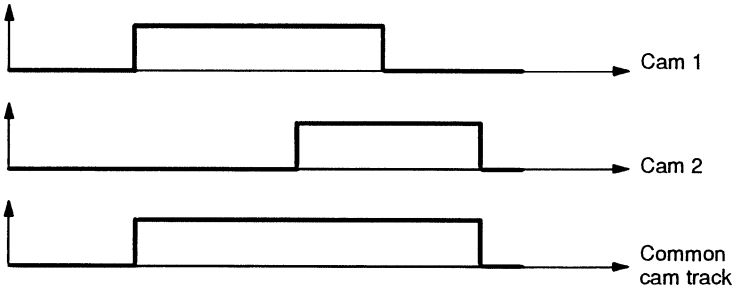


Figure 4.3 Overlapping cams

Cam length

The length of a programmed cam must always be greater than/equal to at the most to the permissible minimum cam length. The shortest permissible cam length depends on the following factors.

- Cycle time
- Number of steps per stroke
- Maximum number of strokes

The shortest cam length for the IP 264 is 100 µsec.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Hysteresis

Even when the machine is at a standstill, a positioning action can cause a drive to move back and forth by one increment, for example. If this minimal movement occurs at a location for which a cam edge is programmed, this would cause the cam track to be switched on and off continuously. The IP 264 module has been equipped with a hysteresis to prevent such undesireable behavior.

This hysteresis allows the drive to oscillate around an encoder step (increment) without the cam tracks changing. When the direction of rotation is reversed, the switching status does not change until two encoder steps have occurred.

The hysteresis function is activated when incremental or absolute value encoders are connected. The hysteresis function is switched off when initiators (proximity switch encoders) and encoder simulators are connected since it serves no useful purpose.

4.1.2.1 Position Cams

Definition

Position cams are defined by a start and an end position in the cam program.

The cam track is set when the actual value reaches the start position. The cam is reset when the end position is reached. The switchon duration is only determined by the distance between the two switching positions.

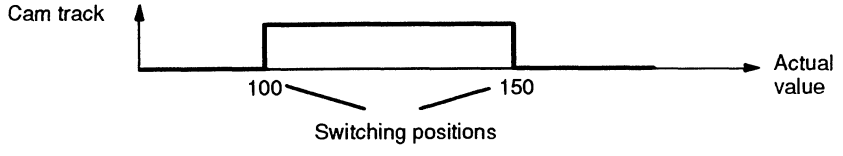


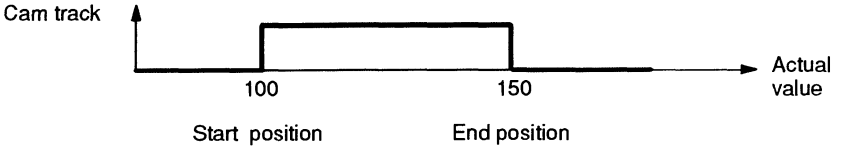
Figure 4.4 Position cams

Active cam

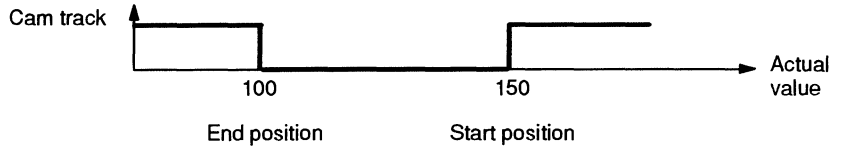
The following rule applies regardless of the cam program you are using.

The cam is active between the start and end position.

Start position < end position



Start position > end position



© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.2.2 Time Cam

Definition

Time cams are defined by a start position and an on time (switchon time) in the cam program.

The cam switches on when the start position is travelled over, and remains switched on for the parameterized time regardless of the distance covered.

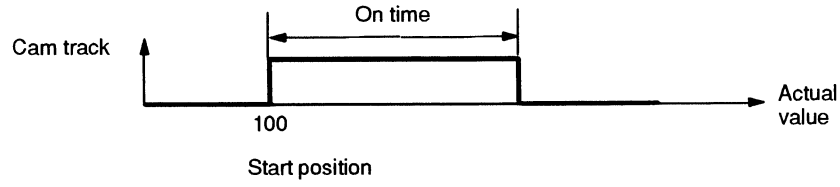


Figure 4.5 Time cams

On time

The on time can be selected in100–µsec increments. The following maximum on times can be used depending on the cycle time.

- 3.77 sec for cycle time of 57.6 µsec
- 6.55 sec for cycle time of 115.2 µsec

Retriggering

A time cam is retriggered when several cam data records are affecting the same cam track and the on times overlap.

☞ A time cam can be almost one clock pulse long, but never several clock pulses. If this is the case, the cam switches off in the area of the programmed "internal" cam, and the time is triggered again.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.2.3 Counting Cam

Definition

Cam track 0 can be parameterized as counting cam. It is activated with command bit 1.

Counting cams are only output every nth clock pulse. The value n from the counting range from 1 to 65,535 is transferred by the SIMATIC S5 to register 3 ("upper counting value") of the IP 264.

Use

Every cam programmed for cam track 0 (position cam, time cam) is counted internally.

For counting, a 16–bit counter is loaded with the value of register 3, and cam track 0 is inhibited. The switchoff of each cam is then counted and the counter decremented. Cam track 0 is enabled when the counter reaches 0. The currently active internal cam is switched through to the output.

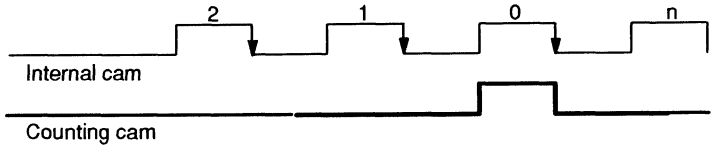


Figure 4.6 Counting cam

The next time an internal cam is switched off, the counter is loaded again with the upper counting value, and cam track 0 is inhibited. Loading can also be triggered by command bit for the synchronization of the counter.

If only one cam is programmed, it is used to count the clock pulses.

If two or more cams are programmed, be sure that these do not overlap (also for the highest machine clock pulse frequencies). If they do overlap, the counting procedure is not continued since a falling edge does not occur.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.2.4 Braking Cams

Definition

Cam track 1 can be parameterized as a braking cam. It is activated with command bit 2.

Use

Mechanical presses, in particular, require a braking cam. Here it controls the coupling to the motor and the brake so that when the press is switched off, for example, it comes to rest in the upper dead point (often called the "UD cam").

This characteristic requires that the cam exhibit the following behavior.

- The braking cam switches on with the rising edge of the brake enable.
- It switches off with the falling edge of the programmed internal cam when the brake enable is no longer in effect.

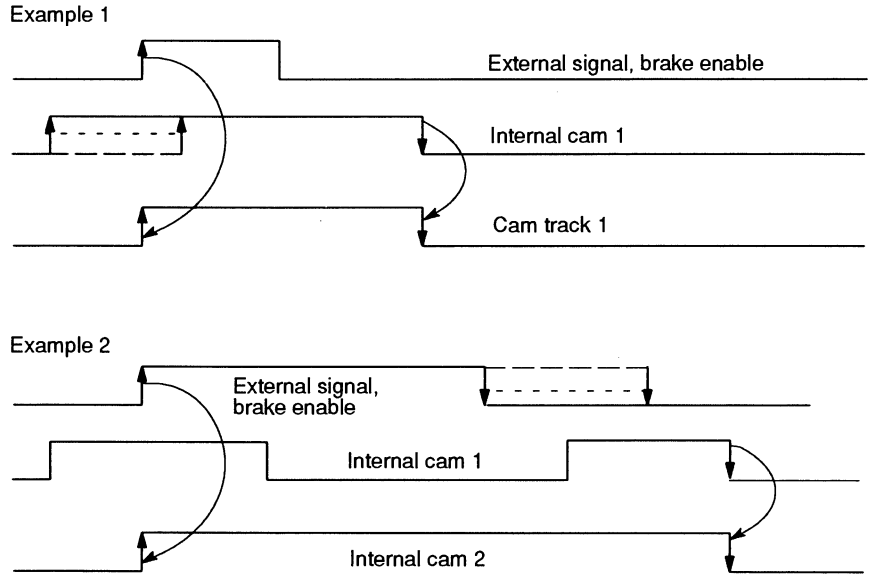


Figure 4.7 Braking cam

The dynamic shift based on the speed also affects the braking cams.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.3 Cam Dynamics

Principle

Each cam can be dynamically shifted to adapt the derivative times to the connected units. The derivative time for the unit is specified in the cam data record in multiples of the shortest cam length (100 µsec). The module then continuously determines the distances required for the offset (derivative distance) and shifts the switchon/switchoff points accordingly.

The updating of the derivative distance is performed in a machine–related time grid calculated from the "maximum derivative time" parameter as shown below.

Update time grid = 0.25 x "maximum derivative time"

When the actual value is located in the dynamic area of a cam, the derivative distance for this cam is not updated to avoid "switching" caused by abrupt changes in speed.

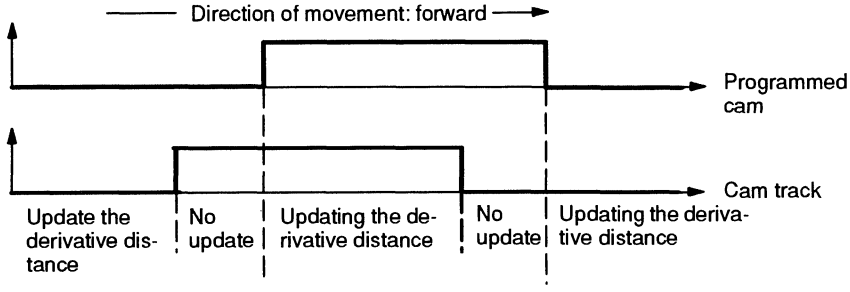


Figure 4.8 Dynamic cam shift

A dynamic shift of 0 is used as long as the speed cycle on the IP 264 has not yet been concluded after a reset or reverse of direction.

Activation

Bit 3 in the control byte of the cam can be used to switch on/off the dynamic shift.

Behavior during changes in speed

At high speeds it can happen that the dynamic switching range of a cam does not overlap the static range. When the speed changes to a low value in the area between dynamic and static cam, the resulting shift value takes effect and the cam switches a second time.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.4 Cam Program

Scope and processing time

The cam program contains 32/64 cam data records depending on the parameterization.

- A maximum of 32 cam data records each with a processing time of 57.6 µsec for separate forward and backward cam programs
- A maximum of 32/64 cam data records with a processing time of 57.6 /115.2 µsec for a "common" forward and backward cam program

4.1.4.1 Rotary Axes

Forward program/ backward program

As found, for example, on mechanical presses or stamping machines, rotary axes usually move in only one direction, and also require only one cam program for both directions.

The same cam program is usually processed when the direction of rotation changes for rotary axes. Only the internal module start and end positions are transposed. During backward rotation, the dynamic shift also causes the cam to be activated before the static switching point is reached. When the zero point is travelled over during backward rotation, the actual value is then set to the parameterized value "steps per stroke".

There are two ways to handle the cam program.

- Cam program with 32 cams:
  32 cams are in effect in both directions on a maximum of 16 cam tracks.
- Cam program with 64 cams:
  64 cams are in effect in both directions on a maximum of 16 cam tracks.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.1.4.2 Linear Axes

Forward program/ backward program

As found, for example, in hydraulic presses, linear axes move back and forth continuously within a certain area. The forward direction requires that different cams be output than for the backward direction.
In this case, there is only one way to handle the cam program.

- Cam program with 32 cams for "forward"
- Cam program with 32 cams for "backward"

Depending on the direction of travel, the cam program for forward or backward travel is selected. The direction of travel is either automatically determined on the IP 264 module, or specified by the command bit.

The backward program can always be inhibited with command bit 3. Only one cam program is then processed for both directions.

Cam mirroring

Both cam programs are linked together since time cams must continue to take effect even when the reversal point has been reached, for example. They must be set up as shown below.

- A mirrored reflection of the cams of the "backward" program is added to the "forward" program.
- A mirrored reflection of the cams of the "forward" program is added to the "backward" program.

Example

This is shown in the following example.

- Cams a, b and c are to be effective in the forward direction.
- Cams d, e and f are to be effective in the backward direction.

The type of cam is of no importance. The following must be performed during the first step.

- Specify the switching points of the forward and backward cams.
- Enter them in a switching diagram.

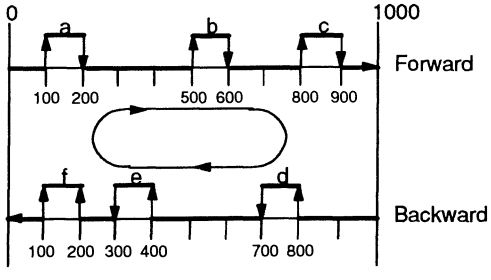


Figure 4.9 Example of cam switching points

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Mirroring backward cams

The following must be performed during the second step.

- Double the distance (2000) of the forward direction (0 to 1000).
- A mirrored reflection (around the 1000 line) of backward cams d, e and f must be entered as cams d' e' and f' in this area (1000 to 2000).

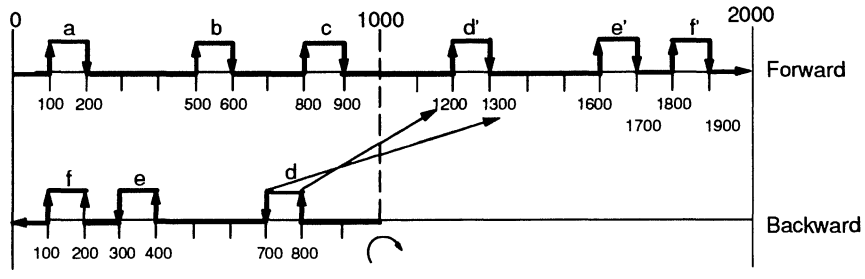


Figure 4.10 Example of mirroring backward cams

The "forward" cam program can now be written. The program is stored on the module in a defined RAM area of 1 kbyte. It always starts at byte address 0 of the RAM memory area.

In our example, the cam data records must be written in the sequence of the cams as shown below.

Byte:	0	Cam a	0 cam data record	
	16	Cam b	1st cam data record	"Forward" cam program
	32	Cam c	2nd cam data record	
	48	Cam d'	3rd cam data record	
	64	Cam e'	4th cam data record	
	80	Cam f'	5th cam data record	
	.	.	.	
	.	.	.	
	.	.	.	
Byte:	496	.	31st cam data record	

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Mirroring forward cams

Forward cams a, b, and c are mirrored in the same way in area 1000 to 2000 as a', b' and c'.

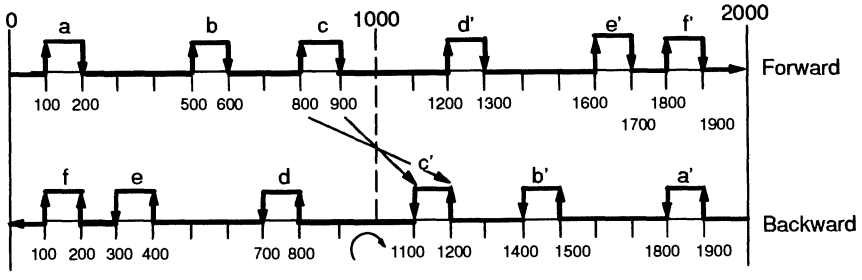


Figure 4.11 Example of mirroring forward cams

The "forward" cam program can now be written in the same way as the "backward" cam program. It always starts at byte address 512. In our example, the cam data records must be written in the sequence of the cams as shown below.

Byte:	512	Cam a'	32nd cam data record	"Backward" cam program
	528	Cam b'	33rd cam data record	
	544	Cam c'	34th cam data record	
	560	Cam d	35th cam data record	
	576	Cam e	36th cam data record	
	592	Cam f	37th cam data record	
	.	.	.	
	.	.	.	
	.	.	.	
Byte:	1008	.	63rd cam data record	

© Siemens AG 1992, Order No: 6ES5 998–5SL21

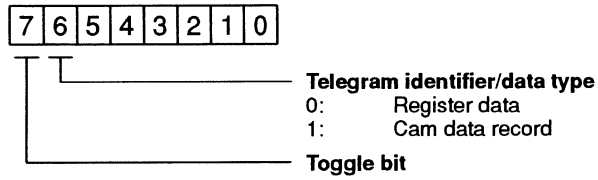
4.2 Parameterization

Supplying with data

The registers of the module must be written and the cam data records stored in the RAM before the IP 264 module can begin its function as a cam controller. Telegrams which are transferred from the PLC to the IP 264 module are used to supply the data.

Telegram control byte

A telegram identifier in the control byte is used to distinguish between register data and cam data records.



Order of parameterization

The registers and cam data records can be supplied with data in any order.

☞ Exceptions:

When **position cams** are used, at least register 1 must be parameterized (type of cam program and number of cam data records).

When **time cams** are used, registers 1, 2 and 11 must be parameterized before cam data records are transferred to the module.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1 Register Data

The parameterization data are stored in registers on the module.

Default setting

After the start or a reset, the registers which can be written are assigned with default settings as shown in table 4.1.

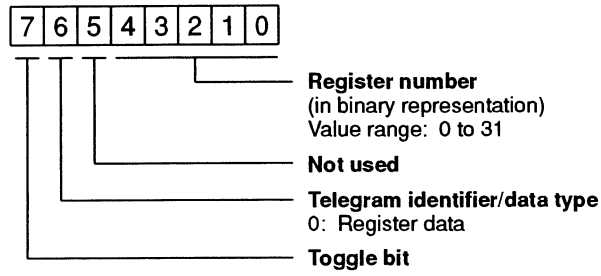
Register Number	Designation (Contents)	Default Values After the Start
0	Data source for cyclic response messages	14 (states of the digital outputs)
1	Command register	0
2	Maximum number of strokes	2500 [min^{-1}]
3	Upper counting value	0
4	Encoder simulator	0
5	RAM address	0
6	Output port	0
7	Output selection	FFFFH
10	Encoder parameterization	0
11	Steps per stroke	FFFFH (increments]

Table 4.1 Default values for the registers

User-related data

The default values in the registers which can be written can be overwritten with the values for your particular application. Transfer the appropriate data from the PLC to the module in output telegrams.

Telegram control byte



© Siemens AG 1992, Order No: 6ES5 998–5SL21

Changing the register data

The register data can also be dynamically adapted to new conditions during operation of the module by transferring telegrams.



Exceptions:

The type of cam program and the number of cams (32/64) may not be changed after the cams are parameterized.

The module **must be parameterized again** if the values for **time cams** in registers 2 and 11 are to be changed.

Units

Depending on their meaning, the register values must be transferred in the units shown below.

- In increments (position steps)
- In 100–µsec time increments
- In revolutions (strokes) per minute
- As binary data

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.1 Register Overview

Use of the registers

Registers are used for the data exchange on the IP 264 module. These are managed by the module. The PLC has access to all registers.

The registers are addressed by register numbers. The registers have different lengths depending on the amount of data (see table 4.2).

Register contents and access mode

Register Number	Access by PLC	Designation (Contents)	Register Size (in Bytes)
0	R/W	Data source for cyclic response messages	1
1	R/W	Command register	2
2	R/W	Maximum number of strokes	2
3	R/W	Upper counting value	2
4	R/W	Encoder simulator	2
5	R/W	RAM address	2
6	R/W	Output port	2
7	R/W	Output selection	2
8	R	Maximum derivative time	2
9	R	RAM data	2
10	R/W	Encoder parameterization	2 for INC 7 for SSI
11	R/W	Steps per stroke (modulo value)	2
12	R	Current counting value	2
13	R	Zero marking pulse value	2
14	R	States of of the digital outputs	2
15 to 30		Not used	
31	R	Firmware release status	3

R/W: Read/write
R: Read only
INC: Incremental encoder
SSI: Absolute value encoder with SSI

Table 4.2 Register overview

4.2.1.2 Cyclic Response Telegram (REG0)

Contents

The data source for the cyclic response messages from the IP 264 to the PLC is selected by writing register 0. All assigned register numbers may be used (→ section 4.2.2).

Data byte 0

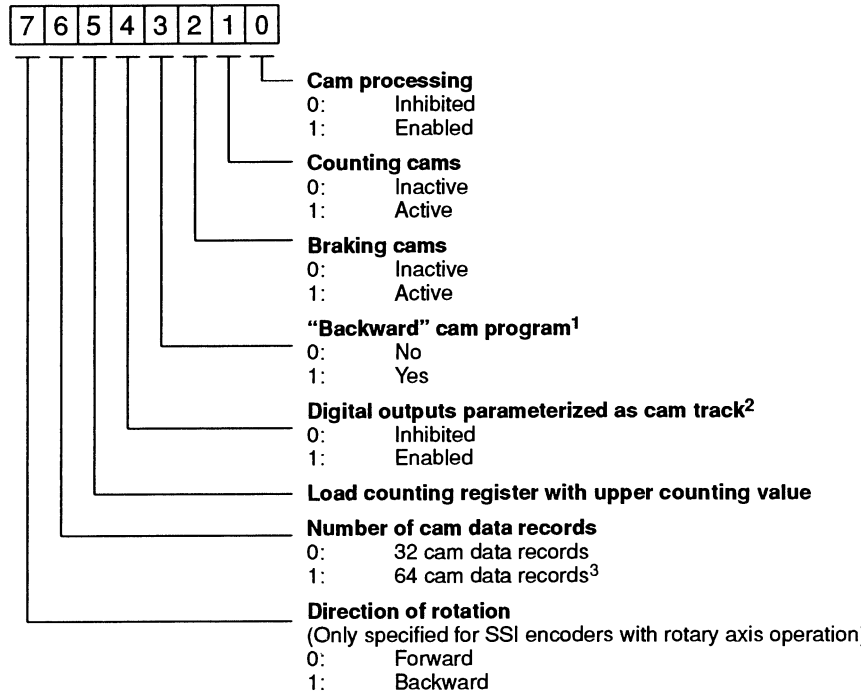


© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.3 Command Register (REG1)

Contents All parameters for processing the cams are stored in the command register.

Data byte 3



1 This bit can be disregarded unless processing of 32 cam data records was selected (bit 6 = 0). The 32 cams are processed in forward and backward directions. "Cam backward" = 1: cam data records 0 to 31 are processed in the forward direction; cam data records 32 to 63 are processed in the backward direction.

The following selections are available.

Number of Cam Data Records	"Backward" Cam Program	Processing the Cams
32	Yes	CDR 0 to 31, only forward CDR 32 to 63, only backward
32	No	CDR 0 to 31, backward and forward
64	Yes	CDR 0 to 63, backward and forward
64	No	CDR 0 to 63, backward and forward

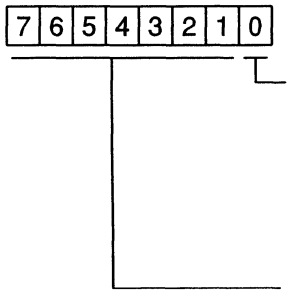
CDR = Cam data record

2 Digital outputs parameterized as port are not affected.

3 Only 32 cam data records can be processed if a separate cam program is activated for traversing backward (bit 3 = 1).

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Data byte 2



Reaction for PLC stop
0: No reaction
(No communication with the PLC although function of the module remains the same.)
1: Cam tracks are switched off.
Registers 6 and 7 must be parameterized again after PLC → IP 264 communication is reestablished.

Not used

4.2.1.4 Maximum Number of Strokes (REG2)

Contents The maximum number of strokes is required for the calculation of internal parameters for time–controlled cams.

It is specified in strokes per minute.

Data byte 3 LOW portion of the maximum number of strokes (0 to FF_H)

Data byte 2 HIGH portion of the maximum number of strokes (0 to FF_H)

4.2.1.5 Upper Counting Value (REG3)

Contents Register 3 contains the upper counting value for the counting cam (→ section 4.1.2.3). Counting values between 0 and 65,535 can be loaded.

Data byte 3 LOW portion of the counting value (0 to FF_H)

Data byte 2 HIGH portion of the counting value (0 to FF_H)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.6 Encoder Simulator (REG4)

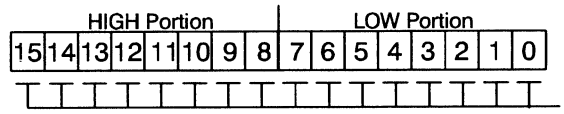
Contents

The encoder simulator on the IP 264 supplies a frequency simulating an encoder. The scaling number for input frequency of 1 MHz is stored in register 4.

$$\text{Encoder frequency} = \frac{1\ \text{MHz}}{\text{Scaling number}}$$

The scaling number is specified as a binary number from 1 to 65535 (→ section 4.1.1.4). The encoder simulator is "stationary" when 0 is specified as the scaling number.

Data bytes 2/3



Scaling number of the encoder simulator

4.2.1.7 RAM Address (REG5)

Contents

The address for read accesses of the internal module RAM is stored in register 5. The cam data records are stored in the RAM (→ section 4.2.2).

The address must always be an even number since word–access is used.
Address range: 0 to 1022

When an odd number address is specified, the address is rounded off to the next lower even number address.

Data byte 3 LOW portion of the address

Data byte 2 HIGH portion of the address

© Siemens AG 1992, Order No: 6ES5 998–5SL21

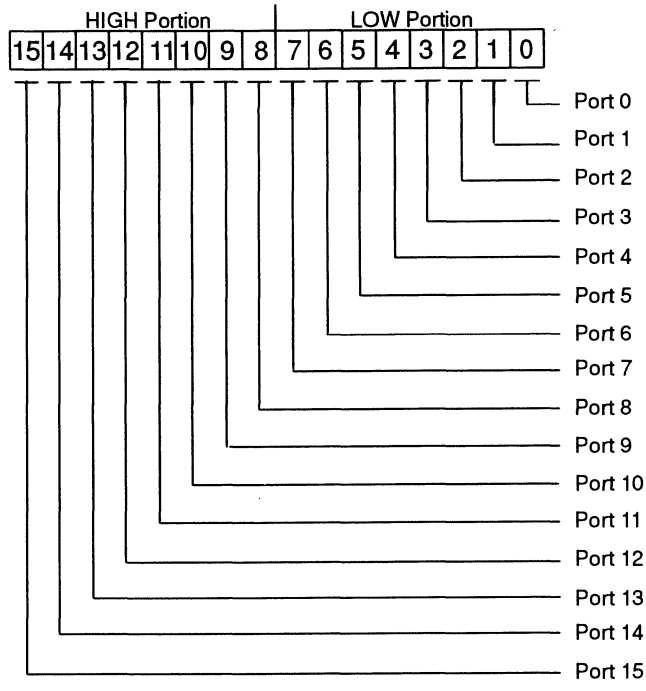
4.2.1.8 Output Ports (REG6)

Contents

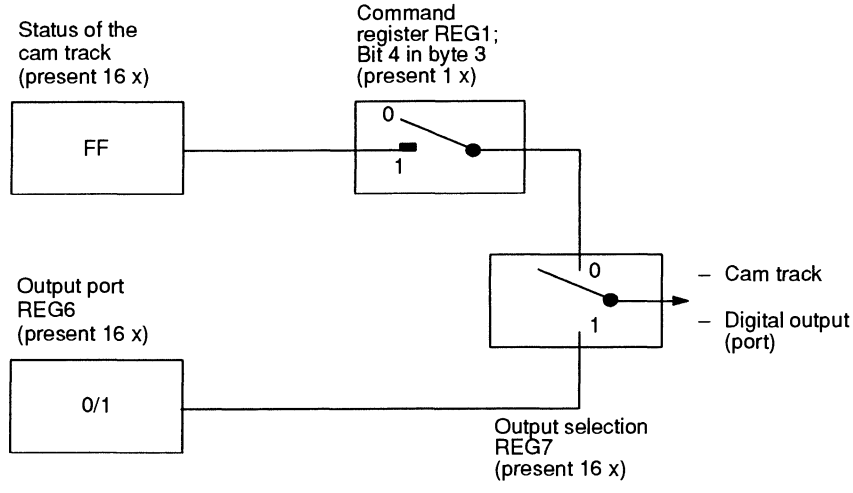
The digital outputs can be switched directly by the PLC–CPU using the output ports.

Register 6 contains information on the activation of the output ports. A set bit activates the corresponding port if it was parameterized as such in REG7 (output selection).

Data bytes 2/3



Interplay with the other registers



© Siemens AG 1992, Order No: 6ES5 998–5SL21

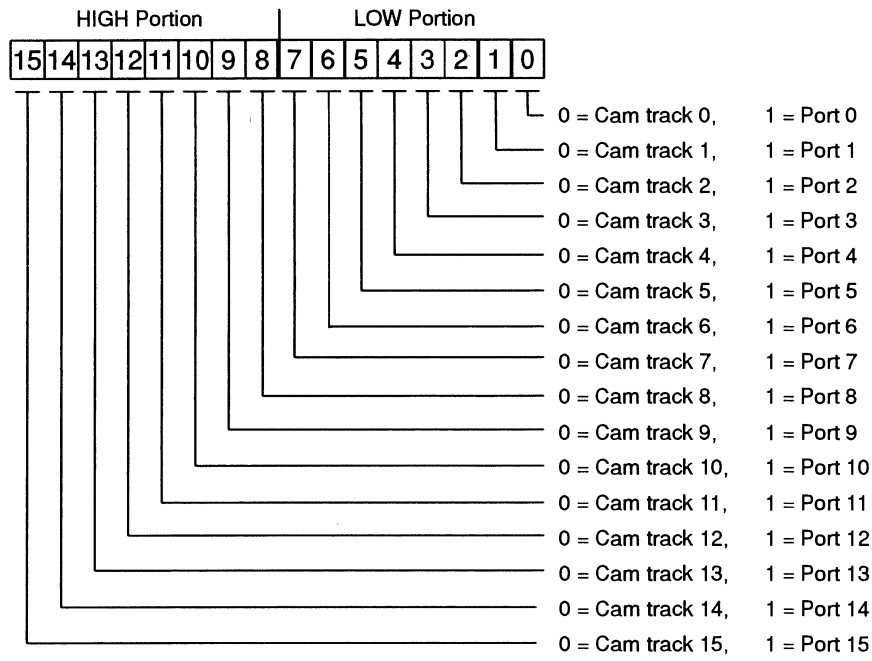
4.2.1.9 Output Selection (REG7)

Contents Each bit of this register determines the special function of the corresponding digital output.

0: The signal of the applicable cam track is output.

1: The status of the output port (REG6) is output.

Data byte 2/3



4.2.1.10 Maximum Derivative Time (REG8)

Contents During parameterization, or when a change in a cam data record occurs, the module determines the maximum derivative time (dead time) from all existing cam data records. This time is stored in register 8 as the factor to the time base of 100 µsec (value range: 0 to 65,535). It is required for measuring the speed.

Data byte 3 LOW portion of the derivative time

Data byte 2 HIGH portion of the derivative time

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.11 RAM Data (REG9)

Contents Register 9 contains two bytes of data from the RAM.

Prior to the required read access of the RAM, the address of the desired data from a cam data record must be entered in register 5 (RAM address).

Data byte 3 LOW–byte data

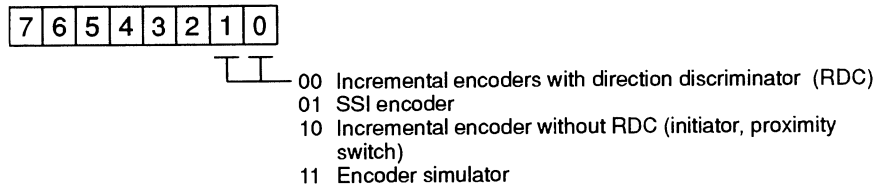
Data byte 2 HIGH–byte data

4.2.1.12 Encoder Parameterization (REG10)

Contents The data for the encoder parameterization are stored in the data bytes of register 10.

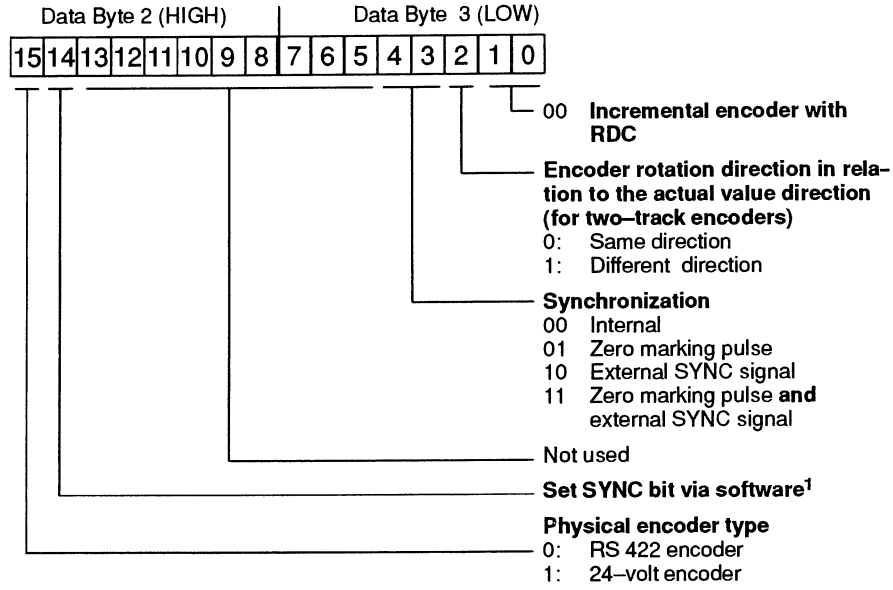
☞ Register 10 may only be loaded once. It may not be accessed again while the IP 264 is in operation.

The connected encoder type is determined (i.e., selected) with the two least significant bits in data byte 3.



The meaning of the other bits depends on the encoder.

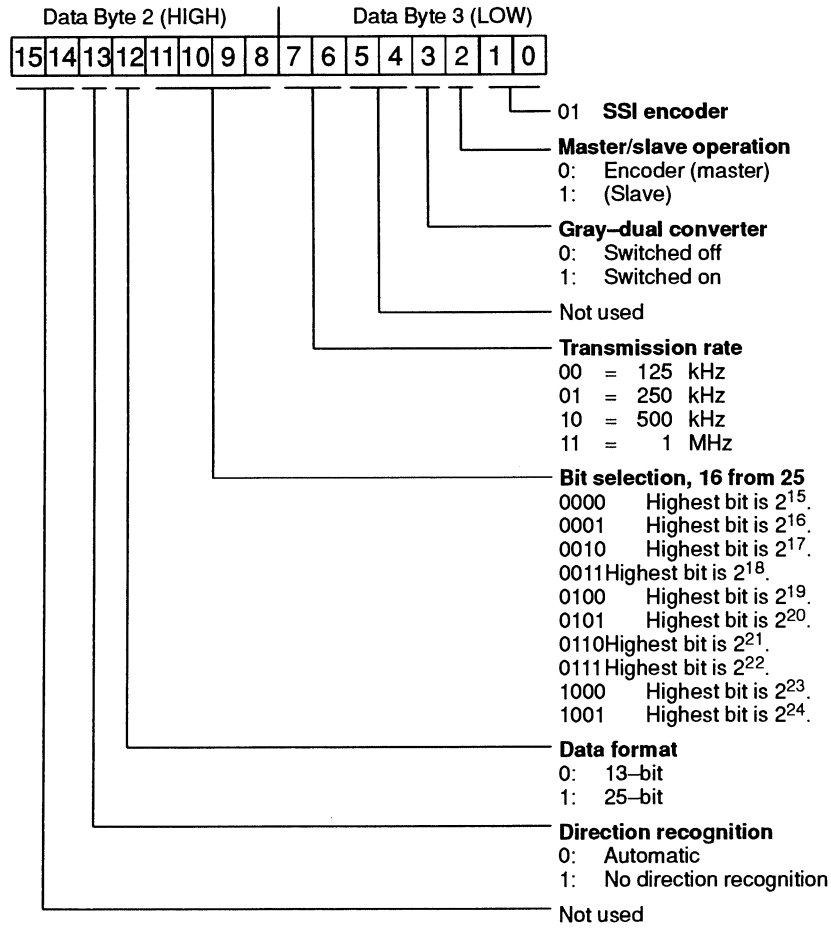
Incremental encoder with RDC



1 Not permitted unless axis is at a standstill

© Siemens AG 1992, Order No: 6ES5 998–5SL21

SSI encoder



Data bytes 0 and 4 to 7 can be disregarded except for the programming of T+R encoders in 25–bit format.

Encoder programming can only be performed during master operation. The setting of "slave operation" in bit 2 of data byte 3 will cause a communication error.

Setting "13 bits" as the data format will also cause a communication error.

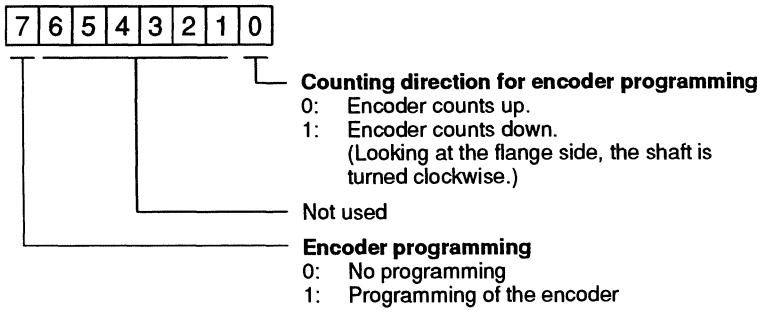
Encoder programming requires approximately 850 msec. The IP 264 module cannot receive telegrams during this time.

The end of encoder programming can be determined from the PLC, if REG10 was set as the data source for cyclic response messages prior to the start of programming. Bytes 2 and 3 of the response message telegram then contain two bytes of the encoder parameterization.

Bit 5 (communication error) is set in the status byte of the response message when an error occurs. A wait time of 1 second must be adhered to before the encoder can be programmed again.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

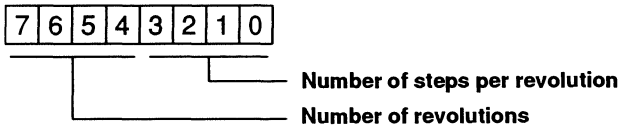
Data byte 0



The connected SSI encoder is programmed when bit 7 is set in data byte 0. The required data are taken from data bytes 0 to 7 of register 10. Bit 7 in data byte 0 is reset when programming is concluded.

The connected encoder is not programmed when bit 7 in data byte 0 equals "0". The parameters in data bytes 0 and 4 to 7 are not evaluated.

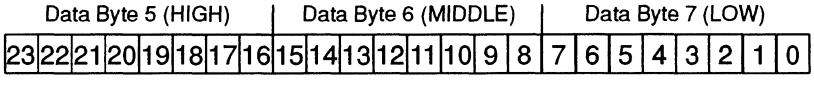
Data byte 4



The respective number or steps or revolutions is coded in four bits to the second power. The possible range is between 2^1 and 2^{13} (for number of revolutions: 2^{11}).

Bit 3/7	2/6	1/5	0/4	Power	Number
1	1	0	1	2^{13}	8192
1	0	1	1	2^{11}	2048
1	0	1	0	2^{10}	1024
1	0	0	0	2^{8}	256
0	0	1	1	2^{3}	8
0	0	0	1	2^{1}	2

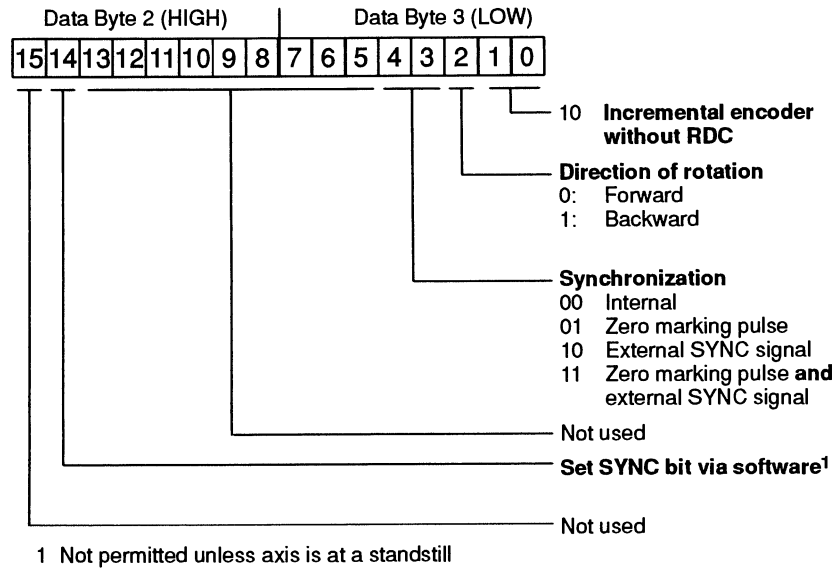
Data bytes 5 to 7



Data bytes 5 to 7 are used as the preset value (24–bit binary number) for the programming of the encoder.

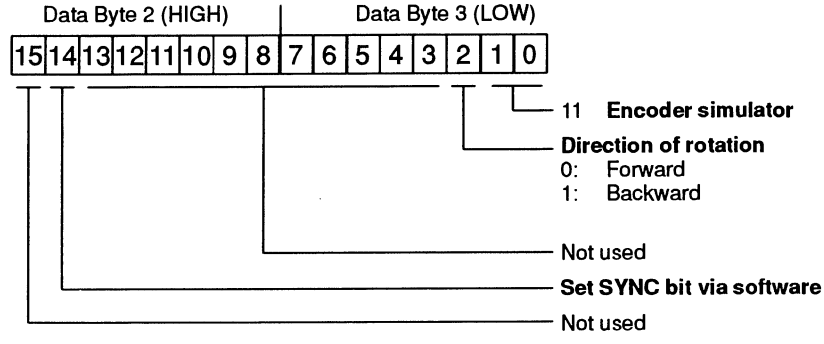
© Siemens AG 1992, Order No: 6ES5 998–5SL21

Incremental encoder without RDC (initiator, proximity switch)



1 Not permitted unless axis is at a standstill

Encoder simulator



© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.13 Steps per Stroke (Modulo Value) (REG11)

Contents	The number of steps (increments) per stroke (revolution) is required for the calculation of internal parameters and when rotary axis is parameterized.
Data byte 3	LOW portion of the number of steps
Data byte 2	HIGH portion of the number of steps

4.2.1.14 Current Counting Value (REG12)

Contents	The current counting value of the module is stored in register 12. It can only be read out. See 4.1.2.3 for counter control.
Data byte 3	LOW portion of the current counting value
Data byte 2	HIGH portion of the current counting value

4.2.1.15 Zero Marking Pulse Value (REG13)

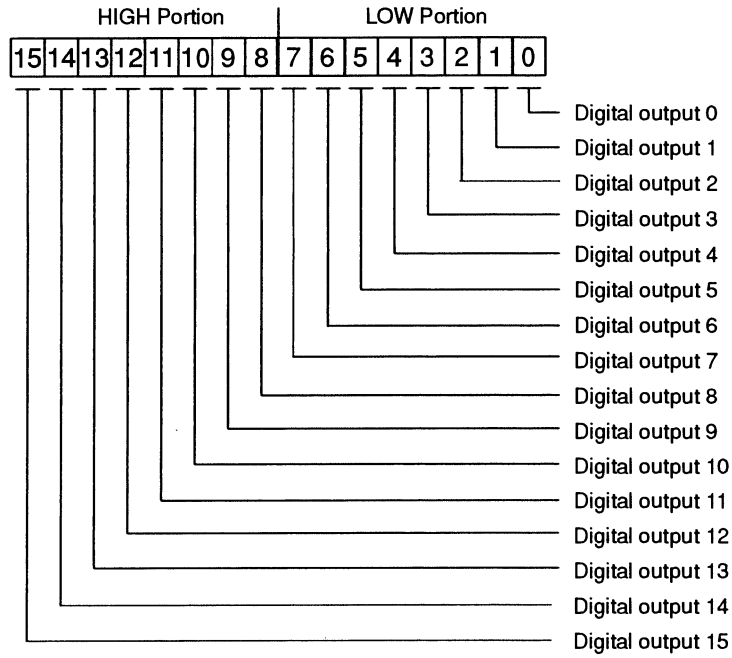
Contents	The current actual value is stored in this register each time a rising edge of the encoder zero marking pulse occurs. It can be read out for monitoring purposes (e.g., machine position, etc.).
Data byte 3	LOW portion of the current zero marking pulse value
Data byte 2	HIGH portion of the current zero marking pulse value

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.1.16 States of the Digital Outputs (REG14)

Contents Register 14 contains the current states of the digital outputs. They can be read out at all times.

Data byte 2/3



4.2.1.17 Firmware Release Status (REG31)

Use The firmware release status of the module can only be read. The data are stored in register 31.

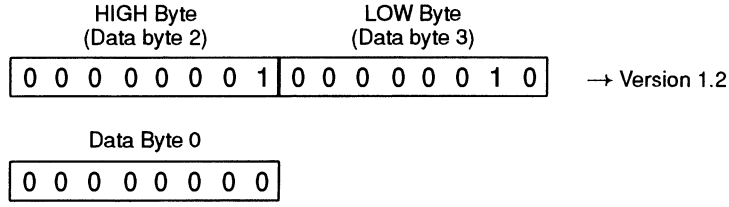
Data byte 0 Always contains 0

Data byte 3 LOW portion of the data

Data byte 2 HIGH portion of the data

Contents The firmware release status is stored in binary–coded format in data bytes 2 and 3. The HIGH portion contains the primary version number; the LOW portion contains the subversion number.

Example:

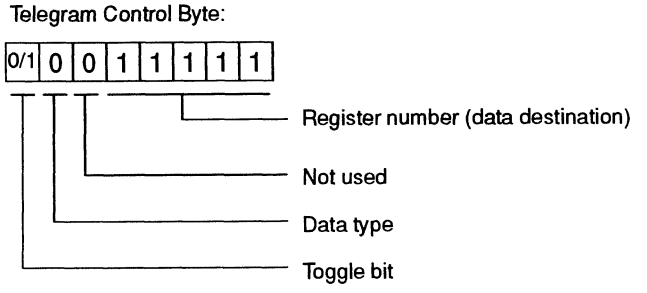


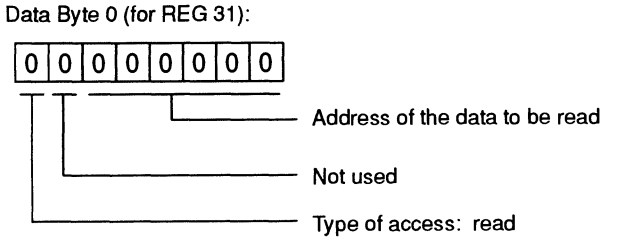
© Siemens AG 1992, Order No: 6ES5 998–5SL21

Procedure

Proceed as follows to read out the firmware release status.

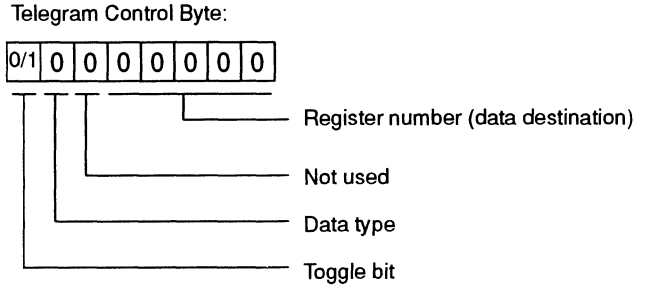
1. Transfer an output telegram with the information "read access of REG13".

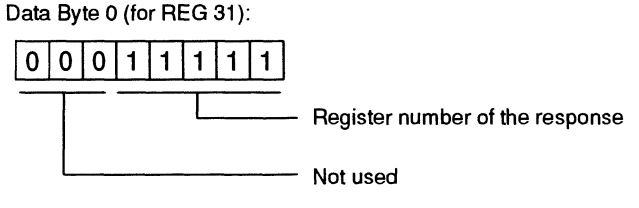




Data bytes 2 and 3 can be disregarded.

2. Write REG0 with "31" (as data source).





3. The next response message telegram contains the firmware release status (as specified above) in bytes 2 and 3.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.2 Cam Data Records

Data structure

One cam data record contains 16 bytes. It is stored in the RAM of the module. All cam data records together make up the cam program.

Byte	Contents		Data Format
	Position Cam	Time Cam	
n	Cam control byte	Cam control byte	KM
n+1	Empty byte	Empty byte	–
n+2, 3	Start position	Start position*	KH
n+4, 5	End position	End position[1]	KH
n+6, 7	Derivative time	Derivative time	KH
n+8, 9	–	On time	KH
n+10, 11	–	Current time*	KH
n+12, 13	Derivative distance*	Derivative time*	KH
n+14, 15	— Reserved —	— Reserved —	–

* Internal calculation

1 For technical reasons, the position which you specified as the start position during the transfer of a cam data record is stored here.

Table 4.3 Structure of a cam data record

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Organization of the RAM

1024 bytes of memory space are reserved in the RAM of the IP 264 module for up to 64 cam data records. This memory area is organized as shown in table 4.4.

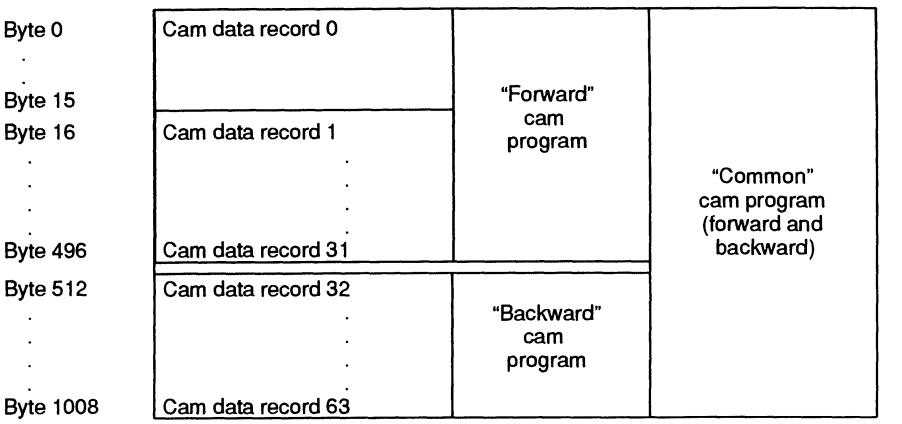


Table 4.4 Addresses of the cam data records in the RAM

Write access

The number of the cam data record must be entered in the telegram control byte if you want to transfer cam data from the S5 to the module. The cam data are then stored at the corresponding address in the RAM of the module (e.g., cam data record 5 → address 60).

Read access

Cam data can only be read out word by word via register 9 (RAM data). This requires that the RAM address of the cam data which you want to read be entered in register 5 in accordance with the structure shown in table 4.4 (e.g., start position of cam data record 1: RAM address = 18). The addressed data are accepted in register 9, and can be read out from there.

Default allocation

After the start of the module, all cam data records are initialized (allocated) as shown below.

Cam control byte = 09H; this includes the following information.
- Cam track 0
- Dynamic shift "off"
- Additional cam data records for the cam track follow.
- Cam is position–controlled.
- Cam track is masked.

Bytes 1 to 15 Are preset to 00H

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Data transfer

The cam data are transferred in a telegram from the PLC to the IP 264 for every cam data record. The telegram contains 7 bytes of data.

The following information must be transferred during parameterization.

- Position–controlled cams:
  - Start position
  - End position
  - Derivative time
- Time–controlled cams:
  - Start position
  - On time
  - Derivative time

The data must be input as follows.

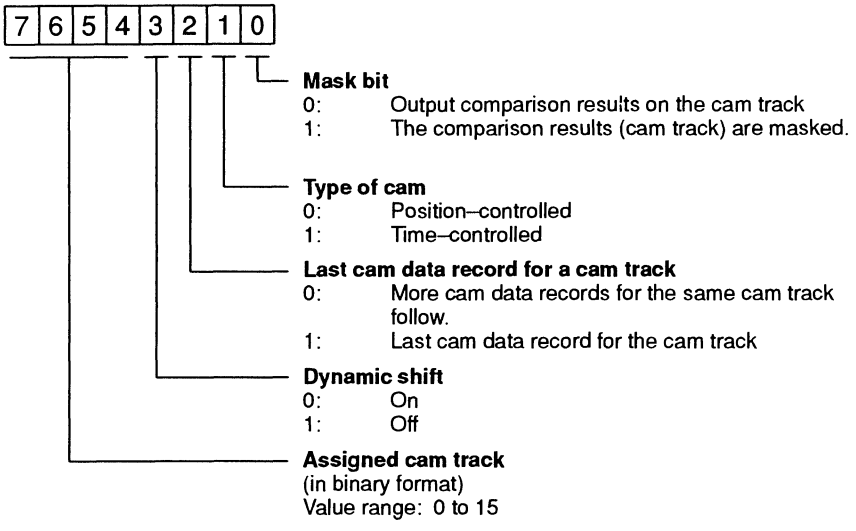
- Position values (increments, steps)
- Times (multiples of 100 µsec)

All other data for the cam data record are calculated internally on the module. The information on the type of cam (position/time–controlled) is provided to the module from the cam control byte.

☞ You only need to transfer as many data records (telegrams) as you have cams.

The other cam data records are retained with their default allocations (cam output is masked).

Cam control byte



☞ If you are using separate cam programs for forward and backward, cam data records which are to be assigned to the same cam track must be entered separately for each program and then concluded with bit 2 = 1.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Last cam data record for cam track (bit 2)

Several cam data records can be assigned to the same cam track. These must be consecutive data records. They can be transferred in any order. Bit 2 must be assigned in all cam data records with "0" and **only in the last** cam data record with "1".

Example:
Five cam data records are to be transferred for cam track 1.

This means that a sequence of five telegrams are transferred (e.g., cam data records 0 to 4).

– Data records 0 to 3 with cam control byte

0	0	0	1	x	0	x	x

x: Specified as required for the individual user application

– Data record 4 contains the following cam control byte.

0	0	0	1	x	1	x	x

The status of the cam track is output after the transfer if both cam processing and cam track 1 are enabled.

☞ Do not change the assignment of the cams to the cam tracks during operation.

Dynamic shift (bit 3) (dead time offset)

Before reaching a switching point, each cam is activated based on the speed. The derivative time required for this is specified in the applicable cam data record.

Activation of the dynamic shift (bit 3 = "0") allows you to adjust this derivative time to different speeds and ensures precise adherence to the switching point.

☞ Following a reset and reverse in rotation direction, the module uses dynamic shift 0 until it has determined the speed.

Cascading

More than 16 cam tracks can be addressed with one encoder when several IP 264 modules are cascaded. Cascading can be used with incremental and absolute value encoders.

☞ When absolute value encoders (SSI encoders) are used, "listen in" must be activated during parameterization of the encoder.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.2.1 Position Cams

Parameterization telegram

The following telegram is transferred by the PLC to the module for the parameterization of a position–controlled cam.

Byte No.	Contents
1	Telegram identification and cam data record number
0	Cam control byte
3	Start position, LOW
2	Start position, HIGH
5	End position, LOW
4	End position, HIGH
7	Derivative time, LOW
6	Derivative time, HIGH

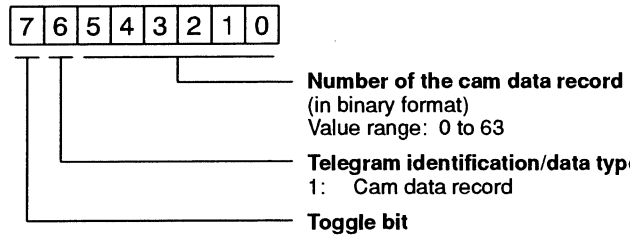
Table 4.5 Telegram for position–controlled cams

Assignment in the RAM

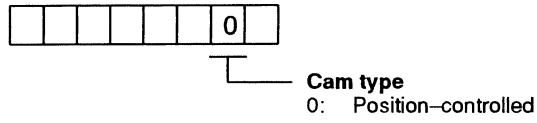
The data bytes of the telegram are entered on the module in the corresponding memory locations of the RAM.

The empty byte (byte n+1) and bytes n+8 to n+15 of the data record are initialized with 00H.

Telegram control byte



Cam control byte



© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.2.2.2 Time Cams

Parameterization telegram

The following telegram is transferred by the PLC to the module for the parameterization of a time–controlled cam.

Byte No.	Contents
1	Telegram identification and cam data record number
0	Cam control byte
3	Start position, LOW
2	Start position, HIGH
5	On time, LOW
4	On time, HIGH
7	Derivative time, LOW
6	Derivative time, HIGH

Table 4.6 Telegram for time–controlled cams

Assignment in the RAM

The data bytes of the telegram are entered on the module in the corresponding memory locations of the RAM.

The empty byte (byte n+1) and bytes n+10 to n+15 of the data record are initialized with 00H.

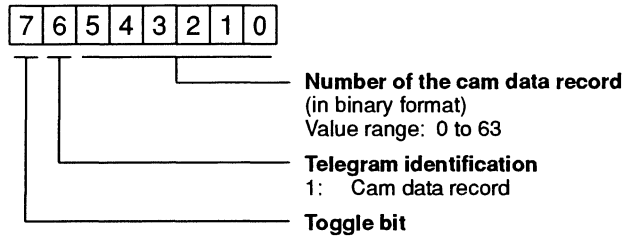
On time

The on time for a time cam can be set in 100–µsec increments.

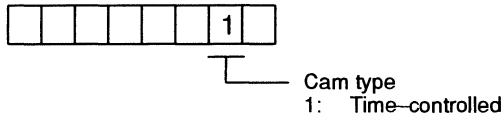
Depending on the number of cam data records, the following maximum times can be parameterized.

- 32 cam data records: 37748 x 100 µsec = 3.77 sec
- 64 cam data records: 65535 x 100 µsec = 6.55 sec

Telegram control byte



Cam control byte



© Siemens AG 1992, Order No: 6ES5 998–5SL21

4.3 Operation of the Module

4.3.1 Activation of Cam Processing

Operating status

Actual values and cams behave differently depending on the operating status of the module. Table 4.7 shows the individual relationships.

Operating Status	Status of the Actual Value	Cam Active
Reset	–	No
Encoder parameterized	Not synchronized	No
Actual value synchronized	Synchronized	No
Cam processing enabled	Synchronized	Yes

Table 4.7 Actual values and cams based on the operating status

Reset

The registers and cam data records are assigned with default values (→ sections 4.2.1 and 4.2.2).

Encoder parameterized

An (unsynchronized) actual value can be read out as soon as the encoder type is parameterized.

Actual value synchronized

A synchronized actual value means a valid actual value. The actual value is synchronized with the following.

- Incremental encoders:
  - When at least one zero marking pulse or the external SYNC signal has arrived
  - When the SYNC bit has been set via software
- Absolute value encoders: When at least one SSI transfer has been successfully concluded

The synchronized status is indicated by the set SYNC bit in the status register of the response message.

Cam processing enabled

Cam processing is started by writing the command register (bit 0 in data byte 3 = 1). The digital outputs parameterized as cam tracks are enabled by setting bit 4 in data byte 3.

Inhibiting the cam tracks

When the cam program is loaded and processing is enabled, the cam tracks can be inhibited via bit 4 in data byte 3 of the command register. The internal states of the cam tracks can still be read out from data bytes 6 and 7 of the response message telegram.

Changing the switching points

The switching points of the cam tracks (cam data records) can also be changed while the module is in operation. This requires that the appropriate telegrams with the new data be transferred from the PLC to the IP 264. The module then handles further processing.

IP 264 Equipment Manual
© Siemens AG 1992, Order No: 6ES5 998–5SL21

Possible errors

Table 4.8 shows the errors which can occur during operation of the module. It also indicates the operating status to which the module "jumps back" after an error occurs (original status: cam processing enabled).

Error	Error LED	Cam Tracks Inhibited	Operating Status after Error
Start/stop bit error for SSI encoders (3 times)	On	Yes[1]	Encoder parameterized
Monoflop time overflow for SSI encoders	On	Yes[1]	Encoder parameterized
Error message of the outputs	On	Yes[1, 2]	Actual value synchronized
Cable break in the encoder cable	On	Yes[1]	Encoder parameterized

[1] Outputs which are parameterized as port can be activated at any time.

[2] All outputs which are parameterized as cam tracks switch off.
Outputs parameterized as ports:
- Only the affected output is switched off when an overload and short circuit occur.
- All outputs of the affected group are switched off when excess temperature occurs. (→ section 2.3.2)

Table 4.8 Errors during operation of the module

4.3.2 Response Messages

Response message telegram

Response messages from the IP 264 module to the PLC are sent by cyclic telegrams. The telegrams are eight bytes long and set up as shown in table 4.9.

Setup

Byte No.	Contents	
0	Status register	1 byte
1	Status byte of the response message	1 byte
2	Contents of the selected register (data source)	HIGH
3	Contents of the selected register (data source)	LOW
4	Actual position	HIGH
5	Actual position	LOW
6	Status of the cam tracks	HIGH
7	Status of the cam tracks	LOW

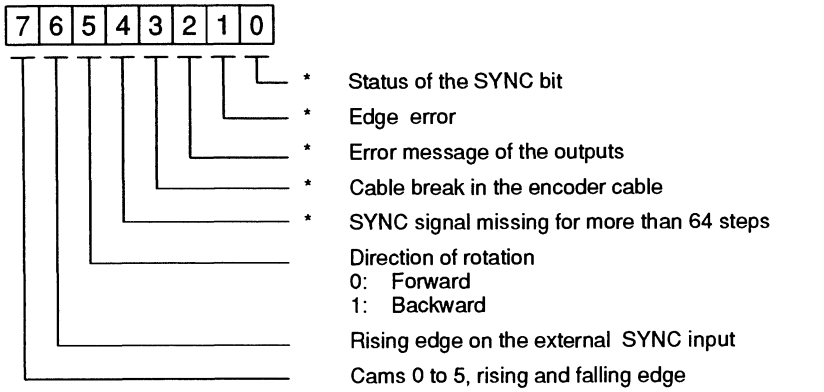
Table 4.9 Response message telegram

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Status register

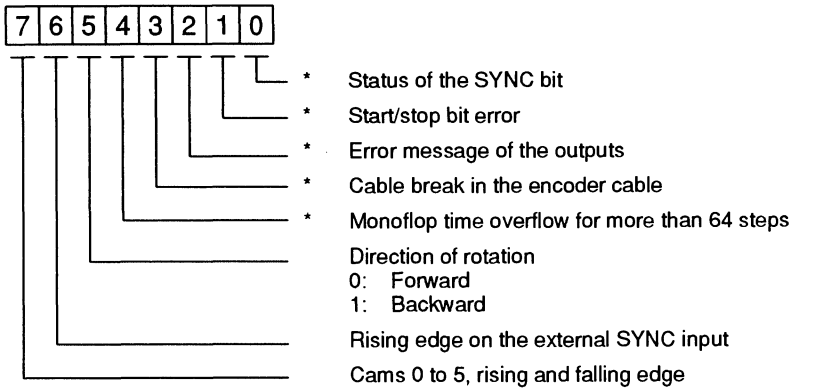
The bits of the status register are assigned differently depending on the type of encoder. This makes it necessary to distinguish between four types of encoders which can be parameterized.

Incremental encoder with direction discriminator



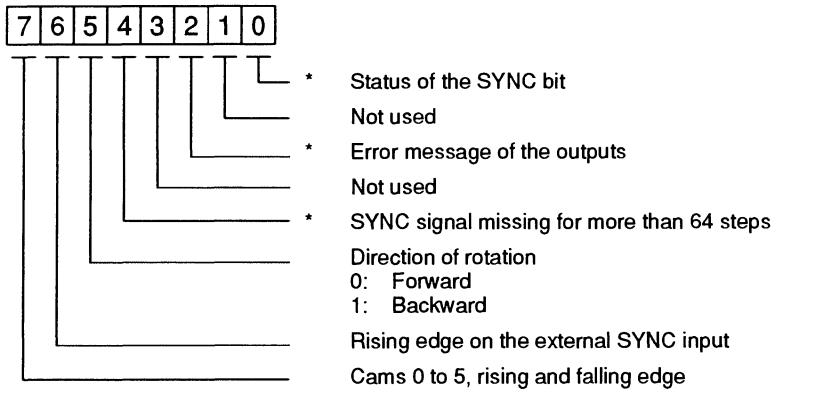
* Generates group error message in the status byte

SSI encoder



* Generates group error message in the status byte

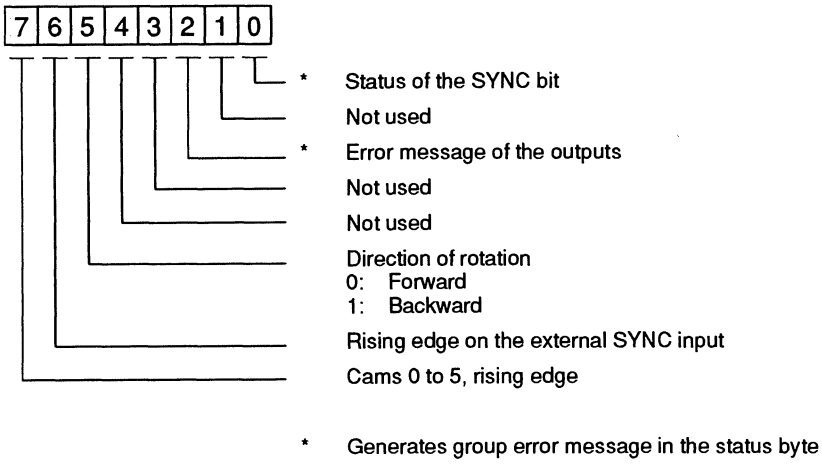
Incremental encoder without direction discriminator (initiator, proximity switch)



* Generates group error message in the status byte

© Siemens AG 1992, Order No: 6ES5 998–5SL21

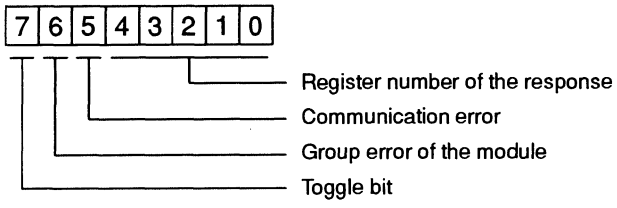
Encoder simulator



Acknowledging errors

All bits are reset after the status register is transferred. This acknowledges the errors. The corresponding bit is reset again immediately if an error is still queued.

Status byte of the response message



Register number of the response

The register number of the response informs the PLC of the source (register number) of bytes 2 and 3. In particular, these are the registers with read access by the PLC (→ section 4.2.2.1).

Communication errors

The bit is set when a communication error occurs. Examples:

- Invalid register number is to be transferred to the IP 264.
- Illegal parameters were transferred.
- Error during reconversion of data

When an invalid register number is specified, a communication error is reported and the previously set (valid) number continues to be used.

Group errors of the module

0: No error
1: Error
The error bit is set for the errors listed below.

- SYNC bit not set
- Edge error (for incremental encoders)
- SYNC signal missing for more than 64 steps (for incremental encoders)
- Start/stop bit error (for SSI encoders)
- Monoflop time overflow for more than 64 clock pulses (for SSI encoders)
- Error message of the outputs
- Cable break in the encoder cable

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Toggle bit

This bit is inverted for every valid telegram.

Default setting

After the start of the module, register number 14 (states of the digital outputs) is used as the default value for the data source.

Acknowledging errors

Errors are acknowledged (if no longer queued) by a one–time transfer of the status information.

Actual position

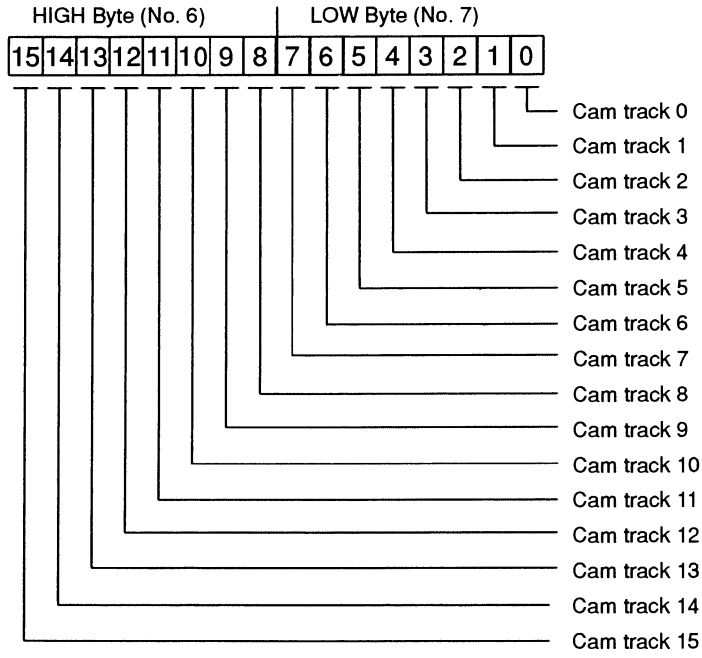
The encoder supplies a new actual position for each cam cycle. This actual position is transferred to the PLC–CPU in bytes 4 and 5 of the response message telegram.

When an SSI transmission cycle exceeds the cycle time of the module, the new actual value is not available until the data transfer is concluded.

When cam processing is not activated, the actual value is updated as quickly as possible.

Status of the cam tracks

The current states of the cam tracks can always be read, even when the cam tracks are inhibited or the output ports are switched to the digital outputs.



© Siemens AG 1992, Order No: 6ES5 998–5SL21

5 Communication of the CPU with the IP 264

5.1	Output Telegram (PLC–CPU → IP 264)	5 – 3
5.1.1	Register Data	5 – 5
5.1.2	Cam Data Records	5 – 7
5.1.2.1	Byte 1: Telegram Control Byte	5 – 7
5.1.2.2	Byte 0, Bytes 2 to 7: Cam Data	5 – 7
5.2	Input Telegram (IP 264 → PLC–CPU)	5 – 9
5.2.1	Byte 1: Status Data	5 – 11
5.2.2	Byte 0: Status Register	5 – 12
5.2.3	Bytes 2 to 7: Current Module Data	5 – 12
5.2.4	Example of an Input Telegram	5 – 12
5.3	Special Operating States	5 – 13
5.3.1	ID Run	5 – 13
5.3.2	STOP Status of the PLC	5 – 13

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Figures

Figure 5.1 Example of data communication between CPU and IP 264 (in slot 2) . 5 – 1

Figure 5.2 Interpretation of a job based on the toggle bit ..... 5 – 5

Tables

Table 5.1 Address allocation of the module ..... 5 – 1

Table 5.2 Addressing the output telegram ..... 5 – 3

Table 5.3 Overview of the output telegram ..... 5 – 3

Table 5.4 Telegram bytes for the individual registers ..... 5 – 6

Table 5.5 Telegram for position cam ..... 5 – 7

Table 5.6 Telegram for time cam ..... 5 – 8

Table 5.7 Addressing the input telegram ..... 5 – 9

Table 5.8 Overview of the input telegram ..... 5 – 9

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5 Communication of the CPU with the IP 264

Slots

The IP 264 can be used in slots 0 to 7 of the PLC. This means a maximum of four modules in one PLC (PLC S5–90U: only slots 0 to 4 and a maximum of three modules).

Eight bytes are reserved for each slot in the process image of the inputs (PAE) and in the process image of the outputs (PAA). Data communication between the CPU and the IP 264 is handled by all eight bytes of PAE and PAA. Remember that the IP 264 cannot be used in PLC S5–100U without the CPU 100 starting with release status 6ES5 100–8MA02.

When used as decentral periphery with the ET 200U, the slot, address and type must be programmed with COM ET 200U. Use the type number "095".

Data communication

Data communication is designated as telegrams in this manual. The manual handles the telegrams from the point of view of the STEP5 programmer.

PLC–CPU → IP 264 communication: output telegram
IP 264 → PLC–CPU communication: input telegram

PS	CPU	Slots 0	1	2	3	4	5	6	7	8	9
Analog addresses		64 to 71	72 to 79	80 to 87	88 to 95	96 to 103	104 to 111	112 to 119	113 to 127	Use on slots starting with slot 8 not permitted	

Table 5.1 Address allocation of the module

Address area

The permissible address area is from 64 to 127 (→ table 5.1). The IP 264 is addressed by byte or word load and transfer commands just as analog input and analog output modules are.

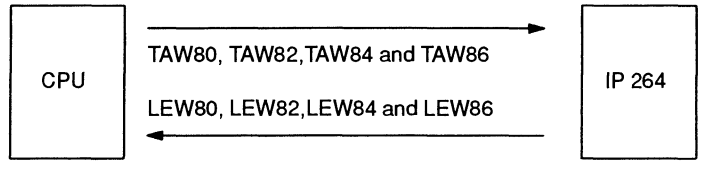


Figure 5.1 Example of data communication between CPU and IP 264 (in slot 2)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Transfer cycle

The IP 264 uses the PLC bus to exchange data with the CPU of the programmable controller. Write the required operating commands in the process image of the outputs (PAA). The commands are transferred from there once per bus cycle to the IP 264. A bit in byte 1 of the output telegram (toggle bit) prevents the same job from being executed more than once.

The data in the output telegram are required for operation of the IP 264. They provide the IP 264 with the following information.

- Parameters (register data and cam data records)
- Cam processing

Data of the IP 264 are stored in the process image of the inputs (PAE) during each bus cycle.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.1 Output Telegram (PLC–CPU → IP 264)

Addressing

Assignment of the individual bytes of the output telegram depends on the slot of the IP 264 in the programmable controller. Table 5.2 shows the assignment of the output bytes to the current slot numbers.

Slot Number	Byte of the Output Telegram							
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0	QB 64	QB 65	QB 66	QB 67	QB 68	QB 69	QB 70	QB 71
1	72	73	74	75	76	77	78	79
2	80	81	82	83	84	85	86	87
3	88	89	90	91	92	93	94	95
4	96	97	98	99	100	101	102	103
5	104	105	106	107	108	109	110	111
6	112	113	114	115	116	117	118	119
7	120	121	122	123	124	125	126	127

Table 5.2 Addressing the output telegram

Setup

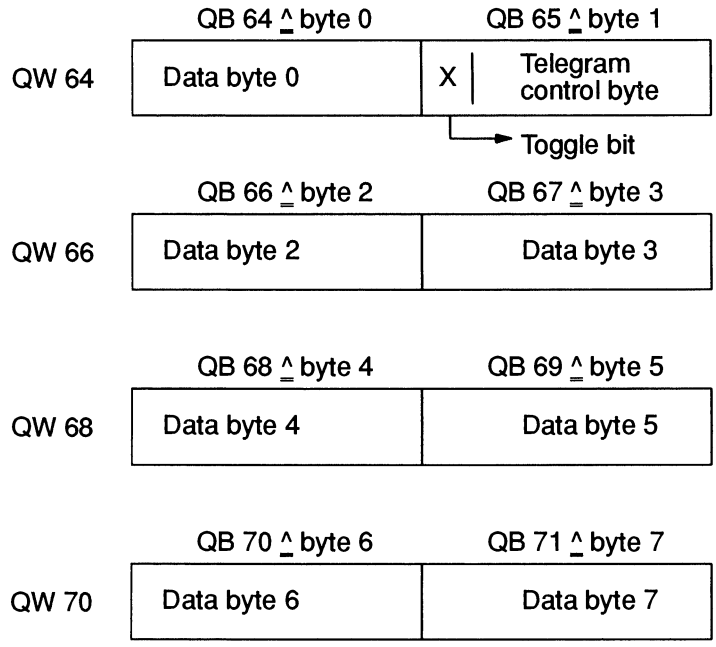
Byte	Description	Recommended Data Format
0	Data byte 0	KH/KM
1	Telegram control byte	KM
2	Data byte 2 (HIGH)	KH/KM
3	Data byte 3 (LOW)	KH/KM
4	Data byte 4 (HIGH)	KH/KM
5	Data byte 5 (LOW)	KH/KM
6	Data byte 6 (HIGH)	KH/KM
7	Data byte 7 (LOW)	KH/KM

Table 5.3 Overview of the output telegram

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Links in the output words (QW)

The individual bytes are combined into output words as shown below. The addresses are specified for slot 0.

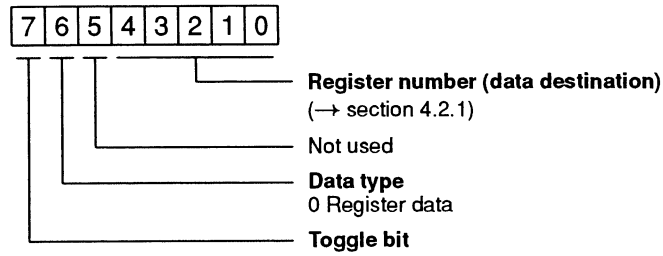


© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.1.1 Register Data

5.1.1.1 Byte 1: Telegram Control Byte

Contents



Toggle bit

Bit 7 has a special function. It is used as an execution bit. A change in the bit signals the IP 264 that a new job is queued. When this happens, the IP 264 interpretes the telegram as a new job.

A next job cannot be started until bit 7 changes again. This prevents a job from being interpreted again and started in each cycle. This bit must be set to "0" in the startup OBs. This ensures that the first job is always started after the 0 → 1 change.

The IP 264 checks this toggle bit in every firmware cycle and, if necessary, starts a new job (→ figure 5.2).

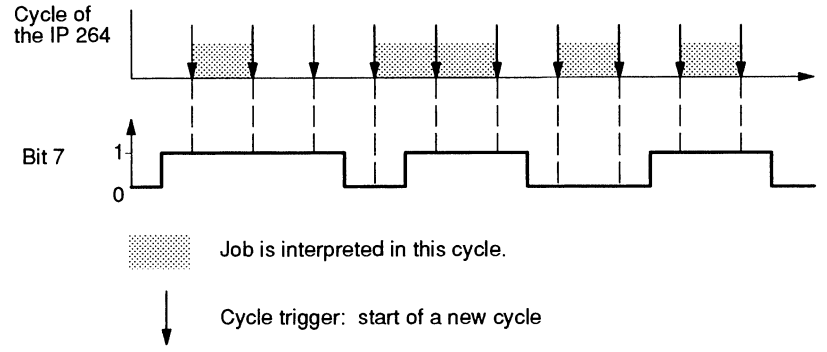


Figure 5.2 Interpretation of a job based on the toggle bit

Example: The following allocation of byte 1 tells the IP 264 the data for register 2 (maximum number of strokes). Bit 7 of byte 1 was "0" before the command was sent.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1	1	1	0	0	1	0	0

(Complete telegram → section 5.1.1.3)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.1.1.2 Byte 0, Bytes 2 to 7: Register Values

Contents

All values required for operation of the module are transferred to the data bytes.

These values can include the following.

- Values for cam processing
- Selection and characteristics of the cam tracks
- Encoder data

The register values are transferred in the telegram bytes as shown in table 5.4.

Register Number	Telegram Byte							
	0	1	2	3	4	5	6	7
0	x	Telegram control byte						
1 to 7, 11			x	x				
10 for INC			x	x				
10 for SSI	x		x	x	x	x	x	x
31	x		x	x				

INC: Incremental encoder
SSI: Absolute encoder with SSI

Table 5.4 Telegram bytes for the individual registers

5.1.1.3 Example of an Output Telegram

A maximum stroke number of 1000 min^{-1} is to be transferred to register 2.

Telegram

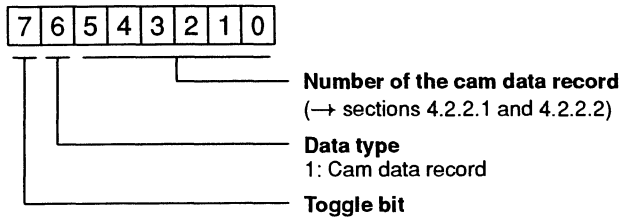
Byte	KF	KM							
0	–	–							
1	–	0/1	0	0	0	0	0	1	0
2,3	1000	–							
4 to 7	–	–							

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.1.2 Cam Data Records

5.1.2.1 Byte 1: Telegram Control Byte

Contents



Toggle bit → Section 5.1.1.1

Example: Use the following allocation of byte 1 to transfer cam data record 20 to the IP 264. Bit 7 of byte 1 was "1" during the last job to the IP 264.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	1	0	1	0	1	0	0

5.1.2.2 Byte 0, Bytes 2 to 7: Cam Data

Contents All data required for processing the cams are transferred in the data bytes.

Position cams

QW 64	Cam control byte	Telegram control byte
QW 66	Start position HIGH	Start position LOW
QW 68	End position HIGH	End position LOW
QW 70	Derivative time HIGH	Derivative time LOW

(Addresses for slot 0)

Table 5.5 Telegram for position cam

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Time cam

QW 64	Cam control byte	Telegram control byte
QW 66	Start position HIGH	Start position LOW
QW 68	On time HIGH	On time LOW
QW 70	Derivative time HIGH	Derivative time LOW

(Addresses for slot 0)

Table 5.6 Telegram for time cam

Cam control byte → Section 4.2.2

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.2 Input Telegram (IP 264 → PLC–CPU)

Addressing

Assignment of the individual bytes of the input telegram depends on the slot of the IP 264 in the programmable controller. Similar to table 5.2 (output telegram), table 5.7 shows the assignment of the input bytes to the current slot numbers.

Slot Number	Byte of the Input Telegram							
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0	IB 64	IB 65	IB 66	IB 67	IB 68	IB 69	IB 70	IB 71
1	72	73	74	75	76	77	78	79
2	80	81	82	83	84	85	86	87
3	88	89	90	91	92	93	94	95
4	96	97	98	99	100	101	102	103
5	104	105	106	107	108	109	110	111
6	112	113	114	115	116	117	118	119
7	120	121	122	123	124	125	126	127

Table 5.7 Addressing the input telegram

Setup

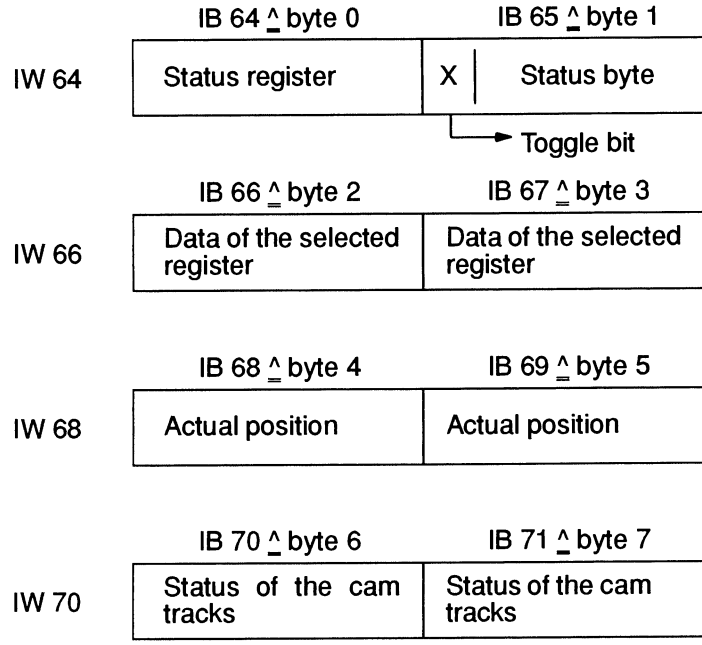
Byte	Description	Recommended Data Format
0	Status register	KM
1	Status byte	KM
2	Contents of the selected register (HIGH)	KH/KM/KF
3	Contents of the selected register (LOW)	KH/KM/KF
4	Actual position (HIGH)	KH/KF
5	Actual position (LOW)	KH/KF
6	Status of the cam tracks (HIGH)	KM
7	Status of the cam tracks (LOW)	KM

Table 5.8 Overview of the input telegram

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Links in the input words (IW)

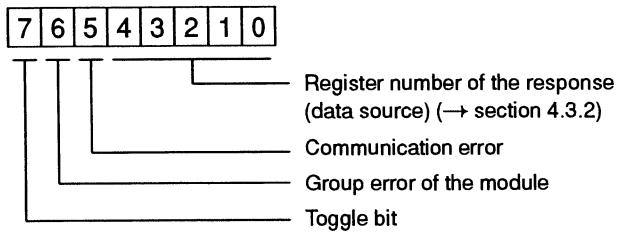
The individual bytes are combined into input words as shown below. The addresses are specified for slot 0.



© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.2.1 Byte 1: Status Data

Contents



Communication error

The bit is set when a communication error has occurred. Examples:

- An invalid register number is to be transferred to the IP 264.
- Illegal parameters were transferred.
- Error during reconversion of data.
- Programming of a T+R encoder failed.

Group error of the module

0: No error
1: Error
The error bit is set when the following errors occur.

- SYNC bit not set
- Edge error (for incremental encoders)
- SYNC signal missing for more than 64 steps (for incremental encoders)
- Start/stop bit error (for SSI encoders)
- Monoflop time overflow, more than 64 clock pulses (for SSI encoders)
- Error message of the outputs
- Cable break in the encoder cable

When the group error bit is set, the exact cause of the error can be determined by reading out the status register.

Errors are acknowledged (if no longer queued) by transferring the status information once.

Toggle bit

The IP 264 changes the toggle bit as soon as the IP 264 provides current data or when the IP 264 is ready to process additional data.

The change of the toggle bit must be evaluated in your program. When the toggle bit has changed in comparison to the preceding bus cycle, this means that the data in the input telegram are current and the module is ready to receive additional data.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.2.2 Byte 0: Status Register

Contents → Section 4.3.2

5.2.3 Bytes 2 to 7: Current Module Data

Updating The IP 264 supplies one current value per firmware cycle.

Data of the selected register Bytes 2 and 3 contain the contents of the register which is entered as the source for the response in REG 0.

Default setting: Register 14
(states of the digital outputs)

Actual position Bytes 4 and 5 contain the current position of the encoder.

Status of the cam tracks Bytes 6 and 7 contain information on the current status of the cam tracks.

5.2.4 Example of an Input Telegram

Telegram

Byte	KF	KM							
0	–	0	0	0	0	1	0	0	0
1	–	0/1	1	0	0	0	0	1	1
2, 3	1000	–							
4, 5	250	–							
6	–	1	1	0	1	1	0	0	0
7	–	0	0	1	1	1	1	0	1

– A group error occurred.
→ Cable break on the incremental encoder

– Bytes 2 and 3 contain the value from register 3.
Upper counting value = 1000

– Encoder position in bytes 4 and 5: 250

– Current status of the cam tracks in bytes 6 and 7

© Siemens AG 1992, Order No: 6ES5 998–5SL21

5.3 Special Operating States

5.3.1 ID Run

Purpose

After the following conditions

- Power voltage ON
- Removal/insertion of a module in the PLC
- Transition of the PLC from STOP to RUN status

the PLC–CPU starts an ID run to determine the current bus configuration (bus length and assignment of slots to modules).

As soon as the module is active (startup and internal initialization are concluded), the green LED goes on (ready indication).

5.3.2 STOP Status of the PLC

Behavior of the module

During transition of the PLC–CPU from RUN to STOP status, the following applies depending on the setting of bit 0 in data byte 2 of the command register (→ section 4.2.1.3).

Bit 0 = 0: The function of the module remains unchanged, but no communication with the PLC takes place.

Bit 0 = 1: The cam tracks are switched off. Registers 6 and 7 must be parameterized again when PLC → IP 264 communication is resumed.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

6 Commissioning

6.1	Programming the System	6 – 1
6.1.1	Emergency Off Switches	6 – 1
6.1.2	Incremental Encoder	6 – 1
6.1.3	SSI Absolute Encoders	6 – 2
6.1.4	Checking the Wiring	6 – 2
6.2	Parameterization of the IP 264	6 – 3

© Siemens AG 1992, Order No: 6ES5 998–5SL21

6 Commissioning

6.1 Programming the System

I/O elements

Before commissioning the IP 264, check to determine that the interfacing and parameterization of the I/O elements are correct.

These I/O elements are listed below.

- The emergency off switches
- The incremental or absolute value encoder

6.1.1 Emergency Off Switches



Caution

The emergency off switches must be correctly installed and their functions checked before the IP 264 is switched on. They must be capable of switching off the entire system.

6.1.2 Incremental Encoder

Mounting

▶ Check to determine that the encoder is mounted correctly.

Encoder type

Which type of encoder are you using? ☐ V

- 5–V incremental encoder in accordance with RS 422 with A/$\overline{A}$, B/$\overline{B}$ and N/$\overline{N}$ signals
- 24–V incremental encoder with A*, B* and N* signals
- Initiator (proximity switch)

Resolution

The minimum resolution (path/encoder increment) must be greater than the desired switching accuracy of the cams.

Limit frequency

The limit frequency of the encoder and the module may not be exceeded for V_{max}. This limit frequency for the individual signals is indicated below.

– For symmetric 5–V signals	At 200 kHz
– For asymmetric 24–V signals	At 100 kHz (with max. line length of 25 m) At 25 kHz (with max. line length of 100 m)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

6.1.3 SSI Absolute Encoders

Encoder data

The SSI encoders and the IP 264 module cannot work together properly unless the encoder data is "known" to the module. The encoder data are written during parameterization in register 10 of the module.

Encoder programming

The IP 264 module can program SSI encoders made by T+R in 25–bit format (→ section 4.2.1.12).

6.1.4 Checking the Wiring

How to proceed

▶ Checking the cable installation OK ○

- Check to be sure that control cables and high–voltage cables are installed in separate rooms and that the cables are not bent. OK ○
- Be sure that the cables to and from the controller are shielded over their entire length. This shielding must be grounded on both sides. OK ○

Installation and laying of the grounding lines is merits careful attention since operating malfunctions can be caused by insufficient cross sections, grounding loops and unconnected ground. Localizing and correcting such malfunctions can be very expensive and time–consuming.

▶ Be sure that the dimensions of the grounding lines are sufficient and correctly connected. OK ○

▶ When using 5–V incremental encoders and SSI encoders, check to be sure that the lines of the signal inverse signal pairs are twisted in pairs. OK ○

▶ Check the cables following for short ciruits, line breaks and correct pin allocation as described in the hardware description (→ section 2).

- Encoder line OK ○
- Lines for digital inputs/outputs and voltage supply of the module OK ○
- If present: Line to the cascaded module OK ○

© Siemens AG 1992, Order No: 6ES5 998–5SL21

6.2 Parameterization of the IP 264

Requirements

The IP 264 module cannot be used unless it is parameterized with valid data. The following is performed.

- The individual registers of the module are written.
- The cam data records are stored in the RAM of the module.

Cam processing can be started after parameterization has been successfully completed.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7 Sample Program

7.1 Startup Behavior ..... 7 – 3

7.2 Cyclic Program ..... 7 – 4

7.3 Parameterization Data Block ..... 7 – 6

7.4 Data Block for Cam Data Records ..... 7 – 7

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7 Sample Program

Purpose

The included floppy disk contains a sample program to help you start working with the module.

In many cases, the function blocks contained in the sample program can be used as standard function blocks for actual applications. These function blocks can also be adapted and expanded for special applications.

The README file contains brief comments concerning the sample program.

To test the module, load the complete sample program in the memory of the PLC.

Device configuration

Testing the IP 264 module can be performed with the following devices, for example.

- One of the listed programmable controllers
- Programmer (e.g., PG 750)
- IP 264 cam controller
- Digital input module

Addresses

The following addresses are programmed.

- IP 264: I/O address 80
- Digital input module: IB 0 to IB 1

Block allocations

DB 10	Parameterization data block (working data block)
DB 11	Data block for cam data records
FB 1	Test program for edge evaluation
FB 64	Startup function block
FB 65	FB for cyclic program (parameterization, processing of the module)
FB 62, FB 63	Have same function for PLCs S5–90U and S5–100U with CPU 100/CPU 102 as FB 64 and FB 65 (adjusted to restrictions of the command set and the number of flag bytes)
OB 1	Cyclic program
OB 20	New start
OB 21	Manual new start/restart
OB 22	Automatic new start/restart

© Siemens AG 1992, Order No: 6ES5 998–5SL21

Use the function blocks of the sample program as shown below based on the PLC in which you are using the IP 264.

Device	Function Blocks To Be Used
PLC S5–90U	FB 62, FB 63 and FB 1
PLC S5–95U	FB 64, FB 65 and FB 1
PLC S5–100U with CPU 100/102	FB 62, FB 63 and FB 1
PLC S5–100U with CPU 103	FB 64, FB 65 and FB 1
ET 200U with PLCs S5–115U to S5–155U	FB 64, FB 65 and FB 1

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7.1 Startup Behavior

New start

Since the IP 264 is not buffered, data stored on the module are lost when a voltage failure occurs or the PLC is switched off.

The data must be transferred to the IP 264 again when a new start is performed.

Communication with the module is not possible during startup since no process image is updated.

OB 20
OB 21
OB 22

These blocks set a startup flag to ensure new start/restart capability for the module when used in decentral I/O device ET 200U together with **PLCs S5–135U to S5–155U**.

PB 1
PB 21
PB 22

Proceed as follows if you are using **PLCs S5–90U to S5–115U.**

1. Delete blocks OB 1, OB 20, OB 21 and OB 22 in the PLC memory.
2. Rename existing program blocks PB 1, PB 2 and PB 22 in OB 1, OB 21 and OB 22 (OB 20 does not exist for this PLC).

OB 21 (manual new start/restart)

FB 64/FB 62 is called in OB 21.

During startup, **FB 64** assigns the BEF parameter of FB 65 with "parameterization" and deletes the working area in DB 10.

During startup, **FB 62** assigns interface flags FW 118 and FW 116 of FB 63 with "parameterization" and deletes the working area in DB 10.

OB 22

During an automatic new start/restart, **FB 64/FB 62** are called by **OB 22**. The rest of the procedure is the same as for a manual new start/restart.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7.2 Cyclic Program

Function blocks FB 65/FB 63 and FB 1 are called by OB 1 in the cyclic program.

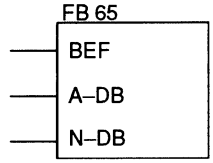
FB 65

FB 65 works together with the following programmable controllers.

- S5–95U
- S5–100U with CPU 103
- ET 200U with PLCs S5–115U to S5–155U

After startup, FB 65 is given the "parameterize the module" command (by the BEF parameter assigned by FB 64).

After parameterization is concluded, the module can be processed with the desired command.



BEF: Command
A–DB: Working data block (= DB 10)
N–DB: Data block for cam data records (= DB 11)

Assignment of the BEF parameter

The following commands are available (BEF1 = FW 20).

FY 20.0 Parameterization of the module
The following registers are written.
- Command register
- Maximum number of strokes
- Upper counting value
- Encoder simulator
- Output selection
- Encoder parameterization
- Steps per stroke
- All cam data records whose active identifier is KH FF (DR 0, DR 4, DR 8,...,DR 252)

20.1 Read back desired register
The register number must be specified in DW 27 of DB 10. The contents of the register are stored in DW 24, and the register number in bits 0 to 4 in DR 23 is reported back. The data are not complete until the correct register number is reported back. Cyclic triggering is not required since the module repeats the telegram automatically.

20.2 Write RAM address
20.3 Write output port
20.4 Read maximum derivative time
20.5 Read current actual value
20.6 Read zero marking pulse value
20.7 Read states of the digital outputs

FY 21.0 Write command register
21.1 Write a definite cam data record
The number of the cam data record is specified in DW 32 of DB 10 (KF 0 to 63). The applicable cam data record is contained in DB 11.

☞ The active identifier is ignored for this command.

21.2 to 21.7 Not used

© Siemens AG 1992, Order No: 6ES5 998–5SL21

FB 63

FB 63 works together with the following programmable controllers.

- S5–90U
- S5–100U with CPU 100/102

These PLCs have a reduced command set and fewer flags. The FB 63 solves these problems.

- It uses only interface flags (no formal operands).
- It uses flag bytes up to 127 only.
- It transfers only cam data records 0, 1, 32 and 33 since the applicable PLCs do not execute "processing" commands. Larger amounts of data (the cam data records in this case) can only be transferred with inefficient program coding.

After startup, FB 63 is given the "parameterize the module" command (by interface flag FW 105 allocated by FB 62).

After parameterization is concluded, the module can be processed with the desired command.

Allocation of interface flag FW 105

See allocation of the BEF parameter for FB 65.

FB 1

Function block FB 1 contains a test program for the edge evaluation of the inputs. At the same time, it checks to determine whether only one command bit each of FB 65/FB 63 is set.

FB 1 was generated especially for the sample program and does not need to be included in a user program.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7.3 Parameterization Data Block

Data block DB 10 is the parameterization data block in our example. It is also used as the working data block for FB 65/FB 63.

Setup

DB10 C:IP264DST.S5D **LEN=38**

```
 0:  KH  = 0000;
 1:  KH  = 0000;
 2:  KH  = 0000;
 3:  KH  = 0000;
 4:  KH  = 0000;
 5:  KH  = 0000;
 6:  KH  = 0000;
 7:  KH  = 0000;
 8:  KH  = 0000;
 9:  KH  = 0000;
10:  KH  = 0000;
11:  KM  = 00000001 00011011;
12:  KH  = 2500;
13:  KH  = 0000;
14:  KH  = 0000;
15:  KH  = 0000;
16:  KM  = 00000000 00000000;
17:  KM  = 00000000 00000000;
18:  KM  = 00010101 11001001;
19:  KM  = 00000000 10001100;
20:  KH  = 0000;
21:  KH  = 0000;
22:  KH  = FFFF;
23:  KM  = 00000000 00000000;
24:  KH  = 0000;
25:  KH  = 0000;
26:  KM  = 00000000 00000000;
27:  KF  = +00000;
28:  KH  = 0000;
29:  KH  = 0000;
30:  KH  = 0000;
31:  KH  = 0000;
32:  KF  = +00000;
33:
```

IB 00, IB 01
IB 02, IB 03
IB 04, IB 05
IB 06, IB 07
QB 00, QB 01
QB 02, QB 03
QB 04, QB 05
QB 06, QB 07
} In relation to address of the module

Internal working area of FB 65/FB 63
Internal working area of FB 65/FB 63
Internal working area of FB 65/FB 63
REG1: Command reg. byte 2, byte 1
REG2: Max. stroke num. HIGH/LOW
REG3: Upper counting val. HIGH/LOW
REG4: Encoder simulator HIGH/LOW
REG5: RAM address HIGH/LOW
REG6: Output port HIGH/LOW
REG7: Output selection HIGH/LOW
REG10: Encoder para. HIGH/LOW
Cting dir. byte 0, Step/around byte 4
– –, preset value HIGH
Preset value MIDDLE/LOW
REG11: Steps per stroke HIGH/LOW
Status register, status byte
REG9: RAM data HIGH/LOW
Actual value HIGH/LOW
Status of cam tracks HIGH/LOW
REG0: Desired register (data source)
REG8: Max. der. time HIGH/LOW
REG12: Current actual value HIGH/LOW
REG13: Zero marking pul. value HIGH/LOW
REG14: States of dig. outputs H/L
Desired cam data rec. number

© Siemens AG 1992, Order No: 6ES5 998–5SL21

7.4 Data Block for Cam Data Records

Contents

DB 11 contains up to 64 cam data records. It must be set up up to DW 255 since there is a fixed assignment between data record number and data word number (see also section 4.2.2).

Active identifier

The respective active identifier specifies whether the cam data record is to be transferred to the module.

- KH FF: Cam data record is active.
- KH 00 to FE: Cam data record is inactive.

FB 65 reads the active identifier and transfer all active cam data records during parameterization of the module.

FB 63 only transfers cam data records 0, 1, 32 and 33.

Setup

DB 11 C:IP264DST.S5D LEN=261

```
 0:  KM = 00001000 11111111;   00 CDR: Control byte, active ID
 1:  KH = 0100;                Start position HIGH/LOW
 2:  KH = 1100;                End position or on time HI/LO
 3:  KH = 0000;                Derivative time HIGH/LOW
 4:  KM = 00001100 11111111;   01 CDR: Control byte, active ID
 5:  KH = 1200;                Start position HIGH/LOW
 6:  KH = 2200;                End position or on time HI/LO
 7:  KH = 0000;                Derivative time HIGH/LOW
 8:  KM = 00011000 11111111;   02 CDR: Control byte, active ID
 9:  KH = 2300;                Start position HIGH/LOW
10:  KH = 3300;                End position or on time HI/LO
11:  KH = 0000;                Derivative time HIGH/LOW
12:  KM = 00011100 11111111;   03 CDR: Control byte, active ID
13:  KH = 3400;                Start position HIGH/LOW
14:  KH = 4500;                End position or on time HI/LO
15:  KH = 0000;                Derivative time HIGH/LOW
16:  KM = 00101000 11111111;   04 CDR: Control byte, active ID
17:  KH = 5600;                Start position HIGH/LOW
18:  KH = 6700;                End position or on time HI/LO
19:  KH = 0000;                Derivative time HIGH/LOW
20:  KM = 00101100 11111111;   05 CDR: Control byte, active ID
21:  KH = 6800;                Start position HIGH/LOW
22:  KH = 7900;                End position or on time HI/LO
23:  KH = 0000;                Derivative time HIGH/LOW
24:  KM = 00111000 11111111;   06 CDR: Control byte, active ID
25:  KH = 7A00;                Start position HIGH/LOW
26:  KH = 8A00;                End position or on time HI/LO
27:  KH = 0000;                Derivative time HIGH/LOW
28:  KM = 00111100 11111111;   07 CDR: Control byte, active ID
29:  KH = 8B00;                Start position HIGH/LOW
30:  KH = 9B00;                End position or on time HI/LO
31:  KH = 0000;                Derivative time HIGH/LOW
32:  KM = 01001000 11111111;   08 CDR: Control byte, active ID
33:  KH = AC00;                Start position HIGH/LOW
34:  KH = BC00;                End position or on time HI/LO
35:  KH = 0000;                Derivative time HIGH/LOW
36:  KM = 01001100 11111111;   09 CDR: Control byte, active ID
37:  KH = BD00;                Start position HIGH/LOW
38:  KH = CD00;                End position or on time HI/LO
39:  KH = 0000;                Derivative time HIGH/LOW
40:  KM = 01011000 11111111;   10 CDR: Control byte, active ID
41:  KH = CE00;                Start position HIGH/LOW
42:  KH = DF00;                End position or on time HI/LO
43:  KH = 0000;                Derivative time HIGH/LOW
```


© Siemens AG 1992, Order No: 6ES5 998–5SL21

```
44:  KM = 01011100 11111111;   11 CDR: Control byte, active ID
45:  KH = 0100;                Start position HIGH/LOW
46:  KH = 1100;                End position or on time HI/LO
47:  KH = 0000;                Derivative time HIGH/LOW
48:  KM = 01101000 11111111;   12 CDR: Control byte, active ID
49:  KH = 1200;                Start position HIGH/LOW
50:  KH = 2200;                End position or on time HI/LO
51:  KH = 0000;                Derivative time HIGH/LOW
52:  KM = 01101100 11111111;   13 CDR: Control byte, active ID
53:  KH = 2300;                Start position HIGH/LOW
54:  KH = 3300;                End position or on time HI/LO
55:  KH = 0000;                Derivative time HIGH/LOW
56:  KM = 01111000 11111111;   14 CDR: Control byte, active ID
57:  KH = 3400;                Start position HIGH/LOW
58:  KH = 4400;                End position or on time HI/LO
59:  KH = 0000;                Derivative time HIGH/LOW
60:  KM = 01111100 11111111;   15 CDR: Control byte, active ID
61:  KH = 4500;                Start position HIGH/LOW
62:  KH = 5500;                End position or on time HI/LO
63:  KH = 0000;                Derivative time HIGH/LOW
64:  KM = 10001000 11111111;   16 CDR: Control byte, active ID
65:  KH = 5600;                Start position HIGH/LOW
66:  KH = 6600;                End position or on time HI/LO
67:  KH = 0000;                Derivative time HIGH/LOW
68:  KM = 10001100 11111111;   17 CDR: Control byte, active ID
69:  KH = 6700;                Start position HIGH/LOW
70:  KH = 7700;                End position or on time HI/LO
71:  KH = 0000;                Derivative time HIGH/LOW
72:  KM = 10011000 11111111;   18 CDR: Control byte, active ID
73:  KH = 7800;                Start position HIGH/LOW
74:  KH = 8800;                End position or on time HI/LO
75:  KH = 0000;                Derivative time HIGH/LOW
76:  KM = 10011100 11111111;   19 CDR: Control byte, active ID
77:  KH = 8900;                Start position HIGH/LOW
78:  KH = 9900;                End position or on time HI/LO
79:  KH = 0000;                Derivative time HIGH/LOW
80:  KM = 10101000 11111111;   20 CDR: Control byte, active ID
81:  KH = 9A00;                Start position HIGH/LOW
82:  KH = AA00;                End position or on time HI/LO
83:  KH = 0000;                Derivative time HIGH/LOW
84:  KM = 10101100 11111111;   21 CDR: Control byte, active ID
85:  KH = AB00;                Start position HIGH/LOW
86:  KH = BB00;                End position or on time HI/LO
87:  KH = 0000;                Derivative time HIGH/LOW
88:  KM = 10111000 11111111;   22 CDR: Control byte, active ID
89:  KH = BC00;                Start position HIGH/LOW
90:  KH = CC00;                End position or on time HI/LO
91:  KH = 0000;                Derivative time HIGH/LOW
92:  KM = 10111100 11111111;   23 CDR: Control byte, active ID
93:  KH = CD00;                Start position HIGH/LOW
94:  KH = DD00;                End position or on time HI/LO
95:  KH = 0000;                Derivative time HIGH/LOW
96:  KM = 11001000 11111111;   24 CDR: Control byte, active ID
97:  KH = DE00;                Start position HIGH/LOW
98:  KH = EE00;                End position or on time HI/LO
99:  KH = 0000;                Derivative time HIGH/LOW
100: KM = 11001100 11111111;   25 CDR: Control byte, active ID
101: KH = EF00;                Start position HIGH/LOW
102: KH = FF00;                End position or on time HI/LO
103: KH = 0000;                Derivative time HIGH/LOW
104: KM = 11011000 11111111;   26 CDR: Control byte, active ID
105: KH = 0100;                Start position HIGH/LOW
106: KH = 1100;                End position or on time HI/LO
107: KH = 0000;                Derivative time HIGH/LOW
108: KM = 11011100 11111111;   27 CDR: Control byte, active ID
109: KH = 1200;                Start position HIGH/LOW
110: KH = 2200;                End position or on time HI/LO
111: KH = 0000;                Derivative time HIGH/LOW
112: KM = 11101000 11111111;   28 CDR: Control byte, active ID
113: KH = 2300;                Start position HIGH/LOW
114: KH = 3300;                End position or on time HI/LO
115: KH = 0000;                Derivative time HIGH/LOW
116: KM = 11101100 11111111;   29 CDR: Control byte, active ID
117: KH = 3400;                Start position HIGH/LOW
118: KH = 4400;                End position or on time HI/LO
119: KH = 0000;                Derivative time HIGH/LOW
```


© Siemens AG 1992, Order No: 6ES5 998–5SL21

```
120:  KM = 11111000 11111111;   30 CDR: Control byte, active ID
121:  KH = 4500;                Start position HIGH/LOW
122:  KH = 5500;                End position or on time HI/LO
123:  KH = 0000;                Derivative time HIGH/LOW
124:  KM = 11111100 11111111;   31 CDR: Control byte, active ID
125:  KH = 5600;                Start position HIGH/LOW
126:  KH = 6600;                End position or on time HI/LO
127:  KH = 0000;                Derivative time HIGH/LOW
128:  KM = 00001000 11111111;   32 CDR: Control byte, active ID
129:  KH = 6700;                Start position HIGH/LOW
130:  KH = 7700;                End position or on time HI/LO
131:  KH = 0000;                Derivative time HIGH/LOW
132:  KM = 00001100 11111111;   33 CDR: Control byte, active ID
133:  KH = 7800;                Start position HIGH/LOW
134:  KH = 8800;                End position or on time HI/LO
135:  KH = 0000;                Derivative time HIGH/LOW
136:  KM = 00011000 11111111;   34 CDR: Control byte, active ID
137:  KH = 8900;                Start position HIGH/LOW
138:  KH = 9900;                End position or on time HI/LO
139:  KH = 0000;                Derivative time HIGH/LOW
140:  KM = 00011100 11111111;   35 CDR: Control byte, active ID
141:  KH = 9A00;                Start position HIGH/LOW
142:  KH = AA00;                End position or on time HI/LO
143:  KH = 0000;                Derivative time HIGH/LOW
144:  KM = 00101000 11111111;   36 CDR: Control byte, active ID
145:  KH = AB00;                Start position HIGH/LOW
146:  KH = BB00;                End position or on time HI/LO
147:  KH = 0000;                Derivative time HIGH/LOW
148:  KM = 00101100 11111111;   37 CDR: Control byte, active ID
149:  KH = BC00;                Start position HIGH/LOW
150:  KH = CC00;                End position or on time HI/LO
151:  KH = 0000;                Derivative time HIGH/LOW
152:  KM = 00111000 11111111;   38 CDR: Control byte, active ID
153:  KH = CD00;                Start position HIGH/LOW
154:  KH = DD00;                End position or on time HI/LO
155:  KH = 0000;                Derivative time HIGH/LOW
156:  KM = 00111100 11111111;   39 CDR: Control byte, active ID
157:  KH = DE00;                Start position HIGH/LOW
158:  KH = EE00;                End position or on time HI/LO
159:  KH = 0000;                Derivative time HIGH/LOW
160:  KM = 01001000 11111111;   40 CDR: Control byte, active ID
161:  KH = EF00;                Start position HIGH/LOW
162:  KH = FF00;                End position or on time HI/LO
163:  KH = 0000;                Derivative time HIGH/LOW
164:  KM = 01001100 11111111;   41 CDR: Control byte, active ID
165:  KH = 0100;                Start position HIGH/LOW
166:  KH = 1100;                End position or on time HI/LO
167:  KH = 0000;                Derivative time HIGH/LOW
168:  KM = 01011000 11111111;   42 CDR: Control byte, active ID
169:  KH = 1200;                Start position HIGH/LOW
170:  KH = 2200;                End position or on time HI/LO
171:  KH = 0000;                Derivative time HIGH/LOW
172:  KM = 01011100 11111111;   43 CDR: Control byte, active ID
173:  KH = 2300;                Start position HIGH/LOW
174:  KH = 3300;                End position or on time HI/LO
175:  KH = 0000;                Derivative time HIGH/LOW
176:  KM = 01101000 11111111;   44 CDR: Control byte, active ID
177:  KH = 3400;                Start position HIGH/LOW
178:  KH = 4400;                End position or on time HI/LO
179:  KH = 0000;                Derivative time HIGH/LOW
180:  KM = 01101100 11111111;   45 CDR: Control byte, active ID
181:  KH = 4500;                Start position HIGH/LOW
182:  KH = 5500;                End position or on time HI/LO
183:  KH = 0000;                Derivative time HIGH/LOW
184:  KM = 01111000 11111111;   46 CDR: Control byte, active ID
185:  KH = 5600;                Start position HIGH/LOW
186:  KH = 6600;                End position or on time HI/LO
187:  KH = 0000;                Derivative time HIGH/LOW
188:  KM = 01111100 11111111;   47 CDR: Control byte, active ID
189:  KH = 6700;                Start position HIGH/LOW
190:  KH = 7700;                End position or on time HI/LO
191:  KH = 0000;                Derivative time HIGH/LOW
192:  KM = 10001000 11111111;   48 CDR: Control byte, active ID
193:  KH = 7800;                Start position HIGH/LOW
194:  KH = 8800;                End position or on time HI/LO
195:  KH = 0000;                Derivative time HIGH/LOW
```


© Siemens AG 1992, Order No: 6ES5 998–5SL21

```
196:  KM = 10001100 11111111;   49 CDR: Control byte, active ID
197:  KH = 8900;                Start position HIGH/LOW
198:  KH = 9900;                End position or on time HI/LO
199:  KH = 0000;                Derivative time HIGH/LOW
200:  KM = 10011000 11111111;   50 CDR: Control byte, active ID
201:  KH = 9A00;                Start position HIGH/LOW
202:  KH = AA00;                End position or on time HI/LO
203:  KH = 0000;                Derivative time HIGH/LOW
204:  KM = 10011100 11111111;   51 CDR: Control byte, active ID
205:  KH = AB00;                Start position HIGH/LOW
206:  KH = BB00;                End position or on time HI/LO
207:  KH = 0000;                Derivative time HIGH/LOW
208:  KM = 10101000 11111111;   52 CDR: Control byte, active ID
209:  KH = BC00;                Start position HIGH/LOW
210:  KH = CC00;                End position or on time HI/LO
211:  KH = 0000;                Derivative time HIGH/LOW
212:  KM = 10101100 11111111;   53 CDR: Control byte, active ID
213:  KH = CD00;                Start position HIGH/LOW
214:  KH = DD00;                End position or on time HI/LO
215:  KH = 0000;                Derivative time HIGH/LOW
216:  KM = 10111000 11111111;   54 CDR: Control byte, active ID
217:  KH = DE00;                Start position HIGH/LOW
218:  KH = EE00;                End position or on time HI/LO
219:  KH = 0000;                Derivative time HIGH/LOW
220:  KM = 10111100 11111111;   55 CDR: Control byte, active ID
221:  KH = EF00;                Start position HIGH/LOW
222:  KH = FF00;                End position or on time HI/LO
223:  KH = 0000;                Derivative time HIGH/LOW
224:  KM = 11001000 11111111;   56 CDR: Control byte, active ID
225:  KH = 0100;                Start position HIGH/LOW
226:  KH = 1100;                End position or on time HI/LO
227:  KH = 0000;                Derivative time HIGH/LOW
228:  KM = 11001100 11111111;   57 CDR: Control byte, active ID
229:  KH = 1200;                Start position HIGH/LOW
230:  KH = 2200;                End position or on time HI/LO
231:  KH = 0000;                Derivative time HIGH/LOW
232:  KM = 11011000 11111111;   58 CDR: Control byte, active ID
233:  KH = 2300;                Start position HIGH/LOW
234:  KH = 3300;                End position or on time HI/LO
235:  KH = 0000;                Derivative time HIGH/LOW
236:  KM = 11011100 11111111;   59 CDR: Control byte, active ID
237:  KH = 3400;                Start position HIGH/LOW
238:  KH = 4400;                End position or on time HI/LO
239:  KH = 0000;                Derivative time HIGH/LOW
240:  KM = 11101000 11111111;   60 CDR: Control byte, active ID
241:  KH = 4500;                Start position HIGH/LOW
242:  KH = 5500;                End position or on time HI/LO
243:  KH = 0000;                Derivative time HIGH/LOW
244:  KM = 11101100 11111111;   61 CDR: Control byte, active ID
245:  KH = 5600;                Start position HIGH/LOW
246:  KH = 6600;                End position or on time HI/LO
247:  KH = 0000;                Derivative time HIGH/LOW
248:  KM = 11111000 11111111;   62 CDR: Control byte, active ID
249:  KH = 6700;                Start position HIGH/LOW
250:  KH = 7700;                End position or on time HI/LO
251:  KH = 0000;                Derivative time HIGH/LOW
252:  KM = 11111100 11111111;   63 CDR: Control byte, active ID
253:  KH = 7800;                Start position HIGH/LOW
254:  KH = 8800;                End position or on time HI/LO
255:  KH = 0000;                Derivative time HIGH/LOW
256:
```

* CDR = Cam data record

© Siemens AG 1992, Order No: 6ES5 998–5SL21

8 Error Treatment

This section contains information on error messages which can occur while you are working with the IP 264.

Occurrence of errors

The occurrence of an error on the module or during communication between the PLC–CPU and the IP 264 is indicated by a set error bit in the status byte. The ERROR LED also goes on. The status register then contains the exact cause of the error (also with a set bit).

Acknowledging errors

Errors are acknowledged (deleted) if no longer queued by either one–time or cyclic reading of the status byte and the status register.

Listing the errors

Possible errors are listed below. Notes on error correction are included in some cases. In addition, the list also provides a cross reference to the section of the manual containing details on error treatment.

Communication errors

- An invalid register number is to be transferred to the IP 264.
- Illegal parameters were transferred.
- Error during reconversion of data
- Programming of a T+R encoder has failed.

Group error on the module

- SYNC bit not set
- Edge error (for incremental encoders)
  (Example: Counting pulses exceed upper limit frequency; the tracks are shifted for two–track encoders.)
  → Section 4.1.1.2
- SYNC signal has been missing for more than 64 steps (for incremental encoders).
- Start/stop bit error (for SSI encoders)
  (Three consecutive data transfers between encoder and module are faulty.)
  → Section 4.1.1.3
- Monoflop time overflow, more than 64 clock pulses (for SSI encoders)
  → Section 4.1.1.3
- Error message of the outputs
  → Section 2.3.2
- Cable break in the encoder cable
  (Check the encoder connection line and the encoder plug connector.)

© Siemens AG 1992, Order No: 6ES5 998–5SL21

9 Definition of Terms

Braking cam	Controls the coupling to the motor and braking in mechanical presses, for example, so that the press comes to rest in the upper dead point (provided in cam track 1)
Braking enable	External signal for controlling cam track 1 (braking cam)
Cam	Area in which a reaction is to occur (i.e., desired)
Cam program	All cam data records together which are transferred to the IP 264 for processing
Cam track	Reaction bar on which a cam can be placed as desired The IP 264 offers up to 16 cam tracks.
Counting cam	When cam track 0 is inhibited, all internal cams for track 0 are counted. When the parameterized "upper counting value" is reached, cam track 0 is enabled, and the currently active internal cam is switched through to the output.
CPU	Central processing unit (in the PLC)
DB	Data block
Dead time	Maximum derivative time from all existing cam data records
Derivative time	A reaction is delayed by the connected unit. A derivative time is parameterized in the corresponding cam data record to offset the delay.
Direction discriminator	Automatic direction recognition (only available with two–track incremental encoders, and , on a restricted basis, with absolute value encoders with SSI)
DW	Data word
Dynamic shift	Adjustment of the derivative time (parameterized in the cam data records) to the different axis speeds
Encoder simulator	Simulation of an external position encoder for the timer–controlled execution of a cam program
Execution bit	See toggle bit.
FB	Function block
FW	Flag word
FY	Flag byte

© Siemens AG 1992, Order No: 6ES5 998–5SL21

IB	Input byte
Initiator	Proximity switch
Input telegram	Data block for data exchange from the IP 264 to the PLC–CPU (See also telegram.)
IW	Input word
OB	Organization block
On time	Time during which a time cam is active (regardless of the distance covered)
Output port	The status of the corresponding controller port is output on the digital output.
Output telegram	Data block for data exchange from the PLC–CPU to the IP 264 (See also telegram.)
PAA	Process image of the outputs
PAE	Process image of the inputs
PLC	Programmable logic controller
Position cam	A cam defined by a start and end position
Proximity switch	Initiator
QB	Output byte
QW	Output word
RDC	Direction discriminator
S5	SIMATIC S5 programmable controller
SPS	Memory programmable controller
SSI	Synchronous serial interface
Telegram	A data block of eight bytes for data communication between the PLC–CPU and the IP 264. It is transferred to the process image of the outputs or inputs.
Time cam	A cam defined by a start position and an on time
Toggle bit	Execution bit (MSB in byte 1 of a telegram) A telegram with a changed toggle bit is interpreted by the IP 264 as a new job.

© Siemens AG 1992, Order No: 6ES5 998–5SL21

10 Index

A

Absolute value encoder, 2 – 8
Acknowledging errors, 4 – 44
Actual position, 4 – 44
Address area, 5 – 1

B

Braking cam, 4 – 12
Braking enable, 2 – 11
Bus cycle, 5 – 2
Bus submodule, 2 – 11, 3 – 4

C

Cable break monitoring, 2 – 14
Cam control byte, 4 – 36
Cam controller, 4 – 1
Cam data record, 4 – 34, 5 – 7
Cam length, 4 – 8
Cam mirroring, 4 – 15
Cam processing, 4 – 40
Cam program, 4 – 14, 4 – 34
Cam track, 2 – 12, 4 – 8
Cams, 4 – 8
Cascading, 4 – 37
Coding element, 3 – 4
Command register, 4 – 22
Counting cam, 4 – 11
Current counting value, 4 – 31
Cycle time, 2 – 16

D

Data communication, 5 – 1
Dead time, 4 – 26
Dead time offset, 4 – 37
Default setting, 4 – 19, 4 – 35
Demounting, 3 – 4
Derivative time, 4 – 13
Digital inputs, 2 – 11
Digital outputs, 2 – 12
Dynamic shift, 4 – 37

E

Edge error, 4 – 4
EMC measures, 3 – 2
Emergency off switch, 3 – 1
Encoder, changing of, 3 – 5
Encoder programming, 4 – 28
Encoder simulator, 4 – 7, 4 – 24, 4 – 30
Encoder type, 4 – 27
Error acknowledgement, 8 – 1
Error bit, 8 – 1
Error correction, 8 – 1
ERROR LED, 2 – 13
Error message, 8 – 1

F

Firmware release status, 4 – 32
Fuse, 2 – 2

G

Grounding, 3 – 3
Group error of the module, 4 – 43

H

Hysteresis, 4 – 9

© Siemens AG 1992, Order No: 6ES5 998–5SL21

I

Incremental encoder, 2 – 3, 4 – 3, 4 – 27
Inductive loads, 2 – 12
Initiator, 2 – 3, 4 – 2, 4 – 30
Input telegram, 5 – 1, 5 – 9

L

Linear axis, 1 – 2, 4 – 15

M

Maximal number of strokes, 4 – 23
Maximum derivative time, 4 – 26
Monoflop error, 4 – 7
Mounting, 3 – 4

O

OK LED, 2 – 13
On time, 4 – 39
Organization of the RAM, 4 – 35
Output port, 4 – 25
Output selection, 4 – 26
Output telegram, 5 – 1, 5 – 3
Output words, 5 – 4

P

Parameterization, 4 – 18
Pin allocation, 2 – 4, 2 – 9
Plug–in line, 2 – 6, 2 – 9
Position cam, 4 – 9, 4 – 36, 4 – 38

R

RAM address, 4 – 24
RAM organization, 4 – 35
Register data, 4 – 19
Register values, 5 – 6
Registers, 4 – 21
RESET, 2 – 12
Response message, 4 – 41
Response message telegram, 4 – 41
Rotary axis, 1 – 3, 4 – 14
Rotation direction recognition, 4 – 2, 4 – 6
Travel direction, 4 – 3
RUN LED, 2 – 13

S

Shielding, 3 – 2
Slots, 5 – 1
SSI data format, 4 – 5
SSI encoder, 4 – 28
Start/stop bit error, 4 – 7
States of the digital outputs, 4 – 32
Status byte, 4 – 43
Status of the cam tracks, 4 – 44
Status register, 4 – 42
Steps per stroke, 4 – 31
Stop status of the PLC, 5 – 13
Synchronization, 2 – 11, 4 – 2, 4 – 3

T

Telegram, 5 – 1
Telegram control byte, 4 – 18, 5 – 5, 5 – 7
Terminal block, 2 – 11
Time cam, 4 – 10, 4 – 36, 4 – 39
Toggle bit, 5 – 5

© Siemens AG 1992, Order No: 6ES5 998–5SL21

U

UD cam, 4 – 12
Upper counting value, 4 – 23

W

Wiring, 6 – 2

Z

Zero marking pulse register, 4 – 4
Zero marking pulse signal, 2 – 3
Zero marking pulse value, 4 – 31

© Siemens AG 1992, Order No: 6ES5 998–5SL21