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Analog Position Decoder IP 241 K

Equipment Manual for Module 6ES5 241-3CA13

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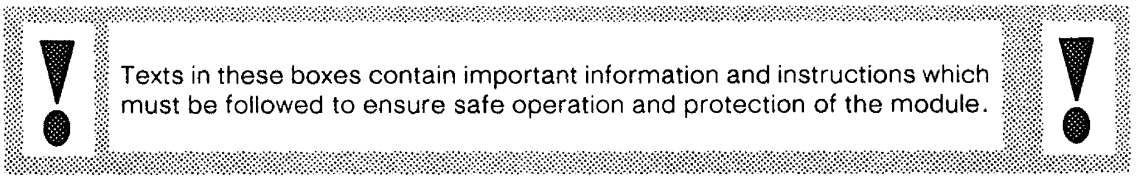
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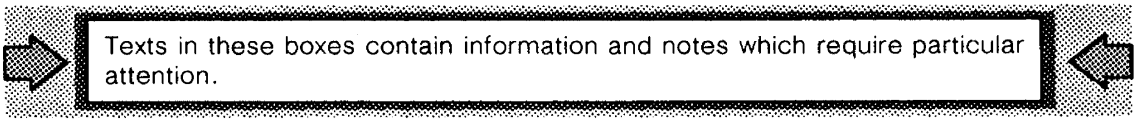
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For clarity's sake, this equipment manual does not cover every conceivable situation in complete detail.

Contact your local Siemens office if you need additional information or if a special problem arises which is not covered in sufficient detail by this manual.

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1 General

The analog position decoder was developed for the SIMATIC S5 programmable controller system and is used to control position-dependent processes.

The primary job of the module is to capture the actual position values from a maximum of 5 channels using analog position encoders and to compare these values with specified track values. Only the actual values are measured on channel 6.

The position encoders are connected to the module with 43-way front plug connectors.

One module can process 1 to 16 tracks (cams) in each of channels 1 to 5.

Actual and track values can be processed in an area from 0 to 4095.

In principle, the tracks simulate a cam controller for which an initial and an end value can be parameterized for each track. In addition, each track value can be parameterized with or without interrupts.

Standard function block FB 105 is available to you for parameterization and control of the module as well as for reading out of the values.

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1.1 Setup

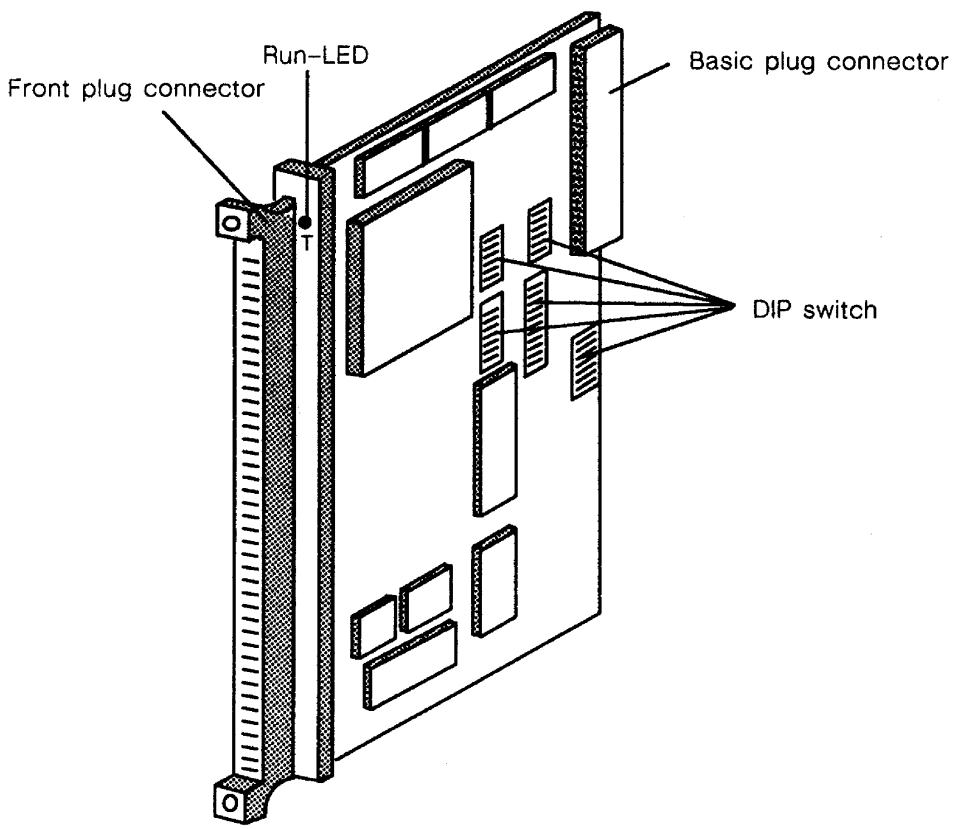
In "double-Europe" format, the module occupies one slot (1 1/3 SEP = standard slot) in the module rack.

It contains 6 independent channels which are used for the connection of analog encoders and the processing of analog voltages.

Channels 1 to 5: For position potentiometer
Input range 0 to 10 V, 0 to 4095 steps (counts)

Channel 6: For pressure sensors
Input range 0 to 31.8 mV, 0 to 4095 steps (counts)

The reference voltage of 10 V is provided by the module.

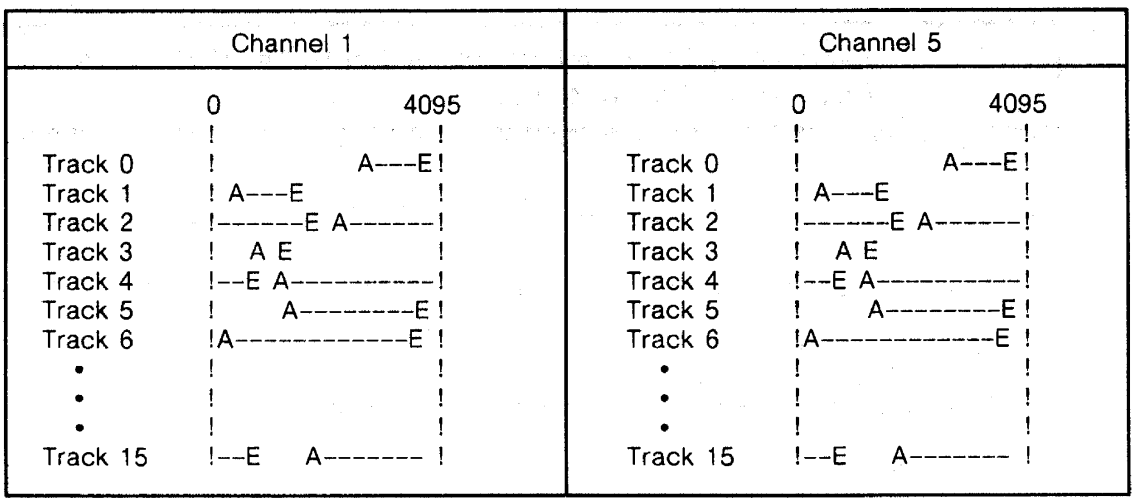


The IP 241 K analog position decoder from the front and side

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1.2 Method of Operation of the Module

Channels 1 to 5 operate with a maximum of 16 so-called tracks. The tracks simulate conventional cams. The initial and end value of each track can be parameterized as desired.



Examples of track distributions (A = initial, E = end)

The module is parameterized by using a function block to specify these tracks.

The processor of the analog position decoder module compares the actual value to the initial and end values of the individual tracks and generates an identifier which indicates the track in which the actual value is. This identifier can be evaluated by the central processor of a programmable controller.

Every track value (i.e., every position) can be assigned an interrupt identifier which generates an interrupt as soon as a setpoint (cam) is reached. User interrupt processing is always performed in the programmable controller.

The actual value is supplied cyclically on channel 6 (i.e., 2 actual values are acquired every 12 msec (Δt between the actual values = 40 to 50 µsec), averaged and this average value made available for evaluations).

Internal Processing Times of the Module

Channel 1 0.5 msec
Channel 2 6.0 msec
Channel 3 6.0 msec
Channel 4 1.0 msec
Channel 5 2.0 msec
Channel 6 6.0 msec

Only the processing time of the reparameterized channel is changed during setpoint transfer. The processing time does not change for the other channels.

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The module must be addressed for the processing of the channels. This can be performed in the conventional manner (I/O addressing; required when **function block 105 is not used**) or with a "page frame" (page frame addressing; always required when **function block 105 is used**; see also section 7.2). The term "page frame" is used to indicate a consecutive, 8-bit wide, 1024-byte long memory area.

In addition, one interrupt input must be assigned to the programmable controller.

1.3 Example of the Combination of the IP 241 K Position Decoder and an Automation System

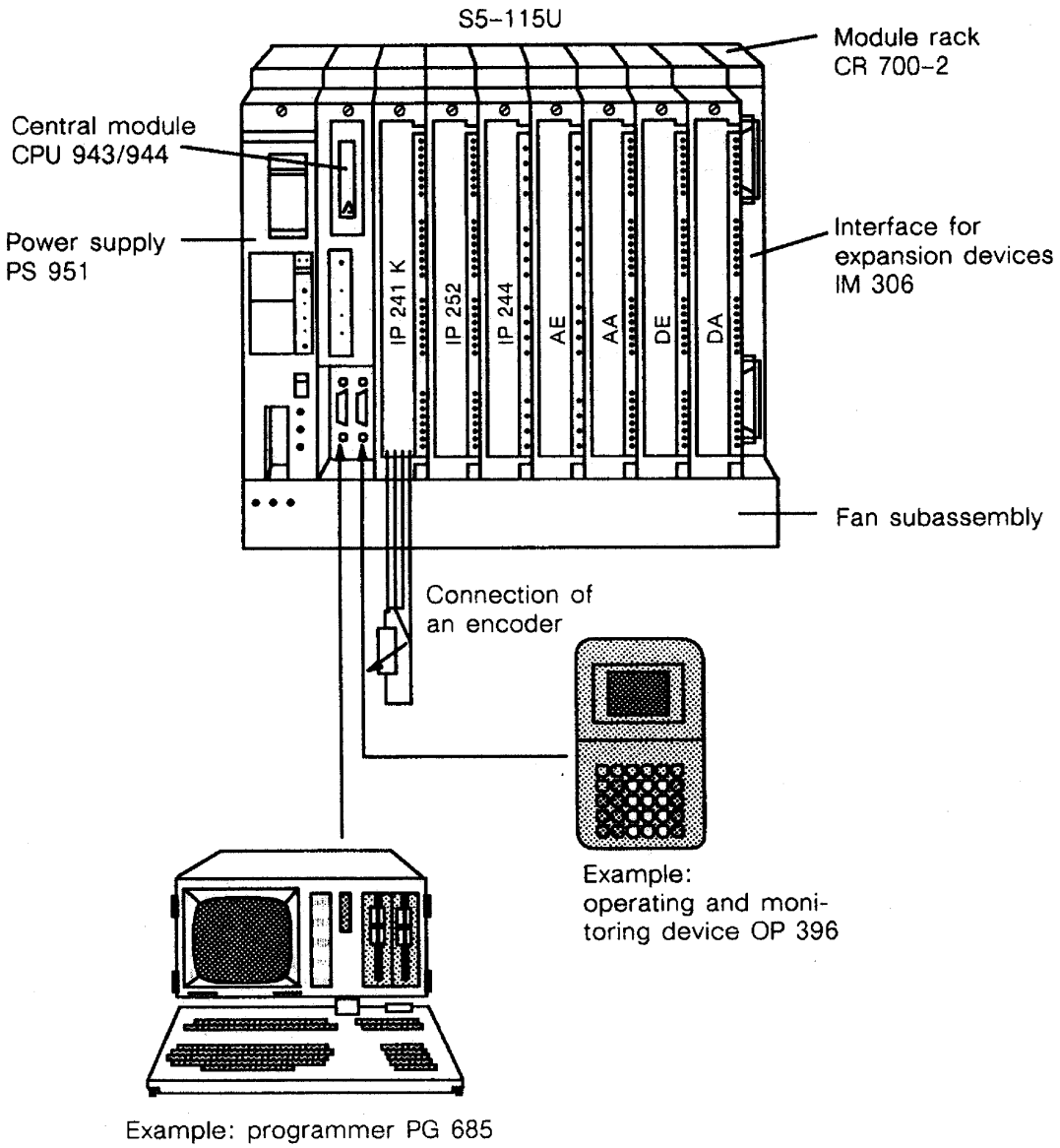
The following is a list of the primary components of a SIMATIC S5 automation system.

The following devices are required when setting up this system with a PLC S5-115U:

- Module rack CR 700-2
  - With slots for 7 I/O modules
  - Contains the bus PCB for the connection of the individual modules
- Power supply module PS 951
- Central module CPU 943 or CPU 944 to control machine operations
  - Contains 2 interfaces
    - One for a programmer
    - One for a device for operating and monitoring a controlled process (e.g., OP 396, SINEC L1, etc.)
- Signal preprocessing (or "intelligent") I/O modules
  Examples:
  - IP 244 for temperature control
  - IP 241 K for analog position encoding
  - IP 252 for general control tasks
- Analog input and output modules
- Digital input and output modules
- Interface module for the connection of expansion devices as required
- Fan subassembly
  - Required when the IP 241 K is used

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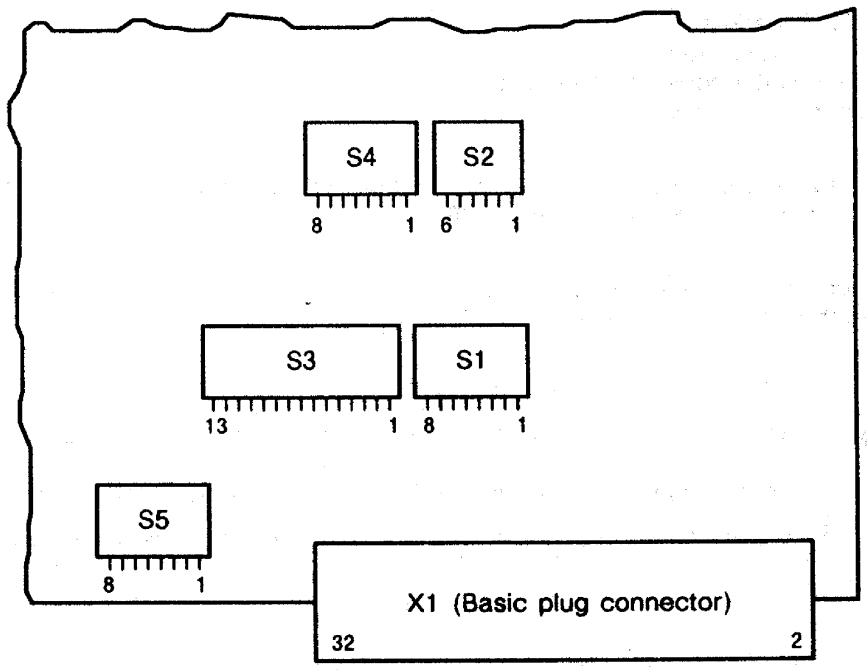
Using the adapter capsule in the slot shown in the below figure, for example, the IP 241 K analog position decoder module can be used in the S5-115U programmable controller.



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2 Module Layout

The following figure shows the location of all DIP switches which you must set before putting into operation.



DIP switches on the configuration side of the module

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3 Settings Prior to Putting into Operation

Before the module can be put into operation, you must adjust the switches on the control (see section 7 on switch and jumper settings) for

- Module address
- Page frame number
- Limit value code (module number)
- Interrupts A to G.

A 48-way basic plug connector links the module to the programmable controller from which the module draws its supply current (+5 V).

The module requires an external voltage supply (+24 V) for the position encoders which is fed in on the front plug connectors.



Be sure that poling is correct when connecting the external voltage !

Do not insert or withdraw the IP 241 K module while the power is on.



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4 Data Transfer and Handling

4.1 Data Transfer (Page Frame)

The page frame is an area within a RAM in the IP 241 K in which data exchange takes place between the IP 241 K and the programmable controller. This data can include, for example, numerical values, commands, and feedback which are required for module operation.

Each IP 241 K has its **own** page frame which receives a number ("vector address" = page frame number).

As seen from the programmable controller, the page frames of all IPs occupy the same address area (module address = F400H).

Using the vector register, a piece of supplementary information is generated in addition to the address which permits the enabling of only one page frame at a time.

The vector registers of all IPs are located at the same address. An 8-bit piece of data is written at this address to inform all IPs of the vector.

Only the page frame of the IP whose switches are set to this vector is enabled.

Data exchange is performed with this page frame. All other page frames are not affected by this procedure. Another page frame cannot be addressed until the vector register is rewritten again.

4.2 Handling

The programmable controller and the IP 241 K cannot communicate unless standard function block FB 105 (see section 10) is executed correctly.

You must have defined the parameterization data blocks used for this in the programmable controller and have assigned them realistic values.

You can perform the following functions with the standard function block:

"PA" – Parameterize the module
"IR" – Read interrupt bits
"IW" – Read actual values
"AE" – Change setpoint of a track
"WI" – Position encoder startup of the module
"RE" – Reset the module

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4.3 Data and Parameters of the IP 241 K

This overview shows the data and parameters which are used by the IP 241 K and which must be handled by the standard function blocks. Some of this data and these parameters do not apply to you.

Description		Number	Type
Actual value	C1-C6	6	word
Result bits	C1-C5	5	word
IR identifier bits		1	byte
Limit value code		1	byte
Firmware status		3	byte
Reparameterization bits	C1-C5	1	byte
Actual value read request		1	byte
Hysteresis	C1-C5	5	word
Module identifer		2	byte
Track IR start/end		80	word
Track initial value		80	word
Track end value		80	word
Maximum scale length		6	word
Minimum counts		6	word

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5 Actual Value and Hysteresis

Each channel on the IP 241 K has its own actual value which can be requested and read by the module.

The actual values (like the track values) are located in the numerical range between 0 and 4095.

The IP 241 K uses time-multiplexing to compare the actual value of all channels in operation with their track values and then sets the result bits accordingly.

A programmable hysteresis prevents a track from being continuously set and reset when the actual value is unsteady and hovering directly around a track value.

You can parameterize one 0 to 30 mm hysteresis for each channel (1 to 5).

It takes effect only when the direction of motion is reversed.

If hysteresis is not parameterized, the actual value is compared directly to the track values with an accuracy of ± count.

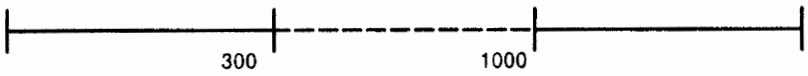
The hysteresis is based on the actual value (i.e., a reversal of direction within the bit-wise hysteresis will cause switching for actual value plus hysteresis or actual value minus hysteresis).

If the slider of the potentiometer is located at the upper end when the module is turned on, the module always acts as if (i.e., sets its internal flags as if) it had come "from below".

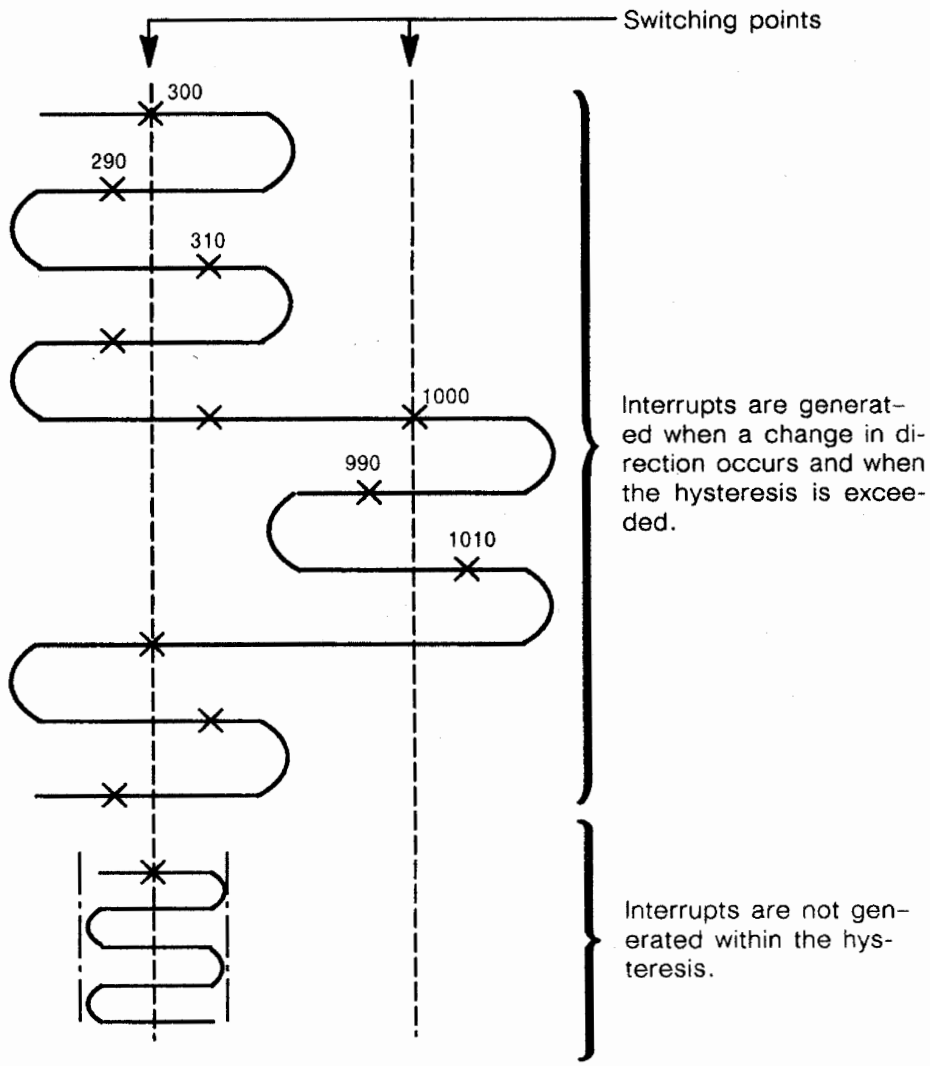
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5.1 Example of Hysteresis Specification

Assumed track distribution:



Interrupt identifiers on this track at a specified hysteresis of 10 mm



X : Switch track identifier bit on or off

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6 Tracks (Cams)

The IP 241 K can process up to 16 tracks for each of channels 1 to 5 with a range of 0 to 4095 counts.

The status of each cam is represented by a result bit and defined by an initial value (AW) and an end value (EW).

In addition, each channel (1 to 5) is assigned a channel interrupt bit.

During transfer of the parameters ("PA" command) or while changing the track set values ("AE" command), you can assign an interrupt identifier to all track values separately to generate an interrupt when this track value is passed.

The corresponding result bit is set or reset when an initial or end track value is exceeded.

If this track value is parameterized with interrupt, an interrupt is then generated for its channel.

These interrupts are entered in an interrupt identifier byte and made available on the basic plug connector of the S5 CPU as a group interrupt.

Use switch S5 to set which of the interrupt lines (IR-A to IR-G) will be used for the group interrupt for channels 1 to 5 (see section 7.3).

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6.1 Track Values Determine the Switching Function

Each cam can fulfill only one of the 4 possible functions.

The result bit is set or reset accordingly as soon as the actual value (IW) passes a track value.

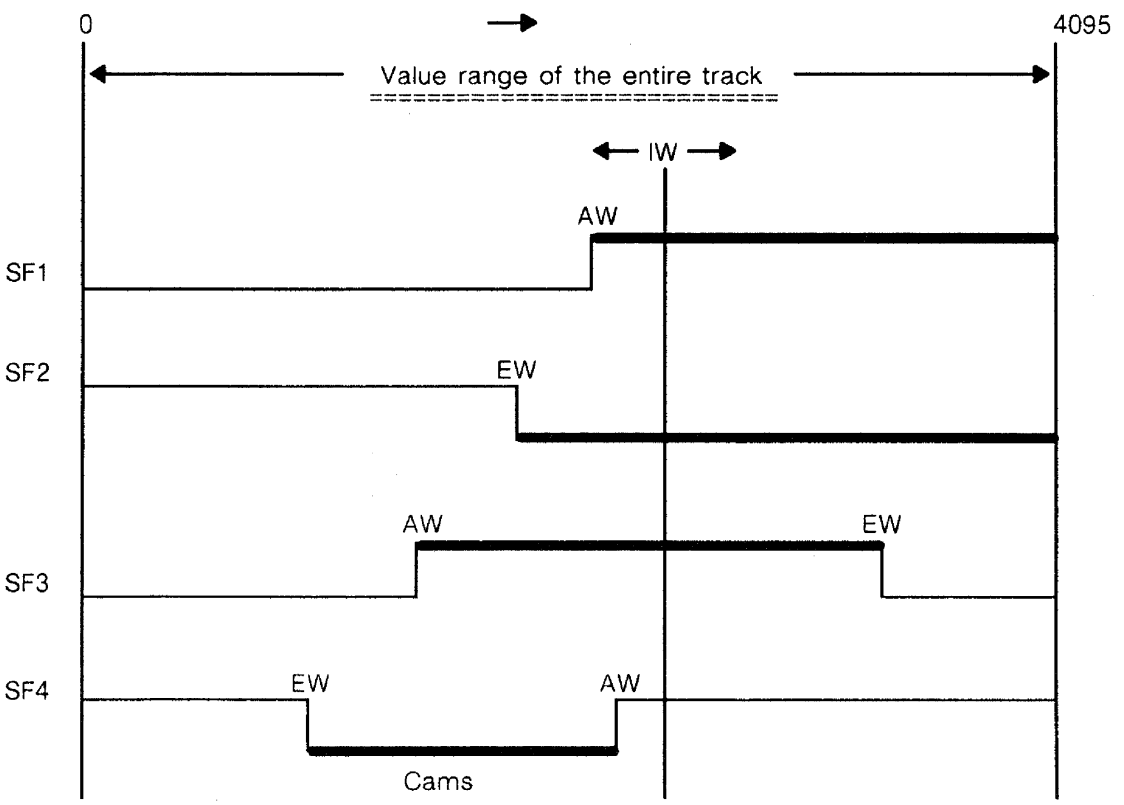
When both track set values are allocated with zero (AW = 0, EW = 0), this track is handled as if it did not exist.

The following switching functions are available to you.

Switch functions:

SF1 – Switch on function (EW = 0)
SF2 – Switch off function (AW = 0)
SF3 – Pulse function (AW < EW)
SF4 – Pulse function (AW > EW)

whereby "AW" = initial value, "EW" = end value, and "IW" = actual value.



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7 Switch Settings

This section describes all switch settings required for putting the module into operation.

7.1 Page Frame Number

The page frame number can be set within the range of 0 to 255.

The page frame number is set by switches S1.1 to S1.8.

You must open the appropriate switches!

Page frame number:

Switch	Address
S1.1	01H
S1.2	02H
S1.3	04H
S1.4	08H
S1.5	10H
S1.6	20H
S1.7	40H
S1.8	80H

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Example:

The page frame number is to be set at 53H.

Switch	Switch Position	Address
S1.1	open	01H
S1.2	open	02H
S1.3	closed	–
S1.4	closed	–
S1.5	open	10H
S1.6	closed	–
S1.7	open	40H
S1.8	closed	–
		53H

Status on delivery:

All DIP switches (S1.1 to S1.8) are open.

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7.2 Module Address

Switches S3.1 to S3.13 are used to set the module address.

7.2.1 I/O Addressing

Conventional module addressing for S5 PLCs (only valid when function block 105 is **not** used)

You must open the appropriate switches!

Switch	Address
S3.1	010H
S3.2	020H
S3.3	040H
S3.4	080H
S3.5	100H
S3.6	200H
S3.13	PESP

PESP = memory I/O select (S5 bus signal)

Example:

The module address is to be set at 120H.

Switch	Switch Position	Address
S3.1	closed	–
S3.2	open	020H
S3.3	closed	–
S3.4	closed	–
S3.5	open	100H
S3.6	closed	–
S3.13	open	(PESP)
		120H

Status on delivery:

An DIP switches (S3.1 to S3.13) are open.

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7.2.2 Page Frame Addressing

Applicable **only** when FB 105 is used

Close S3.1 to S3.6 and S3.13.
(S3.13 closed -> PESP is active.)

S3.7 to S3.12 = start address of page frame

You must close the appropriate switches!

Switch	Address
S3.7	0400H
S3.8	0800H
S3.9	1000H
S3.10	2000H
S3.11	4000H
S3.12	8000H

Example:

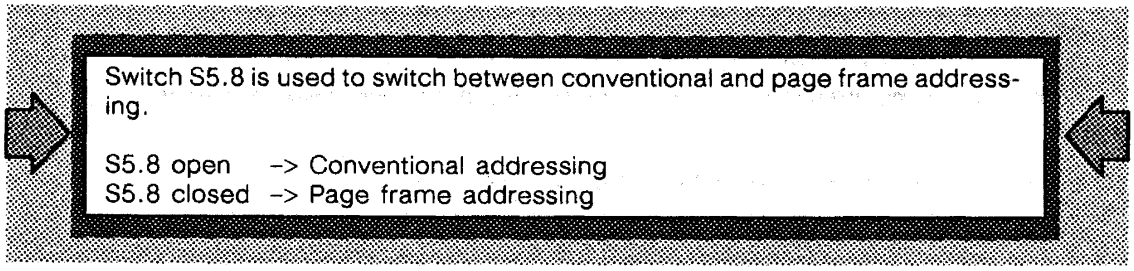
The module address must be set to F400H (S5 standard setting).

Switch	Switch Position	Address
S3.7	closed	0400H
S3.8	open	–
S3.9	closed	1000H
S3.10	closed	2000H
S3.11	closed	4000H
S3.12	closed	8000H
		F400H

Status on delivery:

All DIP switches (S3.1 to S3.13) are open.

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Switch S5.8 is open on delivery.

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7.3 Interrupts (Hardware Line for PLC S5-115U)

Interrupts IR-A to IR-G are activated by **closing** switches S5.1 to S5.7.

Only **one** IR switch may be closed at a time.

Interrupt:

Switch	Interrupt
S5.1	IR-A
S5.2	IR-B
S5.3	IR-C
S5.4	IR-D
S5.5	IR-E
S5.6	IR-F
S5.7	IR-G

Example:

An interrupt is to be triggered on interrupt line IR-B by an event to which an interrupt is assigned.

Switch	Switch Position	Interrupt
S5.1	open	-
S5.2	closed	IR-B
S5.3	open	-
S5.4	open	-
S5.5	open	-
S5.6	open	-
S5.7	open	-

Status on delivery:

All DIP switches (S5.1 to S5.7) are open.

When selecting the slot for the IP 241 K in the device rack, be sure that the interrupt line set on the module is also wired in the rack (S5 bus) between the CPU and the slot of the IP 241 K. (Interrupt lines IR-A to IR-D are assigned when PLC S5-115U is used.)

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7.4 Limit Value Code

The limit value code is a machine-related number from 0 to 255 and is set with switches S4.1 to S4.8. Function block FB 105 is used to enter the code in DL 6 of the parameterization data block during initialization. It can be used for a software test of the machine type and its parameters. It has no effect on module functions.

Limit value code:

You must open the appropriate switches.

Switch	Address
S4.1	01H
S4.2	02H
S4.3	04H
S4.4	08H
S4.5	10H
S4.6	20H
S4.7	40H
S4.8	80H

Example:

A machine with the number 92 is connected to the module.

The hexadecimal value for 92 (92 decimal = 5C hexadecimal) is to be set with switches S4.1 to S4.8.

Switch	Switch Position	Address
S4.1	closed	–
S4.2	closed	–
S4.3	open	04H
S4.4	open	08H
S4.5	open	10H
S4.6	closed	–
S4.7	open	40H
S4.8	closed	–
		5CH

Status on delivery:

All DIP switches (S4.1 to S4.8) are closed.

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7.5 Test Switches

Switches S2.1 to S2.6 are used by the manufacturer for testing purposes and serve no useful purpose during actual operation.



Switches S2.1 to S2.6 must be closed during operation to ensure troublefree module function!



Status on delivery:

All DIP switches (S2.1 to S2.6) are closed.

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8 Plug Connector Allocation

This section shows the allocation of the front and basic plug connectors as well as the contacts used and their signal names. In addition, the installation of the IP 241 K module and the connection of the position potentiometer are discussed.

8.1 Basic Plug Connector Allocation

The module is connected to the system bus by a 48-way basic plug connector. The following table shows all signal lines occupied by the module.

Pin No.	Pin Row		
	a	b	z
2		M	+5 V
4		PESP	
6	DB	ADB 0	CPKL
8	ADB13	ADB 1	RD
10	ADB14	ADB 2	WR
12	ADB15	ADB 3	READY
14	IR-A	ADB 4	DB 0
16	IR-B	ADB 5	DB 1
18	IR-C	ADB 6	DB 2
20	IR-D	ADB 7	DB 3
22	IR-E	ADB 8	DB 4
24	IR-F	ADB 9	DB 5
26	IR-G	ADB 10	DB 6
28		ADB 11	DB 7
30			
32		M	

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8.2 Front Plug Connector Allocation

The position encoders for channels 1 to 6 are connected to the module with the 43-way front plug connector.

The following table shows all contacts which are available for the connection of the position encoders.

Pin No.		Signal
1		+24 V_{ext}
2		+24 V_{ext}
3		M $_{ext}$
4		M $_{ext}$
5		
.		
.		
.		
12		
13	Channel 1	U_{ref}
14		Meas M
15		Meas +
16		M U_{ref}
17		M_{ext}
18	Channel 2	U_{ref}
19		Meas M
20		Meas +
21		M U_{ref}
22		M_{ext}
23	Channel 3	U_{ref}
24		Meas M
25		Meas +
26		M U_{ref}
27		M_{ext}
28	Channel 4	U_{ref}
29		Meas M
30		Meas +
31		M U_{ref}
32		M_{ext}
33	Channel 5	U_{ref}
34		Meas M
35		Meas +
36		M U_{ref}
37		M_{ext}
38	Channel 6	U_{ref}
39		Meas M
40		Meas +
41		M U_{ref}
42		M_{ext}
43		

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8.3 Meaning of the Plug Connector Allocation Abbreviations

CPKL	–	Reset impulse
RD	–	Read memory; signal present for every read access
WR	–	Write memory; signal present for every write access
READY	–	Ready; acknowledgement signal for read/write access
PESP	–	Select I/O memory; signal present for every I/O access
IR-A . . IR-G	–	Interrupt A to G; hardware interrupt signal from IP
DB 0 to 7	–	Data bus
ADB 0 to 15	–	Address bus
+5 V	–	Internal supply voltage of the module
M	–	Mass for +5 V
+24 V_{ext}	–	External supply voltage
M_{ext}	–	Mass for +24 V_{ext}
U_{ref}	–	Reference voltage
M U_{ref}	–	Mass for U_{ref}
Meas +	–	Positive measuring voltage
Meas M	–	Mass for measuring voltage

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8.4 In Which Slots Can the IP 241 K Be Used ?

Since it is realistic to use interrupt processing with the IP 241 K, we have specified here only the slots which can be used with interrupt processing.

Programmable Controller in Module Rack		Slot Designation ▨ ≙ IP 241 K can be operated in this slot
Central unit S5-115U	CR 700-0LA	PS CPU **0** 1 2 3 IM
	CR 700-0LB	PS CPU **0** **1** **2** 3 IM
	CR 700-1	PS CPU **0** 1 2 3 4 5 6 IM
	CR 700-2	PS CPU **0** **1** **2** **3** **4** **5** 6 IM
	CR 700-3	PS CPU **0** **1** **2** **3** **4** **5** 6 IM
Expansion device S5-115U	ER 701-3 ①	PS **0** **1** **2** **3** **4** **5** **6** 7 IM

1 Interrupt processing with expansion devices is possible from release status 6ES5 701-3LA13 on, when optical fibre connection 6ES5 307-3UA11 and 6ES5 317-3UA11 are used.

Please also see the equipment manual of your programmable controller for more information on this subject.

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8.5 Installation of the Module in the Programmable Controller

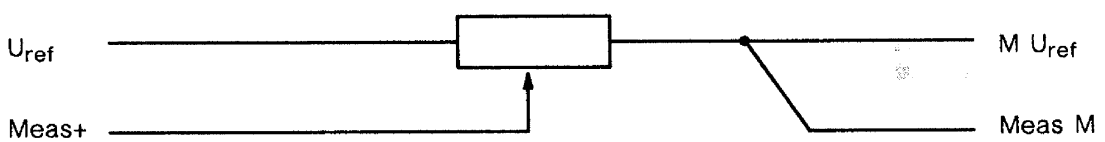
The module is installed in the programmable controller after the DIP switches are set.

This is performed as follows for the S5-115U.

- Place the module in the adapter capsule (righthand configuration).
- Lock the module inside the adapter capsule.
- Swing the adapter capsule with the module into the module rack of the programmable controller (basic plug connector snaps in).
- Screw down the adapter capsule.

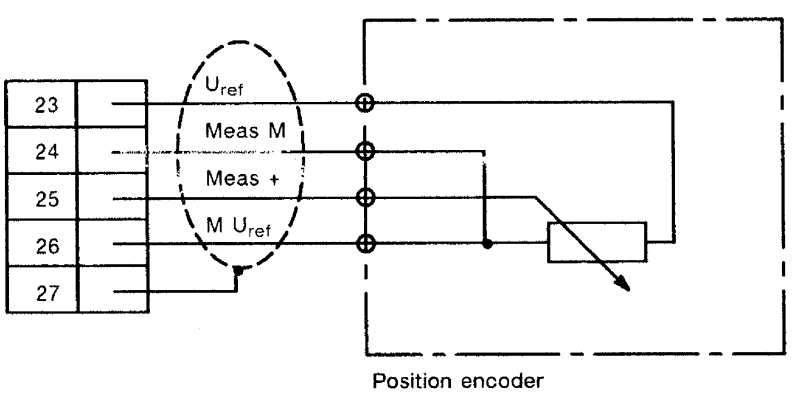
8.6 Connection of the Position Potentiometer

General connection diagram of a position encoder:



U_{ref} is supplied by the module (from 24 V_{ext}).

The position potentiometers are connected to the module with the front plug connector. The following example illustrates this for channel 3.



Pins 23 to 26: Measuring connections for channel 3
Pin 27: Shielding to M_{ext}

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9 Technical Specifications

Input channels:	6
Input impedance:	C1 to C5: 1 Mohm C6: 910 Kohm
Input voltage from encoder:	C1 to C5: 0 to 10 V C6: 0 to 31.8 mV
Measuring range:	0 to 4095 counts
Accuracy:	Better than ± 3 counts at end value 4095 counts
Processing speed per channel (i.e., scanning rate for the new value)	C1: 0.5 msec C2: 6 msec C3: 6 msec C4: 1 msec C5: 2 msec C6: 6 msec
Reference voltage:	DC 10 V/50 mA
Internal supply voltage of the module:	+5 V
Voltage tolerance:	±5%
Internal current consumption at +5 V:	1.5 A (max.)
External supply voltage of the module:	+24 V
Permissible voltage range:	+20 V to +30 V +35 V for 0.5 sec
External current consumption at +24 V:	150 mA
Microfuse protection:	1 A (delayed)
Total supply current:	50 mA
Total power consumption:	Approx. 12 W (Fan subassembly required)
Basic plug connector:	48-way
Front plug connector for position encoder:	43-way
Line length from encoder:	10 m (max.)
Environmental temperature:	0 to +55° C
Shipment and storage temperature:	-40 to +70° C

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Isolation class:	C (in accordance with VDE 0100)
Type of protection:	IP 40 when installed in module rack
Humidity class:	F (in accordance with DIN 40040)
Module width:	1 1/3 SEP (20.32 mm)
Module format:	Double Europe format 233.4 x 160 mm (DIN 41494)
Mass:	Approx. 470 g

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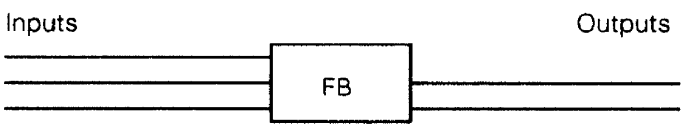
10.1 Introduction

A function block is used to program the module. The programmer is connected to the CPU of the programmable controller and the function block for the parameterization of the IP 241 K is linked to the user program.

The desired position setpoints are specified within the user program for the module by parameterizing the function block.

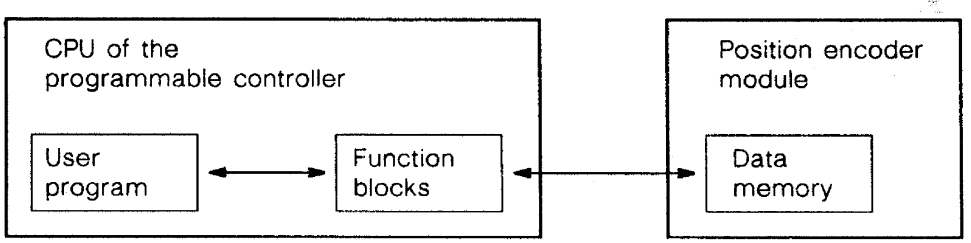
This parameterization must be performed by the user during commissioning. He/she must enter the parameters for the start and end values in the individual channels.

General Setup of a Function Block



The inputs must be parameterized by the user; the function block supplies the data of the outputs to the appropriate data blocks.

The following diagram shows the relationship between user program, function blocks and the position encoder module.



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10.2 Overview - Function Block FB 105

These programming instructions describe the standard function block.

FB 105 (IP 241 K) "Parameterize and control position decoder"

The function block is used with the following programmable controllers:

S5-115U (CPU 941 to CPU 944)

together with the

IP 241 K analog position decoder module.

These programming instructions require you to be familiar with sections 1 to 9 of this manual and the operating instructions of your programmable controller.

10.3 Function Description

The following functions can be executed with the "parameterize and control position decoder" function block:

- Parameterize the module
- Read interrupt bits
- Read actual values
- Delete or modify setpoints of a track
- Specify reference points
- Software reset on the IP 241 K

The function block is usually called in the cyclic program. The module must first be provided with initial data using function block FB 105 before the function block is called in the cyclic program.

Function block PER:USTK can be called in an organization block of interrupt-controlled processing to evaluate interrupts.

Function

- Transfer the setpoints specified in a data block to the analog position decoder module

- Control and monitor the analog position decoder module

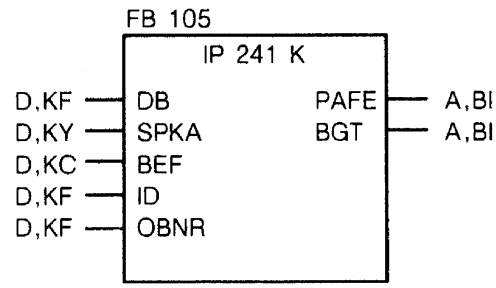
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10.4 Calling the Function Block

STL:

```
        :JU FB105
Name    :     :
DB      :     D,KF
SPKA    :     D,KY
BEF     :     D,KS
ID      :     D,KF
OBNR    :     D,KF
PAFE    :     A,BI
BGT     :     A,BI
```

CSF:



10.5 Explanation of the Parameters

NAME	CLASS	TYPE	DESIGNATION
DB	D	KF	Data block number
SPKA	D	KY	Track number (0 ≤ track ≤ 15) Channel number (1 ≤ channel ≤ 5)
BEF	D	KS	Command, specification of the function
ID	D	KF	ID number of the page frame
OBNR	D	KF	OB number in which the FB is called
PAFE	A	BI	Parameterization error
BGT	A	BI	Module active

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10.6 Assignment of the Parameters

DB : D,KF x — DB number

x = 0 => The input parameters of the FB are read from the opened DB (indirect parameterization).

2 ≤ x ≤ 254 => Formal operands are used.

SPKA : D,KY x,y — x = Track number (0 ≤ x ≤ 15)
y = Channel number (1 ≤ y ≤ 5)

BEF :
- KS = WI — Position encoder startup
- KS = PA — Parameterize the module
- KS = IW — Read actual values
- KS = IR — Read interrupt identifier bits
- KS = AE — Change setpoints
- KS = RE — Reset module

ID : D, KF x — ID number of the page frame
(Set the same page frame number here as you set with switch S1 during hardware setting of the module.)
0 ≤ x ≤ 255

OBNR : D,KF x — Organization block in which function block FB 105 is called

Program Levels	
Cyclic operation	x = 1
Interrupt-controlled processing	2 ≤ x ≤ 5
Time-controlled processing	x = 13
Start-up program	21 ≤ x ≤ 22

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PAFE : A,BI

PAFE has signal status "1" if parameterization is illegal. The error can then be read from the assignment of flag word FY 254 and in DW 10 of data block A.

F 254.0	The bit is set when an error was detected.
F 254.1	–
F 254.2	–
F 254.3	–
F 254.4	–
F 254.5	Check 24 V encoder supply; reset module.
F 254.6	–
F 254.7	The specified OB number is wrong.
F 255.0	Wrong ID number
F 255.1	Wrong DB number (not in DW 10)
F 255.2	DB A not present (not in DW 10)
F 255.3	DB A too short (not in DW 10)
F 255.4	DB B not present
F 255.5	DB B too short
F 255.6	BEF cannot be interpreted.
F 255.7	The channel number or track number is outside the legal range.

BGT : A,BI

0 -> Module active
1 -> Module not active
When output BGT does not accept signal status "0" during the cyclic program, the module has an error.

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10.7 Assignment of Data Block A

The function block requires data block A with a length of 255 data words in which the track setpoints of channels 1 to 5 are entered. The data block is assigned as follows:

Starting at DW	Assignment
0	Working area of the function block
16	Data for track 0 channel 1
19	Data for track 1 channel 1
22	Data for track 2 channel 1
25	Data for track 3 channel 1
28	Data for track 4 channel 1
31	Data for track 5 channel 1
34	Data for track 6 channel 1
37	Data for track 7 channel 1
40	Data for track 8 channel 1
43	Data for track 9 channel 1
46	Data for track 10 channel 1
49	Data for track 11 channel 1
52	Data for track 12 channel 1
55	Data for track 13 channel 1
58	Data for track 14 channel 1
61	Data for track 15 channel 1
64	Data for track 0 channel 2
67	Data for track 1 channel 2
70	Data for track 2 channel 2
73	Data for track 3 channel 2
76	Data for track 4 channel 2
79	Data for track 5 channel 2
82	Data for track 6 channel 2
85	Data for track 7 channel 2
88	Data for track 8 channel 2
91	Data for track 9 channel 2
94	Data for track 10 channel 2
97	Data for track 11 channel 2
100	Data for track 12 channel 2
103	Data for track 13 channel 2
106	Data for track 14 channel 2
109	Data for track 15 channel 2

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Starting at DW	Assignment
112	Data for track 0 channel 3
115	Data for track 1 channel 3
118	Data for track 2 channel 3
121	Data for track 3 channel 3
124	Data for track 4 channel 3
127	Data for track 5 channel 3
130	Data for track 6 channel 3
133	Data for track 7 channel 3
136	Data for track 8 channel 3
139	Data for track 9 channel 3
142	Data for track 10 channel 3
145	Data for track 11 channel 3
148	Data for track 12 channel 3
151	Data for track 13 channel 3
154	Data for track 14 channel 3
157	Data for track 15 channel 3
160	Data for track 0 channel 4
163	Data for track 1 channel 4
166	Data for track 2 channel 4
169	Data for track 3 channel 4
172	Data for track 4 channel 4
175	Data for track 5 channel 4
178	Data for track 6 channel 4
181	Data for track 7 channel 4
184	Data for track 8 channel 4
187	Data for track 9 channel 4
190	Data for track 10 channel 4
193	Data for track 11 channel 4
196	Data for track 12 channel 4
199	Data for track 13 channel 4
202	Data for track 14 channel 4
205	Data for track 15 channel 4
208	Data for track 0 channel 5
211	Data for track 1 channel 5
214	Data for track 2 channel 5
217	Data for track 3 channel 5
220	Data for track 4 channel 5
223	Data for track 5 channel 5
226	Data for track 6 channel 5
229	Data for track 7 channel 5
232	Data for track 8 channel 5
235	Data for track 9 channel 5
238	Data for track 10 channel 5
241	Data for track 11 channel 5
244	Data for track 12 channel 5
247	Data for track 13 channel 5
250	Data for track 14 channel 5
253	Data for track 15 channel 5

When changing the track setpoints. these must be located in the data block A which was used for parameterization.

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10.7.1 Working Area of Function Block 105 in DB A

			Recommended Data Format
DW 0	–		KH
DW 1	Command		KS
DW 2	Track	Channel number	KY
DW 3	ID number of the page frame		KF
DW 4	DB number	–	KF
DW 5	–	OB number	KF
DW 6	Limit value switch	–	KY
DW 7	FW status: Year	FW status: Month	KH
DW 8	FW status: Day		KH
DW 9	Page frame address		KH
DW 10	Error word		KM
DW 11	–		KH
DW 12	–		KH
DW 13	–		KH
DW 14	–		KH
DW 15	–		KH

Is entered by FB 105

Must be supplied with data before FB 105 is called during **indirect** parameterization. Disregard when direct parameterization is used.

May not be used by the user.

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10.7.2 Assignment of a Track in DB A

		Recommended Data Format
DW n	Interrupt start/end	KY
DW n+1	Setpoint start	KH
DW n+2	Setpoint end	KH

Interrupt	=	0,0	→ No interrupt
		0,1	→ Interrupt start
		0.2	→ Interrupt end
		0.3	→ Interrupt start/end
Initial setpoint	=	DL n + 1	→ High
	=	DR n + 1	→ Low
End setpoint	=	DL n + 2	→ High
	=	DR n + 2	→ Low

When interrupt processing is not used, make sure of the following:
- All interrupt lines are open (open switches S5.1 to S5.7).
- Track setpoints are not parameterized with interrupt identification (DW 16 to DW 255).

Enter the value KH = 0000 for initial value and for end value when the track is not assigned. The setpoints are specified in BCD code. Only decades 0 to 3 are considered.

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10.8 Assignment of Data Block B

Processing of FB 105 requires the use of a second data block (data block B) which is 50 data words long.

The following is entered in this block:

- MINC (minimum counts)
- DMAX (maximum measuring scale length)
- HYST (hysteresis value)
- IRCA (Interrupt identifier bits)
- Result bits
- Actual values

The data block is assigned as shown in the below table.

Starting at DW	Assignment	
0	Working Area of the Function Block	
16	MINC	for channel 1
17	DMAX	for channel 1
18	HYST	for channel 1
19	MINC	for channel 2
20	DMAX	for channel 2
21	HYST	for channel 2
22	MINC	for channel 3
23	DMAX	for channel 3
24	HYST	for channel 3
25	MINC	for channel 4
26	DMAX	for channel 4
27	HYST	for channel 4
28	MINC	for channel 5
29	DMAX	for channel 5
30	HYST	for channel 5
31	MINC	for channel 6
32	DMAX	for channel 6
33	Free	
34	IRCA	
35	Free	
36	Result bits	for channel 1
37	Result bits	for channel 2
38	Result bits	for channel 3
39	Result bits	for channel 4
40	Result bits	for channel 5
41	Actual values	for channel 1
42	Actual values	for channel 2
43	Actual values	for channel 3
44	Actual values	for channel 4
45	Actual values	for channel 5
46	Actual values	for channel 6

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10.8.1 Assignment of the Actual Values in Data Block B

		Recommended Data Format
DW 41	Actual value, channel 1	KF
DW 42	Actual value, channel 2	KF
DW 43	Actual value, channel 3	KF
DW 44	Actual value, channel 4	KF
DW 45	Actual value, channel 5	KF
DW 46	Actual value, channel 6	KF

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10.8.2 Assignment of the Result Bits in Data Block B

		Recommended Data Format
DW 36	Result bits, channel 1	KM
DW 37	Result bits, channel 2	KM
DW 38	Result bits, channel 3	KM
DW 39	Result bits, channel 4	KM
DW 40	Result bits, channel 5	KM

When FB 105 is called with either the "IW" or the "IR" command, the result bits are set if the actual value is within the start and end values of the corresponding track.

Result Bits, Channel x:

Bit

0 Track n
1 Track n+1
2 Track n+2
3 Track n+3
4 Track n+4
5 Track n+5
6 Track n+6
7 Track n+7
8 Track n+8
9 Track n+9
10 Track n+10
11 Track n+11
12 Track n+12
13 Track n+13
14 Track n+14
15 Track n+15

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10.8.3 Assignment of the IR Identifier Bits in Data Block B

			Recommended Data Format
DW 34	IR identifier bits		KM

When an interrupt is triggered because of a change in a result bit (see section 10.6.2: DW 16 to 255), the appropriate bit is set.

The channel which triggered a new interrupt after the last one, is stored in the "IR identifier bit" byte. More than one bit can be set at one time.

Result Channel x:

Bit

0 Interrupt from channel 1
1 Interrupt from channel 2
2 Interrupt from channel 3
3 Interrupt from channel 4
4 Interrupt from channel 5
5 Reserved
6 Reserved
7 Reserved

10.8.4 Assignment of the Hysteresis in Data Block B

		Recommended Data Format
DW 18	Hysteresis channel 1	KY
DW 21	Hysteresis channel 2	KY
DW 24	Hysteresis channel 3	KY
DW 27	Hysteresis channel 4	KY
DW 30	Hysteresis channel 5	KY

A programmable hysteresis prevents a track from being constantly set and reset when the actual value is unsteady while it hovers directly around a cam start or cam end.

Value range of the hysteresis: 0 to 30

Do not enter other values (only the right hand four bits are evaluated by the module). The hysteresis takes effect only when direction is reversed (section 5).

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10.9 Technical Specifications of FB 105

Block number	:	FB 105
Block name	:	IP 241 K
Library number	:	
Call length	:	7 words
Block length	:	1312 words
Processing time	:	For BEF = PA : 3.4 - 5.2 msec WI : 3.2 - 5.6 msec IW : 5.2 msec 1) IW : 4.8 msec 2) IR : 3.9 msec AE : 4.6 msec Standby : 0.6 msec
Nesting depth	:	1
Blocks called	:	None
Assignment in data area	:	Specified data blocks
Assignment in flag area	:	FY 220 to FY 255
Assignment in system data area	:	SD 248. SD 249
System instructions	:	Yes
Other	:	-

The specified times are based on the CPU 943B when the function block is called with indirect addressing during the cyclic program. Times are not increased significantly when direct parameterization is used.

The time duration per cycle is specified for the WI (position encoder startup of the module) and PA (parameterization of the module) commands.

1) Without position encoder startup
2) With position encoder startup -> only one value is read per cycle.

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10.10 Application of Function Block FB 105

The setpoints must be written to the data blocks before function block FB 105 is called. Data block A must be at least 255 words long even if the last tracks are not required. Data block B must be at least 50 words long.

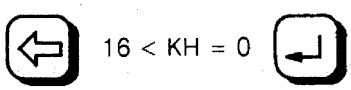
For the "parameterization" or "position encoder startup" command, the firmware status of the module is first read and stored in data block A. The setpoints of each track, the interrupt bit and the modification bit are then transferred in succession.

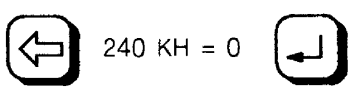
- The setpoints of unassigned tracks must be identified with KH = 0000.
- KH = 0000 must be input if no interrupts are to be entered.
- If an interrupt is to be entered, KH = 0001 (interrupt start) or KH = 0002 (interrupt end) or KH = 0003 (interrupt start/end) must be input.

The setpoints for the tracks are processed (in flag bytes FY 230 to FY 232) so that they can be used by the module. and transferred to the module.

The data blocks are set up with a programmer (e.g., PG 675) using the following command sequence:

- Input command: 

- Keep working area free: 

- Preset tracks: 

- Transfer to floppy disk: 

The block is now preset and the assigned tracks can be entered. Both setpoints must always be specified per track.

The FB 105 can be parameterized directly or indirectly.

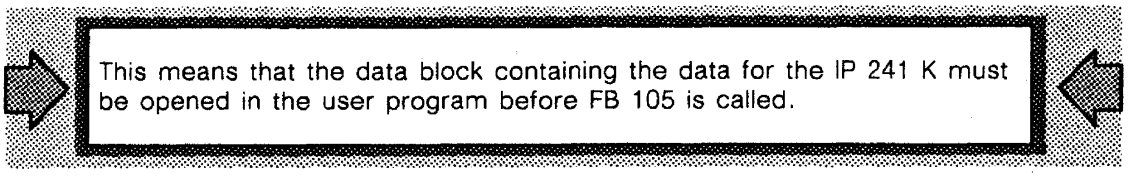
Direct Parameterization

When the function block is called. the parameters specified as actual operands are accepted.

Indirect Parameterization

When the FB 105 is called. the parameters from the currently opened data block are accepted.

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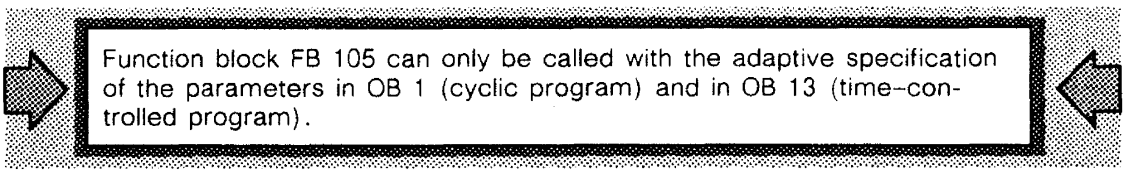
Enter the desired values for the following parameters there.

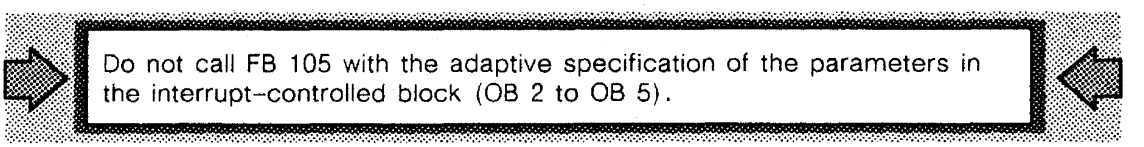
BEF	: Command	(DW 1)
SPKA	: Track, channel number	(DW 2)
ID	: ID number of the page frame	(DW 3)
DB	: Current DB number	(DL 4)
OBNR	: OB number	(DR 5)

The data block number must be stored in DW 4.

Function block FB 105 can now be called.

When the command has been executed, FB 105 deletes it from data word DW 1 of the selected block and the user can enter a new command.





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10.10.1 FB 105 Functions and Their Programming

The BEF parameter is used by the FB 105 to receive the function to be executed.

BEF = WI Position encoder startup

Function:

The position encoder startup is executed with the "WI" command. All actual values are then read in mm/counts. When the position encoder startup is performed in OB 21 or OB 1, the minimum counts (MINC) are read from the machine and stored in data block B. The maximum measuring scale lengths (DMAX) (mm) are taken from data block B.

When the position encoder startup is performed in OB 22, the minimum counts (MINC) and the maximum measuring scale lengths (DMAX) (mm) are taken from data block B. After the position encoder startup, the module is parameterized again.

Supplying the FB:

DB $2 \leq x \leq 254$ or $x = 0$
The setpoints must be located in the specified DB.

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

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BEF = PA Parameterization of the module

Function:

The "PA" command is used to reparameterize the module with setpoints. The following data are transferred to the module:

- Track setpoints, channels 1 to 5
- Hysteresis, channels 1 to 5

Supplying the FB:

DB $2 \leq x \leq 254$ or $x = 0$
The setpoints must be located in the specified DB.

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

BEF = IW Read actual values

Function:

The "IW" command is used to read the actual values of the module. The actual values are located in data block B. Following the position encoder startup, the actual values are read in mm/counts, one value per cycle.

Supplying the FB:

DB $2 \leq x \leq 254$ or $x = 0$

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

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BEF = IR Read interrupt bits

Function:

The "IR" command is used to read the interrupt and result bits in data block B. Do not use this command except in the interrupt program.

Supplying the FB:

DB $2 \leq x \leq 254$ or $x = 0$

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

BEF = AE Change setpoints of a track

Function:

The "AE" command is used to change the setpoints of a track (interrupt identification, setpoint start and end).

Supplying the FB:

DB $2 \leq x \leq 254$ or $x = 0$

SPKA Track number, page frame number
$0 \leq x \leq 15$
$1 \leq y \leq 5$

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

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BEF = RE Reset module

Function:

The "RE" command is used to reset the IP 241 K module. All data in the module are deleted (i.e., the module must be parameterized again and a position encoder restart of all channels must be performed).

Supplying the FB:

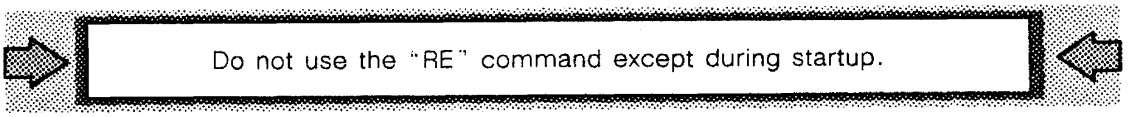
DB $2 \leq x \leq 254$ or $x = 0$

ID ID number of the page frame

OBNR OB number in which the FB is called

PAFE "0" → No error
"1" → Error

BGT "0" → Module inactive
"1" → Module active

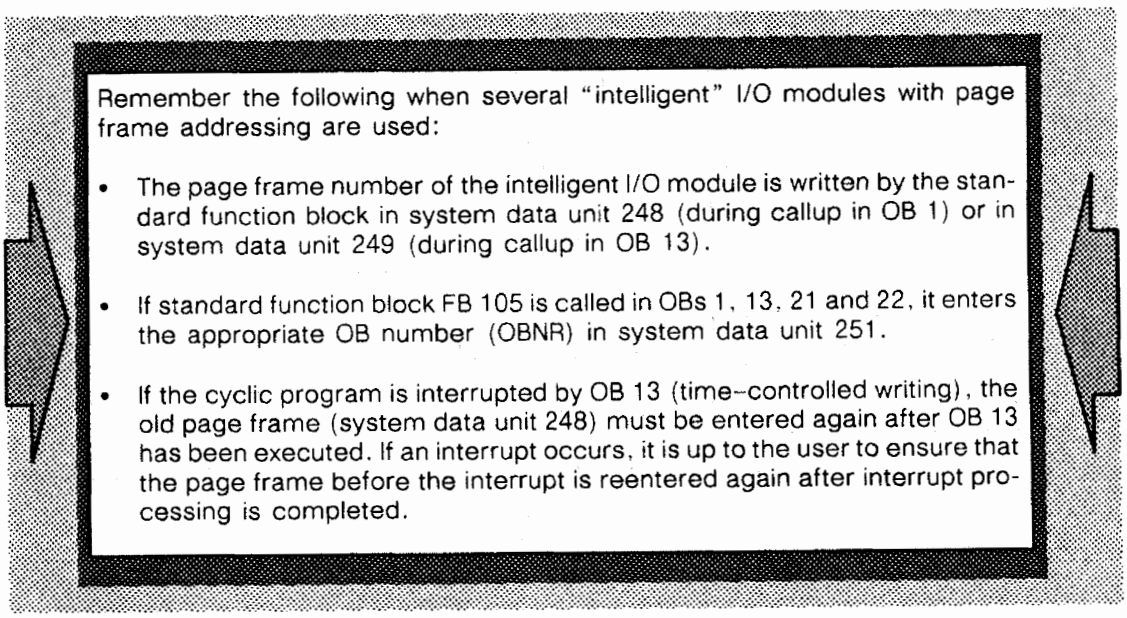


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10.10.2 Interrupt Processing

The module must be set up for an interrupt line if one of the setpoints is provided with an interrupt identifier.

When an interrupt occurs, an organization block of the interrupt-controlled processing (based on the interrupt line selected) is called. This organization block contains the call of function block FB 105 with parameter assignment BEF = IR; afterwards, DW 34 of data block B contains the channel from which the interrupt came. A special interrupt program can now be processed. Do not use the adaptive specification of parameters for commands in interrupt processing.



Remember the following when several "intelligent" I/O modules with page frame addressing are used:

- The page frame number of the intelligent I/O module is written by the standard function block in system data unit 248 (during callup in OB 1) or in system data unit 249 (during callup in OB 13).
- If standard function block FB 105 is called in OBs 1, 13, 21 and 22, it enters the appropriate OB number (OBNR) in system data unit 251.
- If the cyclic program is interrupted by OB 13 (time-controlled writing), the old page frame (system data unit 248) must be entered again after OB 13 has been executed. If an interrupt occurs, it is up to the user to ensure that the page frame before the interrupt is reentered again after interrupt processing is completed.

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The organization blocks must always be set up as follows:

OB 21, 22:

JU FB 105	Call standard function block with the "PA" or "WI" command (basic supply of the module)
JU FB***	User program

OB 1:

JU FB 105	Call standard function block (only once per module) (parameterization by adaptive specification of the parameters)
JU FB***	User program

OB 13:

JU FB***	Save flags in data block [1]
JU FB***	User program
JU FB***	Reenter page frame (via SD 248) which was opened in OB 1
JU FB***	Rewrite flag contents [1]

Interrupt-controlled OB (e.g., OB 2):

JU FB***	Save flags in data block [1]
JU FB 105	Call standard function block with "IR" command (read interrupt identifier bits)
JU FB***	User program
JU FB***	Reenter old page frame
JU FB***	Rewrite flag contents [1]

1) If time-controlled OB 13 uses scratchpad flags which are also used during the cyclic or interrupt-controlled program, these must be saved in a data block while OB 13 is being processed.

   If the interrupt-controlled OB (OB 2, 3, etc.) uses scratchpad flags which are also used during the cyclic or time-controlled program, these must be saved in a data block while the interrupt-controlled OB is being processed. Flag bytes FY 200 to 255 must be saved for standard function block FB 105.

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10.10.3 Startup Behavior

After a "manual cold restart" (OB 21) and an "automatic cold restart" (OB 22), cyclic program processing starts at the beginning of OB 1.

Function block FB 105 is usually called with the commands "reset (RE) and "parameterize (PA)" for a "manual cold restart" and the commands "reset (RE)", "parameterize (PA)", and "position encoder startup (WI)" for an "automatic cold restart".

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10.11 Programming Example

10.11.1 Setting the Module/Explanations

Operating mode:	page frame
Page frame address:	F400 H
ID number:	1
IR routing:	IR-A → OB2

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Use the following switch adjustments to implement this setting.

Switch	Status	
S1.1	open	Implementation of ID no. = 1
S1.2	closed	
S1.3	closed	
S1.4	closed	
S1.5	closed	
S1.6	closed	
S1.7	closed	
S1.8	closed	
S2.1	closed	These switches are always closed. (See section 7.5.)
S2.2	closed	
S2.3	closed	
S2.4	closed	
S2.5	closed	
S2.6	closed	
S3.1	closed	For page frame addressing
S3.2	closed	
S3.3	closed	
S3.4	closed	
S3.5	closed	
S3.6	closed	
S3.7	closed	Implementation of page frame address F400H
S3.8	open	
S3.9	closed	
S3.10	closed	
S3.11	closed	
S3.12	closed	
S3.13	closed	For page frame addressing
S4.1	open	Switches for limit value coding switch Can be set as desired.
S4.2	open	
S4.3	closed	
S4.4	open	
S4.5	open	
S4.6	closed	
S4.7	open	
S4.8	closed	
S5.1	closed	Implementation of IR-A
S5.2	open	
S5.3	open	
S5.4	open	
S5.5	open	
S5.6	open	
S5.7	open	
S5.8	closed	Always for page frame addressing

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Explanations Concerning the Programming Example

In this programming example, it is up to the user to supply the track (FY 20) and the channel (FY 21) for the "AE" command (change setpoints). The module is monitored by time element T1. Output Q12.3 is set when an error occurs on the module.

The module is reset and a position encoder startup performed in OB 21 (start/stop switch). The current actual encoder values (minimum counts, MINC) are read from the machine and stored in the 2nd data block (DB 11). The maximum measuring scale lengths (DMAX) (mm) are taken from the 2nd data block.

A position encoder startup is also performed in OB 22 (power on/off). The minimum counts (MINC) and the maximum measuring scale lengths (DMAX) (mm) are taken from the 2nd data block (DB 11). The module is reparameterized after every position encoder startup.

In the cyclic program (OB 1), the functions of the module can be controlled with inputs.

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10.11.2 Assignment of Inputs/Outputs

Input	Pulse Flag	Edge Flag	Explanation
I 16.0	F 16.0	F 14.0	Position encoder startup
I 16.1	F 16.1	F 14.1	Parameterization
I 16.2	F 16.2	F 14.2	Change setpoints
I 16.3	F 16.3	F 14.3	Read actual values

Output	Explanation
Q 12.0	Parameterization error, PAFE
Q 12.1	Module active, BGT
Q 12.3	Error on the module in OB 1

Flag	Explanation
FY 20	Track number
FY 21	Channel number
FY 200 - FY 255	Scratchpad flag (used by the standard function block)

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10.11.3 Blocks Used

Block	Explanation
DB10	1st data block (setpoints of the tracks)
DB11	2nd data block (MINC, DMAX, HYST, interrupt identifier bits, setpoints)
DB20	Flag bytes 200 to 255 are saved in this data block during interrupt processing.
FB4	Call of the standard function block in the cyclic program
FB10	Save flags during interrupt processing
FB11	Rewrite flags after interrupt processing
FB99	Turn on old page frame again
FB105	Standard function block (IP 241 K control)

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10.11.4 Sample Program Using Organization Blocks

OB1 SPRM-A BIB = 9047 LAE = 8 ABS

```
NETWORK 1
0000        :JU  FB4
0002 NAME   :AUFIP241          Processing of the IP 241 K module
0004        :BE
```

OB2 SPRM-A BIB = 9047 LAE = 33 ABS

```
NETWORK 1
0000        :JU  FB10          Save contents of flags
0002 NAME   :COPY1
0004 OBNR   :    KF+2
0006 DB     :    KF+20
0008 DBS    :    DB20
000A        :
000C        :JU  FB105         Read IR identifier bits
000E NAME   :IP241:A
0010 DB     :    KF+10
0012 SPKA   :    KY0.0
0014 BEF    :    KSIR
0016 ID     :    KF+1
0018 OBNR   :    KF+2
001A PAFE   :    Q12.0
001C BGT    :    Q12.1
001E        :
0020        :                  **Call user program***
0022        :
0024        :JU  FB11          Rewrite contents of flags
0026 NAME   :COPY2
0028 OBNR   :    KF+2
002A DB     :    KF+20
002C DBS    :    DB20
002E        :
0030        :JU  FB99          Turn on old page frame again
0032 NAME   :BBS:SSNR
0034 OBNR   :    KF+2
0036        :BE
```


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OB13 SPRM-A BIB = 9047 LAE = 26 ABS

```
NETWORK 1
0000        :JU  FB10          Save flags
0002 NAME   :COPY1
0004 OBNR   :    KF+13         OB number
0006 DB     :    KF+20         DB number
0008 DBS    :    DB20
000A        :
000C        :
000E        :                  ***Call user program***
0010        :
0012        :
0014        :
0016        :JU  FB11          Rewrite flags
0018 NAME   :COPY2
001A OBNR   :    KF+13         OB number
001C DB     :    KF+20         DB number
001E DBS    :    DB20
0020        :
0022        :JU  FB99          Turn on old page frame again
0024 NAME   :BBS:SSNR
0026        :    KF+13
0028        :BE
```

OB21 SPRM-A BIB = 9047 LAE = 26 ABS

```
NETWORK 1
0000        :JU  FB105
0002 NAME   :IP241:A
0004 DB     :    KF+10         Reset the module
0006 SPKA   :    KY0.0
0008 BEF    :    KCRE
000A ID     :    KF+1
000C OBNR   :    KF+21
000E PAFE   :    Q12.0
0010 BGT    :    Q12.1
0012        :
0014        :JU  FB105         Position encoder startup of the module
0016 NAME   :IP241:A
0018 DB     :    KF+10         The current encoder positions of the
001A SPKA   :    KY0.0         machines are accepted and transferred
001C BEF    :    KSWI          to the 2nd data block.
001E ID     :    KF+1          If this is not  desired,
0020 OBNR   :    KF+21         do not use OB 21 for a position
0022 PAFE   :    Q12.0         encoder startup.
0024 BGT    :    Q12.1
0026        :
0028        :BE
```


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OB22 SPRM-A BIB = 9047 LAE = 17 ABS

```
NETWORK 1
0000      :
0002      :JU  FB105        Position encoder startup of the module
0004 NAME :IP241:A
0006 DB   :    KF+10        The encoder positions which were
0008 SPKA :    KY0.0        determined during the last position
000A BEF  :    KSWI         encoder startup (i.e., values from
000C ID   :    KF+1         the 2nd data block)
000E OBNR :    KF+22        are accepted.
0010 PAFE :    Q12.0
0012 BGT  :    Q12.1
0014      :
0016      :BE
```


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FB4 SPRM-A

```
NETWORK 1                          Cyclic program for IP 241 K module
NAME:AUFIP241                              "WI" command (position encoder startup)

000A        :A    DB10             Call 1st data block
000C        :L    DW1              If DW1 ≠ 0, then block busy
000E        :L    KH0000
0012        :< >  F
0014        :JC   = PA
0016        :U    I 16.0           "Position encoder startup" input
0018        :UN   F 14.0           Edge flag
001A        :=    F 16.0           Pulse flag
001C        :U    I 16.0           Update edge flag
001E        :=    F 14.0
0020        :UN   F 16.0           IF pulse flag = 0, then continue
0022        :JC   = PA
0024        :L    KSWI             Command = WI
0028        :T    DW1
002A        :L    KY0,1            Track, channel (disregard)
002E        :T    DW2
0030        :L    KF+1             ID number (set on module)
0034        :T    DW3
0036        :L    KY10,0           DB number = 10
003A        :T    DW4
003C        :L    KY0.1            OB number = 1
0040        :T    DW5
0042 PA     :***
NETWORK 2                          Parameterize the module
0044        :L    DW1              IF DW1 ≠ 0, then block busy
0046        :L    KH0000
004A        :> <  F
004C        :JC   = AE
004E        :U    I 16.1           "Parameterization" input
0050        :UN   F 14.1           Edge flag
0052        :=    F 16.1           Pulse flag
0054        :U    I 16.1           Update edge flag
0056        :=    F 14.1
0058        :UN   F 16.1           If pulse flag = 0, then continue
005A        :JC   = AE
005C        :L    KSPA             Command = PA
0060        :T    DW1
0062        :L    KY0.0            Track, channel (disregard)
0066        :T    DW2
0068        :L    KF+1             ID number (set on module)
006C        :T    DW3
006E        :L    KY10.0           DB number = 10
0072        :T    DW4
0074        :L    KY0,1            OB number = 1
0078        :T    DW5
007A AE     :***
```


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```
NETWORK 3                          Change setpoints
007C        :L    DW1                    If DW 1 ≠ 0, then module busy
007E        :L    KH0000
0082        :> <  F
0084        :JC   = IQ
0086        :U    I 16.2                 "Change setpoints" input
0088        :UN   F 14.2                 Edge flag
008A        :=    F 16.2                 Pulse flag
008C        :U    I 16.2                 Update edge flag
008E        :=    F 14.2
0090        :UN   F 16.2                 If pulse flag = 0, then continue
0092        :JC   =IW
0094        :L    KSAE                   Command = AE
0098        :T    DW1
009A        :L    FY20                   Track must be handled by the user.
009C        :T    DL2
009E        :L    FY21                   Channel must be handled by the user.
00A0        :T    DR2
00A2        :L    KF+1                   ID number = 1 (set on module)
00A6        :T    DW3
00A8        :L    KY10,0                 DB number = 10
00AC        :T    DW4
00AE        :L    KY0,1                  OB number = 1
00B2        :T    DW5
00B4 IW     :***
NETWORK 4                          Read actual values
00B6        :UN   I 16.3                 "Read actual values" input
00B8        :JC   = SE
00BA        :A    DB10                   If DW 1 ≠ 0, then block busy
00BC        :L    DW1
00BE        :L    KH0000
00C2        :> <  F
00C4        :JC   = SE
00C6        :L    KSIW                   Command = IW
00CA        :T    DW1
00CC        :L    KY0,0                  Track, channel (disregard)
00D0        :T    DW2
00D2        :L    KF+1                   ID number = 1 (set on module)
00D6        :T    DW3
00D8        :L    KY10,0                 DB number = 10
00DC        :T    DW4
00DE        :L    KY0,1                  OB number = 1
00E2        :T    DW5
00E4 SE     :***
```


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```
NETWORK 5
00E6        :A    DB10          Call 1st data block
00E8        :JU   FB 105        Standard function block
00EA NAME   :IP241:A
00EC DB     :     KF+0
00EE SPKA   :     KY0,0
00F0 BEF    :     KSO
00F2 ID     :     KF+1
00F4 OBNR   :     KF+1
00F6 PAFE   :     Q 12.0
00F8 BGT    :     Q 12.1
00FA        :***
NETWORK 6                       Monitor module
00FC        :U    A 12.1              If module active,
00FE        :L    KT100.0             then start time
0102        :SV   T 1
0104        :U    A 12.1              If module active
0106        :UN   T 1                 and time expired,
0108        :=    A 12.3              then error on module
010A        :BE
```


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10.12 Internal Processing Sequence in the Module during I/O Addressing

FB 105 is not used. The central processor of a programmable controller addresses the analog position decoder as if it were an I/O module. SIMATIC S5 processors which are programmed in Assembler, PLM, STEP 5 or other higher-level programming languages access the addresses of the module by byte (8 bits each).

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10.12.1 Position Encoder Startup

The position encoder startup program must be started if the position decoder module is to be parameterized in millimeters. In addition, prior to the initial parameterization, the module must be supplied with maximum length (in mm) and start value (in counts) for each channel using FB 230.

When starting the position encoder startup program, it is important that no write accesses (e.g., parameterization) to the module have been made. Otherwise the module **must** be deleted (FFH → AEBLI).

After bits WML and AEBS are written and the SP-bit scan for "0" is then performed, the module cyclically enters all actual values from C1 to C6 in the result bit addresses. The sequence is C1 to C6; one cycle requires approximately 250 µsec per channel. The user can now read the actual values by word (16 bits) without an SP-bit scan. Reading by byte is not permitted.

The individual channels are now parameterized with the minimal counts MINC (in counts) and the maximum measuring bar length DMAX (in mm). The appropriate WF bit is set after calculation of the conversion factor. The module sets the WIF identifier bit (following conversion) after all channels have been parameterized with MINC and DMAX. When a channel is parameterized with MINC and DMAX = 0000, the WF identifier bit is reset for this channel. Based on the specified measuring bar length DMAX. the module can determine the resolution of the position encoder in mm/count.

Using the determined MINC and the conversion factor Ku, the setpoints and actual values of the module are calculated as follows:

$$IWM\ [mm] = Ku \left[\frac{mm}{counts}\right] \times (IWC - MINC)\ [counts]$$

$$SWC\ [counts] = \frac{SWM}{Ku} \left[mm \times \frac{mm}{counts}\right] + MINC\ [counts]$$

The following is valid:

$0 \leq IWM \leq DMAX$
$0 \leq SWM \leq DMAX$
$0 \leq MINC \leq 4095$ [counts]
$0 \leq DMAX \leq 9999$ [counts]

IWC = actual value [counts]
IWM = actual value [mm]
SWC = setpoint [counts]
SWM = setpoint [mm]

$$Ku = \frac{DMAX}{U_{ref}} \left[\frac{mm}{counts}\right]$$

With: U_{ref} = 10 V = 4095 counts
U_{ref} = 0 V = 0 counts

The position encoder startup program takes the drift of the reference voltage into consideration.

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10.12.2 Specification of Hysteresis

A hysteresis value can be specified for channel 1 to channel 5 (see section 5.1). When the switching point is reached, the hysteresis value prevents an interrupt from being output except when the actual values change (starting with hardware release D3.A4). Parameterization is the same as that of a track value except that the HYST bit is set.

10.12.3 Parameterization of the Tracks

Following switch-on or return of power on the control, the SP-bit (inhibit bit) can be scanned after approximately 100 µsec.

This is "1" until the module is ready to accept read and write commands (internal initialization routines). The module can now be parameterized (i.e., the start and end values and, if necessary, the interrupt identifiers are specified for the required tracks of the 5 channels.

The SP-bit must be scanned for "0" before the first write command of a data block (track identifier, channel number, setpoint, writing of modification bytes). Approximately 100 µsec after the first write command, the SP-bit is set to "1", the cyclic processing is interrupted and the system waits until the AEBS bit (write modification bit) is written. These 5 bytes are then stored intermediately and the affected channel is inhibited for the setpoint-actual value comparison. The new parameters are then sorted later during a phase with more time. After sorting is finished, the channel is enabled again and the SP-bit set to "0". This ensures that the other channels are processed without time delays.

If the value "0000" is assigned to a track start or track end value, this track is deleted or considered not parameterized.

10.12.4 Read Result Tracks

A read routine can be started at any time to evaluate the current assignment of the tracks. The read routine evaluates the read addresses described in section 10.12.7.2.

Result bits are set when the internal value is within a specified start and end value.

Interrupts indicate which channel has issued an interrupt (group signal, bus signal; cases in which a start and end value which is parameterized with an interrupt identifier is exceeded). The interrupt bits of byte 15 must be read so that these and the interrupt line can be reset.

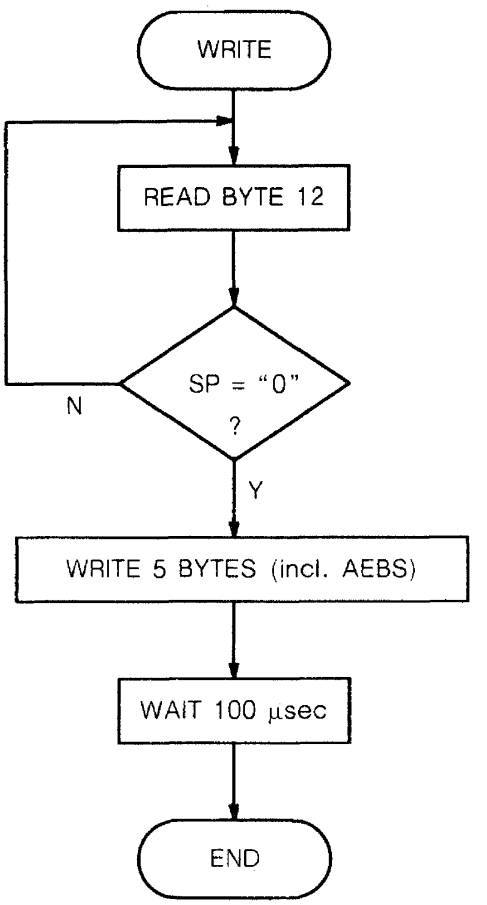
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10.12.5 Read Absolute Values

In addition to the identifiers of the 5 x 16 tracks, all parameterized values, the actual values of the 6 encoders and limit value coding switches (8) can be read if requested. Updating of bytes 13, 14 and 15 of the read register must be triggered so that parameterized start, end and actual values and limit value coding switches can be read and evaluated. For this, a byte, which is located in the fifth position in relation to addressing (AEBLI, for actual values) and in the sixth position (AEBLS, for setpoints) of the parameterization byte, must provide read triggering. The status of the limit coding switches is stored in byte 13 (byte 14 = 00H) when these switches are read.

10.12.6 Write with I/O Addressing

10.12.6.1 Flow Chart



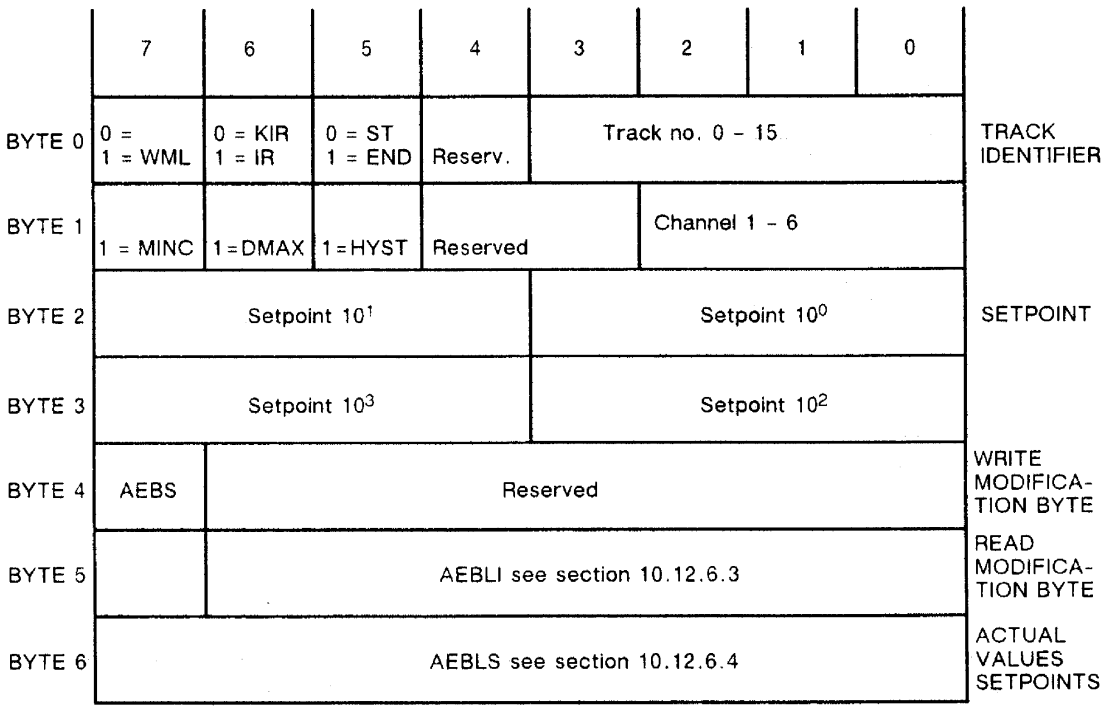
General: After each write of

AEBS
AEBLI
AEBLS

wait 600 µsec and then scan SP-bit

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10.12.6.2 Organization of the Write Addresses



Explanation

AEBLI = Read modification byte, actual values
AEBLS = Read modification byte, setpoints
AEBS = Write modification bit
ANF = Start value
DMAX = Write maximum measuring bar length
END = End value
IR = Interrupt
KIR = No interrupt
MINC = Write start value (minimum counts)
WML = Read distance minimums

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10.12.6.3 Organization of Read Requests for Actual Values AEBLI (Byte 5)

7	6	5	4	3	2	1	0	
1	0	0	0	0	0	0	1	Read actual value, channel 1
1	0	0	0	0	0	1	0	Read actual value, channel 2
1	0	0	0	0	0	1	1	Read actual value, channel 3
1	0	0	0	0	1	0	0	Read actual value, channel 4
1	0	0	0	0	1	0	1	Read actual value, channel 5
1	0	0	0	0	1	1	0	Read actual value, channel 6
1	1	0	0	0	0	0	0	Read limit value coding switch
1	1	1	1	1	1	1	1	Internal reset, delete module (always required after an error message)

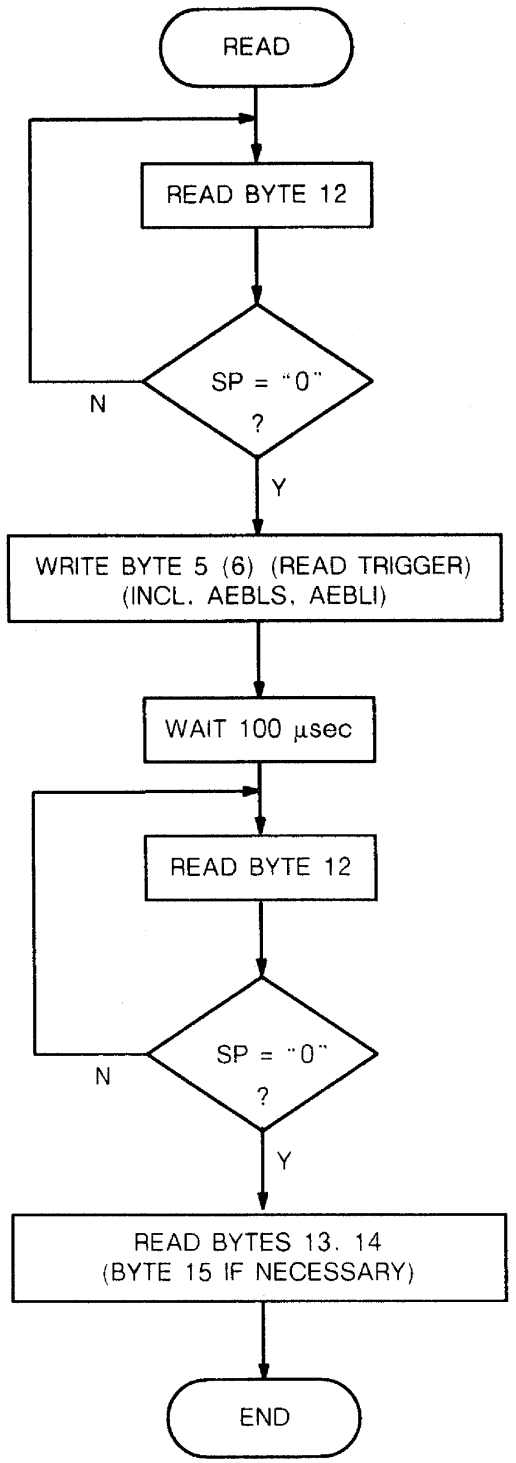
10.12.6.4 Organization of Write Requests for Setpoints AEBLS (Byte 6)

7	6	5	4	3	2	1	0	
A/E	CHANNEL NO.			Track number				A = Start value E = End value
0	0	0	1	X	X	X	X	Read track start values C1 track 0 to 15
1	0	0	1	X	X	X	X	Read track end values C1 track 0 to 15
0	0	1	0	X	X	X	X	Read track start values C2 track 0 to 15
1	0	1	0	X	X	X	X	Read track end values C2 track 0 to 15
0	0	1	1	X	X	X	X	Read track start values C3 track 0 to 15
1	0	1	1	X	X	X	X	Read track end values C3 track 0 to 15
0	1	0	0	X	X	X	X	Read track start values C4 track 0 to 15
1	1	0	0	X	X	X	X	Read track end values C4 track 0 to 15
0	1	0	1	X	X	X	X	Read track start values C5 track 0 to 15
1	1	0	1	X	X	X	X	Read track end values C5 track 0 to 15

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10.12.7 Read with I/O Addressing

10.12.7.1 Flow Chart



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10.12.7.2 Organization of the Read Addresses

	7	6	5	4	3	2	1	0	
0	Track 7	Track 6	Track 5	Track 4	Track 3	Track 2	Track 1	Track 0	RESULT BITS C1[1]
1	Track 15			•	•			Track 8	
2	Track 7			•	•			Track 0	RESULT BITS C2[1]
3	Track 15			•	•			Track 8	
4	Track 7			•	•			Track 0	RESULT BITS C3[1]
5	Track 15			•	•			Track 8	
6	Track 7			•	•			Track 0	RESULT BITS C4[1]
7	Track 15			•	•			Track 8	
8	Track 7			•	•			Track 0	RESULT BITS C5[1]
9	Track 15			•	•			Track 8	
10			10^1			10^0			ACTUAL VALUE CHANNEL 6
11			10^3			10^2			
12	SP	WIF	W C6	W C5	W C4	W C3	W C2	W C1	POSITION ENCODER STARTUP AND SP-BITS[2]
13		AEBLI see section 10.12.6.3							
14		AEBLI see section 10.12.6.4							
15	IR[3]	FB[4]		INT C5	INT C4	INT C3	INT C2	INT C1	IR-IDENTIFIER AND ERROR BITS

Explanation

FB = Irreparable error during parameterization (see section 10.14 for error numbers)
INT C1 = Interrupt generated by channel 1
INT C2 = Interrupt generated by channel 2
INT C3 = Interrupt generated by channel 3
INT C4 = Interrupt generated by channel 4
INT C5 = Interrupt generated by channel 5
IR = Interrupt identifier for setpoint reading of a track
SP = Write enable bit and read absolute value
WIF = Position encoder startup finished
W (C1–C6) = Position encoder startup (C1 to C6 finished)

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1) Result bit = 1 when actual value is inside the track
Result bit = 0 when actual value is outside the track

2) WIF = 1, when position encoder startup is complete; all channels must be parameterized in any order.
WF C1 to C6 not valid until WIF = 1

3) IR is only important when reading the setpoint.
IR = 1 when setpoint is parameterized with interrupts.
IR = 0 when setpoint is parameterized without interrupts.

4) FB = 1 → error (i.e., module only accessible by deletion or reading)
FB = 0 is only possible by deletion of the module.
FB = 0 is connected with interrupts.

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10.13 Error Messages

The following error messages indicate whether the error was caused by the parameterization or by the power supply (24 V ext. missing).

FB BIT	Error No.	Cause
1	F001H	Invalid channel number during parameterization
1	F002H	Position encoder startup after parameterization is performed
1	F003H	Second position encoder startup started; first startup not concluded
1	F004H	Position encoder startup concluded and started again
1	F005H	Invalid channel number during position encoder startup
1	F006H	Write MINC DMAX without position encoder startup
1	F007H	24 V ext. missing or converter not finished after deletion or power on
0	FFFDH	Invalid code for AEBLI bit 7 and 6
0	FFFEH	Invalid code for AEBLI bit 7
0	FFFFH	Invalid channel number for AEBLS

When the FB bit is set, the module can no longer be write accessed except by deleting the module.

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11 Glossary

Actual value	The actual value position data which the encoder sends to IP 241 K
Basic plug connector	Connection to the device bus of the programmable controller (PLC)
BCD coding	4 bits each of a measured value specify a power of ten (thousands, hundreds, tens and ones).
CAM	Area in which a reaction is desired. Start and end values can be selected as desired.
CPU	Central processing unit
Data block (DB)	Data list for the function block (FB)
High byte	More significant portion of a 16-bit word
Hysteresis	Adjustable "blurred" range when the actual value is unsteady
Interrupt	A means of producing a fast reaction by the PLC using an interrupt. An appropriate bit is set when the interrupt is triggered.
Limit value code	Machine-related number from 0 to 255 which is used for a software check of the machine type and its parameters
Low byte	Less significant portion of a 16-bit word
Page frame number	Number of a module which is addressed in the page frame area
Parameterization	Provides the used tracks with start and end values and possibly interrupt identifiers
Position encoder	Sensor which provides position data in analog form
Result bit	The result of the comparison of actual value and setpoint per track is available here.
Scratchpad flag	Flags which are also used by the standard function block (FY 200 to 255)
Setpoints (track values)	Desired start and end values of a cam
Standard function block	Program package in the SIMATIC S5 programmable controller
Test switch	For factory testing only; always closed for operation
Track	A reaction track on which a cam can be set at any point desired. The IP 241 K offers a maximum of 16 tracks in channels 1 to 5.

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