Handbücher/Manuals

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Manual

VIPA Operation List
SPEED7

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About this manual

This manual provides you with a comprehensive overview of the blocks integrated to the VIPA SPEED7 CPUs.

Described are command list, integrated OBs, SFBs, SFCs and the VIPA specific blocks.

Outline

Chapter 1: Instruction list
This chapter lists all available instructions of the CPUs in alphabetical order.

Chapter 2: Organization Blocks
Here the description of the OBs may be found.

Chapter 3: Integrated SFBs
The description of integrated SFBs may be found here.

Chapter 4: Integrated Standard SFCs
The standard SFCs are described in this chapter.

Chapter 5: VIPA specific blocks
Here the description of the VIPA specific blocks may be found that are exclusively used with VIPA SPEED7 CPUs.

Contents

User considerations

Objective and contents

This manual provides you with the instruction list and the description of the integrated blocks that are exclusively may be used with the SPEED7 CPUs from VIPA.

Target audience

The manual is targeted at users who have a background in automation technology.

Structure of the manual

The manual consists of chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document

The following guides are available in the manual:

- an overall table of contents at the beginning of the manual
- an overview of the topics for every chapter
- an index at the end of the manual.

Availability

The manual is available in:

- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings

Important passages in the text are highlighted by following icons and headings:

Danger!
Immediate or likely danger.
Personal injury is possible.

Attention!
Damages to property is likely if these warnings are not heeded.

Note!
Supplementary information and useful tips.

Chapter 1 Instruction list

Outline

The following chapter lists the available commands of the SPEED7 CPUs from VIPA. The instruction list intends to give you an overview over the commands and their syntax. The commands are sorted by topics in alphabetical order.

Via the content the different topics are available.

The alphabetical instruction list gives you direct access to the instructions.

For the parameters are integrated in the instruction list, there is no extra parameter list.

The following chapter describes:

- Instruction and abbreviation list
- Structure of the registers and addressing examples
- Instruction list

Content

Topic **Page**

Alphabetical instruction list

Abbreviations

Abbreviation	Description
/FC	First check bit
2#	Binary constant
a	Byte address
ACCU	Register for processing bytes, words and double words
AR	Address registers, contain the area-internal or area-crossing addresses for the instructions addressed register-indirect
b	Bit address
B	area-crossing, register-indirect addressed byte
B (b1,b2)	Constant, 2byte
B (b1,b2,b3,b4)	Constant, 4byte
B#16#	Byte hexadecimal
BR	Binary result
c	Operand range
C	Counter
C#	Counter constant (BCD-coded)
CC0	Condition code
CC1	Condition code
D	area-crossing, register-indirect addressed double word
D#	IEC date constant
DB	Data block
DBB	Data byte in the data block
DBD	Data double word in the data block
DBW	Data word in the data block
DBX	Data bit in the data block
DI	Instance data block
DIB	Data byte in the instance DB
DID	Data double word in the instance DB
DIW	Data word in the instance DB
DIX	Data bit in the instance DB
DW#16#	Double word hexadecimal
f	Timer/Counter No.
FB	Function block
FC	Functions
g	Operand range
h	Operand range
I	Input (in the PII)
i	Operand range
i8	Integer (8bit)
i16	Integer (16bit)
i32	Integer (32bit)
IB	Input byte (in the PII)
ID	Input double word (in the PII)
IW	Input word (in the PII)
k8	Constant (8bit)
k16	Constant (16bit)
k32	Constant (32bit)

continued ...

... continue

Abbreviation	Description
L	Local data
L#	Integer constant (32bit)
LABEL	Symbolic jump address (max. 4 characters)
LB	Local data byte
LD	Local data double word
LW	Local data word
m	Pointer constant P#x.y (pointer)
M	Bit memory bit
MB	Bit memory byte
MD	Bit memory double word
MW	Bit memory word
n	Binary constant
OB	Organization block
OR	Or
OS	Stored overflow
OV	Overflow
p	Hexadecimal constant
P#	Pointer constant
PIQ	Process image of the outputs
PII	Process image of the inputs
PIB	Periphery input byte (direct periphery access)
PID	Periphery input double word (direct periphery access)
PIW	Periphery input word (direct periphery access)
PQB	Periphery output byte (direct periphery access)
PQD	Periphery output double word (direct periphery access)
PQW	Periphery output word (direct periphery access)
Q	Output (in the PIQ)
q	Real number (32bit floating-point number)
QB	Output byte (in the PIQ)
QD	Output double word (in the PIQ)
QW	Output word (in the PIQ)
r	Block no.
RLO	Result of (previous) logic instruction
S5T#	S5 time constant (16bit), loads the S5-Timer
SFB	System function block
SFC	System function
STA	Status
T	Timer (times)
T#	Time constant (16/32bit)
TOD#	IEC time constant
W	area-crossing, register-indirect addressed word
W#16#	Word hexadecimal

Differences between SPEED7 and 300V programming

General

The SPEED7-CPUs lean in the command processing against the S7-400 from Siemens and differs here to the S7-300 from Siemens.

These differences are listed below.

In the following, the S7-318 from Siemens is counted for the S7-400 series from Siemens.

Status register

In opposite to the System 300V, the SPEED7-CPUs, Siemens S7-400 and CPU 318 use the status register bits OR, STA, /ER.

If your user application is based upon the circumstance that the mentioned bits in the status register are always zero (like S7-300 from Siemens), the program is not executable at SPEED7-CPUs, Siemens S7-400 and CPU 318.

ACCU handling at arithmetic operations

The CPUs of the System 300V contain 2 ACCUs. At an arithmetic operation the content of the 2nd ACCU is not altered.

Whereas the SPEED7-CPUs provide 4 ACCUs. At an arithmetic operation the content of ACCU 3 is loaded to ACCU 2.

This may cause conflicts in applications that presume an unmodified ACCU2.

RLO at jumps

The missing of the implementation of the start command bit /ER in the System 300V may cause, under certain circumstances, deviations in the command execution of bit commands between S7-300 and S7-400 res. SPEED7, especially at a jump to a bit conjunction chain.

Example A:

```
       A I0.0
       A M1.1
       = M2.0    // RLO =1  Command end
       JU =J001  // jumps
       .....
       A M7.6
       A M3.0
       A M3.1
JO01:  A Q2.2    // after the jump...
                 // 300V further combines
                 // This command is used by VIPA SPEED7, Siemens
                 // S7-400 und CPU 318 as first request
```

...continue RLO at jumps

Example B:

```
        A I0.0
        A M1.1
        = M2.0       // RLO =1  command end
        A Q3.3       // first request
        JU =J001     // jumps
        .....
        A M3.0
        A M3.1
JO01:   A M3.2       // after jump
        .....        // The CPUs further combine
```

BCD consistency

At setting a timer or counter, a valid BCD value must be present in AKKU1. The proof of this BCD value is in the System 300V only executed when timer or counter are taken over (edge change). The SPEED7-CPUs (like the S7-400 from Siemens) always execute the verification.

Example:

```
......
A I5.4
L MW20
S T30        // 300V only proofs if timer is actively
             // executed
             // SPEED7, Siemens S7-400 und CPU 318
             // always proof (also when no condition is
             // present)
......
```

Registers

ACCU1 and ACCU4 (32bit)

The ACCUs are registers for the processing of byte, words or double words. Therefore the operands are loaded in the ACCUs and combined. The result of the instruction is always in ACCU1.

ACCU	Bit
ACCUx (x=1 to 4)	Bit 0 to bit 31
ACCUx-L	Bit 0 to bit 15
ACCUx-H	Bit 16 to bit 31
ACCUx-LL	Bit 0 to bit 7
ACCUx-LH	Bit 8 to bit 15
ACCUx-HL	Bit 16 to bit 23
ACCUx-HH	Bit 24 to bit 31

Address register AR1 and AR2 (32bit)

The address registers contain the area-internal or area-crossing addresses for the register-indirect addressed instructions. The address registers are 32bit wide.

The area-internal or area-crossing addresses have the following structure:

area-internal address:

00000000 00000bbb bbbbbbbb bbbbbxxx

area-crossing address:

10000yyy 00000bbb bbbbbbbb bbbbbxxx

Legend:	b	Byte address
	x	Bit number
	Y	Range ID (see chapter "Addressing examples")

Status word (16bit)

The values are analyzed or set by the instructions.
The status word is 16bit wide.

Bit	Assignment	Description
0	/FC	First check bit
1	RLO	Result of (previous) logic instruction
2	STA	Status
3	OR	Or
4	OS	Stored overflow
5	OV	Overflow
6	CC0	Condition code
7	CC1	Condition code
8	BR	Binary result
9 to 15	not used	-

Addressing examples

Addressing example	Description
Immediate addressing	
L +27	Load 16bit integer constant "27" in ACCU1
L L#-1	Load 32bit integer constant "-1" in ACCU1
L 2#1010101010101010	Load binary constant in ACCU1
L DW#16#A0F0_BCFD	Load hexadecimal constant in ACCU1.
L 'End'	Load ASCII code in ACCU1
L T#500ms	Load time value in ACCU1
L C#100	Load counter value in ACCU1
L B#(100,12)	Load constant as 2byte
L B#(100,12,50,8)	Load constant as 4byte
L P#10.0	Load area-internal pointer in ACCU1
L P#E20.6	Load area-crossing pointer in ACCU1
L -2.5	Load real number in ACCU1
L D#1995-01-20	Load date
L TOD#13:20:33.125	Load time-of-day
Direct addressing	
A I 0.0	AND operation of input bit 0.0
L IB 1	Load input byte 1 in ACCU1
L IW 0	Load input word 0 in ACCU1
L ID 0	Load input double word 0 in ACCU1

continued ...

... continue

Indirect addressing timer/counter			
SP T [LW 8] CU C [LW 10]	Start timer; timer no. is in local data word 8 Start counter; counter no. is in local data word 10		
Memory-indirect, area-internal addressing			
A I [LD 12] e.g.: LP#22.2 T LD 12 A I [LD 12]	AND instruction; input address is in local data double word 12 as pointer		
A I [DBD 1]	AND instruction; input address is in data double word 1 of the DB as pointer		
A Q [DID 12]	AND instruction; output address is in data double word 12 of the instance DB as pointer		
A Q [MD 12]	AND instruction; output address is in bit memory double word 12 as pointer		
Register-indirect, area-internal addressing			
A I [AR1,P#12.2]	AND instruction; input address is calculated "pointer value in address register 1 + pointer P#12.2"		
Register-indirect, area-crossing addressing			
For the area-crossing, register indirect addressing the address needs an additional range-ID in the bits 24-26. The address is in the address register.			
Range-ID	**Binary code**	**hex.**	**Area**
P	1000 0**000**	80	Periphery area
I	1000 0**001**	81	Input area
Q	1000 0**010**	82	Output area
M	1000 0**011**	83	Bit memory area
DB	1000 0**100**	84	Data area
DI	1000 0**101**	85	Instance data area
L	1000 0**110**	86	Local data area
VL	1000 0**111**	87	Preceding local data area (access to the local data of the calling block)
L B [AR1,P#8.0]	Load byte in ACCU1; the address is calculated "pointer value in address register 1 + pointer P#8.0"		
A [AR1,P#32.3]	AND instruction; operand address is calculated "pointer value in address register 1 + pointer P#32.3"		
Addressing via parameters			
A parameter	The operand is addressed via the parameter		

Example for pointer calculation

Example when sum of bit addresses ≤ 7:

LAR1 P#8.2
A I [AR1,P#10.2]

Result: The input 18.4 is addressed (by adding the byte and bit addresses)

Example when sum of bit addresses > 7:

L MD 0 at will calculated pointer, e.g. P#10.5
LAR1
A I [AR1,P#10.7]

Result: Addressed is input 21.4 (by adding the byte and bit addresses with carry)

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

(Status word: BR, CC1, CC0, OV, OS, OR, STA, RLO, /FC)

Math instructions

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
Fixed-point arithmetic (16bit)			*Status word*									Math instructions of two 16bit numbers. The result is in ACCU1 res. ACCU1-L.	
+I	-		-	-	-	-	-	-	-	-	-	Add up two integers (16bit) (ACCU1-L)=(ACCU1-L)+(ACCU2-L)	1
-I	-		-	Y	Y	Y	Y	-	-	-	-	Subtract two integers (16bit) (ACCU1-L)=(ACCU2-L)-(ACCU1-L)	1
*I	-											Multiply two integers (16bit) (ACCU1-L)=(ACCU2-L)*(ACCU1-L)	1
/I	-											Divide two integers (16bit) (ACCU1-L)=(ACCU2-L):(ACCU1-L) The remainder is in ACCU1-H	1
Fixed-point arithmetic (32bit)			*Status word*									Math instructions of two 32bit numbers. The result is in ACCU1.	
+D	-		-	-	-	-	-	-	-	-	-	Add up two integers (32bit) (ACCU1)=(ACCU2)+(ACCU1)	1
-D	-		-	Y	Y	Y	Y	-	-	-	-	Subtract two integers (32bit) (ACCU1)=(ACCU2)-(ACCU1)	1
*D	-											Multiply two integers (32bit) (ACCU1)=(ACCU2)*(ACCU1)	1
/D	-											Divide two integers (32bit) (ACCU1)=(ACCU2):(ACCU1)	1
MOD	-											Divide two integers (32bit) and load the rest of the division in ACCU1 (ACCU1)=remainder of [(ACCU2):(ACCU1)]	1
Floating-point arithmetic (32bit)			*Status word*									The result of the math instructions is in ACCU1. The execution time of the instruction depends on the value to calculate.	
+R	-		-	-	-	-	-	-	-	-	-	Add up two real numbers (32bit) (ACCU1)=(ACCU2)+(ACCU1)	1
-R	-		-	Y	Y	Y	Y	-	-	-	-	Subtract two real numbers (32bit) (ACCU1)=(ACCU2)-(ACCU1)	1
*R	-											Multiply two real numbers (32bit) (ACCU1)=(ACCU2)*(ACCU1)	1
/R	-											Divide two real numbers (32bit) (ACCU1)=(ACCU2):(ACCU1)	1
NEGR	-		-	-	-	-	-	-	-	-	-	Negate the real number in ACCU1	1
ABS	-		-	-	-	-	-	-	-	-	-	Form the absolute value of the real number in ACCU1	1

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
Square root an square instructions (32bit)			*Status word*									The result of the instructions is in ACCU1. The instructions may be interrupted by alarms.	
SQRT	-		-	-	-	-	-	-	-	-	-	Calculate the Square root of a real number in ACCU1	1
SQR	-		-	Y	Y	Y	Y	-	-	-	-	Form the square of a real number in ACCU1	1
Logarithmic function (32bit)			*Status word*									The result of the logarithm function is in ACCU1. The instructions may be interrupted by alarms.	
LN	-		-	-	-	-	-	-	-	-	-	Calculate the natural logarithm of a real number in ACCU1	1
EXP	-		-	Y	Y	Y	Y	-	-	-	-	Calculate the exponential value of a real number in ACCU1 on basis e (=2.71828)	1
Trigonometrical functions (32bit)			*Status word*									The result of the trigonometrical function is in ACCU1. The instructions may be interrupted by alarms.	
SIN[1]	-		-	-	-	-	-	-	-	-	-	Calculate the sine of the real number	1
ASIN[2]	-		-	Y	Y	Y	Y	-	-	-	-	Calculate the arcsine of the real number	1
COS[1]	-											Calculate the cosine of the real number	1
ACOS[2]	-											Calculate the arccosine of the real number	1
TAN[1]	-											Calculate the tangent of the real number	1
ATAN[2]	-											Calculate the arctangent of the real number	1
Addition of constants												Addition of integer constants to ACCU1. The condition code bits are not affected.	
+	i8											Add an 8bit integer constant	1
+	i16											Add a 16bit integer constant	2
+	i32											Add a 32bit integer constant	3
Addition via address register												Adding a 16bit integer to contents of address register. The value is in the instruction or in ACCU1-L. Condition code bits are not affected	
+AR1	-											Add the contents of ACCU1-L to AR1	1
+AR1	m											Add a pointer constant to the contents of AR1	2
+AR2	-											Add the contents of ACCU1-L to those of AR2	1
+AR2	m											Add pointer constant to the contents of AR2	2

1 Specify the angle in radians; the angle must be given as a floating point value in ACCU 1.

2 The result is an angle in radians.

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Block instructions

Block call instructions			*Status word*										
CALL	FB r, DB r	0 to 8191	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Unconditional call of a FB, with parameter transfer	
		0 to 8191	-	-	-	-	-	-	-	-	-		
CALL	SFB r, DB r	0 to 8191	-	-	-	-	0	0	1	-	0	Unconditional call of a SFB, with parameter transfer	
		0 to 8191											
CALL	FC r											Unconditional call of a function, with parameter transfer	
CALL	SFC r											Unconditional call of a SFC, with parameter transfer	
UC	FB r	0 to 8191										Unconditional call of blocks, without parameter	1/2
	FC r											transfer	
	Parameter											FB/FC call via parameters	
CC	FB r	0 to 8191	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Conditional call of blocks, without parameter	1/2
	FC r		-	-	-	-	-	-	-	Y	-	transfer	
	Parameter		-	-	-	-	0	0	1	-	0	FB/FC call via parameters	
OPN	DB r	0 to 8191	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Open a data block	1/2
	DI r		-	-	-	-	-	-	-	-	-	Open a instance data block	2
	Parameter		-	-	-	-	-	-	-	-	-	Open a data block via parameter	2
Block end instructions			*Status word*										
BE			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	End block	1
			-	-	-	-	-	-	-	-	-		
BEU			-	-	-	-	0	0	1	-	0	End block unconditionally	1
BEC			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	End block if RLO="1"	
			-	-	-	-	-	-	-	Y	-		
			-	-	-	-	Y	0	1	1	0		
Exchanging shared data block an instance data block												Exchanging the two current data blocks. The current shared data block becomes the current instance data block and vice versa. The condition code bits are not affected	
CDB												Exchange shared data block and instant data block	1

Command	Operand	Parameter	Status word BR CC1 CC0 OV OS OR STA RLO /FC	Function	Length in words
				: Instruction depends on	
				: Instruction influences	

Program display and null instruction instructions

Program display and null operation instructions				The status word is not affected.	
BLD	0 ... 255			Program display instruction: is treated by the CPU like a null operation instruction	1
NOP	0 1			Null operation instruction	1

Edge-triggered instructions

Edge-triggered instructions			*Status word*	Detection of an edge change. The current signal state of the RLO is compared with the signal state of the instruction or edge bit memory. FP detects a change in the RLO from "0" to "1". FN detects a change in the RLO from "1" to "0".	
FP	I/Q a.b	0.0 to 2047.7	BR CC1 CC0 OV OS OR STA RLO /FC	Detecting the positive edge in the RLO. The bit addressed	2
	M a.b	0.0 to 8191.7	- - - - - - - Y -	in the instruction is the auxiliary edge bit memory	2
	L a.b	parameterizable	- - - - - 0 Y Y 1		2
	DBX a.b	0.0 to 65535.7			2
	DIX a.b	0.0 to 65535.7			2
	c [AR1,m]				2
	c [AR2,m]				2
	[AR1,m]				2
	[AR2,m]				2
	Parameter				2
FN	I/Q a.b	0.0 to 2047.7	BR CC1 CC0 OV OS OR STA RLO /FC	Detecting the negative edge in the RLO. The bit addressed	2
	M a.b	0.0 to 8191.7	- - - - - - - Y -	in the instruction is the auxiliary edge bit memory	2
	L a.b	parameterizable	- - - - - 0 Y Y 1		2
	DBX a.b	0.0 to 65535.7			2
	DIX a.b	0.0 to 65535.7			2
	c [AR1,m]				2
	c [AR2,m]				2
	[AR1,m]				2
	[AR2,m]				2
	Parameter				2

Command	Operand	Parameter	Status word: BR CC1 CC0 OV OS OR STA RLO /FC	Function	Length in words
				: Instruction depends on	
				: Instruction influences	

Load instructions

Load instructions				Loading address identifiers into ACCU1. The contents of ACCU1 and ACCU2 are saved first. The status word is not affected.	
L				Load ...	
	IB a	0.0 to 2047		input byte	1/2
	QB a	0.0 to 2047		output byte	1/2
	PIB a	0.0 to 8191		periphery input byte	2
	MB a	0.0 to 8191		bit memory byte	1/2
	LB a	parameterizable		local data byte	2
	DBB a	0.0 to 65535		data byte	2
	DIB a	0.0 to 65535		instance data byte	2
				... in ACCU1	2
	g [AR1,m]			register-indirect, area-internal (AR1)	2
	g [AR2,m]			register-indirect, area-internal (AR2)	2
	B [AR1,m]			area-crossing (AR1)	2
	B [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2
L				Load ...	
	IW a	0.0 to 2046		input word	1/2
	QW a	0.0 to 2046		output word	1/2
	PIW a	0.0 to 8190		periphery input word	
	MW a	0.0 to 8190		bit memory word	1/2
	LW a	parameterizable		local data word	2
	DBW a	0.0 to 65534		data word	1/2
	DIW a	0.0 to 65534		instance data word	1/2
				... in ACCU1-L	
	h [AR1,m]			register-indirect, area-internal (AR1)	2
	h [AR2,m]			register-indirect, area-internal (AR2)	2
	W [AR1,m]			area-crossing (AR1)	2
	W [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2

Command	Operand	Parameter	Status word BR CC1 CC0 OV OS OR STA RLO /FC	Function	Length in words
				: Instruction depends on : Instruction influences	

Command	Operand	Parameter	Status word	Function	Length in words
L				Load ...	
	ID a	0.0 to 2044		input double word	1/2
	QD a	0.0 to 2044		output double word	1/2
	PID a	0.0 to 8188		periphery input double word	2
	MD a	0.0 to 8188		bit memory double word	1/2
	LD a	parameterizable		local data double word	2
	DBD a	0.0 to 65532		data double word	2
	DID a	0.0 to 65532		instance data double word	2
				... in ACCU1-L	
	i [AR1,m]			register-indirect, area-internal (AR1)	2
	i [AR2,m]			register-indirect, area-internal (AR2)	2
	D [AR1,m]			area-crossing (AR1)	2
	D [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2
L				Load ...	
	k8			8bit constant in ACCU1-LL	1
	k16			16bit constant in ACCU1-L	2
	k32			32bit constant in ACCU1	3
	Parameter			Load constant in ACCU1 (addressed via parameters)	2
L	2#n			Load 16bit binary constant in ACCU1-L	2
				Load 32bit binary constant in ACCU1	3
L	B#8#p			Load 8bit hexadecimal constant in ACCU1-LL	1
	W#16#p			Load 16bit hexadecimal constant in ACCU1-L	2
	DW#16#p			Load 32bit hexadecimal constant in ACCU1	3
L	x			Load one character	
L	xx			Load two characters	2
L	xxx			Load three characters	
L	xxxx			Load four characters.	3
L	D# Date			Load IEC-date (BCD-coded)	3
L	S5T# time value			Load time constant (16bit)	2
L	TOD# time value			Load 32bit time constant (IEC-time-of-day)	3
L	T# time			Load 16bit time constant	2
	value			Load 32bit time constant	3
L	C# counter value			Load 16bit counter constant	2
L	P# bit pointer			Load bit pointer	3
L	L# Integer			Load 32bit integer constant	3
L	Real			Load real number	3

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	Status word	Function	Length in words
Load instructions for timer and counter				Load a time or counter value in ACCU1, before the recent content of ACCU1 is saved in ACCU2. The status word is not affected.	
L	T f	0 to 511		Load time value	1/2
	Timer p.			Load time value (addressed via parameters)	2
L	C f	0 to 511		Load counter value	1/2
	Counter p.			Load counter value (addressed via parameters)	2
LD	T f	0 to 511		Load time value BCD-coded	1/2
	Timer p.			Load time value BCD-coded (addressed via parameters)	2
LD	C f	0 to 511		Load counter value BCD-coded	1/2
	Counter p.			Load counter value BCD-coded (addressed via parameters)	2

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Shift instructions

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
Shift instructions			*Status word*									Shifting the contents of ACCU1 and ACCU1-L to the left or right by the specified number of places. If no address identifier is specified, shift the number of places into ACCU2-LL. Any positions that become free are padded with zeros or the sign. The last shifted bit is in condition code bit CC1.	
SLW	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Shift the contents of ACCU1-L to the left	1
SLW	0 ... 15		-	-	-	-	-	-	-	-	-	Positions that become free are provided with zeros	
SLD	-		-	Y	Y	Y	-	-	-	-	-	Shift the contents of ACCU1 to the left	1
SLD	0 ... 32											Positions that become free are provided with zeros	
SRW	-											Shift the contents of ACCU1-L to the right	1
SRW	0 ... 15											Positions that become free are provided with zeros	
SRD	-											Shift the contents of ACCU1 to the right	1
SRD	0 ... 32											Positions that become free are provided with zeros	
SSI	-											Shift the contents of ACCU1-L to the right with sign	1
SSI	0 ... 15											Positions that become free are provided with the sign (bit 15)	
SSD	-											Shift the contents of ACCU1 to the right with sign	1
SSD	0 ... 32												
Rotation instructions			*Status word*									Rotate the contents of ACCU1 to the left or right by the specified number of places. If no address identifier is specified, rotate the number of places into ACCU2-LL.	
RLD	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Rotate the contents of ACCU1 to the left	1
RLD	0 ... 32		-	-	-	-	-	-	-	-	-		
RRD	-		-	Y	Y	Y	-	-	-	-	-	Rotate the contents of ACCU1 to the right	1
RRD	0 ... 32												
RLDA	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Rotate the contents of ACCU1 one bit position to the left,	
			-	-	-	-	-	-	-	-	-	via CC1 bit	
RRDA	-		-	Y	0	0	-	-	-	-	-	Rotate the contents of ACCU1 one bit position to the right,	
												via CC1 bit	

Command	Operand	Parameter	Status word BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC	Function	Length in words
				: Instruction depends on	
				: Instruction influences	

Setting/resetting bit addresses

Set/Reset bit addresses			*Status word*										Assign the value "1" or "0" or the RLO to the addressed instructions.	
S			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		Set ...	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	-		input/output to "1"	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	-	0		set bit memory to "1"	1/2
	L a.b	parameterizable											local data bit to "1"	2
	DBX a.b	0.0 to 65535.7											data bit to "1"	2
	DIX a.b	0.0 to 65535.7											instance data bit to "1"	2
	c [AR1,m]												register-indirect, area-internal (AR1)	2
	c [AR2,m]												register-indirect, area-internal (AR2)	2
	[AR1,m]												area-crossing (AR1)	2
	[AR2,m]												area-crossing (AR2)	2
	Parameter												via parameters	2
R			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		Reset ...	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	-		input/output to "0"	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	-	0		set bit memory to "0"	1/2
	L a.b	parameterizable											local data bit to "0"	2
	DBX a.b	0.0 to 65535.7											data bit to "0"	2
	DIX a.b	0.0 to 65535.7											instance data bit to "0"	2
	c [AR1,m]												register-indirect, area-internal (AR1)	2
	c [AR2,m]												register-indirect, area-internal (AR2)	2
	W [AR1,m]												area-crossing (AR1)	2
	W [AR2,m]												area-crossing (AR2)	2
	Parameter												via parameters	2
=			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		Assign ...	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	-		RLO to input/output	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	-	0		RLO to bit memory	1/2
	L a.b	parameterizable											RLO to local data bit	2
	DBX a.b	0.0 to 65535.7											RLO to data bit	2
	DIX a.b	0.0 to 65535.7											RLO to instance data bit	2
	c [AR1,m]												register-indirect, area-internal (AR1)	2
	c [AR2,m]												register-indirect, area-internal (AR2)	2
	[AR1,m]												area-crossing (AR1)	2
	[AR2,m]												area-crossing (AR2)	2
	Parameter												via parameters	2

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Instructions directly affecting the RLO			*Status word*									The following instructions have a directly effect on the RLO.	
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
CLR			-	-	-	-	-	-	-	-	-	Set RLO to "0"	1
			-	-	-	-	-	0	0	0	0		
SET			-	-	-	-	-	-	-	-	-	Set RLO to "1"	1
			-	-	-	-	-	0	1	1	0		
NOT			-	-	-	-	-	Y	-	Y	-	Negate RLO	1
			-	-	-	-	-	-	1	Y	-		
SAVE			-	-	-	-	-	-	-	Y	-	Save RLO into BR-bit	1
			Y	-	-	-	-	-	-	-	-		

Jump instructions

Jump instructions			*Status word*									Jump, depending on conditions. 8-bit operands have a jump width of (-128...+127), 16-bit operands of (-32768...-129) or (+128...+32767)	
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
JU	LABEL		-	-	-	-	-	-	-	-	-	Jump unconditionally	1/2
			-	-	-	-	-	-	-	-	-		
JC	LABEL											Jump if RLO="1"	1/2
JCN	LABEL		-	-	-	-	-	-	-	Y	-	Jump if RLO="0"	2
			-	-	-	-	-	0	1	1	0		
JCB	LABEL											Jump if RLO="1"	2
			-	-	-	-	-	-	-	Y	-	Save the RLO in the BR-bit	
JNB	LABEL		Y	-	-	-	-	0	1	1	0	Jump if RLO="0"	2
												Save the RLO in the BR-bit	
JBI	LABEL											Jump if BR="1"	2
JNBI	LABEL		Y	-	-	-	-	-	-	-	-	Jump if BR="0"	2
			-	-	-	-	-	0	1	-	0		
JO	LABEL		-	-	-	Y	-	-	-	-	-	Jump on stored overflow (OV="1")	1/2
			-	-	-	-	-	-	-	-	-		
JOS	LABEL		-	-	-	-	Y	-	-	-	-	Jump on stored overflow (OS="1")	2
			-	-	-	-	0	-	-	-	-		

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
JUO	LABEL		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Jump if "unordered instruction" (CC1=1 and CC0=1)	2
JZ	LABEL		-	Y	Y	-	-	-	-	-	-	Jump if result=0 (CC1=0 and CC0=0)	1/2
JP	LABEL		-	-	-	-	-	-	-	-	-	Jump if result>0 (CC1=1 and CC0=0)	1/2
JM	LABEL											Jump if result<0 (CC1=0 and CC0=1)	1/2
JN	LABEL											Jump if result≠0 (CC1=1 and CC0=0) or (CC1=0) and (CC0=1)	1/2
JMZ	LABEL											Jump if result≤0 (CC1=0 and CC0=1) or (CC1=0 and CC0=0)	2
JPZ	LABEL											Jump if result≥0 (CC1=1 and CC0=0) or (CC1=0 and CC0=0)	2
JL	LABEL		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Jump distributor This instruction is followed by a list of jump instructions The operand is a jump label to subsequent instructions in this list. ACCU1-L contains the number of the jump instruction to be executed	2
			-	-	-	-	-	-	-	-	-		
			-	-	-	-	-	-	-	-	-		
LOOP	LABEL											Decrement ACCU1-L and jump if ACCU1-L _ 0 (loop programming)	2

Command	Operand	Parameter	Status word	Function	Length in words
			BR CC1 CC0 OV OS OR STA RLO /FC		
				: Instruction depends on	
				: Instruction influences	

Transfer instructions

Command	Operand	Parameter	Status word	Function	Length in words
Transfer instructions				Transfer the contents of ACCU1 into the addressed operand. The status word is not affected.	
T				Transfer the contents of ACCU1-LL to...	
	IB a	0.0 to 2047		input byte	1/2
	QB a	0.0 to 2047		output byte	1/2
	PQB a	0.0 to 8191		periphery output byte	1/2
	MB a	0.0 to 8191		bit memory byte	1/2
	LB a	parameterizable		local data byte	2
	DBB a	0.0 to 65535		data byte	2
	DIB a	0.0 to 65535		instance data byte	2
	g [AR1,m]			register-indirect, area-internal (AR1)	2
	g [AR2,m]			register-indirect, area-internal (AR2)	2
	B [AR1,m]			area-crossing (AR1)	2
	B [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2
T				Transfer the contents of ACCU1-L to ...	
	IW	0.0 to 2046		input word	1/2
	QW	0.0 to 2046		output word	1/2
	PQW	0.0 to 8190		periphery output word	1/2
	MW	0.0 to 8190		bit memory word	1/2
	LW	parameterizable		local data word	2
	DBW	0.0 to 65534		data word	2
	DIW	0.0 to 65534		instance data word	2
	h [AR1,m]			register-indirect, area-internal (AR1)	2
	h [AR2,m]			register-indirect, area-internal (AR2)	2
	W [AR1,m]			area-crossing (AR1)	2
	W [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2

Command	Operand	Parameter	Status word BR CC1 CC0 OV OS OR STA RLO /FC	Function	Length in words
				: Instruction depends on	
				: Instruction influences	

T				Transfer the contents of ACCU1 to...	
	ID	0.0 to 2044		input double word	1/2
	QD	0.0 to 2044		output double word	1/2
	PQD	0.0 to 8188		periphery output double word	1/2
	MD	0.0 to 8188		bit memory double word	1/2
	LD	parameterizable		local data double word	2
	DBD	0.0 to 65532		data double word	2
	DID	0.0 to 65532		instance data double word	2
	i [AR1,m]			register-indirect, area-internal (AR1)	2
	i [AR2,m]			register-indirect, area-internal (AR2)	2
	D [AR1,m]			area-crossing (AR1)	2
	D [AR2,m]			area-crossing (AR2)	2
	Parameter			via parameters	2
Load and transfer instructions for address register				Load a double word from a memory area or a register into AR1 or AR2.	
LAR1				Load the contents from...	
	-			ACCU1	1
	AR2			address register 2	1
	DBD a	0 to 65532		data double word	2
	DID a	0 to 65532		instance data double word	2
	m			32bit constant as pointer	3
	LD a	parameterizable		local data double word	2
	MD a	0 to 8188		bit memory double word	2
				... into AR1	
LAR2				Load the contents from ...	
	-			ACCU1	1
	DBD a	0 to 65532		data double word	2
	DID a	0 to 65532		instance data double word	2
	m			32bit constant as pointer	3
	LD a	parameterizable		local data double word	2
	MD a	0 to 8188		bit memory double word	2
				... into AR2	
TAR1				Transfer the contents from AR1 to...	
	-			ACCU1	1
	AR2			address register 2	1
	DBD a	0 to 65532		data double word	2
	DID a	0 to 65532		instance data double word	2
	LD a	parameterizable		local data double word	2
	MD a	0 to 8188		bit memory double word	2

Command	Operand	Parameter	Status word BR CC1 CC0 OV OS OR STA RLO /FC	Function	Length in words
				: Instruction depends on : Instruction influences	

Command	Operand	Parameter	Status word	Function	Length in words
TAR2				Transfer the contents from AR2 to...	
	-			ACCU1	1
	DBD a	0 to 65532		data double word	2
	DID a	0 to 65532		instance data double word	2
	LD a	parameterizable		local data double word	2
	MD a	0 to 8188		bit memory double word	2
TAR				Exchange the contents of AR1 and AR2	1
Load and transfer instructions for the status word			*Status word*		
L	STW		BR CC1 CC0 OV OS OR STA RLO /FC	Load status word in ACCU1	
	-		Y Y Y Y Y 0 0 Y 0		
			- - - - - - - - -		
T	STW		BR CC1 CC0 OV OS OR STA RLO /FC	Transfer ACCU1 (bits 0 to 8) into status word	
	-		- - - - - - - - -		
			Y Y Y Y Y - - Y -		
Load instructions for DB number and DB length				Load the number/length of a data block to ACCU1. The old contents of ACCU1 are saved into ACCU2. The condition code bits are not affected	
L	DBNO			Load number of data block	1
L	DINO			Load number of instance data block	1
L	DBLG			Load length of data block into byte	1
L	DILG			Load length of instance data block into byte	1
ACCU transfer instructions, increment, decrement				The status word is not affected.	
CAW	-			Reverse the order of the bytes in ACCU1-L LL, LH becomes LH, LL	1
CAD	-			Reverse the order of the bytes in ACCU1 LL, LH, HL, HH becomes HH, HL, LH, LL	1
TAK	-			Swap the contents of ACCU1 and ACCU2	1
ENT				The contents of ACCU2 and ACCU3 are transferred to ACCU3 and ACCU4	
LEAVE				The contents of ACCU3 and ACCU4 are transferred to ACCU2 and ACCU3	
PUSH	-			The contents of ACCU1, ACCU2 and ACCU3 are transferred to ACCU2, ACCU3 and ACCU4	1
POP	-			The contents of ACCU2, ACCU3 and ACCU4 are transferred to ACCU1, ACCU2 and ACCU3	1
INC	0 ... 255			Increment ACCU1-LL	1
DEC	0 ... 255			Decrement ACCU1-LL	1

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Data type conversion instructions

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
Data type conversion instructions			*Status word*									The results of the conversion are in ACCU1. When converting real numbers, the execution time depends on the value.	
BTI	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Convert contents of ACCU1 from BCD to integer (16bit)	1
			-	-	-	-	-	-	-	-	-	(**B**CD **T**o **I**nt.)	
BTD	-		-	-	-	-	-	-	-	-	-	Convert contents of ACCU1 from BCD to integer (32bit).	1
												(**B**CD **T**o **D**oubleint.)	
DTR	-											Convert cont. of ACCU1 from integer (32bit) to Real number	1
												(32bit) (**D**oubleint. **T**o **R**eal)	
ITD	-											Convert contents of ACCU1 from integer (16bit) to integer	1
												(32bit) (**I**nt. **T**o **D**oubleint	
ITB	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Convert contents of ACCU1 from integer (16bit) to BCD	1
			-	-	-	-	-	-	-	-	-	0 to +/-999 (**I**nt. **T**o **B**CD)	
DTB	-		-	-	-	Y	Y	-	-	-	-	Convert contents of ACCU1 from integer (32bit) to BCD	1
												0 to +/-9 999 999 (**D**oubleint. **T**o **B**CD)	
RND	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Convert a real number to 32bit integer	1
RND-	-		-	-	-	-	-	-	-	-	-	Convert a real number to 32bit integer	1
			-	-	-	Y	Y	-	-	-	-	The number is rounded next hole number	
RND+	-											Convert real number to 32bit integer	1
												It is rounded up to the next integer	
TRUNC	-											Convert real number to 32bit integer	1
												The places after the decimal point are truncated	
Complement creation			*Status word*										
INVI	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Forms the ones complement of ACCU1-L (integer)	1
INVD	-		-	-	-	-	-	-	-	-	-	Forms the ones complement of ACCU1	1
			-	-	-	-	-	-	-	-	-		
NEGI	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Forms the twos complement of ACCU1-L	1
NEGD	-		-	-	-	-	-	-	-	-	-	Forms the twos complement of ACCU1 (double integer)	1
			-	Y	Y	Y	Y	-	-	-	-		

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Comparison instructions

Comparison instructions with integer (16bit)			*Status word*									Comparing the integer (16bit) in ACCU1-L and ACCU2-L. RLO=1, if condition is satisfied.	
==I	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	ACCU2-L=ACCU1-L	1
<>I	-		-	-	-	-	-	-	-	-	-	ACCU2-L≠ACCU1-L	1
<I	-		-	Y	Y	0	-	0	Y	Y	1	ACCU2-L<ACCU1-L	1
<=I	-											ACCU2-L<=ACCU1-L	1
>I	-											ACCU2-L>ACCU1-L	1
>=I	-											ACCU2-L>=ACCU1-L	1
Comparison instructions with integer (32bit)			*Status word*									Comparing the integer (32bit) in ACCU1 and ACCU2. RLO=1, if condition is satisfied.	
==D	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	ACCU2=ACCU1	1
<>D	-		-	-	-	-	-	-	-	-	-	ACCU2≠ACCU1	1
<D	-		-	Y	Y	0	-	0	Y	Y	1	ACCU2<ACCU1	1
<=D	-											ACCU2<=ACCU1	1
>D	-											ACCU2>ACCU1	1
>=D	-											ACCU2>=ACCU1	1
Comparison instructions with 32bit real number			*Status word*									Comparing the 32bit real numbers in ACCU1 and ACCU2. RLO=1, is condition is satisfied. The execution time of the instruction depends on the value to be compared.	
==R	-		BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	ACCU2=ACCU1	1
<>R	-		-	-	-	-	-	-	-	-	-	ACCU2≠ACCU1	1
<R	-		-	Y	Y	Y	Y	0	Y	Y	1	ACCU2<ACCU1	1
<=R	-											ACCU2<=ACCU1	1
>R	-											ACCU2>ACCU1	1
>=R	-											ACCU2>=ACCU1	1

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Combination instructions (Bit)

Combination instructions with bit operands			*Status word*									Examining the signal state of the addressed instruction and gating the result with the RLO according to the appropriate logic function.	
A			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation at signal state "1"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	Y	-	Y	Y	Input/output	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	Y	Y	Y	1	Bit memory	1/2
	L a.b	parameterizable										Local data bit	2
	DBX a.b	0.0 to 65535.7										Data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2
AN			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation of signal state "0"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	Y	-	Y	Y	Input/output	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	Y	Y	Y	1	Bit memory	1/2
	L a.b	parameterizable										Local data bit	2
	DBX a.b	0.0 to 65535.7										Data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2
O			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operation at signal state "1"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	Y	Input/output	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	Y	1	Bit memory	1/2
	L a.b	parameterizable										Local data bit	2
	DBX a.b	0.0 to 65535.7										Data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
ON												OR operation at signal state "0"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	Y	Input/output	1/2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	Y	1	Bit memory	1/2
	L a.b	parameterizable										Local data bit	2
	DBX a.b	0.0 to 65535.7										Data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2
X												EXCLUSIVE-OR operation at signal state "1"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	Y	Input/output	2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	Y	1	Bit memory	2
	L a.b	parametrierbar										Local data bit	2
	DBX a.b	0.0 to 65535.7										data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2
XN												EXCLUSIVE-OR operation at signal state "0"	
	I/Q a.b	0.0 to 2047.7	-	-	-	-	-	-	-	Y	Y	Input/output	2
	M a.b	0.0 to 8191.7	-	-	-	-	-	0	Y	Y	1	Bit memory	2
	L a.b	parameterizable										Local data bit	2
	DBX a.b	0.0 to 65535.7										Data bit	2
	DIX a.b	0.0 to 65535.7										Instance data bit	2
	c [AR1,m]											register-indirect, area-internal (AR1)	2
	c [AR2,m]											register-indirect, area-internal (AR2)	2
	[AR1,m]											area-crossing (AR1)	2
	[AR2,m]											area-crossing (AR2)	2
	Parameter											via parameters	2

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
Combination instructions with parenthetical expressions			*Status word*									Saving the bits BR, RLO, OR and a function ID (A, AN, ...) at the nesting stack. For each block 7 nesting levels are possible.	
A(			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND left parenthesis	1
AN(			Y	-	-	-	-	Y	-	Y	Y	AND-NOT left parenthesis	1
O(			-	-	-	-	-	0	1	-	0	OR left parenthesis	1
ON(												OR-NOT left parenthesis	1
X(												EXCLUSIVE-OR left parenthesis	1
XN(												EXCLUSIVE-OR-NOT left parenthesis	1
)			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Right parenthesis, popping an entry off the nesting stack,	1
			-	-	-	-	-	-	-	Y	-	gating RLO with the current RLO in the processor	
			Y	-	-	-	-	Y	1	Y	1		
ORing of AND operations			*Status word*									The ORing of AND operations is implemented according the rule: AND before OR.	
O			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operations of AND functions according the rule:	1
			-	-	-	-	-	Y	-	Y	Y	AND before OR	
			-	-	-	-	-	Y	1	-	Y		

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Combination instructions with timer and counters			*Status word*									Examining the signal state of the addressed timer/counter an gating the result with the RLO according to the appropriate logic function.	
A			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation at signal state	
	T f	0 to 511	-	-	-	-	-	Y	-	Y	Y	Timer	1/2
	C f	0 to 511	-	-	-	-	-	Y	Y	Y	1	Counter	1/2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	
AN			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation at signal state	
	T f	0 to 511	-	-	-	-	-	Y	-	Y	Y	Timer	1/2
	C f	0 to 511	-	-	-	-	-	Y	Y	Y	1	Counter	1/2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	
O			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operation at signal state	
	T f	0 to 511	-	-	-	-	-	-	-	Y	Y	Timer	1/2
	C f	0 to 511	-	-	-	-	-	0	Y	Y	1	Counter	1/2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	
ON			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operation at signal state	
	T f	0 to 511	-	-	-	-	-	-	-	Y	Y	Timer	1/2
	C f	0 to 511	-	-	-	-	-	0	Y	Y	1	Counter	1/2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	
X			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	EXCLUSIVE-OR operation at signal state	
	T f	0 to 511	-	-	-	-	-	-	-	Y	Y	Timer	2
	C f	0 to 511	-	-	-	-	-	0	Y	Y	1	Counter	2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	
XN			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	EXCLUSIVE-OR operation at signal state	
	T f	0 to 511	-	-	-	-	-	-	-	Y	Y	Timer	2
	C f	0 to 511	-	-	-	-	-	0	Y	Y	1	Counter	2
	Timer p.											Timer addressed via parameters	2
	Counter p.											Counter addressed via parameters	

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Combination instructions using AND, OR and EXCLUSIVE OR			*Status word*									Examining the specified conditions for their signal status, and gating the result with the RLO according to the appropriate function.	
A			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation at signal state "1"	
	==0		Y	Y	Y	Y	Y	Y	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	Y	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=1	1
	BR											BR=1	1
	OV											OV=1	1
AN			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND operation at signal state "0"	
	==0		Y	Y	Y	Y	Y	Y	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	Y	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=0	1
	BR											BR=0	1
	OV											OV=0	1
O			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operation at signal state "1"	
	==0		Y	Y	Y	Y	Y	-	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	0	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=1	1
	BR											BR=1	1
	OV											OV=1	1

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Command	Operand	Parameter	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
ON			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	OR operation at signal state "0"	
	==0		Y	Y	Y	Y	Y	-	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	0	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=0	1
	BR											BR=0	1
	OV											OV=0	1
X			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	EXCLUSIVE-OR operation at signal state "1"	
	==0		Y	Y	Y	Y	Y	-	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	0	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=1	1
	BR											BR=1	1
	OV											OV=1	1
XN			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	EXCLUSIVE-OR operation at signal state "0"	
	==0		Y	Y	Y	Y	Y	-	-	Y	Y	Result=0 (CC1=0) and (CC0=0)	1
	>0		-	-	-	-	-	0	Y	Y	1	Result>0 (CC1=1) and (CC0=0)	1
	<0											Result<0 (CC1=0) and (CC0=1)	1
	<>0											Result≠0 ((CC1=0) and (CC0=1)) or ((CC1=1) and (CC0=0))	1
	<=0											Result<=0 ((CC1=0) and (CC0=1)) or ((CC1=0) and (CC0=0))	1
	>=0											Result>=0 ((CC1=1) and (CC0=0)) or ((CC1=1) and (CC0=0))	1
	UO											unordered (CC1=1) and (CC0=1)	1
	OS											OS=0	1
	BR											BR=0	1
	OV											OV=0	1

Command	Operand	Parameter	Status word									Function	Length in words
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
												: Instruction depends on	
												: Instruction influences	

Combination instructions (Word)

Combination instructions with the contents of ACCU1			*Status word*									Gating the contents of ACCU1 and/or ACCU1-L with a word or double word according to the appropriate function. The word or double word is either a constant in the instruction or in ACCU2. The result is in ACCU1 and/or ACCU1-L.	
AW			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	AND ACCU2-L	1
AW	k16		-	-	-	-	-	-	-	-	-	AND 16bit constant	2
OW			-	Y	0	0	-	-	-	-	-	OR ACCU2-L	1
OW	k16											OR 16bit constant	2
XOW												EXCLUSIVE OR ACCU2-L	1
XOW	k16											EXCLUSIVE OR 16bit constant	2
AD												AND ACCU2	1
AD	k32											AND 32bit constant	3
OD												OR ACCU2	1
OD	k32											OR 32bit constant	3
XOD												EXCLUSIVE OR ACCU2	1
XOD	k32											EXCLUSIVE OR 32bit constant	3

Timer instructions

Time instructions			*Status word*									Starting or resetting a timer (addressed directly or via parameters). The time value must be in ACCU1-L.	
SP	T f	0 to 511	BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Start time as pulse on edge change from "0" to "1"	1/2
	Timer p.		-	-	-	-	-	-	-	Y	-		2
SE	T f	0 to 511	-	-	-	-	-	0	-	-	0	Start timer as extended pulse on edge change from	1/2
	Timer p.											"0" to "1"	2
SD	T f	0 to 511										Start timer as ON delay on edge change	1/2
	Timer p.											from "0" to "1"	2
SS	T f	0 to 511										Start timer as saving start delay on edge change	1/2
	Timer p.											from "0" to "1"	2
SA	T f	0 to 511										Start timer as OFF delay on edge change from	1/2
	Timer p.											"1" to "0"	2
FR	T f	0 to 511										Enable timer for restarting on edge change from "0" to "1"	1/2
	Timer p.											(reset edge bit memory for starting timer)	2
R	T f	0 to 511										Reset timer	1/2
	Timer p.												2

Command	Operand	Parameter	Status word BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC	Function	Length in words
												: Instruction depends on	
												: Instruction influences	

Counter instructions

Counter instructions			*Status word*									The counter value is in ACCU1-L res. in the address transferred as parameter.	
			BR	CC1	CC0	OV	OS	OR	STA	RLO	/FC		
S	C f Counter p.	0 to 511	-	-	-	-	-	-	-	Y	-	Presetting of counter on edge change from "0" to "1"	1/2 2
R	C f Counter p.	0 to 511	-	-	-	-	-	0	-	-	0	Reset counter to "0"	1/2 2
CU	C f Counter p.	0 to 511										Increment counter by 1 on edge change from "0" to "1"	1/2 2
CD	C f Counter p.	0 to 511										Decrement counter by 1 on edge change from "0" to "1"	1/2 2
FR	C f Counter p.	0 to 511										Enable counter on edge change from "0" to "1" (reset the edge bit memory for up and down counting)	1/2 2

Chapter 2 Organization Blocks

Overview

Here the description of the integrated organization blocks of the VIPA SPEED7 CPUs may be found.

The following text describes:

- Overview over the integrated OBs
- Description OBs

Content

Topic

Overview

General

OBs (**O**rganization **b**locks) are the interface between the operating system of the CPU and the user program. For the main program OB 1 is used. There are reserved numbers corresponding to the call event of the other OBs. Organization blocks are executed corresponding to their priority.

OBs are used to execute specific program sections:

- at the startup of the CPU
- in a cyclic or clocked execution
- whenever errors occur
- whenever hardware interrupts occur

Integrated OBs

The following organization blocks (OBs) are available:

OB	Description
OB 1	Main program (cyclic)
OB 10	Time-of-day interrupt
OB 11	Time-of-day interrupt
OB 20	Time-delay interrupt
OB 21	Time-delay interrupt
OB 28	Watchdog interrupt
OB 29	Watchdog interrupt
OB 32	Watchdog interrupt
OB 35	Watchdog interrupt
OB 40	Hardware interrupt
OB 41	Hardware interrupt
OB 57	Manufacturer Specific Interrupt OB
OB 80	Time error (cycle time exceeded or clock alarm run out)
OB 81	Power supply fault
OB 82	Diagnostics interrupt
OB 85	Program execution error (OB not available or Periphery error at update process image)
OB 86	Slave failure / restart)
OB 100	Restart
OB 121	Programming error (synchronous error)
OB 122	Periphery access error

OB 1 - Main program

Description

The operating system of the CPU executes OB 1 cyclically. After STARTUP to RUN the cyclical processing of the OB 1 is started. OB 1 has the lowest priority (priority 1) of each cycle time monitored OB. Within the OB 1 functions and function blocks can be called.

Function

When OB 1 has been executed, the operating system sends global data. Before restarting OB 1, the operating system writes the process-image output table to the output modules, updates the process-image input table and receives any global data for the CPU.

Cycle time

Cycle time is the time required for processing the OB 1. It also includes the scan time for higher priority classes which interrupt the main program respectively communication processes of the operating system. This comprises system control of the cyclic program scanning, process image update and refresh of the time functions.

By means of the Siemens SIMATIC manager the recent cycle time of an online connected CPU may be shown.

With **PLC** > *Module Information* > *Scan cycle time* the min., max. and recent cycle time can be displayed.

Scan cycle monitoring time

The CPU offers a scan cycle watchdog for the *max. cycle time*. The default value for the *max. cycle time* is 150ms as *scan cycle monitoring time*. This value can be reconfigured or restarted by means of the SFC 43 (RE_TRIGR) at every position of your program. If the main program takes longer to scan than the specified *scan cycle monitoring time*, the OB 80 (Timeout) is called by the CPU. If OB 80 has not been programmed, the CPU goes to STOP.

Besides the monitoring of the *max. cycle time* the observance of the *min cycle time* can be guaranteed. Here the restart of a new cycle (writing of process image of the outputs) is delayed by the CPU as long as the *min. cycle time* is reached.

Access to local data

The CPU's operating system forwards start information to OB 1, as it does to every OB, in the first 20 bytes of temporary local data.

The start information can be accessed by means of the system function SFC 6 RD_SINFO. Note that direct reading of the start information for an OB is possible only in that OB because that information consists of temporary local data.

More information can be found at chapter "Integrated standard SFCs".

Local data

The following table describes the start information of the OB 1 with default names of the variables and its data types:

Variable	Type	Description
OB1_EV_CLASS	BYTE	Event class and identifiers: 11h: OB 1 active
OB1_SCAN_1	BYTE	01h: completion of a restart 02h: completion of a hot restart 03h: completion of the main cycle 04h: completion of a cold restart 05h: first OB 1 cycle of the new master CPU after master-reserve switchover and STOP of the previous master
OB1_PRIORITY	BYTE	Priority class: 1
OB1_OB_NUMBR	BYTE	OB number (01)
OB1_RESERVED_1	BYTE	reserved
OB1_RESERVED_2	BYTE	reserved
OB1_PREV_CYCLE	INT	Run time of previous cycle (ms)
OB1_MIN_CYCLE	INT	Minimum cycle time (ms) since the last startup
OB1_MAX_CYCLE	INT	Maximum cycle time (ms) since the last startup
OB1_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

OB 10, OB 11 - Time-of-day Interrupt

Description

Time-of-day interrupts are used when you want to run a program at a particular time, either once only or periodically. Time-of-day interrupts can be configured within the hardware configuration or controlled by means of system functions in your main program at run time.

The prerequisite for proper handling of time-of-day interrupts is a correctly set real-time clock on the CPU.

For execution there are the following intervals:

- once
- every minute
- hourly
- daily
- weekly
- monthly
- once at year
- at the end of each month

Note!
For monthly execution of a time-of-day interrupt OBs, only the day 1, 2, ...28 can be used as a starting date.

Function

To start a time-of-day interrupt, you must first set and than activate the interrupt. The three following start possibilities exist:

- The time-of-day interrupts are configured via the hardware configuration. Open the selected CPU with **Edit** > *Object properties* > *Time-of-Day* interrupts. Here the corresponding time-of-day interrupts may be adjusted and activated. After transmission to CPU and startup the monitoring of time-of-day interrupt is automatically started.
- Set the time-of-day interrupt within the hardware configuration as shown above and then activate it by calling SFC 30 ACT_TINT in your program.
- You set the time-of-day interrupt by calling SFC 28 SET_TINT and then activate it by calling SFC 30 ACT_TINT.

The time-of-day interrupt can be delayed and enabled with the system functions SFC 41 DIS_AIRT and SFC 42 EN_AIRT.

Behavior on error

If a time-of-day interrupt OB is called but was not programmed, the operating system calls OB 85. If OB 85 was not programmed, the CPU goes to STOP. Is there an error at time-of-day interrupt processing e.g. start time has already passed, the time error OB 80 is called. The time-of-day interrupt OB is then executed precisely once.

Possibilities of activation

The possibilities of activation of time-of-day interrupts is shown at the following table:

Interval	Description
Not activated	The time-of-day interrupt is not executed, even when loaded in the CPU. It may be activated by calling SFC 30.
Activated once only	The time-of-day OB is cancelled automatically after it runs the one time specified. Your program can use SFC 28 and SFC 30 to reset and reactivate the OB.
Activated periodically	When the time-of-day interrupt occurs, the CPU calculates the next start time for the time-of-day interrupt based on the current time of day and the period.

Local data for time-of-day interrupt OB

The following table describes the start information of the OB 10 and 11 with default names of the variables and its data types:

Variable	Type	Description
OB10_EV_CLASS	BYTE	Event class and identifiers: 11h: interrupt is active
OB10_STRT_INFO	BYTE	11h: Start request for OB 10 12h: Start request for OB 11
OB10_PRIORITY	BYTE	Assigned priority class: default 2
OB10_OB_NUMBR	BYTE	OB number (10, 11)
OB10_RESERVED_1	BYTE	reserved
OB10_RESERVED_2	BYTE	reserved
OB10_PERIOD_EXE	WORD	The OB is executed at the specified intervals: 0000h: once 0201h: once every minute 0401h: once hourly 1001h: once daily 1201h: once weekly 1401h: once monthly 1801h: once yearly 2001h: end of month
OB10_RESERVED_3	INT	reserved
OB10_RESERVED_4	INT	reserved
OB10_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 20, OB 21 - Time-delay Interrupt

Description

A time-delay interrupt allows you to implement a delay timer independently of the standard timers. The time-delay interrupts can be configured within the hardware configuration respectively controlled by means of system functions in your main program at run time.

Activation

For the activation no hardware configuration is necessary. The time-delay interrupt is started by calling SFC 32 SRT_DINT and by transferring the corresponding OB to the CPU. Here the function needs OB no., delay time and a sign. When the delay interval has expired, the respective OB is called by the operating system. The time-delay interrupt that is just not activated can be cancelled with SFC 33 CAN_DINT respectively by means of the SFC 34 QRY_DINT the status can be queried. It can be blocked with SFC 39 DIS_IRT and released with SFC 40 EN_IRT. More information for using the SFCs can be found at chapter "Integrated standard SFCs".

The priority of the corresponding OBs are changed via the hardware configuration. For this open the selected CPU with **Edit** > *Object properties* > *Interrupts*. Here the corresponding priority can be adjusted.

Behavior on error

If a time-delay interrupt OB is called but was not programmed, the operating system calls OB 85. If OB 85 was not programmed, the CPU goes to STOP. Is there an error at time-delay interrupt processing e.g. delay interval has expired and the associated OB is still executing, the time error OB 80 is called. The time-of-day interrupt OB is then executed. If there is no OB 80 in the user program the CPU goes to STOP

Local data

The following table describes the start information of the OB 20 and 21 with default names of the variables and its data types:

Variable	Type	Description
OB20_EV_CLASS	BYTE	Event class and identifiers: 11h: interrupt is active
OB20_STRT_INF	BYTE	21h: start request for OB 20 22h: start request for OB 21
OB20_PRIORITY	BYTE	assigned priority class: Default 3 (OB 20), 4 (OB 21)
OB20_OB_NUMBR	BYTE	OB number (20, 21)
OB20_RESERVED_1	BYTE	reserved
OB20_RESERVED_2	BYTE	reserved
OB20_SIGN	WORD	User ID: input parameter SIGN from the call for SFC 32 (SRT_DINT)
OB20_DTIME	TIME	Configured delay time in ms
OB20_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 28, 29, 32, 33, 34, 35 - Watchdog Interrupt

Description

By means of a watchdog interrupt the cyclical processing can be interrupted in equidistant time intervals The start time of the time interval and the phase offset is the instant of transition from STARTUP to RUN after execution of OB 100.

Watchdog interrupt OB	Default time interval	Default priority class	Option for phase offset
OB 28	250µs	24	no*
OB 29	500µs	24	no*
OB 32	1s	09	yes
OB 33	500ms	10	yes
OB 34	200ms	11	yes
OB 35	100ms	12	yes

*) If both OBs are activated OB 28 is executed first and then OB 29. Due to the very short time intervals and the high priority a simultaneous execution of OB 28 and OB 29 should be avoided.

Activation

A watchdog interrupt is activated by programming the corresponding OB within the CPU.

The watchdog interrupt can be delayed and enabled with the system functions SFC 41 DIS_AIRT and SFC 42 EN_AIRT.

Function

After startup to RUN the activated watchdog OBs are called in the configured equidistant intervals with consideration of the phase shift.

The equidistant start times of the Watchdog OBs result of the respective time frame and the phase shift.

So a sub program can be called time controlled by programming a respective OB.

Phase offset

The phase offset can be used to stagger the execution of watchdog interrupt handling routines despite the fact that these routines are timed to a multiple of the same interval. The use of the phase offset achieves a higher interval accuracy.

The start time of the time interval and the phase offset is the instant of transition from STARTUP to RUN. The call instant for a watchdog interrupt OB is thus the time interval plus the phase offset.

Parameterization

Time interval, phase offset (not OB 28, 29) and priority may be parameterized by the hardware configurator. Depending on the OB there are the following possibilities for parameterization:

OB 28, 29, 33, 34: Parameterizable as VIPA specific parameter by the properties of the SPEED7 CPU.

OB 32, 35: Parameterizable by Siemens CPU 318-2DP.

Note!
You must make sure that the run time of each cyclic interrupt OB is significantly shorter than its interval. Otherwise the time error OB 80 is started. The watchdog interrupt that caused the error is executed later.

Local data

The following table describes the start information of the OB 28, 29, 32 and 35 with default names of the variables and its data types:

Variable	Type	Description
OB35_EV_CLASS	BYTE	Event class and identifiers: 11h: Cyclic interrupt is active
OB35_STRT_INF	BYTE	2Fh: Start request for OB 28 30h: Start request for OB 29 33h: Start request for OB 32 36h: Start request for OB 35
OB35_PRIORITY	BYTE	Assigned priority class; Defaults: 24 (OB28, 29); 9 (OB32), 12 (OB35)
OB35_OB_NUMBR	BYTE	OB number (28, 29, 32, 35)
OB35_RESERVED_1	BYTE	reserved
OB35_RESERVED_2	BYTE	reserved
OB35_PHASE_OFFSET	WORD	Phase offset in ms
OB35_RESERVED_3	INT	reserved
OB35_EXT_FREQ	INT	Interval in ms
OB35_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 40, OB 41 - Hardware Interrupt

Description

Hardware interrupts are used to enable the immediate detection in the user program of events in the controlled process, making it possible to respond with an appropriate interrupt handling routine. Here OB 41 and OB 42 can be used.

Within the configuration you specify for each module, which channels release a hardware interrupt during which conditions. With the system functions SFC 55 WR_PARM, SFC 56 WR_DPARM and SFC 57 PARM_MOD you can (re)parameterize the modules with hardware interrupt capability even in RUN.

Activation

The hardware interrupt processing of the CPU is always active. So that a module can release a hardware interrupt, you have to activate the hard-ware interrupt on the appropriate module by a hardware configuration.

Here you can specify whether the hardware interrupt should be generated for a coming event, a leaving event or both.

Function

After a hardware interrupt has been triggered by the module, the operating system identifies the slot and the corresponding hardware interrupt OB. If this OB has a higher priority than the currently active priority class, it will be started. The channel-specific acknowledgement is sent after this hardware interrupt OB has been executed.

If another event that triggers a hardware interrupt occurs on the same module during the time between identification and acknowledgement of a hardware interrupt, the following applies:

- If the event occurs on the channel that previously triggered the hardware interrupt, then the new interrupt is lost.
- If the event occurs on another channel of the same module, then no hardware interrupt can currently be triggered. This interrupt, however, is not lost, but is triggered if just active after the acknowledgement of the currently active hardware interrupt. Else it is lost.
- If a hardware interrupt is triggered and its OB is currently active due to a hardware interrupt from another module, the new request can be processed only if it is still active after acknowledgement.

During STARTUP there is no hardware interrupt produced. The treatment of interrupts starts with the transition to operating mode RUN. Hardware interrupts during transition to RUN are lost.

Behavior on error

If a hardware interrupt is generated for which there is no hardware interrupt OB in the user program, OB 85 is called by the operating system. The hardware interrupt is acknowledged. If OB 85 has not been programmed, the CPU goes to STOP.

Diagnostic interrupt

While the treatment of a hardware interrupt a diagnostic interrupt can be released. Is there, during the time of releasing the hardware interrupt up to its acknowledgement, on the same channel a further hardware interrupt, the loss of the hardware interrupt is announced by means of a diagnostic interrupt for system diagnostics.

Local data

The following table describes the start information of the OB 40 and 41 with default names of the variables and its data types:

Variable	Type	Description
OB40_EV_CLASS	BYTE	Event class and identifiers: 11h: Interrupt is active
OB40_STRT_INF	BYTE	41h: Interrupt via Interrupt line 1
OB40_PRIORITY	BYTE	Assigned priority class: Default: 16 (OB 40) Default: 17 (OB 41)
OB40_OB_NUMBR	BYTE	OB number (40, 41)
OB40_RESERVED_1	BYTE	reserved
OB40_IO_FLAG	BYTE	Input Module: 54h Output Module: 55h
OB40_MDL_ADDR	WORD	Logical base address of the module that triggers the interrupt
OB40_POINT_ADDR	DWORD	For digital modules: bit field with the statuses of the inputs on the module (Bit 0 corresponds to the first input). For analog modules: bit field, informing which channel has exceeded which limit. For CPs or IMs: Module interrupt status (not user relevant)
OB40_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 57 - Manufacturer Specific Interrupt OB

Description

The OB 57 is called by the operating system of the CPU if an manufacturer specific interrupt was triggered via the slot of a CAN slave.

Local data

The following table describes the start information of the OB 57 with default names of the variables and its data types:

Variable	Data type	Description
OB57_EV_CLASS	BYTE	Event class and identifiers: 11h: incoming event
OB57_STRT_INF	BYTE	57h: Start request for OB 57
OB57_PRIORITY	BYTE	Configured priority class: Default value: 2
OB57_OB_NUMBR	BYTE	OB number (57)
OB57_RESERVED_1	BYTE	reserved
OB57_IO_FLAG	BYTE	Input module 54h Output module 55h
OB57_MDL_ADDR	WORD	Logical base address of the module that triggers the interrupt
OB57_LEN	BYTE	reserved
OB57_TYPE	BYTE	reserved
OB57_SLOT	BYTE	reserved
OB57_SPEC	BYTE	reserved
OB57_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

OB 80 - Time Error

Description

The operating system of the CPU calls OB 80 whenever an error occurs like:

- Cycle monitoring time exceeded
- OB request error i.e. the requested OB is still executed or an OB was requested too frequently within a given priority class.
- Time-of-day interrupt error i.e. interrupt time past because clock was set forward or after transition to RUN.

The time error OB can be blocked, respectively delayed and released by means of SFC 39 ... 42.

Note!

If OB 80 has not been programmed, the CPU changes to the STOP mode.

If OB 80 is called twice during the same scan cycle due to the scan time being exceeded, the CPU changes to the STOP mode. You can prevent this by calling SFC 43 RE_TRIGR at a suitable point in the program.

Local data

The following table describes the start information of the OB 80 with default names of the variables and its data types:

Variable	Type	Description
OB80_EV_CLASS	BYTE	Event class and identifiers: 35h
OB80_FLT_ID	BYTE	Error code (possible values: 01h, 02h, 05h, 06h, 07h, 08h, 09h, 0Ah)
OB80_PRIORITY	BYTE	Priority class: 26 (RUN mode) 28 (Overflow of the OB request buffer)
OB80_OB_NUMBR	BYTE	OB number (80)
OB80_RESERVED_1	BYTE	reserved
OB80_RESERVED_2	BYTE	reserved
OB80_ERROR_INFO	WORD	Error information: depending on error code
OB80_ERR_EV_CLASS	BYTE	Event class for the start event that caused the error
OB80_ERR_EV_NUM	BYTE	Event number for the start event that caused the error
OB80_OB_PRIORITY	BYTE	Error information: depending on error code
OB80_OB_NUM	BYTE	Error information: depending on error code
OB80_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

Variables depending on error code

The variables dependent on the error code have the following allocation:

Error code	Variable	Bit	Meaning
01h			*Cycle time exceeded*
	OB80_ERROR_INFO		Run time of last scan cycle (ms)
	OB80_ERR_EV_CLASS		Class of the event that triggered the interrupt
	OB80_ERR_EV_NUM		Number of the event that triggered the interrupt
	OB80_OB_PRIORITY		Priority class of the OB which was being executed when the error occurred
	OB80_OB_NUM		Number of the OB which was being executed when the error occurred
02h			*The called OB is still being executed*
	OB80_ERROR_INFO		The respective temporary variable of the called block which is determined by
			OB80_ERR_EV_CLASS and
			OB80_ERR_EV_NUM
	OB80_ERR_EV_CLASS		Class of the event that triggered the interrupt
	OB80_ERR_EV_NUM		Number of the event that triggered the interrupt
	OB80_OB_PRIORITY		Priority class of the OB causing the error
	OB80_OB_NUM		Number of the OB causing the error
05h and 06h			*Elapsed time-of-day interrupt due to moving the clock forward*
			Elapsed time-of-day interrupt on return to RUN after HOLD
	OB80_ERROR_INFO	Bit 0 = "1"	The start time for time-of-day interrupt 0 is in the past
		...	...
		Bit 7 = "1"	The start time for time-of-day interrupt 7 is in the past
		Bit 15 ... 8	Not used
	OB80_ERR_EV_CLASS		Not used
	OB80_ERR_EV_NUM		Not used
	OB80_OB_PRIORITY		Not used
	OB80_OB_NUM		Not used

continued ...

... continue error code

Error code	Variable	Bit	Meaning
07h	meaning of the parameters see error code 02h		*Overflow of OB request buffer for the current priority class* (Each OB start request for a priority class will be entered in the corresponding OB request buffer; after completion of the OB the entry will be deleted. If there are more OB start requests for a priority class than the maximum permitted number of entries in the corresponding Ob request buffer OB 80 will be called with error code 07h)
08h			*Synchronous-cycle interrupt time error*
09h			*Interrupt loss due to high interrupt load*
0Ah	OB80_ERROR_INFO		*Resume RUN after CiR (**C**onfiguration **i**n **R**UN)* CiR synchronizations time in ms

OB 81 - Power supply Error

Description

The operating system of the CPU calls OB 81 whenever an event occurs that is triggered by an error or fault related to the power supply (when entering and when outgoing event).

The CPU does not change to the STOP mode if OB 81 is not programmed.

You can disable or delay and re-enable the power supply error OB using SFCs 39 to 42.

Local Data

The following table describes the start information of the OB 81 with default names of the variables and its data types:

Variable	Data type	Description
OB81_EV_CLASS	BYTE	Event class and identifiers: 39h: incoming event
OB81_FLT_ID	BYTE	Error code: 22h: Back-up voltage missing
OB81_PRIORITY	BYTE	Priority class: 28 (mode STARTUP)
OB81_OB_NUMBR	BYTE	OB-NR. (81)
OB81_RESERVED_1	BYTE	reserved
OB81_RESERVED_2	BYTE	reserved
OB81_RACK_CPU	WORD	Bit 2 ... 0: 000 (Rack number) Bit 3: 1 (master CPU) Bit 7 ... 4: 1111 (fix)
OB81_RESERVED_3	BYTE	reserved
OB81_RESERVED_4	BYTE	reserved
OB81_RESERVED_5	BYTE	reserved
OB81_RESERVED_6	BYTE	reserved
OB80_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 82 - Diagnostic Interrupt

Description

The system diagnostic is the detection, evaluation and reporting of messages which occur within a PLC system. Examples of errors for these messages could be errors in the user program, module failures or wire breaks on signaling modules.

If a module with diagnostic capability for which you have enabled the diagnostic interrupt detects an error, it outputs a request for a diagnostic interrupt to the CPU (when entering and outgoing event). The operating system then calls OB82.

The local variables of OB82 contain the logical base address as well as four bytes of diagnostic data of the defective module.

If OB82 has not been programmed, the CPU changes to the STOP mode.

You can delay and re-enable the diagnostic interrupt OB using SFC 41 DIS_AIRT and SFC 42 EN_AIRT.

Diagnostic in ring buffer

All diagnostic events reported to the CPU operating system are entered in the diagnostic buffer in the order in which they occurred, and with date and time stamp. This is a buffered memory area on the CPU that retains its contents even in the event of a memory reset.

The diagnostic buffer is a ring buffer with. VIPA CPUs offer space for 100 entries. When the diagnostic buffer is full, the oldest entry is overwritten by the newest. By use of the *PLC functions* of the Siemens SIMATIC manager the diagnostic buffer can be queried.

Besides of the standard entries in the diagnostic buffer, the VIPA CPUs support some additional specific entries in form of event-IDs. More information may be found at the manual of the CPU at the chapter "Deployment of the CPU ..." at "VIPA specific diagnostic entries".

Configurable Diagnostics

Programmable diagnostic events are reported only when you have set the parameters necessary to enable diagnostics. Non-programmable diagnostics events are always reported, regardless of whether or not diagnostics have been enabled.

Write diagnostics user entry with SFC

A diagnostic entry can be written to the diagnostic buffer by means of the system function SFC 52 WR_USMSG.

More information can be found at chapter "Integrated standard SFCs".

Read diagnostic data with SFC 59

You can use system function SFC 59 RD_REC (read data record) in OB 82 to obtain detailed error information. The diagnostic information are consistent until OB 82 is exited, that is, they remain "frozen". Exiting of OB 82 acknowledges the diagnostic interrupt on the module.

The module's diagnostic data is in data records DS 0 and DS 1. The data record DS 0 contains 4 byte of diagnostic data describing the current status of the module. The contents of these 4 byte are identical to the contents of byte 8 to 11 of the OB 82 start information

Data record DS 1 contains the 4 byte from data record DS 0 and, in addition, the module specific diagnostic data.

More information about module specific diagnostic data can be found at the description of the appropriate module.

Local data

The following table describes the start information of the OB 82 with default names of the variables and its data types:

Variable	Type	Description
OB82_EV_CLASS	BYTE	Event class and identifiers: 38h: outgoing event 39h: incoming event
OB82_FLT_ID	BYTE	Error code (42h)
OB82_PRIORITY	BYTE	Priority class: can be assigned via hardware configuration
OB82_OB_NUMBR	BYTE	OB number (82)
OB82_RESERVED_1	BYTE	reserved
OB82_IO_FLAG	BYTE	Input Module 54h Output Module 55h
OB82_MDL_ADDR	INT	Logical base address of the module where the fault occurred
OB82_MDL_DEFECT	BOOL	Module is defective
OB82_INT_FAULT	BOOL	Internal fault
OB82_EXT_FAULT	BOOL	External fault
OB82_PNT_INFO	BOOL	Channel fault
OB82_EXT_VOLTAGE	BOOL	External voltage failed
OB82_FLD_CONNCTR	BOOL	Front panel connector not plugged in
OB82_NO_CONFIG	BOOL	Module is not configured
OB82_CONFIG_ERR	BOOL	Incorrect parameters on module
OB82_MDL_TYPE	BYTE	Bit 3 ... 0: Module class Bit 4: Channel information exists Bit 5: User information exists Bit 6: Diagnostic interrupt from substitute Bit 7: Reserved
OB82_SUB_MDL_ERR	BOOL	Submodule is missing or has an error
OB82_COMM_FAULT	BOOL	Communication failure
OB82_MDL_STOP	BOOL	Operating mode (0: RUN, 1:STOP)
OB82_WTCH_DOG_FLT	BOOL	Watchdog timer responded
OB82_INT_PS_FLT	BOOL	Internal power supply failed
OB82_PRIM_BATT_FLT	BOOL	Battery exhausted
OB82_BCKUP_BATT_FLT	BOOL	Entire backup failed
OB82_RESERVED_2	BOOL	Reserved
OB82_RACK_FLT	BOOL	Expansion rack failure
OB82_PROC_FLT	BOOL	Processor failure
OB82_EPROM_FLT	BOOL	EPROM fault
OB82_RAM_FLT	BOOL	RAM fault
OB82_ADU_FLT	BOOL	ADC/DAC error
OB82_FUSE_FLT	BOOL	Fuse tripped
OB82_HW_INTR_FLT	BOOL	Hardware interrupt lost
OB82_RESERVED_3	BOOL	Reserved
OB82_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 85 - Program execution Error

Description

The operating system of the CPU calls OB 85 whenever one of the following events occurs:

- Start event for an OB that has not been loaded
- Error when the operating system accesses a block
- I/O access error during update of the process image by the system (if the OB 85 call was not suppressed due to the configuration)

The OB 85 may be delayed by means of the SFC 41 and re-enabled by the SFC 42.

Note!

If OB 85 has not been programmed, the CPU changes to STOP mode when one of these events is detected.

Local data

The following table describes the start information of the OB 85 with default names of the variables and its data types:

Variable	Type	Description
OB85_EV_CLASS	BYTE	Event class and identifiers: 35h 38h (only with error code B3h, B4h) 39h (only with error code B1h, B2h, B3h, B4h)
OB85_FLT_ID	BYTE	Error code (possible values: A1h, A2h, A3h, A4h, B1h, B2h, B3h, B4h)
OB85_PRIORITY	BYTE	Priority class: 26 (Default value mode RUN) 28 (mode ANLAUF)
OB85_OB_NUMBR	BYTE	OB number (85)
OB85_RESERVED_1	BYTE	reserved
OB85_RESERVED_2	BYTE	reserved
OB85_RESERVED_3	INT	reserved
OB85_ERR_EV_CLASS	BYTE	Class of the event that caused the error
OB85_ERR_EV_NUM	BYTE	Number of the event that caused the error
OB85_OB_PRIOR	BYTE	Priority class of the OB that was active when the error occurred
OB85_OB_NUM	BYTE	Number of the OB that was active when the error occurred
OB85_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 85 dependent on error codes

If you want to program OB 85 dependent on the possible error codes, we recommend that you organize the local variables as follows:

Variable	Type
OB85_EV_CLASS	BYTE
OB85_FLT_ID	BYTE
OB85_PRIORITY	BYTE
OB85_OB_NUMBR	BYTE
OB85_DKZ23	BYTE
OB85_RESERVED_2	BYTE
OB85_Z1	WORD
OB85_Z23	DWORD
OB85_DATE_TIME	DATE_AND_TIME

The following table shows the event that started OB 85:

OB85_EV_CLASS	OB85_FLT_ID	Variable	Meaning
35h	A1h A2h		As a result of your configuration your program or the operating system creates a start event for an OB that is not loaded on the CPU.
	A1h or A2h	OB85_Z1	The respective local variable of the called OB that is determined by OB85_Z23.
	A1h or A2h	OB85_Z23	high word: Class and number of the event causing the OB call low word, high byte: Program level and OB active at the time of error low word, low byte: Active OB
35h	A3h		Eror when the operating system accesses a module
		OB85_Z1	Error ID of the operating system high byte: 1: Integrated function 2: IEC-Timer low byte: 0: no error resolution 1: block not loaded 2: area length error 3: write-protect error

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OB85_EV_CLASS	OB85_FLT_ID	Variable	Meaning
		OB85_Z23	high word: block number low word: Relative address of the MC7 command causing the error. The block type must be taken from OB85_DKZ23. (88h: OB, 8Ch: FC, 8Eh: FB, 8Ah: DB)
35h	A4h		PROFInet Interface DB cannot be addressed
34h	A4h		PROFInet Interface DB can be addressed again
39h	B1h		I/O access error when updating the process image of the inputs
	B2h		I/O access error when transferring the output process image to the output modules
	B1h or B2h	OB85_DKZ23	ID of the type of process image transfer where the I/O access error happened. 10: Byte access 20: Word access 30: DWord access 57h: Transmitting a configured consistency range
	B1h or B2h	OB85_Z1	reserved for internal use by the CPU: logical base address of the module If OB85_RESERVED_2 has the value 76h OB85_Z1 receives the return value of the affected SFC
	B1h or B2h	OB85_Z23	Byte 0: Part process image number Byte 1: Irrelevant, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57: Length of the consistency range in bytes Byte 2, 3 The I/O address causing the PII, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57: Logical start address of the consistency range
You obtain the error codes B1h and B2h if you have configured the repeated OB 85 call of I/O access errors for the system process image table update.			

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OB85_EV_CLASS	OB85_FLT_ID	Variable	Meaning
38h, 39h	B3h		I/O access error when updating the process image of the inputs, incoming/outgoing event
38h, 39h	B4h		I/O access error when updating the process image of the outputs, incoming/outgoing event
	B3h B4h	OB85_DKZ23	ID of the type of process image transfer during which the I/O access error has occurred 10: Byte access 20: Word access 30: DWord access 57h: Transmitting a configured consistency range
	B3h B4h	OB85_Z1	Reserved for internal use by the CPU: logical base address of the module If OB85_RESERVED_2 has the value 76h OB85_Z1 receives the return value of the affected SFC
	B3h B4h	OB85_Z23	Byte 0: Part process image number Byte 1: Irrelevant, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57: Length of the consistency range in bytes Byte 2, 3 The I/O address causing the PII, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57: Logical start address of the consistency range
You obtain the error codes B3h or B4h, if you configured the OB 85 call of I/O access errors entering and outgoing event for process image table updating by the system. After a restart, all access to non-existing inputs and outputs will be reported as I/O access errors during the next process table updating.			

OB 86 - Slave Failure / Restart

Description

The operating system of the CPU calls OB 86 whenever the failure of a slave is detected (both when entering and outgoing event).

Note!

If OB 86 has not been programmed, the CPU changes to the STOP mode when this type of error is detected.

The OB 86 may be delayed by means of the SFC 41 and re-enabled by the SFC 42.

Local data

The following table describes the start information of the OB 86 with default names of the variables and its data types:

Variable	Type	Description
OB86_EV_CLASS	BYTE	Event class and identifiers: 38h: outgoing event 39h: incoming event
OB86_FLT_ID	BYTE	Error code: (possible values: C4h, C5h, C7h, C8h)
OB86_PRIORITY	BYTE	Priority class: may be assigned via hardware configuration
OB86_OB_NUMBR	BYTE	OB number (86)
OB86_RESERVED_1	BYTE	reserved
OB86_RESERVED_2	BYTE	reserved
OB86_MDL_ADDR	WORD	Depends on the error code
OB86_RACKS_FLTD	ARRAY (0 ... 31) OF BOOL	Depends on the error code
OB86_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

OB 86 depending on error codes

If you want to program OB 86 dependent on the possible error codes, we recommend that you organize the local variables as follows:

Variable	Type
OB86_EV_CLASS	BYTE
OB86_FLT_ID	BYTE
OB86_PRIORITY	BYTE
OB86_OB_NUMBR	BYTE
OB86_RESERVED_1	BYTE
OB86_RESERVED_2	BYTE
OB86_MDL_ADDR	WORD
OB86_Z23	DWORD
OB86_DATE_TIME	DATE_AND_TIME

The following table shows the event started OB 86:

EV_CLASS	FLT_ID	Variable		Meaning
39h, 38h	C4h			Failure of a DP station
	C5h			Fault in a DP station
		OB86_MDL_ADDR		Logical base address of the DP master
		OB86_Z23		Address of the affected DP slave:
			Bit 7... 0	Number of the DP station
			Bit 15... 8	DP master system ID
			Bit 30... 16	Logical base address of the DP slave
			Bit 31	I/O identifier
38h	C7h			Return of a DP station, but error in module parameter assignment
		OB86_MDL_ADDR		Logical base address of the DP master
		OB86_Z23		Address of the DP slaves affected:
			Bit 7... 0	Number of the DP station
			Bit 15... 8	DP master system ID
			Bit 30... 16	Logical base address of the DP slave
			Bit 31	I/O identifier
	C8h			Return of a DP station, however discrepancy in configured and actual configuration
		OB86_MDL_ADDR		Logical base address of the DP master
		OB86_Z23		Address of the DP slaves affected:
			Bit 7... 0	Number of the DP station
			Bit 15... 8	DP master system ID
			Bit 30... 16	Logical base address of the DP slave
			Bit 31	I/O identifier

OB 100 - Reboot

Description

On a restart, the CPU sets both itself and the modules to the programmed initial state, deletes all not-latching data in the system memory, calls OB 100 and then executes the main program in OB 1.

Here the current program and the current data blocks generated by SFC remain in memory.

The CPU executes a startup with OB 100 as follows:

- after POWER ON and operating switch in RUN
- whenever you switch the mode selector from STOP to RUN
- after a request using a communication function (menu command from the programming device)

Even if no OB 100 is loaded into the CPU, the CPU goes to RUN without an error message.

Local data

The following table describes the start information of the OB 100 with default names of the variables and its data types:

Variable	Type	Description
OB100_EV_CLASS	BYTE	Event class and identifiers: 13h: active
OB100_STRTUP	BYTE	Startup request 81h: Manuel restart 82h: Automatic restart
OB100_PRIORITY	BYTE	Priority class: 27
OB100_OB_NUMBR	BYTE	OB number (100)
OB100_RESERVED_1	BYTE	reserved
OB100_RESERVED_2	BYTE	reserved
OB100_STOP	WORD	Number of the event that caused the CPU to STOP
OB100_STRT_INFO	DWORD	Supplementary information about the current startup (see next page)
OB100_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

Allocation OB100_STR_INFO

The following table shows the allocation of OB100_STR_INFO variables:

Bit-No.	Meaning	Possible values (binary)	Explanation
31 - 24	Startup information	xxxx xxx0	No difference between expected and actual configuration
		xxxx xxx1	Difference between expected and actual configuration
		xxxx 0xxx	Clock for time stamp not battery-backed at last POWER ON
		xxxx 1xxx	Clock for time stamp battery-backed at last POWER ON
23 - 16	Startup just completed	0000 0011	Restart triggered with mode selector
		0000 0100	Restart triggered by command via MPI
		0001 0000	Automatic restart after battery-backed POWER ON
		0001 0011	Restart triggered with mode selector; last POWER ON battery-backed
		0001 0100	Restart triggered by command via MPI; last POWER ON battery-backed
		0010 0000	Automatic restart battery-backed POWER ON (with memory reset by system)
		0010 0011	Restart triggered with mode selector last POWER ON not battery-backed
		0010 0100	Restart triggered by command via MPI last POWER ON not battery-backed
15 - 12	Permissibility of automatic startup	0000	Automatic startup illegal, memory request requested
		0001	Automatic startup illegal, parameter modifications, etc. necessary
		0111	Automatic startup permitted
11 - 8	Permissibility of manual startup	0000	Manual startup illegal, memory request requested
		0001	Manual startup illegal, parameter modifications, etc. necessary
		0111	Manual startup permitted
7 - 0	Last valid intervention or setting of the automatic startup at POWER ON	0000 0000	No startup
		0000 0011	Restart triggered with mode selector
		0000 0100	Restart triggered by command via MPI
		0001 0000	Automatic restart after battery-backed POWER ON
		0001 0011	Restart triggered with mode selector; last POWER ON battery-backed
		0001 0100	Restart triggered by command via MPI; last POWER ON battery-backed
		0010 0000	Automatic restart after battery-backed POWER ON (with memory reset by system)
		0010 0011	Restart triggered with mode selector last POWER ON not battery-backed
		1010 0000	Restart triggered by command via MPI last POWER ON not battery-backed

OB 121 - Programming Error (Synchronous error)

Description

The operating system of the CPU calls OB 121 whenever an event occurs that is caused by an error related to the processing of the program. If OB 121 is not programmed, the CPU changes to STOP. For example, if your program calls a block that has not been loaded on the CPU, OB 121 is called.

OB 121 is executed in the same priority class as the interrupted block. So you have read/write access to the registers of the interrupted block.

Masking of start events

The CPU provides the following SFCs for masking and unmasking start events for OB 121 during the execution of your program:

- SFC 36 MSK_FLT masks specific error codes.
- SFC 37 DMSK_FLT unmasks the error codes that were masked by SFC 36.
- SFC 38 READ_ERR reads the error register.

Local data

The following table describes the start information of the OB 121 with default names of the variables and its data types:

Variable	Data type	Description
OB121_EV_CLASS	BYTE	Event class and identifiers: 25h
OB121_SW_FLT	BYTE	Error code (see next page)
OB121_PRIORITY	BYTE	Priority class: priority class of the OB in which the error occurred.
OB121_OB_NUMBR	BYTE	OB number (121)
OB121_BLK_TYPE	BYTE	Type of block where the error occurred 88h: OB, 8Ah: DB, 8Ch: FC, 8Eh: FB
OB121_RESEVED_1	BYTE	reserved (Data area and access type)
OB121_FLT_REG	WORD	Source of the error (depends on error code). For example: • Register where the conversation error occurred • Incorrect address (read/write error) • Incorrect timer/counter/block number • Incorrect memory area
OB121_BLK_NUM	WORD	Number of the block with command that caused the error.
OB121_PRG_ADDR	WORD	Relative address of the command that caused the error.
OB121_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called.

Information to access the local data can be found at the description of the OB 1.

Error codes The variables dependent on the error code have the following meaning:

Error code	Variable	Meaning
21h	OB121_FLT_REG:	BCD conversion error ID for the register concerned (0000h: accumulator 1)
22h 23h 28h 29h	OB121_RESERVED_1	Area length error when reading Area length error when writing Read access to a byte, word or double word with a pointer whose bit address is not 0. Write access to a byte, word or double word with a pointer whose bit address is not 0. Incorrect byte address. The data area and access type can be read from OB121_RESERVED_1. Bit 3 ... 0 memory area: 0: I/O area 1: process-image input table 2: process-image output table 3: bit memory 4: global DB 5: instance DB 6: own local data 7: local data of caller Bit 7 ... 4 access type: 0: bit access 1: byte access 2: word access 3: double word access
24h 25h	OB121_FLT_REG	Range error when reading Range error when writing Contains the ID of the illegal area in the low byte (86h of own local data area)
26h 27h	OB121_FLT_REG	Error for timer number Error for counter number Illegal number

continued ...

... continue

Error code	Variable	Meaning
30h		Write access to a write-protected global DB
31h		Write access to a write-protected instance DB
32h		DB number error accessing a global DB
33h		DB number error accessing an instance DB
	OB121_FLT_REG	Illegal DB number
34h		FC number error in FC call
35h		FB number error in FB call
3Ah		Access to a DB that has not been loaded; the DB number is in the permitted range
3Ch		Access to an FC that has not been loaded; the FC number is in the permitted range
3Dh		Access to an SFC that has not been loaded; the SFC number is in the permitted range
3Eh		Access to an FB that has not been loaded; the FB number is in the permitted range
3Fh		Access to an SFB that has not been loaded; the SFB number is in the permitted range
	OB121_FLT_REG	Illegal DB number

OB 122 - Periphery access Error

Description

The operating system of the CPU calls OB 122 whenever an error occurs while accessing data on a module. For example, if the CPU detects a read error when accessing data on an I/O module, the operating system calls OB 122. If OB 122 is not programmed, the CPU changes from the RUN mode to the STOP mode.

OB 122 is executed in the same priority class as the interrupted block. So you have read/write access to the registers of the interrupted block.

Masking of start events

The CPU provides the following SFCs for masking and unmasking start events for OB 122:

- SFC 36 MASK_FLT masks specific error codes
- SFC 37 DMASK_FLT unmasks the error codes that were masked by SFC 36
- SFC 38 READ_ERR reads the error register

Local data

The following table describes the start information of the OB 122 with default names of the variables and its data types:

Variable	Type	Description
OB122_EV_CLASS	BYTE	Event class and identifiers: 29h
OB122_SW_FLT	BYTE	Error code: 42h: I/O access error - reading 43h: I/O access error - writing
OB122_PRIORITY	BYTE	Priority class: Priority class of the OB where the error occurred
OB122_OB_NUMBR	BYTE	OB number (122)
OB122_BLK_TYPE	BYTE	No valid number is entered here
OB122_MEM_AREA	BYTE	Memory area and access type: Bit 3 ... 0: memory area 0: I/O area; 1: Process image of the inputs 2: Process image of the outputs Bit 7 ... 4: access type: 0: Bit access, 1: Byte access, 2: Word access, 3: Dword access
OB122_MEM_ADDR	WORD	Memory address where the error occurred
OB122_BLK_NUM	WORD	No valid number is entered here
OB122_PGR_ADDR	WORD	No valid number is entered here
OB122_DATE_TIME	DATE_AND_TIME	Date and time of day when the OB was called

Information to access the local data can be found at the description of the OB 1.

Chapter 3 Integrated SFBs

Overview

Here the description of the integrated function blocks of the VIPA SPEED7 CPUs may be found.

The following text describes:

- Overview over the integrated SFBs
- Description SFBs

Content

Thema

Overview

General

The system program of the CPU offers you some additional functions that you may use by calling FBs, FCs or OBs. Those additional functions are part of the system program and don't use any work memory. Although the additional functions may be requested, they cannot be read or altered.

The calling of an additional function via FB, FC or OB is registered as block change and influences the nesting depth for blocks.

Integrated SFBs

The following system function blocks (SFBs) are available:

SFB	Label	Description	L-Stack
SFB 0	CTU	Count forward	18Byte
SFB 1	CTD	Count backwards	18Byte
SFB 2	CTUD	Count forward and backwards	18Byte
SFB 3	TP	Create pulse	22Byte
SFB 4	TON	Create switch-on delay	22Byte
SFB 5	TOF	Create switch-off delay	22Byte
SFB 8	USEND	See chapter 5 FB/SFB 8	-
SFB 9	URCV	See chapter 5 FB/SFB 9	-
SFB 12	BSEND	See chapter 5 FB/SFB 12	-
SFB 13	BRCV	See chapter 5 FB/SFB 13	-
SFB 14	GET	See chapter 5 FB/SFB 14	-
SFB 15	PUT	See chapter 5 FB/SFB 15	-
SFB 19	START	See chapter 5 FB/SFB 19	-
SFB 20	STOP	See chapter 5 FB/SFB 20	-
SFB 21	RESUME	See chapter 5 FB/SFB 21	-
SFB 22	STATUS	See chapter 5 FB/SFB 22	-
SFB 23	USTATUS	See chapter 5 FB/SFB 23	-
SFB 32	DRUM	Realization of a step sequential circuit with a max. of 16 steps	-
SFB 47	COUNT	Counter controlling	48Byte
SFB 52	RDREC	DP-V1-SFB Reading a Data Record from a DP slave	-
SFB 53	WRREC	DP-V1-SFB Writing a Data Record in a DP slave	-
SFB 54	RALRM	DP-V1-SFB Receiving an Interrupt from a DP slave	-

Note!

Please note that L-Stack memory is occupied by using the above described SFB 0...5. This can be defined by the CPU parameters. The needed Space is to be found in the table above.

SFB 0 - CTU - Up-counter

Description

The SFB 0 can be used as Up-counter. Here you have the following characteristics:

- If the signal at the up counter input *CU* changes from "0" to "1" (positive edge), the current counter value is incremented by 1 and displayed at output *CV*.
- When called for the first time with *R*="0" the counter value corresponds to the preset value at input *PV*.
- When the upper limit of 32767 is reached the counter will not be incremented any further, i.e. all rising edges at input *CU* are ignored.
- The counter is reset to zero if reset input *R* has signal state "1".
- Output *Q* has signal state "1" if *CV* ≥ *PV*.
- When it is necessary that the instances of this SFB are initialized after a warm start, then the respective instances must be initialized in OB 100 with *R* = 1.

Parameter

Parameter	Declaration	Data type	Memory block	Description
CU	INPUT	BOOL	I,Q,M,D,L,constant	Count input
R	INPUT	BOOL	I,Q,M,D,L,constant	Reset input. *R* takes precedence over *CU*.
PV	INPUT	INT	I,Q,M,D,L,constant	Preset value. The effect of *PV* is described under parameter *Q*.
Q	OUTPUT	BOOL	I,Q,M,D,L	Status of the counter
CV	OUTPUT	INT	I,Q,M,D,L	Current count

CU

Count input:

This counter is incremented by 1 when a rising edge (with respect to the most recent SFB call) is applied to input *CU*.

R

Reset input:

The counter is reset to 0 when input *R* is set to "1", irrespective of the status of input *CU*.

PV

Preset value:

This value is the comparison value for the current counter value. Output *Q* indicates whether the current count is greater than or equal to the preset value *PV*.

Q

Status of the counter:

- *Q* is set to "1", if *CV* ≥ *PV* (current count ≥ preset value)
- else Q = "0"

CV

Current count:

- possible values: 0 to 32767

SFB 1 - CTD - Down-counter

Description

The SFB 1 can be used as Down-counter. Here you have the following characteristics:

- If the signal state at the down counter input *CD* changes from "0" to "1" (positive edge), the current counter value is decremented by 1 and displayed at output *CV*.
- When called for the first time with *LOAD*="0" the counter value corresponds to the preset value at input *PV*.
- When the lower limit of -32767 is reached the counter will not be decremented any further, i.e. all rising edges at input *CU* are ignored.
- When a "1" is applied to the *LOAD* input then the counter is set to preset value *PV* irrespective of the value applied to input *CD*.
- Output *Q* has signal state "1" if *CV* ≤ 0.
- When it is necessary that the instances of this SFB are initialized after a warm start, then the respective instances must be initialized in OB 100 with *LOAD* = 1 and *PV* = required preset value for *CV*.

Parameter

Parameter	Declaration	Data type	Memory block	Description
CD	INPUT	BOOL	I,Q,M,D,L,constant	Count input
LOAD	INPUT	BOOL	I,Q,M,D,L,constant	Load input. *LOAD* takes precedence over *CD*.
PV	INPUT	INT	I,Q,M,D,L,constant	Preset value
Q	OUTPUT	BOOL	I,Q,M,D,L	Status of the counter
CV	OUTPUT	INT	I,Q,M,D,L	Current count

CD

Count input:

This counter is decremented by 1 when a rising edge (with respect to the most recent SFB call) is applied to input *CU*.

LOAD

Load input:

When a 1 is applied to the *LOAD* input then the counter is set to preset value *PV* irrespective of the value applied to input *CD*.

PV

Preset value:

The counter is set to preset value *PV* when the input *LOAD* is “1”.

Q

Status of the counter:

Q is set to

- 1, if 0 ≥ *CV* (Current count value smaller/even 0)
- else Q = "0"

CV

Current count:

- possible values: -32 768 to 32 767

SFB 2 - CTUD - Up-Down counter

Description

The SFB 2 can be used as an Up-Down counter. Here you have the following characteristics:

- If the signal state at the up count input *CU* changes from "0" to "1" (positive edge), the counter value is incremented by 1 and displayed at output *CV*.
- If the signal state at the down count input *CD* changes from "0" to "1" (positive edge), the counter value is decremented by 1 and displayed at output *CV*.
- If both counter inputs have a positive edge, the current counter value does not change.
- When the count reaches the upper limit of 32767 any further edges are ignored.
- When the count reaches the lower limit of -32768 any further edges are ignored.
- When a "1" is applied to the *LOAD* input then the counter is set to preset value *PV*.
- The counter value is reset to zero if reset input *R* has signal state "1". Positive signal edges at the counter inputs and signal state "1" at the load input remain without effect while input *R* has signal state "1".
- Output *QU* has signal state "1", if *CV* ≥ *PV.*
- Output *QD* has signal state "1", if *CV* ≤ 0.
- When it is necessary that the instances of this SFB are initialized after a restart, then the respective instances must be initialized in OB 100 with:

  - when the counter is used as up-counter with *R* = "1"

  - when the counter is used as down-counter with *R* = 0 and *LOAD* = 1 and *PV* = preset value.

Parameter

Parameter	Declaration	Data type	Memory block	Description
CU	INPUT	BOOL	I,Q,M,D,L,constant	Count up input
CD	INPUT	BOOL	I,Q,M,D,L,constant	Count down input
R	INPUT	BOOL	I,Q,M,D,L,constant	Reset input, *R* takes precedence over *LOAD*.
LOAD	INPUT	BOOL	I,Q,M,D,L,constant	Load input, *LOAD* takes precedence over *CU* and *CD*.
PV	INPUT	INT	I,Q,M,D,L,constant	Preset value
QU	OUTPUT	BOOL	I,Q,M,D,L	Status of the up counter
QD	OUTPUT	BOOL	I,Q,M,D,L	Status of the down counter
CV	OUTPUT	INT	I,Q,M,D,L	Current count

CU

Count up input:
A rising edge (with respect to the most recent SFB-call) at input *CU* increments the counter.

CD

Count down input:
A rising edge (with respect to the most recent SFB-call) at input *CD* decrements the counter.

R

Reset input:
When input *R* is set to "1" the counter is reset to 0, irrespective of the status of inputs *CU*, *CD* and *LOAD*.

LOAD

Load input:
When the *LOAD* input is set to "1" the counter is preset to the value applied to *PV*, irrespective of the values of inputs *CU* and *CD*.

PV

Preset value:
The counter is preset to the value applied to *PV*, when the *LOAD* input is set to 1.

QU

Status of the down counter:

- *QU* is set to "1", if *CV* ≥ *PV* (Current count ≥ Preset value)
- else *QU* is 0.

QD

Status of the down counter:

- *QD* is set to 1", if 0 ≥ *CV* (Current count smaller/= 0)
- else *QD* is 0.

CV

Current count

- possible values: -32 768 to 32 767

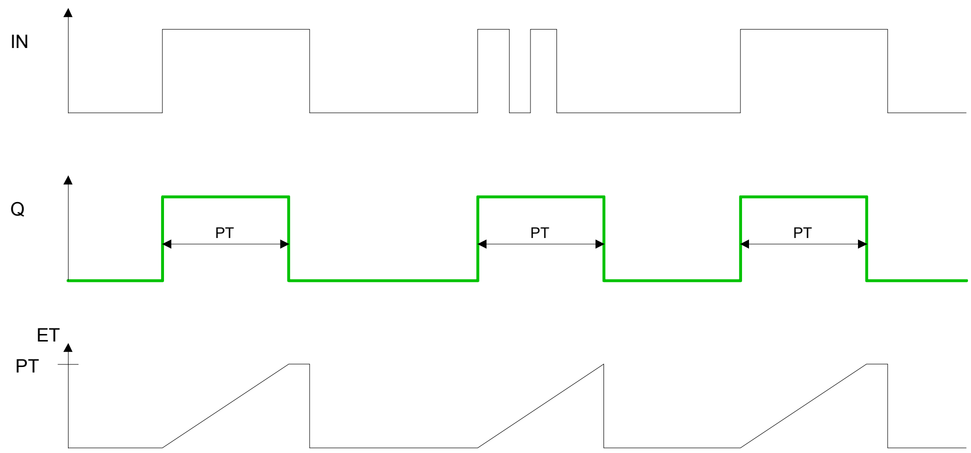
SFB 3 - TP - Create pulse

Description

The SFB 3 can be used to generate a pulse with a pulse duration equal to *PT*. Here you have the following characteristics:

- The pulse duration is only available in the STARTUP and RUN modes.
- The pulse is started with a rising edge at input *IN*.
- During *PT* time the output *Q* is set regardless of the input signal.
- The *ET* output provides the time for which output *Q* has already been set. The maximum value of the *ET* output is the value of the *PT* input. Output *ET* is reset when input *IN* changes to "0", however, not before the time *PT* has expired.
- When it is necessary that the instances of this SFB 3 are initialized after a restart, then the respective instances must be initialized in OB 100 with *PT* = 0 ms.

Time diagram



Parameter

Parameter	Declaration	Data type	Memory block	Description
IN	INPUT	BOOL	I,Q,M,D,L,constant	Start input
PT	INPUT	TIME	I,Q,M,D,L,constant	Pulse duration
Q	OUTPUT	BOOL	I,Q,M,D,L	Status of the time
ET	OUTPUT	TIME	I,Q,M,D,L	Expired time

IN

Start input:

The pulse is started by a rising edge at input *IN*.

PT

Pulse duration:

PT must be positive.
The range of these values is determined by data type TIME.

Q

Output *Q*:

Output *Q* remains active for the pulse duration *PT*, irrespective of the subsequent status of the input signal

ET

Expired time:

The duration for which output *Q* has already been active is available at output *ET* where the maximum value of this output can be equal to the value of *PT*. When input *IN* changes to 0 output *ET* is reset, however, this only occurs after *PT* has expired.

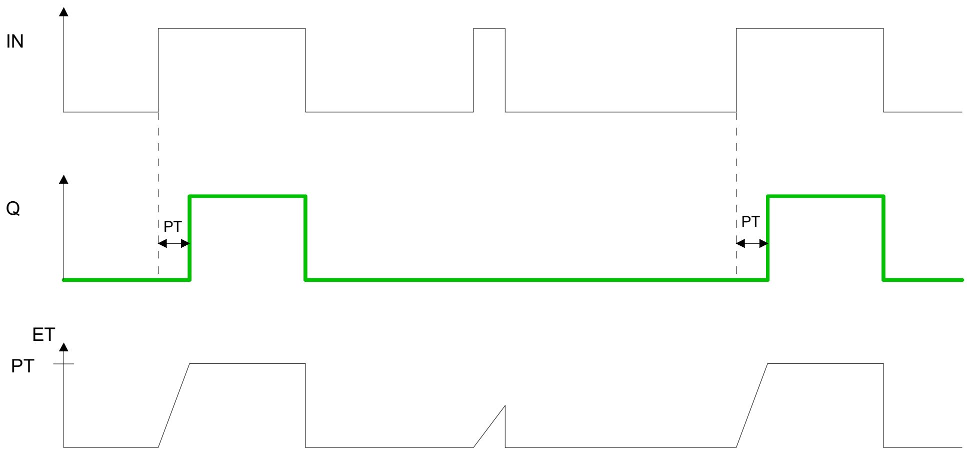
SFB 4 - TON - Create turn-on delay

Description

SFB 4 can be used to delay a rising edge by period *PT*. Here you have the following characteristics:

- The timer runs only in the STARTUP and RUN modes.
- A rising edge at the *IN* input causes a rising edge at output *Q* after the time *PT* has expired. *Q* then remains set until the *IN* input changes to 0 again. If the *IN* input changes to "0" before the time *PT* has expired, output *Q* remains set to "0".
- The *ET* output provides the time that has passed since the last rising edge at the *IN* input. Its maximum value is the value of the *PT* input. *ET* is reset when the *IN* input changes to "0".
- When it is necessary that the instances of this SFB are initialized after a restart, then the respective instances must be initialized in OB 100 with *PT* = 0 ms.

Timing diagram



Parameter

Parameter	Declaration	Type	Memory block	Description
IN	INPUT	BOOL	I,Q,M,D,L,constant	Start input
PT	INPUT	TIME	I,Q,M,D,L,constant	Time delay
Q	OUTPUT	BOOL	I,Q,M,D,L	Status of time
ET	OUTPUT	TIME	I,Q,M,D,L	Expired time

IN

Start input:

The time delay is started by a rising edge at input *IN*. Output *Q* also produces a rising edge when time delay *PT* has expired.

PT

Time delay:

Time delay applied to the rising edge at input *IN PT* must be. The range of values is defined by the data type TIME.

Q

Status of time:

The time delay is started by a rising edge at input *IN*. Output *Q* also produces a rising edge when time delay *PT* has expired and it remains set until the level applied to input *IN* changes back to 0. If input *IN* changes to 0 before time delay *PT* has expired then output *Q* remains at "0".

ET

Expired time:

Output *ET* is set to the time duration that has expired since the most recent rising edge has been applied to input *IN*. The highest value that output *ET* can contain is the value of input *PT*. Output *ET* is reset when input *IN* changes to "0".

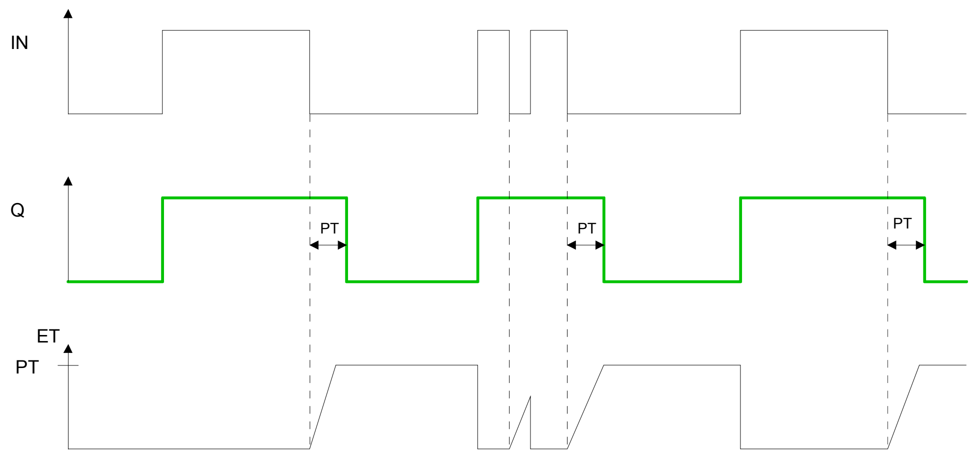
SFB 5 - TOF - Create turn-off delay

Description

SFB 5 can be used to delay a falling edge by period *PT*. Here you have the following characteristics:

- The timer runs only in the STARTUP and RUN modes.
- A rising edge at the *IN* input causes a rising edge at output *Q*. A falling edge at the *IN* input causes a falling edge at output *Q* delayed by the time *PT*. If the *IN* input changes back to "1" before the time *PT* has expired, output *Q* remains set to "1".
- The *ET* output provides the time that has elapsed since the last falling edge at the *IN* input. Its maximum value is, however the value of the *PT* input. *ET* is reset when the *IN* input changes to "1".
- When it is necessary that the instances of this SFB are initialized after a restart, then the respective instances must be initialized in OB 100 with *PT* = 0 ms.

Time diagram



Parameter

Parameter	Declaration	Data type	Memory block	Description
IN	INPUT	BOOL	I,Q,M,D,L,constant	Start input
PT	INPUT	TIME	I,Q,M,D,L,constant	Time delay
Q	OUTPUT	BOOL	I,Q,M,D,L	Status of time
ET	OUTPUT	TIME	I,Q,M,D,L	Expired time

IN

Start input:

The time delay is started by a rising edge at input *IN* results in a rising edge at output *Q*. When a falling edge is applied to input *IN* output *Q* will also produce a falling edge when delay *PT* has expired. If the level at input *IN* changes to "1" before time delay *PT* has expired, then the level at output *Q* will remain at "1".

PT

Time delay:

Time delay applied to the falling edge at input *IN PT* must be. The range of values is defined by the data type TIME.

Q

Status of time:

The time delay is started by a rising edge at input *IN* results in a rising edge at output *Q*. When a falling edge is applied to input *IN* output *Q* will also produce a falling edge when delay *PT* has expired. If the level at input *IN* changes to "1" before time delay *PT* has expired, then the level at output *Q* will remain at "1".

ET

Expired time:

The time period that has expired since the most recent falling edge at input *IN* is available from output *ET*. The highest value that output *ET* can reach is the value of input *PT*. Output *ET* is reset when the level at input *IN* changes to "1".

SFB 32 - DRUM - Realize a step-by-step switch

Description

Implementing a 16-state cycle switch using the SFB 32.

Parameter DSP defines the number of the first step, parameter *LST_STEP* defines the number of the last step.
Every step describes the 16 output bits *OUT0* to *OUT15* and output parameter *OUT_WORD* that summarizes the output bits.
The cycle switch changes to the next step when a positive edge occurs at input *JOG* with respect to the previous SFB-call. If the cycle switch has already reached the last step and a positive edge is applied to *JOG* variables *Q* and *EOD* will be set, *DCC* is set to 0 and SFB 32 remains at the last step until a "1" is applied to the *RESET* input.

Time controlled switching

The switch can also be controlled by a timer. For this purpose parameter *DRUM_EN* must be set to "1". The next step of the cycle switch is activated when:

- the event bit *EVENTi* of the current step is set and
- when the time defined for the current step has expired.

The time is calculated as the product of time base *DTBP* and the timing factor that applies to the current step (from the *S_PRESET* field).

Note!

The remaining processing time *DCC* in the current step will only be decremented if the respective event bit *EVENTi* is set.

If input *RESET* is set to "1" when the call is issued to SFB 32 then the cycle switch changes to the step that you have specified as a number at input *DSP*.

Note!

Special conditions apply if parameter *DRUM_EN* is set to "1":

- timer-controlled cycle switching, if *EVENTi* = 1 with *DSP* = i = *LST_STEP*.
- event-controlled cycle switching by means of event bits *EVENTi*, when *DTBP* = 0.

In addition it is possible to advance the cycle switch at any time (even if *DRUM_EN*=1) by means of the *JOG* input.

When this module is called for the first time the *RESET* input must be set to "1".
If the cycle switch has reached the last step and the processing time defined for this step has expired, then outputs *Q* and *EOD* will be set and SFB 32 will remain at the last step until the *RESET* input is set to "1".

The SFB 32 is only active in operating modes RESTART and RUN.

If SFB 32 must be initialized after a warm start it must be called from OB 100 with *RESET* = 1.

Parameter

Parameter	Declaration	Data type	Memory block	Description
RESET	INPUT	BOOL	I,Q,M,D,L, constant	Reset
JOG	INPUT	BOOL	I,Q,M,D,L, constant	Switch to the next stage
DRUM_EN	INPUT	BOOL	I,Q,M,D,L, constant	Control parameter
LST_STEP	INPUT	BYTE	I,Q,M,D,L, constant	Number of the last step
EVENTi, 1 ≤ i ≤ 16	INPUT	BOOL	I,Q,M,D,L, constant	Event bit No. i (belongs to step i)
OUTj, 0 ≤ j ≤ 15	OUTPUT	BOOL	I,Q,M,D,L	Output bit No. j
Q	OUTPUT	BOOL	I,Q,M,D,L	Status parameter
OUT_WORD	OUTPUT	WORD	I,Q,M,D,L,P	Output bits
ERR_CODE	OUTPUT	WORD	I,Q,M,D,L,P	*ERR_CODE* contains the error information if an error occurs when the SFB is being processed
JOG_HIS	VAR	BOOL	I,Q,M,D,L, constant	Not relevant to the user
EOD	VAR	BOOL	I,Q,M,D,L, constant	Identical with output parameter *Q*
DSP	VAR	BYTE	I,Q,M,D,L,P constant	Number of the first step
DSC	VAR	BYTE	I,Q,M,D,L,P constant	Number of the current step
DCC	VAR	DWORD	I,Q,M,D,L,P constant	The remaining processing time for the current step in ms
DTBP	VAR	WORD	I,Q,M,D,L,P constant	The time base in ms that applies to all steps
PREV_TIME	VAR	DWORD	I,Q,M,D,L, constant	Not relevant to the user
S_PRESET	VAR	ARRAY of WORD	I,Q,M,D,L, constant	One dimensional field containing the timing factors for every step
OUT_VAL	VAR	ARRAY of BOOL	I,Q,M,D,L, constant	Two-dimensional field containing the output values for every step
S_MASK	VAR	ARRAY of BOOL	I,Q,M,D,L, constant	Two-dimensional field containing the mask bits for every step.

RESET	Reset: The cycle switch is reset if this is set to "1". *RESET* must be set to "1" when the initial call is issued to the block.
JOG	A rising edge (with respect to the last SFB call) increments the cycle switch to the next stage if the cycle switch has not yet reached the last step. This is independent of the value of *DRUM_EN*.
DRUM_EN	Control parameter that determines whether timer-controlled cycle switching to the next step should be enabled or not ("1": enable timer-controlled increments).
LST_STEP	Number of the last step: • possible values: 1 to 16
EVENTi, 1≤i≤16	Event bit No. i (belonging to step i)
OUTj 0≤j≤15	Output bit No. j (identical with bit No. j of *OUT_WORD*)
Q	Status parameter specifying whether the processing time that you have defined for the last step has expired.
OUT_WORD	Output bits summarized in a single variable.
ERR_CODE	*ERR_CODE* contains the error information if an error occurs when the SFB is being processed.
JOG_HIS	Not relevant to the user: input parameter *JOG* of the previous SFB-call.
EOD	Identical with output parameter *Q*
DSP	Number of the first step: • possible values 1 to 16
DSC	Number of the current step
DCC	The remaining processing time for the current step in ms (only relevant if *DRUM_EN* = "1" and if the respective event bit = "1")
DTBP	The time base in ms that applies to all steps.
PREV_TIME	Not relevant to the user: system time of the previous SFB call.
S_PRESET	One-dimensional field containing the timing factors for every step. • Meaningful indices are: [1 to 16]. In this case *S_PRESET* [x] contains the timing factor of step x.

OUT_VAL

Two-dimensional field containing the output values for every step if you have not masked these by means of *S_MASK*.

- Meaningful indices are: [1 to 16, 0 to 15].

In this case *OUT_VAL* [x, y] contains the value that is assigned to output bit *OUTy* in step x.

S_MASK

Two-dimensional field containing the mask bits for every step.

- Meaningful indices are: [1 to 16, 0 to 15].

In this case *S_MASK* [x, y] contains the mask bit for the value y of step x.
Significance of the mask bits:

- 0: the respective value of the previous step is assigned to the output bit
- 1: the respective value of *OUT_VAL* is assigned to the output bit.

Error information

ERR_CODE

When an error occurs the status of SFB 32 remains at the current value and output *ERR_CODE* contains one of the following error codes:

ERR_CODE	Description
0000h	No error has occurred
8081h	illegal value for *LST_STEP*
8082h	illegal value for *DSC*
8083h	illegal value for *DSP*
8084h	The product *DCC* = *DTBP* x *S_PRESET*[*DSC*] exceeds the value 2^{31-1} (appr. 24.86 Days)

SFB 47 - COUNT - Counter controlling

Overview

The SFC 47 is a specially developed block for the CPU 31xSC for controlling of the counters.

The SFB is to be called with the corresponding instance DB. Here the parameters of the SFB are stored.

With the SFB COUNT (SFB 47) you have following functional options:

- Start/Stop the counter via software gate SW_GATE
- Enable/control digital output DO
- Read the status bit
- Read the actual count and latch value
- Request to read/write internal counter registers

Parameter SFB 47

Name	Data type	Address (Instance-DB)	Default value	Comment
LADDR	WORD	0.0	300h	This parameter is not evaluated. Always the internal I/O periphery is addressed.
CHANNEL	INT	2.0	0	Channel number
SW_GATE	BOOL	4.0	FALSE	Enables the Software gate
CTRL_DO	BOOL	4.1	FALSE	Enables the output False: Standard Digital Output
SET_DO	BOOL	4.2	FALSE	Parameter is not evaluated
JOB_REQ	BOOL	4.3	FALSE	Initiates the job (edge 0-1)
JOB_ID	WORD	6.0	0	Job ID
JOB_VAL	DINT	8.0	0	Value for write jobs
STS_GATE	BOOL	12.0	FALSE	Status of the internal gate
STS_STRT	BOOL	12.1	FALSE	Status of the hardware gate
STS_LTCH	BOOL	12.2	FALSE	Status of the latch input
STS_DO	BOOL	12.3	FALSE	Status of the output
STS_C_DN	BOOL	12.4	FALSE	Status of the down-count Always indicates the last direction of count. After the first SFB call STS_C_DN is set FALSE.
STS_C_UP	BOOL	12.5	FALSE	Status of the up-count Always indicates the last direction of count. After the first SFB call STS_C_UP is set TRUE.
COUNTVAL	DINT	14.0	0	Actual count value
LATCHVAL	DINT	18.0	0	Actual latch value
JOB_DONE	BOOL	22.0	TRUE	New job can be started
JOB_ERR	BOOL	22.1	FALSE	Job error
JOB_STAT	WORD	24.0	0	Job error ID

Local data only in instance DB

Name	Data type	Address (Instance DB)	Default value	Comment
RES00	BOOL	26.0	FALSE	reserved
RES01	BOOL	26.1	FALSE	reserved
RES02	BOOL	26.2	FALSE	reserved
STS_CMP	BOOL	26.3	FALSE	Comparator Status *) Status bit STS_CMP indicates that the comparison condition of the comparator is or was reached. STS_CMP also indicates that the output was set. (STS_DO = TRUE).
RES04	BOOL	26.4	FALSE	reserved
STS_OFLW	BOOL	26.5	FALSE	Overflow status *)
STS_UFLW	BOOL	26.6	FALSE	Underflow status *)
STS_ZP	BOOL	26.7	FALSE	Status of the zero mark *) The bit is only set when counting without main direction. Indicates the zero mark. This is also set when the counter is set to 0 or if is start counting.
JOB_OVAL	DINT	28.0		Output value for read request.
RES10	BOOL	32.0	FALSE	reserved
RES11	BOOL	32.1	FALSE	reserved
RES_STS	BOOL	32.2	FALSE	Reset status bits: Resets the status bits: STS_CMP, STS_OFLW, STS_ZP. The SFB must be twice called to reset the status bit.

*) Reset with RES_STS

Note!

Per channel you may call the SFB in each case with the same instance DB, since the data necessary for the internal operational are stored here. Writing accesses to outputs of the instance DB is not permissible.

Counter request interface

To read/write counter registers the request interface of the SFB 47 may be used.

So that a new job may be executed, the previous job must have be finished with JOB_DONE = TRUE.

Proceeding

The deployment of the request interface takes place at the following sequence:

- Edit the following input parameters:

Name	Data type	Address (DB)	Default	Comment
JOB_REQ	BOOL	4.3	FALSE	Initiates the job (edges 0-1)
JOB_ID	WORD	6.0	0	Job ID: 00h Job without function 01h Writes the count value 02h Writes the load value 04h Writes the comparison value 08h Writes the hysteresis 10h Writes the pulse duration 20h Writes the end value 82h Reads the load value 84h Reads the comparison value 88h Reads the hysteresis 90h Reads the pulse duration A0h Reads the end value
JOB_VAL	DINT	8.0	0	Value for write jobs (see table at the following page)

- Call the SFB. The job is processed immediately. JOB_DONE only applies to SFB run with the result FALSE. JOB_ERR = TRUE if an error occurred. Details on the error cause are indicated at JOB_STAT.

Name	Data type	Address (DB)	Default	Comment
JOB_DONE	BOOL	22.0	TRUE	New job can be started
JOB_ERR	BOOL	22.1	FALSE	Job error
JOB_STAT	WORD	24.0	0000h	Job error ID 0000h No error 0121h Compare value too low 0122h Compare value too high 0131h Hysteresis too low 0132h Hysteresis too high 0141h Pulse duration too low 0142h Pulse duration too high 0151h Load value too low 0152h Load value too high 0161h Count value too low 0162h Count value too high 01FFh Invalid job ID

- A new job may be started with JOB_DONE = TRUE.
- A value to be read of a read job may be found in JOB_OVAL in the instance DB at address 28.

Permitted value range for JOB_VAL

Continuous count:

Job	Valid range
Writing counter directly	-2147483647 ($-2^{31}+1$) to +2147483646 ($2^{31}-2$)
Writing the load value	-2147483647 ($-2^{31}+1$) to +2147483646 ($2^{31}-2$)
Writing comparison value	-2147483648 (-2^{31}) to +2147483647 ($2^{31}-1$)
Writing hysteresis	0 to 255
Writing pulse duration*	0 to 510ms

Single/periodic count, no main count direction:

Job	Valid range
Writing counter directly	-2147483647 ($-2^{31}+1$) to +2147483646 ($2^{31}-2$)
Writing the load value	-2147483647 ($-2^{31}+1$) to +2147483646 ($2^{31}-2$)
Writing comparison value	-2147483648 (-2^{31}) to +2147483647 ($2^{31}-1$)
Writing hysteresis	0 to 255
Writing pulse duration*	0 to 510ms

Single/periodic count, main count direction up:

Job	Valid range
End value	2 to +2147483646 ($2^{31}-1$)
Writing counter directly	-2147483648 (-2^{31}) to end value -2
Writing the load value	-2147483648 (-2^{31}) to end value -2
Writing comparison value	-2147483648 (-2^{31}) to end value -1
Writing hysteresis	0 to 255
Writing pulse duration*	0 to 510ms

Single/periodic count, main count direction down:

Job	Valid range
Writing counter directly	2 to +2147483647 ($2^{31}-1$)
Writing the load value	2 to +2147483647 ($2^{31}-1$)
Writing comparison value	1 to +2147483647 ($2^{31}-1$)
Writing hysteresis	0 to 255
Writing pulse duration*	0 to 510ms

*) Only even values allowed. Odd values are automatically rounded.

Latch function

As soon as during a count process an edge 0-1 is recognized at the "Latch" input of a counter, the recent counter value is stored in the according latch register.

You may access the latch register via LATCHVAL of the SFB 47.

A just in LATCHVAL loaded value remains after a STOP-RUN transition.

SFB 52 - RDREC - Reading a Data Record from a DP-V1 slave

Note!

The SFB 52 RDREC interface is identical to the FB RDREC defined in the standard "PROFIBUS Guideline PROFIBUS Communication and Proxy Function Blocks according to IEC 61131-3".

Description

With the SFB 52 RDREC (read record) you read a data record with the number *INDEX* from a DP slave component (module or modules) that has been addressed via ID.

Specify the maximum number of bytes you want to read in *MLEN*. The selected length of the target area *RECORD* should have at least the length of *MLEN* bytes.

TRUE on output parameter *VALID* verifies that the data record has been successfully transferred into the target area *RECORD*. In this case, the output parameter *LEN* contains the length of the fetched data in bytes.

The output parameter *ERROR* indicates whether a data record transmission error has occurred. In this case, the output parameter *STATUS* contains the error information.

Note!

If a DP-V1 slave is configured using a GSD file (GSD stating with Rev. 3) and the DP interface of the DP master is set to Siemens "S7 compatible", than data records must not be read from I/O modules in the user program with SFB 52. The reason is that in this case the DP master addresses the incorrect slot (configured slot +3).

Remedy: Set the interface for DP master to "DP-V1"!

Operating principle

The SFB 52 RDREC operates asynchronously, that is, processing covers multiple SFB calls. Start the job by calling SFB 52 with *REQ* = 1.

The job status is displayed via the output parameter *BUSY* and bytes 2 and 3 of output parameter *STATUS*. Here, the *STATUS* bytes 2 and 3 correspond with the output parameter *RET_VAL* of the asynchronously operating SFCs (see also meaning of *REQ*, *RET_VAL* and *BUSY* with Asynchronously Operating SFCs).

Data record transmission is completed when the output parameter *BUSY* = FALSE.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: Transfer data record
IO	INPUT	DWORD	I,Q,M,D,L, constant	Logical address of the DP slave component (module). For an output module, bit 15 must be set (e.g. for address 5: ID: DW = 8005h). For a combination module, the smaller of the two addresses should be specified.
INDEX	INPUT	INT	I,Q,M,D,L, constant	Data record number.
MLEN	INPUT	INT	I,Q,M,D,L, constant	Maximum length in bytes of the data record information to be fetched
VALID	OUTPUT	BOOL	I,Q,M,D,L	New data record was received and valid
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: The read process is not yet terminated.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	*ERROR* = 1: A read error has occurred.
STATUS	OUTPUT	DWORD	I,Q,M,D,L	Call ID (bytes 2 and 3) or error code.
LEN	OUTPUT	INT	I,Q,M,D,L	Length of the fetched data record information.
RECORD	IN_OUT	ANY	I,Q,M,D,L	Target area for the fetched data record.

Error information

See Receiving an interrupt from a DP slave with SFB 54 RALRM.

SFB 53 - WRREC - Writing a Data Record in a DP-V1 slave

Note!

The SFB 53 WRREC interface is identical to the FB WRREC defined in the standard "PROFIBUS Guideline PROFIBUS Communication and Proxy Function Blocks according to IEC 61131-3".

Description

With the SFB 53 WRREC (Write record) you transfer a data record with the number *INDEX* to a DP slave component (module) that has been addressed via ID.

Specify the byte length of the data record to be transmitted. The selected length of the source area *RECORD* should, therefore, have at least the length of *LEN* bytes.

TRUE on output parameter *DONE* verifies that the data record has been successfully transferred to the DP slave.

The output parameter *ERROR* indicates whether a data record transmission error has occurred. In this case, the output parameter *STATUS* contains the error information.

Note!

If a DP-V1 slave is configured using a GSD file (GSD stating with Rev. 3) and the DP interface of the DP master is set to Siemens "S7 compatible", than data records must not be read from I/O modules in the user program with SFB 53. The reason is that in this case the DP master addresses the incorrect slot (configured slot +3).

Remedy: Set the interface for DP master to "DP-V1"!

Operating principle

The SFB 53 WRREC operates asynchronously, that is, processing covers multiple SFB calls. Start the job by calling SFB 52 with *REQ* = 1.

The job status is displayed via the output parameter *BUSY* and bytes 2 and 3 of output parameter *STATUS*. Here, the *STATUS* bytes 2 and 3 correspond with the output parameter *RET_VAL* of the asynchronously operating SFCs (see also meaning of *REQ, RET_VAL* and *BUSY* with Asynchronously Operating SFCs).

Please note that you must assign the same value to the actual parameter of *RECORD* for all SFB 53 calls that belong to one and the same job. The same applies to the *LEN* parameters.

Data record transmission is completed when the output parameter
BUSY = FALSE.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: Transfer data record
IO	INPUT	DWORD	I,Q,M,D,L, constant	Logical address of the DP slave component (module or submodule). For an output module, bit 15 must be set (e.g. for address 5: ID: DW = 8005h). For a combination module, the smaller of the two addresses should be specified.
INDEX	INPUT	INT	I,Q,M,D,L, constant	Data record number.
LEN	INPUT	INT	I,Q,M,D,L, constant	Maximum byte length of the data record to be transferred
DONE	OUTPUT	BOOL	I,Q,M,D,L	Data record was transferred
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: The write process is not yet terminated.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	*ERROR* = 1: A write error has occurred
STATUS	OUTPUT	DWORD	I,Q,M,D,L	Call ID (bytes 2 and 3) or error code
LEN	OUTPUT	INT	I,Q,M,D,L	Length of the fetched data record information
RECORD	IN_OUT	ANY	I,Q,M,D,L	Data record

Error information

See Receiving an interrupt from a DP slave with SFB 54 RALRM.

SFB 54 - RALRM - Receiving an interrupt from a DP-V1 slave

Note!
The SFB 54 RALRM interface is identical to the FB RALRM defined in the standard "PROFIBUS Guideline PROFIBUS Communication and Proxy Function Blocks according to IEC 61131-3".

Description

The SFB 54 RALRM receives an interrupt with all corresponding information from a peripheral module (centralized structure) or from a DP slave component. It supplies this information to its output parameters.

The information in the output parameters contains the start information of the called OB as well as information of the interrupt source.

Call the SFB 54 only within the interrupt OB started by the CPU operating system as a result of the peripheral interrupt that is to be examined.

Note!
If you call SFB 54 RALRM in an OB for which the start event was not triggered by peripherals, the SFB supplies correspondingly reduced information on its outputs.
Make sure to use different instance DBs when you call SFB 54 in different OBs. If you want to evaluate data that are the result of an SFB 54 call outside of the associated interrupt OB you should moreover use a separate instance DP per OB start event.

Parameter

Parameter	Declaration	Data type	Memory block	Description
MODE	INPUT	INT	I,Q,M,D,L, constant	Operating mode
F_ID	INPUT	DWORD	I,Q,M,D,L, constant	Logical start address of the Component (module), from which interrupts are to be received.
MLEN	INPUT	INT	I,Q,M,D,L, constant	Maximum length in bytes of the data interrupt information to be received
NEW	OUTPUT	BOOL	I,Q,M,D,L	A new interrupt was received.
STATUS	OUTPUT	DWORD	I,Q,M,D,L	Error code of the SFB or DP master
ID	OUTPUT	DWORD	I,Q,M,D,L	Logical start address of the component (module), from which an interrupt was received. Bit 15 contains the I/O ID: 0: for an input address 1: for an output address
LEN	OUTPUT	INT	I,Q,M,D,L	Length of the received interrupt information
TINFO	IN_OUT	ANY	I,Q,M,D,L	(task information) Target range OB start and management information
AINFO	IN_OUT	ANY	I,Q,M,D,L	(interrupt information) Target area for header information and additional information. For *AINFO* you should provide a length of at least *MLEN* bytes.

MODE

You can call the SFB 54 in three operating modes (MODE):

0: shows the component that triggered the interrupt in the output parameter ID and sets the output parameter *NEW* to TRUE.

1: describes all output parameters, independent on the interrupt-triggering component.

2: checks whether the component specified in input parameter *F_ID* has triggered the interrupt.
- if not, *NEW* = FALSE
- if yes, *NEW* = TRUE, and all other outputs parameters are described.

Note!
If you select a target area *TINFO* or *AINFO* that is too short the SFC 54 cannot enter the full information.

TINFO Data structure of the target area (task information):

<table>
<tr><th>Byte</th><th>Data type</th><th colspan="5">Meaning</th></tr>
<tr><td>0 ... 19</td><td></td><td colspan="5">Start information of the OB in which SFC 54 was currently called:
Byte 0 ... 11: structured like the parameter TOP_SI in SFC 6 RD_SINFO
Byte 12 ... 19: date and time the OB was requested</td></tr>
<tr><td>20 ... 27</td><td></td><td colspan="5">Management information:</td></tr>
<tr><td>20</td><td>Byte</td><td colspan="5">centralized: 0
decentralized: DP master system ID (possible values: 1 ... 255)</td></tr>
<tr><td>21</td><td>Byte</td><td colspan="5">central: Module rack number (possible values: 0 ... 31)
distributed: Number of DP station (possible values: 0 ... 127)</td></tr>
<tr><td rowspan="8">22</td><td rowspan="8">Byte</td><td colspan="5">centralized: 0</td></tr>
<tr><td rowspan="7">decentralized:</td><td rowspan="5">Bit 3 ... 0</td><td rowspan="5">slave type</td><td>0000:</td><td>DP</td></tr>
<tr><td>0001:</td><td>DPS7</td></tr>
<tr><td>0010:</td><td>DPS7 V1</td></tr>
<tr><td>0011:</td><td>DP-V1</td></tr>
<tr><td>as of 0100:</td><td>reserved</td></tr>
<tr><td rowspan="2">Bit 7 ... 4</td><td rowspan="2">Profile type</td><td>0000:</td><td>DP</td></tr>
<tr><td>as of 0001:</td><td>reserved</td></tr>
<tr><td rowspan="7">23</td><td rowspan="7">Byte</td><td colspan="5">centralized: 0</td></tr>
<tr><td rowspan="6">decentralized:</td><td rowspan="4">Bit 3 ... 0</td><td rowspan="4">Interrupt info type</td><td>0000:</td><td>Transparent (Interrupt originates from a configured decentralized module)</td></tr>
<tr><td>0001:</td><td>Representative (Interrupt originating from a non-DP-V1 slave or a slot that is not configured)</td></tr>
<tr><td>0010:</td><td>Generated (interrupt generated in the CPU)</td></tr>
<tr><td>as of 0011:</td><td>reserved</td></tr>
<tr><td rowspan="2">Bit 7 ... 4</td><td rowspan="2">Structure version</td><td>0000:</td><td>Initial</td></tr>
<tr><td>as of 0001:</td><td>reserved</td></tr>
</table>

continued ...

... continue TINFO

Byte	Data type	Meaning	
24	Byte	centralized: 0	
		decentralized: Flags of the DP master interface	
		Bit 0 = 0:	Interrupt originating from an integrated DP interface
		Bit 0 = 1:	Interrupt originating from an external DP interface
		Bit 7 ... 1:	reserved
25	Byte	centralized: 0	
		decentralized: Flags of the DP slave interface	
		Bit 0:	EXT_DIAG_Bit of the diagnostic message frame, or 0 if this bit does not exist in the interrupt
		Bit 7 ... 1:	reserved
26, 27	WORD	centralized: 0	
		decentralized: PROFIBUS ID number	

AINFO Data structure of the target area (interrupt information):

Byte	Data type	Meaning		
0 ... 3		Header information		
0	Byte	Length of the received interrupt information in bytes		
		centralized: 4 ... 224		
		decentralized: 4 ... 63		
1	Byte	centralized: reserved		
		decentralized:	ID for the interrupt type	
			1:	Diagnostic interrupt
			2:	Hardware interrupt
			3:	Removal interrupt
			4:	Insertion interrupt
			5:	Status interrupt
			6:	Update interrupt
			31:	Failure of an expansion device, DP master system or DP station
			32 ... 126	manufacturer specific interrupt
2	**Byte**	**Slot number of the interrupt triggering component**		
3	Byte	centralized: reserved		
		decentralized:	Identifier	
			Bit 1, 0:	
			00	no further information
			01	incoming event, disrupted slot
			10	going event, slot not disrupted anymore
			11	going event, slot still disrupted
			Bit 2:	Add_Ack
			Bit 7 ... 3	Sequence number
4 ... 223		Additional interrupt information: module specific data for the respective interrupt:		
		centralized:	ARRAY[0] ... ARRAY[220]	
		decentralized:	ARRAY[0] ... ARRAY[59]	

TINFO and AINFO

Target Area:

Depending on the respective OB in which SFB 54 is called, the target areas *TINFO* and *AINFO* are only partially written. Refer to the table below for information on which info is entered respectively.

Interrupt type	OB	TINFO OB status information	TINFO management information	AINFO header information	AINFO additional interrupt information
Hardware interrupt	4x	Yes	Yes	Yes	centralized: No decentralized: as delivered by the DP slave
Status interrupt	55	Yes	Yes	Yes	Yes
Update interrupt	56	Yes	Yes	Yes	Yes
Manufacturer specific interrupt	57	Yes	Yes	Yes	Yes
Peripheral redundancy error	70	Yes	Yes	No	No
Diagnostic interrupt	82	Yes	Yes	Yes	centralized: Data record 1 decentralized: as delivered by the DP slave
Removal/ Insertion interrupt	83	Yes	Yes	Yes	centralized: No decentralized: as delivered by the DP slave
Module rack/ Station failure	86	Yes	Yes	No	No
...	all other OBs	Yes	No	No	No

Error informationen

The output parameter *STATUS* contains information. It is interpreted as ARRAY[1...4] OF BYTE the error information has the following structure:

Field element	Name	Meaning
STATUS[1]	Function_Num	00h: if no error Function ID from DP-V1-PDU: in error case 80h is OR linked. If no DP-V1 protocol element is used: C0h.
STATUS[2]	Error_Decode	Location of the error ID.
STATUS[3]	Error_1	Error ID
STATUS[4]	Error_2	Manufacturer specific error ID expansion: With DP-V1 errors, the DP master passes on *STATUS*[4] to the CPU and to the SFB. Without DP-V1 error, this value is set to 0, with the following exceptions for the SFB 52: • *STATUS*[4] contains the target area length from *RECORD*, if *MLEN* > the target area length from *RECORD* • STATUS[4]=*MLEN*, if the actual data record length < *MLEN* < the target area length from *RECORD*

STATUS[2] (Location of the error ID) can have the following values:

Error_Decode	Source	Meaning
00 ... 7Fh	CPU	No error no warning
80h	DP-V1	Error according to IEC 61158-6
81h ... 8Fh	CPU	8xh shows an error in the nth call parameter of the SFB.
FEh, FFh	DP Profile	Profile-specific error

STATUS[3] (Error ID) can have the following values:

Error_Decode	Error_Code_1	Explanation according to DP-V1	Meaning
00h	00h		no error, no warning
70h	00h	reserved, reject	Initial call; no active data record transfer
	01h	reserved, reject	Initial call; data record transfer has started
	02h	reserved, reject	Intermediate call; data record transfer already active
80h	90h	reserved, pass	Invalid logical start address
	92h	reserved, pass	Illegal Type for ANY Pointer
	93h	reserved, pass	The DP component addressed via *ID* or *F_ID* is not configured.
	A0h	read error	Negative acknowledgement while reading the module.
	A1h	write error	Negative acknowledgement while writing the module.
	A2h	module failure	at layer 2
	A3h	reserved, pass	DP protocol error with Direct-Data-Link-Mapper or User-Interface/User
	A4h	reserved, pass	Bus communication disrupted
	A5h	reserved, pass	-
	A7h	reserved, pass	DP slave or module is occupied (temporary error)
	A8h	version conflict	DP slave or module reports non-compatible versions
	A9h	feature not supported	Feature not supported by DP slave or module
	AA ... AFh	user specific	DP slave or module reports a manufacturer specific error in its application. Please check the documentation from the manufacturer of the DP slave or module.
	B0h	invalid index	Data record not known in module illegal data record number ≥256.
	B1h	write length error	Wrong length specified in parameter *RECORD*; with SFB 54: length error in *AINFO*.
	B2h	invalid slot	Configured slot not occupied.
	B3h	type conflict	Actual module type not equal to specified module type
	B4h	invalid area	DP slave or module reports access to an invalid area
	B5h	state conflict	DP slave or module not ready
	B6h	access denied	DP slave or module denies access

continued ...

... continue STATUS[3]

Error_Decode	Error_Code_1	Explanation according to DP-V1	Meaning
80h	B7h	invalid range	DP slave or module reports an invalid range for a parameter or value
	B8h	invalid parameter	DP slave or module reports an invalid parameter
	B9h	invalid type	DP slave or module reports an invalid type
	BAh ... BFh	user specific	DP slave or module reports a manufacturer specific error when accessing. Please check the documentation from the manufacturer of the DP slave or module.
	C0h	read constrain conflict	The module has the data record, however, there are no read data yet.
	C1h	write constrain conflict	The data of the previous write request to the module for the same data record have not yet been processed by the module.
	C2h	resource busy	The module currently processes the maximum possible jobs for a CPU.
	C3h	resource unavailable	The required operating resources are currently occupied.
	C4h		Internal temporary error. Job could not be carried out. Repeat the job. If this error occurs often, check your plant for sources of electrical interference.
	C5h		DP slave or module not available.
	C6h		Data record transfer was canceled due to priority class cancellation
	C7h		Job canceled due to restart of DP masters.
	C8h ... CFh		DP slave or module reports a manufacturer specific resource error. Please check the documentation from the manufacturer of the DP slave or module.
	Dxh	user specific	DP slave specific, Refer to the description of the DP slaves.
81h	00h ... FFh		Error in the initial call parameter (with SFB 54: *MODE*).
	00h		Illegal operating mode.

continued ...

... continue STATUS[3]

Error_Decode	Error_Code_1	Explanation according to DP-V1	Meaning
82h	00h ... FFh		Error in the 2. call parameter.
...	...		...
88h	00h ... FFh		Error in the 8. call parameter (with SFB 54: *TINFO*).
	01h		Wrong syntax ID.
	23h		Quantity frame exceeded or target area too small.
	24h		Wrong range ID.
	32h		DB/DI no. out of user range.
	3Ah		DB/DI no. is NULL for area ID DB/DI or specified DB/DI does not exist.
89h	00h ... FFh		Error in the 9. call parameter (with SFB 54: *AINFO*).
	01h		Wrong syntax ID.
	23h		Quantity frame exceeded or target area too small.
	24h		Wrong range ID.
	32h		DB/DI no. out of user range.
	3Ah		DB/DI no. is NULL for area ID DB/DI or specified DB/DI does not exist.
8Ah	00h ... FFh		Error in the 10. call parameter
...	...		...
8Fh	00h ... FFh		Error in the 15. call parameter
FEh, FFh			Profile-specific error

Chapter 4 Integrated Standard SFCs

Overview

Here the description of the integrated standard SFCs of the SPEED7 CPUs from VIPA may be found.

The description of the SFCs of the VIPA library may be found at the chapter "VIPA specific blocks".

Note for needed local stack

Please note that local stack memory is occupied by using of some SFCs. This can be defined by the CPU parameters. The needed space is to be found in the following table above:

SFC	Label	L stack
SFC 20	BLKMOV	56Byte
SCF 21	FILL	56Byte
SFC 47	WAIT	22Byte
SFC 64	TIME_TCK	18Byte

Additional error messages of SFC 20, SFC 21

In addition to the standard error messages the SFC 20 and SFC 21 could return the following error messages:

No.	Error message	Remedy
817Dh	Too less local stack	Increase local stack by using CPU parameters
817Eh	Range length error in internal copy loop	Check parameters

The following text describes:

- Overview over the integrated SFCs
- Description of the blocks

Content

Topic

Overview Integrated standard SFCs

Standard SFCs The following standard system functions (SFCs) are available:

SFC	Label	Description
SFC 0	SET_CLK	Set time
SFC 1	READ_CLK	Read time
SFC 2	SET_RTM	Set operating hour counter
SFC 3	CTRL_RTM	Start/stop operating hour counter
SFC 4	READ_RTM	Read operating hour counter
SFC 5	GADR_LGC	Search logical address of a channel (only modules in rack 0)
SFC 6	RD_SINFO	Read start information of the current OB
SFC 12	D_ACT_DP	Activate or deactivate DP slaves
SFC 13	DPNRM_DG	Read slave diagnostic data
SFC 14	DPRD_DAT	Read consistent user data (also from DP slaves → DP master FW ≥ V3.00)
SFC 15	DPWR_DAT	Write consistent user data (also to DP slaves → DP master FW ≥ V3.00)
SCF 17	ALARM_SQ	Create acknowledgeable block related messages
SFC 18	ALARM_S	Create not acknowledgeable block related messages
SFC 19	ALARM_SC	Acknowledgement state of the last Alarm SQ-arrived-message
SFC 20	BLKMOV	Copy variable within work memory
SFC 21	FILL	Preset field within work memory
SFC 22	CREAT_DB	Create data block
SFC 23	DEL_DB	Delete data block
SFC 24	TEST_DB	Test data block
SFC 28	SET_TINT	Set time interrupt
SFC 29	CAN_TINT	Cancel time interrupt
SFC 30	ACT_TINT	Activate time interrupt
SFC 31	QRY_TINT	Request time interrupt
SFC 32	SRT_DINT	Start delay interrupt
SFC 33	CAN_DINT	Cancel delay interrupt
SFC 34	QRY_DINT	Request delay interrupt
SFC 36	MSK_FLT	Mask synchronal error event
SFC 37	DMSK_FLT	De-mask synchronal error event
SFC 38	READ_ERR	Read event status register
SFC 39	DIS_IRT	Disabling the processing of new interrupts and asynchronous errors
SFC 40	EN_IRT	Enabling the processing of new interrupts and asynchronous errors
SFC 41	DIS_AIRT	Delay of interrupt events
SFC 42	EN_AIRT	Abrogate delay of interrupt events
SFC 43	RE_TRIGR	Re-trigger cycle time control
SFC 44	REPL_VAL	Transfer replacement value to AKKU1
SFC 46	STP	Switch CPU in STOP
SFC 47	WAIT	Delay program execution additionally to wait time
SFC 49	LGC_GADR	Search plug-in location of a logical address
SFC 50	RD_LGADR	Search all logical addresses of a module

continued ...

... continue Standard SFCs

SFC	Label	Description
SFC 51	RDSYSST	Read information from the system state list
SFC 52	WR_USMSG	Write user entry in diagnostic buffer (send via MPI in preparation)
SFC 54	RD_DPARM	Read predefined parameters
SFC 55	WR_PARM	Write dynamic parameters (only for analog-, digital modules, FMs, CPs and via Profibus DP-V1 possible)
SFC 56	WR_DPARM	Write predefined parameters (only for analog-, digital modules, FMs, CPs and via Profibus DP-V1 possible)
SFC 57	PARM_MOD	Parameterize module (only for analog-, digital modules, FMs, CPs and via Profibus DP-V1 possible)
SFC 58	WR_REC	Write record set (only for analog-, digital modules, FMs, CPs and via Profibus DP-V1 possible)
SFC 59	RD_REC	Read record set (only for analog-, digital modules, FMs, CPs and via Profibus DP-V1 possible)
SFC 64	TIME_TCK	Read millisecond timer
SFC 65	X_SEND	Send data to external partner
SFC 66	X_RCV	Receive data from external partner
SFC 67	X_GET	Read data from external partner
SFC 68	X_PUT	Write data to external partner
SFC 69	X_ABORT	Interrupt connection to external partner
SFC 81	UBLKMOV	Copy variable non-interruptible

General and Specific Error Information RET_VAL

Overview

The return value *RET_VAL* of a system function provides one of the following types of error codes:

- A *general error code*, that relates to errors that can occur in anyone SFC.
- A *specific error code*, that relates only to the particular SFC.

Although the data type of the output parameter *RET_VAL* is integer (INT), the error codes for system functions are grouped according to hexadecimal values.

If you want to examine a return value and compare the value with the error codes, then display the error code in hexadecimal format.

RET_VAL (Return value)

The table below shows the structure of a system function error code:

Bit	Description
7 ... 0	Event number or error class and single error
14 ... 8	Bit 14 ... 8 = "0": **Specific error code** The specific error codes are listed in the descriptions of the individual SFCs. Bit 14 ... 8 > "0": **General error code** The possible general error codes are shown in the following page.
15	Bit 15 = "1": indicates that an error has occurred.

Specific error code

This error code indicates that an error pertaining to a particular system function occurred during execution of the function. A specific error code consists of the following two numbers:

- Error class between 0 and 7
- Error number between 0 and 15

Bit	Description
3 ... 0	Error number
6 ... 4	Error class
7	Bit 7 = "1"
14 ... 8	Bit 14 ... 8 = "0"
15	Bit 15 = "1": indicates that an error has occurred.

General error codes RET_VAL

The parameter *RET_VAL* of some SFCs only returns general error information. No specific error information is available.
The general error code contains error information that can result from any system function. The general error code consists of the following two numbers:

- A parameter number between 1 and 111, where 1 indicates the first parameter of the SFC that was called, 2 the second etc.
- An event number between 0 and 127. The event number indicates that a synchronous fault has occurred.

Bit	Description
7 ... 0	Event number
14 ... 8	Parameter number
15	Bit 15 = "1": indicates that an error has occurred.

The following table explains the general error codes associated with a return value. Error codes are shown as hexadecimal numbers. The x in the code number is only used as a placeholder. The number represents the parameter of the system function that has caused the error.

General error codes

Error code	Description
8x7Fh	Internal Error. This error code indicates an internal error at parameter x. This error did not result from the actions if the user and he/she can therefore not resolve the error.
8x22h	Area size error when a parameter is being read.
8x23h	Area size error when a parameter is being written. This error code indicates that parameter x is located either partially or fully outside of the operand area or that the length of the bit-field for an ANY-parameter is not divisible by 8.
8x24h	Area size error when a parameter is being read.
8x25h	Area size error when a parameter is being written. This error code indicates that parameter x is located in an area that is illegal for the system function. The description of the respective function specifies the areas that are not permitted for the function.
8x26h	The parameter contains a number that is too high for a time cell. This error code indicates that the time cell specified in parameter x does not exist.
8x27h	The parameter contains a number that is too high for a counter cell (numeric fields of the counter). This error code indicates that the counter cell specified in parameter x does not exist.

continued ...

... continue

Error code	Description
8x28h	Orientation error when reading a parameter.
8x29h	Orientation error when writing a parameter. This error code indicates that the reference to parameter x consists of an operand with a bit address that is not equal to 0.
8x30h	The parameter is located in the write-protected global-DB.
8x31h	The parameter is located in the write-protected instance-DB. This error code indicates that parameter x is located in a write-protected data block. If the data block was opened by the system function itself, then the system function will always return a value 8x30h.
8x32h	The parameter contains a DB-number that is too high (number error of the DB).
8x34h	The parameter contains a FC-number that is too high (number error of the FC).
8x35h	The parameter contains a FB-number that is too high (number error of the FB). This error code indicates that parameter x contains a block number that exceeds the maximum number permitted for block numbers.
8x3Ah	The parameter contains the number of a DB that was not loaded.
8x3Ch	The parameter contains the number of a FC that was not loaded.
8x3Eh	The parameter contains the number of a FB that was not loaded.
8x42h	An access error occurred while the system was busy reading a parameter from the peripheral area of the inputs.
8x43h	An access error occurred while the system was busy writing a parameter into den peripheral area of the outputs.
8x44h	Error during the n-th (n > 1) read access after an error has occurred.
8x45h	Error during the n-th (n > 1) write access after an error has occurred. This error code indicates that access was denied to the requested parameter.

SFC 0 - SET_CLK - Set system clock

Description

The SFC 0 SET_CLK (set system clock) sets the time of day and the date of the clock in the CPU. The clock continues running from the new time and date.
If the clock is a master clock then the call to SFC 0 will start a clock synchronization cycle as well. The clock synchronization intervals are defined by hardware settings.

Parameters

Parameter	Declaration	Data type	Memory block	Description
PDT	INPUT	DT	D,L	Enter the new date and time at *PDT*.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	When an error occurs while the function is being processed then the returned value contains the respective error code.

PDT

Date and time are entered as data type DT.

Example:

date: 04.27.2006, time: 14:15:55 → DT#2006-04-27-14:15:55.

The time can only be entered with one-second accuracy. The day of the week is calculated automatically by SFC 0.

Remember that you must first create the data type DT by means of FC 3 D_TOD_DT before you can supply it to the input parameter (see time functions; FC 3, FC 6, FC 7, FC 8, FC 33, FC 40, FC 1, FC 35, FC 34).

RET_VAL
(Return value)

Value	Description
0000h	no error
8080h	error in the date
8081h	error in the time

SFC 1 - READ_CLK - Read system clock

Description

The SFC 1 READ_CLK (read system clock) reads the contents of the CPU clock. This returns the current time and date.

Parameters

Parameter	Declaration	Data type	Memory block	Description
RET_VAL	OUTPUT	INT	I,Q,M,D,L	If an error occurs when this function is being processed the return value contains the error code.
CDT	OUTPUT	DT	D,L	The current date and time are available at output *CDT*.

RET_VAL (Return value)

SFC 1 does not return any specific error information.

CDT

The current date and time are available at output *CDT*.

SFC 2 ... 4 - Run-time meter

Description

VIPA CPUs have 8 run-time meters.

You can use:

SFC 2	SET_RTM	set run-time meter
SFC 3	CTRL_RTM	run-time meter starting / stopping
SFC 4	READ_RTM	read run-time meter

You can use a runtime meter for a variety of applications:

- for measuring the runtime of a CPU
- for measuring the runtime of controlled equipment or connected devices

Characteristics

When it is started, the runtime meter begins to count starting at the last recorded value. If you want it to start at a different initial value, you must explicitly specify this value with the SFC 2.

If the CPU changes to the STOP mode, or you stop the runtime meter, the CPU records the current value of the runtime meter. When a restart of the CPU is executed, the runtime meter must be restarted with the SFC 3.

Range of values

The runtime meter has a range of value from 0 to 32767 hours.

SFC 2 - SET_RTM - Set run-time meter

Description

The SFC 2 SET_RTM (set run-time meter) sets the run-time meter of the CPU to the specified value. VIPA CPUs contain 8 run-time meters.

Parameters

Parameter	Declaration	Data type	Memory block	Description
NR	INPUT	BYTE	I,Q,M,D,L, constant	Input *NR* contains the number of the run-time meter that you wish to set. Range: 0 to 7
PV	INPUT	INT	I,Q,M,D,L, constant	Input *PV* contains the setting for the run-time meter.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL
(Return value)

Value	Description
0000h	no error
8080h	Incorrect number for the run-time meter
8081h	A negative value was supplied to parameter *PV*.

SFC 3 - CTRL_RTM - Control run-time meter

Description

The SFC 3 CTRL_RTM (control run-time meter) starts or stops the run-time meter depending on the status of input *S*.

Parameters

Parameter	Declaration	Data type	Memory block	Description
NR	INPUT	BYTE	I,Q,M,D,L, constant	Input *NR* contains the number of the run-time meter that you wish to set. Range: 0 to 7
S	INPUT	BOOL	I,Q,M,D,L, constant	Input *S* starts or stops the run-time meter. Set this signal to "0" to stop the run-time meter. Set this signal to "1" to start the run-time meter.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL
(Return value)

Value	Description
0000h	no error
8080h	Incorrect number for the run-time meter

SFC 4 - READ_RTM - Read run-time meter

Description

The SFC 4 READ_RTM (read run-time meter) reads the contents of the run-time meter. The output data indicates the current run-time and the status of the meter ("stopped" or "started").
When the run-time meter has been active for more than 32767 hours it will stop with this value and return value *RET_VAL* indicates the error message "8081: overflow".

Parameters

Parameter	Declaration	Data type	Memory block	Description
NR	INPUT	BYTE	I,Q,M,D,L, constant	Input *NR* contains the number of the run-time meter that you wish to read. Range: 0 to 7
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
CQ	OUTPUT	BOOL	I,Q,M,D,L	output *CQ* indicates whether the run-time meter is started or stopped. • "0": the status of the run-time meter is stopped. • "1": the status of the run-time meter is started.
CV	OUTPUT	INT	I,Q,M,D,L	output *CV* indicates the up to date value of the run-time meter.

RET_VAL
(Return value)

Value	Description
0000	no error
8080	Incorrect number for the run-time meter
8081	run-time meter overflow

SFC 5 - GADR_LGC - Logical address of a channel

Description

The SFC 5 GADR_LGC (convert geographical address to logical address) determines the logical address of the channel of a I/O module.

Parameters

Parameter	Declaration	Data type	Memory block	Description
SUBNETID	INPUT	BYTE	I,Q,M,D,L, constant	area identifier
RACK	INPUT	WORD	I,Q,M,D,L, constant	Rack No.
SLOT	INPUT	WORD	I,Q,M,D,L, constant	Slot-No.
SUBSLOT	INPUT	BYTE	I,Q,M,D,L, constant	Sub-module slot
SUBADDR	INPUT	WORD	I,Q,M,D,L, constant	Offset in user-data address space of the module
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
IOID	OUTPUT	BYTE	I,Q,M,D,L	area identifier
LADDR	OUTPUT	WORD	I,Q,M,D,L	Logical base address for the module

SUBNETID

area identifier:

- "0": if the module is put locally (including expansion rack).
- DP-master-system-ID of the respective decentralized peripheral system when the slot is located in one of the decentralized peripheral devices.

Rack

Rack No., when the address space identification is 0
Station number of the decentralized Peripheral device when falls the area identification >0

SLOT

Slot-Number

SUBSLOT

Sub-module slot
(when sub-modules cannot be inserted this parameter must be 0)

SUBADDR

Offset in user-data address space of the module

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
8094h	No subnet with the specified *SUBNETID* configured.
8095h	Illegal value for parameter *RACK*
8096h	Illegal value for parameter *SLOT*
8097h	Illegal value for parameter SUBSLOT
8098h	Illegal value for parameter *SUBADDR*
8099h	The slot has not been configured.
809Ah	The sub address for the selected slot has not been configured.

IOID

Area identifier:

- 54h: peripheral input (PI)
- 55h: peripheral output (PQ)

For hybrid modules the SFC returns the area identification of the lower address. When the addresses are equal the SFC returns identifier 54h.

LADDR

Logical base address for the module

SFC 6 - RD_SINFO - Read start information

Description

The SFC 6 RD_SINFO (read start information) retrieves the start information of the last OB accessed and that has not yet been processed completely, as well as the last startup OB. These start information items do not contain a time stamp. Two identical start information items will be returned when the call is issued from OB 100.

Parameters

Parameter	Declaration	Data type	Memory block	Description
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
TOP_SI	OUTPUT	STRUCT	D,L	Start information of the current OB
START_UP_SI	OUTPUT	STRUCT	D,L	Start information of the last OB that was started

TOP_SI and START_UP_SI

This refers to two identical structures as shown below.

Structure element	Data type	Description
EV_CLASS	BYTE	Bits 3 to 0: event identifier Bits 7 to 4: event class 1: Start events of standard-OBs 2: Start events of synchronous-error OBs 3: Start events of asynchronous-error OBs
EV_NUM	BYTE	event number
PRIORITY	BYTE	Number defining the priority level
NUM	BYTE	Structure element NUM contains the number of the current OB or of the last OB started
TYP2_3	BYTE	Data identifier 2_3: identifies the information entered into ZI2_3
TYP1	BYTE	Data identifier 1: identifies the information entered into ZI1
ZI1	WORD	Additional information 1
ZI2_3	DWORD	Additional information 2_3

Note!

The content of the structure elements shown in the table above corresponds exactly with the temporary variables of an OB. It must be remembered, however, that the name and the data type of the temporary variables in the different OBs might differ. Furthermore, the call interface of the OBs also contains the date and time at which call to the OB was requested.

RET_VAL (Return value)

The SFC 6 only returns general error information. No specific error information is available.

Example

The OB that was called last and that has not yet been completely processed serves as OB 80; the restart OB that was started last serves as OB 100.

The following table shows the assignment of the structure elements of parameter *TOP_SI* of SFC 6 and the respective local variables of OB 80.

TOP_SI Structure element	Data type	Logical Variable	Data type
EV_CLASS	BYTE	OB100_EV_CLASS	BYTE
EV_NUM	BYTE	OB80_FLT_ID	BYTE
PRIORITY	BYTE	OB80_PRIORITY	BYTE
NUM	BYTE	OB80_OB_NUMBR	BYTE
TYP2_3	BYTE	OB80_RESERVED_1	BYTE
TYP1	BYTE	OB80_ RESERVED_2	BYTE
ZI1	WORD	OB80_ERROR_INFO	WORD
ZI2_3	DWORD	OB80_ERR_EV_CLASS OB80_ERR_EV_NUM OB80_OB_PRIORITY OB80_OB_NUM	BYTE BYTE BYTE BYTE

The following table shows the assignment of the structure elements of parameter *START_UP_SI* of SFC 6 and the respective local variables of OB 100.

START_UP_SI Structure element	Data type	Logical Variable	Data type
EV_CLASS	BYTE	OB100_EV_CLASS	BYTE
EV_NUM	BYTE	OB100_STRTUP	BYTE
PRIORITY	BYTE	OB100_PRIORITY	BYTE
NUM	BYTE	OB100_OB_NUMBR	BYTE
TYP2_3	BYTE	OB100_RESERVED_1	BYTE
TYP1	BYTE	OB100_ RESERVED_2	BYTE
ZI1	WORD	OB100_STOP	WORD
ZI2_3	DWORD	OB100_STRT_INFO	DWORD

SFC 12 - D_ACT_DP - Activating and Deactivating of DP-Slaves

Description

With the SFC 12 D_ACT_DP, you can specifically deactivate and reactivate configured DP slaves. In addition, you can determine whether each assigned DP slave is currently activated or deactivated.

The SFC 12 cannot be used on PROFIBUS PA field devices, which are connected by a DP/PA link to a DP master system.

Note!

As long as any SFC 12 job is busy you cannot download a modified configuration from your PG to the CPU.
The CPU rejects initiation of an SFC 12 request when it receives the download of a modified configuration.

Application

If you configure DP slaves in a CPU, which are not actually present or not currently required, the CPU will nevertheless continue to access these DP slaves at regular intervals. After the slaves are deactivated, further CPU accessing will stop. In this way, the fastest possible DP bus cycle can be achieved and the corresponding error events no longer occur.

Example

Every one of the possible machine options is configured as a DP slave by the manufacturer in order to create and maintain a common user program having all possible options. With the SFC 12, you can deactivate all DP slaves, which are not present at machine startup.

How the SFC operates

The SFC 12 operates asynchronously, in other words, it is executed over several SFC calls. You start the request by calling the SFC 12 with *REQ* = 1.

The status of the job is indicated by the output parameters *RET_VAL* and *BUSY*.

Identifying a job

If you have started a deactivation or activation job and you call the SFC 12 again before the job is completed, the way in which the SFC reacts depends largely on whether the new call involves the same job: if the parameter *LADDR* matches, the SFC call is interpreted as a follow-on call.

Deactivating DP slaves

When you deactivate a DP slave with the SFC 12, its process outputs are set to the configured substitute values or to "0" (secure state).

The assigned DP master does not continue to address this DP slave. Deactivated DP slaves are not identified as fault or missing by the error LEDs on the DP master or CPU.

The process image of the inputs of deactivated DP slaves is updated with 0, that is, it is handled just as for failed DP slaves.

Note!

You can′t deactivate at VIPA all DP slaves.
At least 1 slave must remain activated at the bus.

If you are using your program to directly access the user data of a previously deactivated DP slave, the I/O access error OB (OB 122) is called, and the corresponding start event is entered in the diagnostic buffer.
If you attempt to access a deactivated DP slave with SFC (i.e. SFC 59 RD_REC), you receive the error information in *RET_VAL* as for an unavailable DP slave.

Deactivating a DP slaves OB 85, even if its inputs or outputs belong to the system-side process image to be updated. No entry is made in the diagnostic buffer.

Deactivating a DP slave does not start the slave failure OB 86, and the operating system also does not make an entry in the diagnostic buffer.

If a DP station fails after you have deactivated it with the SFC 12, the operating system does not detect the failure. As a result, there is no subsequent start of OB 86 or diagnostic buffer entry. The station failure is detected only after the station has been reactivated and indicated in *RET_VAL*.

If you wish to deactivate DP slaves functioning as transmitters in cross communication, we recommend that you first deactivate the receivers (listeners) that detect, which input data the transmitter is transferring to its DP master. Deactivate the transmitter only after you have performed this step.

Activating DP slaves

When you reactivate a DP slave with the SFC 12 it is configured and assigned parameters by the designated DP master (as with the return of a failed station). This activation is completed when the slave is able to transfer user data.

Activating a DP slaves does not start the program error OB 85, even if its inputs or outputs belong to the system-side process image to be updated. An entry in the diagnostic buffer is also not made.

Activating a DP slave does not start the slave failure OB 86, and the operating system also does not make an entry in the diagnostic buffer.

If you attempt to use the SFC 12 to activate a slave, who has been deactivated and is physically separated from the DP bus, a supervision time of 10sec expires. After this monitoring period has expired, the SFC returns the error message 80A2h. The slave remains deactivated. If the slave is reconnected to the DP bus at a later time, it must be reactivated with the SFC 12.

Note!

Activating a DP slave may be time-consuming. Therefore, if you wish to cancel a current activation job, start the SFC 12 again with the same value for *LADDR* and *MODE* = 2. Repeat the call of the SFC 12 until successful cancellation of the activation is indicated by *RET_VAL* = 0.

If you wish to activate DP slaves which take part in the cross communication, we recommend that you first activate the transmitters and then the receivers (listeners).

CPU startup

At a restart the slaves are activated automatically. After the CPU start-up, the CPU cyclically attempts to contact all configured and not deactivated slaves that are either not present or not responding.

Note!

The startup OB 100 does not support the call of the SFC 12.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	Level-triggered control parameter *REQ* = 1: execute activation or deactivation
MODE	INPUT	BYTE	I,Q,M,D,L, constant	Job ID Possible values: 0: request information on whether the addressed DP slave is activated or deactivated. 1: activate the DP slave 2: deactivate the DP slave
LAADR	INPUT	WORD	I,Q,M,D,L, constant	Any logical address of the DP slave
RET_VAL	OUTPUT	INT	I,Q,M,D,L	If an error occurs while the function is processed, the return value contains an error code.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	Active code: *BUSY* = 1: the job is still active. *BUSY* = 0: the job was terminated.

RET_VAL
(Return value)

Value	Description
0000h	The job was completed without errors.
0001h	The DP slave is active (This error code is possible only with *MODE* = 0.)
0002h	The DP slave is deactivated (This error code is possible only with *MODE* = 0.)
7000h	First call with *REQ* = 0. The job specified with *LADDR* is not active; *BUSY* has the value 0.
7001h	First call with *REQ* = 1. The job specified with *LADDR* was triggered; *BUSY* has the value 1.
7002h	Interim call (*REQ* irrelevant). The activated job is still active; *BUSY* has the value 1.
8090h	You have not configured a module with the address specified in *LADDR*. You operate your CPU as I-Slave and you have specified in *LADDR* an address of this slave.
8092h	For the addressed DP slave no activation job is processed at the present. (This error code is possible only with *MODE* = 1.)
8093h	No DP slave is assigned to the address stated in *LADDR* (no projection submitted), or the parameter *MODE* is not known.
80A1h	The addressed DP slave could not be parameterized. (This error code is possible only with *MODE* = 1.) **Note!** The SFC supplies this information only if the activated slave fails again during parameterization. If parameterization of a single module was unsuccessful the SFC returns the error information 0000h.
80A2h	The addressed DP slave does not return an acknowledgement.
80A3h	The DP master concerned does not support this function.
80A4h	The CPU does not support this function for external DP masters.
80A6h	Slot error in the DP slave; user data access not possible. (This error code is possible only with *MODE* = 1.) **Note!** The SFC returns this error information only if the active slave fails after parameterization and before the SFC ends. If only a single module is unavailable the SFC returns the error information 0000h.

continued ...

... continue

Value	Explanation
80C1h	The SFC 12 was started and continued with another logical address. (This error code is possible only with *MODE* = 1.)
80C3h	• Temporary resource error: the CPU is currently processing the maximum possible activation and deactivation jobs. (this error code is possible only with *MODE* = 1 and *MODE* = 2). • The CPU is busy receiving a modified configuration. Currently you cannot enable/disable DP slaves.
8xyy	General error information: see Evaluating errors with the Output Parameter *RET_VAL*

SFC 13 - DPNRM_DG - Read diagnostic data of a DP-slave

Description

The SFC 13 DPNRM_DG (read diagnostic data of a DP-slave) reads up-to-date diagnostic data of a DP-slave. The diagnostic data of each DP-slave is defined by EN 50 170 Volume 2, PROFIBUS.

Input parameter *RECORD* determines the target area where the data read from the slave is saved after it has been transferred without error. The read operation is started when input parameter *REQ* is set to 1.

The following table contains information about the principal structure of the slave diagnosis.
For additional information please refer to the manuals for the DP-slaves that you are using.

Byte	description
0	station status 1
1	station status 2
2	station status 3
3	master-station number
4	manufacturer code (high byte)
5	manufacturer code (low byte)
6 ...	additional slave-specific diagnostics

Operation

The SFC 13 is executed as asynchronous SFC, i.e. it can be active for multiple SFC-calls. Output parameters *RET_VAL* and *BUSY* indicate the status of the command as shown by the following table.

Relationship between the call, *REQ*, *RET_VAL* and *BUSY*:

Seq. No. of the call	Type of call	REQ	RET_VAL	BUSY
1	first call	1	7001h or Error code	1 0
2 to (n-1)	intermediate call	irrelevant	7002h	1
n	last call	irrelevant	If the command was completed without errors, then the number of bytes returned is entered as a positive number or the error code if an error did occur.	0 0

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: read request
LADDR	INPUT	WORD	I,Q,M,D,L, constant	The configured diagnostic address of the DP slave
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed. If no error did occur, then *RET_VAL* contains the length of the data that was transferred.
RECORD	OUTPUT	ANY	I,Q,M,D,L	Target area for the diagnostic data that has been read. Only data type BYTE is valid. The minimum length of the read record or respectively the target area is 6. The maximum length of the read record is 240. When the standard diagnostic data exceeds 240bytes on a norm slave and the maximum is limited to 244bytes, then only the first 240bytes are transferred into the target area and the respective overflow-bit is set in the data.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: read operation has not been completed.

RECORD

The CPU tests the actual length of the diagnostic data that was read:
When the length of *RECORD*

- is less than the amount of data the data is discarded and the respective error code is entered into *RET_VAL*.
- is larger than or equal to the amount of data then the data is transferred into the target areas and *RET_VAL* is set to the actual length as a positive value.

Note!
It is essential that the matching *RECORD* parameters are be used for all calls that belong to a single task. A task is identified clearly by input parameter *LADDR* and *RECORD*.

Norm slaves

The following conditions apply if the amount of standard diagnostic data of the norm slave lies between 241 and 244bytes:
When the length of *RECORD*

- is less than 240bytes the data is discarded and the respective error code is entered into *RET_VAL*.
- is greater than 240bytes, then the first 240bytes of the standard diagnostic data are transferred into the target area and the respective overflow-bit is set in the data.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

If no error did occur, then *RET_VAL* contains the length of the data that was transferred.

Note!
The amount of read data for a DP-slave depends on the diagnostic status.

Error information

More detailed information about general error information is to be found at the beginning of this chapter.

The SFC 13 specific error information consists of a subset of the error information for SFC 59 RD_REC. More detailed information is available from the help for SFC 59.

SFC 14 - DPRD_DAT - Read consistent data

Description

The SFC 14 DPRD_DAT (read consistent data of a DP norm slave) reads consistent data from a DP norm slave. The length of the consistent data must be three or more than four bytes, while the maximum length is 64Byte. Please refer to the manual of your specific CPU for details. Input parameter *RECORD* defines the target area where the read data is saved when the data transfer has been completed without errors. The length of the respective target area must be the same as the length that you have configured for the selected module.
If the module consists of a DP-norm slave of modular construction or with multiple DP-identifiers, then a single SFC 14 call can only access the data of a single module / DP-identifier at the configured start address.
SFC 14 is used because a load command accessing the periphery or the process image of the inputs can read a maximum of four contiguous bytes.

Definition

consistent data

Consistent data is data, where the contents belongs to the same category and that may not be separated. It is, for instance, important that data returned by analog modules is always processed consistently, i.e. the value returned by analog modules must not be modified incorrectly when it is read at two different times.

Parameters

Parameter	Declaration	Data type	Memory block	Description
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Configured start address of the receive data buffer of the module from which the data must be read
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed
RECORD	OUTPUT	ANY	I,Q,M,D,L	Target area for the user data that was read. The length must be exactly the same as the length that was configured for the selected module. Only data type BYTE is permitted.

RET_VAL
(Return value)

Value	Description
0000h	No error has occurred.
8090h	You have not configured a module for the logical base address that you have specified, or you have ignored the restrictions that apply to the length of the consistent data.
8092h	The ANY-reference contains a type that is not equal to BYTE.
8093h	No DP-module from which consistent data can be read exists at the logical address that was specified under *LADDR*.
80A0h	Incorrect start address for the address range in the transfer I/O buffer.
80B0h	Slave failure at the external DP-interface
80B1h	The length of the specified target area is not equal to the configured user data length.
80B2h	External DP-interface system error
80B3h	External DP-interface system error
80C0h	External DP-interface system error
80C2h	External DP-interface system error
80Fxh	External DP-interface system error
87xyh	External DP-interface system error
808xh	External DP-interface system error

SFC 15 - DPWR_DAT - Write consistent data

Description

The SFC 15 DPWR_DAT (write consistent data to a DP-norm slave) writes consistent data that is located in parameter *RECORD* to the DP-norm slave. The length of the consistent data must be three or more than four bytes, while the maximum length is 64Byte. Please refer to the manual of your specific CPU for details. Data is transferred synchronously, i.e. the write process is completed when the SFC has terminated. The length of the respective source area must be the same as the length that you have configured for the selected module.
If the module consists of a DP-norm slave of modular construction, then you can only access a single module of the DP-slave.
The SFC 15 is used because a transfer command accessing the periphery or the process image of the outputs can write a maximum of four contiguous bytes.

Definition

Consistent data

Consistent data is data, where the contents belongs to the same category and that may not be separated. For instance, it is important that data returned by analog modules is always processed consistently, i.e. the value returned by analog modules must not be modified incorrectly when it is read at two different times.

Parameters

Parameter	Declaration	Data type	Memory block	Description
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Configured start address of the output buffer of the module to which the data must be written
RECORD	INPUT	ANY	I,Q,M,D,L	Source area for the user data that will be written. The length must be exactly the same as the length that was configured for the selected module. Only data type BYTE is permitted.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL
(Return value)

Value	Description
0000h	No error has occurred.
8090h	You have not configured a module for the logical base address that you have specified, or you have ignored the restrictions that apply to the length of the consistent data.
8092h	The ANY-reference contains a type that is not equal to BYTE.
8093h	No DP-module to which consistent data can be written exists at the logical address that was specified under *LADDR*.
80A1h	The selected module has failed.
80B0h	Slave failure at the external DP-interface
80B1h	The length of the specified source area is not equal to the configured user data length.
80B2h	External DP-interface system error
80B3h	External DP-interface system error
80C1h	The data of the write command that was previously issued to the module has not yet been processed.
80C2h	External DP-interface system error
80Fxh	External DP-interface system error
85xyh	External DP-interface system error
808xh	External DP-interface system error

SFC 17 - ALARM_SQ and SFC 18 - ALARM_S

Description

Every call to the SFC 17 ALARM_SQ and the SFC 18 ALARM_S generates a message that can have an associated value. This message is sent to all stations that have registered for this purpose. The call to the SFC 17 and the SFC 18 can only be issued if the value of signal *SIG* triggering the message was inverted with respect to the previous call. If this is not true output parameter *RET_VAL* will contain the respective information and the message will not be sent. Input *SIG* must be set to "1" when the call to the SFC 17 and SFC 18 is issued for the first time, else the message will not be sent and *RET_VAL* will return an error code.

Note!
The SFC 17 and the SFC 18 should always be called from a FB after you have assigned the respective system attributes to this FB.

System resources

The SFC 17 and the SFC 18 occupy temporary memory that is also used to save the last two signal statuses with a time stamp and the associated value. When the call to the SFC occurs at a time when the signal statuses of the two most recent "valid" SFC-calls has not been sent (signal overflow), then the current signal status as well as the last signal status are discarded and an overflow-code is entered into temporary memory. The signal that occurred before the last signal will be sent as soon as possible including the overflow-code.

Message acknowledgement

Messages sent by means of the SFC 17 can be acknowledged via a display device. The acknowledgement status for the last "message entering state" and the signal status of the last SFC 17-call may be determined by means of the SFC 19 ALARM_SC.
Messages that are sent by SFC 18 are always acknowledged implicitly. The signal status of the last SFC 18-call may be determined by means of the SFC 19 ALARM_SC.

Temporarily saving

The SFCs 17 and 18 occupy temporary memory that is also used to save the last two signal statuses with a time stamp and the associated value. When the call to the SFC occurs at a time when the signal statuses of the two most recent "valid" SFC-calls has not been sent (signal overflow), then the current signal status as well as the last signal status are discarded and an overflow-code is entered into temporary memory. The signal that occurred before the last signal will be sent as soon as possible including the overflow-code.

Instance overflow

The maximum number of SFC 17- und SFC 18-calls depends on the type of CPU being used.
A resource bottleneck (instance overflow) can occur when the number of SFC-calls exceeds the maximum number of dynamic instances. This condition is signaled by means of an error condition in *RET_VAL* and via the registered display device.

Parameters

Parameter	Declaration	Data type	Memory block	Description
SIG	INPUT	BOOL	I,Q,M,D,L	The signal that triggered the message.
ID	INPUT	WORD	I,Q,M,D,L	Data channel for messages: EEEEh
EV_ID	INPUT	DWORD	Const. (I,Q,M,D,L)	Message number (0: not permitted)
SD	INPUT	ANY	I,Q,M,D,T,C	Associated value
RET_VAL	OUTPUT	INT	I,Q,M,D,L	Error information

SD

Associated value

Maximum length: 12Byte

Valid data types BOOL (bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error has occurred.
0001h	• The associated value exceeds the maximum length, or • application memory cannot be accessed (e.g. access to deleted DB). The message will be transferred. • The associated value points to the local data area
0002h	Warning: the last unused message acknowledgement memory has been allocated.
8081h	The specified *EV_ID* lies outside of the valid range.
8082h	Message loss because your CPU suffers from a lack of resources that are required to generate module related messages by means of SFCs.
8083h	Message loss because a signal of the same type is already available but could not be sent (signal overflow).
8084h	The triggering signal *SIG* for messages has the same value for the current and for the preceding SFC 17 / SFC 18 call.
8085h	The specified *EV_ID* has not been registered.
8086h	An SFC call for the specified *EV_ID* is already being processed with a lower priority class.
8087h	The value of the message triggering signal was 0 during the first call to the SFC 17, SFC 18.
8088h	The specified *EV_ID* has already been used by another type of SFC that is currently (still) occupying memory space.
8xyy	General error information

SFC 19 - ALARM_SC - Acknowledgement state of the last Alarm

Description

The SFC 19 ALARM_SC can be used to:

- determine the acknowledgement status of the last SFC 17-entering-state message and the status of the message triggering signal during the last SFC 17 ALARM_SQ call
- the status of the message triggering signal during the last SFC 18 ALARM_S call.

The predefined message number identifies the message and/or the signal. The SFC 19 accesses temporary memory that was allocated to the SFC 17 or SFC 18.

Parameters

Parameter	Declaration	Data type	Memory block	Description
EV_ID	INPUT	DWORD	I,Q,M,D,L, constant	Message number for which you want to determine the status of the signal during the last SFC call or the acknowledgement status of the last entering-state message (only for SFC 17!)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	Return value
STATE	OUTPUT	BOOL	I,Q,M,D,L	Status of the message triggering signal during the last SFC call.
Q_STATE	OUTPUT	BOOL	I,Q,M,D,L	If the specified parameter *EV_ID* belongs to an SFC 18 call: "1"
				If the specified parameter *EV_ID* belongs to an SFC 17 call: acknowledgement status of the last entering-state message: "0": not acknowledged "1": acknowledged

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error has occurred.
8081h	The specified *EV_ID* lies outside of the valid range.
8082h	No memory is allocated to this *EV_ID* at present (possible cause: the status of the respective signal has never been "1", or it has already changed back to status "0".)
8xyy	General Error information

SFC 20 - BLKMOV - Block move

Description

The SFC 20 BLKMOV (block move) copies the contents of one block of memory (source field) into another block of memory (target field).
Any block of memory may be copied, with the exception of :

- the following blocks: FC, SFC, FB, SFB, OB, SDB
- counters
- timers
- memory blocks of the peripheral area.

It is also possible that the source parameter is located in another data block in load memory that is not relevant to the execution (DB that was compiled with key word UNLINKED).

Interruptibility

No limits apply to the nesting depth as long as the source field is not part of a data block that only exists in load memory.
However, when interrupting an SFC 20 that copies blocks from a DB that is not relevant to the current process, then this SFC 20 cannot be nested any longer.

Parameters

Parameter	Declaration	Data type	Memory block	Description
SRCBLK	INPUT	ANY	I,Q,M,D,L	Defines the memory block that must be copied (source field). Arrays of data type STRING are not permitted.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
DSTBLK	OUTPUT	ANY	I,Q,M,D,L	Defines the destination memory block to which the data will be copied (target field). Arrays of data type STRING are not permitted.

Note!

Source and target field must not overlap. If the specified target field is larger than the source filed then only the amount of data located in the source field will be copied. When the specified target field should, however, be smaller than the source filed, then only the amount of data that the target field can accommodate will be copied.
If the type of the ANY-pointer (source or target) is BOOL, then the specified length must be divisible by 8, otherwise the SFC cannot be executed.
If the type of the ANY-pointer is STRING, then the specified length must be equal to 1.

RET_VAL (Return value)

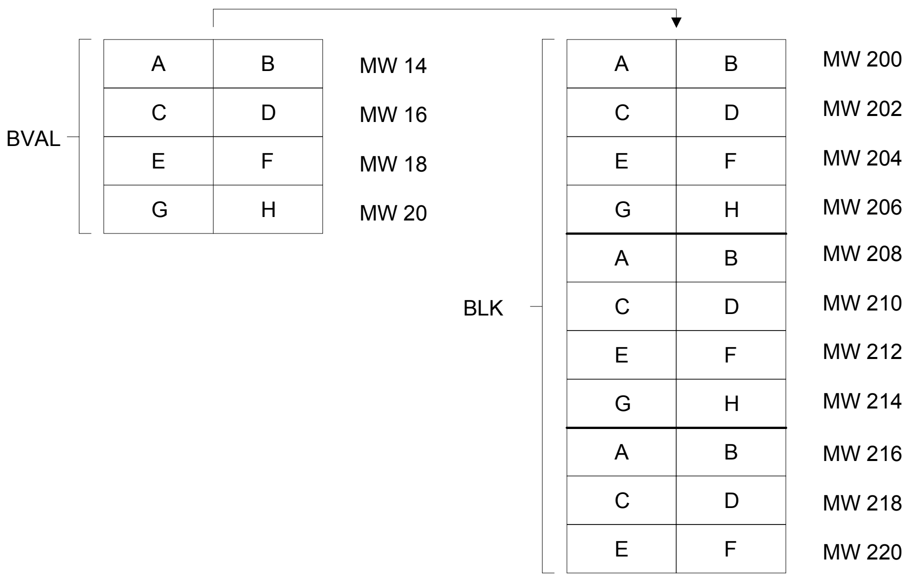
The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error
8091h	The maximum nesting depth was exceeded

SFC 21 - FILL - Fill a field

Description

The SFC 21 FILL fills one block of memory (target field) with the contents of another block of memory (source field). The SFC 21 copies the contents from the source field into the specified target field until the block of memory has been filled completely.



Note!

Source and target field must not overlap. Even if the specified target field is not an integer multiple of the length of input parameter BVAL, the target field will be filled up to the last byte. If the target field is smaller than the source field, only the amount of data that can be accommodated by the target will be copied.

Values cannot be written with the SFC 21 into:

- the following blocks: FC, SFC, FB, SFB, SDB
- counters
- timers
- memory blocks of the peripheral area

Parameters

Parameter	Declaration	Data type	Memory block	Description
BVAL	INPUT	ANY	I,Q,M,D,L	Contains the value or the description of the source field that should be copied into the target field. Arrays of the data type STRING are not permitted.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BLK	OUTPUT	ANY	I,Q,M,D,L	Contains the description of the target field that must be filled. Arrays of the data type STRING are not permitted.

Parameter is a structure

Pay attention to the following when the input parameter consists of a structure:
the length of a structure is always aligned with an even number of bytes. This means, that if you should declare a structure with an uneven number of bytes, the structure will require one additional byte in memory.

Example:

The structure is declared as follows:

STRUKTUR_7_BYTE: STRUCT
BYTE_1_2 : WORD
BYTE_3_4 : WORD
BYTE_5_6 : WORD
BYTE_7: BYTE
END_STRUCT

Structure "STRUKTUR_7_BYTE" requires 8bytes of memory.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

The SFC 21 only returns general error information. No specific error information is available.

SFC 22 - CREAT_DB - Create a data block

Description

The SFC 22 CREAT_DB (create data block) allows the application program to create a data block that does not contain any values. A data block is created that has a number in the specified range and with a specific size. The number assigned to the DB will always be the lowest number in the specified range. To create a DB with specific number you must assigned the same number to the upper and the lower limit of the range. If the application program already contains DBs then the respective numbers cannot be assigned any longer. The length of the DB must be an even number.

Interruptibility

The SFC 22 may be interrupted by OBs with a higher priority. If a call is issued to an SFC 22 from an OB with a higher priority, then the call is rejected with error code 8091h.

Parameters

Parameter	Declaration	Data type	Memory block	Description
LOW_LIMIT	INPUT	WORD	I,Q,M,D,L, constant	The lower limit is the lowest number in the range of numbers that you may assign to your data block.
UP_LIMIT	INPUT	WORD	I,Q,M,D,L, constant	The upper limit is the highest number in the range of numbers that you may assign to your data block.
COUNT	INPUT	WORD	I,Q,M,D,L, constant	The counter defines the number of data bytes that you wish to reserve for your data block. Here you must specify an even number of bytes (maximum 65534).
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
DB_NUMBER	OUTPUT	WORD	I,Q,M,D,L	The data block number is the number of the data block that was created. When an error occurs (bit 15 of *RET_VAL* was set) a value of 0 is entered into *DB_NUMBFC*.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
8091h	You issued a nested call to the SFC 22.
8092h	The function "Create a DB" cannot be executed at present because • the function "Compress application memory" is active
80A1h	Error in the number of the DB: • the number is 0 • the number exceeds the CPU-specific number of DBs • lower limit > upper limit
80A2h	Error in the length of the DB: • the length is 0 • the length was specified as an uneven number • the length is larger than permitted by the CPU
80B1h	No DB-number available
80B2h	Insufficient memory available
80B3h	Insufficient contiguous memory available (compress the memory!).

SFC 23 - DEL_DB - Deleting a data block

Description

The SFC 23 DEL_DB (delete data block) deletes a data block in application memory and if necessary from the load memory of the CPU. The specified DB must not be open on the current level or on a level with a lower priority, i.e. it must not have been entered into one of the two DB-registers and also not into B-stack. Otherwise the CPU will change to STOP mode when the call to the SFC 23 is issued.

The following table indicates when a DB may be deleted by means of the SFC 23.

When the DB ...	then SFC 23 ...
was created by means of a call to SFC 22 "CREAT_DB",	can be used to delete it.
was not created with the key word UNLINKED,	can be used to delete it.

Interruptibility

The SFC 23 may be interrupted by OBs with a higher priority. When another call is issued to the SFC the second call is rejected and *RET_VAL* is set to error code 8091h.

Parameters

Parameter	Declaration	Data type	Memory block	Description
DB_NUMBER	INPUT	WORD	I,Q,M,D,L, constant	Number of the DB that must be deleted.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
8091h	The maximum nesting depth of the respective CPU for nested calls to SFC 23 has been exceeded.
8092h	The function "Delete a DB" cannot be executed at present because • the function "Compress application memory" is active • you are copying the DB to be deleted from the CPU to an offline project
80A1h	Error in input parameter *DB_NUMBER*: the selected actual parameter • has a value of 0 • exceeds the maximum DB number that is possible on the CPU that is being used
80B1h	A DB with the specified number does not exist on the CPU
80B2h	A DB with the specified number was created with the key word UNLINKED
80B3h	The DB is located on the flash memory card

SFC 24 - TEST_DB - Test data block

Description

The SFC 24 TEST_DB (test data block) returns information about a data block that is located in the application memory of the CPU. The SFC determines the number of data bytes and tests whether the selected DB is write protected.

Parameters

Parameter	Declaration	Data type	Memory block	Description
DB_NUMBER	INPUT	WORD	I,Q,M,D,L, constant	Number of the DB that must be tested.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
DB_LENGTH	OUTPUT	WORD	I,Q,M,D,L	The number of data bytes that are contained in the selected DB.
WRITE_PROT	OUTPUT	BOOL	I,Q,M,D,L	Information about the write protection code of the selected DB (1 = write protected).

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
80A1h	Error in input parameter *DB_NUMBER*: the selected actual parameter • has a value of 0 • exceeds the maximum DB number that is possible on the CPU that is being used
80B1h	A DB with the specified number does not exist on the CPU.
80B2h	A DB with the specified number was created with the key word UNLINKED.

SFC 28 ... 31 - Time-of-day interrupt

Conditions

The following conditions must be satisfied before a time-of-day interrupt OB 10 may be called:

- The time-of-day interrupt OB must have been configured by hardware configuration or by means of the SFC 28 (SET_TINT) in the user program.
- The time-of-day interrupt OB must have been activated by hardware configuration or by means of the SFC 30 (ACT_TINT) in the user program.
- The time-of-day interrupt OB must not have been de-selected.
- The time-of-day interrupt OB must exist in the CPU.
- When the SFC 30 is used to set the time-of-day interrupt by a single call to the function the respective start date and time must not have expired when the function is initiated; the periodic execution initiates the time-of-day interrupt OB when the specified period has expired (start time + multiple of the period).

SFCs 28 to 31

The system function are used as follows

- Set: SFC 28
- Cancel: SFC 29
- Activate: SFC 30
- Query: SFC 31

SFC 28 - SET_TINT

The SFC 28 SET_TINT (set time-of-day interrupt) defines the start date and time for the time-of-day interrupt - organization modules. The start time ignores any seconds and milliseconds that may have been specified, these are set to 0.

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB, that is started at a time *SDT* + multiple of *PERIOD* (OB10, OB11).
SDT	INPUT	DT	D,L	Start date and start time
PERIOD	INPUT	WORD	I,Q,M,D,L, constant	Period from the start of *SDT*: 0000h = single 0201h = at minute intervals 0401h = hourly 1001h = daily 1201h = weekly 1401h = monthly 1801h = annually 2001h = at the end of a month
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error
8091h	*SDT* parameter error
8092h	*PERIOD* parameter error
80A1h	The stated date/time has already expired.

SFC 29 - CAN_TINT - Cancel time-of-day interrupt

The SFC 29 CAN_TINT (cancel time-of-day interrupt) deletes the start date and time of the specified time-of-day interrupt - organization block

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB, in which the start date and time will be canceled (OB 10, OB 11).
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error
80A0h	No start date/time was defined for the respective time-of-day interrupt OB.

SFC 30 - ACT_TINT - Activate time-of-day interrupt

The SFC 30 ACT_TINT (activate time-of-day interrupt) is used to activate the specified time-of-day interrupt - organization block

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB to be activated (OB 10, OB 11)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error
80A0h	No start date/time was defined for the respective time-of.-day interrupt OB
80A1h	The activated time has expired; this error can only occur when the function is executed once only.

SFC 31 - QRY_TINT - Query time-of-day interrupt

The SFC 31 QRY_TINT (query time-of-day interrupt) can be used to make the status of the specified time-of-day interrupt - organization block available via the output parameter *STATUS*.

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB, whose status will be queried (OB 10, OB 11).
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status of the time-of-day interrupt.

RET_VAL
(Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error

STATUS

Bit	Value	Description
0	0	The operating system has enabled the time-of-day interrupt.
1	0	New time-of-day interrupts are not discarded.
2	0	Time-of-day interrupt has not been activated and has not expired.
3	-	reserved
4	0	Time-of-day interrupt-OB has not been loaded.
5	0	An active test function disables execution of the time-of-day interrupt-OB.

SFC 32 - SRT_DINT - Start time-delay interrupt

Description

The SFC 32 SRT_DINT (start time-delay interrupt) can be used to start a time-delay interrupt that issues a call to a time-delay interrupt OB after the pre-configured delay time (parameter *DTIME*) has expired. Parameter *SIGN* specifies a user-defined code that identifies the start of the time-delay interrupt. While the function is being executed the values of *DTIME* and *SIGN* appear in the startup event information of the specified OB.

Conditions

The following conditions must be satisfied before a time-delay interrupt OB may be called:

- the time-delay interrupt OB must have been started (using the SFC 32)
- the time-delay interrupt OB must not have been de-selected.
- the time-delay interrupt OB must exist in the CPU.

Parameter

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB, that is started after the time delay (OB 20, OB 21).
DTIME	INPUT	TIME	I,Q,M,D,L, constant	The delay time (1 to 60 000ms)
SIGN	INPUT	WORD	I,Q,M,D,L, constant	Code that is inserted into the startup event information of the OB when a call is issued to the time-delay interrupt.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

Accuracy

The time from the call to the SFC 32 and the start of the time-delay interrupt OB may be less than the configured time by no more than one millisecond, provided that no interrupt events have occurred that delay the call.

RET_VAL (Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error
8091h	*DTIME* parameter error

SFC 33 - CAN_DINT - Cancel time-delay interrupt

Description

The SFC 33 CAN_DINT (cancel time-delay interrupt) cancels a time-delay interrupt that has already been started. The call to the respective time-delay interrupt OB will not be issued.

Conditions

The following conditions must be satisfied before a time-delay interrupt OB may be called:

- The time-delay interrupt OB must have been started (using the SFC 32).
- The time-delay interrupt OB must not have been de-selected.
- The time-delay interrupt OB must exist in the CPU.

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, constant	Number of the OB, that must be cancelled (OB 20, OB 21).
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error
80A0h	Time-delay interrupt has not been started.

SFC 34 - QRY_DINT - Query time-delay interrupt

Description

The SFC 34 QRY_DINT (query time-delay interrupt) can be used to make the status of the specified time-delay interrupt available via the output parameter *STATUS*.

Conditions

The following conditions must be satisfied before a time-delay interrupt OB may be called:

- The time-delay interrupt OB must have been started (using the SFC 32).
- The time-delay interrupt OB must not have been de-selected.
- The time-delay interrupt OB must exist in the CPU.

Parameters

Parameter	Declaration	Data type	Memory block	Description
OB_NR	INPUT	INT	I,Q,M,D,L, Constant	Number of the OB, that must be cancelled (OB 20, OB 21)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status of the time-delay interrupt

RET_VAL
(Return value)

Value	Description
0000h	No error has occurred.
8090h	*OB_NR* parameter error

STATUS

Bit	Value	Description
0	0	The operating system has enabled the time-delay interrupt.
1	0	New time-delay interrupts are not discarded.
2	0	Time-delay interrupt has not been activated and has not expired.
3	-	-
4	0	Time-delay interrupt-OB has not been loaded.
5	0	An active test function disables execution of the time-delay interrupt-OB.

SFC 36 - MSK_FLT - Mask synchronous errors

Description

The SFC 36 MSK_FLT (mask synchronous faults) is used to control the reaction of the CPU to synchronous faults by masking the respective synchronous faults.
The call to the SFC 36 masks the synchronous faults of the current priority class. If you set individual bits of the synchronous fault mask in the input parameters to "1" other bits that have previously been set will remain at "1". This result in new synchronous fault masks that can be retrieved via the output parameters. Masked synchronous faults are entered into an error register and do not issue a call to an OB. The error register is read by means of the SFC 38 READ_ERR.

Parameters

Parameter	Declaration	Data type	Memory block	Description
PRGFLT_SET_MASK	INPUT	DWORD	I,Q,M,D,L, constant	Programming faults that must be masked out
ACCFLT_SET_MASK	INPUT	DWORD	I,Q,M,D,L, constant	Access faults that must be masked out
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
PRGFLT_MASKED	OUTPUT	DWORD	I,Q,M,D,L	Masked programming faults
ACCFLT_MASKED	OUTPUT	DWORD	I,Q,M,D,L	Masked access errors

RET_VAL
(Return value)

Value	Description
0000h	None of the faults has previously been masked.
0001h	One or more of the faults has already been masked, however, the other faults will still be masked out.

SFC 37 - DMSK_FLT - Unmask synchronous errors

Description

The SFC 37 DMSK_FLT (unmask synchronous faults) unmasks any masked synchronous faults. A call to the SFC 37 unmasks the synchronous faults of the current priority class. The respective bits in the fault mask of the input parameters are set to "1". This results in new fault masks that you can read via the output parameters. Queried entries are deleted from in the error register.

Parameters

	Declaration	Data type	Memory block	Description
PRGFLT_RESET_MASK	INPUT	DWORD	I,Q,M,D,L, constant	Programming faults that must be unmasked
ACCFLT_RESET_MASK	INPUT	DWORD	I,Q,M,D,L, constant	Access faults that must be unmasked
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
PRGFLT_MASKED	OUTPUT	DWORD	I,Q,M,D,L	Masked programming faults
ACCFLT_MASKED	OUTPUT	DWORD	I,Q,M,D,L	Masked access errors

RET_VAL
(Return value)

Value	Description
0000h	All the specified faults have been unmasked.
0001h	One or more of the faults was not masked, however, the other faults will still be unmasked.

SFC 38 - READ_ERR - Read error register

Description

The SFC 38 READ_ERR (read error registers) reads the contents of the error register. The structure of the error register is identical to the structure of the programming fault and access fault masks that were defined as input parameters by means of the SFC 36 and 37. When you issue a call to the SFC 38 the specified entries are read and simultaneously deleted from the error register. The input parameters define which synchronous faults will be queried in the error register. The function indicates the masked synchronous faults of the current priority class that have occurred once or more than once. When a bit is set it signifies that the respective masked synchronous fault has occurred.

Parameters

Parameter	Declaration	Data type	Memory block	Description
PRGFLT_QUERY	INPUT	DWORD	I,Q,M,D,L, constant	Query programming faults
ACCFLT_QUERY	INPUT	DWORD	I,Q,M,D,L, constant	Query access faults
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
PRGFLT_ESR	OUTPUT	DWORD	I,Q,M,D,L	Programming faults that have occurred
ACCFLT_ESR	OUTPUT	DWORD	I,Q,M,D,L	Access faults that have occurred

RET_VAL
(Return value)

Value	Description
0000h	All the specified faults have been masked.
0001h	One or more of the faults that have occurred was not masked.

SFC 39 - DIS_IRT - Disabling interrupts

Description

With the SFC 39 DIS_IRT (disable interrupt) you disable the processing of new interrupts and asynchronous errors.
This means that if an interrupt occurs, the operating system of the CPU reacts as follows:

- if neither calls an interrupt OB asynchronous error OB,
- nor triggers the normal reaction if an interrupt OB or asynchronous error OB is not programmed.

If you disable interrupts and asynchronous errors, this remains in effect for all priority classes. The effects of SFC 39 can only be canceled again by calling the SFC 40 or by a restart.

Whether the operating system writes interrupts and asynchronous errors to the diagnostic buffer when they occur depends on the input parameter setting you select for *MODE*.

Note!
Remember that when you program the use of the SFC 39, all interrupts that occur are lost.

Parameters

Parameter	Declaration	Data type	Memory block	Description
MODE	INPUT	BYTE	I,Q,M,D,L, constant	Specifies which interrupts and asynchronous errors are disabled.
OB_NR	INPUT	INT	I,Q,M,D,L, constant	OB number
RET_VAL	OUTPUT	INT	I,Q,M,D,L	If an error occurs while the function is active, the return value contains an error code.

MODE

MODE	Meaning
00	All newly occurring interrupts and asynchronous errors are disabled (Synchronous errors are not disabled).
01	All newly occurring events belonging to a specified interrupt class are disabled. Identify the interrupt class by specifying it as follows: • Time-of-day interrupts: 10 • Time-delay interrupts: 20 • Cyclic interrupts: 30 • Hardware interrupts: 40 • Interrupts for DP-V1: 50 • Asynchronous error interrupts: 80 Entries into the diagnostic buffer are continued.
02	All new occurrences of a specified interrupt are disabled. You specify the interrupt using the OB number. Entries into the diagnostic buffer are continued.
80	All new occurrences of a specified interrupt are disabled. You specify the interrupt using the OB number. Entries continue to be made in the diagnostic buffer.
81	All new occurrences belonging to a specified interrupt class are disabled and are no longer entered in the diagnostic buffer. The operating system enters event 5380h in the diagnostic buffer.
82	All new occurrences belonging to a specified interrupt are disabled and are no longer entered in the diagnostic buffer. The operating system enters event 5380h in the diagnostic buffer.

RET_VAL
(Return value)

Value	Explanation
0000h	No error occurred.
8090h	The input parameter *OB_NR* contains an illegal value.
8091h	The input parameter *MODE* contains an illegal value.
8xyyh	General error information, see Evaluating Errors with the Output parameter *RET_VAL*.

SFC 40 - EN_IRT - Enabling interrupts

Description

With the SFC 40 EN_IRT (enable interrupt) you enable the processing of new interrupts and asynchronous errors that you previously disabled with the SFC 39. This means that if an interrupt event occurs, the operating system of the CPU reacts in one of the follows ways:

- it calls an interrupt OB or asynchronous error OB,
  or
- it triggers the standard reaction if an interrupt OB or asynchronous error OB is not programmed.

Parameters

Parameter	Declaration	Data type	Memory block	Description
MODE	INPUT	BYTE	I,Q,M,D,L, constant	Specifies which interrupts and asynchronous errors will be enabled.
OB_NR	INPUT	INT	I,Q,M,D,L, constant	OB number
RET_VAL	OUTPUT	INT	I,Q,M,D,L	If an error occurs while the function is active, the return value contains an error code.

MODE

MODE	Meaning
00	All newly occurring interrupts and asynchronous errors are enabled.
01	All newly occurring events belonging to a specified interrupt class are enabled. Identify the interrupt class by specifying it as follows: • Time-of-day interrupts: 10 • Time-delay interrupts: 20 • Cyclic interrupts: 30 • Hardware interrupts: 40 • Interrupts for DP-V1: 50 • Asynchronous error interrupts: 80
02	All newly occurring events of a specified interrupt are enabled. You specify the interrupt using the OB number.

RET_VAL
(Return value)

Value	Description
0000h	No error occurred.
8090h	The input parameter *OB_NR* contains an illegal value.
8091h	The input parameter *MODE* contains an illegal value.
8xyyh	General error information, see Evaluating Errors with the Output parameter *RET_VAL*.

SFC 41 - DIS_AIRT - Delaying interrupts

Description

The SFC 41 DIS_AIRT (disable alarm interrupts) disables processing of interrupt OBs and asynchronous fault OBs with a priority that is higher than the priority of the current OB. You can issue multiple calls to the SFC 41. The operating system will count the number of calls to the SFC 41. Processing of interrupt OBs is disabled until you issue an SFC 42 EN_AIRT to enable all interrupt OBs and asynchronous fault OBs that were disabled by means of SFC 41 or until processing of the current OB has been completed.
Any queued interrupt or asynchronous fault interrupts will be processed as soon as you enable processing by means of the SFC 42 EN_AIRT or when processing of the current OB has been completed.

Parameters

Parameter	Declaration	Data type	Memory area	Description
RET_VAL	OUTPUT	INT	I,Q,M,D,L	Number of disable calls (= number of calls to the SFC 41)

RET_VAL (Return value)

When the SFC has been completed the return value *RET_VAL* indicates the number of disables, i.e. the number of calls to the SFC 41 (processing of all alarm interrupts is only enabled again when *RET_VAL* = 0).

SFC 42 - EN_AIRT - Enabling delayed interrupts

Description

The SFC 42 EN_AIRT (enable alarm interrupts) enables processing of high priority interrupt OBs and asynchronous fault OBs.
Every disabled interrupt must be re-enabled by means of the SFC 42. If you have disabled 5 different interrupts by means of 5 SFC 41 calls you must re-enable every alarm interrupt by issuing 5 individual SFC 42 calls.

Parameters

Parameter	Declaration	Data type	Memory block	Description
RET_VAL	OUTPUT	INT	I,Q,M,D,L	Number of disabled interrupts when the SFC 42 has been completed or the error code when an error has occurred while the function was being processed.

RET_VAL (Return value)

When the SFC has been completed the return value *RET_VAL* indicates the number of disables, i.e. the number of calls to the SFC 41 (processing of all alarm interrupts is only enabled again when *RET_VAL* = 0).

Value	Description
8080h	The function was started in spite of the fact that the alarm interrupt had already been enabled.

SFC 43 - RE_TRIGR - Retrigger the watchdog

Description

The SFC 43 RE_TRIGR (retrigger watchdog) restarts the watchdog timer of the CPU.

Parameter and return values

The SFC 43 has neither parameters nor return values.

SFC 44 - REPL_VAL - Replace value to AKKU1

Description

The SFC 44 REPL_VAL (replace value) transfers a value into AKKU1 of the program level that cause the fault. A call to the SFC 44 can only be issued from synchronous fault OBs (OB 121, OB 122).

Application example for the SFC 44:
When an input module malfunctions so that it is not possible to read any values from the respective module then OB 122 will be started after each attempt to access the module. The SFC 44 REPL_VAL can be used in OB 122 to transfer a suitable replacement value into AKKU1 of the program level that was interrupted. The program will be continued with this replacement value. The information required to select a replacement value (e.g. the module where the failure occurred, the respective address) are available from the local variables of OB 122.

Parameters

Parameter	Declaration	Data type	Memory block	Description
VAL	INPUT	DWORD	I,Q,M,D,L, constant	Replacement value
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

RET_VAL (Return value)

Value	Description
0000h	No error has occurred. A replacement value has been entered.
8080h	The call to the SFC 44 was not issued from a synchronous fault OB (OB 121, OB 122).

SFC 46 - STP - STOP the CPU

Description

The SFC 46 STP changes the operation mode of the CPU to STOP.

Parameter and return values

The SFC 46 has neither parameters nor return values.

SFC 47 - WAIT - Delay the application program

Description

The SFC 47 WAIT can be used to program time delays or wait times from 1 up to 32767µs in your application program.

Interruptibility

The SFC 47 may be interrupted by high priority OBs.

Note!
Delay times that were programmed by means of the SFC 47 are minimum times that may be extended by the execution time of the nested priority classes as well as the load on the system!

Parameters

Parameter	Declaration	Data type	Memory block	Description
WT	INPUT	INT	I,Q,M,D,L, constant	Parameter *WT* contains the delay time in µs.

Error information

The SFC 47 does not return specific error codes.

SFC 49 - LGC_GADR - Read the slot address

Description

The SFC 49 LGC_GADR (convert logical address to geographical address) determines the slot location for a module from the logical address as well as the offset in the user-data address space for the module.

Parameters

Parameter	Declaration	Data type	Memory block	Description
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PO) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical address. For hybrid modules the lower of the two addresses must be specified.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
AREA	OUTPUT	BYTE	I,Q,M,D,L	Area identifier: this defines how the remaining output parameters must be interpreted.
RACK	OUTPUT	WORD	I,Q,M,D,L	See next page.
SLOT	OUTPUT	WORD	I,Q,M,D,L	
SUBADDR	OUTPUT	WORD	I,Q,M,D,L	

AREA

AREA specifies how the output parameters *RACK*, *SLOT* and *SUBADDR* must be interpreted. These dependencies are depicted below.

Value of AREA	System	Significance of RACK, SLOT and SUBADDR
0	-	reserved
1	Siemens S7-300	*RACK*: Rack number *SLOT*: Slot number *SUBADDR* : Address offset to base address
2	Decentralized periphery	*RACK* (Low Byte): Station number *RACK* (High Byte): DP master system ID *SLOT*: Slot number at station *SUBADDR* : Address offset to base address
3 ... 6	-	reserved

RET_VAL
(Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error has occurred.
8090h	The specified logical address is not valid or an illegal value exists for parameter *IOID*

SFC 50 - RD_LGADR - Read all logical addresses of a module

Description

The SFC 50 RD_LGADR (read module logical addresses) determines all the stipulated logical addresses of a module starting with a logical address of the respective module.
You must have previously configured the relationship between the logical addresses and the modules. The logical addresses that were determined are entered in ascending order into the field *PEADDR* or into field PAADDR.

Parameters

Parameter	Declaration	Data type	Memory block	Description
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Area identification: 54h = peripheral input (PI) 55h = peripheral output (PQ)
LADDR	INPUT	WORD	I,Q,M,D,L, constant	A logical address
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
PEADDR	OUTPUT	ANY	I,Q,M,D,L	Field for the PI-addresses, field elements must be of data type WORD.
PECOUNT	OUTPUT	INT	I,Q,M,D,L	Number of returned PI addresses
PAADDR	OUTPUT	ANY	I,Q,M,D,L	Field for PQ addresses, field elements must be of data type WORD.
PACOUNT	OUTPUT	INT	I,Q,M,D,L	Number of returned PQ addresses

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	No error has occurred.
8090h	The specified logical address is not valid or illegal value for parameter *IOID*
80A0 h	Error in output parameter *PEADDR*: data type of the field elements is not WORD.
80A1h	Error in output parameter PAADDR: data type of the field elements is not WORD.
80A2h	Error in output parameter *PEADDR*: the specified field could not accommodate all the logical addresses.
80A3h	Error in output parameter PAADDR: the specified field could not accommodate all the logical addresses.

SFC 51 - RDSYSST - Read system status list SZL

Description

The SFC 51 RDSYSST (read system status) returns a SZL partial list or an extract of an SZL partial list.

The read operation is started by setting input parameter *REQ* to 1 when the call to the SFC 51 is issued. If the read operation was execute immediately output parameter *BUSY* returns a value of 0. If the read operation could not be completed *BUSY* is set to 1.

Note!

The read operation is executed immediately when the call to the SFC 51 is issued from the diagnostic interrupt OB with the *SZL-ID* 00B1h, 00B2h or 00B3h and the module that issued the diagnostic interrupt is accessed.

System resources

When multiple asynchronous read operations are initiated (*SZL_ID* 00B4h, 4C91h, 4092h, 4292h, 4692h and possibly 00B1h and 00B3h) within a short period of time then the operating system ensures that all jobs will be executed and that the operations do not interfere with each other. When the system reaches the limit of its resources the situation is signaled via *RET_VAL*. A temporary error can be corrected by repeating the job.
At a maximum of 30 SFC 51 jobs may be active "simultaneously".

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: start processing
SZL_ID	INPUT	WORD	I,Q,M,D,L, constant	*SZL-ID* of the partial list or the partial list extract
INDEX	INPUT	WORD	I,Q,M,D,L, constant	Type or number of an object in a partial list
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: read operation has not been completed
SZL_HEADER	OUTPUT	STRUCT	D,L	See below
DR	OUTPUT	ANY	I,Q,M,D,L	Target area for the SZL partial list that was read or the SZL partial list extract that was read: • If you should only have read the header information of an SZL partial list, then you must not use DR, but only SZL_HEADFC • In all other cases the product of LENGTHDR and N_DR indicates the number of bytes that will be entered into DR.

SZL_HEADER

Parameter *SZL_HEADER* is a structure with the following contents:

```
SZL_HEADER:   STRUCT
   LENGTHDR:  WORD
   N_DR:      WORD
END_STRUCT
```

LENGTHDR defines the length of a record of the SZL partial list or the SZL partial list extract.

- If you have only read the header information from an SZL partial list then N_DR contains the number of existing records.
- Else N_DR contains the number of records that were transferred into the target area.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
0081h	The length of the result field is too low (the function still returns as many records as possible. The SZL header indicates the returned number of records.)
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8081h	The length of the result field is too low (not enough space for one record)
8082h	*SZL_ID* is wrong or unknown to the CPU or the SFC.
8083h	Bad or illegal *INDEX*
8085h	Information not available for system-related reasons, e.g. because of a lack of resources.
8086h	record not readable due to a system error (bus, module, operating system).
8087h	record not readable because the module does not exist or because it does not return an acknowledgement.
8088h	record not readable because the actual type identifier differs from the expected type identifier.
8089h	record not readable because the module does not support diagnostic functions.
80A2h	DP protocol error (Layer-2 error) (temporary fault)
80A3h	DP protocol error on user-interface/user (temporary fault)
80A4h	Bus communication failure (this error occurs between the CPU and the external DP interface) (temporary fault)
80C5h	Decentralized periphery not available (temporary fault)
80C6h	Transfer of records aborted because of a priority class abort (warm start or background)

SFC 52 - WR_USMSG - Write user entry into diagnostic buffer

Description

The SFC 52 WR_USMSG (write user element in diagnosis buffer) writes a used defined diagnostic element into the diagnostic buffer.

Send diagnostic message

To determine whether it is possible to send user defined diagnostic messages you must issue a call to SFC 51 "RDSYSST" with parameters *SZL_ID* = 0132h and *INDEX* = 0005h. Sending of user defined diagnostic messages is possible if the fourth word of the returned data record is set to "1". If it should contain a value of "0", sending is not possible.

Send buffer full

The diagnostic message can only be entered into the send buffer if this is not full. At a maximum of 50 entries can be stored in the send buffer.

If the send buffer is full

- the diagnostic event is still entered into the diagnostic buffer
- the respective error message (8092h) is entered into parameter *RET_VAL*.

Partner not registered

When a user defined diagnostic message must be sent and no partner has registered, then

- the diagnostic event is still entered into the diagnostic buffer.
- the respective error message (0091h or 8091h) is entered into parameter *RET_VAL*.

The contents of an entry

The structure of the entry in the diagnostic buffer is as follows:

Byte	Contents
1, 2	Event ID
3	Priority class
4	OB number
5, 6	reserved
7, 8	Additional information 1
9, 10, 11, 12	Additional information 2
13 to 20	Time stamp: The data type of the time stamp is Date_and_Time.

Event ID

Every event is assigned to an event ID.

Additional information

The additional information contains more specific information about the event. This information differs for each event. When a diagnostic event is generated the contents of these entries may be defined by the user.
When a user defined diagnostic message is sent to the partners this additional information may be integrated into the (event-ID specific) message text as an associated value.

Parameters

Parameter	Declaration	Data type	Memory block	Description
SEND	INPUT	BOOL	I,Q,M,D,L, constant	Enable sending of user defined diagnostic messages to all registered partners
EVENTN	INPUT	WORD	I,Q,M,D,L, constant	Event-ID. The user assigns the event-ID. This is not preset by the message server.
INFO1	INPUT	ANY	I,Q,M,D,L	Additional information, length 1 word
INFO2	INPUT	ANY	I,Q,M,D,L	Additional information, length 2 words
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.

SEND

When SEND is set to 1 the user defined diagnostic message is sent to all partners that have registered for this purpose. Sending is only initiated when one or more partners have registered and the send buffer is not full. Messages are sent asynchronously with respect to the application program.

EVENTN

The event ID of the user event is entered into *EVENTN*. Event IDs must be of the format 8xyzh , 9xyzh, Axyzh and Bxyzh. Here the IDs of format 8xyzh and 9xyzh refer to predefined events and IDs of format Axyzh and Bxyzh refer to user-defined events.
An event being activated is indicated by x = 1, an event being deactivated by x = 0.
For events of the class A and B, yz refers to the message number that was predefined in hexadecimal representation when the messages were configured.

INFO1

INFO1 contains information with a length of one word. The following data types are valid:

- WORD
- INT
- ARRAY [0...1] OF CHAR

INFO1 can be integrated as associated value into the message text, i.e. to add current information to the message.

INFO2

INFO2 contains information with a length of two words. The following data types are valid:

- DWORD
- DINT
- REAL
- TIME
- ARRAY [0...3] OF CHAR

INFO2 can be integrated as associated value into the message text, i.e. to add current information to the message.

RET_VAL (Return value)

The return value contains an error code if an error is detected when the function is being processed.

Value	Description
0000h	no error
0091h	No partner registered (the diagnostic event has been entered into the diagnostic buffer)
8083h	Data type *INFO1* not valid
8084h	Data type *INFO2* not valid
8085h	*EVENTN* not valid
8086h	Length of *INFO1* not valid
8087h	Length of *INFO2* not valid
8091h	Error message identical to error code 0091h
8092h	Send operation currently not possible, send buffer full (the diagnostic event has been entered into the diagnostic buffer)

SFC 54 - RD_DPARM - Read predefined parameter

Description

The SFC 54 RD_DPARM (read defined parameter) reads the record with number *RECNUM* of the selected module from the respective SDB1xy.

Parameter *RECORD* defines the target area where the record will be saved

Parameters

Parameter	Declaration	Data type	Memory block	Description
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical address. For hybrid modules the lower of the two addresses must be specified.
RECNUM	INPUT	BYTE	I,Q,M,D,L, constant	record number (valid range: 0 to 240)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed. Additionally: the length of the record that was read in bytes, provided the size of the record fits into the target area and that no communication errors have occurred.
RECORD	OUTPUT	ANY	I,Q,M,D,L	Target area for the record that was read. Only data type BYTE is valid.

RET_VAL (Return value)

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A1h, 80Bxh, 80Dxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8092h	ANY-reference contains a type definition that is not equal to BYTE.
8093h	This SFC is not valid for the module selected by *LADDR* and *IOID*.
80B1h	The length of the target area defined by *RECORD* is too small.
80D0h	The respective SDB does not contain an entry for the module.
80D1h	The record number has not been configured in the respective SDB for the module.
80D2h	According to the type identifier the module cannot be configured.
80D3h	SDB cannot be accessed since it does not exist.
80D4h	Bad SDB structure: the SDB internal pointer points to an element outside of the SDB.

SFC 55 - WR_PARM - Write dynamic parameter

Description

The SFC 55 WR_PARM (write parameter) transfers the record *RECORD* to the target module. Any parameters for this module that exist in the respective SDB will not be replaced by the parameters that are being transferred to the module.

These SFC can be used for digital-, analog modules, FMs, CPs and via Profibus DP-V1.

Conditions

It is important that the record that must be transferred is not static, i.e.:

- do not use record 0 since this record is static for the entire system.
- if the record appears in SDBs 100 to 129 then the static-bit must not be set.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: write request
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical base address of the module. For hybrid modules the lower of the two addresses must be specified.
RECNUM	INPUT	BYTE	I,Q,M,D,L, constant	record number (valid values: 0 to 240)
RECORD	INPUT	ANY	I,Q,M,D,L	Record
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the write operation has not been completed.

RECORD

With the first call to the SFC the data that must be transferred is read from the parameter *RECORD*. However, if the transfer of the record should require more than one call duration, the contents of the parameter *RECORD* is no longer valid for subsequent calls to the SFC (of the same job).

RET_VAL (Return value)

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A1h, 80Bxh, 80Dxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8092h	ANY-reference contains a type definition that is not equal to BYTE.
8093h	This SFC is not valid for the module selected by *LADDR* and *IOID*.
80A1h	Negative acknowledgement when the record is being transferred to the module (module was removed during the transfer or module failed)
80A2h	DP protocol fault in layer 2, possible hardware-/ interface fault in the DP slave
80A3h	DP protocol fault for user Interface/user
80A4h	Communication failure (this fault occurs between the CPU and the external DP interface)
80B0h	SFC cannot be used with this type of module or the module does not recognize the record.

continued ...

... continue

Value	Description
80B1h	The length of the target area determined by *RECORD* is too small.
80B2h	The slot that was configured has not been populated.
80B3h	The actual type of module is not equal to the required type of module in SDB1
80C1h	The module has not yet completed processing of the data of the preceding write operation for the same record.
80C2h	The module is currently processing the maximum number of jobs for a CPU.
80C3h	Required resources (memory, etc.) are currently occupied.
80C4h	Communication error:
80C5h	Decentralized periphery not available.
80C6h	The transfer of records was aborted due to a priority class abort (warm start or background)
80D0h	The respective SDB does not contain an entry for the module.
80D1h	The record number was not configured in the respective SDB.
80D2h	Based on the type identifier the module cannot be configured.
80D3h	The SDB cannot be accessed since it does not exist.
80D4h	Bad SDB structure: the SDB internal pointer points to an element outside of the SDB.
80D5h	The record is not static.

SFC 56 - WR_DPARM - Write default parameter

Description

The SFC 56 WR_DPARM (write default parameter) transfers the record *RECNUM* from the respective SDB to the target module, irrespective of whether the specific record is static or dynamic.

These SFC can be used for digital-, analog modules, FMs, CPs and via Profibus DP-V1.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: write request
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical base address of the module. For hybrid modules the lower of the two addresses must be specified.
RECNUM	INPUT	BYTE	I,Q,M,D,L, constant	Record number (valid values: 0 to 240)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the write operation has not been completed.

RET_VAL (Return value)

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A1h, 80Bxh, 80Dxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8093h	This SFC is not valid for the module selected by means of *LADDR* and *IOID*.
80A1h	Negative acknowledgement when the record is being transferred to the module (module was removed during the transfer or module failed)
80A2h	DP protocol fault in layer 2, possible hardware-/ interface fault in the DP slave
80A3h	DP protocol fault for user Interface/user
80A4h	Communication failure (this fault occurs between the CPU and the external DP interface)
80B0h	SFC cannot be used with this type of module or the module does not recognize the record.
80B1h	The length of the target area determined by *RECORD* is too small.
80B2h	The slot that was configured has not been populated.
80B3h	The actual type of module is not equal to the required type of module in SDB1
80C1h	The module has not yet completed processing of the data of the preceding write operation for the same record.

continued ...

... continue

Value	Description
80C2h	The module is currently processing the maximum number of jobs for a CPU.
80C3h	Required resources (memory, etc.) are currently occupied.
80C4h	Communication error
80C5h	Decentralized periphery not available.
80C6h	The transfer of records was aborted due to a priority class abort (warm start or background)
80D0h	The respective SDB does not contain an entry for the module.
80D1h	The record number was not configured in the respective SDB.
80D2h	Based on the type identifier the module cannot be configured.
80D3h	The SDB cannot be accessed since it does not exist.
80D4h	Bad SDB structure: the SDB internal pointer points to an element outside of the SDB.

SFC 57 - PARM_MOD - Parameterize module

Description

The SFC 57 PARM_MOD (parameterize module) transfers all the records that were configured in the respective SDB into a module, irrespective of whether the specific record is static or dynamic.

These SFC can be used for digital-, analog modules, FMs, CPs and via Profibus DP-V1.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: write request
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical base address of the module. For hybrid modules the lower of the two addresses must be specified.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the write operation has not been completed.

RET_VAL (Return value)

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A1h, 80Bxh, 80Dxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8093h	This SFC is not valid for the module selected by means of *LADDR* and *IOID*.
80A1h	Negative acknowledgement when the record is being transferred to the module (module was removed during the transfer or module failed)
80A2h	DP protocol fault in layer 2, possible hardware-/ interface fault in the DP slave
80A3h	DP protocol fault for user Interface/user
80A4h	Communication failure (this fault occurs between the CPU and the external DP interface)
80B0h	SFC cannot be used with this type of module or the module does not recognize the record.
80B1h	The length of the target area determined by *RECORD* is too small.
80B2h	The slot that was configured has not been populated.
80B3h	The actual type of module is not equal to the required type of module in SDB1
80C1h	The module has not yet completed processing of the data of the preceding write operation for the same record.
80C2h	The module is currently processing the maximum number of jobs for a CPU.
80C3h	Required resources (memory, etc.) are currently occupied.

continued ...

... continue

Value	Description
80C4h	Communication error
80C5h	Decentralized periphery not available.
80C6h	The transfer of records was aborted due to a priority class abort (warm start or background)
80D0h	The respective SDB does not contain an entry for the module.
80D1h	The record number was not configured in the respective SDB.
80D2h	Based on the type identifier the module cannot be configured.
80D3h	The SDB cannot be accessed since it does not exist.
80D4h	Bad SDB structure: the SDB internal pointer points to an element outside of the SDB.

SFC 58 - WR_REC - Write record

Description

The SFC 58 WR_REC (write record) transfers the record *RECORD* into the selected module.
The write operation is started when input parameter *REQ* is set to 1 when the call to the SFC 58 is issued. Output parameter *BUSY* returns a value of 0 if the write operation was executed immediately. *BUSY* is set to 1 if the write operation could not be completed.

These SFC can be used for digital-, analog modules, FMs, CPs and via Profibus DP-V1.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: write request
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical base address of the module. For hybrid modules the lower of the two addresses must be specified.
RECNUM	INPUT	BYTE	I,Q,M,D,L, constant	Record number (valid range: 2 to 240)
RECORD	INPUT	ANY	I,Q,M,D,L	Record. Only data type BYTE is valid.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the write operation has not been completed.

RECORD

With the first call to the SFC the data that must be transferred is read from the parameter *RECORD*. However, if the transfer of the record should require more than one call duration, the contents of the parameter *RECORD* is no longer valid for subsequent calls to the SFC (of the same job).

RET_VAL
(Return value)

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A0, 80A1h, 80Bxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8092h	ANY-reference contains a type definition that is not equal to BYTE.
8093h	This SFC is not valid for the module selected by *LADDR* and *IOID*.
80A1h	Negative acknowledgement when the record is being transferred to the module (module was removed during the transfer or module failed)
80A2h	DP protocol fault in layer 2, possible hardware-/ interface fault in the DP slave
80A3h	DP protocol fault for user Interface/user
80A4h	Communication failure (this fault occurs between the CPU and the external DP interface)

continued ...

... continue

Value	Description
80B0h	• SFC not valid for the type of module • Module does not recognize the record. • Record number ≥ 241 not permitted. • Records 0 and 1 not permitted.
80B1h	The length specified in parameter *RECORD* is wrong.
80B2h	The slot that was configured has not been populated.
80B3h	The actual type of module is not equal to the required type of module in SDB1
80C1h	The module has not yet completed processing of the data of the preceding write operation for the same record.
80C2h	The module is currently processing the maximum number of jobs for a CPU.
80C3h	Required resources (memory, etc.) are currently occupied.
80C4h	Communication error
80C5h	Decentralized periphery not available.
80C6h	The transfer of records was aborted due to a priority class abort (warm start or background)

Note!
A general error 8544h only indicates that access to at least one byte of I/O memory containing the record was disabled. However, the data transfer was continued.

SFC 59 - RD_REC - Read record

Description

The SFC 59 RD_REC (read record) reads the record with the number *RECNUM* from the selected module.

These SFC can be used for digital-, analog modules, FMs, CPs and via Profibus DP-V1.

The read operation is started when input parameter *REQ* is set to 1 when the call to SFC 59 is issued. Output parameter *BUSY* returns a value of 0 if the read operation was executed immediately. *BUSY* is set to 1 if the read operation could not be completed. Parameter *RECORD* determines the target area where the record is saved when it has been transferred successfully.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	*REQ* = 1: read request
IOID	INPUT	BYTE	I,Q,M,D,L, constant	Identifier for the address space: 54h = peripheral input (PI) 55h = peripheral output (PQ) For hybrid modules the SFC returns the area identifier of the lower address. When the addresses are equal the SFC returns identifier 54h.
LADDR	INPUT	WORD	I,Q,M,D,L, constant	Logical base address of the module. For hybrid modules the lower of the two addresses must be specified.
RECNUM	INPUT	BYTE	I,Q,M,D,L, constant	Record number (valid range: 0 to 240)
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed. Additionally: the length of the actual record that was read, in bytes (range: +1 to +240), provided that the target area is greater than the transferred record and that no communication errors have occurred.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the write operation has not been completed.

continued ...

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Parameter	Declaration	Data type	Memory block	Description
RECORD	OUTPUT	ANY	I,Q,M,D,L	Target area for the record that was read. When SFC 59 is processed in asynchronous mode you must ensure that the actual parameters of *RECORD* have the same length information for all calls. Only data type BYTE is permitted.

Suitable choice of RECORD

To ensure that an entire record is read you must select a target area with a length of 241bytes. In this case the value in *RET_VAL* indicates the actual length of the data that was transferred successfully.

RET_VAL (Return value)

RET_VAL contains an error code when an error occurs while the function was being processed.
When the transfer was successful *RET_VAL* contains:

- a value of 0 if the entire target area was filled with data from the selected record (the record may, however, be incomplete).
- the length of the record that was transferred, in bytes (valid range: 1 to 240), provided that the target area is greater than the transferred record

Error information

Two distinct cases exist for *RET_VAL* = 8xxxh:

- Temporary error (error codes 80A2h to 80A4h, 80Cxh):
  For this type of error it is possible that the error corrects itself without intervention. For this reason it is recommended that you re-issue the call to the SFC (once or more than once).
  Example for temporary errors: the required resources are occupied at present (80C3h).
- Permanent error (error codes 809xh, 80A0h, 80A1h, 80Bxh):
  These errors cannot be corrected without intervention. A repeat of the call to the SFC is only meaningful when the error has been removed.
  Example for permanent errors: incorrect length of the record that must be transferred (80B1h).

Error information

Value	Description
7000h	First call with *REQ* = 0: data transfer not active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified logical base address is invalid: no assignment available in SDB1/SDB2x, or this is not a base address.
8092h	ANY-reference contains a type definition that is not equal to BYTE.
8093h	This SFC is not valid for the module selected by *LADDR* and *IOID*.
80A0h	Negative acknowledgement when reading from the module (module was removed during the transfer or module failed)
80A2h	DP protocol fault in layer 2, possible hardware-/ interface fault in the DP slave
80A3h	DP protocol fault for user Interface/user
80A4h	Communication failure (this fault occurs between the CPU and the external DP interface)
80B0h	• SFC not valid for the type of module. • Module does not recognize the record. • Record number ≥ 241 not permitted.
80B1h	The length specified in parameter *RECORD* is wrong.
80B2h	The slot that was configured has not been populated.
80B3h	The actual type of module is not equal to the required type of module in SDB1
80C0h	The module has registered the record but this does not contain any read data as yet.
80C1h	The module has not yet completed processing of the data of the preceding write operation for the same record.
80C2h	The module is currently processing the maximum number of jobs for a CPU.
80C3h	Required resources (memory, etc.) are currently occupied.
80C4h	Communication error
80C5h	Decentralized periphery not available.
80C6h	The transfer of records was aborted due to a priority class abort (warm start or background)

Note!

A general error 8745h only indicates that access to at least one byte of I/O memory containing the record was disabled. However, the data was read successfully from the module and saved to the I/O memory block.

SFC 64 - TIME_TCK - Read system time tick

Description

The SFC 64 TIME_TCK (time tick) retrieves the system time tick from the CPU. This ma be used to assess the time that certain processes require calculating the difference between the values returned by two SFC 64 calls. The system time is a "time counter" that counts from 0 to a max. of 2147483647ms and that restarts from 0 when an overflow occurs. The timing intervals and the accuracy of the system time depend on the CPU. Only the operating modes of the CPU influence the system time.

System time and operating modes

Operating mode	System time ...
Restart RUN	... permanently updated.
STOP	... stopped to retain the last value.
warm start	... continues from the value that was saved when STOP occurred.
reboot	... is deleted and starts from "0".

Parameters

Parameter	Declaration	Data type	Memory block	Description
RET_VAL	OUTPUT	TIME	I,Q,M,D,L	Parameter *RET_VAL* contains the system time that was retrieved, range from 0 to 2^{31} -1ms.

RET_VAL (Return value)

The SFC 64 does not return any error information.

SFC 65 - X_SEND - Send data

Description

The SFC 65 X_SEND can be used to send data to an external communication partner outside the local station. The communication partner receives the data by means of the SFC 66 X_RCV. Input parameter *REQ_ID* is used to identify the transmit data. This code is transferred along with the transmit data and it can be analyzed by the communication partner to determine the origin of the data. The transfer is started when input parameter *REQ* is set to 1. The size of the transmit buffer that is defined by parameter *SD* (on the sending CPU) must be less than or equal to the size of the receive buffer (on the communication partner) that was defined by means of parameter *RD*. In addition, the data type of the transmit buffer and the receive buffer must be identical.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	control parameter "request to activate", initiates the operation
CONT	INPUT	BOOL	I,Q,M,D,L, constant	control parameter "continue", defines whether the connection to the communication partner is terminated or not when the operation has been completed
DEST_ID	INPUT	WORD	I,Q,M,D,L, constant	Address parameter "destination ID". Contains the MPI-address of the communication partners.
REQ_ID	INPUT	DWORD	I,Q,M,D,L, constant	Operation code identifying the data on the communication partner.
SD	INPUT	ANY	I,Q,M,D	Reference to the send buffer. The following data types are possible: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5_TIME, DATE_AND_TIME as well as arrays of the respective data types, with the exception of BOOL.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the send operation has not yet been completed. *BUSY* = 0: the send operation has been completed, or no send operation is active.

REQ_ID

Input parameter *REQ_ID* identifies the send data.
Parameter *REQ_ID* is required by the receiver when

- the sending CPU issues multiple calls to SFC 65 with different *REQ_ID* parameters and the data is transferred to a single communication partner.
- more than one sending CPU are transferring data to a communication partner by means of the SFC 65.

Receive data can be saved into different memory blocks by analyzing the *REQ_ID* parameter.

Data consistency

Since send data is copied into an internal buffer of the operating system when the first call is issued to the SFC it is important to ensure that the send buffer is not modified before the first call has been completed successfully. Otherwise an inconsistency could occur in the transferred data.
Any write-access to send data that occurs after the first call is issued does not affect the data consistency.

RET_VAL
(Return value)

The return value contains an error code if an error is detected when the function is being processed.

The "real error information" that is contained in the table "specific error information" a. o. may be classified as follows:

Value	Description
809xh	Error on the CPU where the SFC is being executed
80Axh	Permanent communication error.
80Bxh	Error on the communication partner.
80Cxh	Temporary error.

Specific error information:

Value	Description
0000h	Processing completed without errors.
7000h	First call with *REQ* = 0: no data transfer is active; *BUSY* is set to 0.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified target address of the communication partners is not valid, e.g. • bad *IOID* • bad base address exists • bad MPI-address (> 126)
8092h	Error in *SD* or *RD*, e.g.: • illegal length for *SD* • *SD* = NIL is not permitted
8095h	The block is already being processed on a priority class that has a lower priority.
80A0h	Error in received acknowledgement.
80A1h	Communication failures: SFC-call after an existing connection has been terminated.
80B1h	ANY-pointer error. The length of the data buffer that must be transferred is wrong.
80B4h	ANY-pointer data type error, or ARRAY of the specified data type is not permitted.
80B5h	Processing rejected because of an illegal operating mode.
80B6h	The received acknowledgement contains an unknown error code.
80B8h	The SFC 66 "X_RCV" of the communication partner rejected the data transfer (*RD* = NIL).
80B9h	The data block was identified by the communication partner (SFC 66 "X_RCV" was called with *EN_DT* = 0) but it has not yet been accepted into the application program because the operating mode is STOP.
80BAh	The answer of the communication partner does not fit into the communication telegram.
80C0h	The specified connection is already occupied by another operation.
80C1h	Lack of resources on the CPU where the SFC is being executed, e.g.: • the module is already executing the maximum number of different send operations. • connection resources may be occupied, e.g. by a receive operation.
80C2h	Temporary lack of resources for the communication partner, e.g.: • The communication partner is currently processing the maximum number of operations. • The required resources (memory, etc.) are already occupied. • Not enough memory (initiate compression.)
80C3h	Error when establishing a connection, e.g.: • The local station is connected to the MPI sub-net. • You have addressed the local station on the MPI sub-net. • The communication partner cannot be contacted any longer. • Temporary lack of resources for the communication partner.

SFC 66 - X_RCV - Receive data

Description

The SFC 66 X_RCVS can be used to receive data, that was sent by means of SFC 65 X_SEND by one or more external communication partners.
SFC 66 can determine whether the data that was sent is available at the current point in time. The operating system could have stored the respective data in an internal queue. If the data exists in the queue the oldest data block can be copied into the specified receive buffer.

Parameters

Parameter	Declaration	Data type	Memory block	Description
EN_DT	INPUT	BOOL	I,Q,M,D,L, constant	Control parameter "enable data transfer". You can check whether one or more data blocks are available by setting this to 0. A value of 1 results in the oldest data block of the queue being copied into the memory block that was specified by means of *RD*.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
REQ_ID	OUTPUT	DWORD	I,Q,M,D,L	Operation code of the SFC 65 "X_SEND" whose send data is located uppermost in the queue, i.e. the oldest data in the queue. If the queue does not contain a data block *REQ_ID* is set to 0.
NDA	OUTPUT	BOOL	I,Q,M,D,L	Status parameter "new data arrived". *NDA* = 0: • The queue does not contain a data block. *NDA* = 1: • The queue does contain one or more data blocks. (call to the SFC 66 with *EN_DT* = 0). • The oldest data block in the queue was copied into the application program. (call to the SFC 66 with *EN_DT* = 1).

continued ...

... continue

Parameter	Declaration	Data type	Memory block	Description
RD	OUTPUT	ANY	I,Q,M,D	Reference to the receive data buffer (receive data area). The following data types are available: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5_TIME, DATE_AND_TIME as well as arrays of these data types with the exception of BOOL. If you wish to discard the oldest data block in the queue you must assign a value of NIL to *RD*.

Data reception indication

with EN_DT = 0

The operating system inserts data received from a communication partner in the sequence in which they are received.
You can test whether at least one data block is ready by issuing a call to the SFC 66 with *EN_DT* = 0 and testing the resulting output parameter *NDA*.

- *NDA* = 0 means that the queue does not contain a data block. *REQ_ID* is irrelevant, *RET_VAL* contains a value of 7000h.
- *NDA* = 1 means that the queue does contain one or more data blocks.

If the queue contains a data block you should also test output parameters *RET_VAL* and *REQ_ID*. *RET_VAL* contains the length of the data block in bytes, *REQ_ID* contains the operation code of the send block. If the queue should contain multiple data blocks parameters *REQ_ID* and *RET_VAL* refer to the oldest data block contained in the queue.

Transferring data into the receive buffer

with *EN_DT* = 1

When input parameter *EN_DT* = 1 then the oldest data block in the queue is copied into the target block defined by *RD*. You must ensure that the size of *RD* is greater than or equal to the size of the transmit buffer of the respective SFC 65 X_SEND defined by parameter *SD* and that that the data types match. If received data should be saved into different areas you can determine the *REQ_ID* in the first call (SFC-call with *EN_DT* = 0) and select a suitable value for *RD* in the subsequent call (with *EN_DT* = 1). If the operation was processed successfully *RET_VAL* contains the length (in bytes) of data block that was copied and a positive acknowledgement is returned to the sending station.

Discarding data

If you do not want to accept the received data assign a value of NIL to *RD*. The respective communication partner receives a negative acknowledgement (the value of *RET_VAL* of the respective SFC 65 X_SEND is 80B8h) and parameter *RET_VAL* is set to 0.

Data consistency

You must make sure that the receive buffer is not read before the operation has been completed since you could otherwise be reading could cause inconsistent data.

Operating mode transition to STOP mode

When the CPU changes to STOP mode,

- all newly received commands receive a negative acknowledgement.
- For commands that have already been received: all commands that have been entered into the in receive queue receive a negative acknowledgement.
- all data blocks are discarded when a warm start follows.
- when a warm start follows, the data block that belongs to the oldest operation is transferred into the application program, provided that it was falls queried before the operating mode changed to STOP (SFC-call with *EN_DT* = 0). Otherwise it will be discarded.
  All other data blocks are discarded.

Termination of a connection

When the connection is terminated any operation that was entered into the receive queue of this connection is discarded.
Exception: if this is the oldest operation in the queue that has already been recognized by a SFC-call with *EN_DT* = 0 it can be transferred into the receive buffer by means of *EN_DT* = 1.

RET_VAL (Return value)

If no error has occurred, *RET_VAL* contains:

- when *EN_DT* = 0/1 and *NDA* = 0: 7000h. In this case the queue does not contain a data block.
- when *EN_DT* = 0 and *NDA* = 1, *RET_VAL* contains the length (in bytes) of the oldest data block that was entered into the queue as a positive number.
- when *EN_DT* = 1 and *NDA* = 1, *RET_VAL* contains the length (in bytes) of the data block that was copied into the receive buffer *RD* as a positive number.

Error information

The "real error information" that is contained in the table "specific error information" a. o. may be classified as follows:

Value	Description
809xh	Error on the CPU where the SFC is being executed
80Axh	Permanent communication error
80Bxh	Error on the communication partner
80Cxh	Temporary error

Specific Error information:

Value	Description
0000h	Processing completed without errors.
00xyh	When *NDA* = 1 and *RD* <> NIL: *RET_VAL* contains the length of the received data block (when *EN_DT* = 0) or the data block copied into *RD* (when *EN_DT* = 1).
7000h	*EN_DT* = 0/1 and *NDA* = 0
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified target address of the communication partners is not valid, e.g. • bad *IOID* • bad base address exists • bad MPI-address (> 126)
8092h	Error in *SD* or *RD*, e.g.: • The amount of data received is too much for the buffer defined by *RD*. • *RD* has data type BOOL but the length of the received data is greater than one byte.
8095h	The block is already being processed on a priority class that has a lower priority.
80A0h	Error in received acknowledgement.
80A1h	Communication failures: SFC-call after an existing connection has been terminated.
80B1h	ANY-pointer error. The length of the data block that must be transferred is wrong.
80B4h	ANY-pointer data type error, or ARRAY of the specified data type is not permitted.
80B6h	The received acknowledgement contains an unknown error code.
80BAh	The answer of the communication partner does not fit into the communication telegram.
80C0h	The specified connection is already occupied by another operation.
80C1h	Lack of resources on the CPU where the SFC is being executed, e.g.: • the module is already executing the maximum number of different send operations. • connection resources may be occupied, e.g. by a receive operation.
80C2h	Temporary lack of resources for the communication partner, e.g.: • The communication partner is currently processing the maximum number of operations. • The required resources (memory, etc.) are already occupied. • Not enough memory (initiate compression).
80C3h	Error when establishing a connection, e.g.: • The local station is connected to the MPI sub-net. • You have addressed the local station on the MPI sub-net. • The communication partner cannot be contacted any longer. • Temporary lack of resources for the communication partner.

SFC 67 - X_GET - Read data

Description

The SFC 67 X_GET can be used to read data from an external communication partner that is located outside the local station. No relevant SFC exists on the communication partner. The operation is started when input parameter *REQ* is set to 1. Thereafter the call to the SFC 67 is repeated until the value of output parameter *BUSY* becomes 0. Output parameter *RET_VAL* contains the length of the received data block in bytes.
The length of the receive buffer defined by parameter *RD* (in the receiving CPU) must be identical or greater than the read buffer defined by parameter *VAR_ADDR* (for the communication partner) and the data types of *RD* and *VAR_ADDR* must be identical.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	Control parameter "request to activate", used to initiate the operation
CONT	INPUT	BOOL	I,Q,M,D,L, constant	Control parameter "continue", determines whether the connection to the communication partner is terminated or not when the operation has been completed
DEST_ID	INPUT	WORD	I,Q,M,D,L, constant	Address parameter "destination ID". Contains the MPI address of the communication partner.
VAR_ADDR	INPUT	ANY	I,Q,M,D	Reference to the buffer in the partner-CPU from where data must be read. You must select a data type that is supported by the communication partner.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed. If no error has occurred, *RET_VAL* contains the length of the data block that was copied into receive buffer *RD* as positive number of bytes.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the receive operation has not been completed. *BUSY* = 0: The receive operation has been completed or no receive operation active.

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Parameter	Declaration	Data type	Memory block	Description
RD	OUTPUT	ANY	I,Q,M,D	Reference to the receive buffer (receive data area). The following data types are permitted: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5_TIME, DATE_AND_TIME as well as arrays of the above data types, with the exception of BOOL

Data consistency

The following rules must be satisfied to prevent the data consistency from being compromised:

- Active CPU (receiver of data):
  The receive buffer should be read in the OB that issues the call to the respective SFC. If this is not possible the receive buffer should only be read when processing of the respective SFC has been completed.
- Passive CPU (sender of data):
  The maximum amount of data that may be written into the send buffer is determined by the block size of the passive CPU (sender of data).
- Passive CPU (sender of data):
  Send data should be written to the send buffer while interrupts are inhibited.

Operating mode transition to STOP mode

When the CPU changes to STOP mode the connection established by means of the SFC 67 is terminated. The type of start-up that follows determines whether any previously received data located in a buffer of the operating system are discarded or not.

- A warm start means that the data located in the buffer is copied into the area defined by *RD*.
- A reboot start means that the data is discarded.

Operating mode transition of the communication partners to STOP mode

A transition to operating mode STOP of the CPU of the communication partner does not affect the data transfer, since it is also possible to read data in operating mode STOP.

RET_VAL (Return value)

The "real error information" that is contained in the table "specific error information" a. o. may be classified as follows:

Value	Description
809xh	Error on the CPU where the SFC is being executed
80Axh	Permanent communication error
80Bxh	Error on the communication partner
80Cxh	Temporary error

Specific error information:

Value	Description
0000h	Processing completed without errors.
00xyh	*RET_VAL* contains the length of the received data block.
7000h	Call issued with *REQ* = 0 (call without processing), *BUSY* is set to 0, no data transfer is active.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified target address of the communication partners is not valid, e.g. • bad *IOID* • bad base address exists • bad MPI-address (> 126)
8092h	Error in *SD* or *RD*, e.g.: • illegal length for *RD* • the length or the data type of *RD* does not correspond with the received data. • *RD* = NIL is not permitted.
8095h	The block is already being processed on a priority class that has a lower priority.
80A0h	Error in received acknowledgement.
80A1h	Communication failures: SFC-call after an existing connection has been terminated.
80B0h	Object cannot be found, e.g. DB was not loaded.
80B1h	ANY-pointer error. The length of the data block that must be transferred is wrong.

continued ...

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Value	Description
80B2h	HW-error: module does not exist • the slot that was configured is empty. • Actual module type does not match the required module type. • Decentralized periphery not available. • The respective SDB does not contain an entry for the module.
80B3h	Data may only be read or written, e.g. write protected DB
80B4h	The communication partner does not support the data type specified in *VAR_ADDR*.
80B6h	The received acknowledgement contains an unknown error code.
80BAh	The answer of the communication partner does not fit into the communication telegram.
80C0h	The specified connection is already occupied by another operation.
80C1h	Lack of resources on the CPU where the SFC is being executed, e.g.: • the module is already executing the maximum number of different send operations. • connection resources may be occupied, e.g. by a receive operation.
80C2h	Temporary lack of resources for the communication partner, e.g.: • The communication partner is currently processing the maximum number of operations. • The required resources (memory, etc.) are already occupied. • Not enough memory (initiate compression.)
80C3h	Error when establishing a connection, e.g.: • The local station is connected to the MPI sub-net. • You have addressed the local station on the MPI sub-net. • The communication partner cannot be contacted any longer. • Temporary lack of resources for the communication partner.

SFC 68 - X_PUT - Write data

Description

The SFC 68 X_PUT can be used to write data to an external communication partner that is located outside the local station. No relevant SFC exists on the communication partner. The operation is started when input parameter *REQ* is set to 1. Thereafter the call to SFC 68 is repeated until the value of output parameter *BUSY* becomes 0. The length of the send buffer defined by parameter *SD* (in the sending CPU) must be identical or greater than the receive buffer defined by parameter *VAR_ADDR* (for the communication partner) and the data types of *SD* and *VAR_ADDR* must be identical.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	control parameter "request to activate", used to initiate the operation
CONT	INPUT	BOOL	I,Q,M,D,L, constant	control parameter "continue", determines whether the connection to the communication partner is terminated or not when the operation has been completed
DEST_ID	INPUT	WORD	I,Q,M,D,L, constant	Address parameter "destination ID". Contains the MPI address of the communication partner.
VAR_ADDR	INPUT	ANY	I,Q,M,D	Reference to the buffer in the partner-CPU into which data must be written. You must select a data type that is supported by the communication partner.
SD	INPUT	ANY	I,Q,M,D	Reference to the buffer in the local CPU that contains the send data. The following data types are permitted: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5_TIME, DATE_AND_TIME as well as arrays of the above data types, with the exception of BOOL.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: the send operation has not been completed. *BUSY* = 0: The send operation has been completed or no send operation is active.

Data consistency

The following rules must be satisfied to prevent the data consistency from being compromised:

- Active CPU (sender of data):
  The send buffer should be written in the OB that issues the call to the respective SFC. If this is not possible the send buffer should only be written when processing of the first call to the respective SFC has been completed.
- Active CPU (sender of data):
  The maximum amount of data that may be written into the send buffer is determined by the block size of the passive CPU (sender of data).
- Passive CPU (receiver of data):
  Receive data should be read from the receive buffer while interrupts are inhibited.

Operating mode transition to STOP mode

When the CPU changes to STOP mode the connection established by means of the SFC 68 is terminated and data can no longer be sent. If the send data had already been copied into the internal buffer when the transition to STOP mode occurs the contents of the buffer is discarded.

Operating mode transition of the partners to STOP mode

A transition to operating mode STOP of the CPU of the communication partner does not affect the data transfer, since it is also possible to write data in operating mode STOP.

RET_VAL (Return value)

The "real error information" that is contained in the table "specific error information" a. o. may be classified as follows:

Value	Description
809xh	Error on the CPU where the SFC is being executed.
80Axh	Permanent communication error.
80Bxh	Error on the communication partner.
80Cxh	Temporary error.

Specific error information:

Value	Description
0000h	Processing completed without errors.
7000h	Call issued with *REQ* = 0 (call without processing), *BUSY* is set to 0, no data transfer is active.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* is set to 1.
8090h	The specified target address of the communication partners is not valid, e.g. • bad *IOID* • bad base address exists • bad MPI-address (> 126)
8092h	Error in *SD* or *RD*, e.g.: • illegal length of *SD* • *SD* = NIL is not permitted
8095h	The block is already being processed on a priority class that has a lower priority.
80A0h	The data type specified by *SD* of the sending CPU is not supported by the communication partner.
80A1h	Communication failures: SFC-call after an existing connection has been terminated.
80B0h	Object cannot be found, e.g. DB was not loaded.
80B1h	ANY-pointer error. The length of the data block that must be transferred is wrong.
80B2h	HW-error: module does not exist • the slot that was configured is empty. • Actual module type does not match the required module type. • Decentralized periphery not available. • The respective SDB does not contain an entry for the module.
80B3h	Data can either be read or written, e.g. write protected DB
80B4h	The communication partner does not support the data type specified in *VAR_ADDR*.
80B6h	The received acknowledgement contains an unknown error code.
80B7h	Data type and / or the length of the transferred data does not fit the buffer in the partner CPU where the data must be written.

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Value	Description
80BAh	The answer of the communication partner does not fit into the communication telegram.
80C0h	The specified connection is already occupied by another operation.
80C1h	Lack of resources on the CPU where the SFC is being executed, e.g.: • the module is already executing the maximum number of different send operations. • connection resources may be occupied, e.g. by a receive operation.
80C2h	Temporary lack of resources for the communication partner, e.g.: • The communication partner is currently processing the maximum number of operations. • The required resources (memory, etc.) are already occupied. • Not enough memory (initiate compression)
80C3h	Error when establishing a connection, e.g.: • The local station is connected to the MPI sub-net. • You have addressed the local station on the MPI sub-net. • The communication partner cannot be contacted any longer. • Temporary lack of resources for the communication partner.

SFC 69 - X_ABORT - Disconnect

Description

The SFC 69 X_ABORT can be used to terminate a connection to a communication partner that is located outside the local station, provided that the connection was established by means one of SFCs 65, 67 or 68. The operation is started when input parameter *REQ* is set to 1.
If the operation belonging to SFCs 65, 67 or 68 has already been completed (*BUSY* = 0) then the connection related resources occupied by both partners are enabled again when the call to the SFC 69 has been issued. However, if the respective operation has not yet been completed (*BUSY* = 1), the call to the respective SFC 65, 67 or 68 must be repeated after the connection has been terminated with *REQ* = 0 and *CONT* = 0. The connection resources are only available again when *BUSY* = 0.
The SFC 69 can only be called on the side where SFC 65, 67 or 68 is being executed.

Parameters

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L, constant	Control parameter "request to activate", used to initiate the operation
DEST_ID	INPUT	WORD	I,Q,M,D,L, constant	Address parameter "destination ID". Contains the MPI address of the communication partner.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
BUSY	OUTPUT	BOOL	I,Q,M,D,L	*BUSY* = 1: connection termination not yet completed. *BUSY* = 0: connection termination has been completed.

Operating mode transition to STOP mode

The connection termination initiated by means of the SFC 69 is still completed, even if the CPU changes to STOP mode.

Operating mode transition of the partners to STOP mode

A transition to operating mode STOP of the CPU of the communication partner does not affect the connection termination, the connection is terminated in spite of the change of operating mode.

RET_VAL (Return value)

The "real error information" that is contained in the table "specific error information" and others may be classified as follows:

Value	Description
809xh	Error on the CPU where the SFC is being executed
80Axh	Permanent communication error
80Bxh	Error on the communication partner
80Cxh	Temporary error

Specific error information:

Value	Description
0000h	*REQ* = 1 when the specified connection has not been established.
7000h	Call issued with *REQ* = 0 (call without processing), *BUSY* is set to 0, no data transfer is active.
7001h	First call with *REQ* = 1: data transfer initiated; *BUSY* is set to 1.
7002h	Intermediate call with *REQ* = 1.
8090h	The specified target address of the communication partners is not valid, e.g. • bad *IOID* • bad base address exists • bad MPI-address (> 126)
8095h	The block is already being processed on a priority class that has a lower priority.
80A0h	Error in the acknowledgement that was received.
80A1h	Communication failures: SFC-call after an existing connection has been terminated.
80B1h	ANY-pointer error. The length of the data block that must be transferred is wrong.
80B4h	ANY-pointer data type error, or ARRAY of the specified data type is not permitted.
80B6h	The received acknowledgement contains an unknown error code.
80BAh	The answer of the communication partner does not fit into the communication telegram.
80C0h	The specified connection is already occupied by another operation.
80C1h	Lack of resources on the CPU where the SFC is being executed, e.g.: • the module is already executing the maximum number of different send operations. • connection resources may be occupied, e.g. by a receive operation.
80C2h	Temporary lack of resources for the communication partner, e.g.: • The communication partner is currently processing the maximum number of operations. • The required resources (memory, etc.) are already occupied. • Not enough memory (initiate compression).
80C3h	Error when establishing a connection, e.g.: • The local station is connected to the MPI sub-net. • You have addressed the local station on the MPI sub-net. • The communication partner cannot be contacted any longer. • Temporary lack of resources for the communication partner.

SFC 81 - UBLKMOV - Copy data area without gaps

The SFC 81 UBLKMOV (uninterruptible block move) creates a consistent copy of the contents of a memory block (= source field) in another memory block (= target field). The copy procedure cannot be interrupted by other activities of the operating system.
It is possible to copy any memory block, with the exception of:

- the following blocks: FC, SFC, FB, SFB, OB, SDB
- counters
- timers
- memory blocks of the peripheral area
- data blocks those are irrelevant to the execution.

The maximum amount of data that can be copied is 512bytes.

Interruptibility

It is not possible to interrupt the copy process. For this reason it is important to note that any use of the SFC 81 will increase the reaction time of your CPU to interrupts.

Parameters

Parameter	Declaration	Data type	Memory block	Description
SRCBLK	INPUT	ANY	I,Q,M,D,L	Specifies the memory block that must be copied (source field). Arrays of data type STRING are not permitted.
RET_VAL	OUTPUT	INT	I,Q,M,D,L	The return value contains an error code if an error is detected when the function is being processed.
DSTBLK	OUTPUT	ANY	I,Q,M,D,L	Specifies the target memory block where the data must be copied (target field). Arrays of data type STRING are not permitted.

Note!

The source and target field must not overlap.

If the specified target field is larger than the source field, only the amount of data located in the source field will be copied into the target field. However, if the size of the specified target field is less than the size of the source field, then only the amount of data that will fit into the target field will be copied.
If the data type of the ANY-pointer (source or target) is BOOL, then the specified length must be divisible by 8, otherwise the SFC will not be executed.
If the data type of the ANY-pointer is STRING the specified length must be 1.

RET_VAL
(Return value)

Value	Description
0000h	no error
8091h	The source area is located in a data block that is not relevant to execution.

Chapter 5 VIPA specific blocks

Overview

Here you find the description of the VIPA specific blocks that are exclusively used with PLCs from VIPA.

The following text describes:

- VIPA specific FCs, FBs and SFCs and their inclusion

Content

Topic **Page**

Overview

General

The integrated blocks are developed in machine-code and are therefore running with high speed. They do not occupy space in the internal application memory.

The integrated blocks are called via the user application.

The following pages list the VIPA specific blocks that may be called in the control application for special functions.

Overview

The following VIPA specific blocks are available:

FB/SFB	Label	Description
FB/SFB 8	USEND	Uncoordinated data transmission
FB/SFB 9	URCV	Uncoordinated data reception
FB/SFB 12	BSEND	Sending data an blocks
FB/SFB 13	BRCV	Receiving data in blocks
FB/SFB 14	GET	Remote CPU read
FB/SFB 15	PUT	Remote CPU write
FB/SFB 19	START	Remote CPU Restart
FB/SFB 20	STOP	Remote CPU STOP
FB/SFB 21	RESUME	Remote CPU warm start
FB/SFB 22	STATUS	Remote CPU requesting device status
FB/SFB 23	USTATUS	Remote CPU reception device status
FB 55	IP_CONFIG	Programmed Communication Connections

FC	Label	Description
FC 5	AG_SEND	Transfer data to Ethernet CP 343
FC 6	AG_RECV	Receive data from CP
FC 10	AG_CNTRL	Check and control Ethernet CP 343 connections
FC 200	IBS_INIT	Registration and initialization of an Interbus master at the CPU
FC 202	IBS_SERVICE	Service communication between CPU and Interbus master
FC 204	IBS_LOOP	Slow asynchronous data communication between CPU and Interbus master (waits for master release)
FC 205	IBS_CYCLE	Fast asynchronous data communication between CPU and Interbus master (waits not for master release)
FC 206	IBS_IRQ	Synchronous data communication between CPU and Interbus master with synchronization via interrupt
FC 207	IBS_PCP	Peripherals Communication Protocol (PCP) communication for instructions and parameters for Interbus slaves
FC 208	IBS_DIAG	Read diagnostic data from Interbus master res. Interbus slaves

SFB	Label	Description
SFB 7	uS_TIME	VIPA Micro second timer with difference evaluation

SFC	Label	Description
SFC 53	uS_TICK	VIPA micro second timer
SFC 195	FILE_ATT	change VIPA file attributes
SFC 204	IP_CONF	internally used for FB 55 IP_CONF
SFC 205	AG_SEND	internally used for FC 5 AG_SEND
SFC 206	AG_RECV	internally used for FC 6 AG_RECV
SFC 208	FILE_OPN	open VIPA file
SFC 209	FILE _CRE	create VIPA file
SFC 210	FILE_CLO	close VIPA file
SFC 211	FILE_RD	read VIPA file
SFC 212	FILE_WR	write VIPA file
SFC 213	FILE_SEK	position VIPA file pointer
SFC 214	FILE_REN	rename VIPA file
SFC 215	FILE_DEL	delete VIPA file
SFC 216	SER_CFG	RS232 Parameterization
SFC 217	SER_SND	RS232 Send
SFC 218	SER_RCV	RS232 Receive
SFC 219	CAN_TLGR	send CAN telegram
SFC 254	RW_SBUS	VIPA accesses to SPEED-Bus Interbus master

Include VIPA library

Overview

The VIPA specific SFCs can be downloaded as library from VIPA at ftp.vipa.de at support/library. The libraries are available as packed zip-file.

If you want to use VIPA specific SFCs you have to import these in your project.

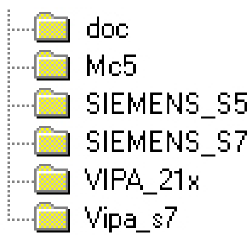
Execute the following steps:

- Extract FX000002_Vxxx.zip
- "Retrieve" the library
- Open library and transfer SFCs into the project

Directory structure of FX000002_Vxxx.zip

Start your un-zip application with a double click on the file FX000002_Vxxx.zip. Extract all files including the directory structure into a destination folder.

The following directory structure is created:



Retrieve library

To retrieve your SFC library for the SPEED7-CPUs, start the SIMATIC manager from Siemens. Open the dialog window for archive selection via **File** > *Retrieve*. You'll find the SFC library in the directory structure shown above under VIPA_S7. The file name is VIPA.ZIP.

Choose VIPA.ZIP and click on [Open].

Select a destination folder where the blocks shall be stored. [OK] starts the extraction.

Open library and transfer SFCs to project

After the extraction open the library.

Open your project and copy the necessary SFCs from the library into the directory "blocks" of your project.

Now you have access to the VIPA specific blocks via your user application.

Siemens S7 Communication - FB/SFB 8 ... FB 55

Overview

With Siemens S7 communication you can transfer large volumes of data between PLC stations bases on Siemens STEP®7. Here the stations are to be connected by Ethernet.

By means of remote functions a CPU can be controlled by an other CPU with the corresponding function block and e.g. switched to STOP.

The communication connections are static i.e. they are configured in the connection table.

Communication functions

At the VIPA SPEED7-CPUs there are the following 2 possibilities to use the communication connections:

- *Siemens S7-300 communication functions*

  By including the VIPA specific function blocks FB 8 ... FB 55 you get access to the Siemens S7-300 communication functions. More information for including the function blocks can be found above at "Include VIPA library".

- *Siemens S7-400 communication functions*

  To deploy the Siemens S7-400 communication functions the in the operating system of the CPU integrated system function blocks SFB 8 ... SFB 23 should be used. Here copy the interface description of the SFBs from the standard library at system function block to the directory container, generate an instance data block for each call and call the SFB with the associated instance data block.

Configuring

The prerequisite for Siemens S7 communication is a configured connection table in which the communication links are defined.

For this e.g. WinPLC7 from VIPA or NetPro from Siemens can be used. A communication link is specified by a connection ID for each communication partner. Use the *local ID* to initialize the FB/SFB in the PLC from which the connection is regarded and the *partner ID* to configure the FB/SFB in the partner PLC.

Function blocks

The following function blocks can be used for Siemens S7 communications:

FB/SFB	Label	Description
FB/SFB 8	USEND	Uncoordinated data transmission
FB/SFB 9	URCV	Uncoordinated data reception
FB/SFB 12	BSEND	Sending data in blocks
FB/SFB 13	BRCV	Receiving data in blocks
FB/SFB 14	GET	Remote CPU read
FB/SFB 15	PUT	Remote CPU write
FB/SFB 19	START	Remote CPU Restart
FB/SFB 20	STOP	Remote CPU STOP
FB/SFB 21	RESUME	Remote CPU Warm start
FB/SFB 22	STATUS	Remote CPU Requesting device status
FB/SFB 23	USTATUS	Remote CPU Reception device status
FB 55	IP_CONFIG	Programmed Communication Connections

FB/SFB 8 - USEND - Uncoordinated data transmission

Description

FB/SFB 8 USEND may be used to transmit data to a remote partner FB/SFB of the type URCV (FB/SFB 9). You must ensure that parameter *R_ID* of both FB/SFBs is identical. The transmission is started by a positive edge at control input *REQ* and proceeds without coordination with the partner FB/SFB.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (FB 8)

The data is sent on a rising edge at *REQ*. The parameters *R_ID*, *ID* and *SD_1* are transferred on each rising edge at *REQ*. After a job has been completed, you can assign new values to the *R_ID*, *ID* and *SD_1* parameters.

Siemens S7-400 Communication (SFB 8)

The data is sent on a rising edge at *REQ*. The data to be sent is referenced by the parameters *SD_1*...*SD_4* but not all four send parameters need to be used.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	Control parameter request, activates the exchange of data when a rising edge is applied (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	Connection reference. The *ID* must be specified in the form W#16#wxyz.
R_ID	INPUT	DWORD	I,Q,M,D,L, constant	Addressing parameter *R_ID*. Format DW#16#wxyzWXYZ.
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: 0: task has not been started or it is still being executed. 1: parameter.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors ERROR=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
SD_i, 1≤ i ≤4	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to transmit buffer i. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.

Note!

You must, however, make sure that the areas defined by the parameters *SD_1*/*SD_1*...*SD_4* and *RD_1*/*RD_1*... *RD_4* (at the corresponding partner FB/SFB URCV) agree in Number, Length and Data type.

The parameter *R_ID* must be identical at both FB/SFBs. Successful completion of the transmission is indicated by the status parameter *DONE* having the logical value 1.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active, since the previous task has not completed.
0	25	Communications initiated. The task is being processed.
1	1	• Communication failures, e.g. Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	4	Error in transmission range pointers *SD_i* with respect to the length or the data type.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 8 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	18	*R_ID* already exists in the connection *ID*.
1	20	Not enough memory.

Data consistency

To ensure data consistency, you can only write to the send area *SD_i* again after the current send operation is complete.

This is the case when the value of the status parameter *DONE* changes to 1.

FB/SFB 9 - URCV - Uncoordinated data reception

Description

FB/SFB 9 URCV can be used to receive data asynchronously from a remote partner FB/SFB of the type USEND (FB/SFB 8). You must ensure that parameter *R_ID* of both FB/SFBs is identical.

The block is ready to receive then there is a logical 1 at the *EN_R* input. An active job can be cancelled with *EN_R*=0.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (FB 9)

The parameters *R_ID*, *ID* and *RD_1* are applied with every positive edge on *EN_R*. After a job has been completed, you can assign new values to the *R_ID*, *ID* and *RD_1* parameters.

Siemens S7-400 Communication (SFB 9)

The receive data areas are referenced by the parameters *RD_1...RD_4*.

Parameter

Parameter	Declaration	Data type	Memory block	Description
EN_R	INPUT	BOOL	I,Q,M,D,L	Control parameter enabled to receive, indicates that the partner is ready for reception
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz
R_ID	INPUT	DWORD	I,Q,M,D,L, constant	Address parameter *R_ID*. Format DW#16#wxyzWXYZ.
NDR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *NDR*: new data transferred.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
RD_i, 1≤ i ≤4	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to receive buffer i. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.

Note!

The quantity, length and data type of the buffer areas defined by parameters *SD_i* and *RD_i*, 1 ≤ i ≤ 4 must be identical (*RD_i* is the receive buffer of the respective partner FB/SFB, see FB/SFB 8). The initial call to FB/SFB 9 creates the "receive box". The receive data available during any subsequent calls must fit into this receive box. When a data transfer completes successfully parameter *NDR* is set to 1.

Error information

ERROR	STATUS (decimal)	Meaning
0	9	Overrun warning: old receive data was overwritten by new receive data.
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	Communications initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	4	Error in receive buffer pointer *RD_i* with respect to the length or the data type.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 9 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	18	*R_ID* already exists in the connection *ID*.
1	19	The respective FB/SFB USEND transmits data quicker than FB/SFB URCV can copy the data into the receive buffers.
1	20	Not enough memory.

Data consistency

The data are received consistently if you remember the following points:

Siemens S7-300 Communication:

After the status parameter *NDR* has changed to the value 1, you must immediately call FB 9 URCV again with the value 0 at *EN_R*. This ensures that the receive area is not overwritten before you have evaluated it.

Evaluate the receive area (*RD_1*) completely before you call the block with the value 1 at control input *EN_R*).

Siemens S7-400 Communication:

After the status parameter *NDR* has changed to the value 1, there are new receive data in your receive areas (*RD_i*). A new block call may cause these data to be overwritten with new receive data. If you want to prevent this, you must call SFB 9 URCV (such as with cyclic block processing) with the value 0 at *EN_R* until you have finished processing the receive data.

FB/SFB 12 - BSEND - Sending data in blocks

Description

FB/SFB 12 BSEND sends data to a remote partner FB/SFB of the type BRCV (FB/SFB 13). The data area to be transmitted is segmented. Each segment is sent individually to the partner. The last segment is acknowledged by the partner as it is received, independently of the calling up of the corresponding FB/SFB/FB BRCV. With this type of data transfer, more data can be transported between the communications partners than is possible with all other communication FBs/SFBs for configured S7 connections, namely 65534 bytes.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (FB 12)

The send job is activated on a rising edge at *REQ*. The parameters *R_ID*, *ID*, *SD_1* and *LEN* are transferred on each positive edge at *REQ*. After a job has been completed, you can assign new values to the *R_ID*, *ID*, *SD_1* and *LEN* parameters. For the transmission of segmented data the block must be called periodically in the user program.

The start address and the maximum length of the data to be sent are specified by *SD_1*. You can determine the job-specific length of the data field with *LEN*.

Siemens S7-400 Communication (SFB 12)

The send job is activated after calling the block and when there is a rising edge at *REQ*. Sending the data from the user memory is carried out asynchronously to the processing of the user program.

The start address and the maximum length of the data to be sent are specified by *SD_1*. You can determine the job-specific length of the data field with *LEN*. In this case, *LEN* replaces the length section of *SD_1*.

Function

If there is a rising edge at control input R, the current data transfer is canceled.

Successful completion of the transfer is indicated by the status parameter *DONE* having the value 1.

A new send job cannot be processed until the previous send process has been completed if the status parameter *DONE* or *ERROR* have the value 1.

Due to the asynchronous data transmission, a new transmission can only be initiated if the previous data have been retrieved by the call of the partner FB/SFB. Until the data are retrieved, the status value 7 will be given when the FB/SFB BSEND is called.

Note!

The parameter *R_ID* must be identical at the two corresponding FBs/SFBs.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	Control parameter request, a rising edge activates the data exchange (with respect to the most recent FB/SFB call)
R	INPUT	BOOL	I,Q,M,D,L, constant	control parameter reset: terminates the active task
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz.
R_ID	INPUT	DWORD	I,Q,M,D,L, constant	Address parameter *R_ID*. Format DW#16#wxyzWXYZ.
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: 0: task has not been started or is still being executed. 1: parameter.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
SD_1	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to the send data buffer. The length parameter is only utilized when the block is called for the first time after a warm start or a cold start. It specifies the maximum length of the send buffer. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.
LEN	IN_OUT	WORD	I,Q,M,D,L	The length of the send data block in bytes.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement received from the partner FB/SFB. The function cannot be executed.
1	3	*R_ID* is not available to the communication link specified by *ID* or the receive block has never been called.
1	4	Error in send buffer pointer *SD_1* with respect to the length or the data type, or parameter *LEN* was set to 0 or an error has occurred in the receive data buffer pointer *RD_1* of the respective FB/SFB 13 BRCV
1	5	Reset was executed.
1	6	The status of the partner FB/SFB is DISABLED (*EN_R* has a value of 0)
1	7	The status of the partner FB/SFB is not correct (the receive block has not been called after the most recent data transfer.)
1	8	Access to the remote object in application memory was rejected.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 12 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	18	*R_ID* already exists in the connection *ID*.
1	20	Not enough memory.

Data consistency

To guarantee consistent data the segment of send buffer *SD_1* that is currently being used can only be overwritten when current send process has been completed. For this purpose the program can test parameter *DONE*.

FB/SFB 13 - BRCV - Receiving data in blocks

Description

The FB/SFB 13 BRCV can receive data from a remote partner FB/SFB of the type BSEND (FB/SFB 12). The parameter *R_ID* of both FB/SFBs must be identical.

After each received data segment an acknowledgement is sent to the partner FB/SFB and the *LEN* parameter is updated.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (FB 13)

The parameters *R_ID*, *ID* and *RD_1* are applied with every positive edge on *EN_R*. After a job has been completed, you can assign new values to the *R_ID*, *ID* and *RD_1* parameters. For the transmission of segmented data the block must be called periodically in the user program.

Siemens S7-400 Communication (SFB 13)

Receipt of the data from the user memory is carried out asynchronously to the processing of the user program.

Parameter

Parameter	Declaration	Data type	Memory block	Description
EN_R	INPUT	BOOL	I,Q,M,D,L, constant	control parameter enabled to receive, indicates that the partner is ready for reception
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz.
R_ID	INPUT	DWORD	I,Q,M,D,L, constant	Address parameter *R_ID*. Format DW#16#wxyzWXYZ.
NDR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *NDR*: new data accepted.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. ERROR=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
RD_1	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to the receive data buffer. The length specifies the maximum length for the block that must be received. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.
LEN	IN_OUT	WORD	I,Q,M,D,L	Length of the data that has already been received.

Function

The FB/SFB 13 is ready for reception when control input *EN_R* is set to 1. Parameter *RD_1* specifies the start address of the receive data buffer. An acknowledgement is returned to the partner FB/SFB after reception of each data segment and parameter *LEN* of the FB/SFB 13 is updated accordingly. If the block is called during the asynchronous reception process a warning is issued via the status parameter *STATUS*.

Should this call be received with control input *EN_R* set to 0 then the receive process is terminated and the FB/SFB is reset to its initial state. When all data segments have been received without error parameter *NDR* is set to 1. The received data remains unaltered until FB/SFB 13 is called again with parameter *EN_R*=1.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	17	Warning: block is receiving asynchronous data.
0	25	Communications has been initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Function cannot be executed.
1	4	Error in the receive data block pointer *RD_1* with respect to the length or the data type (the send data block is larger than the receive data block).
1	5	Reset request received, incomplete data transfer.
1	8	Access to the remote object in application memory was rejected.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 13 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	18	*R_ID* already exists in the connection *ID*.
1	20	Not enough memory.

Data consistency

To guarantee data consistency during reception the following points must be met:

- When copying has been completed (parameter *NDR* is set to 1) FB/SFB 13 must again be called with parameter *EN_R* set to 0 in order to ensure that the receive data block is not overwritten before it has bee evaluated.
- The most recently used receive data block *RD_1* must have been evaluated completely before the block is denoted as being ready to receive (calls with parameter *EN_R* set to 1).

Receiving Data S7-400

If a receiving CPU with a BRCV block ready to accept data (that is, a call with *EN_R* = 1 has already been made) goes into STOP mode before the corresponding send block has sent the first data segment for the job, the following will occur:

- The data in the first job after the receiving CPU has gone into STOP mode are fully entered in the receive area.
- The partner SFB BSEND receives a positive acknowledgement.
- Any additional BSEND jobs can no longer be accepted by a receiving CPU in STOP mode.
- As long as the CPU remains in STOP mode, both *NDR* and *LEN* have the value 0.

To prevent information about the received data from being lost, you must perform a hot restart of the receiving CPU and call SFB 13 BRCV with *EN_R*=1.

FB/SFB 14 - GET - Remote CPU read

Description

The FB/SFB 14 GET can be used to read data from a remote CPU. The respective CPU must be in RUN mode or in STOP mode.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (FB 14)

The data is read on a rising edge at *REQ*. The parameters *ID*, *ADDR_1* and *RD_1* are transferred on each rising edge at *REQ*. After a job has been completed, you can assign new values to the *ID*, *ADDR_1* and *RD_1* parameters.

Siemens S7-400 Communication (SFB 14)

The SFB is started with a rising edge at *REQ*. In the process the relevant pointers to the areas to be read out (*ADDR_i*) are sent to the partner CPU.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, a rising edge activates the data exchange (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz.
NDR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *NDR*: data from partner CPU has been accepted.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
ADDR_1	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU that must be read
ADDR_2	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU that must be read
ADDR_3	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU that must be read
ADDR_4	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU that must be read
RD_i, 1≤ i ≤4	IN_OUT	ANY	I,Q,M,D,T,C	Pointers to the area of the local CPU in which the read data are entered. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.

Function

The remote CPU returns the data and the answer is checked for access problems during the read process for the data. The data type is checked in addition.

When a data transfer error is detected the received data are copied into the configured receive data buffer (*RD_i*) with the next call to FB/SFB 14 and parameter *NDR* is set to 1. It is only possible to activate a new read process when the previous read process has been completed. The quantity, length and data type of the data buffers defined by means of parameters *ADDR_i* and *RD_i*, 1 = i = 4 must be identical.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	4	Error in receive data buffer pointer *RD_i* with respect to the length or the data type.
1	8	Partner CPU access error
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 14 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

Data consistency

The data are received in a consistent state if the following point is observed:

Evaluate the part of the receive area *RD_i* currently being used completely before initiating another job.

FB/SFB 15 - PUT - Remote CPU write

Description

The FB/SFB 15 PUT can be used to write data to a remote CPU. The respective CPU may be in RUN mode or in STOP mode.

Depending upon communication function the following behavior is present:

Siemens S7-300 Communication (SB 15)

The data is sent on a rising edge at *REQ*. The parameters *ID*, *ADDR_1* and *SD_1* are transferred on each rising edge at *REQ*. After a job has been completed, you can assign new values to the *ID*, *ADDR_1* and *SD_1* parameters.

Siemens S7-400 Communication (SFB 15)

The SFB is started on a rising edge at *REQ*. In the process the pointers to the areas to be written (*ADDR_i*) and the data (*SD_i*) are sent to the partner CPU.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, a rising edge activates the data exchange (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz.
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: function completed.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
ADDR_1	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU into which data is written
ADDR_2	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU into which data is written
ADDR_3	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU into which data is written
ADDR_4	IN_OUT	ANY	e.g. I,Q,M,D	Pointer indicating the buffers in the partner CPU into which data is written
SD_i, 1≤i ≤4	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to the data buffers in the local CPU that contains the data that must be sent. Only data type BOOL is valid (Bit field not permitted), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME, COUNTER, TIMER.

Function

The partner CPU stores the data at the respective address and returns an acknowledgement. This acknowledgement is tested and when an error is detected in the data transfer parameter *DONE* is set to 1 with the next call of FB/SFB 15. The write process can only be activated again when the most recent write process has been completed. The amount, length and data type of the buffer areas that were defined by means of parameters *ADDR_i* and *SD_i*, 1 ≤ i ≤ 4 must be identical.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	4	Error in transmission range pointers *SD_i* with respect to the length or the data type.
1	8	Partner CPU access error
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 15 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

Data consistency

Siemens S7-300 Communication

In order to ensure data consistency, send area *SD_1* may not be used again for writing until the current send process has been completed. This is the case when the state parameter *DONE* has the value 1.

Siemens S7-400 Communication

When a send operation is activated (rising edge at *REQ*) the data to be sent from the send area *SD_i* are copied from the user program. After the block call, you can write to these areas without corrupting the current send data.

FB/SFB 19 - START - Remote CPU Restart

Description

A positive edge at control input *REQ* activates the FB/SFB 19 START a warm start or a cold start in a remote device addressed by *ID*.

The following conditions must be met if the remote device is a CPU:

- The CPU must be in the STOP mode.
- The key switch of the CPU must be set to RUN.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, activates the data exchange with a rising edge (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz.
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: function was executed.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1:an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
PI_NAME	IN_OUT	ANY	I,Q,M,D,T,C	Pointer to the memory area, that contains the (ASCII) name of the program that must be started. This name may consist of a maximum of 32 characters.
ARG	IN_OUT	ANY	I,Q,M,D,T,C	Execution argument. • If you do not assign a value to *ARG* the remote device executes a warm start. • If you assign a "C" to *ARG* the remote device executes a cold start (provided the remote device is capable of this type of start). VIPA CPUs are always restarted.
IO_STATE	IN_OUT	BYTE	I,Q,M,D,L	Currently of no significance.

Function

After the warm start or the cold start the remote CPU changes to the RUN mode and returns an acknowledgement. This acknowledgement is tested and if the command was executed without errors parameter *DONE* is set to 1. Arisen errors are indicated over the condition parameters *ERROR* and *STATUS*.

The warm start or the cold start can only be activated again on the same remote device after the previous activation has been completed.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	3	The program name stored in *PI_NAME* is not available.
1	4	Error occurred in pointers *PI_NAME* or *ARG* with respect to the length or the data type.
1	7	The partner device cannot execute a warm start.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 19 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

FB/SFB 20 - STOP - Remote CPU STOP

Description

The FB/SFB 20 STOP can be used to transfer a device addressed by *ID* to STOP mode. The remote CPU must be in RUN, HALT or restart mode. A positive edge at control input *REQ* activates the instruction. When this has been executed successfully *DONE* is set to 1. Another stop-instruction can only be activated on the same remote device after the previous activation has been completed.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, activates the data exchange with a rising edge (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: function was executed.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
PI_NAME	IN_OUT	ANY	I,Q,M,D	Pointer to the memory area, that contains the (ASCII) name of the program that must be stopped. This name may consist of a maximum of 32 characters.
IO_STATE	IN_OUT	BYTE	I,Q,M,D,L	Currently of no significance.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	3	The program name stored in *PI_NAME* is not available.
1	4	Error occurred in pointer *PI_NAME* with respect to the length or the data type.
1	7	The partner device is already in stop mode STOP.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 20 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

FB/SFB 21 - RESUME - Remote CPU Warm start

Description

If there is a rising edge at control input *REQ*, FB/SFB 21 activates a hot restart on the remote device selected with the *ID*.

The following conditions must be met if the remote device is a CPU:

- The CPU must be in the STOP mode.
- The key switch of the CPU must be set to RUN.
- When you created the configuration, you allowed for a manual hot restart.
- There must be no condition preventing a hot restart.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, activates the data exchange with a rising edge (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz
DONE	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *DONE*: function was executed.
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
PI_NAME	IN_OUT	ANY	I,Q,M,D	Pointer to the memory area, that contains the (ASCII) name of the program that must be started. This name may consist of a maximum of 32 characters.
ARG	IN_OUT	ANY	I,Q,M,D,T,C	Argument. Currently of no significance.
IO_STATE	IN_OUT	BYTE	I,Q,M,D,L	Currently of no significance.

Function

After the restart, the mode of the remote CPU changes to RUN and it returns an acknowledgement. This acknowledgement is tested and if it the instruction was executed properly parameter *DONE* is set to 1. Arisen errors are indicated over the condition parameters *ERROR* and *STATUS*. The warm start can only be activated again on the same remote device after the previous activation has been completed.

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	3	The program name stored in *PI_NAME* is not available.
1	4	Error occurred in pointers *PI_NAME* or *ARG* with respect to the length or the data type.
1	7	Warm start cannot be executed.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 21 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

FB/SFB 22 - STATUS - Remote CPU Requesting device status

Description

The FB/SFB 22 STATUS requests the device status from a remote communication partner. A positive edge at control input *REQ* activates the instruction. The reply from the remote partner is tested for possible problems. If the instruction was completed without errors the status is copied into the variables *PHYS*, *LOG* and *LOCAL* with the next FB/SFB-call and parameter *NDR* is set to 1. The request can only be repeated to the same remote device when the previous request has been completed.

Parameter

Parameter	Declaration	Data type	Memory block	Description
REQ	INPUT	BOOL	I,Q,M,D,L	control parameter request, activates the data exchange with a rising edge (with respect to the most recent FB/SFB-call)
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz
NDR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *NDR*: new device status received
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
PHYS	IN_OUT	ANY	I,Q,M,D	Physical status (minimum length: one byte) Possible values: - 10h fully operational - 13h service required
LOG	IN_OUT	ANY	I,Q,M,D	Logical status (minimum length: one byte) Possible value: - 00h change of status enabled
LOCAL	IN_OUT	ANY	I,Q,M,D	Operating mode if the partner device is a CPU (minimum length: two bytes).

IN-OUT parameter LOCAL

If the communication partner is a CPU, then the IN-OUT parameter *LOCAL* contains the respective current operating mode: the first byte is reserved and the second byte contains an identifier for the operating mode as listed in the following table.

Operating mode	Respective identifier
STOP	00h
HOT RESTART (reboot)	01h
RUN	02h
WARM RESTART (warm start)	03h
HALT	04h
COLD RESTART (cold start)	06h
RUN_R	09h
LINK UP	0Bh
UPDATE	0Ch

Error information

ERROR	STATUS (decimal)	Meaning
0	11	Warning: the new task is not active since the previous task has not completed.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	2	Negative acknowledgement from partner device. The function cannot be executed.
1	4	Error occurred in *PHYS*, *LOG* or *LOCAL* with respect to the length or the data type.
1	8	Access to remote object was rejected.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 22 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	20	Not enough memory.

FB/SFB 23 - USTATUS - Remote CPU Reception device status

Description

The FB/SFB 23 USTATUS can be used to receive the device status from a communication partner. When the status changes the communication partner will send the status if this function was enabled in your project. If control input *EN_R* is set to 1 when the FB/SFB-call is issued and if a message is available from the partner, then the status information is stored in variables *PHYS*, *LOG* and *LOCAL* with the next call to FB/SFB 23. Parameter *NDR* is set to 1 when the instruction is completed successfully. The connection used by FB/SFB 23 must be able to transfer operating mode messages. Every connection may only be associated with a single instance of the FB/SFB 23.

Parameter

Parameter	Declaration	Data type	Memory block	Description
EN_R	INPUT	BOOL	I,Q,M,D,L	control parameter enabled to receive, indicates that the partner is ready for reception.
ID	INPUT	WORD	I,Q,M,D, constant	A reference for the connection. Format W#16#wxyz
NDR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *NDR*: New device status accepted
ERROR	OUTPUT	BOOL	I,Q,M,D,L	Status parameter *ERROR*: *ERROR*=0 + *STATUS*=0000h: without warnings or errors *ERROR*=0 + *STATUS* unequal to 0000h: Warning. *STATUS* contains detailed information. *ERROR*=1: an error has occurred.
STATUS	OUTPUT	WORD	I,Q,M,D,L	Status parameter *STATUS*, returns detailed information about the type of error.
PHYS	IN_OUT	ANY	I,Q,M,D	Physical status (minimum length: one byte) Possible values: - 10h fully operational - 13h service required
LOG	IN_OUT	ANY	I,Q,M,D	Logical status (minimum length: one byte) Possible values: - 00h Change of state enabled
LOCAL	IN_OUT	ANY	I,Q,M,D	Operating mode if the partner device is a CPU (minimum length: two bytes).

IN-OUT parameter LOCAL

If the communication partner is a CPU, then the IN-OUT parameter *LOCAL* contains the respective current operating mode: The first byte is reserved, the second byte contains an identifier for the operating mode that is listed in the following table.

Operating mode	Respective identifier
STOP	00h
HOT RESTART (reboot)	01h
RUN	02h
WARM RESTART (warm start)	03h
HALT	04h
COLD RESTART (cold start)	06h
RUN_R	09h
LINK UP	0Bh
UPDATE	0Ch

Error information

ERROR	STATUS (decimal)	Meaning
0	9	Overrun warning: an existing device status was overwritten by a new device status.
0	25	The communication process was initiated. The task is being processed.
1	1	Communication failures, e.g. • Connection parameters not loaded (local or remote) • Connection interrupted (e.g. cable, CPU turned off, CP in STOP)
1	4	Error in *PHYS*, *LOG* or *LOCAL* with respect to the length or the data type.
1	10	Access to local application memory not possible (e.g. access to deleted DB).
1	12	The call to the FB/SFB • contains an instance DB that does not belong to the FB/SFB 23 • contains a global DB instead of an instance DB • could not locate an instance DB (load a new instance DB from the PG)
1	18	The connection defined by *ID* is already associated with an instance of FB/SFB 23
1	19	The remote CPU is sending data faster than the FB/SFB can transfer these to the application program.
1	20	Not enough memory.

FB 55 - IP_CONFIG - Programmed Communication Connections

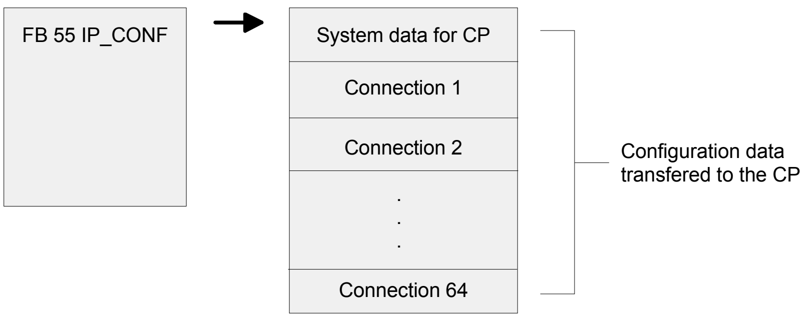
Overview

In some situations, it is an advantage to set up communication connections not with Siemens NetPro but program-controlled by a specific application.

A VIPA function block (FB 55) is available for these applications that allows flexible transfer of data blocks with configuration data to a CP.

Principle

Configuration data for communication connections may be transferred to the CPU by the FB 55 called in the user program.



The configuration DB may be loaded into the CP at any time.

Attention!

As soon as the user program transfers the connection data via FB 55 IP_CONFIG, the CPU switches the CP briefly to STOP. The CP accepts the system data (including IP address) and the new connection data and processes it during startup (RUN).

FB 55 - IP_CONFIG

Depending on the size of the configuration DB, the data may be transferred to the CP in several segments. This means that the FB must as long be called as the FB signals complete transfer by setting the DONE bit to 1.

The Job is started with ACT=1.

Parameter

Parameter	Declaration	Data type	Memory block	Description
ACT	INPUT	BOOL	I, Q, M, D, L	When the FB is called with ACT=1, the DBxx is transmitted to the CP. If the FB is called with ACT=0, only the status codes DONE, ERROR and STATUS are updated.
LADDR	INPUT	WORD	I, Q, M, D, constant	Module base address When the CP is configured by the Siemens hardware configuration, the module base address is displayed in the configuration table. Specify this address here.
CONF_DB	INPUT	ANY	I, Q, M, D	The parameter points to the start address of the configuration data area in a DB.
LEN	INPUT	INT	I, Q, M, D, constant	Length information in bytes for the configuration data area.
DONE	OUTPUT	BOOL	I, Q, M, D, L	The parameter indicates whether the configuration data areas was completely transferred. Remember that it may be necessary to call the FB several times depending on the size of the configuration data area (in several cycles) until the DONE parameter is set to 1 to signal completion of the transfer.
ERROR	OUTPUT	BOOL	I, Q, M, D, L	Error code
STATUS	OUTPUT	WORD	I, Q, M, D	Status code
EXT_ STATUS	OUTPUT	WORD	I, Q, M, D	If an error occurs during the execution of a job, the parameter indicates, which parameter was detected as the cause of the error in the configuration DB. High byte: Index of the parameter block Low byte: Index of the subfield within the parameter block.

Error information

ERROR	STATUS	Meaning
0	0000h	Job completed without errors
0	8181h	Job active
1	80B1h	The amount of data to be sent exceeds the upper limit permitted for this service
1	80C4h	Communication error The error can occur temporarily; it is usually best to repeat the job in the user program.

continued...

...continue

ERROR	STATUS	Meaning
1	80D2h	Configuration error, the module you are using does not support this service.
1	8183h	The CP rejects the requested data record number.
1	8184h	System error or illegal parameter type.
1	8185h	The value of the LEN parameter is larger than the CONF_DB less the reserved header (4bytes) or the length information is incorrect.
1	8186h	Illegal parameter detected. The ANY pointer CONF_DB does not point to data block.
1	8187h	Illegal status of the FB. Data in the header of CONF_DB was possibly overwritten.
1	8A01h	The status code in the data record is invalid (value is >=3).
1	8A02h	There is no job running on the CP; however the FB has expected an acknowledgment for a competed job.
1	8A03h	There is no job running on the CP and the CP is not ready; the FB triggered the first job to read a data record.
1	8A04h	There is no job running on the CP and the CP is not ready; the FB nevertheless expected an acknowledgment for a completed job.
1	8A05h	There is a job running, but there was no acknowledgment; the FB nevertheless triggered the first job for a read data record job.
1	8A06h	A job is complete but the FB nevertheless triggered the first job for a read data records job.
1	8B01h	Communication error, the DB could not be transferred.
1	8B02h	Parameter error, double parameter field
1	8B03h	Parameter error, the subfield in the parameter field is not permitted.
1	8B04h	Parameter error, the length specified in the FB does not match the length of the parameter fields/subfields.
1	8B05h	Parameter error, the length of the parameter field is invalid.
1	8B06h	Parameter error, the length of the subfield is invalid.
1	8B07h	Parameter error, the ID of the parameter field is invalid.
1	8B08h	Parameter error, the ID of the subfield is invalid.
1	8B09h	System error, the connection does not exist.
1	8B0Ah	Data error, the content of the subfield is not correct.
1	8B0Bh	Structure error, a subfield exists twice.
1	8B0Ch	Data error, the parameter does not contain all the necessary parameters.
1	8B0Dh	Data error, the CONF_DB does not contain a parameter field for system data.

continued...

...continue

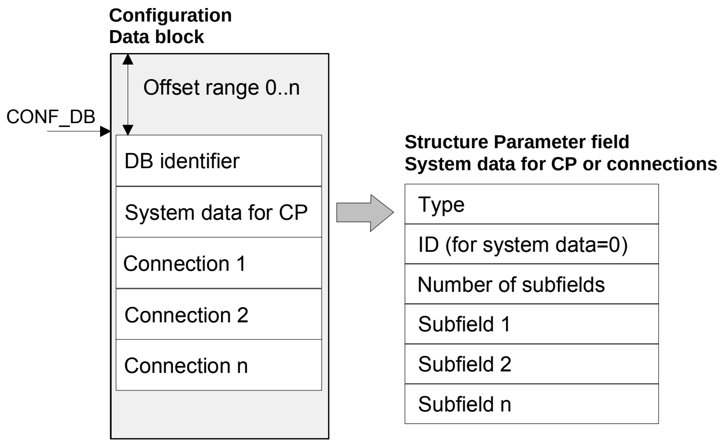
ERROR	STATUS	Meaning
1	8B0Eh	Data error/structure error, the CONF_DB type is invalid.
1	8B0Fh	System error, the CP does not have enough resources to process CONF_DB completely.
1	8B10	Data error, configuration by the user program is not set.
1	8B11	Data error, the specified type of parameter field is invalid.
1	8B12	Data error, too many connections were specified
1	8B13	CP internal error
1	8F22h	Area length error reading a parameter.
1	8F23h	Area length error writing a parameter.
1	8F24h	Area error reading a parameter.
1	8F25h	Area error writing a parameter.
1	8F28h	Alignment error reading a parameter.
1	8F29h	Alignment error writing a parameter.
1	8F30h	The parameter is in the write-protected first current data block.
1	8F31h	The parameter is in the write-protected second current data block.
1	8F32h	The parameter contains a DB number that is too high.
1	8F33h	DB number error
1	8F3Ah	The target area was not loaded (DB).
1	8F42h	Timeout reading a parameter from the I/O area.
1	8F43h	Timeout writing a parameter from the I/O area.
1	8F44h	Address of the parameter to be read is disabled in the accessed rack.
1	8F45h	Address of the parameter to be written is disabled in the accessed rack.
1	8F7Fh	Internal error

Configuration Data Block

The configuration data block (CONF_DB) contains all the connection data and configuration data (IP address, subnet mask, default router, NTP time server and other parameters) for an Ethernet CP. The configuration data block is transferred to the CP with function block FB 55.

Structure

The CONF_DB can start at any point within a data block as specified by an offset range. The connections and specific system data are described by an identically structured parameter field.



Parameter field for System data

Below, there are the subfields that are relevant for networking the CP. These must be specified in the parameter field for system data. Some applications do not require all the subfield types.

Structure

Type = 0
ID = 0
Number of subfields = n
Subfield 1
Subfield 2
Subfield n

Subfield				Parameter	
ID	Type	Length (Byte)	Meaning	Special features	Use
1	SUB_IP_V4	4 + 4	IP address according to IPv4	Locale IP-Address	mandatory
2	SUB_NETMASK	4 + 4	Subnet mask	-	mandatory
4	SUB_DNS_SERV_ ADDR	4 + 4	DNS Server Address	This subfield can occur to 4 times. The first entry is the primary DNS server.	optional
8	SUB_DEF_ROUTER	4 + 4	IP address of the default router	-	optional
14	SUB_DHCP_ENABLE	1 + 4	Obtain an IP address from a DHCP.	0: no DHCP 1: DHCP	optional
15	SUB_CLIENT_ID	Length Client-ID + 4	-	-	optional

Parameter fields for Connection types

There is shown below which values are needed to be entered in the parameter fields and which subfields are to be used for the various connection types.

Some applications do not require all the subfield types. The ID parameter that precedes each connection parameter field beside the type ID is particularly important. On programmed connections this ID may freely be assigned within the permitted range of values. For identification of the connection this ID is to be used on the call interface of the FCs for the SEND/RECV.

Range of values for the connection ID: 1, 2 ... 64

TCP Connection

Type = 1
ID = Connection ID
Number of subfields = n
Subfield 1
Subfield 2
Subfield n

Subfield				Parameter	
ID	Type	Length (Byte)	Meaning	Special features	Use
1	SUB_IP_V4	4 + 4	IP address according to IPv4	IP address of the Partner	mandatory*)
9	SUB_LOC_PORT	2 + 4	Local port	-	mandatory
10	SUB_REM_PORT	2 + 4	Remote port	-	mandatory*)
18	SUB_CONNECT_NAME	Length of the name + 4	Name of the connection	-	optional
19	SUB_LOC_MODE	1 + 4	Local mode of the connection, Possible values: 0x00 = SEND/REC 0x10 = S5-addressing mode for FETCH/WRITE**) 0x80=FETCH**) 0x40=WRITE**) If you do not set the parameter, the default setting is SEND/RECV. For FETCH/WRITE a passive connection setup is necessary	-	optional
21	SUB_KBUS_ADR	-	-	Value: fix 2	optional
22	SUB_CON_ESTABL	1 + 4	Type of connection establishment With this option, you specify whether the connection is established by this station. Possible values: 0 = passive; 1 = active	-	mandatory

*) Option using passive connection

**) May be combined with OR operations

UDP Connection

Type = 2
ID = Connection ID
Number of subfields = n
Subfield 1
Subfield 2
Subfield n

Subfield				Parameter	
ID	Type	Length (Byte)	Meaning	Special features	Use
1	SUB_IP_V4	4 + 4	IP address according to IPv4	IP address of the Partner	mandatory
9	SUB_LOC_PORT	2 + 4	Local port	-	mandatory
10	SUB_REM_PORT	2 + 4	Remote port	-	mandatory
18	SUB_CONNECT_NAME	Length of the name + 4	Name of the connection	-	optional
19	SUB_LOC_MODE	1 + 4	Local mode of the connection Possible values: 0x00 = SEND/REC 0x10 = S5-addressing mode for FETCH/WRITE*) 0x80=FETCH*) 0x40=WRITE*) If you do not set the parameter, the default setting is SEND/RECV.	-	optional
21	SUB_KBUS_ADR	-	-	Value: fix 2	optional
23	SUB_ADDR_IN_DATA_ BLOCK	1 + 4	Select free UDP connection. The remote node is entered in the job header of the job buffer by the user program when it calls AG_SEND. This allows any node on Ethernet/LAN/WAN to be reached. Possible values: 1 = free UDP connection 0 = otherwise	If the "Free UDP connection" is selected for this parameter, the parameters SUB_IP_V4, SUB_LOC_PORT SUB_REM_PORT are omitted.	optional

*) the coding may be combined with OR operations

ISO-on-TCP

Type = 3
ID = Connection ID
Number of subfields = n
Subfield 1
Subfield 2
Subfield n

Subfield				Parameter	
ID	Type	Length (Byte)	Meaning	Special features	Use
1	SUB_IP_V4	4 + 4	IP address according to IPv4	IP address of the Partner	mandatory*)
11	SUB_LOC_PORT	TSAP length + 4	Local TSAP	-	mandatory
12	SUB_REM_PORT	TSAP length + 4	Remote TSAP	-	mandatory*)
18	SUB_CONNECT_NAME	Length of the name + 4	Name of the connection	-	optional
19	SUB_LOC_MODE	1 + 4	Local mode of the connection Possible values: 0x00 = SEND/RECV 0x10 = S5-addressing mode for FETCH/WRITE**) 0x80=FETCH**) 0x40=WRITE**) If you do not set the parameter, the default setting is SEND/RECV.	-	optional
21	SUB_KBUS_ADR	-	-	Value: fix 2	optional
22	SUB_CON_ESTABL	1 + 4	Type of connection establishment With this option, you specify whether the connection is estab-lished by this station. Possible values: 0 = passive; 1 = active	-	mandatory

*) option using passive connection

**) the coding may be combined with OR operation

Additional Parameter fields

Block_VIPA_HWK

As soon as the Block_VIPA_HWK (special identification 99) is contained in the DB, all connections, which were parameterized in the NETPRO, are still remain. Now it is possible to change with IP_CONFIG only the system data (IP, Netmask etc.).

If the special identification Block_VIPA_HWK were found, no other connecting data may be parameterized in the DB, otherwise error is announced in the RETVAL.

If the Block_VIPA_HWK is not in the DB, then all connections are removed from NETPRO (as with Siemens) and the connections from this DB are only configured.

Type = 99
ID = 0
Number of subfields = 0

Block_VIPA_ BACNET

As soon as the Block_VIPA_BACNET (special identification 100) is contained in the DB, a BACNET configuration is derived from the DB and no further blocks are evaluated thereafter.

Type = 100
Number of subfields = 0

Block_VIPA_IPK

Type = 101
ID = Connection ID
Number of subfields = n
Subfield 1
Subfield 2
Subfield n

Subfield				Parameter	
ID	Type	Length (Byte)	Meaning	Special features	Use
1	VIPA_IPK_CYCLE	4 + 4	IPK cycle time for connection ID	VIPA specific	optional

FC 5 - AG_SEND / FC 6 - AG_RECV - CP 343 communication

Overview

The two blocks serve the processing of the Ethernet-CP 343 connection commands on the side of the PLC. Including these blocks in the cycle block OB1 you may send and receive data cyclically.

Within these blocks, the SFCs 205 and 206 are called that are stored as special function blocks in the CPU.

Note!

Please regard that you may only use the SEND/RECV-FCs from VIPA in your user application for the communication with VIPA-CPs. At a change to VIPA-CPs in an already existing project, the present AG_SEND/ AG_LSEND res. AG_RECV/AG_LRECV may be replaced by AG_SEND res. AG_RECV from VIPA without adjustment. Due to the fact that the CP automatically adjusts itself to the length of the data to transfer, the L variant of SEND res. RECV is not required for VIPA CPs.

Communication blocks

For the communication between CPU and CP, the following FCs are available:

AG_SEND (FC 5)

This block transfers the user data from the data area given in *SEND* to the CP specified via *ID* and *LADDR*. As data area you may set a PA, bit memory or data block area. When the data area has been transferred without errors, "order ready without error" is returned.

AG_RECV (FC 6)

The block transfers the user data from the CP into a data area defined via *RECV*. As data area you may set a PA, bit memory or data block area. When the data area has been transferred without errors, "order ready without error" is returned.

Status displays

The CP processes send and receive commands independently from the CPU cycle and needs for this transfer time. The interface with the FC blocks to the user application is here synchronized by means of acknowledgements/receipts.

For status evaluation the communication blocks return parameters that may be evaluated directly in the user application.

These status displays are updated at every block call.

Deployment at high communication load

Do not use cyclic calls of the communication blocks in OB 1. This causes a permanent communication between CPU and CP. Program instead the communication blocks within a time OB where the cycle time is higher res. event controlled.

FC call is faster than CP transfer time

If a block is called a second time in the user application before the data of the last time is already completely send res. received, the FC block interface reacts like this:

AG_SEND

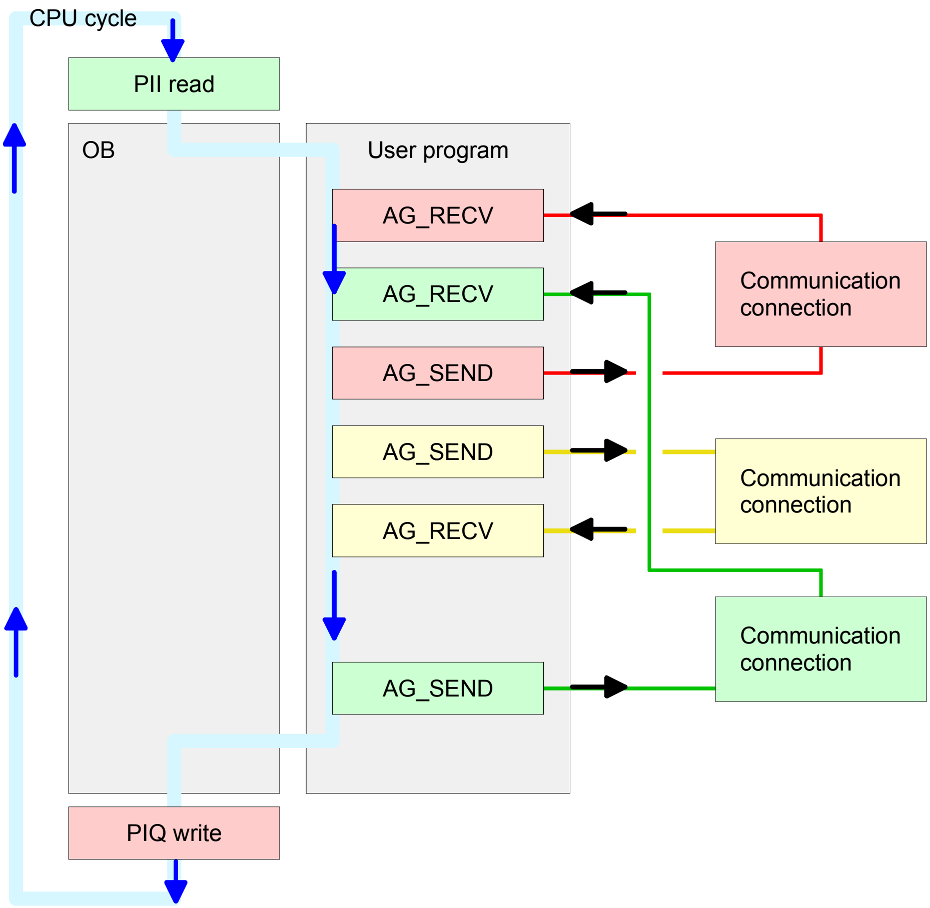
No command is accepted until the data transfer has been acknowledged from the partner via the connection. Until this you receive the message "Order running" before the CP is able to receive a new command for this connection.

AG_RECV

The order is acknowledged with the message "No data available yet" as long as the CP has not received the receive data completely.

AG_SEND, AG_RECV in the user application

The following illustration shows a possible sequence for the FC blocks together with the organizations and program blocks in the CPU cycle:



The FC blocks with concerning communication connection are summed up by color. Here you may also see that your user application may consist of any number of blocks. This allows you to send or receive data (with AG_SEND res. AG_RECV) event or program driven at any wanted point within the CPU cycle.

You may also call the blocks for **one** communication connection several times within one cycle.

AG_SEND (FC5)

By means of AG_SEND the data to send are transferred to the Ethernet CP 343.

Parameter

Parameter	Declaration	Data type	Description
ACT	INPUT	BOOL	Activation of the sender 0: Updates *DONE*, *ERROR* and *STATUS* 1: The data area defined in SEND with the length *LEN* is send
ID	INPUT	INT	Connection number 1 ... 16 (identical with *ID* of NetPro)
LADDR	INPUT	WORD	Logical basic address of the CP (identical with *LADDR* of NetPro)
SEND	INPUT	ANY	Data area
LEN	INPUT	INT	Number of bytes from data area to transfer
DONE	OUTPUT	BOOL	Status parameter for the order 0: Order running 1: Order ready without error
ERROR	OUTPUT	BOOL	Error message 0: Order running (at *DONE* = 0) 0: Order ready without error (at *DONE* = 1) 1: Order ready with error
STATUS	OUTPUT	WORD	Status message returned with *DONE* and *ERROR*. More details are to be found in the following table.

AG_RECV (FC6)

By means of AG_RECV the data received from the Ethernet CP 343 are transferred to the CPU.

Parameter

Parameter	Declaration	Data type	Description
ID	INPUT	INT	Connection number 1 ... 16 (identical with ID of NetPro)
LADDR	INPUT	WORD	Logical basic address of the CP (identical with *LADDR* of NetPro)
RECV	INPUT	ANY	Data area for the received data
NDR	OUTPUT	BOOL	Status parameter for the order 0: Order running 1: Order ready data received without error
ERROR	OUTPUT	BOOL	Error message 0: Order running (at *NDR* = 0) 0: Order ready without error (at *NDR* = 1) 1: Order ready with error
STATUS	OUTPUT	WORD	Status message returned with *NDR* and *ERROR*. More details are to be found in the following table.
LEN	OUTPUT	INT	Number of bytes that have been received

DONE, ERROR, STATUS

The following table shows all messages that can be returned by the Ethernet CP 343 after a SEND res. RECV command.

A "-" means that this message is not available for the concerning SEND res. RECV command.

DONE (SEND)	NDR (RECV)	ERROR	STATUS	Meaning
1	-	0	0000h	Order ready without error
-	1	0	0000h	New data received without error
0	-	0	0000h	No order present
-	0	0	8180h	No data available yet
0	0	0	8181h	Order running
0	0	1	8183h	No CP project engineering for this order
0	-	1	8184h	System error
-	0	1	8184h	System error (destination data area failure)
0	-	1	8185h	Parameter *LEN* exceeds source area *SEND*
	0	1	8185h	Destination buffer (RECV) too small
0	0	1	8186h	Parameter *ID* invalid (not within 1 ...16)
0	-	1	8302h	No receive resources at destination station, receive station is not able to process received data fast enough res. has no receive resources reserved.
0	-	1	8304h	The connection is not established. The send command shouldn't be sent again before a delay time of >100ms.
-	0	1	8304h	The connection is not established. The receive command shouldn't be sent again after a delay time of >100ms.
0	-	1	8311h	Destination station not available under the defined Ethernet address.
0	-	1	8312h	Ethernet error in the CP
0		1	8F22h	Source area invalid, e.g. when area in DB not present Parameter *LEN* < 0
-	0	1	8F23h	Source area invalid, e.g. when area in DB not present Parameter *LEN* < 0
0	-	1	8F24h	Range error at reading a parameter.
-	0	1	8F25h	Range error at writing a parameter.
0	-	1	8F28h	Orientation error at reading a parameter.
-	0	1	8F29h	Orientation error at writing a parameter.
-	0	1	8F30h	Parameter is within write protected 1. recent data block
-	0	1	8F31h	Parameter is within write protected 2. recent data block
0	0	1	8F32h	Parameter contains oversized DB number.
0	0	1	8F33h	DB number error
0	0	1	8F3Ah	Area not loaded (DB)

continued...

... continue DONE, ERROR, STATUS

DONE (SEND)	NDR (RECV)	ERROR	STATUS	Meaning
0	-	1	8F42h	Acknowledgement delay at reading a parameter from peripheral area.
-	0	1	8F43h	Acknowledgement delay at writing a parameter from peripheral area.
0	-	1	8F44h	Address of the parameter to read locked in access track
-	0	1	8F45h	Address of the parameter to write locked in access track
0	0	1	8F7Fh	Internal error e.g. invalid ANY reference e.g. parameter *LEN* = 0.
0	0	1	8090h	Module with this module start address not present or CPU in STOP.
0	0	1	8091h	Module start address not within double word grid.
0	0	1	8092h	ANY reference contains type setting unequal BYTE.
-	0	1	80A0h	Negative acknowledgement at reading the module
0	0	1	80A4h	reserved
0	0	1	80B0h	Module doesn't recognize record set.
0	0	1	80B1h	The length setting (in parameter *LEN*) is invalid.
0	0	1	80B2h	reserved
0	0	1	80C0h	Record set not readable.
0	0	1	80C1h	The set record set is still in process.
0	0	1	80C2h	Order accumulation.
0	0	1	80C3h	The operating sources (memory) of the CPU are temporarily occupied.
0	0	1	80C4h	Communication error (occurs temporarily; a repetition in the user application is reasonable.)
0	0	1	80D2h	Module start address is wrong.

Status parameter at reboot

At a reboot of the CP, the output parameters are set as follows:

- *DONE* = 0
- *NDR* = 0
- *ERROR* = 0
- *STATUS* = 8180h (at AG_RECV)
  STATUS = 8181h (at AG_SEND)

FC 10 - AG_CNTRL - CP 343 communication

Description

The connections of the Ethernet CP 343 may be diagnosed and initialized by means of the VIPA FC 10.

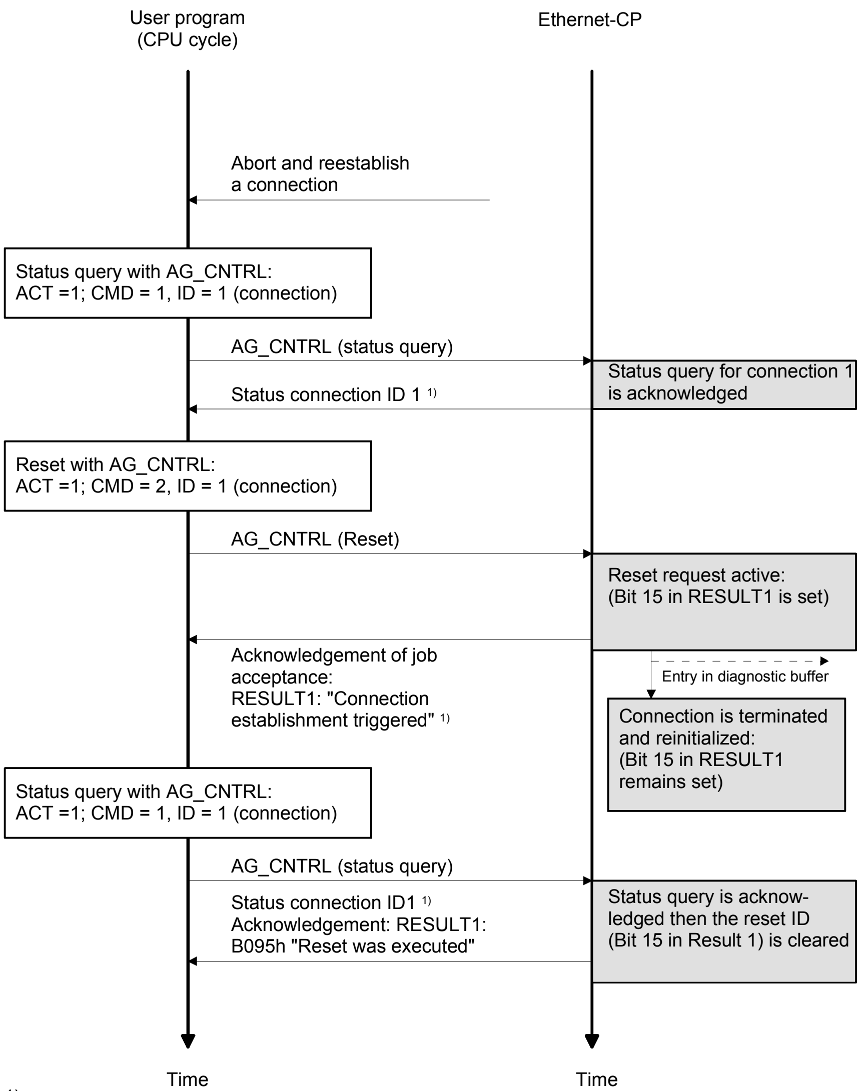
The following jobs may be executed by parameterizable commands:

- Reading connection information
- Resetting configured connections

The commands of this block are permitted only for SEND/RECV connections based on the ISO/RFC/TCP and UDP protocols.

FC 10 in the user program

The following diagram shows a typical sequence of AG_CNTRL. Here it is shown how the connection status is initially queried and then, in a second job, how the connection termination is triggered with the rest command.



1) Parameter transfer DONE, ERROR, STATUS and RESULT1/2

Parameter

Parameter	Declaration	Data type	Description
ACT	INPUT	BOOL	Job triggered by memory bit ACT
ID	INPUT	INT	Connection ID according to configuration
LADDR	INPUT	WORD	Base address of CP in hardware configuration
CMD	INPUT	INT	Job ID
DONE	OUTPUT	BOOL	Execution code
ERROR	OUTPUT	BOOL	Error code
STATUS	OUTPUT	WORD	Status code
RESULT1	OUTPUT	DWORD	Job result 1
RESULT2	OUTPUT	DWORD	Job result 2

ACT

Possible values: 0, 1

The FC is to be called with ACT=1.

If it is called with ACT=0, there is no function call and the block is exited immediately.

ID

Possible values: 1, 2 ... n, or 0

The number of the connection is specified in the parameter ID. The connection number may be found in the configuration. n is the maximum number of connections.

If the call addresses every connection as ID 0 is to be specified (_ALL-function with CMD 3 respectively CMD 4).

LADDR

Module base address

At CP configuration with the hardware configurator the module base address is displayed in the configuration table.

Specify this address here.

CMD

Command to the FC AG_CNTRL

(See Commands and evaluating the job results)

DONE

0: Job is still being processed or not yet triggered

1: Job executed

This parameter indicates whether or not the job was completed without errors. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the table DONE, ERROR, STATUS.

If DONE=1 RESULT may be evaluated.

ERROR

0: No error

1: Error

Error indication (refer to the table DONE, ERROR, STATUS)

STATUS

Status indication (refer to the table DONE, ERROR, STATUS)

RESULT1/2

Information returned according to the command sent to the FC AG_CNTRL (See Commands and evaluating the job results).

DONE, ERROR, STATUS

The following table shows the messages that may be returned by the Ethernet-CP 343 after an AG_CNTRL call.

Additional the command results in the parameters RESULT1 and RESULT2 are to be evaluated.

DONE	ERROR	STATUS	Meaning
1	0	0000h	Job executed without error
0	0	0000h	No job executing
0	0	8181h	Job active, the block call is to be repeated with the same parameters until DONE or ERROR is returned.
0	1	8183h	There is no CP configuration for this job or the service has not yet started in the Ethernet-CP 343.
0	1	8186h	Parameter *ID* is invalid. The permitted ID depends on the selected command.
0	1	8187h	Parameter CMD is invalid
0	1	8188h	Sequence error in the ACT control
0	1	8090h	Module with this address does not exist or CPU in STOP.
0	1	8091h	The module base address is not on a double-word boundary.
0	1	80B0h	The module does not recognize the data record.
0	1	80C0h	The data record cannot be read.
0	1	80C1h	The specified data record is currently being processed.
0	1	80C2h	There are too many jobs pending.
0	1	80C3h	CPU resources (memory) occupied.
0	1	80C4h	Communication error (error occurs temporarily; it is usually best to repeat the job in the user program).
0	1	80D2h	The module base address is incorrect.

Status parameter at cold restart

The output parameters are set to the following values during a cold restart of the CP:

- *DONE* = 0
- *NDR* = 0
- *ERROR* = 8180h (at AG_RECV)
  ERROR = 8181h (at AG_SEND)

Commands and evaluating the job results

The following table shows the possible commands and the results that may be evaluated in the parameters RESULT1 and RESULT2.

CMD 0

NOP - no operation
The block is executed without a job being sent to the CP.

RESULT	Hex value/range	Meaning
RESULT 1	0000 0001h	Executed without error
RESULT 2	0000 0000h	Default

CMD 1

CN_STATUS - connection status

This command returns the status of the connection selected with the ID of the CP addressed by LADDR. If bit 15 (reset ID) is set, this is automatically reset (this action corresponds to the CMD 5 - CN_CLEAR_RESET).

RESULT	Hex value/range	Meaning
RESULT 1	0000 000xh	Bit 3 ... 0: Codes for the send direction (excluded: 0010_b) Bit 0: Connection reserved for send and receive jobs Bit 1: Send job being executed Bit 3, 2: Previous job 00: No information 01: Send job completed successfully 10: Send job not completed successfully
	0000 00x0h	Bit 7 ... 4: Codes for receive direction (excluded: 0010_b) Bit 4: Connection reserved for send and receive jobs Bit 5: Receive job being executed Bit 7, 6: Previous job 00: No information 01: Receive job completed successfully 10: Receive job not completed successfully
	0000 0x00h	Bit 11 ... 8: Codes for FETCH/WRITE (excluded: 0011_b, 0111_b, 1000_b, 1011_b, 0010_b) Bit 8: Connection type 0: No FETCH connection 1: Connection reserved for FETCH jobs Bit 9: Connection type 0: No WRITE connection 1: Connection reserved for WRITE jobs Bit 10: Job status (FETCH/ WRITE) 0: Job status OK 1: Job status not OK This ID is set in the following situations: - The job was acknowledged negatively by the CPU - The job could not be forwarded to the CPU because the connection was in the "LOCKED" status. - The job was rejected because the FETCH/WRITE header did not have the correct structure. Bit 11: Status of FETCH/WRITE job 0: No job active 1: Job from LAN active

continued ...

... continue

RESULT	Hex value/range	Meaning
	0000 x000h	Bit 15 ... 12: General CP information (excluded: 0011_b, 1011_b) Bit 13, 12: Connection status (only available for SEND/RECV connections based on the ISO/RFC/TCP protocols; with UDP, the corresponding internal information is output) 00: Connection is terminated 01: Connection establishment active 10: Connection termination active 11: Connection is established Bit 14: CP information 0: CP in STOP 1: CP in RUN Bit 15: Reset ID 0: FC 10 has not yet reset a connection or the reset ID was cleared. 1: The FC 10 has executed a connection reset
	xxxx 0000h	Bit 31 ... 16: Reserved for later expansions
RESULT 2	0000 0000h	Reserved for later expansions

CMD 2

CN_RESET - connection reset

This command resets the connection selected with the ID of the CP addressed by LADDR.

Resetting the connection means that a connection is aborted and established again (active ore passive depending on the configuration).

An entry is also generated in the diagnostic buffer in which the job result may be found.

RESULT	Hex value/range	Meaning
RESULT 1	0000 0001h	The reset job was transferred to the CP successfully. The connection abort and subsequent connection establishment were triggered.
	0000 0002h	The reset job could not be transferred to the CP because the service has not started on the CP (for example CP in STOP).
RESULT 2	0000 0000h	Default

CMD 3

CN_STATUS_ALL - all connections status

This command returns the connection status of all connections (established/terminated) in the RESULT1/2 parameters (at total of 8byte of group information) of the CP addressed by LADDR.

The ID parameter must be set to "0" (checked for "0").

When necessary, you may obtain detailed information about a terminated or not configured connection using a further connection status call with CMD=1.

RESULT	Hex value/range	Meaning
RESULT 1	xxxx xxxxh	32 Bit: Connection 1 ... 32 0: Connection terminated / not configured 1: Connection established
RESULT 2	xxxx xxxxh	32 Bit: Connection 33 ... 64 0: Connection terminated / not configured 1: Connection established

CMD 4

CN_RESET_ALL - all connections reset

This command resets all connection of the CP addressed by LADDR.

The ID parameter must be set to "0" (checked for "0").

Resetting the connection means that a connection is aborted and established again (active ore passive depending on the configuration).

An entry is also generated in the diagnostic buffer in which the job result may be found.

RESULT	Hex value/range	Meaning
RESULT 1	0000 0001h	The reset job was transferred to the CP successfully. The connection abort and subsequent connection establishment of every connection were triggered.
	0000 0002h	The reset job could not be transferred to the CP because the service has not started on the CP (for example CP in STOP).
RESULT 2	0000 0000h	Default

CMD 5

CN_CLEAR_RESET - Clear the reset ID

This command resets the reset ID (bit 15 in RESULT1) for the connection selected with the ID of the CP addressed by LADDR.

This job executes automatically when the connection status is read (CMD=1); the separate job described here is therefore only required in special situations.

RESULT	Hex value/range	Meaning
RESULT 1	0000 0001h	The clear job was transferred to the CP successfully.
	0000 0002h	The clear job could not be transferred to the CP because the service has not stated on the CP (for example CP in STOP).
RESULT 2	0000 0000h	Default

CMD 6 and 7

CN_RESERVED_1

These jobs are reserved for firmware expansions; in contrast to the "NOP" job, this job is processed on the CP and leads to an appropriate code in the RESULT1/2 parameters.

RESULT	Hex value/range	Meaning
RESULT 1	0000 0001h	The job was transferred to the CP successfully.
	0000 0002h	This job could not be transferred to the CP because the service has not stated on the CP (for example CP in STOP).
RESULT 2	0000 0000h	Default

FC 200 - IBS_INIT

Description

This FC synchronizes the Interbus master with the CPU and checks the number of connected in- and output bytes as well as the bus structure.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
LADDR	IN	INT	Logical base address of Interbus master
MODE	IN	INT	Mode for start-up
WAIT_TIME	IN	S5TIME	Wait time for Interbus Master acknowledgement
TIMER_NO	IN	INT	Timer number for wait time
SERVICE_DB_SEND	IN	INT	DB number with services
SERVICE_DB_REC	IN	INT	DB number for Interbus master acknowledgement
NO_OF_SERVICES	IN	Word	Number of services to be processed starting at FIRST_SERVICE
READ_DIAG	IN	BOOL	Structure diagnostic data
RET_VAL	OUT	WORD	Return value on error
FIRST_SERVICE	IN_OUT	BYTE	Number of 1. service of the service DB to be processed

WORK_DB

Set the work DB for the wanted master.

LADDR

Set the address (**L**ogical **Addr**ess) from where on the register of the masters is to be mapped into the CPU. At start-up of the CPU, the Interbus master are mapped into the I/O address range of the CPU with the following formula if no hardware configuration is present:

Start address = 256· (Slot-101)+2048

The slot numbering at the SPEED-Bus starts with 101 at the left side of the CPU and ascends from the right to the left. For example, the 1. slot has the address 2048, the 2. the address 2304 etc.

MODE

This parameter allows you to preset 3 modes for start-up:

0 = Calculate address only

1 = Calculate address and wait for Ready of the Interbus master

2 = Calculate address, parameterize and start Interbus master

3 = Calculate address and automatically start of Interbus after auto-configuration via switch

WAIT_TIME
TIMER_NO

Here you may define a waiting period with the according timer by setting *WAIT_TIME* and *TIMER-NO* that the CPU has to wait for a master acknowledgement after a service command.

Note!

Please regard at setting a timer number. That always 2 sequential timers are used: Timer 1: *TIMER_NO*, Timer 2: *TIMER_NO* + 1

SERVICE_DB_SEND
SERVICE_DB_REC

Enter the DB that contains the according service instructions via *SERVICE_DB_SEND*. In *SERVICE_DB_REC* the Interbus master returns the receipt.

More details about the structure of the service DB may be found on the following page at "FC 202 Process service".

NO_OF_SERVICES
FIRST_SERVICE

In *NO_OF_SERVICES* you enter the number of services that have to be processed in the service DB after the 1. service that you set in *FIRST_SERVICE*.

READ_DIAG

This parameter allows you to influence the structure of a diagnosis:

0 = Normal diagnosis

1 = Extended diagnosis

RET_VAL

In case of an error, *RET_VAL* may contain the following error messages:

1 = Waiting period for master receipt (READY) exceeded - master not ready

2 = Execution of a service to process has failed

FC 202 - IBS_SERVICE

Description

This function block allows you to transfer services to the Interbus master and to react to the according acknowledgements.

For the Interbus master card USC4-1 from Phoenix Contact is deployed as Interbus hardware platform, please also refer to the extensive documentation (IBS SYS FW G4 UM) from Phoenix Contact for the description of the Interbus services and Interbus error messages.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
SERVICE_DB_SEND	IN	INT	DB number with services
SERVICE_DB_REC	IN	INT	DB number for Interbus master acknowledgement
FIRST_SERVICE	IN	Byte	Number of 1. service of the service DB to be processed
START	IN_OUT	BOOL	Start bit of the function
ERROR	IN_OUT	BOOL	Error bit of the function

WORK_DB

Set the work DB for the wanted master.

SERVICE_DB_SEND
SERVICE_DB_REC

Enter the DB that contains the according service instructions via *SERVICE_DB_SEND*. In *SERVICE_DB_REC* the Interbus master returns the receipt.

FIRST_SERVICE

Enter the position of the first service within the send DB.

Note!

Please regard that you have to enter the number of services that are to be transferred after *FIRST_SERVICE* in the work DB before calling the FC 202.

Structure service DB

You may enter a max. of 30 services in one DB. Up to 2 DBs, 60 services in total, may be transferred to the Interbus master at every FC call.

DBB	Contents
0 ... 69	Record set 1
70 ... 139	Record set 2
:	:
2030 ... 2099	Record set 30
2100	Instruction number 2. DB

Structure record set

DBW	Contents
0	Send length (Number of bytes to be send)
1	Code number of service
2	Parameter count
3 ... 68	Parameter

START

By setting the start bit, the services are transferred to the Interbus master and started.

ERROR

In case of an error, the Start bit is set back and the error bit is set. Additionally, the number of the service that has been processed when the error occurred is entered in the DBB113 of the work DB. The error code is displayed in DBB112.

The following error codes may occur:

2 = Error of the master at reading data from SSGI Box

3 = Return code of the acknowledgement not valid

4 = Service could not be processed

5 = No acknowledgement within waiting period

Note!

If DBB112 contains the error code 4, further error codes are entered into DBW114 and 116 of the work DB.

Information about these error codes is to be found in the documentation of the services (IBS SYS FW G4 UM) from Phoenix Contact.

FC 204 - IBS_LOOP, FC 205 - IBS_CYCLE

Description

The FC 204 serves the exchange of in- and output data between Interbus master and CPU. This block always awaits an acknowledgement of the master after a data request and continues the cycle processing only after reception.

If this block influences the cycle processing of the CPU too much, you should use the FC 205 Asynchr_Cycle instead. In opposite to the FC 204 this does not wait for an acknowledgement but continues cycle processing after data request.

Occurring error messages are to be found after block processing in the work DB in DBW150.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
RW_MODE	IN	INT	Mode of Read/Write (0=R/W, 1=R, 2=W)
OPERATION _MODE	IN	INT	Operation mode (0=asynchr., 1=asynchr. with consistency)
TYP_OUT	IN	INT	Data type of Interbus slave out data (0=DB, 1=MB, 2=OB)
TYP_IN	IN	INT	Data type of Interbus slave in data (0=DB, 1=MB, 2=IB)
START	IN_OUT	BOOL	Start bit of the function

WORK_DB

Set the work DB for the wanted master.

RW_MODE

The following modes are available:

0 = Read input data and write output data

1 = Read input data only

2 = Write output data only

OPERATING_MODE

The transfer may happen with the following operating modes:

0 = Asynchronous data exchange without consistency lock

In this operating mode it may happen that read res. written data is not out of the same Interbus cycle and is therefore inconsistent.

1 = Asynchronous data exchange with consistency lock

Here the CPU sets a bit for read/write request. As soon as the next Interbus cycle is finished and data is ready, the Interbus master sets a release bit. The CPU transfers its data and signalizes the end of data transfer by setting back the request. Now the Interbus master deletes the release and continues the Interbus cycle.

TYP_OUT
TYP_IN

This parameter defines the type of the data area where the I/O data of connected Interbus slaves is stored.

The following types are available:

0 = DB (data block)

1 = MB (bit memory byte)

2 = I/O range of the CPU

START

By setting the Start bit, the FC is executed. The start is set back again in the block.

Error message

During the execution of the block, the following errors that are stored in DBW 150 of the work DB may occur:

1 = Data release of the master missing - read inputs

2 = Data release of the master missing - write outputs

3 = Data release of the masters is not deleted

FC 206 - IBS_IRQ

Description

At deployment of the FC 206, the data transfer of the in- and output data between CPU and Interbus master is controlled via interrupts.

As soon as the Interbus master has provided its data, it initializes an interrupt. The CPU transfers its data and also signalizes the end of the data transfer via an interrupt. Now the Interbus master continues the Interbus cycle.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
RW_MODE	IN	INT	Mode of R/W (0=R/W, 1=R, 2=W)
TYP_OUT	IN	INT	Data type of Interbus slave out data (0=DB, 1=MB, 2=OB)
TYP_IN	IN	INT	Data type of Interbus slave in data (0=DB, 1=MB, 2=IB)

WORK_DB

Set the work DB for the wanted master.

RW_MODE

The following modes are available:

0 = Read input data and write output data

1 = Read input data only

2 = Write output data only

TYP_OUT
TYP_IN

This parameter defines the type of the data area where the I/O data of connected Interbus slaves is stored.

The following types are available:

0 = DB (data block)

1 = MB (bit memory byte)

2 = I/O range of the CPU

FC 207 - IBS_PCP

Description

This function block allows you to transfer PCP services to the Interbus master and to react to the according acknowledgements. The **P**eripherals **C**ommunication **P**rotocol (PCP) serves the transmission of instructions and parameters to connected slaves and the reception of acknowledgements and data of the slaves.

Information about the services is to be found in the documentation of the services, available via our application department.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
SERVICE_DB_SEND	IN	INT	DB number with services
SERVICE_DB_REC	IN	INT	DB number for Interbus master acknowledgement
FIRST_SERVICE	IN	Byte	Number of 1. service of the service DB to be processed
START	IN_OUT	BOOL	Start bit of the function
ERROR	IN_OUT	BOOL	Error bit of the function

WORK_DB

Set the work DB for the wanted master.

SERVICE_DB_SEND
SERVICE_DB_REC

Enter the DB that contains the according PCP service instructions via *SERVICE_DB_SEND*. In *SERVICE_DB_REC* the slaves return the receipt.

FIRST_SERVICE

Enter the position of the first PCP service within the send.

Note!

Please regard that you have to enter the number of services that are to be transferred after *FIRST_SERVICE* in the work DB before calling the FC 207.

Structure service DB

You may enter a max. of 30 PCP services in one DB. Up to 2 DBs, 60 PCP services in total, may be transferred to the Interbus master at every FC call.

DBB	Content
0 ... 69	Record set 1
70 ... 139	Record set 2
:	:
:	:
2030 ... 2099	Record set 30
2100	Sequence number of 2. DB

Structure record set

DBW	Content
0	Send length (Number of bytes to be send)
1	Code number of PCP service
2	Parameter count
3 ... 68	Parameter

START

By setting the start bit, the PCP services are transferred to the Interbus master and started.

ERROR

In case of an error, the start bit is set back and the error bit is set. Additionally, the number of the PCP service that has been processed when the error occurred is entered in the DBB193. The following error codes may be entered into DBB192:

2 = Error of the master at reading data from SSGI Box

3 = Return code of the acknowledgement not valid

4 = Service could not be processed

5 = No acknowledgement within waiting period

Note!

If *ERROR* contains the error code 4, further error codes are entered into DBW194 and 196 of the work DB.

Information about these error codes is to be found in the documentation of the error codes, available via our application department.

FC 208 - IBS_DIAG

Description Via this function block you may read diagnostic data from the master res. slave in case of an Interbus breakdown. Here you may also define the reboot operating mode of the Interbus master after breakdown.

Parameter

Parameter	Declaration	Data type	Description
WORK_DB	IN	BLOCK_DB	Interbus work DB
ACTIVATE	IN	INT	Manual error acknowledgement
AUTO_START	IN	INT	Automatic error acknowledgement
RUN	OUT	Byte	Interbus at status RUN
PERIPHERAL_ERROR	OUT	BOOL	Error at periphery
BUS_QUALITY	OUT	BOOL	Sporadic bus errors occurred
DETECTION	OUT	BOOL	Internal error is searched
BUSY_STATE	OUT	BOOL	Internal diagnostic function is busy

WORK_DB Set the work DB for the wanted master.

ACTIVATE
AUTO_START

The *ACTIVATE* transmission parameter of the type Boolean that you may control for example via an external caliper, allows you to reboot the Interbus master by setting (push button).

By setting of auto-start, the Interbus master reboots automatically after error recovering. *AUTO-START* has always preference before *ACTIVATE*.

RUN This parameter shows the status of the Interbus master:

0 = Interbus master is in STOP

1 = Interbus master is in RUN

PERIPHERAL_ ERROR	If a periphery error occurs, the Interbus master announces PF = 1. At PF = 0 no periphery error occurred. In case of an error you will see the number of the causing slave in the work DB starting with 1.
BUS_QUALITY	This parameter displays information about the transfer quality within the Interbus. As soon as the bit is set by the Interbus master, some single transmission interferences have occurred. Please check the transfer routes with according diagnosis software.
DETECTION	The parameter *DETECTION* is set by the Interbus master when the internal error detection is running. When the error detection is finished, *DETECTION* is set back again.
BUSY_STATE	When a diagnosis is executed within the diagnosis block, *BUSY_STATE* is set. As soon as diagnosis data are available, the block sets *BUSY_STATE* back again.

SFB 7 - uS_TIME and SFC 53 - uS_TICK - Time measurement

SFC 53 uS_TICK

This block allows you to read the µs ticker integrated in the SPEED7-CPU. The µs ticker is a 32Bit µs time counter that starts at every reboot with 0 and counts to 2^{32-1}µs. At overflow the counter starts again with 0. With the help of the difference creation of the *RETVAL* results of 2 SFC 53 calls before and after an application you may thus evaluate the runtime of the application in µs.

Runtime in dependence of the operating mode

Status	µs system time
Start-up	Starts with 0 and is permanently updated
RUN	is permanently updated
STOP	is stopped (time cannot be read)
Reboot (Reset)	Starts again with 0

Parameter

Name	Declaration	Type	Comment
RETVAL	OUT	DINT	System time in µs

RETVAL

The parameter *RETVAL* contains the read system time in the range of 0 to 2^{32-1}µs

SFB 7 uS_TIME

In opposite to the SFC 53, the SFB 7 returns the difference between two calls in µs.

With *RESET* = 1 the current timer value is transferred to *store*. Another call with *RESET* = 0 displays the difference in µs via *VALUE*.

Parameter

Name	Declaration	Type	Comment
RESET	IN	BOOL	*RESET*=1 start timer
VALUE	OUT	DWORD	Difference in µs
STORE	STAT	DWORD	DW for 1. time

RESET

RESET=1 transfers the current timer value to *STORE*.

VALUE

After a call with *RESET*=0, *VALUE* returns the time difference between the two SFB 7 calls.

STORE

STORE serves the storage of the 1. time value. *STORE* is a static variable that is located in the instance block.

MMC - access SFC 208...215 and SFC 195

Overview

The SFC 208 ... SCF 215 and SFC 195 allow you to include the MMC access into your user application. The following parameters are necessary for the usage of the SFCs:

HANDLE, FILENAME

The access takes place via a *HANDLE* number. That is assigned to a *FILENAME* via a call of the SCF 208 FILE_OPN res. SCF 209 FILE_CRE. At the same time a max. of 4 *HANDLE* may be opened (0...3). To close an opened file call the SFC 210 FILE_CLO and thus release the *HANDLE* again.

MEDIA

As media format set 0 for the MMC. Other formats are not supported at this time.

ORIGIN, OFFSET

Read and write start with the position of a write/read flag. After opening res. creation of a file, the write/read flag is at position 0. With SFC 213 FILE_SEK you may shift the write/read flag from an *ORIGIN* position for an *OFFSET* (number Bytes).

REG, BUSY

With *REQ* = 1 you activate the according function. *REG* = 0 returns the current state of a function via *RETVAL*.

Busy = 1 monitors that the according function is in process.

RETVAL

After the execution of a function *RETVAL* returns a number code:

RETVAL = 0:	Function has been executed without errors
0 < *RETVAL* < 7000h:	*RETVAL* = Length of the transferred data (only SFC211 and SFC212)
7000h ≤ *RETVAL* < 8000h	Monitors the execution state of the function
RETVAL ≥ 8000h:	Indicates an error that is described more detailed in the according SFC.

Attention!

For the access of the MMC you must regard the following hints. Nonobservance may cause data loss at the MMC:

- A max. of 4 Handle (0...3) may be used at the same time!
- File names must follow the 8.3 format or special character!
- These SFCs only gives you access to the top directory level (Root directory) of the MMC!
- You may only rename or delete files that you've closed before with SFCs 210 FILE_CLO!

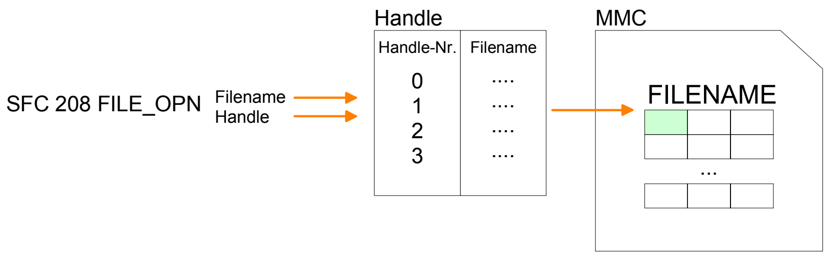
The following pages describe the according SFCs:

SFC 208 - FILE_OPN

Description

You may open a file on the MMC with SFC 208. Here a *HANDLE* is connected to a *FILENAME*. By using the *HANDLE* you now have read and write access to the file until you close the file again with the SFC 210 FILE_CLO. *REQ* =1 initializes the function.

After the opening the read/write flag is at 0.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
MEDIA	IN	INT	0 = MMC
FILENAME	IN	STRING[254]	Name of file (must be in 8.3 format)
HANDLE	IN	INT	Index of file 0...3
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy

RETVAL (Return value)

Codes that are returned by *RETVAL*:

Code	Meaning
0000h	OK
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
8010h	Parameter *FILENAME* is not present (e.g. DB not loaded)
8011h	Error *Filename* (not conform with 8.3 or special character)
8100h	The defined *HANDLE* is not valid
9001h	*Handle* is assigned to another file
9002h	Another function has been called via this *HANDLE* and is ready.
9003h	Another function has been called via this *HANDLE* and is not ready.
A000h	System internal error occurred
A001h	The defined *MEDIA* type is not valid
A003h	A general error in the file system occurred
A004h	The in *FILENAME* defined file doesn't exist or is a directory
A100h	General file system error (e.g. no MMC plugged)

SFC 209 - FILE_CRE

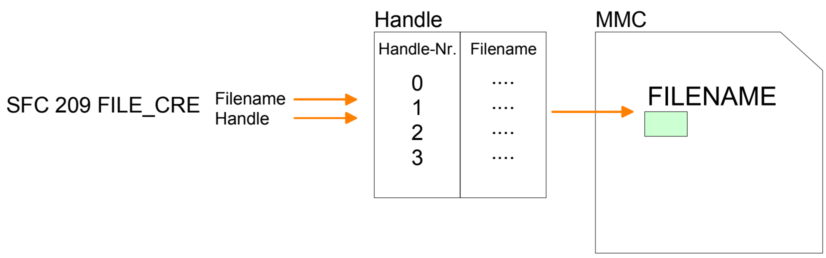
Description

By using this block you may create a new file with the entered file name on the MMC (if plugged) and open it for read/write access.

Please regard that you may only create files at the top directory level.

REQ =1 initializes the function.

After opening, the write /read flag is at 0.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
MEDIA	IN	INT	0 = MMC
FILENAME	IN	STRING[254]	Name of file (must be in 8.3 format)
HANDLE	IN	INT	Index of file 0...3
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy

RETVAL (Return value)

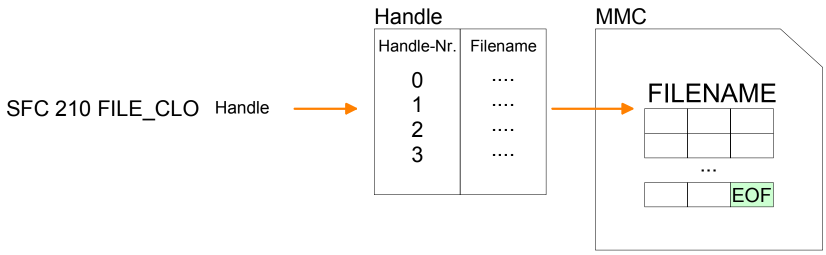
Codes that are returned by *RETVAL*:

Code	Meaning
0000h	OK
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
8010h	Parameter *FILENAME* is not present (e.g. DB not loaded)
8011h	Error *Filename* (not conform with 8.3 or special character)
8100h	The defined *HANDLE* is not valid
9001h	*HANDLE* is assigned to another file
9002h	Another function has been called via this *HANDLE* and is ready.
9003h	Another function has been called via this *HANDLE* and is not ready.
A000h	System internal error occurred
A001h	The defined *MEDIA* type is not valid
A003h	A general error in the file system occurred
A004h	No root-entry is available in the directory
A100h	General file system error (e.g. no MMC plugged)

SFC 210 - FILE_CLO

Description

This block allows you to close an opened file. Here an EOF (**E**nd **o**f **F**ile) is added, the file is closed and the *HANDLE* released. *REQ* =1 initializes the function.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
HANDLE	IN	INT	Index of file 0...3
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy

RETVAL (Return value)

Codes that are returned by *RETVAL*:

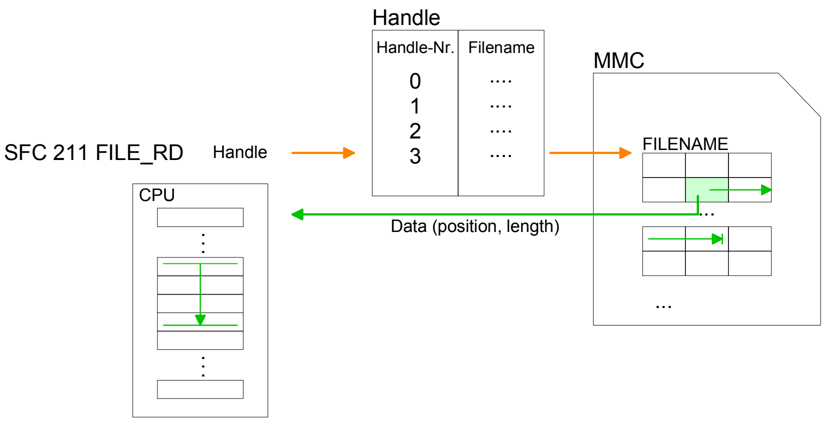
Code	Meaning
0000h	OK
7000h 7001h 7002h	*REQ* = 0, *BUSY* = 0 (nothing present) *REQ* = 1, 1. call Block is executed
8100h	The defined *HANDLE* is invalid
9001h 9002h 9003h	The *HANDLE* is not assigned to a file name Another function has been called via this *Handle* and is ready. Another function has been called via this *Handle* and is not ready.
A000h A100h	System internal error occurred General file system error (e.g. no MMC plugged)

SFC 211 - FILE_RD

Description

This allows you to transfer data from the MMC to the CPU via the opened *HANDLE* starting from an *ORIGIN* position (position of the read-/write flag). During every call you may transfer a max. of 512byte.

By setting of *DATA* you define storage place and length of the write area in the CPU. *REQ* =1 initializes the function.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
HANDLE	IN	INT	Index of file 0...3
DATA	IN	ANY	Pointer to PLC memory and data length
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy

RETVAL (Return value)

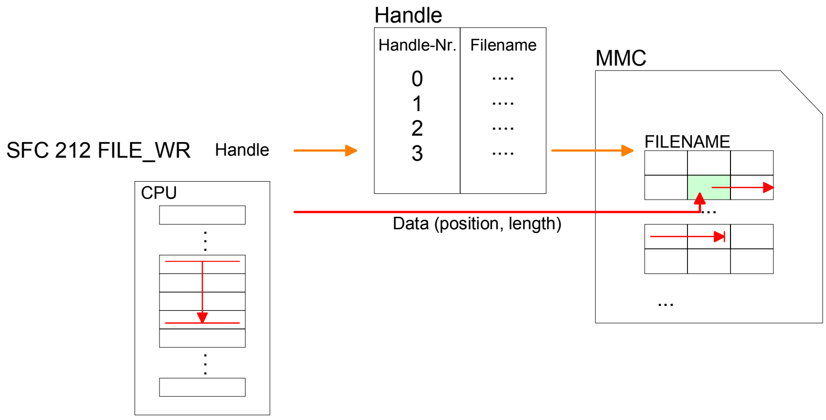
Codes that are returned by *RETVAL*:

Code	Meaning
0XXXh	0 = OK, 0XXX = Length of read data
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
8010h	Pointer in *DATA* has type BOOL
8011h	Pointer in *DATA* cannot be decoded (e.g. DB not loaded)
8012h	Data length exceeds 512Byte
8100h	The defined *HANDLE* is not valid
9001h	For this *HANDLE* no file is opened
9002h	Another function has been called via this *HANDLE* and is ready.
9003h	Another function has been called via this *HANDLE* and is not ready.
A000h	System internal error occurred
A003h	Internal error
A100h	General file system error (e.g. no MMC plugged)

SFC 212 - FILE_WR

Description

Use this block for write access to the MMC. This writes data from the position and length of the CPU defined under *Data* to the MMC via the according *HANDLE* starting at the write/read position. During every call you may transfer a max. of 512byte. *REQ* =1 initializes the function.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
HANDLE	IN	INT	Index of file 0...
DATA	IN	ANY	Pointer to PLC memory and data length
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy

The parameter *RETVAL* returns the length of the written data. The block doesn't announce an error message that the MMC is full. The user has to check himself if the number of the bytes to write corresponds to the number of written bytes returned by *RETVAL*.

RETVAL (Return value)

Codes that are returned by *RETVAL*:

Code	Meaning
0XXXh	0 = OK, 0XXX = Length of written data
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
8010h	Pointer in *DATA* has type BOOL
8011h	Pointer in *DATA* cannot be decoded (e.g. DB not loaded)
8012h	Data length exceeds 512byte
8100h	The defined *HANDLE* is not valid.
9001h	For this *Handle* no file is opened
9002h	Another function has been called via this *HANDLE* and is ready.
9003h	Another function has been called via this *HANDLE* and is not ready.
A000h	System internal error occurred
A002h	File is write-protected.
A003h	Internal error
A100h	General file system error (e.g. no MMC plugged)

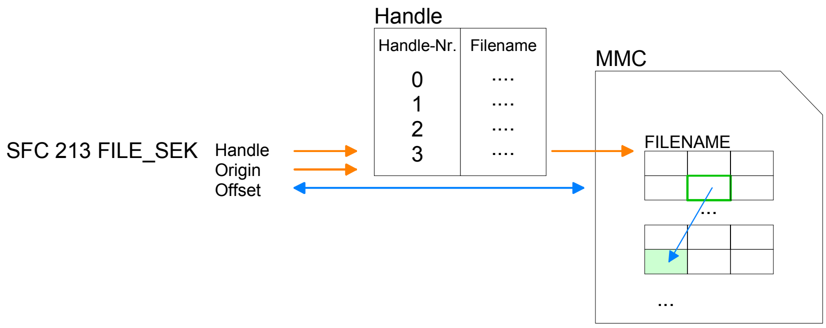
SFC 213 - FILE_SEK

Description

FILE_SEK allows you to detect res. alter the position of the write/read flag of the according *HANDLE*.

By setting *ORIGIN* as start position and an *OFFSET* you may define the write/read flag for the according *HANDLE*.

REQ = 1 starts the function.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
HANDLE	IN	INT	Index of file 0...3
ORIGIN	IN	INT	0=file start, 1=current position, 2=file end
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy
OFFSET	INOUT	DINT	Offset write/read flag

RETVAL (Return value)

Codes that are returned by *RETVAL*:

Code	Meaning
0000h	OK, *OFFSET* contains the current write/read position
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
8100h	The defined *HANDLE* is not valid
9001h	For this *HANDLE* no file is opened
9002h	Another function has been called via this *HANDLE* and is ready.
9003h	Another function has been called via this *HANDLE* and is not ready.
A000h	System internal error occurred
A004h	*ORIGIN* parameter is defective
A100h	General file system error (e.g. no MMC plugged)

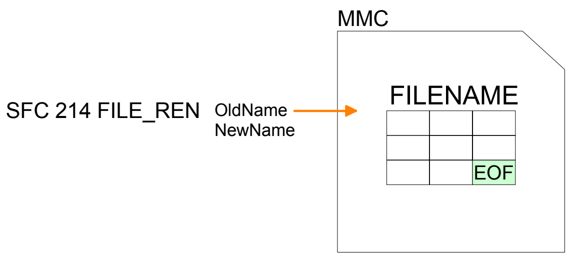
SFC 214 - FILE_REN

Description

Using FILE_REN you may alter the file name defined in *OLDNAME* to the file name that you type in *NEWNAME*.

Attention!

Please regard that you may only rename files that you've closed before with FILE_CLO. Nonobservance may cause data loss at the MMC!



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
MEDIA	IN	INT	0 = MMC
OLDNAME	IN	STRING[254]	Old name of file (must be in 8.3 format)
NEWNAME	IN	STRING[254]	New name of file (must be in 8.3 format)
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy.

RETVAL (Return value)

Codes that are returned by *RETVAL*:

Code	Meaning
0000h	OK, file has been renamed
7000h 7001h 7002h	*REQ* = 0, *BUSY* = 0 (nothing present) *REQ* = 1, 1. call Block is executed
8010h 8011h 8020h 8021h	Parameter *OLDNAME* is not present (e.g. DB not loaded) Error *OLDNAME* (not conform with 8.3 format or special character) Parameter *NEWNAME* is not present (e.g. DB not loaded) Error *NEWNAME* (not conform with 8.3 format or special character)
A000h A001h A003h A004h A006h A100h	System internal error occurred The defined *MEDIA* type is not valid The new filename *NEWNAME* already exists File *OLDNAME* is not found File *OLDNAME* is just open File system returns error at creation of the file (e.g. no MMC plugged)

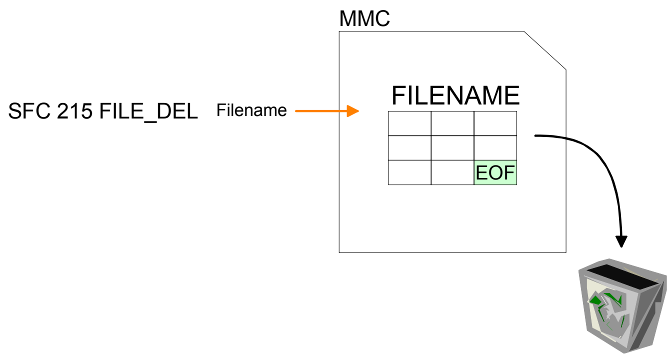
SFC 215 - FILE_DEL

Description

This block allows you to delete a file at the MMC. For this, type the file name of the file to delete under *FILENAME*.

Attention!

Please regard that you may only delete files that you've closed before with FILE_CLO. Nonobservance may cause data loss at the MMC!



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
MEDIA	IN	INT	0 = MMC
FILENAME	IN	STRING[254]	Name of file (must be in 8.3 format)
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy.

RETVAL
(Return value)

Codes that are returned by *RETVAL*:

Code	Meaning
0000h	OK, file has been deleted
7000h 7001h 7002h	*REQ* = 0, *BUSY* = 0 (nothing present) *REQ* = 1, 1. call Block is executed
8010h 8011h	Parameter *FILENAME* is not available (e.g. DB not loaded) *FILENAME* is defective (e.g. is not conform with 8.3 format or special character)
A000h A001h A002h A004h A005h A006h A100h	System internal error occurred The defined *MEDIA* type is not valid The file is write-protected File *FILENAME* is not found *FILENAME* is a directory - you can't delete File is just open General file system error (e.g. no MMC plugged)

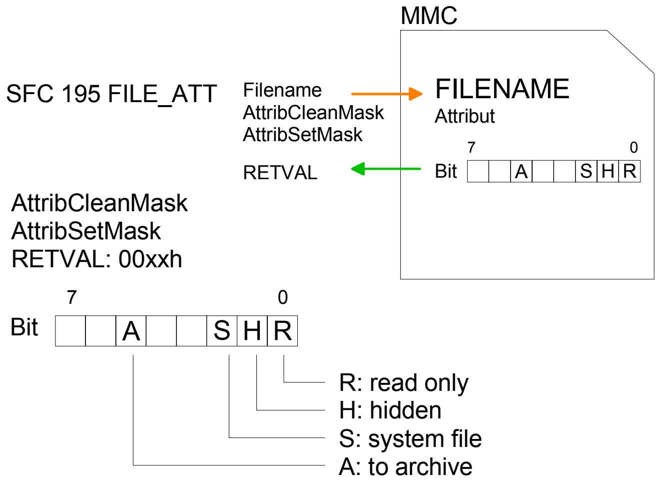
SFC 195 - FILE_ATT

Description

In the root directory of the MMC the file attributes may be changed by FILE_ATT.

Here enter a file name. The corresponding attributes may be reset with *AttribCleanMask* respectively set with *AttribSetMask* by given bit pattern. Setting takes priority over resetting.

After job execution the current state of the attributes is returned with RETVAL 00xxh. For determination of the current file attributes by RETVAL, the parameters *AttribCleanMask* and *AttribSetMask* may be set to value 00h.



Parameter

Parameter	Declaration	Data type	Description
REQ	IN	BOOL	Activate function
MEDIA	IN	INT	0 = MMC
FILENAME	IN	STRING[254]	Name of file (must be in 8.3 format)
ATTRIBCLEANMASK	IN	BYTE	Bit pattern of attributes to clean
ATTRIBSETMASK	IN	BYTE	Bit pattern of attributes to set
RETVAL	OUT	WORD	Return value (00xxh=OK with xx:attributes)
BUSY	OUT	BOOL	Function is busy

RETVAL (Return value)

Return codes of *RETVAL*:

Code	Meaning
00xxh	OK, attributes have been changed with xx:attributes
7000h	*REQ* = 0, *BUSY* = 0 (nothing present)
7001h	*REQ* = 1, 1. call
7002h	Block is executed
A001h	The defined *MEDIA* type is not valid
A002h	Error in parameter *AttribSetMask*
A004h	File *FILENAME* is not found
A005h	*FILENAME* is a directory
A006h	File is just open
A010h	File error *FILENAME*
A100h	General file system error (e.g. no MMC plugged)

PtP communication - SFC 216...218

Overview

You may de-activate the DP master integrated in the SPEED7-CPU via a hardware configuration using *Object properties* and the parameter "Function RS485". and thus release the RS485 interface for PtP (**p**oint-**to**-**p**oint) communication.

The RS485 interface supports in PtP operation the serial process connection to different source res. destination systems.

Parameterization

The parameterization happens during runtime using the SFC 216 (SER_CFG). For this you have to store the parameters in a DB for all protocols except ASCII.

Communication

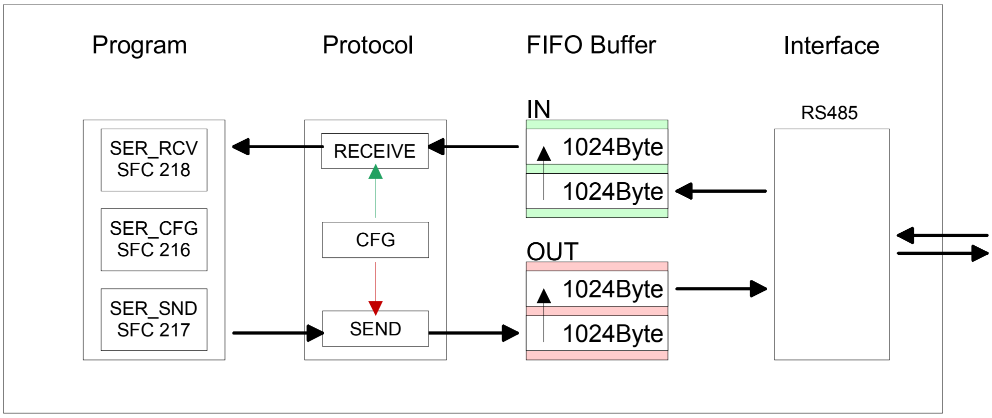
The SFCs are controlling the communication. Send takes place via SFC 217 (SER_SND) and receive via SFC 218 (SER_RCV).

The repeated call of the SFC 217 SER_SND delivers a return value for 3964R, USS and Modbus via *RETVAL* that contains, among other things, recent information about the acknowledgement of the partner station.

The protocols USS and Modbus allow to evaluate the receipt telegram by calling the SFC 218 SER_RCV after SER_SND.

The SFCs are included in the consignment of the CPU 31xS.

CPU 31xS - RS485 PtP communication



Overview SFCs for serial communication

The following SFCs are used for the serial communication:

SFC		Description
SFC 216	SER_CFG	RS485 parameterize
SFC 217	SER_SND	RS485 send
SFC 218	SER_RCV	RS485 receive

SFC 216 - SER_CFG

Description

The parameterization happens during runtime deploying the SFC 216 (SER_CFG). You have to store the parameters for STX/ETX, 3964R, USS and Modbus in a DB.

Parameter

Parameter	Declaration	Data type	Description
PROTOCOL	IN	BYTE	1=ASCII, 2=STX/ETX, 3=3964R
PARAMETER	IN	ANY	Pointer to protocol-parameters
BAUDRATE	IN	BYTE	Number of baudrate
CHARLEN	IN	BYTE	0=5Bit, 1=6Bit, 2=7Bit, 3=8Bit
PARITY	IN	BYTE	0=Non, 1=Odd, 2=Even
STOPBITS	IN	BYTE	1=1Bit, 2=1.5Bit, 3=2Bit
FLOWCONTROL	IN	BYTE	1 (fix)
RETVAL	OUT	WORD	Return value (0=OK)

All time settings for timeouts must be set as hexadecimal value. Find the Hex value by multiply the wanted time in seconds with the baudrate.

Example: Wanted time 8ms at a baudrate of 19200Baud
Calculation: 19200Bit/s x 0,008s ≈ 154Bit → (9Ah)
Hex value is 9Ah.

PROTOCOL

Here you fix the protocol to be used. You may choose between:
1: ASCII
2: STX/ETX
3: 3964R
4: USS Master
5: Modbus RTU Master
6: Modbus ASCII Master

PARAMETER (as DB)

At ASCII protocol, this parameter is ignored.

At STX/ETX, 3964R, USS and Modbus you fix here a DB that contains the communication parameters and has the following structure for the according protocols:

Data block at STX/ETX

DBB0:	STX1	BYTE	(1. Start-ID in hexadecimal)
DBB1:	STX2	BYTE	(2. Start-ID in hexadecimal)
DBB2:	ETX1	BYTE	(1. End-ID in hexadecimal)
DBB3:	ETX2	BYTE	(2. End-ID in hexadecimal)
DBW4:	TIMEOUT	WORD	(max. delay time between 2 telegrams in a time window of 10ms)

Note!

The start res. end sign should always be a value <20, otherwise the sign is ignored!

Data block at 3964R

DBB0:	Prio	BYTE	(The priority of both partners must be different)
DBB1:	ConnAttmptNr	BYTE	(Number of connection trials)
DBB2:	SendAttmptNr	BYTE	(Number of telegram retries)
DBW4:	CharTimeout	WORD	(Char. delay time in 10ms time window)
DBW6:	ConfTimeout	WORD	(Acknowledgement delay time in 10ms time window)

Data block at USS

DBW0:	Timeout	WORD	(Delay time in 10ms time grid)

Data block at Modbus-Master

DBW0:	Timeout	WORD	(Respond delay time in 10ms time grid)

BAUD RATE

Velocity of data transfer in Bit/s (Baud).

04h: 1200Baud	05h: 1800Baud	06h: 2400Baud	07h: 4800Baud
08h: 7200Baud	09h: 9600Baud	0Ah: 14400Baud	0Bh: 19200Baud
0Ch: 38400Baud	0Dh: 57600Baud	0Eh: 115200Baud	

CHARLEN

Number of data bits where a character is mapped to.

0: 5Bit 1: 6Bit 2: 7Bit 3: 8Bit

PARITY

The parity is -depending on the value- even or odd. For parity control, the information bits are extended with the parity bit, that amends via its value ("0" or "1") the value of all bits to a defined status. If no parity is set, the parity bit is set to "1", but not evaluated.

0: NONE 1: ODD 2: EVEN

STOPBITS

The stop bits are set at the end of each transferred character and mark the end of a character.

1: 1Bit 2: 1.5Bit 3: 2Bit

FLOWCONTROL

The parameter *FLOWCONTROL* is ignored. When sending RST=0, when receiving RST=1.

RETVAL SFC 216 (Error message SER_CFG)

Return values send by the block:

Error code	Meaning
0000h	no error
809Ah	interface not found e. g. interface is used by Profibus
8x24h	Error at SFC-Parameter x, with x:
	1: Error at *PROTOCOL*
	2: Error at *PARAMETER*
	3: Error at *BAUDRATE*
	4: Error at *CHARLENGTH*
	5: Error at *PARITY*
	6: Error at *STOPBITS*
	7: Error at *FLOWCONTROL*
809xh	Error in SFC parameter value x, where x:
	1: Error at *PROTOCOL*
	3: Error at *BAUDRATE*
	4: Error at *CHARLENGTH*
	5: Error at *PARITY*
	6: Error at *STOPBITS*
	7: Error at *FLOWCONTROL*
8092h	Access error in parameter DB (DB too short)
828xh	Error in parameter x of DB parameter, where x:
	1: Error 1. parameter
	2: Error 2. parameter
	...

SFC 217 - SER_SND

Description

This block sends data via the serial interface.

The repeated call of the SFC 217 SER_SND delivers a return value for 3964R, USS and Modbus via *RETVAL* that contains, among other things, recent information about the acknowledgement of the partner station.

The protocols USS and Modbus require to evaluate the receipt telegram by calling the SFC 218 SER_RCV after SER_SND.

Parameter

Parameter	Declaration	Data type	Description
DATAPTR	IN	ANY	Pointer to Data Buffer for sending data
DATALEN	OUT	WORD	Length of data sent
RETVAL	OUT	WORD	Return value (0=OK)

DATAPTR

Here you define a range of the type Pointer for the send buffer where the data that has to be sent is stored. You have to set type, start and length.

Example: Data is stored in DB5 starting at 0.0 with a length of 124Byte.

DataPtr:=P#DB5.DBX0.0 BYTE 124

DATALEN

Word where the number of the sent Bytes is stored.

At **ASCII** if data were sent by means of SFC 217 faster to the serial interface than the interface sends, the length of data to send could differ from the *DataLen* due to a buffer overflow. This should be considered by the user program.

With **STX/ETX**, **3964R**, **Modbus** and **USS** always the length set in *DATAPTR* is stored or 0.

RETVAL SFC 217 (Error message SER_SND)

Return values of the block:

Error code	Meaning
0000h	Send data - ready
1000h	Nothing sent (data length 0)
20xxh	Protocol executed error free with xx bit pattern for diagnosis
7001h	Data is stored in internal buffer - active (busy)
7002h	Transfer - active
80xxh	Protocol executed with errors with xx bit pattern for diagnosis (no acknowledgement by partner)
90xxh	Protocol not executed with xx bit pattern for diagnosis (no acknowledgement by partner)
8x24h	Error in SFC parameter x, where x:
	1: Error in *DATAPTR*
	2: Error in *DATALEN*
8122h	Error in parameter *DATAPTR* (e.g. DB too short)
807Fh	Internal error
809Ah	interface not found e.g. interface is used by Profibus
809Bh	interface not configured

Protocol specific RETVAL values

ASCII

Value	Meaning
9000h	Buffer overflow (no data send)
9002h	Data too short (0Byte)

STX/ETX

Value	Meaning
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024Byte)
9002h	Data too short (0Byte)
9004h	Character not allowed

3964R

Value	Meaning
2000h	Send ready without error
80FFh	NAK received - error in communication
80FEh	Data transfer without acknowledgement of partner or error at acknowledgement
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024Byte)
9002h	Data too short (0Byte)

... Continue RETVAL SFC 217 SER_SND

USS

Error code	Meaning
2000h	Send ready without error
8080h	Receive buffer overflow (no space for receipt)
8090h	Acknowledgement delay time exceeded
80F0h	Wrong checksum in respond
80FEh	Wrong start sign in respond
80FFh	Wrong slave address in respond
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024Byte)
9002h	Data too short (<2Byte)

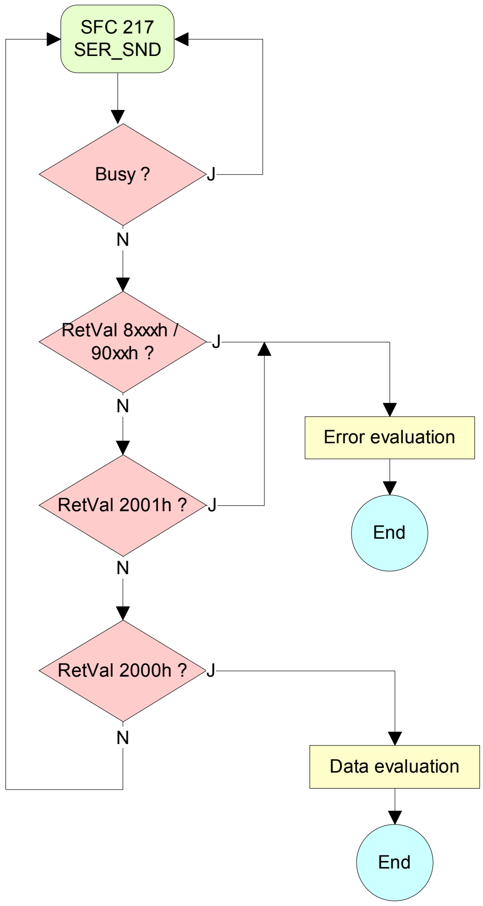
Modbus RTU/ASCII Master

Error code	Meaning
2000h	Send ready (positive slave respond)
2001h	Send ready (negative slave respond)
8080h	Receive buffer overflow (no space for receipt)
8090h	Acknowledgement delay time exceeded
80F0h	Wrong checksum in respond
80FDh	Length of respond too long
80FEh	Wrong function code in respond
80FFh	Wrong slave address in respond
9000h	Buffer overflow (no data send)
9001h	Data too long (>1024Byte)
9002h	Data too short (<2Byte)

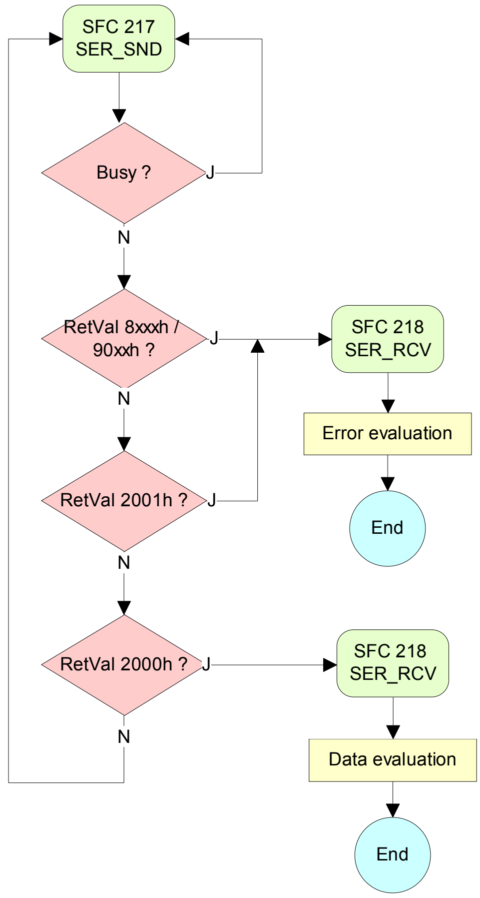
Principles of programming

The following text shortly illustrates the structure of programming a send command for the different protocols.

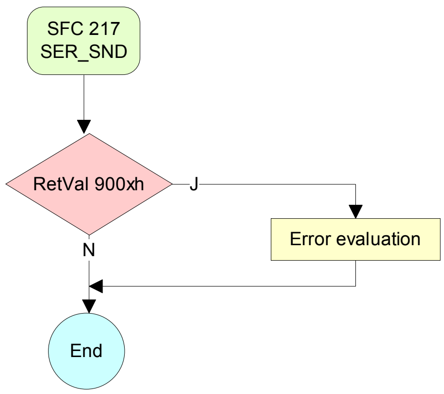
3964R



USS / Modbus



ASCII / STX/ETX



SFC 218 - SER_RCV

Description

This block receives data via the serial interface.

Using the SFC 218 SER_RCV after SER_SND with the protocols USS and Modbus the acknowledgement telegram can be read.

Parameter

Parameter	Declaration	Data type	Description
DATAPTR	IN	ANY	Pointer to Data Buffer for received data
DATALEN	OUT	WORD	Length of received data
ERROR	OUT	WORD	Error Number
RETVAL	OUT	WORD	Return value (0=OK)

DataPtr

Here you set a range of the type Pointer for the receive buffer where the reception data is stored. You have to set type, start and length.

Example: Data is stored in DB5 starting at 0.0 with a length of 124Byte.

DataPtr:=P#DB5.DBX0.0 BYTE 124

DataLen

Word where the number of received Bytes is stored.

At **STX/ETX** and **3964R**, the length of the received user data or 0 is entered.

At **ASCII**, the number of read characters is entered. This value may be different from the read telegram length.

Error

This word gets an entry in case of an error. The following error messages may be created depending on the protocol:

ASCII

Bit	Error	Meaning
0	overrun	Overflow, a sign couldn't be read fast enough from the interface
1	framing error	Error that shows that a defined bit frame is not coincident, exceeds the allowed length or contains an additional Bit sequence (Stop bit error)
2	parity	Parity error
3	overflow	Buffer is full

STX/ETX

Bit	Error	Meaning
0	overflow	The received telegram exceeds the size of the receive buffer.
1	char	A sign outside the range 20h...7Fh has been received.
3	overflow	Buffer is full

3964R / Modbus RTU/ASCII Master

Bit	Error	Meaning
0	overflow	The received telegram exceeds the size of the receive buffer.

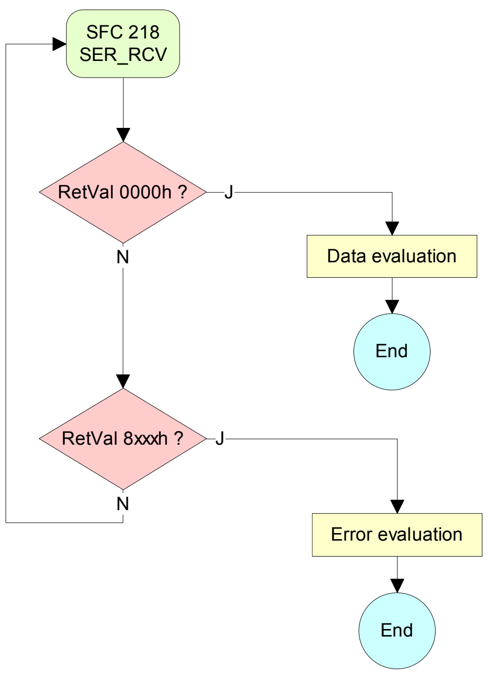
RETVAL (Return value)

Return values of the block:

Error code	Meaning
0000h	no error
1000h	Receive buffer too small (data loss)
8x24h	Error at SFC-Parameter x, with x:
	1: Error at *DATAPTR*
	2: Error at *DATALEN*
	3: Error at *ERROR*
8122h	Error in parameter *DATAPTR* (e.g. DB too short)
809Ah	serial interface not found res. interface is used by Profibus
809Bh	serial interface not configured

Principles of programming

The following picture shows the basic structure for programming a receive command. This structure can be used for all protocols.



SFC 219 - CAN_TLGR - CANopen communication

SFC 219 CAN_TLGR SDO request to CAN master

Every SPEED7-CPU provides the integrated SFC 219. This allows you to initialize a SDO read or write access from the PLC program to the CAN master.

For this you address the master via the slot number and the destination slave via its CAN address. The process data is defined by the setting of index and sub index. Via SDO per each access a max. of one data word process data can be transferred.

Parameter

Parameter	Declaration	Data type	Description
REQUEST	IN	BOOL	1 = Activation
SLOT_MASTER	IN	BYTE	SPEED-Bus slot (101...116)
NODEID	IN	BYTE	CAN address (1...127)
TRANSFERTYPE	IN	BYTE	Type of transfer
INDEX	IN	DWORD	CANopen index
SUBINDEX	IN	DWORD	CANopen sub index
CANOPENERROR	OUT	DWORD	CANopen error
RETVAL	OUT	WORD	Return value (0=OK)
BUSY	OUT	BOOL	Function is busy
DATABUFFER	INOUT	ANY	Data Buffer for SFC communication

REQUEST Control parameter: 1: Initialization of the order

SLOT_MASTER 101...116: slot 1 ... 16 from master at SPEED-Bus

NODELD Address of the CANopen knot (1...127)

TRANSFERTYPE 40h: Read SDO

23h: Write SDO (1 DWORD)
2Bh: Write SDO (1 WORD)
2Fh: Write SDO (1 BYTE)

INDEX CANopen Index

SUBINDEX CANopen Sub index

SLOT_MASTER

0:	System 200 CPU 21xCAN
1 ... 32:	System 200 IM 208CAN
101 ... 115:	System 300S 342-1CA70

CANOPENERROR When no error occurs, *CANOPENERROR* returns 0.

In case of an error *CANOPENERROR* contains one of the following error messages that are created by the CAN master:

Code	Meaning
05030000h	Toggle Bit not alternated
05040000h	SDO Time out value reached
05040001h	Client/server command specify not valid, unknown
05040002h	Invalid block size (only block mode)
05040003h	Invalid sequence number (only block mode)
05040004h	CRC error (only block mode)
05040005h	Insufficient memory
06010000h	Attempt to read a write only object
06010001h	Attempt to write a write only object
06020000h	Object does not exist in the object dictionary
06040041h	Object cannot be mapped to the PDO
06040042h	The number and length of the objects to be mapped would exceed PDO length.
06040043h	General parameter incompatibility reason
06040047h	General internal incompatibility reason in the device
06060000h	Access failed because of an hardware error
06070010h	Data type does not match, length of service parameter does not match.
06070012h	Data type does not match, length of service parameter exceeded.
06070013h	Data type does not match, length of service parameter shortfall.
06090011h	Sub index does not exist
06090030h	value range of parameter exceeded (only for write access)
06090031h	Value of parameter written too high
06090032h	Value of parameter written too low
06090036h	Maximum value is less than minimum value
08000000h	General error
08000020h	Data cannot be transferred or stored to the application.
08000021h	Data cannot be transferred or stored to the application because of local control.
08000022h	Data cannot be transferred or stored to the application because of the present device state.
08000023h	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error.)

RETVAL

When the function has been executed without error, the return value contains the valid length of the response data: 1: BYTE, 2: WORD, 4: DWORD.

If an error occurs during execution, the return value contains one of the following error codes.

Code	Meaning
F021h	Invalid slave address (call parameter equal 0 or higher 127)
F022h	Invalid transfer type (value not equal to 40h, 23h, 2Bh, 2Fh)
F023h	Invalid data length (data buffer too small, at SDO read access this should be at least 4 Byte, at SDO write access at least 1Byte, 2Byte or 4 Byte)
F024h	SFC is not supported
F025h	Write buffer in CANopen master overflow, service cannot be processed at this time.
F026h	Read buffer in CANopen master overflow, service cannot be processed at this time.
F027h	SDO read or write access with defective response, see CANopen Error Codes.
F028h	SDO timeout (no CANopen station with this node-ID found)

BUSY

As long as *BUSY* = 1, the current order is not finished.

DATABUFFER

Data area via that the SFC communicates. Set here an ANY pointer of the type Byte.

SDO read access: Destination area for the read user data.

SDO write access: Source area for the user data to write.

Note!

When the SDO request has been executed without errors, *RETVAL* contains the length of the valid response data (1, 2 or 4 Byte) and *CANOPENERROR* the value 0.

SFC 254 - RW_SBUS - IBS communication

Description

This block serves the Interbus-FCs 20x as communication block between Interbus master and CPU. For the usage of the Interbus-FCs 20x the SFC 254 must be included in your project as block.

Parameter

Name	Declaration	Type	Description
READ/WRITE	IN	Byte	0 = Read, 1 = Write
LADDR	IN	WORD	Logical Address of Interbus master
IBS_ADDR	IN	WORD	Address at Interbus Master
DATAPOINTER	IN	ANY	Pointer to PLC data
RETVAL	OUT	WORD	Return value (0=OK)

READ/WRITE

This defines the transfer direction seen from the CPU. Read reads the data from the Dual port memory of the Interbus master.

LADDR

Enter the address (**L**ogical **Addr**ess) from where on the register of the master is mapped in the CPU. At the start-up of the CPU, the INTERBUS master are stored in the I/O address range of the CPU following the shown formula if no hardware configuration is present:

Start address = 256· (slot-101)+2048

The slot numbers at the SPEED-Bus start with 101 at the left side of the CPU and raises from the right to the left. For example the 1. slot has the address 2048, the 2. the address 2304 etc.

IBS_ADDR

Address in the address range of the Interbus master.

DATAPOINTER

Pointer to the data area of the CPU.

RETVAL

Value that the function returns. 0 means OK.

Appendix

A Index

V

M.Stich