YASKAWA

# VIPA SPEED7

## OPL_SP7 | Operation list | Manual

HB 00 | OPL_SP7 | Operation list | en | Rev. 17-21

www.vipa.com/en/service-support/manual

VIPA CONTROLS

VIPA GmbH
Ohmstr. 4
91074 Herzogenaurach
Telephone: +49 9132 744-0
Fax: +49 9132 744-1864
Email: info@vipa.de
Internet: www.vipa.com

# Table of contents

# 1 General

## 1.1 Copyright © VIPA GmbH



For permission to reproduce or distribute, please contact: VIPA, Gesellschaft für Visualisierung und Prozessautomatisierung mbH Ohmstraße 4, D-91074 Herzogenaurach, Germany

Tel.: +49 9132 744 -0

Fax.: +49 9132 744-1864

EMail: info@vipa.de

http://www.vipa.com

> *Every effort has been made to ensure that the information contained in this document was complete and accurate at the time of publishing. Nevertheless, the authors retain the right to modify the information.*
>
> *This customer document describes all the hardware units and functions known at the present time. Descriptions may be included for units which are not present at the customer site. The exact scope of delivery is described in the respective purchase contract.*

**CE Conformity Declaration**

Hereby, VIPA GmbH declares that the products and systems are in compliance with the essential requirements and other relevant provisions. Conformity is indicated by the CE marking affixed to the product.

***Conformity Information***

For more information regarding CE marking and Declaration of Conformity (DoC), please contact your local VIPA customer service organization.

**Trademarks**

VIPA, SLIO, System 100V, System 200V, System 300V, System 300S, System 400V, System 500S and Commander Compact are registered trademarks of VIPA Gesellschaft für Visualisierung und Prozessautomatisierung mbH.

SPEED7 is a registered trademark of profichip GmbH.

SIMATIC, STEP, SINEC, TIA Portal, S7-300 and S7-400 are registered trademarks of Siemens AG.

Microsoft and Windows are registered trademarks of Microsoft Inc., USA.

Portable Document Format (PDF) and Postscript are registered trademarks of Adobe Systems, Inc.

All other trademarks, logos and service or product marks specified herein are owned by their respective companies.

**Information product support**

Contact your local VIPA Customer Service Organization representative if you wish to report errors or questions regarding the contents of this document. If you are unable to locate a customer service centre, contact VIPA as follows:

VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

Telefax: +49 9132 744-1204

EMail: documentation@vipa.de

**Technical support**

Contact your local VIPA Customer Service Organization representative if you encounter problems with the product or have questions regarding the product. If you are unable to locate a customer service centre, contact VIPA as follows:

VIPA GmbH, Ohmstraße 4, 91074 Herzogenaurach, Germany

Tel.: +49 9132 744-1150 (Hotline)

EMail: support@vipa.de

## 1.2 About this manual

**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
- References with page numbers

**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.

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

*Supplementary information and useful tips.*

# 2 Important notes

*In the following, you will find important notes, which must always be observed when using the blocks.*

## 2.1 Internally used blocks

**CAUTION!**
The following blocks are used internally and must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB! Please always use the corresponding function for the call.

| FC/SFC | Designation | Description |
|---|---|---|
| FC/SFC 192 | CP_S_R | is used internally for FB 7 and FB 8 |
| FC/SFC 196 | AG_CNTRL | is used internally for FC 10 |
| FC/SFC 200 | AG_GET | is used internally for FB/SFB 14 |
| FC/SFC 201 | AG_PUT | is used internally for FB/SFB 15 |
| FC/SFC 202 | AG_BSEND | is used internally for FB/SFB 12 |
| FC/SFC 203 | AG_BRCV | is used internally for FB/SFB 13 |
| FC/SFC 204 | IP_CONF | is used internally for FB 55 IP_CONF |
| FC/SFC 205 | AG_SEND | is used internally for FC 5 AG_SEND |
| FC/SFC 206 | AG_RECV | is used internally for FC 6 AG_RECV |
| FC/SFC 253 | IBS_ACCESS | is used internally for SPEED bus INTERBUS masters |
| SFB 238 | EC_RWOD | is used internally for EtherCAT Communication |

# 3 IL operations

## 3.1 Overview

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

| Instruction | Description | Page |
|---|---|---|
| ) | Combination instructions (Bit) | 53 |
| + | Math instructions | 28 |
| +AR1 | Math instructions | 28 |
| +AR2 | Math instructions | 28 |
| +I | Math instructions | 28 |
| +D | Math instructions | 28 |
| +R | Math instructions | 28 |
| -D | Math instructions | 28 |
| -I | Math instructions | 28 |
| -R | Math instructions | 28 |
| *D | Math instructions | 28 |
| *I | Math instructions | 28 |
| *R | Math instructions | 28 |
| /D | Math instructions | 28 |
| /I | Math instructions | 28 |
| /R | Math instructions | 28 |
| ==D | Comparison instructions | 51 |
| ==I | Comparison instructions | 51 |
| ==R | Comparison instructions | 51 |
| <=D | Comparison instructions | 51 |
| <=I | Comparison instructions | 51 |
| <=R | Comparison instructions | 51 |
| <D | Comparison instructions | 51 |
| <I | Comparison instructions | 51 |
| <R | Comparison instructions | 51 |
| <>D | Comparison instructions | 51 |
| <>I | Comparison instructions | 51 |
| <>R | Comparison instructions | 51 |
| >=D | Comparison instructions | 51 |
| >=I | Comparison instructions | 51 |

| Instruction | Description | Page |
|---|---|---|
| >=R | Comparison instructions | 51 |
| >D | Comparison instructions | 51 |
| >I | Comparison instructions | 51 |
| >R | Comparison instructions | 51 |
| A | Combination instructions (Bit) | 53 |
| A( | Combination instructions (Bit) | 53 |
| ABS | Math instructions | 28 |
| ACOS | Math instructions | 28 |
| AD | Combination instructions (Word) | 61 |
| AN | Combination instructions (Bit) | 53 |
| AN( | Combination instructions (Bit) | 53 |
| ASIN | Math instructions | 28 |
| ATAN | Math instructions | 28 |
| AW | Combination instructions (Word) | 61 |
| BTD | Data type conversion instructions | 49 |
| BTI | Data type conversion instructions | 49 |
| BE | Block instructions | 33 |
| BEC | Block instructions | 33 |
| BEU | Block instructions | 33 |
| BLD | Block instructions | 33 |
| CAD | Transfer instructions | 45 |
| CALL | Block instructions | 33 |
| CAR | Transfer instructions | 45 |
| CAR1 | Transfer instructions | 45 |
| CAR2 | Transfer instructions | 45 |
| CAW | Transfer instructions | 45 |
| CC | Block instructions | 33 |
| CD | Counter instructions | 63 |
| CDB | Block instructions | 33 |
| CLR | Setting/resetting bit addresses | 41 |
| COS | Math instructions | 28 |
| CU | Counter instructions | 63 |
| DEC | Transfer instructions | 45 |
| DTB | Data type conversion instructions | 49 |
| DTR | Data type conversion instructions | 49 |
| EXP | Math instructions | 28 |

| Instruction | Description | Page |
|---|---|---|
| FN | Edge-triggered instructions | 35 |
| FP | Edge-triggered instructions | 35 |
| FR | Counter instructions | 63 |
| | Timer instructions | 62 |
| INC | Transfer instructions | 45 |
| INVD | Data type conversion instructions | 49 |
| INVI | Data type conversion instructions | 49 |
| ITB | Data type conversion instructions | 49 |
| ITD | Data type conversion instructions | 49 |
| JBI | Jump instructions | 43 |
| JC | Jump instructions | 43 |
| JCB | Jump instructions | 43 |
| JCN | Jump instructions | 43 |
| JL | Jump instructions | 43 |
| JM | Jump instructions | 43 |
| JMZ | Jump instructions | 43 |
| JN | Jump instructions | 43 |
| JNB | Jump instructions | 43 |
| JNBI | Jump instructions | 43 |
| JO | Jump instructions | 43 |
| JOS | Jump instructions | 43 |
| JP | Jump instructions | 43 |
| JPZ | Jump instructions | 43 |
| JU | Jump instructions | 43 |
| JUO | Jump instructions | 43 |
| JZ | Jump instructions | 43 |
| L | Load instructions | 36 |
| LAR1 | Transfer instructions | 45 |
| LAR2 | Transfer instructions | 45 |
| LD | Load instructions | 36 |
| LN | Math instructions | 28 |
| LOOP | Jump instructions | 43 |
| MOD | Math instructions | 28 |
| NEGD | Data type conversion instructions | 49 |
| NEGI | Data type conversion instructions | 49 |
| NEGR | Math instructions | 28 |

| Instruction | Description | Page |
|---|---|---|
| NOP | Block instructions | ⇨ *33* |
| NOT | Setting/resetting bit addresses | ⇨ *41* |
| O | Combination instructions (Bit) | ⇨ *53* |
| O( | Combination instructions (Bit) | ⇨ *53* |
| OD | Combination instructions (Word) | ⇨ *61* |
| ON | Combination instructions (Bit) | ⇨ *53* |
| ON( | Combination instructions (Bit) | ⇨ *53* |
| OPN | Block instructions | ⇨ *33* |
| OW | Combination instructions (Word) | ⇨ *61* |
| POP | Transfer instructions | ⇨ *45* |
| PUSH | Transfer instructions | ⇨ *45* |
| R | Setting/resetting bit addresses | ⇨ *41* |
| RLD | Shift instructions | ⇨ *39* |
| RLDA | Shift instructions | ⇨ *39* |
| RND | Data type conversion instructions | ⇨ *49* |
| RND+ | Data type conversion instructions | ⇨ *49* |
| RND- | Data type conversion instructions | ⇨ *49* |
| RRD | Shift instructions | ⇨ *39* |
| RRDA | Shift instructions | ⇨ *39* |
| S | Setting/resetting bit addresses | ⇨ *41* |
| SA | Timer instructions | ⇨ *62* |
| SAVE | Setting/resetting bit addresses | ⇨ *41* |
| SD | Timer instructions | ⇨ *62* |
| SE | Timer instructions | ⇨ *62* |
| SET | Setting/resetting bit addresses | ⇨ *41* |
| SIN | Math instructions | ⇨ *28* |
| SLD | Shift instructions | ⇨ *39* |
| SLW | Shift instructions | ⇨ *39* |
| SP | Timer instructions | ⇨ *62* |
| SQR | Math instructions | ⇨ *28* |
| SQRT | Math instructions | ⇨ *28* |
| SRD | Shift instructions | ⇨ *39* |
| SRW | Shift instructions | ⇨ *39* |
| SS | Timer instructions | ⇨ *62* |
| SSD | Shift instructions | ⇨ *39* |
| SSI | Shift instructions | ⇨ *39* |

| Instruction | Description | Page |
|---|---|---|
| T | Transfer instructions | 45 |
| TAK | Transfer instructions | 45 |
| TAN | Math instructions | 28 |
| TAR | Transfer instructions | 45 |
| TAR1 | Transfer instructions | 45 |
| TAR2 | Transfer instructions | 45 |
| TRUNC | Data type conversion instructions | 49 |
| UC | Block instructions | 33 |
| X | Combination instructions (Bit) | 53 |
| X( | Combination instructions (Bit) | 53 |
| XN | Combination instructions (Bit) | 53 |
| XN( | Combination instructions (Bit) | 53 |
| XOD | Combination instructions (Word) | 61 |
| XOW | Combination instructions (Word) | 61 |

## 3.2 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 |

| Abbreviation | Description |
|---|---|
| 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) |
| 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 |

| Abbreviation | Description |
|---|---|
| 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 |

## 3.3 Comparison of syntax languages

**Comparison**

In the following overview, the German and international syntax languages of STL are compared.

| Area | German | International |
|---|---|---|
| Input | E | I |
| Output | A | Q |
| Counter | Z | C |
| Periphery input byte | PEB | PIB |
| Periphery input word | PEW | PIW |
| Periphery input double word | PED | PID |
| Periphery output byte | PAB | PQB |
| Periphery output word | PAW | PQW |
| Periphery output double word | PAD | PQD |
| Combinations | U | A |
| | UN | AN |
| | U( | A( |
| | UN( | AN( |
| | UW | AW |
| | UD | AD |
| Time functions | SI | SP |
| | SV | SE |
| | SE | SD |
| | SA | SF |
| Counter functions | ZV | CU |
| | ZR | CD |
| Load and transfer | TAR | CAR |
| | TAW | CAW |
| | TAD | CAD |
| Program control | AUF | OPN |
| | BEA | BEU |
| | BEB | BEC |
| | TDB | CDB |
| | UW | AW |
| | UD | AD |
| Jump functions | SPA | JU |
| | SPBB | JCB |
| | SPBIN | JNBI |

| Area | German | International |
|---|---|---|
| | SPBNB | JNB |
| | SPBI | JBI |
| | SPBN | JCN |
| | SPB | JC |
| | SPO | JO |
| | SPS | JOS |
| | SPU | JUO |
| | SPZ | JZ |
| | SPN | JN |
| | SPMZ | JMZ |
| | SPPZ | JPZ |
| | SPL | JL |
| | SPM | JM |
| | SPP | JP |

## 3.4 Differences between SPEED7 and 300V programming

**General**

The SPEED7-CPUs lean in the command processing against the Siemens S7-400 and differ here to the Siemens S7-300 (VIPA 300V).

These differences are listed below.

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

**Status register**

In opposite to the Siemens S7-300, the VIPA SPEED7-CPUs and Siemens S7-400 (CPU 318) use the status register bits OR, STA, /FC.

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

**ACCU handling at arithmetic operations**

The CPUs of the Siemens S7-300 contain 2 ACCUs. At an arithmetic operation the content of the 2nd ACCU is not altered.

Whereas the SPEED7-CPUs provide 4 ACCUs. After an arithmetic operation (+I, -I, *I, /I, +D, -D, *D, /D, MOD, +R, -R, *R, /R) the content of ACCU 3 and ACCU 4 is loaded into ACCU 3 and 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 Siemens S7-300 may cause, under certain circumstances, deviations in the command execution of bit commands between Siemens S7-300 and VIPA SPEED7-CPUs respectively Siemens S7-400, especially at a jump to a bit conjunction chain.

**Examples RLO at jumps**

*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
→J001:
A Q2.2 // after the jump...
// Siemens S7-300 further combines
// This command is used by VIPA SPEED7,
// Siemens S7-400 and CPU 318 as first request
```

*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
→J001:
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 ACCU 1. The proof of this BCD value is in the Siemens S7-300 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
// Siemens S7-300 only proofs if timer
// is actively executed
// SPEED7, Siemens S7-400 and CPU 318
// always proof (also when no condition is present)
......
```

## 3.5 Registers

**ACCU1 ... 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 ... 4) | Bit 0 ... bit 31 |
| ACCUx-L | Bit 0 ... bit 15 |
| ACCUx-H | Bit 16 ... bit 31 |
| ACCUx-LL | Bit 0 ... bit 7 |
| ACCUx-LH | Bit 8 ... bit 15 |
| ACCUx-HL | Bit 16 ... bit 23 |
| ACCUx-HH | Bit 24 ... 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<br>*Chapter 3.6 ‘Addressing examples’ on page 26* |

**Status word (16bit)**

The values are analysed 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 ... 15 | not used | - |

## 3.6 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 time 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 |
| Indirect addressing timer/counter | |
| SP T [LW 8] | Start timer; timer no. is in local data word 8 |

<table>
<tr><th colspan="2">Addressing example</th><th colspan="2">Description</th></tr>
<tr><td colspan="2">CU C [LW 10]</td><td colspan="2">Start counter; counter no. is in local data word 10</td></tr>
<tr><td colspan="4">Memory-indirect, area-internal addressing</td></tr>
<tr><td colspan="2">A I [LD 12]e.g.: LP#22.2 T LD 12 A I [LD 12]</td><td colspan="2">AND instruction; input address is in local data double word 12 as pointer</td></tr>
<tr><td colspan="2">A I [DBD 1]</td><td colspan="2">AND instruction; input address is in data double word 1 of the DB as pointer</td></tr>
<tr><td colspan="2">A Q [DID 12]</td><td colspan="2">AND instruction; output address is in data double word 12 of the instance DB as pointer</td></tr>
<tr><td colspan="2">A Q [MD 12]</td><td colspan="2">AND instruction; output address is in bit memory double word 12 as pointer</td></tr>
<tr><td colspan="4">Register-indirect, area-internal addressing</td></tr>
<tr><td colspan="2">A I [AR1,P#12.2]</td><td colspan="2">AND instruction; input address is calculated "pointer value in address register 1 + pointer P#12.2"</td></tr>
<tr><td colspan="4">Register-indirect, area-crossing addressing</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>Range-ID</td><td>Binary code</td><td>hex.</td><td>Area</td></tr>
<tr><td>P</td><td>1000 0000</td><td>80</td><td>Periphery area</td></tr>
<tr><td>I</td><td>1000 0001</td><td>81</td><td>Input area</td></tr>
<tr><td>Q</td><td>1000 0010</td><td>82</td><td>Output area</td></tr>
<tr><td>M</td><td>1000 0011</td><td>83</td><td>Bit memory area</td></tr>
<tr><td>DB</td><td>1000 0100</td><td>84</td><td>Data area</td></tr>
<tr><td>DI</td><td>1000 0101</td><td>85</td><td>Instance data area</td></tr>
<tr><td>L</td><td>1000 0110</td><td>86</td><td>Local data area</td></tr>
<tr><td>VL</td><td>1000 0111</td><td>87</td><td>Preceding local data area<br><br>(access to the local data of the calling block)</td></tr>
<tr><td colspan="2">L B [AR1,P#8.0]</td><td colspan="2">Load byte in ACCU1; the address is calculated "pointer value in address register 1 + pointer P#8.0"</td></tr>
<tr><td colspan="2">A [AR1,P#32.3]</td><td colspan="2">AND instruction; operand address is calculated "pointer value in address register 1 + pointer P#32.3"</td></tr>
<tr><td colspan="4">Addressing via parameters</td></tr>
<tr><td colspan="2">A parameter</td><td colspan="2">The operand is addressed via the parameter</td></tr>
</table>

**Example for pointer calculation**

*Example when sum of bit addresses ≤ 7:*

```
LAR1 P#8.2
U E [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
U E [AR1,P#10.7]
```

*Result:* Addressed is input 21.4

(by adding the byte and bit addresses with carry)

## 3.7 Math instructions

**Fixed-point arithmetic (16bit)**

Math instructions of two 16bit numbers.

The result is in ACCU1 res. ACCU1-L.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| +I | - | | Add up two integers (16bit)<br>(ACCU1-L)=(ACCU1-L)+(ACCU2-L) | 1 |
| -I | - | | Subtract two integers (16bit)<br>(ACCU1-L)=(ACCU2-L)-(ACCU1-L) | 1 |
| *I | - | | Multiply two integers (16bit)<br>(ACCU1-L)=(ACCU2-L)*(ACCU1-L) | 1 |
| /I | - | | Divide two integers (16bit)<br>(ACCU1-L)=(ACCU2-L):(ACCU1-L)<br>The remainder is in ACCU1-H | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

**Fixed-point arithmetic (32bit)**

Math instructions of two 32bit numbers.

The result is in ACCU1.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| +D | - | | Add up two integers (32bit)<br>(ACCU1)=(ACCU2)+(ACCU1) | 1 |
| -D | - | | Subtract two integers (32bit)<br>(ACCU1)=(ACCU2)-(ACCU1) | 1 |
| *D | - | | Multiply two integers (32bit)<br>(ACCU1)=(ACCU2)*(ACCU1) | 1 |
| /D | - | | Divide two integers (32bit)<br>(ACCU1)=(ACCU2):(ACCU1) | 1 |
| MOD | - | | Divide two integers (32bit) and load the rest of the division in ACCU1<br>(ACCU1)=remainder of [(ACCU2):(ACCU1)] | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

**Floating-point arithmetic (32bit)**

The result of the math instructions is in ACCU1. The execution time of the instruction depends on the value to calculate.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| +R | - | | Add up two real numbers (32bit)<br>(ACCU1)=(ACCU2)+(ACCU1) | 1 |
| -R | - | | Subtract two real numbers (32bit)<br>(ACCU1)=(ACCU2)-(ACCU1) | 1 |
| *R | - | | Multiply two real numbers (32bit)<br>(ACCU1)=(ACCU2)*(ACCU1) | 1 |
| /R | - | | Divide two real numbers (32bit)<br>(ACCU1)=(ACCU2):(ACCU1) | 1 |
| NEGR | - | | Negate the real number in ACCU1 | 1 |
| ABS | - | | Form the absolute value of the real number in ACCU1 | 1 |

| Status word for: R | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

| Status word for: NEGR, ABS | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

**Square root an square instructions (32bit)**

The result of the instructions is in ACCU1.

The instructions may be interrupted by alarms.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| SQRT | - | | Calculate the Square root of a real number in ACCU1 | 1 |
| SQR | - | | Form the square of a real number in ACCU1 | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

**Logarithmic function (32bit)**

The result of the logarithm function is in ACCU1.

The instructions may be interrupted by alarms.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| LN | - | | Calculate the natural logarithm of a real number in ACCU1 | 1 |
| EXP | - | | Calculate the exponential value of a real number in ACCU1 on basis e (=2.71828) | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

**Trigonometrical functions (32bit)**

The result of the trigonometrical function is in ACCU1.

The instructions may be interrupted by alarms.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| SIN[1] | - | | Calculate the sine of the real number | 1 |
| ASIN[2] | - | | 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 |
| 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. | | | | |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

**Addition of constants**

Addition of integer constants to ACCU1.

The condition code bits are not affected.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| + | 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.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| +AR1 | - | | Add the contents of ACCU1-L to AR1 | 1 |
| +AR1 | m | | Add pointer constant to the contents of AR1 | 2 |
| +AR2 | - | | Add the contents of ACCU1-L to AR2 | 1 |
| +AR2 | m | | Add pointer constant to the contents of AR2 | 2 |

## 3.8 Block instructions

**Block call instructions**

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| CALL | FB p<br>DB r | 0 ... 8191<br>0 ... 8191 | Unconditional call of a FB,<br>with parameter transfer | |
| CALL | SFB p<br>DB r | 0 ... 8191<br>0 ... 8191 | Unconditional call of a SFB,<br>with parameter transfer | |
| CALL | FC p | | Unconditional call of a function,<br>with parameter transfer | |
| CALL | SFC p | | Unconditional call of a SFC,<br>with parameter transfer | |
| UC | FB q<br>FC q<br>Parameter | 0 ... 8191 | Unconditional call of blocks,<br>without parameter transfer<br>FB/FC call via parameters | 1/2 |
| CC | FB q<br>FC q<br>Parameter | 0 ... 8191 | Conditional call of blocks,<br>without parameter transfer<br>FB/FC call via parameters | 1/2 |
| OPN | DB p<br>DI p<br>Parameter | 0 ... 8191 | Open a data block<br>Open a instance data block<br>Open a data block via parameter | 1/2<br>2<br>2 |

| Status word for: CALL, UC | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | 0 | 0 | 1 | - | 0 |

| Status word for: CC | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | 0 | 0 | 1 | - | 0 |

| Status word for: OPN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

### Block end instructions

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| BE | | | End block | 1 |
| BEU | | | End block unconditionally | 1 |
| BEC | | | End block if RLO="1" | 1 |

| Status word for: BE, BEU | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | 0 | 0 | 1 | - | 0 |

| Status word for: BEC | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | ✓ | 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.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| CDB | | | Exchange shared data block and instant data block | 1 |

## 3.9 Program display and Null operation instructions

The status word is not affected.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| BLD | 0 ... 255 | | Program display instruction:<br>is treated by the CPU like a null operation instruction | 1 |
| NOP | 0<br>1 | | Null operation instruction | 1 |

## 3.10 Edge-triggered instructions

**Edge-triggered instructions**

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"

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| FP | I/Q a.b | 0.0 ... 2047.7 | Detecting the positive edge in the RLO. The bit addressed in the instruction is the auxiliary edge bit memory. | 2 |
| | M a.b | 0.0 ... 8191.7 | | 2 |
| | L a.b | parameterizable | | 2 |
| | DBX a.b | 0.0 ... 65535.7 | | 2 |
| | DIX a.b | 0.0 ... 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 ... 2047.7 | Detecting the negative edge in the RLO. The bit addressed in the instruction is the auxiliary edge bit memory | 2 |
| | M a.b | 0.0 ... 8191.7 | | 2 |
| | L a.b | parameterizable | | 2 |
| | DBX a.b | 0.0 ... 65535.7 | | 2 |
| | DIX a.b | 0.0 ... 65535.7 | | 2 |
| | c [AR1,m] | | | 2 |
| | c [AR2,m] | | | 2 |
| | [AR1,m] | | | 2 |
| | [AR2,m] | | | 2 |
| | Parameter | | | 2 |

| Status word for: FP, FN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

## 3.11 Load instructions

**Load instructions**

Loading address identifiers into ACCU1. The contents of ACCU1 and ACCU2 are saved first.

The status word is not affected.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| L | | | Load ... | |
| | IB a | | input byte | 1/2 |
| | QB a | | output byte | 1/2 |
| | PIB a | | periphery input byte | 2 |
| | MB a | 0.0 ... 8191 | bit memory byte | 1/2 |
| | LB a | parameterizable | local data byte | 2 |
| | DBB a | 0.0 ... 65535 | data byte | 2 |
| | DIB a | 0.0 ... 65535 | instance data byte | 2 |
| | | | ... in ACCU1 | |
| | 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 ... 2046 | input word | 1/2 |
| | QW a | 0.0 ... 2046 | output word | 1/2 |
| | PIW a | 0.0 ... 8190 | periphery input word | 2 |
| | MW a | 0.0 ... 8190 | bit memory word | 1/2 |
| | LW a | parameterizable | local data word | 2 |
| | DBW a | 0.0 ... 65534 | data word | 1/2 |
| | DIW a | 0.0 ... 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 |
| L | | | Load ... | |
| | ID a | 0.0 ... 2044 | input double word | 1/2 |
| | QD a | 0.0 ... 2044 | output double word | 1/2 |
| | PID a | 0.0 ... 8188 | periphery input double word | 2 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| | MD a<br>LD a<br>DBD a<br>DID a | 0.0 ... 8188<br>parameterizable<br>0.0 ... 65532<br>0.0 ... 65532 | bit memory double word<br>local data double word<br>data double word<br>instance data double word | 1/2<br>2<br>2<br>2 |
| | | | ... in ACCU1-L. | |
| | i [AR1,m]<br>i [AR2,m]<br>D [AR1,m]<br>D [AR2,m]<br>Parameter | | register-indirect, area-internal (AR1)<br>register-indirect, area-internal (AR2)<br>area-crossing (AR1)<br>area-crossing (AR2)<br>via parameters | 2<br>2<br>2<br>2<br>2 |
| L | | | Load ... | |
| | k8<br>k16<br>k32 | | 8bit constant in ACCU1-LL<br>16bit constant in ACCU1-L<br>32bit constant in ACCU1 | 1<br>2<br>3 |
| | Parameter | | Load constant in ACCU1<br>(addressed via parameters) | 2 |
| L | 2#n | | Load 16bit binary constant in ACCU1-L<br>Load 32bit binary constant in ACCU1 | 2<br>3 |
| L | B#8#p<br>W#16#p<br>DW#16#p | | Load 8bit hexadecimal constant in ACCU1-LL<br>Load 16bit hexadecimal constant in ACCU1-L<br>Load 32bit hexadecimal constant in ACCU1 | 1<br>2<br>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#<br>time value | | Load time constant (16bit) | 2 |
| L | TOD#<br>time value | | Load 32bit time constant<br>(IEC-time-of-day) | 3 |
| L | T#<br>time value | | Load 16bit time constant<br>Load 32bit time constant | 2<br>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 |

**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.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| L | T f<br>Timer para. | 0 ... 511 | Load time value<br>Load time value<br>(addressed via parameters) | 1/2<br>2 |
| L | Z f<br>Counter para. | 0 ... 511 | Load counter value<br>Load counter value<br>(addressed via parameters) | 1/2<br>2 |
| LC | T f<br>Timer para. | 0 ... 511 | Load time value BCD-coded<br>Load time value BCD-coded<br>(addressed via parameters) | 1/2<br>2 |
| LC | Z f<br>Counter para. | 0 ... 511 | Load counter value BCD-coded<br>Load counter value BCD-coded<br>(addressed via parameters) | 1/2<br>2 |

## 3.12 Shift instructions

**Shift instructions**

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.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| SLW<br>SLW | -<br>0 ... 15 | | Shift the contents of ACCU1-L to the left. Positions that become free are provided with zeros. | 1 |
| SLD<br>SLD | -<br>0 ... 32 | | Shift the contents of ACCU1 to the left. Positions that become free are provided with zeros. | 1 |
| SRW<br>SRW | -<br>0 ... 15 | | Shift the contents of ACCU1-L to the right. Positions that become free are provided with zeros | 1 |
| SRD<br>SRD | -<br>0 ... 32 | | Shift the contents of ACCU1 to the right. Positions that become free are provided with zeros | 1 |
| SSI<br>SSI | -<br>0 ... 15 | | Shift the contents of ACCU1-L to the right with sign. Positions that become free are provided with the sign (bit 15) | 1 |
| SSD<br>SSD | -<br>0 ... 32 | | Shift the contents of ACCU1 to the right with sign | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | - | - | - | - | - |

**Rotation instructions**

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.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| RLD | - | | Rotate the contents of ACCU1 to the left | 1 |
| RLD | 0 ... 32 | | | |
| RRD | - | | Rotate the contents of ACCU1 to the right | 1 |
| RRD | 0 ... 32 | | | |
| RLDA | - | | Rotate the contents of ACCU1 one bit position to the left, via CC1 bit | |
| RRDA | - | | Rotate the contents of ACCU1 one bit position to the right, via CC1 bit | |

| Status word for: RLD, RRD | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | - | - | - | - | - |

| Status word for: RLDA, RRDA | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | 0 | 0 | - | - | - | - | - |

## 3.13 Setting/resetting bit addresses

**Setting/resetting bit addresses** Assign the value "1" or "0" or the RLO to the addressed instructions.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| S | | | Set ... | |
| | I/Q a.b | 0.0 ... 2047.7 | input/output to "1" | 1/2 |
| | M a.b | 0.0 ... 8191.7 | set bit memory to "1" | 1/2 |
| | L a.b | parameterizable | local data bit to "1" | 2 |
| | DBX a.b | 0.0 ... 65535.7 | data bit to "1" | 2 |
| | DIX a.b | 0.0 ... 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 | | | Reset ... | |
| | I/Q a.b | 0.0 ... 2047.7 | input/output to "0" | 1/2 |
| | M a.b | 0.0 ... 8191.7 | set bit memory to "0" | 1/2 |
| | L a.b | parameterizable | local data bit to "0" | 2 |
| | DBX a.b | 0.0 ... 65535.7 | data bit to "0" | 2 |
| | DIX a.b | 0.0 ... 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 |
| | [AR1,m] | | area-crossing (AR1) | 2 |
| | [AR2,m] | | area-crossing (AR2) | 2 |
| | Parameter | | via parameters | 2 |
| = | | | Assign ... | |
| | I/Q a.b | 0.0 ... 2047.7 | RLO to input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | RLO to bit memory | 1/2 |
| | L a.b | parameterizable | RLO to local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | RLO to data bit | 2 |
| | DIX a.b | 0.0 ... 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 |

| Status word for: S, R, = | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | - | 0 | ✓ | - | 0 |

**Instructions directly affecting the RLO**

The following instructions have a directly effect on the RLO.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| CLR | | | Set RLO to "0" | 1 |
| SET | | | Set RLO to "1" | 1 |
| NOT | | | Negate RLO | 1 |
| SAVE | | | Save RLO into BR-bit | 1 |

| Status word for: CLR | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | 0 | 0 | 0 | 0 |

| Status word for: SET | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | 0 | 1 | 1 | 0 |

| Status word for: NOT | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | ✓ | - | ✓ | - |
| Instruction influences | - | - | - | - | - | - | 1 | ✓ | - |

| Status word for: SAVE | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | ✓ | - | - | - | - | - | - | - | - |

## 3.14 Jump instructions

Jump, depending on conditions.

8-bit operands have a jump width of (-128...+127)

16-bit operands of (-32768...-129) or (+128...+32767)

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| JU | LABEL | | Jump unconditionally | 1/2 |
| JC | LABEL | | Jump if RLO="1" | 1/2 |
| JCN | LABEL | | Jump if RLO="0" | 2 |
| JCB | LABEL | | Jump if RLO="1"<br>Save the RLO in the BR-bit | 2 |
| JNB | LABEL | | Jump if RLO="0"<br>Save the RLO in the BR-bit | 2 |
| JBI | LABEL | | Jump if BR="1" | 2 |
| JNBI | LABEL | | Jump if BR="0" | 2 |
| JO | LABEL | | Jump on stored overflow (OV="1") | 1/2 |
| JOS | LABEL | | Jump on stored overflow (OS="1") | 2 |
| JUO | LABEL | | Jump if "unordered instruction" (CC1=1 and CC0=1) | 2 |
| JZ | LABEL | | 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<br>(CC1=1 and CC0=0) or (CC1=0) and (CC0=1) | 1/2 |
| JMZ | LABEL | | Jump if result ≤ 0<br>(CC1=0 and CC0=1) or (CC1=0 and CC0=0) | 2 |
| JPZ | LABEL | | Jump if result ≥ 0<br>(CC1=1 and CC0=0) or (CC1=0 and CC0=0) | 2 |
| JL | LABEL | | Jump distributor<br>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<br>(loop programming) | 2 |

| Status word for: JU, JL, LOOP | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

| Status word for: JC, JCN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | - | 0 | 1 | 1 | 0 |

| Status word for: JCB, JNB | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | ✓ | - | - | - | - | 0 | 1 | 1 | 0 |

| Status word for: JBI, JNBI | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | 0 | 1 | - | 0 |

| Status word for: JO | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | ✓ | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

| Status word for: JOS | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | ✓ | - | - | - | - |
| Instruction influences | - | - | - | - | 0 | - | - | - | - |

| Status word for: JUO, JZ, JP, JM, JN, JMZ, JPZ | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | ✓ | ✓ | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

## 3.15 Transfer instructions

**Transfer instructions**

Transfer the contents of ACCU1 into the addressed operand.

The status word is not affected.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| T | | | Transfer the contents of ACCU1-LL to ... | |
| | IB a | 0.0 ... 2047 | input byte | 1/2 |
| | QB a | 0.0 ... 2047 | output byte | 1/2 |
| | PQB a | 0.0 ... 8191 | periphery output byte | 1/2 |
| | MB a | 0.0 ... 8191 | bit memory byte | 1/2 |
| | LB a | parameterizable | local data byte | 2 |
| | DBB a | 0.0 ... 65535 | data byte | 2 |
| | DIB a | 0.0 ... 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 ... 2046 | input word | 1/2 |
| | QW | 0.0 ... 2046 | output word | 1/2 |
| | PQW | 0.0 ... 8190 | periphery output word | 1/2 |
| | MW | 0.0 ... 8190 | bit memory word | 1/2 |
| | LW | parameterizable | local data word | 2 |
| | DBW | 0.0 ... 65534 | data word | 2 |
| | DIW | 0.0 ... 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 |
| T | | | Transfer the contents of ACCU1 to ... | |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| | ID | 0.0 ... 2044 | input double word | 1/2 |
| | QD | 0.0 ... 2044 | output double word | 1/2 |
| | PQD | 0.0 ... 8188 | periphery output double word | 1/2 |
| | MD | 0.0 ... 8188 | bit memory double word | 1/2 |
| | LD | parameterizable | local data double word | 2 |
| | DBD | 0.0 ... 65532 | data double word | 2 |
| | DID | 0.0 ... 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.

The status word is not affected.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| LAR1 | | | Load the contents from ... | |
| | - | | ACCU1 | 1 |
| | AR2 | | address register 2 | 1 |
| | DBD a | 0 ... 65532 | data double word | 2 |
| | DID a | 0 ... 65532 | instance data double word | 2 |
| | m | | 32bit constant as pointer | 3 |
| | LD a | parameterizable | local data double word | 2 |
| | MD a | 0 ... 8188 | bit memory double word | 2 |
| | | | ... into AR1 | |
| LAR2 | | | Load the contents from ... | |
| | - | | ACCU1 | 1 |
| | DBD a | 0 ... 65532 | data double word | 2 |
| | DID a | 0 ... 65532 | instance data double word | 2 |
| | m | | 32bit constant as pointer | 3 |
| | LD a | parameterizable | local data double word | 2 |
| | MD a | 0 ... 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 ... 65532 | data double word | 2 |
| | DID a | 0 ... 65532 | instance data double word | 2 |
| | LD a | parameterizable | local data double word | 2 |
| | MD a | 0 ... 8188 | bit memory double word | 2 |
| TAR2 | | | Transfer the contents from AR2 to... | |
| | - | | ACCU1 | 1 |
| | DBD a | 0 ... 65532 | data double word | 2 |
| | DID a | 0 ... 65532 | instance data double word | 2 |
| | LD a | parameterizable | local data double word | 2 |
| | MD a | 0 ... 8188 | bit memory double word | 2 |
| TAR | | | Exchange the contents of AR1 and AR2 | 1 |

**Load and transfer instructions for the status word**

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| L | STW | | Load status word in ACCU1 | |
| T | STW | | Transfer ACCU1 (bits 0 ... 8) into status word | |

| Status word for: L STW | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 0 |
| Instruction influences | - | - | - | - | - | - | - | - | - |

| Status word for: T STW | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✓ | - |

**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.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| 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.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| CAW | - | | Reverse the order of the bytes in ACCU1-L<br>LL, LH becomes LH, LL | 1 |
| CAD | - | | Reverse the order of the bytes in ACCU1<br>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 |

## 3.16 Data type conversion instructions

**Data type conversion instructions**

The results of the conversion are in ACCU1. When converting real numbers, the execution time depends on the value.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| BTI | - | | Convert contents of ACCU1 from BCD to integer (16bit)<br>(BCD to Int.) | 1 |
| BTD | - | | Convert contents of ACCU1 from BCD to integer (32bit)<br>(BCD to Doubleint.) | 1 |
| DTR | - | | Convert cont. of ACCU1 from integer (32bit) to Real number (32bit)<br>(Doubleint. to Real) | 1 |
| ITD | - | | Convert contents of ACCU1 from integer (16bit) to integer (32bit)<br>(Int. to Doubleint) | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| ITB | - | | Convert contents of ACCU1 from integer (16bit) to BCD 0 ... +/-999 (Int. To BCD) | 1 |
| DTB | - | | Convert contents of ACCU1 from integer (32bit) to BCD 0 ... +/-9 999 999 (Doubleint. To BCD) | 1 |
| RND | - | | Convert a real number to 32bit integer | 1 |
| RND- | - | | Convert a real number to 32bit integer<br>The number is rounded next hole number | 1 |
| RND+ | - | | Convert real number to 32bit integer<br>It is rounded up to the next integer | 1 |
| TRUNC | - | | Convert real number to 32bit integer<br>The places after the decimal point are truncated | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | ✓ | ✓ | - | - | - | - |

**Complement creation**

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| INVI | - | | Forms the ones complement of ACCU1-L | 1 |
| INVD | - | | Forms the ones complement of ACCU1 | 1 |
| NEGI | - | | Forms the twos complement of ACCU1-L (integer) | 1 |
| NEGD | - | | Forms the twos complement of ACCU1 (double integer) | 1 |

| Status word for: INVI, INVD | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | - | - | - | - | - | - | - | - |

| Status word for: NEGI, NEGD | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | - | - | - | - |

## 3.17 Comparison instructions

**Comparison instructions with integer (16bit)**

Comparing the integer (16bit) in ACCU1-L and ACCU2-L.

RLO=1, if condition is satisfied.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| ==I | - | | ACCU2-L = ACCU1-L | 1 |
| <>I | - | | ACCU2-L different to ACCU1-L | 1 |
| <I | - | | ACCU2-L < ACCU1-L | 1 |
| <=I | - | | ACCU2-L <= ACCU1-L | 1 |
| >I | - | | ACCU2-L > ACCU1-L | 1 |
| >=I | - | | ACCU2-L >= ACCU1-L | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | 0 | - | 0 | ✓ | ✓ | 1 |

**Comparison instructions with integer (32bit)**

Comparing the integer (32bit) in ACCU1 and ACCU2.

RLO=1, if condition is satisfied.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| ==D | - | | ACCU2 = ACCU1 | 1 |
| <>D | - | | ACCU2 different to ACCU1 | 1 |
| <D | - | | ACCU2 < ACCU1 | 1 |
| <=D | - | | ACCU2 <= ACCU1 | 1 |
| >D | - | | ACCU2 > ACCU1 | 1 |
| >=D | - | | ACCU2 >= ACCU1 | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | 0 | - | 0 | ✓ | ✓ | 1 |

**Comparison instructions with 32bit real number**

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.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| ==R | - | | ACCU2 = ACCU1 | 1 |
| <>R | - | | ACCU2 different to ACCU1 | 1 |
| <R | - | | ACCU2 < ACCU1 | 1 |
| <=R | - | | ACCU2 <= ACCU1 | 1 |
| >R | - | | ACCU2 > ACCU1 | 1 |
| >=R | - | | ACCU2 >= ACCU1 | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | ✓ | ✓ | ✓ | 0 | ✓ | ✓ | 1 |

## 3.18 Combination instructions (Bit)

**Combination instructions with bit operands**

Examining the signal state of the addressed instruction and gating the result with the RLO according to the appropriate logic function.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| A | | | AND operation at signal state "1" | |
| | I/Q a.b | 0.0 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 | | | AND operation of signal state "0" | |
| | I/Q a.b | 0.0 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 |

| Status word for: A, AN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | ✓ | ✓ | ✓ | 1 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| O | | | OR operation at signal state "1" | |
| | I/Q a.b | 0.0 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 |
| ON | | | OR operation at signal state "0" | |
| | I/Q a.b | 0.0 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 |

| Status word for: O, ON | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| X | | | EXCLUSIVE-OR operation at signal state "1" | |
| | I/Q a.b | 0.0 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 ... 2047.7 | Input/output | 1/2 |
| | M a.b | 0.0 ... 8191.7 | Bit memory | 1/2 |
| | L a.b | parameterizable | Local data bit | 2 |
| | DBX a.b | 0.0 ... 65535.7 | Data bit | 2 |
| | DIX a.b | 0.0 ... 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 |

| Status word for: X, XN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

**Combination instructions with parenthetical expressions**

Saving the bits BR, RLO, OR and a function ID (A, AN, ...) at the nesting stack.

For each block 7 nesting levels are possible.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| A( | | | AND left parenthesis | 1 |
| AN( | | | AND-NOT left parenthesis | 1 |
| O( | | | OR left parenthesis | 1 |
| ON( | | | OR-NOT left parenthesis | 1 |
| X( | | | EXCLUSIVE-OR left parenthesis | 1 |
| XN( | | | EXCLUSIVE-OR-NOT left parenthesis | 1 |
| ) | | | Right parenthesis; popping an entry off the nesting stack.<br>Gating RLO with the current RLO in the processor. | 1 |

| Status word for: A(, AN(, O(, ON( X(, XN( | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | - | - | - | - | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | 1 | - | 0 |

| Status word for: ) | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | ✓ | - | - | - | - | ✓ | 1 | ✓ | 1 |

**ORing of AND operations**

The ORing of AND operations is implemented according the rule: AND before OR.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| O | | | OR operations of AND functions according the rule: AND before OR | 1 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | ✓ | 1 | - | ✓ |

**Combination instructions with timer and counters**

Examining the signal state of the addressed timer/counter an gating the result with the RLO according to the appropriate logic function.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| A | | | AND operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |
| AN | | | AND operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | ✓ | ✓ | ✓ | 1 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| O | | | OR operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |
| ON | | | OR operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| X | | | EXCLUSIVE-OR operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |
| XN | | | EXCLUSIVE-OR operation at signal state | |
| | T f | 0 ... 511 | Timer | 1/2 |
| | C f | 0 ... 511 | Counter | 1/2 |
| | Timer para. | | Timer addressed via parameters | 2 |
| | Counter para. | | Counter addressed via parameters | 2 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

**Combination instructions**

Examining the specified conditions for their signal status, and gating the result with the RLO according to the appropriate function.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| A, O, X | | | AND, OR, EXCLUSIVE OR operation at signal state "1" | |
| | ==0 | | Result = 0 (CC1=0) and (CC0=0) | 1 |
| | >0 | | Result > 0 (CC1=1) and (CC0=0) | 1 |
| | <0 | | Result < 0 (CC1=0) and (CC0=1) | 1 |
| | <>0 | | Result different to 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 |

| Status word for: A | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | ✓ | ✓ | ✓ | 1 |

| Status word for: O, X | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | 0 | ✓ | ✓ | 1 |

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| AN<br>ON<br>XN | | | AND NOT/OR NOT/EXCLUSIVE OR NOT<br>Operation at signal state "0" | 1 |
| | ==0 | | Result = 0 (CC1=0) and (CC0=0) | 1 |
| | >0 | | Result > 0 (CC1=1) and (CC0=0) | 1 |
| | <0 | | Result < 0 (CC1=0) and (CC0=1) | 1 |
| | <>0 | | Result different to 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 |

| Status word for: AN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | ✓ | ✓ | ✓ | 1 |

| Status word for: ON, XN | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | ✓ | ✓ |
| Instruction influences | - | - | - | - | - | - | ✓ | ✓ | 1 |

## 3.19 Combination instructions (Word)

**Combination instructions with the contents of ACCU1**

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.

| Command | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| AW | k16 | | AND ACCU2-L | 1 |
| AW | | | AND 16bit constant | 2 |
| OW | k16 | | OR ACCU2-L | 1 |
| OW | | | OR 16bit constant | 2 |
| XOW | k16 | | EXCLUSIVE OR ACCU2-L | 1 |
| XOW | | | EXCLUSIVE OR 16bit constant | 2 |
| AD | k32 | | AND ACCU2 | 1 |
| AD | | | AND 32bit constant | 3 |
| OD | k32 | | OR ACCU2 | 1 |
| OD | | | OR 32bit constant | 3 |
| XOD | k32 | | EXCLUSIVE OR ACCU2 | 1 |
| XOD | | | EXCLUSIVE OR 32bit constant | 3 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | - | - |
| Instruction influences | - | ✓ | 0 | 0 | - | - | - | - | - |

## 3.20 Timer instructions

Starting or resetting a timer (addressed directly or via parameters).

The time value must be in ACCU1-L.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| SP | T f | 0 ... 511 | Start time as pulse on edge change from "0" to "1" | 1/2 |
| | Timer para. | | | 2 |
| SE | T f | 0 ... 511 | Start timer as extended pulse on edge change from "0" to"1" | 1/2 |
| | Timer para. | | | 2 |
| SD | T f | 0 ... 511 | Start timer as ON delay on edge change from "0" to "1" | 1/2 |
| | Timer para. | | | 2 |
| SS | T f | 0 ... 511 | Start timer as saving start delay on edge change from "0" to "1" | 1/2 |
| | Timer para. | | | 2 |
| SA | T f | 0 ... 511 | Start timer as OFF delay on edge change from "1" to "0" | 1/2 |
| | Timer para. | | | 2 |
| FR | T f | 0 ... 511 | Enable timer for restarting on edge change from "0" to "1" (reset edge bit memory for starting timer) | 1/2 |
| | Timer para. | | | 2 |
| R | T f | 0 ... 511 | Reset timer | 1/2 |
| | Timer para. | | | 2 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | - | 0 | - | - | 0 |

## 3.21 Counter instructions

The counter value is in ACCU1-L res. in the address transferred as parameter.

| Com-mand | Operand | Parameter | Function | Length in words |
|---|---|---|---|---|
| S | C f | 0 ... 511 | Presetting of counter on edge change from "0" to "1" | 1/2 |
| | Counter para. | | | 2 |
| R | C f | 0 ... 511 | Reset counter to "0" on edge change from "0" to "1" | 1/2 |
| | Counterpara. | | | 2 |
| CU | C f | 0 ... 511 | Increment counter by 1 on edge change from "0" to "1" | 1/2 |
| | Counterpara. | | | 2 |
| CD | C f | 0 ... 511 | Decrement counter by 1 on edge change from "0" to "1" | 1/2 |
| | Counter para. | | | 2 |
| FR | C f | 0 ... 511 | Enable counter on edge change from "0" to "1" (reset the edge bit memory for up and down counting) | 1/2 |
| | Counter para. | | | 2 |

| Status word | BR | CC1 | CC0 | OV | OS | OR | STA | RLO | /FC |
|---|---|---|---|---|---|---|---|---|---|
| Instruction depends on | - | - | - | - | - | - | - | ✓ | - |
| Instruction influences | - | - | - | - | - | 0 | - | - | 0 |

# 4 Block parameters

## 4.1 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**<br>The specific error codes are listed in the descriptions of the individual SFCs.<br>Bit 14 ... 8 > "0": **General error code**<br>The possible general error codes are shown |
| 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. |
| 8x01h | Illegal syntax detection for an ANY parameter. |
| 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. |
| 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. |

| Error code | Description |
|---|---|
| 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. |

# 5 Organization Blocks

## 5.1 Overview

OBs (Organization blocks) 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:

- On start-up of the CPU
- On cyclic or clocked execution
- On errors
- On hardware interrupts occur

## 5.2 Main

### 5.2.1 OB1 - Main - Program Cycle

**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.

**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<br>03h: completion of the main cycle |
| 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 |

## 5.3 Startup

### 5.3.1 OB 100, OB 102 - Complete/Cold Restart - Startup

**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 Startup OB and then executes the main program in OB 1. Here the current program and the current data blocks generated by SFC remain in memory.

A distinction is made between the following types of startup:

- OB 100: Complete restart
- OB 102: Cold restart

The CPU executes a startup as follows:

- after PowerON 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 startup OB 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 startup OB with default names of the variables and its data types:

| Variable | Type | Description |
|---|---|---|
| OB10x_EV_CLASS | BYTE | Event class and identifiers:<br>13h: active |
| OB10x_STRTUP | BYTE | Startup request<br>■ 81h: Manual restart request<br>■ 82h: Automatic restart request<br>■ 85h: Request for manual cold restart<br>■ 86h: Request for automatic cold restart<br>■ 8Ah: Master: Manual restart request<br>■ 8Bh: Master: Automatic restart request |
| OB10x_PRIORITY | BYTE | Priority class: 27 |
| OB10x_OB_NUMBR | BYTE | OB number (100 or 102) |
| OB10x_RESERVED_1 | BYTE | reserved |
| OB10x_RESERVED_2 | BYTE | reserved |
| OB10x_STOP | WORD | Number of the event that caused the CPU to STOP |
| OB10x_STRT_INFO | DWORD | Supplementary information about the current startup |
| OB10x_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 OB10x_STRT_INFO**

| Bit no. | Explanation | Possible values (binary) | Description |
|---|---|---|---|
| 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 PowerON |
| | | xxxx 1xxx | Clock for time stamp battery-backed at last PowerON |
| 23...16 | Startup just completed | 0000 0011 | Restart triggered with mode selector |
| | | 0000 0100 | Restart triggered by command via MPI |
| | | 0000 0111 | Cold restart triggered with mode selector |
| | | 0000 1000 | Cold restart triggered by command via MPI |
| | | 0001 0000 | Automatic restart after battery-backed PowerON |
| | | 0001 0011 | Restart triggered with mode selector; last PowerON battery-backed |
| | | 0001 0100 | Restart triggered by command via MPI; last PowerON battery-backed |
| | | 0010 0000 | Automatic restart battery-backed PowerON (with memory reset by system) |
| | | 0010 0011 | Restart triggered with mode selector last PowerON not battery-backed |
| | | 0010 0100 | Restart triggered by command via MPI last PowerON not battery-backed |
| 15...12 | Permissibility of automatic startup | 0000 | Automatic startup illegal, memory request requested |

| Bit no. | Explanation | Possible values (binary) | Description |
|---|---|---|---|
| | | 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 PowerON | 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 PowerON |
| | | 0001 0011 | Restart triggered with mode selector; last PowerON battery-backed |
| | | 0001 0100 | Restart triggered by command via MPI; last PowerON battery-backed |
| | | 0010 0000 | Automatic restart after battery-backed PowerON (with memory reset by system) |
| | | 0010 0011 | Restart triggered with mode selector last PowerON not battery-backed |
| | | 0010 0100 | Restart triggered by command via MPI last PowerON not battery-backed |

## 5.4 Communication Interrupts

### 5.4.1 OB 55 - DP: Status Alarm - Status Interrupt

**Description**

*A status interrupt OB (OB 55) is only available for DP-V1 capable CPUs.*

The CPU operating system calls OB 55 if a status interrupt was triggered via the slot of a DP-V1 slave. This might be the case if a component (module) of a DP-V1 slaves changes its operating mode, for example from RUN to STOP. For precise information on events that trigger a status interrupt, refer to the documentation of the DP-V1 slave‘s manufacturer.

**Local data**

The following table describes the start information of the OB 55 with default names of the variables and its data types:

| Variable | Data type | Description |
|---|---|---|
| OB55_EV_CLASS | BYTE | Event class and identifiers:<br>11h: incoming event |
| OB55_STRT_INF | BYTE | 55h: Status interrupt for DP<br>58h: Status interrupt for PROFINET IO |

| Variable | Data type | Description |
|---|---|---|
| OB55_PRIORITY | BYTE | Configured priority class:<br>Default value: 2 |
| OB55_OB_NUMBR | BYTE | OB number (55) |
| OB55_RESERVED_1 | BYTE | reserved |
| OB55_IO_FLAG | BYTE | Input module: 54h<br>Output module: 55h |
| OB55_MDL_ADDR | WORD | Logical base address of the module that triggers the interrupt |
| OB55_LEN | BYTE | Data block length supplied by the interrupt |
| OB55_TYPE | BYTE | ID for the interrupt type "Status interrupt" |
| OB55_SLOT | BYTE | Slot number of the interrupt triggering component (module) |
| OB55_SPEC | BYTE | Specifier:<br>■ Bit 1, 0: Interrupt specifier<br>■ Bit 2: Add_Ack<br>■ Bit 7 ... 3: Seq. number |
| OB55_DATE_TIME | DATE_AND_TIME | Date and time of day when the OB was called |

*You can obtain the full additional information on the interrupt from the frame by calling SFB 54 "RALRM" in OB 55.* *Chapter 13.2.22 'SFB 54 - RALRM - Receiving an interrupt from a periphery module' on page 406*

## 5.4.2 OB 56 - DP: Update Alarm - Update Interrupt

**Description**

*A update interrupt OB (OB 56) is only available for DP-V1 capable CPUs.*

The CPU operating system calls OB 56 if an update interrupt was triggered via the slot of a DP-V1 slave. This can be the case if you have changed the parameters for the slot of a DP-V1 slave. For precise information on events that trigger an update interrupt, refer to the documentation of the DP-V1 slave manufacturer.

**Local data**

The following table describes the start information of the OB 56 with default names of the variables and its data types:

| Variable | Data type | Description |
|---|---|---|
| OB56_EV_CLASS | BYTE | Event class and identifiers:<br>11h: incoming event |
| OB56_STRT_INF | BYTE | 56h: Update interrupt for DP<br>59h: Update interrupt for PROFINET IO |

| Variable | Data type | Description |
|---|---|---|
| OB56_PRIORITY | BYTE | Configured priority class:<br>Default value: 2 |
| OB56_OB_NUMBR | BYTE | OB number (56) |
| OB56_RESERVED_1 | BYTE | reserved |
| OB56_IO_FLAG | BYTE | Input module: 54h<br>Output module: 55h |
| OB56_MDL_ADDR | WORD | Logical base address of the module that triggers the interrupt |
| OB56_LEN | BYTE | Data block length supplied by the interrupt |
| OB56_TYPE | BYTE | ID for the interrupt type "Update interrupt" |
| OB56_SLOT | BYTE | Slot number of the interrupt triggering component |
| OB56_SPEC | BYTE | Specifier:<br>■ Bit 1, 0: Interrupt specifier<br>■ Bit 2: Add_Ack<br>■ Bit 7 ... 3: Seq. number |
| OB56_DATE_TIME | DATE_AND_TIME | Date and time of day when the OB was called |

*You can obtain the full additional information on the interrupt from the frame by calling SFB 54 "RALRM" in OB 56.* *Chapter 13.2.22 'SFB 54 - RALRM - Receiving an interrupt from a periphery module' on page 406*

### 5.4.3 OB 57 - DP: Manufacture Alarm - Manufacturer Specific Interrupt

**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 slave system.

**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:<br>11h: incoming event |
| OB57_STRT_INF | BYTE | 57h: Start request for OB 57 |
| OB57_PRIORITY | BYTE | Configured priority class:<br>Default value: 2 |
| OB57_OB_NUMBR | BYTE | OB number (57) |
| OB57_RESERVED_1 | BYTE | reserved |
| OB57_IO_FLAG | BYTE | Input module: 54h<br>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 |

*You can obtain the full additional information on the interrupt from the frame by calling SFB 54 "RALRM" in OB 57.*

## 5.5 Time delay Interrupts

### 5.5.1 OB 20, OB 21 - DEL_INTx - 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 number, 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. 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.

**Local data**

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

| Variable | Type | Description |
|---|---|---|
| OB20_EV_CLASS | BYTE | Event class and identifiers:<br>11h: interrupt is active |
| OB20_STRT_INF | BYTE | 21h: start request for OB 20<br>22h: start request for OB 21 |
| OB20_PRIORITY | BYTE | assigned priority class:<br>Default:<br>3 (OB 20)<br>...<br>6 (OB 23) |
| OB20_OB_NUMBR | BYTE | OB number (20, 21) |
| OB20_RESERVED_1 | BYTE | reserved |
| OB20_RESERVED_2 | BYTE | reserved |
| OB20_SIGN | WORD | User ID:<br>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.

## 5.6 Time of day Interrupts

### 5.6.1 OB 10, OB 11 - TOD_INTx - 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

*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:

1. 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.
2. 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.
3. 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.<br>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 ... OB 11 with default names of the variables and its data types. The variable names are the default names of OB 10.

| Variable | Type | Description |
|---|---|---|
| OB10_EV_CLASS | BYTE | Event class and identifiers:<br>11h: interrupt is active |
| OB10_STRT_INFO | BYTE | 11h: Start request for OB 10<br>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:<br>0000h: once<br>0201h: once every minute<br>0401h: once hourly<br>1001h: once daily<br>1201h: once weekly<br>1401h: once monthly<br>1801h: once yearly<br>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.

## 5.7 Cyclic Interrupts

### 5.7.1 OB 28, 29, 32, 33, 34, 35 - CYC_INTx - Cyclic Interrupt

**Description**

By means of a cyclic 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 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 cyclic interrupt is activated by programming the corresponding OB within the CPU. The cyclic 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 cyclic OBs are called in the configured equidistant intervals with consideration of the phase shift. The equidistant start times of the cyclic 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 cyclic 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 cyclic 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: | Parameterizable as VIPA specific parameter by the properties of the CPU. |
| OB 32, 35: | Parameterizable by Siemens CPU 318-2DP. |

*You must make sure that the run time of each cyclic interrupt OB is significantly shorter than its interval. The cyclic interrupt that caused the error is executed later.*

**Local data**

The following table describes the start information with default names of the variables and its data types. The variable names are the default names of OB 35.

| Variable | Type | Description |
|---|---|---|
| OB35_EV_CLASS | BYTE | Event class and identifiers:<br>11h: Cyclic interrupt is active |
| OB35_STRT_INF | BYTE | 2Fh: Start request for OB 28<br>30h: Start request for OB 29<br>33h: Start request for OB 32<br>34h: Start request for OB 33<br>35h: Start request for OB 34<br>36h: Start request for OB 35 |
| OB35_PRIORITY | BYTE | Assigned priority class;<br>Default values: 24 (OB 28, 29),<br>9 (OB 32) ... 12 (OB 35) |

| Variable | Type | Description |
|---|---|---|
| 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_EXC_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.

*Since the blocks SFC58/59 respectively SFB52/53 for reading and writing data blocks cannot be interrupted, in conjunction with OB 28 and OB 29 the CPU may change to STOP state!*

## 5.8 Hardware Interrupts

### 5.8.1 OB 40, OB 41 - HW_INTx - 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 40 and OB 41 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. *Chapter 13.1.43 'SFC 55 - WR_PARM - Write dynamic parameter' on page 322* *Chapter 13.1.44 'SFC 56 - WR_DPARM - Write default parameter' on page 324* *Chapter 13.1.45 'SFC 57 - PARM_MOD - Parameterize module' on page 326*

**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 hardware 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 OB 41 with default names of the variables and its data types:

| Variable | Type | Description |
|---|---|---|
| OB40_EV_CLASS | BYTE | Event class and identifiers:<br>11h: Interrupt is active |
| OB40_STRT_INF | BYTE | 41h: Interrupt via Interrupt line 1 |
| OB40_PRIORITY | BYTE | Assigned priority class:<br>Default: 16 (OB 40)<br>Default: 17 (OB 41) |
| OB40_OB_NUMBR | BYTE | OB number (40, 41) |
| OB40_RESERVED_1 | BYTE | reserved |
| OB40_IO_FLAG | BYTE | Input Module: 54h<br>Output Module: 55h |
| OB40_MDL_ADDR | WORD | Logical base address of the module that triggers the interrupt |
| OB40_POINT_ADDR | DWORD | ■ For digital modules<br>– Bit field with the states of the inputs on the module (bit 0 corresponds to the first input).<br>■ For analog modules<br>– Bit field with information which channel has exceeded which limit.<br>■ For CPs or IMs<br>– Informs about the module interrupt status. |
| 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.

## 5.9 Asynchronous error Interrupts

### 5.9.1 OB 80 - CYCL_FLT - 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.

*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:<br>01h, 02h, 05h, 06h, 07h, 08h, 09h, 0Ah) |
| OB80_PRIORITY | BYTE | Priority class: 26 (RUN mode)<br>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 | Description |
|---|---|---|---|
| *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<br>OB80_ERR_EV_CLASS and<br>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 |

| Error code | Variable | Bit | Description |
|---|---|---|---|
| | 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 |
| *07h* | meaning of the parameters see error code 02h | | *Overflow of OB request buffer for the current priority class*<br>(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 **in** **R**UN)* CiR synchronizations time in ms |

## 5.9.2 OB 81 - PS_FLT - 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 ... 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:<br>39h: incoming event |
| OB81_FLT_ID | BYTE | Error code:<br>22h: Back-up voltage missing |
| OB81_PRIORITY | BYTE | Priority class:<br>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)<br>Bit 3: 1 (master CPU)<br>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 |
| OB81_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.

### 5.9.3 OB 82 - I/O_FLT1 - 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 signalling 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 on income and outgoing event. The operating system then calls OB 82.
- The local variables of OB 82 contain the logical base address as well as four bytes of diagnostic data of the faulty module.
- If OB 82 has not been programmed, the CPU changes to the STOP mode. You can delay the diagnostic interrupt OB with SFC 41 DIS_AIRT or disable the delay with 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 an overall reset.

- This diagnostic buffer is a ring buffer and offers at the CPUs of VIPA space for 100 entries.
- When the diagnostic buffer is full, the oldest entry is overwritten by the newest.
- If you are online with the CPU, you can read out the diagnostic buffer by means of the PLC functions of the Siemens SIMATIC Manager. Besides of the standard entries in the diagnostics buffer, the VIPA CPUs support some additional specific entries as event-IDs. More information may be found in the manual of the CPU at "Deployment of the CPU ..." at "Diagnostic entries".

**Configurable Diagnostics**

With programmable diagnostic events a message only occurs if you have enabled diagnostic by parameter assignment. Non-programmable diagnostic events are always reported, regardless of whether or not diagnostic has been enabled.

**Write diagnostic data with SFC**

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

**Read diagnostic data with SFC 59**

You can use the SFC 59 RD_REC (read record set) in OB 82 to obtain detailed error information. The diagnostic data are consistent until OB 82 is exited. Exiting of OB 82 acknowledges the diagnostic interrupt. The module's diagnostic data are in record set 0 (DS 0) and record set 1 (DS 1). DS 0 contains 4byte, which describe the current status of the module. The contents of these bytes are identical to the contents of byte 8 ... 11 of the start information of OB 82. DS 1 contains the 4 byte of 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**

Information to access the local data can be found at the description of the OB 1. The following table describes the start information of the OB 82 with default names of the variables and its data types:

| Variable | Data type | Description |
|---|---|---|
| OB82_EV_CLASS | BYTE | Event class and identifiers:<br>38h: outgoing event<br>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-NO. (82) |
| OB82_RESERVED_1 | BYTE | reserved |
| OB82_IO_FLAG | BYTE | Input module 54h<br>Output module 55h |
| OB82_MDL_ADDR | INT | Logical base address of the module where the fault occurred |
| OB82_MDL_DEFECT | BOOL | Module fault |
| OB82_INT_FAULT | BOOL | Internal error |
| OB82_EXT_FAULT | BOOL | External error |
| OB82_PNT_INFO | BOOL | Channel error exists |
| OB82_EXT_VOLTAGE | BOOL | External power supply was not found |
| OB82_FLD_CONNCTR | BOOL | Front plug not found |
| OB82_NO_CONFIG | BOOL | Module is not configured |
| OB82_CONFIG_ERR | BOOL | Wrong parameters in module |

| Variable | Data type | Description |
|---|---|---|
| OB82_MDL_TYPE | BYTE | Bit 3 ... 0: Module class<br>Bit 4: Channel information available<br>Bit 5: User information available<br>Bit 6: Diagnostic interrupt from substitute<br>Bit 7: reserved |
| OB82_SUB_MDL_ERR | BOOL | User module incorrect/missing |
| OB82_COMM_FAULT | BOOL | Communication error |
| OB82_MDL_STOP | BOOL | Operating mode (0: RUN, 1:STOP) |
| OB82_WTCH_DOG_FLT | BOOL | Watchdog was triggered |
| OB82_INT_PS_FLT | BOOL | Module internal power supply failed |
| OB82_PRIM_BATT_FLT | BOOL | Battery empty |
| OB82_BCKUP_BATT_FLT | BOOL | Total failed buffering |
| OB82_RESERVED_2 | BOOL | Reserved |
| OB82_RACK_FLT | BOOL | Expansion unit failure |
| OB82_PROC_FLT | BOOL | Processor failure |
| OB82_EPROM_FLT | BOOL | EPROM error |
| OB82_RAM_FLT | BOOL | RAM error |
| OB82_ADU_FLT | BOOL | ADC/DAC error |
| OB82_FUSE_FLT | BOOL | Fuse failure |
| 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 |

## 5.9.4 OB 83 - I/O_FLT2 - Insert / Remove Module

**Description**

The CPU operating system calls OB 83 in following situations:

- after insertion / removal of a configured module
- after modifications of module parameters and download of changes to the CPU during RUN

If you have not programmed OB 83, the CPU changes to STOP mode. You can disable/ delay/enable the insert/remove interrupt OB with the help of SFCs 39 to 42.

**Insert/Remove**

Each time a configured module is removed or inserted during the RUN, STOP, and STARTUP modes, an insert/remove interrupt is generated (power supply modules, CPUs and Bus coupler must not be removed in these modes). This interrupt causes an entry in the diagnostic buffer and in the system status list for the CPU involved. The insert/remove OB is also started if the CPU is in the RUN mode. If this OB has not been programmed, the CPU changes to the STOP mode. Then system polls modules in seconds intervals to detect insertion or removal. To enable the CPU to detect the removal and insertion of a module, a minimum time interval of two seconds must expire between removal and insertion. If you remove a configured module in the RUN mode, OB 83 is started. Since the existence of modules is only monitored at intervals of one second, an access error may be detected first if the module is accessed directly or when the process image is updated. If you insert a module in a configured slot in the RUN mode, the operating system checks whether the type of the module inserted corresponds to the recorded configuration. OB 83 is then started and parameters are assigned if the module types match.

**Reconfiguring modules**

You can reassign the parameters to existing modules when you modify your system configuration during runtime. This reassignment of parameters is performed by transferring the required parameter data records to the modules. This is the procedure:

1. OB 83 will be started (Start event: 3367h) after you have assigned new parameters to a module and downloaded this configuration to the CPU in RUN mode. Relevant OB start information is the logical basic address (OB83_MDL_ADDR) and the module type (OB83_MDL_TYPE). Module I/O data may be incorrect as of now, which means that no SFC may be busy sending data records to this module.
2. The module parameters are reassigned after OB 83 was executed.
3. OB 83 will be restarted after the parameters have been assigned
   - Start event: 3267h, provided this parameter assignment was successful, or
   - 3968h, if failed

   The modules I/O data response is identical to their response after an insertion interrupt, that is, currently they may be incorrect. You can now call SFCs again to send data records to the module.

**Local Data**

The following table describes the start information of the OB 83 with default names of the variables and its data types:

| Variable | Data type | Description |
|---|---|---|
| OB83_EV_CLASS | BYTE | Event class and identifiers:<br>32h: End of reassignment of module parameters<br>33h: Start of reassignment of module parameters<br>38h: module inserted<br>39h: module removed or not responding, or end of parameter assignment |
| OB83_FLT_ID | BYTE | Error code:<br>(possible values: 51h, 54h ... 56h, 58h, 61, 63h ... 68h) |
| OB83_PRIORITY | BYTE | Priority class: can be assigned via hardware configuration |
| OB83_OB_NUMBR | BYTE | OB number (83) |
| OB83_RESERVED_1 | BYTE | Identification of module or submodule/interface module |
| OB83_MDL_ID | BYTE | 54h: Peripheral input (PI)<br>55h: Peripheral output (PQ) |

| Variable | Data type | Description |
|---|---|---|
| OB83_MDL_ADDR | WORD | ■ Central or distributed PROFIBUS DP:<br>– Logical base address of the module affected. If it is a mixed module, it is the smallest logical address used in the module.<br>– If the I and O addresses in the mixed block are equal, the logical base address is the one that receives the event identifier.<br>■ Distributed PROFINET IO:<br>– Logical base address of the module/ submodule |
| OB83_RACK_NUM | WORD | ■ If OB83_RESERVED_1 = A0h:<br>number of submodule/interface submodule (low byte)<br>■ If OB83_RESERVED_1 = C4h:<br>– central: rack number<br>– distributed PROFIBUS DP:<br>number of DP station (low byte) and DP master system ID (high byte)<br>– distributed PROFINET IO:<br>physical address: identifier bit (bit 15, 1 = PROFINET IO), IO system ID (bits 11 ... 14) and device number (bits 0 ... 10) |
| OB83_MDL_TYPE | WORD | ■ Central or distributed PROFIBUS DP:<br>Module type of affected module<br>(x:irrelevant to the user)<br>– x5xxh: analog module<br>– x8xxh: function module<br>– xCxxh: CP<br>– xFxxh: digital module<br>– 8340h: Replacement type identifier for input module<br>– 9340h: Replacement type identifier for output module<br>– A340h: Replacement type identifier for mixed module (I/O)<br>– F340h: Replacement type identifier for uniquely identifiable module (e.g. with packed addresses)<br>■ Distributed PROFINET IO:<br>– 8101h: module type of the inserted module is the same as the module type of the removed module<br>– 8102h: module type of the inserted module is not the same as the module type of the removed module |
| OB83_DATE_TIME | DATE_AND_TIME | DATE_AND_TIME of day when the OB was called |

**OB83_EV_CLASS**

The following table shows the event that started OB 83:

| OB83_EV_CLASS | OB83_FLT_ID | Description |
|---|---|---|
| 39h | 51h | PROFINET IO module removed |
| | 54h | PROFINET IO submodule removed |
| 38h | 54h | PROFINET IO submodule inserted and matches configured submodule |
| | 55h | PROFINET IO submodule inserted, but does not match configured sub-module |
| | 56h | PROFINET IO submodule inserted, but error with module parameters |
| | 58h | PROFINET IO submodule, access error corrected |
| 39h | 61h | Module removed or not responding OB83_MDL_TYPE: Actual module type |
| 38h | 61h | Module inserted. Module type OK OB83_MDL_TYPE: Actual module type |
| | 63h | Module inserted but incorrect module type OB83_MDL_TYPE: Actual module type |
| | 64h | Module inserted but problem (module ID cannot be read)<br>OB83_MDL_TYPE: Configured module type |
| | 65h | Module inserted but error in module parameter assignment<br>OB83_MDL_TYPE: Actual module type |
| 39h | 66h | Module not responding, load voltage error |
| 38h | 66h | Module responds again, load voltage error corrected |
| 33h | 67h | Start of module reconfiguration |
| 32h | 67h | End of module reconfiguration |
| 39h | 68h | Module reconfiguration terminated with error |

*If you are using a DP-V1- or PROFINET-capable CPU you can obtain additional information on the interrupt with the help of SFB 54 "RALRM" which exceeds the start information of the OB.*

## 5.9.5 OB 85 - OBNL_FLT - Priority Class 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.

*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<br>38h (only with error code B3h, B4h)<br>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:<br>26 (Default value mode RUN)<br>28 (mode STARTUP) |
| 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 | Description |
|---|---|---|---|
| 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, A2h | OB85_Z1 | The respective local variable of the called OB that is determined by OB85_Z23. |
| | A1h, A2h | OB85_Z23 | high word:<br>Class and number of the event causing the OB call |
| | | | low word, high byte:<br>Program level and OB active at the time of error low word, low byte:<br>Active OB |
| 35h | A3h | | Error when the operating system accesses a module |
| | | OB85_Z1 | Error ID of the operating system |
| | | | high byte:<br>1: Integrated function<br>2: IEC-Timer |
| | | | low byte:<br>0: no error resolution<br>1: block not loaded<br>2: area length error<br>3: write-protect error |
| | | OB85_Z23 | high word: block number |
| | | | low word:<br>Relative address of the MC7 command causing the error. The block type must be taken from OB85_DKZ23.<br>(88h: OB, 8Ch: FC, 8Eh: FB, 8Ah: DB) |
| 35h | A4h | | PROFINET DB cannot be addressed |
| 34h | A4h | | PROFINET 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, B2h | OB85_DKZ23 | ID of the type of process image transfer where the I/O access error happened.<br>10h: Byte access<br>20h: Word access<br>30h: DWord access<br>57h: Transmitting a configured consistency range |

| OB85_EV_CLASS | OB85_FLT_ID | Variable | Description |
| --- | --- | --- | --- |
| | B1h, B2h | OB85_Z1 | Reserved for internal use by the CPU: logical base address of the module<br>If OB85_RESERVED_2 has the value 76h OB85_Z1 receives the return value of the affected SFC |
| | B1h, B2h | OB85_Z23 | Byte 0: Part process image number |
| | | | Byte 1: Irrelevant, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57:<br>Length of the consistency range in bytes |
| | | | The I/O address causing the PII, if OB85_DKZ23=10, 20 or 30 OB85_DKZ23=57:<br>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. | | | |
| 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:<br>10h: Byte access<br>20h: Word access<br>30h: DWord access<br>57h: Transmitting a configured consistency range |
| | B3h, B4h | OB85_Z1 | Reserved for internal use by the CPU: logical base address of the module.<br>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<br>Irrelevant, if<br>OB85_DKZ23=10, 20 or 30<br>OB85_DKZ23=57:<br>Length of the consistency range in bytes<br>Byte 2, 3<br>The I/O address causing the PII, if<br>OB85_DKZ23=10, 20 or 30<br>OB85_DKZ23=57:<br>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. | | | |

### 5.9.6 OB 86 - RACK_FLT - 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).

*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:<br>38h: outgoing event<br>39h: incoming event |
| OB86_FLT_ID | BYTE | Error code:<br>(possible values: C4h, C5h, C7h, C8h) |
| OB86_PRIORITY | BYTE | Priority class:<br>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 |

| Variable | Type |
|---|---|
| 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 | Bit ... | Description |
|---|---|---|---|---|
| 39h, 38h | C4h | | | Failure of a DP station |
| | C5h | | | Fault in a DP station |
| | C4h, C5h | 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 |

## 5.10 Synchronous Interrupts

### 5.10.1 OB 121 - PROG_ERR - Programming 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 |
| OB121_PRIORITY | BYTE | Priority class:<br>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<br>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).<br>For example:<br>■ Register where the conversation error occurred<br>■ Incorrect address (read/write error)<br>■ Incorrect timer/counter/block number<br>■ 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 | Description |
|---|---|---|
| 21h | OB121_FLT_REG: | BCD conversion error |
| | | ID for the register concerned<br>(0000h: accumulator 1) |
| 22h | OB121_RESERVED_1 | Area length error when reading |
| 23h | | Area length error when writing |
| 28h | | Read access to a byte, word or double word with a pointer whose bit address is not 0. |
| 29h | | Write access to a byte, word or double word with a pointer whose bit address is not 0. |
| | | Incorrect byte address.<br>The data area and access type can be read from OB121_RESERVED_1. |
| | | Bit 3 ... 0 memory area:<br>0: I/O area<br>1: process-image input table<br>2: process-image output table<br>3: bit memory<br>4: global DB<br>5: instance DB<br>6: own local data<br>7: local data of caller<br>Bit 7 ... 4 access type:<br>0: bit access<br>1: byte access<br>2: word access<br>3: double word access |
| 24h | OB121_FLT_REG | Range error when reading |
| 25h | | Range error when writing |
| | | Contains the ID of the illegal area in the low byte<br>(86h of own local data area) |
| 26h | OB121_FLT_REG | Error for timer number |
| 27h | | Error for counter number |
| | | Illegal number |
| 30h | OB121_FLT_REG | 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 |
| | | Illegal DB number |
| 34h | OB121_FLT_REG | FC number error in FC call |

| Error code | Variable | Description |
|---|---|---|
| 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 |
| | | Illegal DB number |

### 5.10.2 OB 122 - MOD_ERR - 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:<br>42h: I/O access error - reading<br>43h: I/O access error - writing |
| OB122_PRIORITY | BYTE | Priority class:<br>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 |

| Variable | Type | Description |
|---|---|---|
| OB122_MEM_AREA | BYTE | Memory area and access type:<br>Bit 3 ... 0: memory area<br>0: I/O area;<br>1: Process image of the inputs<br>2: Process image of the outputs<br>Bit 7 ... 4: access type:<br>0: Bit access,<br>1: Byte access,<br>2: Word access,<br>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.

# 6 Include VIPA library

**Libraries**

The VIPA specific blocks can be found as library *'...LIB'* for download in the service area of www.vipa.com at *'Downloads'*. The libraries are packed ZIP files. As soon as you want to use VIPA specific blocks you have to import them into your project. The VIPA specific blocks can be found in the libraries according to its applications with the following structure:

- General library
  - *Chapter 7 'Building Control' on page 100*
  - *Chapter 8 'Network Communication' on page 113*
  - *Chapter 10 'Serial Communication' on page 201*
  - *Chapter 11 'EtherCAT Communication' on page 233*
  - *Chapter 13 'Integrated Standard' on page 275*
  - *Chapter 15 'System Blocks' on page 513*
- Modbus library
  - *Chapter 9 'Modbus Communication' on page 181*
- Library for motion, energy and frequency measurement
  This library is only available for the Siemens SIMATIC Manager.
  - *Chapter 12 'Device Specific' on page 241*

## 6.1 Integration into Siemens SIMATIC Manager

**Overview**

The integration into the Siemens SIMATIC Manager requires the following steps:

1. Load ZIP file
2. "Retrieve" the library
3. Open library and transfer blocks into the project

**Load ZIP file**

- Navigate on the web page to the desired ZIP file, load and store it in your work directory.

**Retrieve library**

1. Start the Siemens SIMATIC Manager with your project.
2. Open the dialog window for ZIP file selection via *'File → Retrieve'*.
3. Select the according ZIP file and click at [Open].
4. Select a destination folder where the blocks are to be stored.
5. Start the extraction with [OK].

**Open library and transfer blocks into the project**

1. Open the library after the extraction.
2. Open your project and copy the necessary blocks from the library into the directory "blocks" of your project.

   ⇨ Now you have access to the VIPA specific blocks via your user application.

> *Are FCs used instead of SFCs, so they are supported by the VIPA CPUs starting from firmware 3.6.0.*

## 6.2 Integration into Siemens TIA Portal

**Overview**

The integration into the Siemens TIA Portal requires the following steps:

1. Load ZIP file
2. Unzip the Zip file
3. Open library and transfer blocks into the project

**Load ZIP file**

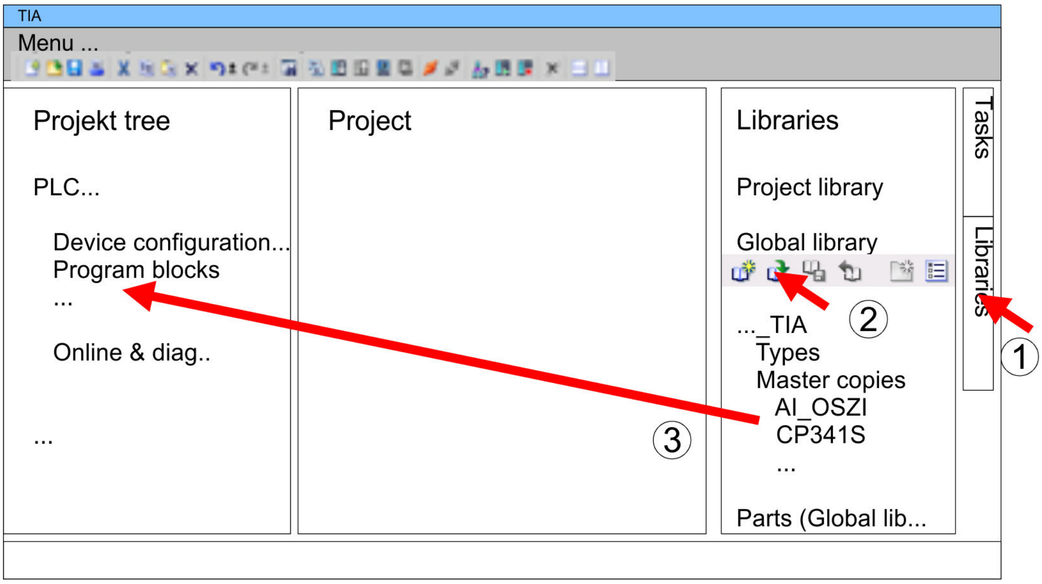
1. Navigate on the web page to the ZIP file, that matches your version of the program.
2. Load and store it in your work directory.

**Unzip the Zip file**

- Unzip the zip file to a work directory of the Siemens TIA Portal with your unzip application.

**Open library and transfer blocks into the project**

1. Start the Siemens TIA Portal with your project.
2. Switch to the *Project view*.
3. Choose "Libraries" from the task cards on the right side.
4. Click at "Global libraries".
5. Click at "Open global libraries".
6. Navigate to your work directory and load the file ..._TIA.al1x.




7. Copy the necessary blocks from the library into the "Program blocks" of the *Project tree* of your project. Now you have access to the VIPA specific blocks via your user application.

# 7 Building Control

## 7.1 Overview

In this chapter the function blocks (FB45 ... FB50) for building control (GLT) can be found. The blocks use the system time of the CPU. There are no S7 timers required. You have the option to use for each block an instance data block or multiple instances. There are the following blocks:

| FB | | Description |
|---|---|---|
| FB 45 | LAMP | Controlling a lamp or socket |
| FB 46 | BLIND | Controlling blind |
| FB 47 | DSTRIKE | Controlling an electric door opener |
| FB 48 | ACONTROL | Access control |
| FB 49 | KEYPAD | Requesting a keypad with external power supply |
| FB 50 | KEYPAD2 | Requesting a keypad without external power supply |

### 7.1.1 Call example - instance DB

**Network 1**

```
CALL "Ceiling lamp", DB 1
  ON        :=M20.0
  OFF       :=20.1
  ONOFF     :=20.2
  Duration  :=T#5M
  Output    :=M20.3
  PulseOn   :=
  PulseOff  :=
```

### 7.1.2 Call example - multi instances DB

**Content of: “Environment \Interface\Stat"**

In the following there is a STL call example of the usage of multiple lights and a blind with multiple instances.

| Name | Data type | Address |
|---|---|---|
| Ceiling lamp | LAMP | 0.0 |
| Floor lamp | LAMP | 46.0 |
| Mirror lamp | LAMP | 92.0 |
| Blind | BLIND | 138.0 |

**Network 1**

```
CALL #Ceiling lamp
  ON        :=M20.0
  OFF       :=20.1
  ONOFF     :=20.2
```

```
  Duration  :=T#5M
  Output    :=M20.3
  PulseOn   :=
  PulseOff  :=
```

**Network 2**

```
CALL #Blind
  Up               :=M30.0
  Down             :=M30.1
  CentralUp        :=
  CentralDown      :=
  TimeMaxDuration  :=T#10S
  TimePause        :=T#1S
  TimeShortLong    :=T#2S
  Endable          :=
  BlindUp          :=M30.6
  BlindDown        :=M30.7
```

## 7.2 Room

### 7.2.1 FB 45 - LAMP - Controlling lamp / socket

**Description**

With this block you can control load relays for lamps and sockets. It can be controlled via On/Off button or via separate On and Off button. Additionally with *Duration* you have the possibility to set a duration for the automatic switching-off. With *TimeDebounce* you can specify a debounce time for the input signals.

- When driving a monostable relay the output remains set as long as the relay is to be activated. With an edge change 0-1 at *OnOff* respectively *On* the static output *Output* is set. It remains set until you reset it with an edge change 0-1 at *OnOff* respectively *Off* or the time of *Duration* has expired.
- When controlling a bistable relay 2 outputs are used. Here *PulseOn* controls the switch on and *PulseOff* the switch off procedure. With *TimePulse* the pulse duration and with *TimePause* the switch time of the two outputs can be specified.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| OnOff | INPUT | BOOL | With an edge change 0-1 *Output* is activated respectively deactivated and *PulseOn* or *PulseOff* is activated.<br>Default: FALSE |
| On | INPUT | BOOL | With an edge change 0-1 *Output* is activated respectively deactivated and *PulseOn* is activated.<br>Default: FALSE |
| Off | INPUT | BOOL | With an edge change 0-1 *Output* is deactivated and *PulseOff* is activated.<br>Default: FALSE |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Duration | INPUT | TIME | Time for the duration the *Output* is deactivated respectively *PulseOff* is activated.<br>With 0ms the automatic switch off is deactivated.<br>Default: 0ms |
| Output | OUTPUT | BOOL | Static output to drive a monostable relay. |
| PulseOn | OUTPUT | BOOL | Pulse output to control the bistable relay (On signal). |
| PulseOff | OUTPUT | BOOL | Pulse output to control the bistable relay (Off signal). |
| TimeDebounce | CONSTANT | TIME | Time for debounce of the inputs.<br>Default: 100ms |
| TimePulse | CONSTANT | TIME | Time for the pulse duration of *PulseOn* respectively *PulseOff*.<br>Default: 100ms |
| TimePause | CONSTANT | TIME | Time for the break between resetting and setting of *PulseOn* respectively *PulseOff*.<br>Default: 100ms |

### 7.2.2 FB 46 - BLIND - Controlling blind

**Description**

With this block a motorized blind can be controlled. For this you have to release the drive with *Enable*.

- The controlling for “lifting” *BlindUp* and “sinking" *BlindDown* happens by 2 buttons (*Up*/*Down* respectively *CentralUp*/*CentralDown*).
  - *CentralUp*/*CentralDown*: Used for central control of all blinds in a building.
  - *Up*/*Down*: Used for local control of a blind. Here a pending *CentralUp*/*CentralDown* signal is ignored.
- If the corresponding button is pressed longer as the specified *TimeShortLong* the blend drive moves to the respective end position. By pressing on of the two buttons (*Up/Down* respectively *CentralUp/CentralDown*) you can stop the movement and reverse, it if necessary.
- With *TimeMaxDuration* you can specify the maximum run time of the motor and with *TimePause* you can specify the pause for the change of direction.
- By jogging the blend drive shortly moves. With this function you can adjust the blind slats fine.
- With *TimeDebounce* you can specify a debounce time for the input signals.
- With Status you can check the position of the blend.
  - 0: Upper limit position
  - 50: Unknown position between the two limit positions
  - 100: Lowest limit position

**CAUTION!**
The blend drive must have its own limit switches that turn off power automatically!

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↪ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Up | INPUT | BOOL | With an edge change 0-1 the output *BlindUp* is activated. Depending on the input signal the blend drives to the upper limit position or is shortly moved.<br>As long as the signal is pending the signals *Cen-tralUp/CentralDown* are ignored.<br>Default: FALSE |
| Down | INPUT | BOOL | With an edge change 0-1 the output *BlindDown* is activated. Depending on the input signal the blend drives to the lower limit position or is shortly moved.<br>As long as the signal is pending the signals *Cen-tralUp/CentralDown* are ignored.<br>Default: FALSE |
| CentralUp | INPUT | BOOL | With an edge change 0-1 the output *BlindUp* is activated. Here the blind moves to the upper limit position.<br>Default: FALSE |
| CentralDown | INPUT | BOOL | With an edge change 0-1 the output *BlindDown* is activated. Here the blind moves to the lowest limit position.<br>Default: FALSE |
| TimeMaxDuration | INPUT | TIME | Maximum drive time to reach the respective end position.<br>Default: 30s |
| TimePause | INPUT | TIME | Break between a direction change.<br>Default: 2s |
| TimeShortLong | INPUT | TIME | Time for the distinction between jog mode and continuous mode.<br>Default: 1s |
| Enable | INPUT | BOOL | Release for the drive (static)<br>Default: TRUE |
| BlindUp | OUTPUT | BOOL | Static output blind "lifting" |
| BlindDown | OUTPUT | BOOL | Static output blind "sinking" |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Status | OUTPUT | INT | ■ Status - Blind position<br>– 0: Upper limit position<br>– 50: Unknown position between the two limit positions<br>– 100: Lowest limit position |
| TimeDebounce | CONSTANT | TIME | Time for debounce of the inputs.<br>Default: 100ms |

### 7.2.3 FB 47 - DSTRIKE - Electric door opener

**Description**

With this block an electric door opener can be controlled, if its not locked with *DoorIsLocked*.

- With an edge change 0-1 at the input *Open* for the duration *'TimeOpening'* *'Output'* is controlled.
- With an edge change 0-1 at the input *EnableAlwaysOpen* respectively *DisableAlwaysOpen Open* is static activated respectively deactivated. Additionally with set *EnableAlwaysOpen* the static output *AlwaysOpen* is set.
- You can connect your door contacts at *DoorIsClosed* and *DoorIsLocked*. *DoorIsClosed* is set, as soon as the door is closed. *DoorIsLocked* is set as soon as the door is locked, i.e. the contact is controlled by the locking mechanism of the door and opening of the door by means of the electric door opener is disabled.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Open | INPUT | BOOL | With an edge change 0-1 *Output* is activated for the duration of *TimeOpening*.<br>Default: FALSE |
| EnableAlwaysOpen | INPUT | BOOL | With an edge change 0-1 *Output* is static set.<br>Default: FALSE |
| DisableAlwaysOpen | INPUT | BOOL | With an edge change 0-1 *Output* is static reset.<br>Default: FALSE |
| TimeOpening | INPUT | TIME | Time for the duration of the activation of *Output*.<br>Default: 3s |
| DoorIsClosed | INPUT | BOOL | ■ Optional - Position door<br>TRUE: Door is closed<br>FALSE: Door is open<br>Default: FALSE |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| DoorIsLocked | INPUT | BOOL | ■ Optional - Lock state of the door<br>– TRUE: Door is locked<br>– FALSE: Door is not locked<br>Default: FALSE |
| Output | OUTPUT | BOOL | Static output to drive a monostable relay. |
| AlwaysOpen | OUTPUT | BOOL | Static output to indicate "Door is static open". |

## 7.3 Access Control

### 7.3.1 FB 48 - ACONTROL - Access control

**Description**

With this block a access control can be implemented. After getting a code from an external keypad, panel or RFID reader, the code is compared with a list. Depending on the result, then the relative outputs are controlled.

- The access codes are to be applied in a data block, which is specified by *ACLBlock*. Here you can also specify which outputs *Access1...6* are to be controlled and how (pulse/static) are they controlled. With the data block up to 16 access codes can be treaded.
- Via *AccessCode1...4* the code of the corresponding input device is specified.
- Via *CheckCode1...4* the code is compared with the code in your data block *ACLBlock*.
  - If the access code in the data block exists, the corresponding outputs are controlled according to the specifications. With configured pulse output you can specify the pulse duration with *TimePulse*.
  - If the access code does not exist in the data block, the output *Error* is set for the duration *TimeError*.
- With an edge change 0-1 of *CentralLock* all the access codes are disabled. Here the output *CentralLocked* is set.
- With an edge change 0-1 of *CentralUnlock* all the access codes are enabled and the output *CentralLocked* is reset.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

#### 7.3.1.1 Block parameters

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| AccessCode1 | INPUT | STRING[16] | Access code, e.g. from keypad. |
| CheckCode1 | INPUT | BOOL | With an edge change 0-1, the *AccessCode1* is compared with the access code in the data block *ACLBlock*.<br>Default: 0 |
| AccessCode2 | INPUT | STRING[16] | Access code, e.g. from panel. |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| CheckCode2 | INPUT | BOOL | With an edge change 0-1, the *AccessCode2* is compared with the access code in the data block *ACLBlock*.<br>Default: 0 |
| AccessCode3 | INPUT | STRING[16] | Access code, e.g. RFID reader. |
| CheckCode3 | INPUT | BOOL | With an edge change 0-1, the *AccessCode3* is compared with the access code in the data block *ACLBlock*.<br>Default: 0 |
| AccessCode4 | INPUT | STRING[16] | Access code, e.g. from an other system |
| CheckCode4 | INPUT | BOOL | With an edge change 0-1, the *AccessCode4* is compared with the access code in the data block *ACLBlock*.<br>Default: 0 |
| CentralLock | INPUT | BOOL | With an edge change 0-1 all the access codes are disabled. Here the output *CentralLocked* is set. |
| CentralUnlock | INPUT | BOOL | With an edge change 0-1 of *CentralUnlock* all the access codes are enabled and the output *Central-Locked* is reset. |
| ACLBlock | INPUT | BLOCK | Data block with the access codes. *Chapter 7.3.3 'UDT 4 - ACL - Data structure for FB48' on page 107* |
| Access1 | OUTPUT | BOOL | Output 1, can be controlled as pulse or static. |
| Access2 | OUTPUT | BOOL | Output 2, can be controlled as pulse or static. |
| Access3 | OUTPUT | BOOL | Output 3, can be controlled as pulse or static. |
| Access4 | OUTPUT | BOOL | Output 4, can be controlled as pulse or static. |
| Access5 | OUTPUT | BOOL | Output 5, can be controlled as pulse or static. |
| Access6 | OUTPUT | BOOL | Output 6, can be controlled as pulse or static. |
| Error | OUTPUT | BOOL | If the access code does not exist in the data block, the output *Error* is set for the duration *Time-Error*. |
| CentralLocked | OUTPUT | BOOL | ■ Access<br>– TRUE: locked - access not possible<br>– FALSE: not locked - access possible<br>Default: TRUE |
| TimePulse | CONSTANT | Time | Time for the pulse duration at an output.<br>Default: 3s |
| TimeError | CONSTANT | Time | Time for the duration of the error signal.<br>Default: 500ms |

## 7.3.2 UDT 3 - ACLREC - Data structure for FB48

**Description**

| Address | Name | Type | Start value | Comment |
|---|---|---|---|---|
| **0.0** | | **STRUCT** | | |
| +0.0 | Code | STRING[16] | ' ' | Byte 0 ... 17: Access code<br>S7String with max. 16 ASCII characters for access code |
| +18.0 | EnableOutput1 | BOOL | FALSE | Byte 18: Signal for the outputs to be controlled<br>TRUE: activate output, FALSE: deactivate output |
| +18.1 | EnableOutput2 | BOOL | FALSE | |
| +18.2 | EnableOutput3 | BOOL | FALSE | |
| +18.3 | EnableOutput4 | BOOL | FALSE | |
| +18.4 | EnableOutput5 | BOOL | FALSE | |
| +18.5 | EnableOutput6 | BOOL | FALSE | |
| +18.6 | EnableRes7 | BOOL | FALSE | |
| +18.7 | EnableRes8 | BOOL | FALSE | |
| +19.0 | SignalOutput1 | BOOL | FALSE | Byte 19: Signal type<br>FALSE: Pulse, TRUE: static 1, deactivation with additional code |
| +19.1 | SignalOutput2 | BOOL | FALSE | |
| +19.2 | SignalOutput3 | BOOL | FALSE | |
| +19.3 | SignalOutput4 | BOOL | FALSE | |
| +19.4 | SignalOutput5 | BOOL | FALSE | |
| +19.5 | SignalOutput6 | BOOL | FALSE | |
| +19.6 | SignalRes7 | BOOL | FALSE | |
| +19.7 | SignalRes8 | BOOL | FALSE | |
| =20.0 | | | | |

## 7.3.3 UDT 4 - ACL - Data structure for FB48

**Description**

| Address | Name | Type | Start value | Comment |
|---|---|---|---|---|
| **0.0** | | **STRUCT** | | |
| +0.0 | RecordCount | INT | 16 | DBW0: Number valid record sets (0 ... n) |
| +2.0 | RecordLen | INT | 20 | DBW2: Length of one record set in bytes (20) |
| +4.0 | Record | ARRAY[0...15] | | The first record set starts from DBB4 |
| *20.0 | | "UDT 3 - ACLREC" | | *Chapter 7.3.2 'UDT 3 - ACLREC - Data structure for FB48' on page 107* |
| =324.0 | | BOOL | | |

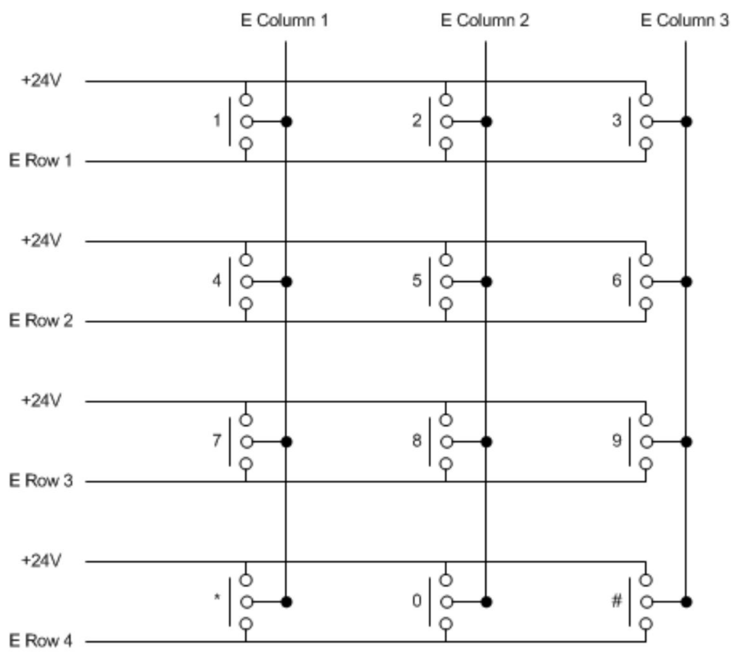
**CAUTION!**
A code must only occur 1 x in the whole list. Duplicate Codes are not allowed.

### 7.3.4 FB 49 - KEYPAD - Keyboard

**Description**

This block is used to connect an external keypad (0...9,*,#) with external DC 24V power supply. Depending on the pressed key, the keyboard provides the row and column signals (24V). The block evaluates the signals internally by means of a bit pattern table and transfers the determined ASCII code into the keyboard buffer. If necessary, or automatically the keyboard buffer is output as max. 16byte character string.

- Via *Row 1...4* the rows 1...4 of the keyboard matrix are connected.
- Via *Column 1...3* the columns 1...3 of the keyboard matrix are connected.
- Via *ClearCode* you can specify a key code to clear the keyboard buffer.
- Via *EnterCode* you can specify a key code to output the keyboard buffer at *Output* for one cycle. During this time the output *Valid* is enabled.
- Via edge change 0-1 of *Clear* the keyboard buffer cleared.
- Via *TimeAutoClear* you specify the max. duration for pressing the keys. Otherwise the keyboard buffer is cleared.
- Via *CountCharAutoEnter* you can specify the number of characters, which are automatically output as keyboard buffer at *Output* for one cycle. During this time the output *Valid* is enabled.
- *Error* is activated for the time *TimeError* when a key is pressed, but the keyboard buffer is full.
- With *TimeDebounce* you can specify a debounce time for the input signals.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Row1 | INPUT | BOOL | Row 1 of the keyboard matrix.<br>Default: FALSE |
| Row2 | INPUT | BOOL | Row 2 of the keyboard matrix.<br>Default: FALSE |
| Row3 | INPUT | BOOL | Row 3 of the keyboard matrix.<br>Default: FALSE |
| Row4 | INPUT | BOOL | Row 4 of the keyboard matrix.<br>Default: FALSE |
| Column1 | INPUT | BOOL | Column 1 of the keyboard matrix.<br>Default: FALSE |
| Column2 | INPUT | BOOL | Column 2 of the keyboard matrix.<br>Default: FALSE |
| Column3 | INPUT | BOOL | Column 3 of the keyboard matrix.<br>Default: FALSE |
| ClearCode | INPUT | BYTE | The value at which the keyboard buffer is to be cleared.<br>0: deactivated<br>Default: 42 = * |
| EnterCode | INPUT | BYTE | The value at which the keyboard buffer is to be output.<br>0: deactivated<br>Default: 35 = # |
| Clear | INPUT | BOOL | Edge change 0-1 clears the keyboard buffer.<br>Default: FALSE |
| TimeAutoClear | INPUT | TIME | Duration within a further key must be pressed. Otherwise the keyboard buffer is cleared.<br>0: Buffer is not cleared<br>Default: 10s |
| CountCharAutoEnter | INPUT | INT | Number of characters, which are automatically output as keyboard buffer.<br>0: deactivated<br>Default: 0 |
| Output | OUTPUT | STRING[16] | Contents of the keyboard buffer as max. 16 byte string. |
| Valid | OUTPUT | BOOL | The static output indicates that the string at *Output* is valid. The signal is pending for one cycle. |
| Error | OUTPUT | BOOL | *Error* is activated for the time *TimeError* when a key is pressed, but the keyboard buffer is full. |

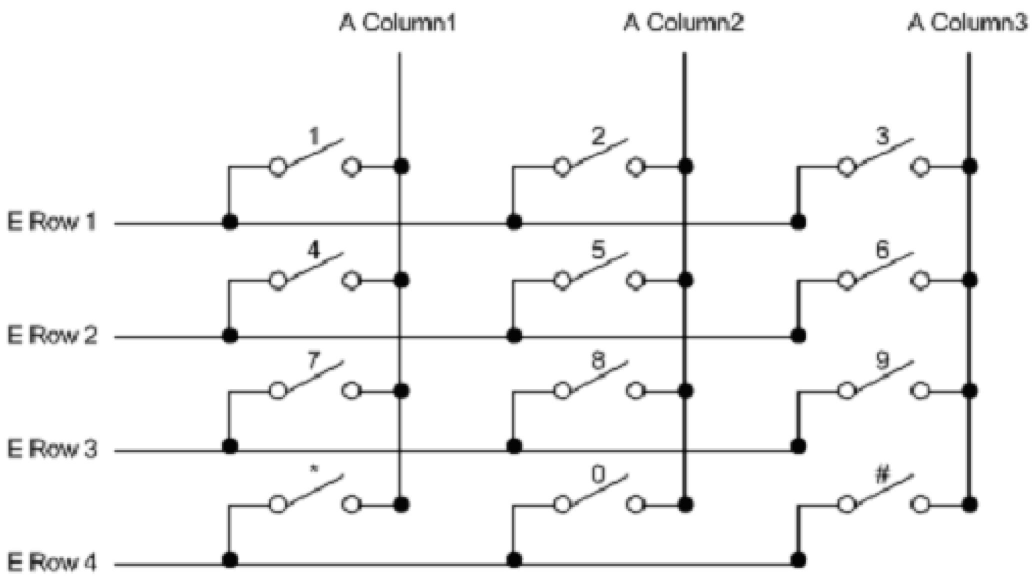
| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| TimeDebounce | CONSTANT | TIME | Time for debounce of the inputs.<br>Default: 100ms |
| TimeError | CONSTANT | TIME | Time for the duration of the error signal.<br>Default: 500ms |

### 7.3.5 FB 50 - KEYPAD2 - Keyboard

**Description**

This block is used to connect an external keypad (0...9,*,#) without an own power supply. The block provides output column signals. Depending on the pressed key, the keyboard provides the according row signals. The block evaluates the signals internally by means of a bit pattern table and transfers the determined ASCII code into the keyboard buffer. If necessary, or automatically the keyboard buffer is output as max. 16byte character string.

- Via *Row 1...4* the rows 1...4 of the keyboard matrix are connected.
- Via *Column 1...3* the columns 1...3 of the keyboard matrix are connected.
- Via *TimeDelay* you can specify a waiting time after setting the column outputs up to reading the corresponding row inputs. This time must be greater than the delay time of the used module.
- Via *ClearCode* you can specify a key code to clear the keyboard buffer.
- Via *EnterCode* you can specify a key code to output the keyboard buffer at *Output* for one cycle. During this time the output *Valid* is enabled.
- Via edge change 0-1 of *Clear* the keyboard buffer cleared.
- Via *TimeAutoClear* you specify the max. duration for pressing the keys. Otherwise the keyboard buffer is cleared.
- Via *CountCharAutoEnter* you can specify the number of characters, which are automatically output as keyboard buffer at *Output* for one cycle. During this time the output *Valid* is enabled.
- *Error* is activated for the time *TimeError* when a key is pressed, but the keyboard buffer is full.
- With *TimeDebounce* you can specify a debounce time for the input signals.



***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Row1 | INPUT | BOOL | Row 1 of the keyboard matrix.<br>Default: FALSE |
| Row2 | INPUT | BOOL | Row 2 of the keyboard matrix.<br>Default: FALSE |
| Row3 | INPUT | BOOL | Row 3 of the keyboard matrix.<br>Default: FALSE |
| Row4 | INPUT | BOOL | Row 4 of the keyboard matrix.<br>Default: FALSE |
| ClearCode | INPUT | BYTE | The value at which the keyboard buffer is to be cleared.<br>0: deactivated<br>Default: 42 = * |
| EnterCode | INPUT | BYTE | The value at which the keyboard buffer is to be output.<br>0: deactivated<br>Default: 35 = # |
| Clear | INPUT | BOOL | Edge change 0-1 clears the keyboard buffer.<br>Default: FALSE |
| TimeAutoClear | INPUT | TIME | Duration within a further key must be pressed. Otherwise the keyboard buffer is cleared.<br>0: Buffer is not cleared<br>Default: 10s |
| CountCharAutoEnter | INPUT | INT | Number of characters, which are automatically output as keyboard buffer.<br>0: deactivated<br>Default: 0 |
| Column1 | OUTPUT | BOOL | Column 1 of the keyboard matrix.<br>Default: FALSE |
| Column2 | OUTPUT | BOOL | Column 2 of the keyboard matrix.<br>Default: FALSE |
| Column3 | OUTPUT | BOOL | Column 3 of the keyboard matrix.<br>Default: FALSE |
| Output | OUTPUT | BYTE | Contents of the keyboard buffer as max. 16 byte string. |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| Valid | OUTPUT | BOOL | The static output indicates that the string at *Output* is valid. The signal is pending for one cycle. |
| Error | OUTPUT | BOOL | *Error* is activated for the time *TimeError* when a key is pressed, but the keyboard buffer is full. |
| TimeDebounce | CONSTANT | TIME | Time for debounce of the inputs.<br>Default: 100ms |
| TimeError | CONSTANT | TIME | Time for the duration of the error signal.<br>Default: 500ms |
| TimeDelay | CONSTANT | TIME | Duration after setting the column outputs up to reading the corresponding row inputs. This time must be greater than the delay time of the used module.<br>Default: 10ms |

# 8 Network Communication

## 8.1 Open Communication

### 8.1.1 Connection-oriented protocols

- Connection-oriented protocols establish a (logical) connection to the communication partner before data transmission is started. And if necessary they terminate the connection after the data transfer was finished.
- Connection-oriented protocols are used for data transmission when reliable, guaranteed delivery is of particular importance. Also the correct order of the received packets is ensured.
- In general, many logical connections can exist on one physical line.
- The following connection-oriented protocols are supported with FBs for open communication via industrial Ethernet:
  – TCP/IP native according to RFC 793 (connection types 01h and 11h)
  – ISO on TCP according to RFC 1006 connection type 12h)

**TCP native**

- During data transmission, no information about the length or about the start and end of a message is transmitted. However, the receiver has no means of detecting where one message ends in the data stream and the next one begins.
- The transfer is stream-oriented. For this reason, it is recommended that the data length of the FBs is identical for the sending and receiving station.
- If the number of received data does not fit to the preset length you either will get not the whole data, or you will get data of the following job.
- The receive block copies as many bytes into the receive area as you have specified as length. After this, it will set NDR to TRUE and write RCVD_LEN with the value of LEN. With each additional call, you will thus receive another block of sent data.

**ISO on TCP**

- During data transmission, information on the length and the end of the message is also transmitted. The transfer is block-oriented
- If you have specified the length of the data to be received greater than the length of the data to be sent, the receive block will copy the received data completely into the receive range. After this, it will set NDR to TRUE and write RCVD_LEN with the length of the sent data.
- If you have specified the length of the data to be received less than the length of the sent data, the receive block will not copy any data into the receive range but instead will supply the following error information: ERROR = 1, STATUS = 8088h.

### 8.1.2 Connection-less protocols

There is thus no establishment and termination of a connection with a remote partner. Connection-less protocols transmit data with no acknowledge and with no reliable guaranteed delivery to the remote partner. The following connection-oriented protocol is supported with FBs for open communication via Industrial Ethernet:

- UDP according to RFC 768 (with connection type 13h)

**UDP**

- In this case, when calling the sending block you have to specify the address parameters of the receiver (IP address and port number). During data transmission, information on the length and the end of the message is also transmitted.
- Analog after finishing the receive block you get a reference to the address parameter of the sender (IP address and port no.)
- In order to be able to use the sending and receiving blocks first you have to configure the local communications access point at both sides.

- With each new call of the sending block, you re-reference the remote partner by specifying its IP address and its port number.
- If you have specified the length of the data to be received greater than the length of the data to be sent, the receive block will copy the received data completely into the receive range. After this, it will set NDR to TRUE and write RCVD_LEN with the length of the sent data.
- If you have specified the length of the data to be received less than the length of the sent data, the receive block will not copy any data into the receive range but instead will supply the following error information: ERROR = 1, STATUS = 8088h.

### 8.1.3 FB 63 - TSEND - Sending data - TCP native and ISO on TCP

**Description**

- FB 63 TSEND Sends data over an editing communications connection. FB 63 TSEND is an asynchronously functioning FB, which means that its processing extends over several FB calls.
- To start sending data, call FB 63 with *REQ* = 1.
- The job status is indicated at the output parameters *BUSY* and *STATUS*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with Asynchronous SFCs).
- The following table shows the relationships between *BUSY*, *DONE* and *ERROR*. Using this table, you can determine the current status of FB 63 or when the establishment of the connection is complete.

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |
| FALSE | FALSE | TRUE | The job was ended with an error.<br>The cause of the error can be found in the STATUS parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

*Due to the asynchronous function of FB 63 TSEND, you must keep the data in the sender area consistent until the DONE parameter or the ERROR parameter assumes the value TRUE.*

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | Control parameter *REQ*, initiates terminating the connection specified by the *ID*. Initiation occurs at rising edge.<br>At the first call with *REQ* = 1, data are transmitted from the area specified by the *DATA* parameter. |
| ID | INPUT | WORD | M, D, constant | Reference to the connection to determinated. *ID* must be identical to the associated parameter *ID* in the local connection description.<br>Range of values: 0001h ... 0FFFh |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| LEN | INPUT | INT | I, Q, M, D, L | Number of bytes to be sent with the job<br>Range of values:<br>■ 1 ... 1460, if connection type = 01h<br>■ 1 ... 8192, if connection type = 11h<br>■ 1 ... 1452, if connection type = 12h and a CP is being used<br>■ 1 ... 8192, if connection type = 12h and no CP is being used |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | *DONE* status parameter:<br>■ 0: Job not yet started or still running.<br>■ 1: Job executed without error. |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed. A new job cannot be triggered.<br>■ *BUSY* = 0: Job is completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error. |
| STATUS | OUTPUT | WORD | M, D | *STATUS* parameter: Status information |
| DATA | IN_OUT | ANY | I, Q, M, D | Send area, contains address and length. The address refers to:<br>■ The process image input<br>■ The process image output<br>■ A bit memory<br>■ A data block<br>Allowed referenced data types: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TIME_OF_DAY, TIME, S5TIME, DATE_AND_TIME, STRING |

**Status information**

| ERROR | STATUS | Description |
|---|---|---|
| 0 | 0000h | Send job completed without error. |
| 0 | 7000h | First call with *REQ* = 0, sending not initiated. |
| 0 | 7001h | First call with *REQ* = 1, sending initiated. |
| 0 | 7002h | Follow-on call (REQ irrelevant ), job being processed<br>**Note**: during this processing the operating system accesses the data in the *DATA* send buffer. |
| 1 | 8085h | *LEN* parameter has the value 0 or is greater than the largest permitted value. |
| 1 | 8086h | The *ID* parameter is not in the permitted address range. |
| 0 | 8088h | LEN parameter is larger than the memory area specified in *DATA*. |
| 1 | 80A1h | Communications error:<br>■ FB 65 TCON was not yet called for the specified *ID*<br>■ The specified connection is currently being terminated. Transmission over this connection is not possible.<br>■ The interface is being reinitialized. |
| 1 | 80B3h | The parameter for the connection type (*connection_type* parameter in the connection description) is set to UDP.<br>Please use the FB 67 TUSEND. |
| 1 | 80C3h | The resources (memory) of the CPU are temporarily occupied. |
| 1 | 80C4h | Temporary communications error:<br>■ The connection to the communications partner cannot be established at this time.<br>■ The interface is receiving new parameters. |
| 1 | 8822h | *DATA* parameter: Source area invalid: area does not exist in DB. |
| 1 | 8824h | *DATA* parameter: Range error in ANY pointer. |
| 1 | 8832h | *DATA* parameter: DB number too large. |
| 1 | 883Ah | *DATA* parameter: Access to send buffer not possible<br>(e.g. due to deleted DB). |
| 1 | 887Fh | *DATA* parameter: Internal error, such as an invalid ANY reference. |
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 8.1.4 FB 64 - TRCV - Receiving Data - TCP native and ISO on TCP

**Description**

FB 64 TRCV receives data over an existing communication connection. The are two variants available for receiving and processing the data:

- Variant 1: Received data block is processed immediately.
- Variant 2: Received data block is stored in a receive buffer and is only processed when the buffer is full.

The following table shows the relationships between the connection type is shown in the following table:

| Connection type | Variant |
|---|---|
| 01h and 11h | The user can specify the variant. |
| 12h | Variant 2 (fix) |

The two variants are more described in the following table.

| Received Data ... | Range Values for *LEN* | Range Values for *RCVD_LEN* | Description |
|---|---|---|---|
| are available immediately. | 0 | 1 ... x | The data go into a buffer whose length x is specified in the ANY pointer of the receive buffer (*DATA* parameter).<br>After being received, a data block is immediately available in the receive buffer.<br>The amount of data received (*RCVD_LEN* parameter) can be no greater than the size specified in the *DATA* parameter. Receiving is indicated by *NDR* = 1. |
| are stored in the receive buffer. The data are available as soon as the configured length is reached. | 1 ... 1460, if the connection type = 01h<br>1 ... 8192, if the connection type = 11h<br>1 ... 1452, if the connection type = 12h and a CP is being used<br>1 ... 8192, if the connection type = 12h and no CP is being used | Same value as in the LEN parameter | The data go into a buffer whose length is specified by the LEN parameter. If this specified length is reached, the received data are made available in the *DATA* parameter<br>(*NDR* = 1). |

**Function**

- FB 64 TRCV is an asynchronously functioning FB, which means that its processing extends over several FB calls. To start receiving data, call FB 64 with *REQ* = 1.
- The job status is indicated at the output parameters *BUSY* and *STATUS*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with Asynchronous SFCs).
- The following table shows the relationships between *BUSY*, *DONE* and *ERROR*. Using this table, you can determine the current status of FB 64 or when the receiving process is complete.

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| FALSE | FALSE | TRUE | The job was ended with an error. The cause of the error can be found in the *STATUS* parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

*Due to the asynchronous function of FB 64 TRCV, the data in the receiver area are only consistent when the NDR parameter assumes the value TRUE.*

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | I, Q, M, D, L | With *EN_R* = 1, FB 64 TRCV is ready to receive (Control parameter). The receive job is processed. |
| ID | INPUT | WORD | M, D, constant | Reference to the connection to be terminated. *ID* must be identical to the associated parameter *id* in the local connection description.<br>Range of values: 0001h ... 0FFFh |
| LEN | INPUT | INT | I, Q, M, D, L | ■ *LEN* = 0 (ad hoc mode): use implied length specified in the ANY pointer for *DATA*. The received data are made available immediately when the block is called. The amount of data received is available in *RCVD_LEN*.<br>■ 1 ≤ LEN ≤ max: number of bytes to be received. The amount of data actually received is available in *RCVD_LEN*. The data are available after they have been completely received. "max" depends on the connection type:<br>– max = 1460 with connection type 01h<br>– max = 8192 with connection type 11h<br>– max = 1452 with connection type 12h with a CP<br>– max = 8192 with connection type 12h without a CP |
| NDR | OUTPUT | BOOL | I, Q, M, D, L | *NDR* status parameter:<br>■ *NDR* = 0: Job not yet started or still running.<br>■ *NDR* = 1: Job successfully completed |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed. A new job cannot be triggered.<br>■ *BUSY* = 0: Job is completed. |
| STATUS | OUTPUT | WORD | M, D | *STATUS* parameter: Status information |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| RCVD_LEN | OUTPUT | INT | I, Q, M, D, L | Amount of data actually received, in bytes |
| DATA | IN_OUT | ANY | I, Q, M, D | Receiving area (address and length)The address refers to:<br>■ The process image input<br>■ The process image output<br>■ A bit memory<br>■ A data block<br>Allowed referenced data types: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TIME_OF_DAY, TIME, S5TIME, DATE_AND_TIME, STRING |

**Status information**

| ERROR | STATUS | Description |
|---|---|---|
| 0 | 0000h | New data were accepted. The current length of the received data is shown in *RCVD_LEN*. |
| 0 | 7000h | First call with *REQ* = 0, receiving not initiated |
| 0 | 7001h | Block is ready to receive. Receiving job has been activated. |
| 0 | 7002h | Follow-on call, job being processed<br>**Note**: during this processing the operating system writes the operating system data to the *DATA* receive buffer. For this reason, an error could result in inconsistent data being in the receive buffer. |
| 1 | 8085h | *LEN* parameter is greater than the largest permitted value, or you changed the value of *LEN* from the one that existed during the first call |
| 1 | 8086h | The *ID* parameter is not in the permitted address range |
| 1 | 8088h | ■ Target buffer (*DATA*) is too small<br>value LEN is greater than the predetermined by *DATA*. Troubleshooting if the connection type = 12h:<br>Increase the destination buffer *DATA*. |
| 1 | 80A1h | Communications error:<br>■ FB 65 TCON was not yet called for the specified *ID*<br>■ The specified connection is currently being terminated. Receiving over this connection is not possible.<br>■ The interface is receiving new parameters. |
| 1 | 80B3h | The parameter for the connection type (*connection_type* parameter in the connection description) is set to UDP. Please use the FB 68 TRCV. |
| 1 | 80C3h | The operating resources (memory) in the CPU are temporarily occupied. |
| 1 | 80C4h | Temporary communications error: The connection is currently being terminated. |
| 1 | 8922h | *DATA* parameter: Target area invalid: area does not exist in DB. |
| 1 | 8924h | *DATA* parameter: Range error in ANY pointer |
| 1 | 8932h | *DATA* parameter: DB number too large. |
| 1 | 893Ah | *DATA* parameter: Access to receive buffer not possible (e.g. due to deleted DB) |
| 1 | 897Fh | *DATA* parameter: Internal error, such as an invalid ANY reference |

| ERROR | STATUS | Description |
|---|---|---|
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 8.1.5 FB 65 - TCON - Establishing a connection

**Use with TCP native and ISO on TCP**

Both communications partners call FB 65 TCON to establish the communications connection. In the parameters you specify which partner is the active communications transmission point and which is the passive one. For information on the number of possible connections, please refer to the technical data for your CPU. After the connection is established, it is automatically monitored and maintained by the CPU. If the connection is interrupted, such as due a line break or due to the remote communications partner, the active partner attempts to reestablish the connection. In this case, you do not have to call FB 65 TCON again. An existing connection is terminated when FB 66 TDISCON is called or when the CPU has gone into STOP mode. To reestablish the connection, you will have to call FB 65 TCON again.

**Use with UDP**

Both communications partner call FB 65 TCON in order to configure their local communications access point. A connection is configured between the user program and the communications level of the operating system. No connection is established to the remote partner. The local access point is used to send and receive UDP message frames.

**Description**

FB 65 TCON is an asynchronously functioning FB, which means that its processing extends over several FB calls. To start establishing a connection, call FB 65 with REQ = 1. The job status is indicated at the output parameters *RET_VAL* and *BUSY*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with asynchronous SFCs). The following table shows the relationships between BUSY, DONE and ERROR. Using this table, you can determine the current status of FB 65 or when the establishment of the connection is complete.

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |
| FALSE | FALSE | TRUE | The job was ended with an error. The cause of the error can be found in the *STATUS* parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | Control parameter *REQ*, initiates establishing the connection at rising edge. |
| ID | INPUT | WORD | M, D,<br>constant | Reference to the connection to be established to the remote partner or between the user program and the communications level of the operating system. ID must be identical to the associated parameter ID in the local connection description. Range of values: 0001h ... 0FFFh |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | *DONE* status parameter:<br>■ 0: Job not yet started or still running.<br>■ 1: Job executed without error. |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed.<br>■ *BUSY* = 0: Job is completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error. |
| STATUS | OUTPUT | WORD | M, D | *STATUS* status parameter:<br>Error information |
| CONNECT | IN_OUT | ANY | D | Pointer to the associated connection description.<br>*Chapter 8.1.6 'UDT 65 - TCON_PAR Data structure for FB 65' on page 122* |

**Status information**

| ERROR | STATUS | Explanation |
|---|---|---|
| 0 | 0000h | Connection is able to be established |
| 0 | 7000h | Call with *REQ* = 0, establishment of connection not initiated |
| 0 | 7001h | First call with *REQ* = 1, connection being established |
| 0 | 7002h | Follow-on call (*REQ* irrelevant), connection being established |
| 1 | 8086h | The ID parameter must not have value of zero. |
| 0 | 8087h | Maximal number of connections reached; no additional connection possible |
| 1 | 8089h | The *CONNECT* parameter does not point to a data block. |
| 1 | 809Ah | The *CONNECT* parameter points to a field that does not have the length of the data structure for assigning connection (UDT 65). |
| 1 | 809Bh | The communication interface specified via *local_device_id* and *next_staddr* is not supported by the CPU. |
| 1 | 80A1h | Connection or port is already occupied by the user. |
| 1 | 80A2h | Local or remote port is occupied by the system. |
| 1 | 80A3h | Attempt being made to re-establish an existing connection. |
| 1 | 80A4h | IP address of the remote connection endpoint is invalid. |

| ERROR | STATUS | Explanation |
|---|---|---|
| 1 | 80A7h | Communications error: you have called TDISCON before TCON was complete. TDISCON must first complexly terminate the connection referenced by the ID. |
| 1 | 80B4h | In the ISO on TCP protocol, one or more of the following conditions have been violated during passive connection setup:<br>■ *local_tsap_id_len* ≥ 02h<br>■ *local_tsap_id*[1] = E0h at *local_tsap_id_len* = 02h<br>■ *local_tsap_id*[1] an ASCII character *local_tsap_id_len* ≥ 03h<br>■ *local_tsap_id*[1] is an ASCII character and *local_tsap_id_len* ≥ 03h |
| 1 | 80B5h | Parameter active_est (UDT 65) is TRUE with the protocol variant UDP. |
| 1 | 80B7h | Error in one of the following parameters of UDT 65:<br>■ block_length<br>■ local_tsap_id_len<br>■ rem_subnet_id_len<br>■ rem_staddr_len<br>■ rem_tsap_id_len<br>■ next_staddr_len |
| 1 | 80B8h | Parameters *id* in the local connection description (UDT 65) and parameter ID are different. |
| 1 | 80C3h | Temporary lack of resources in the CPU. |
| 1 | 80C4h | Temporary communications error:<br>■ The connection cannot be established at this time.<br>■ The interface is receiving new parameters. |
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 8.1.6 UDT 65 - TCON_PAR Data structure for FB 65

### 8.1.6.1 Data structure for assigning connection

In the TCP Connection parameterization of native or ISO on TCP, you define which communication partners enabled the connection and which to a request through the communication partner performs a passive connection. If both communication partners have launched their connection, the operating system can restore the communication link. To communicate a DB is needed. Facility whereby the DB's data structure from the UDT 65 TCON_PAR. For each connection such a data structure is needed that can be summarized in a global DB. The CONNECT connection parameter address of FB 65 TCON contains a reference to the associated connection description (e.g. P#DB10.DBX0.0 byte 64).

**Data structure**

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 0 ... 1 | block_length | WORD | 40h | Length of UDT 65: 64 Bytes (fixed) |
| 2 ... 3 | id | WORD | 0000h | ■ Reference to the connection (range of values: 0001h ... 0FFFh)<br>■ You must specify the value of the parameter in the respective block with *ID*. |
| 4 | connection _type | BYTE | 01h | Connection type:<br>■ 11h: TCP/IP native<br>■ 12h: ISO on TCP<br>■ 13h: UDP<br>■ 01h: TCP/IP native (Compatibility mode) |
| 5 | active_est | BOOL | FALSE | ID for the way the connection is established:<br>TCP, TCP, IoT:<br>■ FALSE: passive establishment<br>■ TRUE: active establishment<br>UDP:<br>■ FALSE |
| 6 | local_device_id | BYTE | 02h | Communicaton device<br>■ 00h: Ethernet PG/OP channel of the CPU<br>■ 02h: Ethernet CP of the CPU |
| 7 | local_tsap_id_len | BYTE | 02h | Length of parameter *local_tsap_id* used; possible values:<br>TCP<br>■ Active side: 0 (dynamic port) or 2<br>■ Passive side: 2<br>ISO on TCP<br>■ 2 ... 16<br>UDP<br>■ 2<br>TCP<br>■ Active side: 0<br>■ Passive side: 2 |
| 8 | rem_subnet_id_len | BYTE | 00h | This parameter is currently not used. You must assign 00h to it. |
| 9 | rem_staddr_len | BYTE | 00h | Length of address for the remote connection transmission point:<br>TCP/ISO on TCP/TCP (Comp.)<br>■ 0: unspecified, i.e. parameter *rem_staddr* is irrelevant.<br>4: valid IP address in the parameter *rem_staddr*<br>UDP<br>■ 0* |

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 10 | rem_tsap_id_len | BYTE | 00h | Length of parameter *rem_tsap_id* used; possible values:<br>TCP<br>■ Active side: 2 (The port must be specified.)<br>■ Passive side: 0 or 2<br>ISO on TCP<br>■ 0 or 2 ... 16<br>UDP<br>■ This parameter is not used. Assign parameter to 00h.<br>TCP (Comp.)<br>■ Active side: 2 (The port must be specified.) For the passive side, only the value 00h permitted. |
| 11 | next_staddr_len | BYTE | 00h | Length of parameter *next_staddr* used<br>■ 00h: Ethernet CP of the CPU<br>■ 01h: Ethernet PG/OP channel of the CPU |
| 12 ... 27 | local_tsap_id | ARRAY [1..16] of BYTE | 00h ... | With *connection_type*<br>TCP, UDP<br>■ local_tsap_id[1] = high byte of port number in hexadecimal representation<br>■ local_tsap_id[2] = low byte of port number in hexadecimal representation<br>■ local_tsap_id[3-16] = 00h<br>ISO on TCP<br>■ local TSAP-ID (possible values: 2000 ... 5000)<br>– local_tsap_id[1] = E0h (connection type T-connection)<br>– local_tsap_id[2] = Rack and slot in own CPU (bits 0 ... 4 slot, bits 5 ... 7: rack number)<br>– local_tsap_id[3-16] = TSAP extension<br>TCP (Comp.)<br>■ local_tsap_id[1] = low byte of port number in hexadecimal representation<br>■ local_tsap_id[2] = high byte of port number in hexadecimal representation<br>■ local_tsap_id[3-16] = 00h<br>**Note:** Make sure that each value of *local_tsap_id* that you use in your CPU is unique. |
| 28 ... 33 | rem_subnet_id | ARRAY [1..6] of BYTE | 00h ... | This parameter is currently not used. You must assign 00h to it. |

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 34 ... 39 | rem_staddr | ARRAY [1..6] of BYTE | 00h ... | IP address for the remote connection transmission point: e.g. 192.168.002.003: With *connection_type*<br>■ TCP / ISO on TCP<br>– rem_staddr[1] = C0h (192)<br>– rem_staddr[2] = A8h (168)<br>– rem_staddr[3] = 02h (002)<br>– rem_staddr[4] = 03h (003)<br>– rem_staddr[5-6] = irrelevant<br>■ UDP<br>– This parameter is not used. Assign parameter to 00h.<br>■ TCP (Komp.)<br>– rem_staddr[1] = 03h (003)<br>– rem_staddr[2] = 02h (002)<br>– rem_staddr[3] = A8h (168)<br>– rem_staddr[4] = C0h (192)<br>– rem_staddr[5-6] = irrelevant |
| 40 ... 55 | rem_tsap_id | ARRAY [1..16] of BYTE | 00h ... | With *connection_type*<br>■ TCP: remote port number (possible values: 2000 ... 5000)<br>– rem_tsap_id[1] = high byte of port no in hexadecimal representation<br>– rem_tsap_id[2] = low byte of port no in hexadecimal representation<br>– rem_tsap_id[3-16] = 00h<br>■ ISO on TCP: remote TSAP-ID:<br>– rem_tsap_id[1] = E0h (connection type T-connection)<br>– rem_tsap_id[2] = Rack and slot for the remote connection transmission point CPU (bits 0 ... 4: slot, bits 5 ... 7: rack number),<br>– rem_tsap_id[3-16] = TSAP extension<br>■ UDP<br>This parameter is not used. Assign parameter to 00h<br>■ 01h: remote port number (possible values: 2000 ... 5000)<br>– local_tsap_id[1] = low byte of port number in hexadecimal representation<br>– local_tsap_id[2] = high byte of port number in hexadecimal representation<br>– local_tsap_id[3-16] = 00h |
| 56 ... 61 | next_staddr | ARRAY [1..6] of BYTE | 00h ... | Rack and slot of the configured CP for the PG/OP interface<br>■ 00h (Ethernet P/OP channel)<br>– next_staddr[1]: 04h<br>– next_staddr[2-6]: 00h<br>■ 02h (Ethernet CP)<br>– next_staddr[1-6]: 00h |

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 62 ... 63 | spare | WORD | 0000h | irrelevant |
| *) The partner IP address is specified by calling the TUSEND/TURECV parameter via the *ADDR* parameter. | | | | |

### 8.1.6.2 Data structure for communications access point

A communications access point provides the link between application of the communication layer of the operating system. Defined for communication over UDP, each communication partner a communication access point using a DB. Facility whereby the DB's data structure from the UDT 65 "TCON_PAR".

**Data structure**

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 0 ... 1 | block_length | WORD | 40h | Length of UDT 65: 64 Bytes (fixed) |
| 2 ... 3 | id | WORD | 0000h | ■ Reference to this connection between the user program and the communications level of the operating system (range of values: 0001h ... 0FFFh)<br>■ You must specify the value of the parameter in the respective block with the ID. |
| 4 | connection_type | BYTE | 01h | Connection type:<br>■ 13h: UDP |
| 5 | active_est | BOOL | FALSE | ID for the way the connection is established: You must assign FALSE to this parameter since the communications access point can be used to both send and receive data. |
| 6 | local_device_id | BYTE | 02h | Communicaton device<br>■ 00h: Ethernet PG/OP channel of the CPU<br>■ 02h: Ethernet CP of the CPU |
| 7 | local_tsap_id_len | BYTE | 02h | Length of parameter local_tsap_id used; possible value: 2 |
| 8 | rem_subnet_id_len | BYTE | 00h | This parameter is currently not used. Value 00h (fix). |
| 9 | rem_staddr_len | BYTE | 00h | This parameter is currently not used. Value 00h (fix). |
| 10 | rem_tsap_id_len | BYTE | 00h | This parameter is currently not used. Value 00h (fix). |
| 11 | next_staddr_len | BYTE | 00h | This parameter is currently not used. Value 00h (fix). |

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 12 ... 27 | local_tsap_id | ARRAY [1..16] of BYTE | 00h ... | ■ Remote port no. (possible values: 2000 ... 5000), local_tsap_id[1] = high byte of port no in hexadecimal representation, local_tsap_id[2] = low byte of port no in hexadecimal representation, local_tsap_id[3-16] = irrelevant<br>**Note:** Make sure that each value of *local_tsap_id* that you use in your CPU is unique. |
| 28 ... 33 | rem_subnet_id | ARRAY [1..6] of BYTE | 00h ... | This parameter is currently not used. Value 00h (fix). |
| 34 ... 39 | rem_staddr | ARRAY [1..6] of BYTE | 00h ... | This parameter is currently not used. Value 00h (fix). |
| 40 ... 55 | rem_tsap_id | ARRAY [1..16] of BYTE | 00h ... | This parameter is currently not used. Value 00h (fix). |
| 56 ... 61 | next_staddr | ARRAY [1..6] of BYTE | 00h ... | This parameter is currently not used. Value 00h (fix). |
| 62 ... 63 | spare | WORD | 0000h | irrelevant |

### 8.1.7 FB 66 - TDISCON - Terminating a connection

**Use with TCP native and ISO on TCP**

FB 66 TDISCON terminates a communications connection from the CPU to a communications partner.

**Use with UDP**

The FB 66 TDISCON closes the local communications access point. The connection between the user program and the communications level of the operating system is terminated.

**Description**

FB 66 TDISCON is an asynchronously functioning FB, which means that its processing extends over several FB calls. To start terminating a connection, call FB 66 with REQ = 1.

After FB 66 TDISCON has been successfully called, the ID specified for FB 65 TCON is no longer valid and thus cannot be used for sending or receiving.

The job status is indicated at the output parameters *RET_VAL* and *BUSY*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters REQ, RET_VAL and *BUSY* with asynchronous SFCs).

The following table shows the relationships between *BUSY*, *DONE* and *ERROR*. Using this table, you can determine the current status of FB 66 or when the establishment of the connection is complete.

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| FALSE | FALSE | TRUE | The job was ended with an error.<br>The cause of the error can be found in the *STATUS* parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | Control parameter *REQ*, initiates terminating the connection specified by the *ID*. Initiation occurs at rising edge. |
| ID | INPUT | WORD | M, D, constant | Reference to the connection to be terminated to the remote partner or between the user program and the communications level of the operating system. *ID* must be identical to the associated parameter *ID* in the local connection description.<br>Range of values: 0001h ... 0FFFh |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | *DONE* status parameter:<br>■ 0: Job not yet started or still running.<br>■ 1: Job executed without error. |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed<br>■ *BUSY* = 0: Job is completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | ERROR status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error. |
| STATUS | OUTPUT | WORD | M, D | *STATUS* parameter: Status information |

**Status information**

| ERROR | STATUS | Explanation |
|---|---|---|
| 0 | 0000h | Connection is terminated |
| 0 | 7000h | First call with *REQ* = 0, establishment of connection not initiated |
| 0 | 7001h | First call with *REQ* = 1, start of the processing, connection being terminated |
| 0 | 7002h | Follow-on call (*REQ* irrelevant ), connection being terminated |
| 1 | 8086h | The ID parameter is not in the permitted address range |
| 1 | 80A3h | Attempt being made to terminate a non-existent connection |
| 1 | 80C4h | Temporary communications error: The interface is receiving new parameters. |
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 8.1.8 FB 67 - TUSEND - Sending data - UDP

**Description**

FB 67 TUSEND sends data via UDP to the remote partner specified by the parameter *ADDR*.

*When sending separate data in sequence to different partners, you only need to adjust the parameter ADDR when calling FB 67 TUSEND. It is not necessary to call FB 65 TCON and FB 66 TDISCON again.*

**Function**

- FB 67 TUSEND is an asynchronously functioning FB, which means that its processing extends over several FB calls. To start sending data, call FB 67 with *REQ* = 1.
- The job status is indicated at the output parameters *BUSY* and *STATUS*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with asynchronous SFCs).
- The following table shows the relationships between *BUSY*, *DONE* and *ERROR*. Using this table, you can determine the current status of FB 67 or when the sending process (transmission) is complete.

| BUSY | DONE | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |
| FALSE | FALSE | TRUE | The job was ended with an error.<br>The cause of the error can be found in the *STATUS* parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

*Due to the asynchronous function of FB 67 TUSEND, you must keep the data in the sender area consistent until the DONE parameter or the ERROR parameter assumes the value TRUE.*

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | Control parameter *REQ*, initiates the transmission at rising edge.<br>At the first call with *REQ* = 1, bytes are transmitted from the area specified by the *DATA* parameter. |
| ID | INPUT | WORD | M, D,<br>constant | Reference to the associated connection between the user program and the communication level of the operating system.<br>*ID* must be identical to the associated parameter *ID* in the local connection description.<br>Range of values: 0001h ... 0FFFh |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| LEN | INPUT | INT | I, Q, M, D, L | Number of bytes to be sent with the job:<br>Range of values: 1 ... 1460 |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | *DONE* status parameter:<br>■ 0: Job not yet started or still running<br>■ 1: Job executed without error. |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed. A new job cannot be triggered.<br>■ *BUSY* = 0: Job is completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | ERROR status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error |
| STATUS | OUTPUT | WORD | M, D | *STATUS* parameter:<br>Error information |
| DATA | IN_OUT | ANY | I, Q, M, D | Sender area, contains address and length<br>The address refers to:<br>■ The process image input table<br>■ The process image output table<br>■ A bit memory<br>■ A data block<br>Allowed referenced data types: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TIME_OF_DAY, TIME, S5TIME, DATE_AND_TIME, STRING |
| ADDR | IN_OUT | ANY | D | Pointer to the address of the receiver (e.g. P#DB100. DBX0.0 byte 8), see Structure of the Address Information for the Remote Partner with UDP. |

**Error information**

| ERROR | STATUS | Description |
|---|---|---|
| 0 | 0000h | Send job completed without error. |
| 0 | 7000h | First call with *REQ* = 1, sending not initiated. |
| 0 | 7001h | First call with *REQ* = 1, sending initiated. |
| 0 | 7002h | Follow-on call (*REQ* irrelevant), job being processed<br>**Note**: during this processing the operating system accesses the data in the *DATA* send buffer. |
| 1 | 8085h | *LEN* parameter has the value 0 or is greater than the largest permitted value. |
| 1 | 8086h | The *ID* parameter is not in the permitted address range. |
| 0 | 8088h | *LEN* parameter is larger than the memory area specified in *DATA*. |

| ERROR | STATUS | Description |
|---|---|---|
| 1 | 80A1h | Communications error:<br>■ FB 65 TCON was not yet called for the specified *ID*<br>■ The specified connection between the user program and the communication level of the operating system is currently being terminated. Transmission over this connection is not possible.<br>■ The interface is being reinitialized (receiving new parameters). |
| 1 | 80B3h | ■ The parameter for the connection type (connection_type parameter in the connection description) is not set to UDP.<br>Please use the FB 63 TSEND.<br>■ Parameter *ADDR*: invalid port number or IP address. |
| 1 | 80B7h | Length error: The parameter *ADDR* is the length specification < 8byte. |
| 1 | 80C4h | Temporary communications error:<br>■ The communication partner is currently not available.<br>■ The connection is currently being configured (or TCON is still running). |
| 1 | 8822h | *DATA* parameter: Source area invalid: area does not exist in DB. |
| 1 | 8824h | *DATA* parameter: Range error in ANY pointer. |
| 1 | 8832h | *DATA* parameter: DB number too large. |
| 1 | 883Ah | *DATA* parameter: Access to send buffer not possible<br>(e.g. due to deleted DB). |
| 1 | 887Fh | *DATA* parameter: Internal error, e.g. an invalid ANY reference. |
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 8.1.9 FB 68 - TURCV - Receiving data - UDP

**Description**

- FB 68 TURCV receives data via UDP. After successful completion of FB 68 TURCV the parameter ADDR will show you the address of the remote partner (the sender).
- FB 68 TURCV is an asynchronously functioning FB, which means that its processing extends over several FB calls. To start sending data, call FB 68 with *REQ* = 1.
- The job status is indicated at the output parameters *RET_VAL* and *BUSY*. *STATUS* corresponds to the *RET_VAL* output parameter of asynchronously functioning SFCs (see also Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with asynchronous SFCs).
- The following table shows the relationships between *BUSY*, *NDR* and *ERROR*. Using this table, you can determine the current status of FB 68 or when the receiving process is complete.

| BUSY | NDR | ERROR | Description |
|---|---|---|---|
| TRUE | irrelevant | irrelevant | The job is being processed. |
| FALSE | TRUE | FALSE | The job was completed successfully. |
| FALSE | FALSE | TRUE | The job was ended with an error. The cause of the error can be found in the *STATUS* parameter. |
| FALSE | FALSE | FALSE | The FB was not assigned a (new) job. |

*Due to the asynchronous function of FB 68 TURCV, the data in the receiver area are only consistent when the NDR parameter assumes the value TRUE.*

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | I, Q, M, D, L | Control parameter enabled to receive: when *EN_R* = 1, FB 68 TURCV is ready to receive. |
| ID | INPUT | WORD | M, D, constant | Reference to the associated connection between the user program and the communication level of the operating system.<br>*ID* must be identical to the associated parameter *ID* in the local connection description.<br>Range of values: 0001h ... 0FFFh |
| LEN | INPUT | INT | I, Q, M, D, L | 1 ≤ *LEN* ≤ 1472: number of bytes to be received.<br>The received data are immediately available when the block is called.<br>The amount of data received is available in *RCVD_LEN*. |
| NDR | OUTPUT | BOOL | I, Q, M, D, L | NDR status parameter:<br>■ *NDR* = 0: Job not yet started or still running.<br>■ *NDR* = 1: Job successfully completed |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter:<br>■ *ERROR* = 1: Error occurred during processing. *STATUS* provides detailed information on the type of error |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | ■ *BUSY* = 1: Job is not yet completed. A new job cannot be triggered.<br>■ *BUSY* = 0: Job is completed. |
| STATUS | OUTPUT | WORD | M, D | Status parameter:<br>Error information |
| RCVD_LEN | OUTPUT | INT | I, Q, M, D, L | Amount of data actually received, in bytes |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DATA | IN_OUT | ANY | I, Q, M, D | Receiver area, contains address and length<br>The address refers to:<br>■ The process image input table<br>■ The process image output table<br>■ A bit memory<br>■ A data block<br>Allowed referenced data types: BOOL, BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TIME_OF_DAY, TIME, S5TIME, DATE_AND_TIME, STRING |
| ADDR | IN_OUT | ANY | D | Pointer to the address of the sender<br>(e.g. P#DB100.DBX0.0 byte 8), see Structure of the Address Information for the Remote Partner with UDP |

**Error information**

| ERROR | STATUS | Explanation |
|---|---|---|
| 0 | 0000h | New data were accepted. The current length of the received data is shown in *RCVD_LEN*. |
| 0 | 7000h | First call with *REQ* = 0, receiving not initiated |
| 0 | 7001h | Block is ready to receive. |
| 0 | 7002h | Follow-on call, job being processed<br>**Note**: during this processing the operating system writes the operating system data to the *DATA* receive buffer. For this reason, an error could result in inconsistent data being in the receive buffer. |
| 1 | 8085h | *LEN* parameter is greater than the largest permitted value, or you changed the value of *LEN* from the one that existed during the first call |
| 1 | 8086h | The *ID* parameter is not in the permitted address range |
| 1 | 8088h | ■ Target buffer (*DATA*) is too small.<br>■ The value in *LEN* is greater than the receiver area specified by *DATA*. |
| 1 | 80A1h | Communications error:<br>■ FB 65 TCON was not yet called for the specified *ID*<br>■ The specified connection between the user program and the communication level of the operating system is currently being terminated. Receiving over this connection is not possible.<br>■ The interface is being reinitialized (receiving new parameters). |
| 1 | 80B3h | The parameter for the connection type (connection_type parameter in the connection description) is not set to UDP.<br>Please use the FB 64 TRCV. |
| 1 | 80B7h | Length error: The parameter *ADDR* is the length specification < 8byte. |
| 1 | 80C4h | Temporary communications error:<br>■ The connection is currently being configured (or TCON is still running). |
| 1 | 8922h | *DATA* parameter: Target area invalid: area does not exist in DB. |

| ERROR | STATUS | Explanation |
|---|---|---|
| 1 | 8924h | *DATA* parameter: Range error in ANY pointer |
| 1 | 8932h | *DATA* parameter: DB number too large. |
| 1 | 893Ah | *DATA* parameter: Access to receive buffer not possible (e.g. deleted DB) |
| 1 | 897Fh | *DATA* parameter: Internal error, such as an invalid ANY reference |
| 1 | 8F7Fh | Internal Error (VIPA specific) |
| 1 | 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 8.1.10 UDT 66 - TADDR_PAR Data structure

### 8.1.10.1 Data structure for assigning connection

**Description**

- With FB 67 TUSEND, at the parameter *ADDR* you transfer the address of the receiver. This address information must have structure specified below.
- With FB 68 TURCV, in the parameter *ADDR* you get the address of the sender of the data that were received. This address information must have structure specified below.

**Data block**

You have to create an DB that contains one or more data structures as per UDT 66 TADDR_PAR.

In parameter *ADDR* of FB 67 TUSEND you transfer and in parameter *ADDR* of FB 68 TURCV you receive a pointer to the address of the associated remote partner (e.g. P#DB10.DBX0.0 byte 8).

**Structure of the address information for the remote partner**

| Byte | Parameter | Data type | Start value | Description |
|---|---|---|---|---|
| 0 ... 3 | rem_ip_addr | ARRAY [1..4] of BYTE | 00h ... | IP address of the remote partner, e.g. 192.168.002.003:<br>■ rem_ip_addr[1] = C0h (192)<br>■ rem_ip_addr[2] = A8h (168)<br>■ rem_ip_addr[3] = 02h (002)<br>■ rem_ip_addr[4] = 03h (003) |
| 4 ... 5 | rem_port_nr | ARRAY [1..2] of BYTE | 00h ... | remote port number<br>(possible values: 2000 ... 5000)<br>■ rem_port_nr[1] = high byte of port number in hexadecimal representation<br>■ rem_port_nr[2] = low byte of port number in hexadecimal representation |
| 6 ... 7 | spare | ARRAY [1..2] of BYTE | 00h ... | reserved (00h) |

## 8.2 Ethernet Communication

### 8.2.1 Communication - FC 5...6 for CP 343

The two blocks are used to process connection requests on the PLC side of an Ethernet CP 343. Through integration of these blocks in the cycle block OB1 you may cyclically send and receive data. Within these blocks, the SFCs 205 and 206 are called that are stored as special function blocks in the CPU.

*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 adaptation. 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 Ethernet-CP 343, 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 PI, bit memory or data block area. When the data area has been transferred without errors, "job 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 PI, bit memory or data block area. When the data area has been transferred without errors, "job 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 OB 1 res. event controlled.

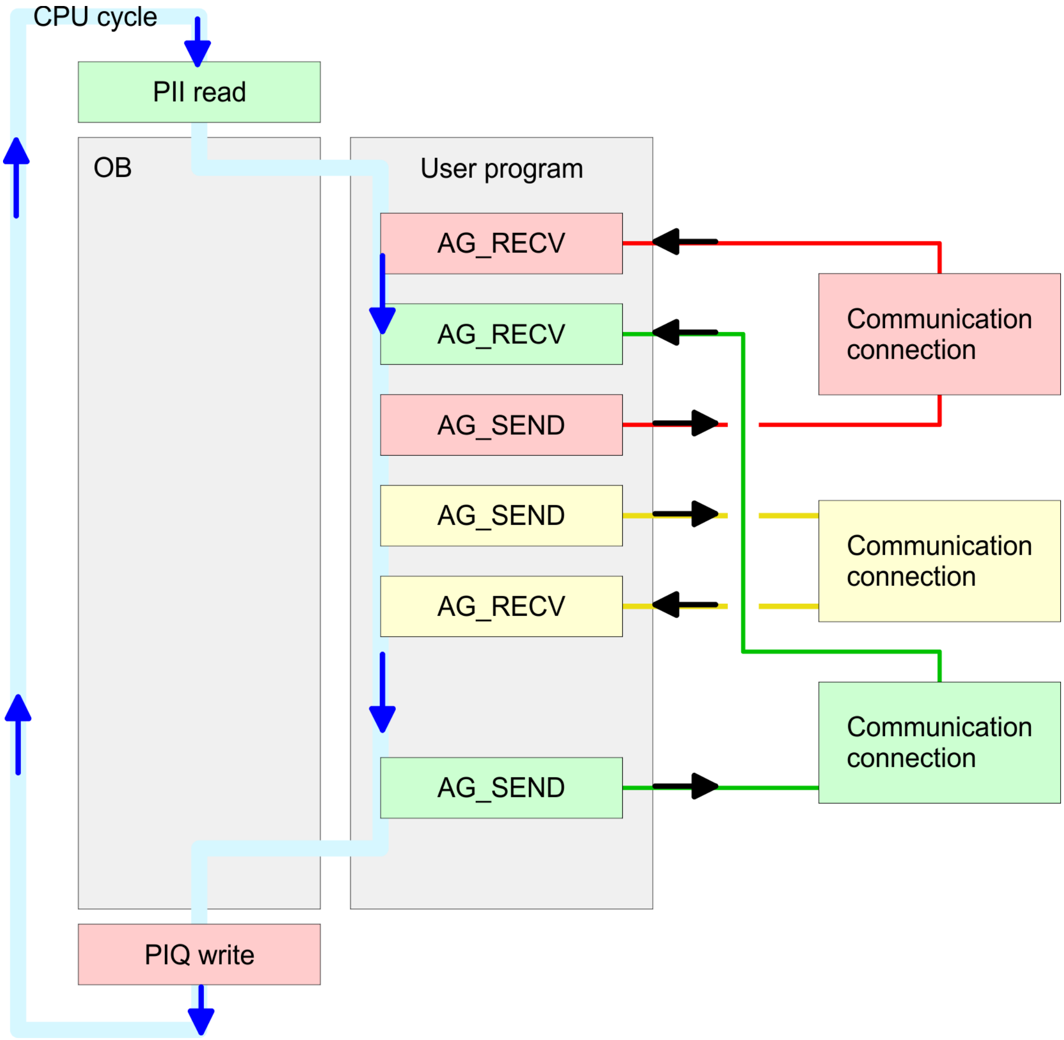
***FC call is faster than CP transfer time***

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 job 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 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 grouped 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.

### 8.2.2 FC 5 - AG_SEND - send to CP 343

By means of AG_SEND the data to send are transferred from the CPU to an Ethernet CP.

*Please note that this block calls the FC or SFC 205 AG_SEND internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

***Parameter***

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| ACT | INPUT | BOOL | Activation of the sender<br>0: Updates *DONE, ERROR* and *STATUS*<br>1: The data area defined in *SEND* with the length *LEN* is send |
| ID | INPUT | INT | Connection number 1 ... 16<br>(identical with *ID* of NetPro) |
| LADDR | INPUT | WORD | Logical basic address of the CP<br>(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 job<br>0: Job running<br>1: Job finished without error. |
| ERROR | OUTPUT | BOOL | Error message<br>0: Job running (at *DONE* = 0)<br>0: Job ready without error (at *DONE* = 1)<br>1: Job ready with error |
| STATUS | OUTPUT | WORD | Status message returned with *DONE* and *ERROR*. More details are to be found in the following table. |

**DONE, ERROR, STATUS**

The following table shows all messages that can be returned by the Ethernet CP after a SEND res. RECV job. A "-" means that this message is not available for the concerning SEND res. RECV command.

| DONE (SEND) | NDR (RECV) | ERROR | STATUS | Description |
|---|---|---|---|---|
| 1 | - | 0 | 0000h | Job finished without error. |
| - | 1 | 0 | 0000h | New data taken without error. |
| 0 | - | 0 | 0000h | There is no job being executed |
| - | 0 | 0 | 8180h | No data available yet. |
| 0 | 0 | 0 | 8181h | Job running |
| 0 | 0 | 1 | 8183h | No CP project engineering for this job. |
| 0 | - | 1 | 8184h | System error occurred |
| - | 0 | 1 | 8184h | System error occurred<br>(source 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). |

| DONE (SEND) | NDR (RECV) | ERROR | STATUS | Description |
|---|---|---|---|---|
| 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 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) |
| 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 from module. |
| 0 | 0 | 1 | 80A4h | reserved |
| 0 | 0 | 1 | 80B0h | Module doesn't recognize the record set. |
| 0 | 0 | 1 | 80B1h | The length setting (in parameter *LEN*) is invalid. |

| DONE (SEND) | NDR (RECV) | ERROR | STATUS | Description |
|---|---|---|---|---|
| 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 | There is a job jam. |
| 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)

### 8.2.3 FC 6 - AG_RECV - receive von CP 343

With the 1. call of AG_RECV a receive buffer for the communication between CPU and an Ethernet CP 343 is established. From now on received data are automatically stored in this buffer. As soon as after calling AG_RECV the return value of *NDR* = 1 is returned, valid data are present. Since with a further call of AG_RECV the receive buffer is established again for the receipt of new data, you have to save the previous received data.

*Please note that this block calls the FC or SFC 206 AG_RECV internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

***Parameter***

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| ID | INPUT | INT | Connection number 1 ... 16<br>(identical with *ID* of NetPro) |
| LADDR | INPUT | WORD | Logische Basisadresse des CPs<br>(identisch mit *LADDR* aus NetPro) |
| RECV | INPUT | ANY | Data area for the received data. |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| NDR | OUTPUT | BOOL | Status parameter for the order<br>0: Order running<br>1: Order ready data received without error |
| ERROR | OUTPUT | BOOL | Error message<br>0: Order running (at *NDR* = 0)<br>0: Order ready without error (at *NDR* = 1)<br>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 after a SEND res. RECV job. A "-" means that this message is not available for the concerning SEND res. RECV command.

| DONE (SEND) | NDR (RECV) | ERROR | STATUS | Description |
|---|---|---|---|---|
| 1 | - | 0 | 0000h | Job finished without error. |
| - | 1 | 0 | 0000h | New data taken without error. |
| 0 | - | 0 | 0000h | There is no job being executed |
| - | 0 | 0 | 8180h | No data available yet. |
| 0 | 0 | 0 | 8181h | Job running |
| 0 | 0 | 1 | 8183h | No CP project engineering for this job. |
| 0 | - | 1 | 8184h | System error occurred |
| - | 0 | 1 | 8184h | System error occurred<br>(source 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. |

| DONE (SEND) | NDR (RECV) | ERROR | STATUS | Description |
|---|---|---|---|---|
| 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 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) |
| 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 from module. |
| 0 | 0 | 1 | 80A4h | reserved |
| 0 | 0 | 1 | 80B0h | Module doesn’t recognize the 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 | There is a job jam. |
| 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)

### 8.2.4 FC 10 - AG_CNTRL - Control CP 343

**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:

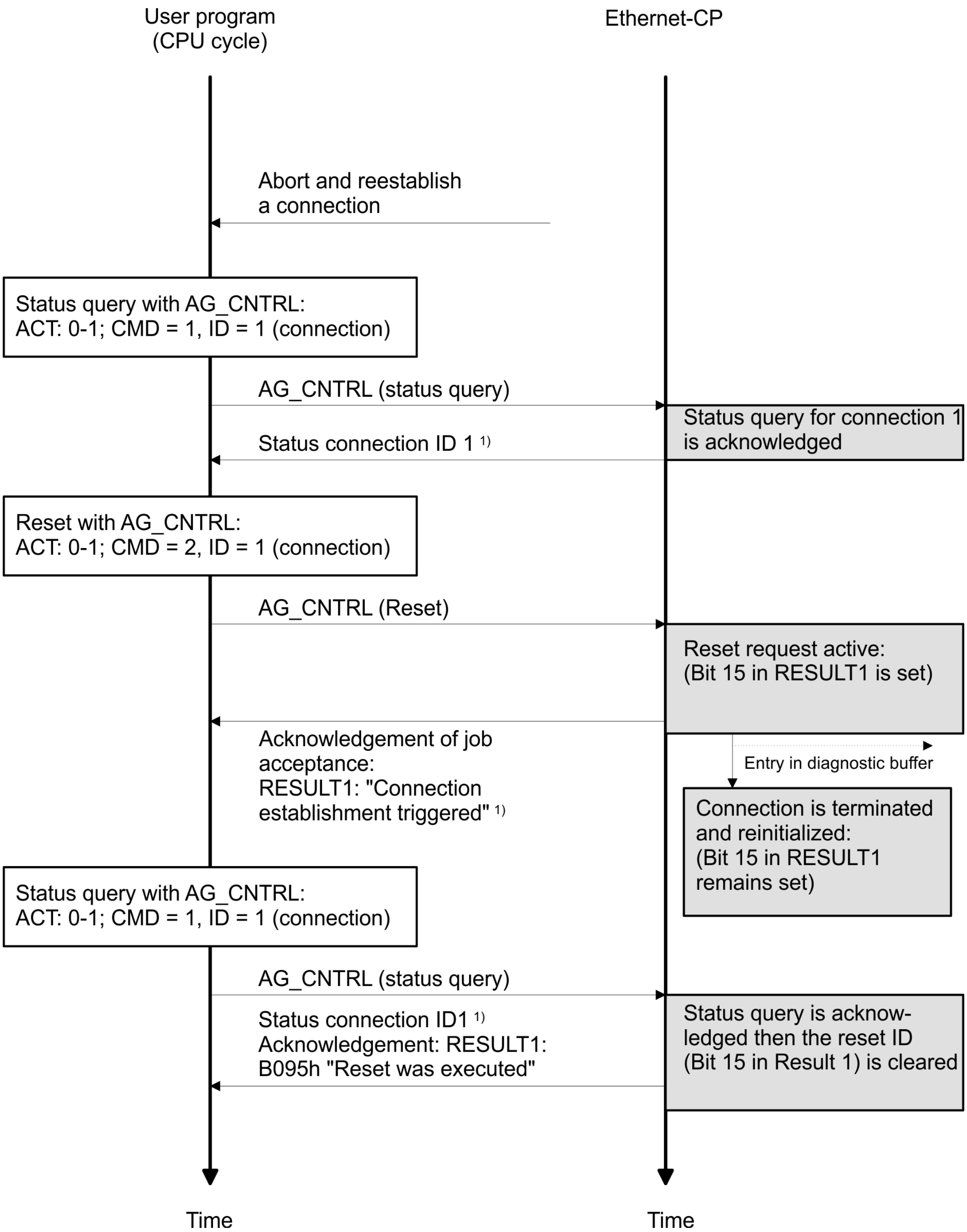
- Reading connection information
- Resetting configured connections

The commands of this block are permitted only for SEND/RECV connections based on the ISO/RFC/TCP and UDP protocols.

*Please note that this block calls the FC or SFC 196 AG_CNTRL internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

**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*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *⮩ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| ACT | INPUT | BOOL | Job triggered by edge change 0-1 of the memory bit *ACT* |
| ID | INPUT | INT | Connection ID according to configuration |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| 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 under command |
| RESULT2 | OUTPUT | DWORD | Job result 2 under command |

***ACT***

Possible values: 0, 1

The FC is to be called with edge change 0-1 of *ACT*.

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

***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.

If *DONE* = 1 *RESULT* may be evaluated.

***ERROR***

0: No error

1: Error indication

***STATUS***

Status indication

***RESULT1/2***

Information returned according to the command sent to the FC AG_CNTRL

***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 | Description |
|---|---|---|---|
| 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 record set. |
| 0 | 1 | 80C0h | The record set cannot be read. |
| 0 | 1 | 80C1h | The specified record set 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 restart of the CP:

- *DONE* = 0
- *NDR* = 0
- *ERROR* = 8180h (at AG_RECV)
- *ERROR* = 8181h (at AG_SEND)

*Please consider the block may only be called with new parameters if a job started before was just ended with DONE = 1.*

**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 | Description |
|---|---|---|
| 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 | Description |
|---|---|---|
| RESULT 1 | 0000 000xh | Bit 3 ... 0: Codes for the send direction (excluded: $0010_b$)<br>Bit 0: Connection reserved for send and receive jobs<br>Bit 1: Send job being executed<br>Bit 3, 2: Previous job<br>00: No information<br>01: Send job completed successful<br>10: Send job not completed successfully |
| | 0000 00x0h | Bit 7 ... 4: Codes for receive direction (excluded: $0010_b$)<br>Bit 4: Connection reserved for send and receive jobs<br>Bit 5: Receive job being executed<br>Bit 7, 6: Previous job<br>00: No information<br>01: Receive job completed successfully<br>10: Receive job not completed successfully |

| RESULT | Hex value/range | Description |
|---|---|---|
| | 0000 0x00h | Bit 11 ... 8: Codes for FETCH/WRITE<br>(excluded: $0011_b$, $0111_b$, $1000_b$, $1011_b$, $0010_b$)<br>Bit 8: Connection type<br>0: No FETCH connection<br>1: Connection reserved for FETCH jobs<br>Bit 9: Connection type<br>0: No WRITE connection<br>1: Connection reserved for WRITE jobs<br>Bit 10: Job status (FETCH/ WRITE)<br>0: Job status OK<br>1: Job status not OK<br>This ID is set in the following situations:<br>- The job was acknowledged negatively by the CPU<br>- The job could not be forwarded to the CPU because the connection was in the "LOCKED" status.<br>- The job was rejected because the FETCH/WRITE header did not have the correct structure.<br>Bit 11: Status of FETCH/WRITE job<br>0: No job active<br>1: Job from LAN active |
| | 0000 x000h | Bit 15 ... 12: General CP information<br>(excluded: $0011_b$, $1011_b$)<br>Bit 13, 12: Connection status<br>(only available for SEND/RECV connections based on the ISO/RFC/TCP protocols; with UDP, the corresponding internal information is output)<br>00: Connection is terminated<br>01: Connection establishment active<br>10: Connection termination active<br>11: Connection is established<br>Bit 14: CP information<br>0: CP in STOP<br>1: CP in RUN<br>Bit 15: Reset ID<br>0: FC 10 has not yet reset a connection or the reset ID was cleared.<br>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 | Description |
|---|---|---|
| RESULT 1 | 0000 0001h | The reset job was transferred to the CP successfully.<br>The connection abort and subsequent connection establishment were triggered. |
| | 0000 0002h | The reset job could not be transferred to the CP because the service was 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 | Description |
|---|---|---|
| RESULT 1 | xxxx xxxxh | 32 Bit: Connection 1 ... 32<br>0: Connection terminated / not configured<br>1: Connection established |
| RESULT 2 | xxxx xxxxh | 32 Bit: Connection 33 ... 64<br>0: Connection terminated / not configured<br>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 | Description |
|---|---|---|
| RESULT 1 | 0000 0001h | The reset job was transferred to the CP successfully.<br>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 was 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 | Description |
|---|---|---|
| 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 was not started on the CP (for example CP in STOP). |
| RESULT 2 | 0000 0000h | Default |

***CMD 6***

CN_DISCON - connection disconnect

This command resets the connection, which was selected by *ID* and *LADDR*. The reset is executed by means of aborting the connection.

Possibly in the stack stored data are lost without any instructions. After that no further connection is automatically established. The connection may again be established by the control job CN_STARTCON. An entry is also generated in the diagnostic buffer in which the job result may be found.

| RESULT | Hex value/ range | Description |
|---|---|---|
| RESULT 1 | 0000 0001h | The job was transferred to the CP successfully. The connection abort was triggered. |
| | 0000 0002h | This job could not be transferred to the CP because the service was not started on the CP (for example CP in STOP). |
| RESULT 2 | 0000 0000h | Default |

***CMD 7***

CN_STARTCON - start connection

This command establishes a connection, which was selected by *ID* and *LADDR* and aborted by the control job CN_DISCON before. An entry is also generated in the diagnostic buffer in which the job result may be found.

| RESULT | Hex value/ range | Description |
|---|---|---|
| RESULT 1 | 0000 0001h | The job was transferred to the CP successfully. The connection abort was triggered. |
| | 0000 0002h | This job could not be transferred to the CP because the service was not started on the CP (for example CP in STOP). |
| RESULT 2 | 0000 0000h | Default |

### 8.2.5 FC 62 - C_CNTR - Querying the Connection Status

**Description**

Query a connection status with FC 62. The current status of the communication that has been determined via ID is queried after the system function has been called with value 1 at the control input *EN_R*.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | E, A, M, D, L, Konst. | Control parameter enabled to receive, signals ready to receive if the input is set. |
| ID | INPUT | WORD | M, D, Konst. | Addressing parameter *ID*, |
| RET_VAL | OUTPUT | INT | E, A, M, D, L | Error information |
| ERROR | OUTPUT | BOOL | E, A, M, D, L | Status parameter *ERROR* and *STATUS* |
| STATUS | OUTPUT | WORD | E, A, M, D, L | ■ *ERROR*=0 and *STATUS* have the values:<br>– 0000h: Neither warning nor error<br>– <> 0000h: Warning, *STATUS* supplies detailed information.<br>■ *ERROR*=1<br>– There is an error. *STATUS* supplies detailed information on the type of error. |
| C_CONN | OUTPUT | BOOL | E, A, M, D, L | Status of the corresponding connection.<br>Possible values:<br>■ 0: The connection was dropped or it is not up.<br>■ 1: Verbindung wird gerade eingerichtet. |
| C_STATUS | OUTPUT | WORD | E, A, M, D, L | Connection status:<br>■ W#16#0000: Connection is not established<br>■ W#16#0001: Connection is being established<br>■ W#16#0002: Connection is established<br>■ W#16#000F: No data on connection status available (such as at CP startup)<br>■ W#16#00FF: Connection is not configured |

**Error Information**

The output parameter *RET_VAL* can assume the following values at FC 62 C_CNTRL:

- 0000h: No error when FC was executed.
- 8000h: Error when FC was executed.

> *The output parameters ERROR and STATUS are to be evaluated regardless of the output parameter RET_VAL showing the value 0000h.*

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 10 | CP access error. Another job is currently running. Repeat job later. |
| 1 | 27 | There is no function code in the CPU for this block. |

## 8.2.6 FB/SFB 8 - FB 55 - Overview

With the Siemens S7 connection large data sets may be transferred between via Ethernet connected PLC systems based on Siemens STEP®7.® The communication connections are static i.e. they are to be configured in a connection table.

**Possibilities of communication functions**

- 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. *Chapter 6 'Include VIPA library' on page 98*
- 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.

**Project engineering**

Precondition for the Siemens S7 communication is a configured connection table, which contains the defined connections for communication. For this e.g. WinPLC7 from VIPA or NetPro from Siemens can be used. A communication connection is specified by a connection ID for each connection 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**

| FB/SFB | Designation | 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 55 | IP_CONF | Programmed communication connections |

*Please use for the Siemens S7 communication exclusively the FB/SFBs listed here. The direct call of the associated internal SFCs leads to errors in the corresponding instance DB!*

### 8.2.7 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.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | E, A, 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 | E, A, M, D, Konstante | Connection reference. The *ID* must be specified in the form wxyzh. |
| R_ID | INPUT | DWORD | E, A, M, D, L, Konstante | Addressing parameter *R_ID*. Format DW#16#wxyzWXYZ. |
| DONE | OUTPUT | BOOL | E, A, M, D, L | Status parameter *DONE*:<br>■ 0: task has not been started or it is still being exe-cuted.<br>■ 1: task was executed without error. |
| ERROR | OUTPUT | BOOL | E, A, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– An error has occurred. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| STATUS | OUTPUT | WORD | E, A, M, D, L | Status parameter *STATUS*, returns detailed information about the type of error. |
| SD_i,1≤ i ≤4 | IN_OUT | ANY | E, A, M, D, T, Z | Pointer to transmit buffer i..<br>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. |

*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.*

**Fehlerinformationen**

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 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.<br>■ Connection parameters not loaded (local or remote)<br>■ 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<br>■ contains an instance DB that does not belong to the FB/SFB 8<br>■ contains a global DB instead of an instance DB<br>■ 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 the data consistency is not compromised, can the currently used transmission ranges SD_i be described again only if the current job is completed. This requires that the DONE parameter is evaluated. This is the case when the value of the status parameter *DONE* changes to 1.

## 8.2.8 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*.

**Parameters**

| Parameters | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | E, A, M, D, L | Control parameter enabled to receive, indicates that the partner is ready for reception |
| ID | INPUT | WORD | E, A, M, D, Konstante | A reference for the connection. Format wxyzh |
| R_ID | INPUT | DWORD | E, A, M, D, L, Konstante | Address parameter *R_ID*. Format DW#16#wxyzWXYZ. |
| NDR | OUTPUT | BOOL | E, A, M, D, L | Status parameter *NDR*: new data transferred. |
| ERROR | OUTPUT | BOOL | E, A, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occured. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– An error has occurred. |
| STATUS | OUTPUT | WORD | E, A, M, D, L | Status parameter *STATUS*, returns detailed information about the type of error. |
| RD_i,1≤ i ≤4 | IN_OUT | ANY | E, A, M, D, T, Z | Pointer to receive buffer i.<br>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. |

*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) | Description |
|---|---|---|
| 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.<br>■ Connection parameters not loaded (local or remote)<br>■ 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<br>■ contains an instance DB that does not belong to the FB/SFB 9<br>■ contains a global DB instead of an instance DB<br>■ 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.

### 8.2.9 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.

*Please note that this block calls the FC or SFC 202 AG_BSEND internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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*, I*D, 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 cancelled.
- 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.

*The parameter R_ID must be identical at the two corresponding FBs/ SFBs.*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *⇨ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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<br>(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.<br>Format W#16#xxxx |
| R_ID | INPUT | DWORD | I, Q, M, D, L, constant | Address parameter *R_ID*.<br>Format DW#16#wxyzWXYZ. |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*:<br>0: task has not been started or is still being executed.<br>1: task was executed without error. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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 start. It specifies the maximum length of the send buffer. Only data type BOOL is valid (Bit field not permitted),<br>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) | Description |
|---|---|---|
| 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.:<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g. cable, CPU turned off, CP in STOP) |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 2 | Negative acknowledgment 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<br>or an error has occurred in the receive data buffer pointer *RD_1* of the respective FB/SFB 13 BRCV |
| 1 | 5 | Reset request 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<br>■ contains an instance DB that does not belong to the FB/SFB 12<br>■ contains a global DB instead of an instance DB<br>■ could not locate an instance DB<br>(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*.

## 8.2.10 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 acknowledgment is sent to the partner FB/SFB and the *LEN* parameter is updated.

*Please note that this block calls the FC or SFC 203 AG_BRCV internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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#xxxx |
| 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*: <br>■ *ERROR* = 0 + *STATUS* = 0000h <br>– No warnings or errors. <br>■ *ERROR* = 0 + *STATUS* unequal to 0000h <br>– A Warning has occurred. *STATUS* contains detailed information. <br>■ *ERROR* = 1 <br>– An error has occurred. |
| STATUS | OUTPUT | WORD | I, Q, M, D ,T, C | 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), <br>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 acknowledgment 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) | Description |
|---|---|---|
| 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.<br>■ Connection parameters not loaded (local or remote)<br>■ 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<br>(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<br>(e.g. access to deleted DB). |
| 1 | 12 | The call to the FB/SFB<br>■ contains an instance DB that does not belong to the FB/SFB 13<br>■ contains a global DB instead of an instance DB<br>■ 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 acknowledgment.
- 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.

### 8.2.11 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.

*Please note that this block calls the FC or SFC 200 AG_GET internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *➪ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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#xxxx |
| NDR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *NDR*: data from partner CPU has been accepted. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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. You must ensure that the defined parameters on the *ADDR_i* and *RD_i* areas and the number that fit in quantity, length and data type of data to each other.

**Error information**

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 0 | 11 | Warning: the new task is not active since the previous task has not completed. |
| 0 | 25 | The communication process was initiated.<br>The task is being processed. |
| 1 | 1 | Communication failures, e.g.<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g.: cable, CPU turned off, CP in STOP) |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 2 | Negative acknowledgment from partner device.<br>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<br>(e.g. access to deleted DB). |
| 1 | 12 | The call to the FB/SFB<br>■ contains an instance DB that does not belong to the FB/SFB 14<br>■ contains a global DB instead of an instance DB<br>■ could not locate an instance DB<br>(load a new instance DB from the PG) |
| 1 | 20 | Not enough memory. |

**Data consistency**

The data are received consistently if you evaluate the current use of range *RD_i* completely before initiating another job.

### 8.2.12 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.

*Please note that this block calls the FC or SFC 201 AG_PUT internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

Depending upon communication function the following behavior is present:

- *Siemens S7-300 Communication (FB 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.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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<br>(with respect to the most recent FB/SFB-call) |
| ID | INPUT | WORD | I, Q, M, D,<br>constant | A reference for the connection. Format W#16#xxxx |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*: function completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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 acknowledgment.
- This acknowledgment 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) | Description |
|---|---|---|
| 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. |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 1 | Communication failures, e.g.<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g.: cable, CPU turned off, CP in STOP) |
| 1 | 2 | Negative acknowledgment 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<br>contains an instance DB that does not belong to the FB/SFB 15.<br>contains a global DB instead of an instance DB.<br>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.

## 8.2.13 FB 55 - IP_CONF - Progr. Communication Connections

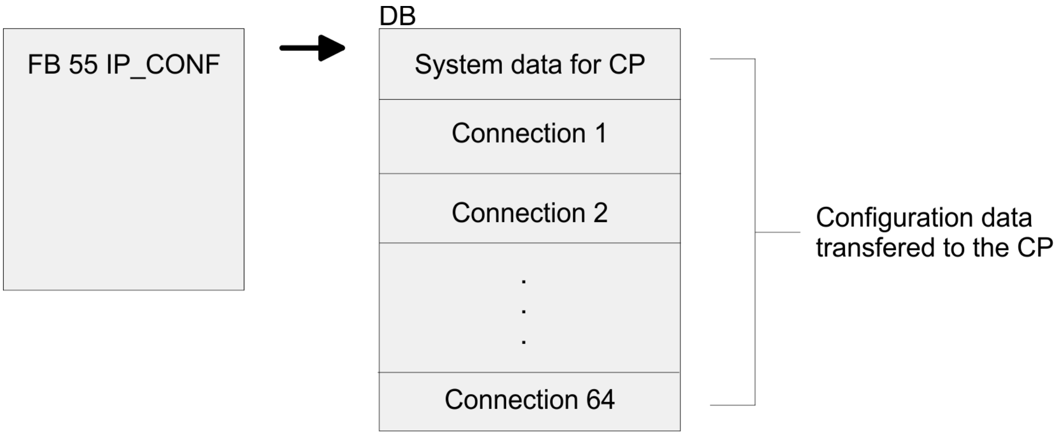
**Overview**

To configure flexible communication connections, the FB 55 - IP_CONF allows the program controlled transfer of data blocks with configuration data for a CP.

*Please note that this block calls the FC or SFC 204 IP_CONF internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

**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.




**CAUTION!**
As soon as the user program transfers the connection data via FB 55 IP_CONF, 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).

### 8.2.13.1 FB 55 - IP_CONF

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.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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.<br>■ 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<br>When the CP is configured by the hardware configuration, the module base address is displayed in the configuration table. Enter 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. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| 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.<br>■ High byte: Index of the parameter block<br>■ Low byte: Index of the subfield within the parameter block |

**Error information**

| ERROR | STATUS | Description |
|---|---|---|
| 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<br>The error can occur temporarily; it is usually best to repeat the job in the user program. |
| 1 | 80D2h | Configuration error, the module you are using does not support this service. |
| 1 | 8183h | The CP rejects the requested record set 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 record set 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 record set. |
| 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 record set job. |
| 1 | 8A06h | A job is complete but the FB nevertheless triggered the first job for a read record sets job. |
| 1 | 8B01h | Communication error, the DB could not be transferred. |

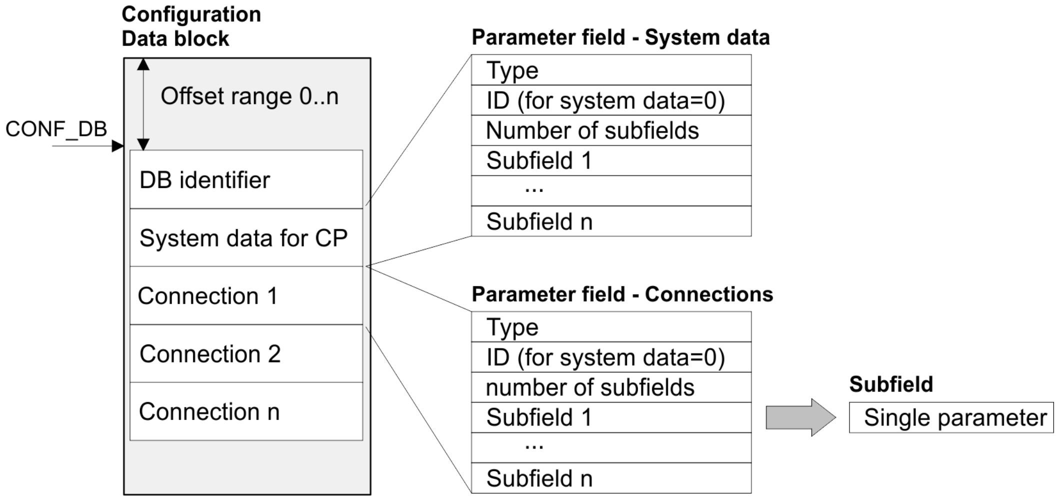
| ERROR | STATUS | Description |
|---|---|---|
| 1 | 8B02h | Parameter error, double parameter field |
| 1 | 8B03h | Parameter error, the subfield in the parameter field is not permitted. |
| 1 | 8B04h | Parameter error, the length specified in the FB does not match the length of the parameter fields/subfields. |
| 1 | 8B05h | Parameter error, double parameter field. |
| 1 | 8B06h | Parameter error, the subfield in the parameter field is not permitted. |
| 1 | 8B07h | Parameter error, the length 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. |
| 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 |

### 8.2.13.2 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 for CP**

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)** | **Description** | **Special features** | **Use** |
| 1 | SUB_IP_V4 | 4 + 4 | IP address of the local station according to IPv4 | | mandatory |
| 2 | SUB_NETMASK | 4 + 4 | Subnet mask of the local station | | 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 |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| **ID** | **Type** | **Length (byte)** | **Description** | **Special features** | **Use** |
| 14 | SUB_DHCP_ENABLE | 4 + 1 | Obtain an IP address from a DHCP | 0: no DHCP<br>1: DHCP | optional |
| 15 | SUB_CLIENT_ID | Length Client-ID + 4 | - | - | optional |
| 51 | MAC-ADR | 4 + 6 | MAC address local node | | optional |

***Parameter fields for Connections***

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)** | **Description** | **Special features** | **Use** |
| 1 | SUB_IP_V4 | 4 + 4 | IP address of the remote station according to IPv4 | | mandatory[1] |
| 9 | SUB_LOC_PORT | 4 + 2 | Port of the local station | | mandatory |
| 10 | SUB_REM_PORT | 4 + 2 | Port of the remote station | | mandatory[1] |
| 18 | SUB_CONNECT_NAME | Length Name + 4 | Name of the connection | | optional |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| ID | Type | Length (byte) | Description | Special features | Use |
| 19 | SUB_LOC_MODE | 4 + 1 | Local mode of the connection,<br>Possible values:<br>0x00 = SEND/REC<br>0x10 = S5-addressing mode for FETCH/ WRITE [2]<br>0x80 = FETCH[2]<br>0x40 = WRITE [2]<br>If you do not set the parameter, the default setting is SEND/RECV.<br>For FETCH/WRITE a passive connection setup is necessary. | | optional |
| 21 | SUB_KBUS_ADR | - | - | Value: fix 2 | optional |
| 22 | SUB_CON_ESTABL | 4 + 1 | Type of connection establishment.<br>With this option, you specify whether the connection is established by this station.<br>Possible values:<br>0 = passive<br>1 = active | | mandatory |
| 1) Option using passive connection<br>2) the coding 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) | Description | Special features | Use |
| 1 | SUB_IP_V4 | 4 + 4 | IP address of the remote station according to IPv4 | | mandatory |
| 9 | SUB_LOC_PORT | 4 + 2 | Port of the local station | | mandatory |
| 10 | SUB_REM_PORT | 4 + 2 | Port of the remote station | | mandatory |
| 18 | SUB_CONNECT_NAME | Length Name + 4 | Name of the connection | | optional |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| **ID** | **Type** | **Length(byte)** | **Description** | **Special features** | **Use** |
| 19 | SUB_LOC_MODE | 4 + 1 | Local mode of the connection<br>Possible values:<br>0x00 = SEND/REC0x10 = S5-addressing mode for FETCH/WRITE [1]<br>0x80 = FETCH [1]<br>0x40 = WRITE [1]<br>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 |
| 23 | SUB_ADDR_IN_DATA_BLOCK | 4 + 1 | Select free UDP connection.<br>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.<br>Possible values:<br>1 = free UDP connection<br>0 = otherwise | | optional |

1) the coding may be combined with OR operations

***ISO-on-TCP connection***

| |
|---|
| **Type = 3** |
| **ID = Connection ID** |
| Number of subfields = n |
| Subfield 1 |
| Subfield 2 |
| Subfield n |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| **ID** | **Type** | **Length (byte)** | **Description** | **Special features** | **Use** |
| 1 | SUB_IP_V4 | 4 + 4 | IP address of the remote station according to IPv4 | | mandatory[1] |
| 11 | SUB_LOC_PORT | Length TSAP + 4 | TSAP of the local station | | mandatory |
| 12 | SUB_REM_PORT | Length TSAP + 4 | TSAP of the remote station | | mandatory[1] |
| 18 | SUB_CONNECT_NAME | Length Name + 4 | Name of the connection | | optional |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| **ID** | **Type** | **Length (byte)** | **Description** | **Special features** | **Use** |
| 19 | SUB_LOC_MODE | 4 + 1 | Local mode of the connection<br>Possible values:<br>0x00 = SEND/RECV<br>0x10 = S5-addressing mode for FETCH/ WRITE [2]<br>0x80 = FETCH [2]<br>0x40 = WRITE [2]<br>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 | 4 + 1 | Type of connection establishment<br>With this option, you specify whether the connection is established by this station.<br>Possible values:<br>0 = passive<br>1 = active | | mandatory |
| 1) option using passive connection<br>2) the coding may be combined with OR operation | | | | | |

**H1 connection (ISO)**

| |
|---|
| **Type = 10** |
| **ID = Connection ID** |
| Number of subfields = n |
| Subfield 1 |
| Subfield 2 |
| Subfield n |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| **ID** | **Type** | **Length (byte)** | **Description** | **Special features** | **Use** |
| 51 | SUB_MAC | 4 + 6 | MAC address of the remote station | | mandatory |
| 11 | SUB_LOC_TSAP | Length TASP + 4 | TSAP of the local station | | mandatory |
| 12 | SUB_REM_TSAP | Length TASP + 4 | TSAP of the remote station | | mandatory[1] |
| 18 | SUB_CONNECT_NAME | Length Name + 4 | Name of the connection | | optional |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| ID | Type | Length (byte) | Description | Special features | Use |
| 19 | SUB_LOC_MODE | 4 + 1 | Local mode of the connection<br>Possible values:<br>0x00 = SEND/RECV<br>0x10 = S5-addressing mode for FETCH/WRITE 2<br>0x80 = FETCH 2<br>0x40 = WRITE 2<br>If you do not set the parameter, the default setting is SEND/RECV.For FETCH/WRITE a passive connection setup is necessary | | optional |
| 22 | SUB_CON_ESTABL | 4 + 1 | Type of connection establishment<br>With this option, you specify whether the connection is established by this station.<br>Possible values: 0 = passive; 1 = active | | mandatory |
| 52 | SUB_TIME_CON_RETRAN | 4 + 2 | Time interval after which a failed connection is established again.<br>(1...60s, default: 5s) | irrelevant with passive connection establishment | optional |
| 53 | SUB_TIME_DAT_RETRAN | 4 + 2 | Time interval after which a failed send is triggered again.<br>(100...30000ms, default: 1000ms) | | optional |
| 54 | | 4 + 2 | Number of send attempts, incl 1. attempt(1...100, Default: 5) | | optional |
| 55 | | 4 + 2 | Time interval after which a connection is released, if there is no responds of the partner station.(6...160s, default: 30s) | | optional |
| 1) option using passive connection<br>2) the coding may be combined with OR operation | | | | | |

**Siemens S7 connection**

| |
|---|
| **Type = 11** |
| **ID = Connection ID** |
| Number of subfields = n |
| Subfield 1 |
| Subfield 2 |
| Subfield n |

| Subfield | | | | Parameter | |
|---|---|---|---|---|---|
| ID | Type | Length (byte) | Description | Special features | Use |
| 56 | SUB_S/_C_DETAIL | 4 + 14 | Connection specific parameter | | mandatory |
| 18 | SUB_CONNECT_NAME | LengthName + 4 | Name of the connection | | optional |
| 1 | SUB_IP_V4 | 4 + 4 | IP address according to IPv4 | IP address of the remote partner | mandatory[1] |
| 51 | SUB_MAC | 4 + 6 | MAC address of the remote station | | mandatory |
| 22 | SUB_CON_ESTABL | 4 + 1 | Type of connection establishment. With this option, you specify whether the connection is established by this station.<br>Possible values:<br>0 = passive<br>1 = active | | mandatory |
| 1) option using passive connection | | | | | |

***SUB_S/_C_DETAIL***

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| SubBlockID | IN | WORD | ID |
| SubBlockLen | IN | WORD | Length |
| TcpIpActive | IN | INT | Connection via MAC or IP address<br>(MAC=0, IP=1) |
| LocalResource | IN | WORD | Local resource 0001h ... 00DFh<br>(1=PG, 2=OP, 0010h ... 00DFh=not specified) |
| LocalRack | IN | WORD | Number local rack 0000h ... 0002h |
| LocalSlot | IN | WORD | Number local slot 0002h ... 000Fh<br>(2=CPU, 4=VIPA-PG/OP, 5=CP int., 6=CP ext.) |
| RemoteResource | IN | WORD | Remote resource 0001h ... 00DFh<br>(1=PG, 2=OP, 0010h ... 00DFh=not specified) |
| RemoteRack | IN | WORD | Number remote rack 0000h ... 0002h |
| RemoteSlot | IN | WORD | Number remote slot 0002h ... 000Fh<br>(2=CPU, 4=VIPA-PG/OP, 5=CP int., 6=CP ext.) |

The "local TSAP" is created with *LocalResource*, *LocalRack* and *LocalSlot*.

The "remote TSAP" is created with *RemoteResource*, *RemoteRack* and *RemoteSlot*.

***Example for configuring a Siemens S7 connection***

The configuration of a dynamic Siemens S7 connection via IP_CONF takes place analog to the configuration of a fix Siemens S7 connection with Siemens NetPro. Based on Siemens NetPro there are the following parameters corresponding to the following subfields:

| Properties - Siemens S7- Connection | |
|---|---|
| **Siemens NetPro** | **FB55 - IP_CONFIG** |
| establish an active connection | SUB_CON_ESATBL.CON_ESTABL |
| TCP/IP | SUB_S7_C_DETAILS.TcpIpActive |
| IP respectively MAC address remote station | SUB_IP_V4.rem_IP.IP_0...IP_3 resp.<br>SUB_MAC.rem_MAC.MAC_0...MAC5 |
| Local ID | Connection ID |

| Address details | |
|---|---|
| **Siemens NetPro** | **FB55 - IP_CONFIG** |
| Local rack | SUB_S7_C_DETAILS.LocalRack |
| Local slot | SUB_S7_C_DETAILS.LocalSlot |
| Local resource | SUB_S7_C_DETAILS.LocalResource |
| Remote rack | SUB_S7_C_DETAILS.RemoteRack |
| Remote slot | SUB_S7_C_DETAILS.RemoteSlot |
| Remote resource | SUB_S7_C_DETAILS.RemoteResource |

**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)** | **Description** | **Special features** | **Use** |
| 1 | VIPA_IPK_CYCLE | 4 + 4 | IPK cycle time for connection ID | VIPA specific | optional |

**Example DB**

| Address | Name | Type | Initial value | Actual | Comment |
|---|---|---|---|---|---|
| 0.0 | DB_Ident | WORD | W#16#1 | W#16#1 | |
| 2.0 | Systemdaten.Typ | INT | 0 | 0 | System data |
| 4.0 | Systemdaten.VerbId | INT | 0 | 0 | fix 0 |
| 6.0 | Systemdaten.SubBlock_Anzahl | INT | 3 | 3 | |
| 8.0 | Systemdaten.ip.SUB_IP_V4 | WORD | W#16#1 | W#16#1 | |
| 10.0 | Systemdaten.ip.SUB_IP_V4_LEN | WORD | W#16#8 | W#16#8 | |
| 12.0 | Systemdaten.ip.IP_0 | BYTE | B#16#0 | B#16#AC | |
| 13.0 | Systemdaten.ip.IP_1 | BYTE | B#16#0 | B#16#14 | |
| 14.0 | Systemdaten.ip.IP_2 | BYTE | B#16#0 | B#16#8B | |
| 15.0 | Systemdaten.ip.IP_3 | BYTE | B#16#0 | B#16#61 | |
| 16.0 | Systemdaten.netmask.SUB_NETMASK | WORD | W#16#2 | W#16#2 | |
| 18.0 | Systemdaten.netmask.SUB_NETMASK_LEN | WORD | W#16#8 | W#16#8 | |
| 20.0 | Systemdaten.netmask.NETMASK_0 | BYTE | B#16#0 | B#16#FF | |
| 21.0 | Systemdaten.netmask.NETMASK_1 | BYTE | B#16#0 | B#16#FF | |
| 22.0 | Systemdaten.netmask.NETMASK_2 | BYTE | B#16#0 | B#16#FF | |
| 23.0 | Systemdaten.netmask.NETMASK_3 | BYTE | B#16#0 | B#16#0 | |
| 24.0 | Systemdaten.router.SUB_DEF_ROUTER | WORD | W#16#8 | W#16#8 | |
| 26.0 | Systemdaten.router.SUB_DEF_ROUTER_LEN | WORD | W#16#8 | W#16#8 | |
| 28.0 | Systemdaten.router.ROUTER_0 | BYTE | B#16#0 | B#16#AC | |
| 29.0 | Systemdaten.router.ROUTER_1 | BYTE | B#16#0 | B#16#14 | |
| 30.0 | Systemdaten.router.ROUTER_2 | BYTE | B#16#0 | B#16#8B | |
| 31.0 | Systemdaten.router.ROUTER_3 | BYTE | B#16#0 | B#16#61 | |
| 32.0 | Con_TCP_ID1.Typ | INT | 1 | 1 | TCP connection |
| 34.0 | Con_TCP_ID1.VerbId | INT | 0 | 1 | Connection ID |
| 36.0 | Con_TCP_ID1.SubBlock_Anzahl | INT | 4 | 4 | |
| 38.0 | Con_TCP_ID1.ip1.SUB_IP_V4 | WORD | W#16#1 | W#16#1 | |
| 40.0 | Con_TCP_ID1.ip1. SUB_IP_V4_LEN | WORD | W#16#8 | W#16#8 | |

| Address | Name | Type | Initial value | Actual | Comment |
|---|---|---|---|---|---|
| 42.0 | Con_TCP_ID1.ip1.IP_0 | BYTE | B#16#0 | B#16#AC | |
| 43.0 | Con_TCP_ID1.ip1.IP_1 | BYTE | B#16#0 | B#16#14 | |
| 44.0 | Con_TCP_ID1.ip1.IP_2 | BYTE | B#16#0 | B#16#8B | |
| 45.0 | Con_TCP_ID1.ip1.IP_3 | BYTE | B#16#0 | B#16#62 | |
| 46.0 | Con_TCP_ID1.locport.SUB_LOC_PORT | WORD | W#16#9 | W#16#9 | |
| 48.0 | Con_TCP_ID1.locport.SUB_LOC_PORT_LEN | WORD | W#16#6 | W#16#6 | |
| 50.0 | Con_TCP_ID1.locport.LOC_PORT | WORD | W#16#0 | W#16#3E9 | |
| 52.0 | Con_TCP_ID1.remport.SUB_REM_PORT | WORD | W#16#A | W#16#A | |
| 54.0 | Con_TCP_ID1.remport.SUB_REM_PORT_LEN | WORD | W#16#6 | W#16#6 | |
| 56.0 | Con_TCP_ID1.remport.REM_PORT | WORD | W#16#0 | W#16#3E9 | |
| 58.0 | Con_TCP_ID1.con_est.SUB_CON_ESTABL | WORD | W#16#16 | W#16#16 | |
| 60.0 | Con_TCP_ID1.con_est.SUB_CON_ESTABL_LEN | WORD | W#16#6 | W#16#6 | |
| 62.0 | Con_TCP_ID1.con_est.CON_ESTABL | BYTE | B#16#0 | B#16#1 | |
| 64.0 | Con_ISO_ID3.Typ | INT | 3 | 3 | ISO-on-TCP connection |
| 66.0 | Con_ISO_ID3.VerbId | INT | 0 | 3 | Connection ID |
| 68.0 | Con_ISO_ID3.SubBlock_Anzahl | INT | 4 | 4 | |
| 70.0 | Con_ISO_ID3.ip1. SUB_IP_V4 | WORD | W#16#1 | W#16#1 | |
| 72.0 | Con_ISO_ID3.ip1. SUB_IP_V4_LEN | WORD | W#16#8 | W#16#8 | |
| 74.0 | Con_ISO_ID3.ip1.IP_0 | BYTE | B#16#0 | B#16#AC | |
| 75.0 | Con_ISO_ID3.ip1.IP_1 | BYTE | B#16#0 | B#16#10 | |
| 76.0 | Con_ISO_ID3.ip1.IP_2 | BYTE | B#16#0 | B#16#8B | |
| 77.0 | Con_ISO_ID3.ip1.IP_3 | BYTE | B#16#0 | B#16#62 | |
| 78.0 | Con_ISO_ID3.loc_TSAP.SUB_LOC_PORT | WORD | W#16#B | W#16#B | |
| 80.0 | Con_ISO_ID3.loc_TSAP.SUB_LOC_PORT_LEN | WORD | W#16#A | W#16#A | |
| 82.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[0] | BYTE | B#16#0 | B#16#54 | |
| 83.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[1] | BYTE | B#16#0 | B#16#53 | |
| 84.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[2] | BYTE | B#16#0 | B#16#41 | |
| 85.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[3] | BYTE | B#16#0 | B#16#50 | |
| 86.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[4] | BYTE | B#16#0 | B#16#30 | |
| 87.0 | Con_ISO_ID3.loc_TSAP.LOC_TSAP[5] | BYTE | B#16#0 | B#16#31 | |
| 88.0 | Con_ISO_ID3.rem_TSAP.SUB_REM_PORT | WORD | W#16#C | W#16#C | |
| 90.0 | Con_ISO_ID3.rem_TSAP.SUB_REM_PORT_LEN | WORD | W#16#A | W#16#A | |
| 92.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[0] | BYTE | B#16#0 | B#16#54 | |
| 93.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[1] | BYTE | B#16#0 | B#16#53 | |
| 94.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[2] | BYTE | B#16#0 | B#16#41 | |
| 95.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[3] | BYTE | B#16#0 | B#16#50 | |
| 96.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[4] | BYTE | B#16#0 | B#16#30 | |
| 97.0 | Con_ISO_ID3.rem_TSAP.REM_TSAP[5] | BYTE | B#16#0 | B#16#31 | |
| 98.0 | Con_ISO_ID3.con_est.SUB_CON_ESTABL | WORD | W#16#16 | W#16#16 | |
| 100.0 | Con_ISO_ID3.con_est.SUB_CON_ESTABL_LEN SUB_CON_ESTABL SUB_CON_ESTABL_LEN | WORD | W#16#6 | W#16#6 | |

| Address | Name | Type | Initial value | Actual | Comment |
|---|---|---|---|---|---|
| 102.0 | Con_ISO_ID3.con_est.CON_ESTABL | BYTE | B#16#0 | B#16#1 | |
| 104.0 | S7_Verb.Typ | INT | 11 | 11 | S7 connection |
| 106.0 | S7_Verb.Verb_ID | INT | 0 | 0 | Connection ID |
| 108.0 | S7_Verb.SubBlock_Anzahl | INT | 5 | 5 | |
| 110.0 | S7_Verb.Verb_Parameter.SUB_S7_C_DETAIL | INT | 56 | 56 | |
| 112.0 | S7_Verb.Verb_Parameter. SUB_S7_C_DETAIL_LEN | INT | 18 | 18 | |
| 114.0 | S7_Verb.Verb_Parameter.TcpIpActive | INT | 0 | 1 | |
| 116.0 | S7_Verb.Verb_Parameter.LocalResource | INT | 0 | 2 | |
| 118.0 | S7_Verb.Verb_Parameter.LocalRack | INT | 0 | 0 | |
| 120.0 | S7_Verb.Verb_Parameter.LocalsSlot | INT | 0 | 2 | |
| 122.0 | S7_Verb.Verb_Parameter.RemoteResource | INT | 0 | 2 | |
| 124.0 | S7_Verb.Verb_Parameter.RemoteRack | INT | 0 | 0 | |
| 126.0 | S7_Verb.Verb_Parameter.RemoteSlot | INT | 0 | 2 | |
| 128.0 | S7_Verb.ipl.SUB_IP_V4 | WORD | W#16#1 | W#16#1 | |
| 130.0 | S7_Verb.ipl. SUB_IP_V4_LEN | WORD | W#16#8 | W#16#8 | |
| 132.0 | S7_Verb.ipl.IP_0 | BYTE | B#16#0 | B#16#AC | |
| 133.0 | S7_Verb.ipl.IP_1 | BYTE | B#16#0 | B#16#10 | |
| 134.0 | S7_Verb.ipl.IP_2 | BYTE | B#16#0 | B#16#8B | |
| 135.0 | S7_Verb.ipl.IP_3 | BYTE | B#16#0 | B#16#62 | |
| 136.0 | S7_Verb.Mac.SUB_MAC | INT | 51 | 51 | |
| 138.0 | S7_Verb.Mac.SUB_MAC_LEN | INT | 10 | 10 | |
| 140.0 | S7_Verb.Mac.MAC_0 | BYTE | B#16#0 | B#16#0 | |
| 141.0 | S7_Verb.Mac.MAC_1 | BYTE | B#16#0 | B#16#20 | |
| 142.0 | S7_Verb.Mac.MAC_2 | BYTE | B#16#0 | B#16#D5 | |
| 143.0 | S7_Verb.Mac.MAC_3 | BYTE | B#16#0 | B#16#77 | |
| 144.0 | S7_Verb.Mac.MAC_4 | BYTE | B#16#0 | B#16#53 | |
| 145.0 | S7_Verb.Mac.MAC_5 | BYTE | B#16#0 | B#16#9B | |
| 146.0 | S7_Verb.con_est .SUB_CON_ESTABL | WORD | W#16#16 | W#16#16 | |
| 148.0 | S7_Verb.con_est.SUB_CON_ESTABL_LEN | WORD | W#16#6 | W#16#6 | |
| 150.0 | S7_Verb.con_est.CON_ESTABL | BYTE | B#16#0 | B#16#1 | |
| 152.0 | S7_Verb.name_verb.SUB_CONNECT_NAME | WORD | W#16#12 | W#16#12 | |
| 154.0 | S7_Verb.name_verb.SUB_CONNECT_NAME_LEN | WORD | W#16#23 | W#16#23 | |
| 156.0 | S7_Verb.name_verb.CONNECT_NAME[0] | CHAR | ' ' | 'V' | Connection S7 with IP-Config 1 |
| 157.0 | S7_Verb.name_verb.CONNECT_NAME[1] | CHAR | ' ' | 'e' | |
| 158.0 | S7_Verb.name_verb.CONNECT_NAME[2] | CHAR | ' ' | 'r' | |
| 159.0 | S7_Verb.name_verb.CONNECT_NAME[3] | CHAR | ' ' | 'b' | |
| 160.0 | S7_Verb.name_verb.CONNECT_NAME[4] | CHAR | ' ' | 'l' | |
| 161.0 | S7_Verb.name_verb.CONNECT_NAME[5] | CHAR | ' ' | 'n' | |
| 162.0 | S7_Verb.name_verb.CONNECT_NAME[6] | CHAR | ' ' | 'd' | |
| 163.0 | S7_Verb.name_verb.CONNECT_NAME[7] | CHAR | ' ' | 'u' | |
| 164.0 | S7_Verb.name_verb.CONNECT_NAME[8] | CHAR | ' ' | 'n' | |

| Address | Name | Type | Initial value | Actual | Comment |
|---|---|---|---|---|---|
| 165.0 | S7_Verb.name_verb.CONNECT_NAME[9] | CHAR | ' ' | 'g' | |
| 166.0 | S7_Verb.name_verb.CONNECT_NAME[10] | CHAR | ' ' | ' ' | |
| 167.0 | S7_Verb.name_verb.CONNECT_NAME[11] | CHAR | ' ' | 'S' | |
| 168.0 | S7_Verb.name_verb.CONNECT_NAME[12] | CHAR | ' ' | '7' | |
| 169.0 | S7_Verb.name_verb.CONNECT_NAME[13] | CHAR | ' ' | ' ' | |
| 170.0 | S7_Verb.name_verb.CONNECT_NAME[14] | CHAR | ' ' | 'm' | |
| 171.0 | S7_Verb.name_verb.CONNECT_NAME[15] | CHAR | ' ' | 'I' | |
| 172.0 | S7_Verb.name_verb.CONNECT_NAME[16] | CHAR | ' ' | 't' | |
| 173.0 | S7_Verb.name_verb.CONNECT_NAME[17] | CHAR | ' ' | ' ' | |
| 174.0 | S7_Verb.name_verb.CONNECT_NAME[18] | CHAR | ' ' | 'I' | |
| 175.0 | S7_Verb.name_verb.CONNECT_NAME[19] | CHAR | ' ' | 'P' | |
| 176.0 | S7_Verb.name_verb.CONNECT_NAME[20] | CHAR | ' ' | '-' | |
| 177.0 | S7_Verb.name_verb.CONNECT_NAME[21] | CHAR | ' ' | 'C' | |
| 178.0 | S7_Verb.name_verb.CONNECT_NAME[22] | CHAR | ' ' | 'o' | |
| 179.0 | S7_Verb.name_verb.CONNECT_NAME[23] | CHAR | ' ' | 'n' | |
| 180.0 | S7_Verb.name_verb.CONNECT_NAME[24] | CHAR | ' ' | 'f' | |
| 181.0 | S7_Verb.name_verb.CONNECT_NAME[25] | CHAR | ' ' | 'I' | |
| 182.0 | S7_Verb.name_verb.CONNECT_NAME[26] | CHAR | ' ' | 'g' | |
| 183.0 | S7_Verb.name_verb.CONNECT_NAME[27] | CHAR | ' ' | ' ' | |
| 184.0 | S7_Verb.name_verb.CONNECT_NAME[28] | CHAR | ' ' | '1' | |
| 185.0 | S7_Verb.name_verb.CONNECT_NAME[29] | CHAR | ' ' | ' ' | |
| 186.0 | S7_Verb.name_verb.CONNECT_NAME[30] | CHAR | ' ' | ' ' | |

# 9 Modbus Communication

## 9.1 TCP

### 9.1.1 FB 70 - TCP_MB_CLIENT - Modbus/TCP client

**Description**

This function allows the operation of an Ethernet interface as Modbus/TCP client.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *➡ Chapter 6 'Include VIPA library' on page 98*

**Call parameter**

| Name | Declaration | Type | Description |
|---|---|---|---|
| REQ | IN | BOOL | Start job with edge 0-1. |
| ID | IN | WORD | ID from TCON. |
| MB_FUNCTION | IN | BYTE | Modbus: *Function code*. |
| MB_DATA_ADDR | IN | WORD | Modbus: Start address or *sub function code*. |
| MB_DATA_LEN | IN | INT | Modbus: Number of register/bits. |
| MB_DATA_PTR | IN | ANY | Modbus: Data buffer (only flag area or data block of data type byte allowed) for access with *function code 03h*, *06h* and *10h*. |
| DONE * | OUT | BOOL | Job finished without error. |
| BUSY | OUT | BOOL | Job is running. |
| ERROR * | OUT | BOOL | Job is ready with error - parameter STATUS has error information. |
| STATUS * | OUT | WORD | Extended status and error information. |
| *) Parameter is available until the next call of the FB | | | |

**Parameter in instance DB**

| Name | Declaration | Type | Description |
|---|---|---|---|
| PROTOCOL_TIMEOUT | STAT | INT | Blocking time before an active job can be cancelled by the user.<br>Default: 3s |
| RCV_TIMEOUT | STAT | INT | Monitoring time for a job.<br>Default: 2s |
| MB_TRANS_ID | STAT | WORD | Modbus: Start value for the transaction identifier.<br>Default: 1 |
| MB_UNIT_ID | STAT | BYTE | Modbus: Device identification.<br>Default: 255 |

The following must be observed:

- The *call parameters* must be specified with the block call. Besides the *call parameters* all parameters are located in the instance DB.
- The communication link must be previously initialized via FB 65 (TCON).
- FB 63 (TSEND) and FB 64 (TRCV) are required for the use of the block.
- During a job processing the instance DB is blocked for other clients.
- During job processing changes to the input parameters are not evaluated.
- With the following conditions a job processing is completed or cancelled:
  – DONE = 1 job without error
  – ERROR = 1 job with error
  – Expiration of RCV_TIMEOUT
  – REQ = FALSE after expiration of PROTOCOL_TIMEOUT
- REQ is reset before DONE or ERROR is set or PROTOCOL_TIMEOUT has expired, STATUS 8200h is reported. Here the current job is still processed.

**Status and error indication**

The function block reports via STATUS the following status and error information.

| STATUS | DONE | BUSY | ERROR | Description |
|---|---|---|---|---|
| 0000h | 1 | 0 | 0 | Operation executed without error. |
| 7000h | 0 | 0 | 0 | No connection established or communication error (TCON). |
| 7004h | 0 | 0 | 0 | Connection established and monitored. No job active. |
| 7005h | 0 | 1 | 0 | Data are sent. |
| 7006h | 0 | 1 | 0 | Data are received. |
| 8210h | 0 | 0 | 1 | The hardware is incompatible with the block library Modbus RTU/TCP. |
| 8380h | 0 | 0 | 1 | Received Modbus frame does not have the correct format or has an invalid length. |
| 8381h | 0 | 0 | 1 | Server returns *Exception code 01h*. |
| 8382h | 0 | 0 | 1 | Server returns *Exception code 03h* or wrong start address. |
| 8383h | 0 | 0 | 1 | Server returns *Exception code 02h*. |
| 8384h | 0 | 0 | 1 | Server returns *Exception code 04h*. |
| 8386h | 0 | 0 | 1 | Server returns wrong *Function code*. |
| 8387h | 0 | 0 | 1 | Connection ID (TCON) does not match the instance or server returns wrong protocol ID. |
| 8388h | 0 | 0 | 1 | Server returns wrong value or wrong quantity. |
| 80C8h | 0 | 0 | 1 | No answer of the server during the duration (RCV_TIMEOUT). |
| 8188h | 0 | 0 | 1 | MB_FUNCTION not valid. |
| 8189h | 0 | 0 | 1 | MB_DATA_ADDR not valid. |
| 818Ah | 0 | 0 | 1 | MB_DATA_LEN not valid. |
| 818Bh | 0 | 0 | 1 | MB_DATA_PTR not valid. |
| 818Ch | 0 | 0 | 1 | BLOCKED_PROC_TIMEOUT or RCV_TIMEOUT not valid. |

| STATUS | DONE | BUSY | ERROR | Description |
|---|---|---|---|---|
| 818Dh | 0 | 0 | 1 | Server returns wrong transaction ID. |
| 8200h | 0 | 0 | 1 | Another Modbus request is processed at the time via the port (PROTOCOL_TIMEOUT). |

### 9.1.1.1 Example

**Task**

With *Function code 03h*, starting from address 2000, 100 register are to be read from a Modbus/TCP server and stored in flag area starting from MB200. Errors are to be stored.

**OB1**

```
 CALL  FB    65 , DB65
       REQ    :=M100.0
       ID     :=W#16#1
       DONE   :=M100.1
       BUSY   :=
       ERROR  :=M100.2
       STATUS :=MW102
       CONNECT:=P#DB255.DBX 0.0 BYTE 64

      UN    M    100.2
      SPB   ERR1
      L     MW   102
      T     MW   104
ERR1: NOP   0
      U     M    100.1
      R     M    100.0

CALL  FB    70 , DB70
       REQ          :=M101.0
       ID           :=W#16#1
       MB_FUNCTION  :=B#16#3
       MB_DATA_ADDR:=W#16#7D0
       MB_DATA_LEN  :=100
       MB_DATA_PTR  :=P#M 200.0 BYTE 200
       DONE         :=M101.1
       BUSY         :=
       ERROR        :=M101.2
       STATUS       :=MW106

      UN    M    101.2
      SPB   ERR2
      L     MW   106
      T     MW   108
ERR2: NOP   0
      U     M    101.1
      R     M    101.0
```

**OB1 - Description**

1. Calling of FB 65 (TCON) to establish a communication connection with the partner station.
2. Calling the handling block of the Modbus/TCP client with the correct parameters.
3. There is no connection to the partner station and MW102 returns 7000h.
4. Set M100.0 in the CPU to TRUE.
   ⇨ If M100.0 is automatically reset, the connection to the partner station is established and MW108 returns 7004h.

5. Set M101.0 in the CPU to TRUE.

⇨ The Modbus request is sent and it is waited for a response.

If M101.0 is automatically reset, the job was finished without errors and the read data are stored in the CPU starting from bit memory byte 200. MW108 returns 7004h and indicates waiting for a new job.

If M101.0 is not automatically reset and MW108 returns non-zero, an error has occurred. The cause of error can be read by the code of MW108 (e.g. MW108 = 8382h when the start address 2000 in the server is not available). MW108 returns 7004h and indicates waiting for a new job.

### 9.1.2 FB 71 - TCP_MB_SERVER - Modbus/TCP server

**Description**

This function allows the operation of an Ethernet interface as Modbus/TCP server.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Call parameter**

| Name | Declara-tion | Type | Description |
|---|---|---|---|
| ENABLE | IN | BOOL | Activation/Deactivation Modbus server. |
| MB_DATA_PTR | IN | ANY | Modbus: Data buffer (only flag area or data block of type Byte allowed) for access with *function code 03h*, *06h* and *10h*. |
| ID | IN | WORD | ID from TCON. |
| NDR* | OUT | BOOL | New data were written by the Modbus client. |
| DR* | OUT | BOOL | Data were read by the Modbus client. |
| ERROR* | OUT | BOOL | Job is ready with error - parameter STATUS has error information. |
| STATUS* | OUT | WORD | Extended status and error information. |
| *) Parameter is available until the next call of the FB | | | |

**Parameter in instance DB**

| Name | Declara-tion | Type | Description |
|---|---|---|---|
| REQUEST_COUNT | STAT | WORD | Counter for each received frame. |
| MESSAGE_COUNT | STAT | WORD | Counter for each valid Modbus request. |
| XMT_RCV_COUNT | STAT | WORD | Counter for each received frame, which contains no valid Modbus request. |
| EXCEPTION_COUNT | STAT | WORD | Counter for each negatively acknowledged Modbus request. |

| Name | Declara-tion | Type | Description |
|---|---|---|---|
| SUCCESS_COUNT | STAT | WORD | Counter for each positively acknowledged Modbus request. |
| FC1_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 01h* start register for Q0.0<br>Default: 0 |
| FC1_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 01h* end register for Qx.y<br>Default: 19999 |
| FC1_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 01h* start register for M0.0<br>Default: 20000 |
| FC1_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 01h* end register for Mx.y<br>Default: 39999 |
| FC2_ADDR_INPUT_START | STAT | WORD | Modbus *Function code 02h* start register for I0.0<br>Default: 0 |
| FC2_ADDR_INPUT_END | STAT | WORD | Modbus *Function code 02h* end register for Ix.y<br>Default: 19999 |
| FC2_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 02h* start register for M0.0<br>Default: 20000 |
| FC2_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 02h* end register for Mx.y<br>Default: 39999 |
| FC4_ADDR_INPUT_START | STAT | WORD | Modbus *Function code 04h* start register for IW0<br>Default: 0 |
| FC4_ADDR_INPUT_END | STAT | WORD | Modbus *Function code 04h* end register for IWx<br>Default: 19999 |
| FC4_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 04h* start register for MW0<br>Default: 20000 |
| FC4_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 04h* end register for MWx<br>Default: 39999 |
| FC5_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 05h* start register for Q0.0<br>Default: 0 |
| FC5_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 05h* end register for Qx.y<br>Default: 19999 |
| FC5_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 05h* start register for M0.0<br>Default: 20000 |
| FC5_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 05h* end register for Mx.y<br>Default: 39999 |
| FC15_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 0Fh* start register for Q0.0<br>Default: 0 |

| Name | Declara-tion | Type | Description |
|---|---|---|---|
| FC15_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 0Fh* end register for Qx.y<br>Default: 19999 |
| FC15_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 0Fh* start register for Q0.0<br>Default: 20000 |
| FC15_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 0Fh* end register for Qx.y<br>Default: 39999 |

The following must be observed:

- The *call parameters* must be specified with the block call. Besides the *call parameters* all parameters are located in the instance DB.
- The communication link must be previously initialized via FB 65 (TCON).
- FB 63 (TSEND) and FB 64 (TRCV) are required for the use of the block.
- The INPUT/OUTPUT Modbus addresses of a *Function code* must be located in front of the MEMORY Modbus address and thus always be lower.
- Within a *Function code* no Modbus address may be defined multiple times - also not 0!
- The server can only process one job simultaneously. New Modbus requests during job processing are ignored and not answered.

**Status and error indication**

The function block reports via *STATUS* the following status and error information.

| STATUS | NDR | DR | ERROR | Description |
|---|---|---|---|---|
| 0000h | 0 or 1* | | 0 | Operation executed without error. |
| 7000h | 0 | 0 | 0 | No connection established or communication error (TCON). |
| 7005h | 0 | 0 | 0 | Data are sent. |
| 7006h | 0 | 0 | 0 | Data are received. |
| 8210h | 0 | 0 | 1 | The hardware is incompatible with the block library Modbus RTU/TCP. |
| 8380h | 0 | 0 | 1 | Received Modbus frame does not have the correct format or bytes are missing. |
| 8381h | 0 | 0 | 1 | *Exception code 01h*, *Function code* is not supported. |
| 8382h | 0 | 0 | 1 | *Exception code 03h*, data length or data value are not valid. |
| 8383h | 0 | 0 | 1 | *Exception code 02h*, invalid start address or address range. |
| 8384h | 0 | 0 | 1 | *Exception code 04h*, area length error when accessing inputs, outputs or bit memories. |
| 8387h | 0 | 0 | 1 | Connection ID (TCON) does not match the instance or client returns wrong protocol ID. |
| 8187h | 0 | 0 | 1 | MB_DATA_PTR not valid. |
| *) Error free Modbus job with *Function code 05h, 06h, 0Fh* or *10h* returns NDR=1 and DR=0.<br>Error free Modbus job with *Function code 01h, 02h, 03h, 04h* return DR=1 and NDR=0. | | | | |

### 9.1.2.1 Example

**Task**

The CPU provides 100 byte data in the flag area starting from MB200 for a Modbus client via the Modbus register 0...49. Data can be read from the Modbus client via *Function code 03h* and written with *Function code 06h, 10h*. The CPU output Q1.0 is to be controlled by a Modbus client via *Function code 05h* and the start address 5008. Errors are to be stored.

**OB1**

```
CALL  FB    65 , DB65
       REQ     :=M100.0
       ID      :=W#16#1
       DONE    :=M100.1
       BUSY    :=
       ERROR   :=M100.2
       STATUS  :=MW102
       CONNECT:=P#DB255.DBX 0.0 BYTE 64

      UN    M    100.2
      SPB   ERR1

      L     MW   102
      T     MW   104

ERR1: NOP   0
      U     M    100.1
      R     M    100.0

      L     5000
      T     DB71.DBW   52

      CALL  FB    71 , DB71
       ENABLE      :=M101.0
       MB_DATA_PTR:=P#M 200.0 BYTE 100
       ID          :=W#16#1
       NDR         :=M101.1
       DR          :=M101.2
       ERROR       :=M101.3
       STATUS      :=MW106

      UN    M    101.3
      SPB   ERR2
      L     MW   106
      T     MW   108
ERR2: NOP   0
```

**OB1 - Description**

1. Call of FB 65 (TCON) to establish a communication connection with the partner station.
2. Calling the handling block of the Modbus/TCP server with the correct parameters.
3. There is no connection to the partner station and MW102 returns 7000h.
4. Set M100.0 in the CPU to TRUE.
   ⇨ If M100.0 is automatically reset, the connection to the partner station is established and MW108 returns 7006h.
5. The Modbus start register in the process image, which can be reached by *Function code 05h*, may be changed in the example by the parameter FC5_ADDR_OUTPUT_START (word 52 in the instance data block).
6. Set M101.0 in the CPU to TRUE.
   ⇨ The Modbus server now works.
7. The client sends a Modbus request with *Function code 03h* start address 10 and quantity 30.

⇨ The server responds with 60 byte starting from MB220. DR is set for one CPU cycle and thus M101.2 is set to "1".

8. The client sends a Modbus request with *Function code 05h* start address 5008 and the value FF00h.

⇨ The server acknowledges the request and writes "1" to the output Q1.0. NDR is set for one CPU cycle and thus M101.1 is set to "1".

9. The client sends a Modbus request with *Function code 03h* start address 50 (does not exist) and quantity 1.

⇨ The server responds with *Exception code 02h* an sets ERROR/STATUS for one CPU cycle. MW108 returns 8383h.

## 9.2 RTU

### 9.2.1 FB 72 - RTU_MB_MASTER - Modbus RTU master

**Description**

This function block allows the operation of the internal serial RS485 interface of a CPU from VIPA or a System SLIO CP 040 as Modbus RTU master.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *✎ Chapter 6 ‘Include VIPA library’ on page 98*

**Call parameter**

| Name | Declaration | Type | Description |
|---|---|---|---|
| REQ | IN | BOOL | Start job with edge 0-1. |
| HARDWARE | IN | BYTE | 1 = System SLIO CP 040 /<br>2 = VIPA SPEED7 CPU |
| LADDR | IN | INT | Logical address of the System SLIO CP 040 (parameter is ignored with the VIPA SPEED7 CPU). |
| MB_UNIT_ID | IN | BYTE | Modbus: Device identification = Address of the slave (0 ... 247). |
| MB_FUNCTION | IN | BYTE | Modbus: *Function code*. |
| MB_DATA_ADDR | IN | WORD | Modbus: Start address or *Sub function code*. |
| MB_DATA_LEN | IN | INT | Modbus: Number of register/bits. |
| MB_DATA_PTR | IN | ANY | Modbus: Data buffer (only flag area or data block of data type byte allowed) for access with *function code 03h*, *06h* and *10h*. |
| DONE* | OUT | BOOL | Job finished without error. |
| BUSY | OUT | BOOL | Job is running. |
| ERROR* | OUT | BOOL | Job is ready with error - parameter *STATUS* has error information. |
| STATUS* | OUT | WORD | Extended status and error information. |
| *) Parameter is available until the next call of the FB | | | |

**Parameter in instance DB**

| Name | Declaration | Type | Description |
|---|---|---|---|
| INIT | STAT | BOOL | With an edge 0-1 an synchronous reset is established at the System SLIO CP 040. After a successful reset the bit automatically reset. |

The following must be observed:

- The *call parameters* must be specified with the block call. Besides the *call parameters* all parameters are located in the instance DB.
- The interface to be used must be configured before:
  – VIPA System SLIO CP 040: Configuration as "Modbus master RTU" with 60 byte IO-Size in the hardware configuration.
  – Internal serial RS485 interface of a VIPA CPU:
  Configuration via SFC 216 (SER_CFG) with protocol "Modbus master RTU".
- FB 60 SEND and FB 61 RECEIVE (or FB 65 SEND_RECV) are required for the use of the block, even if the internal serial RS485 interface of a CPU from VIPA is used.
- During job processing changes to the input parameters are not evaluated.
- Broadcast request via MB_UNIT_ID = 0 are only accepted for writing functions.
- With the following conditions a job processing is completed or cancelled:
  – *DONE* = 1 job without error
  – *ERROR* = 1 job with error
  – Expiration of time-out (parameterization at the interface)
- If *REQ* is reset before *DONE* or *ERROR* is set, STATUS 8200h is reported. Here the current job is still processed.

**Status and error indication**

The function block reports via STATUS the following status and error information.

| STATUS | DONE | BUSY | ERROR | Description |
|---|---|---|---|---|
| 0000h | 1 | 0 | 0 | Operation executed without error. |
| 7000h | 0 | 0 | 0 | No connection established or communication error. |
| 7004h | 0 | 0 | 0 | Connection established and monitored. No job active. |
| 7005h | 0 | 1 | 0 | Data are sent. |
| 7006h | 0 | 1 | 0 | Data are received. |
| 8210h | 0 | 0 | 1 | The hardware is incompatible with the block library Modbus RTU/TCP. |
| 8381h | 0 | 0 | 1 | Server returns *Exception code 01h*. |
| 8382h | 0 | 0 | 1 | Server returns *Exception code 03h* or wrong start address. |
| 8383h | 0 | 0 | 1 | Server returns *Exception code 02h*. |
| 8384h | 0 | 0 | 1 | Server returns *Exception code 04h*. |
| 8386h | 0 | 0 | 1 | Server returns wrong *Function code*. |
| 8388h | 0 | 0 | 1 | Server returns wrong value or quantity. |
| 80C8h | 0 | 0 | 1 | No answer of the server during the defined duration (time-out parameterizable via interface). |
| 8188h | 0 | 0 | 1 | MB_FUNCTION not valid. |
| 8189h | 0 | 0 | 1 | MB_DATA_ADDR not valid. |
| 818Ah | 0 | 0 | 1 | MB_DATA_LEN not valid. |

| STATUS | DONE | BUSY | ERROR | Description |
|---|---|---|---|---|
| 818Bh | 0 | 0 | 1 | MB_DATA_PTR not valid. |
| 8201h | 0 | 0 | 1 | HARDWARE not valid. |
| 8202h | 0 | 0 | 1 | MB_UNIT_ID not valid. |
| 8200h | 0 | 0 | 1 | Another Modbus request is processed at the time via the port. |

### 9.2.1.1 Example

**Task**

With *Function code 03h*, starting from address 2000, 100 register are to be read from a Modbus RTU slave with address 99 and stored in flag area starting from MB200. Errors are to be stored. The Modbus RTU master is realized via the internal serial RS485 interface of a VIPA CPU.

**OB100**

```
 CALL  SFC  216
       Protocol :=B#16#5
       Parameter :=DB10
       Baudrate:=B#16#9
       CharLen:=B#16#3
       Parity:=B#16#2
       StopBits:=B#16#1
       FlowControl:=B#16#1
       RetVal:=MW100
```

**OB100 - Description**

1. Calling of the SFC 216 (SER_CFG) to configure the internal serial interface of the CPU from VIPA.
2. Protocol: "Modbus Master RTU", 9600 baud, 8 data bit, 1 stop bit, even parity, no flow control.
3. DB10 has a variable of type WORD with a Modbus time-out (value in ms).

**OB1**

```
CALL  FB    72 , DB72
       REQ          :=M101.0
       HARDWARE     :=B#16#2
       LADDR        :=
       MB_UNIT_ID   :=B#16#63
       MB_FUNCTION :=B#16#3
       MB_DATA_ADDR:=W#16#7D0
       MB_DATA_LEN :=100
       MB_DATA_PTR :=P#M 200.0 BYTE 200
       DONE         :=M101.1
       BUSY         :=
       ERROR        :=M101.2
       STATUS       :=MW102

      UN    M    101.2
      SPB   ERR1
      L     MW   102
      T     MW   104
ERR1: NOP   0
      U     M    101.1
      R     M    101.0
```

**OB1 - Description**

1. Calling the handling block of the Modbus RTU master with the correct parameters.
2. If the interface was correctly initialized in the OB 100, the master can be used and MW102 returns 7004h.
3. Set M101.0 in the CPU to TRUE.
   ⇨ The Modbus request is sent and it is waited for a response.

   If M101.0 is automatically reset, the job was finished without errors and the read data are stored in the CPU starting from bit memory byte 200. MW104 returns 7004h and indicates waiting for a new job.

   If M101.0 is not automatically reset and MW104 returns non-zero, an error has occurred. The cause of error can be read by the code of MW104 (e.g. MW104 = 8382h when the start address 2000 in the server is not available). MW102 returns 7004h and indicates waiting for a new job.

## 9.2.2 FB 73 - RTU_MB_SLAVE - Modbus RTU slave

**Description**

This function block allows the operation of the internal serial RS485 interface of a CPU from VIPA or a System SLIO CP 040 as Modbus RTU slave.

> ***VIPA specific block***
>
> *The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Call parameter**

| Name | Declaration | Type | Description |
|---|---|---|---|
| ENABLE | IN | BOOL | Activation/Deactivation Modbus server. |
| HARDWARE | IN | BYTE | 1 = System SLIO CP 040 /<br>2 = VIPA SPEED7 CPU |
| LADDR | IN | INT | Logical address of the System SLIO CP 040 (parameter is ignored with the VIPA SPEED7 CPU). |
| MB_UNIT_ID | IN | BYTE | Modbus: Device identification = own address (1 ... 247). |
| MB_DATA_PTR | IN | ANY | Modbus: Data buffer (only flag area or data block of data type byte allowed) for access with *function code 03h*, *06h* and *10h*. |
| NDR* | OUT | BOOL | New data were written by the Modbus client. |
| DR* | OUT | BOOL | Data were read by the Modbus client. |
| ERROR* | OUT | BOOL | Job is ready with error - parameter *STATUS* has error information. |
| STATUS* | OUT | WORD | Extended status and error information. |
| *) Parameter is available until the next call of the FB | | | |

**Parameter in instance DB**

| Name | Declaration | Type | Description |
|---|---|---|---|
| INIT | STAT | BOOL | With an edge 0-1 an synchronous reset is established at the System SLIO CP 040. |
| REQUEST_COUNT | STAT | WORD | Counter for each received frame. |
| MESSAGE_COUNT | STAT | WORD | Counter for each valid Modbus request. |
| BROADCAST_COUNT | STAT | WORD | Counter for each valid Modbus broadcast request. |
| EXCEPTION_COUNT | STAT | WORD | Counter for each negatively acknowledged Modbus request. |
| SUCCESS_COUNT | STAT | WORD | Counter for each positively acknowledged Modbus request. |
| BAD_CRC_COUNT | STAT | WORD | Counter for each valid Modbus request with CRC error. |
| FC1_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 01h* start register for Q0.0<br>Default: 0 |
| FC1_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 01h* end register for Qx.y<br>Default: 19999 |
| FC1_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 01h* start register for M0.0<br>Default: 20000 |
| FC1_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 01h* end register for Mx.y<br>Default: 39999 |
| FC2_ADDR_INPUT_START | STAT | WORD | Modbus *Function code 02h* start register for I0.0<br>Default: 0 |
| FC2_ADDR_INPUT_END | STAT | WORD | Modbus *Function code 02h* end register for Ix.y<br>Default: 19999 |
| FC2_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 02h* start register for M0.0<br>Default: 20000 |
| FC2_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 02h* end register for Mx.y<br>Default: 39999 |
| FC4_ADDR_INPUT_START | STAT | WORD | Modbus *Function code 04h* start register for IW0<br>Default: 0 |
| FC4_ADDR_INPUT_END | STAT | WORD | Modbus *Function code 04h* end register for IWx<br>Default: 19999 |
| FC4_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 04h* start register for MW0<br>Default: 20000 |
| FC4_ADDR_MEMORY_END | STAT | WORD | Modbus *function-Code 04 h* end register for MW0<br>Default: 39999 |
| FC5_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 05h* start register for Q0.0<br>Default: 0 |

| Name | Declaration | Type | Description |
|---|---|---|---|
| FC5_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 05h* end register for Qx.y<br>Default: 19999 |
| FC5_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 05h* start register for M0.0<br>Default: 20000 |
| FC5_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 05h* end register for Mx.y<br>Default: 39999 |
| FC15_ADDR_OUTPUT_START | STAT | WORD | Modbus *Function code 0Fh* start register for Q0.0<br>Default: 0 |
| FC15_ADDR_OUTPUT_END | STAT | WORD | Modbus *Function code 0Fh* end register for Qx.y<br>Default: 19999 |
| FC15_ADDR_MEMORY_START | STAT | WORD | Modbus *Function code 0Fh* start register for M0.0<br>Default: 20000 |
| FC15_ADDR_MEMORY_END | STAT | WORD | Modbus *Function code 0Fh* end register for Mx.y<br>Default: 39999 |

The following must be observed:

- The *call parameters* must be specified with the block call. Besides the *call parameters* all parameters are located in the instance DB.
- The interface to be used must be configured before:
  - VIPA System SLIO CP 040: Configuration as ASCII module with 60 byte IO-Size in the hardware configuration.
  - Internal serial RS485 interface of a VIPA CPU:
    Configuration via SFC 216 (SER_CFG) with protocol "ASCII".
- FB 60 SEND and FB 61 RECEIVE (or FB 65 SEND_RECV) are required for the use of the block, even if the internal serial RS485 interface of a CPU from VIPA is used.
- Broadcast request via MB_UNIT_ID = 0 are only accepted for writing functions.
- The INPUT/OUTPUT Modbus addresses of a *Function code* must be located in front of the MEMORY Modbus address and thus always be lower.
- Within a *Function code* no Modbus address may be defined multiple times - also not 0!
- The slave can only process one job simultaneously. New Modbus requests during job processing are ignored and not answered.

**Status and error indication**

The function block reports via STATUS the following status and error information.

| STATUS | NDR | DR | ERROR | Description |
|---|---|---|---|---|
| 0000h | 0 or 1* | | 0 | Operation executed without error. |
| 7000h | 0 | 0 | 0 | No connection established or communication error. |
| 7005h | 0 | 0 | 0 | Data are sent. |
| 7006h | 0 | 0 | 0 | Data are received. |
| 8210h | 0 | 0 | 1 | The hardware is incompatible with the block library Modbus RTU/TCP. |
| 8380h | 0 | 0 | 1 | CRC error |

| STATUS | NDR | DR | ERROR | Description |
|---|---|---|---|---|
| 8381h | 0 | 0 | 1 | *Exception code 01h*, *Function code* is not supported. |
| 8382h | 0 | 0 | 1 | *Exception code 03h*, data length or data value are not valid. |
| 8383h | 0 | 0 | 1 | *Exception code 02h*, invalid start address or address range. |
| 8384h | 0 | 0 | 1 | *Exception code 04h*, area length error when accessing inputs, outputs or bit memories. |
| 8187h | 0 | 0 | 1 | MB_DATA_PTR not valid. |
| 8201h | 0 | 0 | 1 | HARDWARE not valid. |
| 8202h | 0 | 0 | 1 | MB_UNIT_ID not valid. |
| 8203 h | 0 | 0 | 1 | |
| *) Error free Modbus job with *Function code 05h, 06h, 0Fh* or *10h* returns NDR=1 and DR=0. Error free Modbus job with *Function code 01h, 02h, 03h, 04h* return DR=1 and NDR=0. | | | | |

### 9.2.2.1 Example

**Task**

The CPU provides 100 byte data in the flag area starting from MB200 for a Modbus master via the Modbus register 0 ... 49. Data can be read by the Modbus master via *Function code 03h* and written with *Function code 06h, 10h*. The CPU output Q1.0 is to be controlled by a Modbus master via *Function code 05h* and the start address 5008. Errors are to be stored. The Modbus RTU slave with the address 99 is realized via the internal serial RS485 interface of a VIPA CPU.

**OB100**

```
CALL  SFC  216
      Protocol :=B#16#1
      Parameter :=DB10
      Baudrate:=B#16#9
      CharLen:=B#16#3
      Parity:=B#16#2
      StopBits:=B#16#1
      FlowControl:=B#16#1
      RetVal:=MW100
```

**OB100 - Description**

1. Calling of the SFC 216 (SER_CFG) to configure the internal serial interface of the CPU from VIPA.
2. Protocol: "ASCII", 9600 baud, 8 data bit, 1 stop bit, even parity, no flow control.
3. DB10 has a variable of type WORD and must be passed as "Dummy".

**OB1**

```
L      5000
T      DB73.DBW   58

CALL  FB     73 , DB73
 ENABLE      :=M101.0
 HARDWARE    :=B#16#2
 LADDR       :=
 MB_UNIT_ID  :=B#16#63
 MB_DATA_PTR:=P#M 200.0 BYTE 100
 NDR         :=M101.1
 DR          :=M101.2
 ERROR       :=M101.3
```

```
          STATUS      :=MW102

         UN     M    101.3
         SPB    ERR1
         L      MW   102
         T      MW   104
   ERR1: NOP    0
```

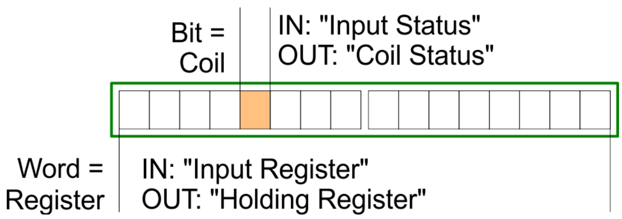
**OB1 - Description**

1. Calling the handling block of the Modbus/TCP server with the correct parameters.
2. If the interface was correctly initialized in the OB100, the slave can be used and MW102 returns 7006h.
3. The Modbus start register in the process image, which can be reached by *Function code 05h*, may be changed in the example by the parameter FC5_ADDR_OUTPUT_START (word 58 in the instance data block).
4. Set M101.0 in the CPU to TRUE.
   ⇨ The Modbus slave now works.
5. The master sends a Modbus request with *Function code 03h* start address 10 and quantity 30.
   ⇨ The slave responds with 60byte starting from MB200. DR is set for one CPU cycle and thus M101.2 is set to "1".
6. The master sends a Modbus request with *Function code 05h* start address 5008 and the value FF00h.
   ⇨ The salve acknowledges the request and writes "1" to the output Q1.0. NDR is set for one CPU cycle and thus M101.1 is set to "1".
7. The master sends a Modbus request with *Function code 03h* start address 50 (does not exist!) and quantity 1.
   ⇨ The server responds with *Exception code 02h* and sets ERROR/STATUS for one CPU cycle. MW104 returns 8383h.

## 9.3 FKT Codes

**Naming convention**

Modbus has some naming conventions:




- Modbus differentiates between bit and word access; Bits = "Coils" and Words = "Register".
- Bit inputs are referred to as "Input-Status" and bit outputs as "Coil-Status".
- Word inputs are referred to as "Input-Register" and word outputs as "Holding-Register".

**Range definitions**

Normally the access with Modbus happens by means of the ranges 0x, 1x, 3x and 4x.

0x and 1x gives you access to *digital* bit areas and 3x and 4x to *analog* word areas.

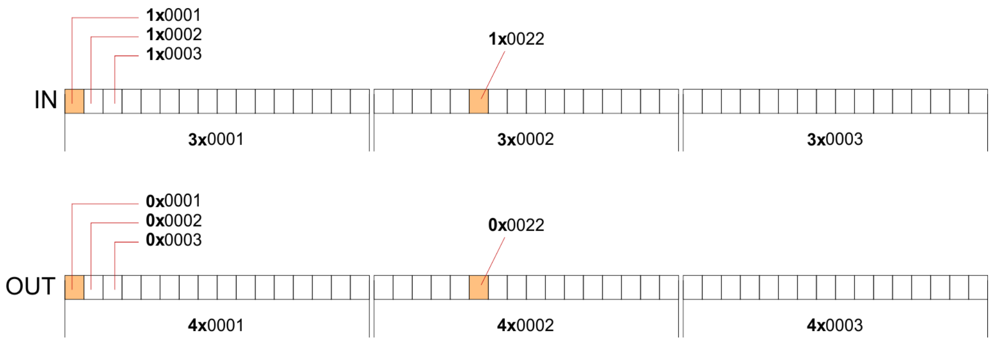
For the Ethernet coupler from VIPA is not differentiating digital and analog data, the following assignment is valid:

0x - Bit area for master output
Access via function code 01h, 05h, 0Fh

1x - Bit area for master input
Access via function code 02h

3x - Word area for master input
Access via function code 04h

4x - Word area for master output
Access via function code 03h, 06h, 10h, 16h




**Overview**

With the following Modbus function codes a Modbus master can access a Modbus slave. The description always takes place from the point of view of the master:

| Code | Command | Description |
|---|---|---|
| 01h | Read n Bits | Read n bits of master output area 0x |
| 02h | Read n Bits | Read n bits of master input area 1x |
| 03h | Read n Words | Read n words of master output area 4x |
| 04h | Read n Words | Read n words master input area 3x |
| 05h | Write 1 Bit | Write 1 bit to master output area 0x |
| 06h | Write 1 Word | Write 1 word to master output area 4x |
| 0Fh | Write n Bits | Write n bits to master area 0x |
| 10h | Write n Words | Write n words to master area 4x |
| 16h | Mask 1 Word | Mask 1 word in master output area 4x |
| 17h | Write n Words and Read m Words | Write n words into master output area 4x and the respond contains m read words of the master input area 3x |

**Byte sequence in a word**

| 1 word | |
|---|---|
| High byte | Low byte |

**Respond of the coupler**

If the slave announces an error, the function code is sent back with a "OR" and 80h. Without an error, the function code is sent back.

| | | |
|---|---|---|
| Coupler answer: | Function code OR 80h | → Error & error number |
| | Function code | → OK |

If the slave announces an error, the function code is sent back with a "OR" and 80h. Without an error, the function code is sent back.

01h: Function number is not supported

02h: Addressing errors

03h: Data errors

04h: System SLIO bus is not initialized

07h: General error

**Read n Bits 01h, 02h**

Code 01h: Read n bits of master output area 0x.

Code 02h: Read n bits of master input area 1x.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address1. bit | Number of bits |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Number of read bytes | Data 1. byte | Data 2. byte | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | | | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1byte | 1byte | 1byte | |
| | | | | | | | | | max. 252byte | | |

**Read n words 03h, 04h**

03h: Read n words of master output area 4x.

04h: Read n words master input area 3x.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address word | Number of words |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Number of read bytes | Data 1. word | Data 2. word | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | | | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1byte | 1word | 1word | |
| | | | | | | | | | max. 126words | | |

**Write 1 bit 05h**

Code 05h: Write 1 bit to master output area 0x.

A status change is via "Status bit" with following values:

"Status bit" = 0000h → Bit = 0

"Status bit" = FF00h → Bit = 1

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address bit | Status bit |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address bit | Status bit |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Write 1 word 06h**

Code 06h: Write 1 word to master output area 4x.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address word | Value word |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address word | Value word |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Write n bits 0Fh**

Code 0Fh: Write n bits to master output area 0x.

Please regard that the number of bits are additionally to be set in byte.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address1 . bit | Number of bits | Number of bytes | Data 1. byte | Data 2. byte | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | | | | | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word | 1byte | 1byte | 1byte | 1byte |
| | | | | | | | | | | | max. 248byte | | |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address 1. bit | Number of bits |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Write n words 10h**

Code 10h: Write n words to master output area 4x.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address1 . word | Number of words | Number of bytes | Data 1. word | Data 2. word | ... |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | | | | | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word | 1word | 1word | 1word | 1word |
| | | | | | | | | | | | max. 124byte | | |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address 1. word | Number of words |
|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 6 | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word |

**Mask a word 16h**

Code 16h: This function allows to mask a word in the master output area 4x.

**Command telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address word | AND Mask | OR Mask |
|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 8 | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word | 1word |

**Respond telegram**

| Modbus/TCP-Header | | | | | | Slave address | Function code | Address word | AND Mask | OR Mask |
|---|---|---|---|---|---|---|---|---|---|---|
| x | x | 0 | 0 | 0 | 8 | | | | | |
| 6byte | | | | | | 1byte | 1byte | 1word | 1word | 1word |

# 10 Serial Communication

## 10.1 Serial communication

### 10.1.1 SFC 207 - SER_CTRL - Modem functionality PtP

**Description**

Using the RS232 interface by means of ASCII protocol the serial modem lines can be accessed with this SFC during operation. Depending on the parameter *FLOWCONTROL*, which is set by *SFC 216 (SER_CFG)*, this SFC has the following functionality:

| | Read | Write |
|---|---|---|
| *FLOWCONTROL=0:* | DTR, RTS, DSR, RI, CTS, CD | DTR, RTS |
| *FLOWCONTROL>0:* | DTR, RTS, DSR, RI, CTS, CD | not possible |

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| WRITE | IN | BYTE | ■ Bit 0: New state DTR<br>■ Bit 1: New state RTS |
| MASKWRITE | IN | BYTE | ■ Bit 0: Set state DTR<br>■ Bit 1: Set state RTS |
| READ | OUT | BYTE | Status flags (CTS, DSR, RI, CD, DTR, RTS) |
| READDELTA | OUT | BYTE | Status flags of change between 2 accesses |
| RETVAL | OUT | WORD | Return value (0 = OK) |

**WRITE**

With this parameter the status of DTR and RTS is set and activated by *MASKWRITE*. The byte has the following allocation:

- Bit 0 = DTR
- Bit 1 = RTS
- Bit 7 ... Bit 2: reserved

**MASKWRITE**

Here with "1" the status of the appropriate parameter is activated. The byte has the following allocation:

- Bit 0 = DTR
- Bit 1 = RTS
- Bit 7 ... Bit 2: reserved

**READ**

You get the current status by *READ*. The current status changed since the last access is returned by *READDELTA*. The bytes have the following structure:

| Bit No. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Read | x | x | RTS | DTR | CD | RI | DSR | CTS |
| ReadDelta | x | x | x | x | CD | RI | DSR | CTS |

**RETVAL (Return value)**

| Value | Description |
|---|---|
| 0000h | no error |
| 8x24h | Error SFC parameter x, with x:<br>■ 1: Error at *WRITE*<br>■ 2: Error at *MASKWRITE*<br>■ 3: Error at *READ*<br>■ 4: Error at *READDELTA* |
| 809Ah | Interface missing |
| 809Bh | Interface not configured (SFC 216) |

## 10.1.2 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". Thus release the RS485 interface for PtP (point-to-point) communication. The RS485 interface supports in PtP operation the serial process connection to different source res. destination systems.

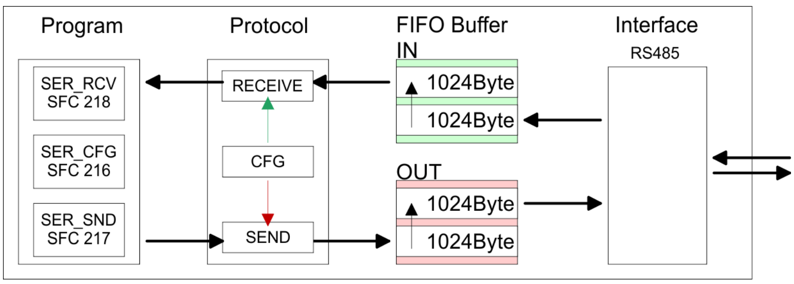
**Parametrization**

The parametrization happens during runtime using the FC/SFC 216 (SER_CFG). For this you have to store the parameters in a DB for all protocols except ASCII.

**Communication**

- Data, which are written into the according data channel by the PLC, is stored in a FIFO send buffer (first in first out) with a size of 2x1024byte and then put out via the interface.
- When the interface receives data, this is stored in a FIFO receive buffer with a size of 2x1024byte and can there be read by the PLC.
- If the data is transferred via a protocol, the adoption of the data to the according protocol happens automatically. In opposite to ASCII and STX/ETX, the protocols 3964R, USS and Modbus require the acknowledgement of the partner.
- An additional call of the FC/SFC 217 SER_SND causes a return value in RETVAL that includes among others recent information about the acknowledgement of the partner. Further on for USS and Modbus after a SER_SND the acknowledgement telegram must be evaluated by call of the FC/SFC 218 SER_RCV.

***RS485 PtP communication***



**Overview FC/SFCs for serial communication**

The following FC/SFCs are used for the serial communication:

| FC/SFC | | Description |
|---|---|---|
| FC/SFC 216 | SER_CFG | RS485 parametrize |
| FC/SFC 217 | SER_SND | RS485 send |
| FC/SFC 218 | SER_RCV | RS485 receive |

### 10.1.3 FC/SFC 216 - SER_CFG - Parametrization PtP

**Description**

The parametrization happens during runtime deploying the FC/SFC 216 (SER_CFG). You have to store the parameters for STX/ETX, 3964R, USS and Modbus in a DB.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *➫ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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) |

*The start res. end sign should always be a value <20, otherwise the sign is ignored!*

*With not used IDs please always enter FFh!*

| 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) |
| DBB4: | CharTimeout | WORD | (Char. delay time) |
| DBW6: | ConfTimeout | WORD | (Acknowledgement delay time ) |

| Data block at USS | | | |
|---|---|---|---|
| DBW0: | Timeout | WORD | (Delay time) |

| Data block at Modbus master | | | |
|---|---|---|---|
| DBW0: | Timeout | WORD | (Respond delay time) |

**BAUDRATE**

| 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 |
| *) Only permitted when *CHARLEN* = 0 (5bit) | | |

**FLOWCONTROL**

The parameter *FLOWCONTROL* is ignored. When sending RTS=1, when receiving RTS=0.

**RETVAL FC/SFC 216 (Return values)**

Return values send by the block:

| Error code | Description |
|---|---|
| 0000h | no error |
| 809Ah | Interface not found e. g. interface is used by PROFIBUS<br>In the VIPA SLIO CPU with FeatureSet PTP_NO only the ASCII protocol is configurable. If another protocol is selected the FC/SFC216 also left with this error code. |
| 8x24h | Error at FC/SFC-Parameter x, with x:<br>1: Error at *PROTOCOL*<br>2: Error at *PARAMETER*<br>3: Error at *BAUDRATE*<br>4: Error at *CHARLENGTH*<br>5: Error at *PARITY*<br>6: Error at *STOPBITS*<br>7: Error at *FLOWCONTROL* |
| 809xh | Error in FC/SFC parameter value x, where x:<br>1: Error at *PROTOCOL*<br>3: Error at *BAUDRATE*<br>4: Error at *CHARLENGTH*<br>5: Error at *PARITY*<br>6: Error at *STOPBITS*<br>7: Error at *FLOWCONTROL* (parameter is missing) |

| Error code | Description |
|---|---|
| 8092h | Access error in parameter DB (DB too short) |
| 828xh | Error in parameter x of DB parameter, where x:<br>1: Error 1. parameter<br>2: Error 2. parameter<br>... |

## 10.1.4 FC/SFC 217 - SER_SND - Send to PtP

**Description**

This block sends data via the serial interface. The repeated call of the FC/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 FC/SFC 218 SER_RCV after SER_SND.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 to be sent are 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 FC/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 FC/SFC 217 (Return values)**

Return values of the block:

| Error code | Description |
|---|---|
| 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 FC/SFC parameter x, where x:<br>1: Error in *DATAPTR*<br>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 | Description |
|---|---|
| 9000h | Buffer overflow (no data send) |
| 9002h | Data too short (0byte) |

**STX/ETX**

| Value | Description |
|---|---|
| 9000h | Buffer overflow (no data send) |
| 9001h | Data too long (>1024byte) |
| 9002h | Data too short (0byte) |
| 9004h | Character not allowed |

**3964R**

| Value | Description |
|---|---|
| 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) |

| Value | Description |
|---|---|
| 9001h | Data too long (>1024byte) |
| 9002h | Data too short (0byte) |

**USS**

| Error code | Description |
|---|---|
| 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) |

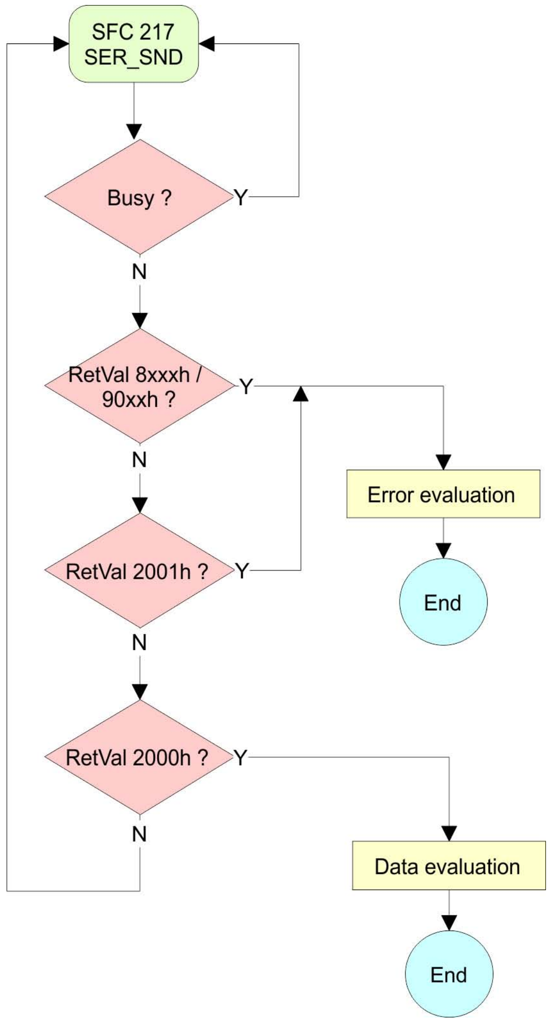
**Modbus RTU/ASCII Master**

| Error code | Description |
|---|---|
| 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) |

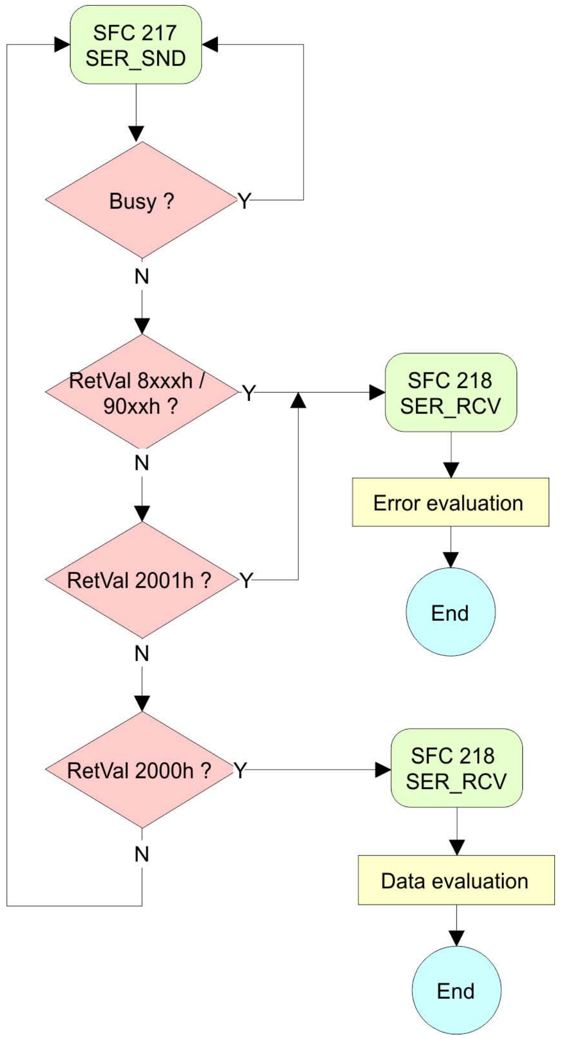
**Principles of programming**

The following text shortly illustrates the structure of programming a send command for the different protocols.

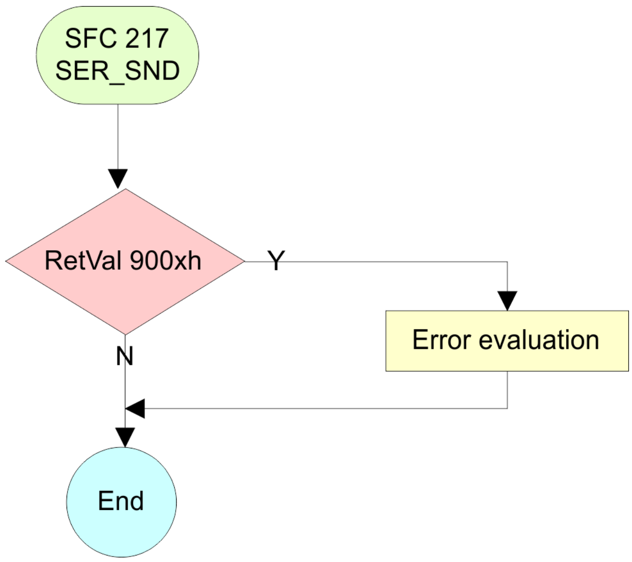
3964R



USS / Modbus




ASCII / STX/ETX



### 10.1.5 FC/SFC 218 - SER_RCV - Receive from PtP

**Description**

This block receives data via the serial interface. Using the FC/SFC 218 SER_RCV after SER_SND with the protocols USS and Modbus the acknowledgement telegram can be read.

> ***VIPA specific block***
>
> *The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 | Description |
|---|---|---|
| 0 | overrun | Overflow, a sign couldn't be read fast enough from the inter- face |
| 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 | Description |
|---|---|---|
| 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**

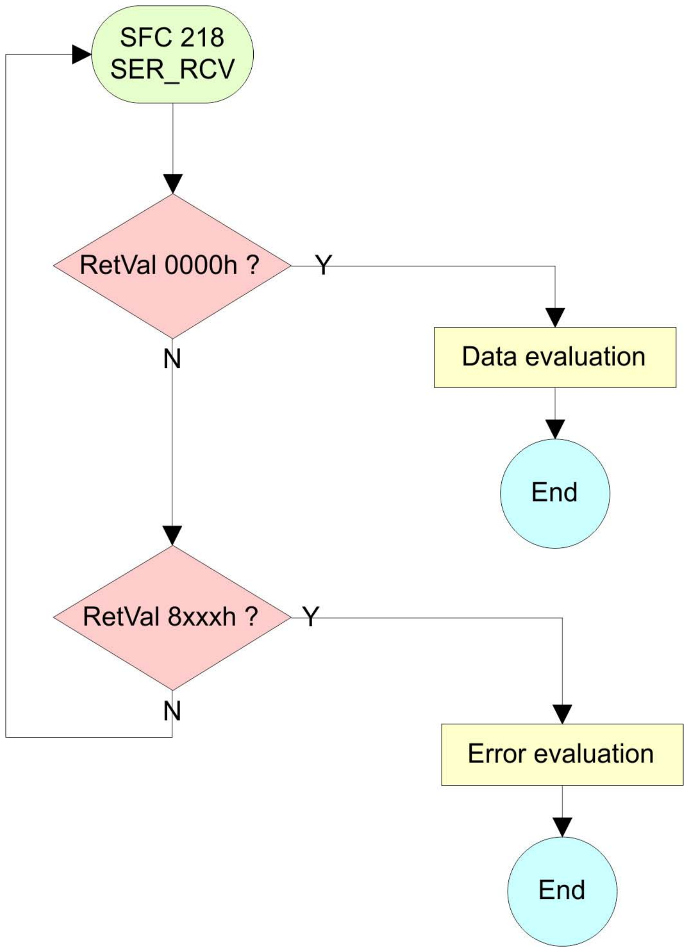
| Bit | Error | Description |
|---|---|---|
| 0 | overflow | The received telegram exceeds the size of the receive buffer. |

**RETVAL FC/SFC 218 (Return value)**

| Error code | Description |
|---|---|
| 0000h | no error |
| 1000h | Receive buffer too small (data loss) |
| 8x24h | Error at FC/SFC-Parameter x, with x:<br>1: Error at *DATAPTR*<br>2: Error at *DATALEN*<br>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.




## 10.1.6 FB 1 - RECEIVE_ASCII - Receiving with defined length from PtP

**Description**

This FB collects the data, which are received via the internal serial interface in PtP operation and copies them into the telegram buffer specified by *EMPF_PUFFER*. If the entire telegram was received *EMPF_FERTIG* is set and the FB is left. The reading of the data may require several FB calls. The next telegram is only be read, if the bit *EMPF_FERTIG* was reset by the user. With this FB only telegrams with fix length can be received.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| EMPF_PUFFER | IN | ANY | Pointer to DB in which the received telegram is transmitted. |
| ER_BYTE | OUT | WORD | Error code |
| EMPF_FERTIG | IN_OUT | BOOL | Status |

**EMPF_PUFFER**

Specify here an area of type pointer, in which the received data are to be copied. Specify type, start and length.

Example:

- Data are to be stored in DB5 starting from 0.0 with length 124byte
  – DataPtr:=P#DB5.DBX0.0 BYTE 124

**ER_BYTE**

This word gets an entry in case of error.

| Error code | Description |
|---|---|
| 0003h | DB with telegram buffer does not exist. |
| 0004h | DB with telegram buffer is too short. |
| 7000h | Receive buffer is too small - data have been deleted! |
| 8000h | Pointer setting in *EMPF_PUFFER* is faulty or does not exist. |
| 9001h | DB setting in *EMPF_PUFFER* is faulty or does not exist. |
| 9002h | Length setting in *EMPF_PUFFER* is faulty or does not exist. |

### 10.1.7 FB 7 - P_RCV_RK - Receive from CP 341

**Description**

The FB 7 P_RCV_RK transfers data from the CP to a data area of the CPU specified by the parameter *DB_NO, DBB_NO* and *LEN*. For data transfer the FB is to be called either cyclically or statically by a timer-driven program. Please note that this block calls the FC or SFC 192 CP_S_R internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| EN_R | IN | BOOL | Enables data read |
| R | IN | BOOL | Aborts request - current request is aborted and receiving is blocked. |
| LADDR | IN | INT | Logical basic address of the CP - corresponds to the address of the hardware configuration of the CP. |
| DB_NO | IN | INT | Data block number - number of the receive DB, zero is not allowed. |
| DBB_NO | IN | INT | Data byte number - received data as of data byte 0 ≤ *DBB_NO* ≤ 8190 |
| L_... | OUT | - | These parameters are not relevant for ASCII and 3964(R). But they may be used by loadable protocols. |
| NDR* | OUT | BOOL | Request complete without errors, data received Parameter *STATUS* = 00h |
| ERROR* | OUT | BOOL | Request complete with error Parameter *STATUS* contains error details |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| LEN* | OUT | BOOL | Length of the received telegram in byte 1 ≤ *LEN* ≤ 1024 |
| STATUS* | OUT | WORD | Specification of the error on *ERROR* = 1 |
| *) Parameter is available until the next call of the FB. | | | |

**Release and cancel a request**

- With the signal state ”1” at parameter *EN_R*, the software checks whether data can be read by the CP. A data transmission operation can run over several program cycles, depending on the amount of data involved.
- An active transmission can be aborted with signal state ”0” at the *EN_R* parameter. The aborted receive request is terminated with an error message (*STATUS*).
- Receiving is deactivated as long as the *EN_R* parameter shows the signal state ”0”. A running request may me canceled with R = "1" then the FB is reset to the basic state. Receiving is deactivated as long as the R parameter shows the signal state ”1”.

**Mechanism for startup synchronization**

The FB 7 has a mechanism for startup-synchronization between CPU and CP, which is automatically executed at the first call of the FB. Before the CP can process an activated request after the CPU has changed from STOP to RUN mode, the CP CPU start-up mechanism must be completed. Any requests initiated in the meantime are transmitted once the start-up coordination with the CP is finished.

*A minimum pulse time is necessary for a signal change to be identified. Significant time periods are the CPU cycle time, the updating time on the CP and the response time of the communication partner.*

**Error indication**

- The *NDR* output shows ”request completed without errors/data accepted”. If there was an *ERROR*, the corresponding event number is displayed in the *STATUS*. If no error occurs the value of *STATUS* is "0".
- *NDR* and *ERROR/STATUS* are also output in response to a *RESET* of the FB. In the event of an error, the binary result BR is reset. If the block is terminated without errors, the binary result has the status "1".
- Please regard the parameter *NDR, ERROR* and *STATUS* are only available at one block call. For further evaluation these should be copied to a free data area.

**Addressing**

With *LADDR* the address of the corresponding CP is specified. This is the address, which was specified by the hardware configuration of the CP. Please regard that the base address for input and output of the CP are identical.

**Data area**

The FB 7 - P_RCV_RK deals with an Instanz-DB I_RCV_RK. This has a length from 60byte. The DB no. is transmitted with the call. It is not allowed to access the data of an instance DB.

### 10.1.8 FB 8 - P_SND_RK - Send to CP 341

**Description**

The FB 8 - P_SND_RK transfers a data block of a DB to the CP, specified by the parameters *DB_NO*, *DBB_NO* and *LEN*. For data transfer the FB is to be called either cyclically or statically by a timer-driven program. Please note that this block calls the FC or SFC 192 CP_S_R internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| SF | IN | CHAR | S = Send, F = Fetch. At ASCII and 3964R the default value "S" for Send may be used |
| REQ | IN | BOOL | Initiates request with positive edge |
| R | IN | BOOL | Aborts request - current request is aborted and sending is blocked. |
| LADDR | IN | INT | Logical basic address of the CP - corresponds to the address of the hardware configuration of the CP. |
| DB_NO | IN | INT | Data block number - number of the send DB, zero is not allowed. |
| DBB_NO | IN | INT | Data byte number - transmitted data as of data byte 0 ≤ *DBB_NO* ≤ 8190 |
| LEN | IN | INT | Length of message frame to be sent in byte 1 ≤ *LEN* ≤ 1024 |
| R_... | IN | - | These parameters are not relevant for ASCII and 3964(R). But they may be used by loadable protocols. With Modbus enter here "X". |
| DONE* | OUT | BOOL | Request complete without errors, data sent Parameter *STATUS* = 00h |
| ERROR* | OUT | BOOL | Request complete with error Parameter *STATUS* contains error details |
| STATUS* | OUT | WORD | Specification of the error on *ERROR* = 1 |
| *) Parameter is available until the next call of the FB. | | | |

**Release and cancel a request**

- The data transmission is initiated by a positive edge at the *REQ* input of FB 8 - P_SND_RK. A data transmission operation can run over several program cycles, depending on the amount of data involved.
- A running request may me canceled at any time with *R* = "1" then the FB is reset to the basic state. Please regard that data, which the CP still has received from the CPU, were sent to the communication partner.
- If the *R* input is statically showing the signal state "1", this means that sending is deactivated.

**Mechanism for startup synchronization**

The FB 8 has a mechanism for startup-synchronization between CPU and CP, which is automatically executed at the first call of the FB. Before the CP can process an activated request after the CPU has changed from STOP to RUN mode, the CP CPU start-up mechanism must be completed. Any requests initiated in the meantime are transmitted once the start-up coordination with the CP is finished.

*A minimum pulse time is necessary for a signal change to be identified. Significant time periods are the CPU cycle time, the updating time on the CP and the response time of the communication partner.*

**Error indication**

- The *DONE* output shows ”request completed without errors”. If there was an *ERROR*, the corresponding event number is displayed in the *STATUS*. If no error occurs the value of *STATUS* is "0".
- *DONE* and *ERROR/STATUS* are also output in response to a *RESET* of the FB. In the event of an error, the binary result BR is reset. If the block is terminated without errors, the binary result has the status "1".
- Please regard the parameter *DONE, ERROR* and *STATUS* are only available at one block call. For further evaluation these should be copied to a free data area.

**Addressing**

With *LADDR* the address of the corresponding CP is specified. This is the address, which was specified by the hardware configuration of the CP. Please regard that the base address for input and output of the CP are identical.

**Data area**

The FB 8 - P_SND_RK deals with an Instanz-DB I_SND_RK. This has a length from 62byte. The DB no. is transmitted with the call. It is not allowed to access the data of an instance DB.

## 10.2 CP040

### 10.2.1 FB 60 - SEND - Send to System SLIO CP 040

**Description**

This FB serves for the data output from the CPU to the System SLIO CP 040. Here you define the send range via the identifiers *DB_NO*, *DBB_NO* and *LEN*. A rising edge at *REQ* a transmission is initiated and the data is sent.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 ‘Include VIPA library’ on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| REQ | IN | BOOL | Release SEND with positive edge. |
| R | IN | BOOL | Release synchronous reset. |
| LADDR | IN | INT | Logical base address of the CP. |
| DB_NO | IN | INT | Number of DB containing data to send. |
| DBB_NO | IN | INT | Data byte number - send data starting from data byte. |
| LEN | IN | INT | Length of telegram in byte, to be sent. |
| IO_SIZE | IN | WORD | Configured IO size of the module. |
| DONE* | OUT | BOOL | Send order finished without errors. |
| ERROR* | OUT | BOOL | Send order finished with errors.<br>Parameter *STATUS* contains the error information. |
| STATUS* | OUT | WORD | Specification of the error with *ERROR* = 1. |
| CONTROL | IN_OUT | BYTE | Divided byte with RECEIVE handling block:<br>SEND (bit 0 … 3), RECEIVE (bit 4 … 7). |
| *) Parameter is available until the FB is called. | | | |

***REQ***

Request - Send release:

- With a positive edge on input *REQ* the transfer of the data is triggered.
- Depending on the number of data, a data transfer can run over several program cycles.

***R***

Synchronous reset:

- For the initialization SEND is once to be called in the start-up OB with every parameter and set *R*.
- At any time a current order may be cancelled and the FB may be set to initial state with signal state "1" of *R*. Please regard that the data, which the CP has already received, are still sent to the communication partner.
- The Send function is deactivated as long as *R* is statically set to "1".

***LADDR***

Peripheral address:

- With *LADDR* the address of the corresponding CP may be determined. This is the address, which you have assigned via the hardware configuration for the CP.

***DB_NO***

Data block number:

- Number of the data block, which contains the data to send.
- Zero is not permitted.

***DBB_NO***

Data byte number:

- Number of data byte in the data block, starting from which the transmit data are stored.

***LEN***

Length:

- Length of the user data to be sent.
- It is: 1 ≤ *LEN* ≤ 1024.

***IO_SIZE***

Size I/O area:

- Enter the size of the I/O area. Depending on the host system the CP occupies for input and output the following bytes in the I/O areas:
  – PROFIBUS: 8byte, 20byte or 60byte selectable
  – PROFINET: 20byte or 60byte selectable
  – CANopen: 8byte
  – EtherCAT: 60byte
  – DeviceNET: 60byte
  – ModbusTCP: 60byte

***DONE***

*DONE:*

- is set at order ready without errors and *STATUS* = 0000h.

***ERROR***

*ERROR:*

- is set at order ready with error. Here *STATUS* contains the corresponding error message.

**STATUS**

If there is no error, *STATUS* = 0000h or 8181h. With an error here the corresponding error code may be found. As long as *ERROR* is set, the value of *STATUS* is available. The following status messages are possible:

| STATUS | Description |
|---|---|
| 0000h | No error found |
| 0202h | Handling block and CP are not synchronous (Remedy: Start synchronous reset) |
| 0301h | DB not valid |
| 070Ah | Transfer failed, there is no response of the partner or the telegram was negative acknowledged. |
| 0816h | Parameter *LEN* is not valid<br>(LEN = 0 or LEN > 1024) |
| 8181h | Order running (Status and no error message) |

**CONTROL**

The handling blocks SEND and RECEIVE use the common parameter *CONTROL* for the handshake. Assign to this parameter a common flag byte.

**Error indication**

- The *DONE* output shows "order ready without error". If there was an *ERROR*, the corresponding event number is displayed in the *STATUS*. If no error occurs the value of *STATUS* is "0".
- *DONE*, *ERROR* and *STATUS* are also output in response to a reset of the FB. In the event of an error, the binary result *BR* is reset. If the block is terminated without errors, the binary result has the status "1".
- Please regard the parameter *DONE*, *ERROR* and *STATUS* are only available at one block call. For further evaluation these should be copied to a free data area.

## 10.2.2 FB 61 - RECEIVE - Receive from System SLIO CP 040

**Description**

This FB serves for the data reception from the System SLIO CP 040. Here you set the reception range via the identifiers *DB_NO* and *DBB_NO*. The length of the telegram is stored in *LEN*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| EN_R | IN | BOOL | Release RECEIVE data. |
| R | IN | BOOL | Release synchronous reset. |
| LADDR | IN | INT | Logical base address of the CP. |
| DB_NO | IN | INT | Number of DB containing received data. |
| DBB_NO | IN | INT | Data byte number - receive data starting from data byte. |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| IO_SIZE | IN | WORD | Configured IO size of the module. |
| LEN | OUT | INT | Length of received telegram in byte |
| NDR* | OUT | BOOL | Receive order finished without errors. |
| ERROR* | OUT | BOOL | Receive order finished with errors. Parameter *STATUS* contains the error information. |
| STATUS* | OUT | WORD | Specification of the error with *ERROR* = 1. |
| CONTROL | IN_OUT | BYTE | Divided byte with RECEIVE handling block:<br>SEND (bit 0 … 3), RECEIVE (bit 4 … 7). |
| *) Parameter is available until the FB is called. | | | |

***EN_R***

Enable Receive - Release to read:

- With signal status "1" at *EN_R* the examination, whether data from the CP are read, is released. Depending upon the number of data, a data transfer can run over several program cycles.
- At any time a current order may be cancelled with signal state "0" of *EN_R*. Here the cancelled receipt order is finished with an error message (*STATUS*).
- The Receive function is deactivated as long as *EN_R* is statically set to "0".

***R***

Synchronous reset:

- For the initialization RECEIVE is once to be called in the start-up OB with every parameter and set *R*.
- At any time a current order may be cancelled and the FB may be set to initial state with signal state "1" of *R*.
- The Receive function is deactivated as long as *R* is statically set to "1".

***LADDR***

Peripheral address:

- With *LADDR* the address of the corresponding CP may be determined. This is the address, which you have assigned via the hardware configuration for the CP.

***DB_NO***

Data block number:

- Number of the data block, which contains the data are read.
- Zero is not permitted.

***DBB_NO***

Data byte number:

- Number of data byte in the data block, starting from which the received data are stored.

***IO_SIZE***

Size I/O area:

- Enter the size of the I/O area. Depending on the host system the CP occupies for input and output the following bytes in the I/O areas:
  - PROFIBUS: 8byte, 20byte or 60byte selectable
  - PROFINET: 20byte or 60byte selectable
  - CANopen: 8byte
  - EtherCAT: 60byte
  - DeviceNET: 60byte
  - ModbusTCP: 60byte

***LEN***

Length:

- Length of the user data to be sent.
- It is: 1 ≤ *LEN* ≤ 1024.

***NDR***

- New received data are ready for the CPU in the CP.

***ERROR***

ERROR:

- is set at order ready with error. Here *STATUS* contains the corresponding error message.

***STATUS***

If there is no error, *STATUS* = 0000h or 8181h. With an error here the corresponding error code may be found. As long as *ERROR* is set, the value of *STATUS* is available. The following status messages are possible:

| STATUS | Description |
|---|---|
| 0000h | No error found |
| 0202h | Handling block and CP are not synchronous (Remedy: Start synchronous reset) |
| 0301h | DB not valid |
| 070Ah | Transfer failed, there is no response of the partner or the telegram was negative acknowledged. |
| 0816h | Parameter *LEN* is not valid<br>(*LEN* = 0 or *LEN* > 1024) |
| 080Ah | A free receive buffer is not available |
| 080Ch | Wrong character received<br>(Character frame or parity error) |
| 8181h | Order running<br>(Status and no error message) |

***CONTROL***

- The handling blocks SEND and RECEIVE use the common parameter *CONTROL* for the handshake.
- Assign to this parameter a common flag byte.

**Error indication**

- The *NDR* output shows "order ready without error / data kept". If there was an *ERROR*, the corresponding event number is displayed in the *STATUS*. If no error occurs the value of *STATUS* is "0".
- *NDR*, *ERROR* and *STATUS* are also output in response to a reset of the FB. In the event of an error, the binary result BR is reset. If the block is terminated without errors, the binary result has the status "1".
- Please regard the parameter *NDR*, *ERROR* and *STATUS* are only available at one block call. For further evaluation these should be copied to a free data area.

### 10.2.3 FB 65 - CP040_COM - Communication SLIO CP 040

**Description**

The FB 65 serves the data in-/output from the System SLIO CPU to the CP 040. Here you define the send/receive range via the identifiers *DB_NO_SEND* and *DB_NO_RECV*. A rising edge at *REQ_SEND* a transmission is initiated and the data are sent. Via *EN_RECV* the received data are enabled.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declara-tion | Type | Description |
|---|---|---|---|
| REQ_SEND | IN | BOOL | Release SEND with positive edge. |
| EN_RECV | IN | BOOL | Enable receive data. |
| RESET | IN | BOOL | Release synchronous reset. |
| ADDR_IN | IN | INT | Logical input base address of the CP from the Hardware configuration. |
| ADDR_OUT | IN | INT | Logical output base address of the CP from the Hardware configuration. |
| DB_NO_SEND | IN | INT | Number of DB containing data to send.<br>Zero is not permitted. |
| DBB_NO_SEND | IN | INT | Data byte number - send data starting from data byte. |
| LEN_SEND | IN | INT | Length of telegram in byte, to be sent.<br>1 ≤ *LEN_SEND* ≤ 1024 |
| DB_NO_RECV | IN | INT | Number of DB containing data to receive.<br>Zero is not permitted. |
| DBB_NO_RECV | IN | INT | Data byte number - receive data starting from data byte. |
| IO_SIZE | IN | WORD | Configured IO size of the module. |
| DONE_SEND* | OUT | BOOL | Send order finished without errors.<br>Data sent: Parameter *STATUS_SEND* = 0000h. |
| ERROR_SEND* | OUT | BOOL | Send order finished with errors.<br>Here Parameter *STATUS_SEND* contains the corresponding error message. |

| Name | Declaration | Type | Description |
|---|---|---|---|
| STATUS_SEND* | OUT | WORD | Specification of the error with *ERROR_SEND* = 1 |
| LEN_RCV | OUT | INT | Length of received telegram in byte<br>1 ≤ *LEN_RCV* ≤ 1024 |
| NDR_RCV* | OUT | BOOL | Receive order finished without errors.<br>Data sent: Parameter *STATUS_RCV* = 0000h.<br>The Parameter is available until a cycle. |
| ERROR_RCV* | OUT | BOOL | Receive order finished with errors.<br>Parameter *STATUS_RCV* contains the error information. |
| STATUS_RCV* | OUT | WORD | Specification of the error with *ERROR_RCV* = 1 |
| *) Parameter is available until the FB is called. | | | |

***REQ_SEND***

Request - Send release:

- With a positive edge on input *REQ_SEND* the transfer of the data is triggered. Depending on the number of data, a data transfer can run over several program cycles.

***EN_RECV***

Enable receive data.

***RESET***

Synchron Reset:

- For the initialization the FB 65 is once to be called in the start-up OB with every parameter and set *RESET*.
- At any time a current order may be cancelled and the FB may be set to initial state with signal state "1" of *RESET*.
- Please regard that the data, which the CP has already received, are still sent to the communication partner. The Send function is deactivated as long as *RESET* is statically set to "1".

***ADDR_IN***

Peripheral input address:

- With *ADDR_IN* the input address of the corresponding CP may be determined. This is the address, which you have assigned via the hardware configuration for the CP.

***ADDR_OUT***

Peripheral output address:

- With *ADDR_OUT* the output address of the corresponding CP may be determined. This is the address, which you have assigned via the hardware configuration for the CP.

***DB_NO_SEND***

Number of the DB SEND:

- Number of the data block, which contains the data to send.
- Zero is not permitted.

***DBB_NO_SEND***

Data byte number SEND:

- Number of data byte in the data block, starting from which the transmit data are stored.

***LEN_SEND***

Length SEND:

- Length of the user data to be sent.
- It is: 1 ≤ *LEN_SEND* ≤ 1024.

***DB_NO_RECV***

Number of the DB RECV:

- Number of the data block, which contains the receive data.
- Zero is not permitted.

***DBB_NO_RECV***

Data byte number RECV:

- Number of data byte in the data block, starting from which the received data are stored.

***IO_SIZE***

Size I/O area:

- Enter the size of the I/O area. Depending on the host system the CP occupies for input and output the following bytes in the I/O areas:
  – SLIO CPU: 8byte, 20byte or 60byte selectable
  – PROFIBUS: 8byte, 20byte or 60byte selectable
  – PROFINET: 20byte or 60byte selectable
  – CANopen: 8byte
  – EtherCAT: 60byte
  – DeviceNET: 60byte
  – ModbusTCP: 60byte

***DONE_SEND***

*DONE_SEND* is set at order ready without errors and *STATUS_SEND* = 0000h.

***ERROR_SEND***

*ERROR_SEND* is set at order ready with error. Here *STATUS_SEND* contains the corresponding error message.

***STATUS_SEND***

If there is no error, *STATUS_SEND* = 0000h or 8181h. With an error here the corresponding error code may be found. As long as *ERROR_SEND* is set, the value of *STATUS_SEND* is available. Following status messages are possible:

| STATUS | Description |
|---|---|
| 0000h | No error found |
| 0202h | *IO_SIZE* = 0 or *IO_SIZE* > 60 |
| 0301h | DB not valid |
| 070Ah | Transfer failed, there is no response of the partner or the telegram was negative acknowledged |

| STATUS | Description |
|---|---|
| 0517h | Parameter *LEN_SEND* is not valid<br>(*LEN_SEND* = 0 or *LEN_SEND* > 1024) |
| 8181h | Order running<br>(Status and no error message) |

***LEN_RCV***

Length Receive:

- Length of the received telegram in byte.
- 1 ≤ *LEN_RCV* ≤ 1024

***NDR_RCV***

New data ready:

- New received data are ready in receive DB. Signal stays for one cycle.
- Received data without error: Parameter *STATUS_RCV* = 0000h.

***ERROR_RCV***

*ERROR_RCV* is set at order ready with error. Here *STATUS_RCV* contains the corresponding error message.

***STATUS_RCV***

If there is no error, *STATUS_RCV* = 0000h or 8181h. With an error here the corresponding error code may be found. As long as *ERROR_RCV* is set, the value of *STATUS_RCV* is available. The following status messages are possible:

| STATUS | Description |
|---|---|
| 0000h | No error found |
| 0202h | *IO_SIZE* = 0 or *IO_SIZE* > 60 |
| 0301h | DB not valid |
| 070Ah | Transfer failed, there is no response of the partner or the telegram was negative acknowledged |
| 0816h | Parameter *LEN_RCV* is not valid<br>(*LEN_RCV* = 0 or *LEN_RCV* > 1024) |
| 080Ah | A free receive buffer is not available |
| 080Ch | Wrong character received<br>(Character frame or parity error) |
| 8181h | Order running<br>(Status and no error message) |

**Error indication**

- The *DONE_SEND* output shows "send order finished without error / data kept".
- The *NDR_RCV* output shows "receive order finished without error".
- If there was *ERROR_SEND* or *ERROR_RCV*, the corresponding event number is displayed in the *STATUS_SEND, STATUS_RCV*. If no error occurs the value of *STATUS_SEND* and *STATUS_RCV* is 0000h.

- *DONE_SEND, NDR_RCV, ERROR_SEND, ERROR_RCV* and *STATUS_SEND, STATUS_RCV* are also output in response to a reset of the FB. In the event of an error, the binary result BR is reset. If the block is terminated without errors, the binary result has the status "1".
- Please regard the parameter *DONE_SEND, NDR_RCV, ERROR_SEND, ERROR_RCV* and *STATUS_SEND, STATUS_RCV* are only available at one block call. For further evaluation these should be copied to a free data area.

## 10.3 CP240

### 10.3.1 FC 0 - SEND - Send to CP 240

**Description**

This FC serves the data output from the CPU to the CP 240. Here you define the send range via the identifiers *_DB, ABD* and *ANZ*. Via the bit *FRG* the send initialization is set and the data is send. After the data transfer the handling block sets the bit *FRG* back again.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| ADR | IN | INT | Logical Address |
| _DB | IN | BLOCK_DB | DB No. of DB containing data to send |
| ABD | IN | WORD | Number of 1. data word to send |
| ANZ | IN | WORD | No of bytes to send |
| FRG | IN_OUT | BOOL | Start bit of the function |
| GESE | IN_OUT | WORD | internal use |
| ANZ_INT | IN_OUT | WORD | internal use |
| ENDE_KOMM | IN_OUT | BOOL | internal use |
| LETZTER_BLOCK | IN_OUT | BOOL | internal use |
| SENDEN_LAEUFT | IN_OUT | BOOL | Status of function |
| FEHLER_KOM | IN_OUT | BOOL | internal use |
| PAFE | OUT | BYTE | Parameterization error (0 = OK) |

**ADR**

Periphery address with which you may call the CP 240. Via the hardware configuration you may set the periphery address.

**_DB**

Number of the data block, which contains the data to send.

**ABD**

Word variable that contains the number of the data word from where on the characters for output are stored.

**ANZ**

Number of the bytes that are to be transferred.

**FRG enable send**

At *FRG* = "1" the data defined via *_DB, ADB* and *ANZ* are transferred once to the CP addresses by *ADR*. After the transmission the *FRG* is set back again. When *FRG* = "0" at call of the block, it is left immediately!

**PAFE**

At proper function, all bits of this bit memory byte are "0". At errors an error code is entered. The error setting is self-acknowledging, i.e. after elimination of the error cause, the byte is set back to "0" again. The following errors may occur:

- 1 = Data block not present
- 2 = Data block too short
- 3 = Data block number outside valid range

**GESE, ANZ_INT**
**ENDE_KOM**
**LETZTER_BLOCK**
**SENDEN_LAEUFT**
**FEHLER_KOM**

These parameters are internally used. They serve the information exchange between the handling blocks. For the deployment of the SYNCHRON_RESET (FC9) the control bits ENDE_KOM, LETZTER _BLOCK, SENDEN_LAEUFT and FEHLER_KOM must always be stored in a bit memory byte.

### 10.3.2 FC 1 - RECEIVE - Receive from CP 240

**Description**

This FC serves the data reception of the CP 240. Here you set the reception range via the identifiers *_DB* and *ABD*. When the output *EMFR* is set, a new telegram has been read completely. The length of the telegram is stored in *ANZ*. After the evaluation of the telegram this bit has to be set back by the user, otherwise no further telegram may be taken over by the CPU.

> ***VIPA specific block***
>
> *The VIPA specific blocks can be found in the VIPA library.* *➪ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| ADR | IN | INT | Logical Address |
| _DB | IN | BLOCK_DB | DB No. of DB containing received data |
| ABD | IN | WORD | No. of 1st data word received |
| ANZ | OUT | WORD | No of bytes received |
| EMFR | OUT | BOOL | 1=data received, reset by user |
| GEEM | IN_OUT | WORD | internal use |
| ANZ_INT | IN_OUT | WORD | internal use |
| EMPF_LAEUFT | IN_OUT | BOOL | Status of function |
| LETZTER_BLOCK | IN_OUT | BOOL | internal use |
| FEHLER_EMPF | IN_OUT | BOOL | internal use |
| PAFE | OUT | BYTE | Parameterization error (0 = OK) |
| OFFSET | IN_OUT | WORD | internal use |

**ADR**

Periphery address for calling the CP 240. You define the periphery address via the hardware configuration.

**_DB**

Number of the data block, which contains the data.

**ABD**

Word variable that contains the number of the data word from where on the received characters are stored.

**ANZ**

Word variable that contains the amount of received bytes.

**EMFR**

By setting of *EMFR* the handling block shows that data has been received. Not until setting back *EMFR* in the user application new data can be received.

**PAFE**

At proper function, all bits of this bit memory byte are "0". At errors an error code is entered. The error setting is self-acknowledging, i.e. after elimination of the error cause, the byte is set back to "0" again. The following errors may occur:

- 1 = Data block not present
- 2 = Data block too short
- 3 = Data block number outside valid range

**GEEM, ANZ_INT LETZTER_BLOCK EMPF_LAEUFT FEHLER_EMPF OFFSET**

These parameters are internally used. They serve the information exchange between the handling blocks. For the deployment of the SYNCHRON_RESET (FC9) the control bits LETZTER_BLOCK, EMPF_LAEUFT and FEHLER_EMPF must always be stored in a bit memory byte.

## 10.3.3 FC 8 - STEUERBIT - Modem functionality CP 240

**Description**

This block allows you the following access to the serial modem lines:

| | |
|---|---|
| Read: | DTR, RTS, DSR, RI, CTS, CD |
| Write: | DTR, RTS |

> ***VIPA specific block***
>
> *The VIPA specific blocks can be found in the VIPA library.* *⇨ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| ADR | IN | INT | Logical Address |
| RTS | IN | BOOL | New state RTS |
| DTR | IN | BOOL | New state DTR |
| MASKE_RTS | IN | BOOL | ■ 0: do nothing<br>■ 1: set state RTS |

| Name | Declaration | Type | Comment |
|---|---|---|---|
| MASKE_DTR | IN | BOOL | ■ 0: do nothing<br>■ 1: set state DTR |
| STATUS | OUT | BYTE | Status flags |
| DELTA_STATUS | OUT | BYTE | Status flags of change between 2 accesses |
| START | IN_OUT | BOOL | Start bit of the function |
| AUFTRAG_LAEU | IN_OUT | BOOL | Status of function |
| RET_VAL | OUT | WORD | Return value (0 = OK) |

*This block must not be called as long as a transmit command is running otherwise you risk a data loss.*

**ADR**

Periphery address with which you may call the CP 240. Via the hardware configuration you may set the periphery address.

**RTS, DTR**

This parameter presets the status of RTS res. *DTR*, which you may activate via *MASK_RTS* res. *MASK_DTR*.

**MASK_RTS, MASK_DTR**

With 1, the status of the according parameter is taken over when you set *START* to 1.

**STATUS, DELTA_STATUS**

*STATUS* returns the actual status of the modem lines. *DELTA_STATUS* returns the state of the modem lines that have changed since the last access. The bytes have the following structure:

| Bit no. | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| STATUS | x | x | RTS | DTR | CD | RI | DSR | CTS |
| DELTA_STATUS | x | x | x | x | CD | RI | DSR | CTS |

**START**

By setting of *START*, the state, which has been activated via the mask, is taken over.

**AUFTRAG_LAEU**

As long as the function is executed, this bit remains set.

**RET_VAL**

At this time, this parameter always returns 00h and is reserved for future error messages.

## 10.3.4 FC 9 - SYNCHRON_RESET - Synchronization CPU and CP 240

**Description**

The block must be called within the cyclic program section. This function is used to acknowledge the start-up ID of the CP 240 and thus the synchronization between CPU and CP. Furthermore it allows to set back the CP in case of a communication interruption to enable a synchronous start-up.

*A communication with SEND and RECEIVE blocks is only possible when the parameter ANL of the SYNCHRON block has been set in the start-up OB before.*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| ADR | IN | INT | Logical address |
| TIMER_NR | IN | WORD | Timer number |
| ANL | IN_OUT | BOOL | CPU restart progressed |
| NULL | IN_OUT | BOOL | Internal use |
| RESET | IN_OUT | BOOL | Reset the CP |
| STEUERB_S | IN_OUT | BYTE | Internal use |
| STEUERB_R | IN_OUT | BYTE | Internal use |

**ADR**

Periphery address with which you may call the CP 240. Via the hardware configuration you may set the periphery address.

**TIMER_NR**

Number of the timer for the delay time.

**ANL**

With *ANL* = 1 the handling block is informed that a STOP/START res. NETZ-AUS/NETZ-EIN has been executed at the CPU and now a synchronization is required. After the synchronization, *ANL* is automatically set back.

**NULL**

Parameter is used internally.

**RESET**

*RESET* = 1 allows you to set back the CP out of your user application.

**STEUERB_S**

Here you have to set the bit memory byte where the control bits ENDE_KOM, LETZTER_BLOCK, SENDEN_LAEUFT and FEHLER_KOM for the SEND-FC are stored.

**STEUERB_R**

Here you have to set the bit memory byte where the control bits LETZTER_BLOCK, EMPF_LAEUFT and FEHLER_EMPF for the RECEIVE-FC are stored.

## 10.3.5 FC 11 - ASCII_FRAGMENT - Receive fragmented from CP 240

**Description**

This FC serves the fragmented ASCII data reception. This allows you to handle on large telegrams in 12byte blocks to the CPU directly after the reception. Here the CP does not wait until the complete telegram has been received. The usage of the FC 11 presumes that you've parameterized "ASCII-fragmented" at the receiver. In the FC 11, you define the reception range via the identifiers *_DB* and *ABD*. When the output *EMFR* is set, a new telegram has been read completely. The length of the read telegram is stored in ANZ. After the evaluation of the telegram this bit has to be set back by the user, otherwise no further telegram may be taken over by the CPU.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| ADR | IN | INT | Logical Address |
| _DB | IN | BLOCK_DB | DB No. of DB containing received data |
| ABD | IN | WORD | No. of 1st data word received |
| ANZ | OUT | WORD | No of bytes received |
| EMFR | IN_OUT | BOOL | Receipt confirmation |
| GEEM | IN_OUT | WORD | Internal use |
| ANZ_INT | IN_OUT | WORD | Internal use |
| EMPF_LAEUFT | IN_OUT | BOOL | Internal use |
| LETZTER_BLOCK | IN_OUT | BOOL | Internal use |
| FEHLER_EMPF | IN_OUT | BOOL | Internal use |
| PAFE | OUT | BYTE | Parameterization error (0 = OK) |

**ADR**

Periphery address with which you may call the CP 240. Via the hardware configuration you may set the periphery address.

**_DB**

Number of the data block, which contains the data to receive.

**ABD**

Word variable that contains the number of the data word from where on the received characters are stored.

**ANZ**

Word variable that contains the amount of bytes that have been received.

**EMFR**

By setting of *EMFR*, the handling block announces that data has been received. Only by setting back *EMFR* in the user application new data can be received.

**PAFE**

At proper function, all bits of this bit memory byte are "0". At errors an error code is entered. The error setting is self-acknowledging, i.e. after elimination of the error cause, the byte is set back to "0" again. The following errors may occur:

- 1 = Data block not present
- 2 = Data block too short
- 3 = Data block number outside valid range

**GEEM, ANZ_INT**
**LETZTER_BLOCK**
**EMPF_LAEUFT**
**FEHLER_EMPF**

These parameters are internally used. They serve the information exchange between the handling blocks. For the deployment of the SYNCHRON_RESET (FC 9) the control bits LETZTER_BLOCK, EMPF_LAEUFT and FEHLER_EMPF must always be stored in a bit memory byte.

# 11 EtherCAT Communication

## 11.1 SDO Communication

### 11.1.1 FB 52 - SDO_READ - Read access to Object Dictionary Area

**Description**

With this block, you will have read access to the object directory of the EtherCAT slave stations and EtherCAT master. The block operates asynchronously, that is, processing covers multiple FB calls. Start the job by calling FB 52 with REQ = 1. The job status is displayed via the output parameters BUSY and RETVAL. The record set transmission is completed when the output parameter BUSY = FALSE. The error handling happens with the parameters ERROR, ERROR_ID and RETVAL.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQ | IN | BOOL | REQ = 1:<br>activates the SDO access at rising edge. |
| ID | IN | WORD | Logical base address of the EtherCAT slave station respectively master in the hardware configuration.<br>With an output module bit 15 must be set (example for address 5: ID:=DW#16#8005). With a combination module you have to set the lower one of the two addresses. |
| INDEX | IN | WORD | Index of the object for the SDO access. |
| SUBINDEX | IN | BYTE | Sub index of the object for the SDO access. |
| COMPL_ACCESS | IN | BOOL | This parameter defines whether only a single sub-index, or the entire object is to be read. |
| MLEN | IN | INT | Maximum length of the data to be read. |
| VALID | OUT | BOOL | indicates that a new record set was received and is valid. |
| BUSY | OUT | BOOL | This parameter indicates the status of the SDO access.<br>*BUSY* = 1: SDO access is not yet terminated. |
| ERROR | OUT | BOOL | *ERROR* = 1: A read error has occurred. |
| RETVAL | OUT | INT | Return value (0 = OK) |
| ERROR_ID | OUT | DWORD | Bus specific error code. If there was an error during the SDO access, the SDO abort error code (EtherCAT error code) can be found here. |
| LEN | OUT | INT | Length of the read data. |
| RECORD | IN_OUT | ANY | Area of the read data. |

**Special features at *COMPL_ACCESS* (CompleteAccess)**

With the activation of the parameter *COMPL_ACCESS* the following is to be considered:

- With *COMPL_ACCESS* = true only *SUBINDEX* 0 or 1 is allowed! Otherwise you will get an error message.
- With *COMPL_ACCESS* = true for *SUBINDEX* 0 2 bytes are read, because *SUBINDEX* 1 has an offset of 2 byte.

**RETVAL (return value)**

In addition to the module specific error codes, which are listed here, also the general error codes for FC/SFC as return value are possible. *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64*

| RETVAL | Description | Error code in *ERROR_ID* |
|---|---|---|
| 0x80A0 | Negative acknowledgement while reading the module. | yes |
| 0x80A1 | Negative acknowledgement while writing the module. | yes |
| 0x80A3 | General protocol error. | yes |
| 0x80A5 | Internal error. | Value = 0: no |
| | | Value ≠ 0: yes |
| 0x80A7 | Module is occupied (Timeout). | yes |
| 0x80A9 | Feature not supported by the module. | yes |
| 0x80AA | Module reports a manufacturer-specific error in its application. | yes |
| 0x80B0 | Data record not known in module / Illegal data record number. | yes |
| 0x80B4 | Module reports access to an invalid area. | yes |
| 0x80B5 | Module not ready. | yes |
| 0x80B6 | Module denies access. | yes |
| 0x80B7 | Module reports an invalid range for a parameter or value. | yes |
| 0x80B8 | Module reports an invalid parameter. | yes |
| 0x80B9 | Module reports an invalid type:<br>Buffer too small (reading subsets is not possible). | yes |
| 0x80C2 | The module currently processes the maximum possible jobs for a CPU. | yes |
| 0x80C3 | The required operating resources are currently occupied. | no |
| 0x80C4 | Internal temporary error: Job could not be carried out. | yes |
| 0x80C5 | Module not available. | yes |
| 0x80D2 | Error on reading an SDO due to wrong call parameters. | yes |

**ERROR_ID**

On a *RETVAL* more information can be found in the *ERROR_ID* if available. Otherwise *ERROR_ID* is 0.

| Internal error | Description |
|---|---|
| 0x00000000 | No error |
| 0x98110001 | Feature not supported |
| 0x98110002 | Invalid Index |
| 0x98110003 | Invalid Offset |
| 0x98110005 | Invalid Size |
| 0x98110006 | Invalid Data |

| Internal error | Description |
|---|---|
| 0x98110007 | Not ready |
| 0x98110008 | Busy |
| 0x9811000A | No Memory left |
| 0x9811000B | Invalid Parameter |
| 0x9811000C | Not Found |
| 0x9811000E | Invalid state |
| 0x98110010 | Timeout |
| 0x98110011 | Open Failed |
| 0x98110012 | Send Failed |
| 0x98110014 | Invalid Command |
| 0x98110015 | Unknown Mailbox Protocol Command |
| 0x98110016 | Access Denied |
| 0x98110024 | Slave error |
| 0x9811002D | Ethernet link cable disconnected |
| 0x98110031 | No mailbox support |

| CoE Error codes | Description | CoE slave abort code |
|---|---|---|
| 0x98110040 | SDO: Toggle bit not alternated | 0x05030000 |
| 0x98110041 | SDO protocol timed out | 0x05040000 |
| 0x98110042 | SDO: Client/server command specifier not valid or unknown | 0x05040001 |
| 0x98110043 | SDO: Invalid block size (block mode only) | 0x05040002 |
| 0x98110044 | SDO: Invalid sequence number (block mode only) | 0x05040003 |
| 0x98110045 | SDO: CRC error (block mode only) | 0x05040004 |
| 0x98110046 | SDO: Out of memory | 0x05040005 |
| 0x98110047 | SDO: Unsupported access to an object | 0x06010000 |
| 0x98110048 | SDO: Attempt to read a write only object | 0x06010001 |
| 0x98110049 | SDO: Attempt to write a read only object | 0x06010002 |
| 0x9811004A | SDO: Object does not exist in the object dictionary | 0x06020000 |
| 0x9811004B | SDO: Object cannot be mapped to the PDO | 0x06040041 |
| 0x9811004C | SDO: The number and length of the objects to be mapped would exceed PDO length | 0x06040042 |
| 0x9811004D | SDO: General parameter incompatibility reason | 0x06040043 |
| 0x9811004E | SDO: General internal incompatibility in the device | 0x06040047 |
| 0x9811004F | SDO: Access failed due to an hardware error | 0x06060000 |
| 0x98110050 | SDO: Data type does not match, length of service parameter does not match | 0x06070010 |
| 0x98110051 | SDO: Data type does not match, length of service parameter too high | 0x06070012 |

| CoE Error codes | Description | CoE slave abort code |
|---|---|---|
| 0x98110052 | SDO: Data type does not match, length of service parameter too low | 0x06070013 |
| 0x98110053 | SDO: Sub-index does not exist | 0x06090011 |
| 0x98110054 | SDO: Value range of parameter exceeded (only for write access) | 0x06090030 |
| 0x98110055 | SDO: Value of parameter written too high | 0x06090031 |
| 0x98110056 | SDO: Value of parameter written too low | 0x06090032 |
| 0x98110057 | SDO: Maximum value is less than minimum value | 0x06090036 |
| 0x98110058 | SDO: General error | 0x08000000 |
| 0x98110059 | SDO: Data cannot be transferred or stored to the application | 0x08000020 |
| 0x9811005A | SDO: Data cannot be transferred or stored to the application because of local control | 0x08000021 |
| 0x9811005B | SDO: Data cannot be transferred or stored to the application because of the present device state | 0x08000022 |
| 0x9811005C | SDO: 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) | 0x08000023 |
| 0x9811005D | SDO: Unknown code | unknown |
| 0x9811010E | Command not executed | Slave is not present at the bus |

### 11.1.2 FB 53 - SDO_WRITE - Write access to Object Dictionary Area

**Description**

With this block, you will have write access to the object directory of the EtherCAT slave stations and EtherCAT master. The block operates asynchronously, that is, processing covers multiple FB calls. Start the job by calling FB 53 with REQ = 1. The job status is displayed via the output parameters BUSY and RETVAL. The record set transmission is completed when the output parameter BUSY = FALSE.

The error handling happens with the parameters ERROR, ERROR_ID and RETVAL.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQ | IN | BOOL | REQ = 1:<br>activates the SDO access at rising edge. |
| ID | IN | WORD | Logical base address of the EtherCAT slave station respectively master in the hardware configuration.<br>With an output module bit 15 must be set (example for address 5: ID:=DW#16#8005). With a combination module you have to set the lower one of the two addresses. |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| INDEX | IN | WORD | Index of the object for the SDO access. |
| SUBINDEX | IN | BYTE | Sub index of the object for the SDO access. |
| COMPL_ACCESS | IN | BOOL | This parameter defines whether only a single sub-index, or the entire object is to be written. |
| LEN | IN | INT | Maximum length of the data to be written. |
| DONE | OUT | BOOL | indicates that a new record set was written. |
| BUSY | OUT | BOOL | This parameter indicates the status of the SDO access.<br>*BUSY* = 1: SDO access is not yet terminated. |
| ERROR | OUT | BOOL | *ERROR* = 1: A write error has occurred. |
| RETVAL | OUT | INT | Return value (0 = OK) |
| ERROR_ID | OUT | DWORD | Bus specific error code. If there was an error during the SDO access, the SDO abort error code (EtherCAT error code) can be found here. |
| LEN | OUT | INT | Length of the data to be written. |
| RECORD | IN_OUT | ANY | Area of the data to be written. |

**Special features at *COMPL_ACCESS* (CompleteAccess)**

With the activation of the parameter *COMPL_ACCESS* the following is to be considered:

- With *COMPL_ACCESS* = true only *SUBINDEX* 0 or 1 is allowed! Otherwise you will get an error message.
- With *COMPL_ACCESS* = true for *SUBINDEX* 0 2 bytes are written, because *SUBINDEX* 1 has an offset of 2 bytes.

**RETVAL (return value)**

In addition to the module specific error codes, which are listed here, also the general error codes for FC/SFC as return value are possible. *Chapter 4.1 ‘General and Specific Error Information RET_VAL’ on page 64*

| RETVAL | Description | Error code in *ERROR_ID* |
|---|---|---|
| 0x80A0 | Negative acknowledgement while reading the module. | yes |
| 0x80A1 | Negative acknowledgement while writing the module. | yes |
| 0x80A3 | General protocol error. | yes |
| 0x80A5 | Internal error. | Value = 0: no<br>Value ≠ 0: yes |
| 0x80A7 | Module is occupied (Timeout). | yes |
| 0x80A9 | Feature not supported by the module. | yes |
| 0x80AA | Module reports a manufacturer-specific error in its application. | yes |
| 0x80B0 | Data record not known in module / Illegal data record number. | yes |
| 0x80B4 | Module reports access to an invalid area. | yes |
| 0x80B5 | Module not ready. | yes |

| RETVAL | Description | Error code in *ERROR_ID* |
|---|---|---|
| 0x80B6 | Module denies access. | yes |
| 0x80B7 | Module reports an invalid range for a parameter or value. | yes |
| 0x80B8 | Module reports an invalid parameter. | yes |
| 0x80B9 | Module reports an invalid type:<br>Buffer too small (writing subsets is not possible). | yes |
| 0x80C2 | The module currently processes the maximum possible jobs for a CPU. | yes |
| 0x80C3 | The required operating resources are currently occupied. | no |
| 0x80C4 | Internal temporary error: Job could not be carried out. | yes |
| 0x80C5 | Module not available. | yes |
| 0x80D2 | Error on reading an SDO due to wrong call parameters. | yes |

**ERROR_ID**

On a *RETVAL* more information can be found in the *ERROR_ID* if available. Otherwise *ERROR_ID* is 0.

| Internal error | Description |
|---|---|
| 0x00000000 | No error |
| 0x98110001 | Feature not supported |
| 0x98110002 | Invalid Index |
| 0x98110003 | Invalid Offset |
| 0x98110005 | Invalid Size |
| 0x98110006 | Invalid Data |
| 0x98110007 | Not ready |
| 0x98110008 | Busy |
| 0x9811000A | No Memory left |
| 0x9811000B | Invalid Parameter |
| 0x9811000C | Not Found |
| 0x9811000E | Invalid state |
| 0x98110010 | Timeout |
| 0x98110011 | Open Failed |
| 0x98110012 | Send Failed |
| 0x98110014 | Invalid Command |
| 0x98110015 | Unknown Mailbox Protocol Command |
| 0x98110016 | Access Denied |
| 0x98110024 | Slave error |

| Internal error | Description |
|---|---|
| 0x9811002D | Ethernet link cable disconnected |
| 0x98110031 | No mailbox support |

| CoE Error codes | Description | CoE slave abort code |
|---|---|---|
| 0x98110040 | SDO: Toggle bit not alternated | 0x05030000 |
| 0x98110041 | SDO protocol timed out | 0x05040000 |
| 0x98110042 | SDO: Client/server command specifier not valid or unknown | 0x05040001 |
| 0x98110043 | SDO: Invalid block size (block mode only) | 0x05040002 |
| 0x98110044 | SDO: Invalid sequence number (block mode only) | 0x05040003 |
| 0x98110045 | SDO: CRC error (block mode only) | 0x05040004 |
| 0x98110046 | SDO: Out of memory | 0x05040005 |
| 0x98110047 | SDO: Unsupported access to an object | 0x06010000 |
| 0x98110048 | SDO: Attempt to read a write only object | 0x06010001 |
| 0x98110049 | SDO: Attempt to write a read only object | 0x06010002 |
| 0x9811004A | SDO: Object does not exist in the object dictionary | 0x06020000 |
| 0x9811004B | SDO: Object cannot be mapped to the PDO | 0x06040041 |
| 0x9811004C | SDO: The number and length of the objects to be mapped would exceed PDO length | 0x06040042 |
| 0x9811004D | SDO: General parameter incompatibility reason | 0x06040043 |
| 0x9811004E | SDO: General internal incompatibility in the device | 0x06040047 |
| 0x9811004F | SDO: Access failed due to an hardware error | 0x06060000 |
| 0x98110050 | SDO: Data type does not match, length of service parameter does not match | 0x06070010 |
| 0x98110051 | SDO: Data type does not match, length of service parameter too high | 0x06070012 |
| 0x98110052 | SDO: Data type does not match, length of service parameter too low | 0x06070013 |
| 0x98110053 | SDO: Sub-index does not exist | 0x06090011 |
| 0x98110054 | SDO: Value range of parameter exceeded (only for write access) | 0x06090030 |
| 0x98110055 | SDO: Value of parameter written too high | 0x06090031 |
| 0x98110056 | SDO: Value of parameter written too low | 0x06090032 |
| 0x98110057 | SDO: Maximum value is less than minimum value | 0x06090036 |
| 0x98110058 | SDO: General error | 0x08000000 |
| 0x98110059 | SDO: Data cannot be transferred or stored to the application | 0x08000020 |
| 0x9811005A | SDO: Data cannot be transferred or stored to the application because of local control | 0x08000021 |
| 0x9811005B | SDO: Data cannot be transferred or stored to the application because of the present device state | 0x08000022 |

| CoE Error codes | Description | CoE slave abort code |
|---|---|---|
| 0x9811005C | SDO: 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) | 0x08000023 |
| 0x9811005D | SDO: Unknown code | unknown |
| 0x9811010E | Command not executed | Slave is not present at the bus |

# 12 Device Specific

## 12.1 Frequency Measurement

### 12.1.1 FC 300 ... 303 - Frequency measurement SLIO consistent

**Overview**

The following VIPA specific functions are used to control the System SLIO frequency measurement modules, which are connected via PROFIBUS, PROFINET or EtherCAT. The usage with EtherCAT is only possible at an EtherCAT CPU from VIPA. By this functions SFC 14 - DPRD_DAT respectively SFC 15 - DPWR_DAT for consistent read respectively write access to the data are internally called. Error messages of these blocks are reported by the parameter *ERROR*.

| Function | Symbol | Comment |
|---|---|---|
| FC 300 | FM_SET_CONTROL | Function to control the frequency measurement with integrated consistent access. |
| FC 301 | FM_GET_PERIOD | Function to calculate the period duration with integrated consistent access. |
| FC 302 | FM_GET_FREQUENCY | Function to calculate the frequency with integrated consistent access. |
| FC 303 | FM_GET_SPEED | Function to calculate the rotational speed with integrated consistent access. |

### 12.1.2 FC 300 - FM_SET_CONTROL - Control frequency measurement consistent

**Description**

The System SLIO Frequency measurement module is controlled by the FC 300 FM_SET_CONTROL. By this function the SFC 15 - DPWR_DAT for consistent write access of data is called. Here error messages of the block are reported by *ERROR*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

#### 12.1.2.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| ENABLE_FM | INPUT | BOOL | I, Q, M, D, L | Enable frequency measurement |
| LADDR_OUT | INPUT | WORD | I, Q, M, D, L | Logical base address |
| PRESET_CH0 | INPUT | DINT | I, Q, M, D, L | Channel 0: Measurement period |
| PRESET_CH1 | INPUT | DINT | I, Q, M, D, L | Channel 1: Measurement period |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal (TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value (0 = OK) |

**ENABLE_FM**

With setting *ENABLE_FM* the *measuring periods*, which were preset by PRESET_CH0/1, are transferred to the channels and the measurement of both channels are started. Both frequency meters are stopped by resetting *ENABLE_FM*.

*Only while ENABLE_FM is set, evaluated values can be retrieved from the module. Otherwise you get the error message that the channels are disabled.*

**LADDR_OUT**

Configured base address of the output area of the System SLIO frequency measurement module, which is to be written to. The address must be in hexadecimal notation.

(Example: Address 100: *LADDR_OUT* : = W#16#64).

**PRESET_CHx**

Enter here the measurement period in µs for the corresponding channel.

Range of values: 1µs ... 8 388 607µs

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**ERROR (Return value)**

The following code can be reported:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D2 | Channel 0:<br>Input value measurement period ≤ 0 |
| 0x80D3 | Channel 1:<br>Input value measurement period ≤ 0 |
| 0x80D4 | Channel 0:<br>Input value measurement period > 8 388 607µs |
| 0x80D5 | Channel 1:<br>Input value measurement period > 8 388 607µs |

### 12.1.2.2 Errors of the internally called SFC 15

| Code | Description |
|---|---|
| 0x808x | System error on the bus coupler |
| 0x8090 | *LADDR_OUT* is wrong, possible reasons:<br>■ there is no module configured on this address<br>■ limitation of the length of consistent data was not considered<br>■ Basic address in parameter *LADDR_OUT* was not entered in hexadecimal type |
| 0x8093 | There is no bus coupler existing for *LADDR_OUT*, from which consistent data can be read. |

| Code | Description |
|---|---|
| 0x80A0 | An access error was detected during peripheral access. |
| 0x80B0 | System error on the bus coupler |
| 0x80B1 | Specified length of the source area does not correspond to the configured user data length. |
| 0x80B2 | System error on the bus coupler |
| 0x80B3 | System error on the bus coupler |
| 0x80C1 | The data from the previous read request on the module are not processed by the module, yet. |
| 0x80C2 | System error on the bus coupler |
| 0x80Fx | System error on the bus coupler |
| 0x85xy | System error on the bus coupler |
| 0x8xyy | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 12.1.3 FC 301 - FM_GET_PERIOD - Calculate period duration consistent

**Description**

With the FC 301 FM_GET_PERIOD, you can calculate the period duration of the input signals of both channels. By this function internally SFC 14 - DPRD_DAT for consistent reading of user data is called. Here, the error messages of the function block are returned by *ERROR*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

#### 12.1.3.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| LADDR_IN | INPUT | WORD | I, Q, M, D, L | Logical base input address |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal (TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value (0 = OK) |
| PERIOD_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0: Period duration |
| PERIOD_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1: Period duration |

**LADDR_IN**

Configured base address of the input area of the System SLIO frequency measurement module, which is to be read from. The address must be in hexadecimal notation.

(Example: Address 100: *LADDR_IN*: = W#16#64).

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**PERIOD_CHx**

Currently determined period duration of the corresponding channel in 100ns.

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |
| 0x80E0 | Channel 0: Determined number of edges = 0 |
| 0x80E1 | Channel 1: Determined number of edges = 0 |
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |
| 0x80E8 | Channel 0: No valid measurement within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement within the entered measurement period. |

### 12.1.3.2 Error of the internal called SFC 14

| Code | Description |
|---|---|
| 0x808x | System error on the bus coupler |
| 0x8090 | *LADDR_IN* is not correct, possible reasons:<br>■ there is no module configured on this address<br>■ limitation of the length of consistent data was not considered<br>■ Basic address in parameter *LADDR_IN* was not entered in hexadecimal type |
| 0x8093 | There is no bus coupler existing for *LADDR_IN*, to which consistent data can be written. |
| 0x80A0 | An access error was detected during peripheral access. |

| Code | Description |
|---|---|
| 0x80B0 | System error on the bus coupler |
| 0x80B1 | Specified length of the source area does not correspond to the configured user data length. |
| 0x80B2 | System error on the bus coupler |
| 0x80B3 | System error on the bus coupler |
| 0x80C1 | The data from the previous write request on the module are not processed by the module, yet. |
| 0x80C2 | System error on the bus coupler |
| 0x80Fx | System error on the bus coupler |
| 0x85xy | System error on the bus coupler |
| 0x8xyy | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 12.1.4 FC 302 - FM_GET_FREQUENCY - Calculate frequency consistent

**Description**

With the FC 302 FM_GET_FREQUENCY, you can calculate the frequency of the input signals of both channels. By this function internally SFC 14 - DPRD_DAT for consistent reading of user data is called. Here, the error messages of the function block are returned by *ERROR*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

#### 12.1.4.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| LADDR_IN | INPUT | WORD | I, Q, M, D, L | Logical base input address |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal<br>(TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value<br>(0 = OK) |
| FREQUENCY_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0: Frequency |
| FREQUENCY_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1: Frequency |

**LADDR_IN**

Configured base address of the input area of the System SLIO frequency measurement module, which is to be read from. The address must be in hexadecimal notation.

(Example: Address 100: *LADDR_IN*: = W#16#64).

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**FREQUENCY_CHx**

Currently determined frequency of the corresponding channel in mHz.

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80DA | Channel 0: Measured time value = 0 |
| 0x80DB | Channel 1: Measured time value = 0 |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |
| 0x80E6 | Channel 0: Frequency > 600kHz |
| 0x80E7 | Channel 1: Frequency > 600kHz |
| 0x80E8 | Channel 0: No valid measurement within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement within the entered measurement period. |

### 12.1.4.2 Error of the internal called SFC 14

| Code | Description |
|---|---|
| 0x808x | System error on the bus coupler |
| 0x8090 | *LADDR_IN* is not correct, possible reasons:<br>■ there is no module configured on this address<br>■ limitation of the length of consistent data was not considered<br>■ Basic address in parameter *LADDR_IN* was not entered in hexadecimal type |

| Code | Description |
|---|---|
| 0x8093 | There is no bus coupler existing for *LADDR_IN*, to which consistent data can be written. |
| 0x80A0 | An access error was detected during peripheral access. |
| 0x80B0 | System error on the bus coupler |
| 0x80B1 | Specified length of the source area does not correspond to the configured user data length. |
| 0x80B2 | System error on the bus coupler |
| 0x80B3 | System error on the bus coupler |
| 0x80C1 | The data from the previous write request on the module are not processed by the module, yet. |
| 0x80C2 | System error on the bus coupler |
| 0x80Fx | System error on the bus coupler |
| 0x85xy | System error on the bus coupler |
| 0x8xyy | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 12.1.5 FC 303 - FM_GET_SPEED - Calculate rotational speed consistent

**Description**

With the FC 303 FM_GET_SPEED, you can calculate the rotational speed of the input signals of both channels. By this function internally SFC 14 - DPRD_DAT for consistent reading of user data is called. Here, the error messages of the function block are returned by *ERROR*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

#### 12.1.5.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| LADDR_IN | INPUT | WORD | I, Q, M, D, L | Logical<br>base input address |
| RESOLUTION_CH0 | INPUT | DINT | I, Q, M, D, L | Channel 0:<br>Resolution of the sensor |
| RESOLUTION_CH1 | INPUT | DINT | I, Q, M, D, L | Channel 1:<br>Resolution of the sensor |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal<br>(TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | return value<br>(0 = OK) |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| SPEED_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0:<br>Rotational speed |
| SPEED_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1:<br>Rotational speed |

**LADDR_IN**

Configured base address of the input area of the System SLIO frequency measurement module, which is to be read from. The address must be in hexadecimal notation.

(Example: Address 100: *LADDR_IN*: = W#16#64).

**RESOLUTION_CHx**

Enter here the resolution in increments per revolution for the corresponding channel .

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**SPEED_CHx**

Currently determined rotational speed of the corresponding channel in revolutions per minute (rpm).

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80D6 | Channel 0: Input value RESOLUTION_CH0 = 0 |
| 0x80D7 | Channel 1: Input value RESOLUTION_CH1 = 0 |
| 0x80D8 | Channel 0: Input value RESOLUTION_CH0 < 0 |
| 0x80D9 | Channel 1: Input value RESOLUTION_CH1 < 0 |
| 0x80DA | Channel 0: Measured time value = 0 |
| 0x80DB | Channel 1: Measured time value = 0 |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |

| Code | Description |
|---|---|
| 0x80E6 | Channel 0: Determined rotational speed > max (DINT) |
| 0x80E7 | Channel 1: Determined rotational speed > max (DINT) |
| 0x80E8 | Channel 0: No valid measurement<br>within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement<br>within the entered measurement period. |

#### 12.1.5.2 Error of the internal called SFC 14

| Code | Description |
|---|---|
| 0x808x | System error on the bus coupler |
| 0x8090 | *LADDR_IN* is not correct, possible reasons:<br>■ there is no module configured on this address<br>■ limitation of the length of consistent data was not considered<br>■ Basic address in parameter *LADDR_IN* was not entered in hexadecimal type |
| 0x8093 | There is no bus coupler existing for *LADDR_IN*, to which consistent data can be written. |
| 0x80A0 | An access error was detected during peripheral access. |
| 0x80B0 | System error on the bus coupler |
| 0x80B1 | Specified length of the source area does not correspond to the configured user data length. |
| 0x80B2 | System error on the bus coupler |
| 0x80B3 | System error on the bus coupler |
| 0x80C1 | The data from the previous write request on the module are not processed by the module, yet. |
| 0x80C2 | System error on the bus coupler |
| 0x80Fx | System error on the bus coupler |
| 0x85xy | System error on the bus coupler |
| 0x8xyy | General error information<br>*Chapter 4.1 ‘General and Specific Error Information RET_VAL’ on page 64* |

## 12.1.6 FC 310 ... 313 - Frequency measurement SLIO

**Overview**

The following VIPA specific functions are used to control the System SLIO frequency measurement modules, if the consistency of the data are ensured by the bus protocol and consistent reading respectively writing with SFC 14 respectively SFC 15 is not possible. Within the functions there are "FM_..." parameters, whose content is to be consistently connected to the corresponding input or output area of the frequency measurement module by means of the bus system. By calling the appropriate function the corresponding "FM_..." parameters are automatically filled by the function.

| Function | Symbol | Comment |
|---|---|---|
| FC 310 | FM_CONTROL | Function to control the frequency measurement |
| FC 311 | FM_CALC_PERIOD | Function to calculate the period duration |
| FC 312 | FM_CALC_FREQUENCY | Function to calculate the frequency |
| FC 313 | FM_CALC_SPEED | Function to calculate the rotational speed |

## 12.1.7 FC 310 - FM_CONTROL - Control frequency measurement

**Description**

The System SLIO Frequency measurement module is controlled by the FC 310 FM_CONTROL. Since this FC does not internally call a block for consistent write access of data, you have to ensure consistent data transfer in your system.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *➪ Chapter 6 'Include VIPA library' on page 98*

### 12.1.7.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| ENABLE_FM | INPUT | BOOL | I, Q, M, D, L | Enable frequency measurement |
| PRESET_CH0 | INPUT | DINT | I, Q, M, D, L | Channel 0: Measurement period |
| PRESET_CH1 | INPUT | DINT | I, Q, M, D, L | Channel 1: Measurement period |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal (TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | return value (0 = OK) |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| FM_PRESET_PERIOD_CH0 | OUTPUT | DWORD | I, Q, M, D, L | Setpoint value for frequency measurement module output address:<br>+0 |
| FM_PRESET_PERIOD_CH1 | OUTPUT | DWORD | I, Q, M, D, L | Setpoint value for frequency measurement module output address:<br>+4 |
| FM_CONTROL_CH0 | OUTPUT | WORD | I, Q, M, D, L | Setpoint value for frequency measurement module output address:<br>+8 |
| FM_CONTROL_CH1 | OUTPUT | WORD | I, Q, M, D, L | Setpoint value for frequency measurement module output address:<br>+10 |

**ENABLE_FM**

With setting *ENABLE_FM* the corresponding CONTROL is generated and issued via *FM_CONTROL_CHx*. The measurement of both channels is started as soon as the content of *FM_CONTROL_CHx* was consistent transferred by the bus system to the frequency measurement module. The measurement of both channels is stopped by resetting *ENABLE_FM*, after *FM_CONTROL_CHx* was consistent transferred to the frequency measurement module.

*Only as long as the frequency meters are started, evaluated values can be retrieved from the module. Otherwise you get the error message that the channels are disabled.*

**PRESET_CHx**

Enter here the measurement period in µs for the corresponding channel.

Range of values: 1µs ... 8 388 607µs

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**FM_PRESET_ PERIOD_CHx**

This parameter contains the measuring period for channel 0 respectively channel 1. The content is to be consistent connected with address +0 respectively +4 of the output area of the frequency measurement module, via the according bus system.

**FM_CONTROL_CHx**

This parameter contains CONTROL, which is generated by *ENABLE_FM*. The content for channel 0 respectively channel 1 is to be consistent connected with address +8 respectively +10 of the output area of the frequency measurement module, via the according bus system.

**ERROR (Return value)**

The following code can be reported:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D2 | Channel 0:<br>Input value measurement period ≤ 0 |
| 0x80D3 | Channel 1:<br>Input value measurement period ≤ 0 |
| 0x80D4 | Channel 0:<br>Input value measurement period > 8 388 607µs |
| 0x80D5 | Channel 1:<br>Input value measurement period > 8 388 607µs |

## 12.1.8 FC 311 - FM_CALC_PERIOD - Calculate period duration

**Description**

With the FC 311 FM_CALC_PERIOD, you can calculate the period duration of the input signals of both channels. Since this FC does not internally call a block for consistent read access of data, you have to ensure consistent data transfer in your system.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

### 12.1.8.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| FM_PERIOD_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+0 |
| FM_PERIOD_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+4 |
| FM_RISING_EDGES_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+8 |
| FM_RISING_EDGES_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+12 |
| FM_STATUS_CH0 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+16 |
| FM_STATUS_CH1 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+18 |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal (TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value (0 = OK) |
| PERIOD_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0: Period duration |
| PERIOD_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1: Period duration |

**FM_PERIOD_CHx**

This parameter contains the measured time value of channel 0 respectively channel 1. The content is to be consistent connected with address +0 respectively +4 of the input area of the frequency measurement module, via the according bus system.

**FM_RISING_ EDGES_CHx**

This parameter contains the determined number of rising edges for channel 0 respectively channel 1. The content is to be consistent connected with address +8 respectively +12 of the input area of the frequency measurement module, via the according bus system.

**FM_STATUS_CHx**

This parameter contains the status of channel 0 respectively channel 1. The content is to be consistent connected with address +16 respectively +18 of the input area of the frequency measurement module, via the according bus system.

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**PERIOD_CHx**

Currently determined period duration of the corresponding channel in 100ns.

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |
| 0x80E0 | Channel 0: Determined number of edges = 0 |
| 0x80E1 | Channel 1: Determined number of edges = 0 |

| Code | Description |
|---|---|
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |
| 0x80E8 | Channel 0: No valid measurement within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement within the entered measurement period. |

### 12.1.9 FC 312 - FM_CALC_FREQUENCY - Calculate frequency

**Description**

With the FC 312 FM_CALC_FREQUENCY, you can calculate the period duration of the input signals of both channels. Since this FC does not internally call a block for consistent read access of data, you have to ensure consistent data transfer in your system.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 ‘Include VIPA library’ on page 98*

#### 12.1.9.1 Parameters

| Parameter | Declara-tion | Data type | Memory block | Description |
|---|---|---|---|---|
| FM_PERIOD_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +0 |
| FM_PERIOD_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +4 |
| FM_RISING_EDGES_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +8 |
| FM_RISING_EDGES_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +12 |
| FM_STATUS_CH0 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +16 |
| FM_STATUS_CH1 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +18 |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal (TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value (0 = OK) |
| FREQUENCY_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0: Calculated frequency |
| FREQUENCY_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1: Calculated frequency |

**FM_PERIOD_CHx**

This parameter contains the measured time value of channel 0 respectively channel 1. The content is to be consistent connected with address +0 respectively +4 of the input area of the frequency measurement module, via the according bus system.

**FM_RISING_ EDGES_CHx**

This parameter contains the determined number of rising edges for channel 0 respectively channel 1. The content is to be consistent connected with address +8 respectively +12 of the input area of the frequency measurement module, via the according bus system.

**FM_STATUS_CHx**

This parameter contains the status of channel 0 respectively channel 1. The content is to be consistent connected with address +16 respectively +18 of the input area of the frequency measurement module, via the according bus system.

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**FREQUENCY_CHx**

Currently determined frequency of the corresponding channel in mHz.

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80DA | Channel 0: Measured time value = 0 |
| 0x80DB | Channel 1: Measured time value = 0 |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |

| Code | Description |
|---|---|
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |
| 0x80E6 | Channel 0: Frequency > 600kHz |
| 0x80E7 | Channel 1: Frequency > 600kHz |
| 0x80E8 | Channel 0: No valid measurement within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement within the entered measurement period. |

## 12.1.10 FC 313 - FM_CALC_SPEED - Calculate rotational speed

**Description**

With the FC 313 FM_CALC_SPEED, you can calculate the velocity of the input signals of both channels. Since this FC does not internally call a block for consistent read access of data, you have to ensure consistent data transfer in your system.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *➪ Chapter 6 'Include VIPA library' on page 98*

### 12.1.10.1 Parameters

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| FM_PERIOD_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +0 |
| FM_PERIOD_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +4 |
| FM_RISING_EDGES_CH0 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +8 |
| FM_RISING_EDGES_CH1 | INPUT | DWORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +12 |
| FM_STATUS_CH0 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address: +16 |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| FM_STATUS_CH1 | INPUT | WORD | I, Q, M, D, L | Actual value of frequency measurement module input address:<br>+18 |
| RESOLUTION_CH0 | INPUT | DINT | I, Q, M, D, L | Channel 0:<br>Resolution of the sensor |
| RESOLUTION_CH1 | INPUT | DINT | I, Q, M, D, L | Channel 1:<br>Resolution of the sensor |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Ready signal<br>(TRUE = OK) |
| ERROR | OUTPUT | WORD | I, Q, M, D, L | Return value<br>(0 = OK) |
| SPEED_CH0 | OUTPUT | DINT | I, Q, M, D, L | Channel 0:<br>Calculated rotational speed |
| SPEED_CH1 | OUTPUT | DINT | I, Q, M, D, L | Channel 1:<br>Calculated rotational speed |

**FM_PERIOD_CHx**

This parameter contains the measured time value for channel 0 respectively channel 1. The content is to be consistent connected with address +0 respectively +4 of the input area of the frequency measurement module, via the according bus system.

**FM_RISING_EDGES_CHx**

This parameter contains the determined number of rising edges for channel 0 respectively channel 1. The content is to be consistent connected with address +8 respectively +12 of the input area of the frequency measurement module, via the according bus system.

**FM_STATUS_CHx**

This parameter contains the status of channel 0 respectively channel 1. The content is to be consistent connected with address +16 respectively +18 of the input area of the frequency measurement module, via the according bus system.

**RESOLUTION_CHx**

Enter here the resolution in increments per revolution for the corresponding channel.

**DONE**

Ready signal of the function

- TRUE: Function was finished without error.
- FALSE: Function is not active respectively there is an error.

**SPEED_CHx**

Currently determined rotational speed of the corresponding channel in revolutions per minute (rpm).

**ERROR (Return value)**

The following codes can be returned:

| Code | Description |
|---|---|
| 0x0000 | No error |
| 0x80D0 | Channel 0 not in status active |
| 0x80D1 | Channel 1 not in status active |
| 0x80D6 | Channel 0: Input value RESOLUTION_CH0 = 0 |
| 0x80D7 | Channel 1: Input value RESOLUTION_CH1 = 0 |
| 0x80D8 | Channel 0: Input value RESOLUTION_CH0 < 0 |
| 0x80D9 | Channel 1: Input value RESOLUTION_CH1 < 0 |
| 0x80DA | Channel 0: Measured time value = 0 |
| 0x80DB | Channel 1: Measured time value = 0 |
| 0x80DC | Channel 0: Measured time value < 0 |
| 0x80DD | Channel 1: Measured time value < 0 |
| 0x80DE | Channel 0: Measured time value > 0x7FFFFFF |
| 0x80DF | Channel 1: Measured time value > 0x7FFFFFF |
| 0x80E2 | Channel 0: Determined number of edges < 0 |
| 0x80E3 | Channel 1: Determined number of edges < 0 |
| 0x80E4 | Channel 0: Determined number of edges > 0xFFFFFF |
| 0x80E5 | Channel 1: Determined number of edges > 0xFFFFFF |
| 0x80E6 | Channel 0: Determined rotational speed > max (DINT) |
| 0x80E7 | Channel 1: Determined rotational speed > max (DINT) |
| 0x80E8 | Channel 0: No valid measurement<br>within the entered measurement period. |
| 0x80E9 | Channel 1: No valid measurement<br>within the entered measurement period. |

## 12.2 Energy Measurement

### 12.2.1 FB 325 - EM_COM_1 - Communication with 031-1PA00

**Overview**

This module enables the communication with the module 031-1PA00 for energy metering and power measurement. For the communication a data block is necessary. Here the DB gets its structure from the UDT 325 EM_COM_1. The block has the following functionalities:

- Load default parameters after start-up
- Storage of parameters, limit values, measured values and messages
- Transfer of consistent measured values
- Definition of the measured values by means of an UDT structure
- Communication by means of telegram type and ID
- Functional diagnostics, connection monitoring and error message evaluation

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| MODE | INPUT | BYTE | ■ 0x01 = Data exchange via process data<br>Currently only the MODE = 1 is supported |
| CHANNEL_ IN | INPUT | ANY | Pointer to the input data<br>■ With MODE = 0x01 exclusively data type BYTE and length 16 are permitted.<br>Example: P#E100.0 BYTE 16 or P#DB10.DBX0.0 BYTE 16 |
| CHANNEL_OUT | INPUT | ANY | Pointer to the output data<br>■ With MODE = 0x01 exclusively data type BYTE and length 16 are permitted.<br>Example: P#A100.0 BYTE 16 or P#DB10.DBX16.0 BYTE 16 |
| MEAS_DATA | IN_OUT | UDT | ■ UDT for the measured values *Chapter 12.2.2 'UDT 325 - EM_DATA_R1 - Data structure for FB 325' on page 259* |

## 12.2.2 UDT 325 - EM_DATA_R1 - Data structure for FB 325

**UDT - Header**

| Name | Declaration | Data type | Description |
|---|---|---|---|
| Timeout | INPUT | TIME | ■ Timeout for reading measured values |
| Polltime | INPUT | TIME | ■ Interval for the periodic reading |
| Control_Global | INPUT | BYTE | 0: de-activated, 1: activated<br>■ Bit 0: Periodic execution according to the *Polltime* (default)<br>■ Bit 1: Immediate execution - bit is to be reset after the execution.<br>■ Bit 6 ... 2: reserved<br>■ Bit 7: Re-initialization of the block by the configuration is sent again |
| Status_Global | OUTPUT | BYTE | Block status<br>■ 0x00: Not processed<br>■ 0x01: In process (BUSY)<br>■ 0x02: Ready without error (DONE)<br>■ 0x80: Error on processing (ERROR) |

| Name | Declaration | Data type | Description |
|---|---|---|---|
| Status Alarm_Global | OUTPUT | BYTE | Corresponds to B3: Header byte 3 - *Common status*<br>■ Bit 0: Frequency *F_MAX* exceeded<br>■ Bit 1: Frequency *F_MIN* undershot<br>■ Bit 2: Temperature *T_MAX* exceeded<br>■ Bit 3: Voltage *VRMS_MAX* exceeded<br>■ Bit 4: Voltage *VRMS_MIN* undershot<br>■ Bit 5: Efficiency *PF_MIN* undershot<br>■ Bit 6: Current *IRMS_MAX* exceeded<br>■ Bit 7: reserved |
| Cmd | INPUT | BYTE | 0: de-activated, 1: activated<br>■ Bit 0: Reset the energy counters<br>■ Bit 1: Trigger Reset at current transformer<br>■ Bit 2: Reset *status measurement*<br>– If several bits are set, they are sequentially processed. |
| Status_Cmd | OUTPUT | BYTE | Status command<br>■ 0x00: Not processed<br>■ 0x01: In process (BUSY)<br>■ 0x02: Ready without error (DONE)<br>■ 0x80: Error on processing (ERROR) |
| Jobtime | OUTPUT | TIME | ■ Duration to read the measured values respectively to run a command |
| DsID | OUTPUT | BYTE | Number of the current DS-ID |
| Frame_ID | OUTPUT | BYTE | Number of the current FR-ID |
| Error_ID | OUTPUT | WORD | Detailed error information |
| Reserved | | ARRAY of BYTE (1...28) | reserved |

**UDT - data**

After the header data, in the UDT there are the measurands sequentially listed with the following structure:

| Name | Declaration | Data type | Description |
|---|---|---|---|
| *Name* | IN_OUT | STRUCT | ■ Name of the measurand |
| Read_Mode | INPUT | BYTE | ■ Bit 0: Accessing the measured value<br>– 0: Measured value is not read<br>– 1: Measured value is read |
| Value | OUTPUT | DWORD | ■ Current measured value |

**ERROR IDs**

| ERROR ID | Description |
|---|---|
| 0x0000 | no error |
| 0x8070 | Error: Parameter MODE |

| ERROR ID | Description |
|---|---|
| 0x8073 | Error: Parameter CHANNEL_IN does not match MODE |
| 0x8074 | Error: Parameter CHANNEL_OUT does not match MODE |
| 0x8080 | Error: Write parameter: Data length is beyond 1 or 2 byte |
| 0x8081 | Error: Write parameter: Timeout detected when writing |
| 0x8091 | Error: Read measured value: Timeout detected when reading |
| 0x80A1 | Error: Telegram type not available - invalid request |
| 0x80A2 | Error: Frame not defined |
| 0x80A3 | Error: Measurand not available |
| 0x80A4 | Error: Telegram length |
| 0x80A5 | Error: Frame too big |
| 0x80A6 | Error: No new measured values available |
| 0x80A7 | Error: DS-ID |
| 0x80A8 | Error: "CMD Frame" - Command could not be executed |
| 0x80AF | Internal error - Please contact the hotline!<br>On an internal error (0x0F) all the measurements are stopped and a reset to the default parameters of the module is triggered! Here all counter values and Frame definitions are deleted! |

## 12.3 Motion Modules

### 12.3.1 FB 320 - ACYC_RW - Acyclic access to the System SLIO motion module

**Description**

With this block you can access the object dictionary of the System SLIO motion modules by means of your user program. Here the block uses an acyclic communication channel based on a request/response sequence. This is part of the input/output area of motion module.

*Due to the blocks FB 320 and FB 321 access the same data base, for each channel (if multichannel) you can use only one of these blocks in your user program! Also this block must be called per cycle only once!*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQUEST | IN | BOOL | The job is started with edge 0-1. |
| MODE | IN | BYTE | Enter 0x01 for the acyclic protocol |
| COMMAND | IN | BYTE | 0x11 = Reading a data object (max. 4byte)<br>0x21 = Writing a data object (max. 4byte) |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| INDEX | IN | WORD | Index of the object |
| SUBINDEX | IN | BYTE | Subindex of the object |
| WRITE_LENGTH | IN | DINT | Length of the data to be written in byte (max. 4byte) |
| WRITE_DATA | IN | ANY | Pointer to the data to be written. |
| READ_DATA | IN | ANY | Pointer to the received data. |
| CHANNEL_IN | IN | ANY | Pointer to the beginning of the acyclic channel in the input area of the motion module.<br>Enter as length 10bytes.<br>Examples P#E100.0 BYTE 10 or P#DB10.DBX0.0 BYTE 10 |
| CHANNEL_OUT | IN | ANY | Pointer to the beginning of the acyclic channel in the output area of the motion module.<br>Enter as length 8bytes.<br>Examples P#A100.0 BYTE 8 or P#DB10.DBX10.0 BYTE 8 |
| READ_LENGTH | OUT | DInt | Length of the received data in byte.<br>This value is to be rounded up to a multiple of 4, because the length specification is not transmitted. |
| DONE | OUT | BOOL | 1: Job has been executed without error |
| BUSY | OUT | BOOL | 0: There is no job being executed<br>1: Job is currently being executed |
| ERROR | OUT | BOOL | 0: No Error<br>1: There is an error. The cause of the error is shown on the *ERROR_ID* parameter |
| ERROR_ID | OUT | WORD | Detailed error information |

*Please note that the parameters WRITE_DATA and READ_DATA are not checked for data type and length!*

**Behavior of the block parameters**

- Exclusiveness of the outputs
  – The outputs *BUSY, DONE* and *ERROR* are mutually exclusive. There can only one of these outputs be TRUE at the same time.
  – As soon as the input *REQUEST* is TRUE, one of the outputs must be TRUE.
- Output status
  – The outputs *DONE, ERROR, ERROR_ID* and *READ_LENGTH* are reset by an edge 1-0 at the input *REQUEST*, when the function block is not active (*BUSY* = FALSE).
  – An edge 1-0 at *REQUEST* does not affect the job processing.
  – If *REQUEST* is already reset during job processing, so it is guaranteed that one of the outputs is set at the end of the command for a PLC cycle. Only then the outputs are reset.

- Input parameter
  – The input parameters are taken with edge 0-1 at *REQUEST*. To change parameters, you have to trigger the job again.
  – If there is again an edge 0-1 at *REQUEST* during the job processing, an error is reported, no new command is activated and the answer rejected by the current command!
- Error handling
  – The block has 2 error outputs for displaying errors during order processing. ERROR indicates the error and ERROR_ID shows an additional error number.
  – The outputs *DONE* and *READ_LENGTH* designates a successful command execution and are not set when *ERROR* becomes TRUE.
- Behavior of the *DONE* output
  – The *DONE* output is set, when a command was successfully executed.
- Behavior of the *BUSY* output
  – The *BUSY* output indicates that the function block is active.
  – Busy is immediately set with edge 0-1 of *REQUEST* and will not be reset until the job was completed successfully or failed.
  – As long as *BUSY* is TRUE, the function block must be called cyclically to execute the command.

*If there is again an edge 0-1 at REQUEST during the job processing, an error is reported, no new command is activated and the answer rejected by the current command!*

**ERROR_ID**

| ERROR_ID | Description |
|---|---|
| 0x0000 | There is no Error |
| 0x8070 | Faulty parameter *MODE* |
| 0x8071 | Faulty parameter *COMMAND* |
| 0x8072 | Parameter *WRITE_LENGTH* exceeds the maximum size |
| 0x8073 | Parameter *CHANNEL_IN* does not fit the parameter *MODE* |
| 0x8074 | Parameter *CHANNEL_OUT* does not fit the parameter *MODE* |
| 0x8075 | Impermissible command (edge 0-1 at *REQUEST* during job is executed) |
| 0x8081 | Error - read access - data do not exist<br>Command rejected! |
| 0x8091 | Error - write access - data do not exist<br>Command rejected! |
| 0x8092 | Error - write access - data out of range<br>Command rejected! |
| 0x8093 | Error - write access - data can only be read<br>Command rejected! |
| 0x8094 | Error - write access - data are write protected<br>Command rejected! |
| 0x8099 | Error during acyclic communication<br>Command rejected! |

**Program code**

If no job is active, all output parameters must be set to 0 (Command = IDLE). With an edge 0-1 at *REQUEST*, with the following approach a job is activated:

1. Check if a job is already active, if necessary terminate job and output error.
   ⇨ Wait until Status = IDLE
2. Check input parameters:
   - MODE
   - COMMAND
   - WRITE_LENGTH
   - CHANNEL_IN
   - CHANNEL_OUT

   ⇨ Terminate job on error, otherwise continue with step 3.
3. Save input parameters internally.
4. Execute the desired command and wait until this has been carried out.
5. Save and output the result of the command execution internally.
6. Set the command to IDLE again.

### 12.3.2 FB 321 - ACYC_DS - Acyclic parametrization System SLIO motion module

**Description**

With this block you can parametrize you motion module motion module by means of your user program. Here you can store your parameters as *Object list* in a data block an transfer them via the acyclic communication channel in your motion module

*Due to the blocks FB 320 and FB 321 access the same data base, for each channel (if multichannel) you can use only one of these blocks in your user program! Also this block must be called per cycle only once!*

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQUEST | IN | BOOL | The job is started with edge 0-1. |
| MODE | IN | BYTE | Enter 0x01 for the acyclic protocol. |
| READ_BACK | IN | BOOL | 0: Written objects are not read back.<br>1: Written objects are read back immediately after the write operation and compared. |
| GROUP | IN | WORD | 0x01...0x7F: Selection of a group in the object list.<br>0xFF: Section of all the objects in the object list. |
| OBJECT_DATA | IN | ANY | Pointer to the UDT. *Chapter 12.3.3 'UDT 321 - ACYC_OBJECT-DATA - Data structure for FB 321' on page 267* |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| CHANNEL_IN | IN | ANY | Pointer to the beginning of the input data of the *Acyclic channel* of the motion module. |
| CHANNEL_OUT | IN | ANY | Pointer to the beginning of the output data of the *Acyclic channel* of the motion module. |
| DONE | OUT | BOOL | 1: Job has been executed without error. |
| BUSY | OUT | BOOL | 0: There is no job being executed.<br>1: Job is currently being executed. |
| DATASET_INDEX | OUT | INT | Object that is currently being processed. |
| ERROR | OUT | BOOL | 0: No Error<br>1: There is an error. The cause of the error is shown on the *ERROR_ID* parameter. |
| ERROR_ID | OUT | WORD | Detailed error information |

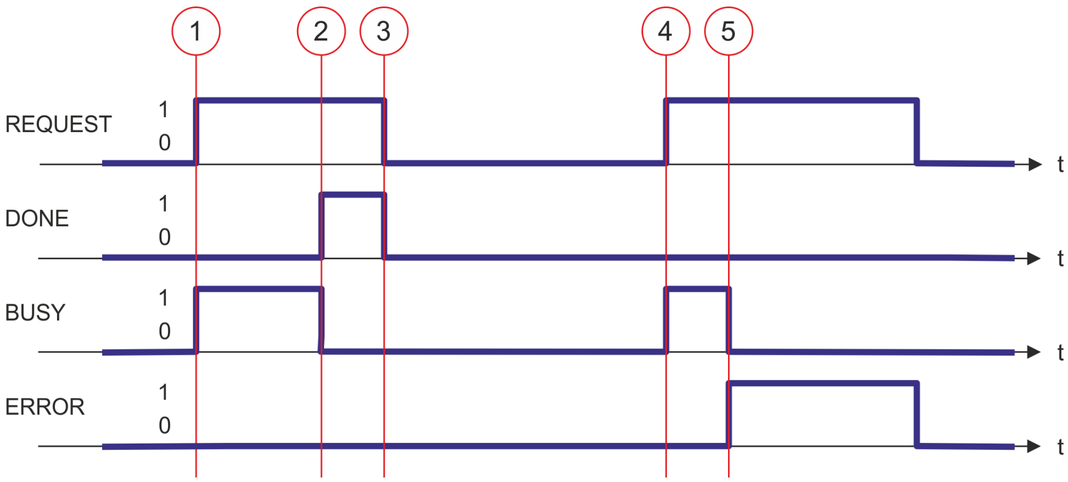
**Behavior of the block parameters**

- Exclusiveness of the outputs:
  - The outputs *BUSY*, *DONE* and *ERROR* are mutually exclusive. There can only one of these outputs be TRUE at the same time.
  - As soon as the input *REQUEST* is TRUE, one of the outputs must be TRUE.
- Output status
  - The outputs *DONE, ERROR, ERROR_ID* and *DATASET_INDEX* are reset by an edge 1-0 at the input *REQUEST*, when the job is finished.
  - If *REQUEST* is already reset during job processing, so it is guaranteed that the whole object list is processed.
  - At the end of the job with no error, *DONE* is set for one PLC cycle. Only then the outputs are reset.
- Input parameter
  - The input parameters are taken with edge 0-1 at *REQUEST*. To change parameters, you have to trigger the job again.
  - If there is again an edge 0-1 at *REQUEST* during the job, an error is reported (invalid command sequence) and the processing of the object list is finished.
- Input parameter *READ_BACK*
  - With activated parameter *READ_BACK* written objects are read back immediately after the write operation by a read job.
  - The written an read values are compared.
    If they are identical, the next object is handled
    If they are not identical, an error message (*ERROR ID* = 0x8079) is returned and the development of the object list is finished.
- Input parameter *GROUP*
  - For a better structure you can assign a group to each object.
  - Via *GROUP* you define the group whose parameters are to be transferred.
    0x01...0x7F: Transfer the objects of the selected group.
    0xFF: Transfer the objects of all the groups.
- Error handling
  - The block has error outputs to show errors during job processing. *ERROR* indicates the error, *ERROR_ID* shows an additional error number and *DATASET_INDEX* informs at which object the error occurred.
  - The output *DONE* designates a successful job execution and is not set when ERROR becomes TRUE.
- Behavior of the *DONE* output
  - The *DONE* output is set, when a command was successfully executed.

- Behavior of the *BUSY* output
  – The *BUSY* output indicates that the function block is active.
  – *BUSY* is immediately set with edge 0-1 of *REQUEST* and will not be reset until the job was completed successfully or failed.
  – As long as *BUSY* is TRUE, the function block must be called cyclically to execute the command.
- Behavior of the *DATASET_INDEX* output
  – The *DATASET_INDEX* output indicates, which object of the object list is currently being processed.
  – If there is no job active, *DATASET_INDEX* = 0 is returned.
  – If there is an error during the object processing, *DATASET_INDEX* shows the faulting object.

*If there is again an edge 0-1 at REQUEST during the job processing, an error is reported (ERROR_ID = 0x8075), no new command is activated and the answer rejected by the current command!*

**Status diagram**




(1) The job is started with edge 0-1 at *REQUEST* and *BUSY* becomes TRUE.
(2) At the time (2) the job is completed. *BUSY* has the value FALSE and *DONE* den value TRUE.
(3) At the time (3) the job is completed and *REQUEST* becomes FALSE and thus each output parameter FALSE respectively 0.
(4) At the time (4) with an edge 0-1 at *REQUEST* the job is started again and *BUSY* becomes TRUE.
(5) At the time (5) an error occurs during the job. *BUSY* has the value FALSE and *ERROR* den value TRUE.

**ERROR_ID**

| ERROR_ID | Description |
|---|---|
| 0x0000 | There is no Error |
| 0x8070 | Faulty parameter *MODE* |
| 0x8071 | Faulty parameter *OBJECT_DATA* |
| 0x8075 | Invalid command (edge 0-1 at *REQUEST* during job is executed) |
| 0x8078 | Faulty parameter *GROUP* |
| 0x8079 | *READ_BACK* detects an error (written and read value unequal) |
| 0x807A | Pointer at *OBJECT_DATA* not valid |

*Within the function block the FB 320 is called. Here, any error of the FB 320 is passed to the FB 321.* *'ERROR_ID' on page 263*

### 12.3.3 UDT 321 - ACYC_OBJECT-DATA - Data structure for FB 321

**Data structure for the object list**

The parameters are to be stored in a data block as *object list*, which consists of individual *objects*. The structure of an *objects* is defined via an UDT.

**Structure of an object**

| Variable | Declaration | Data type | Description |
|---|---|---|---|
| Group | IN | WORD | 0 < *Group* < 0x80 permitted |
| COMMAND | IN | BYTE | 0x11 = Read from the object list<br>0x21 = Write to the object list |
| Index | IN | WORD | Index of the object |
| Subindex | IN | BYTE | Subindex of the object |
| Write_Length | IN | BYTE | Length of the data to be written in byte |
| Data_Write | IN | DWORD | Data to be written. |
| Data_Read | OUT | DWORD | Read data |
| State | OUT | BYTE | 0x00 = never processed<br>0x01 = *BUSY* - in progress<br>0x02 = *DONE* - successfully processed<br>0x80 = *ERROR* - an error has occurred during the processing |

*Please note that you always specify the appropriate length for the object during a write job!*

**Example DB**

| Addr. | Name | Type | Start value | Current value | Comment |
|---|---|---|---|---|---|
| 0.0 | Object(1).Group | WORD | | | 1. Object |
| 2.0 | Object(1).Command | BYTE | | | |
| 4.0 | Object(1).Index | WORD | | | |
| 6.0 | Object(1).Subindex | BYTE | | | |
| 7.0 | Object(1).Write_Length | BYTE | | | |
| 8.0 | Object(1).Data_Write | DWORD | | | |
| 12.0 | Object(1).Data_Read | DWORD | | | |
| 16.0 | Object(1).State | BYTE | | | |

| Addr. | Name | Type | Start value | Current value | Comment |
|---|---|---|---|---|---|
| 18.0 | Object(2).Group | WORD | | | 2. Object |
| ... | ... | ... | | | |
| 34.0 | Object(2).State | BYTE | | | |
| 36.0 | Object(3).Group | WORD | | | 3. Object |
| ... | ... | ... | | | |
| 52.0 | Object(3).State | BYTE | | | |
| ... | ... | ... | | | ... |

## 12.4 WLD

### 12.4.1 FB 240 - RAM_to_s7prog.wld - RAM to s7prog.wld

**Description**

With *REQ* = TRUE this block copies the currently loaded project of a CPU on an inserted memory card as s7prog.wld. With a SPEED7 CPU from VIPA the s7prog.wld is automatically read from an inserted memory card always after an overall reset. The FB 240 internally calls the block SFB 239 with the corresponding parameters. Here the values of *BUSY* and *RET_VAL* are returned from the SFB 239 to the FB 240.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Name | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | IN | BOOL | I, Q, M, D, L | Function request with *REQ* = 1 |
| BUSY | OUT | BOOL | I, Q, M, D, L | Return value of the SFB 239 |
| RET_VAL | OUT | WORD | I, Q, M, D, L | Return value of the SFB 239 |

### 12.4.2 FB 241 - RAM_to_autoload.wld - RAM to autoload.wld

**Description**

With *REQ* = TRUE this block copies the currently loaded project of a CPU on an inserted memory card as autoload.wld. With a SPEED7 CPU from VIPA the s7prog.wld is automatically read from an inserted memory card always after PowerON. The FB 241 internally calls the block SFB 239 with the corresponding parameters. Here the values of *BUSY* and *RET_VAL* are returned from the SFB 239 to the FB 241.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameter**

| Name | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | IN | BOOL | I, Q, M, D, L | Function request with *REQ* = 1 |
| BUSY | OUT | BOOL | I, Q, M, D, L | Return value of the SFB 239 |
| RET_VAL | OUT | WORD | I, Q, M, D, L | Return value of the SFB 239 |

## 12.5 Onboard I/O System 100V

### 12.5.1 SFC 223 - PWM - Pulse duration modulation

**Description**

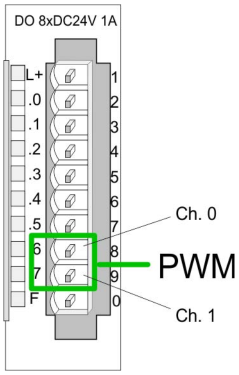
This block serves the parameterization of the pulse duration modulation for the last two output channels of X5.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↪ Chapter 6 'Include VIPA library' on page 98*

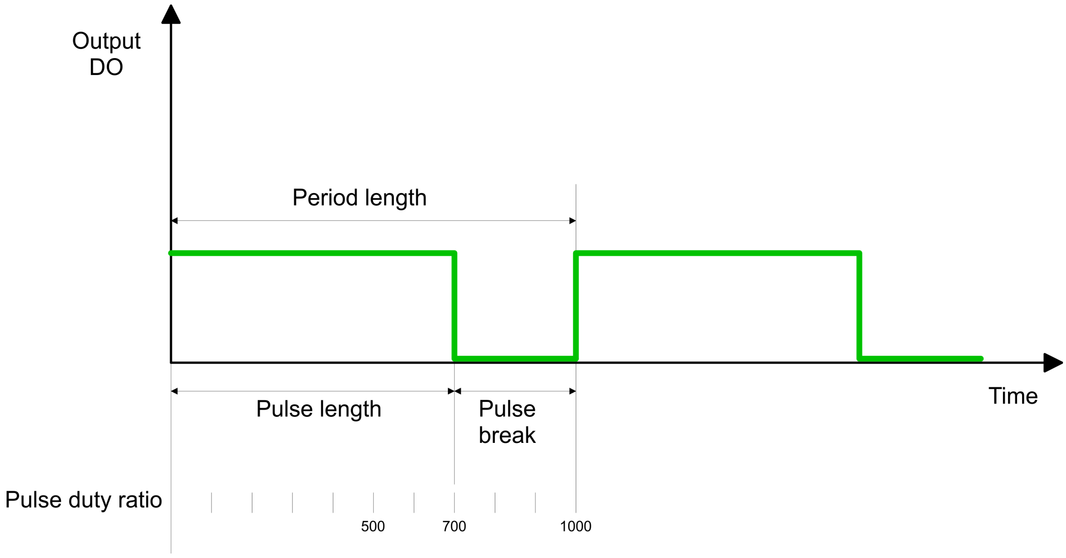
**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| CHANNEL | IN | INT | Number of the output channel for PWM |
| ENABLE | IN | BOOL | Start bit of the job |
| TIMEBASE | IN | INT | Time base |
| PERIOD | IN | DINT | Period of the PWM |
| DUTY | IN | DINT | Output value per mille |
| MINLEN | IN | DINT | Minimum pulse duration |
| RET_VAL | OUT | WORD | Return value (0 = OK) |




➔ You define a time base, a period, the pulse duty ratio and min. pulse length. The CPU determines a pulse series with an according pulse/break relation and issues this via the according output channel.

⇨ The SFC returns a certain error code. You can see the concerning error messages in the table at the following page. The PWM parameters have the following relationship:




Period length = time base x period

Pulse length = (period length / 1000) x pulse duty ratio

Pulse break = period length - pulse length

The parameters have the following meaning:

**CHANNEL**

- Define the output channel that you want to address.
  – Value range: 0 ... 1

**ENABLE**

- Via this parameter you may activate the PWM function (true) res. deactivate it (false).
  – Value range: true, false

**TIMEBASE**

- *TIMEBASE* defines the resolution and the value range of the pulse, period and minimum pulse length per channel.
- You may choose the values 0 for 0.1ms and 1 for 1ms.
  – Value range: 0 ... 1

**PERIOD**

- Through multiplication of the value defined at period with the *TIMEBASE* you get the period length.
  – Value range: 0 ... 60000

**DUTY**

- This parameter shows the pulse duty ratio per mille. Here you define the relationship between pulse length and pulse break, concerned on one period.
  – 1 per mille = 1 *TIMEBASE*
- IIf the calculated pulse duration is no multiplication of the *TIMEBASE*, it is rounded down to the next smaller *TIMEBASE* limit.
  – Value range: 0 ... 1000

**MINLEN**

- Via *MINLEN* you define the minimal pulse length. Switches are only made, if the pulse exceeds the here fixed minimum length.
  – Value range: 0 ... 60000

**RET_VAL (Return Value)**

Via the parameter RET_VAL you get an error number in return. See the table below for the concerning error messages:

| Value | Description |
|---|---|
| 0000h | no error |
| 8005h | Parameter *MINLEN* outside the permissible range |
| 8006h | Parameter *DUTY* outside the permissible range |
| 8007h | Parameter *PERIOD* outside the permissible range |
| 8008h | Parameter *TIMEBASE* outside the permissible range |
| 8009h | Parameter *CHANNEL* outside the permissible range. |
| 9001h | Internal error - There was no valid address for a parameter. |
| 9002h | Internal hardware error - Please contact the hotline. |
| 9003h | Output is not configured as PWM output respectively there is an error in hardware configuration. |
| 9004h | HF-PWM was configured but SFC 223 was called (please use SFC 225 HF_PWM!). |

## 12.5.2 SFC 224 - HSC - High-speed-Counter

**Description**

This SFC serves for parameterization of the counter functions (high speed counter) for the first 4 inputs.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| CHANNEL | IN | INT | Number of the input channel for HSC |
| ENABLE | IN | BOOL | Start bit of the job |
| DIRECTION | IN | INT | Direction of counting |

| Name | Declaration | Type | Description |
|---|---|---|---|
| PRESETVALUE | IN | DINT | Preset value |
| LIMIT | IN | DINT | Limit for counting |
| RET_VAL | OUT | WORD | Return value (0 = OK) |
| SETCOUNTER | IN_OUT | BOOL | Load preset value |

**CHANNEL**

- Type the input channel that you want to activate as counter.
  – Value range: 0 ... 3

**ENABLE**

- Via this parameter you may activate the counter (true) res. deactivate it (false).
  – Value range: true, false

**DIRECTION**

- Fix the counting direction.
  – Hereby is:
  0: Counter is deactivated, means *ENABLE* = false
  1: count up
  2: count down

**PRESETVALUE**

- Here you may preset a counter content, that is transferred to the according counter via *SETCOUNTER* = true.
  – Value range: 0 ... FFFFFFFFh

**LIMIT**

- Via Limit you fix an upper res. lower limit for the counting direction (up res. down). When the limit has been reached, the according counter is set zero and started new. If necessary an alarm occurs.
  – Value range: 0 ... FFFFFFFFh

**RET_VAL (Return Value)**

Via the parameter *RET_VAL* you get an error number in return. See the table below for the concerning error messages:

| Value | Description |
|---|---|
| 0000h | No error |
| 8002h | The chosen channel is not configured as counter (Error in the hardware configuration). |
| 8008h | Parameter *DIRECTION* outside the permissible range |
| 8009h | Parameter *CHANNEL* outside the permissible range |
| 9001h | Internal error - There was no valid address for a parameter. |
| 9002h | Internal hardware error - Please contact the hotline. |

**SETCOUNTER**

- Per *SETCOUNTER* = true the value given by PRESETVALUE is transferred into the according counter.
- The bit is set back from the SFC.
  – Value range: true, false

### 12.5.3 SFC 225 - HF_PWM - HF pulse duration modulation

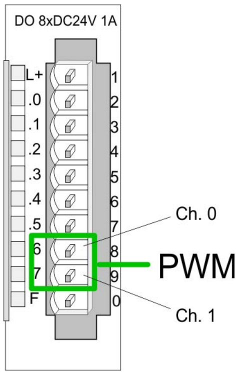
**Description**

This block serves the parameterization of the pulse duration modulation for the last two output channels. This block is function identical to SFC 223. Instead of *TIMEBASE* and *PERIOD*, the SFC 225 works with a predefined frequency (up to 50kHz).

> ***VIPA specific block***
> *The VIPA specific blocks can be found in the VIPA library.* *➪ Chapter 6 'Include VIPA library' on page 98*

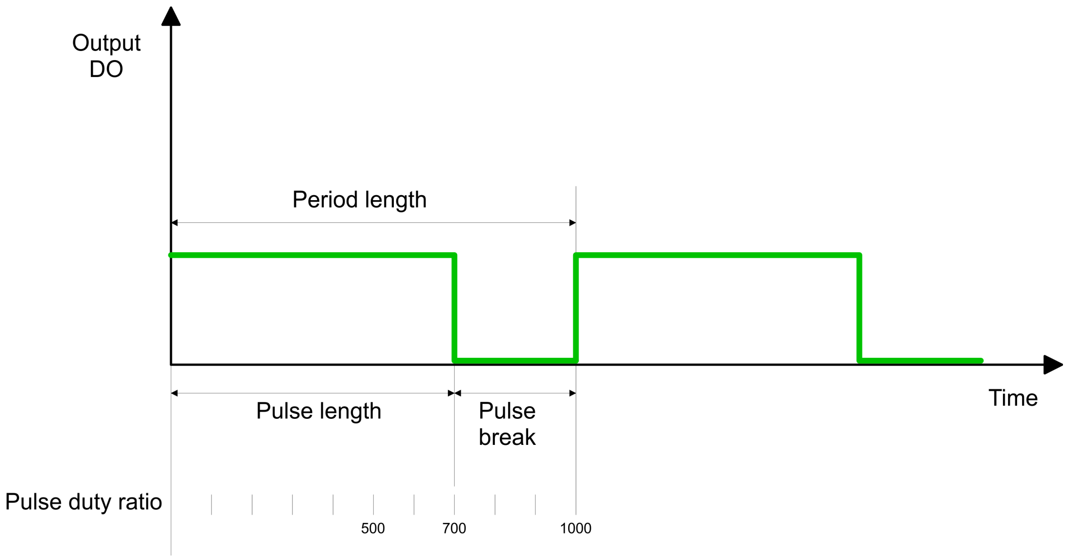
**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| CHANNEL | IN | INT | Number of the output channel for HF-PWM |
| ENABLE | IN | BOOL | Start bit of the job |
| FREQUENCE | IN | WORD | Frequency of the HF-PWM |
| DUTY | IN | DINT | Pulse duty ratio per mille |
| MINLEN | IN | DINT | Minimum pulse duration |
| RET_VAL | OUT | WORD | Return value (0 = OK) |




You define a time base, a period, the pulse duty ratio and min. pulse length. The CPU determines a pulse series with an according pulse/break relation and issues this via the according output channel.

⇨ The SFC returns a certain error code. You can see the concerning error messages in the table at the following page.The PWM parameters have the following relationship:




Period length = 1 / frequency

Pulse length = (period length / 1000) x pulse duty ratio

Pulse break = period length - pulse length

**CHANNEL**

- Define the output channel that you want to address.
  – Value range: 0 ... 1

**ENABLE**

- Via this parameter you may activate the PWM function (true) res. deactivate it (false).
  – Value range: true, false

**FREQUENCE**

- Type in the frequency in Hz as hexadecimal value.
  – Value range: 09C4h ... C350h (2,5kHz ... 50kHz)

**DUTY**

- This parameter shows the pulse duty ratio per mille. Here you define the relationship between pulse length and pulse break, concerned on one period.
  – 1 per mille = 1 *TIMEBASE*
- If the calculated pulse duration is no multiplication of the *TIMEBASE*, it is rounded down to the next smaller *TIMEBASE* limit.
  – Value range: 0 ... 1000

**MINLEN**

- Via *MINLEN* you define the minimal pulse length in µs. Switches are only made, if the pulse exceeds the here fixed minimum length.
  – Value range: 0 ... 60000

**RET_VAL (Return Value)**

Via the parameter RET_VAL you get an error number in return. See the table below for the concerning error messages:

| Value | Description |
|---|---|
| 0000h | no error |
| 8005h | Parameter *MINLEN* outside the permissible range |
| 8006h | Parameter *DUTY* outside the permissible range |
| 8007h | Parameter *FREQUENCE* outside the permissible range |
| 8008h | Parameter *TIMEBASE* outside the permissible range |
| 8009h | Parameter *CHANNEL* outside the permissible range. |
| 9001h | Internal error - There was no valid address for a parameter. |
| 9002h | Internal hardware error - Please contact the hotline. |
| 9003h | Output is not configured as PWM output respectively there is an error in hardware configuration. |
| 9004h | HF-PWM was configured but SFC 223 was called (please use SFC 225 HF_PWM!). |

# 13 Integrated Standard

## 13.1 Standard Functions

### 13.1.1 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 |

### 13.1.2 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*.

### 13.1.3 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 run-time meter must be restarted with the SFC 3.

**Range of values**

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

### 13.1.4 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.

| 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 ... 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*. |

## 13.1.5 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 ... 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 |

## 13.1.6 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 "8081h: 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.<br>Range: 0 ... 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.<br>■ "0": the status of the run-time meter is stopped.<br>■ "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 |
|---|---|
| 0000h | no error |
| 8080h | Incorrect number for the run-time meter |
| 8081h | run-time meter overflow |

### 13.1.7 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.

**Parameter**

| 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 | Submodule slot |
| SUBADDR | INPUT | WORD | I, Q, M, D, L, constant | Offset in user-data address space of the module |

| 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. |
| 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**

Submodule slot

(when submodules 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

### 13.1.8 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 ... 0: event identifier<br>Bits 7 ... 4: event class<br>1: Start events of standard-OBs<br>2: Start events of synchronous-error OBs<br>3: Start events of asynchronous-error OBs |
| EV_NUM | BYTE | event number |
| PRIORITY | BYTE | Structure element PRORITY shows the priority class of the current OB. |
| 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 |

*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<br>OB80_ERR_EV_NUM<br>OB80_OB_PRIORITY<br>OB80_OB_NUM | BYTE<br>BYTE<br>BYTE<br>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 |

### 13.1.9 SFC 7 - DP_PRAL - Triggering a hardware interrupt on the DP master

**Description**

With SFC 7 DP_PRAL you trigger a hardware interrupt on the DP master from the user program of an intelligent slave. This interrupt starts OB 40 on the DP master. Using the input parameter AL_INFO, you can identify the cause of the hardware interrupt. This interrupt identifier is transferred to the DP master and you can evaluate the identifier in OB 40 (variable OB40_POINT_ADDR). The requested hardware interrupt is uniquely specified by the input parameters *IOID* and *LADDR*. For each configured address area in the transfer memory, you can trigger exactly one hardware interrupt at any time.

**How the SFC operates**

SFC 7 DP_PRAL operates asynchronously, in other words, it is executed over several SFC calls. You start the hardware interrupt request by calling SFC 7 with *REQ* = 1. The status of the job is indicated by the output parameters *RET_VAL* and *BUSY*, see Meaning of the Parameters *REQ*, *RET_VAL* and *BUSY* with Asynchronous SFCs. The job is completed when execution of OB 40 is completed on the DP master.

*If you operate the DP slave as a standard slave, the job is completed as soon as the diagnostic frame is obtained by the DP master.*

**Identifying a job**

The input parameters *IOID* and *LADDR* uniquely specify the job. If you have called SFC 7 DP_PRAL on a DP slave and you call this SFC again before the master has acknowledged the requested hardware interrupt, the way in which the SFC reacts depends largely on whether the new call involves the same job: if the parameters *IOID* and *LADDR* match a job that is not yet completed, the SFC call is interpreted as a follow-on call regardless of the value of the parameter *AL_INFO*, and the value W#16#7002 is entered in *RET_VAL*.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | E, A, M, D, L, Constant | *REQ* = 1: Hardware interrupt on the DP master belonging to the slave |
| IOID | INPUT | BYTE | E, A, M, D, L, Constant | Identifier of the address area in the transfer memory (for the perspective of the DP slave):<br>■ B#16#00:Bit15 of *LADDR* specifies whether a an input (Bit15=0) or output address (Bit15=1) is involved.<br>■ B#16#54: Peripheral input (PI)<br>■ B#16#55: Peripheral output (PQ)<br>If a mixed module is involved, the area identifier of the lower address must be specified. If the addresses are the same, B#16#54 must be specified. |
| LAADR | INPUT | WORD | E, A, M, D, L, Constant | Start address of the address range in the transfer memory (from the point of view of the DP slave).<br>If this is a range belonging to a mixed module, specify the lower of the two addresses. |

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| AL_INFO | INPUT | DWORD | E, A, M, D, L, Constant | Interrupt ID<br>This is transferred to the OB40 that will be started on the DP master (variable OB40_POINT_ADDR).<br>If you operate the intelligent slave with a remote master, you must evaluate the diagnostic frame on the master. |
| RET_VAL | OUTPUT | INT | E, A, M, D, L | If an error occurs while the function is being executed, the return value contains an error code. |
| BUSY | OUTPUT | BOOL | E, A, M, D, L | *BUSY* = 1: The triggered hardware interrupt has not yet been acknowledged by the DP master. |

**RET_VAL (Return value)**

| Value | Description |
|---|---|
| 0000h | The job was executed without errors. |
| 7000h | First call with *REQ* = 0. No hardware interrupt request is active; *BUSY* has the value 0. |
| 7001h | First call with *REQ* = 1. A hardware interrupt request has already been sent to the DP master; *BUSY* has the value 1. |
| 7002h | Interim call (*REQ* irrelevant): the triggered hardware interrupt has not yet been acknowledged by the DP master; *BUSY* has the value 1. |
| 8090h | Start address of the address range in the transfer memory is incorrect. |
| 8091h | Interrupt is blocked (block configured by user) |
| 8093h | The parameters *IOID* and *LADDR* address a module that is not capable of a hardware interrupt request. |
| 80B5h | Call in the DP master not permitted. |
| 80C3h | The required resources (memory, etc.) are occupied at this time. |
| 80C5h | Distributed I/O device is not available at this time (i.e. station failure). |
| 80C8h | The function is not permitted in the current DP master operating mode. |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 13.1.10 SFC 12 - D_ACT_DP - 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.

*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.

*With VIPA you can not deactivate 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.

*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.

*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<br>*REQ* = 1: execute activation or deactivation |
| MODE | INPUT | BYTE | I, Q, M, D, L, constant | Job ID<br>Possible values:<br>0: request information on whether the addressed DP slave is activated or deactivated.<br>1: activate the DP slave<br>2: deactivate the DP slave |
| LAADR | INPUT | WORD | I, Q, M, D, L, constant | Any logical address of the DP slave |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| 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:<br>*BUSY* = 1: the job is still active.<br>*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*.<br>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.<br>(This error code is possible only with *MODE* = 1.)<br>**Note!**<br>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.<br>(This error code is possible only with *MODE* = 1.)<br>**Note!**<br>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. |
| 80C1h | The SFC 12 was started and continued with another logical address.<br>(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).<br>■ The CPU is busy receiving a modified configuration. Currently you cannot enable/disable DP slaves. |

| Value | Description |
|---|---|
| F001h | Not all slaves may be deactivated. At least 1 slave must remain activated. |
| F002h | Unknown slave address. |

### 13.1.11 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.

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<br>Error code | 1<br>0 |
| 2 ... (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 |

**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 | return value |
| 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.

*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.

> *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.

## 13.1.12 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 128Byte. 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 |

### 13.1.13 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 128Byte. 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 |

### 13.1.14 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.

*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**

When generating messages with the SFC 17 and SFC 18, the operating system uses one system resource for the duration of the signal cycle.

For SFC 18 , the signal cycle lasts from the SFC call *SIG* = "1" until another call with SIG = "0". For SFC 17, this time period also includes the time until the incoming signal is acknowledged by one of the reported display devices, if necessary.

If, during the signal cycle, the message-generating block is overloaded or deleted, the associated system resource remains occupied until the next restart.

**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- and 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 indicated 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.<br>(I, Q, M, D, L) | Message number<br>(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<br>■ application memory cannot be accessed (e.g. access to deleted DB). The message will be transferred.<br>■ The associated value points to the local data area. |
| 0002h | Warning: the last unused message acknowledgment 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. |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.15 SFC 19 - ALARM_SC - Acknowledgement state 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"). |
| 8xyyh | General error information *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.16 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. |

*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)**

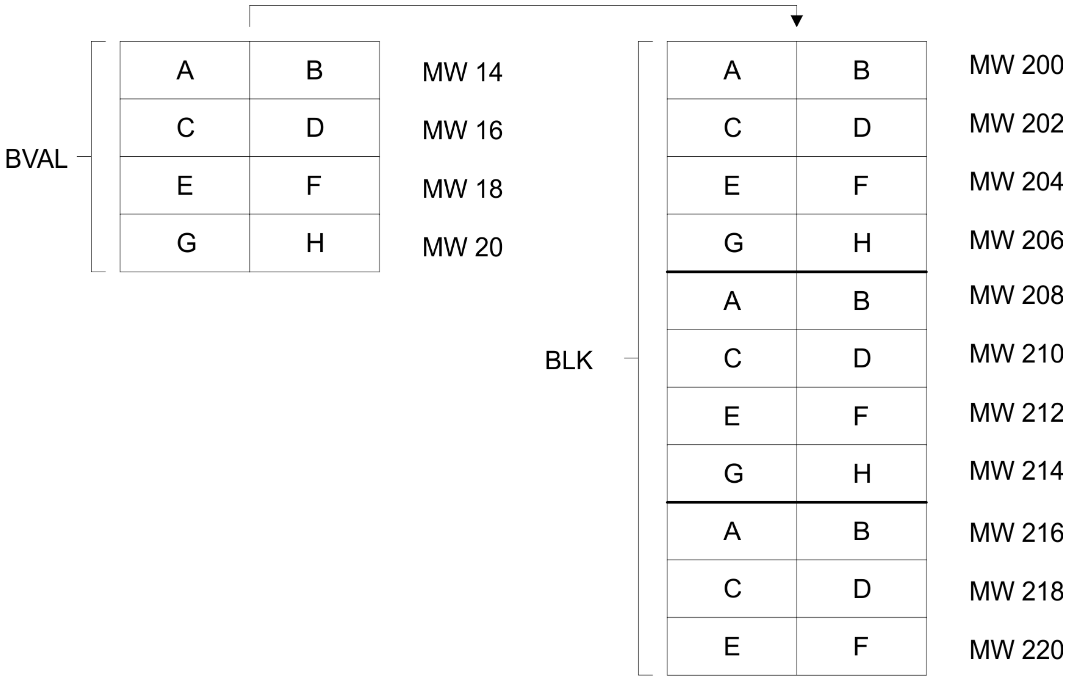
The return value contains an error code if an error is detected when the function is being processed.

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

## 13.1.17 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.




*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 returns no specific error information.

## 13.1.18 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_NUMBER* |

**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<br>■ the function "Compress application memory" is active |
| 80A1h | Error in the number of the DB:<br>■ the number is 0<br>■ the number exceeds the CPU-specific number of DBs<br>■ lower limit > upper limit |
| 80A2h | Error in the length of the DB:<br>■ the length is 0<br>■ the length was specified as an uneven number<br>■ the length is larger than permitted by the CPU |
| 80B1h | No DB-number available |
| 80B2h | Insufficient memory available |
| 80B3h | Insufficient contiguous memory available<br>(compress the memory!) |

## 13.1.19 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<br>■ the function "Compress application memory" is active<br>■ you are copying the DB to be deleted from the CPU to an offline project |
| 80A1h | Error in DB number:<br>■ has a value of 0<br>■ 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 |

## 13.1.20 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:*<br>the selected actual parameter<br>■ has a value of 0<br>■ 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. |

## 13.1.21 SFC 25 - COMPRESS - Compressing the User Memory

**Gaps in Memory**

Gaps can occur in the load memory and in the work memory if data blocks are deleted and reloaded several times. These gaps reduce the effective memory area.

**Description**

With SFC 25 COMPRESS, you start compression of the RAM section of both the load memory and the work memory. The compression function is the same as when started externally in the RUN mode (mode selector setting).

If compression was started externally and is still active (via Module Status Information), the SFC 25 call will result in an error message.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Error information |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | Indicates whether the compression function started by an SFC 25 call is still active.<br>(1 means active) |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Indicates whether the compression function started by SFC 25 was completed successfully.<br>(1 means completed successfully) |

**Checking the Compression Function**

If SFC 25 COMPRESS is called once, the compression function is started.

Call SFC 25 cyclically. First evaluate the parameter *RET_VAL* after every call. Provided that its value is 0, the parameters *BUSY* and *DONE* can be evaluated. If *BUSY* = 1 and *DONE* = 0, this indicates that the compression function is still active. When *BUSY* changes to value 0 and *DONE* to the value 1, this indicates that the compression function was completed successfully.

If SFC 25 is called again afterwards, the compression function is started again.

## 13.1.22 SFC 28 ... SFC 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 ... 31**

The system function are used as follows:

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

### 13.1.22.1 SFC 28 - SET_TINT - Set time-of-day interrupt

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*:<br>0000h = single<br>0201h = at minute intervals<br>0401h = hourly<br>1001h = daily<br>1201h = weekly<br>1401h = monthly<br>1801h = annually<br>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. |

### 13.1.22.2 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. |

### 13.1.22.3 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 (Rückgabewert)**

| 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. |

### 13.1.22.4 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. |

### 13.1.23 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.

**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 after the time delay (OB 20, OB 21). |
| DTIME | INPUT | TIME | I, Q, M, D, L, constant | The delay time (1 ... 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 |

### 13.1.24 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. |

### 13.1.25 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. |

### 13.1.26 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. |

### 13.1.27 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**

| Parameter | 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. |

### 13.1.28 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. |

### 13.1.29 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*.

*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 | Description |
|---|---|
| 00 | All newly occurring interrupts and asynchronous errors are disabled<br>(Synchronous errors are not disabled). |
| 01 | All newly occurring events belonging to a specified interrupt class are disabled.<br>Identify the interrupt class by specifying it as follows:<br>■ Time-of-day interrupts: 10<br>■ Time-delay interrupts: 20<br>■ Cyclic interrupts: 30<br>■ Hardware interrupts: 40<br>■ Interrupts for DP-V1: 50<br>■ Asynchronous error interrupts: 80<br>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.<br>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.<br>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.<br>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.<br>The operating system enters event 5380h in the diagnostic buffer. |

**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<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 13.1.30 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 | Description |
|---|---|
| 00 | All newly occurring interrupts and asynchronous errors are enabled. |
| 01 | All newly occurring events belonging to a specified interrupt class are enabled.<br>Identify the interrupt class by specifying it as follows:<br>■ Time-of-day interrupts: 10<br>■ Time-delay interrupts: 20<br>■ Cyclic interrupts: 30<br>■ Hardware interrupts: 40<br>■ Interrupts for DP-V1: 50<br>■ 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<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.31 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<br>(= 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).

### 13.1.32 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. |

### 13.1.33 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.

### 13.1.34 SFC 44 - REPL_VAL - Replace value to ACCU1

**Description**

The SFC 44 REPL_VAL (replace value) transfers a value into ACCU1 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 ACCU1 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). |

### 13.1.35 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.

### 13.1.36 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.

*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.

### 13.1.37 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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| RACK | OUTPUT | WORD | I, Q, M, D, L | See *AREA* below |
| 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<br>*SLOT*: Slot number<br>*SUBADDR*: Address offset to base address |
| 2 | Decentralized periphery | *RACK* (Low Byte): Station number<br>*RACK* (High Byte): DP master system ID<br>*SLOT*: Slot number at station<br>*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*. |

### 13.1.38 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:<br>54h = peripheral input (PI)<br>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*. |
| 80A0h | Error in output parameter *PEADDR*:<br>data type of the field elements is not WORD. |
| 80A1h | Error in output parameter *PAADDR*:<br>data type of the field elements is not WORD. |
| 80A2h | Error in output parameter *PEADDR*:<br>the specified field could not accommodate all the logical addresses. |
| 80A3h | Error in output parameter *PAADDR*:<br>the specified field could not accommodate all the logical addresses. |

## 13.1.39 SFC 51 - RDSYSST - Read system status list SSL

**Description**

With the SFC 51 RDSYSST (read system status) a partial list respectively an extract of a partial list of the SSL (**s**ystem **s**tatus **l**ist) may be requested. Here with the parameters *SSL_ID* and *INDEX* the objects to be read are defined.

The *INDEX* is not always necessary. It is used to define an object within a partial list.

By setting *REQ* the query is started. As soon as *BUSY* = 0 is reported, the data are located in the target area *DR*.

IInformation about the SSL may be found in Chapter "System status list SSL".

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L, constant | *REQ* = 1: start processing |
| SSL_ID | INPUT | WORD | I, Q, M, D, L, constant | *SSL_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 |
| SSL_HEADER | OUTPUT | STRUCT | D, L | WORD structure with 2 types:<br>LENGTHDR: length record setN_DR: number of existing related records (for access to partial list header information) or number of records transmitted in DR. |
| DR | OUTPUT | ANY | I, Q, M, D, L | Target area for the SSL partial list or the extraction of the partial list that was read:<br>If you have only read the SSL partial list header info of a SSL partial list, you may not evaluate DR, but only *SSL_HEADER*.<br>Otherwise the product of LENGTHDR and N_DR shows the number of bytes stored in *DR*. |

**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.<br>The function still returns as many records as possible.<br>The SSL header indicates the returned number of records. |
| 7000h | First call with *REQ* = 0: data transfer not active; *BUSY* = 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated; *BUSY* = 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active; *BUSY* = 1. |
| 8081h | The length of the result field is too low. There is not enough space for one record. |
| 8082h | *SSL_ID* is wrong or unknown to the CPU or the SFC. |
| 8083h | Bad or illegal *INDEX*. |
| 8085h | Information is not available for system-related reasons, e.g. because of a lack of resources. |
| 8086h | Record set may not be read due to a system error. |

| Value | Description |
|---|---|
| 8087h | Record set may not be read because the module does not exist or it does not return an acknowledgement. |
| 8088h | Record set may not be read because the current type identifier differs from the expected type identifier. |
| 8089h | Record set may not be read 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). |

### 13.1.40 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 *SSL_ID* = 0132h and *INDEX* = 0005h. Sending of user defined diagnostic messages is possible if the fourth word of the returned record set 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**

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 (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 ... 20 | Time stamp:<br>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,<br>constant | Enable sending of user defined diagnostic messages to all registered partners. |
| EVENTN | INPUT | WORD | I, Q, M, D, L,<br>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<br>(the diagnostic event has been entered into the diagnostic buffer) |

## 13.1.41 FC/SFC 53 - uS_Tick - Time measurement

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 FC/SFC 53 calls before and after an application you may thus evaluate the runtime of the application in µs.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

***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 | Starts again with 0 |

**Parameters**

| 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 ... $2^{32}$-1µs.

*Please note for further calculations that the system time is returned in a signed data type.*

### 13.1.42 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 ... 240) |

| 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.<br>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 ... 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).
  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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*BUSY* is set to 1. |
| 8090h | The specified logical base address is invalid:<br>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. |

### 13.1.43 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 ... 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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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<br>(valid values: 0 ... 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 ... 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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*BUSY* is set to 1. |
| 8090h | The specified logical base address is invalid: no assignment available in SDB1/SDB2x,<br>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<br>(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. |
| 80C4h | Communication error. |
| 80C5h | Decentralized periphery not available. |
| 80C6h | The transfer of records was aborted due to a priority class abort. |
| 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. |

| Value | Description |
|---|---|
| 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 static. |

### 13.1.44 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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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<br>(valid values: 0 ... 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 ... 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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*BUSY* is set to 1. |
| 8090h | The specified logical base address is invalid: no assignment available in SDB1/SDB2x,<br>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<br>(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<br>(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. |
| 80C4h | Communication error. |
| 80C5h | Decentralized periphery not available. |
| 80C6h | The transfer of records was aborted due to a priority class abort. |
| 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. |

| Value | Description |
|---|---|
| 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. |

## 13.1.45 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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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 ... 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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*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. |
| 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) |
| 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. |
| 80C4h | Communication error |
| 80C5h | Decentralized periphery not available. |
| 80C6h | The transfer of records was aborted due to a priority class abort. |
| 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. |

| Value | Description |
|---|---|
| 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. |

## 13.1.46 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.

System dependent this block cannot be interrupted!

**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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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<br>(valid range: 2 ... 240) |
| RECORD | INPUT | ANY | I, Q, M, D, L | Record<br>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 ... 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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*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<br>(this fault occurs between the CPU and the external DP interface) |
| 80B0h | SFC not valid for the type of module.<br>Module does not recognize the record.<br>Record number ≥ 241 not permitted.<br>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 |

| Value | Description |
|---|---|
| 80C5h | Decentralized periphery not available. |
| 80C6h | The transfer of records was aborted due to a priority class abort. |

*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.*

### 13.1.47 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.

System dependent this block cannot be interrupted!

**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:<br>54h = peripheral input (PI)<br>55h = peripheral output (PQ)<br>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<br>(valid range: 0 ... 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.<br>Additionally: the length of the actual record that was read, in bytes (range: +1 ... +240), provided that the target area is greater than the transferred record and that no communication errors have occurred. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | *BUSY* = 1: the write operation has not been completed. |
| 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 ... 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 ... 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;<br>*BUSY* is set to 0. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*BUSY* is set to 1. |
| 8090h | The specified logical base address is invalid: no assignment available in<br>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*. |

| Value | Description |
|---|---|
| 80A0h | Negative acknowledgment when reading from the module<br>(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<br>(this fault occurs between the CPU and the external DP interface). |
| 80B0h | SFC not valid for the type of module.<br>Module does not recognize the record.<br>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. |

*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.*

### 13.1.48 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. |
| 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 ... $2^{31}$ -1ms. |

**RET_VAL (Return value)** The SFC 64 does not return any error information.

## 13.1.49 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.<br>*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.<br>■ bad *IOID*<br>■ bad base address exists<br>■ bad MPI-address (> 126) |
| 8092h | Error in *SD* or *RD*, e.g.:<br>■ illegal length for *SD*<br>■ *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. |

| Value | Description |
|---|---|
| 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.:<br>■ the module is already executing the maximum number of different send operations.<br>■ Connection resources may be occupied, e.g. by a receive operation. |
| 80C2h | Temporary lack of resources for the communication partner, e.g.:<br>■ The communication partner is currently processing the maximum number of operations.<br>■ The required resources (memory, etc.) are already occupied.<br>■ Not enough memory (initiate compression). |
| 80C3h | Error when establishing a connection, e.g.:<br>■ The local station is connected to the MPI sub-net.<br>■ You have addressed the local station on the MPI sub-net.<br>■ The communication partner cannot be contacted any longer.<br>■ Temporary lack of resources for the communication partner. |

## 13.1.50 SFC 66 - X_RCV - Receive data

**Description**

The SFC 66 X_RCV 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,<br>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 pro-cessed. |
| 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. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| NDA | OUTPUT | BOOL | I, Q, M, D, L | Status parameter "new data arrived".<br>*NDA* = 0:<br>■ The queue does not contain a data block.<br>*NDA* = 1:<br>■ The queue does contain one or more data blocks.<br>(call to the SFC 66 with *EN_DT* = 0)<br>■ The oldest data block in the queue was copied into the application program.<br>(call to the SFC 66 with *EN_DT* = 1) |
| RD | OUTPUT | ANY | I, Q, M, D | Reference to the receive data buffer (receive data area).<br>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 new start follows.

**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. |

| Value | Description |
|---|---|
| 8090h | The specified target address of the communication partners is not valid, e.g.<br>■ bad *IOID*<br>■ bad base address exists<br>■ bad MPI-address (> 126) |
| 8092h | Error in *SD* or *RD*, e.g.:<br>■ The amount of data received is too much for the buffer defined by *RD*.<br>■ *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 acknowledgment. |
| 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 acknowledgment contains an unknown error code. |
| 80BAh | The answer of the communication partner does not fit into the communication telegram. |
| 80C0h | The answer of the communication partner does not fit into the communication telegram. |
| 80C1h | Lack of resources on the CPU where the SFC is being executed, e.g.:<br>■ the module is already executing the maximum number of different send operations.<br>■ connection resources may be occupied, e.g. by a receive operation. |
| 80C2h | Temporary lack of resources for the communication partner, e.g.:<br>■ The communication partner is currently processing the maximum number of operations.<br>■ The required resources (memory, etc.) are already occupied.<br>■ Not enough memory (initiate compression). |
| 80C3h | Error when establishing a connection, e.g.:<br>■ The local station is connected to the MPI sub-net.<br>■ You have addressed the local station on the MPI sub-net.<br>■ The communication partner cannot be contacted any longer.<br>■ Temporary lack of resources for the communication partner. |

### 13.1.51 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 communica-tion 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 pro-cessed. If no error has occurred, *RET_VAL* con-tains 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.<br>*BUSY* = 0: the receive operation has been com-pleted or no receive operation active. |
| RD | OUTPUT | ANY | I, Q, M, D | Reference to the receive buffer (receive data area).<br>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 compro-mised:

- 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 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" 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),<br>BUSY is set to 0, no data transfer is active. |
| 7001h | First call with *REQ* = 1: Data transfer started;<br>*BUSY* has the value 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.:<br>■ bad *IOID*<br>■ bad base address exists<br>■ bad MPI-address (> 126) |
| 8092h | Error in *SD* or *RD*, e.g.:<br>■ illegal length for *RD*<br>■ the length or the data type of *RD* does not correspond with the received data.<br>■ *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. |
| 80B2h | HW-error: module does not exist<br>■ The slot that was configured is empty.<br>■ Actual module type does not match the required module type.<br>■ Decentralized periphery not available.<br>■ The respective SDB does not contain an entry for the module. |
| 80B3h | Data may only be read or written, e.g. write protected DB. |

| Value | Description |
|---|---|
| 80B4h | The communication partner does not support the data type specified in *VAR_ADDR*. |
| 80B6h | The received acknowledgment 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.:<br>■ The module is already executing the maximum number of different send operations.<br>■ Connection resources may be occupied, e.g. by a receive operation. |
| 80C2h | Temporary lack of resources for the communication partner, e.g.:<br>■ The communication partner is currently processing the maximum number of operations.<br>■ The required resources (memory, etc.) are already occupied.<br>■ Not enough memory (initiate compression). |
| 80C3h | Error when establishing a connection, e.g.:<br>■ The local station is connected to the MPI sub-net.<br>■ You have addressed the local station on the MPI sub-net.<br>■ The communication partner cannot be contacted any longer.<br>■ Temporary lack of resources for the communication partner. |

## 13.1.52 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. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| SD | INPUT | ANY | I, Q, M, D | Reference to the buffer in the local CPU that contains the send data.<br>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.<br>*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),<br>*BUSY* is set to 0, no data transfer is active. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*BUSY* is set to 1. |
| 7002h | Intermediate call (*REQ* irrelevant): data transfer active;<br>*BUSY* is set to 1. |
| 8090h | The specified target address of the communication partners is not valid, e.g.<br>■ bad *IOID*<br>■ bad base address exists<br>■ bad MPI-address (> 126) |
| 8092h | Error in *SD* or *RD*, e.g.:<br>■ illegal length of *SD*<br>■ 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<br>■ the slot that was configured is empty.<br>■ Actual module type does not match the required module type.<br>■ Decentralized periphery not available.<br>■ 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. |
| 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.:<br>■ the module is already executing the maximum number of different send operations.<br>■ connection resources may be occupied, e.g. by a receive operation. |

| Value | Description |
|---|---|
| 80C2h | Temporary lack of resources for the communication partner, e.g.:<br>■ The communication partner is currently processing the maximum number of operations.<br>■ The required resources (memory, etc.) are already occupied.<br>■ Not enough memory (initiate compression). |
| 80C3h | Error when establishing a connection, e.g.:<br>■ The local station is connected to the MPI sub-net.<br>■ You have addressed the local station on the MPI sub-net.<br>■ The communication partner cannot be contacted any longer.<br>■ Temporary lack of resources for the communication partner. |

### 13.1.53 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.<br>*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),<br>*BUSY* is set to 0, no data transfer is active. |
| 7001h | First call with *REQ* = 1: data transfer initiated;<br>*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.:<br>■ bad *IOID*<br>■ bad base address exists<br>■ 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.:<br>■ the module is already executing the maximum number of different send operations.<br>■ connection resources may be occupied, e.g. by a receive operation. |

| Value | Description |
|---|---|
| 80C2h | Temporary lack of resources for the communication partner, e.g.:<br>■ The communication partner is currently processing the maximum number of operations<br>■ The required resources (memory, etc.) are already occupied.<br>■ Not enough memory (initiate compression). |
| 80C3h | Error when establishing a connection, e.g.:<br>■ The local station is connected to the MPI sub-net.<br>■ You have addressed the local station on the MPI sub-net.<br>■ The communication partner cannot be contacted any longer.<br>■ Temporary lack of resources for the communication partner. |

### 13.1.54 SFC 70 - GEO_LOG - Determining the Start Address of a Module

**Description**

Assumption: the associated module slot of the module is known from the channel of a signal module. With SFC 70 GEO_LOG (convert geographical address to logical address) you can determine the associated start address of the module, that is, the smallest I address or Q address. If you use SFC 70 on power modules or modules with packed addresses, the diagnostic address is returned.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| MASTER | INPUT | INT | E, A, M, D, L,<br>constant | Area ID:<br>■ 0, if the slot is located in one of the racks 0-3 (S7-300) or 0 bis 21 (S7-400)<br>■ 1 to 32: DP master system ID of the associated field device if the slot is located in a field device on PROFIBUS<br>■ 100 to 115: PROFINET IO system ID of the associated field device if the slot is located in a field device on PROFINET |
| STATION | INPUT | INT | E, A, M, D, L,<br>constant | ■ No. of rack, if area ID= 0<br>■ Station number of field device if area ID > 0 |
| SLOT | INPUT | INT | E, A, M, D, L,<br>constant | Slot no. |
| SUBSLOT | INPUT | INT | E, A, M, D, L<br>constant | Interface module slot (if no interface module can be inserted, enter 0 here) |
| RET_VAL | OUTPUT | INT | E, A, M, D, L | Error information |
| LADDR | OUTPUT | WORD | E, A, M, D, L | Start address of the module Bit 15 of *LADDR* indicates whether an input address (bit 15 = 0) or an output address (bit 15 = 1) is present |

**RET_VAL (Return value)**

| Value | Description |
|---|---|
| 0000h | The job was executed without errors. |
| 8094h | No subnet was configured with the specified *SUBNETID*. |
| 8095h | Invalid value for *STATION* parameter |
| 8096h | Invalid value for *SLOT* parameter |
| 8097h | Invalid value for *SUBSLOT* parameter |
| 8099h | The slot is not configured. |
| 809Ah | The interface module address is not configured for the selected slot. |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.55 SFC 71 - LOG_GEO - Determining the slot belonging to a logical address

**Description**

SFC 71 LOG_GEO (convert logical address to geographical address) lets you determine the module slot belonging to a logical address as well as the offset in the user data area of the module.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| LADDR | INPUT | WORD | E, A, M, D, L,<br>constant | Any logical address of the module In bit 15 you indicate whether an input address (bit 15 = 0) or an output address (bit 15 = 1) is present. |
| RET_VAL | OUTPUT | INT | E, A, M, D, L, | Error information |
| AREA | OUTPUT | INT | E, A, M, D, L, | Area ID: indicates how the remaining parameters are to be interpreted. |
| MASTER | OUTPUT | INT | E, A, M, D, L<br>constant | Area ID:<br>■ 0, if the slot is located in one of the racks 0 - 3 (S7-300) or 0 - 21 (S7-400)<br>■ 1 to 32: DP master system ID of the associated field device if the slot is located in a field device on PROFIBUS<br>■ 100 to 115: PROFINET IO system ID of the associated field device if the slot is located in a field device on PROFINET |
| STATION | OUTPUT | INT | E, A, M, D, L | ■ No. of rack, if area ID= 0<br>■ Station number of field device if area ID > 0 |
| SLOT | OUTPUT | INT | E, A, M, D, L | Slot no. |
| SUBSLOT | OUTPUT | INT | E, A, M, D, L | Interface module number |
| OFFSET | OUTPUT | INT | E, A, M, D, L | Offset in user data area of the associ-ated module |

**AREA Output Parameter**

| Value of AREA | System | Meaning of RACK, SLOT and SUBADDR |
|---|---|---|
| 0 | S7-400 | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no.<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Difference between the logical address and the logical base address. |
| 1 | S7-300 | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no.<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Difference between the logical address and the logical base address. |
| 2 | PROFIBUS DP | ■ *MASTER*: DP master system ID<br>■ *STATION*: Station number<br>■ *SLOT*: Slot no. in the station<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Offset in user data address area of the associated module |
| | PROFINET IO | ■ *MASTER*: PROFINET IO-System-ID<br>■ *STATION*: Station number<br>■ *SLOT*: Slot no. in the station<br>■ *SUBSLOT*: Submodulnummer<br>■ *OFFSET*: Offset in user data address area of the associated module |
| 3 | S5-P area | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no. of the adapter module<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Address in the S5 x area |
| 4 | S5-Q area | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no. of the adapter module<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Address in the S5 x area |
| 5 | S5-IM3 area | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no. of the adapter module<br>■ *OFFSET*: Address in the S5 x area |
| 6 | S5-IM4 area | ■ *MASTER*: 0<br>■ *STATION*: Rack no.<br>■ *SLOT*: Slot no. of the adapter module<br>■ *SUBSLOT*: 0<br>■ *OFFSET*: Address in the S5 x area |

**RET_VAL (Return value)**

| Value | Description |
|---|---|
| 0000h | The job was executed without errors. |
| 8090h | Specified logical address invalid |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.56 SFC 81 - UBLKMOV - Copy data area without gaps

**Description**

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: FB, SFB, FC, SFC, 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.

| 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 pro-cessed. |
| 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. |

*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. |

### 13.1.57 SFC 101 - RTM - Handling Runtime meters

**Description**

Call SFC 101 RTM (runtime meter) to set, start, stop and read a 32-bit runtime meter of your CPU. To fetch the values of all 32-bit runtime meters of your CPU, call SFC 51 RDSYSST with SZL_ID=W#16#0132 and INDEX=W#16#000B (for runtime meters 0 … 7) or INDEX=W#16#000C (for runtime meters 8 … 15).

**Parameters**

| Parameter | Deklaration | Datentyp | Speicherbereich | Beschreibung |
|---|---|---|---|---|
| NR | INPUT | BYTE | E, A, M, D, L, Konstante | Number of the runtime meter<br>Numbering starts at 0. You will find the number of runtime meters of your CPU in the technical specifications. |
| MODE | INPUT | BYTE | E, A, M, D, L, Konstante | Job ID:<br>■ 0: fetch (the status is then written to CQ and the current value to CV). After the runtime meter has reached (2E31) -1 hours, it stops at the highest value that can be displayed and outputs an "Overflow" error message.<br>■ 1: start (at the last counter value)<br>■ 2: stop<br>■ 4: set (to the value specified in *PV*)<br>■ 5: set (to the value specified in *PV*) and then start<br>■ 6: set (to the value specified in *PV*) and then stop |
| PV | INPUT | DINT | E, A, M, D, L, Konstante | New value for the runtime meter |

| Parameter | Deklaration | Datentyp | Speicherber- eich | Beschreibung |
|---|---|---|---|---|
| RET_VAL | OUTPUT | INT | E, A, M, D, L | The return value will contain an error code if an error occurs while the function is being pro- cessed. |
| CQ | OUTPUT | BOOL | E, A, M, D, L | Status of the runtime meter (1: running) |
| CV | OUTPUT | DINT | E, A, M, D, L | Current value of the runtime meter |

**Compatibility to programs for a CPU with 16-bit run- time meters**

You can also operate your 32-bit runtime meters with the SFCs 2 SET_RTM, SFC 3 CTRL_RTM and SFC 4 READ_RTM. In this case however, the 32-bit runtime meters operate in the same way as 16-bit meters (Range of values: 0 to 32767 hours). The par- tial list extract with SSL ID W#16#0132 and index W#16#0008 displays the 32-bit runtime meters 0 to 7 in 16-bit mode. This means that you can continue to use programs devel- oped for a CPU with 16-bit runtime meters that use partial list extract with SSL ID W#16#0132 and index W#16#0008.

**RET_VAL (Return value)**

| Error code | Description |
|---|---|
| 0000h | The job was executed without errors. |
| 8080h | Wrong runtime meter number |
| 8081h | A negative value was passed to parameter *PV*. |
| 8082h | Overflow of the runtime meter. |
| 8091h | Illegal value in input parameter *MODE*. |
| 8xyyh | General error information<br>*Chapter 4.1 ‘General and Specific Error Information RET_VAL’ on page 64* |

## 13.1.58 SFC 102 - RD_DPARA - Reading Predefined Parameters

**Description**

With SFC 102 RD_DPARA you can read the record set with the number *RECNUM* of a selected module from system data configured with STEP7. The read record set is entered into the target area opened with the parameter *RECORD*.

**Operating principle**

The SFC 102 RD_DPARA operates asynchronously, that is, processing covers multiple SFC calls.

Start the job by calling SFC 102 with REQ = 1. The job status is displayed via the output parameters *RET_VAL* and *BUSY*. Refer also to Meaning of *REQ*, *RET_VAL* and *BUSY* with Asynchronously Operating SFCs.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | *REQ* = 1: Read request |
| LADDR | INPUT | WORD | I, Q, M, D, L,<br>constant | Address of the module.<br>For an output address, the highest value bit must be set. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| RECNUM | INPUT | BYTE | I, Q, M, D, L, constant | Record set number (permitted values: 0 ... 240). |
| 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. If no error occurred during the transmission, the following two cases are distinguished: <br>■ *RET_VAL* contains the length of the actually read record set in bytes if the destination area is larger than the read record set. <br>■ *RET_VAL* contains 0 if the length of the read record set is equal to the length of the destination area. |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | *BUSY* = 1: The job is not yet closed. |
| RECORD | OUTPUT | ANY | I, Q, M, D, L | Destination area for the read record set. Only data type BYTE is permitted. Note: Note that the *RECORD*parameter of CPUs always required the full specification of the DB parameters. (for example: P#DB13.DBX0.0 byte 100). Omitting an explicit DB number is not permitted for CPUs and causes an error message in the user program. |

**Error Information** *Chapter 13.1.45 'SFC 57 - PARM_MOD - Parameterize module' on page 326*

### 13.1.59 SFC 105 - READ_SI - Reading Dynamic System Resources

**Overview**

When messages are generated with SFCs 107 ALARM_DQ and 108 ALARM_D, the operating system occupies temporarily system memory space. For example, if you do not delete a FB that exists in the CPU with SFC 107 or SFC 108 calls it may happen that corresponding system resources stay permanently occupied.

If you reload the FB with SFC 108 or SFC 108 calls, it may happen that the SFCs 107 and 108 are not processed properly anymore.

**Description**

With SFC 105 READ_SI you can read currently used system resources occupied with the SFCs 107 and 108 when messages were generated.

This is done via the values of *EV_ID* and *CMP_ID* used in this place. The values are passed on to SFC 105 READ_SI in parameter *SI_ID*.

SFC 105 READ_SI has four possible operating modes that we explain in the table below. Set the desired operating mode via the*MODE* parameter.

| MODE | Which of the system resources occupied by SFC 107/SFC 108 are read? |
|---|---|
| 1 | All (call of SFC 105 with *SI_ID*: =0) |
| 2 | The system resource occupied by the call of SFC 107-/SFC 108 with *EV_ID*:= ev_id (call of the SFC 105 with *SI_ID*: = ev_id) |

| MODE | Which of the system resources occupied by SFC 107/SFC 108 are read? |
|---|---|
| 3 | The system resource occupied by the call of SFC 107-/SFC 108 with *CMP_ID*: = cmp_id (call of the SFC 105 with *SI_ID*: = ev_id) |
| 0 | Additional system resources that could not be read with the previous call in *MODE* =1 or *MODE* =3 because you have specified a target field *SYS_INST* that is too small. |

**Operating principle**

If you have not selected a sufficiently large *SYS_INST* target area when you called the SFC 105 in *MODE* =1 or *MODE* =3, it contains the content of all currently occupied system resources selected via *MODE* parameter.

High system load on resources will cause a correspondingly high SFC runtime. That is, a high load on CPU performance may result in overshoot of the maximum configurable cycle monitoring time. You can work around this runtime problem as follows: Select a relatively small *SYS_INST* target area.

*RET_VAL* = 0001h informs you if the SFC cannot enter all system resources to be read in *SYS_INST*. In this case, call SFC 105 with *MODE* =0 and the same *SI_ID* as for the previous call until the value of *RET_VAL* is 0000h.

*Since the operating system does not coordinate the SFC 105 calls that belong to the read job, you should execute all SFC 105 calls with the same priority class.*

**Target Area SYS_INST**

The target area for the fetched occupied system resource must lie within a DB. You should appropriately define the target area as a field of structures, whereby a structure is constructed as follows:

| Structure element | Data type | Description |
|---|---|---|
| SFC_NO | WORD | No. of the SFC that occupies the system resource |
| LEN | BYTE | Length of the structures in bytes, incl. *SFC_NO* and *LEN*: 0Ch |
| SIG_STAT | BOOL | Signal state |
| ACK_STAT | BOOL | Acknowledgement status of the incoming event (positive edge) |
| EV_ID | DWORD | Message number |
| CMP_ID | DWORD | Partial system ID |

**Parameters**

| Parameter | Declaration | Data type | Memory Area | Description |
|---|---|---|---|---|
| MODE | INPUT | INT | I, Q, M, D, L, constant | Job identifier<br>Permissible values:<br>■ 1: Read all system resources<br>■ 2: Read the system resource that was occupied with *EV_ID* = ev_id when SFC 107-/SFC 108 was called<br>■ 3: Read the system resources that were occupied with *CMP_ID* = cmp_id when SFC 107-/SFC 108 was called<br>■ 0: subsequent call |
| SI_ID | INPUT | DWORD | I, Q, M, D, L, constant | ID for the system resource(s) to be read<br>Permissible values<br>■ 0, if *MODE* = 1<br>■ Message number ev_id, if *MODE* = 2<br>■ ID cmp_id for identification of the system section, if *MODE* = 3 |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L, | Return value<br>(error information or job status) |
| N_SI | OUTPUT | INT | I, Q, M, D, L, | Number of output system resources with *SYS_INT* |
| SYS_INST | OUTPUT | ANY | D | Target area for the fetched system resources. |

**RET_VAL (Return value)**

| Error code | Description |
|---|---|
| 0000h | No error occurred. |
| 0001h | Not all system resources could be read because the *SYS_INT* target range you have selected is too short. |
| 8081h | (only with *MODE* =2 or 3)<br>You have assigned the value 0 to *SI_ID*. |
| 8082h | only with *MODE* =1)<br>You have assigned one of 0 different values to *SI_ID*. |
| 8083h | (only with *MODE* =0)<br>You have assigned *SI_ID* a value other than at the preceding call of the SFC with *MODE* =1 or 3. |
| 8084h | You have assigned an illegal value to *MODE*. |
| 8085h | SFC 105 is already being processed in another OB. |
| 8086h | Target area *SYS_INST* too small for a system resource. |
| 8087h or 8092h | Target area *SYS_INST* does not exist in a DB or error in the ANY pointer. |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.60 SFC 106 - DEL_SI - Reading Dynamic System Resources

**Overview**

When messages are generated with SFCs 107 ALARM_DQ and 108 ALARM_D, the operating system occupies temporarily system memory space.

For example, if you do not delete a FB that exists in the CPU with SFC 107 or SFC 108 calls it may happen that corresponding system resources stay permanently occupied. If you reload the FB with SFC 108 or SFC 108 calls, it may happen that the SFCs 107 and 108 are not processed properly anymore.

**Description**

With SFC 106 DEL_SI you can delete currently used system resources.

SFC 106 DEL_SI has three possible operating modes explained in the table below. Set the desired operating mode via the *MODE* parameter.

| MODE | Which of the system resources occupied by SFC 107/SFC 108 are deleted? |
|---|---|
| 1 | All (call of SFC 106 with *SI_ID*: = 0) |
| 2 | The system resource occupied by the call of SFC 107-/SFC 108 with *EV_ID*: = ev_id<br>(call of the SFC 106 with *SI_ID*: = ev_id) |
| 3 | The system resource occupied by the call of SFC 107-/SFC 108 with *CMP_ID*:= cmp_id<br>(call of the SFC 106 with *SI_ID*: =e v_id) |

**Parameters**

| Parameter | Declaration | Data type | Memory Area | Description |
|---|---|---|---|---|
| MODE | INPUT | INT | I, Q, M, D, L,<br>constant | Job identifier<br>Permissible values<br>■ 1: delete all system resources<br>■ 2: delete the system resource that was occupied with *EV_ID* = ev_id when SFC 107-/SFC 108 was called<br>■ 3: delete the system resources that were occupied with *CMP_ID* = cmp_id when SFC 107-/SFC 108 was called |
| SI_ID | INPUT | DWORD | I, Q, M, D, L,<br>constant | ID of the system resource(s) to be deleted<br>Permissible values<br>■ 0, if *MODE* = 1<br>■ Message number ev_id, if *MODE* = 2<br>■ ID cmp_id for identification of the system section, if *MODE* = 3 |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Error Information |

**RET_VAL (Return value)**

| Error code | Description |
|---|---|
| 0000h | No error occurred. |
| 8081h | (only with *MODE* = 2 or 3)<br>You have assigned the value 0 to *SI_ID*. |
| 8082h | (only with *MODE* = 1)<br>You have assigned one of 0 different values to *SI_ID*. |
| 8084h | You have assigned an illegal value to MODE. |
| 8085h | SFC 106 is currently being processed. |
| 8086h | Not all selected system resources could be deleted because at least one of them was being processed when SFC 106 was called. |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 13.1.61 SFC 107 - ALARM_DQ and SFC 108 - ALARM_D

**Description**

With every call the SFCs 107 ALARM_DQ (Generating Acknowledgeable Block Related Messages) and 108 ALARM_D (Permanently Acknowledged Block Related Messages) generate a message to which you can append an associated value. Thus, you correspond with SFCs 17 ALARM_SQ and 18 ALARM_S.

When generating messages with SFCs 107 ALARM_DQ and 108 ALARM_D, the operating system temporarily occupies a system resource for the duration of the signal cycle.

The signal cycle time for SFC 108 ALARM_D starts at the SFC call with *SIG* = 1 and ends at a new call with *SIG* = 0. This interval for SFC 107 ALARM_DQ may be extended by the time expiring until the incoming signal is acknowledged at a logged in displaying device.

For SFC 108 ALARM_D, the signal cycle lasts from the SFC call *SIG* = 1 until another call with *SIG* = 0. For SFC 107 ALARM_DQ, this time period also includes the time until the incoming signal is acknowledged by one of the reported display devices, if necessary.

If, during the signal cycle, the message-generating block is overloaded or deleted, the associated system resource remains occupied until the next restart.

The additional functionality of SFCs 107 ALARM_DQ and 108 ALARM_D compared to SFCs 17 and 18 is now that you can manage these occupied system resources:

- With the help of SFC 105 READ_SI you can fetch information related to occupied system resources.
- With SFC 106 DEL_SI you can release occupied system resources again. This is of special significance for permanently occupied system resources. A currently occupied system resource, for example, stays occupied until the next restart if you, in the course of a program change, delete an FB call that contains SFC 107 or SFC 108 calls. When you change the program, and reload an FB with SFC 107 or SFC 108 calls, it may happen that the SFCs 107 and 108 do not generate anymore messages.

**Description Parameter**

The SFCs 107 and 108 contain one parameter more than the SFCs 17 and 18, namely the input *CMP_ID*. Use this input to assign the messages generated with SFCs 107 and 108 to logical areas, for example to parts of the system. If you call SFC 107/SFC 108 in an FB the obvious thing to do is to assign the number of the corresponding instance DB to *CMP_ID*.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| SIG | INPUT | BOOL | I, Q, M, D, L | The message triggering signal |
| ID | INPUT | WORD | I, Q, M, D, L, constant | Data channel for messages: EEEEh |
| EV_ID | INPUT | DWORD | I, Q, M, D, L, constant | Message number<br>(not allowed: 0) |
| CMP_ID | INPUT | DWORD | I, Q, M, D, L, constant | Component identifier (not allowed: 0)<br>ID for the partial system to which thecorres-ponding message is assigned<br>Recommended values:<br>■ Low-Word: 1 ... 65535<br>■ High-Word: 0<br>You will not be confronted with any conflicts if you are compliant with these recommendations. |
| SD | INPUT | ANY | I, Q, M, D, T, C | Associated value<br>Maximum length: 12 bytes<br>Permitted are only data of the type<br>BOOL (not allowed: Bit field),BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND_TIME |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Error Information |

**RET_VAL (Return value)**

| Error code | Description |
|---|---|
| 0000h | No error occurred. |
| 0001h | ■ The length of the associated value exceeds the maximum permissible length, or<br>■ Access to user memory not possible (for example, access to deleted DB).The activated message is sent.<br>■ The associated value points to a value in the local data area. The message is sent. (S7-400 only) |
| 0002h | Warning: The last free message acknowledge memory was occupied. (S7-400 only) |
| 8081h | The specified *EV_ID* lies outside the valid range. |
| 8082h | Message loss because your CPU has no more resource for generating block related messages with SFCs. |
| 8083h | Message loss, the same signal transition is already present but could not be sent yet (signal overflow). |
| 8084h | With the current and the previous SFC 107-/SFC-108 call the message triggering signal SIG has the same value. |
| 8085h | There is no logon for the specified *EV_ID*. |
| 8086h | An SFC call for the specified *EV_ID* is already being processed in a lower priority class. |
| 8087h | At the initial call of SFC 107/SFC 108 the message triggering signal had the value 0. |
| 8088h | The specified *EV_ID* is already in use by another system resource (to SFC 17, 18, 107, 108). |

| Error code | Description |
| --- | --- |
| 8089h | You have assigned the value 0 to *CMP_ID*. |
| 808Ah | *CMP_ID* not fit to *EV_ID* |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

## 13.2 Standard Function Blocks

### 13.2.1 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 restart, then the respective instances must be initialized in OB 100 with R = 1.

**Parameters**

| 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 |
| 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 ... 32767

### 13.2.2 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 restart, then the respective instances must be initialized in OB 100 with *LOAD* = 1 and *PV* = required preset value for CV.

**Parameters**

| 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:

- "1", if $CV \leq 0$
- else $Q$ = "0"

**CV**

Current count:

- possible values: -32 768 ... 32 767

### 13.2.3 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 $CV \geq PV$.
- Output *QD* has signal state "1", if $CV \leq 0$.
- 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.

**Parameters**

| 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 up counter:

- *QU* = "1" if *CV* ≥ *PV* (Current count ≥ Preset value)
- else *QU* = "0"

**QD**

Status of the down counter:

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

**CV**

Current count

- possible values: -32 768 ... 32 767

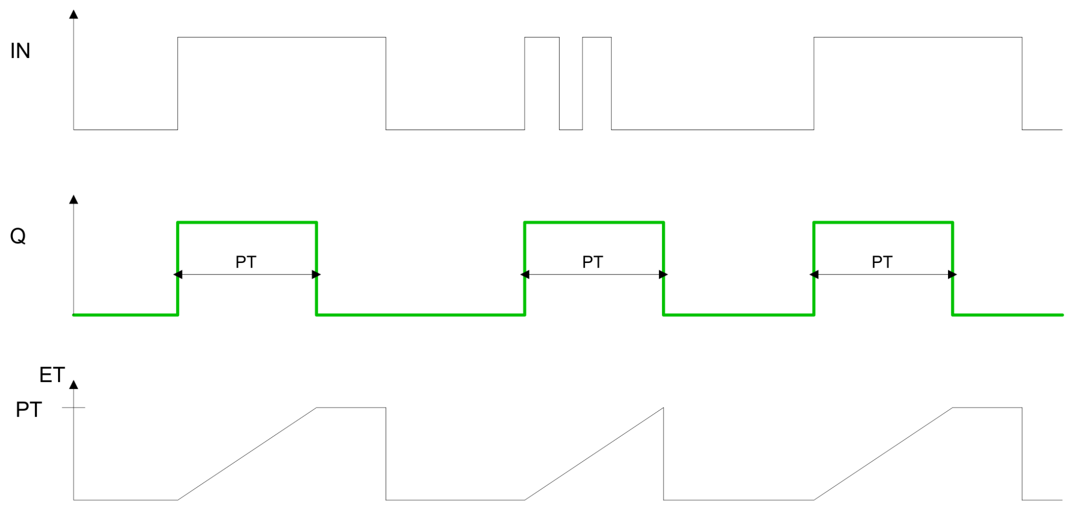
## 13.2.4 SFB 3 - TP - Create pulse

**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**




**Parameters**

| 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.

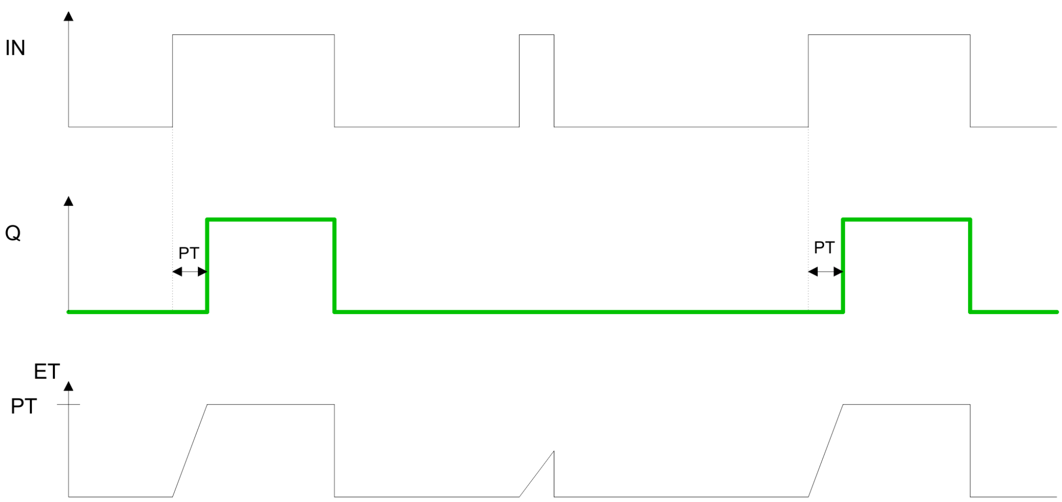
### 13.2.5 SFB 4 - TON - Create turn-on delay

**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**



**Parameters**

| 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* to *PT* must be. The range of values is defined by the data type TIME.

**Q**

Output Q:

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".

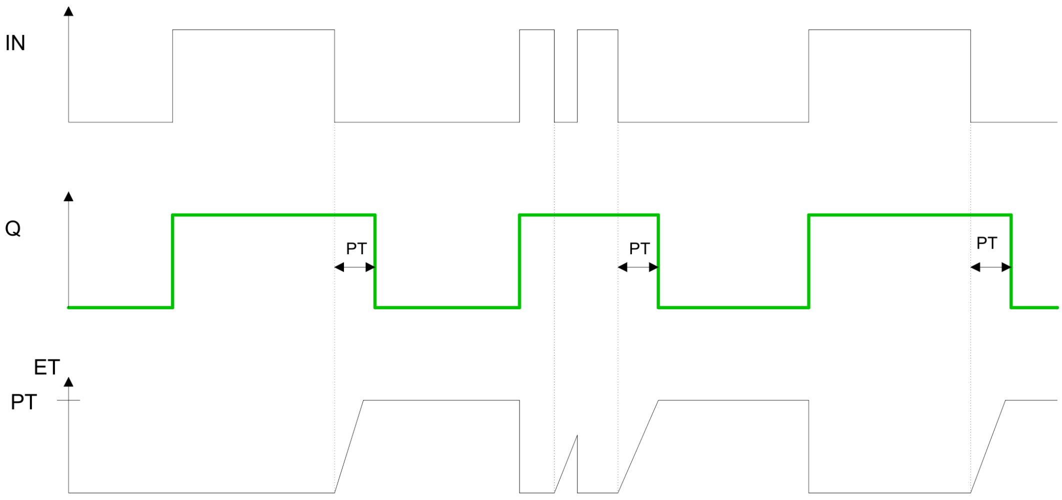
### 13.2.6 SFB 5 - TOF - Create turn-off delay

**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**




**Parameters**

| 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* to *PT* must be. The range of values is defined by the data type TIME.

**Q**

Output *Q*:

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".

### 13.2.7 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.

*Please note that this block calls the FC or SFC 202 AG_BSEND internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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*, I*D, 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 cancelled.
- 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.

*The parameter R_ID must be identical at the two corresponding FBs/ SFBs.*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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<br>(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.<br>Format W#16#xxxx |
| R_ID | INPUT | DWORD | I, Q, M, D, L, constant | Address parameter *R_ID*.<br>Format DW#16#wxyzWXYZ. |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*:<br>0: task has not been started or is still being executed.<br>1: task was executed without error. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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 start. It specifies the maximum length of the send buffer. Only data type BOOL is valid (Bit field not permitted),<br>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) | Description |
|---|---|---|
| 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.:<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g. cable, CPU turned off, CP in STOP) |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 2 | Negative acknowledgment 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<br>or an error has occurred in the receive data buffer pointer *RD_1* of the respective FB/SFB 13 BRCV |
| 1 | 5 | Reset request 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<br>■ contains an instance DB that does not belong to the FB/SFB 12<br>■ contains a global DB instead of an instance DB<br>■ could not locate an instance DB<br>(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*.

### 13.2.8 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 acknowledgment is sent to the partner FB/SFB and the *LEN* parameter is updated.

*Please note that this block calls the FC or SFC 203 AG_BRCV internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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.<br>Format: W#16#xxxx |
| R_ID | INPUT | DWORD | I, Q ,M, D, L, constant | Address parameter *R_ID*.<br>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*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– An error has occurred. |
| STATUS | OUTPUT | WORD | I, Q, M, D ,T, C | 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),<br>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 acknowledgment 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) | Description |
|---|---|---|
| 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.<br>■ Connection parameters not loaded (local or remote)<br>■ 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<br>(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<br>(e.g. access to deleted DB). |
| 1 | 12 | The call to the FB/SFB<br>■ contains an instance DB that does not belong to the FB/SFB 13<br>■ contains a global DB instead of an instance DB<br>■ 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 acknowledgment.
- 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.

### 13.2.9 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.

*Please note that this block calls the FC or SFC 200 AG_GET internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

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.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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#xxxx |
| NDR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *NDR*: data from partner CPU has been accepted. |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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. You must ensure that the defined parameters on the *ADDR_i* and *RD_i* areas and the number that fit in quantity, length and data type of data to each other.

**Error information**

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 0 | 11 | Warning: the new task is not active since the previous task has not completed. |
| 0 | 25 | The communication process was initiated.<br>The task is being processed. |
| 1 | 1 | Communication failures, e.g.<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g.: cable, CPU turned off, CP in STOP) |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 2 | Negative acknowledgment from partner device.<br>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<br>(e.g. access to deleted DB). |
| 1 | 12 | The call to the FB/SFB<br>■ contains an instance DB that does not belong to the FB/SFB 14<br>■ contains a global DB instead of an instance DB<br>■ could not locate an instance DB<br>(load a new instance DB from the PG) |
| 1 | 20 | Not enough memory. |

**Data consistency**

The data are received consistently if you evaluate the current use of range *RD_i* completely before initiating another job.

### 13.2.10 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.

*Please note that this block calls the FC or SFC 201 AG_PUT internally. These must not be overwritten! The direct call of an internal block leads to errors in the corresponding instance DB!*

Depending upon communication function the following behavior is present:

- *Siemens S7-300 Communication (FB 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.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library. Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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<br>(with respect to the most recent FB/SFB-call) |
| ID | INPUT | WORD | I, Q, M, D,<br>constant | A reference for the connection. Format W#16#xxxx |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*: function completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR*:<br>■ *ERROR* = 0 + *STATUS* = 0000h<br>– No warnings or errors.<br>■ *ERROR* = 0 + *STATUS* unequal to 0000h<br>– A Warning has occurred. *STATUS* contains detailed information.<br>■ *ERROR* = 1<br>– 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 acknowledgment.
- This acknowledgment 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) | Description |
|---|---|---|
| 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. |

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 1 | 1 | Communication failures, e.g.<br>■ Connection parameters not loaded (local or remote)<br>■ Connection interrupted (e.g.: cable, CPU turned off, CP in STOP) |
| 1 | 2 | Negative acknowledgment 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<br>contains an instance DB that does not belong to the FB/SFB 15.<br>contains a global DB instead of an instance DB.<br>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.

## 13.2.11 SFB 31 - NOTIFY_8P - Messages without acknowledge display (8x)

**Description**

Generating block related messages without acknowledgement display for 8 signals.

- SFB 31 NOTIFY_8P represents an extension of SFB 36 "NOTIFY" to 8 signals.
- A message is generated if at least one signal transition has been detected. A message is always generated at the initial call of SFB 31. All 8 signal are allocated a common message number that is split into 8 sub-messages on the displaying device.
- One memory with 2 memory blocks is available for each instance of SFB 31 NOTIFY_8P.
- The displaying device shows the last two signal transitions, irrespective of message loss.

*Before you call SFB 31 NOTIFY_8P in a automation system, you must insure that all connected displaying devices know this block. More information about this may be found in the manuals of the components used.*

**Parameter**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| SIG_i, | INPUT | BOOL | I, Q, M, D, L | i-th signal to be monitored |
| ID | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Data channel for messages:<br>EEEEh. ID is only evaluated at the first call. |
| EV_ID | INPUT | DWORD | Constant<br>(I, Q, M, D, L) | Message number<br>(not permitted: 0) |
| SEVERITY | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Weighting of the event |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter DONE:<br>Message generation completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter ERROR |
| STATUS | OUTPUT | WORD | I, Q, M, D, L | Status parameter STATUS:<br>Display of an error information |
| SD_i | IN_OUT | ANY | I, Q, M, D, T, C | i-th associated value |

**SIG_i,**

i-th signal to be monitored It is valid 1 ≤ I ≤ 8.

**ID**

Data channel for messages: EEEEh. *ID* is only evaluated at the first call.

**EV_ID**

EV_ID is only evaluated at the first call. Subsequently, the message number used for the first call applies to every call of SFB with the corresponding instance DB. The message number is automatically assigned by the Siemens STEP®7 programming tool. So the consistency of the message numbers is guaranteed. The message numbers within a user program must be unique.

**SEVERITY**

Weighting of the event Here the value 0 is the highest weighting. This parameter is irrelevant for processing the message. Possible values: 0 ... 127 (default value: 64)

**DONE**

Status parameter *DONE*, Message generation completed.

**SD_i**

i-th associated value It is valid 1 ≤ i ≤ maxNumber. The max. number of associated values may be found in the technical data of your CPU. Permitted are only data of the type BOOL, (not permitted: bit field), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND _TIME.

*When the ANY pointer accesses a DB, the DB always must be specified (e.g.: P# DB10.DBX5.0 Byte 10).*

**Error information ERROR / STATUS**

*ERROR* = TRUE indicates that an error has occurred during processing. For details refer to parameter *STATUS*. The following table contains all the error information specific to SFB 31 that can be output with the *ERROR* and *STATUS* parameters.

| ERROR | STATUS (decimal) | Description |
|---|---|---|
| 0 | 11 | Message lost: The previous signal change or the previous message could not be sent and will be replaced by the current message. |
| 0 | 22 | ■ Error in the pointer to the associated values *SD_i*:<br>– relating to the data length or the data type<br>– Associated values in the user memory not accessible, for example, due to deleted DB or area length error. The activated message is sent without associated values or if necessary with even possible number of associated values.<br>■ The actual parameter you have selected for *SEVERITY* is higher than the permitted range. The activated message is sent with *SEVERITY* = 127. |
| 0 | 25 | Communication was initiated. The message is being processed. |
| 1 | 1 | Communication problems: Disconnection or no logon |
| 1 | 4 | At the first call the specified *EV_ID* is outside the permitted range or the ANY pointer *SD_i* has a formal error or the maximum memory area that can be sent for the CPU per SFB 31 was exceeded. |
| 1 | 10 | Access to local user memory not possible (for example, access to a deleted DB) |
| 1 | 12 | When the SFB was called: an instance DB that does not belong to SFB 31 was specified or a shared DB instead of an instance DB was specified. |
| 1 | 18 | *EV_ID* was already being used by one of the SFBs 31 or 33 ... 36. |
| 1 | 20 | Not enough working memory. |
| 1 | 21 | The message with the specified *EV_ID* is disabled. |

## 13.2.12 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 ... 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).

- 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*.
- 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 STARTUP and RUN.
- If SFB 32 must be initialized after a restart it must be called from OB 100 with *RESET* = "1".

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

*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.*

**Parameters**

| 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 |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| 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 ... 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. *'Error information' on page 382*

**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 ... 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 ... 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 ... 16, 0 ... 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.

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

- Meaningful indices are: [1 ... 16, 0 ... 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) |

### 13.2.13 SFB 33 - ALARM - Messages with acknowledgement display

**Description**

Generating block-related messages with acknowledgement display:

- SFB 33 ALARM monitors a signal:
  – Acknowledgement triggered reporting is disabled (default): The block generates a message both on a rising edge (event entering state) and on a falling edge (event leaving state) to which associated values can be added.
  – Acknowledgement triggered reporting is enabled: After an incoming message is generated for the signal, the block will no longer generate messages until you have acknowledged this incoming message on a displaying device.
- When the SFB is first called, a message with the current signal state is sent. The message is sent to all stations logged on for this purpose.
- Once your acknowledgement has been received from a logged on display device, the acknowledgement information is passed on to all other stations logged on for this purpose.
- One message memory with 2 memory blocks is available for each instance of SFB 33 ALARM.
- SFB 33 ALARM complies with the IEC 1131-5 standard.

**Parameter**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | I, Q, M, D, L | Control parameter |
| SIG | INPUT | BOOL | I, Q, M, D, L | The signal to be monitored. |
| ID | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Data channel for messages: EEEEh.<br>*ID* is only evaluated at the first call. |
| EV_ID | INPUT | DWORD | Constant<br>(I, Q, M, D, L) | Message number (not allowed: 0) |
| SEVERITY | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Weighting of the event |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*:<br>Message generation completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter |

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| STATUS | OUTPUT | WORD | I, Q, M, D, L | *STATUS* parameter:<br>Display of an error information |
| ACK_DN | OUTPUT | BOOL | I, Q, M, D, L | Outgoing event was acknowledged |
| ACK_UP | OUTPUT | BOOL | I, Q, M, D, L | Incoming event was acknowledged. |
| SD_i | IN_OUT | ANY | I, Q, M, D, T, C | i-th associated value |

**EN_R**

Control parameter (enabled to receive) that decides whether the outputs *ACK_UP* and *ACK_DN* are updated at the first block call (*EN_R* = 1) or not (*EN_R* = 0). If *EN_R* = 0 the output parameters *ACK_UP* and *ACK_DN* remain unchanged.

**SIG**

The signal to be monitored.

**ID**

Data channel for messages: EEEEh. *ID* is only evaluated at the first call.

**EV_ID**

*EV_ID* is only evaluated at the first call. Subsequently, the message number used for the first call applies to every call of SFB with the corresponding instance DB. The message number is automatically assigned by the Siemens STEP®7 programming tool. So the consistency of the message numbers is guaranteed. The message numbers within a user program must be unique.

**SEVERITY**

Weighting of the event Here the value 0 is the highest weighting. This parameter is irrelevant for processing the message. Possible values: 0 ... 127 (default value: 64)

**DONE**

Status parameter *DONE*, Message generation completed.

**ACK_DN**

Outgoing event has been acknowledged on a display device. Initialization status: 1. The *ACK_DN* output is reset at the negative edge. It is set when your acknowledgement of the event leaving the state is received from a logged on display device.

**ACK_UP**

Incoming event has been acknowledged on a display device. Initialization status: 1 The *ACK_UP* output is reset at the rising edge. It is set when your acknowledgement of the event entering the state has arrived from a logged on display device.

**SD_i**

i-th associated value It is valid 1 ≤ i ≤ maxNumber. The max. number of associated values may be found in the technical data of your CPU. Permitted are only data of the type BOOL, (not permitted: bit field), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND _TIME.

*When the ANY pointer accesses a DB, the DB always must be specified. (e.g.: P# DB10.DBX5.0 Byte 10).*

**Error information *ERROR / STATUS***

*ERROR* = TRUE indicates that an error has occurred during processing. For details refer to parameter *STATUS*. The following table contains all the error information specific to SFB 33 that can be output with the *ERROR* and *STATUS* parameters.

| *ERROR* | *STATUS* (decimal) | Description |
|---|---|---|
| 0 | 11 | Message lost: The previous signal change or the previous message could not be sent and will be replaced by the current message. |
| 0 | 22 | ■ Error in the pointer to the associated values *SD_i*:<br>– relating to the data length or the data type<br>– Associated values in the user memory not accessible, for example, due to deleted DB or area length error. The activated message is sent without associated values or if necessary with even possible number of associated values.<br>■ The actual parameter you have selected for *SEVERITY* is higher than the permitted range. The activated message is sent with *SEVERITY* = 127. |
| 0 | 25 | Communication was initiated. The message is being processed. |
| 1 | 1 | Communication problems: Disconnection or no logon With acknowledgement-triggered reporting active: temporary display, if no display devices support acknowledgement-triggered reporting. |
| 1 | 4 | At the first call the specified *EV_ID* is outside the permitted range or the ANY pointer *SD_i* has a formal error or the maximum memory area that can be sent for the CPU per SFB 31 was exceeded. |
| 1 | 10 | Access to local user memory not possible (for example, access to a deleted DB) |
| 1 | 12 | When the SFB was called: an instance DB that does not belong to SFB 31 was specified or a shared DB instead of an instance DB was specified. |
| 1 | 18 | *EV_ID* was already being used by one of the SFBs 31 or 33 ... 36. |
| 1 | 20 | Not enough working memory. |
| 1 | 21 | The message with the specified *EV_ID* is disabled. |

*After the first block call, the ACK_UP and ACK_DN outputs have the value 1 and it is assumed that the previous value of the SIG input was 0.*

### 13.2.14 SFB 34 - ALARM_8 - Messages without associated values (8x)

**Description**

Generating block-related messages without associated values for 8 signals.

- SFB 34 ALARM_8 is identical to SFB 35 ALARM_8P.
- Except the associated values are not transferred.

**Parameter**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | I, Q, M, D, L<br>Constant | Control parameter |
| SIG_i | INPUT | BOOL | I, Q, M, D, L | i-th signal to be monitored |
| ID | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Data channel for messages: EEEEh.<br>*ID* is only evaluated at the first call. |
| EV_ID | INPUT | DWORD | Constant<br>(I, Q, M, D, L) | Message number (not allowed: 0) |
| SEVERITY | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Weighting of the event |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*: Message generation completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *ERROR* |
| STATUS | OUTPUT | WORD | I, Q, M, D, L | Status parameter *STATUS*: Display of an error information |
| ACK_STATE | OUTPUT | WORD | I, Q, M, D, L | Bit field acknowledgement status of all 8 messages |

**EN_R**

Control parameter (enabled to receive) that decides whether the output *ACK_STATE* is updated (*EN_R* = 1) when the block is called or not (*EN_R* = 0).

**SIG_i**

i-th signal to be monitored It is valid 1 ≤ i ≤ 8.

**ID**

Data channel for messages: EEEEh. *ID* is only evaluated at the first call.

**EV_ID**

*EV_ID* is only evaluated at the first call. Subsequently, the message number used for the first call applies to every call of SFB with the corresponding instance DB. The message number is automatically assigned by the Siemens STEP®7 programming tool. So the consistency of the message numbers is guaranteed. The message numbers within a user program must be unique.

**SEVERITY**

Weighting of the event Here the value 0 is the highest weighting. This parameter is irrelevant for processing the message. Possible values: 0 ... 127 (default value: 64)

**DONE**

Status parameter *DONE*: Message generation completed.

**ACK_STATE**

Bit field with the current acknowledgement status of all 8 messages.

- Bit 7 ... 0: incoming event of SIG_1 ... SIG_8
- Bit 15 ... 8: outgoing event of SIG_1 ... SIG_8

(1: Event acknowledged, 0: Event not acknowledged):

Initialization status: FFFFh, this means, all incoming and outgoing events have been acknowledged.

**Error information *ERROR* / *STATUS***

*ERROR* = TRUE indicates that an error has occurred during processing. For details refer to parameter *STATUS*. The following table contains all the error information specific to SFB 34 that can be output with the *ERROR* and *STATUS* parameters.

| *ERROR* | *STATUS* (decimal) | Description |
|---|---|---|
| 0 | 11 | Message lost: The previous signal change or the previous message could not be sent and will be replaced by the current message. |
| 0 | 22 | The actual parameter you have selected for *SEVERITY* is higher than the permitted range. The activated message is sent with *SEVERITY* = 127. |
| 0 | 25 | Communication was initiated. The message is being processed. |
| 1 | 1 | Communication problems: Communications problems: connection abort or no logon With acknowledgement-triggered reporting active: temporary display, if no display devices support acknowledgement-triggered reporting. |
| 1 | 4 | At the first call, the specified *EV_ID* is outside the permitted range. |
| 1 | 10 | Access to local user memory not possible (for example, access to a deleted DB) |
| 1 | 12 | When the SFB was called: an instance DB that does not belong to SFB 34 was specified or a shared DB instead of an instance DB was specified. |
| 1 | 18 | EV_ID was already being used by one of the SFBs 31 or 33 ... 36. |
| 1 | 20 | Not enough working memory. |
| 1 | 21 | The message with the specified *EV_ID* is disabled. |

*After the first block call. all the bits of the ACK_STATE output are set and it is assumed that the previous values of inputs SIG_i, 1≤ i ≤ 8 were 0.*

### 13.2.15 SFB 35 - ALARM_8P - Messages with associated values (8x)

**Description**

Generating block-related messages with associated values for 8 signals.

- SFB 35 ALARM_8P represents a linear extension of SFB 33 ALARM to 8 signals.
- As long as you have not enabled acknowledgement triggered reporting, a message will always be generated when a signal transition is detected at one or more signals (exception: a message is always sent at the first block call). All 8 signal are allocated a common message number that is split into 8 sub-messages on the displaying device. You can acknowledge each individual message separately or a group of messages.
- You can use the *ACK_STATE* output parameter to process the acknowledgement state of the individual messages in your program. If you disable or enable a message of an ALARM_8P block, this always affects the entire ALARM_8P block. Disabling and enabling of individual signals is not possible.
- One message memory with 2 memory blocks is available for each instance of SFB35 ALARM_8P.

**Parameter**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| EN_R | INPUT | BOOL | I, Q, M, D, L | Control parameter |
| SIG_i, | INPUT | BOOL | I, Q, M, D, L | i-th signal to be monitored |
| ID | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Data channel for messages: EEEEh.<br>ID is only evaluated at the first call. |
| EV_ID | INPUT | DWORD | Constant<br>(I, Q, M, D, L) | Message number (not allowed: 0) |
| SEVERITY | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Weighting of the event |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*: Message generation completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter |
| STATUS | OUTPUT | WORD | I, Q, M, D, L | Status parameter *STATUS*: Display of an error information |
| ACK_STATE | OUTPUT | WORD | I, Q, M, D, L | Bit field acknowledgement status of all 8 messages |
| SD_j | IN_OUT | ANY | I, Q, M, D, T, C | j-th associated value |

**EN_R**

Control parameter (enabled to receive) that decides whether the output *ACK_STATE* is updated (*EN_R* = 1) when the block is called or not (*EN_R* = 0).

**SIG_i**

i-th signal to be monitored It is valid 1 ≤ i ≤ 8.

**ID**

Data channel for messages: EEEEh. ID is only evaluated at the first call.

**EV_ID**

EV_ID is only evaluated at the first call. Subsequently, the message number used for the first call applies to every call of SFB with the corresponding instance DB. The message number is automatically assigned by the Siemens STEP®7 programming tool. So the consistency of the message numbers is guaranteed. The message numbers within a user program must be unique.

**SEVERITY**

Weighting of the event Here the value 0 is the highest weighting. This parameter is irrelevant for processing the message. Possible values: 0 ... 127 (default value: 64)

**DONE**

Status parameter *DONE*, Message generation completed.

**ACK_STATE**

Bit field with the current acknowledgement status of all 8 messages.

- Bit 7 ... 0: incoming event of SIG_1 ... SIG_8
- Bit 15 ... 8: outgoing event of SIG_1 ... SIG_8

1 Event acknowledged, 0: Event not acknowledged):

Initialization status: FFFFh, this means, all incoming and outgoing events have been acknowledged.

**SD_i**

i-th associated value It is valid 1 ≤ i ≤ maxNumber. The max. number of associated values may be found in the technical data of your CPU. Permitted are only data of the type BOOL, (not permitted: bit field), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND _TIME.

*When the ANY pointer accesses a DB, the DB always must be specified. (e.g.: P# DB10.DBX5.0 Byte 10).*

**Error information *ERROR / STATUS***

*ERROR* = TRUE indicates that an error has occurred during processing. For details refer to parameter *STATUS*. The following table contains all the error information specific to SFB 35 that can be output with the *ERROR* and *STATUS* parameters.

| *ERROR* | *STATUS* (dec-imal) | Description |
|---|---|---|
| 0 | 11 | Message lost: The previous signal change or the previous message could not be sent and will be replaced by the current message. |
| 0 | 22 | ■ Error in the pointer to the associated values SD_i:<br>– relating to the data length or the data type<br>– No access to associated values in user memory, for example, due to deleted DB or area length error. The activated message is sent without associated values.<br>■ The actual parameter you have selected for *SEVERITY* is higher than the permitted range. The activated message is sent with *SEVERITY* = 127. |
| 0 | 25 | Communication was initiated. The message is being processed. |
| 1 | 1 | Communication problems: Disconnection or no logon With acknowledgement-triggered reporting active: temporary display, if no display devices support acknowledgement-triggered reporting. |
| 1 | 4 | At the first call the specified *EV_ID* is outside the permitted range or the ANY pointer SD_i has a formal error or the maximum memory area that can be sent for the CPU per SFB 35 was exceeded. |
| 1 | 10 | Access to local user memory not possible (for example, access to a deleted DB) |
| 1 | 12 | When the SFB was called: an instance DB that does not belong to SFB 34 was specified or a shared DB instead of an instance DB was specified. |
| 1 | 18 | EV_ID was already being used by one of the SFBs 31 or 33 ... 36. |
| 1 | 20 | Not enough working memory. |
| 1 | 21 | The message with the specified *EV_ID* is disabled. |

*After the first block call. all the bits of the ACK_STATE output are set and it is assumed that the previous values of inputs SIG_i, 1≤ i ≤ 8 were 0.*

## 13.2.16 SFB 36 - NOTIFY - Messages without acknowledgement display

**Description**

Generating block-related messages without acknowledgement display.

- SFB 36 NOTIFY monitors a signal. It generates a message both on a rising edge (event entering state) and on a falling edge (event leaving state) with associated values.
- When the SFB is first called, a message with the current signal state is sent. The message is sent to all stations logged on for this purpose.
- The associated values are queried when the edge is detected and assigned to the message.

**Parameter**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| SIG | INPUT | BOOL | I, Q, M, D, L | The signal to be monitored. |
| ID | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Data channel for messages: EEEEh.<br>*ID* is only evaluated at the first call. |
| EV_ID | INPUT | DWORD | Constant<br>(I, Q, M, D, L) | Message number (not allowed: 0) |
| SEVERITY | INPUT | WORD | Constant<br>(I, Q, M, D, L) | Weighting of the event |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Status parameter *DONE*:<br>Message generation completed. |
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | *ERROR* status parameter |
| STATUS | OUTPUT | WORD | I, Q, M, D, L | *STATUS* parameter:<br>Display of an error information |
| SD_i | IN_OUT | ANY | I, Q, M, D, T, C | i-th associated value |

**SIG**

The signal to be monitored.

**ID**

Data channel for messages: EEEEh. *ID* is only evaluated at the first call.

**EV_ID**

*EV_ID* is only evaluated at the first call. Subsequently, the message number used for the first call applies to every call of SFB with the corresponding instance DB. The message number is automatically assigned by the Siemens STEP®7 programming tool. So the consistency of the message numbers is guaranteed. The message numbers within a user program must be unique.

**SEVERITY**

Weighting of the event Here the value 0 is the highest weighting. This parameter is irrelevant for processing the message. Possible values: 0 ... 127 (default value: 64)

**DONE**

Status parameter *DONE*: Message generation completed.

**SD_i**

i-th associated value It is valid 1 ≤ I ≤ maxNumber. The max. number of associated values may be found in the technical data of your CPU. Permitted are only data of the type BOOL, (not permitted: bit field), BYTE, CHAR, WORD, INT, DWORD, DINT, REAL, DATE, TOD, TIME, S5TIME, DATE_AND _TIME.

*When the ANY pointer accesses a DB, the DB always must be specified. (e.g.: P# DB10.DBX5.0 Byte 10).*

**Error information *ERROR / STATUS***

The following table contains all the error information specific to SFB 36 that can be output with the *ERROR* and *STATUS* parameters.

| *ERROR* | *STATUS* (decimal) | Description |
|---|---|---|
| 0 | 11 | Message lost: The previous signal change or the previous message could not be sent and will be replaced by the current message. |
| 0 | 22 | ■ Error in the pointer to the associated values SD_i:<br>– relating to the data length or the data type<br>– Associated values in the user memory not accessible, for example, due to deleted DB or area length error. The activated message is sent without associated values or if necessary with even possible number of associated values.<br>■ The actual parameter you have selected for *SEVERITY* is higher than the permitted range. The activated message is sent with *SEVERITY* = 127. |
| 0 | 25 | Communication was initiated. The message is being processed. |
| 1 | 1 | Communication problems: Disconnection or no logon |
| 1 | 4 | At the first call the specified *EV_ID* is outside the permitted range or the ANY pointer *SD_i* has a formal error or the maximum memory area that can be sent for the CPU per SFB 36 was exceeded. |
| 1 | 10 | Access to local user memory not possible (for example, access to a deleted DB) |
| 1 | 12 | When the SFB was called: an instance DB that does not belong to SFB 36 was specified or a shared DB instead of an instance DB was specified. |
| 1 | 18 | *EV_ID* was already being used by one of the SFBs 31 or 33 ... 36. |
| 1 | 20 | Not enough working memory. |
| 1 | 21 | The message with the specified *EV_ID* is disabled. |

## 13.2.17 SFB 47 - COUNT - Counter controlling

**Description**

The SFB 47 is a specially developed block for compact CPUs 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

**Parameters**

| 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<br>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<br>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<br>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 * <br> Status bit *STS_CMP* indicates that the comparison condition of the comparator is or was reached. <br> *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 * <br> 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: <br> Resets the status bits: STS_CMP, STS_OFLW, STS_ZP. <br> The SFB must be twice called to reset the status bit. |
| *) Reset with RES_STS | | | | |

*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:

1. 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:<br>00h Job without function<br>01h Writes the *count value*<br>02h Writes the *load value*<br>04h Writes the *comparison value*<br>08h Writes the *hysteresis*<br>10h Writes the *pulse duration*<br>20h Writes the *end value*<br>82h Reads the *load value*<br>84h Reads the *comparison value*<br>88h Reads the *hysteresis*<br>90h Reads the *pulse duration*<br>A0h Reads the *end value* |
| JOB_VAL | DINT | 8.0 | 0 | Value for write jobs |
| *) State remains set also after a CPU STOP-RUN transition. | | | | |

2. 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<br>0000h No error<br>0121h *Comparison value* too low<br>0122h *Comparison value* too high<br>0131h *Hysteresis* too low<br>0132h *Hysteresis* too high<br>0141h *Pulse duration* too low<br>0142h *Pulse duration* too high<br>0151h *Load value* too low<br>0152h *Load value* too high<br>0161h *Count value* too low<br>0162h *Count value* too high<br>01FFh Invalid *job ID* |

3. A new job may be started with *JOB_DONE* = TRUE.

4. 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 ($-2^{31}+1$) ... +2147483646 ($2^{31}-2$) |
| Writing the *load value* | -2147483647 ($-2^{31}+1$) ... +2147483646 ($2^{31}-2$) |
| Writing *comparison value* | -2147483648 ($-2^{31}$) ... +2147483647 ($2^{31}-1$) |
| Writing *hysteresis* | 0 ... 255 |
| Writing *pulse duration** | 0 ... 510ms |

**Single/periodic count, no main count direction:**

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

**Single/periodic count, main count direction up:**

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

**Single/periodic count, main count direction down:**

| Job | Valid range |
|---|---|
| Writing *counter directly* | 2 ... +2147483647 ($2^{31}-1$) |
| Writing the *load value* | 2 ... +2147483647 ($2^{31}-1$) |
| Writing *comparison value* | 1 ... +2147483647 ($2^{31}-1$) |
| Writing *hysteresis* | 0 ... 255 |

| Job | Valid range |
|---|---|
| Writing *pulse duration** | 0 ... 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.

### 13.2.18 SFB 48 - FREQUENC - Frequency measurement

**Description**

The SFB 48 is a specially developed block for compact CPUs for frequence measurement.

- The SFB FREQUENC should cyclically be called (e.g. OB 1) for controlling the frequency measurement.
- The SFB is to be called with the corresponding instance DB. Here the parameters of the SFB are stored.
- Among others the SFB 48 contains a request interface. Hereby you get read and write access to the registers of the frequency meter.
- So that a new job may be executed, the previous job must have be finished with *JOB_DONE* = TRUE.
- 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.
- With the SFB FREQUENC (SFB 48) you have following functional options:
  – Start/Stop the frequency meter via software gate SW_GATE
  – Read the status bit
  – Read the evaluated frequency
  – Request to read/write internal registers of the frequency meter.

**Parameters**

| Name | Declaration | Data type | Address (Inst.-DB) | Default value | Comment |
|---|---|---|---|---|---|
| LADDR | INPUT | WORD | 0.0 | 300h | This parameter is not evaluated. Always the internal I/O periphery is addressed. |
| CHANNEL | INPUT | INT | 2.0 | 0 | Channel number |
| SW_GATE | INPUT | BOOL | 4.0 | FALSE | Enables the Software gate |
| JOB_REQ | INPUT | BOOL | 4.3 | FALSE | Initiates the job (edge 0-1) |
| JOB_ID | INPUT | WORD | 6.0 | 0 | Job ID |
| JOB_VAL | INPUT | DINT | 8.0 | 0 | Value for write jobs |
| STS_GATE | OUTPUT | BOOL | 12.0 | FALSE | Status of the internal gate |
| MEAS_VAL | OUTPUT | DINT | 14.0 | 0 | Evaluated frequency |
| JOB_DONE | OUTPUT | BOOL | 22.0 | TRUE | New job can be started. |

| Name | Declaration | Data type | Address (Inst.-DB) | Default value | Comment |
|---|---|---|---|---|---|
| JOB_ERR | OUTPUT | BOOL | 22.1 | FALSE | Job error |
| JOB_STAT | OUTPUT | WORD | 24.0 | 0 | Job error ID |

**Local data only in instance DB**

| Name | Data type | Address (Instance DB) | Default | Comment |
|---|---|---|---|---|
| JOB_OVAL | DINT | 28.0 | - | Output value for read request. |

*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.*

**Frequency meter request interface**

To read/write the registers of the frequency meter the request interface of the SFB 48 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:<br>00h Job without function<br>04h Writes the integration time<br>84h Read the integration time |
| JOB_VAL | DINT | 8.0 | 0 | Value for write jobs.<br>Permitted value for integration time:<br>10 ... 10000ms |

→ 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<br>0000h No error<br>0221h Integration time too low<br>0222h Integration time too high<br>02FFh Invalid job ID<br>8001h Parameter error<br>8009h Channel no. not valid |

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

***Channel no. not valid***

(8009h and Parameter error 8001h)

If you have preset a CHANNEL number greater than 3, the error "Channel no. not valid " (8009h) is reported. if you have preset a CHANNEL number greater than the maximum channel number of the CPU, "Parameter error" (8001h) is reported.

**Controlling frequency meter**

The frequency meter is controlled by the internal gate (I gate). The I gate is identical to the software gate (SW gate).

SW gate:

open (activate): In the user program by setting *SW_GATE* of SFB 48

close (deactivate): In the user program by resetting *SW_GATE* of SFB 48

## 13.2.19 SFB 49 - PULSE - Pulse width modulation

**Description**

The SFB 49 is a specially developed block for compact CPUs for *PWM* and *pulse train* output. With the SFB PULSE (SFB 49) the following functionalities are available:

- PWM (**P**uls**w**idth**m**odulation)
  - Start/Stop via software gate *SW_EN*
  - Enabling/controlling of the PWM output
  - Read status bits
  - Request to read/write the internal PWM registers
- Configurable pulse train output with a maximum of 2 drive jobs
  - Start/Stop via software gate *SW_EN*
  - Enabling/controlling of the pulse train output
  - Read status bits
  - Request to read/write the internal pulse train registers
- Configurable time base (1µs ... 1ms)

When using the block, the following must be observed:

- The SFB is cyclically to be called with the corresponding instance DB e.g. in OB 1.
- You have read and write access to the corresponding registers via the SFB 49 job interface.

- Per channel you may call the SFB in each case with the same instance DB. Write accesses to outputs of the instance DB is not permissible.
- So that a new job may be executed, the previous job must have be finished with *JOB_DONE* = TRUE.
- The switching between the modes takes place by the presetting of the pulse number (JOB_ID = 08h/09h). As soon as you specify a pulse number > 0, you switch to the pulse train mode, otherwise PWM is active.

*Please note that some functions of this block are not available in all CPUs. If you call a functionality that is not supported, you receive the error message 04FFh 'Order no. invalid' as Return value. More about the supported functions can also be found in the 'Properties' of your CPU.*

**Parameter**

| Parameter | Declaration | Data type | Address (Inst.-DB) | Default Value | Comment |
|---|---|---|---|---|---|
| LADDR | INPUT | WORD | 0.0 | 300h | This parameter is not evaluated. Always the internal I/O periphery is addressed. |
| CHANNEL | INPUT | INT | 2.0 | 0 | Channel number |
| SW_EN | INPUT | BOOL | 4.0 | FALSE | Enable software gate |
| MAN_DO | INPUT | BOOL | 4.1 | FALSE | This parameter is not evaluated. |
| SET_DO | INPUT | BOOL | 4.2 | FALSE | This parameter is not evaluated. |
| OUTP_VAL | INPUT | INT | 6.0 | 0 | Output value |
| JOB_REQ | INPUT | BOOL | 8.0 | FALSE | Job trigger (edge 0-1) |
| JOB_ID | INPUT | WORD | 10.0 | 0 | Job number |
| JOB_VAL | INPUT | DINT | 12.0 | 0 | Value for write jobs |
| STS_EN | OUTPUT | BOOL | 16.0 | FALSE | Status internal gate |
| STS_STRT | OUTPUT | BOOL | 16.1 | FALSE | This parameter is reserved. |
| STS_DO | OUTPUT | BOOL | 16.2 | FALSE | This parameter is reserved. |
| JOB_DONE | OUTPUT | BOOL | 16.3 | TRUE | Status parameter<br>■ 0: The job has not started or is still running.<br>■ 1: Job has been executed. A new job can be started. |
| JOB_ERR | OUTPUT | BOOL | 16.4 | FALSE | Status parameter<br>■ 0: no error<br>■ 1: Error (see *JOB_STAT*) |
| JOB_STAT | OUTPUT | WORD | 18.0 | 0 | |

**OUTP_VAL**

The *'output format'* for PWM and pulse train can be set via the hardware configuration. Depending on the output format, there are the following range of values for the *output value*:

- Output in ‰
  - Range of values: 0 ... 1000
  - *Pulse duration* = (*OUTP_VAL* / 1000) x *period duration*
- Output format: S7 analog value
  - *Pulse duration* = (*OUTP_VAL* / 27648) x *period duration*
  - Range of values: 0 ... 27648

**JOB_ID**

Job number

- 00h: Job without function
- 01h: Write *period duration* for PWM and. 1 pulse train job
  Range of values in dependence of the time base:
  - 1ms: 1 ... 87
  - 0.1ms: 1 ... 870:
  - 10µs 2 ... 8700
  - 1µs: 20 ... 65535
- 02h: Write *on-delay*
  Range of values in dependence of the time base:
  - 1ms: 0 ... 65535
  - 0.1ms: 0 ... 65535
  - 10µs 0 ... 65535
  - 1µs: 0 ... 65535
- 04h: Write *minimum pulse duration*
  Range of values in dependence of the time base:
  - 1ms: 0 ... Period duration/2
  - 0.1ms: 0 ... Period duration/2
  - 10µs 0 ... Period duration/2
  - 1µs: 5 ... Period duration/2
- 08h: Write *number of pulses* for the 1. pulse train job
  Range of values:
  - 0 ... 8.388.607
- 09h: Write *number of pulses* for the 2. pulse train job
  Range of values:
  - 0 ... 8.388.607
- 0Ah: *Period duration* for writing 2. pulse train job
- 0Bh: Write *time base*
  - 00h: 0.1ms
  - 01h: 1ms
  - 02h: 1µs:
  - 03h: 10µs
- 0Ch 2. Attach pulse train job to the 1. pulse train job
  - With this job number, the duty factor for the 2. pulse train job is additionally to be specified via *OUTP_VAL*.
- 81h: Read *period duration* of PWM and 1. pulse train job
- 82h: Read *on-delay*
- 84h: Read *minimum pulse duration*
- 88h: Read *number of pulses* of the 1. pulse train job
- 89h: Read *number of pulses* of the 2. pulse train job

- 8Ah: Read *period duration* of the 2. pulse train job
- 8Bh Read *time base*
  - 00h: 0.1ms
  - 01h: 1ms
  - 02h: 1µs:
  - 03h: 10µs

**JOB_VAL**

Value for write jobs, which range of values depends on the according job:

-2147483648 ($-2^{31}$) ... +2147483647 ($2^{31}$-1)

***Local data only in instance DB***

| Name | Data type | Address (Instance DB) | Default | Comment |
|---|---|---|---|---|
| JOB_OVAL | DINT | 20.0 | - | Output values for read jobs |

*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. Write accesses to outputs of the instance DB is not permissible.*

**Request interface**

- To read/write the registers the request interface of the SFB 49 may be used.
- So that a new job may be executed, the previous job must have be finished with *JOB_DONE* = TRUE.
- With an edge 0-1 at *JOB_REQ*, you can always transfer a job, regardless of the state of *SW_EN* and *STS_EN*.
- Changes of the *period duration* and the *minimum pulse duration* will immediately take effect.
- Changes of the *on-delay* take effect with the next edge 0-1 of *SW_EN*.
- A running PWM output is not affected by setting pulse train specific values such as *pulse number* and *period duration* for the 2. pulse train job.

**Controlling the output**

**Controlling the PWM output**

The request interface is used according to the following sequence:

1. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *period duration* here
   - *JOB_ID* = 01h: Write *period duration* for PWM output.
   - *JOB_REQ* = TRUE

   ⇨ - From*JOB_VAL* the period duration is transmitted to the PWM output.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*

2. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *on-delay* here
   - *JOB_ID* = 02h: Write *on-delay* for PWM output.
   - *JOB_REQ* = TRUE

   ⇨ - From *JOB_VAL* the *on-delay* is transmitted to the PWM output.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
3. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *minimum pulse duration* here
   - *JOB_ID* = 04h: Write *minimum pulse duration* for PWM output.
   - *JOB_REQ* = TRUE

   ⇨ - From *JOB_VAL* the *minimum pulse duration* is transmitted to the PWM output.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
4. Call the SFB 49:
   - *SW_EN* = TRUE (edge 0-1)
   - *OUTP_VAL*: Specify a duty factor.

   ⇨ - The PWM output is started
     - *STS_EN* goes to TRUE and remains in this state until SFB 49 is called with *SW_EN* = FALSE.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
5. Call the SFB 49 cyclically:
   - *SW_EN* = FALSE
   - Via *STS_EN* you get the current status of the PWM output. With *OUTP_VAL* you can always change the duty factor.
6. As soon as *JOB_DONE* returns TRUE, you can change the PWM parameters by repeating the steps 1 to 5.

> *If values are changed during PWM output, the new values are only output with the beginning of a new period. A started period is always finished!*

7. By resetting of *SW_EN* (*SW_EN* = FALSE) the output is immediately stopped.
8. With reading jobs, you can find the values to be read in the parameter *JOB_OVAL* in the instance DB at address 20.

**Controlling the pulse train output**

The request interface is used according to the following sequence:

1. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *number of pulses* here.
   - *JOB_ID* = 08h: Write *number of pulses* for the 1. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ - From *JOB_VAL* the *number of pulses* for the 1. pulse train job is transmitted.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
2. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *period duration* here.
   - *JOB_ID* = 01h: Write *period duration* for the 1. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ - From *JOB_VAL* the *period duration* for the 1. pulse train job is transmitted.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
3. Optional for the 2. pulse train job: Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *number of pulses* here.
   - *JOB_ID* = 09h: Write *number of pulses* for the 2. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ - The *number of pulses* for the 2. pulse train job is transmitted.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
4. Optional for the 2. pulse train job: Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *period duration* here.
   - *JOB_ID* = 0Ah: Write *period duration* for the 2. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ - From *JOB_VAL* the *period duration* for the 2. pulse train job is transferred.
     - *JOB_DONE* is FALSE during the SFB run.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
5. Call the SFB 49:
   - *SW_EN* = TRUE (edge 0-1)
   - *OUTP_VAL*: Enter the duty factor such as 50%.

   ⇨ - The 1. pulse train job is started and then if present the 2. pulse train job.
     - Via *STS_EN* you get the current status of the pulse train output. As long as the required number of pulses is output, *STS_EN* returns TRUE. *STS_EN* returns FALSE if either the requested number of pulses has been output or output with *SW_EN* = FALSE was terminated early.
     - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*

6. Call the SFB 49 cyclically:
   - *SW_EN* = FALSE
   - Via *STS_EN* you get the current status of the pulse train output.
7. As soon as *JOB_DONE* returns TRUE, you can transfer additional pulse train jobs by repeating the steps 1 to 6.
8. By resetting of *SW_EN* (*SW_EN* = FALSE) the output is immediately stopped.
9. With reading jobs, you can find the values to be read in the parameter *JOB_OVAL* in the instance DB at address 20.

**Extend a running pulse train job**

As long as only one pulse train job is defined and currently being processed, there is the possibility to attach a 2. pulse train job to the 1. pulse train job.

1. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *number of pulses* here.
   - *JOB_ID* = 09h: Write *number of pulses* for the 2. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ 
   - From *JOB_VAL* the *number of pulses* for the 2. pulse train job is transmitted.
   - *JOB_DONE* is FALSE during the SFB run.
   - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
2. Call the SFB 49:
   - *SW_EN* = FALSE
   - *JOB_VAL* = Enter a value for the *period duration* here.
   - *JOB_ID* = 0Ah: Write *period duration* for the 2. pulse train job.
   - *JOB_REQ* = TRUE

   ⇨ 
   - From *JOB_VAL* the *period duration* for the 2. pulse train job is transferred.
   - *JOB_DONE* is FALSE during the SFB run.
   - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*
3. Call the SFB 49:
   - *SW_EN* = TRUE (edge 0-1)
   - *JOB_ID* = 0Ch: Attach 2. pulse train job to the 1. pulse train job.
   - *OUTP_VAL*: Enter the duty factor such as 50%.

   ⇨ 
   - As long as the 1. pulse train job is still running, the 2. pulse train job is attached. Otherwise you receive the error message 0461h as *return value*.
   - Via *STS_EN* you get the current status of the pulse train output. As long as the required number of pulses is output, *STS_EN* returns TRUE. *STS_EN* returns FALSE if either the requested number of pulses has been output or output with *SW_EN* = FALSE was terminated early.
   - On error *JOB_ERR* = TRUE and the cause of the error is returned in *JOB_STAT*

> *Please note that a maximum of 2 pulse train jobs can be executed directly after another!*

**Return value *JOB_STAT***

The JOB_STAT return value gives you detailed information in the event of an error.

| Value | Description |
|---|---|
| 0000h | no error |
| 0411h | *Period duration* too small |
| 0412h | *Period duration* too big |
| 0421h | *On-delay* too small |
| 0422h | *On-delay* too big |
| 0431h | *Minimum pulse duration* too small |
| 0432h | *Minimum pulse duration* too big |
| 0441h | *Number of pulses* too small |
| 0442h | *Number of pulses* too big |
| 0451h | Invalid *time base* |
| 0461h | Pulse train job could not be attached |
| 04FFh | Job number not valid<br>You receive this error message e.g. if the corresponding functionality is not supported by your CPU. |
| 8001h | Parametrization error<br>You will get a parametrization error (8001h), if you have transmitted a channel number with *CHANNEL*, which is bigger than the max. available number of channels of the CPU. |
| 8009h | Channel no. not valid<br>You will get the return value channel no. not valid (8009h), if you have transmitted a channel number with *CHANNEL*, which is bigger than 3. |

## 13.2.20 SFB 52 - RDREC - Reading record set

*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 can read a record set with the number INDEX from a module 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 record set 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 record set transmission error has occurred. In this case, the output parameter *STATUS* contains the error information. System dependent this block cannot be interrupted!

**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). Record set transmission is completed when the output parameter *BUSY* = FALSE.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D , L, constant | *REQ* = 1: Transfer record set |
| ID | INPUT | DWORD | I, Q, M, D, L, constant | Logical address of the module<br>For an output module, bit 15 must be set (e.g. for address 5: *ID*: DW = 8005h).<br>For a combination module, the smaller of the two addresses should be specified. |
| INDEX | INPUT | INT | I, Q, M, D, L, constant | Record set number |
| MLEN | INPUT | INT | I, Q, M, D, L, constant | Maximum length in bytes of the record set information to be fetched |
| VALID | OUTPUT | BOOL | I, Q, M, D, L | New record set 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 record set information. |
| RECORD | IN_OUT | ANY | I, Q, M, D, L | Target area for the fetched record set. |

**Error information**

*Chapter 13.2.22 ‘SFB 54 - RALRM - Receiving an interrupt from a periphery module’ on page 406*

## 13.2.21 SFB 53 - WRREC - Writing record set

*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 record set with the number *INDEX* to a module that has been addressed via ID. Specify the byte length of the record set 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 record set has been successfully transferred to the DP slave. The output parameter *ERROR* indicates whether a record set transmission error has occurred. In this case, the output parameter *STATUS* contains the error information. System dependent this block cannot be interrupted!

**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. Record set transmission is completed when the output parameter *BUSY* = FALSE.

**Parameters**

| Parameter | Declaration | Data type | Memory block | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L, constant | *REQ* = 1: Transfer record set |
| ID | INPUT | DWORD | I, Q, M, D, L, constant | Logical address of the 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 | Record set number. |
| LEN | INPUT | INT | I, Q, M, D, L, constant | Maximum byte length of the record set to be transferred. |
| DONE | OUTPUT | BOOL | I, Q, M, D, L | Record set 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. |
| RECORD | IN_OUT | ANY | I, Q, M, D, L | Record set |

**Error information**

*Chapter 13.2.22 'SFB 54 - RALRM - Receiving an interrupt from a periphery module' on page 406*

## 13.2.22 SFB 54 - RALRM - Receiving an interrupt from a periphery module

*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 or a component of the corresponding bus slave and provides this information to its output parameters. The information contained in the input parameters contains the start information of the called OB as well as information from 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.

*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.*

**Parameters**

| 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 | TRUE: A new interrupt was received.<br>FALSE: No new interrupt was received. |
| STATUS | OUTPUT | DWORD | I, Q, M, D, L | C0000000h: no error<br>C080C300h: Resources are presently occupied<br>C0809000h: Invalid logical start address<br>**Only PROFINET IO:**<br>C080A000h: Read error<br>C080B700h: Invalid area |
| ID | OUTPUT | DWORD | I, Q, M, D, L | Logical start address of the component (module), from which an interrupt was received.<br>Bit 15 contains the I/O ID:<br>0: for an input address<br>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)<br>Target range OB start and management information |
| AINFO | IN_OUT | ANY | I, Q, M, D, L | (interrupt information)<br>Target area for header information and additional information.<br>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.

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

**TINFO**

| TINFO PROFIBUS: Data structure of the target area (task information) | | | | | | |
|---|---|---|---|---|---|---|
| **Byte** | **Data type** | **Description** | | | | |
| 0 ... 19 | | Start information of the OB in which the SFC 54 was currently called<br>Byte 0 ... 11: structured like the parameter *TOP_SI* in SFC 6 RD_SINFO<br>Byte 12 ... 19: date and time the OB was requested | | | | |
| 20 ... 27 | | Management information: | | | | |
| 20 | Byte | centralized: 0<br>decentralized: DP master system ID (possible values: 1 ... 255) | | | | |
| 21 | Byte | central: Module rack number (possible values: 0 ... 31)<br>distributed: Number of DP station (possible values: 0 ... 127) | | | | |
| 22 | Byte | centralized: 0 | | | | |
| | | decentral-ized: | Bit 3 ... 0 | Slave type | 0000: | DP |
| | | | | | 0001: | DPS7 |
| | | | | | 0010: | DPS7 V1 |
| | | | | | 0011: | DP-V1 |
| | | | | | ab 0100: | reserved |
| | | | Bit 7 ... 4 | Profile type | 0000: | DP |
| | | | | | ab 0001: | reserved |
| 23 | Byte | centralized: 0 | | | | |
| | | decentral-ized: | Bit 3 ... 0 | Interrupt info type | 0000: | Transparent<br>(Interrupt originates from a configured decentralized module) |
| | | | | | 0001: | Representative<br>(Interrupt originating from a non-DP-V1 slave or a slot that is not configured) |
| | | | | | 0010: | Generated interrupt (gen-erated in the CPU) |
| | | | | | as of 0011: | reserved |
| | | | Bit 7 ... 4 | Structure version | 0000: | Initial |
| | | | | | as of 0001: | reserved |
| 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 | | | | |

| TINFO PROFIBUS: Data structure of the target area (task information) | | | |
|---|---|---|---|
| **Byte** | **Data type** | **Description** | |
| | | 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 | |

| TINFO PROFINET IO: Data structure of the target area (task information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 0 ... 19 | OB Startinfo | BYTE | Start information of the OB in which the SFC 54 was currently called: |
| 20 ... 21 | Addressinfo | WORD | Bit 0 ... 10: Number of the DP station (0-2047)<br>Bit 11 ... 14: the last two digits of the PROFINET IO system ID (0-15), to get the whole PROFINET IO system ID you have to add 100 (decimal).<br>Bit 15: 1 |
| 22 | Slavetype | BYTE | Bit 0 ... 3: 1000: Fixed value for PROFINET IO<br>Bit 4 ... 7: reserved |
| 23 | Alarminfo | BYTE | Bit 0 ... 3: 0000: Transparent, which is always the case for PROFINET IO (interrupt originates from a configured distributed module)<br>Bit 4 ... 7: reserved |
| 24 | PROFINET IO controller inter-face | BYTE | Flags of the PROFINET IO controller interface module<br>Bit 0: 0: Interrupt originating from an integrated interface<br>Bit 0: 1: Interrupt originating from an external interface<br>Bit 1 ... 7: reserved |
| 25 | Flags of the PROFINET IO controller inter-face | BYTE | Bit 0: AR data status failure bit of the interrupt message frame or "0" if there is no information in the interrupt<br>Bit 0: 1: IO device is faulty<br>Bit 1... 7: reserved |
| 26 ... 27 | PROFINET IO device ID number | WORD | PROFINET IO device ID number as unique identifier of the PROFINET IO device |
| 28 ... 29 | | WORD | Manufacturer ID |
| 30 ... 31 | ID | WORD | ID number of the instance |

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

| Byte | Declaration | Data type | Description |
|---|---|---|---|
| 0 ... 19 | OB Startinfo | BYTE | Start information of the OB in which the SFC 54 was currently called. |
| 20 ... 21 | Addressinfo | WORD | Bit 0 ... 10: Master/Slave<br>Bit 11 ... 14: System ID EtherCAT network - 100<br>Bit 15: 1: Bit for EtherCAT (PROFINET "look and feel") |
| 22 | Slavetype | BYTE | Bit 0 ... 3: 1000: 0b1111 EtherCAT[1]<br>Bit 4 ... 7: reserved |
| 23 | Alarminfo | BYTE | Bit 0 ... 3: 0000: Transparent, interrupt originates from a configured distributed module<br>Bit 4 ... 7: reserved |
| 24 | EC Flags I | BYTE | Flags of the EtherCAT IO controller interface<br>Bit 0: 0: Interrupt originating from an integrated interface<br>1: Interrupt originating from an external interface<br>Bit 1 ... 7: reserved |
| 25 ... 31 | | | reserved |
| 1) At 0b1001 PROFINET IO | | | |

**AINFO**

<table>
<tr><th colspan="5">AINFO PROFIBUS: Data structure of the target area (interrupt information)</th></tr>
<tr><th>Byte</th><th>Data type</th><th colspan="3">Description</th></tr>
<tr><td>0 ... 3</td><td></td><td colspan="3">Header information</td></tr>
<tr><td rowspan="3">0</td><td rowspan="3">Byte</td><td colspan="3">Length of the received interrupt information in bytes</td></tr>
<tr><td colspan="3">centralized: 4 ... 224</td></tr>
<tr><td colspan="3">decentralized: 4 ... 63</td></tr>
<tr><td rowspan="10">1</td><td rowspan="10">Byte</td><td colspan="3">centralized: reserved</td></tr>
<tr><td rowspan="9">decentralized:</td><td colspan="2">ID for the interrupt type</td></tr>
<tr><td>1:</td><td>Diagnostic interrupt</td></tr>
<tr><td>2:</td><td>Hardware interrupt</td></tr>
<tr><td>3:</td><td>Removal interrupt</td></tr>
<tr><td>4:</td><td>Insertion interrupt</td></tr>
<tr><td>5:</td><td>Status interrupt</td></tr>
<tr><td>6:</td><td>Update interrupt</td></tr>
<tr><td>31:</td><td>Failure of an expansion device, DP master system or DP station</td></tr>
<tr><td>32 ... 126</td><td>manufacturer specific interrupt</td></tr>
<tr><td>2</td><td>Byte</td><td colspan="3">Slot number of the interrupt triggering component</td></tr>
<tr><td rowspan="9">3</td><td rowspan="9">Byte</td><td colspan="3">centralized: reserved</td></tr>
<tr><td rowspan="8">decentralized:</td><td colspan="2">Identifier</td></tr>
<tr><td>Bit 1, 0:</td><td></td></tr>
<tr><td>00</td><td>no further information</td></tr>
<tr><td>01</td><td>incoming event, disrupted slot</td></tr>
<tr><td>10</td><td>going event, slot not disrupted anymore</td></tr>
<tr><td>11</td><td>going event, slot still disrupted</td></tr>
<tr><td>Bit 2:</td><td>Add_Ack</td></tr>
<tr><td>Bit 7 ... 3</td><td>Sequence number</td></tr>
<tr><td rowspan="3">4 ... 223</td><td rowspan="3"></td><td colspan="3">Additional interrupt information: module specific data for the respective interrupt:</td></tr>
<tr><td>centralized:</td><td colspan="2">ARRAY[0] ... ARRAY[220]</td></tr>
<tr><td>decentralized:</td><td colspan="2">ARRAY[0] ... ARRAY[59]</td></tr>
</table>

| AINFO PROFINET IO: Data structure of the target area (interrupt information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 0 ... 1 | Block type | WORD | Bit 0 ... 7: Block type<br>Bit 8 ... 15: reserved |
| 2 ... 3 | Block length | WORD | Length of the received interrupt information in byte<br>MIN: 0<br>MAX: 1536 (1.5kbyte) |
| 4 ... 5 | Version | WORD | Bits 0 ... 7: low byte<br>Bits 8 ... 15: high byte |

| AINFO PROFINET IO: Data structure of the target area (interrupt information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 6 ... 7 | Interrupt type | WORD | Identifier for the interrupt type:<br>1: Diagnostic interrupt (incoming)<br>2: Hardware interrupt<br>3: Removal interrupt<br>4: Insertion interrupt<br>5: Status interrupt<br>6: Update interrupt<br>7: Redundancy interrupt<br>8: Controlled by supervisor<br>9: Released by supervisor<br>10: Configured module not inserted<br>11: Return of submodule<br>12: Diagnostic interrupt (exiting state)<br>13: Direct data exchange connection message<br>14: Neighbourhood change message<br>15: Clock synchronization message (from bus)<br>16: Clock synchronization message (from device)<br>17: Network component message<br>18: Time synchronization message (from bus)<br>19 to 31: Reserved<br>32 to 127: Vendor-specific interrupt<br>128 ... 65535: reserved, without the following VIPA specific interrupt types:<br>38CAh: Recovery of the controller<br>48CAh: Configuration of the controller accepted<br>39CAh: Controller failure<br>49CAh: Failure of the controller due to the watchdog<br>38CBh: Recovery of the device<br>38CCh: Failure of the recovery of the device<br>38CDh: Another device is detected during the recovery of the device.<br>38CEh: Parameter error during the recovery of the device<br>39CBh: Device failure |
| 8 ... 11 | API | DWORD | API (Application Process Identifier) |
| 12 ... 13 | Slot number | WORD | Slot number of the component triggering the interrupt (range of values 0 to 65535) |
| 14 ... 15 | Interface module slot number | WORD | Interface module slot number of the component triggering the interrupt (range of values 0 to 65535) |
| 16 ... 19 | Module ID | DWORD | Specific information on the source of the interrupt: Module ID |

| AINFO PROFINET IO: Data structure of the target area (interrupt information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 20 ... 23 | Submodule ID | DWORD | Specific information on the source of the interrupt: Submodule ID |
| 24 ... 25 | Interrupt specifier | WORD | Bits 0 to 10: Sequence number<br>(range of values: 0 to 2047)<br>Bit 11: Channel diagnostics:<br>0: No channel diagnostics available<br>1: Channel diagnostics available<br>Bit 12: Status of manufacturer-specific diagnostics:<br>0: No manufacturer-specific status information available<br>1: Manufacturer-specific status information available<br>Bit 13: Status of diagnostics for interface module:<br>0: No status information available; all errors corrected<br>1: Diagnostics for at least one channel and/or status information available<br>Bit 14: reserved<br>Bit 15: Application Relationship Diagnosis State<br>0: None of the configured modules within this AR is reporting a diagnosis<br>1: At least one of the configured modules within this AR is reporting a diagnosis |
| 26 ... 1535 | Interrupt specifier | WORD | **Note:**<br>The additional interrupt specifier can also be omitted. |

| AINFO EtherCAT: Data structure of the target area (interrupt information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 0, 1 | Length | WORD | Length of the received interrupt information in byte:<br>MIN: 0<br>MAX: 1535 (1.5kbyte) |
| 2, 3 | InterruptType | WORD | ID of the interrupt type:<br>0001h: DIAGNOSTICS_INTERRUPT_COMMING<br>0002h: HARDWARE_INTERRUPT<br>000Ch: DIAGNOSTICS_INTERRUPT_GOING<br>0020h: MANUFACTOR_SPECIFIC_ALARM_MIN<br>// VIPA specific:<br>39CAh: CONTROLLER_FAILURE<br>49CAh: CONTROLLER_FAILURE_WATCHDOG<br>// EtherCAT specific:<br>8001h: BUS_STATE_CHANGED<br>8002h: SLAVE_STATE_CHANGED<br>8003h: TOPOLOGY_OK<br>8004h: TOPOLOGY_MISMATCH |
| 4, 5 | RackSlot | WORD | Slot number of the EtherCAT master |
| 6, 7 | Master/Slave ID | WORD | EtherCAT master/slave address |
| 8, 9 | InterruptSpecifier | WORD | Value depends on the interrupt type:<br>InterruptType: Value<br>BUS_STATE_CHANGED: new bus status [1]<br>DIAGNOSTICS_INTERRUPT_GOING: reserved<br>DIAGNOSTICS_INTERRUPT_COMMING: reserved<br>HARDWARE_INTERRUPT: reserved<br>MANUFACTOR_SPECIFIC_ALARM_MIN: reserved<br>SLAVE_STATE_CHANGED: new bus status<br>CONTROLLER_FAILURE: reserved<br>CONTROLLER_FAILURE_WATCHDOG: reserved<br>TOPOLOGY_OK: reserved<br>TOPOLOGY_MISMATCH: reserved |

| AINFO EtherCAT: Data structure of the target area (interrupt information) | | | |
|---|---|---|---|
| **Byte** | **Declaration** | **Data type** | **Description** |
| 10 ... n | Data | BYTE | Content depends on the InterruptType:<br>AlarmType: Content<br>BUS_STATE_CHANGED: Data structure [2]<br>DIAGNOSTICS_INTERRUPT_GOING: CoE-Emergency [3]<br>DIAGNOSTICS_INTERRUPT_COMMING: CoE-Emergency<br>PROCESS_INTERRUPT: CoE-Emergency<br>MANUFACTOR_SPECIFIC_INTERRUPT_MIN: CoE-Emergency<br>SLAVE_STATE_CHANGED: AL Status Code [4]<br>CONTROLLER_FAILURE: Failure code [5]<br>CONTROLLER_FAILURE_WATCHDOG: reserved<br>TOPOLOGY_OK: reserved<br>TOPOLOGY_MISMATCH: reserved |

1) EtherCAT-States ➪ *418*

2) Data structure BUS_STATE_CHANGED ➪ *419*

3) CoE emergency ➪ *419*

4) AL Status Code ➪ *419*

5) Failure code ➪ *419*

### 13.2.22.1 EtherCAT-States

The bus states are coded as follows

| Name | Code | Description |
|---|---|---|
| Undefined/Unknown | 0x00 | This status has a slave before he could carry out its initialization routines. For the VIPA EtherCAT master a slave has the undefined state, if there is a slave failure (disconnect). |
| Init | 0x01 | There is no direct communication between master and slaves. In this state the master initializes the configuration register of the ESC. There is no process data or mailbox communication. |
| PreOp | 0x02 | In this state mailbox communication is possible, but there is no process data communication. |
| BootStrap | 0x03 | Special state of the EtherCAT slave, there only mailbox communication takes place. For a firmware update of the salve, the slave must be switched in this state. |
| SafeOp | 0x04 | In the state SafeOp mailbox communication is possible an process input data can be exchanged. However, there will be no exchange of process output data. |
| Op | 0x08 | In this state mailbox and process data can be exchanged. |

### 13.2.22.2 Cause of controller failure

On a controller failure the alarm specifier provides information about the cause of the failure

| Name | Code | Description |
|---|---|---|
| REASON_UNKNOWN | 0 | The reason is unknown |
| ALARM_OVERFLOW | 1 | Overflow of interrupts |
| MESSAGE_QUEUE_OVERFLOW | 2 | Overflow of EtherCAT events |
| CYCLIC_FRAMES_NOT_IN_BUSCYCLE | 3 | EtherCAT receive telegram was not received within the bus cycle time |
| APPL_BUSCYCLE_ERROR | 4 | Bus cycle time could not be fetched e.g. due to a high system load |

### 13.2.22.3 CoE emergency

A CoE emergency is a special type of mailbox communication in the EtherCAT slave. Here the EtherCAT slave can signalise the EtherCAT master that an error has occurred. It has the following structure:

| Name | Data type | Description |
|---|---|---|
| Error Code | WORD | Error Code |
| Error Register | BYTE | EtherCAT state on the error of the salve |
| Data | BYTE[5] | Manufacturer Specific Error Field (MEF), contains additional diagnostics data |

### 13.2.22.4 AL Status Code

AL is the abbreviation for Application Layer. The AL status code is an error code of the slave application.

### 13.2.22.5 Data structure BUS_STATE_CHANGED

Header

NrOfSlavesTotal - Number of slaves, which are not in master state

NrOfSlavesUndefined - Number of slaves in state *undefined*

NrOfSlavesInit - Number of slaves in state *Init*

NrOfSlavesPreop - Number of slaves in state *PreOp*

NrOfSlavesBoostrap - Number of slaves in state *Bootstrap*

NrOfSlavesSafeop - Number of slaves in state *SafeOp*

NrOfSlavesOp - Number of slaves in state *Op*

| | |
|---|---|
| DeviceId | |
| DeviceId[0] ... | - EtherCAT address of the slave as defined in the configuration |
| DeviceId[NrOfSlaves-Total-1] | - EtherCAT address of the slave as defined in the configuration |

**TINFO and AINFO**

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.

| Target Area | | | | | |
|---|---|---|---|---|---|
| **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: Record set 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 information**

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 | Description |
|---|---|---|
| STATUS[1] | Function_Num | 00h: if no error<br>Function ID from DP-V1-CPU:<br>in error case 80h is OR linked.<br>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:<br>With DP-V1 errors, the DP master passes on *STATUS*[4] to the CPU and to the SFB.<br>Without DP-V1 error, this value is set to 0, with the following exceptions for the SFB 52:<br>■ *STATUS*[4] contains the target area length from RECORD, if *MLEN* > the target area length from *RECORD*<br>■ *STATUS*[4]=*MLEN*, if the actual record set length < MLEN < the target area length from *RECORD*. |

| **STATUS[2] (Location of the error ID) can have the following values:** | | |
|---|---|---|
| **Error_Decode** | **Source** | **Description** |
| 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** | **Description** |
| 00h | 00h | | no error, no warning |
| 70h | 00h | reserved, reject | Initial call;<br>no active record set transfer |
| | 01h | reserved, reject | Initial call;<br>record set transfer has started |
| | 02h | reserved, reject | Intermediate call;<br>record set 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. |

| ***STATUS[3]*** **(Error ID) can have the following values:** | | | |
|---|---|---|---|
| **Error_Decode** | **Error_Code_1** | **Explanation according to DP-V1** | **Description** |
| | A0h | read error | Negative acknowledgement while reading the module. |
| | A1h | write error | Negative acknowledgement while writing the module. |
| | A2h | module failure | DP protocol error 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 noncompatible 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 | Record set not known in module<br>illegal record set 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 |
| | 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 record set, however, there are no read data yet. |

| ***STATUS[3]*** **(Error ID) can have the following values:** | | | |
|---|---|---|---|
| **Error_Decode** | **Error_Code_1** | **Explanation according to DP-V1** | **Description** |
| | C1h | write constrain conflict | The data of the previous write request to the module for the same record set 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.<br>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 | | Record set 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, |
| 81h | 00h ... FFh | | Error in the initial call parameter<br>(with SFB 54: MODE) |
| | 00h | | Illegal operating mode |
| 82h | 00h ... FFh | | Error in the 2. call parameter. |
| ... | ... | | ... |
| 88h | 00h ... FFh | | Error in the 8. call parameter<br>(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 zero for area ID DB/DI or specified DB/DI does not exist. |
| 89h | 00h ... FFh | | Error in the 9. call parameter<br>(with SFB 54: *AINFO*) |
| | 01h | | Wrong syntax ID |
| | 23h | | Quantity frame exceeded or target area too small |
| | 24h | | Wrong range ID |

| ***STATUS[3]*** **(Error ID) can have the following values:** | | | |
|---|---|---|---|
| **Error_Decode** | **Error_Code_1** | **Explanation according to DP-V1** | **Description** |
| | 32h | | DB/DI no. out of user range |
| | 3Ah | | DB/DI no. is zero 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 |

# 14 Standard

## 14.1 Converting

### 14.1.1 FB 80 - LEAD_LAG - Lead/Lag Algorithm

**Description**

The Lead/Lag Algorithm LEAD_LAG function block allows signal processing to be done on an analog variable. An output *OUT* is calculated based on an input *IN* and the specified gain *GAIN*, lead *LD_TIME*, and lag *LG_TIME* values. The gain value must be greater than zero. The LEAD_LAG algorithm uses the following equation:

$$und\ OUT = \left[\frac{LG\_TIME}{LG\_TIME + SAMPLE\_T}\right] PREV\_OUT + GAIN \left[\frac{LD\_TIME + SAMPLE\_T}{LG\_TIME + SAMPLE\_T}\right] IN - GAIN \left[\frac{LD\_TIME}{LG\_TIME + SAMPLE\_T}\right] PREV\_IN$$

Typically, LEAD_LAG is used in conjunction with loops as a compensator in dynamic feed-forward control. LEAD_LAG consists of two parts. Phase lead shifts the phase of the function block's output so that it leads the input whereas phase lag shifts the output so that it lags the input. Because the lag operation is equivalent to an integration, it can be used as a noise suppressor or a low-pass filter. A lead operation is equivalent to a differentiation and is thus a high-pass filter. LEAD_LAG combined can cause the output phase to lag input at low frequency, and to lead input at high frequency, and can thus be used as a band-pass filter.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function block is executed without error |
| IN | Input | REAL | I, Q, M, D, L, P, constant | The input value of the current sample period to be processed |
| SAMPLE_T | Output | INT | I, Q, M, D, L, P, constant | Sample time |
| OUT | Output | REAL | I, Q, M, D, L, P, constant | The result of the LEAD_LAG operation |
| ERR_CODE | Output | WORD | E, A, M, D, L, P | Returns a value of W#16#0000 if the instruction executes without error; see Error Information for values other than W#16#0000 |
| LD_TIME | Static | REAL | I, Q, M, D, L, P, constant | Lead time in minutes |
| LG_TIME | Static | REAL | I, Q, M, D, L, P, constant | Lag time in minutes |
| GAIN | Static | REAL | I, Q, M, D, L, P, constant | Gain as % / % (the ratio of the change in output to the change in input as a steady state). |
| PREV_IN | Static | REAL | I, Q, M, D, L, P, constant | Previous input |
| PREV_OUT | Static | REAL | I, Q, M, D, L, P, constant | Previous output |

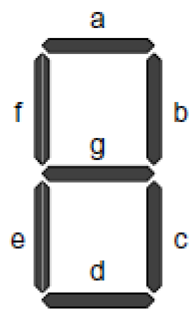
**Error Information**

If *GAIN* is less than or equal to 0, the function block is not executed. The signal state of *ENO* is set to 0 and *ERR_CODE* is set equal to W#16#0009.

## 14.1.2 FC 93 - SEG - Seven Segment Decoder

**Description**

The Seven Segment Decoder SEG function converts each of the four hexadecimal digits in the designated source data word *IN* into four equivalent 7-segment display codes and writes it to the output destination double word *OUT*. The Figure below shows the relationship between the input hex digits and the output bit patterns.




**Parameters**

| Digit | – g f e d c b a | Display |
|---|---|---|
| 0 0 0 0 | 0 0 1 1 1 1 1 1 | 0 |
| 0 0 0 1 | 0 0 0 0 0 1 1 0 | 1 |
| 0 0 1 0 | 0 1 0 1 1 0 1 1 | 2 |
| 0 0 1 1 | 0 1 0 0 1 1 1 1 | 3 |
| 0 1 0 0 | 0 1 1 0 0 1 1 0 | 4 |
| 0 1 0 1 | 0 1 1 0 1 1 0 1 | 5 |
| 0 1 1 0 | 0 1 1 1 1 1 0 1 | 6 |
| 0 1 1 1 | 0 0 0 0 0 1 1 1 | 7 |
| 1 0 0 0 | 0 1 1 1 1 1 1 1 | 8 |
| 1 0 0 1 | 0 1 1 0 0 1 1 1 | 9 |
| 1 0 1 0 | 0 1 1 1 0 1 1 1 | A |
| 1 0 1 1 | 0 1 1 1 1 1 0 0 | b |
| 1 1 0 0 | 0 0 1 1 1 0 0 1 | C |
| 1 1 0 1 | 0 1 0 1 1 1 1 0 | d |
| 1 1 1 0 | 0 1 1 1 1 0 0 1 | E |
| 1 1 1 1 | 0 1 1 1 0 0 0 1 | F |

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | WORD | I, M, D, P,<br>or constant | Source data word in four hexadecimal digits |
| OUT | Output | DWORD | Q, M, D, L, P | Destination bit pattern in four bytes |

**Error Information**

This function does not detect any error conditions.

### 14.1.3 FC 94 - ATH - ASCII to Hex

**Description**

The ASCII to Hex (ATH) function converts the ASCII character string pointed to by *IN* into packed hexadecimal digits and stores these in the destination table pointed to by *OUT*. Since 8 bits are required for the ASCII character and only 4 bits for the hexadecimal digit, the output word length is only half of the input word length. The ASCII characters are converted and placed into the hexadecimal output in the same order as they are read in. If there is an odd number of ASCII characters, the hexadecimal digit is padded with zeros in the right-most nibble of the last converted hexadecimal digit.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | Pointer* | I, Q, M, D, L | Points to the starting location of an ASCII string |
| N | Input | INT | I, Q, M, L, P | Number of ASCII input characters to be converted |
| RET_VAL | Output | WORD | I, Q, M, D, L, P | Returns a value of W#16#0000 if the instruction executes without error; see Error Information for values other than W#16#0000 |
| OUT | Output | Pointer* | Q, M, D, L | Points to the starting location of the table |
| *) Double word pointer format for area-crossing register indirect addressing | | | | |

**Error Information**

If any ASCII character is found to be invalid, it is converted as 0. The signal state of *ENO* is set to 0 and *RET_VAL* is set equal to W#16#0007.

### 14.1.4 FC 95 - HTA - Hex to ASCII

**Description**

The Hex to ASCII (HTA) function converts packed hexadecimal digits, pointed to by *IN*, and stores them in the destination string pointed to by *OUT*. Since 8 bits are required for the character and only 4 bits for the hex digit, the output word length is two times that of the input word length. Each nibble of the hexadecimal digit is converted into a character in the same order as they are read in (left-most nibble of a hexadecimal digit is converted first, followed by the right-most nibble of that same digit).

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | Pointer * | I, Q, M, D | Points to the starting location of the hexadecimal digit string |

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| N | Input | WORD | I, Q, M, L, P | Number of hex input bytes to be converted |
| OUT | Output | Pointer * | Q, M, D, L | Points to the starting location of the destination table |
| *) Double word pointer format for area-crossing register indirect addressing | | | | |

**Error Information**

This function does not detect any error conditions.

### 14.1.5 FC 96 - ENCO - Encode Binary Position

**Description**

The Encode Binary Position ENCO function converts the contents of *IN* to the 5-bit binary number corresponding to the bit position of the right-most set bit in *IN* and returns the result as the function's value. If *IN* is either 0000 0001 or 0000 0000, a value of 0 is returned.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | DWORD | I, M, D, L, P,<br>or constant | Value to be encoded |
| RET_VAL | Input | INT | Q, M, D, L, P | Value returned (contains 5-bit binary number) |

**Error Information**

This function does not detect any error conditions.

### 14.1.6 FC 97 - DECO - Decode Binary Position

**Description**

The Decode Binary Position DECO function converts a 5-bit binary number (0 – 31) from input *IN* to a value by setting the corresponding bit position in the function's return value. If *IN* is greater than 31, a modulo 32 operation is performed to get a 5-bit binary number.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | WORD | I, M, D, L, P, constant | Variable to decode |
| RET_VAL | Output | DWORD | Q, M, D, L, P | Value returned |

**Error Information** This function does not detect any error conditions.

### 14.1.7 FC 98 - BCDCPL - Tens Complement

**Description** The Tens Complement BCDCPL function returns the Tens complement of a 7-digit BCD number *IN*. The mathematical formula for this operation is the following:

*10000000 (in BCD) - 7digit BCD value = Tens complement value (in BCD)*

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | DWORD | I, M, D, L, P, constant | 7-digit BCD number |
| RET_VAL | Output | DWORD | Q, M, D, L, P | Value returned |

**Error Information** This function does not detect any error conditions.

### 14.1.8 FC 99 - BITSUM - Sum Number of Bits

**Description** The Sum Number of Bits BITSUM function counts the number of bits that are set to a value of 1 in the input *IN* and returns this as the function's value.

**Parameter**

| Parameter | Deklaration | Datentyp | Speicherbereich | Beschreibung |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | Enable input with signal state of 1 activates the box |
| ENO | Output | BOOL | I, Q, M, D, L | Enable output has a signal state of 1 if the function is executed without error |
| IN | Input | DWORD | I, M, D, L, P, constant | Variable to count bits in |
| RET_VAL | Output | INT | Q, M, D, L, P | Value returned |

**Error Information** This function does not detect any error conditions.

### 14.1.9 FC 105 - SCALE - Scaling Values

**Description** The Scaling Values SCALE function takes an integer value *IN* and converts it to a real value in engineering units scaled between a low and a high limit *LO_LIM* and *HI_LIM*. The result is written to *OUT*. The SCALE function uses the equation:

$$OUT = [((FLOAT\ (IN) - K1) / (K2 - K1)) \cdot (HI\_LIM - LO\_LIM)] + LO\_LIM$$

The constants K1 and K2 are set based upon whether the input value is *BIPOLAR* or *UNIPOLAR*.

- *BIPOLAR*:
  – The input integer value is assumed to be between -27648 and 27648, therefore, K1 = -27648,0 and K2 = +27648,0.
- *UNIPOLAR*:
  – The input integer value is assumed to be between 0 and 27648, therefore, K1 = 0,0 and K2 = +27648,0.

If the input integer value is greater than K2, the output *OUT* is clamped to *HI_LIM*, and an error is returned. If the input integer value is less than K1, the output *OUT* is clamped to *LO_LIM*, and an error is returned. Reverse scaling can be obtained by programming *LO_LIM* > *HI_LIM*. With reverse scaling, the value of the output decreases as the value of the input increases.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed without error |
| IN | INPUT | INT | I, Q, M, D, L, constant | The input value to be scaled to a REAL value in engineering units |
| HI_LIM | INPUT | REAL | I, Q, M, D, L, P, constant | Upper limit in engineering units |
| LO_LIM | INPUT | REAL | I, Q, M, D, L, P, constant | Lower limit in engineering units |
| BIPOLAR | INPUT | BOOL | I, Q, M, D, L | A signal state of 1 indicates the input value is bipolar, a signal state of "0" indicates unipolar |
| OUT | OUTPUT | REAL | I, Q, M, D, L, P | The result of the scale conversion |
| RET_VAL | INPUT | WORD | I, Q, M, D, L, P | Returns a value of W#16#0000 if the instruction executes without error; see Error Information for values other than W#16#0000 |

**Error information**

- If the input integer value is greater than K2, the output *OUT* is clamped to *HI_LIM*, and an error is returned.
- If the input integer value is less than K1, the output *OUT* is clamped to *LO_LIM*, and an error is returned.
- The signal state of *ENO* is set to FALSE and *RET_VAL* is set equal to W#16#0008.

## 14.1.10 FC 106 - UNSCALE - Unscaling Values

**Description**

The Unscaling Values UNSCALE function takes a real input value *IN* in engineering units scaled between a low and a high limit *LO_LIM* and *HI_LIM* and converts it to an integer value. The result is written to *OUT*. The UNSCALE function uses the equation:

$$OUT = [((IN - LO\_LIM) / (HI\_LIM - LO\_LIM)) \cdot (K2 - K1)] + K1$$

and sets the constants K1 and K2 based upon whether the input value is *BIPOLAR* or *UNIPOLAR*.

- *BIPOLAR*:
  - The input integer value is assumed to be between -27648 and 27648, therefore, K1 = -27648.0 and K2 = +27648.0.
- *UNIPOLAR*:
  - The input integer value is assumed to be between 0 and 27648, therefore, K1 = 0.0 and K2 = +27648.0.

If the input value is outside the *LO_LIM* and *HI_LIM* range, the output *OUT* is clamped to the nearer of either the low limit or the high limit of the specified range for its type (*BIPOLAR* or *UNIPOLAR*), and an error is returned.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | Input | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | Output | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed without error |
| IN | Input | REAL | I, Q, M, D, L, P, constant | The input value to be unscaled to an integer value |
| HI_LIM | Input | REAL | I, Q, M, D, L, P, constant | Upper limit in engineering units |
| LO_LIM | Input | REAL | I, Q, M, D, L, P, constant | Lower limit in engineering units |
| BIPOLAR | Input | BOOL | I, Q, M, D, L | A signal state of 1 indicates the input value is bipolar and a signal state of "0" indicates unipolar |
| OUT | Output | INT | I, Q, M, D, L, P | The result of the scale conversion |
| RET_VAL | Output | WORD | I, Q, M, D, L, P | Returns a value of W#16#0000 if the instruction executes without error; see Error Information for values other than W#16#0000 |

**Error Information**

If the input real value is outside the *LO_LIM* and *HI_LIM* range the output *OUT* is clamped to the nearer of either the low limit or the high limit of the specified range for its type (*BIPOLAR* or *UNIPOLAR*), and an error is returned. The signal state of *ENO* is set to 0 and *RET_VAL* is set equal to W#16#0008.

## 14.1.11 FC 108 - RLG_AA1 - Issue an Analog Value

**Description**

The function RLG_AA1 (Issue an Analog Value) transforms an Input Value *XE* (Fixed Point Number) into an output value for an analog output module in accordance with the nominal range between *OGR* and *UGR*. If the nominal range is exceeded, an error message is displayed.

| Parameter | Datentyp | Speicherbereich | Beschreibung |
|---|---|---|---|
| XE | INT | I, Q, M, L, D, constant | Input value *XE* as a fixed point number |
| BG | INT | I, Q, M, L, D, constant | Specify the module address |
| KNKT | WORD | I, Q, M, L, D, constant | Channel number KN<br>Channel type KT |
| OGR | INT | I, Q, M, L, D, constant | Upper limit of the input value *XE* |
| UGR | INT | I, Q, M, L, D, constant | Lower limit of the input value *XE* |
| FEH | BOOL | I, Q, M, L, D | Error bit |
| BU | BOOL | I, Q, M, L, D | Range excess |

**Differences between S5 and S7**

- The BG parameter
  – There is no address check. The range is the whole P area.

*This function is only used to convert the FB251 of an existing S5 program of an S5 CPU 941 to 944 to a function of an S7 program for the S7-400 programmable controller.*

### 14.1.12 FC 109 - RLG_AA2 - Write Analog Value 2

**Description**

The function RLG_AA2 (Issue an Analog Value) transforms an Input Value *XE* (Floating Point Number) into an output value for an analog output module in accordance with the nominal range between *OGR* and *UGR*. If the nominal range is exceeded, an error message is displayed.

| Parameter | Data Type | Memory Area | Description |
|---|---|---|---|
| XE | REAL | I, Q, M, L, D, constant | Input value *XE* as a floating point number |
| BG | INT | I, Q, M, L, D, constant | Specify the module address |
| P_Q | WORD | I, Q, M, L, D, constant | Peripheriebereich normal/erweitert |
| KNKT | WORD | I, Q, M, L, D, constant | Channel number KN<br>Channel type KT |
| OGR | REAL | I, Q, M, L, D, constant | Upper limit of the input value *XE* |
| UGR | REAL | I, Q, M, L, D, constant<br>const. | Lower limit of the input value *XE* |
| FEH | BOOL | I, Q, M, L, D | Error bit |
| BU | BOOL | I, Q, M, L, D | Range excess |

**Differences between S5 and S7**

- The BG parameter
  – There is no address check. The range is the whole P area.
- In S7, no value is assigned to the parameter *P_Q*.
- A process image of the S5 I/O areas P/Q/IM3/IM4 is made in the S7 I/O area. You must assign the I/O area in the configuration table.

> *This function is only used to convert the FB41 of an existing S5 program of an S5 CPU 928B, 945 or 948 to a function of an S7 program for the S7-400 programmable controller.*

### 14.1.13 FC 110 - PER_ET1 - Read/Write Ext. Per. 1

**Description**

The function PER_ET1 (Reading and Writing for Expanded Peripheries) transfers either a peripheral area into a CPU-internal area or vice-versa (depending on the parameter assignment). In this way, input bytes can be read from, and output bytes written to, the expanded I/O. If a data block is selected as an internal area, the block must have been set up by the user with the necessary length prior to calling up the function.

| Parameter | Data Type | Memory Area | Description |
|---|---|---|---|
| PBIB | WORD | I, Q, M, L, D, constant | Specify the areas to be processed |
| ANF | INT | I, Q, M, L, D, constant | Beginning of the internal area |
| ANEN | WORD | I, Q, M, L, D, constant | Beginning and end of the block on the interface module |
| E_A | BOOL | I, Q, M, L, D, constant | Transfer direction |
| PAFE | BOOL | E, A, M, L, D | Parameter assignment error |

**Differences between S5 and S7**

- The *PBIB* parameter
  – In S7, the I/O area is assigned values as follows:

| | S5 | | S7 |
|---|---|---|---|
| P area | 0 to 255 | P area | 0 to 255 |
| Q area | 0 to 255 | P area | 256 to 511 |
| IM3 area | 0 to 255 | P area | 512 to 767 |
| IM4 area | 0 to 255 | P area | 768 to 1023 |
| DB | 0 to 255 | DB | 0 to 255 |
| DX | 0 to 255 | DB | 256 to 511 |
| M | 0 to 199 | M | 0 to 199 |
| S | | Error message: "Invalid range" | |

- A process image of the S5 I/O areas P/Q/IM3/IM4 is made in the S7 I/O area. You must assign the I/O area in the configuration table.

*This function is only used to convert the FB196 of an existing S5 program of an S5 CPU 95U, 103, 941 to 944, 945, 928B, 948 to a function of an S7 program for the S7-300/400 programmable controller.*

### 14.1.14 FC 111 - PER_ET2 - Read/Write Ext. Per. 2

**Description**

The function PER_ET2 (Reading and Writing for Expanded Peripheries) transfers either a peripheral area into a CPU-internal area or vice-versa (depending on the parameter assignment). In this way, input bytes can be read from, and output bytes written to, the expanded I/O. If a data block is selected as an internal area, the block must have been set up by the user with the necessary length prior to calling up the function.

**Differences between S5 and S7:**

- The *PBIB* parameter (defined in DB)
  - In S7, the I/O area is assigned values as follows:

| | S5 | | S7 |
|---|---|---|---|
| P area | 0 to 255 | P area | 0 to 255 |
| Q area | 0 to 255 | P area | 256 to 511 |
| IM3 area | 0 to 255 | P area | 512 to 767 |
| IM4 area | 0 to 255 | P area | 768 to 1023 |
| DB | 0 to 255 | DB | 0 to 255 |
| DX | 0 to 255 | DB | 256 to 511 |
| M | 0 to 199 | M | 0 to 199 |
| S | | Error message: "Invalid range" | |

- A process image of the S5 I/O areas P/Q/IM3/IM4 is made in the S7 I/O area. You must assign the I/O area in the configuration table.

*This function is only used to convert the FB197 of an existing S5 program of an S5 CPU 95U, 103, 941 to 944, 945, 928B, 948 to a function of an S7 program for the S7-300/400 programmable controller.*

## 14.2 IEC

### 14.2.1 Date and time as complex data types

**Actual parameters for DATE_AND_TIME**

The DATE_AND_TIME data type is a complex data type like ARRAY, STRING, and STRUCT. The permissible memory areas for complex data types are the data block (DB) and local data (L stack) areas. If you use the data type DATE_AND_TIME as formal parameter in an instruction, due to the complex data type you can specify only one of the following formats:

- A block-specific symbol from the variable declaration table for a specific block
- A symbolic name for a data block, such as e.g. "DB_sys_info.System_Time", made up of the following parts:
  – A name defined in the symbol table for the number of the data block (e.g. "DB_sys_info" for DB 5)
  – A name defined within the data block for the DATE_AND_TIME element (e.g. "Time" for a variable of data type DATE_AND_TIME contained in DB 5)

*You cannot pass constants as actual parameters to formal parameters of the complex data types, including DATE_AND_TIME. Also, you cannot pass absolute addresses as actual parameters to DATE_AND_TIME.*

### 14.2.2 FC 1 - AD_DT_TM - Add duration to instant of time

**Description**

The function FC 1 adds a duration *D* (time) to an instant of time *T* (date and time) and provides a new instant of time (date and time) as the result. The instant of time *T* must be in the range DT#1990-01-01-00:00:00.000 ... DT#2089-12-31-23:59:59.999. The function does not check the input parameters. If the result of the addition is not within the valid range, the result is limited to the corresponding value and the binary result (BR) bit of the status word is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| T* | INPUT | DATE_AND_TIME | D, L | Instant of time in format DT |
| D | INPUT | TIME | I, Q, M, D, L<br>Constant | Duration in Format TIME |
| RET_VAL* | OUTPUT | DATE_AND_TIME | D, L | Sum in format DT |

*) You can assign only a symbolically defined variable for the parameter.

### 14.2.3 FC 2 - CONCAT - Concatenate two STRING variables

**Description**

The function FC 2 concatenates two STRING variables together to form one string. If the resulting string is longer than the variable given at the output parameter, the result string is limited to the maximum set length and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1* | INPUT | STRING | D, L | Input variable in format STRING |
| IN2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL* | OUTPUT | STRING | D, L | Concatenated string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.4 FC 3 - D_TOD_DT - Combine DATE and TIME_OF_DAY

**Description**

The function FC 3 combines the data formats DATE and TIME_OF_DAY (TOD) and converts these formats to the data format DATE_AND_TIME (DT). The input value *IN1* must be in the range DATE#1990-01-01 ... DATE#2089-12-31. The function does not check the input parameters and does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1 | INPUT | DATE | I, Q, M, D, L<br>Constant | Input variable in format DATE |
| IN2 | INPUT | TIME_OF_DAY | I, Q, M, D, L<br>Constant | Input variable in format TOD |
| RET_VAL* | OUTPUT | DATE_AND_TIME | D, L | Return value in format DT |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.5 FC 4 - DELETE - Delete in a STRING variable

**Description**

The function FC 4 deletes a number of characters *L* from the character at position *P* (inclusive) in a string. The function does not report any errors.

- If *L* and/or *P* are equal to zero or if *P* is greater than the current length of the input string, the input string is returned.
- If the sum of *L* and *P* is greater than the input string, the string is deleted up to the end.
- If *L* and/or *P* is negative, a blank string is returned and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN* | INPUT | STRING | D, L | STRING variable to be deleted in |
| L | INPUT | INT | I, Q, M, D, L<br>Constant | Number of characters to be deleted |
| P | INPUT | INT | I, Q, M, D, L<br>Constant | Position of 1. character to be deleted |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.6 FC 5 - DI_STRNG - Convert DINT to STRING

**Description**

The function FC 5 converts a variable in DINT data format to a string. The string is shown preceded by a sign. If the variable given at the return parameter is too short, no conversion takes place and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| I | INPUT | DINT | I, Q, M, D, L<br>Constant | Input value |
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.7 FC 6 - DT_DATE - Extract DATE from DT

**Description**

The function FC 6 extracts the data format DATE from the format DATE_AND_TIME. DATE value is between the limits DATE#1990-1-1 and DATE#2089-12-31. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN* | INPUT | DATE_AND_TIME | D, L | Input variable in format DT |
| RET_VAL | OUTPUT | DATE | I, Q, M, D, L | Return value in format DATE |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.8 FC 7 - DT_DAY - Extract day of the week from DT

**Description**

The function FC 7 extracts the day of the week from the format DATE_AND_TIME. The function does not report any errors. The day of the week is returned as INTEGER value.

- 1: Sunday
- 2: Monday
- 3: Tuesday
- 4: Wednesday
- 5: Thursday
- 6: Friday
- 7: Saturday

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
| --- | --- | --- | --- | --- |
| IN* | INPUT | DATE_AND_TIME | D, L | Input variable in format DT |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Return value in format INT |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.9 FC 8 - DT_TOD - Extract TIME_OF_DAY from DT

**Description**

The function FC 8 extracts the data format TIME_OF_DAY from the format DATE_AND_TIME. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
| --- | --- | --- | --- | --- |
| IN* | INPUT | DATE_AND_TIME | D, L | Input variable in format DT |
| RET_VAL | OUTPUT | TIME_OF_DAY | I, Q, M, D, L | Return value in format TOD |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.10 FC 9 - EQ_DT - Compare DT for equality

**Description**

The function FC 9 compares the contents of two variables in the data type format DATE_AND_TIME to determine if they are equal and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is the same as the time at parameter *DT2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
| --- | --- | --- | --- | --- |
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.11 FC 10 - EQ_STRNG - Compare STRING for equal

**Description**

The function FC 10 compares the contents of two variables in the format STRING to determine if they are equal and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is the same as the string at parameter *S2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
| --- | --- | --- | --- | --- |
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.12 FC 11 - FIND - Find in a STRING variable

**Description**

The function FC 11 provides the position of the second string *IN2* within the first string *IN1*. The search starts on the left; the first occurrence of the string is reported. If the second string is not found in the first, zero is returned. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1* | INPUT | STRING | D, L | STRING variable to be searched in |
| IN2* | INPUT | STRING | D, L | STRING variable to be found |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Position of the string found |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.13 FC 12 - GE_DT - Compare DT for greater than or equal

**Description**

The function FC 12 compares the contents of two variables in the data format DATE_AND_TIME to determine if one is greater or equal to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is greater (younger) than the time at parameter *DT2* or if both instants of time are the same. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameters. | | | | |

## 14.2.14 FC 13 - GE_STRNG - Compare STRING for greater than or equal

**Description**

The function FC 13 compares the contents of two variables in the data format STRING to determine if one is greater or equal to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is greater than or equal to the string at parameter *S2*. The characters are compared by their ASCII code (e.g. 'a' is greater than 'A'), starting from the left. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered as greater. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.15 FC 14 - GT_DT - Compare DT for greater than

**Description**

The function FC 14 compares the contents of two variables in the data format DATE_AND_TIME to determine if one is greater to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is greater (younger) than the time at parameter *DT2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.16 FC 15 - GT_STRNG - Compare STRING for greater than

**Description**

The function FC 15 compares the contents of two variables in the data format STRING to find out if the first is greater than the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is greater than the string at parameter *S2*. The characters are compared by their ASCII code (e.g. 'a' is greater than 'A'), starting from the left. The first character to be different decides the result of the comparison. If the left part of the longer string is identical to the shorter string, the longer string is considered as greater. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.17 FC 16 - I_STRNG - Convert INT to STRING

**Description**

The function FC 16 converts a variable in DINT data format to a string. The string is shown preceded by a sign. If the variable given at the return parameter is too short, no conversion takes place and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| I | INPUT | INT | I, Q, M, D, L<br>Constant | Input value |
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.18 FC 17 - INSERT - Insert in a STRING variable

**Description**

The function FC 17 inserts a string at parameter *IN2* into the string at parameter *IN1* after the character at position *P*.

- If *P* equals zero, the second string is inserted before the first string.
- If *P* is greater than the current length of the first string, the second string is appended to the first.
- If *P* is negative, a blank string is output and the BR bit is set to "0". The binary result bit is also set to "0" if the resulting string is longer than the variable given at the output parameter; in this case the result string is limited to the maximum set length.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1* | INPUT | STRING | D, L | STRING variable to be inserted into |
| IN2* | INPUT | STRING | D, L | STRING variable to be inserted |
| P | INPUT | INT | I, Q, M, D, L<br>Constant | Insert position |
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.19 FC 18 - LE_DT - Compare DT for smaller than or equal

**Description**

The function FC 18 compares the contents of two variables in the format DATE_AND_TIME to determine if one is smaller or equal to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is smaller (older) than the time at parameter *DT2* or if both instants of time are the same. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL* | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.20 FC 19 - LE_STRNG - Compare STRING for smaller then or equal

**Description**

The function FC 19 compares the contents of two variables in the format STRING to determine if one is smaller or equal to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is smaller than or equal to the string at parameter *S2*. The characters are compared by their ASCII code (e.g. 'A' smaller than 'a'), starting from the left. The first character to be different decides the result of the comparison. If the left part of the longer character string and the shorter character string are the same, the shorter string is smaller. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.21 FC 20 - LEFT - Left part of a STRING variable

**Description**

The function FC 20 provides the first *L* characters of a string.

- If *L* is greater than the current length of the STRING variable, the input value is returned.
- With *L* = 0 and with a blank string as the input value, a blank string is returned.
- If *L* is negative, a blank string is returned and the BR bit of the status word is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN* | INPUT | STRING | D, L | Input variable in format STRING |
| L | INPUT | INT | I, Q, M, D, L<br>Constant | Length of the left character string |
| RET_VAL* | OUTPUT | STRING | D, L | Output variable in format STRING |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.22 FC 21 - LEN - Length of a STRING variable

**Description**

A STRING variable contains two lengths:

- Maximum length
  – It is given in square brackets when the variables are being defined.
- Current length
  – This is the number of currently valid characters.

The current length is smaller or equal to the maximum length. The number of bytes occupied by a string is 2 greater than the maximum length. The function FC 21 outputs the current length of a string (number of valid characters) as a return value. A blank string (' ') has the length zero. The maximum length is 254. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Number of current characters |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.23 FC 22 - LIMIT

**Description**

The function FC 22 limits the number value of a variable to limit values which can have parameters assigned.

- Variables of the data types INT, DINT, and REAL are permitted as input values.
- All variables with parameters assigned must be of the same data type.
- The variable type is recognized by the ANY pointer.
- *MN* may not be greater as *MX*.
- The output value remains unchanged and the BR bit is set to "0" if:
  – a variable with parameters assigned has an invalid data type.
  – all variables with parameters assigned do not have the same data type.
  – the lower limit value is greater than the upper limit value.
  – a REAL variable does not represent a valid floating-point number.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| MN | INPUT | ANY | I, Q, M, D, L | Lower limit |
| IN | INPUT | ANY | I, Q, M, D, L | Input variable |
| MX | INPUT | ANY | I, Q, M, D, L | Upper limit |
| RET_VAL | OUTPUT | ANY | I, Q, M, D, L | Limited output variable |

### 14.2.24 FC 23 - LT_DT - Compare DT for smaller than

**Description**

The function FC 23 compares the contents of two variables in the format DATE_AND_TIME to determine if one is smaller to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is smaller (older) than the time at parameter *DT2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.25 FC 24 - LT_STRNG - Compare STRING for smaller

**Description**

The function FC 24 compares the contents of two variables in the format STRING to determine if one is smaller to the other and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is smaller than the string at parameter *S2*. The characters are compared by their ASCII code (e.g. 'A' smaller than 'a'), starting from the left. The first character to be different decides the result of the comparison. If the left part of the longer character string and the shorter character string are the same, the shorter string is smaller. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.26 FC 25 - MAX - Select maximum

**Description**

The function FC 25 selects the largest of three numerical variable values.

- Variables of the data types INT, DINT, and REAL are permitted as input values.
- All variables with parameters assigned must be of the same data type.
- The variable type is recognized by the ANY pointer.
- The output value remains unchanged and the BR bit is set to "0" if:
  - a variable with parameters assigned has an invalid data type.
  - all variables with parameters assigned do not have the same data type.
  - a REAL variable does not represent a valid floating-point number.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1 | INPUT | ANY | I, Q, M, D, L | 1. Input value |
| IN2 | INPUT | ANY | I, Q, M, D, L | 2. Input value |
| IN3 | INPUT | ANY | I, Q, M, D, L | 3. Input value |
| RET_VAL | OUTPUT | ANY | I, Q, M, D, L | Largest of the input values |

*The admitted data types INT, DINT and REAL must be entered in the ANY pointer. Such parameters as "MD20" are also admitted, but you must define the corresponding data type of "MD20" in "Symbol".*

**Example in STL:**

```
CALL FC 25
IN1 := P#M 10.0 DINT 1
IN2 := MD20
IN3 := P#DB1.DBX 0.0 DINT 1
RET_VAL := P#M 40.0 DINT 1
= M 0.0
```

## 14.2.27 FC 26 - MID - Middle part of a STRING variable

**Description**

The function FC 26 provides the middle part of a string (*L* characters from the character *P* inclusive).

- If the sum of *L* and (*P*-1) exceeds the current length of the STRING variables, a string is returned from the character *P* to the end of the input value.
- In all other cases (*P* is outside the current length, *P* and/or *L* are equal to zero or negative), a blank string is returned and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN* | INPUT | STRING | D, L | Input variable in format STRING |
| L | INPUT | INT | I, Q, M, D, L<br>Constant | Length of the middle character string |
| P | INPUT | INT | I, Q, M, D, L<br>Constant | Position of first character |
| RET_VAL* | OUTPUT | STRING | D, L | Output variable in format STRING |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.28 FC 27 - MIN - Select minimum

**Description**

The function FC 27 selects the smallest of three numerical variable values.

- Variables of the data types INT, DINT, and REAL are permitted as input values.
- All variables with parameters assigned must be of the same data type.
- The variable type is recognized by the ANY pointer.
- The output value remains unchanged and the BR bit is set to "0" if:
  – a variable with parameters assigned has an invalid data type.
  – all variables with parameters assigned do not have the same data type.
  – a REAL variable does not represent a valid floating-point number.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1 | INPUT | ANY | I, Q, M, D, L | 1. Input value |
| IN2 | INPUT | ANY | I, Q, M, D, L | 2. Input value |
| IN3 | INPUT | ANY | I, Q, M, D, L | 3. Input value |
| RET_VAL | OUTPUT | ANY | I, Q, M, D, L | Smallest of the input values |

*The admitted data types INT, DINT and REAL must be entered in the ANY pointer. Such parameters as "MD20" are also admitted, but you must define the corresponding data type of "MD20" in "Symbol".*

**Example in STL:**

```
CALL FC 27
IN1 := P#M 10.0 DINT 1
IN2 := MD20
IN3 := P#DB1.DBX 0.0 DINT 1
RET_VAL := P#M 40.0 DINT 1
= M 0.0
```

## 14.2.29 FC 28 - NE_DT - Compare DT for unequal

**Description**

The function FC 28 compares the contents of two variables in the format DATE_AND_TIME to determine if they are unequal and outputs the result of the comparison as a return value. The return value has the signal state "1" if the time at parameter *DT1* is unequal the time at parameter *DT2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| DT2* | INPUT | DATE_AND_TIME | D, L | Input variable in format TD |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.30 FC 29 - NE_STRNG - Compare STRING for unequal

**Description**

The function FC 29 compares the contents of two variables in the format STRING to determine if they are unequal and outputs the result of the comparison as a return value. The return value has the signal state "1" if the string at parameter *S1* is unequal to the string at parameter *S2*. The function does not report any errors.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S1* | INPUT | STRING | D, L | Input variable in format STRING |
| S2* | INPUT | STRING | D, L | Input variable in format STRING |
| RET_VAL | OUTPUT | BOOL | I, Q, M, D, L | Comparison result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.31 FC 30 - R_STRNG - Convert REAL to STRING

**Description**

The function FC 30 converts a variable in REAL data format to a string.

- The string is shown with 14 digits:
  ±v.nnnnnnnE±xx
  – ±: Sign
  – v: 1 digit before the decimal point
  – n: 7 digits after the decimal point
  – x: 2 exponential digits
- If the variable given at the return parameter is too short or if no valid floating-point number is given at parameter IN, no conversion takes place and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN | INPUT | REAL | I, Q, M, D, L<br>Constant | Input value |
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.32 FC 31 - REPLACE - Replace in a STRING variable

**Description**

The function FC 31 replaces a number of characters *L* of the first string *IN1* starting at the character at position *P* (inclusive) with the entire second string *IN2*.

- If *L* is equal to zero and *P* is not equal to zero, the first string is returned.
- If *L* is equal to zero and *P* is equal to zero, the second string is precent to the first string.
- If *L* is not equal to zero and *P* is equal to zero or one, the string is replaced from the 1. character (inclusive).
- If *P* is outside the first string, the second string is appended to the first string.
- If *L* and/or *P* is negative, a blank string is returned and the BR bit is set to "0". The BR bit is also set to "0" if the resulting string is longer than the variable given at the output parameter; in this case the result string is limited to the maximum set length.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN1* | INPUT | STRING | D, L | STRING variable to be inserted into |
| IN2* | INPUT | STRING | D, L | STRING variable to be inserted |
| L | INPUT | INT | I, Q, M, D, L<br>Constant | Number of characters to be replaced |
| P | INPUT | INT | I, Q, M, D, L<br>Constant | Position of 1. character to be replaced |
| RET_VAL* | OUTPUT | STRING | D, L | Result string |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.33 FC 32 - RIGHT - Right part of a STRING variable

**Description**

The function FC 32 provides the last *L* characters of a string.

- If *L* is greater than the current length of the STRING variable, the input value is returned.
- With *L* = 0 and with a blank string as the input value, a blank string is returned.
- If *L* is negative, a blank string is returned and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN* | INPUT | STRING | D, L | Input variable in format STRING |
| L | INPUT | INT | I, Q, M, D, L<br>Constant | Length of the right character string |
| RET_VAL* | OUTPUT | STRING | D, L | Output variable in format STRING |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

## 14.2.34 FC 33 - S5TI_TIM - Convert S5TIME to TIME

**Description**

The function FC 33 converts the data format S5TIME to the data format TIME. If the result of the conversion is outside the TIME range, the result is limited to the corresponding value and the binary result (BR) bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN | INPUT | S5TIME | I, Q, M, D, L<br>Constant | Input variable in format S5TIME |
| RET_VAL | OUTPUT | TIME | I, Q, M, D, L | Return value in format TIME |

### 14.2.35 FC 34 - SB_DT_DT - Subtract two instants of time

**Description**

The function FC 34 subtracts two instants of time *DTx* (date and time) and provides a duration (time) as the result. The instants of time *DTx* must be in the range DT#1990-01-01-00:00:00.000 ... DT#2089-12-31-23:59:59.999. The function does not check the input parameters. It is valid:

- With *DT1* > *DT2* the result is positive.
- With *DT1* < *DT2* the result is negative.
- If the result of the subtraction is outside the TIME range, the result is limited to the corresponding value and the binary result (BR) bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| DT1* | INPUT | DATE_AND_TIME | D, L | 1. instant of time in format DT |
| DT2* | INPUT | DATE_AND_TIME | D, L | 2. Instant of time in format DT |
| RET_VAL | OUTPUT | TIME | I, Q, M, D, L | Difference in format TIME |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.36 FC 35 - SB_DT_TM - Subtract a duration from a time

**Description**

The function FC 35 subtracts a duration *D* (TIME) from a time *T* (DT) and provides a new time (DT) as the result. The time *T* must be between DT#1990-01-01-00:00:00.000 and DT#2089-12-31-23:59:59.999. The function does not run an input check. If the result of the subtraction is not within the valid range, the result is limited to the corresponding value and the binary result (BR) bit of the status word is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| T* | INPUT | DATE_AND_TIME | D, L | Time in format DT |
| D | INPUT | TIME | E, A, M, D, L, Constant | Duration in format TIME |
| RET_VAL * | OUTPUT | DATE_AND_TIME | D, L | Difference in format DT |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.37 FC 36 - SEL - Binary selection

**Description**

The function FC 36 selects one of two variable values depending on a switch *G*.

- Variables with all data types which correspond to the data width bit, byte, word, and double word (not data types DT and STRING) are permitted as input values at the parameters *IN0* and *IN1*.
- *IN0*, *IN1* and *RET_VAL* must be of the same data type.
- The output value remains unchanged and the BR bit is set to "0" if:
  – a variable with parameters assigned has an invalid data type.
  – all variables with parameters assigned do not have the same data type.
  – a REAL variable does not represent a valid floating-point number.

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| G | INPUT | BOOL | I, Q, M, D, L<br>Constant | Selection switch |
| IN0 | INPUT | ANY | I, Q, M, D, L | 1. Input value |
| IN1 | INPUT | ANY | I, Q, M, D, L | 2. Input value |
| RET_VAL | OUTPUT | ANY | I, Q, M, D, L | Selected input value |

### 14.2.38 FC 37 - STRNG_DI - Convert STRING to DINT

**Description**

The function FC 37 converts a string to a variable in DINT data format.

- The first character in the string may be a sign or a number, the characters which then follow must be numbers.
- If the length of the string is equal to zero or greater than 11, or if invalid characters are found in the string, no conversion takes place and the BR bit is set to "0".
- If the result of the conversion is outside the DINT range, the result is limited to the corresponding value and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S* | INPUT | STRING | D, L | Input string |
| RET_VAL | OUTPUT | DINT | I, Q, M, D, L | Result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.39 FC 38 - STRNG_I - Convert STRING to INT

**Description**

The function FC 38 converts a string to a variable in INT data format.

- The first character in the string may be a sign or a number, the characters which then follow must be numbers.
- If the length of the string is equal to zero or greater than 6, or if invalid characters are found in the string, no conversion takes place and the BR bit is set to "0".
- If the result of the conversion is outside the INT range, the result is limited to the corresponding value and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S* | INPUT | STRING | D, L | Input string |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.40 FC 39 - STRNG_R - Convert STRING to REAL

**Description**

The function FC 39 converts a string to a variable in REAL data format.

- The string must have the following format:
  ±v.nnnnnnnE±xx
  – ±: Sign
  – v: 1 digit before the decimal point
  – n: 7 digits after the decimal point
  – x: 2 exponential digits
- If the length of the string is smaller than 14, or if it is not structured as shown above, no conversion takes place and the BR bit is set to "0".
- If the result of the conversion is outside the REAL range, the result is limited to the corresponding value and the BR bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| S* | INPUT | STRING | D, L | Input string |
| RET_VAL | OUTPUT | REAL | I, Q, M, D, L | Result |
| *) You can assign only a symbolically defined variable for the parameter. | | | | |

### 14.2.41 FC 40 - TIM_S5TI - Convert TIME to S5TIME

**Description**

The function FC 40 converts the data format TIME to the format S5TIME. Here is always rounded down. If the input parameter is greater than the displayable S5TIME format (TIME#02:46:30.000), S5TIME#999.3 is output as result and the binary result (BR) bit is set to "0".

**Parameter**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| IN | INPUT | TIME | I, Q, M, D, L<br>Constant | Input variable in format TIME |
| RET_VAL | OUTPUT | S5TIME | I, Q, M, D, L | Return value in format S5TIME |

## 14.3 IO

### 14.3.1 FB 20 - GETIO - PROFIBUS/PROFINET read all Inputs

**Description**

With the FB 20 GETIO you consistently read out all inputs of a PROFIBUS DP slave/ PROFINET IO device. In doing so, FB 20 calls the SFC 14 DPRD_DAT. If there was no error during the data transmission, the data that have been read are entered in the target area indicated by *INPUTS*. The target area must have the same length that you configured for the selected component. In the case of a PROFIBUS DP slave with a modular structure or with several DP IDs, you can only access the data for one component/DP ID with an FB 20 call each time at the configured start address.

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| ID | INPUT | DWORD | I, Q, M, D, L<br>constant | ■ Low word: logical address of the DP slave/PROFINET IO component (module or submodule)<br>■ High word: irrelevant |
| STATUS | OUTPUT | DWORD | I, Q, M, D, L | Contains error information for SFC 14 DPRD_DAT in the form DW#16#40xxxx00 |
| LEN | OUTPUT | INT | I, Q, M, D, L | Amount of data read in bytes |
| INPUTS | IN_OUT | ANY | I, Q, M, D | Target area for the read data.<br>It must have the same length as the area that you configured for the selected DP slave/PROFINET IO component. Only the data type BYTE is permitted. |

**Error Information**

*Chapter 13.1.12 'SFC 14 - DPRD_DAT - Read consistent data' on page 289*

### 14.3.2 FB 21 - SETIO - PROFIBUS/PROFINET write all Outputs

**Description**

With the FB 21 SETIO you consistently transfer the data from the source area indicated by *OUTPUTS* to the addressed PROFIBUS DP slave/PROFINET IO device, and, if necessary, to the process image (in the case where you have configured the affected address area for the DP standard slave as a consistency area in a process image). In doing so, FB 21 calls the SFC 15 DPWR_DAT. The source area must have the same length that you configured with for the selected component. In the case of a DP standard slave with a modular structure or with several DP IDs, you can only access the data for one component/DP ID with an FB 20 call each time at the configured start address.

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| ID | INPUT | DWORD | I, Q, M, D, L,<br>constant | ■ Low word: logical address of the DP slave/PROFINET IO component<br>■ (module or submodule)<br>■ High word: irrelevant |
| LEN | INPUT | INT | E, A, M, D, L | Irrelevant |
| STATUS | OUTPUT | DWORD | E, A, M, D, L | Contains error information for SFC 15 DPRD_DAT in the form DW#16#40xxxx00 |
| OUTPUTS | IN_OUT | ANY | E, A, M, D | Source area for the read data to be read. It must have the same length as the area that you configured for the selected DP slave/ PROFINET IO component. Only the data type BYTE is permitted. |

**Error Information**

*Chapter 13.1.13 'SFC 15 - DPWR_DAT - Write consistent data' on page 290*

### 14.3.3 FB 22 - GETIO_PART - PROFIBUS/PROFINET read a part of the Inputs

**Description**

With the FB 22 GETIO_PART you consistently read a part of the process image area belonging to a PROFIBUS DP slave/PROFINET IO device. In doing so, FB 22 calls the SFC 81 UBLKMOV.

*You must assign a process image partition for inputs to the OB in which FB 22 GETIO_PART is called. Furthermore, before calling FB 22 you must add the associated PROFIBUS DP slave or the associated PROFINET IO device to this process image partition for inputs. If your CPU does not recognize any process image partitions or you want to call FB 22 in OB 1, you must add the associated PROFIBUS DP slave or the associated PROFINET IO device to this process image partition for inputs before calling FB 22. You use the OFFSET and LEN parameters to specify the portion of the process image area to be read for the components addressed by means of their ID. If there was no error during the data transmission, ERROR receives the value FALSE, and the data that have been read are entered in the target area indicated by INPUTS. If there was an error during the data transmission, ERROR receives the value TRUE, and STATUS receives the SFC 81 error information UBLKMOV. If the target area (INPUTS parameter) is smaller than LEN, then as many bytes as INPUTS can accept are transferred. ERROR receives the value FALSE. If the target area is greater than LEN, then the first LEN bytes in the target area are written. ERROR receives the value FALSE.*

*The FB 22 GETIO_PART does not check the process image for inputs for delimiters between data belonging to different PROFIBUS DP or PROFINET IO components. Because of this, you yourself must make sure that the process image area specified by means of OFFSET and LEN belongs to one component. Reading of data for more than one component cannot be guaranteed for future systems and compromises the transferability to systems from other manufacturers.*

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| ID | INPUT | DWORD | I, Q, M, D, L<br>constant | ■ Low word: logical address of the DP slave/ PROFINET IO component (module or submodule)<br>■ High word: irrelevant |
| OFFSET | INPUT | INT | I, Q, M, D, L<br>constant | Number of the first byte to be read in the process image for the component<br>(smallest possible value: 0) |
| LEN | INPUT | INT | I, Q, M, D, L<br>constant | Amount of bytes to be read |
| STATUS | OUTPUT | DWORD | I, Q, M, D, L | Contains error information for SFC 81 UBLKMOV in the form DW#16#40xxxx00 if *ERROR* = TRUE |

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| ERROR | OUTPUT | BOOL | I, Q, M, D, L | Error display:<br>*ERROR* = TRUE if an error occurs when calling SFC 81 UBLKMOV. |
| INPUTS | IN_OUT | ANY | I, Q, M, D | Target area for read data:<br>■ If the target area is smaller than *LEN*, then as many bytes as *INPUTS* can accept are transferred. ERROR receives the value FALSE.<br>■ If the target area is greater than *LEN*, then the first *LEN* bytes of the target area are written. *ERROR* receives the value FALSE. |

**Error Information**

*Chapter 13.1.56 'SFC 81 - UBLKMOV - Copy data area without gaps' on page 350*

## 14.3.4 FB 23 - SETIO_PART - PROFIBUS/PROFINET write a part of the Outputs

**Description**

With the FB 23 SETIO_PART you transfer data from the source area indicated by *OUTPUTS* into a part of the process image area belonging to a PROFIBUS DP slave/ PROFINET IO device. In doing so, FB 23 calls the SFC 81 UBLKMOV.

*You must assign a process image partition for outputs to the OB in which FB 23 SETIO_PART is called. Furthermore, before calling FB 23 you must add the associated PROFIBUS DP slave or the associated PROFINET IO device to this process image partition for outputs. If your CPU does not recognize any process image partitions or you want to call FB 23 in OB 1, you must add the associated PROFIBUS DP slave or the associated PROFINET IO device to this process image partition for outputs before calling FB 23. You use the OFFSET and LEN parameters to specify the portion of the process image area to be written for the components addressed by means of their ID. If there was no error during the data transmission, ERROR receives the value FALSE. If there was an error during the data transmission, ERROR receives the value TRUE, and STATUS receives the SFC 81 error information UBLKMOV. If the source area (OUTPUTS parameter ) is smaller than LEN, then as many bytes as OUTPUTS contains are transferred. ERROR receives the value FALSE. If the source area is greater than LEN, then the first LEN bytes are transferred from OUTPUTS. ERROR receives the value FALSE.*

*The FB 23 SETIO_PART does not check the process image for inputs for delimiters between data that belong to different PROFIBUS DP or PROFINET IO components. Because of this, you yourself must make sure that the process image area specified by means of OFFSET and LEN belongs to one component. Writing of data for more than one component cannot be guaranteed for future systems and compromises the transferability to systems from other manufacturers.*

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| ID | INPUT | DWORD | I, Q, M, D, L, constant | ■ Low word: logical address of the DP slave/PROFINET IO component (module or submodule)<br>■ High word: irrelevant |
| OFFSET | INPUT | INT | I, Q, M, D, L, constant | Number of the first byte to be written in the process image for the component<br>(smallest possible value: 0) |
| LEN | INPUT | INT | I, Q, M, D, L, constant | Amount of bytes to be written |
| STATUS | OUTPUT | DWORD | I, Q, M, D | Contains error information for SFC 81 UBLKMOV in the form DW#16#40xxxx00 if *ERROR* = TRUE |
| ERROR | OUTPUT | BOOL | I, Q, M, D | Error display:<br>*ERROR* = TRUE if an error occurs when calling SFC 81 UBLKMOV. |
| OUTPUTS | IN_OUT | ANY | I, Q, M, D | Source area for the data to be written:<br>■ If the source area is smaller than *LEN*, then as many bytes as OUTPUTS contains are transferred. *ERROR* receives the value FALSE.<br>■ If the source area is greater than *LEN*, then the first *LEN* bytes are transferred from *OUTPUTS*. *ERROR* receives the value FALSE. |

**Error Information** *Chapter 13.1.56 'SFC 81 - UBLKMOV - Copy data area without gaps' on page 350*

## 14.4 S5 Converting

### 14.4.1 FC 112 - Sine(x) - Sine

**Description**

The function FC 112 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between zero

   (REAL = +0.0000000e+00) ... 2 x π (REAL = +0.6283185e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).

   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, the function sets the RLO to signal state *ENO* to TRUE (if the input value is out of range from 0 to 2 x π). In this case, the contents of ACCU 1 remain unchanged. The assignment of the remaining registers and the auxiliary flags are not changed.

> *This function is only used to convert the FB 101 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.4.2 FC 113 - Cosine(x) - Cosine

**Description**

The function FC 113 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between zero

   (REAL = +0.0000000e+00) ... 2 x π (REAL = +0.6283185e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).

   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is out of range from 0 ... 2 x π, the function sets the RLO to signal state *ENO* to TRUE. In this case, the contents of ACCU 1 remain unchanged. The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 102 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.3 FC 114 - Tangent(x) - Tangent

**Description**

The function FC 114 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between zero

   (REAL = +0.0000000e+00) ... 2 x π (REAL = +0.6283185e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).

   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, the function sets the RLO to signal state *ENO* to TRUE. In this case, the contents of accumulator 1 remain unchanged. One of the following errors has occurred:

- The input value is out of range from 0 ... 2 x π.
- A number range overflow occurred during calculation of the function.
- The input value amounts to π/2 or 3 x π/2. In this case, the function value is infinite.

The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 103 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.4 FC 115 - Cotangent(x) - Cotangent

**Description**

The function FC 115 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between zero

   (REAL = +0.0000000e+00) ... 2 x π (REAL = +0.6283185e+01)

2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, the function sets the RLO to signal state *ENO* to TRUE. In this case, the contents of accumulator 1 remain unchanged. One of the following errors has occurred:

- The input value is out of range from REAL = +0.2938734e-34 and REAL = +0.6283184e+01.
- A number range overflow occurred during calculation of the function.
- The input value amounts to zero or π or 2 x π. In this case, the function value is infinite.

The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 103 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.5 FC 116 - Arc Sine(x) - Arcussine

**Description**

The function FC 116 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between
   -1 (REAL = -0.1000000e+01) ... +1 (REAL = +0.1000000e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is out of range of -1 ... +1, the function sets the RLO signal state *ENO* to TRUE. The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 105 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.6 FC 117 - Arc Cosine(x) - Arcuscosine

**Description**

The function FC 117 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between

   -1 (REAL = -0.1000000e+01) ... +1 (REAL = +0.1000000e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).

   ⇨ If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is out of range of -1 ... +1, the function sets the RLO signal state *ENO* to TRUE. The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 106 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.7 FC 118 - Arc Tangent(x) - Arcustangent

**Description**

The function FC 118 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between

   -1 (REAL = -0.1000000e+01) ... +1 (REAL = +0.1000000e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
4. If the input value is greater than REAL = +0.1209486e+07, the result + $\pi$/2 is issued.

   If the input value is less than REAL = -0.5773456e+07, the result $\pi$/2 is issued.

   ⇨ The RLO *ENO* is set to signal state FALSE.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is out of range of -1 ... +1, the function sets the RLO signal state *ENO* to TRUE. The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB107 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.8 FC 119 - Arc Cotangent(x) - Arcuscotangent

**Description**

The function FC 119 expects the input value in ACCU 1 as a floating point number.

1. The input value must be within the range between

   -1 (REAL = -0.1000000e+01) ... +1 (REAL = +0.1000000e+01)
2. The function also stores the result in ACCU 1 as a floating point number.
3. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
4. If the input value is greater than REAL = +1.209486e+07, the result +$\pi$/2 is issued.

   If the input value is less than REAL = -0.5773456e+07, the result $\pi$/2 is issued.

   ⇨ The RLO *ENO* is set to signal state FALSE.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is not in the range of -1 ... +1, the function sets the RLO signal state *ENO* to TRUE. The assignment of the remaining registers and the auxiliary flags are not changed.

*This function is only used to convert the FB 108 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.9 FC 120 - Naperian Logarithm ln(x) - Naperian Logarithm

**Description**

The function FC 120 expects the input value in accumulator 1 as a floating point number.

1. The input value must be within the range between

   -1 (REAL = -0.1000000e+01) and +1 (REAL = +0.1000000e+01).
2. The function also stores the result in accumulator 1 as a floating point number.
3. If the calculation is carried out correctly, the RLO is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, the function sets the *ENO* to signal state TRUE (if the input value is less than or equal to zero). In this case, the contents of accumulator 1 remain unchanged. The assignment of the remaining registers and that of the auxiliary flags are not changed.

*This function is only used to convert the FB 109 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.4.10 FC 121 - Decimal Logarithm lg(x) - Decimal Logarithm

**Description**

The function FC 121 expects the input value in accumulator 1 as a bit floating point number.

1. The input value must be within the range between

   -1 (REAL = -0.1000000e+01) and +1 (REAL = +0.1000000e+01).
2. The function also stores the result in accumulator 1 as a floating point number.
3. If the calculation is carried out correctly, the RLO is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, the function sets the *ENO* to signal state TRUE (if the input value is less than or equal to zero). In this case, the contents of accumulator 1 remain unchanged. The assignment of the remaining registers and that of the auxiliary flags are not changed.

*This function is only used to convert the FB 110 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.4.11 FC 122 - Gen. Logarithm to Base b - General Logarithm log (x) to base b

**Description**

The function FC 122 expects both the input value for the base (b) in ACCU 2 and the input value for the antilogarithm (x) in ACCU 1 as floating point numbers.

1. Both input values must be greater than zero and in addition, the base may not have the value +1.
2. If the calculation is carried out correctly, the result is stored in ACCU 1 as a floating point number, the previous contents of ACCU 3 are in ACCU 2, and the previous contents of ACCU 4 are in ACCU 3. The contents of ACCU 4 are not changed. The assignment of the remaining registers and that of the auxiliary flags are not changed.
3. In the case of a calculation without errors, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In case of an error, if one of the input values is less than or equal to zero, or if the base has the value +1, the function sets the link result *ENO* to the signal state TRUE. Then the contents of the ACCUs remain unchanged.

*This function is only used to convert the FB 111 of an existing S5 program to a function of an S7 program programmable controller.*

### 14.4.12 FC 123 - E to Power n - E high n

**Description**

The function FC 123 expects the input value in ACCU 1 as a floating point number.

1. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
2. The function also stores the result in ACCU 1 as a floating point number.
3. If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is not within the range from REAL = -0.8802962e+02 to REAL = +0.8802966e+02 (than the value would be outside the number range), the function sets the RLO *ENO* to signal state TRUE. In this case, the contents of ACCU 1 remain unchanged. The assignment of the auxiliary flags is not changed.

*This function is only used to convert the FB 112 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.4.13 FC 124 - 10 to Power n - 10 high n

**Description**

The function FC 124 expects the input value in ACCU 1 as a floating point number.

1. The input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).
2. The function also stores the result in ACCU 1 as a floating point number.
3. If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

In the event of an error, if the input value is not within the range from -0.3823079e+02 ... REAL = + 0.3823080e+02 (than the value would be outside the number range), the function sets the RLO *ENO* to signal state TRUE. In this case, the contents of ACCU 1 remain unchanged. The assignment of the auxiliary flags is not changed.

*This function is only used to convert the FB 113 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.4.14 FC 125 - ACCU 2 to Power ACCU 1 - ACCU 2 high ACCU 1

**Description**

The function FC 125 expects both the input value for the base in ACCU 2 and the input value for the exponent in ACCU 1 as floating point numbers.

1. The input value for the base must be positive.

   An input value DWORD = DW#16#0000 0000 is treated the same way as the floating point value zero (REAL = +0.0000000e+00 in accordance with DWORD = DW#16#8000 0000).

   For zero high zero the result is zero.
2. The function also stores the result in ACCU 1 as a floating point number.
3. If the calculation is carried out correctly, the RLO *ENO* is FALSE after the function has been called up.

**Parameters**

| Parameter | Declaration | Data Type | Memory Area | Description |
|---|---|---|---|---|
| EN | INPUT | BOOL | I, Q, M, D, L | ■ Enable<br>– TRUE: activates the function<br>– FALSE: deactivates the function |
| ENO | OUTPUT | BOOL | I, Q, M, D, L | ■ Status<br>– TRUE: function executed with error |

**Error information**

If the RLO *ENO* is TRUE, one of the following errors has occurred:

- the input value for the base is less than zero
- a number range overflow occurred during calculation of the function

In the event of an error, the contents of ACCU 1 and 2 remain unchanged.

*This function is only used to convert the FB 114 of an existing S5 program to a function of an S7 program programmable controller.*

## 14.5 PID Control

### 14.5.1 FB 41 - CONT_C - Continuous control

**Description**

FB 41 CONT_C is used to control technical processes with continuous input and output variables. During parameter assignment, you can activate or deactivate subfunctions of the PID controller to adapt the controller to the process.

**Parameters**

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| COM_RST | INPUT | BOOL | COMPLETE RESTART<br>■ The block has a complete restart routine that is processed when the input *COM_RST* is set.<br>■ Default: FALSE |
| MAN_ON | INPUT | BOOL | MANUAL VALUE ON<br>■ If the input *MAN_ON* is set, the control loop is interrupted. A manual value is set as the manipulated value.<br>■ Default: TRUE |
| PVPER_ON | INPUT | BOOL | PROCESS VARIABLE PERIPHERY ON<br>■ If the process variable is read from the I/Os, the input *PV_PER* must be connected to the I/Os and the input *PVPER_ON* must be set.<br>■ Default: FALSE |
| P_SEL | INPUT | BOOL | PROPORTIONAL ACTION ON<br>■ The PID actions can be activated or deactivated individually in the PID algorithm. The P action is on when the input *P_SEL* is set.<br>■ Default: TRUE |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| I_SEL | INPUT | BOOL | INTEGRAL ACTION ON<br>■ The PID actions can be activated or deactivated individually in the PID algorithm. The I action is on when the input *I_SEL* is set.<br>■ Default: TRUE |
| INT_HOLD | INPUT | BOOL | INTEGRAL ACTION HOLD<br>■ The output of the integrator can be "frozen" by setting the input *INT_HOLD*.<br>■ Default: FALSE |
| I_ITL_ON | INPUT | BOOL | INITIALIZATION OF THE INTEGRAL ACTION<br>■ The output of the integrator can be connected to the input *I_ITL_VAL* by setting the input *I_ITL_ON*.<br>■ Default: FALSE |
| D_SEL | INPUT | BOOL | DERIVATIVE ACTION ON<br>■ The PID actions can be activated or deactivated individually in the PID algorithm. The D action is on when the input *D_SEL* is set.<br>■ Default: FALSE |
| CYCLE | INPUT | TIME | SAMPLE TIME<br>■ The time between the block calls must be constant. The *CYCLE* input specifies the time between block calls.<br>■ Default: T#1s<br>■ Range of Values: ≥ 1ms |
| SP_INT | INPUT | REAL | INTERNAL SETPOINT<br>■ The *SP_INT* input is used to specify a setpoint.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[1] |
| PV_IN | INPUT | REAL | PROCESS VARIABLE IN<br>■ An initialization value can be set at the *PV_IN* input or an external process variable in floating point format can be connected.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[1] |
| PV_PER | INPUT | WORD | PROCESS VARIABLE PERIPHERY<br>■ The process variable in the I/O format is connected to the controller at the *PV_PER* input.<br>■ Default: W#16#0000 |
| MAN | INPUT | REAL | MANUAL VALUE<br>■ The *MAN* input is used to set a manual value using the operator interface functions.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[2] |

| **Parameter** | **Declaration** | **Data Type** | **Description** |
|---|---|---|---|
| GAIN | INPUT | REAL | PROPORTIONAL GAIN<br>■ The *GAIN* input specifies the controller gain.<br>■ Default: 2.0<br>■ Range of Values: ≥ CYCLE |
| TI | INPUT | TIME | RESET TIME<br>■ The *TI* input determines the time response of the integrator.<br>■ Default: T#20s<br>■ Range of Values: ≥ CYCLE |
| TD | INPUT | TIME | DERIVATIVE TIME<br>■ The *TD* input determines the time response of the derivative unit.<br>■ Default: T#10s<br>■ Range of Values: ≥ CYCLE |
| TM_LAG | INPUT | TIME | TIME LAG OF THE DERIVATIVE ACTION<br>■ The algorithm of the D action includes a time lag that can be assigned at the *TM_LAG* input.<br>■ Default: T#2s<br>■ Range of Values: ≥ CYCLE/2 |
| DEADB_W | INPUT | REAL | DEAD BAND WIDTH<br>■ A dead band is applied to the error. The *DEADB_W* input determines the size of the dead band.<br>■ Default: 0.0<br>■ Range of Values: ≥ 0.0 (%) or phys. value[1] |
| LMN_HLM | INPUT | REAL | MANIPULATED VALUE HIGH LIMIT<br>■ The manipulated value is always limited by an upper and lower limit. The *LMN_HLM* input specifies the upper limit.<br>■ Default: 100.0<br>■ Range of Values: *LMN_LLM* ...100.0 (%) or phys. value[2] |
| LMN_LLM | INPUT | REAL | MANIPULATED VALUE LOW LIMIT<br>■ The manipulated value is always limited by an upper and lower limit. The *LMN_LLM* input specifies the lower limit.<br>■ Default: 0.0<br>■ Range of Values: -100.0... *LMN_HLM* (%) or phys. value[2] |
| PV_FAC | INPUT | REAL | PROCESS VARIABLE FACTOR<br>■ The *PV_FAC* input is multiplied by the process variable. The input is used to adapt the process variable range.<br>■ Default: 1.0 |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| PV_OFF | INPUT | REAL | PROCESS VARIABLE OFFSET<br>■ The *PV_OFF* input is added to the process variable. The input is used to adapt the process variable range.<br>■ Default: 0.0 |
| LMN_FAC | INPUT | REAL | MANIPULATED VALUE FACTOR<br>■ The *LMN_FAC* input is multiplied by the manipulated value. The input is used to adapt the manipulated value range.<br>■ Default: 1.0 |
| LMN_OFF | INPUT | REAL | MANIPULATED VALUE OFFSET<br>■ The *LMN_OFF* is added to the manipulated value. The input is used to adapt the manipulated value range.<br>■ Default: 0.0 |
| I_ITLVAL | INPUT | REAL | INITIALIZATION VALUE OF THE INTEGRAL ACTION<br>■ The output of the integrator can be set at input *I_ITL_ON*. The initialization value is applied to the input *I_ITLVAL*.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[2] |
| DISV | INPUT | REAL | DISTURBANCE VARIABLE<br>■ For feed forward control, the disturbance variable is connected to input *DISV*.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[2] |
| LMN | OUTPUT | REAL | MANIPULATED VALUE<br>■ The effective manipulated value is output in floating point format at the *LMN* output.<br>■ Default: 0.0 |
| LMN_PER | OUTPUT | WORD | MANIPULATED VALUE PERIPHERY<br>■ The manipulated value in the I/O format is connected to the controller at the *LMN_PER* output.<br>■ Default: W#16#0000 |
| QLMN_HLM | OUTPUT | BOOL | HIGH LIMIT OF MANIPULATED VALUE REACHED<br>■ The manipulated value is always limited to an upper and lower limit. The output *QLMN_HLM* indicates that the upper limit has been exceeded.<br>■ Default: FALSE |
| QLMN_LLM | OUTPUT | BOOL | LOW LIMIT OF MANIPULATED VALUE REACHED<br>■ The manipulated value is always limited to an upper and lower limit. The output *QLMN_LLM* indicates that the lower limit has been exceeded.<br>■ Default: FALSE |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| LMN_P | OUTPUT | REAL | PROPORTIONALITY COMPONENT<br>■ The *LMN_P* output contains the proportional component of the manipulated variable.<br>■ Default: 0.0 |
| LMN_I | OUTPUT | REAL | INTEGRAL COMPONENT<br>■ The *LMN_I* output contains the integral component of the manipulated value.<br>■ Default: 0.0 |
| LMN_D | OUTPUT | REAL | DERIVATIVE COMPONENT<br>■ The *LMN_D* output contains the derivative component of the manipulated value..<br>■ Default: 0.0 |
| PV | OUTPUT | REAL | PROCESS VARIABLE<br>■ The effective process variable is output at the *PV* output.<br>■ Default: 0.0 |
| ER | OUTPUT | REAL | ERROR SIGNAL<br>■ The effective error is output at the *ER* output.<br>■ Default: 0.0 |
| 1) Parameters in the setpoint and process variable branches with the same unit<br>2) Parameters in the manipulated value branch with the same unit | | | |

**Application**

You can use the controller as a PID fixed setpoint controller or in multi-loop controls as a cascade, blending or ratio controller. The functions of the controller are based on the PID control algorithm of the sampling controller with an analog signal, if necessary extended by including a pulse generator stage to generate pulse duration modulated output signals for two or three step controllers with proportional actuators.

Apart from the functions in the setpoint and process value branches, the FB implements a complete PID controller with continuous manipulated variable output and the option of influencing the manipulated value manually.

**Setpoint Branch**

The setpoint is entered in floating-point format at the *SP_INT* input.

**Process Variable Branch**

The process variable can be input in the peripheral (I/O) or floating-point format. The *CRP_IN* function converts the *PV_PER* peripheral value to a floating-point format of -100 to +100 % according to the following formula:

$$Output\ of\ \ CPR\_IN = PV\_PER * \frac{100}{27648}$$

The *PV_NORM* function normalizes the output of *CRP_IN* according to the following formula:

$$Output\ of\ \ PV\_NORM = (Output\ of\ \ CPR\_IN) * PV\_FAC + PV\_OFF$$

*PV_FAC* has a default of 1 and *PV_OFF* a default of 0.

**Error Signal**

The difference between the setpoint and process variable is the error signal. To suppress a small constant oscillation due to the manipulated variable quantization (for example in pulse duration modulation with PULSEGEN), a dead band is applied to the error signal (DEADBAND). If *DEADB_W* = 0, the dead band is switched off.

**PID Algorithm**

The PID algorithm operates as a position algorithm. The proportional, integral (*INT*), and derivative (*DIF*) actions are connected in parallel and can be activated or deactivated individually. This allows P, PI, PD, and PID controllers to be configured. Pure I and D controllers are also possible.

**Manual Value**

It is possible to switch over between a manual and an automatic mode. In the manual mode, the manipulated variable is corrected to a manually selected value. The integrator (*INT*) is set internally to *LMN* - *LMN_P* - *DISV* and the derivative unit (*DIF*) to 0 and matched internally. This means that a switchover to the automatic mode does not cause any sudden change in the manipulated value.

**Manipulated Value**

The manipulated value can be limited to a selected value using the *LMNLIMIT* function. Signaling bits indicate when a limit is exceeded by the input variable. The *LMN_NORM* function normalizes the output of *LMNLIMIT* according to the following formula:

$$LMN = (Output\ of\ LMNLIMIT) * LMN\_FAC + LMN\_OFF$$

*LMN_FAC* has the default 1 and *LMN_OFF* the default 0.

The manipulated value is also available in the peripheral format. The *CRP_OUT* function converts the floating-point value *LMN* to a peripheral value according to the following formula:

$$LMN\_PER = LMN * \frac{27648}{100}$$

**Feedforward Control**

A disturbance variable can be fed forward at the *DISV* input.

**Modes**

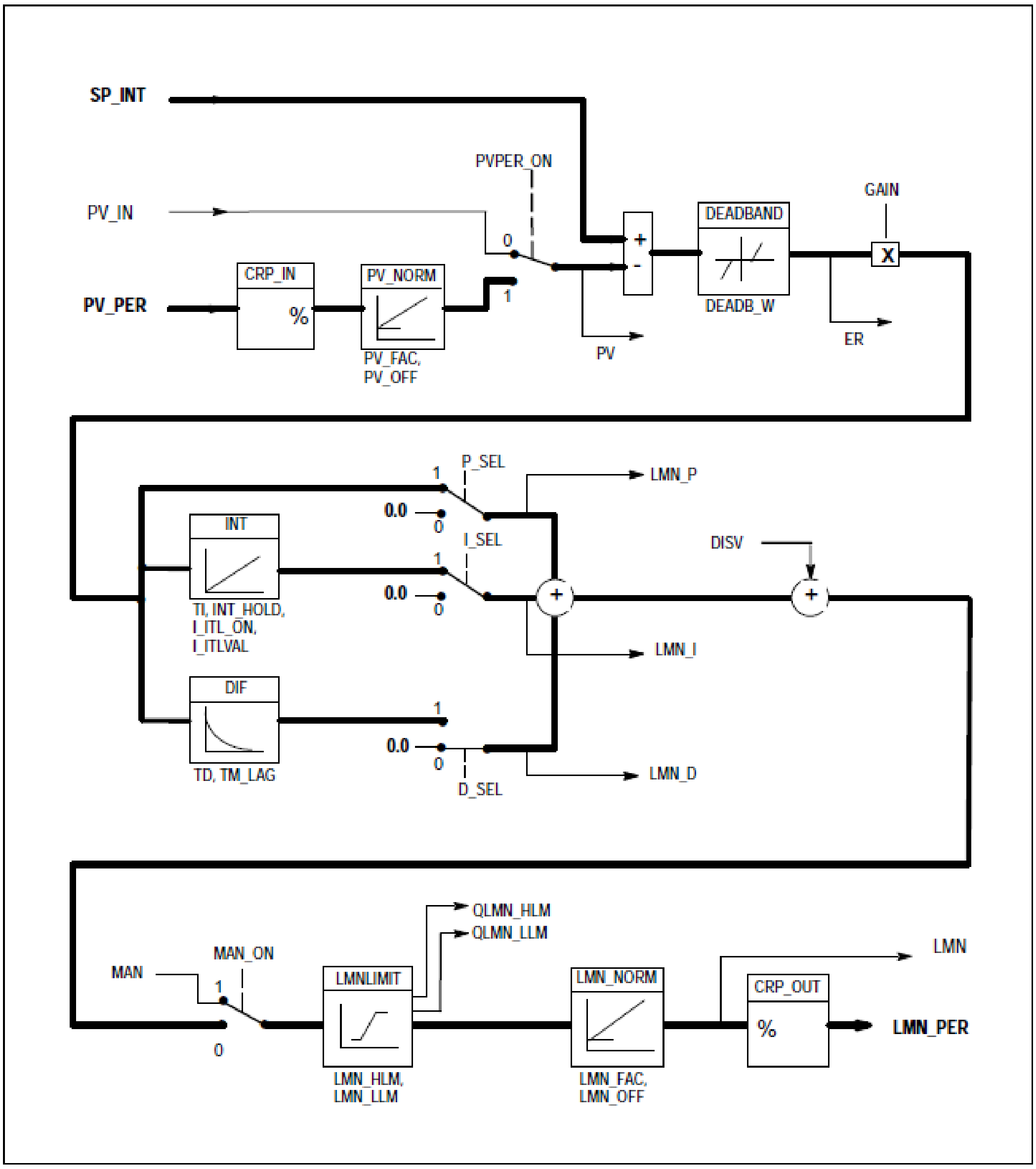
*Complete Restart/Restart*

- FB 41 CONT_C has a complete restart routine that is run through when the input parameter *COM_RST* = TRUE is set.
- During startup, the integrator is set internally to the initialization value *I_ITVAL*. When it is called in a cyclic interrupt priority class, it then continues to work starting at this value.
- All other outputs are set to their default values.

**Error Information**

The block does not check for errors, so no error Information is output.

**Block Diagram**




## 14.5.2 FB 42 - CONT_S - Step Control

**Description**

FB42 CONT_S is used to control technical processes with digital manipulated value output signals for integrating actuators. During parameter assignment, you can activate or deactivate subfunctions of the PI step controller to adapt the controller to the process.

**Parameter**

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| COM_RST | INPUT | BOOL | COMPLETE RESTART<br>■ The block has a complete restart routine that is processed when the input *COM_RST* is set.<br>■ Default: FALSE |
| LMNR_HS | INPUT | BOOL | HIGH LIMIT SIGNAL OF REPEATED MANIPULATED VALUE<br>■ The "actuator at upper limit stop" signal is connected to the *LMNR_HS* input.<br>– *LMNR_HS* = TRUE means the actuator is at upper limit stop.<br>■ Default: FALSE |
| LMNR_LS | INPUT | BOOL | LOW LIMIT SIGNAL OF REPEATED MANIPULATED VALUE<br>■ The "actuator at lower limit stop" signal is connected to the *LMNR_LS* input.<br>– *LMNR_LS* = TRUE means the actuator is at lower limit stop.<br>■ Default: FALSE |
| LMNS_ON | INPUT | BOOL | MANIPULATED SIGNALS ON<br>■ The actuating signal processing is switched to manual at the *LMNS_ON* input..<br>■ Default: FALSE |
| LMNUP | INPUT | BOOL | MANIPULATED SIGNALS UP<br>■ With manual actuating value signals, the output signal *QLMNUP* is set at the input *LMNUP*.<br>■ Default: FALSE |
| LMNDN | INPUT | BOOL | MANIPULATED SIGNALS DOWN<br>■ With manual actuating value signals, the output signal *QLMNDN* is set at the input *LMNDN*.<br>■ Default: FALSE |
| PVPER_ON | INPUT | BOOL | PROCESS VARIABLE PERIPHERY ON<br>■ If the process variable is read in from the I/Os, the input *PV_PER* must be connected to the I/Os and the input *PVPER_ON* must be set.<br>■ Default: FALSE |
| CYCLE | INPUT | TIME | SAMPLE TIME<br>■ The time between the block calls must be constant. The *CYCLE* input specifies the time between block calls.<br>■ Default: T#1s<br>■ Range of Values: ≥ 1ms |
| SP_INT | INPUT | REAL | INTERNAL SETPOINT<br>■ The *SP_INT* input is used to specify a setpoint.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[1] |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| PV_IN | INPUT | REAL | PROCESS VARIABLE IN<br>■ An initialization value can be set at the *PV_IN* input or an external process variable in floating point format can be connected.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[1] |
| PV_PER | INPUT | WORD | PROCESS VARIABLE PERIPHERY<br>■ The process variable in the I/O format is connected to the controller at the *PV_PER* input.<br>■ Default: W#16#0000 |
| GAIN | INPUT | REAL | PROPORTIONAL GAIN<br>■ The *GAIN* input sets the controller gain.<br>■ Default: 2.0<br>■ Range of Values: ≥ *CYCLE* |
| TI | INPUT | TIME | RESET TIME<br>■ The *TI* input determines the time response of the integrator.<br>■ Default: T#20s<br>■ Range of Values: ≥ *CYCLE* |
| DEADB_W | INPUT | REAL | DEAD BAND WIDTH<br>■ A dead band is applied to the error. The *DEADB_W* input determines the size of the dead band.<br>■ Default: 1.0<br>■ Range of Values: 0.0...100.0 (%) or phys. value[1] |
| PV_FAC | INPUT | REAL | PROCESS VARIABLE FACTOR<br>■ The *PV_FAC* input is multiplied by the process variable. The input is used to adapt the process variable range.<br>■ Default: 1.0 |
| PV_OFF | INPUT | REAL | PROCESS VARIABLE OFFSET<br>■ The *PV_OFF* input is added to the process variable. The input is used to adapt the process variable range.<br>■ Default: 0.0 |
| PULSE_TM | INPUT | TIME | MINIMUM PULSE TIME<br>■ A minimum pulse duration can be assigned with the parameter *PULSE_TM*.<br>■ Default: T#3s<br>■ Range of Values: ≥ *CYCLE* |
| BREAK_TM | INPUT | TIME | MINIMUM BREAK TIME<br>■ A minimum break duration can be assigned with the parameter *BREAK_TM*.<br>■ Default: T#3s<br>■ Range of Values: ≥ *CYCLE* |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| MTR_TM | INPUT | TIME | MOTOR MANIPULATED VALUE<br>■ The time required by the actuator to move from limit stop to limit stop is entered at the *MTR_TM* parameter.<br>■ Default: T#30s<br>■ Range of Values: ≥ *CYCLE* |
| DISV | INPUT | REAL | DISTURBANCE VARIABLE<br>■ For feed forward control, the disturbance variable is connected to input *DISV*.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100. 0 (%) or phys. value[2] |
| QLMNUP | OUTPUT | BOOL | MANIPULATED SIGNAL UP<br>■ If the output *QLMNUP* is set, the actuating valve is opened.<br>■ Default: FALSE |
| QLMNDN | OUTPUT | BOOL | MANIPULATED SIGNAL DOWN<br>■ If the output *QLMNDN* is set, the actuating valve is opened.<br>■ Default: FALSE |
| PV | OUTPUT | REAL | PROCESS VARIABLE<br>■ The effective process variable is output at the *PV* output.<br>■ Default: 0.0 |
| ER | OUTPUT | REAL | ERROR SIGNAL<br>■ The effective error is output at the *ER* output.<br>■ Default: 0.0 |
| 1) Parameters in the setpoint and process variable branches with the same unit<br>2) Parameters in the manipulated value branch with the same unit | | | |

**Application**

You can use the controller as a PI fixed setpoint controller or in secondary control loops in cascade, blending or ratio controllers, however not as the primary controller. The functions of the controller are based on the PI control algorithm of the sampling controller supplemented by the functions for generating the binary output signal from the analog actuating signal.

Apart from the functions in the process value branch, the FB implements a complete PI controller with a digital manipulated value output and the option of influencing the manipulated value manually. The step controller operates without a position feedback signal.

**Setpoint Branch**

The setpoint is entered in floating-point format at the *SP_INT* input.

**Process Variable Branch**

The process variable can be input in the peripheral (I/O) or floating-point format. The *CRP_IN* function converts the PV_PER peripheral value to a floating-point format of -100 to +100 % according to the following formula:

$$Output\ of\ CPR\_IN = PV\_PER * \frac{100}{27648}$$

The *PV_NORM* function normalizes the Output of *CRP_IN* following formula:

$$Output\ of\ PV\_NORM = (Output\ of\ CPR\_IN) * PV\_FAC + PV\_OFF$$

*PV_FAC* has a default of 1 and *PV_OFF* a default of 0.

**Error Signal**

The difference between the setpoint and process variable is the error signal. To suppress a small constant oscillation due to the manipulated variable quantization (for example due to a limited resolution of the manipulated value by the actuator valve), a dead band is applied to the error signal (DEADBAND). If *DEADB_W* = 0, the dead band is switched off.

**PI Step Algorithm**

The FB operates without a position feedback signal. The I action of the PI algorithm and the assumed position feedback signal are calculated in one integrator (INT) and compared with the remaining P action as a feedback value. The difference is applied to a three-step element (THREE_ST) and a pulse generator (PULSEOUT) that creates the pulses for the actuator. The switching frequency of the controller can be reduced by adapting the threshold on of the three-step element.

**Feedforward Control**

A disturbance variable can be fed forward at the *DISV* input.

**Modes**

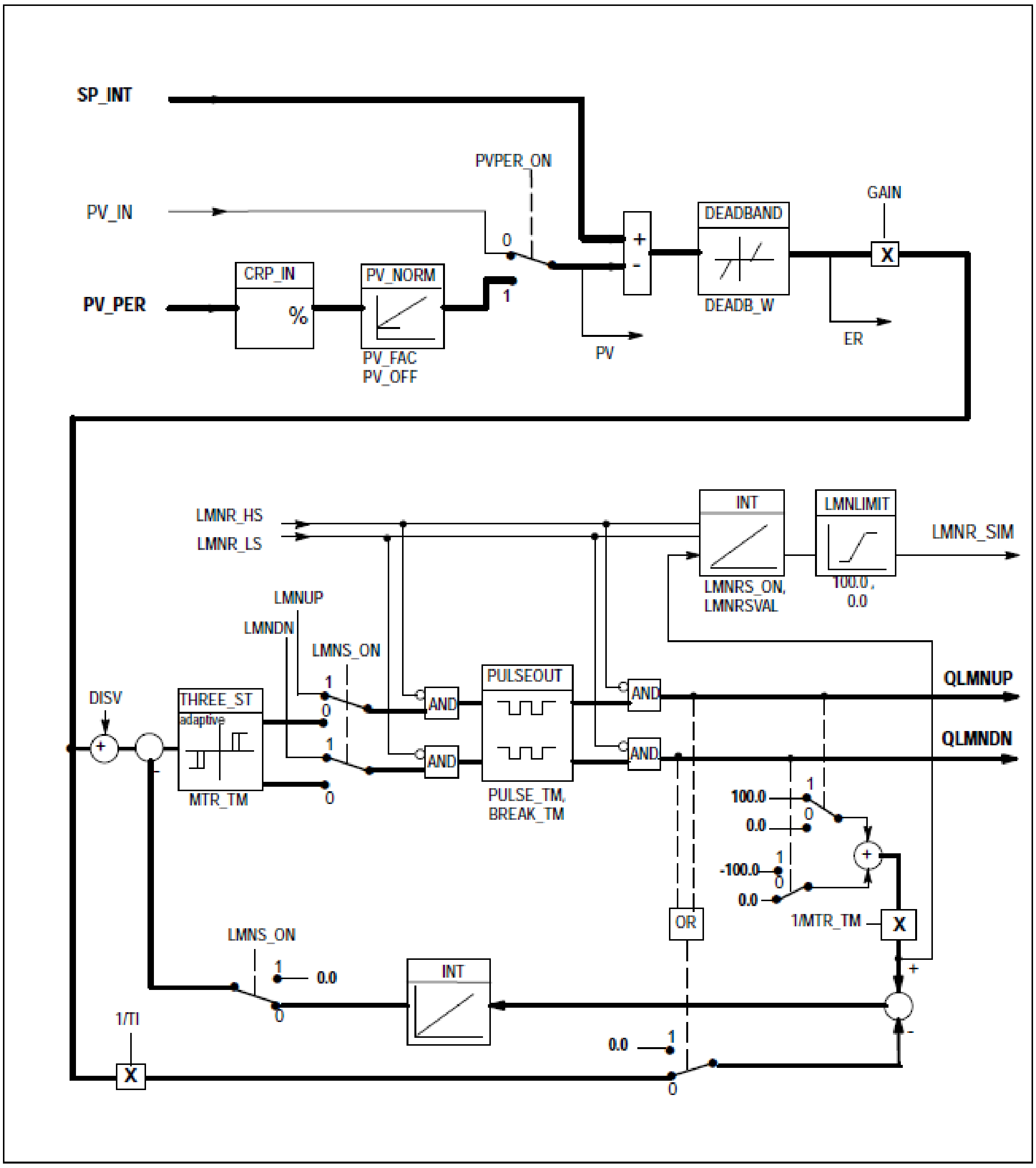
*Complete Restart/Restart*

- FB42 CONT_S has a complete restart routine that is run through when the input parameter *COM_RST* = TRUE is set.
- All other outputs are set to their default values.

**Error Information**

The block does not check for errors, so no error Information is output.

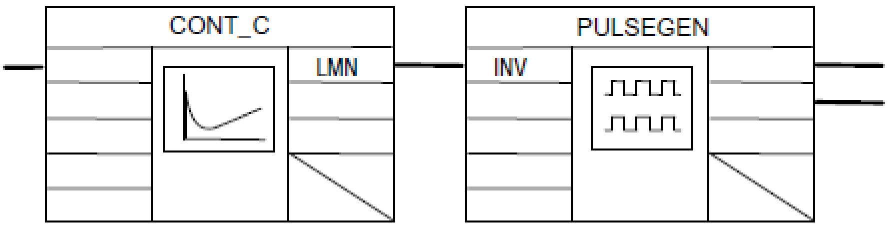
**Block Diagram**




## 14.5.3 FB 43 - PULSGEN - Pulse generation

**Description**

FB 43 PULSEGEN is used to structure a PID controller with pulse output for proportional actuators. Using FB43, PID two or three step controllers with pulse duration modulation can be configured. The function is normally used in conjunction with the continuous controller CONT_C.



**Parameters**

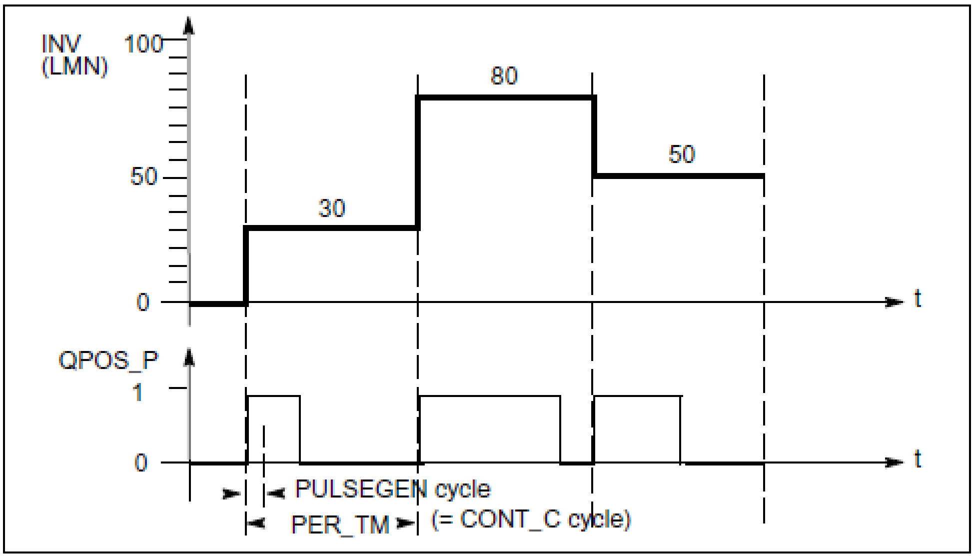
| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| INV | INPUT | REAL | INPUT VARIABLE<br>■ An analog manipulated value is connected to the input parameter *INV*.<br>■ Default: 0.0<br>■ Range of Values: -100.0...100.0 (%) |
| PER_TM | INPUT | TIME | PERIOD TIME<br>■ The constant period of pulse duration modulation is input with the *PER_TM* input parameter. This corresponds to the sampling time of the controller. The ratio between the sampling time of the pulse generator and the sampling time of the controller determines the accuracy of the pulse duration modulation.<br>■ Default: T#1s<br>■ Range of Values: ≥ 20**CYCLE* |
| P_B_TM | INPUT | TIME | MINIMUM PULSE/BREAK TIME<br>■ A minimum pulse or minimum break time can be assigned at the input parameters *P_B_TM*.<br>■ Default: T#50ms<br>■ Range of Values: ≥ *CYCLE* |
| RATIOFAC | INPUT | REAL | RATIO FACTOR<br>■ The input parameter *RATIOFAC* can be used to change the ratio of the duration of negative to positive pulses. In a thermal process, this would, for example, allow different time constants for heating and cooling to be compensated (for example, in a process with electrical heating and water cooling).<br>■ Default: 1.0<br>■ Range of Values: 0.1 ...10.0 |
| STEP3_ON | INPUT | BOOL | THREE STEP CONTROL ON<br>■ The *STEP3_ON* input parameter activates this mode. In three-step control, both output signals are active.<br>■ Default: TRUE |
| ST2BI_ON | INPUT | BOOL | TWO STEP CONTROL FOR BIPOLAR MANIPULATED VALUE RANGE ON<br>■ With the input parameter *ST2BI_ON* you can select between the modes "two-step control for bipolar manipulated value" and "two-step control for monopolar manipulated value range".<br>The parameter *STEP3_ON* = FALSE must be set.<br>■ Default: FALSE |
| MAN_ON | INPUT | BOOL | MANUAL MODE ON<br>■ By setting the input parameter *MAN_ON*, the output signals can be set manually.<br>■ Default: FALSE |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| POS_P_ON | INPUT | BOOL | POSITIVE MODE ON<br>■ In the manual mode with three-step control, the output signal *QPOS_P* can be set at the input parameter *POS_P_ON*. In the manual mode with two-step control, *QNEG_P* is always set inversely to *QPOS_P*.<br>■ Default: FALSE |
| NEG_P_ON | INPUT | BOOL | NEGATIVE PULSE ON<br>■ In the manual mode with three-step control, the output signal *QNEG_P* can be set at the input parameter *NEG_P_ON*. In the manual mode with two-step control, *QNEG_P* is always set inversely to *QPOS_P*.<br>■ Default: FALSE |
| SYN_ON | INPUT | BOOL | SYNCHRONISATION ON<br>■ By setting the input parameter *SYN_ON*, it is possible to synchronize automatically with the block that updates the input variable *INV*. This ensures that a changing input variable is output as quickly as possible as a pulse.<br>■ Default: TRUE |
| COM_RST | INPUT | BOOL | COMPLETE RESTART<br>■ The block has a complete restart routine that is processed when the *COM_RST* input is set.<br>■ Default: FALSE |
| CYCLE | INPUT | TIME | SAMPLE TIME<br>■ The time between block calls must be constant. The *CYCLE* input specifies the time between block calls.<br>■ Default: T#10ms<br>■ Range of Values: ≥ 1ms |
| QPOS_P | OUTPUT | BOOL | OUTPUT POSITIVE PULSE<br>■ The output parameter *QPOS_P* is set when a pulse is to be output. In three-step control, this is always the positive pulse. In two-step control, *QNEG_P* is always set inversely to *QPOS_P*.<br>■ Default: FALSE |
| QNEG_P | OUTPUT | BOOL | OUTPUT NEGATIVE PULSE<br>■ The output parameter *QNEG_P* is set when a pulse is to be output. In three-step control, this is always the negative pulse. In two-step control, *QNEG_P* is always set inversely to *QPOS_P*.<br>■ Default: FALSE |

*The values of the input parameters are not limited in the block. There is no parameter check.*

**Application**

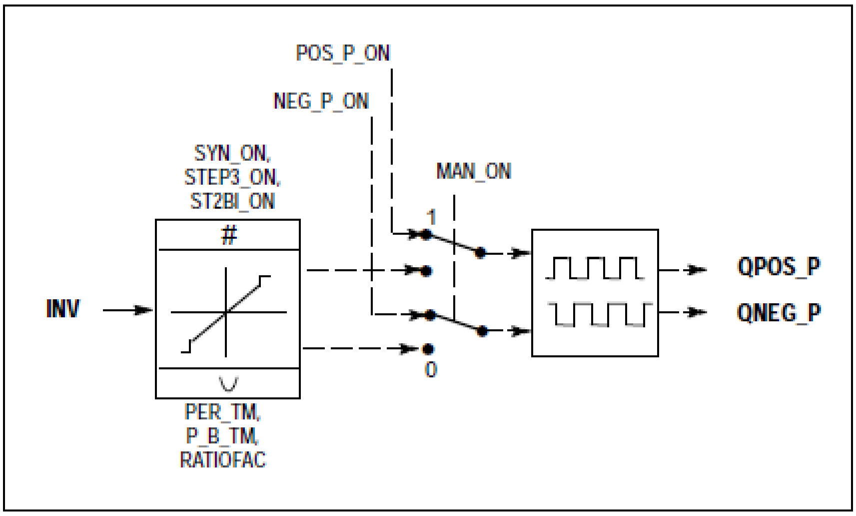
The PULSEGEN function transforms the input variable *INV* ( = manipulated value of the PID controller) by modulating the pulse duration into a pulse train with a constant period, corresponding to the cycle time at which the input variable is updated and which must be assigned in *PER_TM*. The duration of a pulse per period is proportional to the input variable. The cycle assigned to *PER_TM* is not identical to the processing cycle of the FB PULSEGEN. The *PER_TM* cycle is made up of several processing cycles of FB PULSEGEN, whereby the number of FB PULSEGEN calls per *PER_TM* cycle is the yardstick for the accuracy of the pulse duration modulation.




An input variable of 30% and 10 FB PULSEGEN calls per *PER_TM* means the following:

- "1" at the *QPOS* output for the first three calls of FB PULSEGEN (30% of 10 calls)
- "0" at the *QPOS* output for seven further calls of FB PULSEGEN (70% of 10 calls)

**Block Diagram**




**Accuracy of the Manipulated Value**

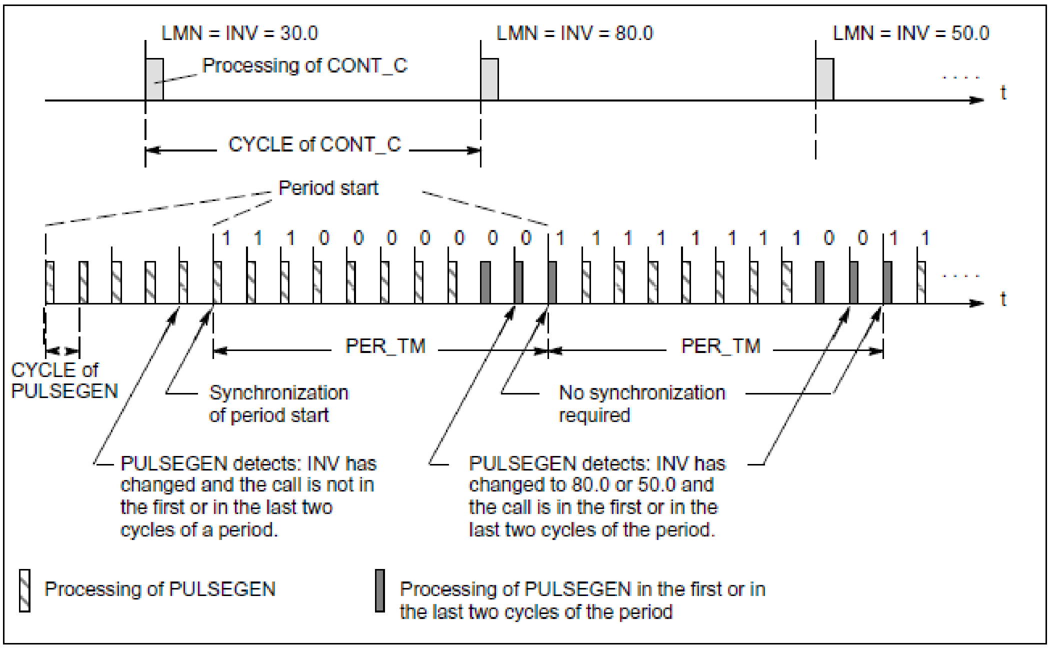
With a "sampling ratio" of 1:10 (CONT_C calls to PULSEGEN calls) the accuracy of the manipulated value in this example is restricted to 10 %, in other words, set input values *INV* can only be simulated by a pulse duration at the *QPOS* output in steps of 10 %. The accuracy is increased as the number of FB PULSEGEN calls per CONT_C call is increased. If PULSEGEN is called, for example 100 times more often than CONT_C, a resolution of 1 % of the manipulated value range is achieved.

*The call frequency must be programmed by the user.*

**Automatic Synchronization**

It is possible to synchronize the pulse output with the block that updates the input variable *INV* (for example CONT_C). This ensures that a change in the input variable is output as quickly as possible as a pulse. The pulse generator evaluates the input value *INV* at intervals corresponding to the period *PER_TM* and converts the value into a pulse signal of corresponding length. Since, however, *INV* is usually calculated in a slower cyclic interrupt class, the pulse generator should start the conversion of the discrete value into a pulse signal as soon as possible after the updating of *INV*. To allow this, the block can synchronize the start of the period using the following procedure:

- If *INV* changes and if the block call is not in the first or last two call cycles of a period, the synchronization is performed. The pulse duration is recalculated and in the next cycle is output with a new period.




The automatic synchronization can be disabled at the *SYN_ON* input (= FALSE).

*With the beginning of a new period, the old value of INV (in other words, of LMN) is simulated in the pulse signal more or less accurately following the synchronization.*

**Modes**

Depending on the parameters assigned to the pulse generator, PID controllers with a three-step output or with a bipolar or monopolar two-step output can be configured. The following table illustrates the setting of the switch combinations for the possible modes.

| Mode | Switch | | |
|---|---|---|---|
| | MAN_ON | STEP3_ON | ST2BI_ON |
| Three-step control | FALSE | TRUE | Any |
| Two-step control with bipolar control range (-100 % to +100 %) | FALSE | FALSE | TRUE |
| Two-step control with monopolar control range (0 % ... 100 %) | FALSE | FALSE | FALSE |
| Manual mode | TRUE | Any | Any |

**Three-Step Control**

In the three-step control mode, the actuating signal can adopt three states. The values of the binary output signals *QPOS_P* and *QNEG_P* are assigned to the statuses of the actuator. The table shows the example of a temperature control:

| Output signal | Actuator | | |
|---|---|---|---|
| | Heat | Off | Cool |
| QPOS_P | TRUE | FALSE | FALSE |
| QNEG_P | FALSE | FALSE | TRUE |

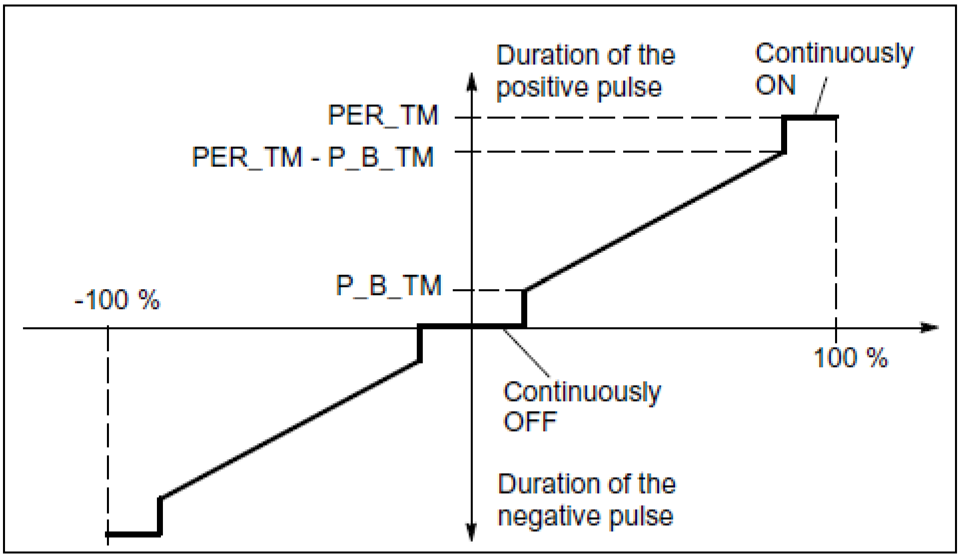
Based on the input variable, a characteristic curve is used to calculate a pulse duration. The form of the characteristic curve is defined by the minimum pulse or minimum break time and the ratio factor. The normal value for the ratio factor is 1. The “doglegs” in the curves are caused by the minimum pulse or minimum break times.

- *Minimum Pulse or Minimum Break Time*
  A correctly assigned minimum pulse or minimum break time *P_B_TM* can prevent short on/off times that reduce the working life of switching elements and actuators.

> *Small absolute values at the input variable LMN that could otherwise generate a pulse duration shorter than P_B_TM are suppressed. Large input values that would generate a pulse duration longer than (PER_TM - P_B_TM) are set to 100 % or -100 %.*

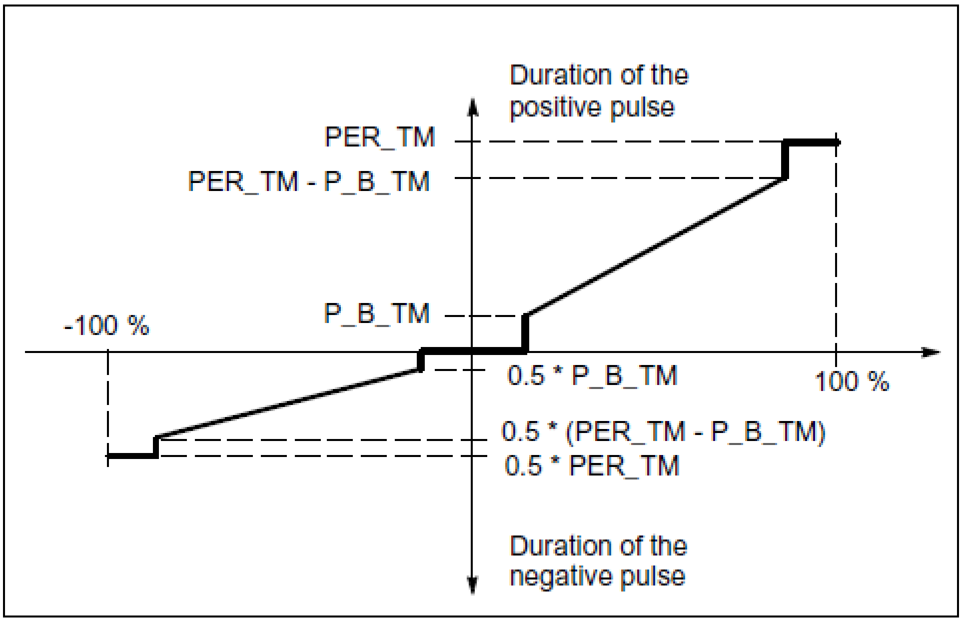
The positive and negative pulse duration is calculated by multiplying the input variable (in %) with the period time:

$$Pulse\ duration = \frac{INV}{100} * PER\_TM$$




**Three-Step Control Asymmetrical**

Using the ratio factor *RATIOFAC*, the ratio of the duration of positive to negative pulses can be changed. In a thermal process, for example, this would allow different system time constants for heating and cooling. The ratio factor also influences the minimum pulse or minimum break time. A ratio factor < 1 means that the threshold value for negative pulses is multiplied by the ratio factor.




- *Ratio Factor < 1*
  The pulse duration at the negative pulse output calculated from the input variable multiplied by the period time is reduced by the ratio factor.

$$\text{Duration of the positive pulse} = \frac{INV}{100} * PER\_TM$$

$$\text{Duration of the negative pulse} = \frac{INV}{100} * PER\_TM * RATIOFAC$$

- *Ratio Factor > 1*
  The pulse duration at the positive pulse output calculated from the input variable multiplied by the period time is reduced by the ratio factor.

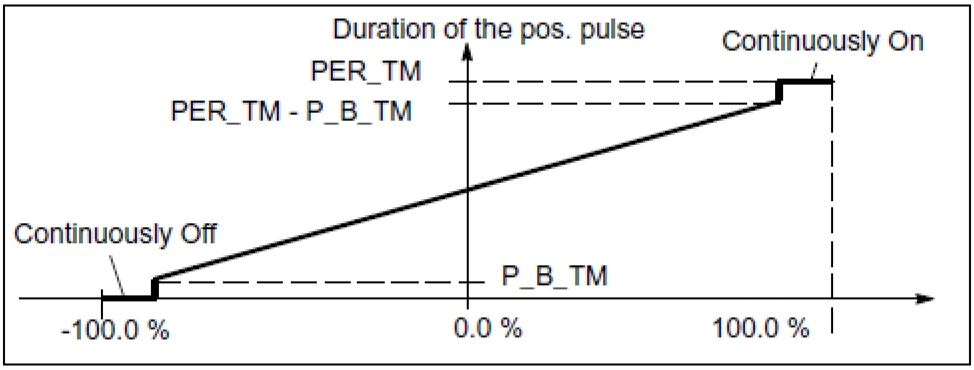
$$Duration\ of\ the\ negative\ pulse = \frac{INV}{100} * PER\_TM$$

$$Duration\ of\ the\ positive\ pulse = \frac{INV}{100} * \frac{PER\_TM}{RATIOFAC}$$

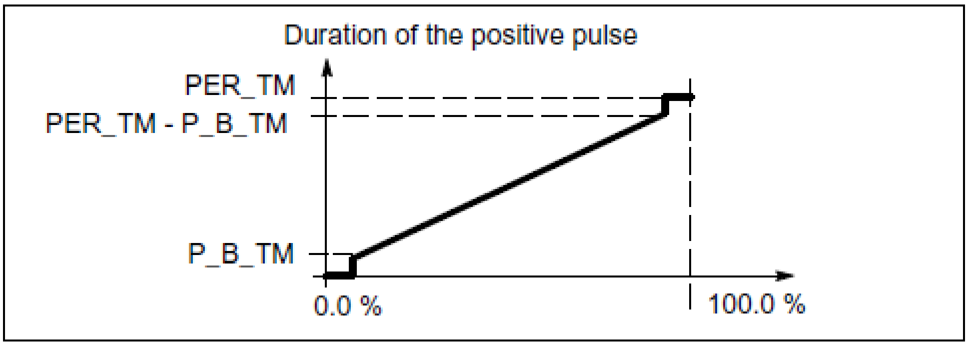
**Two-Step Control**

In two-step control, only the positive pulse output *QPOS_P* of PULSEGEN is connected to the on/off actuator. Depending on the manipulated value range being used, the two-step controller has a bipolar or a monopolar manipulated value range.

- *Two-Step Control with Bipolar Manipulated Variable Range (-100 % to 100 %)*




- *Two-Step Control with Monopolar Manipulated Variable Range (0 % to 100 %)*




The negated output signal is available at *QNEG_P* if the connection of the two-step controller in the control loop requires a logically inverted binary signal for the actuating pulses.

| Pulse | Actuator | |
|---|---|---|
| | On | Off |
| QPOS_P | TRUE | FALSE |
| QNEG_P | FALSE | TRUE |

**Manual Mode in Two/ Three-Step Control**

In the manual mode (*MAN_ON* = TRUE), the binary outputs of the three-step or two-step controller can be set using the signals *POS_P_ON* and *NEG_P_ON* regardless of *INV*.

| | POS_P_ON | NEG_P_ON | QPOS_P | QNEG_P |
|---|---|---|---|---|
| Three-step control | FALSE | FALSE | FALSE | FALSE |
| | TRUE | FALSE | TRUE | FALSE |
| | FALSE | TRUE | FALSE | TRUE |
| | TRUE | TRUE | FALSE | FALSE |
| Two-step control | FALSE | Any | FALSE | TRUE |
| | TRUE | Any | TRUE | FALSE |

**Modes**

*Complete Restart/Restart*

- During a complete restart, all the signal outputs are set to 0.

**Error Information**

The block does not check for errors, so no error Information is output.

### 14.5.4 FB 58 - TCONT_CP - Continuous Temperature Control

**Description**

FB 58 TCONT_CP is used to control temperature processes with continuous or pulsed control signals. You can set parameters to enable or disable subfunctions of the PID controller and adapt it to the process.

**Parameters**

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| PV_IN | INPUT | REAL | PROCESS VARIABLE IN<br>■ An initialization value can be set at the *PV_IN* input or an external process variable in floating-point format can be connected.<br>■ Default: 0.0<br>■ Dependent on the sensors used |
| PV_PER | INPUT | WORD | PROCESS VARIABLE PERIPHERY<br>■ The process variable in the peripheral I/O format is connected to the controller at the *PV_PER* input.<br>■ Default: 0 |
| DISV | INPUT | REAL | DISTURBANCE VARIABLE<br>■ For feed forward control, the disturbance variable is connected to the *DISV* input.<br>■ Default: 0.0 |
| INT_HPOS | INPUT | BOOL | INTEGRAL ACTION HOLD IN POSITIVE DIRECTION<br>■ The output of the integral action can be blocked in a positive direction. To achieve this, the *INT_HPOS* input must be set to TRUE. In a cascade control, the *INT_HPOS* of the primary controller is interconnected to *QLMN_HLM* of the secondary controller.<br>■ Default: FALSE |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| INT_HNEG | INPUT | BOOL | INTEGRAL ACTION HOLD IN NEGATIVE DIRECTION<br>■ The output of the integral action can be blocked in a positive direction. To achieve this, the *INT_HPOS* input must be set to TRUE. In a cascade control, the *INT_HPOS* of the primary controller is interconnected to *QLMN_HLM* of the secondary controller.<br>■ Default: FALSE |
| SELECT | INPUT | BOOL | SELECTION OF CALL PID AND PULSE GENERATOR<br>■ If the pulse generator is activated, there are several ways of calling the PID algorithm and pulse generator:<br>– *SELECT* = 0: The controller is called in a fast cyclic interrupt level and the PID algorithm and pulse generator are processed.<br>– *SELECT* = 1: The controller is called in OB1 and only the PID algorithm is processed.<br>– *SELECT* = 2: The controller is called in a fast cyclic interrupt level and only the pulse generator is processed.<br>– *SELECT* = 3: The controller is called in a slow cyclic interrupt level only the PID algorithm is processed.<br>■ Default: 0<br>■ Range of Values: 0 ... 3 |
| PV | OUTPUT | REAL | PROCESS VARIABLE<br>■ The effective process variable is output at the *PV* output.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| LMN | OUTPUT | REAL | MANIPULATED VALUE<br>■ The effective value of the manipulated variable is output in floating-point format at the *LMN* output.<br>■ Default: 0.0 |
| LMN_PER | OUTPUT | WORD | MANIPULATED VALUE PERIPHERY<br>■ The value of the manipulated variable in the peripheral format is connected to the controller at the *LMN_PER* output.<br>■ Default: 0 |
| QPULSE | OUTPUT | BOOL | QUTPUT PULSE SIGNAL<br>■ The value of the manipulated variable is output pulse duration modulated at the *QPULSE* output.<br>■ Default: FALSE |
| QLMN_HLM | OUTPUT | BOOL | HIGH LIMIT OF MANIPULATED VALUE REACHED<br>■ The value of the manipulated variable is always limited to an upper and lower limit. The *QLMN_HLM* output indicates when the upper limit is exceeded.<br>■ Default: FALSE |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| QLMN_LLM | OUTPUT | BOOL | LOW LIMIT OF MANIPULATED VALUE REACHED<br>■ The value of the manipulated variable is always limited to an upper and lower limit. The *QLMN_LLM* output indicates when the lower limit is exceeded.<br>■ Default: FALSE |
| QC_ACT | OUTPUT | BOOL | NEXT CYCLE, THE CONTINUOUS CONTROLLER IS WORKING<br>■ This parameter indicates whether or not the continuous controller stage will be executed at the next block call (relevant only when *SELECT* has the value 0 or 1).<br>■ Default: TRUE |
| CYCLE | INPUT/ OUTPUT | REAL | SAMPLE TIME OF CONTINUOUS CONTROLLER [s]<br>■ This sets the sampling time for the PID algorithm. The tuner calculates the sampling time in Phase 1 and enters this in *CYCLE*.<br>■ Default: 0.1s<br>■ Range of Values: ≥ 1ms |
| CYCLE_P | INPUT/ OUTPUT | REAL | SAMPLE TIME OF PULSE GENERATOR [s]<br>■ At this input, you enter the sampling time for the pulse generator stage. FB 58 "TCONT_CP" calculates the sampling time in Phase 1 and enters it in *CYCLE_P*.<br>■ Default: 0.2s<br>■ Range of Values: ≥ 1ms |
| SP_INT | INPUT/ OUTPUT | REAL | INTERNAL SETPOINT<br>■ The *SP_INT* input is used to specify a setpoint.<br>■ Default: 0.0<br>■ Range of Values: Value range of the process value |
| MAN | INPUT/ OUTPUT | REAL | MANUAL VALUE<br>■ The *MAN* input is used to specify a manual value. In automatic mode, it is corrected to the manipulated variable.<br>■ Default: 0.0 |
| COM_RST | INPUT/ OUTPUT | REAL | COMPLETE RESTART<br>■ The block has an initialization routine that is processed when the *COM_RST* input is set.<br>■ Default: FALSE |
| MAN_ON | INPUT/ OUTPUT | REAL | MANUAL OPERATION ON<br>■ If the *MAN_ON* input is set, the control loop is interrupted. The MAN manual value is set as the value of the manipulated variable.<br>■ Default: TRUE |

**Internal Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| DEADB_W | INPUT | REAL | DEAD BAND WIDTH<br>■ The error passes through a dead band. The *DEADB_W* input decides the size of the dead band.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| I_ITLVAL | INPUT | REAL | INITIALIZATION VALUE OF THE INTEGRAL ACTION<br>■ The output of the integral action can be set at the *I_ITL_ON* input. The initialization value is applied to the *I_ITLVAL* input.<br>■ During a restart *COM_RST* = TRUE, the I action is set to the initialization value.<br>■ Default: 0.0<br>■ Range of Values: 0 to 100 % |
| LMN_HLM | INPUT | REAL | MANIPULATED VARIABLE HIGH LIMIT<br>■ The value of the manipulated variable is always limited to an upper and lower limit. The *LMN_HLM* input specifies the upper limit.<br>■ Default: 100.0<br>■ Range of Values: > *LMN_ LLM* |
| LMN_LLM | INPUT | REAL | MANIPULATED VARIABLE LOW LIMIT<br>■ The value of the manipulated variable is always limited to an upper and lower limit. The *LMN_LLM* input specifies the lower limit.<br>■ Default: 0.0<br>■ Range of Values: < *LMN_HLM* |
| PV_FAC | INPUT | REAL | PROCESS VARIABLE FACTOR<br>■ The *PV_FAC* input is multiplied by the *PV_PER*. The input is used to adapt the process variable range.<br>■ Default: 1.0 |
| PV_OFFS | INPUT | REAL | PROCESS VARIABLE OFFSET<br>■ The *PV_OFFS* input is added to the *PV_PER*. The input is used to adapt the process variable range.<br>■ Default: 0.0 |
| LMN_FAC | INPUT | REAL | MANIPULATED VARIABLE FACTOR<br>■ The *LMN_FAC* input is multiplied by the manipulated variable. The input is used to adapt the manipulated variable range.<br>■ Default: 1.0 |
| LMN_OFFS | INPUT | REAL | MANIPULATED VARIABLE OFFSET<br>■ The *LMN_OFFS* input is added to the value of the manipulated variable. The input is used to adapt the manipulated variable range.<br>■ Default: 0.0 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| PER_TM | INPUT | REAL | PERIOD TIME [s]<br>■ The pulse repetition period of the pulse duration modulation is entered at the *PER_TM* parameter. The relationship of the pulse repetition period to the sampling time of the pulse generator decides the accuracy of the pulse duration modulation.<br>■ Default: 1.0 s<br>■ Range of Values: ≥ *CYCLE* |
| P_B_TM | INPUT | REAL | MINIMUM PULSE/BREAK TIME [s]<br>■ A minimum pulse or minimum break time can be set at the *P_B_TM* parameter. *P_B_TM* is limited internally to > *CYCLE_P*.<br>■ Default: 0.02 s<br>■ Range of Values: ≥ 0.0 |
| TUN_DLMN | INPUT | REAL | DELTA MANIPULATED VARIABLE FOR PROCESS EXCITATION<br>■ Process excitation for controller tuning results from a setpoint step change at *TUN_DLMN*.<br>■ Default: 20.0<br>■ Range of Values: -100.0 ... 100.0 % |
| PER_MODE | INPUT | INT | PERIPHERY MODE<br>■ You can enter the type of the I/O module at this switch. The process variable at input *PV_PER* is then normalized to °C at the *PV* output.<br>– *PER_MODE* = 0: standard<br>– *PER_MODE* = 1: climate<br>– *PER_MODE* = 2: current/voltage<br>■ Default: 0<br>■ Range of Values: 0, 1, 2 |
| PVPER_ON | INPUT | BOOL | PROCESS VARIABLE PERIPHERY ON<br>■ If you want the process variable to be read in from the I/O, the *PV_PER* input must be connected to the I/O and the *PVPER_ON* input must be set.<br>■ Default: FALSE |
| I_ITL_ON | INPUT | BOOL | INITIALIZATION OF THE INTEGRAL ACTION ON<br>■ The output of the integral action can be set to the *I_ITLVAL* input. The *I_ITL_ON* input must be set.<br>■ Default: FALSE |
| PULSE_ON | INPUT | BOOL | PULSE GENERATOR ON<br>■ If *PULSE_ON* = TRUE is set, the pulse generator is activated<br>■ Default: FALSE |
| TUN_KEEP | INPUT | BOOL | KEEP TUNING ON<br>■ The mode changes to automatic only when *TUN_KEEP* changes to FALSE.<br>■ Default: FALSE |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| ER | OUTPUT | REAL | ERROR SIGNAL<br>■ The effective error is output at the *ER* output.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| LMN_P | OUTPUT | REAL | PROPORTIONALITY COMPONENT<br>■ The *LMN_P* contains the proportional action of the manipulated variable.<br>■ Default: 0.0 |
| LMN_I | OUTPUT | REAL | INTEGRAL COMPONENT<br>■ The *LMN_I* contains the integral action of the manipulated variable.<br>■ Default: 0.0 |
| LMN_D | OUTPUT | REAL | DERIVATIVE COMPONENT<br>■ The *LMN_D* contains the derivative action of the manipulated variable.<br>■ Default: 0.0 |
| PHASE | OUTPUT | INT | PHASE OF SELF TUNING<br>■ The current phase of the controller tuning is indicated at the *PHASE* output (0...7).<br>■ Default: 0<br>■ Range of Values: 0, 1, 2, 3, 4, 5, 7 |
| STATUS_H | OUTPUT | INT | STATUS HEATING OF SELF TUNING<br>■ *STATUS_H* indicates the diagnostic value of the search for the point of inflection when heating.<br>■ Default: 0 |
| STATUS_D | OUTPUT | INT | STATUS CONTROLLER DESIGN OF SELF TUNING<br>■ *STATUS_D* indicated the diagnostic value of the controller design when heating.<br>■ Default: 0 |
| QTUN_RUN | OUTPUT | BOOL | TUNING IS ACTIVE (PHASE 2)<br>■ The tuning manipulated variable has been applied, tuning has started and is still in phase 2 (locating the point of inflection).<br>■ Default: 0 |
| PI_CON | OUTPUT | STRUCT | PI CONTROLLER PARAMETERS |
| GAIN | OUTPUT | REAL | PI PROPORTIONAL GAIN<br>■ Default: 0.0<br>■ Range of Values: % / phys. unit |
| TI | OUTPUT | REAL | PI RESET TIME [s]<br>■ Default: 0.0 s<br>■ Range of Values: ≥ 0.0 s |
| PID_CON | OUTPUT | STRUCT | PID CONTROLLER PARAMETERS/ PID Reglerparameter |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| GAIN | OUTPUT | REAL | PID PROPORTIONAL GAIN<br>■ Default: 0.0 |
| TI | OUTPUT | REAL | PID RESET TIME [s<br>■ Default: 0.0 s<br>■ Range of Values: ≥ 0.0 s |
| TD | OUTPUT | REAL | PID DERIVATIVE TIME [s]<br>■ Default: 0.0 s<br>■ Range of Values: ≥ 0.0 s |
| PAR_SAVE | OUTPUT | STRUCT | SAVED CONTROLLER PARAMETERS<br>■ The PID parameters are saved in this structure. |
| PFAC_SP | INPUT/ OUTPUT | REAL | PROPORTIONAL FACTOR FOR SETPOINT CHANGES<br>■ Default: 1.0<br>■ Range of Values: 0.0 ... 1.0 |
| GAIN | OUTPUT | REAL | PROPORTIONAL GAIN<br>■ Default: 0.0<br>■ Range of Values: % / phys. unit |
| TI | INPUT/ OUTPUT | REAL | RESET TIME [s]<br>■ Default: 40.0 s<br>■ Range of Values: ≥ 0.0 s |
| TD | INPUT/ OUTPUT | REAL | DERIVATIVE TIME [s]<br>■ Default: 10.0 s<br>■ Range of Values: ≥ 0.0 s |
| D_F | OUTPUT | REAL | DERIVATIVE FACTOR<br>■ Default: 5.0<br>■ Range of Values: 5.0 ... 10.0 |
| CON_ZONE | OUTPUT | REAL | CONTROL ZONE ON<br>■ Default: 100.0<br>■ Range of Values: ≥ 0.0 |
| CONZ_ON | OUTPUT | REAL | CONTROL ZONE<br>■ Default: FALSE |
| PFAC_SP | INPUT/ OUTPUT | REAL | PROPORTIONAL FACTOR FOR SETPOINT CHANGES<br>■ *PFAC_SP* specifies the effective P action when there is a setpoint change. This is set between 0 and 1.<br>– 1: P action has full effect if the setpoint changes.<br>– 0: P action has no effect if the setpoint changes.<br>■ Default: 1.0<br>■ Range of Values: 0.0 ... 1.0 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| GAIN | INPUT/ OUTPUT | REAL | PROPORTIONAL GAIN<br>■ The *GAIN* input specifies the controller gain. The direction of control can be reversed by giving GAIN a negative sign.<br>■ Default: 0.0<br>■ Range of Values: % / phys. Value |
| TI | INPUT/ OUTPUT | REAL | RESET TIME [s]<br>■ The *TI* input (integral time) decides the integral action response.<br>■ Default: 40.0 s<br>■ Range of Values: ≥ 0.0 s |
| TD | INPUT/ OUTPUT | REAL | DERIVATIVE TIME [s]<br>■ The *TD* input decides the derivative action response.<br>■ Default: 10.0 s<br>■ Range of Values: ≥ 0.0 s |
| D_F | INPUT/ OUTPUT | REAL | DERIVATIVE FACTOR<br>■ The derivative factor *D_F* decides the lag of the D-action.<br>– *D_F* = derivative time / "lag of the D-action"<br>■ Default: 5.0<br>■ Range of Values: 5.0 ... 10.0 |
| CON_ZONE | INPUT/ OUTPUT | REAL | CONTROL ZONE ON<br>■ If the error is greater than the control zone width *CON_ZONE*, the upper manipulated variable limit is output as the manipulated variable.<br>■ If the error is less than the negative control zone width, the lower manipulated variable limit is output as the manipulated variable.<br>■ Default: 100.0<br>■ Dependent on the sensors used |
| CONZ_ON | INPUT/ OUTPUT | BOOL | CONTROL ZONE<br>■ *CONZ_ON* =TRUE activates the control zone.<br>■ Default: FALSE |
| TUN_ON | INPUT/ OUTPUT | BOOL | SELF TUNING ON<br>■ If *TUN_ON* = TRUE is set, the manipulated value is averaged until the manipulated variable excitation *TUN_DLMN* is activated either by a setpoint step change or by *TUN_ST* = TRUE.<br>■ Default: FALSE |
| TUN_ST | INPUT/ OUTPUT | BOOL | START SELF TUNING<br>■ If the setpoint is to remain constant during controller tuning at the operating point, a manipulated variable step change by the amount of *TUN_DLMN* is activated by *TUN_ST* = TRUE.<br>■ Default: FALSE |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| UNDO_PAR | INPUT/ OUTPUT | BOOL | UNDO CHANGE OF CONTROLLER PARAMETERS<br>■ Loads the controller parameters *PFAC_SP*, *GAIN*, *TI*, *TD*, *D_F*, *CONZ_ON* and *CON_ZONE* from the data structure *PAR_SAVE* (only in manual mode).<br>■ Default: FALSE |
| SAVE_PAR | INPUT/ OUTPUT | BOOL | SAVE CURRENT CONTROLLER PARAMETERS<br>■ Saves the controller parameters *PFAC_SP*, *GAIN*, *TI*, *TD*, *D_F*, *CONZ_ON* and *CON_ZONE* in the data structure *PAR_SAVE*.<br>■ Default: FALSE |
| LOAD_PID | INPUT/ OUTPUT | BOOL | LOAD OPTIMIZED PI/PID PARAMETERS<br>■ Loads the controller parameters *GAIN*, *TI*, *TD* depending on *PID_ON* from the data structure *PI_CON* or *PID_CON* (only in manual mode)<br>■ Default: FALSE |
| PID_ON | INPUT/ OUTPUT | BOOL | PID MODE ON<br>■ At the *PID_ON* input, you can specify whether or not the tuned controller will operate as a PI or PID controller.<br>– PID controller: *PID_ON* = TRUE<br>– PI controller: *PID_ON* = FALSE<br>■ It is nevertheless possible that with certain process types, only a PI controller will be designed despite *PID_ON* = TRUE.<br>■ Default: TRUE |
| GAIN_P | OUTPUT | REAL | PROZESS PROPORTIONAL GAIN<br>■ Identified process gain. For the process type I, *GAIN_P* tends to be estimated too low.<br>■ Default: 0.0 |
| TU | OUTPUT | REAL | DELAY TIME [s]<br>■ Identified delay of the process.<br>■ Default: 0.0<br>■ Range of Values: ≥ 3**CYCLE* |
| TA | OUTPUT | REAL | RECOVERY TIME [s]<br>■ Identified system time constant of the process. For the process type I, *TA* tends to be estimated too low.<br>■ Default: 0.0 |
| KIG | OUTPUT | REAL | MAXIMAL ASCENT RATIO OF PV WITH 100 % LMN CHANGE<br>■ *GAIN_P* = 0.01 * *KIG* * *TA*<br>■ Default: 0.0 |
| N_PTN | OUTPUT | REAL | PROCESS ORDER<br>■ The parameter specifies the order of the process. "Non-integer values" are also possible.<br>■ Default: 0.0<br>■ Range of Values: 1.01 to 10.0 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| TM_LAG_P | OUTPUT | REAL | TIME LAG OF PTN MODEL [s]<br>■ Time lag of PTN model (values only for *N_PTN* ≥ 2).<br>■ Default: 0.0 |
| T_P_INF | OUTPUT | REAL | TIME TO POINT OF INFLECTION [s]<br>■ Time from process excitation until the point of inflection.<br>■ Default: 0.0 |
| P_INF | OUTPUT | REAL | PV AT POINT OF INFLECTION - PV0<br>■ Process variable change from process excitation until the point of inflection.<br>■ Default: 0.0<br>■ Range of Values: Value range of the process value |
| LMN0 | OUTPUT | REAL | MANIPULATED VAR. AT BEGIN OF TUNING<br>■ Detected in phase 1 (mean value).<br>■ Default: 0.0<br>■ Range of Values: 0 ... 100 % |
| PV0 | OUTPUT | REAL | PROCESS VALUE AT BEGIN OF TUNING<br>■ Default: 0.0<br>■ Range of Values: Value range of the process value |
| PVDT0 | OUTPUT | REAL | RATE OF CHANGE OF PV AT BEGIN OF TUNING [1/s]<br>■ Sign adapted<br>■ Default: 0.0 |
| PVDT | OUTPUT | REAL | CURRENT RATE OF CHANGE OF PV [1/s]<br>■ Sign adapted<br>■ Default: 0.0 |
| PVDT_MAX | OUTPUT | REAL | MAX. RATE OF CHANGE OF PV PER SECOND [1/s]<br>■ Maximum rate of change of the process variable at the point of inflection at the (sign adapted, always > 0), used to calculate *TU* and *KIG*.<br>■ Default: 0.0 |
| NOI_PVDT | OUTPUT | REAL | RATIO OF NOISE IN PVDT_MAX IN %<br>■ The higher the proportion of noise, less accurate (less aggressive) the control parameters.<br>■ Default: 0.0 |
| NOISE_PV | OUTPUT | REAL | ABSOLUTE NOISE IN PV<br>■ Difference between maximum and minimum process variable in phase 1.<br>■ Default: 0.0 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| FIL_CYC | OUTPUT | INT | NO OF CYCLES FOR MEAN-VALUE FILTER<br>■ The process variable is averaged over *FIL_CYC* cycles. When necessary, *FIL_CYC* is increased automatically from 1 to a maximum of 1024.<br>■ Default: 1<br>■ Range of Values: 1 ... 1024 |
| POI_CMAX | OUTPUT | INT | MAX NO OF CYCLES AFTER POINT OF INFLEC-TION<br>■ This time is used to find a further (in other words better) point of inflection when measurement noise is present. The tuning is completed only after this time.<br>■ Default: 2 |
| POI_CYCL | OUTPUT | INT | NUMBER OF CYCLES AFTER POINT OF INFLEC-TION<br>■ Default: 0 |

**Application**

- The functionality is based on the PID control algorithm with additional functions for temperature processes. The controller supplies analog manipulated values and pulse-duration modulated actuating signals. The controller outputs signals to one actuator; in other words, with one controller, you can either heat or cool but not both.
- FB 58 TCONT_CP can be used either purely for heating or purely for cooling. If you use the block for cooling, *GAIN* must be assigned a negative value. This inversion of the controller means that, for example if the temperature rises, the manipulated variable *LMN* and with it the cooling effort is increased.
- Apart from the functions in the setpoint and process value branches, the FB implements a complete PID temperature controller with a continuous and binary manipulated variable output. To improve the control response with temperature processes, the block includes a control zone and reduction of the P-action if there is a setpoint step change. The block can set the PI/PID parameters itself using the controller tuning function.

*The values in the controller blocks are only calculated correctly if the block is called at regular intervals. Therefore, you have to call the controller blocks in a cyclic interrupt OB (OB 30 ... 38) at regular intervals. The sampling time is predefined on the parameter CYCLE.*

**Setpoint Branch**

The setpoint is entered at input *SP_INT* in floating-point format as a physical value or percentage. The setpoint and process value used to form the error must have the same unit.

**Process Value Options (*PVPER_ON*)**

Depending on *PVPER_ON*, the process value can be acquired in the peripheral (I/O) or floating-point format.

| *PVPER_ON* | Process Value Input |
|---|---|
| TRUE | The process value is read in via the analog peripheral I/Os (PIW xxx) at input *PV_PER*. |
| FALSE | The process value is acquired in floating-point format at input PV_IN. |

**Process Value Format Conversion *CRP_IN* (*PER_MODE*)**

The *CRP_IN* function converts the peripheral value *PV_PER* to a floating-point format depending on the switch *PER_MODE* according to the following rules:

| *PER_MODE* | Output of *CRP_IN* | Analog Input Type | Unit |
|---|---|---|---|
| 0 | *PV_PER* * 0.1 | Thermoelements; PT100/NI100; standard | °C; °F |
| 1 | *PV_PER* * 0.01 | PT100/NI100; climate | °C; °F |
| 2 | *PV_PER* * 100/27648 | Voltage/current | % |

**Process Value Normalization *PV_NORM* (*PV_FAC*, *PV_OFFS*)**

The *PV_NORM* function calculates the output of *CRP_IN* according to the following rule: *Output of PV_NORM = Ausgang von CPR_IN * PV_FAC + PV_OFFS*

It can be used for the following purposes:

- Process value correction with *PV_FAC* as the process value factor and *PV_OFFS* as the process value offset.
- Normalization of temperature to percentage
  You want to enter the setpoint as a percentage and must now convert the measured temperature value to a percentage.
- Normalization of percentage to temperature
  You want to enter the setpoint in the physical temperature unit and must now convert the measured voltage/current value to a temperature.

Calculation of the parameters:

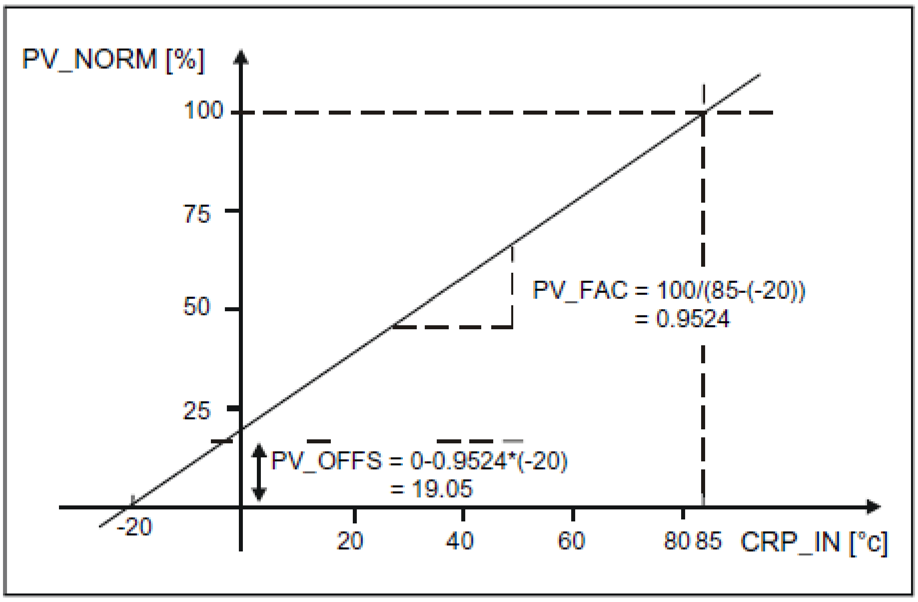
- *PV_FAC = range of PV_NORM/range of CRP_IN*
- *PV_OFFS = LL(PV_NORM) - PV_FAC * LL(CRP_IN)*; where *LL* is the lower limit

With the default values (*PV_FAC* = 1.0 and *PV_OFFS* = 0.0), normalization is disabled. The effective process value is output at the *PV* output.

*With pulse control, the process value must be transferred to the block in the fast pulse call (reason: mean value filtering). Otherwise, the control quality can deteriorate.*

**Example of Process Variable Normalization**

If you want to enter the setpoint as a percentage, and you have a temperature range of -20 ... 85 °C applied to *CRP_IN*, you must normalize the temperature range as a percentage. The schematic below shows an example of adapting the temperature range -20 ... 85 °C to an internal scale of 0 ... 100 %:

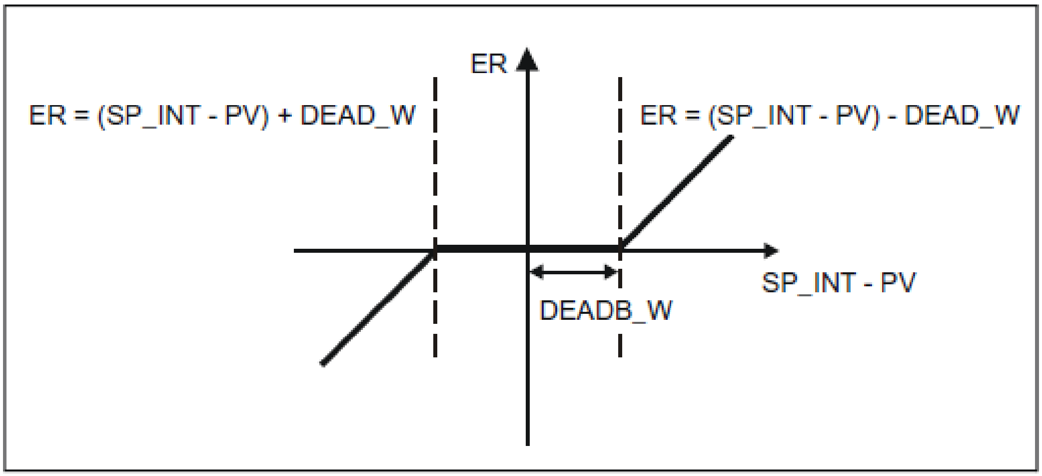



**Forming the Error**

The difference between the setpoint and process value is the error before the deadband. The setpoint and process value must exist in the same unit.

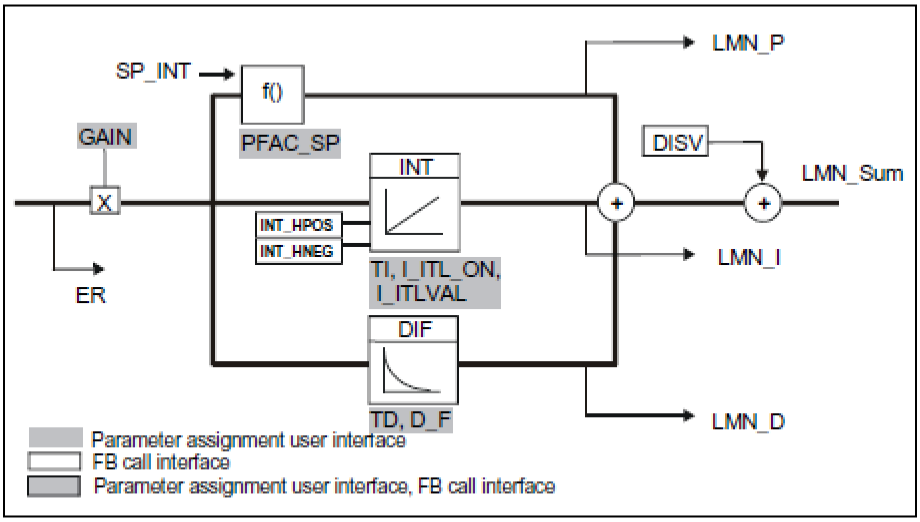
**Deadband (*DEADB_W*)**

To suppress a small constant oscillation due to the manipulated variable quantization (for example in pulse duration modulation with PULSEGEN) a deadband (DEADBAND) is applied to the error. If *DEADB_W* = 0.0, the deadband is deactivated. The effective error is indicated by the *ER* parameter.




**PID Algorithm**

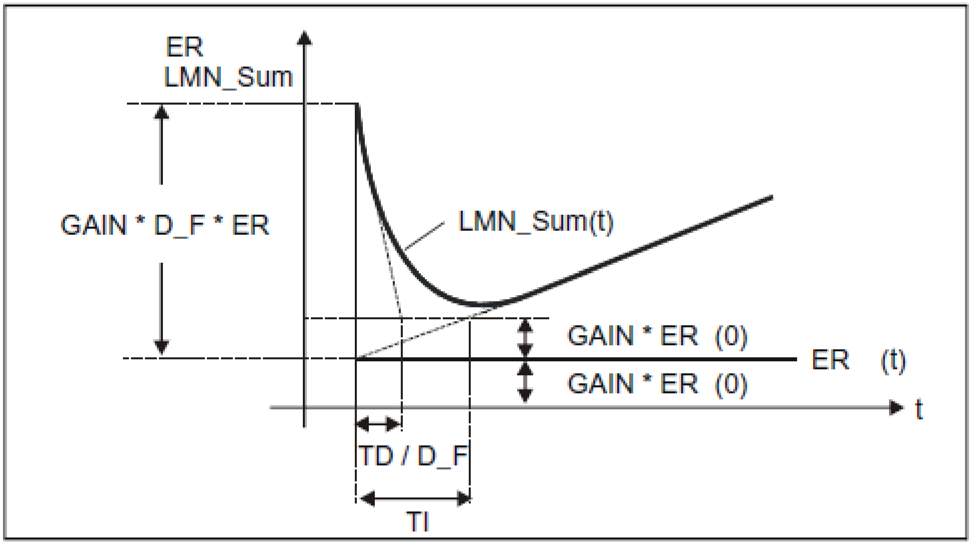
The schematic below is the block diagram of the PID algorithm:




**PID Algorithm (*GAIN, TI, TD, D_F*)**

- The PID algorithm operates as a position algorithm. The proportional, integral (*INT*), and derivative (*DIF*) actions are connected in parallel and can be activated or deactivated individually. This allows P, PI, PD, and PID controllers to be configured.
- The controller tuning supports PI and PID controllers. Controller inversion is implemented using a negative *GAIN* (cooling controller).
- If you set *TI* and *TD* to 0.0, you obtain a pure P controller at the operating point.

$$LMN\_Sum(t) = GAIN * ER(0) \left(1 + \frac{1}{TI} * t + D\_F * e^{\frac{-t}{TD/D\_F}}\right)$$




| | |
|---|---|
| LMN_Sum(t) | manipulated variable in automatic mode of the controller |
| ER (0) | step change of the normalized error |
| GAIN | controller gain |
| TI | integral time |
| TD | derivative time |
| D_F | derivative factor |

**Integrator (*TI, I_ITL_ON, I_ITLVAL*)**

In the manual mode, it is corrected as follows: *LMN_I = LMN - LMN_P - DISV*

If the manipulated variable is limited, the I-action is stopped. If the error moves the I-action back in the direction of the manipulated variable range, the I-action is enabled again.

The I-action is also modified by the following measures:

- The I-action of the controller is deactivated by *TI* = 0.0
- Weakening the P-action when setpoint changes occur
- Control zone
- The limits of the manipulated variable can be changed online

**Weakening the P-Action when Setpoint Changes Occur (*PFAC_SP*)**

To prevent overshoot, you can weaken the P-action using the "proportional factor for setpoint changes" parameter (*PFAC_SP*). Using *PFAC_SP*, you can select continuously between 0.0 and 1.0 to decide the effect of the P-action when the setpoint changes:

- *PFAC_SP* = 1.0: P-action has full effect if the setpoint changes
- *PFAC_SP* = 0.0: P-action has no effect if the setpoint changes

The weakening of the P-action is achieved by compensating the I-action.

**Derivative Action Element (*TD, D_F*)**

- The D-action of the controller is deactivated with *TD* = 0.0.
- If the D-action is active, the following relationship should apply: *TD* = 0.5 * *CYCLE* * *D_F*

**Parameter Settings of a P or PD Controller with Operating Point**

In the user interface, deactivate the I-action (TI = 0.0) and possible also the D-action (TD = 0.0). Then make the following parameter settings:

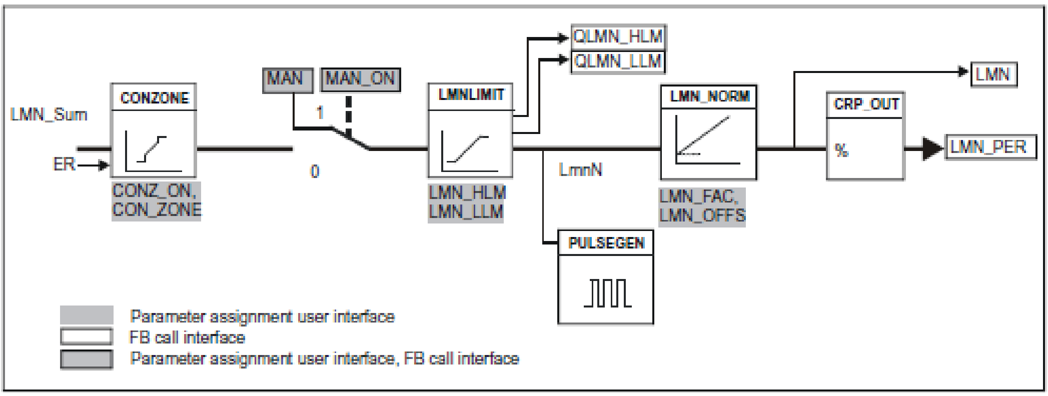
- *I_ITL_ON* = TRUE
- *I_ITLVAL* = operating point;

**Feedforward Control (*DISV*)**

A feedforward variable can be added at the *DISV* input.

**Calculating the Manipulated Variable**

The schematic below is the block diagram of the manipulated variable calculation:

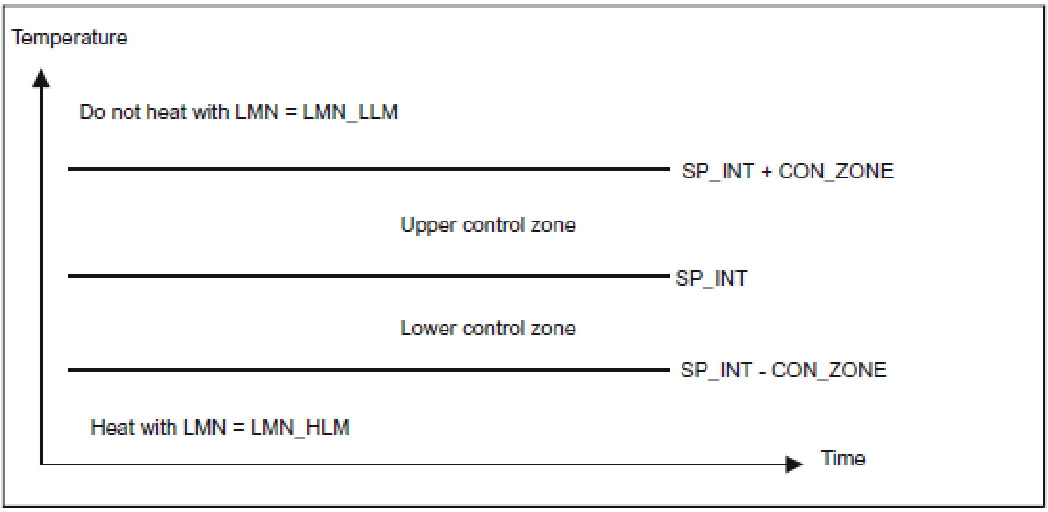



**Control Zone (*CONZ_ON, CON_ZONE*)**

If *CONZ_ON* = TRUE, the controller operates with a control zone. This means that the controller operates according to the following algorithm:

- If *PV* exceeds *SP_INT* by more than *CON_ZONE*, the value *LMN_LLM* is output as the manipulated variable (controlled closed-loop).
- If *PV* falls below *SP_INT* by more than *CON_ZONE*, the value *LMN_HLM* is output as the manipulated variable (controlled closed-loop).
- If *PV* is within the control zone (*CON_ZONE*), the manipulated variable takes its value from the PID algorithm *LMN_Sum* (automatic closed-loop control).

*The changeover from controlled closed-loop to automatic closed-loop control takes into account a hysteresis of 20% of the control zone.*




*Before activating the control zone manually, make sure that the control zone band is not too narrow. If the control zone band is too small, oscillations will occur in the manipulated variable and process variable.*

**Advantage of the Control Zone**

When the process value enters the control zone, the D-action causes an extremely fast reduction of the manipulated variable. This means that the control zone is only useful when the D-action is activated. Without a control zone, basically only the reducing P-action would reduce the manipulated variable. The control zone leads to faster settling without overshoot or undershoot if the output minimum or maximum manipulated variable is a long way from the manipulated variable required for the new operating point.

**Manual Value Processing (*MAN_ON, MAN*)**

You can switch over between manual and automatic operation. In the manual mode, the manipulated variable is corrected to a manual value. The integral action (*INT*) is set internally to *LMN - LMN_P - DISV* and the derivative action (*DIF*) is set to 0 and synchronized internally. Switching over to automatic mode is therefore bumpless.

*During tuning, the MAN_ON parameter has no effect.*

**Manipulated Variable Limitation *LMNLIMIT* (*LMN_HLM, LMN_LLM*)**

The value of the manipulated variable is limited to the *LMN_HLM* and *LMN_LLM* limits by the *LMNLIMIT* function. If these limits are reached, this is indicated by the message bits *QLMN_HLM* and *QLMN_LLM*. If the manipulated variable is limited, the I-action is stopped. If the error moves the I-action back in the direction of the manipulated variable range, the I-action is enabled again.

**Changing the Manipulated Variable Limits Online**

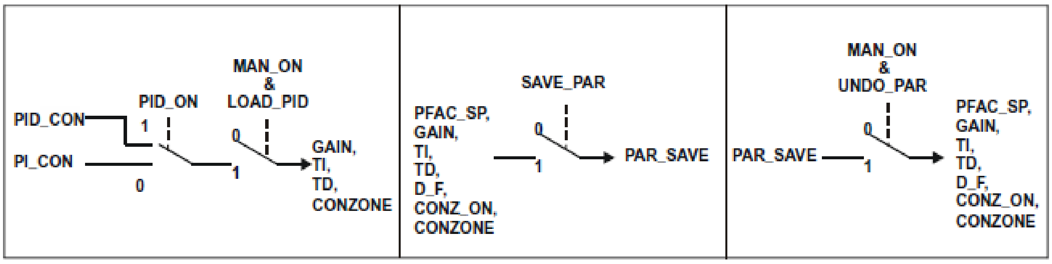
If the range of the manipulated variable is reduced and the new unlimited value of the manipulated variable is outside the limits, the I-action and therefore the value of the manipulated variable shifts. The manipulated variable is reduced by the same amount as the manipulated variable limit changed. If the manipulated variable was unlimited prior to the change, it is set exactly to the new limit (described here for the upper manipulated variable limit).

**Manipulated Variable Normalization *LMN_NORM* (*LMN_FAC, LMN_OFFS*)**

- The *LMN_NORM* function normalizes the manipulated variable according to the following formula:
  *LMN = LmnN * LMN_FAC + LMN_OFFS*
- It can be used for the following purposes:
  Manipulated variable adaptation with *LMN_FAC* as manipulated variable factor and *LMN_OFFS* manipulated variable offset
- The value of the manipulated variable is also available in the peripheral format. The *CRP_OUT* function converts the LMN floating-point value to a peripheral value according to the following formula:
  *LMN_PER = LMN * 27648/100*
  With the default values (*LMN_FAC* = 1.0 and *LMN_OFFS* = 0.0), normalization is disabled. The effective manipulated variable is output at output *LMN*.

**Saving and Reloading Controller Parameters**

The schematic below shows the block diagram:




**Saving Controller Parameters *SAVE_PAR***

If the current parameter settings are usable, you can save them in a special structure in the instance DB of FB 58 TCONT_CP prior to making a manual change. If you tune the controller, the saved parameters are overwritten by the values that were valid prior to tuning. *PFAC_SP, GAIN, TI, TD, D_F, CONZ_ON* and *CON_ZONE* are written to the *PAR_SAVE* structure.

**Reloading Saved Controller Parameters *UNDO_PAR***

The last controller parameter settings you saved can be activated for the controller again using this function (in manual mode only).

**Changing Between PI and PID Parameters *LOAD_PID* (*PID_ON*)**

Following tuning, the PI and PID parameters are stored in the *PI_CON* and *PID_CON* structures. Depending on *PID_ON*, you can use *LOAD_PID* in the manual mode to write the PI or PID parameters to the effective controller parameters.

| **PID parameter *PID_ON* = TRUE** | | **PI parameter PID_ON = FALSE** | |
|---|---|---|---|
| GAIN | = PID_CON.GAIN | GAIN | = PI_CON.GAIN |
| TI | = PID_CON.TI | TI | = PI_CON.TI |
| TD | = PID_CON.TD | | |

- *The controller parameters are only written back to the controller with UNDO_PAR or LOAD_PID when the controller gain is not 0:*
  *Bei LOAD_PID werden die Parameter nur kopiert, falls das jeweiligen GAIN <> 0 ist (entweder vom PI- oder PID-Parametersatz). Damit ist der Fall berücksichtigt, dass noch keine Optimierung durchgeführt wurde bzw. PID-Parameter fehlen. War PID_ON = TRUE und PID.GAIN = FALSE, wird PID_ON auf FALSE gesetzt und die PI-Parameter kopiert.*
- *D_F, PFAC_SP are set to default values by the tuning. These can then be modified by the user. LOAD_PID does not change these parameters.*
- *With LOAD_PID, the control zone is always recalculated (CON_ZONE = 250/GAIN) even when CONZ_ON = FALSE is set.*

### 14.5.5 FB 59 - TCONT_S - Temperature Step Control

**Description**

FB 59 TCONT_S is used to control technical temperature processes with binary controller output signals for integrating actuators. By setting parameters, subfunctions of the PI step controller can be activated or deactivated and the controller adapted to the process.

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| CYCLE | INPUT | REAL | SAMPLE TIME OF STEP CONTROLLER [s]<br>■ At this input *CYCLE*, you enter the sampling time for the controller.<br>■ Default: 0.0<br>■ Range of Values: ≥ 0.001 |
| SP_INT | INPUT | REAL | INTERNAL SETPOINT<br>■ The *SP_INT* input is used to specify a setpoint.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| PV_IN | INPUT | REAL | PROCESS VARIABLE IN<br>■ An initialization value can be set at the *PV_PER* input or an external process variable in floating-point format can be connected.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| PV_PER | INPUT | WORD | PROCESS VARIABLE PERIPHERY<br>■ The process variable in the peripheral I/O format is connected to the controller at the *PV_PER* input.<br>■ Default: 0 |
| DISV | INPUT | REAL | DISTURBANCE VARIABLE<br>■ For feed forward control, the disturbance variable is connected to the *DISV* input.<br>■ Default: 0.0 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| LMNR_HS | INPUT | BOOL | HIGH LIMIT SIGNAL OF REPEATED MANIPULATED VALUE<br>■ The signal "valve at upper limit stop" is connected to the *LMNR_HS*.<br>■ *LMNR_HS* = TRUE: The valve is at the upper limit stop.<br>■ Default: FALSE |
| LMNR_LS | INPUT | BOOL | LOW LIMIT SIGNAL OF REPEATED MANIPULATED VALUE<br>■ The signal "valve at upper lower stop" is connected to the input *LMNR_LS*.<br>■ *LMNR_LS* = TRUE: The valve is at the lower limit stop.<br>■ Default: FALSE |
| LMNS_ON | INPUT | BOOL | MANIPULATED SIGNALS ON<br>■ The processing of the controller output signal is set to manual at the *LMNS_ON* input.<br>■ Default: TRUE |
| LMNUP | INPUT | BOOL | MANIPULATED SIGNALS UP<br>■ With the controller output signals set to manual, the *QLMNUP* output signal is applied to the *LMNUP* input.<br>■ Default: FALSE |
| LMNDN | INPUT | BOOL | MANIPULATED SIGNALS DOWN<br>■ With the controller output signals set to manual, the *QLMNDN* output signal is applied to the *LMNDN* input.<br>■ Default: FALSE |
| QLMNUP | OUTPUT | BOOL | MANIPULATED SIGNAL UP<br>■ If the *QLMNUP* output is set, the valve will be opened.<br>■ Default: FALSE |
| QLMNDN | OUTPUT | BOOL | MANIPULATED SIGNAL DOWN<br>■ If the *QLMNDN* output is set, the valve will be closed.<br>■ Default: FALSE |
| PV | OUTPUT | REAL | PROCESS VARIABLE<br>■ The effective process variable is output at the *PV* output.<br>■ Default: 0.0 |
| PE | OUTPUT | REAL | ERROR SIGNAL<br>■ The effective error is output at the *PE* output.<br>■ Default: 0.0 |
| COM_RST | INPUT/ OUTPUT | BOOL | COMPLETE RESTART<br>■ The block has an initialization routine that is processed when the *COM_RST* input is set.<br>■ Default: FALSE |

**Internal Parameters**

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| PV_FAC | INPUT | REAL | PROCESS VARIABLE FACTOR<br>■ The *PV_FAC* input is multiplied by the "process value". The input is used to adapt the process variable range.<br>■ Default: 1.0 |
| PV_OFFS | INPUT | REAL | PROCESS VARIABLE OFFSET<br>■ The *PV_OFFS* input is added to the process variable. The input is used to adapt the process variable range.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| DEADB_W | INPUT | REAL | DEAD BAND WIDTH<br>■ The error passes through a dead band. The *DEADB_W* input decides the size of the dead band.<br>■ Default: 0.0<br>■ Range of Values: Dependent on the sensors used |
| PFAC_SP | INPUT | REAL | PROPORTIONAL FACTOR FOR SETPOINT CHANGES [0..1 ]<br>■ *PFAC_SP* specifies the effective P action when there is a setpoint change. This is set between 0 and 1.<br>– 1: P action has full effect if the setpoint changes.<br>– 0: P action has no effect if the setpoint changes.<br>■ Default: 1.0<br>■ Range of Values: 0.0 ... 1.0 |
| GAIN | INPUT | REAL | PROPORTIONAL GAIN<br>■ The *GAIN* input specifies the controller gain. The direction of control can be reversed by giving GAIN a negative sign.<br>■ Default: 2.0<br>■ Range of Values: %/phys. unit |
| TI | INPUT | REAL | RESET TIME [s]<br>■ The *TI* input (integral time) decides the integral action response.<br>■ Default: 40.0 s<br>■ Range of Values: ≥ 0.0 s |
| MTR_TM | INPUT | REAL | MOTOR ACTUATING TIME<br>■ The operating time of the valve from limit stop to limit stop is entered in the *MTR_TM* parameter.<br>■ Default: 30 s<br>■ Range of Values: ≥ *CYCLE* |

| Parameter | Declaration | Data Type | Description |
|---|---|---|---|
| PULSE_TM | INPUT | REAL | MINIMUM PULSE TIME<br>■ A minimum pulse time can be set with the *PULSE_TM* parameter.<br>■ Default: 0.1s<br>■ Range of Values: ≥ 0.0 s |
| BREAK_TM | INPUT | REAL | MINIMUM BREAK TIME<br>■ A minimum break time can be set with the *BREAK_TM* parameter.<br>■ 0.1s<br>■ Range of Values: ≥ 0.0 s |
| PER_MODE | INPUT | INT | PERIPHERIE MODE<br>■ You can enter the type of the I/O module at this switch. The process variable at input *PV_PER* is then normalized to °C at the *PV* output.<br>– *PER_MODE* = 0: standard<br>– *PER_MODE* = 1: climate<br>– *PER_MODE* = 2: current/voltage<br>■ Default: 0<br>■ Range of Values: 0, 1, 2 |
| PVPER_ON | INPUT | BOOL | PROCESS VARIABLE PERIPHERY ON<br>■ If you want the process variable to be read in from the I/O, the *PV_PER* input must be connected to the I/O and the *PVPER_ON* input must be set.<br>■ Default: FALSE |

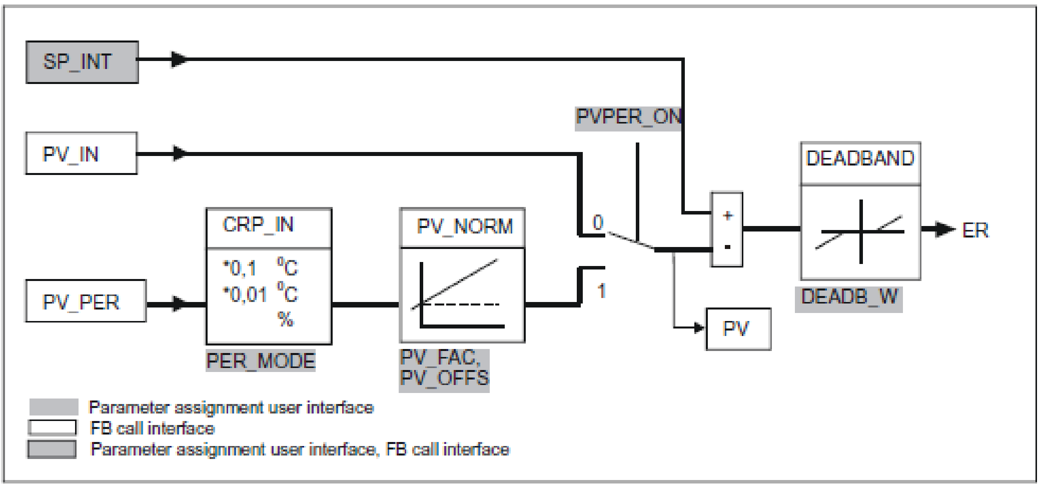
**Application**

- The functionality is based on the PI control algorithm of the sampling controller. This is supplemented by the functions for generating the binary output signal from the analog actuating signal.
- You can also use the controller in a cascade control as a secondary position controller. You specify the actuator position via the setpoint input *SP_INT*. In this case, you must set the process value input and the parameter *TI* (integral time) to zero. An application might be, for example, temperature control with heating power control using pulse-break activation and cooling control using a butterfly valve. To close the valve completely, the manipulated variable (*ER* * *GAIN*) should be negative.
- Apart from the functions in the process variable branch, FB 59 TCONT_S implements a complete PI controller with binary manipulated value output and the option of influencing the controller output signals manually. The step controller operates without a position feedback signal.

*The values in the controller blocks are only calculated correctly if the block is called at regular intervals. Therefore, you have to call the controller blocks in a cyclic interrupt OB (OB 30 ... 38) at regular intervals. The sampling time is predefined on the parameter CYCLE.*

**Forming the Error**

Block Diagram




**Setpoint Branch**

The setpoint is entered at input *SP_INT* in floating-point format as a physical value or percentage. The setpoint and process value used to form the error must have the same unit.

**Process Value Options (*PVPER_ON*)**

Depending on *PVPER_ON*, the process value can be acquired in the peripheral (I/O) or floating-point format.

| *PVPER_ON* | Process Value Input |
|---|---|
| TRUE | The process value is read in via the analog peripheral I/Os (PIW xxx) at input *PV_PER*. |
| FALSE | The process value is acquired in floating-point format at input *PV_IN*. |

**Process Value Format Conversion *CRP_IN* (*PER_MODE*)**

The *CRP_IN* function converts the peripheral value *PV_PER* to a floating-point format depending on the switch *PER_MODE* according to the following rules:

| *PER_MODE* | Output of *CRP_IN* | Analog Input Type | Unit |
|---|---|---|---|
| 0 | *PV_PER* * 0.1 | Thermoelements; PT100/ NI100; standard | °C; °F |
| 1 | *PV_PER* * 0.01 | PT100/NI100; climate | °C; °F |
| 2 | *PV_PER* * 100/27648 | Voltage/current | % |

**Process Value Normalization *PV_NORM* (*PF_FAC, PV_OFFS*)**

The *PV_NORM* function calculates the output of *CRP_IN* according to the following rule:

*Output of PV_NORM = Output of CPR_IN * PV_FAC + PV_OFFS*

This can be used for the following purposes:

- Process value correction with *PV_FAC* as the process value factor and *PV_OFFS* as the process value offset.
- Normalization of temperature to percentage
  You want to enter the setpoint as a percentage and must now convert the measured temperature value to a percentage.
- Normalization of percentage to temperature
  You want to enter the setpoint in the physical temperature unit and must now convert the measured voltage/current value to a temperature.

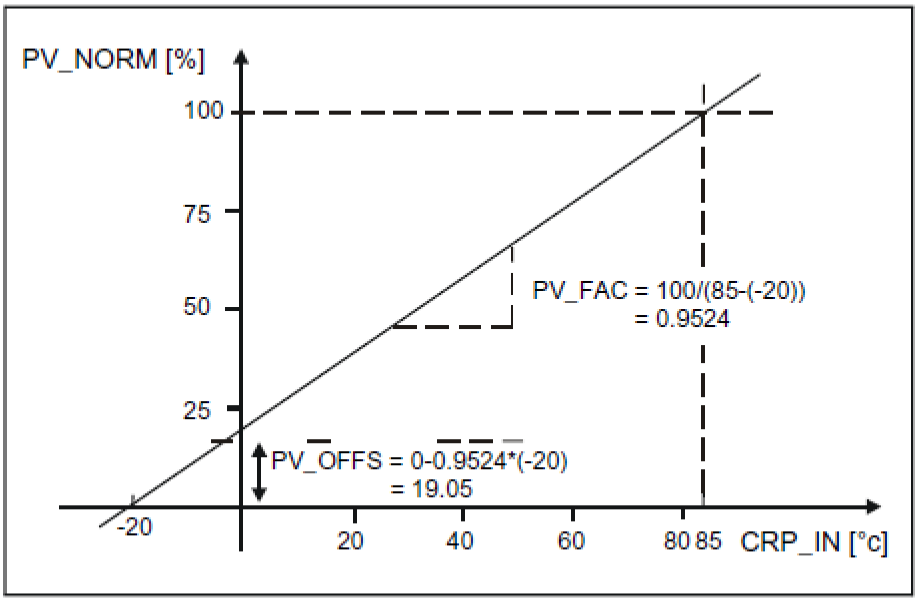
Calculation of the parameters:

- *PV_FAC = range of PV_NORM / range of CRP_IN*
- *PV_OFFS = LL(PV_NORM) - PV_FAC * LL(CRP_IN)*; where *LL* is the lower limit

With the default values (*PV_FAC* = 1.0 and *PV_OFFS* = 0.0), normalization is disabled. The effective process value is output at the *PV* output.

**Example of Process Variable Normalization**

If you want to enter the setpoint as a percentage, and you have a temperature range of -20 to 85 °C applied to *CRP_IN*, you must normalize the temperature range as a percentage. The schematic below shows the adaptation of the temperature range from -20 ... 85°C to an internal scale of 0 ... 100 %:

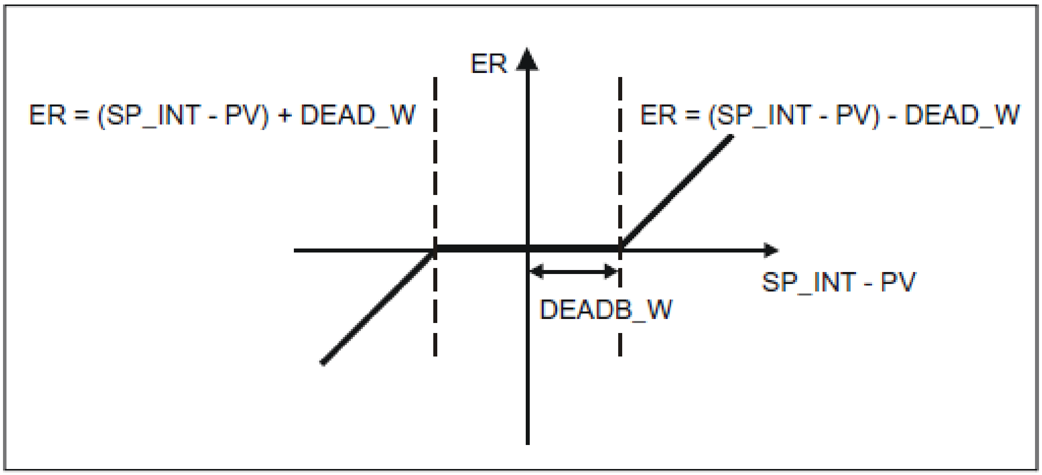



**Forming the Error**

The difference between the setpoint and process value is the error before the deadband. The setpoint and process value must exist in the same unit.

**Deadband (*DEADB_W*)**

To suppress a small constant oscillation due to the manipulated variable quantization (for example in pulse duration modulation with PULSEGEN) a deadband (DEADBAND) is applied to the error. If *DEADB_W* = 0.0, the deadband is deactivated.




**PI Step Controller Algorithm**

FB 59 TCONT_S works without a position feedback signal (see following block diagram). The I-action of the PI algorithm and the assumed position feedback signal are calculated in an integrator (INT) and compared as a feedback value with the remaining P-action. The difference is applied to a three-step element (THREE_ST) and a pulse generator (PULSEOUT) that forms the pulses for the valve. Adapting the response threshold of the three-step element reduces the switching frequency of the controller.

**Weakening the P-Action when Setpoint Changes Occur**

To prevent overshoot, you can weaken the P-action using the "proportional factor for setpoint changes" parameter (*PFAC_SP*). Using *PFAC_SP*, you can now select continuously between 0.0 and 1.0 to decide the effect of the P-action when the setpoint changes:

- *PFAC_SP* = 1.0: P-action has full effect if the setpoint changes
- *PFAC_SP* = 0.0: P-action has no effect if the setpoint changes

A value for *PFAC_SP* < 1.0 can reduce the overshoot as with the continuous controller if the motor run time *MTR_TM* is small compared with the recovery time *TA* and the ratio *TU/TA* is < 0.2. If *MTR_TM* reaches 20 % of TA, only a slight improvement can be achieved.

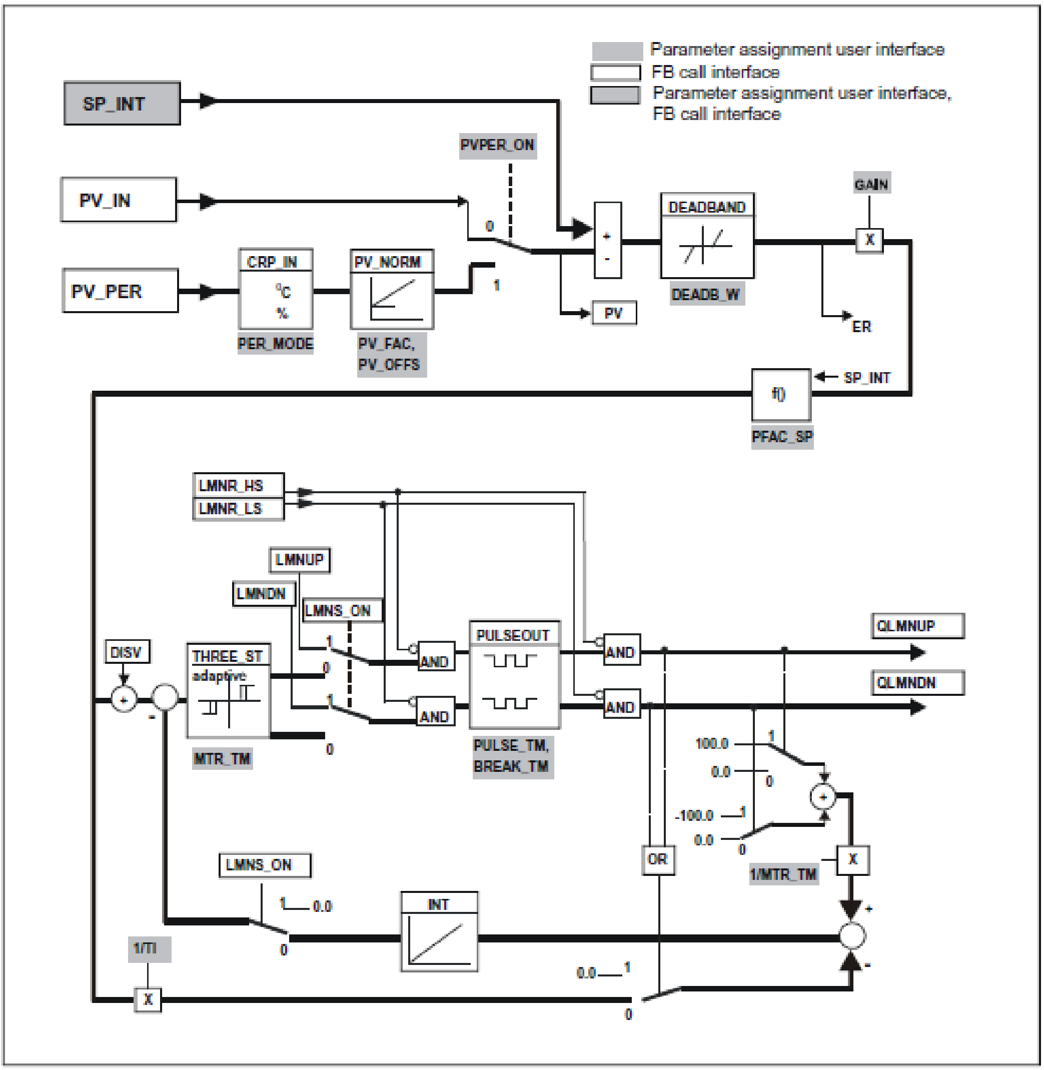
**Feedforward Control**

A load can be added at the *DISV* input.

**Manual Value Processing (*LMNS_ON*)**

With *LMNS_ON*, you can change between manual and automatic mode. In manual mode, the actuator and the integrator (INT) are set to 0 internally. Using *LMNUP* and *LMNDN*, the actuator can be adjusted to OPEN and CLOSED. Switching over to automatic mode therefore involves a bump. As a result of the *GAIN*, the existing error leads to a step change in the internal manipulated variable. The integral component of the actuator, however, results in a ramp-shaped excitation of the process.

**Block Diagram**




## 14.6 Time Functions

### 14.6.1 UDT 60 - WS_RULES - Rule DB

**Description**

Your system must provide certain information in a DB that is evaluated by the various blocks. You create this data block as a DB of the type UDT60 and enter the values that apply to your location (in local time!).

**Calculation of base time < - > local time and "set alarm acc. to local time"**

| Name | Type | Start value | Comment |
|---|---|---|---|
| B2L | STRUCT | | Base time < - > Local time |
| S | INT | 2 | Offset base time -> local time [30 min] in winter<br>permitted: -24 .. +24. |
| T | INT | 3 | Difference summer to winter time [30 min]<br>permitted: 2 |

**Rule for: standard -> daylight-saving time. Default: Last Sunday in March; 2:00 o'clock**

| Name | Type | Start value | Comment |
|---|---|---|---|
| W2S | STRUCT | | W2S must be specified in STANDARD TIME! |
| M | BYTE | B#16#3 | Month of switchover |
| W | BYTE | B#16#9 | nth occurrence of the weekday<br>(1 = first, 2 = second,. , 9 = last) |
| D | BYTE | B#16#1 | Day of week (Sunday = 1) |
| H | BYTE | B#16#2 | Hour |

**Rule for: daylight-saving -> standard time. Default: Last Sunday in October 3:00 o'clock**

| Name | Type | Start value | Comment |
|---|---|---|---|
| S2W | STRUCT | | S2W must be specified in DAYLIGHT-SAVING TIME |
| M | BYTE | B#16#10 | Month of switchover |
| W | BYTE | B#16#9 | nth occurrence of the weekday<br>(1 = first, 2 = second,. , 9 = last) |
| D | BYTE | B#16#1 | Day of week (Sunday = 1) |
| H | BYTE | B#16#3 | Hour |

*All the parameters that have the format BYTE are interpreted as BCD values!*

*The specification of the daylight-saving/standard time switchover points by a rule is mandatory in the EU as of 2002.*

## 14.6.2 FC 61 - BT_LT - Convert base timer to local time

**Description**

The FC 61 calculates the local time for the base time specified at the input.

**Parameter**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| BT | INPUT | DATE_AND_TIME | Base time |
| WS_DAT | INPUT | BLOCK_DB | Information on the time zone for standard/daylight saving switchover (Rule DB) |
| RET_VAL | OUTPUT | INT | Error code |
| LT | OUTPUT | DATE_AND_TIME | Local time |

**How It Works**

The base time entered at input *BT* is converted to the local time using the data stored in a DB and applied to output *LT*. The DB contains the number of 30-minute units by which the base time and local time differ and the difference between daylight-saving time and standard time also in units of 30 minutes. (Rule DB) If the calculation results in a date overflow, this is indicated by a special return value.

**Calling OBs**

FC 61 BT_LT can be called in any priority class.

**Call Environment**

Internally, FC 61 uses the following functions. These functions must be loaded in your project with the numbers shown here. FC1 (AD_DT_TM), FC7 (DT_DAY), FC35 (SB_DT_TM)

**Output Values / Errors**

| RET_VAL | LT | Description |
|---|---|---|
| 0 | Local time | Block executed error-free |
| 1 | Local time | No error, but date jump |
| 8082 | DT#90-01-01-0:0:0 | Invalid data in the rule data block |

### 14.6.3 FC 62 - LT_BT - Convert local time to base time

**Description**

The FC 62 calculates the base time for the local time specified at the input.

**Parameters**

| Parameter | Deklaration | Datentyp | Beschreibung |
|---|---|---|---|
| LT | INPUT | DATE_AND_TIME | Local time |
| WS_DAT | INPUT | BLOCK_DB | Information on the time zone for standard/daylight saving switchover (Rule DB) |
| RET_VAL | OUTPUT | INT | Error code |
| LT | OUTPUT | DATE_AND_TIME | Base time |

**How It Works**

The local time entered at input *LT* is converted to the base time using the data stored in a DB and applied to output *BT*. The DB contains the number of 30-minute units by which the base time and local time differ and the difference between daylight-saving time and standard time also in units of 30 minutes. (Rule DB) If the calculation results in a date overflow, this is indicated by a special return value.

**"Forbidden Hour"**

During the switchover from standard to daylight-saving time the local time is put forward one hour. This, however, means that the hour in between is not run through. If there is an *LT* (local time) within this hour, FC62 LT_BT "thinks" in daylight-saving time. This is reported with return value 4 or 5.

**"Double Hour"**

During the switchover from daylight-saving to standard time the local time is put back one hour. This, however, means that one hour is run through twice. (For CE(S)T the designators 2A and 2B apply). For an *LT* (local time) within this hour, no unique identification relative to a base time is possible. FC LT_BT receives an *LT* as an input parameter and must decide whether the time is standard or daylight-saving before converting it to BT. If the *LT* is within the double hour, the *LT* is interpreted as standard time. This is reported with return value 2 or 3.

**Calling OBs**

FC 62 LT_BT can be called in any priority class.

**Call Environment**

Internally, FC 62 uses the following functions. These functions must be loaded in your project with the numbers shown here. FC1 (AD_DT_TM), FC7 (DT_DAY), FC35 (SB_DT_TM)

**Output Values / Errors**

| RET_VAL | LT | Description |
|---|---|---|
| 0 | Base time | Block executed error-free |
| 1 | Base time | No error, but date jump |
| 2 | Base time | The LT at the input is within the "double" hour |
| 3 | Base time | As 2, also date jump |
| 4 | Base time | The LT at the input is within the "forbidden" hour |
| 5 | Base time | As 4, also date jump |
| 8082 | DT#90-01-01-0:0:0 | Invalid data in the rule data block |

### 14.6.4 FC 63 - S_LTINT - Set time interrupt in local time

**Description**

The FC sets the required time-of-day interrupt at the set time. This time is output in local time.

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| OB_NR | INPUT | INT | No of the OB to be started (permitted 10 – 17) |
| SDT | INPUT | BLOCK_DB | Start date and time-of-day in local time (see SFC28) |
| PERIOD | INPUT | INT | Period from start point SDT:<br>■ W#16#0000 = once<br>■ W#16#0201 = every minute<br>■ W#16#0401 = every hour<br>■ W#16#1001 = daily<br>■ W#16#1201 = weekly<br>■ W#16#1401 = monthly<br>■ W#16#1801 = annually<br>■ W#16#2001 = at end of month |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| WS_DAT | INPUT | DATE_AND_TIME | Information on the time zone for standard/daylight saving switchover (see above) |
| RET_VAL | OUTPUT | INT | Error code |

**How It Works**

The local time entered at input *LT* is converted to the base time using the rule stored in a DB. The DB contains the number of 30-minute units by which the base time and local time differ and the difference between daylight-saving time and standard time also in units of 30 minutes (see above). The specified time-of-day interrupt OB is assigned parameter values and activated using the calculated base time. If the calculation results in a date overflow, this is indicated by a special return value.

**"Forbidden Hour"**

During the switchover from standard to daylight-saving time the local time is put forward one hour. This, however, means that the hour in between is not run through. If there is an *LT* (local time) within this hour, FC S_LTINT "thinks" in daylight-saving time. This is reported with return value 4 or 5.

**"Double Hour"**

During the switchover from daylight-saving to standard time the local time is put back one hour. This, however, means that one hour run through twice. (For CE(S)T the designators 2A and 2B apply). For an *LT* (local time) within this hour, no unique identification relative to a base time is possible. FC S_LTINT receives an *LT* as input parameter and must decide whether the time is standard or daylight-saving before converting it to *BT*. If the *LT* is within the double hour, the *LT* is interpreted as standard time. This is reported with return value 2 or 3.

**Calling OBs**

FC S_LTINT can be called in any priority class. Internally, FC S_LTINT uses the following functions. These functions must be loaded in your project with the numbers shown here. FC7 (DT_DAY), FC35 (SB_DT_TM)

**Output Values / Errors**

| RET_VAL | Description |
|---|---|
| 0 | Block executed error-free |
| 1 | No error, but date jump |
| 2 | The LT at the input was within the "double" hour |
| 3 | As 2, also date jump |
| 4 | The LT at the input is within the "forbidden" hour |
| 5 | As 4, also date jump |
| 8082 | Invalid data in the rule data block |
| 8090 | Bad OB_NR parameter |
| 8091 | Bad SDT parameter |
| 8092 | Bad PERIOD parameter |
| 80A1 | The set start time is in the past |
| 80A2 | OB is not loaded |
| 80A3 | OB cannot be started |

# 15 System Blocks

## 15.1 Fetch/Write Communication

### 15.1.1 SFC 228 - RW_KACHEL - Page frame direct access

**Description**

This SFC allows you the direct access to the page frame area of the CPU with a size of 4kbyte. The page frame area is divided into four page frames, each with a size of 1kbyte. Setting the parameters page frame number, -offset and data width, the SFC 228 enables read and write access to an eligible page frame area.

*This SFC has been developed for test purposes and for building-up proprietary communication systems and is completely at the user's disposal. Please regard that a write access to the page frame area influences a communication directly!*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *✎ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| K_NR | IN | INT | Page frame number |
| OFFSET | IN | INT | Page frame offset |
| R_W | IN | INT | Access |
| SIZE | IN | INT | Data width |
| RET_VAL | OUT | BYTE | Return value (0 = OK) |
| VALUE | IN_ OUT | ANY | Pointer to area of data transfer |

**K_NR**

Page frame number

- Type the page frame no. that you want to access.
  - Value range: 0 ... 3

**OFFSET**

Page frame offset

- Fix here an offset within the specified page frame.
  - Value range: 0 ... 1023

**R_W**

Read/Write

- This parameter specifies a read res. write access.
  - 0 = read access
  - 1 = write access

**SIZE**

Size

- The size defines the width of the data area fixed via *K_NR* and *OFFSET*. You may choose between the values 1, 2 and 4byte.

**RET_VAL (Return Value)**

Byte where an error message is returned to.

**VALUE**

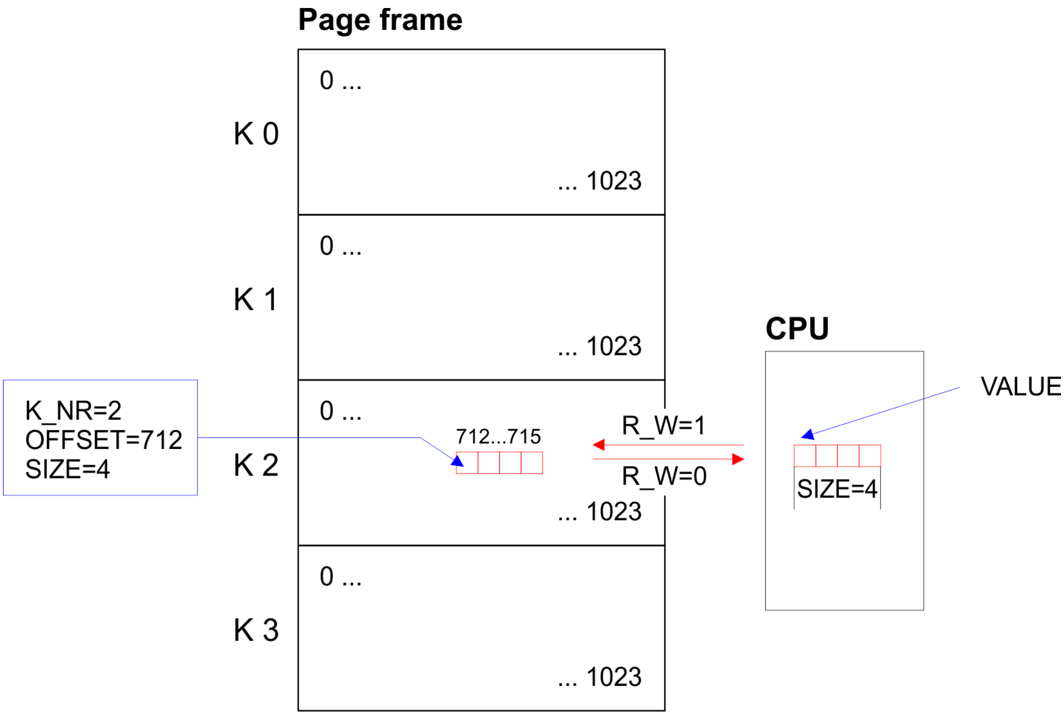
In-/output area

- This parameter fixes the in- res. output area for the data transfer.
- At a read access, this area up to 4byte width contains the data read from the page frame area.
- At a write access, the data up to 4byte width is transferred to the page frame area.
  – Parameter type: Pointer

**Example**

The following example shows the read access to 4byte starting with byte 712 in page frame 2. The read 4byte are stored in DB10 starting with byte 2. For this the following call is required:

```
CALL SFC 228
K_NR    :=2
OFFSET  :=712
R_W     :=0
SIZE    :=4
RET_VAL :=MB10
VALUE   :=P#DB10.DBX 2.0 Byte 4
```




**Error messages**

| Value | Description |
|---|---|
| 00h | no error |
| 01h ... 05h | Internal error: No valid address found for a parameter |
| 06h | defined page frame does not exist |
| 07h | parameter SIZE ≠ 1, 2 or 4 at read access |

| Value | Description |
|---|---|
| 08h | parameter SIZE ≠ 1, 2 or 4 at write access |
| 09h | parameter R_W ist ≠ 0 or 1 |

## 15.1.2 SFC 230 ... 238 - Page frame communication

**Overview**

The delivered handling blocks allow the deployment of communication processors in the CPUs from VIPA. The handling blocks control the complete data transfer between CPU and the CPs. Advantages of the handling blocks:

- you loose only few memory space for user application
- short runtimes of the blocks

The handling blocks don't need:

- bit memory area
- time areas
- counter areas

### 15.1.2.1 Parameter description

All handling blocks described in the following use an identical interface to the user application with these parameters:

| | | |
|---|---|---|
| *SSNR* | - | Interface number |
| *ANR* | - | Order number |
| *ANZW* | - | Indicator word (double word) |
| *IND* | - | Indirect fixing of the relative start address of the data source res. destination |
| *QANF/ZANF* | - | Relative start address within the type |
| *PAFE* | - | Parameterization error |
| *BLGR* | - | Block size |

***SSNR***

Interface number

- Number of the logical interface (page frame address) to which the according order refers to.
  - Parameter type: Integer
  - Convenient range: 0 ... 255

***ANR***

Job number

- The called job number for the logical interface.
  - Parameter type: Integer
  - Convenient range: 1 ... 223

***ANZW***

Indicator word (double word)

- Address of the indicator double word in the user memory where the processing of the order specified under ANR is shown.
  – Parameter type: Double word
  – Convenient range: DW or MW; use either DW and DW+1 or MW and MW+2
    The value DW refers to the data block opened before the incoming call or to the directly specified DB.

***IND***

Kind of parameterization (direct, indirect)

- This parameter defines the kind of data on which the pointer *QANF* points.
  – 0: *QANF* points directly to the initial data of the source res. destination data.
  – 1: the pointer *QANF/ZANF* points to a memory cell, from where on the source res. destination data are defined (indirect).
  – 2: the pointer *QANF/ZANF* points to a memory area where the source res. destination information lies (indirect).
  – 5: the pointer *QANF/ZANF* points to a memory cell, from where on the source res. destination data and parameters of the indicator word are defined (indirect).
  – 6: the pointer *QANF/ZANF* points to a memory area where the source res. destination data and parameters of the indicator word are laying (indirect).
  – Parameter type: Integer
  – Convenient entries: 0, 1, 2, 5, 6

*Please regard, that at IND = 5 res. IND = 6, the parameter ANZW is ignored!*

***QANF/ZANF***

Relative start address of the data source res. destination and at *IND* = 5 res. *IND* = 6 of the indicator word.

- This parameter of the type "pointer" (Any-Pointer) allows you fix the relative starting address and the type of the data source (at SEND) res. the data destination (at RECEIVE).
- At *IND* = 5 res. *IND* = 6 the parameters of the indicator word are also in the data source.
  – Parameterart: Zeiger
  – Sinnvoller Bereich: DB, M, A, E

**Example:**

```
P#DB10.DBX0.0 BYTE 16
P#M0.0 BYTE 10
P#E 0.0 BYTE 8
P#A 0.0 BYTE 10
```

***BLGR***

Block size

- During the boot process the stations agree about the block size (size of the data blocks) by means of SYNCHRON.
- A high block size = high data throughput but longer run-times and higher cycle load.
- A small block size = lower data throughput but shorter run-times of the blocks.

These block sizes are available:

| Value | Block size | Value | Block size |
|---|---|---|---|
| 0 | Default (64byte) | 4 | 128byte |
| 1 | 16byte | 5 | 256byte |
| 2 | 32byte | 6 | 512byte |
| 3 | 64byte | 255 | 512byte |

- Parameter type: Integer
- Convenient range: 0 ... 255

***PAFE***

Error indication at parameterization defects

- This "BYTE" (output, marker) is set if the block detects a parameterization error, e.g. interface (plug-in) not detected or a non-valid parameterization of QUANF/ZANF.
  - Parameter type: Byte
  - Convenient range: AB 0 ... AB127, MB 0...MB 255

### 15.1.2.2 Parameter transfer

**Direct/indirect parameterization**

A handling block may be parameterized directly or indirectly. Only the "*PAFE*" parameter must always been set directly. When using the direct parameterization, the handling block works off the parameters given immediately with the block call. When using the indirect parameterization, the handling block gets only pointers per block parameters. These are pointing to other parameter fields (data blocks or data words). The parameters *SSNR*, *ANR*, *IND* and *BLGR* are of the type "integer", so you may parameterize them indirectly.

**Example**

**Direct parameter transfer**

```
CALL   SFC  230
        SSNR:=0
        ANR :=3
        IND :=0
        QANF:=P#A 0.0 BYTE 16
        PAFE:=MB79
        ANZW:=MD44
```

**Indirect parameter transfer**

```
CALL   SFC  230
        SSNR:=MW10
        ANR :=MW12
        IND :=MW14
        QANF:=P#DB10.DBX0.0 BYTE 16
        PAFE:=MB80
        ANZW:=MD48
```

Please note that you have to load the bit memory words with the corresponding values before.

### 15.1.2.3 Source res. destination definition

**Overview**

You have the possibility to set the entries for source, destination and *ANZW* directly or store it indirectly in a block to which the *QANF / ZANF* res. *ANZW* pointer points. The parameter *IND* is the switch criterion between direct and indirect parameterization.

**Direct parameterization of source and destination details (IND = 0)**

With *IND* = 0 you fix that the pointer *QANF / ZANF* shows directly to the source res. destination data. The following table shows the possible *QANF / ZANF* parameters at the direct parameterization:

| QTYP/ZTYP | Data in DB | Data in MB | Data in OB Process image of the outputs | Data in IB Process image of the inputs |
|---|---|---|---|---|
| Pointer:<br>Example: | `P#DBa.DBX b.0 BYTE`<br>`CP#DB10.DBX 0.0 BYTE 8` | `P#M b.0 BYTE cP#M`<br>`5.0 BYTE 10` | `P#A b.0 BYTE cP#A`<br>`0.0 BYTE 2` | `P#E b.0 BYTE cP#E`<br>`20.0 BYTE 1` |
| DB, MB, AB, EB Definition | `P#DBa`<br>"a" means the DB-No., from where the source data is fetched or where to the destination data is transferred. | `P#M`<br>The data is stored in a MB. | `P#A`<br>The data is stored in the output byte. | `P#E`<br>The data is stored in the input byte. |
| Valid range for "a" | 0 ... 32767 | irrelevant | irrelevant | irrelevant |
| Data / Marker Byte, OB, IB Definition | DB-No., where data fetch or write starts. | Bit memory byte no., where data fetch or write starts. | Output byte no., where data fetch or write starts. | Input byte no., where data fetch or write starts. |
| Valid range for "b" | 0.0 ... 2047.0 | 0 ... 255 | 0 ... 127 | 0 ... 127 |
| `BYTE c`<br>Valid range for "c" | Length of the Source/ Destination data blocks in Words.<br>1 ... 2048 | Length of the Source/ Destination data blocks in bytes.<br>1 ... 255 | Length of the Source/ Destination data blocks in bytes.<br>1 ... 128 | Length of the Source/ Destination data blocks in bytes.<br>1 ... 128 |

**Indirect parameterization of source and destination details (*IND* = 1 or *IND* = 2)**

Indirect addressing means that *QANF / ZANF* points to a memory area where the addresses of the source res. destination areas and the indicator word are stored. In this context you may either define one area for data source, destination and indicator word (*IND* = 1) or each, data source, data destination and the indicator word, get an area of their own (*IND* = 2). The following table shows the possible *QANF / ZANF* parameters for indirect parameterization:

| QTYP/ZTYP | IND = 1 | | IND = 2 | | |
|---|---|---|---|---|---|
| Definition | Indirect addressing for source **or** destination parameters. The source or destination parameters are stored in a DB.<br>*QANF/ZANF:* | | Indirect addressing for source and destination parameters. The source **and** destination parameters are stored in a DB in a sequential order.<br>*QANF/ZANF:* | | |
| | DW +0 | Data type source | DW +0 | Data type source | Description data source |
| | +2 | DB-Nr. at type "DB", otherwise irrelevant | +2 | DB-Nr. at type "DB", otherwise irrelevant | |
| | +4 | Start address | +4 | Start address | |
| | +6 | Length in Byte | +6 | Length in Byte | |
| | | | +8 | Data type destin. | Description data destination |
| | | | +10 | DB-Nr. at type "DB", otherwise irrelevant | |
| | | | +12 | Start address | |
| | | | +14 | Length in Byte | |
| valid DB-No. | 0 ... 32767 | | 0 ... 32767 | | |

| QTYP/ZTYP | IND = 1 | IND = 2 |
|---|---|---|
| Data word Definition | DW-No., where the stored data starts | DW-No., where the stored data starts |
| Valid range | 0.0 ... 2047.0 | 0.0 ... 2047.0 |
| Length Definition | Length of the DBs in byte | Length of the DBs in byte |
| Valid range | 8 fix | 16 fix |

**Indirect parameterization of source and destination details and *ANZW* (*IND* = 5 or *IND* = 6)**

Indirect addressing means that *QANF / ZANF* points to a memory area where the addresses of the source res. destination areas and the indicator word are stored. In this context you may either define one area for data source, destination and indicator word (*IND* = 5) or each, data source, data destination and the indicator word, get an area of their own (*IND* = 6). The following table shows the possible *QANF / ZANF* parameters for indirect parameterization:

<table>
<tr><th>QTYP/ZTYP</th><th colspan="3">IND = 5</th><th colspan="3">IND = 6</th></tr>
<tr><td rowspan="12">Definition</td><td colspan="3">Indirect addressing for source or destination parameters and indicator word (ANZW). The source or destination parameters and ANZW are stored in a DB in a sequential order.<br>QANF/ZANF</td><td colspan="3">Indirect addressing for source and destination parameters and indicator word (ANZW). The source and destination parameters and ANZW are stored in a DB in a sequential order.<br>QANF/ZANF</td></tr>
<tr><td>DW +0</td><td>Data type source</td><td rowspan="4">Description data source/ destination</td><td>DW +0</td><td>Data type source</td><td rowspan="4">Description data source</td></tr>
<tr><td>+2</td><td>DB-Nr. at type "DB", otherwise irrelevant</td><td>+2</td><td>DB-Nr. at type "DB", otherwise irrelevant</td></tr>
<tr><td>+4</td><td>Start address</td><td>+4</td><td>Start address</td></tr>
<tr><td>+6</td><td>Length in Byte</td><td>+6</td><td>Length in Byte</td></tr>
<tr><td>+8</td><td>Data type destin.</td><td rowspan="7">Description indicator word</td><td>+8</td><td>Data type destin.</td><td rowspan="4">Description data destination</td></tr>
<tr><td>+10</td><td>DB-Nr. at type "DB", otherwise irrelevant</td><td>+10</td><td>DB-Nr. at type "DB", otherwise irrelevant</td></tr>
<tr><td rowspan="5">+12</td><td rowspan="5">Start address</td><td>+12</td><td>Start address</td></tr>
<tr><td>+14</td><td>Length in Byte</td></tr>
<tr><td>+16</td><td>Data type source</td><td rowspan="3">Description indicator word</td></tr>
<tr><td>+18</td><td>DB-Nr. at type "DB", otherwise irrelevant</td></tr>
<tr><td>+20</td><td>Start address</td></tr>
<tr><td>valid DB-No.</td><td colspan="3">0 ... 32767</td><td colspan="3">0 ... 32767</td></tr>
<tr><td>Data word Definition</td><td colspan="3">DW-Nr., where the stored data starts</td><td colspan="3">DW-Nr., where the stored data starts</td></tr>
<tr><td>Valid range</td><td colspan="3">0.0 ... 2047.0</td><td colspan="3">0.0 ... 2047.0</td></tr>
<tr><td>Length Definition</td><td colspan="3">Length of the DBs in byte</td><td colspan="3">Length of the DBs in byte</td></tr>
<tr><td>Valid range</td><td colspan="3">14 fix</td><td colspan="3">22 fix</td></tr>
</table>

### 15.1.2.4 Indicator word *ANZW*

**Status and error reports**

Status and error reports are created by the handling blocks:

- by the indicator word *ANZW* (information at order commissioning).
- by the parameter error byte *PAFE* (indication of a wrong order parameterization).

**Content and structure of the indicator word *ANZW***

The "Indicator word" shows the status of a certain order on a CP. In your PLC program you should keep one indicator word for each defined order at hand. The indicator word has the following structure:

| Byte | Bit 7 ... Bit 0 |
|---|---|
| 0 | ■ Bit 3 ... Bit 0: Error management CPU<br>– 0: no error<br>– 1 ... 5: CPU-Error<br>– 6 ... 15: CP-Error<br>■ Bit 7 ... Bit 4: reserved |
| 1 | State management CPU<br>■ Bit 0: Handshake convenient (data exists)<br>– 0: RECEIVE blocked<br>– 1: RECEIVE released<br>■ Bit 1: order commissioning is running<br>– 0: SEND/FETCH released<br>– 1: SEND/FETCH blocked<br>■ Bit 2: Order ready without errors<br>■ Bit 3: Order ready with errors<br>Data management handling block<br>■ Bit 4: Data receive/send is running<br>■ Bit 5: Data transmission active<br>■ Bit 6: Data fetch active<br>■ Bit 7: Disable/Enable data block<br>– 1: released<br>– 0: blocked |
| 2 ... 3 | Length word handling block |

In the "length word" the handling blocks (SEND, RECEIVE) store the data that has already been transferred, i.e. received data in case of a Receive order, send data when there is a Send order. The announcement in the "length word" is always in byte and absolute.

**Error management Byte 0, Bit 0 ... Bit 3**

Those bits announce the error messages of the order. The error messages are only valid if the bit "Order ready with error" in the status bit is set simultaneously.

The following error messages may occur:

0 - **no error**

If the bit "Order ready with error" is set, the CP had to reinitialize the connection, e.g. after a reboot or RESET.

1 - **wrong Q/ZTYP at HTB**

The order has been parameterized with the wrong type label.

2 - **AG area not found**

The order impulse had a wrong parameterized DB-No.

3 - **AG area too small**

Q/ZANF and Q/ZLAE overwrite the range boundaries. Handling with data blocks the range boundary is defined by the block size. With flags, timers, counters etc. the range size depends on the AG.

4 - **QVZ-Error in the AG**

This error message means, that you chose a source res. destination parameter of the AG area, where there is either no block plugged in or the memory has a defect. The QVZ error message can only occur with the type Q/ZTYP AS, PB, QB or memory defects.

5 - **Error at indicator word**

The parameterized indicator word cannot be handled. This error occurs, if *ANZW* declared a data word res. double word, that is not (any more) in the specified data block, i.e. DB is too small or doesn't exist.

6 - **no valid ORG-Format**

The data destination res. source isn't declared, neither at the handling block (Q/TYP="NN") nor at the coupler block.

7 - **Reserved**

8 - **no available transfer connections**

The capacity for transfer connections is at limit. Delete unnecessary connections.

9 - **Remote error**

There was an error at the communication partner during a READ/WRITE-order.

A - **Connection error**

The connection is not (yet) established. The message disappears as soon as the connection is stable. If all connections are interrupted, please check the block itself and the bus cable. Another possibility for the occurrence of this error is a wrong parameterization, like e.g. inconsistent addressing.

B - **Handshake error**

This could be a system error or the size of the data blocks has been defined out of range.

C - **Initial error**

The wrong handling block tried to initialize the order or the size of the given data block was too large.

D - **Cancel after RESET**

This is a normal system message. With PRIO 1 and 2 the connection is interrupted but will be established again, as soon as the communication partner is online. PRIO 3 connections are deleted, but can be initialized again.

E - **Order with basic load function**

This is a normal system message. This order is a READ/WRITEPASSIV and can not be started from the AG.

F - **Order not found**The called order is not parameterized on the CP. This error may occur when the SSNR/A-No. combination in the handling block is wrong or no connection block is entered.

The bits 4 to 7 of byte 2 are reserved for extensions.

**Status management Byte 1, Bit 0 ... Bit 3**

Here you may see if an order has already been started, if an error occurred or if this order is blocked, e.g. a virtual connection doesn't exist any longer.

- **Bit 0 - Handshake convenient**
  - Set:
    Per plug-in according to the "delete"-announcement in the order status bit: Handshake convenient (= 1) is used at the RECEIVE block (telegram exists at PRIO 1 or RECEIVE impulse is possible at PRIO 2/3)
  - Analyze:
    Per RECEIVE block: The RECEIVE initializes the handshake with the CP only if this bit is set. Per application: for RECEIVE request (request a telegram at PRIO 1).
- **Bit 1 - Order is running**
  - Set:
    Per plug-in: when the CP received the order.
  - Delete:
    Per plug-in: when an order has been commissioned (e.g. receipt received).
  - Analyze:
    Per handling blocks: A new order is only send, when the order before is completely commissioned. Per user: when you want to know, if triggering a new order is convenient.
- **Bit 2 - Order ready without errors**
  - Set:
    Per plug-in: when the according order has been commissioned without errors.
  - Delete:
    Per plug-in: when the according order is triggered for a second time.
  - Analyze:
    Per user: to proof that the order has been commissioned without errors.
- **Bit 3 - Order ready with errors**
  - Set:
    Per plug-in: when the according order has been commissioned with errors. Error causes are to find encrypted in the high-part of the indicator word.
  - Delete:
    Per plug-in: when the according order is triggered for a second time.
  - Analyze:
    Per user: to proof that the order has been commissioned with errors. If set, the error causes are to find in the highbyte of the indicator word.

**Data management Byte 1, Bit 4 ... Bit 7**

Here you may check if the data transfer is still running or if the data fetch res. transmission is already finished. By means of the bit "Enable/Disable" you may block the data transfer for this order (Disable = 1; Enable = 0).

- **Bit 4 - Data fetch / Data transmission is active**
  – Set:
    Per handling block SEND or RECEIVE, if the fetch/transmission has been started, e.g. when data is transferred with the ALL-function (DMA-replacement), but the impulse came per SEND-DIRECT.
  – Delete:
    Per handling blocks SEND or RECEIVE, if the data transfer of an order is finished (last data block has been transferred).
  – Analyze:
    Per user: During the data transfer CP <<->> AG the user must not change the record set of an order. This is uncritical with PRIO 0/1 orders, because here the data transfer is realizable in one block cycle. Larger data amounts however are transferred in blocks during more AG cycles. To ensure data consistency you should proof that the data block isn’t in transfer any more before you change the content!
- **Bit 5 - Data transmission is active**
  – Set:
    Per handling block SEND, when the data transition for an order is ready.
  – Delete:
    Per handling block SEND, when the data transfer for a new order has been started (new trigger). Per user: When analysis is ready (flank creation).
  – Analyze:
    Per user: Here you may ascertain, if the record set of an order has already been transferred to the CP res. at which time a new record set concerning a running order (e.g. cyclic transition) may be started.
- **Bit 6 - Data fetch active**
  – Set:
    Per RECEIVE, when data fetch for a new order has been finished.
  – Delete:
    Per RECEIVE, when data transfer to AG for a new order (new trigger) has been started. Per user, when analyzing (edge creation).
  – Analyze:
    Per user: Here you may ascertain, if the record set of an order has already been transferred to the CP res. at what time a new record set for the current order has been transferred to the AG.
- **Bit 7 - Disable/Enable data block**
  – Set:
    Per user: to avoid overwriting an area by the RECEIVE block res. data transition of an area by the SEND block (only for the first data block).
  – Delete:
    Per user: to release the according data area.
  – Analyze:
    Per handling blocks SEND and RECEIVE: if Bit 7 is set, there is no data transfer anymore, but the blocks announce an error to the CP.

**Length word Byte 2 and Byte 3**

In the length word the handling blocks (SEND, RECEIVE) store the already transferred data of the current order, i.e. the received data amount for receiving orders, the sent data amount for sending orders.

Describe: - Per SEND, RECEIVE during the data transfer. The length word is calculated from: current transfer amount + amount of already transferred data

Delete: - Per overwrite res. with every new SEND, RECEIVE, FETCH. If the bit "order ready without error" res. "Data fetch/data transition ready" is set, the "Length word" contains the current source res. destination length. If the bit "order ready with error" is set, the length word contains the data amount transferred before the failure occurred.

**Status and error reports**

The following section lists important status and error messages of the CPU that can appear in the "Indicator word". The representation is in "HEX" patterns. The literal X means "not declared" res. "irrelevant"; No. is the error number.

X F X A - The error index "F" shows, that the according order is not defined on the CP. The state index "A" causes a block of this order (for SEND/FETCH and RECEIVE).

X A X A - The error index "A" shows that the connection of the communication order is not (yet) established. Together with the state index "A" SEND, RECEIVE and FETCH are blocked.

X 0 X 8 - The connection has been established again (e.g. after a CP reboot), the SEND order is released (SEND-communication order).

X 0 X 9 - The connection has been established again, the RECEIVE order is released (RECEIVE-communication order).

X 0 2 4 - SEND has been worked off without errors, the data was transferred.

X 0 4 5 - RECEIVE was successful, the data arrived at the AG.

X 0 X 2 - The SEND-, RECEIVE-, READ- res. WRITE order is still running. At SEND the partner is not yet ready for RECEIVE or vice versa.

**Important indicator word states**

**Messages at SEND**

| State at H1 | Prio 0/1 | Prio 2 | Prio 3/4 |
|---|---|---|---|
| **State at TCP/IP** | **Prio 1** | **Prio 2** | **Prio 3** |
| after reboot | 0 A 0 A | 0 A 0 A | 0 0 0 8 |
| after connection start | X 0 X 8 | X 0 X 8 | ..... |
| after initial impulse | X 0 X 2 | X 0 X 2 | X 0 X 2 |
| ready without error | X 0 2 4 | X 0 2 4 | X 0 2 4 |
| ready with error | X No X 8 | X No X 8 | X No X 8 |
| after RESET | X D X A | X D X A | X D X 8 |

**Messages at RECEIVE**

| State at H1 | Prio 0/1 | Prio 2 | Prio 3/4 |
|---|---|---|---|
| **State at TCP/IP** | **Prio 1** | **Prio 2** | **Prio 3** |
| after reboot | 0 A 0 A | 0 A 0 A | 0 0 0 1 |
| after connection start | X 0 X 4 | X 0 0 9 | ..... |
| after initial impulse | X 0 X 2 | X 0 X 2 | X 0 X 2 |
| Telegramm da | X 0 X 1 | ..... | ..... |
| ready without error | X 0 4 1 | X 0 4 5 | X 0 4 5 |
| ready with error | X No X 8 | X No X 9 | X No X 9 |
| after RESET | X D X A | X D X A | X D X 9 |

**Messages at READ/WRITE-ACTIVE**

| State at H1 | Prio 0/1 | Prio 2 | Prio 3/4 |
|---|---|---|---|
| **State at TCP/IP** | **Prio 1** | **Prio 2** | **Prio 3** |
| after reboot | | 0 A 0 A | |
| after connection start | | X 0 0 8 | |
| after initial impulse | | X 0 X 2 | |
| READ ready | | X 0 4 4 | |
| WRITE ready | | X 0 2 4 | |
| ready with error | | X No X 8 | |
| after RESET | | X D X A | |

### 15.1.2.5 Parameterization error *PAFE*

The parameterization error byte *PAFE* is set (output or bit memory), when the block detects a "parameterization error", e.g. there is no interface or there is an invalid parameterization of *QANF* / *ZANF*. *PAFE* has the following structure:

| Byte | Bit 7 ... Bit 0 |
|---|---|
| 0 | ■ Bit 0: error<br>– 0: no error<br>– 1: error, error-No. in Bit 4 ... Bit 7<br>■ Bit 3 ... Bit 1: reserved<br>■ Bit 7 ... Bit 4: error number<br>– 0: no error<br>– 1: wrong ORG-Format<br>– 2: area not found (DB not found)<br>– 3: area too small<br>– 4: QVZ-error<br>– 5: wrong indicator word<br>– 6: no Source-/Destination parameters at SEND/RECEIVE ALL<br>– 7: interface not found<br>– 8: interface not specified<br>– 9: interface overflow<br>– A: reserved<br>– B: invalid order-No.<br>– C: interface of CP doesn't quit or is negative<br>– D: Parameter *BLGR* not allowed<br>– E: reserved<br>– F: reserved |

### 15.1.3 SFC 230 - SEND - Send to page frame

**Description**

The SEND block initializes a send order to a CP. Normally SEND is called in the cyclic part of the user application program. Although the insertion of this block into the interrupt or the time-alarm program part is possible, the indicator word (*ANZW*), however, may not be updated cyclically. This should be taken over by a CONTROL block.

The connection initialization with the CP for data transmission and for activating a SEND impulse is only started, if:

- the FB RLO (result of operation) received "1".
- the CP released the order.
  (Bit "order active" in *ANZW* = 0).

During block stand-by, only the indicator word is updated.

> ***VIPA specific block***
> *The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| IND | IN | INT | Mode of addressing |
| QANF | IN | ANY | Pointer to data source |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

**SEND_ALL for data transmission**

If the CP is able to take over the data directly, the SEND block transfers the requested data in one session. If the CP requests only the order parameters or the amount of the depending data is too large, the CP only gets the sending parameters res. the parameter with the first data block. The according data res. the assigned serial blocks for this order are requested from the CP by SEND_ALL to the CPU. For this it is necessary that the block SEND_ALL is called minimum one time per cycle. The user interface is for all initialization types equal, only the transfer time of the data is postponed for minimum one CPU cycle.

### 15.1.4 SFC 231 - RECEIVE - Receive from page frame

**Description**

The RECEIVE block receives data from a CP. Normally the RECEIVE block is called in the cyclic part of the user application program. Although the insertion of this block into the interrupt or the waking program part is possible, the indicator word cannot be updated cyclically. This should be taken over by a CONTROL block.

The handshake with the CP (order initialization) and for activating a RECEIVE block is only started, if

- the FB RLO received "1".
- the CP released the order (Bit "Handshake convenient" = 1).

> ***VIPA specific block***
>
> *The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| IND | IN | INT | Mode of addressing |
| ZANF | IN | ANY | Pointer to data destination |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

If the block runs in stand-by only the indicator word is updated. The RECEIVE block reacts different depending from the kind of supply and the CP reaction:

- If the CP transmits a set of parameters although the RECEIVE block itself got destination parameters, the parameter set of the block has the priority above those of the CP.
- Large amounts of data can only be transmitted in blocks. Therefore you have to transmit the assigned serial blocks by means of RECEIVE_ALL to the CPU. It is necessary that the block RECEIVE_ALL is called minimum one time per application cycle and CP interface, if you want to transmit larger data amounts. You also have to integrate the RECEIVE_ALL cyclically, if the CP only uses the RECEIVE for releasing a receipt telegram and the data is transmitted via the background communication of the CPU.

### 15.1.5 SFC 232 - FETCH - Fetch from page frame

**Description**

The FETCH block initializes a FETCH order in the partner station. The FETCH order defines data source and destination and the data source is transmitted to the partner station. The CPU from VIPA realizes the definition of source and destination via a pointer parameter. The partner station provides the Source data and transmits them via SEND_ALL back to the requesting station. Via RECEIVE_ALL the data is received and is stored in Destination. The update of the indicator word takes place via FETCH res. CONTROL.

The handshake for initializing FETCH is only started, if

- the FB RLO receives "1".
- the function has been released in the according CP indicator word (order active = 0).

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| IND | IN | INT | Mode of addressing |
| ZANF | IN | ANY | Pointer to data destination |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

*Information for indirect parameterization* *Chapter 15.1.2.3 'Source res. destination definition' on page 517*

## 15.1.6 SFC 233 - CONTROL - Control page frame

**Description**

The purpose of the CONTROL block is the following:

- Update of the indicator word
- Query if a certain order of the CP is currently "active", e.g. request for a receipt telegram
- Query the CP which order is recently in commission

The CONTROL block is not responsible for the handshake with the CP, it just transfers the announcements in the order status to the parameterized indicator word. The block is independent from the RLO and should be called from the cyclic part of the application.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

**ANR**

If *ANR* ≠ 0, the indicator word is built up and handled equal to all other handling blocks. If the parameter *ANR* gets 0, the CONTROL command transmits the content of the order state cell 0 to the LOW part of the indicator words. The order state cell 0 contains the number of the order that is in commission, e.g. the order number of a telegram (set by the CP).

## 15.1.7 SFC 234 - RESET - Reset page frame

**Description**

The RESET ALL function is called via the order number 0. This resets all orders of this logical interface, e.g. deletes all order data and interrupts all active orders. With a direct function (*ANR* ≠ 0) only the specified order will be reset on the logical interface. The block depends on the RLO and may be called from cyclic, time or alarm controlled program parts.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| PAFE | OUT | BYTE | Parameterization error |

**Operating modes**

The block has two different operating modes:

- RESET ALL
- RESET DIRECT

### 15.1.8 SFC 235 - SYNCHRON - Synchronization page frame

**Description**

The SYNCHRON block initializes the synchronization between CPU and CP during the boot process. For this it has to be called from the starting OBs. Simultaneously the transition area of the interface is deleted and predefined and the CP and the CPU agree about the block size.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↪ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| BLGR | IN | INT | Block size |
| PAFE | OUT | BYTE | Parameterization error |

**Block size**

To avoid long cycle run-times it is convenient to split large data amounts into smaller blocks for transmitting them between CP and CPU. You declare the size of these blocks by means of "block size". A large block size = high data throughput, but also longer run-times and therefore a high cycle time strain. A small block size = smaller data throughput, but also shorter run-times of the blocks. Following block sizes are available:

| Value | Block size | Value | Block size |
|---|---|---|---|
| 0 | Default (64byte) | 4 | 128byte |
| 1 | 16byte | 5 | 256byte |
| 2 | 32byte | 6 | 512byte |
| 3 | 64byte | 255 | 512byte |

| | |
|---|---|
| Parameter type: | Integer |
| Valid range: | 0 ... 255 |

### 15.1.9 SFC 236 - SEND_ALL - Send all to page frame

**Description**

Via the SEND_ALL block, the data is transmitted from the CPU to the CP by using the declared block size. Location and size of the data area that is to transmit with SEND_ALL, must be declared before by calling SEND res. FETCH. In the indicator word that is assigned to the concerned order, the bit "Enable/Disable" is set, "Data transmission starts" and "Data transmission running" is calculated or altered.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

**ANZW**

In the indicator word of the block, that is parameterized in the SEND_ALL block, the current order number is stored (0 means stand-by). The amount of the transmitted data for one order is shown in the data word of SEND_ALL which follows the indicator word.

*In the following cases, the SEND_ALL command has to be called for minimum one time per cycle of the block OB 1:*

- *if the CP is able to request data from the CPU independently.*
- *if a CP order is initialized via SEND, but the CP still has to request the background communication data of the CPU for this order.*
- *if the amount of data, that should be transmitted by this SEND to the CP, is higher than the declared block size.*

### 15.1.10 SFC 237 - RECEIVE_ALL - Receive all from page frame

**Description**

Via the RECEIVE_ALL block, the data received from the CP is transmitted from the CP to the CPU by using the declared block size. Location and size of the data area that is to transmit with RECEIVE_ALL, must be declared before by calling RECEIVE. In the indicator word that is assigned to the concerned order, the bit "Enable/Disable" is set, "Data transition starts" and "Data transition/fetch running" is analyzed or altered. The receiving amount is shown in the following word.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

**ANZW**

In the indicator word of the block, that is parameterized in the RECEIVE_ALL block, the current order number is stored. In the stand-by running mode of RECEIVE_ALL the block indicator word is deleted.

*In the following cases, the RECEIVE_ALL command has to be called for minimum one time per cycle of the block OB 1:*

– *if the CP should send data to the CPU independently.*
– *if a CP order is initialized via RECEIVE, but the CP still has to request the "background communication" data of the CPU for this order.*
– *if the amount of data that should be transmitted to the CPU by this RECEIVE, is higher than the declared block size.*

### 15.1.11 SFC 238 - CTRL1 - Control1 page frame

**Description**

This block is identical to the CONTROL block SFC 233 except that the indicator word is of the type Pointer and that it additionally includes the parameter *IND*, reserved for further extensions. The purpose of the CONTROL block is the following:

- Update of the indicator word.
- Query if a certain order of the CP is currently active, e.g. request for a receipt telegram
- Query the CP which order is recently in commission

The CONTROL block is not responsible for the handshake with the CP; it just transfers the announcements in the order status to the parameterized indicator word. The block is independent from the RLO and should be called from the cyclic part of the application.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 ‘Include VIPA library’ on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| SSNR | IN | INT | Interface number |
| ANR | IN | INT | Job number |
| IND | IN | INT | Reserved |
| PAFE | OUT | BYTE | Parameterization error |
| ANZW | IN_OUT | DWORD | Indicator word |

**ANR**

If *ANR* ≠ 0, the indicator word is built up and handled equal to all other handling blocks. If the parameter *ANR* gets 0, the CONTROL command transmits the content of the order state cell 0 to the LOW part of the indicator words. The order state cell 0 contains the number of the order that is in commission, e.g. the order number of a telegram (set by the CP).

**IND**

The parameter *IND* has no functionality at this time and is reserved for further extensions.

**ANZW**

The indicator word *ANZW* is of the type Pointer. This allows you to store the indicator word in a data block.

## 15.2 MMC Functions standard CPUs

### 15.2.1 SFC 220 ... 222 - MMC Access

**Overview**

By means of these blocks there is the possibility to integrate MMC access to your application program. Here a new file may be created respectively an existing file may be opened for accessed when a MMC is plugged-in. As long as you do not open another file, you may access this file via read/write commands.

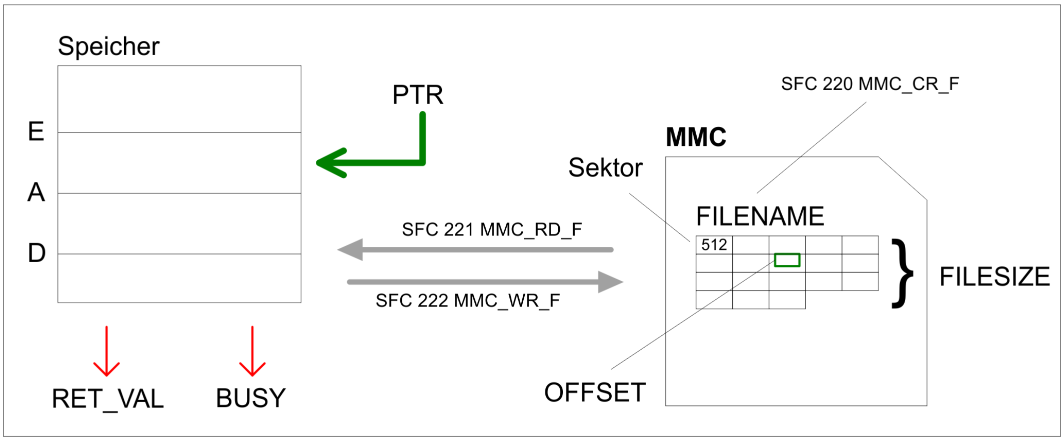
**Restrictions**

For deploying the SFCs 220, 221 and 222, you have to regard the following restrictions:

- A read res. write access to the MMC is only possible after creation res. opening of the file via SFC 220.
- The data on MMC must not be fragmented, for only complete data blocks may be read res. written.
- When transferring data to the MMC from an external reading device, they may be fragmented, i.e. the data is divided into blocks. This may be avoided by formatting the MMC before the write access.
- At a write access from the CPU to the MMC, the data is always stored not fragmented.
- When opening an already existing file, you have to use the same *FILENAME* and *FILESIZE* that you used at creation of this file.
- A MMC is structured into sectors. Every sector has a size of 512byte. Sector overlapping writing or reading is not possible. Access to sector overlapping data is only possible by using a write res. read command for every sector. By giving the offset, you define the according sector.

The following picture shows the usage of the single SFCs and their variables:

**CPU**




*For read and write accesses to the MMC, you firstly have to open the file with SFC 220!*

### 15.2.2 SFC 220 - MMC_CR_F - create or open MMC file

**Overview**

By means of this SFC a new file may be created respectively an existing file may be opened for accessed when a MMC is plugged-in. As long as you do not open another file, you may access this file via read/write commands. For more detailed information to this and to the restrictions *Chapter 15.2.1 'SFC 220 ... 222 - MMC Access' on page 533*.

*Since calling the SFC from the OB 1 can result in a cycle time-out, instead of this you should call the SFC from the OB 100.*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| FILENAME | IN | STRING[254] | Name of file |
| FILESIZE | IN | DWORD | Size of file |
| RET_VAL | OUT | WORD | Return value (0 = OK) |

**FILENAME**

Type in the file name used to store the data on the MMC. The name inclusive end ID may not exceed a maximum length of 13 characters:

- 8 characters for name
- 1 character for "."
- 3 characters for file extension
- 1 character 00h as end ID

*For software technical reasons you have to enter 00h into the byte next to the file name (end ID of the file name).*

**FILESIZE**

The *FILESIZE* defines the size of the user data in byte. When accessing an already existing file, it is mandatory to give not only the *FILENAME* but also the *FILESIZE*. The entry of a "Joker" length is not supported at this time.

**Structure**

| Byte 0 | Byte 1 | Byte 2 | Byte 3 | ... | Byte 255 |
|---|---|---|---|---|---|
| Max. length | occupied length | ASCII value 1 | ASCII value 2 | ... | ASCII value 254 |

**RET_VAL (Return Value)**

Word that returns a diagnostic/error message. 0 means OK.

| Value | Description |
|---|---|
| *Diagnostic messages* | |
| 0000h | No errors (appears if new file is generated). |
| 0001h | File already exists, is not fragmented and the length value is identical or smaller. |
| 8001h | No or unknown type of MMC is plugged-in. |
| *Error messages* | |
| 8002h | No FAT on MMC found. |
| A001h | File name missing. This message appears if file name is inside a not loaded DB. |
| A002h | File name wrong (not 8.3 or empty) |
| A003h | File exists but *FILESIZE* too bigger than existing file. |
| A004h | File exists but is fragmented and cannot be opened. |
| A005h | Not enough space on MMC. |
| A006h | No free entry in root directory. Depending on the used MMC there may be min. 16 up to max. 512 entries in the root directory. |
| B000h | An internal error occurred. |

### 15.2.3 SFC 221 - MMC_RD_F - read from MMC file

**Description**

Via the SFC 221 you may read data from a MMC. For read and write accesses to the MMC, you firstly have to open the file with SFC 220 and it has to be not fragmentized. For more detailed information to this and to the restrictions *Chapter 15.2.1 'SFC 220 ... 222 - MMC Access' on page 533*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| PTR | IN | ANY | Pointer to area for reading data |
| OFFSET | IN | DWORD | Offset of data within the file |
| BUSY | OUT | BOOL | Job state |
| RET_VAL | OUT | WORD | Return value (0 = OK) |

**PTR**

This variable of the type pointer points to a data area in the CPU where the content of the MMC has to be written to.

**OFFSET**

Here you define the start address inside the file on the MMC from where on the data has to be transferred to the CPU.

**BUSY** During data transfer this bit remains set. The bit is reset as soon as the data transfer is complete.

**RET_VAL (Return Value)** Word that returns a diagnostic/error message. 0 means OK.

| Value | Description |
|---|---|
| 0000h | No errors (data was read) |
| 8001h | No or unknown type of MMC is plugged-in |
| 8002h | No FAT found on MMC |
| 9000h | Bit reading has been tried (Boolean variable). Bit reading is not possible. |
| 9001h | Pointer value is wrong (e.g. points outside DB) |
| 9002h | File length exceeded |
| 9003h | Sector limit of 512 has been tried to overrun. Sector overrun reading is not possible. |
| B000h | An internal error occurred. |

### 15.2.4 SFC 222 - MMC_WR_F - write to MMC file

**Description** Via the SFC 222, you may write to the MMC. For read and write accesses to the MMC, you firstly have to open the file with SFC 220 and it has to be not fragmentized. For more detailed information to this and to the restrictions *Chapter 15.2.1 'SFC 220 ... 222 - MMC Access' on page 533*.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Description |
|---|---|---|---|
| PTR | IN | ANY | Pointer to area for writing data |
| OFFSET | IN | DWORD | Offset of data within the file |
| BUSY | OUT | BOOL | Job state |
| RET_VAL | OUT | WORD | Return value (0 = OK) |

**PTR** This variable of the type pointer points to a data area from where on the data starts that will be written to the MMC.

**OFFSET** This defines the beginning of the data inside the file on the MMC where the data is written to.

**BUSY** During data transfer this Bit remains set. The Bit is reset as soon as the data transfer is complete.

**RET_VAL (Return Value)** Word that returns a diagnostic/error message. 0 means OK.

| Value | Description |
|---|---|
| 0000h | No errors |
| 8001h | No or unknown type of MMC is plugged-in. |
| 8002h | No FAT found on MMC. |
| 9000h | Bit writing has been tried (Boolean variable). Bit writing is not possible. |
| 9001h | Pointer value is wrong (e.g. points outside DB). |
| 9002h | File length exceeded. |
| 9003h | Sector limit of 512 has been tried to overrun. Sector overrun reading is not possible. |
| B000h | An internal error occurred. |

## 15.3 File Functions SPEED7 CPUs

### 15.3.1 FC/SFC 195 and FC/SFC 208...215 - Memory card access

**Overview**

The FC/SFC 195 and FC/SFC 208 ... FC/SFC 215 allow you to include the memory card access into your user application. The following parameters are necessary for the usage of the FC/SFCs:

***HANDLE, FILENAME***

The access takes place via a *HANDLE* number. That is assigned to a *FILENAME* via a call of the FC/SFC 208 FILE_OPN res. FC/SFC 209 FILE_CRE. At the same time a max. of 4 *HANDLE* may be opened (0 ... 3). To close an opened file call the FC/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 FC/SFC 213 FILE_SEK you may shift the write/read flag from an *ORIGIN* position for an *OFFSET* (number Bytes).

***REQ, BUSY***

- With *REQ* = 1 you activate the according function.
- *REQ* = 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 FC/SFC 211 and FC/SFC 212). |
| 7000h ≤ RETVAL < 8000h: | Monitors the execution state of the function. |
| RETVAL ≥ 8000h: | Indicates an error that is described more detailed in the according FC/SFC. |

**CAUTION!**

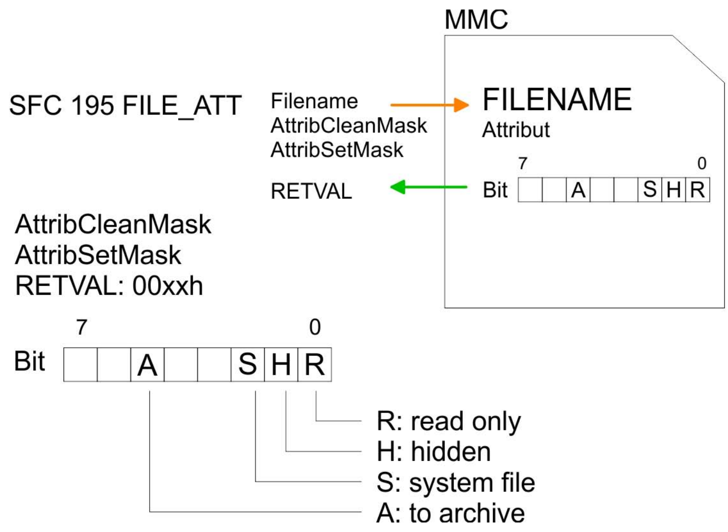
For the access of the memory card you must regard the following hints. Nonobservance may cause data loss at the memory card:

- 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 FC/SFCs only gives you access to the top directory level (Root directory) of the memory card!
- You may only rename or delete files that you've closed before with FC/SFCs 210 FILE_CLO!

## 15.3.2 FC/SFC 195 - FILE_ATT - Change file attributes

**Description**

In the root directory of the memory card 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.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| RETVAL | OUT | WORD | Return value (00xxh=OK with xx: attributes) |
| BUSY | OUT | BOOL | Function is busy |

***RETVAL (Return value)***

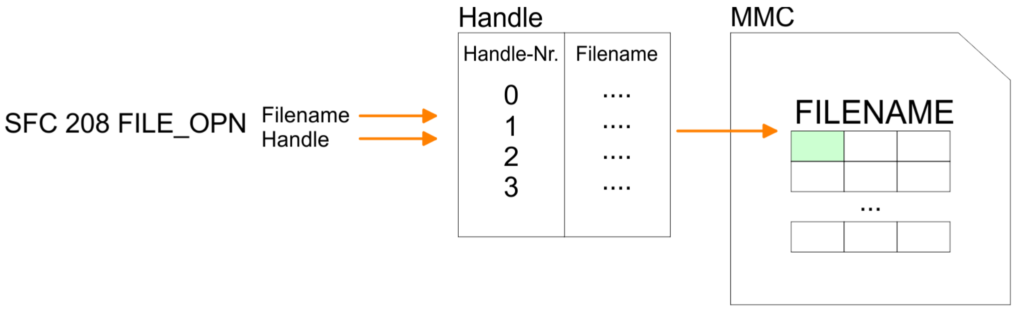
Return codes of *RETVAL*:

| Code | Description |
|---|---|
| 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 |
| A007h | Memory card is write protected |
| A010h | File error FILENAME |
| A100h | General file system error (e.g. no memory card plugged) |

### 15.3.3 FC/SFC 208 - FILE_OPN - Open file

**Description**

You may open a file on the memory card with FC/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 FC/SFC 210 FILE_CLO. *REQ* = 1 initializes the function. After the opening the read/write flag is at 0.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 |

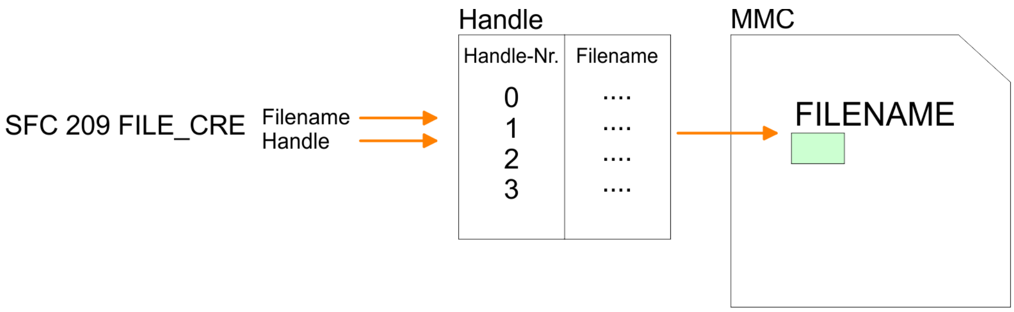
***RETVAL (Return value)*** Codes that are returned by *RETVAL*:

| Code | Description |
|---|---|
| 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*<br>(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 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 memory card plugged) |

## 15.3.4 FC/SFC 209 - FILE_CRE - Create file

**Description**

By using this block you may create a new file with the entered file name on the memory card (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.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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:

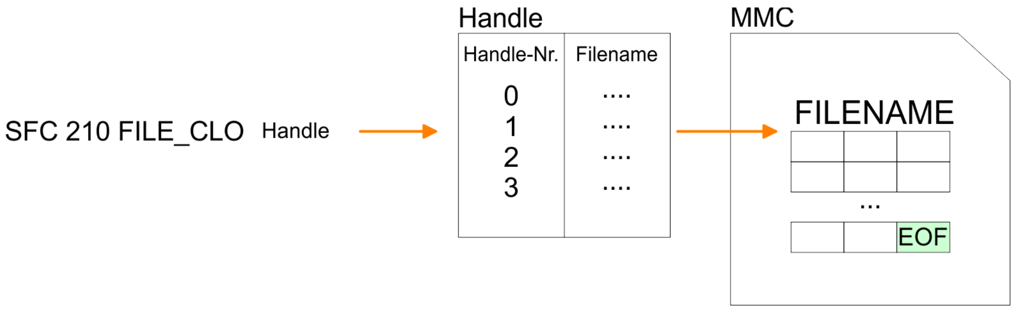
| Code | Description |
|---|---|
| 0000h | OK |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |
| 8010h | Parameter *FILENAME* is not present (e.g. DB not loaded) |
| 8011h | Error *FILENAME* (not conform with 8.3 or special character) |
| 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 |

| Code | Description |
|---|---|
| A004h | No root-entry is available in the directory |
| A005h | Memory card is write-protected |
| A100h | General file system error (e.g. no memory card plugged) |

### 15.3.5 FC/SFC 210 - FILE_CLO - Close file

**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.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *↳ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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*:

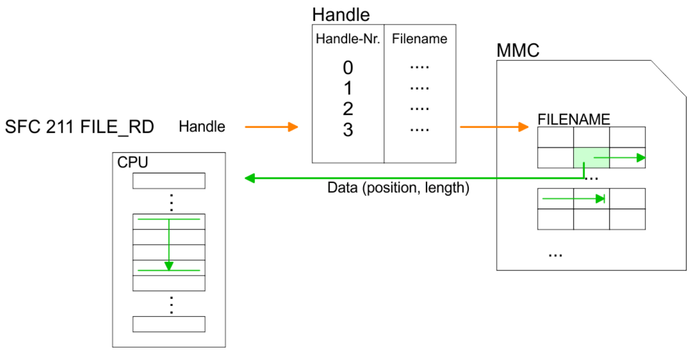
| Code | Description |
|---|---|
| 0000h | OK |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |
| 8100h | The defined *HANDLE* is invalid |
| 9001h | The *HANDLE* is not assigned to a file name |
| 9002h | Another function has been called via this *HANDLE* and is ready |

| Code | Description |
|---|---|
| 9003h | Another function has been called via this *HANDLE* and is not ready |
| A000h | System internal error occurred |
| A100h | General file system error (e.g. no memory card plugged) |

### 15.3.6 FC/SFC 211 - FILE_RD - Read file

**Description**

This allows you to transfer data from the memory card 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.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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*:

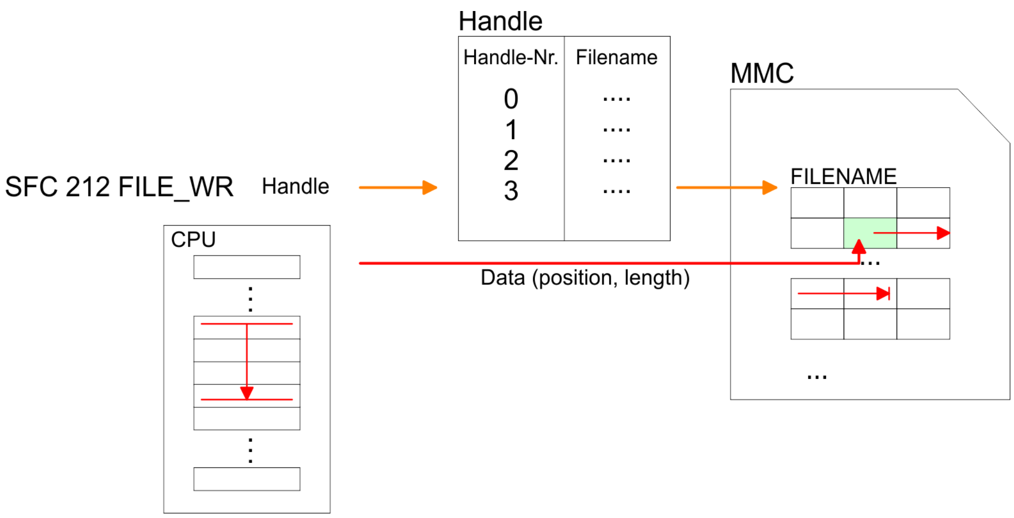
| Code | Description |
|---|---|
| 0xxxh | 0 = OK, 0xxx = Length of read data |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |

| Code | Description |
|---|---|
| 8010h | Pointer in *DATA* has type *BOOL* |
| 8011h | Pointer in *DATA* cannot be decoded (e.g. DB not loaded) |
| 8012h | Data length exceeds 512byte |
| 8013h | A write access to a write-protected DB happened |
| 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 memory card plugged) |

### 15.3.7 FC/SFC 212 - FILE_WR - Write file

**Description**

Use this block for write access to the memory card. This writes data from the position and length of the CPU defined under *DATA* to the memory card 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.




***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQ | IN | BOOL | Activate function |
| HANDLE | IN | INT | Index of file 0 ... 3 |

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| DATA | IN | ANY | Pointer to PLC memory and data length |
| RETVAL | OUT | WORD | Return value |
| 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)***

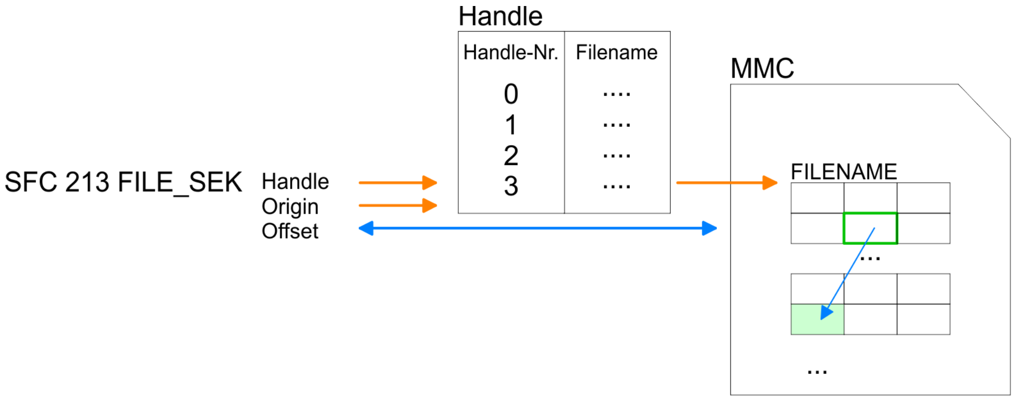
Codes that are returned by *RETVAL*:

| Code | Description |
|---|---|
| 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 |
| A004h | Memory card is write-protected |
| A100h | General file system error (e.g. no memory card plugged) |

### 15.3.8 FC/SFC 213 - FILE_SEK - Position pointer

**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.




*VIPA specific block*

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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*:

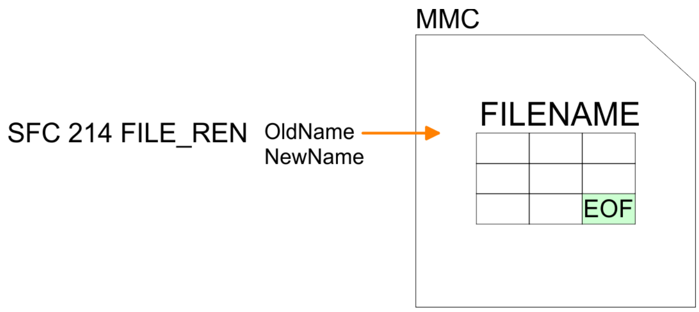
| Code | Description |
|---|---|
| 0000h | OK, *OFFSET* contains the current write-/read position |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |
| 8100h | The defined *HANDLE* is not valid |
| 9001h | For this *HANDLE* no file is opened |
| 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 memory card plugged) |

### 15.3.9 FC/SFC 214 - FILE_REN - Rename file

**Description**

Using FILE_REN you may alter the file name defined in *OLDNAME* to the file name that you type in *NEWNAME*.

**CAUTION!**
Please regard that you may only rename files that you've closed before with FILE_CLO. Nonobservance may cause data loss at the memory card!




***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 | Description |
|---|---|
| 0000h | OK, file has been renamed |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |
| 8010h | Parameter *OLDNAME* is not present (e.g. DB not loaded) |

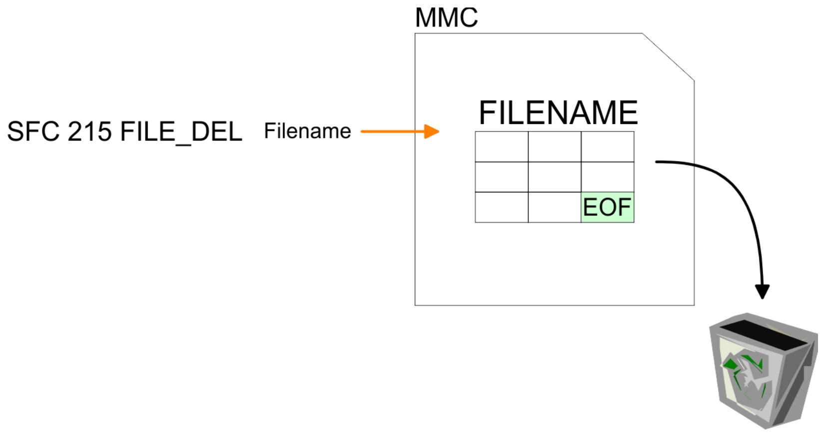
| Code | Description |
|---|---|
| 8011h | Error *OLDNAME*<br>(not conform with 8.3 format or special character) |
| 8020h | Parameter *NEWNAME* is not present (e.g. DB not loaded) |
| 8021h | Error *NEWNAME*<br>(not conform with 8.3 format or special character) |
| A000h | System internal error occurred |
| A001h | The defined MEDIA type is not valid |
| A003h | The new filename NEWNAME already exists |
| A004h | File *OLDNAME* is not found |
| A006h | File *OLDNAME* is just open |
| A007h | Memory card write-protected |
| A100h | Error occurs when file creation (e.g. no memory card plugged) |

### 15.3.10 FC/SFC 215 - FILE_DEL - Delete file

**Description**

This block allows you to delete a file at the memory card. For this, type the file name of the file to delete under *FILENAME*.

**CAUTION!**
Please regard that you may only delete files that you've closed before with FILE_CLO. Nonobservance may cause data loss at the memory card!




***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *↪ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| 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 | Description |
|---|---|
| 0000h | OK, file has been deleted |
| 7000h | *REQ* = 0, *BUSY* = 0 (nothing present) |
| 7001h | *REQ* = 1, 1. call |
| 7002h | Block is executed |
| 8010h | Parameter *FILENAME* is not available (e.g. DB not loaded) |
| 8011h | *FILENAME* is defective<br>(e.g. is not conform with 8.3 format or special character) |
| A000h | System internal error occurred |
| A001h | The defined *MEDIA* type is not valid |
| A002h | The file is write-protected |
| A004h | File *FILENAME* is not found |
| A005h | *FILENAME* is a directory - you cannot delete |
| A006h | File is just open |
| A007h | Memory card is write-protected |
| A100h | General file system error (e.g. no memory card plugged) |

## 15.4 System Functions

### 15.4.1 SFC 75 - SET_ADDR - Set PROFIBUS MAC address

**Description**

With this SFC you can change the MAC address of the integrated PROFIBUS interface of a CPU. The function is only possible in the passive DP slave mode. To identify the diagnostic address is used. The SFC is asynchronous and can be applied only to one interface. At STOP and subsequent warm start the set network address is retained. With PowerOFF-PowerON or on overall reset the interface gets the configured node number The DP slave consistently assumes the identity of the DP slave with the new address. For the DP master the DP slave with the old address fails and a DP slave with the new address returns. If an address is selected, which is already used by another node on the DP line, then both slaves fail in accordance to the DP communication.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Memory area | Description |
|---|---|---|---|---|
| REQ | INPUT | BOOL | I, Q, M, D, L | Function request with *REQ* = 1 |
| LADDR | INPUT | WORD | I, Q, M, D, L | Identification of the interface |
| ADDR | INPUT | BYTE | I, Q, M, D, L | New node address |
| RET_VAL | OUTPUT | INT | I, Q, M, D, L | Error code |
| BUSY | OUTPUT | BOOL | I, Q, M, D, L | *BUSY* = 1: In progress |

**RET_VAL (return value)**

| Value | Description |
|---|---|
| 0000h | Job has been executed without error |
| 7000h | Function request with *REQ* = 0 (call without processing)<br>*BUSY* is set to 0, no data transfer is active |
| 7001h | First call with *REQ* = 1: Data transfer started *BUSY* is set to 1 |
| 7002h | Intermediate call (*REQ* irrelevant): Data transfer started *BUSY* is set to 1 |
| 8xyyh | General error information<br>*Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |
| 8090h | Identification of the interfaces: Logical address is not valid |
| 8091h | New node address is not valid |
| 8093h | Identification of the interfaces: Logical address is no interface |
| 809Bh | Function not executable (e.g.. interface is no DP slave or active) |
| 80C3h | There are no resources (e.g. multiple call of the SFC) |

## 15.4.2 FC/SFC 193 - AI_OSZI - Oscilloscope-/FIFO function

**Description**

- The FC/SFC 193 serves for controlling the oscilloscope-/FIFO function of analog input channels with this functionality.
- It allows to start the recording and to read the buffered data.
- Depending upon the parameterization there are the following possibilities:

***Oscilloscope operation***

- Depending on the trigger condition at edge evaluation the monitoring of the configured channel may be started respectively at manual operation the recording may be started.
- The recorded measuring values may be accessed by the FC/SFC 193 as soon as the buffer is full.

***FIFO operation***

- Start the recording.
- Read the puffer at any time.

*The FC/SFC may only be called from on level of priority e.g. only from OB 1 or OB 35.*

*The module is to be parameterized before.*

*For starting and reading in each case the FC/SCF 193 is to be called. The differentiation of both variants takes place in the parameter MODE.*

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Function depending on MODE |
|---|---|---|---|
| REQ | IN | BOOL | Execute function (start/read) |
| LADR | IN | WORD | Base address of the module |
| MODE | IN | WORD | Mode (start/read) |
| CHANNEL | IN | BYTE | Channel to be read |
| OFFSET | IN | DWORD | Address offset for reading (not FIFO operation) |
| RECORD | IN | ANY | Memory for the read data |
| RETVAL | OUT | WORD | Return value (0 = OK) |
| BUSY | OUT | BOOL | Function is busy |
| TIMESTAMP | OUT | DWORD | Time stamp (only at edge evaluation) |
| LEN | INOUT | DWORD | Number of values to be handled per channel |

***REQ***

- Depending on the set *MODE* when the bit is set the recording respectively the reading may be started.
- Depending on the trigger condition at edge evaluation the monitoring of the configured channel may be started respectively at manual operation the recording may be started.
- The data are read from the module, if "read" is set at *MODE*.

***LADR***

Logical basic address of the module.

***MODE***

The FC/SFC 193 may be called with 3 different modes. The corresponding mode may be set by the parameter *MODE*. The configured mode is executed by setting *REQ*. The following values are supported:

- 01h: Starts recording respectively edge monitoring depending upon the parameterization.
- 00h: Read data within several cycles until *BUSY* = 0.
- 80h: Read data with one access.

***CHANNEL***

Here the channel is specified to be read. With each call one channel may be read. This parameter is irrelevant at start calls with *MODE* = 01h.

***OFFSET***

- Offset specifies an address offset for the reading process. By this you get access to sub-ranges of the recorded data.
- The value for the maximum offset depends on the number of values, which were recorded per channel.
- *OFFSET* is not supported in FIFO operation. It will be ignored.

***RECORD***

- Here an area for the read values to be stored at may be defined.
- In FIFO operation every value of the selected channel may be read, which were stored up to the time of start reading.
- Please regard that the buffer has a sufficient size for the data to be buffered, otherwise an error is reported.

***BUSY***

- *BUSY* = 1 indicates that the function just processed.
- *BUSY* = 0 indicates that the function is finished.

***TIMESTAMP***

- There is an internal clock with a resolution of 1µs running in every SPEED-Bus module.
- The returned value corresponds to the time at the SPEED-Bus module, on which the trigger event occurred.
- *TIMESTAMP* is only available at the edge triggered oscilloscope operation.
- It is valid as long as the job is running (*RETVAL* = 7xxxh) and bit 4 of byte 0 is set respectively the job has been finished without an error (*RETVAL* = 0000h).

***LEN***

The length parameter realized as IN/OUT is variably interpreted depending on the selected mode at the function call.

**Mode: start (MODE: = 01h)**

At *MODE* = 01h this parameter may only be used at the manual oscilloscope start. Here the requested number of values per channel to be buffered may be assigned. In this mode there is no value reported by *LEN*.

**Mode: read (MODE: = 00h or 80h)**

At *MODE* = 00h respectively 80h the number of values to be read may be set. This parameter is ignored in FIFO operation. The number of the read values is returned by *LEN*.

***RETVAL (Return value)***

In addition to the module specific error codes listed here, there general FC/SFC error information may be returned as well.

| RETVAL | Description depending on the BUSY-Bit | BUSY |
|---|---|---|
| Byte | | |
| 0 | Bit 1, 0: | |
| | 00: Call with REQ: = 0 (idle, waiting for *REQ* = 1) | 0 |
| | 01: First call with *REQ*: = 1 | 1 |
| | 10: Subsequent call with *REQ*: = 1 | 1 |

| RETVAL | Description depending on the BUSY-Bit | BUSY |
|---|---|---|
| | 11: Oscilloscope is just recording | 1 |
| | Bit 2: REQ: = 1, but recording was not yet started. (*MODE*: = 00h or *MODE*: = 80h) | 0 |
| | Bit 3: reserved | - |
| | Bit 4: Trigger event occurred and recording is just running. | 1 |
| | Bit 5: Waiting for trigger event | 1 |
| | Bit 7…6: reserved | - |
| 1 | Bit 0: reserved | - |
| | Bit 1: The number of recorded values exceeds the target area defined by *RECORD* (in words). | 0 |
| | Bit 2: The number of the recorded values exceeds the area defined by *LEN* and *OFFSET*. | 0 |
| | Bit 3: Buffer overflow in FIFO operation. | 0 |
| | Bit 7...4: | |
| | 0000: Job finished without an error | 0 |
| | 0111: Job still running | 1 |
| | 1000: Job finished with error | 0 |

***Job finished without an error***

| RETVAL | Description depending on the BUSY-Bit | BUSY |
|---|---|---|
| 0000h | Job was finished without an error. | 0 |

***Job finished with error***

| RETVAL | Description depending on the BUSY-Bit | BUSY |
|---|---|---|
| 8002h: | Oscilloscope-/FIFO function is not configured. | 0 |
| 8003h: | An internal error occurred - please contact VIPA. | 0 |
| 8005h: | The selected channel may not be read - wrong channel number. | 0 |
| 8007h: | The value at *OFFSET* exceeds the number of recorded values. | 0 |
| 8090h: | There is no SPEED-Bus module with this address available. | 0 |
| 80D2h: | *LADR* exceeds the peripheral address area. | 0 |

### 15.4.3 FC/SFC 194 - DP_EXCH - Data exchange with CP342S

**Description**

With the FC/SFC 194 you can exchange data between your CPU and a PROFIBUS DP master, which is connected via SPEED-Bus. Normally each PROFIBUS DP master embeds its I/O area into the peripheral area of the CPU. Here you can address a periphery range of 0 ... 2047 via the hardware configuration. Since this limits the maximum number of PROFIBUS DP master modules at the SPEED-Bus, there is the possibility to deactivate the mapping at the appropriate DP master and to activate instead the access via handling blocks. Here you can write data from the CPU in a defined area of the DP master and read data from a defined area of the DP master.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library.* *Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Functionality depending on MODE |
|---|---|---|---|
| LADR | IN | WORD | Base address of the DP master module on the SPEED-Bus |
| MODE | IN | WORD | Modus (0 = read / 1 = write) |
| LEN | IN | WORD | Length of the data area in the DP master |
| OFFSET | IN | DWORD | Begin of the data area in the DP master |
| RETVAL | OUT | WORD | Return value (0 = OK) |
| DATA | IN OUT | ANY | Pointer to the data area of the CPU |

***LADR***

Logical base address of the module.

***MODE***

Den FC/SFC 194 may be called with the following modes:

- 0000 = Transfer data from the DP master to the CPU.
- 0001 = Transfer data from the CPU to the DP master.

***LEN***

Here the length of the data area in the DP master is defined.

***OFFSET***

Here the beginning of the data area in the DP master is defined. Please consider that the area defined via *OFFSET* and *LEN* does not exceed the area defined of the DP master by the hardware configuration.

***RETVAL (Return value)***

In addition to the module-specific error codes listed here, as return value there are also general error codes possible for FC/SFCs . *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64*

| RETVAL | Description |
|---|---|
| 0000h | No error |
| 8001h | *LADR* could not be assigned to a DP master at the SPEED-Bus. |
| 8002h | The value of the parameter *MODE* is out of range. |
| 8003h | The value of the parameter *LEN* is 0. |
| 8004h | The value of the parameter *LEN* is greater than the data area defined at *DATA*. |
| 8005h | The area defined by *OFFSET* and *LEN* is out of the range 0 …2047. |

| RETVAL | Description |
|---|---|
| 8006h | The DP master specified by *LADR* is not configured for access via handling block. Activate in the properties of the DP master "IO-Mode HTB". |
| 8008h | There are gap(s) in the input area. |
| 8009h | There are gap(s) in the output area. |
| 8010h | Error while accessing the input area (e.g. DP master is not reachable) |
| 8011h | Error while accessing the output area (e.g. DP master is not reachable) |
| 8Fxxh | Error at DATA (xx) *Chapter 4.1 'General and Specific Error Information RET_VAL' on page 64* |

### 15.4.4 FC/SFC 219 - CAN_TLGR - CANopen communication

**FC/SFC 219 CAN_TLGR SDO request to CAN master**

Every SPEED7-CPU provides the integrated FC/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 *SUBINDEX*. Via SDO per each access a max. of one data word process data can be transferred.

***VIPA specific block***

*The VIPA specific blocks can be found in the VIPA library. Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Data type | Description |
|---|---|---|---|
| REQUEST | IN | BOOL | Activate function |
| SLOT_MASTER | IN | BYTE | SPEED-Bus slot (101 ... 116) |
| NODEID | IN | BYTE | CAN address (1 ... 127) |
| TRANSFERTYP | 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 FC/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 node (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 | Description |
|---|---|
| 0503 0000h | Toggle Bit not alternated |
| 0504 0000h | SDO Time out value reached |
| 0504 0001h | Client/server command specify not valid, unknown |
| 0504 0002h | Invalid block size (only block mode) |
| 0504 0003h | Invalid sequence number (only block mode) |
| 0504 0004h | CRC error (only block mode) |
| 0504 0005h | Insufficient memory |
| 0601 0000h | Attempt to read a write only object |
| 0601 0001h | Attempt to write a read only object |
| 0602 0000h | Object does not exist in the object dictionary |
| 0604 0041h | Object cannot be mapped to the PDO |
| 0604 0042h | The number and length of the objects to be mapped would exceed PDO length. |
| 0604 0043h | General parameter incompatibility reason |
| 0604 0047h | General internal incompatibility reason in the device |
| 0606 0000h | Access failed because of an hardware error |
| 0607 0010h | Data type does not match, length of service parameter does not match. |
| 0607 0012h | Data type does not match, length of service parameter exceeded. |
| 0607 0013h | Data type does not match, length of service parameter shortfall. |
| 0609 0011h | Sub index does not exist |
| 0609 0030h | Value range of parameter exceeded (only for write access) |
| 0609 0031h | Value of parameter written too high |

| Code | Description |
|---|---|
| 0609 0032h | Value of parameter written too low |
| 0609 0036h | Maximum value is less than minimum value |
| 0800 0000h | General error |
| 0800 0020h | Data cannot be transferred or stored to the application. |
| 0800 0021h | Data cannot be transferred or stored to the application because of local control. |
| 0800 0022h | Data cannot be transferred or stored to the application because of the present device state. |
| 0800 0023h | 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 | Description |
|---|---|
| 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 4byte, at SDO write access at least 1byte, 2byte or 4byte). |
| F024h | FC/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 *‘CANOPENERROR’ on page 556*. |
| 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 FC/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.

*When the SDO request has been executed without errors, RETVAL contains the length of the valid response data (1, 2 or 4byte) and CANOPENERROR the value 0.*

## 15.4.5 FC/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 FC/SFC 254 must be included in your project as block.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *↬ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Parameter | Declaration | Type | Description |
|---|---|---|---|
| READ/WRITE | IN | Byte | 0 = Read, 1 = Write |
| LADDR | IN | WORD | Logical Address INTERBUS master |
| IBS_ADDR | IN | WORD | Address 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.

## 15.5 System Function Blocks

### 15.5.1 SFB 7 - TIMEMESS - Time measurement

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 InstDB. Another call with *RESET* = 0 displays the difference in µs via *VALUE*.

***VIPA specific block***
*The VIPA specific blocks can be found in the VIPA library.* *↬ Chapter 6 'Include VIPA library' on page 98*

**Parameters**

| Name | Declaration | Type | Comment |
|---|---|---|---|
| RESET | IN | BOOL | *RESET* = 1 start timer |
| VALUE | OUT | DWORD | Difference in µs |

***RESET***

*RESET* = 1 transfers the current timer value to InstDB. Here *VALUE* is not influenced.

***VALUE***

After a call with *RESET* = 0, *VALUE* returns the time difference between the two SFB 7 calls.

# 16 SSL System status list

## 16.1 Overview SSL

**SSL**

This chapter describes all the partial lists of the system status list, readable via SFC 51 RDSYSST or via Hardware configurator. SSL partial lists, which are only for internal usage, are not described here.The SSL (**s**ystem **s**tatus **l**ist) describes the current status of a automation system. It contains the following information:

- System data
  - These are fixed or assigned characteristics data of a CPU as configuration of the CPU, status of the priority classes and communication.
- Module status data in the CPU
  - This describes the current status of the components monitored by system diagnostic functions.
- Diagnostics data
  - The diagnostics data of modules with diagnostic capabilities assigned to the CPU.
- Diagnostics buffer
  - Diagnostic entries of the diagnostic buffer in the order in which they occur.

**SSL partial list**

- Only partial lists of the SSL may be accessed. The partial lists are virtual list, this means, they are only created by the operating system of the CPUs when specifically requested and my only be read.
- A partial list or a list extract may be read e.g. by means of the SFC 51 RDSYSST.
- Here with the parameters SSL_ID and INDEX you define the kind of information to read.

A partial list always has the following structure:

- Header
  - SSL-ID
  - Index
  - Length of the record set in byte
  - Number of record sets of the partial list
- Record sets
  - A record set of a partial list has a certain length, depending on the information of the partial list. It depends on the partial list as the data words are used in a record set.

**SSL-ID**

**Structure**

| | SSL-ID | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | Module class:<br>CPU: 0000<br>IM: 0100<br>FM: 1000<br>CP: 1100 | | | | Number of the partial list extract:<br>Definition of the subset of the partial list | | | | Number of the partial list:<br>Definition of the partial list of the SSL | | | | | | | |

## 16.2 Overview - SSL partial lists

**SSL partial lists**

In the following all the possible SSL partial lists with additional SSL-ID are listed, which are supported by the SPEED7 system.

SSL partial lists, which are only for internal usage, are no more described.

| SSL partial list | SSL-ID |
|---|---|
| Module identification | xy11h |
| CPU characteristics | xy12h |
| User memory areas | xy13h |
| System areas | xy14h |
| Block Types | xy15h |
| Status of all LEDs | xy19h |
| Identification of the component | xy1Ch |
| Interrupt status | xy22h |
| Communication status data | xy32h |
| Ethernet details of the module | xy37h |
| Status of the TCON Connections | xy3Ah |
| Status of the LEDs | xy74h |
| Status information CPU | xy91h |
| Stations status information (DPM) | xy92h |
| Stations status information (DPM, PROFINET-IO and EtherCAT) | xy94h |
| Module status information (PROFIBUS DP, PROFINET-IO, EtherCAT) | xy96h |
| Diagnostic buffer of the CPU | xyA0h |
| Module diagnostic information (record set 0) | xyB1h |
| Module diagnostic information (record set 1)<br>via physical address | xyB2h |
| Module diagnostic information (record set 1)<br>via logical address | xyB3h |
| Diagnostic data of a DP slave | xyB4h |
| Information EtherCAT master/slave | xyE0h |
| EtherCAT bus system | xyE1h |
| Statistics information to OBs | xyFAh |
| Status of the VSC features from the System SLIO CPU | xyFCh |

## 16.3 Module Identification - SSL-ID: xy11h

**Description**

With the *SSL-ID* xy11h you obtain the module identification data of your module.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0011h | - | All identification data |
| 0111h | | Selection of the identification data: |
| | 0001h | Identification data of the module |
| | 0006h | Identification data of the basic hardware |
| | 0007h | Identification data of the basic firmware |
| | 0081h | Identification data of the VIPA firmware |
| | 0082h | Identification of the SVN version CPU |
| | 0083h | Identification of the version CP |
| | 6501h* | Identification of the module: CP at 1. SPEED-Bus slot (User slot = 101) |
| | 6506h* | Identification of the basic hardware: CP at 1. SPEED-Bus slot (User slot = 101) |
| | 6507h* | Identification of the basic firmware: CP at 1. SPEED-Bus slot (User slot = 101) |
| | 6601h* | Identification of the module: CP at 2. SPEED-Bus slot (User slot = 102) |
| | 6606h* | Identification of the basic hardware: CP at 2. SPEED-Bus slot (User slot = 102) |
| | 6607h* | Identification of the basic firmware: CP at 2. SPEED-Bus slot (User slot = 102) |
| | 6701h* | Identification of the module: CP at 3. SPEED-Bus slot (User slot = 103) |
| | 6706h* | Identification of the basic hardware: CP at 3. SPEED-Bus slot (User slot = 103) |
| | 6707h* | Identification of the basic firmware: CP at 3. SPEED-Bus slot (User slot = 103) |
| | 6801h* | Identification of the module: CP at 4. SPEED-Bus slot (User slot = 104) |
| | 6806h* | Identification of the basic hardware: CP at 4. SPEED-Bus slot (User slot = 104) |
| | 6807h* | Identification of the basic firmware: CP at 4. SPEED-Bus slot (User slot = 104) |
| | 6901h* | Identification of the module: CP at 5. SPEED-Bus slot (User slot = 105) |
| | 6906h* | Identification of the basic hardware: CP at 5. SPEED-Bus slot (User slot = 105) |
| | 6907h* | Identification of the basic firmware: CP at 5. SPEED-Bus slot (User slot = 105) |
| | 6A01h* | Identification of the module: CP at 6. SPEED-Bus slot (User slot = 106) |
| | 6A06h* | Identification of the basic hardware: CP at 6. SPEED-Bus slot (User slot = 106) |

| SSL_ID | INDEX | Description |
|---|---|---|
| | 6A07h* | Identification of the basic firmware: CP at 6. SPEED-Bus slot (User slot = 106) |
| | 6B01h* | Identification of the module: CP at 7. SPEED-Bus slot (User slot = 107) |
| | 6B06h* | Identification of the basic hardware: CP at 7. SPEED-Bus slot (User slot = 107) |
| | 6B07h* | Identification of the basic firmware: CP at 7. SPEED-Bus slot (User slot = 107) |
| | 6C01h* | Identification of the module: CP on 8. SPEED-Bus slot (User slot = 108) |
| | 6C06h* | Identification of the basic hardware: CP at 8. SPEED-Bus slot (User slot = 108) |
| | 6C07h* | Identification of the basic firmware: CP at 8. SPEED-Bus slot (User slot = 108) |
| | 6D01h* | Identification of the module: CP at 9. SPEED-Bus slot (User slot = 109) |
| | 6D06h* | Identification of the basic hardware: CP at 9. SPEED-Bus slot (User slot = 109) |
| | 6D07h* | Identification of the basic firmware: CP at 9. SPEED-Bus slot (User slot = 109) |
| | 6E01h* | Identification of the module: CP at 10. SPEED-Bus slot (User slot = 110) |
| | 6E06h* | Identification of the basic hardware: CP at 10. SPEED-Bus slot (User slot = 110) |
| | 6E07h* | Identification of the basic firmware: CP at 10. SPEED-Bus slot (User slot = 110) |
| | CE01h* | Identification of the module: CP at CPU (User slot = 206) |
| | CE06h* | Identification of the basic hardware: CP at CPU (User slot = 206) |
| | CE07h* | Identification of the basic firmware: CP at CPU (User slot = 206) |
| 0F11h | - | only SSL partial list header information |
| *) This INDEX only exists in the CPUs 300S+ (up on V3.7) | | |

| | |
|---|---|
| LENTHDR | One record set is 14words long (28bytes). |
| N_DR | Number of record sets |

**Record set** ***SSL_ID: xy11h***

**CPU is not configured as Siemens 318-2AJ00**

| Name | Length | Description |
|---|---|---|
| Index | 1word | Number of a identification record set |
| Mlfb | 20byte | ■ 0001h and 0006h: Order number (MlfB) of the module; string of 19 characters and one blank (20h) e.g. 6ES7 315-2EH14<br>■ 0007h: Space (20h)<br>■ 0081h: VIPA product name and hardware release: e.g. VIPA 015-CEFPR00-0100<br>■ 0082h: Text: "SVN Revision"<br>■ 0083h: Text: "SVN Revision CP" |
| BGTyp | 1word | reserved |
| Ausbg1 | 1word | ■ 0001h and 0006h: Hardware release of the module<br>■ 0007h: "V" and first digit of the version ID<br>■ 0081h: VIPA version ID: First digit in ASCII, second digit in hex<br>■ 0082h: High word of "SVN revision" in hex<br>■ 0083h: High word of "SVN revision CP" in hex |
| Ausbg2 | 1word | ■ 0001h and 0006h: reserved<br>■ 0007h: remaining digits of the version ID<br>■ 0081h: VIPA version ID: third and fourth digit in hex<br>■ 0082h: Low word of "SVN revision" in hex<br>■ 0083h: Low word of "SVN revision CP" in hex |

**CPU is configured as Siemens 318-2AJ00**

| Name | Length | Description |
|---|---|---|
| Index | 1word | Number of an identification record set |
| MlfB | 20byte | ■ 0001h and 0006h: Order number (MlfB) of the module; string of 19 characters and one blank (20h) e.g. 6ES7 318-2AJ00-0AB0<br>■ 0007h: VIPA product name and hardware release: e.g. VIPA 317-4NE23-0119 |
| BGTyp | 1word | reserved |
| Ausbg1 | 1word | ■ 0001h and 0006h: Hardware release of the module<br>■ 0007h: "V" and first digit of the version ID |
| Ausbg2 | 1word | ■ 0001h and 0006h: reserved<br>■ 0007h: remaining digits of the version ID |

**CP**

| Name | Length | Description |
|---|---|---|
| Index | 1word | Number of an identification record set (0x6501h ... 0xCE07h) |
| MlfB | 20byte | ■ xx01h and xx06h: Order number (MlfB) of the module; string of 19 characters and one blank (20h)<br>■ xx07h: VIPA product name |
| BGTyp | 1word | reserved |

| Name | Length | Description |
|---|---|---|
| Ausbg1 | 1word | ■ xx01h and xx06h: Hardware release of the module<br>■ xx07h: "V" and first digit of the version ID |
| Ausbg2 | 1word | ■ xx01h and xx06h: reserved<br>■ xx07h: remaining digits of the version ID |

## 16.4 CPU characteristics - SSL-ID: xy12h

**Description**

Here you can determine the hardware-specific characteristics of your CPU by specifying the appropriate feature code.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0012h | - | All CPU characteristics |
| 0112h | | CPU characteristics of one group: |
| | 0000h | MC7 processing unit |
| | 0100h | Time system |
| | 0200h | System response |
| | 0300h | MC7 language description of the CPU |
| 0E11h | 0F12h | SSL partial list header information |

| | |
|---|---|
| LENTHDR | One record set is 1word long (2bytes). |
| N_DR | Number of record sets |

**Record set**

***SSL_ID: 0012h***

All record sets of the CPU characteristics relevant for your CPU are listed. They follow completely one behind the other. One record set is 1word long. For each feature there is an ID. This ID is 1word long. You will find the list of the characteristics IDs on the following page.

***SSL_ID: 0112h***

All data records relevant for the group are listed. They follow completely one behind the other.

**Characteristics identifier**

| Identifier | Description |
|---|---|
| **0000h - 00FFh** | **MC7 processing unit** |
| 0001h | MC7 processing generating code |
| 0002h | MC7 interpreter |
| **0100h - 01FFh** | **Time system** |
| 0101h | 1ms resolution |
| 0102h | 10ms resolution |

| Identifier | Description |
|---|---|
| 0103h | no real time clock |
| 0104h | BCD time-of-day format |
| 0105h | all time-of-day functions<br>(set time-of-day, set and read time-of-day, time-of-day synchronization: time-of-day slave and time-of-day master) |
| **0300h - 03FFh** | **MC7 language description of the CPU** |
| 0301h | reserved |
| 0302h | all 32 bit fixed-point instructions |
| 0303h | all floating-point instructions |
| 0304h | sin, asin, cos, acos, tan, atan, sqr, sqrt, in, exp |
| 0305h | ACCU3/ACCU4 with corresponding instructions<br>(ENT, PUSH, POP, LEAVE) |
| 0306h | Master Control Relay instructions |
| 0307h | Address register 1 exists with corresponding instructions |
| 0308h | Address register 2 exists with corresponding instructions |
| 0309h | Operations for area-crossing addressing |
| 030Ah | Operations for area-internal addressing |
| 030Bh | all memory-indirect addressing instructions via M |
| 030Ch | all memory-indirect addressing instructions via DB |
| 030Dh | all memory-indirect addressing instructions via DI |
| 030Eh | all memory-indirect addressing instructions for L |
| 030Fh | all instructions for parameter transfer in FCs |
| 0310h | Memory bit edge instructions via I |
| 0311h | Memory bit edge instructions via Q |
| 0312h | Memory bit edge instructions via M |
| 0313h | Memory bit edge instructions via DB |
| 0314h | Memory bit edge instructions via DI |
| 0315h | Memory bit edge instructions via L |
| 0316h | Dynamic evaluation of the FC bits |
| 0317h | Dynamic local data area with the corresponding instructions |

## 16.5 User memory areas - SSL-ID: xy13h

**Description**

With the partial list with the SSL-ID xy13h you obtain information about the memory areas of the CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0013h | xxxx | Record sets for any memory areas |

| SSL_ID | INDEX | Description |
|---|---|---|
| 0013h | xxxx | Record sets for any memory areas |
| | 0001h | Work memory |
| | 0002h | Load memory integrated |
| | 0003h | Load memory plugged |
| | 0004h | Max. plug-in load memory |
| | 0005h | Size of backup memory |
| 0F13h | xxxx | SSL partial list header information |

| | |
|---|---|
| LENTHDR | One record set is 18words long (36byte). |
| N_DR | Number of record sets |

**Record set *SSL_ID: xy13h***

| Name | Length | Description |
|---|---|---|
| index | 1word | Not relevant |
| code | 1word | Type of memory:<br>■ 0001h: volatile memory (RAM)<br>■ 0002h: non volatile memory (RAM)<br>■ 0003h: mixed memory (RAM and EPROM) |
| größe | 2words | Total size of the selected memory<br>(total of area Ber1 and Ber2) |
| modus | 1word | Logical mode of the memory:<br>■ Bit 0: RAM<br>■ Bit 1: EPROM<br>■ Bit 2: RAM and EPROM<br>For work memory:<br>■ Bit 3: Code and data separated<br>■ Bit 4: Code and data together |
| granu | 1word | 0 (fix) |
| ber1 | 2words | Size of the RAM in byte |
| belegt1 | 2words | Size of the RAM being used |
| block1 | 2words | Largest free block in the RAM<br>■ "0": no information available or cannot be determined. |
| ber2 | 2words | Size of the EPROM in byte |

| Name | Length | Description |
|---|---|---|
| belegt2 | 2words | Size of the EPROM being used |
| block2 | 2words | Largest free block in the EPROM<br>■ "0": no information available or cannot be determined. |

## 16.6 System areas - SSL-ID: xy14h

**Description**

If you read the partial list with SSL-ID xy14h, you obtain information about the system areas of the CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0014h | - | All system areas of a CPU |
| 0F14h | - | SSL partial list header information |

| | |
|---|---|
| LENTHDR | One record set is 4words long (8byte) |
| N_DR | Number of record sets<br>■ You must at least assign a number of 9 record sets.<br>■ If you select a target area, which is too small, the SFC 51 RDSYSST does not provide a record set. |

**Record set *SSL_ID: xy14h***

| Name | Length | Description |
|---|---|---|
| index | 1word | Index of the system area<br>■ 0001h: PII (quantity in byte)<br>■ 0002h: PIQ (quantity in byte)<br>■ 0003h: Memory (number in bits)<br>– This index is only provided by the CPU, where the number of flags can be shown in one word. If your CPU does not provide this value, you must evaluate index 0008h<br>■ 0004h: Timers (quantity)<br>■ 0005h: Counters (quantity)<br>■ 0006h: Quantity of bytes in the logical address area.<br>■ 0007h: Local data (entire local data area of the CPU in byte)<br>– This index is only provided by the CPU, where the number of local data area can be shown in one word. If your CPU does not provide this value, you must evil index 0009h<br>■ 0008h: Memory (number in bytes)<br>■ 0009h: Local data (entire local data area of the CPU in kbytes) |
| code | 1word | Memory type:<br>■ 0001h: RAM<br>■ 0002h: EPROM |
| quantity | 1word | Number of elements of the system area defined by *INDEX*. |
| remain | 1word | Number of retentive elements defined by *INDEX*. |

## 16.7 Block Types - SSL-ID: xy15h

**Description**

You obtain the block types (OBs, DBs, SDBs, FCs and FBs) that exists on the CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0015h | - | Record sets of all block types of a CPU (Standard blocks) |
| 0115h | xxxh | Record set of a block type of a CPU |
| 0815h | xxxh | Record set of a block type of a CPU (VIPA specific blocks) |
| 0F15h | - | Returns the number of records and the size of the data sets for standard blocks |
| 8F15h | - | Returns the number of records and the size of the data sets for VIPA blocks |

| | |
|---|---|
| LENTHDR | one record set is 5words long (10byte) |
| N_DR | Number of record sets |

**Record set *SSL-ID: 0115h***

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | Block type number:<br>■ 0800h: OB<br>■ 0A00h: DB<br>■ 0B00h: SDB<br>■ 0C00h: FC<br>■ 0E00h: FB<br>■ 8800h: VOB<br>■ 8A00h: VDB<br>■ 8B00h: VSDB<br>■ 8C00h: VFC<br>■ 8E00h: VFB |
| MaxAnz | 1word | Maximum number of blocks of the type:<br>■ at OBs:<br>– max. possible number of OBs for a CPU<br>■ at DBs:<br>– max. possible number of DBs including DB0<br>■ at SDBs:<br>– max. possible number of SDBs including SDB2<br>■ at FCs and FBs:<br>– max. possible number of loadable blocks |
| MaxLng | 1word | Maximum total size of the object to be loaded in kbytes |
| Maxabl | 2words | Maximum length of the work memory part of a block in bytes |

**Record set *SSL-ID: 0815h***

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | Block type number (VIPA specific)<br>■ 8800h: VOB<br>■ 8A00h: VDB<br>■ 8B00h: VSDB<br>■ 8C00h: VFC<br>■ 8E00h: VFB |
| MaxAnz | 1word | Maximum number of blocks of the type:<br>■ at OBs:<br>– max. possible number of OBs for a CPU<br>■ at DBs:<br>– max. possible number of DBs including DB0<br>■ at SDBs:<br>– max. possible number of SDBs including SDB2<br>■ at FCs and FBs:<br>– max. possible number of loadable blocks |
| MaxLng | 1word | Maximum total size of the object to be loaded in kbytes |
| Maxabl | 2words | Maximum length of the work memory part of a block in bytes |

## 16.8 Status of all LEDs - SSL-ID: xy19h

**Description**

You obtain information about the status of all LEDs from your CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| | | Status of the LEDs |
| 0019h | - | Status of all LEDs (without VIPA specific) |
| 0119h | xxxxh | Status of one LED, to specify via INDEX |
| 0E19h | xxxxh | Status of all VIPA specific LEDs |
| 0F19h | - | SSL partial list header information |

| | |
|---|---|
| LENTHDR | one record set is 2words long (4byte) |
| N_DR | Number of record sets |

**Record set *SSL-ID: xy19h***

| Name | Length | 0019h | 0119h | 0E19h | Value | Description LED |
|---|---|---|---|---|---|---|
| INDEX | 1word | x | x | - | 0001h | 0001h: SF (Group error) |
| | | x | x | - | 0004h | RUN |
| | | x | x | - | 0005h | STOP |
| | | x | x | - | 0006h | FRCE (Force) |

| Name | Length | 0019h | 0119h | 0E19h | Value | Description LED |
|---|---|---|---|---|---|---|
| | | x | x | - | 0008h | BATF (always "0") |
| | | x | x | - | 000Bh | DP Master BUSF1 (Bus error interface 1) |
| | | x | x | - | 000Ch | BF LED only at EtherCAT and PROFINET |
| | | x | x | - | 0015h | MT LED (not MICRO CPU) |
| | | - | x | x | 0100h | CP LED (VIPA specific) (not MICRO CPU) |
| | | - | x | x | 1000h | Access to memory card LED (VIPA specific) |
| | | - | x | x | 1001h | PROFIBUS Data Exchange slave LED (VIPA specific) (not MICRO CPU) |
| | | - | x | x | 1002h | MICRO: Status bar ( left green) |
| | | - | x | x | 1003h | MICRO: Status bar ( right green) |
| | | - | x | x | 1004h | MICRO: Status bar ( left red) |
| | | - | x | x | 1005h | MICRO: Status bar ( right yellow) |
| | | - | x | x | 2000h | PROFIBUS master RUN LED (VIPA specific, SLIO CPU = 0) (not MICRO CPU) |
| | | - | x | x | 2001h | PROFIBUS master ERR LED (VIPA specific) (not MICRO CPU) |
| | | - | x | x | 2002h | PROFIBUS master Data Exchange LED (VIPA specific) (not MICRO CPU) |
| | | - | x | x | 2003h | PROFIBUS master IF LED (VIPA specific, SLIO CPU = 0) (not MICRO CPU) |
| | | - | x | x | 6501h* | SF (Group error) from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6504h* | RUN from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6505h* | STOP from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6601h* | SF (Group error) from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6604h* | RUN from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6605h* | STOP from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6701h* | SF (Group error) from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6704h* | RUN from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6705h* | STOP from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6801h* | SF (Group error) from CP on 4. SPEED-Bus slot (User slot = 104) |
| | | - | x | x | 6804h* | RUN vom CP from CP on 4. SPEED-Bus slot (User slot = 104) |
| | | - | x | x | 6805h* | STOP from CP on 4. SPEED-Bus slot (User slot = 104) |

| Name | Length | 0019h | 0119h | 0E19h | Value | Description LED |
|---|---|---|---|---|---|---|
| | | - | x | x | 6901h* | SF (Group error) from CP on 5. SPEED-Bus slot (User slot = 105) |
| | | - | x | x | 6904h* | RUN from CP on 5. SPEED-Bus slot (User slot = 105) |
| | | - | x | x | 6905h* | STOP from CP on 5. SPEED-Bus slot (User slot = 105) |
| | | - | x | x | 6A01h* | SF (Group error) from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6A04h* | RUN from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6A05h* | STOP from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6B01h* | SF (Group error) from CP on 7. SPEED-Bus slot (User slot = 107) |
| | | - | x | x | 6B04h* | RUN from CP on 7. SPEED-Bus (User slot = 107) |
| | | - | x | x | 6B05h* | STOP from CP on 7. SPEED-Bus (User slot = 107) |
| | | - | x | x | 6C01h* | SF (Group error) from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6C04h* | RUN from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6C05h* | STOP from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6D01h* | SF (Group error) from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6D04h* | RUN from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6D05h* | STOP from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6E01h* | SF (Group error) from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | 6E04h* | RUN from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | 6E05h* | STOP from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | CE01h* | SF (Group error) from CP to CPU (User slot = 206) |
| | | - | x | x | CE04h* | RUN from CP to CPU (User slot = 206) |
| | | - | x | x | CE05h* | STOP from CP to CPU (User slot = 206) |
| *) This INDEX only exists in the CPUs 300S+ (ab V3.7) | | | | | | |
| Led_on | 1byte | 1byte | 1byte | 1byte | | Status of one LED:<br>■ 0: off<br>■ 1: on |

| Name | Length | 0019h | 0119h | 0E19h | Value | Description LED |
|---|---|---|---|---|---|---|
| Blink Code | 1byte | 1byte | 1byte | 1byte | | Flashing status of the LEDs: (decimal)<br>■ 0: off<br>■ 1: flashing normally (2Hz)<br>■ 2: flashing slowly (0.5Hz)<br>– **Note:** EtherCat systemic flashing frequency 1Hz<br>■ 3: flashing with 1Hz (VIPA specific LED)<br>■ 4: flashing with 4Hz (VIPA specific LED)<br>■ 5: flashing with 2.5Hz (VIPA specific LED)<br>■ 6: flashing with 10Hz (VIPA specific LED)<br>■ 7: cyclically: short (200 ms) flashes once then off for 1000ms. (VIPA specific LED)<br>■ 8: cyclical: flashes twice briefly (200ms) then off for 1000ms. (VIPA specific LED)<br>■ 9: cyclically: three short flashes (200ms) then off for 1000ms. (VIPA specific LED)<br>■ 10: cyclical: remains 4 seconds, then 2 seconds off. (VIPA specific LED) |
| *) This INDEX only exists in the CPUs 300S+ (ab V3.7) | | | | | | |

## 16.9 Identification of the component - SSL-ID: xy1Ch

**Description**

If you read the partial list you can identify the CPU or the automation system.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 001Ch | - | Identification of all components |
| 011Ch | | Identification of one component: |
| | 0001h | Name of the automation system |
| | 0002h | Name of the module |
| | 0003h | Plant identification of the module |
| | 0005h | Serial number of the module |
| | 0006h | Reserved for the operating system |
| | 0007h | Module type name |
| | 0008h | Serial number of the memory card - CID without CardType |
| | 000Ah | OEM identification of the module |
| | 000Bh | Location identifier of the module |
| | 00E0h | Serial number at the key file in the activated memory card (only at *SSL_ID 011Ch*) |
| | 00E1h | Serial number at the key file in the plugged memory card (only at *SSL_ID 011Ch*) |
| | 00FFh | Serial number of the memory card - CID with CardType (only at *SSL_ID 011Ch*) |
| 0F1Ch | - | SSL partial list header information |

| | |
|---|---|
| LENTHDR | ■ A record set is 17words long (34byte):<br>– at INDEX < 00E0h<br>■ A record set is 5words long (10byte):<br>– at INDEX = 00E0h, 00E1h<br>■ A record set is 19words long (38byte):<br>– at INDEX = 00FFh |
| N_DR | Number of record sets<br>■ 0009h: at SSL: 001Ch<br>■ 0001h: at SSL: 011Ch |

**Record set *SSL_ID: 011Ch***

| INDEX | Name | Length | Description |
|---|---|---|---|
| 0001h | name | 12words | Name of the automation system<br>(max. 24 characters) * |
| | res | 4words | reserved |
| 0002h | name | 12words | Name of the module (max. 24 characters) * |
| | res | 4words | reserved |
| 0003h | tag | 16words | Plant identification of the module<br>(max. 32 characters) * |
| | res | 4words | reserved |
| 0005h | serialn | 12words | Serial number of the module<br>(max. 24 characters) * |
| | res | 3words | reserved |
| 0007h | cputypname | 16words | Module type name as character string<br>(max. 32 characters) * |
| 0008h | sn_cid | 16words | Serial number of the memory card CID without CardType: (max. 32 characters) *<br>CID without CardType: |
| | | | at MMC card: "MMC " + serial number |
| | | | at SD card: "SD " + serial number<br>(Product serial number from CID ) |
| | | | if no card is plugged: 0 |
| 000Ah | oem | 1word | OEM identification of the module |
| 000Bh | ok | 1word | Location identifier of the module |
| 00E0h | sn_act | 1word | Serial number at the key file in the activated memory card (only at *SSL_ID* x11Ch) |
| 00E1h | sn_plug | 1word | Serial number at the key file in the plugged memory card (only at *SSL_ID* x11Ch) |
| 00FFh | cid | | Serial number of the memory card (only at *SSL_ID* x11Ch) CID with CardType: |
| | | 2words | Manufacturer ID |

| INDEX | Name | Length | Description |
|---|---|---|---|
| | | 2words | Application ID |
| | | 4words | Product Name |
| | | 2words | Product Revision |
| | | 2words | Product Serial Number |
| | | 2words | Manufacturer Month |
| | | 2words | Manufacturer Year |
| | | 2words | Card Type:<br>■ 0 = MMC<br>■ 1 = SD<br>■ 2 = SDHC |

*) If names and designations are shorter than the corresponding max. characters, the gaps are filled with 00h.

## 16.10 Interrupt status - SSL-ID: xy22h

**Description**

This partial list contains information about the current status of interrupt processing and interrupt generation in the module.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0222h | | Record set on the specified interrupt.<br>The interrupt class is to be specified via INDEX: |
| | 0001h | OB 1 (Free cycle) |
| | 000Ah | OB 10 (Time-of-day interrupt) |
| | 000Bh | OB 11 (Time-of-day interrupt) |
| | 0014h | OB 20 (Time-delay interrupt) |
| | 0015h | OB 21 (Time-delay interrupt) |
| | 001Ch | OB 28 (VIPA Watchdog Interrupt) |
| | 001Dh | OB 29 (VIPA Watchdog Interrupt) |
| | 0020h | OB 32 (Watchdog Interrupt) |
| | 0021h | OB 33 (Watchdog Interrupt) |
| | 0022h | OB 34 (Watchdog Interrupt) |
| | 0023h | OB 35 (Watchdog Interrupt) |
| | 0028h | OB 40 (Hardware Interrupt) |
| | 0029h | OB 41 (Hardware Interrupt) |
| | 0037h | OB 55 (Status Interrupt) |
| | 0038h | OB 56 (Update Interrupt) |
| | 0039h | OB 57 (Manufacturer Specific Interrupt) |
| | 003Dh | OB 61 (Clock synchronous error) |
| | 0050h | OB 80 (Asynchronous error) |
| | 0051h | OB 81 (Asynchronous error) |
| | 0052h | OB 82 (Asynchronous error) |
| | 0053h | OB 83 (Asynchronous error) |
| | 0055h | OB 85 (Asynchronous error) |
| | 0056h | OB 86 (Asynchronous error) |
| | 0057h | OB 87 (Asynchronous error) |
| | 0064h | OB 100 (Reboot) |
| | 0066h | OB 102 (Reboot) |
| | 0079h | OB 121 (Synchronous error) |
| | 007Ah | OB 122 (Synchronous error) |

| | |
|---|---|
| LENTHDR | A record set is 14words long (28bytes) |
| N_DR | Number of record sets (here always 1) |

**Record set *SSL_ID: xy22h***

| Name | Length | Description |
|---|---|---|
| info | 10words | Start info for the given OB, with following exceptions:<br>■ OB 1 provides the current minimum (in bytes 8 and 9) and maximum cycle time (in bytes 10 and 11)<br>(time base: ms, byte count begins at 0).<br>■ When a job is active for a time-delay interrupt, bytes 8 ... 11 (byte count begins at) get the remaining time in ms left of the delay time set as a parameter.<br>■ OB 80 contains the configured minimum (in bytes 8 and 9) and maximum cycle time (in bytes 10 and 11)<br>(time base: ms, byte count begins at 0).<br>■ Error interrupts without the current information.<br>■ Interrupts contain the status info from the current parameter settings of the interrupt source.<br>■ In the case of synchronous errors, the priority class entered is 7Fh if the OBs were not yet processed; otherwise, the priority class of the last call.<br>■ If an OB has several start events and these have not yet occurred at the information time, then event no. xyzzh is returned with:<br>x: event class<br>y: undefined<br>zz: smallest defined number in the group<br>Otherwise, the number of the last start event that occurred is used. |
| al 1 | 1word | Processing identifiers:<br>■ Bit 0: Interrupt event is caused by parameters:<br>– 0: enabled<br>– 1: disabled<br>■ Bit 1: Interrupt event as per SFC 39 DIS_IRT<br>– 0: not locked<br>– 1: locked<br>■ Bit 2: 1: Interrupt source is active<br>(generation job ready for time interrupts, time-of-day/time-delay interrupt OB started, cyclic interrupt OB was configured)<br>■ Bit 4: Interrupt OB<br>– 0: is not loaded<br>– 1: is loaded<br>■ Bit 5: Interrupt OB is by TIS:<br>– 0: enabled<br>– 1: disabled<br>■ Bit 6: Entry in diagnostic buffer<br>– 0: enabled<br>– 1: disabled<br>■ Bit 15 ... 7: reserved |
| al 2 | 1word | Reaction with not loaded/locked OB<br>■ Bit 0: 1: Lock interrupt source<br>■ Bit 1: 1: Generate interrupt event error<br>■ Bit 2: 1: CPU goes into STOP mode<br>■ Bit 3: 1: Interrupt only discarded<br>■ Bit 15 ... 4: reserved |
| al 3 | 2words | Discard by TIS functions |

**Record set**

***SSL_ID: 0222h INDEX: 003Dh***

The data set contains the local data of OB 61 and further information on the status to the OB 61.

| Name | Length | Description |
|---|---|---|
| OB61_EV_CLASS | 1byte | Event class and identifiers:<br>11h: Alarm is active |
| OB61_STRT_INF | 1byte | 64h: Start request for OB 61 |
| OB61_PRIORITY | 1byte | Assigned priority class<br>Default value: 25 |
| OB61_OB_NUMBR | 1byte | OB number: 61 ... 64 |
| OB61_RESERVED_1 | 1byte | reserved |
| OB61_RESERVED_2 | 1byte | reserved |
| OB61_GC_VIOL | 1bit | GC violation at PROFIBUS DP |
| OB61_FIRST | 1bit | First run after start up or stop state |
| OB61_MISSED_EXEC | 1byte | Number of failed OB 61 starts since the last OB 61 execution |
| OB61_DP_ID | 1byte | PROFINET-IO system ID of the clock synchronous PN IO system (100 ... 115) |
| OB61_RESERVED_3 | 1byte | reserved |
| OB61_RESERVED_4 | 2bytes | reserved |
| OB61_DATE_TIME | 8bytes | Date and time of day when the OB was called |
| al 1 | 2bytes | Processing identifiers (see below) |
| al 2 | 2bytes | Reaction with not loaded/locked OB (see below) |
| al 3 | 4bytes | Discard by TIS functions (see below) |

**Additional status information OB 61:**

| Name | Length | Description |
|---|---|---|
| al 1 | 2 Bytes | Processing identifiers:<br>■ Bit 0: Interrupt event is caused by parameters:<br>– 0: enabled<br>– 1: disabled<br>■ Bit 1: Interrupt event as per SFC 39 DIS_IRT:<br>– 0: not locked<br>– 1: locked<br>■ Bit 2:<br>(Generation job ready for time interrupts, time-of-day/time-delay interrupt OB started, cyclic interrupt OB was configured)<br>– 0 = not active<br>– 1 = Interrupt source is active<br>■ Bit 4: Interrupt OB:<br>– 0: is not loaded<br>– 1: is loaded<br>■ Bit 5: Interrupt OB is by TIS:<br>– 0: enabled<br>– 1: disabled<br>■ Bit 6: Entry in diagnostic buffer:<br>– 0: enabled<br>– 1: disabled<br>■ Bit 15 ... 7: reserved |
| al 2 | 2 Bytes | Reaction with not loaded / locked OB<br>■ Bit 0: 1: Lock interrupt source<br>■ Bit 1: 1: Generate interrupt event error<br>■ Bit 2: 1: CPU goes into STOP mode<br>■ Bit 3: 1: Interrupt only discarded<br>■ Bit 15 ... 4: reserved |
| al 3 | 4 Bytes | Discard by TIS functions<br>Bit number x set means:<br>The event number that is larger than the smallest event to x the according event number is discard by TIS function. |

## 16.11 Communication status data - SSL-ID: xy32h

**Description**

If you read this partial list you obtain the status data of the CPU communication section.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0132h | | Status data of the CPU communication section |
| | 0001h | General of communication status data. |
| | 0002h | TIS status data |
| | 0004h | Protection status data |
| | 0006h | Data exchange via communication SFB |

| SSL_ID | INDEX | Description |
|---|---|---|
| | 0008h | Time system (16bit Run-time meter 0 ... 7) |
| | 0009h | MPI status data |
| | 000Ah | K-Bus status data |
| | 000Bh | Time system (32bit Run-time meter 0 ... 7) |

| | |
|---|---|
| LENTHDR | A record set is 20words long (40bytes)<br>The assignment depends on the INDEX parameter |
| N_DR | Number of record sets |

**Record set**

***SSL_ID: 0132h INDEX: 0001h***

The partial list extract contains information about general of communication status data.

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | General condition data for communication |
| | 1word | Reserved number of PG connections (Default = 1) |
| | 1word | Reserved Number of OP connections (Default = 1) |
| | 1word | Number of occupied PG connections |
| | 1word | Number of occupied OP connections |
| | 1word | Number of configured S7 connections (Default = 0) |
| | 1word | Number of occupied S7 connections |
| | 1word | Number of unused connection resources |
| | 1word | reserved |
| | 1word | Max. preset communication load of the CPU in % (Default = 20%) |
| | 6words | reserved (0000h) |
| | 1byte | reserved (00h) |
| | 1byte | Reserved number S7 basic communication connections (Default = 0) |
| | 1byte | Number of occupied S7 basic communication connections (XPut/XGet/MPI) |
| | 1byte | reserved (00h) |

| Name | Length | Description |
|---|---|---|
| | 1word | Number of occupied other connections |
| | 1word | Dialog mode switching (communication dialog) via Siemens SIMATIC Manager:<br>■ 0000h: communication dialog<br>– Siemens CPU 318<br>– VIPA CPU 317-4NE12<br>■ 0001h: communication dialog<br>– VIPA CPU 315-2AG10<br>– VIPA CPU 317-2AJ10<br>■ 0002h: reserved<br>■ 0003h: communication dialog<br>– Siemens CPU 315-2EH13 FW: V2.6<br>– Siemens CPU 317-4EK14 FW: V3.x |

**Record set**

***SSL_ID: 0132h INDEX: 0002h***

The partial list extract contains information about the TIS status data.

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | 0002h: TIS status |
| | 1word | Number of furnished TIS orders |
| | 18words | reserved |

**Record set**

***SSL_ID: 0132h INDEX: 0004h***

The partial list extract contains information about protection status data.

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | 0004h: Protection status |
| | 1word | Protection at the key switch (possible value : 1, 2 or 3) |
| | 1word | Configured protection level<br>(possible values: 0, 1, 2 or 3<br>0: no password, parameterized protection level is invalid) |
| | 1word | Valid protection level of the CPU<br>(possible values: 1, 2 or 3) |
| | 1word | Position of the mode switch:<br>■ 0: undefined or can not be determined<br>■ 1: RUN<br>■ 2: RUN_P<br>■ 3: STOP<br>■ 4: MRES |

| Name | Length | Description |
|---|---|---|
| | 1word | Position of the mode CRST/WRST:<br>■ 0: undefined or can not be determined<br>■ 1: CRST (Cold Restart)<br>■ 2: WRST (Warm Restart) |
| | 14words | reserved |

**Record set**

***SSL_ID: 0132h INDEX: 0006h***

The partial list extract contains information about data exchange via communication SFB of configured connections.

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | 0006h: Data exchange via communication SFB of configured connections |
| | 1words | Used SFB blocks |
| | 1byte | reserved |
| | 1word | Number of loaded SFB instances |
| | 1word | Number of multicast used blocks |
| | 25byte | reserved |

**Record set**

***SSL_ID: 0132hINDEX 0008h***

The partial list extract contains information about the status of the 16bit run-time meter 0 ... 7.

| Name | Length | Description |
|---|---|---|
| index | 1word | 0008h: Time system status |
| zykl | 1word | Cycle time of the synchronization telegram |
| korr | 1word | Correction factor for the time |
| clock 0 | 1word | Run-time meter 0: time in hours |
| clock 1 | 1word | Run-time meter 1: time in hours |
| clock 2 | 1word | Run-time meter 2: time in hours |
| clock 3 | 1word | Run-time meter 3: time in hours |
| clock 4 | 1word | Run-time meter 4: time in hours |
| clock 5 | 1word | Run-time meter 5: time in hours |
| clock 6 | 1word | Run-time meter 6: time in hours |
| clock 7 | 1word | Run-time meter 7: time in hours |
| time | 4words | Current date and time (format: date_and_time) |
| bszl_0 | 1byte | ■ Bit x: Run-time meter x with $0 \leq x \leq 7$<br>– 1: Run-time meter active |
| bszl_1 | 1byte | reserved |

| Name | Length | Description |
|---|---|---|
| bszü_0 | 1byte | ■ Bit x: Run-time meter overflow x with $0 \leq x \leq 7$<br>– 1: overflow |
| res | 1byte | reserved |
| res | 3words | reserved |

| status | Time status | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | SG | correction value | | | | | - | - | hr | su/wi | - | res | | - | - | sync |

| Bit | Description | Default value |
|---|---|---|
| 0 | Synchronization failure<br>This parameter indicates whether the time transmitted in the frame from an external time master is synchronized.<br>■ 0: synchronization failed<br>■ 1: synchronization occurred<br>**Note:**<br>Evaluation of this bit in a CPU is only useful if there is continuous external time synchronization. | 0 |
| 1 | Parameter is not used. | 0 |
| 2 | Parameter is not used. | 0 |
| 4, 3 | Time resolution<br>■ 00: 0.001s<br>■ 01: 0.01s<br>■ 10: 0.1s<br>■ 11: 1s | 00 |
| 5 | Parameter is not used. | 0 |
| 6 | Summer/winter time indicator<br>The parameter indicates whether the local time calculated using the correction value is summer or winter time.<br>■ 0: winter time<br>■ 1: summer time | 0 |
| 7 | Notification hour<br>This parameter indicates whether the next time adjustment also includes a switchover from summer to winter time or vice versa.<br>■ 0: no adjustment made<br>■ 1: adjustment made | 0 |
| 8 | reserved | 0 |
| 9 | reserved | 0 |

| Bit | Description | Default value |
|---|---|---|
| 14 ... 10 | Correction value (Local time = basic time ± correction value * 0.5h)<br>This correction takes into account the time zone and the time difference. | 00000 |
| 15 | Sign for the correction value<br>■ 0: positive<br>■ 1: negative | 0 |

**Record set**

***SSL_ID: 0132h INDEX: 0009h***

The partial list extract contains information about the status data of the MPI.

| Name | Length | Description |
|---|---|---|
| Index | 1word | 0009h: MPI status data |
| | 1words | Used Baud rate (hexadecimal code) |
| | 17words | reserved |

**Record set**

***SSL_ID: 0132h INDEX: 000Ah***

The partial list extract contains information about the status data of the K-Bus.

| Name | Length | Description |
|---|---|---|
| Index | 1word | 000Ah: K-Bus status data |
| | 2words | Used Baud rate (hexadecimal code) |
| | 17words | reserved |

**Record set**

***SSL_ID: 0132h INDEX: 000Bh***

The partial list extract contains information about the status of the 32bit run-time meter 0 ... 7.

| Name | Length | Description |
|---|---|---|
| index | 1word | 000Bh: Time system status |
| bszl_0 | 1byte | ■ Bit x: Run-time meter x with 0 ≤ x ≤ 7<br>– 1: Run-time meter active |
| res | 1byte | reserved |
| bszü_0 | 1byte | ■ Bit x: Run-time meter overflow x with 0 ≤ x ≤ 7<br>– 1: overflow |
| res | 1byte | reserved |
| clock 0 | 1Dword | Run-time meter 0: time in hours |
| clock 1 | 1Dword | Run-time meter 1: time in hours |
| clock 2 | 1Dword | Run-time meter 2: time in hours |

| Name | Length | Description |
|---|---|---|
| clock 3 | 1Dword | Run-time meter 3: time in hours |
| clock 4 | 1Dword | Run-time meter 4: time in hours |
| clock 5 | 1Dword | Run-time meter 5: time in hours |
| clock 6 | 1Dword | Run-time meter 6: time in hours |
| clock 7 | 1Dword | Run-time meter 7: time in hours |
| res | 1word | reserved |

## 16.12 Ethernet details of the module - SSL xy37h

**Description**

With this partial list you get information about the configuration of the TCP/IP stack, the vendor specified MAC address and the connection properties on layer 2 - security layer (data link layer) of the CP interface of the PROFINET CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0037h | | Details of all Ethernet interfaces |
| | 0000h | if the details of all Ethernet interfaces are requested |
| 0137h | | Details of an Ethernet interface |
| | xxxxh | Logical base address of the Ethernet interface, which details are requested |
| 0F37h | xxxxh | SSL partial list header information |

| | |
|---|---|
| LENTHDR | One record set is 24words long (48bytes) |
| N_DR | Number of record sets |

**Record set**

***SSL_ID: xy37h***

| Name | Length | Description |
|---|---|---|
| logaddr | 2byte | Logical base address of the interface |
| ip_addr | 4byte | IP address<br>The IP address is stored in the following format (at the example a.b.c.d):<br>Offset x: a, Offset x+1: b, Offset x+2: c, Offset x+3: d |
| subnetmask | 4byte | subnet mask<br>The subnet mask is stored in the following format (at the example a.b.c.d):<br>Offset x: a, Offset x+1: b, Offset x+2: c, Offset x+3: d |
| defaultrouter | 4byte | IP address of the default router<br>If you have not configured a default router, here the IP address of the interface is entered. |
| mac_addr | 6byte | MAC address |

| Name | Length | Description |
|---|---|---|
| source | 1byte | Origin of the IP address:<br>■ 00h: IP address is not initialized<br>■ 01h: IP address was configured<br>■ 02h: IP address was set by DCP<br>■ 03h: IP address comes from a DHCP server<br>■ 04h ... FFh: reserved |
| reserved | 1byte | reserved |
| dcp_mod_ time-stamp | 8byte | Time stamp of the last change of the IP address via DCP<br>**Note:** The content of this field may be evaluated only when bit 1 is set in source. |
| phys_mode1 | 1byte | State of port 1:<br>■ Bit 0: Duplex mode (only relevant if AUI-Mode = 0):<br>– 1: phys. Layer works full duplex<br>– 0: phys. Layer works half duplex<br>■ Bit 1: Baud rate ID (only relevant if AUI-Mode = 0):<br>– 1: phys. Layer works with 100MBaud<br>– 0: phys. Layer works with 10MBaud<br>■ Bit 2: Link status:<br>– 1: phys. Layer has link pulses<br>– 0: phys. Layer has no link pulses<br>■ Bit 3: Auto mode:<br>– 1: phys. Layer has to automatically adjust to the LAN medium<br>– 0: phys. Layer will not automatically adjust to the LAN medium<br>■ Bit 6 ... 4: 0<br>■ Bit 7: Validity:<br>– 0: phys_mode1 has no valid data<br>– 1: phys_mode1 has valid data<br>The numbering of the ports is identical to the numbering in the configuration. If the interface has only one port , whose physical properties are entered at port 1. |
| phys_mode2 | 1byte | State of port 2 (structure like phys_mode1) |
| ... | ... | ... |
| phys_mode16 | 1byte | State of port 16 (structure like phys_mode1) |
| reserved | 2byte | reserved |

*If you have not carried out any IP configuration, the variables ip_addr , subnetmask and defaultrouter each have the value zero.*

## 16.13 TCON Connection - SSL-ID: xy3Ah

**Description**

If you read this partial list, you obtain information of the TCON connection from qualified CPUs.

The "Open Communication via Industrial Ethernet" in the Siemens SIMATIC Manager dialog is visible only when the SSL 003Ah and 0F3Ah exist and are available. For this, you must be entered in the table of contents (SSL 0000h).

The diagnostic data that can be read by the SSL, will be updated by the system with a period of one second.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| xy3Ah | | Status TCON connection |
| 003Ah | xxxxh | Read diagnostic information |
| 0F3Ah | xxxxh | Only header |

| | |
|---|---|
| LENTHDR | Length of following record set is 74words (148byte) |
| N_DR | ■ 0: TCON Online Diagnostics is not possible ("Diagnostics" button in the Siemens SIMATIC Manager = "gray"). It is delivered only the header and no further user data.<br>■ >0: TCON Online Diagnosis enabled |

**Record set**

***SSL_ID: xy3Ah INDEX: 003Ah***

If you read this partial list, you obtain information of the TCON connection from qualified CPUs.

| Name | Length | Description |
|---|---|---|
| 003Ah | 1word | 0100h: unknown |
| | 1word | "current connection number": not connection ID |
| | 1word | Block_length[3]<br>40h: Up to Offset 4 … 67 = 64 byte |
| | 1word | ID[3]: connection ID |
| | 1byte | ■ connection_type[3]:<br>– 11h = TCP/IP<br>– 12h = ISO on TCP<br>– 13h = UDP<br>– 01h = TCP (compatibility mode) |
| | 1byte | active_est[3] |
| | 1byte | local_device_id[3]<br>02h: CPU Type |
| | 1byte | local_tsap_id_len[3] |
| | 1byte | rem_subnet_id_len[3] |
| | 1byte | rem_staddr_len[3]<br>04h: für IP-Adresse |
| | 1byte | rem_tsap_id_len[3] |
| | 1byte | next_staddr_len[3] |
| | 16byte | local_tsap_id (include TSAP or Port number)[3] |
| | 6byte | rem_subnet_id[3] for routing |

| Name | Length | Description |
|---|---|---|
| | 6byte | rem_staddr (remote IP address)[3] |
| | 16byte | rem_tsap_id (include TSAP or Port number)[3] |
| | 6byte | next_staddr (next IP address)[3] for routing |
| | 1word | spare[3] |
| | 4byte | local_staddr (local IP address)[3] |
| | 8byte | 1. timestamp[1]<br>timestamp for 1. call attempt |
| | 8byte | 2. timestamp[1]<br>Storage for timestamp 4 at disconnection |
| | 8byte | 3. timestamp[1]<br>Timestamp, the error message of the last disconnection<br>In this purpose there is an error number (Offset: 132) |
| | 8byte | 4. timestamp[1]<br>Timestamp for successful connection<br>Is copied in disconnection by timestamp 2 and deleted (reset all to 0) |
| | 8byte | 5. timestamp[1]<br>Timestamp of the last failed connection attempt<br>In this purpose there is an error number (Offset: 130) |
| | 4byte | rem_ip_addr (remote IP address)[4] |
| | 2byte | rem_port_nr (remote Port number)[4] |
| | 2byte | spare[4] |
| | 4byte | rem_ip_addr (remote IP address)[5] |
| | 2byte | rem_port_nr (remote Port number)[5] |
| | 2byte | spare[5] |
| | 1word | ■ State of connection:<br>– 0000h: no display<br>– 0001h: Connection is established<br>– 0002h: no display<br>– 0003h: Connection is established passive<br>– 0004h: Connection is established active<br>– 0005h: Connection is established passive<br>– > 0005h: no display |

| Name | Length | Description |
|---|---|---|
| | 1word | ■ Error message of the last connection attempt:<br>– 0000h: no error<br>– 0001h: local network error<br>– 0002h: participant not available<br>– 0003h: local abort<br>– 0004h: abort by partner<br>– 0005h: abort due to timeout<br>– 0006h: abort by protocol error<br>– 0007h: system internal error (7)<br>– 0008h: system internal error (8)<br>– 0009h: system internal error (9)<br>– 000Ah: system internal error (10)<br>– 000Bh: call attempt to own station address<br>– 000Ch: double addressing<br>– ≥ 000Dh: unknown error |
| | 1word | ■ – Error message from the last disconnection:<br>– 0000h: no error<br>– 0001h: local network error<br>– 0002h: participant not available<br>– 0003h: local abort<br>– 0004h: abort by partner<br>– 0005h: abort due to timeout<br>– 0006h: abort by protocol error<br>– 0007h: system internal error (7)<br>– 0008h: system internal error (8)<br>– 0009h: system internal error (9)<br>– 000Ah: system internal error (10)<br>– 000Bh: Call attempt to own station address<br>– 000Ch: double addressing<br>– ≥ 000Dh: unknown error |
| | 1word | Current connection attempts; is reset when connected |
| | 1Dword | Number of bytes sent |
| | 1Dword | Number of bytes received |
| | 1word | Number of successful connection attempts |
| | 1word | 0000h: unknown |

1) Time stamp (data type: S7 Date and Time), resolution in seconds, milliseconds are zeroed

3) Fields corresponding TCON Config DB (UDT65). Fields rem_staddr_len, rem_tsap_id_len, rem_staddr and rem_tsap_id updated when connected with address data of the communication partner

4) Fields according to the address of DB TUSEND (UDT66)

5) Fields according to the address of DB TURCV by calling (UDT66)

## 16.14 Status of the LEDs - SSL-ID: xy74h

**Description** This partial list contains information about the LEDs of the CPU.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0074h | - | Record sets of all CPU LEDs |
| 0174h | | Record set of one CPU LED: |
| | 0001h | SF (group error) |
| | 0004h | RUN |
| | 0005h | STOP |
| | 0006h | FRCE (Force) |
| | 0008h | BATF: 0 (fix)<br>INDEX exists only at CPUs that are configured as CPU 318-2AJ00. |
| | 000Bh | BF (Bus error interface 1) |
| | 000Ch | BF LED only at EtherCAT, PROFINET and PROFIBUS (ERROR) |
| | 0015h | MT LED (VIPA specific) |
| | 0100h | CP LED (VIPA specific) |
| | 1000h | Memory card (VIPA specific) |
| | 1001h | PROFIBUS slave DE (VIPA specific, not for SLIO CPU) |
| | 2000h | PROFIBUS master RUN (VIPA specific) |
| | 2001h | PROFIBUS master ERR (VIPA specific) |
| | 2002h | PROFIBUS master DE (VIPA specific) |
| | 2003h | PROFIBUS master IF (VIPA specific) |
| 0E74h | | Records sets of all CPU status LEDs also PROFIBUS DP master/slave if available. |
| | 0000h | INDEX = 0000h (mandatory) |

| | |
|---|---|
| LENTHDR | A record set is 2words long (4bytes). |
| N_DR | Number of record sets |

**Record set *SSL-ID: xy74h***

| Name | Length | 0074h | 0174h | 0E74h | Value | Description LED |
|---|---|---|---|---|---|---|
| INDEX | 1word | x | x | - | 0001h | 0001h: SF (Group error) |
| | | x | x | - | 0004h | RUN |
| | | x | x | - | 0005h | STOP |
| | | x | x | - | 0006h | FRCE (Force) |
| | | x | x | - | 0008h | BATF (always "0") |
| | | x | x | - | 000Bh | DP Master BUSF1 (Bus error interface 1) |
| | | x | x | - | 000Ch | BF LED only at EtherCAT and PROFINET |
| | | x | x | - | 0015h | MT LED (not MICRO CPU) |

| Name | Length | 0074h | 0174h | 0E74h | Value | Description LED |
|---|---|---|---|---|---|---|
| | | - | x | x | 0100h | CP LED (VIPA specific)<br>(not MICRO CPU) |
| | | - | x | x | 1000h | Access to memory card LED (VIPA specific) |
| | | - | x | x | 1001h | PROFIBUS Data Exchange slave LED (VIPA specific)<br>(not MICRO CPU) |
| | | - | x | x | 1002h | MICRO: Status bar ( left green) |
| | | - | x | x | 1003h | MICRO: Status bar ( right green) |
| | | - | x | x | 1004h | MICRO: Status bar ( left red) |
| | | - | x | x | 1005h | MICRO: Status bar ( right yellow) |
| | | - | x | x | 2000h | PROFIBUS master RUN LED (VIPA specific, SLIO CPU = 0)<br>(not MICRO CPU) |
| | | - | x | x | 2001h | PROFIBUS master ERR LED (VIPA specific)<br>(not MICRO CPU) |
| | | - | x | x | 2002h | PROFIBUS master Data Exchange LED (VIPA specific)<br>(not MICRO CPU) |
| | | - | x | x | 2003h | PROFIBUS master IF LED (VIPA specific, SLIO CPU = 0)<br>(not MICRO CPU) |
| | | - | x | x | 6501h* | SF (Group error) from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6504h* | RUN from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6505h* | STOP from CP on 1. SPEED-Bus slot (User slot = 101) |
| | | - | x | x | 6601h* | SF (Group error) from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6604h* | RUN from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6605h* | STOP from CP on 2. SPEED-Bus slot (User slot = 102) |
| | | - | x | x | 6701h* | SF (Group error) from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6704h* | RUN from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6705h* | STOP from CP on 3. SPEED-Bus slot (User slot = 103) |
| | | - | x | x | 6801h* | SF (Group error) from CP on 4. SPEED-Bus slot (User slot = 104) |
| | | - | x | x | 6804h* | RUN vom CP from CP on 4. SPEED-Bus slot (User slot = 104) |
| | | - | x | x | 6805h* | STOP from CP on 4. SPEED-Bus slot (User slot = 104) |
| | | - | x | x | 6901h* | SF (Group error) from CP on 5. SPEED-Bus slot (User slot = 105) |
| | | - | x | x | 6904h* | RUN from CP on 5. SPEED-Bus slot (User slot = 105) |
| | | - | x | x | 6905h* | STOP from CP on 5. SPEED-Bus slot (User slot = 105) |

| Name | Length | 0074h | 0174h | 0E74h | Value | Description LED |
|---|---|---|---|---|---|---|
| | | - | x | x | 6A01h* | SF (Group error) from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6A04h* | RUN from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6A05h* | STOP from CP on 6. SPEED-Bus slot (User slot = 106) |
| | | - | x | x | 6B01h* | SF (Group error) from CP on 7. SPEED-Bus slot (User slot = 107) |
| | | - | x | x | 6B04h* | RUN from CP on 7. SPEED-Bus (User slot = 107) |
| | | - | x | x | 6B05h* | STOP from CP on 7. SPEED-Bus (User slot = 107) |
| | | - | x | x | 6C01h* | SF (Group error) from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6C04h* | RUN from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6C05h* | STOP from CP on 8. SPEED-Bus (User slot = 108) |
| | | - | x | x | 6D01h* | SF (Group error) from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6D04h* | RUN from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6D05h* | STOP from CP on 9. SPEED-Bus (User slot = 109) |
| | | - | x | x | 6E01h* | SF (Group error) from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | 6E04h* | RUN from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | 6E05h* | STOP from CP on 10. SPEED-Bus (User slot = 110) |
| | | - | x | x | CE01h* | SF (Group error) from CP to CPU (User slot = 206) |
| | | - | x | x | CE04h* | RUN from CP to CPU (User slot = 206) |
| | | - | x | x | CE05h* | STOP from CP to CPU (User slot = 206) |
| *) This INDEX only exists in the CPUs 300S+ (up on V3.7) | | | | | | |
| Led_on | 1byte | 1byte | 1byte | 1byte | | Status of one LED:<br>■ 0: off<br>■ 1: on |

| Name | Length | 0074h | 0174h | 0E74h | Value | Description LED |
|---|---|---|---|---|---|---|
| Blink Code | 1byte | 1byte | 1byte | 1byte | | Flashing status of the LEDs: (decimal)<br>■ 0: off<br>■ 1: flashing normally (2Hz)<br>■ 2: flashing slowly (0.5Hz)<br>– **Note:** EtherCat systemic flashing frequency 1Hz<br>■ 3: flashing with 1Hz (VIPA specific LED)<br>■ 4: flashing with 4Hz (VIPA specific LED)<br>■ 5: flashing with 2.5Hz (VIPA specific LED)<br>■ 6: flashing with 10Hz (VIPA specific LED)<br>■ 7: cyclically: short (200 ms) flashes once then off for 1000ms. (VIPA specific LED)<br>■ 8: cyclical: flashes twice briefly (200ms) then off for 1000ms. (VIPA specific LED)<br>■ 9: cyclically: three short flashes (200ms) then off for 1000ms. (VIPA specific LED)<br>■ 10: cyclical: remains 4 seconds, then 2 seconds off. (VIPA specific LED) |
| *) This INDEX only exists in the CPUs 300S+ (up on V3.7) | | | | | | |

## 16.15 Status information CPU - SSL-ID: xy91h

**Description**

If you read the partial list, you obtain the status information of modules assigned to the CPU. In this manual are only the available partial lists for the EtherCAT-CPUs described. Not described are SSL partial list: W#16#0191, W#16#0291, W#16#0391, W#16#0591, W#16#0991.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0091h | - | Module status information of all plugged and projected modules/submodules from the CPU |
| 0A91h | - | Module status information of a module in the central structure or at an integrated bus system (PROFIBUS, PROFINET or EtherCAT) via the logical base address. |
| 0C91h | adr | Module status information of a module an external bus interface (PROFIBUS, PROFINET or EtherCAT) via the logical base address.<br>xxxx: Bits 0 ... 14: any logical address of the module<br>■ Bit 15:<br>– 0 = Input<br>– 1 = Output |
| 4C91h | xxxxh | Module status information of all modules of the rack or the station (central, decentral PROFIBUS DP, PROFINET-IO or EtherCAT).<br>xxxx: Bits 0 ... 14: any logical address of the module<br>■ Bit 15:<br>– 0 = Input<br>– 1 = Output |

| SSL_ID | INDEX | Description |
|---|---|---|
| 0D91h | | Module status information of all configured modules (central, decentral PROFIBUS DP, PROFINET-IO or EtherCAT) |
| | xx00h | Modules or submodules from the rack or station number.<br>With xx you have to specify the number of the rack. |
| | xxyyh | xxyy: all modules of a DP station or a PROFINET-IO station or an EtherCAT station<br>PROFIBUS DP: xx include master system ID, yy station number;<br>■ PROFINET-IO:<br>– Bit 0 ... 10: Device number<br>– Bit 11 ... 14: the last two digits of the PN IO Subsystem ID<br>– Bit 15: 1<br>■ EtherCAT:<br>– Bit 0 ... 10: Slave number<br>– Bit 11 ... 14: the last two digits of the EtherCAT Sub-system ID<br>– Bit 15: 1 |
| 0E91h | - | Module status information of all assigned modules. |

| | |
|---|---|
| LENTHDR | A record set is 8words long (16bytes). |
| N_DR | Number of record sets; product-specific, the number of trans-mitted record set can be less |

***Additional Record sets***

In the case of *SSL_ID* 0091h, 0191h and 0F91h two additional record sets are supplied per rack:

- A record for the power supply if it exists
- A record set for the rack

The sequence of the records in case of a centralized structure is:

Power supply, slots 1 ... n, rack

**Record set *SSL_ID: xy91h:***

| Name | Length | Description |
|---|---|---|
| adr1 | 1word | ↬ *'adr1' on page 595* |
| adr2 | 1word | ↬ *'adr2' on page 596* |
| logadr | 1word | First assigned logical I/O address (base address). |
| solltyp | 1word | Target type: only at PROFINET or EtherCAT (otherwise reserved) |
| isttyp | 1word | Actual type: only at PROFINET or EtherCAT (otherwise reserved) |

| Name | Length | Description | |
|---|---|---|---|
| reserved | 1word | ■ At PROFINET-IO or EtherCAT (otherwise reserved):<br>– SSL-ID=0C91h: Number of really existing submodules (without submodule 0)<br>– SSL-ID=0D91h: Number of submodules (without submodule 0)<br>– SSL-ID=4C91h: Number of really existing submodules (without submodule 0)<br>– SSL-ID=4D91h: Number of really existing submodules (without submodule 0) | |
| eastat | 1word | ■ I/O status:<br>– Bit 0: 1: Module error (detected by diagnostic interrupt)<br>– Bit 1: 1: Module exists<br>– Bit 2: 1: Module does not exist<br>– Bit 3: 1: Module disabled<br>– Bit 4: 1: Station error<br>– Bit 5: 1: A CiR event at this module /station is busy or not yet completed.<br>– Bit 6: 1: reserved<br>– Bit 7: 1: Module in local bus segment<br>– Bit 8 ... 15: Data ID for logical address (Input: B4h, Output: B5h, DP interface: FFh) | |
| ber_bgbr | 1word | ■ Area ID/module width<br>– Bit 0 ... 2: Module width<br>– Bit 3: reserved<br>– Bit 4 ... 6: Area ID | |
| | | 0: | Siemens S7-400 |
| | | 1: | Siemens S7-300 |
| | | 2: | ET area (PROFIBUS/PROFINET/EtherCAT-decentralized) |
| | | 3: | P area |
| | | 4: | Q area |
| | | 5: | IM3 area |
| | | 6: | IM4 area |
| | | 7: | Consistent area (PROFIBUS slave) |
| | | Bit 7 ... 15: reserved | |

**adr1**

*At a centralized configuration*

| | adr1 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 0 | | | | | | | | Rack number (0 ... 31) | | | | | | | |

*At a decentralized configuration with PROFIBUS DP*

Bit 15: 0 is the ID for PROFIBUS

| | adr1 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 0 | DP master system ID (1 ... 32) | | | | | | | Station number (0 ... 127) | | | | | | | |

*At a decentralized configuration with PROFINET IO or EtherCAT*

To obtain the full PROFINET IO system ID, you have to add 100 (decimal) to bit 12 ... 14.

Bit 15: 1 is the ID for PROFINET or EtherCAT

| | adr1 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | 1 | PROFINET IO system ID (0 ... 15) | | | Station number (0 ... 2047) | | | | | | | | | | | |

**adr2** *At a centralized respectively decentralized structure with PROFIBUS DP*

| | adr2 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | High byte | | | | | | | | Low byte | | | | | | | |
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | Slot number | | | | | | | | Submodule slot number | | | | | | | |

**adr2** Slot number: for a decentralized configuration with PROFINET-IO or EtherCAT.

## 16.16 Stations status information (DPM) - SSL-ID: xy92h

**Description**

If you read this partial list, you obtain information about the expected and the current hardware configuration of centrally installed stations of a DP master system, connected via a DP interface.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0092h | DPM-ID | Expected status of the central stations of a DP master system. |
| 0292h | DPM-ID | Actual status of the stations of a DP master system. |
| 0692h | DPM-ID | Diagnostic status of the expansion racks in the central configuration of the stations of a DP master system. |

| SSL_ID | INDEX | Description |
|---|---|---|
| 4092h | DPM-ID | Expected status of a DP master system, which is connected via an **external** DP switch. |
| 4192h | DPM-ID | Activation status of a DP master system, which is connected via an **external** DP switch. |
| 4292h | DPM-ID | Actual status of a DP master system, which is connected via an **external** DP switch. |
| 4692h | DPM-ID | Diagnostic status of the expansion racks of a DP master system, which is connected via an **external** DP switch. |

| | |
|---|---|
| LENTHDR | One record set is 8words long (16bytes). |
| N_DR | Number of record sets |

**Record set *SSL_ID: xy92h***

| Name | Length | Description | | |
|---|---|---|---|---|
| status_0 ... status_15 | 16byte | Rack status / station status or backup status (the backup status is only relevant for DP modules). | | |
| | | 0092h: | 0: | Rack/station not configured |
| | | | 1: | Rack/station configured |
| | | 4092h: | 0: | Station not configured |
| | | | 1: | Station configured |
| | | 0292h: | 0: | Rack/station failure, deactivated or not configured |
| | | | 1: | Rack/station exists, is activated and has not failed |
| | | 0692h: | 0: | All modules of the expansion rack / of a station exist, are available with no problems and activated. |
| | | | 1: | At least 1 module of the expansion rack / of a station is not OK or the station is deactivated. |
| | | 4692h: | 0: | All modules of a station exist, are available with no problems, and activated. |
| | | | 1: | At least 1 module of a station is not OK or the station is deactivated. |
| | | | | |
| status_0 | 1byte | Bit 0: | | Central rack (INDEX = 0) or station 1 (INDEX > 0) |
| | | Bit 1: | | 1. Expansion rack or station 2 |
| | | ... | | ... |
| | | Bit 7: | | 7. Expansion rack or station 8 |
| status_1 | 1byte | Bit 0: | | 8. Expansion rack or station 9 |
| | | ... | | ... |
| | | Bit 7: | | 15. Expansion rack or station 16 |
| status_2 | 1byte | Bit 0: | | 16. Expansion rack or station 17 |

| Name | Length | Description | |
|---|---|---|---|
| | | ... | ... |
| | | Bit 5: | 21. Expansion rack or station 22 |
| | | Bit 6: | 0: or station 23 |
| | | Bit 7: | 0: or station 24 |
| status_3 | 1byte | Bit 0: | 0: or station 25 |
| | | ... | ... |
| | | Bit 5: | 0: or station 30 |
| | | Bit 6: | Expansion rack in Siemens S5 area or station 31 |
| | | Bit 7: | 0: or station 32 |
| status_4 | 1byte | Bit 0: | 0: or station 33 |
| | | ... | ... |
| | | Bit 7: | 0: or station 40 |
| ... | ... | ... | ... |
| status_15 | 1byte | Bit 0: | 0: or station 121 |
| | | ... | ... |
| | | Bit 7: | 0: or station 128 |

## 16.17 Stations status information (DPM, PROFINET-IO and EtherCAT) - SSL-ID: xy94h

**Description**

If you read this partial list, you obtain information about the expected and the current hardware configuration of centrally installed stations of a DP master system / PROFINET IO controller system or EtherCAT master system.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0094h | PN-ID | Expected status of the central stations of a PROFINET-IO control system / PN IO subsystem-ID<br>With EtherCAT only the stations configured as *mandatory* are registered.<br>■ Status bit = 1:<br>– Rack/station configure |
| 0194h | PN-ID | Activation status of a station of an IO controller system, which is configured and disabled.<br>■ Status bit = 1 |
| 0294h | PN-ID | Actual state of the rack in the central configuration of the stations of an IO controller system<br>■ Status bit = 1:<br>– Rack/station exists, activated and not failed |
| 0694h | PN-ID | Diagnostic status of the expansion racks in the central configuration of the stations of a PROFINET-IO control system / PN IO subsystem-ID<br>■ Status bit = 1:<br>– at least one module of rack/station has malfunction or is de-activated: coming diagnostics interrupt, neighbourhood interrupt, remove/fit interrupt, failure mandatory station |
| 0794h | PN-ID | Diagnostic / Maintenance condition of the central stations of a PROFINET-IO control system / PN IO subsystem-ID<br>■ Status bit = 0:<br>– no problem and no maintenance necessary<br>■ status bit = 1:<br>– rack/station has a problem or maintenance requirement or maintenance request |
| 0994h | PN-ID | Set point - actual value difference<br>■ Status bit = 1:<br>– Set point - actual value difference in station exists ModDiffBlock, EC state unequal master state |
| 0A94h | PN-ID | Set point state of the stations of an EtherCAT IO controller system.<br>In this partial list besides the *mandatory* stations additionally the *optional* configured stations are registered.<br>■ Status bit = 1:<br>– Rack/station configured |
| 0F94h | | only header information |

| | |
|---|---|
| LENTHDR | One record set is 129words long (258bytes). |
| N_DR | Number of record sets |

**Record set *SSL_ID: xy94h***

| Name | Length | Description |
|---|---|---|
| INDEX | 1word | ■ 0: Central module<br>■ 1 ... 31: Distributed module at PROFIBUS DP<br>■ 100 ... 115: Distributed module at PROFINET-IO / EtherCAT-IO |
| status_0 | BOOL | ■ Group information:<br>– 1: one of the following status bits has the value 1<br>– 0: all subsequent status bits have the value 0 |
| status_1 | BOOL | Status station 1 |
| status_2 | BOOL | Status station 2 |
| ... | | ... |
| status_2047 | BOOL | Status station 2047 |

A status bit of non-configured racks/stations/devices has the value 0.

**Important difference to the previous SSL ID: xy92h**

*Compared to the previous SSL ID: xy92h, the data have been shifted by one bit since bit status_0 is used for group information.*

**Local SLIO bus**

- *A virtual PN device on the PROFINET network is configured for the SLIO CPU of a local SLIO bus. The corresponding SSLs xy94h is filled with this configured station number.*
- *If no virtual PN Device for the SLIO bus is configured, then natively for the station number 2047 is used.*

**EtherCAT bus**

- *A virtual PN device is configured on the PROFINET network for the EtherCAT network. The corresponding SSLs xy94h is filled with this configured station number.*
- *The EtherCAT master (controller) has normally the station number 0. This can not be located in the SSL ID: xy94h because the bit 0 is used as a group bit. Thus is set in Topology Mismatch in the SSL ID: xy94h the bit for the station 512 (maximum station number for EtherCAT).*

**Local SLIO bus with EtherCAT CPU**

*With an EtherCAT CPU, please note that addressing in the virtual PROFINET system requires no duplicate station addresses. Otherwise this results in a double assignment of the corresponding bit in the SZL ID: xy94h.*

## 16.18 Status information PROFINET/EtherCAT/PROFIBUS DP - SSL-ID: xy96h

**Description**

This partial list contains status information on all the modules assigned to the CPU. It provides information specific to PROFINET IO as well as information on PROFIBUS DP modules, EtherCAT modules and central modules. Complementing *SSL_ID* xy91 you get on the partial list with the *SSL_ID* xy96 additional state information of modules and submodules.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0696h | logadr | Module status information of all submodules of a specified module (only with integrated interface with PROFINET IO) address with IO identifier. |
| 0C96h | logadr | Module status information of a module/submodule located centrally or on a PROFIBUS DP/PROFINET/EtherCAT interface module over the start address. |

| | |
|---|---|
| LENTHDR | Length of the data record is 24words (48byte). |
| N_DR | Number of record sets |

**Record set *SSL_ID: xy96h***

| Name | Length | Description | |
|---|---|---|---|
| logadr | 1word | ■ Bits 0 ... 14: Address of the module<br>■ Bit 15: 0 = Input, 1 = Output | |
| System | 1word | ID for centralized module / DP master system ID / PROFINET IO system ID / EtherCAT system:<br>■ 0: Central Module<br>■ 1 ... 31: Decentralized module at PROFIBUS DP<br>■ 100 ... 115: Decentralized module at PROFINET-IO / EtherCAT-IO | |
| res | 2words | Not relevant | |
| Station | 1word | Rack no./station number/device number | |
| Slot | 1word | Slot number | |
| Subslot | 1word | Submodule slot number<br>(Enter 0 if no submodule can be installed) | |
| res | 1word | Not relevant | |
| Set point type | 7words | Set point type:<br>With PROFINET-IO the structure of the set point type is hierarchical | |
| | | **PROFINET-IO / EtherCAT-IO** | **PROFIBUS DP** |

<table>
<tr><th>Name</th><th>Length</th><th colspan="2">Description</th></tr>
<tr><td rowspan="7"></td><td>1. word:</td><td>Vendor number or profile ID</td><td>0000</td></tr>
<tr><td>2. word:</td><td>Product code (High Word)</td><td>0000</td></tr>
<tr><td>3. word:</td><td>Product code (Low Word)</td><td>0000</td></tr>
<tr><td>4. word:</td><td>1. Word of the double word Module identification</td><td>Type ID</td></tr>
<tr><td>5. word:</td><td>2. Word of the double word Module identification</td><td>0000</td></tr>
<tr><td>6. word:</td><td>1. Word of the double word submodule identification<br>with EtherCAT-IO: reserved</td><td>0000</td></tr>
<tr><td>7. word:</td><td>2. Word of the double word submodule identification<br>with EtherCAT-IO: reserved</td><td>0000</td></tr>
<tr><td>Soll_ungleic_Ist_typ</td><td>1word</td><td colspan="2">ID set point/actual<br>■ Bit 0 = 0: Set point equal actual<br>■ Bit 0 = 1: Set point unequal actual<br>■ Bit 1 ... 15: reserved</td></tr>
<tr><td>reserved</td><td>1word</td><td colspan="2">reserved</td></tr>
<tr><td>eastat</td><td>1word</td><td colspan="2">I/O status:<br>■ Bit 0: 1: Module has malfunction (detected by diagnostics)<br>■ Bit 1: 1: Module exists<br>■ Bit 2: 1: Module not available<br>■ Bit 3: 1: Module de-activated<br>■ Bit 4: 1: Station has malfunction<br>■ Bit 5, 6: reserved<br>■ Bit 7: 1: Module in local bus segment<br>■ Bit 8: 1: Module maintenance required<br>■ Bit 9: 1: Module maintenance request<br>■ Bit 10 ... 15: reserved</td></tr>
<tr><td>ber_bgbr</td><td>1word</td><td colspan="2">Area ID/module width<br>■ Bit 0 ... 2: Module width<br>■ Bit 3: reserved<br>■ Bit 4 ... 6: Area ID<br>– 0: Siemens S7-400<br>– 1: Siemens S7-300<br>– 2: PROFINET IO (decentralized)<br>– 3: P area<br>– 4: Q area<br>– 5: IM3 area<br>– 6: IM4 area<br>– 7: EtherCAT (decentralized)<br>■ Bit 7 ... 15: reserved</td></tr>
<tr><td>reserve</td><td>5words</td><td colspan="2">reserved</td></tr>
</table>

***Note!***

*Partial List with SSL-ID 0696h for modules on PROFIBUS DP: This results in the error message "submodule level not present".*

## 16.19 Diagnostic buffer of the CPU/CP - SSL-ID: xyA0h

**Description**

If you read the partial list, you obtain the entries of the diagnostic buffer of your CPU or your CP.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00A0h | - | Shows all entries of the diagnostics buffer, which are possible in the current mode. |
| 01A0h | xxxxh | Shows the most recent entries of the diagnostics buffer. Here you specify the number of INDEX. |
| 0FA0h | - | SSL partial list header information |

| | |
|---|---|
| LENTHDR | A record set is 10words long (20bytes). |
| N_DR | Number of record sets |

**Record set *SSL_ID: 00A0h and 01A0h***

| Name | Length | Description |
|---|---|---|
| ID | 1word | Event ID |
| Pk | 1byte | Depending on the diagnostic buffer entry |
| ObNr | 1byte | Depending on the diagnostic buffer entry |
| DatId | 1word | Depending on the diagnostic buffer entry |
| ZInfo1 | 1word | Information about the event |
| ZInfo2 | 1word | Information about the event |
| ZInfo3 | 1word | Information about the event |
| time | 4words | Time stamp of the event (DATE_AND_TIME) |

**DATE_AND_TIME**

DATE_AND_TIME: BCD format

| Bytes | Description | Area |
|---|---|---|
| 0 | year | 1990 ... 2089 |
| 1 | month | 01 ... 12 |
| 2 | day | 1 ... 31 |

| Bytes | Description | Area |
|---|---|---|
| 3 | hour | 0 ... 23 |
| 4 | minute | 0 ... 59 |
| 5 | second | 0 ... 59 |
| 6 | ■ 2 MSD from ms<br>– MSD: Most Significant Decade | 00 ... 99 |
| 7 (4 MSB) | ■ LSD from ms<br>– LSD: Least Significant Decade | 0 ... 9 |
| 7 (4 LSB) | weekday | 1 ... 7 (1 = Sunday) |

**Diagnostic buffer**

More information about the events in the diagnostics buffer of your CPU may be found in the manual of your CPU or in the manual of you programming software.

## 16.20 Module diagnostic information - SSL-ID: 00B1h

**Description**

If you read this partial list, you obtain the first 4 diagnostic bytes of a module with diagnostic capability.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00B1h | adr | Shows the first 4 diagnostic bytes of a module. Here the following is to be specified via INDEX:<br>■ Bit 0 ... 14: Logical base address of the module<br>■ Bit 15:<br>– 0: Input<br>– 1: Output |

| | |
|---|---|
| LENTHDR | A record set is 2words long (4bytes). |
| N_DR | Number of record sets |

**Record set *SSL_ID: 00B1h***

| Name | Length | Description |
|---|---|---|
| byte0 | 1byte | ■ Bit 0: Module fault (group fault ID)<br>■ Bit 1: Internal fault<br>■ Bit 2: External fault<br>■ Bit 3: Channel error exists<br>■ Bit 4: No external auxiliary voltage<br>■ Bit 5: No front connector<br>■ Bit 6: Module not assigned parameters<br>■ Bit 7: Wrong parameters on module |
| byte1 | 1byte | ■ Bit 0 ... 3: Module class<br>– 0000: CPU<br>– 0101: Analog modules<br>– 1000: FM<br>– 1100: CP<br>– 1111: Digital modules<br>– 0011: DP Norm slave<br>– 0100: IM<br>■ Bit 4: Channel information exists<br>■ Bit 5: User information exists<br>■ Bit 6: Diagnostic interrupt from substitute<br>■ Bit 7: Maintenance requirement (PROFINET IO only) |
| byte2 | 1byte | ■ Bit 0: User module incorrect / does not exist<br>■ Bit 1: Communication fault<br>■ Bit 2: Mode 0: RUN, 1: STOP<br>■ Bit 3: Watchdog responded<br>■ Bit 4: Internal module power supply failed<br>■ Bit 5: Battery exhausted<br>■ Bit 6: Entire buffer failed<br>■ Bit 7: Maintenance requirement (PROFINET IO only) |
| byte3 | 1byte | ■ Bit 0: Expansion rack failure (detected by IM)<br>■ Bit 1: Processor failure<br>■ Bit 2: EPROM error<br>■ Bit 3: RAM error<br>■ Bit 4: ADC/DAC error<br>■ Bit 5: Fuse blown<br>■ Bit 6: Hardware error lost<br>■ Bit 7: reserved (fix 0) |

## 16.21 Module diagnostic information via physical address - SSL-ID: 00B2h

**Description**

If you read this partial list, you obtain the diagnostic record set 1 of a module in a central rack (not for PROFIBUS DP or submodules). The diagnostic record 1 contains the 4 bytes of diagnostic data that are also in data record 0, plus module-specific diagnostics data that describe the state of a channel or a channel group. The module is to be specified via rack and slot number.

**Parameter**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00B2h | xxyyh | Shows diagnostic record set 1 of a module. Here the following is to be specified via INDEX:<br>■ xx: Number of the rack<br>■ yy: Slot number of the module |

| | |
|---|---|
| LENTHDR | The length of the record set depends on the module. |
| N_DR | 1 (Number of record set) |

**Record set**

Information to length and structure of the diagnostic record set may be found in the corresponding manual of your diagnosable module.

## 16.22 Module diagnostic information via logical address - SSL-ID: 00B3h

**Description**

If you read this partial list, you obtain all the diagnostic data of a module. You can also obtain this information for PROFIBUS DP and submodules. The diagnostic record 1 contains the 4 bytes of diagnostic data that are also in data record 0, plus module-specific diagnostics data that describe the state of a channel or a channel group. The module is to be specified via the logical base address.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00B3h | adr | Shows all the diagnostic data of a module. Here the following is to be specified via INDEX:<br>■ Bit 0 ... 14: Logical base address of the module<br>■ Bit 15: 0: Input, 1: Output |

| | |
|---|---|
| LENTHDR | The length of the record set depends on the module. |
| N_DR | 1 (Number of record set) |

**Record set**

Information to length and structure of the diagnostic data may be found in the corresponding manual of your diagnosable module.

## 16.23 Diagnostic data of a DP slave - SSL-ID: 00B4h

**Description**

If you read this partial list, you obtain the diagnostic data of a PROFIBUS DP slave. This diagnostic data is structured in compliance with EN 50 170 Volume 2, PROFIBUS. The module is to be specified via the configured diagnostic address.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00B4h | diagadr | Shows all the diagnostic data of a PROFIBUS DP slave.<br>Here the configured diagnostic address of the DP slave is to be specified with INDEX. |

| | |
|---|---|
| LENTHDR | Length of a record set<br>The maximum length is 240bytes. For standard slaves, which have a diagnostic data length of more than 240bytes up to a maximum of 244bytes, the first 240bytes are read and the overflow bit is set in the data. |
| N_DR | 1 (Number of record set) |

**Record set *SSL_ID: 00B4h***

| Name | Length | Description |
|---|---|---|
| status1 | 1byte | Station status 1 |
| status2 | 1byte | Station status 2 |
| status3 | 1byte | Station status 3 |
| stat_nr | 1byte | Number of master station |
| ken_hi | 1byte | Vendor ID (high byte) |
| ken_lo | 1byte | Vendor ID (low byte) |
| ... | ... | Further diagnostic data specific to the particular slave |

## 16.24 Information EtherCAT master/slave - SSL-ID: xyE0h

**Description**

This SSL partial list is a VIPA specific SSL to request EtherCAT states of master/slave via logical and geographical addresses.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| x0E0h | | State info of a master + all the configured slaves via the ID of the EtherCAT network |
| | xxxxh | ■ Bit 0 ... 10:<br>– not relevant (all devices, max. 512+1) |
| | | ■ Bit 11 ... 14:<br>– System ID [1] of the EtherCAT network - 100 |
| | | ■ Bit 15:<br>– 1: ID bit for EtherCAT (PROFINET "look and feel") |
| xCE0h | | State info of the EtherCAT master/slave via logical base address |
| | xxxxh | ■ Bits 0 ... 14:<br>– logical base address of the EtherCAT device |
| | | ■ Bit 15:<br>– 0 = Input<br>– 1 = Output |
| xDE0h | | State info of a EtherCAT master/slave via the geographical address |
| | xxxxh | ■ Bit 0 ... 10:<br>– Master/slave ID |

| SSL_ID | INDEX | Description |
|---|---|---|
| | | ■ Bit 11 ... 14:<br>– System ID [1] of the EtherCAT network-100 |
| | | ■ Bit 15:<br>– 1: ID bit for EtherCAT (PROFINET "look and feel") |
| xFE0h | | Only header |
| | xxxxh | not relevant |
| 1) Refer PROFINET IO system ID, because EtherCAT is configured as PROFINET in the Siemens SIMATIC Manager. | | |

| | |
|---|---|
| LENTHDR | A record set is 1byte long |
| N_DR | ■ 00E0h: Number of record sets<br>– 512 slaves + 1 master<br>■ 0CE0h, 0DE0h: Number of record sets |

**Record set *SSL_ID: xyE0h***

| Name | Length | Value | Description |
|---|---|---|---|
| ecstate | 1 byte | B#16#00 | Undefined/Unknown |
| | | B#16#01 | Init |
| | | B#16#02 | PreOp |
| | | B#16#03 | BootStrap |
| | | B#16#04 | SafeOp |
| | | B#16#08 | Op |
| | | B#16#FF | NotProjected (for not projected EtherCAT periphery) |

## 16.25 EtherCAT bus system - SSL-ID: xyE1h

**Description**

This SSL partial list is a VIPA specific SSL to request information from the EtherCAT bus system.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 0CE1h | | State info of the EtherCAT master via logical base address |
| | xxxxh | ■ Bits 0 ... 14:<br>– logical base address of the EtherCAT master (diagnostics address of the interface) |
| | | ■ Bit 15:<br>– 0 = Input<br>– 1 = Output |
| 0DE1h | | State info of a EtherCAT master via the geographical address |
| | xxxxh | ■ Bits 0 ... 10:<br>– not relevant |

| SSL_ID | INDEX | Description |
|---|---|---|
| | | ■ Bits 0 ... 14:<br>– System ID [1] of the EtherCAT network - 100 |
| | | ■ Bit 15:<br>– 1: ID bit for EtherCAT (PROFINET "look and feel") |
| 0FE1h | | Only header |
| | xxxxh | not relevant |
| 1) Refer PROFINET IO system ID, because EtherCAT is configured as PROFINET in the Siemens SIMATIC Manager. | | |

| | |
|---|---|
| LENTHDR | A record set is 2words long (4bytes). |
| N_DR | Number of record sets (1) |

**Record set *SSL_ID: xyE1h***

| Name | Length | Value | Description |
|---|---|---|---|
| Bus system | 2words | W#32xxxxxxxx | Information via the EtherCAT bus system |
| | | | ■ Bit 0:<br>– 0: Topology OK<br>– 1: Topology Mismatch |
| | | | ■ Bit 1:<br>– 0: DC master out of "sync"<br>– 1: DC master in "sync" |
| | | | ■ Bit 2 ... 31: reserved |

## 16.26 Statistics information to OBs - SSL-ID: xyFAh

**Description**

This partial list contains statistical information about the OBs (additionally OB 60 and OB 61).

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00FAh | | All statistical information for OB xx<br>(5 record sets with 24bytes) |
| 01FAh | | Response time: time between the request and the start of execution |
| 02FAh | | Process image of the inputs (only relevant for OBs are assigned a process image) |
| 03FAh | | OB execution time: included alarm interrupts |
| 04FAh | | Process image of the outputs (only relevant for OBs are assigned a process image) |
| 05FAh | | Processing time: Time for an execution cycle of request until the completion of processing follow up |
| 0FFAh | - | SSL partial list header information |

| SSL_ID | INDEX | Description |
|---|---|---|
| | xx00h | Statistical information for all used OBs (additionally OB 60 and OB 61) |
| | xx3Ch | Statistical information for OB 60 |
| | xx3Dh | Statistical information for OB 61 |

| | |
|---|---|
| LENTHDR | one record set is 12words long (24byte) |
| N_DR | Number of record sets |

– *The times must be specified in µs*
– *During startup, the times are reset to zero - without minimum times.*
– *The minimum times are assigned with the value FFFFh.*

**Record set**

***SSL-ID: 01FAh***

The data set includes the response time. This is the time between the request and the start of execution. This time also includes a process input image.

| Length | Value | Description |
|---|---|---|
| 1byte | 01h | Number of partial list: *SSL Sub ID* |
| 1byte | xxh | OB Number: statistical information for OB xx<br>(INDEX see above) |
| 1word | xxxxh | reserved |
| 2words | xxxxxxxxh | Minimum execution time: The smallest measured time |
| 2words | xxxxxxxxh | Maximum execution time: Maximum measured time |
| 2words | xxxxxxxxh | Last run time: Last measured time |
| 2words | xxxxxxxxh | Average execution time: The time is determined by the last 1000 recorded times. |
| 2words | xxxxxxxxh | reserved |

– *The times must be specified in µs*
– *The measurement of time starts with the first transition from Startup to RUN.*

**Record set**

***SSL-ID: 02FAh***

The data set includes the time taken to create the process image of inputs. Only relevant for OBs which a process image is assigned.

| Length | Value | Description |
|---|---|---|
| 1byte | 02h | Number of partial list: *SSL Sub ID* |
| 1byte | xxh | OB Number: statistical information for OB xx<br>(INDEX see above) |
| 1word | xxxxh | reserved |
| 2words | xxxxxxxxh | Minimum execution time: The smallest measured time |
| 2words | xxxxxxxxh | Maximum execution time: Maximum measured time |
| 2words | xxxxxxxxh | Last run time: Last measured time |
| 2words | xxxxxxxxh | Average execution time: The time is determined by the last 1000 recorded times. |
| 2words | xxxxxxxxh | reserved |

- *The times must be specified in µs*
- *The measurement of time starts with the first transition from Startup to RUN.*

**Record set**

***SSL-ID: 03FAh***

The data set contains the execution time of the OBs. This is the time between the start of the OBs until leaving the OB including all alarm interrupts and SFC operations. The time from a higher priority OB is executed by a synchronous or asynchronous error is counted with.

| Length | Value | Description |
|---|---|---|
| 1byte | 03h | Number of partial list: *SSL Sub ID* |
| 1byte | xxh | OB Number: statistical information for OB xx<br>(INDEX see above) |
| 1word | xxxxh | reserved |
| 2words | xxxxxxxxh | Minimum execution time: The smallest measured time |
| 2words | xxxxxxxxh | Maximum execution time: Maximum measured time |
| 2words | xxxxxxxxh | Last run time: Last measured time |
| 2words | xxxxxxxxh | Average execution time: The time is determined by the last 1000 recorded times. |
| 2words | xxxxxxxxh | reserved |

- *The times must be specified in µs*
- *The measurement of time starts with the first transition from Startup to RUN.*

**Record set**

***SSL-ID: 04FAh***

The data set includes the time for creating the process image of outputs. Only relevant for OBs which a process image is assigned.

| Length | Value | Description |
|---|---|---|
| 1byte | 04h | Number of partial list: *SSL Sub ID* |
| 1byte | xxh | OB Number: statistical information for OB xx<br>(INDEX see above) |
| 1word | xxxxh | reserved |
| 2words | xxxxxxxxh | Minimum execution time: The smallest measured time |
| 2words | xxxxxxxxh | Maximum execution time: Maximum measured time |
| 2words | xxxxxxxxh | Last run time: Last measured time |
| 2words | xxxxxxxxh | Average execution time: The time is determined by the last 1000 recorded times. |
| 2words | xxxxxxxxh | reserved |

– *The times must be specified in µs*
– *The measurement of time starts with the first transition from Startup to RUN.*

**Record set**

***SSL-ID: 05FAh***

The data set contains the determined times for one execution cycle. This is the time between the request and the full completion of the processing.

| Length | Value | Description |
|---|---|---|
| 1byte | 05h | Number of partial list: *SSL Sub ID* |
| 1byte | xxh | OB Number: statistical information for OB xx<br>(INDEX see above) |
| 1word | xxxxh | reserved |
| 2words | xxxxxxxxh | Minimum execution time: The smallest measured time |
| 2words | xxxxxxxxh | Maximum execution time: Maximum measured time |
| 2words | xxxxxxxxh | Last run time: Last measured time |
| 2words | xxxxxxxxh | Average execution time: The time is determined by the last 1000 recorded times. |
| 2words | xxxxxxxxh | Error counter: This counter is increased at the time, when the execution cycle is longer than 60% of the projected Sync clock. |

– *The times must be specified in µs*
– *The measurement of time starts with the first transition from Startup to RUN.*
– *The cycle time of the Sync signal is set (HW configuration) via the CPU properties.*

## 16.27 VSC features - SSL-ID: xyFCh

**Description**

Via this partial list you get the current status of the VSC features of the System SLIO CPU. There are features at the VIPA memory card to unlock e.g. additional memory or PROFIBUS functionality.

**Parameters**

| SSL_ID | INDEX | Description |
|---|---|---|
| 00FCh | - | Status of all the VSC features |
| 01FCh | | Specifies the VSC feature, whose state is requested |
| | 0001h | VSC feature PROFIBUS |
| | 0002h | VSC feature memory extension |
| | 0003h | VSC feature Timeout |
| | 0004h | VSC feature CP fieldbus |
| | 0005h | VSC feature motion |

| | |
|---|---|
| LENTHDR | Length of the following record set in byte |
| N_DR | Number of record sets |

**Record set *SSL_ID*: 0xFCh**

| Name | Length | Value | Description |
|---|---|---|---|
| VSC_Feature PROFIBUS-DP | 2words | 000xh | ■ 0 = PROFIBUS_NO<br>■ 1 = PROFIBUS_MASTER<br>■ 2 = PROFIBUS_SLAVE |
| VSC_Feature MemKeySize | 2words | xxxxh | Size of the memory extension via VSC card in byte |
| VSC TimeOut | 2words | xxxxh | Remaining time of the CPU with removed VSC card in ms (for S7 data type Time) |
| VSC_Feature CpFieldbus | 2words | xxxxh | ■ 0 = FEATURE_SET_CP_FIELDBUS_NO<br>■ 1 = FEATURE_SET_CP_FIELDBUS_ETHERCAT |
| VSC_Feature Motion | 2words | xxxxh | ■ 0 = FEATURE_SET_MOTION_NO<br>■ 1 = FEATURE_SET_MOTION_8AXIS<br>■ 2 = FEATURE_SET_MOTION_20AXIS |

# 17 Index

**H**