Programmable Safety Systems
PSS-Range

PSS Standard Function Blocks
MBS Sensor Signal Evaluation
Version 1.0
Item No. 21 149-01
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Modular Block System: Sensor Signal Evaluation
This manual describes how to manage the standard function blocks in the “MBS Sensor Signal Evaluation” software package in accordance with their intended use.

Standard function blocks in the “MBS Sensor Signal Evaluation” package are part of the Pilz MBS Modular Block System. They can be used in the failsafe section of a PSS-range programmable safety system.

To fully understand this manual you will need to be conversant with the information found in the general documentation for the PSS-range (System Manual, Installation Manual for the modular/compact PSS, PSS SW PG Programming Manual/PSS WIN-PRO Programming Manual). In particular you should refer to the following documents from the System Manual:

- Safety Manual
- FS System Description
- Error List

To fully understand the bus-specific requirements and correlations for SafetyBUS p applications you will need some knowledge of the design and management of SafetyBUS p.

Knowledge of the safety regulations for the particular area of application is assumed.

You will find details to the function of the sensor in the manufacturer's operating manual.

This installation manual is intended for instruction and should be retained for future reference.
Introduction

MBS Modular Block System

Safety-related areas can be equipped with a multitude of safety devices such as E-STOPs, safety gates, light barriers etc. Safety devices are required in various quantities and combinations, depending on the object requiring protection. The Pilz MBS Modular Block System was developed to drive the various safety devices and to carry out process engineering functions, helping users to save time and money.

The MBS consists of individual standard function blocks (SBs), which are geared specifically towards the relevant safety device or process engineering function. It allows standard function blocks to be used in any combination. The standard function blocks can be combined in any sequence (max. 600).

Standard function blocks are encoded by an authorised body so that they cannot be modified. If an encoded standard function block is used within an application program, program testing may be restricted to the new parts of the program, considerably reducing the test time.
Categories / requirement classes

EN 954-1 divides safety devices into categories. All standard function blocks are designed for the highest category permitted for the safety device to be monitored. If safety devices with lower categories are to be monitored, input parameters may be assigned identical inputs (further information can be found in the description for the relevant standard function block).

In process engineering, safety requirements must conform to DIN V 19250 (Basic Safety Requirements for Measurement and Control Protection Devices). Requirement classes in accordance with DIN V 19250 may be referred to the categories as per EN 954-1. The Appendix contains a table showing the assignment of category and requirement class.
Introduction

Overview of manual

1 Introduction
The chapter you are reading provides an introduction to the Modular Block System (MBS). It is designed to familiarise you with the contents, structure and specific order of this manual and also contains terminology definitions.

2 Overview
This chapter provides information on the most important features of the software package and provides a brief overview of the application range.

3 Safety
This chapter must be read as it contains important information on safety regulations.

4 Intended Use
This chapter must be read as it contains information on intended use.

5 MBS Basics
This chapter explains the basic functions and safety requirements of the MBS.

6 Standard Function Blocks
This chapter explains the function of the standard function blocks in the software package.

7 Link Blocks
This chapter is designed to help you link the standard function blocks into your project and to commission the safety functions.

8 Examples
This chapter is designed to give an overview of how the standard function blocks may be applied and contains typical application examples.

9 Appendix
The Appendix contains a table that explains the relationship between categories and requirement classes, plus a list that documents the current version status of the standard function blocks.
Definition of symbols

Information in this manual that is of particular importance can be identified as follows:

**DANGER!**

This warning must be heeded! It warns of a **hazardous situation that poses an immediate threat of serious injury and death** and indicates preventive measures that can be taken.

**WARNING!**

This warning must be heeded! It warns of a **hazardous situation that could lead to serious injury and death** and indicates preventive measures that can be taken.

**CAUTION!**

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.

**NOTICE**

This describes a situation in which the product or devices in its immediate environment could be damaged. It also provides information on preventive measures that can be taken.

**INFORMATION**

This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of particular importance.
Introduction

Terminology

- The term “input” is frequently abbreviated to “I” (e.g. I-Parameter).
- The term “output” is frequently abbreviated to “O” (e.g. O-Parameter).
- The term “PSS” is always used when the description is valid for all applicable PSS programmable safety systems. If the description only relates to a specific PSS series, the specific name for that series will be used (e.g. PSS 3000 or PSS SB 3056).
- In this manual, the system software “PSS WIN-PRO” is referred to as “programming device” or “PG”.
- The term "sensor" describes the inductive safety switch. Its signals are evaluated by the software package.
- "Sensor chain" is a number of sensors switched in series in accordance with a sensor manufacturer specification. The chain requires only one test signal, and it provides only one feedback signal, and therefore the block sees it as an individual sensor.
Overview

Software package

The “MBS Sensor Signal Evaluation” software package is part of the Pilz MBS Modular Block System. The software package includes all the required standard function blocks for the evaluation of the inductive safety switch (sensor) GM504S of ifm electronic GmbH.

Functionality

The SB220 is a standard function block for the evaluation of the fail-safe inductive switch GM504S from ifm up to and including category 4 in accordance with EN 954-1, 03/97 and SIL3 in accordance with EN/IEC 61508-3. The fail-safe switch can be connected directly to the inputs/outputs of the PSS, without the separate evaluation device.

The SB220 specifies the test signal for the safety switch and evaluates the feedback signal from the sensor. In doing so, centralised and decentralised PSS inputs can be used.

All the wiring errors between the safety switch and the PSS are recognized. If the fail-safe switch was switched in a safe state or if it is not damped, or if a wiring error is detected, the enable output on the standard function block is immediately disabled and the error is entered in the corresponding error data word for diagnostic purposes. The enable is set automatically when the safety switch is damped and no errors are present.

Safety switches can be connected in series up to a maximum number specified by ifm (sensor chain). In this case, only one PSS input and one PSS output are required. SB220 can be used in programs with more than 200 standard function blocks. To do this, SB071 must be used in OB120.

Standard function blocks in the “MBS Sensor Signal Evaluation” software package are used in the failsafe section of a PSS-range programmable safety system.
Overview

Range

The software package consists of:

- The files for the software package on CD and
- An operating manual:
  PSS Standard Function Blocks MBS Sensor Signal Evaluation, Version 1.0

The software package on the CD contains the following standard function blocks:

- SB220  GM504S
  Evaluation of the inductive safety switch GM504S from ifm
  (approved safety block)
- SB071  INIT_MBS
  Initialisation of the administration data blocks (DB015/DB016/DB017)
  (approved safety block)
- SB255  System block
  SB255 is described in the PSS System Description
Safety guidelines

These safety guidelines are an important part of this manual. Failure to keep to these guidelines will render all warranty, guarantee and liability claims invalid.

• All health and safety / accident prevention regulations for the particular area of application must be observed.
• Before using one or more of the standard function blocks in this software package, you must perform a safety assessment in accordance with the Machinery Directive.

Use of qualified personnel

The safety system may only be assembled, installed, commissioned, operated, maintained and decommissioned by qualified personnel who, because they are:

• Qualified electrical engineers or
• Have received training from qualified electrical engineers

are suitably experienced to operate units, systems, plant and machinery in accordance with general standards and guidelines for safety technology.

Warranty and liability

All claims to warranty and liability will be rendered invalid if:

• Standard function blocks are used contrary to the purpose for which they were intended
• Damage can be attributed to not having followed the guidelines in the manual
• Operating personnel are not suitably qualified.
Safety

Application guidelines

- The instructions given in the “Safety Manual” and in the “Installation Manual” must be followed.
- Please read the information in Chapter 4 regarding the intended use of these blocks.
- The use of Pilz SBs does not detract from the fact that it is the responsibility of the user to design appropriate safety systems for plant, machinery and software.
- It is the users’ responsibility to determine their application requirements by carrying out a detailed risk analysis, which should take into account relevant regulations and standards, etc.

WARNING!

Please note: To achieve the corresponding category or requirement class, the whole system including all safety-related components (parts, devices, user program etc.) must be included in the assessment. For this reason, Pilz cannot accept liability for the correct classification into a category or requirement class.
Standards

To use the SBs correctly you will need to have a good knowledge of the relevant standards and directives. The following gives an overview of the most important standards:

• E-STOP circuits EN 418
• Safety of machinery - Two-hand controls EN 574
• Mechanical presses EN 692
• Hydraulic presses EN 693
• Hydraulic stamping and bending presses EN 12 622
• Machinery directive - basic terminology EN 292-1 and EN 292-2
• Printing and paper machinery prEN 1010
• Safety gates EN 1088
• Electrosensitive protective equipment EN 61 496-1
• Electrical equipment EN 60 204-1
• Machinery safety EN 954-1
• Basic Safety Requirements for Measurement and Control Protection Devices DIN V 19 250
• Electrical equipment on firing plants prEN 50 156-1

Please note this is not an exhaustive list of safety standards and directives.
Fault detection

The detection of errors and defects is an important function of the PSS, in addition to pure control tasks.

Information of the concept of error detection can be found in the PSS System Description.

**WARNING!**
It is particularly important to detect open circuits and shorts within the safety circuits (e.g. two-hand, E-STOP etc.)

It is the responsibility of the user to select and apply an appropriate fault detection system.

Feasibility test

Redundant input devices for safety functions must undergo a feasibility test within the application program.

The plant must be stopped immediately if a feasibility error occurs. Similar tests will also be required for other input devices. If safety valves have feedback contacts, these must be evaluated accordingly.

Fault prevention

Not all potential faults can be detected and managed. Such faults must be excluded by suitable wiring.

Additional information on how to exclude potential errors can be found in the BIA Handbook (BG Institute for Occupational Safety, St Augustin) or in the directive VDI 2854 (safety requirements on automated manufacturing systems).
Intended Use

Use

The software package “MBS Sensor Signal Evaluation” is designed for use within the failsafe section of the PSS-range of programmable safety systems.

**INFORMATION**

Use of standard function blocks outside the specifications described here will be deemed improper use.

**INFORMATION**

Always use the current version of a standard function block. Please ensure you refer to the Appendix, sections entitled “Standard function blocks: current versions” and the amendment list.

System software

The software package “MBS Sensor Signal Evaluation” can be used with the PSS WIN-PRO system software.

Further information is available in the programming manual for “PSS WIN-PRO”.

Modular Block System: Sensor Signal Evaluation

4-1
Intended Use

Intended use of the standard function blocks

WARNING!
The SB220 may only be used in combination with the fail-safe inductive switch GM504S of ifm Syntron GmbH. Applications with other sensors are not permitted.

WARNING!
Category 4 in accordance with EN 954 can only be achieved under the condition that the fail-safe switch is cyclically damped and undamped, and that the fail safe switch is kept in a damped state most of the time.

WARNING!
If SB220 is used to lock hazardous machine functions (e.g. a safety gate application), the setting of the enable of the SB220 (output parameter PULS) must not start the hazardous machine functions.
The enable must be evaluated by the monitoring function provided for the application, e.g. by the block SB064 S-GATE safety gate application. Only the monitoring function may trigger the start of the hazardous machine function.

WARNING!
You must consider the resulting reaction times. The reaction times consist of the reaction times of the fail-safe switch (see manufacturer's details) and the PSS.
The reaction time of the PSS depends on half the time period of the test signal (output parameter PULS) and the tolerance for the monitoring of the feedback signal. Using the resulting reaction time you must assess whether the combination SB220 with a fail-safe switch is technically safe for a certain application.
NOTICE

It is not permitted to use dual-pole outputs (e.g. outputs of PSS(1) DI(2)O Z) for the test signal to the fail-safe switch!

WARNING!

It is not permitted to use outputs that can be configured as test pulse outputs (e.g. outputs of the PSS(1) DI(2)O T) for the test signal to the safety switch. Detection of shorts between contacts is not effective with these outputs. The safety switch cannot drive the constant logic '1' signal with these outputs. Error detection then is no longer possible.

NOTICE

It is absolutely necessary to test beforehand in each application whether shorts between contacts are recognized by the PSS.

CAUTION!

Shorts between contact between the individual test signals can not be detected.

If several test signals are used, e.g. when the safety switch is not connected in series, but if it is connected to the PSS individually with an own test signal each, it must be possible to exclude this wiring error. This is possible by e.g. laying cables to the safety switches outside the control cabinet separate from each other.
**Intended Use**

**SB220: Evaluation of the inductive safety switch GM504S**

The SB220 is used to evaluate the fail-safe inductive switch GM504S of ifm electronic Syntron GmbH. The switch is called “sensor” in this manual. The building block can evaluate a max. of 1 sensor or sensor chain (see terminology definitions in chapter 1, Introduction). The block can be connected to centralised input/output modules and to SafetyBUS p modules.

**SB071: Initialisation of administration data blocks (DB015/DB016/DB017)**

SB071 is used to calculate the global parameters, depending on the set minimum scan time (see also under “Minimum Scan Time” in Chapter 5). The global parameters DW1001 ... DW1023 in the administration data blocks DB015, DB016 and DB017 are initialised using SB071.

Function:

- Reads in the set minimum scan time from DB002 (configurator)
- Calculates the cycles based on the times transferred in the parameters
- Enters the calculated values into the administration data blocks
Block design

Safety-related areas can be equipped with a multitude of safety devices such as (e.g. E-STOPs, safety gates, light barriers). These safety devices are used in various quantities and combinations, depending on the object requiring protection.

The Modular Block System (MBS) is made up of individual standard function blocks. A standard function block is geared towards the requirements of specific safety devices (e.g. monitoring an E-STOP button, safety gate monitoring).

A standard function block must be assigned to each safety device in order for it to be evaluated and monitored using the MBS. This procedure enables any combination of individual safety devices to be evaluated and monitored. The standard function blocks can be combined in any sequence within the user program (max. 600).

One exception to this are standard function blocks used to drive and monitor contactors or valves. For control engineering reasons, these should be called up at the end of the user program.
Formal parameters and actual parameters

Parameters can be set on the MBS standard function blocks. Formal parameters are established in the block header. The user must assign a corresponding actual parameter to each formal parameter. When the standard function block is called up in the user program, the formal parameters will be replaced by the user-specific actual parameters.

<table>
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<tr>
<th>Formal parameter</th>
<th>Actual parameter</th>
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<tr>
<td>X</td>
<td>Input bit E</td>
</tr>
<tr>
<td></td>
<td>Output bit A</td>
</tr>
<tr>
<td></td>
<td>Flag bit M</td>
</tr>
<tr>
<td>B</td>
<td>Input byte EB</td>
</tr>
<tr>
<td></td>
<td>Output byte AB</td>
</tr>
<tr>
<td></td>
<td>Flag byte MB</td>
</tr>
<tr>
<td></td>
<td>Constant KB</td>
</tr>
<tr>
<td>W</td>
<td>Input word EW</td>
</tr>
<tr>
<td></td>
<td>Output word AW</td>
</tr>
<tr>
<td></td>
<td>Flag byte MW</td>
</tr>
<tr>
<td></td>
<td>Constant KW</td>
</tr>
<tr>
<td>D</td>
<td>Data block DB</td>
</tr>
<tr>
<td>Z</td>
<td>Timer or counter</td>
</tr>
</tbody>
</table>

Further information is available in the programming manual for “PSS WIN-PRO”.
Administration data blocks DB015, DB016 and DB017

Data blocks DB015, DB016 and DB017 are permanently specified within the Modular Block System (MBS).

These data blocks are common administration blocks for fault and diagnostic data from the MBS standard function blocks and for block and parameter data that is required internally.

The administration data block DB015 must always be installed when using MBS standard function blocks. Administration data blocks DB016 and DB017 are installed when necessary. The administration data blocks must always be installed with their full length of 1024 data words and they must always have read/write status.

**NOTICE**
Data blocks DB015, DB016 and DB017 should only be used as MBS administration data blocks and not for other data.

Structure of the administration data blocks

The administration data blocks DB015, DB016 and DB017 have the same structure.

Each standard function block in the user program has 5 data words available in one of the administration data blocks. These data words are used to back up the temporary flags from the standard function block (see section entitled “Temporary flag range in MBS blocks”).

In each of the administration data blocks, the range DW0001 to DW1000 is divided into 5 blocks, each with 200 data words (see Fig. 5-1).
Fig. 5-1: Structure of the administration data blocks
Blocks contained in the administration data blocks

Each standard function block occupies 1 data word per block (see Fig. 5-2). This means a max. of 200 safety devices (e.g. E-STOP 1, E-STOP 2, safety gate 1) can be managed per administration data block.

The PSS uses a standard function block’s SSNR to automatically generate the corresponding data words (see section entitled “Input parameter SSNR”).

Fig. 5-2: Contents of the administration data blocks
DW0000 (DB015)

If parameters for a standard function block’s input parameter SSNR are not within the permitted range, DW0000 of DB015 will contain the incorrect SSNR parameter. The standard function block will not be enabled (output parameter ENBL= 0). If the SSNR=0, DW0000 of DB015 will contain the decimal value -1 or KH FFFF.

1st data block (DB015/DB016/DB017):

DW 0001 ... DW0200 Bits for hardware and operator errors

The significance of the individual bits can be found in the description for the relevant standard function block (see section entitled “Fault diagnostics”). If a data word contains the value 0, no error has been found

2nd data block ... 5th data block (DB015/DB016/DB017):

DW0201 ... DW1000

Data blocks 2 ... 5 are used for internal block data.

6th data block (DB015/DB016/DB017)

DW1001 ... DW1023

Data block 6 contains the global parameters (see section entitled “Global parameters”).
**Input parameter SSNR**

MBS standard function blocks have input and output parameters which can be adapted to suit the respective control configuration. The input parameter SSNR (safety subroutine number) is available on all MBS standard function blocks. It is required to manage the administration data blocks DB015, DB016 and DB017.

**INFORMATION**

MBS standard function blocks may differ in terms of the permitted value range for the SSNR. The following value ranges are possible for the SSNR:

- Value range of input parameter SSNR: 1 ... 200  
  (byte constant type: KB001 ... KB200)
- Value range of input parameter SSNR: 1 ... 600  
  (word constant type: KF000001 ... KF000600)

The valid value range for the SSNR of a standard function block is documented in the standard function block description.

The input parameter SSNR determines the administration data block plus the 5 data words assigned in the administration data block of the corresponding safety device (1 DW per block). The administration data blocks are assigned the following SSNR ranges:

- SSNR 001 ... 200: DB015
- SSNR 201 ... 400: DB016
- SSNR 401 ... 600: DB017

The one data word per block is generated automatically internally (SSNR + offset).
MODULAR BLOCK SYSTEM: SENSOR SIGNAL EVALUATION

NOTICE

- One MBS standard function block must be used for each safety device.
- Each standard function block should be assigned its own SSNR.
- Make sure that each SSNR is assigned once only.
  If two SB calls have the same value for the SSNR, they will access the same data word in the administration data block. This can lead to malfunctions.
- Document the assignment of the safety device to the respective SSNR of the standard function block.

Example

Safety device 2 (E-STOP button) is monitored using SB061. The value KB002 is assigned to input parameter SSNR of SB061.

The following DWs in DB015 are therefore assigned to safety device 2:

Block 1:  DW0002
Block 2:  DW0202
Block 3:  DW0402
Block 4:  DW0602
Block 5:  DW0802

The user program has read-only access to these data words.
Fault diagnostics

Error types

On programmable safety systems from the PSS-range, a distinction is made between two types of errors. On the one hand there are errors which are detected and evaluated through the PSS operating system, and on the other there are errors which are detected and evaluated through the user program. The reaction to these two types of errors is different.

Where errors are detected through the operating system, the FS section of the PSS will switch to a STOP condition and all outputs will be switched off safely.

Where errors are detected through the user program, only the configured error reaction will occur. Errors that are detected via an MBS standard function block belong to this second type of error.
Fault diagnostics using the administration data blocks

Data words DW0001 … DW0200 of an administration data block contain the error messages from the individual MBS standard function blocks (see Fig 5-3). 1 data word is reserved for each standard function block used. The assignment is made using the SSNR.

Fig. 5-3: Managing the MBS error messages using the administration data blocks (example)
Temporary flag range in MBS blocks

Internally, MBS blocks use the flags in the range M 64.00 ... M69.31 as temporary flags.

NOTICE
We recommend the following:
- Do not use flags from the temporary flag range for your own applications. Malfunctions may occur if you use the temporary flag range M64.00 ... M69.31 for your own applications.
- If it is absolutely necessary to use this flag range, under no circumstances should you use the flags:
  - in alarm OBs
  - as input parameters for standard function blocks
  - as output parameters for standard function blocks
  - as global parameters

Output parameter ENBL

Many standard function blocks have an enable output FG/ENBL. This output parameter indicates the enable status of a standard function block. The enable status results from the standard function block’s check of the inputs.

ENBL = 1: No error found, function is enabled
ENBL = 0: An error has been found, function is not enabled.
Assignment of input and output parameters

Input and output parameters should be assigned in accordance with the details given in the operating manual.

WARNING!
If several unused output parameters are connected to the same flag, malfunctions may occur in the standard function blocks. If an unused output has to be assigned a flag, make sure the output is assigned to a flag that is not used anywhere else in the program.

Minimum scan time

Most of the timer functions required within the blocks are performed using cycle counters. This means that almost all the timers are available for use in applications.

INFORMATION
• If MBS blocks are used, a minimum scan time must always be entered in the configurator. Empirical values should be used.
• If the error message F-20/06 (error category/error number) appears in the CPU display, you must amend the minimum scan time appropriately. This error message indicates that the minimum scan time has been exceeded. The PSS must not be operated while this error message is present.

SB070 and SB071 automatically enter the minimum scan time in DW1022 of the administration data blocks. In this way it is automatically available to the MBS.

INFORMATION
Please note that the times are imprecise. The lack of precision on times is due to the cyclical processing of the user program. It is determined by the scan time of the respective user program. The following is generally valid:
The greater the ratio of time value to scan time, the greater accuracy you will have with the required times.
Global parameters

Block 6 (DW1001 ... DW1023) of the administration data blocks contains global parameters. These are parameters that are valid for several blocks. For details of which global parameters a standard function block uses, please refer to the description of the individual standard function blocks.

The data words in block 6 must be initialised when the program is started (OB120) using SB070/SB071 (INIT_MBS). The abbreviations in brackets {... : ...} at the end of each data word correspond to the parameters in SB071. The times that are also specified within the brackets are empirical values, unless stated otherwise.

<table>
<thead>
<tr>
<th>Data Word</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW1001</td>
<td>Number of cycles in the contact synchronisation time between 2 N/O contacts or 2 N/C contacts (e.g. E-STOP button, reset key, etc.)</td>
<td>{CoSy : 50 ms}</td>
</tr>
<tr>
<td>DW1002</td>
<td>Number of cycles in the feedback loop's reaction time to a change in the PSS output connected to the main contactor</td>
<td>{RFbL : 100 ms}</td>
</tr>
<tr>
<td>DW1003</td>
<td>Number of cycles in the contact switchover time between a N/O and N/C contact (pushbutton)</td>
<td>{CS_B : 100 ms}</td>
</tr>
<tr>
<td>DW1004</td>
<td>Number of cycles in the contact switchover time between a N/O and N/C contact (relay)</td>
<td>{CS_R : 50 ms}</td>
</tr>
<tr>
<td>DW1005</td>
<td>Number of cycles in the machine clock time</td>
<td>{MaCy : max. 30 s in accordance with EN 61496-1 section A.8.4, 06/98}</td>
</tr>
<tr>
<td>DW1006</td>
<td>Number of cycles in the permitted ESPE reaction time</td>
<td>{ESPE : max. 150 ms in accordance with EN 61496-1 section 5.2.4, 06/98}</td>
</tr>
<tr>
<td>DW1007</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>DW1009</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>DW1010</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>DW1011</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>DW1012</td>
<td>Reserved</td>
<td></td>
</tr>
</tbody>
</table>
### MBS Basics

<table>
<thead>
<tr>
<th>DW1013</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW1014</td>
<td>Reserved</td>
</tr>
<tr>
<td>DW1015</td>
<td>Counter for monitoring the SSNR</td>
</tr>
<tr>
<td>DW1016</td>
<td>Reserved</td>
</tr>
<tr>
<td>DW1017</td>
<td>Reserved</td>
</tr>
<tr>
<td>DW1018</td>
<td>Reserved</td>
</tr>
<tr>
<td>DW1019</td>
<td>Reserved for administration</td>
</tr>
<tr>
<td>DW1020</td>
<td>Reserved</td>
</tr>
<tr>
<td>DW1021</td>
<td>Reserved for burner management</td>
</tr>
<tr>
<td>DW1022</td>
<td>Min. scan time from DB002/DW0002</td>
</tr>
<tr>
<td>DW1023</td>
<td>Reserved</td>
</tr>
</tbody>
</table>
Standard Function Blocks

SB220: Evaluation of the fail-safe inductive switch GM504S

Block header

Input parameters

- **SSNR**: Safety subroutine number
  Permitted value range: 1 ... 600
  Format: Word constants KF000001 ... KF000600
  (see sections in Chapter 5 entitled “Administration data blocks DB015, DB016 and DB017” and “Input parameter SSNR”).

- **IN**: Feedback signal from fail-safe switch GM504S
  Connect this input parameter with the output “A” of the fail-safe switch.
  It is possible to connect an individual fail-safe switch or a series connection of up to the max. number of fail-safe switches specified by the fail-safe switch manufacturer.

Output parameters

- **ENBL**: Enable flag bit (Enable)
  \( ENBL = 0 \): Error detected or fail-safe switch not damped
  \( ENBL = 1 \): The enable is given when the fail-safe switch is damped and no error is present.

- **PULS**: Test signal for fail-safe switch GM504S
  Connect this output parameter with the input “TE” of the fail-safe switch.
Standard Function Blocks

Function

- Creating a test signal to the fail-safe switch
- Monitoring the feedback signal from the fail-safe switch
- Detecting wiring errors between fail-safe switch and PSS
- Enable of the function monitored by the fail-safe switch when it is error-free

Error messages

Any fault that is detected will be stored in the corresponding error data word (SSNR) of the administration data block (1st data block), until the fault has been fully dealt with.

- Error messages in the administration data block
  - Bit 00: No correct feedback signal present.
    The feedback signal does not correspond to the test signal.
    The safety switch is not damped, or there is an error present, e.g. internal error in the fail-safe switch.
    Remedy: Check fail-safe switch and wiring, dampen fail-safe switch.
  - Bit 01: No minimum cycle time set.
    Remedy: Set minimum cycle time and load program again.

- Error messages on the CPU-display
  - E003 Administration data block not initialised
    Remedy: Call SB071 in OB120

Global parameters used in the administration blocks

Global parameters are set in OB120 using SB071.
- DW 1022: Minimum PSS scan time
Blocks required

- DB015, DB016, DB017: Administration data blocks
  The data blocks must consist of their total length of 1024 data words and have READ/WRITE access (see section entitled “Administration data blocks” in Chapter 5).
- SB071: Initialisation of global parameters in DB015, DB016 and DB017
- SB255: For calling up the operating system
Standard Function Blocks

Wiring of input and output parameters

Test signal

The test signal generated by the block to the fail-safe switch (output parameter PULS) is a rectangle signal, and half of its period length depends on the minimum cycle time set as follows:

Half period length (in PSS cycles) = 75 / minimum cycle time set.

If the resulting half period length is below 55 ms, the number of cycles is increased by one.

• Example 1:
  Minimum cycle time set is 10 ms.
  Half period length (in PSS cycles) = 75 / 10 = 7 cycles = 70 ms.

• Example 2:
  Minimum cycle time set is 45 ms.
  Half period length (in PSS cycles) = 75 / 45 = 1 cycle.

One cycle means half a period length of 45 ms. This is less than 55 ms, therefore the number of cycles in increased by one. Resulting half period length = 2 cycles = 90 ms.

Fig. 6-1: Wiring principle
• Example 3: Minimum cycle time set is 90 ms.
  Half period length (in PSS cycles) = 75 / 90 = 0 cycles.

  Zero cycles means half a period length of 0 ms. This is less than 55 ms, therefore the number of cycles is increased by one.
  Resulting half period length = 1 cycle = 90 ms

Feedback signal

At the feedback input of the block (input parameter IN) a signal is expected with the same period length as the test signal sent by the block (output parameter PULS). The feedback signal does not have to be simultaneous to the test signal, it can be phase-delayed. This means a feedback signal with any delay is possible.

The monitoring of the feedback signal consists of a time measurement that measures half the period length of the feedback signal. The resolution is a PSS cycle. If half the period length of the feedback signal deviates from half the period length of the test signal, the enable (output parameter ENBL) is reset.

If a minimum cycle time of below 30 ms is set, monitoring tolerates a deviation of half the period length of the feedback signal of up to ca. ± 50 ms. In this case, half the period length of the feedback signal can be ca. 50 ms shorter or up to ca. 50 ms longer than half the period length of the test signal.

Formula for the calculation of the tolerance period:
  Tolerance period (in PSS cycles) = 30 / minimum cycle time set.

If the resulting half period length is below 25 ms, the number of cycles is increased by one.

• Example 1: Minimum cycle time set is 10 ms.
  Tolerance period (in PSS cycles) = 30 / 10 = 3 cycles = ± 30 ms.

• Example 2: Minimum cycle time set is 20 ms.
  Tolerance period (in PSS cycles) = 30 / 20 = 1 cycle.

  One cycle means a tolerance time of 20 ms. This is less than 25 ms, therefore the number of cycles is increased by one. Resulting tolerance period length = 2 cycles = ± 40 ms.
**Standard Function Blocks**

**Monitoring times**

Below you find some examples for the monitoring times of the feedback signal:

- **Example 1:**
  
  Minimum cycle time set is 10 ms
  - Half period length test signal = 75 / 10 = 7 cycles = 70 ms
  - Set value half period length feedback signal = 70 ms
  - Tolerance period monitoring feedback signal = 30 / 10 = 3 cycles = 30 ms

![Fig. 6-3: Set behaviour of the feedback signal in example 1](image)

- **Example 2:**
  
  Minimum cycle time set is 90 ms
  - Half period length test signal = 75 / 90 = 0 cycles +1 cycle = 90 ms
  - Set value half period length feedback signal = 90 ms
  - Tolerance period monitoring feedback signal = 0 ms

![Fig. 6-4: Set behaviour of the feedback signal in example 2](image)
Reaction times

The reaction time of the overall system PSS with fail-safe switch in case of an error or an undamping of the fail-safe switch consists of the following times:

- Reaction time of the fail-safe switch (see manufacturer’s details) plus
- Half period length of the test signal plus
- Tolerance time in the monitoring of the feedback signal plus
- Imprecision of the PSS, i.e. the time that elapses until an event is present in the process image of the inputs, and until it can be processed by the program.

Example: Minimum cycle time set is 20 ms
- Half period length of the test signal = 60 ms
- Tolerance time in the monitoring of the feedback signal = 40 ms

The reaction time of the fail-safe switch and the imprecision of the PSS need to be added to the 100 ms.

Delayed setting of the enable

The enable is only set when the SB220 receives a correct feedback signal over a time period of 5 pulse edges (see section “Feedback signal”)

Standard Function Blocks

SB071: Initialisation of administration data blocks

Block header

<table>
<thead>
<tr>
<th>SB071</th>
<th>INIT_MBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>B - CoSy</td>
<td></td>
</tr>
<tr>
<td>B - RFbL</td>
<td></td>
</tr>
<tr>
<td>B - CS_B</td>
<td></td>
</tr>
<tr>
<td>B - CS_R</td>
<td></td>
</tr>
<tr>
<td>W - MaCy</td>
<td></td>
</tr>
<tr>
<td>B - ESPE</td>
<td></td>
</tr>
</tbody>
</table>

Input Parameters

- **CoSy**: Contact synchronisation time of 2 N/O or N/C contacts
- **RFbL**: Reaction time of contactor feedback loop
- **CS_B**: Contact switchover time N/O / N/C on buttons
- **CS_R**: Contact switchover time N/O / N/C on relays
- **MaCy**: Machine scan time for cycling ESPE/AOPD
- **ESPE**: ESPE/AOPD reaction time

Function

- Reads in the set minimum scan time from DB002? 
  A minimum scan time **must** always be configured when using MBS blocks. Please note the section “Minimum scan time” in chapter 5.
- Calculates the cycles based on the times transferred in the parameters
- Enters the values to the global parameters DW1001 ... DW1023 of the administration data blocks
Table for setting the parameters of the global parameters:

<table>
<thead>
<tr>
<th>Input Parameters</th>
<th>Parameters in Administration-DB</th>
<th>Limits in [ms]</th>
<th>proposed values in [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CoSy</td>
<td>DW 1001</td>
<td>0 ... 255</td>
<td>50</td>
</tr>
<tr>
<td>RFbL</td>
<td>DW 1002</td>
<td>0 ... 255</td>
<td>100</td>
</tr>
<tr>
<td>CS_B</td>
<td>DW 1003</td>
<td>0 ... 255</td>
<td>100</td>
</tr>
<tr>
<td>CS_R</td>
<td>DW 1004</td>
<td>0 ... 255</td>
<td>50</td>
</tr>
<tr>
<td>MaCy</td>
<td>DW 1005</td>
<td>0 ... 30 000</td>
<td>30 000 in acc. with EN 61-496-1 A.8.4</td>
</tr>
<tr>
<td>ESPE</td>
<td>DW 1006</td>
<td>0 ... 255</td>
<td>150 in acc. with EN 61-496-1</td>
</tr>
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<td>reserved</td>
<td>DW 1007</td>
<td></td>
<td></td>
</tr>
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</tr>
<tr>
<td></td>
<td>DW 1009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserved</td>
<td>DW 1010</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DW 1011</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DW 1012</td>
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<td></td>
</tr>
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<td></td>
</tr>
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<td>DW 1016</td>
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<td></td>
<td>DW 1017</td>
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<td></td>
<td>DW 1018</td>
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<td></td>
</tr>
<tr>
<td>reserved</td>
<td>DW 1019</td>
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<td>reserved</td>
<td>DW 1021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reserved</td>
<td>DW 1022</td>
<td></td>
<td>min. cycle time DB002/DW0002</td>
</tr>
<tr>
<td>reserviert</td>
<td>DW 1023</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INFORMATION**

- All times should be entered in ms.
- The values suggested are standard values. If your plant does not run stably using these values, you can work out the values to suit your plant as follows:
  - Select the standard value as a starting point.
  - Increase this value by appropriate time intervals until your plant runs stably.
Please note:
Entering excessively high time values for monitoring will reduce the level of safety on your plant.

If you are using Type 2 ESPE/AOPDs, the maximum value you may enter for the ESPE parameter is a maximum value of 150 ms (EN 61496-1).

• The number of cycles calculated is rounded down and is transmitted to the data words of the administration blocks.

• The SB must be called once only as the PSS starts up (e.g. in the OB 120).

Error messages

• none

Blocks required

• OB120

• DB015/DB016/DB017: Administration data blocks
  The data blocks must consist of its total length of 1024 data words. The data blocks must be declared READ/WRITE.
Check list

- **Safety regulations**
  - Which safety regulations need to be met?
  - Aid: Relevant standards and regulations.

- **Selecting standard function blocks**
  - Which safety devices or process functions need to be supported?
    Aid: Consult plant and machinery plans.
  - Which standard function blocks should be used?
    Aid: Consult sample programs in Chapter 8.
  - Is the contact arrangement on the operator elements suitable for the standard function blocks?
  - Does the PSS have the correct I/O arrangement?

- **Start up the failsafe section of the programming device**
  - Enter password.

- **Load project into programming device**
  - Aid: Use “Change Project” from the project menu.

- **Import all the blocks you need into the project**
  - Aid: Use “Import” from the project menu.

- **Link the project allocation table to the block allocation table**
  - Aid: Use “Import” from the project menu.
  - Does the allocation table contain all the operands and tags?
    Tip: Logic signals may be linked symbolically.

- **Adapt the allocation table to the wiring plan**
  - Adapt the I/Os in the allocation table.
    Aid: Allocation table editor.
  - Keep reserved flags free (do not use for your own applications).

- **Configure system**
  - Call up the configurator
  - Enter the set layout configuration
  - Enter the test pulse allocation
  - Enter preliminary run times for test purposes.
    These can be optimised during commissioning.
  - Enter a minimum scan time.
  - If test pulses are to be connected to the 3 ms inputs (E x.16 ... E x.31): Make sure the DI test time is set correctly.
Link Blocks

- Establish the sequence in which the blocks will be called up
  - MBS blocks must be run through as part of each cycle.
  - Aid: Flow chart and listing.
- Create a supervisory (master) block
  - The master block should be either a PB or an FB (if parameters are required: FB).
  - Call up the blocks in the correct sequence and set parameters for them
    ° Assign a different number to each block SSNR (1 ... 600)
    ° Document the SSNR you have used
    ° If necessary, combine the enable output parameters (FG/ENBL) into suitable groups by means of a logic AND-operation.
  - Remember to take into account any links which have already been made.
  - Enter details on the operation of the selected fault indicator
- Import / set up DB015 or DB015/DB016/DB017 in the project
  - DB015/DB016/DB017 must always contain 1024 data words
  - DB015/DB016/DB017 must have READ/WRITE status
- Create OB120
  If necessary, add SB070 or SB071 call.
- Create OB101
  - Reset all enable flags (FG/ENBL) at the start of the OB or at the start of the cycle. This way you can be sure that the FG flags are indeed set.
On some blocks (e.g. E-STOP) the input parameter “SSNR” is monitored (see the description of the relevant SB in Chapter 6). These blocks must be run through as part of each PSS cycle. The following commands should therefore be entered once only at the end of OB101:

```
DB015 A
DW1015 I
```

- Call up the E-STOP standard function blocks directly in OB101 or, for example, global call in an FB.
- Check:
  Have all the blocks required for the application been called up?

**Things to note when starting up the program**

**Tip:**
- On start up, the PSS clears all the flag words, outputs, timers and counters in the FS section. All the necessary constants should therefore be set when starting up the program.

**Link Project**

**INFORMATION**
- All safety devices should be checked to ensure they operate correctly.
- Short-circuits and open circuits should be simulated.
Link Blocks

Notes
Applications and parameters of individual blocks

The following examples are designed to show the application and parameters of individual standard function blocks.

The voltage supply to the PSS and the reset input E 0.31 are not shown in the wiring diagrams for the sake of clarity.

Many of the following diagrams state the category for which the circuitry is designed, in accordance with EN 954-1, 03/97. For details of how this relates to the corresponding AK requirement class (DIN V 19 250, 05/94), please refer to the table in the Appendix.

NOTICE
It is important to note that the categories stated refer exclusively to the PSS circuitry and the parameters set on the SBs. To achieve the corresponding category throughout the whole system, all safety-related components/devices (e.g. E-STOP button, safety limit switch etc.), plus the whole of the application program must be considered in the assessment (approved SBs do not need to be tested).

Pilz cannot accept responsibility for classifying installations into particular categories.
Examples

Application example

Example of a safety gate monitoring with the blocks SB220 GM504S and SB064 S-GATE:

CAL SB220

<table>
<thead>
<tr>
<th>SB220 GM504S</th>
</tr>
</thead>
<tbody>
<tr>
<td>KF 000310</td>
</tr>
<tr>
<td>E 1.08</td>
</tr>
</tbody>
</table>

Feedback signal:

CAL SB064

<table>
<thead>
<tr>
<th>SB064 S-GATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KF 000311</td>
</tr>
<tr>
<td>M 110.01</td>
</tr>
<tr>
<td>M 080.00</td>
</tr>
<tr>
<td>M 080.00</td>
</tr>
<tr>
<td>KF 000000</td>
</tr>
<tr>
<td>M 110.01</td>
</tr>
<tr>
<td>M 110.00</td>
</tr>
<tr>
<td>M 110.00</td>
</tr>
<tr>
<td>E 1.16</td>
</tr>
</tbody>
</table>
Assignment table: category and requirement class

In process engineering, safety requirements must conform to DIN V 19 250, 01/89 (Basic Safety Requirements for Measurement and Control Protection Devices). Requirement classes in accordance with DIN V 19 250, 01/89 may be referred to the categories as per EN 954-1, 11/94.

<table>
<thead>
<tr>
<th>Assignment as per requirements</th>
<th>Assignment as per safety measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk class VDI/VDE 2180</td>
<td>Safety Integrity Level EN IEC 61508</td>
</tr>
<tr>
<td></td>
<td>Category of Control EN 954-1</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
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<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

**Fig. 9-1: Assignment table**

*1 This assignment cannot be definitive. It depends on the system and/or product.

*2 Depending on the anticipated extent of damage, requirement class 1 may either be category 1 or may have no safety requirement.
Appendix

Standard function blocks: current versions

INFORMATION
This manual is intended exclusively for use with the standard function block versions listed below.

Older SB versions may differ from the description given in this manual. A description of the changes which have taken place when versions have been upgraded can be found in the amendment list below.

The version number can be determined from the information stated in the block header of the SB (date and CRC).

<table>
<thead>
<tr>
<th>SB No.</th>
<th>Name</th>
<th>Date</th>
<th>CRC</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB220</td>
<td>GM504S</td>
<td>14.01.05</td>
<td>A11F</td>
<td>1.0</td>
</tr>
<tr>
<td>SB071</td>
<td>INIT_MBS</td>
<td>19.07.02</td>
<td>DF40</td>
<td>1.0</td>
</tr>
</tbody>
</table>

INFORMATION
Always use the current version of the relevant standard function block for your application program.
In many countries we are represented by sales partners.

Please refer to our Homepage for further details or contact our headquarters.