XPSMFEXT

Extended Software Manual

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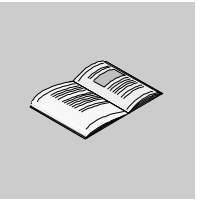

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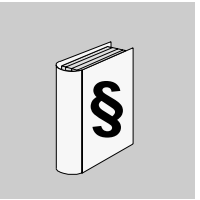
Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION
CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

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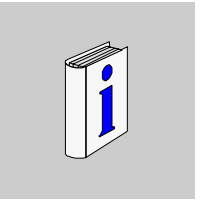
About the Book



At a Glance

Document Scope

This manual is a quick and easy start for learning XPSMFWIN. It includes an overview of all functions and step-by-step instructions on creating a project.

Validity Note

This documentation is valid for XPSMFWIN under Microsoft Windows XP service pack or Windows 2000 professional with service pack 1 or higher.

Related Documents

You can download these technical publications and other technical information from our website at *www.telemecanique.com*.

Title of Documentation	Reference Number
Safety Suite V2 Installation Instruction	33003529
XPSMF•• Manuals	

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User Comments

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Certificated Function Block Library

I

Overview

This part contains a certificated function block library.

What's in this Part?

This part contains the following chapters:

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H_BA01_ANALOG_01

1

Overview

This chapter provides information on the certificated function block H_BA01_ANALOG_01.

What's in this Chapter?

This chapter contains the following sections:

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1.1 General

Overview

This section provides information on the function block characteristics and the function block layout of the certificated function block H_BA01_ANALOG_01 (CFB80).

What's in this Section?

This section contains the following topics:

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Function Block Layout H_BA01_ANALOG_01	18

Characteristics

Usage

The H_BA01_ANALOG_01 function block is used for the evaluation, conversion and scaling of an analog input signal from an XPSMF Safety PLC.

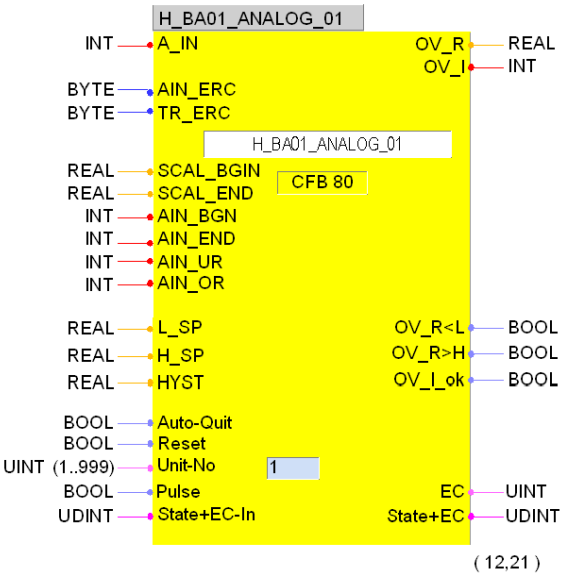
Characteristics

The H_BA01_ANALOG_01 function block provides the following characteristics:

- certified function block CFB 80 (analog)
- monitoring of the measurements on exceeded range
- evaluation of hardware problems
- A conditional call of the function block is not permitted.

Function Block Layout H_BA01_ANALOG_01

Inputs/Outputs



1.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_ANALOG_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

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Functional Description

Basic Functions

The function block H_BA01_Analog_01 (CFB 80)

- evaluates the signal of an analog input,
- checks the input value for validity,
- converts it to a physical value,
- checks the analog/digitally converted value on underrun and overrun,
- reports exceeded measurement ranges in the error diagnosis,
- compares the scaled value with an upper and lower threshold under consideration of a perhaps predefined hysteresis and
- signals overrun or underrun at two function block outputs.

Diagnose Functions

The diagnostic functions provide further information about the analog input value and the analog input module.

The certified function block can also be used to diagnose the condition of the hardware. It can be detected whether

- there is a fault in an analog input module,
- there is fault in the wiring of an input,
- there is a parameterization error,
- a measurement range overrun or underrun has taken place,
- the Unit-No. is in the predefined range of values or
- the reset pushbutton at the `Reset` input of the function block is bridged.

Measurement

The measurement is refreshed once per PES cycle. Details on the sampling time are provided in the documentation for the respective modules and compact systems.

SafeEthernet

The H_BA01_Analog_01 was developed for use with XPSMF•• controllers. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Analog Input Modules

The certified function block CFB 80 is usable with the following input and output modules:

- F3 AIO 8/4 - XPSMF3AIO8401
- F35 - XPSMF35

- F60 AI 8 - XPSMFAI801
- F60 MI 24 - XPSMFDI2401
- F60 AO - XPSMFAO801

Voltage and Current Inputs

The CFB 80 provides the following voltage and current inputs:

Voltage inputs	0...10 V
Voltage inputs	-10...+10 V
Current inputs	0/4...20 mA; Current inputs are carried out as 2-wire and 3-wire connections

The feeding of the voltage and current inputs can be carried out by the analog input module, or by a separate voltage source.

Inputs

Description

Input	Type	Default	Range of Values	Description
A_IN	INT		According to the documentation of the analog input module.	digitally converted instantaneous value from the analog input module The A/D conversion is carried out on the analog input module.
AIN_ERC	BYTE			error code of the analog input module Connect the input to the same signal that is used for AI[0x].error code (for XPSMFDI2401: AI[xx].error code) with the **Connect Signals** command.
TR_ERC	BYTE			error code of the transmitter supply of the analog input module Connect the input to the same signal that is used for Transmitter[x].error code wwith the **Connect Signals** command. **Note**: This input is only relevant for the XPSMF60. You do not have to wire it in all other cases.
CAL_BGIN	REAL	0.0	-3.402823466e+38 to 3.402823466e+38	physical beginning of the measurement range of the analog input module corresponds to e.g. 290 bar, 30 °C, 0 m level
SCAL_END	REAL	100.0	-3.402823466e+38 to 3.402823466e+38	physical end of the measurement range of the analog input module

Input	Type	Default	Range of Values	Description	
AIN_BGN	INT	0	- 32768...32767	digital beginning of the measurement range of the analog input module Depending on the type of the PES and the analog input, the following combinations make sense:	
				AIN_BGN=0 AIN_END=2000	0...10 V 0...20 mA
				AIN_BGN=0 AIN_END=1000	0...10 V 0...20 mA
				AIN_BGN=-1000 AIN_END=+1000	-10 V...+10 V
				AIN_BGN=400 AIN_END=2000	4...20 mA
				AIN_BGN=200 AIN_END=1000	4...20 mA
				To find the values valid for the analog input module in the documentation to the corresponding modules enter the keywords *range of values*.	
AIN_END	INT	2000	- 32768...32767	digital end of the measurement range of the analog input module For combinations and value ranges see AIN_BGN.	
AIN_UR	INT	-1	- 32768...32767	limit for measurement range underrun of the digital measurement range digital values below AIN_BGIN	
AIN_OR	INT	2001	- 32768...32767	limit for measurement range overrun of the digital measurement range digital value above AIN_END	
L_SP	REAL	10.0	-3.402823466e+38 to 3.402823466e+38	lower threshold in physical units according to SCAL_BGIN/SCAL_END (see *Signal Table, page 28*)	
H_SP	REAL	90.0	-3.402823466e+38 to 3.402823466e+38	upper threshold in physical units according to SCAL_BGIN/SCAL_END (see *Signal Table, page 28*)	

Input	Type	Default	Range of Values	Description
HYST	REAL	1.0	-3.402823466e+38 to3.402823466e+38	hysteresis in physical units according to SCAL_BGIN/SCAL_END (see *Signal Table, page 28*)
Auto-Quit	BOOL	FALSE	FALSE/TRUE	Auto-Quit must be connected to a static signal (constantly TRUE or FALSE). TRUE: The function block need not be reset manually after eliminating a fault. The fault is automatically acknowledged. FALSE /(or not used): The function block must be manually reset after eliminating the fault. **Note**: Only activate this function if it is guaranteed that with the clearing of the error no immediately dangerous movement is initialized.
Reset	BOOL	FALSE	FALSE/TRUE	Reset is used to acknowledge errors and reset the function block. To do this, a 0/1 transition change must be carried out at the Reset input. The function block cannot be reset as long as there are errors (0 < EC ≤ 500).
Unit-No.	UINT	1	1...999	With Unit-No. the user defines a unit number which is distributed together with the error number at the output State+EC, so that the error code can explicitly be associated with a function block. Values outside the valid range are blocked at the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.

Input	Type	Default	Range of Values	Description
Pulse	BOOL	FALSE	FALSE/TRUE	Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT	0	80001000... 80999999	status of the function block comprising CFB-No. + Unit-No. + Error Code

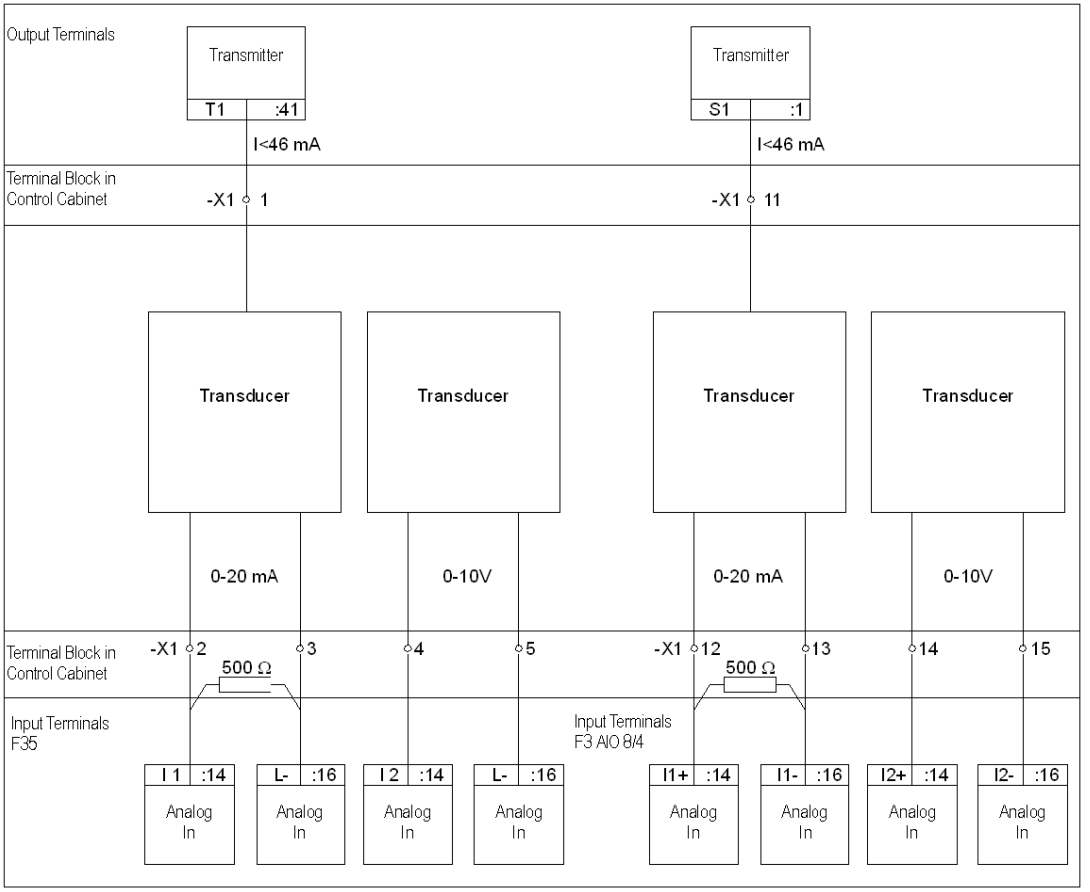
Outputs

Description

Output	Type	Range of Values	Description
OV_R	REAL	-3.402823466e+38 to 3.402823466e+38	Physical value calculated from A_IN under consideration of the scaling. OV_R = (A_IN - AIN_BGN) *(SCAL_END - SCAL_BGIN) /(AIN_END - AIN_BGN) + SCAL_BGIN Corresponds to e.g. 4 bar, 90 °C, 2 m level
OV_I	INT	- 3276832767	Integer part of OV_R **Note**: OV_I is only correct, if -32768 ≤ OV_R ≤ 32767 (OV_I_ok = TRUE).
OV_R<L	BOOL	FALSE/TRUE	TRUE: L_SP threshold underrun FALSE: OV_R > L_SP + HYST (see *Signal Table, page 28*)
OV_R>H	BOOL	FALSE/TRUE	TRUE: H_SP threshold overrun FALSE: OV_R < H_SP - HYST (see *Signal Table, page 28*)
OV_I_ok	BOOL	FALSE/TRUE	TRUE: -32768 ≤ OV_R ≤ 32767 FALSE: all other cases
EC	UINT	0...999	Error status of the function block
State+EC	UDINT	0...999999999	Status of the function block comprising CFB-No. + Unit-No. + EC

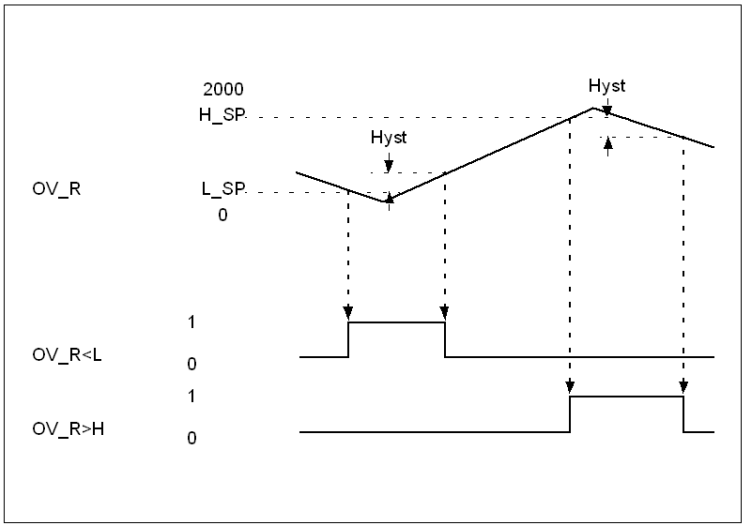
Wiring

Wiring Diagram



Signal Table

Schema



H_BA01_BWS_PLS_01

2

Overview

This chapter provides information on the certificated function block H_BA01_BWS_PLS_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
2.1	General	30
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2.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_BWS_PLS_01 (CFB60).

What's in this Section?

This section contains the following topics:

Topic	Page
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Characteristics

Usage

The H_BA01_BWS_PLS_01 function block is used for monitoring electro-sensitive protective equipment in accordance with IEC 61508 and EN 954-1 to category 4.

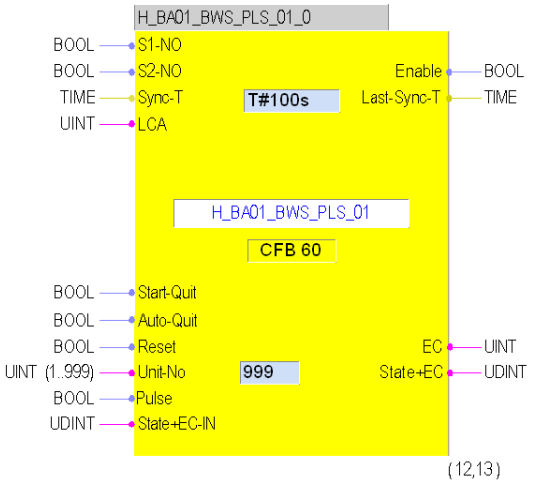
Characteristics

The H_BA01_BWS_PLS_01 function block provides the following characteristics:

- certified function block CFB 60 (ESPE/PLS)
- redundancy by dual channel
- manual or automatic acknowledgment (Reset) at the start of the XPSMF Safety PLC
- manual or automatic acknowledgment after tripping
- monitoring and limiting the synchronization time of the correlated contacts
- synchronization time of the input signals separately configurable for each function block
- A conditional call of the function block is not permitted.

Function Block Layout (H_BA01_BWS_PLS_01)

Inputs/Outputs



2.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_BWS_PLS_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

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Functional Description

Basic Function

The function block H_BA01_BWS_PLS_01 (CFB 60) monitors electro-sensitive protective equipment according to IEC 61508 and EN 954-1 up to the category 4.

Every electro-sensitive protective equipment is monitored by a certified function block CFB 60 in the application program XPSMFWIN.

Diagnose Functions

The CFB 60 can also be used to diagnose the condition of the hardware. The monitoring of the 2 ESPE switching elements detects, whether

- one contact opens late, or does not open at all,
- one contact closes late, or does not close at all,
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_BWS_PLS_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Output

If...	**Then the function block output `Enable` is...**
the associated ESPE has not tripped. (The protection area, which is monitored by the ESPE, is vacant.)	TRUE
the associated ESPE has been engaged. (The protection area of the ESPE is not free.)	FALSE
the function block has detected a fault.	FALSE

The not safety relevant function block output `EC` provides more detailed information.

Inputs

Description

Input	Type	Default	Range of Values	Description
S1-NO, S2-NO	BOOL	FALSE	FALSE/ TRUE	S1-NO and S2-NO are the inputs of the safety related controller at which the statuses for the contacts of the ESPE/PLS are read. If the protection area to be monitored by the ESPE/PLS is vacant, the ESPE/PLS has not tripped and the inputs S1-NO and S2-NO are TRUE.
Sync-T	TIME	100 ms	0...500 ms	The time Sync-T indicates the synchronization time of the individual normally closed/normally open contacts against each other. If the default value is used, the input need not be connected. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to ESPE engaged. In this case the functional test obligatory after the occurrence of a hardware fault is not required.

Input	Type	Default	Range of Values	Description	
LCA	UINT	0	0, 1, 2	0	FALSE at S1-NO or S2-NO results in immediate shut-down.
				1	Bridging of the line control blanking (LCA) of the sensor is taken into account. Blanking the line control signal for either S1-NO or S2-NO for only one PES cycle does not lead to switching off the Enable output. Both a simultaneous blanking of both inputs and the blanking of only one input for max. one PES cycle do not lead to switching off. The output Enable is immediately switched off if the PES detects a FALSE signal at 1 of the 2 inputs for 2 consecutive PES cycles.
				2	Bridging of the line control blanking (LCA) of the sensor is taken into account.
				Note: For LCA = 1 and LCA = 2 the shut-down is delayed by one PES cycle. This time must be taken into account when planning the safe distance!	
Start-Quit	BOOL	FALSE	FALSE/ TRUE	Start Quit must be connected to a static signal (constantly TRUE or FALSE). If the input Start-Quit is set to TRUE, the function block does not have to be reset manually directly after booting the controller. Consider also the following caution:	

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Only activate the function Start-Quit if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the ESPE is disengaged (restart inhibit).

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Range of Values	Description
Reset	BOOL	FALSE	FALSE/ TRUE	With Reset the State+EC output of the function block is set to TRUE. To do this a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults (0 < EC ≤ 500).
Auto-Quit	BOOL	FALSE	FALSE/ TRUE	Auto-Quit must be connected to a static signal (constantly TRUE or FALSE). If the input Auto-Quit is TRUE, the function block does not have to be reset manually after disengaging the ESPE/PLS; the function block is acknowledged automatically. If the input Auto-Quit is set to FALSE or not used at all, the function block must be reset via the Reset input after unlocking, so that the output Enable can change from FALSE to TRUE if no other fault exists. Auto-Quit does not work when booting the controller. In this case you must acknowledge separately or set the input Start-Quit to TRUE. Consider also the following caution:

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Only activate the function Auto-Quit if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the ESPE is disengaged (restart inhibit).

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Rage of Values	Description
Unit-No.	UINT	1	1...999	With the Unit-No. the user defines a unit number which is distributed at the output Error code together with the error number. So, the error code can explicitly be associated with a function block.Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT	0	1001000... 999999999	Status of the function block, comprising CFB-No. + Unit-No. + Error Code.

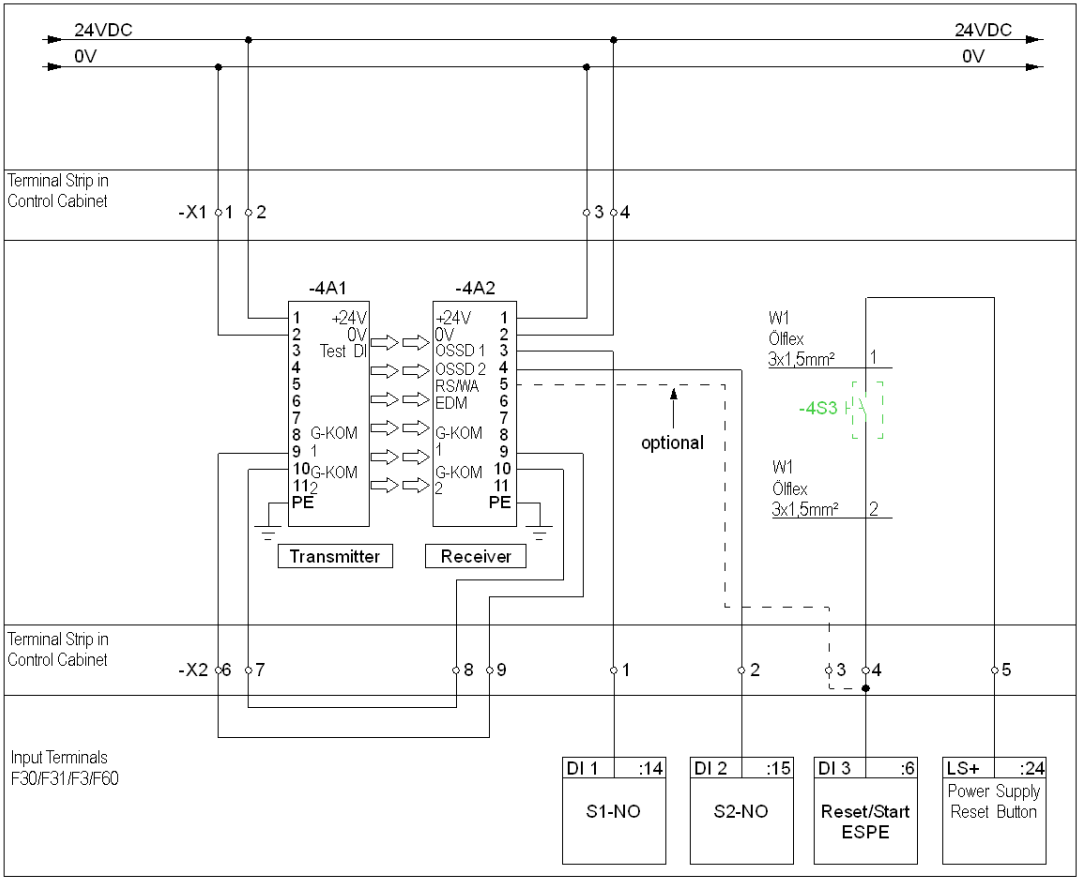
Outputs

Description

Output	Type	Default	Range of Values	Description	
Enable	BOOL		FALSE/ TRUE	Status of the ESPE/PLS	
				TRUE	● the protection area to be monitored is vacant (ESPE/PLS has not tripped) and ● there are no faults
				FALSE	● there are persons in the protection area (ESPE/PLS has tripped) or ● there is a fault
EC	UINT			Error status of the function block	
State+EC	UDINT		60001000... 60999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	
Last-Sync-T	TIME		0...Sync-T	Measured temporal offset in milliseconds between opening of S1-NO and opening of S2-NO.	

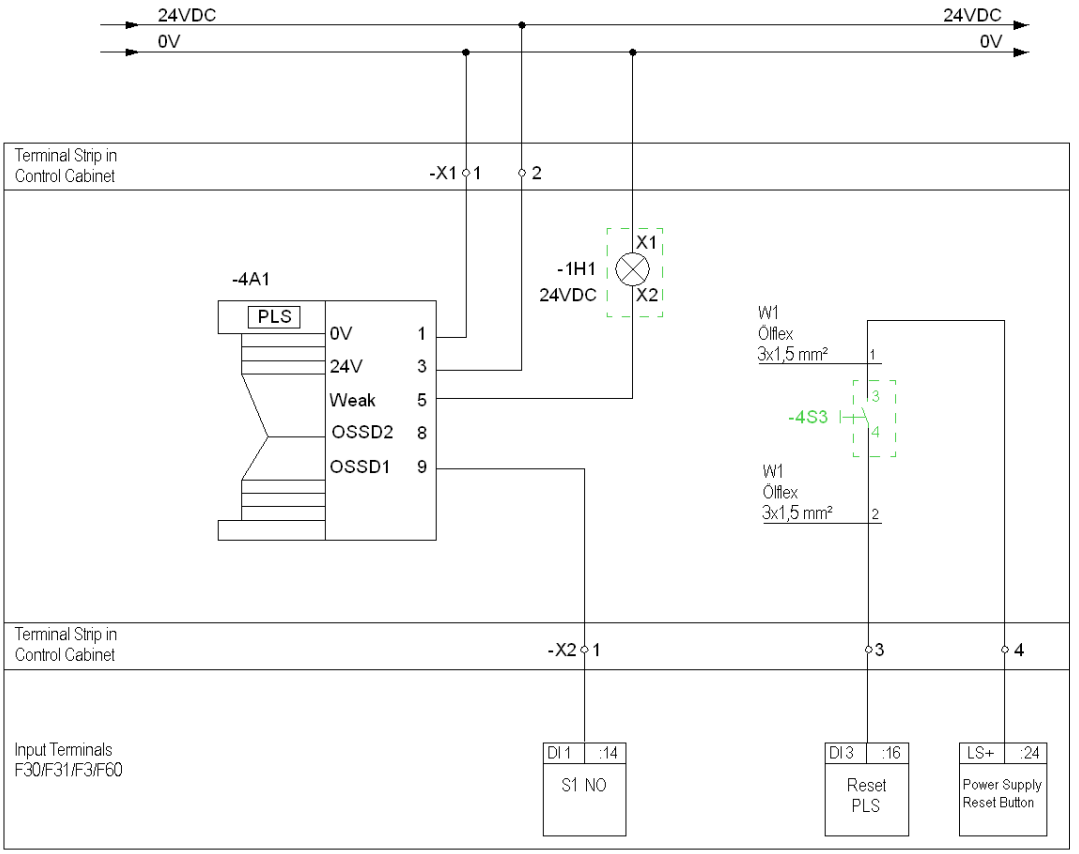
Wiring ESPE According to SIL 3, Cat. 4

Wiring Diagram



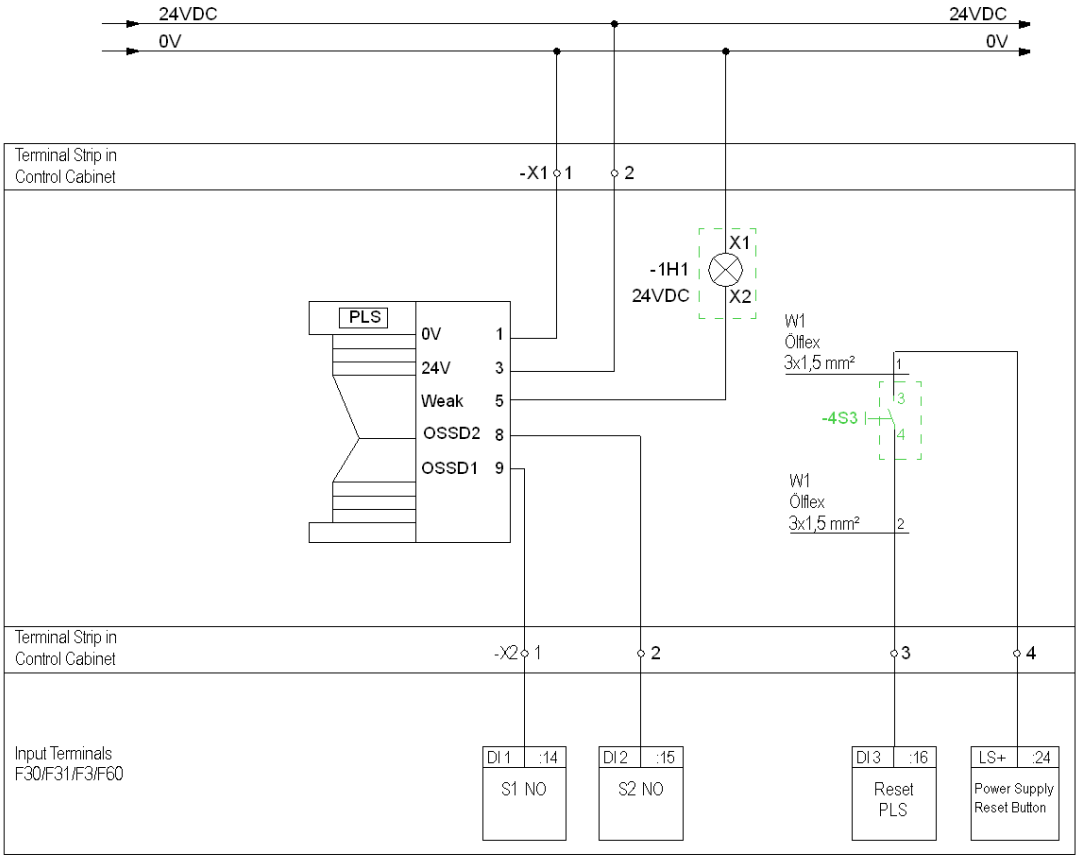
Wiring ESPE According to SIL1, Cat. 2

Wiring Diagram



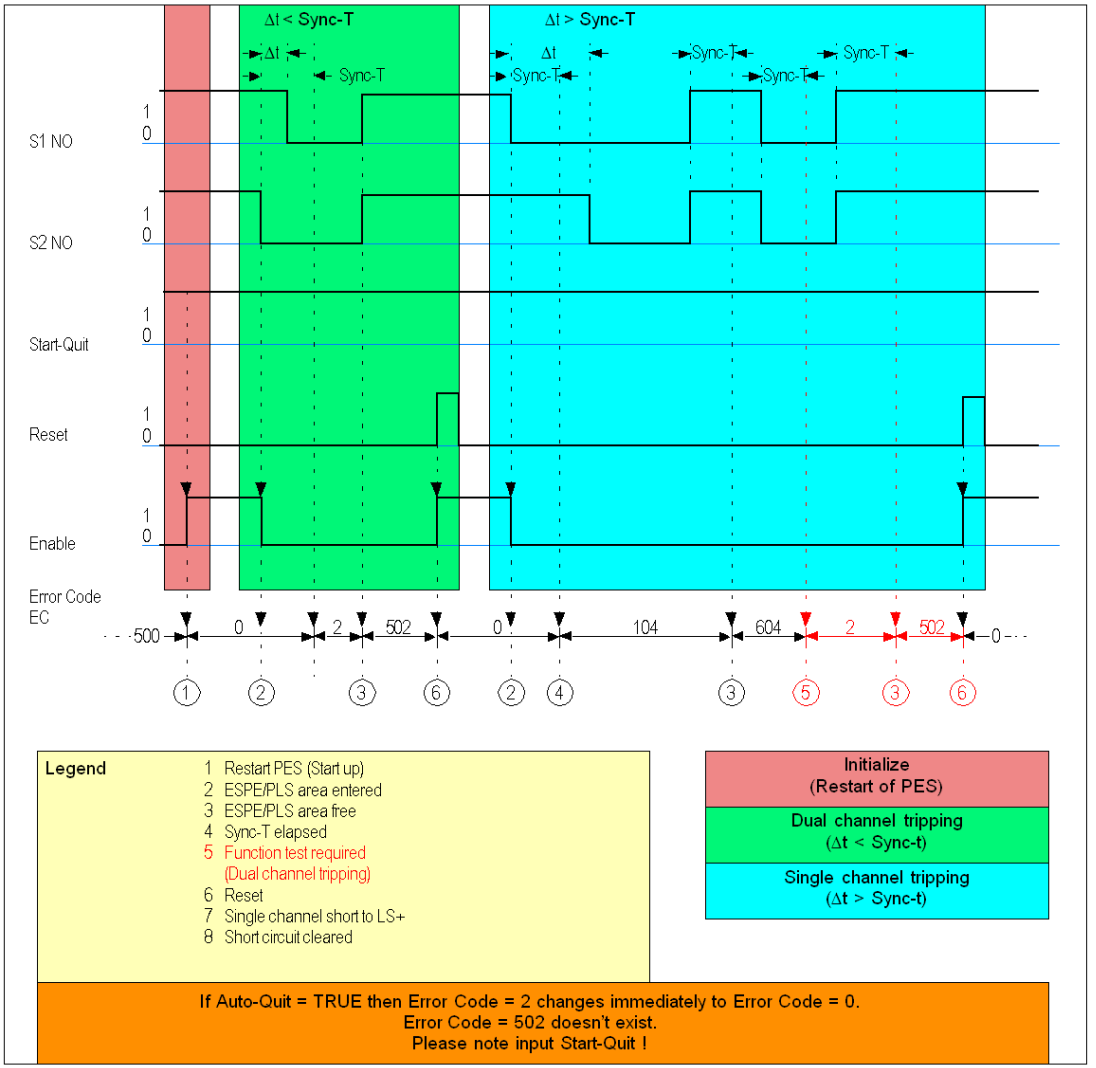
Wiring PLS According to SIL2, Cat. 3

Wiring Diagram



Signal Table

Schema



H_BA01_Dyn_Init_01

3

Overview

This chapter provides information on the certificated function block H_BA01_Dyn_Init_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
3.1	General	46
3.2	Functions	49

3.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_Dyn_Init_01 (CFB30).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	47
Function Block Layout (H_BA01_Dyn_Init_01)	48

Characteristics

Usage

The H_BA01_Dyn_Init_01 function block is used for ifm-electronic GmbH safety switches (effector):

- GM 504 S, GM 505 S,
- GG 505 S, GG 506 S,
- GI 505 S, GI 506 S

in accordance with IEC 61508 up to SIL 3 and EN 954-1, Cat. 4.

Characteristics

The H_BA01_Dyn_Init_01 function block provides the following characteristics:

- certified function block CFB 30 Dyn-Init
- pulse presetting for the dynamic initiator
- several cascadable switches
- manual acknowledgment after the XPSMF•• controller start-up
- manual or automatic acknowledgment after the damping of an initiator
- cycle duration of the initiators (proximity switches) configurable at the function block input
- A conditional call is not permitted.

Safety Level

Safety Level according to IEC 61508 and EN 954-1:

If the dynamic initiator (proximity switch) is correctly attached to the controller and all requirements in this document are met, the application complies with the safety category 4 according to EN 954-1.

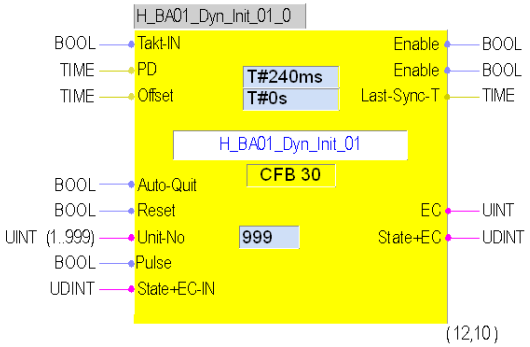
However exceptions are possible in countries with additional federal state regulations, where the EN 954-1 only has a limited validity or none.

If the initiator has received the approval for category 3, this also applies to the complete loop!

NOTE: The system variable `Cycle Time` provides the task value of the PC. Therefore the offline simulation is not applicable.

Function Block Layout (H_BA01_Dyn_Init_01)

Inputs/Outputs



3.2 Functions

Overview

This section describes the functions and provides information on inputs and outputs.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	50
Inputs	52
Outputs	54
Wiring with Line Control	56
Signal Table	57

Functional Description

Basic Function

The function block H_BA01_Dyn_Init_01 (CFB 30) monitors initiator loops according to IEC 61508 SIL 3 and EN 954-1 up to category 4.

Every initiator in the application program XPSMFWIN is monitored by a certified function block CFB 30.

For initiators connected in series the initiators are monitored collectively by 1 function block. Regard the maximum number of initiators given by the initiator manufacturer. The function block provides the timing signal for the initiator according to the manufacturer specification and monitors the signal returned by the initiator.

Diagnose Functions

With the CFB 30 the status of the hardware also can be diagnosed. The monitoring of the initiator allows to check whether

- the `Unit-No.` is in the predefined range of values,
- the cycle duration is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_Dyn_Init_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Outputs

The output `Enable` indicates whether the initiator is damped and whether there are faults in the initiator or function block. `Enable` can be used to trigger a shutdown function in the user program.

If...	**Then the function block output `Enable` is...**
the initiator is damped (see data sheet for initiator) in the right distance, the clock input signal is passed on to the output of the initiator with delay. The signal can be returned invertedly or in phase.	TRUE
the initiator is not damped or a fault occurs, the initiator does not pass the clock input signal on to the output any more.	FALSE

Inputs

Description

Input	Type	Default	Range of Values	Description
Takt-IN	BOOL	FALSE	FALSE/ TRUE	The signal Takt-IN returns the delayed value of Takt-Out, provided that the initiator is damped.
PD	TIME	240 ms	50...500 ms	This value allows to adjust the cycle duration of the Takt-OUT between 50...500 ms.
Offset	TIME	0 ms	0...100 ms	The offset serves for balancing vacillations in the signal propagation time and can be adjusted manually between 0 and 100 ms. **Note**: The Offset increases the response time!
Auto-Quit	BOOL	FALSE	FALSE/ TRUE	If Auto-Quit is set to TRUE, the function block does not have to be reset manually after the damping of the dynamic initiator or after the removal of a fault. The function block is acknowledged automatically. If Auto-Quit is set to FALSE or not used at all, the function block must be reset via the Reset input after the next damping, so that the output Enable can change from TRUE to FALSE if no other fault exists. Auto-Quit does not work when booting the Safety PLC. In this case you must acknowledge separately. Note: Only use Auto-Quit = TRUE if it is guaranteed that damping the initiator does not result in an immediate dangerous movement.
Reset	BOOL	FALSE	FALSE/ TRUE	Reset is used to acknowledge errors and set the Enable output to TRUE. To do this a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are errors (0 < EC ≤ 500).

Input	Type	Default	Range of Values	Description
Unit-No.	UINT (1,999)	999	1...999	With Unit-No. define a unit number which is distributed together with the error number at the output State+EC, so that the error code can explicitly be associated with a function block. Values outside the valid range are blocked at the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State+EC-IN	UDINT	0	30001000... 30999999	Status of the function block, comprising CFB No. + Unit-No. + Error Code.

Outputs

Description

Output	Type	Range of Values	Description
`Takt-OUT`	`BOOL`	`FALSE`/`TRUE`	`Takt-OUT` puts out a signal in compliance with the preset cycle duration.
`Enable`	`BOOL`	`FALSE`/`TRUE`	State of the initiator (Dyn-Init switch) If the initiator is damped and if initiator and function block work without errors, the `Enable` output is `TRUE`.Enable is usually used to trigger a disabling function.The time for monitoring the initiator output signal can be adapted to the fluctuations of the signal propagation time by using `Offset`.
`T-Diff`	`TIME`		`T-Diff` is the difference between the maximum permissible time and the actually measured time between 2 signal changes at `Takt-IN`. ● CT = Cycle time (determined by the function block) ● Stop_T = Measured time between two signal changes at `Takt-IN` ● $PD/2_{Max} = PD/2 + C_T + 10$ ms + Offset The maximum is created since the last reset or the last change of Offset or PD. ● T-Diff = max ($PD/2_{Max}$ - Stop_T) Example 1: Offset = 0 ms (see paragraph *Examples* below) Example 2: Offset = 15 ms (see paragraph *Examples* below)
`EC`	`UINT`	0...999	Error condition of the function block
`State+EC`	`UDINT`	0...999999999	Status of the function block, comprising `CFB-No.` + `Unit-No.` + `EC`

Examples

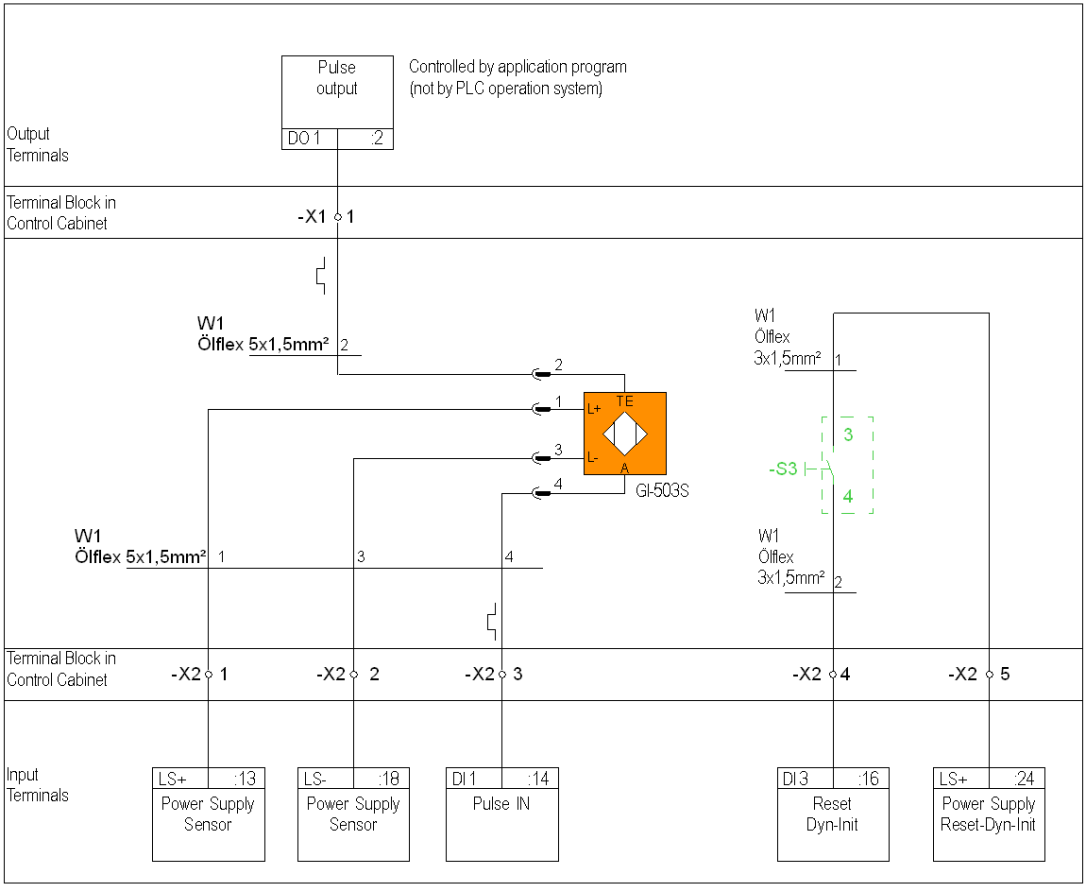
Examples for the calculation of `T-Diff` and $PD/2_{Max}$:

Example 1		Example 2	
Offset	= 0 ms	Offset	= 15 ms
PD	= 240 ms	PD	= 240 ms
C_T	= 6 ms	C_T	= 6 ms

Example 1		**Example 2**	
$PD/2_{Max}$	= PD/2 + C_T + 10 ms + Offset = 120 ms + 6 ms + 10 ms + 0 ms = 136 ms	$PD/2_{Max}$	= PD/2 + C_T + 10 ms + Offset = 120 ms + 6 ms + 10 ms + 15 ms = 151 ms
Stop_T	= measured value = 126 ms		
T-Diff	= $PD/2_{Max}$ - Stop_T = 136 ms - 126 ms = 10 ms		

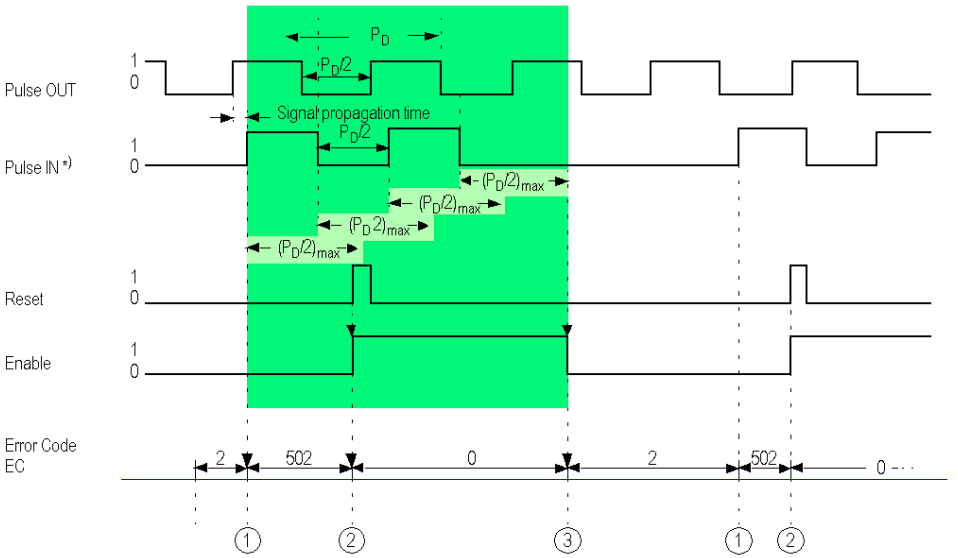
Wiring with Line Control

Wiring Diagram



Signal Table

Schema



Legend		
	1 Dyn-Init is damped ==> Initiator interconnects signal 2 Reset 3 Dyn-Init is not damped ==> Pulse-IN = FALSE *) Inverted signal of the initiator is also processed	Initiator damped Time slot within wich an edge transition is expected

If Auto-Quit = TRUE then Error Code = 2 immediately changes to Error Code = 0.
The intermediate state Error Code = 502 does not exist.

H_BA01_Emerg_Stop_01

4

Overview

This chapter provides information on the certificated function block H_BA01_Emerg_Stop_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	General	60
4.2	Functions	63

4.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_Emerg_Stop_01 (CFB50).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	61
Function Block Layout (H_BA01_Emerg_Stop_01)	62

Characteristics

Usage

The function block H_BA01_Emerg_Stop_01 is used for monitoring emergency stop circuits in accordance with IEC 61508 up to SIL 3 and EN 954-1, categories 2 and 4.

Characteristics

The function block H_BA01_Emerg_Stop_01 provides the following characteristics:

- certified function block CFB 50 (emergency stop)
- redundancy by dual channel
- manual or automatic acknowledgment at the start of the XPSMF•• Safety PLC
- manual or automatic acknowledgment (reset) after unlocking the emergency stop pushbutton
- monitoring and limiting the synchronization time of the contacts to each other
- contact synchronization time configurable for each function block separately
- A conditional call of the function block is not permitted.

Safety Level

IEC 61508, SIL3 and EN 954-1, Cat. 4	IEC 61508, SIL3 and EN 954-1, Cat. 4
If the emergency stop pushbutton is correctly attached to the controller, the inputs `S1-NC` (NC=Normally Closed) and `S2-NC` are run with line control and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1 (see wiring). However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity. Consider also the caution below.	If the 2 inputs `S1-NC` and `S2-NC` are not driven directly by line control, but by variables, the application meets only EN 954-1, safety category 2 (see wiring).

⚠ CAUTION

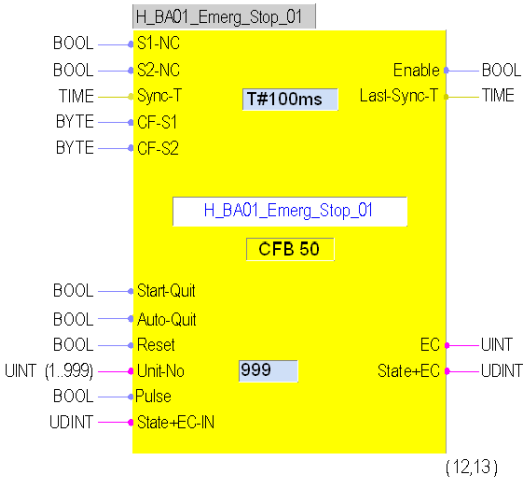
IMPROPER OPERATION

Make sure that no automatic restart is possible (restart inhibit). Guarantee this by the parameter settings of the function block or by appropriate external wiring.

Failure to follow these instructions can result in injury or equipment damage.

Function Block Layout (H_BA01_Emerg_Stop_01)

Inputs/Outputs



4.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_Emerg_Stop_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	64
Inputs	65
Outputs	68
Wiring Line Control According to SIL 3, Cat. 4	69
Wiring Line Control According to SIL1, Cat. 2	70
Signal Table	71

Functional Description

Basic Function

The function block H_BA01_Emerg_Stop_01 (CFB 50) monitors emergency stop circuits according to IEC 61508 and EN 954-1 up to the category 4.

Every emergency stop pushbutton is monitored by a certified function block CFB 50 in the application program XPSMFWIN.

Diagnose Functions

The CFB 50 can also be used to diagnose the condition of the hardware. The monitoring of the 2 switching elements of the emergency stop pushbutton detects whether

- 1 contact opens late, or does not open at all,
- 1 contact closes late, or does not close at all,
- there are Line Control faults (LC; Line control channel),
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_Emerg_Stop_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Output

If the safety relevant function block `Enable` is...	**Then...**
TRUE	the associated emergency stop pushbutton is not engaged. The function block has not detected any fault.
FALSE	the associated emergency stop pushbutton has been engaged.
FALSE	the function block has detected a fault.

The not safety relevant function block output `EC` provides some exact information.

Inputs

Description

Input	Type	Default	Range of Values	Description
S1-NC, S2-NC	BOOL	FALSE	FALSE/TRUE	S1-NC and S2-NC are the inputs of safety related controllers at which the statuses of the normally closed contacts of the emergency stop pushbutton are read. If the input signals S1-NC and S2-NC are TRUE, the emergency stop pushbutton is not engaged.
CF-S1, CF-S2	Byte	0	–	CF-Detect (CF =Channel Fault) represents the status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is put out by means of the error code EC.
Sync-T	TIME	100 ms	0...500 ms	The time Sync-T indicates the synchronization time of the individual normally closed/normally open contacts against each other. If the default value is used, the input need not be connected. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to emergency stop pushbutton tripped. In this case the functional test obligatory after the occurrence of a hardware fault is not required.
Start-Quit	BOOL	FALSE	FALSE/TRUE	Start-Quit must be connected to a static signal (constantly TRUE or FALSE). If the input Start-Quit is set to TRUE, a manual reset of the function directly after booting the controller is not required. **Note**: Only activate this function if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the emergency stop pushbutton is unlocked (restart inhibit).

Input	Type	Default	Range of Values	Description
Reset	BOOL	FALSE	FALSE/ TRUE	With Reset the Enable output of the function block is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults. (0 < EC ≤ 500).
Auto-Quit	BOOL	FALSE	FALSE/ TRUE	Auto-Quit must be connected to a static signal (constantly TRUE or FALSE). If Auto-Quit is TRUE, a manual reset of the function block after unlocking the emergency stop pushbutton is not required. The function block is acknowledged automatically. If Auto-Quit is FALSE or unused, you must reset the function block via the Reset input after unlocking. This ensures that the Enable output can change from FALSE to TRUE if there are no other faults. Auto-Quit does not work when booting the controller. In this case you must acknowledge separately or set the input Start-Quit to TRUE. Consider also the following caution.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Only activate the Auto-Quit function if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the emergency stop pushbutton is unlocked (restart inhibit).

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Rage of Values	Description
Unit-No.	UINT	1	1...999	With Unit-No. define a unit number which is distributed together with the error number at the output State+EC. This way the error code can explicitly be associated with a function block. Values outside the range of values are blocked at the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	>UDINT	0	1001000... 999999999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.

Outputs

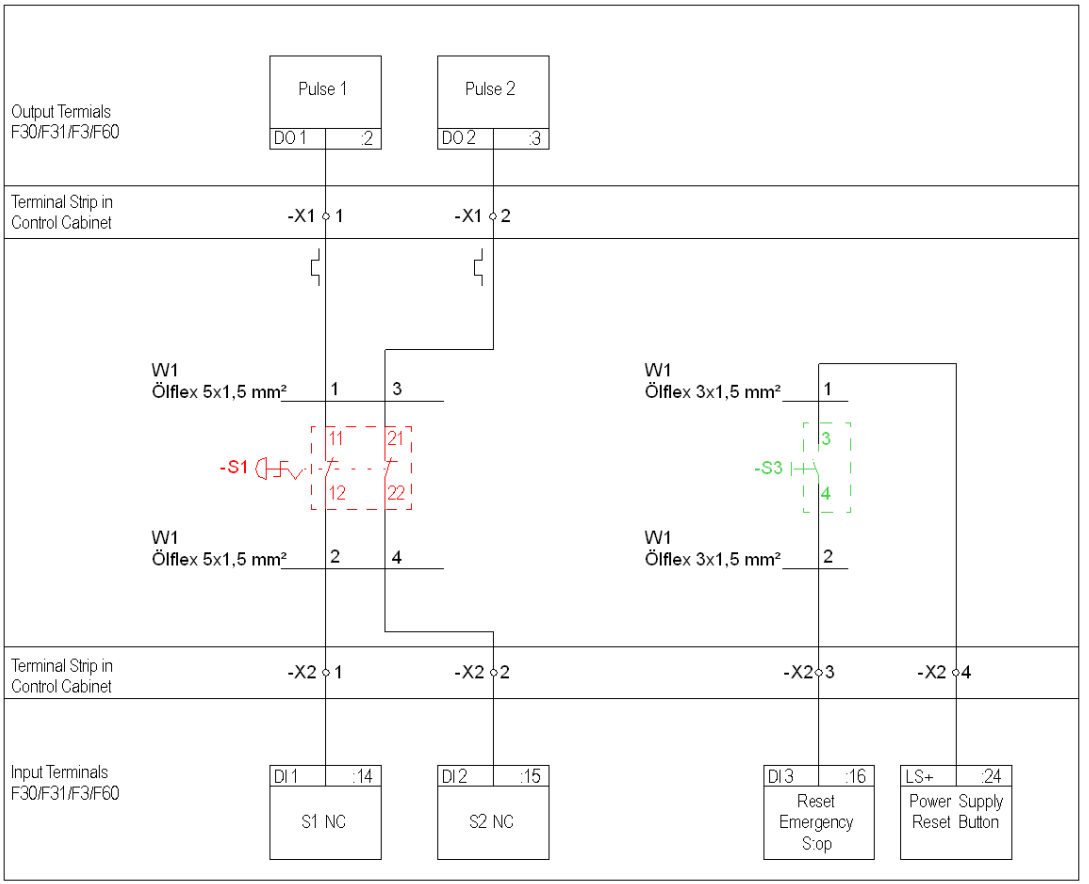
Description

Output	Type	Default	Range of Values	Description
Enable	BOOL	–	FALSE/ TRUE	Status of the emergency stop pushbutton This safety-related output is TRUE if the emergency stop pushbutton is disengaged and there are no faults.
EC	UINT	–	0...999	Error code of the function block
State+EC	UDINT	–	50001000... 50999999	Status of the function block, comprising CFB-No. + Unit-No. + EC
Last-Sync-T	TIME	–	0...Sync-T	Measured temporal offset in milliseconds between opening of S1-NC and opening of S2-NC.

Wiring Line Control According to SIL 3, Cat. 4

Wiring Diagram

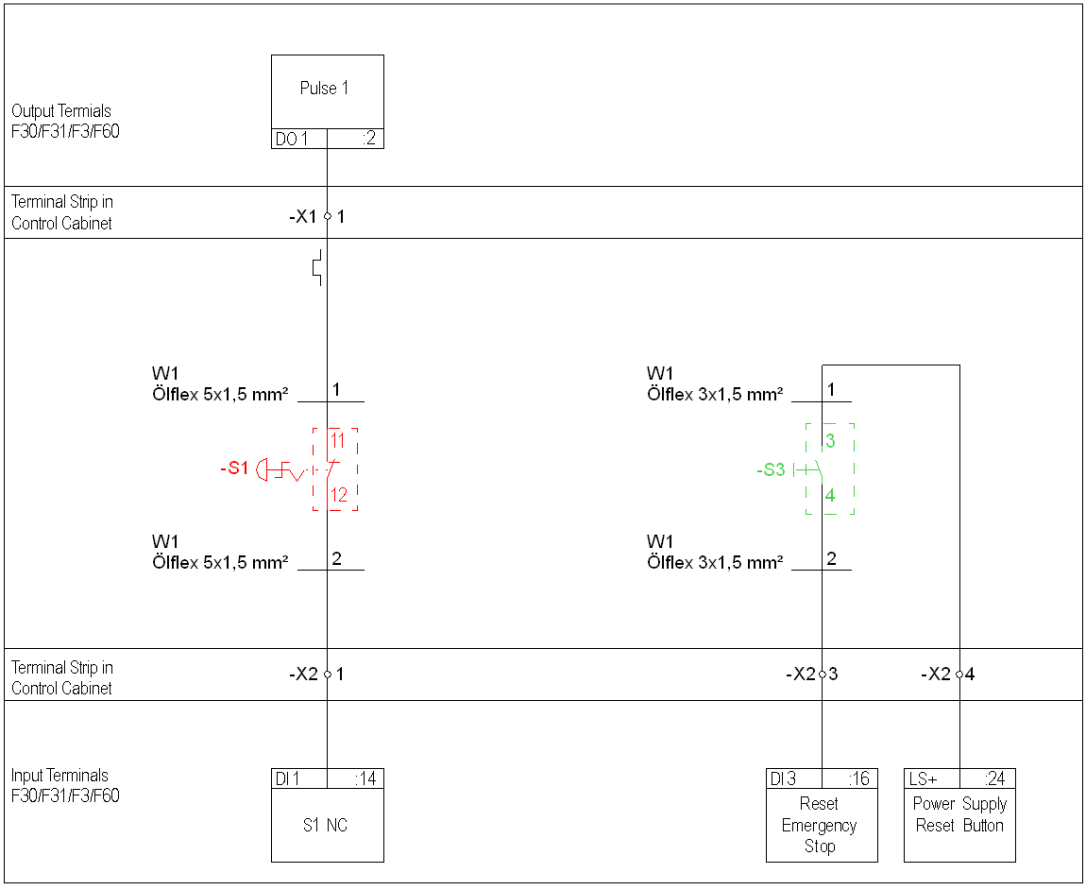
NOTE: Category 3 does not require Line Control.



Wiring Line Control According to SIL1, Cat. 2

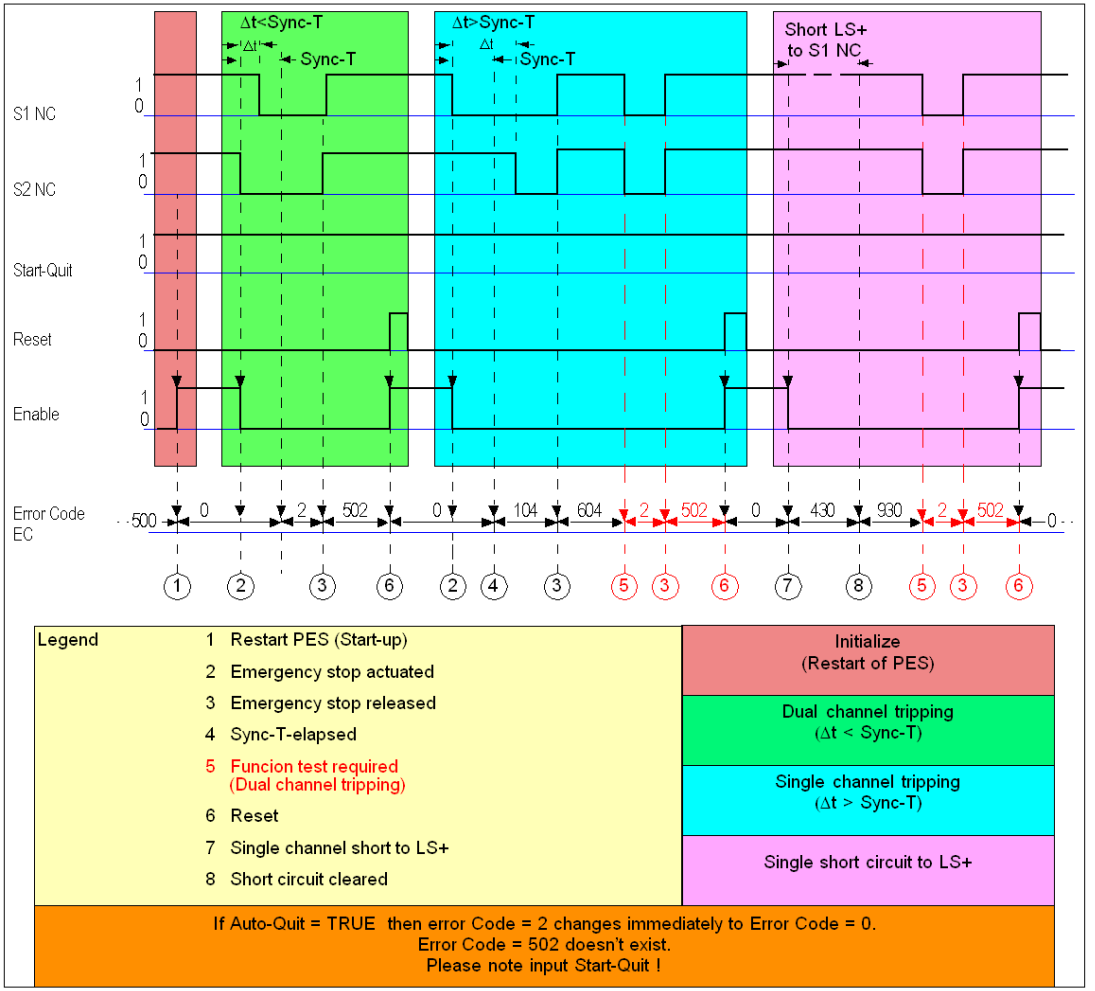
Wiring Diagram

NOTE: Category 2 does not require Line Control.



Signal Table

Schema



H_BA01_Enable_Sw01

5

Overview

This chapter provides information on the certificated function block H_BA01_Enable_Sw01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
5.1	General	74
5.2	Functions	77

5.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_Enable_Sw01 (CFB43).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	75
Function Block Layout (H_BA01_Enable_Sw01)	76

Characteristics

Usage

The function block H_BA01_Enable_Sw01 is used for monitoring of enabling switches in accordance with IEC 61508 and EN 954-1 up to category 4.

Characteristics

The function block H_BA01_Enable_Sw01 provides the following characteristics:

- certified function block CFB 43 (enable switch)
- redundancy by dual channel
- manual acknowledgment after trouble shooting
- monitoring and clipping of the synchronization time of the contacts S1, S2 to each other
- contact synchronization time configurable for each function block separately
- A conditional call of the function block is not permitted.

Hardware Restrictions

The function block is provided for hardware according to EN 775 and VDI 2854.

According to EN 60204 (DIN VDE 0113 Z1) the operating mode in automated installations must be defined with lockable selector switches. The enabling switch alone must not initialize a hazardous movement.

NOTE: It is not allowed to utilize enabling switches which change from position `Off function with positively driven disconnection` directly to `enabling function`.

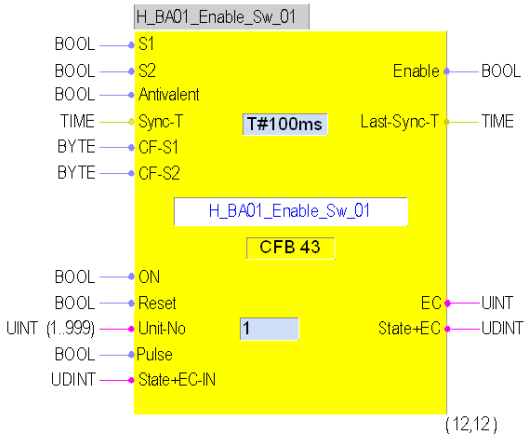
Safety Level in Accordance with EN 954-1, Cat. 4

If the enabling switch is correctly attached to the controller and all requirements in this document are met, the application complies with safety category 4 according to EN 954-1.

However, exceptions are possible in countries with additional federal state regulations where the EN 954-1 only has a limited validity or none.

Function Block Layout (H_BA01_Enable_Sw01)

Inputs/Outputs



5.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_Enable_Sw01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
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Wiring Antivalent	83
Wiring Equivalent	84
Signal Table	85

Functional Description

Basic Function

The function block H_BA01_Enable_Sw01 (CFB 43) monitors enabling switches according to IEC 61508 and EN 954-1 up to category 4.

Every enabling switch is monitored by a certified function block CFB 43 in the application program XPSMFWIN.

Diagnose Functions

The function block H_BA01_Enable_Sw01 can also be used to diagnose the status of the hardware. The monitoring of the 2 switching elements of the enabling switch detects whether

- 1 contact opens late, or does not open at all,
- 1 contact closes late, or does not close at all,
- there are Line Control faults (LC; Line control channel),
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_Enable_Sw01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Enabling Switches

An enabling switch is a manually operated pushbutton which enables a sojourn in the danger zone of engines or robots.

The signal from the enabling switch can annul the protection effect of protective devices and thus allows entering the danger zone for commissioning, check of process flows or for service and maintenance.

An enabling switch has the following 3 different settings:

Setting	Position	Effect
1	off	enabling switch released

Setting	Position	Effect
2	switch in center position - enabling active	enabling switch depressed until trigger point
3	pushbutton in panic position - off with positively driven disconnection	enabling switch completely depressed

By releasing the pushbutton or by depressing the pushbutton beyond the trigger point the enabling function is cancelled. When switching from position 3 to position 1 the enabling function must not get effective.

Output

If the safety relevant function block `Enable` is...	Then...
TRUE	the associated enabling switch is depressed (enabling active, pushbutton in center position).
FALSE	the associated associated enabling switch is in any other position.

Monitored Hardware Wirings

The CFB 43 provides monitoring for 2 different hardware wirings:

- The first wiring describes the connection of 2 antivalent contacts S1 and S2.
- The second wiring describes the connection of 2 equivalent contacts S1 and S2. 1 of the 2 variants can be preselected with the input `Antivalent`.

Inputs

Description

Input	Type	Default	Range of Values	Description
S1, S2	BOOL	FALSE	FALSE/TRUE	Inputs for reading the status of the enabling switch contacts. ● Enabling switch engaged with antivalent contacts: S1 = FALSE and S2 = TRUE ● Enabling switch engaged with equivalent contacts: S1 = TRUE and S2 = TRUE
Antivalent	BOOL	FALSE	FALSE/TRUE	TRUE: S1 and S2 must be **antivalent** FALSE: S1 and S2 must be **equivalent**
Sync-T	TIME	100 ms	1...500 ms	Maximum permissible synchronization time between the individual normally closed/normally open contacts S1, S2. If the default value is used, the input need not be connected. **Note**: Sync-T = 0 ms is not permissible.
CF-S1, CF-S2	Byte	0	–	CF-S1 and CF-S2 (CF = Channel Fault) provide the status of the connected hardware. The evaluation of the hardware is carried out in the function block and faults are distributed at the output EC.
ON	BOOL	FALSE	FALSE/TRUE	TRUE: function block enabled, status of the enabling switch is evaluated FALSE: function block disabled, status of the enabling switch not evaluated
Reset	BOOL	FALSE	FALSE/TRUE	With a reset faults are acknowledged and the output Enable is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults (0 < EC < 500).

Input	Type	Default	Range of Values	Description
Unit-No.	UINT	1	1...999	Defines the unit number which is distributed at the output State+EC together with the error code (EC). So, the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT	0	1001000. ..999999 999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.

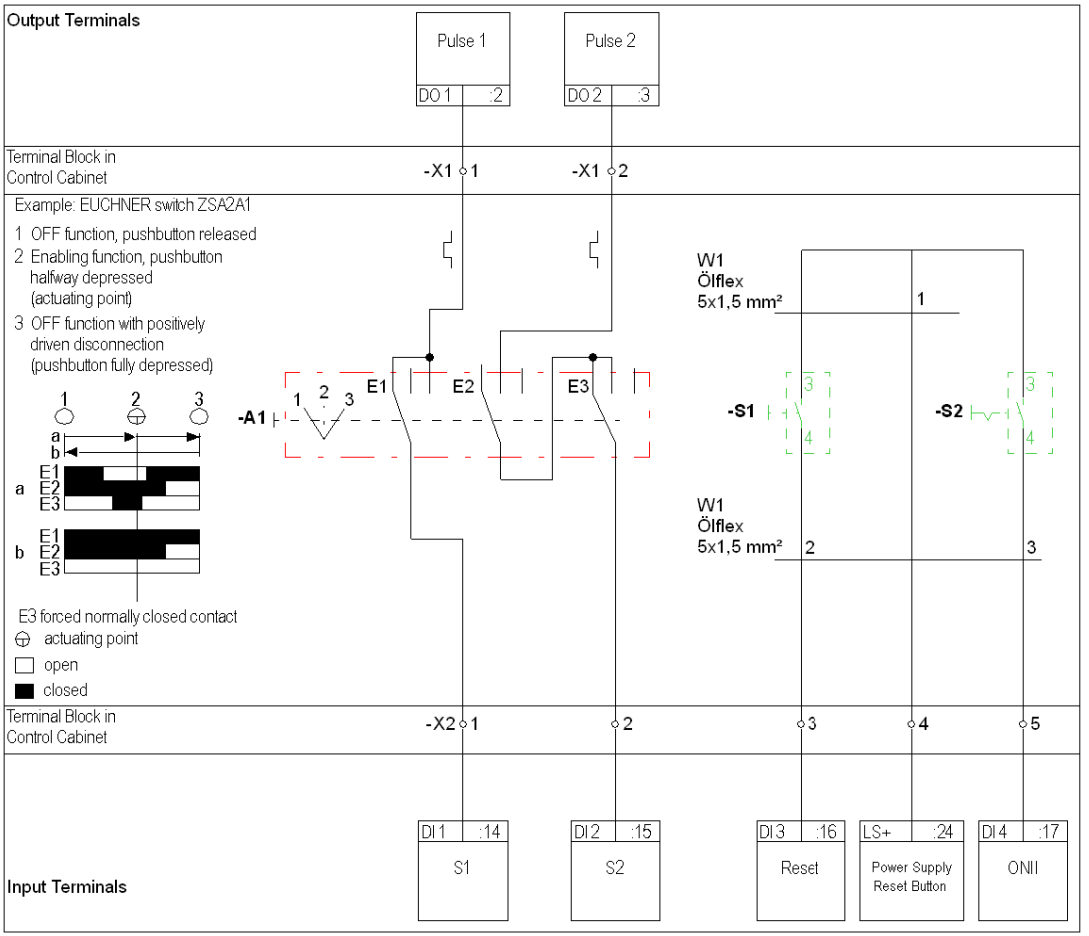
Outputs

Description

Output	Type	Default	Range of Values	Description	
Enable	BOOL	–	FALSE/ TRUE	Status of the enabling switch	
				TRUE	● no fault at the enabling switch and ● the enabling switch is in position enabling function
				FALSE	● the enabling switch is in position off or panic, or ● a fault has occurred.
Last-Sync-T	TIME	–	0...Sync-T	Measured temporal offset in milliseconds between the change-over of the 2 inputs S1 and S2.	
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	0...999999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	

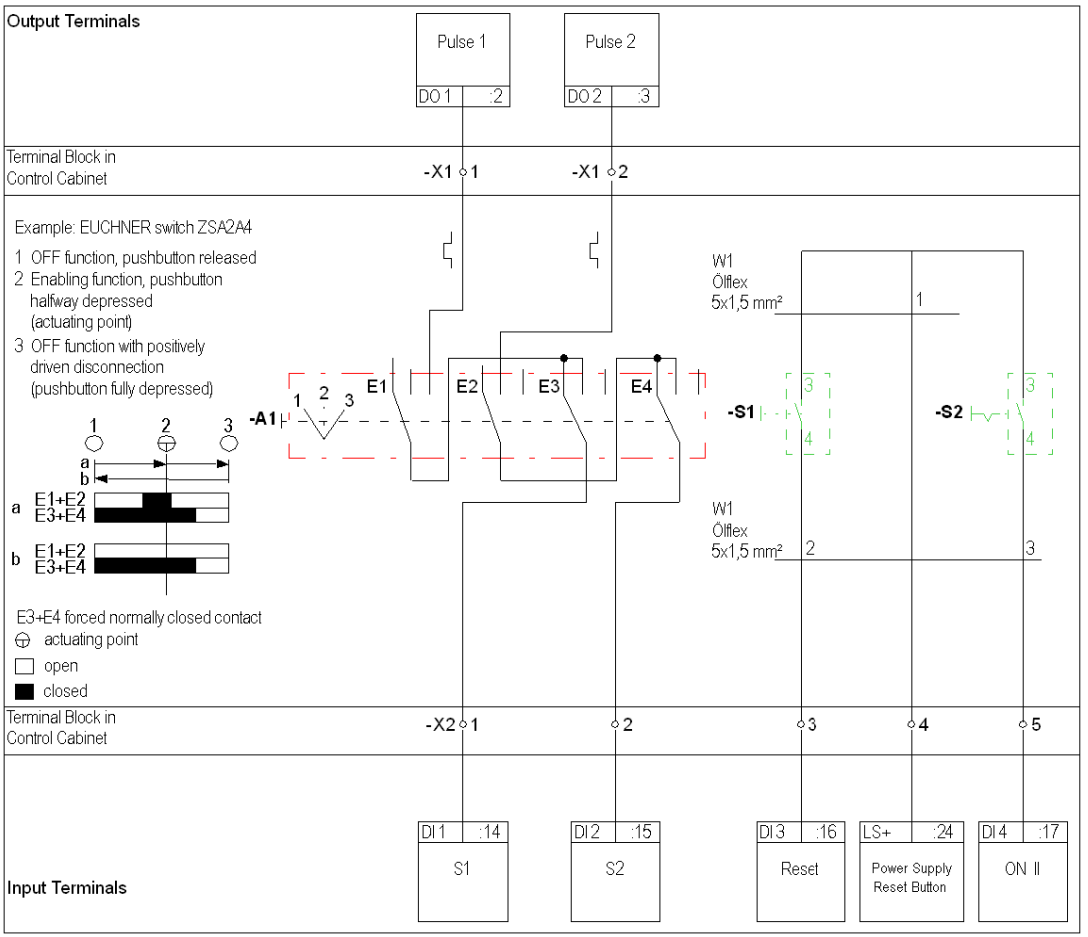
Wiring Antivalent

Wiring Diagram



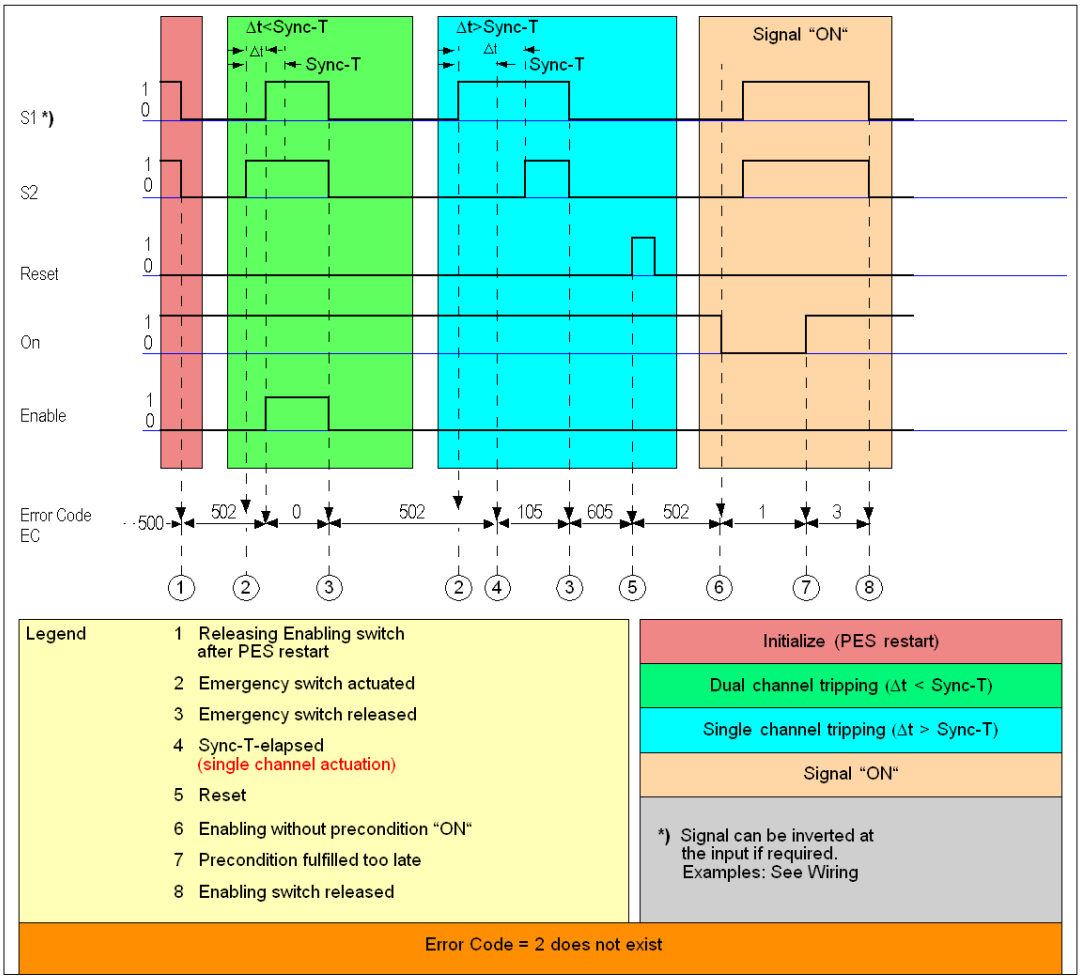
Wiring Equivalent

Wiring Diagram



Signal Table

Schema



H_BA01_ES_E4_01

6

Overview

This chapter provides information on the certificated function block H_BA01_ES_E4_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
6.1	General	88
6.2	Functions	91

6.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_ES_E4_01 (CFB44).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	89
Function Block Layout (H_BA01_ES_E4_01)	90

Characteristics

Usage

The function block H_BA01_ES_E4_01 is used for monitoring enabling switches in accordance with EN 775 and VDI 2854.

Characteristics

The function block H_BA01_ES_E4_01 provides the following characteristics:

- certified function block CFB 44 (enable switch)
- manual acknowledgment after trouble shooting
- monitoring and clipping of the synchronization time of the contacts S1, S2 to each other
- contact synchronization time configurable for each function block separately
- A conditional call of the function block is not permitted.

Hardware Restrictions

The function block is provided for hardware according to EN 775 and VDI 2854.

According to EN 60204 (DIN VDE 0113 Z1) the operating mode in automated installations must be defined with lockable selector switches. The enabling switch alone must not initialize a hazardous movement.

NOTE: It is not allowed to utilize enabling switches which change from position `Off function with positively driven disconnection` directly to `enabling function`.

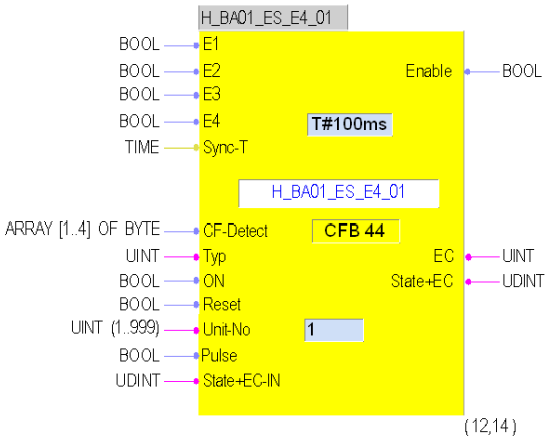
Safety Level in Accordance with EN 954-1, Cat. 4

If the enabling switch is correctly attached to the controller and all requirements in this document are met, the application complies with safety category 4 according to EN 954-1.

However, exceptions are possible in countries with additional federal state regulations where the EN 954-1 only has a limited validity or none.

Function Block Layout (H_BA01_ES_E4_01)

Inputs/Outputs



6.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_ES_E4_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	92
Inputs	94
Outputs	96
Wiring for EUCHNER ZSA2A1	97
Wiring for EUCHNER ZSA2A2	98
Wiring for EUCHNER ZSA2A3	99
Wiring for EUCHNER ZSA2A4	100
Signal Table for ZSA2A1	101
Signal Table for ZSA2A2	102
Signal Table for ZSA2A3	103
Signal Table for ZSA2A4	104

Functional Description

Basic Function

The function block H_BA01_ES_E4_01 (CFB 44) monitors enabling switches according to IEC 61508 and EN 954-1 up to category 4.

Every enabling switch is monitored by a certified function block CFB 44 in the application program XPSMFWIN.

Diagnose Functions

The function block H_BA01_ES_E4_01 can also be used to diagnose the status of the hardware. The monitoring of the 2 switching elements of the enabling switch detects whether

- there is a malposition of the contacts
- there are Line Control faults (LC; Line control channel)
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_ES_E4_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Enabling Switches

An enabling switch is a manually operated pushbutton which enables a sojourn in the danger zone of engines or robots.

The signal from the enabling switch can annul the protection effect of protective devices and thus allows entering the danger zone for commissioning, check of process flows or for service and maintenance.

An enabling switch has the following 3 different settings:

Setting	Position	Effect
1	off	enabling switch released
2	switch in center position - enabling active	enabling switch depressed until trigger point
3	pushbutton in panic position - off with positively driven disconnection	enabling switch completely depressed

By disengaging the pushbutton or by depressing the pushbutton beyond the trigger point the enabling function is cancelled. When switching from position 3 to position 1 the enabling function must not get effective.

Output

If the safety relevant function block `Enable` is...	**Then...**
TRUE	the function block works correctly and the associated enabling switch is depressed (enabling active, pushbutton in center position).
FALSE	the associated associated enabling switch is in any other position.

Monitored Hardware Wirings

The CFB 44 provides monitoring for 4 different hardware wirings. These are described in the hardware configuration for 4 different types of enabling switches manufactured by Euchner

The type of enabling switch can be preselected at the input `TYP`:

Input `TYP`	**Enabling Switch Type**
`TYP` = 1	enabling switch EUCHNER ZSA2A1G05
`TYP` = 2	enabling switch EUCHNER ZSA2A2G05
`TYP` = 3	enabling switch EUCHNER ZSA2A3G05
`TYP` = 4	enabling switch EUCHNER ZSA2A4G05

Inputs

Description

Input	Type	Default	Range of Values	Description
E1, E2, E3, E4	BOOL	FALSE	FALSE/TRUE	Inputs for reading the status of the enabling switch contacts.
Sync-T	TIME	100 ms	1...500 ms	Maximum permissible synchronization time between the individual normally closed and normally open contacts. None of the contacts E1...E4 must remain in a position other than released, enabling active or panic for more than Sync-T. If the default value is used, the input need not be connected. **Note**: Sync-T = 0 ms is not permissible.
CF-Detect	Array 1...4 of Byte	0	16#0...16#90	CF-Detect (CF = Channel Fault) represents the status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is output by means of the error code EC. The array detects channel errors of the following inputs:
				1. byte: E1
				2. byte: E2
				3. byte: E3
				4. byte: E4
TYP	UINT	1	1...4	**TYP** / **Enabling Switch**
				1 / EUCHNER ZSA2A1G05
				2 / EUCHNER ZSA2A2G05
				3 / EUCHNER ZSA2A3G05
				4 / EUCHNER ZSA2A4G05
ON	BOOL	FALSE	FALSE/TRUE	TRUE: function block enabled, status of the enabling switch is evaluated FALSE: function block disabled, status of the enabling switch is not evaluated
Reset	BOOL	FALSE	FALSE/TRUE	With a reset faults are acknowledged and the output Enable is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults (EC ≤ 500).

Input	Type	Default	Range of Values	Description
Unit-No.	UINT	1	1...999	Defines the unit number which is distributed at the output State+EC together with the error code (EC). So, the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used to distribute the error code (EC) of several function blocks sequentially via a common error signal. To do this, Pulse is connected to a pulse signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is displayed even if the EC is 0.
State + EC-IN	UDINT	0	1001000...9 99999999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.

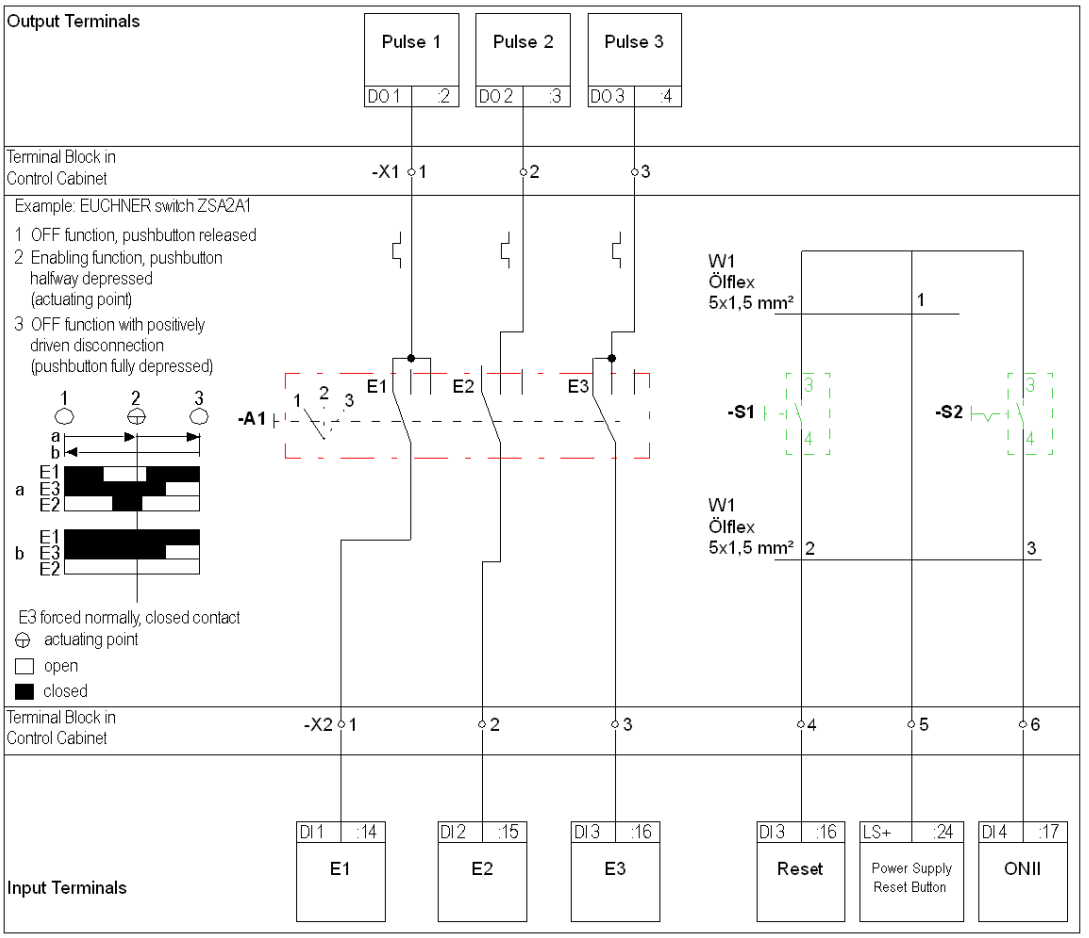
Outputs

Description

Output	Type	Default	Range of Values	Description	
Enable	BOOL	–	FALSE/ TRUE	Status of the enabling switch	
				TRUE	● no fault at the enabling switch and ● the enabling switch is in position enabling function
				FALSE	● the enabling switch is in position off or panic, or ● a fault has occurred.
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	0...999999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	

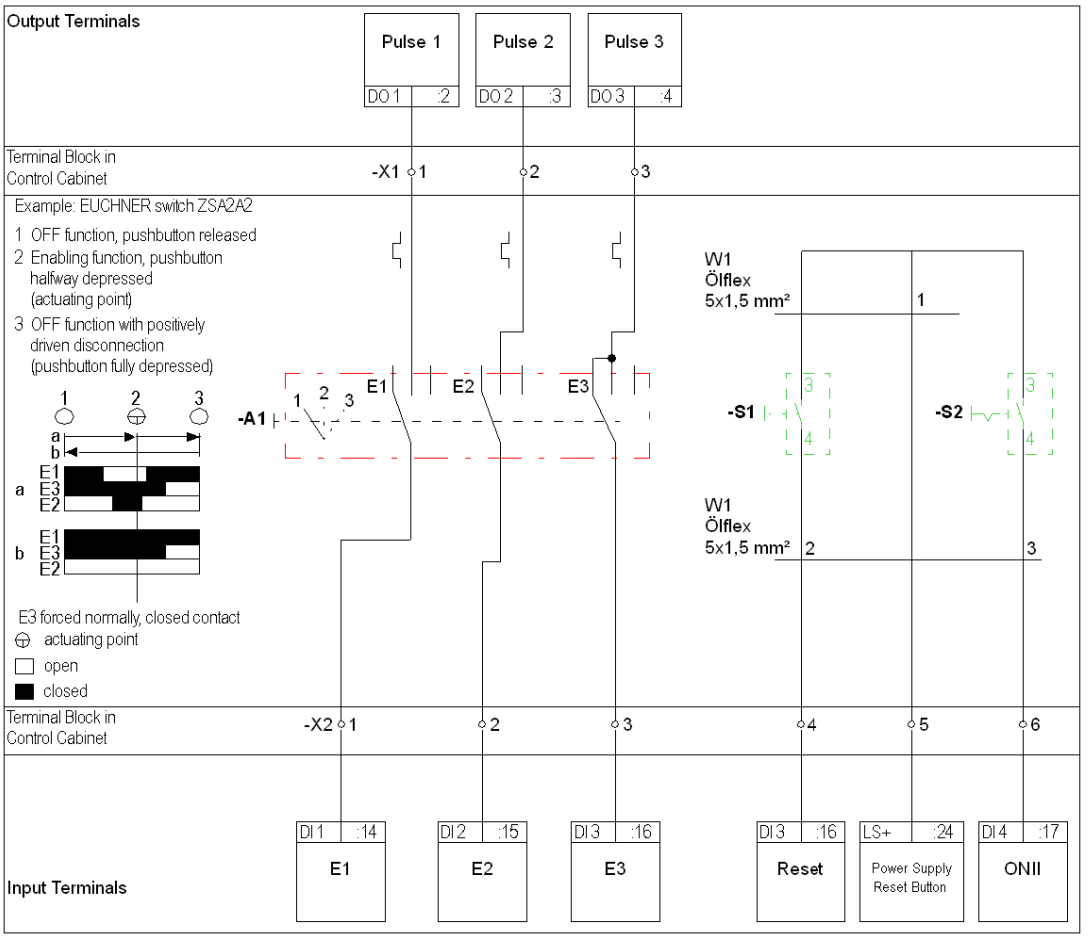
Wiring for EUCHNER ZSA2A1

Wiring Diagram



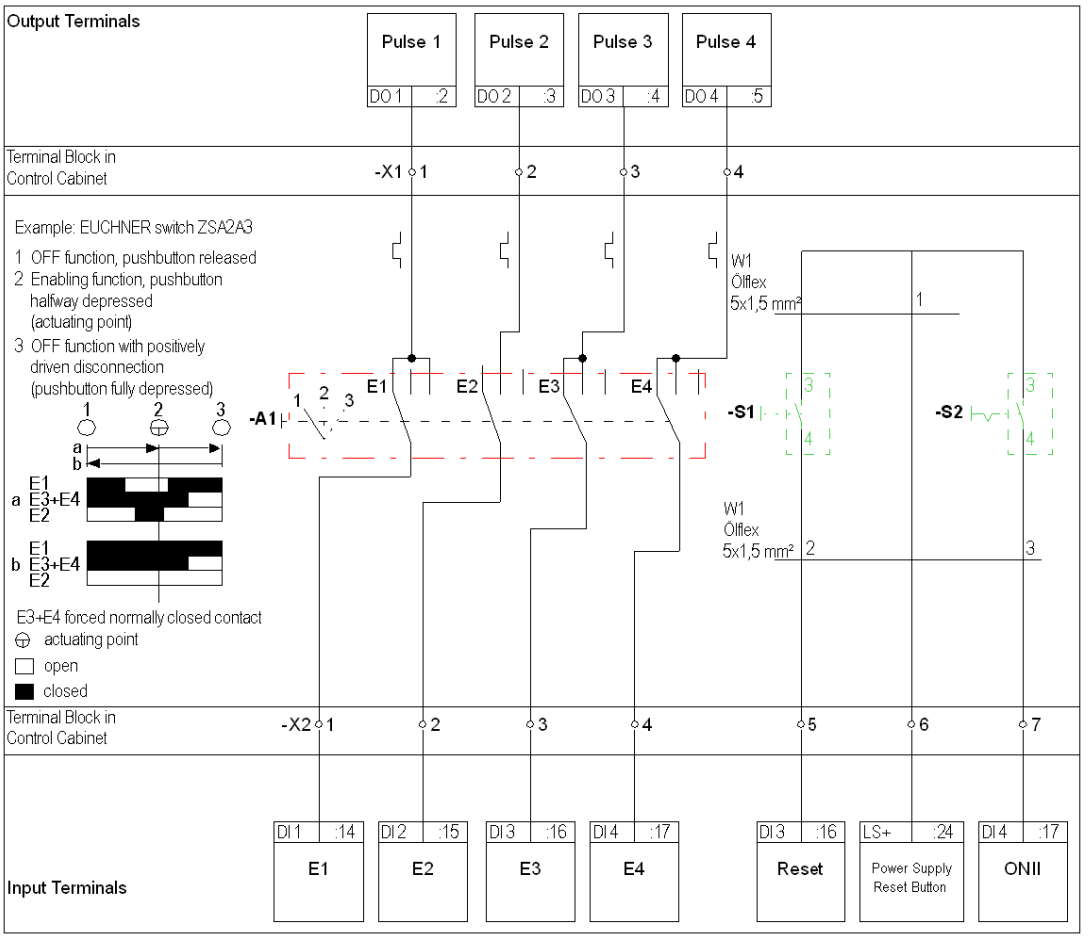
Wiring for EUCHNER ZSA2A2

Wiring Diagram



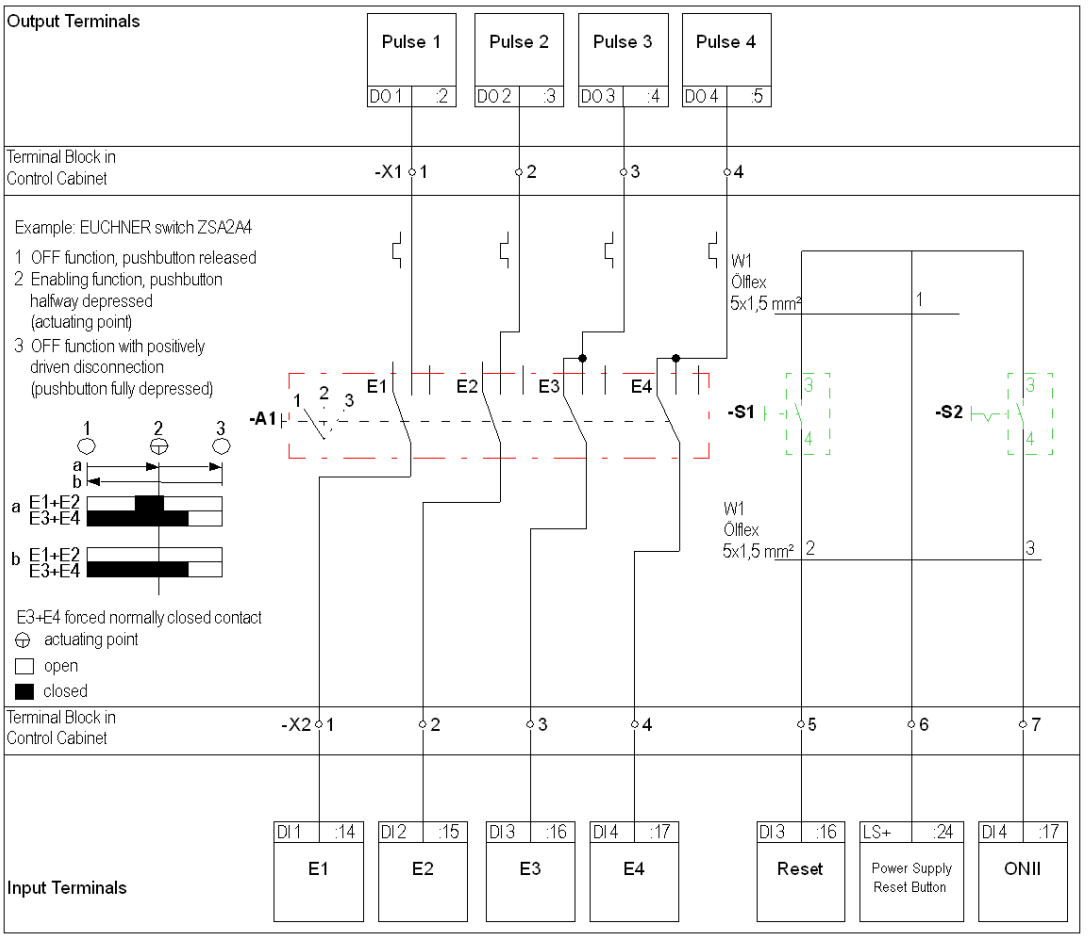
Wiring for EUCHNER ZSA2A3

Wiring Diagram



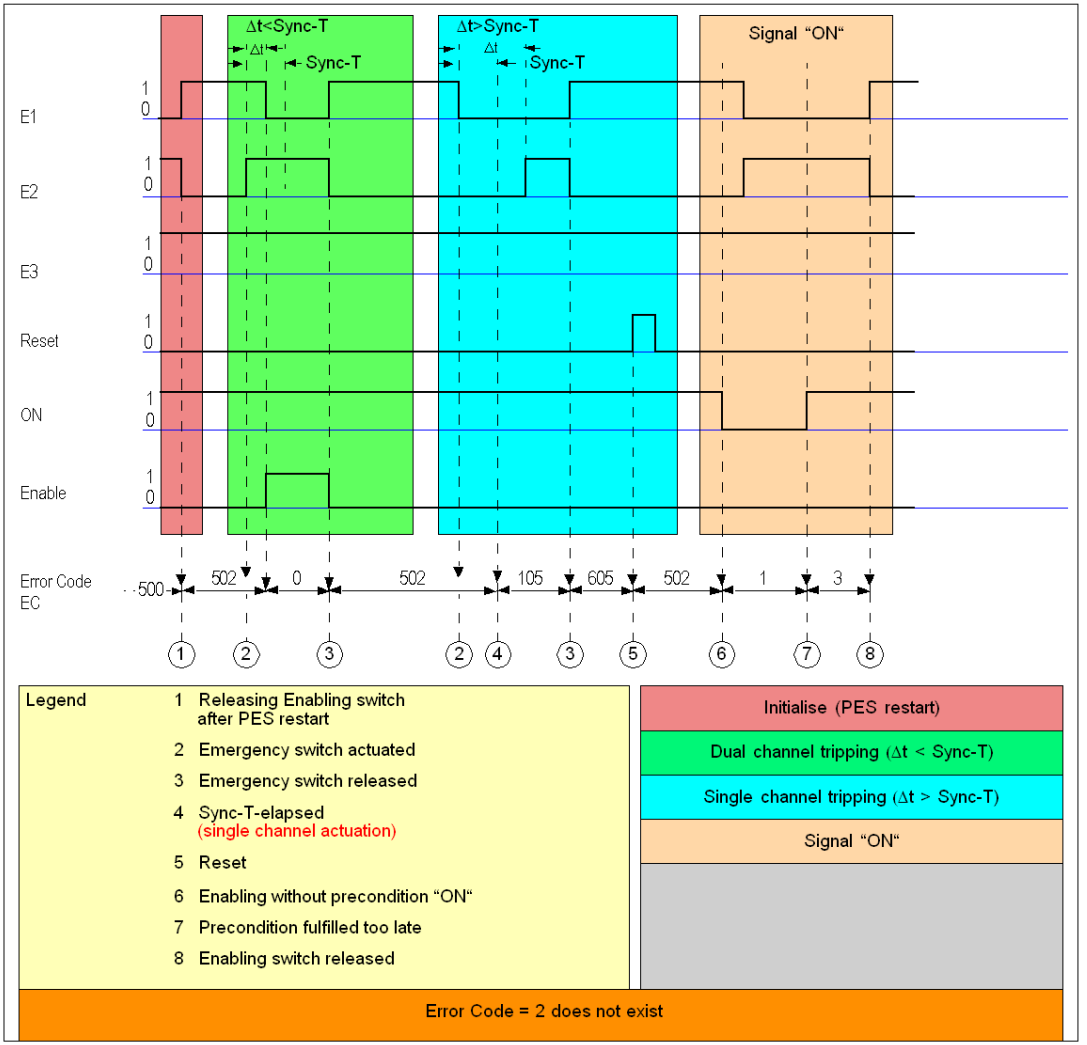
Wiring for EUCHNER ZSA2A4

Wiring Diagram



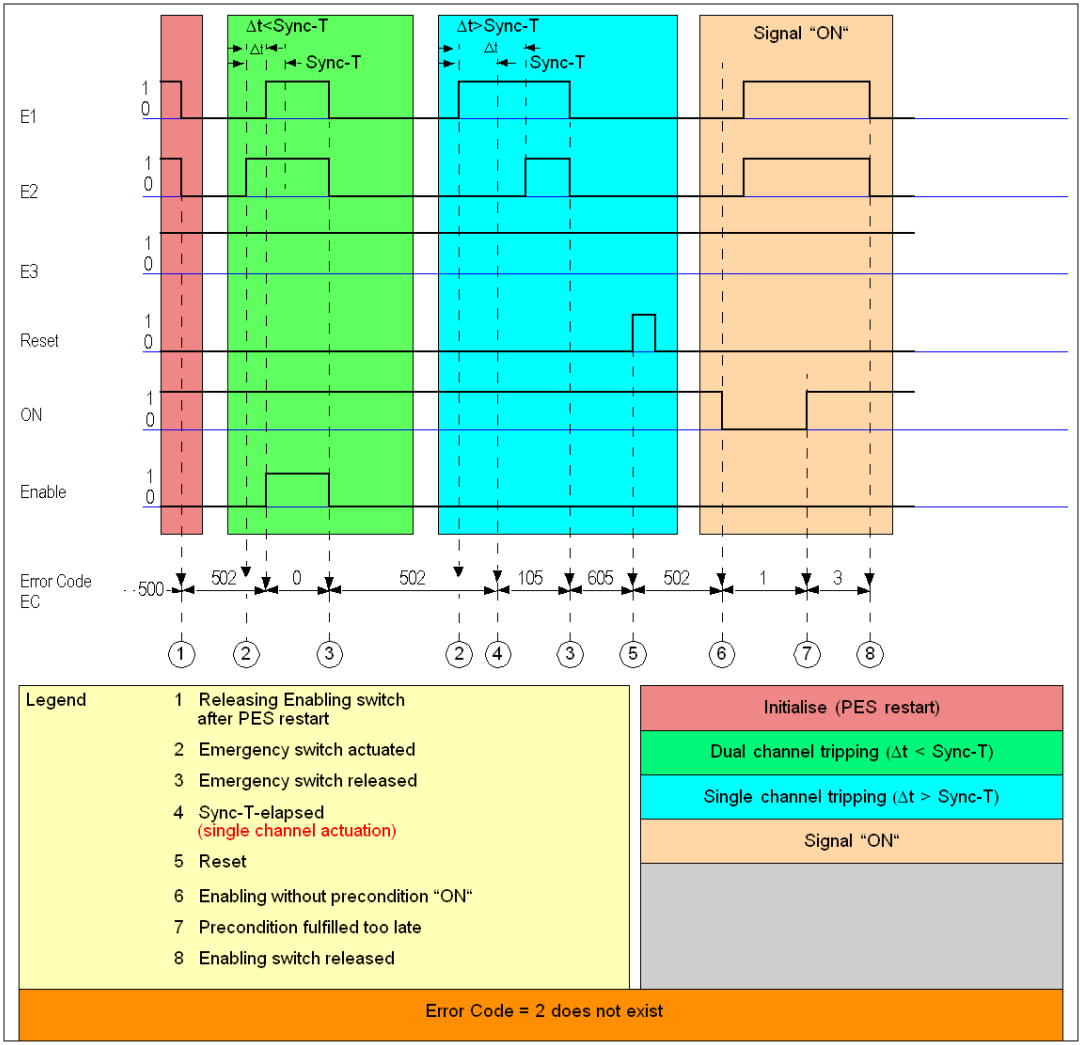
Signal Table for ZSA2A1

Schema



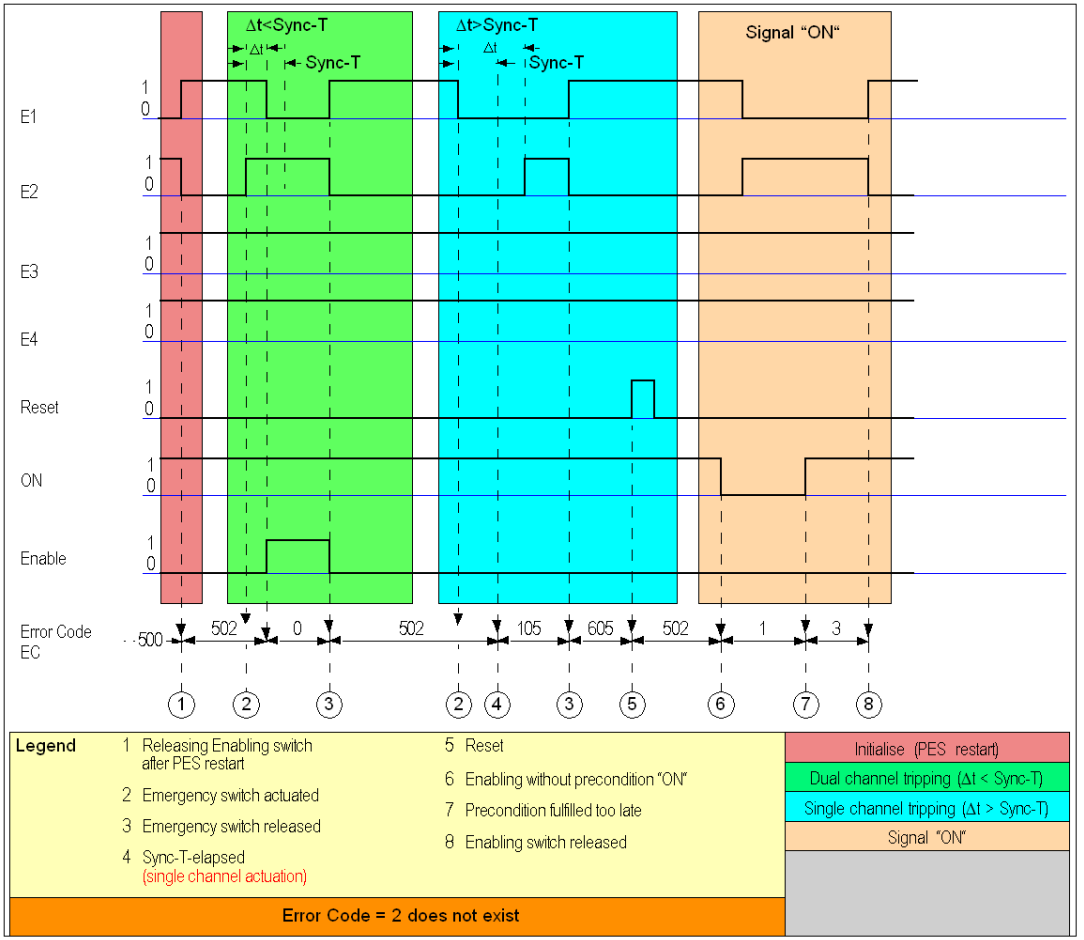
Signal Table for ZSA2A2

Schema



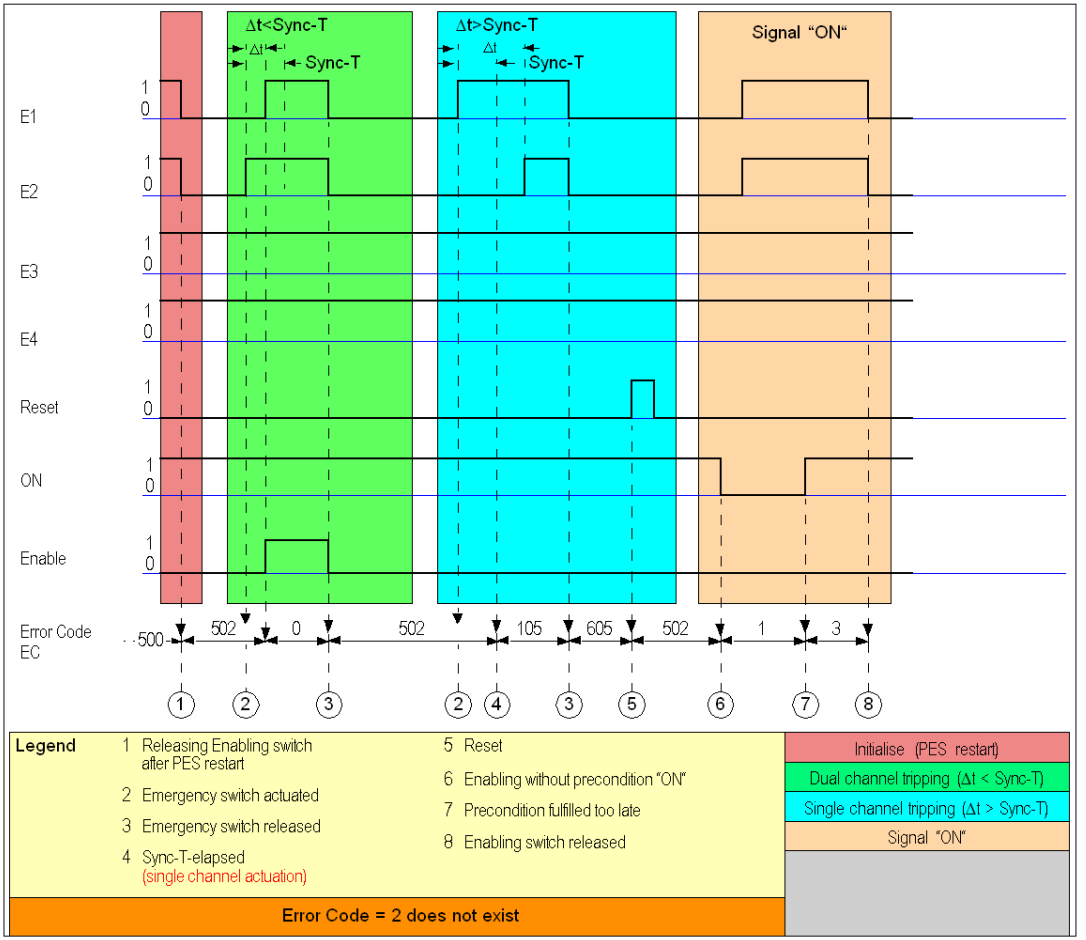
Signal Table for ZSA2A3

Schema



Signal Table for ZSA2A4

Schema



H_BA01_FBL_01

7

Overview

This chapter provides information on the certificated function block H_BA01_FBL_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
7.1	General	106
7.2	Functions	109

7.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_FBL_01 (CFB58).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	107
Function Block Layout (H_BA01_FBL_01)	108

Characteristics

Usage

The function block H_BA01_FBL_01 is used for monitoring feedback contacts of contactor loops in accordance with IEC 61508 up to SIL3 and EN 954-1, cat. 2 and 4.

Characteristics

The function block H_BA01_FBL_01 provides the following characteristics:

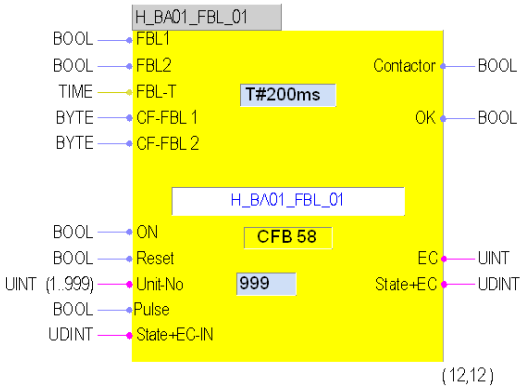
- Certified function block CFB 58 (feedback loop)
- Redundancy by dual channel
- Monitoring and clipping of the maximum permissible feedback time
- Maximum permissible feedback time individually configurable for every function block

Safety Level

IEC 61508, SIL3 and EN 954-1	**IEC 61508, SIL3 and EN 954-1, Cat. 4**	**IEC 61508, SIL1 and EN 954-1, Cat. 2**
If the feedback loop contacts are correctly attached to the controller and all requirments in this document are met, the application complies with the safety category 4 according to EN 954-1. However exceptions are possible in countries with additional federal state regulations, where the EN 954-1 has only limited or no validity.	If the hardware is correctly attached to the controller, the inputs `FBL1` and `FBL2` are monitored by line control and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1. However exceptions are possible in countries with additional federal state regulations, where the EN 954-1 has only limited or no validity.	If the contactor loop only provides 1 variable `FBL1` (single channel), `FBL1` is monitored by line control and all requirements in this document are met, this application meets only EN 954-1, safety category 2 (see *Wiring with Electronic Output, Cat. 2, page 118*).

Function Block Layout (H_BA01_FBL_01)

Inputs/Outputs



7.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_FBL_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
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Outputs	114
Wiring with 2 Electronic Outputs, Cat. 4	115
Wiring with Relay Module, Cat. 4	116
Wiring with Electronic Output and Relay Module, Cat. 4	117
Wiring with Electronic Output, Cat. 2	118
Signal Table	119

Functional Description

Basic Function

The function block H_BA01_FBL_01 (CFB 58) monitors feedback contacts of a contactor loop according to IEC 61508 up to SIL3 and EN 954-1 up to category 4.

Every contactor loop is monitored by a certified function block CFB 58 in the application program XPSMFWIN.

Diagnose Functions

The function block H_BA01_FBL_01 can also be used to diagnose the status of the hardware. The monitoring of the 2 switching contacts of the contactor detects whether

- 1 contact opens late or does not open at all,
- 1 contact closes late or does not close at all,
- there are Line Control faults (LC; Line control channel),
- the feedback monitoring time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_FBL_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Output

The H_BA01_FBL_01 function block comprises the following outputs:

Output	Function
`Contactor`	`Contactor` switches 2 contactors on and off. = `TRUE` if the input `ON` is true and there are no errors. The return information of the contactors are fed back in a loop to the function block (feedback loop).
`OK`	`OK` is the safety relevant function block output. The function block monitors whether the return information after switching the contactors on or off are within the contactor feedback monitoring time `FBL-T`. = `TRUE` if the contactor loop (`FBL` energized) and function block work without errors. = `FALSE` if the return information of the contactors are not available or a fault occurs.
`EC`	diagnosis output supplementing the diagnostic function of the output `OK`
`State+EC`	diagnosis output supplementing the diagnostic function of the output `OK`

Inputs

Description

Input	Type	Default	Range of Values	Description	
FBL1, FBL2	BOOL	FALSE	FALSE/TRUE	FBL1 = input for feedback of contactor 1 FBL2 = input for feedback of contactor 2	
				TRUE	FBL1, FBL2: The contactors 1 and 2 are dropped out.
				FALSE	FBL1, FBL2: The contactors 1 and 2 are operated.
CF-FBL1, CF-FBL2	Byte	0	16#0... 16#90	CF (Channel Fault) represents the status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is put out by means of the error code EC. These inputs report existing line control faults which have been detected by the operating system of the HIMA??? PES.	
FBL-T	TIME	200 ms	1... 50000 ms	Maximum permissible delay between switching of the FBL contacts and feedback on switch-on or switch-off. If the default value is used, the input need not be connected. Note: FBL-T = 0 ms is not allowed.	
ON	BOOL	FALSE	FALSE/ TRUE	If there are no faults and input ON is set to TRUE, the output Contactor becomes TRUE.	
Reset	BOOL	FALSE	FALSE/ TRUE	Reset is used to acknowledge errors and to set the OK output to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are erors (0 < EC ≤ 500).	

Input	Type	Default	Range of Values	Description
Unit-No.	UINT	1	1...999	Defines the unit number which is distributed together with the error number at the output State+EC so that the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output even if the EC is 0.
State + EC-IN	UDINT	0	1001000. ..999999 999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.

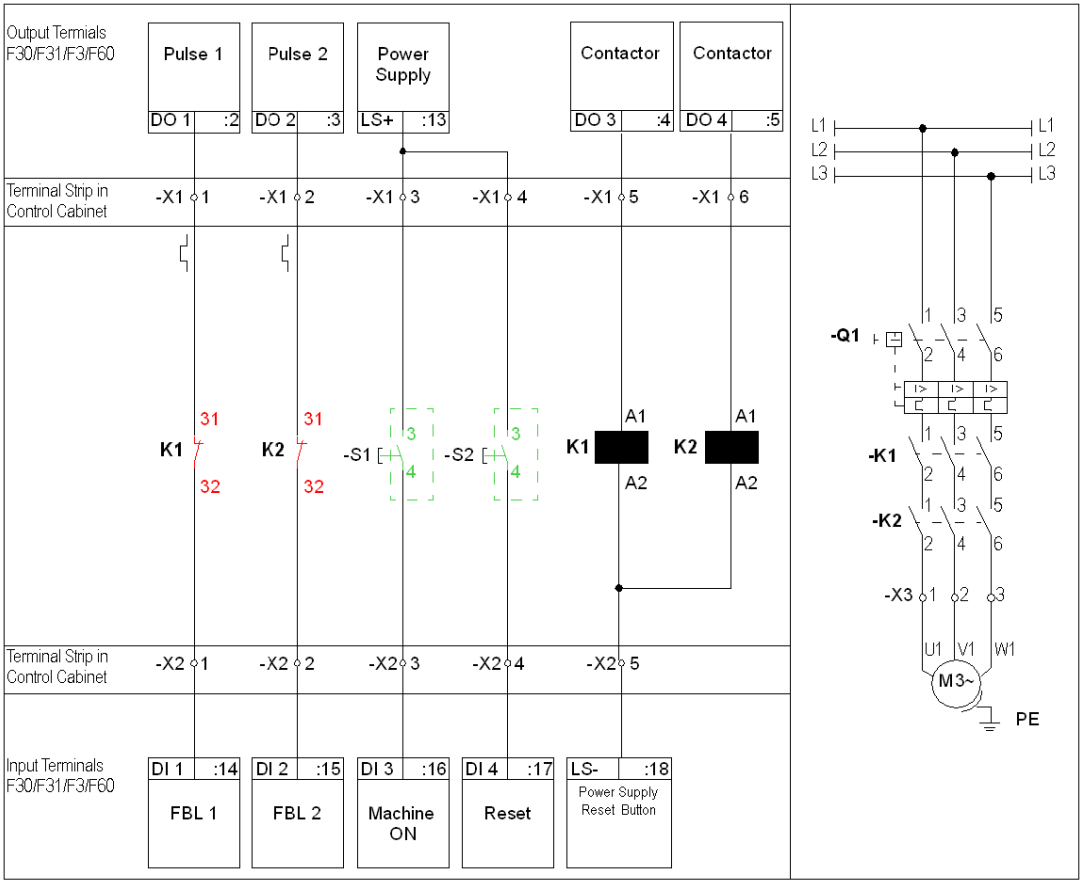
Outputs

Description

Output	Type	Default	Range of Values	Description	
Contactor	BOOL	–	FALSE/ TRUE	Contactor is used to switch the contactors on and off via the output ON.	
				TRUE	● there are no errors and ● ON is TRUE **Meaning**: The contactors are energized (operated).
				FALSE	● there are errors (e.g. the feedback from the contactor is missing), or ● ON is FALSE.
OK	BOOL	–	FALSE/ TRUE	= TRUE if there are no errors, independant of the switching state of the contactor.	
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	58001000... 58999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	

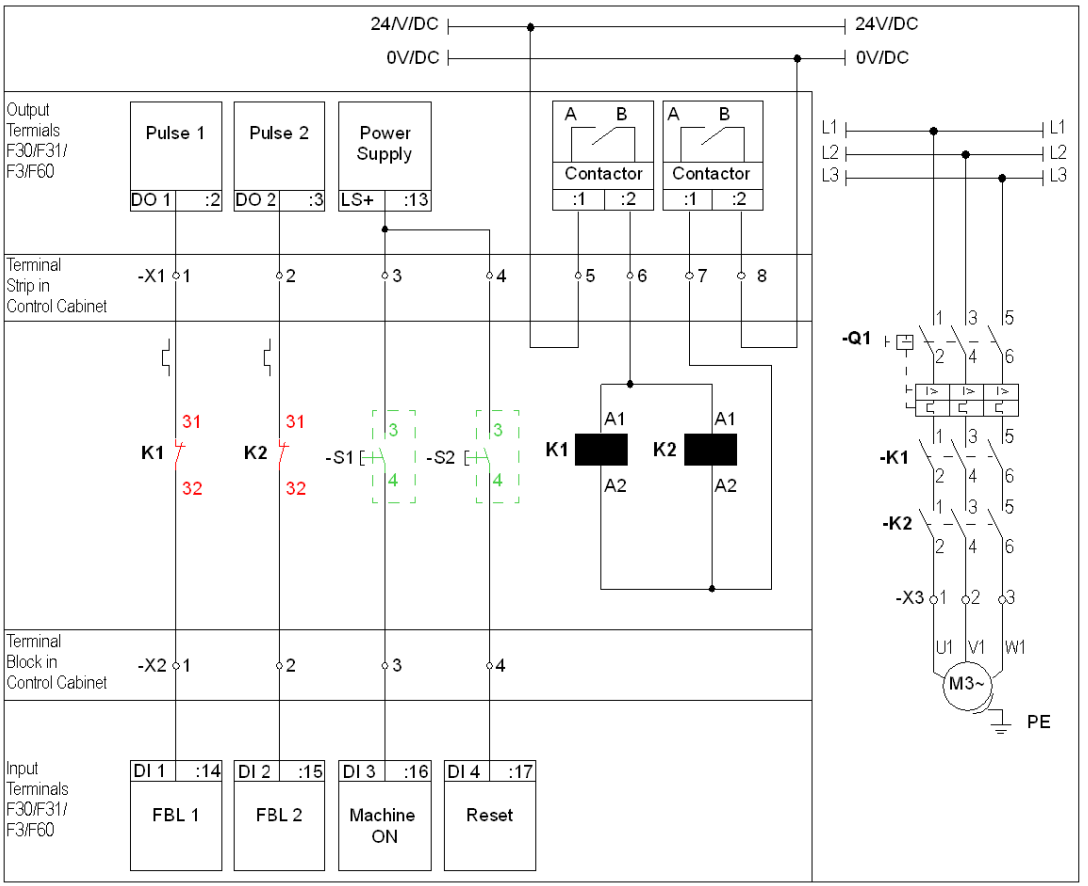
Wiring with 2 Electronic Outputs, Cat. 4

Wiring Diagram



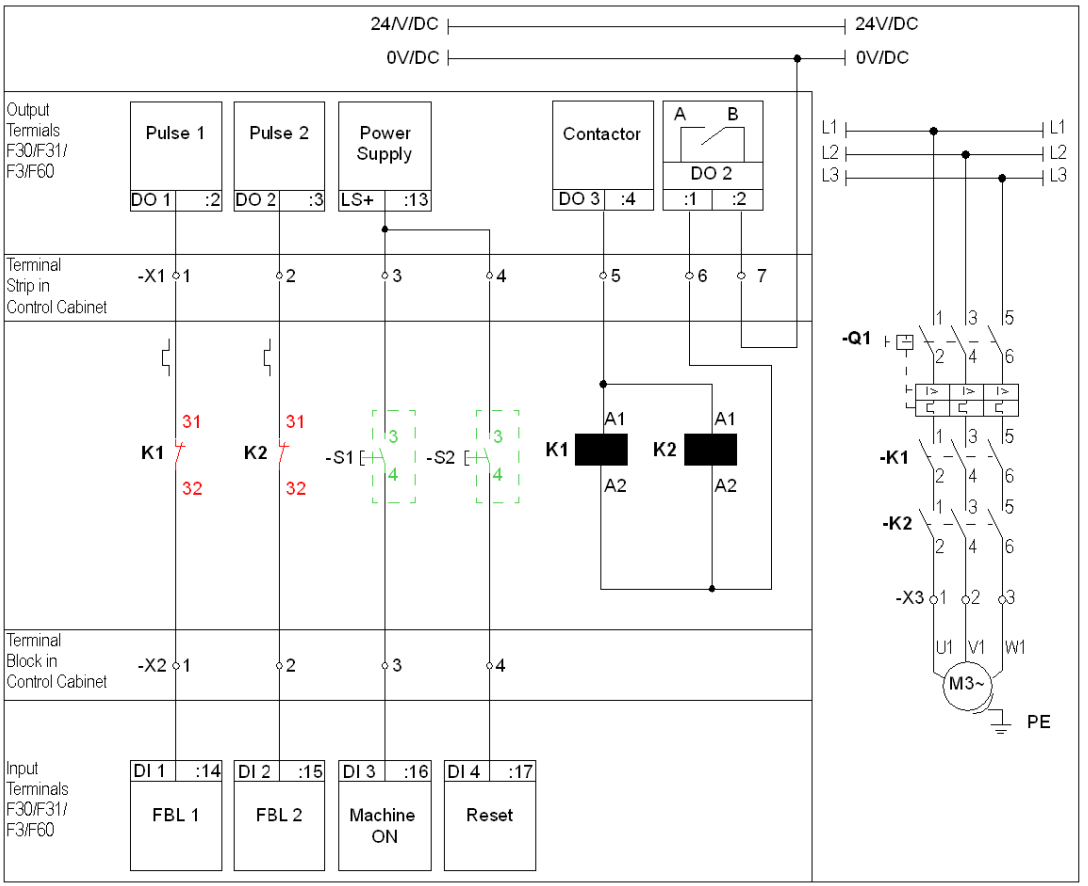
Wiring with Relay Module, Cat. 4

Wiring Diagram



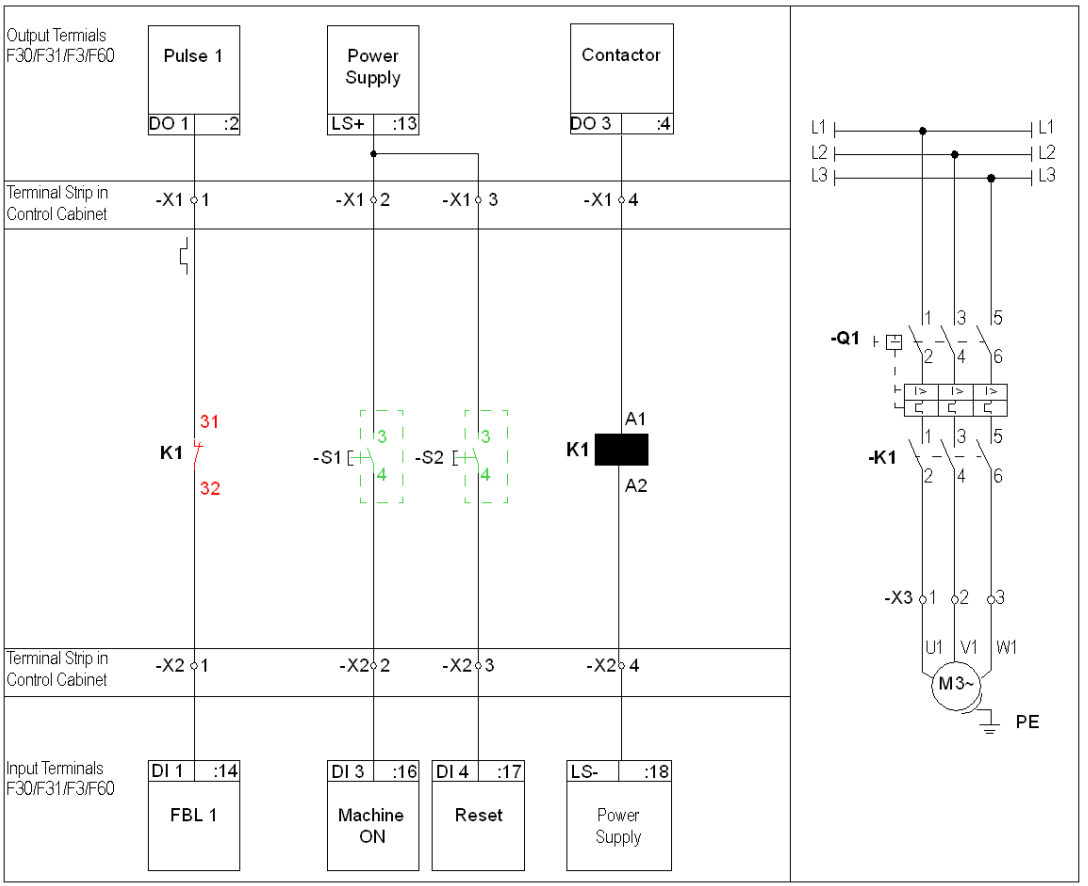
Wiring with Electronic Output and Relay Module, Cat. 4

Wiring Diagram



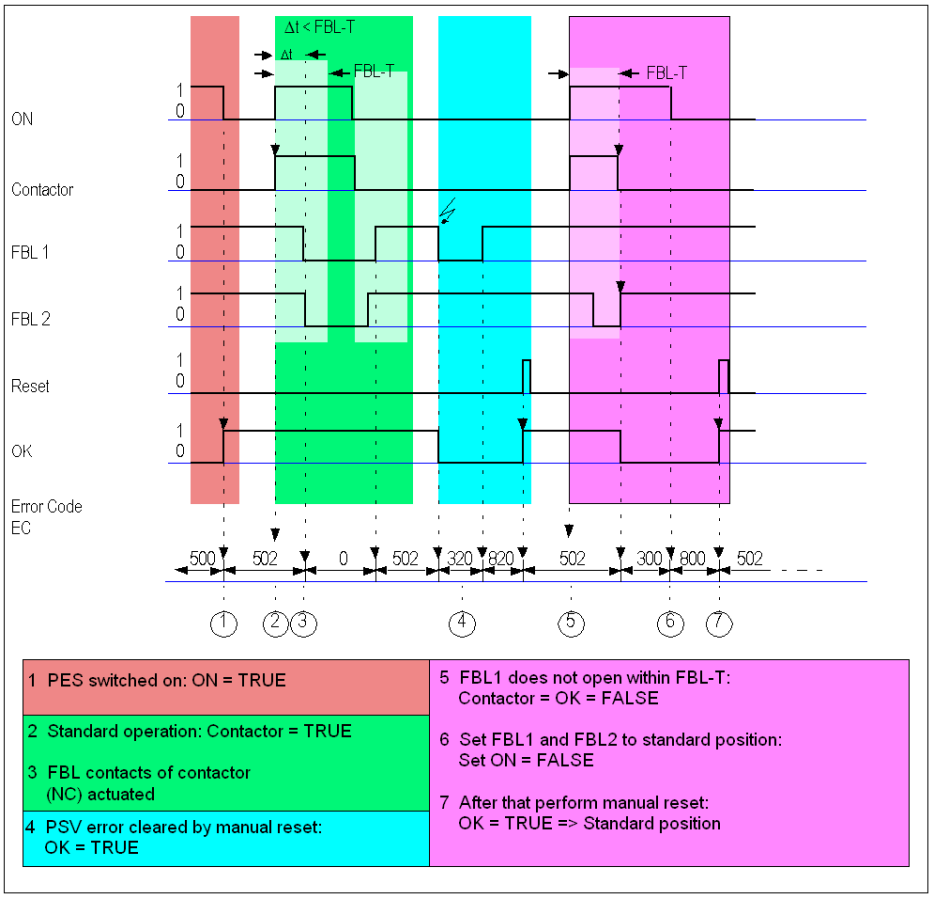
Wiring with Electronic Output, Cat. 2

Wiring Diagram



Signal Table

Schema



H_BA01_Muting_01

8

Overview

This chapter provides information on the certificated function block H_BA01_Muting_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
8.1	General	122
8.2	Functions	131
8.3	Hardware Design	150

8.1 General

Overview

This section provides information on the function block characteristics and the function block layout of the certificated function block H_BA01_Muting_01 (CFB70).

What's in this Section?

This section contains the following topics:

Topic	Page
What Is Muting?	123
Characteristics	124
General Information	126
Additional Applicable Conventions	129
Function Block Layout (H_BA01_Muting_01)	130

What Is Muting?

Danger Zones

In production processes with high automation levels there are areas in which robots move or machine sets lose their way.

These areas are called **danger zones** since entering them can result in serious consequences for life and limb of persons.

Persons may stay only in **non-dangerous zones**.

Universal Optical Sensor (UOS)

A redundant (= dual channel) universal optical sensor (UOS) is used to separate the zones.

In manufacturing processes which require the goods to be worked on to be transported from a danger zone into a non-dangerous zone, a shut-off caused by a universal optical sensor must be able to be temporarily overridden under strict safety-relevant requirements.

Definition

The temporary neglect of signals of the universal optical sensor is called muting.

⚠ CAUTION

IMPROPER OPERATION

You must absolutely obey the very strict safety regulations concerning the set-up and monitoring of muting station.

Failure to follow these instructions can result in injury or equipment damage.

Characteristics

Usage

The function block H_BA01_Muting_01 is used for monitoring electro-sensitive protective equipment in accordance with IEC 61508 and EN 954-1 up to category 4.

Characteristics

The H_BA01_Muting_01 function block provides the following characteristics:

- certified function block CFB 70 (muting)
- redundancy by dual channel of the UOS (universal optical sensor)
- manual or automatic acknowledgment at the start of the HIMatrix controller
- manual acknowledgment (reset) after appearance of a fault
- monitoring and limiting of the synchronization time of the correlated initiators as well as the two UOS contacts
- synchronization time of the input signals separately configurable for each function block
- A conditional call of the function block is not permitted.
- serial and parallel muting
- monitoring of the muting indicator lamps
- key-operated switches to relieve the muting station and the UOS

Safety Level

IRC 612805, SIL3 and EN 954-1, Cat. 4	**IRC 612805, SIL2 and EN 954-1, Cat. 3**	**IRC 612805, SIL1 and EN 954-1, Cat. 2**
If the electro-sensitive protective equipment is correctly attached to the controller and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1. However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity. Consider also the caution below.	If the sensor (e.g. scanner) has the approval for category 3, only category 3 can be met with this controller.	If the 2 inputs `S1-NO` and `S2-NO` are not driven directly by the pulsed output signals of the ESPE or the PLS but by variables, this application meets only safety category 2 according to EN 954-1 (see hardware configuration).

⚠ CAUTION

IMPROPER OPERATION

Make sure that no automatic restart is possible. Guarantee this by the parameter settings of the function block or by appropriate external wiring.

Failure to follow these instructions can result in injury or equipment damage.

General Information

Conventions

Please pay attention to the *Conventions, page 129*.

Line Control

Line control for the 4 muting initiators is possible provided that the initiators allow this and do not have line control of their own.

Line control allows monitoring of
- short against supply voltage,
- cross short and
- line change.

NOTE: Line Control cannot monitor line break since this cannot be distinguished by the PES from disengaging an initiator.

Monitoring

3 different forms of monitoring are performed:
- permanent sequence monitoring (see paragraph *Muting Modes*)
- Permanent monitoring of the initiators on disengaging (un-damping):
  A muting initiator may become disengaged for a maximum of 1 second e.g. because of a hole in the auto body without being considered «disengaged» by the H_BA01_Muting_01.
  Example for serial muting:
  If initiator 2 becomes disengaged for more than 1 second although the transported material damps the initiators 1 to 3, the function block recognizes a hardware fault and sets the Enable output to `FALSE`. An error message is additionally generated.
- Monitoring of the transition periods
  - monitoring on damping of the initiators 1 and 2 as well as 3 and 4 within a limited time period
  - monitoring of the time which at most may elapse between the activation of muting and the damping of the ESPE
  - monitoring of the time which the ESPE may be damped at most
  - monitoring of the time which muting may be active at most

Muting Modes

There are 3 muting modes, all providing forwards and backwards directions of travel:

Muting Mode	Description	Sequence Monitoring
Serial Muting	Serial muting with 1 UOS and 4 initiators In this case the UOS is an ESPE, such as a light grid, light curtain, laser scanner etc. which immediately switches off engines if a human being gets into the protected danger zone.	Permanent monitoring of the damping sequence of the initiators (sequence monitoring): I1 g I2 g I3 g I4 (forward) and I1 f I2 f I3 f I4 (backwards)
Parallel Muting 1	Parallel muting with 1 UOS and 4 initiators	Permanent monitoring of the damping sequence of the initiators (sequence monitoring): I1/I2 g I3/I4 (forwards) and I1/I2 f I3/I4 (backwards) «I1/I2» means that it does not matter whether «I1» is damped before «I2». The same applies to «I3/I4».
Parallel Muting 2	Parallel muting with 1 AOS and a pair of light barriers	This muting mode does not allow sequence monitoring!

Muting

Muting is active if at least 2 adjacent initiators are damped and there are no hardware or other faults.

The exception is parallel muting with 4 initiators at which the transported material must temporarily damp all 4 initiators.

If muting has been activated, 2 digital outputs to which muting indicator lamps can be connected are set to `TRUE`. The wiring of the muting indicator lamps can be carried out in different ways (see *Wiring Indicator Lamp - Version 1, page 145*). The monitoring includes line break and short to an external potential.

A third digital output is used to signal that 1 or both of the muting indicator lamps have failed. An error message concerning the outage of 1 indicator lamp can be suppressed when using the corresponding input of the function block.

If an error occurs it must be cleared. After that the muting station must be relieved by means of the key-operated switch Clear key.

NOTE: The key-operated switch Clear key temporarily bridges (configurable) all safety functions of the function block!

Error Treatment

If a sequence monitoring fault occurs, the H_BA01_Muting_01 immediately switches off.

If a hardware or parameterization error occurs, the safety-related output `Enable` becomes `FALSE` immediately and hence muting is stopped.

NOTE: Faults detected by the H_BA01_Muting_01 can only be acknowledged, if they were eliminated and the connected hardware reports `muting station incl. ESPE free` to the function block. The acknowledgment is triggered with a positive edge at the Reset input of the function block.

Permanent Reset

If the function block...	And the Reset input becomes ...	Then the function block...
has not detected any faults	permanently `TRUE`	merely issues a warning message `permanent reset`
has detected faults	permanently `TRUE`	issues an error message `permanent reset` after the elimination of the fault since the function block cannot be acknowledged any more

In both cases the permanent `TRUE` signal at the reset input must be removed and then the function block must be acknowledged.

Additional Applicable Conventions

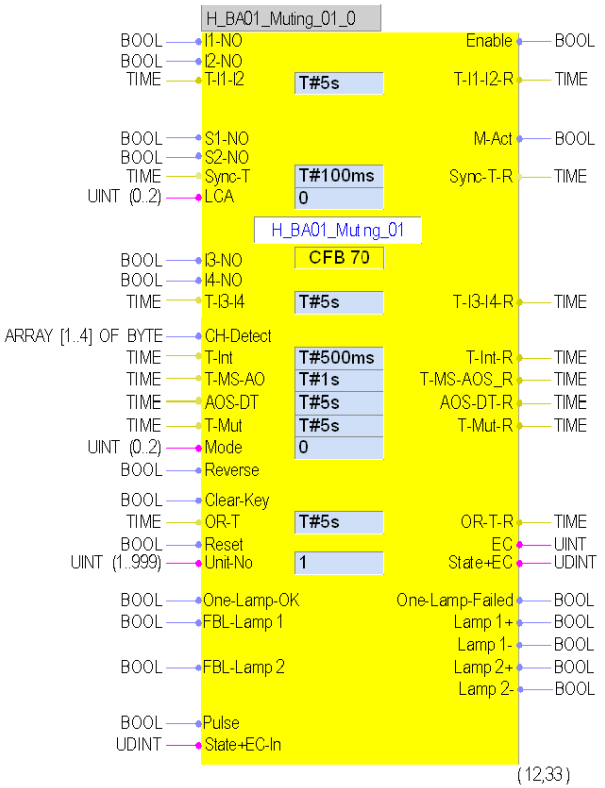
Conventions

Conventions valid in this manual:

1. Before a new muting procedure the muting station must be completely vacant, including the UOS. This also applies to the first muting after the restart of the PES.
2. Initiators must be connected in a way to output `TRUE` if the initiator is damped and `FALSE` if the initiator is not damped.
3. The initiators in the non-hazardous area are the initiators 1 and 2.
4. The initiators in the hazardous area are the initiators 3 and 4.

Function Block Layout (H_BA01_Muting_01)

Inputs/Outputs



8.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_Muting_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	132
Inputs	134
Outputs	140
Wiring ESPE According to SIL 3, Cat. 4	142
Wiring PLS According to SIL2, Cat. 3	144
Wiring Indicator Lamp - Version 1	145
Wiring Indicator Lamp - Version 2	146
Wiring Indicator Lamp - Version 3	147
Wiring Indicator Lamp - Version 4	148
Signal Table	149

Functional Description

Basic Function

The function block H_BA01_Muting_01 (CFB 70) monitors the muting function including the indicator lamps according to the IEC 61508 and the EN 954-1 up to category 4.

Each muting station is monitored by a certified function block CFB 70 in the application program XPSMFWIN.

Diagnose Functions

The CFB 70 can also be used to diagnose the condition of the hardware.

Monitoring for procedural faults (times, etc.) detects whether

- there are faults of the UOS (single channel faults and switching faults: 1 contact does not open/close or is late)
- there are initiator errors (continuous `TRUE` or `FALSE` signal, incorrect wiring)
- the contact synchronization time is in the predefined range of values
- the `Unit-No.` and other function block parameters are in the predefined range of values
- the reset push button at the `Reset` input of the function block is bridged.

NOTE: Only if the fault is eliminated and the muting station has been relieved by means of the key-operated switch, the fault can be acknowledged.

XPSMF•• System Family

The H_BA01_Muting_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Output

The Enable output of the function block becomes `TRUE` after a successful acknowledgment and the non-safety-related function block output `EC` is zero (all is `OK`).

The safety relevant function block `Enable` is...	**If...**
TRUE	the hardware is correctly wired,
	all sensors incl. the UOS are operating correctly, and
	the function block has not detected any faults.

The not safety relevant function block output `EC` provides some exact information.

Inputs

Description

Input	Type	Default	Range of Values	Description
I1-NO, I2-NO	BOOL	FALSE	FALSE/TRUE	Inputs for 2 single channel initiators I1-NO and I2-NO. In direction of travel the initiators are in front of the light grid (or laser scanner), i.e. outside the danger zone. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to ESPE activated.
T-I1-I2	TIME	5s	0...30s	Admissible synchronization time for the initiators I1 and I2. After 1 initiator has been damped, the other initiator must also be damped within T-I1-I2.
S1-NO, S2-NO	BOOL	FALSE	FALSE/TRUE	Inputs of the UOS (light grid or laser scanner)
Sync-T	TIME	100 ms	0...500 ms	The time Sync-T indicates the synchronization time of the individual normally closed/normally open contacts against each other. If the default value is used, the input need not be connected. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to ESPE activated. A functional test is not forced by the program after a hardware problem (see *Error Code Table, page 246*).

Input	Type	Default	Range of Values	Description
LCA	UINT	0	0,1,2	Line Control Blanking of the UOS: 0: FALSE at S1-NO or S2-NO results in immediate shut-down. 1: Bridging of the line control blanking (LCA) of the sensor is taken into account. Blanking the line control signal for either S1-NO or S2-NO for only 1 PES cycle does not lead to switching off the Enable output. 2: Bridging of the line control blanking (LCA) of the sensor is taken into account. Both a simultaneous blanking of both inputs and the blanking of only 1 input for max. 1 PES cycle do not lead to switching off. **Note**: For LCA = 1 and LCA = 2 the shut-down is delayed by 1 PES cycle. This time must be taken into account when planning the safe distance!
I3-NO,I4-NO	BOOL	FALSE	FALSE/TRUE	Inputs for 2 single channel initiators I3-NO and I4-NO. In direction of travel the initiators are behind the light grid (or laser scanner), i.e. inside the danger zone. **Note**: Serial muting allows to monitor the operating sequence of I3-NO g I4-NO. This does not apply to parallel muting.
T-I3-I4	TIME	5 s	0...30 s	Admissible synchronization time for the initiators I3 and I4. After 1 initiator has been damped, the other initiator must also be damped within T-I3-I4.

Input	Type	Default	Range of Values	Description
CH-Detect	Array [1...4] of Byte	0	16#0...16#90	Status of the connected hardware. The detection of hardware faults is performed by the PES operating system. This information is supplied to the muting function block, evaluated in the function block and distributed by means of the error code (EC and State+EC). Shorts to external voltages, cross shorts and channel mix-up are detected.The array detects channel faults of the input: 1. Byte (status I1-NO) ... 4. Byte (status I4-NO) **Note**: For the PES the digital inputs to be monitored and the line control outputs have to be configured. Besides the allocation of the I/O channels, an allocation of the channel error status bytes to the array CH-Detect also has to be carried out.
T-Int	TIME	500 ms	0...1 s	Permitted initiator signal override time: After the beginning of muting an initiator may become disengaged temporarily for less than or equal to T-Int before is regarded as 'not damped'. Maximum time between the beginning of muting and the damping of the UOS.
T-MS-AOS	TIME	5 s	0...5 s	This time is needed as an additional margin if the transported material does not block the access to the danger zone completely when muting is active. It has to be guaranteed that as of the beginning of muting no access to the danger zone is possible within T-MS-AOS.
AOS-DT	TIME	5 s	0...28800 s (8 h)	Universal optical sensor damping time: Maximum permissible duration of the UOS damping. If exceeded, muting is terminated with an error message.

Input	Type	Default	Range of Values	Description
T-Mut	TIME	5 s	0...28800 s (8 h)	Maximum permissible duration of the muting process. 0: Serial muting with 4 sensors and 1 UOS: Serial muting allows to monitor the damping sequence of the initiators: I1-NO g I2-NO g I3-NO g I4-NO and I4-NO g I3-NO g I2-NO g I1-NO If the direction of travel does not coincide with the sequence of the damping, muting is aborted with an error message. 1: Parallel muting with 4 sensors and 1 UOS: Parallel muting allows to monitor the damping sequence of the initiators: I1-NO/I2-NO g I3-NO/I4-NO and I2-NO/I1-NO f I4-NO/I3-NO Whether the initiator 1 or initiator 2 is damped first within the initiator group 1/2 and whether the initiator 3 or initiator 4 is damped first within the initiator group 3/4 does not matter. But if the direction of travel does not coincide with the sequence of the damping, muting is aborted with an error message. 2: Parallel muting with 2 light barriers and 1 UOS: This muting mode does not allow conveying direction monitoring!
Reverse	BOOL	FALSE	FALSE/ TRUE	Input for sequence monitoring of the initiators. FALSE: Serial muting requires the damping of the initiators in the following sequence: I1-NO g I2-NO g I3-NO g I4-NO. TRUE: Serial muting requires the damping of the initiators in the following sequence: I1-NO f I2-NO f I3-NO f I4-NO.
Clear-Key	BOOL	FALSE	FALSE/ TRUE	A key-operated switch can be connected to this input. When pressing the CLEAR KEY pushbutton the muting indicator lamps are turned on to signal the bridging and the Enable output becomes TRUE simultaneously. Consider also the following caution:

⚠ CAUTION

IMPROPER OPERATION

The key-operated switch CLEAR KEY temporarily bridges the muting process and all safety functions of the function block for at most `OR-T` seconds (see below)! The danger zone must be visible from the location of the key-operated switch!

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Range of Values	Description
`OR-T`	`TIME`	5 s	0...600 s	Override Time: Temporal limit for relieving the muting station by means of the pushbutton Clear key.
`Reset`	`BOOL`	`FALSE`	`FALSE/ TRUE`	With `Reset` the Enable output of the function block is set to `TRUE`. To do this a 0/1 transition change must be carried out at the `Reset` input. The function block is not enabled as long as there are faults (0 < **EC** ≤ 500).
`Unit-No.`	`UINT`	`1`	1...999	With the `Unit-No.` the user defines a unit number which is distributed at the output `Error code` together with the error number. So, the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, use a new Unit-No. for every function block.

Input	Type	Default	Range of Values	Description
One-Lamp-OK	BOOL	FALSE	FALSE/ TRUE	The muting indicator lamps are monitored permanently, independent of whether the indicator lamps are turned off or on (muting active or key-operated switch operated). FALSE: If 1 of the 2 muting indicator lamps fails, the Enable output becomes FALSE and muting is terminated with an error message. The output One-Lamp-Failed becomes TRUE. TRUE: The loss (wire break) of 1 muting indicator lamp does not lead to the termination of muting. The output One-Lamp-Failed becomes TRUE. If the second muting indicator lamp fails also, the Enable output becomes FALSE and muting is terminated with an error message.
FBL-Lamp 1	BOOL	FALSE	FALSE/ TRUE	Feedback Loop (FBL) for monitoring muting indicator lamp 1 on line break.
FBL-Lamp 2	BOOL	FALSE	FALSE/ TRUE	Feedback Loop (FBL) for monitoring muting indicator lamp 2 on line break.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable.To do this Pulse is connected to a clock signal created externally (transition change e.g. every 3 s).With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT		1001000... 999999999	Status of the function block, comprising CFB-No. + Unit-No. + Error Code.

Outputs

Description

Output	Type	Range of Values	Description
Enable	BOOL	FALSE/ TRUE	Safety-related enable signal of the function block: The hardware can be connected directly or via additional logic. TRUE: Muting is active, no errors (hardware faultless, sensors and UOS properly dampened and undampened) FALSE: muting inactive
T-I1-I2-R	TIME		T-I1-I2-Return (return value): elapsed time
M-Act	BOOL	FALSE/ TRUE	TRUE, if muting is active.
Sync-T-R	TIME		Sync-T-Return (return value): elapsed time
T-I3-I4-R	TIME		T-I3-I4-Return (return value): elapsed time
T-Int-R	TIME		T-Int-Return (return value): elapsed time
T-MS-AOS-R	TIME		T-MS-AOS-Return (return value): elapsed time
AOS_DT-R	TIME		AOS Damp-Time Return (return value): elapsed time
T-Mut-R	TIME		T-Mut-Return (return value): elapsed time
OR-T_R	TIME		OR-T_Return (return value): elapsed time
EC	UINT	0...999	error code of the function block
State+EC	UDINT	0...050999999	status of the function block, comprising CFB-No. + Unit-No. + EC
One-Lamp-Failed	BOOL	FALSE/ TRUE	signal for defective muting indicator lamps TRUE: At least 1 of the 2 muting lamps is faulty. FALSE: Both muting lamps are okay.
LAMP1+	BOOL	FALSE/ TRUE	Permanent supply for muting indicator lamp 1+.

Output	Type	Range of Values	Description
LAMP1-	BOOL	FALSE/ TRUE	Driver for muting indicator lamp 1 if muting is active or the key-operated switch «Clear key» is engaged.
LAMP2+	BOOL	FALSE/ TRUE	Permanent supply for muting indicator lamp 2+.
LAMP2-	BOOL	FALSE/ TRUE	Driver for muting indicator lamp 2 if muting is active or the key-operated switch «Clear key» is engaged.

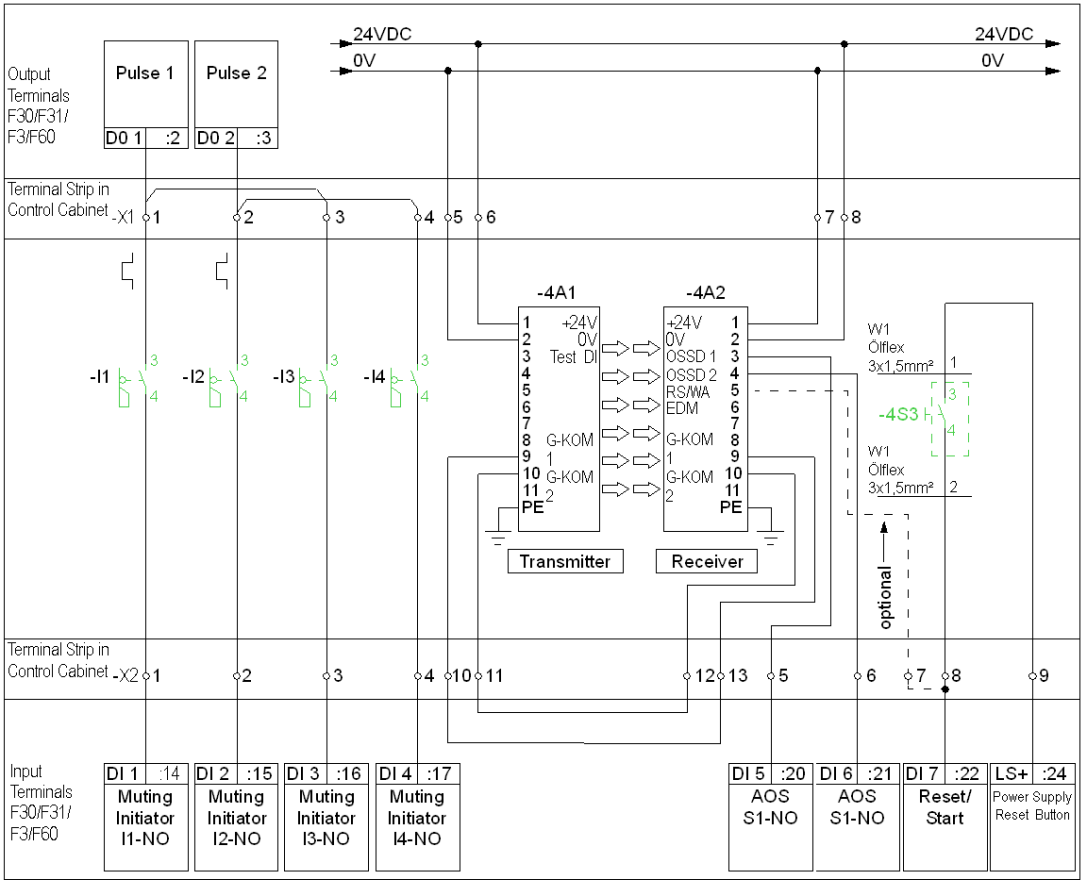
Wiring ESPE According to SIL 3, Cat. 4

Usable Switching Components

You can use the following muting switching components:

- switches which are monitored by the PES by means of line control
- initiators with line control of their own (see *Wiring PLS According to SIL2, Cat. 3, page 144*)
- standard initiators which must be examined regularly (e.g. at shift beginning)
  In this case the lines of the individual muting sensors I1...I4 may not be run in trunk cables.

Wiring Diagram


24VDC
0V
24VDC
0V
Output Terminals F30/F31/ F3/F60
Pulse 1
Pulse 2
D0 1 :2
D0 2 :3
Terminal Strip in Control Cabinet -X1
-4A1
-4A2
+24V
0V
Test DI
G-KOM 1
G-KOM 2
PE
OSSD 1
OSSD 2
RS/WA
EDM
-I1
-I2
-I3
-I4
W1 Ölflex 3x1,5mm²
-4S3
optional
Transmitter
Receiver
Terminal Strip in Control Cabinet -X2
Input Terminals F30/F31/ F3/F60
DI 1 :14 Muting Initiator I1-NO
DI 2 :15 Muting Initiator I2-NO
DI 3 :16 Muting Initiator I3-NO
DI 4 :17 Muting Initiator I4-NO
DI 5 :20 AOS S1-NO
DI 6 :21 AOS S1-NO
DI 7 :22 Reset/ Start
LS+ :24 Power Supply Reset Button

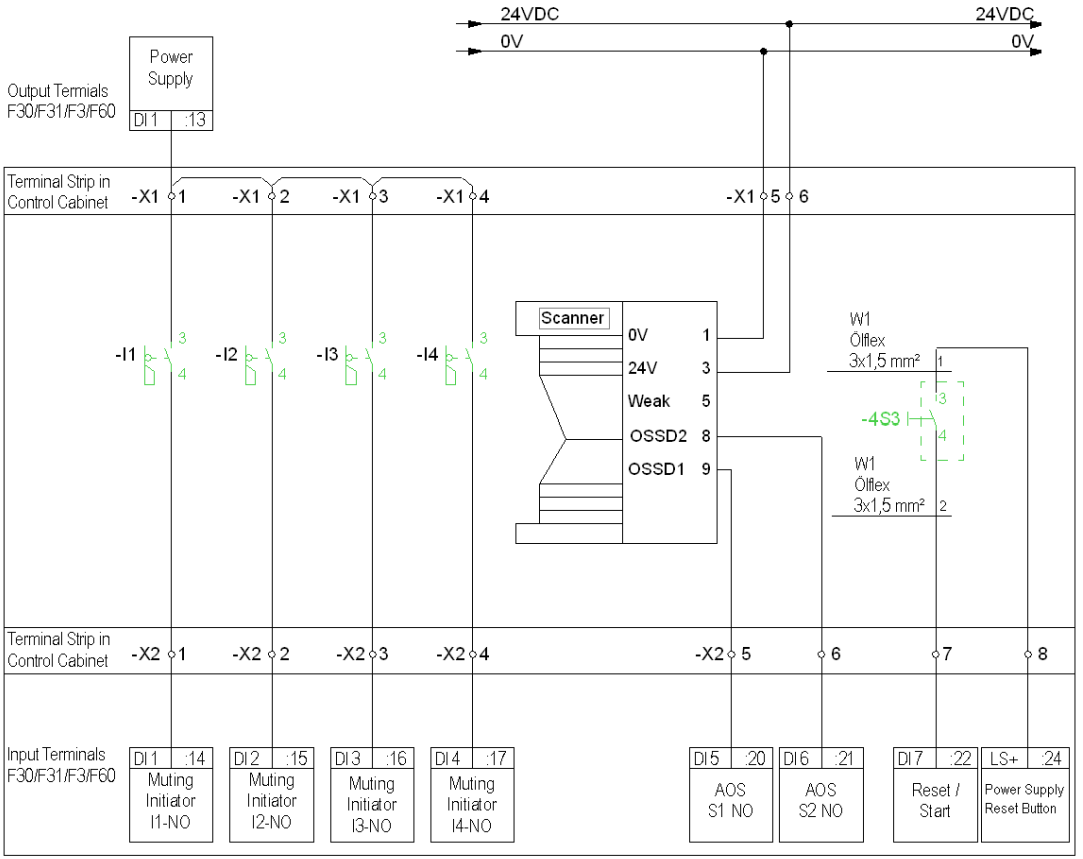
Wiring PLS According to SIL2, Cat. 3

Usable Switching Components

You can use the following muting switching components:

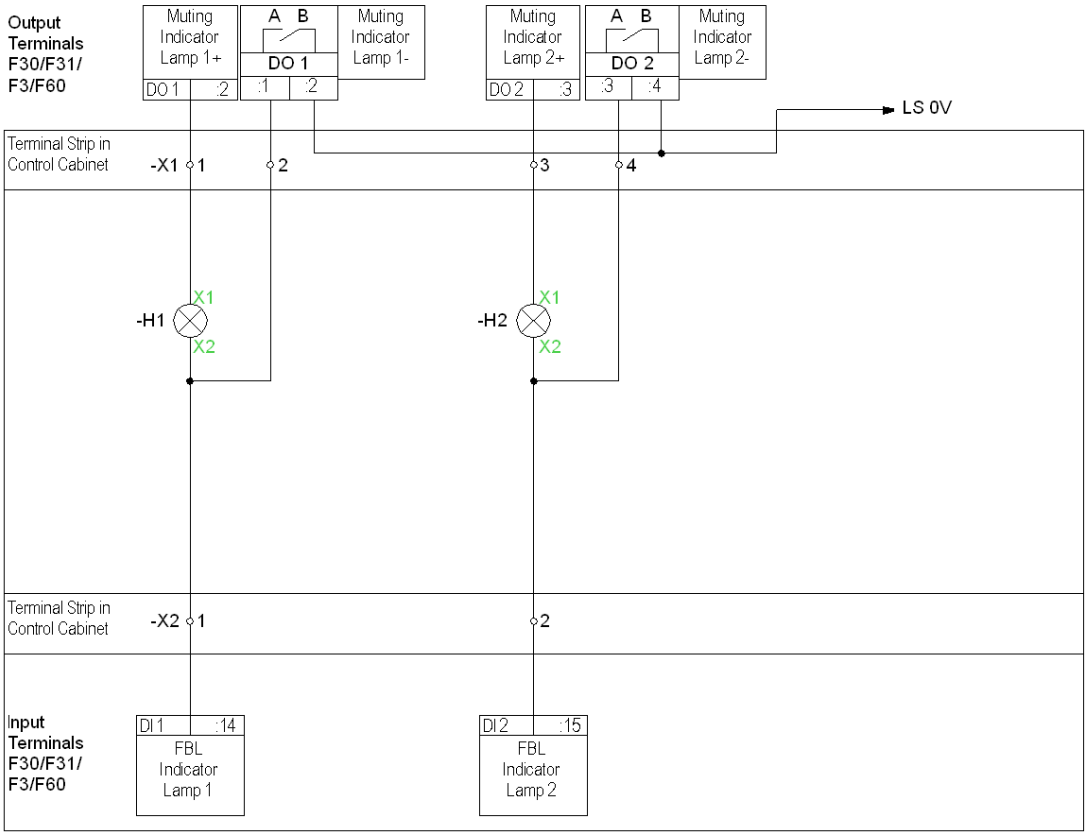
- switches which are monitored by the PES by means of line control (see *Wiring ESPE According to SIL 3, Cat. 4, page 142*)
- initiators with line control of their own
- standard initiators which must be examined regularly (e.g. at shift beginning)
  In this case the lines of the individual muting sensors I1...I4 may not be run in trunk cables.

Wiring Diagram



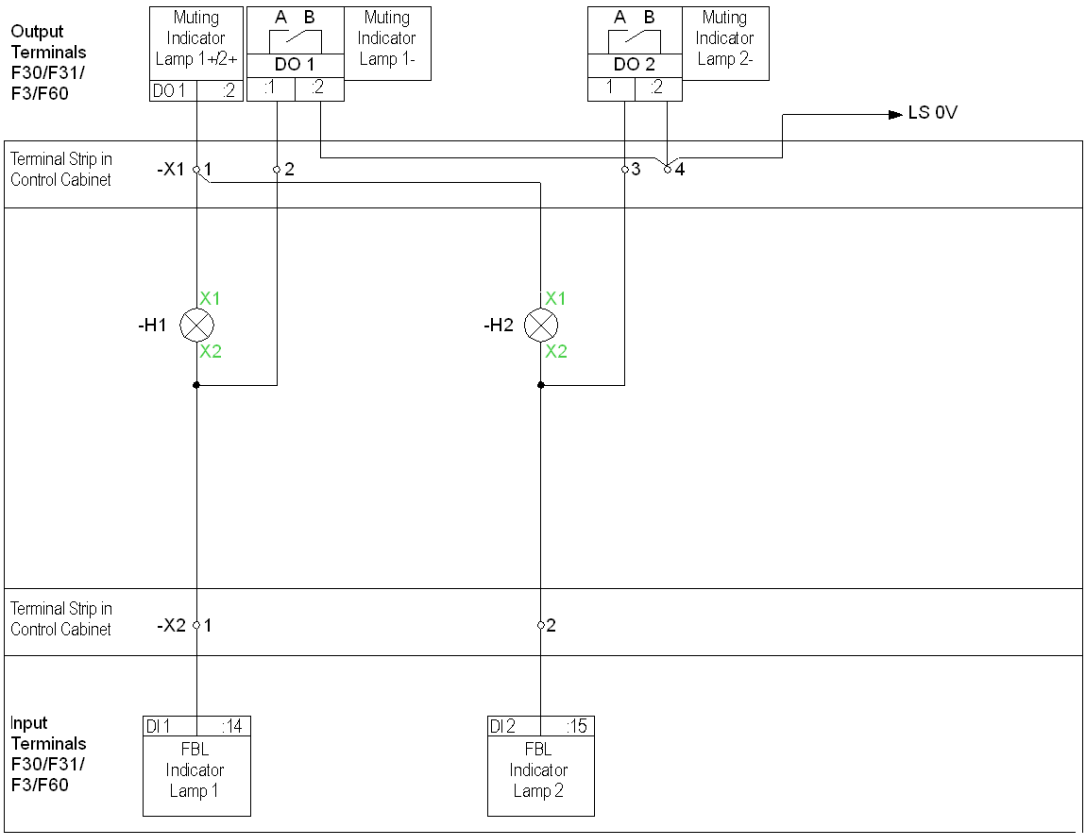
Wiring Indicator Lamp - Version 1

Wiring Diagram



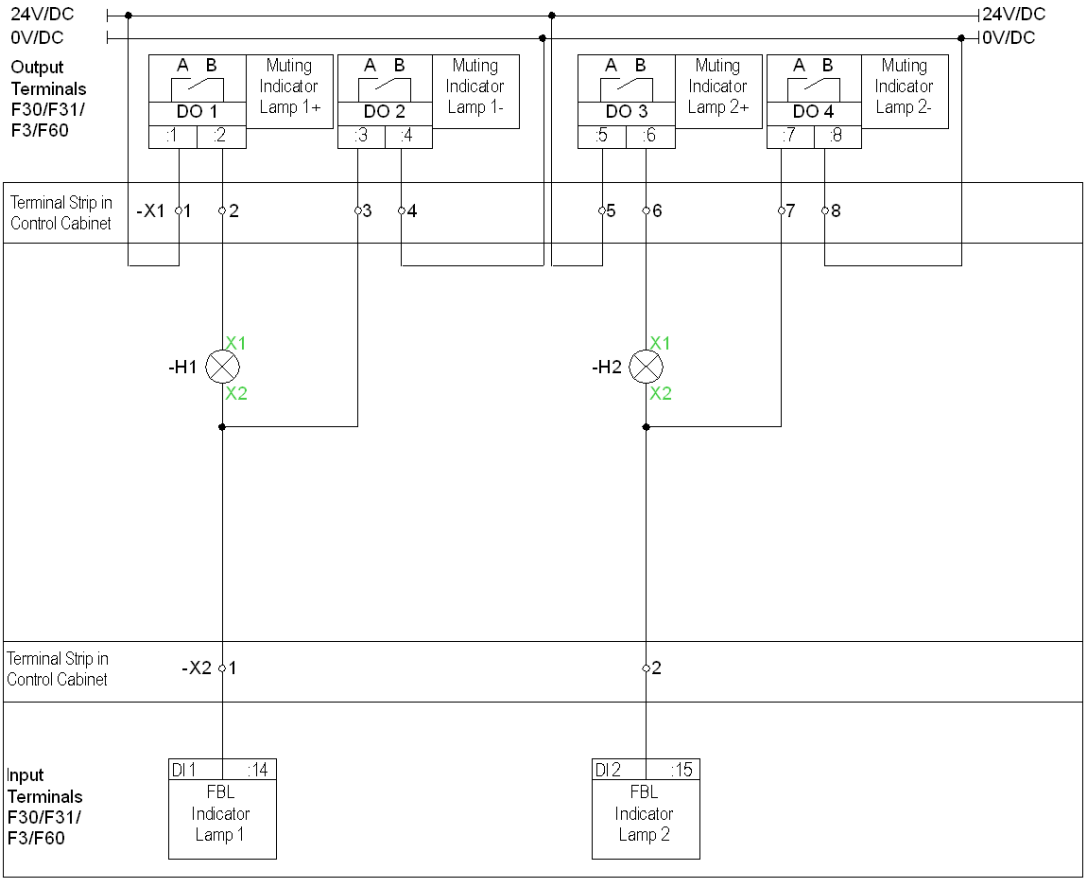
Wiring Indicator Lamp - Version 2

Wiring Diagram



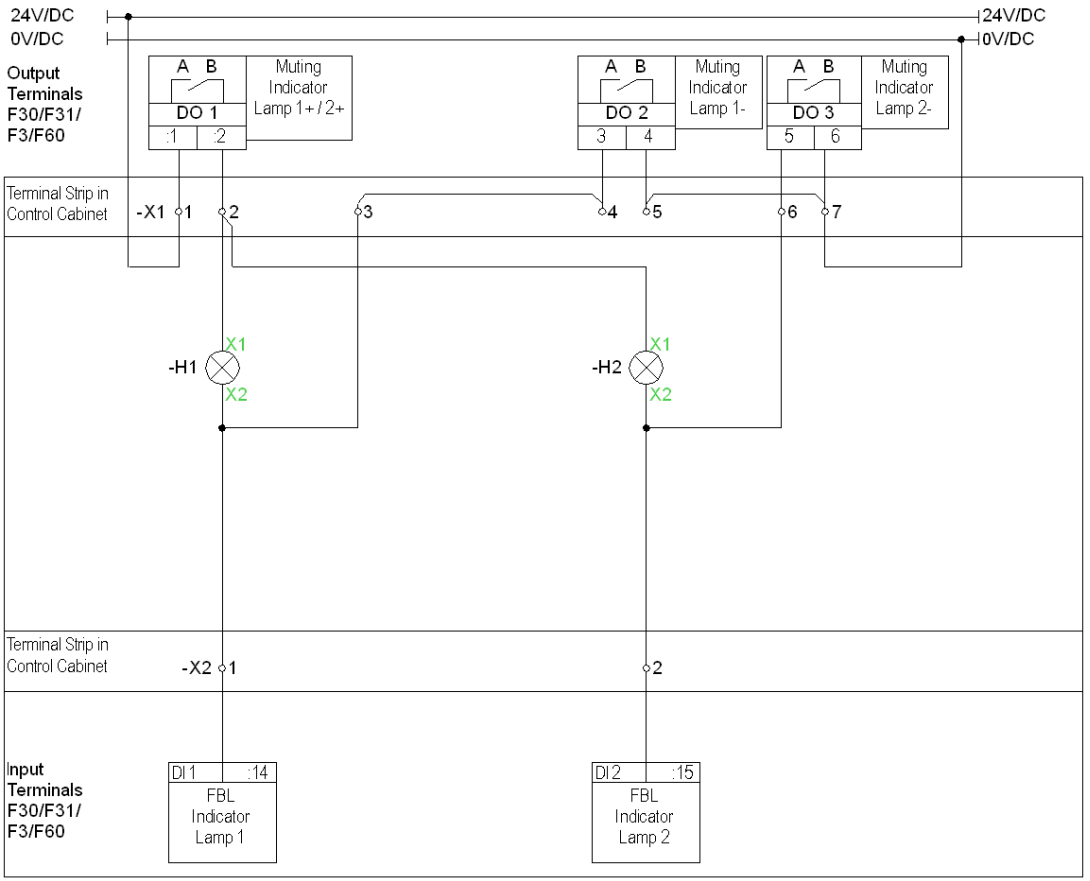
Wiring Indicator Lamp - Version 3

Wiring Diagram



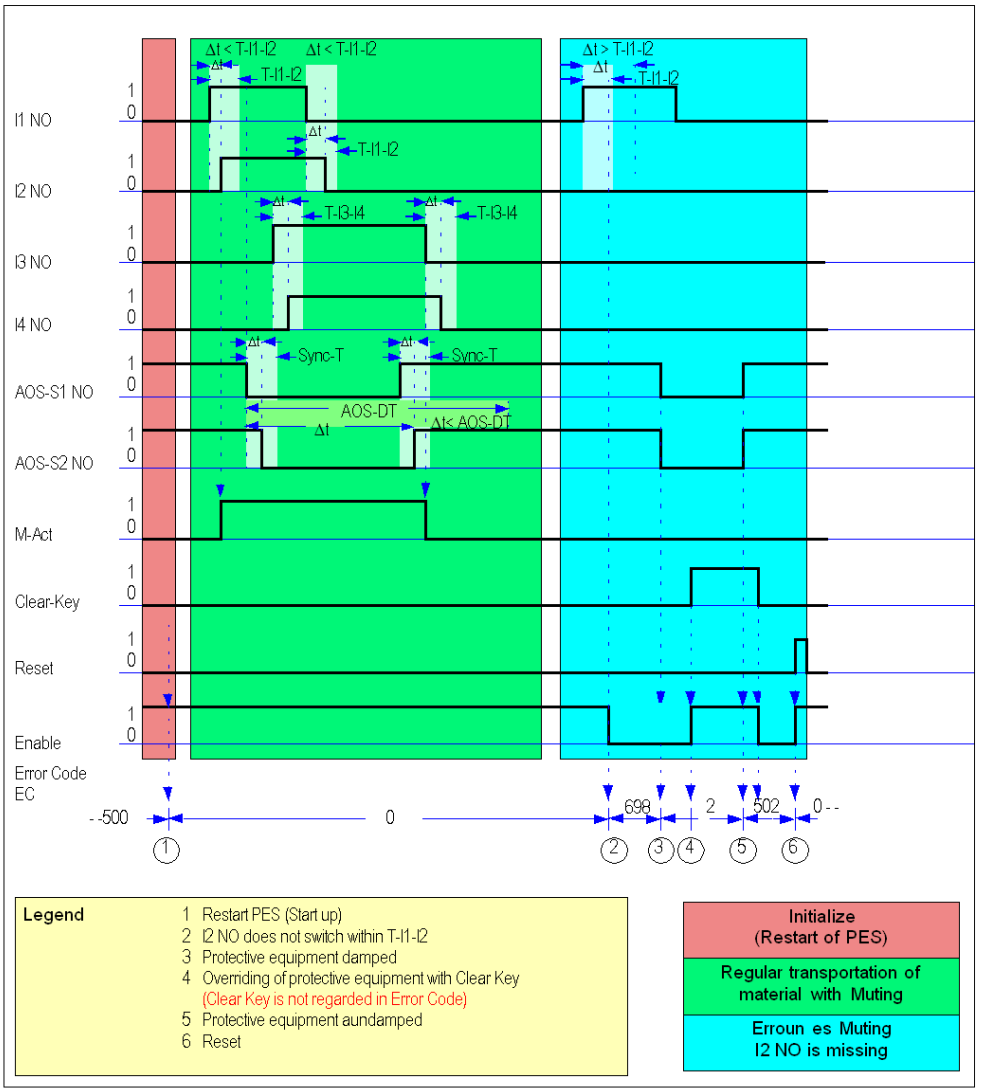
Wiring Indicator Lamp - Version 4

Wiring Diagram



Signal Table

Schema



8.3 Hardware Design

Overview

This section describes the hardware design requirements for the 3 different muting modes.

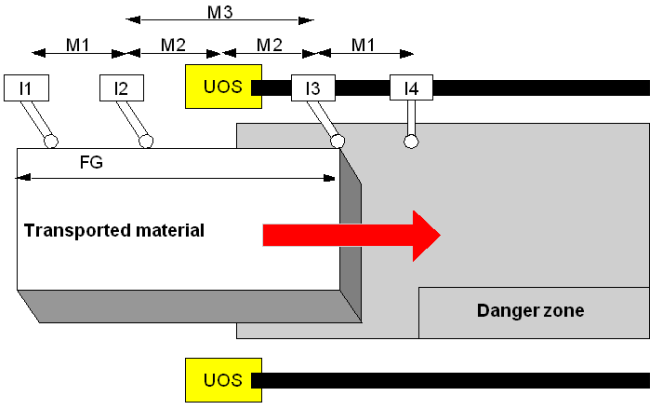
What's in this Section?

This section contains the following topics:

Topic	Page
Serial Muting - Entering the Danger Zone	151
Serial Muting - Leaving the Danger Zone	152
Parallel Muting - Entering the Danger Zone	153
Parallel Muting - Leaving the Danger Zone	154
Parallel Muting with 1 Pair of Light Barriers	155

Serial Muting - Entering the Danger Zone

Schema



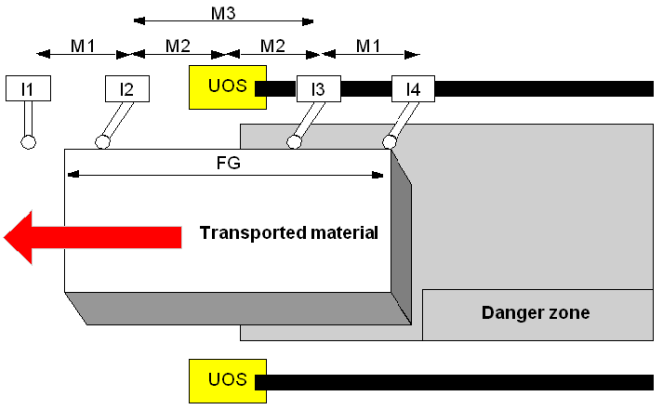
Requirements

- The sum of the distances M1 and M3 must be less than the length of the transported material (FG).
- For serial muting the sequence of engaging the initiators must match the arrangement of the initiators.
- Muting is active if at least 2 adjacent initiators are operated.
- The switching components must be arranged that way that muting cannot be activated inadvertently (e.g. hard-toed shoe on 2 initiators).
- The arrangement of the muting initiators has to be chosen so that muting is active only when the transported material completely blocks the entrance to the danger zone.
  If this is not possible, undetected access must be prevented by limiting the time `T_MS-AOS`.
- The distance between 2 transported materials must be greater than the distance M3, since otherwise permanent muting would be detected (exceedance of T-Mut).
- Sequence for «Reverse» = `FALSE`: I1gI2gI3gI4)
  Sequence for «Reverse» = `TRUE`: I1fI2fI3fI4

Please pay attention to the *Conventions, page 129*.

Serial Muting - Leaving the Danger Zone

Schema



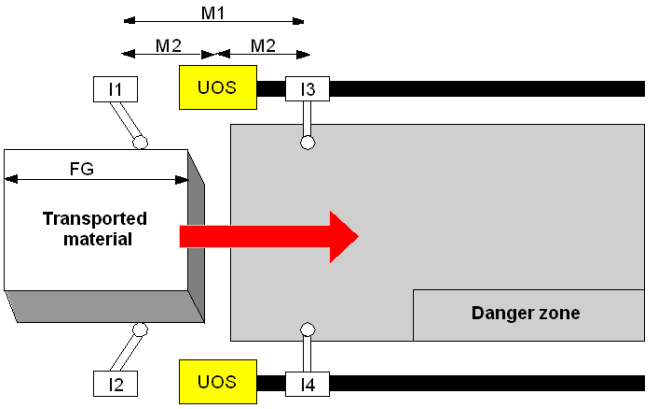
Requirements

- The sum of the distances M1 and M3 must be less than the length of the transported material (FG).
- For serial muting the sequence of engaging the initiators must match the arrangement of the initiators.
- Muting is active if at least 2 adjacent initiators are operated.
- The switching components must be arranged that way that muting cannot be activated inadvertently (e.g. hard-toed shoe on 2 initiators).
- The arrangement of the muting initiators has to be chosen so that muting is active only when the transported material completely blocks the entrance to the danger zone.
  If this is not possible, undetected access must be prevented by limiting the time `T_MS-AOS`.
- The distance between 2 transported materials must be greater than the distance M3, since otherwise permanent muting would be detected (exceedance of T-Mut)
- Sequence for «Reverse» = `FALSE`: I1gI2gI3gI4)
  Sequence for «Reverse» = `TRUE`: I1fI2fI3fI4

Please pay attention to the *Conventions, page 129*.

Parallel Muting - Entering the Danger Zone

Schema



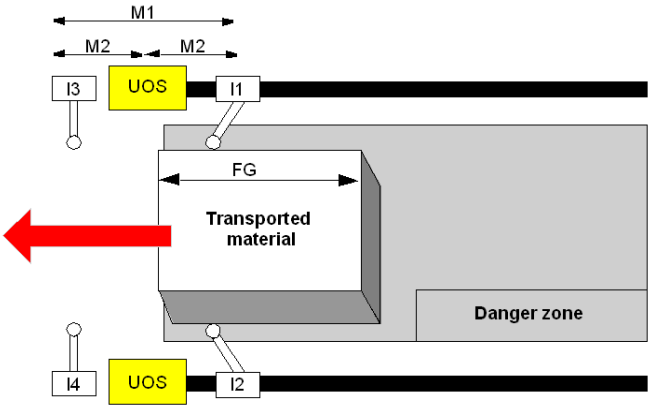
Requirements

- The distance M1 must be less than the length of the transported material (FG).
- Parallel muting does not monitor the damping of a pair of initiators (e.g. I1, I2).
- Muting is active if a pair of initiators is operated [(I1 and I2) or (I3 and I4)].
- The arrangement of the muting initiators has to be chosen so that muting is active only when the transported material completely blocks the entrance to the danger zone.
  If this is not possible, undetected access must be prevented by limiting the time `T_MS-AOS`.
- The distance between 2 transported materials must be greater than the distance M1. Otherwise permanent muting is detected (exceedance of `T-Mut`).
- Sequence for «Reverse» = `FALSE`: I1/I2gI3/I4
  Sequence for «Reverse» = `TRUE`: I2/I1fI4/I3
- At the passage of the transported material all four initiators must be damped for a short time.

Please pay attention to the *Conventions, page 129*.

Parallel Muting - Leaving the Danger Zone

Schema



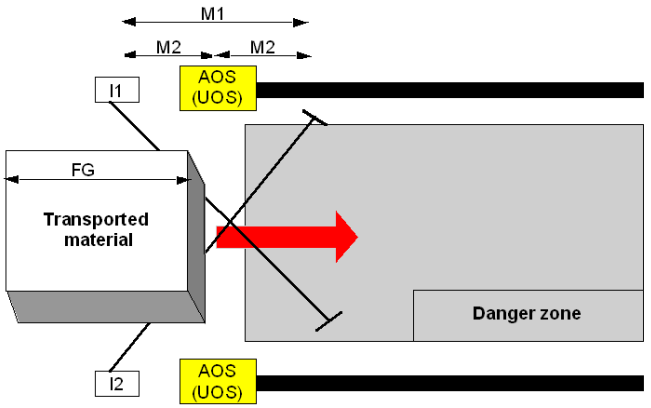
Requirements

- The distance M1 must be less than the length of the transported material (FG).
- Parallel muting does not monitor the damping of a pair of initiators (e.g. I1, I2).
- Muting is active if a pair of initiators is operated [(I1 and I2) or (I3 and I4)].
- The arrangement of the muting initiators has to be chosen so that muting is active only when the transported material completely blocks the entrance to the danger zone.
  If this is not possible, undetected access must be prevented by limiting the time `T_MS-AOS`.
- The distance between 2 transported materials must be greater than the distance M1, since otherwise permanent muting would be detected (exceedance of `T-Mut`).
- Sequence for «Reverse» = `FALSE`: I1/I2gI3/I4
  Sequence for «Reverse» = `TRUE`: I2/I1fI4/I3
- At the passage of the transported material all 4 initiators must be damped for a short time.

Please pay attention to the *Conventions, page 129*.

Parallel Muting with 1 Pair of Light Barriers

Schema



Requirements

- Choose the geometry of the light barriers in such a way that the distance M1 is greater than the length of the transported material (FG).
- While the transported material is passing through the muting station, the 2 light barriers must be damped permanently.
- Parallel muting does not monitor the damping of a pair of initiators (e.g. I1, I2).
- Muting is only active if the optical paths of both light barriers are intercepted.
- Arrange the muting initiators in such a way that muting is active only when the transported material completely blocks the entrance to the danger zone.
  If this is not possible, undetected access must be prevented by limiting the time `T-MS-AOS`.
- The distance between 2 transported materials must be greater than the distance M1, since otherwise permanent muting would be detected (exceedance of `T-Mut`).

Please pay attention to the *Conventions, page 129*.

H_BA01_OpMod_1oo8_01

9

Overview

This chapter provides information on the certificated function block H_BA01_OpMod_1oo8_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
9.1	General	158
9.2	Functions	161

9.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_OpMod_1oo8_01 (CFB42).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	159
Function Block Layout (H_BA01_OpMod_1oo8_01)	160

Characteristics

Usage

The function block H_BA01_OpMod_1oo8_01 is used for monitoring a mode switch in accordance with IEC 61508 up to SIL3 and EN 954-1 up to cat. 4.

Characteristics

The function block H_BA01_OpMod_1oo8_01 provides the following characteristics:

- certified function block CFB 42 (OpMod_1oo8)
- monitoring of the contacts on short, cross short, interchange and line break by means of line control
- manual acknowledgement at the start ot the XPSMF•• controller (restart inhibit)
- manual acknowledgement with a defined mode switch position
- A conditional call of the function block is not permitted.

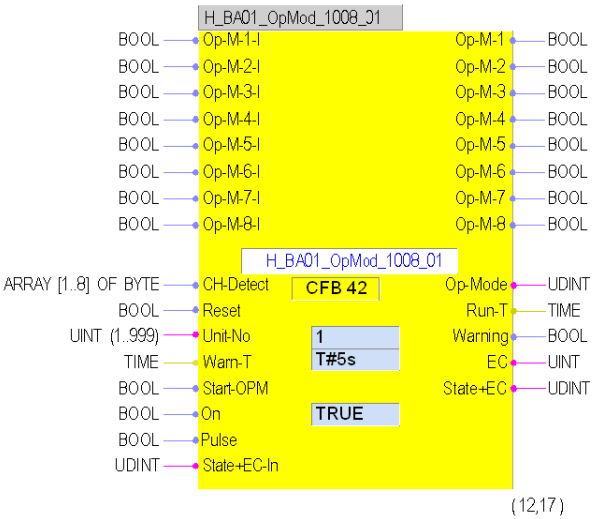
Safety Level in Accordance with IEC 61508, SIL3 and EN 954-1, Cat. 4

If the mode switch is correctly attached to the controller, the inputs `Op-M-1-I` to `Op-M-8-I` are run with line control and all requirements in this document are met, the application complies with safety category 4 according to EN 954-1.

However, exceptions are possible in countries with additional federal state regulations where the EN 954-1 only has a limited validity or none.

Function Block Layout (H_BA01_OpMod_1oo8_01)

Inputs/Outputs



9.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_OpMod_1oo8_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	162
Inputs	163
Outputs	166
Wiring with Line Control	168
Signal Table	169

Functional Description

Basic Function

The function block H_BA01_OpMod_1oo8_01 (CFB 42) monitors mode switches according to IEC 61508 up to SIL 3 and EN 954-1 up to category 4.

Every mode switch is monitored by a certified function block CFB 42 in the application program XPSMFWIN.

Monitoring the Switching Elements of the Mode Switch

The function block H_BA01_OpMod_1oo8_01 is used to monitor the switching elements of the mode switch. It detects whether

- there are Line Control faults (LC; Line control channel),
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_OpMod_1oo8_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Safety-Related Outputs

If ...	Then...
the hardware is wired correctly and the mode switch enables an operating mode	the associated safety-related output (`Op-M-1`...`Op-M-8`) becomes `TRUE`, provided that the function block does not detect any faults.

Non-Safety-Related Outputs

Any faults are specified via the non-safety-related outputs `EC` and`State+EC`.

Inputs

Description

Input	Type	Default	Range of Values	Description
Op-M-1-I... Op-M-8-I	BOOL	FALSE	FALSE/TRUE	The inputs Op-M-1-I to Op-M-8-I are used to read the statuses of the mode switch contacts. If the input Op-M-1-I is TRUE and there are no faults, the selected operating mode is activated, depending on the warning time Warn-T. ● Warn-T = 0 ms The operating mode is immediately activated. ● Warn-T > 0 ms The operating mode is activated when Start-OPM is TRUE and after the expiry of the warning time.
CH-Detect	Array [1...8] of Byte	0	16#10...16#90	Status of the connected hardware. The detection of the hardware faults is carried out by the operating system of the controller. This information is supplied to the function block, evaluated there and provided to the outputs EC and State+EC. Shorts to external voltages, cross shorts and channel mix-up are detected. Allocation of the channel errors to the array:

Input	Array
Op-M-1-I	1. Byte
...	...
Op-M-8-I	8. Byte

Note: Also carry out a function block external allocation of the channel error status bytes to the array CH-Detect, besides the allocation of the I/O channels, so that the function block can monitor the line control inputs.

Input	Type	Default	Range of Values	Description
Reset	BOOL	FALSE	FALSE/ TRUE	• Warn-T > 0, no errors existing Pressing the reset pushbutton (0/1 transition change at the reset input) acknowledges an eliminated fault. The error code changes to 502. All safety-related outputs OP-M-1...OP-M-8 remain on FALSE. • Warn-T = 0, no errors existing Pressing the reset pushbutton acknowledges an eliminated fault. The selected operating mode is activated. The associated safety-related output OP-M-1...OP-M-8 is set to TRUE. • Errors existing (0<EC≤500) The function block is not enabled.
Unit-No.	UINT	1	1...999	With Unit-No. define a unit number which is distributed together with the error code (EC) at the output State+EC. This way the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block
Warn-T	TIME	5 s	0...30 s	The selected operating mode is activated after the expiration of the warning time Warn-T. Warn-T is startet with Start-OPM. If Warn-T = 0, the selected operating mode is immediately activated without regarding Start-OPM.
Start-OPM	BOOL	FALSE	FALSE/ TRUE	Initiates the new operating mode if Warn-T > 0. Must be permanently TRUE for the duration of the warning time Warn-T (e.g. pushbutton pressed) to have the operating mode changed. If Start-OPM goes to FALSE before the expiration of Warn-T, the formerly selected operating mode remains active.

Input	Type	Default	Range of Values	Description	
ON	BOOL	TRUE	FALSE/ TRUE	TRUE	normal operation Operating modes can be changed via mode switch.
				FALSE	The current operating mode is deactivated (deliberate manual intervention). Other modes cannot be activated.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.	
State + EC-IN	UDINT	0	1001000. ..999999 999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.	

Outputs

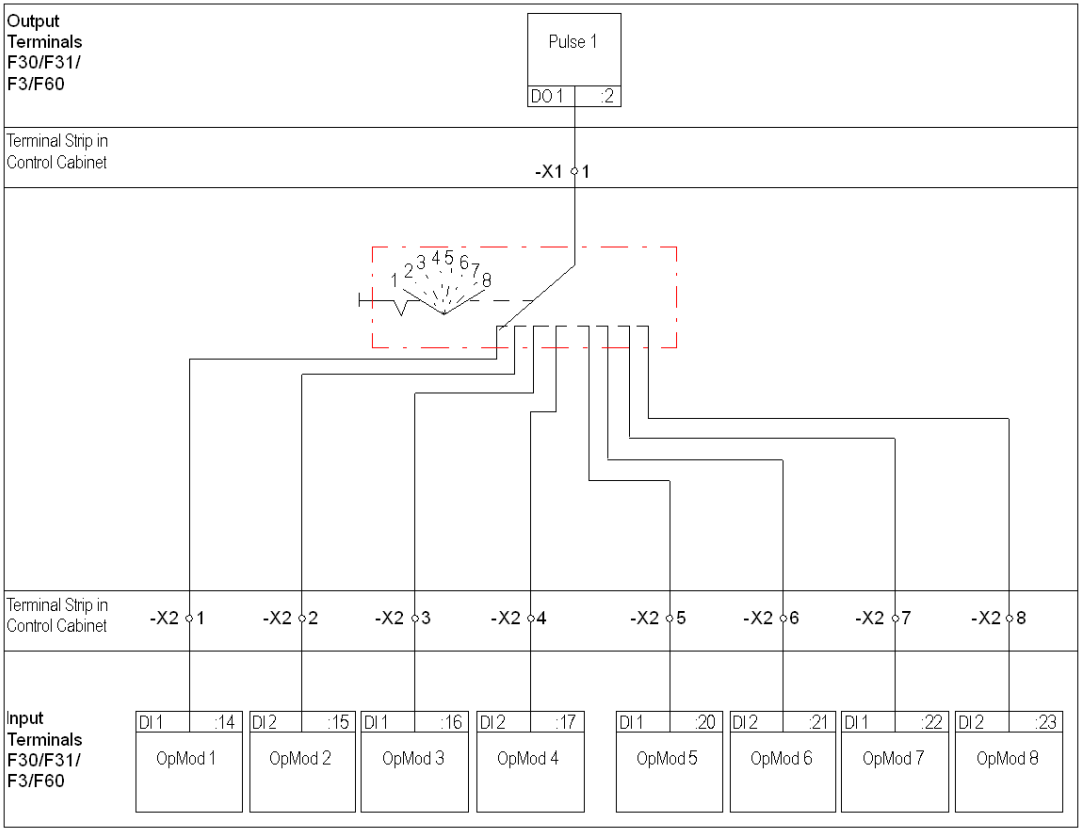
Description

Output	Type	Default	Range of Values	Description	
Op-M-1 ...Op-M-8	BOOL	–	FALSE/ TRUE	1 of these outputs (mode dependant) is TRUE, if a mode has been activated and there are no errors.	
Op-Mode	UDINT	–	–	Not safety-related output to provide the number of the active mode.	
				Single digit values (x)	
				0	No mode active
				1...8	Number of the active mode
				2-digit values	
				xy	Transition from the active mode (x) to the new, selected mode (y) while Warn-T is running. When switching from no operating mode active (Op-Mode = x = 0) to a new mode, Op-Mode is only single-digit (leading 0 is not displayed).
				Note: Switching from 1 operating mode to another is usually carried out without interruption, which means that the new operating mode is immediately activated after the expiration of Warn-T. The error code (EC) is 0. If an interruption (ON = FALSE) occurs when switching modes without errors emerging, the error code (EC) is set to 502 temporarily.	

Output	Type	Default	Range of Values	Description	
Run-T	TIME	–	0...30 s	Run-T indicates how much of the warning time has already elapsed. When activating an operating mode, a function block internal timer for Warn-T is started.	
Warning	BOOL	–	FALSE/ TRUE	Output for connecting an indicator lamp:	
				FALSE	Indicator lamp OFF No change of mode, or Warn-T = 0
				FALSE/ TRUE	Indicator lamp flashes slowly ● A new mode has been selected. ● Start-OPM has not been engaged yet.
				FALSE/ TRUE	Indicator lamp flashes rapidly ● A new mode has been selected. ● Start-OPM has been engaged. Warn-T is running.
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	0...050999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	

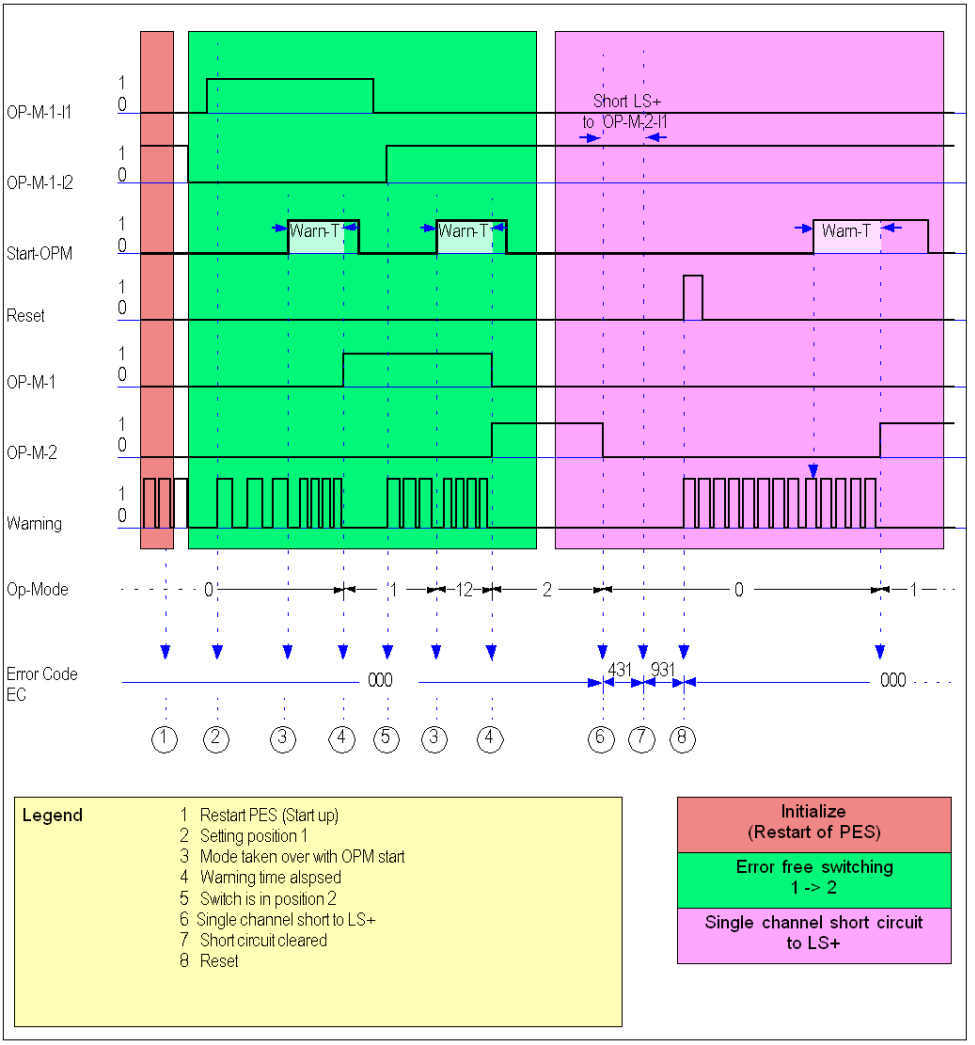
Wiring with Line Control

Wiring Diagram



Signal Table

Schema



H_BA01_OpMod_2oo6_01

10

Overview

This chapter provides information on the certificated function block H_BA01_OpMod_2oo6_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
10.1	General	172
10.2	Functions	175

10.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_OpMod_2oo6_01 (CFB41).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	173
Function Block Layout (H_BA01_OpMod_2oo6_01)	174

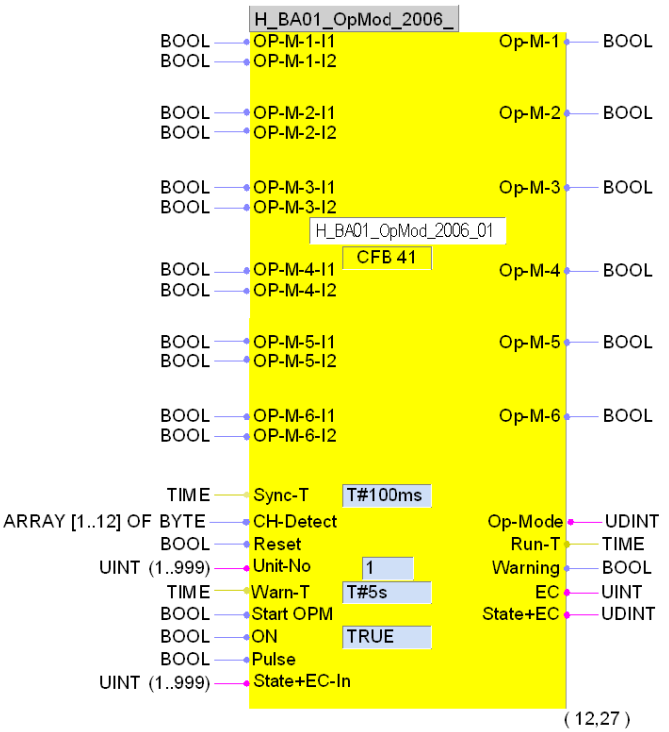
Characteristics

Usage

The function block H_BA01_OpMod_2oo6_01 is used for monitoring a mode switch in accordance with IEC 61508 up to SIL3 and EN 954-1 up to cat. 4.

Function Block Layout (H_BA01_OpMod_2oo6_01)

Inputs/Outputs



10.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_OpMod_2oo6_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	176
Inputs	177
Outputs	180
Wiring with Line Control	182
Signal Table	183

Functional Description

Basic Function

The function block H_BA01_OpMod_2oo6_01 (CFB 41) monitors mode switches according to IEC 61508 up to SIL 3 and EN 954-1 up to category 4.

Every mode switch is monitored by a certified function block CFB 41 in the application program XPSMFWIN.

Monitoring the Switching Elements of the Mode Switch

The function block H_BA01_OpMod_2oo6_01 is used to monitor the switching elements of the mode switch. It detects whether

- there are Line Control faults (LC; Line control channel),
- the contact synchronization time is in the predefined range of values
- the mode switch has tripped on a single channel only
- the `Unit-No.` and the other parameters are in the predefined range of values,
- the reset push button at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_OpMod_2oo6_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised.

SafeEthernet is used for decentralized functions and networking. SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Safety-Related Outputs

If ...	Then...
the hardware is wired correctly and the mode switch enables an operating mode	the associated safety-related output (`Op-M-1`...`Op-M-6`) becomes `TRUE`, provided that the function block does not detect any faults.

Non-Safety-Related Outputs

Any faults are specified via the non-safety-related outputs `EC` and `State+EC`.

Inputs

Description

Input	Type	Default	Range of Values	Description
Op-M-6-I1... Op-M-6-I2	BOOL	FALSE	FALSE/TRUE	The inputs Op-M-1-I1 to Op-M-6-I2 are used to read the statuses of the mode switch contacts. If the inputs Op-M-1-I1 and Op-M-2-I2 are TRUE and there are no faults, the selected operating mode is activated, depending on the warning time Warn-T. ● Warn-T = 0 ms The operating mode is immediately activated. ● Warn-T > 0 ms The operating mode is activated when Start-OPM is TRUE and after the expiry of the warning time.
Sync-T	TIME	100 ms	0...30 s	Maximum permissible synchronization time between the individual normally closed/normally open contacts. If the default value is used, the input need not be connected.

⚠ DANGER

IMPROPER OPERATION

If Sync-T = 0 ms the monitoring of the synchronization time is deactivated. In this case all error messages for single channel and asynchronous switching are not evaluated.

Failure to follow these instructions will result in death or serious injury.

Input	Type	Default	Range of Values	Description
CH-Detect	Array [1...12] of Byte	0	16#0... 16#90	Status of the connected hardware. The detection of the hardware faults is carried out by the operating system of the controller. This information is supplied to the function block, evaluated there and provided to the outputs EC and State+EC. Shorts to external voltages, cross shorts and channel mix-up are detected. Allocation of the channel errors to the array: **Input** / **Array** Op-M-1-I1 / 1. Byte Op-M-1-I2 / 2. Byte ... / ... Op-M-6-I1 / 11. Byte Op-M-6-I2 / 12. Byte **Note**: Also carry out a function block external allocation of the channel error status bytes to the array CH-Detect, besides the allocation of the I/O channels, so that the function block can monitor the line control inputs.
Reset	BOOL	FALSE	FALSE/ TRUE	• Warn-T > 0, no errors existing Pressing the reset pushbutton (0/1 transition change at the reset input) acknowledges an eliminated fault. The error code changes to 502. All safety-related outputs OP-M-1...OP-M-6 remain on FALSE. • Warn-T = 0, no errors existing Pressing the reset pushbutton acknowledges an eliminated fault. The selected operating mode is activated. The associated safety-related output OP-M-1...OP-M-6 is set to TRUE. • Errors existing (0<EC≤500) The function block is not enabled.

Input	Type	Default	Range of Values	Description
Unit-No.	UINT	1	1...999	With Unit-No. define a unit number which is distributed together with the error code (EC) at the output State+EC. This way the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block
Warn-T	TIME	5 s	0...30 s	The selected operating mode is activated after the expiration of the warning time Warn-T. Warn-T is startet with Start-OPM. If Warn-T = 0, the selected operating mode is immediately activated (after expiry of Sync-T) without regarding Start-OPM.
Start-OPM	BOOL	FALSE	FALSE/ TRUE	Initiates the new operating mode if Warn-T > 0. Must be permanently TRUE for the duration of the warning time Warn-T (e.g. pushbutton pressed) to have the operating mode changed. If Start-OPM goes to FALSE before the expiration of Warn-T, the formerly selected operating mode remains active.
ON	BOOL	TRUE	FALSE/ TRUE	TRUE: normal operation Operating modes can be changed via mode switch. FALSE: The current operating mode is deactivated (deliberate manual intervention). Other modes cannot be activated.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT	0	1001000. ..999999 999	Status of the function block, comprising CFB-No. + Unit-No.. + Error Code.

Outputs

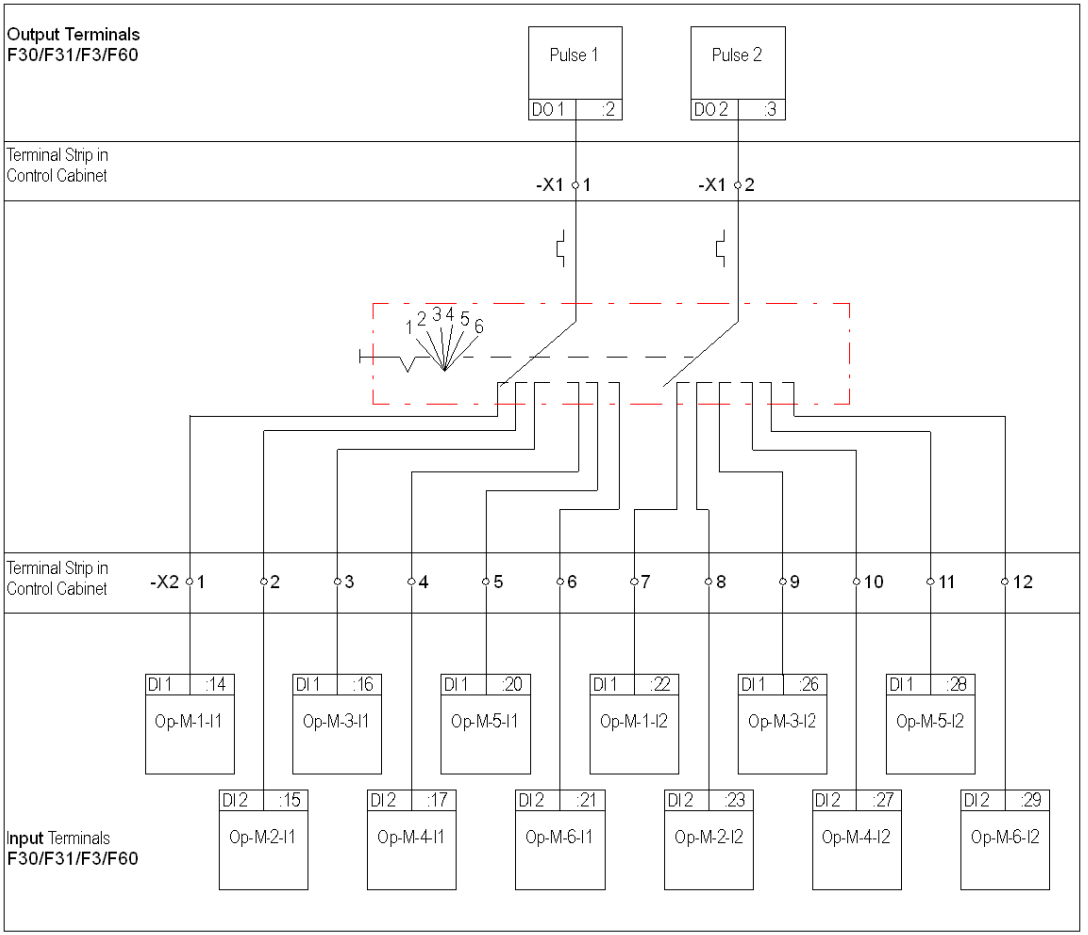
Description

Output	Type	Default	Range of Values	Description	
Op-M-1 ...Op-M-6	BOOL	–	FALSE/ TRUE	1 of these outputs (mode dependant) is TRUE, if a mode has been activated and there are no errors.	
Op-Mode	UDINT	–	–	Not safety-related output to provide the number of the active mode.	
				Single digit values (x)	
				0	No mode active
				1...6	Number of the active mode
				2-digit values (xy)	
				xy	Transition from the active mode (x) to the new, selected mode (y) while Warn-T is running. When switching from no operating mode active (Op-Mode = x = 0) to a new mode, Op-Mode is only single-digit (leading 0 is not displayed).
				Note: Switching from one operating mode to another is usually carried out without interruption, which means that the new operating mode is immediately activated after the expiration of Warn-T. The error code (EC) is 0. If an interruption (ON = FALSE) occurs when switching modes without errors emerging, the error code (EC) is set to 502 temporarily.	

Output	Type	Default	Range of Values	Description	
Run-T	TIME	–	0...30 s	Run-T indicates how much of the warning time has already elapsed. When activating an operating mode, a function block internal timer for Warn-T is started.	
Warning	BOOL	–	FALSE/ TRUE	Output for connecting an indicator lamp:	
				FALSE	Indicator lamp OFF No change of mode, or Warn-T = 0
				FALSE/ TRUE	Indicator lamp flashes slowly ● A new mode has been selected. ● Start-OPM has not been engaged yet.
				FALSE/ TRUE	Indicator lamp flashes rapidly ● A new mode has been selected. ● Start-OPM has been engaged. Warn-T is running.
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	0...050999999	Status of the function block, consisting of CFB-No. + Unit-No. + EC	

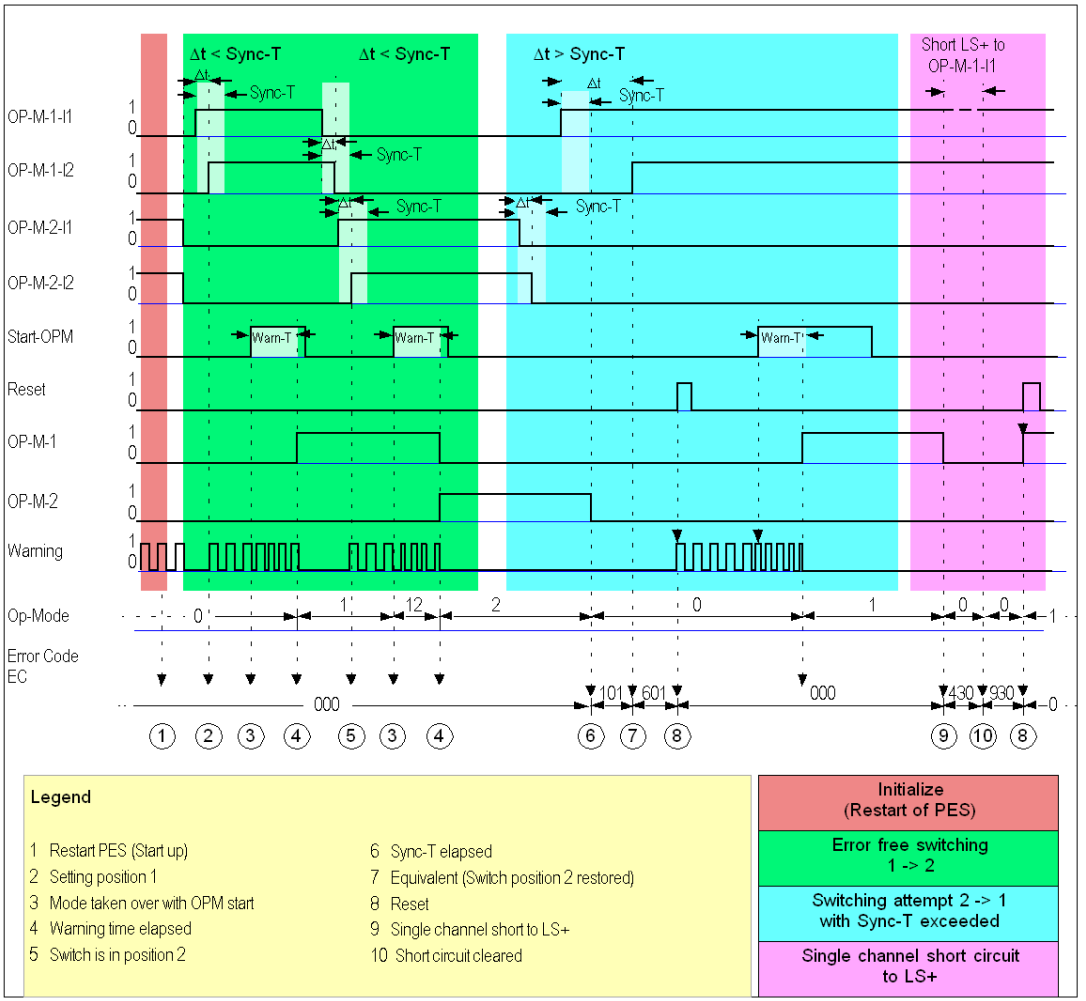
Wiring with Line Control

Wiring Diagram



Signal Table

Schema



H_BA01_PSV_01

11

Overview

This chapter provides information on the certificated function block H_BA01_PSV_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
11.1	General	186
11.2	Functions	189

11.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_PSV_01 (CFB90).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	187
Function Block Layout (H_BA01_PSV_01)	188

Characteristics

Usage

The function block H_BA01_PSV_01 is used for monitoring press safety valves in accordance with IEC 61508 up to SIL 3 and EN 954-1 up to cat. 4.

Characteristics

The function block H_BA01_PSV_01 provides the following characteristics:

- certified function block CFB 90 (Press Safety Valve)
- redundancy by dual channel
- monitoring and limiting the maximum permissible energizing time
- contact synchronization time configurable separately for every function block
- A conditional call of the function block is not permitted.
- maximum permissible energizing and de-energizing time separately configurable for each certified function block
- delayed 2-stage energizing time configurable for the valve

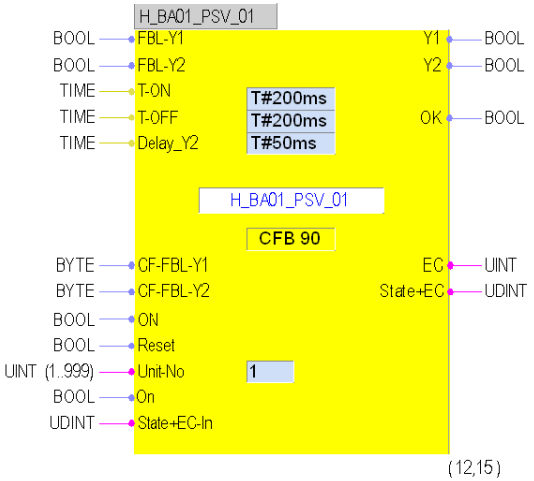
Safety Level

Safety level in accordance with IEC 61508 and EN 954-1:

Safety level in accordance with EN 954-1, Cat. 4	**Safety level in accordance with EN 954-1, Cat. 2**
If the Feedback Loop inputs `FBL-Y1` and `FBL-Y2` are correctly attached to the controller and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1. However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity. If the hardware is installed with the controller as instructed, the inputs `FBL-Y1` and `FBL-Y2` are monitored with line control and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1.	If the press safety valve is only driven by one signal `Y1` (single channel), the feedback loop `FBL-Y1` is monitored with line control and all requirements in this document are obeyed, the application merely complies with the safety category 2 according to EN 954-1.

Function Block Layout (H_BA01_PSV_01)

Overview



11.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_PSV_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	190
Inputs	192
Outputs	194
Wiring With Switches in Feedback Loop, Cat. 4	195
Wiring With Initiators in Feedback Loop, Cat. 4	196
Wiring With Switches in Feedback Loop, Cat. 2	197
WIring WIth Initiators in Feedback Loop, Cat. 2	198
SIgnal Table	199

Functional Description

Basic Function

The H_BA01_PSV_01 monitors the turn-on contacts and turn-off contacts of a redundant, 2-stage energized press safety valve according to IEC 61508 up to SIL 3 and EN 954-1 up to category 4.

The safe state of the press safety valve is 'turned off' (both individual valves are closed).

The 2 stages of the valve are turned on and off with the outputs `Y1` and `Y2`. The second stage can be turned on with a configurable delay `Delay-Y2` to avoid pressure surges and high inrush currents.

The CFB 90 monitors whether the two-stage turn-on and turn-off is accomplished within `T-ON` and `T-OFF`.

Diagnose Functions

With the CFB 90 the status of the hardware also can be diagnosed.

The monitoring of the 2 valve switching elements detects, whether
- 1 contact opens late, or does not open at all
- 1 contact closes late, or does not close at all
- there are Line Control faults (LC; Line control channel)
- the feedback monitoring times are in the predefined range of values
- the `Unit-No.` is in the predefined range of values
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_PSV_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Outputs

If...	Then...
the 2-stage turn-on and turn-off is within `T-ON` and `T-OFF`	the safety-related output OK becomes `TRUE` and the valve monitoring loop and CFB 90 work without errors.

If...	Then...
`ON` is set to `TRUE` and there are no faults	the output `Y1` becomes `TRUE` immediately. Output `Y2` follows with a delay of `Delay-Y2`. The return information of the valves are fed back into the function block.
the return information of the valves are not available or there are faults	the output `OK` becomes `FALSE`. The diagnosis function of the output is supplemented by the diagnosis outputs `EC` and `State + EC`.

Inputs

Description

Input	Type	Default	Range of Values	Description
FBL-Y1, FBL-Y2	BOOL	FALSE	FALSE/ TRUE	Inputs of the safety related controller at which the statuses for the opener contacts of the two valves are read. If FBL-Y1 = FBL-Y2 = FALSE: The valve has switched.
T-ON	TIME	200 ms	1...50000 ms	Maximum permissible turn-on-time delay during which both stages (Y1 and Y2) of the press safety valve must have been switched on. If T-ON is not connected, the default value is used. **Note**: T-ON = 0 ms is not allowed!
T-OFF	TIME	200 ms	1...50000 ms	Maximum permissible turn-off-time delay during which both stages (Y1 and Y2) of the press safety valve must have been switched off. If T-OFF is not connected, the default value is used. **Note**: T-OFF = 0 ms is not allowed!
Delay-Y2	TIME	50 ms	0...5000 ms	Switching delay for the second stage of the press safety valve (Y1 → Y2). If Delay-Y2 is not connected, the default value is used. **Note**: Delay = 0 ms is permitted, i.e. no delay. CF-FBL-Y1
CF-FBL-Y1, CF-FBL-Y2	BYTE	0	16#0...16#90	For the evaluation of Line control faults detected by the operating system of the PES. The fault evaluation (CF = Channel Fault) is carried out in the function block and distributed at EC.
ON	BOOL	FALSE	FALSE/ TRUE	If ON is set to TRUE and there are no errors, output Y1 becomes immediately TRUE and Y2 becomes TRUE after Delay-Y2. If ON is set to FALSE, Y1 and Y2 become FALSE immediately.

Input	Type	Default	Range of Values	Description
Reset	BOOL	FALSE	FALSE/ TRUE	Reset is used to acknowledge errors and to set the OK output to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are errors (0 < EC ≤ 500).
Unit-No.	UINT	1	1...999	With Unit-No: the user defines a unit number which is distributed together with the error number at the output State+EC, so that the error code can explicitly be associated with a function block. Values outside the range of values are blocked at the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable.To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s).With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	UDINT	0	90001000... 90999999	Status of the function block, comprising CFB-No. + Unit-No. + Error Code.

Outputs

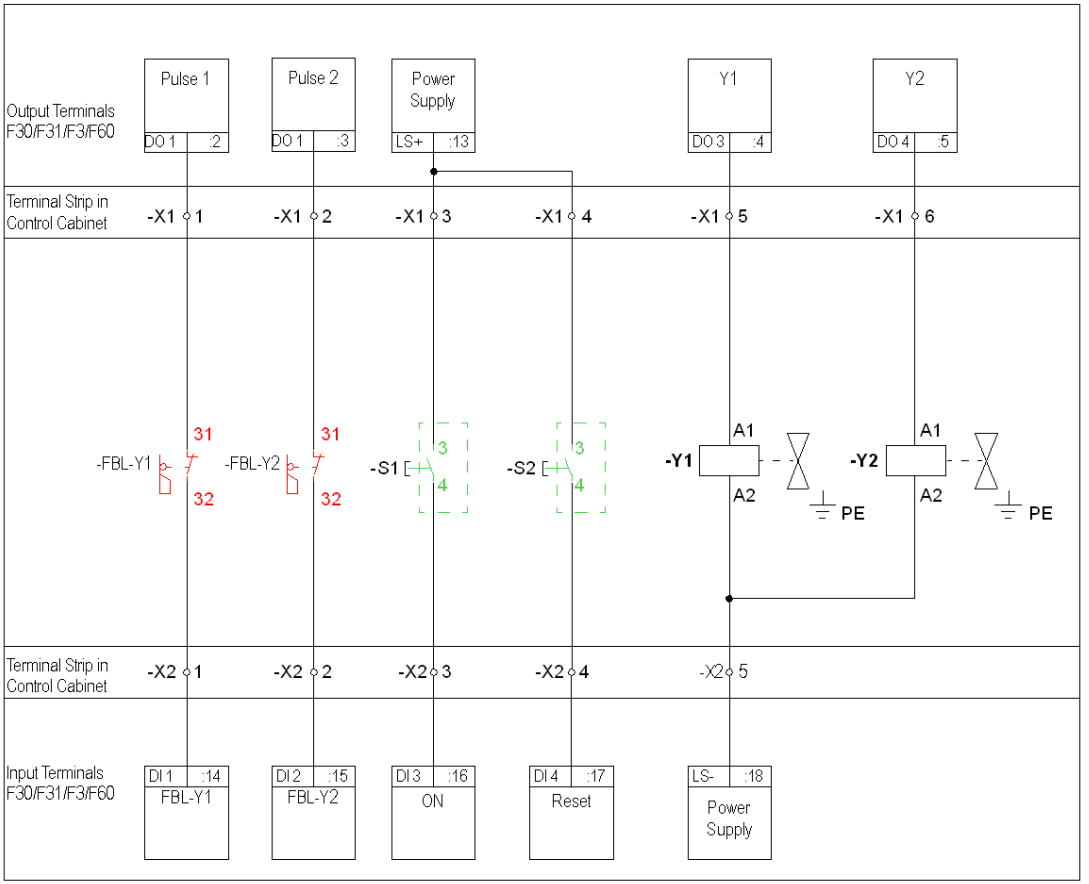
Description

Output	Type	Range of Values	Description	
Y1	BOOL	FALSE, TRUE	Valve control stage 1	
			TRUE	Input ON is TRUE and there are no errors
			FALSE	Input ON is FALSE or there are errors
Y2	BOOL	FALSE, TRUE	Valve control stage 2 Use Delay-Y2 to switch Y2 with a delay.	
			TRUE	Input ON is TRUE and Delay-Y2 has elapsed and there are no errors
			FALSE	Input ON is FALSE, or Delay-Y2 has not elapsed, or there are errors
OK	BOOL	FALSE, TRUE	TRUE	There are no errors*.
			FALSE	There are errors*.
EC	UINT	0...999	Error status of the function block	
State + EC	UDINT	0...999999999	Status of the function block, consisting of CFB-No. + Unit-No. + EC	

* independent of the stages of the PSV

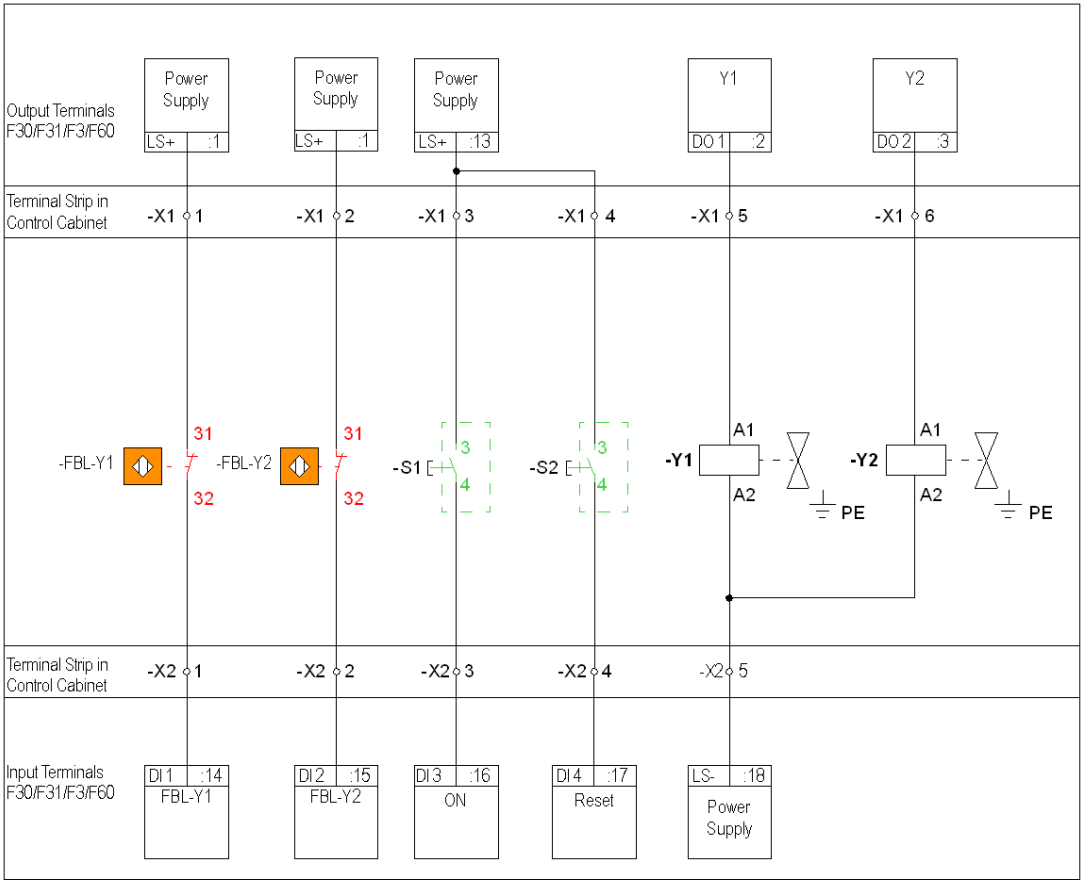
Wiring With Switches in Feedback Loop, Cat. 4

Wiring Diagram



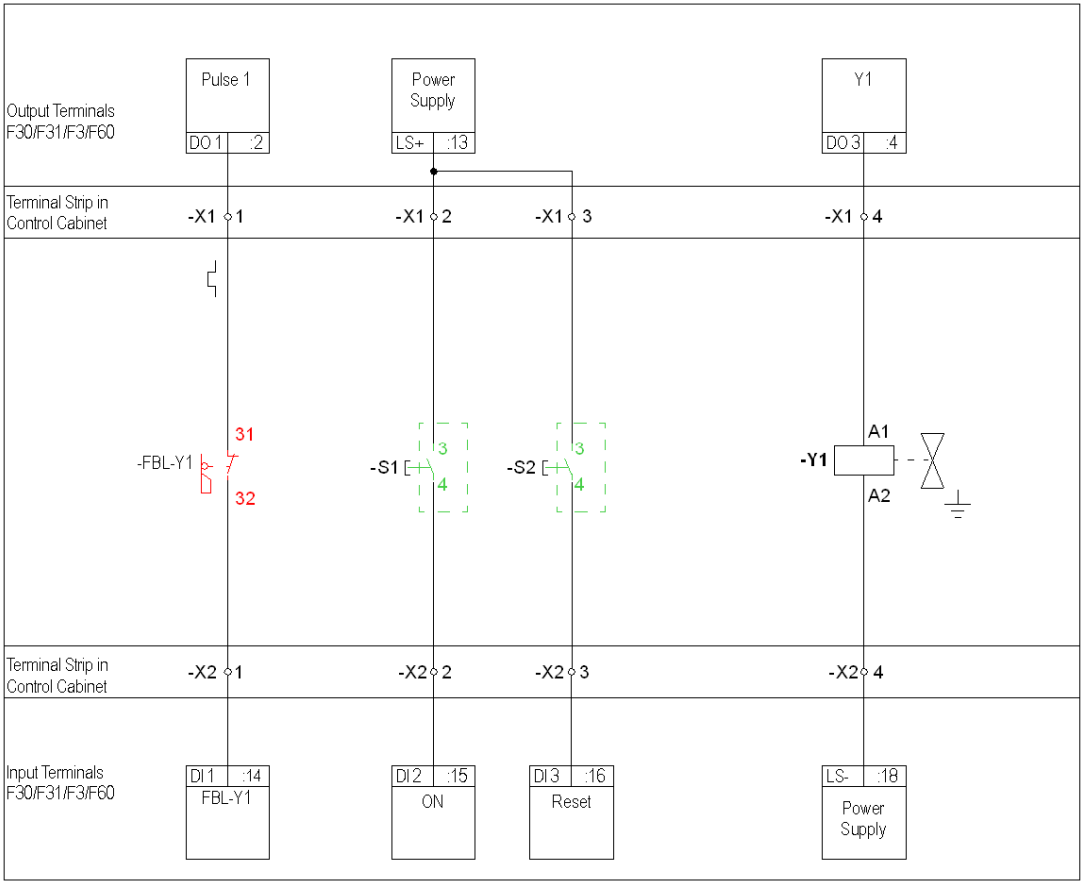
Wiring With Initiators in Feedback Loop, Cat. 4

Wiring Diagram



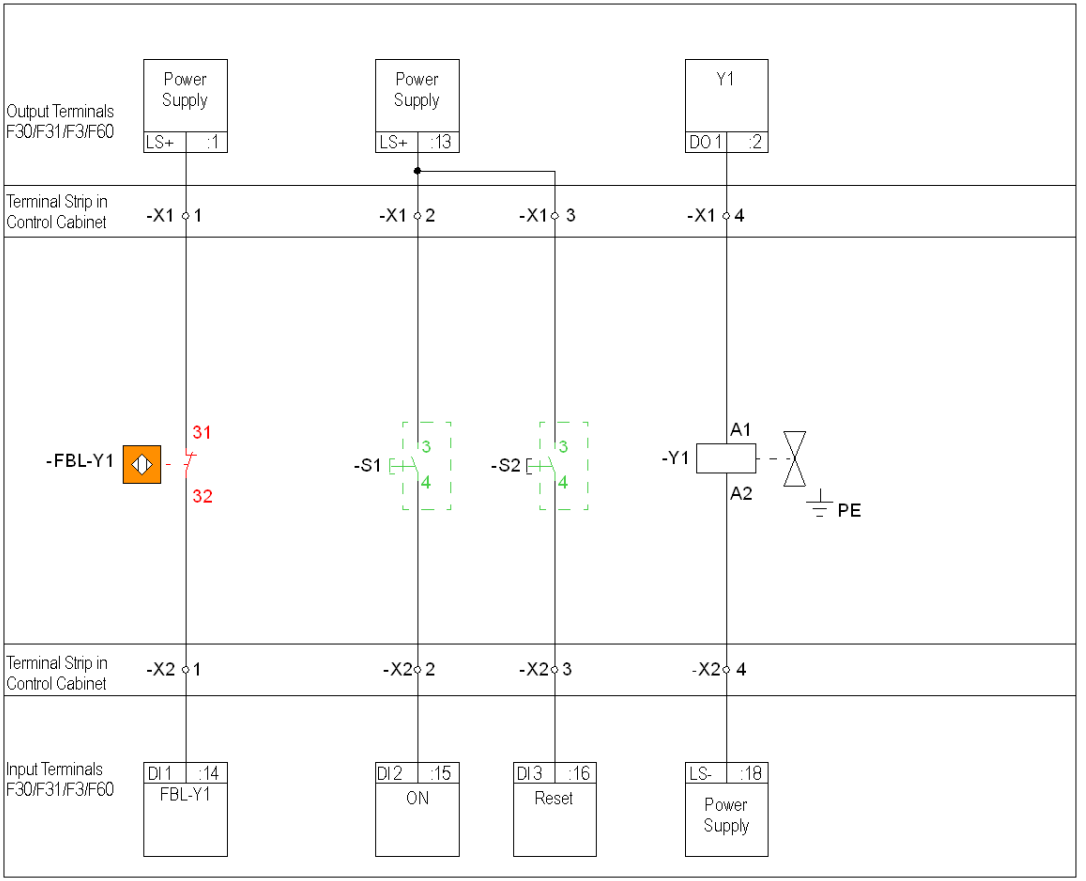
Wiring With Switches in Feedback Loop, Cat. 2

Wiring Diagram



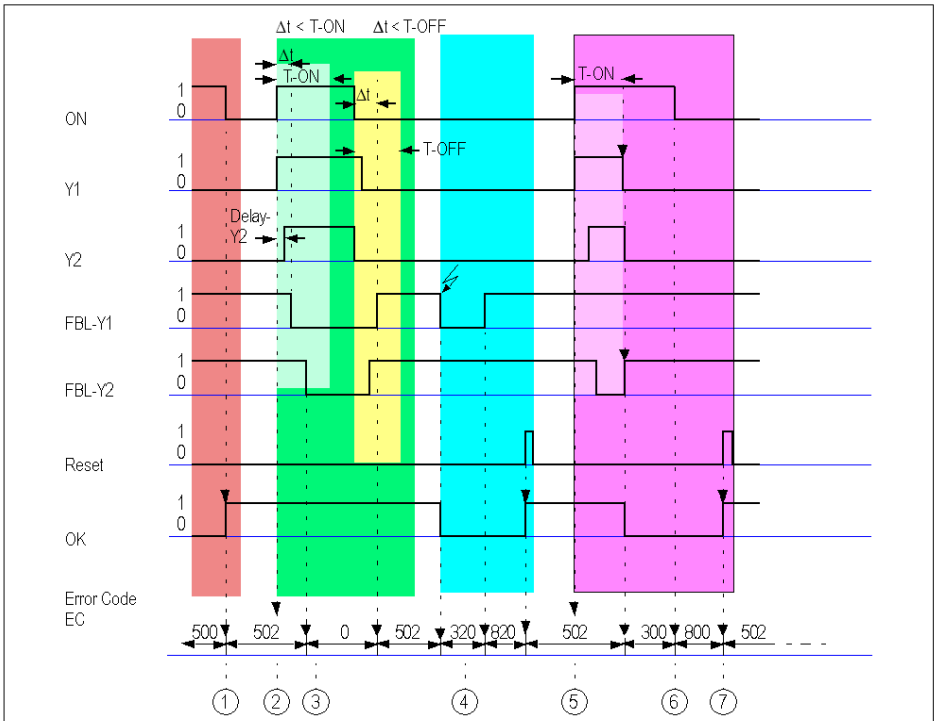
WIring WIth Initiators in Feedback Loop, Cat. 2

Wiring Diagram



SIgnal Table

Schema



1 PES switched on: ON = TRUE	5 FBL-Y1 does not open within T-ON: Y1 = Y2 = OK = FALSE
2 Standard operation: OK = TRUE 3 FBL contacts Y1/Y2 of PSV (NC) actuated	6 Set FBL-Y1 and FBL-Y2 to standard position: Set ON = FALSE 7 After that perform manual reset: OK = TRUE => Standard position
4 PSV error cleared by manual reset: OK = TRUE	

H_BA01_Safety_Door_01

12

Overview

This chapter provides information on the certificated function block H_BA01_Safety_Door_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
12.1	General	202
12.2	Functions	205

12.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_Safety_Door_01 (CFB55).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	203
Function Block Layout (H_BA01_Safety_Door_01)	204

Characteristics

Usage

The function block H_BA01_Safety_Door_01 is used for monitoring safety doors in accordance with IEC 61508 up to SIL 3 and EN 954-1, cat. 2 and 4.

Characteristics

The function block H_BA01_Safety_Door_01 provides the following characteristics:
- characteristics certified function block CFB 55 (safety door)
- redundancy by dual channel
- manual or automatic acknowledgment at the start of the XPSMF•• Safety PLC
- manual or automatic acknowledgment after unlocking the safety door switch
- monitoring and limiting the synchronization time of the contacts to each other
- contact synchronization time configurable separately for every function block
- A conditional call of the function block is not permitted

Safety Level

Safety level in accordance with IEC 61508, SIL 3 and EN 954-1, cat. 4

IEC 61508, SIL 3 and EN 954-1, Cat. 4	IEC 61508, SIL 1 and EN 954-1, Cat. 2
If the safety door switch is correctly attached to the controller, the inputs `S1` and `S2` are run with line control and all requirements in this document are met, the application complies with safety category 4 according to EN 954-1 (see *Wiring Line Control According to SIL 3, Cat. 4, page 211*). However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity. Consider also the caution below this table.	If the two inputs `S1` and `S2` are not driven directly by line control but by variables, the application meets only safety category 2 according to EN 954-1 (see *Wiring Line Control According to SIL1, Cat. 2, page 213*).

⚠ CAUTION

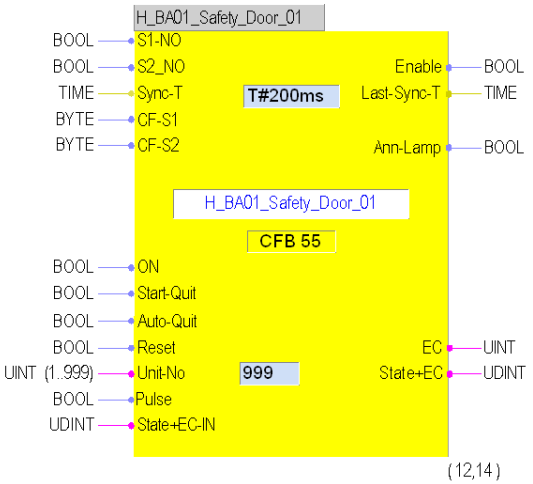
UNINTENDED EQUIPMENT OPERATION

Make sure that no automatic restart is possible (restart inhibit). This must be guaranteed by the parameter setting of the function block or by appropriate external wiring.

Failure to follow these instructions can result in injury or equipment damage.

Function Block Layout (H_BA01_Safety_Door_01)

Inputs/Outputs



12.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_Safety_Door_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	206
Inputs	207
Outputs	210
Wiring Line Control According to SIL 3, Cat. 4	211
Transponder Wiring with Line Control According to SIL 3, Cat. 4	212
Wiring Line Control According to SIL1, Cat. 2	213
Signal Table	214

Functional Description

Basic Function

The function block H_BA01_Safety_Door_01 (CFB 55) monitors safety door loops according to the IEC 61508 and EN 954-1 up to category 4.

Every safety door switch in the application program XPSMFWIN is monitored by a certified function block CFB 55.

Diagnose Functions

With the CFB 55 the status of the hardware can also be diagnosed.

The monitoring of the 2 safety door switching elements detect, whether
- 1 contact opens late, or does not open at all,
- 1 contact closes late, or does not close at all,
- there are Line Control faults (LC; Line control channel),
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset push button at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_Safety_Door_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Outputs

If the safety relevant function block output `Enable` is	**Then...**
`TRUE`	the associated safety door switch is not engaged and the function block has not detected any fault.
`FALSE`	either the associated safety door switch has been engaged, or the function block has detected a fault.

The not safety relevant function block output `EC` provides some exact information.

Inputs

Description

Input	Type	Default	Range of Values	Description
S1, S2	BOOL	FALSE	FALSE/TRUE	Inputs of the safety related controller at which the statuses for the contacts of the safety door switch are read. If the safety door switch is locked, the input signals S1 and S2 are TRUE.
CF-S1, CF-S2	Byte	0	–	CF (Channel Fault) represents the status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is put out by means of the error code EC.
ON	BOOL	FALSE	FALSE/TRUE	Soft control The output Enable can only become TRUE if the input ON is TRUE (static precondition).
Sync-T	TIME	100 ms	0...500 ms	The time Sync-T indicates the synchronization time of the individual normally closed/normally open contacts against each other. If the default value is used, the input need not be connected. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to safety door unlocked. In this case the functional test obligatory after the occurrence of a hardware fault is not required (see)???.

Input	Type	Default	Range of Values	Description
Start-Quit	BOOL	FALSE	FALSE/TRUE	Start-Quit must be connected to a static signal (constantly TRUE or FALSE). TRUE: The function block does not have to be reset manually directly after booting the controller. **Note**: This function may only be activated if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the safety door switch is locked (restart inhibit).
Reset	BOOL	FALSE	FALSE/TRUE	With Reset the Enable output of the function block is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults (0 < EC ≤ 500).
Auto-Quit	BOOL	FALSE	FALSE/TRUE	Auto-Quit must be connected to a static signal (constantly TRUE or FALSE). TRUE: The function block does not have to be reset manually after locking the safety door switch. The function block is acknowledged automatically. FALSE or not used at all: The function block must be reset via the Reset input after unlocking, so that the output Enable can change from FALSE to TRUE if no other fault exists. Auto-Quit does not work when booting the controller. In this case you must acknowledge separately or set the input Start-Quit to TRUE. Consider also the following caution.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Only activate the `Auto-Quit` function if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the safety door switch is locked (restart inhibit).

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Range of Values	Description
`Unit-No.`	`UINT`	1	1...999	With `Unit-No.` define a unit number which is distributed together with the error number at the output `State+EC`, so that the error code can explicitly be associated with a function block. Values outside the valid range are blocked at the input. **Note**: If the function block is used repeatedly within a program, use a new `Unit-No.` for every function block.
`Pulse`	`BOOL`	`FALSE`	`FALSE`/`TRUE`	`Pulse` is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, `Pulse` is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (`EC`) of the next function block is output, even if `EC` is 0.
`State + EC-IN`	`UDINT`	0	1001000... 999999999	Status of the function block comprising `CFB-No.` + `Unit-No.` + `Error Code`.

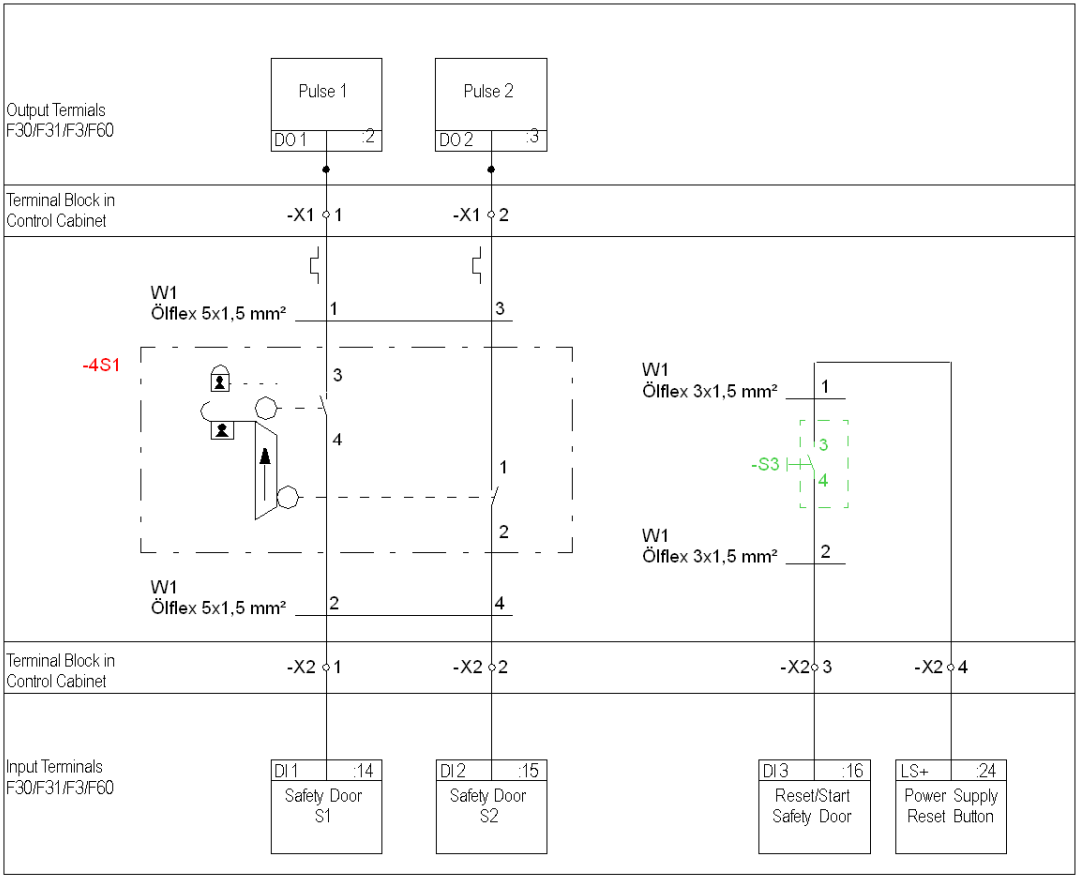
Outputs

Description

Output	Type	Default	Range of Values	Description	
Enable	BOOL	–	FALSE/ TRUE	Status of the safety door	
				TRUE	● if the safety door switch is locked and ● there are no faults
Ann-Lamp	BOOL	–	FALSE / TRUE	Ann-Lamp indicates the status of the dual channel sensor:	
				OFF	switch unlocked
				FLASH	switch locked but not acknowledged
				ON	switch locked and acknowledged
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	55001000... 55999999	Status of the function block, comprising CFB-No. + Unit-No. + EC	
Last-Sync-T	TIME	–	0...Sync-T	Measured temporal offset in milliseconds between opening of S1 and opening of S2.	

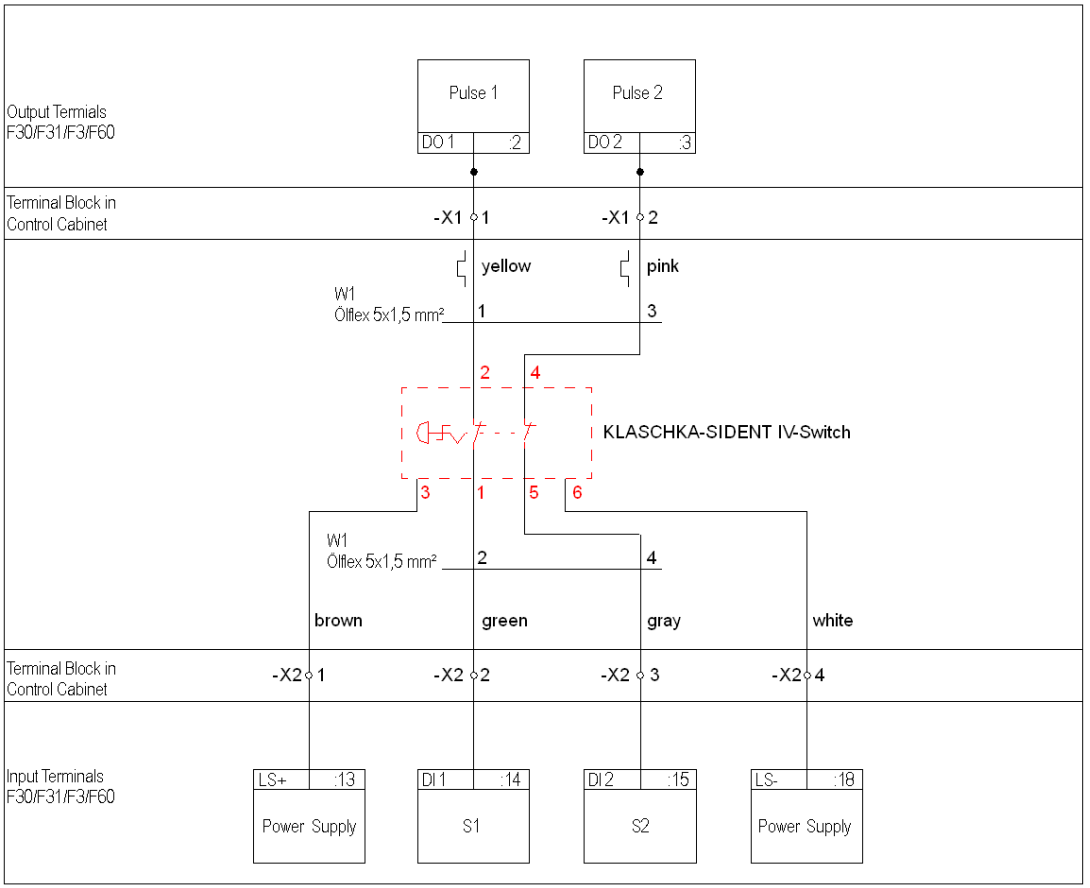
Wiring Line Control According to SIL 3, Cat. 4

Wiring Diagram



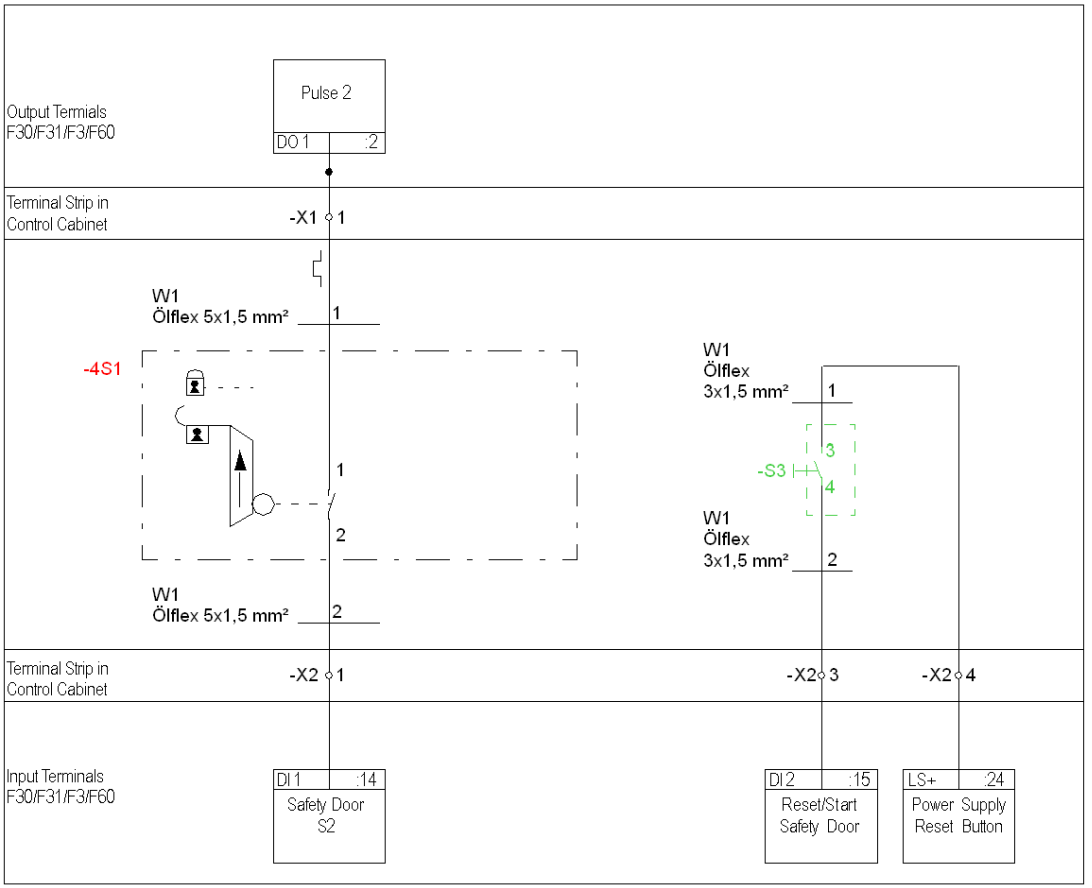
Transponder Wiring with Line Control According to SIL 3, Cat. 4

Wiring Diagram



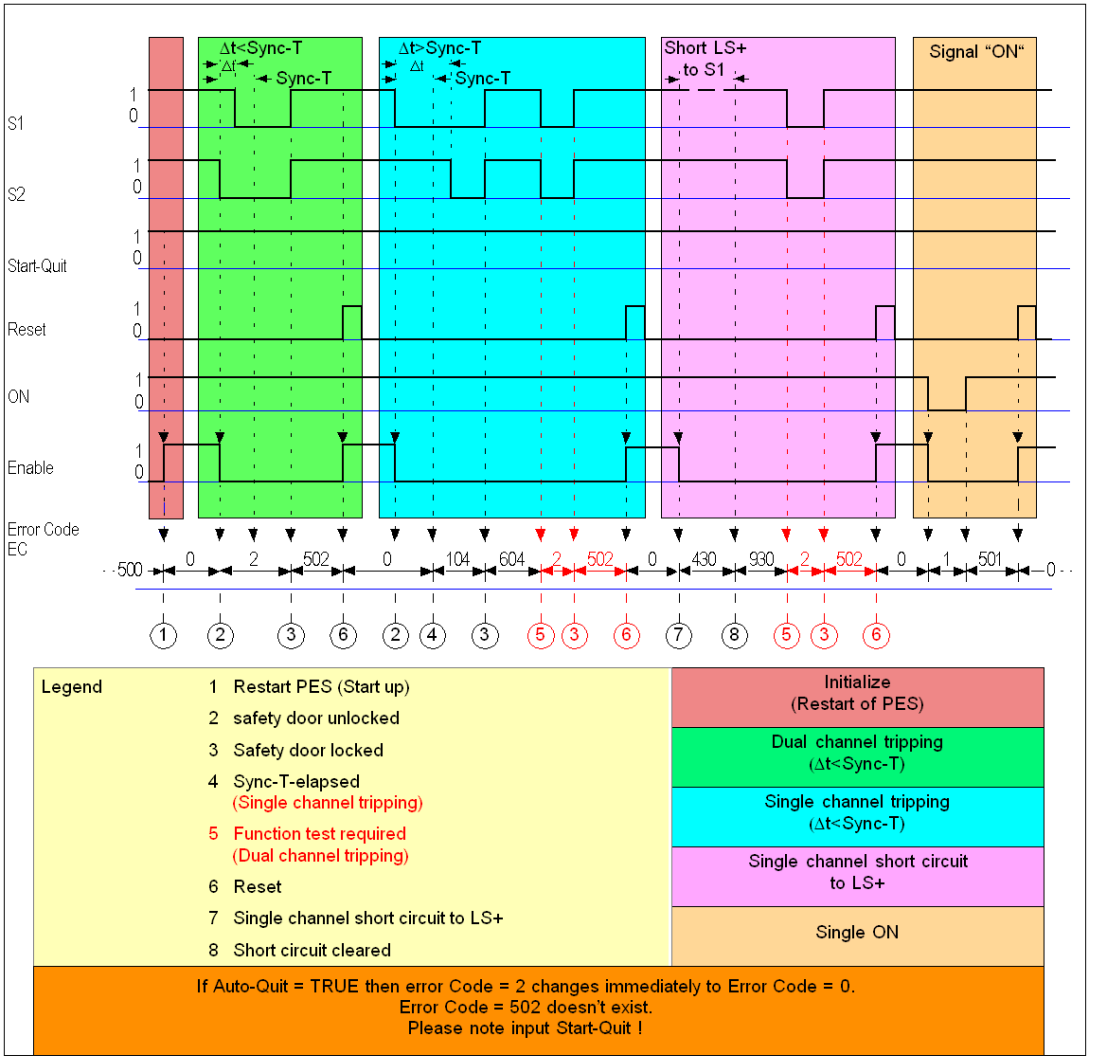
Wiring Line Control According to SIL1, Cat. 2

Wiring Diagram



Signal Table

Schema



H_BA01_Safety_Locking_01

13

Overview

This chapter provides information on the certificated function block H_BA01_Safety_Locking_01.

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
13.1	General	216
13.2	Functions	219

13.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_Safety_Locking_01 (CFB51).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	217
Function Block Layout (H_BA01_Safety_Locking_01)	218

Characteristics

Usage

The function block H_BA01_Safety_Locking_01 is used for monitoring safety lockings in accordance with IEC 61508 and EN 954-1 up to cat. 4.

Characteristics

The function block H_BA01_Safety_Locking_01 provides the following characteristics:

- certified function block CFB 51 (safety locking)
- redundancy by dual channel
- manual or automatic acknowledgment at the start of the XPSMF•• Safety PLC
- manual or automatic acknowledgment (reset) after unlocking the safety locking
- monitoring and limiting the synchronization time of the contacts to each other
- contact synchronization time configurable separately for every function block
- A conditional call of the function block is not permitted.

Safety Level

Safety level in accordance with IEC 61508, SIL 3 / 1 and EN 954-1, cat. 4 / 2

IEC 61508, SIL 3 and EN 954-1, Cat. 4	IEC 61508, SIL 1 and EN 954-1, Cat. 2
If the safety locking is correctly attached to the controller, the inputs `S1` and `S2` are run with line control and all requirements in this document are met, the application complies with safety category 4 according to EN 954-1 (see *Wiring Line Control According to SIL 3, Cat. 4, page 225*). However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity. Consider also the caution below this table.	If the 2 inputs `S1` and `S2` are not driven directly by line control but by variables, the application meets only safety category 2 according to EN 954-1 (see wiring).

⚠ CAUTION

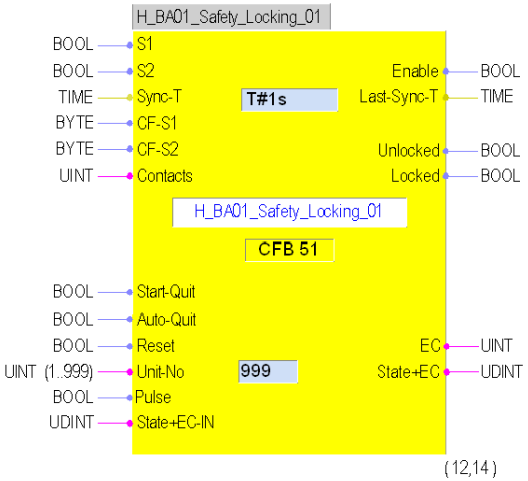
UNINTENDED EQUIPMENT OPERATION

Make sure that no automatic restart is possible (restart inhibit). This must be guaranteed by the parameter setting of the function block or by appropriate external wiring.

Failure to follow these instructions can result in injury or equipment damage.

Function Block Layout (H_BA01_Safety_Locking_01)

Inputs/Outputs



13.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_Safety_Locking_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	220
Inputs	221
Outputs	224
Wiring Line Control According to SIL 3, Cat. 4	225
Wiring Line Control According to SIL1, Cat. 2	226
Signal Table	227

Functional Description

Basic Function

The function block H_BA01_Safety_Locking_01 (CFB 51) monitors safety lockings according to IEC 61508 and EN 954-1 up to category 4.

Every safety locking in the application program XPSMFWIN is monitored by a certified function block CFB 51.

Diagnose Functions

With the CFB 51 the status of the hardware can also be diagnosed.

The monitoring of the 2 safety locking switching elements detect, whether

- 1 contact opens late, or does not open at all,
- 1 contact closes late, or does not close at all,
- there are Line Control faults (LC; Line control channel),
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton at the `Reset` input of the function block is bridged.

XPSMF•• System

The H_BA01_Safety_Locking_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Outputs

If the safety relevant function block output `Enable` is	**Then...**
`TRUE`	the associated safety locking is unlocked and the function block has not detected any faults.
`FALSE`	either the associated safety locking has been engaged, or the function block has detected a fault.

The not safety relevant function block output `EC` provides some exact information.

Inputs

Description

Input	Type	Default	Range of Values	Description	
S1, S2	BOOL	FALSE	FALSE/TRUE	S1 and S2 are the inputs of the safety related controllers at which the statuses of the contacts of the safety locking are read. If the input signals S1 and S2 are TRUE in dependence of the parameter **Contacts**, the safety locking is unlocked, i.e. not engaged.	
CF-S1, CF-S2	Byte	0	–	CF (CF = Channel Fault) represents the status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is put out by means of the error code EC.	
Contacts	UINT	–	0...2	Wiring of the safety locking.	
				0	A TRUE signal is required at the inputs S1 and S2. Use 2 antivalent switching elements (normally closed and normally open contacts).
				1	A TRUE signal is required at S1 and a FALSE signal at S2. Use 2 antivalent switching elements (normally closed and normally open contacts). The idle position of the contacts mates the engaged position for **Contacts** =0. The engaged position of the contacts mates the idle position for **Contacts** =0.
				2	A FALSE signal is required at S1 and a TRUE signal at S2. Use 2 equivalent switching elements (normally closed or normally open contacts).
Sync-T	TIME	1 s	0...5 s	The time Sync-T indicates the synchronization time of the individual normally closed/normally open contacts against each other. If the default value is used, the input need not be connected. **Note**: When Sync-T = 0 ms the synchronization time monitoring is deactivated and all error messages for single channel or asynchronous switching are confined to safety locking locked.	
Start-Quit	BOOL	FALSE	FALSE/TRUE	Start-Quit must be connected to a static signal (constantly TRUE or FALSE). If the input Start-Quit is set to TRUE, a manual reset of the function directly after booting the controller is not required. **Note**: Only activate this function if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the safety locking is unlocked (restart inhibit).	

Input	Type	Default	Range of Values	Description
Reset	BOOL	FALSE	FALSE/ TRUE	With Reset the Enable output of the function block is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults. (0 < EC ≤ 500).
Auto-Quit	BOOL	FALSE	FALSE/ TRUE	Auto-Quit must be connected to a static signal (constantly TRUE or FALSE). If Auto-Quit is TRUE, a manual reset of the function block after unlocking the safety locking is not required. The function block is acknowledged automatically. If Auto-Quit is FALSE or unused, you must reset the function block via the Reset input after unlocking. This ensures that the Enable output can change from FALSE to TRUE if there are no other faults. Auto-Quit does not work when booting the controller. In this case you must acknowledge separately or set the input Start-Quit to TRUE. Consider also the following caution.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Only activate the Auto-Quit function if it is guaranteed that with the start of the controller no immediately dangerous movement is initialized when the safety locking is unlocked (restart inhibit).

Failure to follow these instructions can result in injury or equipment damage.

Input	Type	Default	Rage of Values	Description
Unit-No.	UINT	1	1...999	With Unit-No. define a unit number which is distributed together with the error number at the output State+EC. This way the error code can explicitly be associated with a function block. Values outside the range of values are blocked at the input. **Note**: If the function block is used repeatedly within a program, a new Unit-No. must be used for every function block.
Pulse	BOOL	FALSE	FALSE/ TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.
State + EC-IN	>UDINT	0	1001000... 999999999	Status of the function block, comprising CFB-No. + Unit-No. + Error Code.

Outputs

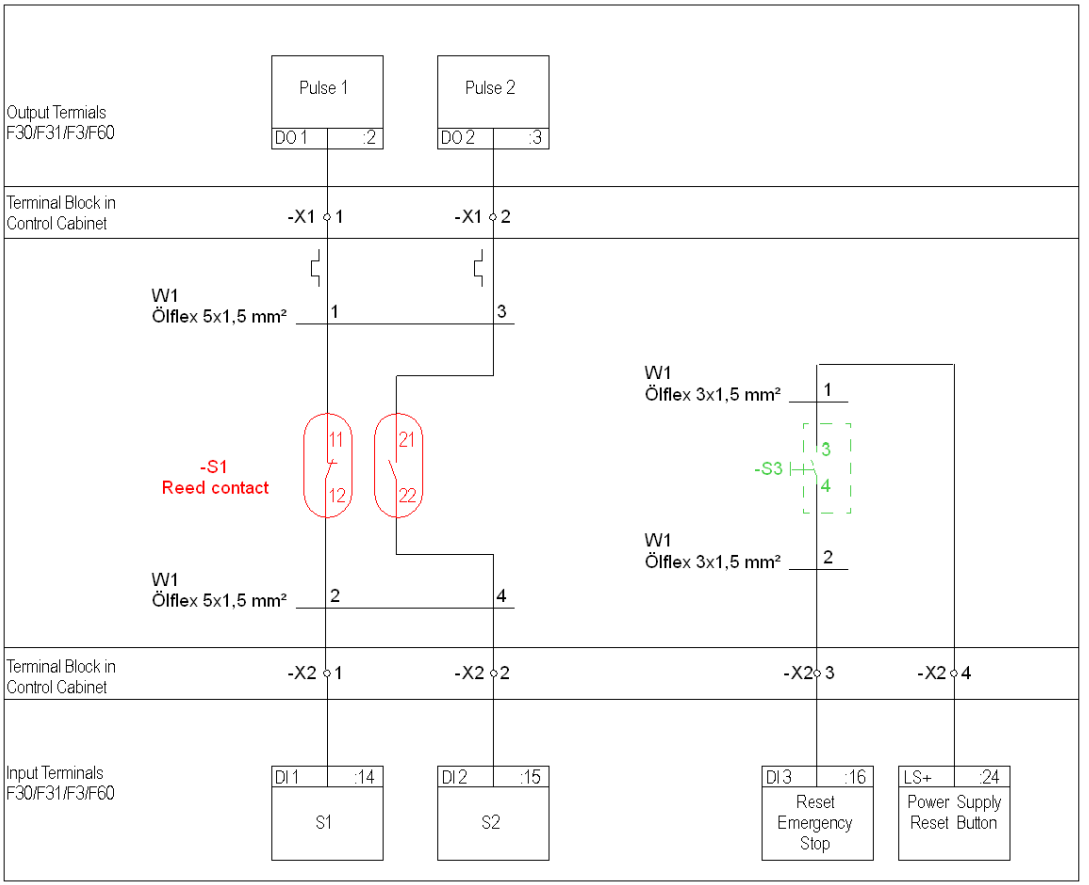
Description

Output	Type	Default	Range of Values	Description
Enable	BOOL	–	FALSE/ TRUE	Status of the safety locking. This safety-related output is TRUE if the safety locking is unlocked and there are no faults.
Last-Sync-T	TIME	–	0...Sync-T	Measured temporal offset in milliseconds between the switching of the contacts S1 and S2 for the switching from unlocked to locked.
Unlocked, Locked	BOOL	–	FALSE/ TRUE	Unlocked = TRUE The machine element to be blocked by the safety locking is not locked and can be moved (not safety-related, suitable for visualization purposes). Unlocked = FALSE Unlocked = FALSE does not mean that the machine element to be barred is locked. The safety locking can be extended only half and not yet be in the final position locked. Locked = TRUE The machine element to be blocked by the safety locking is barred and thus locked (not safety-related, suitable for visualization purposes). Locked = FALSE Locked = FALSE does not mean that the machine element to be barred is unlocked. The safety locking can be retarded only half and not yet be in the final position unlocked.
EC	UINT	–	0...999	Error code of the function block
State+EC	UDINT	–	51001000... 51999999	Status of the function block, comprising No. + Unit-No. + EC

Wiring Line Control According to SIL 3, Cat. 4

Wiring Diagram

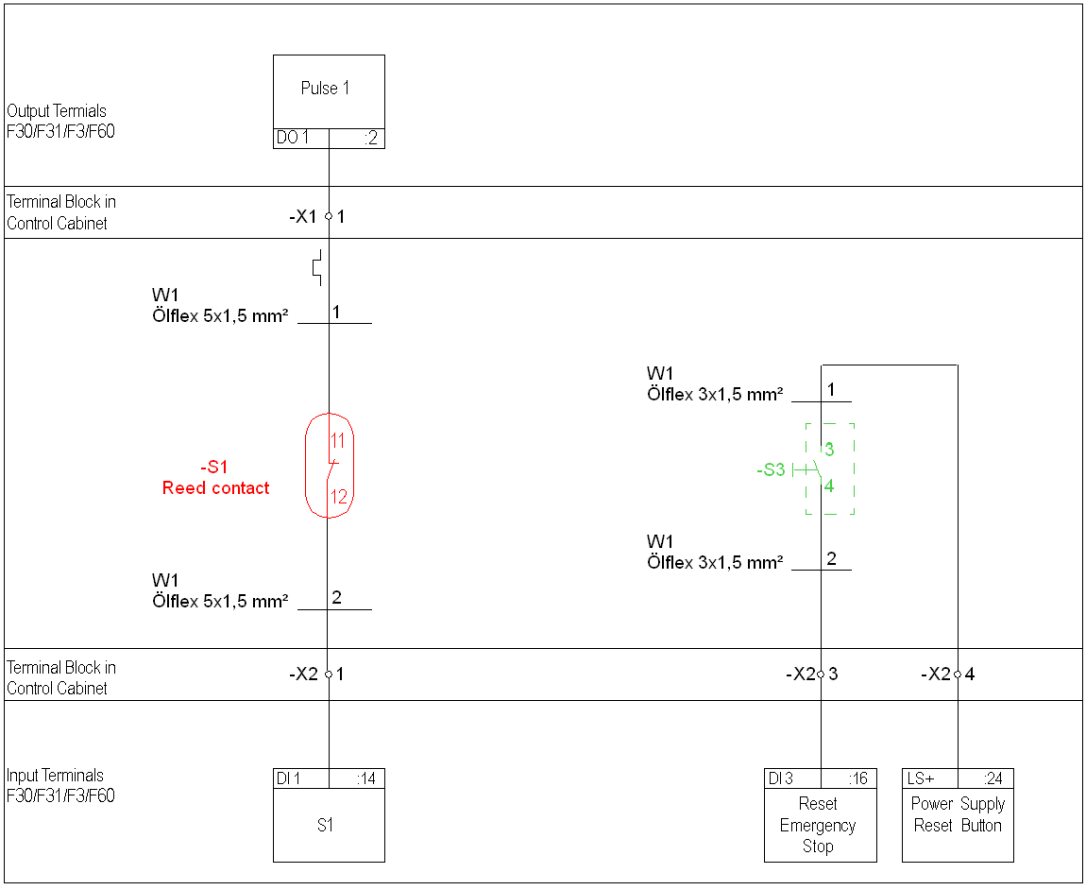
NOTE: Category 3 does not require Line Control.



Wiring Line Control According to SIL1, Cat. 2

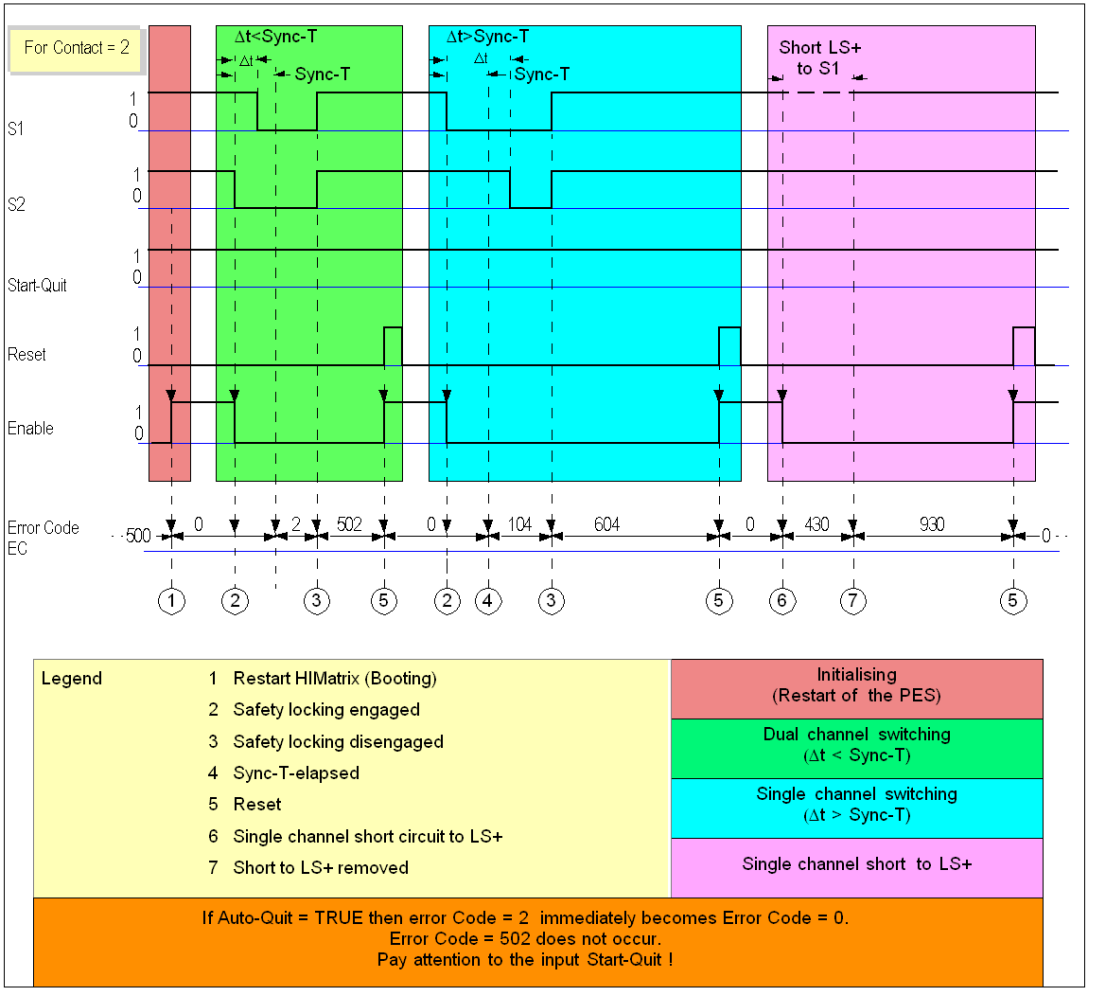
Wiring Diagram

NOTE: Category 2 does not require Line Control.



Signal Table

Schema



H_BA01_THOp_01

14

Overview

This chapter provides information on the certificated function block H_BA01_THOp_01 (2-hand operating).

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
14.1	General	230
14.2	Functions	233

14.1 General

Overview

This section provides information on the function block characteristics and function block layout of the certificated function block H_BA01_THOp_01 (CFB40).

What's in this Section?

This section contains the following topics:

Topic	Page
Characteristics	231
Function Block Layout H_BA01_THOp_01	232

Characteristics

Usage

The function block H_BA01_THOp_01 is used for monitoring 2-hand operating in accordance with IEC 61508 up to SIL 3 and EN 954-1 up to cat. 4.

Characteristics

The function block H_BA01_THOp_01 provides the following characteristics:

- certified function block CFB 40 (THOp = 2-hand operating)
- redundancy by dual channel
- manual acknowledgment (reset) after failures
- monitoring and limiting the synchronization time of the contacts to each other
- contact synchronization time configurable separately for every function block
- A conditional call of the function block is not permitted.
- Monitoring of the simultaneity of the 2 switches is 500 ms in accordance with EN 574.

Safety Level

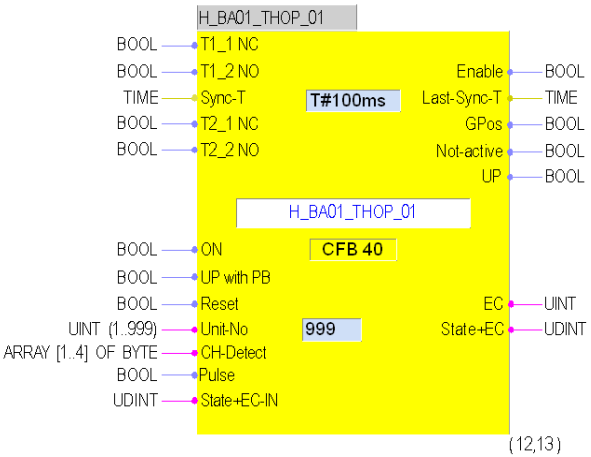
Safety level in accordance with IEC 61508, SIL 3 and EN 954-1, cat. 4:

If the 2-hand operating panel is correctly attached to the controller, the inputs `T1_1 NC`, `T2_1 NC` (NC = normally closed) and `T1_2 NO`, `T2_2 NO` (NO = normally open) are run with line control and all requirements in this document are obeyed, the application complies with the safety category 4 according to EN 954-1.

However exceptions are possible in countries with additional Federal State Regulations, where the EN 954-1 has only limited or no validity.

Function Block Layout H_BA01_THOp_01

Inputs/Outputs



14.2 Functions

Overview

This section describes the functions of the certificated function block H_BA01_THOp_01 and provides information on its inputs, outputs and wiring.

What's in this Section?

This section contains the following topics:

Topic	Page
Functional Description	234
Inputs	236
Outputs	238
Wiring with Line Control	240
Signal Table	241

Functional Description

Basic Function

The function block H_BA01_THOp_01 (CFB 40) monitors the 2-hand operating according to IEC 61508 up to SIL 3 and EN 954-1 up to category 4.

Safety Functions

Every 2-hand operating panel in the application program XPSMFWIN is monitored by a certified function block CFB 40 on the following safety functions:

If...	Then ...
the 2 pushbuttons at the inputs `T1_x` and `T2_x` are engaged synchronously within 500 ms	the safety relevant output `Enable` goes on `TRUE`.
the 2 pushbuttons are engaged asynchronously	both pushbuttons must be released and been engaged once more to put `Enable` on `TRUE`.
only 1 pushbutton is released	`Enable` becomes `FALSE`. Only if the second pushbutton also is let off and the 2 pushbuttons are engaged synchronously once more after this, `Enable` becomes `TRUE` again.

Monitoring Pushbutton Actuation

Each pushbutton is monitored individually for correct actuation.

When pressing pushbutton 1 the contacts `T1_1 NC` and `T1_2 NO` must switch within `Sync-T`. The state `T1_1 NC = T1_2 NO` may at most exist for the duration of `Sync-T`.

The same applies to the contacts `T2_1 NC` and `T2_2 NO` of pushbutton 2. Only then `Enable` becomes `TRUE`.

If a signal change occurs at 1 of the 4 contacts of the 2 pushbuttons while both pushbuttons are depressed, `Enable` becomes `FALSE` immediately.

Diagnose Functions

With the CFB 40 the status of the hardware also can be diagnosed.

The monitoring of the switching element of the 2-hand control device detects, whether

- there are Line Control errors (LC; Line control channel),
- the contact synchronization time is in the predefined range of values,
- the `Unit-No.` is in the predefined range of values,
- the reset pushbutton is bridged at the `Reset` input of the function block.

XPSMF•• System

The H_BA01_THOp_01 was developed for use with XPSMF•• Safety PLCs. With the XPSMF•• system family centralized and decentralized structures can be supervised. SafeEthernet is used for decentralized functions and networking.

SafeEthernet is certified for safety applications in accordance with IEC 61508 SIL 3 and EN 954-1 up to category 4.

Inputs

Description

Input	Type	Default	Range of Values	Description
T1_1 NC , T1_2 NO	BOOL	FALSE	FALSE/TRUE	T1_1NC and T1_2NO are the antivalently switching pair of contacts for pushbuttons 1. When pressing the pushbutton, T1_1 NC opens while T1_2 NO is closing. S1 = T1_1 NC + T1_2 NO (see hardware connection???)
Sync-T	TIME	100 ms	1...500 ms	Sync-T is the monitoring time for the NC/NO contacts for each of the 2 pairs of contacts. If the default value is used, the input need not be connected. **Note**: Sync-T = 0 ms is not allowed!
T2_1 NC , T2_2 NO	BOOL	FALSE	FALSE/TRUE	T2_1 NC and T2_2 NO are the antivalently switching pair of contacts for pushbuttons 2. When pressing the pushbutton, T2_1 NC opens while T2_2 NO is closing. S2 = T2_1 NC + T2_2 NO (see hardware connection???)
ON	BOOL	FALSE	FALSE/TRUE	If the input ON is set to TRUE, the function block is enabled. Use this input to find out whether a 2- hand control device is connected.
UP with PB	BOOL	FALSE	FALSE/TRUE	Use this input to initialize the machine action UP (UP on pushbutton).
Reset	BOOL	FALSE	FALSE/TRUE	With Reset faults are acknowledged and the Enable output is set to TRUE. To do this, a 0/1 transition change must be carried out at the Reset input. The function block is not enabled as long as there are faults. (EC ≤ 500).
Unit-No.	UINT	999	1...999	With Unit-No. define a unit number which is distributed together with the error number at the output State+EC. This way the error code can explicitly be associated with a function block. Values outside the range of values are blocked during the input. **Note**: If the function block is used repeatedly within a program, use a new Unit-No. for every function block

Input	Type	Default	Range of Values	Description	
CH-Detect	Array [1...4] of Byte	0	16#0...16#90	Status of the connected hardware. The evaluation of the hardware faults is carried out in the function block and is issued by means of the error code EC. The array detects channel errors of the following inputs:	
				1. byte	T1_1 NC
				2. byte	T1_2 NO
				3. byte	T2_1 NC
				4. byte	T2_2 NO
Pulse	BOOL	FALSE	FALSE/TRUE	The input Pulse is used if the output of the error codes for all certified function blocks is carried out with a common variable. To do this, Pulse is connected to a clock signal created externally (transition change e.g. every 3 s). With every transition change the error code (EC) of the next function block is output, even if EC is 0.	
State + EC-IN	UDINT	0	40001000...40999999	Status of the function block, comprising CFB-No. + Unit-No. + Error Code.	

Outputs

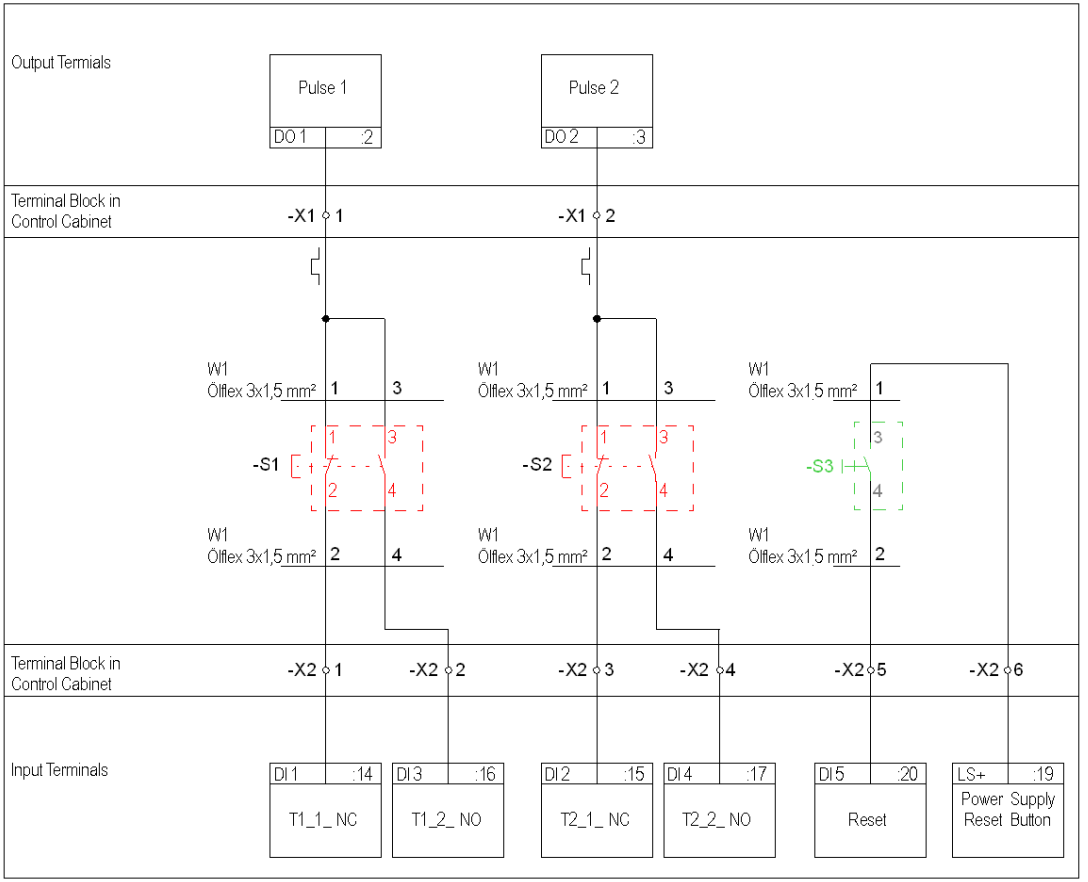
Description

Output	Type	Default	Range of Values	Description	
Enable	BOOL		FALSE/ TRUE	TRUE	● the 2-hand control device is connected correctly and ● the 2-hand control device was engaged correctly
				FALSE	● a pair of contacts of the 2-hand control device was disengaged, or ● an error has occured
Last-Sync-T	TIME		0...Sync-T	The switching intervals between T1_1 NC <-> T1_2 NO and T2_1 NC <-> T2_2 NO are measured and the larger value is output at Last Sync-T. If Last Sync-T is greater or equal Sync-T, an error (EC = 200...215) is output.	
GPos	BOOL	–	FALSE/ TRUE	General position.	
				TRUE	● the 2-hand control device is connected correctly and ● the 2-hand control device has not been engaged and ● there are no errors
				FALSE	● the 2-hand control device has been engaged, or ● there are errors
UP	BOOL	–	FALSE/ TRUE	TRUE	UP with PB is TRUE
				FALSE	UP with PB is FALSE

Output	Type	Default	Range of Values	Description	
Not active	BOOL	–	FALSE/ TRUE	TRUE	The function block is disabled. The input ON is FALSE.
				FALSE	The function block is enabled. The input ON is TRUE.
EC	UINT	–	0...999	Error status of the function block	
State+EC	UDINT	–	0...40999999	Status of the function block, comprising CFB-No. + Unit-No. + EC .	

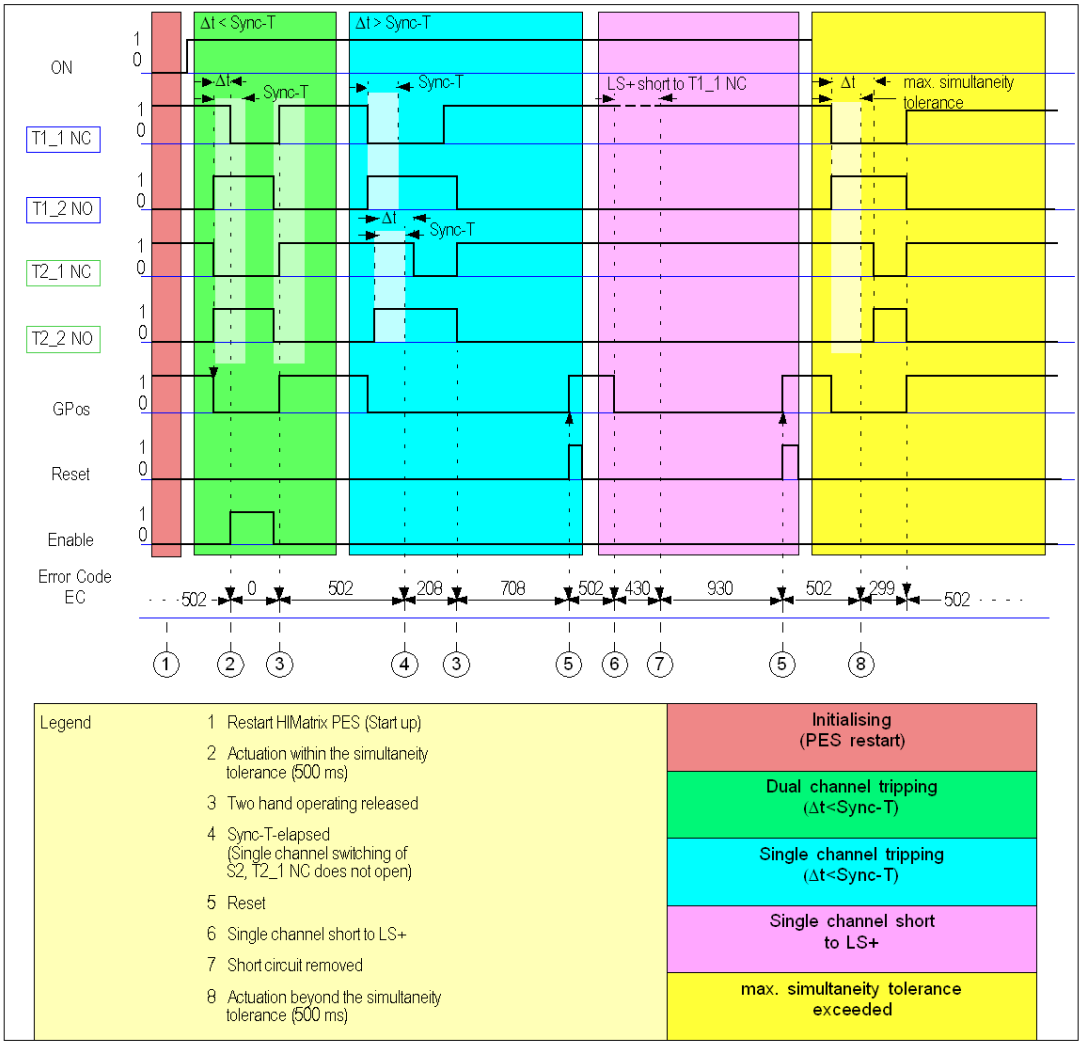
Wiring with Line Control

Wiring Diagram



Signal Table

Schema



Title of Chapter

15

Title of overview block

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What's in this Chapter?

This chapter contains the following topics:

Topic	Page
Map Title	244
Map Title	245
Error Code Table	246
State+EC	253

Map Title

Title of Overview Block

First paragraph of overview block. First paragraph of overview block. First paragraph of overview block. First paragraph of overview block. First paragraph of overview block. First paragraph of overview block. First paragraph of overview block. First paragraph of overview block.

Map Title

Title of Overview Block

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Error Code Table

Definition

Applies to present faults: EC < 500

Applies to cleared faults: EC ≥ 500

The error numbers provided at the output EC (Error Code) of the function block are summarized in the table below.

Example

		Error Code	Cause
1.	A fault occurs	EC = 002	ESPE/PLS area entered
2.	ESPE/PLS area free	EC = 502	
3.	Fault acknowledged	EC = 000	

General Faults

Error Code		Status of the Function Block	Trouble Shooting
Present	Cleared		
000	500	fault inexistent	Error code 500 appears directly after the restart of a controller if the UOS is closed (S1-NO = S2-NO = TRUE) and the sensors of the muting station are not damped. With a reset faults are acknowledged and the output Enable is set to TRUE.
002	502	UOS is dampened (dual channel tripping, the ESPE/PLS area is not free)	
007	507	At least 1 muting initiator is damped after the restart of the PES.	Check visually whether the muting station is free. If 'yes', there is an initiator fault. Relieve the muting station with the key-operated switch «Clear key» after eliminating the fault.

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
008	508	Function block cannot be acknowledged since permanent reset is present (acknowledgment requires a positive edge).	**Note**: Error message The Enable output is already `FALSE`.
009	509	Reset push button permanently pressed	**Note**: Warning message The `Enable` output remains on `TRUE`. Error analysis: Check acknowledgment push button, cable, wiring on the controller and terminals, then re-engage the acknowledgment push button.
081	581	`Mode` outside the range of values	Correct value and reset, if necessary download program into controller and start once more.
085	585	`T-MS-AOS` outside the range of values	see EC: 081 / 581
086	586	`LCA` outside the range of values	see EC: 081 / 581
087	587	`T-I1-I2` outside the range of values	see EC: 081 / 581
088	588	`T-I3-I4` outside the range of values	see EC: 081 / 581
089	589	`T-Int` outside the range of values	see EC: 081 / 581
090	590	`AOS-DT` outside the range of values	see EC: 081 / 581
091	591	`T-Mut` outside the range of values	see EC: 081 / 581
092	592	`OR-T` outside the range of values	see EC: 081 / 581
098	598	`Sync-T` outside the range of values	see EC: 081 / 581
099	599	`Unit-No`. outside the range of values	see EC: 081 / 581

SIngle Channel Faults

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
100	600	Fault: `S1-NC` got stuck Regular tripping: `S2-NC`	Inspect plant: ● check UOS ● check all cables belonging to the UOS ● check PES wiring ● check terminals ● if necessary exchange or repair UOS If the fault was eliminated, the function block first puts out an error code between 600 to 607, followed by the error codes 2 and 502. Following: ● exit the protection area of the UOS ● acknowledge the fault
101	601	Fault: `S1-NC` got stuck Regular reset: `S2-NC`	see EC: 100 / 600
102	602	Fault `S1-NC`: Temporary tripping + reset within Sync-T, `S2-NC` remained in reset position	see EC: 100 / 600
103	603	Fault `S1-NO`: Temporary tripping + reset within Sync-T	see EC: 100 / 600
104	604	Fault: `S2-NC` got stuck Regular tripping: `S1-NC`	see EC: 100 / 600
105	605	Fault: `S2-NC` got stuck Regular reset: `S1-NC`	see EC: 100 / 600

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
106	606	Fault `S2-NC`: Temporary tripping + reset within `Sync-T`, `S1-NC` remained in reset position	see EC: 100 / 600
107	607	Fault `S2-NO`: Temporary tripping + reset within `Sync-T`, `S1-NO` remained in zero position	see EC: 100 / 600

Monitoring Time Errors, Sequence Errors

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
178	678	Sequence of the damping of the initiatorsI1fI2fI3fI4 (backwards) incorrect	Possible causes for the sequence errors 178 and 179: ● interchanging of individual initiators ● wrong signal at the «Reverse» input (conveying direction) at mode = 0 or 1 Possible causes for the sequence errors 186 to 192: ● (short-time) deadlocks of the conveying facility ● monitoring times too low ● Initiator signal override time «T-Int» exceeded because of improperly located initiators Inspect plant: ● check the actuators and sensors on wrong wiring ● check the muting sensors on interchange ● check the cables from and to the PES, incl. the PES wiring ● check the terminals
179	679	Sequence of the damping of the initiators I1gI2gI3gI4 (forwards) incorrect	see EC: 178/ 678

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
186	686	Interrupt time `T-Int` exceeded by I4	see EC: 178/ 678
187	687	Interrupt time `T-Int` exceeded by I3	see EC: 178/ 678
188	688	Interrupt time `T-Int` exceeded by I2	see EC: 178/ 678
189	689	Interrupt time `T-Int` exceeded by I1	see EC: 178/ 678
190	690	muting time exceeded	see EC: 178/ 678
191	691	`AOS-DT` release time of the UOS exceeded	see EC: 178/ 678
192	692	Maximum conveying time from the last muting sensor in front of the UOS up to the UOS was exceeded	see EC: 178/ 678
193	693	`OR-T` override time of the UOS exceeded	Consider the caution below this table. If nobody is endangered in the environment of the muting station by bridging all safety functions turn override switch off and on again when required!
198	698	reaction time of the contact I3 = I4 exceeded	see remarks on EC 178/ 678 to 192/698
199	699	reaction time of the contact I1 = I2 exceeded	see remarks on EC 178/ 678 to 192/698

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Make sure that nobody is endangered in the environment of the muting station when you turn the override switch off and on.

Failure to follow these instructions can result in injury or equipment damage.

Indicator Lamp Faults

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
300	800	FBL-M1 is defective (short to LS+)	The muting indicator lamps are monitored on short circuit when turned on and on wire break when turned off. Also regard the output `One Lamp failed` in combination with the input `One Lamp o.k`: ● If 1 muting indicator lamp fails the output `One Lamp failed` is set to `TRUE`. ● If the input `One Lamp OK` is `TRUE`, an error message is issued only when both muting indicator lamps are defective. Consider also the caution below this table Inspect plant: ● check the muting indicator lamps on incorrect wiring. ● check the cables from and to the PES, incl. the PES wiring ● check the terminals
301	801	FBL-M2 is defective (short to LS+)	see EC: 300/ 800
320	820	FBL-M1 and FBL-M2 are defective (short to LS+)	see EC: 300/ 800
321	821	FBL-M1 is defective (line break)	see EC: 300/ 800
340	840	FBL-M2 is defective (line break)	see EC: 300/ 800
350	850	FBL-M1 and FBL-M2 are defective (line break)	see EC: 300/ 800

Line Control Faults

Error Code		Status of the Function Block	Trouble Shooting
Present	**Cleared**		
400	900	Input signal I1-NO does not come from the assigned pulse, but from a wrong pulse.	The module of the input channel has detected a short to a wrong timing signal (signal of another muting initiator which also is provided with line control). For fault analysis, trouble shooting and acknowledgment see error codes 178...193.
401	901	Input signal I2-NO does not come from the assigned pulse, but from a wrong pulse.	see EC: 400/ 900
402	902	Input signal I3-NO does not come from the assigned pulse, but from a wrong pulse.	see EC: 400/ 900
403	903	Input signal I4-NO does not come from the assigned pulse, but from a wrong pulse.	see EC: 400/ 900
430	930	T1_1 NC has short to external voltage.	The module of the input channel has detected an external voltage. Cause: a short to LS+ or a cross short to another line control channel For fault analysis, trouble shooting and acknowledgment see error codes 178...193.
431	931	T1_2 NO has short to external voltage.	see EC: 430 / 930
432	932	T2_1 NC has short to external voltage.	see EC: 430 / 930
433	933	T2_2 NO has short to external voltage.	see EC: 430 / 930

State+EC

Definition

A 9-digit code which consists of 3 numbers each is put out at `State+EC`:

- CFB-No.
- Unit-No.
- EC

Range of Values

The ranges of values are:

- CFB-No.: 1...999
- Unit-No.: 1...999
- EC: 0...999

Example for State+EC

State+EC	Elements
70001000	CFB-No. = 70 Unit-No. = 1 EC = 0
70002099	CFB-No. = 70 Unit-No. = 2 EC = 99

Configuration Guide for Communication Configuration between XPSMF Safety PLCs

II

Overview

This part contains a configuration guide for configuring communication between XPSMF safety PLCs and Premium PLCs, Advantys STB and HMI Magelis terminals.

What's in this Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
16	Communication between Safety PLCs and Premium PLCs	257
17	Communication between Safety PLCs and HMI Magelis	289
18	Communication between Safety PLCs and Advantys STB	319

Communication between Safety PLCs and Premium PLCs

16

Overview

This chapter describes configuration of XPSMF safety PLCs and Premium PLCs (Quantum, Premium, Modicon M340) for communication via Ethernet (Modbus TCP/IP) using the following 2 software configuration tools:

- XPSMFWIN for creating a Modbus TCP/IP server and defining input and output signals
- Unity for creating the Premium hardware and I/O scanner

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
16.1	XPSMFWIN Configuration	258
16.2	Unity Configuration	272

16.1 XPSMFWIN Configuration

Overview

This section describes XPSMFWIN configuration of an XPSMF safety PLC for communication with a Premium PLC (Quantum, Premium, Modicon M340).

What's in this Section?

This section contains the following topics:

Topic	Page
Creating a Modbus TCP/IP Server in XPSMFWIN	259
Defining Input / Output Signals	264
General Notes on Defining Addressing Areas	269

Creating a Modbus TCP/IP Server in XPSMFWIN

Overview

For communication with a Premium PLC you first of all have to create a Modbus TCP/IP server in the XPSMFWIN (ELOP II) programming software. To create a new Modbus TCP/IP server, add a **Modbus Slave** to the resource of your choice in XPSMFWIN as shown below.

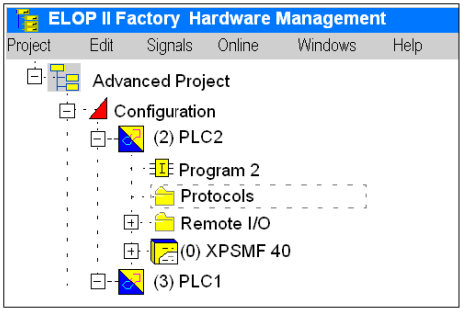
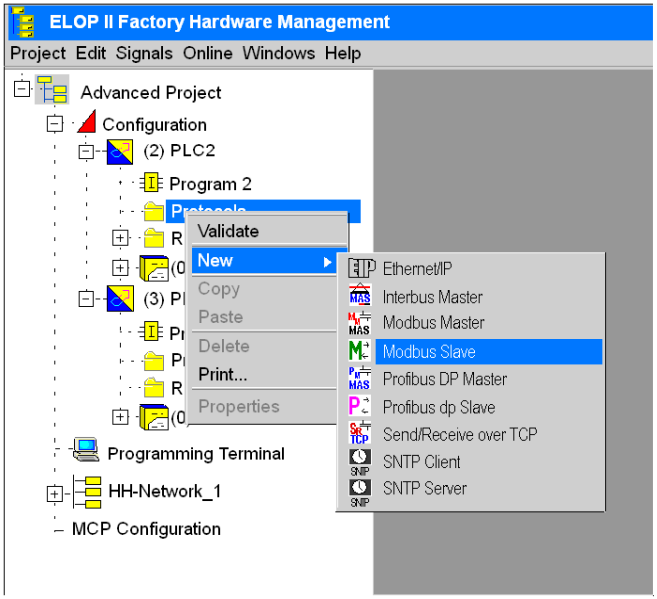
Prerequisites

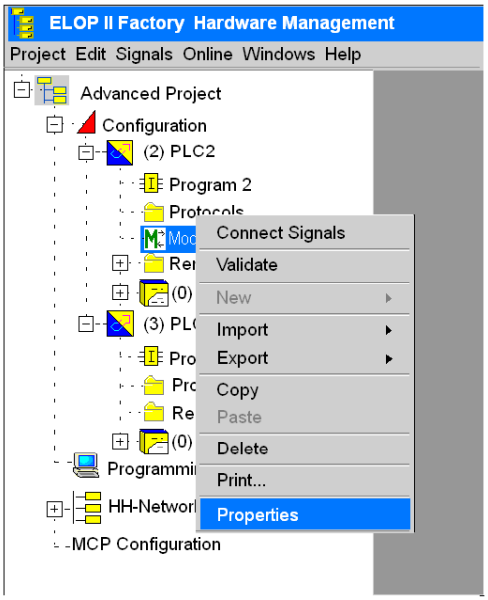
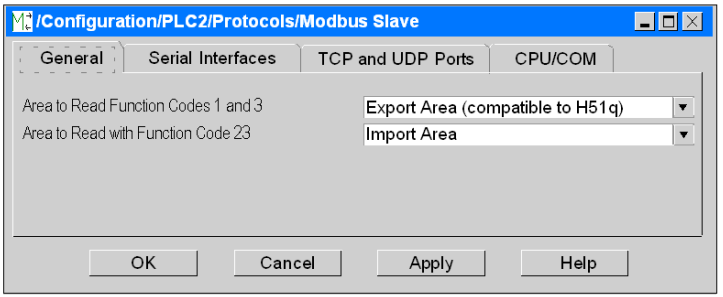
Before you can add a Modbus Slave the following steps have to be performed as a prerequisite.

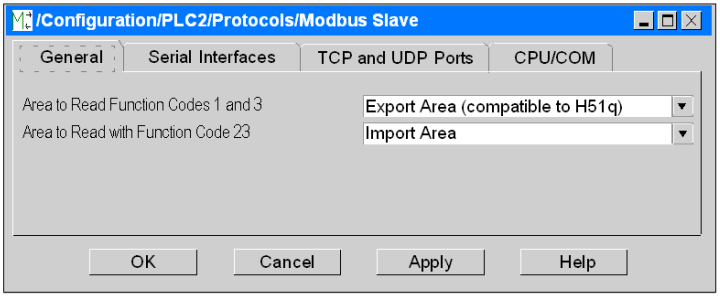
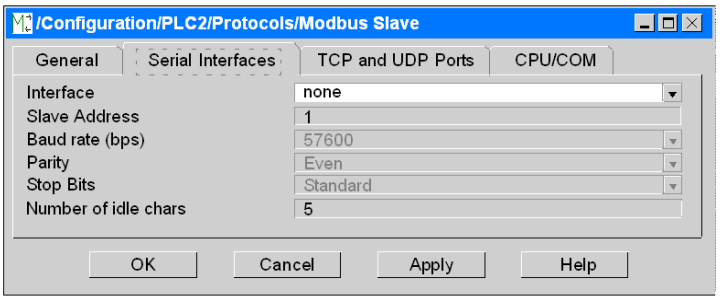
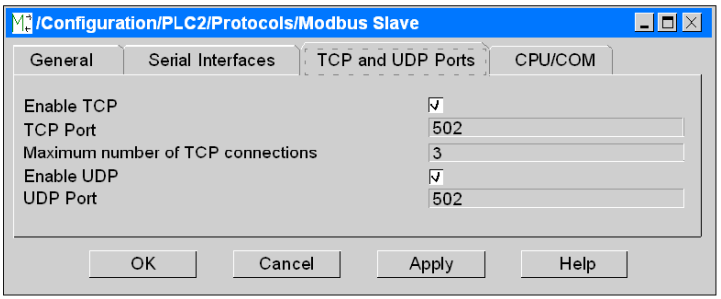
- Start XPSMFWIN from Safety Suite.
- Create a new project in XPSMFWIN.
- Create the required program in the **Project Management** area of XPSMFWIN.
- Define the required hardware in the **Hardware Management** area of XPSMFWIN.

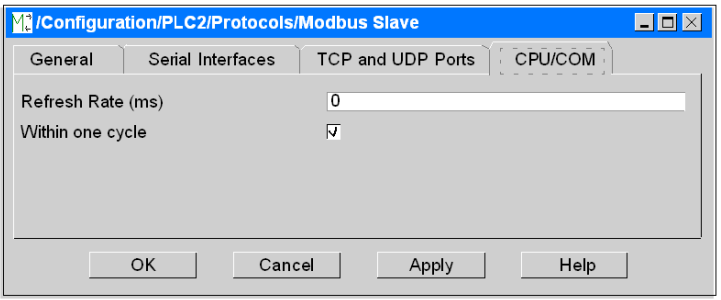
Creating a New Modbus Slave

To add a **Modbus Slave** proceed as follows:

Step	Action
1	Within the **Hardware Management** window open the project tree as shown below and select the resource you wish to have as Modbus TCP/IP server (e.g. **PLC2**): 
2	Right-click on the item **Protocols** of your resource (**PLC2**) and select **New** → **Modbus Slave** from the context menu. 

Step	Action
3	To assign properties to this new Modbus slave right-click on the **Modbus Slave** and select **Properties**.  **Result**: The Modbus Slave Properties dialog box will be displayed. 

Step	Action
4	In the **General** tab of the Properties dialog box set the parameter **Area to Read Function Codes1 and 3** to **Export Area (compatible to H51q)**. 
5	In the **Serial Interfaces** tab of the Properties dialog box you do not have to change the default settings. 
6	In the **TCP and UDP Ports**tab of the Properties dialog box activate the check boxes **Enable TCP** and **Enable UDP** 

Step	Action
7	In the **CPU/COM** tab of the Properties dialog box you do not have to change the default settings. The refresh rate should be as fast as possible. 
8	Click **Apply** and **OK** to confirm.

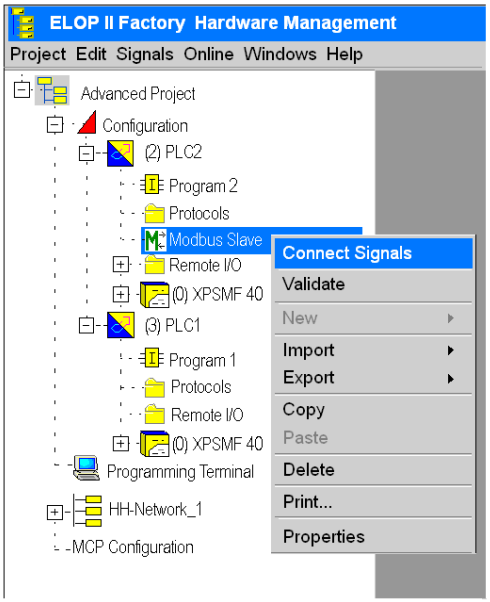
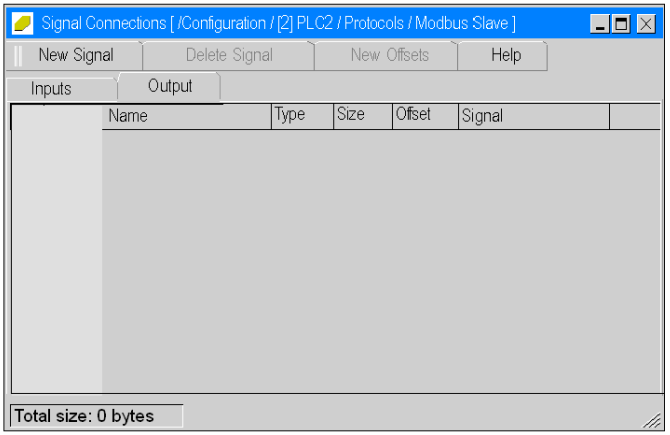
Defining Input / Output Signals

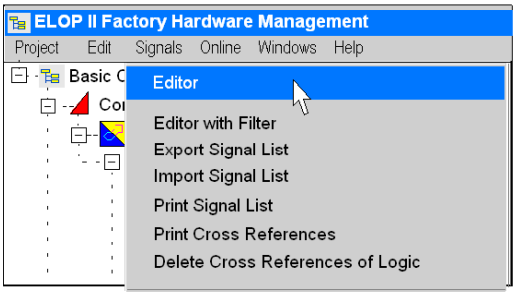
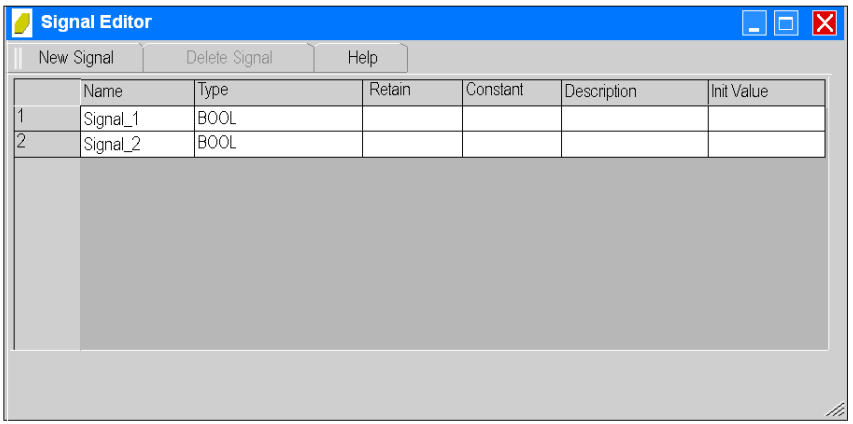
Overview

Define the required signals which will be used by the Premium PLC for reading / writing data.

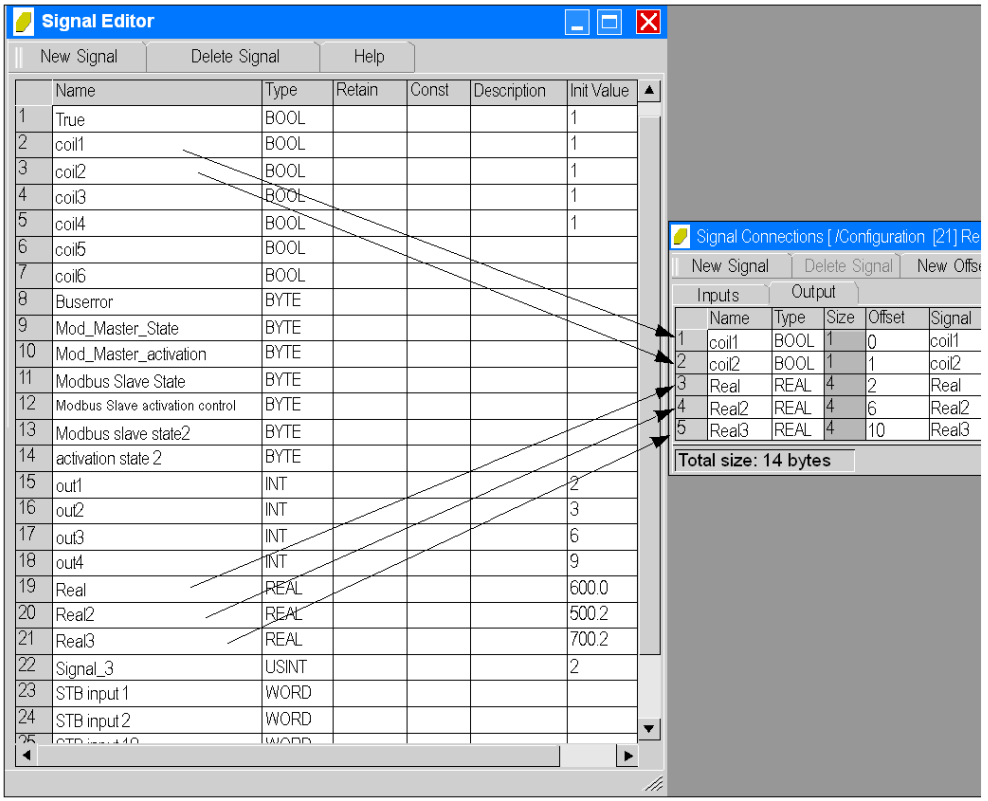
Connecting?????????? Signals

To define input / output signals proceed as follows:

Step	Action
1	To define the signals which you require read or written to, right-click on **Modbus Slave** and select **Connect Signals** from the context menu.  **Result:** The **Signals Connections** dialog box will be displayed.  **Note:** The **Signals Connections** dialog box has 2 tabs, **Inputs** and **Outputs**. The **Inputs** tab defines all inputs from the Premium PLC. The **Inputs** area is where the Premium PLC writes data to. The **Outputs** tab defines all outputs to the Premium. The **Outputs** area is where the Premium PLC reads data from.

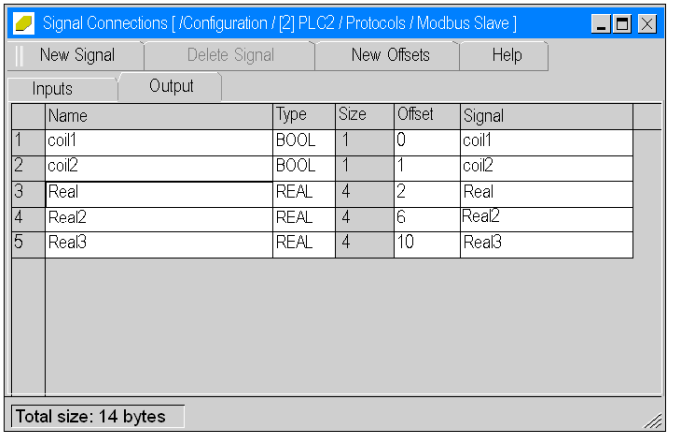
Step	Action
2	Additionally open the **Signal Editor** from the menu bar of the **Hardware Management** by clicking **Signals** → **Editor**. 
3	Click on **New Signal** to create new signals. Rename each signal and assign the appropriate signal type.  **Note:** You can also create all signals in an Excel file and import this into XPSMFWIN. For further information see the *XPSMFWIN Software Manual*.

Step	Action
4	Arrange the **Signal Editor** and the **Signal Connections** windows next to each other (side by side) on your desktop.



	Name	Type	Retain	Const	Description	Init Value
1	True	BOOL				1
2	coil1	BOOL				1
3	coil2	BOOL				1
4	coil3	BOOL				1
5	coil4	BOOL				1
6	coil5	BOOL				
7	coil6	BOOL				
8	Buserror	BYTE				
9	Mod_Master_State	BYTE				
10	Mod_Master_activation	BYTE				
11	Modbus Slave State	BYTE				
12	Modbus Slave activation control	BYTE				
13	Modbus slave state2	BYTE				
14	activation state 2	BYTE				
15	out1	INT				2
16	out2	INT				3
17	out3	INT				6
18	out4	INT				9
19	Real	REAL				600.0
20	Real2	REAL				500.2
21	Real3	REAL				700.2
22	Signal_3	USINT				2
23	STB input 1	WORD				
24	STB input 2	WORD				

	Name	Type	Size	Offset	Signal
1	coil1	BOOL	1	0	coil1
2	coil2	BOOL	1	1	coil2
3	Real	REAL	4	2	Real
4	Real2	REAL	4	6	Real2
5	Real3	REAL	4	10	Real3

Step	Action
5	Select from the **Signal Editor** the signals you wish to transfer to the Modbus master and drag and drop the signals into the **Output** tab of the **Signals Connections** window.
6	After you have inserted all required signals, select the **New Offsets** tab. The offsets are the %MW address areas used by the Premium PLC (or any other Modbus device) to read from and write to. The address parameters are automatically set by selecting the **New Offsets** tab: 

General Notes on Defining Addressing Areas

Overview

The following paragraphs provide general information on defining addressing areas.

Data Transfer Size

Data exchanged between XPSMF and Premium PLCs is packed in packets with the minimum data size of Word (2 bytes).

You can convert those signals that are smaller than 2 bytes (`BOOLEAN`, `BYTE`, `SINT`, `USINT`) into 1 Word, e.g. by putting 16 Boolean signals together, in the **Project Management** window. This reduces network load as well as the PLCs cycle time.

Make sure that there is always an even number of bytes within the Modbus **Signal Connections** window. If necessary, use packing signals.???

The size of the signals in the Modbus **Signal Connections** window is represented in bytes.

Data Types and Sizes

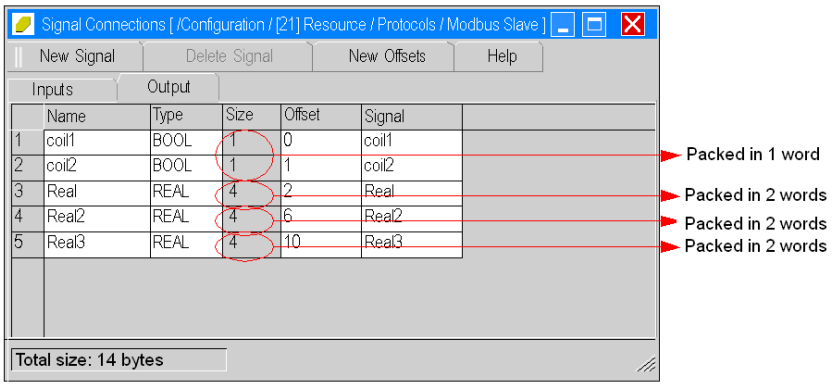
The following table lists the data types and their sizes:

Data Type	Size
BOOLEAN	1 byte
BYTE	1 byte
USINT	1 byte
SINT	1 byte
INT	2 bytes
UINT	2 bytes
WORD	2 bytes
DWORD	4 bytes
DINT	4 bytes
REAL	4 bytes
UDINT	4 bytes
LREAL	8 bytes
TIME	8 bytes

For the 1 byte signals it is recommended to use packing signals but not obligatory.???

Example of Packing Signals

The graphic below shows an example of packing signals:



The offset address area is stored in bytes.The Premium PLC must therefore read the following address areas when requesting the 5 signals of the above example

Signal	Address Area Index	No. of Words Transferred
`coil1 (BOOL)`	0	half word for transfer of Boolean (packed with second Boolean signal)
`coil2 (BOOL)`	1	half word for transfer of Boolean (packed with first Boolean signal)
`Real (REAL)`	2	2 Words for transfer or Real (indexes 2 and 3)
`Real2 (REAL)`	4	2 Words for transfer or Real (indexes 4 and 5)
`Real3 (REAL)`	6	2 Words for transfer or Real (indexes 6 and 7)

Note: Make sure to have an even number of Boolean signals in the **Signal Connections** window. If you have an uneven number of Boolean signals, insert an additional Boolean signal for correct data sequencing.

Verifying Addressing Areas with Online-Test Function

To verify that the signals you configured are read from / written to the correct address, use the Online-Test function of XPSMFWIN. We recommend to carry out a full test plan to help to ensure that data is transferred correctly.

When you start creating your program, attempt only to send and receive 1 signal in each direction. Test the functions and add the remaining signals when everything works as required.

Finishing Address Configuration

After you have completely configured the program, close the dialog boxes (**Signal Editor**, **Signal Connections**) and code generate your complete project within the **Project Management** window of XPSMFWIN.

Communication Signals Received from the Premium PLC

You can use the communication signals which have been received from the Premium PLC within the users program by dragging them from the **Hardware Management** dialog box into the **Project Management** dialog box. For more information on this procedure see the *XPSMFWIN Software Manual*.

Communication Signals Read by the Premium PLC

Signals which are being read by the Premium PLC can com from the user program or from system signal areas such as the CPU dialog box of each Safety PLC / Remote I/O.

16.2 Unity Configuration

Overview

This section describes Unity configuration of a Premium PLC (Quantum, Premium, Modicon M340) for communication with XPSMF Safety PLCs.

What's in this Section?

This section contains the following topics:

Topic	Page
Creating an Ethernet Network in Unity	273
Configuring the Ethernet Network	278
Consistency Check	283

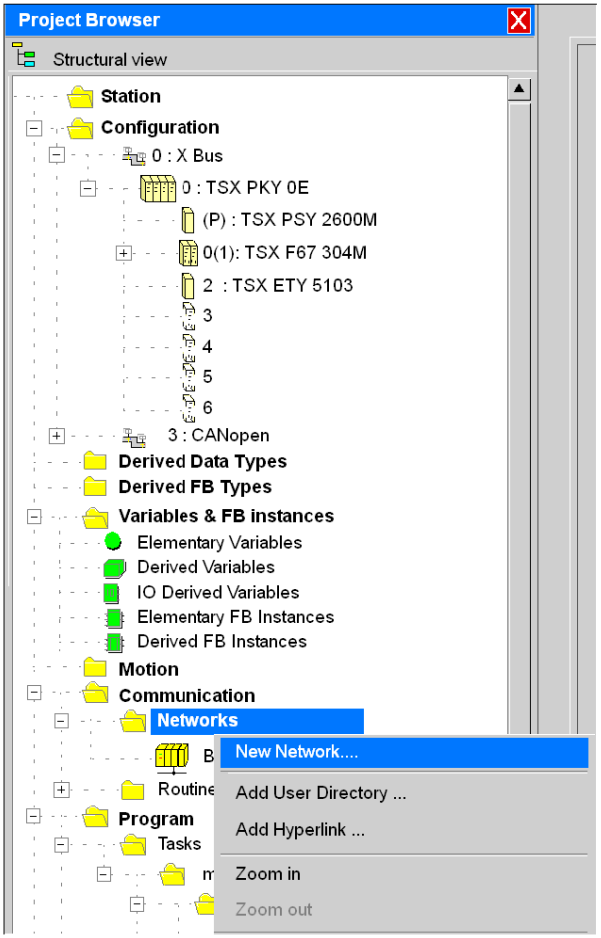
Creating an Ethernet Network in Unity

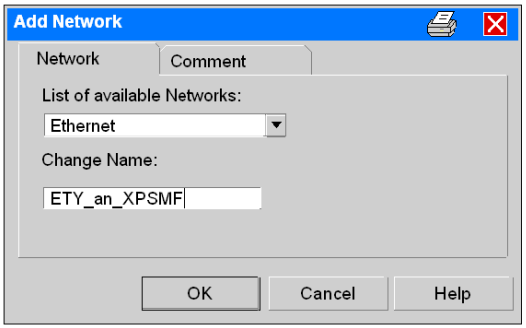
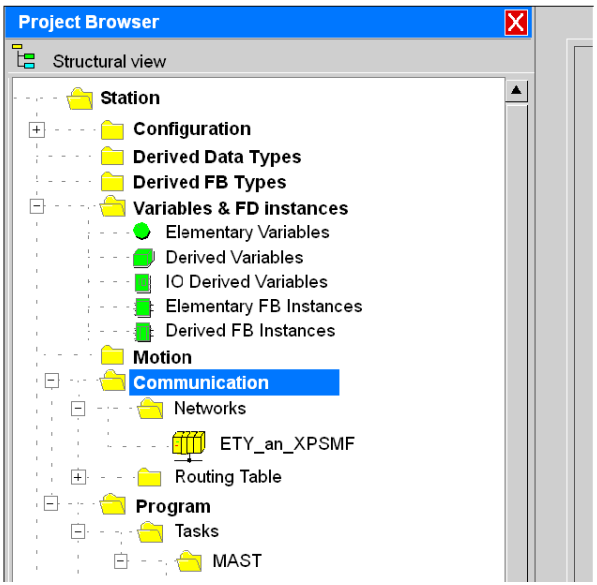
Overview

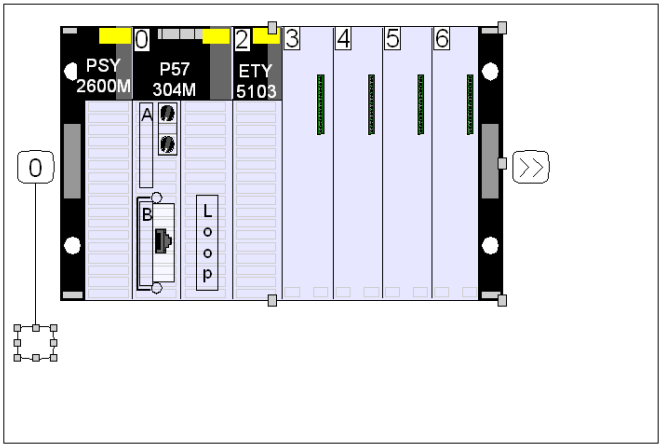
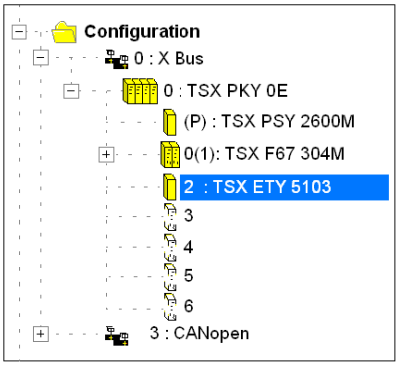
This section briefly describes how to create a new Ethernet network in Unity.

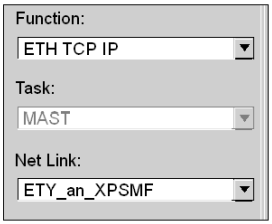
How to Create an Ethernet Network

To create an Ethernet network proceed as follows:

Step	Action
1	Open Unity.
2	Create a new project by right-clicking the **Networks** item in the **Project Browser** and selecting the command **New Network...** from the context menu.  **Result**: The **Add Network** dialog box will be displayed.

Step	Action
3	In the **Add Network** dialog box select **Ethernet** from the **List of available Networks** and enter a name for this network in the **Change Name** textbox. 
4	Click **OK** to confirm your settings. **Result**: The new Ethernet network will be displayed in the **Project Browser** as subentry of **Communication** → **Networks**. 
5	Assign the function **ETH TCP IP** and the network connection **ETY_an_XPSMF** to the Ethernet module. You can achieve this in 2 different ways.

Step	Action
6	Possibility 1: Double-click the Ethernet module:  Possibility 2: Double-click the Ethernet reference from the sub menu **Configuration** in the **Project Browser**:  **Result**: After you have performed one of the above steps, the dialog box of the Ethernet module will be displayed.

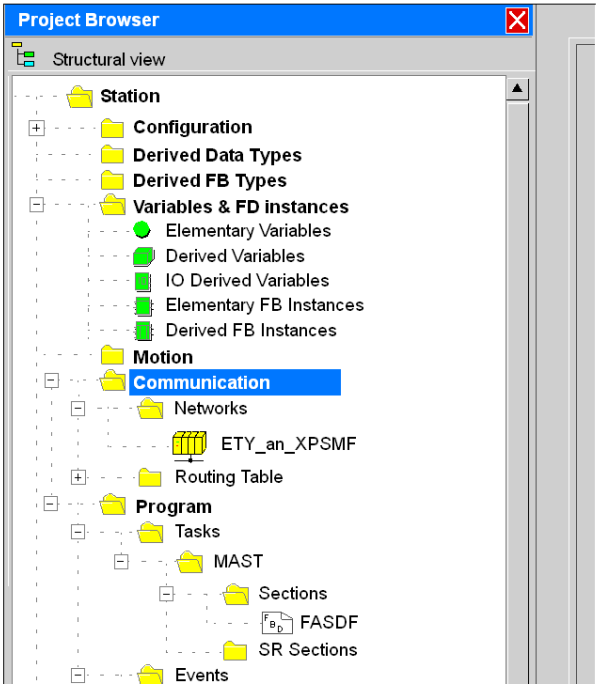
Step	Action
7	Assign to the Ethernet module the **Function ETH TCP IP** and enter the network connection **ETY_an_XPSMF** in the **Net Link** textbox. 

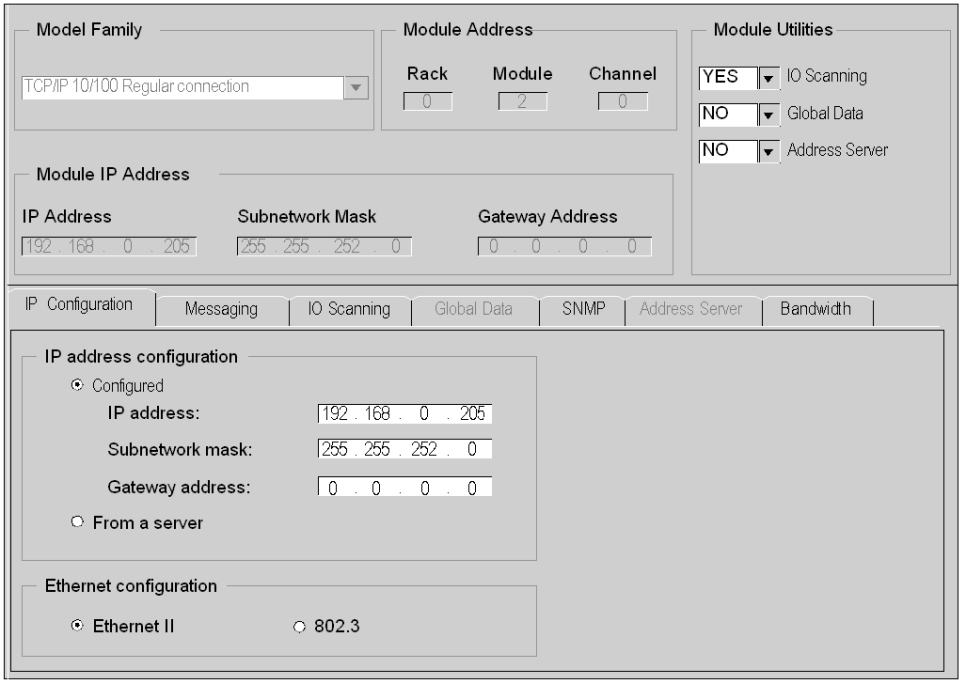
Configuring the Ethernet Network

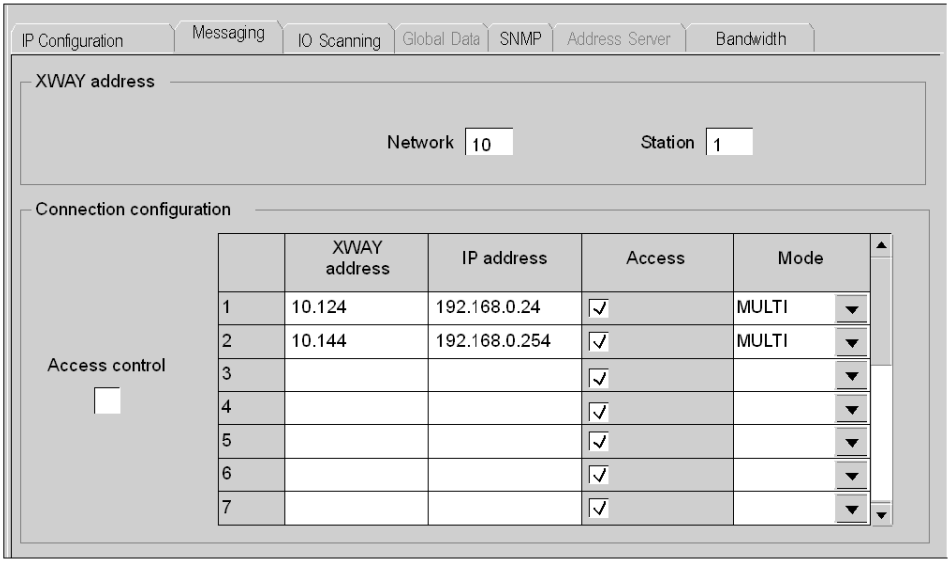
Overview

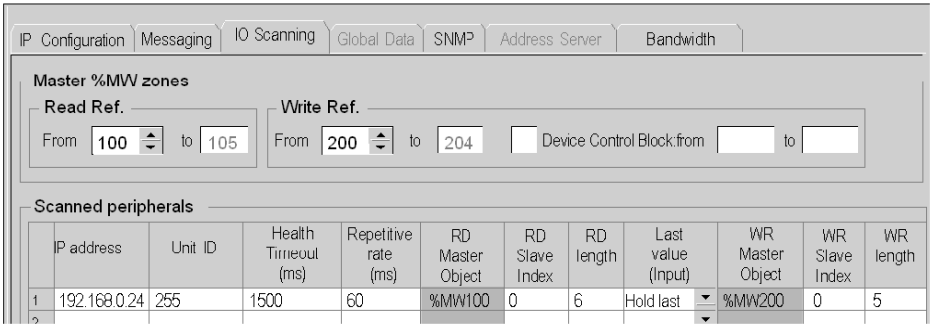
The following paragraphs describe the steps to be performed for configuring the Ethernet network connection you have created in the previous step.

How to Configure the Ethernet Network

Step	Action
1	To configure the Ethernet network, double-click the Ethernet item in the sub folder **Communication** → **Networks** of the **Project Browser**.  **Result**: The network properties dialog box of the selected network will be displayed.

Step	Action
2	The upper part of the network properties dialog box, area **Module Utilities** select **YES** from the **IO Scanning** list.  The lower part of the network properties dialog box provides different tabs. In the **IP Configuration** tab of the network properties perform the following settings: In the **IP address configuration** area select the option **Configured** and enter the **IP address**, **Subnetwork mask** and **Gateway address** of your Ethernet network. In the **Ethernet configuration** area select the option **Ethernet II**.

Step	Action
3	In the **Messaging** tab of the network properties perform the following settings:  In the **XWAY address** area of the dialog box enter any XWAY address numbers of your choice. In the **Connection configuration** area configure on line with the **IP address** of your Safety PLC and one line with the IP address of your computer. Enter **XWAY addresses** of your choice because this parameter is not evaluated by Unity.

Step	Action
4	In the **IO Scanning** tab of the network properties perform the following settings:  In the upper area **Master %MW zones** of the dialog box define the read and write areas of the Safety PLC. The values you enter for **Read Ref** and **Write Ref** are internal Premium PLC data storage areas. The will automatically be used as values for the parameters **RD Master Object** and **WR Master Object** in the table **Scanned peripherals** below. In the **Scanned peripherals** table below perform the following settings: Enter the **IP address** and the **Unit ID** of the Safety PLC with Modbus TCP/IP server you want to communicate with. Set the parameter **RD Slave Index** to the value 0 (offset in XPSMFWIN = 0) and define the number of words to be read with the parameter **RD length**. **Note**: The Safety PLC transmits data in words. If the read length is incorrect an error will occur in communication. Set the parameter **WR Slave Index** to the value 0 (offset in XPSMFWIN = 0) and define the number of words to be read with the parameter **WR length**.
5	Code generate your project and download it to the Premium PLC.

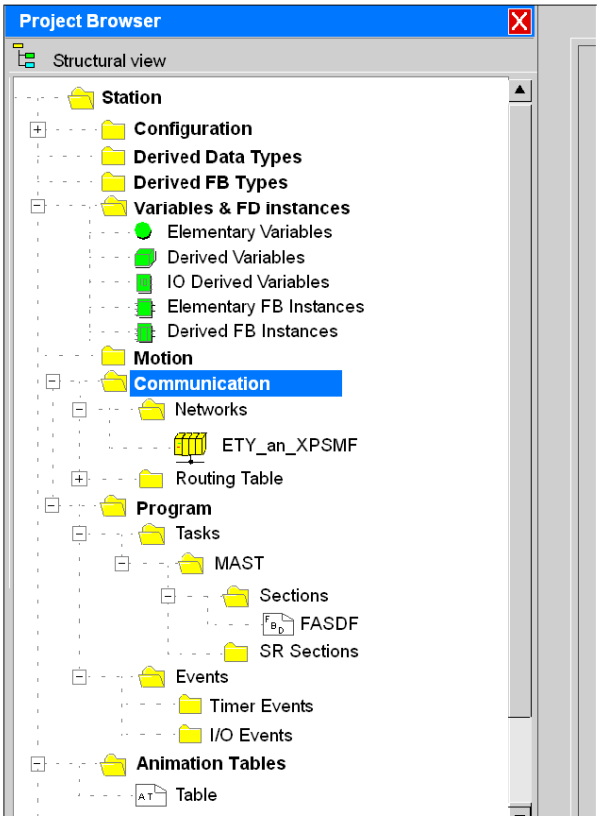
Consistency Check

Overview

To verify whether you have configured in Unity identical input and output values as in XPSMFWIN, use the Animation table. The Animation table displays the values for the relevant assigned `%MW` values.

Displaying the Animation Table

To display the Animation table proceed as follows:

Step	Action
1	Double-click the **Table** item in the **Animation Tables** folder of the **Project Browser**. 

Step	Action
2	In the Animation table verify that the values are identical to the values configured in XPSMFWIN. Name / Value / Type / Com %MW100:5 — ARRAY [0..4... %MW100[0] — INT %MW100[1] — INT %MW100[2] — INT %MW100[3] — INT %MW100[4] — INT %MW200:5 — ARRAY [0..4... %MW200[0] — INT %MW200[1] — INT %MW200[2] — INT %MW200[3] — INT %MW200[4] — INT **Note**: You can again use these `%MW` values within the Premium PLC's program.

Communication between Safety PLCs and HMI Magelis

17

Overview

This chapter describes communication configuration between an XPSMF Safety PLC and an HMI Magelis terminal using the following 2 software configuration tools:

- XPSMFWIN for creating a Modbus TCP/IP server and defining input and output signals
- Vijeo Designer for configuring the HMI terminal and creating variables

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
17.1	XPSMFWIN Configuration	290
17.2	Vijeo Designer Configuration	310

17.1 XPSMFWIN Configuration

Overview

This section describes XPSMFWIN configuration of an XPSMF safety PLC for communication with an HMI Magelis terminal.

What's in this Section?

This section contains the following topics:

Topic	Page
Creating a Modbus TCP/IP Server in XPSMFWIN	291
Defining Input / Output Signals	296
General Notes on Defining Addressing Areas	307

Creating a Modbus TCP/IP Server in XPSMFWIN

Overview

For communication with a HMI Magelis you first of all have to create a Modbus TCP/IP server in the XPSMFWIN (ELOP II) programming software. To create a new Modbus TCP/IP server, add a **Modbus Slave** to the resource of your choice in XPSMFWIN as shown below.

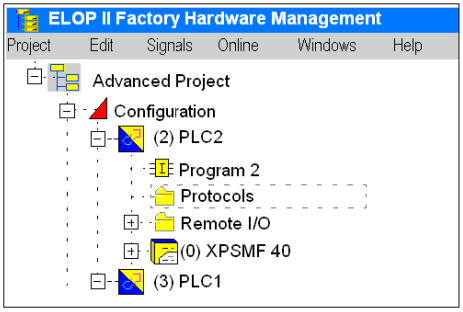
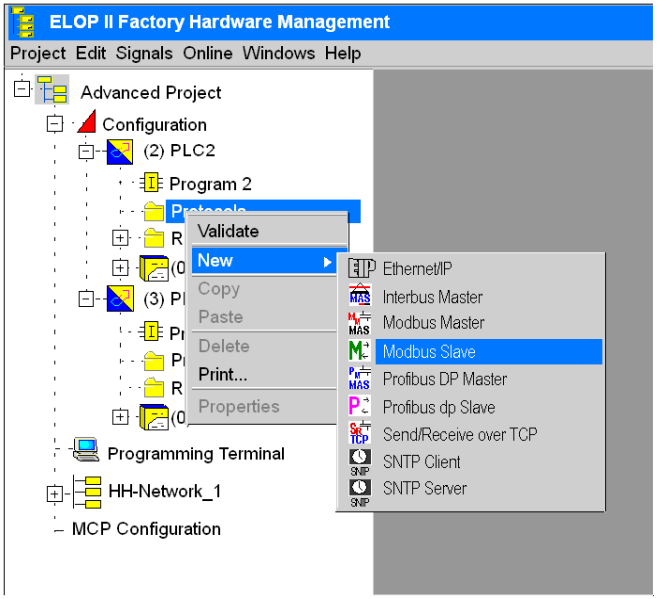
Prerequisites

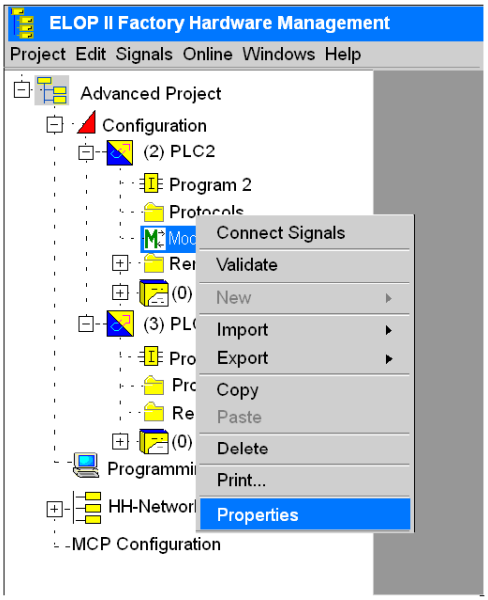
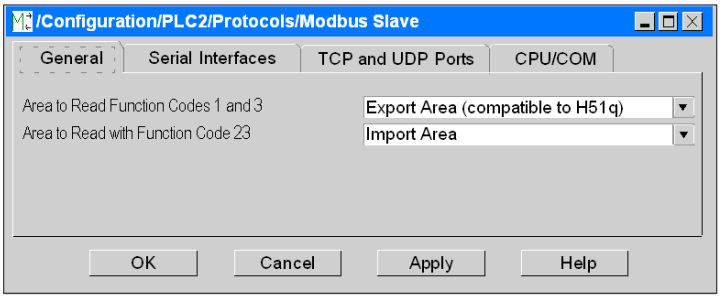
Before you can add a Modbus Slave the following steps have to be performed as a prerequisite.

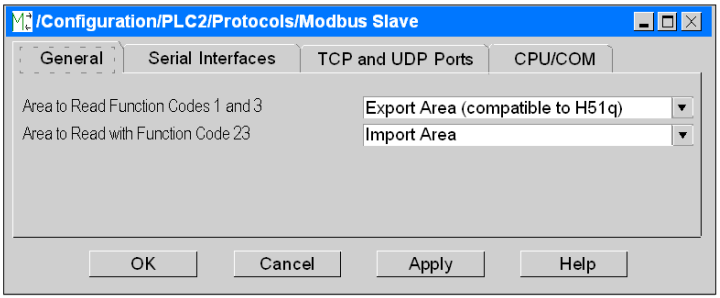
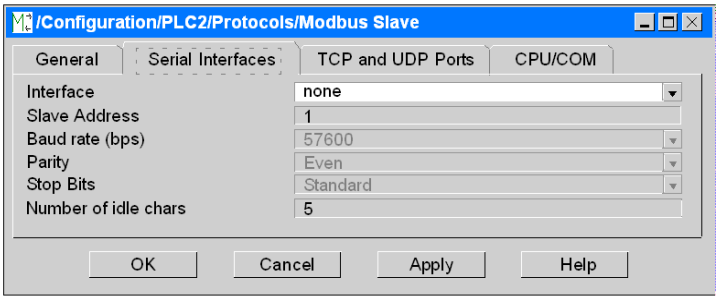
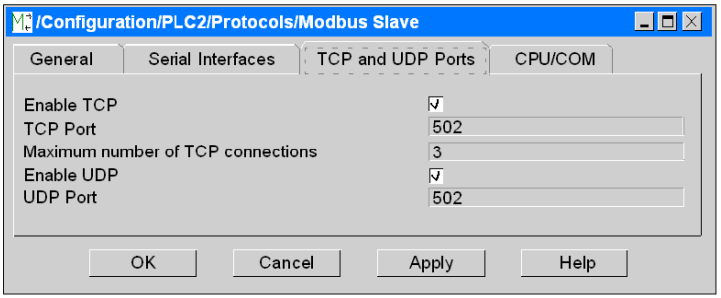
- Start XPSMFWIN from Safety Suite.
- Create a new project in XPSMFWIN.
- Create the required program in the **Project Management** area of XPSMFWIN.
- Define the required hardware in the **Hardware Management** area of XPSMFWIN.

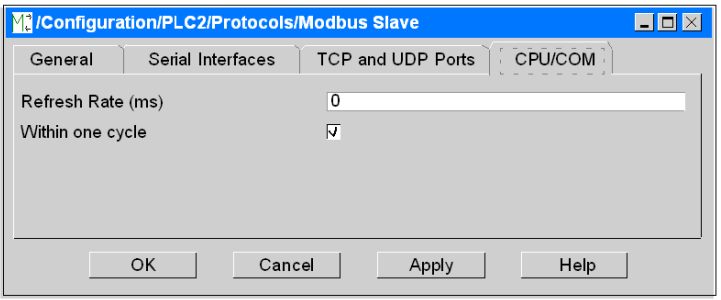
Creating a New Modbus Slave

To add a **Modbus Slave** proceed as follows:

Step	Action
1	Within the **Hardware Management** window open the project tree as shown below and select the resource you wish to have as Modbus TCP/IP server (e.g. **PLC2** 
2	Right-click on the item **Protocols** of your resource (**PLC2**) and select **New** → **Modbus Slave** from the context menu. 

Step	Action
3	To assign properties to this new Modbus slave right-click on **Modbus Slave** and select **Properties**.  **Result**: The **Modbus Slave Properties** dialog box will be displayed. 

Step	Action
4	In the **General** tab of the Properties dialog box you do not have to change the settings for the parameter **Area to Read Function Codes1 and 3** because the function codes 1 and 3 are best read from the Export area (output area) and the function 23 is not supported by Magelis. 
5	In the **Serial Interfaces** tab of the Properties dialog box you do not have to change the default settings. 
6	In the **TCP and UDP Ports**tab of the Properties dialog box activate the check boxes **Enable TCP** and **Enable UDP** 

Step	Action
7	In the **CPU/COM** tab of the Properties dialog box you do not have to change the default settings. The refresh rate should be as fast as possible. 
8	Click **Apply** and **OK** to confirm.

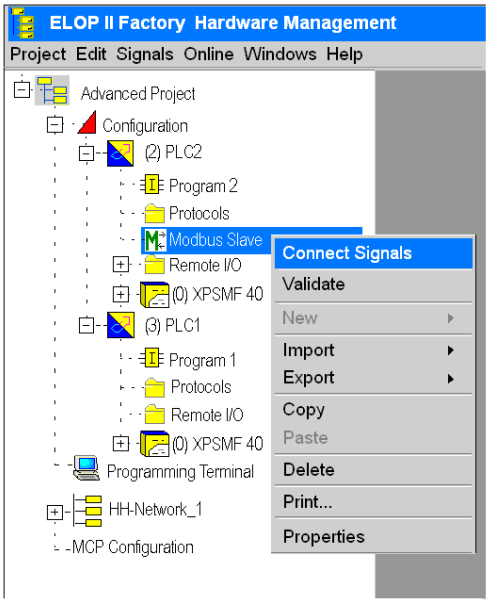
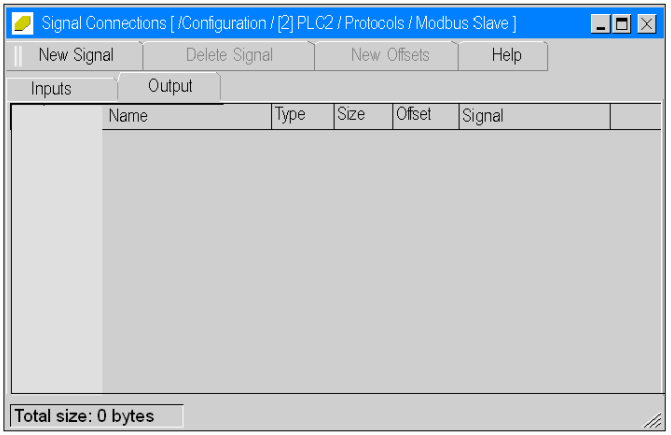
Defining Input / Output Signals

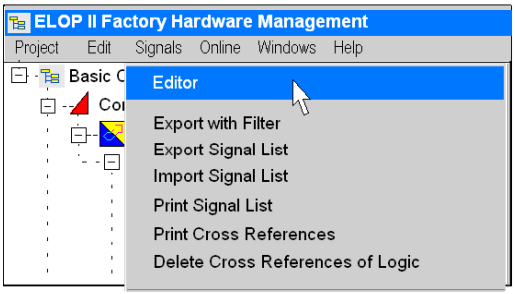
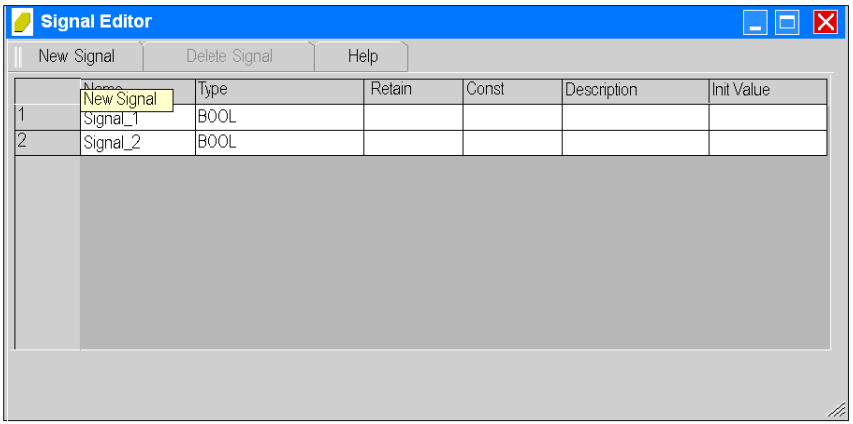
Overview

Define the required signals which will be used by the HMI Magelis for reading / writing data.

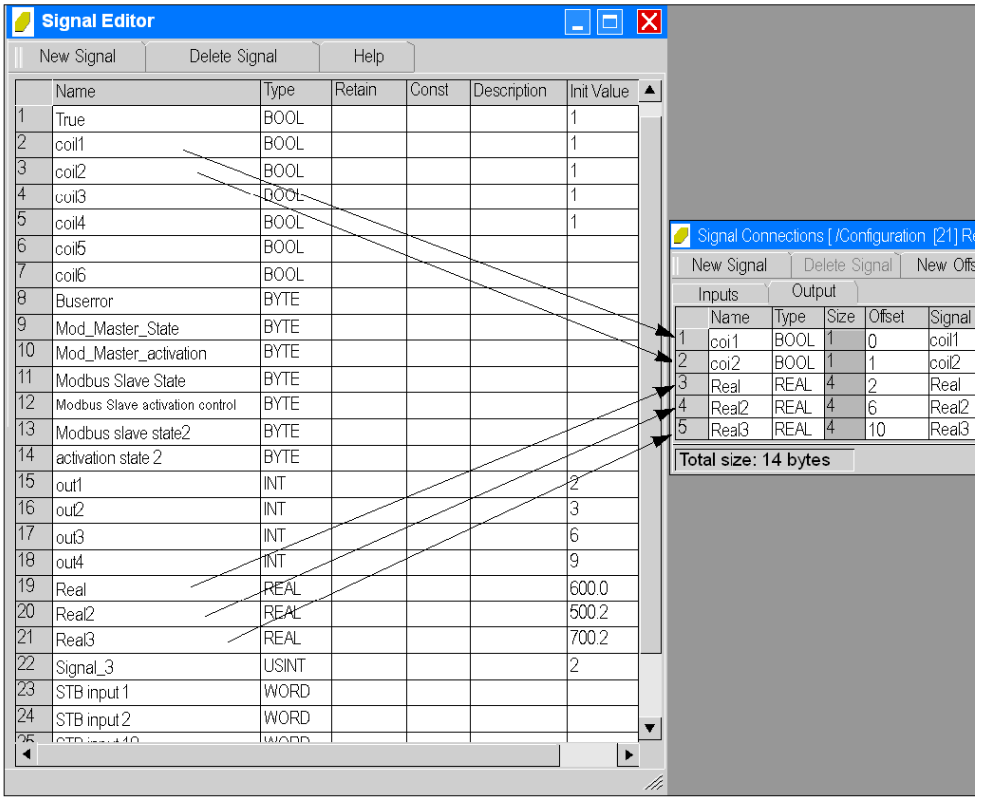
Connecting Signals

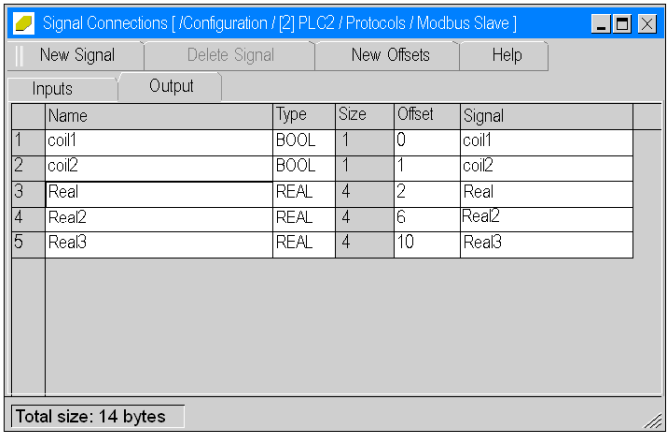
To define input / output signals proceed as follows:

Step	Action
1	To define the signals which you require read or written to, right-click on **Modbus Slave** and select **Connect Signals** from the context menu.  **Result:** The **Signals Connections** dialog box will be displayed.  **Note:** The **Signals Connections** dialog box has 2 tabs, **Inputs** and **Outputs**. The **Inputs** tab defines all inputs from the HMI Magelis. The **Inputs** area is where the HMI Magelis writes data to. The **Outputs** tab define all outputs to the HMI Magelis. The **Outputs** area is where the HMI Magelis reads data from.

Step	Action
2	Additionally open the **Signal Editor** from the **Signals** menu to create input / output signals as follows: In the menu bar of the **Hardware Management** click on **Signals** → **Editor**. 
3	Click on **New Signal** and create new signals within the **Signal Editor**. 
4	Rename the new signals, assign the signal type as required and create a description for each signal. Note: All signals can also be created using an Excel file and can be imported to XPSMFWIN (ELOP II). For further information please refer to the chapter Importing and Exporting Signals in the *XPSMFWIN Software Manual*.

Step	Action
5	Arrange the **Signal Editor** and the **Signal Connections** windows next to each other (side by side) on your desktop.

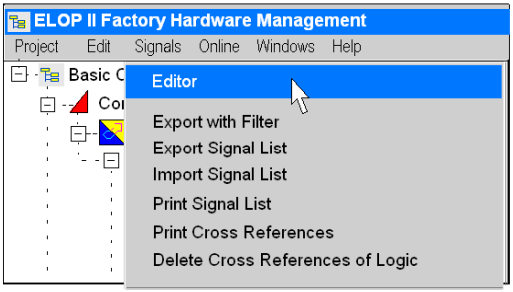
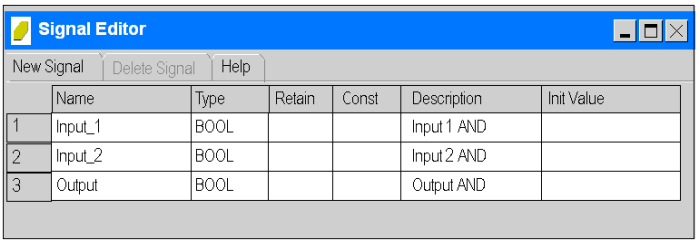


Step	Action
6	Select from the **Signal Editor** the signals you wish to transfer to the Modbus Slave Input / Output tab and drag and drop the signals into **Inputs** and **Output** tabs of the **Signal Connections** dialog box:
7	After you have inserted all required signals, select the **New Offsets** tab. The offsets are the %MW address areas used by the Premium PLC (or any other Modbus device) to read from and write to. The address parameters are automatically set by selecting the **New Offsets** tab: 

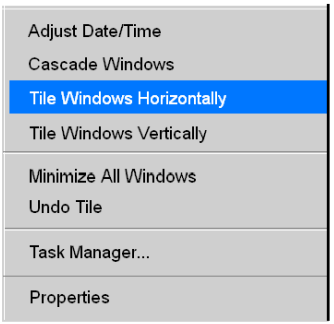
	Name	Type	Size	Offset	Signal
1	coil1	BOOL	1	0	coil1
2	coil2	BOOL	1	1	coil2
3	Real	REAL	4	2	Real
4	Real2	REAL	4	6	Real2
5	Real3	REAL	4	10	Real3

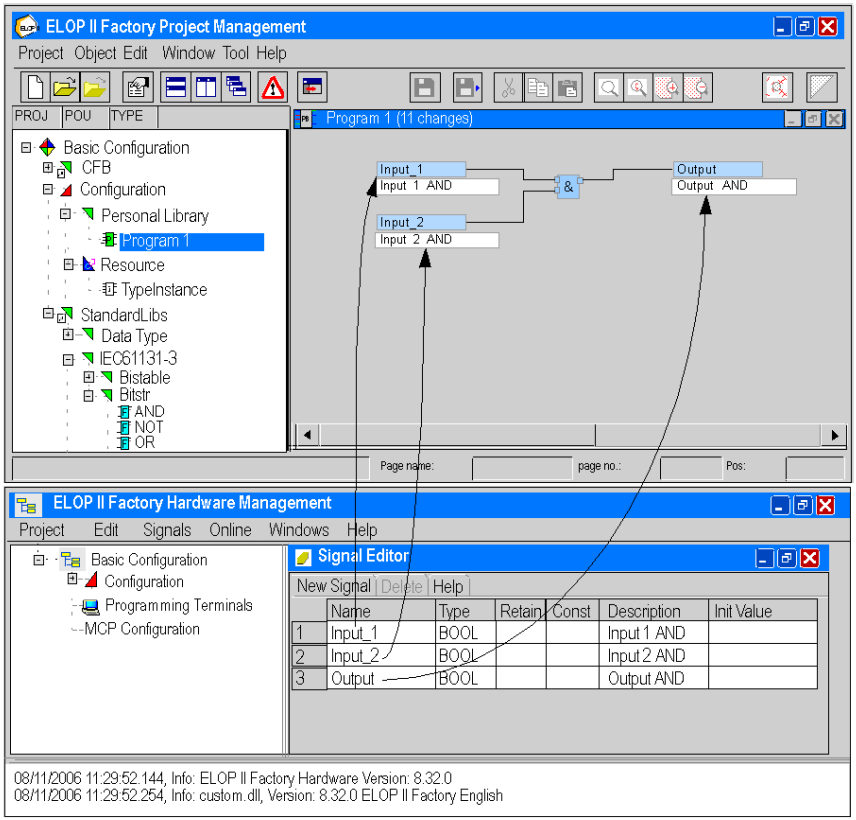
Creating Signals

The creation of signals is done in the **Hardware Management** window.

Step	Action
1	In the menu bar of the **Hardware Management** click on **Signals** → **Editor**. 
2	Click on **New Signal** and create 3 signals.  Name Type Retain Const Description Init Value 1 Input_1 BOOL Input 1 AND 2 Input_2 BOOL Input 2 AND 3 Output BOOL Output AND
3	Rename the signals and create a description for each.

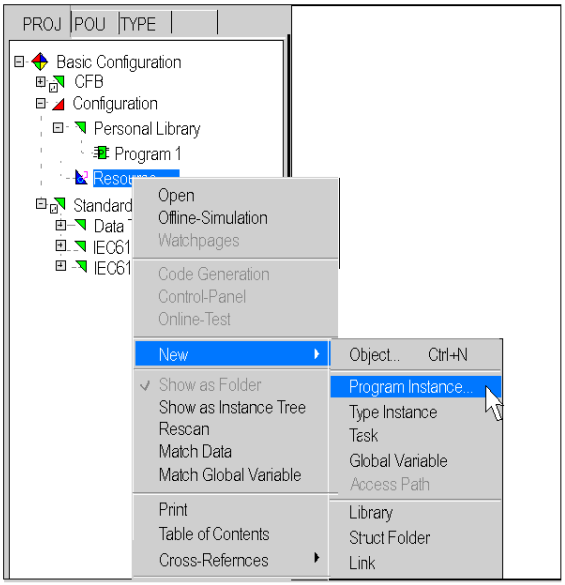
Connecting Signals to Logical Program

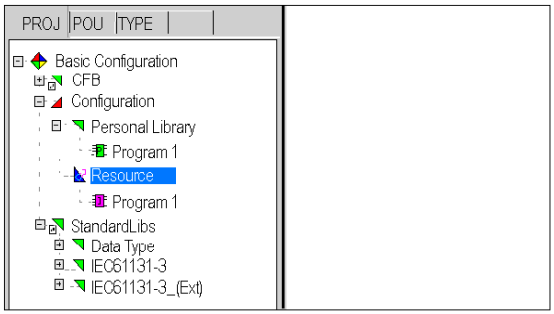
Step	Action
1	Minimize all programs which are running except the **Hardware Management** and **Project Management** window.
2	On the Windows task bar select **Tile Windows Horizontally**. 
3	Select the signal from the **Signal Editor** in the **Hardware Management** and drag the signal to a free space in the **Project Management** window.

Step	Action
4	Repeat until all 3 signals are in the **Project Management**. **Result:** 
5	Minimize the **Hardware Management** and maximize the **Project Management** window.
6	To connect the signals to the `AND` gate: Left-click on a node of the `AND` function block, press and hold the left mouse button and drag to a signal.
7	The program is now complete, use the save button to save the program, and close the program after saving.

Creating Program Connection to a Resource

The following steps show the procedure to delete the type instance and assign the program.

Step	Action
1	Delete the default type instance from the resource by clicking on **TypeInstance** and press DEL (delete).
2	Right-click on **Resource** and select **New** → **Program Instance...** to attach your configuration from the personal library folder. 

Step	Action
3	From **Personal Library** select **Program 1**.
4	When the program instance is connected a purple **I** can be seen attached to the **Resource**.  Now the logical program is connected to the resource (however the hardware type is not defined).

General Notes on Defining Addressing Areas

Overview

The following paragraphs provide general information on defining addressing areas.

Data Transfer Size

Data exchanged between XPSMF and Premium PLCs is packed in packets with the minimum data size of Word (2 bytes).

You can convert those signals that are smaller than 2 bytes (`BOOLEAN`, `BYTE`, `SINT`, `USINT`) into 1 Word, e.g. by putting 16 Boolean signals together, in the **Project Management** window. This reduces network load as well as the PLCs cycle time.

Make sure that there is always an even number of bytes within the Modbus **Signal Connections** window. If necessary, use packing signals.???

The size of the signals in the Modbus **Signal Connections** window is represented in bytes.

Data Types and Sizes

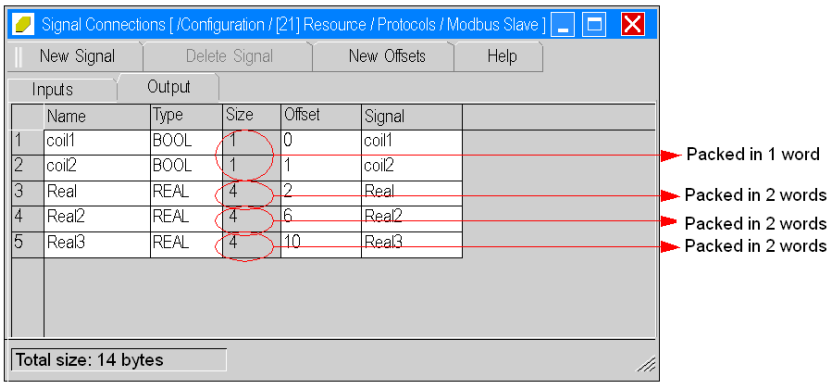
The following table lists the data types and their sizes:

Data Type	Size
BOOLEAN	1 byte
BYTE	1 byte
USINT	1 byte
SINT	1 byte
INT	2 bytes
UINT	2 bytes
WORD	2 bytes
DWORD	4 bytes
DINT	4 bytes
REAL	4 bytes
UDINT	4 bytes
LREAL	8 bytes
TIME	8 bytes

For the 1 byte signals it is recommended to use packing signals but not obligatory.???

Example of Packing Signals

The graphic below shows an example of packing signals:



The offset address area is stored in bytes.The HMI Magelis terminal must therefore read the following address areas when requesting the 5 signals of the above example

Signal	Address Area Index	No. of Words Transferred
`coil1` (BOOL)	0	half word for transfer of Boolean (packed with second Boolean signal)
`coil2` (BOOL)	1	half word for transfer of Boolean (packed with first Boolean signal)
`Real` (REAL)	2	2 Words for transfer or Real (indexes 2 and 3)
`Real2` (REAL)	4	2 Words for transfer or Real (indexes 4 and 5)
`Real3` (REAL)	6	2 Words for transfer or Real (indexes 6 and 7)

Note: Make sure to have an even number of Boolean signals in the **Signal Connections** window. If you have an uneven number of Boolean signals, insert an additional Boolean signal for correct data sequencing.

Verifying Addressing Areas with Online-Test Function

To verify that the signals you configured are read from / written to the correct address, use the Online test function of XPSMFWIN. We recommend to carry out a full test plan to help to ensure that data is transferred correctly.

When you start creating your program, attempt only to send and receive 1 signal in each direction. Test the functions and add the remaining signals when everything works as required.

Finishing Address Configuration

After you have completely configured the program, close the dialog boxes (**Signal Editor**, **Signal Connections**) and code generate your complete project within the **Project Management** window of XPSMFWIN.

Communication Signals Received from the HMI Magelis Terminal

You can use the communication signals which have been received from the HMI Magelis terminal within the users program by dragging them from the **Hardware Management** dialog box into the **Project Management** dialog box. For more information on this procedure see the *XPSMFWIN Software Manual*.

Communication Signals Read by the HMI Magelis Terminal

Signals which are being read by the HMI Magelis terminal can come from the user program or from system signal areas such as the CPU dialog box of each Safety PLC / Remote I/O.

17.2 Vijeo Designer Configuration

Overview

This section describes Vijeo Designer configuration of an HMI Magelis terminal for communication with XPSMF Safety PLCs.

What's in this Section?

This section contains the following topics:

Topic	Page
Configuring the Modbus TCP/IP Connection in Vijeo Designer	311
Configuring Variables in Vijeo Designer	313

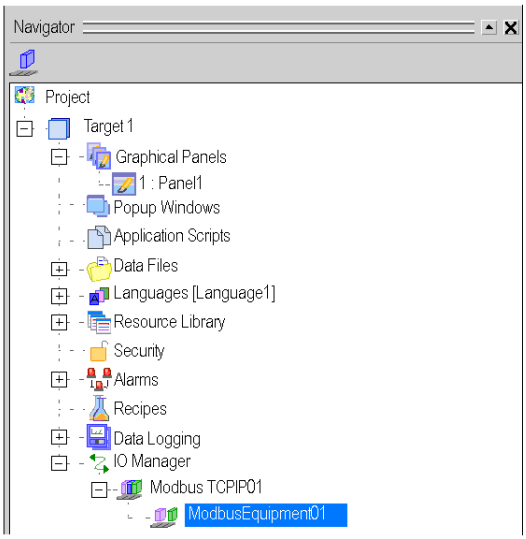
Configuring the Modbus TCP/IP Connection in Vijeo Designer

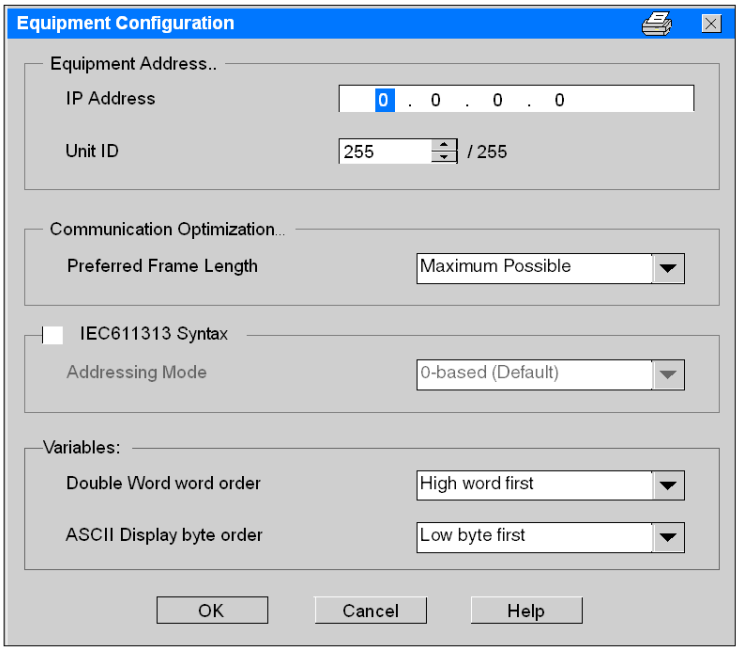
Overview

For communication with a HMI Magelis terminals you first of all have to configure the Modbus TCP/IP Connection in the Vijeo Designer programming software.

Configuring the Modbus TCP/IP Connection

To configure the Modbus TCP/IP connection proceed as follows:

Step	Action
1	Start Vijeo Designer and create a new project.
2	Define the Magelis HMI terminal and IP configuration using the project wizard.
3	Define the relevant configuration for the HMI Magelis terminal (the required display design for the project).
4	Create a new Modbus TCP/IP connection by selecting **New Device Driver** from the Vijeo Designer **Navigator**. Enter `Modbus TCP/IP` as name for this Modbus TCP/IP connection. Result: The new **Modbus TCP/IP** entry will be displayed in the **Navigator** as subnode of **IO Manager**.
5	Right-click on the item **ModbusEquipment01** of the new **Modbus TCP/IP** entry:  **Result**: The **Equipment Configuration** dialog box will be displayed.

Step	Action
6	In the **Equipment Configuration** dialog box configure the following:  • **IP Address**: enter the IP address of the Safety PLCs you want to read data from / write data to. • **Unit ID**: enter 255 for Modbus TCP/IP slave • **Communication Optimization** → **Preferred Frame Length**: select **Maximum Possible** from the list • **IEC611313 Syntax**: select this checkbox • **Variables** → **Double Word word order**: select **High word first** from the list • **ASCII Display byte order**: select **Low byte first** from the list
7	Click **OK** to confirm and close the dialog box.

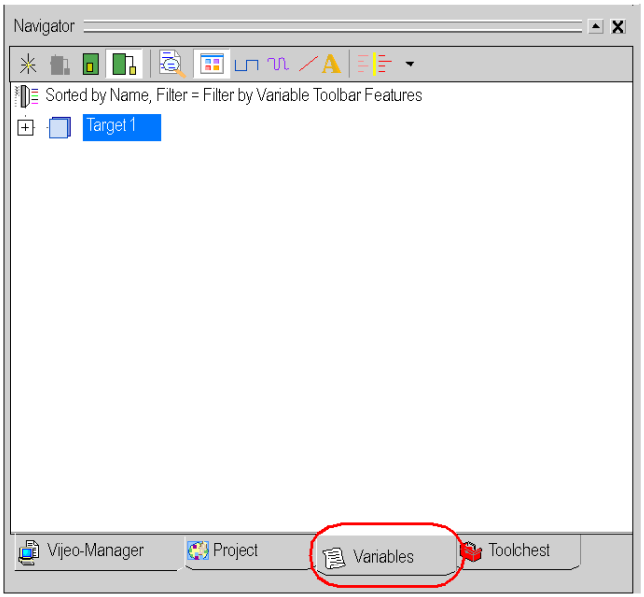
Configuring Variables in Vijeo Designer

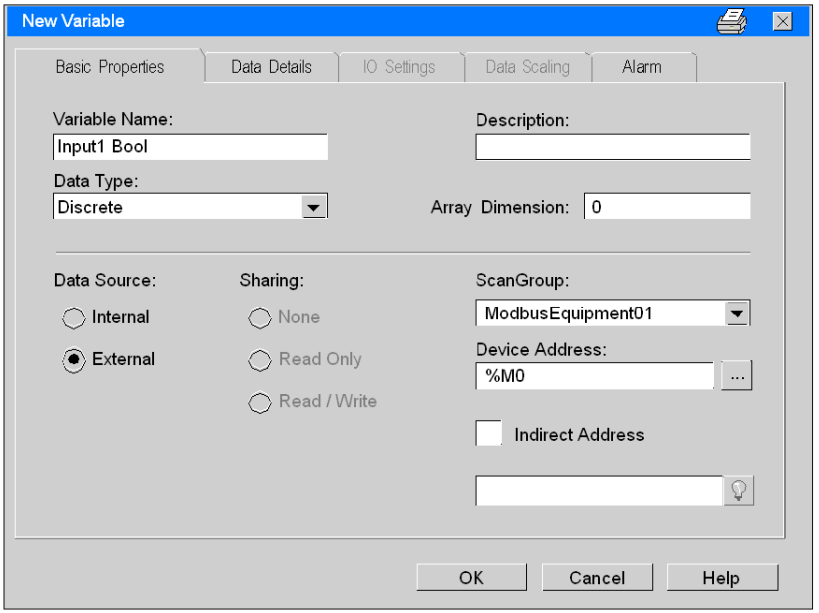
Overview

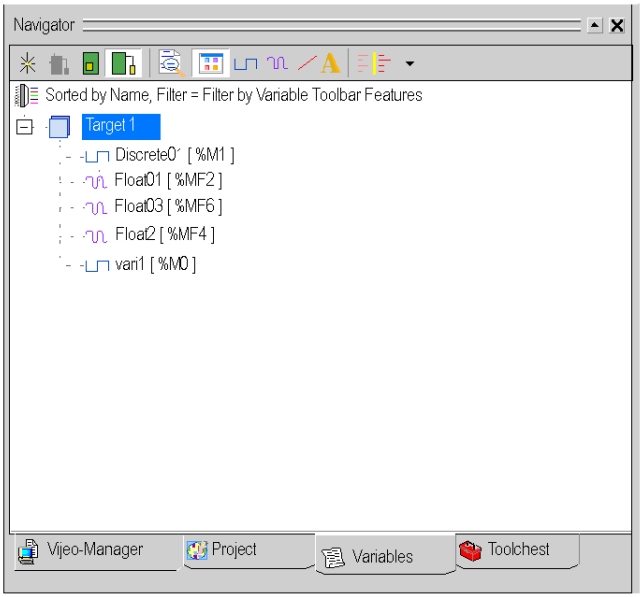
The paragraphs below describe how to define variables with Vijeo Designer.

Configuring Variables

To configure the variables in Vijeo Designer proceed as follows:

Step	Action
1	In the **Navigator** dialog box select the **Variables** tab: 

Step	Action
2	Right-click the **Target1** entry to open the **New Variable** dialog box:  In the **New Variable** dialog box create new variables for Boolean values (data type: discrete) and for real values (data type: float). ● **Variable Name**: enter a name for the variable ● **Data Type**: select the data type (**Discrete** or **Float** from the list ● **Data Source**: select the option **External** ● **Device Address**: enter the address areas
3	Click **OK** to confirm and close the dialog box.

Step	Action
4	In the **Variables** tab of the **Navigator** dialog box the new variables will be displayed and you can now attach them to various objects on the HMI panel: 
5	After you have completed the project, build the project and download it to the HMI terminal (make sure that you have assigned the correct IP address to the Magelis terminal in the **Offline** tab **Network Settings** on the Magelis terminal. The HMI terminal can now read and write to the values of the Safety PLC. **Note**: Check the consistency between values in both software platforms.

Communication between Safety PLCs and Advantys STB

18

Overview

The XPSMF Safety PLCs can be used to control non-safety Ethernet STB Remote I/O. This chapter describes configuration of XPSMF Safety PLCs and Advantys STB for communication via Ethernet (Modbus TCP/IP) using the following 2 software tools:

- Advantys programming software for creating the STB and the number of words required for communication
- XPSMFWIN for creating a Modbus TCP/IP client and defining signals and address areas form the STB to be read or written to

What's in this Chapter?

This chapter contains the following sections:

Section	Topic	Page
18.1	Advantys STB Configuration	320
18.2	XPSMFWIN Configuration	333
18.3	Troubleshooting	365

18.1 Advantys STB Configuration

Overview

This section describes Advantys_STB configuration of an Ethernet STB Remote I/O for communication with XPSMF Safety PLCs.

What's in this Section?

This section contains the following topics:

Topic	Page
Hardware Configuration of Advantys STB	321
Accessing and Configuring Advantys STB via Web Server	325
Addressing in Advantys STB	328

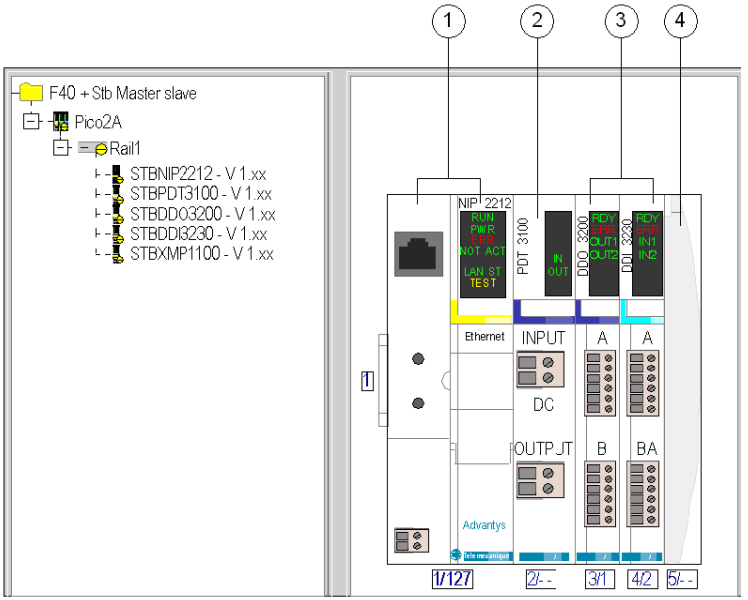
Hardware Configuration of Advantys STB

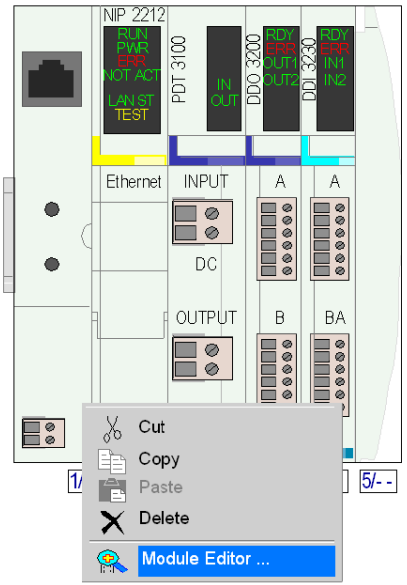
Overview

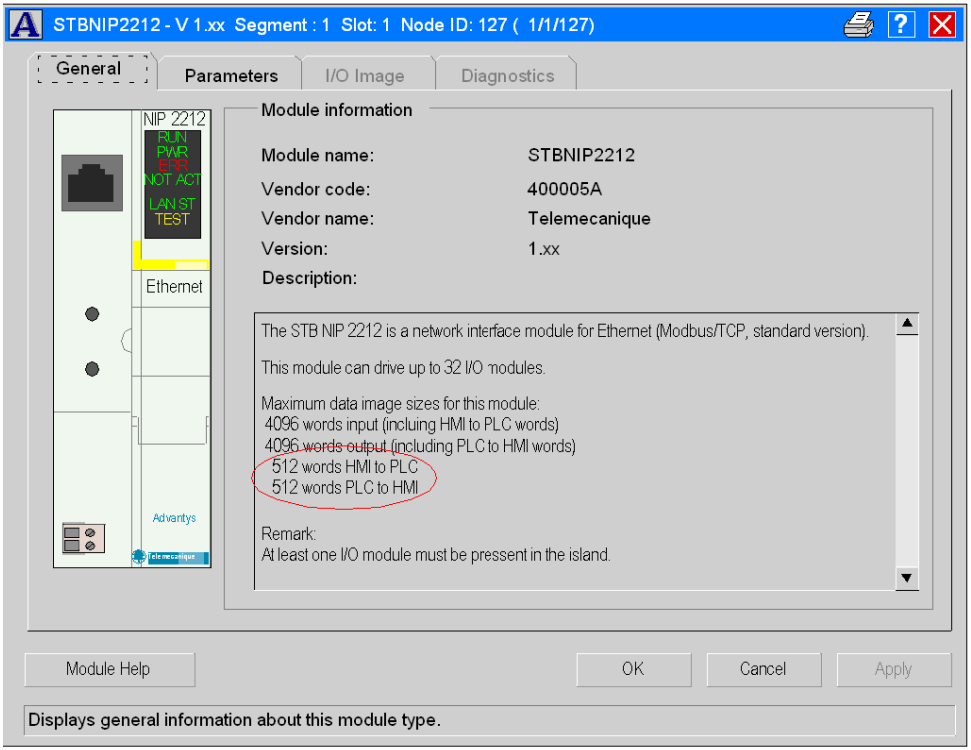
The first step in Advantys STB configuration is defining the available hardware in the Advantys STB programming software.

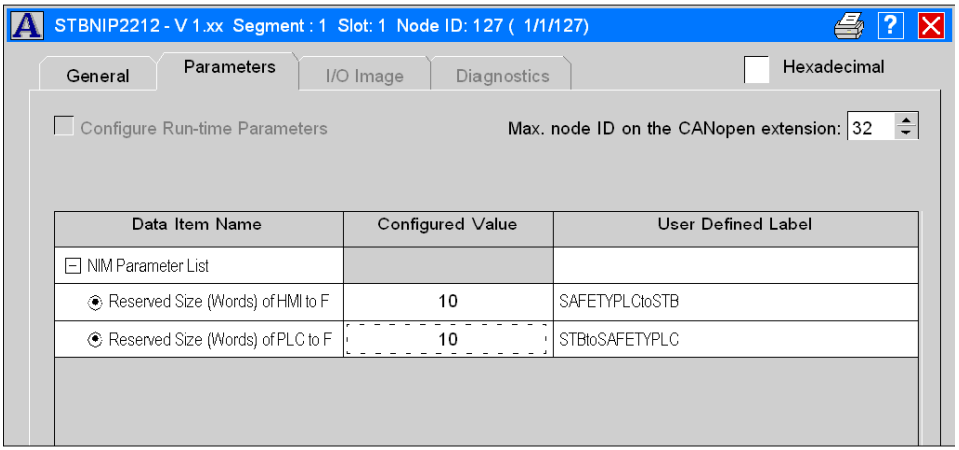
Configuring Advantys STB Hardware

To configure the Advantys STB hardware proceed as follows:

Step	Action
1	Open the Advantys STB programming software and create a new project.
2	Define the available hardware as in the example below:  **1** NIM: communications interface **2** power supply for DIO **3** DIO modules **4** terminator

Step	Action
3	Right-click the NIM module and select the command **Module Editor** from the context menu:  **Result**: The editor for the NIM module opens.

Step	Action
4	The **General** tab of the editor indicates the maximum words available for communications between Safety PLC and Advantys STB. 

Step	Action
5	Open the **Parameters** tab to set the number of words for communication:  In the **Reserved Size (Words) of HMI to PLC** line enter the number of words to be transferred from the Safety PLC to the Advantys STB. In the **Reserved Size (Words) of PLC to HMI** line enter the number of words to be transferred from the Advantys STB to the Safety PLC.

Accessing and Configuring Advantys STB via Web Server

Overview

Communications with the Advantys_STB are performed via its web server. The paragraphs below describe how to access the web server.

Accessing the Web Server

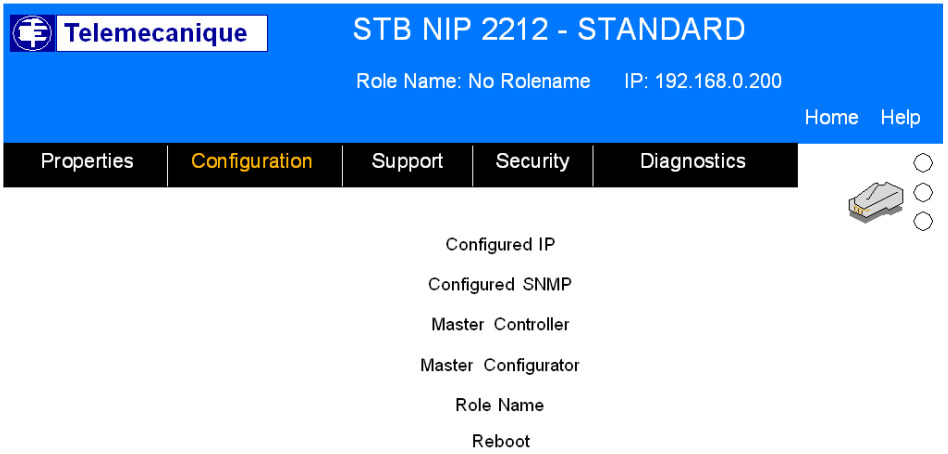
To access the Advantys STB web server proceed as follows:

Step	Action
1	Convert the MAC address of the NIM module into decimal format using a scientific calculator (e.g. Microsoft Calculator). **Example**: MAC address of the NIM module: 00.00.54.11-EC.D9 Resulting IP address of the web server: 84.17.236.217 (with the first set of zeros ignored)
2	Change the IP address of the programming terminal (PC) via **Start** → **Control Panel** → **Network and Dial-up Settings** → **Properties**. Set the IP address of your PC to an IP address similar to the web server, such as `84.17.236.216`, and use the subnet mask `255.0.0.0`.
3	Open your web browser and enter the IP address of the Advantys STB web server in the **Address** field. **Result**: The Advantys STB web server will be displayed. Hint: In case the Advantys STB web server does not open, refer to the **Read Help** file of the NIM module.
4	Log into the Advantys STB web server: **User name** = `USER` **Password** = `USER`

Configuring Advantys STB

In the Advantys STB web server click the **Configuration** tab to configure your STB.

Configuration tab of the STB web server



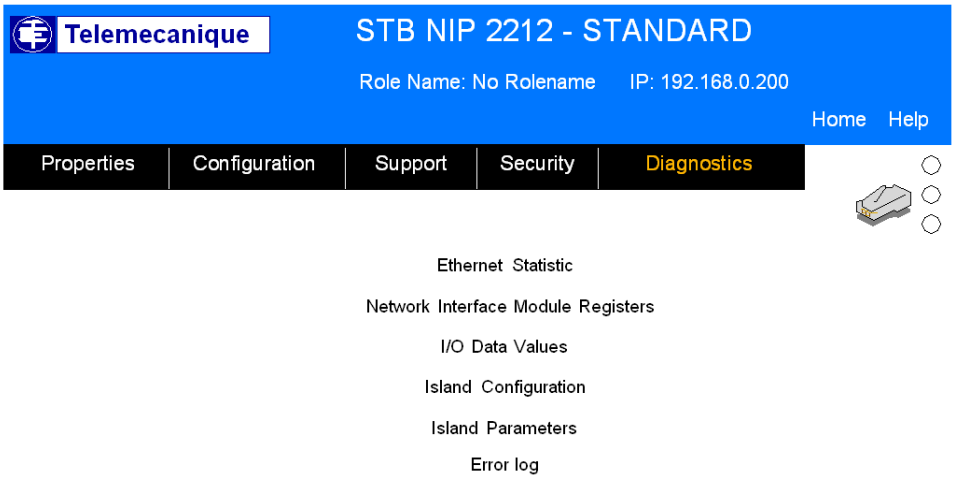
The individual links provide access to different configuration pages:

Link	Configuration to be performed
Configured IP	Configure the IP address of the Advantys STB.
Master Controller	Configure the IP addresses of Modbus master PLC's or HMI terminals. We recommend to configure IP addresses for up to 3 master devices. It is technically possible to define more master devices but 3 masters will then be assigned priority over the remaining master devices.
Master Configurator	Configure the IP address of the PC for programming.
Role Name	To use the configurations made here, set the rotary switch on the NIM module to **Internal**.

Statistical Information and Troubleshooting

For statistical information and to get further information that may help solving problems click the **Diagnostics** tab.

Diagnostics tab of the STB web server



The individual links provide access to different information pages:

Link	Information Provided
Ethernet Statistics	provides diagnostic information
Network Interface Module Registers	Set address and view information being sent over Modbus TCP.
I/O Data Values	provides all physical I/O information
Island Configuration	provides island statistics
Island Parameters	provides general information on STB island
Error Log	provides error information

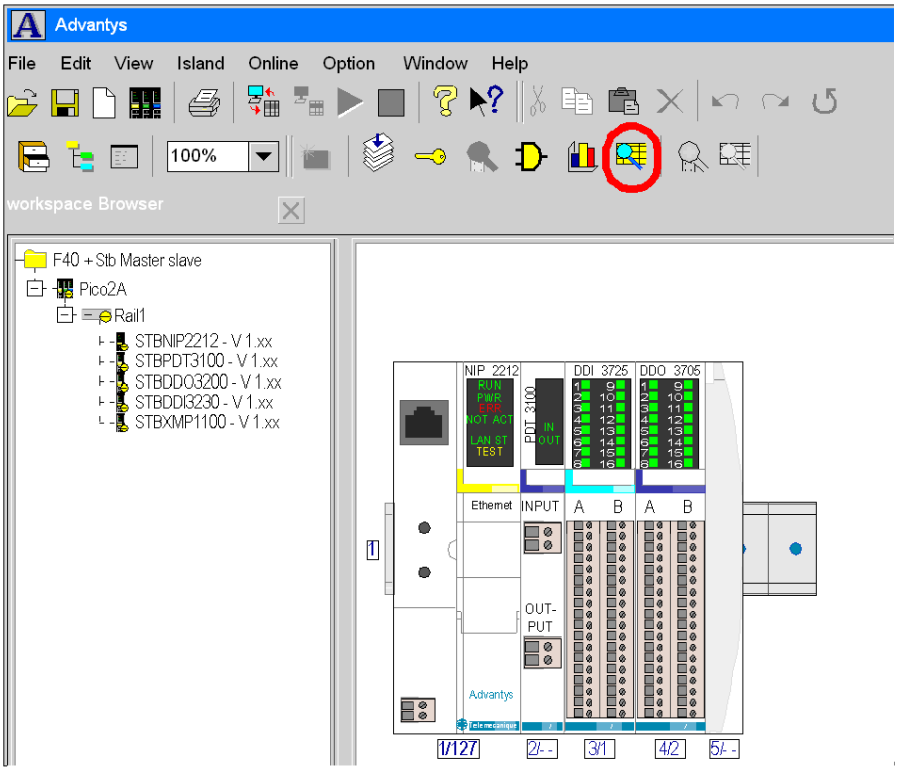
Addressing in Advantys STB

Overview

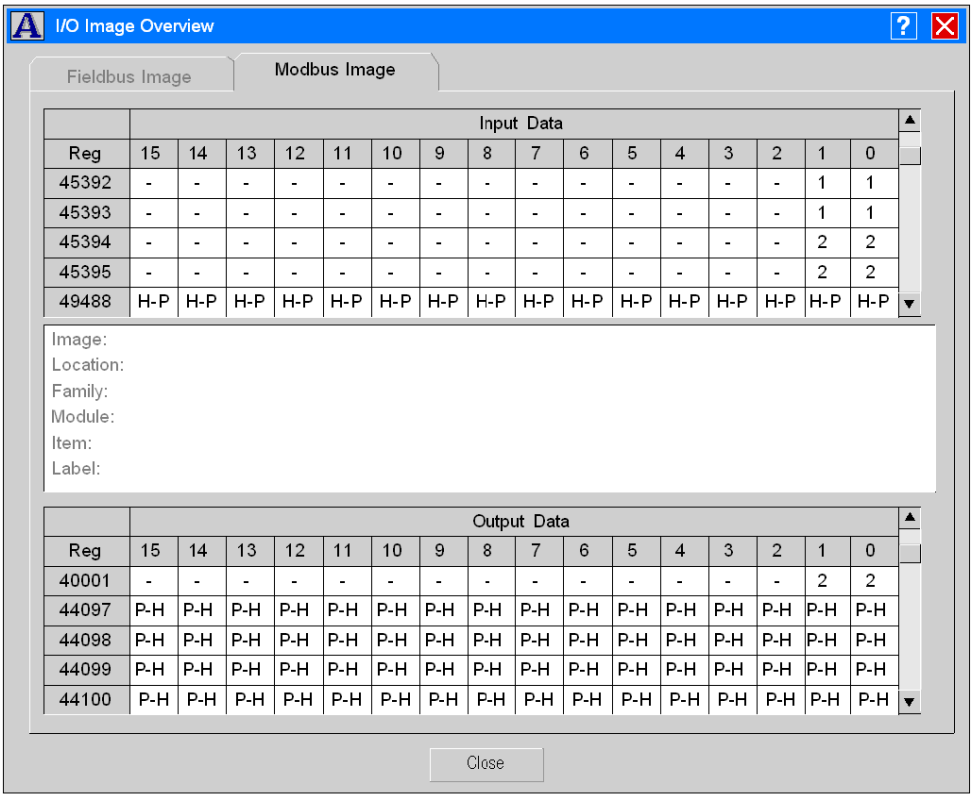
The paragraphs below describe how to configure address areas in the Advantys STB configuration software.

Configuring Address Areas

To configure address areas in the Advantys STB configuration software proceed as follows:

Step	Action
1	In the Advantys STB configuration software click the ??? button:  Result: The **I/O Image Overview** dialog box will be displayed.

Step	Action
2	The **I/O Image Overview** dialog box shows the areas the Safety PLC can read from / write to.



Input Data

Reg	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
45392	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
45393	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
45394	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
45395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
49488	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P	H-P

Output Data

Reg	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
40001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
44097	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H
44098	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H
44099	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H
44100	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H	P-H

The **Input Data** section indicates the read area.
The **Output Data** section indicates the write area.
Calculate the address areas for the Safety PLC to be configured in XPSMFWIn as follows.
From the original Advantys STB start address of the read / write area

- remove the `4` from the beginning
- subtract `1`

Calculation Examples

The following table shows examples of how to access Advantys STB addresses from Safety PLCs:

Advantys STB Address	Safety PLC Address
read area: 45392	5391
read area: 45394	5393

Advantys STB Address	Safety PLC Address
write area: 40001	0
write area: 44097	4096

18.2 XPSMFWIN Configuration

Overview

This section describes XPSMFWIN configuration of an XPSMF safety PLC for communication with Advantys STB.

What's in this Section?

This section contains the following topics:

Topic	Page
Creating a Modbus TCP/IP Client in XPSMFWIN	334
Creating an Ethernet Slave in XPSMFWIN	340
Diagnostics using Input / Output Signals	346
Defining Input / Output Signals	349
Modbus Function Codes	353
Defining Input / Output Signals for Ethernet Slave	355
General Notes on Defining Addressing Areas	359
Address Areas of Advantys STB	362

Creating a Modbus TCP/IP Client in XPSMFWIN

Overview

For communication with Advantys STB you first of all have to create a Modbus TCP/IP client in the XPSMFWIN (ELOP II) programming software. To create a new Modbus TCP/IP client, add a **Modbus Master** to the resource of your choice in XPSMFWIN as shown below.

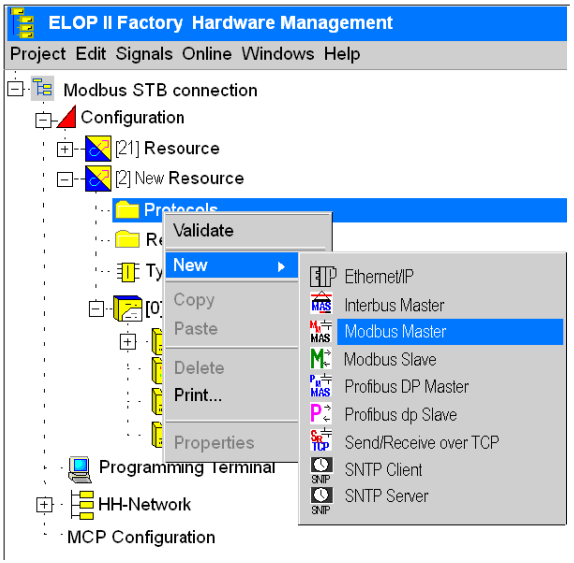
Prerequisites

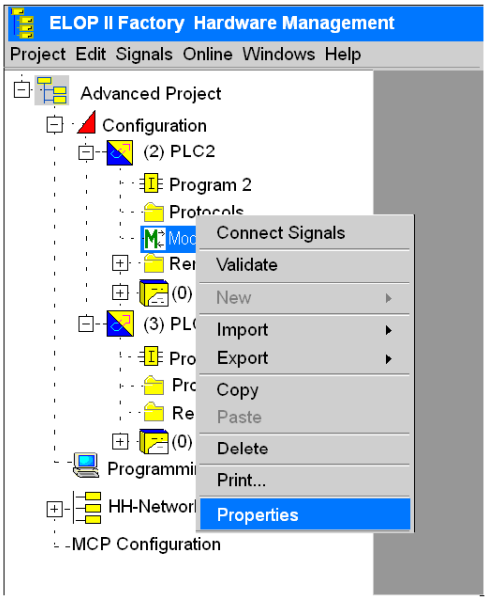
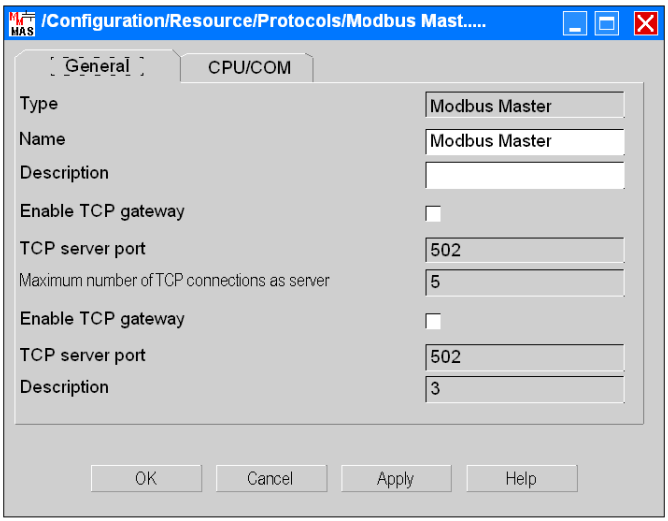
Before you can add a Modbus Master the following steps have to be performed as a prerequisite.

- Start XPSMFWIN from Safety Suite.
- Create a new project in XPSMFWIN.
- Create the required program in the **Project Management** area of XPSMFWIN.
- Define the required hardware in the **Hardware Management** area of XPSMFWIN.

Creating a New Modbus Master

To add a **Modbus Master** proceed as follows:

Step	Action
1	Within the **Hardware Management** window open the project tree as shown below, select the resource you wish to have as Modbus TCP/IP client, right-click on the item **Protocols** of your resource, and select **New** → **Modbus Master** from the context menu: 

Step	Action
2	To assign properties to this new Modbus Master, right-click on the **Modbus Master** and select **Properties** from the context menu.  **Result**: The Modbus Master Properties dialog box will be displayed. 

Step	Action
3	You do not have to change any settings of the Modbus Master Properties. Just click **OK** to confirm and close the dialog box.

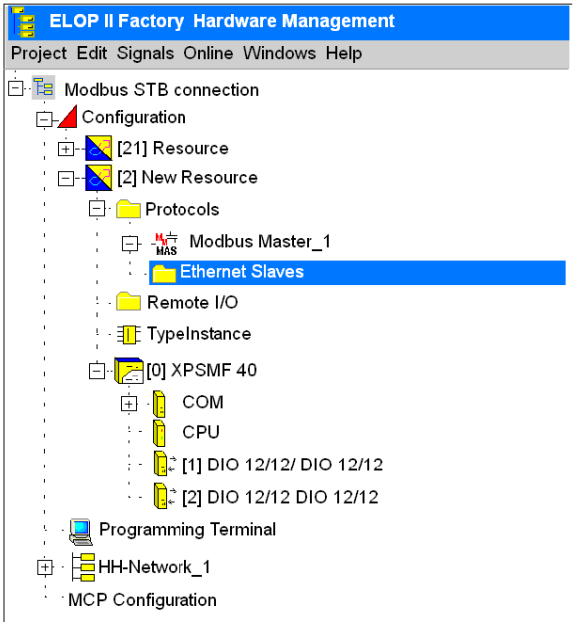
Creating an Ethernet Slave in XPSMFWIN

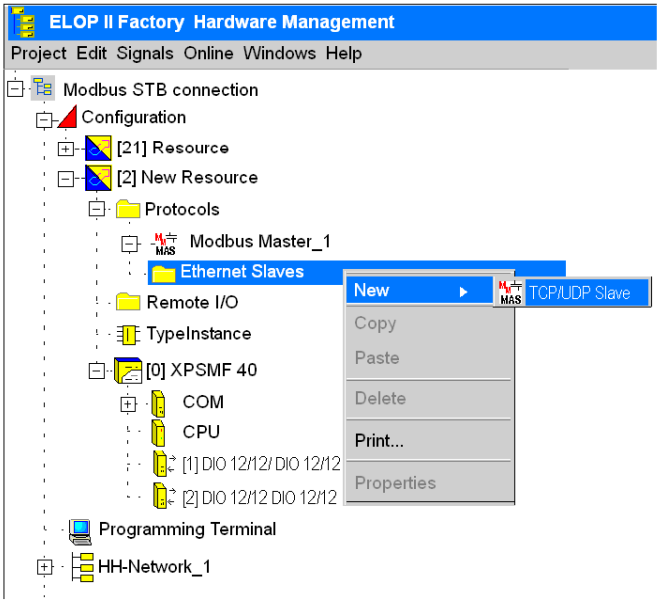
Overview

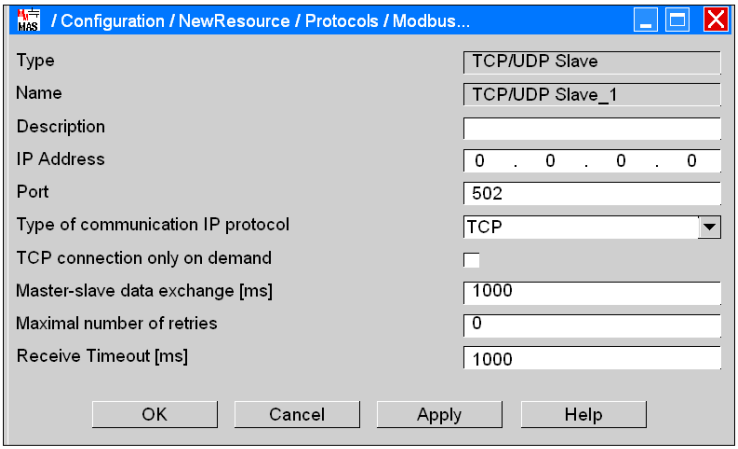
For the **Modbus Master** you have to create and configure **Ethernet Slaves** in XPSMFWIN as described in the following.

Creating New Ethernet Slaves

To create and configure a **Ethernet Slaves** proceed as follows:

Step	Action
1	Within the project tree click the plus sign in front of your new **Modbus Master** protocol to view the **Ethernet Slaves** folder: 

Step	Action
2	To assign properties to the Ethernet Slave (which will be the STB), right-click on **Ethernet Slaves** and select **New** → **TCP/UDP Slave** from the context menu.  **Result**: The properties dialog box of the TCP/UDP slave will be displayed.

Step	Action
3	In the properties dialog box of the TCP/UDP slave perform the following settings:  In the **Name** textbox enter a name for your TCP/UDP slave. In the **IP Address** textbox enter the IP address of the STB NIM. The remaining parameters do not require any modifications for initial configuration. Click **OK** to confirm your settings and to close the dialog box.

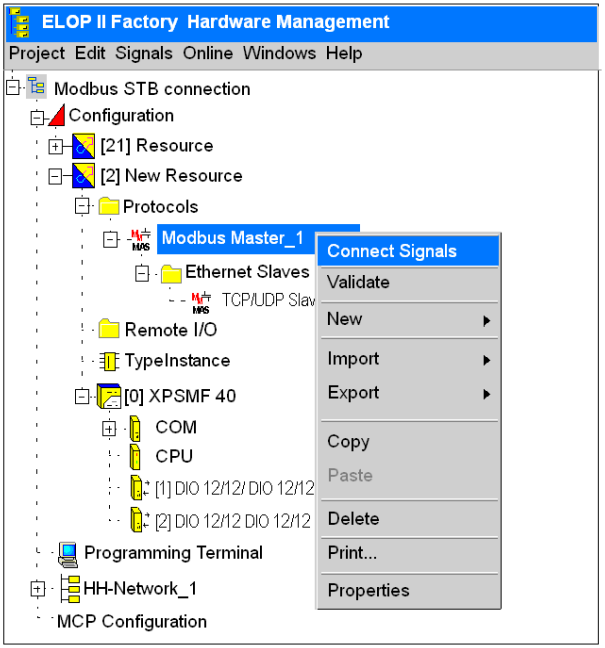
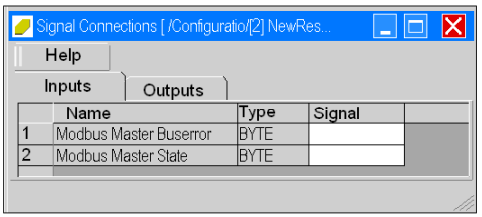
Diagnostics using Input / Output Signals

Overview

Define the required input / output signals which will be used by the Safety PLC for diagnostics on the Modbus master and the TCP/UDP slave.

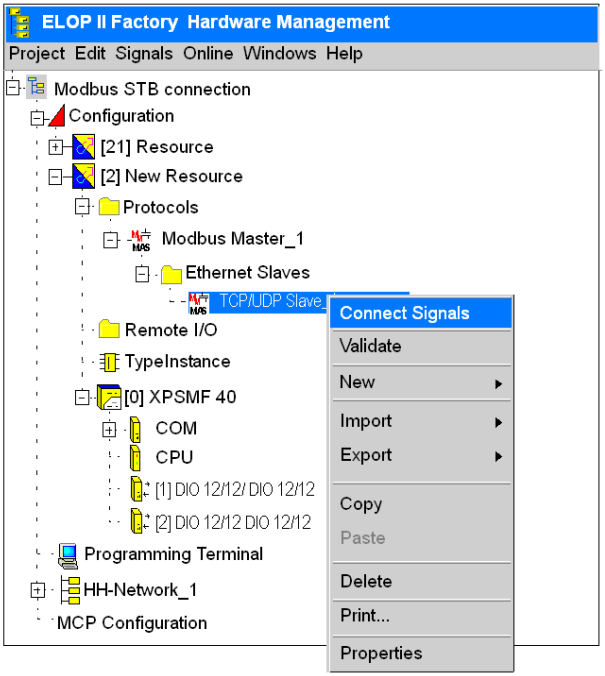
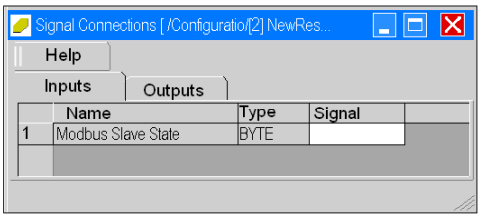
Defining Modbus Master Signals

To define input / output signals of Modbus master proceed as follows:

Step	Action
1	To define input/output signals on the Modbus master for diagnostics of the Safety PLC, right-click on **Modbus Master** and select **Connect Signals** from the context menu.  **Result:** The **Signal Connections** dialog box will be displayed.
2	In the **Signal Connections** dialog box define **Inputs** and **Outputs** for diagnostics information from Modbus master in the respective tabs: 

Defining Ethernet Slave Signals

To define input / output signals of Ethernet slave proceed as follows:

Step	Action
1	To define input/output signals on the Ethernet slave for diagnostics of the Safety PLC, right-click on **TCP/UDP Slave** and select **Connect Signals** from the context menu.  **Result:** The **Signal Connections** dialog box will be displayed.
2	In the **Signal Connections** dialog box define **Inputs** and **Outputs** for diagnostics information from Ethernet slave in the respective tabs: 

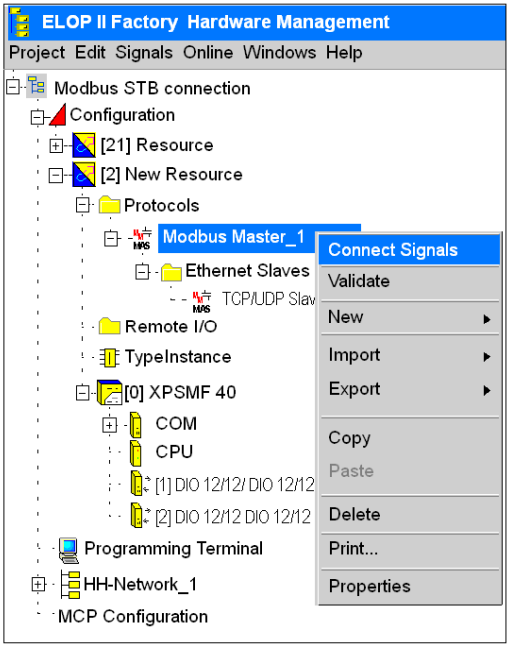
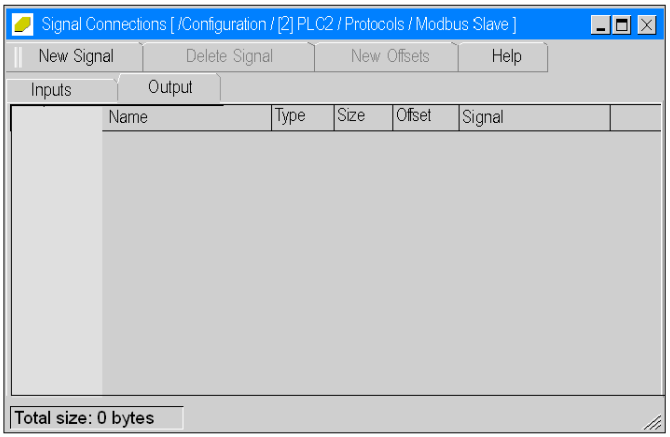
Defining Input / Output Signals

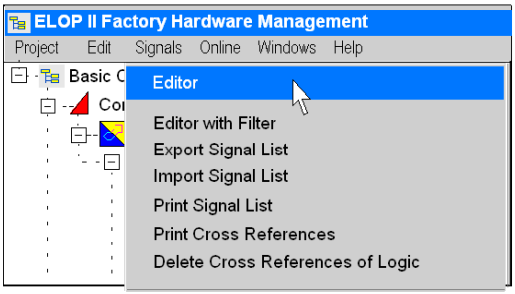
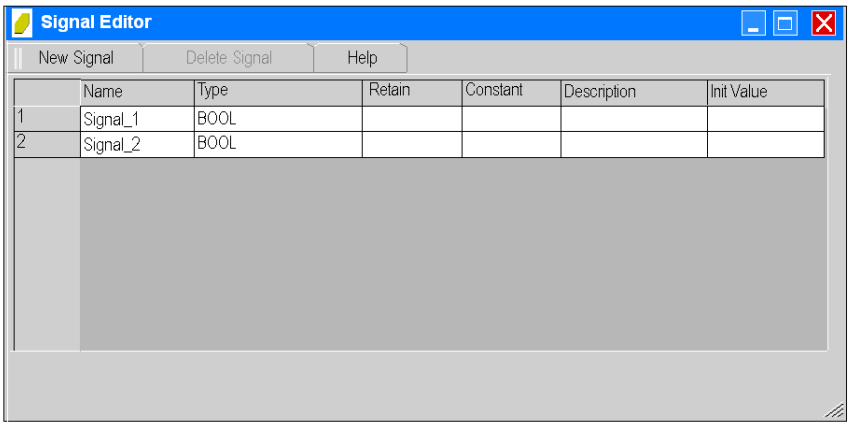
Overview

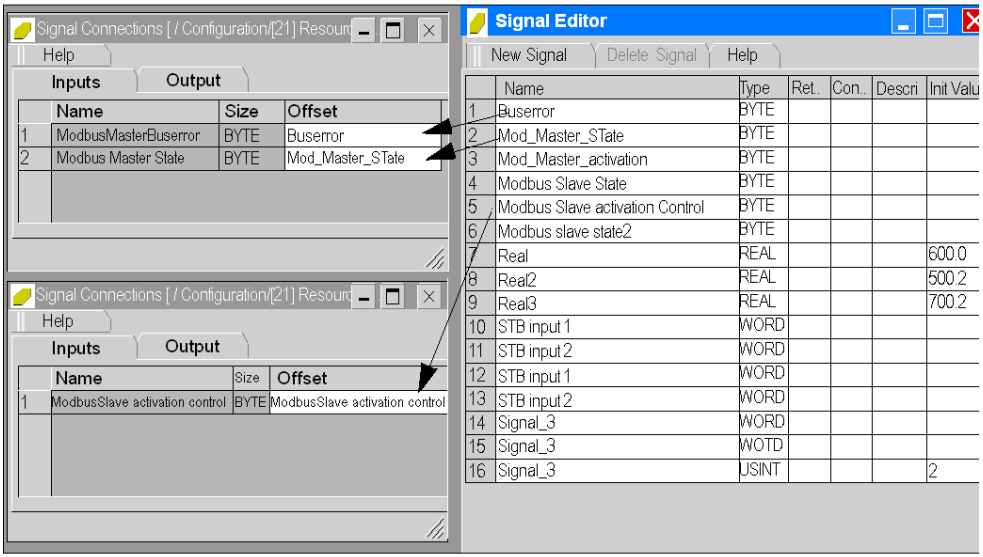
Define the required signals which will be used by the Advantys STB for reading / writing data.

Defining Modbus Input / Output Areas

To define Modbus input / output areas proceed as follows:

Step	Action
1	To define the signals which you require read or written to, right-click on **Modbus Master** and select **Connect Signals** from the context menu.  **Result:** The **Signal Connections** dialog box will be displayed.  **Note:** The **Signal Connections** dialog box has 2 tabs for defining **Inputs** from the Advantys STB (Safety PLC reads Advantys STB data) and **Outputs** for defining outputs to the Advantys STB (Safety PLC writes data to Advantys STB).

Step	Action
2	Additionally open the **Signal Editor** from the menu bar of the **Hardware Management** by clicking **Signals** → **Editor** to create input and output signals. 
3	In the **Signal Editor** click on **New Signal** to create new signals. Rename each signal and assign the appropriate signal type.  **Note:** You can also create all signals in an Excel file and import this into XPSMFWIN. For further information see the *XPSMFWIN Software Manual*.

Step	Action
4	Arrange the **Signal Editor** and the **Signal Connections** dialog boxes next to each other (side by side) on your desktop. 
5	Select from the **Signal Editor** the signals you wish to transfer to the Modbus master / slave and drag and drop the signals into the **Output** tab of the respective **Signal Connections** window.

Modbus Function Codes

Overview

Since the Advantys STB does not support all Modbus function codes you have to define those function codes suitable for communications between the Safety PLC and the Advantys STB.

Supported Read Function Codes

The following read functions can be used in communications between the Safety PLC and the Advantys STB:

- Read Holding Registers (3)

Supported Write Function Codes

The following write functions can be used in communications between the Safety PLC and the Advantys STB:

- Write Single Register (6)
- Write Multiple Registers (16)

Supported Read/Write Function Codes

The following read functions can be used in communications between the Safety PLC and the Advantys STB:

- Read/Write Holding Registers (23)

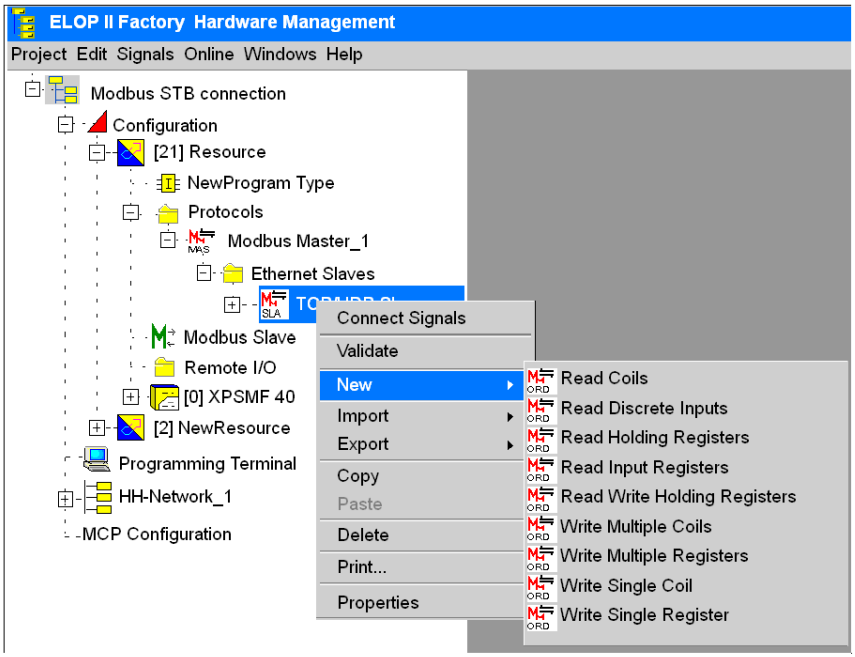
Overview of Supported Function Codes

The following functions codes are compatible between the Safety PLC and the Advantys STB:

Modbus Function Code	Command	Valid Range	Max. No. of Words per Message
3	Read Holding Registers (4x)	1-9999	125
6	Write Single Register (4x)	1-5120 and 9488-9999	1
16	Write Multiple Registers (4x)	1-5120 and 9488-9999	100
23	Read / Write Multiple Registers (4x)	1-5120 and 9488-9999 1-9999 (read)	100 (write) 125 (read)

Selecting Function Codes for Communications

To select the required Modbus functions for communications between he Safety PLC and the Advantys STB proceed as follows:

Step	Action
1	Right-click on **TCP/UDP Slave** and select the command **New**:  **Result**: A list of Modbus function codes will be displayed.
2	From the list of Modbus function codes select those you want to use. Make sure to select only those that are supported by the Safety PLC as well as the Advantys STB as indicated in the above table.

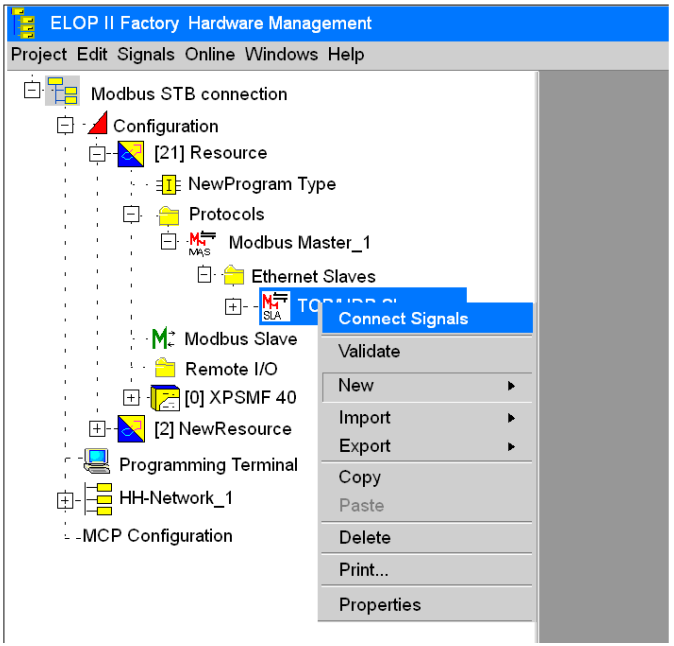
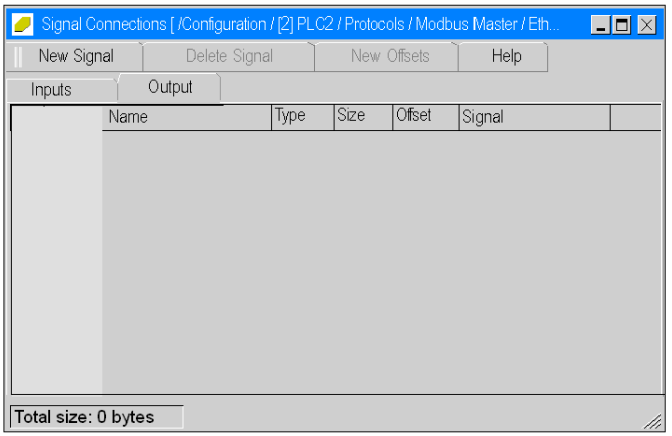
Defining Input / Output Signals for Ethernet Slave

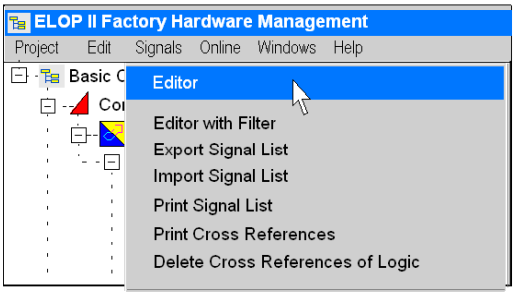
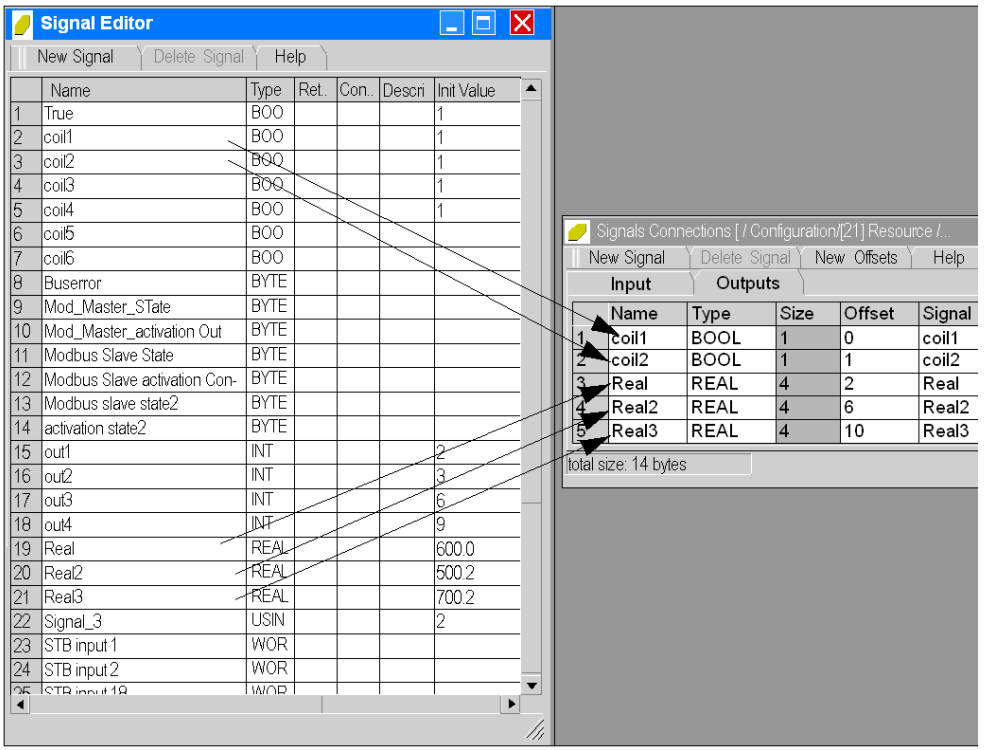
Overview

Define the required input / output signals which will be used by the Advantys STB for data exchange with the Ethernet slave.

Modbus Slave Input / Output Areas

To define input / output signals for Modbus slave proceed as follows:

Step	Action
1	To define the signals which you require read or written to, right-click on **TCP/UDP Ethernet Slave** and select **Connect Signals** from the context menu.  **Result:** The **Signals Connections** dialog box will be displayed.  **Note:** The **Signals Connections** dialog box has 2 tabs for defining **Inputs** read from the STB (Safety PLC reads Advantys STB data) and **Outputs** written to the STB (Safety PLC writes data to the Advantys STB).

Step	Action
2	Additionally open the **Signal Editor** from the menu bar of the **Hardware Management** by clicking **Signals** → **Editor**. 
3	Arrange the **Signal Editor** and the **Signal Connections** dialog boxes next to each other (side by side) on your desktop. 

Step	Action
4	Select from the **Signal Editor** the signals for the relevant read/write data transfer to the Advantys STB and drag and drop the signals into the **Output** tab of the **Signals Connections** window.
5	After you have inserted all required signals, select the **New Offsets** tab. The offsets are the %MW address areas used by the Safety PLC (or any other Modbus device) to read from and write to the STB. The address parameters are automatically set by selecting the **New Offsets** tab:

General Notes on Defining Addressing Areas

Overview

The following paragraphs provide general information on defining addressing areas.

Data Transfer Size

Data exchanged between Safety PLCs and Advantys STB is packed in packets with the minimum data size of Word (2 bytes).

You can convert those signals that are smaller than 2 bytes (`BOOLEAN`, `BYTE`, `SINT`, `USINT`) into 1 Word, e.g. by putting 16 Boolean signals together, in the **Project Management** window. This reduces network load as well as the PLCs cycle time.

Make sure that there is always an even number of bytes within the Modbus **Signal Connections** window. If necessary, use packing signals.???

The size of the signals in the Modbus **Signal Connections** window is represented in bytes.

Data Types and Sizes

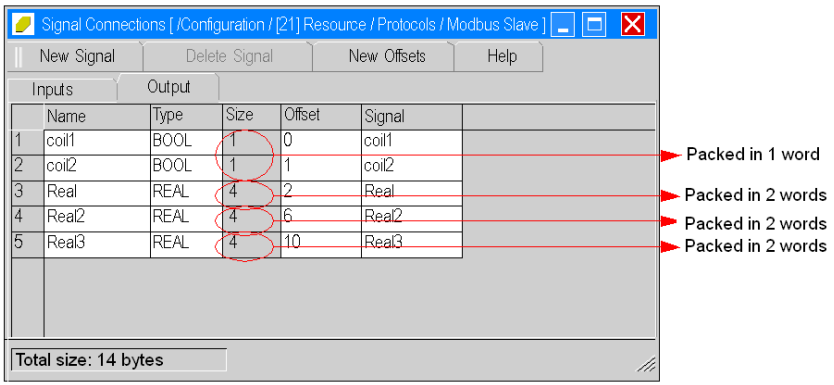
The following table lists the data types and their sizes:

Data Type	Size
BOOLEAN	1 byte
BYTE	1 byte
USINT	1 byte
SINT	1 byte
INT	2 bytes
UINT	2 bytes
WORD	2 bytes
DWORD	4 bytes
DINT	4 bytes
REAL	4 bytes
UDINT	4 bytes
LREAL	8 bytes
TIME	8 bytes

For the 1 byte signals it is recommended to use packing signals but not obligatory.???

Example of Packing Signals

The graphic below shows an example of packing signals:



The offset address area is stored in bytes.The Premium PLC must therefore read the following address areas when requesting the 5 signals of the above example

Signal	Address Area Index	No. of Words Transferred
`coil1` (BOOL)	0	half word for transfer of Boolean (packed with second Boolean signal)
`coil2` (BOOL)	1	half word for transfer of Boolean (packed with first Boolean signal)
`Real` (REAL)	2	2 Words for transfer or Real (indexes 2 and 3)
`Real2` (REAL)	4	2 Words for transfer or Real (indexes 4 and 5)
`Real3` (REAL)	6	2 Words for transfer or Real (indexes 6 and 7)

Note: Make sure to have an even number of Boolean signals in the **Signal Connections** window. If you have an uneven number of Boolean signals, insert an additional Boolean signal for correct data sequencing.

Verifying Addressing Areas with Online-Test Function

To verify that the signals you configured are read from / written to the correct address, use the Online-Test function of XPSMFWIN. We recommend to carry out a full test plan to help to ensure that data is transferred correctly.

When you start creating your program, attempt only to send and receive 1 signal in each direction. Test the functions and add the remaining signals when everything works as required.

Finishing Address Configuration

After you have completely configured the program, close the dialog boxes (**Signal Editor**, **Signal Connections**) and code generate your complete project within the **Project Management** window of XPSMFWIN.

Licensing

Ensure that you have a valid Modbus Client license.

Communication Signals Received from the Premium PLC

You can use the communication signals which have been received from the Advantys STB within the users program by dragging them from the **Hardware Management** dialog box into the **Project Management** dialog box. For more information on this procedure see the *XPSMFWIN Software Manual*.

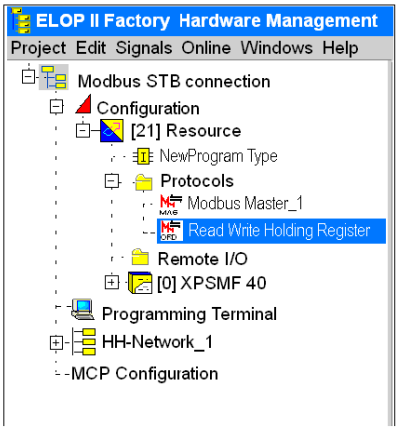
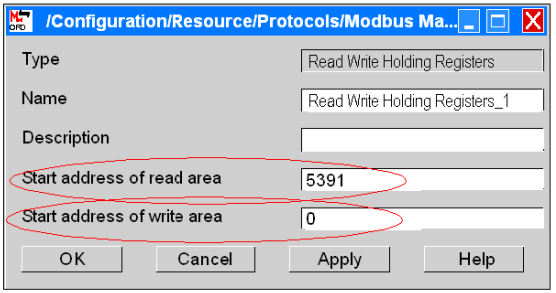
Address Areas of Advantys STB

Overview

To perform this step of addressing Advantys STB it is required that you set up Advantys STB.

Defining Address Areas of Advantys STB

To define the address areas of Advantys STB proceed as follows:

Step	Action
1	Right-click a Modbus function code item in the project tree, below the **Modbus Master** folder and select the **Properties** command:  **Result**: The properties dialog box of the selected function code will be displayed indicating the start addresses of read and write data.  With Advantys STB the address area uses either 3x format or 4x format.
2	Since the Safety PLCs can only read the 4x format function codes, use this format. To achieve this, convert the start addresses of read and write areas, that you can find in the animation table of Advantys STB, as follows: From the original Advantys STB start address of the read area, e.g. `45392`, ● remove the `4` from the beginning ● subtract `1` **Result**: n-1 = `5391`

Manipulating Values

To manipulate values in Advantys STB use the Reflex editor.???FURTHER INFORMATION? WHERE TO FIND?

Directly Sending / Reading Values

It is possible to send the values directly to the output channels and to read them directly from the input channels.???HOW???

Download to Advantys STB

To download the settings to Advantys STB use either the Ethernet cable or the programming cable provided with the software.

After successful download and if all devices are in run state, the Advantys STB will be controlled by the Safety PLC.

18.3 Troubleshooting

I/O Card Error

Error: RDY Lamp Flashes

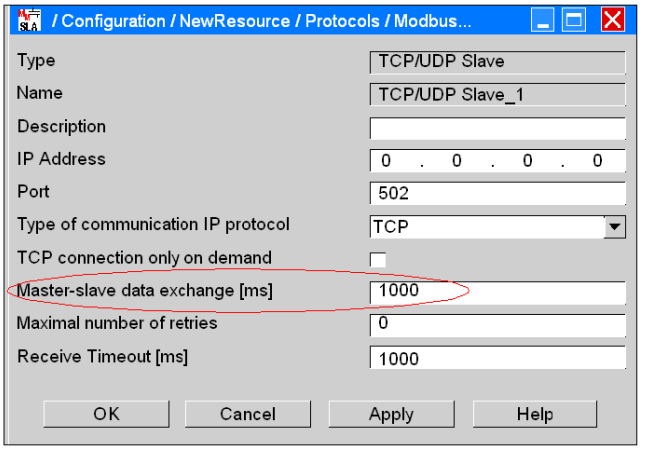
The RDY lamp on the I/O cards of Advantys STB flashes in a steady state.

Reason

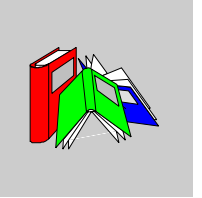
The communication refresh rate is too low.

Solution

To set the communication refresh rate to a higher level proceed as follows:

Step	Action
1	Start XPSMFWIN.
2	Right-click the **Ethernet Slaves** item in the project tree. **Result**: The properties dialog box of the Ethernet slave opens.
3	In the properties dialog box of the Ethernet slave reduce the value of the parameter **Master-slave data exchange (ms)** and click **OK** to confirm and close the dialog box. 

Glossary



E

ESPE

electro-sensitive protective equipment

U

UOS

universal optical sensor

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