Connection of a two-hand operation console to AS-Interface with MSS 3RK3

SIRIUS Safety

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Question

How can a two-hand operation console be used on the AS-Interface with fail-safety up to SIL 3 per IEC 62061 or PL e per ISO 13849-1?

Answer

Since a two-hand operation console has an arrangement of two pushbuttons and usually also an emergency stop pushbutton, use of the AS-i bus system is recommended to minimize the wiring overhead. Using two safe AS-i slaves, the signals of the command and signaling devices are transferred via a bus to the safety relay. The monitoring block "Two-hand operation" is available in the parameterizing system of the MSS 3RK3 central units for evaluating the safe command devices. Fail-safe ASIsafe signals from the central units MSS 3RK3 Advanced, MSS 3RK3 ASIsafe basic and MSS 3RK3 ASIsafe extended can be read in and evaluated.

This document explains how to connect a 3SB3 two-hand operation console to the AS-i bus, and how to assign parameters in MSS ES 2008 SP3. In the explanations below, the above-named AS-i-enabled MSS central units are referred to generally as MSS 3RK3.

Table of contents

1 Introduction

1.1 AS-Interface

What is AS-Interface?

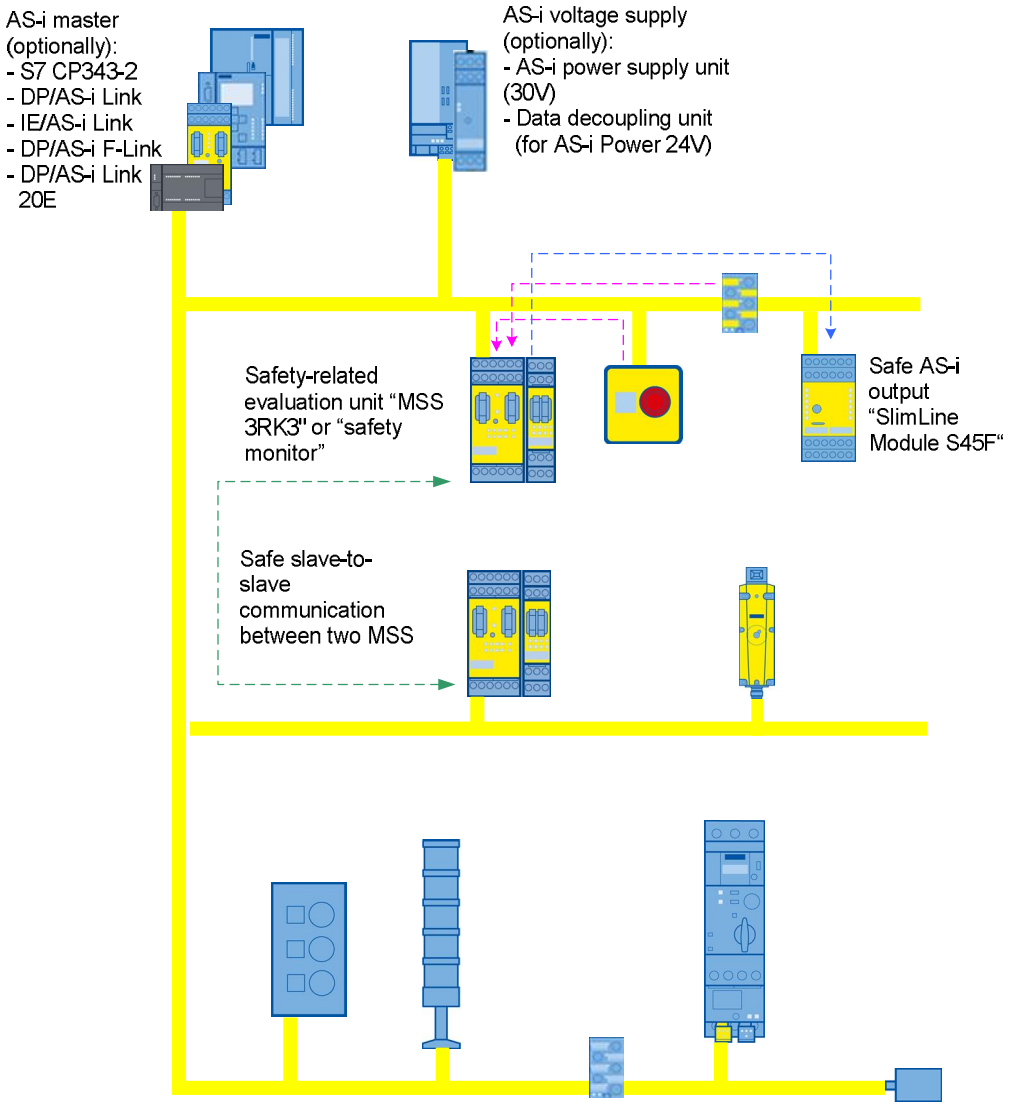
- Standardized, bit-oriented field bus system
- For use at the lowest field level
- Single master system
- Open network topology, i.e. star, bus, or tree topologies are possible
- Network extent up to 100 m (expansion up to 600 m possible)
- Shaped data/power cable for fast and simple installation

- Fast response times (cyclic data exchange up to 5 ms for 31 stations, up to 10 ms for 62 stations)
- Also for fail-safe data transmission (ASIsafe) up to SIL 3 per EN 62061 and PL e per ISO 13849-1
- For further information, please refer to: http://support.automation.siemens.com/WW/view/en/26250840

What is required for using an AS-i bus system?

In addition to the sensors and actuators (AS-i slaves) used, operation of an AS-i bus system requires an AS-i power supply or a data decoupling unit for the supply voltage of the data line, as well as an AS-i master to ensure communication.

Below is the schematic representation of a possible AS-Interface infrastructure:



1.2 Standardized requirements of two-hand operation consoles

DIN EN 574:2008 describes the two-hand control device as a piece of equipment requiring at least simultaneous operation by both hands. This measure ensures protection for the operator's hands. Only by means of simultaneous operation with both hands can operation of a machine be started and maintained.

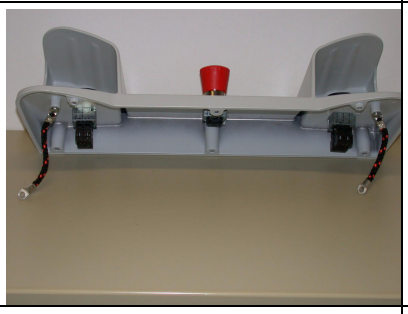
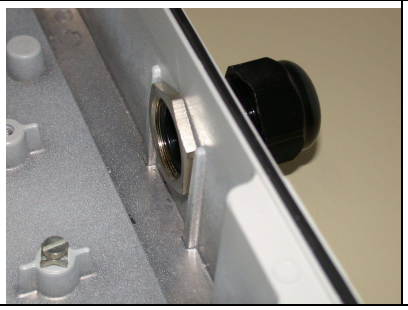
This standard also describes the requirements regarding two-hand operation consoles. Depending on the result of the risk assessment of the application, two-hand operation consoles are divided into different types. To meet the requirements of the diverse types, the safety equipment must also comply with the categories of ISO 13849-1:2006.

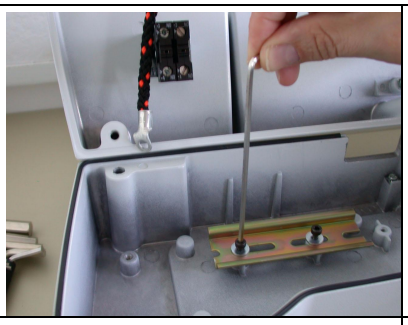
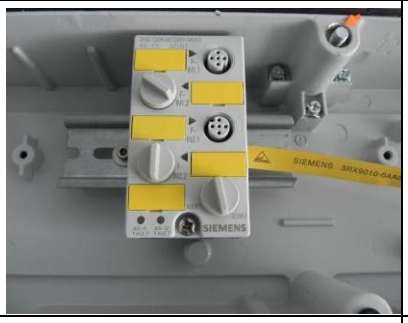
Requirements	Type				
	I	II	III		
			a	b	c
Use of both hands	x	x	x	x	x
Relationship between input signals and output signals	x	x	x	x	x
Termination of the output signal	x	x	x	x	x
Avoidance of inadvertent operation	x	x	x	x	x
Avoiding bypassing	x	x	x	x	x
Renewed generation of the output signal		x	x	x	x
Synchronous activation (< 0.5 s)			x	x	x
Application of Category 1	x		x		
Application of Category 3		x		x	
Application of Category 4					x

Table 1: Categorization of two-hand operation consoles

2 Installing the two-hand operation console

2.1 Installing the required components

Installation sequence	Photo	Description of installation	Required parts
1		Push out cable bushing and cut thread for attaching the standard mounting rail (see 5.)	1 x two-hand operation console 3SB38 63-4BC Alternative: 1 x 3SB38 63-4BB Installation steps 2 and 3 are omitted for this type
2		Install command devices in the upper section of the two-hand operation console	Command devices from the SIRIUS 3SB3 series: 1 x EMERGENCY STOP mushroom pushbutton 3SB35 00-1HA20 2 x mushroom pushbutton 3SB35 00-1QA11
3		Install contact blocks for two-hand push-to-trip buttons	4 x NO contact block 3SB34 00-0B
4		Install cable bushing for AS-Interface flat cable	1 x cable bushing M25 Cable sleeve for AS-Interface shaped cable 1 x metal nut

5		Screw on the standard mounting rail	Standard mounting rail 100 mm long 5ST1 145 2 x self-tapping screws M4 x 10 2 x washer M4
6		Snap mounting plate onto standard mounting rail	1 x mounting plate 3RK1901-2DA00
7		Thread AS-Interface cable through cable bushing, draw it into the lower section, and insert it into the mounting plate	AS-Interface cable, e.g. 3RX9010-0AA00
8		Install AS-Interface module K45-F	1 x AS-Interface module K45-F 3RK1205-0CQ00-0AA3 Alternative: 2 x AS-Interface module K45-F 3RK1205-0BQ00-0AA3
9		AS-Interface Install F-adapter on the EMERGENCY STOP command device and connect it to the AS-Interface cable	1 x AS-Interface F-adapter for EMERGENCY STOP command devices 3SF5402-1AA03

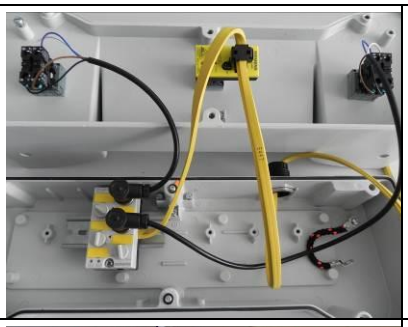
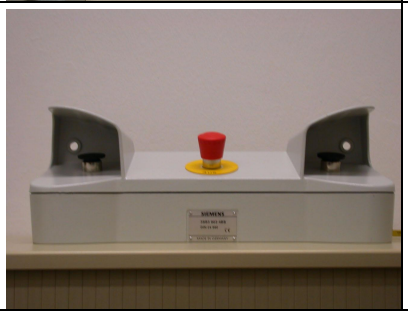
10		Wiring of the contact blocks according to the wiring diagram on the following pages	2 x angle plug, e.g.: 3RK1902-4HB15-5AA0
11		Retract AS-Interface cable to the required length and tighten the nut of the cable bushing	
12		Screw the upper section to the lower section	

Table 2: Installation instructions

2.2 Connecting the pushbuttons to the ASIsafe module K45F

When wiring the two mushroom pushbuttons for two-hand operation, ensure Pins 1 and 2 as well as Pins 3 and 4 each form one AS-i slave. The two contact blocks of a pushbutton are each connected with one pair of pins.

"Crossover" of the contact blocks is not permissible. The two contact blocks of a mushroom pushbutton must each be assigned to the same AS-i slave.

Note Only NO contact blocks can be used for interconnecting the command devices on AS-i modules. An NO/NC combination is not possible.

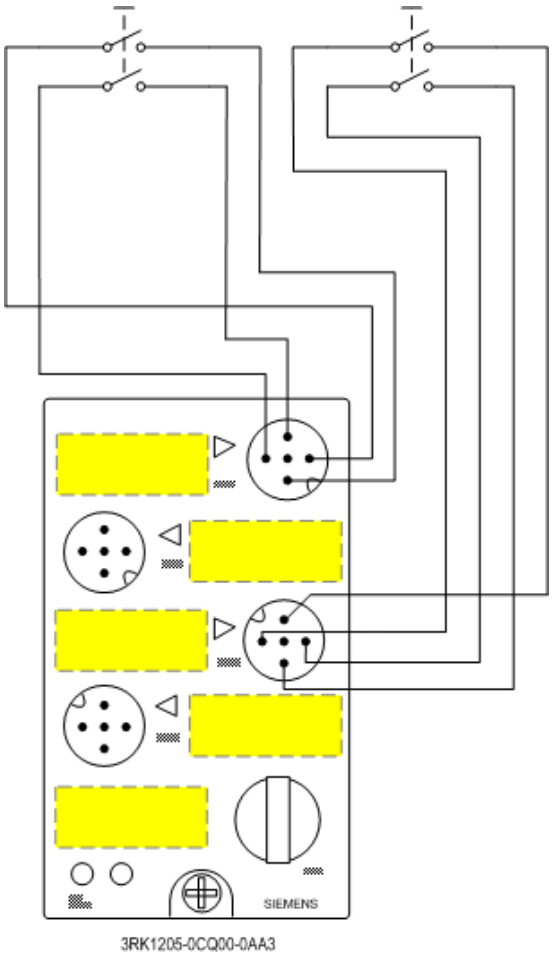


Fig.: Overview of the wiring of both pushbuttons

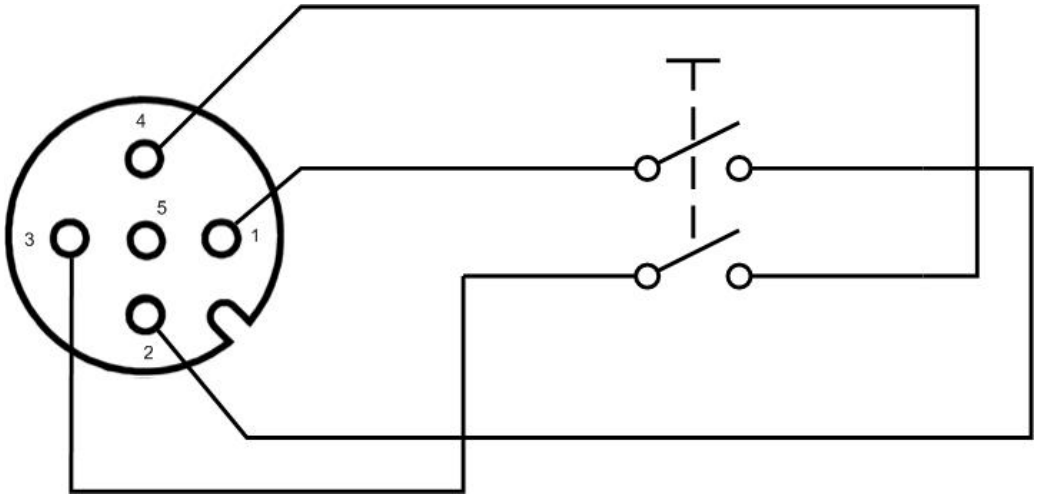
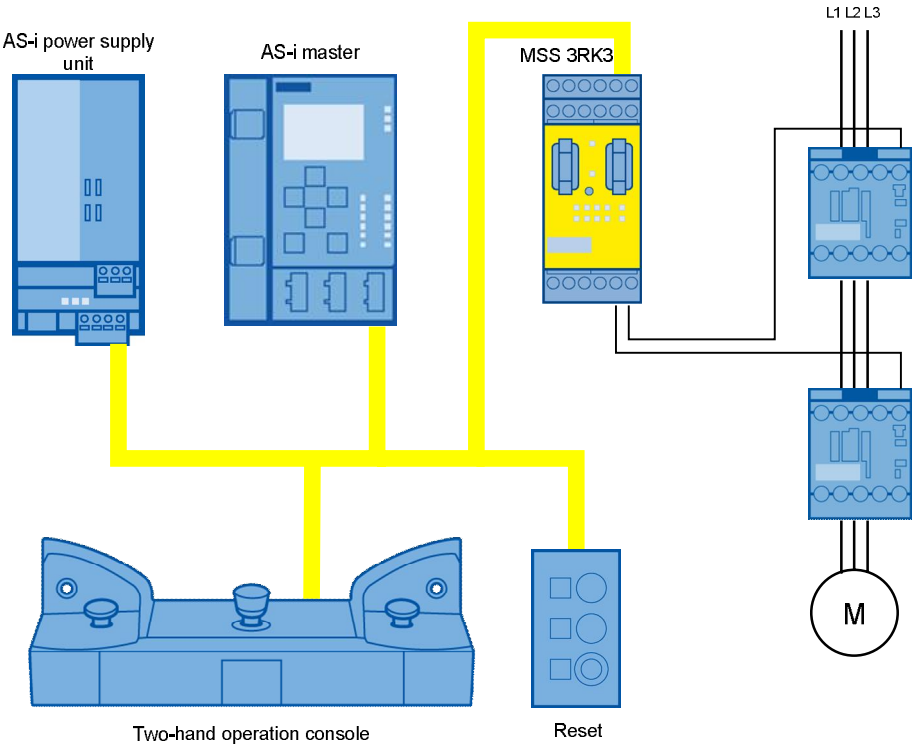


Fig.: Wiring of a two-channel pushbutton in detail

3 Application example: Fail-safe machine operation with two-hand operation console via AS-i

The two-hand operation console is connected to the AS-i bus. An MSS 3RK3 monitors the switching state of the emergency stop command device, as well as the two mushroom pushbuttons. Operation is switched on and off safely using two redundant, downstream contactors.

The application represented here meets Category 4 in accordance with ISO 13849-1. For this reason, the two-hand operation console can be categorized in accordance with Table 1 on page 6 as Type III c per EN 574. With these prerequisites, SIL 3 per IEC 62061 or PLe per ISO 13849-1 can be implemented.



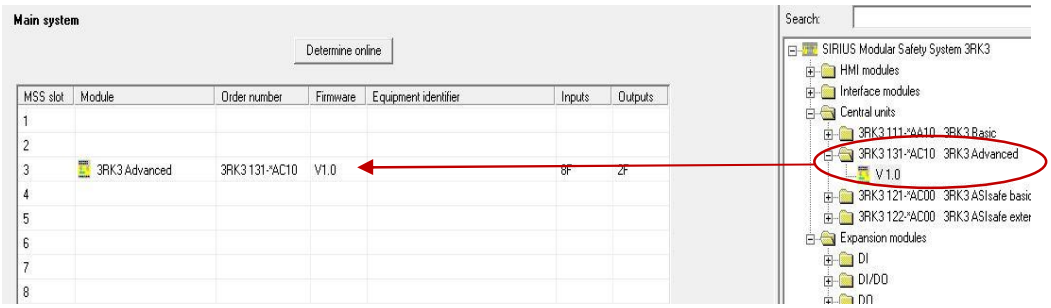
Note

In this application, the reset pushbutton is installed in a 3-button enclosure. The additional command points are not used and serve only as a standby.

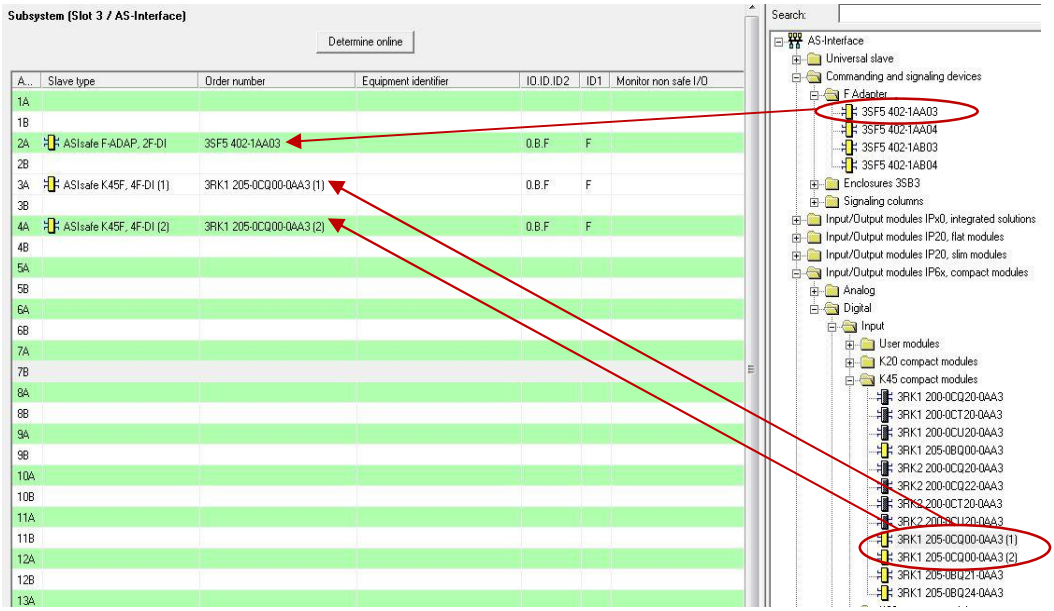
3.1 Parameterizing the MSS 3RK3

Procedure:

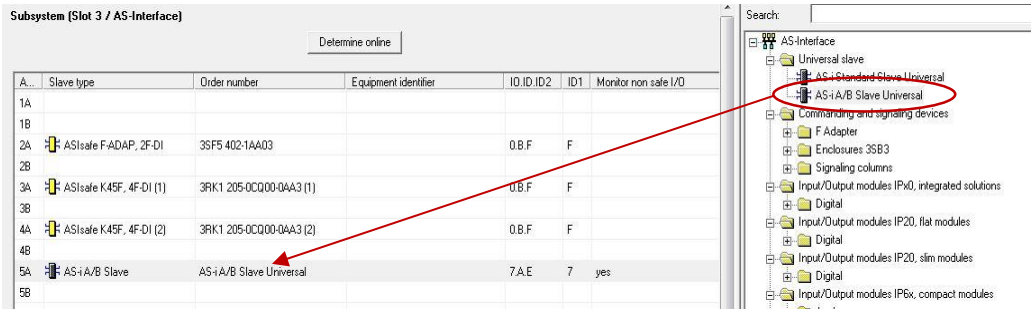
1. Open the parameterizing software "Modular Safety System ES" and create a new project.
2. Assign a project name under "Identification" > "Project" and fill in the fields "Name of configuration engineer" and "Configuration engineer's company name".
3. Insert the MSS 3RK3 Advanced from the catalog into Slot 3 under "Configuration" > "Main system".



4. Insert the AS-i slaves of the two-hand operation console from the catalog at the corresponding addresses under "Subsystem":



5. Insert an "AS-i A/B Slave Universal" for the emergency stop reset pushbutton.

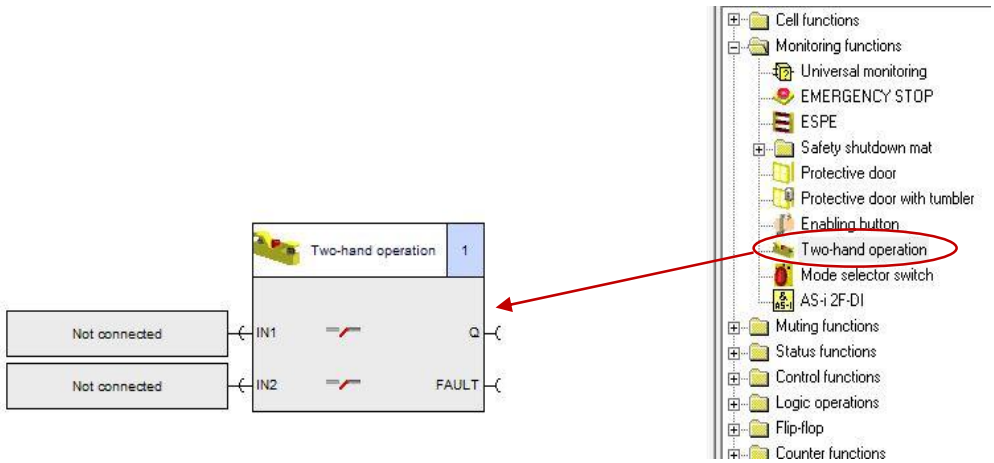


In this example, the emergency stop is assigned AS-i address 2, and the two pushbuttons are assigned AS-i address 3 and 4. The reset pushbutton is at address 5.
In the case of non-safe slaves, such as the reset pushbutton, the setting "Monitor non safe I/O" must be activated in the Object properties so that the inputs of the slaves are available for interconnection in the logic diagram.

Note

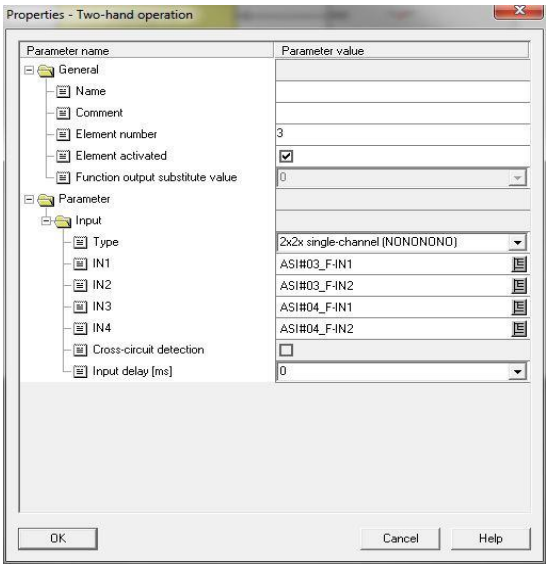
When the configuration of the AS-i bus system is ready for service, the available slaves can be determined automatically as an option. Connect your PC/PG with the MSS central unit, and click on the "Determine online" button in the Subsystem configuration.

6. Change to the logic diagram in the navigation bar, and insert the monitoring block "Two-hand operation" by dragging and dropping it from the catalog to the diagram:



7. Open the Object properties by double-clicking on the block.
   Select "2x2x single-channel (NONONONO)" as the type, and combine the AS-i signals with the respective inputs.

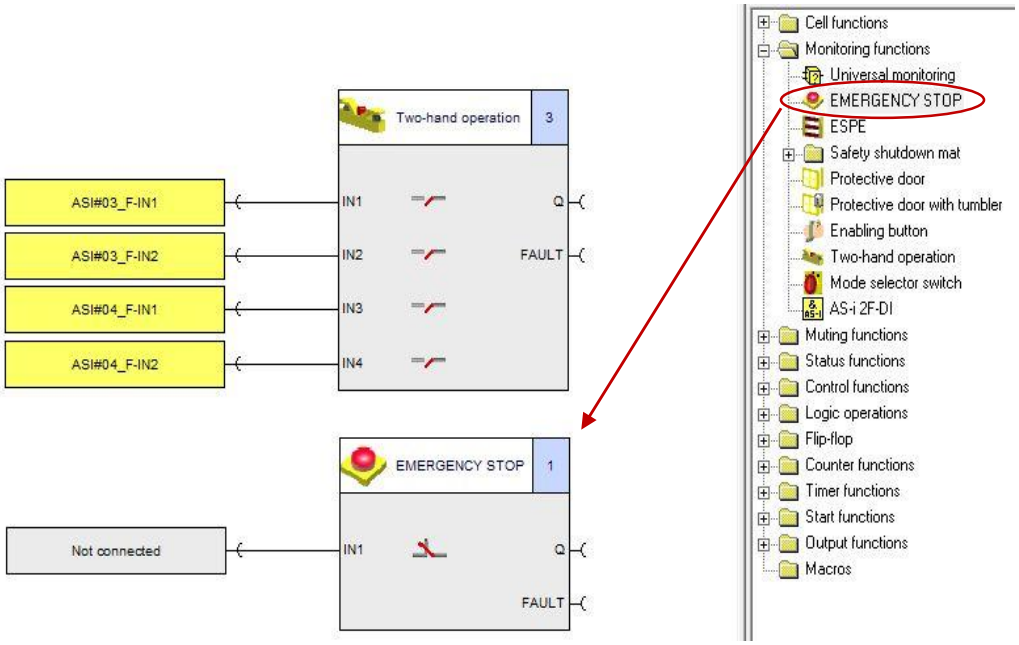
   The different combination options are explained in more detail in the table below.



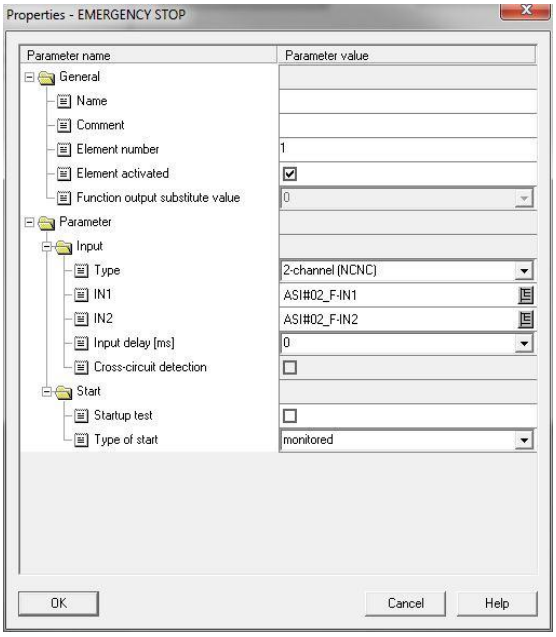
Input type	**Cross-circuit detection necessary**	**Type per EN 574**	**Corresponds to category per ISO 13849-1**
NONO	No	III a	1
NONCNONC	No	III c	4
NONONONO	No	III a	1
NONONONO	Yes	III c	4
NONONONO (via AS-i)	No	III c	4

Table 3: Classification of the contact combinations

8. Insert the monitoring block "EMERGENCY STOP" into your logic diagram from the catalog.

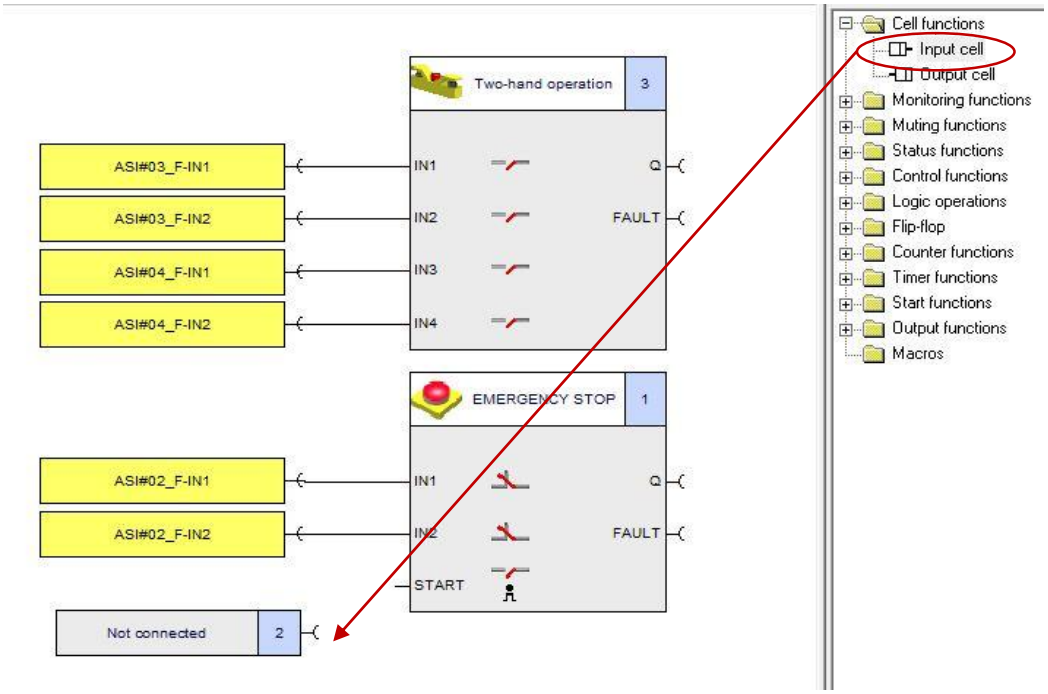


9. Open the Object properties by double-clicking on the block and select "2-channel (NCNC)" as the Type. Combine the AS-i addresses with the respective inputs.

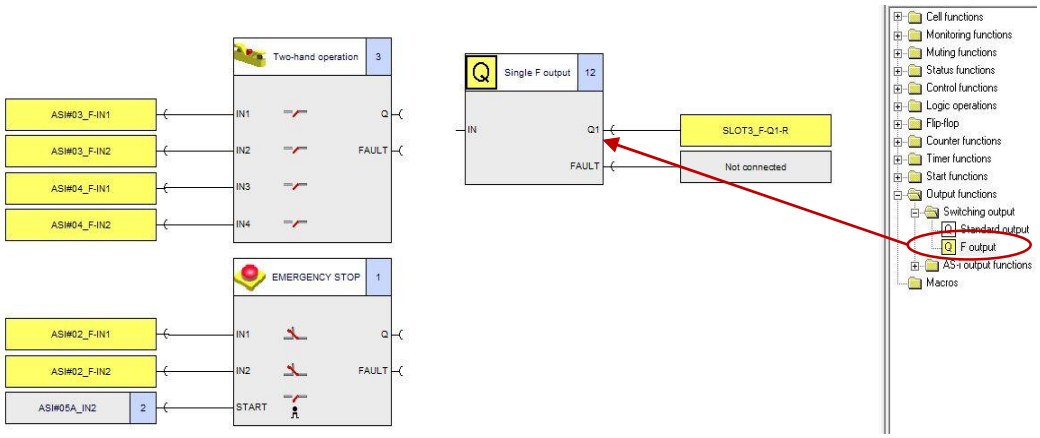


10. Keep the selection "monitored" as the Type of start, and confirm with "OK".

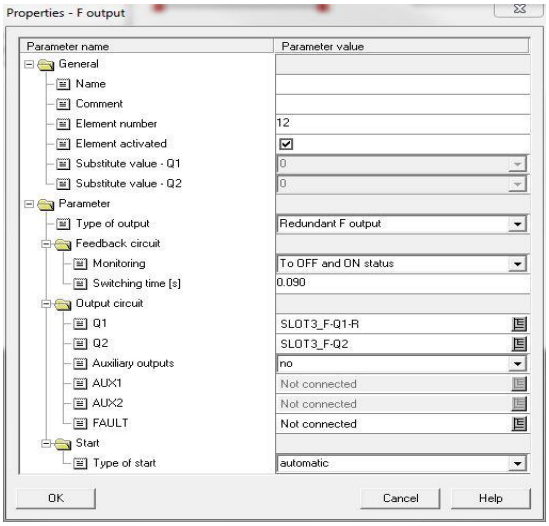
11. Now insert an input cell for the reset pushbutton. Open the Object properties by double-clicking on the block and select AS-i address 5 as the signal for the reset pushbutton.



12. Now connect the input cell with the "START" input of the emergency stop function block.
13. Insert the function block "F output" into your logic diagram from the catalog:



14. Open the Object properties by double-clicking on the block, and select "Redundant F output" as the Type of output.

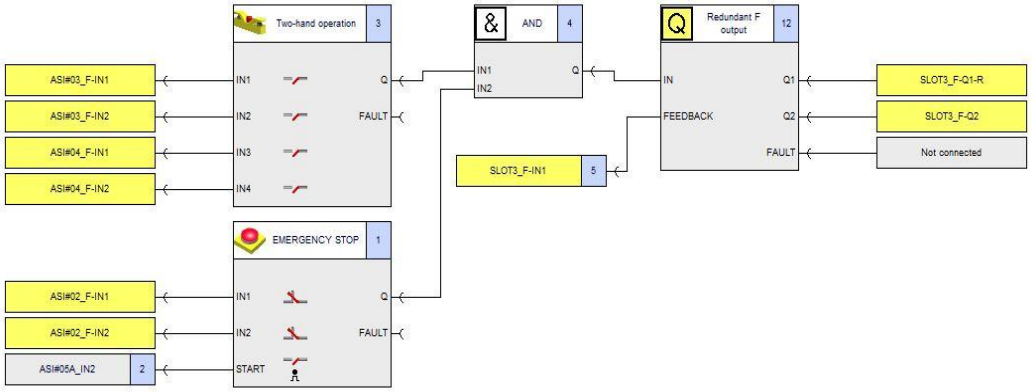


15. Select "To OFF and ON status" for feedback circuit monitoring.

16. Keep the selections for the respective outputs for controlling the contactors, and confirm with OK.

17. Now insert another input cell. Open the Object properties by double-clicking on the cell, and select the relevant input for the feedback circuit of the contactors. Then connect the feedback circuit of the contactors with the "FEEDBACK" input of the F output block.

18. Connect the function blocks to each other. The logic diagram should finally appear as follows:



3.2 Commissioning

Transfer the project to MSS 3RK3

After the project has been successfully saved, it can then be transferred to the MSS 3RK3. To do so, select the command "Load to Switching Device ..." under "Target System" in the menu bar, or use the "Load to Switching Device" button. 

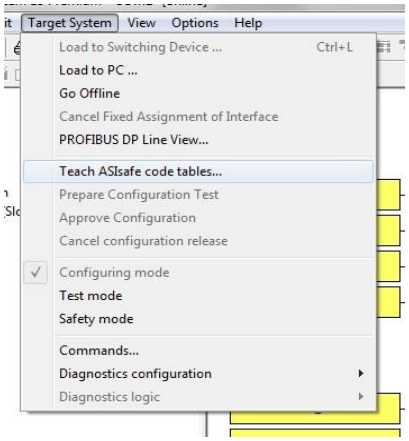
Teaching code tables

Every fail-safe AS-i input slave transmits an individual code sequence that is permanently stored in the device. This must be taught once to the MSS 3RK3 central unit during commissioning or after a device has been replaced. The MSS can only learn complete code sequences. This means both channels of an ASIsafe slave must send a "1" signal. An emergency stop command device, for example, must be unlocked for this, or a protective door must be closed.

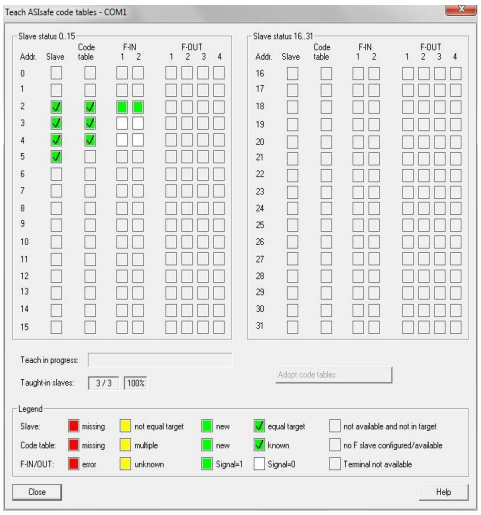
1. Connect your PC to the MSS 3RK3 central unit, and switch to the online view with the help of the "Open online" button. 

2. Choose the "Teach ASIsafe code tables" command from the "Target system" menu.

3. Operate the pushbuttons of the two-hand operation console to teach the code sequences. The emergency stop command device is taught in the unlocked state. The reset pushbutton is also automatically detected.



4. Once the MSS has learned all slaves (display =100%), click the "Adopt code tables" button. The MSS now stores the code sequences in the memory submodule.



Note Code tables can also be taught-in automatically by prolonged pressing (for 3 seconds) of the RESET button on the MSS 3RK3.

The two-hand operation console is now ready for operation. You can now change to test or safety mode via the "Target system" menu.

4 Contact Partners / Support

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