EUCHNER

Application

EKS FSA on Siemens S7-300 – selection of operating mode with touchscreen

– Practical implementation

EN

Contents

1. About this document

1.1. Version

Version	Date	Change/addition	Chapter
02-06/19	6/14/2019	Change to new format, addition of FC for the calculation of the checksum, addition of scripts for the HMI	All

1.2. Scope

This document is used to integrate and program the safe selection of the operating mode using HMI and the EKS *FSA* with PROFINET or PROFIBUS interface.

1.3. Target group

Design engineers and installation planners for safety systems on machines, as well as setup and servicing staff possessing special expertise in handling safety components as well as expertise in the installation, setup, programming and diagnostics of programmable logic controllers (PLC) and bus systems.

1.4. Supplementary documents

The overall documentation for this application consists of the following documents:

Document title (document number)	Contents	
Application AP000169-7	EKS FSA on Siemens S7-300 – selection of operating mode with touchscreen	
Manual (2516210)	Electronic-Key-System Manual EKS and EKS *FSA* with PROFINET IO interface	
Manual (092009)	Electronic-Key-System Manual EKS Electronic-Key Adapter PROFIBUS-DP & PROFIBUS-DP *FSA*	
Possibly enclosed data sheets	Item-specific information about deviations or additions	

1.5. Notice

This document is based on application AP000169-7_02_09-15… that has been checked by the Institute for Occupational Safety and Health in St. Augustin. For details of the safety assessment, the Electronic-Key structure and other key data, please refer to the application stated.

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2. Components/modules used

2.1. EUCHNER

Description	Order number / item
EKS PROFINET *FSA*	106306 / EKS-A-IIXA-G01-ST02/03/04
	122353 / EKS-A-AIXA-G18
EKS PROFIBUS *FSA*	100378 / EKS-A-IDXA-G01-ST09/03/04
EKS Electronic-Key	077859 / EKS-A-K1RDWT32-EU
	084735 / EKS-A-K1BKWT32-EU
	091045 / EKS-A-K1BLWT32-EU
	094839 / EKS-A-K1GNWT32-EU
	094840 / EKS-A-K1YEWT32-EU
	123097 / EKS-A-K1WHWT32-EU
	123098 / EKS-A-K1OGWT32-EU

TIP!

More information and downloads about the aforementioned EUCHNER products can be found at www.euchner.com. Simply enter the order number in the search box.

2.2. Others

Description	Order number / item
S7-300, CPU 315F-2 PN/DP	6ES7315-2FJ14-0AB0
SIMATIC S7, digital input module SM 326, F-DI	6ES7 326-1BK02-0AB0
SIMATIC HMI TP900 Comfort	6AV2 124-0JC01-0AX0

2.3. Software

Description	Version
Totally Integrated Automation Portal	Version V14 SP1 update 6
STEP 7 Professional	Version V14 SP1 update 6
STEP 7 Safety	Version V14 SP1 update 6

3. Glossary

Abbreviation	Explanation
EKS EKS *FSA*	Electronic-Key-System Electronic-Key-System For Safety Applications The EKS with *FSA* functionality and databus interface used in this application (refer to the EUCHNER components used)
PLC	The conventional control system used and that offers PLC functionality. The PLC has connections for the bus systems used
F-PLC	The fail-safe PLC used in this application. The F-PLC shares a data range with the PLC via flag words or data blocks
HMI	The human-machine interface comprising a screen with touch-sensitive surface or softkeys
MW	Flag word, a 16-bit data word for data exchange between the F-PLC and the PLC
PL	Performance Level according to EN ISO 13849-1
PL_r	Performance Level required according to EN ISO 13849-1
SRASW	Safety-related application software according to EN ISO 13849-1

4. Functional description

4.1. General

Selection of the operating mode is to be realized on a machine using the EKS *FSA* with data interface as an access system. The operating mode is selected via a touchscreen or other control elements, e.g. softkeys in the HMI (human-machine interface). Operation is therefore possible via the standard user interface; no key-operated rotary switch is required. Evaluation and switchover of the operating mode are realized via a safe programmable logic controller (F-PLC). With the aid of the EKS *FSA*, five access rights for the selection of the operating mode can be defined. Which operating modes the owner of the related Electronic-Key can select depends on the access rights.

This application addresses the program-related implementation in a safe control system based on the example of an S7-300. The operating modes MSO 1 to MSO 4 are possible. MSO 0 is not used in this example (gray in Table 1).

4.2. Definition of the data words for the operating mode level

In order to avoid errors due to overwriting of the memory in the PLC, the meaning of the operating mode selection in the various memory locations used **must** change the value. For this purpose, Table 1 defines the meaning of the operating mode selection in the respective variable or in the data word. This is undertaken by means of constants.

Variable / data word	Operating mode definition	Hex	Comment
Value range for ReadAuthorization, Electronic-Key content (the Electronic-Key must be written according to these values) Permitted operating mode on the EKS Electronic-Key	RE_MSO_0	0F0FH	Mode of Safe Operation 0: manual mode
	RE_MSO_1	0FF0H	Mode of Safe Operation 1: automatic mode
	RE_MSO_2	3333H	Mode of Safe Operation 2: setup mode
	RE_MSO_3	33CCH	Mode of Safe Operation 3: automatic mode with manual intervention
	RE_MSO_4	3C3CH	Mode of Safe Operation Service: operating mode for servicing and setup
SelectMSO – value range for the selection of the operating mode	SE_MSO_0	0FF0H	Mode of Safe Operation 0: manual mode
	SE_MSO_1	3333H	Mode of Safe Operation 1: automatic mode
	SE_MSO_2	33CCH	Mode of Safe Operation 2: setup mode
	SE_MSO_3	3C3CH	Mode of Safe Operation 3: automatic mode with manual intervention
	SE_MSO_4	0F0FH	Mode of Safe Operation Service: operating mode for servicing and setup
CheckMSO – value range for the confirmation of the operating mode	CH_MSO_0	3333H	Mode of Safe Operation 0: manual mode
	CH_MSO_1	33CCH	Mode of Safe Operation 1: automatic mode
	CH_MSO_2	3C3CH	Mode of Safe Operation 2: setup mode
	CH_MSO_3	0F0FH	Mode of Safe Operation 3: automatic mode with manual intervention
	CH_MSO_4	0FF0H	Mode of Safe Operation Service: operating mode for servicing and setup
SwitchMSO – value range for setting the operating mode	SW_MSO_0	33CCH	Mode of Safe Operation 0: manual mode
	SW_MSO_1	3C3CH	Mode of Safe Operation 1: automatic mode
	SW_MSO_2	0F0FH	Mode of Safe Operation 2: setup mode
	SW_MSO_3	0FF0H	Mode of Safe Operation 3: automatic mode with manual intervention
	SW_MSO_4	3333H	Mode of Safe Operation Service: operating mode for servicing and setup

Table 1: Data word definition

NOTICE!

The values represent a hierarchical order – MSO 1 and MSO 2 are contained in MSO 3, for example.

IMPORTANT!

These values **must** be used to safeguard the data transfer on the bus between the PLC and the HMI.

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4.3. Block diagram and description

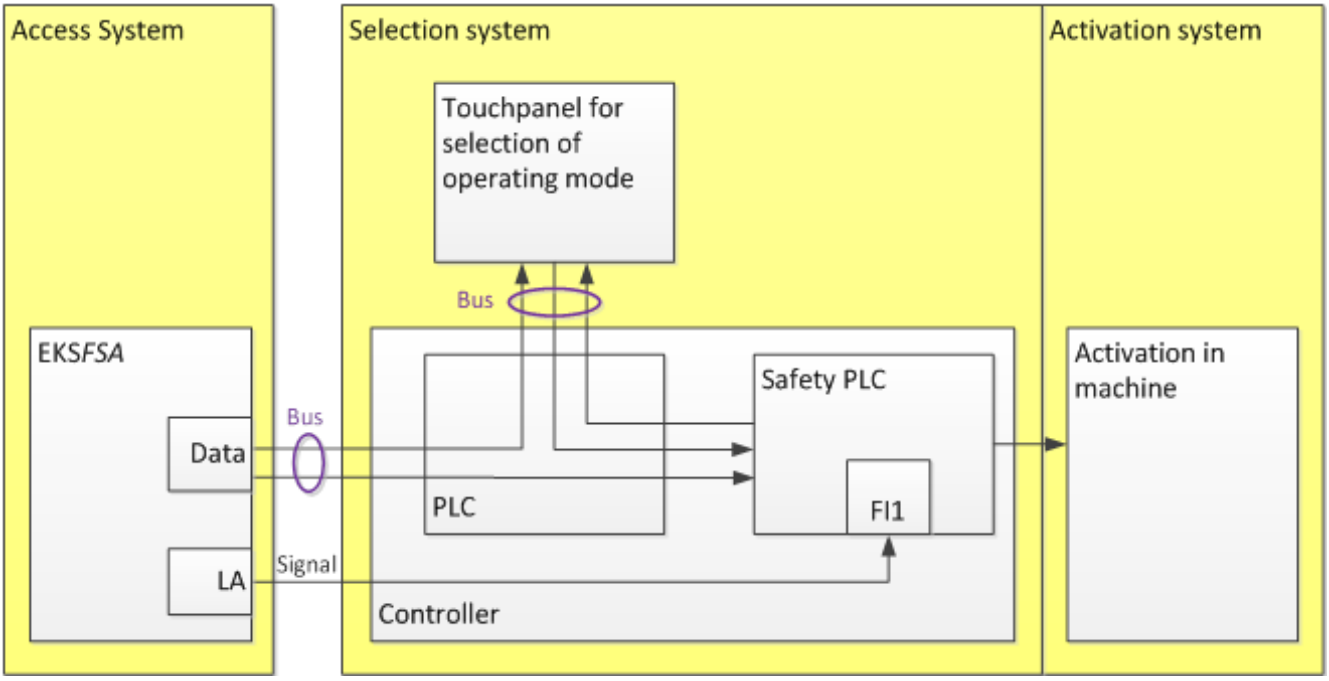

Figure 1: Block diagram

The EKS *FSA* is connected to the PLC via the bus. Data are sent exclusively to the PLC. The PLC internally forwards the data to the safety PLC (F-PLC). Any form of communication with the HMI is permissible, typically via a bus. Switching channel LA on the EKS *FSA* must be connected to a safe input on the F-PLC. FI5 is used in the example. The safe PLC is responsible for switching the operating mode. This could be internal signals to the PLC. First and foremost, however, the safety equipment for the selected operating mode is also switched on via outputs. It must be observed that this part of selection of the operating mode is also relevant to safety and therefore must fulfill the required Performance Level (PLr) for the selection of the operating mode.

4.4. General notes about programming

The sequences in the four different devices are structured so that the F-PLC detects errors automatically based on the data generated and forwarded by the various devices.

The sequences given below must be programmed in the devices PLC, HMI and F-PLC. During this process the programming principles required in EN ISO 13849-1:2008 section 4.6 are to be followed. All sequences relevant to safety are programmed in the F-PLC. The PLC is only used to forward data between the HMI and F-PLC.

The depiction in the following diagrams is a logical sequence that is not automatically observed in a PLC or in an F-PLC with cyclical processing. The sequence as per the flowchart is maintained by the use of flags or certain data words as a prerequisite in the individual steps.

In the flow diagram there is an overview of the complete sequence in the various devices such that both the cycle and the logical sequence are depicted. For each step, or also for several combined steps, you will find the related logical F-PLC or PLC network in ladder diagram format (LD).

4.5. Flowchart

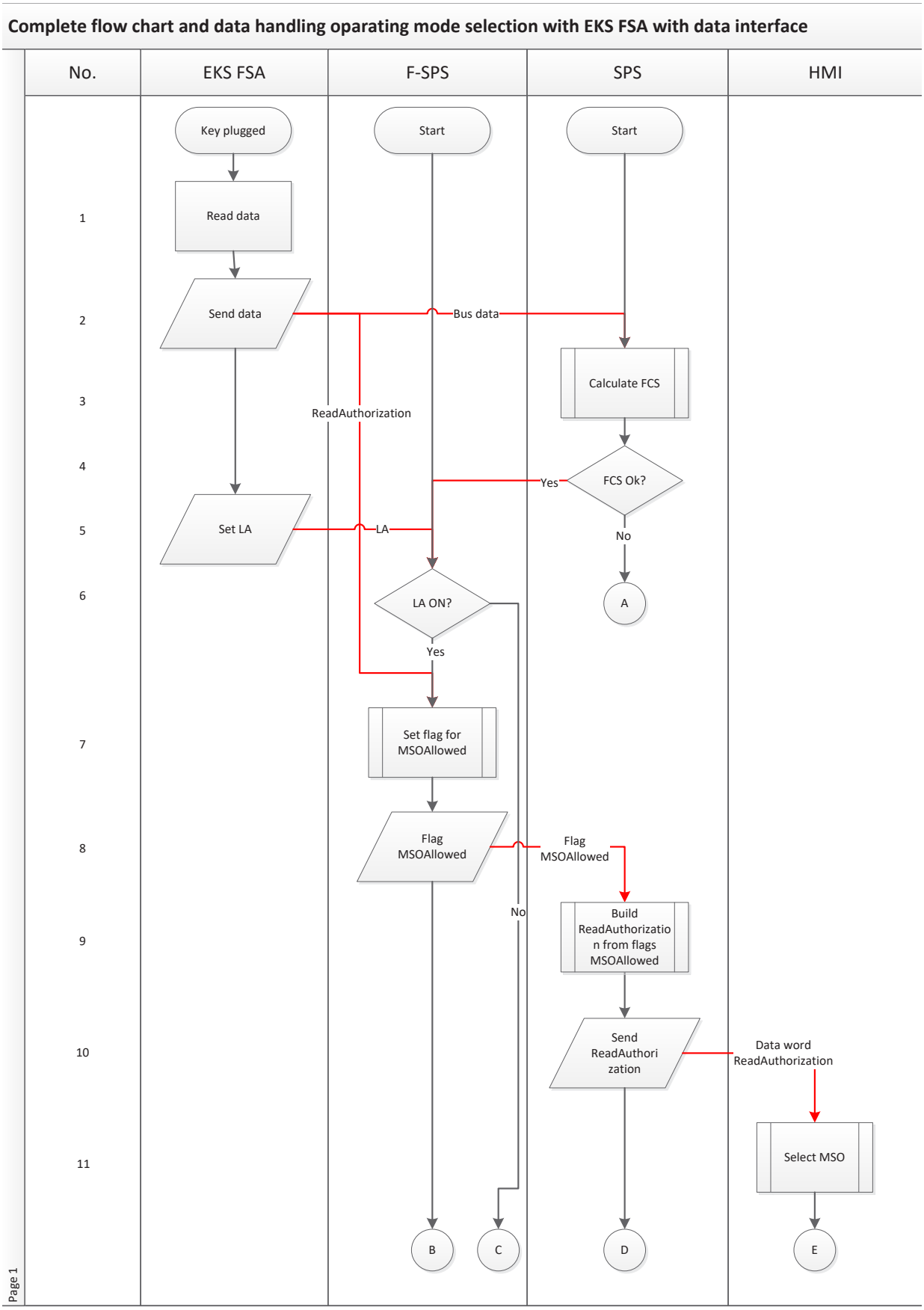

Figure 2: Flowchart step 1 - 11

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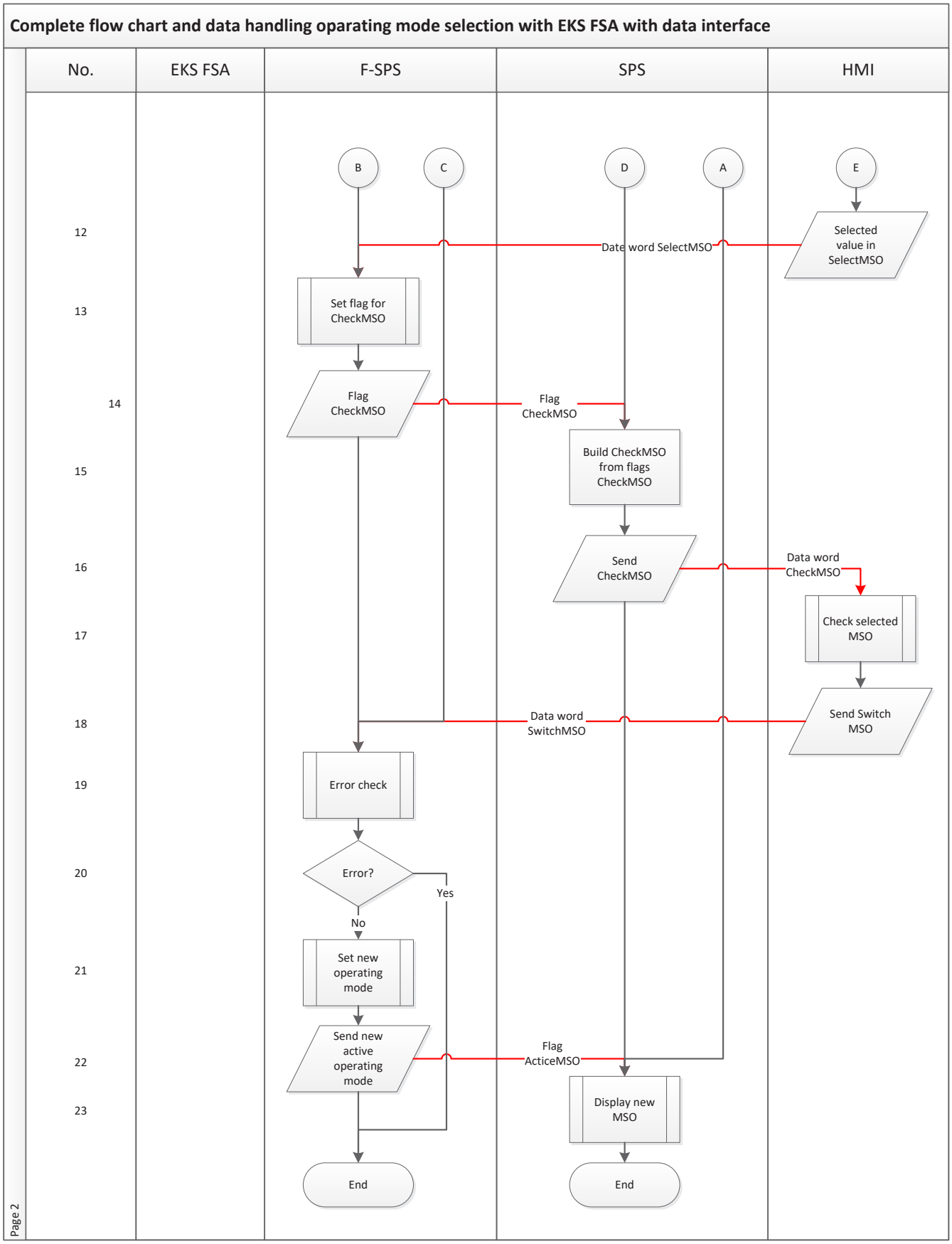

Figure 3: Flowchart step 12 - 23

4.6. Memory usage

The following safe variables are saved in a data block in the global, non-volatile memory. These variables can be read by both the PLC and the F-PLC. They are written only by the F-PLC.

Name	Data type	Description
M_MSO1_Allowed	Bool	The flag is set in sequence step 5 if operating mode MSO 1 is allowed.
M_MSO2_Allowed	Bool	The flag is set in sequence step 5 if operating mode MSO 2 is allowed.
M_MSO3_Allowed	Bool	The flag is set in sequence step 5 if operating mode MSO 3 is allowed.
M_MSO4_Allowed	Bool	The flag is set in sequence step 5 if operating mode MSO 4 is allowed.
M_MSO1_Check	Bool	The flag is set in sequence step 6 if it has been detected that MSO 1 is to be selected.
M_MSO2_Check	Bool	The flag is set in sequence step 6 if it has been detected that MSO 2 is to be selected.
M_MSO3_Check	Bool	The flag is set in sequence step 6 if it has been detected that MSO 3 is to be selected.
M_MSO4_Check	Bool	The flag is set in sequence step 6 if it has been detected that MSO 4 is to be selected.
M_Global_Error	Bool	The flag is set if any error has occurred.

The following standard variables are saved or defined in the global, non-volatile memory. These variables can be written by the PLC. The F-PLC must be able to read the variables ReadAuthorization_to_SafePLC, Select_MSO_To_SafePLC and SwitchMSO_To_Safe_PLC.

Name	Data type	Address range	Description
I_EKS_LA	Bool	%E0.5	Safe input LA from the EKS Light
ReadAuthorization_To_Touch	Word	%MW0	This variable is set if an operating mode can be selected
SelectMSO_To_SafePLC	Word	%MW2	The variable indicates the selected operating mode
CheckMSO_To_Touch	Word	%MW4	This variable indicates what has been detected in the safe PLC
SwitchMSO_To_SafePLC	Word	%MW6	The variable contains the confirmation for the selected operating mode
ReadAuthorization_To_SafePLC	Word	%EW367	The input word contains the contents of the EKS Electronic-Key that is currently inserted in the EKS *FSA* connected
M_Error_Off_Detected	Bool	%M8.0	Is used to filter error messages without an Electronic-Key inserted
M_Error_Off_Locked	Bool	%M8.1	An error found previously is locked with the aid of this variable
M_Ack_Err	Bool	%M8.2	This variable makes it possible to acknowledge a previously locked error
EKS_Key_FCS_OK	Bool	%M8.3	In this variable it is indicated whether the checksum for the EKS Electronic-Key is correct

The following safe variables are saved in the local or global non-volatile memory in the safe PLC. These variables must be available only in the safe PLC. The transfer of the operating mode selected to the PLC is not taken into account in this example.

Name	Data type	Address range	Description
M_MSO1_Active	Bool	0.0	Indicates that MSO 1 is to be activated
M_MSO2_Active	Bool	0.1	Indicates that MSO 2 is to be activated
M_MSO3_Active	Bool	0.2	Indicates that MSO 3 is to be activated
M_MSO4_Active	Bool	0.3	Indicates that MSO 4 is to be activated
M_Error_Select	Bool	1.0	Indicates that there is a serious error in the data for the selection
M_Error_Switch	Bool	1.1	Indicates that there is a serious error in the data for the confirmation

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4.7. Description of the step sequence

The step number relates to the flowchart in Figures 2 to 3.

Step	System	Description
1	EKS *FSA*	A user has inserted an Electronic-Key.
2	EKS *FSA*	The EKS reads the data and sends them to the PLC
3	PLC	The checksum for the Electronic-Key is calculated in the PLC. If the result is correct, the flag EKS_Key_FCS_OK is set. You will find a description of how the Calc_FCS function can be programmed in the documentation "Electronic-Key-Manager EKM – Additional documentation." One possible way of implementing this function in software is contained in the application AP000169-5 "EKS on Siemens S7-300 – checking KEYCRC" that you can download from the Internet. The checksum is also formed if an Electronic-Key is not inserted. The result must then be the value 0.

```
14  #Help_Calc_FCS := 0;
15  #Ind_Val := #START_EKS_BUFFER;
16
17  // Sum over bytes used on key for FCS calculation
18  FOR #Counter := 0 TO #LEN_EKS_BUFFER BY #WORD_INC DO
19      // Bytes have to be swapped before summarized. Therefor higher byte is read first.
20      #Help_Val_Dint := SHL(IN := BYTE_TO_WORD(%EB(#Ind_Val+1)), N := 8);
21      #Help_Val_Dint:=#Help_Val_Dint+BYTE_TO_DINT(%EB(#Ind_Val));
22      #Help_Calc_FCS := #Help_Calc_FCS + #Help_Val_Dint; // add to FCS
23      #Ind_Val := #Ind_Val + #WORD_INC;
24  END_FOR;
25
26  // when FCS is built over an unequal number OF Bytes only 1 Byte is read.
27  // Do not use this part of calculation when an equal number of bytes is used in FCS
28  #Help_Val_Dint := BYTE_TO_DINT(%EB(#Ind_Val));
29  #Help_Calc_FCS := #Help_Calc_FCS + #Help_Val_Dint; // add to FCS
30
31  // All words from serial number of key have to be added.
32  #Ind_Val := #START_EKS_SERIAL;
33  FOR #Counter := 0 TO #LEN_SERIAL BY #WORD_INC DO
34      // Bytes have to be swapped before summarized. Therefor higher byte is read first.
35      #Help_Val_Dint := SHL(IN := BYTE_TO_WORD(%EB(#Ind_Val + 1)), N := 8);
36      #Help_Val_Dint := #Help_Val_Dint + BYTE_TO_DINT(%EB(#Ind_Val));
37      #Help_Calc_FCS := #Help_Calc_FCS + #Help_Val_Dint; // FCS aufaddieren
38      #Ind_Val := #Ind_Val + #WORD_INC;
39  END_FOR;
40
41  // Recalculate to WORD (16 Bit) and cut overflow
42  #Help_Calc_FCS:=(WORD_TO_DINT(DINT_TO_WORD(#Help_Calc_FCS)));
43
44  // Load FCS from key and swap bytes
45  #Help_Val_Dint := SHL(IN := BYTE_TO_WORD(%EB(#BYTE_EKS_FCS + 1)), N := 8);
46  #Help_Val_Dint := #Help_Val_Dint + BYTE_TO_DINT(%EB(#BYTE_EKS_FCS));
47
48  // Check if calculated FCS is the same as on key
49  IF (#Help_Calc_FCS = #Help_Val_Dint) THEN
50      #Calc_FCS := TRUE; // Return value if FCS is ok
51  ELSE
52      #Calc_FCS := FALSE; // Return value FCS is not ok
53  END_IF;
```

Figure 4: Calc_FCS (in SCL) function for the calculation of the checksum

NOTICE!

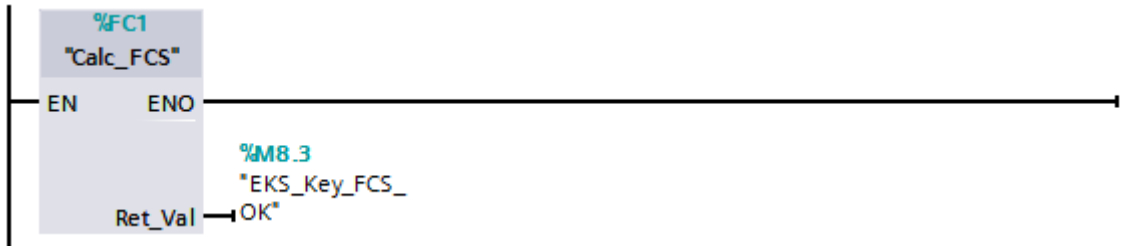
In this application, the checksum calculation is performed in SCL.

The calculation of the checksum in IL can be found in application AP000169-5.

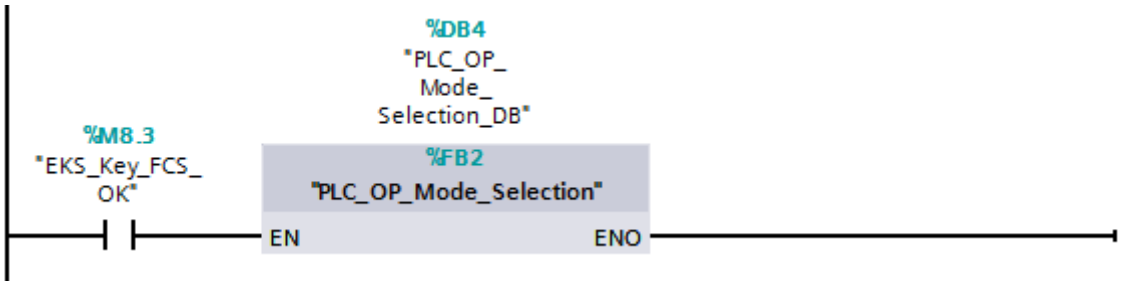
Step	System	Description
4	PLC	The subroutine for coupling the PLC to the HMI is only called if the checksum was correct. This also occurs if an Electronic-Key is not inserted.

Cyclic call for networks 1 and 2 e.g. in the OB1:

PLC network 1:

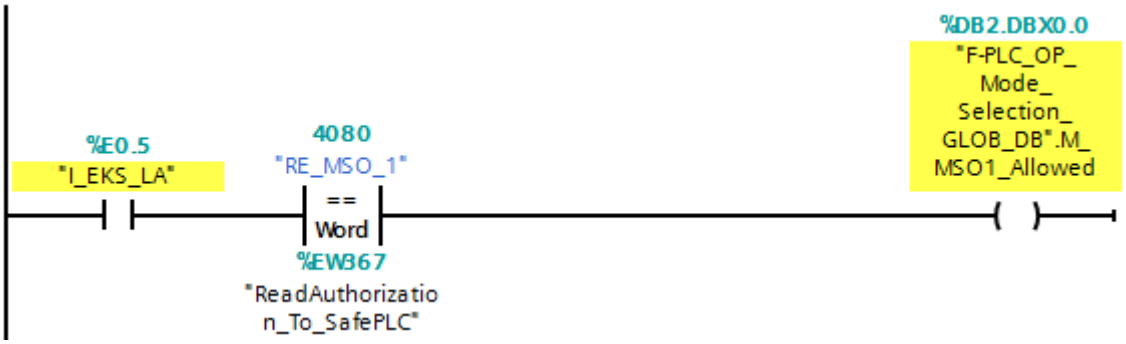


PLC network 2:

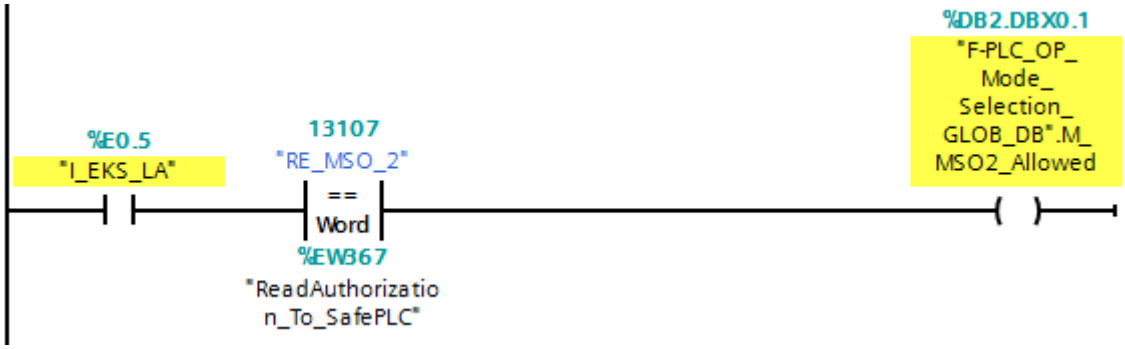


Step	System	Description
5	EKS *FSA*	The EKS *FSA* sets the output LA if an Electronic-Key is inserted
6	F-PLC	The input LA is also checked directly in the F-PLC networks 1 to 4
7	F-PLC	The EKS continues to make available the data in the PLC input area. In this example it is also possible to access the inputs directly from the F-PLC. The flag indicating which operating mode is allowed is set in F-PLC networks 1 to 4.
8	F-PLC	The flags formed from step 7 must be available in the PLC. For this reason, these flags are saved in a global area.

F-PLC network 1:



F-PLC network 2:



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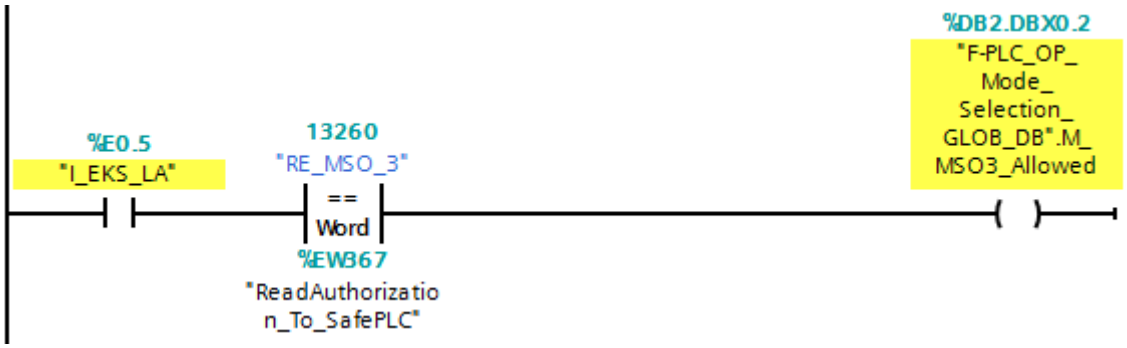
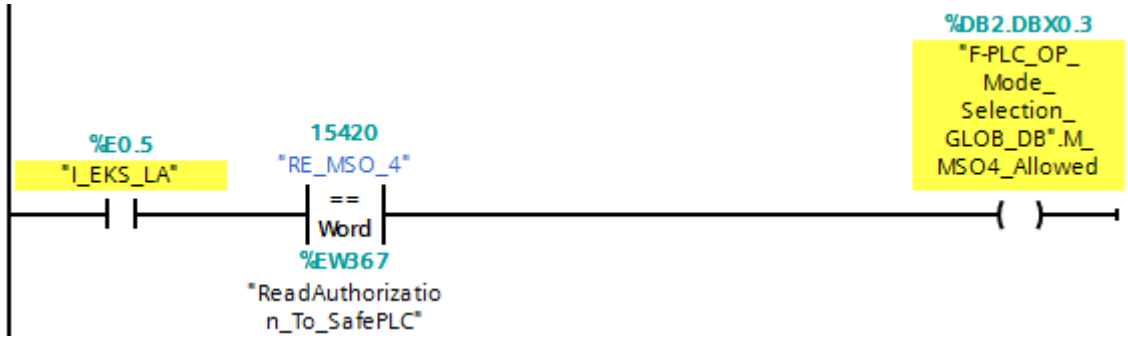
F-PLC network 3:

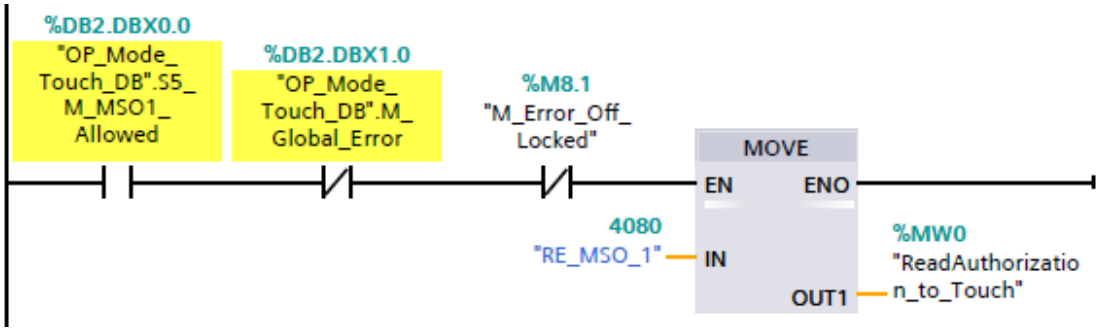


F-PLC network 4:

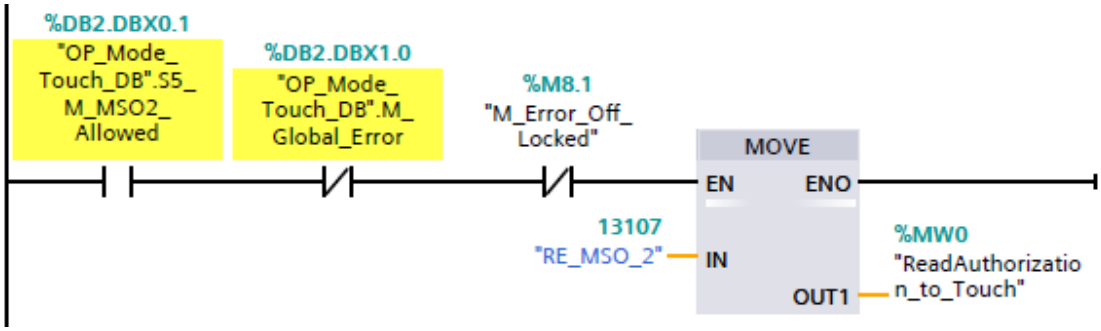


Step	System	Description
9	PLC	The PLC forms a data word for the HMI from the flags for the permitted operating mode. PLC network 1 to 4: a fixed data word from the pool is assigned to each flag. If an error has been detected, the assignment to ReadAuthorization is not made so that there can be no indication on the HMI if there is an error. PLC network 5: if there is no longer a flag set or an error has been detected, ReadAuthorization for the HMI is set to 0.
10	PLC	The data word formed in step 9 must be available to the HMI.

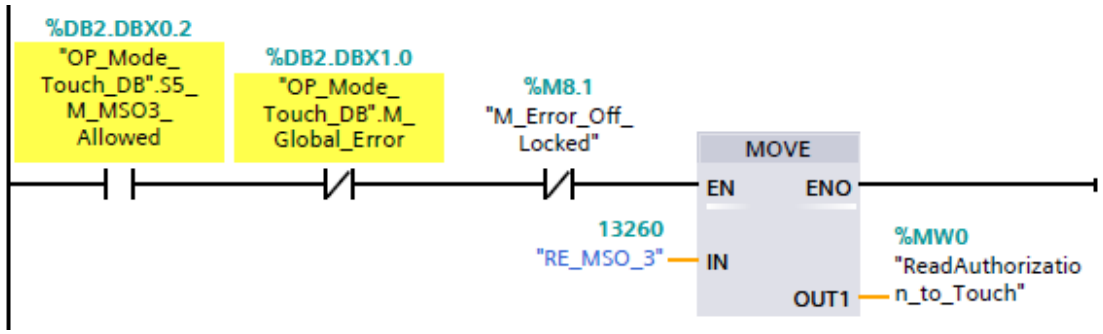
PLC network 1:



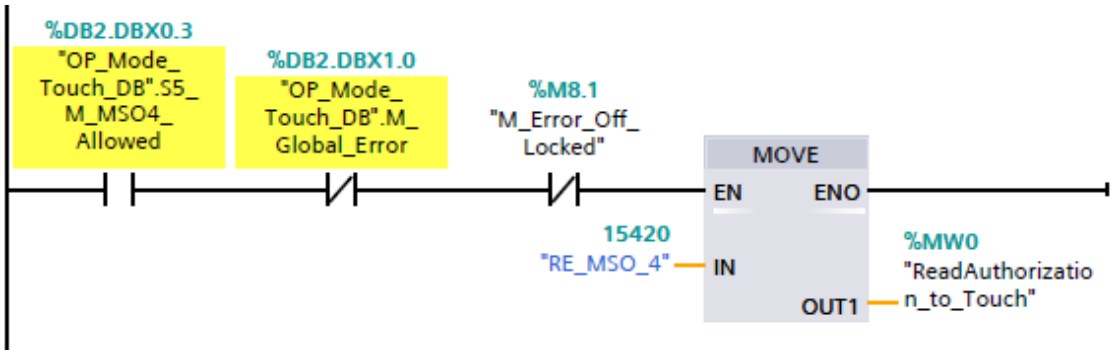
PLC network 2:



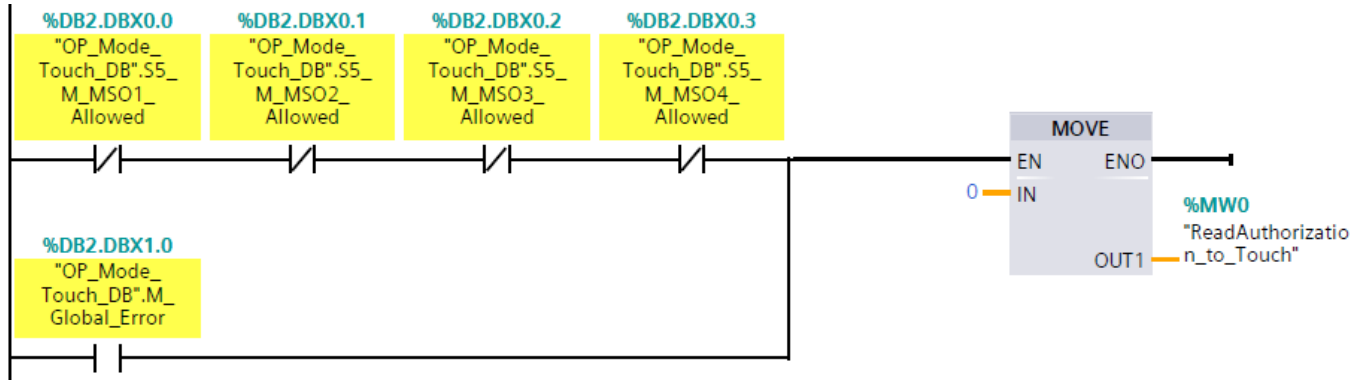
PLC network 3:



PLC network 4:



PLC network 5:



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Step	System	Description
11	HMI	A screen with the permitted operating mode(s) is displayed or made available in the HMI. The user can now select an operating mode.

```
1  Sub Check_ReadAuthorization()
2  'This script is called when variable ReadAuthorization_to_Touch is changing value
3
4  'Variable declaration
5  Dim ReadAuthorization_to_Touch
6
7  'Allocation of SmartTag to Variable
8  Set ReadAuthorization_to_Touch = SmartTags("ReadAuthorization_to_Touch")
9
10 'When no key is plugged return to main picture, les go to MSO selection
11 If ReadAuthorization_to_Touch = 0 Then
12     ActivateScreen "Main_Screen",0
13     SmartTags("SelectMSO_To_SafePLC") = 0
14     SmartTags("SwitchMSO_To_SafePLC") = 0
15 Else
16     ActivateScreen "MSO_Selection",0
17 End If
18
19
20 End Sub
```

Figure 5: Script for opening the screen for the selection of the operating mode in the HMI

```
1  Sub Enable_Buttons()
2  'This script starts when window MSO_selection is displayed first
3
4  'Variable declaration
5  Dim MSO1, MSO2, MSO3, MSO4 'Values in INT for MSO
6  Dim Button_MSO1,Button_MSO2, Button_MSO3, Button_MSO4 'Softkeys
7  Dim ReadAuthorization_to_Touch
8
9  'Allocation of constants
10 MSO1 = 4080
11 MSO2 = 13107
12 MSO3 = 13260
13 MSO4 = 15420
14
15
16 'Allocation of Softkey to Variable
17 Set Button_MSO1 = HmiRuntime.Screens("MSO_Selection").ScreenItems("Schaltfläche_MSO1")
18 Set Button_MSO2 = HmiRuntime.Screens("MSO_Selection").ScreenItems("Schaltfläche_MSO2")
19 Set Button_MSO3 = HmiRuntime.Screens("MSO_Selection").ScreenItems("Schaltfläche_MSO3")
20 Set Button_MSO4 = HmiRuntime.Screens("MSO_Selection").ScreenItems("Schaltfläche_MSO4")
21
22 'Allocation of SmartTag to Variable
23 Set ReadAuthorization_to_Touch = SmartTags("ReadAuthorization_to_Touch")
24
25 'Enable buttons with Read Authorization
26 If  ReadAuthorization_to_Touch = MSO1 Then
27         Button_MSO1.Enabled = True
28         Button_MSO1.Visible = True
29         Button_MSO2.Enabled = False
30         Button_MSO2.Visible = False
31         Button_MSO3.Enabled = False
32         Button_MSO3.Visible = False
33         Button_MSO4.Enabled = False
34         Button_MSO4.Visible = False
```

Figure 6: Script for activating the fields for the selection of the operating mode (row 1 -34)

```
35
36 ElseIf  ReadAuthorization_to_Touch = MSO2 Then
37         Button_MSO1.Enabled = True
38         Button_MSO1.Visible = True
39         Button_MSO2.Enabled = True
40         Button_MSO2.Visible = True
41         Button_MSO3.Enabled = False
42         Button_MSO3.Visible = False
43         Button_MSO4.Enabled = False
44         Button_MSO4.Visible = False
45 ElseIf  ReadAuthorization_to_Touch = MSO3 Then
46         Button_MSO1.Enabled = True
47         Button_MSO1.Visible = True
48         Button_MSO2.Enabled = True
49         Button_MSO2.Visible = True
50         Button_MSO3.Enabled = True
51         Button_MSO3.Visible = True
52         Button_MSO4.Enabled = False
53         Button_MSO4.Visible = False
54
55 ElseIf  ReadAuthorization_to_Touch = MSO4 Then
56         Button_MSO1.Enabled = True
57         Button_MSO1.Visible = True
58         Button_MSO2.Enabled = True
59         Button_MSO2.Visible = True
60         Button_MSO3.Enabled = True
61         Button_MSO3.Visible = True
62         Button_MSO4.Enabled = True
63         Button_MSO4.Visible = True
64
65 Else
66         ActivateScreen ("Main_Screen"),0
67         Button_MSO1.Enabled = False
68         Button_MSO1.Visible = False
69         Button_MSO2.Enabled = False
70         Button_MSO2.Visible = False
71         Button_MSO3.Enabled = False
72         Button_MSO3.Visible = False
73         Button_MSO4.Enabled = False
74         Button_MSO4.Visible = False
75 End If
76
77
78
79 End Sub
```

Figure 7: Script for activating the fields for the selection of the operating mode (row 35 -79)

Step	System	Description
12	HMI	The HMI writes the value for the selected operating mode from step 11 to a data word that is available to the F-PLC. Notice: If this action is not possible directly, an intermediate step can also be inserted during which the PLC forms a data word for the F-PLC from the data word from the HMI. The value from the HMI must be forwarded unchanged to the F-PLC by the PLC.
13	F-PLC	It is checked which operating mode is to be selected. For this purpose the data word must be a word from the pool for the selected operating mode and the selected operating mode must be within the range allowed. F-PLC networks 5 to 8: a flag is formed that corresponds to the operating mode selected. An error in SelectMSO is detected in F-PLC network 10.
14	F-PLC	The flag formed in step 13 is made available to the PLC for checking by the user.

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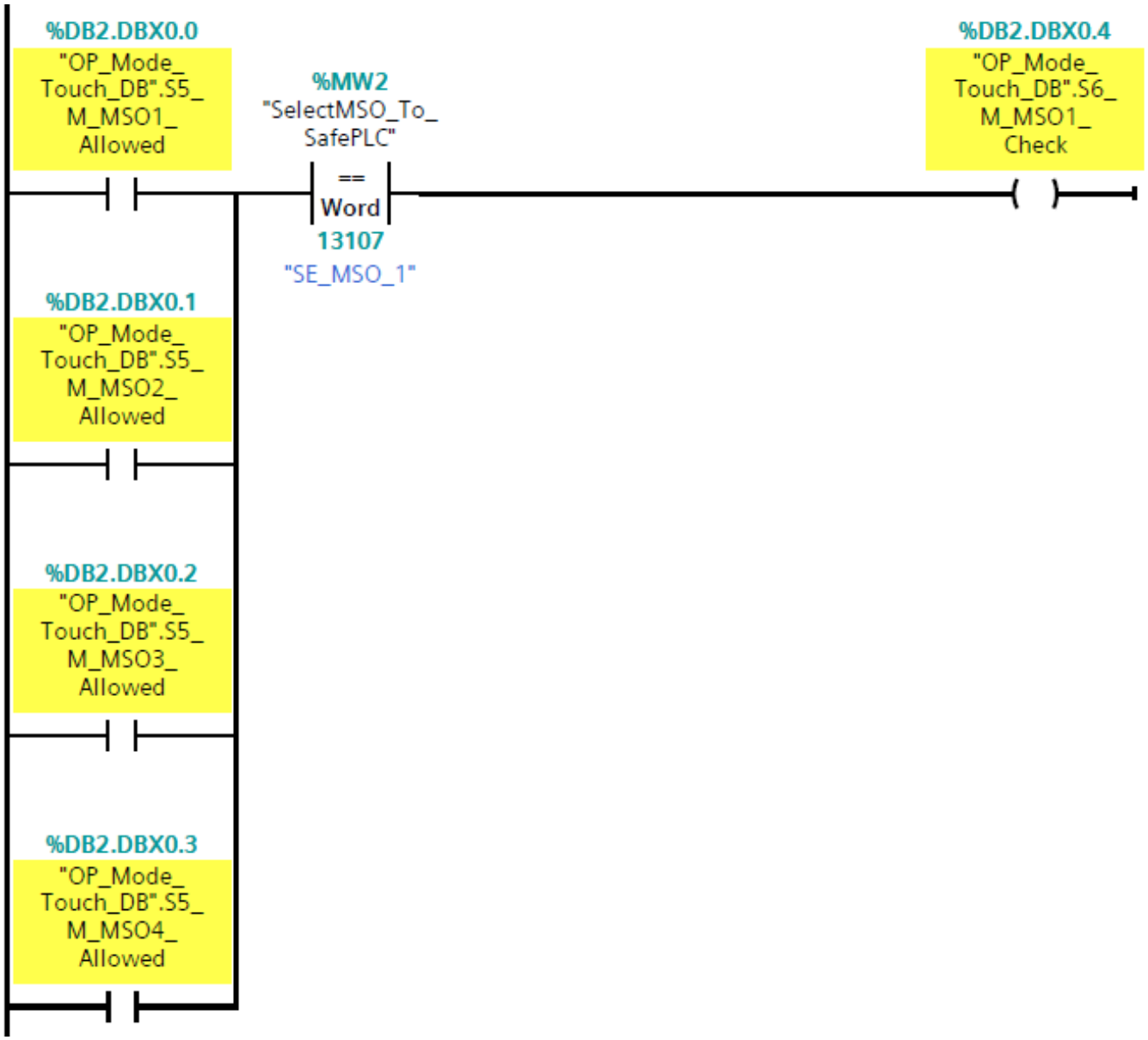
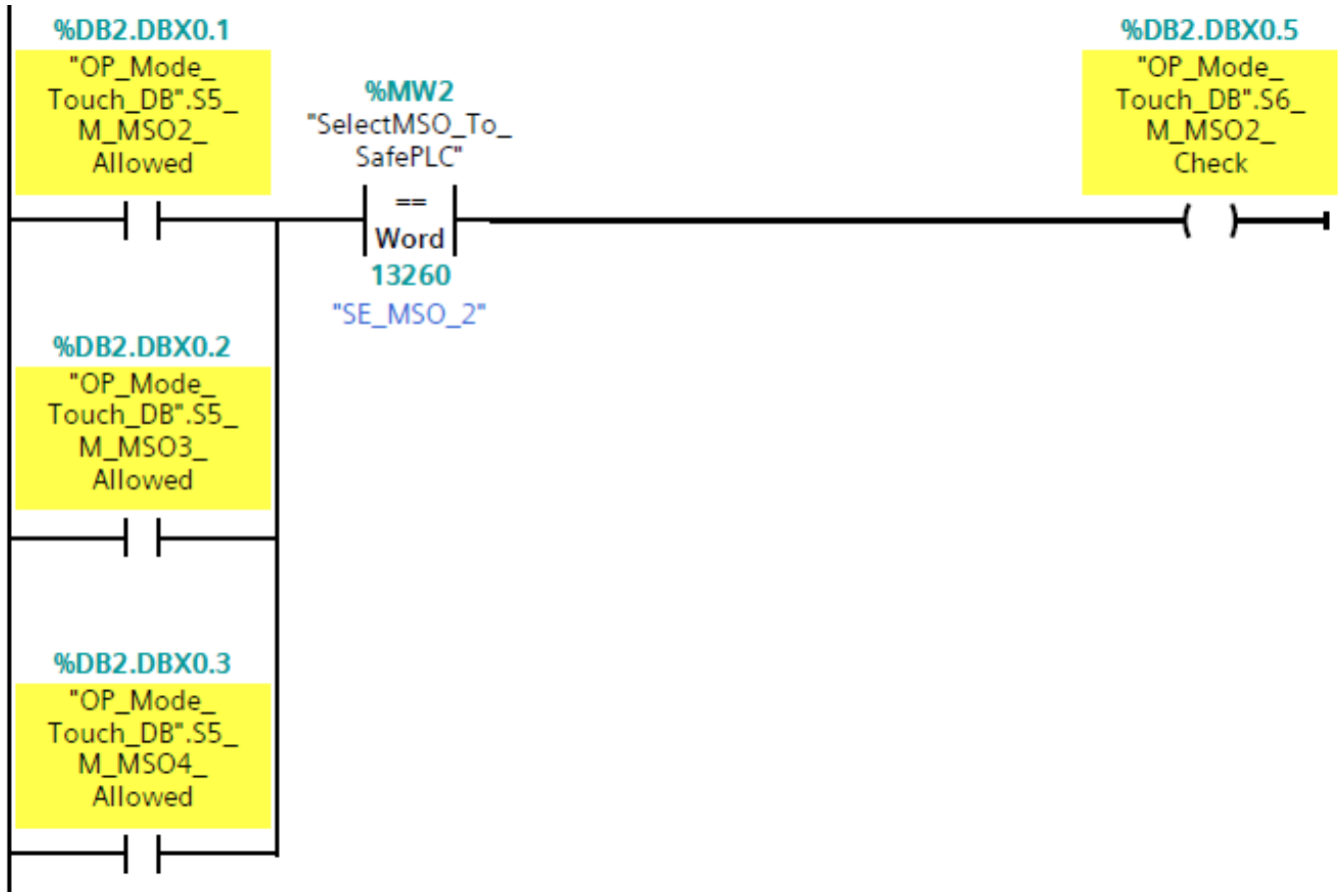
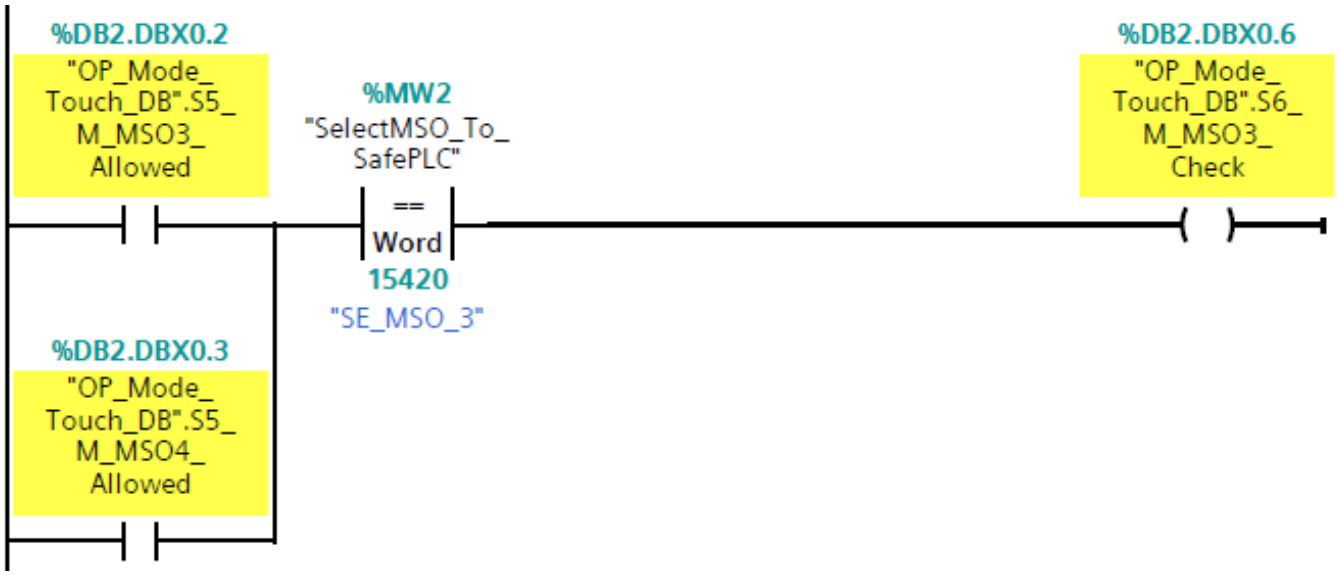
F-PLC network 5:



F-PLC network 6:



F-PLC network 7:



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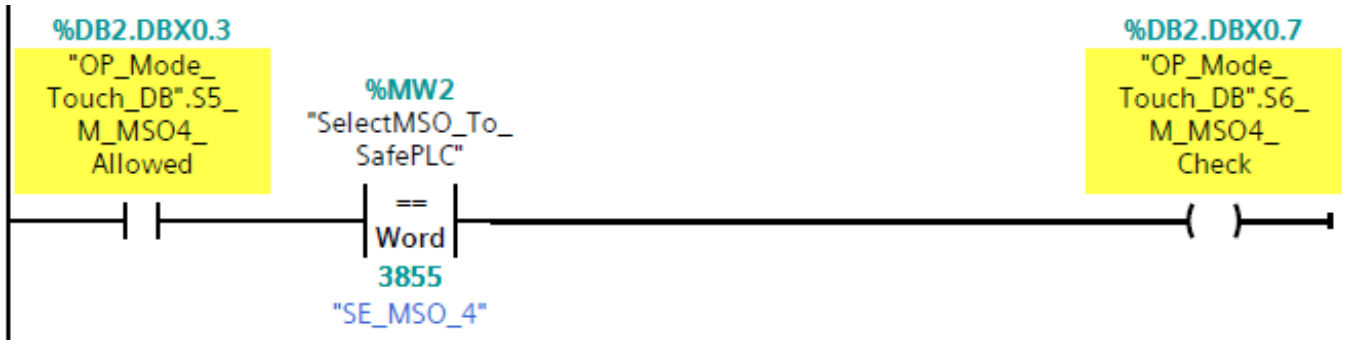
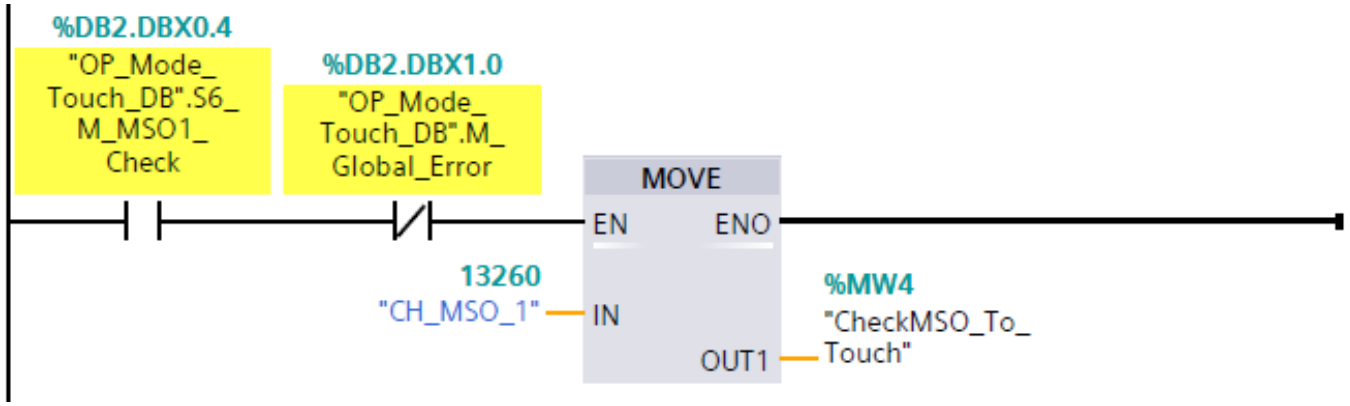
F-PLC network 8:

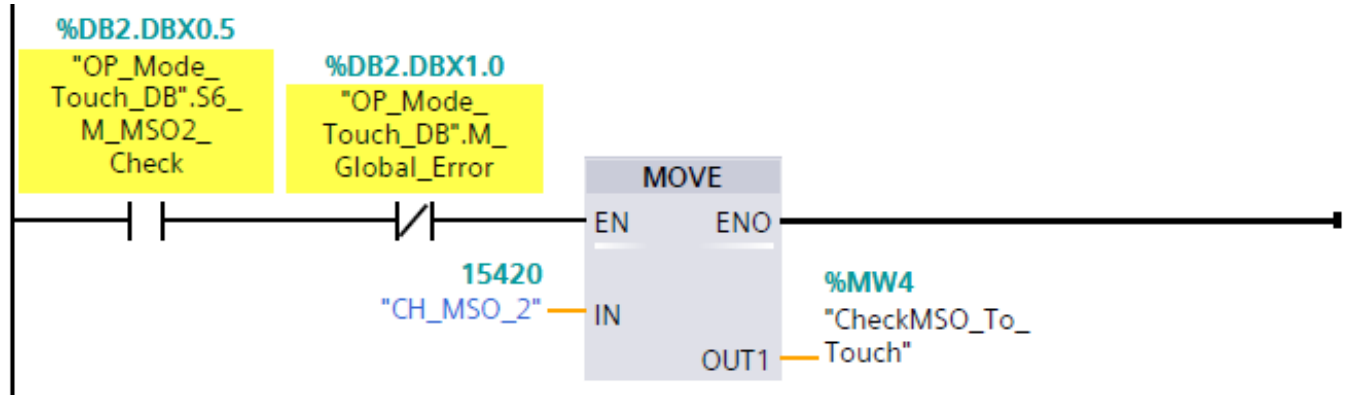


Step	System	Description
15	PLC	The PLC forms a data word for the HMI from the flags M_MSO_Check for the operating mode to be checked. PLC network 6 to 9: a fixed data word from the pool is assigned to each flag. If an error has been detected, the assignment to CheckMSO is not made so that there is no indication on the HMI if there is an error. PLC network 10: if there is no longer a flag set or an error has been detected, CheckMSO for the HMI is set to 0.
16	PLC	The data word formed in step 15 must be available to the HMI.

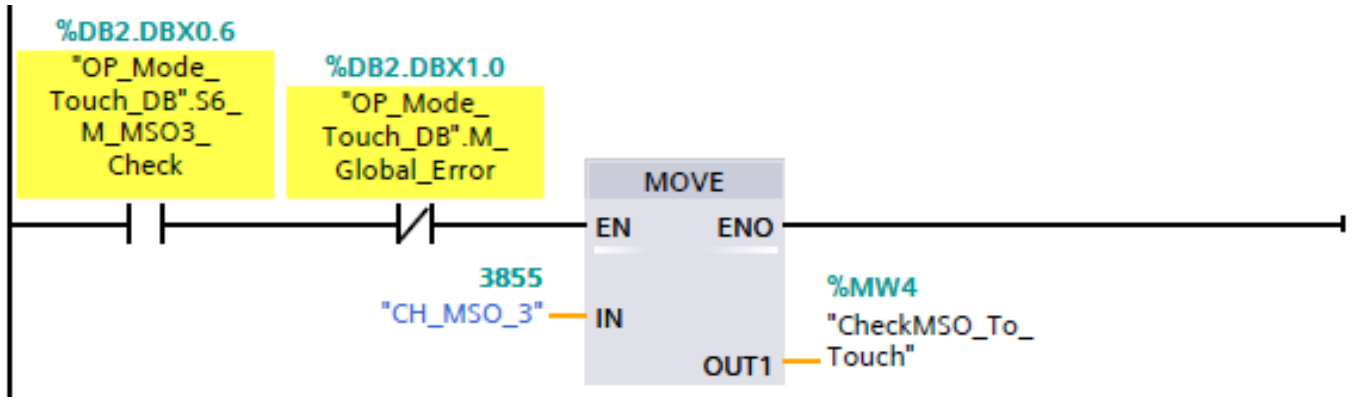
PLC network 6:



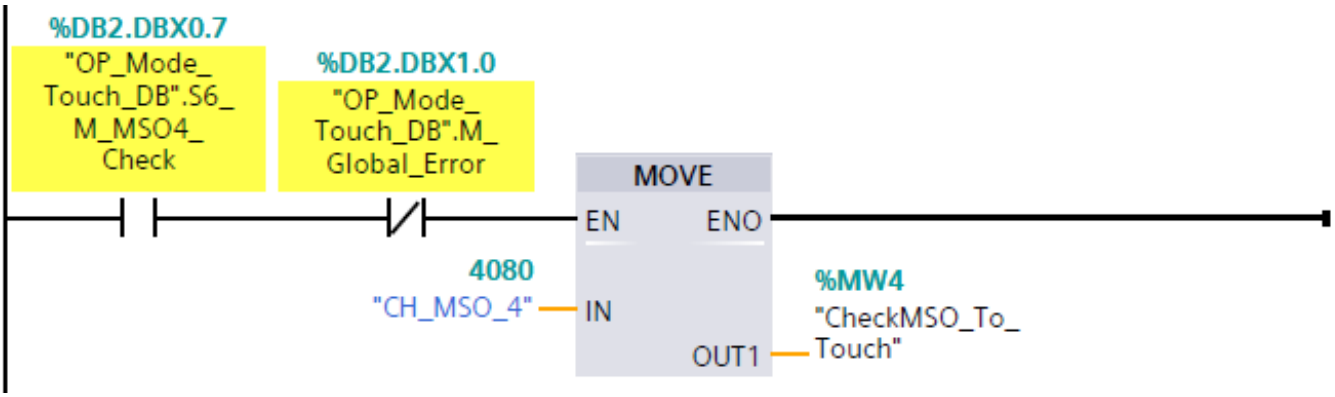
PLC network 7:



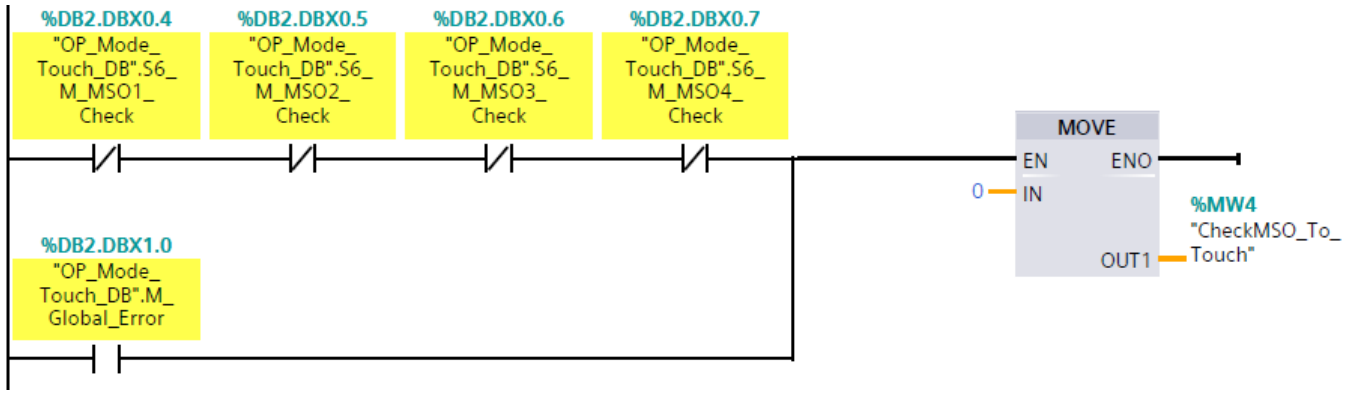
PLC network 8:



PLC network 9:



PLC network 10:



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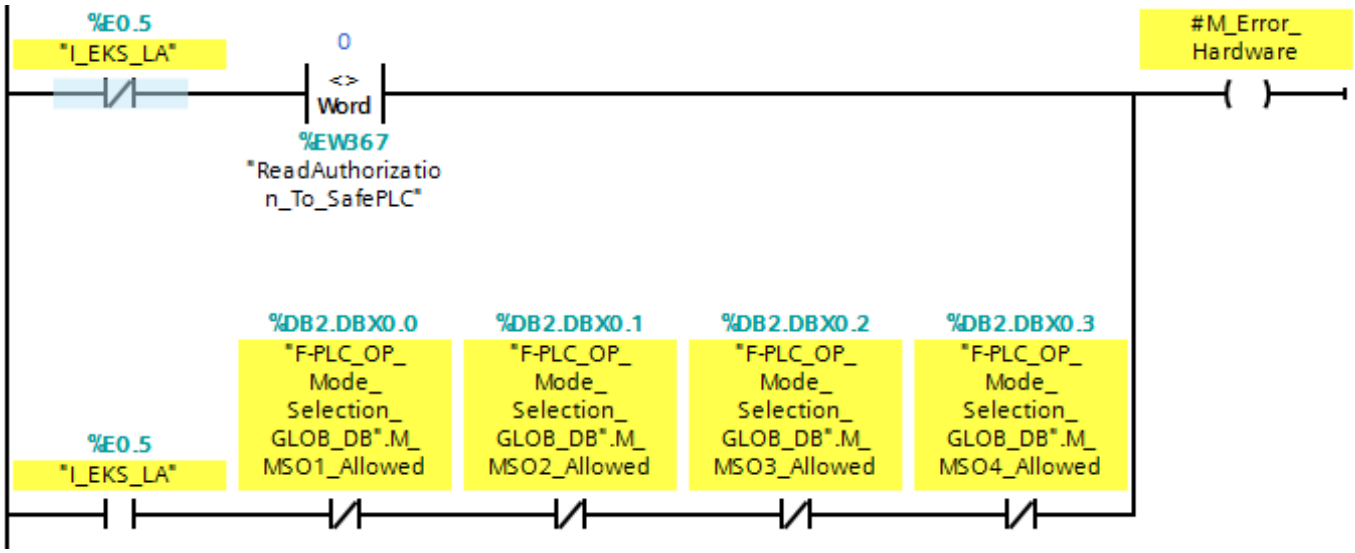
Step	System	Description
17	HMI	In the HMI, a screen is displayed where the operating mode to be confirmed and a selection for “OK” and “Not OK” are displayed. This confirmation must be in a separate prompt to the previous selection of the operating mode to prevent errors in the HMI (e.g. in a new dialog box).

```
Sub Start_Check_Screen()
'This script is executed when value of CheckMSO_To_Touch is changed

'Variable declaration
Dim CheckMSO_To_Touch

Dim Button_MSO1_OK, Button_MSO1_NOK
Dim Button_MSO2_OK, Button_MSO2_NOK
Dim Button_MSO3_OK, Button_MSO3_NOK
Dim Button_MSO4_OK, Button_MSO4_NOK

Dim CH_MSO1, CH_MSO2,CH_MSO3, CH_MSO4

'Allocation of Softkey to Variable
Set CheckMSO_To_Touch = SmartTags("CheckMSO_To_Touch")

'Allocation of constants
CH_MSO1 = 13260
CH_MSO2 = 15420
CH_MSO3 = 3855
CH_MSO4 = 4080

'Call display CheckMSO
If CheckMSO_To_Touch = CH_MSO1 Then
    ActivateScreen "01_Check_MSO1",0

ElseIf  CheckMSO_To_Touch = CH_MSO2 Then
    ActivateScreen "02_Check_MSO2",0

ElseIf  CheckMSO_To_Touch = CH_MSO3 Then
    ActivateScreen "03_Check_MSO3",0

ElseIf  CheckMSO_To_Touch = CH_MSO4 Then
    ActivateScreen "04_Check_MSO4",0

End If

End Sub
```

Step	System	Description
18	HMI	The HMI writes the value for the confirmed operating mode from step 17 to a data word that is available to the F-PLC. Notice: If this action is not possible directly, an intermediate step can also be inserted during which the PLC forms a data word for the F-PLC from the data word from the HMI. The value from the HMI must then be forwarded unchanged to the F-PLC by the PLC. If “OK” has been selected, the value from the data pool for the operating mode confirmed must be sent. If the operating mode is not confirmed, an invalid data word, e.g. the value FFFFH, can be sent.
19	F-PLC	It is checked in the F-PLC whether an error has occurred. F-PLC network 9: it is checked whether a discrepancy has occurred in the data words from the Electronic-Key. If LA is OFF and the data word from the Electronic-Key is not 0, or if LA is ON and there is no valid data word on the Electronic-Key, an error has occurred. If input LA is set, the M_MSO_Allowed flags are checked because only one of these flags can be set. The logic is a 1 of N check. F-PLC network 10: there is a selection error if an Electronic-Key is not inserted but there is a value in the data word for the selection. There is also a selection error if a value has been selected that is not allowed according to the EKS Electronic-Key. F-PLC network 11: there is an error in the confirmation if the previously selected operating mode is different to the operating mode confirmed. There is also a rejection, e.g. using the data word FFFFH, included here. F-PLC network 12: if one of the errors from the F-PLC networks 9 to 11 is found, a global error flag is set. PLC network 11 and 12: the global error from F-PLC network 12 can occur briefly each time on inserting and removing an Electronic-Key. A switch-on delay of 500 ms is therefore used in PLC network 11 to filter out brief errors before the error is saved as a real error. This error is latched in network 12 because otherwise it would be deleted by inserting an Electronic-Key. The error can be reset with an acknowledgment. The time for the filtering can be set to suit the cycle time in the PLC and the HMI such that hardware errors latch but software errors, e.g. data corruption on the communication cable, are detected but do not result in a latching error. The input can then be repeated. An indication for the user on the detection of such an error can be useful.

F-PLC network 9:



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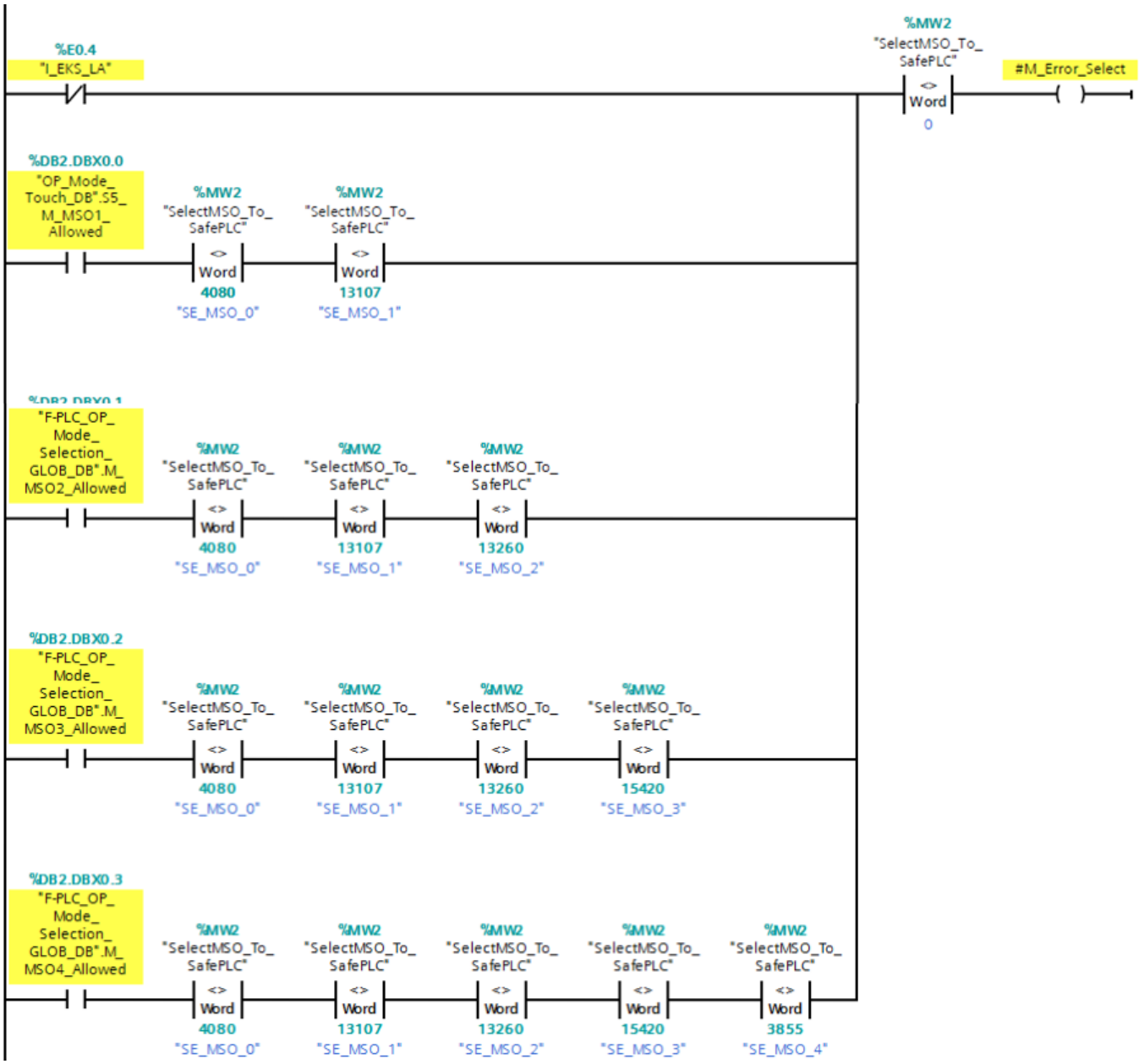
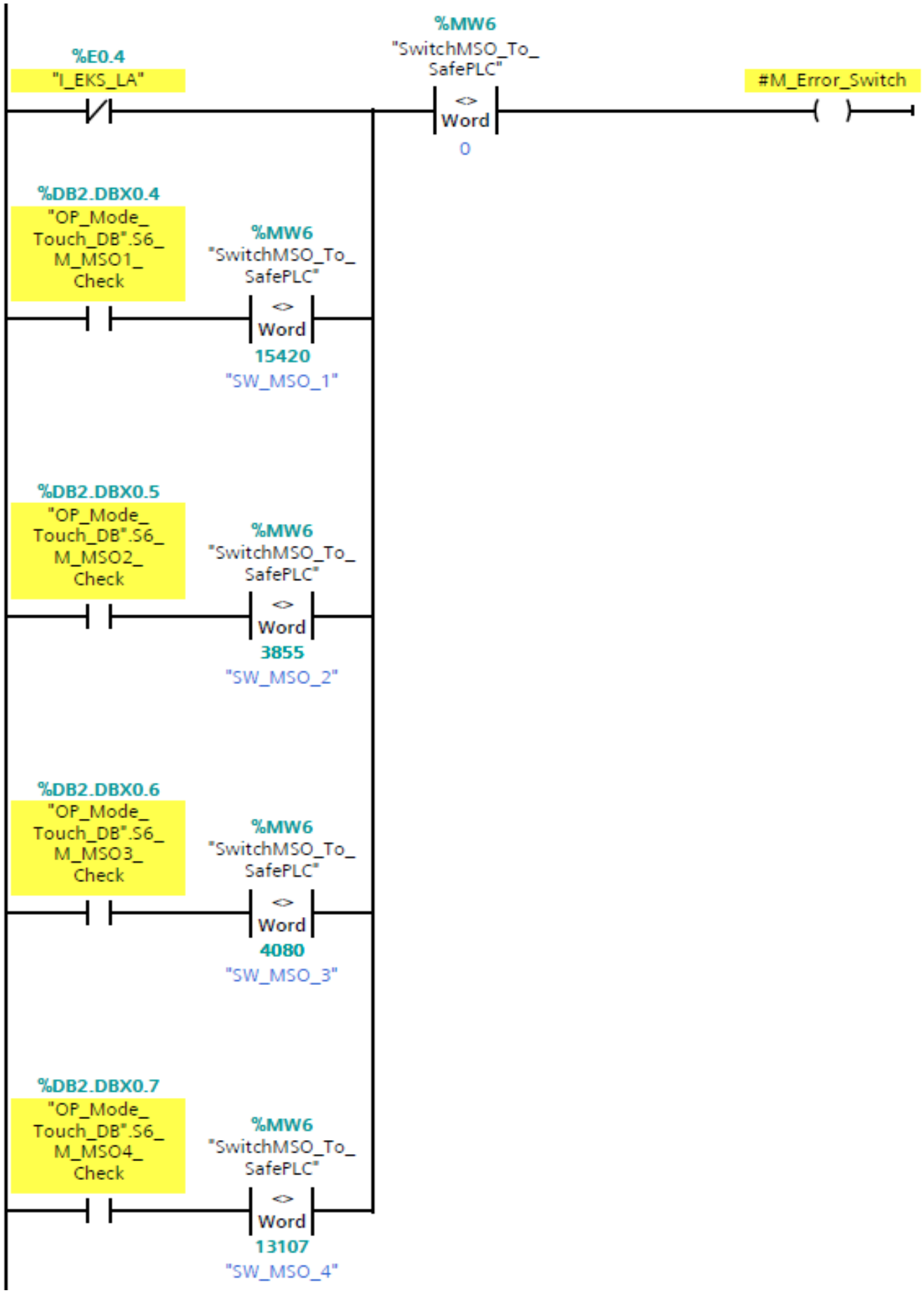
F-PLC network 10:



F-PLC network 11:



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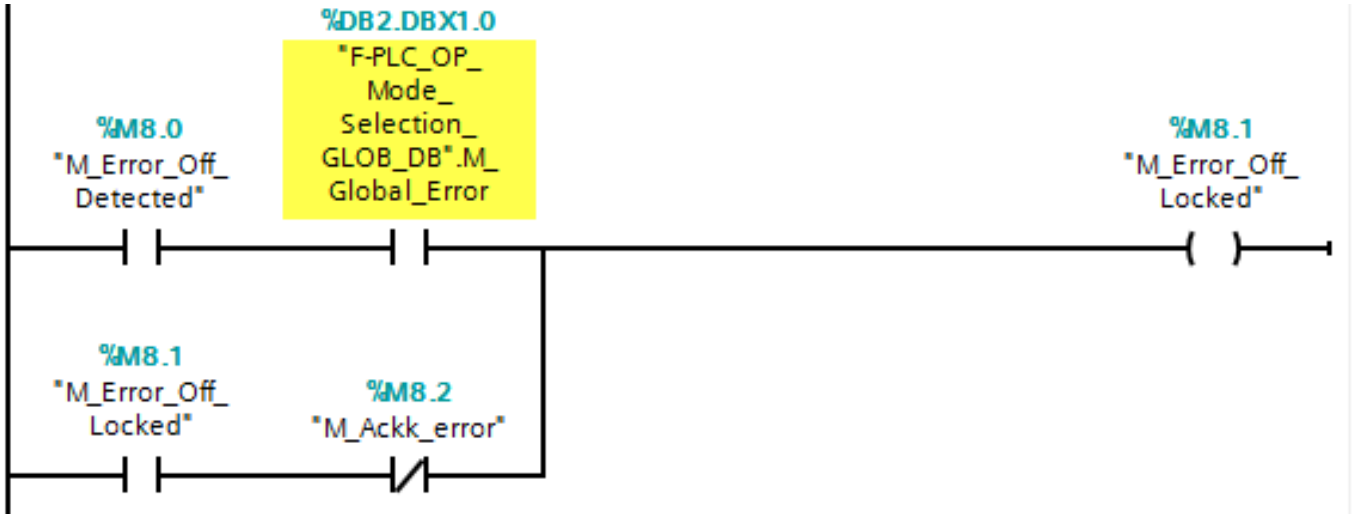
F-PLC network 12:

PLC network 11:

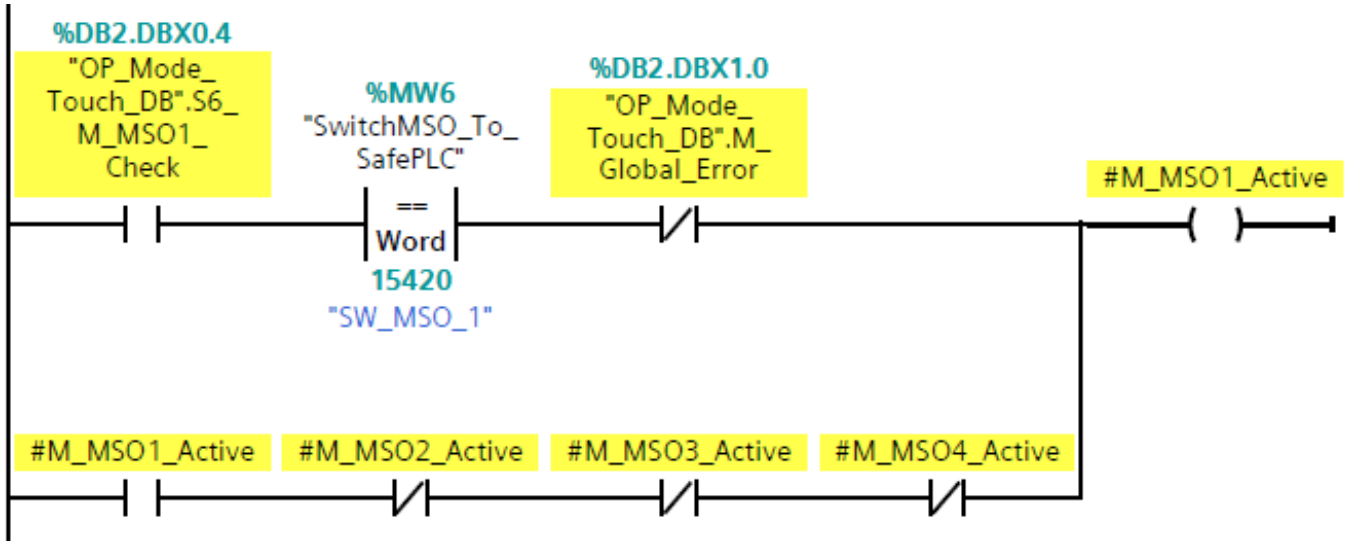
PLC network 12:



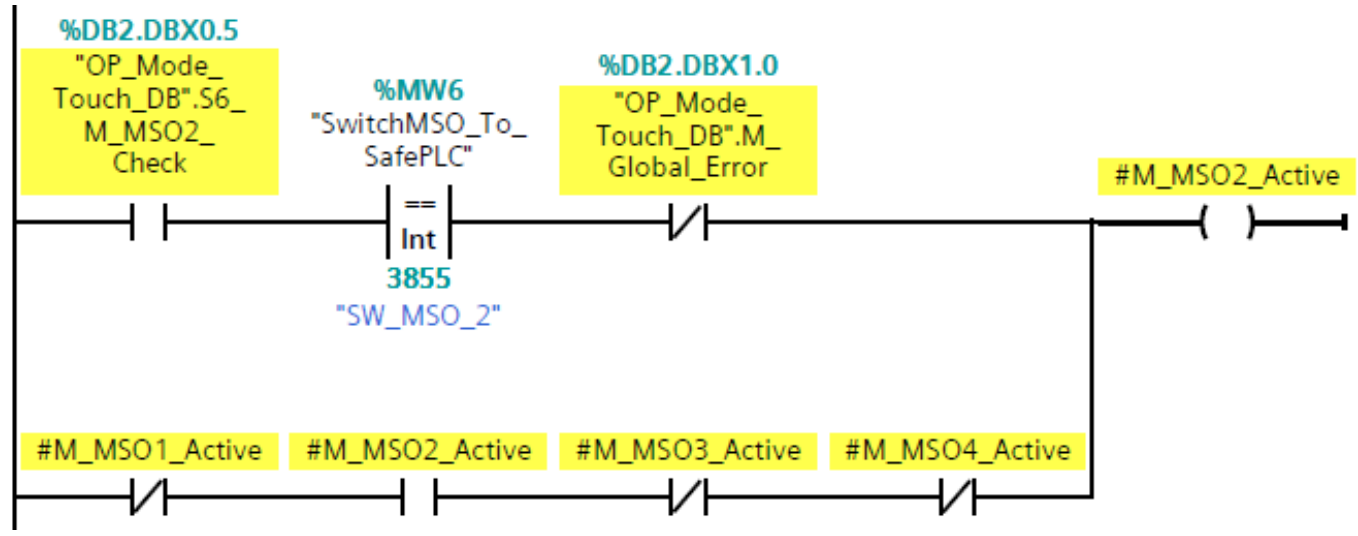
Step	System	Description
20	F-PLC	The error check is linked to F-PLC networks 13 to 16.

Step	System	Description
21	F-PLC	The switch to the new operating mode is made, provided an error does not occur. For this purpose, the previously selected operating mode saved in the flag for which confirmation has been requested from the HMI must match the operating mode confirmed. F-PLC network 13: a check for operating mode 1 has been saved, and operating mode 1 is now confirmed. F-PLC network 14: a check for operating mode 2 has been saved, and operating mode 2 is now confirmed. F-PLC network 15: a check for operating mode 3 has been saved, and operating mode 3 is now confirmed. F-PLC network 16: a check for operating mode SE has been saved, and operating mode SE is now confirmed.
22	F-PLC	The flags formed in step 21 are also available in the PLC or HMI if an indication or reaction is required.

F-PLC network 13:



F-PLC network 14:



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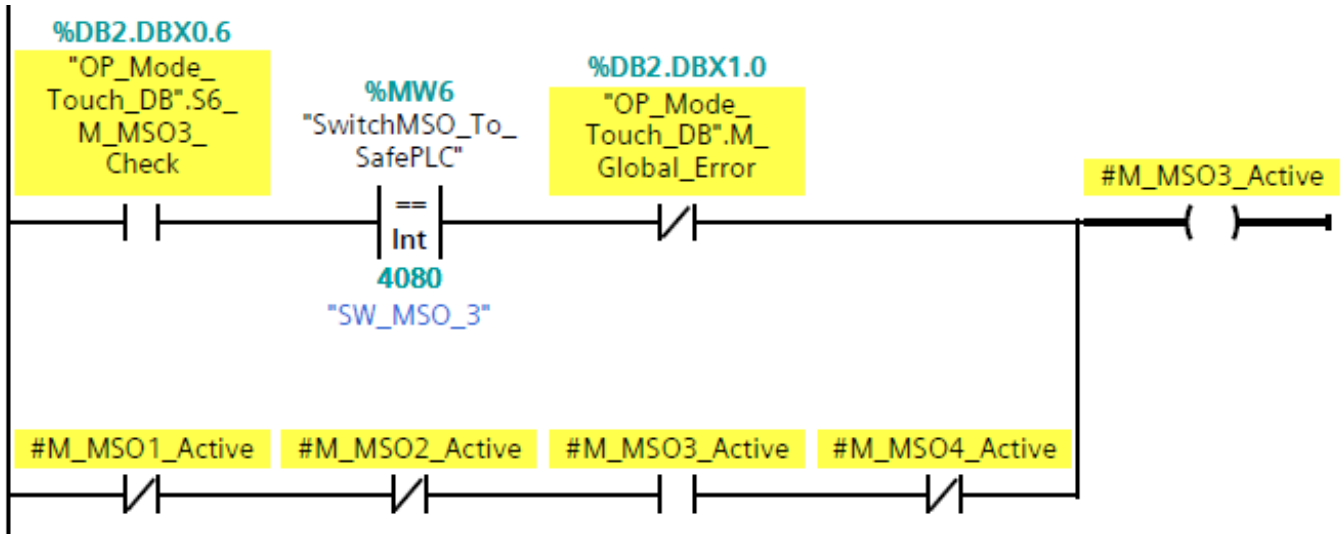
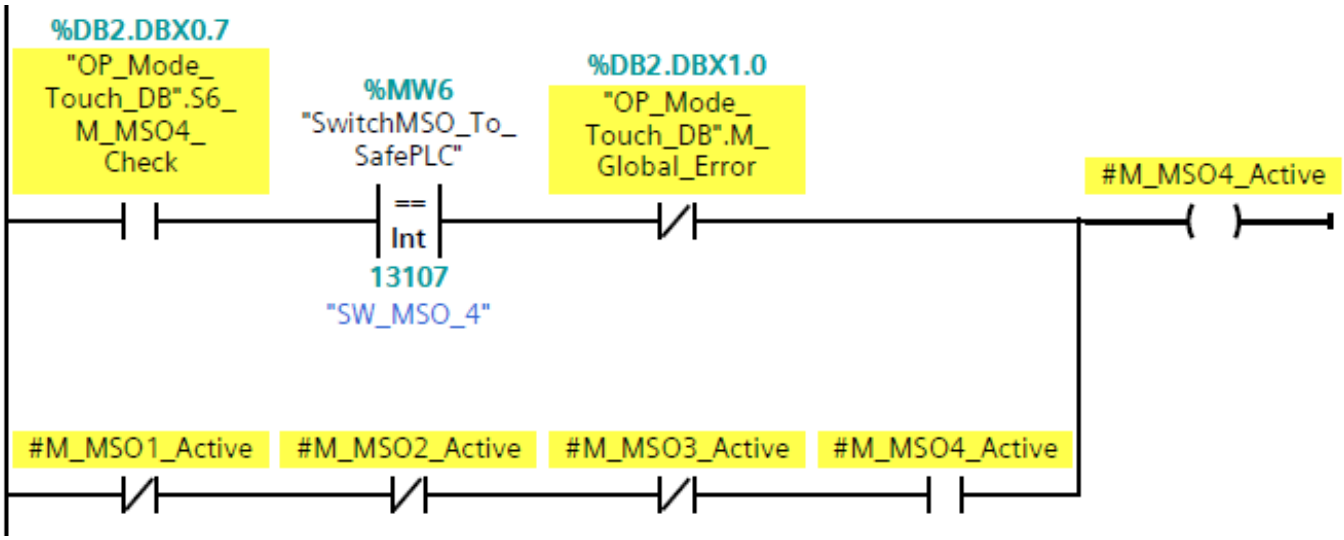
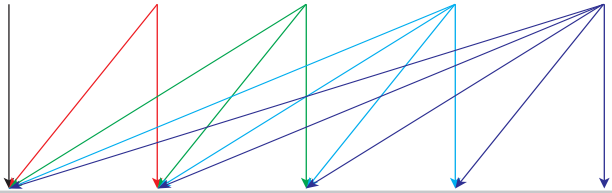
F-PLC network 15:



F-PLC network 16:



5. Overview table of the data words

Permitted operating mode on the EKS Electronic-Key (ReadAutho-rization)	**MSO0**	**MSO1**	**MSO2**	**MSO3**	**MSO4**
Data word on Electronic-Key	0F0FH	0FF0H	3333H	33CCH	3C3CH
					
Selected operating mode (SelectMSO)	**MSO0**	**MSO1**	**MSO2**	**MSO3**	**MSO4**
	0FF0H	3333H	33CCH	3C3CH	0F0FH
	↓	↓	↓	↓	↓
Operating mode to be confirmed (CheckMSO)	**MSO0**	**MSO1**	**MSO2**	**MSO3**	**MSO4**
	3333H	33CCH	3C3CH	0F0FH	0FF0H
	↓	↓	↓	↓	↓
Application of the selected operating mode (SwitchMSO)	**MSO0**	**MSO1**	**MSO2**	**MSO3**	**MSO4**
	33CCH	3C3CH	0F0FH	0FF0H	3333H

6. Basic circuit diagram

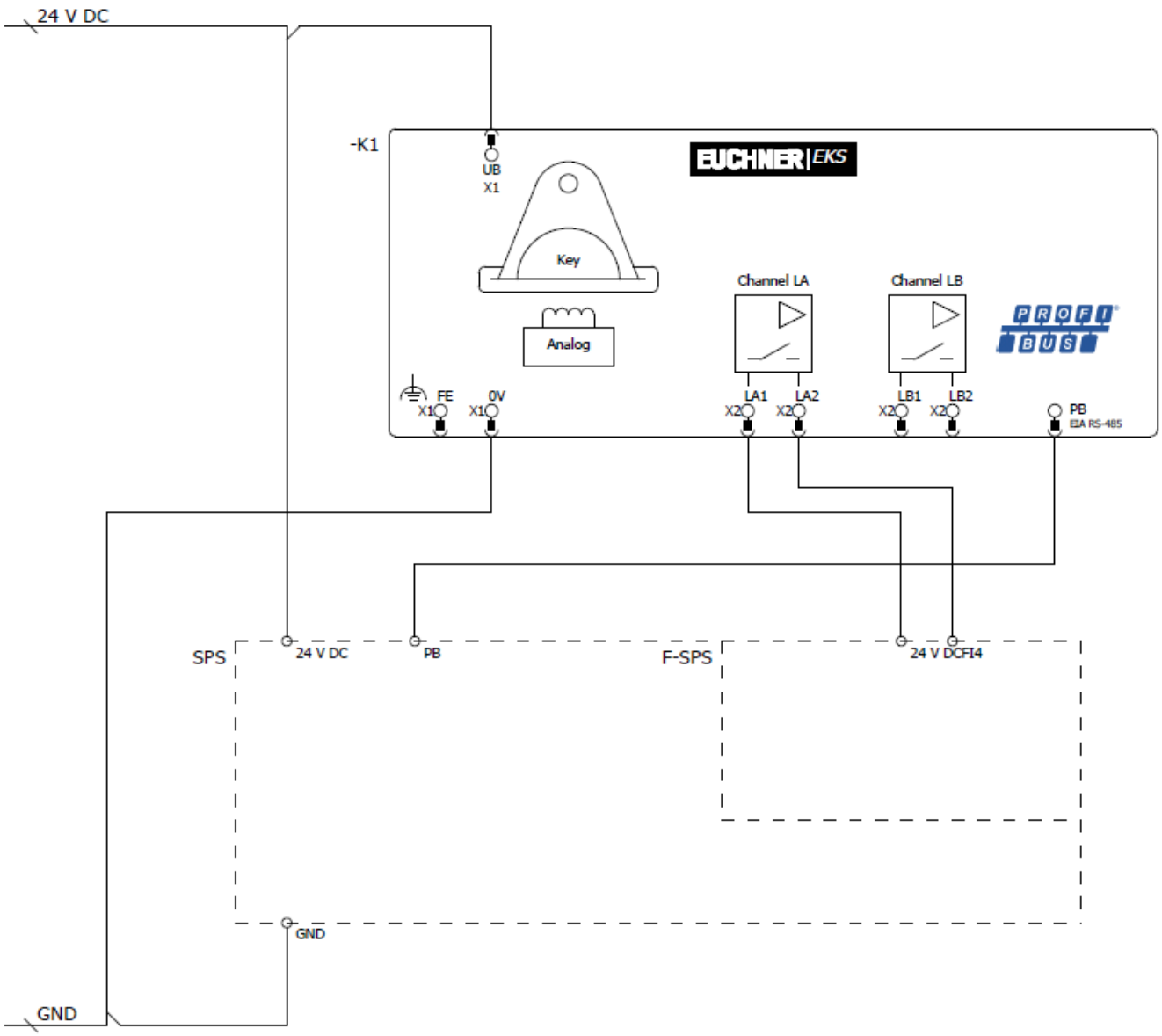


Figure 8: Basic circuit diagram

7. Safety assessment

For the safety description, please refer to the application AP000169-7_02_09-15…, which you will find on the Internet at www.euchner.com.

EN

8. Important notice – please observe carefully!

This document is intended for a design engineer who possesses the requisite knowledge in safety engineering and knows the applicable standards, e.g. through training for qualification as a safety engineer. Only with the appropriate qualification is it possible to integrate the example provided into a complete safety chain.

The example represents only part of a complete safety chain and does not fulfill any safety function on its own. In order to fulfill a safety function, the energy switch-off function for the danger zone and the software within the safety evaluation must also be considered, for example.

The applications provided are only examples for solving certain safety tasks for protecting safety doors. The examples cannot be comprehensive due to the application-dependent and individual protection goals within a machine/installation.

If questions concerning this example remain open, please contact us directly.

According to the Machinery Directive 2006/42/EC, the design engineer of a machine or installation has the obligation to perform a risk assessment and take measures to reduce the risk. While doing this, the engineer must comply with the applicable national and international safety standards. Standards generally represent the current state-of-the-art. Therefore, the design engineer should continuously inform himself about changes in the standards and adapt his considerations to them. Relevant standards include EN ISO 13849 and EN 62061. This application must be regarded only as assistance for the considerations about safety measures.

The design engineer of a machine/installation has the obligation to assess the safety technology him/herself. The examples must not be used for an assessment, because only a small excerpt of a complete safety function was considered in terms of safety engineering here.

In order to be able to use the safety switch applications correctly on safety doors, it is indispensable to observe the standards EN ISO 13849-1, EN ISO 14119 and all relevant C-standards for the respective machine type. Under no circumstances does this document replace the engineer's own risk assessment, and it cannot serve as the basis for a fault assessment.

In particular in relation to a fault exclusion, it must be noted that a fault can only be excluded by the machine's or installation's design engineer and this action requires justification. A general fault exclusion is not possible. More information about fault exclusion can be found in EN ISO 13849-2.

Changes to products or within assemblies from third-party suppliers used in this example can lead to the function no longer being ensured or the safety assessment having to be adapted. In any event, the information in the operating instructions on the part of EUCHNER, as well as on the part of third-party suppliers, must be used as the basis before this application is integrated into an overall safety function. If contradictions should arise between the operating instructions and this document, please contact us directly.

Use of brand names and company names

All brand names and company names stated are the property of the related manufacturer. They are used only for the clear identification of compatible peripheral devices and operating environments in relation to our products.

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