

Welcome to the 2022 Web-Seminar series for application engineers

ctrlX CORE

Web-Seminar

ctrlX SAFETY

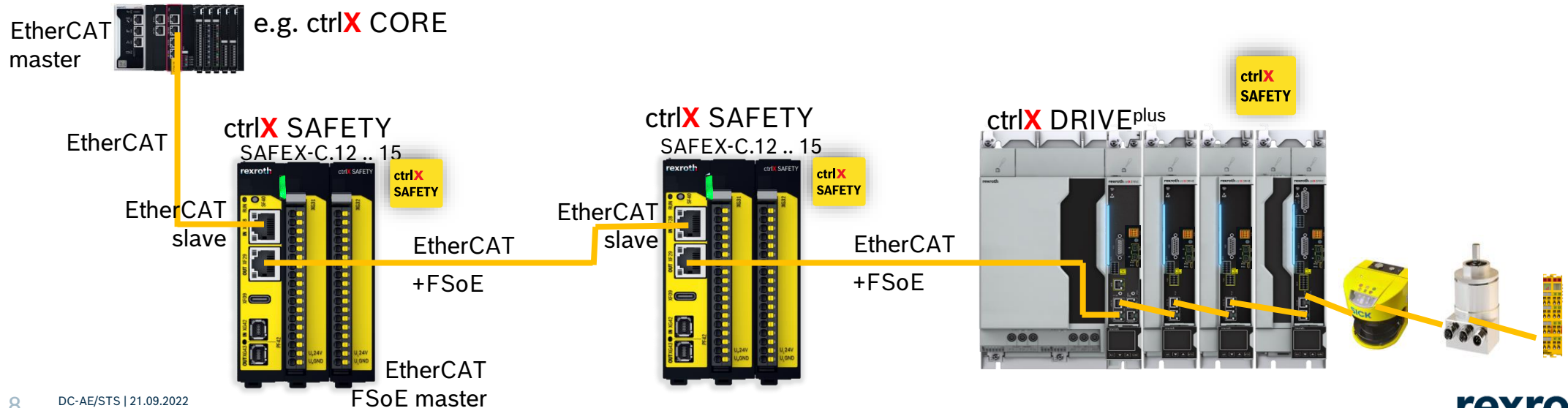
Part 3/3

ctrlX SAFETY (Part 3/3)

Solution using safe fieldbus FSoE

SAFEX-C.1x – EtherCAT FSoE connection

- EtherCAT control necessary, like ctrlX CORE !
- Slower in reaction time if compared to ctrlX SAFETYlink solution
- Up to in total 32 FSoE slaves (other SAFEX-C12 .. 15, drives, safe devices and safe I/Os) possible
- Several safe areas possible (every drive can be controlled individually)
- Cross communication in between up to theoretically 31 SAFEX-C.12 .. 15 done over EtherCAT FSoE

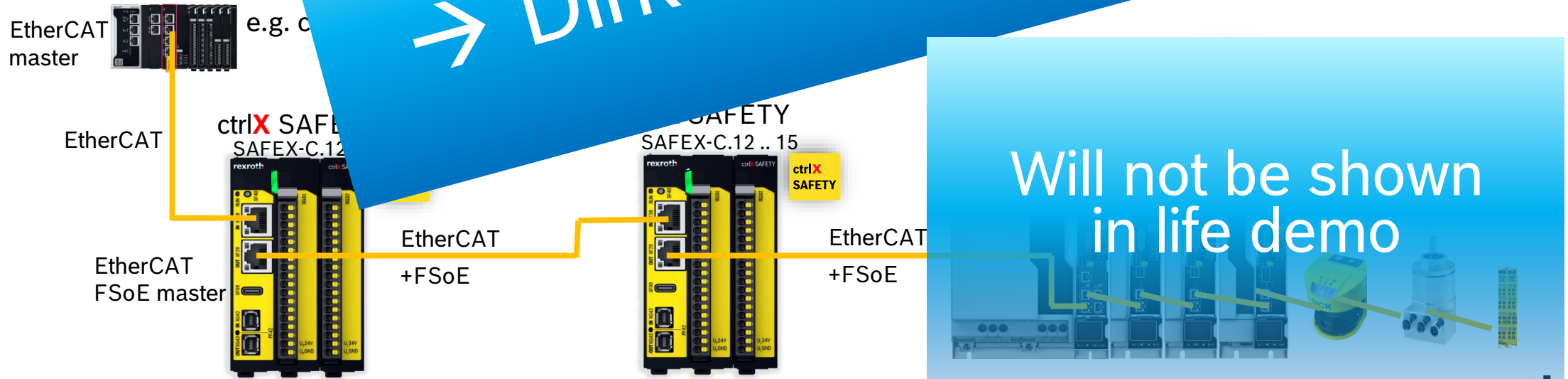


ctrlX SAFETY (Part 3/3)

Solution using safe fieldbus FSoE

Life Demo: SAFEX-C.12 – EtherCAT FSoE connection

- EtherCAT control: ctrlX CORE
- Up to in total 32 FSoE slaves (1200000) possible
- Several safe areas
- Cross communication



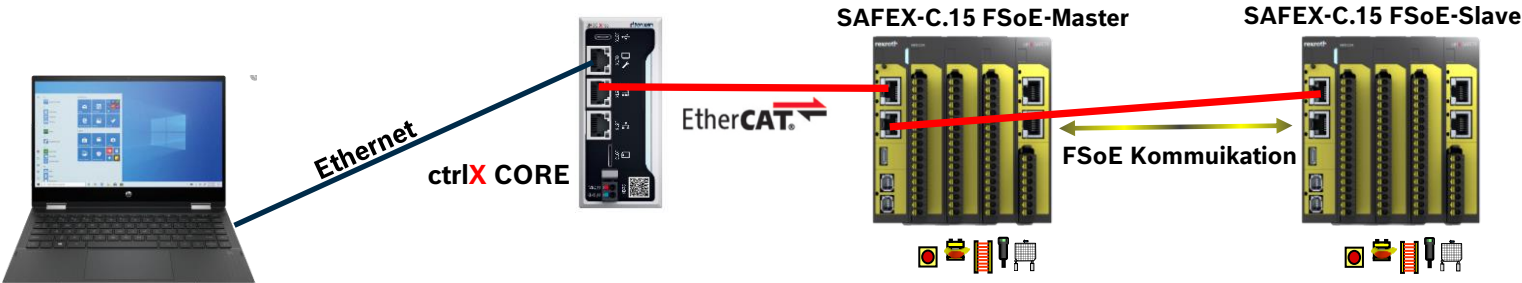
ctrlX SAFETY (Part 3/3)

Solution using safe fieldbus FSoE

Life Demo

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

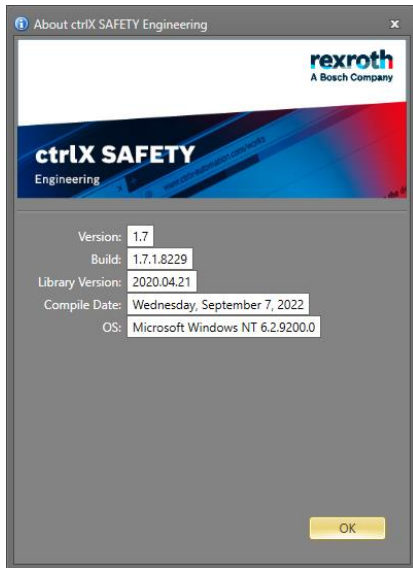
Topology and Layout of Life Demo



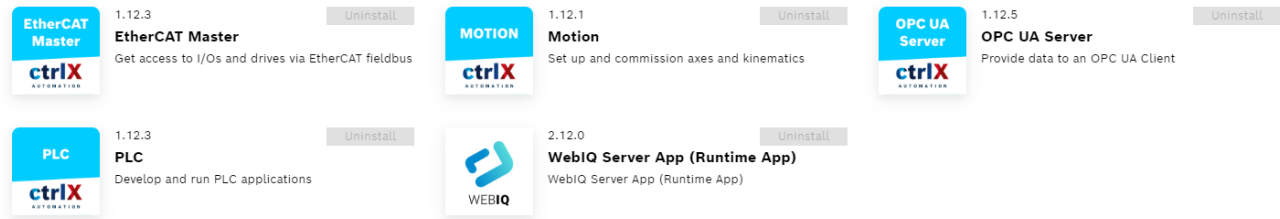
ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Life Demo: Engineering and Firmware Versions used

Version ctrlX SAFETY Engineering



Firmware ctrlX CORE



Ethercat ESI-Files of SAFEX-C.1x must be match to the Firmware

File Name	Date	Type	Size
BoschRexroth_ctrlX_SAFETY_SAFEX_C12_C15_ECAT.xml	18.03.2021 18:22	XML-Dokument	406 KB
BoschRexroth_ctrlX_SAFETY_SAFEX_C12_C15_ModulesECAT.xml	22.04.2022 09:01	XML-Dokument	770 KB

Firmware SAFEX-C.15

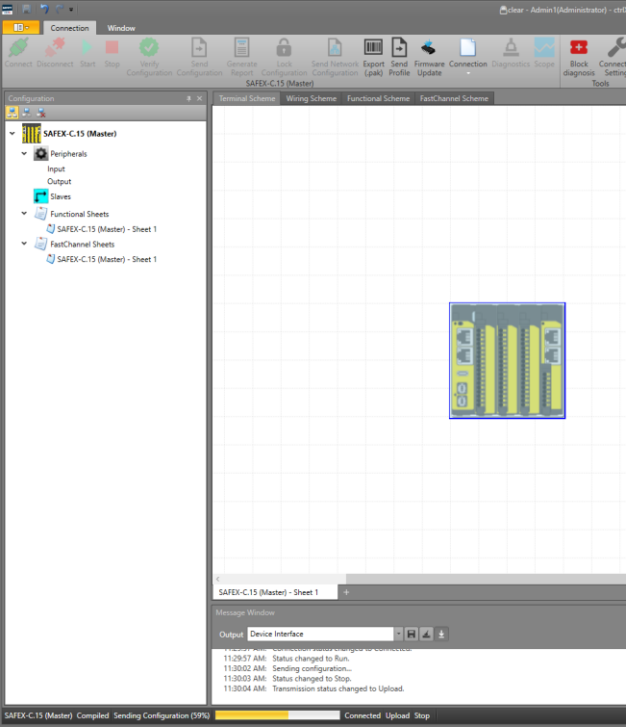
Diagnostics - SAFEX-C.15 (Master)	
Log Book	Function Block
Process image	Process image FC
System Info	
PAA Name	Value
Device Config CRC	1984607822 (0x764AB64E)
Transfer Counter	271
Serial Number	150000204
FW Version	1.0.1.19
HW Version	4
FPGA Version	207
Lifetime [s]	2170939
Temperature MPU B [deg]	74

Firmware SAFEX-C.15

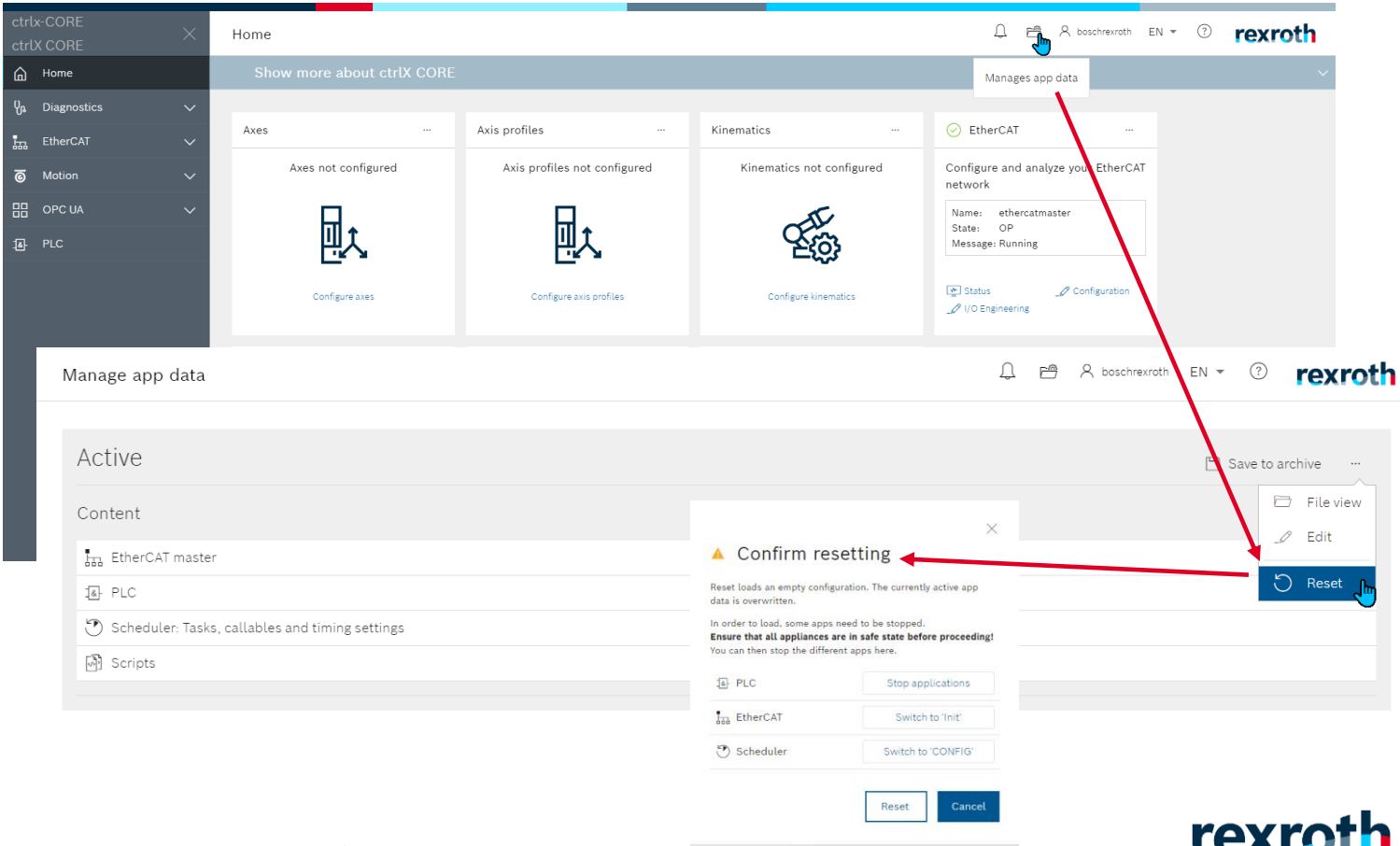
Diagnostics - SAFEX-C.15 (Master)	
Log Book	Function Block
Process image	Process image FC
System Info	
PAA Name	Value
Device Config CRC	1984607822 (0x764AB64E)
Transfer Counter	140
Serial Number	150000214
FW Version	1.0.1.19
HW Version	4
FPGA Version	207
Lifetime [s]	1134062
Temperature MPU B [deg]	78

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE Life Demo - Preparation: Clear program memory of ctrlX CORE and ctrlX SAFETY

Load an empty project into
SAFEX-C.1x control



Delete the program memory from the ctrlX CORE with reset



Solution using safe fieldbus FSoE

ctrlX SAFETY

FSoE Master program (Life Demo)

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE Life Demo – FSoE master (SN15000204) program: Wiring scheme

The screenshot shows the ctrlX SAFETY Engineering software interface. The main workspace displays a wiring scheme for an FSoE master. The SAFEX-C.15 (Master) device is connected to three Emergency Stop inputs (Emergency Stop 1, 2, and 3). A context menu is open over the Emergency Stop 1 input, showing options like 'Rename' and 'Delete'. The Properties window for Emergency Stop 1 is also visible, showing configuration details such as 'Signal #1' and 'Start Behaviour'.

Properties for Emergency Stop 1:

- Inputs
 - Can be used in FastChannel:
 - Type: 1 N.C.
 - Signal #1: SAFEX-C.15 (Master) - I0.0
 - Cross Circuit Check: OFF
- Start Behaviour
 - Start Type: Auto
 - Start test:
- Miscellaneous
 -
- Name
 - Name: Emergency Stop 1

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE Life Demo – FSoE master (SN15000204) program: Configuration of FSoE properties of SAFEX-C.1x control

The screenshot displays the ctrlX SAFETY Engineering software interface. The central workspace shows a wiring diagram with a terminal block and a control unit. The right-hand Properties panel is open, showing various settings for the device. The 'Switch Off FSoE Diagnose' property is highlighted in red. The bottom status bar indicates 'SAFEX-C.15-SN15000204 (Master) Not Compiled'.

Property	Value
Logical Device Address	0
Cycle Time	4 ms
Number of Analog Inputs	0
High Side	<input type="checkbox"/>
Switch Off FSoE Diagnose	<input checked="" type="checkbox"/>
OSSD Test Pulse	250 μ s
OSSD Period	500 ms
Output Level	Low Level 5V
Output Quality	Quality1
SIL Level	SIL3
Slave Network Interface	<input type="checkbox"/>
FastChannel	SAFETYlink
Ethernet Port	32000
IP	192.168.1.1
Slave amount	<input type="checkbox"/>
UserEnableNO	<input type="checkbox"/>
IP	192.168.1.1
Comment	
Name	SAFEX-C.15-SN15000204

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

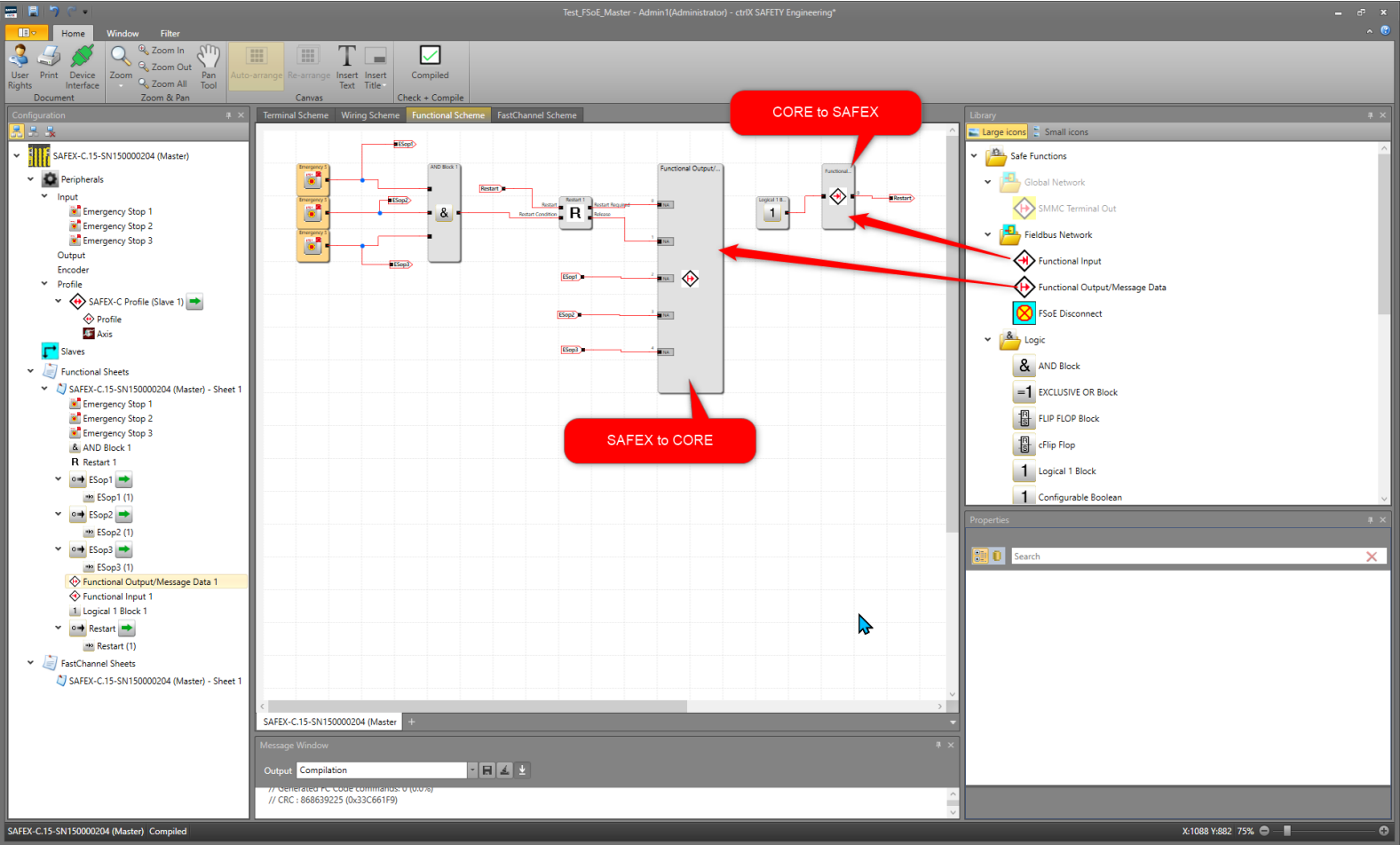
Life Demo – FSoE master (SN15000204) program:

Configuration of FSoE slave SAFEX-C.1x control

The screenshot displays the ctrlX SAFETY Engineering software interface. The main workspace shows a terminal scheme with three emergency stop buttons connected to a slave device. The left sidebar shows the project tree with 'SAFEX-C Profile (Slave 1)' selected. The right sidebar shows the library with 'SAFEX-C.1x Slave' selected. The bottom right pane shows the properties for the slave, with 'SAFEX-C Profile' and 'Slave Address 1' (set to 10) highlighted.

Property	Value
Device	Logical Device Address: 1 Cycle Time: 8 ms
Profile	SAFEX-C Profile
FSoE	Slave Address 1: 10 Watchdog time: 200 Connection ID 1: 1 Config Type: CoE using SRA
Miscellaneous	Comment: <input type="checkbox"/>
Name	Name: SAFEX-C.1x Slave

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE Life Demo – FSoE master (SN15000204) program: Functional Scheme: Functional exchange SAFEX<->CORE



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Life Demo – FSoE master (SN15000204) program: Functional Scheme (new sheet „FSoE“ used)

The screenshot displays the ctrlX SAFETY Engineering software interface. The main window shows the Functional Scheme for the SAFEX-C Profile (Slave 1). The Configuration tree on the left lists the master (SAFEX-C-15-SN15000204) and various peripherals, including Emergency Stops (ESop1, ESop2, ESop3) and FSoE signals (EStop1_SN214, EStop2_SN214, EStop3_SN214). The Functional Scheme diagram shows a 'Just a dummy program' block connected to the FSoE signals. Red callouts point to the FSoE signals and the dummy program block, with text indicating connections to FSoE Slave SN15000214. The Library on the right shows various safety functions, including Logic, Safety Monitorings, and Muting Functions. The Properties window at the bottom right shows the configuration for the EStop1_SN214 signal, including its name and text color.

Solution using safe fieldbus FSoE

ctrl**X** SAFETY

FSoE Slave program (Life Demo)

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Life Demo – FSoE slave (SN15000214) program:

Local Network settings

The screenshot displays the ctrlX SAFETY Engineering software interface. The main workspace shows a wiring diagram with a slave device connected to a primary/secondary interface. A red arrow points from the 'Primary/Secondary Interface' in the left-hand tree view to the 'Properties' dialog box for the 'Primary/Secondary Interface'. In this dialog, the 'Safe Slave Protocol' is set to 'FSoE'. Another red arrow points from the 'Local Network' section in the right-hand 'Properties' panel to the 'Slave Network Interface' checkbox, which is checked. The 'Local Network' section also shows 'FastChannel Interface' checked and 'SAFETYlink' selected as the network type. The 'Device' section shows 'Switch Off FSoE Diagnose' checked. The 'Local Network' section shows 'Slave Network Interface' checked and 'SAFETYlink' selected. The 'Device' section shows 'Switch Off FSoE Diagnose' checked. The 'Local Network' section shows 'Slave Network Interface' checked and 'SAFETYlink' selected. The 'Device' section shows 'Switch Off FSoE Diagnose' checked.

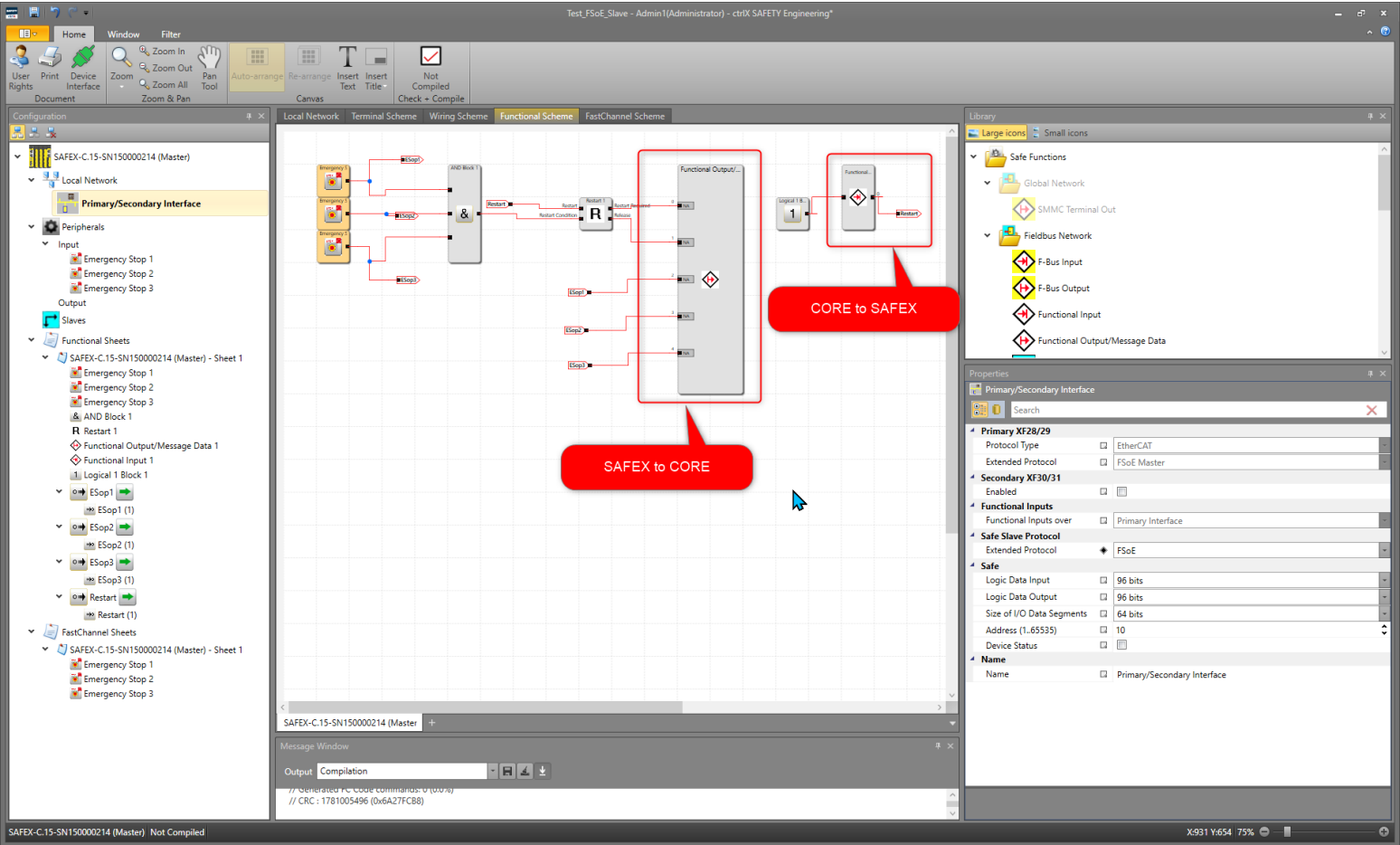
ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE Life Demo – FSoE slave (SN15000214) program: Wiring scheme (for Life Demo test same as master)

The screenshot displays the ctrlX SAFETY Engineering software interface. The main workspace shows a wiring scheme for a slave device (SAFEX-C-15-SN150000214) connected to a master device. The wiring scheme includes three emergency stop inputs (ESop1, ESop2, ESop3) and three restart outputs (Restart1, Restart2, Restart3). The slave device is connected to the master device via a safe fieldbus (FSoE). The interface includes a Configuration tree on the left, a Library on the right, and a Properties panel at the bottom right. The Properties panel shows the device configuration, including the Logical Device Address (0), Cycle Time (4 ms), Number of Analog Inputs (0), High Side, and Switch Off FSoE Diagnose (checked). The Local Network section shows the Slave Network Interface (checked), FastChannel (SAFETLink), Ethernet Port (32000), and IP (192.168.1.1). The SAFETYlink section shows the Slave amount (checked), UserEnableNO (checked), and Global Network IP (192.168.1.1). The Miscellaneous section shows the Comment field. The Message Window at the bottom shows the output of the compilation process, including the generated PLC code commands and the CRC value (1781005496 (0x6A27FC88)).

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Life Demo – FSoE slave (SN15000214) program:

Functional Scheme: Functional exchange SAFEX<->CORE



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Life Demo – FSoE slave (SN15000214) program: Functional Scheme (new sheet „FSoE“ used)

The screenshot displays the ctrlX SAFETY Engineering software interface. The main workspace shows a Functional Scheme diagram with the following components and connections:

- F-Bus Input** and **F-Bus Output** blocks are connected to a central block labeled "Just a dummy program".
- Red callouts point to the connections, labeled "to FSoE Master SN15000204" and "from FSoE Master SN15000204".
- The diagram also includes **ESop1**, **ESop2**, and **ESop3** blocks connected to the F-Bus Input and Output.

The interface includes a Configuration tree on the left, a Library on the right, and a Message Window at the bottom. The Message Window shows the following output:

```
Output: Compilation  
// Generated PC code command: 0 (0.0s)  
// CRC : 1781005496 (0x6A27FCB8)
```

Solution using safe fieldbus FSoE

ctrlX CORE

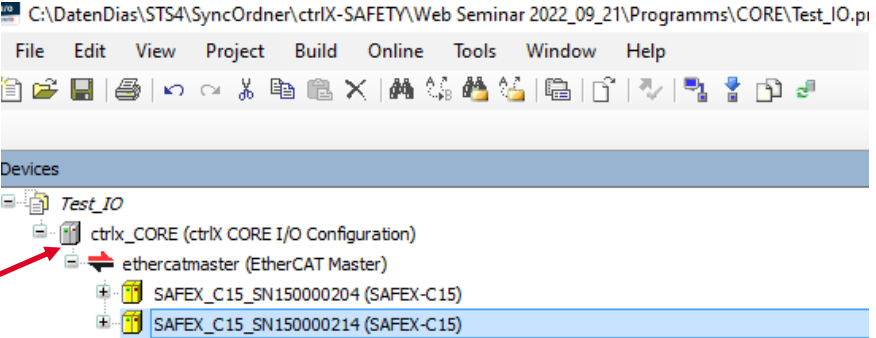
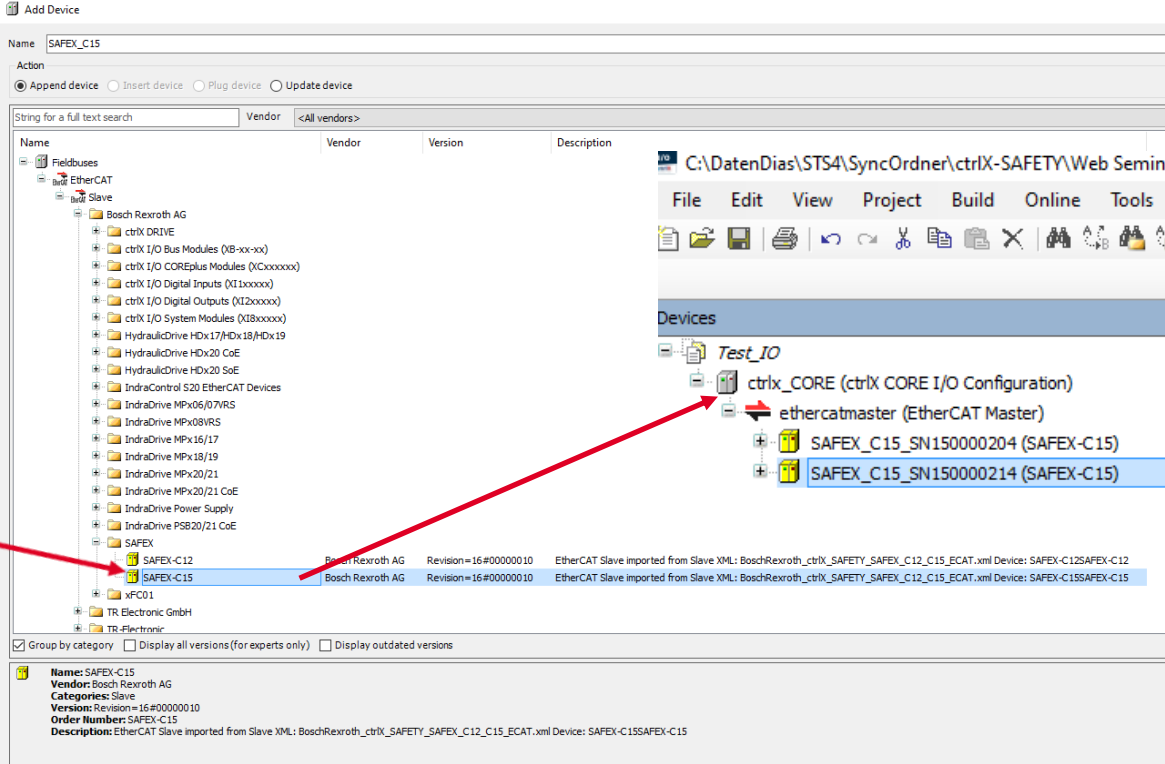
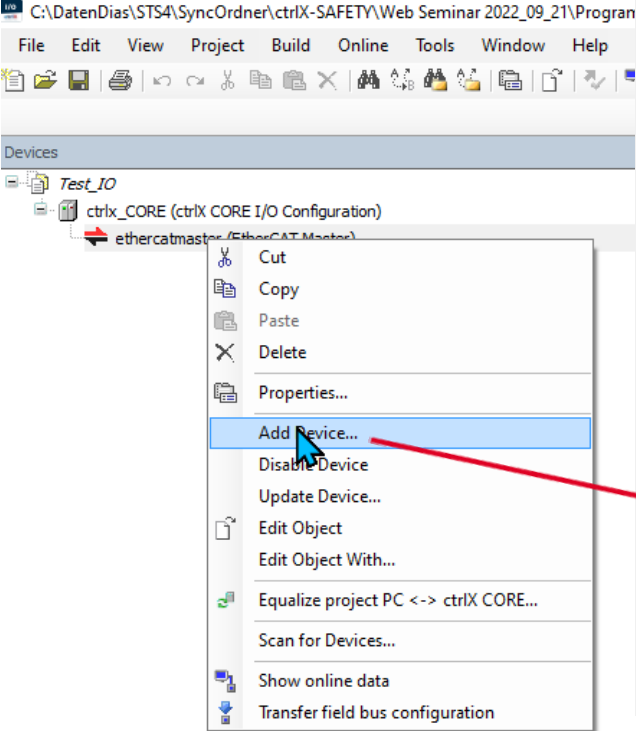
IO-configuration

(Life Demo)

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: ctrlX IO- Engineering

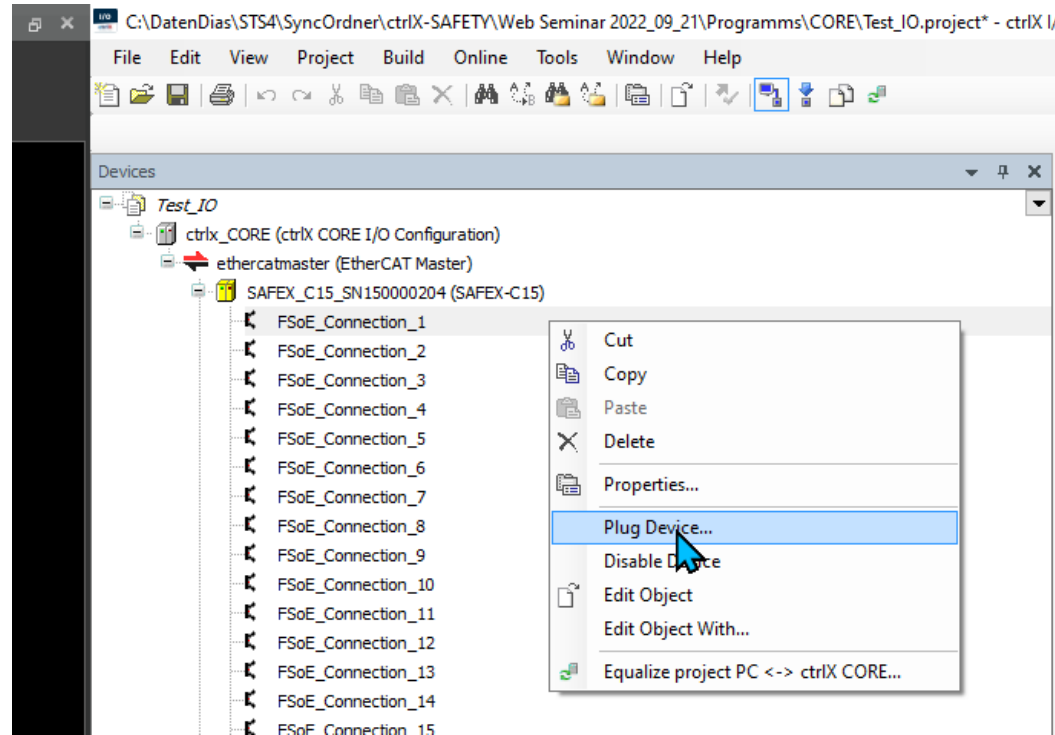
IO- Configuration



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: ctrlX IO- Engineering

Plug device for FSoE Master Connection



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: ctrlX IO- Engineering Plug device for FSoE Master Connection

Plug Device

Name: FSoE_Connection_1

Action: Append device Insert device Plug device Update device

String for a full text search: Vendor: <All vendors>

Name	Vendor	Version	Description
Fieldbuses			
EtherCAT			
Module			
Alignment Byte 6302	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: Alignment Byte 6302
FSoE Master Connection 1 Byte In/1 Byte Out 14 bytes safety parameters 620A	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 14 bytes safety parameters 620A
FSoE Master Connection 1 Byte In/1 Byte Out 32 bytes safety parameters 6210	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 32 bytes safety parameters 6210
FSoE Master Connection 1 Byte In/1 Byte Out 5 bytes safety parameters 6207	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 5 bytes safety parameters 6207
FSoE Master Connection 1 Byte In/1 Byte Out 5 bytes safety parameters 6208	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 5 bytes safety parameters 6208
FSoE Master Connection 1 Byte In/1 Byte Out 8 bytes safety parameters 6200	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 8 bytes safety parameters 6200
FSoE Master Connection 1 Byte In/1 Byte Out 8 bytes safety parameters 6201	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 8 bytes safety parameters 6201
FSoE Master Connection 1 Byte In/1 Byte Out 9 bytes safety parameters 6209	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 1 Byte In/1 Byte Out 9 bytes safety parameters 6209
FSoE Master Connection 10 Bytes In/10 Bytes Out 0 byte safety parameter 6205	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 10 Bytes In/10 Bytes Out 0 byte safety parameter 6205
FSoE Master Connection 12 Bytes In/12 Bytes Out 0 byte safety parameter 620B	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 12 Bytes In/12 Bytes Out 0 byte safety parameter 620B
FSoE Master Connection 12 Bytes In/8 Bytes Out 07 bytes safety parameters 6206	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 12 Bytes In/8 Bytes Out 07 bytes safety parameters 6206
FSoE Master Connection 14 Bytes In/14 Bytes Out 0 byte safety parameter 621A	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 14 Bytes In/14 Bytes Out 0 byte safety parameter 621A
FSoE Master Connection 2 Bytes In/2 Bytes Out 0 byte safety parameter 6202	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 2 Bytes In/2 Bytes Out 0 byte safety parameter 6202
FSoE Master Connection 8 Bytes In/2 Bytes Out 06 bytes safety parameters 6219	Bosch Rexroth AG	0	EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 8 Bytes In/2 Bytes Out 06 bytes safety parameters 6219

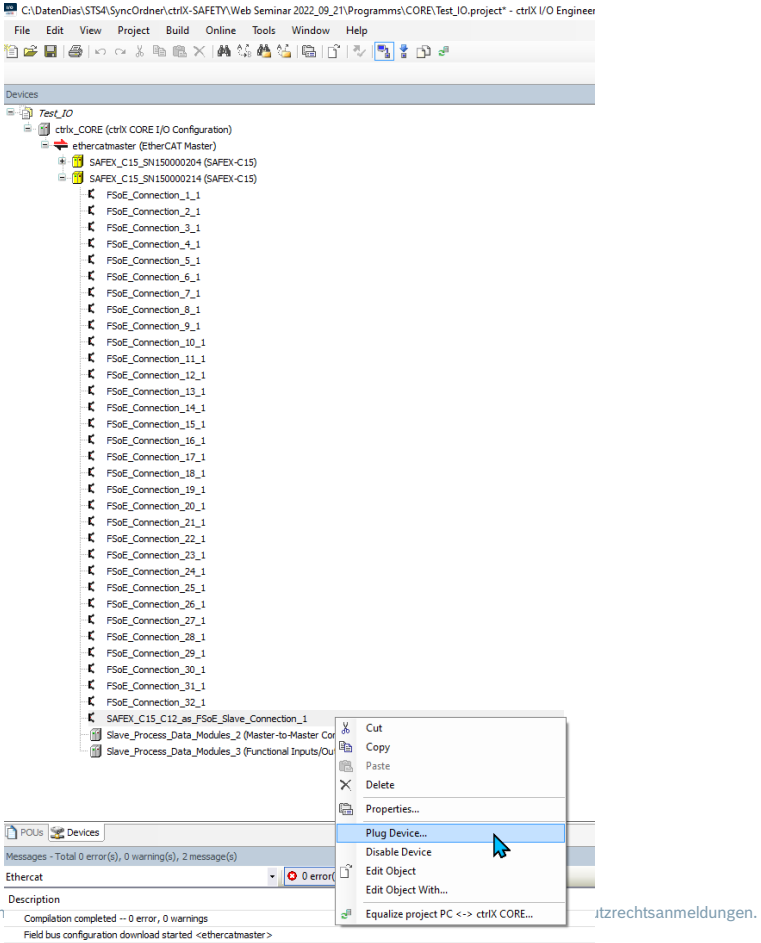
Group by category Display all versions (for experts only) Display outdated versions

Name: FSoE Master Connection 12 Bytes In/12 Bytes Out 0 byte safety parameter 620B
Vendor: Bosch Rexroth AG
Categories: Module
Version: 0
Order Number: 12 Bytes In/12 Bytes Out
Description: EtherCAT Module imported from Slave XML: BoschRexroth_ctrlX_SAFETY_SAFE_C12_C15_ModulesECAT.xml Device: FSoE Master Connection 12 Bytes In/12 Bytes Out 0 byte safety parameter 620B

Plug selected device into the slot
 FSoE_Connection_1
 ⓘ (You can select another target node in the navigator while this window is open.)

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

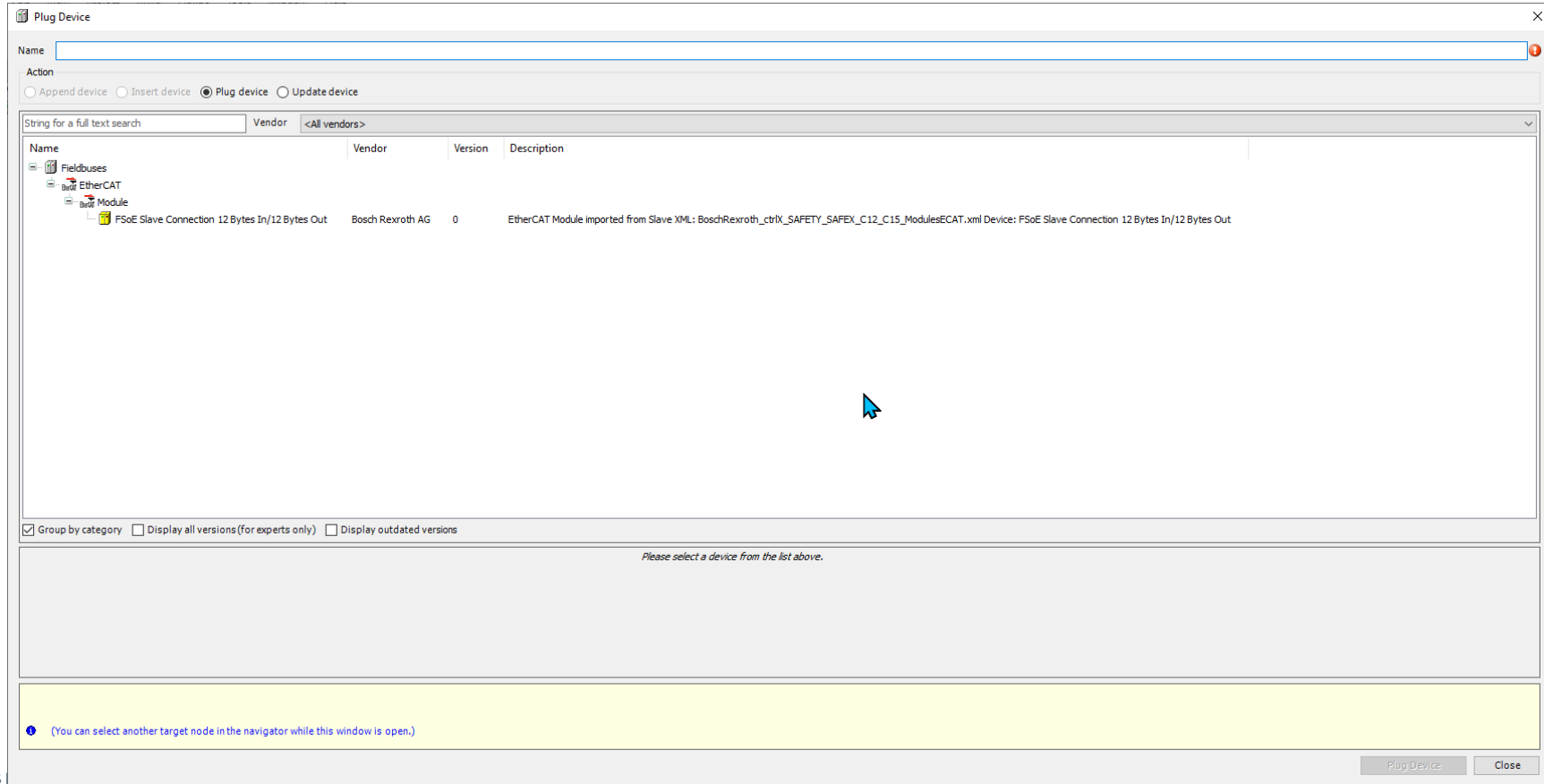
ctrlX CORE: ctrlX IO- Engineering Plug device for FSoE Slave Connection



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: ctrlX IO- Engineering

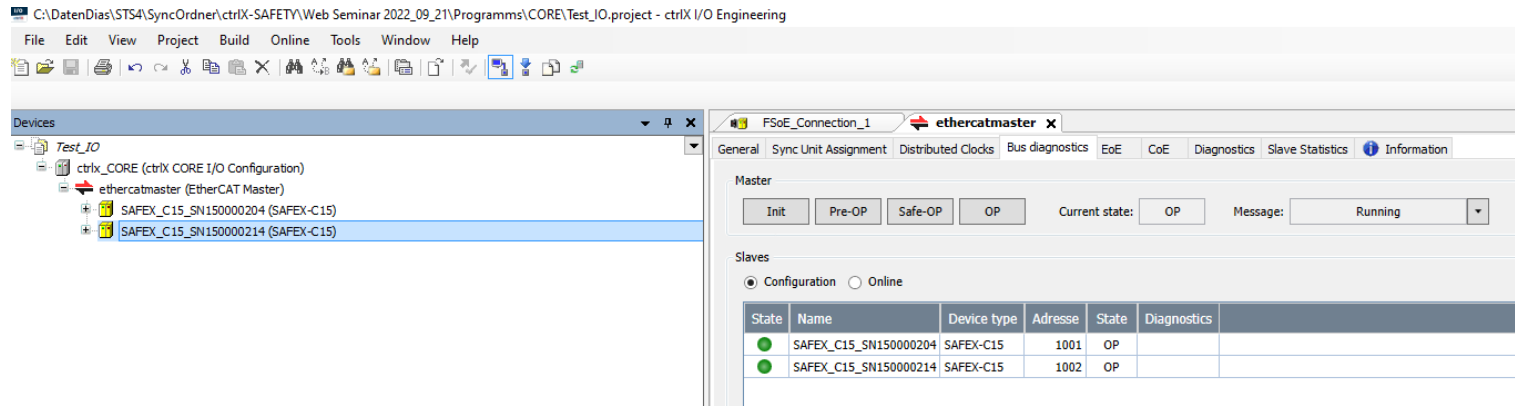
Plug device for FSoE Slave Connection



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: ctrlX IO- Engineering

IO- Configuration



Solution using safe fieldbus FSoE

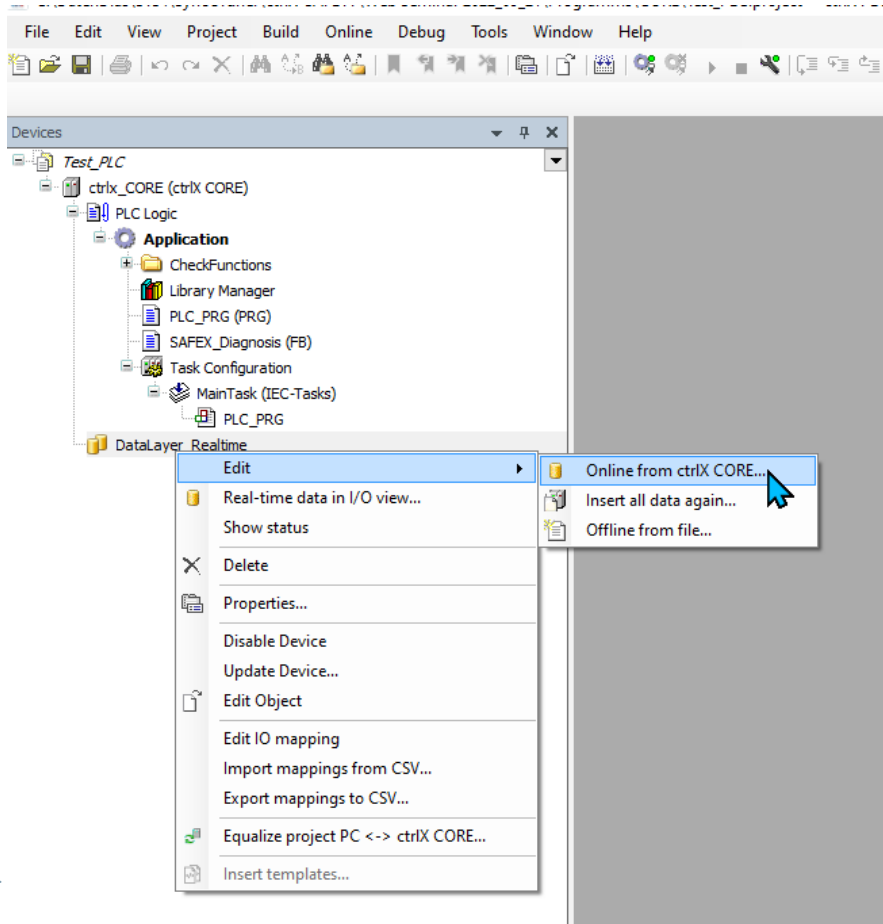
ctrlX CORE

PLC-Engineering (Life Demo)

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Include I/O configuration



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Change cycle time from 200ms to, e.g. 20ms (otherwise FSoE is not running)

The screenshot shows the ctrlX PLC Engineering software interface. The left pane displays a project tree for 'Test_PLC', including 'ctrlX CORE (ctrlX CORE)', 'Application', 'DataLayer_Realtime', and various EtherCAT instances. The right pane shows the 'MainTask' configuration window. The 'Configuration' tab is active, showing the following settings:

- Priority (20..39): 30
- Task group: IEC-Tasks
- Type: Cyclic
- Interval (e.g. t#200ms): 20
- Watchdog: Enable
- Time (e.g. t#200ms): 20 (highlighted with a red box)
- Sensitivity: 1

Below the configuration fields, there are buttons for 'Add Call', 'Remove Call', 'Change Call', 'Move Up', 'Move Down', and 'Open POU'. A table at the bottom lists the POU (Program Organization Unit) 'PLC_PRG' with an empty comment field.

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Declaration of Arrays at FSoE Input addresses

The screenshot displays the SIMATIC Manager interface for a PLC project. The main window shows the 'PROGRAM PLC_PRG' editor with variable declarations and ladder logic. Two windows show I/O mapping tables for 'FSoE_Connection_1' and 'SAFEX_C15_C12_as_FSoE_Slave_Connection_1'.

Variable Declaration (PLC_PRG):

```

VAR
  FSoE_MasterSN15000204 AT %IB0: ARRAY[0..27] OF BYTE;
  FSoE_SlaveSN15000204Output AT %QB0: ARRAY[0..27] OF BYTE;
  FSoE_SlaveSN15000214Input AT %IB1: ARRAY[0..27] OF BYTE;
  FSoE_SlaveSN15000214Output AT %QB1: ARRAY[0..27] OF BYTE;
  bClearErrorSN15000204 AT %QW6.0: BOOL;
  bClearErrorSN15000214 AT %QX170.0: BOOL;
  bClearError: BOOL;
  fbSAFEX_Diagnosis_SN15000214: SAFEX_Diagnosis;
  fbSAFEX_Diagnosis_SN214: SAFEX_Diagnosis;
END_VAR
  
```

I/O Mapping - FSoE_Connection_1:

Variable	Mapping	Channel	Address	Type
FSoE_SafetySlaveMessage_12_Bytes_InFSoE_SlaveCommand			%IB0	US1
FSoE_SafetySlaveMessage_12_Bytes_InData_1_0			%IX1.0	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_1			%IX1.1	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_2			%IX1.2	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_3			%IX1.3	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_4			%IX1.4	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_5			%IX1.5	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_6			%IX1.6	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_7			%IX1.7	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_8			%IX2.0	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_9			%IX2.1	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_10			%IX2.2	BIT
FSoE_SafetySlaveMessage_12_Bytes_InData_1_11			%IX2.3	BIT

I/O Mapping - SAFEX_C15_C12_as_FSoE_Slave_Connection_1:

Variable	Mapping	Channel	Address	Type
FSoE_SlaveMessage_12_Byte_FSoE_Slave_CMD			%B74	US1
FSoE_SlaveMessage_12_Byte_Data_1_0			%IX75.0	BIT
FSoE_SlaveMessage_12_Byte_Data_1_1			%IX75.1	BIT
FSoE_SlaveMessage_12_Byte_Data_1_2			%IX75.2	BIT
FSoE_SlaveMessage_12_Byte_Data_1_3			%IX75.3	BIT
FSoE_SlaveMessage_12_Byte_Data_1_4			%IX75.4	BIT
FSoE_SlaveMessage_12_Byte_Data_1_5			%IX75.5	BIT
FSoE_SlaveMessage_12_Byte_Data_1_6			%IX75.6	BIT
FSoE_SlaveMessage_12_Byte_Data_1_7			%IX75.7	BIT
FSoE_SlaveMessage_12_Byte_Data_1_8			%IX76.0	BIT
FSoE_SlaveMessage_12_Byte_Data_1_9			%IX76.1	BIT
FSoE_SlaveMessage_12_Byte_Data_1_10			%IX76.2	BIT
FSoE_SlaveMessage_12_Byte_Data_1_11			%IX76.3	BIT

Code Comments:

```

// Mapping FSoE-Data from FSoE-Master to FSoE-Slave
FSoE_SlaveSN15000214Output:= FSoE_MasterSN15000204Input;

// Mapping FSoE-Data from FSoE-Slave to FSoE-Master
FSoE_MasterSN15000204Output:= FSoE_SlaveSN15000214Input;

// Example for functional exchange
bClearErrorSN15000204:= bClearError;
bClearErrorSN15000214:= bClearError;

// call FunctionBlocks for Diagnosis from SAFEX
fbSAFEX_Diagnosis_SN204(
  FunctionalOutput:= ADDR(%IW40),
  Mode=>,
  FatalError=>,
  Alarm=>,
  RunInterm=>,
  Run=>,
  Stop=>,
  LiveCounter=>,
  ErrorCode=>,
  CommunicationOK=> );

fbSAFEX_Diagnosis_SN214(
  FunctionalOutput:= ADDR(%IW114),
  Mode=>,
  FatalError=>,
  Alarm=>,
  RunInterm=>,
  Run=>,
  Stop=>,
  LiveCounter=>,
  ErrorCode=>,
  CommunicationOK=> );
  
```

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Declaration of Arrays at FSoE Output addresses

The screenshot displays the SIMATIC Manager interface for a PLC project. The left pane shows the project tree with 'DataLayerNode 1/0 Mapping' selected. The main window is divided into three panes: 'DataLayerNode 1/0 Mapping', 'PLC_PRG', and 'Visualization Toolbox'.

DataLayerNode 1/0 Mapping (Top):

Variable	Mapping	Channel	Address	Typ
FSoE_SafetySlaveMessage_12_Bytes_In_FSoE_Slave_CRC_5		%IW24	UD	
FSoE_SafetySlaveMessage_12_Bytes_In_FSoE_Slave_ConnectionID		%IW26	UD	
FSoE_SafetyMasterMessage_12_Bytes_Out_FSoE_MasterCommand		%QB0	USI	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_0		%QX1.0	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_1		%QX1.1	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_2		%QX1.2	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_3		%QX1.3	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_4		%QX1.4	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_5		%QX1.5	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_6		%QX1.6	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_7		%QX1.7	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_8		%QX1.8	BIT	
FSoE_SafetyMasterMessage_12_Bytes_Out_Data_1_9		%QX1.9	BIT	

DataLayerNode 1/0 Mapping (Bottom):

Variable	Mapping	Channel	Address	Typ
FSoE_SlaveMessage_12_Byte_FSoE_Slave_CRC_5		%IW98	UD	
FSoE_SlaveMessage_12_Byte_FSoE_Slave_CmdID		%IW100	UD	
FSoE_MasterMessage_12_Byte_FSoE_SlaveCommand		%QB94	USI	
FSoE_MasterMessage_12_Byte_Data_1_0		%QX95.0	BIT	
FSoE_MasterMessage_12_Byte_Data_1_1		%QX95.1	BIT	
FSoE_MasterMessage_12_Byte_Data_1_2		%QX95.2	BIT	
FSoE_MasterMessage_12_Byte_Data_1_3		%QX95.3	BIT	
FSoE_MasterMessage_12_Byte_Data_1_4		%QX95.4	BIT	
FSoE_MasterMessage_12_Byte_Data_1_5		%QX95.5	BIT	
FSoE_MasterMessage_12_Byte_Data_1_6		%QX95.6	BIT	
FSoE_MasterMessage_12_Byte_Data_1_7		%QX95.7	BIT	
FSoE_MasterMessage_12_Byte_Data_1_8		%QX95.8	BIT	
FSoE_MasterMessage_12_Byte_Data_1_9		%QX95.9	BIT	

PLC_PRG (Right):

```

PROGRAM PLC_PRG
VAR
  FSoE_MasterSN15000204Input AT %I80: ARRAY[0..27] OF BYTE;
  FSoE_MasterSN15000204Output AT %QB5: ARRAY[0..27] OF BYTE;
  FSoE_SlaveSN15000214Input AT %I874: ARRAY[0..27] OF BYTE;
  FSoE_SlaveSN15000214Output AT %QB94: ARRAY[0..27] OF BYTE;
  bClearErrorSN15000204 AT %XQ76.0: BOOL;
  bClearErrorSN15000214 AT %XQ170.0: BOOL;
  bClearError: BOOL;
  fbSAFEX_Diagnosis_SN204: SAFEX_Diagnosis;
  fbSAFEX_Diagnosis_SN214: SAFEX_Diagnosis;
END_VAR

// Mapping FSoE-Data from FSoE-Master to FSoE-Slave
FSoE_SlaveSN15000214Output:= FSoE_MasterSN15000204Input;

// Mapping FSoE-Data from FSoE-Slave to FSoE-Master
FSoE_MasterSN15000204Output:= FSoE_SlaveSN15000214Input;

// Examples for functional exchange
bClear_ErrorSN15000204:= bClearError;
bClear_ErrorSN15000214:= bClearError;

// call Functionblocks for Diagnosis from SAFEX
fbSAFEX_Diagnosis_SN204(
  FunctionalOutput:= ADR(%I80),
  Mode=>,
  FatalError=>,
  Alarm=>,
  RunInterm=>,
  Run=>,
  Stop=>,
  LiveCounter=>,
  ErrorCode=>,
  CommunicationOK=> );

fbSAFEX_Diagnosis_SN214(
  FunctionalOutput:= ADR(%I874),
  Mode=>,
  FatalError=>,
  Alarm=>,
  RunInterm=>,
  Run=>,
  Stop=>,
  LiveCounter=>,
  ErrorCode=>,
  CommunicationOK=> );
  
```

The 'Messages' pane at the bottom shows 7 messages, including synchronization messages from the PC to the control.

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Programm for FSoE-Mapping between FSoE-Master and -Slave

// Deklaration

FSoE_MasterSN15000204Input	AT	%IB0:	ARRAY[0..27] OF	BYTE;
FSoE_MasterSN15000204Output	AT	%QB0:	ARRAY[0..27] OF	BYTE;
FSoE_SlaveSN15000214Input	AT	%IB74:	ARRAY[0..27] OF	BYTE;
FSoE_SlaveSN15000214Output	AT	%QB94:	ARRAY[0..27] OF	BYTE;
bClearErrorSN15000204	AT	%QX76.0:	BOOL;	
bClearErrorSN15000214	AT	%QX170.0:	BOOL;	
bClearError:	BOOL;			

// Programm

// Mapping FSoE-Data from FSoE-Master to FSoE-Slave

```
FSoE_SlaveSN15000214Output:= FSoE_MasterSN15000204Input;
```

// Mapping FSoE-Data from FSoE-Slave to FSoE-Master

```
FSoE_MasterSN15000204Output:= FSoE_SlaveSN15000214Input;
```

// Example for functional exchange

```
bClearErrorSN15000204:= bClearError;
```

```
bClearErrorSN15000214:= bClearError;
```

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Import and Call of Function block for SAFEX Diagnosis

The screenshot shows the SIMATIC Manager interface with the following components:

- Left Panel (Project Tree):** Shows the project structure for 'ctrlX CORE'. The 'PLC_PRG (PRG)' folder is expanded, and 'SAFEX_Diagnosis (FB)' is highlighted with a red box.
- Right Panel (Code Editor):** Displays the ladder logic program 'PROGRAM PLC_PRG'.
 - Lines 3-7: Variable declarations for FSoE Master and Slave inputs and outputs.
 - Lines 10-12: Boolean variables for clearing errors.
 - Lines 13-14: Declaration of function blocks 'fbSAFEX_Diagnosis_SN204' and 'fbSAFEX_Diagnosis_SN214', both pointing to the 'SAFEX_Diagnosis' function block. These lines are highlighted with a red box.
 - Line 15: 'END_VAR' statement.
 - Lines 2-6: Comments for mapping FSoE data between Master and Slave.
 - Lines 7-9: Comments and assignments for functional exchange of error clearing variables.
 - Lines 12-23: Call to 'fbSAFEX_Diagnosis_SN204' with parameters: FunctionalOutput, Mode, FatalError, Alarm, RunIntern, Run, Stop, LiveCounter, ErrorCodes, and CommunicationOK.
 - Lines 24-34: Call to 'fbSAFEX_Diagnosis_SN214' with parameters: FunctionalOutput, Mode, FatalError, Alarm, RunIntern, Run, Stop, LiveCounter, ErrorCodes, and CommunicationOK.

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Check the Function block for SAFEX Diagnosis

The screenshot displays the SIMATIC Manager interface for a PLC project. The left pane shows the project tree with the 'Application [run]' block selected. The main pane shows the 'Function Block' configuration for 'fbSAFEX_Diagnosis_SN204'. The 'Run' parameter is highlighted in red, indicating it is set to TRUE. The 'Value' column shows the current state of various parameters.

Expression	Type	Value	Prepared value
bClearError	BOOL	FALSE	
fbSAFEX_Diagnosis_SN204	SAFEX_Diagnosis		
FunctionalOutput	POINTER TO ARRAY...	16#0000007F2A...	
Mode	BYTE	4	
FatalError	BOOL	FALSE	
Alarm	BOOL	FALSE	
RunIntern	BOOL	FALSE	
Run	BOOL	TRUE	
Stop	BOOL	FALSE	
LiveCounter	BYTE	32	
ErrorCode	WORD	0	
CommunicationOK	BOOL	TRUE	
arFunctionalOutput	ARRAY [0..4] OF BYTE		
wTempHigh	WORD	0	
TOF_LiveCounter	TOF		
byLiveCounterOld	BYTE	32	
bLiveBit	BOOL	TRUE	
fbSAFEX_Diagnosis_SN214	SAFEX_Diagnosis		
FunctionalOutput	POINTER TO ARRAY...	16#0000007F2A...	
Mode	BYTE	4	
FatalError	BOOL	FALSE	
Alarm	BOOL	FALSE	
RunIntern	BOOL	FALSE	
Run	BOOL	TRUE	
Stop	BOOL	FALSE	
LiveCounter	BYTE	96	
ErrorCode	WORD	0	
CommunicationOK	BOOL	TRUE	
arFunctionalOutput	ARRAY [0..4] OF BYTE		
wTempHigh	WORD	0	
TOF_LiveCounter	TOF		
byLiveCounterOld	BYTE	96	
bLiveBit	BOOL	TRUE	

```
1 // Mapping FSoE-Data from FSoE-Master to FSoE-Slave
2 FSoE_SlaveSN15000214Output:= FSoE_MasterSN15000204Input;
3
4 // Mapping FSoE-Data from FSoE-Slave to FSoE-Master
5 FSoE_MasterSN15000204Output:= FSoE_SlaveSN15000214Input;
6
7 // Example for functional exchange
8 bClearErrorSN15000204FALSE:= bClearErrorFALSE;
9 bClearErrorSN15000214FALSE:= bClearErrorFALSE;
10
```

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

ctrlX CORE: PLC Engineering

Check the FSoE Communication

The screenshot displays the ctrlX SAFETY Engineering software interface. The main window shows a functional scheme diagram with components like 'F-Bus Output' and 'F-Stop' blocks. A red box highlights a specific part of the diagram, and a red arrow points from this box to a camera view of the hardware. The camera view shows the internal components of a PLC, with a red box highlighting the FSoE communication module. The software interface includes a menu bar, a toolbar, a configuration tree on the left, and a message window at the bottom.

Configuration Tree (Left):

- SAFEX-C.15-SN150000214 (Master)
- Local Network
- Primary/Secondary Interface
- Peripherals
- Input
 - Emergency Stop 1
 - Emergency Stop 2
 - Emergency Stop 3
- Output
- Slaves
- Functional Sheets
 - SAFEX-C.15-SN150000214 (Master) - She...
 - Emergency Stop 1
 - Emergency Stop 2
 - Emergency Stop 3
 - AND Block 1
 - Restart 1
 - Restart 1
 - Functional Output/Message Data 1
 - Functional Input 1
 - Logical 1 Block 1
 - ESop1
 - ESop1 (1)
 - ESop1 (2)
 - ESop2
 - ESop2 (1)
 - ESop2 (2)
 - ESop3
 - ESop3 (1)
 - ESop3 (2)
 - Restart
 - Restart (1)
- FSoE
 - F-Bus Output 1
 - F-Bus Input 1
 - EStop1_SN204
 - EStop2_SN204
 - EStop3_SN204

Message Window (Bottom):

```
Output Device Interface
1:50:23 PM: Connecting...
1:50:23 PM: Connection status changed to Authenticating.
1:50:32 PM: Status changed to Run.
1:50:32 PM: Connection status changed to Connected.
1:50:41 PM: Transmission status changed to Diagnosis.
```

ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Symbolic names/several sheets in functional scheme

Instead of directly using the safe digital inputs and outputs inside the functional scheme symbolic names may be used → makes a later exchange over fieldbus easier and may improve the simple reading of the functional scheme logic.

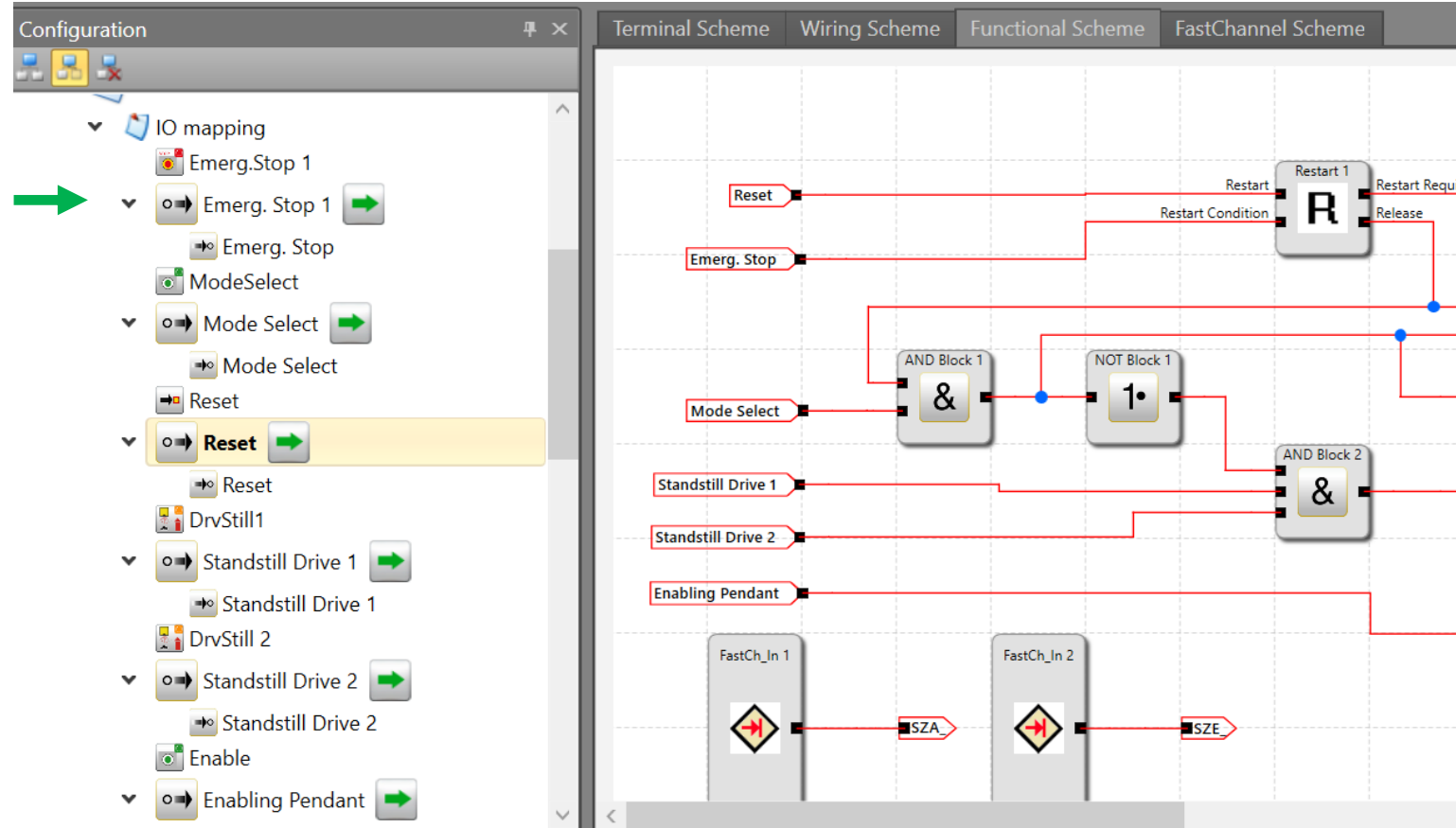
As well several sheets may be used to create a better overview of the functions in “Functional Scheme” → here “I/O mapping” and “Logic” are used.



ctrlX SAFETY (Part 3/3) - Solution using safe fieldbus FSoE

Symbolic names/several sheets in functional scheme

Symbolic names can be used several times → Just click here and place the new appearing “symbolic name” in the functional scheme where you need it.



ctrlX SAFETY (Part 3/3)

Solution using safe fieldbus FSoE

Life Demo
(End)

ctrlX SAFETY (Part 3/3)

Solution using safe fieldbus FSoE

SAFEX-C.1x – EtherCAT FSoE connection

- EtherCAT control: ctrlX CORE
- Up to in total 32 FSoE slaves (other SAFEX-C12 .. 15, drives, safe devices and safe I/Os) possible
- Several safe areas possible (every drive can be controlled individually)
- Cross communication in between SAFEX-C.1x done over FSoE

