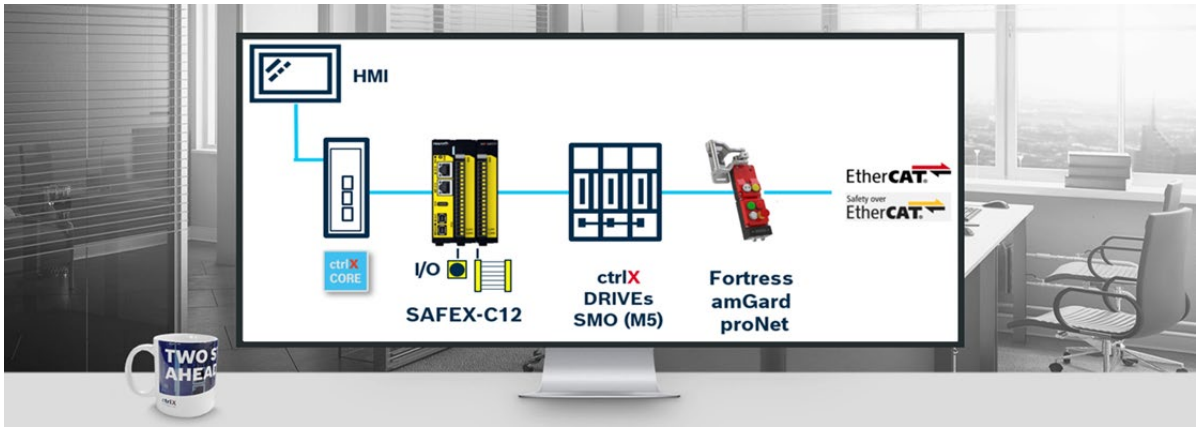
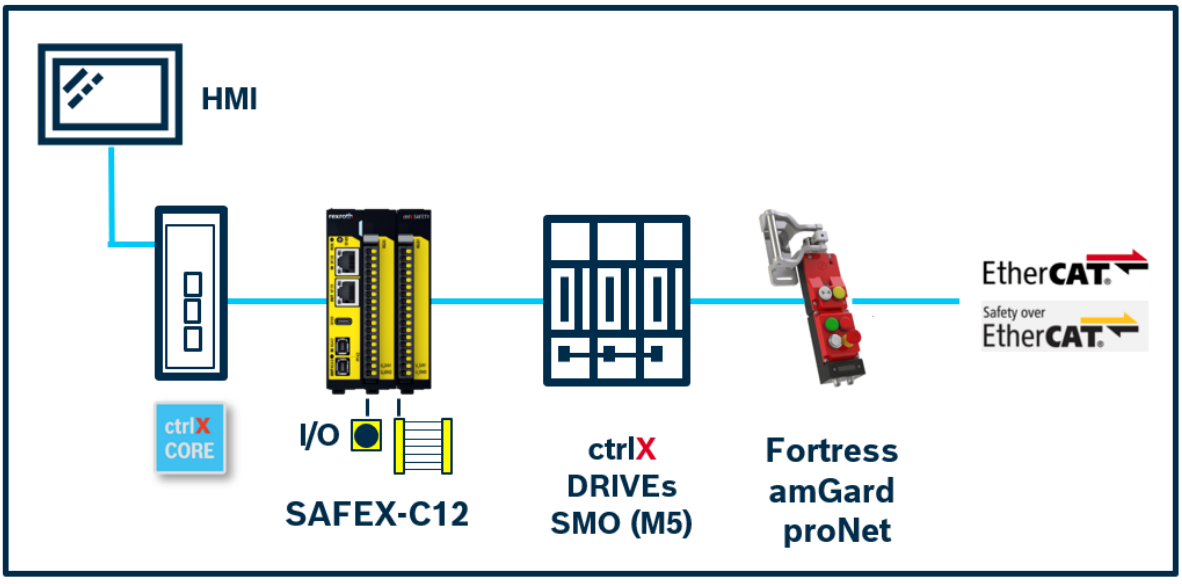


ctrlX SAFETY with Fortress amGard proNet FSoE

Introudction

In this article we show to you how to connect a Fortress amGard proNet interlock via Safety over EtherCAT (FSoE) with a SAFEX-C1x SAFETY controller.



EtherCAT is registered trademark and patented technology licensed by Beckhoff Automation GmbH, Germany

Topology Overview

General Information

All functions and screen shots are based on:

- ctrlX SAFETY Engineering version >= 1.7.3.9558
- SAFEX Runtime / Firmware version >= 1.0.1.45
- ctrlX WORKS version >= 1.20.5

Fortress amGard proNet

The Fortress amGard proNet is available with the solenoid controlled by either the safety controller or standard controller. This is depicted in the model number:

- “NM” indicates the solenoid is controlled by the standard controller.
- “NR” indicates the solenoid is controlled by the safety controller.

In this example a unit with the solenoid controlled by the standard controller was used with the following ESI file:

- HL1S6SKV11SVRALY0000N**NM**LGLRP7EINPF09
- ESI_Fortress_amGard_proNet 1.xml

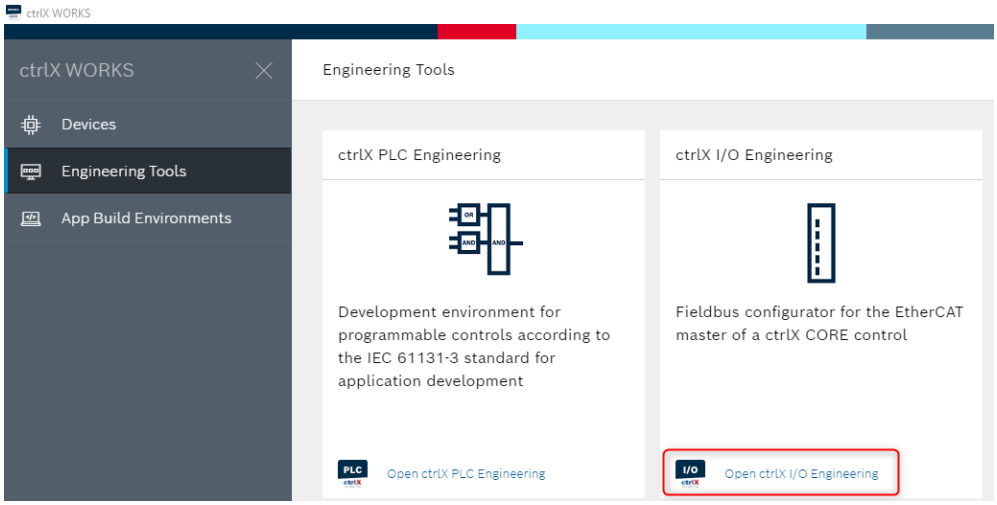
Further details including the ESI file are available from Fortress.

Prerequisites

- A connection to the SAFEX-C1x SAFETY control and ctrlX CORE have been successfully established.
- The devices are correctly wired and have been powered on with 24V.
- Engineering tools ctrlX SAFETY and ctrlX WORKS have been started.
- ctrlX CORE has EtherCAT Master, PLC app and licenses for each app installed.

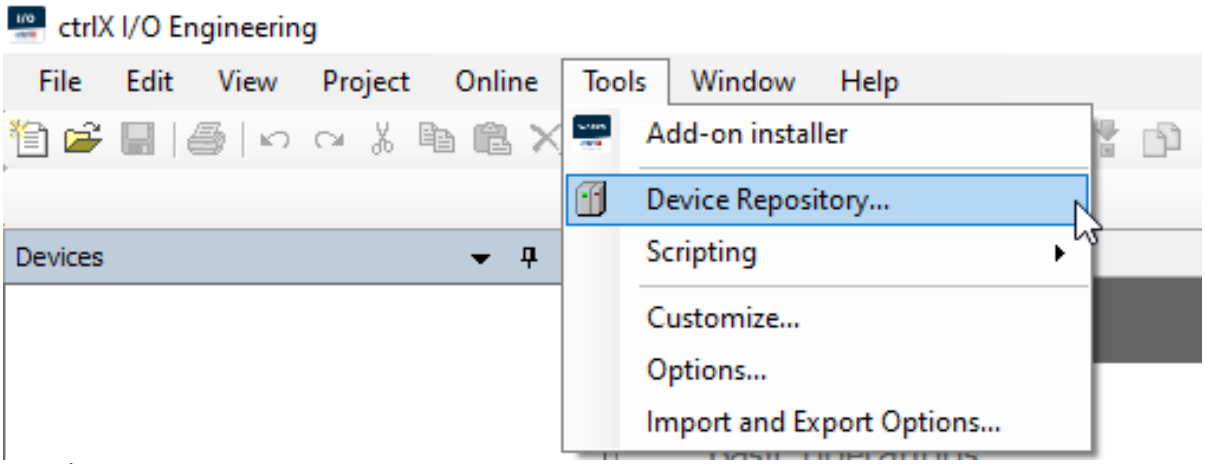
ctrlX I/O Engineering

Open ctrlX I/O Engineering from ctrlX WORKS:



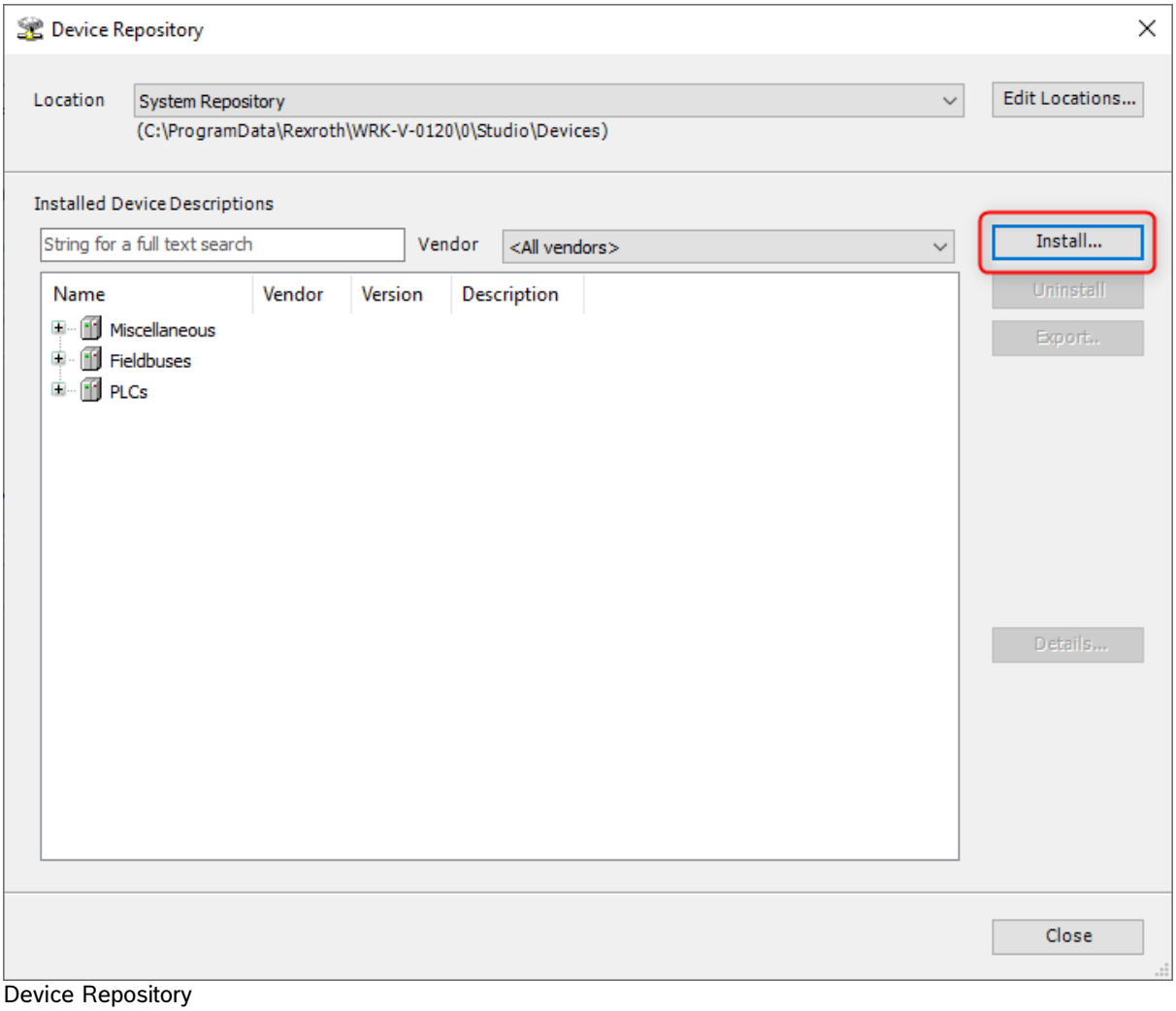
ctrlX WORKS Engineering Tools

Open Tools\Device Repository:



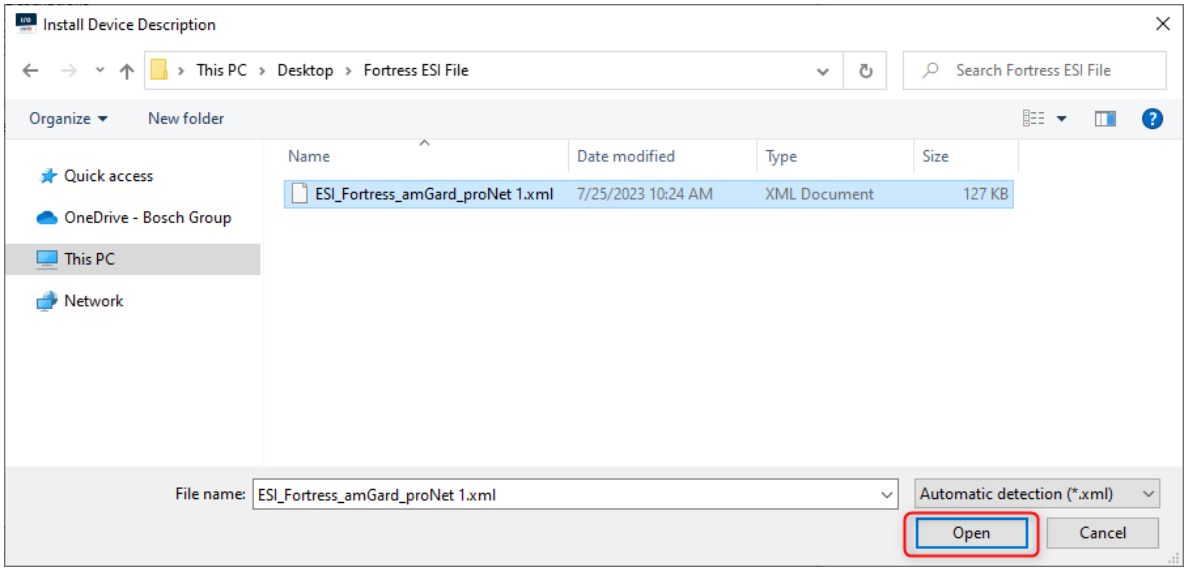
ctrlX I/O Engineering Device Repository

Click “Install..”:



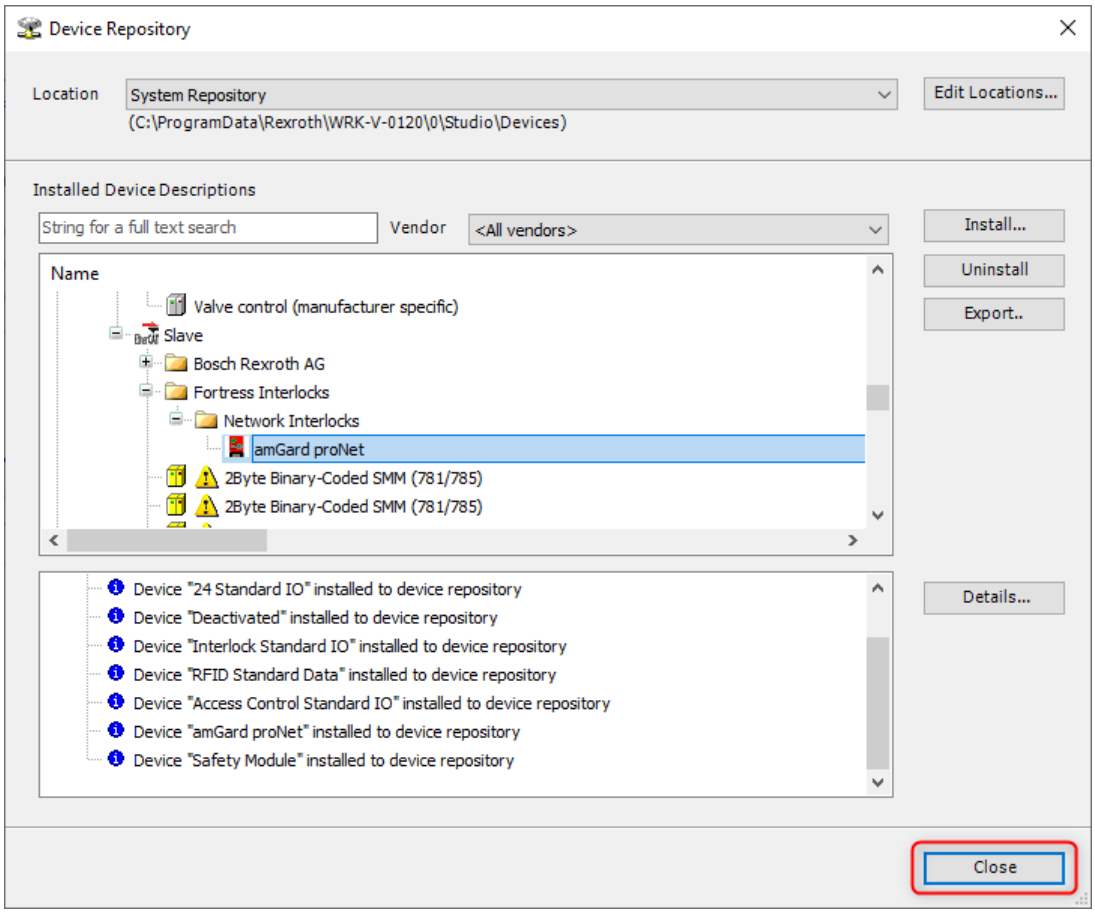
Device Repository

Select Fortress ESI file, click “Open”:



Device Repository Select ESI File

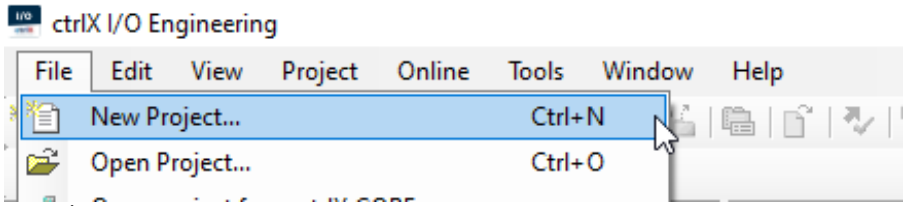
The Fortress amGard proNet device is added, click “Close”:



Device Repository Device Added

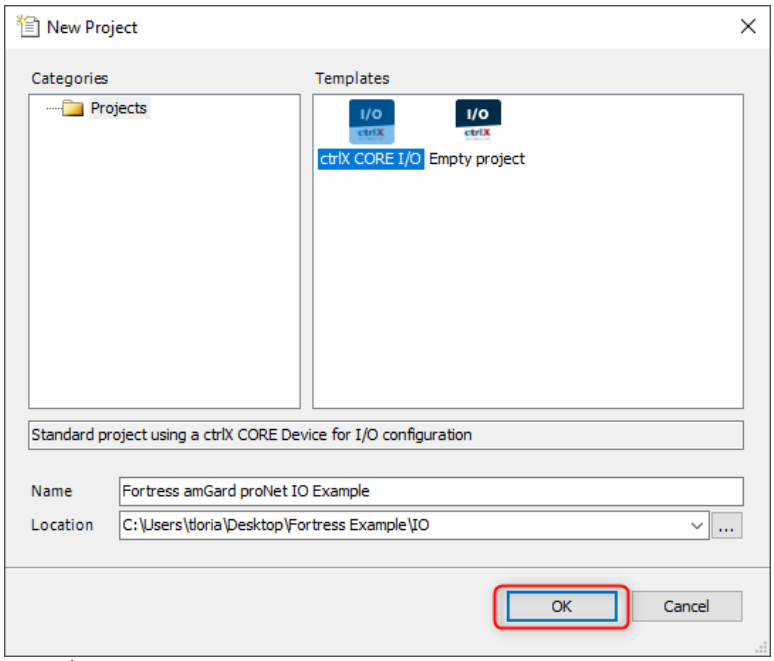
If needed repeat the process for SAFEX-C1x ESI file installation.

Select File\New Project:



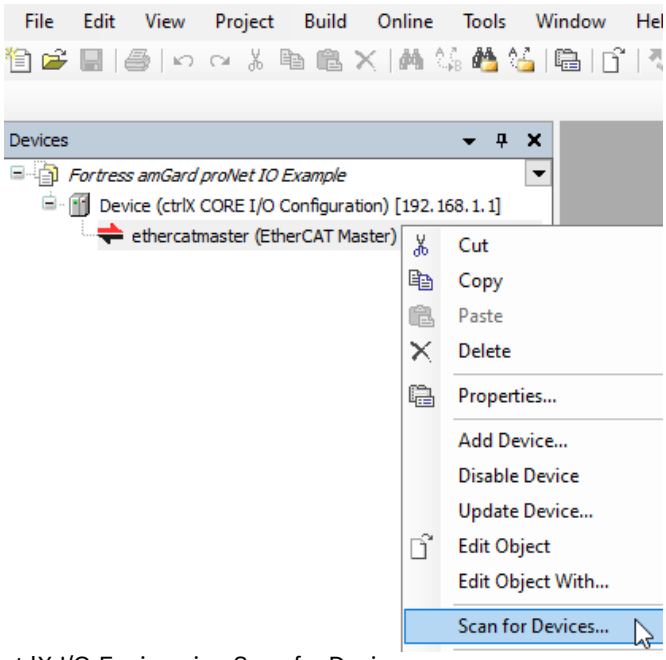
ctrlX I/O Engineering New Project

Select ctrlX CORE I/O, enter name and location of project then click “OK”:



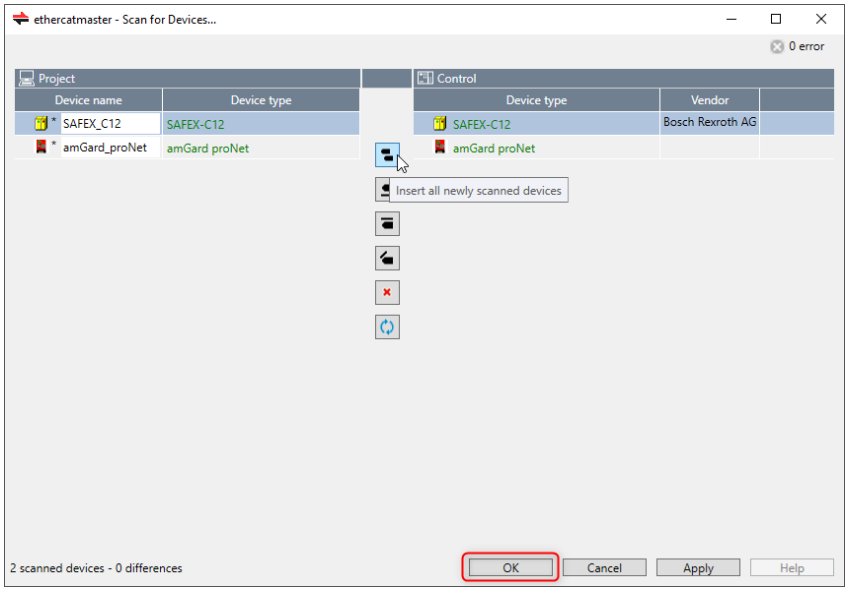
ctrlX I/O Engineering New Project Template Selection

A new project was created, right click on “ethercatmaster (EtherCAT Master)” then “Scan for Devices…”:



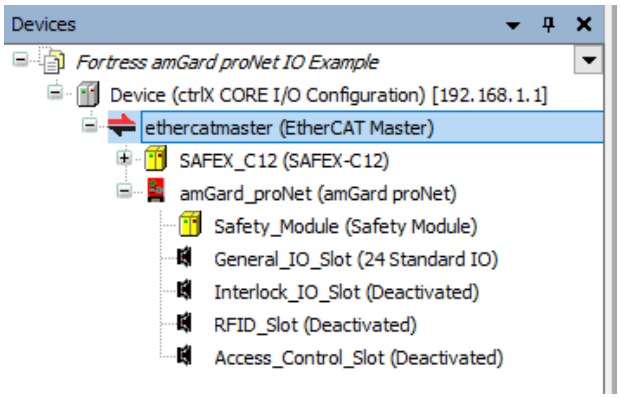
ctrlX I/O Engineering Scan for Devices

The SAFEX-C12 and amGard proNet are found. Click “Insert all newly scanned devices” then OK:



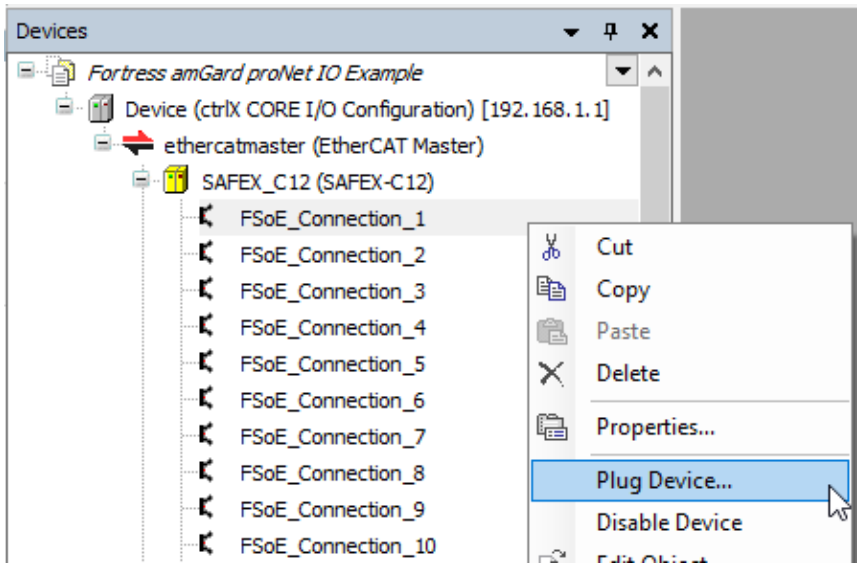
Insert Scanned Devices

The devices are added to the project:



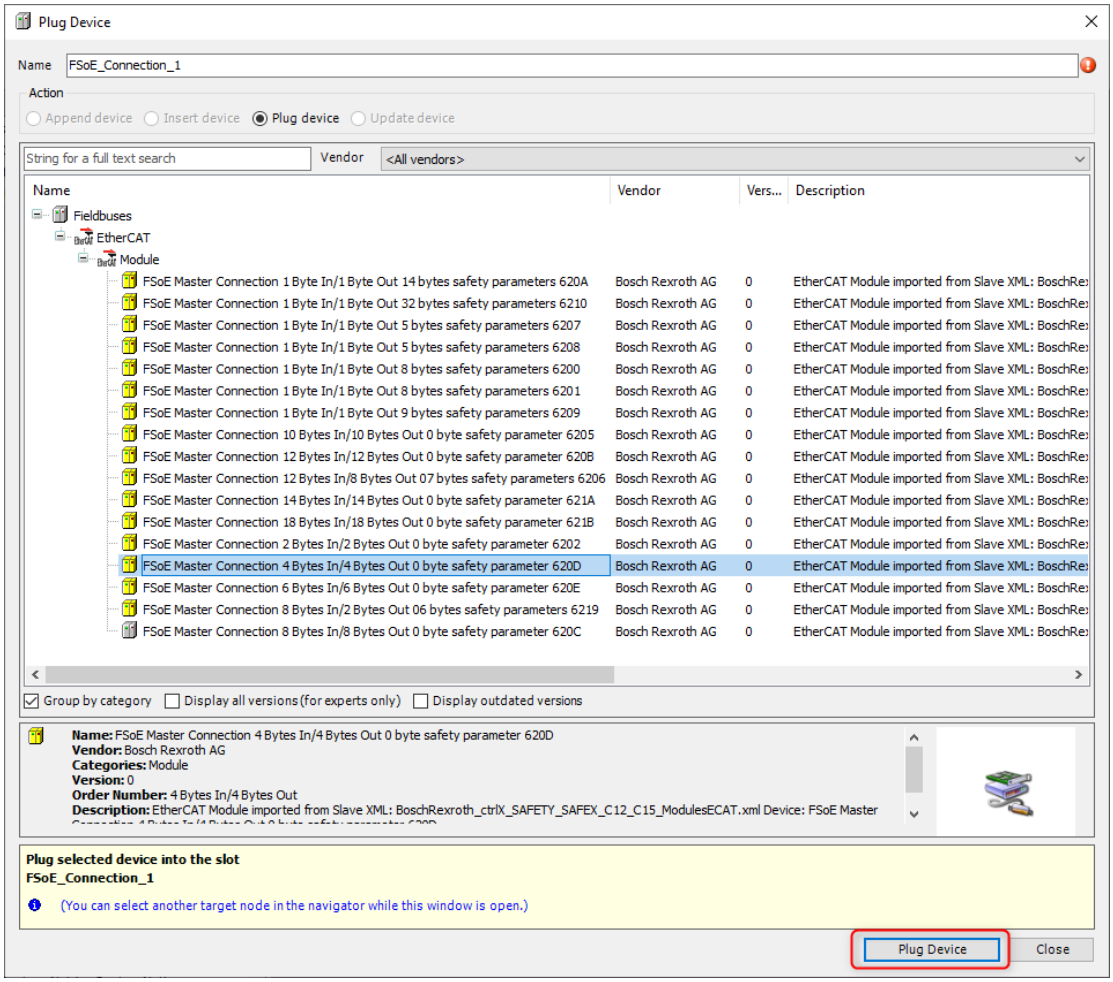
Scanned Devices Added to Project

Expand SAFEX_C12 (SAFEX-C12) then right click on FSoE Connection_1\Plug Device...:



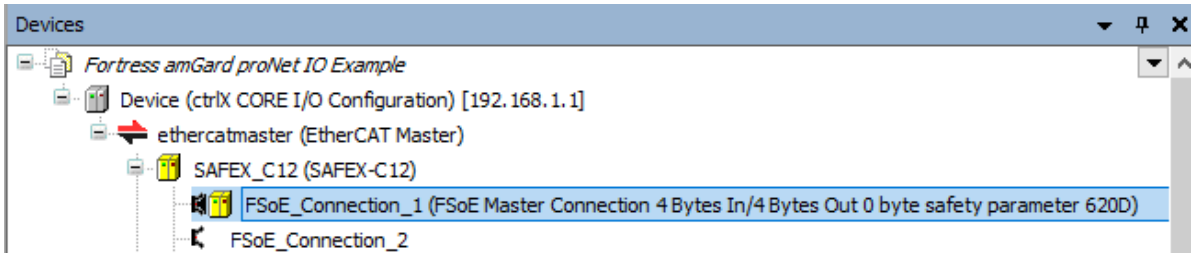
Plug Device

The Fortress interlock requires 4 bytes in/4 bytes out, select this data length then click “Plug Device”:



Plug Device Data Length Selection

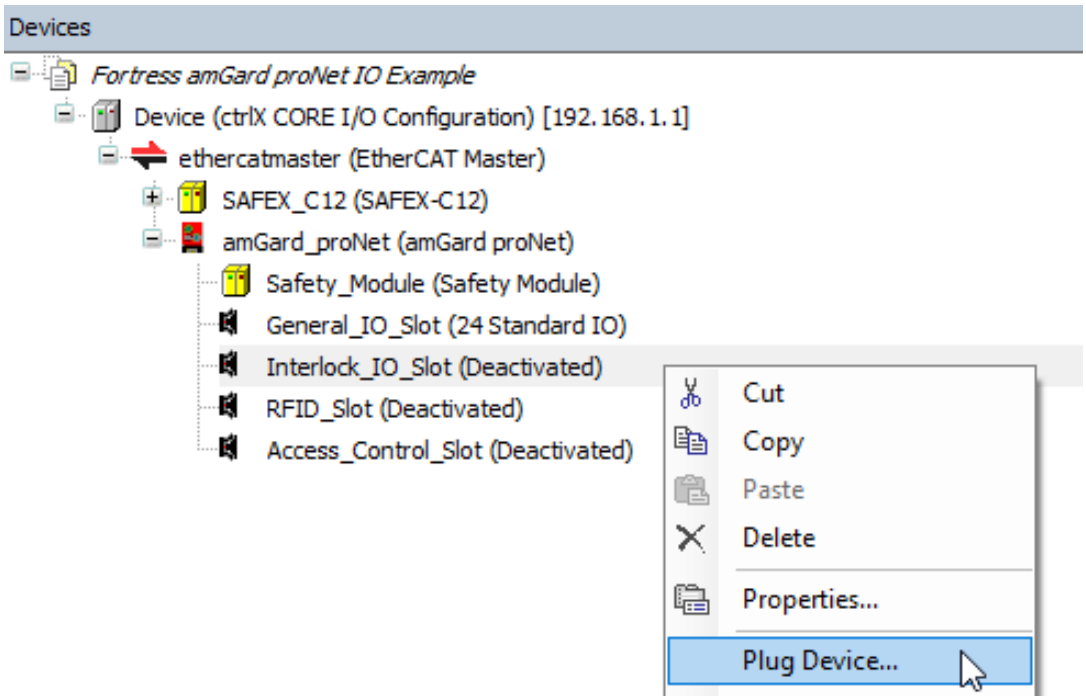
The FSoE connection is added to the project:



FSoE Connection Added to Project

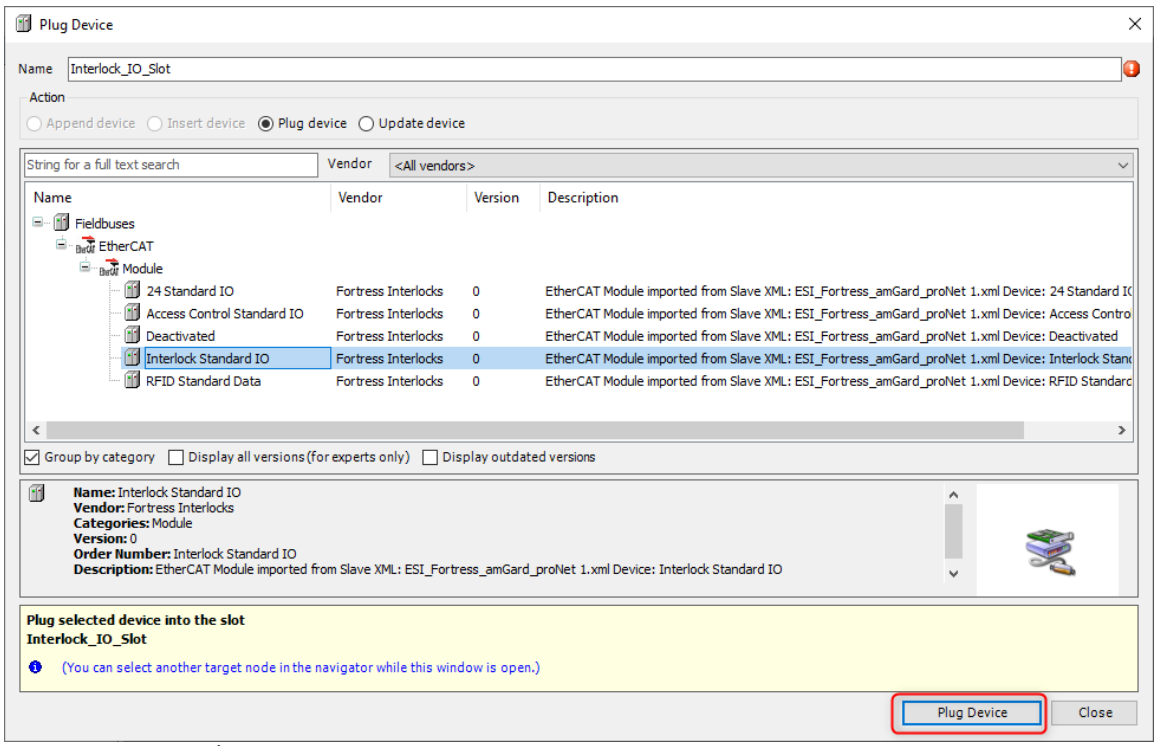
This step is required for the module used in this example. It may or may not be required for your module.

Expand amGard_proNet (amGard proNet) then right click on Interlock_IO (Deactivated)\Plug Device.:



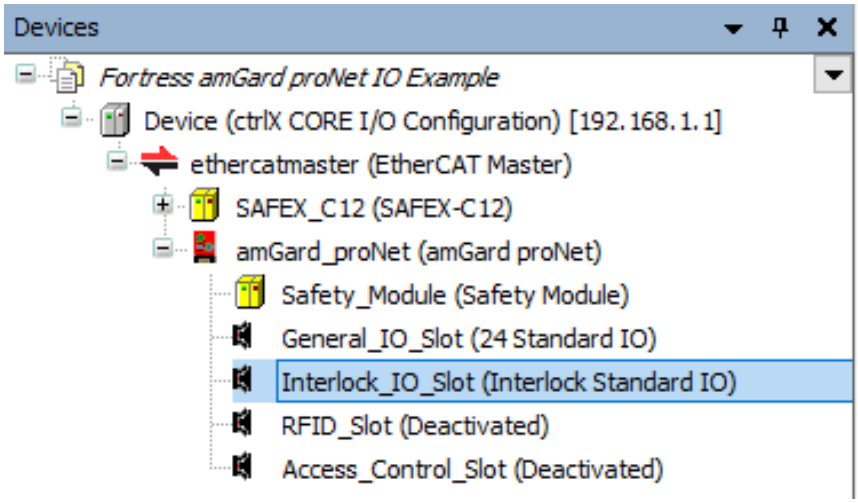
Add Standard Interlock I/O

Select “Interlock Standard IO then click “Plug Device”:



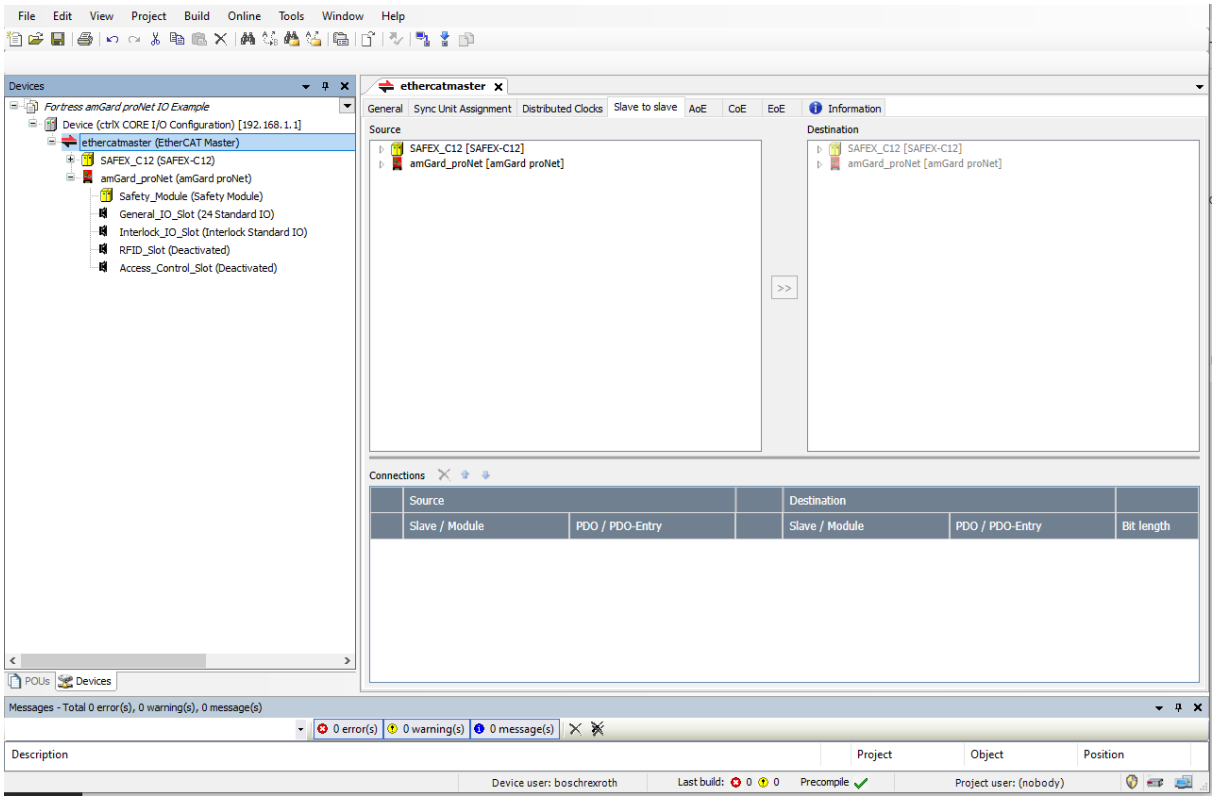
Interlock Standard I/O Plug Device Selection

The control for the solenoid from the standard I/O has been added:



Standard Interlock I/O Added to Project

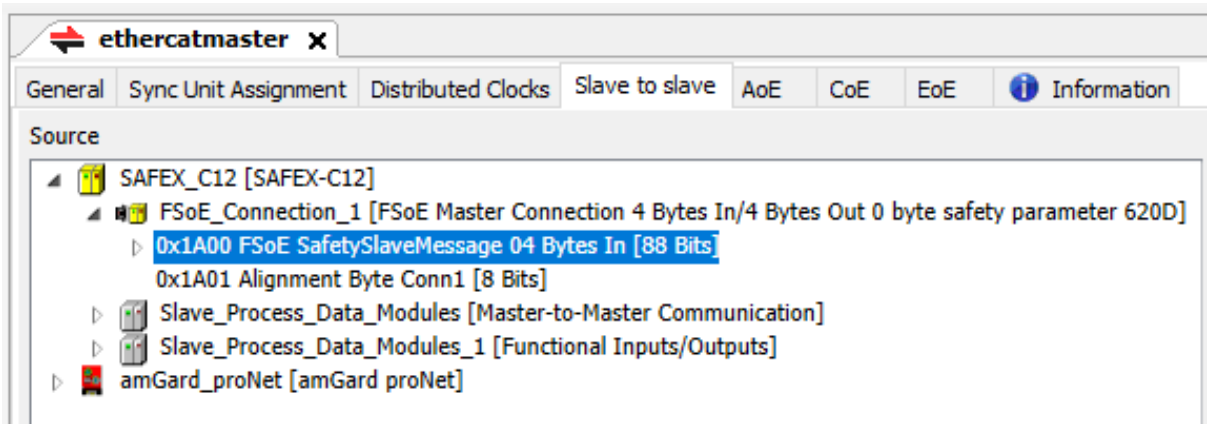
Double click on “ethercatmaster (EtherCAT Master)” then “Slave to slave” tab to add the FSoE connections between the SAFEX-C12 SAFETY controller and amGard proNet interlock:



Slave to Slave Data Mapping

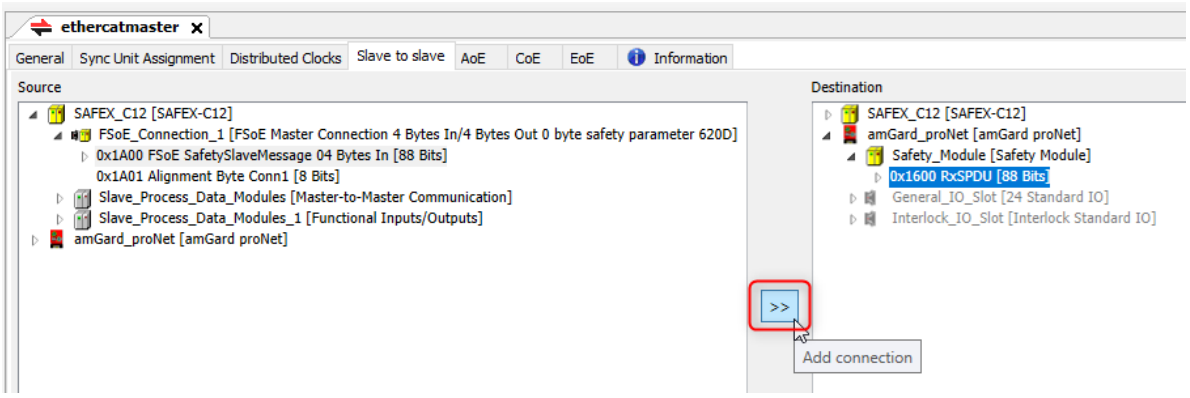
First the SAFEX-C12 FSoE outputs to the amGard proNet interlock inputs will be added.

On the “Source” side expand SAFEX_C12 [SAFEX-C12]\FSoE_Connection1 [FSoE Master Connection 4 Bytes In/4 Bytes out 0 bye safety parameter 620D] then select 0x1A00 FSoE SafetySlaveMessage 04 Bytes In [88 Bits]:



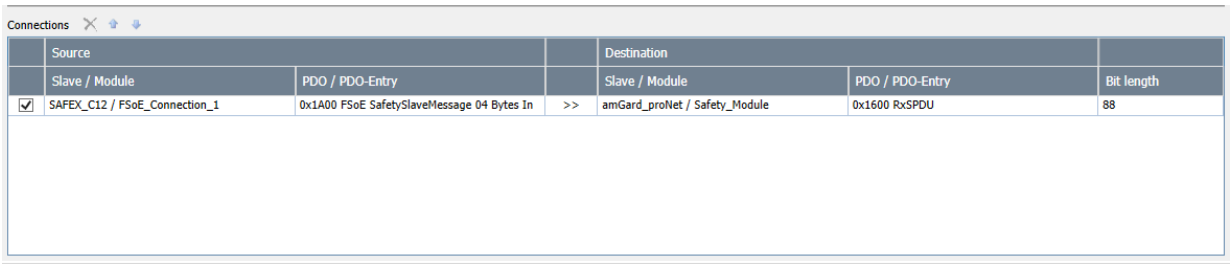
SAFEX-C1x Source Data Selection

On the “Destination” side expand amGard_proNet [amGard proNet]\Safety_Module [Safety Module] then select 0x1600 RxSPDU [88 bits] then click “Add connection”:



amGard proNet Destination Data Selection

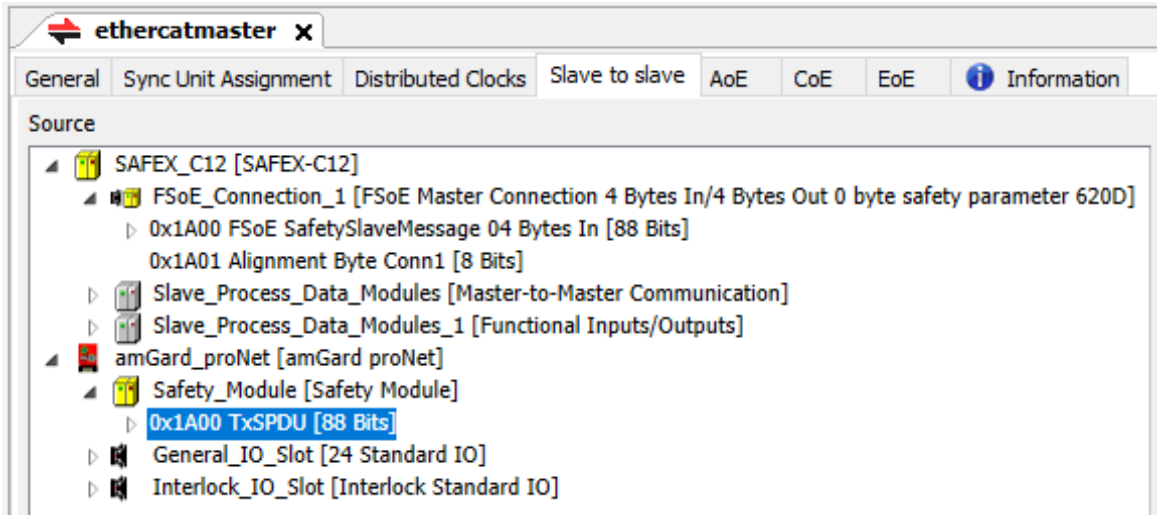
The connection is added to the project:



Slave to Slave Data Mapping Complete

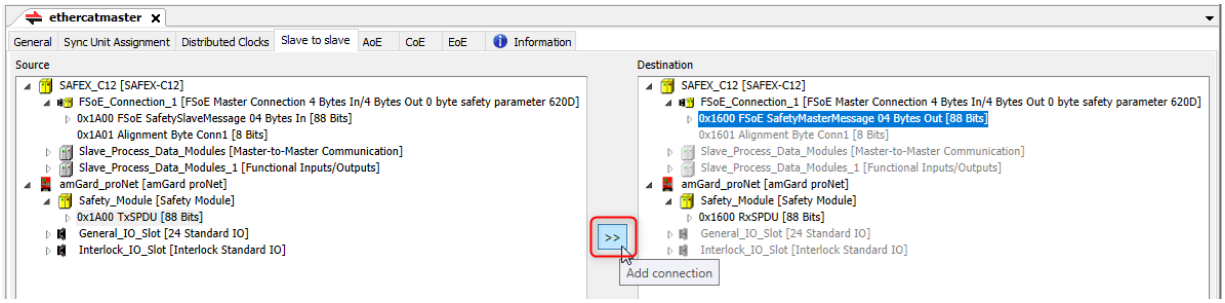
Now the amGard proNet interlock outputs to SAFEX-C12 FSoE inputs will be added.

On the “Source” side expand amGard_proNet [amGard proNet]\Safety_Module [Safety Module] then select 0xA00 TxSPDU [88 bits]:



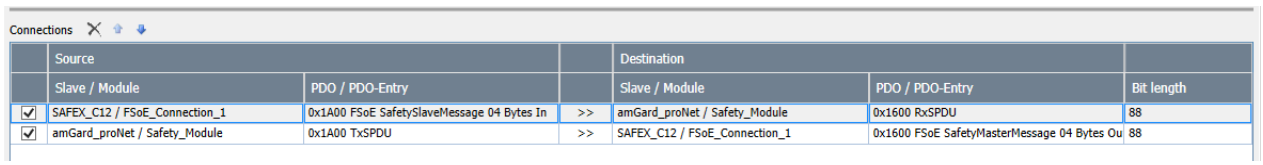
amGard proNet Source Data Selection

On the “Destination” side expand SAFEX_C12 [SAFEX-C12]\FSoE_Connection1 [FSoE Master Connection 4 Bytes In/4 Bytes out 0 bye safety parameter 620D] then select 0x1600 FSoE SafetyMasterMessage 04 Bytes Out [88 Bits] then click “Add connection”:



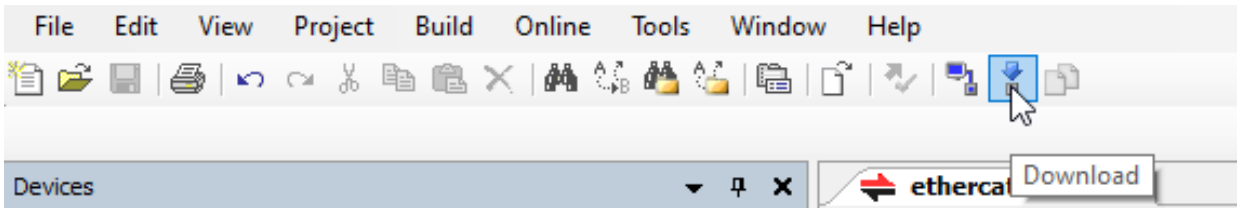
SAFEX-C1x Destination Data Selection

The connection is added to the project:



Slave to Slave Data Mapping Complete

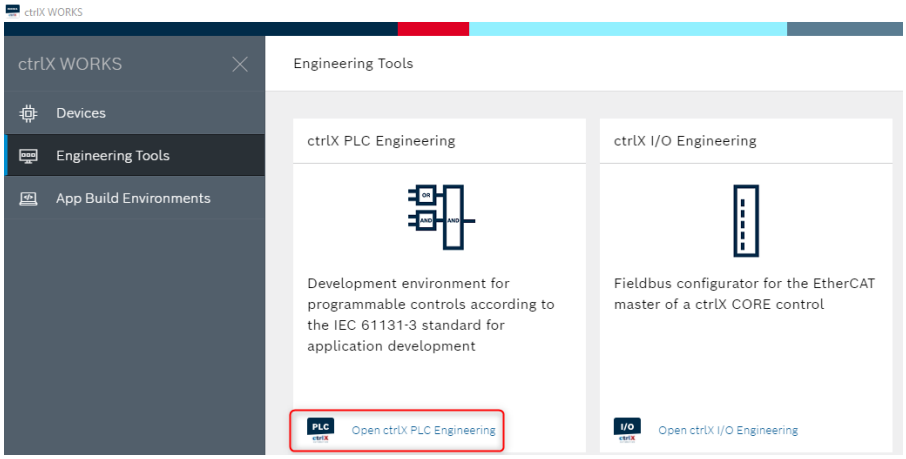
The I/O configuration is completed and can be downloaded to the CORE. Click on the “Download” icon from the tool bar and ensure the project downloads successfully:



ctrlX I/O Engineering Download

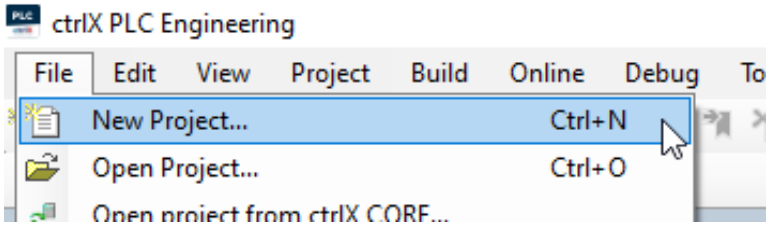
ctrlX PLC Engineering

Open ctrlX PLC Engineering from ctrlX WORKS:



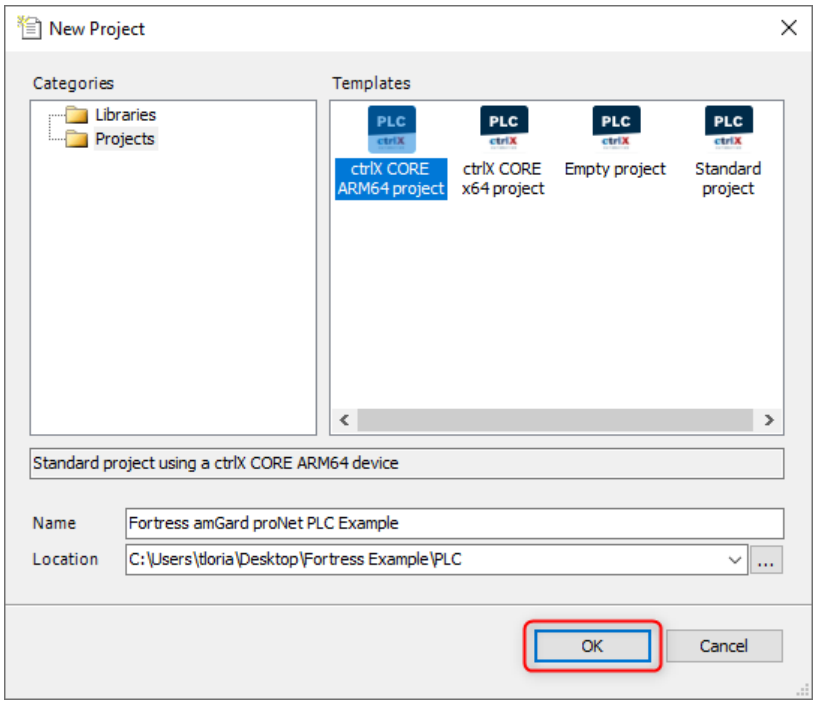
ctrlX WORKS Engineering Tools -PLC

Select File\New Project:



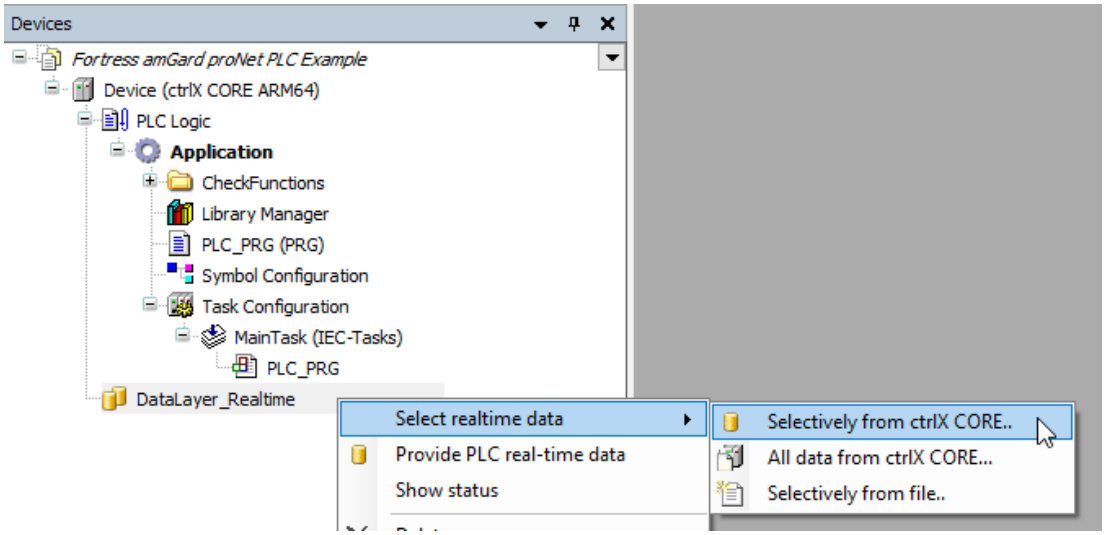
ctrlX PLC Engineering New Project

Select ctrlX CORE hardware type, enter name and location of project then click “OK”:



ctrlX PLC Engineering New Project Template Selection

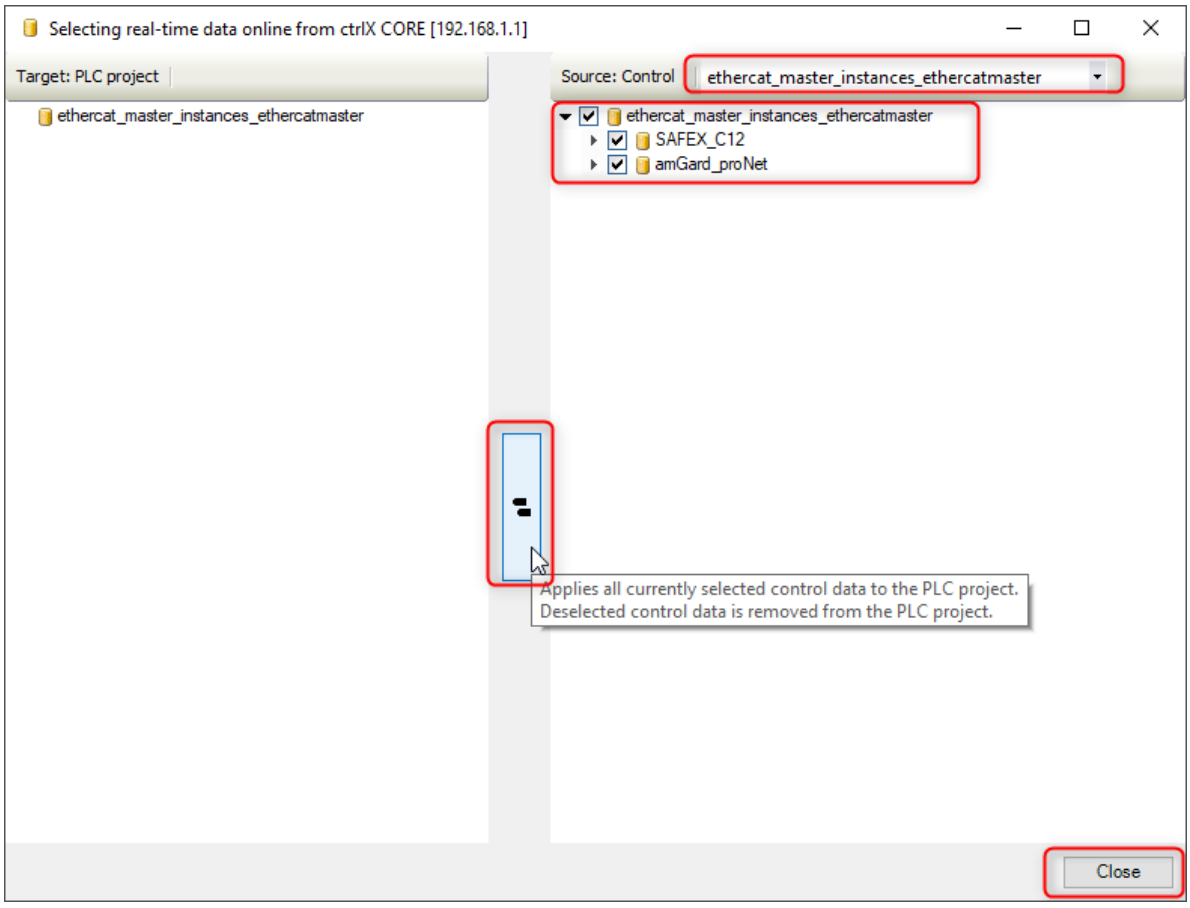
A new project was created, right click on “DataLayer_Realtime\Select realtime data\Selectively from ctrlX CORE…”:



Read I/O Configuration Data from CORE

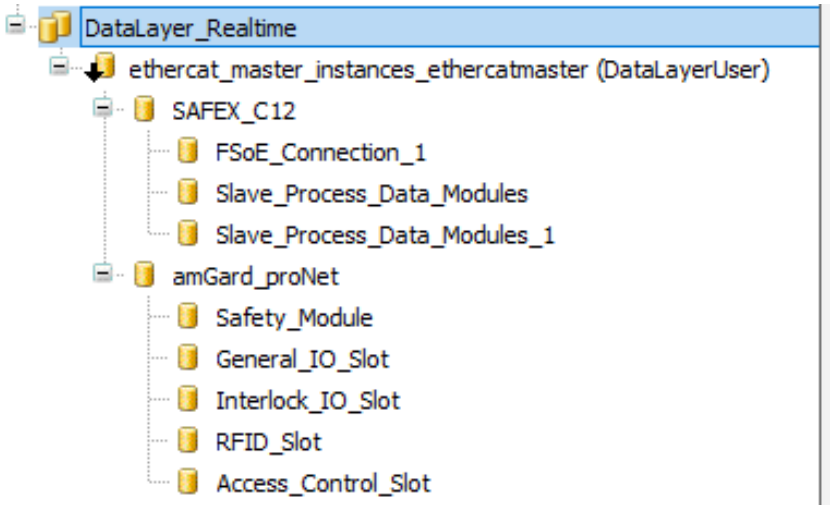
Use the pull-down menu to Select Source:

Control ethercat_master_instance_ethercatmaster, check the boxes for all devices then click “Applies all currently selected control data to the PLC project.” Click close:



Source Selection

The SAFEX-C12 and amGard proNet interlock devices are added to the PLC project:



I/O Devices Added to PLC Project

Here is an overview of the Fortress amGard proNet I/O from the documentation. Please see the Fortress website for the latest documentation and additional information:

Applicable units: EtherCAT FSoE									
ESI File: ESI_Fortress_amGard_*pro*Net									
Description		**Bits**							
		0	1	2	3	4	5	6	7
Slot 1 / Safety Inputs									
Input Channel x	Bit is reset when the relevant safety signal is broken	Head/ Solenoid* Ch1	Head/ Solenoid* Ch2	Aux Ch1****	Aux Ch2****	ESTOP Ch1	ESTOP Ch2	-	-
Qualifier Input Channel x	Qualifier Set (QS) bit is reset when the relevant safety signal is invalid (latching)	Head/ Solenoid* Ch1 QS	Head/ Solenoid* Ch2 QS	Aux Ch1 QS	Aux Ch2 QS	ESTOP Ch1 QS	ESTOP Ch2 QS	-	-
Qualifier Output Channel x	Qualifier Set (QS) bit is reset when the relevant safety signal is invalid (latching)	Safety Output Ch1 QS	Safety Output Ch2 QS	-	-	-	-	-	-
Slot 1 / Safety Outputs									
Output Channel x	Safety Output is enabled when bit is set	Safety Output **		-	-	-			
Error Reset Input Channel x	Qualifier Reset (QR) bit to reset the relevant Qualifier Set bit if an invalid state has been experienced	Head/ Solenoid QR	-	Aux QR	-	ESTOP QR	-	-	-
Error Reset Output Channel	Qualifier Reset (QR) bit to reset the relevant Qualifier Set bit if an invalid state has been experienced	Safety Output QR	-	-	-	-			
Slot 2 / Standard Inputs									
Button(s)	Bit is set when button is pressed	Button 1	Button 2	Button 3	Button 4	Button 5	Button 6	Button 7	Button 8
Button(s) Extended	Bit is set when the button is pressed	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
Slot 2 / Standard Outputs									
Lamps	Lamp is illuminated when bit is set	Lamp 1	Lamp 2	Lamp 3	Lamp 4	Lamp 5	Lamp 6	Lamp 7	Lamp 8
Lamps Extended	Lamp is illuminated when bit is set	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
Slot 3 / Interlock Standard Inputs									
Gate Monitor	Bit is set when the actuator is out of the interlock head, or first key is operated	Head Monitor*	-	-	-	-	-	-	-
Solenoid Monitor	Bit is set when interlock is unlocked	Solenoid Monitor*	-	-	-	-	-	-	-
Slot 3 / Interlock Standard Outputs									
Solenoid Drive	The solenoid is energised when the bit is set	Solenoid Drive*	-	-	-	-	-	-	-
Slot 4 / RFID Data (8 bytes)									
Byte 0-7	RFID data***	Unique ID							
Slot 5 / Access Control Inputs									
Byte 0-1	Reserved Access Control Inputs***	-	-	-	-	-	-	-	-
Slot 5 / Access Control Outputs									
Byte 0	Reserved Access Control Outputs***	-	-	-	-	-	-	-	-
Configured dual channel safety inputs (for example safety inputs byte 0 bit 0&1) will always move synchronously. *I/O allocation when a *pro*Net Option Pod is configured with amGard*pro* Interlock with associated head and solenoid contacts. **I/O allocation default is dual channel safety output. Can be configured with amGard*pro* interlock as a single channel solenoid drive safety output on bit 0. ***For more information on RFID and permissions management for Access Control I/O see Fortress FRANK Operating Instructions. ****Aux I/O is determined by external connected device or custom configuration – contact Fortress for further information.									

Fortress amGard proNet I/O

The following PLC program was created only as a functional example for demonstration purposes of the communications. It is not written to meet any specific PL or SIL rating nor any specific risk assessment. Programming methods must be used to meet your specific application requirements:

PLC_PRG

```
5
6       FSoE_AmGuardInterlockSlaveInputs        AT      %IB58:  ARRAY[0..11]    OF  BYTE;
7       FSoE_AmGuardInterlockSlaveOutputs       AT      %QB78:  ARRAY[0..11]    OF  BYTE;
8
9       Button                                  AT      %IX70.2:    BOOL;
10      GreenLamp                               AT      %QX88.0:    BOOL;
11      RedLamp                                 AT      %QX88.1:    BOOL;
12      WhiteLamp                               AT      %QX88.2:    BOOL;
13      EStopLamp                               AT      %QX88.3:    BOOL;
14      SolRelease                              AT      %QX92.0:    BOOL;
15      GateMonitor                             AT      %IX74.0:    BOOL;
16      SolMonitor                              AT      %IX74.1:    BOOL;
17      EStop_Ch1                               AT      %IX59.4:    BOOL;
18      EStop_Ch2                               AT      %IX59.5:    BOOL;
19  END_VAR
```

```
1   SolRelease := Button OR NOT EStop_Ch1 AND NOT EStop_Ch2;
2   GreenLamp := (NOT GateMonitor) AND (NOT SolMonitor);
3   RedLamp := GateMonitor OR SolMonitor;
4   WhiteLamp := NOT SolMonitor;
```

PLC I/O Variables Declaration and Program

PLC_PRG

Device.Application.PLC_PRG

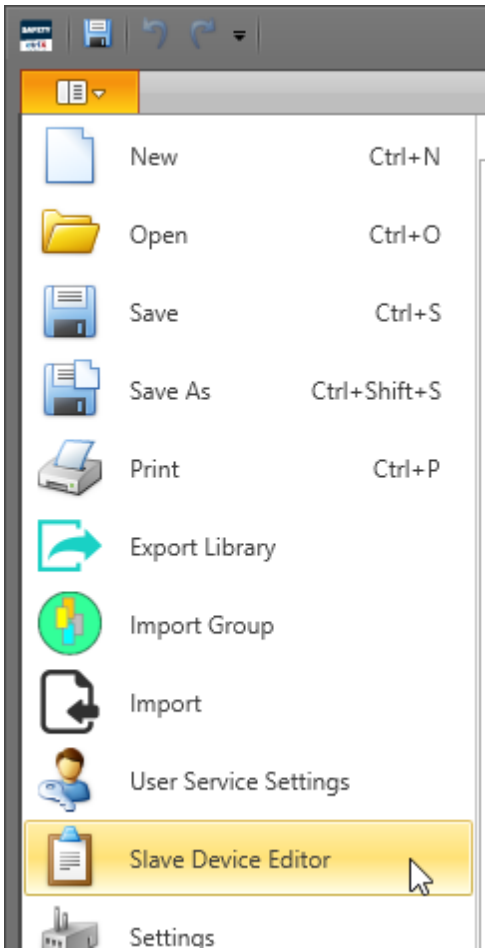
Expression	Type	Value	Prepar...	Address	Comm...
FSoE_AmGuardInterlockMasterInputs	ARRAY ...			%IB0	
FSoE_AmGuardInterlockMasterOutputs	ARRAY ...			%QB0	
FSoE_AmGuardInterlockSlaveInputs	ARRAY ...			%IB58	
FSoE_AmGuardInterlockSlaveOutputs	ARRAY ...			%QB78	
Button	BIT	FALSE		%IX70.2	
GreenLamp	BIT	TRUE		%QX88.0	
RedLamp	BIT	FALSE		%QX88.1	
WhiteLamp	BIT	TRUE		%QX88.2	
EStopLamp	BIT	FALSE		%QX88.3	
SolRelease	BIT	TRUE		%QX92.0	
GateMonitor	BIT	FALSE		%IX74.0	
SolMonitor	BIT	FALSE		%IX74.1	
EStop_Ch1	BIT	FALSE		%IX59.4	
EStop_Ch2	BIT	FALSE		%IX59.5	

```
1   SolRelease TRUE := Button FALSE OR NOT EStop_Ch1 FALSE AND NOT EStop_Ch2 FALSE;
2   GreenLamp TRUE := (NOT GateMonitor FALSE) AND (NOT SolMonitor FALSE);
3   RedLamp FALSE := GateMonitor FALSE OR SolMonitor FALSE;
4   WhiteLamp TRUE := NOT SolMonitor FALSE; RETURN
```

PLC I/O Variables Declaration and Program Online

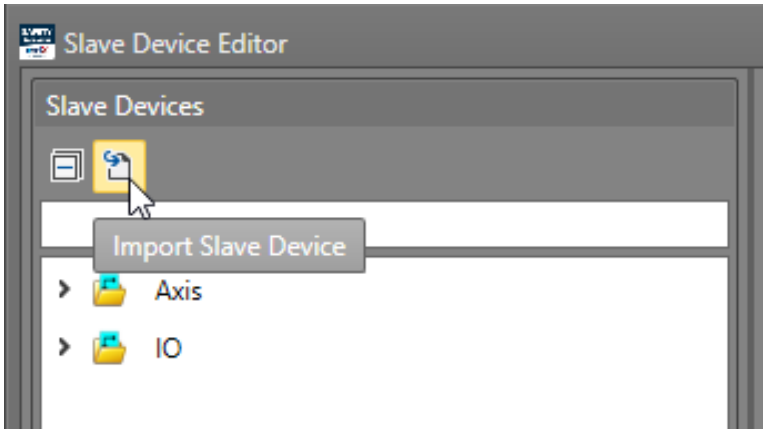
ctrlX SAFETY Engineering

Open ctrlX SAFETY Engineering then select “Slave Device Editor” from the Main Menu:



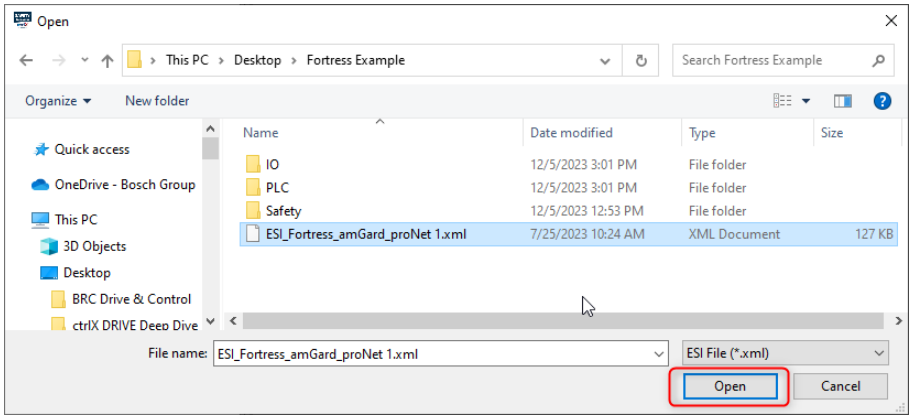
ctrlX SAFETY Engineering Slave Device Editor

Click “Import Slave Device” icon:



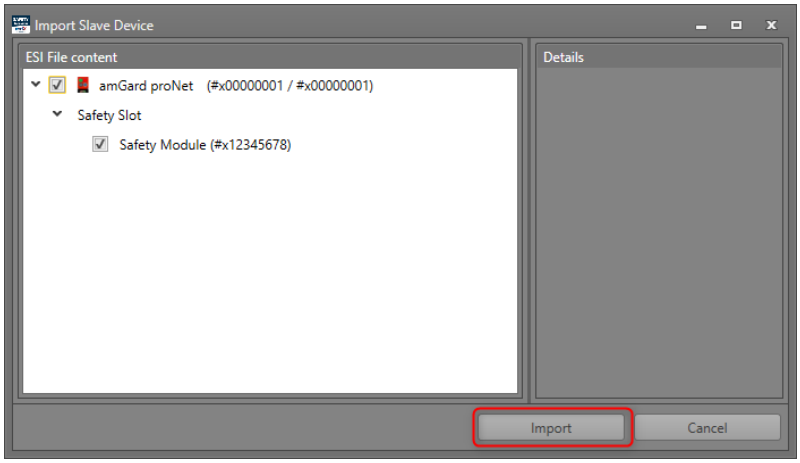
Slave Device Import

Select Fortress ESI file, click “Open”:



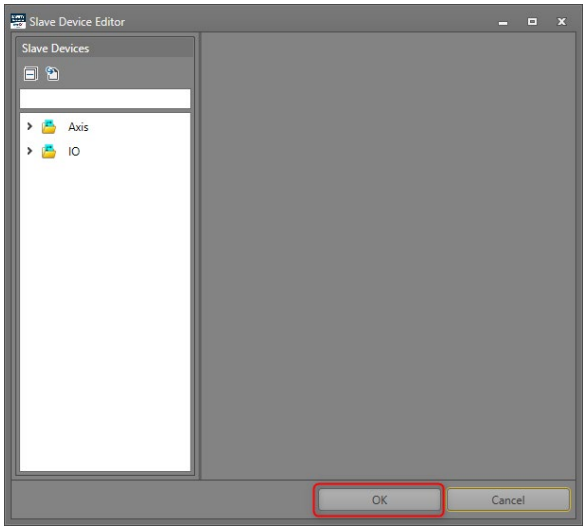
ESI File Selection

Click amGard proNet checkbox, click “Import”:

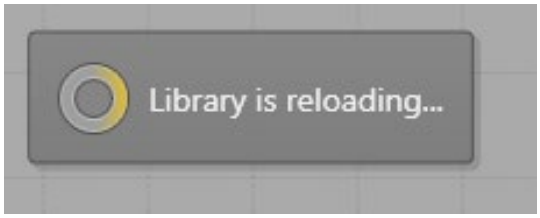


Fortress amGard proNet ESI File Import

Click “OK” to close the Slave Device Editor and finish the import process:

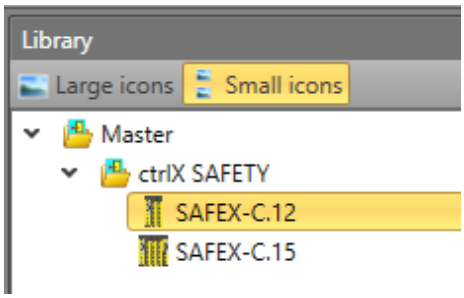


Close Slave Device Editor



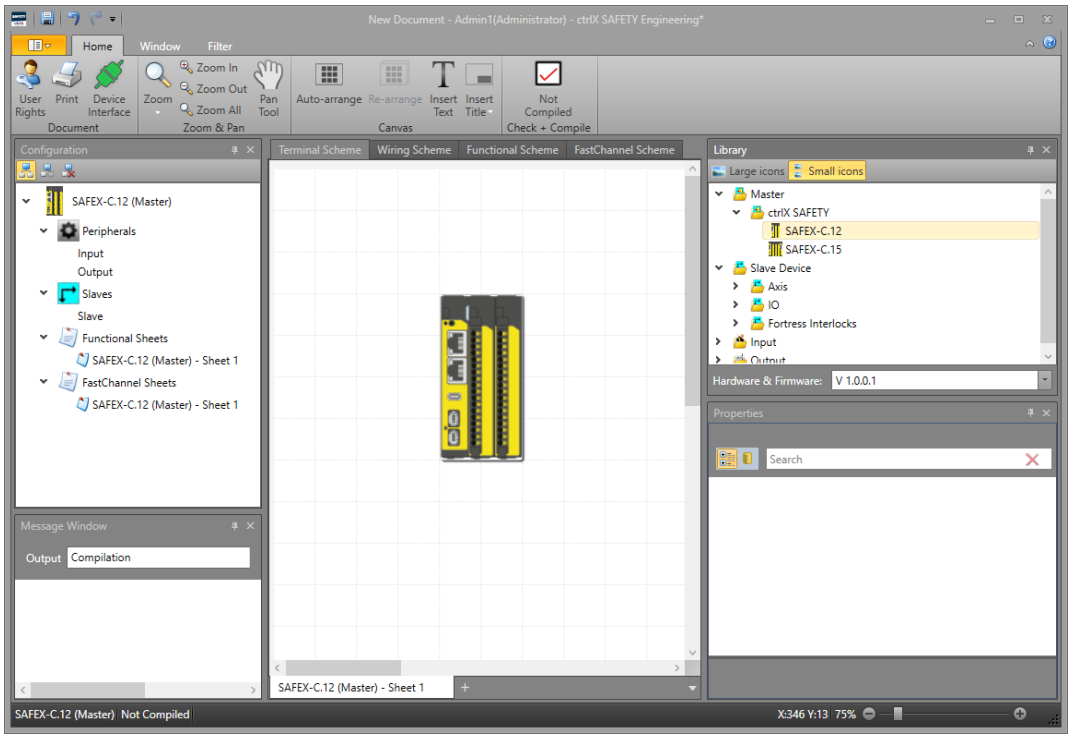
Library Loading

If needed expand Master\ctrlX SAFETY in the Library window then drag and drop the control type you have in the workspace area:



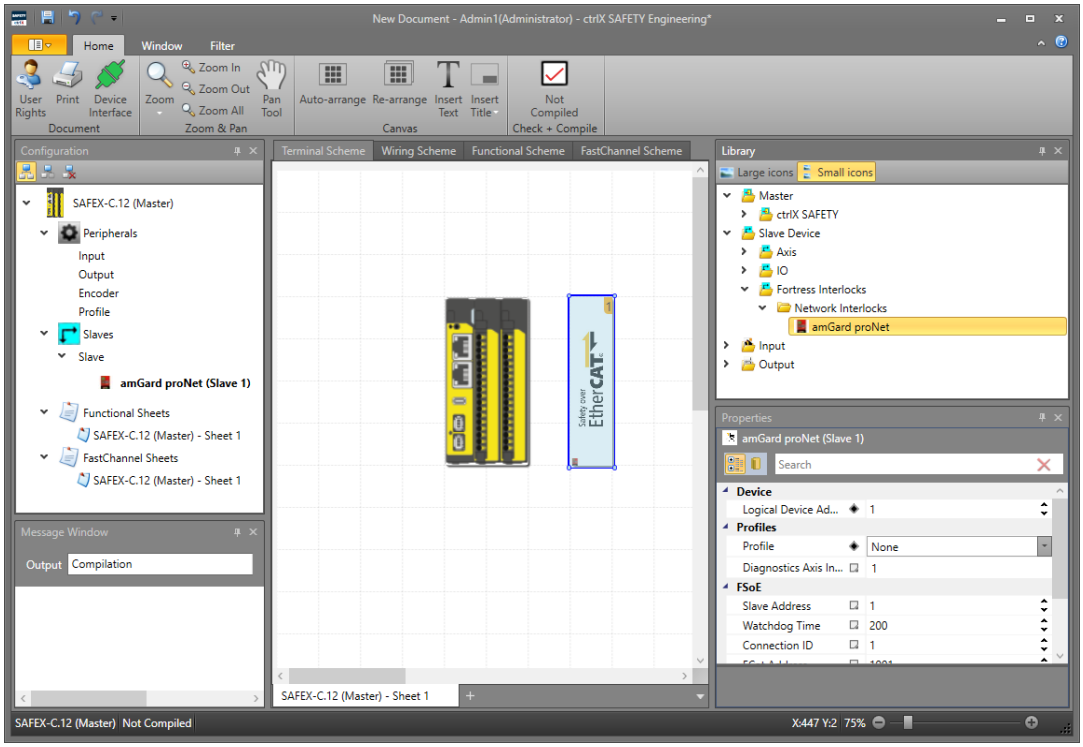
SAFEX-C1x Selection

In this case a SAFEX-C12 has been added:



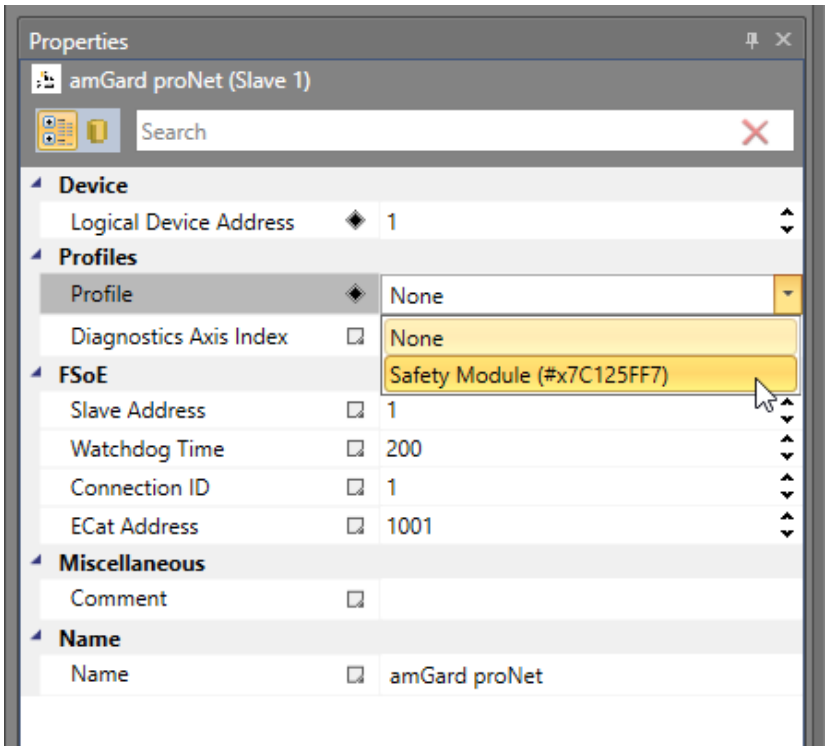
SAFEX-C1x Added to Project

Expand Slave Device\Fortress Interlocks\Network Interlocks then drag and drop an amGard proNet to the workspace area:



Fortress amGard proNet added to project

In the properties window for the amGard proNet select the Profile type using the pulldown menu:



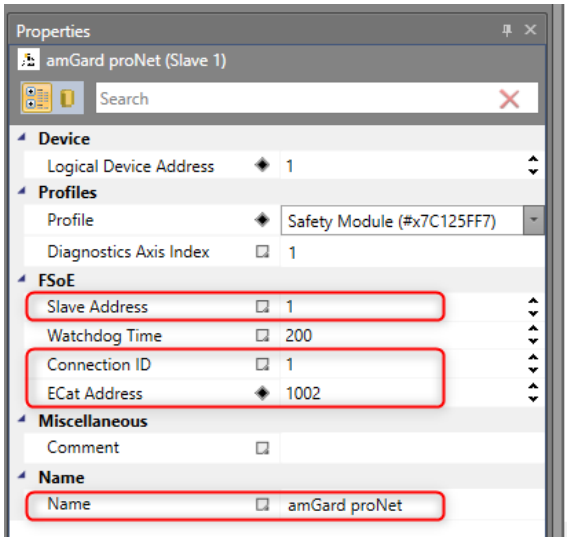
Fortress amGard proNet Profile Selection

The Slave Address must match the address on the unit set with the DIP switches. Please see the Fortress website for the latest documentation and additional information on setting the FSoE Slave Address:

Fortress amGard proNet Slave Address

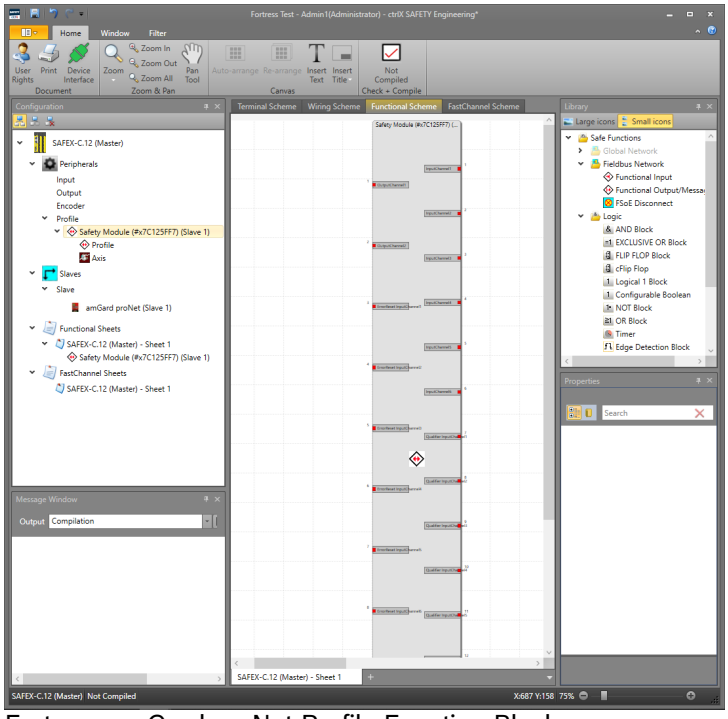
- For this example, the DIP switches were set to Slave Address 1.
- The Connection ID must match the Connection ID used in ctrlX I/O Engineering. In this example the Connection ID used was 1.
- The ECat Address must match the address assigned by the EtherCAT master in ctrlX I/O Engineering. In this example the ECat Address assigned was 1002.

These values will be used in the properties along with changing the Name:



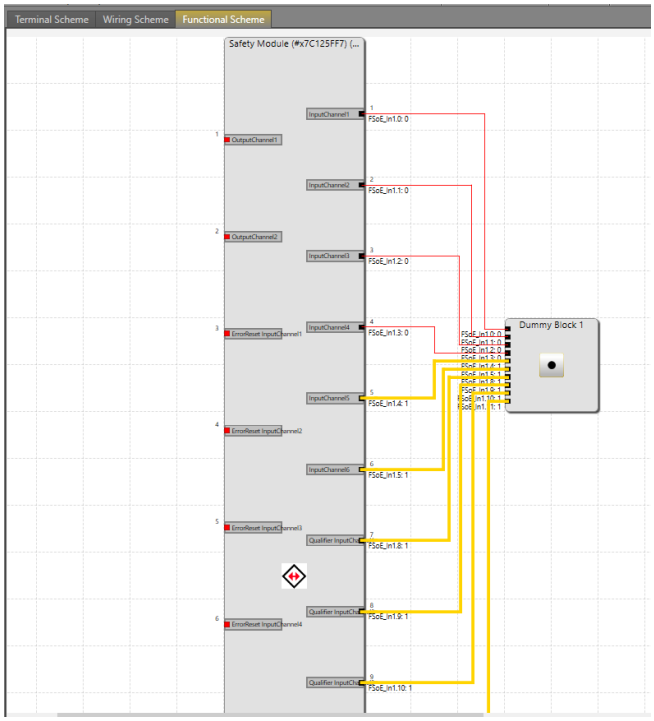
Fortress amGard proNet Properties

The Safety Module profile was added to the configuration and can now be used in the Functional Scheme:



Fortress amGard proNet Profile Function Block

Since the module used for this example is configured to use the standard controller for control of the solenoid. Programming can be added to monitor the bits. The following ctrlX SAFETY program was created only as a functional example for demonstration purposes of the communications. It is not written to meet any specific PL or SIL rating nor any specific risk assessment. Programming methods must be used to meet your specific application requirements:



Fortress amGard proNet Profile Function Block Online

ctrlX Example Projects

The following example projects are included in the SAFEX-C1x - Fortress Example Projects.zip available for download below:

- ctrlX I/O Engineering
- ctrlX PLC Engineering
- ctrlX SAFETY Engineering

Additional Resources

- How-to All about ctrlX AUTOMATION
- Quick Start Guide ctrlX CORE
- Quick Start Guide Licensing
- Create safety PLC project with ctrlX SAFETY Engineering
- Set up a ctrlX CORE and PLC Programming