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# AS-i Fieldbus System on CM AS-i Master with AS-i Safety

S7-1500 CPU / ET 200SP

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## Contents

<b>1</b>	<b>Introduction .....</b>	<b>3</b>
1.1	Hardware Components Used .....	4
1.2	Wiring of the Hardware Components .....	5
<b>2</b>	<b>Configuration .....</b>	<b>8</b>
2.1	CPU 1511F-1 PN .....	8
2.2	ET 200SP .....	9
2.3	AS-i Slaves .....	11
2.4	Configure Safe Inputs and Outputs (F-I/Os) .....	15
2.5	Compile and Download the Configuration.....	19
2.6	Assign F Destination Address .....	22
2.7	Read In AS-i Code Sequences .....	23
<b>3</b>	<b>Programming .....</b>	<b>26</b>
3.1	Create F Block.....	26
3.2	Implement Emergency Stop Switch-Off .....	27
3.3	Diagnostics of the AS-i Bus System.....	28
<b>4</b>	<b>Visualization .....</b>	<b>29</b>

# 1 Introduction

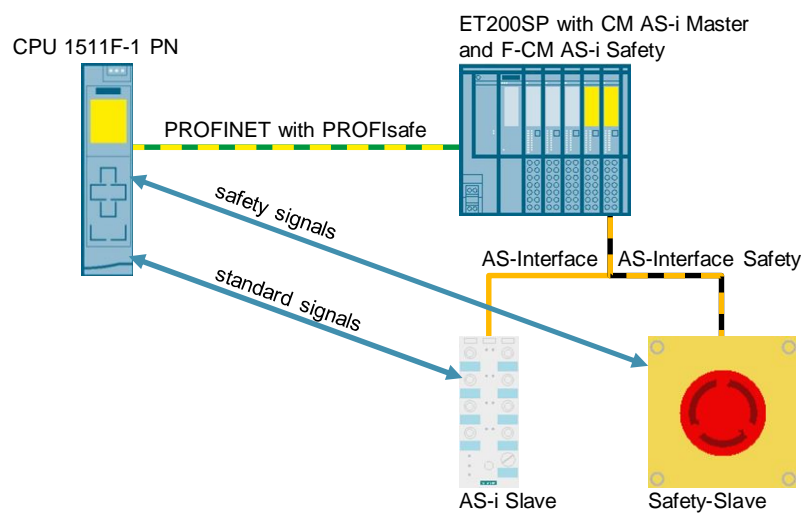
This entry shows how you operate an AS-i field bus system for different AS-i slaves with the CM AS-i Master and F-CM AS-i Safety modules.

You can use the following AS-i slaves:

- Standard DI/DO, AI or AO
- Fail-safe DI
- Fail-safe DO

The ET 200SP works as a gateway. It is connected via PROFINET with PROFINsafe to a CPU 1511F-1 PN. An AS-i field bus system is connected to the ET 200SP. The AS-i field bus system consists of AS-i slaves for standard signals and safety slaves for safety signals.

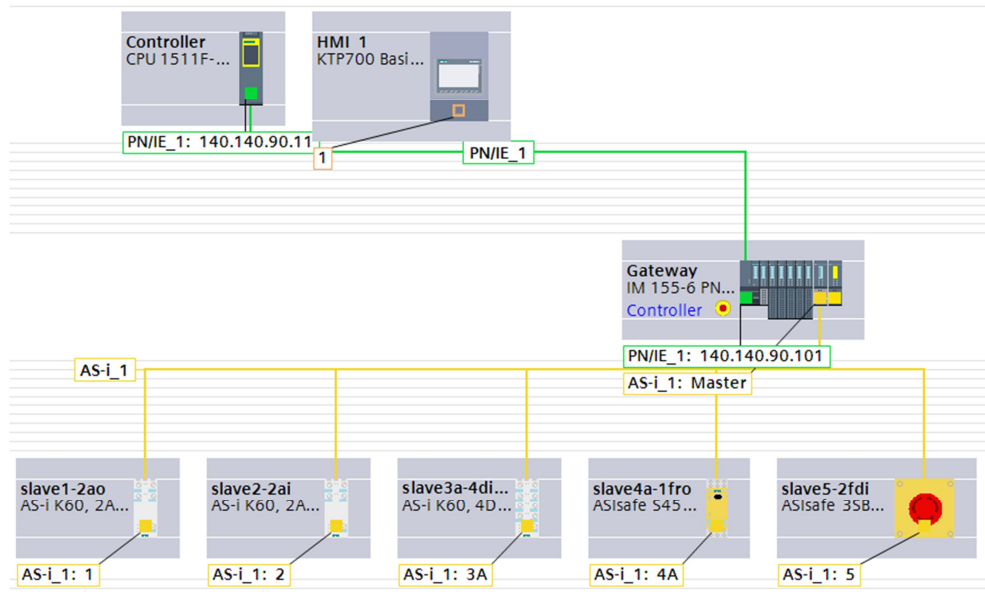
Figure 1-1



## 1.1 Hardware Components Used

[Figure 1-2](#) and [Table 1-1](#) show the components used with the assigned bus systems and addresses.

Figure 1-2



### Note

With AS-i the bus cycle time is governed by the number of AS-i slaves. 150  $\mu$ s are required per AS-i slave. If you are using a fail-safe output, it only works if at least 5 AS-i slaves are connected to the AS-i bus system. Otherwise the F-CM AS-i Safety gets muddled with the F time, because it is too fast. Therefore there is the need for additional standard AS-i slaves to increase the bus cycle time.

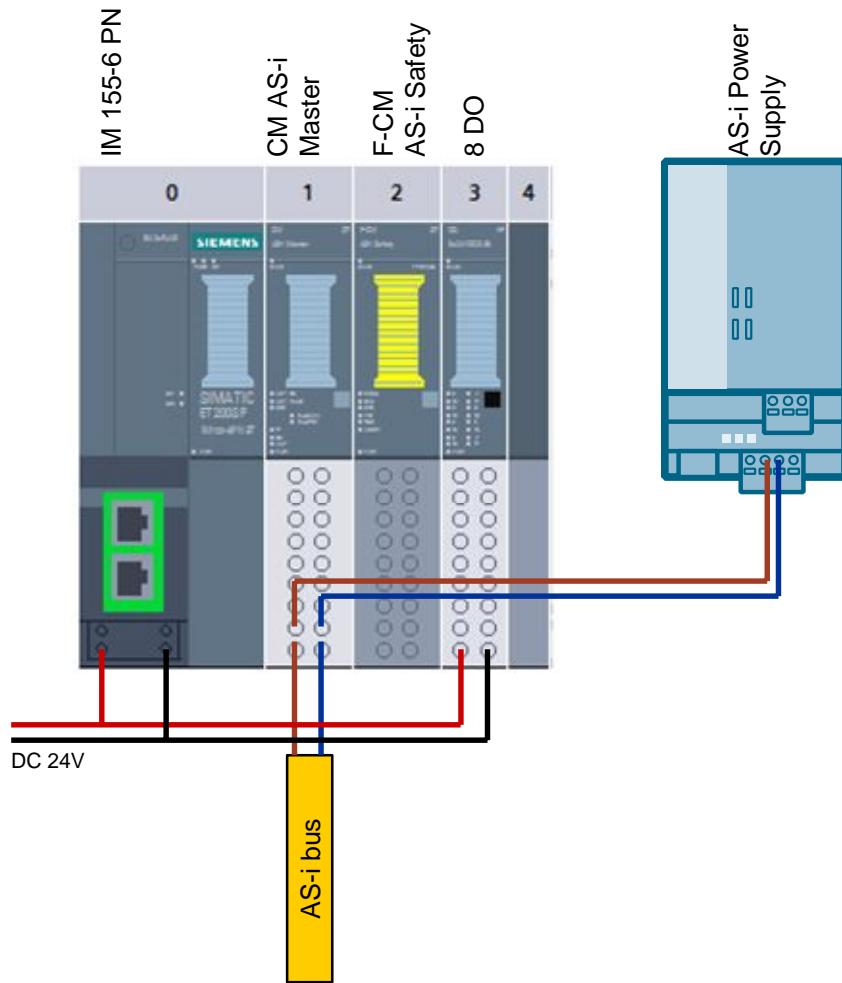
Table 1-1

Module	Article number	Bus system	Address
CPU 1511F-1 PN	6ES7511-1FK00-0AB0	PROFINET	140.140.90.11
IM 155-6 PN ST	6ES7155-6AU00-0CN0	PROFINET	140.140.90.101
AS-i Power 3A AC 120V / 230V	3RX9501-0BA00	AS-i	Power supply for AS-i field bus system
CM AS-i Master	3RK7137-6SA00-0BC1	AS-i	AS-i Master
CM AS-i Safety	3RK7136-6SC00-0BC1	AS-i	Processing of safety signals on AS-i field bus system
AS-i analog module (2AA +/- 10V)	3RK1107-2BQ40-0AA3	AS-i	1
AS-i analog module (2AE +/- 10V)	3RK1207-2BQ40-0AA3	AS-i	2
AS-i K60 4 DI/DO	3RK2400-1DQ00-1AA3	AS-i	3A
AS-i safe slimline module S45F 1F-RO/3DI/2DO	3RK1405-1SE15-0AA2	AS-i	4A
Emergency stop button	3SF5811-2AA08	AS-i	5

## 1.2 Wiring of the Hardware Components

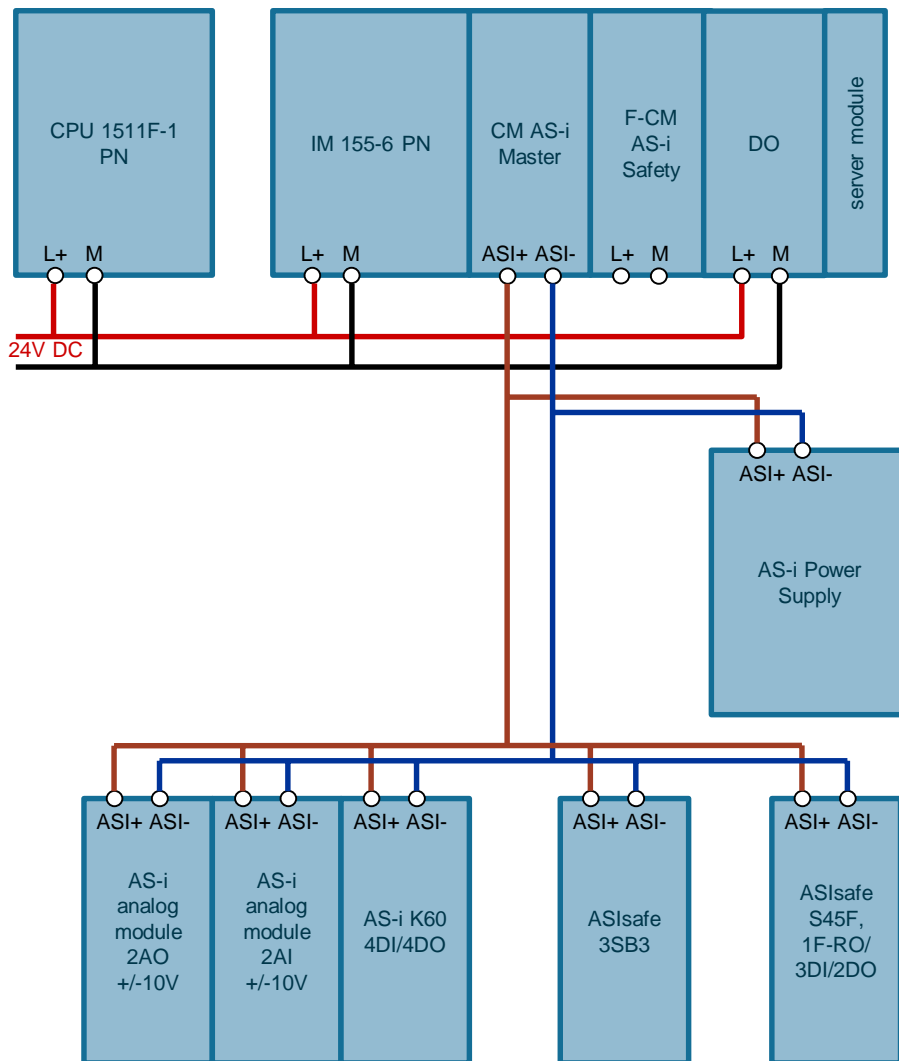
[Figure 1-3](#) and [Figure 1-4](#) show the wiring of the hardware components. The CM AS-i Master must be connected to an AS-i power supply that delivers 30V. The F-CM AS-i Safety is not wired but does have to be slotted on a dark Base Unit next to the CM AS-i Master. A light Base Unit is slotted on the right next to the F-CM AS-i Safety.

Figure 1-3



**Note** The CM AS-i Master module is supplied with 30V by the AS-i power supply. All other modules (DI/DO) of the ET 200SP are supplied with 24V by the interface module.

Figure 1-4



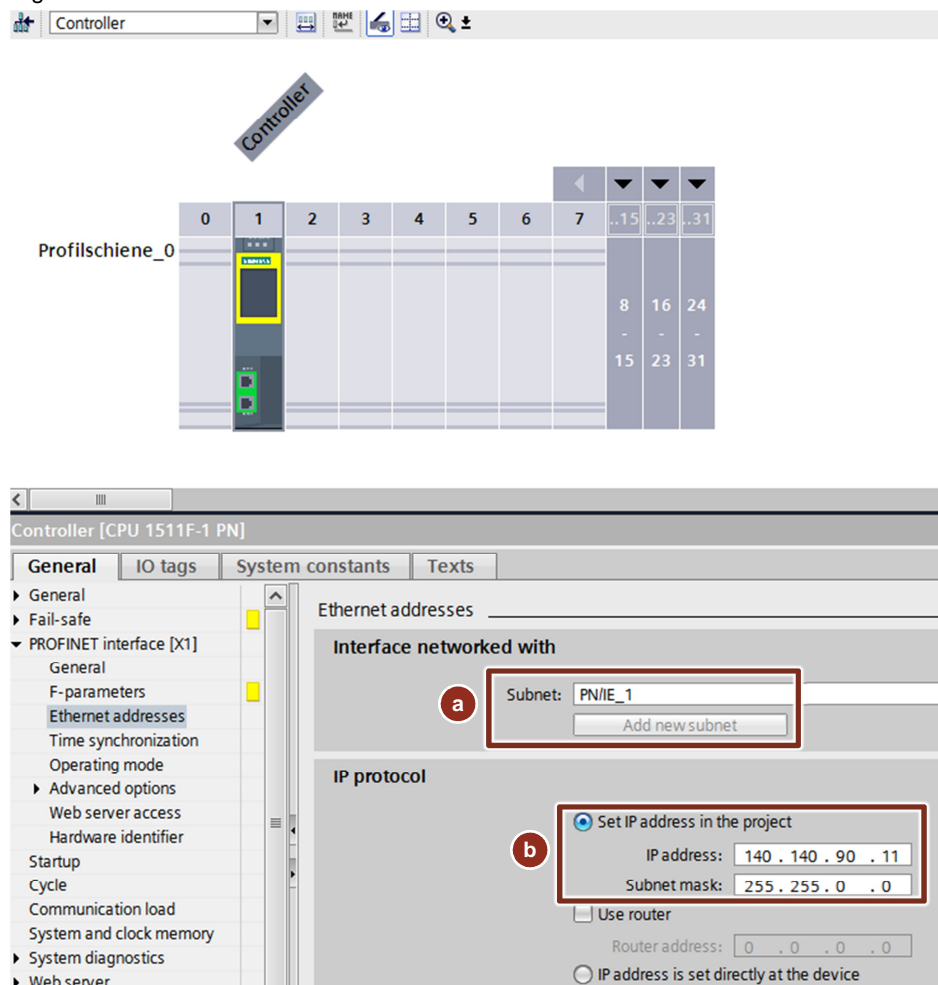
## 2 Configuration

### 2.1 CPU 1511F-1 PN

Proceed as follows to configure the CPU1511F-1 PN.

1. Create a new project in the TIA Portal.
2. Insert the S7-1500 F-CPU in the project, CPU1511F-1 PN, for example.
3. On the CPU display you set the required IP address and subnet mask, for example the IP address 140.140.90.11 and the subnet mask 255.255.0.0.
4. In the Devices and Networks editor you open the Device view of the CPU.
5. In the Device view you mark the CPU. The properties of the CPU are displayed in the inspector window.
6. Go to the "General" tab and navigate to "PROFINET interface > Ethernet addresses".
  - a. Assign an existing subnet to the PROFINET interface. If there is no subnet available, click the "Add new subnet" button.
  - b. Enable the function "Set IP address in the project" and enter the IP address and subnet mask that you set in the CPU display.

Figure 2-1



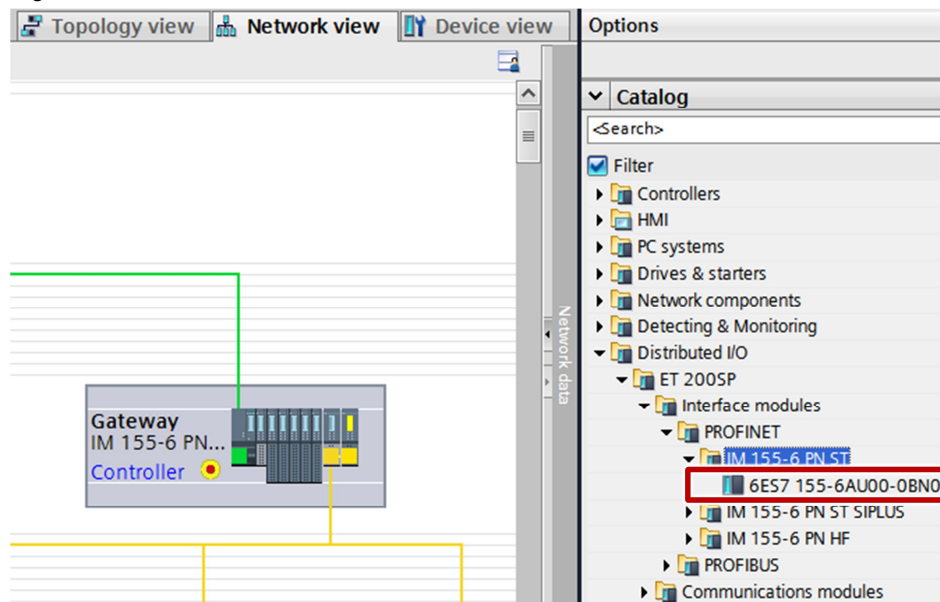


## 2.2 ET 200SP

Proceed as follows to configure the ET 200SP.

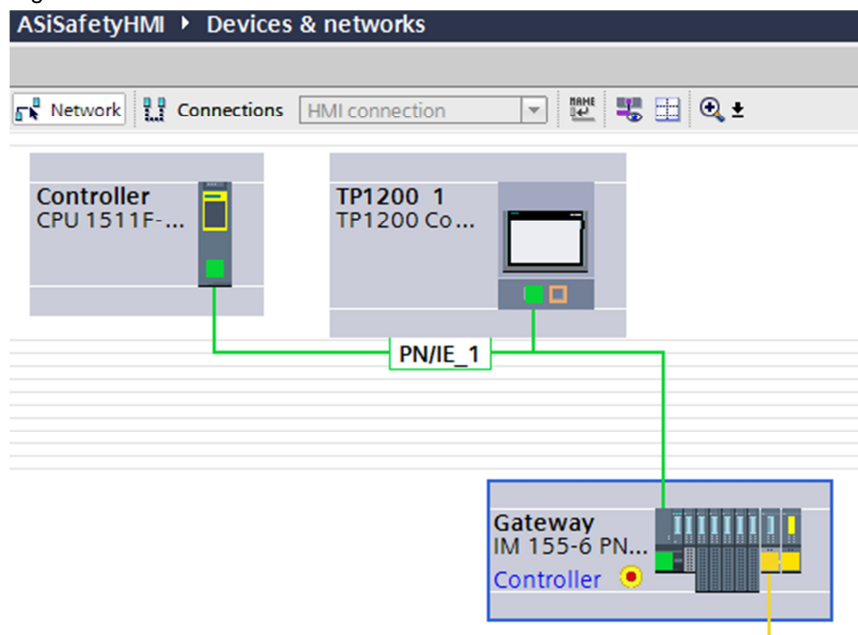
1. In the Devices and Networks editor you select the Network view.
2. Drag and drop the interface module of the ET 200SP, IM 155-6 PN ST, for example, from the Hardware Catalog into the Network view.  
The interface modules of the ET 200SP are located in the Hardware Catalog under "Distributed IO > ET 200SP > Interface Modules".

Figure 2-2



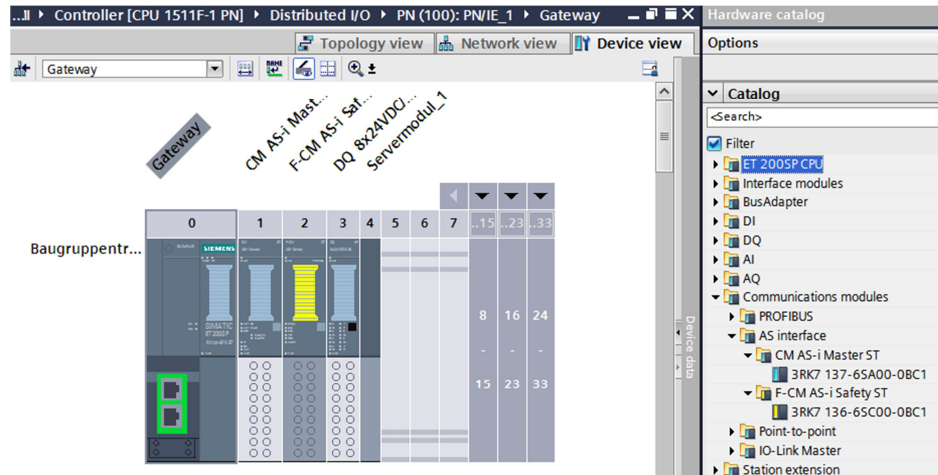
3. Use drag-and-drop to assign the ET 200SP to the IO controller.

Figure 2-3



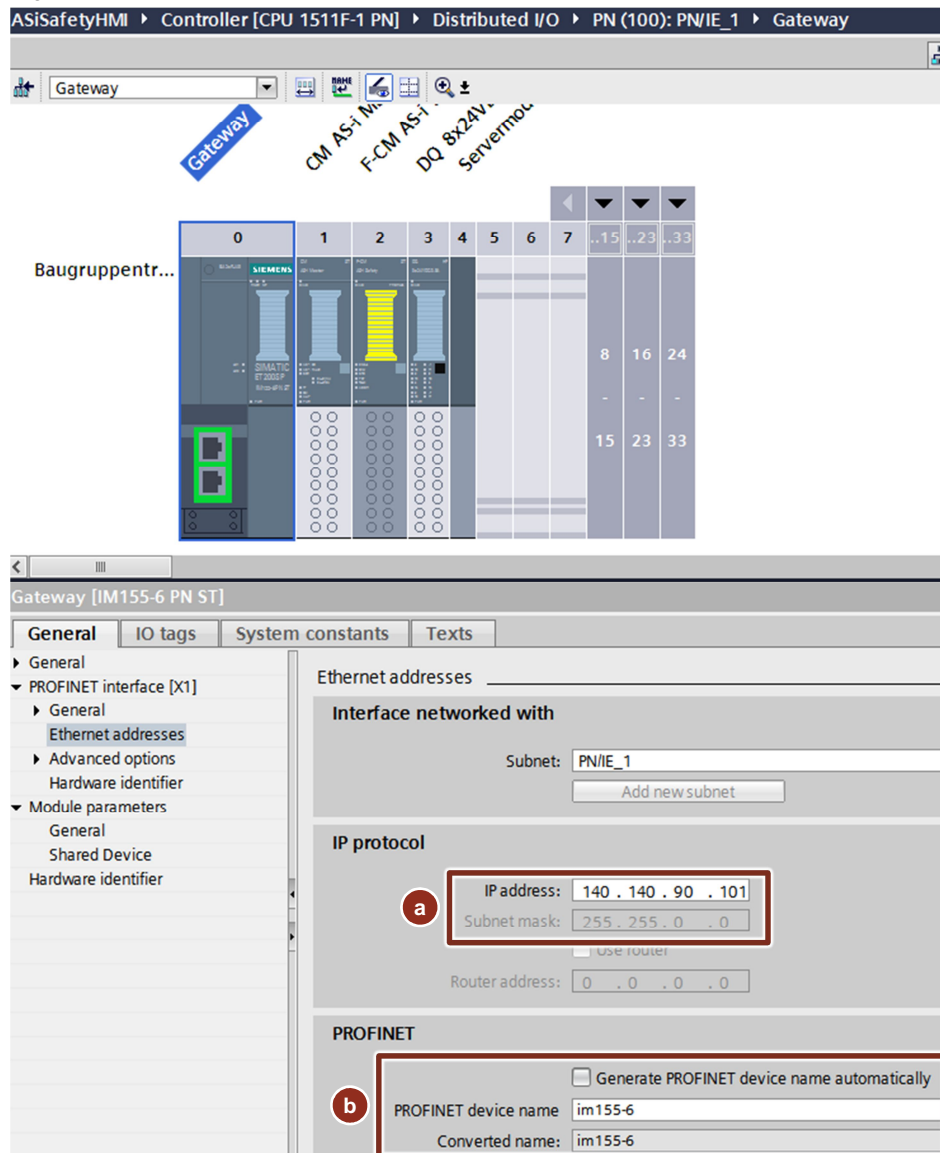
4. In the Devices and Networks editor you open the Device view of the ET 200SP.
5. In the Device view of the ET 200SP you use drag-and-drop to insert the following modules from the Hardware Catalog into the rack of the ET 200SP.
  - CM AS-i Master ST
  - F-CM AS-i Safety ST
  - DO 8x24VDC/0.5A HF (optional)
  - Server module

Figure 2-4



6. In the Device view you mark the interface module of the ET 200SP. The properties of the IM 155-6 PN ST are displayed in the inspector window.
7. Go to the "General" tab and navigate to "PROFINET interface > Ethernet addresses".
  - a. Enable the function "Set IP address in the project" and enter the IP address and subnet mask of the ET 200SP. In this example the ET 200SP has the IP address 140.140.90.101 and subnet mask 255.255.0.0.
  - b. Enter the PROFINET device name of the ET 200SP. In this example the ET 200SP has the PROFINET device name "im155-6".

Figure 2-5



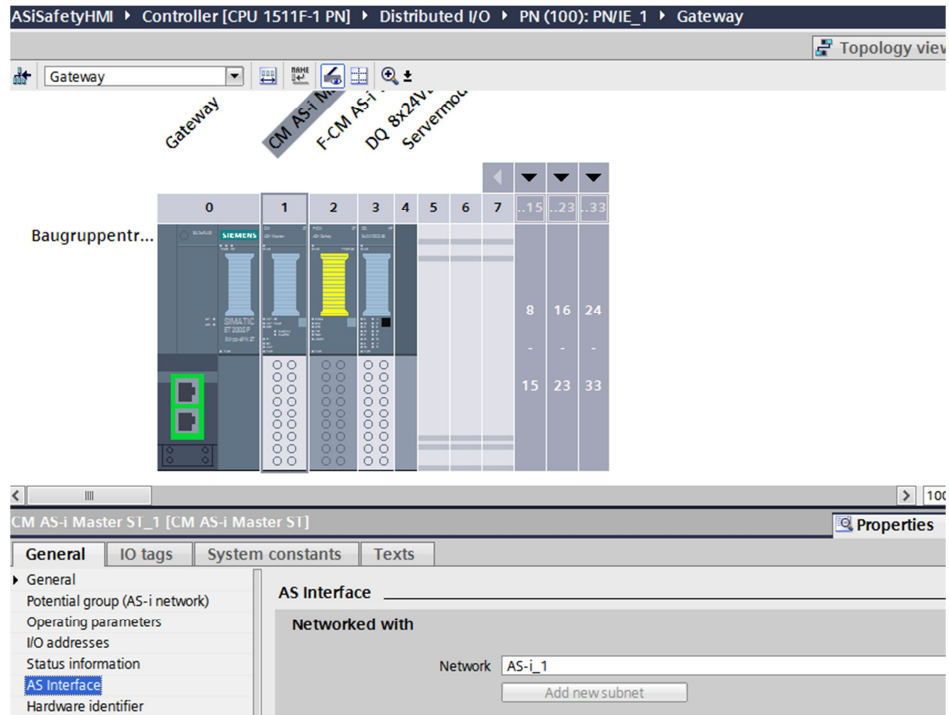
8. Via the TIA Portal you assign the PROFINET device name "im155-6" to the ET 200SP. The IP address 140.140.90.101 and the subnet mask 255.255.0.0 are assigned automatically by the IO controller.

## 2.3 AS-i Slaves

Proceed as follows to configure the AS-i slaves.

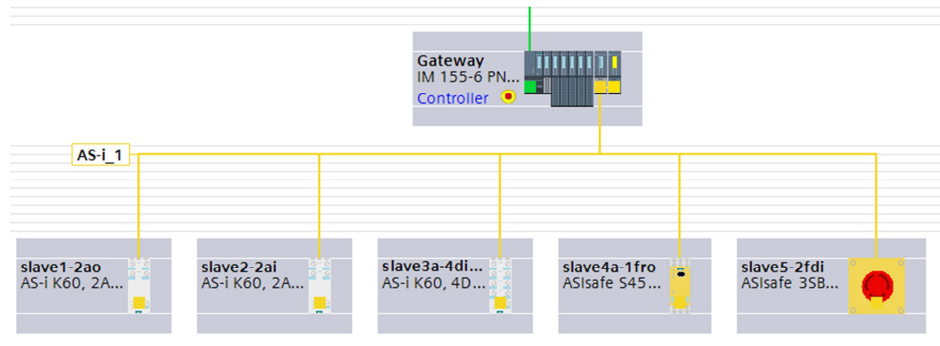
1. In the Device View of the ET 200S you mark the CM AS-i Master. The properties of the CM AS-i Master are displayed in the inspector window.
2. Go to the "General" tab and navigate to "AS Interface".
  - a. Click the "Add new subnet" button to create a new AS-i subnet.
  - b. Select the created AS-i subnet to network the CM AS-i Master with it.

Figure 2-6



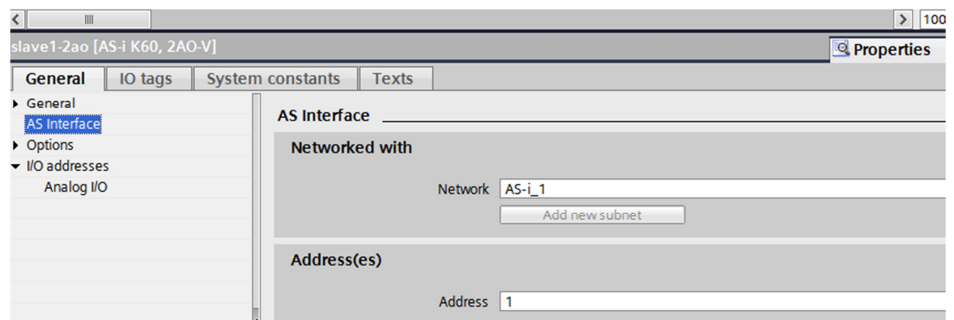
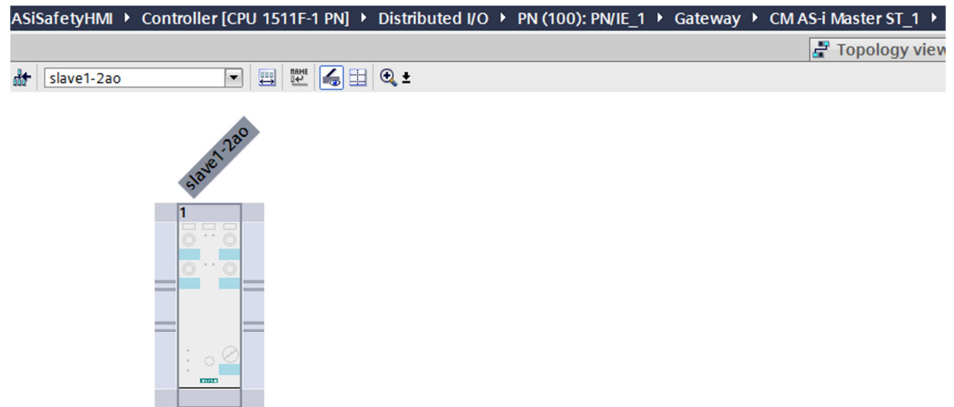
3. Use drag-and-drop to insert the required AS-i slaves from the Hardware Catalog into the Network view of the Devices and Networks editor.

Figure 2-7



4. In the Devices and Networks editor you open the Device view of the AS-i slave.
5. You mark the AS-i slave in the Device view. The properties of the AS-i slave are displayed in the inspector window.
6. Go to the "General" tab and navigate to "AS Interface".
  - a. Network the AS-i slave with the same AS-i subnet with which you network the CM AS-i Master.
  - b. Enter the address of the AS-i slave.

Figure 2-8



7. Repeat steps 4 to 6 for all the configured AS-i slaves.
8. Assign the configured addresses to the AS-i slaves with the addressing device:
  - a. You have to unscrew the Emergency Stop to assign the address (see [Figure 2-9](#)).

Figure 2-9

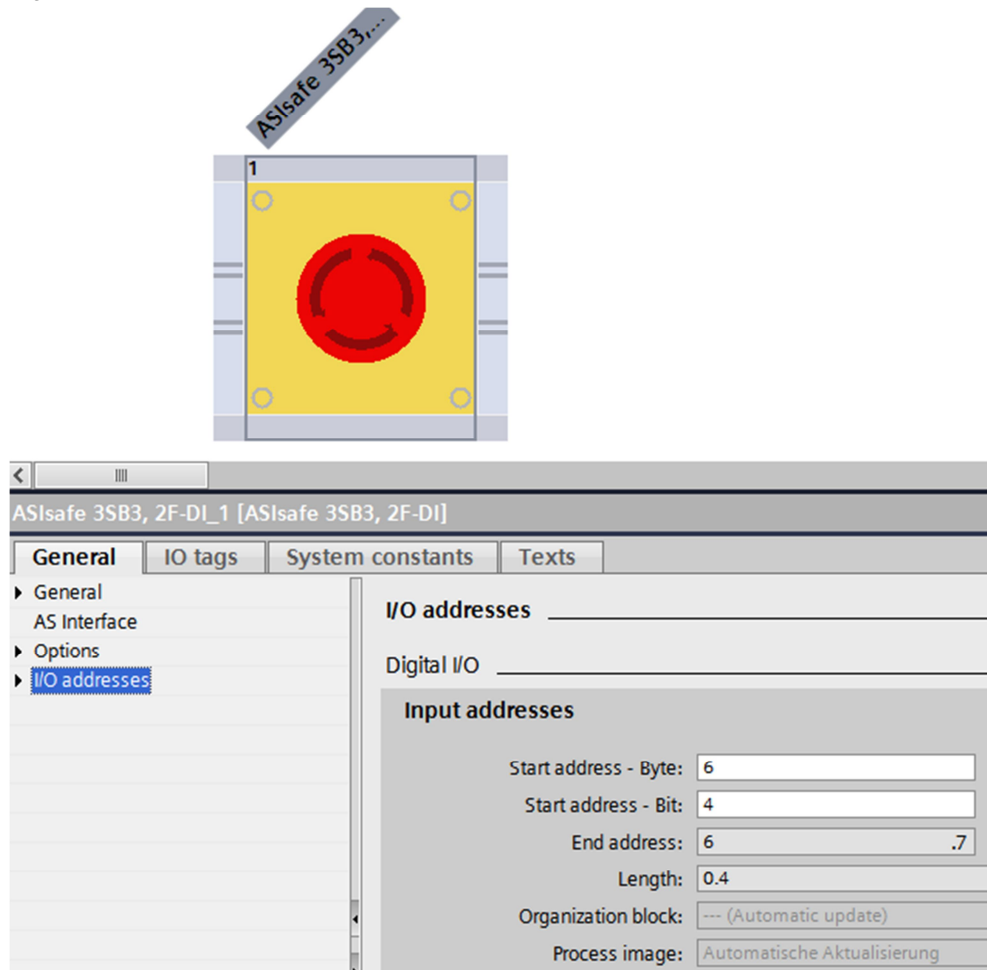


- b. With module S45F 1F-RO/3DI/2DO each F output receives a second safe AS-i address as well as the "standard" AS-i address. The module has a DIP switch. When the DIP switch is in the "RUN" position (left), the module can be operated and the "standard" AS-i address can be set. When the DIP switch is in the "F-ADDR" position (right), the safe AS-i address can be set. In this position it is not possible to operate the module. After setting the safe AS-i address you must set the DIP switch back to the "RUN" position (left).

## 2.4 Configure Safe Inputs and Outputs (F-IOs)

Until now, the safe AS-i slaves have only the normal IO addresses in the configuration. These IO addresses can be accessed in the user program.

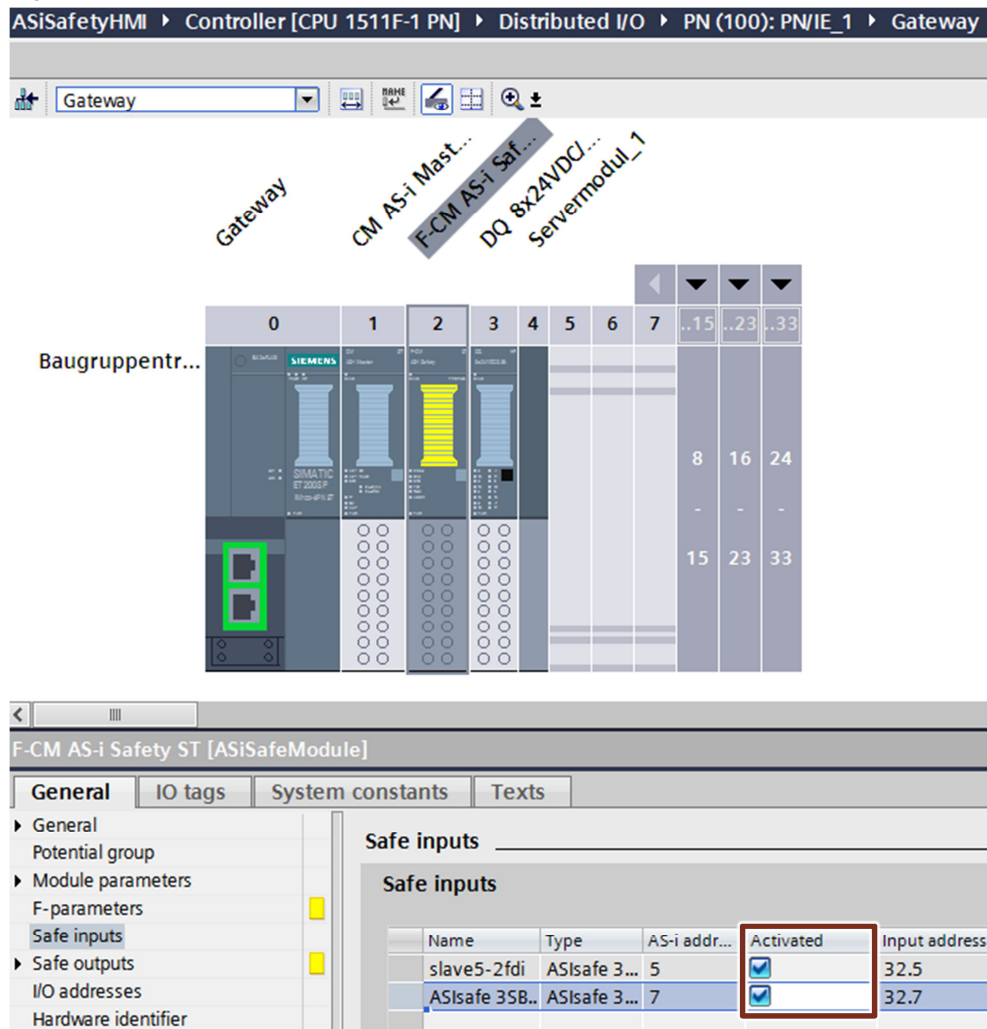
Figure 2-10



To activate the safe IO addresses you open the Device view of the ET 200SP. In the Device view you mark the F-CM AS-i Safety. The properties of the F-CM AS-i Safety are displayed in the inspector window.

Go to the "General" tab and navigate to "Safe inputs". Activate the safe inputs of the safe AS-i slave.

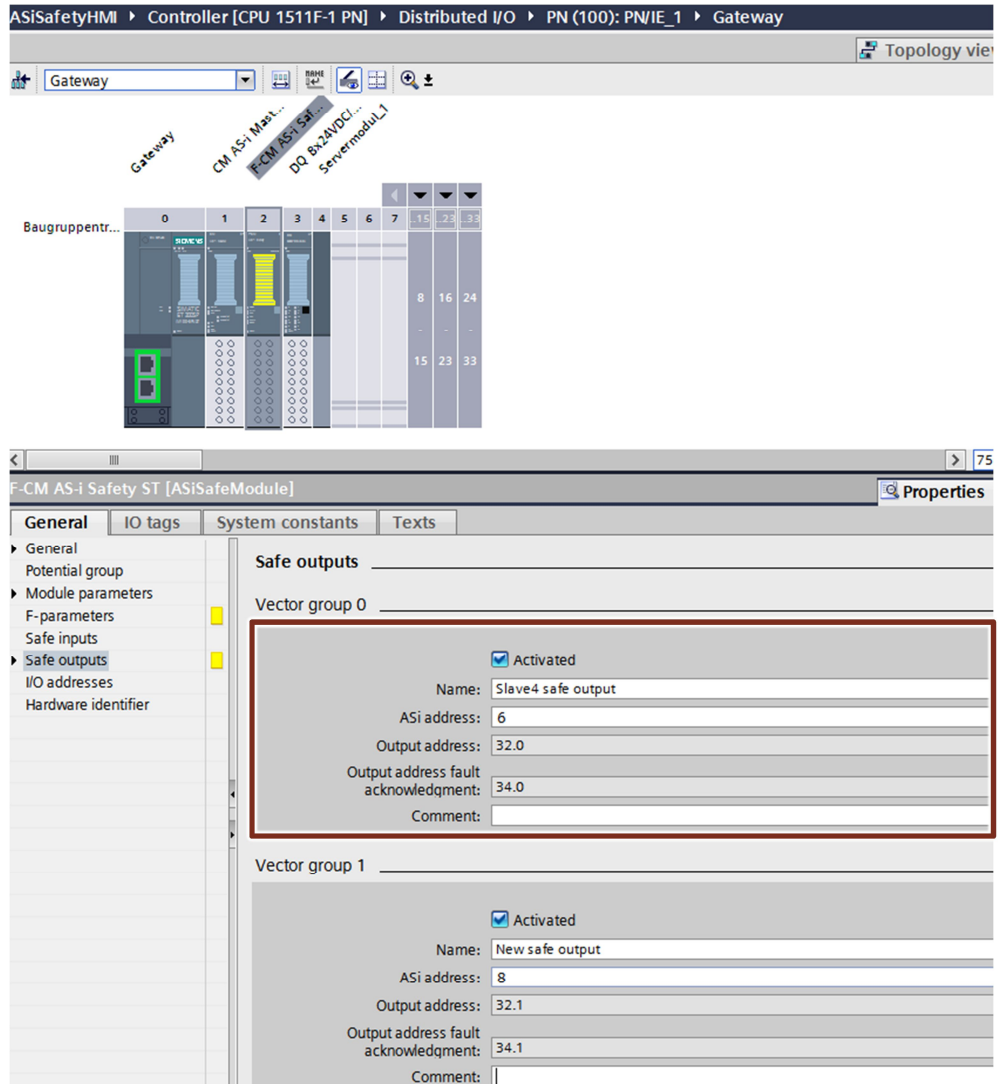
Figure 2-11





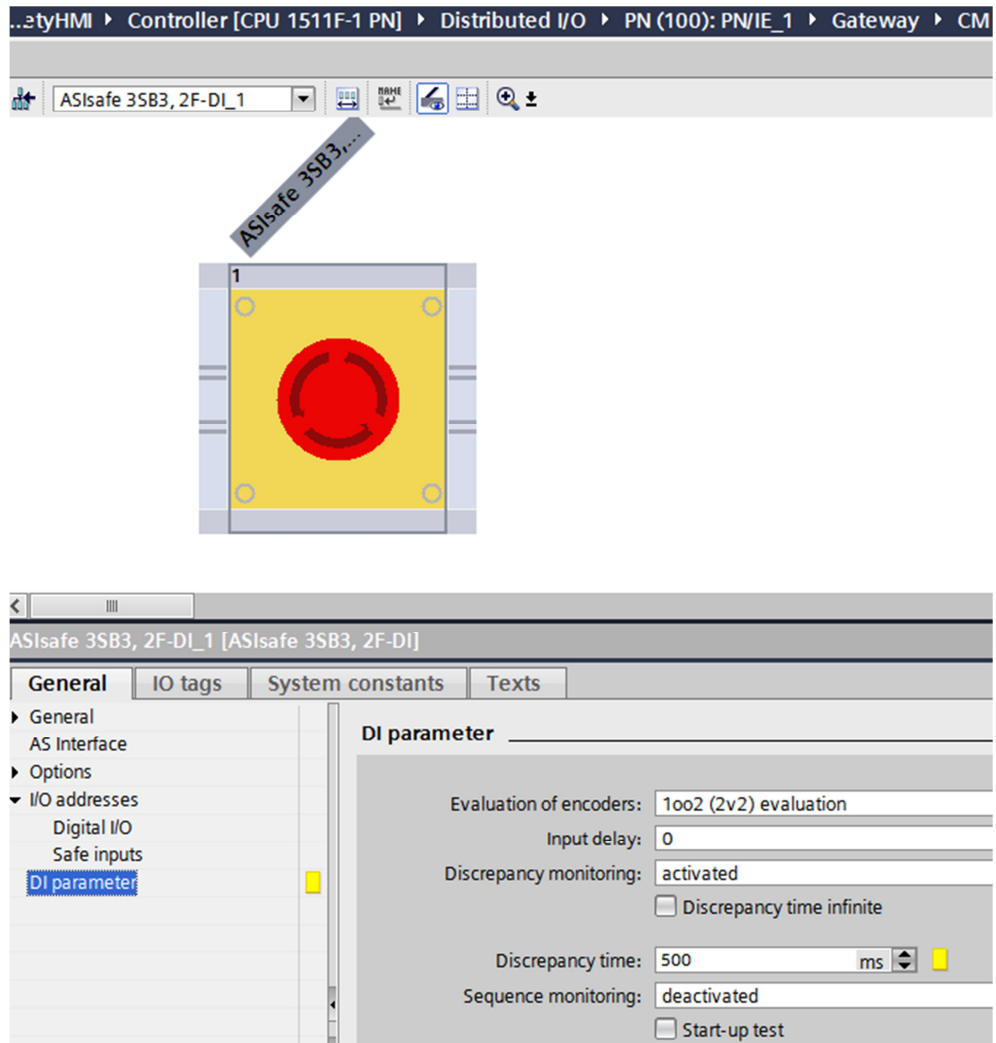
Go to the "General" tab and navigate to "Safe outputs". You can activate up to 16 safe AS-i vector groups. In the settings of each required vector group you activate the output controller and set the associated AS-i address. In this example the safe output A32.0 of the safe relay is activated. The safe relay has the safe AS-i address 6. The safe AS-I address which you set in the project must accord with the address of the safe part of AS-i slave. A lot of AS-I slaves with safe outputs have two AS-I addresses, one standard AS-I address and one safe AS-I address. The safe output can be passivated. It is acknowledged / passivated via the output A34.0.

Figure 2-12



After activating the safe inputs and outputs more options for the safety parameters are displayed in the properties of the safe AS-i slave.

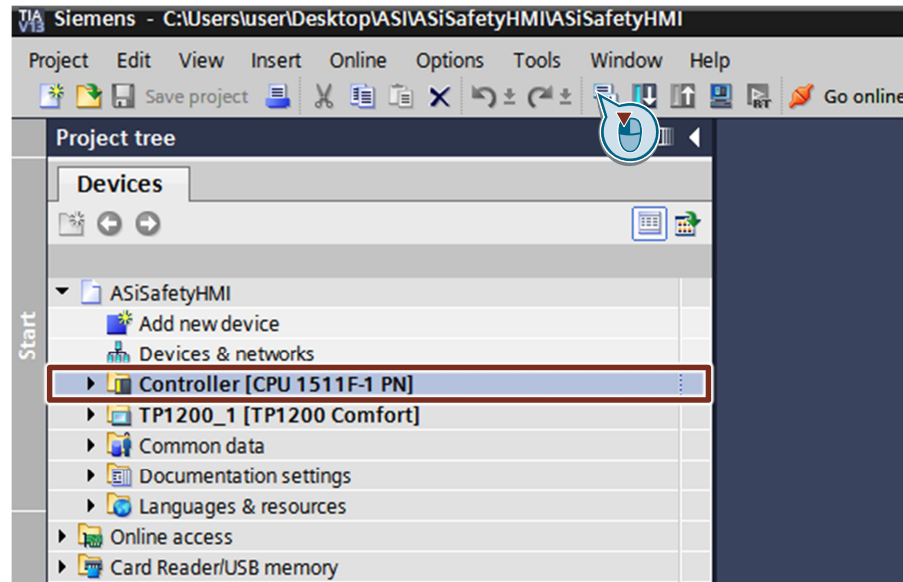
Figure 2-13



## 2.5 Compile and Download the Configuration

In the project tree you mark the S7-500 CPU. In the toolbar you click the "Compile" button.

Figure 2-14



In the project tree you mark the S7-1500 CPU. In the toolbar you click the "Download to device" button. The "Extended download to device" or "Load preview" dialog opens automatically.

The "Extended download to device" dialog opens automatically only if the access path has to be set.

(1) Make the following settings:

- Type of the PG/PC interface: PN/IE
- PG/PC interface: network card of the PC/PG connected with the S7-1500 CPU.
- Connection to interface/subnet: subnet networked with the PROFINET interface of the S7-1500 CPU, PN/IE\_1, for example

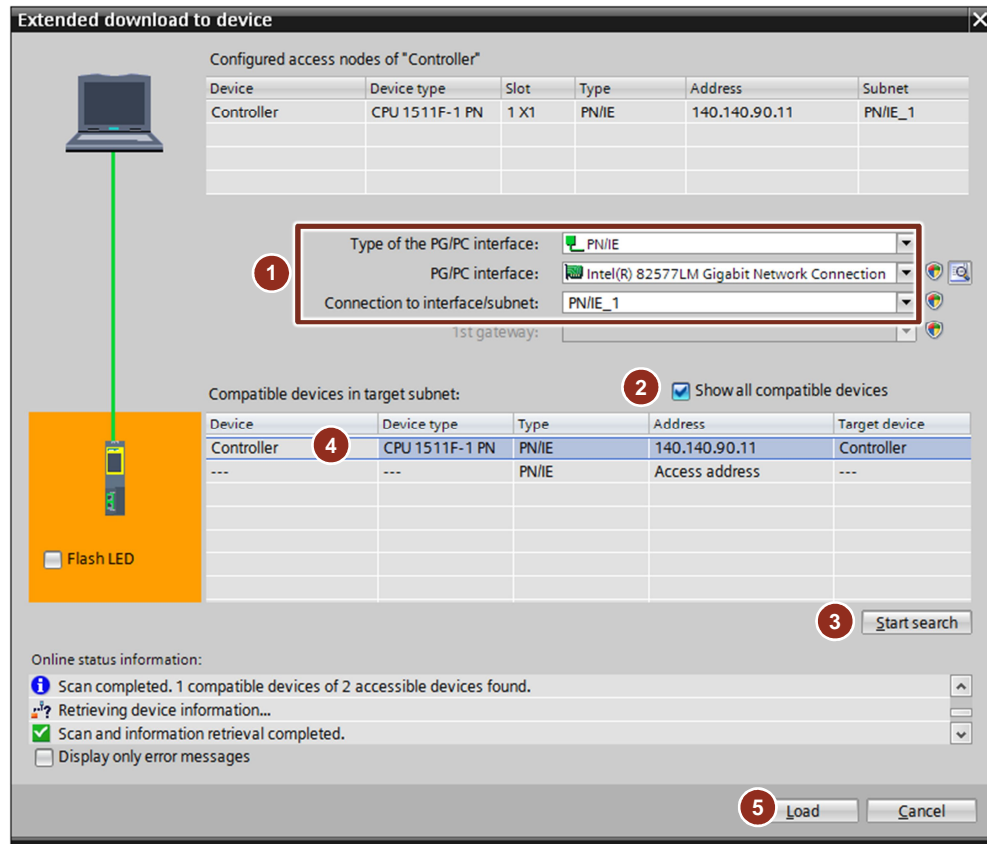
(2) Activating the "Show all compatible devices" option.

(3) Click the "Start search" button.

(4) The S7-1500 CPU is displayed in the "Compatible devices in target subnet:" list. Mark the S7-1500 CPU.

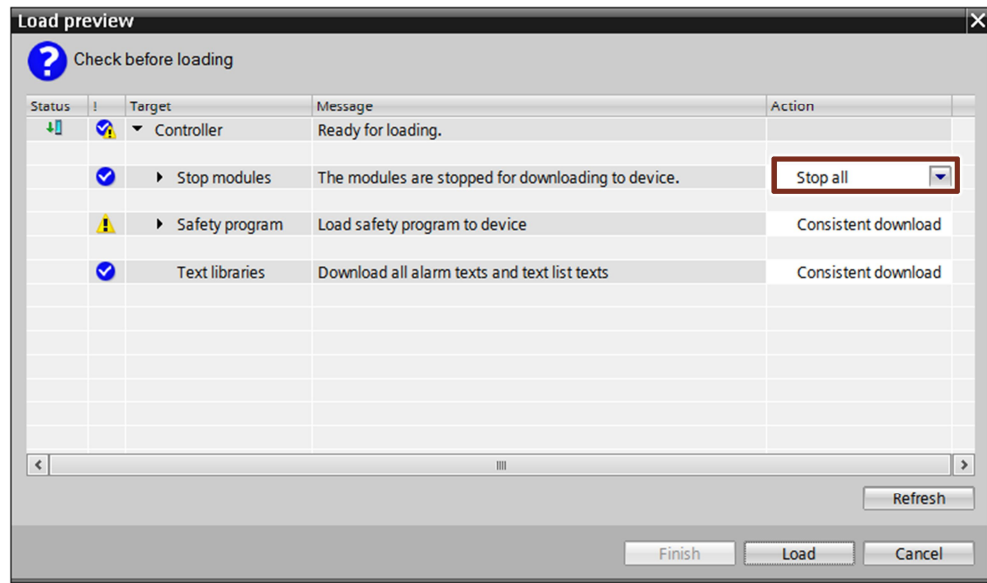
(5) Click the "Load" button. The "Load preview" dialog opens.

Figure 2-15



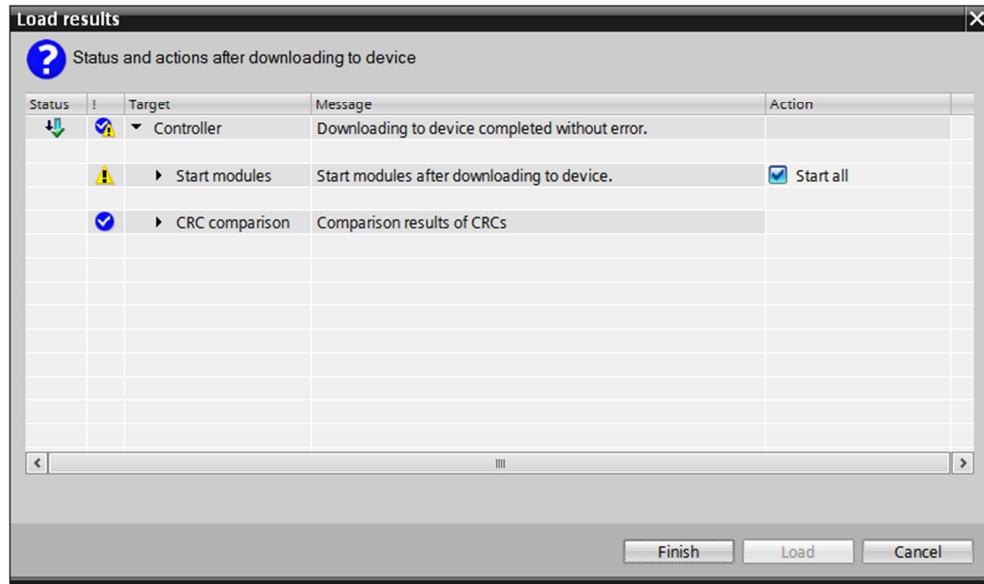
In the "Load preview" dialog you click the "Load" button to start the download procedure. Enable the "Stop all" action to stop the modules before the load procedure.

Figure 2-16



In the "Load results" dialog you click the "Finish" button to terminate the download procedure. Enable the "Start all" action to start the modules after the load procedure.

Figure 2-17



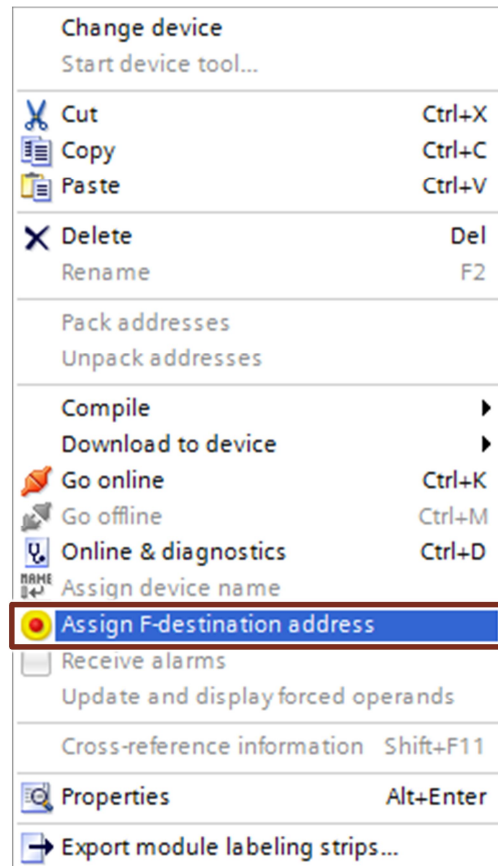
After the project has been loaded:

- The following LEDs of the CM AS-i Master light green:
  - DIAG
  - AS-i ok
  - PWR
- The RN-LED of the interface module of the ET 200SP no longer flashes, but lights green.

## 2.6 Assign F Destination Address

You assign the F destination address to the F-CM AS-i Safety. For this, in the Device view of the ET 200SP you right-click the CM AS-i Safety and select in the pop-up menu you select "Assign F-destination address".

Figure 2-18

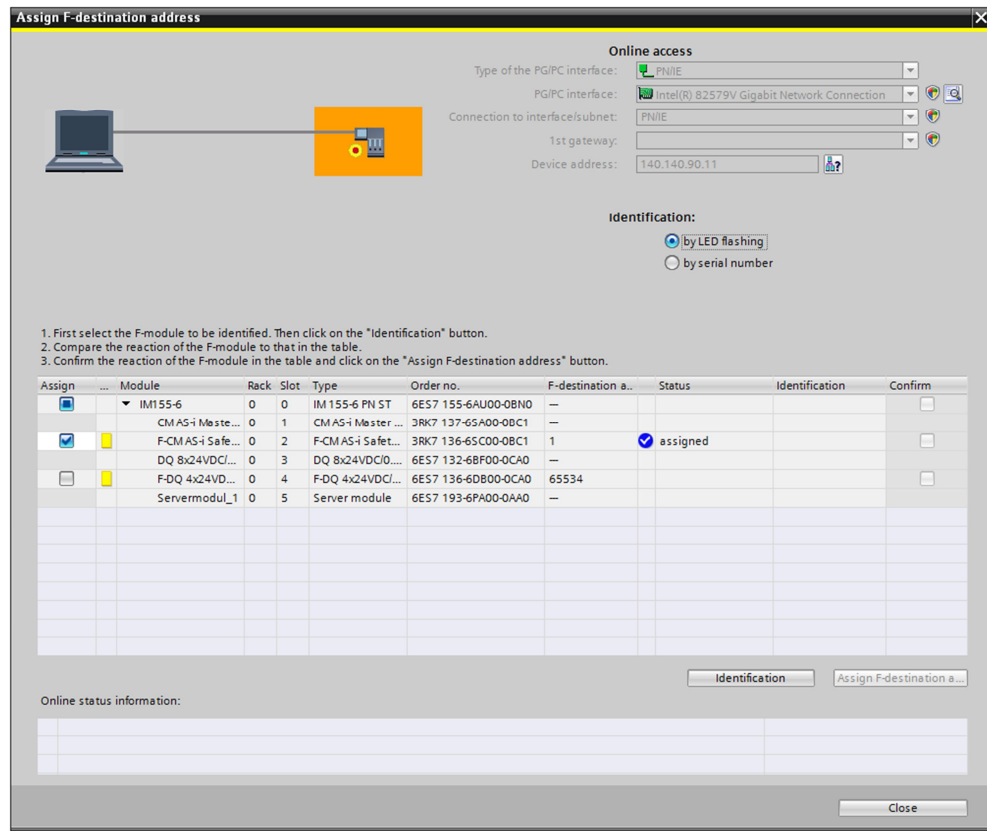


### Note

If the "Assign F-destination address" item is not available in the pop-up menu with the F-CM AS-i Safety, add an F-DI/DO module in the configuration of the ET 200SP. Right-click the F-DI/DO module and in the pop-up menu you select the item "Assign F-destination address".

In the "Assign F-destination address" dialog you select the F-CM AS-i Safety. Click the "Identification" button. Then the "Assigned" status is displayed.

Figure 2-19



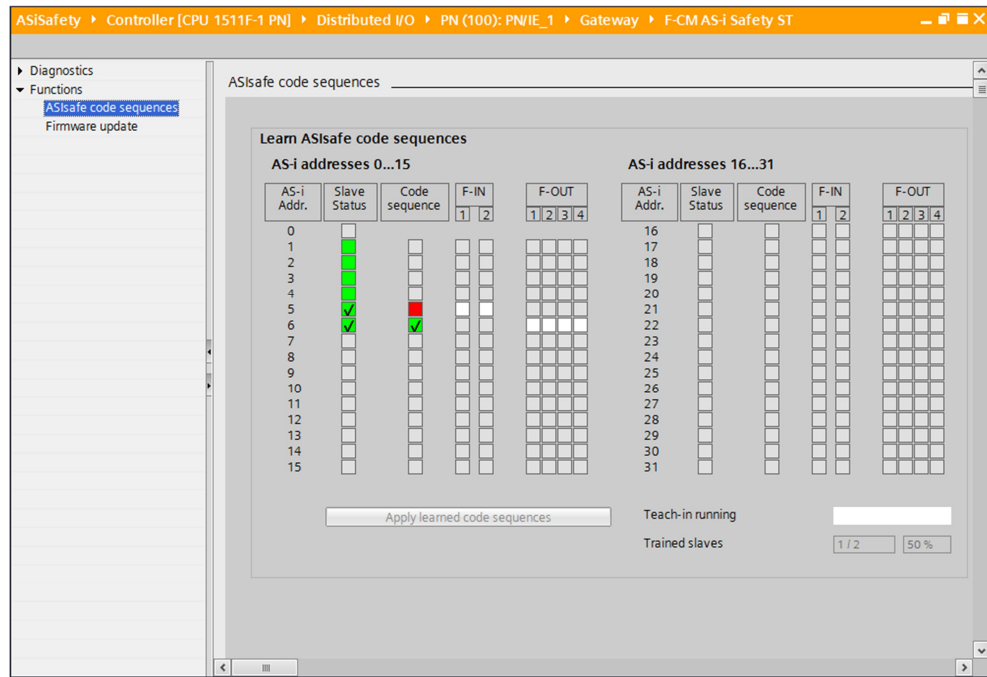
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## 2.7 Read In AS-i Code Sequences

The F-CM AS-i Safety retrieves the code sequences of the safe AS-i slave from the CM AS-i master via the backplane bus. The F-CM AS-i Safety must have received all the code sequences in order to be able to start the safe operation. For this the F-CM AS-i Safety must recognize the right addresses of all the AS-i slaves and the contacts must also be closed. The Emergency Stop button must be open, not pressed, at least once for the F-CM AS-i Safety to recognize the right code sequences.

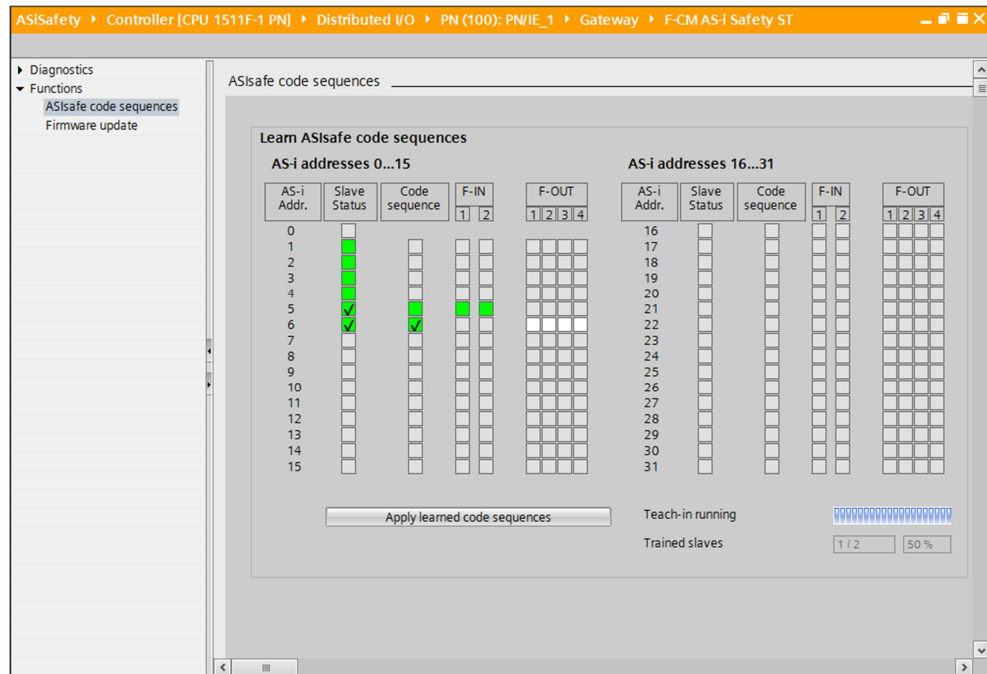
The figure below shows the "Online&Diagnostics" view of the F-CM AS-i Safety. The module sees the right addresses of all the AS-i slaves. However, the Emergency Stop button is pressed so that the code sequence cannot be recognized and is displayed red. With F-IN the contacts 1 and 2 are shown white, which means the contacts are open.

Figure 2-20



When the Emergency Stop button is opened, the contacts are shown green with F-IN. The code sequence is also shown green. The "Trained slaves" display is still on "1/2". Click the "Apply learned code sequences" button.

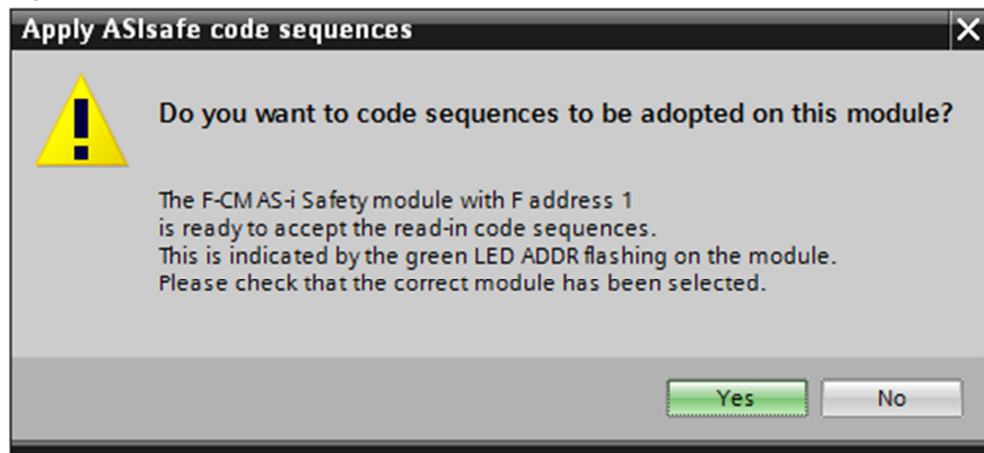
Figure 2-21





Confirm the message displayed with "Yes".

Figure 2-22



The "Trained slaves" display is now on "2/2". The code sequence of the Emergency Stop button is shown green with a check mark, which means ready for operation.

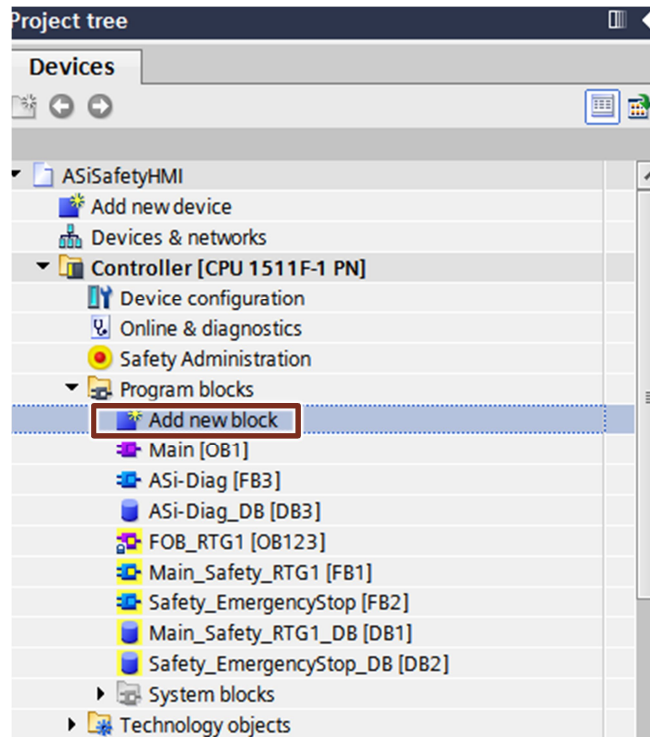
Now all of the modules should be green.

## 3 Programming

### 3.1 Create F Block

In the project tree you double-click the "Add new block" entry in the "Program blocks" folder of the CPU. The "Add new block" dialog opens.

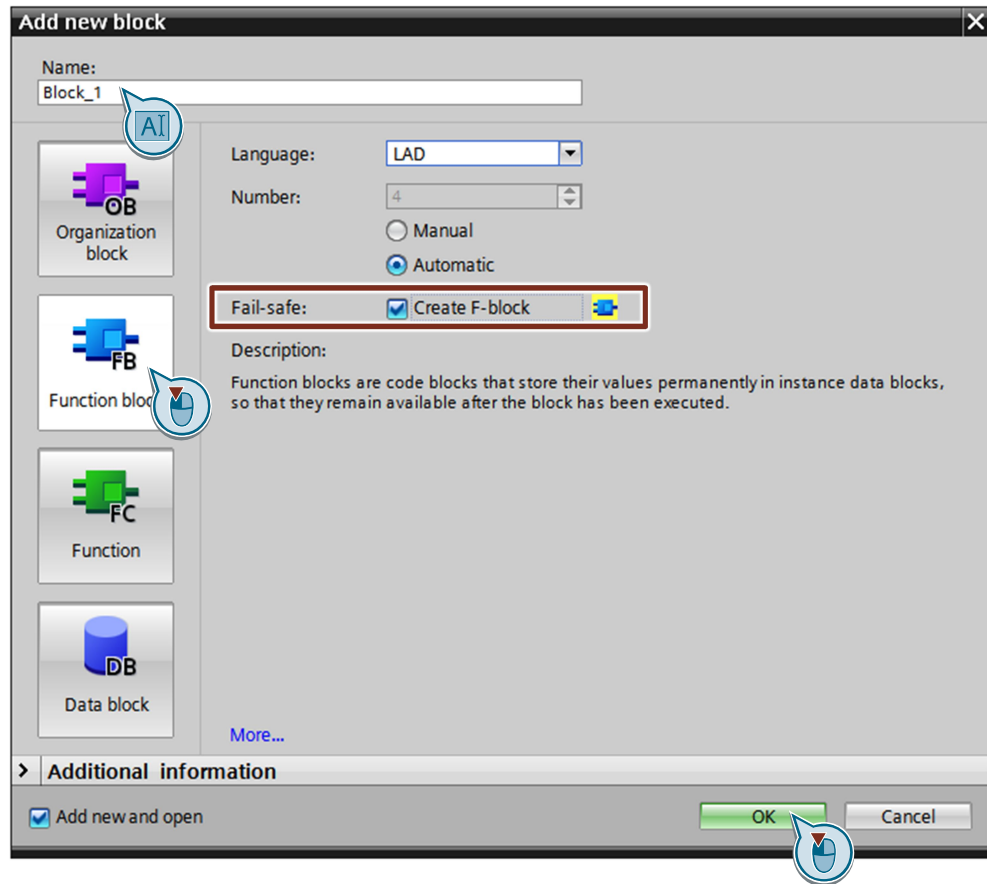
Figure 3-1



In the "Add new block" dialog you make the following settings.

- Click the "Function block" button.
- Enable the "Create F-block" option.
- Enter a name for the F-block.
- Click the "OK" button. The F-block is created.

Figure 3-2



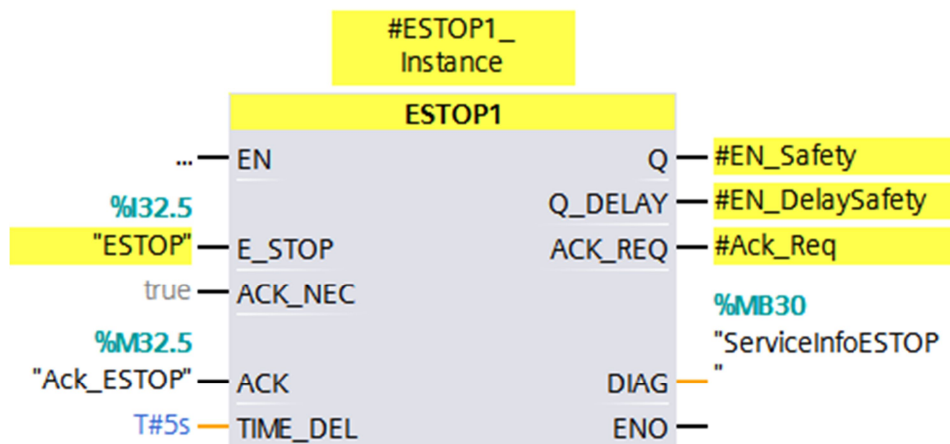
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## 3.2 Implement Emergency Stop Switch-Off

### Call of the "ESTOP1" instruction

The "ESTOP1" instruction is called in the F-block. The instruction does an Emergency Stop switch-off with acknowledgment for stop categories 0 and 1.

Figure 3-3



### Input parameters

[Table 3-1](#) shows the input parameters of the "ESTOP1" instruction.

Table 3-1

Input parameters	Data type	Description
E_STOP	BOOLEAN	Emergency Stop
ACK_NEC	BOOLEAN	1=Acknowledgment required
ACK	BOOLEAN	1=Acknowledgment
TIME_DEL	TIME	Delay time

### Output parameters

[Table 3-2](#) shows the output parameters of the "ESTOP1" instruction.

Table 3-2

Output parameters	Data type	Description
Q	BOOLEAN	1=Enable
Q_DELAY	BOOLEAN	Enable delayed switch-off
ACK_REQ	BOOLEAN	1=Acknowledgment required
DIAG	BYTE	Service data

### Function

In normal operation the Emergency Stop button is not pressed, in other words the E\_STOP input parameter is 1, so that the output parameters Q and Q\_DELAY are set to 1 and the output parameter ACK\_REQ is set to 0 (enable and no acknowledgment required).

If the Emergency Stop button is pressed, the E\_STOP input parameter is set to 0 so that the output parameter Q is reset to 0 (immediate emergency switch-off). The output parameter Q-DELAY is reset to 0 only after expiry of the delay time TIME\_DEL (delayed emergency switch-off).

When the Emergency Stop button is released again, the output parameters Q and Q\_DELAY remain at 0 (no enable). The output parameter ACK\_REQ is set to 1 (acknowledgment required). Normal operation resumes only when the input parameter ACK is set to 1 (acknowledgment).

## 3.3 Diagnostics of the AS-i Bus System

The operating status of the AS-i master, the connected AS-i network and the AS-i slaves is stored as diagnostics data record DS92 in CM AS-i Master module. In the user program of the CPU you use the instruction RDREC to read out the data record DS92.

A description of the data record DS92 is available in the CM AS-i Master manual, section 8.9 "Data Records for Diagnostics" at this link:

<https://support.industry.siemens.com/cs/ww/en/view/71756485>

## 4 Visualization

The modules that have to be acknowledged are displayed on the SIMATIC Panel:

- F-DO
- F-CM AS-i Safety
- Emergency Stop button

The modules below are acknowledged by the corresponding button on the SIMATIC Panel.

- Click the "ACK F-DO" button to acknowledge the safe output A32.0 of the safe relay.
- Click the "ACK F-CM" button to re-introduce the F-CM AS-i Safety.
- Click the "ACK ESTOP" button to acknowledge the Emergency Stop switch-off.

If you click the "ACK Global" button, you trigger a global acknowledgment.

In addition the status of the configured AS-i slaves is displayed.

- Active (green)
- Failure (red)

Figure 4-1

