



System Manual

Starter kit for ecomatController

EC2121

CODESYS Version 3.5 or higher

English

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1 About this manual

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1.1 Legal and copyright information

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1.2 Explanation of Symbols

34171



WARNING

Warning of serious personal injury.
Death or serious irreversible injuries may result.



CAUTION

Warning of personal injury.
Slight reversible injuries may result.



NOTICE

Warning of damage to property



Important note
Non-compliance can result in malfunction or interference



Information
Supplementary note



... Request for action



... Reaction, result



... "see"

abc

Cross-reference

123

Decimal number

0x123

Hexadecimal number

0b010

Binary number

[...]

Designation of pushbuttons, buttons or indications

1.3 Purpose of the document

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These instructions describe how to prepare and program a controller of the device family for mobile applications, ecomatmobile from ifm electronic gmbh, using the CR711S controller as example.

These instructions are intended for the operation in conjunction with the starter kit EC2121; it can, however, also be used independently.

This document will be continuously updated.

The current version is available for download on the ifm website: → www.ifm.com

1.4 Required previous knowledge

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This manual addresses people with basic knowledge in automation technology. Experience in PLC technology and basic knowledge in Ethernet networks are useful.

1.5 Required software

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To reproduce the descriptions in this manual, the following software components are required:

- UpdateTool
- Programming software CODESYS 3.5
- Controller-specific packages for CODESYS 3.5

The software versions referred to in this manual are on the USB flash drive supplied with the starter kit.

The current software versions are available for download on the ifm website: → www.ifm.com

1.6 Overview: User documentation for EC2121

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The documentation of the starter kit consists of the following modules:

Document	Content/Description
Data sheet EC2121	Technical data of the starter kit
Data sheet CR711S	Technical data of the controller
System manual starter kit for ecomatController	Step-by-step explanations how to prepare and program a PLC CR711S
Original operating instructions	▪ Instructions for installation, electrical installation and commissioning ▪ Technical data
Programming manual	▪ Functions of the set-up menu of the device ▪ Creation of a CODESYS project with this device ▪ Target system configuration with CODESYS ▪ Programming the device-internal PLC using CODESYS ▪ Description of the device-specific CODESYS function libraries

If any documents are not available, they can be requested from ifm or can be downloaded from the ifm website: → www.ifm.com

1.7 Overview: documentation for CODESYS 3.n

54178

3S-Smart Software Solutions GmbH (→ www.codesys.com) offers the following user documentation to program the device using CODESYS:

Document	Content / Description
Online help	- Context-sensitive help - Description of the CODESYS programming system After the programming system is installed, the following is stored and accessible on the hard disk of the PC/laptop: ... \Programme (x86) \3S CODESYS \CODESYS \Online Help ! The online help is for programming the standard PLC. The CODESYS online help only applies to the safety PLC with restrictions. ► Please read this programming manual when programming the safety PLC.
CODESYS installation and first steps	- Remarks about the installation of the programming system CODESYS - First steps for handling the CODESYS programming system After the installation of the programming system stored and accessible on the hard disk of the PC/laptop: ... \Programme (x86) \3S CODESYS \CODESYS \Documentation
CODESYS user manual Safety SIL2	[H2] CODESYS Safety SIL2 - IEC Programming Guidelines.pdf This document is for programmers who program safety-related controllers. ! The CODESYS user manual only applies to the safety PLC with restrictions. ► Please observe this programming manual when programming the safety PLC.

If any documents are not available, they can be requested from ifm or can be downloaded from the ifm website:

→ www.ifm.com

1.8 Change history

57256

Date	State	Change
11 / 2019	00	Creation of the document.

2 Prepare the controller

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Check and update OS version	12

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2.1 Hardware installation

57258

Connect the 81-pole AMP connector to the controller:

- ▶ Pull out the locking slide on the connector until the end stop.
- ▶ Attach the connector to the controller and click home.
- ▶ Insert the slide to lock the connector on the controller.
- > The AMP connector is connected to the controller.

Connect the voltage supply via an external voltage source 24 V DC (not supplied):

- ▶ Connect the voltage source to both 4 mm lab sockets on the prewired connection cable:
 - plus pole - red
 - minus pole - black
- > The LEDs SYS0 and SYS1 are on or flash green.



If one of the LEDs SYS0 or SYS1 is permanently on in red, there is a hardware fault or system fault (→ Data sheet CR711S > Operating states of the system).

2.2 Install UpdateTool on the PC

57259

To install the UpdateTool_Vn.n.n.n on the PC:

- ▶ Copy the folder x:\ecomatController\UpdateTool_Vn.n.n.n from the supplied USB flash drive to the PC.



The user must have write access in the target directory.
The directory path must not contain any blanks.



Recommendation: Copy the UpdateTool to the desktop or the project folder.

2.3 Establish a connection between the controller and the PC via Ethernet.

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2.3.1 Connect the controller and the PC

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To connect the controller to the PC:

- ▶ Connect the supplied network cable (Ethernet cable) to:
 - the interface ETH0 of the controller
 - the Ethernet interface of the PC
- > The controller and PC are connected to the network cable.

2.3.2 Check and set the network settings of the PC

57262

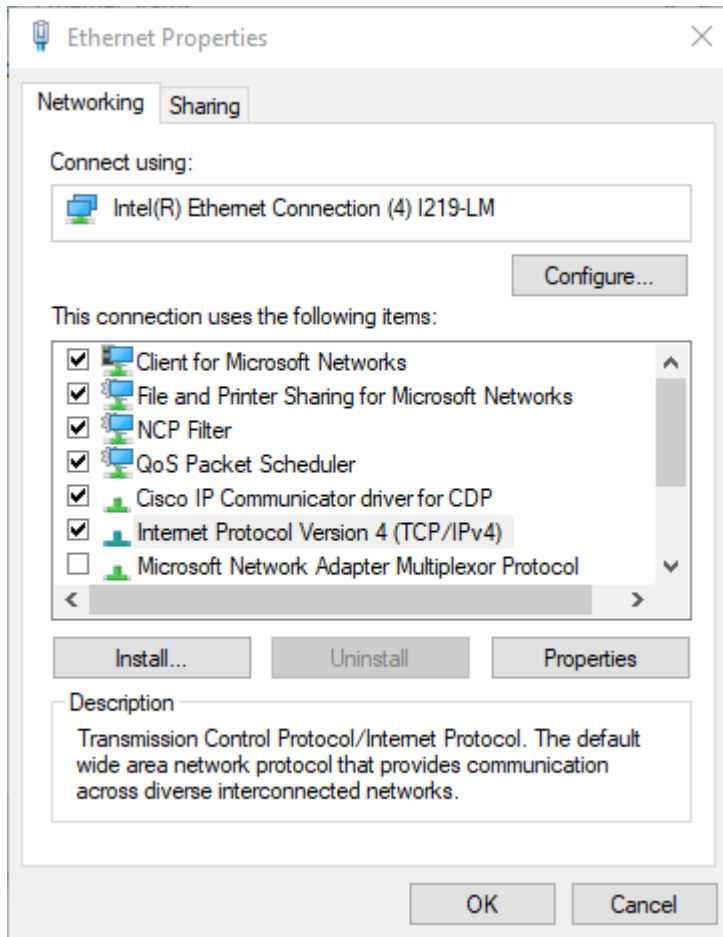


Changes in the network settings of the PC require extended user rights.
Contact your system administrator.

To check and, if necessary, set the network settings of the PC:

- ▶ Switch on the PC.

- ▶ Activate the Windows menu [Internet Protocol Properties Version 4 (TCP/IPv4: for example [Start] > right click > [Network Connections] > [Ethernet] > [Change adapter settings] > [Ethernet] > right click > [Properties] (→ Figure below)



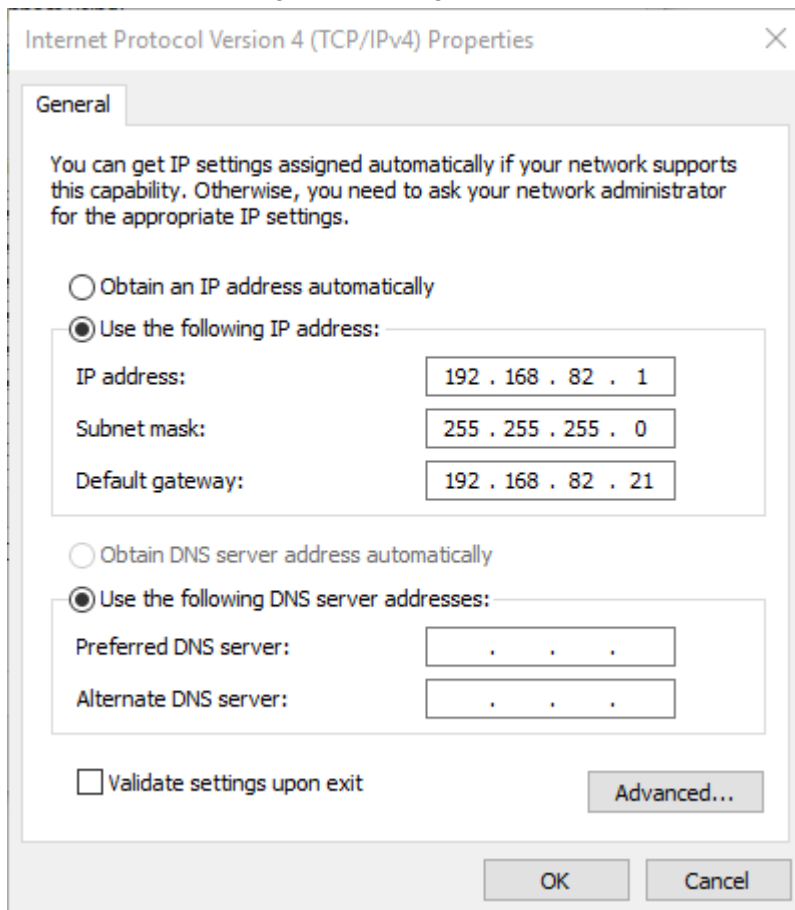
- ▶ Click the [Properties] button.
- ▶ Select the menu item [Use the following IP address].
- ▶ Check the IP address on 192.168.82.xxx and set, if necessary.



The following addresses are already used and must not be used for the PC:
192.168.82.21 (gateway), 192.168.82.247 (controller)

- ▶ Enter the subnet mask (255.255.255.0).
- ▶ Enter the default gateway (192.168.82.21) (→ Figure below).
- ▶ Confirm the settings with [OK].

> The network settings were changed.



Summary of the network settings:

Setting	Value
Internet protocol	TCP/IP
IP address	192.168.82.xxx (except .21 and .247)
Subnet mask	255.255.255.0
Gateway IP address	192.168.82.21

2.3.3 Test connection between the controller and PC

57263

The connection can be tested with the UpdateTool.

NOTE!

If the instructions on the screen are not complied with,

> the controller may be damaged.

► Strictly follow the instructions on the screen during the entire update process.

► Start Update.bat in the folder of the UpdateTool.

- Confirm with [Enter] twice.
- > The menu appears.

```

C:\WINDOWS\system32\cmd.exe

=====
ecomatController Update Start Menu
UpdateTool Version: V3.0.0.3-2
=====

For the update this script connects to the device over ethernet.
The installation path of the script must not contain blanks.
If the device has another IP address than 192.168.82.247
use "set connection ip-address of device" to configure the script
for the IP address of the device.

Set connection ip address of device ..... 1
Ping device ..... 2

Set authentication ..... 3

Continue update process ..... 4
Application features ..... 5
Utilities ..... 6
Quit program ..... q

Insert your choice and press ENTER to continue:
  
```

- Select menu item [Ping device] by entering [2] and confirming with [Enter].
- > The ping replies are displayed. When the ping replies are displayed as shown in the figure, the connection is OK.

```

C:\WINDOWS\system32\cmd.exe

Ping device 192.168.82.247...

C:\Users\usthamwo\Desktop\Mobile\V3.5\ecomatController\ifm_UpdateTool_V3003_2>ping 192.168.82.247

Pinging 192.168.82.247 with 32 bytes of data:
Reply from 192.168.82.247: bytes=32 time<1ms TTL=64
Reply from 192.168.82.247: bytes=32 time<1ms TTL=64
Reply from 192.168.82.247: bytes=32 time<1ms TTL=64
Reply from 192.168.82.247: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.82.247:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

Press ENTER to return to menu:
  
```

- Return to the menu with [Enter].

From the menu, the next step can be taken: → **Check and update OS version** (→ p. [12](#))

2.4 Check and update OS version

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The OS version of the device can be checked and updated with the UpdateTool.

Check OS version:

- In the menu of the UpdateTool, select the menu item [Continue update process] by entering [4] and confirming with [ENTER].
- > After a short time, information about the current controller and the update menu (→ figure) appear in the window.

```

C:\WINDOWS\system32\cmd.exe
=====
ecomatController Update Menu
UpdateTool Version: V3.0.0.3-2   Authentication as: No Authentication
=====
current device IP: 192.168.82.247
current device   : CR0711, V1.0.4.2, SN000005387318
current software : V2.9.0.2
=====

Read device information..... 1
Ping device ..... 2
List compatibility ..... 3
Set authentication ..... 4

Recover default memory config ..... 5
Write comconf.cfg to device ..... 6
Write iomapping.cfg to device ..... 7
Delete both applications ..... 8

Update V2.8.2.3 ..... 9
Update V2.8.3.2 ..... 10
Update V2.9.0.2 ..... 11
Update V3.0.0.2 ..... 12
Update V3.0.0.3 ..... 13

Back to the start menu ..... q

Insert Update Step: 13

```

The figure shows that OS version 2.9.0.2 is on the controller. Now an update to version 3.0.0.3 is to be made

NOTE!

If the instructions on the screen are not complied with,

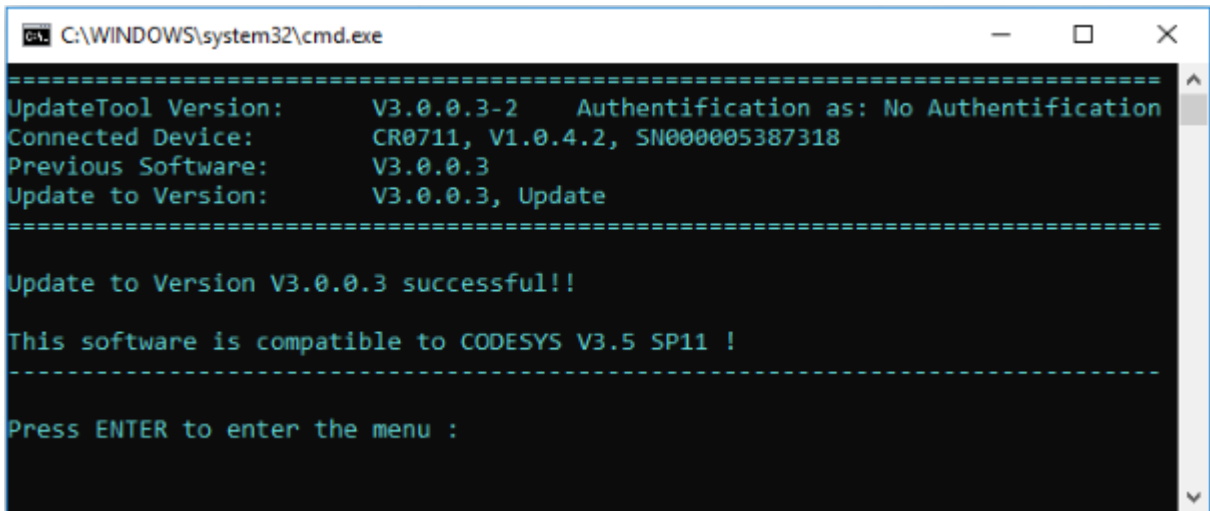
> the controller may be damaged.

- Strictly follow the instructions on the screen during the entire update process.

Update OS version:

- To start the update process, select menu item update V3.0.0.3 by entering [13] and confirming with [Enter].

- > The update process starts. During the update process, various messages appear; to conclude, the following success message is displayed:



```
C:\WINDOWS\system32\cmd.exe

=====
UpdateTool Version:      V3.0.0.3-2    Authentication as: No Authentication
Connected Device:       CR0711, V1.0.4.2, SN000005387318
Previous Software:      V3.0.0.3
Update to Version:      V3.0.0.3, Update
=====

Update to Version V3.0.0.3 successful!!

This software is compatible to CODESYS V3.5 SP11 !
-----

Press ENTER to enter the menu :
```

- Exit the UpdateTool with [Enter] and twice [q].

3 Installation

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3.1 Prepare installation

57267



The major part of the required software is on the supplied USB flash drive.

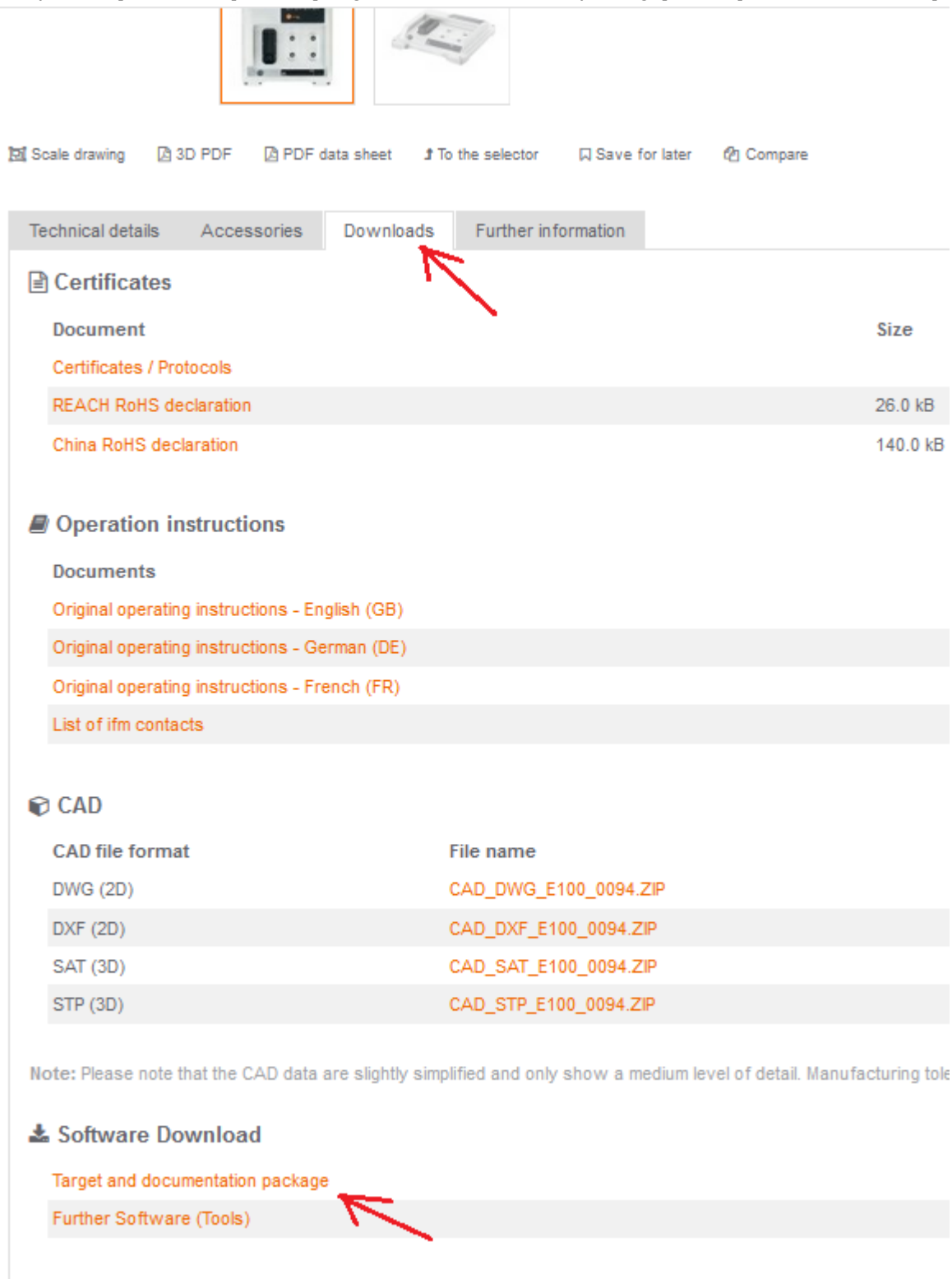
Since the used controller can also be used for applications with functional safety, it is necessary for legal reasons that you download the controller-specific packages directly from ifm's website.

In this way, you are registered as customer of this controller and will be automatically informed in the event of changes (e.g. to the firmware or documentation).

Download the packages from ifm's website:

- → www.ifm.com > selection of your country > CR711S [Search] > select product page of CR711S from the search results

- Open tab [Downloads] > click [Target and documentation package] under [Software Download]



Scale drawing 3D PDF PDF data sheet To the selector Save for later Compare

Technical details Accessories **Downloads** Further information

Certificates

Document	Size
Certificates / Protocols	
REACH RoHS declaration	26.0 kB
China RoHS declaration	140.0 kB

Operation instructions

Documents

- Original operating instructions - English (GB)
- Original operating instructions - German (DE)
- Original operating instructions - French (FR)
- List of ifm contacts

CAD

CAD file format	File name
DWG (2D)	CAD_DWG_E100_0094.ZIP
DXF (2D)	CAD_DXF_E100_0094.ZIP
SAT (3D)	CAD_SAT_E100_0094.ZIP
STP (3D)	CAD_STP_E100_0094.ZIP

Note: Please note that the CAD data are slightly simplified and only show a medium level of detail. Manufacturing tolerance is not guaranteed.

Software Download

- Target and documentation package
- Further Software (Tools)

- > Login page for my ifm appears
- Log in to my ifm.



If you do not have your my ifm- access data, you have to register as customer beforehand.

- > The website to download safety operating systems is displayed.
- Download the package for [CR711S (Version V3.0.0.3)] and save it on your PC.



3.2 Carry out installation

57268

The CODESYS Development System (short: CODESYS) is a platform for the creation of PLC applications according to the standard IEC 61131-3.

3.2.1 Install the programming software CODESYS 3.5

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Administrator rights are required for the installation on the PC.



On the supplied USB flash drive you find the 32-bit version of CODESYS since its use is compulsory.

To install the programming software CODESYS 3.5:

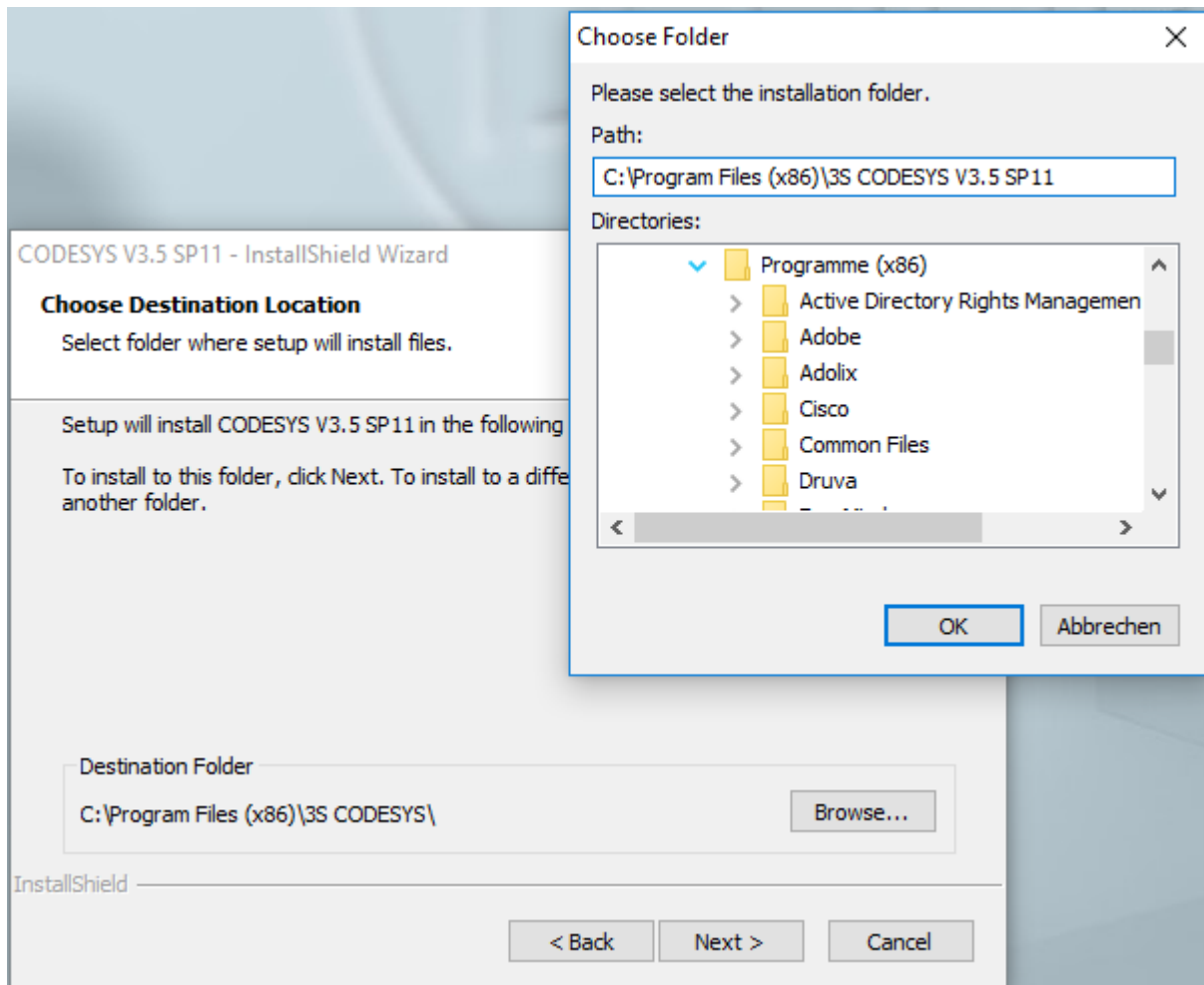
- Start the installation program Setup_CODESYS<Version>.exe in the main directory on the supplied USB flash drive.
- > The window to select the installation directory [Choose Destination Location] appears.



For parallel installation of several different CODESYS versions on the PC, the installation directory has to be adapted accordingly.

- > Click the [Browse...] button.
- > The window to enter the installation directory [Choose Folder] appears.

- Change the installation path in C:\Program Files (x86)\3S CODESYS V3.5 SP11 and confirm with [OK].



- Activate the [Next >] button to continue the installation.
- > The installation wizard will guide you through the installation. It is recommended to apply the default settings during further installation.

3.3 Start CODESYS 3.5

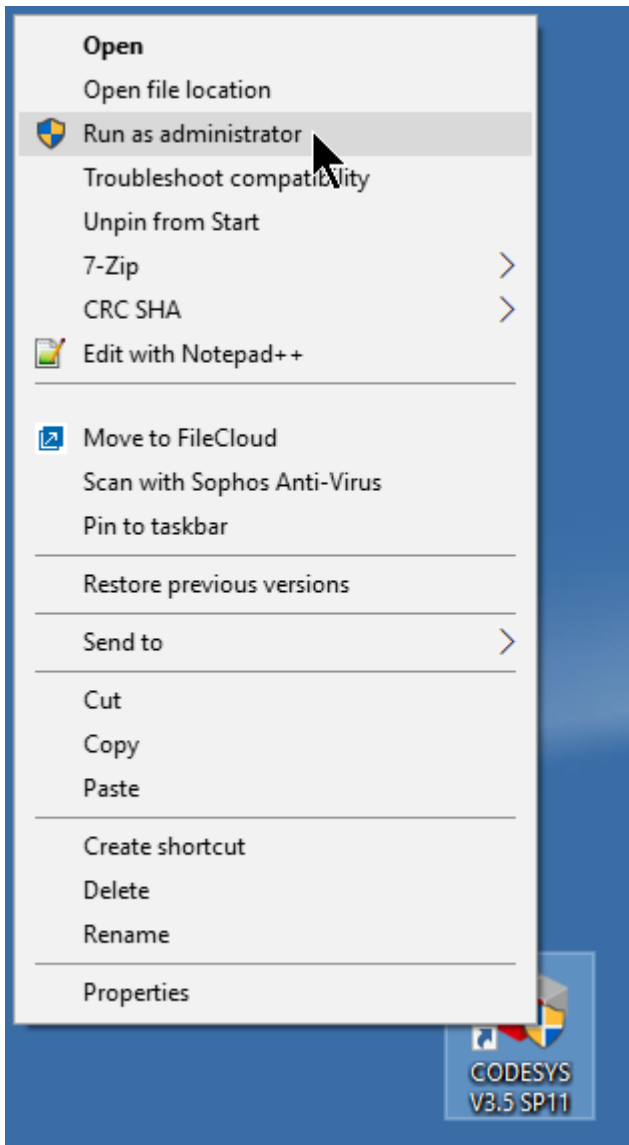
57270



Administrator rights are required to install the packages on the PC.

After the first program start, the packages belonging to the controller have to be installed.

- Start CODESYS as admin with: desktop symbol [CODESYS V3.5 SP11] > (right click) > [Run as administrator].



- > CODESYS starts.
- > CODESYS user interface appears.

3.4 Install packages

57271

- ▶ Install the following packages in the indicated order:
 1. Package of the controller (ifm_R360-3_Vn.n.n.n.package)
 2. Safety SIL2 package from 3S (3S_CODESYS_Safety_SIL2_Vn.n.n.n.package)
 3. Safety SIL2 extension package from ifm
(ifm_R360-3_CODESYS_Safety_SIL2_Extensions_V0.0.0.6.package)

3.4.1 Start the package manager

57272

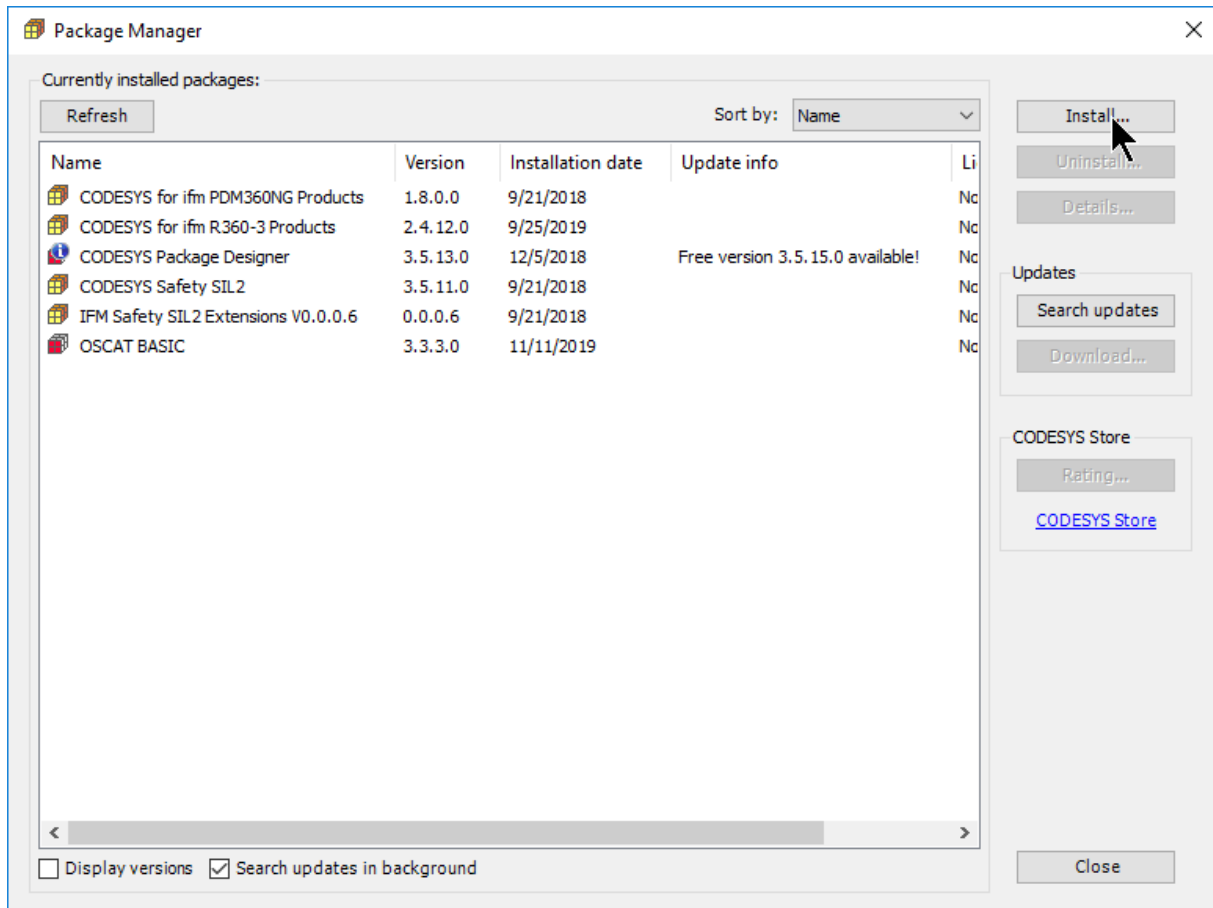
- ▶ Select [Tools] > [Package Manager] to start the package manager.
- > Package manager appears.
- > Window shows installed packages.

3.4.2 Install packages with the package manager

Install packages:

- ▶ Click [Install...].
- > The file explorer appears.
- ▶ Select the file ifm_R360-3_Vn.n.n.n.package from the directory
x:\ifm_CR711S_Vn.n.n.n\CODESYS_Package of the supplied USB flash drive and [Open].
- ▶ Acknowledge the licence agreement.
- ▶ Select [Complete Setup].
- ▶ Confirm the message [The package has been successfully installed. [...]] with [Exit].
- > The [Package Manager] window shows the installed package.
- ▶ Repeat the installation process for the packages 3S_CODESYS_Safety_SIL2_Vn.n.n.n.package and ifm_R360-3_CODESYS_Safety_SIL2_Extensions_V0.0.0.6.package in the directory
x:\ifm_CR711S_Vn.n.n.n\CODESYS_Package\PlugIn.

> To conclude, the package manager shows all installed packages.



► Click [Close] to quit the package manager.

To complete the installation of the packages, CODESYS has to be restarted.

- Exit CODESYS.
- Restart CODESYS by double-clicking on the desktop symbol [CODESYS V3.5 SP11].
- > The installed packages are now available.
- > Done: The conditions for programming are now met.

Basics of programmable logic controllers: → **Features of a PLC** (→ p. [22](#))

or continue to programming: → **A first program** (→ p. [24](#))

4 Features of a PLC

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Time response	23

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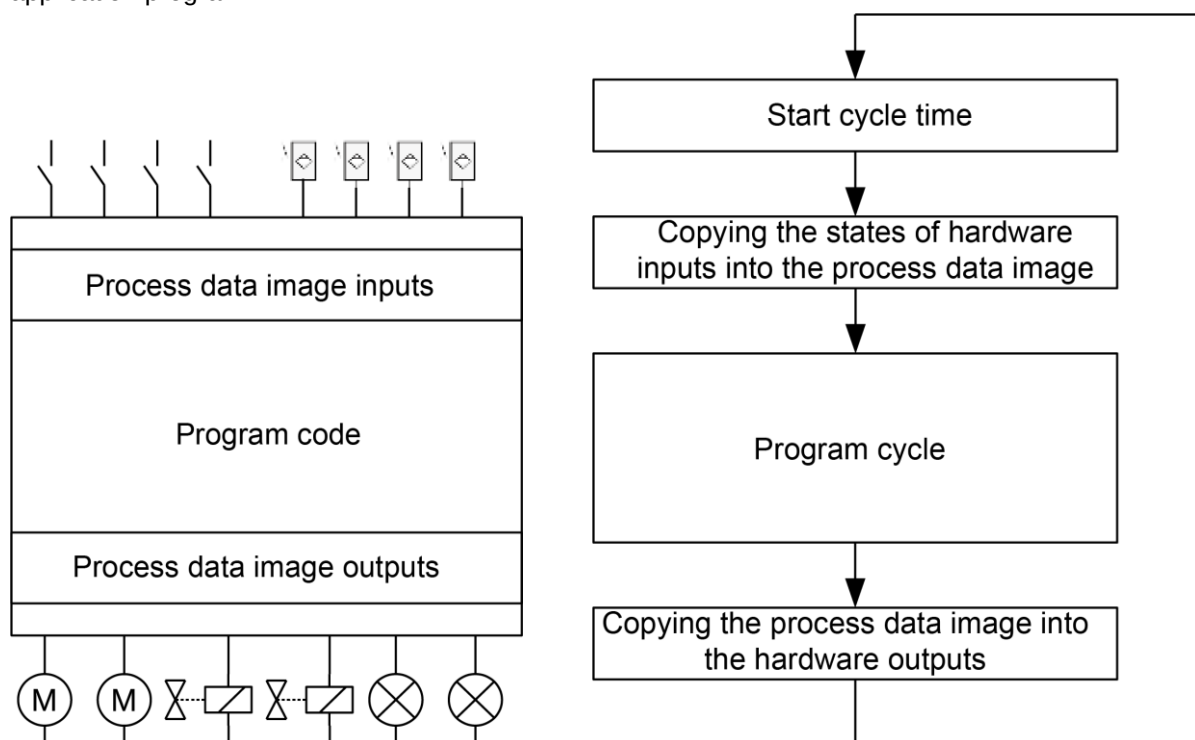
This chapter describes some basics of programmable logic controllers. Should you have some knowledge of the operation of a PLC, you can skip this chapter.

4.1 Cyclical program processing

57275

Characteristic of PLC systems is the cyclical program processing, i.e. after processing of the application program, processing is automatically started from the beginning.

This ensures that the input signals are read continuously. Changes are found and considered in the application program.



If input signals of the switches and sensors change during processing of the application program, this may lead to incorrect results for the output signals. Therefore the input signals are copied to a clipboard (process image of the inputs - PII) at the beginning of the cycle.

The application program then only works with the signals from the PII when the inputs are read. The results for the outputs are also written to the clipboard (process image of the outputs - PIO) during processing.

When processing of the application program is completed (end of cycle), the signals are transferred from the PIO to the outputs and the actuators switch accordingly.

4.2 Time response

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4.2.1 Cycle time

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The time a controller needs for one cycle is called cycle time.

Typically, this time is in the ms range.

The cycle time is also the time an input signal has to be present to be reliably detected by the controller.

If a signal is shorter, it depends on whether it happens to come at that point of time at which the inputs are read. Only then will it be recognised.

With the ecomatController, the cycle time is determined by the configuration of the tasks.



It is recommended to define as few tasks as possible.

That means, usually one task is sufficient. You may need a second task for a bus system.

4.2.2 Watchdog

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A PLC monitors itself if the cycle is correctly processed. The case that a program cycle is not complete is dangerous. Then no inputs are read. A change of the state on the input, e.g. "limit switch reached" cannot be processed.

The status of the output cannot change, e.g. the drive keeps on running although the limit switch has been reached.

The watchdog function exists to avoid such states. If the end of the cycle has not been reached within a certain time which is started with each new cycle, the watchdog becomes active. The controller is stopped and the outputs are disconnected.

What can cause such an event?

1. Hardware error

If a processor fails, for example, the controller must pass into a safe state.

2. Program error

If loops or jumps are used in programming, it is possible that processing takes too long or in the worst case a closed loop leads to the situation that the end of the cycle cannot be reached.

4.2.3 Response time

57279

This value is often used to characterise the time response of a PLC.

This is the time that elapses from a change of an input signal to the corresponding response of the output.

If an input signal changes only shortly after the PII has been written and is therefore not copied to the PII before the following cycle, the output signal changes after two cycles.

In the worst case, the response time = 2 * cycle time.

5 A first program

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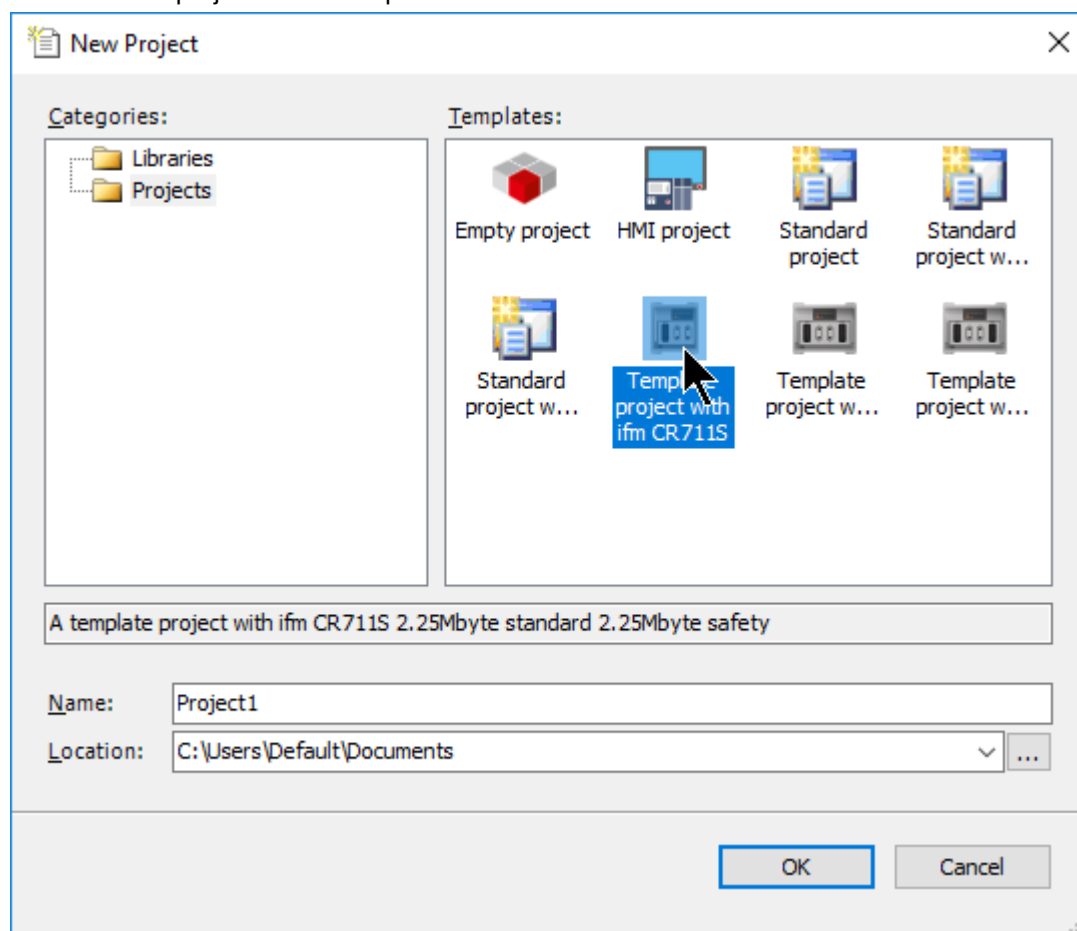
57280

When all packages have been installed, a first program for test purposes should be written.

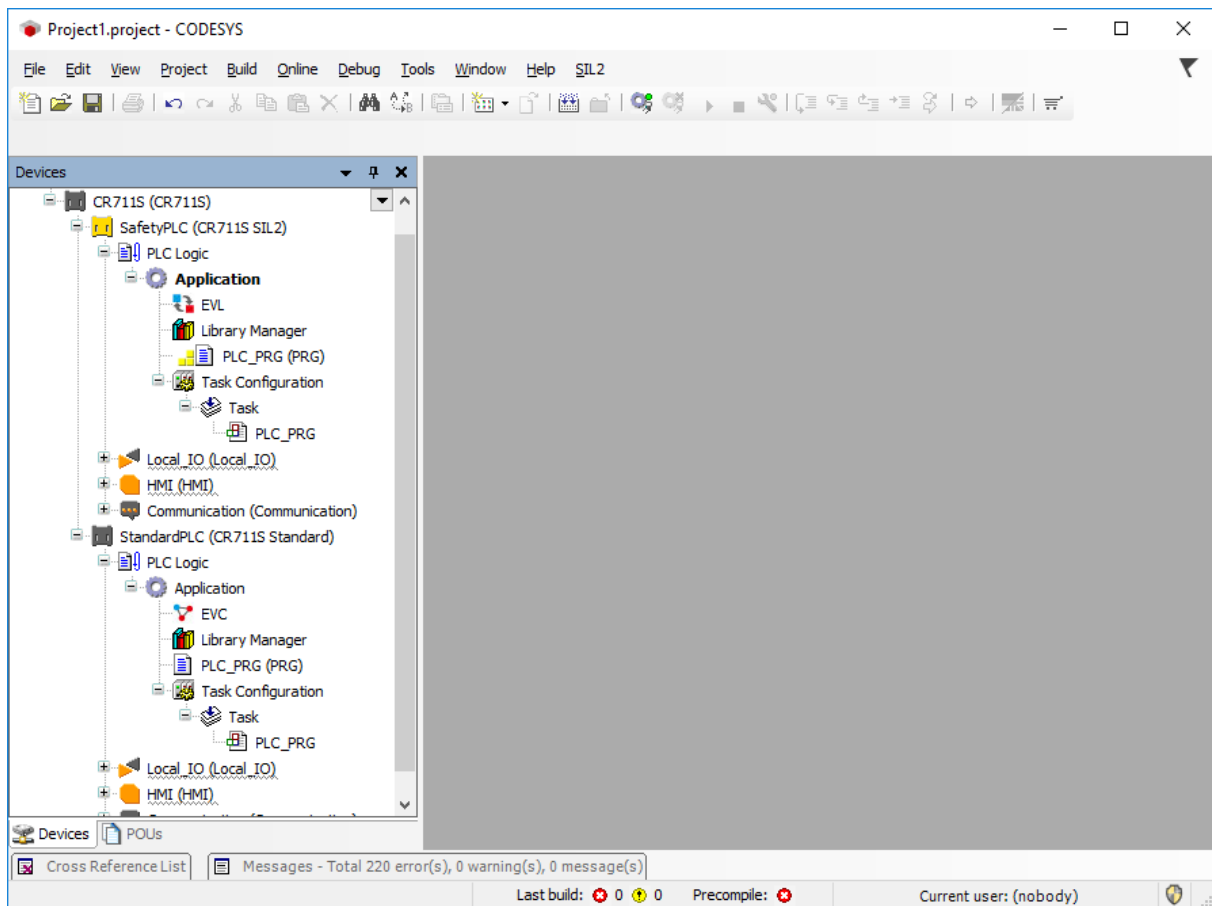
To do so, a new project is created with [New project...] when CODESYS has been started.

ifm provides one template each for every controller. The basic elements and configurations in these basic projects are already prepared.

Create a new project with a template:



- ▶ Select [Template project with ifm CR711S].
- ▶ Enter file name [Name: Project01].
- ▶ Select the target folder [location: ... \Dokumente\CODESYS 3\Starter kit EC2121].
- > CODESYS opens the template for the controller CR711S. This is an unprepared project in which hardware-specific settings have already been made.

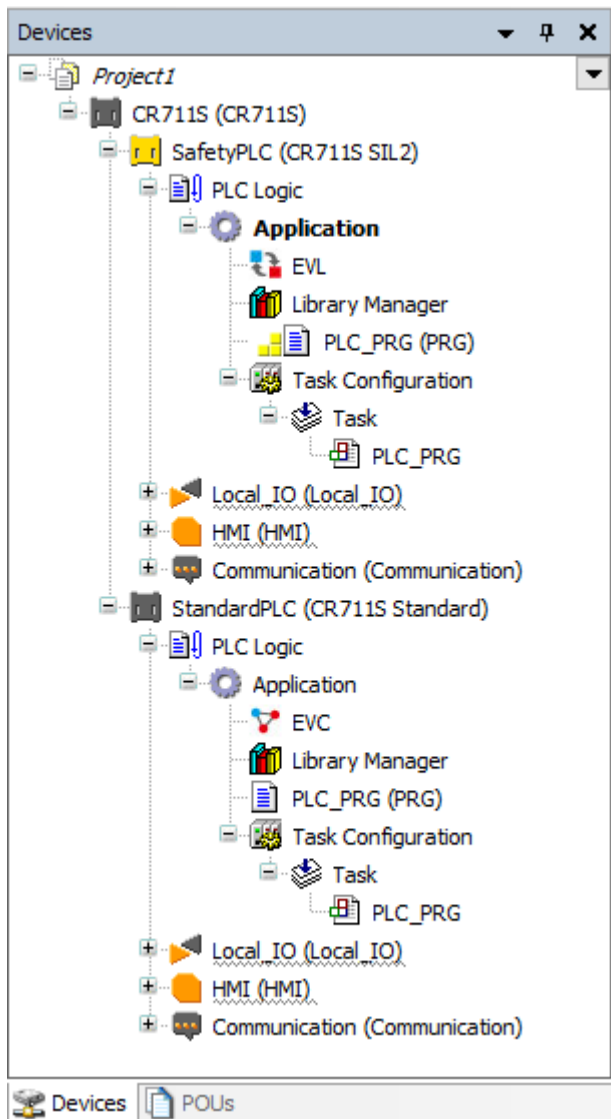


When a new project is created via [Empty project], the hardware-specific settings have to be made manually.

5.1 Device tree

On the left side of the CODESYS project view, there is the device tree. It contains all components for the configuration, administration and programming of the controller.

The structure can be seen in the figure:



The main elements are described as follows:

Element	Description
CR711S (CR711S)	Logical father controller, provides access to the general settings of CR711S.
SafetyPLC (CR711S SIL2)	Contents of the SafetyPLC, provides access to the contents of the safety controller.
StandardPLC (CR711S Standard)	Contents of the StandardPLC, provides access to the contents of the standard controller.
PLC logic	Contains the application of the respective controller.
Local_IO (Local IO)	Provides access to the configuration options of the inputs and outputs.
HMI (HMI)	Provides access to the configuration options of the operating and display elements.
Communication (Communication)	Provides access to configuration options of the communication interfaces.

The ecomatController devices contain two independent programmable logic controllers:

- StandardPLC (CR711S standard)
- SafetyPLC (CR711S SIL2)

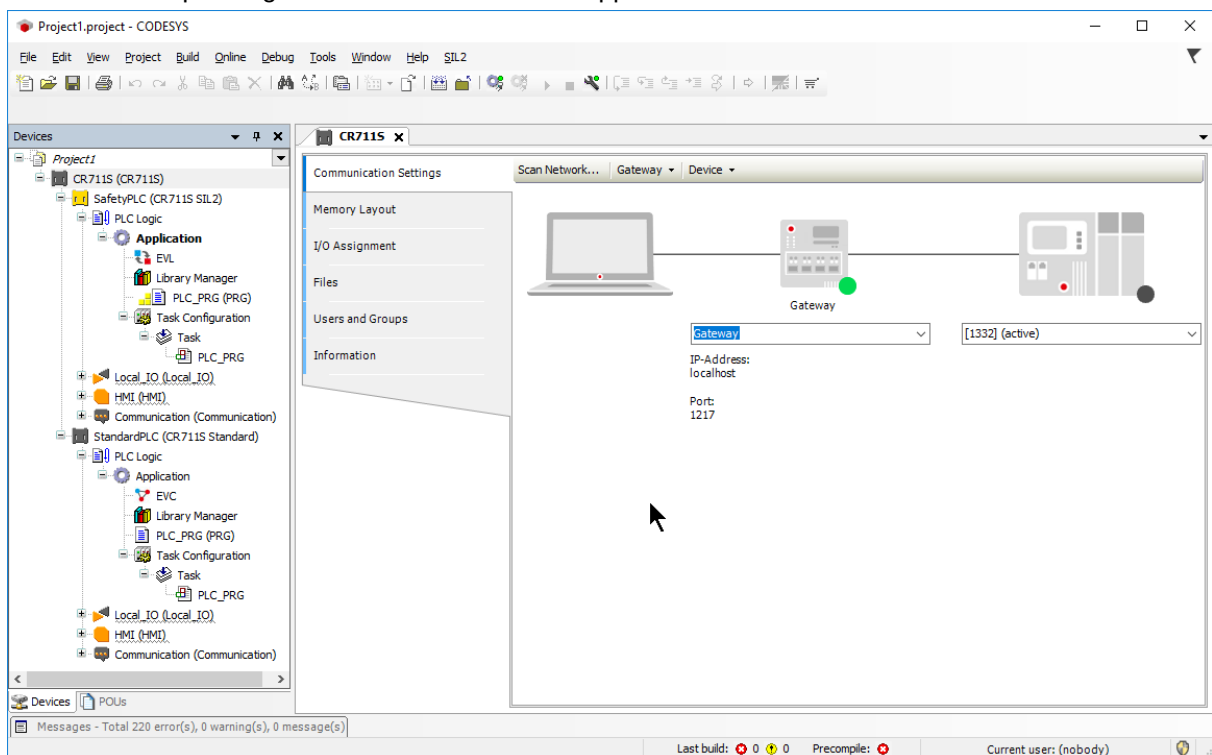
For this first introduction, only the StandardPLC is used. The distribution of the resources (e.g. memory) to the two controllers does not have to be taken into account here.

5.2 Connect to the device

57282

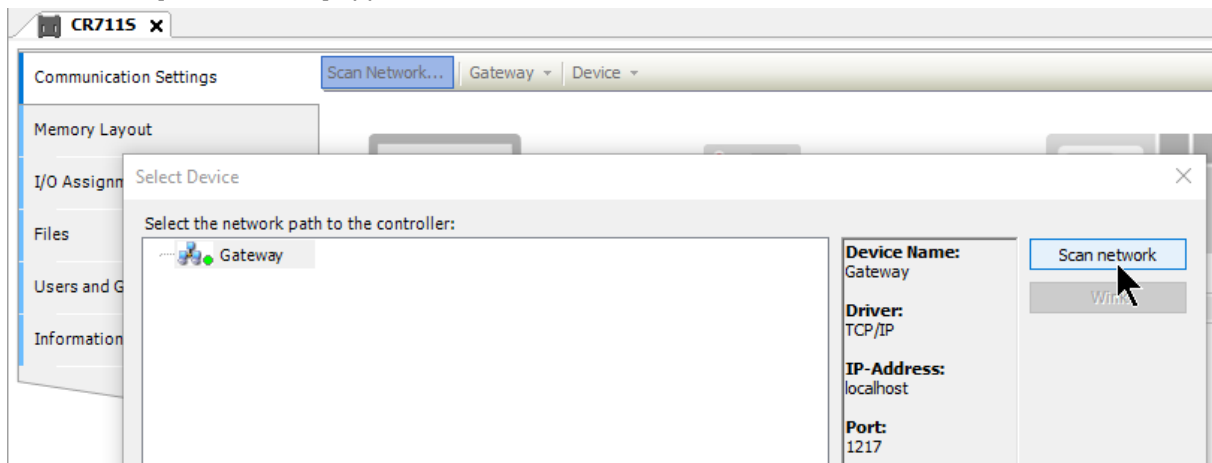
First of all, check the connection to the controller:

- In the device tree: Double-click on the controller [CR711S (CR711S)].
- > The corresponding detailed view of CR711S appears.



- Select tab [Communication Settings].
- Click [Scan network...].

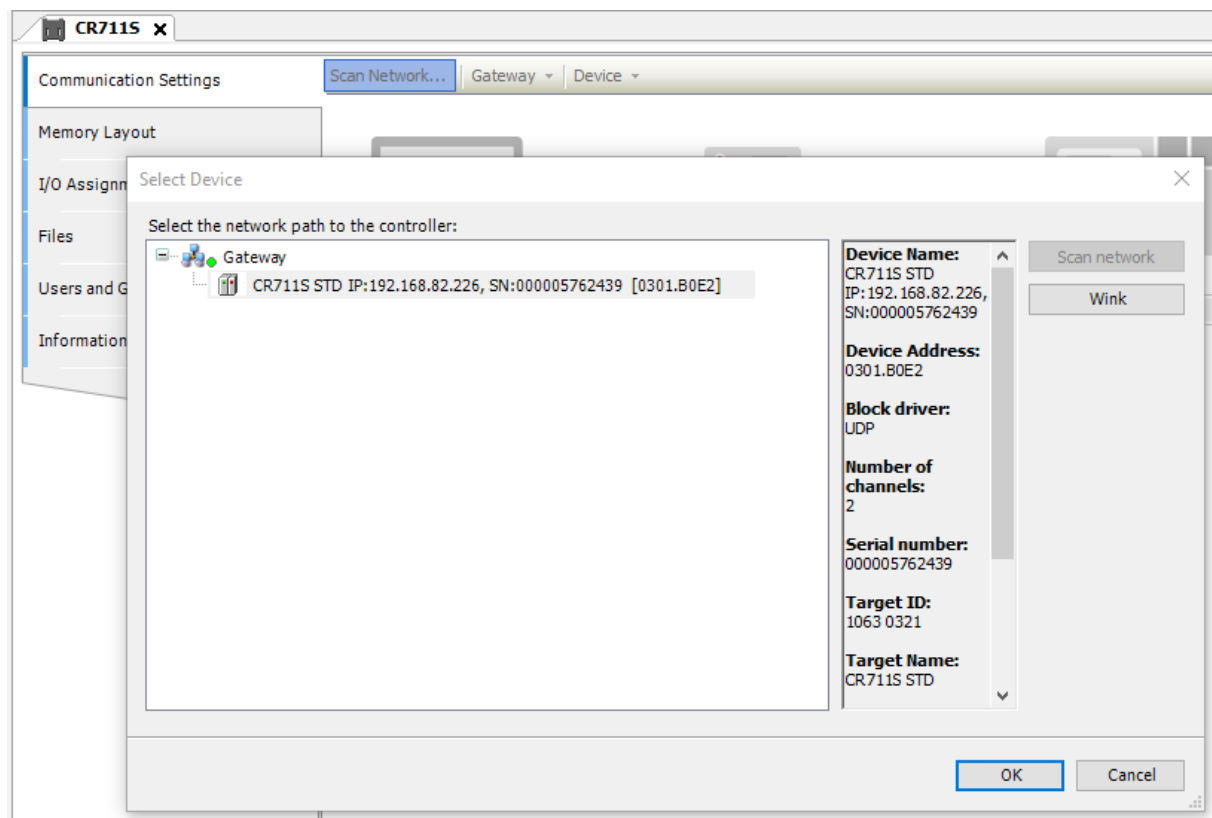
- Window [Select device] appears.



- Select [Gateway-1] on the left and search for the controller by clicking the [Scan network] button.
- > The controller appears below the gateway.

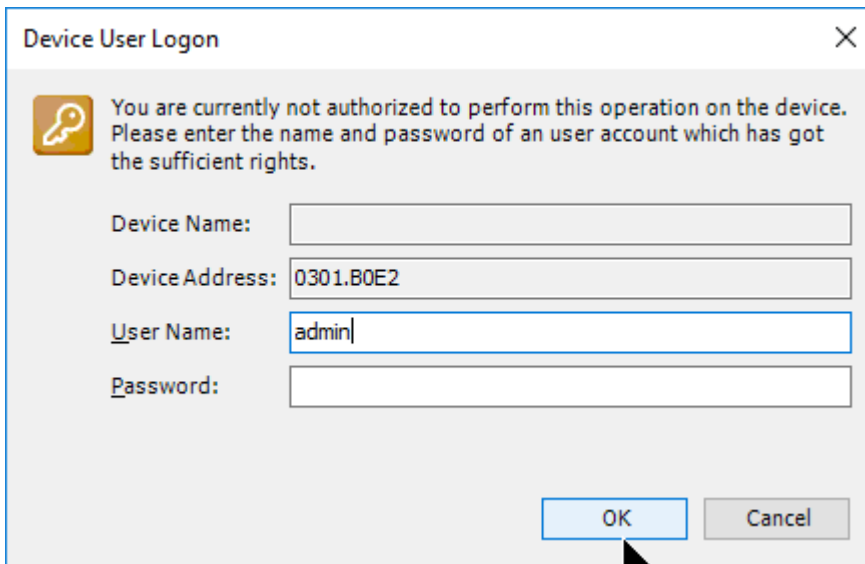


It is possible that the function [Scan network] has to be executed twice.



- Select the controller and click [OK].
- > The window [Device User Logon] appears.

- Enter user name admin and no password and confirm with [OK].



Device User Logon [X]

 You are currently not authorized to perform this operation on the device. Please enter the name and password of an user account which has got the sufficient rights.

Device Name:

Device Address:

User Name:

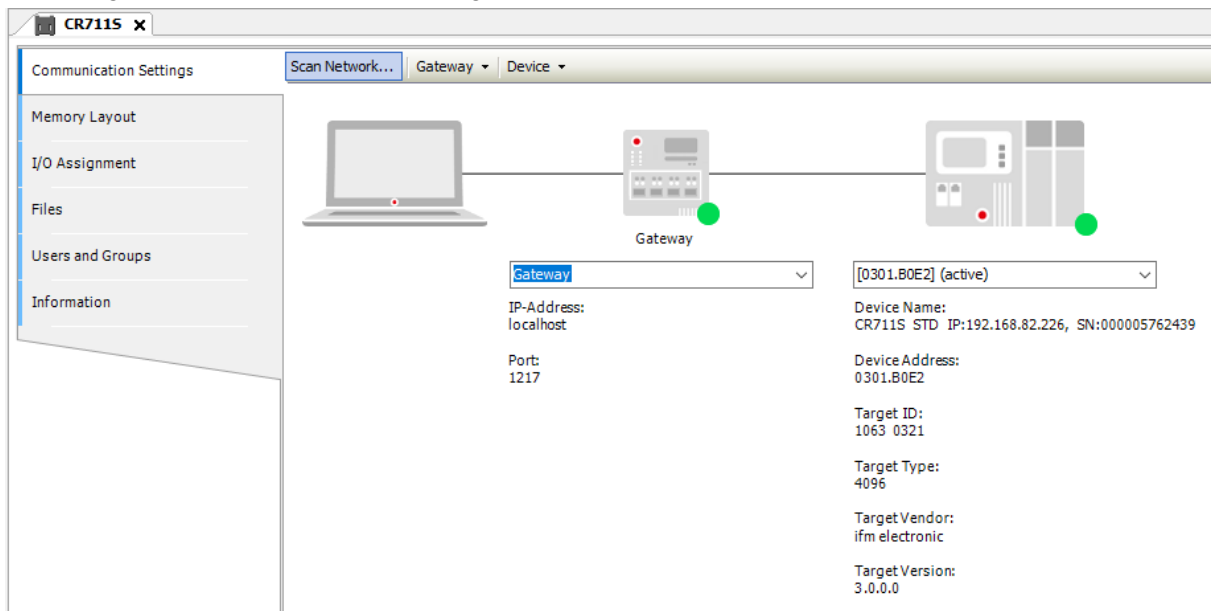
Password:

OK Cancel



If a password was already set, it has to be entered for login.

- > The connection to the controller is established.
- > The green circle on the controller signals that the connection has been established.



CR711S [X]

Communication Settings Scan Network... Gateway Device

Memory Layout

I/O Assignment

Files

Users and Groups

Information

Diagram: Laptop -> Gateway (green circle) -> Controller (green circle)

Gateway

IP-Address: localhost

Port: 1217

[0301.B0E2] (active)

Device Name: CR711S STD IP:192.168.82.226, SN:000005762439

Device Address: 0301.B0E2

Target ID: 1063 0321

Target Type: 4096

Target Vendor: ifm electronic

Target Version: 3.0.0.0

5.3 Create the program

In the first small program a two-hand control is to be implemented which is used for presses, for example. There are two pushbuttons on the press which are installed so that they cannot be operated with one hand. That means that the operator has to press one pushbutton with each hand to release the press. This ensures that no hand gets underneath the press.

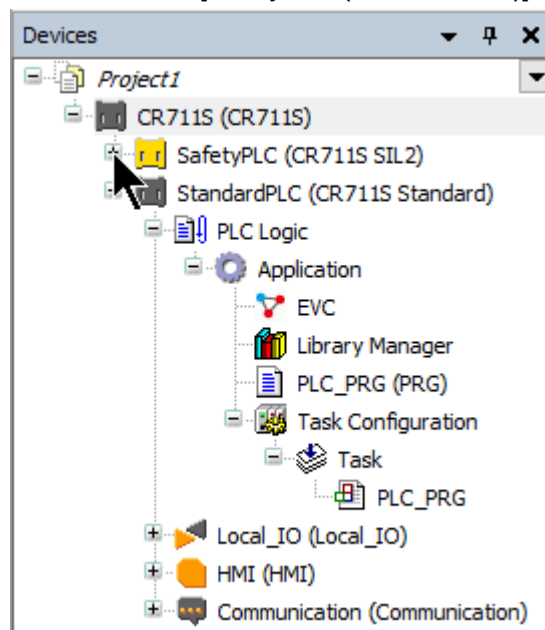
For the simulation, the IO-simulator box is used with the following signals:

Operand	Comments
IN0100	Press, pushbutton 1
IN0101	Press, pushbutton 2
OUT0000	Press release signal

5.3.1 Suppress SafetyPLC in the device tree

Since only the controller StandardPLC is used for the first program, the section of the SafetyPLC is suppressed in the device tree.

- Click minus sign before [SafetyPLC (CR711S SIL2)].
- > The branch [SafetyPLC (CR711S SIL2)] is closed.



5.3.2 Cyclical program processing

In CODESYS 3.5, the program has to be processed cyclically. A program block has to exist to which a task is assigned.

One task and one program block PLC_PRG are already pre-configured in the used template. The program block PLC_PRG is assigned to the task and is therefore activated cyclically.

In the program block PLC_PRG other program blocks (also called POU - Programming Organization Unit) are started. They can be programs, function blocks and functions.

5.3.3 Structured programming

57286

In principle, the complete program can be contained in only one block such as the PLC_PRG. This becomes quite confusing, however, and the fault location is difficult.

It is better to distribute different program sections to different blocks. Then the blocks are activated one after the other in PLC_PRG.

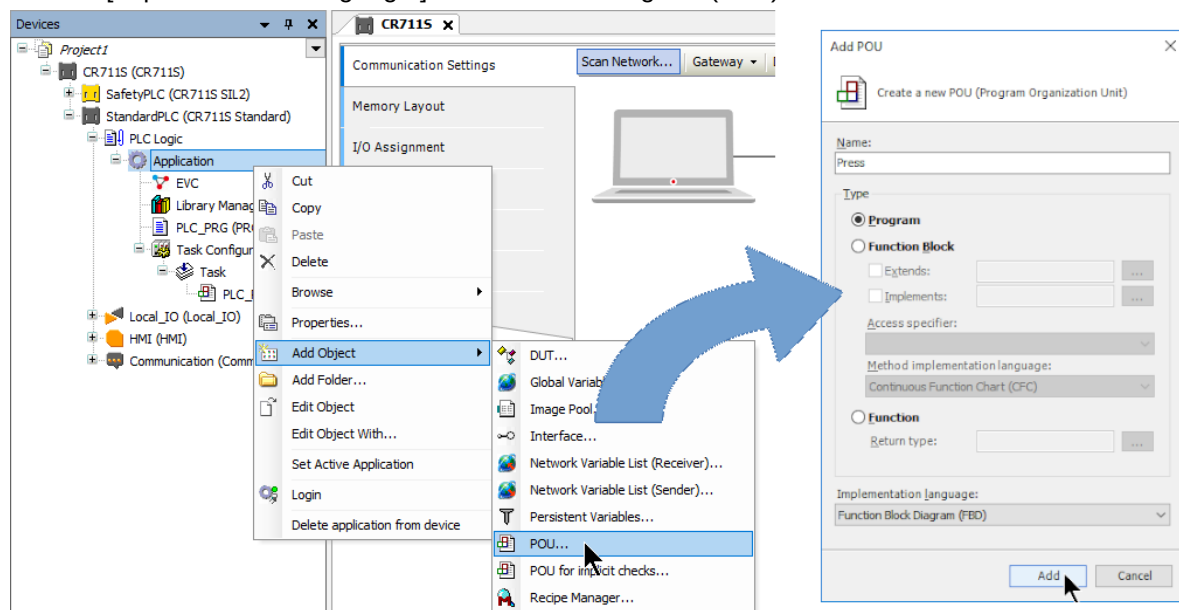
Therefore one separate program block press is created for the press controller in this example.

5.3.4 Create new block

57287

To create a new block:

- In the device tree: Select [Application] > (right click) > [Add Object] > [POU...].
- > The window [Add POU] appears.
- Configure POU and complete with [Add]:
 - [Name:] Press
 - [Type:] Program
 - [Implementation language:] function block diagram (FBD)



- > The new block appears.

5.3.5 Function block diagram (FBD)

57288

FBD (function block diagram) is a graphic programming language in the standard IEC 61131-3. Blocks with symbols from the boolean algebra, for example, are added to the program.

Since FBDs are particularly suited for boolean functions, it is also used in the example program.

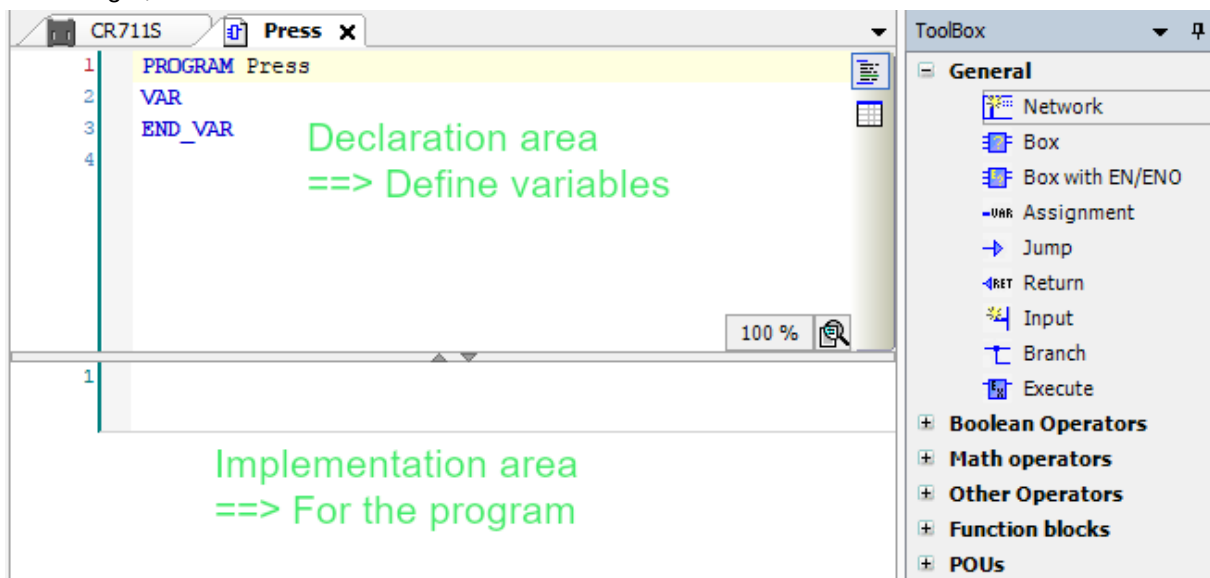


To enter more complex formulas, a textual language from IEC 61131-3 such as structured text (ST) is better suited and clearer than FBD.

The upper part of the block is for the declaration of variables.

Underneath, there is the first (still empty) network. In this area, the program is created.

On the right, there is a section with the available tools.

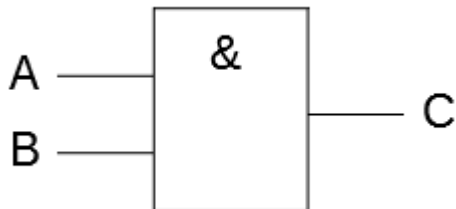


5.3.6 Program linking

57289

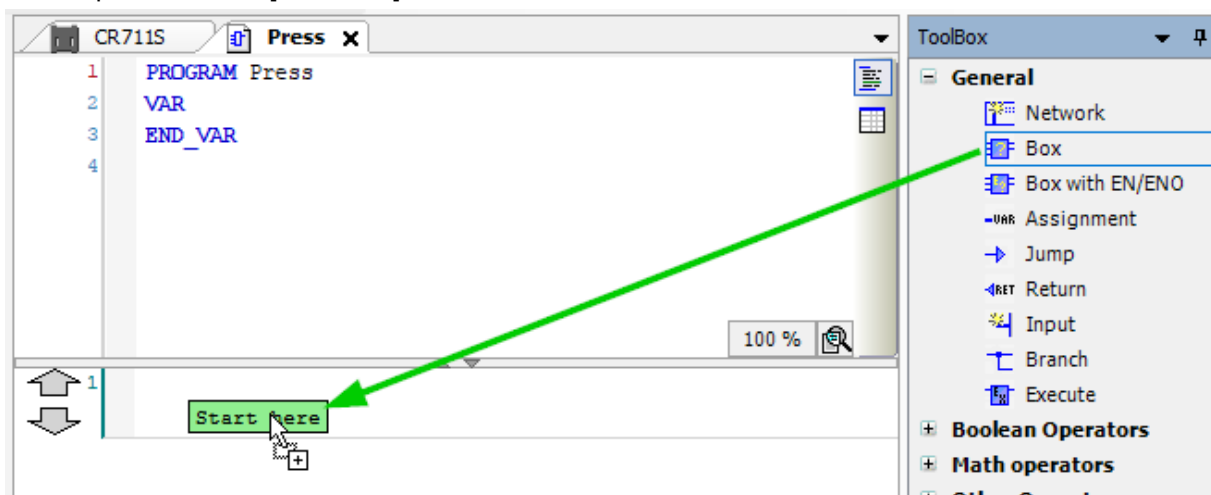
According to the task, the output signal must only be active if both input signals are active.

This functionality can be implemented with an AND operator. The general symbol for an AND operator is shown in the image below:

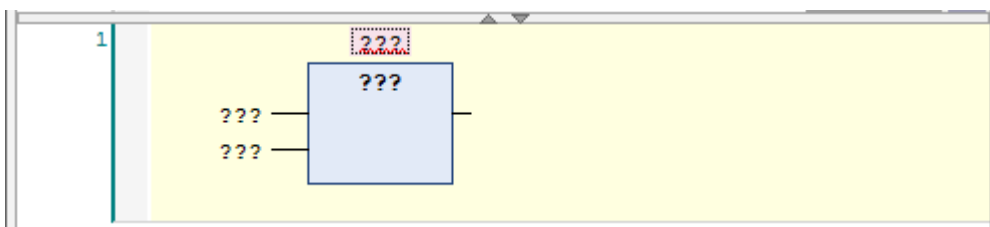


To add a link in CODESYS:

- In the [Toolbox] section: Drag a [Box] to the first network.
- > [Start here] appears.
- Drop the block on [Start here].



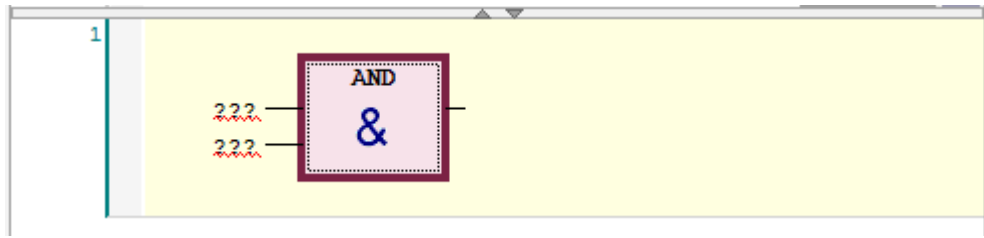
- > The block is added.



This operator is called AND operator in CODESYS. It is entered in the block.

- Click the question marks [???] in the block.

- Enter AND and confirm with [Enter].



5.3.7 Address binary inputs and outputs

57290

The links to the inputs and outputs are still missing.

For the first small program, the terms from I/O mapping are used: device tree > Local_IO > Inputs > I/O mapping



Only apply this use of the inputs and outputs:

- in case of binary use of all inputs and outputs
- if all inputs and outputs use the standard settings of the diagnostic level (→ data sheet)

Resetting faults (e.g. excessive current) is only possible by switching off and on again.

Basic recommendation: Configure the inputs and outputs via the integrated function blocks.



Background:

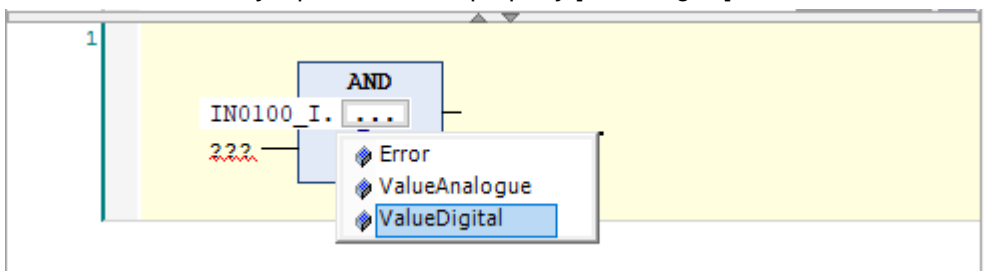
If inputs or outputs from I/O mapping are used, these values are updated at the end of the cycle. If you have configured such an input or output simultaneously in the program via a function block, this value will be overwritten. This is usually not what you want.

If you use both methods in parallel (binary inputs via I/O mapping, other inputs via function blocks), it may become unclear which may cost a lot of time during set-up, fault location or program changes.

In addition it has to be noted that it is not possible to reset diagnostic errors via I/O mapping. The integrated function blocks, however, have an input xResetError so that reset is also possible during the program sequence.

The first input to be connected is IN0100. It is addressed via IN0100_I:

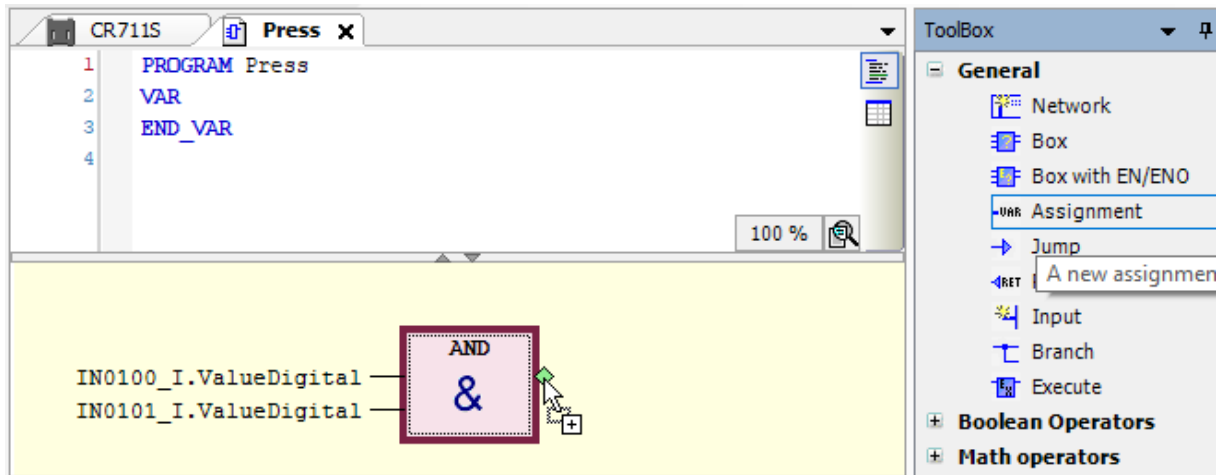
- Click the question marks [???] of the upper input of the AND operator.
- Enter IN0100_I..
- > When the dot has been entered, a selection menu with the attributes of the input appears.
- Since it is a binary input, select the property [ValueDigital].



- Repeat the same procedure with input IN0101 for the second input of the AND operator.
- > Both control inputs are connected to the AND operator.

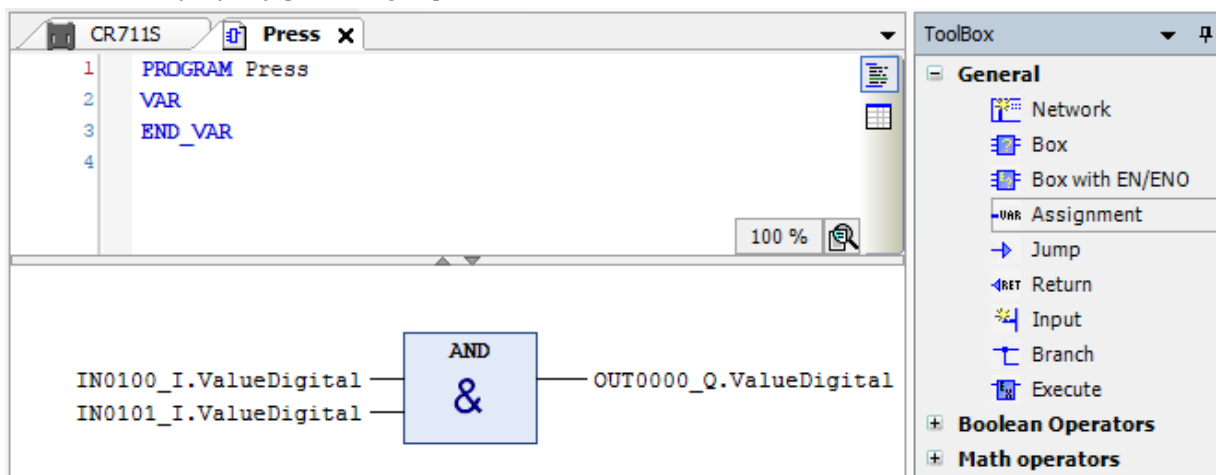
To transfer the link result to the output, an assignment has to be added to the output of the AND operator:

- Drag an [Assignment] to the output of the AND operator in the section [Toolbox] and drop it at the appearing green square.



Then name the binary output in the same way as the inputs:

- Click the question marks [???] at the input of the AND operator.
- Enter OUT0000_Q..
- Select the property [ValueDigital].



- > Then the inputs of the AND operator are connected to the input signals and the link result is assigned to the output.

5.3.8 Call in PLC_PRG

57291

The block PLC_PRG is the block which is automatically called by the controller.

To ensure that the block Press is processed, it has to be called in the block PLC_PRG.

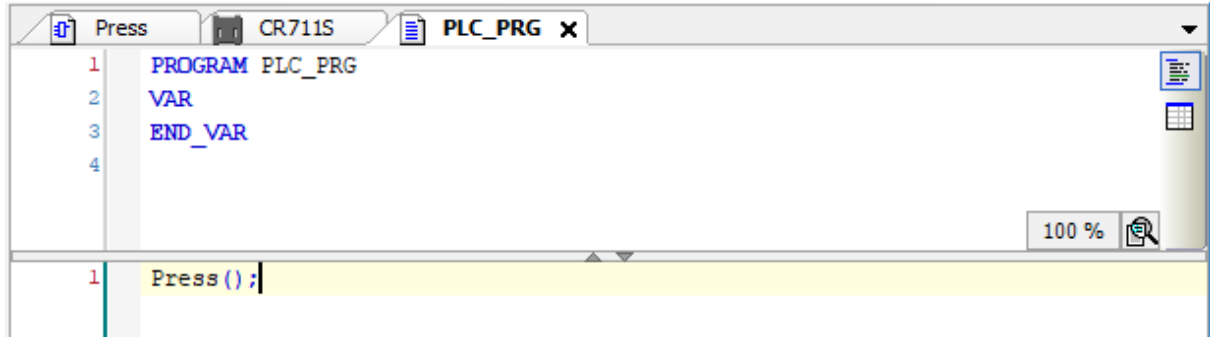
5.3.9 Structured text (ST)

The block PLC_PRG is here programmed in Structured Text (ST). This is a textual programming language of the standard IEC 61131-3 which follows the programming language PASCAL.

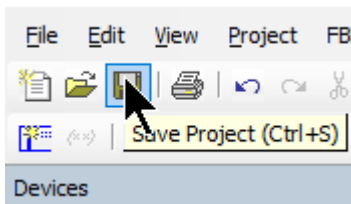
Since commands are entered here in text format, there are no tools in this programming window.

The implementation part consists of a text editor in which instructions are entered. Each instruction has to be finished with a semicolon.

- Call the block Press with the following command: `Press()` ;



- Save the project by clicking on the save symbol.



- > The program is completed.
- > The project is saved.

5.4 Transfer and test the program

57293

To test the program, it has to be transferred to the controller. A connection to the controller was already established in chapter **Establish a connection between the controller and the PC via Ethernet**. (→ p. 9). If required, the steps can be repeated.

5.4.1 Transfer program

57294

Since the device comprises the two controllers (SafetyPLC and StandardPLC), the user has to choose to which controller the program should be transferred.

- ▶ Set the StandardPLC as active application: [StandardPLC] > [Application] > context menu > [Set Active Application]

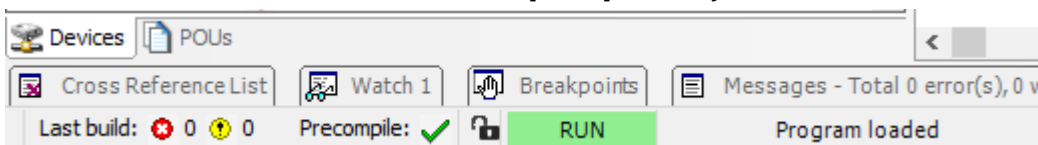


The option [Set Active Application] only appears if the application is not yet active.
The active application is highlighted in **bold type**.

- ▶ Log in to the controller: [Application] > context menu > [Login]
- > Application is compiled and transferred. During the transfer, the LEDs [SYS0] and [SYS1] are flashing green/yellow.
- > When the transfer of the program is finished: The controller is in the stop mode. The LED [SYS0] lights yellow.



- ▶ Restart the controller: [Application] > context menu > [Start]
- > The controller is in the RUN mode. LED [SYS0] flashes yellow.

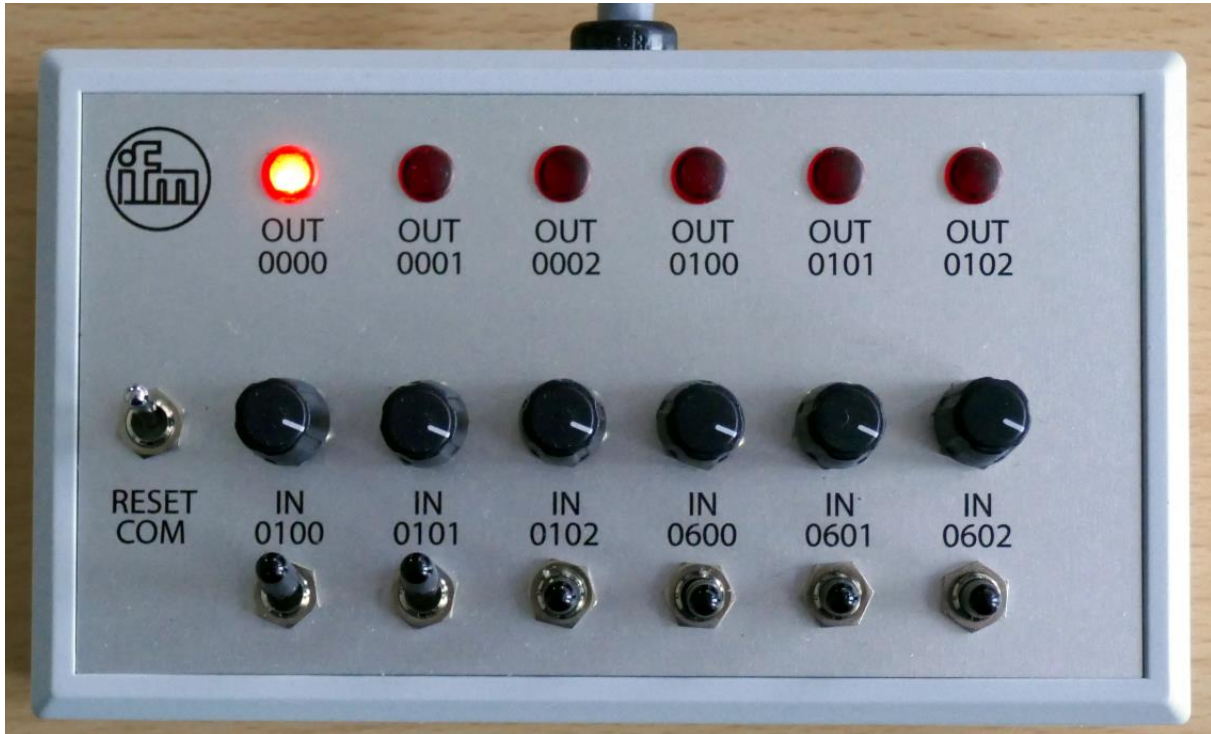


5.4.2 Test program

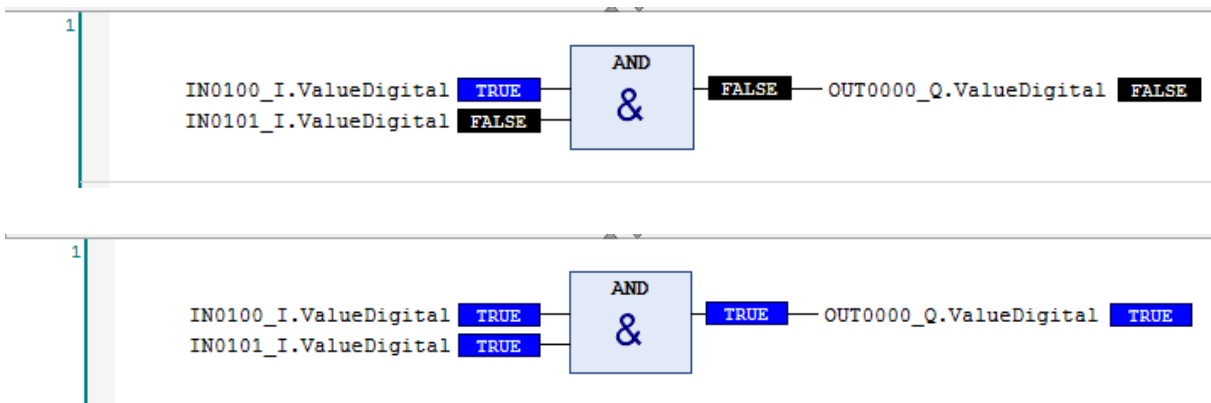
57295

Now the program can be tested.

When the potentiometers are positioned at the right end stop, both switches [IN0100] and [IN0101] can be switched on. Only if both switches are switched on, is the lamp [OUT0000] on.



This behaviour can also be seen in CODESYS. Here, a supplied H signal is shown as TRUE and an L signal as FALSE.



Congratulations! You have successfully created your first program in CODESYS 3.5, loaded it to the controller and tested it.

6 Annex

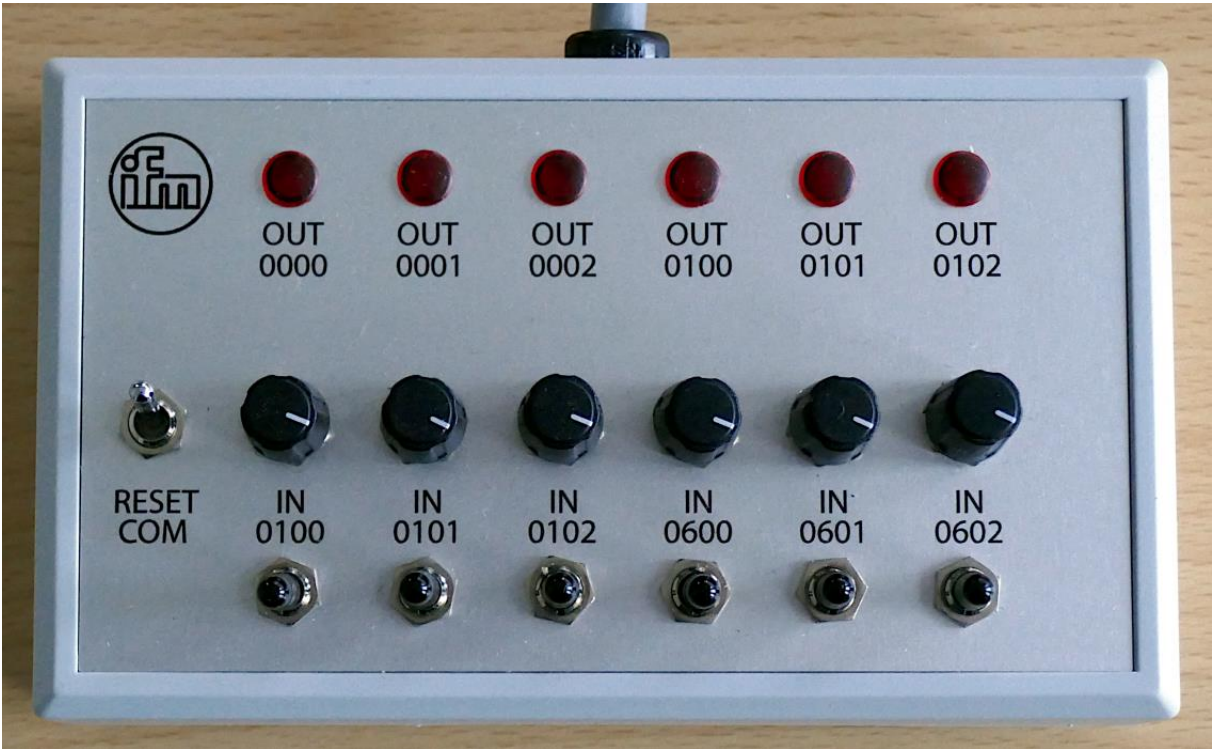
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57296

6.1 The I/O simulator box

57297

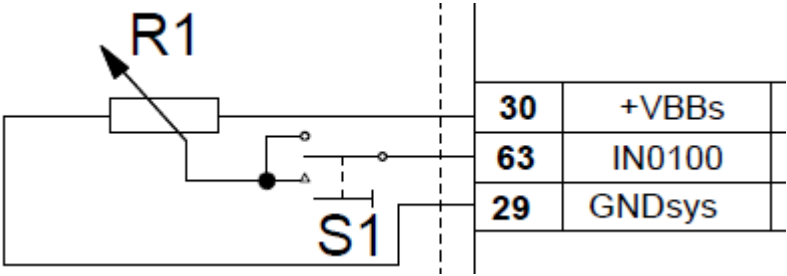
The I/O simulator box is used for the simulation of input and output signals and the reset of communication parameters of the controller. Six inputs and outputs each are connected via the box.



6.1.1 Inputs

57298

The input circuit is shown in the image below using [IN0100] as example.



The following modes can be simulated on the inputs:

- binary input (IN_DIGITAL_CSI)
- voltage measurement 0...10 V (IN_VOLTAGE_10)

- voltage measurement 0...32 V (IN_VOLTAGE_32)
- ratiometric voltage measurement / operating voltage ratio (IN_VOLTAGE_RATIO)

The potentiometer forms a voltage divider to also simulate analogue values. When a value is set on a potentiometer and the corresponding switch is activated, this value is sent to the controller.

In case of binary use of the input, the potentiometer has to be positioned at the right end stop. That means that the switch supplies the operating voltage (+24 V DC), i.e. an H signal, to the input.

Since we work under ideal conditions (short cable lengths, "clean" voltage supply, no internal and external noise signals), ground can be connected via GNDsys in the analogue modes.

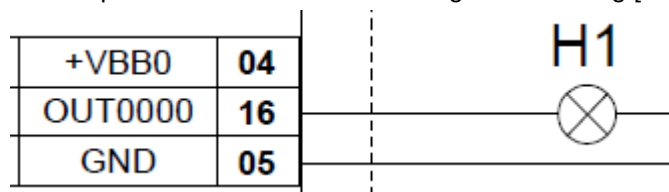


- If used in the field, the notes on laying and connecting the signal, voltage and ground cables in the original operating instructions have to be observed.

6.1.2 Outputs

57299

The output circuit is shown in the image below using [OUT0000] as example.



The following modes can be simulated on the outputs:

- binary output (OUT_DIGITAL_CSO)
- PWM output

6.1.3 Communication reset

57300

Should a connection to the controller not be possible, the interface parameters can be reset to factory setting using the switch [RESET COM].

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