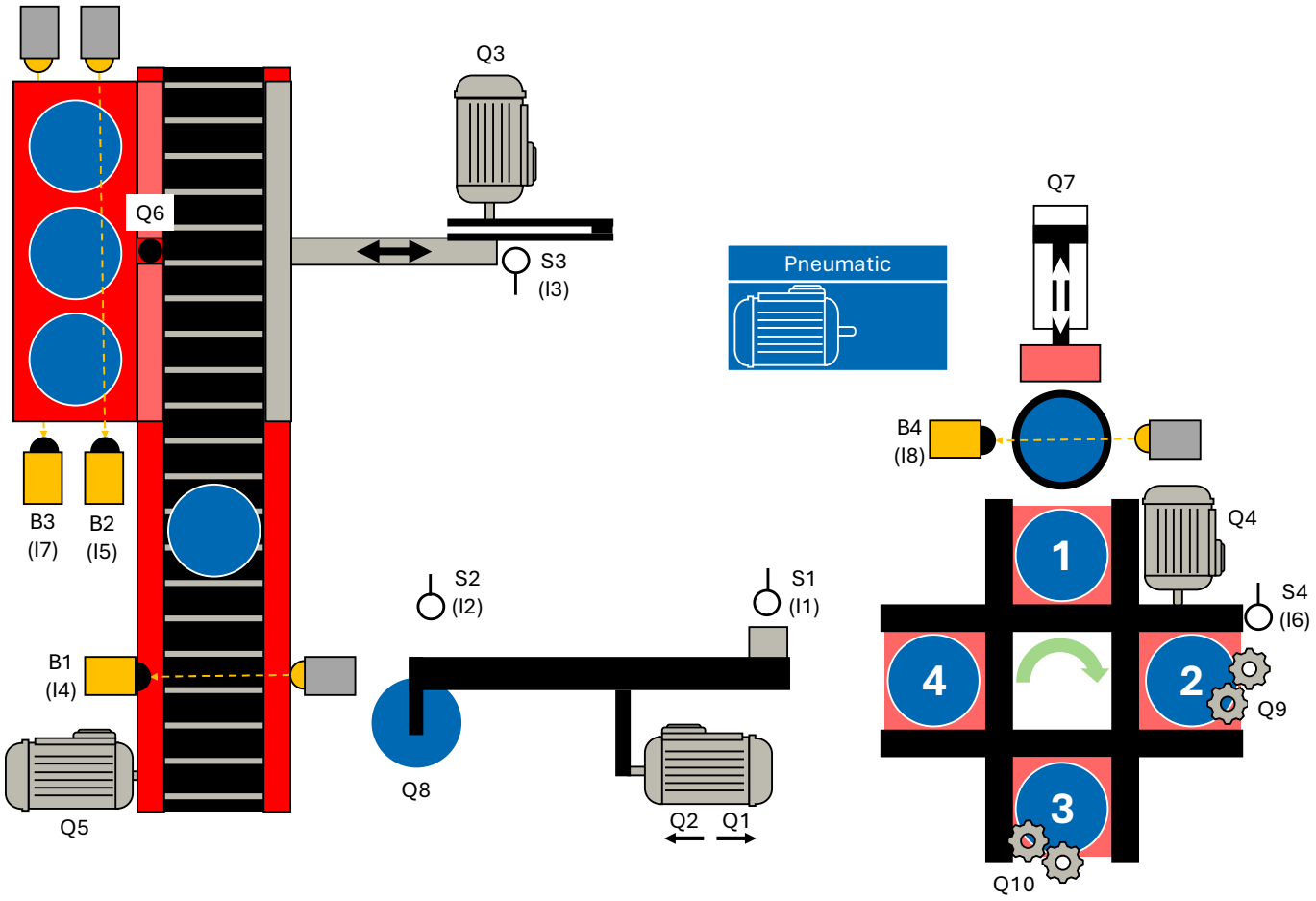
fischertechnik

GROLLMUS

KNOWLEDGE | SOFTWARE | AUTOMATION

24V production line

Commissioning (hardware)



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3 Commissioning (hardware)

3.1 Introduction

To be able to transfer the hardware configuration to the control system, it must be switched on, which first requires the system to be commissioned step by step.

Commissioning is the first intended use of a machine or system. It may only take place when the machine meets the requirements of the relevant EC directives and has been verified by the EU Declaration of Conformity and CE marking. Commissioning is an important step in the construction of industrial plants and ensures that the plant functions properly and can be operated safely. This process requires careful planning and execution.

The general steps for hardware commissioning are described below. Depending on the structure of the real system, this procedure may need to be adapted.

Before the actual commissioning begins, various preparatory work must be carried out to ensure that all the requirements for a successful start are met.

- Document review
  - Checking the circuit diagrams, wiring diagrams, parts lists and functional descriptions.
  - Ensure that all necessary permits and safety documents are available.
- Visual inspection
  - Physical inspection of the system for damage, loose connections and correct installation.
  - Check the mechanical installation and all electrical connections.
- Checking the safety equipment
  - Ensure that all safety devices are installed and functional.
  - Testing emergency stop switches and other safety-relevant devices.
- Check continuity and insulation resistance
  - Measurement of the low resistance of all protective conductor connections.
  - Carry out insulation measurements to ensure that there are no unwanted earth connections or short circuits.

Once the visual inspection and electrical test have been successfully completed, the system can be switched on step by step. The circuits should be switched on one after the other in a controlled manner and the corresponding voltages and rotating fields should be checked, starting with the power supply to the control unit and then the main power supply.

Once the PLC has started up, the hardware configuration can be transferred. Then check whether the configured modules and firmware versions correspond to those of the real hardware components.

To complete the commissioning of the hardware, an I/O check must be carried out to check that the sensors and actuators are wired correctly and that the signals are correctly located in the process image of the inputs and outputs.

3.2 Commissioning protocol

In order to be able to carry out structured commissioning, it is essential to create a commissioning log beforehand, which can be processed and in which the results are documented accordingly.
A simplified protocol was created for this system. In addition to the hardware commissioning, this also includes the part for the software that will be required at a later date.

Description	OK	Not OK
Visual inspection		
Device manuals for the (PLC) components used available		
The electrical equipment complies with the technical documentation		
Operating equipment is without visible damage that could impair safety.		
Selection and adjustment of protection and monitoring devices		
Labeling of all equipment		
Professional conductor connection		
Wiring between model and PLC completed		
PLC hardware		
PLC voltage switched on		
Voltage model switched on		
Device configuration (created in the TIA Portal)		
Project data loaded in PLC		
Wiring of the sensors checked (I/O check)		
Wiring of the actuators checked (I/O check)		
PLC software		
Software translated		
Software loaded in PLC		
Transport route		
Switching on the control unit (STOP -> RUN) initializes the step chain		
Empty pallet inserted (B3 interrupted, B2 not interrupted)		
Slider (Q3) moves to home position (S3 actuated)		
Divider is closed (Q6)		
Step chain dwells in step 4 to - Workpiece placed on belt (B1 interrupted) - and converter not in station (S1 not actuated)		
Conveyor belt (Q5) is activated for a defined time (3 seconds) when a workpiece is placed on it		
Workpiece reaches end of belt, counter is incremented		
Repeat the process until there are 3 workpieces at the end of the belt		
Divider (Q6) is opened		
If an empty pallet is available (B3 interrupted, B2 not interrupted), the slider (Q3) is activated.		
Workpiece counter is reset		
Slider stops when it has returned to its home position (S3 actuated)		
Process starts from the beginning		
Converter		
Switching on the control unit (STOP -> RUN) initializes the step chain		
Converter moves to home position (S1 and S2 not actuated)		
The converter remains in this position until - Turntable in position (S4 actuated)		

- Workpiece is ready on rotary table (wstReady in workpiece management)		
Transfer unit moves in the direction of the turntable (Q1) until S2 is actuated		
Vacuum is switched on (Q8)		
wstReady in workpiece management is reset		
Converter moves in the direction of the belt (Q1) when - Band free (B1 not interrupted) - Tape stopped (Q5 not activated)		
Pressing S1 stops the movement		
Vacuum is switched off		
Once the vacuum has dissipated (1 second), the cycle starts again from the beginning		
Magazine		
Switching on the control unit (STOP -> RUN) initializes the step chain		
To switch to the next step, you must - Magazine must be filled for at least 1 second - Turntable in position (S4 actuated) - Workpiece position on rotary table must be free (nestOccupied in workpiece management)		
Slider (Q7) is moved forward for 2 seconds		
nestOccupied in workpiece management is set		
If nestOccupied is set, the cycle starts again from the beginning		
Drilling processing station		
Switching on the control unit (STOP -> RUN) initializes the step chain		
To switch to the next step, you must - Turntable in position (S4 actuated) - drillBody blank must be set in workpiece management		
Edit (Q9) is activated for a defined time (3 seconds)		
drillingRough part is reset drillFinished part is set		
If drillFinished part is set in workpiece management, the cycle starts again from the beginning		
Welding processing station		
Switching on the control unit (STOP -> RUN) initializes the step chain		
To switch to the next step, you must - Turntable in position (S4 actuated) - WeldingRaw part must be set in workpiece management		
Edit (Q10) is activated for a defined time (5 seconds)		
WeldingRough part is reset weldingFinished part is set		
If WeldFinished part is set in workpiece management, the cycle starts again from the beginning		
Turntable		
Motor (Q4) must not be activated if - Slider (Q7) is extended - Transfer unit is in position Turntable (S2) and - DrillBody or WeldBody or TransferPart is set in the workpiece management		
Motor (Q4) is activated when - Table is not in position (S4 not actuated) - magazinePart or drillPrefabricated part or weldPrefabricated part is set in workpiece management - The above interlocks are fulfilled		

3.3 Exercise: Performing a visual inspection

Target:

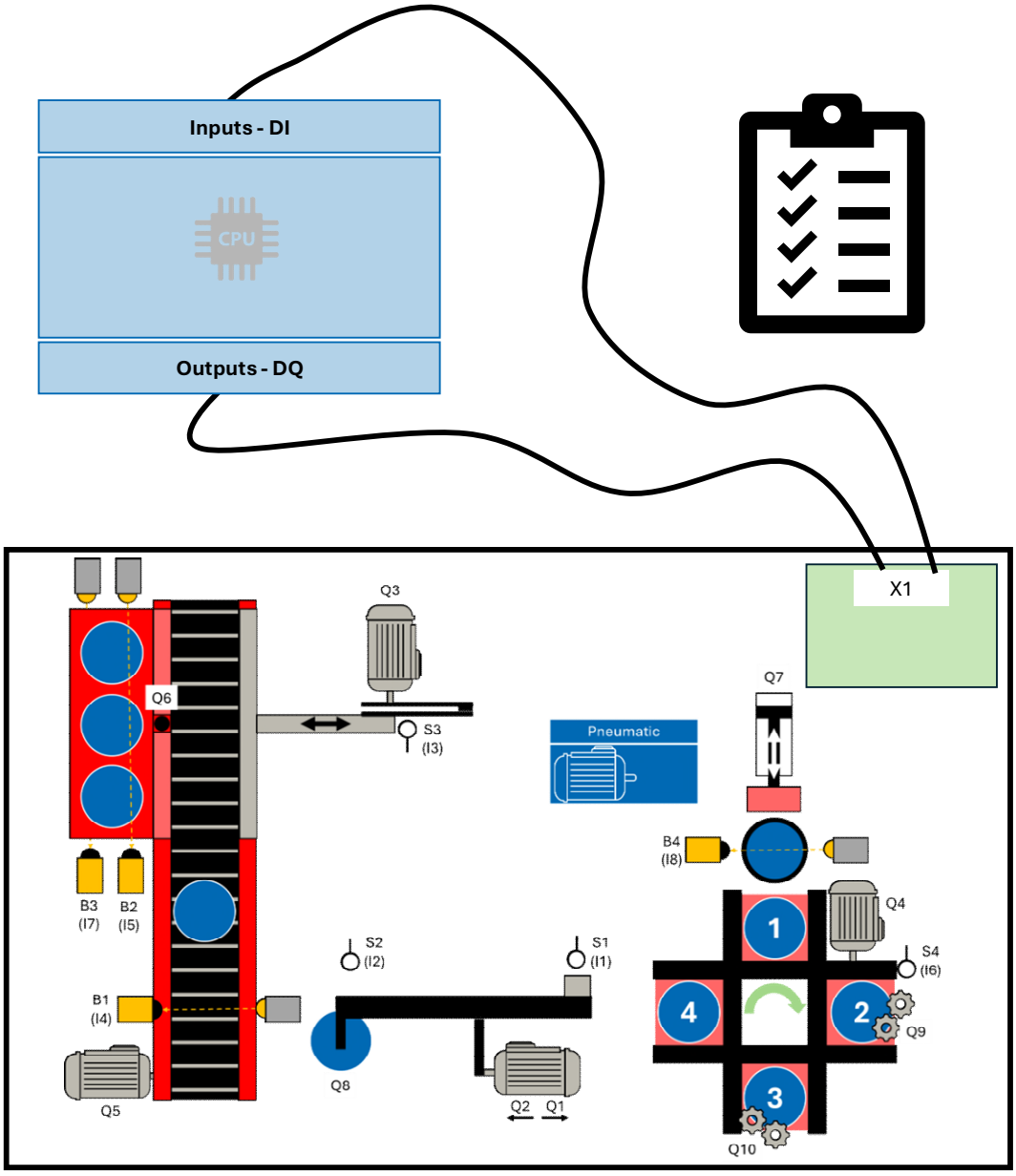
I can prepare my system for commissioning and carry out the visual inspection.

Task:

Prepare the system for commissioning.

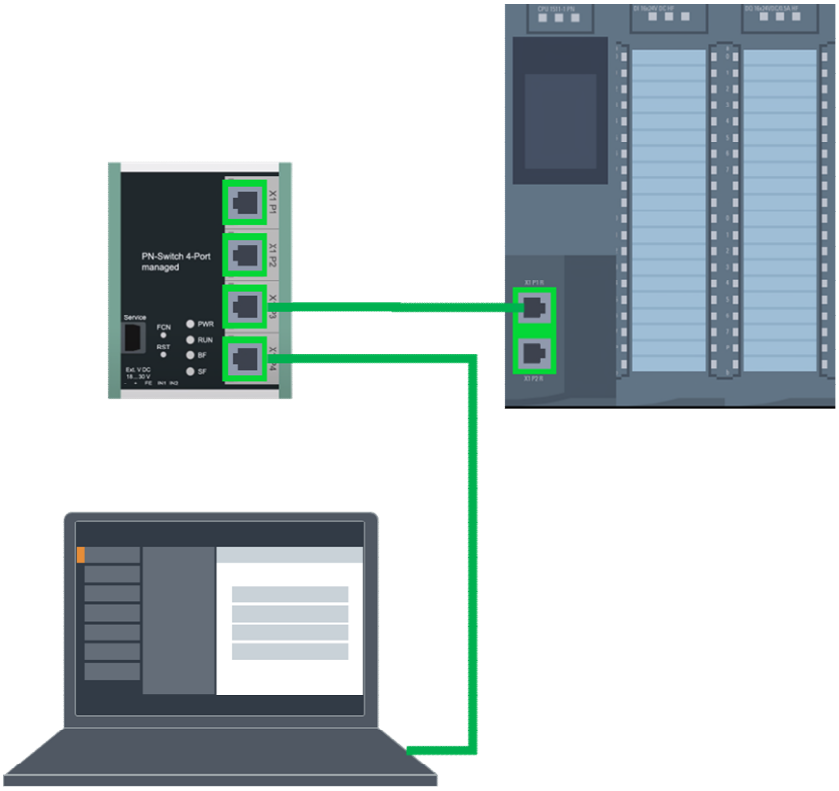
If the model has not yet been wired to the automation system used, carry this out. "Table 1 Terminal strip X1 assignment diagram" from the "Model description" chapter and the device manuals for the hardware used may be helpful for this.

Carry out a visual inspection and document the result in a log.



3.4 Connect programming device and PLC

In order to establish the connection to the PLC (target system), the programming device (PG) and the target system must be connected via an interface. The PG and PLC exchange data and information via this communication link, which must be defined.



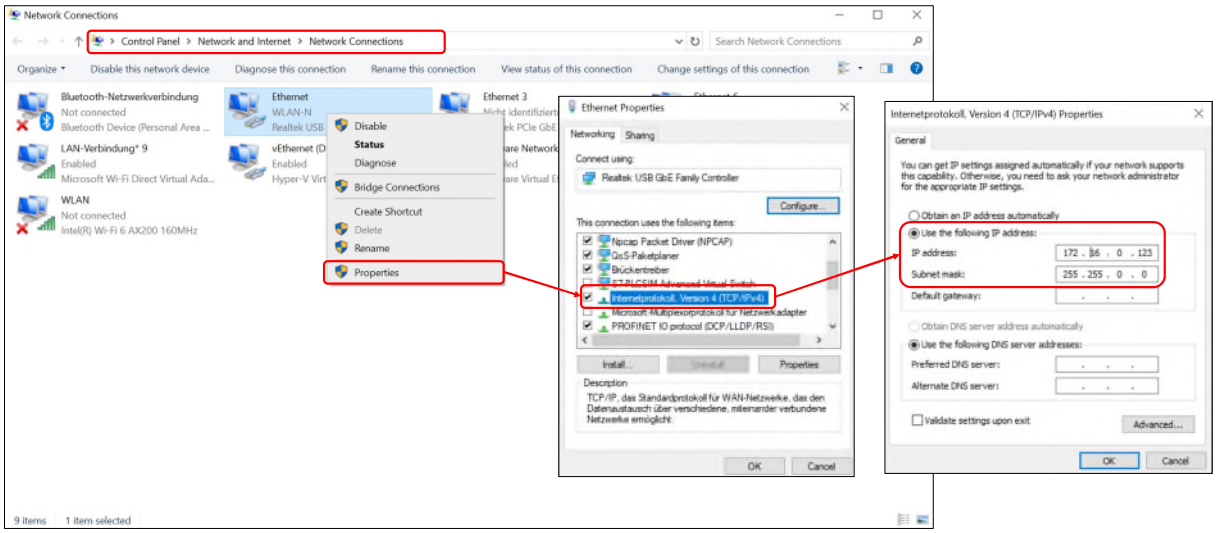
Picture 1 Physical networking

Common programming interfaces are, for example: PROFIBUS or PROFINET or Ethernet.

In order for communication to be established, the following requirements must be met:

- Both devices have an Ethernet connection.
- both devices are physically connected to the same network.
- Both devices are correctly parameterized (IP address set).

The IP address of the programming device can be adjusted in the Windows Control Panel under "Control Panel→ Network and Internet→ Network connections".



Picture 2 Setting the Windows network adapter

The corresponding network adapter must be selected here. In the context menu under "Properties→ Internet Protocol Version 4 (TCP/IPv4)", a free IP address and subnet mask can be assigned manually, which is located in the address space of the PLC.

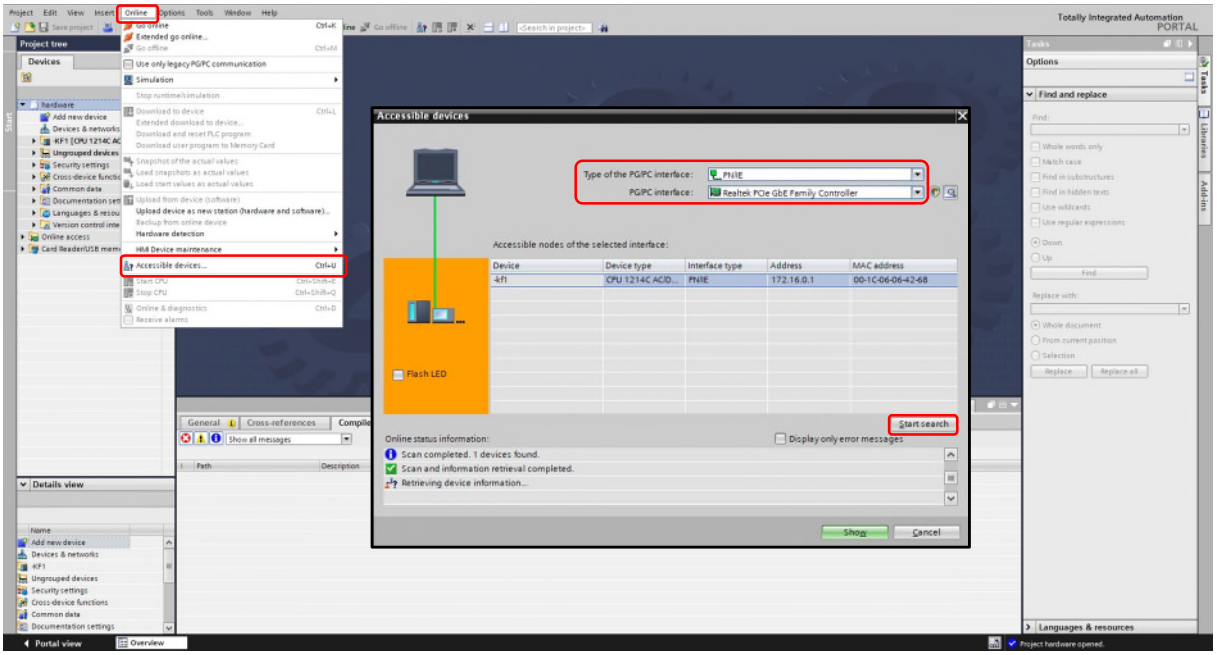
Reachable participants

Once the physical networking and the parameterization of the programming device's online interface have been completed, it must be checked whether a connection to the target system can be established.
Depending on the programming environment and target system used, various on-board tools are available for this purpose.

For example, Beckhoff offers the option of searching for accessible target systems in TwinCAT under "SYSTEM→ Select target system→ Search (Ethernet)" using Broadcast Search.

The procedure in the TIA portal, in combination with an S7 1200 CPU, is shown in detail below.

The connection to the CPU can be checked under "Online→ Reachable users...".



Picture 3 Accessible devices in the TIA Portal

The "Reachable users" function offers a simple way of determining which users can be reached via the set PG/PC interface. These are displayed in the "Accessible users of the selected interface" table after the "Start search" button has been pressed.

If a device found is selected, a flashing light can be activated on the selected device by ticking the "Flash LED" box. This allows you to check beyond doubt whether the selected device corresponds to the expected device.

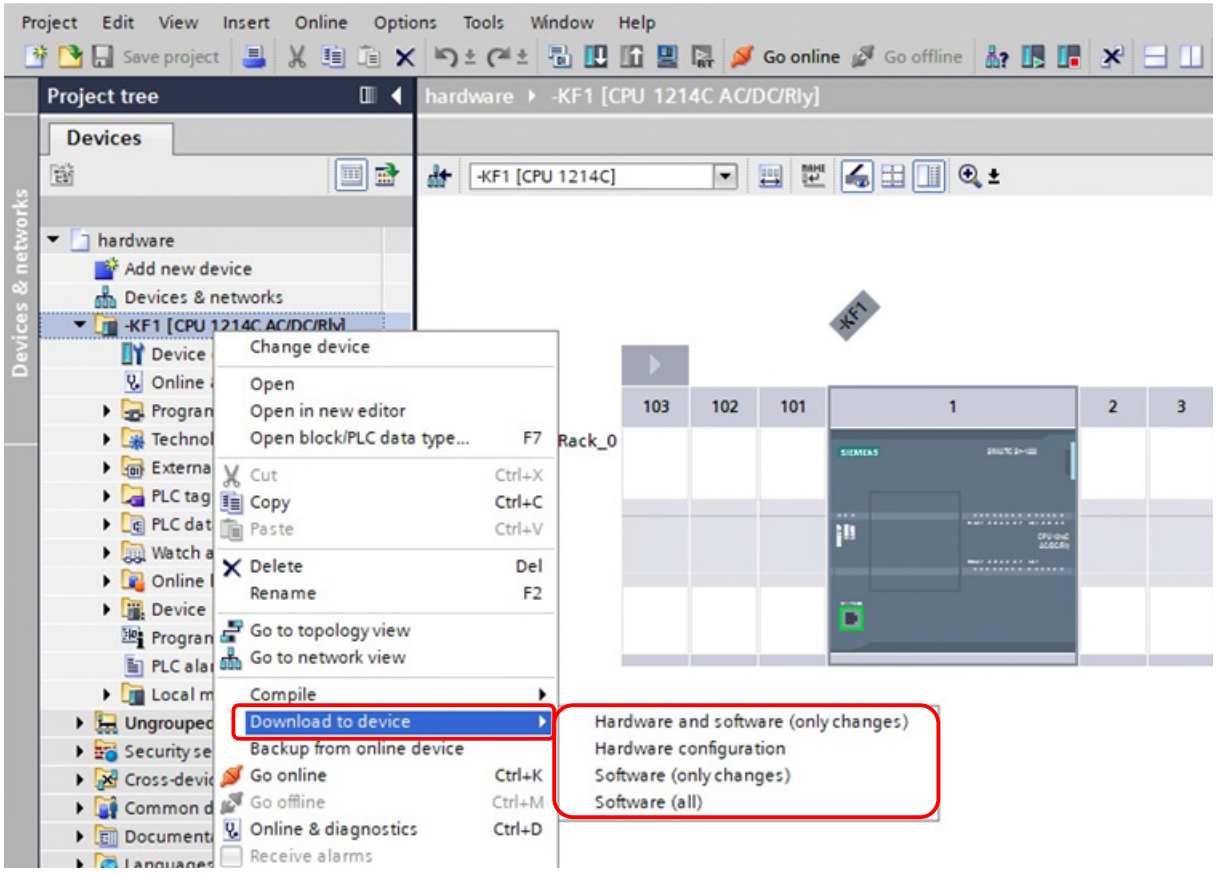
3.5 Load project data

Once your project planning has been successfully translated, the project data that you have generated offline must be loaded into the connected device.
When loading for the first time, the project data is loaded completely. Only changes are loaded during subsequent loading processes.

3.5.1 TIA

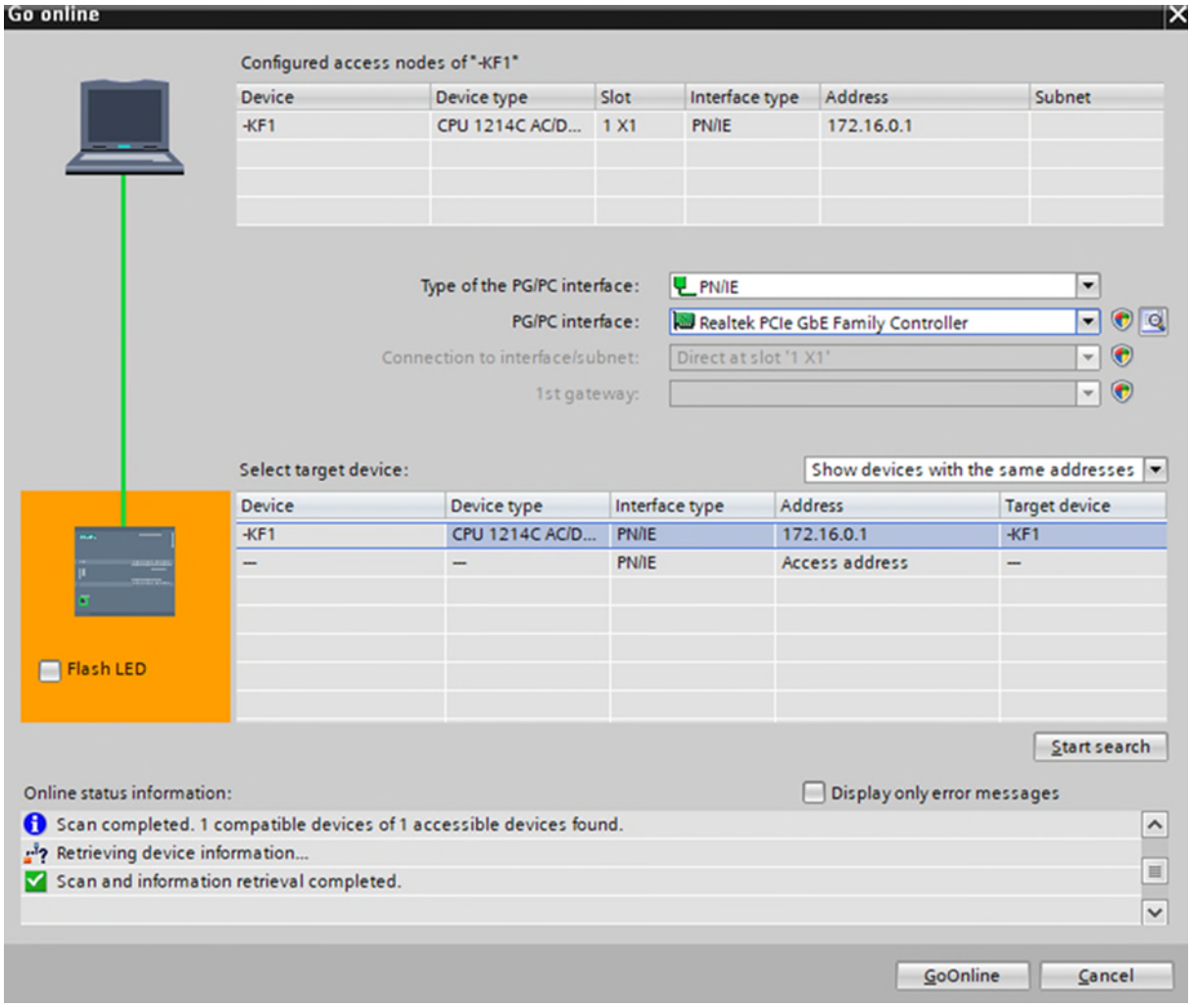
The procedure in the TIA Portal is described below.
To load the project data into the device, proceed as follows:

- Select the desired device in the project navigation
- Select "Load to device" in the context menu of the right mouse button
- Select what you want to load:
  - Hardware and software (changes only)
  - Hardware configuration
  - Software (changes only)
  - Software (load completely); all values are reset to their initial values



Picture 4 Charging in device

If the connection information of the project planning does not match an accessible device, the "Extended loading" dialog box appears.



Picture 5 Extended charging

Configured access

The parameters defined in the configuration are displayed in the configured access nodes area.

Selected interface

The interface via which the PLC is connected to the programming device (PG) can be selected here.

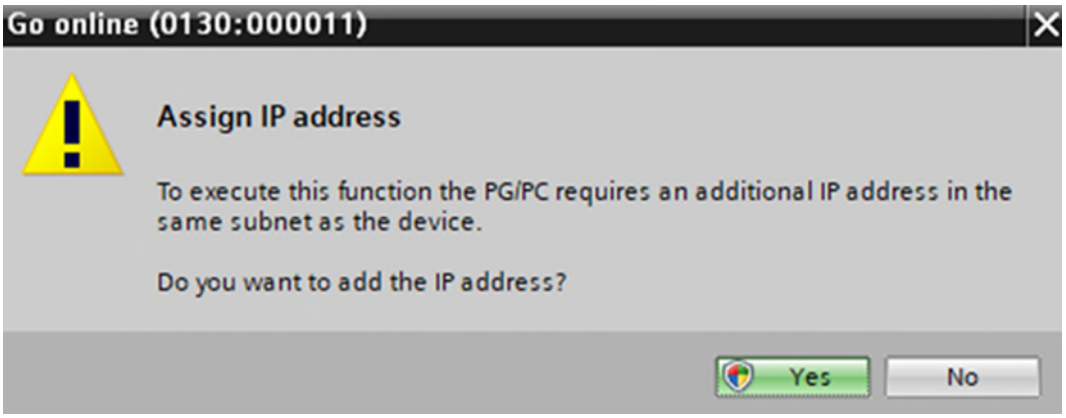
Devices found

The devices accessible via the set interface are displayed in a table after pressing the "Start search" button.

Load" button

These buttons are used to execute the selected loading action.

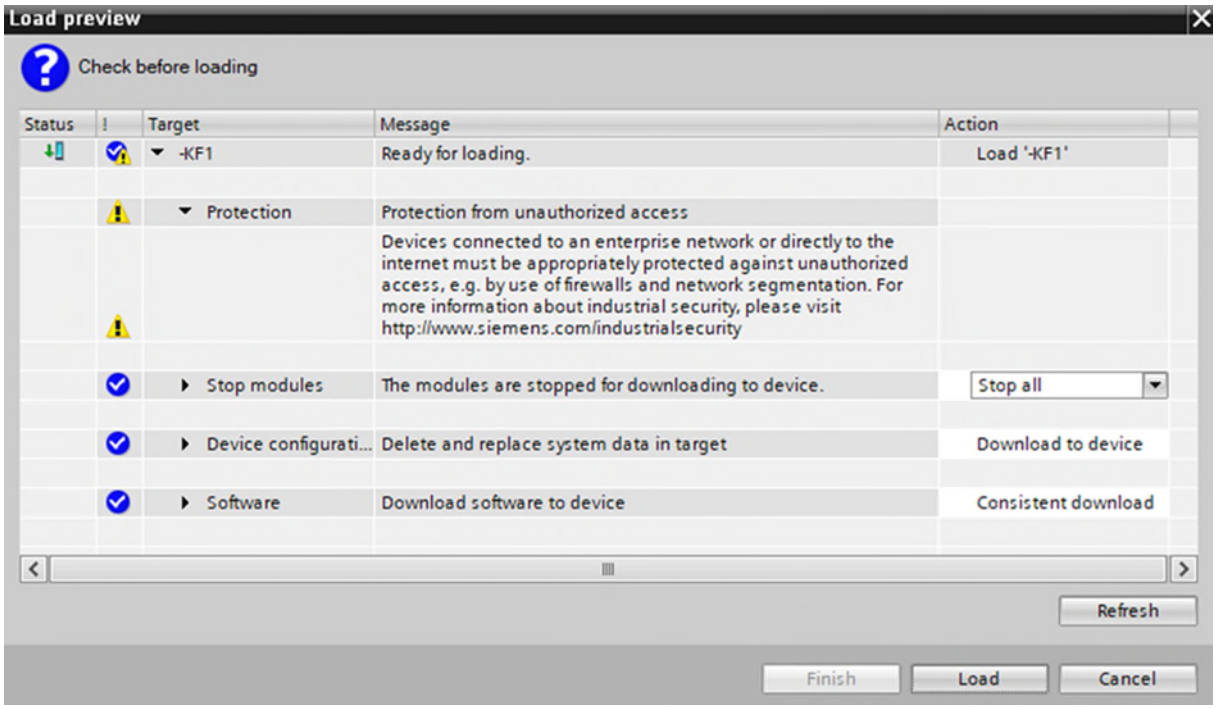
The TIA Portal searches for the configured PLC in the target subnet. If you have not yet assigned an IP address to the PG in the same subnet via the Windows Control Panel, you can now do this using the dialog shown in the following image.



Picture 6 Advanced loading - Assign IP address

By clicking on "Yes", the PG is temporarily assigned a suitable IP address from the subnet of the device.

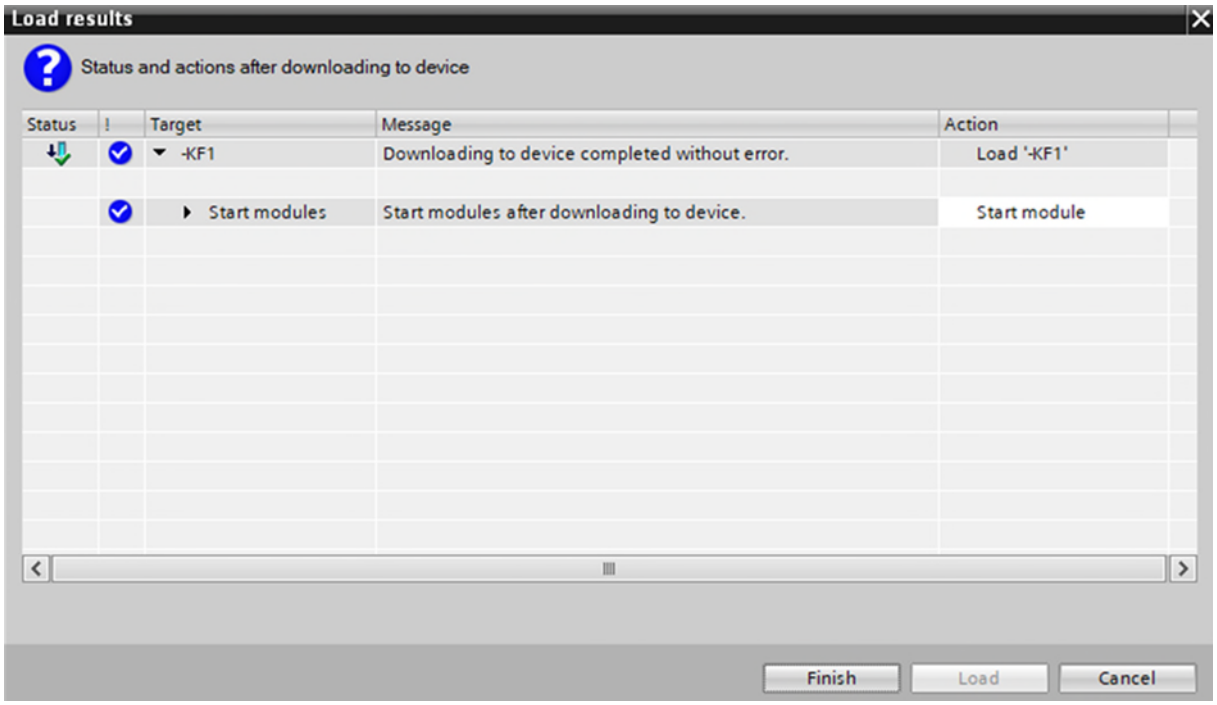
The "Load preview" dialog now appears.



Picture 7 Loading preview

The actions that are performed during loading are listed here. Warnings and errors may also be detected here.
After pressing the "Load" button, the loading process is executed.

Once the process has been completed, the result is displayed in a corresponding dialog box.

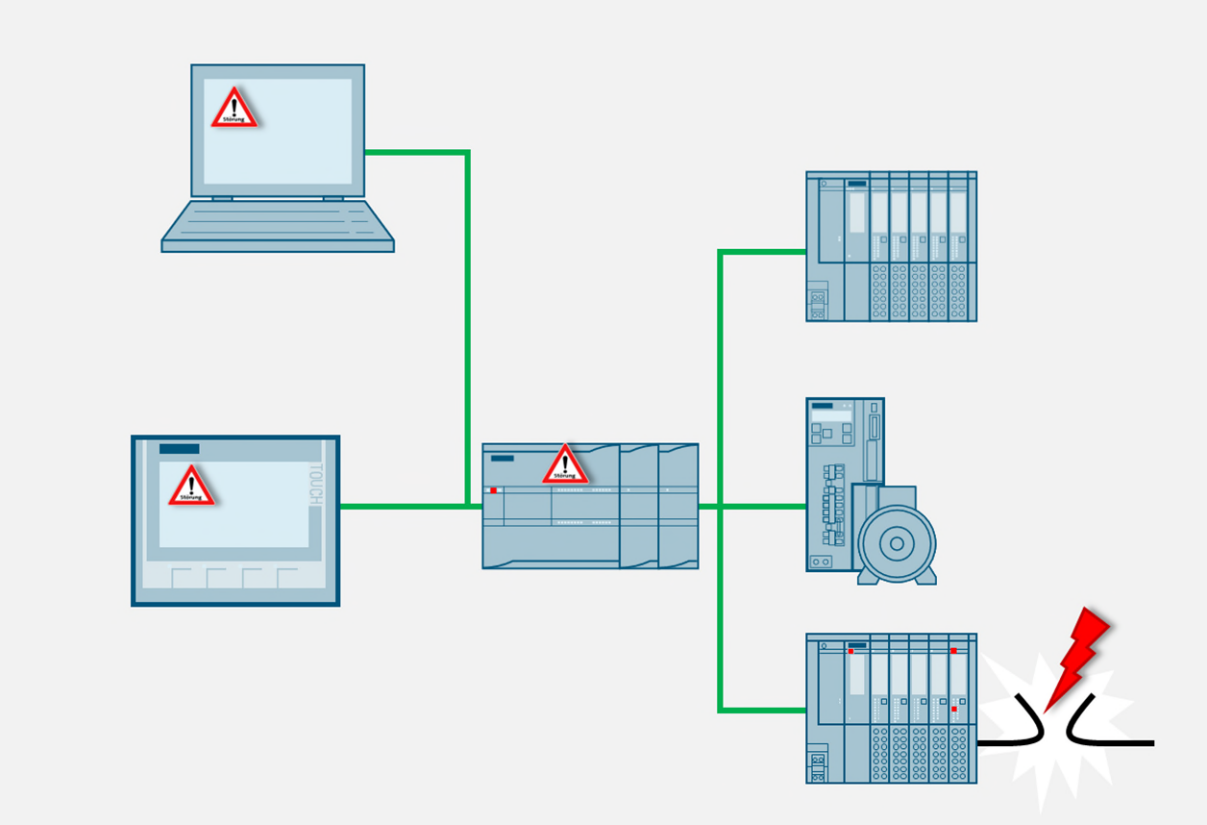


Picture 8 Results of the charging process

In the "Results of the loading process" dialog box, you can view any stopped Start assemblies again. Finally, press the "Done" button
place".
The charging process is now complete.

3.6 System diagnostics

In the SIMATIC environment, the diagnosis of devices and modules is referred to as system diagnostics. The components automatically report an operating fault and provide additional diagnostic information.



Picture 9 System diagnostics

The automation system monitors the following states in the running system:

- Device failure/recovery
- Pull/Push event
- Assembly errors
- Peripheral access error
- Channel error
- Parameterization error
- Failure of the external auxiliary voltage

System diagnostics is integrated as standard in the firmware of the PLC S7-1200. Faults are detected immediately and reported to the HMI device, the web server, the LED displays on the affected module and the TIA portal.

3.6.1 Diagnostic functions and events

System diagnostics is the detection, evaluation and reporting of errors that occur within an automation system.

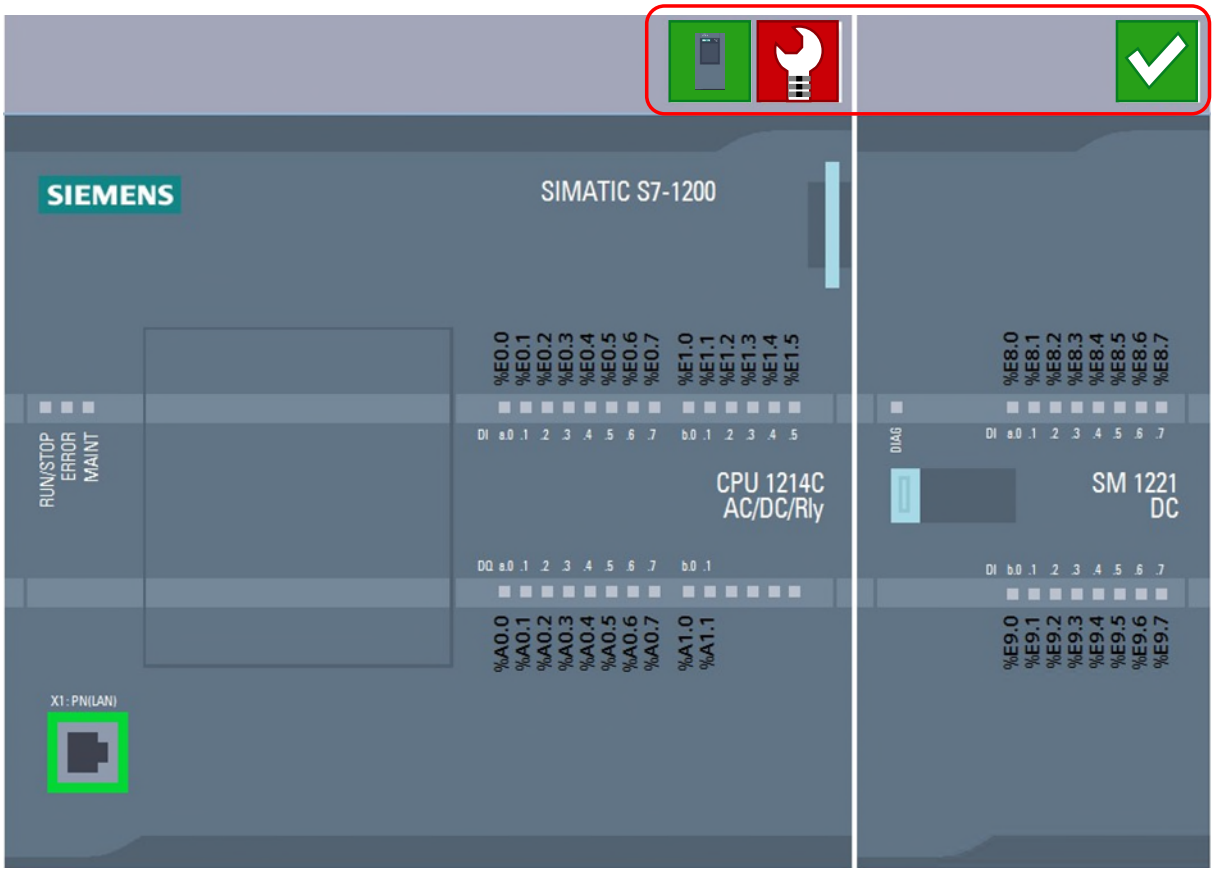
Acquisition of diagnostic data

The recording of diagnostic data by the system diagnostics does not need to be programmed, it is available as standard and runs automatically. The PLC detects system errors, hardware errors and errors in the user program, for which diagnostic events are entered in the system status list and the diagnostic buffer in the order in which they occur.

The content of the diagnostic buffer is retained when the PLC is reset or de-energized. Errors in the system can still be evaluated by the diagnostic buffer even after a longer period of time in order to trace and assign the occurrence of individual diagnostic events.

3.6.2 Diagnostics in the device view

In the device view, you receive the status display for the individual modules via diagnostic icons. These can be found in various places in the TIA Portal.



Picture 10 Diagnostics icon Device view

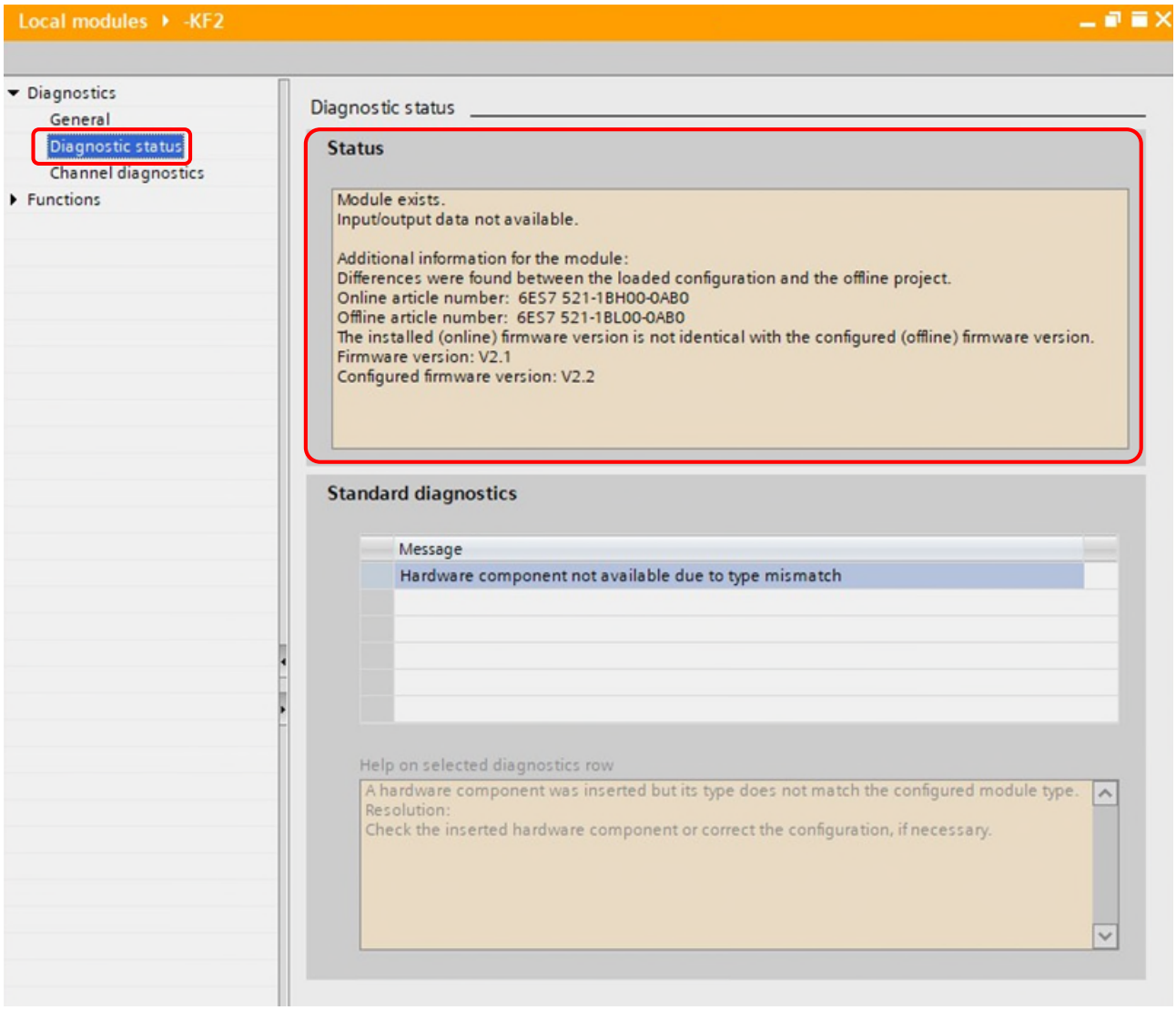
Fault categorization

The following symbols are used to categorize faults quickly and easily.

Icon	Meaning
	Operating status "RUN"
	Operating status "STOP"
	Start-up" operating state
	No interference
	Maintenance requirements
	Maintenance request
	Error

Table 1 System diagnostics symbols

Double-click on the diagnostics symbol to start the online and diagnostics view (if available). The status of the module is displayed here under "Diagnostics→ Diagnostic status". If the module is not working properly, the error that was diagnosed is listed here. In most cases, corrective measures are also indicated.



Picture 11 Diagnostic status component

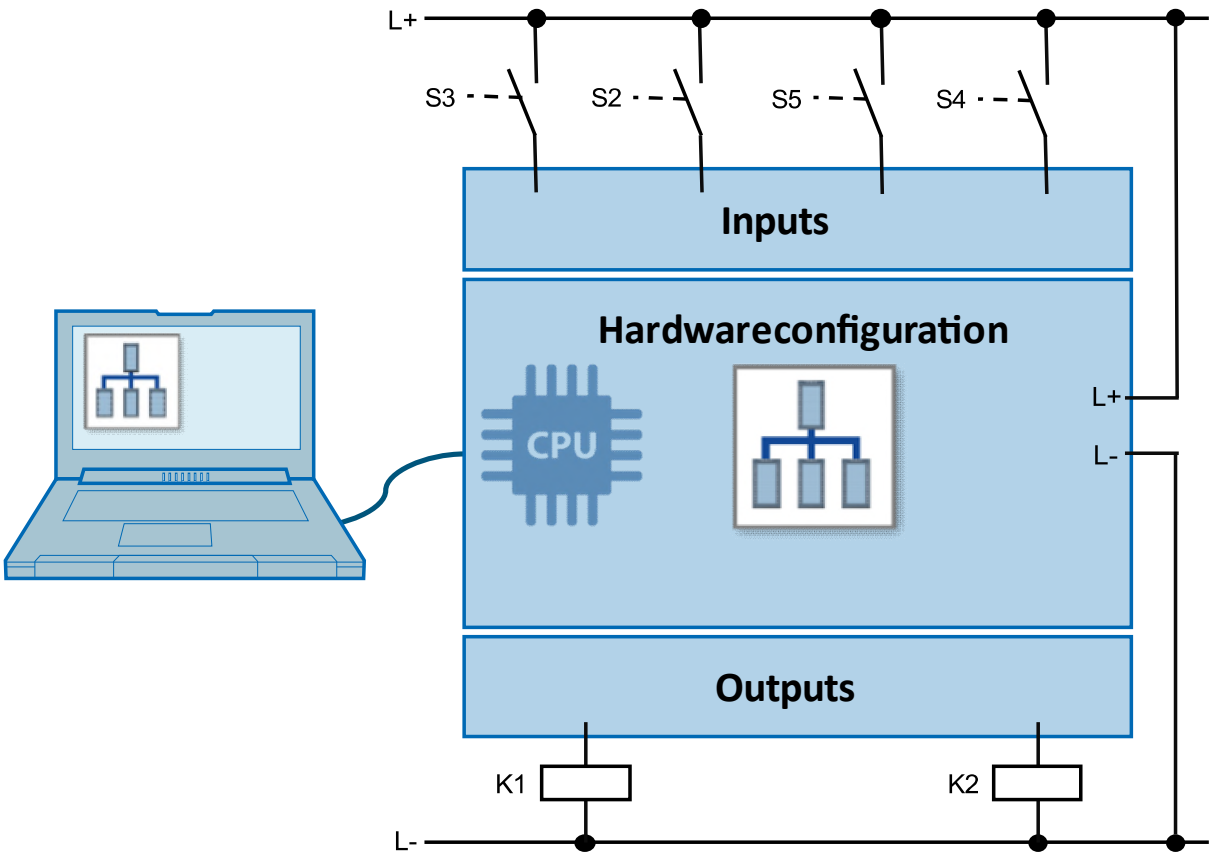
3.7 Exercise: Commissioning the hardware project planning

Target:

I can put the PLC hardware into operation independently.

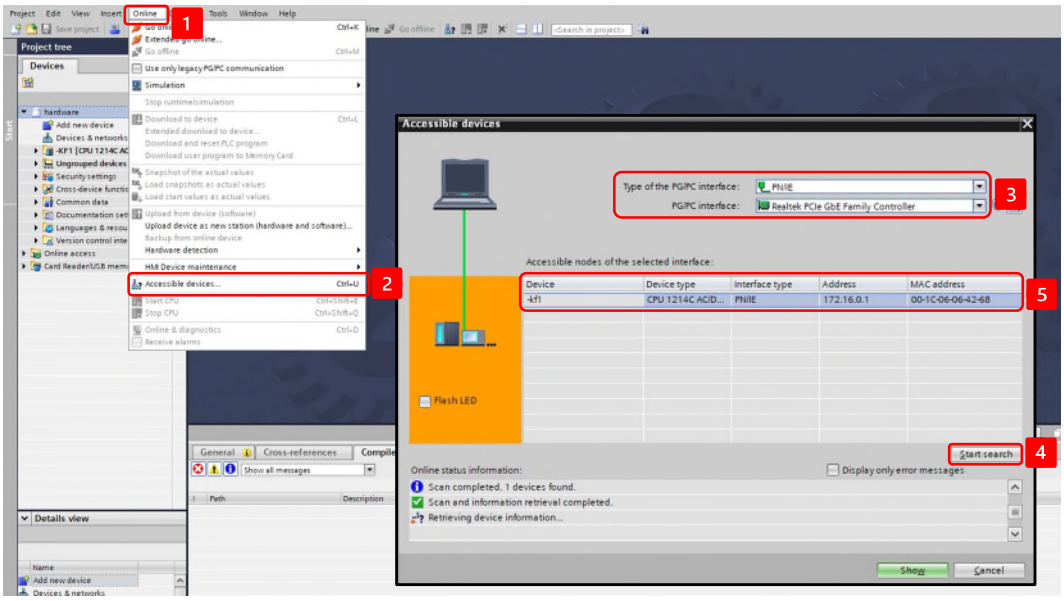
Task:

Connect the PLC to the programming device and transfer the PLC hardware by loading the configuration data into the device.

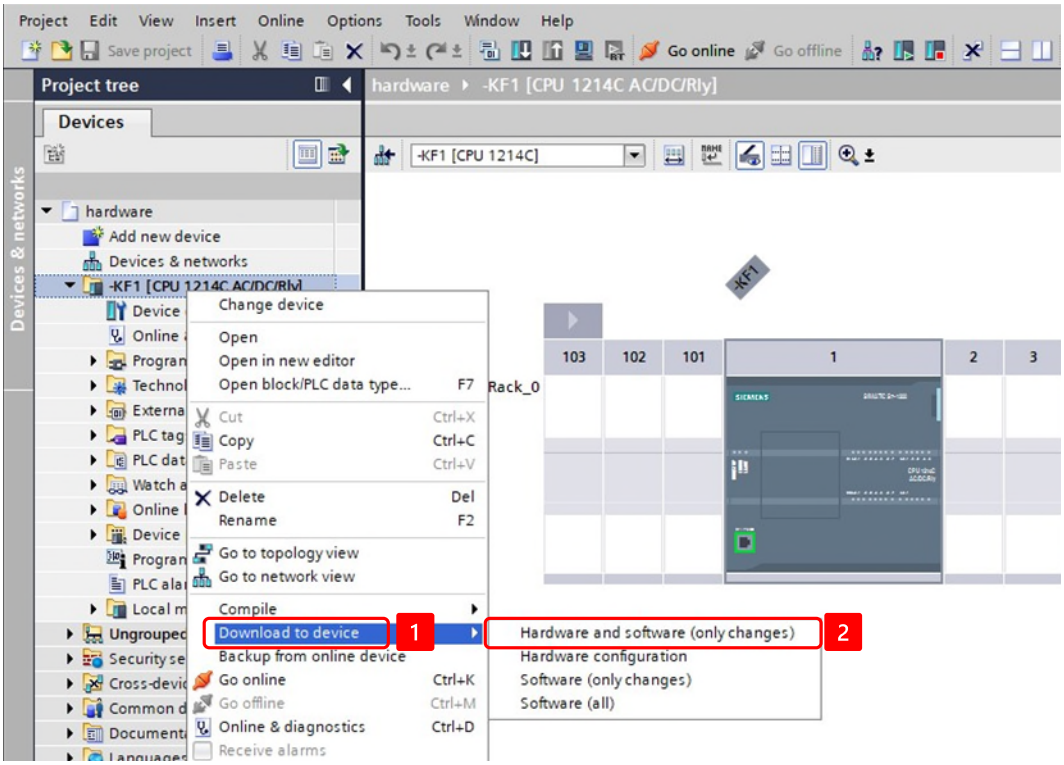


Procedure:

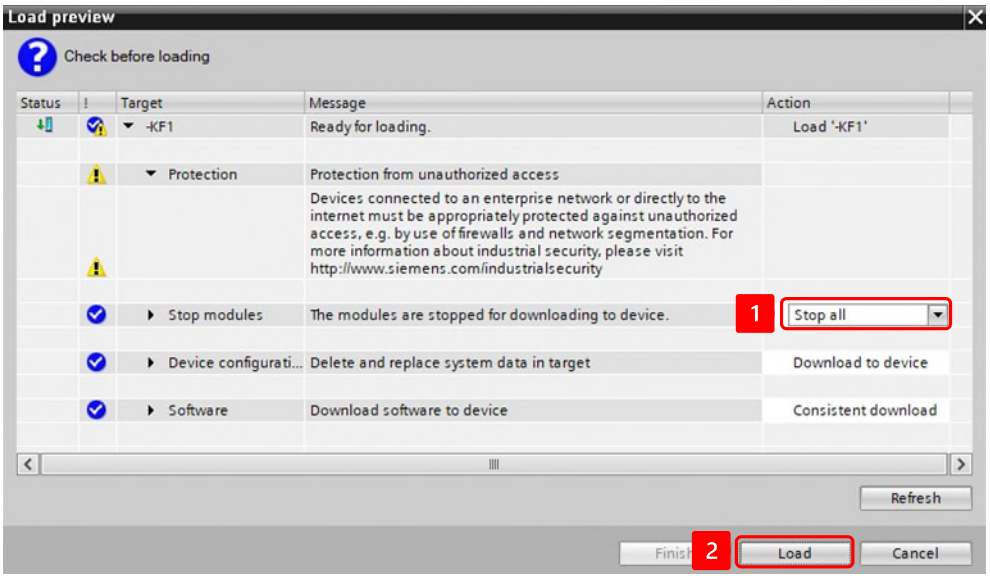
1. Check whether a connection to the target system can be established using "Reachable subscribers":



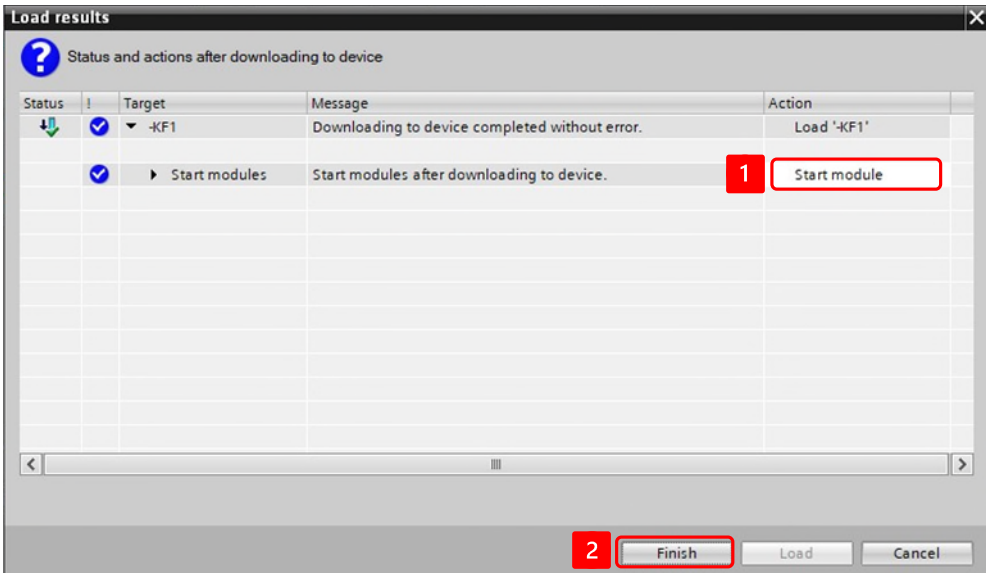
2. Select your PLC in the project navigation and choose in the context menu of the right mouse button:
"Load in device"→ "Hardware and software (changes only)".



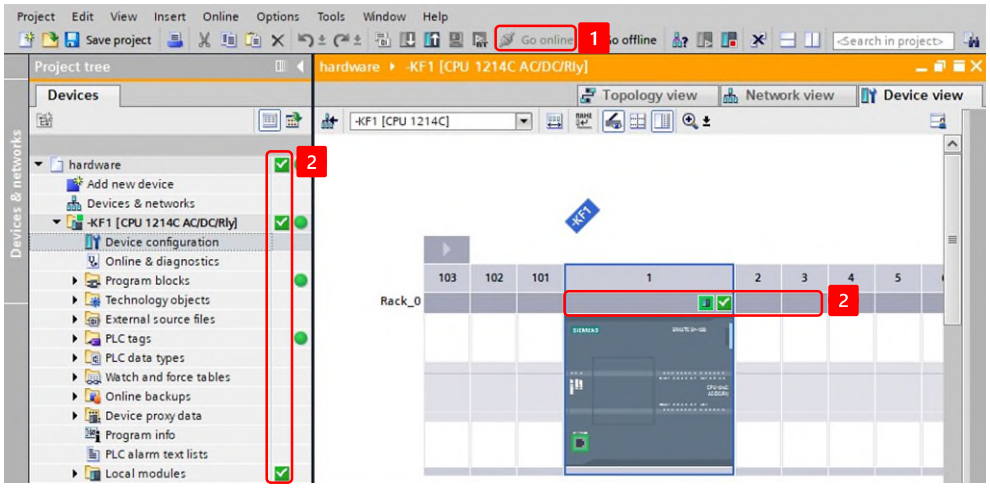
3. Follow the "Load preview" window:



4. After the successful loading process, start the PLC.



5. If the PLC is now in RUN mode and is fault-free, the exercise is complete.



3.8 I/O check

An I/O check (input/output check) is an essential step during commissioning. It is used to ensure that all inputs and outputs are correctly wired to the PLC and are functioning properly. This check is crucial in order to identify possible sources of error at an early stage and to ensure that the system works as planned.

The I/O check is so important because an incorrect assignment or a defective sensor/actuator in a PLC system can have serious consequences, such as system downtimes, unexpected movements of machines or even accidents. The I/O check ensures that each input variable (e.g. button, sensor) reacts correctly to the PLC and that each output variable (e.g. motor, valve) shows the desired behavior.

Due to possible faulty wiring, unwanted system reactions may occur during the I/O check. A careful and considered approach must be taken to ensure that any remaining wiring or hardware faults do not pose a risk to people, the environment or system components at any time.

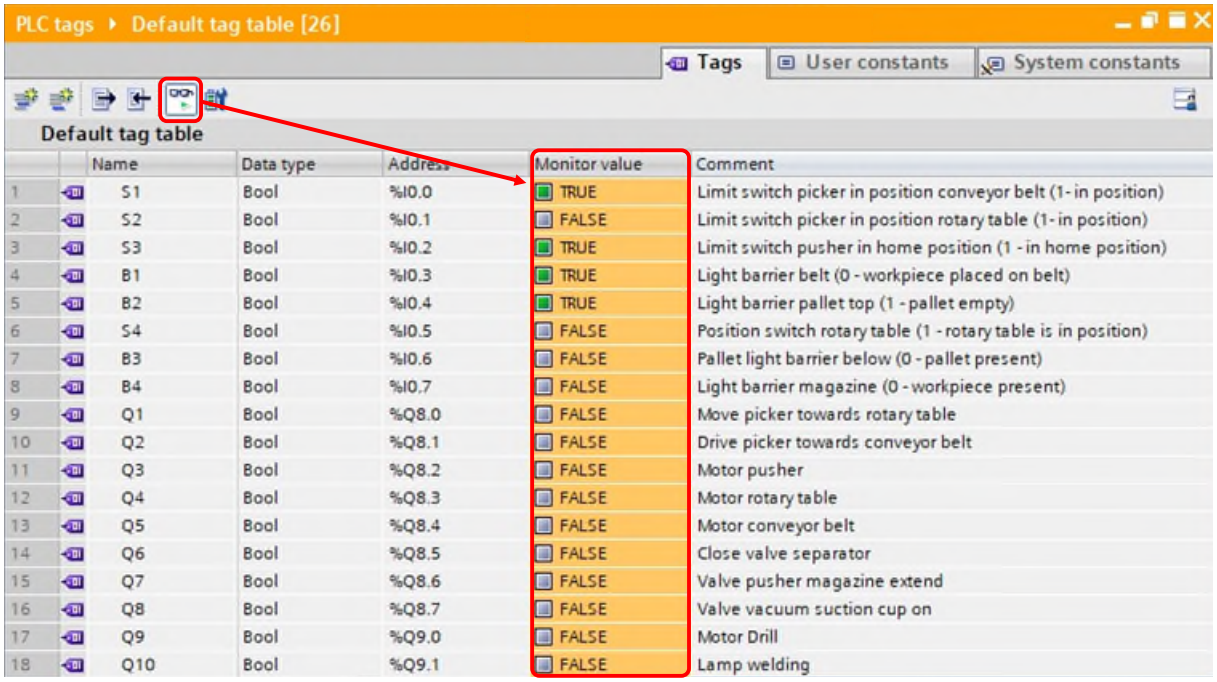
Ideally, an I/O check is carried out when no control program is being processed. In this way, the manually activated outputs are not overwritten and manually activated sensors do not result in a program response.

Depending on the target system, the following tools are available:

- Monitoring table (Siemens) / Monitoring list (Beckhoff)
- PLC variable table (Siemens) / Global variable list (Beckhoff)

3.8.1 PLC variable table

You can use the PLC variable table to put the peripheral inputs into operation. take.



		Name	Data type	Address	Monitor value	Comment
1		S1	Bool	%I0.0	TRUE	Limit switch picker in position conveyor belt (1- in position)
2		S2	Bool	%I0.1	FALSE	Limit switch picker in position rotary table (1- in position)
3		S3	Bool	%I0.2	TRUE	Limit switch pusher in home position (1 - in home position)
4		B1	Bool	%I0.3	TRUE	Light barrier belt (0 - workpiece placed on belt)
5		B2	Bool	%I0.4	TRUE	Light barrier pallet top (1 - pallet empty)
6		S4	Bool	%I0.5	FALSE	Position switch rotary table (1 - rotary table is in position)
7		B3	Bool	%I0.6	FALSE	Pallet light barrier below (0 - pallet present)
8		B4	Bool	%I0.7	FALSE	Light barrier magazine (0 - workpiece present)
9		Q1	Bool	%Q8.0	FALSE	Move picker towards rotary table
10		Q2	Bool	%Q8.1	FALSE	Drive picker towards conveyor belt
11		Q3	Bool	%Q8.2	FALSE	Motor pusher
12		Q4	Bool	%Q8.3	FALSE	Motor rotary table
13		Q5	Bool	%Q8.4	FALSE	Motor conveyor belt
14		Q6	Bool	%Q8.5	FALSE	Close valve separator
15		Q7	Bool	%Q8.6	FALSE	Valve pusher magazine extend
16		Q8	Bool	%Q8.7	FALSE	Valve vacuum suction cup on
17		Q9	Bool	%Q9.0	FALSE	Motor Drill
18		Q10	Bool	%Q9.1	FALSE	Lamp welding

Picture 12 PLC variable table

Check inputs

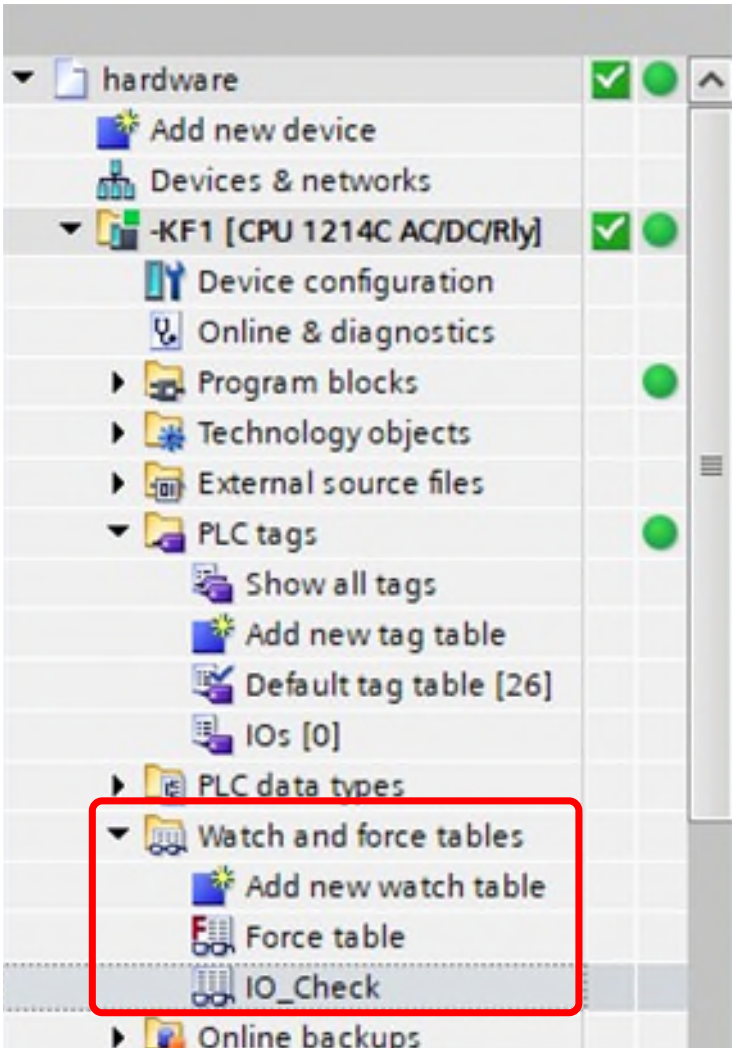
Inputs can be monitored in the variable table, making the function suitable for testing input modules and encoder circuits. This allows you to check the status of inputs that are read in from the process image (PAE).
Click on the "Monitor all" icon to monitor. The Observation values column appears, in which you can observe the values.

Check outputs

Outputs cannot be controlled or changed in the PLC variable table. They can only be monitored here. The watch table must be used to change the status of an output.

3.8.2 Observation table

In monitoring tables, you have the option of monitoring and also controlling variables from different PLC variable tables in one place.
There must be an online connection to the PLC to monitor variables. Once you have created an observation table, you can save it, duplicate it, print it out and use it again and again to observe and control variables.
You will find the observation tables in the "Observation and force tables" folder in the project navigation of your PLC. Several watch tables can be created. The names can be freely chosen.



Picture 13 Observation table - project navigation

The following image shows an open observation table. Some variables have already been entered.

Fertigungslinie 24V ▸ -KF1 [CPU 1214C DC/DC/Rly] ▸ Watch and force tables ▸ IO-Check

	i	Name	Address	Display format	Monitor value	Modify value		Comment	Tag comment
1		// Inputs							
2		"S1"	%I0.0	Bool	FALSE		☐		Limit switch picker in position conveyor belt (1- in position)
3		"S2"	%I0.1	Bool	FALSE		☐		Limit switch picker in position rotary table (1- in position)
4		"S3"	%I0.2	Bool	FALSE		☐		Limit switch pusher in home position (1 - in home position)
5		"B1"	%I0.3	Bool	FALSE		☐		Light barrier belt (0 - workpiece placed on belt)
6		"B2"	%I0.4	Bool	FALSE		☐		Light barrier pallet top (1 - pallet empty)
7		"S4"	%I0.5	Bool	FALSE		☐		Position switch rotary table (1 - rotary table is in position)
8		"B3"	%I0.6	Bool	FALSE		☐		Pallet light barrier below (0 - pallet present)
9		"B4"	%I0.7	Bool	FALSE		☐		Light barrier magazine (0 - workpiece present)
10		// Outputs							
11		"Q1"	%Q8.0	Bool	FALSE	TRUE	☑ ⚠		Move picker towards rotary table
12		"Q2"	%Q8.1	Bool	FALSE		☐		Drive picker towards conveyor belt
13		"Q3"	%Q8.2	Bool	FALSE	TRUE	☑ ⚠		Motor pusher
14		"Q4"	%Q8.3	Bool	FALSE		☐		Motor rotary table
15		"Q5"	%Q8.4	Bool	FALSE		☐		Motor conveyor belt
16		"Q6"	%Q8.5	Bool	FALSE		☐		Close valve separator
17		"Q7"	%Q8.6	Bool	FALSE		☐		Valve pusher magazine extend
18		"Q8"	%Q8.7	Bool	FALSE		☐		Valve vacuum suction cup on
19		"Q9"	%Q9.0	Bool	FALSE		☐		Motor Drill
20		"Q10"	%Q9.1	Bool	FALSE		☐		Lamp welding

Picture 14 View of observation table

The structure is very similar to the PLC variable table. However, the names of the variables cannot be changed.

Add observation table

To create an observation table, proceed as follows:

1. In the project navigation, open the structure below the PLC for which you want to create a watch table.
2. Open the "Observation and force tables" folder.
3. Double-click on the "Add new observation table" command.
4. A new observation table is added.

Different test cases

You can create several watch tables via "Add new watch table" and name them according to a specific test case. These observation tables are always part of the project.

Check inputs

Inputs can be monitored in the monitoring table. This makes the function suitable for checking the input modules and the encoder circuits. This allows you to check the status of inputs that are read in from the process image.

Control outputs

At the same time, individual outputs can be switched using the "Control" test function. The function of the connected actuators can thus be checked.

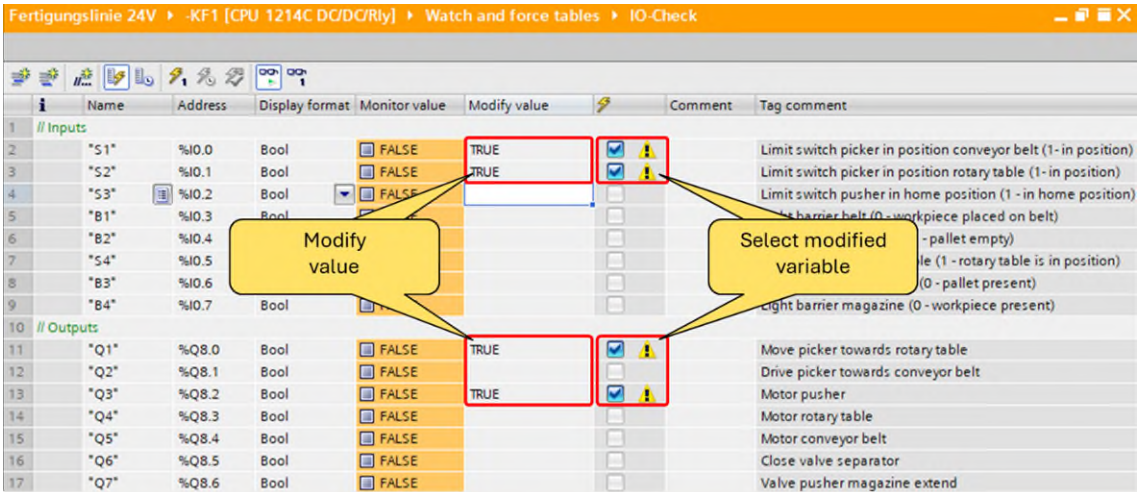
You need the following operating elements for monitoring or controlling:

Icon	Meaning
	Showing and hiding the control columns
	Switching the monitoring function on and off
	One-time control of the selected PLC variable "Control flash"

Table 2 Symbols Observation table

Procedure Observe

1. Enter the name of the variable in the "Name" column.
2. Start the monitoring function (glasses with green triangle).



Picture 15 Control variable

Procedure Taxes

1. Enter the name of the variable in the "Name" column.
2. Start the monitoring function (glasses with green triangle).
3. Activate the control columns.
4. Enter the desired value in the "Tax value" column.
5. For a binary signal, this will be 0 or "FALSE" or 1 or "TRUE".
6. Activate the "control flash".

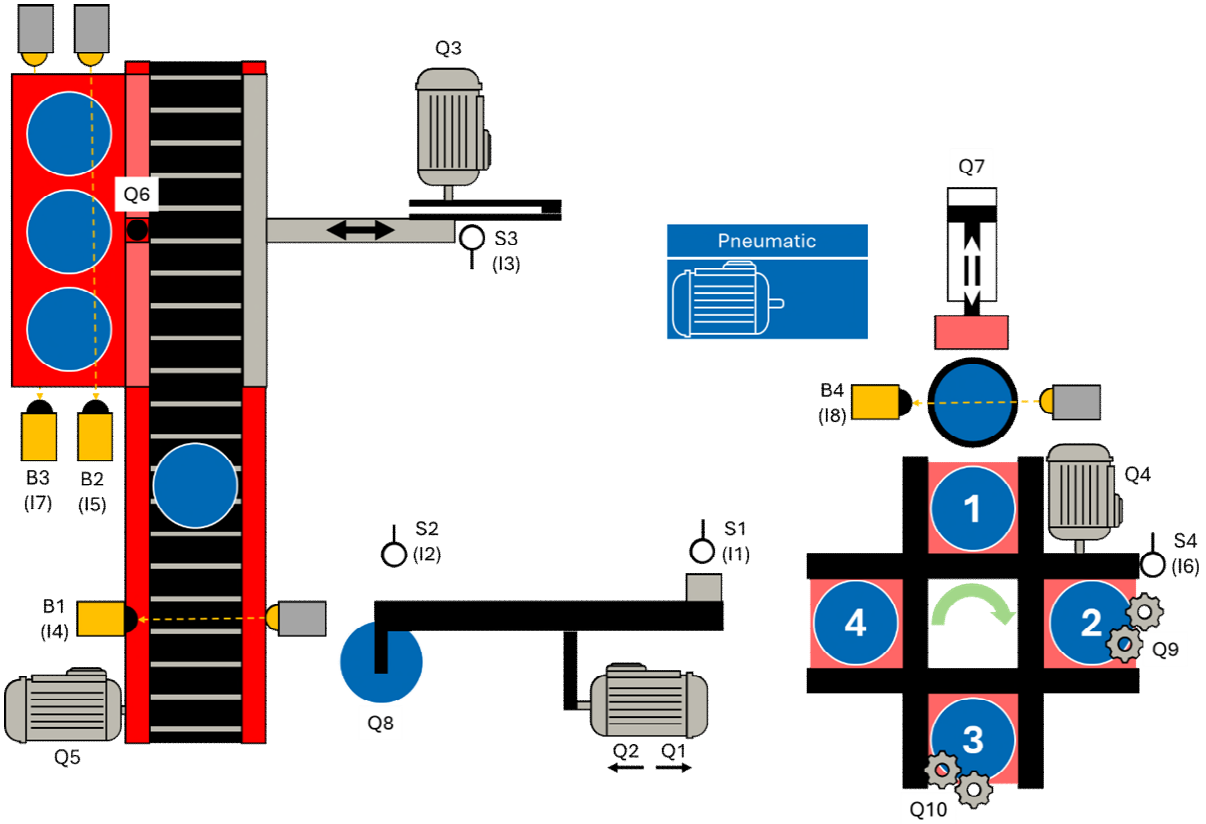
3.8.3 Exercise: Performing an I/O check

Target:

I can check connected peripheral modules.

Task:

Check the correct wiring of the inputs and outputs of your PLC using an observation table.

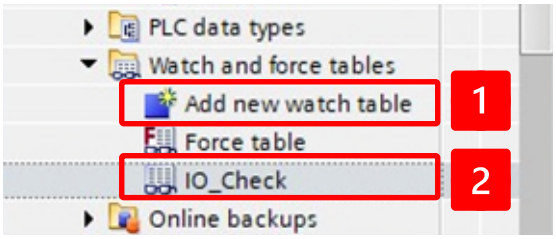


When controlling the converter, make sure that it does not move to its end positions, otherwise it will block. If the motor stalls, this can lead to an overload.

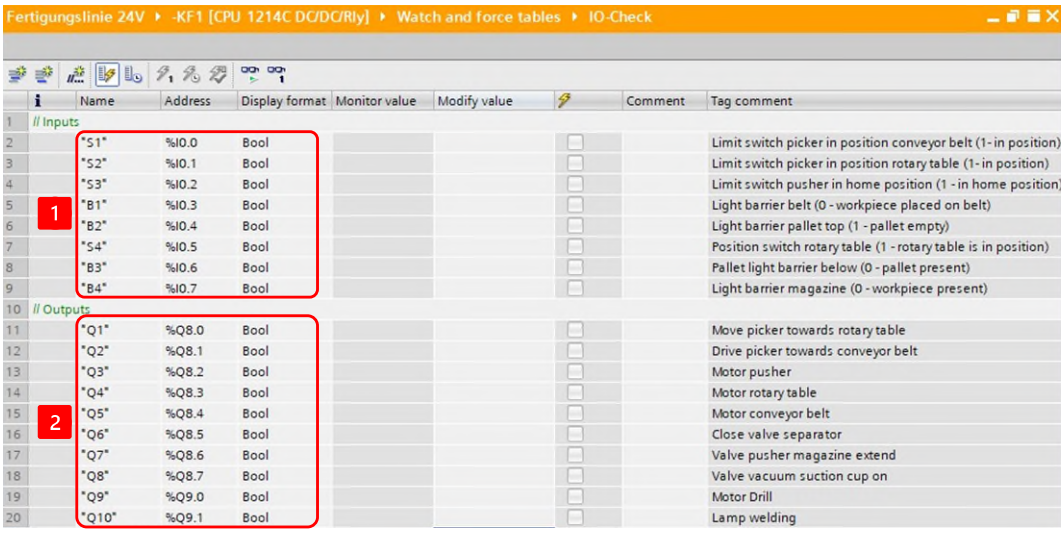
A variable selected in the observation table can be immediately set to "TRUE" using the shortcut "Ctrl + F2" and to "FALSE" using "Ctrl + F3". This can be a helpful tool to avoid overrunning the end position.

Procedure:

1. Use the "Add new watch table" button to add a new watch table and assign a meaningful name (e.g. "IO check"):

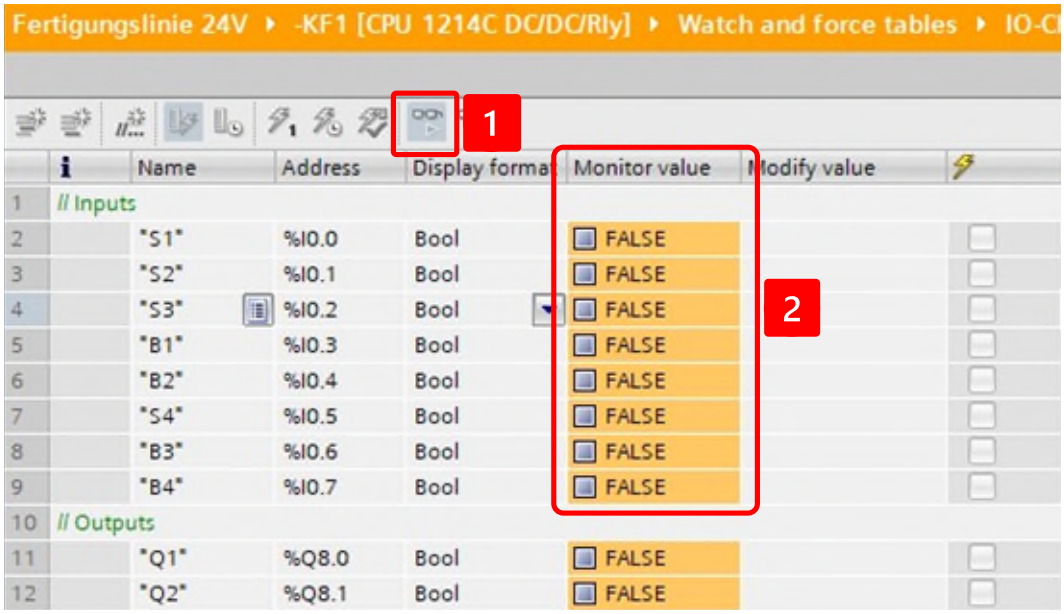


2. Enter the variables from your PLC variable table:



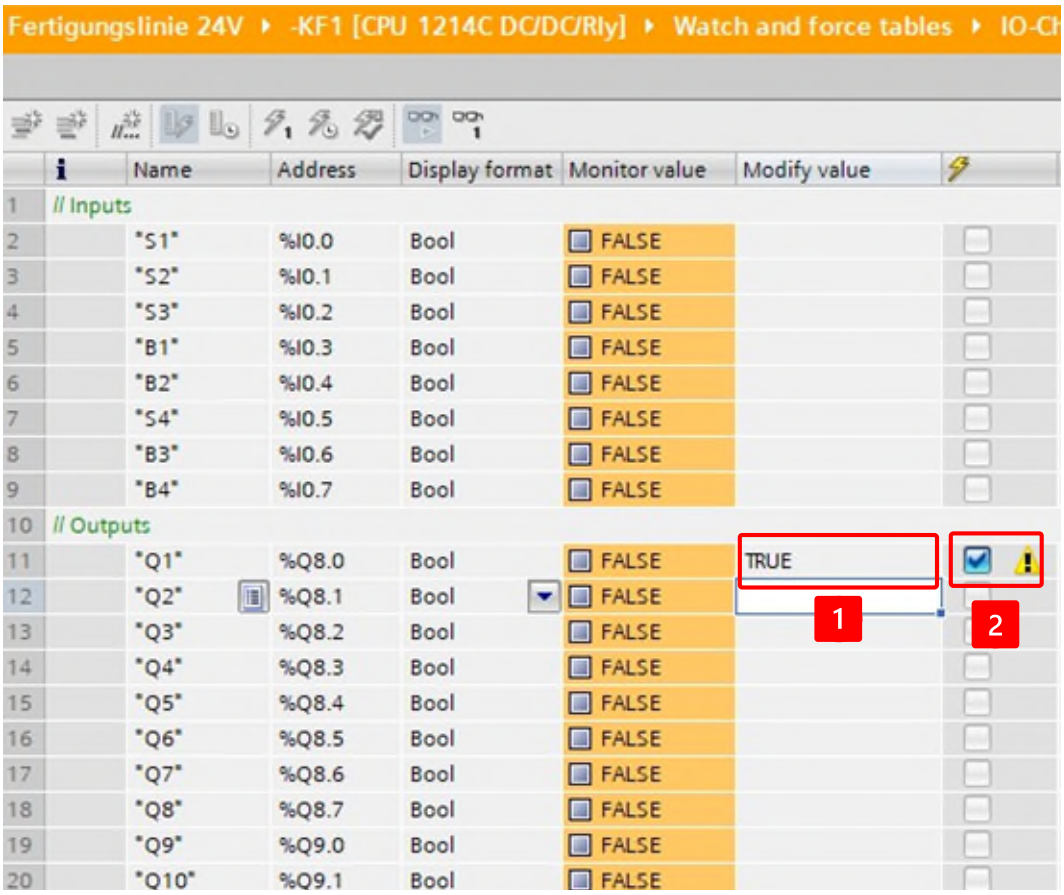
	Name	Address	Display format	Monitor value	Modify value	Comment	Tag comment
1	// Inputs						
2	"S1"	%I0.0	Bool				Limit switch picker in position conveyor belt (1 - in position)
3	"S2"	%I0.1	Bool				Limit switch picker in position rotary table (1 - in position)
4	"S3"	%I0.2	Bool				Limit switch pusher in home position (1 - in home position)
5	"B1"	%I0.3	Bool				Light barrier belt (0 - workpiece placed on belt)
6	"B2"	%I0.4	Bool				Light barrier pallet top (1 - pallet empty)
7	"S4"	%I0.5	Bool				Position switch rotary table (1 - rotary table is in position)
8	"B3"	%I0.6	Bool				Pallet light barrier below (0 - pallet present)
9	"B4"	%I0.7	Bool				Light barrier magazine (0 - workpiece present)
10	// Outputs						
11	"Q1"	%Q8.0	Bool				Move picker towards rotary table
12	"Q2"	%Q8.1	Bool				Drive picker towards conveyor belt
13	"Q3"	%Q8.2	Bool				Motor pusher
14	"Q4"	%Q8.3	Bool				Motor rotary table
15	"Q5"	%Q8.4	Bool				Motor conveyor belt
16	"Q6"	%Q8.5	Bool				Close valve separator
17	"Q7"	%Q8.6	Bool				Valve pusher magazine extend
18	"Q8"	%Q8.7	Bool				Valve vacuum suction cup on
19	"Q9"	%Q9.0	Bool				Motor Drill
20	"Q10"	%Q9.1	Bool				Lamp welding

3. Start the observation with the "glasses"  . Manually operate all sensors and check that they are correctly wired and functioning:



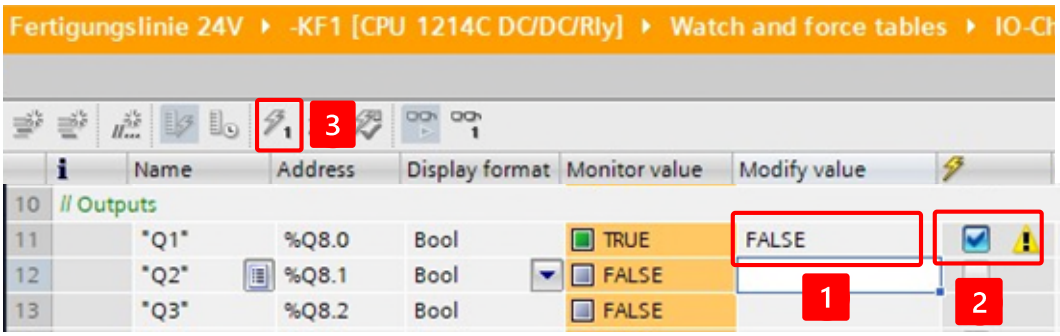
	Name	Address	Display format	Monitor value	Modify value
1	// Inputs				
2	"S1"	%I0.0	Bool	FALSE	
3	"S2"	%I0.1	Bool	FALSE	
4	"S3"	%I0.2	Bool	FALSE	
5	"B1"	%I0.3	Bool	FALSE	
6	"B2"	%I0.4	Bool	FALSE	
7	"S4"	%I0.5	Bool	FALSE	
8	"B3"	%I0.6	Bool	FALSE	
9	"B4"	%I0.7	Bool	FALSE	
10	// Outputs				
11	"Q1"	%Q8.0	Bool	FALSE	
12	"Q2"	%Q8.1	Bool	FALSE	

4. Enter "TRUE" or "1" in the "Control value" column for the first output variable. Make sure that the variable also has a tick in the "Flash" column:



5. Press the button with the lightning bolt and the "1"  .

6. If the correct component is activated, enter "FALSE" or "0" for the output in the "Control value" column and press the flash again  :



7. Carry out procedure 4 - 6 for all outputs.