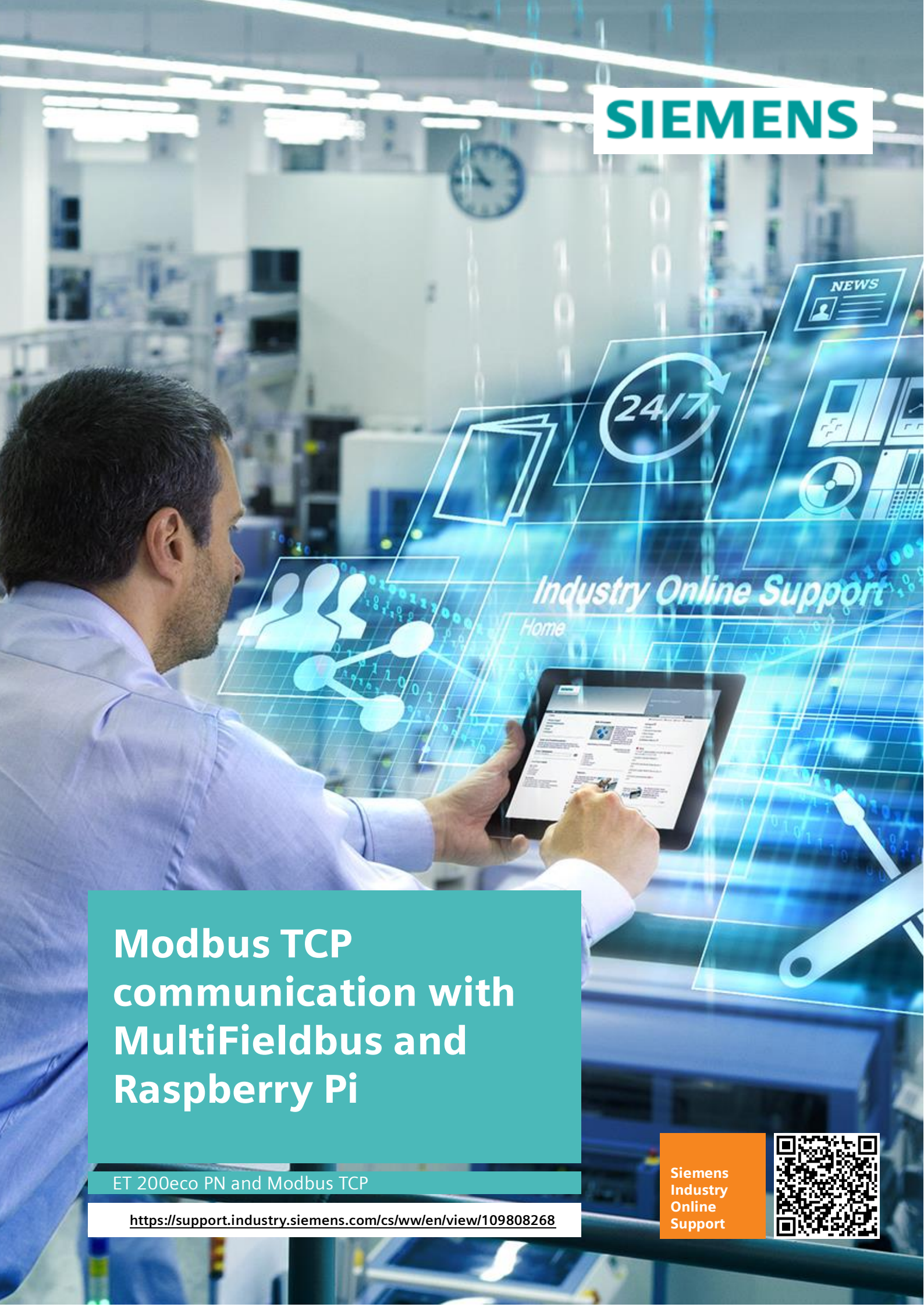

Modbus TCP communication with MultiFieldbus and Raspberry Pi

ET 200eco PN and Modbus TCP

https://support.industry.siemens.com/cs/ww/en/view/109808268

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Table of contents

1 Introduction

1.1 Overview

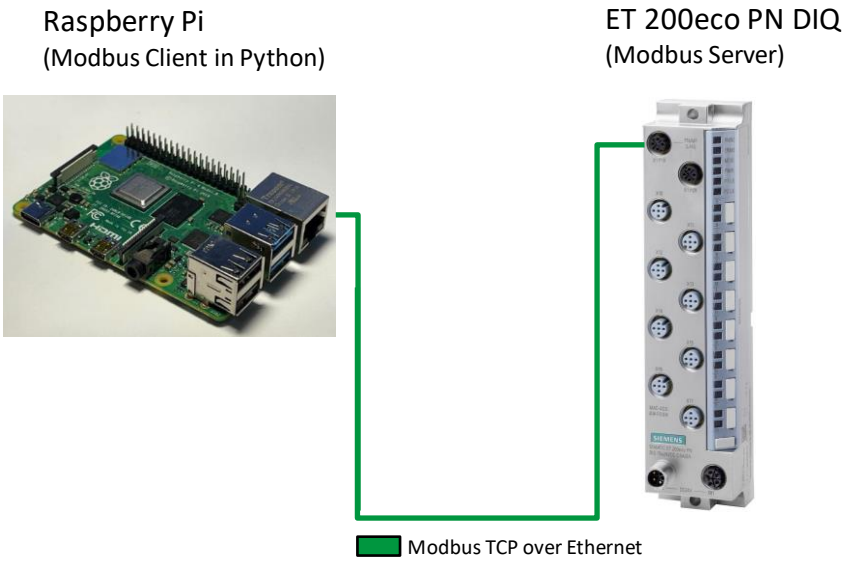
MultiFieldbus modules (e.g. the ET 200eco PN) can be run as a distributed I/O system either on a PROFINET controller or on an Ethernet/IP/Modbus TCP controller.

Note

For more information on the topic "SIMATIC MultiFieldbus", please refer to the following article: https://support.industry.siemens.com/cs/ww/en/view/109779189

This application example shows how a MultiFieldbus-capable ET 200eco PN on a Raspberry Pi can be controlled via Modbus TCP with the help of a simple Python program (controller).

Figure 1-1



1.2 Principle of operation

The Modbus TCP protocol can be employed to exchange data over an Ethernet connection between one or more Modbus TCP devices.

This application example describes data exchange, based on the Modbus TCP protocol, between a Modbus TCP client and a MultiFieldbus module.

The user program, realized in Python on a Raspberry Pi platform, implements the following functions:

- Establish connection between a Modbus TCP client (Raspberry Pi) and a Modbus TCP server (ET 200eco PN)

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- Implement cyclic program execution
- Read MultiFieldbus module digital inputs
- Write MultiFieldbus module digital outputs

We also describe all the steps necessary to configure the ET 200eco PN with the MFCT tool.

Note

Modbus TCP communication can also be implemented with a SIMATIC controller. The library and the description for SIMATIC controllers can be found in this article: https://support.industry.siemens.com/cs/ww/en/view/109803984

1.3 Components used

This application example was created with the following hardware and software components:

Table 1-1

Component	Quantity	Item number	Note
ET 200eco PN DIQ 16x24VDC/2A, M12-L	1	6ES7143-6BH00-0BB0	FW V5.1.1
Power M12 Cable Connector PRO	1	6GK1906-0EB00	FAQ: Which connectors and cables can you order for the distributed IO systems ET 200eco PN and ET 200eco? https://support.industry.siemens.com/cs/ww/en/view/109781065
PROFINET M12 plug connector, D-coded	1	6GK1901-0DB20-6AA0	
M12 PLUG STRAIGHT 5-PIN	1	3RK1902-4BA00-5AA0	
Raspberry Pi 4 B	1		Kernel version: 5.15 Debian version: 11 (bullseye) https://www.raspberrypi.com/
MultiFieldbus Configuration Tool (MFCT)	1		V1.3 SP1 https://support.industry.siemens.com/cs/ww/en/view/109773881

This application example consists of the following components:

Table 1-2

Component	File name	Note
Documentation	109808268_ModbusTCP_MF_DOC_V10_en.pdf	This document
Python program	109808268_ModbusTCP_MF_CODE_V10.zip	

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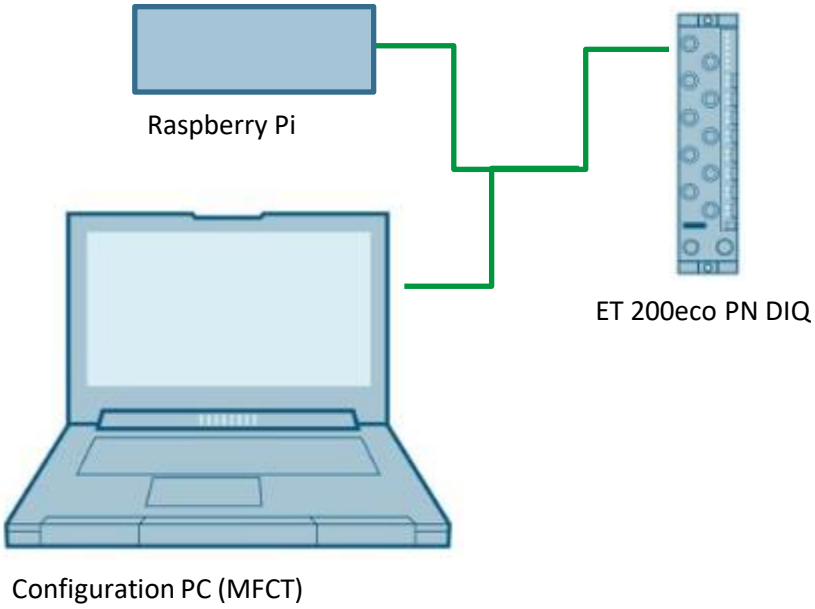
2 Engineering

2.1 Hardware setup

The ET 200eco PN module is connected over Ethernet with the project engineering PC and the Raspberry Pi, e.g. via a switch. The engineering PC is only required for the configuration of the ET 200eco PN.

Figure 2-1



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2.2 Configuration of the ET 200eco PN module

This application example uses the MultiFieldbus Configuration Tool (MFCT) for the configuration.

You can find an article on the tool at the following link:
https://support.industry.siemens.com/cs/ww/en/view/109773881

Refer to the following link for an FAQ on the topic "How can MultiFieldbus devices be configured and parameterized?":
https://support.industry.siemens.com/cs/ww/en/view/109778898

Wire up the ET 200eco PN according to the setup guidelines from the manual at https://support.industry.siemens.com/cs/ww/en/view/109781058. Use a 24 V power supply with the Power Connection cable and an M12-L plug/coupling.

Connect a PROFINET I/O M12-D plug cable to the M12 Ethernet port. Connect it to the configuration PC and Raspberry Pi via a switch.

Assign the module an IP address and a subnet mask using a tool such as MFCT or TIA Portal. Sample addresses:

- IP address: 192.168.187.143
- Subnet mask: 255.255.255.0

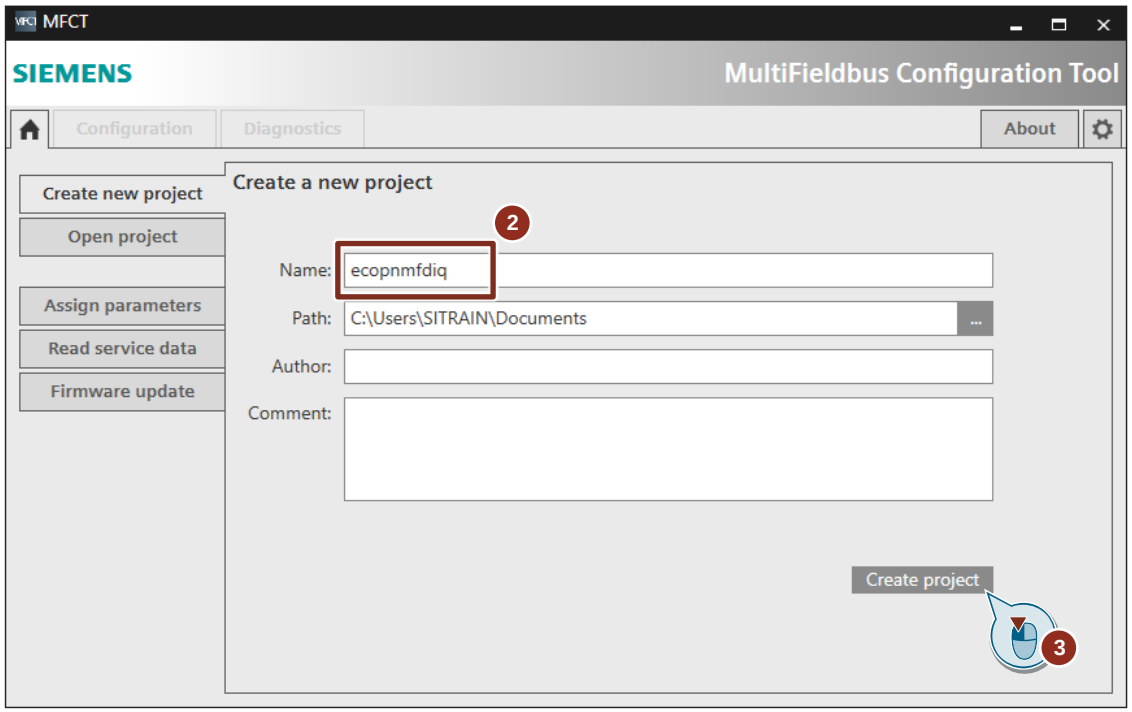
Only the steps relevant for this application example will be listed below.

1. Launch the MFCT tool on your configuration PC.

The tool starts with the "Create a new project" tab.

2. Assign a name for the project.
3. Click "Create project" to create the new project.

Figure 2-2



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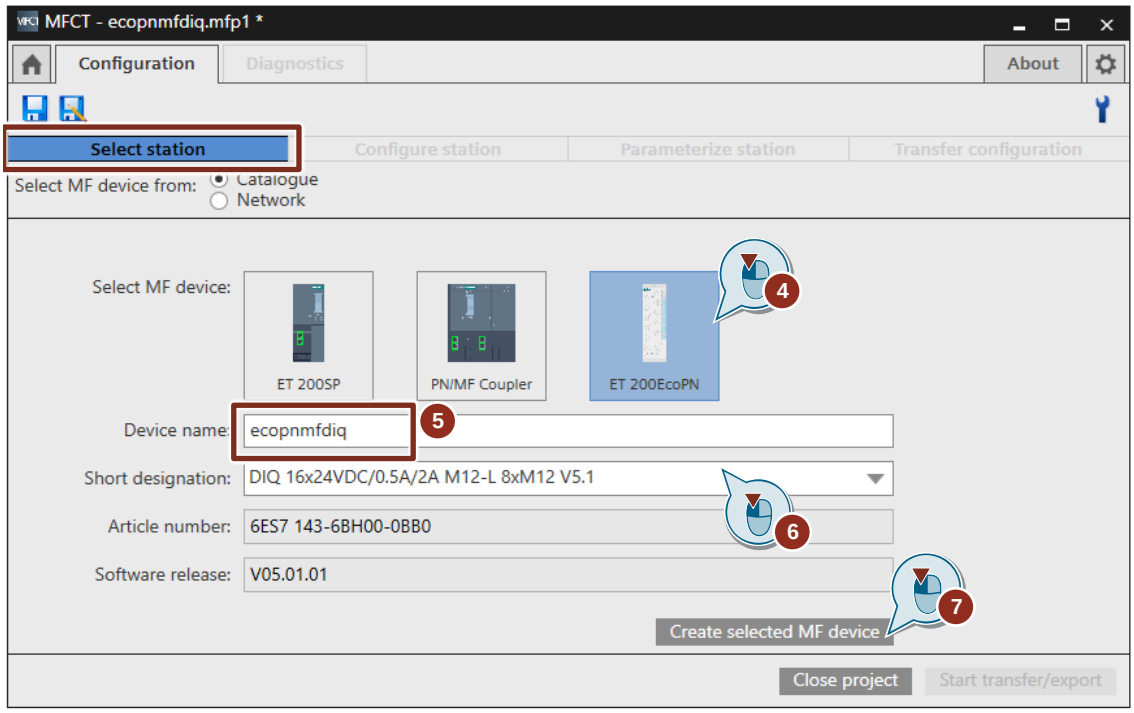
The project will be created and the tool will switch to the "Select station" tab.

4. Select your MF device.
   This application example uses the ET 200eco PN DIQ module.
5. Assign a name for the device.
6. Select the "DIQ" module from "Short designation".
7. Click "Create selected MF device" to create your MF device.

Figure 2-3



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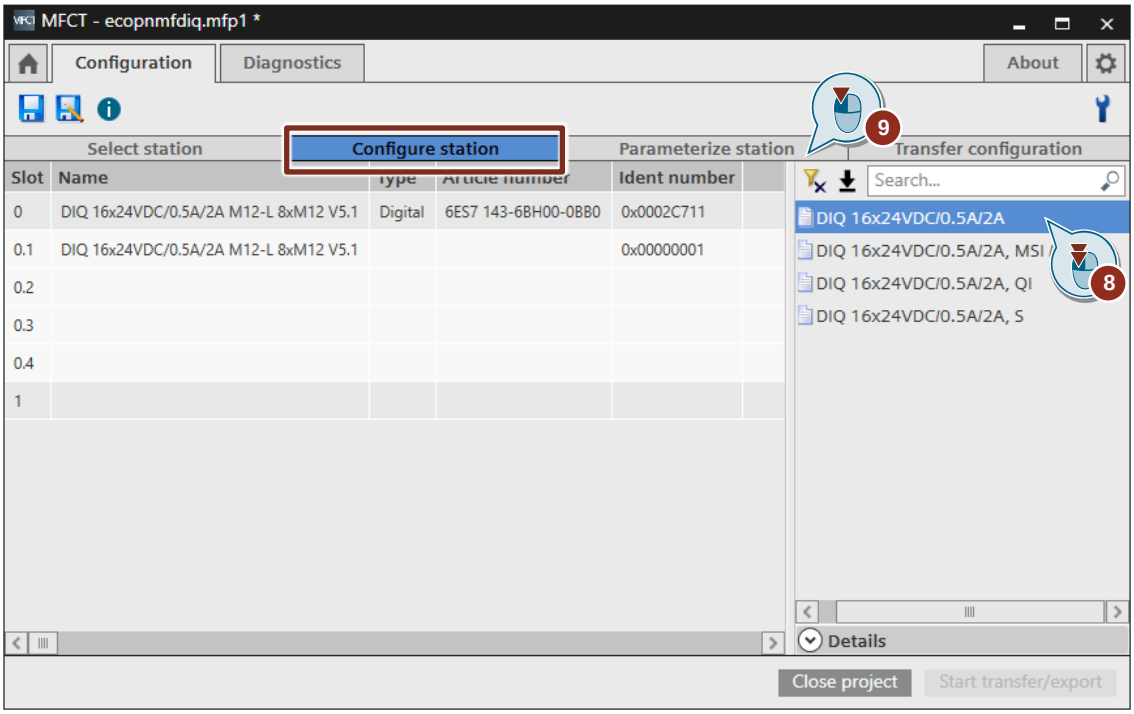
The MF device will be created and the tool will switch to the "Configure station" tab.

8. Double-click on "DIQ 16x24VDC/0.5A/2A" to add the module to your configuration.

Figure 2-4



9. Switch to the "Parameterize station" tab by clicking on the tab.
10. Set the "Fieldbus connection" to "Modbus TCP".
11. Click to select the DIQ module in "Slot 1".

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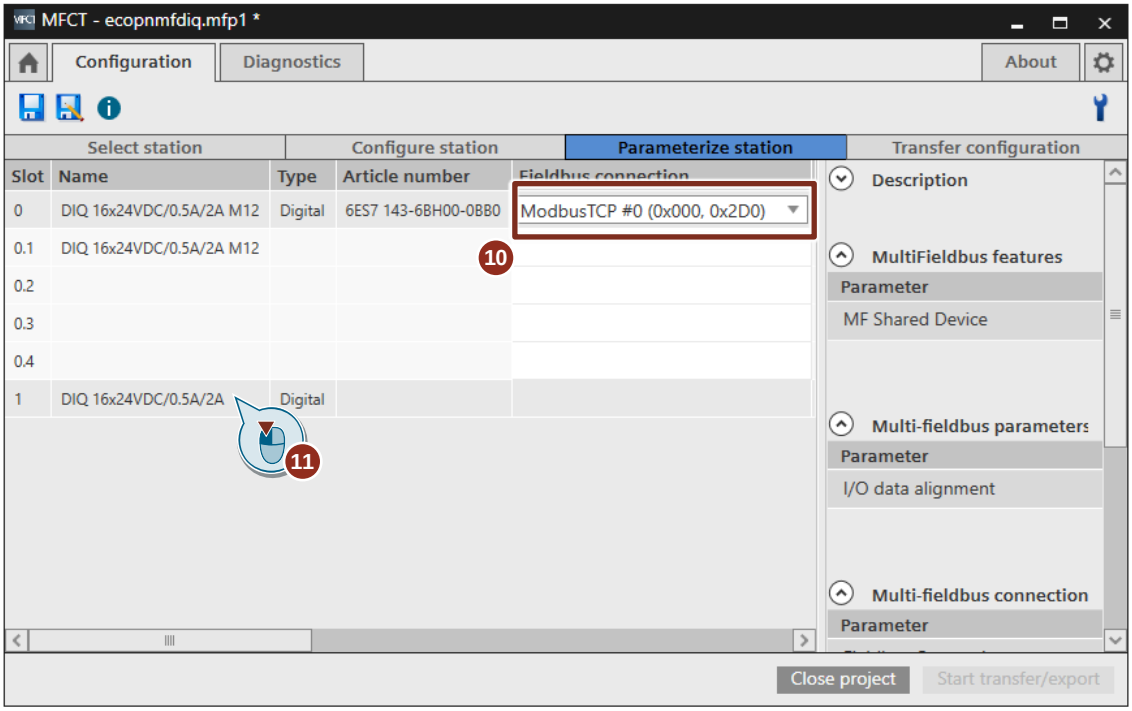
Figure 2-5



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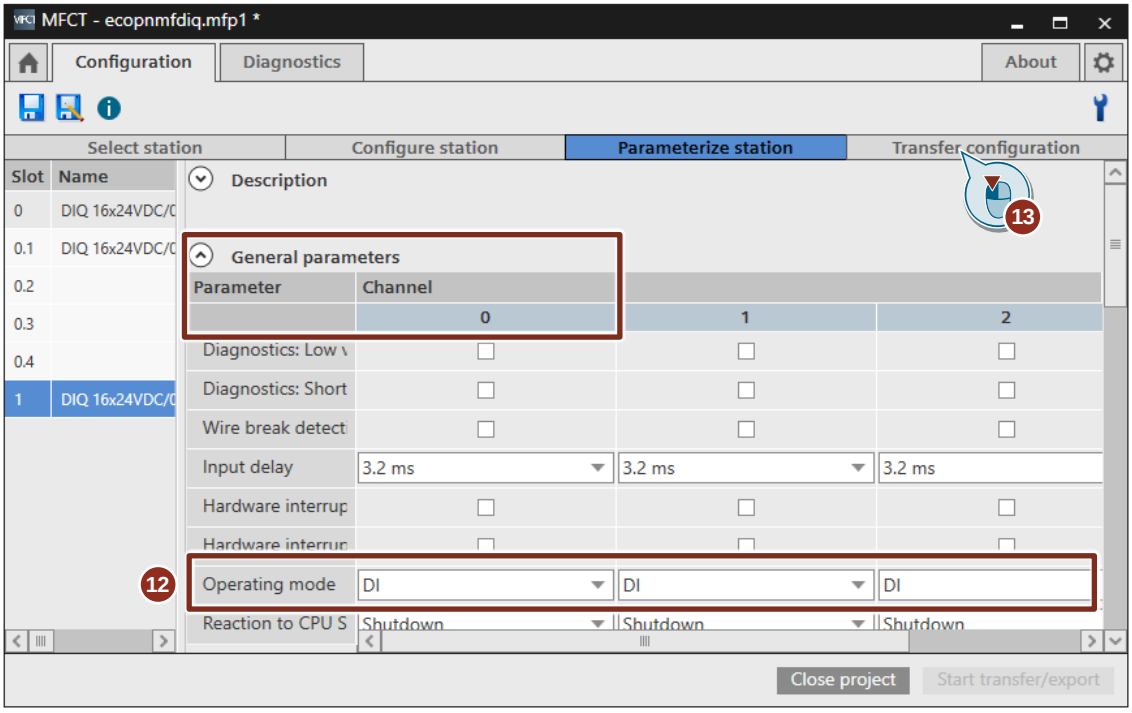
The parameters for this module will be displayed and can now be modified.

12. Set the "Operating mode" of "Channel" 0 through 7 to "DI". Set it to "DQ" for channels 8 through 15.
13. Change to the "Transfer Configuration" tab by clicking on it.

Figure 2-6



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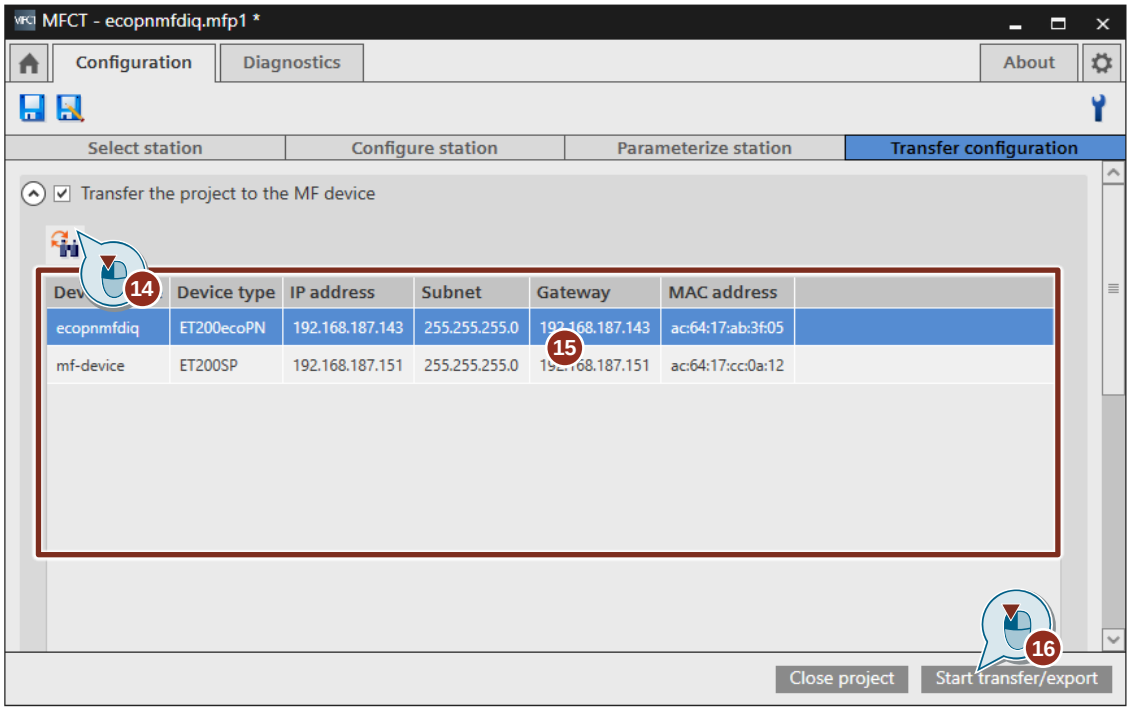
14. Start the scan process to search for available modules.
15. Select your module in the results pane.
16. Click "Start transfer/export" to initiate the transfer.

Figure 2-7



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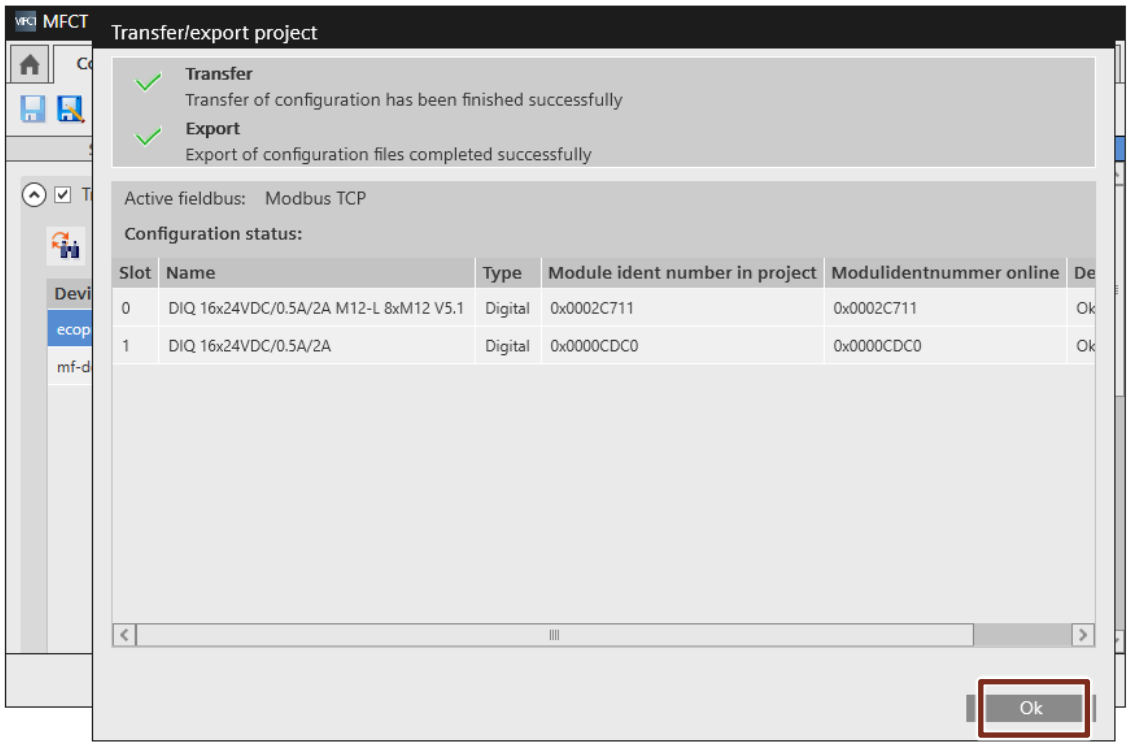
The "Transfer/export project" view will open.

Figure 2-8



The project has been transferred to the module. You can now confirm the transfer by clicking "OK" and then close the MFCT tool.

Result

The ET 200eco PN assembly is configured.

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Configuration file (.CSV)

A configuration file (.CSV) has also been created in the project directory. This file contains the structure of the registers in the module that can be read or written to.

These are parameters of the module that you can use for Modbus TCP communication, e.g.: registers 0 and 1 for inputs, registers 2 and 720 for outputs.

The "Data State" registers each describe the status/validity of the data.

Figure 2-9

FieldbusCon	Direction	RegAddr	Lo/Hi	ByteAddr	Slot	Subslot	DataItem	Submodule	BitAddr
ModbusTCP	INPUT	0	MSB	0	0	1	IDS	DIQ 16x24VDC/0.5A/2A M12-L 8xM12 V5.1 / Input Data State	0x0000
ModbusTCP	INPUT	0	LSB	1	1	1	Inputs_0	DIQ 16x24VDC/0.5A/2A	0x0008
ModbusTCP	INPUT	1	MSB	2	1	1	Inputs_1	DIQ 16x24VDC/0.5A/2A	0x0010
ModbusTCP	INPUT	1	LSB	3	1	1	IDS	DIQ 16x24VDC/0.5A/2A / Input Data State	0x0018
ModbusTCP	INPUT	2	MSB	4	1	1	ODS	DIQ 16x24VDC/0.5A/2A / Output Data State	0x0020
ModbusTCP	INPUT	2	LSB	5	-	-	-	Reserved	0x0028
ModbusTCP	OUTPUT	720	MSB	0	1	1	Outputs_0	DIQ 16x24VDC/0.5A/2A	0x0000
ModbusTCP	OUTPUT	720	LSB	1	1	1	Outputs_1	DIQ 16x24VDC/0.5A/2A	0x0008

Note

More information on the topic of "Modbus TCP registers" can be found in this article: https://support.industry.siemens.com/cs/ww/en/view/109773209

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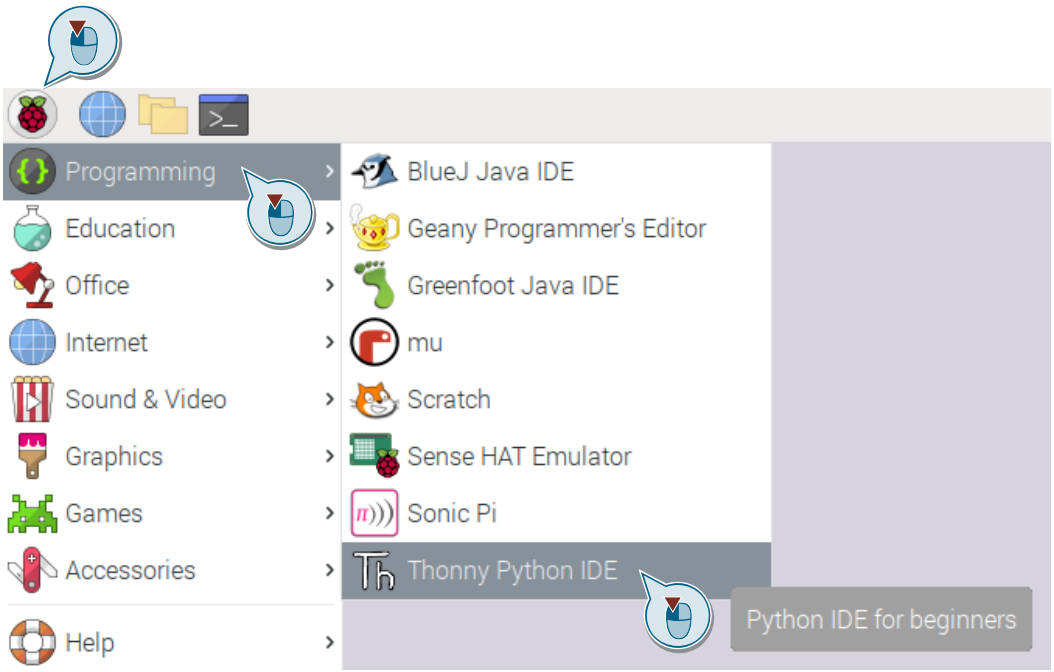
2.3 Configuration in the Raspberry Pi

The "Thonny Python IDE" development environment used in this application example is already installed in your version of "Raspberry Pi OS".

1. Launch "Thonny Python IDE".

Figure 2-10



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Install required software libraries

The Python program requires the following software libraries:

Table 2-1

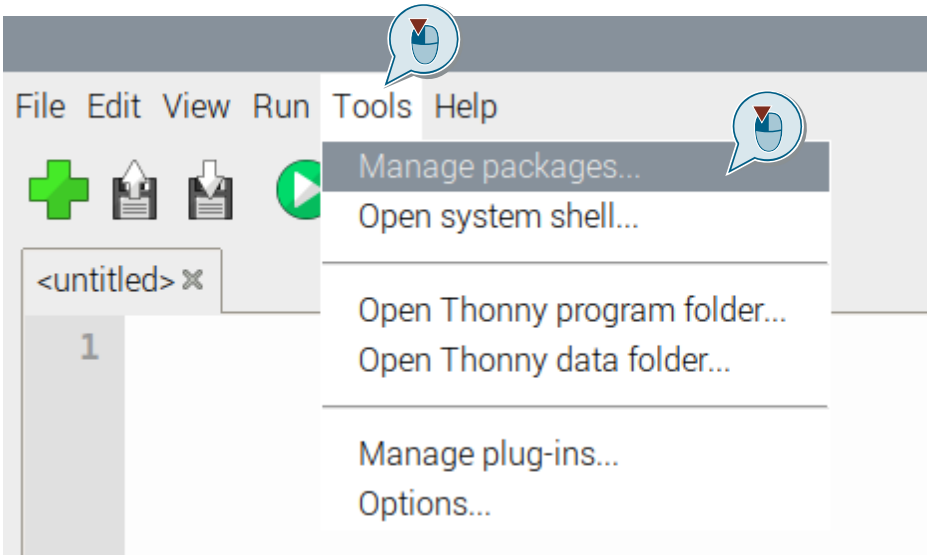
	Name	Description
1.	APScheduler	In-process task scheduler with Cron-like capabilities https://pypi.org/project/APScheduler/
2.	pyModbusTCP	Simple Modbus/TCP client library for Python https://pypi.org/project/pyModbusTCP/

Note

The necessary installation steps are described for the "Thonny Python IDE" development environment. Of course, you can also install these software libraries another way, for example with the terminal.

The "Manage packages" tool in the "Thonny Python IDE" lets you download additional libraries from the internet and install them on your device.

Figure 2-11



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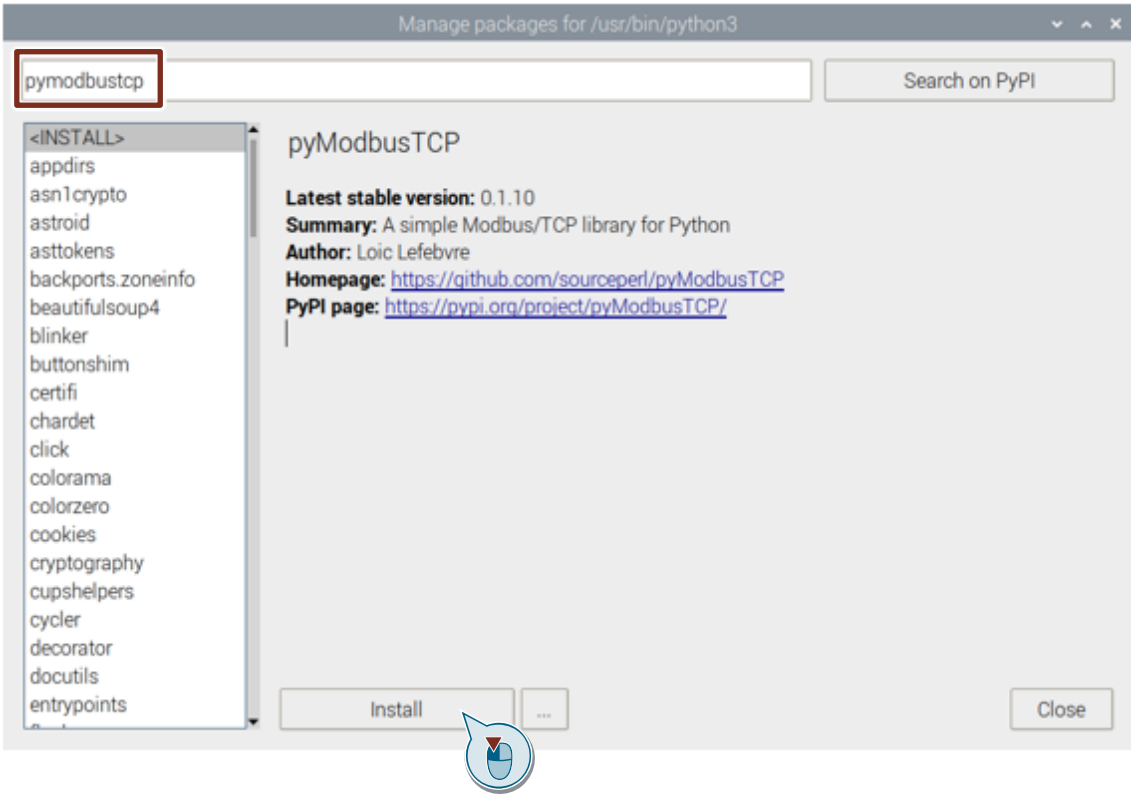
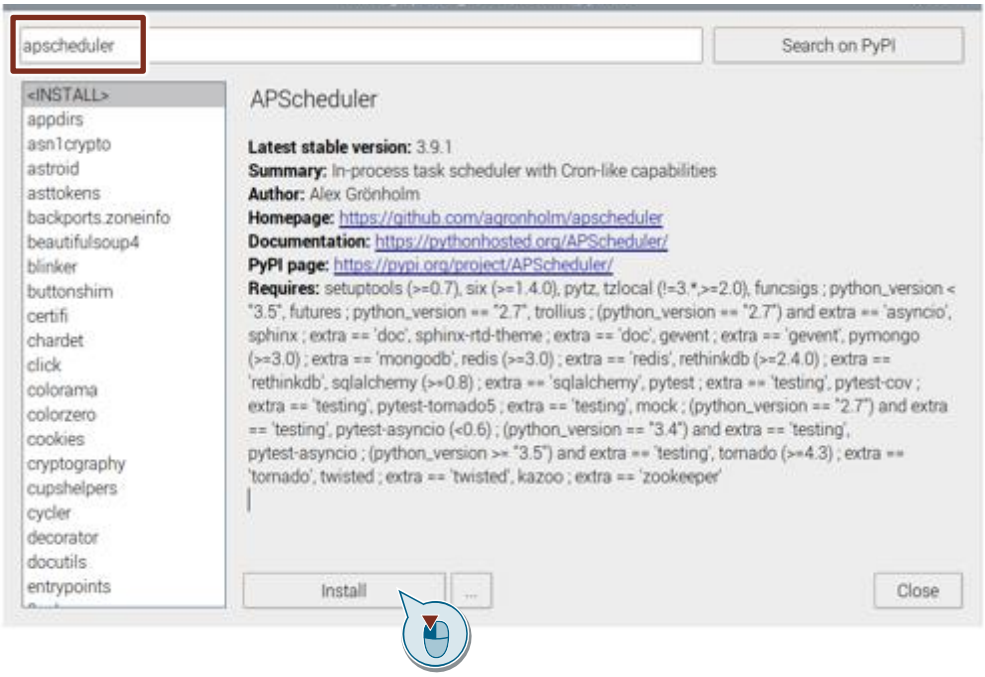
If you have not done so already, install the "pyModbusTCP" library.

Figure 2-12



If you have not done so already, install the "APScheduler" library.

Figure 2-13



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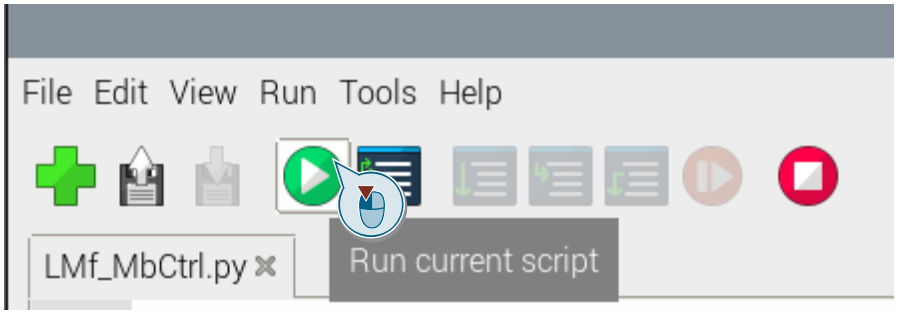
Python program

1. Extract the file "109808268_ModbusTCP_MF_CODE_V10.zip".
2. Transfer the Python program ("LMf_MbCtrl.py" file) to your Raspberry Pi, for example on a USB drive.
3. Adjust the IP address of your device to match the IP address of your MFB device. This application example uses the IP address 192.168.187.143 for the ET 200eco PN module.
4. Adjust the Modbus parameters if necessary. This application example uses the register address "0" for the inputs and "720" for the outputs. Here, compare the CSV file that was described above.
5. Run the program, for example by clicking the "PLAY" button.

Figure 2-14



Result

The program connects to the ET 200eco PN and reads/writes data via Modbus TCP.

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2.4 Python program

Refer to the following table for the meaning of selected methods:

Table 2-2: Central methods of the program sequence

Method	Meaning
mfMbCtrl()	This method is the main part of the program. Other methods are called inside of it.
readInputs()	This method reads the inputs. Methods from the "pyModbusTCP" library are used here.
writeOutputs()	This method writes the outputs. Methods from the "pyModbusTCP" library are used here.

The methods described above contain methods from the "pyModbusTCP" library. The exact method calls and the necessary parameters have already been described in sufficient detail in the Python program.

Cyclic task handling by the scheduler is derived from the installed "Apscheduler" library. The aforementioned "mfMbCtrl" method is passed here; the cycle time is set via the "seconds" parameter.

The following code activates the cyclic execution of the main part:

```
sched.add_job(mfMbCtrl, 'interval', seconds=…..)
sched.start()
```

You can modify the Python program to establish additional Modbus TCP connections to multiple MultiFieldbus modules, for example.

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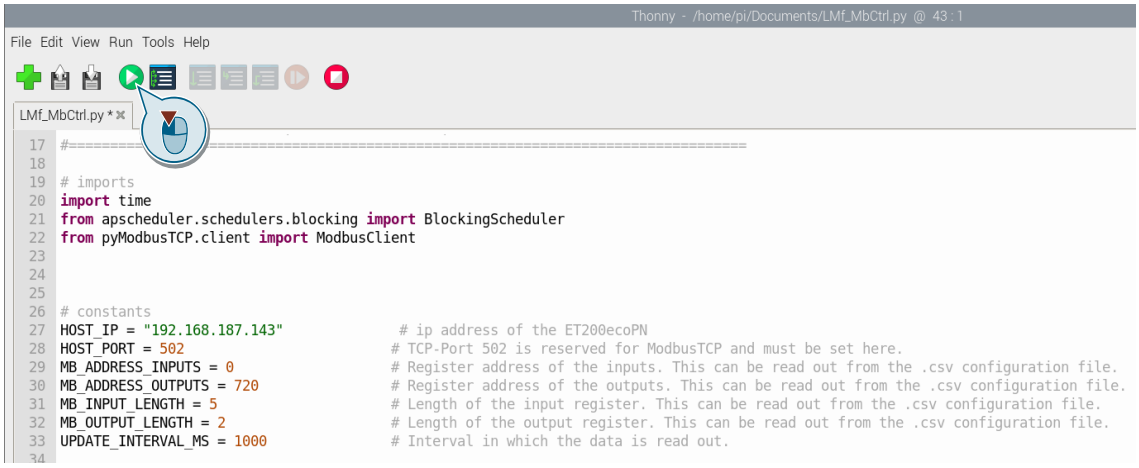
3 Operation

3.1 Thonny Python IDE

This application example uses Raspberry Pi OS Desktop. "Thonny Python IDE" is already preinstalled. Launch "Thonny Python IDE". Use the Python program found in the article.

Figure 3-1



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The Python program communicates cyclically with the Modbus TCP module. Data are output in the "Shell" output of "Thonny Python IDE". Try setting an input and monitoring the change in the output.

Figure 3-2

You can cross-compare with the CSV file described above in order to interpret the structure of the data that were read. The number 128 describes the status/validity of each of the data (128 is OK); the two zeros describe the input values. In this case, no input was set. In the outputs, the 1 indicates that output 8 was set.

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Examples:

Status info:

- Value "128": Bit mask: 1000 0000

Channel info:

- Value "0": no channel, bit mask: 0000 0000
- Value "4": one channel, bit mask: 0000 0100
- Value "7": three channels, bit mask: 0000 0111

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4 Appendix

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4.3 Links and literature

Table 4-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109808268
\3\	

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4.4 Change documentation

Table 4-2

Version	Date	Modifications
V1.0	06/2022	First version