SIEMENS

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MANUAL

SIMATIC

S7-1500 / ET 200MP

Technology Module TM NPU
6ES7556-1AA00-0AB0

support.industry.siemens.com

SIEMENS

SIMATIC

S7-1500/ET 200MP Technology Module TM NPU

Equipment Manual

07/2023
A5E46384784-AC

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

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Purpose of the documentation

This manual supplements the system manual S7-1500, ET 200MP automation system (https://support.industry.siemens.com/cs/ww/en/view/59191792). Functions that generally relate to the system are described in this manual.
The information provided in this manual and in the system/function manuals support you in commissioning the system.

Conventions

Please also observe notes marked as follows:

NOTE

A note contains important information on the product, on the handling of the product and on the section of the documentation to which particular attention should be paid.

1.1 Open Source Software

Open-source software is used in the firmware of the module. Open Source Software is provided free of charge. We are liable for the product described, including the open-source software contained in it, pursuant to the conditions applicable to the product. Siemens accepts no liability for the use of the open source software over and above the intended program sequence, or for any faults caused by modifications to the software.
For legal reasons, we are obliged to publish the original text of the license conditions and copyright notices. Please read the information relating to this on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109765637).

Security information 2

2.1 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit (https://www.siemens.com/industrialsecurity).

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customers' exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (https://www.siemens.com/cert).

2.2 Module-specific security information

Observe the following security instructions. In this way, you protect the TM NPU against unauthorized access.
In addition, you prevent:

- Loss of data
  or
- Manipulation
  or
- Limited availability of the module

Use of the Ethernet interface

The TM NPU Ethernet interface and the services contained therein are exclusively designed for communication in an access-protected area of your system.
Connecting the TM NPU Ethernet to a cloud or a device outside of this access-protected area is a security risk. Establish the communication with external cloud services or devices via a secure interface, e.g. Industrial Edge.
Note that all FTP, GigE Vision (Page 21) and web server communication is unencrypted.
The following table shows the services, their port numbers and the respective default states:

Service	Port no.	Default state
FTP client	Dynamic	Disabled
GigE Vision	49152	Disabled
Web server	80	Disabled

When designing the network to which the TM NPU is connected, take the following criteria into account:

- Avoidance of excessive network load
  - A network overload is diagnosed in the value status (status byte, bit 0).
    You can find more information in section: Status and error information in the process image input (PII) (Page 28).
  - The module might stop functioning. In this case, restart the module.
- Prevention of unauthorized access

Locking the housing

To protect the data on the SIMATIC Memory Card from unauthorized access, lock the housing using a lock on the front cover (Page 55).

Ports disabled by default: USB and Ethernet

To prevent a third-party device from damaging your system, the USB and Ethernet interfaces are disabled by default.
To activate the interfaces and related services, use these options:

- Parameter settings in HW Config (Page 26)

Locking the Ethernet port

Lock the unused Ethernet port mechanically with an RJ 45 port lock.

Diagnostic message when the SIMATIC Memory Card is removed

Removing the SIMATIC Memory Card during operation triggers a diagnostic event, which is indicated in the value status (error byte, bit 1) in the PII.

You can find more information in section: Status and error information in the process image input (PII) (Page 28)

Preventing loss of data on the SIMATIC Memory Card

Routinely create backup copies of the contents of the SIMATIC Memory Card, e.g. neural networks, apps/scripts and configuration files.

In this way, you protect your know-how from tampering or stolen SIMATIC Memory Cards.

Disabling debug mode via web server during operation

If the module has been enabled for commissioning, then ensure that debug mode via web server has been disabled during module operation. This prevents unauthorized access and thus the reading of potentially confidential diagnostic information (MicroPython debug information).

You disable the web server through configuration in HW Config. Default state of the web server: disabled.

To prevent it from being enabled (again) without permission, also delete the configuration file debug.conf (Page 59) from the SIMATIC Memory Card after commissioning.

2.3 Important information regarding decommissioning of the module

When you decommission the TM NPU, remove the SIMATIC Memory Card. In this way, you prevent improper access to your data.

Product overview

3

3.1 S7-1500/ET 200MP Documentation Guide

3.1.1 Information classes S7-1500/ET 200MP

The documentation for the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system is arranged into three areas.

This arrangement enables you to access the specific content you require. Changes and supplements to the manuals are documented in a Product Information.

You can download the documentation free of charge from the Internet (https://support.industry.siemens.com/cs/ww/en/view/109742691).

Basic information

The System Manual and Getting Started describe in detail the configuration, installation, wiring and commissioning of the SIMATIC S7-1500 and ET 200MP systems.

The STEP 7 online help supports you in the configuration and programming.

Examples:

- Getting Started S7-1500
- S7-1500/ET 200MP System Manual
- Online help TIA Portal

Device information

Equipment manuals contain a compact description of the module-specific information, such as properties, wiring diagrams, characteristics and technical specifications.

Examples:

- Equipment Manuals CPUs
- Equipment Manuals Interface Modules
- Equipment Manuals Digital Modules
- Equipment Manuals Analog Modules
- Equipment Manuals Communications Modules
- Equipment Manuals Technology Modules
- Equipment Manuals Power Supply Modules

General information

The function manuals contain detailed descriptions on general topics relating to the SIMATIC S7-1500 and ET 200MPsystems.
Examples:

- Function Manual Diagnostics
- Function Manual Communication
- Function Manual Motion Control
- Function Manual Web Server
- Function Manual Cycle and Response Times
- PROFINET Function Manual
- PROFIBUS Function Manual

Product Information

Changes and supplements to the manuals are documented in a Product Information. The Product Information takes precedence over the device and system manuals.
You can find the latest Product Information on the S7-1500 and ET 200MP systems on the Internet (https://support.industry.siemens.com/cs/de/en/view/68052815).

Manual Collection S7-1500/ET 200MP

The Manual Collection contains the complete documentation on the SIMATIC S7-1500 automation system and the ET 200MP distributed I/O system gathered together in one file.
You can find the Manual Collection on the Internet.
(https://support.industry.siemens.com/cs/ww/en/view/86140384)

Manual Collection fail-safe modules

The Manual Collection contains the complete documentation on the fail-safe SIMATIC modules, gathered together in one file.
You can find the Manual Collection on the Internet.
(https://support.industry.siemens.com/cs/de/en/view/109806400)

SIMATIC S7-1500 comparison list for programming languages

The comparison list contains an overview of which instructions and functions you can use for which controller families.
You can find the comparison list on the Internet
(https://support.industry.siemens.com/cs/ww/en/view/86630375).

3.1.2 Basic tools

The tools described below support you in all steps: from planning, over commissioning, all the way to analysis of your system.

TIA Selection Tool

The TIA Selection Tool tool supports you in the selection, configuration, and ordering of devices for Totally Integrated Automation (TIA).

As successor of the SIMATIC Selection Tools , the TIA Selection Tool assembles the already known configurators for automation technology into a single tool.

With the TIA Selection Tool , you can generate a complete order list from your product selection or product configuration.
You can find the TIA Selection Tool on the Internet.
(https://support.industry.siemens.com/cs/ww/en/view/109767888)

SIMATIC Automation Tool

You can use the SIMATIC Automation Tool to perform commissioning and maintenance activities on various SIMATIC S7 stations as bulk operations independent of TIA Portal.

The SIMATIC Automation Tool offers a wide range of functions:

- Scanning of a PROFINET/Ethernet system network and identification of all connected CPUs
- Assignment of addresses (IP, subnet, Gateway) and device name (PROFINET device) to a CPU
- Transfer of the date and the programming device/PC time converted to UTC time to the module
- Program download to CPU
- RUN/STOP mode switchover
- CPU localization through LED flashing
- Reading out of CPU error information
- Reading the CPU diagnostic buffer
- Reset to factory settings
- Firmware update of the CPU and connected modules

You can find the SIMATIC Automation Tool on the Internet.
(https://support.industry.siemens.com/cs/ww/en/view/98161300)

PRONETA

SIEMENS PRONETA (PROFINET network analysis) is a commissioning and diagnostic tool for PROFINET networks. PRONETA Basic has two core functions:

- In the network analysis, you get an overview of the PROFINET topology. Compare a real configuration with a reference installation or make simple parameter changes, e.g. to the names and IP addresses of the devices.
- The "IO test" is a simple and rapid test of the wiring and the module configuration of a plant, including documentation of the test results.

You can find SIEMENS PRONETA Basic on the Internet:
(https://support.industry.siemens.com/cs/ww/en/view/67460624)

SIEMENS PRONETA Professional is a licensed product that offers you additional functions. It offers you simple asset management in PROFINET networks and supports operators of

automation systems in automatic data collection/acquisition of the components used through various functions:

- The user interface (API) offers an access point to the automation cell to automate the scan functions using MQTT or a command line.
- With PROFIenergy diagnostics, you can quickly detect the current pause mode or the readiness for operation of devices that support PROFIenergy and change these as needed.
- The data record wizard supports PROFINET developers in reading and writing acyclic PROFINET data records quickly and easily without PLC and engineering.

You can find SIEMENS PRONETA Professional on the Internet.
(https://www.siemens.com/proneta-professional)

SINETPLAN

SINETPLAN, the Siemens Network Planner, supports you in planning automation systems and networks based on PROFINET. The tool facilitates professional and predictive dimensioning of your PROFINET installation as early as in the planning stage. In addition, SINETPLAN supports you during network optimization and helps you to exploit network resources optimally and to plan reserves. This helps to prevent problems in commissioning or failures during productive operation even in advance of a planned operation. This increases the availability of the production plant and helps improve operational safety.

The advantages at a glance

- Network optimization thanks to port-specific calculation of the network load
- Increased production availability thanks to online scan and verification of existing systems
- Transparency before commissioning through importing and simulation of existing STEP 7 projects
- Efficiency through securing existing investments in the long term and the optimal use of resources

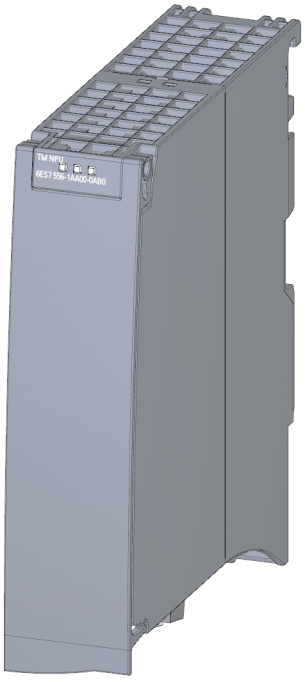
You can find SINETPLAN on the Internet
(https://new.siemens.com/global/en/products/automation/industrial-communication/profinet/sinetplan.html).

3.2 Properties

Article number

6ES7556-1AA00-0AB0

View of the module



Technical properties

- Open software architecture through integrated MicroPython interpreter
- Loading and executing of neural networks
- Processing of data of the utilized cameras
- Processing of data from the CPU user program
- Data exchange between the CPU and TM NPU via the process image
- USB 3.1 Gen2 (10 Gbit/s)
  In view of a bandwidth limitation of 6 GHz of the upstream EMI filter, the data rate may only reach USB 3.1 Gen1 (5 Gbit/s).
- Gigabit Ethernet IO connection via RJ45 bus connector (metal)

SIMATIC Memory Card

You load the application-specific files into the TM NPU with the help of a SIMATIC Memory Card. Examples of application-specific files include the files for the application and the neural networks.
Use only the SIMATIC Memory Card specified below:

Article number	Capacity
6ES7954-8LPxx-0AA0	2 GB

Supported cameras

The cameras can be connected via the integrated USB interface or the Ethernet interface of the TM NPU.
The following cameras are approved for the TM NPU:

- USB camera from Intel, type RealSense D435

NOTE

Use of a connected USB camera

Use the USB interface only for testing and commissioning purposes.

The USB camera Intel RealSense D435 is not suitable for productive operation.

For details on the USB interface, refer to section: Terminal assignment, section: USB 3.1 interface (Page 19).

- Gigabit Ethernet Vision cameras

You can find the list with an overview of the supported cameras on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109815405).

Accessories

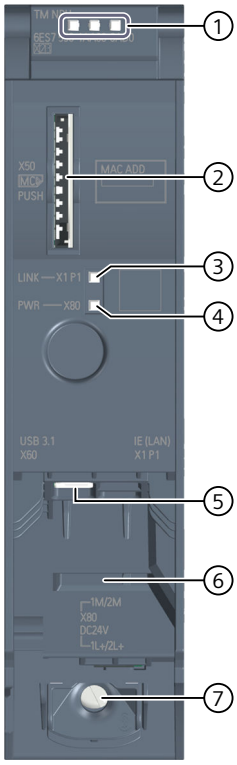
The following accessories are supplied with the module and can also be ordered separately as spare parts:

- Supply voltage connection plug
- U connector
- Universal front cover

You can find more information on accessories and the article numbers in the system manual of the S7-1500, ET 200MP Automation System (https://support.industry.siemens.com/cs/ww/en/view/59191792).

3.3 Operator controls and display elements

The figure below shows the operator controls and display elements of the TM NPU.



① LEDs: RUN, ERROR and MAINTENANCE
② Slot for the SIMATIC memory card
③ LINK: LED for Ethernet interface port
④ PWR: LED for 24 V DC supply voltage
⑤ USB 3.1 interface
⑥ Gigabit Ethernet interface
⑦ Terminal for 24 V DC supply voltage

More information

You can find more information on the location of the terminals on the bottom of the TM NPU in section Terminal assignment (Page 19).

3.4 Functions

Advances in automation are requiring more and more computing power, as well as the use of technologies with artificial intelligence (AI).

The TM NPU is equipped with an AI-capable processor. This enables fast and efficient processing of large amounts of data by means of neural networks.

The AI processor is especially well-suited for image processing using neural networks. In principle, the AI processor can be used in a wide range of applications.

Field of application

The TM NPU can be used in the S7-1500 automation system and the ET 200MP distributed I/O system. This enables scalable solutions from the field level, to the control and Edge level, all the way to the management level and the cloud.

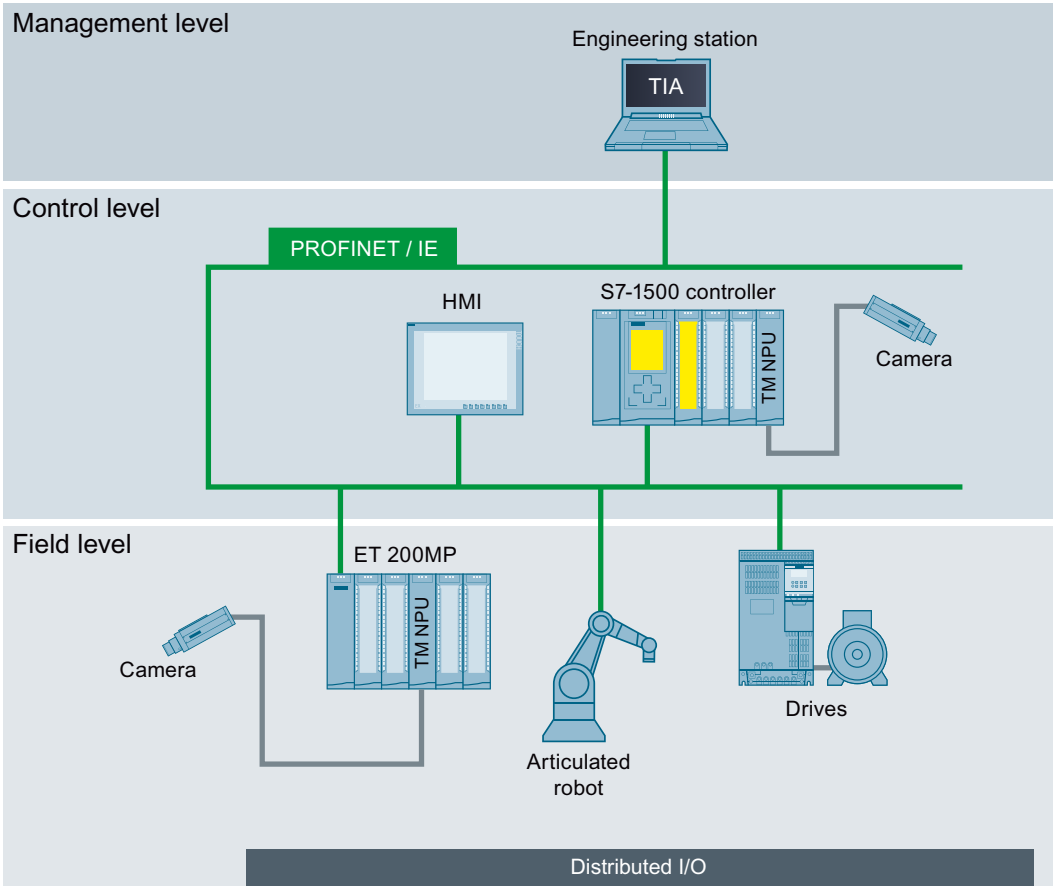


Figure 3-1 Automation levels of the TM NPU

Principle of operation

The TM NPU enables evaluation of input data, such as video and process data, by neural networks.
The data of connected cameras and the data from the user program of the CPU is processed with a high data throughput/high data rate through neural networks in the TM NPU. The TM NPU transfers the result of the processing operation to the CPU via the backplane bus. The CPU then allows further evaluation to take place in the user program.
A typical area of application is a visual quality check in production plants.

Advantages

The advantages at a glance:

- Lower programming and engineering workload
- Implementation of flexible and precise production processes
- Streamlined collaboration between IT (DataScience) and OT (Automation)
- Cost-effective solution because everything is supplied by SIEMENS
- Availability of tailored tool chains for the AI side
- Efficient solutions thanks to low costs
- Experience-based solutions that would be difficult to implement with conventional image processing algorithms

Wiring

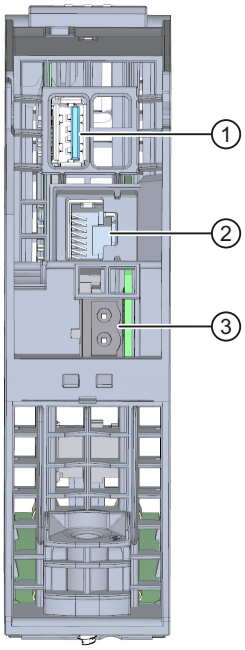
4

4.1 Terminal assignments and interface descriptions

4.1.1 Terminal assignment

Terminals on the bottom of the TM NPU

The figure below shows the terminals on the bottom of the TM NPU:



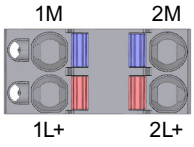
① X60: USB 3.1 interface, type A
② X1P1: Gigabit Ethernet interface, RJ-45
③ X80: Terminal for the 24 V DC supply voltage

More information

You can find more information on connecting and commissioning the TM NPU in the S7-1500, ET 200MP Automation System (https://support.industry.siemens.com/cs/ww/en/view/59191792) System Manual.

4.1.2 24 V DC supply voltage

The following table shows the signal names and the descriptions of the pin assignment of the 24 V DC supply voltage.

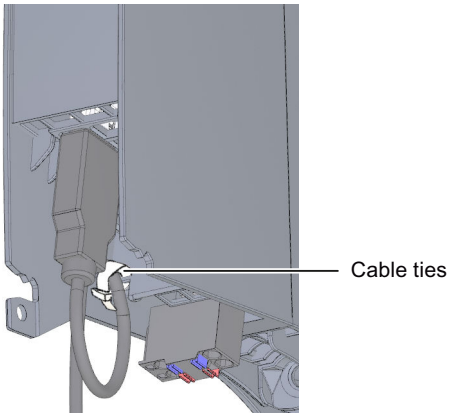
View	Signal name[1]	Description
	1L+	24 V DC
	2L+	24 V DC (for looping through)[2]
	1M	Ground
	2M	Ground (for looping through)[2]

1 1L+ and 2L+ as well as 1M and 2M are bridged internally

2 Maximum 10 A permitted

4.1.3 USB 3.1 interface

The USB 3.1 interface is designed with a type A connection socket. The plug connector does not have a strain relief. Provide strain relief for the USB cable with a 2.5 mm-wide cable tie.
The figure below shows the TM NPU with installed cable tie.



Only connect sensors and cables to the USB interface in which the shield and ground signal are galvanically isolated.
If the shield and ground (PIN 4) are connected to each other, an impermissible current flows over the cable shield in the event of a ground fault of the 24 V DC supply. The impermissible current flows over the shield spring of the module and the grounded mounting rail.
If you are using components whose shield and ground signal are connected, you must supply the TM NPU from an electrically isolated 24 V DC supply. Do not connect the ground of this 24 V DC supply to the functional ground (FE).

NOTE

Use of the USB camera Real Sense D435

If you are using the USB camera RealSense D435, note that the shield and the ground signal are connected to each another in the camera.

NOTE

Use of a USB camera

Use the USB interface only for testing and commissioning purposes.

Electromagnetic interference (EMI) on the supply cable of the 24 V DC supply of the module can lead to failure of the connected USB camera. The value status (error byte, bit 5) signals this state, allowing you to react accordingly with your user program.

For test operation of the USB interface, use a 24 V DC supply with max. 3 m cable length. In this way, you minimize interference and prevent failure of the USB camera.

NOTE

TM NPU supports only "Super Speed" connections of the camera

Cable lengths > 2 m or the use of a USB2 cable prevent the camera from being connected with "Super Speed". In such cases, the TM NPU refuses the camera connection.

4.1.4 Gigabit Ethernet

The Gigabit Ethernet interface is implemented as an RJ45 connection. A strain relief is not present on the module.

Enable and disable the available Ethernet services in the parameter assignment:

- GigE Vision
- FTP client
- Debug web server

To simultaneously establish a connection to an Ethernet camera and an external device, e.g. FTP server, connect the TM NPU to an Ethernet switch.

Use a Gigabit-capable switch to achieve the best performance.

4.1.4.1 GigE Vision

If your application is based on recording of camera images during productive operation, an Industrial Ethernet camera is necessary.

This camera must support the GigE Vision protocol. The Ethernet interface serves as the input for these cameras.

The TM NPU can connect to only one GigE Vision camera at a time.

Ensure that the TM NPU and **only one other** GigE Vision camera are in the same subnet.

NOTE

The GigE Vision camera can also be connected via an Ethernet switch. We strongly recommend use of Gigabit-capable SIEMENS SCALANCE devices.

Required network settings

Make the required network settings, such as IP address, MTU size, etc. in the configuration file named below: network.conf (Page 56).

Required parameter settings

When assigning parameters of the GigE Vision camera, ensure that a value of at least 10,000 is entered for the parameter "Packet Delay" (SCPDx). Lower values may result in an overload of the Ethernet port.

More information

You can find the list with an overview of the supported cameras and the recommended parameter settings ("Packet Delay", "MTU Size", "Frame Rate", "Resolution", etc.) on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109815405).

4.1.4.2 FTP client

You establish a connection to an external FTP server via the Ethernet interface with the integrated FTP client, for example, to

- archive individual images of the connected camera.
- read in data such as neural networks.

The FTP client is enabled in the configuration in HW Config and configured in the configuration file "ftpclient.conf" (Page 57).

NOTE

Note that data transferred via FTP is not buffered in the module. If an interruption, such as a cable break, power supply dip, etc., occurs during the data transfer, data may be lost.

4.1.4.3 Debug mode via web server

With the help of the web server of the TM NPU, the outputs of the user program (MicroPython script) can be read out and displayed for debugging purposes.

Prepare your system for this as described below:

1. Create a configuration file: debug.conf (Page 59).
2. Copy the configuration file to the SIMATIC Memory Card.
3. Enable debug mode in HW Config.

NOTE

Debug mode is only intended for commissioning. For security reasons, disable debug mode after commissioning is complete.

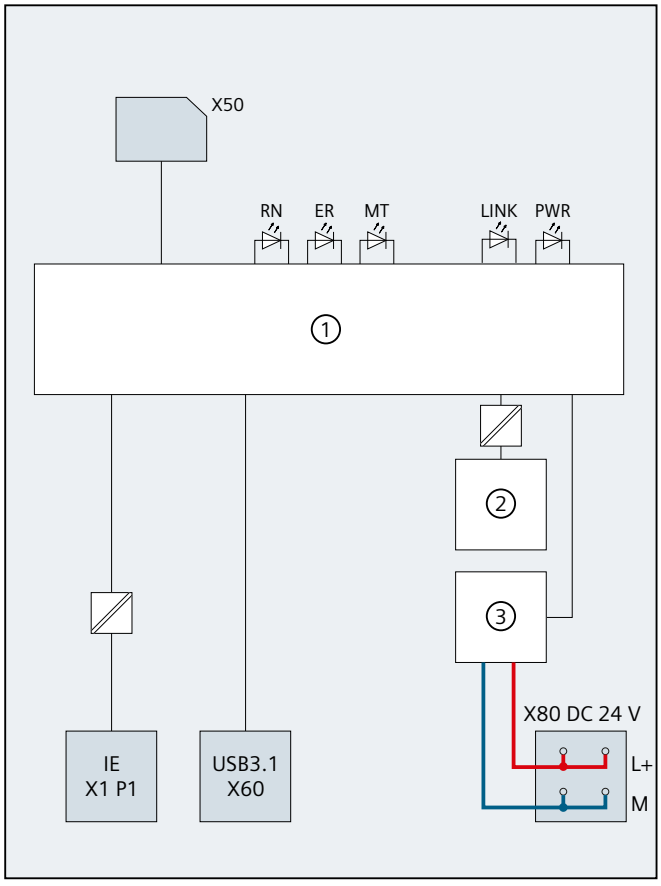
Also remove the configuration file "debug.conf", if present, from the SIMATIC Memory Card to prevent debug mode from being enabled (again) without permission.

More information

You can find more information on the debug messages and debug mode in section Viewing MicroPython debug messages via web server (Page 43) and in the module-specific security instructions (Page 8).

4.2 Block diagram (electrical)

The figure below shows the schematic circuit diagram of the TM NPU:

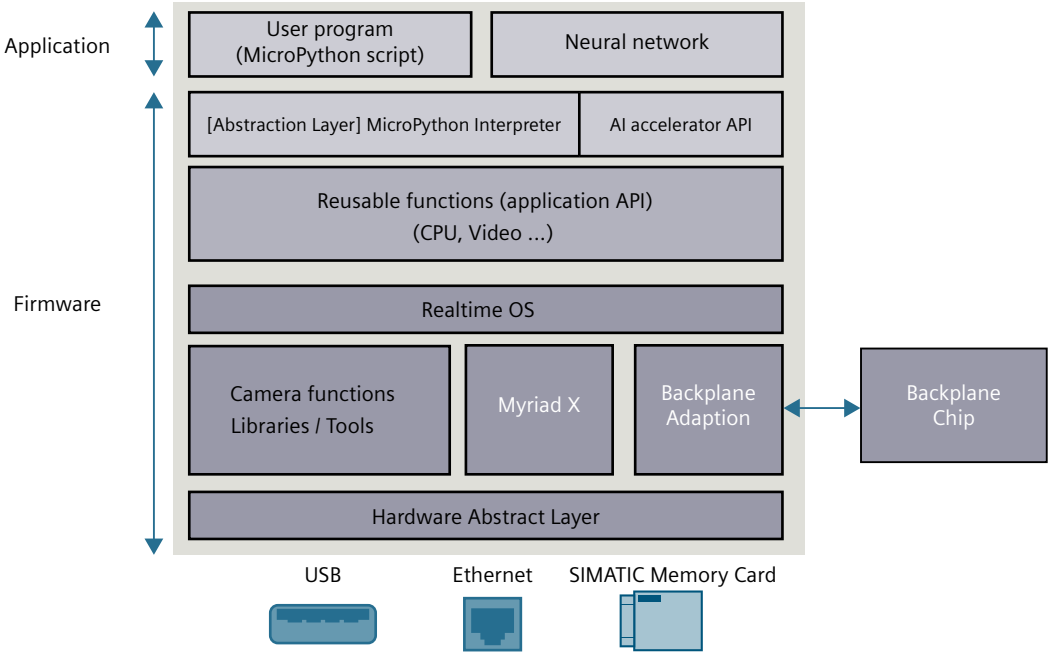


①	NPU processor unit	L+	24 V DC supply voltage
②	Backplane bus interface	M	Ground
③	Internal supply voltage converter	RN	RUN LED (green)
X50	Slot for SIMATIC Memory Card	ER	ERROR LED (red)
X80 24 VDC	Supply voltage connection	MT	MAINT LED (yellow)
IE X1 P1	Gigabit Ethernet interface	LINK	Link LED (green)
USB 3.1 X60	USB 3.1 interface	PWR	PWR LED (green)

4.3 Block diagram (logical)

Symbolic structure and function of the TM NPU

The figure below shows the symbolic structure, method of operation and software architecture of the TM NPU:



Hardware Accelerator Intel® Movidius™ Myriad™ X Vision Processing Unit (VPU)

The core operations of the TM NPU are performed by the Intel® Movidius™ Myriad™ X VPU processor. The processor has a Neural Compute Engine: a specially developed hardware accelerator for deep learning inferences in neural networks.

The Neural Compute Engine in conjunction with the 16 powerful SHAVE cores and high-throughput intelligent memory structure makes Intel® Movidius™ Myriad™ X ideal for on-device deep neural networks and computer vision applications.

The OpenVINO™ toolkit is used to prepare neural networks for the Myriad X.

Reference: Intel Movidius (https://www.intel.com/)

Structural distribution and mode of operation

The TM NPU is subdivided functionally into "application" and "firmware":

- The **application** consists of the neural network (or networks) and the user program – the so-called MicroPython script.
  The user program is **not** supplied with the TM NPU, but instead must be loaded from the SIMATIC Memory Card.
  The user program is referred to in this documentation as the MicroPython script. You define the user-specific workflow in the MicroPython script.
- The integrated MicroPython interpreter enables access to the module functions via the MicroPython script.
- The **firmware** is the executing part of the TM NPU. It monitors and controls the subordinate module functions, e.g.
  - Backplane bus communication
  - Ethernet and other services, e.g. USB
  - Execution of the neural networks

More information

You can find more information on the functionality and the creation and use of the user program in section MicroPython functionality (Page 31).
You can find more information on the flow and mode of operation in section Flow and procedures (Page 33).

Configuration / address space

5

5.1 Configuration of the TM NPU

The TM NPU can be configured with STEP 7 (TIA Portal) as of V17 with HSP 0379 and GSDML:

- Central deployment
  - S7-1500 CPUs: as of V2.5
- Distributed deployment
  - Interface Module IM 155-5 PN HF (6ES7 155-5AA00-0AC0): V3.0 or higher
  - Interface Module IM 155-5 PN ST (6ES7 155-5AA01-0AB0): as of V4.1

Configuring the TM NPU

You specify the properties of the module while configuring the module with STEP 7:

- Start address of the inputs
- Start address of the outputs
- Enable/disable load voltage diagnostics
- Enable/disable USB interface
  - Enable/disable USB camera
- Enable/disable Gigabit Ethernet interface
  - Enable/disable GigE Vision
  - Enable/disable FTP client
  - Enable/disable debug mode via web server

Hardware Support Packages (HSP)

You integrate firmware version V2.0 of the module (6ES7 556-1AA00-0AB0) using HSP 0379.
The Hardware Support Packages (HSP) are available for download on the Internet (https://support.industry.siemens.com/cs/ww/en/view/72341852).
Alternatively, you can access this download from the menu bar of STEP 7 (TIA Portal): Options > Support Packages > Download from the Internet.

GSD file

The respective GSD file for the ET 200MP distributed I/O system is available for download on the Internet:

- PROFINET GSD files: I/O - ET 200MP (http://support.automation.siemens.com/WW/view/en/68189683)

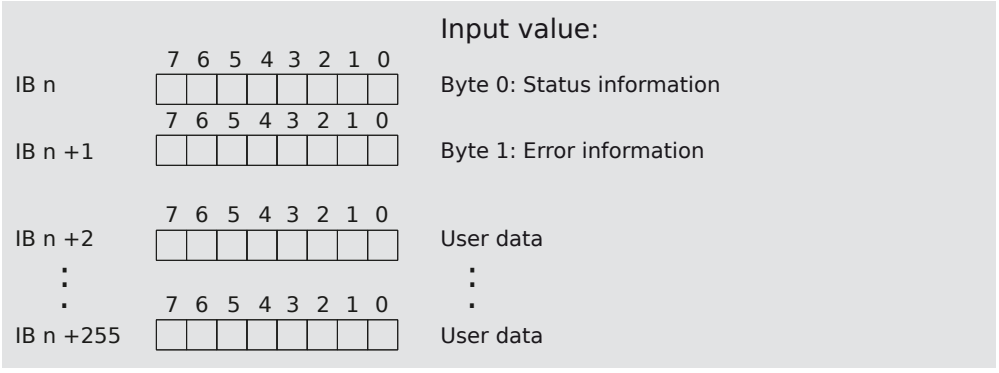
5.2 Address space and address assignment

The CPU and TM NPU exchange their data via the process image.
The TM NPU works with a process image of 256 bytes for inputs and 256 bytes for outputs.
In the process image of the inputs and outputs, the first two bytes are always reserved for the control, status and error information.
You can use all other addresses for communication and data transfer with the running application (app).

- PII: Byte 0 = Status information
- PII: Byte 1 = Error information
- PIQ: Bytes 0 and 1 = Control information

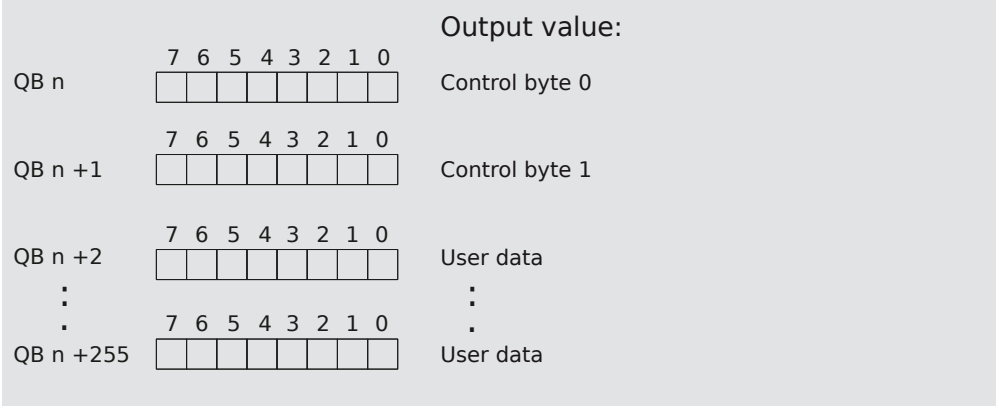
Address assignment in the process image input (PII)

The figure below shows the assignment of the address space for the configuration with 256 bytes for inputs.
You can freely assign the start addresses.



Address assignment in the process image output (PIQ)

The figure below shows the assignment of the address space for the configuration with 256 bytes for outputs.
You can freely assign the start addresses.



More information

You can find more information on the diagnostic messages in section Diagnostic messages (Page 41).

5.3 Status and error information in the process image input (PII)

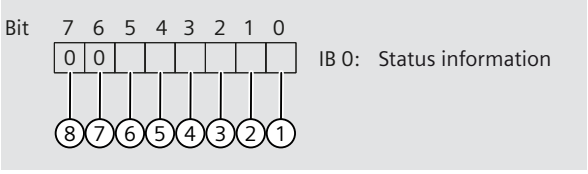
Status byte 0 provides information regarding the validity of the processed data and the status of the module.
If the processed data is invalid ("value status", bit 0 of the status byte is 0), error byte 1 provides additional information on the cause.

Additional information for "bit 0"

The value status is also "0", during startup of the module and in the event of an overload on the Ethernet interface of the module.
You can find more information regarding an overload on the Ethernet interface in section Effects of a high network load (Page 44).

Status information in the IB n

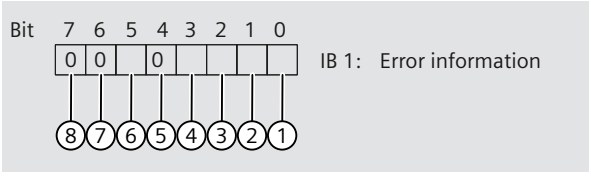
The figure below shows the assignment of the status bytes in the PII**.**



① Bit 0: Value status bit: Error at module, data invalid
② Bit 1: Ethernet link status
③ Bit 2: USB link status, like: Ethernet link status
④ Bit 3: Application is active, MicroPython script is running
⑤ Bit 4: Debug mode active, indicates whether MicroPython debug mode is active
⑥ Bit 5: GigE Vision connection established
⑦ Bit 6: Reserved
⑧ Bit 7: Reserved

Error information in the IB n+1

The following image shows the assignment of the input byte IB n+1. The byte provides information about the errors detected.



① Bit 0: Error in the application, for example, uncaught exception in the script, script termination, syntax error in the script, etc.

② Bit 1: SIMATIC Memory Card present/not present

③ Bit 2: Script initialization error

④ Bit 3: Error in the configuration files (network.conf, ftpclient.conf, debug.conf).
For more information, read section Diagnostics alarms (Page 41).
Check the parameters set in the file(s); for more information, read section Configuration files (Page 56).

⑤ Bit 4: Reserved

⑥ Bit 5: No USB connection to the camera, no camera data

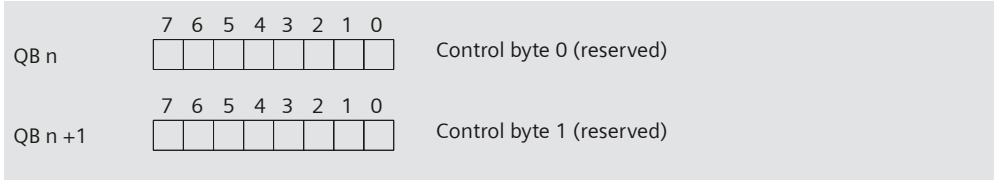
⑦ Bit 6: Reserved

⑧ Bit 7: Reserved

5.4 Control information in the process image output (PIQ)

Control bytes 0 and 1 are reserved.

Assignment of the control bytes



Programming

6

The application-specific program for the TM NPU consists of multiple program sections that are loaded into the memory of the TM NPU from a SIMATIC Memory Card:

- Application: MicroPython script in "main.py"
- Configuration files
- Neural networks

Application

The application uses the MicroPython API for the following:

- Communication with the module firmware and reading data of connected cameras.
- Processing of data through the neural network(s).

Neural network

The neural network:

- Processes input data, for example, from the process image or a connected camera, using the trained AI model.
- Transfers the result to the application.
- Use of the Intel® Movidius™ Myriad™ X as AI accelerator results in several hardware-specific limitations when using a self-created network.

You can find out more details on the supported layers and the limitations on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109812049).

Application example

The application example contains files (with detailed description) of executable programs for object classification and recognition.

The description supplements the TM NPU Equipment Manual and covers the following topics:

- Configuring the TM NPU with STEP 7 (TIA Portal)
- Loading the application and the neural networks into the TM NPU
- Displaying the results on the HMI device or in the watch table
- Use of function blocks for controlling the data exchange between the PLC and TM NPU
- Procedure for changing and expanding the programs by customer-specific objects

The application example and the associated documentation is available for download on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109781466).

Intel® Distribution of OpenVINO™ Toolkit

The OpenVINO toolkit is required for building the neural networks that are run on the Intel® Movidius™ Myriad™ processor.
The Intel Distribution of OpenVINO-Toolkit includes a model optimizer as well as runtime and development tools. It enables you to optimize, tune, and run comprehensive AI inference on the device.
OpenVINO enables you to increase the deep learning performance for computer vision and other tasks, including outside the TM NPU.
Use models that were trained with conventional frameworks, such as TensorFlow.
Use the OpenVINO version that is compatible with the TM NPU version in each case so that the neural network is converted correctly.
You can find the compatible versions on the Internet (https://support.industry.siemens.com/cs/us/en/view/109812049).
Reference: OpenVINO Toolkit (https://www.intel.com)

See also

Hardware Accelerator (https://www.intel.com)

6.1 MicroPython functionality

6.1.1 Overview and description

The TM NPU has no function without the MicroPython script. The entire functionality of the TM NPU is provided and controlled by the MicroPython script.
You can find more information in section: Block diagram (logical) (Page 24)
During startup, the module searches the "Scripts" folder on the SIMATIC Memory Card for a script named "main.py" and executes it.
An example script with an application example is available for download on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109781466).

MicroPython

- MicroPython is a slim and efficient implementation of the Python 3 programming language.
- MicroPython contains a subset of the Python standard library.
- MicroPython is optimized for execution on microcontroller systems with limited resources and in restricted environments.

Compiling and executing

MicroPython is provided with an integrated interpreter and a runtime environment in the module. Additional tools are not required for compiling and executing the script.

More information

You can find more information on the website of MicroPython (https://www.micropython.org/). You can find the documentation of MicroPython at micropython.org (https://docs.micropython.org/en/v1.12/).

6.1.2 Using MicroPython

Use the MicroPython libraries in the "main.py" script to allow flexibility for adaption of the pre-processing and post-processing in the application.

Supported libraries

The TM NPU has a MicroPython interpreter integrated as an application interface.
The MicroPython interpreter enables the following functionalities:

- Access to the subordinate module functions, e.g. control of the camera, access to the SIMATIC Memory Card, communication via the process image, etc.
- Flexible adaption of the application:
  - Pre-processing of the (image) data for the neural network
  - Post-processing of the inference results before passing them on to the CPU

These functionalities are made available via the MicroPython libraries included in the module:

- The MicroPython standard library provides the basic commands and functionalities of MicroPython.
- The TM NPU-specific library enables the use of TM NPU-specific interfaces and features such as the camera and the video pipeline, loading of a neural network, read/write access to the SIMATIC Memory Card or an external FTP server (via the FTP client integrated in the TM NPU) and more

Non-supported libraries are not available in the "main.py". Calling a non-supported library results in a MicroPython exception, e.g. "Method not available".

MicroPython in the TM NPU

The script can contain the following functionalities and tasks:

- Reading and writing data on the SIMATIC Memory Card or FTP server
- Loading the neural network into the Neural Compute Engine
- Accessing data supplied by the camera
- Configuring the video pipeline (pre-processing - flow for image data processing)
- Executing the neural networks
- Communicating with the CPU

NOTE

You can find examples in the "main.py" script which is offered as part of the application example.

The application example is available for download on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109781466).

NOTE

The documentation of the implemented MicroPython is provided with the latest firmware version. Note that future versions may contain additional changes.

You can find a full list of supported functions and their description as well as information regarding changes here (https://support.industry.siemens.com/cs/ww/en/view/109812049).

More information

You can find more information in section Further information about the MicroPython user interface (Page 38).

6.2 Sequence and procedures

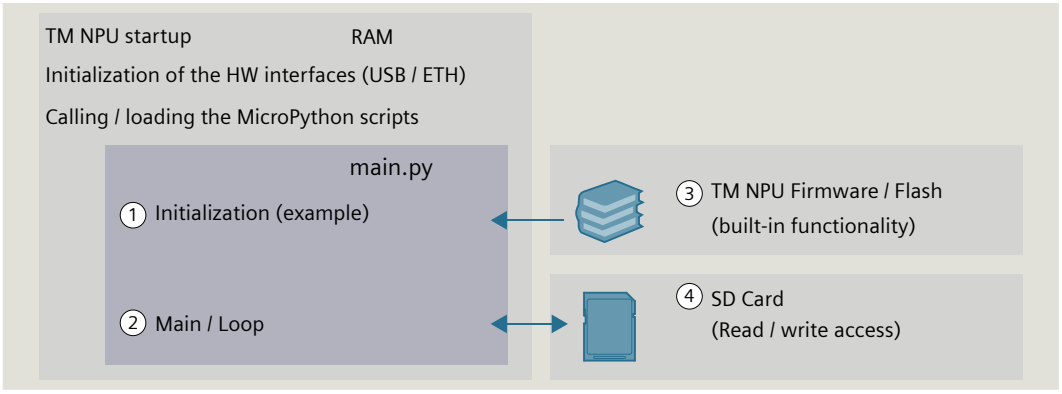
Program sequence

The basic program flow is described in the following:

1. The MicroPython script is copied to the SIMATIC Memory Card that is inserted in the TM NPU.
2. During initialization, the TM NPU checks if the MicroPython script "main.py" is present on the inserted SIMATIC Memory Card.
3. The "main.py" script is loaded into the RAM of the TM NPU.
4. The required initializations are executed by the "main.py" script:
   - Instantiation of the camera and video pipeline
   - Loading of the neural network
5. Additional module functionality is defined, e.g.:
   - Waiting for trigger condition from the CPU
   - Fetching an image from the camera stream
   - Pre-processing the image via video pipeline
   - Processing of the pre-processed image via neural network

Example of a program flow

The following figure shows an example of the basic program flow:



①
- Initializing the camera
- Video pipeline
- Initializing the neural network
- ...

②
- Input/trigger from the CPU
- Fetching image from camera
- Image pre-processing
- Calling up inference
- Post-processing results
- ...
- Sending results to the CPU

③ MicroPython standard libraries
TM NPU-specific libraries and objects for access to:
- Camera(s)
- Process image
- SIMATIC Memory Card
- FTP
- ...

④
- User data, e.g. images
- Configurations
- Trace

6.2.1 Process overview

6.2.1.1 SIMATIC Memory Card

Transfer of data

A SIMATIC Memory Card is used to load the neural network and the application into the TM NPU and to receive data from the TM NPU for further processing.
Before a trained neural network can be used with the TM NPU, this network must be converted for processing by the AI accelerator, e.g. with Intel® Distribution of OpenVINO™ or the SIMATIC AI Model Deployer.
The SIMATIC AI Model Deployer converts the neural network and creates an image of the SIMATIC Memory Card with all required (configuration) files.
The following data structure is copied to the SIMATIC Memory Card:

- "config" folder
  - "network.conf": Configuration of the network interface
  - "ftpclient.conf": Configuration of the FTP client
  - "debug.conf": Enabling of debug mode
- "res" folder
  - "npu_app.conf": Each folder with neural network models
- "scripts" folder
  - "main.py": Application script

NOTE

Useful information about the configuration files: "network.conf" / "ftpclient.conf" / "debug.conf" / "npu_app.conf"

- The configuration file "network.conf" is mandatory and must always be provided. Otherwise, the module does not start.
- The configuration files "ftpclient.conf" and "debug.conf" only have to be provided on the SIMATIC Memory Card if these functionalities are being used.
- The configuration file "npu_app.conf" can be used for editing parameters relating to the neural network and the camera. However, the file is not mandatory since the data could also be entered directly in the MicroPython script (main.py).

More information

You can find more information on the SIMATIC AI Model Deployer in the AI Model Deployer System Manual (https://support.industry.siemens.com/cs/ww/en/view/109810811).
You can find more information on the configuration files in section Configuration files (Page 56).

6.2.1.2 Initialization

Requirement

The SIMATIC Memory Card contains the neural network(s) and the script.

Starting the TM NPU

Follow the steps below to start the TM NPU:

1. Insert the SIMATIC Memory Card into the intended slot.
2. Select the TM NPU.

Result

The hardware interfaces are initialized.
The MicroPython script is loaded into the RAM.

6.2.2 main.py - structure and setup

6.2.2.1 Application start / execution of the Python script

The application starts after the MicroPython interpreter has been initialized.

Example for the application

- The "main.py" script is loaded into the RAM.
- Libraries referenced in the script are loaded.
- The connected camera is initialized.
- The video pipeline is initialized.
- The neural networks are initialized.

6.2.2.2 Working with MicroPython

The user creates his application in the "main.py" script.
A script can be created and edited with any text editor without special tools.
The user has write and read access to the SIMATIC Memory Card.
Access to the libraries stored in the flash memory of the SIMATIC Memory Card is read-only.

6.2.2.3 Structure of the "main.py" script file

The structure of the "main.py" script file is described by way of example below. This structure can be modified as needed depending on the application.

Structure

The "main.py" script file consists of 3 blocks:

- Import statement to reference libraries
- Functions
  User-specific functions that can be modified and used are also provided.
- Script for operation
  Initialization of camera, video pipeline, etc.
  Subsequent function calls which are repeated in a loop:
  - Fetch image
  - Image pre-processing
  - Transfer image to the neural network and start inference
  - Process results
  - Save image
  - Data exchange with the CPU

6.2.2.4 "main.py" script file during operation

After the initialization, the script runs through the specified steps.
The script is stopped when

- the power supply to the TM NPU is interrupted.
- an exception in the script is not caught.
- the module is reset by a new parameter assignment.

Example operation: Programmed loop

- The CPU triggers the TM NPU via the process image.
- An image is fetched from the camera.
  The original image data (RAW) is saved on the SIMATIC Memory Card or sent to the FTP server via the FTP client.
- The image is pre-processed by the video pipeline.
  The pre-processing normalizes the image data and changes the size to enable processing by the neural network.
- The inference is queried.
- The results are prepared.
- The results are sent to the PLC via the process image.

Access to an FTP server

During runtime, there is read and write access to an external FTP server, which can be accessed via the FTP client of the module (Page 22).

The FTP server access can be used, for example, for the following:

- Saving inference results and recorded images, e.g. for gathering training data
- Loading neural networks
- For validation of a neural network:
  Reading images from the FTP server and using them as input for the neural network.

During startup, the FTP client of the module requires a little time (approx. 10 s) to become fully initialized, since the startup runs in parallel with the initialization routines of the "main.py" script.
If you attempt to access the FTP server during this time, an error message occurs. To avoid accessing the FTP server during startup, you have the option of integrating a waiting period in the script (sleep).

NOTE

Use of the "Change" and "Attach" functions

Use of the "Change" or "Attach" function when accessing files on the FTP server, e.g. "r+", "w+", etc. or "a*", is not supported and results in overwriting of the file.

6.2.3 Further information about the MicroPython User Interface

You can find more information on the Online API and on MicroPython functions on the Internet (https://support.industry.siemens.com/cs/ww/en/view/109812049):

- MicroPython APIs
- Additional documentation

You can find the complete MicroPython documentation in the same entry, organized under the compatible TM NPU firmware version.

Diagnostics

7

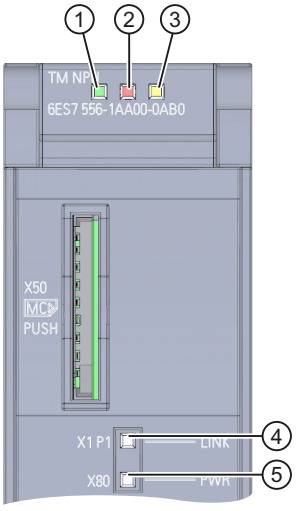
7.1 Status and error displays

The diagnostic information provided by the status LEDs of the module represents an initial aid in limiting errors. To identify the error more precisely, the display of the CPU, the module status information indicated in STEP 7 or the diagnostic buffer of the CPU can be evaluated. There you will find plain text information about the error that occurred and the number of the matching error OB.

You can find more information on the status bytes in section Address space and address assignment (Page 27).

LED display

The figure below shows the LED displays of the TM NPU:



① RUN LED (green)
② ERROR LED (red)
③ MAINT LED (yellow)
④ LINK LED (green)
⑤ PWR LED (green)

LED displays RUN/ERROR/MAINT

Table 7-1 Meaning of the LEDs RUN/ERROR/MAINT

LEDs			Meaning	Remedy
RUN	ERROR	MAINT		
Off	Off	Off	No or too low supply voltage via backplane bus.	• Switch on the CPU or IM and/or the system power supply. • Check that the U connectors are inserted. • Check whether too many modules are inserted.
Flashes	Off	Off	The technology module starts and waits until the valid parameter assignment is set.	---
On	Off	Off	Parameter assignment of the technology module is valid.	---
On	Flashes	Off	Module error, e.g. no supply voltage	Check the supply voltage.
			Firmware update running.	---
			Communication between AI processor and backplane bus is faulty.	• Make sure that the SIMATIC Memory Card contains all the files required for the application. In case of doubt, replace them with a new copy. • Switch the supply voltage off and on again.
Flashes	Flashes	Flashes	Hardware or firmware defective.	Replace the technology module.

PWR LED display

Table 7-2 Meaning of the PWR LED display

LED PWR	Meaning	Remedy
Off	External supply voltage too low or missing.	Check the external supply voltage.
On	External supply voltage available.	---

LINK LED display

Table 7-3 Meaning of the LINK LED display

LINK LED	Meaning	Remedy
Off	No Ethernet link detected.	Check whether: • The Ethernet configuration is activated • The configuration file "network.conf" was saved correctly [1] For the correct coding of the configuration file, refer to section network.conf (Page 56). • An Ethernet cable is inserted

[1] This file must be in Linux or Windows format in order to be read by the TM NPU. Editors outside a Linux environment can change the line endings and thus make the file unreadable for the TM NPU.

LINK LED	Meaning	Remedy
■ On	Ethernet connection established. Parameter assignment of the technology module is valid.	---

[1] This file must be in Linux or Windows format in order to be read by the TM NPU. Editors outside a Linux environment can change the line endings and thus make the file unreadable for the TM NPU.

7.2 Diagnostics alarms

Diagnostic messages

For each diagnostic event, the ERROR LED on the module flashes and a diagnostic message is output internally.
You can read out the diagnostic messages, for example, in the diagnostic buffer of the CPU.
You can evaluate the error code with the user program.

Table 7-4 Diagnostic messages with meaning and corrective measures

Diagnostic message	Error code	Meaning	Corrective measures
Parameter assignment error	10_H	The module cannot evaluate parameters for the channel. Incorrect parameter assignment.	Correct the parameter assignment.
No load voltage	11_H	External supply voltage of the module is missing.	Connect external supply voltage to module/channel.
Communication error -> LINK LED is permanently on or off	13_H	Internal communication error in the module: Interrupted data connection between the AI processor and the backplane bus.	Restart the module. If the communication error still exists after the restart, perform the firmware update again.

Diagnostic interrupt

For an incoming or outgoing event, the module triggers a diagnostic interrupt. The CPU interrupts user program execution and executes the diagnostic interrupt OB. The event that triggered the interrupt is entered in the start information of the diagnostic interrupt OB.
The module generates a diagnostic interrupt at the following events:

- Parameter assignment error
- Missing supply voltage (configurable)
- Communication error

You can find detailed information on the event in the organization block with the "RALRM" instruction (read additional interrupt info) and in the STEP 7 online help.

7.3 Troubleshooting

7.3.1 SIMATIC Memory Card cannot be read

Cause

When the TM NPU writes data to the SIMATIC Memory Card, the files must be opened with write access.
The application must ensure that files are closed after the write operation. If the SIMATIC Memory Card is removed from the module during the write operation or if the power supply is interrupted, the files cannot be closed correctly. This results in a defective file system on the SIMATIC Memory Card.

Further procedure

A SIMATIC Memory Card with a defective file system must not be used further.
Microsoft Windows Explorer may show files, but these files cannot be deleted. New files cannot be created on the SIMATIC Memory Card. Data on the SIMATIC Memory Card are inconsistent.
For further use, the SIMATIC Memory Card must be formatted and reconfigured on the computer using TIA Portal.
"Online formatting" with the TIA Portal is not possible!

7.3.2 Check data integrity on the SIMATIC Memory Card

Cause

One possible cause of Save errors is interruption of the power supply to the TM NPU.
If this happens, check the data on the SIMATIC Memory Card for integrity.

Identification of files with errors

Newly created files and files that are opened with write access are identified by the file extension `.dirty`.
If a file cannot be closed correctly, this `.dirty` file extension is retained.
If an identically named file with file extension `.dirty` already exists, additional files are created, and the extension is incremented by 1.
Example: `file.dirty.1` --> `file.dirty.2`.
The file extension `.dirty` is retained in the following cases:

- The SIMATIC Memory Card is removed while a file is open with write access.
- The power supply is interrupted while a file is open with write access.
- The SIMATIC Memory Card is already full.

If a file can be closed, it is renamed with the correct file extension.

7.3.3 Camera-specific error

Interruption of the connection to the camera during ongoing operation

- The application continues running.
- The connection to the camera must be reestablished.

Camera not found during start

- If the camera is called up in the script, execution of the script pauses until the camera has been found.

Unusable images

In individual application cases, it is possible that the camera delivers images that should not be transferred to the neural network, for example due to a soiled camera lens or while the monitored production process is stopped.

The option exists to incorporate routines in the script that prevent the transfer of unusable image data.

7.3.4 Viewing MicroPython debug messages via web server

To debug a script, messages generated by the application can be displayed on a connected PC using the web browser under Windows/Linux/Mac OS. These displayed messages are called "print statements".

Requirement

- The Ethernet connection is enabled. A valid configuration file "network.conf" (Page 56) is present in the "/config" folder on the SIMATIC Memory Card. The LINK LED lights up permanently.
- Debug mode is enabled in the configuration of the module.
- The configuration file "debug.conf" (Page 59) is present in valid form in the "/config" folder on the SIMATIC Memory Card. In this way, debug mode is enabled.

NOTE

Restriction when using debug mode

When debug mode is used, all outputs that are initiated by the application are made available through the use of "print statements", for example.

The interval at which such messages are output has an impact on the performance of the debug server. We therefore discourage the use of fast, cyclic outputs because they can result in display errors.

When debug mode is used, a temporary change in the runtime of the application may occur when retrieving the web page for the debug information.

Outputs may not be available or may be incomplete due to internal processing mechanisms when retrieving the web page. These outputs are made available by refreshing the web page.

Procedure

To view the MicroPython debug messages via web server, follow these steps:

1. Connect a programming device with an IP address in the same subnet to the TM NPU via Ethernet.
2. Start the TM NPU.
   The web server starts.
3. On the programming device, call the following website: "`http://[IP address of the TM NPU]/index.html`".
   The IP address of the TM NPU is the address specified in the configuration file "network.conf".

The start page of the web server is displayed.

Writing service data to SIMATIC Memory Card

This method is reserved for service technicians.
If you are using a programming device, it is possible to write the service data to the folder `/service data` on the SIMATIC Memory Card by writing the data record Idx 1990.

7.3.5 Effects of a high network load

Too much traffic on the Ethernet interface of the module can limit the module function as follows:

- Very long response times
- No response of the module
- Error when accessing the:
  - SIMATIC Memory Card
  - FTP client

An overload on the Ethernet interface can be recognized from the value status bit of the process image input -> it changes to "0".
You can find more information on the value status bit in section Status and error information in the process image input (PII) (Page 28).

Checking the network connection

If limitations occur in the module function or response, check the module:

1. Restart the module.
2. If the error behavior persists, check the network for unusually high network communication or Ethernet requests to the module. Ethernet requests also include high-frequency requests to the web server of the module.

More information

You can find more information on the use of the Ethernet interface in section Module-specific security information (Page 8).

Technical specifications

8

Technical specifications TM NPU

The following table shows the technical specifications at the time of printing. You can find a data sheet with the latest technical specifications on the Internet (https://support.industry.siemens.com/cs/ww/en/pv/6ES7556-1AA00-0AB0/td?dl=en):

Article number	6ES7556-1AA00-0AB0
General information	
Product type designation	TM NPU
HW functional status	04
Firmware version	V2.0
• FW update possible	Yes
Product function	
• I&M data	Yes; I&M0 to I&M3
• Artificial intelligence/processing of neural networks	Yes
Engineering with	
• STEP 7 TIA Portal configurable/integrated from version	STEP 7 V17 or higher with HSP
• STEP 7 configurable/integrated from version	- / -
• PROFIBUS from GSD version/GSD revision	- / -
• PROFINET from GSD version/GSD revision	GSDML V2.35
Installation type/mounting	
Mounting position	Horizontal, vertical
Rail mounting	Yes
Control cabinet installation	Yes
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Short-circuit protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	5 ms

Article number	6ES7556-1AA00-0AB0
Input current	
Current consumption (rated value)	0.35 A; 24 V input voltage, USB load of 800 mA, 25 °C ambient temperature
Current consumption, max.	0.6 A
Inrush current, max.	3 A
I^2t	0.17 $A^2 \cdot s$
Power	
Power available from the backplane bus	0.65 W
Power consumption from the backplane bus (balanced)	1.1 W
Power loss	
Power loss, typ.	4.6 W
Processor	
Processor type	Myriad X 2x LEON processor with 700 MHz
Address area	
Address space per module	
• Inputs	254 byte; +2 bytes QI and application-specific status bytes
• Outputs	254 byte; +2 application-specific control bytes
Interfaces	
Number of Ethernet interfaces	1
Number of USB interfaces	1
Ethernet interface	Yes
USB port	Yes
SD card slot	Yes
1. Interface	
Interface type	Ethernet
Isolated	Yes; 1500 V AC (type test)
supported image format	YUYV422, UYVY422
supported image resolution	1 280 x 1 024, 1 280 x 720, 640 x 480
Interface types	
• RJ 45 (Ethernet)	Yes
• Number of ports	1
• integrated switch	No
2. Interface	
Interface type	USB
Isolated	Yes; 500 V DC (type test)
supported image format	YUYV422
supported image resolution	1 280 x 720

Article number	6ES7556-1AA00-0AB0
Interface types	
• USB	Yes; only for commissioning and test purposes
• Number of ports	1
• Output current of the interface, max.	900 mA
Interface types	
RJ 45 (Ethernet)	
• 1000 Mbps	Yes
USB port	
• USB specification	USB 3.1
• Design of the USB ports	USB type A socket
Protocols	
Protocols (Ethernet)	
• GigE Vision	Yes; V2.1
Web server	
• supported	Yes; only for Debug purposes. Should be disabled during normal operation.
Interrupts/diagnostics/status information	
Status indicator	Yes
Alarms	No
Diagnostics function	Yes
Diagnostics indication LED	
• RUN LED	Yes
• ERROR LED	Yes
• MAINT LED	Yes
• LINK LED	Yes
• Monitoring of the supply voltage (PWR-LED)	Yes
Isolation	
Isolation tested with	1 500 V AC between Ethernet and functional ground
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-25 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	-25 °C
• vertical installation, max.	40 °C
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C

Article number	6ES7556-1AA00-0AB0
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	2 000 m
Decentralized operation	
to SIMATIC S7-300	Yes
to SIMATIC S7-400	Yes
to SIMATIC S7-1200	Yes
to SIMATIC S7-1500	Yes
to standard PROFIBUS master	No
to standard PROFINET controller	No
Dimensions	
Width	35 mm
Height	147 mm
Depth	129 mm
Weights	
Weight, approx.	400 g

8.1 Firmware update

The TM NPU firmware consists of two parts:

- NPU processing unit (Myriad X): LZ4 file
- Backplane bus interface (PER ASIC): UPD file(s)

To update the firmware of the TM NPU, the following steps must be followed:

1. Create the folder "FWUPD" on the root directory of the SIMATIC Memory Card
2. Place the LZ4 file in this folder
3. Inserting the SIMATIC Memory Card in the TM NPU
4. Ensure presence of the 24 V DC power supply on the module
5. Perform the TM NPU firmware update via the SIMATIC S7 Standard Firmware Update mechanisms (e.g. in the TIA Portal) using the UPD file(s).

NOTE

Important: The LZ4 file must not be modified or renamed when it is copied to the SIMATIC Memory Card.

The firmware update of the TM NPU is initiated by triggering the update via the SIMATIC firmware update mechanisms. The module uses the file name to locate the LZ4 file which matches the UPD file version on the SIMATIC Memory Card, and then updates both components (the processor unit and the backplane bus interface) accordingly. If the matching LZ4 file cannot be found on the SIMATIC Memory Card in the "FWUPD" folder, the update will be aborted.

A firmware update of the TM NPU is only possible when the CPU is stopped.

8.2 Hardware versions and hardware functional state

Hardware functional state FS03

- A firmware update from firmware version V1.x to V2.x is not possible and will be aborted if attempted.
  The original firmware is retained unchanged.

Both TIA Portal and Simatic Manager abort the update and issue a message.

NOTE

Note that firmware version V2.0 is not operable on hardware functional state FS03.

Hardware functional state FS04

- A firmware downgrade from firmware version V2.x to V1.x is not possible and is refused by the module.
  The original firmware version is retained unchanged.
  A message is output that the firmware version is not accepted.

Incompatible parameter assignments

Firmware version V2.0 is not compatible with the previous firmware version of the TM NPU.

The TM NPU with firmware version V2.0 cannot be configured with the HSP or the GSDML of a previous firmware version.

In addition, it is not possible to configure a module with firmware version V1.x with the HSP or GSDML for firmware version ≥ V2.0.

In both cases, the TM NPU returns the following error message during startup:

- Error code 16#55 - Hardware component not available due to type mismatch

Checking the firmware version of the module

To ensure that the correct firmware version is installed, check the firmware version of your module. You read out the firmware version using the online editor of the engineering system you are using.

Use either:

- SIMATIC Manager
- TIA Portal

Parameter data records

A

A.1 Parameter data record 128

NOTE

The parameter data record 128 is read-only. Write access using WRREC (SFB53), for example, is rejected.

Data record structure

The following table shows the structure of the data record 128.

Bit → / Byte	7	6	5	4	3	2	1	0
0	Reserved[1]	1	Major version		Minor version			
1	Number of following parameter structures = 5							
2	**Number of following parameter blocks = 1**							
3	**Length of the following parameter blocks in bytes = 2**							
4	ID = 0 (common)							
5	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Diagnostics: No load voltage L+: 0 = Disabled 1 = Enabled
6	**Number of following parameter blocks = 1**							
7	**Length of the following parameter blocks in bytes = 2**							
8	ID = 1 (SD)							
9	Reserved[1]							
10	**Number of following parameter blocks = 1**							
11	**Length of the following parameter blocks in bytes = 3**							
12	ID = 2 (USB)							
13	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Enable USB camera	USB interface: 0 = Disabled 1 = Enabled
14	Reserved[1]							
15	**Number of following parameter blocks = 1**							
16	**Length of the following parameter blocks in bytes = 3**							
17	ID = 3 (Ethernet)							

[1] Reserved bits must be set to 0.

Bit → / Byte	7	6	5	4	3	2	1	0
18	Reserved[1]	Reserved[1]	Reserved[1]	GigE Vision: 0 = Disabled 1 = Enabled	Debug mode (HTTP server): 0 = Disabled 1 = Enabled	Reserved[1]	FTP client	Ethernet interface: 0 = Disabled 1 = Enabled
19	Reserved[1]							
20	**Number of following parameter blocks = 1**							
21	**Length of the following parameter blocks in bytes = 2**							
22	ID = 4 (App)							
23	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]	Reserved[1]

[1] Reserved bits must be set to 0.

A.2 Parameter data record 1990

During operation of the TM NPU, (internal) module states are written to a ring buffer in the RAM. You can call up this information about the internal state of the TM NPU for analysis, e.g. in case of an error.
The data is written to the SIMATIC Memory Card and can be forwarded to Technical Support.

Functionality

If no service data is present on the SIMATIC Memory Card yet, the "/servicedata" folder with the "servicedata.dummy" file (2 MB) is created automatically. The "servicedata.dummy" file is overwritten when the service data is requested for the first time.
To request the data, write the parameter data record 1990 to the TM NPU.
The requested information is stored in a file in the "/servicedata" folder.
The file is named according to the following schema: servicedata_$counter(0...3 char)_$user(0...29 characters).bin.
Example: servicedata_0001_usertriggered.bin, servicedata_0002_usertriggered.bin.
Existing data is retained.

NOTE

If a communication error occurs, this function is no longer available.

Data record structure (write)

Byte	Format	Name	Value
0	uint8	command	0x42
1	uint8	subcommand	0x00
2 ... 32	char[31]	userString	$user in file name of the servicedata.bin file NULL-terminated string

After sending the data record "write", the data record "read" is set to zero.

Data record structure (read)

Byte	Format	Name	Value
0	uint8	command	0x42
1	uint8	status	0 = SUCCESS 1 = ERROR 2 = BUSY (read again)
2 ... 32	uint16	counter	0 (if status != SUCCESS) 1 ... 9999

The data record "read" remains set to zero until the data record "write" is written.

Dimension drawing

B

The dimensional drawing of the module on the mounting rail, as well as a dimensional drawing with open front panel, are provided in the appendix. Always observe the specified dimensions for installation in cabinets, control rooms, etc.

Dimensional drawings of the TM NPU technology module

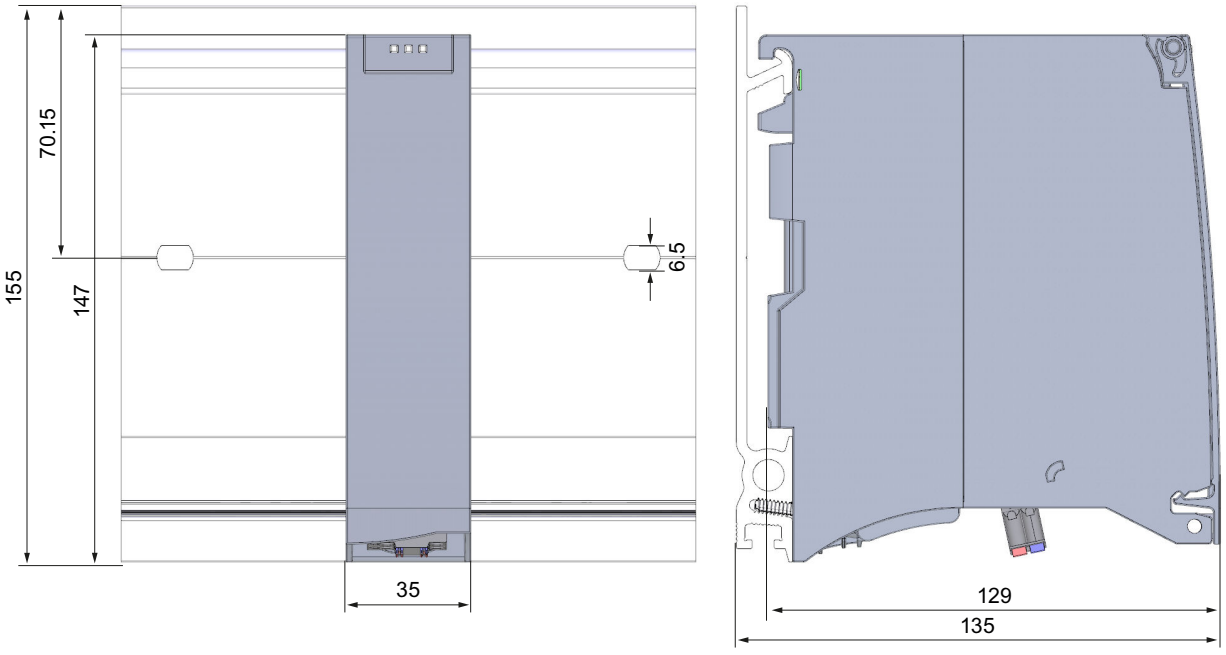


Figure B-1 Dimensional drawing of the TM NPU technology module, front and side views

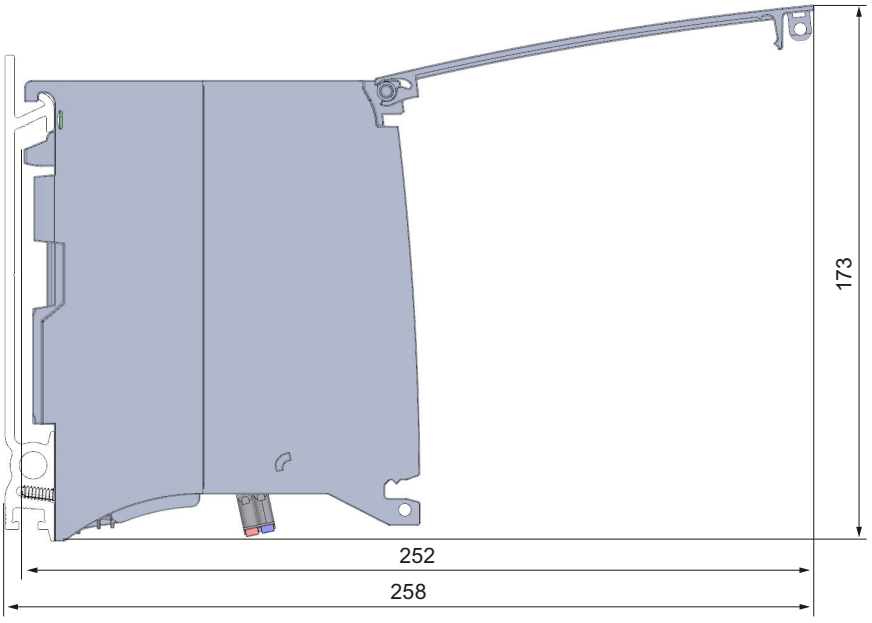


Figure B-2 Dimensional drawing of the TM NPU technology module, side view with open front cover

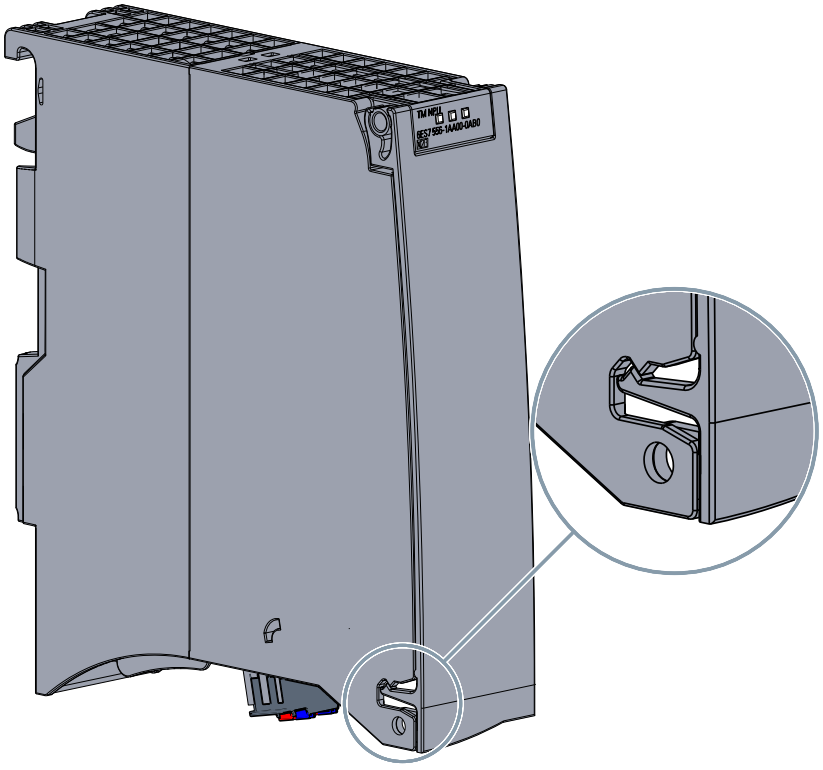
Interlock of the TM NPU

C

Locking options

Provide additional protection for your TM NPU technology module from unauthorized access (for example to the SIMATIC memory card) by using a secure front cover.
You have e.g. the following options:

- Attach a seal
- Secure the front cover with a lock (shackle diameter: 3 mm)



Configuration files

D

Inconsistent entries and errors in the network.conf, ftpclient.conf and debug.conf configuration files are reported via a group error in the PII.
You can find more information on the process image input (PII) in the value status (error byte, bit 1) in section Status and error information in the process image input (PII) (Page 28).

D.1 network.conf

NOTE

The configuration file "network.conf" is required for use of the TM NPU. The file must be present with valid entries in the "/config" folder on the SIMATIC Memory Card, even if the Ethernet port is disabled and not being used. Otherwise, the module does not start.

The configuration file "network.conf" is only read during startup of the TM NPU. The IP address of the TM NPU is specified in the configuration.

Structure of the configuration file

The configuration file "network.conf" contains the following information:

- address
- mtu

Supported character sets: UTF-8, CP1252
Permitted line endings: LF (Unix)

Procedure

1. Create or edit the configuration file "network.conf".
2. Copy the configuration file "network.conf" to the "/config" folder on the SIMATIC Memory Card.
   The Ethernet connection is only established if the configuration file "network.conf" is present on the SIMATIC Memory Card.
   Changes to the configuration file "network.conf" only take effect after a restart of the TM NPU.

Example file

```
// Start of the configuration block - interface description
iface igb0 inet static
// IP address of the TM NPU and the subnet mask as short notation
address 192.168.0.5/24
// Maximum transmission unit
mtu 1500
```

Use of the parameter "mtu"

"mtu" stands for Maximum Transmission Unit and, in IP networks, refers to the maximum length (in bytes) of an IP packet that can be transmitted unfragmented in the network.
The possible value range setting for the TM NPU is between 1500 bytes and 9216 bytes.
When using a switch, e.g. for data transmission via FTP, the parameter "mtu" must be set according to the performance capability of the switch used and the FTP server.
When a GigE Vision camera is used, we recommend working with jumbo frames for best performance.
Set "mtu" to 9000 bytes. Set the same value for the "mtu" parameter on the TM NPU and the camera.
If the parameter is not specified in the configuration file "network.conf", the default value 1500 bytes is used.
If you set a value outside the permissible range of 1500 to 9216 bytes, the Ethernet interface is not enabled. A configuration error (Page 28) is signaled in the value status (error byte, bit 3) in the process image input (PII).

D.2 ftpclient.conf

In order to exchange data with the TM NPU using the FTP protocol, you must transfer the configuration file "ftpclient.conf" to the TM NPU using the SIMATIC Memory Card beforehand.

Structure of the configuration file

The configuration file "ftpclient.conf" contains the following information:

- readonly
- server
- localPath
- ftpUser
- ftpPass

Supported character sets: UTF-8, CP1252
Permitted line endings: CR-LF (Windows), LF (Unix), CR (Mac)

Procedure

1. Create or edit the configuration file "ftpclient.conf".
   The file is in JSON format.
2. Copy the configuration file "ftpclient.conf" to the "config" folder on the SIMATIC Memory Card.
   The FTP client of the TM NPU only starts if the configuration file "ftpclient.conf" is present on the SIMATIC Memory Card.
   Changes to the configuration file "ftpclient.conf" only take effect after a restart of the TM NPU.
3. Provide an external FTP server and connect it to the TM NPU via Ethernet.
   You can then exchange data with the external FTP server by calling corresponding MicroPython commands in the TM NPU.

Example file

```
{
   "readonly":false,
   "server":"192.168.0.97",
   "localPath":"/FTPserver",
   "ftpUser":"user1",
   "ftpPass":"userPasswd"
}
```

NOTE
Use of /FTP
"/FTP" is not a valid value for "localPath".

NOTE
Use of "ftpPass"
Due to the JSON format of the "ftpclient.conf" configuration file, the following must be noted for the password:
When using the characters " or \, these characters must be entered as \" and \\.

Description of the example file

```
{
   "title": "ftpclientconf",
   "description": "configuration file of ftp client for TM NPU",
   "type": "object",
   "properties": {
      "readonly": {
         "description": "mount ftp filesystem read only",
         "type": "bool"
      },
      "server": {
         "description": "hostname or IP4 address of FTP server",
         "type": "string"
      },
      "localPath": {
         "description": "local path to 'mount'",
         "type": "string"
      },
      "ftpUser": {
         "description": "user name for logging in",
         "type": "string"
      },
      "ftpPass": {
         "description": "password for authenticated login",
         "type": "string"
      }
```

```
    },
    "required": [ "server","localPath" ]
}
```

D.3 debug.conf

To enable debug mode, transfer the configuration file "debug.conf" to the TM NPU using the SIMATIC Memory Card.

Requirement

In order to access the debug web page of the module, the following requirements must be met:

- The debug server must be enabled in the engineering.
- The configuration file "debug.conf" is present on the SIMATIC Memory Card.
- The MAC address specified in the configuration file "debug.conf" is the same as the actual MAC address of the module.
- The keyword "DebugOn" is set.

NOTE

If one of these four requirements is not met, the web page cannot be reached.

Structure of the configuration file

The configuration file "debug.conf" contains the following information:

- DebugOn

Supported character sets: UTF-8, CP1252
Permitted line endings: CR-LF (Windows), LF (Unix), CR (Mac)

Procedure

1. Create or edit the configuration file "debug.conf".
   The file is in JSON format and contains exactly one entry.
2. Copy the configuration file "debug.conf" to the "config" folder on the SIMATIC Memory Card.

Example file

NOTE

MAC address

Use the notation with hyphens and uppercase letters to specify the MAC address, as shown in the example.

```
{
  "DebugOn":"AC-64-17-CF-31-F1"
}
```

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