SIEMENS

SIMATIC IOT
SIMATIC IOT2050

Operating Instructions

07/2024
A5E39456816-AF

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

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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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Ⓟ 08/2024 Subject to change

Preface

These operating instructions contain all the information you need for commissioning and operation of a device in the SIMATIC IOT2000 family.

It is intended both for programming and testing personnel who commission the device and connect it with other units (automation systems, programming devices), as well as for service and maintenance personnel who install add-ons or carry out fault/error analyses.

Basic knowledge requirements

Knowledge of personal computers, operating systems and programming is required to understand this manual. General knowledge in the field automation control engineering is recommended.

Scope of validity of this document

These operating instructions apply to the IOT2050 devices of the device family SIMATIC IOT2000.

- IOT2050 Basic: 6ES7647-0BA00-0YA2
- IOT2050 Advance: 6ES7647-0BA00-1YA2
- IOT2050 M.2: 6ES7647-0BB00-1YA2
- IOT2050 SM: 6ES7647-0CA00-1AA2

And the expansion module IPC SM SENS DI.

- 6ES7647-0CM00-1AA2

Scope of this documentation

The device documentation comprises:

- Product information, for example, "Important notes on your device"
- Quick Install Guide SIMATIC IOT2050
- SIMATIC IOT2050 operating instructions in German, English and Chinese

Conventions

The following generic terms are used in this documentation:

Generic term	Specific name
Device	IOT2050 device
Arduino shield	ARDUINO UNO (Rev3)

⚠

The manual is delivered online, you can download the document from Central technical support (https://support.industry.siemens.com/cs/ww/en/).

Figures

This manual contains figures of the described devices. The supplied device might differ in some details from the figures. Within some of the figures, one device is used to represent all devices.

History

The following editions of these operating instructions have been published:

Edition	Comment
03/2020	First edition
09/2021	Updated X60-USB1 as USB 3.0 type A
10/2022	Add description for UKCA approvals
12/2022	• Add a configuration in the configuration plan • Add information on installing M.2 card
12/2023	Add a new configuration, IOT2050 SM (6ES7647-0CA00-1AA2), specifically designed for S7-1200 modules
07/2024	Add the expansion module IPC SM SENS DI for IOT2050 SM

Table of contents

Overview

1

1.1 Product description

The devices of the SIMATIC IOT family offer a robust, compact and flexible solution with a focus on the IOT environment and round off the SIMATIC IPC product range in the lower output range.

Features

- High degree of ruggedness
- Compact design
- External RS232/RS422/RS485, Ethernet, DP and USB interfaces
- Internal interfaces for Arduino Shield and Mini PCIe card
- Freely programmable interfaces
- Maintenance-free

1.2 Configuration plan

Depending on the industrial area of application, the following SIMATIC IOT devices are available with the following features:

	IOT2050 Basic **6ES7647-0BA00-0YA2**	**IOT2050 Advance** **6ES7647-0BA00-1YA2**	**IOT2050 M.2** **6ES7647-0BB00-1YA2**	**IOT2050 SM** **6ES7647-0CA00-1AA2**
Processor	TI SOC AM6528 GP Dual Core	TI SOC AM6548 HS Quad Core with High Security possibility	TI SOC AM6548 HS Quad Core with High Security possibility	TI SOC AM6548 HS Quad Core with High Security possibility
RAM	1 GB RAM (DDR4)	2 GB RAM (DDR4)	2 GB RAM (DDR4)	4 GB RAM (DDR4)
eMMC	No	16 G	16 G	16 G
Battery-buffered real-time clock	No	Yes	Yes	Yes
PCIE interface on motherboard	Yes	Yes	No	Yes
M.2 interface on motherboard	No	No	Yes. a B-key interface and a E-key interface	No
USB Type A	• FS1: 2 x USB 2.0 • FS2: 1 x USB 2.0, 1 x USB 3.0	• FS1 ~ FS3: 2 x USB 2.0 • FS4: 1 x USB 2.0, 1 x USB 3.0	2 x USB 2.0	• 1 x USB 2.0
Interface for IOT2050 SM expansion SMs	No	No	No	Yes

1.3 Structure of the devices

1.3.1 IOT2050 SM

SIMATIC IOT2050 SM is a new member with connectivity to the following S7-1200 and IPC Signal modules.

S7-1200 Signal modules

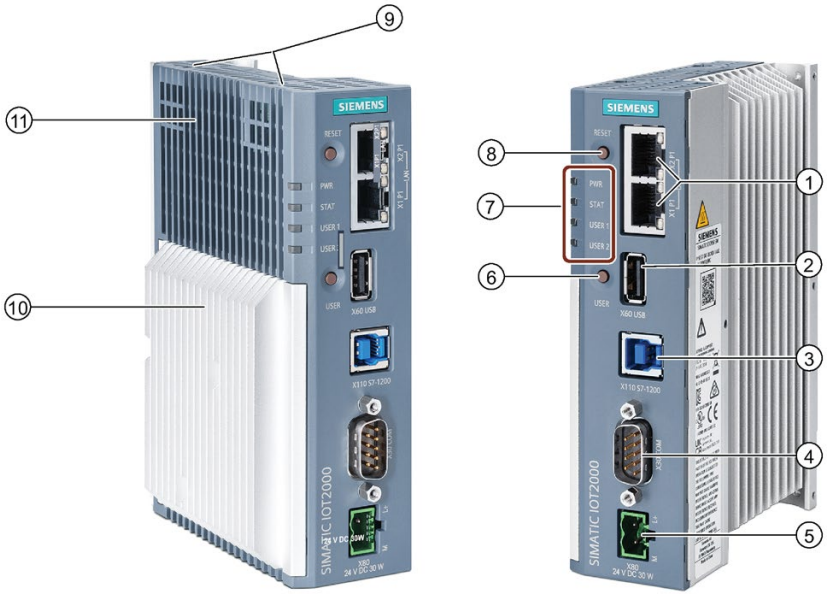
- 6ES7223-1QH32-0XB0
- 6ES7223-1PL32-0XB0
- 6ES7231-5PD32-0X80
- 6E57231-5PF32-0X80
- 6ES7231-4HF32-0X80
- 6ES7238-5XA32-0XB0
- 6ES7231-4HD32-0XB0
- 6ES7221-1BF32-0XB0

IPC SM SENS DI

- 6ES7647-0CM00-1AA2

1.3.1.1 IOT2050 SM

The following figures show the configuration and interfaces of the SIMATIC IOT2050 SM.



① Ethernet interfaces 100/1000 Mbps
② USB2.0 Type A
③ Interface for IOT2050 SM expansion SMs only, see "Installing and removing the expansion cable (Page 40)" [1]
④ COM interface (RS232/422/485)
⑤ Power supply connector
⑥ USER button, programmable
⑦ LED display, see section "Status displays (Page 16)"
⑧ RESET button for the CPU
⑨ Markings for mini PCIe/M.2 installation accessory
⑩ Shield cover
⑪ Top housing

[1] The extension cable has a length of 2 m and is available as an accessory for IOT2050 SM.

1.3.1.2 IPC SM SENS DI

The SIMATIC IPC SM SENS DI offers two types of digital input signals.

- 4 x AC DI, 120 VAC / 230 VAC up to 4 separated inputs with same neutral potential.
- 2 x DC DI with unspecified polarity up to 240V DC. Special feature of these two galvanically insulated inputs to each other.

SM SENS DI 2x digital inputs special functionality

Device digital inputs measure and count impulses within range of 5-200ms

- For impulse < 5ms - impulse is not counted
- For impulse > 200ms - impulse is not counted
- For impulse in range 6-199ms - impulse is counted

Each input has its own signaling green LED that lights when the input is activated. This also applies to wire break detection.

Interfaces for connecting the SIMATIC IOT2050 SM and other SM

The following figures show the interfaces for connecting SIMATIC IOT2050 SM and other expansion signal modules.

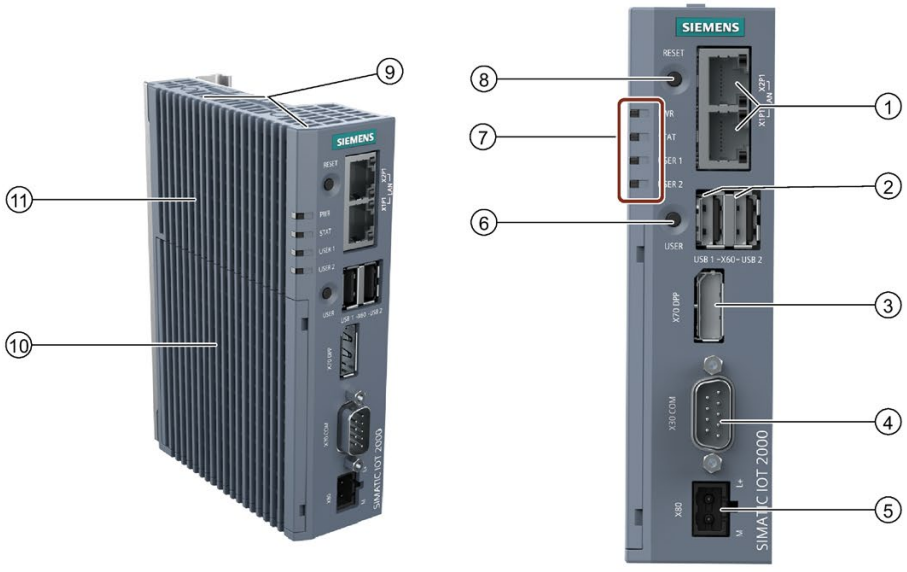
① Tab of the male connector

② Interface for other expansion signal modules

③ Interface for IOT2050 SM or other expansion signal modules

1.3.2 Other configurations for IOT2050

The following figures show the configuration and interfaces of the SIMATIC IOT2050.



① Ethernet interfaces 100/1000 Mbps

② For IOT2050 Basic (FS02),
IOT2050 Advance (FS04):
- X60-USB1: USB3.0 Type A
- X60-USB2: USB2.0 Type A

For IOT2050 M.2,
IOT2050 Advance (FS01 ~ FS03)
IOT2050 Basic (FS01):
- X60-USB1/X60-USB2: USB2.0 Type A

③ DisplayPort 1.1 A

④ COM interface (RS232/422/485)

⑤ Power supply connector

⑥ USER button, programmable

⑦ LED display, see section "Status displays (Page 16)"

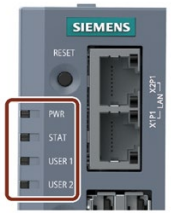
⑧ RESET button for the CPU

⑨ Markings for mini PCIe/M.2 installation accessory

⑩ Shield cover

⑪ Top housing

1.3.3 Status displays



Display	Meaning	LED	Description
PWR	PC operating status display	Green	PC is in operation
STAT	Display for operating system	Green	System is starting up
		Green blink	The operating system is running
		Red	System start up failed / No valid operating system detected
		Red blink	The operating system has crashed
USER1 USER2	User-programmable LED	Red	User defined
		Green	
		Orange	

1.4 Accessories

This chapter contains the scope of accessories valid at the time these operating instructions were written. The following accessories are not included in the scope of delivery and can be ordered separately. Additional accessories can be found on the Internet at: Industry mall ((https://mall.industry.siemens.com/))

Name	Specification	Order number
DisplayPort line	3 m long	6AV7860-0DH30-0AA0
	5 m long	6AV7860-0DH50-0AA0
Arduino Shield	SIMATIC IOT2000 Input/Output Module, 5 x DI, 2 x AI, 2 x DO	6ES7647-0KA01-0AA2
	SIMATIC IOT2000 Input Module Sink/Source, 10 x DI	6ES7647-0KA02-0AA2
Google Coral mini PCIe Accelerator (https://www.coral.ai/docs/mini-pcie/datasheet/)	Half-Mini PCIe card	6ES7648-1AA50-0XX0

Safety instructions 2

2.1 General safety instructions

⚠ WARNING

Life-threatening voltages are present with an open control cabinet

When you install the device in a control cabinet, some areas or components in the open control cabinet might be carrying life-threatening voltages.

If you touch these areas or components, you might be killed by electric shock.

Switch off the power supply to the cabinet before opening it.

System expansions

NOTICE

Damage through system expansions

Device and system expansions might be faulty and can affect the entire machine or plant.

The installation of expansions can damage the device, machine or plant. Device and system expansions might violate safety rules and regulations regarding radio interference suppression. If you install or exchange system expansions and damage your device, the warranty becomes void.

Note the following for system expansions:

- Only install system expansion devices designed for this device. Contact your technical support team or where you purchased your PC to find out which system expansion devices can safely be installed.
- Observe the information on electromagnetic compatibility (Page 114).

⚠ WARNING

Risk of fire through expansion cards

Expansion cards generate additional heat. The device may overheat and cause a fire.

Note the following:

- Observe the safety and installation instructions for the expansion cards.

NOTICE

Use in the scope of application for the UL61010-2-201

When the device is used in the area of Industrial Control Equipment in accordance with UL61010-2-201, note that the device is classified as "Open equipment".

Open equipment must be installed within an enclosure which protects you from hazards, including mechanical hazards, electrical shock and spread of fire.

If the device is used in a manner not specified by the manufacturer, the approval is lost and the protection associated with it may be impaired.

Note

Limitation of liability

All technical specifications and approvals of the device only apply if you use expansion components that have a valid CE approval (CE mark). The installation conditions for expansion components in the associated documentation must be observed.

UL approval of the device only applies when the UL-approved components are used according to their "Conditions of Acceptability".

We are not liable for functional limitations caused by using of third-party devices or components.

NOTICE

The approvals are voided if certain modifications are made

The device approvals are voided if the following modifications are made:

- The enclosure was physically modified, for example, openings were created to make LEDs on a plug-in card in the device visible.
- Cables are routed from the inside out of the device or from the outside into the device, for example, to connect sensors or displays.

Battery and rechargeable battery

⚠ WARNING

Risk of explosion and release of harmful substances

Improper handling of lithium batteries can result in an explosion of the batteries.

Explosion of the batteries and the released pollutants can cause severe physical injury. Worn batteries jeopardize the function of the device.

Note the following when handling lithium batteries:

- Replace used batteries in good time; see the section "Replacing the backup battery" in the operating instructions.
- Replace the lithium battery only with an identical battery or types recommended by the manufacturer (article number: SM:A5E50549527, Others: A5E44491494).
- Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

Strong high-frequency radiation

NOTICE

Observe immunity to RF radiation

The device has an increased immunity to RF radiation according to the specifications on electromagnetic compatibility in the technical specifications.

Radiation exposure in excess of the specified immunity limits can impair device functions, result in malfunctions and therefore injuries or damages.

Read the information on immunity to RF radiation in the technical specifications.

ESD Guideline

Electrostatic sensitive devices can be labeled with an appropriate symbol.

NOTICE

Electrostatic sensitive devices (ESD)

When you touch electrostatic sensitive components, you can destroy them through voltages that are far below the human perception threshold.

If you work with components that can be destroyed by electrostatic discharge, observe the ESD Guideline.

2.2 Cybersecurity information

Siemens provides products and solutions with industrial cybersecurity 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 cybersecurity 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 cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

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 customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Cybersecurity RSS Feed under
https://new.siemens.com/cert.

2.3 Data protection

Siemens observes the data protection guidelines, especially the requirements regarding data minimization (privacy by design). This means the following for this SIMATIC product: The product does not process / save any personal information, but only technical functional data (e.g. time stamps). If the user links this data to other data (e.g. shift plans) or if the user saves personal information on the same medium (e.g. hard disk) and therefore creates a personal reference in the process, the user has to ensure meeting the guidelines regarding data protection.

2.4 Notes on use

NOTICE
Possible functional restrictions in case of non-validated plant operation The device is tested and certified based on the technical standards. In rare cases, functional restrictions can occur during plant operation. Validate the correct functioning of the plant to avoid functional restrictions.

Note

Use in an industrial environment without additional protective measures

This device is designed for use in a normal industrial environment according to IEC 60721-3-3.

Disclaimer

Please note that the following list of recommended risk-minimizing security measures is not intended to be exhaustive. Thus, please consult your security expert for final assessment and configuration. Further, as already mentioned in IndustrialSecurity (https://www.siemens.com/industrialsecurity).

Please note (i) that you are responsible for preventing unauthorized access to your plants, systems, machines, and networks, and (ii) that you should only connect such systems, machines, and components 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. Since you are solely responsible for the conception, implementation, and maintenance of a holistic, state-of-the-art security concept to protect your enterprise, factories/plants, systems, machines, and networks (including the products) against cyberthreats, you are liable for any damage caused by implementing no or insufficient security measures.

Security notification

- Follows the general security rules for networks.
- Install hardware firewall before connecting to internet. Install software firewall on the device and open necessary ports only.
- Deploy DLP (data leakage protection) over your system to protect sensitive data.
- Install the device in cabinets, separated rooms or controlled areas. Restrict the access to the device with lock if possible.
- Only authorized personal can access the device.
- Only access secured wireless networks using secured software/hardware components.
- Use separate accounts for admin tasks and user tasks.
- Only enable the debug functionality (for example, TCF) when necessary.
- Always integrate security updates from latest example image or official upstream.
- Only install software components from trusted sources.
- Change the system password regularly.
- The device can be identified by collecting MAC/UID information from the system.
- When Secure Boot is not enabled, set SPI flash in write protected state through "Jumper" and lock flash in bootloader while the device is in normal operation.

Installing and connecting the device 3

3.1 Preparing for installation

3.1.1 Checking the delivery

Procedure

1. When accepting a delivery, please check the packaging for visible transport damage.

   If any transport damage is present at the time of delivery, lodge a complaint at the shipping company in charge. Have the shipper confirm the transport damage immediately.
2. Unpack the device at its installation location.
3. Keep the original packaging in case you have to transport the unit again.

   Note

   Damage to the device during transport and storage

   If a device is transported or stored without packaging, shocks, vibrations, pressure and moisture may impact the unprotected unit. A damaged packaging indicates that ambient conditions have already had a massive impact on the device.

   The device might be damaged.

   Do not dispose of the original packaging. Pack the device during transportation and storage.
4. Check the contents of the packaging and any accessories you may have ordered for completeness and damage.
   - Device
   - DC connecting terminal, already plugged into the device.
   - One mounting accessory kit including: 1 x Rail clamp, 2 x mounting brackets and screws.

5. If the contents of the packaging are incomplete, damaged or do not match your order, inform the responsible delivery service immediately.

WARNING

Electric shock and fire hazard due to damaged device

A damaged device can be under hazardous voltage and trigger a fire in the machine or plant. A damaged device has unpredictable properties and states.

Death or serious injury could occur.

Make sure that the damaged device is not inadvertently installed and put into operation. Label the damaged device and keep it locked away. Send off the device for immediate repair.

NOTICE

Damage from condensation

If the device is subjected to low temperatures or extreme fluctuations in temperature during transportation, for example in cold weather, moisture could build up on or inside the device (condensation).

Moisture causes a short circuit in electrical circuits and damages the device.

In order to prevent damage to the device, proceed as follows:

- Store the device in a dry place.
- Bring the device to room temperature before starting it up.
- Do not expose the device to direct heat radiation from a heating device.
- If condensation develops, wait approximately 12 hours or until the device is completely dry before switching it on.

6. Keep the enclosed documentation in a safe place. You need the documentation when you commission the device for the first time.
7. Write down the identification data of the device.

3.1.2 Identification data of the device

The device can be clearly identified with the help of this identification data in case of repairs or theft.

You can find this information on the rating plate. The following illustration shows an example.

Example rating plate:	**Enter the identification data in the table below:**	
	Order number	6ES ...
	Serial number	S V
	Production version	FS
	All existing Ethernet addresses (MAC)	

3.1.3 Device QR code

An identifiable QR code is printed on the product label of each device. The QR code is the ID Link of the device.

You can use a smart mobile device with QR code reader to scan the QR code on the product label. Then you are directed to the digital online nameplate website of this module. On the digital online nameplate, you can browse all necessary information of this module, for example, product basic information, technical documentation, certification and approval information and so on.

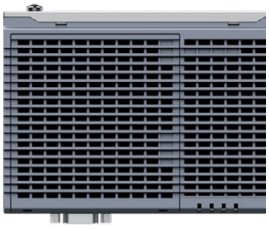
Below is an example of the QR code on IOT2050 SM.

3.1.4 Permitted mounting positions and mounting types

The device can be mounted horizontally or vertically on a DIN rail or to a wall.

Vertical mounting position, preferred

Horizontal mounting position

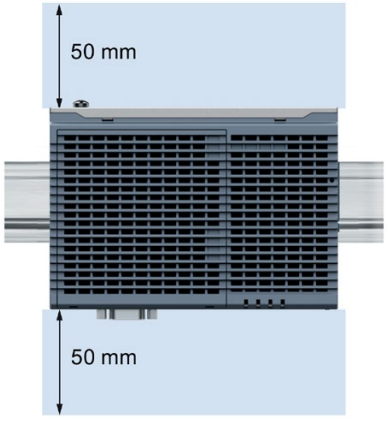


Consider the permitted temperature range for operation that depends on the mounting position in accordance with the "Technical specifications (Page 110)" section.

Clearances

Ensure that the following clearances measurements to another component or to a wall of a housing are complied with:

- Below the device: ≥ 50 mm
- Above the device: ≥ 50 mm



3.2 Mounting the device

3.2.1 Mounting instructions

Note the following:

- The device is approved for indoor operation only.
- For installation in a cabinet, observe the SIMATIC setup guidelines (http://support.automation.siemens.com/WW/view/de/1064706) as well as the relevant DIN/VDE requirements or the applicable country-specific regulations.
- When the device is used in the area of Industrial Control Equipment in accordance with UL61010-2-201, note that the device is classified as "Open equipment".
- Install all the expansions in the device before mounting the device on a DIN rail or a wall, see section "Expand device (Page 60)".
- Siemens recommends you use 0.6 Nm tightening torque to install the mounting clamps and brackets.

Fasten securely

NOTICE
Insufficient load carrying capacity If the mounting surface for wall mounting does not have an enough load-bearing capacity, the device may fall and be damaged. Ensure that the mounting surface on the wall can bear four times the total weight of the device, including fixing elements.

NOTICE
Incorrect fixing elements If you use anchors and screws other than those specified below for wall mounting, safe mounting is not guaranteed. The device can fall and may be damaged. Only use the anchors and screws specified in the following table.

Material	Bore diameter	Fixing element
Concrete	Select according to the specification of the mounting elements used	• Anchor, ∅ 6 mm, 40 mm long • Screw, ∅ 4 mm, 40 mm long
Plasterboard, (at least 13 mm thick)		Toggle plug, ∅ 12 mm, 50 mm long
Metal, (at least 2 mm thick)		• Screw M4 × 15 • M4 nut

3.2.2 Mounting on DIN rails

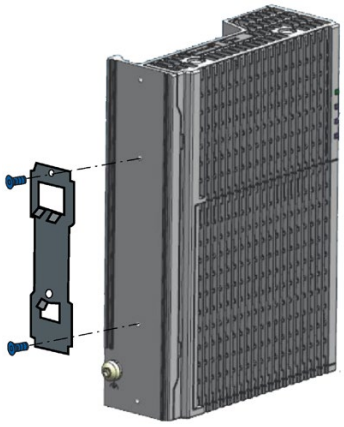
3.2.2.1 Secure the mounting clips

Requirement

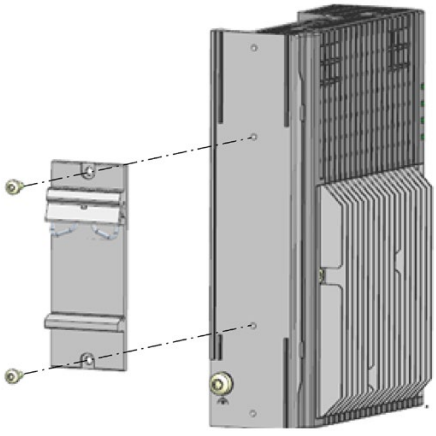
- The DIN rail is installed at the installation site (35 mm standard profile).
- Mounting bracket and mounting clamps
- Two screws
- T8 screwdriver

Secure the mounting clips for vertical mounting

1. Lay the rail clamp on the rear of the device.
2. Fasten the rail clamp with the supplied screws.



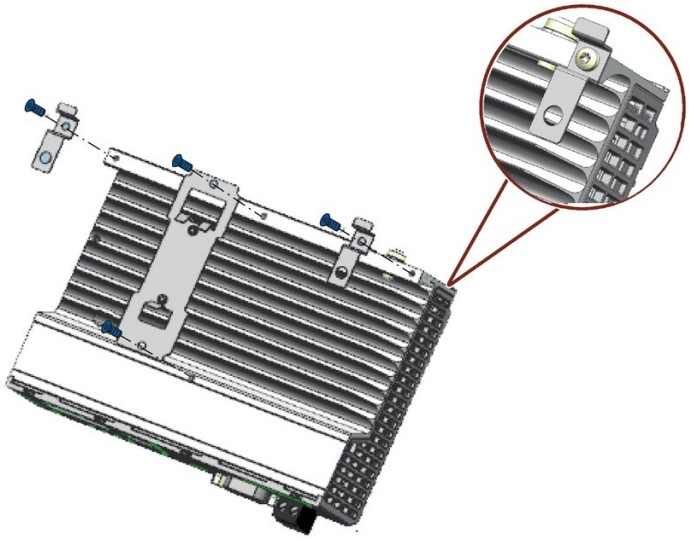
Other configurations for IOT2050



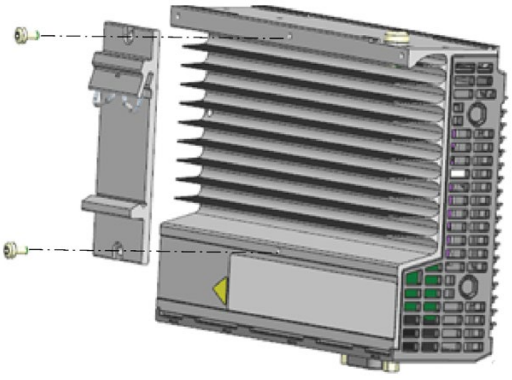
IOT2050 SM

Secure the mounting clips for horizontal mounting

1. Lay the rail clamp on the rear of the device.
2. Fasten the rail clamp with the two supplied screws.
3. Lay the brackets on the rear of the device. Align the bracket edge with the device edge.
4. Fasten the brackets with the supplied screws.



Other configurations for IOT2050

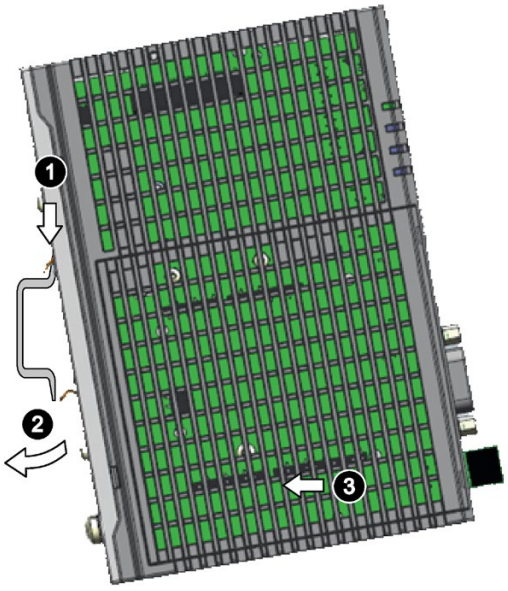


IOT2050 SM

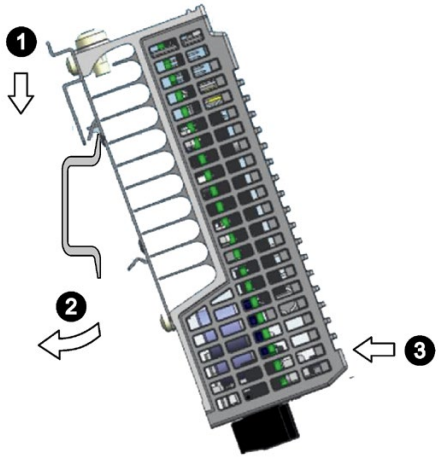
3.2.2.2 Mounting on DIN rails

Mounting

1. Place the device and rail clamp on the upper edge of the standard profile rail at the position shown and push the device down.
2. Swing the rail clamp of the device from below through the standard profile rail.
3. Push the device in the direction of the standard profile rail. You will hear the device click into place.



Vertical



Horizontal

Removing

1. Push down the device until it is released by the rail clamp.
2. Swing the device out of the standard profile rail.
3. Lift the device up and off.

3.2.3 Wall mounting

3.2.3.1 Vertical wall mounting

The device is suitable for horizontal or vertical wall mounting.

Note

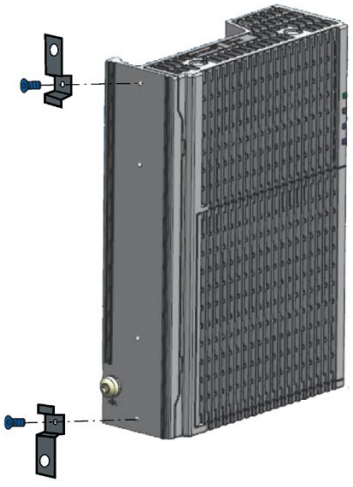
The device must be installed on the plate of an enclosure.

Requirement

- Two mounting brackets
- Two screws
- T8 screwdriver

Procedure for mounting

1. Lay the mounting brackets on the rear of the device.
2. Fasten the brackets with supplied screws.
3. Mark the bore holes, drill the required holes in the wall and fasten the device to the wall using two screws.



3.2.3.2 Horizontal wall mounting

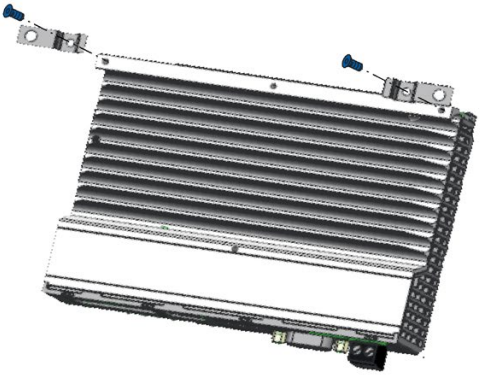
The device is suitable for horizontal or vertical wall mounting.

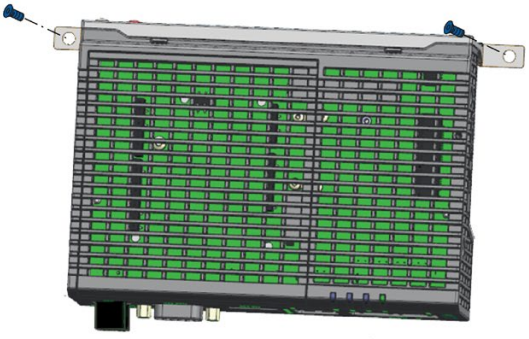
Requirement

- Two mounting brackets
- Two screws
- T8 screwdriver

Procedure for mounting

1. Lay the mounting brackets on the rear of the device.
2. Fasten the brackets with supplied screws.
3. Mark the bore holes, drill the required holes in the wall and fasten the device to the wall using two screws.





3.2.4 Installing and mounting the expansion module for IOT2O50 SM

3.2.4.1 Guidelines for installing SIMATIC IPC SM SENS DI

The IPC SM SENS DI equipment is designed to be easy to install. You can install an IPC SM SENS DI either on a wall or on a standard rail, and you can orient the IPC SM SENS DI either horizontally or vertically. The small size of the IPC SM SENS DI allows you to make efficient use of space.

Electrical equipment standards classify the SIMATIC IPC SM SENS DI system as open Equipment. You must install the IPC SM SENS DI in a housing, cabinet, or electric control room. You should limit entry to the housing, cabinet, or electric control room to authorized personnel.

The installation should provide a dry environment for the IPC SM SENS DI. SELV/PELV circuits are considered to provide protection against electric shock in dry locations.

The installation should provide the appropriate mechanical strength, flammability protection, and stability protection that is approved for open equipment in your particular location category according to applicable electrical and building codes.

Conductive contamination due to dust, moisture, and airborne pollution can cause operational and electrical faults in the IPC.

If you locate the IPC in an area where conductive contamination may be present, the IPC must be protected by an enclosure with appropriate protection rating. IP54 is one rating that is generally used for electronic equipment enclosures in dirty environments and may be appropriate for your application.

⚠ WARNING

Risks associated with improper installation

Improper installation of the IPC SM SENS DI can result in electrical faults or unexpected operation of machinery.

All instructions for installation and maintenance of a proper operating environment must be followed to ensure the equipment operates safely.

Electrical faults or unexpected machine operation can result in death, severe personal injury, and/or property damage.

Separating the IPC SM SENS DI devices from heat, high voltage, and electrical noise

When configuring the layout of the IPC SM SENS DI devices in a panel, always do the following:

- Separate the devices that generate high voltage and high electrical noise from the low-voltage, logic-type devices such as the IPC SM SENS DI.
- Place electronic-type devices in the cooler areas of the cabinet away from heat-generating devices to reduce exposure to high-temperatures and extend the operating life of the devices.
- Avoid placing low-voltage signal wires and communications cables in the same tray with AC power wiring and high-energy, rapidly-switched DC wiring when routing wiring for the devices.

Providing adequate clearance for cooling and wiring

IPC devices are designed for natural convection cooling. For proper cooling, you must provide a clearance of at least 25 mm above and below the devices. Also, allow at least 25 mm of depth between the front of the modules and the inside of the enclosure.

⚠ CAUTION

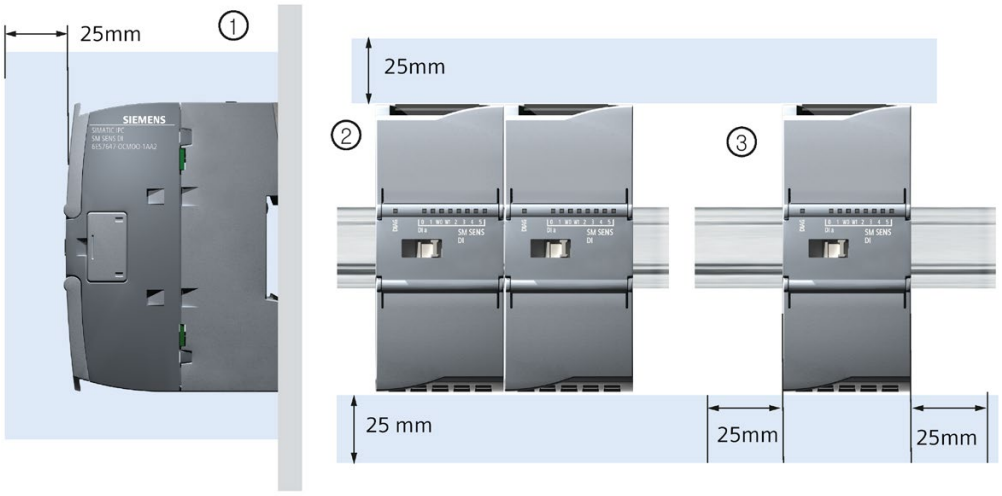
Effect of vertical mounting on allowable ambient temperature

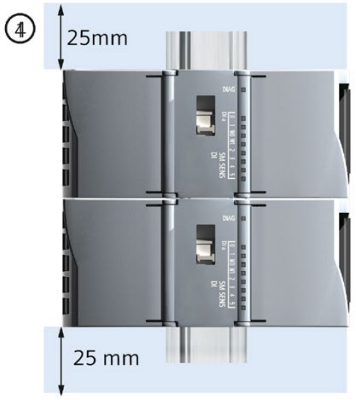
Vertical mounting reduces the maximum allowable ambient temperature by 10 degrees C.

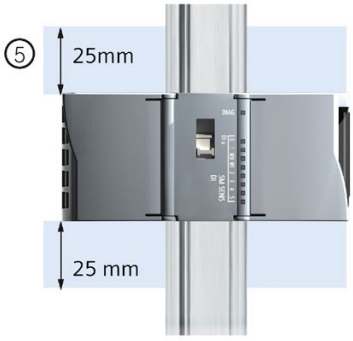
Orient a vertically mounted IPC SM SENS DI system as shown in the following figure. Ensure that the IPC SM SENS DI system is mounted correctly.

Improper installation of a vertically mounted system can result in personal injury.

When planning your layout for the IPC SM SENS DI system, allow enough clearance for the wiring and communications cable connections.





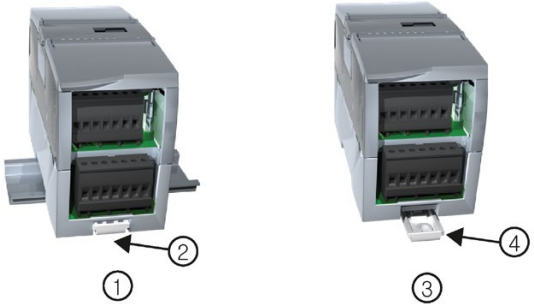


① Side view
② Vertical installation
③ Vertical installation, no adjacent module
④ Horizontal installation
⑤ Horizontal installation, no adjacent module

3.2.4.2 Installing and removing the IPC SM SENS DI

Installing and removing the IPC SM SENS DI devices

The CPU can be easily installed on a standard DIN rail or on wall. DIN rail clips are provided to secure the device on the DIN rail. The clips also snap into an extended position to provide a screw mounting position for wall-mounting.



① DIN rail installation
② DIN rail clip in latched position
③ wall-mounting
④ Clip in extended position for wall-mounting

Before you install or remove any electrical device, ensure that the power to that equipment has been turned off. Also, ensure that the power to any related equipment has been turned off.

WARNING

Installation or removal of IPC SM SENS DI devices with power applied

Installation or removal of IPC SM SENS DI or related equipment with the power applied can cause electric shock or unexpected operation of equipment.

Always follow appropriate safety precautions and ensure that power to the IPC SM SENS DI is disabled before attempting to install or remove IPC SM SENS DI CPUs or related equipment.

Failure to disable all power to the IPC SM SENS DI and related equipment during installation or removal procedures can result in death, severe personal injury and/or property damage due to electric shock or unexpected equipment operation.

Always ensure that whenever you replace or install an IPC SM SENS DI device you use the correct module or equivalent device.

WARNING

Risks with incorrect installation of an IPC SM SENS DI module

Incorrect installation of an IPC SM SENS DI module can cause the program in the IPC SM SENS DI to function unpredictably.

Replace an IPC SM SENS DI device with the same model, and be sure to orient and position it correctly.

Failure to replace an IPC SM SENS DI device with the same model, orientation, or order can result in death, severe personal injury and/or property damage due to unexpected equipment operation.

WARNING

Risks when working in a flammable or combustible atmosphere

Disconnection of equipment when a flammable or combustible atmosphere is present can cause a fire or explosion.

Do not disconnect equipment when a flammable or combustible atmosphere is present. Always follow appropriate safety precautions when a flammable or combustible atmosphere is present.

A fire or explosion can result in death, serious injury and/or property damage.

NOTICE

Risks associated with electrostatic discharge

Electrostatic discharge can damage the memory card or the receptacle on the CPU. If damaged, the receptacle or memory card can malfunction or become inoperable.

To protect the memory card and receptacle from electrostatic discharge, do the following:

- Make contact with a grounded conductive pad or wear a grounded wrist strap when handling the memory card.
- Store the memory card in a conductive container.

Receptacle or memory card malfunction can result in property damage.

3.3 Connecting the device

3.3.1 Notes on connecting

⚠ WARNING

Risk of lightning strikes

A lightning flash may enter the mains cables and data transmission cables and jump to a person.

Death, serious injury and burns can be caused by lightning.

Take the following precautions:

- Disconnect the device from the power supply in good time when a thunderstorm is approaching.
- Do not touch mains cables and data transmission cables during a thunderstorm.
- Keep an enough distance from electric cables, distributors, systems, etc.

⚠ CAUTION

Use copper cables at connectors with terminal connections

Use copper (Cu) cables for all supply lines that are connected to the device with terminals, e.g. 24 VDC power supply cables to the 24 VDC power supply connectors.

Utiliser des câbles en cuivre sur les connexions à bornes

Utilisez des câbles en cuivre (Cu) pour tous les câbles d'alimentation qui sont raccordés à l'appareil par des bornes, par exemple les câbles d'alimentation 24 V CC sur le connecteur d'alimentation 24 V CC.

NOTICE

Fault caused by I/O devices

The connection of I/O devices can cause faults in the device.

The result might be personal injury and damage to the machine or plant.

Note the following when connecting I/O devices:

- Read the documentation of the I/O devices. Follow all instructions in the documentation.
- Only connect I/O devices which are approved for industrial applications in accordance with EN 61000-6-2 and IEC 61000-6-2.
- I/O devices that are not hotplug-capable may only be connected after the device has been disconnected from the power supply.

NOTICE

Damage through regenerative feedback

Regenerative feedback of voltage to ground by a connected or installed component can damage the device.

Connected or built-in I/Os, for example, a USB drive, are not permitted to supply any voltage to the device. Regenerative feedback is generally not permitted.

NOTICE

Ferrite required at USB cables

The interference immunity of the device according to the data in the technical specifications is only guaranteed when the cables at USB and micro USB ports are equipped with a ferrite magnet. Use only USB cables equipped with a ferrite magnet.

3.3.2 Connecting the function earth

A connected function earth discharges electrical charges from the metal enclosure.

The function earth also improves the discharge of interference generated by external power cables, signal cables or cables for I/O modules to ground.

The connection for the function earth is labeled with the following symbol:

WARNING

Electric shock and risk of fire

High voltage may be present in a defective device, which can cause fire or an electric shock if touched. This can result in death and serious injury.

- Connect the device to the function earth before you put it into operation.
- The function earth terminal on the device must be connected to the function earth of the control cabinet or system in which the device is installed.
- Never operate the device without function earth.
- If a device is defective, remove it from operation without delay and label it accordingly.

Requirement

- T20 screwdriver
- Cable lug for M4
- Function earth with minimum cross-section of 2.5 mm^2 copper cable

Procedure

1. Clamp the cable lug on the function earth.
2. Firmly attach the cable lug to the function earth connection on the device using the M4 thread with the torque of 1 Nm (see part labeled).
3. Connect the function earth to the protective conductor connection of the cabinet or the plant in which the device is installed.

3.3.3 Connecting the power supply

Note

The device should only be connected power supply which meets the requirements of safe extra low voltage (SELV) according to IEC/EN/DIN EN/UL 61010-1.

- IOT2050 SM: 24 VDC (20.4 to 28.8 V)
- Other configurations for IOT2050: 12 to 24 VDC (9 to 36 V)

Note

The power supply must be adapted to the input data of the device, see chapter "General technical specifications (Page 114)".

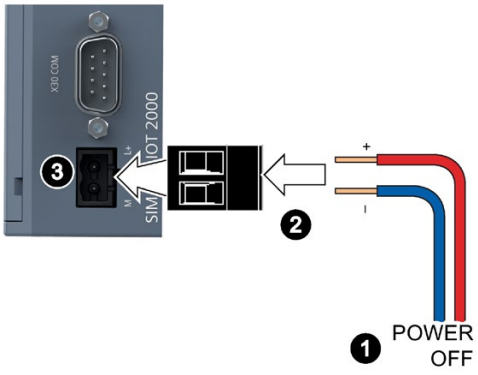
If there are voltage peaks on power supply lines, use a protective device in the form of a varistor (MOV) UMOV = U-rated x 1.2 (BLITZDUCTOR BVT AVD 24 (918 422) or compatible).

Requirement

- You are using the supplied terminal.
- A two-core cable meet the following requirements:
  - a copper (Cu) cable with cross-section of 0.75 mm^2 to 2.5 mm^2
  - rated temperature 70 °C
- A slotted screwdriver with a 3 mm blade.

Procedure

1. Switch off the power supply.
2. Connect the lines to the connecting terminal with a torque of 0.56 Nm (5lb-in).
3. Connect the connecting terminal to the connection for the power supply.



3.3.4 IOT2050 SM

3.3.4.1 Installing and removing the expansion cable

Note
Use the IO expansion cable in accessory kit

When connecting the expansion SMs, only use the IO expansion cable in accessory kit.

If you use a wrong cable and damage your device, the warranty becomes void.

You install the expansion cable between the expansion SM and IOT2050 SM. The expansion cable provides additional flexibility in configuring the layout of your system.

Table 3- 1 Installing the female connector of the expansion cable

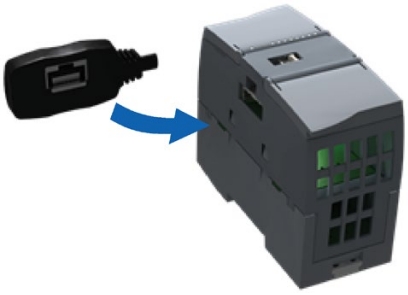
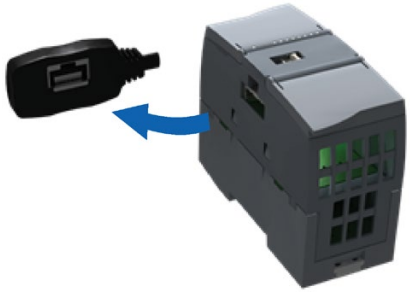
Task	Procedure
  	1. Ensure that IOT2050 SM and all expansion SMs are disconnected from electrical power. 2. Place the female connector to the bus connector on the left side of the signal module. 3. Slip the hook extension of the female connector into the housing at the bus connector and press down slightly to engage the hook. 4. Lock the connector into place: – Place a screwdriver beside the tab on the top of the signal module. – Slide the tab fully to the left. To engage the connector, you must slide the connector tab all the way to the left. The connector tab must be locked into place.

Table 3- 2 Removing the female connector of the expansion cable

Task	Procedure
  	1. Ensure that the IOT2050 SM and all expansion SMs are disconnected from electrical power. 2. Unlock the connector: – Place a screwdriver beside the tab on the top of the signal module. – Press down slightly and slide the tab fully to the right. 3. Lift the connector up slightly to disengage the hook extension. 4. Remove the female connector.

Note

Installing the expansion cable in a vibration environment

If the expansion cable is connected to modules that move, or are not firmly fixed, the cable male end snap-on connection can gradually become loose.

Use a cable tie to fix the male end cable on the DIN-rail (or other place) to provide extra strain relief.

Avoid using excessive force when you pull the cable during installation. Ensure the cable-module connection is in the correct position once installation is complete.

3.3.4.2 Connecting the Ethernet

To ensure the safety and protect IOT2050 SM from electrical surges, ground the Ethernet cable as follows:

1. Strip the insulation of ethernet cable (typically within the last 10 cm of the cable).
2. Mount the earthing clamps on the DIN rail.
3. Plug the shielding of the cable into the earthing clamp.

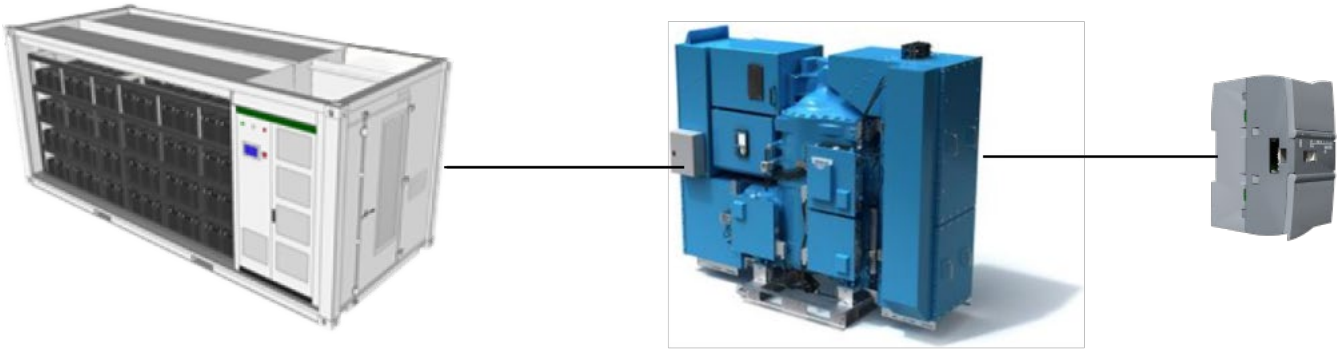
3.3.4.3 Connecting IPC SM SENS DI

DI Requirement ⚠

- A two-core cable meet the following requirements:
  - a copper (Cu) cable with cross-section of 0.3 mm^2 to 2 mm^2
  - rated temperature 75 °C
- A slotted screwdriver with a 3 mm blade
- The maximum torque for the connector screw is 0.45 N*m

Quintessence

Make sure you include an overcurrent protection device in the circuit. See an example of DI inputs wiring of digital input modules below.



① Battery Station, DC-main supply

② Siemens Energy switch-gear (8VM1 Blue GISTM)

- Fuse integrated
- Circuit breakers equipment for command / control lines voltage
- MCBs (Miniature Circuit Breaker) are integrated for the protection of the control circuit
- Control circuit handles lines function and protection (e.g. signal feedback to SCADA systems)

③ SM SENS DI module

- DI inputs

Software and commissioning

4

4.1 Software and commissioning

Operating system and software for the SIMATIC IOT devices are freely programmable and are loaded from the Micro SD/eMMC card when the device is booted.

For SIMATIC IOT2050 6ES7647-0BA00-1YA2: The device is capable of "Secure Boot", which means it only boots from trusted contents if enabled.

Additional information on the software topics, "Secure Boot", commissioning and Micro SD image is available in the SIMATIC IOT2000 Forum.

General information on commissioning

CAUTION

Danger of burns

The device surface can reach over 70 °C. You may get burned without any protection when touching it.

Don't directly touch the device during its operation. Always wear protective gloves before touching the device.

La surface de l'appareil peut atteindre une température supérieure à 70 °C. Vous risquez de vous brûler au contact de l'appareil si vous ne portez pas de gants de protection.

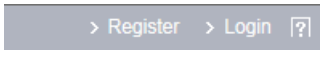
Évitez le contact direct avec l'appareil pendant son fonctionnement. Portez toujours des gants de protection avant de toucher l'appareil.

SIMATIC IOT2000 Forum

To use the SIMATIC IOT2000 Forum, you need a login for online support.

Follow these steps to participate in the Technical Forum:

1. Open the website "Technical Forum (https://support.industry.siemens.com/forum/us/en/conf/60/)".
2. If you do not yet have a login for online support, click "Register" at the top right of the window and follow the registration instructions.

   During registration, you enter an alias for the forum, for example. This alias is the pseudonym under which other users can see you and talk to you in the forum.

   You will receive a confirmation e-mail after registering successfully.

4.2 Install example image on eMMC

4.2.1 Overview

This chapter describes how to install the example image on the eMMC of the IOT2050.

Note

As IOT2050 doesn't have eMMC, this procedure is not applicable for IOT2050 Basic (6ES7647-0BA00-0YA2).

Procedure

The installation includes the following procedures:

1. Use engineering station to flash the example image to the first USB flash drive or SD card using, for example, **Win32DiskImager**.
2. Power on IOT2050 (Page 39).
3. Install the example image on eMMC of the IOT2050 in one of the following two ways:
   - Use a single USB flash drive / SD card
   - Use two different USB flash drives / SD card
     - One to run the Example Image
     - One to transfer the Example Image to the eMMC

Required Hardware

Required hardware	Description
SD card or USB flash driver	The internal eMMC can also be used.
Engineering station	To remotely access the IOT2050 and transfer files, an engineering station is required. In this document, a PC running Windows 10 Enterprise is used. The Engineering Station must include the following interfaces: • SD card slot • Ethernet port
Ethernet cable	For connecting the engineering station to the IOT2050 using SSH.
DisplayPort Cable (Male-Male) and Monitor	For connecting to a local IOT2050
Keyboard	For connecting to a local IOT2050

Required Software

Required software	Description	Download
Micro-SD Card Example Image	To use the full functionality of SIMATIC IOT2050, you must install an SD-Card sample image with Debian-based Linux operating system.	SIMATIC IOT2050 SD-Card example image (https://support.industry.siemens.com/cs/ww/en/view/109741799)
SSH Client	For remotely access to the SIMATIC IOT2050. In this document "PuTTY" is used. **Note**: Besides PuTTY, you can also use the built-in SSH client in Windows 10 or Linux.	Putty
Win32DiskImager	For putting the SD Card image to the SD Card.	Win32DiskImager

4.2.2 Install sample image to eMMC with single USB stick

Use one single USB flash drive

1. Flash the sample image to a USB flash drive or SD card using a tool such as Win32DiskImager (Page 48).
2. To resize the file system on the USB flash drive, boot the IOT2050 once from this stick. Otherwise, the flash drive might be too small to perform the next step.

   The boot is complete once the STAT LED flashes green.
3. Mount the USB flash drive or SD card onto a Linux PC and copy the file "IOT2050_Example_Image_Vx...x.img" to it, for example, to the directory "/home".
4. Insert the USB flash drive or SD card into the IOT2050 (Page 60) and power on IOT2050 (Page 39). The IOT2050 should boot.
5. Connect to the IOT2050 by using SSH (Page 48), and log in as root.
6. Use `dd` command to transfer the "IOT2050_Example_Image_Vx...x.img" file from the USB flash drive or SD card to the internal eMMc.

   This is an example of having the external boot devices before the internal eMMC.

   ```
   dd if=/home/IOT2050_Example_Image_Vx...x.img of=/dev/mmcblk1
   bs=100M conv=fsync status=progress
   ```

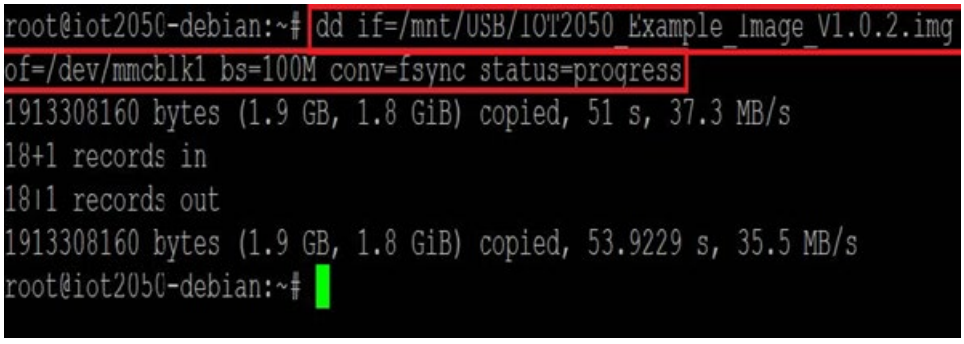
   - `if=/home/IOT2050_Example_Image_Vx...x.img`: file path of the image file
   - `of=/dev/mmcblk1`: the block device path of the eMMC
   - `bs=100M`: write 100MB at a time
   - `conv=fsync`: Synchronize to device before finishing
   - `status=progress`: Show progress status

7. Power off the IOT2050.
8. Safely remove the USB flash drive or SD card.
9. Power on the IOT2050.

   IOT2050 now booted in eMMC

Use two different USB flash drives

1. Flash the sample image to a USB flash drive or SD card using a tool such as **Win32DiskImager**.
2. Insert the USB flash drive or SD card into the IOT2050 and power on IOT2050. The IOT2050 should boot.
3. Copy the file "IOT2050_Example_Image_Vx...x.img" to a second USB flash drive.
4. Connect the second USB flash drive to the IOT2050.
5. Connect to the IOT2050 by using SSH, and log in as root.
6. Mount the second USB flash drive to the file system.



7. Use `dd` command to transfer the "IOT2050_Example_Image_Vx...x.img" file from the USB flash drive or SD card to the internal eMMc.

   This is an example of having the external boot devices before the internal eMMC.

   ```
   dd if=/home/IOT2050_Example_Image_Vx...x.img of=/dev/mmcblk1
   bs=100M conv=fsync status=progress
   ```

   - `if=/home/IOT2050_Example_Image_Vx...x.img`: file path of the image file
   - `of=/dev/mmcblk1`: the block device path of the eMMC
   - `bs=100M`: write 100MB at a time
   - `conv=fsync`: Synchronize to device before finishing
   - `status=progress`: Show progress status
8. Power off the IOT2050.
9. Safely remove the USB flash drive or SD card.
10. Power on the IOT2050.

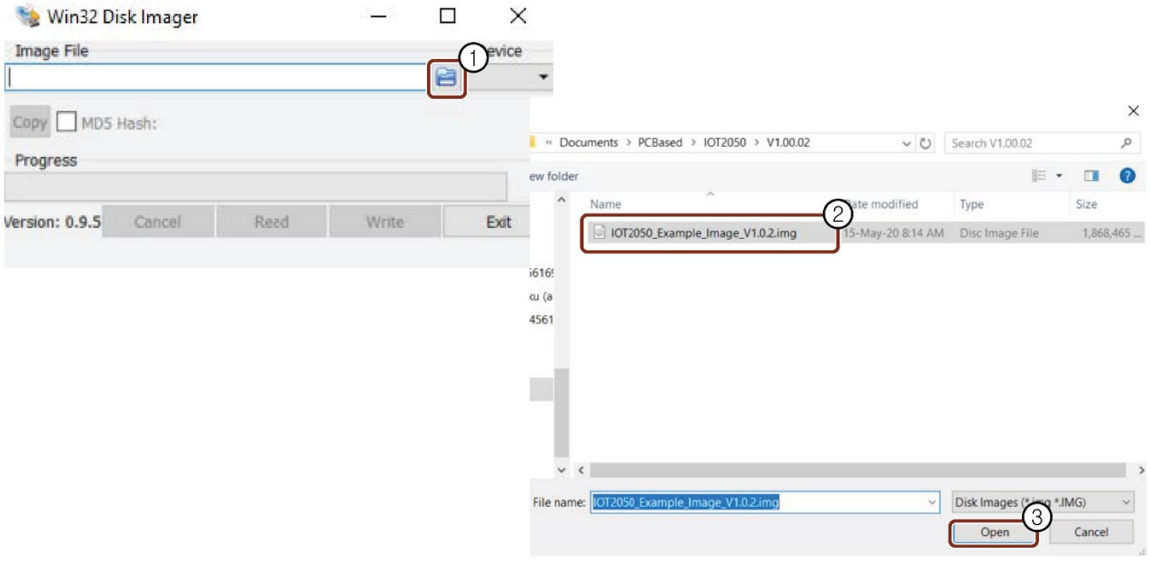
    IOT2050 now booted in eMMC

4.2.3 Setting up the IOT2050 with example image

4.2.3.1 Installing the SD-card Example image

To transfer the SD card image to a micro SD card, perform the following steps:

1. Insert the SD-card via SD-card adapter in the SD-card slot (Page 60) of your engineering station.
2. Retrieve downloaded SD card image `.zip`.
3. Install the downloaded `Win32DiskImager-x.x.x-install.exe`.
4. Start the Win32 Disk Imager.
5. Click ①, navigate to the folder where the retrieved SD card image is saved, select ②, and then click ③.



6. Select the drive letter of your SD card.
7. Click "Write".
8. Click "Yes" to confirm the overwrite.
9. Click "OK" when you get the complete message.
10. Safely remove the SD card.

4.2.3.2 Remote access with Putty SSH Connection

Condition

- Engineering station with monitor and keyboard
- Putty.exe is available on an engineering station
- The Engineering Station and IOT2050 must be on the same subnet

Access IOT2050 with Putty

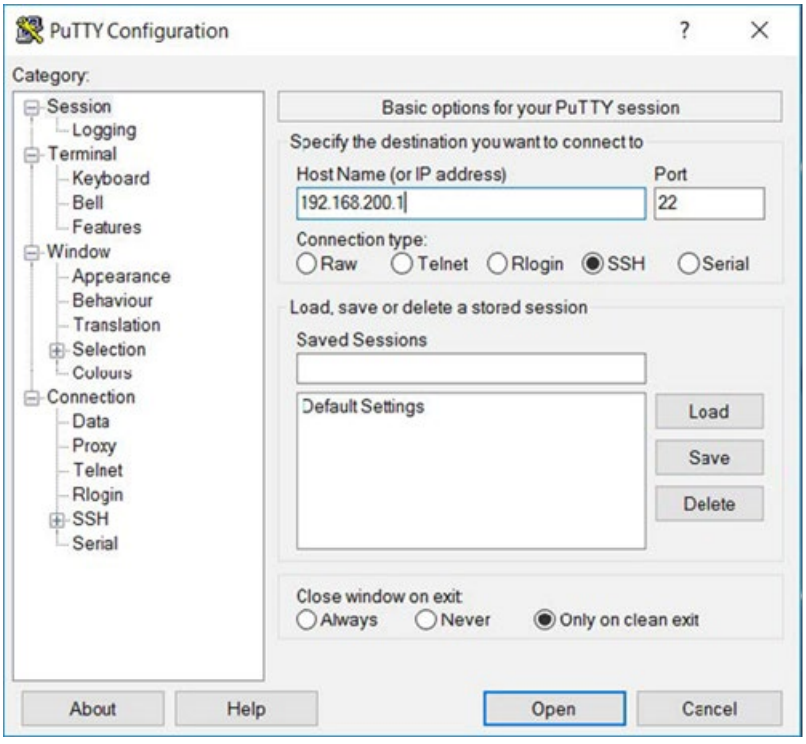
1. Connect the engineering station and the SIMATIC IOT2050 with an Ethernet cable.

   Note: The SIMATIC IOT2050 has a static IP address by default, which is 192.168.200.1. For version 1.0.2 this IP address is set to X1P2, but from version 1.1.1 it is set to X1P1.

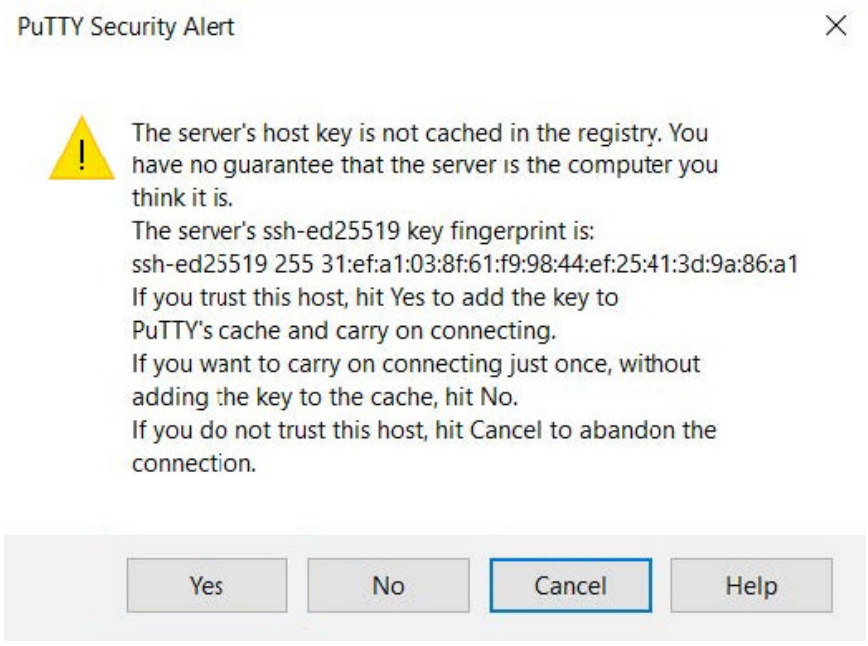
   - For V1.0.2, connect the Ethernet port X1P2
   - For V1.1.1, connect the Ethernet port X1P1

2. Double-click the downloaded Putty.exe.
3. Enter "Default setting" in the description and click the Save button to save it.
4. Configure the Putty connection.
   - connection type: SSH
   - IP address: 192.168.200.1
   - Port: 22
5. Click "Open".

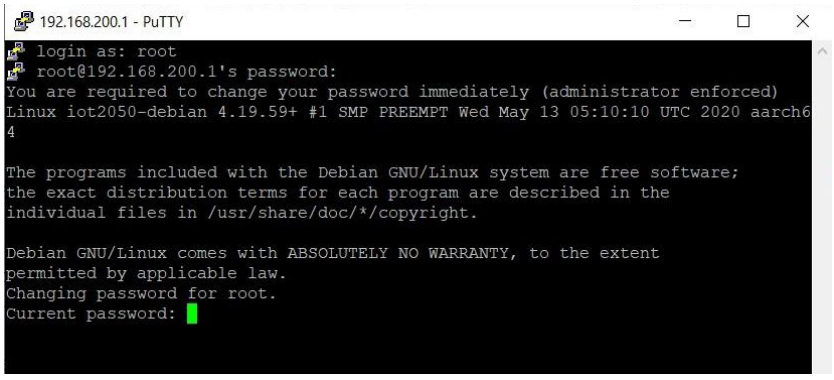
   The Putty communication window opens.



6. When connecting via SSH for the first time, a warning dialog appears indicating that it is necessary to update the SSH key. Press the "Yes" button to continue.



7. Enter "root" after "login as" and then enter the password for "root".



You will be prompted to change the root password the first time you log in. Change the password when prompted.

8. Now you can test some Linux commands.

4.2.3.3 Remote access with UART connection

Condition

- Engineering station with monitor and keyboard
- A UART cable
- Putty.exe is available on an engineering station
- The engineering station and IOT2050 must be on the same subnet

Access IOT2050 with UART

1. Loosen the shield cover and remove it.

2. Connect the USB end of UART cable to the engineering station.
3. In engineering station, type "Device Manager" in the search box on the taskbar, then select from the menu.

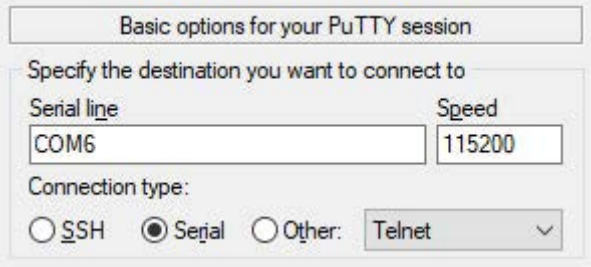
4. Check the assigned COM port.

Note

If no COM port is assigned and the device appears as an unknown device, you must install the drivers for the cable.

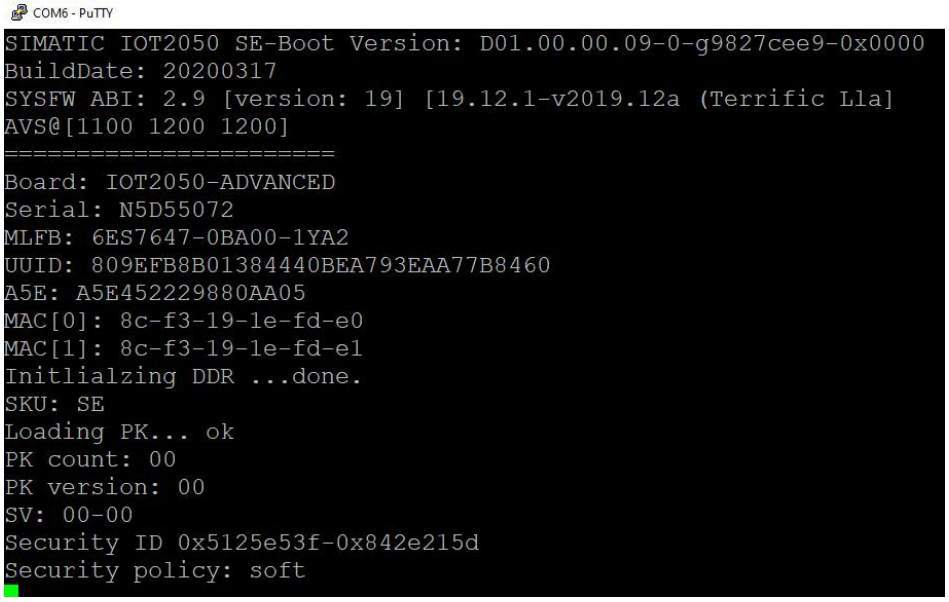
5. Double-click the downloaded Putty.exe.

6. Configure the Putty connection.
   - Connection type: Serial
   - Serial production line: COM6 (We use COM6 for demonstration, which is the port number obtained from step 3.)
   - Speed: 115200

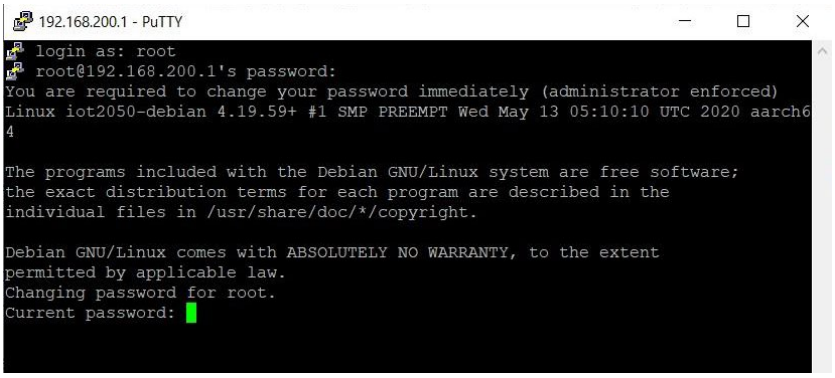


7. Power on the IOT2050

   You can see the whole boot process in the Putty communication window.



8. Enter "root" after "login as" and then enter the password for "root".



   You will be prompted to change the root password the first time you log in. Change the password when prompted.

9. Now you can test some Linux commands.

4.2.3.4 Setting up network interface

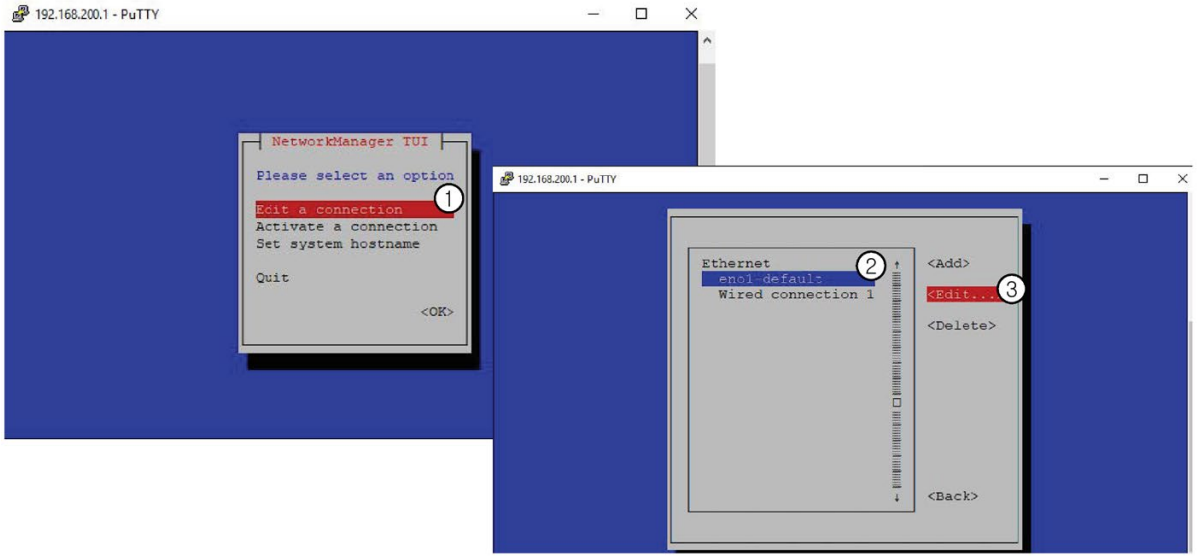
The IP address on SIMATIC IOT2050's default image is set as 192.168.200.1. Therefore, if a DHCP address or another static IP address is needed, you can configure it using the "nmtui".

Set the IP address of IOT2050

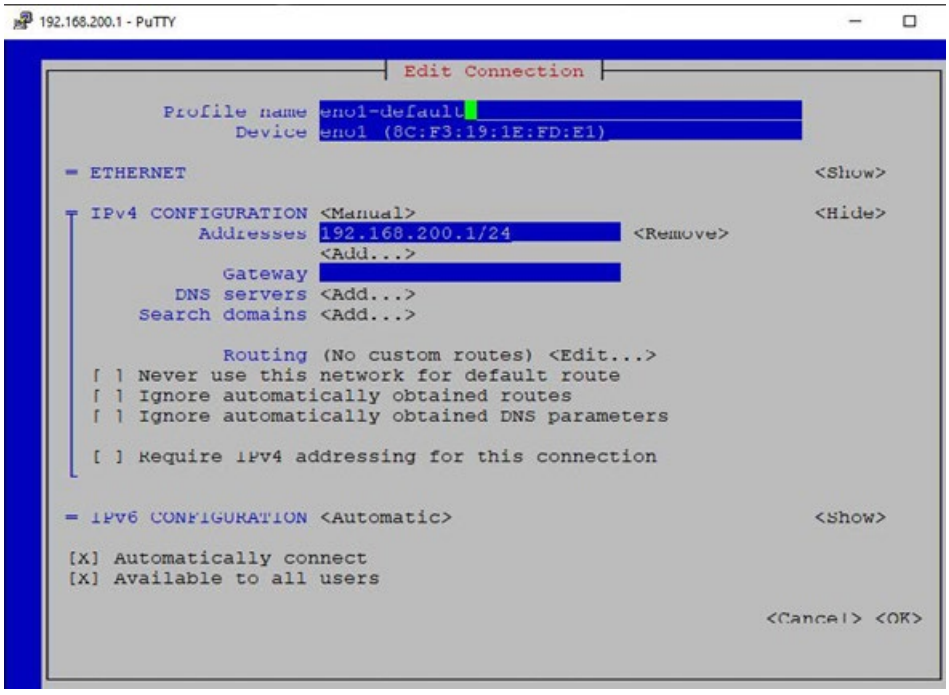
1. Open a serial Putty connection and log in as root.
2. Enter "nmtui" to open the network manager tool.
3. Navigate to the "Activate a connection" and press **Enter**.
4. Select the interfaces you want to enable.
   - For V1.0.1, select "eth0" and "eth1"
   - For V1.1.1, select "eno1" and "eno2"

   Note: eth0 and eno1 are enabled by default, while eth1 and eno2 is disabled by default. However, eth1 and eno2 are automatically enabled when a LAB cable is connected.

5. To access the "Edit a connection" page, click "Edit a Connection" and select the ethernet interface. Then, click the "Edit...".

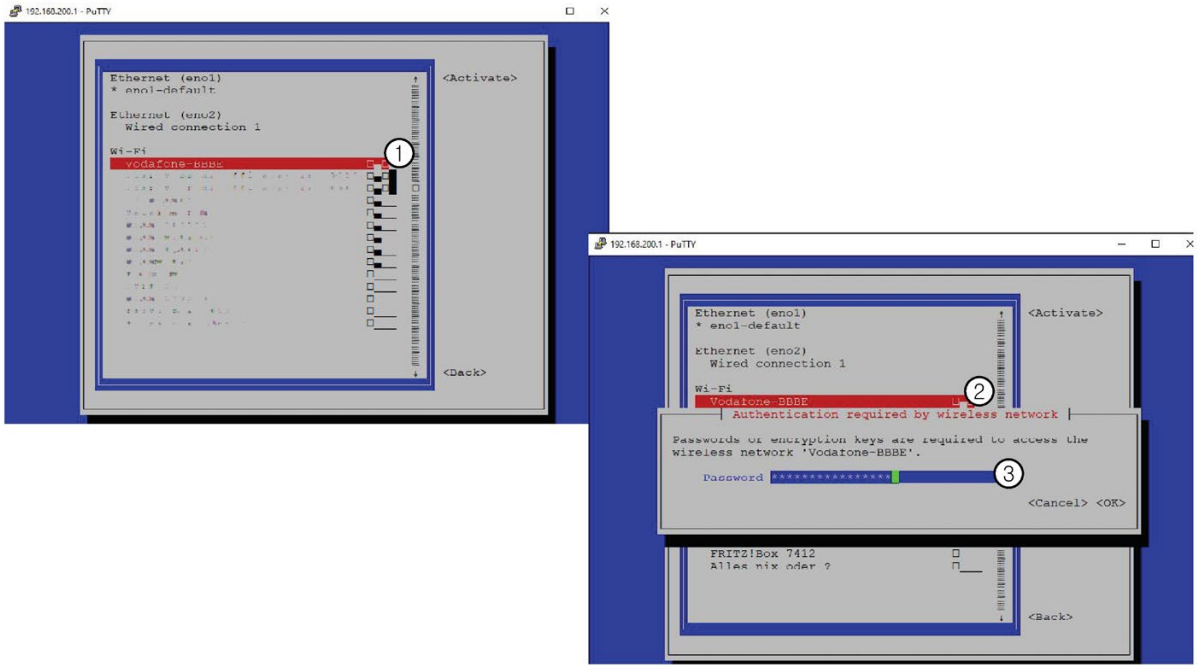


6. Now you can configure the connection on the "Edit a connection" page.



Use USB Wifi dongle to connect the IOT2050 to a wireless access point

1. Insert your USB Wifi dongle into the IOT2050 device.
2. Navigate to "Activate a connection" and select the wireless access point that you want to connect to. And then enter the password.



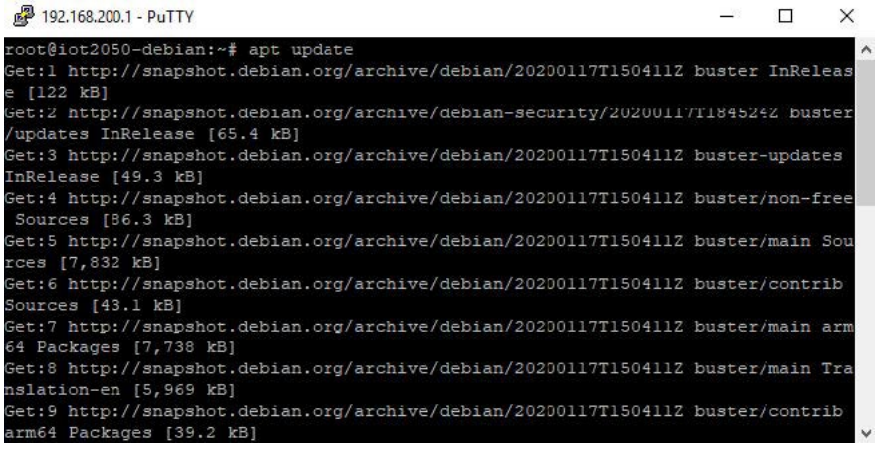
3. To change the wireless connection, go to the "Edit a connection" page.

4.2.3.5 Installing software on IOT2050

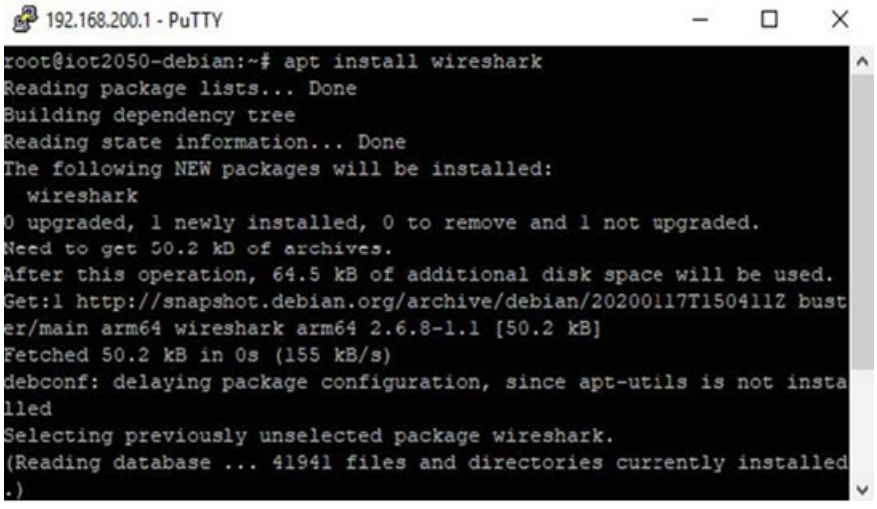
The provide example image includes the apt package manager, with which you can install software on IOT2050.

Install software

1. Open a serial Putty connection and log in as root.
2. Update repositories by typing `apt update`.



3. Type `apt install <name of software>`



4. Accept all licenses during installation.

Remove software

1. To remove the software with its configuration file, type `apt purge <name of software>`

4.2.3.6 Change boot order of IOT2050

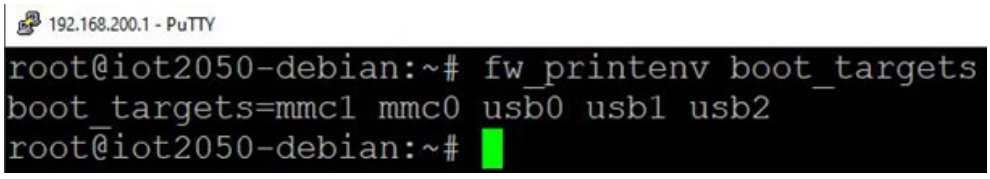
IOT2050 Advance and IOT2050 M.2 have internal eMMC which is automatically set as the first boot device for FS:01, FS:02 and FS:04. Here (https://support.industry.siemens.com/forum/ww/en/posts/overview-about-fs-states-of-iot2050/273280/?page=0&pageSize=10) you can find more information on functional state(FS).

Note

mmc1 refers to eMMC, mmc0 refers to the SD card, and usbx refers to the USB slots.

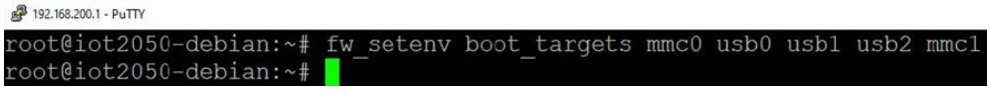
For example image V1.0.2 or V1.1.1

1. Open a serial Putty connection and log in as root.
2. To check the current boot order, type `fw_printernv boot_targets`



3. To change the boor order, type `fw_setenv boot_targets [devices]`

   This is an example of having the external boot devices before the internal eMMC.

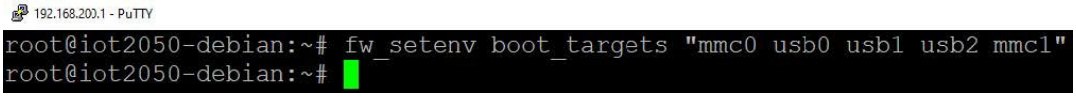


4. Type `fw_printernv boot_targets` to check the current boot order.

For example image V1.2.1

1. Open a serial Putty connection and log in as root.
2. To check the current boot order, type `fw_printernv boot_targets`
3. To change the boor order, type `fw_setenv boot_targets ["devices"]`

   This is an example of having the external boot devices before the internal eMMC.



4. Type `fw_printernv boot_targets` to check the current boot order.

4.2.3.7 Using UART connection

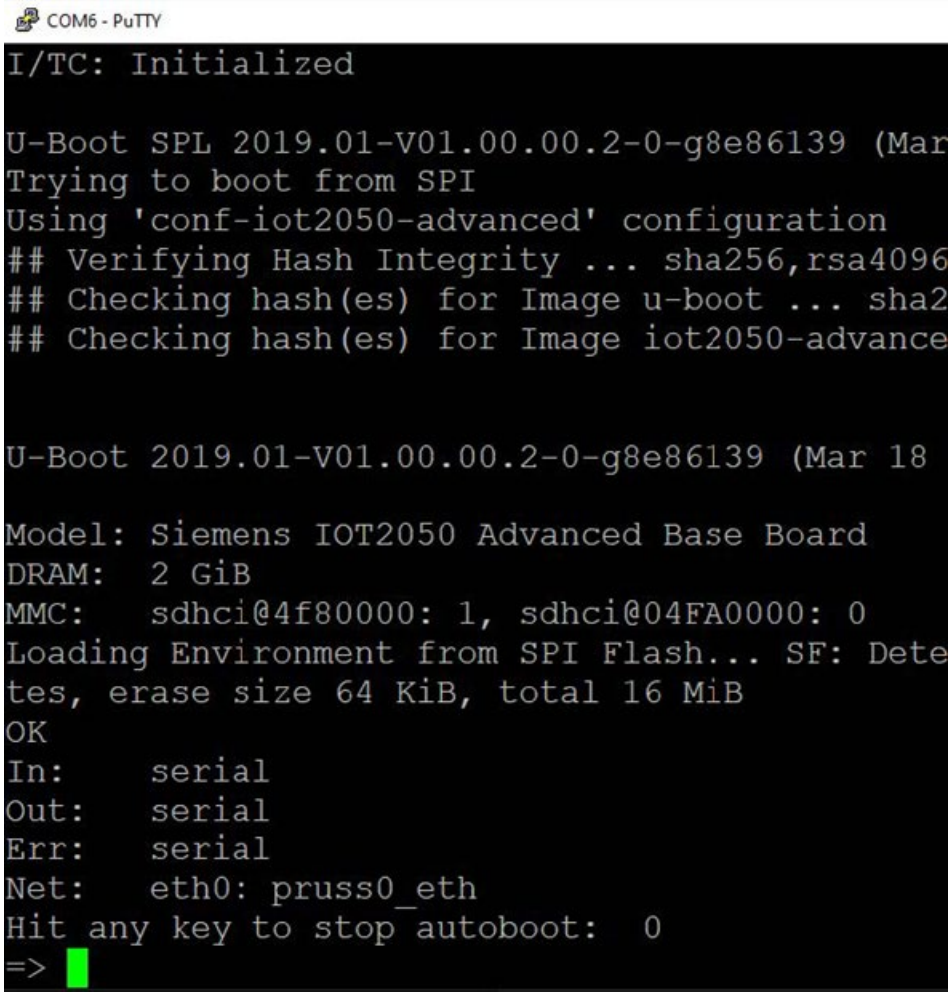
You can use the UART connection to perform the following tasks:

- Enter u-boot shell
- Change the boot order
- Select a specific boot device

Permanently change boot order

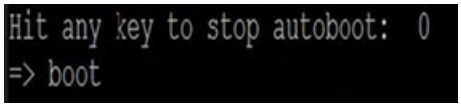
1. Interrupt the boot process by hitting any key when prompted to "Hit the Spacebar to stop autoboot".

   You should get "u-boot shell", which is indicated by `=>` or `IOT2050`



2. To change the boot order, type `setenv boot_targets "[devices]"`

3. To continue boot with the changed boot order, type `boot`



Select boot device only for the next boot

1. Interrupt the boot process by hitting any key when prompted to "Hit the **Spacebar** to stop autoboot".

   You should get "u-boot shell", which is indicated by `=>` or `IOT2050`

2. To boot from one specific device, type `run bootcmd_<devices>`

Expand device

5

5.1 Insert Micro SD card/Nano SIM card

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 Basic: 6ES7647-0BA00-0YA2
- IOT2050 Advance: 6ES7647-0BA00-1YA2
- IOT2050 M.2: 6ES7647-0BB00-1YA2
- IOT2050 SM: 6ES7647-0CA00-1AA2

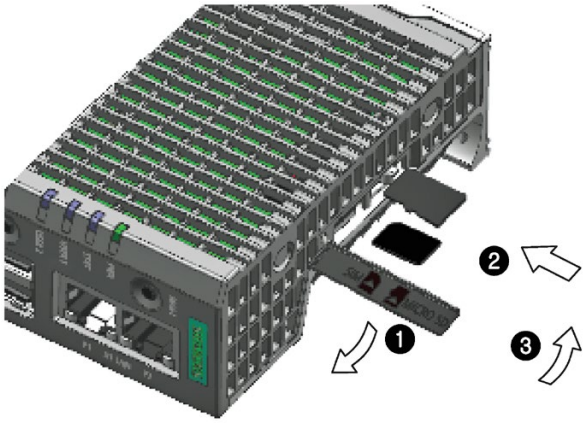
Requirement

- The device is disconnected from the power supply.
- Micro SD card or Nano SIM card that is suitable for industrial use.

Installation

NOTICE
Inserting a memory card If you are using the Micro SD card/Nano SIM card in a device installed in a system, you must observe the safety regulations for work on electrical systems. Carefully insert the Micro SD card/Nano SIM card into the card holder without applying excess force.

1. Open the card cover on the bottom.
2. Push the Micro SD card/Nano SIM card correctly into the supporting frame. The contacts of the Micro SD card/Nano SIM card must point in the direction of the motherboard.
3. Push the card cover back.



5.2 Install Arduino shield

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 Basic: 6ES7647-0BA00-0YA2
- IOT2050 Advance: 6ES7647-0BA00-1YA2
- IOT2050 M.2: 6ES7647-0BB00-1YA2

Requirement

- The device is disconnected from the power supply.
- An Arduino shield

Procedure

NOTICE

Install Arduino shield

Ensure that the Arduino shield is inserted in its correct orientation. Ensure that the contact pins of the Arduino shield connect correctly with the terminal strips of the motherboard.

Arduino shield with operator control or display elements

Some Arduino shields have operator control and display elements. The device loses its approval certificates if you drill or mill openings in the cover in order to make the operator control or display elements of the Arduino shield accessible or visible from outside. In this case, the customer is responsible for the re-approval of the device.

Note

Power consumption

If the power consumption of the Arduino shield is too high, the device will be damaged.

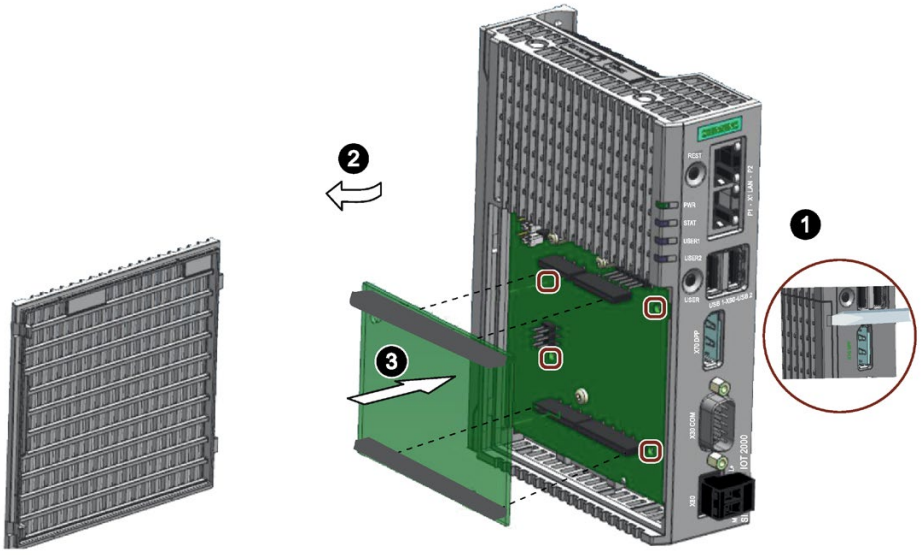
Note the information in section "Technical specifications (Page 110)".

Ambient temperature

The temperature in the housing of the device can be up to 30 °C above the maximum permissible ambient temperature of the device.

Make sure that the maximum permissible ambient temperature of the Arduino shield is specified accordingly.

1. Loosen the shield cover. Carefully press with the blade of a flat-blade screwdriver in the marked recesses and carefully pull on the appropriate place on the shield cover.



2. Remove the shield cover.
3. Insert the Arduino shield into the motherboard. Ensure that the contact pins of the Arduino shield fit perfectly on the contact strips of the motherboard and that the components of the Arduino shield do not touch the components of the motherboard.

   Note: Customize the shield cover according to the Arduino shield.

Note

Only use fixing elements made from plastic.

You can use the four boreholes in the motherboard to additionally fasten the Arduino shield on the motherboard. The boreholes are shown in the figure above. Only use fixing elements made from plastic, not metallic or conductive materials.

5.3 Install Mini PCIe card

You can install a Mini PCIe card in a IOT2050.

Note

Power consumption

If the power consumption of the Mini PCIe card is too high, the device will be damaged.

Note the information in section "Technical specifications (Page 110)".

Ambient temperature

The temperature in the housing of the device can be up to 30 °C above the maximum permissible ambient temperature of the device.

Make sure that the maximum permissible ambient temperature of the Mini PCIe- card is specified accordingly.

⚠ CAUTION

Risk of burns due to hot components

The motherboard and internal components can get hot during operation. Motherboard and internal components will only cool down slowly after the device has been switched off.

To avoid getting burned, wait a while after switching off the power supply. Be very careful when opening the enclosure and removing the motherboard.

5.3.1 IOT2050 SM: Installing Mini PCIe card

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 SM: 6ES7647-0CA00-1AA2

Requirement

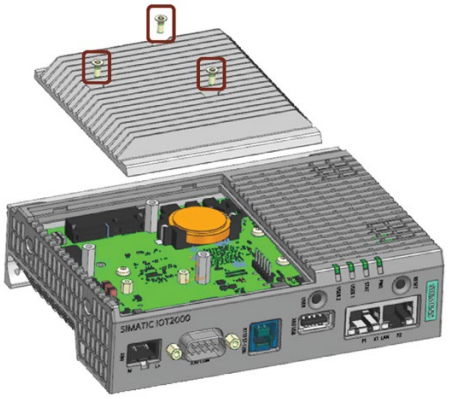
- The device is disconnected from the power supply.
- A Mini PCIe card or an half-size Mini PCIe card
- M2 screws

Install Mini PCIe card

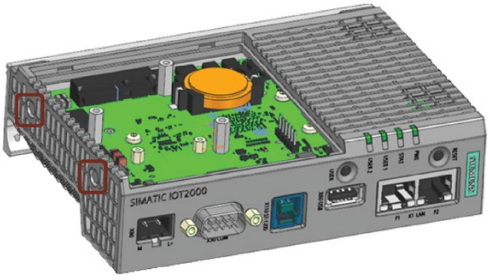
The following example describes the installation of a Mini PCIe card, including mounting of the antenna jacks. If the Mini PCIe card you install doesn't have an antenna, the work steps 4 and 5 are not required.

Then follow these steps:

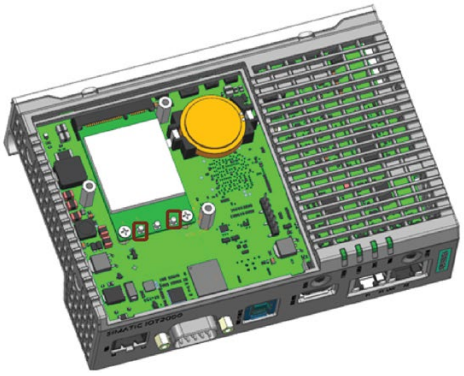
1. Remove the marked three screws on shield cover and remove the shield cover.

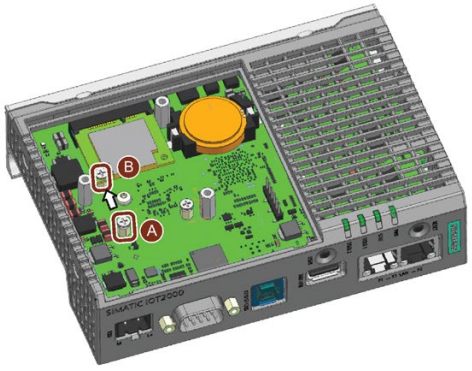


2. Drill holes with a corresponding diameter at the marking shown for mini PCIe installation accessory. There are four reserved antenna-holes, two on each side of the top housing.

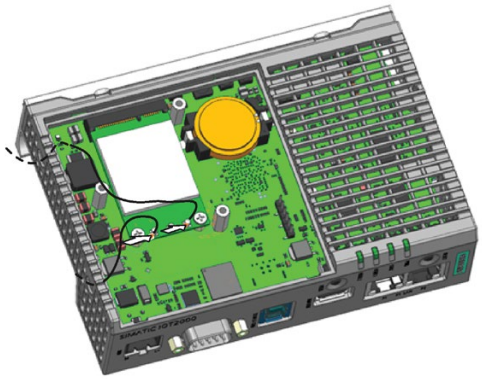


3. Insert the Mini PCIe card in the Mini PCIe interface and fix it with two M2 screws.
   For half size Mini PCIe card, you need to move one standoff from A to B. Then install the half size Mini PCIe card and fix it with a M2 screw.





4. Connect the cables of mini PCIe installation accessory to the Mini PCIe card.



5. Get the cable of mini PCIe installation accessory out of the housing through the hole drilled.

6. Place the thermal pad on top of the PCIe card.

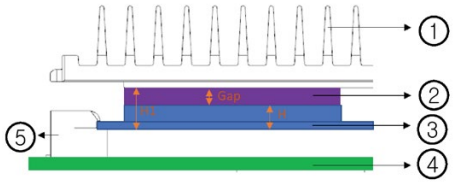
Note

Use of thermal pad

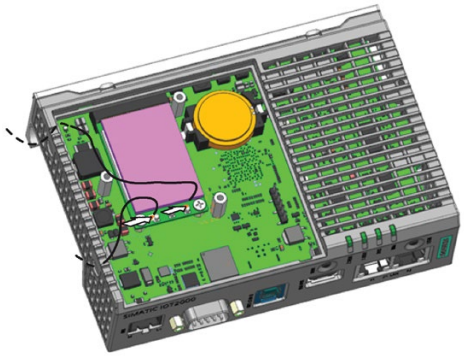
Distance between card and heatsink H1=5.9mm, gap=H1-H

- If 0 < gap < 1, use 1 mm thermal pad
- If 1 < gap < 2, use 2 mm thermal pad
- If 2 < gap < 3, use 1 mm and 2 mm thermal pads together

This thermal pad is included in the accessory pack and has a thermal conductivity of 4.5W/mK.



① heatsink
② thermal pad
③ card
④ PCB board
⑤ miniPCLe



① heatsink
② thermal pad
③ card
④ PCB board
⑤ miniPCLe
⑥ adapter card

7. Put the shield cover back.

5.3.2 IOT2050 Basic/Advance: Installing Mini PCIe card

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 Basic: 6ES7647-0BA00-0YA2
- IOT2050 Advance: 6ES7647-0BA00-1YA2

Requirement

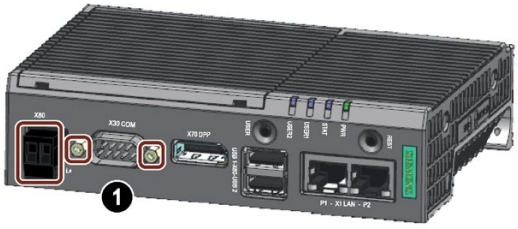
- The device is disconnected from the power supply.
- A Mini PCIe card
- Two M2 screws (supplied in accessory kit)

Procedure

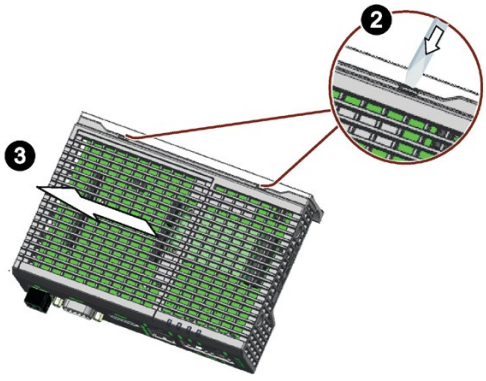
The following example describes the installation of a Mini PCIe card, including mounting of the antenna jacks. If the Mini PCIe card you install doesn't have an antenna, the work steps 4, 7 and 8 are not required.

Then follow these steps:

1. Remove the power plug and marked screws.

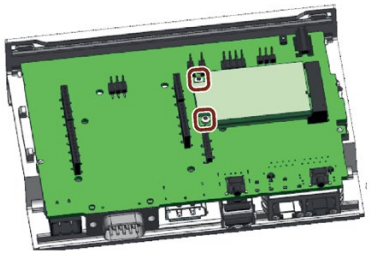


2. Loosen the top housing. Carefully press with the blade of a flat-blade screwdriver in the marked recesses and carefully pull on the appropriate place on the top housing of the enclosure.
3. Remove the top housing of the enclosure.

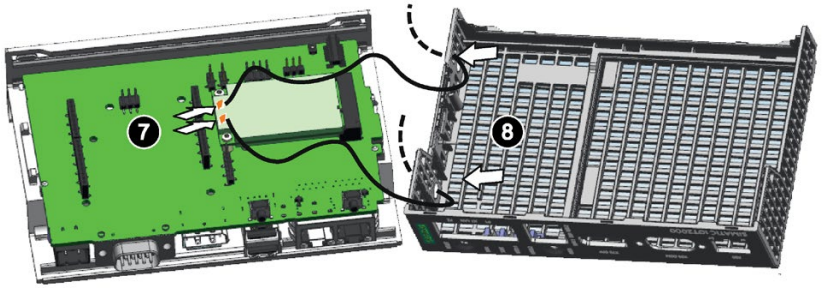


4. Drill holes with a corresponding diameter at the marking shown for mini PCIe installation accessory. There are four reserved antenna-holes, two one each side of the top housing.

5. Insert the Mini PCIe card in the Mini PCIe interface on the motherboard.
6. Fix the mini PCIe card with two M2 screws.

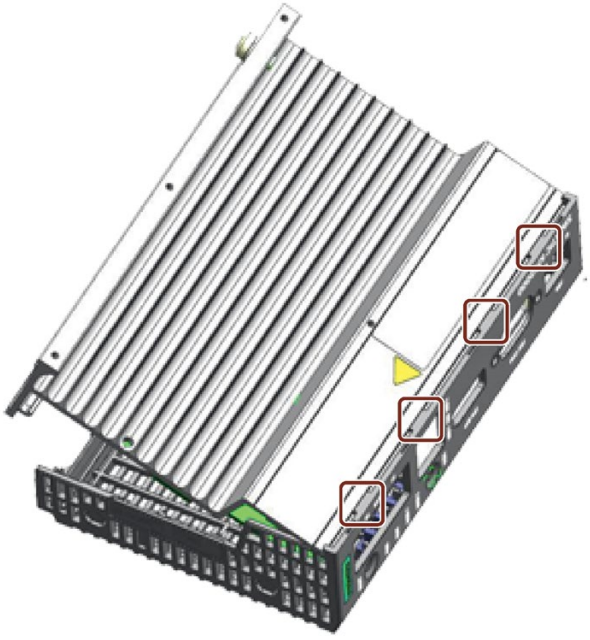


7. Connect the cables of mini PCIe installation accessory to the Mini PCIe card.
8. Get the cable of mini PCIe installation accessory out of the housing through the whole drilled in step 4.

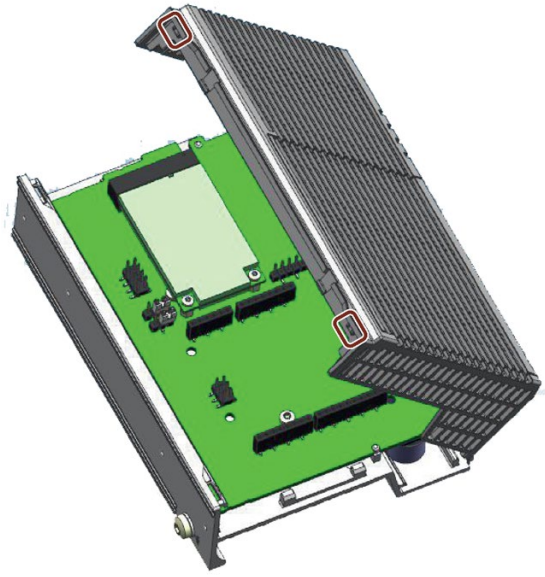


Installing the top housing

1. Align the bottom of the top housing to the heatsink edge. Make sure the marked hooks hooked the heatsink. Carefully insert the COM interface into the top housing.



2. Insert the two plastic clips of top housing into the clip holes on heatsink.



3. Press the top housing to fix the clips.

Then install power plug and screws for COM interface.

5.3.3 IOT2050 Basic/Advance: Installing half-size Mini PCIe card

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 Basic: 6ES7647-0BA00-0YA2
- IOT2050 Advance: 6ES7647-0BA00-1YA2

Requirement

- The device is disconnected from the power supply.
- A half-size Mini PCIe card
- One M2 screw

Procedure

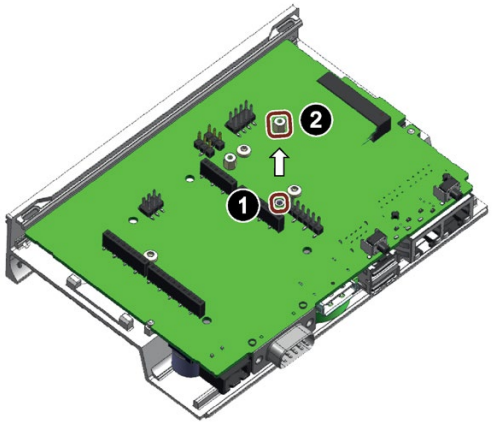
You can install the half-size Mini PCIe card by two ways.

- Expand the length of half-size Mini PCIe card with a expansion card. Then follow the procedure in IOT2050 Basic/Advance: Installing Mini PCIe card (Page 67)
- Install the half-size Mini PCIe cards directly.

The following example describes the installation of a half-size Mini PCIe card, including mounting of the antenna jacks. If the Mini PCIe card you install doesn't have an antenna, the work steps 5 and 6 are not required.

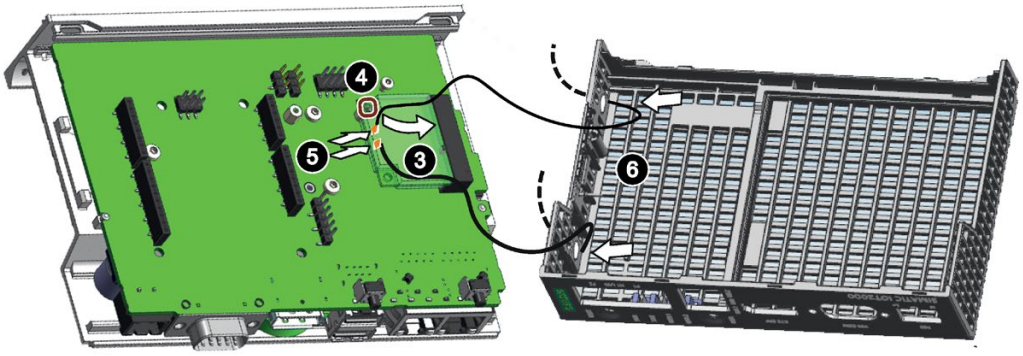
Follow steps 1 to 4 as described in IOT2050 Basic/Advance: Installing Mini PCIe card (Page 67) to open the top housing with shield cover. Then the following steps:

1. Remove one standoff for Mini PCIe card from motherboard.
2. Install the standoff to the place as shown in the picture.



3. Insert the half-size Mini PCIe card in the Mini PCIe interface on the motherboard as illustrated.
4. Fix the mini PCIe card with one M2 screw.

5. Connect the cables of mini PCIe installation accessory to the Mini PCIe card.
6. Get the cable of mini PCIe installation accessory out of the housing.



Then install the top housing (Page 67).

5.3.4 IOT2050 M.2: Installing M.2 card

Applicable Configuration

This operation is only applicable for the following configurations:

- IOT2050 M.2: 6ES7647-0BB00-1AA2

Requirement

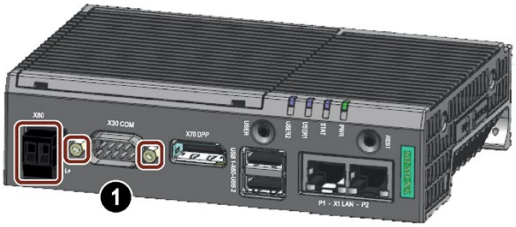
- The device is disconnected from the power supply.
- B-key M.2 card with length of 42 mm / 52 mm or E-key M.2 card with length of 30 mm
- M3 screw and M3 screw with spacer (supplied in accessory kit)

Quintessence

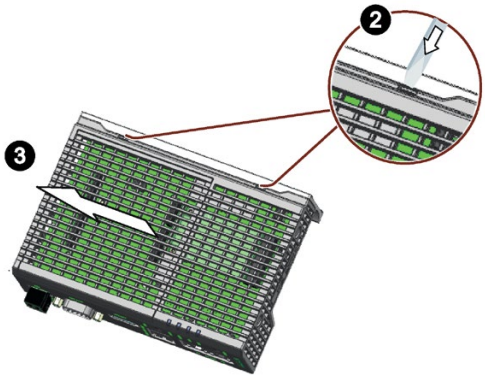
The following example describes the installation of a M.2 card, including mounting of the antenna jacks. If the M.2 card you install doesn't have an antenna, the work steps 4, 7 and 8 are not required.

Then follow these steps:

1. Remove the power plug and marked screws.



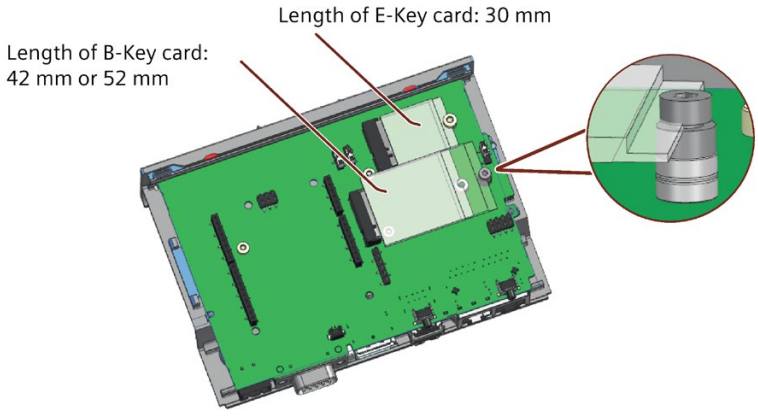
2. Loosen the top housing. Carefully press with the blade of a flat-blade screwdriver in the marked recesses and carefully pull on the appropriate place on the top housing of the enclosure.



3. Remove the top housing of the enclosure.
4. Drill holes with a corresponding diameter at the marking shown for M.2 installation accessory. There are four reserved antenna-holes, two on each side of the top housing.

5. Insert the M.2 card in the M.2 interface on the motherboard.

6. Fix the M.2 card.
   - For M.2 card on E-key, fix it with a M3 screw.
   - For M.2 card on B-key, make sure you fix the card between the spacer and the screw head.



7. Connect the cables of M.2 installation accessory to the M.2 card.
8. Get the cable of M.2 installation accessory out of the housing through the whole you drilled.

Maintaining and repairing the device

6

6.1 Maintenance

To retain a high level of system availability, or devices with a back-up battery, we recommend the preventative replacement of the back-up battery at replacement intervals of 5 years.

Cleaning the device

If you need to clean the device, use dry ESD cleaning cloths (observing the ESD protective measures).

6.2 Repair information

Carrying out repairs

Only qualified personnel are permitted to repair the device. Contact your local representative, see section "Service and support (Page 142)".

WARNING

Unauthorized opening and improper repairs on the device may result in substantial damage to equipment or endanger the user.

- Always disconnect the power plug before you open the device.
- Only install system expansion devices designed for this device. If you install other expansion devices, you may damage the device or violate the safety requirements and regulations on RF suppression. Contact your technical support team or where you purchased your PC to find out which system expansion devices may safely be installed.

If you install or exchange system expansions and damage your device, the warranty becomes void.

CAUTION

Electrostatic sensitive devices (ESD)

The device contains electronic components which are destroyed by electrostatic charges. This can result in malfunctions and damage to the machine or plant.

Make sure you take precautionary measures even when you open the device, for example, when opening device doors, device covers or the housing cover. For more information, refer to the chapter "ESD Guideline"

Limitation of liability

All technical specifications and approvals of the device only apply if you use expansion components that have a valid CE approval (CE mark). The installation instructions for expansion components in the associated documentation must be observed.

UL approval of the device only applies when the UL-approved components are used according to their "Conditions of Acceptability".

We are not liable for functional limitations caused by using third-party devices or components.

6.3 Replacing the backup battery

6.3.1 Overview

Prior to replacement

⚠ WARNING

Risk of explosion and release of harmful substances

Improper handling of lithium batteries can result in an explosion of the batteries.

Explosion of the batteries and the released pollutants can cause severe physical injury. Worn batteries jeopardize the function of the device.

Note the following when handling lithium batteries:

- Replace the battery every 5 years.
- Replace the lithium battery only with the type recommended by the manufacturer. The battery article numbers are as follows.
  - IOT2050 SM: A5E50549527
  - Other configurations for IOT2050: A5E44491494
- Do not throw lithium batteries into fire, do not solder on the cell body, do not recharge, do not open, do not short-circuit, do not reverse polarity, do not heat above 100°C and protect from direct sunlight, moisture and condensation.

NOTICE
Disposal of batteries and rechargeable batteries Batteries and rechargeable batteries do not belong in domestic garbage. The user is legally obliged to return used batteries and rechargeable batteries. Used batteries and rechargeable batteries pollute the environment as special waste. You as a user liable to prosecution if you do not properly dispose of batteries and rechargeable batteries. Please observe the following when disposing of batteries and rechargeable batteries: • Dispose of used batteries and rechargeable batteries separately as hazardous waste in accordance with local regulations. • You can return used batteries and rechargeable batteries to public collection points and wherever batteries or rechargeable batteries of the type in question are sold. • Label the battery container "Used batteries and rechargeable batteries".

6.3.2 IOT2050 Advanced and IOT2050 M.2

Applicable configuration

This operation is only applicable for the following configurations:

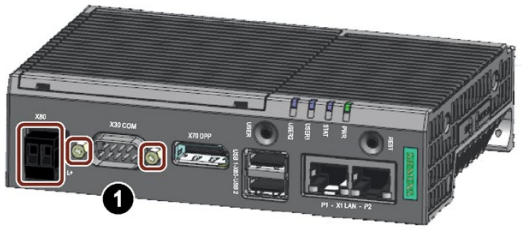
- IOT2050 Advanced: 6ES7647-0BA00-1YA2
- IOT2050 M.2: 6ES7647-0BB00-1YA2

Requirement

- The device is disconnected from the power supply.
- A replacement battery with the article number A5E44491494 is available.

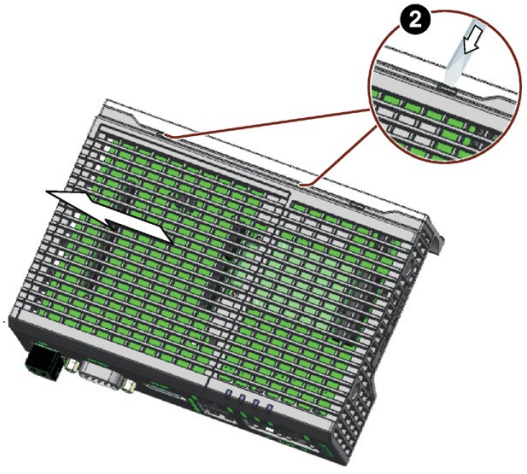
Procedure

1. Remove the power plug and marked screws.

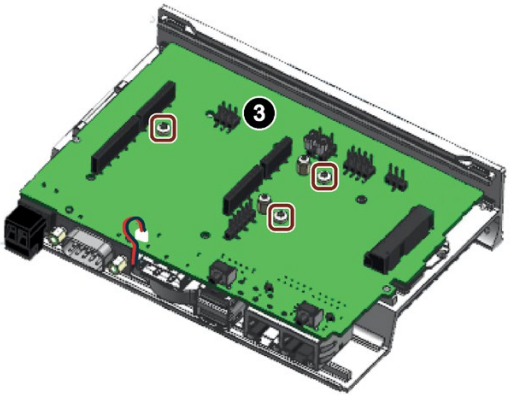


2. Loosen the top housing. Carefully press with the blade of a flat-blade screwdriver in the marked recesses and carefully pull on the appropriate place on the top housing of the enclosure.

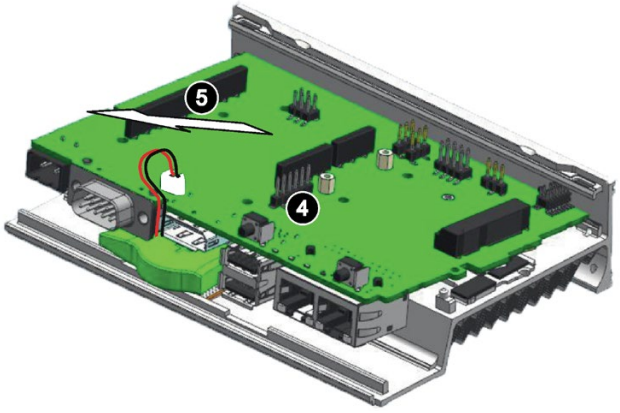
   Remove the top housing of the enclosure.



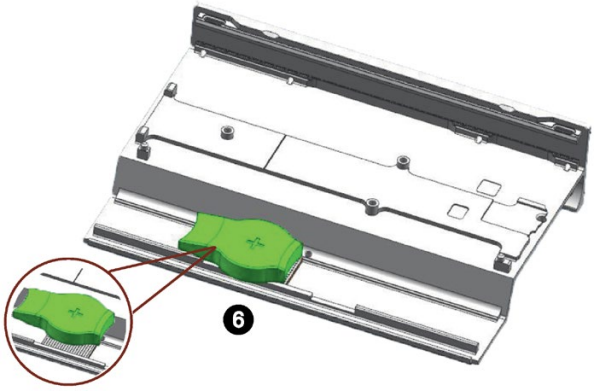
3. Remove the marked screws on the motherboard.



4. Unplug the battery cable from the motherboard.
5. Remove the motherboard.



6. Remove the battery.
   Paste the lock tape on the battery and then paste it on the device housing.
   Plug in the battery cable on the motherboard.



Then install the motherboard again and install the top housing (Page 67).

6.3.3 IOT2050 SM

Applicable configuration

This operation is only applicable for the following configurations:

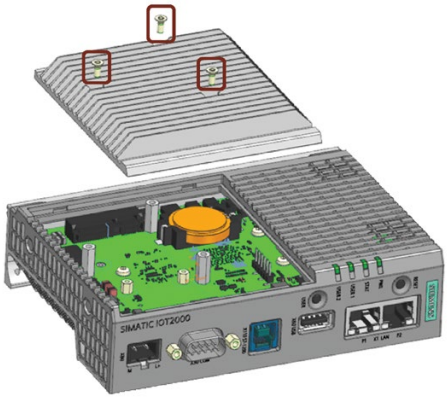
- IOT2050 SM: 6ES7647-0CA00-1AA2

Requirement

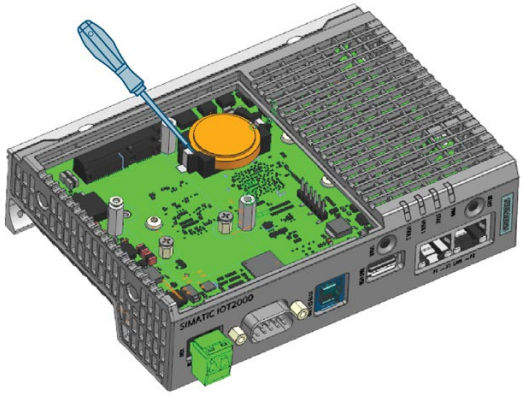
- The device is disconnected from the power supply.
- A same replacement battery as the original

Procedure

1. Remove the marked three screws on shield cover and remove the shield cover.



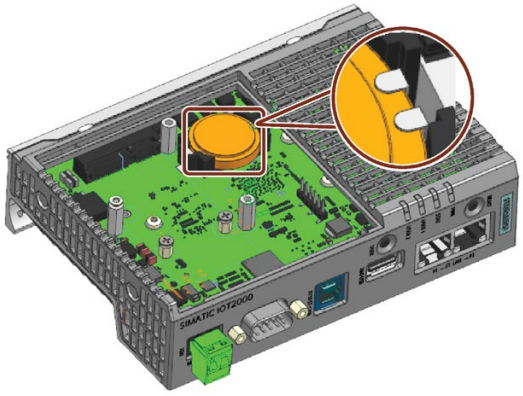
2. Use a screwdriver to poke the battery holder's tab, then remove the battery.



3. Replace the battery.

Note

- The printed side should be facing up after the battery is installed.
- The marked shrapnel should stay up after the battery is installed.



4. Put the shield cover back.

6.4 Recycling and disposal

Due to the low levels of pollutants in the devices described in these operating instructions, they can be recycled.

Contact a certified disposal service company for electronic scrap for environmentally sound recycling and disposal of your old devices, and dispose of the device according to the relevant regulations in your country.

6.5 Update the firmware

6.5.1 Overview

To use the latest **Example Image** or the **Industrial OS Vx.x**, it is necessary to update the firmware to the latest version.

Note

Skip eMMc with firmware V1.3.1 or later

With firmware V1.3.1, it is possible to skip the eMMC as boot device and only check external devices for bootable images.

1. Press and hold the USER button
2. Power on or reset the IOT2050 Advanced
3. Hold the USER button until the STAT LED turns orange
4. Release the USER button

IOT2050 boots from external media only.

Required Hardware

SIMATIC IOT2050

- SD card or USB flash driver. For the IOT2050 Advanced, the internal eMMC can also be used.
- Power supply (12 to 24 V DC)
- Engineering station: to remotely access the SIMATIC IOT2050 and transfer files, an engineering station is required. In the document, a PC running Windows 10 Enterprise is used.
- Ethernet cable: An ethernet cable is required to connect the engineering station to the SIMATIC IOT2050 using SSH.

Required Software

Required Software	Description	Download
Firmware update tool	• iot2050-firmare-update_x.x_arm64.deb	
Firmware file	• IOT2050-FW-Update-PKG-Vx...x6.tar.xz	Downloads for SIMATIC IOT20x0 (https://support.industry.siemens.com/cs/ww/en/view/109741799)
ssh Client	For remotely access to the SIMATIC IOT2050. In this document "PuTTY" is used. **Note**: Besides PuTTY, you can also use the built-in ssh client in Windows 10 or Linux.	PuTTY
WinSCP or USB flash drive	For transferring files between Engineering station and IOT2050. You can use the WinSCP software to copy the files from the Engineering station to the IOT2050 by drag and drop. **Note**: You can also use USB flash drive to transfer the data.	WinSCP

6.5.2 Transfer required software

Precondition

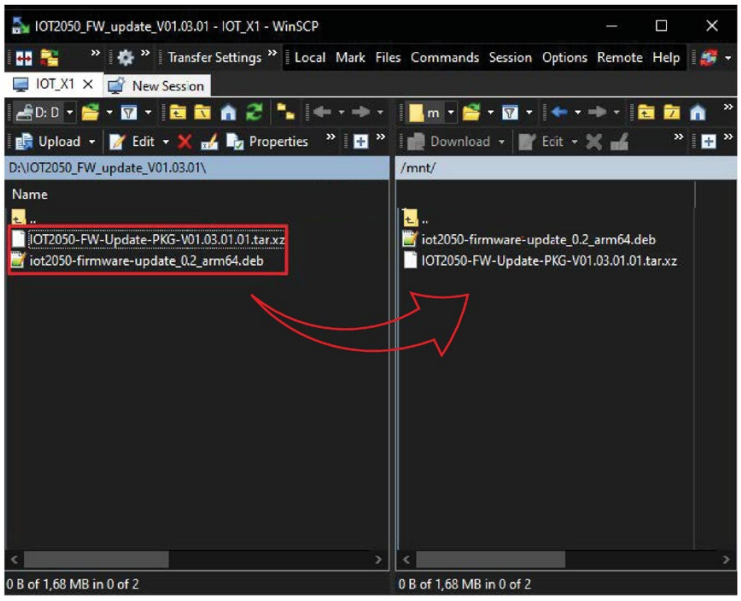
- The example image is installed on the IOT2050.

Both the firmware update tool and the firmware file must be copied from the engineering station to the IOT2050. In this document, both files are copied to the directory `/mnt`

1. Enter `cat /etc/os-release` to check the version of running example image.

```
root@iot2050-debian:~# cat /etc/os-release
PRETTY_NAME="Debian GNU/Linux 11 (bullseye)"
NAME="Debian GNU/Linux"
VERSION_ID="11"
VERSION="11 (bullseye)"
VERSION_CODENAME=bullseye
ID=debian
HOME_URL="https://www.debian.org/"
SUPPORT_URL="https://www.debian.org/support"
BUG_REPORT_URL="https://bugs.debian.org/"
BUILD_ID="V01.02.02-0-g883c59c"
VARIANT="IOT2050 Debian Example Image"
VARIANT_VERSION="1.0"
root@iot2050-debian:~#
```

2. Establish a connection with WinSCP and copy the downloaded files to the IOT2050 by drag and drop.



6.5.3 Clean eMMc on IOT2050 (Optional)

Note

To ensure that the device does not hang due to an incompatible operating system, you must clear `eMMC` in the following situation.

- mmc1 is the first boot device
- You reset the current settings

If your current boot order has `mmc0` or `usbx` as the first boot device, and you keep the current settings, you do not need to clear `eMMc`.

1. Enter `mkfs.ext4 /dev/mmcblk1` to clear `eMMc`.

```
root@iot2050-debian:~# mkfs.ext4 /dev/mmcblk1
mke2fs 1.46.2 (28-Feb-2021)
Found a dos partition table in /dev/mmcblk1
Proceed anyway? (y,N) y
Discarding device blocks: done
Creating filesystem with 3885056 4k blocks and 972944 inodes
Filesystem UUID: 46032714-53df-4644-ab95-af2290f1c25a
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

root@iot2050-debian:~#
```

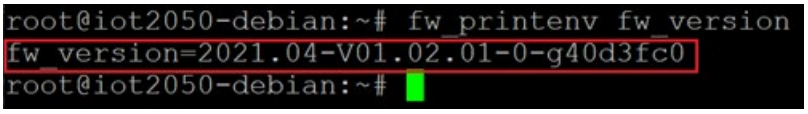
6.5.4 Install firmware update tool

1. Enter `dpkg -r iot2050-firmware-update` to uninstall the pre-installed update tool.
2. Go to the directory where you copied the two download files. In this example, go to directory `/mnt` by entering `cd /mnt`.
3. Enter `dpkg -i iot2050-firmware-update_x.x_arm64.deb` to install the correct version of update tool.

```
root@iot2050-debian:~# cd /mnt
root@iot2050-debian:/mnt# dpkg -i iot2050-firmware-update_0.2_arm64.deb
Selecting previously unselected package iot2050-firmware-update.
(Reading database ... 58005 files and directories currently installed.)
Preparing to unpack iot2050-firmware-update_0.2_arm64.deb ...
Unpacking iot2050-firmware-update (0.2) ...
Setting up iot2050-firmware-update (0.2) ...
root@iot2050-debian:/mnt#
```

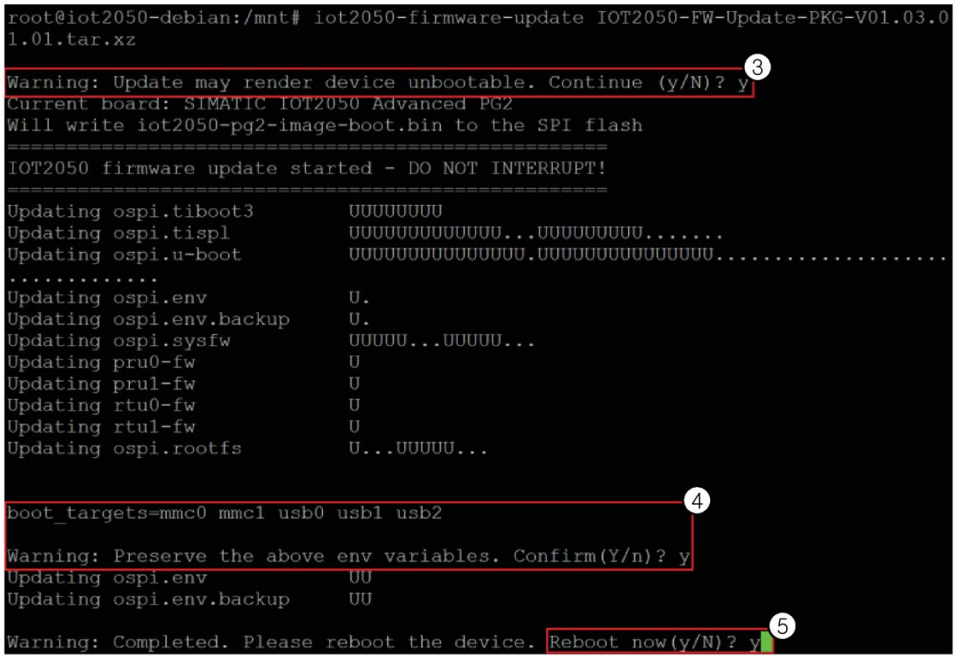
6.5.5 Update firmware

1. Check the installed firmware by entering `fw_printenv fw_version`.

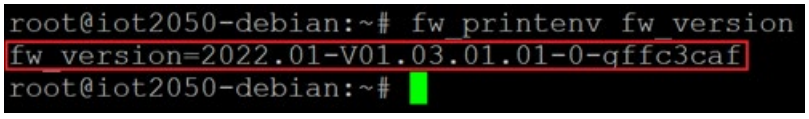


2. Update the firmware by entering `iot2050-firmware-update IOT2050-FW-Update-PKG-Vxx...xx.tar.xz`
3. Continue the update by entering `Y`.

   The updating process begins.
4. When the current boot order displays, enter `Y` to keep it or enter `n` to reset it to the default.
5. Reboot the device by entering `Y` .



6. Check the current firmware version by entering `fw_printenv fw_version`.



6.6 Configure IOT2050 SM

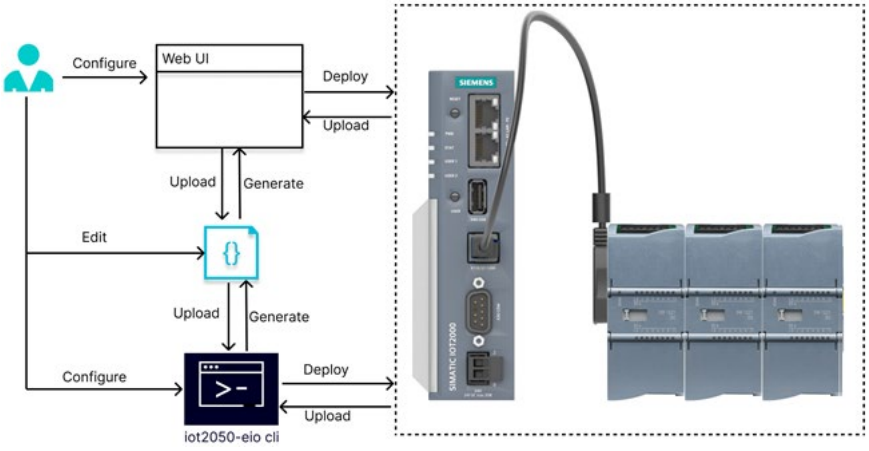
You can use IOT2050 SM to manage the expansion SM, such as S7-1200 SM, including the following Key features:

- Configuration
- Data reading and writing

- Diagnostic tools
- System upgrade

You can use either of the following ways to configure modules:

- Web UI
- eio command line tool iot2050-eio



Precondition

- To use the full functionality of IOT2050 SM, you must install an SD-Card sample image with Debian-based Linux operating system.

Required Hardware

Required hardware	Description
Engineering station	To access the IOT2050 SM, an engineering station is required. In this document, a PC running Windows 10 Enterprise is used. The Engineering Station must include the following interfaces: • SD card slot • Ethernet port
Ethernet cable	For connecting the engineering station to the IOT2050 SM using SSH.
DisplayPort Cable (Male-Male) and Monitor	For connecting to engineering station
Keyboard	For connecting to engineering station
Expansion cable	Cable length: 2m, for connecting IOT2050 SM and expansion SM

Procedure

1. Connect IOT2050 SM and expansion SMs.
2. Power on IOT2050 SM.
3. Configure the expansion SMs through Web UI or eio cli.

4. Deploy the configuration to expansion SMs.
5. Monitoring the status with diagnostic tools.

6.6.1 Working with Web UI

Access the Web UI

To access the Web-based configuration from a PC, follow these steps:

1. Ensure that the IOT2050 SM and the PC are on a common Ethernet network or are connected directly to each other with a standard Ethernet cable.
2. Open a Web browser and enter the URL "https://ww.xx.yy.zz:2050" corresponds to the IP address of the IOT2050 SM.

Note

The default IP address of the IOT2050 SM P1 - X1 LAN is "https://192.168.200.1:2050".

Note

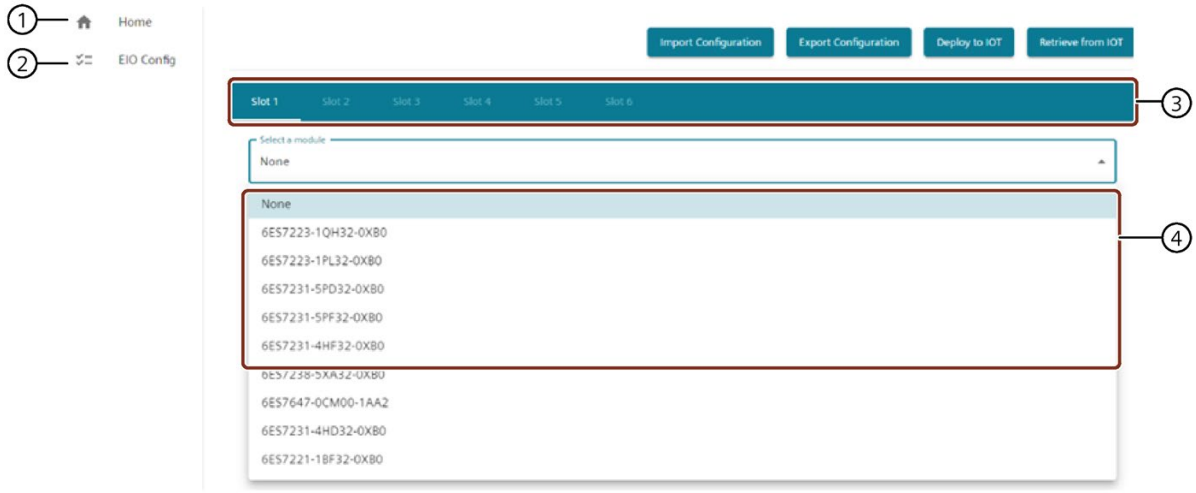
Make sure you do not disable cookies on your browser.

Note

You can only log into web-based configuration with one browser at a time.

Configure the SM

1. Click ② to enter the configuration page.



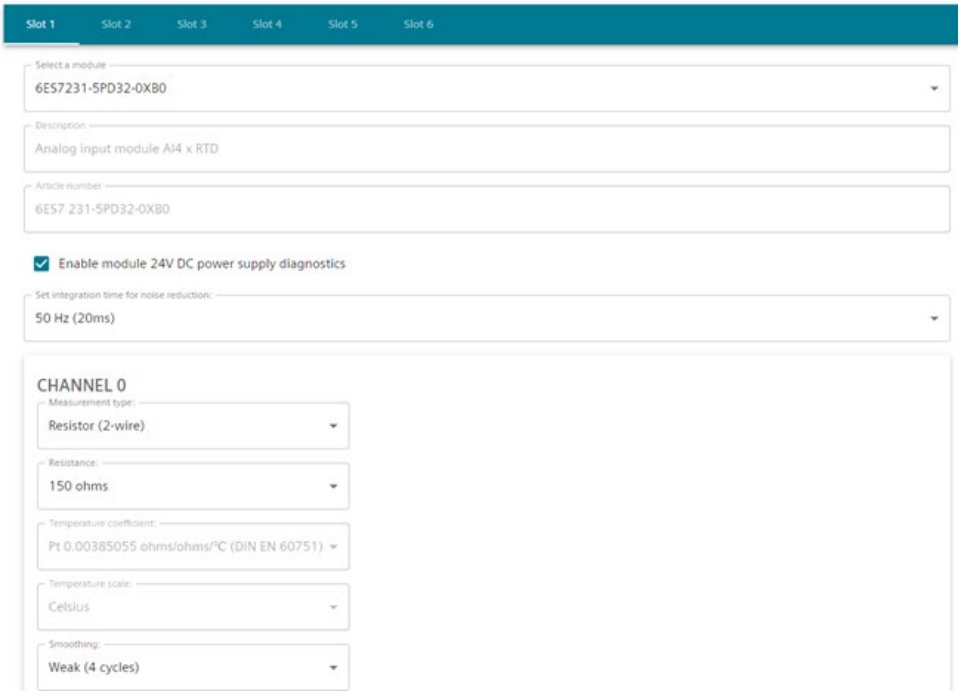
① Home
② EIM config
③ Slots of the selected SM
④ SM modules that IOT supports to configure

2. Select SM module from ④.

Note

An IOT2050 SM can manage a maximum of 6 SMs.

3. Configure the features of the module according to your needs.
Click the button in ③ to switch slots.



Generate yaml file

- After configuring, you can export the current configuration to a Yaml file by clicking ②.
- After configuring, you can deploy the configuration to S7-1200 SM by clicking ③
- You can import the configuration in a YAML file to the WebUI by clicking ①.
- Once you established the connection of IOT2050 SM and expansion SM, you can retrieve the existing configuration on S7-1200 CM by clicking ④.

① Click here to import a configuration file if you have one
② Click here to download the configuration file
③ Deploy the configuration to the connected IOT
④ Retrieve the configuration from the connected IOT

6.6.2 Working with eil cli interface

6.6.2.1 Configure S7-1200 SM with eio cli

This chapter introduces you to deploying and retrieving a YAML file to the device using `IOT2050-eio cli`.

Deploy the configuration

1. Deploy the configuration of S7-1200 signal module using yaml file

   ```
   iot2050-eio config deploy config.yaml
   ```

2. Check the status after configuration in `/eiofs/controller/status`.

   There are five states of EIO: `State: running|startup|config|running|idle`

   – startup: means EIO is waiting for time synchronization from IOT2050 SM.

Retrieve the current configuration

- Retrieve the current configuration of IOT2050 SM into a Yaml file

  ```
  iot2050-eio config retrieve save-config.yaml
  ```

6.6.2.2 Reading and writing data to IOT2050 SM

In the context of configuration, modules are visible in the directory `/eiofs/controller/slotN/`.

Description

The following shows that there is a Module configured:

```
/eiofs
    ├── proc
    │ └── version
    ├── log
    │ └── event
    └── controller
        ├── control
        ├── config
        ├── status
        ├── slot1
         | ├── name
         | ├── article_number
         | ├── description
         | ├── status
         | ├── value_raw
         | ├── ch0
         | | └── value
         | ├── ch1
         | . .
         | . .
         | . .
         |
        ├── slot2
        ├── slot3
        ├── slot4
```

```
├── slot5
└── slot6
```

Empty `/eiofs/controller/slotX` means that there is no module in the configuration.

- Properties of a slot

Directory	Description	Attributes
/eiofs/controller/slotX/name	Name of module in slotX	Read
/eiofs/controller/slotX/article_number	MLFB number of module in slotX	Read
/eiofs/controller/slotX/description	Description of module in slotX	Read
/eiofs/controller/slotX/status	Status of module in slotX	Read
/eiofs/controller/slotX/value_raw	All values in byte array of module in slotX	Read and write in binary format

- Properties of a channel of a module

  Note: The channel name depends on the specific module. It can be the following names.

  - `chX`: means Xth channel
  - `dqX`: means Xth digital output channel
  - `diX`: means Xth digital input channel

Directory	Descritpion	Attributes
/eiofs/controller/slotX/<channel-name>/value	Value of the X channel of the module	Read and write in string format

Example

The following is an example of 6ES7 223-1QH32-0XB0, 8-channel digital input and 8-channel digital output module.

1. Write all digital output values at once:

   ```
   $ echo -n -e \\x81 > /eiofs/controller/slot1/dq_value_raw
   ```

2. Read all digital output values at once:

   ```
   $ cat /eiofs/controller/slot1/dq_value_raw | hexdump -C
   00000000 81
   00000001
   ```

Note

Type `hexdump --help` for the format description.

3. Read the value of digital output channel 0 individually:

```
$ cat /eioFS/controller/slot1/dq0/value
1
```

4. Write the value of digital output channel 1 individually:

```
$ echo 1 > /eiofs/controller/slot1/dq1/value
```

5. Read the value of digital input channel 0 individually:

```
$ cat /eiofs/controller/slot1/di0/value
0
```

The above examples use Linux command line to operate the file node.
You can also use C/C++, Python, Java and other programming languages to operate the above file nodes.

Example

The following uses the C language as an example:

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <fcntl.h>
#include <unistd.h>
/* The following code depends on di0 of sm1223-ac-rly connected
to di0 for loop test */
int main(int argc, char *argv[])
{

    #define TMP_SIZE 16
    char tmp[TMP_SIZE] = { 0 };
    int dq0 = open("/eiofs/controller/slot1/dq0/value", O_RDWR);
    if (dq0 < 0) {
        return 0;

    }


    int di0 = open("/eiofs/controller/slot1/di0/value", O_RDWR);

    if (di0 < 0) {
    close(dq0);
```

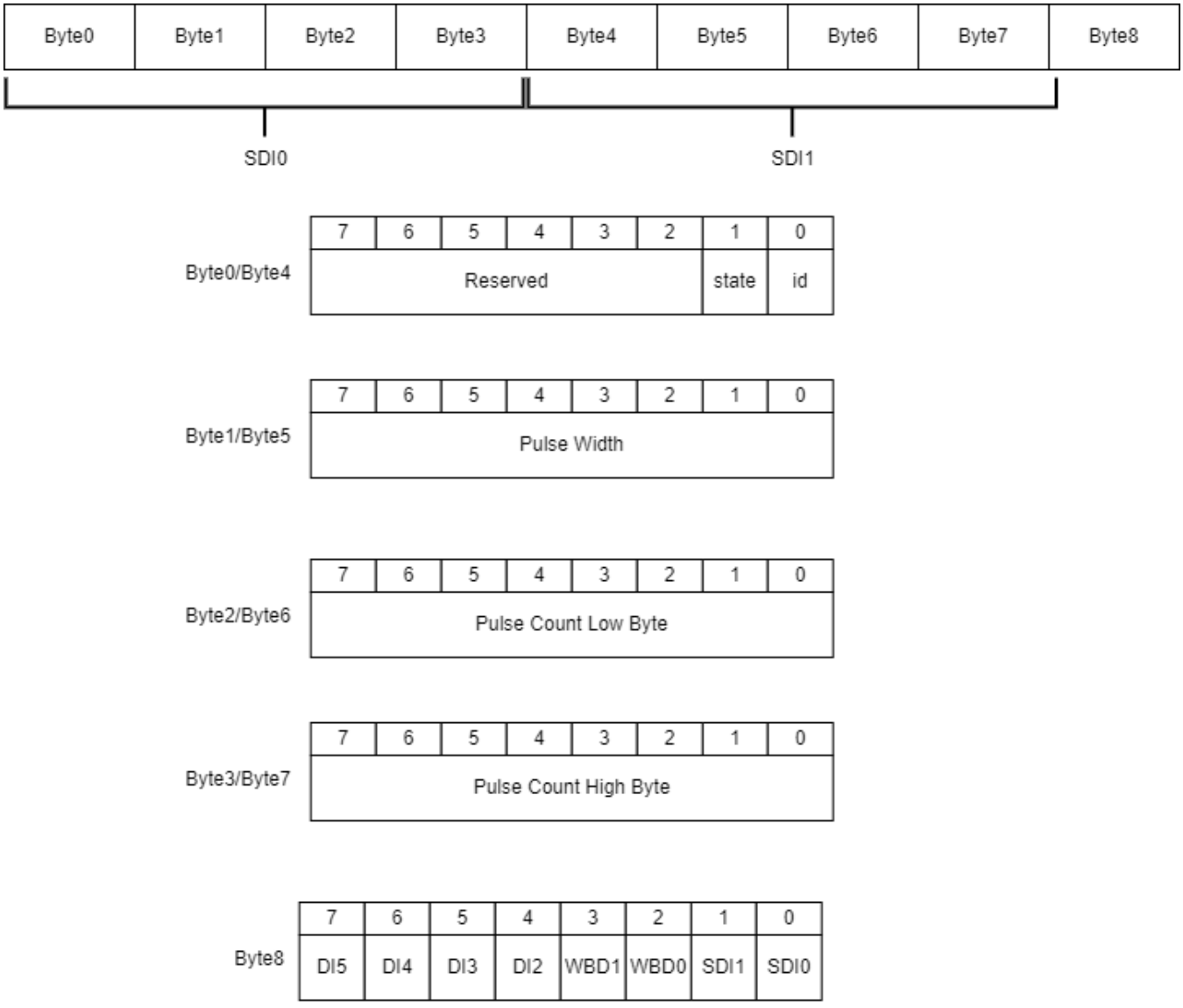
```
    return 0;
}


ssize_t ret = 0;
for (int i = 0; i < 3; i++) {
    int dq_value = i & 0x01;


    /* Convert dq value to string */
    snprintf(tmp, TMP_SIZE, "%d", dq_value);
    /* Output value in string format to dq0 */
    ret = write(dq0, tmp, strlen(tmp));

    if (ret < 0) {

        printf("Write failed, %d\r\n", ret);
        break;
    }
    printf("Set dq0 to %s\r\n", dq_value);

    /* Note that when reading a file node multiple times,
the offset must be set to 0 before the next read */
    lseek(di0, 0, SEEK_SET);

    memset(tmp, 0, TMP_SIZE);
    /* Read value from di0 */
    ret = read(di0, tmp, TMP_SIZE);

    if (ret < 0) {

        printf("Read di0 value failed, %d\r\n", ret);
        break;
    }
    printf("Get di0 value: %s\r\n", tmp);

    /* Convert di0 string value to integer */
    int di_value = strtol(tmp, NULL, 10);
    if (di_value != dq_value) {
```

```
                printf("Test failed: dq0 != di0\r\n");
                break;
            }
            printf("Test ok\r\n");

        }
        close(dq0);

        close(di0);

        return ret;
    }
```

6.6.2.3 IPC SM SEN DI: 6ES7647-0CM00-1AA2

In the context of configuration, IPC SM SEN DI are visible in the directory `/eiofs/controller/slotN/value_raw`.

raw data format



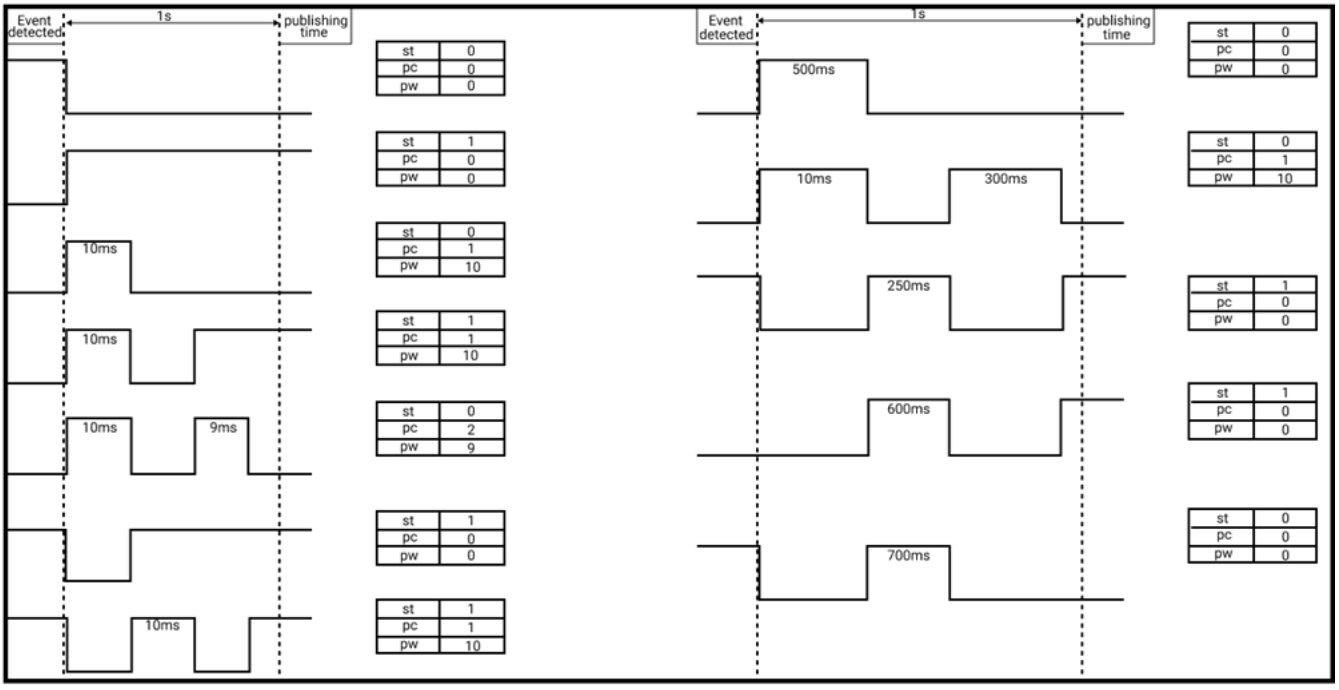
WBD1 Wire break detection on SDI1
WBD0 Wire break detection on SDI0
SDI1 Special DI1 input value
SDI0 Special DI0 input value

Principle

The sense SM can only acquire data in a minimum cycle of 1 second, it measures and counts the high level impulses if the impulse width is less than 200 ms and greater than 5 ms. If the pulse width is greater than 200 ms, the pulse width is "0" but the level value is "1".

Sense SM has two dedicated digital input channels with the following characteristics:

- pulse_count: The number of pulses is counted
- pulse_width: The pulse width is measured
- wire_break: the wire break status is detected
- state: the on/off status at the end of the sampling cycle time



st state
pc pulse count
pw pulse width

Update the firmware

The firmware of SM SEN DI consists of two parts: firmware A and firmware B. The firmware can be updated with the command `iot2050-module-firmware-update`.

Below is explained how to use the command `iot2050-module-firmware-update`

```
root@iot2050-debian:~# iot2050-module-firmware-update -h
usage: iot2050-module-firmware-update [-h] -s SLOT [-fwa FIRMWARE_A]
[-fwb FIRMWARE_B]
```

```
Script for updating module firmware on IoT2050
Examples usage:
  1. iot2050-module-firmware-update -s 1 -fwa firmwareA.bin
  2. iot2050-module-firmware-update -s 1 -fwa firmwareA.bin -fwb
firmwareB.bin
options:
  -h, --help show this help message and exit
  -s SLOT, --slot SLOT Slot number
  -fwa FIRMWARE_A, --firmware-a FIRMWARE_A
                        Path to firmware A file
  -fwb FIRMWARE_B, --firmware-b FIRMWARE_B
                        Path to firmware B file
```

The following is an example of a SM SEN DI firmware update:

```
# Update the firmware A of sense SM
iot2050-module-firmware-update -s 1 -fwa firmwareA.bin
# Update the firmware B of sense SM
iot2050-module-firmware-update -s 1 -fwb firmwareB.bin
# Update the firmware A and B of sense SM
iot2050-module-firmware-update -s 1 -fwa firmwareA.bin -fwb
firmwareB.bin
```

6.6.2.4 Converting real to float

If the raw value of the module contains real type, convert these values to a float data type. The following examples show converting real to float with C and Python.

Example: converts real to float with C

```
/**

* @brief Convert IEEE754 floating point.

*/
double real_to_float(uint32_t real)

{
    int sign = real >> 31;
```

```
    int exponent = ((real >> 23) & 0xFF) - 127;

    uint32_t mantissa = real & 0x7FFFFF;

    int power_count = -1;

    double mantissa_int = 0;

    for (int i = 0; i < 23; i++) {

    mantissa_int += ((mantissa >> (22 - i)) & 1) * pow(2,
power_count);

    power_count -= 1;

  }

    mantissa_int += 1;

    return pow(-1, sign) * mantissa_int * pow(2, exponent);

}
```

Example: converts real to float with Python

```
def real_to_float(u32:int) -> float:

    """

    Convert IEEE754 floating point.

    """

    sign = u32 >> 31

    exponent = ((u32 >> 23) & 0xFF) - 127

    mantissa = u32 & 0x7FFFFF

    power_count = -1

    mantissa_int = 0
```

```
    for i in range(0, 23):

        mantissa_int += ((mantissa >> (22 - i)) & 1) * pow(2,
power_count)

        power_count -= 1

    mantissa_int += 1

    return pow(-1, sign) * mantissa_int * pow(2, exponent)
```

6.6.2.5 Upgrade

You can upgrade the firmware of EIO ASIC controller with the following command:

```
iot2050-eio fwu controller
```

6.6.2.6 Diagnostic EIO

Problem	Probable cause	Solution
After configuration, SlotN remains empty.	The connected module is incompatible with the configuration.	1. Check the article number of the device. 2. For the detailed reason, read the following files: – `/eiofs/controller/status` – `/eiofs/controller/slotN/status`
After configuration, the attributes of slotN cannot be read or written.	• Incorrect configuration parameters • IOT2050 has lost connection with SM module	For the detailed reason, read the following files: • `/eiofs/controller/status` • `/eiofs/controller/slotN/status`
EIO does not run after configuration.		For the detailed reason, read the following files: • `/eiofs/controller/status` • `/eiofs/controller/slotN/status`

Example: content of /eiofs/controller/slotN/status

- The following status means the module lost connection:

```
Status: lost
```

- The following example shows the configuration status and alarm information:

```
Status:
  configured: yes|no
  operational: yes|no
Alarm:
  type: %s
scope: entire submodule|channel %d
direction: output channel|input channel or others
```

Example: content of /eiofs/log/event

Once configured, it is easy to capture EIO events. See an example as follows.

```
root@iot2050-debian:~# journalctl SYSLOG_IDENTIFIER=IOT2050-
EventRecord | grep IOT2050_EVENTS.eio
Nov 10 00:26:32 iot2050-debian IOT2050-EventRecord[500]:
IOT2050_EVENTS.eio: 2024-1-10 7:6:37 [1] watchdog occurred
Nov 10 00:26:32 iot2050-debian IOT2050-EventRecord[500]:
IOT2050_EVENTS.eio: 2024-1-10 7:3:57 [4] slot1 loss
Nov 10 00:26:32 iot2050-debian IOT2050-EventRecord[500]:
IOT2050_EVENTS.eio: 2024-1-10 7:2:57 [5] slot2 loss
```

6.6.2.7 Controller status

Controller status shows in : /eiofs/controller/status

```
State: startup|config|running|idle
```

State	Description
startup	eiofs is waiting for time synchronization with IOT2050 SM.
config	eiofs is scanning and configuring connected S7-1200 signal modules.
running	eiofs has configured all connected modules.
idle	Not configured, not connected, or other critical errors occurred.

Certificates and approvals

7

NOTICE
The approvals are voided if certain modifications are made The device approvals are voided if the following modifications are made: • An Arduino shield or a Mini PCIe card was installed. • The enclosure was physically modified, for example, openings were created to make LEDs on a plug-in card in the device visible. • Cables are routed from the inside out of the device or from the outside into the device, for example, to connect sensors or displays.

Note

Applicability

The following shows the approvals that may be available. For the device itself, it is certificated as shown on the product label and package label.

CE

The device meets the guidelines listed in the following sections.

EU Declaration of Conformity

The associated declaration of conformity is available on the Internet at the following address: EC Declaration of Conformity, UL approval Canada/USA (http://support.automation.siemens.com/WW/view/en/48958203).

UKCA

The device complies with the designated British standards (BS) for IPC published in the official consolidated list of the British Government. The device meets the requirements and protection targets of the following regulations and related amendments:

- Electromagnetic Compatibility Regulations 2016 (EMC)
- Regulations on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2012 (RoHS).

UK Declarations of Conformity for the respective authorities are available from:

Siemens AG
Digital Industries
Factory Automation
DI FA TI COS TT
P.O. Box 1963
D-92209 Amberg

The UK Declaration of Conformity is also available for download from the Siemens Industry Online Support website under the keyword "Declaration of Conformity".

ISO 9001 certificate

The Siemens quality management system for all production processes (development, production and sales) meets the requirements of GB/T 19001-2008/ISO 9001:2015, ISO 14001:2015 + Cor. 1:2009 and BS OHSAS 18001:2007.

Certificate registration no.01 100 1430201, 01 104 1430201 and 01 113 1430201.

Software license agreements

If the device is supplied with preinstalled software, you must observe the corresponding license agreements.

UL approval

The following approvals are available for the device:

- Underwriters Laboratories (UL) in accordance with standard UL61010-2-201 (IND.CONT.EQ), File E472609
- Canadian National Standard CSA-C22.2 No. 61010-2-201

FCC and Canada

USA	
Federal Communications Commission Radio Frequency Interference Statement	This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
Shielded Cables	Shielded cables must be used with this equipment to maintain compliance with FCC regulations.
Modifications	Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.
Conditions of Operations	This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CANADA	
Canadian Notice	This Class A digital apparatus complies with Canadian ICES-003 (A).
Avis Canadien	Cet appareil numérique de la classe A est conforme à la norme NMB-003 (A) du Canada.

Responsible party for Supplier's Declaration of Conformity

Siemens Industry, Inc.

Digital Factory - Factory Automation

5300 Triangle Parkway, Suite 100

Norcross, GA 30092

USA

Mail to: (amps.automation@siemens.com)

RCM AUSTRALIA/NEW ZEALAND

This product meets the requirements of the standard EN 61000-6-4:2007 Generic standards – Emission standard for industrial environments.

Korea Certification

This product satisfies the requirement of the Korean Certification (KC Mark).

이 기기는 업무용(A 급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

WEEE label (European Union)

Disposal instructions, observe the local regulations and the section "Recycling and disposal (Page 80) ".

7.1 Directives and declarations

7.1.1 Notes on CE marking

Electromagnetic compatibility

This product meets the requirements of EU Directive 2014/30/EU "Electromagnetic Compatibility".

The device is designed for the following areas of application corresponding to the CE marking:

Scope of application	Devices	Requirements for	
		Interference emission	Immunity to interference
Industrial area	• IOT2050 Basic • IOT2050 Advance • IPC SM SENS DI • IOT2050 M.2 • IOT2050 SM	EN IEC 61000-6-4	EN IEC 61000-6-2
Residential, commercial and light-industrial environments	• IOT2050 M.2 • IOT2050 SM	EN IEC 61000-6-3	EN IEC 61000-6-1

7.1.2 ESD guideline

What does ESD mean?

An electronic module is equipped with highly integrated components. Due to their design, electronic components are highly sensitive to overvoltage and thus to the discharge of static electricity. Such electronic components or modules are labeled as electrostatic sensitive devices.

The following abbreviations are commonly used for electrostatic sensitive devices:

- ESD – Electrostatic sensitive device
- ESD – Electrostatic Sensitive Device as a common international designation

Electrostatic sensitive devices can be labeled with an appropriate symbol.

NOTICE

Damage to ESD from touch

Electrostatic sensitive devices, ESD, can be destroyed by voltages which are far below the human perception limit. If you touch a component or electrical connection of a module without discharging any electrostatic energy, these voltages may arise.

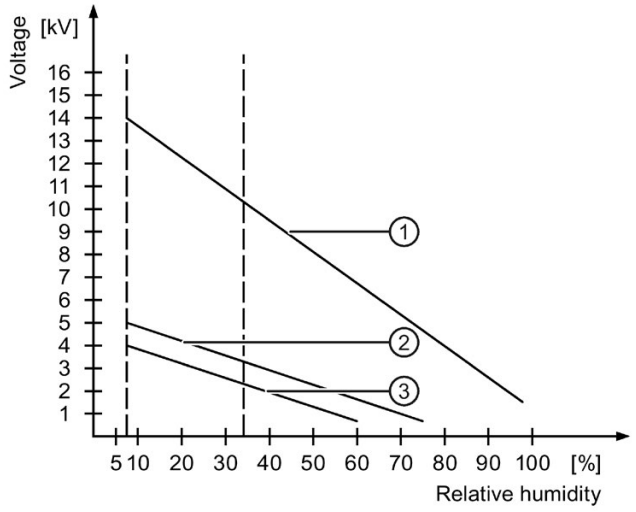
The damage to a module by an overvoltage can often not be immediately detected and only becomes evident after an extended period of operation. The consequences are incalculable and range from unforeseeable malfunctions to a total failure of the machine or system.

Avoid touching components directly. Make sure that persons, the workstation and the packaging are properly grounded.

Charge

Every person without a conductive connection to the electrical potential of his/her surroundings can be electrostatically charged.

The material with which this person comes into contact is of particular significance. The figure shows the maximum electrostatic voltages with which a person is charged, depending on humidity and material. These values conform to the specifications of IEC 61000-4-2.



① Synthetic materials

② Wool

③ Antistatic materials such as wood or concrete

NOTICE
Grounding measures There is no equipotential bonding without grounding. An electrostatic charge is not discharged and may damage the ESD. Protect yourself against discharge of static electricity. When working with electrostatic sensitive devices, make sure that the person and the workplace are properly grounded.

Protective measures against discharge of static electricity

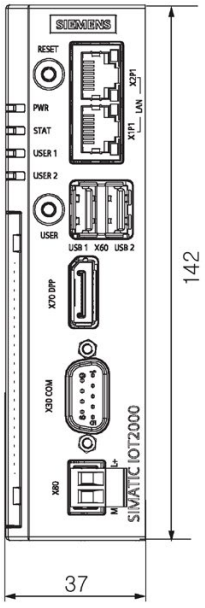
- Disconnect the power supply before you install or remove modules which are sensitive to ESD.
- Pay attention to good grounding:
  - When handling electrostatical sensitive devices, make sure that persons, the workstation and devices, tools and packaging used are properly grounded. This way you avoid static discharge.
- Avoid direct contact:
  - As a general rule, do not touch electrostatic sensitive devices, except in the case of unavoidable maintenance work.
  - Hold the modules at their edge so that you do not touch the connector pins or conductor paths. This way, the discharge energy does not reach and damage the sensitive components.
  - Discharge your body electrostatically before you take a measurement at a module. Do so by touching grounded metallic parts. Always use grounded measuring instruments.

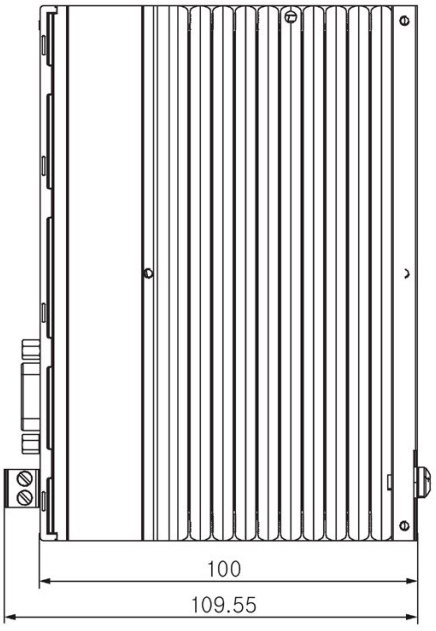
Dimension drawings

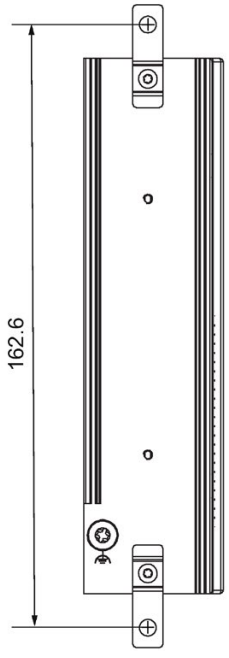
8

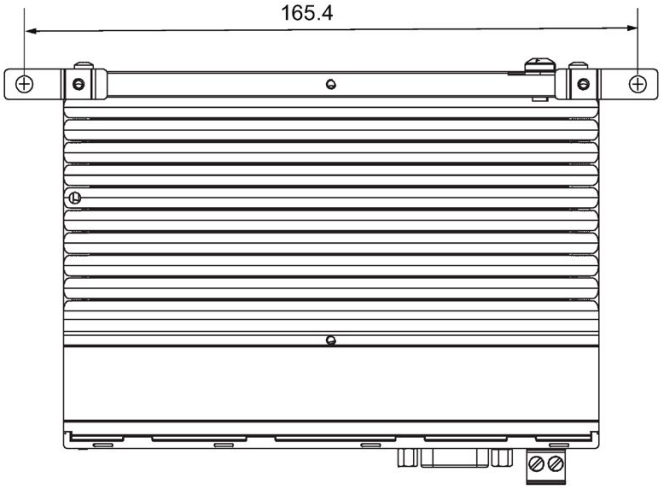
8.1 Dimension drawings

The following figures show the dimension drawings of the type IOT2050.





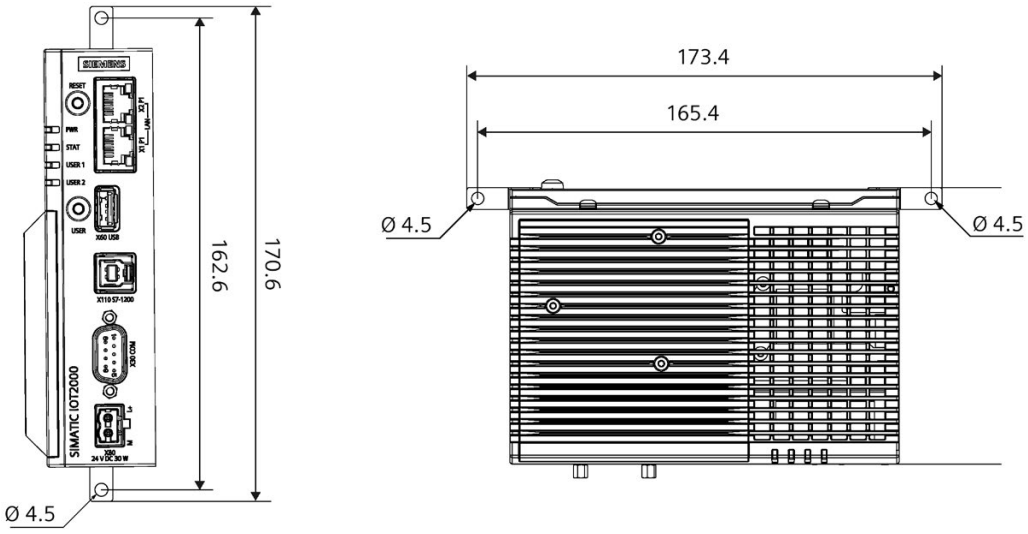




All dimensions in mm.

8.2 Dimension drawings SM

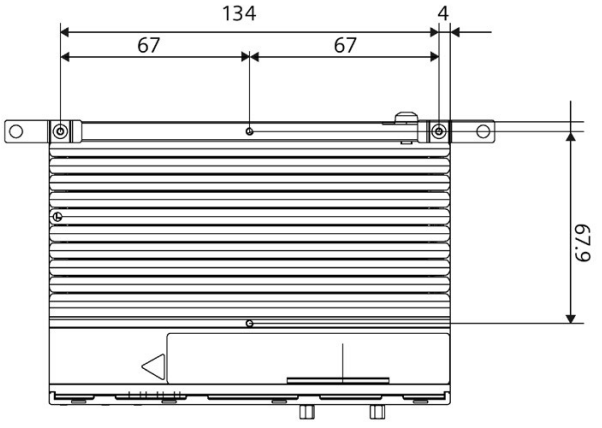
The following figures show the dimension drawings of the type IOT2050 SM.

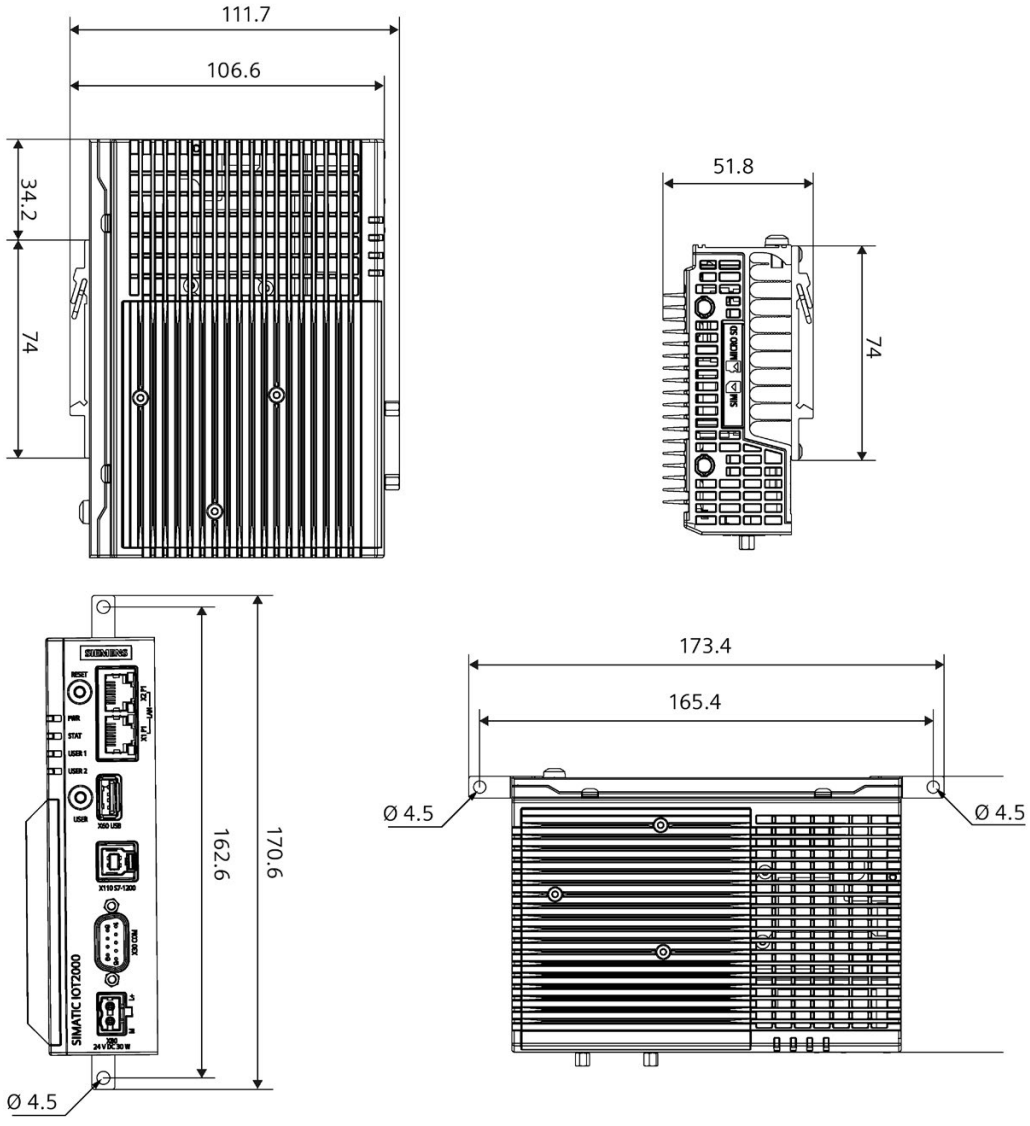


All dimensions in mm.

8.3 Dimension drawings mounting

The following figures show the dimension drawings of the mounting holes.





All dimensions in mm.

Technical specifications

9

9.1 IOT2050 SM

9.1.1 General technical specifications

General technical specifications

Order number	See order documents
Weight without mounting brackets	approx. 425 g
Power supply [1]	24 VDC (20.4 to 28.8 V), no galvanic isolation
Brief voltage interruption in accordance with Namur	Up to 10 ms buffer time at 24 V DC and full load [2] Max. 10 events per hour; recovery time at least 10 ms
Current consumption	Max. power consumption 30W
Noise emission	< 40 dB(A) according to DIN 45635-1
Degree of protection	IP20 according to IEC 60529
Protection class	Protection class III in accordance with IEC 61140
Degree of pollution	Device is designed for environments with pollution degree 2
MTBF	13.8 years. This was calculated under conditions of a temperature of 40 °C and a workload of 100%.
Quality assurance	In accordance with ISO 9001

1 The device should only be connected to a power supply which meets the requirements of safe extra low voltage (SELV) according to IEC/EN/DIN EN/UL 61010-1.

2 In the event of low supply voltage, the buffer time is reduced

Motherboard

Processor	TI Sitara AM6548 HS, 1000 MHz
RAM	4 GB
BIOS SPI Flash	16 MB
Micro SD	Slot for one Micro SD card
Nano SIM card	Slot for one Nano SIM card
EMMC	16 GB
Expansion slots	1 x mini PCIe for PCIe cards 30 x 50.59 mm or 30 x 26.8 mm

Interfaces

USB Type A, X60	X60-USB: USB2.0 Type A
S7-1200 interface, X110	Interface for S7-1200 SM modules only

LAN interface P1 - X1 LAN - P2, RJ45 [1]	1 GB LAN port
COM X30	• RS232 [2], max. 115 Kbps, D-sub connector, 9-pin • RS422 [2] [3], max. 115 Kbps, D-sub connector, 9-pin • RS485 [2] [3], max. 115 Kbps, D-sub connector, 9-pin

[1] For unique labeling, the LAN interfaces are numbered on the enclosure. The numbering by the operating system can differ. Siemens recommends you use shielded ethernet cables.

[2] You can use any COM port as an RS232, RS422 or RS485 interface through the software-controlled interface parameter assignment.

[3] Termination with 120 Ω terminal resistance can be set with the software.
The maximum cable length is 1000 m under the following preconditions:
- Data signaling rate is below 90Kbps
- Using twisted pair copper wire of 24AWG or larger diameter

Additional information on parameter assignment is available in the SIMATIC IOT2000-Forum, see section "Software and commissioning (Page 44)".

9.1.2 Electromagnetic compatibility

Emission

Radiated emission according to IEC 61000-6-3, measuring distance 3 m	
Frequency range	Interference emission
30 to 230 MHz	< 40 dB (µV/m) quasi-peak
230 to 1000 MHz	< 47 dB (µV/m) quasi-peak
1 to 3 GHz	< 70 dB (µV/m) peak and < 56 dB (µV/m) average
3 to 6 GHz	< 74 dB (µV/m) peak and < 60 dB (µV/m) average

Emission of radio interference voltages according to IEC 61000-6-3	
Emission port	Interference emission
Power port	0.15 to 0.5 MHz
	< 79 dB (µV) quasi peak and < 66 dB (µV) average
	0.5 to 30 MHz
	< 73 dB (µV) quasi peak and < 60 dB (µV) average
Telecommunication / Network port	0.15 to 0.5 MHz
	< 84 dB (µV) to 74 dB (µV) quasi peak and < 84 dB (µV) to 74 dB (µV) average
	0.5 to 30 MHz
	< 74 dB (µV) quasi peak and < 74 dB (µV) average

Immunity

Pulse-shaped interference	
Electrostatic discharge according to IEC 61000-4-2	Air discharge: ± 8 kV
	Contact discharge: ± 6 kV
Bursts (high-speed transient disturbance variable) according to IEC 61000-4-4	± 2 kV supply line
	± 1 kV signal line, < 30 m ± 2 kV signal line, > 30 m
Powerful single pulse (surge) according to IEC 61000-4-5	Asymmetric coupling (line to ground)
	± 1 kV supply line ± 2 kV signal line, > 30 m
	Symmetrical coupling (line to line)
	± 0.5 kV supply line ± 1 kV signal line, > 30 m

Sinusoidal interference	
Radiation disturbances according to IEC 61000-4-3	80% amplitude modulation at 1 kHz • on 10 V/m in the range of 80 MHz to 2.7 GHz • on 3 V/m in the range of 2.7 GHz to 6 GHz
Conducted disturbances according to IEC 61000-4-6	Test voltage 10 V at 80% amplitude modulation of 1 kHz in the range from 10 kHz to 80 MHz

If there are voltage peaks on power supply lines, use a protective device in the form of a varistor (MOV) UMOV = U-rated x 1.2

9.1.3 Ambient conditions

Climatic ambient conditions

The temperature values have been checked in accordance with IEC 60068-2-1, IEC 60068-2-2 and IEC 60068-2-14. Permitted mounting positions, see section "Permitted mounting positions and mounting types (Page 25)".

Ambient temperature	
• Operation	DIN Rail mounting: • Vertical: -20 to 50 °C * • Horizontal: -20 to 40 °C * Wall mounting • Vertical: -20 to 45 °C * • Horizontal: -20 to 40 °C *
• Storage/transport	-20 to 70 °C
Gradient	
• Operation	Max. 10 °C/h
• Storage	20 °C/h, no condensation
Relative humidity, tested in accordance with IEC 60068-2-78, IEC 60068-2-30	

• Operation	5 to 95% at 30°C, no condensation
• Storage/transport	5 to 95 % at 25/55 °C, no condensation
Atmospheric pressure, Altitude	
• Operation	1080 to 795 hPa, corresponds to an elevation of -1000 m to 2000 m
• Storage/transport	1080 to 660 hPa, corresponds to an elevation of -1000 to 3500 m

* Also note the following section "Power consumption of the components".

Mechanical ambient conditions

Vibration resistance, tested in accordance with IEC 60068-2-6	
• Operation	Vibration load 1g, 10 cycles per axle: • 5 to 8.4 Hz, deflection 3.5 mm • 8.4 to 200 Hz, acceleration 9.8 m/s^2
• Storage/transport	• 5 to 8.4 Hz: Deflection 3.5 mm • 8.4 Hz to 500 Hz: Acceleration 9.8 m/s^2
Impact resistance, tested in accordance with IEC 60068-2-27	
• Operation	150 m/s^2, 11 ms
• Storage/transport	250 m/s^2, 6 ms

9.1.4 Power demand of the components

Maximum power consumption of the auxiliary components

For the ambient temperature for permitted mounting position, refer to Ambient conditions (Page 112).

Auxiliary components	Maximum permitted power consumption			Maximum total power
	+5 V	+3.3 V	+1.5 V	
All components				6.5 W
Mini PCIe card	--	1.5 A [1]	0.3 A [2]	Permitted power distribution • Mini PCIe card: 5.6 W [3]; USB: 2.5 W
USB 2.0 high current	500 mA	--	--	
Interface for S7-1200 SM modules	1200 mA	--	--	

[1] May amount to maximum 3.0 A for up to 100 ms at start-stop torque of device

[2] May amount to maximum 1.2 A for up to 100 ms at start-stop torque of device

[3] Long-term operation under high-temperature conditions at an average load of 5.6W is not recommended.

Note
Device can overheat!

The power supply cannot make unlimited power available. The auxiliary components consume energy and produce heat.

The device may overheat. The device and the auxiliary components may be damaged.

9.1.5 Direct current supply (DC)

Technical specifications

Input voltage	24 VDC (20.4 to 28.8 V)
Power consumption	max. 30 W

Typical power consumption

	Power consumption (at a rated voltage of 24 V)
Basic device	12 W
S7-1200 signal module	See section "Power demand of the components (Page 113)"
USB ports	
Expansion cards	

9.2 Other configurations for IOT2050

9.2.1 General technical specifications

General technical specifications

Order number	See order documents
Weight without mounting brackets	• IOT2050 Basic: approx. 330 g • IOT2050 Advance/IOT2050 M.2: approx. 340 g
Power supply [1]	12 to 24 VDC (9 to 36 V), no galvanic isolation
Brief voltage interruption in accordance with Namur	Up to 5 ms buffer time at 24 V DC and full load [2] Max. 10 events per hour; recovery time at least 10 ms
Current consumption	Max. 1.7 A
Noise emission	< 40 dB(A) according to DIN 45635-1
Degree of protection	IP20 according to IEC 60529
Protection class	Protection class III in accordance with IEC 61140

Degree of pollution	Device is designed for environments with pollution degree 2
MTBF	13.8 years. This was calculated under conditions of a temperature of 40 °C and a workload of 100%.
Quality assurance	In accordance with ISO 9001

[1] The device should only be connected to a power supply which meets the requirements of safe extra low voltage (SELV) according to IEC/EN/DIN EN/UL 61010-1.

[2] In the event of low supply voltage, the buffer time is reduced

Motherboard

Processor	• IOT2050 Basic: TI Sitara AM6528 GP, 1000 MHz • IOT2050 Advance/IOT2050 M.2: TI Sitara AM6548 HS, 1000 MHz
RAM	• IOT2050 Basic: 1 GB • IOT2050 Advance/IOT2050 M.2: 2 GB
BIOS SPI Flash	16 MB
Micro SD	Slot for one Micro SD card
Nano SIM card	Slot for one Nano SIM card
EMMC	• IOT2050 Basic: No • IOT2050 Advance/IOT2050 M.2: 16 GB
Expansion slots	1 x Arduino shield
	IOT2050 Basic/IOT2050 Advance: 1 x mini PCIe for PCIe cards 30 x 50.59 mm or 30 x 26.8 mm
	IOT2050 M.2: • 1 x M.2 slot for E-key card 30 mm • 1 x M.2 slot for B-key card 42 mm or 52 mm

Interfaces

USB Type A, X60	For IOT2050 Basic (FS02), IOT2050 Advance (FS04): • X60-USB1: USB3.0 Type A • X60-USB2: USB2.0 Type A
	For IOT2050 M.2, IOT2050 Advance (FS01 ~ FS03), IOT2050 Basic (FS01): • X60-USB1/X60-USB2: USB2.0 Type A
DisplayPort, X70	DisplayPort interface (DP) Only for 6ES7647-0BA00-0YA2, 6ES7647-0BA00-1YA2 and 6ES7647-0BB00-1YA2
LAN interface P1 - X1 LAN - P2, RJ45 [1]	1 GB LAN port
COM X30	• RS232 [2], max. 115 Kbps, D-sub connector, 9-pin • RS422 [2 3], max. 115 Kbps, D-sub connector, 9-pin • RS485 [2 3], max. 115 Kbps, D-sub connector, 9-pin

[1] For unique labeling, the LAN interfaces are numbered on the enclosure. The numbering by the operating system can differ. Siemens recommends you use shielded ethernet cables.

[2] You can use any COM port as an RS232, RS422 or RS485 interface through the software-controlled interface parameter assignment.

[3] Termination with 120 Ω terminal resistance can be set with the software.
The maximum cable length is 1000 m under the following preconditions:
- Data signaling rate is below 90Kbps
- Using twisted pair copper wire of 24AWG or larger diameter

Additional information on parameter assignment is available in the SIMATIC IOT2000-Forum, see section "Software and commissioning (Page 44)".

9.2.2 Electromagnetic compatibility

Emission

Radiated emission according to IEC 61000-6-4, measuring distance 3 m	
Frequency range	Interference emission
30 to 230 MHz	< 50 dB (µV/m) quasi-peak
230 to 1000 MHz	< 57 dB (µV/m) quasi-peak
1 to 3 GHz	< 76 dB (µV/m) peak and < 56 dB (µV/m) average
3 to 6 GHz	< 80 dB (µV/m) peak and < 60 dB (µV/m) average

Emission of radio interference voltages according to IEC 61000-6-4	
Emission port	Interference emission
Power port	0.15 to 0.5 MHz
	< 79 dB (µV) quasi peak and < 66 dB (µV) average
	0.5 to 30 MHz
	< 73 dB (µV) quasi peak and < 60 dB (µV) average
Telecommunication / Network port	0.15 to 0.5 MHz
	< 97 dB (µV) to 87 dB (µV) quasi peak and < 84 dB (µV) to 74 dB (µV) average
	0.5 to 30 MHz
	< 87 dB (µV) quasi peak and < 74 dB (µV) average

Immunity

Pulse-shaped interference	
Electrostatic discharge according to IEC 61000-4-2	Air discharge: ± 8 kV
	Contact discharge: ± 4 kV
Bursts (high-speed transient disturbance variable) according to IEC 61000-4-4	± 2 kV supply line
	± 1 kV signal line, < 30 m ± 2 kV signal line, > 30 m

Powerful single pulse (surge) according to IEC 61000-4-5	Asymmetric coupling (line to ground)
	± 1 kV supply line ± 2 kV signal line, > 30 m
	Symmetrical coupling (line to line)
	± 0.5 kV supply line ± 1 kV signal line, > 30 m

Sinusoidal interference	
Radiation disturbances according to IEC 61000-4-3	80% amplitude modulation at 1 kHz • on 10 V/m in the range of 80 MHz to 1 GHz • on 3 V/m in the range of 1.4 GHz to 6 GHz
Conducted disturbances according to IEC 61000-4-6	Test voltage 10 V at 80% amplitude modulation of 1 kHz in the range from 150 kHz to 80 MHz

If there are voltage peaks on power supply lines, use a protective device in the form of a varistor (MOV) UMOV = U-rated x 1.2 (BLITZDUCTOR BVT AVD 24 (918 422) or compatible).

9.2.3 Ambient conditions

Climatic ambient conditions

The temperature values have been checked in accordance with IEC 60068-2-1, IEC 60068-2-2 and IEC 60068-2-14. Permitted mounting positions, see section "Permitted mounting positions and mounting types (Page 25)".

Ambient temperature	
• Operation	DIN Rail mounting • Vertical: 0 to 50 °C * • Horizontal: 0 to 40 °C * Wall mounting • Vertical: 0 to 45 °C * • Horizontal: 0 to 40 °C *
• Storage/transport	-20 to 70 °C
Gradient	
• Operation	Max. 10 °C/h
• Storage	20 °C/h, no condensation
Relative humidity, tested in accordance with IEC 60068-2-78, IEC 60068-2-30	
• Operation	5 to 95% at 30°C, no condensation
• Storage/transport	5 to 95 % at 25/55 °C, no condensation
Atmospheric pressure, Altitude	
• Operation	1080 to 795 hPa, corresponds to an elevation of -1000 m to 2000 m
• Storage/transport	1080 to 660 hPa, corresponds to an elevation of -1000 to 3500 m

* Also note the following section "Power consumption of the components".

Mechanical ambient conditions

Vibration resistance, tested in accordance with IEC 60068-2-6	
• Operation	Vibration load 1g, 10 cycles per axle: • 5 to 8.4 Hz, deflection 3.5 mm • 8.4 to 200 Hz, acceleration 9.8 m/s^2
• Storage/transport	• 5 to 8.4 Hz: Deflection 3.5 mm • 8.4 Hz to 500 Hz: Acceleration 9.8 m/s^2
Impact resistance, tested in accordance with IEC 60068-2-27	
• Operation	150 m/s^2, 11 ms
• Storage/transport	250 m/s^2, 6 ms

9.2.4 Power demand of the components

Maximum power consumption of the auxiliary components

For the ambient temperature for permitted mounting position, refer to Ambient conditions (Page 117).

Auxiliary components	Maximum permitted power consumption			Maximum total power
	+5 V	+3.3 V	+1.5 V	
All components				6.5 W
Arduino shield				Permitted power distribution • Arduino shield: 4 W, USB: 2.5 W • Arduino shield: 2 W, USB: 4.5 W • Mini PCIe card: 2 W; USB: 2.5 W; Arduino shield: 2 W • M.2 card(E Key + B Key) [3] : 2 W; USB 2.5 W; Arduino shield: 2 W
Mini PCIe card	--	1.5 A [1]	0.3 A [2]	
USB 2.0 high current	500 mA	--	--	
USB 3.0 high current	900 mA	--	--	

[1] May amount to maximum 3.0 A for up to 100 ms at start-stop torque of device

[2] May amount to maximum 1.2 A for up to 100 ms at start-stop torque of device

[3] Rail mounting Vertical: 0 to 50 °C, the maximum power of M.2 card(E Key + B Key) 1.5 W, total power is 6 W

[3] Rail mounting Vertical: 0 to 45 °C, the maximum power of M.2 card(E Key + B Key) 2 W, total power is 6.5 W

Note
Device can overheat!

The power supply cannot make unlimited power available. The auxiliary components consume energy and produce heat.

The device may overheat. The device and the auxiliary components may be damaged.

9.2.5 Direct current supply (DC)

Technical specifications

Input voltage	12 to 24 VDC (9 to 36 V)
Power consumption	max. 24 W

Typical power consumption

	Power consumption (at a rated voltage of 24 V)
Basic device	12 W
Arduino shields	See section "Power demand of the components (Page 118)"
USB ports	
Expansion cards	

9.3 Expansion module for IOT2050 SM

9.3.1 SIMATIC IPC SM SENS DI

9.3.1.1 General technical specifications

Industrial environments

IPC SM SENS DI is designed for use in industrial environments.

Application field	**Emission requirements**	**Immunity requirements**
Industrial	EN 61000-6-4	EN 61000-6-2

Emission

Radiated emission according to IEC 61000-6-4, measuring distance 3 m	
Frequency range	Interference emission
30 to 230 MHz	< 50 dB (µV/m) quasi-peak
230 to 1000 MHz	< 57 dB (µV/m) quasi-peak
1 to 3 GHz	< 76 dB (µV/m) peak and < 56 dB (µV/m) average
3 to 6 GHz	< 80 dB (µV/m) peak and < 60 dB (µV/m) average

Emission of radio interference voltages according to IEC 61000-6-4	
Emission port	Interference emission
Power port	0.15 to 0.5 MHz
	< 79 dB (µV) quasi peak and < 66 dB (µV) average
	0.5 to 30 MHz
	< 73 dB (µV) quasi peak and < 60 dB (µV) average

Immunity

Pulse-shaped interference	
Electrostatic discharge according to IEC 61000-4-2	Air discharge: ± 8 kV
	Contact discharge: ± 4 kV
Bursts (high-speed transient disturbance variable) according to IEC 61000-4-4	± 2 kV supply line
	± 1 kV signal line, < 30 m ± 2 kV signal line, > 30 m
Powerful single pulse (surge) according to IEC 61000-4-5	Asymmetric coupling (line to ground)
	± 1 kV supply line ± 2 kV signal line, > 30 m
	Symmetrical coupling (line to line)
	± 0.5 kV supply line ± 1 kV signal line, > 30 m

Sinusoidal interference	
Radiation disturbances according to IEC 61000-4-3	80% amplitude modulation at 1 kHz • on 10 V/m in the range of 80 MHz to 1 GHz • on 3 V/m in the range of 1.4 GHz to 6 GHz
Conducted disturbances according to IEC 61000-4-6	Test voltage 10 V at 80% amplitude modulation of 1 kHz in the range from 150 kHz to 80 MHz

If there are voltage peaks on power supply lines, use a protective device in the form of a varistor (MOV) UMOV = U-rated x 1.2 (BLITZDUCTOR BVT AVD 24 (918 422) or compatible).

Environmental conditions

Environmental conditions - Shipping and storage	
EN 60068-2-2, Test Bb, Dry heat and EN 60068-2-1, Test Ab, Cold	-40 °C to +70 °C
EN 60068-2-30, Test Db, Damp heat	25 °C to 55 °C, 95% humidity
EN 60068-2-14, Test Na, temperature shock	-40 °C to +70 °C, dwell time 3 hours, 5 cycles
EN 60068-2-31, Free fall	0.3 m, 10 times, product packaging
Atmospheric pressure	1140 to 540 hPa (corresponding to an altitude of -1000 to 5000 m)

Environmental conditions - Operation	
The IPC automation system is suitable for use in weather-proof, fixed locations. The operating conditions are based on requirements according to DIN IEC 60721-3-3: • Class 3M3 (mechanical requirements) • Class 3K3 (climatic requirements)	
Ambient temperature range (Inlet Air 25 mm below unit)	-20°C to +60°C horizontal, no adjacent module -20°C to +50°C vertical, no adjacent module -20°C to +55°C horizontal -20°C to +45°C vertical
Humidity	5 to 95% at 30°C
Atmospheric pressure	1140 to 795 hPa (corresponding to an altitude of -1000 to 2000 m)[1]
Concentration of contaminants	SO_2: < 0.5 ppm; H_2S: < 0.1 ppm; RH < 60% non-condensing
	ISA-S71.04 severity level G1, G2, G3
EN 60068-2-14, Test Nb, temperature change	- 20 °C to 60 °C
EN 60068-2-27 Mechanical shock	15 g, 11 ms pulse, 6 shocks in each of 3 axis
EN 60068-2-6 Sinusoidal vibration	DIN rail mount: 3.5 mm from 5-8.4 Hz, 1G from 8.4 - 150 Hz Wall Mount: 7.0 mm from 5-8.4 Hz, 2G from 8.4 to 150 Hz 10 sweeps each axis, 1 octave per minute

[1] This rating applies to relay output or input AC IPC CPUs.

Contamination level/overvoltage category according to IEC 61131-2

- Polution degree 2
- Overvoltage category: II

Protection class

- Protection Class II according to EN 61131-2 (Protective conductor not required)

Degree of protection

- IP20 Mechanical Protection, EN 60529
- Protects against finger contact with high voltage as tested by standard probe. External protection required for dust, dirt, water and foreign objects of < 12.5mm in diameter.

9.3.1.2 Digital Inputs

SM SENS DI Module Specifications

Model	**SIMATIC IPC SM SENS DI**
Order number (MLFB)	6ES7647-0CM00-1AA2
General	
Dimensions W x H x D (mm)	45 x 100 x 75
Weight	190 grams
Power dissipation	7.5 W
Current consumption (SM Bus)	80 mA

SM SENS AC Digital Input Specifications

AC Digital inputs	
Number of inputs	4
In groups	1
Input characteristic curve in accordance with IEC 61131, type 1	Yes
Type	Source
Rated voltage	120 V AC at 6 mA, 230 V AC at 9 mA
Continuous permissible voltage	264 VAC
Logic 1 signal (min.)	79 V AC at 2.5 mA
Logic 0 signal (max.)	20 V AC at 1 mA
Isolation	3000 V AC for 1 minute
Filter times	Not selectable
Number of inputs on simultaneously	4
Cable length (meters)	500 m shielded, 300 m unshielded

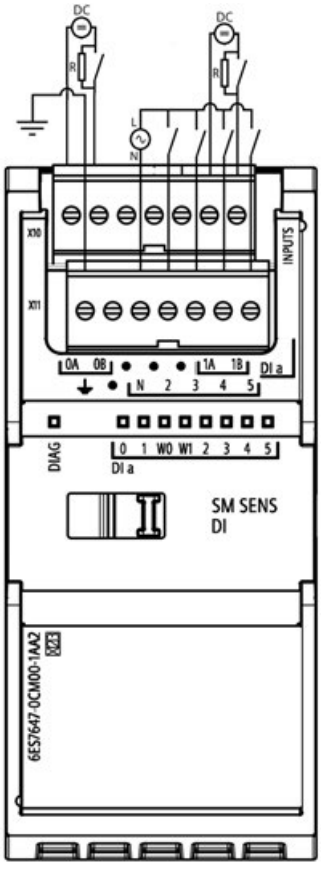
SM SENS DI DC Digital Input Specifications

DC Digital inputs	
Number of inputs	2
In groups	1
Input characteristic curve in accordance with IEC 61131, type 1	No, customized
Type	Source
Continuous permissible voltage	240 V DC

Logic 1 signal (min.)	-240 V to -20 V or +20 V to +240 V • Input current : 2,0 mA min • Input current: 5,0 mA type
Logic 0 signal (max.)	-12 V to +12 V
Isolation	3000 V AC for 1 minute
Filter times	No
Number of inputs on simultaneously	2
Cable length (meters)	500 m shielded, 300 m unshielded

9.3.1.3 Wiring diagrams

Wiring Diagrams

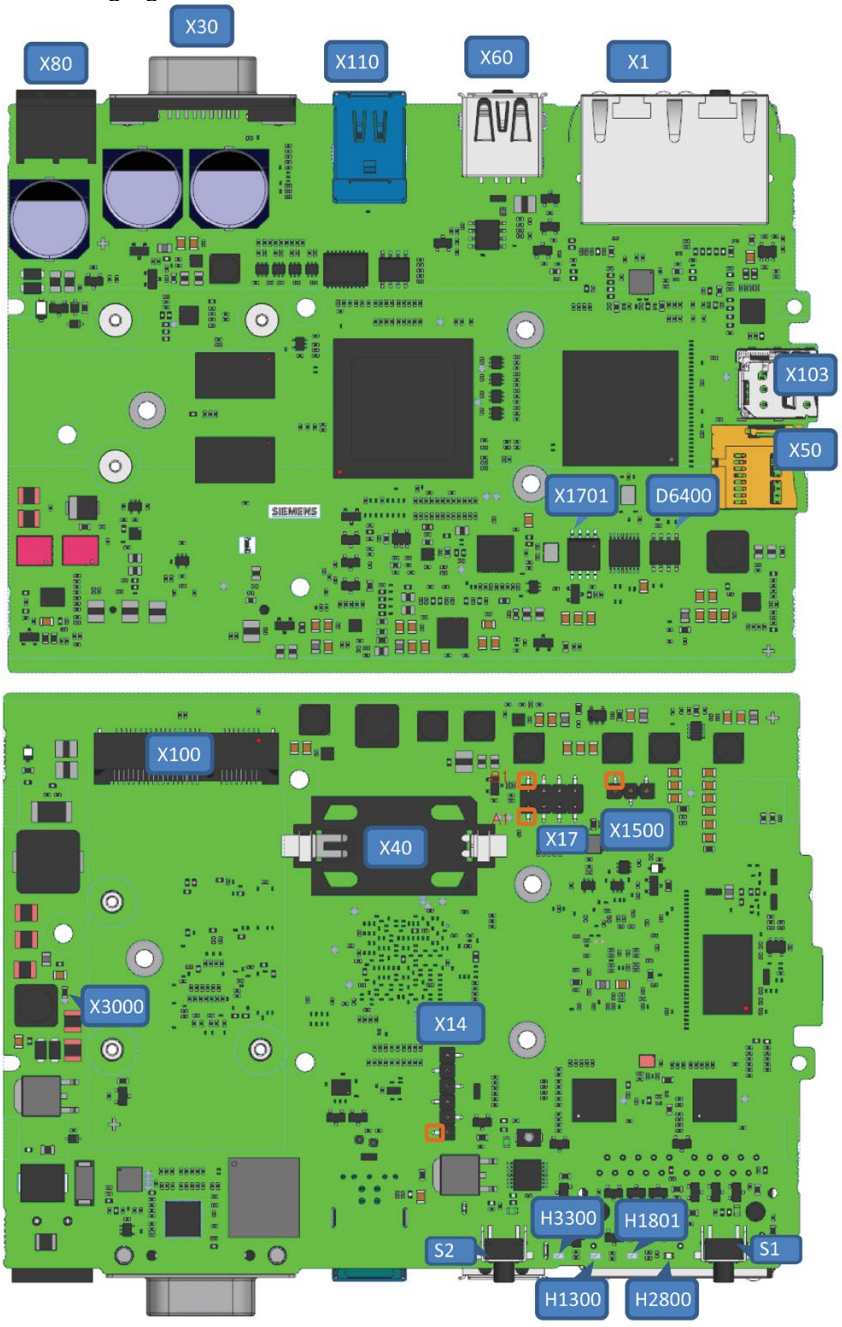


Hardware descriptions

10

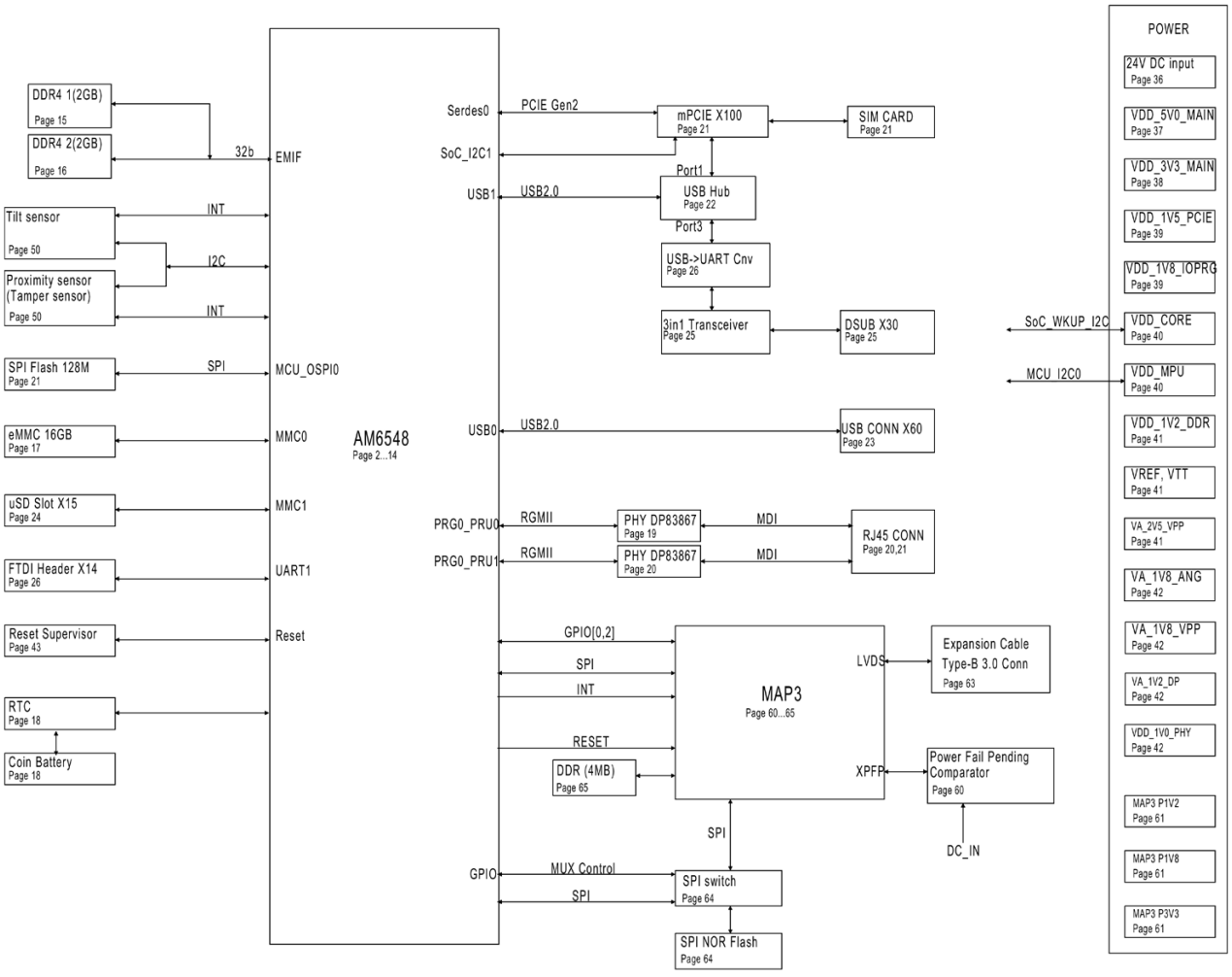
10.1 IOT2050 SM: Motherboard

The following figures show the motherboard of IOT2050 SM.



Pin 1

The following figures show the diagram of IOT2050 SM.

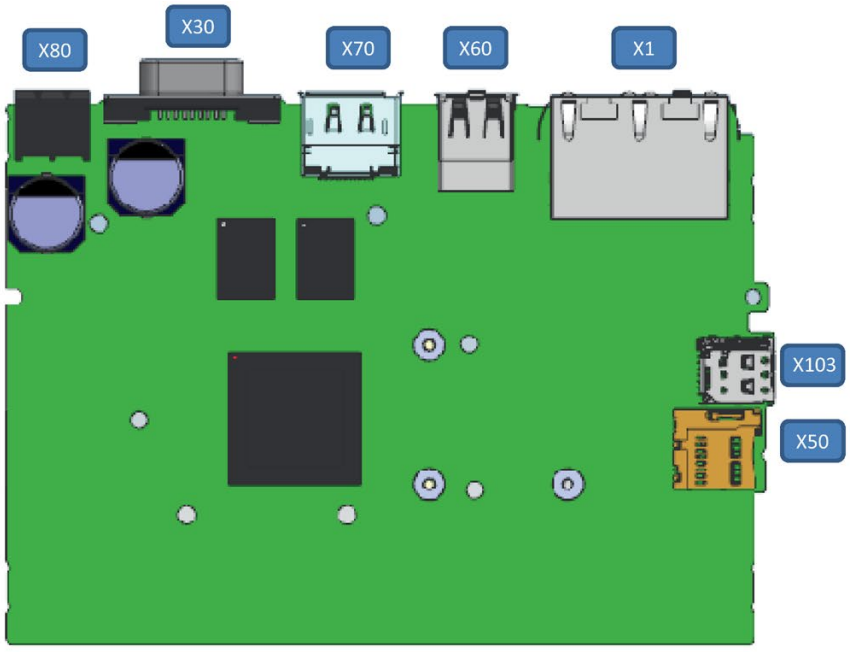


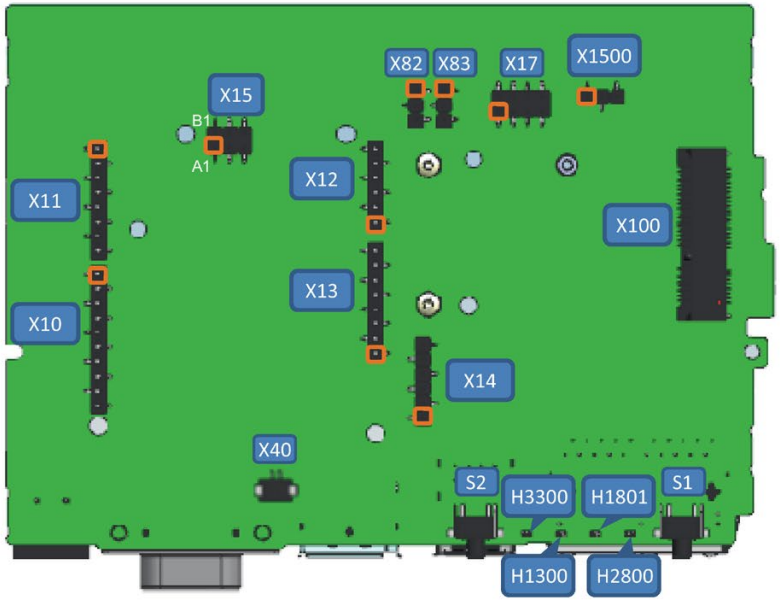
Component/interface	Description / inscription		Meaning, comment
H2800	LEDs	PWR	Power (green)
H1801		STAT	OS is running (Green Blink). OS is not running (Red blink).
H1300		USER1	User LED (green/red/orange), programmable
H3300		USER2	User LED (green/red/orange), programmable
S1	RESET		For a reset of the CPU
S2	USER		Status can be queried with programming
X1	Ethernet 1 and Ethernet 2		
X30	COM D-Sub9		
X60	USB A Host		USB2.0 Type A
X110	Interface for S7-1200 SM modules		
X14	UART Debug		
X40	Battery-Con		
X50	µSD slot		

Component/interface	Description / inscription	Meaning, comment
X17	DediProg Connector	
X80	Power supply	
X1500	Jumper, 3 pin, SMD	Jumper defines Flash write protection enable or disable: • Jumper on pins 1-2: write protection enable • Jumper on pins 2-3: write protection disable **Note**: When Secure Boot is not enabled, set the flash write protection jumper in write protection enabled state (pins 1-2) and lock flash in bootloader during normal operation.
X103	Nano SIM Connector	
X100	mini-PCIe	mini-PCIe slot

10.2 IOT2050 Advance/Basic: Motherboard

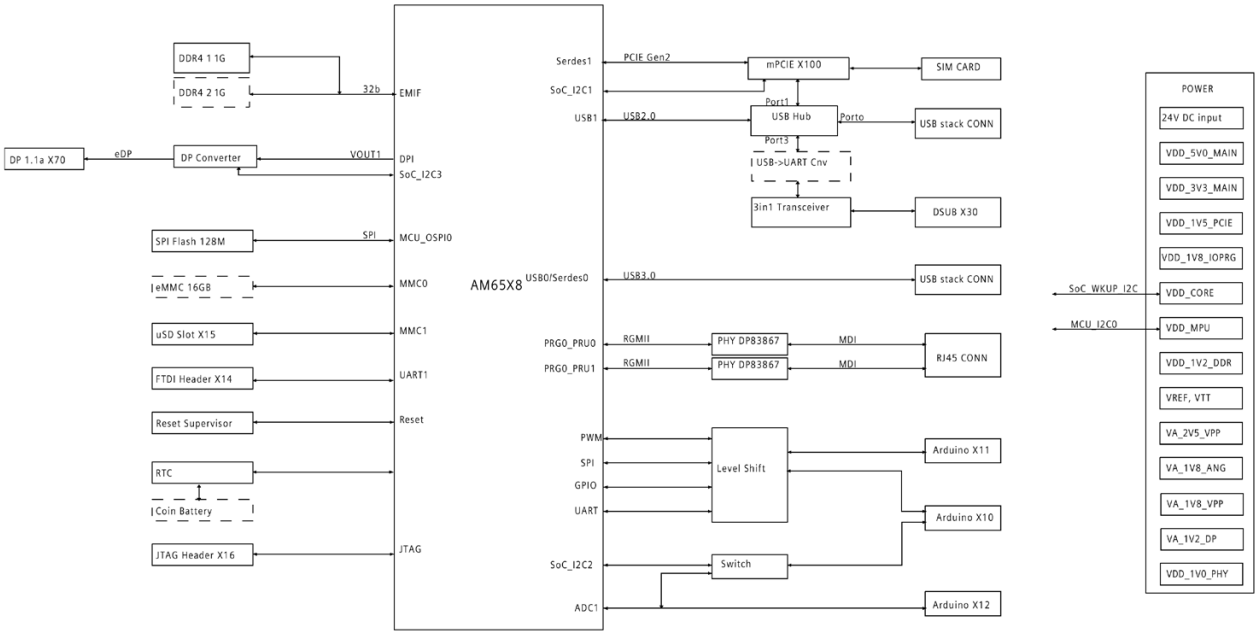
The following figures show the motherboard for IOT2050 Advance/Basic.





Pin 1

The following figures show the diagram for IOT2050 Advance/Basic.



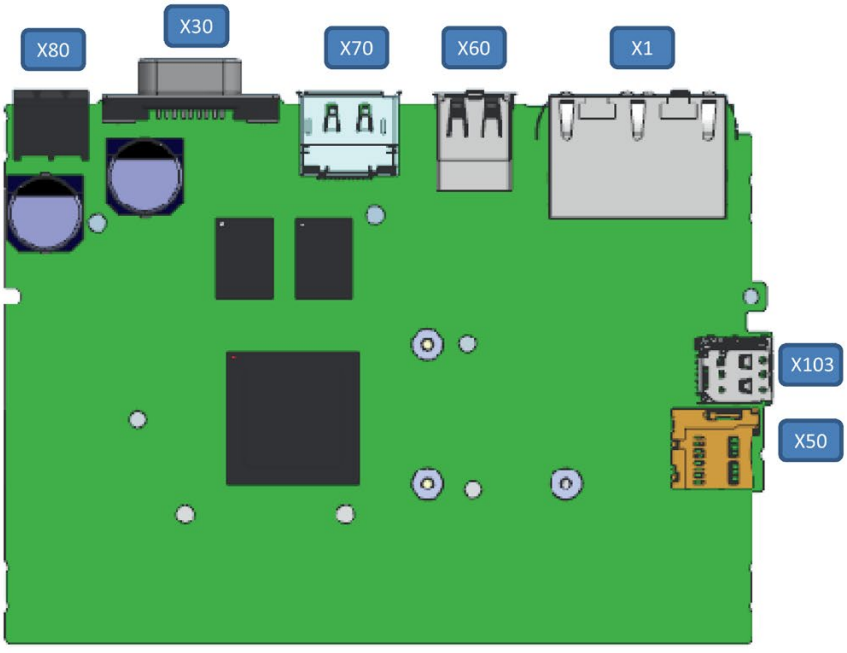
Note: the parts in dash rectangles are only available for advanced versions.

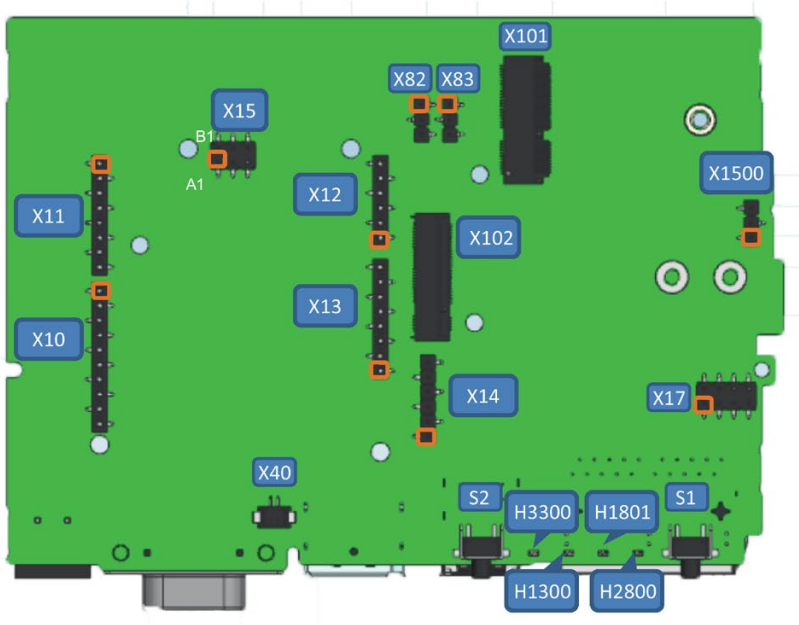
Component/interface	Description / inscription		Meaning, comment
H2800	LEDs	PWR	Power (green)
H1801		STAT	OS is running (Green Blink). OS is not running (Red blink).
H1300		USER1	User LED (green/red/orange), programmable
H3300		USER2	User LED (green/red/orange), programmable
S1	RESET		For a reset of the CPU
S2	USER		Status can be queried with programming
X1	Ethernet 1 and Ethernet 2		
X30	COM D-Sub9		
X60	USB A Host		X60-USB1: USB3.0 Type A X60-USB2: USB2.0 Type A
X70	DisplayPort		
X14	UART Debug		
X40	Battery-Con		
X50	µSD slot		
X11, X13	Arduino, 8-pin (2x)		
X10	Arduino, 10-pin		
X12	Arduino, 6-pin		
X15	ICSP		Part of Arduino Interface
X17	DediProg Connector		
X80	Power supply		

Component/interface	Description / inscription	Meaning, comment
X83	Jumper, 3 pin, SMD	Jumper defines IO voltage for Arduino shield: • Jumper on pins 1-2: 5 V • Jumper on pins 2-3: 3.3 V
X1500	Jumper, 3 pin, SMD	Jumper defines Flash write protection enable or disable: • Jumper on pins 1-2: write protection enable • Jumper on pins 2-3: write protection disable **Note**: When Secure Boot is not enabled, set the flash write protection jumper in write protection enabled state (pins 1-2) and lock flash in bootloader during normal operation.
X100	MiniPCIe Connector	
X103	Nano SIM Connector	
X82	VIN Separation (power supply, 24 V DC)	Jumper defines VIN connection to the Arduino shield: • Jumper on pins 1-2: VIN is connected to the Arduino shield • Jumper on pins 2-3: VIN is not connected to the Arduino shield

10.3 IOT2050 M.2: Motherboard

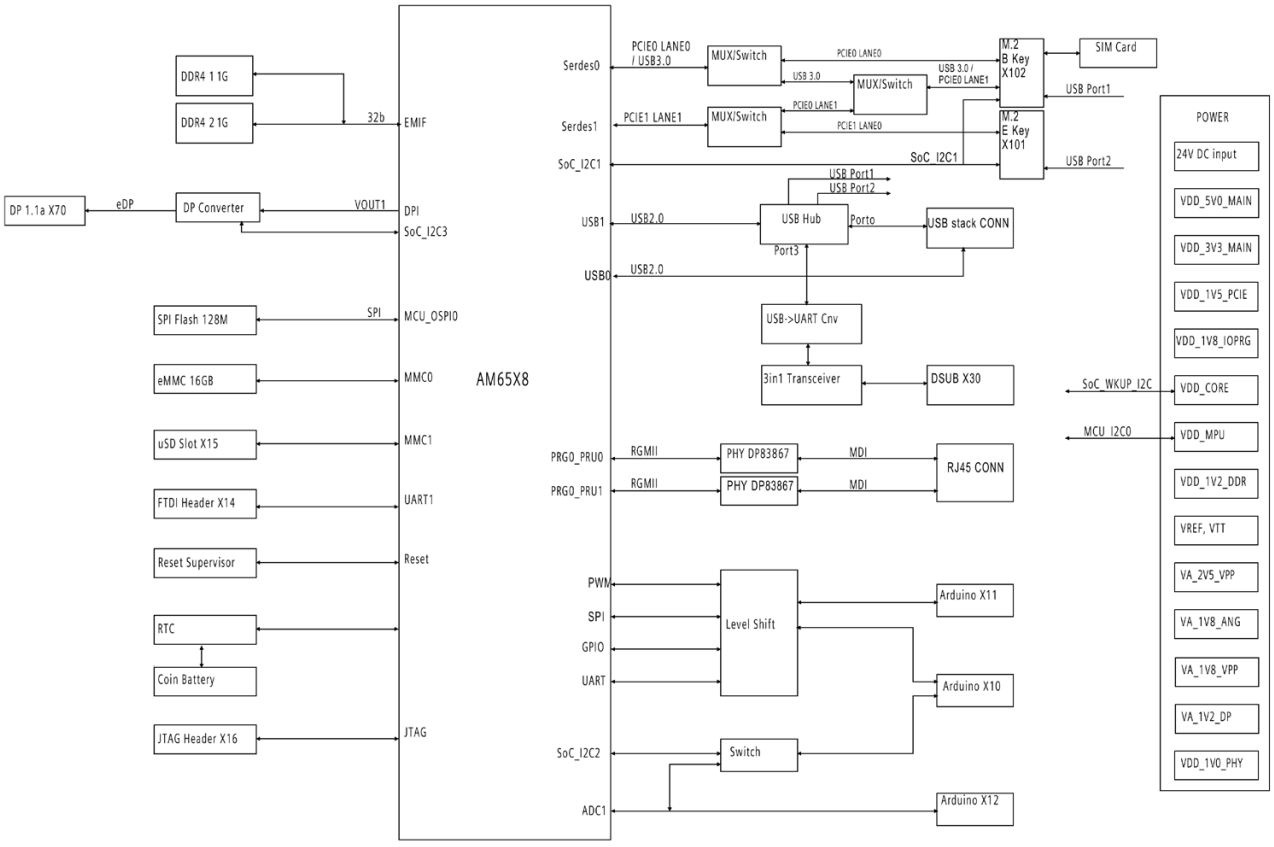
The following figures show the motherboard of MLFB 6ES7647-0BB00-1YA2.





Pin 1

The following figures show the diagram of MLFB 6ES7647-0BB00-1YA2.



Component/interface	Description / inscription		Meaning, comment
H2800	LEDs	PWR	Power (green)
H1801		STAT	OS is running (Green Blink). OS is not running (Red blink).
H1300		USER1	User LED (green/red/orange), programmable
H3300		USER2	User LED (green/red/orange), programmable
S1	RESET		For a reset of the CPU
S2	USER		Status can be queried with programming
X1	Ethernet 1 and Ethernet 2		
X30	COM D-Sub9		
X60	USB A Host		X60-USB1/USB2: USB2.0 Type A
X70	DisplayPort		
X14	UART Debug		
X40	Battery-Con		
X50	µSD slot		
X11, X13	Arduino, 8-pin (2x)		
X10	Arduino, 10-pin		
X12	Arduino, 6-pin		
X15	ICSP		Part of Arduino Interface
X17	DediProg Connector		

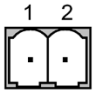
Component/interface	Description / inscription	Meaning, comment
X80	Power supply	
X83	Jumper, 3 pin, SMD	Jumper defines IO voltage for Arduino shield: • Jumper on pins 1-2: 5 V • Jumper on pins 2-3: 3.3 V
X1500	Jumper, 3 pin, SMD	Jumper defines Flash write protection enable or disable: • Jumper on pins 1-2: write protection enable • Jumper on pins 2-3: write protection disable **Note**: When Secure Boot is not enabled, set the flash write protection jumper in write protection enabled state (pins 1-2) and lock flash in bootloader during normal operation.
X103	Nano SIM Connector	
X101	M.2 Key E	Type 2230-E
X102	M.2 Key B	Type 3042-B and 3052-B
X82	VIN Separation (power supply, 24 V DC)	Jumper defines VIN connection to the Arduino shield: • Jumper on pins 1-2: VIN is connected to the Arduino shield • Jumper on pins 2-3: VIN is not connected to the Arduino shield

10.4 External Interfaces

10.4.1 Power supply

Plug connector, 2-pin

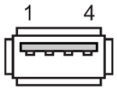
Name of interface on the device: X80



Pin	Assignment
1	GND (M)
2	• IOT2050 SM: 24 VDC (20.4 to 28.8 V) • Other configurations for IOT2050: 12 to 24 VDC (9 to 36 V)

10.4.2 USB

USB socket type A



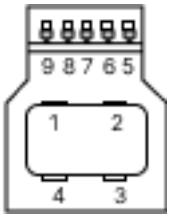
Name of interface on the device: USB 2.0

-Pin	Assignment
1	+5 VDC, out (max. 500 mA)
2	USB-DN
3	USB-DP
4	GND

Name of interface on the device: USB 3.0

-Pin	Assignment
1	+5 VDC, out (max. 900 mA)
2	USB-DN
3	USB-DP
4	GND
5	RX-
6	RX+
7	GND
8	TX-
9	TX+

10.4.3 Interface for S7-1200 modules



Name of interface on the device:

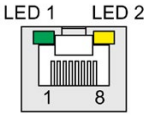
-Pin	Assignment
1	VCC1
2	VCC2
3	GND1
4	GND2
5	RX-

-Pin	Assignment
6	RX+
7	N/A
8	SSTX-
9	SSTX+

10.4.4 Ethernet port

RJ45 socket

Name of interface on the device: P1 - X1 LAN - P2



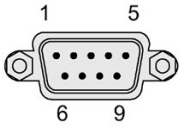
Pin	Short description	Meaning
1	BI_DA+	Bidirectional data A+, input/output
2	BI_DA–	Bidirectional data A–, input/output
3	BI_DB+	Bidirectional data B+, input/output
4	BI_DC+	Bidirectional data C+, input/output
5	BI_DC–	Bidirectional data C–, input/output
6	BI_DB–	Bidirectional data B–, input/output
7	BI_DD+	Bidirectional data D+, input/output
8	BI_DD–	Bidirectional data D–, input/output

LED	Meaning	Status	Meaning of the status
LED 1	Connection status	OFF	No data transmission
		Green flashing	Data transfer active
LED 2	Data transmission rate	OFF	Reserved
		Yellow	100 Mbps
		Green	1000 Mbps

10.4.5 Serial port

D-sub socket, 9-pin, with screw lock

Name of interface on the device: X30 COM



RS 232
RS 422
RS 485

Differential termination resistance for RS485/422 is 120 Ohm.

Assignment RS 232

Pin	Short description	Meaning
1	DCD	Data carrier detect (I)
2	RxD	Received data (I)
3	TxD	Transmitted data (O)
4	DTR	Data terminal ready (O)
5	M	Ground
6	DSR	Data set ready (I)
7	RTS	Request to send (O)
8	CTS	Clear to send (I)
9	RI	Incoming call (I)

Assignment RS 422

Pin	Short description	Meaning
1	TX-	Transmitted data - (O) for full-duplex mode
2	TX+	Transmitted data + (O) for full-duplex mode
3	RX+	Receive data + (I) for full-duplex mode
4	RX-	Receive data - (I) for full-duplex mode
5	M	Signal ground
6	nc	
7	nc	
8	nc	
9	nc	

Assignment RS 485

Pin	Short description	Meaning
1	Data-	Transmit / receive data - (I/O) for half-duplex mode
2	Data+	Transmit / receive data+ (I/O) for half-duplex mode
3	nc	

Pin	Short description	Meaning
4	nc	
5	M	Signal ground
6	nc	
7	nc	
8	nc	
9	nc	

10.5 Internal interfaces

10.5.1 Arduino shield interfaces

The tables below show the pin assignment of the interfaces of the Arduino shield, depending on the operating mode.

The position of the interfaces and Pin 1 of the respective interface is available in section "IOT2050 Advance/Basic: Motherboard (Page 127)".

X10

Pin	Operating mode						
	DIGITAL	ANALOG	POWER	SERIAL	SPI	I2C	PWM
1	8						X
2	9						X
3	10				SS		
4	11				MOSI		
5	12				MISO		
6	13				SCK		
7			GND				
8							
9						SDA	
10						SCL	

X11

Pin	Operating mode						
	DIGITAL	ANALOG	POWER	SERIAL	SPI	I2C	PWM
1	0			UART_Rx			
2	1			UART_Tx			
3	2			UART_CTS			
4	3			UART_RTS			
5	4						X
6	5						X

Pin	Operating mode						
7	6						X
8	7						X

X12

Pin	Operating mode						
	DIGITAL	**ANALOG**	**POWER**	**SERIAL**	**SPI**	**I2C**	**PWM**
1	14	A0					
2	15	A1					
3	16	A2					
4	17	A3					
5	18	A4				SDA	
6	19	A5				SCL	

X13

Pin	Operating mode						
	DIGITAL	**ANALOG**	**POWER**	**SERIAL**	**SPI**	**I2C**	**PWM**
1							
2			IOREF				
3			RESET				
4			3.3 V				
5			5 V				
6			GND				
7			GND				
8			VIN				

X15 (ICSP)

Pin	Operating mode						
	DIGITAL	**ANALOG**	**POWER**	**SERIAL**	**SPI**	**I2C**	**PWM**
A1	12				MISO		
B1			5 V				
A2	13				SCK		
B2	11				MOSI		
A3			RESET				
B3			GND				

10.5.2 UART Debug

X14

Pin	Assignment
1	GND
2	RTS_N
3	n. c.
4	RxD
5	TxD
6	CTS_N

10.5.3 Mini PCIe interface

X100

Pin	Signal Name	Pin	Signal Name
51		52	+3.3 V_{aux}
49		50	GND
47	ANTCTRL3	48	+1.5 V / ANTCTRL1
45	ANTCTRL2	46	
43	GND	44	
41	+3.3V_{aux}	42	
39	+3.3V_{aux}	40	GND
37	GND	38	USB_D+
35	GND	36	USB_D-
33	PETp0	34	GND
31	PETn0	32	SMB_DATA
29	GND	30	SMB_CLK
27	GND	28	+1.5V / ANTCTRL0
25	PERp0	26	GND
23	PERn0	24	+3.3V_{aux}
21	GND	22	PERST#
19		20	W_DISABLE1#
17		18	GND
Mechanical Key			
15	GND	16	
13	REFCLK+	14	UIM_RESET
11	REFCLK-	12	UIM_CLK
9	GND	10	UIM_DATA
7		8	UIM_PWR
5		6	1.5 V
3		4	GND
1	WAKE#	2	3.3 V_{aux}

10.5.4 M.2 interface

M.2 Key E

X101

Pin	Signal Name	Pin	Signal Name
74	3.3 V	75	GND
72	3.3 V	73	
70		71	
68		69	GND
66		67	
64		65	
62		63	GND
60	12C_CLK	61	
58	12C_DATA	59	
56	W_DISABLE1#	57	GND
54	W_DISABLE2#	55	PEWAKE0#
52	PERST0#	53	CLKREQ0#
50	SUSCLK	51	GND
48	COEX_TXD	49	REFCLKn0
46	COEX_RXD	47	REFCLKp0
44	COEX3	45	GND
42		43	PERn0
40		41	PERp0
38		39	GND
36		37	PETn0
34		35	PETp0
32		33	GND
30	ADD-IN CARD KKEY E	31	ADD-IN CARD KKEY E
28	ADD-IN CARD KKEY E	29	ADD-IN CARD KKEY E
26	ADD-IN CARD KKEY E	27	ADD-IN CARD KKEY E
24	ADD-IN CARD KKEY E	25	ADD-IN CARD KKEY E
22		23	
20		21	
18	GND	19	
16		17	
14		15	
12		13	
10		11	
8		9	
6		7	GND
4	3.3 V	5	USB_D-
2	3.3 V	3	USB_D+
		1	GND

M.2 Key B

X102

Pin	Signal Name	Pin	Signal Name
74	3.3 V	75	CONFIG_2
72	3.3 V	73	GND
70	3.3 V	71	GND
68	SUSCLK	69	CONFIG_1
66		67	RESET#
64	COEX_RXD	65	
62	COEX_TXD	63	
60	COEX3	61	
58		59	
56		57	GND
54	PEWAKE#	55	REFCLKp
52	CLKREQ#	53	REFCLKn
50	PERST#	51	GND
48		49	PETp0
46		47	PETn0
44		45	GND
42		43	PERp0
40		41	PERn0
38		39	GND
36	UIM_PWR	37	USB3.1-Tx+
34	UIM_DATA	35	USB3.1-Tx-
32	UIM_CLK	33	GND
30	UIM_RESET	31	USB3.1-Rx+
28		29	USB3.1-Rx-
26		27	GND
24		25	
22		23	
20		21	CONFIG_0
18	ADD-IN CARD KKEY B	19	ADD-IN CARD KKEY B
16	ADD-IN CARD KKEY B	17	ADD-IN CARD KKEY B
14	ADD-IN CARD KKEY B	15	ADD-IN CARD KKEY B
12	ADD-IN CARD KKEY B	13	ADD-IN CARD KKEY B
10		11	GND
8	W_DISABLE1#	9	USB_D-
6	FULL_CARD_POWER_OFF#	7	USB_D+
4	3.3 V	5	GND
2	3.3 V	3	GND
		1	CONFIG_3

10.5.5 Micro SD interface

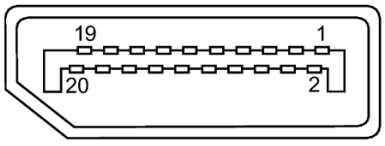
X50

Pin	Abbreviation	Function
1	Dat2	Data line bit 2
2	Dat3	Card Detect / data line bit 3
3	CMD	Command Line
4	Vdd	Voltage supply 2.7–3.6 V
5	Clk	Clock input
6	GND	Signal Ground
7	Dat0	Data line bit 0
8	Dat1	Data line bit 1

10.5.6 DisplayPort 1.1A

X70

DisplayPort interface



Pin no.	Abbreviation	Function	Input/output
1	Lane 0_P	Lane 0+	Input
2	GND	Ground	-
3	Lane 0_N	Lane 0-	Input
4	Lane 1_P	Lane 1+	Input
5	GND	Ground	-
6	Lane 1_N	Lane 1-	Input
7			
8	GND	Ground	-
9			
10			
11	GND	Ground	-
12			
13	CONFIG1	Connected to ground	-
14	CONFIG2	Connected to ground	-
15	AUX CH_P	Auxiliary channel+	Bidirectional
16	GND	Ground	-
17	AUX CH_N	Auxiliary channel-	Bidirectional
18	Hot plug	Hot Plug Detect	output
19	Return	Return for power Connected to ground	-
20	DP_PWR	Power for connector (3.3 V 500 mA)	power out

Technical support

A

A.1 Service and support

You can find additional information and support for the products described on the Internet at the following addresses:

- SIMATIC IOT2000 (www.siemens.com/iot2000)
- Technical support (https://support.industry.siemens.com)
- After Sales Information System SIMATIC IPC/PG (http://www.siemens.com/asis)
- SIMATIC Documentation Collection (https://support.industry.siemens.com/cs/us/en/view/109744171)
- Your local representative (https://www.automation.siemens.com/aspa_app)
- Training center (https://www.sitrain-learning.siemens.com/PLG/?AppLang=en)
- Industry Mall (https://mall.industry.siemens.com/)

When contacting your local representative or Technical Support, please have the following information at hand:

- MLFB of the device
- BIOS version for industrial PC or image version of the device
- Other installed hardware
- Other installed software

Tools & downloads

Please check regularly if updates and hotfixes are available for download to your device. The download area is available on the Internet at the following link:

After Sales Information System SIMATIC IPC/PG (http://www.siemens.com/asis)

A.2 Troubleshooting

Error pattern	Possible cause	Possible remedy
Host monitor flashes black for a few seconds when you insert the DC connecting terminal to the device.	You turned the switch on before you connect the DC connecting terminal.	Avoid turning on/off the device by plugging /unplugging the DC connecting terminal. Use a external switch to control the power of the device.
User button can't work when Arduino shield reset pin is working.	User button and Arduino interface reset pin can't work at same time.	Avoid using user button and Arduino interface reset pin at the same time.

Markings and symbols

B

B.1 Overview

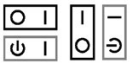
The following tables show all the symbols which may be found on your SIMATIC industrial PC, SIMATIC industrial monitor or SIMATIC Field PG in addition to the symbols which are explained in the operating instructions.

The symbols on your device may vary in some details from the symbols shown in the following tables.

B.2 Safety

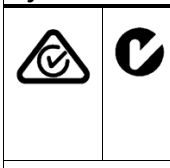
Symbol	Meaning		Symbol	Meaning
	Warning, observe the supplied documentation.			Lock is closed
	Attention, radio equipment			Lock is open
	Disconnect the power plug before opening			Opening for Kensington lock
	Attention ESD (Electrostatic sensitive device)			Warning of hot surface

B.3 Operator controls

Symbol	Meaning		Symbol	Meaning
	On/off switch, without electrical isolation			Eject CD/DVD
	On/off switch, without electrical isolation			

B.4 Certificates, approvals and markings

The following table shows symbols relating to certificates, approvals and markings which may be on the device. You can find more information in the operating instructions for your device:

Symbol	Meaning		Symbol	Meaning
	Approved for Australia and New Zealand			Approval for India
	Approved for China			Test mark of Factory Mutual Research
	CE markings for European countries			Marking of Federal Communications Commission for the USA
	EFUP (Environment Friendly Use Period) marking for China			Approved for Korea
	Test mark of the Underwriters Laboratories			Disposal information, observe the local regulations.

B.5 Interfaces

Symbol	Meaning		Symbol	Meaning
⎓	Connection to the power supply			PS/2 mouse interface
	Protective conductor terminal			PS/2 keyboard-interface
	Connection for functional earthing (equipotential bonding line)			Multimedia Card Reader
DPP	DisplayPort interface			Smart Card Reader
	DVI-D interface			Line In
LAN 	LAN interface, not approved for connecting WAN or telephone			Line Out
	Serial port			Microphone input
	USB port			Universal Audio Jack
	USB 2.0 high-speed port			Headphone output
	USB 3.0 super-speed port			
	USB 3.1 SuperSpeedPlus interface			

List of abbreviations

C

ACPI	Advanced Configuration and Power Interface	
BIOS	Basic Input Output System	
CE	Communauté Européenne	
COM	Communications Port	Term for the serial interface
CPU	Central Processing Unit	CPU
CSA	Canadian Standards Association	Canadian organization for tests and certifications according to national or binational standards
CTS	Clear To Send	Clear to send
DC	Direct Current	DC current
DCD	Data Carrier Detect	Data carrier signal detection
DQS	Deutsche Gesellschaft zur Zertifizierung von Qualitätsmanagement mBH	
DSR	Data Set Ready	Ready for operation
DTR	Data Terminal Ready	Data terminal is ready
ESD	Components sensitive to electrostatic charge	
EN	European standard	
ESD	Electrostatic Sensitive Device	Electrostatic Sensitive Devices
	Electrostatic discharge	Electrostatic discharge
GND	Ground	Chassis ground
IDE	Integrated Device Electronics	
IEC	International Electronical Commission	
LAN	Local Area Network	Computer network that is limited to a local area.
LED	Light Emitting Diode	Light emitting diode
LPS	Limited Power Source	
MAC	Media access control	Media access control
MLFB	Machine-readable product designation	
PC	Personal computer	
PCIe	Peripheral Component Interconnect express	High-speed serial, differential full-duplex PtP interface with high data rate.
PG	Programming device	
RI	Ring Input	Incoming call
RTS	Request to send	Request to send
RxD	Receive Data	Data transfer signal
SELV	Safety Extra Low Voltage	Safety extra low voltage
UEFI	Unified Extensible Firmware Interface	

UL	Underwriters Laboratories Inc.	US organization for testing and certification according to national or binational standards.
USB	Universal Serial Bus	

Glossary

CE marking

Communauté **E**uropéene: The CE symbol confirms the conformity of the product with all applicable EC directives such as the EMC Directive.

COM interface

The COM interface is a serial V.24 interface. The interface is suitable for asynchronous data transfer.

Debian

Debian is a Linux distribution composed of free and open-source software. Debian systems currently use the Linux kernel or the FreeBSD kernel. Linux is a piece of software started by Linus Torvalds and supported by thousands of programmers worldwide. FreeBSD is an operating system including a kernel and other software.

Distribution framework

Exemplary reference distribution "Debian" of Embedded Linux (see "Debian" and "ISAR").

Drivers

Program parts of the operating system. They adapt user program data to the specific formats required by I/O devices such as hard disk, printers, and monitors.

Embedded Linux

Linux for industrial, embedded systems (see "Debian").

ESD Guideline

Guideline for using electrostatic sensitive components.

Ethernet

Local network (bus structure) for text and data communication with a transfer rate of 100/1000 Mbps.

Interface

- Physical interconnection (cable) of hardware elements such as PLCs, PCs, programming devices, printers or monitors.
- Interface for interactive software applications.

LAN

Local **A**rea **N**etwork: LAN is a local network that consists of a group of computers and other devices that are distributed across a relatively restricted range and are linked with communication cables. The devices connected to a LAN are called nodes. The purpose of networks is the mutual use of files, printers or other resources.

Module

Modules are plug-in units for PLCs, programming devices or PCs. They are available as local modules, expansion modules, interfaces or mass storage (Mass storage module).

Motherboard

The motherboard is the core of the computer. Here, data are processed and stored, and interfaces and device I/Os are controlled and managed.

Operating system

Generic term which describes all functions for controlling and monitoring user program execution, distribution of system resources to the user programs and the operating mode in cooperation with the hardware (for example, Windows 7 Ultimate).

Reset

Hardware reset: Reset/restart of the PC using a button/switch.

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