

The Siemens logo is displayed in a white rectangular box in the top right corner of the image. The background of the entire image is a blurred industrial factory setting with a man in a light blue shirt looking at a tablet. Overlaid on the scene are various digital graphics: a '24/7' icon with a circular arrow, a 'NEWS' section with a person icon, a 'Home' button, and a network diagram with three nodes and binary code (0s and 1s) floating around.

White paper: Graphics cards for use with SIMATIC IPCs

SIMATIC IPCs

<https://support.industry.siemens.com/cs/ww/en/view/109823223>

Siemens
Industry
Online
Support



Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (<https://support.industry.siemens.com>) shall also apply.

Security information

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

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

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

For additional information on industrial security measures that may be implemented, please visit

<https://www.siemens.com/industrialsecurity>.

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

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under <https://www.siemens.com/cert>.

Table of contents

Legal information	2
1 Introduction	4
2 Key criteria	4
2.1 The PCI Express bus system.....	4
2.2 Form factor.....	5
2.3 Power supply.....	5
2.4 Graphics card video interfaces.....	6
3 Example: Technical specifications of the SIMATIC IPC847E	7
3.1 PCIe expansion card slots	8
3.2 Supported expansion card form factors.....	11
3.3 Power supply: Power from the power supply unit	13
4 Instructions for installing graphics cards in SIMATIC IPCs	14
5 Further information	15
6 Appendix	16
6.1 Service and support.....	16
6.2 Industry Mall.....	17
6.3 Application support.....	17
6.4 Links and literature	17
6.5 Change documentation.....	18

1 Introduction

Motivation

SIMATIC IPCs are equipped with various graphics interfaces when they leave the factory. However, there are numerous applications where installing one or more additional graphics cards makes sense.

This document provides an introduction to this topic and gives you an overview of the requirements and criteria which you can use to select the right graphics card model for your application.

Applications

Using additional graphics cards can make sense in a number of scenarios.

One such scenario is image processing in production operations. Combined with a camera, a frame grabber can take images of finished components and automatically check them for defects.

SCADA systems such as WinCC V7.x/WinCC V8 benefit when the user's display is spread across multiple monitors, up to and including entire walls of displays. In such a multi-monitor scenario, the SIMATIC IPC will require hardware support from additional dedicated graphics cards.

Structure of this document

Owing to the diversity of IPC models and graphics cards, summarizing the most relevant data and information for all devices within one document is an impossible task. Instead, this document is broken down as follows:

- Chapter 2, "[Key criteria](#)" gives you an overview of the most important characteristics of IPCs and graphics cards that must be matched against each other for a successful combination.
- Chapter 3, "[Example: Technical specifications of the SIMATIC IPC847E](#)" uses the IPC847E to demonstrate where to find the most relevant information for your IPC.

Note

Since the market is changing rapidly and new models are always coming onto the market, we cannot recommend the purchase of any specific products.

2 Key criteria

This chapter explains the most important criteria that you should pay attention to when planning to use a SIMATIC IPC + graphics card combination.

2.1 The PCI Express bus system

Overview

Among motherboard manufacturers, the "PCI Express" ("Peripheral Component Interconnect Express", or "PCIe" / "PCI-E" for short) has become the de-facto standard for connecting dedicated expansion cards such as a graphics cards. SIMATIC IPCs are no different from ordinary PCs in that they provide a number of PCIe slots.

Note

The older PCI bus system is irrelevant in today's graphics card market and will not be covered further in this document.

"Lanes"

The connections between the PCIe slot and the ultimate endpoints are implemented as point-to-point connections in the form of so-called "lanes". A slot can typically provide 1, 2, 4, 8 or 16 lanes.

Not all **physical** connections are **electrically** connected, however. In many PCIe slots, some pins have no electrical function.

There are various notations for indicating the mechanical and electrical design. The number of lanes in a slot is typically denoted with an "x" prefix, followed by a second parameter that indicates the number of electrically connected lanes. A slot with 16 physical lanes but only 4 electrical lanes may be designated as "x16 @ x4", "x16 (4 Lanes)" or "x16 (x4 mode)".

The slot for a card must have at least the same number of connections as the card, if not more. It is generally possible to install a card in a larger slot.

2.2 Form factor

Various standard formats exist for PCIe cards. Motherboards and PC cases are designed to fit cards in these formats.

Table 2-1

PCIe standard format	Maximum dimensions: Height x Length x Width
Full-Length	111.15 x 312.00 x 20.32
Half-Length	111.15 x 167.65 x 20.32
Low-Profile/Slim	68.90 x 167.65 x 20.32

Most SIMATIC Rack PCs have space to install full-length PCIe cards (see [3.2, "Supported expansion card form factors"](#) for details).

Many graphics card that need large cooling fans exceed the standard width, causing them to take up space in two neighboring PCIe slots. Therefore, when selecting your graphics card, make sure there is enough space in the PC case to install it.

2.3 Power supply

Power consumption

Graphics cards are power-intensive, and this additional power demand must be supplied by the power supply unit in the SIMATIC IPC in addition to the power required to run other components (CPU, fans, etc.). With your combination of SIMATIC IPC and graphics card, make sure that the power supply unit in the SIMATIC IPC has enough spare capacity after powering the other components when the PC is in operation.

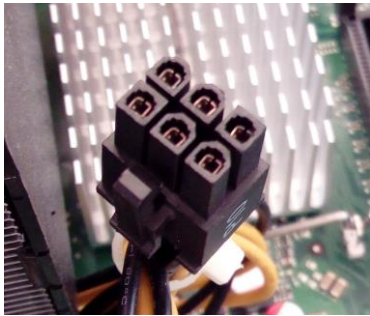
Remember that electrical power from the power supply is not the only thing that the graphics card requires. The heat generated by the graphics card must also be transported out of the case, posing additional strain on the fans. Therefore, the power supply unit must have enough spare capacity to cover the additional load from the fans.

Due to varying applications and configurations, it is not possible to make a one-size-fits-all recommendation in this respect, however.

Power supply connectors

Low-power components can draw their power directly from the PCIe slot. High-power components such as graphics cards are supplied by additional connectors from the PC's power supply unit. These connectors differ with respect to format, number of pins and power capacity.

Figure 2-1: 6-pin power supply, protective cap removed



The most common types are 6-pin and 8-pin connectors, also found in IPCs. Besides their form factor, these connectors also differ in their maximum power handling capacity. The plug-in connectors between the PCIe slot and the inserted card must match.¹

For the plug-in connectors provided by your IPC and their electrical power constraints, see the corresponding device manual (see also [3.3, "Power supply: Power from the power supply unit"](#)).

2.4 Graphics card video interfaces

Interface types

The older analog VGA system has been supplanted by various digital interfaces that connect the graphics card and the monitor. The most important ones are:

Table 2-2

Name	Maximum resolution ²	Maximum cable length ³	Note
Digital Visual Interface (DVI)	3840 × 2400 (33 Hz)	Approx. 5 m	Outdates; only video, various sub-types: Digital (DVI-D), analog (DVI-A) or even digital/analog transmission (DVI-I, "integrated")
High-Definition Multimedia Interface (HDMI)	V2.1: 3840 × 2160 (120 Hz)	Approx. 7 m	Video and audio, backwards-compatible with DVI-D and DVI-I
Display Port (DP)	V2.0: 7680 × 4320 (120 Hz)	Approx. 15 m	Video and audio, compatibility with DVI-D and DVI-D only with external passive adapters

The outputs on your graphics card must match with the monitors that you are using (see below). Use appropriate converters if applicable.

¹ It is possible to connect a 6-pin plug with an 8-pin jack. The maximum power would nevertheless be limited to the 6-pin connector's capacity.

² Depends on the version of the standard.

³ In some cases, longer cables are possible by sacrificing resolution.

Example: Ports on the "NVIDIA Professional" and GeForce graphics card lines

A typical example of high-end graphics cards are the products from the "NVIDIA Professional" line. They generally possess four Display Port or Mini Display Port interfaces.

Lower- and mid-range cards such as cards from the GeForce line also usually have four video ports, but in a mix of Display port, HDMI and DVI.

Note

This example is based on the specifications at the time of publication. More recent models on the market may have a different configuration.

3 Example: Technical specifications of the SIMATIC IPC847E

This chapter is based on the example of a SIMATIC IPC 847E and will give you an overview of the relevant specifications when using other graphics cards.

Most key data can be found in Siemens Online Support (see [11](#)), the relevant device manual or, for the IPC847E, in its device manual (see [9](#)).

Note

For links to all IPC device manuals, see reference [10](#).

The large case and high-performance power supply unit of rack PCs make these PCs ideal for installing graphics cards. However, the number of factors involved means that you should check on a case-by-base basis if your intended graphics card can in fact be used with your SIMATIC IPC for a specific application.

3.1 PCIe expansion card slots

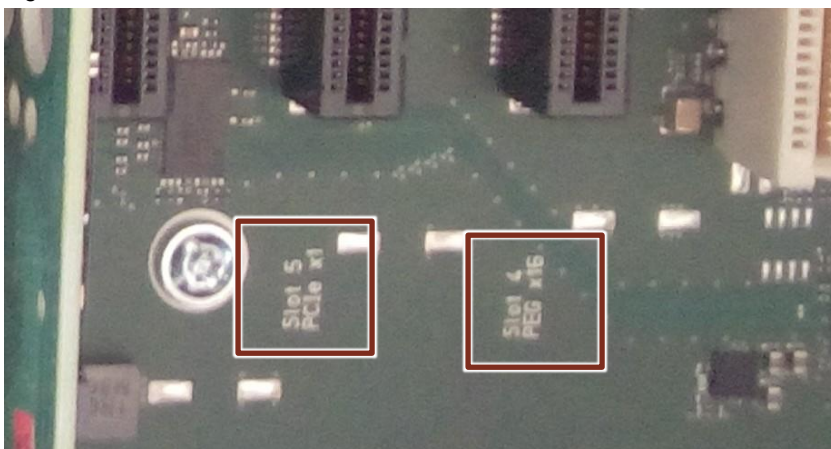
The motherboard of a SIMATIC IPC847E

Figure 3-1



Above is a view of a SIMATIC IPC847E with its case open. There are a total of 11 PCI/PCIe slots: On the left there are three PCI slots and on the right eight additional PCIe slots. Two of the PCIe slots are occupied by a card. Red boxes highlight the labels for the PCI and PCIe slots with their respective number of electrical lanes.

Figure 3-2



Detail view of a IPC847E motherboard with the labels for PCIe slots. Slot 4 has 16 lanes, while slot 5 only has one lane (counting left to right). The lanes are independent of the physical form factor.

The labels are similar in other IPCs.

PCIe slots for the SIMATIC IPC847E

The IPC847E ships with three different PCI/PCIe configurations:

Table 3-1

Total slots	Configuration
9	<ul style="list-style-type: none">• 7x PCI,• 2x PCI-Express (x16) (8 lanes)
11	<ul style="list-style-type: none">• 3x PCI,• 1x PCI-Express (x16) (8 lanes),• 5x PCI-Express (x16) (4 lanes),• 2x PCI-Express (x4) (4 lanes)
11	<ul style="list-style-type: none">• 3x PCI,• 1x PCI-Express (x16) (16 lanes),• 3x PCI-Express (x16) (4 lane),• 2x PCI-Express (x16) (1 lane),• 2x PCI-Express (x4) (4 lanes)

For details on the configuration of your bus board, see Appendix A.3, "Bus boards" or chapter 8.7, "Technical specifications of bus boards, expansion cards" in [9](#).

Figure 3-3

Hardware description

A.3 Bus board

A.3 Bus board

A.3.1 Slots for expansion cards on the bus board

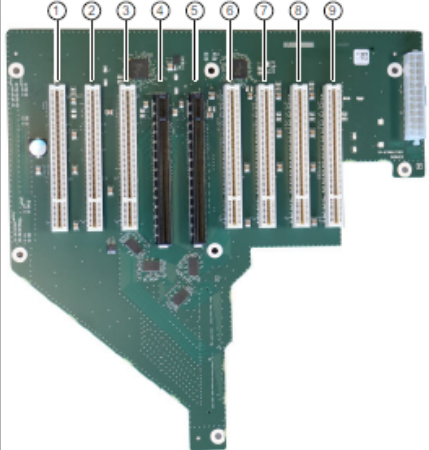
The bus board is designed as a link between the motherboard and the expansion cards. It is mounted using six screws.
Power is directly supplied to the expansion cards via the bus board connection.

NOTE

The maximum permitted power loss of the expansion cards is 80 W.

The bus board is available in three versions.

Variant 1: 9 slots

Bus board	Slot	Specification
	①	PCI
	②	• Rev. 2.3
	③	• PCI bus primary
		• Master-capable
	④	PCIe x16
	⑤	• Gen. 3
		• Active lanes: 8
	⑥	PCI
	⑦	• Rev. 2.3
⑧	• PCI bus primary	
⑨	• Master-capable	

3.2 Supported expansion card form factors

All slots in the IPC847E can accommodate full-length cards up to 312 mm in length.

For dimension drawings of the maximum possible expansion card dimensions, see chapter 9.3 of "Expansion card dimension drawing" in [5](#).

Figure 3-4

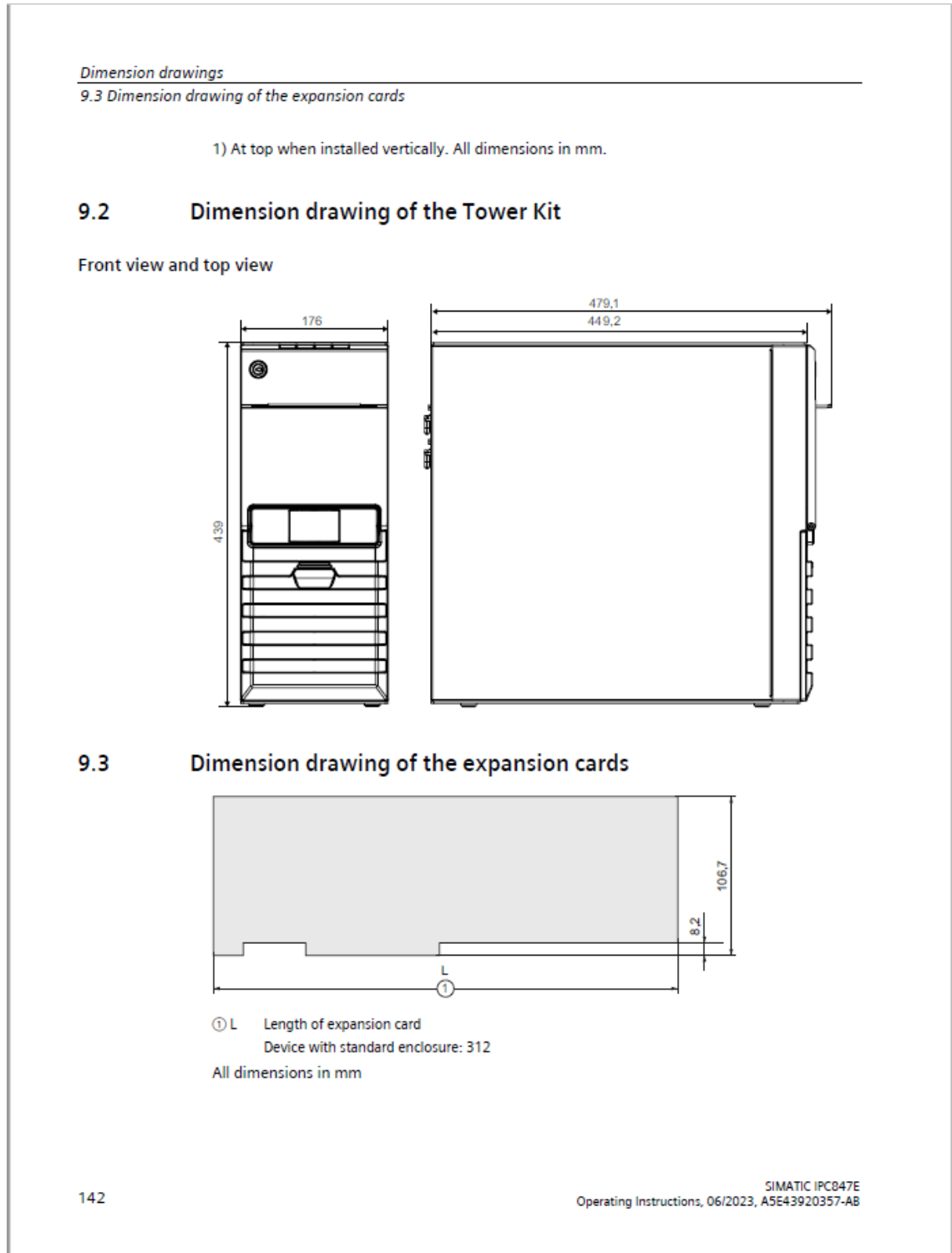
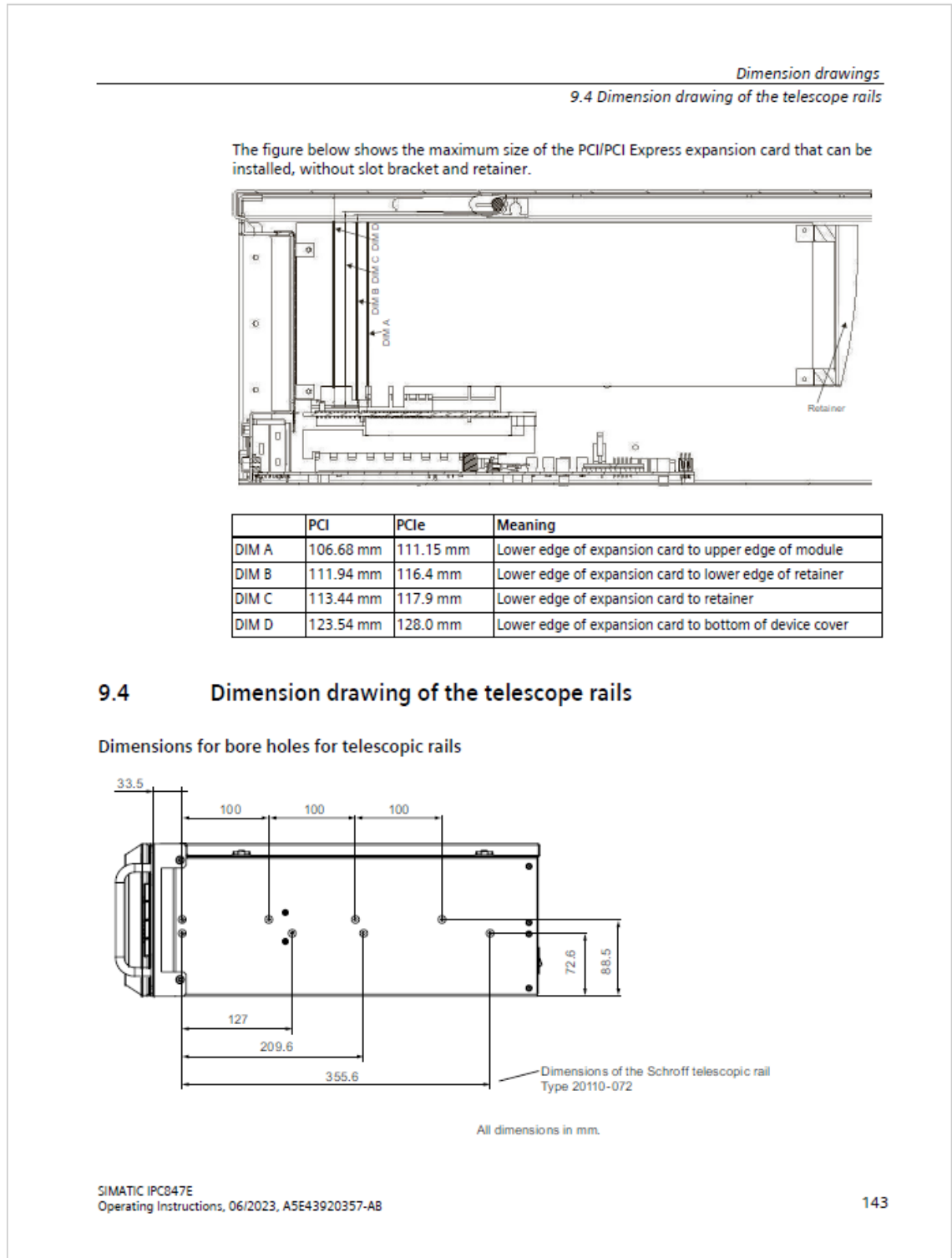


Figure 3-5



© Siemens AG 2023 All rights reserved

Note

Besides the length and height of the cards, you must also pay attention to their width. Depending on their design, graphics cards can take up the space of two expansion slots together (see [2.2](#)).

3.3 Power supply: Power from the power supply unit

For the total power available from the power supply unit of the IPC847E, see the device manual, chapter 8.3, "Current/power requirements and power supply" in [9](#).

Figure 3-6

Technical specifications
8.3 Current/power requirements and power supply

Safety regulations	<ul style="list-style-type: none"> IEC 61010-2-201 EN 61010-2-201 UL 61010-2-201 CSA C22.2 No 61010-2-201
--------------------	---

¹ Only with protected installation, see "Notes on ambient and environmental conditions" ([Page 37](#))

8.3 Current/power requirements and power supply

8.3.1 Current and power requirements of the system components

Maximum current values

Component	Voltage					
	+3.3 V	+5 V	+12 V	+12 V2	-12 V	5 V _{aux}
Motherboard Core i3 processor with cooling ¹	1.53 A	3.44 A	1.3 A	3.3 A	0 A	0.28 A
Motherboard Core i5 /i7 processor with cooling ¹	1.53 A	3.44 A	1.3 A	5 A	0 A	0.28 A
Motherboard Xeon processor with cooling ¹	1.53 A	3.44 A	1.3 A	7.5 A	0 A	0.28 A
SSD SATA (typical)		0.8 A				
Hard disk drive ¹ SATA (typical values)		0.6 A	0.3 A			
Hard disk drive ¹ SATA type Enterprise (typical values)		0.5 A	0.7 A			
M.2 NVMe SSD	2.24 A					
Internal fan			0.25 A			
Triple Head graphics card	3.3 A		1.5 A			
T400	3.1 A		1.7 A			
RTX4000	0.4 A		13.4 A			
RTXA4000	0.4 A		11.6 A			
Individual currents AC max. permissible; single power supply (400 W)	20 A ²	25 A ²	14 A	11 A	0.1 A	2.0 A ³
Individual currents AC max. permissible; single power supply (850 W)	20 A	35 A	70 A		0.3 A	3 A

¹ Depends on the selected device configuration
² 2.5 A for 10 seconds
³ In total, 200 W is the maximum permitted

SIMATIC IPC847E
Operating Instructions, 06/2023, A5E43920357-AB

129

To find how much power is already demanded by other components (CPU, fans, drives, etc.), you can derive an estimate from the values in chapter 8.3.1, "Current/power requirements and power supply" of the document in reference [9](#).

4 Instructions for installing graphics cards in SIMATIC IPCs

This chapter will provide you with guidance on installing a graphics card in a SIMATIC IPC.

Note

The following installation instructions are simply a guideline. Always consult your SIMATIC IPC's manual (for the IPC847E, chapter 6.2.2 in reference [\9\](#)) and the documentation of the graphics card.



Risk of fatal electric shock

Parts inside the SIMATIC IPC can be live with mains voltage. If handled incorrectly, these parts can deliver fatal electric shocks.

Before opening the case of the SIMATIC IPC, de-energize the SIMATIC IPC (e.g. by unplugging the power cable) and wait until any capacitors have discharged. Secure the SIMATIC IPC against inadvertent restart.

Installation sequence

CAUTION

Risk of damaging the graphics card by static discharge

Static discharge can damage or destroy components on the graphics card.

When installing the graphics card, ensure your work space is properly grounded. One way to accomplish this is with wearing an anti-static wristband or similar protective equipment.

1. Power off the PC and disconnect it from all power sources. See the warning above.
2. Open the case and locate the PCIe slots on the motherboard. If you need assistance with this, see Appendix A.3, "Bus board" or chapter 8.7, "Technical specifications of the motherboard > Expansion cards" in reference [\9\](#), or the corresponding chapter in the manual for other IPCs.
3. Remove the cover plate(s) from the backplane of the SIMATIC IPC for the slot(s) where you wish to install the graphics card.⁴
4. Remove the graphics card from its packaging.
5. Insert the graphics card into the selected slot. In the process, make sure that the slot's lanes are correctly configured (see [2.1](#)). The card must snap into the slot's connectors and rest securely. The contacts cannot be allowed to become loose later on while the IPC is running.
6. If your IPC features a bar with card retainers, follow the manual's instructions in order to use the bar and lock the expansion card in position.
7. Connect the SIMATIC IPC power supply unit with the graphics card's external power connector (see [2.3](#)).
8. Close the case and reconnect the SIMATIC IPC to the grid.
9. Start up the operating system of the SIMATIC IPC and install any drivers that may be necessary, following the graphics card manufacturer's instructions to do so.

⁴ Most graphics card models are two slots wide.

5 Further information

For more information on this topic, see the following articles in Siemens Industry Online Support:

- "Industrial image processing on SIMATIC IPCs", [\3](#)
- "Industrial PC - White papers", [\4](#)

See also the other SIOS articles linked in section [6.4](#).

6 Appendix

6.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:

support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

Please send queries to Technical Support via Web form:

siemens.com/SupportRequest

SITRAIN – Digital Industry Academy

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:

siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:

support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" APP. The app is available for iOS and Android:

support.industry.siemens.com/cs/ww/en/sc/2067

6.2 Industry Mall



The Siemens Industry Mall is the platform on which the entire Siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing process – directly and independently of time and location:

mall.industry.siemens.com

6.3 Application support

Siemens AG
 Digital Factory Division
 Factory Automation
 Production Machines
 DF FA PMA APC
 Frauenausracher Str. 80
 91056 Erlangen, Germany
 mailto: tech.team.motioncontrol@siemens.com

6.4 Links and literature

Table 6-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the article page of the application example https://support.industry.siemens.com/cs/ww/en/view/109823223
\3\	"Industrial image processing on SIMATIC IPCs", article ID 109766012, https://support.industry.siemens.com/cs/ww/en/view/109766012
\4\	"Industrial PCs - White Papers", article ID 109737064, https://support.industry.siemens.com/cs/ww/en/view/109737064
\5\	FAQ "Why does the SIMATIC IPC no longer start after installing an additional graphics card?" article ID 109738154, https://support.industry.siemens.com/cs/ww/en/view/109738154
\6\	Product information: "Industrial PC SIMATIC IPC547G - optional graphic card", article ID 109747996, https://support.industry.siemens.com/cs/ww/en/view/109747996
\7\	FAQ "How can the integrated graphics interface of a SIMATIC IPC be used together with an additional graphics card?" article ID 109744036, https://support.industry.siemens.com/cs/ww/en/view/109744036
\8\	FAQ "How many industrial flat panel monitors (IFPs) can you connect to one SIMATIC IPC?" article ID 109483774, https://support.industry.siemens.com/cs/ww/en/view/109483774
\9\	IPC847E operating instructions, article ID 109822881, https://support.industry.siemens.com/cs/ww/en/view/109822881

No.	Topic
\10\	"SIMATIC PC-based Automation" topic page: "An overview of the most important documents and links" with references to all IPC device manuals, https://support.industry.siemens.com/cs/ww/en/view/75852684/en

6.5 Change documentation

Table 6-2

Version	Date	Change
V1.0	09/2023	First edition