

PACSystems™ IPC 6010/7010/8010

HARDWARE REFERENCE MANUAL



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Warnings and Caution Notes as Used in this Publication

WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury, exist in this equipment, or may be associated with its use. In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

NOTICE

Notes and information that are not safety-related.

Note: Notes merely call attention to information that is especially significant to understanding and operating the equipment.

These instructions do not purport to cover all details or variations in the equipment, nor to provide for every possible contingency to be met during installation, operation, and maintenance. The information is supplied for informational purposes only, and Emerson makes no warranty as to the accuracy of the information included herein. Changes, modifications, and/or improvements to equipment and specifications are made periodically and these changes may or may not be reflected herein. It is understood that Emerson may make changes, modifications, or improvements to the equipment referenced herein or to the document itself at any time. This document is intended for use by trained personnel familiar with the Emerson products referenced herein.

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Section 1: Introduction

The PACSystems™ IPC 6010/7010/8010 industrial computing platform delivers a compact, rugged, mid- to high-performance solution for demanding applications such as AI, machine learning, and advanced graphics. It is designed to efficiently support HMI, historian, and analytics applications for real-time control and operation visualization.

The platform is composed of the following key components:

- A mainboard powered by 13th Generation Intel® Core™ processors
- An industrial-grade enclosure with a heat sink to ensure optimal cooling for the platform components.

This chapter outlines the features, capabilities, and compatibility of the PACSystems™ IPC 6010/7010/8010 and its components.

Figure 1: PACSystems™ IPC 6010/7010/8010



1.1 Document History

Rev	Date	Description
A	May 2025	Initial Release

1.2 Capability and Compatibility

The PACSystems™ IPC 6010/7010/8010 leverages the high performance and diverse range of standard interfaces offered by the 13th Generation Intel® Core™ Processors generation (formerly known as “Raptor Lake”), enabling a wide variety of use cases and benefits.

The power supply module of the PACSystems™ IPC 6010/7010/8010 accepts a nominal 24 VDC input ($\pm 25\%$) and includes features for under- and overvoltage supervision, along with unlimited in time protection against reverse polarity. Polarity reversion recovery is automatic and instant. No wait time, maintenance or repair needed.

The PACSystems™ IPC 6010 offers a wide range voltage input from 9 V to 30 V when no extensions are attached, and system power is limited to 75 W.

1.3 Software Requirements

- Microsoft® Windows® 10 IoT Enterprise 2021 LTSC
- (Microsoft® Windows® 11 IoT Enterprise 2024 LTSC)
- Linux® Kernel 6.8 / Ubuntu 24.04 LTS
- Linux® Kernel 6.11 / Ubuntu 24.04.2 LTS or later

1.4 Features

- PACSystems™ IPC 6010/7010/8010 module features are as follows:
 - Intel 13th Generation processors (RaptorLake)
 - i3, i5, i7 processors with 15/28/45W TDP in various configurations
 - Up to 64GB LPDDR5-6400, soldered with ECC
 - 3pin powerin connector
 - 2x DisplayPort++ HBR3 support (4 independent displays)
 - 4x serial interfaces (2x RS-232, 2x galvanic isolated RS485 [2- and 4-Wire])
 - 5x 10/100/1000/2500BASE-T Ethernet ports (based on Intels I226) with IEEE 1588 TSN features, option to enable AMT remote management functionality on one port
 - 4x USB 3.2 Gen2x1 (10Gbit/s)
 - 2x USB Type-C with TBT4 support (including USB4 and DisplayPort UHBR20)
 - 1x µSD slot (supports OS boot, hot plug)
 - 1x Fan connector (4-wire) for optional fan accessory
 - 1x Mini PCIe slot (half and full size) as option

- 1x M.2 M-Key with up to PCIe Gen4x4
- 2x M.2 E-Key with up to PCIe Gen3x1 and USB2.0
- 1x proprietary riser slot for extension capabilities
- 1x 8 Mbit SPI bus MRAM as option
- Operating at 24V DC ($\pm 25\%$), including over- and under-voltage protection
- 1x User defined LED and 1x Unlock button
- WiFi variant
 - 802.11 ac/a/b/g/n/ax
 - Bluetooth V5.3
 - Two dipole antennas

1.5 Product Family, Extension Options and Accessories

The following chapter provides an update on the PACSystems™ IPC 6010/7010/8010 product family, including details on the field upgradeable PCIe slot extensions, mounting options and available accessories.

1.5.1 PACSystems™ IPC 6010/7010/8010 Base Units

The PACSystems™ IPC ranges from the IPC 6010 which is based on the 13th Generation Intel® Core™ Processors (15 W TDP, U-Series).

Followed by the IPC 7010 which is based on the 13th Generation Intel® Core™ Processors (28 W TDP, P-Series).

The IPC 8010 is the upper end of the PACSystems™ IPC product family and is based on 13th Generation Intel® Core™ Processors (45 W TDP, H-Series).

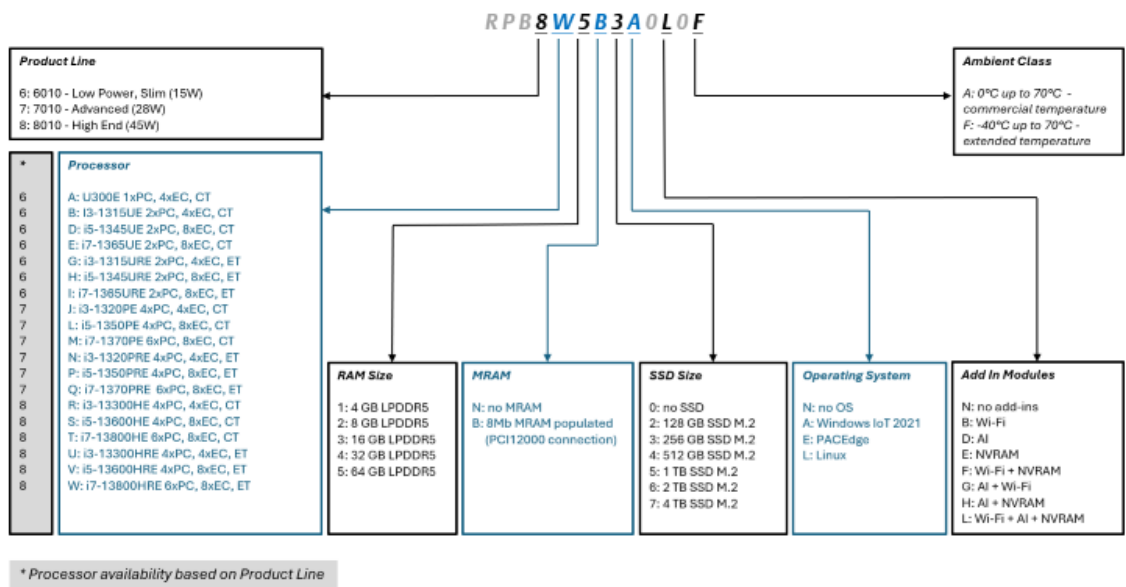
Figure 2: PACSystems™ IPC 6010/7010/8010 Base units

Product Family			
Product Line	IPC 6010	IPC 7010	IPC 8010
	Low Power, Slim	Advanced	High End
Base Unit - w/o Extension			

1.5.2 PACSystems™ IPC Configurator

The PACSystems™ IPC Configurator is listed below. Various configurations are possible based on the available options. EMERSON has established a list of part numbers which are based on demand of the marked and historical data. However, if you have a demand for a special configuration contact the sales team.

Figure 3: PACSystems™ IPC Configurator



1.5.3 Field Upgradeable PCIe Slot Extension

The PACSystems™ IPC Base Units can be ordered together with PCIe Slot Extensions, allowing the functionality of their system with either EMERSON PCIe cards or third-party PCIe cards. The PCIe Slot Extensions are field-upgradeable, offering customers the flexibility to enhance system capabilities as needed, while also future-proofing their investment. A detailed description on installing PCIe cards into the Slot Extension is available in the document YME-RPE-01-1 in its latest version or contact Emerson.

Figure 4: PACSystems™ Slot Extension

Slot Extension				
Qty PCIe Slots	1	2	3	4
				

1.5.4 PCIe Slots Availability

The PACSystems™ IPC Base units support the following number of PCIe slots.

Figure 5: PACSystems™ PCIe Slot Extension Availability

Extension Availability			
Product Line	IPC 6010	IPC 7010	IPC 8010
Base Unit - w/o Extension	YES, *	YES	YES
1 Slot Extension	YES	YES	YES
2 Slot Extension	NO	YES	YES
3 Slot Extension	NO	YES	YES
4 Slot Extension	NO	NO	YES
Power Supply: 24 V +/-25 % (standard), * 9-30 V (wide range)			

1.5.5 PCIe Slots Extension Speed and Bandwidth

The below table lists the speed and bandwidth of the PCIe slot extensions. PCIe cards must be in the formfactor “half-length”. Slot nearest to the base unit is slot 1.

Figure 6: PACSystems™ PCIe Slot Extension Speed and Bandwidth

Speed and Bandwidth				
Qty PCIe Slots	1	2	3	4
Slot 1	Gen4x4	Gen4x4	Gen4x4	Gen4x4
Slot 2	N/A	Gen3x1	Gen3x1	Gen3x1
Slot 3	N/A	N/A	Gen3x1	Gen3x1
Slot 4	N/A	N/A	N/A	Gen4x8

Section 2: Unpacking and Inspection

This chapter describes unpacking, initial inspection, and required preparation considerations before using the PACSystems™ IPC 6010/7010/8010. Perform the procedures in this chapter to verify proper operation after shipping and before system integration.

WARNING

When operating in ambient temperatures of 40 °C (104°F) and above, the surface of the enclosure, especially the heat sink, can reach a temperature of 75 °C (167 °F) and above. Be careful and do not touch with bare fingers.

2.1 Package Contents

Verify that the delivered package contains the contents listed in the following table.

Table 2-1 Delivery Volume

Item	QTY
PACSystems™ IPC 6010/7010/8010	1
Serial Connector Plug	4
24V Power-In Connector Plug	1
Quick Start Guide	1
PACSystems™ IPC 6010/7010/8010 Installation and Maintenance Requirements	1

2.2 Available Options and Accessories

The following tables list the available accessories for the PACSystems™ IPC 6010/7010/8010. For the complete list of orderable product SKUs please refer to the PACSystems™ IPC 6010/7010/8010 Datasheet.

Table 2-2 Available Accessories

Item	Description
RPE141A0A0A0F	IPC Slot Extension (1x PCIe slot)
RPE242A0A0A0F	IPC Slot Extension (2x PCIe slots)
RPE343A0A0A0F	IPC Slot Extension (3x PCIe slots)
RPE444A0A0A0F	IPC Slot Extension (4x PCIe slots)
RPF120	Fan Accessory
R2B00ACCOMP01	1pcs Panel Mounting Kit
R2B00ACCRM01	1pcs DIN Rail Mounting Kit
SVL424100	96W 24V DIN Power Supply 85-264VAC

Item	Description
SVL524100	120W 24V DIN Power Supply 85-264VAC
SVL1024100	240W 24V DIN Power Supply 85-264VAC
IC756CSW24IM	24" RXi - Industrial Monitor - Emerson Bezel Display Port In and Out, Audio Out, Widescreen
IC756CSW19IM	19" RXi - Industrial Monitor - Emerson Bezel Display Port In and Out, Audio Out, Widescreen
IC756CSW15IM	15" RXi - Industrial Monitor - Emerson Bezel Display Port In and Out, Audio Out, Widescreen

Note: For the most current information on options and accessories, contact the nearest Emerson sales or service office, or an authorized Emerson sales representative. Options are subject to change without notice.

2.3 ESD and EMI

Electrostatic Discharge (ESD) is the discharge of static electricity. Electromagnetic Interference (EMI) is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction. ESD and EMI issues may come up when installing and connecting the system to the other components. There are many ways to avoid problems with these issues.

Any operational system with cables for I/O signals, connectivity, or peripheral devices provide an entry point for ESD and EMI. If Emerson has not manufactured the complete system, including the enclosure and cables, then it is the responsibility of the system integrator and end-user to protect their system against potential problems. Filtering, optical isolation, ESD gaskets, and other measures might be required at the physical point of entry (enclosure).

Products manufactured by Emerson should normally be suitable for use in properly designed and produced customer equipment (cabinets, racks) without any major redesign. However, the systems might be subject to ESD and EMI problems once installed and interconnected with other systems. The end-user, system integrator, or installer must test for possible problems and in some cases, show compliance to local regulations as required in his country or by the intended application.

CAUTION

Static-sensitive Devices: Handle only at static-safe work stations.

CAUTION

This is an FCC Class A product intended for use in an industrial environment. In a home or residential environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

CAUTION

Drain static electricity before you install or remove any parts. Installing or removing modules without observing this precaution could result in damage to this and/or other modules or components in your system.

Wear a properly-functioning anti-static strap and make sure you are fully grounded. Any surface upon which you place the unprotected module or unit should be static-safe, which is usually facilitated by the use of anti-static mats. From the time it is removed from the anti-static bag until it is in the board carrier and functioning properly, extreme care should be taken to avoid zapping the component with ESD. Be aware that you could zap the component without knowing it; a small discharge, imperceptible to the eye and touch, can often be enough to damage electronic components. Extra caution should be taken in cold and dry weather when electrostatics easily builds up.

Only after ensuring that both you and the surrounding area are protected from ESD, carefully remove the component from the shipping carton by grasping the module on its edges. Place the component, in its anti-static bag, flat down on a suitable surface. You may then remove the component from the anti-static bag by tearing the ESD warning labels.

2.4 Unpack and Inspect

CAUTION

Before installing or removing any board or module, ensure that the system power and external supplies have been turned off.

CAUTION

DO NOT apply power to the board if it has visible damage. Doing so may cause further, possibly irreparable damage, as well as introduce a fire or shock hazard.

NOTICE

Retain all packing material in case of future need.

Before unpacking the board or module, or fitting the device into your system, read the manual carefully. Also, adhere to the following guidelines:

- Observe all precautions for electrostatic sensitive modules.
- If the product contains batteries, do not place it on conductive surfaces, anti-static plastic, or a sponge, which can cause shocks and lead to battery or board trace damage.
- Do not exceed the specified operational temperatures. Batteries and storage devices might also have temperature restrictions.
- Keep all original packaging material for future storage or warranty shipments of the board.

After unpacking the component, inspect it for visible damage that may have occurred during shipping or unpacking. Although the product is carefully packaged to protect it against the rigors of shipping, it is still possible that shipping damages may occur. A careful inspection of the shipping carton should reveal some information about how the package was handled by the shipping service.

If evidence of damage or rough handling is found (usually in the form of bent component leads or loose socketed components), notify the shipping service as soon as possible and contact Emerson for additional instructions. Depending on the severity of the damage, it may be necessary to return the product to the factory for repair.

2.5 Handling

WARNING

When operating in ambient temperatures of 40 °C (104°F) and above, the surface of the enclosure, especially the heat sink, can reach a temperature of 75 °C (167 °F) and above. Be careful and do not touch with bare fingers.

WARNING

Install the PACSystems™ IPC 6010/7010/8010 only in areas with restricted access. Equipment for use in locations where children are not likely to be present.

Section 3: Mounting

PACSystems™ IPC 6010/7010/8010 cooling is designed for wall mounted orientation of the box. There are three possible mounting options:

- DIN Rail Mounting
- Mounting Panel
- VESA Mounting

Mounting Options			
Product Line	IPC 6010	IPC 7010	IPC 8010
Base Unit - w/o Extension	DIN Rail VESA*** Panel - Mount	DIN Rail VESA*** Panel - Mount	DIN Rail VESA*** Panel - Mount
1 Slot Extension	DIN Rail* VESA*** Panel - Mount*	DIN Rail** VESA*** Panel - Mount**	DIN Rail** VESA*** Panel - Mount**
2 Slot Extension	N/A	DIN Rail** VESA*** Panel - Mount**	DIN Rail** VESA*** Panel - Mount**
3 Slot Extension	N/A	DIN Rail** VESA*** Panel - Mount**	DIN Rail** VESA*** Panel - Mount**
4 Slot Extension	N/A	N/A	DIN Rail** VESA*** Panel - Mount**
Mounting Options: VESA 100mm x 100mm (4 x M6), * reduced S&V levels, ** Qty 2 of the Mounting Kits are needed, *** Fan accessory can't be used with VESA Mounting			

3.1 DIN Rail Mounting

To mount the PACSystems™ IPC 6010/7010/8010 to a DIN Rail, the customer needs to attach the DIN Rail Clamp #R2B00ACCRM01 to the rear of the device:

1. Place the DIN Rail on the rear face of the PACSystems™ IPC 6010/7010/8010.
2. Using a TX9 Torx driver, secure the DIN Rail with the provided M3x5-A2 screws, tightening to 0.6 Nm. (Do not overtighten.)
3. Two DIN Rail Clamp kits #R2B00ACCRM01 are needed for units with extension slots.

Note: For rugged applications, use a thread-locker to ensure that screws do not loosen.

Note: For more details please refer to the DIN Rail instruction guide YME-RPB-02-1 or contact Emerson.

Figure 7: Attaching a DIN Rail to an PACSystems™ IPC 6010/7010/8010 (without an extension slot)

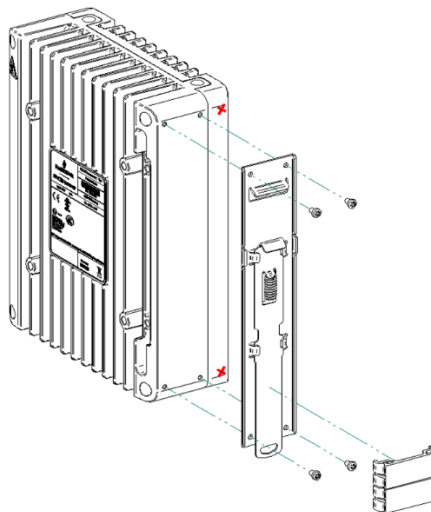
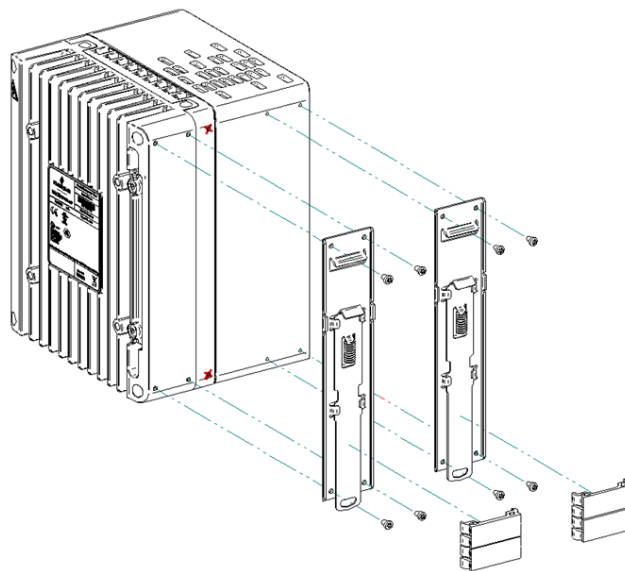


Figure 8: Attaching a DIN Rail to an PACSystems™ IPC 6010/7010/8010 with a 4 slot extension



3.2 Panel Mounting

To mount the PACSystems™ IPC 6010/7010/8010 in a panel mount configuration, the user will need to connect Mounting Panel #R2B00ACCMP01 to the rear of the IPC:

1. Place the mounting plate on the rear of the of the PACSystems™ IPC 6010/7010/8010.
2. Using a TX9 Torx driver, secure the mounting plate with the two provided M3x6 screws, tightening to 0.6 Nm. (Do not overtighten.)
3. For regular mounting, secure the mounting plate and PACSystems through the top and bottom center holes. For more rugged applications, secure the mounting plate with the four provided M3x6 screws in all four corners of the mounting panel.

Note: For rugged applications, use a thread-locker to ensure that screws do not loosen.

Note: For more details please contact Emerson or refer to the Panel mount instruction guide YME-RPB-01-1 or contact Emerson.

Figure 9: Attaching Mounting Plate PACSystems™ IPC 6010/7010/8010 without an extension slot

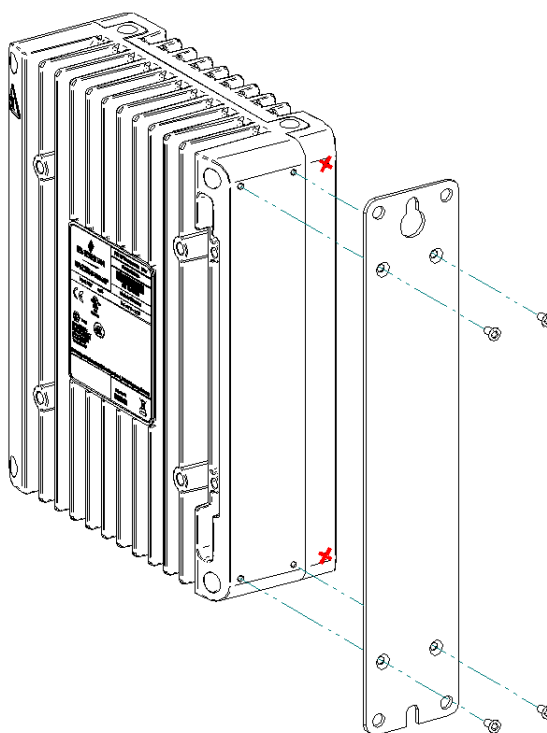
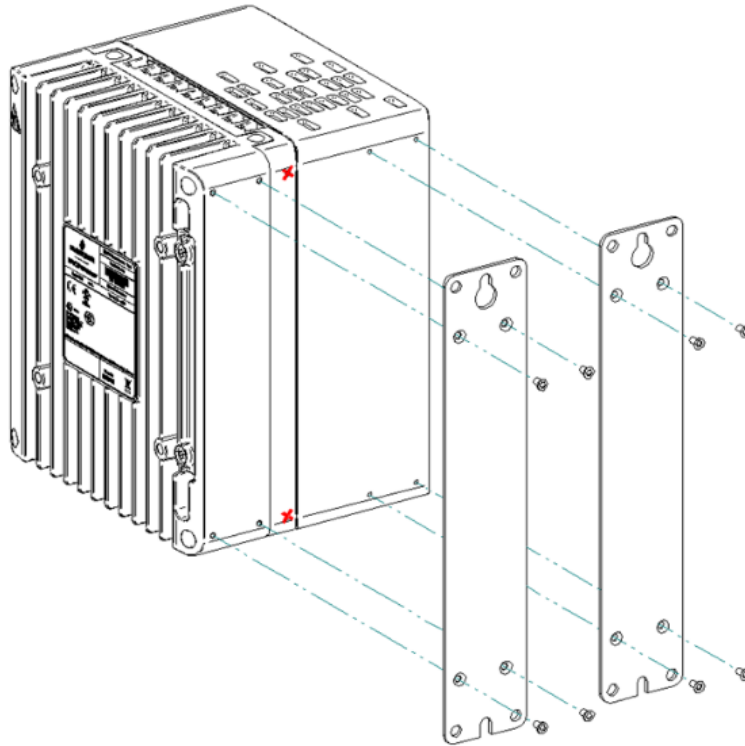


Figure 10: Attaching Mounting Plate PACSystems™ IPC 6010/7010/8010 with a 4 slot extension



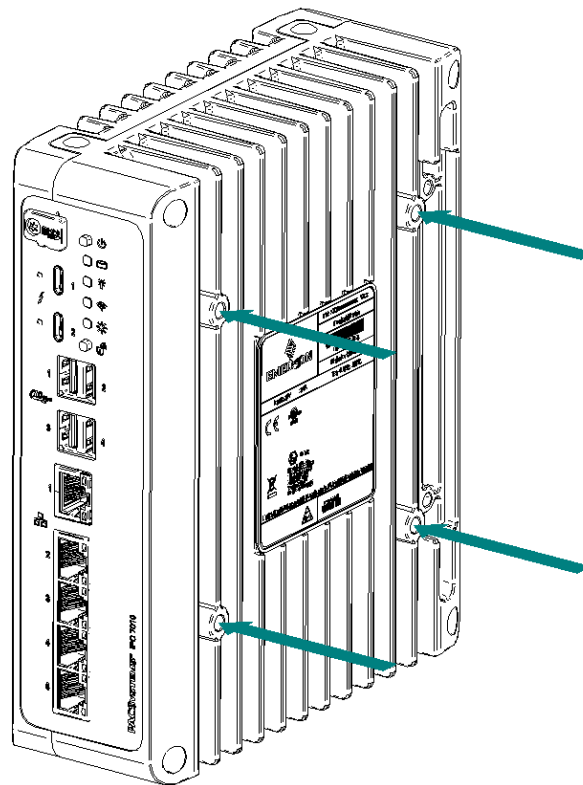
3.3 VESA Mounting

The PACSystems™ IPC 6010/7010/8010 features a 100 mm x 100 mm mounting pattern centered at the main heat sink. It includes four M6 threaded holes, each with a working thread depth of at least 7 mm.

1. Prepare the installation wall by drilling mounting holes with a 100 mm x 100 mm pattern.
2. Select M6 screws that are no longer than 7 mm to ensure they do not extend too far into the unit (consider wall thickness, and screw type when selecting the screws).

Note: For rugged applications, use a thread-locker to ensure that screws do not loosen.

Figure 11: PACSystems™ IPC 6010/7010/8010 with VESA mounting



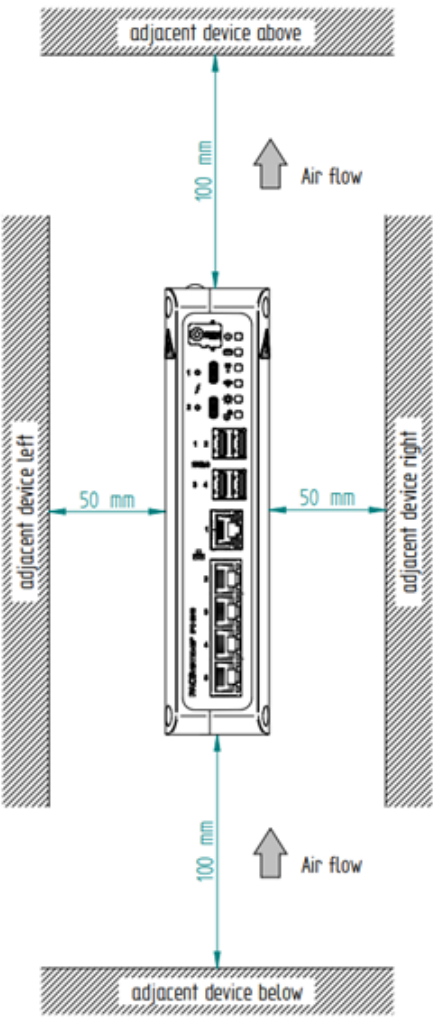
3.4 Clearance Requirements for all Mounting Options

Figure 12 shows the optimal clearances required for the PACSystems™ IPC 6010/7010/8010 devices to operate within its full thermal specifications. These clearance requirements apply to both DIN Rail and panel mount options.

Any deviation from the specified clearance may lead to reduced thermal performance and must be evaluated by the customer based on the final setup.

The same clearances also apply to the all slot extensions configurations as well as for fan configurations.

Figure 12: Minimum Clearances



Section 4: Installation and Startup

This chapter describes the installation and initial startup operations.

⚠ CAUTION

Before installing or removing any component, make sure that the system power and external supplies have been turned off.

⚠ CAUTION

Static-sensitive Devices: Handle only at static-safe work stations.

⚠ CAUTION

Drain static electricity before you install or remove any parts. Installing or removing modules without observing this precaution could result in damage to this and/or other components in your system.

4.1 General Installation Guidelines

Adhere to the following guidelines during installation:

- Observe all safety procedures to avoid damaging the system, and to protect operators and users.
- Before installing or removing any board, verify that the system power and external supplies have been turned off.
- Make sure the PACSystems™ IPC 6010/7010/8010 is properly mounted.
- Connect all I/O cables.
- Do not restore power until all components are fitted correctly into the system and all connections have been made properly.

4.2 Required Materials

The following items are required to start the PACSystems™ IPC 6010/7010/8010 in a standard configuration:

- Power supply
- Keyboard and mouse
- Monitor

4.2.1 Power Supply

⚠ CAUTION

Verify that the power supply is turned off while installing boards or modules into the PACSystems™ IPC 6010/7010/8010.

Adhere to the following guidelines:

- Verify that the power supply can meet the total power requirements of the PACSystems™ IPC 6010/7010/8010. (Refer to the Section 9: Specifications.)
- Verify that the power supply is turned OFF while opening the enclosure to install add-on boards and modules into the PACSystems™ IPC 6010/7010/8010 (such as the PCIe boards or internal SATA drives).

4.2.2 Keyboard

For the PACSystems™ IPC 6010/7010/8010, you will need a compatible USB keyboard for the initial system operation. Depending on your application, this may be a standard keyboard or one that uses membrane switches for harsh environments.

4.2.3 Video Monitor

Any video monitor with a native Display Port (or a suitable adaptor for the Display Port) or USB-C can be used for the initial setup.

4.3 Minimum System Requirements

The PACSystems™ IPC 6010/7010/8010 has been thoroughly tested and is nearly ready for usage in the target system. To verify operation for the first time, Emerson recommends that you only configure a minimal system. It is not necessary to have disk drives, a flash disk, or other accessories connected, to perform the Power-On Self-Test (POST).

4.4 Initial Startup

A few seconds after powering up, the PACSystems™ IPC 6010/7010/8010 system UEFI Firmware banner will display on the screen. If you do not see any error messages up to this point, the PACSystems™ IPC 6010/7010/8010 is running properly and ready to be configured for your application.

Note: *If the PACSystem™ IPC 6010/7010/8010 does not perform as described above, some damage may have occurred during shipment, or the board is not installed or configured properly. Contact Emerson for technical support. (Refer to the section Contact Information.)*

4.5 UEFI Firmware Setup

4.5.1 Entering UEFI Firmware Setup

To enter setup during the initial startup sequence: press the **Delete** or **F2** key during the startup sequence.

Follow the on-screen messages when prompted.

To save changes, go to **Save & Exit** page and choose **Save Changes and Exit** option.

4.5.2 Select Alternative Boot Source

To select an alternative boot device (for example, boot from USB stick), without changing settings in UEFI Firmware, please press and hold the **F7** key during the power-up sequence.

4.5.3 Setting up Boot Priority

To configure a particular boot priority, within UEFI Firmware Setup, navigate to the **Boot** page and configure **Boot Option #1** and **Boot Option #2**, as required. Go to **Save & Exit** page and choose **Save Changes and Exit** option.

4.5.4 Restoring UEFI Default Settings

When within UEFI Firmware Setup, navigate to the **Save & Exit** page, choose **Restore Defaults**, choose **Save Changes and Exit**.

4.5.5 Configuring Hibernation and Sleep States

When within UEFI Firmware Setup, navigate to the **Advanced** page, choose **ACPI Settings**, make required changes. Go to **Save & Exit** page and choose **Save Changes and Exit** option.

4.5.6 UEFI Passwords

To configure Administrator and User passwords, within UEFI Firmware Setup, navigate to **Security** page, choose **Administrator/User Password**, make required changes. Go to **Save & Exit** page and choose **Save Changes and Exit** option

4.5.7 Secure Boot Configuration

To configure Secure Boot, change/reset Keys, within UEFI Firmware Setup, navigate to the **Security** page, choose the **Secure Boot** option, make required changes. Go to **Save & Exit** page and choose **Save Changes and Exit** option.

4.5.8 Fan Configuration

Note: This section applies only if RPF is attached to the system.

Pre-OS / non-ACPI OS

The EC will control the Fan in relation to the CPU temperature when in S0 state.

The fan starts at about 60 degree Celsius and turns fully on at about 105 degree Celsius. In between, the PWM value is adjusted linearly.

In non-S0 states the Fan will be turned off.

ACPI OS

You can find all setup entries regarding the Fan Control in ACPI OS at the following path :

Advanced -> Thermal Configuration -> Platform Thermal Configuration

When an ACPI OS runs, the fan is also controlled according to the CPU temperature.

There will be two temperature margins: a higher Active Trip Point 0 and a lower Active Trip Point 1.

When the CPU temperature is below Active Trip Point 1 the Fan will be off.

When the CPU temperature is above Active Trip Point 1 but below Active Trip Point 0 the Fan PWM will be set to the PWM value given in setup as “Active Trip Point 1 Fan Speed”.

When the CPU temperature is above Active Trip Point 0 the Fan PWM will be set to the PWM value given in setup as “Active Trip Point 0 Fan Speed”.

“Active Trip Point 0” and “Active Trip Point 1” are also values from setup, with one exception:

“Active Trip Point 0” from setup is ignored as long as the current CPU has a valid value for this Trip Point. This follows the recommendation from Intel.

A typical value for “Active Trip Point 0” read from the CPU is 100 degree Celsius.

Fail Safe values

In situations where the OS is no longer able to control the Fan there is a mechanism to detect this and set fail safe values.

To support this there are two setup settings:

- CPU Temp
- CPU Fan Speed

The Embedded Controller permanently monitors the CPU temperature and Fan PWM setting. When the CPU Temperature is at or above “CPU Temp” from Setup and the current PWM value of the Fan is below “CPU Fan Speed” from Setup the EC assumes that the OS is no longer able to control the Fan.

In this case the Fan PWM value is set to “CPU Fan Speed” until the CPU Temperature goes below 40 degree Celsius.

4.5.9 RS4xx Configuration

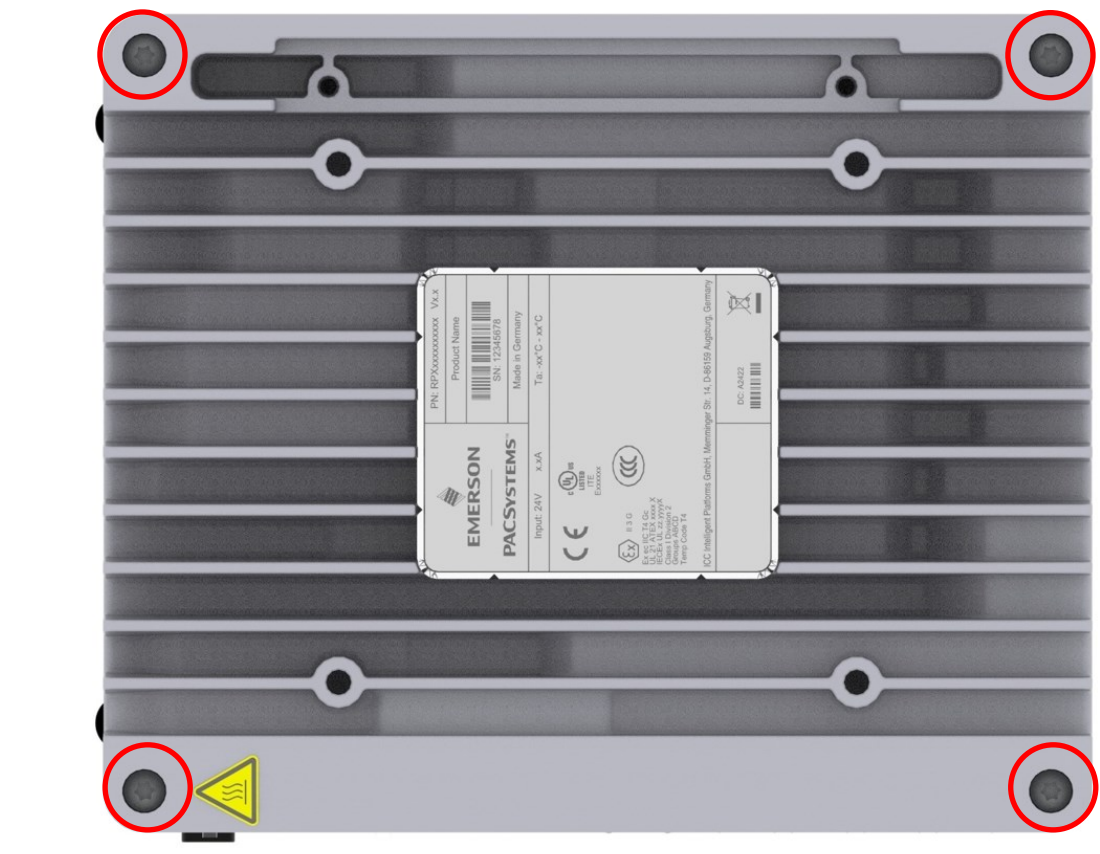
In advanced -> RS4xx Configuration both RS4xx ports can be independently adjusted to either 2- or 4-Wire mode.

Section 5: Installation and Replacement Procedures

5.1 Remove and Attach Cover

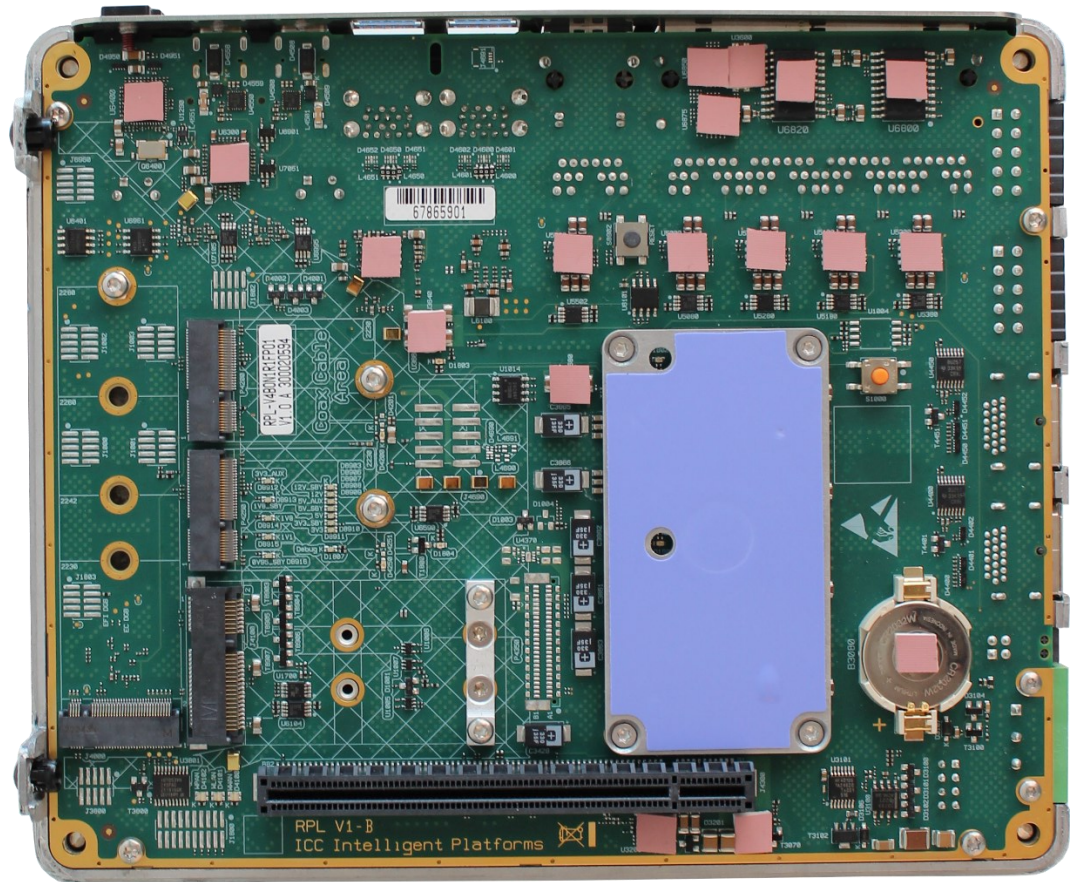
1. Shut down the system and remove power from the PACSystems™ IPC 6010/7010/8010.
2. Loosen the four screws on the PACSystems™ IPC 6010/7010/8010s heat sink side, swap the unit and carefully remove the blue cover with a straight movement (Figure 13).

Figure 13: PACSystems™ IPC 6010/7010/8010 Remove and Attach Cover



3. Please be aware that all gap pads (pink soft pads) are correctly position (Figure 14). These pads are crucial for thermal management, and play an important role in the system's longevity. The battery is equipped with a thicker gap pad.
Do not mix!

Figure 14: Position of Gap Pads



4. Once the desired maintenance or replacement task is completed, attach the cover again, double-check that the lid is correctly placed. Tighten the four screws within 1.0 Nm.

5.2 Replace the Real-Time Clock (RTC) battery

NOTICE

It is recommended to replace RTC battery every 3 years to avoid malfunction of the system. This interval is a worst case without any power applied to the system.

⚠ CAUTION

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type. Dispose of used batteries according to Emerson provided instructions and applicable local regulations.
Battery can only be exchanged by skilled person.

⚠ CAUTION

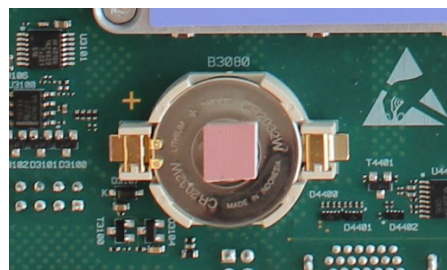
Static-sensitive Devices: Handle only at static-safe work stations.

NOTICE

The information described in this section applies to service technicians only.
Please refer to section [Battery](#) for technical details.

1. Follow instructions on how to remove the cover, see Section 5.1 *Remove and Attach Cover*.
2. Locate the RTC battery see below figure

Figure 15: RTC Battery (with pink gap pad)



3. Remove the RTC battery (including the pink gap pad) carefully from its retaining clip.
4. Remove the gap pad from the battery and put it aside

5. Install a new RTC battery in the retaining clip with the positive (+) side up and reapply the gap pad. (The gap pad establishes a thermal connection from battery to the lid. Otherwise, thermal derating might be required). Make sure the RTC battery is type BR/CR 2032 and is rated for at least 100 °C.
6. To attach cover, follow instructions in Section 5.1, Remove and Attach Cover.

⚠ CAUTION

The battery may explode if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate!



Use of a different battery type other than the same type as removed or equivalent type may present a risk of fire or explosion!

5.3 Inserting and removal of μ SD Card

1. Unscrew the μ SD card lid with TX8 screwdriver until the μ SD opening is accessible (Figure 16).
2. Turn lid to access the opening of the μ SD card slot (Figure 16).
3. Plug-in the μ SD card until you hear a click. The populated connector is a push-push type (Figure 16).
4. Re-attach the lid and tighten the screw to 0.45 Nm (Figure 16).
5. To remove the μ SD card, remove the lid first and push it carefully in the same direction as step 3, the μ SD card will pop out slightly and can then be removed.

Figure 16: Insert μ SD card



5.4 Change M.2 Mass Storage Device

NOTICE

The information described in this section applies to service technicians only.

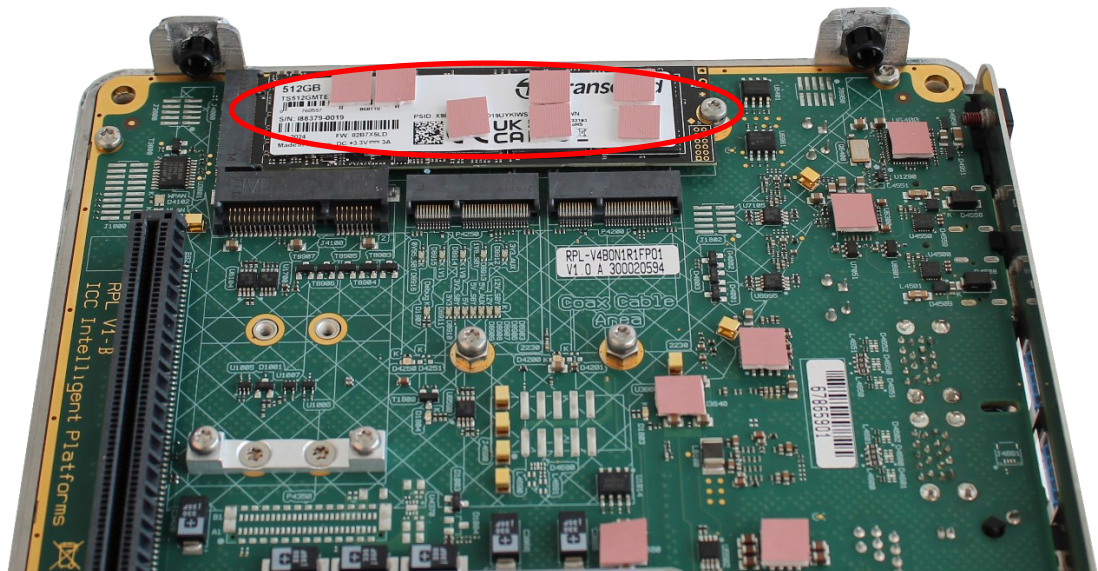
The M.2 slot provided to hold mass storage devices is located at the edge of the mainboard (J4000)(Figure 17). SSDs with 2230, 2242, 2260, and 2280 form factors and M-keying are supported. These SSDs can be replaced with others of the same form factor without any modifications. For different form factors, please contact Emerson Support for guidance on relocating the mounting nut.

CAUTION

Verify that the power supply is turned off while installing boards or modules into the PACSystems™ IPC 6010/7010/8010.

1. To remove the cover, follow instructions in Section 5.1 *Remove and Attach Cover*.
2. Locate M.2 mass storage and unscrew the TX8 screw (Figure 17).

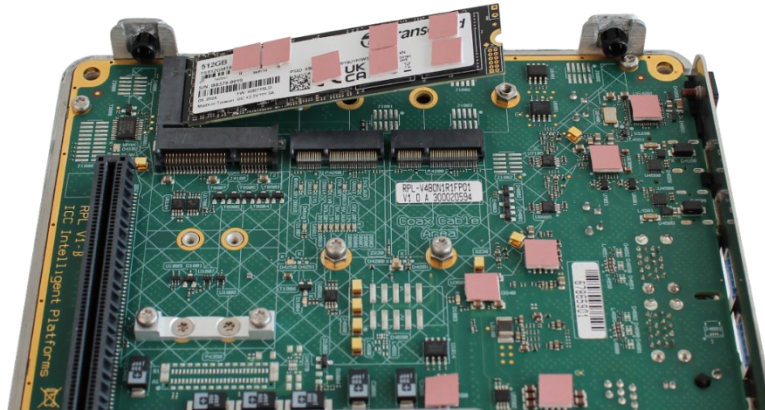
Figure 17: Populated M.2 Mass Storage



Note: Pink gap pads on the M.2 storage must be re-used.

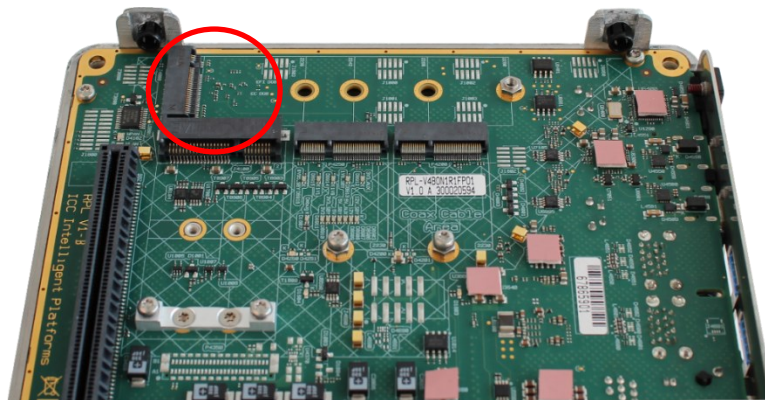
3. Remove the M.2 mass storage device
4. Remove the thermal gap pads from the M.2 mass storage device and store them for reuse on a replacement device

Figure 18: M.2 mass storage device Removal



An empty slot is now ready for new M.2 mass storage devices (Figure 19).

Figure 19: Empty Slot



4. To insert a new M.2 storage device, connect the M.2 storage device in the slot and tighten the mounting screw to 0.45 Nm

Reuse the gap pads from the previous M.2 module. Install them in the same location as shown in Figure 17. (The gap pad establishes a thermal connection from M.2 to the lid, otherwise, thermal derating may be possible).

The used gap pads are:

1,5 mm -> GPVOUS-0.060-00-0816 from Henkel cuttlet into 7 mm x 7 mm .

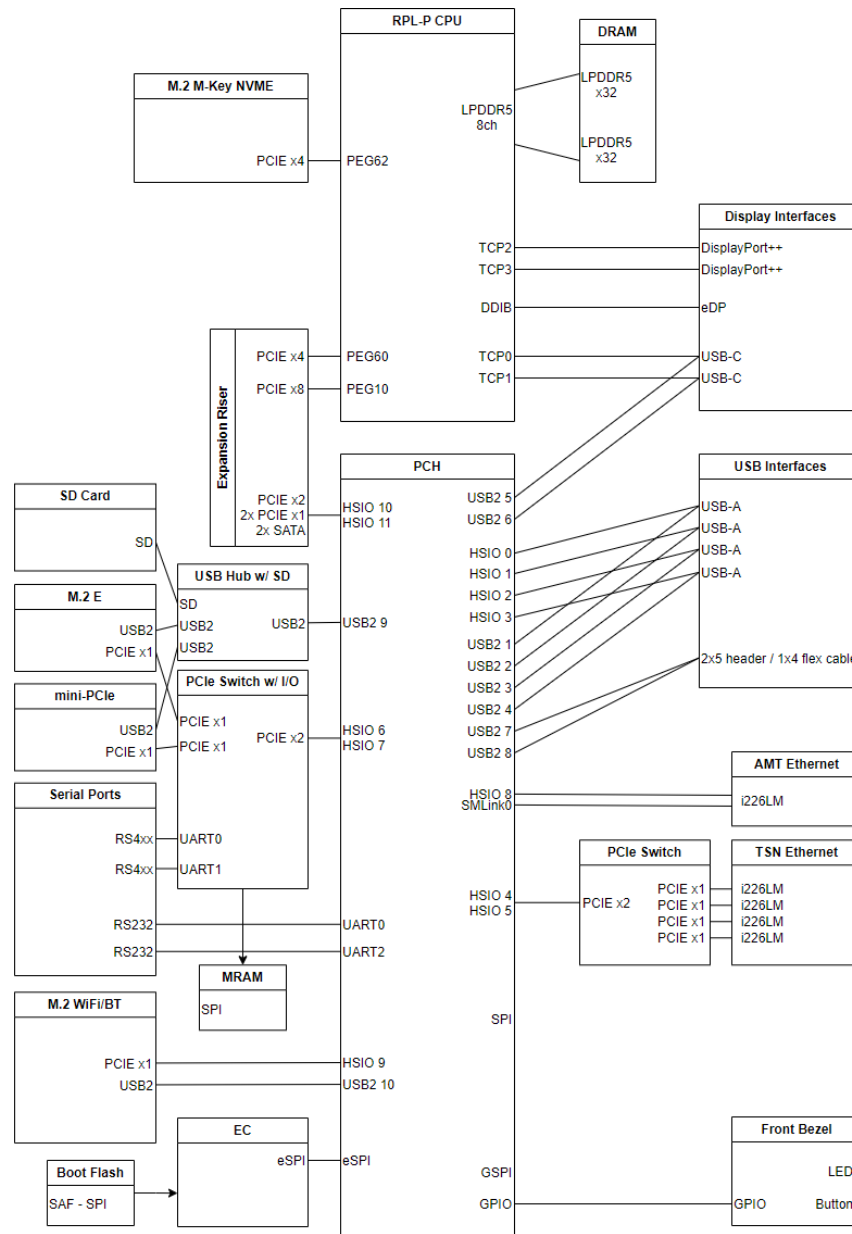
or 1,5 mm -> TCGF-1,0S5F-297x210x1,5-SST-E1 from MTC cuttlet into 7 mm x 7 mm.

5. Follow instructions in section 5.1 *Remove and Attach Cover*.

Section 6: Hardware Interfaces

This chapter describes the hardware interfaces used in the PACSystems™ IPC 6010/7010/8010. The following diagram provides an overview of the way the hardware interface is used.

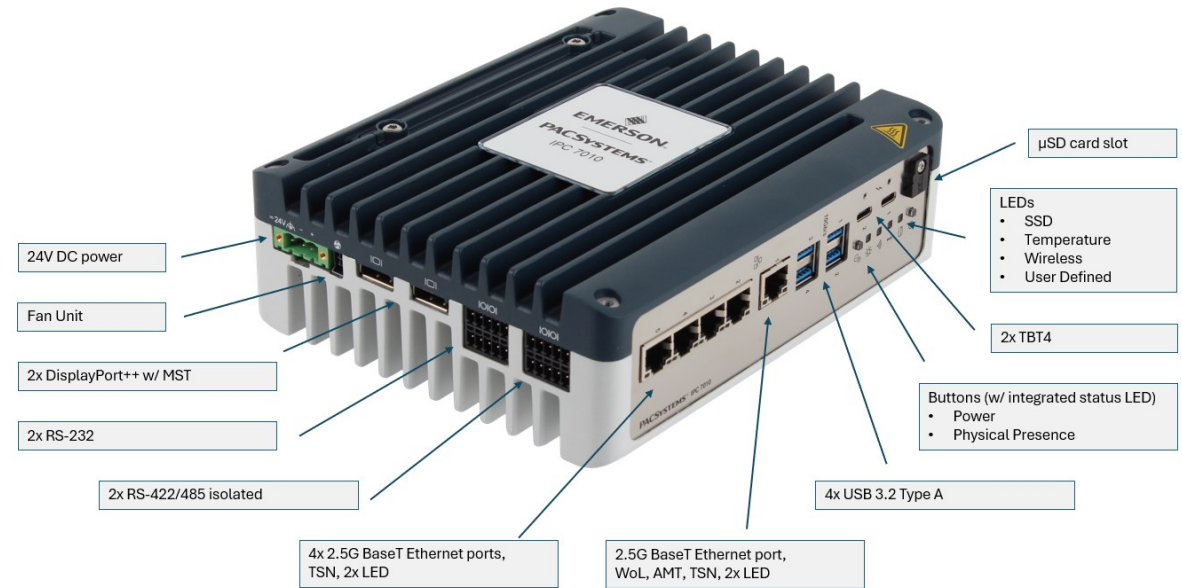
Figure 20: Overview of the Interface Usage



6.1 External Interfaces

This chapter describes the external interfaces of the PACSystems™ IPC 6010/7010/8010. The following diagram provides an overview of the location of the external interfaces.

Figure 21: Overview of the external interfaces



6.1.1 Power-In

The receptacle is from Phoenix contact with MPN: 1776702.

Corresponding plug must be a Phoenix Contact 1732975 or equivalent.

PACSystems™ IPC 6010/7010/8010 can be powered with a DC power supply with 24V (+/-25%).

For PSU dimensions, please see *Section 9.1 Power Consumption* and refer to *Section 2.2*

Available Options and Accessories.

DC-IN



Signal Name	Pin (left to right)
FGND	1
GND	2
+24V DC	3

Note: FGND is for proper EMC shielding only.

FGND and GND are hard connected.

PSU shall have PS2 output according to IEC62368-1.

6.1.2 LEDs

The PACSystems™ IPC 6010/7010/8010 provides a set of different status-LEDs on the front panel to indicate various functions.

Figure 22: LEDs

LED Name	Color	LED status indication
Power (also a button) 	Green	All power rails available and valid and system in state S0 (running)
	Yellow	Standby power valid and system in S3 (sleeping) or S4 (hibernation)
	Red	System off and system is in S5 (soft-off)
Mass storage 	Green	Storage activity (M.2, depending on installed M.2 device)
TEMP 	Green	Temperatures below T_{hot} and T_{crit} , see also chapter 9.1.2 “Temperature Monitoring and Protection”
	Yellow	Temperatures above T_{hot} and below T_{crit} If supported by OS, a graceful shutdown is initiated

LED Name	Color	LED status indication
	Red	Temperatures above T_{hot} and T_{crit} An immediate shutdown has occurred to protect the system
WiFi 	Blue	Indicates an active WiFi module. Can be either triggered from M.2 E-Key or mPCIe slot.
USER 	Green/Red	Can be controlled by user. Implementation depending on OS. See chapter 7.tbd
Unlock (also a button) 	Yellow	Unlock button is for user defined functionality. Contact Emerson for details.

6.1.3 Buttons

The PACSystems™ IPC 6010/7010/8010 provides two buttons integrated into the light pipe. One Power button and Unlock button.
See Section 6.1.2, *LEDs*.

Power Button

In a running system (Power LED is green), a short push of the power button triggers an operating system action as configured by the user. OS default typically is to shut down to state S5 (soft-off) or S4 (hibernate).

An unresponsive system can be forced into S5 by holding this button for 5 or more seconds. Note that this method does not gracefully shut down the operating system. File system and/or storage media corruption may occur.

State S5 (Soft-off mode) will switch off the CPU core power.

The state S5 is indicated with a red power LED.

At this stage, it is possible to reactivate the PACSystems™ IPC 6010/7010/8010 by pressing (short push) the Power button.

Unlock Button

Unlock button is for user defined functionality. Contact Emerson for details.

6.1.4 Ethernet Ports

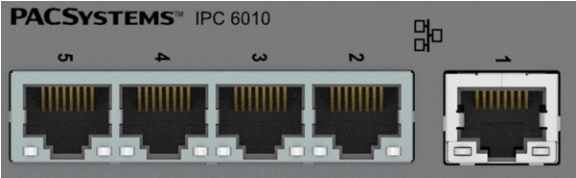
The PACSystems™ IPC 6010/7010/8010 provides five Ethernet ports at the front side. All Ethernet ports support 10/100/1000/2500 Base-T. For a proper 100/1000/2500 Mbit connection, a CAT5 cable is recommended.

The four RJ45 (labeled 2-5) ports located at the front are connected to Intel I226-IT devices.

The other RJ45 (labeled 1) port located at the front is connected to an AMT capable Intel I226 devices, this Ethernet port is also called Maintenance port.

Note: AMT is available on select CPU models only. Please see *Section 6.5, AMT capable versions* for the detailed list.

Figure 23: Ethernet Ports

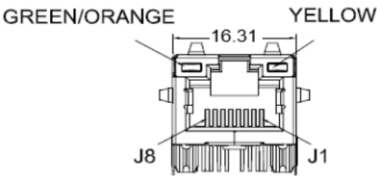


10/100 BaseT Name	1000 BaseT Name	Pin
TxD+	LP_DA+	1
TxD-	LP_DA-	2
RxD+	LP_DB+	3
NC	LP_DC+	4
NC	LP_DC-	5
RxD-	LP_DB-	6
NC	LP_DD+	7
NC	LP_DD-	8

Ethernet Ports LEDs

Same configuration for all Ethernet ports:

Figure 24: Ethernet Ports LEDs



Pin	LED color	LED status indication
12	Yellow	ACT/LINK Blink with activity, Steady on with no activity at 10/100/1000/2500
13/14	Green Orange Off Off	LINK2500 (steady on) LINK1000 (steady on) LINK100 LINK10

6.1.5 USB3.2 Gen2x1

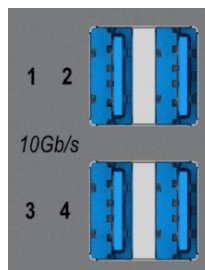
The PACSystems™ IPC 6010/7010/8010 provides four USB3.2 Gen2x1 (10Gbps) ports at the front, all four are standard USB type-A connectors.

Each ports is protected with an electrical fuse rated up to 1 A per port.

For normal operation, please do not exceed the USB standard power allowance of 900mA per port.

The current limiter circuit is shared between both ports of a pair.USB3.2 Gen2x1

Figure 25: USB3.2 Port and Pinout



Signal Name	Pin
VCC (5V_SBY)	1
USB-	2
USB+	3
GND	4
SSRX-	5
SSRX+	6
GND	7
SSTX-	8
SSTX+	9

6.1.6 USB-C

The PACSystems™ IPC 6010/7010/8010 provides two USB-C ports at the front which are also capable of running TBT4.

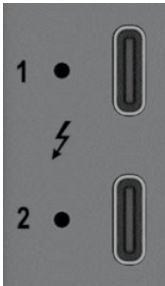
First port (labeled “1”) and second port (labeled “2”) are independently protected with an electrical fuse rated up to 3 A.

Exceeding these power limits will trigger an appropriate OS reaction by means of the USB-C power delivery protocols.

Both ports implement TBT4 at a maximum bandwidth of 40Gbps each.

DisplayPort is supported up to UHBR20 (2 x 20Gbps) on each port. A total of four monitors can be connected across DisplayPort and USB-C.

Figure 26: USB-C

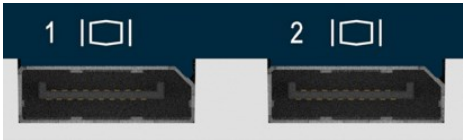


6.1.7

DisplayPort

PACSystems™ IPC 6010/7010/8010 provides two Display port interface connectors for either a suitable DP-monitor or an adaptor to various other display standards. DisplayPort++ is provided for use with DP-HDMI adapter dongles or cables. Both DisplayPorts support up to HBR3 (7680x4320 @ 60Hz). MST is supported for daisy chaining of multiple monitors. A total of four monitors can be connected across DisplayPort and USB-C.

Figure 27: DisplayPort Pinout

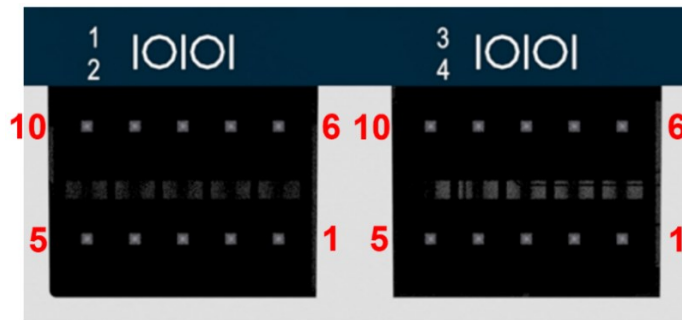


Signal Name Pin	Pin
TxD0+/-	1/3
TxD1+/-	4/6
TxD2+/-	7/9
TxD3+/-	10/12
AUXSEL	13
NC	14
CLK/AUX+	15
DAT/AUX-	17
HTPLG	18
DP_VCC	20
GND	2, 5, 8, 11, 16, 19

6.1.8 Serial Ports

The PACSystems™ IPC 6010/7010/8010 provides two serial interfaces ports with two ports each. Two configured to RS232 (P1 and P2) and two configurable RS485 [2-wire and 4-wire modes supported] (P3 and P4). The connector is a Phoenix Contact “1953745” or equivalent and mates with Phoenix Contact “1952296.” Four mating plugs are shipped with the system.

Figure 28: Serial Ports



Signal Name Pin RS232 (left connector, next to Displayport)	Pin
TX	1 / 6
RTS	2 / 7
GND	3 / 8
CTS	4 / 9
RX	5 / 10
Signal Name Pin RS4xx (right connector)	Pin
RX+	1 / 6
RX-	2 / 7
GND	3 / 8
TX-	4 / 9
TX+	5 / 10

For RS–485-4-wire modes, connect the corresponding RX+/- signals with the TX+/- signals and vice versa on the remote device.

For RS–485 2-wire mode connect RX+ and TX+ to the + line of the cable and the RX- and the TX- to the – line of the cable.

The difference between the various RS–485 modes is the TX/RX signal control. In RS-485 4-wire mode, TX is only active when there is something to transmit, RX is always active. In RS-485 2-wire mode, TX and RX are active when transmitting and inactive when not transmitting.

The various modes can be selected via the Operating System device driver. Please refer also to [RS4xx Configuration](#) for UEFI based configuration.

The PACSystems™ IPC 6010/7010/8010 system does not provide any termination resistors. If required, the termination can be attached to the plug directly.

6.1.9 μSD Slot

The PACSystems™ IPC 6010/7010/8010 provides a μSD card slot with a mechanical lock.

The following types of μSD cards are supported:

Type SDHC and SDXC

High Speed mode of operation – 3.3 V card supply voltage, 25 MB/s gross bandwidth

Figure 29: μSD Slot



Signal Name	Pin
DATA2	1
DATA3	2
CMD	3
VDD	4
CLK	5
GND	6
DATA0	7
DATA1	8
DC	9

6.1.10 Cable requirements

Ensure that your system and peripherals connection comply with the list below to ensure EMC compatibility.

Port Name	Port Type	Max. cable length	Cable must be shielded?
24VDC	DC Power Input	≤3m	No
Fan	DC IO Field Power	≤3m	No
DisplayPort	Communication	≤3m	Yes
USB-C	Communication	≤3m	Yes
USB-A	Communication	≤3m	Yes
COM1&2 (RS232)	Communication	≤30m	Yes
COM3&4 (RS4xx)	Communication	>30m	Yes
ETH1-5	Communication	>30m	Yes

6.2 Internal Interfaces

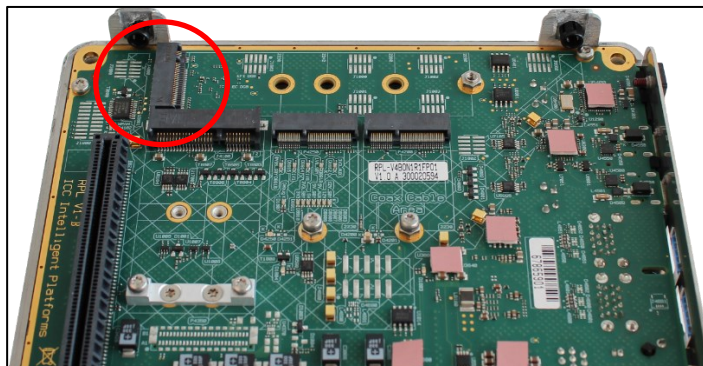
6.2.1 M.2 M-Key (NVMe)

A mass storage M.2 type M-connector (as per M.2 specification V4.0 R1.0) is located under the system lid to accommodate devices with the NVMe interface; SATA modules (B-Key) are not supported.

Form factors 2230, 2042, 2060 and 2080 are supported and 2080 is the default. If you require to change from form factor 2080 to any other please refer to chapter 5.4 for guidance.

The pinout is specified in the M.2 standard and is not listed in this document.

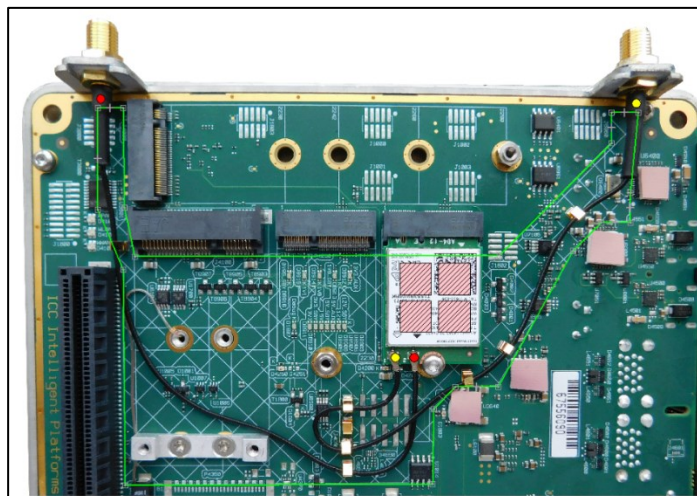
Figure 30: M.2 M-Key (NVMe)



6.2.2 M.2 E-Key (WiFi)

The below image shows the installed WiFi Module and antenna. Please check order code for Wifi option.

Figure 31: M.2 E-Key (WiFi)

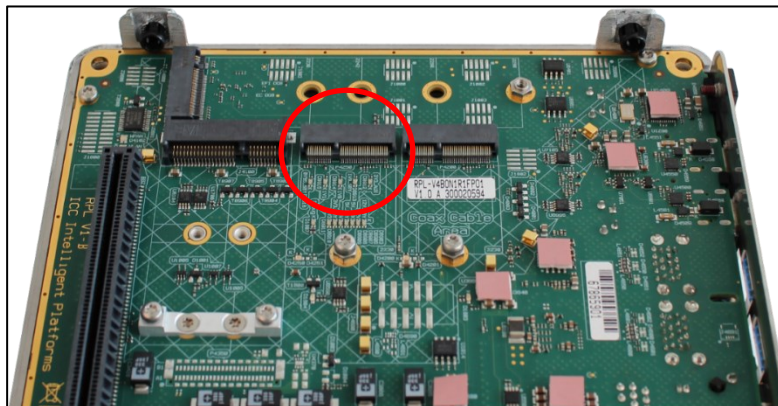


Note: To ensure correct thermal behavior of WiFi Module it is recommended to use at least Linux® Kernel 6.11.

6.2.4 M.2 E-Key

The below image shows the M.2 E-Key location.

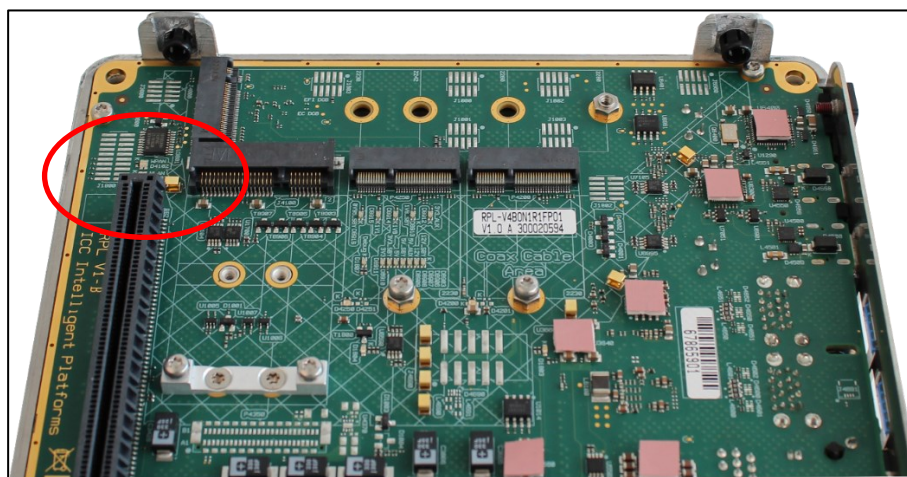
Figure 32: M.2 E-Key



6.2.5 mPCIe (generic)

The below image shows the mPCIe location.

Figure 33: mPCIe (generic)



6.4 Internal Devices

6.4.1 MRAM

The PACSystems™ IPC 6010/7010/8010 is capable of Non-Volatile Random Access Memory (MRAM) with 8 Mbit.

MRAM is an optional orderable feature.

MRAM is connected to Microchip's PCI12000 SPI host controller which runs at maximum of 31.25MHz.

For proper software driver support at least kernel 6.8 is recommended. To obtain future updates and bug fixes install the latest stable mainline kernel.

MRAM can be accessed via sysfs interface using generic nvmem support:

```
/sys/bus/nvmem/devices/<EMR_MRAM_DEVICE>/nvmem
```

6.4.2 Temperature Sensors

UEFI Firmware sets up one thermal zones on the PACSystems™ IPC 6010/7010/8010 board based on three distributed NTCs. All three thermal sensors are distributed in a way that in every of the mounting options, always the hottest point can be observed.

All three thermal sensors are grouped into one ACPI object and only the hottest one is shown within the ACPI object.

6.5 AMT capable versions

<i>Processor overview & AMT capability</i>						
Processor	Performance-cores	Performance-core Max Turbo Frequency	Efficient-cores	Efficient-core Max Turbo Frequency	Thermal Design Power	vPro Enterprise
A: U300E	1	4.30 GHz	4	3.20 GHz	15 W	w/o
B: i3-1315UE	2	4.50 GHz	4	3.30 GHz	15 W	w/o
D: i5-1345UE	2	4.60 GHz	8	3.40 GHz	15 W	with
E: i7-1365UE	2	4.90 GHz	8	3.70 GHz	15 W	with
G: i3-1315URE	2	4.50 GHz	4	3.30 GHz	15 W	w/o
H: i5-1345URE	2	4.60 GHz	8	3.40 GHz	15 W	with
I: i7-1365URE	2	4.90 GHz	8	3.70 GHz	15 W	with
J: i3-1320PE	4	4.50 GHz	4	3.30 GHz	28 W	w/o
L: i5-1350PE	4	4.60 GHz	8	3.40 GHz	28 W	with
M: i7-1370PE	6	4.80 GHz	8	3.70 GHz	28 W	with
N: i3-1320PRE	4	4.50 GHz	4	3.30 GHz	28 W	w/o
P: i5-1350PRE	4	4.60 GHz	8	3.40 GHz	28 W	with
Q: i7-1370PRE	6	4.80 GHz	8	3.70 GHz	28 W	with
R: i3-13300HE	4	4.60 GHz	4	3.40 GHz	45 W	w/o
S: i5-13600HE	4	4.80 GHz	8	3.60 GHz	45 W	with
T: i7-13800HE	6	5.00 GHz	8	4.00 GHz	45 W	with
U: i3-13300HRE	4	4.60 GHz	4	3.40 GHz	45 W	w/o
V: i5-13600HRE	4	4.80 GHz	8	3.60 GHz	45 W	with
W: i7-13800HRE	6	5.00 GHz	8	4.00 GHz	45 W	with

Section 7: System Device Mapping

7.1 PCI Routing

```

-[0000:00]--+00.0 Intel Corporation Raptor Lake-P/U 4p+8e cores Host Bridge/DRAM Controller
    +-02.0 Intel Corporation Raptor Lake-P [UHD Graphics]
    +-05.0 Intel Corporation Device a75d
    +-06.0-[01]--
    +-06.2-[02]--
    +-07.0-[03-2c]--
    +-07.1-[2d-56]--
    +-08.0 Intel Corporation GNA Scoring Accelerator module
    +-0a.0 Intel Corporation Raptor Lake Crashlog and Telemetry
    +-0d.0 Intel Corporation Raptor Lake-P Thunderbolt 4 USB Controller
    +-0d.2 Intel Corporation Raptor Lake-P Thunderbolt 4 NHI #0
    +-0d.3 Intel Corporation Raptor Lake-P Thunderbolt 4 NHI #1
    +-10.0 Intel Corporation Alder Lake-P Serial IO I2C Controller #2
    +-14.0 Intel Corporation Alder Lake PCH USB 3.2 xHCI Host Controller
    +-14.2 Intel Corporation Alder Lake PCH Shared SRAM
    +-15.0 Intel Corporation Alder Lake PCH Serial IO I2C Controller #0
    +-15.1 Intel Corporation Alder Lake PCH Serial IO I2C Controller #1
    +-16.0 Intel Corporation Alder Lake PCH HECI Controller
    +-16.3 Intel Corporation Alder Lake AMT SOL Redirection
    +-19.0 Intel Corporation Alder Lake-P Serial IO I2C Controller #0
    +-19.2 Intel Corporation Device 51c7
    +-1c.0-[57-5c]----00.0-[58-5c]--+04.0-[59]----00.0 Intel Corporation Ethernet Controller I226-
IT      |
IT      |          +-05.0-[5a]----00.0 Intel Corporation Ethernet Controller I226-
IT      |
IT      |          +-06.0-[5b]----00.0 Intel Corporation Ethernet Controller I226-
IT      |
IT      |          \-07.0-[5c]----00.0 Intel Corporation Ethernet Controller I226-
IT      |
    +-1c.6-[5d-61]----00.0-[5e-61]--+01.0-[5f]--
    |          +-02.0-[60]--
    |          \-04.0-[61]--+00.0 Microchip Technology / SMSC Device
a002    |
    |          +-00.1 Microchip Technology / SMSC Device
a003    |
    |          +-00.2 Microchip Technology / SMSC Device
a004    |
    |          \-00.3 Microchip Technology / SMSC Device
a005@
    +-1d.0-[62]----00.0 Intel Corporation Ethernet Controller I226-IT
    +-1d.1-[63]--

```

+1d.2-[64]--
+1d.3-[65]--
+1e.0 Intel Corporation Alder Lake PCH UART #0
+1e.2 Intel Corporation Alder Lake SPI Controller
+1f.0 Intel Corporation Raptor Lake LPC/eSPI Controller
+1f.3 Intel Corporation Raptor Lake-P/U/H cAVS
+1f.4 Intel Corporation Alder Lake PCH-P SMBus Host Controller
+1f.5 Intel Corporation Alder Lake-P PCH SPI Controller

Note : This routing is only an example of one particular system and bus numbers >0 are likely to change.

7.2 Internal connections:

7.2.1 SoC

- 0:1.0 [PEG10] is connected to Riser Slot 4 via expansion slot [t G4x8] [not visible in example device tree]
- 0:6.0 [PEG60] is connected to Riser Slot 1 via expansion slot [PCIe G4x4]
- 0:6.2 [PEG62] is connected to internal M.2 M-Key [PCIe G4x4]
- 0:1d.0 [HSIO08] is connected LAN1 [PCIe G2x1]
- 0:1d.1 [HSIO09] is connected to M.2 E-Key (P4200) usually used with Intel AX210 (Typhoon Peak) [PCIe G3x1]
- 0:1d.2 [HSIO10] is connected to Riser Slot 2 via expansion slot [PCIe G3x1]
- 0:1d.3 [HSIO11] is connected to Riser Slot 3 via expansion slot [PCIe G3x1]
- PCH offers 2x RS232, labeled “1” and “2”, see [Serial Ports](#)

7.2.3 PCI12000

- 61:01.0 is Downstream P1 [5f] to mPCIe (J4100) [PCIe G3x1]
- 61:02.0 is Downstream P2 [60] to M.2 E-Key (P4250) [PCIe G3x1]
- PCI12000 offers 2xRS4xx, labeled “3” and “4”, see [Serial Ports](#)

7.2.4 3G606

- 0.1c.0 is connected to Upstream Port of 3G606
 - Four downstream ports [59, 5A, 5B, 5C] of 3G606 are connected to LAN2, 3, 4, 5

7.3 ACPI table

Device	ACPI-Device	_HID	_UID
User LED	_SB.GPIO.ULED	EMR1011	1
MRAM	_SB.PC00.RP07.MC UP. MCD4.MCSP.MCMR	EMR1010	NVR1
RS232 PCH UART 0	_SB.PC00.UA00	INT3511	UA00
RS232 PCH UART 2	_SB.PC00.UA02	INT3512	UA02
Unlock Button	tbd	tbd	tbd

7.4 SMBUS Devices (controlled by SoC)

Device	Address [7b format]	Function
MCP98244 #1	54h	SPD #1 (EEPROM)
MCP98244 #2	55h	SPD #2 (EEPROM)

7.5 SMBUS Devices (controlled by EC)

Device	Address [7b format]	Function
PI6CB33602Z	6Bh	Clock Buffer 4x (on motherboard)
PI6CB33602Z	6Dh	Clock Buffer 4x (on Riser)
3G606	6Fh	PCIe Switch
MP2964R	26h	Core/GT DCDC
PD Controller	20/24h	USBC PD Controller

7.6 I2C Devices (controlled by SoC)

Device	Address [7b format]	Function
Module EEPROM	50h	Factorydata

7.7 I2C Devices at extensions (controlled by EC)

Device	Address [7b format]	Function
Module EEPROM	0x52	Factorydata of Slotextension
Port Expander	0x22	Get PRSNT statuses of slots
PCIe Gen5 CLKBuf	0x6D	CLKBuf for slot 1 and 4, applies only for 4-slot extension

7.8 Ethernet (Intel I226-IT)

The Ethernet controllers provide an iNVM, which contains the MAC address, as well as their configuration. This content is not accessible to the user.

7.9 PCIe Switch (Diodes PI7C9X3G606GP)

The PCIe switch has a dedicated EEPROM connected for configuration and is not accessible to the user.

7.10 Multi I/O with PCIe Switch (Microchip PCI12000)

The Multi I/O controller (in this system, configured to 2x serial, 1x SPI) has a dedicated EEPROM connected for configuration and is not accessible to the user.

7.11 PD Controller (Texas Instruments TPS65994AD)

The USB PD Controller has its own dedicated EEPROM and is not accessible to the user.

7.12 VCCCORE/VCCGT DCDC (MPS MP2964R)

The Core DCDC has its own internal NVM area and is adjusted in manufacturing and is not available to the user.

7.13 TBT4 ReTimer (Intel JH9040R)

TBT4 ReTimer utilize one shared SPI Flash to store their configuration and is updateable via EFI capsule update.

Section 8: Thermal Performance

Thermal design with modern x86 processor architecture is a complex topic with many variables that contribute to the final performance:

- CPU Maximum frequency (user configurable)
- CPU Boost mode (Turbo mode) (user configurable)
- Software application and the worst-case workload it creates for the CPU
- Peripherals being used (display, USB devices, number of active Ethernet ports)
- PACSystems mounting, orientation and clearances
- Ambient air temperature and how static the air is (airflow)

8.1 x86 Processor Thermal Design Features

8.1.1 Dynamic CPU Frequency and Boost Modes

Modern x86 architectures made a significant improvement in increasing computing performance while reducing power and heat dissipation at the same time. In a typical application, CPU activity varies and highly depends on memory, storage, and other I/O devices. When CPU needs data for the computation, it attempts to process it as quickly as possible and then, while waiting for the next set of data, goes to a low frequency, low power mode. Following this strategy, modern CPUs can transition to a very high CPU frequency (high power), but only for a limited time, and will then need to slow down and wait for more data. Such bursts of CPU activity come at a relatively high rate (milliseconds/microseconds). This strategy allows an increase in observable performance, while simultaneously averaging out to a lower heat dissipation. PACSystems™ IPC 6010/7010/8010 processor that it uses supports these techniques, and they are enabled in UEFI settings by default. It is highly recommended to keep these settings enabled so that performance and thermal advantages of the architecture can be utilized.

8.1.2 CPU Throttling

One other important aspect of modern x86 architecture is the CPU's ability to protect itself from thermal events. This is called CPU throttling and results in the CPU reducing its operating frequency when it reaches its maximum temperature. This throttling effect occurs automatically, and at the first glance might not be obvious to the user. Application performance, however, will be significantly reduced in this case and might lead to a variation in performance test results. To avoid performance loss due to CPU throttling, it is recommended to ensure that the CPU temperature is significantly lower than its maximum value in the worst-case ambient air environment. PACSystems™ IPC 6010/7010/8010 is designed specifically to optimize heat transfer from the CPU die to the external heatsink, and in most cases will not be a factor in limiting Industrial PC performance.

8.1.3 Temperature Monitoring and Protection

The PACSystems™ IPC 6010/7010/8010 is equipped with thermal monitoring capabilities to protect itself from overtemperature conditions. It includes multiple thermal zones:

- TZ00: CPU Thermal Zone
- TZBE: Circuit board edge thermal zone
- TZE1 and TZE2: Static thermal zones for peripheral circuitry
- TZCP and TZD1: Thermal zone for CPU circuitry

Thermal monitoring is supported both on the module and carrier levels. When running under an ACPI-aware operating system, the system implements enhanced thermal management. In contrast, non-ACPI-aware systems depend solely on internal hardware protection and must be assessed individually.

If the system temperature exceeds the T_{HOT} threshold, it will attempt a graceful shutdown into S4 sleep state, depending on the OS configuration.

Note: The T_{HOT} threshold is *not* implemented in the CPU Thermal Zone.

For the CPU Thermal Zone, Tactive thresholds are defined to activate an optional fan. For more details, please see *Section 4.5.8, Fan Configuration*.

The system's thermal status is continuously indicated by the THRM LED. In case of an overtemperature shutdown, the last LED state remains visible, even in S4 or S5 states.

Once the T_{CRIT} threshold is exceeded, the system will try to shut down within 500ms into S5.

Note: The "Active" Thermal Zone is optional and only implemented in CPU zones. It is not available in fanless PACSystems™ IPC 6010/7010/8010 configurations. If the system is rebooting while the overtemperature situation is still present, the system will be shut down again after handing over to the operating system.

However, this behavior depends on the operating system configuration. Overtemperature conditions may result in unbootable SSDs or other data loss. Therefore, it is strongly recommended to resolve any thermal issues before rebooting the system. For further assistance, please contact Emerson Support.

8.2 Thermal Design Strategy

Having many parameters that influence the thermal performance of an PACSystems™ IPC 6010/7010/8010 makes it difficult to perform thermal design by simply analyzing thermal test data and specifications.

The recommended way to assess thermal performance is to test the real software application, or a good approximation of it, in an environment that would be the worst-case for the real use scenario. This typically means static air, no airflow at all.

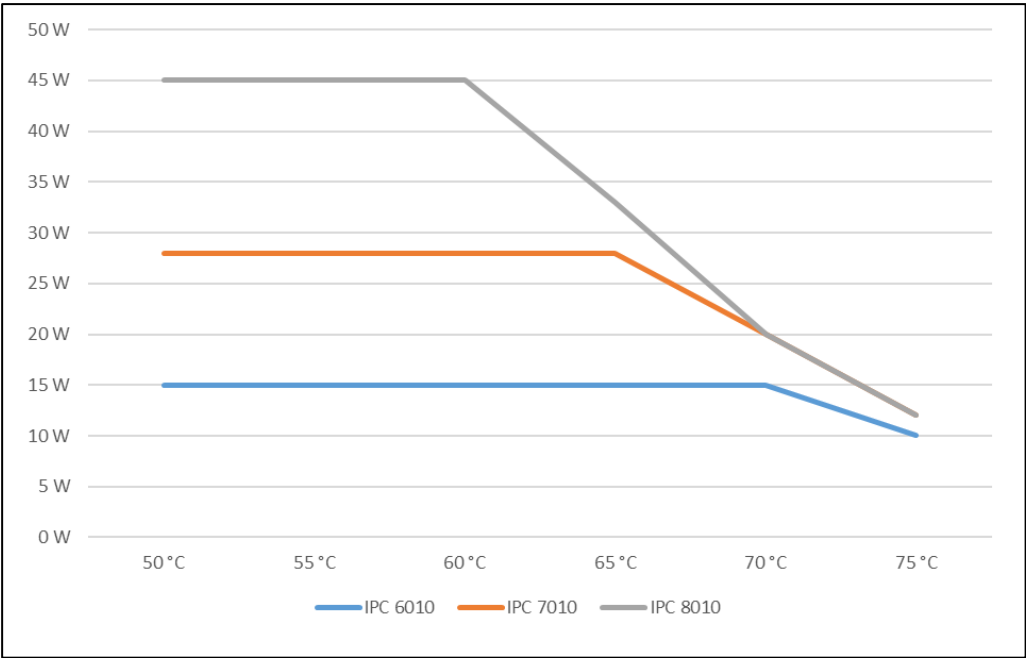
Note that typical thermal test chambers have a significant internal airflow, which results in higher thermal performance levels than those observed in real installations.

8.2.1 Thermal Guidance

The following thermal guidance applies to PACSystems™ IPC 6010/7010/8010 and is based on zero airflow conditions. Even minimal airflow can significantly extend the system’s allowable operating temperature range.

The graph below illustrates the available CPU power at the maximum ambient temperature range, assuming a CPU-centric workload on the the IPC 6010, 7010 and 8010 models without slot extension, and using standard I/O (USB, DisplayPort).

Figure 34: Performance at CPU centric workload at upper ambient air Temperature



Section 9: Specifications

This chapter provides specifications and other useful information about PACSystems™ IPC 6010/7010/8010.

The PACSystems™ IPC 6010/7010/8010 must be connected from PowerIn port. See *Section 0*,

Power-In to ensure proper EMC protection.

9.1 Power Consumption

⚠ WARNING

The PACSystems™ IPC 6010/7010/8010 industrial PC power supply must meet the requirements for SELV (safety extra-low voltage)/LPS (limited power source) or ES1/PS2. Refer to chapter 2.2 for recommended power supplies.

The max. current consumption can vary, depending on the product line, load, input voltage, and temperature. Please consult below table to select a proper power supply.

Note:

When operating the IPC 6010 with 9V power supply, it is critical to ensure that the voltage does not drop below 9V at the power input connector, under any load conditions.

Large current

spikes can cause voltage drops across the power wires between the power supply and the IPC 6010. If the voltage falls below 9V, it may trigger a system reset. This risk must be carefully considered during system design and installation.

Power Supply Requirement			
Product Line	IPC 6010	IPC 7010	IPC 8010
Base Unit - w/o Extension Peak current	3A	4A	5A
Base Unit - w/o Extension TDP current	2A 5,3 - 1,6A**	2,5A	3,1A
Base Unit - with Extension* Peak current	4A	5A	6A
Base Unit - with Extension* TDP current	3A	3,5A	4,1A
Current values at 24V input voltage * with max. 25W power consumption inside the slot extension and per slot extension (not per slot!) ** Current values for 9 - 30V			

Figure 35: Product Labels

 PN: RPB6xxxxxxxx Vx.x IPC 6010 SN: 12345678 Made in Germany I.T.E. & I.T.E. for HAZ. LOC. CI Div 2 Grps ABCD Temp Code T4 Ex ec IIC T4 Gc, Ta: -xx°C to xx°C UL 24 ATEX 3283X, IECEx ULD 24.0022X Input: 24V --- 2A (w/o RPE) Input: 9-30V --- 5.3-1.6A (w/o RPE) Input: 24V --- 3A (w/ RPE) Ta: -xx°C - xx°C   E219177 E157515  II 3 G The use of accessories may affect the Ta and the suitability for use in hazardous locations. Refer to GFK-3306 & GFK-3307 Intelligent Platforms, LLC, 2500 Austin Drive, Charlottesville, VA 22911 USA [License] AUG2506 	 PN: RPB7xxxxxxxx Vx.x IPC 7010 SN: 12345678 Made in Germany I.T.E. & I.T.E. for HAZ. LOC. CI Div 2 Grps ABCD Temp Code T4 Ex ec IIC T4 Gc, Ta: -xx°C to xx°C UL 24 ATEX 3283X, IECEx ULD 24.0022X Input: 24V --- 2.5A (w/o RPE) Input: 24V --- 3.5A (w/ RPE) Ta: -xx°C - xx°C   E219177 E157515  II 3 G The use of accessories may affect the Ta and the suitability for use in hazardous locations. Refer to GFK-3306 & GFK-3307 Intelligent Platforms, LLC, 2500 Austin Drive, Charlottesville, VA 22911 USA [License] AUG2506 	 PN: RPB8xxxxxxxx Vx.x IPC 8010 SN: 12345678 Made in Germany I.T.E. & I.T.E. for HAZ. LOC. CI Div 2 Grps ABCD Temp Code T4 Ex ec IIC T4 Gc, Ta: -xx°C to xx°C UL 24 ATEX 3283X, IECEx ULD 24.0022X Input: 24V --- 3.1A (w/o RPE) Input: 24V --- 4.1A (w/ RPE) Ta: -xx°C - xx°C   E219177 E157515  II 3 G The use of accessories may affect the Ta and the suitability for use in hazardous locations. Refer to GFK-3306 & GFK-3307 Intelligent Platforms, LLC, 2500 Austin Drive, Charlottesville, VA 22911 USA [License] AUG2506 
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9.2

Temperature

Ambient temperatures and humidity values for the PACSystems™ IPC 6010/7010/8010 are provided in the following table. For more details on operating temperature and its dependency on application software, please refer to the Thermal Design section.

⚠ WARNING

The following table provides an overview about the product safety related ambient temperatures. The usage of slot extensions does reduce the possible ambient temperature as well as the usage of the DIN Rail Mounting method. Make sure that you do not operate the unit above the specified ambient temperature.

Ta - Tambient				
Product Line	Mounting	IPC 6010	IPC 7010	IPC 8010
Base Unit - w/o Extension	Panel Mount / VESA	70°C	65°C	60°C
	DIN Rail	65°C	60°C	55°C
1 Slot Extension	Panel Mount / VESA	65°C	65°C	55°C
	DIN Rail	60°C	60°C	50°C
2 Slot Extension	Panel Mount / VESA	N/A	65°C	55°C
	DIN Rail		60°C	50°C
3 Slot Extension	Panel Mount / VESA		65°C	55°C
	DIN Rail		60°C	50°C
4 Slot Extension	Panel Mount / VESA		N/A	55°C
	DIN Rail			50°C
Any defined Base Unit / Slot Extension Combination using the Fan Accessory RPF120	Panel Mount DIN Rail	70°C	70°C	70°C
Slot extensions support a maximum power consumption of 25W per slot extension unit, not per individual PCIe slot.				

The optional Fan Accessory RPF120 will result in a high ambient temperature of **70 °C** for all product flavors, independent from product line, usage of slot extensions and mounting kit. Furthermore, the usage of a Fan Accessory will result in lower unit and therefore component temperatures. Units with extended temperature range (-40 °C) will be limited to -20 °C when using the Fan Accessory due to the temperature range of the fan itself.

NOTICE

The usage of the optional Fan Accessory is not compatible with the VESA Mounting method. If you like to make advantage of the optional Fan Accessory you need to chose the Din Rail Mounting Kit (R2B00ACCRM01) or the Panel Mounting Kit (R2B00ACCOMP01) for installation of the unit.

9.3 Shock and Vibration

Shock and vibration values for the PACSystems™ IPC 6010/7010/8010 are provided in the following table for all possible combinations.

Shock and Vibration Matrix			
	DIN Rail	VESA	Panel Mount
6010	Shock = 15 g Vibration = 1 g RMS	Shock = 20 g Vibration = 2 g RMS	Shock = 15 g Vibration = 1 g RMS
6010 - 1 slot	Shock = 10 g Vibration = 0,5 g RMS		
7010 / 8010			
7010 / 8010 - 1 slot	Shock = 15 g Vibration = 1 g RMS		Shock = 20 g Vibration = 2 g RMS
7010 / 8010 - 2 slot			
7010 / 8010 - 3 slot			
8010 - 4 slot			
Vibration: DIN EN 60068-2-64 Vibration random operating: 5 - 100 Hz 0.04 g ² /Hz Effective value aeff: 1.96 m/s ² (g RMS) Duration per axis: 60 minutes		Shock: DIN EN 60068-2-27 Impact operating: Pulse shape: half sine Acceleration: 200 m/s ² Duration: 11 ms Number: 5 impacts per direction Total number: 30 impacts Time between pulse: 3 s	

9.4 Altitude

Altitude, air pressure, and ambient temperature influence the thermal operation of the components described in this document. They have been developed and tested at ~500 m (1650 ft) above sea level at a typical ambient temperature of 20°C (68 °F). Because of only marginal variations within a limited range of altitudes, this product operates as specified within altitudes from sea level to 1,000 m (6,560 ft), depending on the level.

The maximum altitude for the PACSystems™ IPC 6010/7010/8010 is specified in the following table.

Maximum Altitude	
Operating	2 km (6600ft)
Storage	12 km (40000ft)

9.5 Regulations and Certifications

Item	Specification
Safety	LV Directive 2014/35/EU EN/IEC 62368-1 UL 62368-1 (UL file number E219177), CSA-C22.2 No.62368-1
EMC	EMC Directive 2014/30/EU EN 61000-6-4 Emission standard for industrial environments EN 61000-6-2 Immunity standard for industrial environments Models that include the WiFi option, also meet the following: RE Directive 2014/53/EU EN 301 489-1 EN 301 489-17 FCC 47 CFR 15 Contains FCC ID: PD9AX210NG CAN ICES-3 (A)/NMB-3(A) Contains IC: 1000M-AX210NG FCC Part 15 B 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.

Item	Specification
Ex	ATEX Directive 2014/34/EU ATEX & IECEx Zone 2 – IEC/EN 60069-0; IEC/EN60079-7 UL 24 ATEX 3263X and IECEx ULD 24.0022X UL Listed US/CAN Hazardous Locations: Class 1 Division 2 Groups ABCD – UL 121201(US); CSA-C22.2 No. 213(Canada) (UL file number E157515) Note: only for base unit configurations
RoHS	RoHS Directive 2011/65/EU

9.5.1 Additional WiFi/BT relevant information

Operation of this equipment is subject to the following two conditions:

1. This equipment or device may not cause harmful interference, and
2. This equipment or device must accept any interference, including interference that may cause undesired operation.

Transmitter Frequency

- 2412 - 2472 MHz (20 MHz)
- 2422 - 2462 MHz (40 MHz)
- 5180 - 5320 MHz (20MHz)
- 5190 - 5310 MHz (40MHz)
- 5210 - 5290 MHz (80MHz)
- 5250 MHz (160MHz)
- 5500 - 5700 MHz (20MHz)
- 5510 - 5670 MHz (40MHz)
- 5530 - 5610 MHz (80MHz)
- 5570 MHz (160MHz)
- 5745 - 5865 MHz (20MHz)
- 5755 - 5835 MHz (40MHz)
- 5775MHz (80MHz)
- 5955 - 6415 MHz (20MHz)
- 5965 - 6405 MHz (40MHz)
- 5985 - 6385 MHz (80MHz)

- 6025 - 6345 MHz (160MHz)

Maximum measured ERP power

- 2402 MHz: 10.3 dBm
- 2479.9 MHz: 12.6 dBm
- 5323 MHz: 4.1 dBm
- 5747.5 MHz: 9.8 dBm
- 6100.07 MHz: -2.6dBm

Modulation

- Bluetooth: GFSK, pi/4 DQPSD, 8DPSK
- 802.11b: DSS (DBPSK, DQPSD, CCK)
- 802.11g: OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM)
- 802.11n: OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM)
- 802.11a: OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM)
- 802.11ac: OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
- 802.11ax: OFDM/OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

9.5.2 European Union National Restrictions

Frequency band 5150 – 5350 MHz is for indoor use only

Frequency band 5470 - 5725 MHz is for indoor use only

Frequency band 5925 – 6425 MHz is for Low Power in-door (LPI) use only

Figure 36: EU National Restrictions

	AT	BE	BG	CH	CY	CZ	DE
	DK	EE	EL	ES	FI	FR	HR
	HU	IE	IS	IT	LI	LT	LU
	LV	MT	NL	PL	PT	RO	SE
	SI	SK	TR	UK (NI)			

9.5.3 Intel Dynamic Regulatory Solutions

The Intel Wi-Fi 6E AX210 module detects its location and automatically optimizes the Wi-Fi settings to local regulatory requirements, maximizing performance in each geography, simplifying travel experience and global enterprise procurement.

Future regulatory changes are easily managed during the product life cycle. This functionality is handled by Intel PROSet/Wireless WiFi version 22.x and above which is included in Emerson Windows deployment image.

9.6 Battery

The PACSystems™ IPC 6010/7010/8010 contains a BR/CR 2032 lithium coin battery. The maximum current used by the PACSystems™ IPC 6010/7010/8010 is 6 µA. Depending on the operating hours and temperature, the estimated battery life is 2 to 8 years. Battery current is not used when the PACSystems™ IPC 6010/7010/8010 is externally supplied. RTC battery must be BR/CR 2032 with a rating of at least 100 °C.

WARNING

Batteries may explode if mistreated. Do not charge, disassemble, or incinerate.

9.7 Technical Specifications

Item	Specification
Processor	13th Generation Intel® Core™ Processors (Raptor Lake)
Memory	Up to 64GB LPDDR5 with up to 6400MT/s
NVMe	M.2 M-keyed interface up to 16GT/s
Ethernet	5x Ethernet (10/100/1000/2500 Mbit)
Graphics	2x DisplayPort and 2x USB-C (supports up to HBR20)
USB	4x USB 3.2 Gen 2x1 and 2x USB-C with USB4 support
Serial	2x RS232 and 2x RS4xx (galv. Isolated)
Non-volatile memory	MRAM, 8Mb
UEFI	UEFI AMI Aptio© V

Section 10: Troubleshooting

10.1 Unexpected Restarts When Booting

Unlike other automation components, Industrial PCs exhibit frequent and steep load changes caused by their dynamic performance and power management capabilities. For the same reason, their current demand may very briefly exceed the rated power.

Please make sure to use a suitable and adequate power supply unit. Inadequate power often results in unstable operation, typical symptoms being random reboots or software crashes.

For power supply recommendations, please refer to *6.1.1 Power-In*.

For unexpected hardware problems, missing hardware devices and interfaces, or booting issues, please restart the IPC and restore the UEFI settings to factory defaults. To do this, reboot the unit, press and hold the [F2] key immediately after power-up, and then restore the default settings through the appropriate menu options.

Contact Information and Support Guide

Questions? We are here to help.

Try searching the Knowledge Base system on our Customer Center website before starting a case or picking up the phone.

Search our Knowledge Base	Open a Support Ticket	Register for a Customer Account
 pacsystems.co/knowledge	 pacsystems.co/support	 pacsystems.co/signup
Customer Center Home Page	Commercial Website	Contact Information
 pacsystems.co/customercenter	 pacsystems.co/commercial	 pacsystems.co/contactus

Note: If the product is purchased through an Authorized Channel Partner, please contact the seller directly for any support.

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