



Intel® NUC 12 Extreme / Pro X Kit / Compute Element Product Specification

Revision 1.1

Regulatory Models: NUC12DCM / NUC12EDB

June 2022

Intel® NUC 12 Extreme / Pro X Kit NUC12DCMi9, NUC12DCMi7, Intel® NUC 12 Extreme / Pro X Compute Element NUC12EDBi9, or NUC12EDBi7, may contain design defects or errors known as errata that may cause the product to deviate from published specifications. Current characterized errata, if any, are documented in this product specification.

Revision History

Revision	Revision History	Date
1.0	First release	February 2022
1.1	Specification update	June 2022

Disclaimer

This product specification applies only to the standard Intel® NUC 12 Extreme / Pro X Kits and Intel® NUC 12 Extreme / Pro X Compute Element with BIOS identifier EDADL579 / EDADLMIV.

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Preface

This Product Specification specifies the layout, components, connectors, power and environmental features for the Intel® NUC 12 Extreme / Pro X Kit NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, NUC12DCMv7, NUC 12 Extreme / Pro X Compute Element NUC12EDBi9, NUC12EDBi7, NUC12EDBv9, and NUC12EDBv7.



NOTE

In this document, the use of “Intel® NUC 12 Extreme / Pro X Kit” will refer to the NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, and NUC12DCMv7. The usage of “NUC 12 Extreme / Pro X Compute Element” refers to the Intel® NUC Element product contained inside the NUC 12 Extreme / Pro X Kit.

Intended Audience

This document is intended to provide technical information about Intel® NUC 12 Extreme / Pro X Kit NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, and NUC12DCMv7, and its components to the vendors, system integrators, and other engineers and technicians who need this level of information. It is specifically *not* intended for general audiences.

What This Document Contains

Chapter	Description
1	A description of the NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, NUC12DCMv7, NUC12EDBi9, NUC12EDBi7, NUC12EDBv9, and NUC12EDBv7
2	A technical description of the NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, NUC12DCMv7, NUC12EDBi9, NUC12EDBi7, NUC12EDBv9, and NUC12EDBv7
3	The features supported by the BIOS Setup program
4	Characterized errata

Typographical Conventions

This section contains information about the conventions used in this specification. Not all of these symbols and abbreviations appear in all specifications of this type.

Notes, Cautions, and Warnings



NOTE

Notes call attention to important information.



CAUTION

Cautions are included to help you avoid damaging hardware or losing data

Other Common Notation

#	Used after a signal name to identify an active-low signal (such as USBP0#)
GB	Gigabyte (1,073,741,824 bytes)
GB/s	Gigabytes per second
Gb/s	Gigabits per second
KB	Kilobyte (1024 bytes)
Kb	Kilobit (1024 bits)
kb/s	1000 bits per second
MB	Megabyte (1,048,576 bytes)
MB/s	Megabytes per second
Mb	Megabit (1,048,576 bits)
Mb/s	Megabits per second
TDP	Thermal Design Power
Xxh	An address or data value ending with a lowercase h indicates a hexadecimal value.
x.x V	Volts. Voltages are DC unless otherwise specified.
*	This symbol is used to indicate third-party brands and names that are the property of their respective owners.

Intel® NUC 12 Extreme / Pro X Kit Identification Information

Intel® NUC 12 Extreme / Pro X Kit / Compute Element Identification Information

AA Revision	Product Code	BIOS Revision	Notes
M30142-xxx	RNUC12DCMi9xxxx	EDADL579.xxxx	1,2
M30143-xxx	RNUC12DCMi7xxxx	EDADL579.xxxx	1,3
M30146-xxx	BNUC12DCMv9xxxx	EDADLMIV.xxxx	1,2
M30147-xxx	BNUC12DCMv7xxxx	EDADLMIV.xxxx	1,3
M27907-xxx	BNUC12EDBi9xxxx	EDADL579.xxxx	1,2
M27908-xxx	BNUC12EDBi7xxxx	EDADL579.xxxx	1,3
M27905-xxx	BNUC12EDBv9xxxx	EDADLMIV.xxxx	1,2
M27906-xxx	BNUC12EDBv7xxxx	EDADLMIV.xxxx	1,3

Notes:

- The AA number is found on the bottom of the NUC 12 Extreme / Pro X and back of the NUC 12 Extreme / Pro X Compute Element.
- The Intel® Core™ i9-12900 processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i9-12900	C0	SRL4K

- The Intel® Core™ i7-12700 processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i7-12700	C0	SRL4Q

Intel® NUC Products NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, NUC12DCMv7

Kit Product Name	Intel® NUC Compute Element
NUC12DCMi9	NUC12EDBi9
NUC12DCMi7	NUC12EDBi7
NUC12DCMv9	NUC12EDBv9
NUC12DCMv7	NUC12EDBv7

Specification Changes or Clarifications

The table below indicates the Specification Changes or Specification Clarifications that apply to the Intel® NUC 12 Extreme / Pro X Kit NUC12DCMi9, NUC12DCMi7, NUC12DCMv9, or NUC12DCMv7.

Specification Changes or Clarifications

Date	Type of Change	Description of Changes or Clarifications

Errata

Current characterized errata, if any, will be documented in Section 0 of this Technical Product Specification.

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1 Product Description

1.1 Overview

The Intel® NUC 12 Extreme / Pro X Kit is a small form factor PC barebones kits. The NUC 12 Extreme / Pro X Kit consists of the processor, chipset, memory slots, wireless, Bluetooth*, M.2 storage slots, integrated heat sink and fan. See Table 1 for a summary.

The Intel® NUC 12 Extreme / Pro X Compute Element can operate as a standalone card but may require a compatible baseboard to take advantage of additional PCI Express functionality.

For information on compatible devices for use with the Intel® NUC 12 Extreme / Pro X Kit and the Intel® NUC 12 Extreme / Pro X Compute Element see <http://www.intel.com/NUCElements>.

1.2 Version Summary

There are three different versions of the Intel® NUC 12 Extreme / Pro X Kit which are summarized in Table 1. Unless otherwise noted in this document, not all features are available on all versions.

Table 1. Version Summary

Version	Intel® vPro™	Discrete TPM	Memory	XMP	Processor
NUC12DCMi9/ NUC12EDBi9 (Extreme)	No	No	Up to 64GB	Yes	Intel® Core™ i9-12900
NUC12DCMi7/ NUC12EDBi7 (Extreme)	No	No	Up to 64GB	Yes	Intel® Core™ i7-12700
NUC12DCMv9/ NUC12EDBv9 (Pro X)	Yes	Yes	Up to 64GB	Yes	Intel® Core™ i9-12900
NUC12DCMv7/ NUC12EDBv7 (Pro X)	Yes	Yes	Up to 64GB	Yes	Intel® Core™ i7-12700



NOTE

Intel® NUC 12 Extreme / Pro X Kits listed in Table 1 have been certified for use as a component in Information Technology Equipment in certain countries. The system integrator is responsible for testing and acquiring any additional country-specific regulatory approvals, including all system-wide certifications.



NOTE

For information on the Intel® NUC 12 Extreme / Pro X Kit and Intel® NUC 12 Extreme / Pro X Compute Element is available at www.intel.com/NUCSupport

1.3 Feature Summary

Table 2 summarizes the major features of the Intel® NUC 12 Extreme / Pro X Kits.

Table 2. Feature Summary

Kit Form Factor	357mm x 189mm x120mm
Element Form Factor	202mm x 131mm x 39.04mm
Processor	<ul style="list-style-type: none"> • Socketed Intel® processor <ul style="list-style-type: none"> ○ Integrated graphics ○ Integrated memory controller • The following processors are supported as intalled in the corresponding NUC 12 Extreme / Pro X Compute Element <ul style="list-style-type: none"> ○ Intel® Core™ i9-12900 ○ Intel® Core™ i7-12700
PCH Options	<ul style="list-style-type: none"> • Intel® Z690 Platform Controller Hub (Extreme) • Intel® W680 Platform Controller Hub (Pro X)
Memory	<ul style="list-style-type: none"> • Two 260-pin 1.2 V DDR4 SDRAM Small Outline Dual Inline Memory Module (SO-DIMM) sockets • Support for DDR4 3200 MHz SO-DIMMs • Support for 8 Gb and 16 Gb memory technology† • Support for up to 64 GB of system memory with two SO-DIMMs using 16 Gb memory technology† • Support for 1.2 V and 1.35 V (with XMP) low voltage JEDEC memory only • Support for Intel® XMP memory profiles • Note: 2 Gb memory technology (SDRAM Density) is not compatible
Graphics	<ul style="list-style-type: none"> • Integrated graphics support for processors with Intel® Graphics Technology: • One High Definition Multimedia Interface* (HDMI*) v2.1 TMDS compatible back panel connector • Two DisplayPort signals via USB Type C back panel connectors
Audio	<ul style="list-style-type: none"> • Intel® High Definition (Intel® HD) Audio via the HDMI and Type C interfaces through the processor • USB Audio via a stereo 3.5mm combination microphone/headphone on the front panel (on the NUC Kits)
Storage	<ul style="list-style-type: none"> • NUC 12 Extreme / Pro X Compute Element: • One CPU-Attached PCIe Gen4 x4 NVMe M.2 2280. • Two SATA 6.0 Gb/s or PCIe Gen4 x4 AHCI, NVMe ports are reserved for M.2 storage modules supporting M.2 2242 / M.2 2280 Note: Supports key type M (PCI Express* x1/x2/x4 and SATA),
Peripheral Interfaces	<ul style="list-style-type: none"> • USB 3.2 (Gen 2/10 Gbps) Type C ports: <ul style="list-style-type: none"> • Two ports are implemented via the back panel Type C connectors • One port is implemented on the front panel of the Kit • USB 3.2 (Gen 2/10 Gbps) Type A ports: <ul style="list-style-type: none"> • Six ports are implemented via the back panel connectors (blue) • One port via the desktop front panel of the Kit • USB 2.0 ports: <ul style="list-style-type: none"> • Two ports via two single-port internal 1x4 1.25 mm pitch headers (contained in the 20pin Common IO Header), one is used for baseboard communication • SD Card Reader: <ul style="list-style-type: none"> • One UHS-II capable SDXC Card Reader on Front Panel (on the NUC Kits)
Chassis Expansion Capabilities	<ul style="list-style-type: none"> • One PCIe 5.0 x16 slot* with support for a dual slot GPU up to ~12" (300mm) maximum length
NUC Element Expansion Capabilities	<ul style="list-style-type: none"> • Three M.2 connectors supporting AHCI and NVME protocols (only Slot 1 and Slot 2 support AHCI) • Two Thunderbolt™ 4 via back panel Type C connectors
BIOS	<ul style="list-style-type: none"> • Intel® BIOS resident in the Serial Peripheral Interface (SPI) Flash device • Support for Advanced Configuration and Power Interface (ACPI), Plug and Play, and System Management BIOS (SMBIOS)

Wireless LAN	<ul style="list-style-type: none"> • Intel® Wi-Fi 6E AX211, 802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth 5.2 • Maximum Transfer speed up to 2.4 Gbps • M.2 2230 Form Factor NGFF PCIe only • Supports OFDMA, 1024QAM, Target Wake Time (TWT) and spatial reuse
LAN	<ul style="list-style-type: none"> • 10 Gigabit (10/100/1000/2500/5000/10000 Mb/s) LAN subsystem using the Marvell® AQtion™ AQC113C <ul style="list-style-type: none"> • Available on all SKUs • 2.5 Gigabit (10/100/1000/2500 Mb/s) LAN subsystem using the Intel® Gigabit Ethernet Controller I225-LM <ul style="list-style-type: none"> • Only available on NUC12DCMi9, NUC12DCMv9, NUC12DCMv7, NUC12EDBv9, and NUC12EDBv7
Hardware Monitor Subsystem	<p>Hardware monitoring subsystem, based on an embedded controller, including:</p> <ul style="list-style-type: none"> • Voltage sense to detect out of range power supply voltages • Thermal sense to detect out of range thermal values • One processor fan header • One chassis fan header • Fan sense input used to monitor fan activity • Fan speed control
Devices Supported via PCIe Bifurcation	<ul style="list-style-type: none"> • PCI Express 5.0 x16 <ul style="list-style-type: none"> • Bifurcation supported to a maximum of two PCI Express devices (x8 + x8)
Advanced Technologies	<ul style="list-style-type: none"> • Intel® vPro™ Technology (NUC12DCMv9, NUC12DCMv7, NUC12EDBv9, and NUC12EDBv7 only) • Intel® Virtualization Technology (VT-x) • Intel® Virtualization for Directed I/O (VT-d) • Intel® VT-x with Extended Page Tables (EPT) • Intel® Speed Shift Technology • Intel® Turbo Boost Technology • Intel® Hyper-Threading Technology • Enhanced Intel® SpeedStep® Technology • Intel® Identity Protection Technology (Intel® IPT) • Intel® Platform Trust Technology (Intel® PTT)
Security and Reliability	<ul style="list-style-type: none"> • Intel® Active Management Technology • Intel® Memory Protection Extensions (Intel® MPX) • Intel® AES New Instructions • Execute Disable Bit • Discrete Trusted Platform Module 2.0 (TPM) – (NUC12DCMv9, NUC12DCMv7, NUC12EDBv9, and NUC12EDBv7 only)
TPM	Discrete TPM on NUC12DCMv9, NUC12DCMv7, NUC12EDBv9, and NUC12EDBv7 only.
Operating Systems Support (64-bit only)	<ul style="list-style-type: none"> • Windows 11 Home • Windows 11 Pro • Windows 11 Enterprise • Windows 11 Education • Windows 11 IoT Enterprise

To find information about...

Intel® NUC Elements

Intel® NUC Element Support

Intel® NUC Element Warranty Information

Available configurations for Intel® NUC 12 Extreme / Pro X Kit

Intel Processors

Intel Chipsets

Intel Graphics

Intel Wireless

Visit this World Wide Web site:

<http://www.intel.com/ComputeElements>

<http://www.intel.com/ComputeElementsSupport>

<http://www.intel.com/NUCWarranty>

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2 Technical Reference

2.1 Block Diagrams

2.1.1 Block Diagram – NUC 12 Extreme / Pro X Compute Element

Figure 1 is a block diagram of the major functional areas of the Intel® NUC 12 Extreme / Pro X Compute Element.

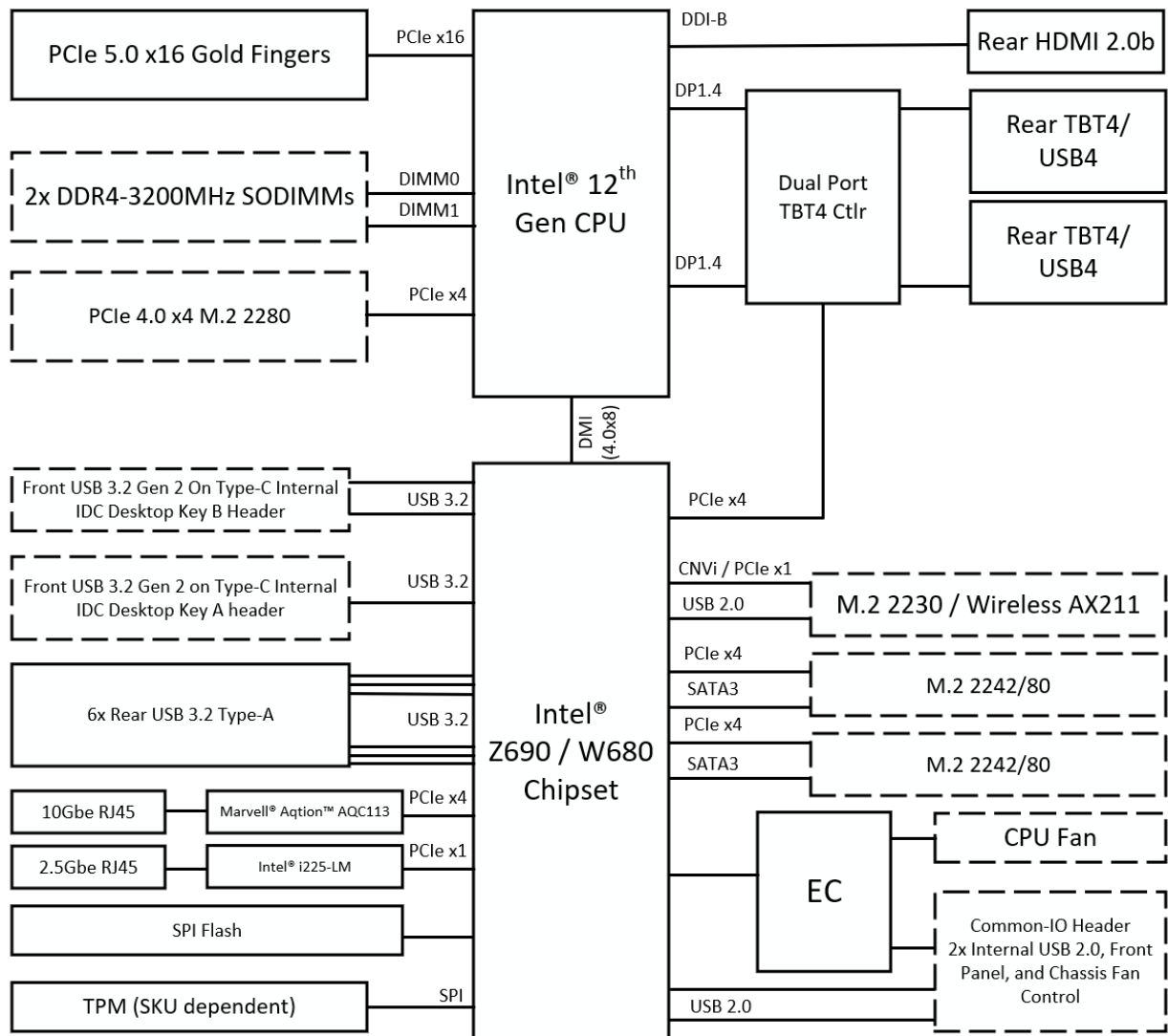


Figure 1. Block Diagram – NUC 12 Extreme / Pro X Compute Element

2.1.2 Block Diagram – NUC 12 Extreme / Pro X Kit

Figure 2 is a block diagram of the major functional areas of the Intel® NUC 12 Extreme / Pro X Kit.

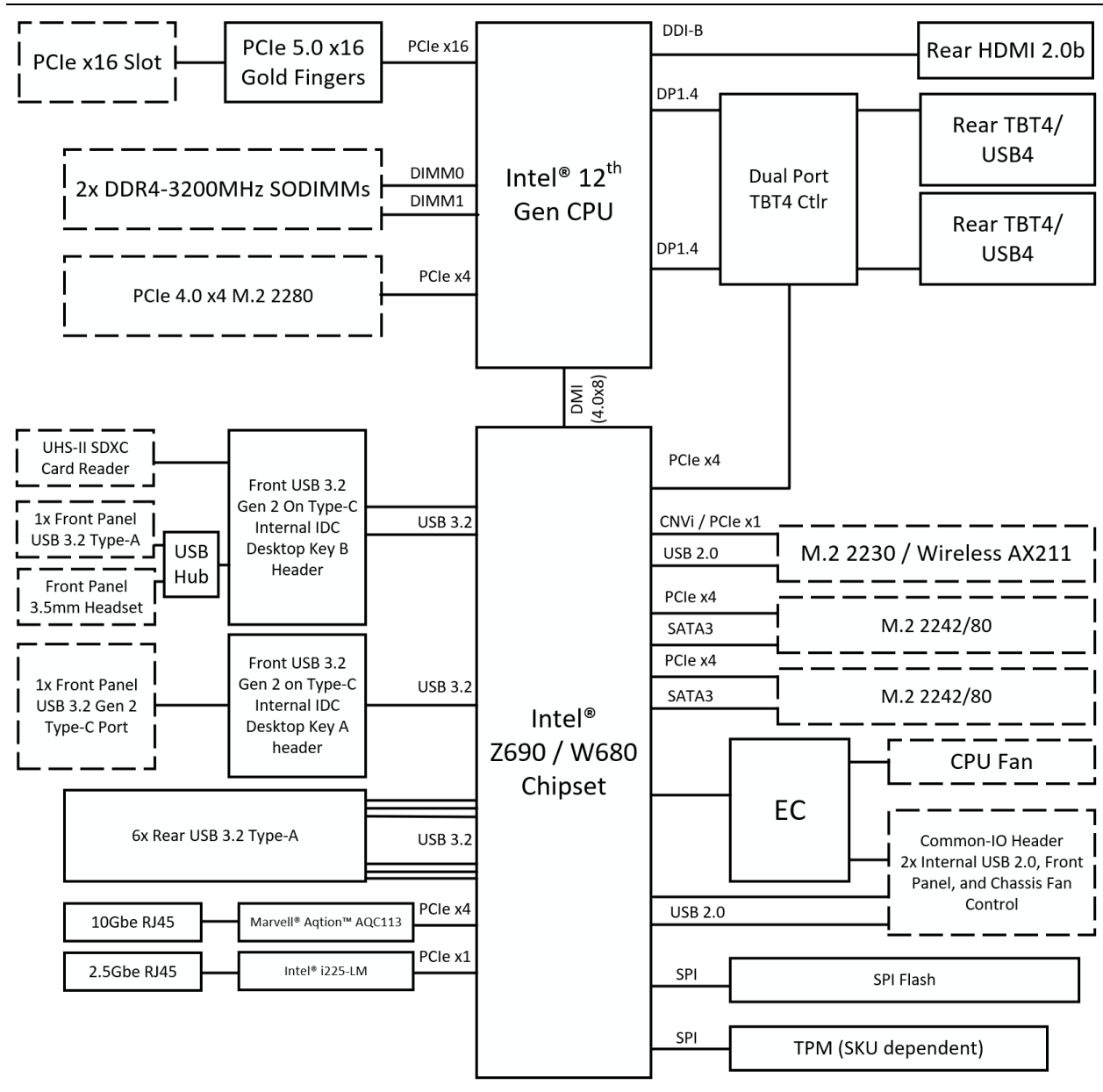


Figure 2. Block Diagram – NUC 12 Extreme / Pro X Kit



NOTE

The LAN options are SKU dependent as referenced in the Feature Summary in Table 0 LAN section.

2.2 Processor

Intel NUC 12 Extreme / Pro X Kits feature the Intel NUC 12 Extreme / Pro X Compute Element pre-installed. The Intel® NUC 12 Extreme / Pro X Kits NUC12DCMi9 and NUC12DCMi7 feature a 12th Gen Intel® Core™ processor with 65W TDP.

The NUC12DCMi9/ features the 12th Gen Intel® Core™ i9-12900 16-core processor.

The NUC12DCMi7 features the 11th Gen Intel® Core™ i7-12700 12-core processor.

- Intel® UHD 770 Graphics for 12th Gen Intel® Processors
- Integrated memory controller

2.3 Platform Controller Hub (PCH)

The Intel NUC 12 Extreme / Pro X Kits feature the Intel® Z690 / W680 Platform Controller Hub with Direct Media Interface (DMI) interconnect providing interfaces to the processor and the USB, SATA, LAN, PCI Express interfaces. The Z690 / W680 is a centralized controller for the kit's I/O paths.

2.3.1 Direct Media Interface (DMI)

Direct Media Interface (DMI) is the chip-to-chip connection between the processor and PCH. This high-speed interface integrates advanced priority-based servicing allowing for concurrent traffic and true isochronous transfer capabilities.

2.4 System Memory

The Intel NUC 12 Extreme / Pro X Kit has two 260-pin SO-DIMM sockets and supports the following memory features:

- 1.2 V DDR4 SDRAM SO-DIMMs with gold plated contacts
- Two independent memory channels with interleaved mode support
- Unbuffered, single-sided or double-sided SO-DIMMs
- 64 GB maximum total system memory (with 16 Gb memory technology)
- Minimum recommended total system memory: 4096 MB
- Non-ECC SO-DIMMs on NUC 12 Extreme and Pro X
- ECC SO-DIMM support on the NUC 12 Pro X
- Serial Presence Detect
- DDR4 2133/2400/2666/2933/3200 MHz SDRAM SO-DIMMs
- Intel® XMP support

Supports 4 Gb, 8 Gb, and 16 Gb memory technology (SDRAM Density)



NOTE

To be fully compliant with all applicable DDR SDRAM memory specifications, the board should be populated with SO-DIMMs that support the Serial Presence Detect (SPD) data structure. This allows the BIOS to read the SPD data and program the chipset to accurately configure memory settings for optimum performance. If non-SPD memory is installed, the BIOS will attempt to correctly configure the memory settings, but performance and reliability may be impacted or the SO-DIMMs may not function under the determined frequency.



NOTE

Intel NUC 12 Extreme / Pro X Kits support only 4 Gb, 8 Gb, and 16 Gb memory technologies (also referred to as “SDRAM density”).

For information about...

Tested Memory

Refer to:

<http://www.intel.com/NUCSupport>

The SODIMM memory slots on the NUC 12 Extreme / Pro X Kits is located underneath the NUC 12 Extreme / Pro X Compute Element shroud door. See Figure 3.

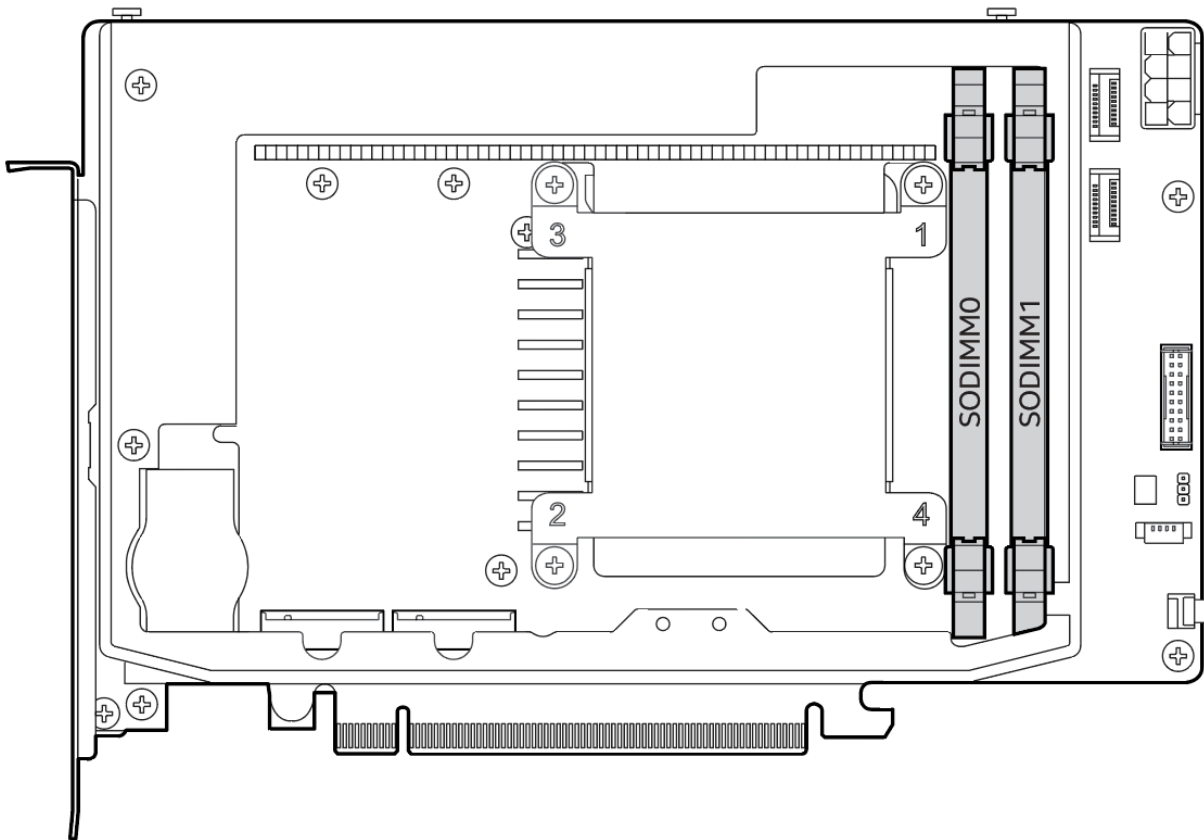


Figure 3. SODIMM Location on NUC 12 Extreme / Pro X Element

2.4.1 Addressable Memory

The system has been validated with up to 64 GB of addressable system memory. Typically, the address space that is allocated for PCI Express configuration space, BIOS (SPI Flash device), and chipset overhead resides above the top of DRAM (total system memory). On a system that has 16 GB of system memory installed, it is not possible to use all of the installed memory due to system address space being allocated for other system critical functions. These functions include the following:

- BIOS/SPI Flash device (32 MB)
- Local APIC (19 MB)
- Direct Media Interface (40 MB)
- PCI Express configuration space (256 MB)
- PCH base address registers PCI Express ports (up to 256 MB)
- Memory-mapped I/O that is dynamically allocated for M.2 add-in cards (256 MB)
- Integrated graphics shared memory (up to 1.5 GB; 64 MB by default)

2.5 Processor Graphics Subsystem

The NUC 12 Extreme / Pro X Kit supports graphics through the Intel® UHD 770 Graphics for 12th Gen Intel® Processors.

For information about...

Intel Graphics Technologies

Refer to:

<http://www.intel.com/graphics>

2.5.1 Integrated Graphics

The NUC 12 Extreme / Pro X Kit supports integrated graphics via the processor.

2.5.1.1 Intel® UHD Graphics for 12th Gen Intel Processors

Intel® UHD 770 Graphics for 12th Gen Intel Processors features the following:

- DirectX* 12.1 support
- OpenGL* 4.5 support
- Max HDMI resolution 4096x2304 at 60Hz
- Max Type-C DP resolution 7680x4320 at 30Hz
- OpenCL* 2.0 support

2.5.1.2 High Definition Multimedia Interface* (HDMI*)

The HDMI port is HDMI 2.1 TMDS compatible specification compliant and support standard, enhanced, or high definition video, plus multi-channel digital audio on a single cable. The port is compatible with all ATSC and DVB HDTV standards and supports thirty-two full range channels of lossless audio formats. The system can support a display at the maximum supported resolution of 4096 x 2160 @ 60 Hz, 24bpp.

For information about

HDMI technology

Refer to<http://www.hdmi.org>

2.5.1.2.1 High-bandwidth Digital Content Protection (HDCP)

The HDMI Port supports HDCP 2.2. HDCP is the technology for protecting high definition content against unauthorized copy or interception between a source (computer, digital set top boxes, etc.) and the sink (panels, monitor, and TVs). The PCH supports HDCP 2.2 for content protection over wired displays.

2.5.1.3 DisplayPort* via Type C

DisplayPort is a digital communication interface that utilizes differential signaling to achieve a high bandwidth bus interface designed to support connections between PCs and monitors, projectors, and TV displays. DisplayPort is suitable for display connections between consumer electronics devices such as high definition optical disc players, set top boxes, and TV displays. The Type C DisplayPort connectors are compliant with the DisplayPort 1.4 specification and have a maximum supported resolution of 7680 x 4320 @ 30Hz 24bpp.

DisplayPort output supports Multi-Stream Transport (MST) which allows for multiple independent video streams (daisy-chain connection with multiple monitors) over a single DisplayPort. This will require the use of displays that support DisplayPort 1.4 specification and allow for this feature.

**NOTE**

Resolution support is subject to memory bandwidth availability. Single 8K@30hz resolution may be dependent on monitors and adapters utilized.

For information about

DisplayPort technology

Refer to<http://www.displayport.org>

2.6 USB

The NUC 12 Extreme / Pro X Kit supports twelve USB ports. All twelve ports are high-speed, full-speed, and low-speed capable. The USB 3.2 Gen 2 ports are capable of up to 10gb/s per port. The port arrangement is as follows:

- USB 3.2 Gen 2 Type-A ports:
 - One port implemented with external front panel connector (black)
 - Six ports are implemented with external back panel connectors (blue)
- USB 3.2 Gen 2 Type-C ports:
 - Two ports are implemented with as USB Type-C back panel connectors (black)
 - One port is implemented with external front panel USB Type-C (black)
- USB 2.0 ports:
 - Two ports via two single-port internal 1x4 1.25 mm pitch headers on NUC 12 Extreme / Pro X Compute Element (contained in the 20pin Common IO header)



NOTE

Computer systems that have an unshielded cable attached to a USB port may not meet FCC Class B requirements, even if no device is attached to the cable. Use a shielded cable that meets the requirements for full-speed devices.

2.7 Thunderbolt 4

The NUC 12 Extreme / Pro X Kits support Thunderbolt™ 4 with up to 40 Gbps of data throughput, two 4k (60Hz) monitor outputs, USB3.2 (Gen 2) connection and charging capabilities up to 5V at 3A via the back panel USB Type C connectors. Item D in Figure 8 shows the location of the rear panel USB Type C ports.



NOTE

The two Thunderbolt™ 4 connectors share maximum available bandwidth between the two ports where a single device can utilize the full allocation until those resources are dynamically reassigned and or shared.

For information about	Refer to
Compatible Thunderbolt™ 4 devices	https://www.intel.com/content/www/us/en/support/articles/000027966.html
Thunderbolt™ 4 information	http://www.intel.com/Thunderbolt

2.8 Storage Options

The NUC 12 Extreme / Pro X Kit provides the following Storage interfaces:

- Two PCIe Gen 4 x4 M.2 NVMe/SATA slots, one supporting M.2 2242/80 and one supporting 2280 on the NUC 12 Extreme / Pro X Compute Element.
- One CPU-Attached internal PCIe Gen 4 x4 M.2 NVMe only slot located on the NUC 12 Extreme / Pro X Element.

The PCH provides independent SATA ports with a theoretical maximum transfer rate of 6 Gb/s. A point-to-point interface is used for host to device connections.

Figure 4 shows the locations of the M.2 slots.

NOTE

The Front Side M.2 slots are capable of double-sided M.2 devices while the Rear Side M.2 slot is limited to single-sided M.2 devices.

2.8.1 AHCI Mode

The NUC 12 Extreme / Pro X Kit supports AHCI storage mode.



NOTE

In order to use AHCI mode, AHCI must be enabled in the BIOS. Microsoft Windows* 11 includes the necessary AHCI drivers without the need to install separate AHCI drivers during the operating system installation process; however, it is always good practice to update the AHCI drivers to the latest available by Intel.*

2.8.2 NVMe

The board supports M.2 NVM Express* (NVMe) drives. NVMe is an optimized, high-performance scalable host controller interface designed to utilize PCIe-based solid-state storage. NVMe is designed to provide efficient access to storage devices built with non-volatile memory, from current NAND flash technology to future, higher performing persistent memory technologies like Optane. NVMe is designed to meet serial bandwidth requirements and very high IOPs. It is based on PCIe Gen 4 and can deliver up to 8GB/s bandwidth. Current NVMe is based on version 1.3 of the specification.



NOTE

Actual device performance may vary based on OS version, storage type, and workload utilized.

2.8.3 Intel® Volume Management Device (Intel® VMD)

The Z690 / W680 PCH supports Intel® Volume Management Device Technology, providing both AHCI and integrated RAID functionality. The RAID capability provides high-performance RAID 0 and 1 functionality on the M.2 Slots. Other RAID features include hot spare support, SMART alerting, and RAID 0 auto replace. Software components include an Option ROM for pre-boot configuration and boot functionality, a Microsoft Windows compatible driver, and a user interface for configuration and management of the RAID capability of the PCH.



NOTE

Intel® VMD SATA or NVMe RAID is only supported if devices share the same type of connection protocol. Mixing an M.2 SATA SSD with an NVMe module is not supported. CPU attached storage can also be used with NVMe SSD RAID options, functionality of RAID from the PCH on the NUC 12 Extreme / Pro X Compute Element cannot be shared with functionality of RAID from the Baseboard. See Figure 4 for the M.2 Storage location on the NUC 12 Extreme / Pro X Compute Element.

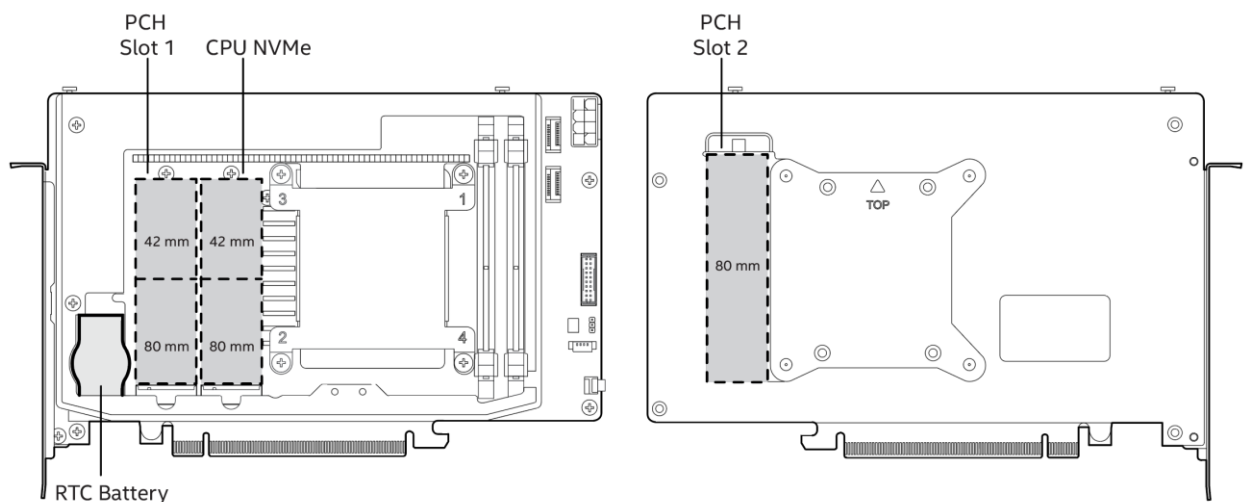


Figure 4. Location of NUC 12 Extreme / Pro X Compute Element M.2 Slots and Battery

2.9 Real-Time Clock Subsystem

A coin-cell battery (CR2032) powers the real-time clock and CMOS memory. When the computer is not plugged into a wall socket, the battery has an estimated life of three years. When the computer is plugged in, the standby current from the power supply extends the life of the battery. The clock is accurate to ± 13 minutes/year at 25 °C with 3.3 VSB applied via the power supply 5 V STBY rail.



NOTE

If the battery and AC power fail, date and time values will be reset and the user will be notified during the POST.

When the voltage drops below a certain level, the BIOS Setup program settings stored in CMOS RAM (for example, the date and time) might not be accurate. Replace the battery with an equivalent one. Figure 4 shows the location of the battery.

2.10 LAN

The onboard LAN controllers consist of the following:

- Marvell® AQtion™ AQC113 (10/100/1000/2500/5000/10000 Mb/s)
- Intel® Gigabit Ethernet Controller i225-LM (10/100/1000/2500 Mb/s)
- RJ-45 LAN connectors with integrated status LEDs

Additional features of the i225-LM LAN subsystem include:

- CSMA/CD protocol engine
- LAN connect interface between the Processor and the LAN controller
- Power management capabilities
 - ACPI technology support
 - LAN wake capabilities
- LAN subsystem software

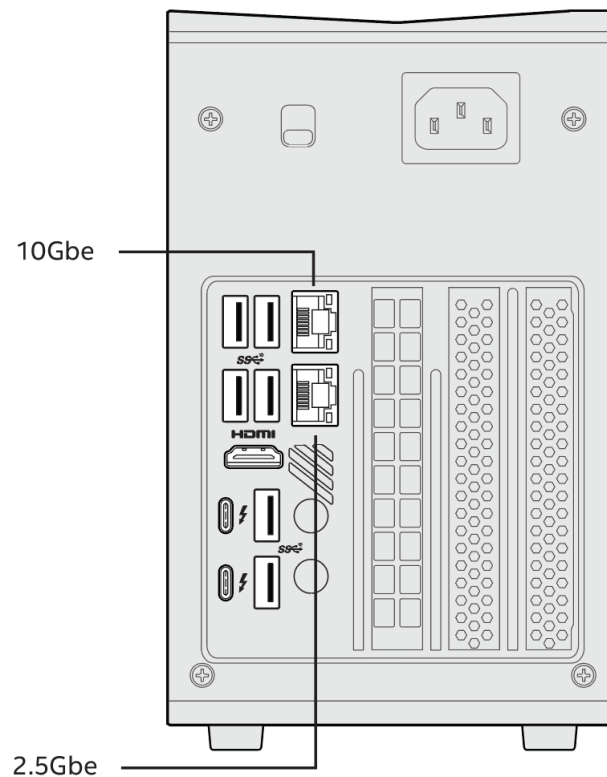


Figure 5. NUC 12 Extreme / Pro X Kit LAN Controller Layout



NOTE

The LAN options are SKU dependent as referenced in the Feature Summary in Table 0 LAN section.

2.10.1 LAN Software

LAN software and drivers are available from Intel's website.

For information about	Refer to
Obtaining LAN software and drivers	http://downloadcenter.intel.com

2.11 Intel® Security and Manageability Technologies

Intel® Security and Manageability Technologies provides tools and resources to help small business owners and IT organizations protect and manage their assets in a business or institutional environment.



NOTE

Software with security and/or manageability capability is required to take advantage of Intel platform security and/or management technologies. Section 2.11 is only fully applicable to the NUC12 Pro X platforms, NUC12DCMv9, NUC12DCMv7, NUC12EDBv9, and NUC12EDBv7.

2.11.1 Intel® vPro™ Technology

Intel® vPro™ Technology is a collection of platform capabilities that support enhanced manageability, security, virtualization and power efficiency. The key platform capabilities include:

- Intel® Active Management Technology (Intel® AMT)
- Intel® Virtualization (Intel® VT-x)
- Intel® Virtualization for Directed I/O (Intel® VT-d)
- Intel® Trusted Execution Technology (Intel® TXT)
- Intel® Identity Protection Technology (Intel® IPT)
- Trusted Platform Module 2.0 (TPM)

For information about	Refer to
Intel® vPro Technology	http://support.intel.com/support/vpro/

2.11.2 Intel® Active Management Technology

When used with third-party management and security applications, Intel Active Management Technology (Intel® AMT) allows business owners and IT organizations to better discover, heal, and protect their networked computing assets.

Some of the features of Intel AMT include:

- Out-of-band (OOB) system access, to discover assets even while PCs are powered off
- Remote trouble-shooting and recovery, which allows remote diagnosis and recovery of systems after OS failures
- Hardware-based agent presence checking that automatically detects and alerts when critical software agents have been stopped or are missing

- Proactive network defense, which uses filters to block incoming threats while isolating infected clients before they impact the network
- Remote hardware and software asset tracking, helping to track computer assets and keep virus protection up-to-date
- Keyboard, video and mouse (KVM) remote control, which allows redirection of a managed system's video to a remote console which can then interact with it using the console's own mouse and keyboard



NOTE

Intel AMT requires a network connector and an Intel AMT enabled remote management console. Setup requires additional configuration of the platform.

For information about	Refer to
Intel® Active Management Technology	http://www.intel.com/technology/platform-technology/intel-amt/index.htm

2.11.3 Trusted Platform Module (TPM)

The TPM version 2.0 component is specifically designed to enhance platform security above-and-beyond the capabilities of today's software by providing a protected space for key operations and other security critical tasks. Using both hardware and software, the TPM protects encryption and signature keys at their most vulnerable stages—operations when the keys are being used unencrypted in plain-text form. The TPM shields unencrypted keys and platform authentication information from software-based attacks.

The NUC 12 Extreme platform utilizes the Intel Platform Trust Technology (Intel® PTT) only, while the NUC12 Pro X platform uses a discrete hardware based TPM solution.



NOTE

Support for TPM v2.0 requires a UEFI-enabled operating system, such as Microsoft Windows 11.

TPM/TCM 2.0-compliant devices:

Infineon SLB-9670VQ2.0

NationZ TCM-Z32H330TC TPM v2.0

2.12 Intel® Virtualization Technology

Intel® Virtualization Technology (Intel® VT-x) is a hardware-assisted technology that, when combined with software-based virtualization solutions, provides maximum system utilization by consolidating multiple environments into a single server or client.



NOTE

A processor with Intel VT does not guarantee that virtualization will work on your system. Intel VT requires a computer system with a chipset, BIOS, enabling software and/or operating system, device drivers, and applications designed for this feature.

For information about	Refer to
Intel® Virtualization Technology	http://www.intel.com/technology/virtualization/technology.htm

2.13 Intel® Virtualization Technology for Directed I/O

Intel® Virtualization Technology for Directed I/O (Intel® VT-d) allows addresses in incoming I/O device memory transactions to be remapped to different host addresses. This provides Virtual Machine Monitor (VMM) software with:

- Improved reliability and security through device isolation using hardware assisted remapping.
- Improved I/O performance and availability by direct assignment of devices.

For information about	Refer to
Intel® Virtualization Technology for Directed I/O	https://software.intel.com/en-us/node/139035?wapkw=vt+directed+io

2.14 Power Management

Power management is implemented at several levels, including:

- Software support through Advanced Configuration and Power Interface (ACPI)
- Hardware support:
 - Power Input
 - LAN wake capabilities
 - Wake from USB

2.14.1 ACPI

ACPI gives the operating system direct control over the power management and Plug and Play functions of a computer. The use of ACPI with this board requires an operating system that provides full ACPI support. ACPI features include:

- Plug and Play (including bus and device enumeration)
- Power management control of individual devices, add-in boards (some add-in boards may require an ACPI-aware driver), video displays, and hard disk drives
- Methods for achieving less than 15-watt system operation in the power-on/standby sleeping state
- A Soft-off feature that enables the operating system to power-off the computer
- Support for a front panel power and sleep mode switch

Table 3 lists the system states based on how long the power switch is pressed, depending on how ACPI is configured with an ACPI-aware operating system.

Table 3. Effects of Pressing the Power Switch

If the system is in this state...	...and the power switch is pressed for	...the system enters this state
Off (ACPI G2/G5 – Soft off)	Less than four seconds	Power-on (ACPI G0 – working state)
On (ACPI G0 – working state)	Less than four seconds	Soft-off/Standby (ACPI G1 – sleeping state) ^{Note}
On (ACPI G0 – working state)	More than six seconds	Fail safe power-off (ACPI G2/G5 – Soft off)
Sleep (ACPI G1 – sleeping state)	Less than four seconds	Wake-up (ACPI G0 – working state)
Sleep (ACPI G1 – sleeping state)	More than six seconds	Power-off (ACPI G2/G5 – Soft off)

Note: Depending on power management settings in the operating system.

2.14.1.1 System States and Power States

Under ACPI, the operating system directs all system and device power state transitions. The operating system puts devices in and out of low-power states based on user preferences and knowledge of how devices are being used by applications. Devices that are not being used can be turned off. The operating system uses information from applications and user settings to put the system into a low-power state.

Table 4 lists the power states supported by the board along with the associated system power targets. See the ACPI specification for a complete description of the various system and power states.

Table 4. Power States and Targeted System Power

Global States	Sleeping States	Processor States	Device States
G0 – working state	S0 – working	C0 – working	D0 – working state.
G1 – sleeping state	S3 – Suspend to RAM. Context saved to RAM.	No power	D3 – no power except for wake-up logic.
G1 – sleeping state	S4 – Suspend to disk. Context saved to disk.	No power	D3 – no power except for wake-up logic.
G2/S5	S5 – Soft off. Context not saved. Cold boot is required.	No power	D3 – no power except for wake-up logic.
G3 – mechanical off AC power is disconnected from the computer.	No power to the system.	No power	D3 – no power for wake-up logic, except when provided by battery or external source.

Notes:

1. Total system power is dependent on the system configuration, including add-in boards and peripherals powered by the system chassis' power supply.
2. Dependent on the standby power consumption of wake-up devices used in the system.

2.14.1.2 Wake-up Devices and Events

Table 5 lists the devices or specific events that can wake the computer from specific states.

Table 5. Wake-up Devices and Events

Devices/events that wake up the system...	...from this sleep state	Comments
Power switch	S3, S4, S5 ¹	
RTC alarm	S3, S4, S5 ¹	Monitor to remain in sleep state
LAN	S3, S4, S5 ^{1,3}	"S5 WOL after G3" must be supported; monitor to remain in sleep state
WIFI	S3, S4, S5 ^{1,3}	Monitor to remain in sleep state
Bluetooth	S3 ¹ , S4	
USB	S3, S4, S5 ^{1,2,3}	Wake S4, S5 controlled by BIOS option (not after G3)
PCIE	S3, S4	Via WAKE; monitor to remain in sleep state
HDMI CEC	S3, S4, S5 ¹	Emulates power button push

Notes:

1. S4 implies operating system support only.
2. Will not wake from Deep S4/S5. USB S4/S5 Power is controlled by BIOS. USB S5 wake is controlled by BIOS. USB S4 wake is controlled by OS driver, not just BIOS option.
3. Windows Fast startup will block wake from LAN and USB from S5.



NOTE

The use of these wake events from an ACPI state requires an operating system that provides full ACPI support. In addition, software, drivers, and peripherals must fully support ACPI wake events.

2.14.2 Hardware Support

The board provides several power management hardware features, including:

- Wake from Power Button signal
When resuming from an AC power failure, the computer returns to the power state defined in the BIOS. Available states are "Power On", "Stay Off", and "Last State".
- LAN wake capabilities
Enables remote wake-up of the computer through a network. The LAN subsystem monitors network traffic at the Media Independent Interface. Upon detecting a Magic Packet* frame, the LAN subsystem asserts a wake-up signal that powers up the computer.
- Wake from USB
USB bus activity wakes the computer from an ACPI S3 state (not after G3).



NOTE

The use of Wake from USB from an ACPI state requires an operating system that provides full ACPI support. Wake from USB requires the use of a USB peripheral that supports Wake from USB.

2.15 Audio Subsystem Software

Audio is supported through the HDMI 2.1 TMDS compatible port interface through the processor and supports eight full range channels of lossless audio formats per port. When using an encoded format (such as DTS-HD MA or Dolby True HD) the board supports a single 7.1 stream. When using an un-encoded format the board supports 8 discrete, un-encoded channels per HDMI port simultaneously, for a total of 16 discrete/un-encoded channels.

2.15.1 HDMI Audio Subsystem Software

HDMI Audio drivers are built into the Graphics driver and are available from Intel's website.

For information about

Obtaining NUC software and drivers

Refer to

<https://downloadcenter.intel.com>

2.15.2 Front Panel Audio Subsystem

The Intel® NUC 12 Extreme / Pro X Kit features an integrated front panel audio subsystem which supports the following features:

- Analog line-out/Analog Headphone/Analog Microphone (front panel jack)
 - Analog Speakers only (Stereo)
- Front Panel Audio Jack Support (see Figure 6 for 3.5 mm audio jack pin out):
 - Speakers only (Stereo)
 - Headphones only (Stereo)
 - Microphone only (mono)
 - Combo Headphone (Stereo)/Microphone (mono)



Pin Number	Pin Name	Description
1	Tip	Left Audio Out
2	Ring	Right Audio Out
3	Ring	Common/Ground
4	Sleeve	Audio In/MIC

Figure 6. 4-Pin 3.5 mm (1/8 inch) Audio Jack Pin Out



NOTE

When the NUC 12 Extreme Kit is in standby mode (S4) or Powered off (S5) power states the front panel audio codec may cause feedback when paired with powered speakers.

2.16 Connectors, Headers, and Expansion



CAUTION

Only the following connectors and headers have overcurrent protection: back panel USB, front panel USB, internal USB headers, PCI Express Slots, and M.2 slots.

All other connectors and headers are not overcurrent protected and should connect only to devices inside the computer's chassis, such as fans and internal peripherals. Do not use these connectors or headers to power devices external to the computer's chassis. A fault in the load presented by the external devices could cause damage to the computer, the power cable, and the external devices themselves.

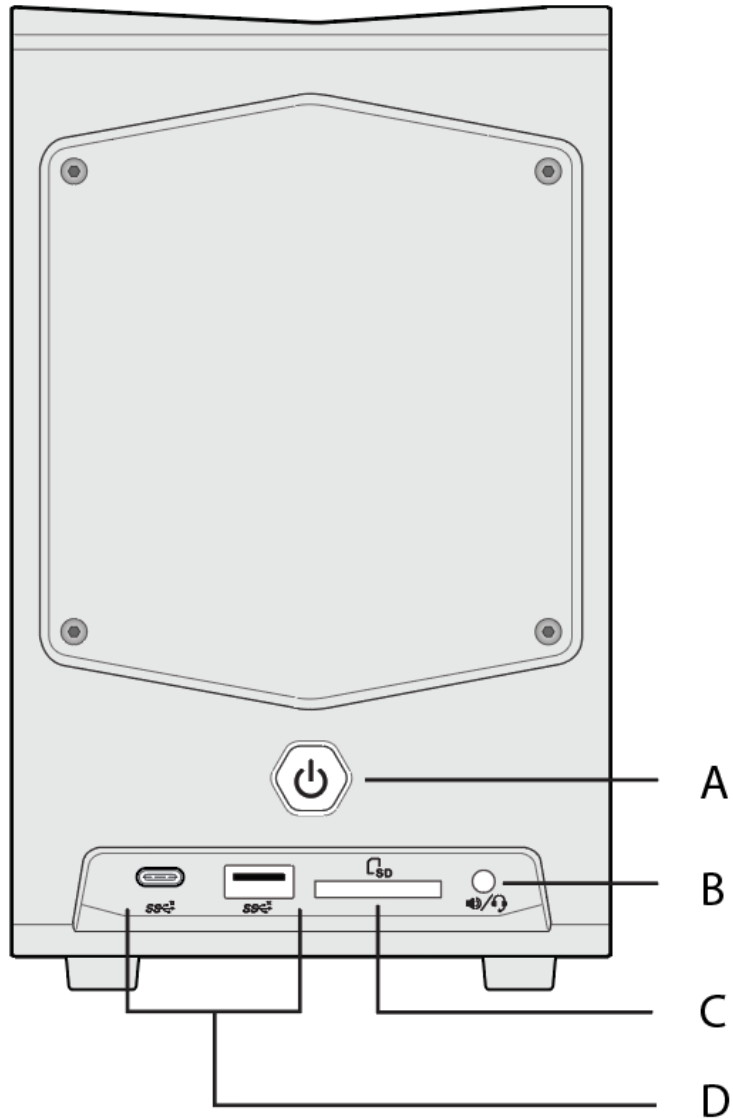
Furthermore, improper connection of USB header single wire connectors may eventually overload the overcurrent protection and cause damage to the board.

This section describes the board's connectors and headers. The connectors and headers can be divided into these groups:

- Front panel I/O connectors
- Back panel I/O connectors
- Baseboard connectors and headers
- Interior chassis connectors and headers
- NUC Element Extreme board connectors and headers

2.16.1 Front Panel Connectors

Figure 7 indicates the location of the front panel connectors present on the chassis.

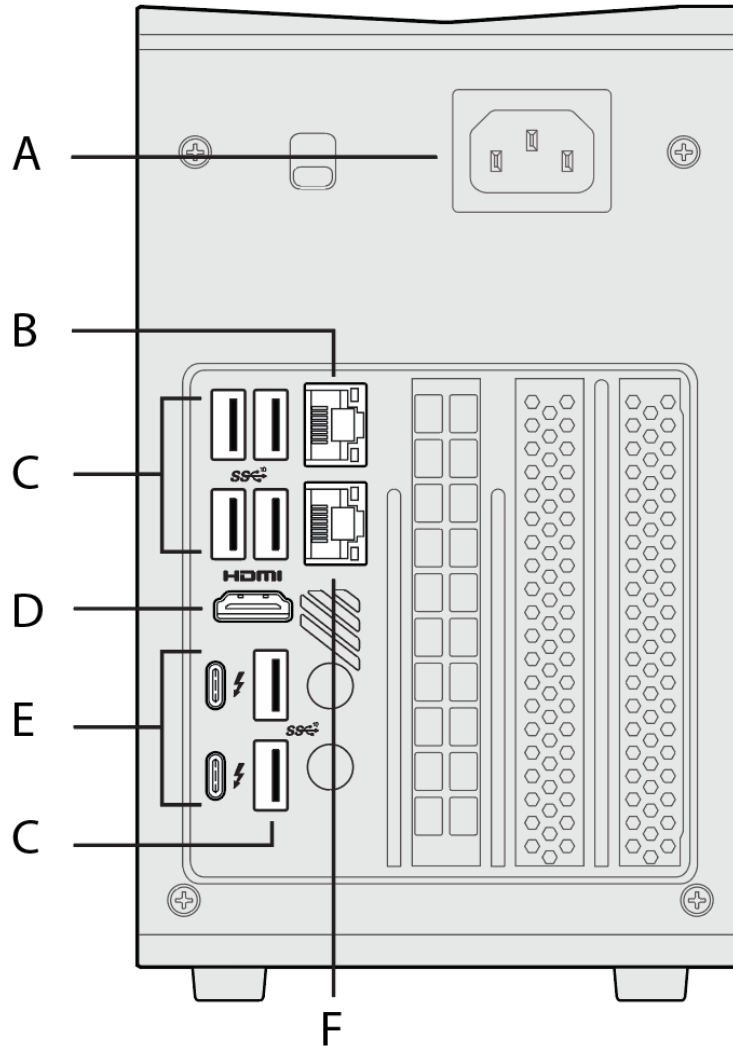


Item	Description
A	Power button (backlit)
B	3.5mm Speaker/Headset
C	UHS-II SDXC Reader
D	USB 3.1 Gen 2 Type A/C Ports (Black)

Figure 7. Front Panel Connectors

2.16.2 Back Panel Connectors

Figure 8 indicates the location of the back panel connectors present.



Item	Description
A	AC Power input (C13)
B	LAN Connector (AQC113-10Gbe)
C	USB 3.2 Gen 2 Type A Ports
D	HDMI Port
E	Thunderbolt 4 ports
F	LAN Connector (i225-LM)

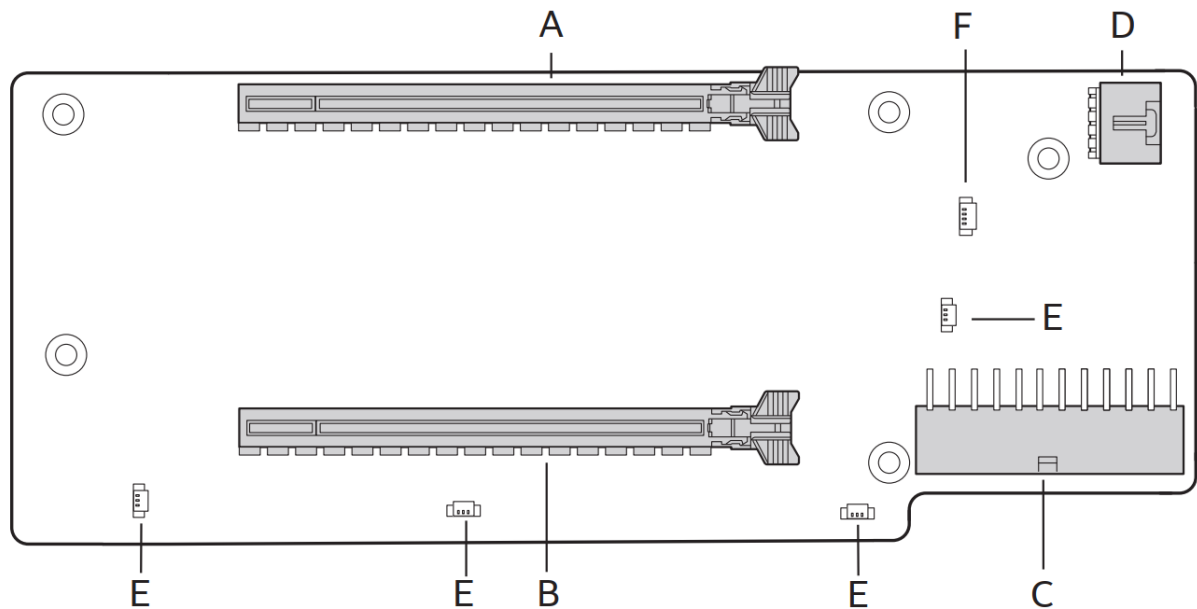
Figure 8. Back Panel Connectors

2.16.3 Baseboard Connectors

The NUC 12 Extreme / Pro X Kit has a baseboard that expands the connectivity of the NUC 12 Extreme / Pro X Compute Element through the usage of PCI Express lanes. Connectors that are used for expansion through the NUC Element gold fingers to the Baseboard are shown in Table 6. Figure 9 shows a top down view of all connectors and headers on the BBMC1B2 Baseboard.

Table 6. Intel BBMC1B2 Baseboard configuration

Connector Type	Description
PCIe 5.0 x16 Slot	The NUC Extreme Compute Element input connector (black)
PCIe 5.0 x16 Slot	PCIe 5.0 x16 standard compliant slot (blue)



Item	Description
A	NUC 12 Extreme / Pro X PCIe 5.0 x16 Slot input (black)
B	PCIe 5.0 x16 Slot (Blue)
C	Standard ATX Power input connector (24pin)
D	PMBUS 5pin header
E	Addressable RGB 5V LED Headers
F	4pin USB 2.0 input (interface to control RGB LEDs)

Figure 9. BBMC1B2 Baseboard Connectors

2.16.3.1 BBMC1B2 baseboard LED Switch location.

The Intel® NUC 12 Extreme / Pro X Kit features a bottom mounted LED toggle switch on the baseboard that is has a dedicated button for enabling or disabling the LEDs on the chassis.

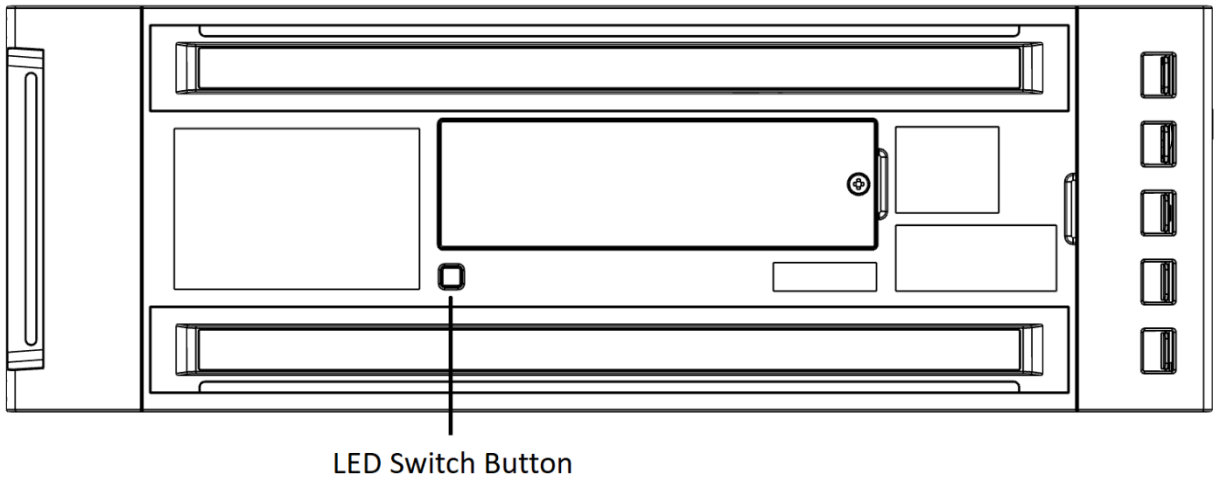
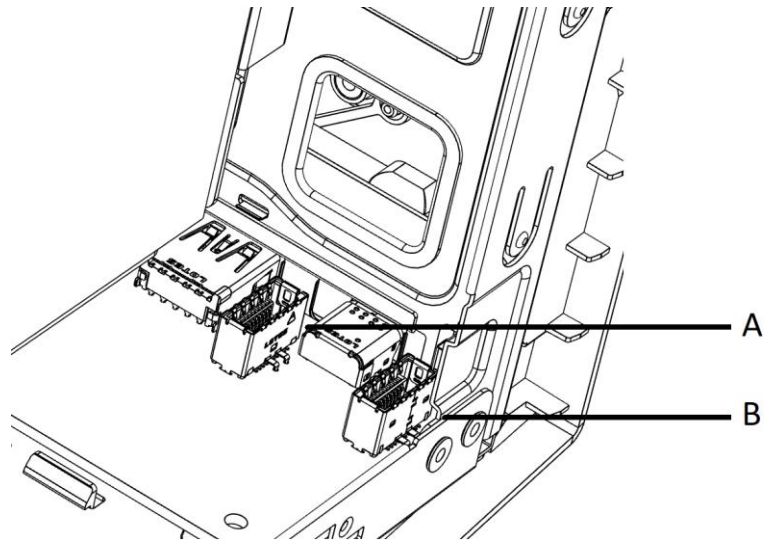


Figure 10. NUC 12 Extreme / Pro X Baseboard LED Switch location

2.16.4 Interior Chassis Connectors

The bottom front portion of the NUC 12 Extreme / Pro X chassis has interior headers that connect to the NUC 12 Extreme / Pro X Compute Element. Figure 11 shows a simplified view of the front panel connectors.



Item	Description
A	20pin Internal Desktop Type-C Key A Header
B	20pin Internal Desktop Type-C Key B Header

Figure 11. NUC 12 Extreme / Pro X Chassis Interior Front Panel Headers and Connectors

2.17 NUC 12 Extreme / Pro X Element Headers and Connectors

The NUC 12 Extreme / Pro X Compute Element contains headers and connectors necessary for function inside the NUC 12 Extreme / Pro X Kit. Figure 12 shows the headers and connectors that are utilized by default and for expansion.

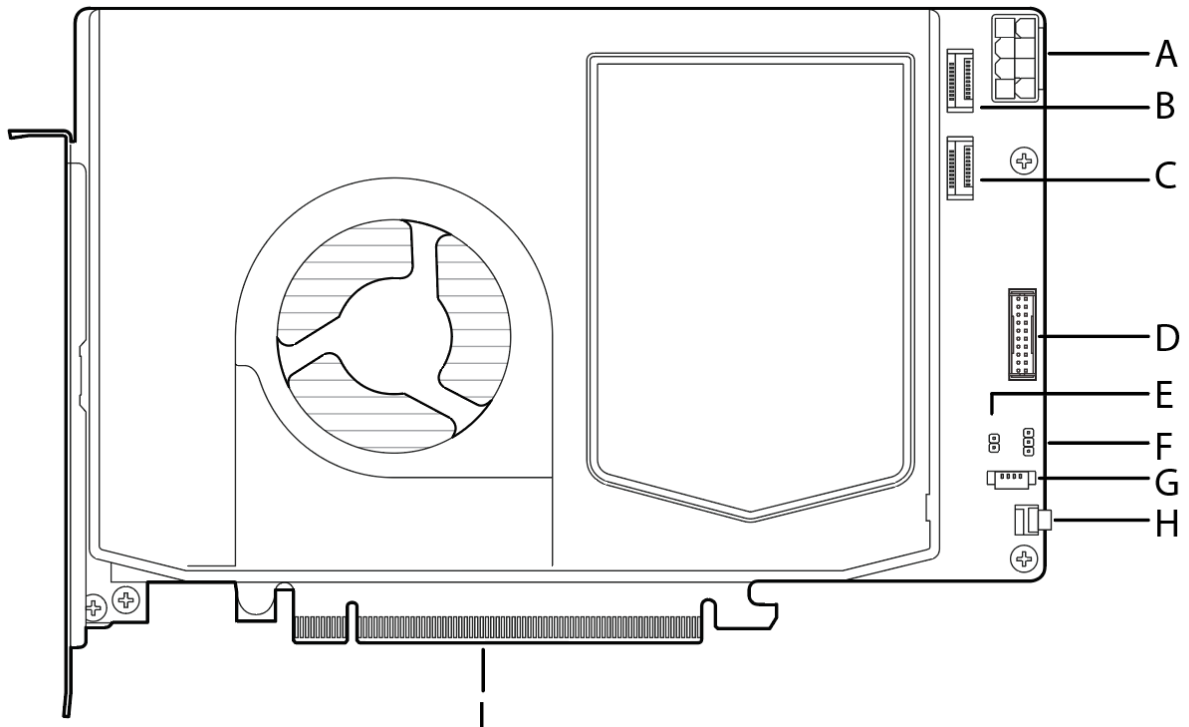


Figure 12. NUC 12 Extreme / Pro X Compute Element Headers and Connectors

Table 7. Components shown in Figure 12.

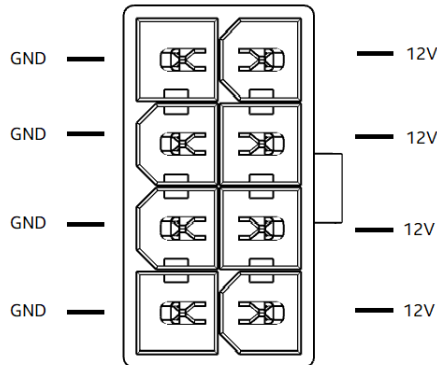
Item from Figure 12	Description
A	EPS 8 Pin Power Connector (see ATX Power Supply Specification Standard)
B	Internal USB 3.1 Gen 2 Type-C 20pin Header (Key B)
C	Internal USB 3.1 Gen 2 Type-C 20pin Header (Key A)
D	20pin Common IO Breakout connector
E	2-pin MEBX Reset Jumper
F	3-pin BIOS Security Jumper
G	NUC Card 4pin PWM Fan Header
H	Power Button
I	NUC 12 Extreme / Pro X Compute Element PCIe 5.0 x16 Gold Fingers

2.17.1 Signal Tables for Headers and Connectors

This section more clearly defines the pinouts and connector types used in Table 7.

A – EPS 8 Pin Power Connector

The EPS 8 Pin Power Connector follows the ATX standard layout and requirements. With one side being Ground and the opposite side with the connector lock being 12V. The NUC 12 Extreme / Pro X Compute element can utilize 12-19V input, while the NUC 12 Extreme / Pro X Kit provides the standard ATX 12V.



B - Internal USB 3.1 Gen 2 Type-C 20pin Header (Key B)

C, Internal USB 3.1 Gen 2 Type-C 20pin Header (Key B)	Pin Number	Signal	Pin Number	Signal
	1	Ground	11	Ground
	2	TX1+	12	TX2-
	3	TX1-	13	TX2+
	4	Ground	14	Ground
	5	RX1+	15	RX2-
	6	RX1-	16	RX2+
	7	Ground	17	Ground
	8	D1+	18	D2+
	9	D1-	19	D2-
	10	VBUS	20	VBUS

C - Internal USB 3.2 Gen 2 Type-C 20pin Header (Key A)

C, Internal USB 3.2 Gen 2 Type-C 20pin Header (Key A)	Pin Number	Signal	Pin Number	Signal
	1	VBUS	11	VBUS
	2	TX1+	12	TX2+
	3	TX1-	13	TX2-
	4	Ground	14	Ground
	5	RX1+	15	RX2+
	6	RX1-	16	RX2-

	7	VBUS	17	Ground
	8	CC1	18	D-
	9	SBU1	19	D+
	10	SBU2	20	CC2

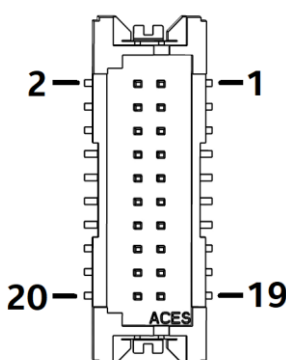
D - 20pin Common IO Header

The 20pin Common IO Header utilizes a “Molex Micro-Lock” or equivalent 1.25mm pitch connector which contains signals for the following types of headers.

2x USB 2.0 4 Pin Headers

1x 8pin Internal Dual PWM Fan Header

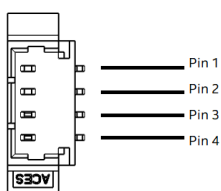
1x 10pin Front Panel Header (Power LED and Button)

Molex Micro-Lock equivalent	Pin Number	Signal	Pin Number	Signal
	1	USB_VBUS	2	GND
	3	USB1_N	4	USB2_P
	5	USB1_P	6	USB2_N
	7	GND	8	USB_VBUS
	9	GND	10	PWR_LED_P
	11	PWR_BTN_N	12	PWR_LED_N
	13	+12V_Slot	14	GND
	15	FAN_PWM1	16	FAN_PWM2
	17	FAN_TACH1	18	FAN_TACH2
	19	GND	20	+12V_Slot

Note that a fan-out cable is included that adapts the 20pin Common IO cable assembly into the individual headers listed below. Pin 13 and Pin 20 are powered by the +12V Slot power that is produced by an Element compatible baseboard design. If not connected to a baseboard these two FAN PWM headers capabilities are non-functional. Fan selection should use designs with less than 1A of power required.

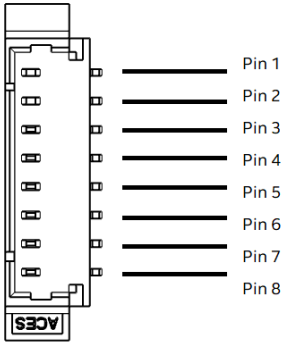
2x USB 2.0 4 pin Header

Molex part number 53398-0471, 1.25mm Pitch PicoBlade* Header, Surface Mount, Vertical, Lead-Free, 4 Circuits.

USB 2.0 Header	Pin Number	Pin Definition - Signal
	1	+5V DC power
	2	D – Data
	3	D + Data
	4	Ground

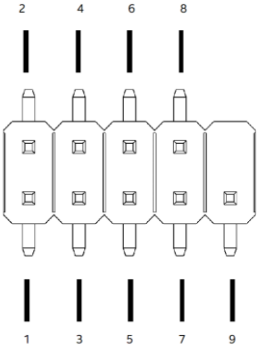
Internal 8pin Dual PWM Fan header

Molex part number 53398-0867, 1.25mm Pitch PicoBlade* Header, Surface Mount, Vertical, Lead-Free, 8 circuits.

Dual PWM Fan Header	Pin Number	Pin Definition - Signal
	1	Ground
	2	Ground
	3	Tachometer 1
	4	Pulse-Width Modulation (PWM) 1
	5	Tachometer 2
	6	Pulse-Width Modulation (PWM) 2
	7	+12V DC Power
	8	+12V DC Power

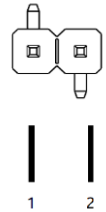
10-pin Front Panel IO Header

Connector is a 2 x 5, 2.0mm pitch connector.

Front Panel Header	Pin Number	Signal Name	Description
	1	N/C	N/C
	2	POWER_LED_MAIN	[Out] Front panel LED (main color)
	3	N/C	N/C
	4	POWER_LED_ALT	[Out] Front panel LED (alt color)
	5	N/C	N/C
	6	POWER_SWITCH#	[In] Power switch
	7	N/C	N/C
	8	GROUND	Ground
	9	N/C	N/C
	10	Key (EMPTY)	No Pin

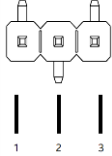
E – 2-pin MEBX Reset Jumper

Note* This header is non-functional on the NUC 9 Extreme

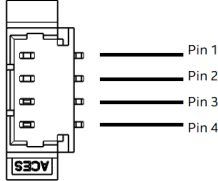
E, 2-pin MEBX Reset Jumper	Pin Setting	BIOS Security setting behavior
	Closed	Pins 1&2: jumper installed for RTCRST
	OPEN	No jumper: Normal operation

F – 3-pin BIOS Security Header

F, 3-pin BIOS Security Header	Pin Setting	BIOS Security setting behavior
	1 & 2	Pins 1&2: jumper position for Normal mode
	2 & 3	Pins 2&3: jumper position for Lockdown mode

	OPEN	No jumper: Recovery mode
---	------	--------------------------

G - NUC Card 4pin PWM Fan Header

G, NUC Blower 4pin PWM Header	Pin Number	Pin Definition - Signal
	1	Ground
	2	Tachometer
	3	+12V
	4	Pulse-Width Modulation (PWM)

2.18 Wireless Network Module

The Intel® NUC 12 Extreme / Pro X Kit / Compute Element comes with an Intel® WI-FI 6E AX211 module preinstalled into the M.2 2230 slot under the back plate.

For information about

Intel Wireless Technologies

Refer to

<http://www.intel.com/wireless>

2.19 Antenna Connectors

The NUC 12 Extreme / Pro X Kit wireless module has front and rear panel internal antennas that connect to the NUC 12 Extreme / Pro X Compute Element MMCX style connectors. For wireless and Bluetooth operation appropriate antennas will be required. Figure 13 shows the location of the two antenna connectors on the NUC 12 Extreme / Pro X Compute Element

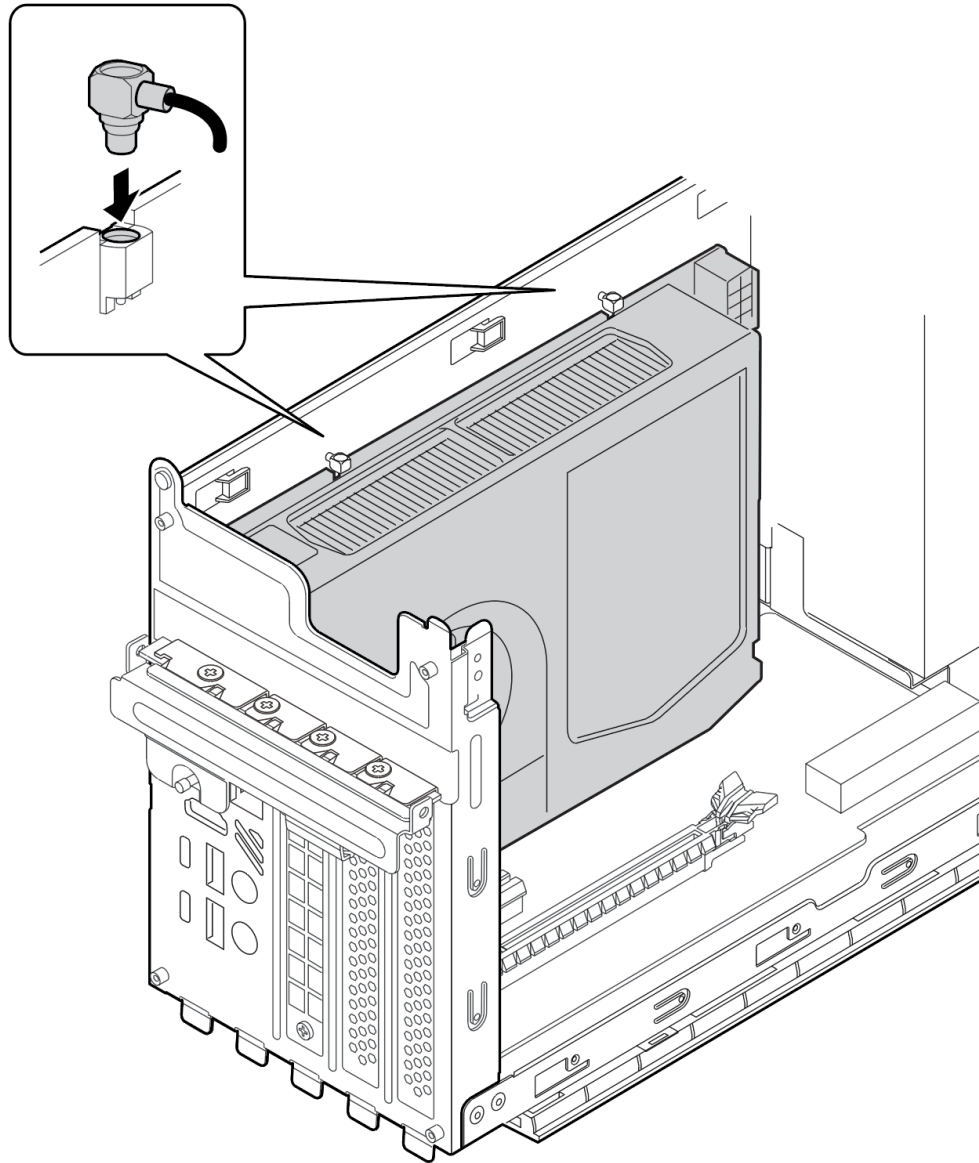


Figure 13. Location of the Antenna Connectors

The wireless module on the NUC 12 Extreme / Pro X Compute element is the Intel WIFI 6E AX211NGW and uses a standard 2x2 mm size RF micro coaxial receptacle (connector) with an outer diameter of 1.5 mm as defined in the PCI-E M.2 Specification, the coaxial receptacle is then changed to the MMCX Micromate style connector for more robust connection in chassis.

2.20 Internal Power Supply

The Intel® NUC 12 Extreme / Pro X Kit has an internal power supply that takes in AC 100-240V and outputs DC 12V, 3.3V, 5V, -12V, and 5Vsb.

The default power supply installed in the NUC 12 Extreme / Pro X Kit is a FSP650-57SAB-A 650W 80+Gold rated supply.

Table 8. Power supply rating table.

Model No. FSP650-57SAB-A					
AC Input	100-240V~, 10-5A, 60-50Hz				
DC Output	+3.3V	+5V	+12V	+5Vsb	-12V
	20.0A	20.0A	54.0A	2.5A	0.3A
	120W Max				
Total output continuous shall not exceed	650W				

The internal power supply FSP650-57SAB-A 650W features the following cables:

- EPS12V 8pin power connector for Intel® NUC Extreme Element
- PCI Express 8pin right angle power connector
- PCI Express 6+2pin straight power connector + 6+2 Daisy Chain*
- Standard ATX 24pin straight power connector



CAUTION

Disconnect the attached AC power cable before you open or service the device. Installing or removing devices from the Intel® NUC 12 Extreme / Pro X Kit while a power source is connected to the Kit may cause damage to the Intel® NUC 12 Extreme / Pro X Kit, operating system corruption, create a no boot condition or result in data loss.

2.21 Add-in Card Limitations

The Intel® NUC 12 Extreme / Pro X Kit supports the installation of add-in PCIe cards. The PCI Express 4.0 x16 and 4.0 x4 connectors on the baseboard mentioned in Section 2.16.3 are designed to accept PCI Express compliant devices. The table below demonstrates the maximum accepted dimensions and specifications for add-in cards.

Table 9. PCI Express Add-in Cards Limitations

Dimensions			
Add-in Card Type	Maximum Length	Maximum Width	Maximum Height
PCI Express 5.0 x16 Add-in Card Dual Slot	300mm	Dual Slot Spec limit Total 39mm (34.8mm Front components +2.7mm rear backplate +1.7mm PCB thickness)	131mm From Card edge to absolute top most component or cable of card

The maximum power consumption supported for add-in card design is 375W (150W from each PCI Express 6+2/8pin + 75W from PCI Express Slot).

For a list of validated and compatible add-in cards go to the Intel® Product Compatibility Tool

<https://compatibleproducts.intel.com/ProductDetails?activeModule=Intel%C2%AE%20NUC>

2.22 NUC 12 Extreme / Pro X Kit Dimensions

The following figures illustrate the mechanical form factor for the NUC 12 Extreme / Pro X Kit. All dimensions are shown in millimeters (mm).

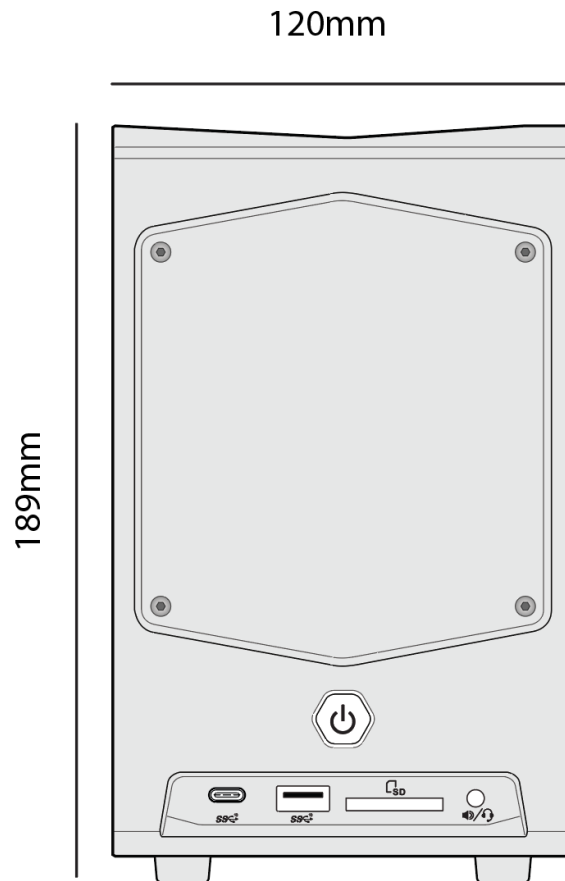


Figure 14. Front Side

120mm

189mm

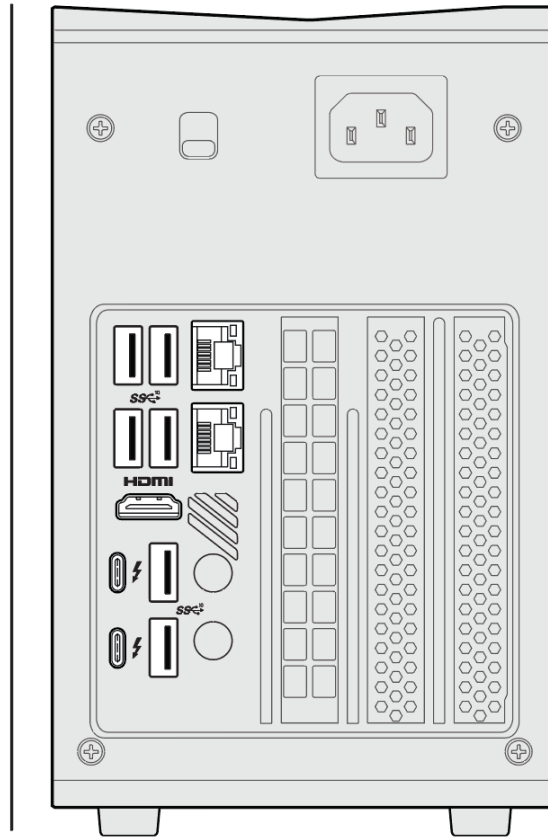


Figure 15. Back Side

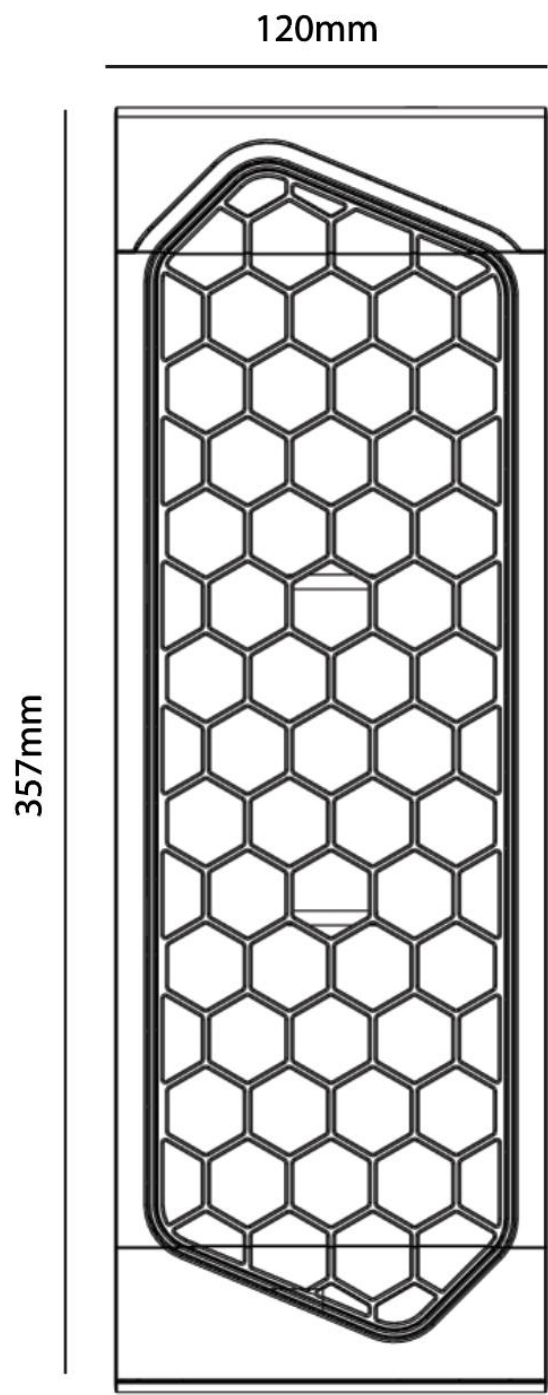


Figure 16. Top Side

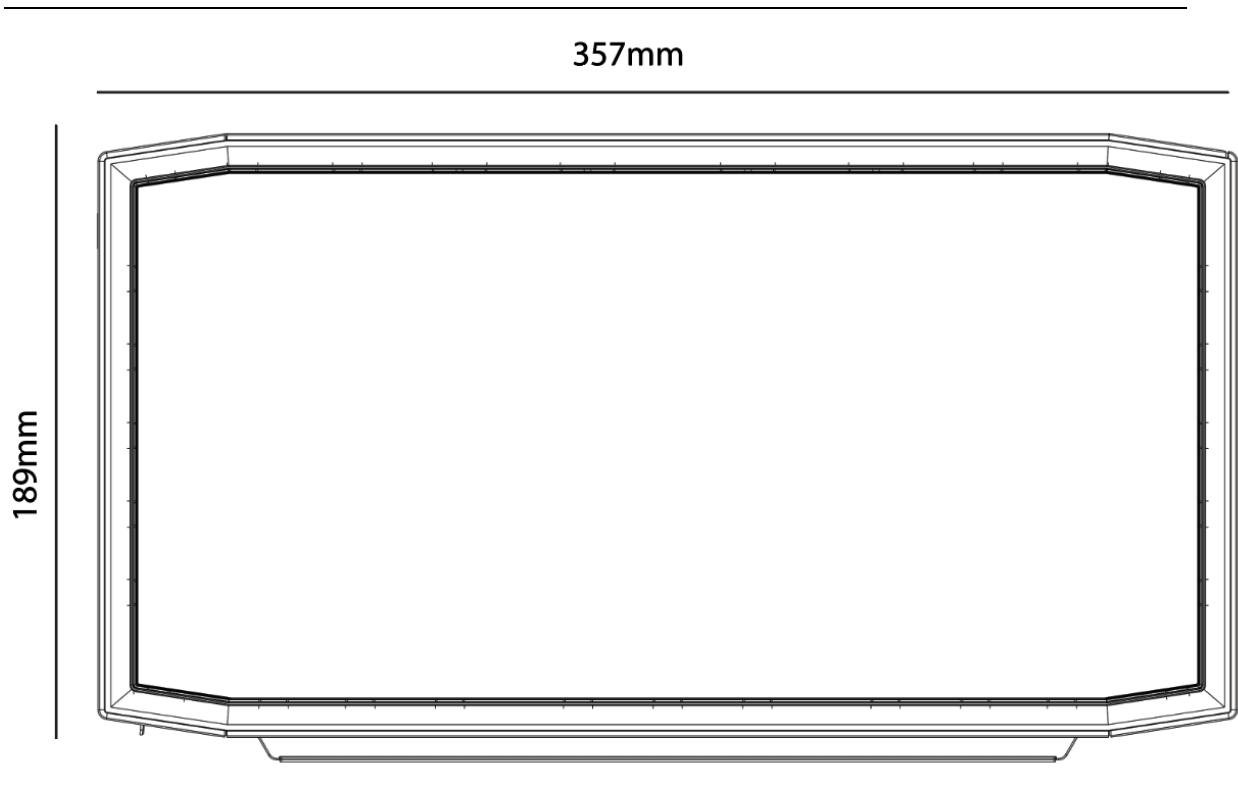


Figure 17. Side Panel

2.23 Thermal Considerations



CAUTION

The NUC 12 Extreme / Pro X Kit is designed to take in airflow from the sides through the ventilated panels and exhausts through the top. Failure to ensure appropriate airflow may result in reduced performance of both the processor and/or voltage regulator or, in some instances, damage to the board.

The NUC 12 Extreme / Pro X Kit features a chassis air guide which prevents pre-heated air from entering the CPU blower fan, failure to install this chassis air guide may result in reduced performance of both the processor and/or the voltage regulator.

All responsibility for determining the adequacy of any thermal or system design remains solely with the system integrator. Intel makes no warranties or representations that merely following the instructions presented in this document will result in a system with adequate thermal performance.



CAUTION

Ensure that the ambient temperature does not exceed the board's maximum operating temperature. Failure to do so could cause components to exceed their maximum case temperature and malfunction. For information about the maximum operating temperature, see the environmental specifications in Section 2.25.



CAUTION

Ensure that proper airflow is maintained in the processor voltage regulator circuit. Failure to do so may result in shorter than expected product lifetime.

2.24 Reliability

The demonstrated Mean Time Between Failures (MTBF) is done through 24/7 testing. Full Intel® NUC systems in chassis with memory, SSD or HDD, and fans are run at 100% of target PWM for 90 days while running system wide stress inducing software in a 35 °C ambient air temperature chamber. The demonstrated MTBF for Intel NUC 12 Extreme / Pro X Kit is 50,000 hours.

2.25 Environmental

Table 10 lists the environmental specifications for the Intel® NUC 12 Extreme / Pro X Kit.

Table 10. Environmental Specifications

Parameter	Specification		
Temperature			
Sustained Storage Limits (i.e. warehouse)	-20 °C to +40 °C		
Short Duration Limits (i.e. shipping)	-40 °C to +60 °C		
Ambient Operating – NUC Kit*	0 °C to +35 °C		
* Processor performance may automatically decrease when the system exceeds ambient operating temperature ranges above.			
Shock (Board)			
Unpackaged	25 g trapezoidal waveform		
	Velocity change of 170 inches/s ²		
Packaged	Free fall package drop machine set to the height determined by the weight of the package.		
	Product Weight (pounds)	Non-palletized Product drop height (inches)	Palletized drop heights (single product) (inches)
	<20	36	N/A
	21-40	30	N/A
	41-80	24	N/A
	81-100	18	12
	100-120	12	9
Vibration (System)			
Unpackaged	Random profile 5 Hz @ 0.001 g ² /Hz to 20 Hz @ 0.01 g ² /Hz(slope up)		
	20 Hz to 500 Hz @ 0.01 g ² /Hz (flat)		
	Input acceleration is 2.20g RMS		
Packaged	Random profile 5 Hz @ 0.01 g ² /Hz to 20 Hz @ 0.02 g ² /Hz(slope up)		
	20 Hz to 500 Hz @ 0.02 g ² /Hz (flat)		
	Input acceleration is 3.13g RMS		

Note: Before attempting to operate the Intel® NUC 12 Extreme / Pro X Kit, the overall temperature of the system must be above the minimum operating temperature specified. It is recommended that the system temperature be at least room temperature before attempting to power on the NUC 12 Extreme / Pro X Kit. The operating and non-operating environment must avoid condensing humidity.

2.26 Shipping Considerations for System Integrators

The Intel® NUC 12 Extreme / Pro X Kit is designed to properly integrate full length dual slot add-in-cards. Due to drop forces exerted on packages being shipped, it is recommended where possible to ship the add-in-card separately to avoid damage to the interior of the NUC 12 Extreme / Pro X Kit chassis or the add-in-card itself.

When shipping the add-in-card separately is not possible it is highly recommended to add ESD-Safe packing material in-between the add-in-card and the top fan shroud, as well as around the add-in-card to prevent vibration and the chance to dislodge the card mid shipment. Figure 18. Packaging Guidance notates possible locations for ESD-Safe packing material.

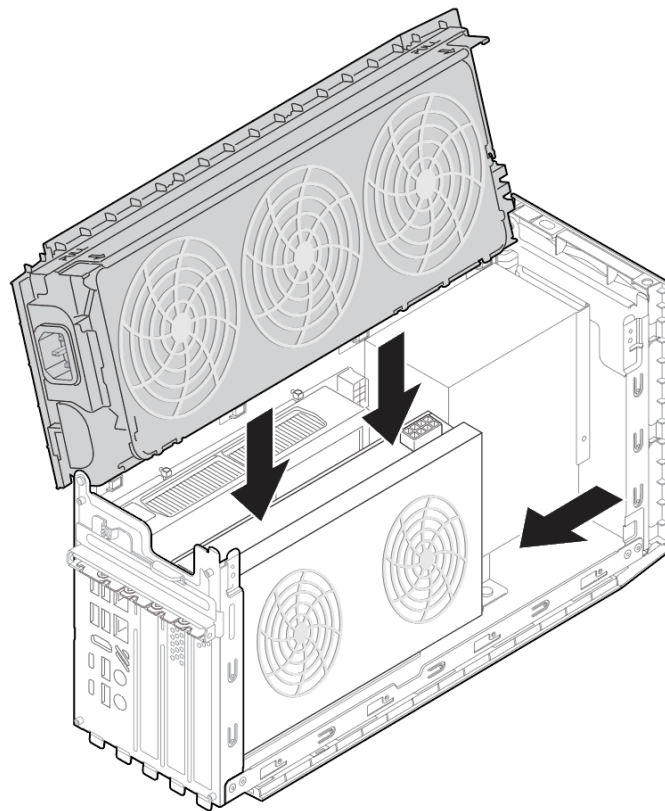


Figure 18. Packaging Guidance



NOTE

Packaging material must be removed from system prior to operation to maintain proper thermal performance of the NUC 12 Extreme / Pro X Kit.

3 Overview of BIOS Features

3.1 Introduction

The board uses Intel AMI BIOS core that is stored in the Serial Peripheral Interface Flash Memory (SPI Flash) and can be updated using a disk-based program. The SPI Flash contains the Visual BIOS Setup program, POST, the PCI auto-configuration utility, LAN EEPROM information, and Plug and Play support.

The BIOS displays a message during POST identifying the type of BIOS and a revision code. The initial production BIOSs are identified as TBD.

The Visual BIOS Setup program can be used to view and change the BIOS settings for the computer. The BIOS Setup program is accessed by pressing the <F2> key after the Power-On Self-Test (POST) memory test begins and before the operating system boot begins.



BIOS FLASH MEMORY ORGANIZATION

The Serial Peripheral Interface Flash Memory (SPI Flash) includes a 16 MB flash memory device.

3.2 System Management BIOS (SMBIOS)

SMBIOS is a Desktop Management Interface (DMI) compliant method for managing computers in a managed network.

The main component of SMBIOS is the Management Information Format (MIF) database, which contains information about the computing system and its components. Using SMBIOS, a system administrator can obtain the system types, capabilities, operational status, and installation dates for system components. The MIF database defines the data and provides the method for accessing this information. The BIOS enables applications such as third-party management software to use SMBIOS. The BIOS stores and reports the following SMBIOS information:

- BIOS data, such as the BIOS revision level
- Fixed-system data, such as peripherals, serial numbers, and asset tags
- Resource data, such as memory size, cache size, and processor speed
- Dynamic data, such as event detection and error logging

Non-Plug and Play operating systems require an additional interface for obtaining the SMBIOS information. The BIOS supports an SMBIOS table interface for such operating systems. Using this support, an SMBIOS service-level application running on a non-Plug and Play operating system can obtain the SMBIOS information. Additional board information can be found in the BIOS under the Additional Information header under the Main BIOS page.

3.3 Legacy USB Support

Legacy USB support is not offered with the Intel® NUC 12 Extreme / Pro X Kit or Intel® NUC 12 Extreme / Pro X Compute Element.

3.4 BIOS Updates

The BIOS can be updated using one of the following methods:

- Intel® Express BIOS Update utility, which enables automated updating while in the Windows environment. Using this utility, the BIOS can be updated from a file on a hard disk, a USB drive, a CD-ROM, or from the file location on the Web.
- Intel® F7 switch during POST allows a user to select where the BIOS Capsule file .CAP file is located and perform the update from that location/device. This is similar to performing a BIOS Recovery without removing the BIOS configuration jumper. The F7 switch supports FAT, FAT32, and NTFS format storage.

Both utilities verify that the updated BIOS matches the target system to prevent accidentally installing an incompatible BIOS.



NOTE

Review the instructions distributed with the upgrade utility before attempting a BIOS update.

For information about	Refer to
BIOS update utilities	https://www.intel.com/content/www/us/en/support/articles/000033291.html

3.4.1 Language Support

The BIOS Setup program and help messages are supported in US English. Check the Intel web site for support.

3.4.2 BIOS Recovery

It is unlikely that anything will interrupt a BIOS update; however, if an interruption occurs, the BIOS could be damaged. Table 11 lists the drives and media types that can and cannot be used for BIOS recovery. The BIOS recovery media does not need to be made bootable.

Table 11. Acceptable Drives/Media Types for BIOS Recovery

Media Type ^(Note)	Can be used for BIOS recovery?
Hard disk drive (connected to SATA or USB)	Yes
CD/DVD drive (connected to USB)	Yes
USB flash drive	Yes



NOTE

Supported file systems for BIOS recovery:

- *NTFS (sparse, compressed, or encrypted files are not supported)*
- *FAT32*
- *FAT16*
- *FAT12*

- *ISO 9660*

For information about**Refer to**

BIOS recovery

<https://www.intel.com/content/www/us/en/support/articles/000033291/>

3.5 Boot Options

In the BIOS Setup program, the user can choose to boot from a hard drive, optical drive, removable drive, or the network. The default setting is for the optical drive to be the first boot device, the hard drive second, removable drive third, and the network fourth.



NOTE

Optical drives are not supported by the onboard SATA connectors. Optical drives are supported only via the USB interfaces.

3.5.1 Network Boot

The network can be selected as a boot device. This selection allows booting from the onboard LAN or a network add-in card with a remote boot ROM installed.

Pressing the <F12> key during POST automatically forces booting from the LAN. To use this key during POST, the User Access Level in the BIOS Setup program's Security menu must be set to Full.



NOTE

Network boot options are only supported on the Intel i225-LM network adapter.

3.5.2 Booting Without Attached Devices

For use in embedded applications, the BIOS has been designed so that after passing the POST, the operating system loader is invoked even if the following devices are not present:

- Video cable
- Keyboard
- Mouse

3.5.3 Boot Device Selection During POST

Pressing the <F10> key during POST causes a boot device menu to be displayed. This menu displays the list of available boot devices. Table 12 lists the boot device menu options.

Table 12. Boot Device Menu Options

Boot Device Menu Function Keys	Description
<↑> or <↓>	Selects a default boot device
<Enter>	Exits the menu, and boots from the selected device
<Esc>	Exits the menu and boots according to the boot priority defined through BIOS setup

3.5.4 Power Button Menu

As an alternative to Back-to-BIOS Mode or normal POST Hotkeys, the user can use the power button to access a menu. The Power Button Menu is accessible via the following sequence:

1. System is in S4/S5 (not G3)
2. User pushes the power button and holds it down for 3 seconds
3. The system will emit three short beeps from the front panel (FP) audio port, then stop to signal the user to release the power button. The FP power button LED will also change from Solid White to Flashing White when the user can release the power button.
4. User releases the power button before the 4-second shutdown override

If this boot path is taken, the BIOS will use default settings, ignoring settings in VPD where possible.

At the point where Setup Entry/Boot would be in the normal boot path, the BIOS will display the following prompt and wait for a keystroke:

[ESC] Normal Boot
[F2] Intel Visual BIOS
[F3] Disable Fast Boot
[F4] BIOS Recovery
[F7] Update BIOS
[F10] Enter Boot Menu
[F12] Network Boot

[F2] Enter Setup is displayed instead if Visual BIOS is not supported.

[F3] Disable Fast Boot is only displayed if at least one Fast Boot optimization is enabled.

If an unrecognized key is hit, then the BIOS will beep and wait for another keystroke. If one of the listed hotkeys is hit, the BIOS will follow the indicated boot path. Password requirements must still be honored.

If Disable Fast Boot is selected, the BIOS will disable all Fast Boot optimizations and reset the system.

3.6 Hard Disk Drive Password Security Feature

The Hard Disk Drive Password Security feature blocks read and write accesses to the hard disk drive until the correct password is given. Hard Disk Drive Passwords are set in BIOS SETUP and are prompted for during BIOS POST. For convenient support of S3 resume, the system BIOS will automatically unlock drives on resume from S3. Valid password characters are A-Z, a-z, and 0-9. Passwords may be up to 19 characters in length.

The User hard disk drive password, when installed, will be required upon each power-cycle until the Master Key or User hard disk drive password is submitted.

The Master Key hard disk drive password, when installed, will not lock the drive. The Master Key hard disk drive password exists as an unlock override in the event that the User hard disk drive password is forgotten. Only the installation of the User hard disk drive password will cause a hard disk to be locked upon a system power-cycle.

Table 13 shows the effects of setting the Hard Disk Drive Passwords.

Table 13. Master Key and User Hard Drive Password Functions

Password Set	Password During Boot
Neither	None
Master only	None
User only	User only
Master and User Set	Master or User

During every POST, if a User hard disk drive password is set, POST execution will pause with the following prompt to force the user to enter the Master Key or User hard disk drive password:

“Enter Hard Disk Drive Password:”

Upon successful entry of the Master Key or User hard disk drive password, the system will continue with normal POST.

If the hard disk drive password is not correctly entered, the system will go back to the above prompt. The user will have three attempts to correctly enter the hard disk drive password. After the third unsuccessful hard disk drive password attempt, the system will halt with the message:

“Hard Disk Drive Password Entry Error”

A manual power cycle will be required to resume system operation.



NOTE

As implemented on Intel NUC 12 Extreme / Pro X Kit, Hard Disk Drive Password Security is only supported on M.2 ports 1 and 2 on the NUC 12 Extreme / Pro X Compute Element. The passwords are stored on the hard disk drive so if the drive is relocated to another computer that does not support Hard Disk Drive Password Security feature, the drive will not be accessible.

3.7 BIOS Security Features

The BIOS includes security features that restrict access to the BIOS Setup program and who can boot the computer. A supervisor password and a user password can be set for the BIOS Setup program and for booting the computer, with the following restrictions:

- The supervisor password gives unrestricted access to view and change all the Setup options in the BIOS Setup program. This is the supervisor mode.
- The user password gives restricted access to view and change Setup options in the BIOS Setup program. This is the user mode.
- If only the supervisor password is set, pressing the <Enter> key at the password prompt of the BIOS Setup program allows the user restricted access to Setup.
- If both the supervisor and user passwords are set, users can enter either the supervisor password or the user password to access Setup. Users have access to Setup respective to which password is entered.
- Setting the user password restricts who can boot the computer. The password prompt will be displayed before the computer is booted. If only the supervisor password is set, the computer boots without asking for a password. If both passwords are set, the user can enter either password to boot the computer.
- For enhanced security, use different passwords for the supervisor and user passwords.
- Valid password characters are A-Z, a-z, and 0-9. Passwords may be up to 16 characters in length.
- To clear a set password, enter a blank password after entering the existing password.

Table 14 shows the effects of setting the supervisor password and user password. This table is for reference only and is not displayed on the screen.

Table 14. Supervisor and User Password Functions

Password Set	Supervisor Mode	User Mode	Setup Options	Password to Enter Setup	Password During Boot
Neither	Can change all options (Note)	Can change all options (Note)	None	None	None
Supervisor only	Can change all options	Can change a limited number of options	Supervisor Password	Supervisor	None
User only	N/A	Can change all options	Enter Password Clear User Password	User	User
Supervisor and user set	Can change all options	Can change a limited number of options	Supervisor Password Enter Password	Supervisor or user	Supervisor or user

Note: If no password is set, any user can change all Setup options.

3.8 Error Messages

3.8.1 BIOS Error Messages

Table 15 lists the error messages and provides a brief description of each.

Table 15. BIOS Error Messages

Error Message	Explanation
CMOS Battery Low	The battery may be losing power. Replace the battery soon.
CMOS Checksum Bad	The CMOS checksum is incorrect. CMOS memory may have been corrupted. Run Setup to reset values.
Memory Size Decreased	Memory size has decreased since the last boot. If no memory was removed, then memory may be bad.
No Boot Device Available	System did not find a device to boot.

4 Characterized Errata

This section of the document communicates product Errata for the Intel® NUC 12 Extreme / Pro X Kit and the Intel® NUC 12 Extreme / Pro X Compute Element.

Errata are design defects or deviations from current published specifications for a given product. Published errata may or may not be corrected. Hardware and software designed to be used with any given processor stepping must assume that all errata documented for that process stepping are present on all devices.

There are no characterized errata at this time.