Intel® NUC Products NUC11PA[x]i3/NUC11PA[x]i5/ NUC11PA[x]i7

Technical Product Specification

Regulatory Models: NUC11PAK (Slim Kit/Mini PC)
NUC11PAH (Tall Kit/Mini PC)
NUC11PAQ (Kit/Mini PC Wireless Charging)

September 2021
Revision 5.0

Intel NUC NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 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 Intel NUC Products NUC11PA[x]i3/NUC11PA[x]i5/NUC11PA[x]i7 Specification Update.

Revision History

Revision	Revision History	Date
1.0	First release of Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 Technical Product Specification	January 2021
2.0	Second release of Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 Technical Product Specification	January 2021
3.0	Third release of Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 Technical Product Specification	April 2021
4.0	Fourth release of Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 Technical Product Specification	August 2021
5.0	Fifth release of Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 Technical Product Specification	September 2021

1.1 Disclaimer

This product specification applies to only the standard Intel NUC Board, Kit or System with BIOS identifier PATGL357.86A.

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Preface

This Technical Product Specification (TPS) specifies the board layout, components, connectors, power and environmental requirements, and the BIOS for Intel® NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7

Intended Audience

The TPS is intended to provide detailed, technical information about Intel® NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 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 features and hardware used on Intel NUC Boards NUC11PAB
2	A map of the resources of the Intel NUC Board
3	The features supported by the BIOS Setup program
4	A description of the BIOS error messages and POST codes
5	A description of the features of Intel NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5 and NUC11PA[x]i7

Typographical Conventions

This section contains information about the conventions used in this specification. Not all 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.
x.x A	Amperes.
*	This symbol is used to indicate third-party brands and names that are the property of their respective owners.

Board Identification Information

Basic Intel® NUC Board NUC11PA(x)i3 Identification Information

AA Revision	BIOS Revision	Notes
M11790-xxx	PATGL357.*vvvv.yyyy.dddd.tttt*	1,2,3

Notes:

1. Where, *v* = version, *y* = year, *d* = date, *t* = time
2. The AA number is found on a small label on the SO-DIMM sockets.
3. The Intel® Core™ i3-1115G4 processor is used on this AA revision consisting of the following component:

Device	Stepping	S-Spec Numbers
Intel Core i3-1115G4	B1	SRK02

Basic Intel® NUC Board NUC11PA(x)i5 Identification Information

AA Revision	BIOS Revision	Notes
K90634-xxx	PATGL357.*vvvv.yyyy.dddd.tttt*	1,2,3

Notes:

1. Where, *v* = version, *y* = year, *d* = date, *t* = time
2. The AA number is found on a small label on the SO-DIMM sockets.
3. The Intel® Core™ i5-1135G7 processor is used on this AA revision consisting of the following component:

Device	Stepping	S-Spec Numbers
Intel Core i5-1135G7	B1	SRK05

Basic Intel® NUC Board NUC11PA(x)i7 Identification Information

AA Revision	BIOS Revision	Notes
K90104-xxx	PATGL357.*vvvv.yyyy.dddd.tttt*	1,2,3

Notes:

1. Where, *v* = version, *y* = year, *d* = date, *t* = time
2. The AA number is found on a small label on the SO-DIMM sockets.
3. The Intel® Core™ i7-1165G7 processor is used on this AA revision consisting of the following component:

Device	Stepping	S-Spec Numbers
Intel Core i7-1165G7	B1	SRK02

Production Identification Information

Intel® NUC Products NUC11PA(x)i(x) Identification Information

Product Name	Intel® NUC Board	Differentiating Features
RNUC11PAKi3000	NUC11PAB M11790-xxx	Kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAHi3000		HDD-capable kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAQi30QA		HDD-capable kit with power adapter, Wireless Charging Lid, 500GB SSD, 8GB DDR4-3200 SDRAM, Microsoft Windows 10 Home, “Intel® NUC 11 Performance Mini PC, a Mini PC with Windows 10”
RNUC11PAKi5000	NUC11PAB K90634-xxx	Kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAHi5000		HDD-capable kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAQi5000		HDD-capable kit with power adapter, Wireless Charging Lid, and “Intel® NUC 11 Performance kit”
RNUC11PAQi50WA		HDD-capable kit with power adapter, Wireless Charging Lid, 500GB SSD, 16GB DDR4-3200 SDRAM, Microsoft Windows 10 Home, “Intel® NUC 11 Performance Mini PC, a Mini PC with Windows 10”
RNUC11PAKi7000	NUC11PAB K90104-xxx	Kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAHi7000		HDD-capable kit with power adapter, “Intel® NUC 11 Performance kit”
RNUC11PAQi7000		HDD-capable kit with power adapter, Wireless Charging Lid, and “Intel® NUC 11 Performance kit”
RNUC11PAQi70QA		HDD-capable kit with power adapter, Wireless Charging Lid, 500GB SSD, 16GB DDR4-3200 SDRAM, Microsoft Windows 10 Home, “Intel® NUC 11 Performance Mini PC, a Mini PC with Windows 10”

Notes:

The maximum supported memory speed of the Intel NUC Board NUC11PAB is 3200 MHz

Specification Changes or Clarifications

The table below indicates the Specification Changes or Specification Clarifications that apply to the Intel NUC Products NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7.

Specification Changes or Clarifications

Date	Type of Change	Description of Changes or Clarifications

Errata

Current characterized errata, if any, are documented in a separate Specification Update. See for the latest documentation.

Online Support

To Find Information About...	Visit this World Wide Web site:
Intel NUC Kit/Mini PC NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7	http://www.intel.com/NUC
Intel NUC Board/Kit/Mini PC Support	http://www.intel.com/NUCSupport
High level details for Intel NUC Kit/Mini PC NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7	https://ark.intel.com
BIOS and driver updates	https://downloadcenter.intel.com
Tested memory	http://www.intel.com/NUCSupport
Integration information	http://www.intel.com/NUCSupport
Processor datasheet	https://ark.intel.com
Regulatory documentation	http://www.intel.com/NUCSupport

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2 Product Description

2.1 Overview

2.1.1 Summary of Mini PC SKUs

Product Codes and MM#s for the SKUs below can be found at https://ark.intel.com.

Processor	Chassis	AC Cord (C5)	RAM	Storage	OS
Intel® Core™ i7-1165G7 Processor	Wireless Charging	US, EU, UK, AU, or No Cord	2 x 8 GB	500 GB Gen4 NVMe SSD	Win 10 Home
		CN			
Intel® Core™ i5-1135G7 Processor	Wireless Charging	US, EU, UK, AU, or No Cord	2 x 4 GB	500 GB Gen4 NVMe SSD	Win 10 Home
		CN			
Intel® Core™ i3-1115G4 Processor	Wireless Charging	US, EU, UK, AU, or No Cord	2 x 4 GB	500 GB Gen4 NVMe SSD	Win 10 Home
		CN			

[1] "WW" refers to worldwide

2.1.2 Summary of Kit and Board SKUs

Product Codes and MM#s for the SKUs below can be found at https://ark.intel.com.

Processor	Chassis	AC Cord (C5)	RAM	Storage
Intel® Core™ i7-1165G7 Processor	Slim	US, EU, or No Cord	-	-
	Tall	US, EU, UK, AU, IN or No Cord	-	-
		CN[2]	-	-
	Wireless Charging	US, EU, or No Cord	-	-
Intel® Core™ i5-1135G7 Processor	Slim	US, EU, or No Cord	-	-
	Tall	US, EU, UK, AU, IN or No Cord	-	-
		CN[2]	-	-
	Wireless Charging	US, EU, or No Cord	-	-
Intel® Core™ i3-1115G4 Processor	Slim	US, EU, or No Cord	-	-
		CN[2]	-	-
	Tall	US, EU, UK, AU, IN or No Cord	-	-
		CN[2]	-	-

[1] "WW" refers to worldwide
[2] "CN" refers to China

2.1.3 Feature Summary

Table 1 summarizes the major features of Intel® NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7.

Table 1. Feature Summary

Form Factor	4.0 inches by 4.0 inches 117mm x 117mm x 48mm for tall chassis, 117mm x 117mm x 54mm for tall chassis with Wireless Charging, 117mm x 117mm x 35mm for slim chassis, (including feet)
Processor **(one of 3 models)**	A soldered-down 11th generation Intel® Core™ i3-1115G4 dual-core processor with up to a maximum 28 W TDP (if thermal margin is available). • 3.00 GHz base frequency, 4.10 GHz turbo frequency, 4 threads • 6 MB Intel® Smart Cache • Intel® UHD Graphics • Integrated memory controller • Integrated PCH A soldered-down 11th generation Intel® Core™ i5-1135G7 quad-core processor with up to a maximum 28 W TDP (if thermal margin is available). • 2.40 GHz base frequency, 4.20 GHz turbo frequency, 8 threads • 8 MB Intel® Smart Cache • Intel® Iris Xe Graphics • Integrated memory controller • Integrated PCH A soldered-down 11th generation Intel® Core™ i7-1165G7 quad-core processor with up to a maximum 28 W TDP (if thermal margin is available). • 2.80 GHz base frequency, 4.70 GHz turbo frequency, 8 threads • 12 MB Intel® Smart Cache • Intel® Iris Xe Graphics • Integrated memory controller • Integrated PCH
Memory†	• 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 non-ECC memory • Support for 1.2 V low voltage JEDEC memory only Note: 2 Gb and 4 Gb memory technology (SDRAM Density) is not compatible
Graphics	• Integrated graphics support for processors with Intel® Graphics Technology: • One High Definition Multimedia Interface* (HDMI*) v2.0b back panel connector • 2 DisplayPort 1.4 signal via USB Type C front and back panel connectors • 1 DisplayPort 1.4 mDP Port back panel connector
Audio	• Intel® High Definition (Intel® HD) Audio via the HDMI and USB Type C interfaces through the processor • Realtek HD Audio via a stereo microphone/headphone 3.5 mm jack on the front panel • Quad digital microphone array (DMICS) connector (internal)
Storage	• SATA ports: — One SATA 6.0 Gbps port (black) for 2.5“ storage device • One SATA 6.0 Gbps port is reserved for an M.2 storage module supporting M.2 2242 and M.2 2280 (key type M) modules

	Note: Supports key type M (PCI Express* x4 and SATA)

Peripheral Interfaces	• Thunderbolt™ 3 ports:
	  • One port is implemented via the external front panel Type C connector
	  • One port is implemented via the external back panel Type C connector
	  • PD Modes Supported: TBT3, USB3, DP-alt/MF
	  • 18W, 15W, 7.5W, and 4.5W supported port bus power
	Visit this URL for more information about Thunderbolt™ technology
	• USB 3.2 (Gen 2/10 Gbps) Type A ports:
	  • One port is implemented via the external front panel connectors (blue)
	  • Two ports are implemented via the external back panel connectors (blue)
	• Consumer Infrared (CIR)

Expansion Capabilities	• One M.2 connector supporting M.2 2280 (key type M) modules • One Standard SDXC slot • Two Thunderbolt™ 3 via front and back panel USB Type C connectors
BIOS	• Intel® BIOS resident in the Serial Peripheral Interface (SPI) Flash device • Support for Advanced Configuration and Power Interface (ACPI), Plug and Play, System Management BIOS (SMBIOS), and Modern Standby
Instantly Available PC Technology	• Suspend to RAM support • Wake on PCI Express, LAN, front panel, CIR, and USB ports • Microsoft Modern Standby
LAN	Gigabit (10/100/1000/2500 Mbps) LAN subsystem using the Intel® I225V Gigabit Ethernet Controller
Hardware Monitor Subsystem	Hardware monitoring subsystem, based on an embedded controller, including: • Voltage sense to detect out of range power supply voltages • Thermal sense to detect out of range thermal values • One processor fan header • Fan sense input used to monitor fan activity • Fan speed control
Wireless	• Intel® Wi-Fi 6 AX201, 802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth 5.2 • Maximum Transfer speed up to 2.4 Gbps • Next Generation Form Factor (NGFF) 12x16 soldered-down package • Supports OFDMA, 1024QAM, Target Wake Time (TWT) and spatial reuse

Table 2. Additional Features

Chassis Expandability and Replaceable Lids	Intel® NUC Kits and Mini PCs NUC11PA(x) ship with a replaceable lid that allows you to replace the cover of the NUC with a full range of cosmetic and functional lids More information about Intel NUC replaceable lids is available on intel.com at this URL and https://intel.com/nuclidsupport
Wireless Charging Lid	Intel® NUC Kits and Mini PCs NUC11PAQx ship with a Wireless Charging lid attached. This lid is connected via the Wireless Charging header on the bottom of the board. See Section 4.2
HDMI CEC API	Built-in support for HDMI CEC is available on both HDMI ports, which may be enabled in the BIOS for display power control, as well as via an API supporting other HDMI CEC functions. More information about the HDMI CEC API specification is available on https://www.intel.com/content/www/us/en/support/articles/000056864/intel-nuc.html
Auto CMOS Reset	
Delayed AC Start	Short delay after AC power is applied before unit is ready to power on to protect the system against voltage fluctuations in environments where multiple devices are being powered on simultaneously

Kensington Security Slot	Available on the right side of the chassis when viewed from the front
VESA Mount	Intel® NUC Kits NUC11PA[x] ship with a VESA mount and screws for attaching the system to compatible screens and monitors More information about Intel NUC VESA mounts is available on intel.com at this URL

3 Product Layout

3.1 Board Layout

3.1.1 Board Layout (Bottom)

Figure 1 shows the location of the major components on the bottom of Intel® NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7

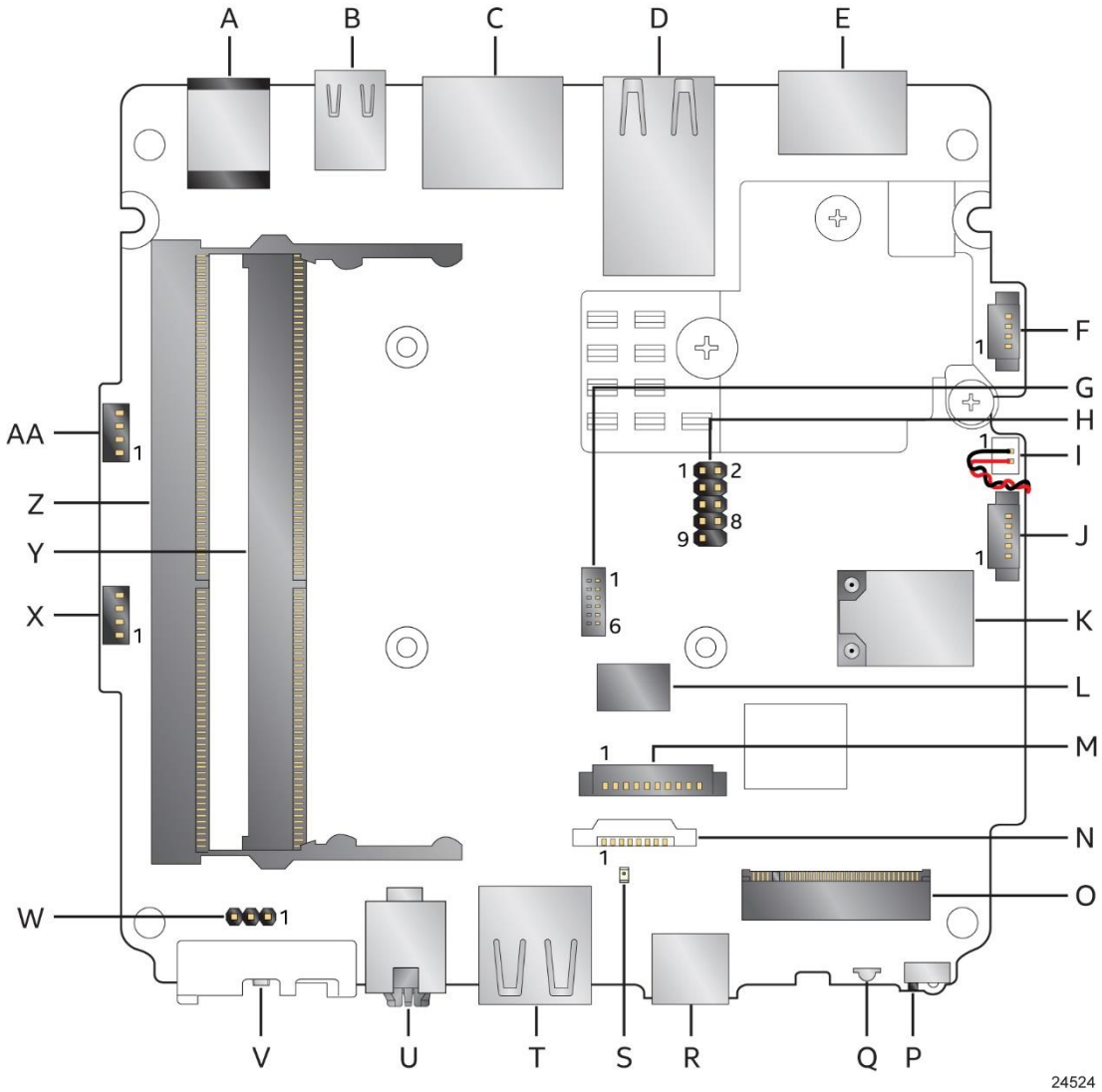


Figure 1. Major Board Components (Bottom) with Pin 1 Indicators

Table 3. Components Shown in Figure 1

Item from Figure 2	Description
A	DC Input Jack
B	mDP Jack
C	LAN connector
D	Dual USB 3.1 ports (blue)
E	HDMI 2.0b Jack
F	RGB LED Header
G	DMIC Connector
H	Front Panel Header
I	CPU Fan Header
J	Wireless Charging Lid Header
K	AX201 WIFI Connector
L	BIOS SPI Part
M	USB 3.0 Header
N	SATA HDD connector (0.5 mm pitch)
O	M.2 connector (key type M) for 2280 modules
P	Consumer Infrared (CIR) sensor
Q	HDD Activity LED
R	Front panel USB 3.2 Type-C connector
S	Power Indicator LED
T	USB 3.1 port (blue)
U	Front panel stereo microphone/headphone jack
V	Front panel power button
W	BIOS Security Jumper
X	Single-port USB 2.0 header (1.25 mm pitch)
Y	DDR4 SO-DIMM1 socket
Z	DDR4 SO-DIMM2 socket
AA	Consumer Electronics (CEC) Header

3.1.2 Board Layout (Top)

Figure 2 shows the location of the major components on the bottom-side of Intel® NUC Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7.

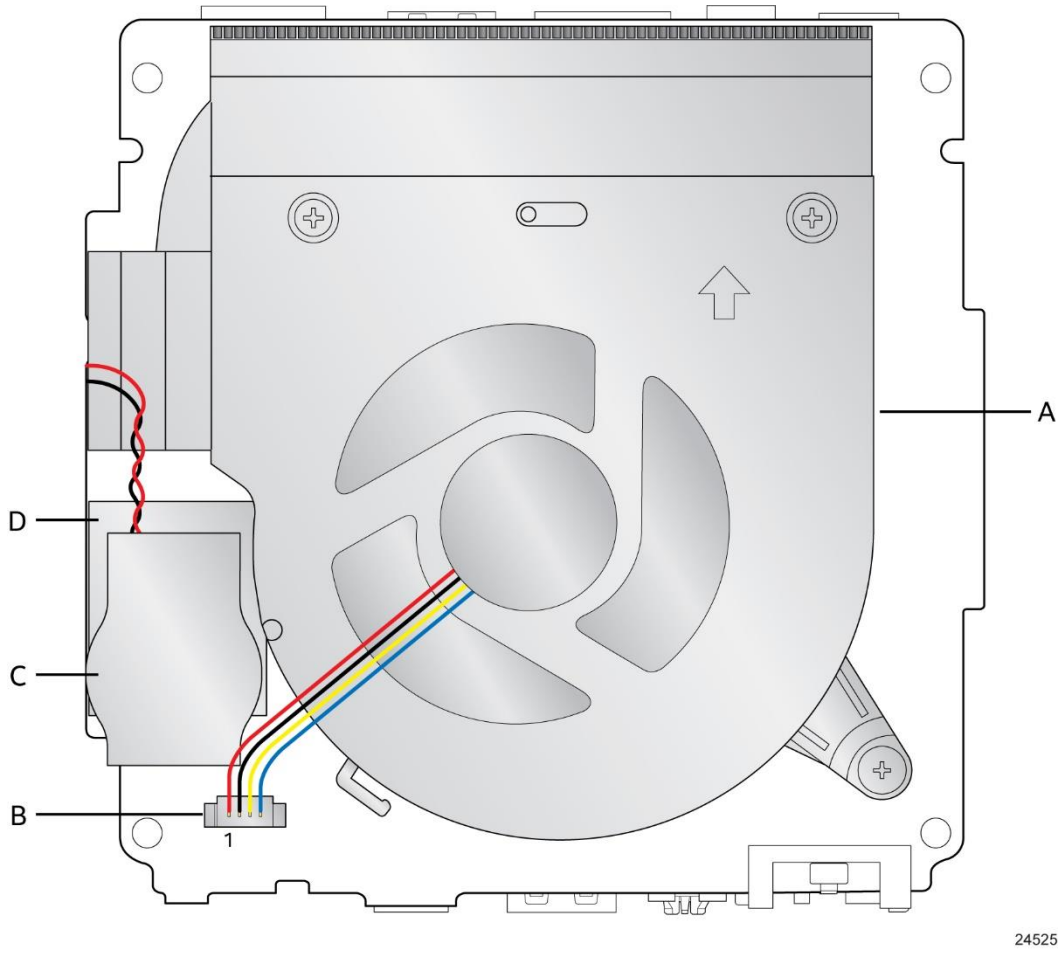
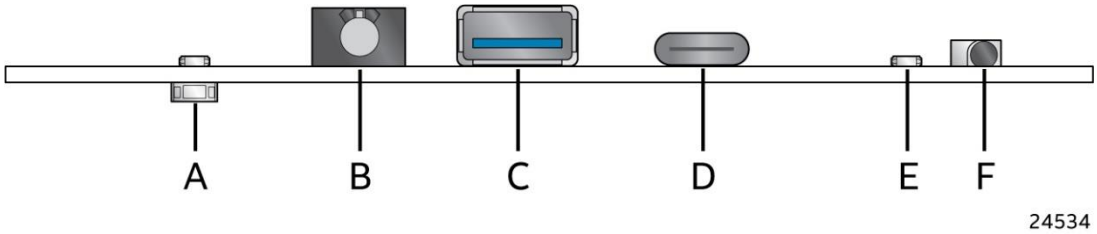


Figure 2. Major Board Components (Top)

Table 4. Components Shown in Figure 2

Item from Figure 2	Description
A	Fan and Thermal Solution
B	Fan Header
C	CMOS Battery
D	SD Card Reader

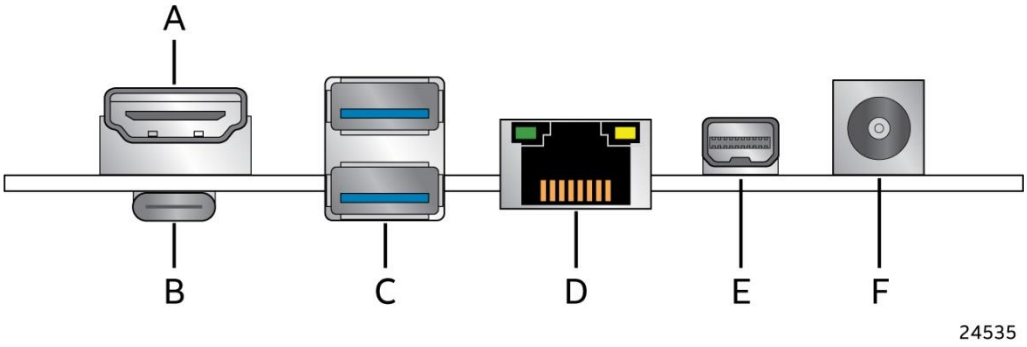
3.1.3 Front Panel



Item	Description
A	Front Panel Power Button
B	Audio Jack
C	USB 3.2 Gen 2 Port (blue)
D	Thunderbolt™ Port
E	HDD Activity LED
F	Consumer Infrared (CIR) sensor

Figure 3. Front Panel Connectors

3.1.4 Back Panel



Item	Description
A	HDMI 2.0b
B	Thunderbolt™ Port
C	USB 3.2 Gen 2 Ports
D	LAN Connector
E	mDP Port
F	19V DC Input Jack

Figure 4. Back Panel Connectors

3.1.5 Block Diagram

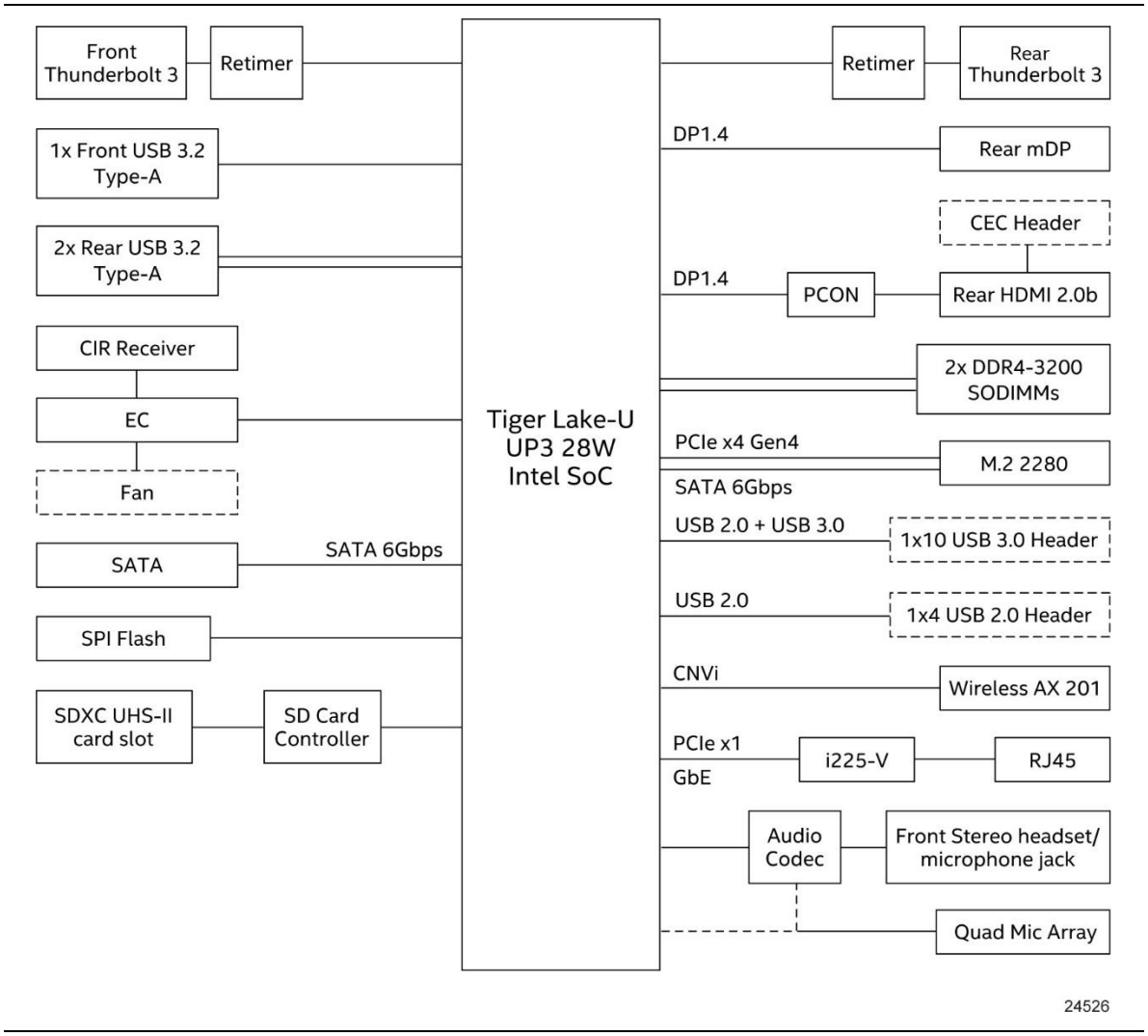


Figure 5. Block Diagram

4 Feature Descriptions

4.1 System Memory

Figure 1 illustrates the memory channel and SO-DIMM configuration.

4.1.1 Intel® NUC Mini PC Memory Information

Intel® NUC Mini PCs ship with 2 x 4 GB DDR4 3200 MHz SODIMMs or 2 x 8 GB DDR4 3200 MHz SODIMMs included. More information about available Intel® NUC Mini PCs NUC11PA can be found in Section 2.1.1 Summary of Mini PC SKUs.

4.2 Wireless Charging

Intel® NUC Kits and Mini PCs NUC11PAQ[x] features a Wireless Charging lid attached to the system. System will auto negotiate and use the highest supported charging mode. Supported charging modes are 5W, 7.5W, 15W (Fast Charging)

Table 5. Wireless Charging LED Behavior

LED	Behavior	Description	Other Indicators
Blue	Solid on for 4 seconds then off	Startup sequence and ready to accept device	Any other LED sequence indicates other faults and will continue until resolved. (OVP/UVP)
	Breathing on/off for 2-3 second periods for 60 seconds	Charging	
	Breathing on/off for 1 second periods for 3 cycles then off	Charging complete	
Red	Slow flash for 2 second periods for 60 seconds	Foreign object detected	
	Solid on for 60 seconds then off	Overheat	

Lid attaches via connector to bottom of board. See Figure 6 and Figure 1

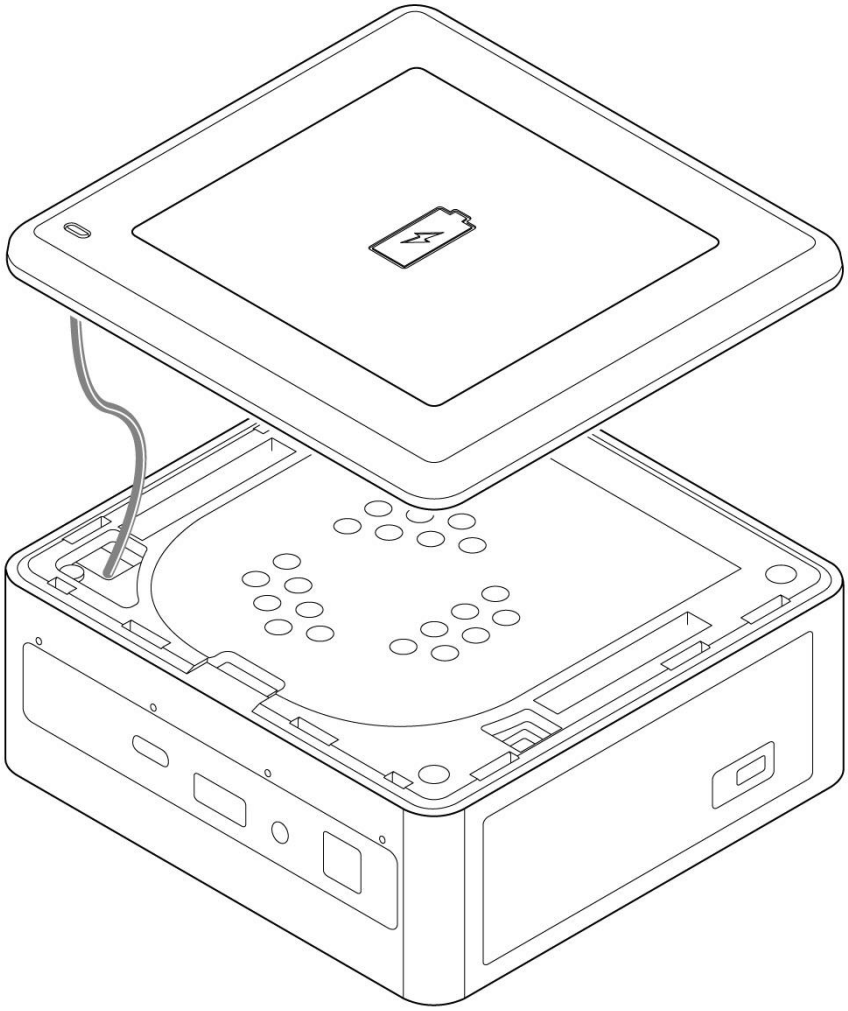


Figure 6. Wireless Charging Lid

4.3 Graphics Subsystem

Intel® NUC Kits and Mini PCs NUC11PA[x]i5, and NUC11PA[x]i7 support Intel® Iris® Xe Graphics. NUC11PA[x]i3 supports Intel® UHD Graphics

4.3.1 General Power and Memory Guidance for Optimal Graphics Performance

Intel® NUC Boards Kits and Mini PCs NUC11PA[x]i3, NUC11PA[x]i5, and NUC11PA[x]i7 graphics performance is significantly impacted by power levels and memory selection. For the best performance:

- Allow for higher system power level budgets

- Use DDR4-3200 32 GB and DDR4-3200 16 GB SODIMMs
    - 128bit (Dual Channel) memory is better performing than 64bit (Single Channel) memory
    - A full list of tested memory modules are available on https://compatibleproducts.intel.com

4.3.2 Intel® Iris Xe Graphics

Intel® Iris® Xe Graphics supports the following features:

- The HW decode is exposed by the graphics driver using the following APIs: Direct3D* 9 Video API (DXVA2), Direct3D11 Video API, Intel Media SDK, MFT filters, Intel VA API
    - Full HW accelerated video decoding for AVC/VC1/MPEG2/HEVC/VP9/JPEG/AV1
- The HW encode is exposed by the graphics driver using the following APIs: Intel Media SDK, MFT filters
    - Full HW accelerated video encoding for AVC/HEVC/VP9/JPEG
- Max resolution (with DSC or tiled screen) 7680x4320 at 60Hz[1,2]
- Max display frequency 1.3 GHz
- Up to quad 4K at 60Hz simultaneous displays
- Four display pipes – supporting blending, color adjustments, scaling and dithering
- Direct 3D* 2015, Direct3D* 12
- OpenGL* 4.5
- Open CL* 2.1
- HDR (High Dynamic Range) support
- HDCP (High-bandwidth Digital Content Protection) 2.3, 2.2, and 1.4

Notes:

1. Resolution support is subject to memory bandwidth availability
2. Single 8k at 60 Hz display, supported by monitors that accept dual input for tiled screen

4.3.3 Intel® UHD Graphics for 11th Gen Intel Processors

Intel® UHD Graphics for 11th Gen Intel Processors features the following:

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

4.3.4 Integrated Audio

HDMI and DP interfaces can carry audio along with video. The processor supports three HD audio streams over four digital ports simultaneously. The processor supports the following audio formats over HDMI and DP:

- AC-3 Dolby* Digital
- Dolby* Digital Plus
- DTS-HD*
- LPCM, 192 kHz/24 bit, 6 channel
- Dolby* TrueHD, DTS-HD Master Audio*

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

4.3.5 SATA Interface

The board provides the following SATA interfaces:

- One SATA 6.0 Gb/s combined Data and Power connector
  - Accepts up to 7mm in height 2.5" drives

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.

4.3.6 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 ºC with 3.3 VSB applied via the power supply 5 V STBY rail.

NOTE

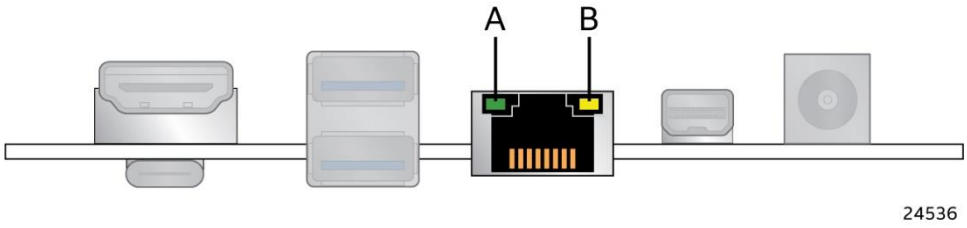
If the battery and AC power fail, date and time values will be reset and the user will be notified during the POST.

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 2 on page 20 shows the location of the battery.

4.4 LAN Subsystem

4.4.1 RJ-45 LAN Connector with Integrated LEDs

Two LEDs are built into the RJ-45 LAN connector (shown in Figure 7).



Item	Description
A	Link LED (Green)
B	Data Rate LED (Green/Yellow)

Figure 7. LAN Connector LED Locations

Table 6 describes the LED states when the board is powered up and the LAN subsystem is operating.

Table 6. LAN Connector LED States

LED	LED Color	LED State	Condition
Link	Green	Off	LAN link is not established
		Solid	LAN link is established
		Blinking	LAN activity is occurring
Data Rate	Green/Yellow	Off	10/100 Mb/s data rate is selected
		Yellow	1000 Mb/s data rate is selected
		Green	2500 Mb/s data rate is selected

4.5 Hardware Management Subsystem

4.5.1 Fan Monitoring

Fan monitoring can be implemented using third-party software.

4.5.2 System States and Power States

Table 7 describes the ACPI states supported by the processor.

Table 7. Systems States

State	Description
G0/S0/C0	**Full On:** CPU operating. Individual devices may be shut to save power. The different CPU operating levels are defined by Cx states.
GO/S0/Cx	**Cx State:** CPU manages C-states by itself and can be in lower power states.
G1	**Suspend-To-RAM (STR):** The system context is maintained in system DRAM, but power is shut to non-critical circuits. Memory is retained and refreshes continue. All external clocks are shut off; RTC clock and international oscillator clocks are still toggling.
G1/S4	**Suspend-To-Disk (STD):** The context of the system is maintained on the disk. All power is then shut to the system except to the logic required to resume. Externally appears the same as S5 but may have different wake events.
G2/S5	**Soft Off:** System context not maintained. All power is shut except for the logic required to restart. A full boot is required when waking.
G3	**Mechanical Off:** System context not maintained. All power shut except for the RTC. No "Wake" events are possible because the system does not have any power. This state occurs if the user removes the batteries, turns off a mechanical switch, or if the system power supply is at a level that is insufficient to power the "waking" logic.

4.5.2.1 Wake-up Devices and Events

Table 8 lists the devices or specific events that can wake the computer from specific states.

Table 8. Wake-up Devices and Events

Devices/events that wake up the system...	...from this sleep state	Comments
Power switch	S0iX, S4, S5[1]	
RTC alarm	S0iX, S4, S5[1]	Option for monitor to remain in sleep state
LAN	S0iX, S4, S5[1, 3]	"S5 WOL after G3" is supported; monitor to remain in sleep state
WIFI	S0iX, S4, S5[1, 3]	
Bluetooth	S0iX, S4[1]	
USB	S0iX, S4, S5[1, 2, 3]	Wake S4, S5 controlled by BIOS option (not after G3)
PCIe	S0iX, S4[1]	Via WAKE; monitor to remain in sleep state

HDMI CEC	S0iX, S4, S5[1]	Wake S4, S5 controlled by BIOS option

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-up 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.

5 Technical Reference

5.1 Connectors and Headers

CAUTION

Only the following connectors and headers have overcurrent protection: back panel USB Type A and Type C, front panel USB, internal USB headers, internal power header, and DC Vin jack.

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.

5.1.1 Signal Tables for the Connectors and Headers

Table 9. SATA Combined Data/Power Header

Pin	Signal Name	Pin	Signal Name
1	+5V (2A total for pins 1, 2, 3, 4 (0.5A per pin))	2	+5V (2A total for pins 1, 2, 3, 4 (0.5A per pin))
3	+5V (2A total for pins 1, 2, 3, 4 (0.5A per pin))	4	+5V (2A total for pins 1, 2, 3, 4 (0.5A per pin))
5	NC	6	NC
7	NC	8	DEVSLP
9	GND	10	GND
11	SATA_RX_P	12	SATA_RX_N
13	GND	14	SATA_TX_N
15	SATA_TX_P	16	GND

Connector is vertical 0.5mm contact pitch ZIF FPC/FFC with lock

Table 10. SDXC Card Reader Connector

Pin	Signal Name
1	CD/DAT3
2	CMD
3	VSS1
4	VDD1
5	CLK
6	VSS2
7	DAT0/RCLK+
8	DAT1/RCLK-
9	DAT2
10*	VSS3
11*	D0+
12*	D0-
13*	VSS4
14*	VDD2
15*	D1-
16*	D1+
17*	VSS5

The board has a full-sized Secure Digital (SD) card reader that supports the Secure Digital eXtended Capacity (SDXC) format, 4.0 specification, UHS-II bus speed.

NOTE

**Pins 10-17 added with UHS-II v4.0 specification. Not present on all SD cards.*

Table 11. Internal USB 2.0 Header (1.25 mm pitch)

Pin	Signal Name
1	5 V
2	D -
3	D +
4	GND

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

Table 12. M.2 2280 Module (Mechanical Key M) Connector

Pin	Signal Name	Pin	Signal Name
74	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	75	GND
72	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	73	GND
70	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	71	GND
68	SUSCLK(32kHz) (O)(0/3.3V)	69	PEDET (NC-PCIe)
66	Connector Key	67	N/C
64	Connector Key	65	Connector Key
62	Connector Key	63	Connector Key
60	Connector Key	61	Connector Key
58	N/C	59	Connector Key
56	N/C	57	GND
54	PEWAKE# (I/O)(0/3.3V) or N/C	55	REFCLKP
52	CLKREQ# (I/O)(0/3.3V) or N/C	53	REFCLKN
50	PERST# (O)(0/3.3V) or N/C	51	GND
48	N/C	49	PETp0
46	N/C	47	PETn0
44	N/C	45	GND
42	N/C	43	PERp0
40	N/C	41	PERn0
38	DEVSLP (O)	39	GND
36	N/C	37	PETp1
34	N/C	35	PETn1
32	N/C	33	GND
30	N/C	31	PERp1
28	N/C	29	PERn1
26	N/C	27	GND
24	N/C	25	PETp2
22	N/C	23	PETn2
20	N/C	21	GND
18	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	19	PERp2
16	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	17	PERn2
14	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	15	GND
12	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	13	PETp3
10	DAS/DSS# (I/O)/LED1# (I)(0/3.3V)	11	PETn3
8	N/C	9	GND
6	N/C	7	PERp3
4	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	5	PERn3
2	3.3V (4A total for pins 74, 72, 70, 18, 16, 14, 12, 4, 2 (0.5A per pin))	3	GND
		1	GND

5.1.1.1 Front Panel Header (2.0 mm Pitch)

This section describes the functions of the front panel header. Table 13 lists the signal names of the front panel header. Front Panel Header (2.0 mm Pitch) is a connection diagram for the front panel header.

Table 13. Front Panel Header (2.0 mm Pitch)

Pin	Signal Name	Description	Pin	Signal Name	Description
1	HDD_POWER_LED	Pull-up 750Ω to +5V	2	POWER_LED_MAIN	[Out] Front panel LED (main color) Pull-up 300Ω to +5V
3	HDD_LED#	[Out] HDD activity LED	4	POWER_LED_ALT	[Out] Front panel LED (alt color)
5	GROUND	Ground	6	POWER_SWITCH#	[In] Power switch
7	RESET_SWITCH#	[In] Reset switch	8	GROUND	Ground
9	+5V_DC (1A) (Vcc)	Power	10	Key	No pin

5.1.1.1.1 Hard Drive Activity LED Header

Pins 1 and 3 can be connected to an LED to provide a visual indicator that data is being read from or written to a hard drive. Proper LED function requires a SATA hard drive or optical drive connected to an onboard SATA connector.

5.1.1.1.2 Reset Switch Header

Pins 5 and 7 can be connected to a momentary single pole, single throw (SPST) type switch that is normally open. When the switch is closed, the board resets and runs the POST.

5.1.1.1.3 Power/Sleep LED Header

Pins 2 and 4 can be connected to a one- or two-color LED. Table 14 and Table 15 show the possible LED states.

Table 14. States for a One-Color Power LED

LED State	Description
Off	Power off
Blinking	Standby
Steady	Normal operation

Table 15. States for a Dual-Color Power LED

LED State	Description
Off	Power off
Blinking (white)	Standby
Steady (white)	Normal operation

NOTE

The LED behavior shown in Table 14 is default – other patterns may be set via BIOS setup.

5.1.1.1.4 Power Switch Header

Pins 6 and 8 can be connected to a front panel momentary-contact power switch. The switch must pull the SW_ON# pin to ground for at least 50 ms to signal the power supply to switch on or off (the time requirement is due to internal debounce circuitry on the board). At least two seconds must pass before the power supply will recognize another on/off signal.

5.1.1.2 BIOS Security Jumper

CAUTION

Do not move a jumper with the power on. Always turn off the power and unplug the power cord from the computer before changing a jumper setting. Otherwise, the board could be damaged.

Figure 8 shows the location of the BIOS Security Jumper. The 3-pin jumper determines the BIOS Security program's mode.

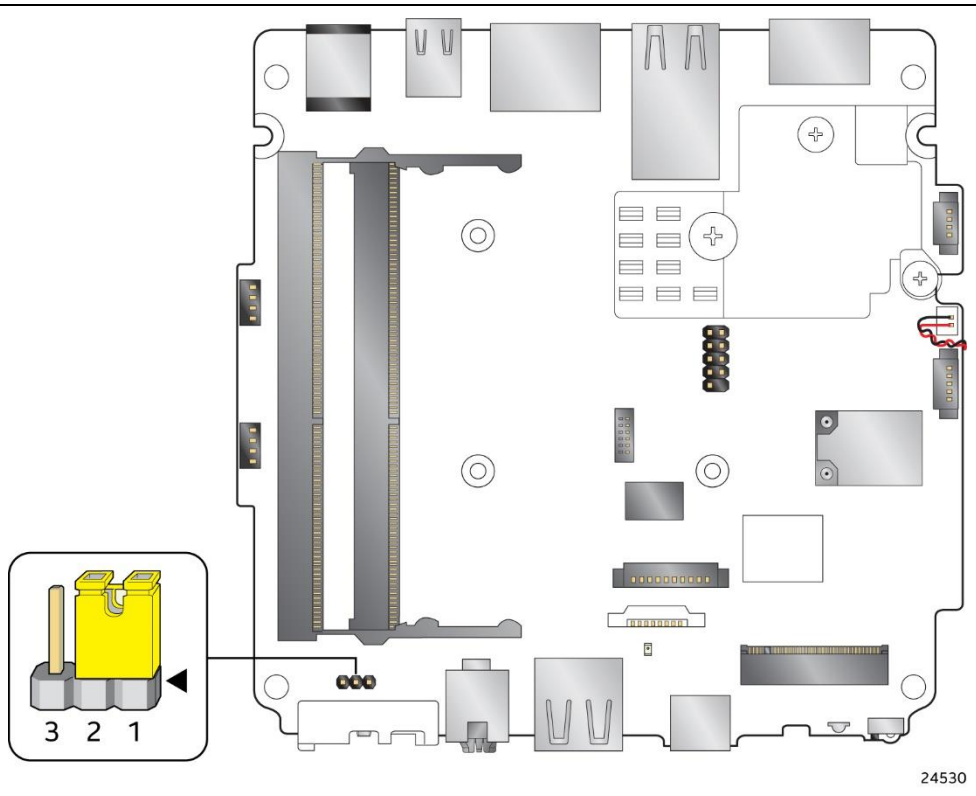


Figure 8. Location of the BIOS Security Jumper

Table 16 describes the jumper settings for the three modes: normal, lockdown, and configuration.

Table 16. BIOS Security Jumper Settings

Function/Mode	Jumper Setting	Configuration
Normal	1-2	The BIOS uses current configuration information and passwords for booting.
Lockdown	2-3	The BIOS uses current configuration information and passwords for booting, except: • All POST Hotkeys are suppressed (prompts are not displayed and keys are not accepted. For example, F2 for Setup, F10 for the Boot Menu). • Power Button Menu is not available (see Section 6.3.2 Power Button Menu). BIOS updates are not available except for automatic Recovery due to flash corruption.
Configuration	None	BIOS Recovery Update process if a matching *.bio file is found. Recovery Update can be cancelled by pressing the Esc key. If the Recovery Update was cancelled or a matching *.bio file was not found, a Config Menu will be displayed. The Config Menu consists of the following (followed by the Power Button Menu selections): [1] Suppress this menu until the BIOS Security Jumper is replaced. [2] Clear BIOS User and Supervisor Passwords. [3] Reset Intel® AMT to default factory settings. [4] Clear Trusted Platform Module. Warning: Data encrypted with the TPM will no longer be accessible if the TPM is cleared. [F2] Intel® Visual BIOS. [F4] BIOS Recovery. See Section 6.3.2 Power Button Menu

5.1.1.3 Fan Header Current Capability

Table 17 lists the current capability of the fan headers.

Table 17. Fan Header Current Capability

Fan Header	Maximum Available Current
Processor fan	1 A

5.1.1.4 Power Supply Connectors

NOTE *External power voltage, 19 (±5%) V DC, is dependent on the type of power supply used. System power requirements will depend on actual system configurations chosen by the integrator, as well as end user expansion preferences. It is the system integrator's responsibility to ensure an appropriate power budget for the system configuration is properly assessed based on the system-level components chosen.*

5.2 Mechanical Considerations

5.2.1 Form Factor

The board is designed to fit into a custom chassis. Figure 9 illustrates the mechanical form factor for the board. Dimensions are given in inches [millimeters]. The outer dimensions are 104.8 millimeters (front to back) by 105.7 millimeters (side to side).

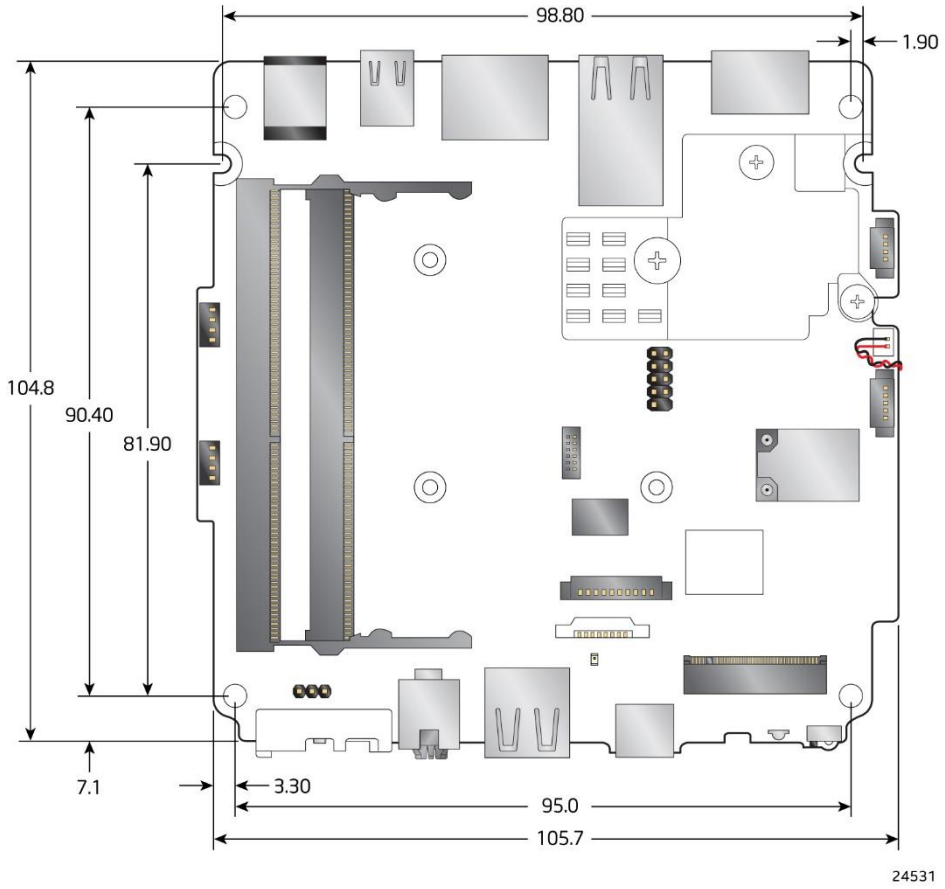


Figure 9. Board Dimensions

Figure 10 shows the height dimensions of the board. Dimensions are in mm.

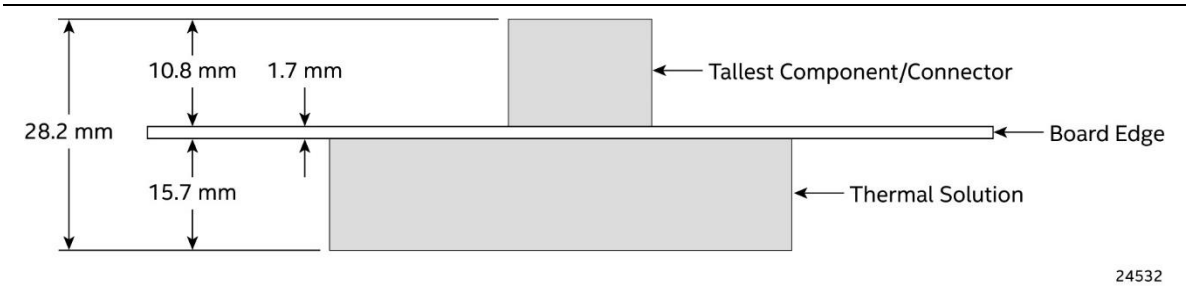


Figure 10. Board Height Dimensions

5.3 Thermal Considerations

CAUTION

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.

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 5.4.

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.

5.4 Environmental

Table 18 lists the environmental specifications for the board.

CAUTION

If the external ambient temperature exceeds 35 °C, further thermal testing is required to ensure components do not exceed their maximum operating temperature.

Table 18. 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		
Ambient Operating – NUC Board*	0 °C to +35 °C		
	* Processor performance may automatically decrease when the system operates in the top 5 °C of the ambient operating temperature ranges above.		
Shock (Board)			
Unpackaged	50 g trapezoidal waveform		
	Velocity change of 170 inches/s²		
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 to 40 Hz @ 0.015 g^2/Hz to 500 Hz @ 0.00015 g^2/Hz(slope down)		
	Input acceleration is 1.09 gRMS		
Packaged	Random profile 5 Hz to 40 Hz @ 0.015 g^2/Hz to 500 Hz @ 0.00015 g^2/Hz(slope down)		
	Input acceleration is 1.09 gRMS		

Note: The operating temperature of the board may be determined by measuring the air temperature from the junction of the heatsink fins and fan, next to the attachment screw, in a closed chassis, while the system is in operation.

Note: Before attempting to operate this board, the overall temperature of the board must be above the minimum operating temperature specified. It is recommended that the board temperature be at least room temperature before attempting to power on the board. The operating and non-operating environment must avoid condensing humidity.

6 Overview of BIOS Features

6.1 Introduction

The board uses an Intel AMI BIOS core that is stored in the Serial Peripheral Interface Flash Memory (SPI Flash) and can be updated through multiple methods (see Section 6.2). The SPI Flash contains the BIOS Setup program, POST, the PCI auto-configuration utility, LAN EEPROM information, and Plug and Play support. The SPI Flash includes a 256 MB flash memory device.

The BIOS Setup program can be used to view and change the identification information and the BIOS settings for the system. The BIOS Setup program is accessed by pressing <F2> after the POST memory test beings and before the operating ssystem boots.

6.2 BIOS Updates

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

1. Express BIOS (Windows-based) Update
2. F7 Update
3. Power Button Menu Update
4. UEFI Shell Update

More information and instructions on how to use each of these methods can be found at BIOS Update and Recovery Instructions. All BIOS update files for Intel NUCs are available on Download Center.

6.2.1 BIOS Recovery

It is unlikely that anything will interrupt a BIOS update; however, if an interruption occurs the BIOS could be unstable. Table 19 lists the drives and media types that can be used for BIOS recovery. The BIOS recovery media does not need to be made bootable. More information about BIOS recovery methods and instructions can be found at BIOS Update and Recovery Instructions.

Table 19. Acceptable Drives/Media Type for BIOS Recovery

Media Type (Note)	Can be used for BIOS recovery?
Hard disk drive (connected to SATA or USB)	Yes
USB flash drive	Yes
NVME SSD (M.2 interface)	Yes

NOTE *Supported file systems for BIOS recovery: NTFS (sparse, compressed, or encrypted files are not supported), FAT32, EXT*

6.3 Boot Options

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

NOTE *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.*

6.3.1 Boot Device Selection During Post

Pressing the <F10> key during POST causes a boot device menu to be displayed. The menu displays the list of available boot devices.

6.3.2 Power Button Menu

As an alternative to Configuration Mode or normal POST hotkeys, the user can use the power button to access a menu with BIOS and boot options. 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 Front Panel Power Button LED will be on for the first 3 seconds. After 3 seconds, the LED will begin to blink in the following pattern: 0.25 seconds off, 0.25 seconds on, 0.25 seconds off to signal the user to 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:

   If an unrecognized key is hit, then the BIOS will do nothing 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.

Table 20. Power Button Menu Options

Keystroke	Option	Description
[ESC]	Normal Boot	
[F2]	BIOS Setup Menu	
[F3]	Disable Fast Boot	Note: Will only be displayed if at least one Fast Boot optimization is enabled. If Disable Fast Boot is selected, the BIOS will disable all Fast Boot optimizations and reset the system.
[F4]	BIOS Recovery	The BIOS will search for a matching .CAP file from the \EFI\Intel folder in the supported media with the supported file system. If a matching recovery capsule is found, the BIOS will display the following: **BIOS will Recover to <BIOSID> in 20 seconds.** **[ESC] Cancel Recovery** Recovery will proceed if not cancelled via the ESC key within 20 seconds. The BIOS shall display the recovery progress. If a BIOS .CAP file was not detected (or the BIOS Recovery was cancelled) then the BIOS will reset the system and continue normally to POST.

[F5]	Restore BIOS Settings	The BIOS will restore the current setup settings and the current defaults to the build time defaults in the case of a boot issue caused by setup variable changes.
[F7]	Update BIOS	BIOS Update during the BDS phrase. The BIOS will update independent of any OS loading and provides a menu UI accessible during boot up. This is not a recovery tool and will not overwrite a corrupt BIOS or ME firmware.
[F9]	Remote Assistance	Note: Will only be displayed if Remote Assistance is supported.
[F10]	Enter Boot Menu	
[F12]	Network Boot	

6.4 Hard Disk Drive Password Security Feature

The Hard Disk Drive Password Security feature blocks ready and write access to the hard disk drive until the correct password is given. Hard disk drive passwords are set in BIOS Setup and are prompted for BIOS POST. For convenient support for resuming from S3, 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 32 characters in length.

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

The Master Key hard disk drive password, when set, will not lock the drive. The Master Key hard disk drive password exists as an unlock override if the User hard disk drive password is forgotten. Only the User hard disk drive password, when set, will cause a hard disk to be locked on a system power cycle. Table 21 show the effects of setting the hard disk drive passwords.

Table 21. Master Key and User Hard Disk Drive Password Functions

Password Set	Password During Boot
Neither	None
Master only	None
User only	User only
Master and User Set	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 the 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 attempt, the system will halt with the following message:

"Hard Disk Drive Password Entry Error"

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

NOTE *As implemented on the Intel NUC11PAB board, the hard disk drive password security feature is only supported on the SATA Port 0 (M.2) or the SATA port 1 (onboard SATA connector).*

6.5 BIOS Security Features

The BIOS includes security features that restrict access to the BIOS Setup program and who can boot the computer. A Supervisor and User password can be set for the BIOS Setup program and for botting 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 Supervisor Mode.
- The User password gives restricted access to view and change Setup options in the BIOS Setup program. This is 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 or User password to access Setup. Users have access to Setup regardless to which password is used.
- Setting the User password restricts who can boot the computer. The password prompt will be displayed before the computer boots. 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, 0-9, and special characters. Passwords may be up to 20 characters in length.
- To clear a set password, enter a blank password after entering the existing password.

Table 22 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 22. Supervisor and User Password Functions

Password Set	Supervisor Mode	User Mode	Setup Options	Password to Enter Setup	Password During Boot
Neither	Any user can change all options	Any user can change all options	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

6.6 BIOS Error Messages

Table 23 lists the error messages and provides a brief description of each.

Table 23. BIOS Error Messages

Error Message	Explanation
CMOS Battery Failure	The battery may be losing power. Replace the battery soon.
CMOS Checksum Error	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 the memory may be bad.

CMOS Timer Not Set	The battery may be losing power. Replace the battery soon.
Processor Thermal Trip	Processor overheated.
Auto RTC Reset	The system triggers RTC clear to recover the system back to the normal condition from consecutive boot failure.