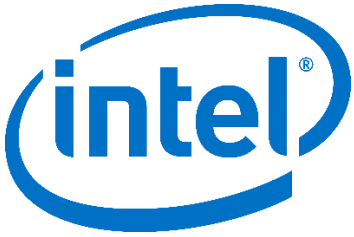

Intel® NUC Products

NUC8CCHK/NUC8CCHB

Technical Product Specification

Regulatory Models: NUC8CHK (Mini PC)

NUC8CHB (Board)

November 2019

Version Number: 001

Intel NUC Products NUC8CCH and NUC8CCB 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 NUC8CCH/NUC8CCB Specification Update.

Revision History

Revision	Revision History	Date
001	First release of Intel NUC Products NUC8CCH/NUC8CCB Technical Product Specification	November 2019

Disclaimer

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

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Note: For this Technical Product Specification, the use of **Intel NUC Products NUC8CHK/NUC8CHB** refers to **Intel NUC Rugged Mini PC NUC8CCHKRx** and **Intel NUC Board NUC8CCHB**.

Board Identification Information

Basic Intel® NUC Board NUC8CCHB Identification Information

AA Revision	BIOS Revision	Notes
K44767-500	CHAPLCEL.0030	1,2

Notes:

1. The AA number is found on a small label on the HDMI connectors.
2. The Intel® Celeron® N3350 processor is used on this AA revision consisting of the following component:

Device	Stepping	S-Spec Numbers
Intel Celeron	B1	SR2Z7

Product Identification Information

Intel® NUC Products NUC8CCH{x} Identification Information

Product Name	Intel® NUC Board	Differentiating Features
NUC8CCHKR	NUC8CCHB	Kit with power adapter
NUC8CCHB	NUC8CCHB	Board with thermal solution

Specification Changes or Clarifications

The table below indicates the Specification Changes or Specification Clarifications that apply to the Intel NUC Products NUC8CH.

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 http://www.intel.com/content/www/us/en/nuc/overview.html for the latest documentation.

Preface

This Technical Product Specification (TPS) specifies the board layout, components, connectors, power and environmental requirements, and the BIOS for Intel® NUC Board NUC8CCHB.

Intended Audience

The TPS is intended to provide detailed, technical information about Intel® NUC Board NUC8CHB 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 Board NUC8CHB
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, beep codes, and POST codes
5	A description of the Intel NUC Rugged Kit NUC8CHK & Intel NUC Board NUC8CHB features

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)
GBps	Gigabytes per second
Gbps	Gigabits per second
KB	Kilobyte (1024 bytes)
Kb	Kilobit (1024 bits)
kbps	1000 bits per second
MB	Megabyte (1,048,576 bytes)
MBps	Megabytes per second
Mb	Megabit (1,048,576 bits)
Mbps	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.

Contents

1 Product Description

1.1 Overview

1.1.1 Feature Summary

Table 1. Feature Summary

Form Factor	Board: 4.0 inches by 5.7 inches (102 mm by 146 mm) Chassis: 4.2 inches by 6.0 inches by 1.2 inches (108 mm by 154 mm by 32 mm)
Processor	Soldered-down Intel® Celeron® N3350 dual-core processor with a maximum 6W TDP, 1.10 GHz to 2.40 GHz burst, 2 MB cache, 2 threads • Intel® HD Graphics 500
Memory	4GB dual-channel soldered-down LPDDR3 @ 1866 MHz
Graphics	Integrated graphics support for processors with Intel® Graphics Technology: • Two High Definition Multimedia Interface* (HDMI*) back panel connectors • 1 High Definition Multimedia Interface* (HDMI*) 1.4b back panel connector • 1 High Definition Multimedia Interface* (HDMI*) 2.0a back panel connector (HDCP 2.2) See Figure 2 For the location of this port • Flat panel display via the internal Embedded DisplayPort* 1.3 (eDP) connector
Audio	Intel® High Definition (Intel® HD) Audio via the HDMI ports through the processor Realtek HD Audio via a stereo microphone/headphone 3.5 mm jack on the front panel
Storage	Soldered-down 64GB Embedded MultiMediaCard (eMMC) onboard storage module One SATA 6.0Gbps port is reserved for an M.2 storage module supporting M.2 2280 (key Type M) Note: Supports key type M (PCI Express* x1/x2/x4 and SATA)
Peripheral Interfaces	USB 3.0 Type A ports: • One port is implemented with an external front panel connector (blue) • One port is implemented with an external back panel connector (blue) • One port is implemented via an internal 1x10 1.25mm pitch header (white) USB 2.0 ports: • Two ports are implemented with external back panel connectors (black) • Two ports are implemented via two single-port internal 1x4 1.25mm pitch headers (white) Serial Port 1x9 1.25mm pitch header (black)
Expansion Capabilities	One M.2 connector supporting M.2 2280 (Key Type M) One M.2 connector supporting M.2 2230 (Key Type E) with pre-installed M.2 for Wireless on Kit SKUs only
LAN	Gigabit (10/100/1000 Mbps) LAN subsystem using the Intel® I211AT Gigabit Ethernet Controller
Wireless (Kit only)	Intel® Dual Band Wireless-AC 3168 pre-installed M.2 Module • 802.11ac, Dual Band, 1x1 Wi-Fi + Bluetooth 4.2 • Maximum Transfer speed up to 433 Mbps
Hardware Management Subsystem	Hardware monitoring subsystem, based on an ITE Tech. IT8987 embedded controller, including: • Processor and system ambient temperature monitoring • Voltage monitoring of DC Vin, Memory Vcc (V_SM), CPU IN Vcc (+Vccp) • SMBus interface

	• Chassis fan speed monitoring can be implemented using third-party software, but is not used as NUC8CHX is a fanless system

continued

Table 1. Feature Summary (continued)

BIOS	• 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)

1.2 Technical Reference

1.2.1 Processor

A soldered-down Intel® Dual-Core Celeron® N3350 with a max TDP of 6W

- Integrated Intel HD Graphics 500
- Integrated Memory Controller
- Integrated PCH

NOTE

There are specific power requirements for providing power to the processor. Refer to Section 3.3.1 on page 25 for information on power supply requirements.

For information about	Refer to
Intel® Dual-Core Celeron® N3350	https://ark.intel.com/content/www/us/en/ark/products/95598/intel-celeron-processor-n3350-2m-cache-up-to-2-4-ghz.html

1.2.2 Graphics

The Intel NUC Board NUC8CHB support graphics through Intel HD Graphics 500. The Intel HD graphics controller features the following:

- API Support
  - DX* (9.3, 10, 11.1, 12), OGL ES 3.0, OpenGL* 4.4 support, OpenCL* 2.0 support
- Supports 3D rendering, media compositing, and video encoding
- Supports Content protection using PAVP 2.0 and HDCP 1.4/2.2
- Full HEVC/VP8/VP9/VC1/MPEG2/JPEG hardware-accelerated video decode
- Full HEVC/VP8/MPEG2/JPEG hardware-accelerated video encode
- Intel HD Graphics with Advanced Hardware Video Transcoding (Intel® Quick Sync Video)

NOTES

Intel Quick Sync Video is enabled by an appropriate software application.

HDMI 2.0a is enabled by LSPCON (DP 1.2 to HDMI 2.0a protocol converter); Stereo 3D (S3D) technology is not supported.

HDMI 2.0a supports High Dynamic Range (HDR) and 10-bit sampling. HDR requires use of appropriate software and display hardware.

1.2.2.1 Video Memory Allocation

Intel Dynamic Video Memory Technology (DVMT) is a method for dynamically allocating system memory for use as graphics memory to balance 2D/3D graphics and system performance. If your computer is configured to use DVMT, graphics memory is allocated based on system requirements and application demands (up to the configured maximum amount). When memory is no longer needed by an application, the dynamically allocated portion of memory is returned to the operating system for other uses.

1.2.2.2 High Definition Multimedia Interface* (HDMI*)

The Intel NUC Board NUC8CHB has two HDMI connectors. The first is supported through a Parade PS175 DisplayPort 1.2 to HDMI 2.0 Level Shifter/Protocol Converter (LSPCON) with a maximum resolution of 4096x2160 @ 60Hz with 24-bit color. The port is compatible with all ATSC and DVB HDTV standards and supports eight full range channels at 24-bit/192 kHz audio of loseless audio formats. The HDMI port is compliant with the HDMI 2.0a specification. The second HDMI port is a natively supported HDMI 1.4 with a maximum resolution of 3840x2160 @ 30Hz. The HDMI port is compliant with the HDMI 1.4b specification.

For information about	Refer to
HDMI technology	http://www.hdmi.org

1.2.2.3 Digital Audio (HDMI)

Both HDMI ports support digital audio HBR Dolby TrueHD and DTS – HD Master Audio Bitstreaming

1.2.2.4 High-bandwidth Digital Content Protection (HDCP)

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 processor supports HDCP 2.2 for 4k Premium content protection over wired displays (HDMI).

1.2.2.5 HDMI Consumer Electronics Control (CEC)

The system provides built-in HDMI CEC support on both HDMI ports. The built-in HDMI CEC feature is OS agnostic and supports bi-directional power on/power off between the system and the attached display, as well as automatic HDMI input port detection from the display. This feature can be enabled and configured in BIOS Setup (Advanced → Onboard Devices tab).

For information about	Refer to
HDMI CEC feature on NUC	https://www.intel.com/content/www/us/en/support/articles/000023500/mini-pcs/intel-nuc-kits.html

1.2.2.6 Flat Panel Display Interfaces

The Intel NUC Board NUC8CHB supports flat panel displays via the Embedded DisplayPort (eDP) interface. The eDP flat panel display interface supports the following:

- Maximum resolution of 3840x2160 @ 60Hz with 24-bit color
- 4-lane bandwidth at 5.4GT/s

- Multiple EDID data source capability (panel, predefined, and customer payloads)
- 3.3V flat panel displays voltage
- 1.0A of maximum backlight current capability
- Backlight power voltage same as NUC board DC power source
- Board connector used is I-PEX-20455-040E-12, or compatible
- Mating plug is I-PEX-20453-040T, or compatible

1.2.2.6.1 eDP Configuration Modes

Video mode configuration for eDP display is supported as follows:

- Panel: automatic panel identification via Extended Display Identification Data (EDID) for panels with onboard EDID support
- Predefined: panel selection from common predefined panel types
- Customer payloads: custom EDID payload installation for ultimate parameter flexibility, allowing custom definition of EDID data on panels without onboard EDID

In addition, BIOS setup provides the following configuration parameters for internal flat panel displays when a display is connected prior to booting:

- Color Depth: allows the system integrator to select whether the panel is 24-bit color with VESA or JEIDA color mapping, or 18-bit color
- eDP Interface Type: allows the system integrator to select whether the eDP panel is a single-lane, dual-lane, or quad-lane display
- eDP Data Rate: allows the system integrator to select whether the eDP panel runs at 1.62Gb/s, 2.7Gb/s, or 5.4Gb/s
- Inverter Frequency and Polarity: allows the system integrator to set the operating frequency and polarity of the panel inverter board
- Maximum and Minimum Inverter Current Limit (%): allows the system integrator to set maximum PWM%, as appropriate, according to the power requirements of the internal flat panel display and the selected inverter board

NOTE

eDP Configuration Parameters will not be visible in the BIOS until a flat panel display is connected prior to boot.

Support for flat panel display configuration complies with the following:

1. *Internal flat panel display settings will be preserved across BIOS updates*
2. *Backlight inverter voltage option "Vin" refers to the board input voltage as provided to the board power input connector*

1.2.2.7 Multiple Display Configurations

Table 2. Display Configurations Maximum Resolutions

Single Display HDMI	Single Display eDP	Dual Display HDMI	Dual Display HDMI and eDP
4K @ 60Hz	4K @ 60Hz	HDMI 2.0 4K @ 60Hz plus HDMI 1.4 1080 @ 60Hz	4K @ 60Hz on HDMI or eDP 1080 @ 60Hz on second port

Note: Higher resolutions may be achievable but only at lower refresh rates

For information about	Refer to
Multiple display maximum resolutions	https://www.intel.com/content/www/us/en/products/docs/processors/core/core-technical-resources.html

1.2.3 Display Emulation

The Intel NUC Board NUC8CHB supports emulation of displays using the HDMI ports so that the system may be remotely accessed in a headless configuration or be capable of tolerating display connectivity interruptions without the operating system redetecting and rearranging the overall display layout. The display emulation feature may be enabled in BIOS Setup (Advanced → Video → "Display Emulation" drop down menu) with the following options:

- "No display emulation" (default selection): the system operates normally.
- "Virtual display emulation": provides a 1280x1024 virtual display when no displays are connected to the system and provides an additional 1280x1024 virtual display if one display is attached to the system. (If two display are attached to the system these displays will be enabled and no virtual displays will be provided).
- "Persistent display emulation": emulates that both displays are always connected to the system no matter their actual connection status. The EDID information from each display will remain programmed through S3, S4, and S5 power states until the feature is disabled or a power cycle event (G3 global state) occurs.
    - When "Persistent display emulation" is enabled another drop down menu ("Inconsistent Display Device") will become visible that allows the user to select the behavior of the system when the display device EDID is inconsistent with the EDID stored by the system.
        - "Block boot" (default selection): the BIOS will display a warning message with options and will wait indefinitely for a user selection.
        - "Countdown": the BIOS will display a warning message with options and will wait 10 seconds before booting.

NOTE

"Persistent display emulation" is not compatible with HDCP 2.2 displays.

When using "Persistent display emulation" it would be expected behavior for the system not to properly drive displays different than those connected when the feature was enabled, as the EDID parameters of the initially connected displays are still being driven by the system. A power cycle (AC power loss) is required to retrain the system with a different display configuration.

1.2.4 Audio Subsystem

The audio subsystem supports the following features:

- Analog line-out (rear jack)
- Support for 44.1 kHz/48 kHz/96 kHz/192 kHz

For information about	Refer to
Audio software and drivers	https://downloadcenter.intel.com

NOTE

The analog circuit of the back panel audio connector is designed to power headphones or amplified speakers only. Poor audio quality occurs if passive (nonamplified) speakers are connected to this output.

1.2.5 Storage

The Intel NUC Board NUC8CHB and NUC8CCHK kit contains an embedded MultiMediaCard (eMMC) onboard storage module with 64GB of space

1.2.5.1 AHCI Mode

The Intel NUC Board NUC8CHB supports AHCI storage mode.

NOTE

In order to use AHCI mode, AHCI must be enabled in the BIOS. Microsoft Windows* 10 includes the necessary AHCI drivers without the need to install separate AHCI drivers during the operating system installation process; however, it is always a good practice to update the AHCI drivers to the latest available by Intel.*

1.2.6 USB

The USB port arrangement is as follows:

- USB 3.0 ports (maximum current is 900mA for each port and header):
  - One Type A port is implemented with an external front panel connector (blue)
  - One Type A port is implemented with an external back panel connector (blue)
  - One port via a single-port internal 1x10 1.25mm pitch header (white)
- USB 2.0 ports (maximum current is 500mA for each port and header):
  - Two Type A ports implemented with external back panel connectors (black)
  - Two ports via two single-port internal 1x4 1.25mm pitch headers (white)

NOTE

USB ports are always enabled in the power button menu and the BIOS setup menu. This is the case even if they have been specifically disabled previously in the BIOS.

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.

For information about	Refer to
The location of the USB connectors on the back panel	Figure 2, page 16
The location of the front panel USB headers	Figure 1, page 16

The location of the internal connectors	Figure 6, page 18

1.2.7 Serial Port Header

The Intel® NUC Rugged Kit includes one 1x9, 1.25mm-pitch Molex PicoBlade or equivalent black header onboard. Signals are RS-322 Compliant and the pinout is as stated below.

Table 3 - Serial Port Header Pinout

Pin Signal Name Description	Pin Signal Name Description	Pin Signal Name Description
1	DCD	Data Carrier Detect
2	RXD#	Receive Data
3	TXD#	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

1.2.8 LAN Subsystem

The LAN subsystem consists of the following:

- Intel I211AT Gigabit Ethernet Controller (10/100/1000 Mbps)
- RJ-45 LAN connector with integrated status LEDs

Additional features of the 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

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

1.2.8.1 Intel I211AT Gigabit Ethernet Controller

The Intel I211AT Gigabit Ethernet Controller supports the following features:

- Compliant with the 1 Gbps Ethernet 802.3, 802.3u, 802.ab specifications
- Multi-speed operation: 10/100/1000 Mbps
- Full-duplex operation at 10/100/1000 Mbps; half-duplex operation at 10/100 Mbps
- Flow control support compliant with the 802.3x specification as well as the specific operation of asymmetrical flow control defined by 802.3z
- Supports for packets up to 9.5KB (Jumbo Frames)
    - IEEE 1588/802.1AS precision time synchronization
- MAC address filters: perfect match unicast filters, multicast hash filtering, broadcast filter, and promiscuous mode
- Preboot eXecution Environment (PXE) enables system boot up in both Legacy and UEFI modes. Requires a preconfigured PXE server infrastructure.

1.2.9 Wireless Network Module

The Intel Dual Band Wireless-AC 3168 provides hi-speed wireless connectivity with the following capabilities. The wireless network module is only installed on the NUC8CCHK kit.

- Compliant with IEEE 802.11 a/b/g/n/ac, 802.11d, 802.11e, 802.11i, 802.11h, 802.11w
- WiFi CERTIFIED* a/b/g/n/ac, WMM*, WMM-PS*, WPA*, WPA2*, WPS2
- Maximum bandwidth up to 433 Mbps
- Dual mode Bluetooth* 4.2 BLE
- 1x1: one Transmit and one Receive streams
- 80 MHz channels
- Seamless roaming between respective access points
- Full support for Microsoft Windows 10*; limited feature support for Linux*
- WiFi Direct* encryption and authentication (Microsoft Windows* only): WPA2, AES-CCMP
- WiFi Miracast* as Source, Protected Management Frames
- Security Features
    - Authentication: WPA and WPA2, 802.1X (EAP-TLS, TTLS, PEAP), EAP-SIM, EAP-AKA
    - Authentication protocols: PAP, CHAP, TLS, GTC, MS-CHAP*, MS-CHAPv2
    - Encryption: 64-bit and 128-bit WEP, AES-CCMP

1.2.9.1 Wireless Antennas

The NUC8CHK Rugged Kit includes wireless expandability features to enable the use of external wireless antennas. Included in the kit box are two RP-SMA Cables that can be mounted through two back panel expansion ports by removing the two rubber plugs.

For information about	Refer to
WLAN software and drivers	https://downloadcenter.intel.com
Full specifications	https://intel.com/wireless

1.2.10 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 3.3VSB applied via the power supply 5V STBY rail.

NOTE

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

CAUTION

Risk of explosion if the battery is replaced with an incorrect type. Batteries should be recycled where possible. Disposal of used batteries must be in accordance with local environmental regulations.

1.2.11 Hardware Management Subsystem

The hardware management subsystem is based on an ITE Tech. IT8987 embedded controller, which supports the following:

- Processor and system ambient temperature monitoring
- Voltage monitoring of DC Vin, Memory Vcc (V_SM), CPU IN Vcc (+Vccp)
- SMBus interface
- Chassis fan speed monitoring can be implemented using third-party software, but is not used as NUC8CHX is a fanless system

1.2.12 Power Management Subsystem

Power management is implemented at several levels, including:

- Software support through Advanced Configuration and Power Interface (ACPI)
- Hardware support:
    - Power Input (12V~24V)
    - LAN wake capabilities
    - Wake from USB
    - WAKE# signal wake-up support
    - Wake from S5
    - +5V Standby Power Indicator LED
    - TVS (Transient-voltage-suppression) up to 26.4V
    - Internal Input Power Header

1.2.12.1 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 multiple wake-up events (see Table 6. Wake-up Devices and Events on page11)
- Support for a front panel power and sleep mode switch

Table 4. Effects of Pressing the Power Switch 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 4. 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.

1.2.12.1.1 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 as a whole into a low-power state.

Table 5. Power States and Targeted System Power 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 5. Power States and Targeted System Power

Global States	Sleeping States	Processor States	Device States	Targeted System Power (Note 1)
G0 – working state	S0 – working	C0 – working	D0 – working state.	Full power > 30 W

G1 – sleeping state	S3 – Suspend to RAM. Context saved to RAM.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
G1 – sleeping state	S4 – Suspend to disk. Context saved to disk.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
G2/S5	S5 – Soft off. Context not saved. Cold boot is required.	No power	D3 – no power except for wake-up logic.	Power < 5 W (Note 2)
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.	No power to the system. Service can be performed safely.

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.

1.2.12.1.2 Wake-up Devices and Events

Table 6. Wake-up Devices and Events lists the devices or specific events that can wake the computer from specific states.

Table 6. 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
USB	S3, S4, S5[1, 2, 3]	Wake S4, S5 controlled by BIOS option
WAKE#	S3, S4[1]	Via WAKE; monitor to remain in sleep state
WiFi	S3, S4, S5	
Bluetooth	S3, S4	
Serial	S3, S4, S5	

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 10 Fast startup will block wake from LAN, USB, and CIR 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.

1.2.12.2 Transient Voltage Suppression

The Intel® NUC Rugged Kit & Board features TVS (Transient Voltage Suppression). This feature works to protect the system from voltage spikes of up to ~8% over the normal operating specification.

NOTE

Normal Power model is 12~24V. TVS tolerates spikes of up to ~26.4V for limited times.

1.2.12.3 Internal Input Power Header

The Intel® NUC Rugged Kit & Board features a Molex MicroFit 2x2 (3mm pitch) Internal Input Power Header. Table 7. Internal Input Power Header Pinout lists the pinout specification of the header.

NOTE

Power requirements follow the same 12~24V requirement of the standard power model for the power adapter.

Table 7. Internal Input Power Header Pinout

Pin	Function
1-2	Vin
3-4	Gnd

1.2.13 Intel Platform Security Technologies

Intel platform security technologies provides tools and resources to help the user protect their information by creating a safer computing environment.

NOTE

Software with security capabilities are required to take advantage of Intel platform security technologies.

1.2.13.1 Intel® Virtualization Technology

Intel Virtualization Technology (Intel® VT) 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

1.2.13.2 Intel® Platform Trust Technology

Intel® Platform Trust Technology (Intel® PTT) is a platform functionality for credential storage and key management. Intel® PTT supports Microsoft* BitLocker* Drive Encryption for hard drive encryption and supports all Microsoft requirements for firmware Trusted Platform Module (fTPM) 2.0 for client computers.

NOTE

Support for fTPM version 2.0 requires a UEFI-enabled operating system, such as Microsoft Windows* 10.*

CAUTION

BIOS recovery using the BIOS security jumper clears Intel® Platform Trust Technology (Intel® PTT) keys. These keys will not be restored after the BIOS recovery. Disable HDD encryption like BitLocker and other uses of data encryption and authentication before using BIOS recovery.

For information about	Refer to
Intel Platform Trust Technology	http://www.intel.com/content/dam/www/public/us/en/documents/white-papers/enterprise-security-platform-trust-technology-white-paper.pdf

1.2.14 Online Support

To find information about...	Visit this Intel web site:
Intel NUC Rugged Kit NUC8CCHKR and Intel NUC Board NUC8CCHB	http://www.intel.com/NUC
Intel NUC Support	http://www.intel.com/NUCSupport
Available configurations for Intel NUC 8 Rugged Kit NUC8CCHKR and Intel NUC Board NUC8CCHB	https://ark.intel.com/content/www/us/en/ark/products/190989/intel-nuc-board-nuc8cchb.html#tab-blade-1-4
Product support page for NUC8CCHKR	https://www.intel.com/content/www/us/en/support/products/190736/
Product support page for NUC8CCHB	https://www.intel.com/content/www/us/en/support/products/190989/

BIOS and driver updates for NUC8CCHKR	https://downloadcenter.intel.com/product/190736
BIOS and driver updates for NUC8CCHB	https://downloadcenter.intel.com/product/190989
Compatible peripherals and components	http://compatibleproducts.intel.com/
Integration information	http://www.intel.com/NUCSupport
Processor datasheet	https://ark.intel.com/content/www/us/en/ark/products/190989/intel-nuc-board-nuc8cchb.html#tab-blade-1-4
Regulatory documentation	https://www.intel.com/content/www/us/en/support/articles/000054888.html

2 Mechanical Reference

2.1 Chassis Features

2.1.1 Front Panel Features

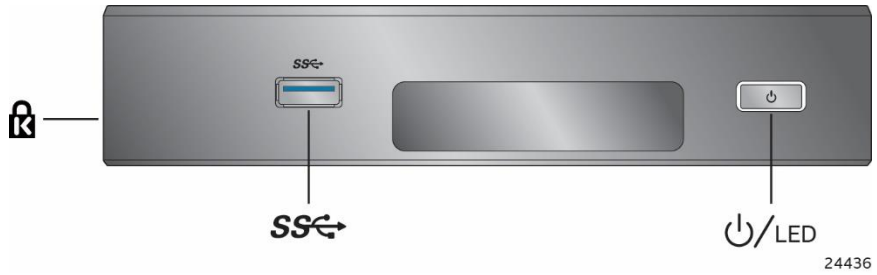


Figure 1. Intel NUC Rugged Kit NUC8CCHKR Features – Front

Table 8. Components Shown in Figure 1

Item from Figure 1	Description
	Kensington* Anti-Theft Key Lock Hole
	USB 3.0 Type Connector
	Daughter Card Expansion Slot
	Power Switch

2.1.2 Back Panel Features

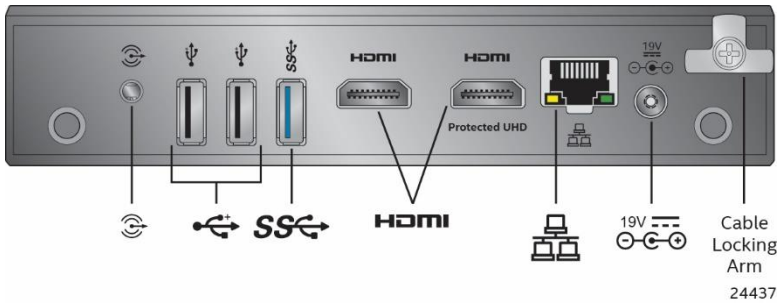


Figure 2. Intel NUC Rugged Kit NUC8CCHKR Features – Back

Table 9. Components Shown in Figure 1

Item from Figure 1	Description
	Speaker/Headset Jack
	USB 2.0 Type A Connector

	USB 3.0 Type A Connector
	HDMI (1.4) Port 1 Connector
	HDMI (2.0a) Port 2 Connector
	Ethernet Port
	DC Power Inlet
	2 External Antenna Expansion Ports (Optional) (Unlabeled)

2.2 Weights

Table 10. Select Weights lists select weights of boards and kits.

Table 10. Select Weights

Item	Weight (in kg)
Board with Thermal Solution	0.18
Board with Thermal Solution in Chassis	0.55
Boxed Board with Thermal Solution in Chassis with Accessories	1.03

2.3 Board Form Factor

The Intel NUC Board NUC8CHB is designed to fit into a custom chassis. Figure 3 illustrates the mechanical form factor for the board. Dimensions are given in [millimeters].

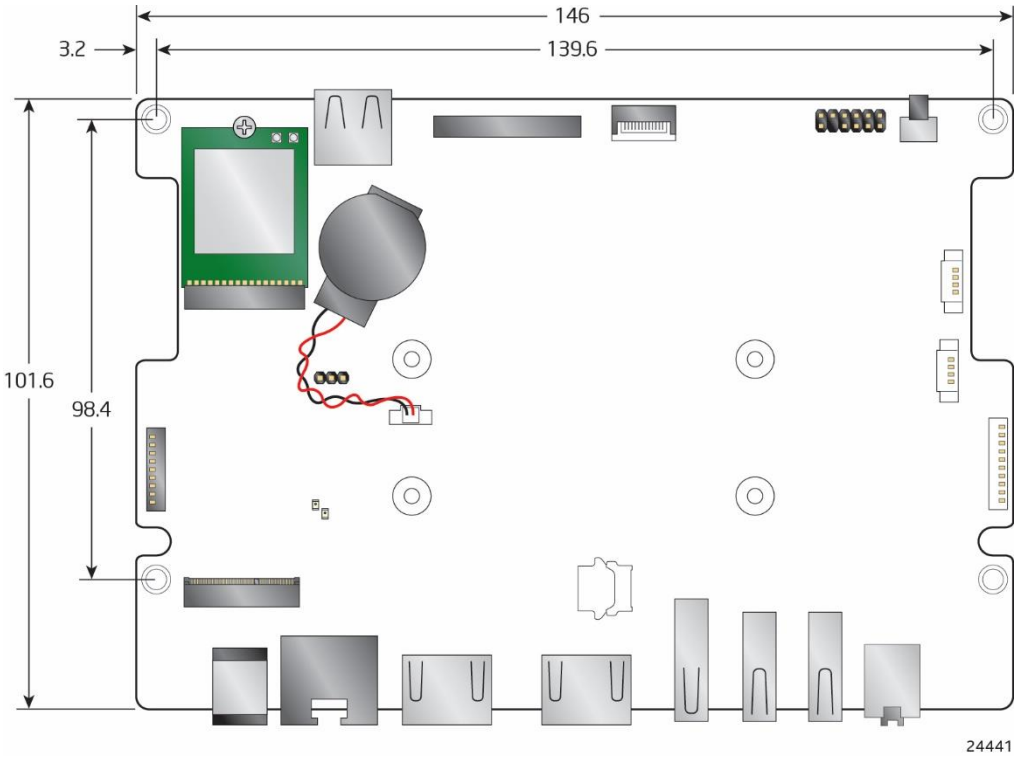


Figure 3. Board Dimensions

Figure 4. Board Height Dimensions

2.4 Board Layout

2.4.1 Board Layout (Top)

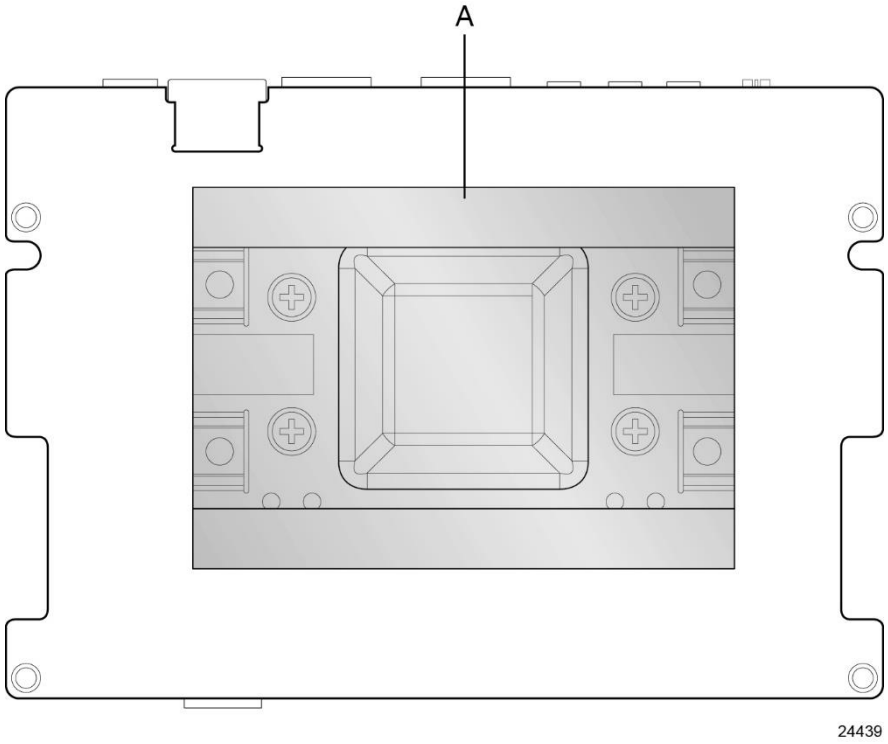


Figure 5. Major Board Components (Top)

Table 11. Components Shown in Figure 1

Item from Figure 1	Description
A	Thermal solution

2.4.2 Board Layout (Bottom)

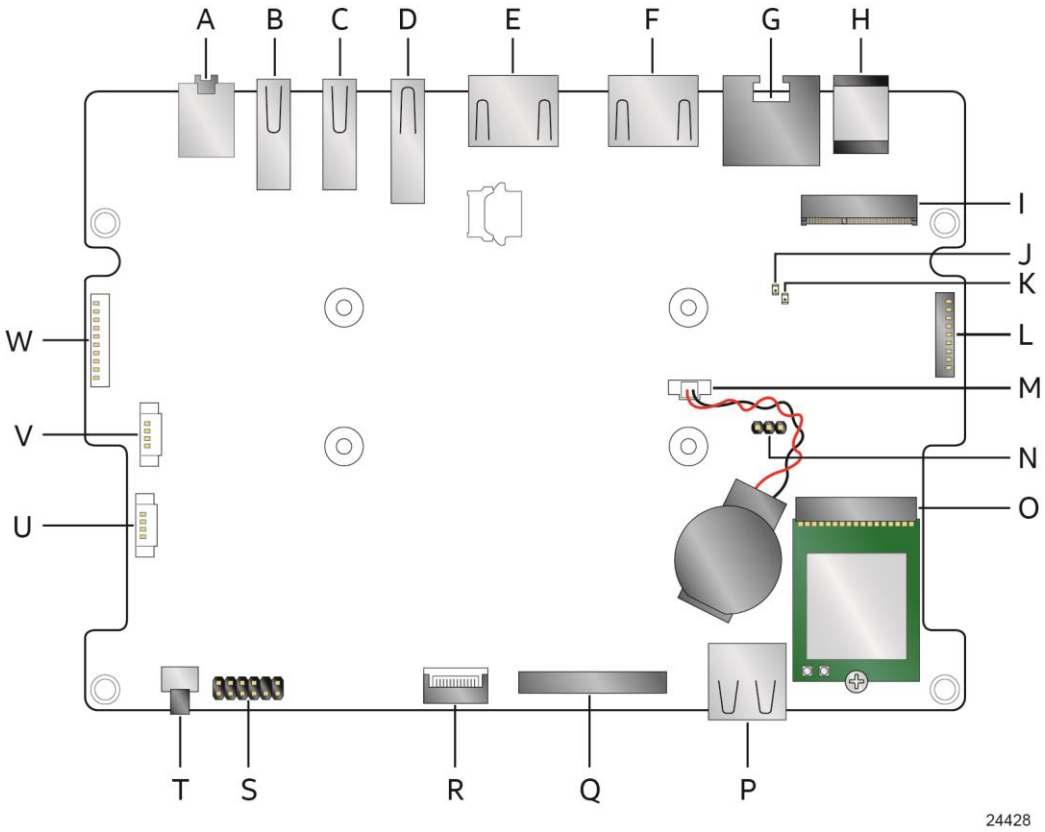


Figure 6. Major Board Components (Bottom)

Table 12. Components Shown in Figure 2

Item from Figure 2	Description
A	Audio Jack
B	Back Panel USB 2.0
C	Back Panel USB 2.0
D	Back Panel USB 3.0
E	HDMI 1.4b Port 2
F	HDMI 2.0a Port 1
G	LAN Connector
H	DC Input Jack
I	M.2 Slot (Key Type M) 80mm
J	Onboard 5V Standby LED
K	Power-on LED
L	Serial Port Header
M	CMOS Battery Header
N	BIOS Jumper
O	M.2 Slot (Key Type E) 30mm
P	Front Panel USB 3.0
Q	eDP Connector
R	LPC Debug Port Header
S	Front Panel Header
T	Front Panel Power Button
U	USB 2.0 Header
V	USB 2.0 Header
W	USB 3.0 Header

2.4.3 Block Diagram

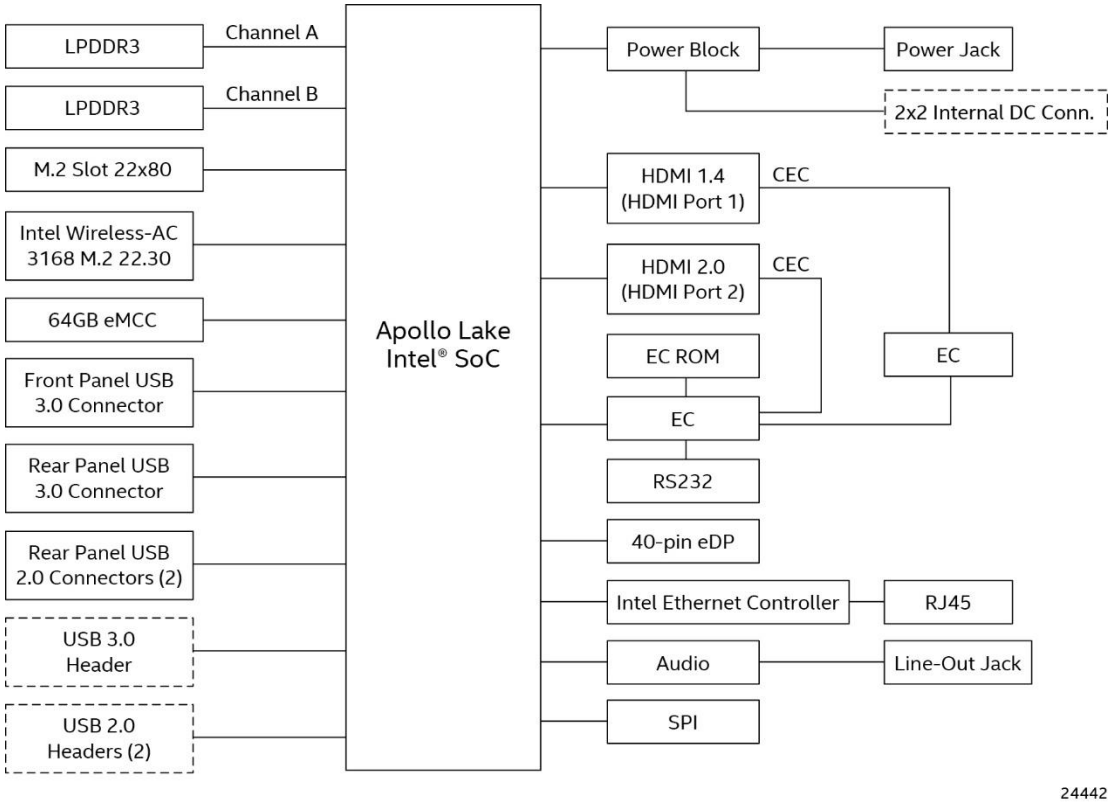


Figure 7. Block Diagram

3 Technical Reference

3.1 Memory Resources

3.1.1 Addressable Memory

The board utilizes up to 4 GB of addressable system memory. Typically the address space that is allocated for PCI Conventional bus add-in cards, 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 4 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 (64 Mb)
- Local ACPI (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 512 MB; 64 MB by default)

The board provides the capability to reclaim the physical memory overlapped by the memory mapped I/O logical address space. The board remaps physical memory from the top of usable DRAM boundary to the 4 GB boundary to an equivalent sized logical address range located just above the 4 GB boundary. All installed system memory can be used when there is no overlap of system addresses.

3.2 Intel NUC Rugged Kit & Intel NUC Rugged Kit 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.

Table 13 describes the jumper settings for the three modes: normal, lockdown, and configuration.

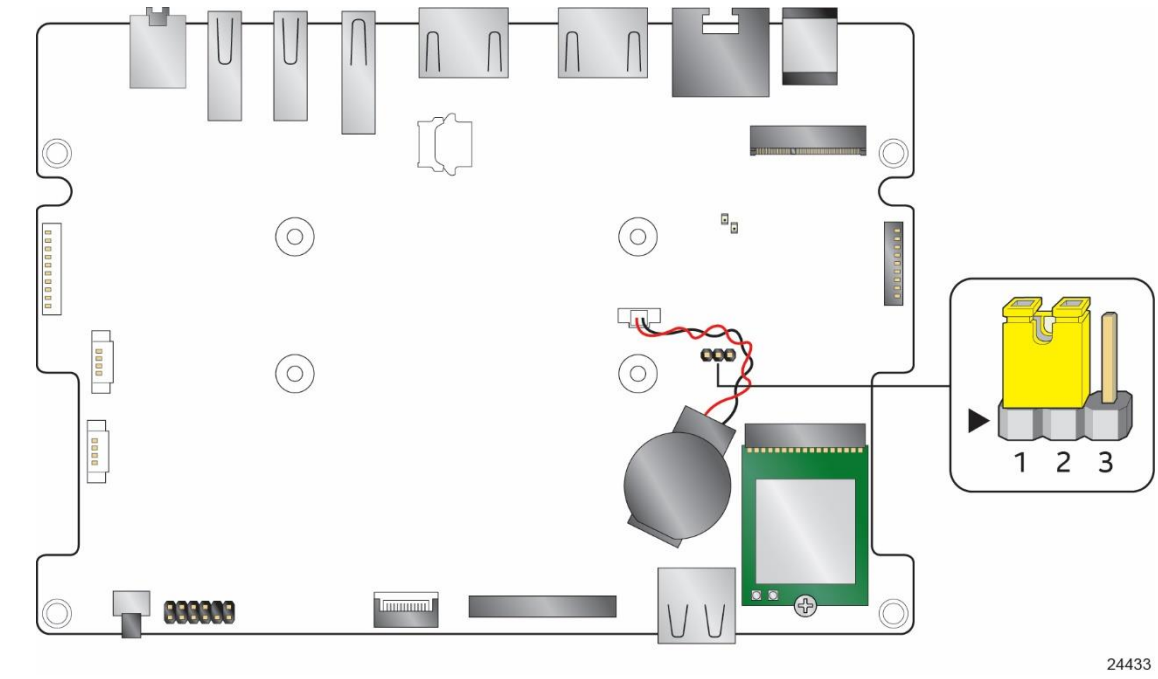


Figure 8. Location of the BIOS Security Jumper

Table 13lists the settings for the jumper.

Table 13. 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 3.7.4 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 options: [1] Suppress this menu until the BIOS Security Jumper is replaced. [2] Clear BIOS User and Supervisor Passwords. [3] Clear Trusted Platform Module Warning: Data encrypted with the TPM will no longer be accessible if the TPM is cleared [4] Disable Privacy MSR Bit (Clear MSR C80[0] to 0) [5] Enable Privacy MSR Bit (Set MSR C80[0] to 1) [F2] Intel® Visual BIOS [F4] BIOS Recovery

3.3 Electrical Considerations

3.3.1 Power Supply Considerations for NUC8CHB

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.

3.4 Thermal Considerations

CAUTION

If the external ambient temperature exceeds 40 °C, further thermal testing is required to ensure components do not exceed their maximum case temperature.

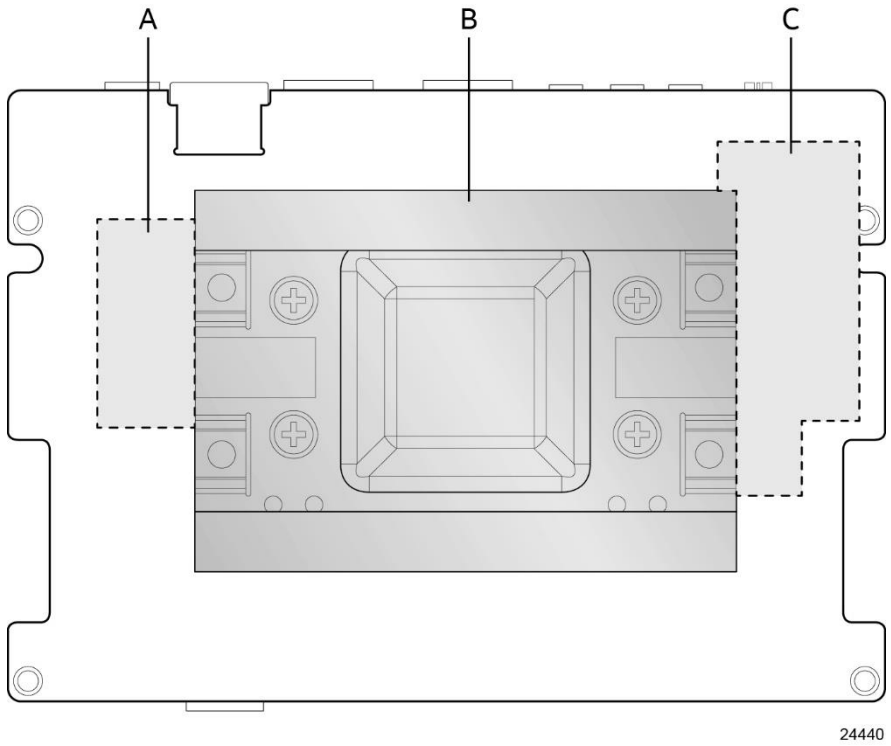
CAUTION

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 2.8.

Figure 9 shows the locations of the localized high temperature zones.



Item	Description
A	Thermal solution
B	Processor voltage regulator area
C	Processor voltage regulator area

Figure 9. Localized High Temperature Zones

Table 14. Thermal Considerations for Components provides maximum case temperatures for the components that are sensitive to thermal changes. The operating temperature, current load, or operating frequency could affect case temperatures. Maximum case temperatures are important when considering cooling the board.

Table 14. Thermal Considerations for Components

Component	Information on Maximum Case Temperature
Processor	https://ark.intel.com/content/www/us/en/ark/products/95598/intel-celeron-processor-n3350-2m-cache-up-to-2-4-ghz.html

To ensure functionality and reliability, the component is specified for proper operation when Case Temperature is maintained at or below the maximum temperature listed in Table 15. This is a requirement for sustained power dissipation equal to Thermal Design Power (TDP is specified as the maximum sustainable power to be dissipated by the components). When the component is dissipating less than TDP, the case temperature should be below the Maximum Case Temperature. The surface temperature at the geometric center of the component corresponds to Case Temperature.

It is important to note that the temperature measurement in the system BIOS is a value reported by embedded thermal sensors in the components and does not directly correspond to the Maximum Case Temperature. The upper operating limit when monitoring this thermal sensor is Tcontrol.

Table 15. Tcontrol Values for Components

Component	Information on Tcontrol
Processor	https://ark.intel.com/content/www/us/en/ark/products/95598/intel-celeron-processor-n3350-2m-cache-up-to-2-4-ghz.html

For information about	Refer to
Processor datasheets and specification updates	Section 1.2.1, page 3

3.5 Reliability

The Mean Time between Failures (MTBF) predictions are demonstrated using component and subassembly random failure rates. The demonstrated test is based on 90 days stress at 40C. The MTBF prediction is used to estimate repair rates and spare parts requirements.

3.6 Environmental

Table 16. Environmental Specifications lists the environmental specifications for the board.

Table 16. Environmental Specifications

Parameter	Specification	
Temperature		
Non-Operating	-40 °C to +60 °C	
Operating (Board)	0 °C to +40 °C	
Operating (System)	0 °C to +40 °C	
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)	Free Fall (inches)
	<20	36
	21-40	30
	41-80	24
	81-100	18
Vibration (System)		
Unpackaged	5 Hz to 20 Hz: 0.01 g² /Hz sloping up to 0.02 g² Hz	
	20 Hz to 500 Hz: 0.02 g² /Hz (flat)	
	Input acceleration is 2.20 g RMS	
Packaged	5 Hz to 40 Hz: 0.015 g² /Hz (flat)	
	40 Hz to 500 Hz: 0.015 g² /Hz sloping down to 0.00015 g² Hz	
	Input acceleration is 1.09 g RMS	
Acoustic		
Fanless	N/A	

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.

4 Overview of BIOS Features

4.1 Introduction

The board uses an AMI core BIOS 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 BIOS Setup program, POST, the PCI auto-configuration utility, embedded controller (EC) firmware, 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 production BIOSs are identified as CHAPLCEL.

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.

4.2 BIOS Flash Memory Organization

The Serial Peripheral Interface Flash Memory (SPI Flash) includes a 128 Mb flash memory device.

4.3 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.

4.4 Legacy USB Support

Legacy USB support enables USB devices to be used even when the operating system's USB drivers are not yet available. Legacy USB support is used to access the BIOS Setup program, and to install an operating system that supports USB. By default, Legacy USB support is set to Enabled.

Legacy USB support operates as follows:

1. When you first apply power to the computer, legacy support is disabled.
2. POST begins.
3. Legacy USB support is enabled by the BIOS allowing you to use a USB keyboard to enter and configure the BIOS Setup program and the maintenance menu.
4. POST completes.
5. The operating system loads. While the operating system is loading, USB keyboards and mice are recognized and may be used to configure the operating system. (Keyboards and mice are not recognized during this period if Legacy USB support was set to Disabled in the BIOS Setup program.)
6. After the operating system loads the USB drivers, all legacy and non-legacy USB devices are recognized by the operating system, and Legacy USB support from the BIOS is no longer used.

4.5 BIOS Updates

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

- Intel iFlash utility, which requires booting from EFI shell. Using this utility, the BIOS can be updated from a file on a hard disk or a USB drive (a flash drive or a USB hard drive).
- Pressing <F7> key during POST allows a user to select where the BIOS .cap file is located and perform the update from that location/device. Similar to performing a BIOS Recovery without removing the BIOS configuration jumper.
- The BIOS has an option to update the BIOS from a valid .cap file located on a hard disk or USB drive. Enter The BIOS by pressing <F2> during POST.
- Using Front Panel power button menu option

The update BIOS will be verified that it 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	http://www.intel.com/content/www/us/en/support/boards-and-kits/000005636.html

4.5.1 Language Support

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

4.6 BIOS Recovery

It is unlikely that anything will interrupt a BIOS update; however, if an interruption occurs, the BIOS could be damaged. Table 17. Acceptable Drives/Media Types for BIOS Recovery 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 17. 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 SATA or USB)	No
USB flash drive	Yes
USB diskette drive (with a 1.4 MB diskette)	No (BIOS update file is bigger than 1.4 MB size limit)

NOTE

Supported file systems for BIOS recovery:

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

For information about	Refer to
BIOS recovery	http://www.intel.com/support/motherboards/desktop/sb/cs-034524.htm

4.7 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. If the optical drive is not bootable, it will be ignored during the POST process.

4.7.1 Network Boot

The network can be selected as a boot device. This selection allows booting from the onboard LAN.

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

When no bootable disk or USB device is found, the system will default to network boot.

4.7.2 Booting Without Attached Devices (Headless)

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 monitor
- Keyboard
- Mouse

4.7.3 Changing the Default Boot Device 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 18. Boot Device Menu Options lists the boot device menu options.

Table 18. 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

4.7.4 Power Button Menu

As an alternative to 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 (soft off); will not work if system is in G3 (after "no power" state)
2. User pushes the power button and holds it down for 3 seconds
3. The front panel power button LED will change from Blue to Amber then the user can release the power button.
4. User releases the power button before the 4-second shutdown override can occur.

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

The BIOS will display the following prompt and wait for a keystroke:

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

† **[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 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.

4.8 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 20 characters in length.
- To clear a set password, enter a blank password after entering the existing password.

Table 19. Supervisor and User Password Functions 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 19. 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.

5 Error Messages and Blink Codes

5.1 Front-panel Power LED Blink Codes

Whenever a recoverable error occurs during POST, the BIOS causes the board's front panel power LED to blink an error message describing the problem (see Table 20. Front-panel Power LED Blink Codes).

Table 20. Front-panel Power LED Blink Codes

Type	Pattern	Note
Power-on	Solid on primary color. Indicates S0 state.	
S3 Standby	Blink alternate color .25 seconds on, .25 seconds off, indefinitely. Indicates S3 state.	
BIOS update in progress	Off when the update begins, then primary color on for 0.5 seconds, then off for 0.5 seconds. The pattern repeats until the BIOS update is complete.	
Memory error	On-off (1.0 second each) three times, then 2.5-second pause (off), entire pattern repeats (blinks and pause) until the system is powered off.	
Thermal trip warning	Blink primary color .25 seconds on, .25 seconds off, .25 seconds on, .25 seconds off. This will result in a total of 16 blinks (blink for 8 seconds).	

5.2 BIOS Error Messages

Table 21. BIOS Error Messages lists the error messages and provides a brief description of each.

Table 21. 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.
A bootable device has not been detected	System did not find a device to boot.