

Intel® NUC Rugged Board Element CMB1ABA, CMB1ABB and CMB1ABC Product Specification

Revision 1.3

Regulatory Model: CMB1AB

July 2020

Intel® NUC Rugged Board Element CMB1ABA, CMB1ABB or CMB1ABC 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 in this product specification.

Revision History

Revision	Revision History	Date
1.0	First release	October 2019
1.01	Ethernet model number correction, Updated Figure 5	December 2019
1.2	Added CMB1ABC	June 2020
1.3	Added back panel power connector section, clarified M.2 slot support and added vPro® section.	July 2020

Disclaimer

This product specification applies only to the standard Intel® NUC Rugged Board Element with product codes CMB1ABA, CMB1ABB and CMB1ABC.

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Preface

This Product Specification specifies the layout, components, connectors, power and environmental features for the Intel® NUC Rugged Board Element CMB1ABA, CMB1ABB and CMB1ABC.



NOTE

In this document, the use of “Intel® NUC Rugged Board Element” will refer to the CMB1ABA, CMB1ABB and CMB1ABC versions of the Intel® NUC Rugged Board Element.

Intended Audience

The document is intended to provide technical information about Intel® NUC Rugged Board Element 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 Intel® NUC Rugged Board Element features.
2	A technical description of the Intel® NUC Rugged Board Element.

Typographical Conventions

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

Notes, Cautions, and Warnings



NOTE

Notes call attention to important information.



CAUTION

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

Other Common Notation

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

Intel® NUC Rugged Board Element Identification Information

Intel® NUC Rugged Board Element Identification Information

AA Revision	Product Code	Board Type	Notes
K53775-202	BKCMB1ABA	Expandable	1
K53777-202	BKCMB1ABB	Dual LAN	1
K53779-302	BKCMB1ABC	Six HDMI	1

Notes:

1. The AA number is found on the top of the board

Specification Changes or Clarifications

The table below indicates the Specification Changes or Specification Clarifications that apply to the Intel® NUC Rugged Board Element CMB1ABA, CMB1ABB and CMB1ABC.

Specification Changes or Clarifications

Date	Type of Change	Description of Changes or Clarifications

Errata

Current characterized errata, if any, are documented in Section 3 of this Product Specification.

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1 Product Description

1.1 Overview

The Intel® NUC Rugged Board Element is a board only solution for the Intel® NUC Compute Element and consists of a connector for the Intel® NUC Compute Element to plug into along with input/output connectors and headers.

The Intel® NUC Rugged Board Element requires a compatible Intel® NUC Compute Element in order to operate.

For information on compatible devices for use with the Intel® NUC Rugged Board Element see <http://www.intel.com/NUCElements>.

1.2 Version Summary

There are three different board versions of this model of Intel® NUC Rugged Board Element which are summarized in Table 1. Unless otherwise noted in this document, not all features are available on all versions of the Intel® NUC Rugged Board Element.

Table 1. Intel® NUC Rugged Board Element Version Summary

Version	HDMI Ports	M.2 Connectors	eDP Connectors	LAN	USB 2 Ports	USB 3 Ports	USB 2.0 Headers	USB 3.0 Headers	Serial Port Headers
CMB1ABA	2	2	1	1	1	3	2	1	2
CMB1ABB	2	2	0	2	3	3	0	1	2
CMB1ABC	6	2	0	1	1	3	2	1	2



NOTE

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

To find information about...

Intel® NUC Element

Intel® NUC Element Support

Intel® NUC Element Warranty Information

Available configurations for Intel® NUC Rugged Board Element

Intel Processors

Intel Graphics

Intel Wireless

Intel Technologies

Visit this World Wide Web site:

<https://www.intel.com/NUCElements>

<https://www.intel.com/NUCElementsSupport>

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<https://www.intel.com/processors>

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

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

<https://www.intel.com/technology>

1.3 Feature Summary

Table 2 summarizes the major features of the Intel® NUC Rugged Board Elements.

Table 2. Feature Summary

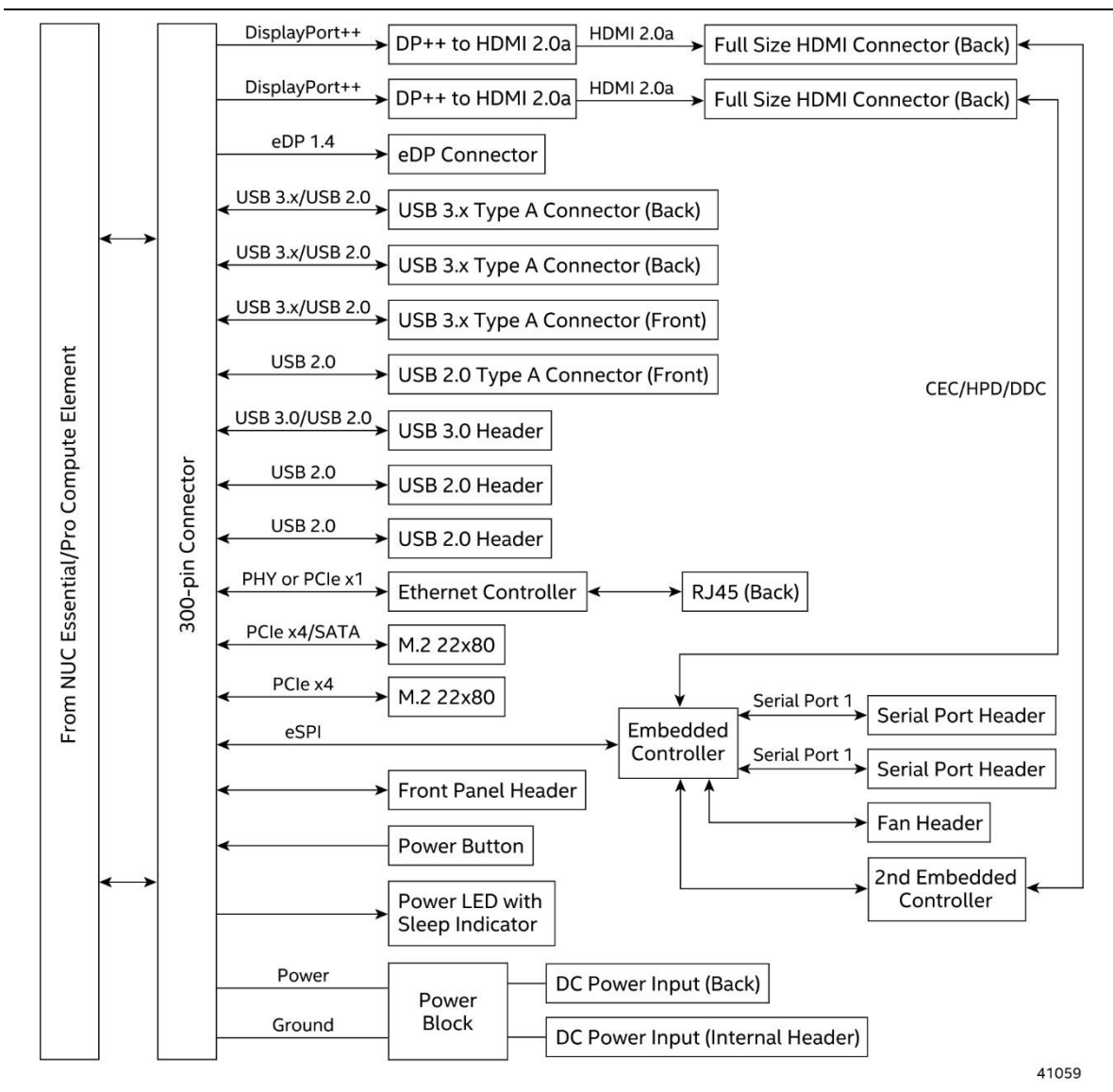
Board Size	<ul style="list-style-type: none"> • CMB1ABA: 170 millimeters by 136.4 millimeters • CMB1ABB: 170 millimeters by 136.4 millimeters • CMB1ABC: 200 millimeters by 136.4 millimeters
Graphics Outputs	<p>Integrated graphics support with Intel[®] HD Graphics Technology</p> <ul style="list-style-type: none"> • Two HDMI 2.0a • Four HDMI 1.4 on CMB1ABC • One Embedded DisplayPort (eDP) on CMB1ABA • Built in CEC for all HDMI ports • High-Bandwidth Digital Content Protection support for content protection <ul style="list-style-type: none"> ◦ HDCP 1.4 and 2.2 supported via HDMI • Resolutions and refresh rates supported <ul style="list-style-type: none"> ◦ Up to 4K @ 60Hz ◦ Up to 1080p @ 120Hz
Audio	Intel [®] High Definition (Intel [®] HD) Audio via HDMI
Storage	<ul style="list-style-type: none"> • One M.2 22x80 Key M slot for PCIe x4 NVMe or SATA SSDs • One M.2 22x80 Key M slot for PCIe x4 NVMe or PCIe add in devices
Wireless LAN	Intel [®] NUC Compute Element supplies the solution, antennas will be required
Wired LAN	<ul style="list-style-type: none"> • Intel[®] Ethernet Connection I219-LM (Support for Intel[®] vPro™ Technology when using a vPro™ enabled NUC Compute Element) • Intel[®] Ethernet Controller I211-AT (CMB1ABB only)
USB 2.0	<ul style="list-style-type: none"> • CMB1ABA: 3 (1 Front Panel, 2 Internal Headers) • CMB1ABB: 2 (1 Front Panel, 2 Back Panel) • CMB1ABC: 3 (1 Front Panel, 2 Internal Headers)
USB 3.0	1 Internal Header
USB 3.x¹	3 (1 Front Panel, 2 Back Panel)
Serial Ports	2 Internal Headers
Operating Systems Support (64-bit only)	<ul style="list-style-type: none"> • Windows* 10 Home • Windows 10 Pro • Windows 10 Enterprise • Windows 10 Education • Windows 10 IoT Enterprise • Some Linux* operating systems may be compatible. Check with the specific Linux distribution to make sure that support is available for this platform.
Connector Supported	Lotes APCIO468-P001A01 Edge Mount Connector
Sustained Operation (24x7 usage)	Sustained Operation is defined as 24x7 operation for 5 years with 50% system utilization on average, with an expected service rate of 1% per year during this period.

¹ USB 3.x port speed is determined by the Intel[®] NUC Compute Element.

2 Technical Reference

2.1 Block Diagrams

Figure 1 is a block diagram of the major functional areas of the NUC Rugged Board Element CMB1ABA.



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Figure 1. CMB1ABA Block Diagram

Figure 2 is a block diagram of the major functional areas of the NUC Rugged Board Element CMB1ABB.

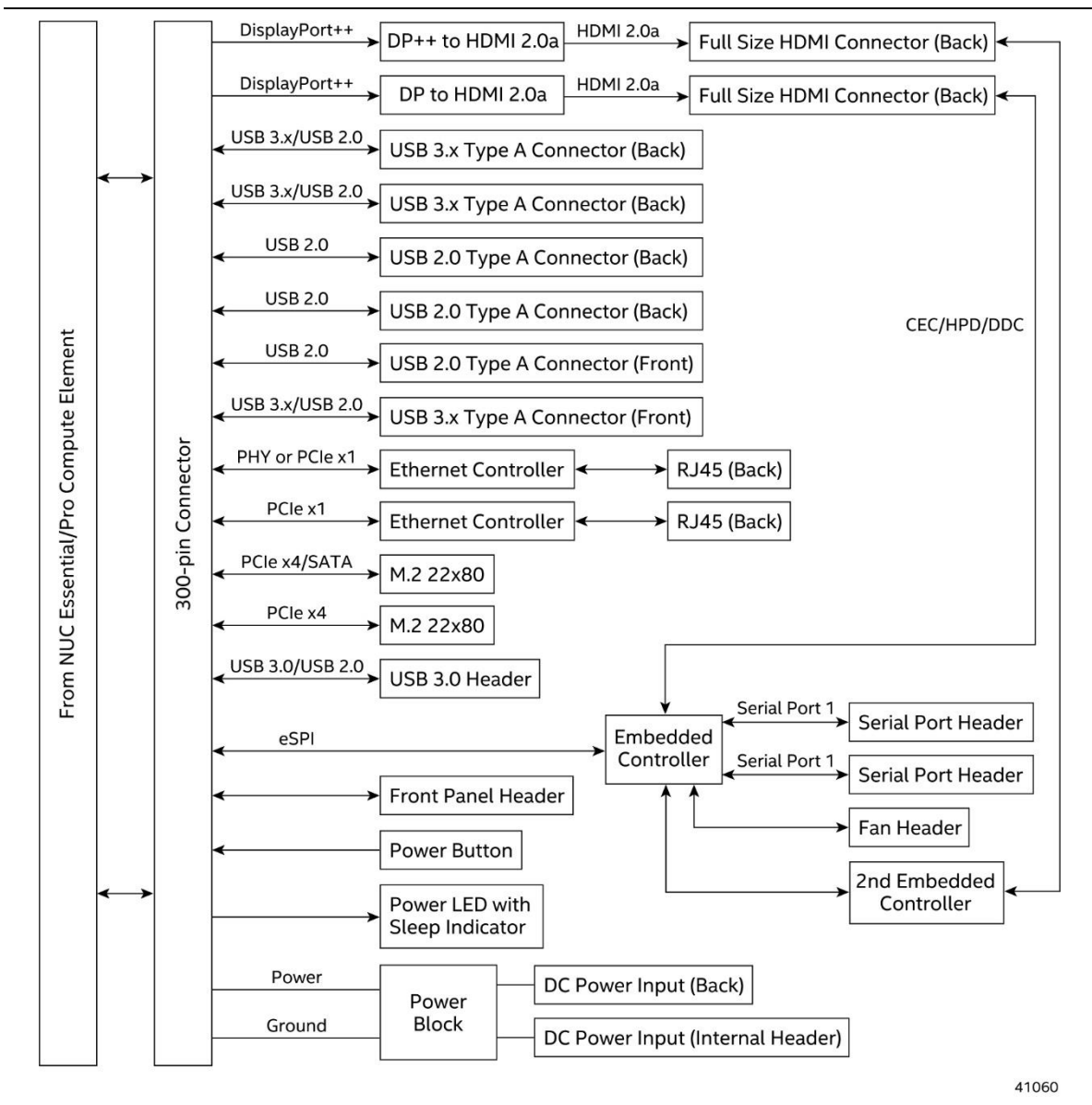
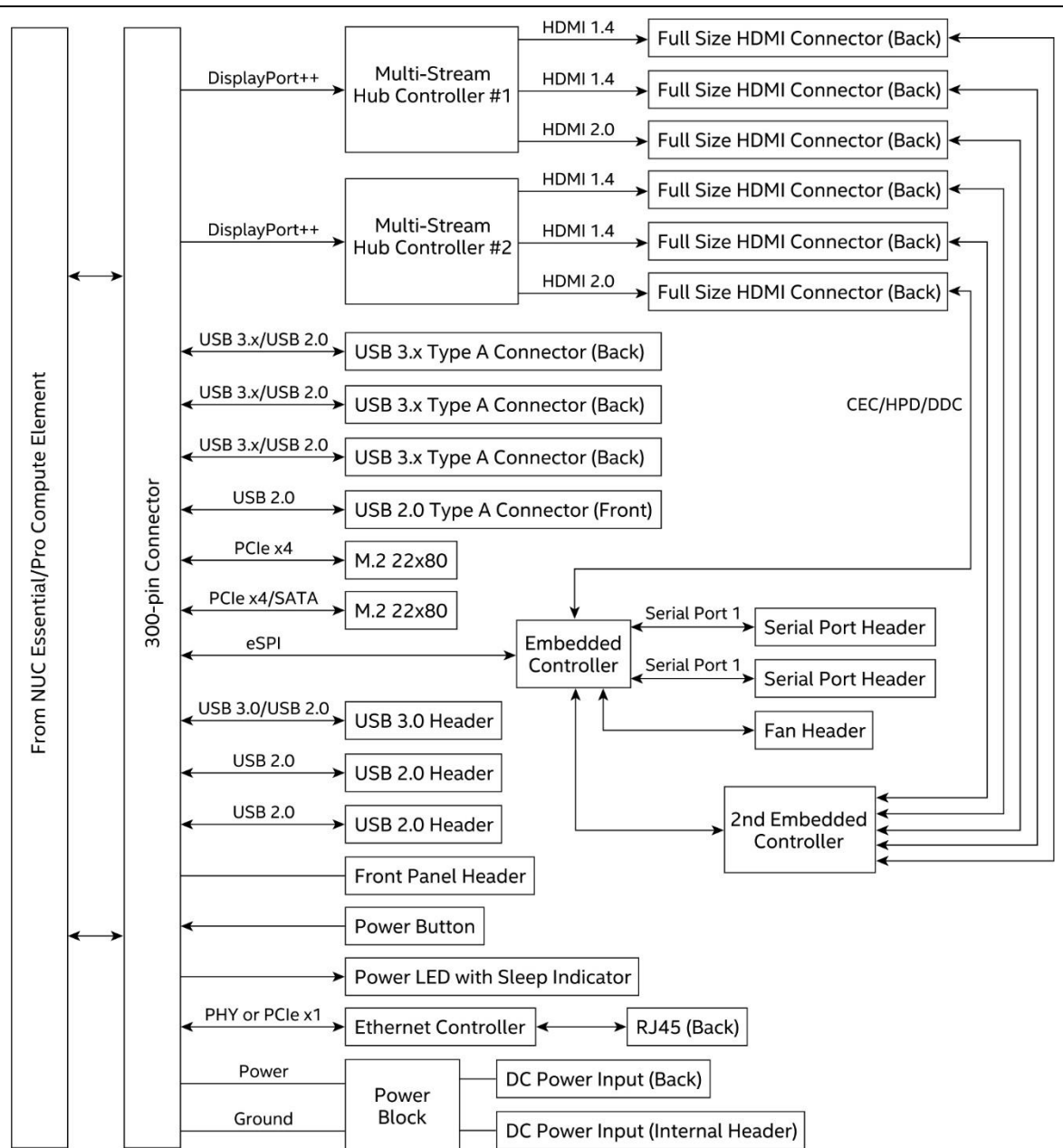


Figure 2. CMB1ABB Block Diagram

Figure 3 is a block diagram of the major functional areas of the NUC Rugged Board Element CMB1ABC.

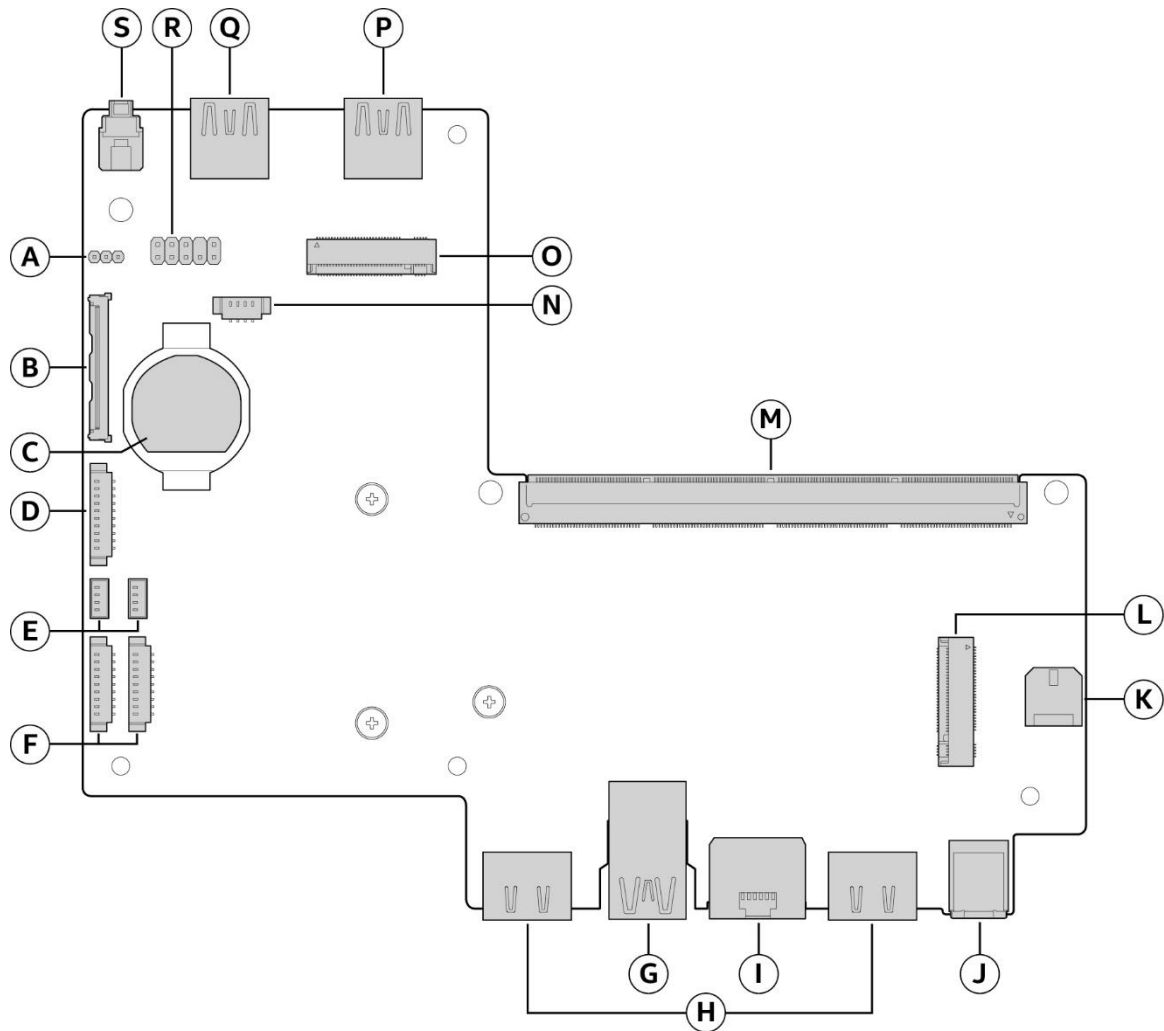


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Figure 3. CMB1ABC Block Diagram

2.2 Features

The NUC Rugged Board Elements have a 300-pin edge connector. The top of the board, the front panel and the back panel have input/output connectors and headers. See the below figures for the locations of the connectors, headers, buttons and jumpers.

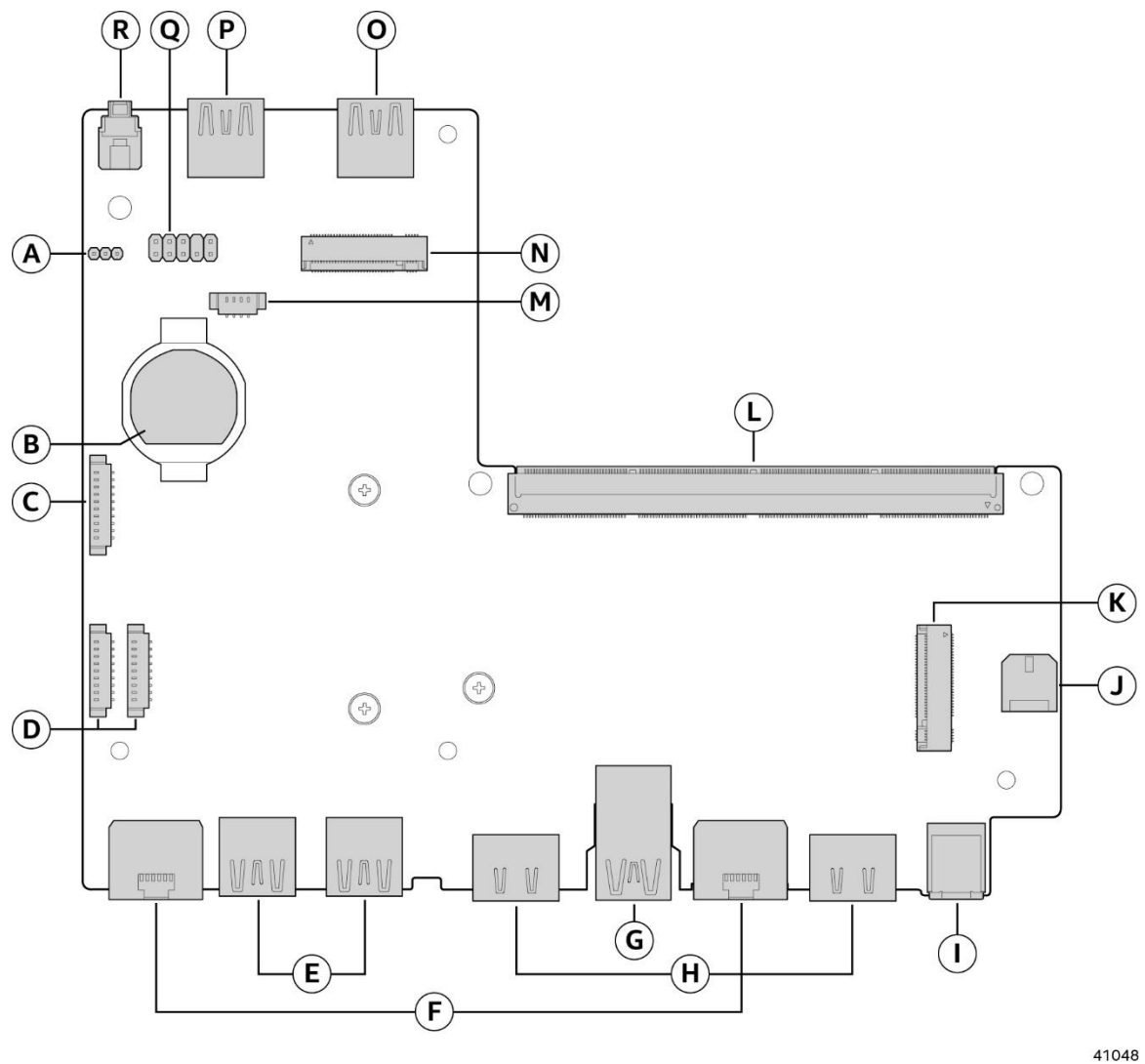


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Figure 4. CMB1ABA Features

Table 3. CMB1ABA Features

Item	Description	Item	Description	Item	Description
A	Wireless Enable/Disable Jumper	H	HDMI Ports	N	System Fan Header
B	eDP Connector	I	Ethernet Connector (RJ-45)	O	M.2 Slot (NVMe)
C	Battery	J	Power Input Jack	P	USB 3.x ¹ Port
D	USB 3.0 Header	K	2x2 Power Connector	Q	USB 2.0 Port
E	USB 2.0 Headers	L	M.2 Slot (SATA/NVMe)	R	Front Panel Header
F	Serial Port Headers	M	300-pin Connector	S	Power Button
G	USB 3.x ¹ Ports	¹ USB 3.x port speed is determined by the Intel® NUC Compute Element.			



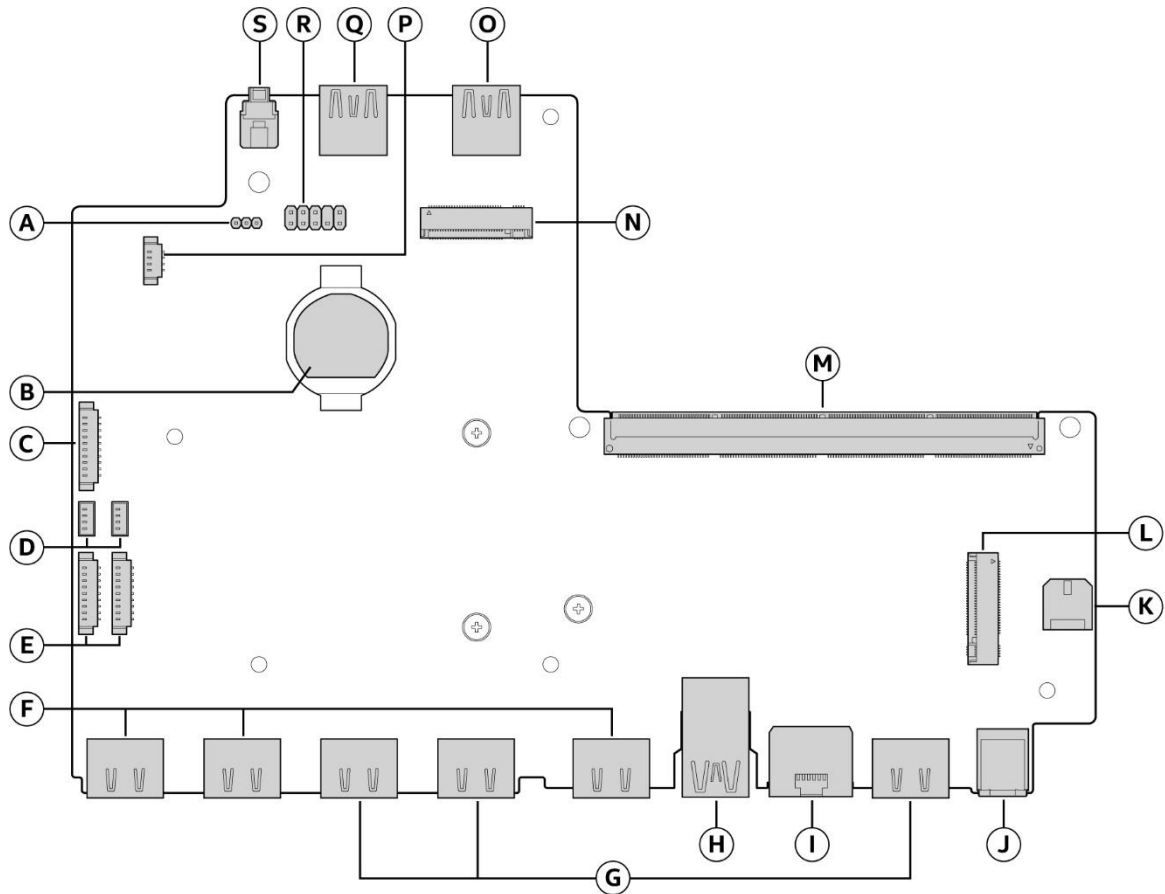
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Figure 5. CMB1ABB Features

Table 4. CMB1ABB Features

Item	Description	Item	Description	Item	Description
A	Wireless Enable/Disable Jumper	H	HDMI Ports	M	System Fan Header
B	Battery	I	Power Input Jack	N	M.2 Slot (NVMe)
C	USB 3.0 Header	J	2x2 Power Connector	O	USB 3.x ¹ Port
D	Serial Port Ports	K	M.2 Slot (NVMe/SATA)	P	USB 2.0 Port
E	USB 2.0 Headers	L	300-pin Connector	Q	Front Panel Header
F	Ethernet Connectors (RJ-45)	K	M.2 Slot	R	Power Button
G	USB 3.x ¹ Ports	L	300-pin Connector		

¹ USB 3.x port speed is determined by the Intel® NUC Compute Element.



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Figure 6. CMB1ABC Features

Table 5. CMB1ABC Features

Item	Description	Item	Description	Item	Description
A	Wireless Enable/Disable Jumper	H	USB 3.x ³ Ports	O	USB 3.x ³ Port
B	Battery	I	Ethernet Connector (RJ-45)	P	System Fan Header
C	USB 3.0 Header	J	Power Input Jack	Q	USB 2.0 Port
D	USB 2.0 Headers	K	2x2 Power Connector	R	Front Panel Header
E	Serial Port Headers	L	M.2 Slot (NVMe/SATA)	S	Power Button
F	HDMI Ports B ¹	M	300-Pin Connector		
G	HDMI Ports A ²	N	M.2 Slot (NVMe)		

¹ Group B HDMI ports are configured from left to right as B, B2 and B3. See Table 6.

² Group A HDMI ports are configured from left to right as A, A3 and A2. See Table 6.

³ USB 3.x port speed is determined by the Intel® NUC Compute Element.

2.2.1 CMB1ABC HDMI Port Configuration

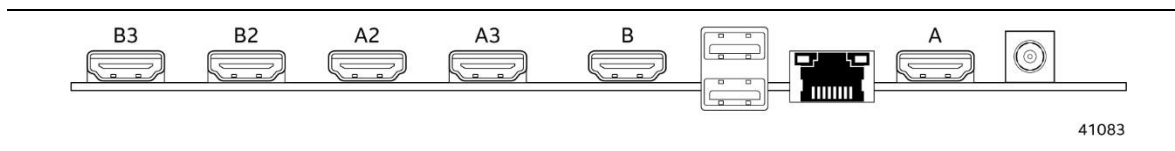


Figure 7. CMB1ABC HDMI Port Configuration

Table 6. HDMI Port Configuration and Supported Resolutions

Configuration	HDMI A	HDMI B	HDMI A3	HDMI A2	HDMI B2	HDMI B3
1	4K@60					
2	1080@120		1080@120			
3	1080@120			1080@120		
4			1080@120	1080@120		
5	1080@60		1080@60	1080@60		
6		4K@60				
7		1080@120			1080@120	
8		1080@120				1080@120
9					1080@120	1080@120
10		1080@60			1080@60	1080@60
11	4K@60	4K@60				
12	1080@120	4K@60	1080@120			
13	1080@120	4K@60		1080@120		
14		4K@60	1080@120	1080@120		
15	1080@60	4K@60	1080@60	1080@60		
16	4K@60	1080@120			1080@120	
17	4K@60	1080@120				1080@120
18	4K@60				1080@120	1080@120
19	4K@60	1080@60			1080@60	1080@60
20	1080@120	1080@120	1080@120		1080@120	
21	1080@120	1080@120		1080@120		1080@120
22			1080@120	1080@120	1080@120	1080@120
23	1080@60	1080@60	1080@60	1080@60	1080@60	1080@60

2.3 USB 2.0 Headers

The NUC Rugged Board Elements have two white, 1x4, 1.25mm pitch USB 2.0 headers.

Table 7. USB 2.0 Header Pinout

Pin	Signal Name	Description	Pin	Signal Name	Description
1	+5 V DC	Voltage In	3	D+	Data Positive
2	D-	Data Minus	4	GND	Ground

2.4 Serial Port Headers

The NUC Rugged Board Elements have two white, 1x9, 1.25mm pitch Serial Port headers.

Table 8. Serial Port Header Pinout

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

2.5 Fan Header

The NUC Rugged Board Elements have one black, 1x4, 1.25mm pitch, fan header. The fan header can be used for a thermal solution fan or for a system fan.

Table 9. Fan Header Pinout

Pin	Signal Name	Description	Pin	Signal Name	Description
1	GND	Ground	3	FAN_TAC	Fan Speed
2	+VCC	Fan Power	4	FAN_PWM	Fan Pulse Width Modulation

2.6 Power Input Connector

The NUC Rugged Board Elements have a 2x2, 1.25mm pitch right angled power input connector.

Table 10. Power Input Connector Pinout

Pin	Signal Name	Description	Pin	Signal Name	Description
1	Vin	Voltage In	3	GND	Ground
2	Vin	Voltage In	4	GND	Ground

See section 2.12 for information on power requirements.

2.7 USB 3.0 Header

The NUC Rugged Board Elements have a white, 1x10, 1.25mm pitch USB 3.0 header.

Table 11. USB 3.0 Header Pinout

Pin	Signal Name	Description	Pin	Signal Name	Description
1	USB_VBUS	+ 5 V Power	6	USBSS1_RX_P	USB 3.0 Receiver +
2	USB1_N	USB 2.0 Data -	7	GND	Ground
3	USB1_P	USB 2.0 Data +	8	USBSS1_RX_N	USB 3.0 Transmitter -
4	GND	Ground	9	USBSS1_RX_P	USB 3.0 Transmitter +
5	USBSS1_TX_N	USB 3.0 Receiver -	10	RSVD	Reserved (no connection)

2.8 Front Panel Header

The NUC Rugged Board Elements have a 1x11, 1.25mm pitch, right angle front panel header.

Table 12. Front Panel Header Pinout

Pin	Signal Name	Description	Pin	Signal Name	Description
1	POWER_SWITCH#	[In] Power Switch	7	RSVD	Reserved
2	GND	Ground	8	HDD_LED-	[Out] HDD activity LED
3	POWER_LED_MAIN	[Out] Front Panel LED (main color)	9	HDD_LED+	[Out] HDD activity LED with current limiting resistor
4	POWER_LED_ALT	[Out] Front Panel LED (alternate color)	10	GND	Ground
5	RSVD	Reserved	11	RESET_SWITCH#	[In] Reset Swtich
6	+5V_DC	Power, 1A (Vcc)			

2.9 Power Connector

The NUC Rugged Board Elements have a power connector on the back panel.

- Dual barrel
- 2.5mm inner diameter
- 5.5mm outer diameter

See section 2.12 for information on power requirements.

2.10 Embedded DisplayPort Connector

The NUC Rugged Board Element CMCB1ABA has a 1x40, 0.5mm pitch, right angled Embedded DisplayPort (eDP) connector.

Table 13. eDP Connector Pinout

Pin	Signal Name	Description
1	NC - RESERVED	Reserved for LCD manufacturer's use
2	H_GND	High Speed Ground
3	Lane3_N	Complement Signal Link Lane 3
4	Lane3_P	True Signal Link Lane 3
5	H_GND	High Speed Ground
6	Lane2_N	Complement Signal Link Lane 2
7	Lane2_P	True Signal Link Lane 2
8	H_GND	High Speed Ground
9	Lane1_N	Complement Signal Link Lane 1
10	Lane1_P	True Signal Link Lane 1
11	H_GND	High Speed Ground
12	Lane0_N	Complement Signal Link Lane 0
13	Lane0_P	True Signal Link Lane 0
14	H_GND	High Speed Ground
15	AUX_CH_P	True Signal Auxiliary Channel
16	AUX_CH_N	Complement Signal Auxiliary Channel
17	H_GND	High Speed Ground
18	LCD_VCC	LCD logic and driver power (Vcc3)
19	LCD_VCC	LCD logic and driver power (Vcc3)
20	LCD_VCC	LCD logic and driver power (Vcc3)
21	LCD_VCC	LCD logic and driver power (Vcc3)
22	NC	LCD Panel Self-Test Enable (Optional)
23	LCD_GND	LCD logic and driver ground
24	LCD_GND	LCD logic and driver ground
25	LCD_GND	LCD logic and driver ground
26	LCD_GND	LCD logic and driver ground
27	HPD	HPD signal pin
28	BL_GND	Backlight ground
29	BL_GND	Backlight ground
30	BL_GND	Backlight ground
31	BL_GND	Backlight ground
32	BL_ENABLE	Backlight On/Off
33	BL_PWM_DIM	PWM dimming control signal
34	NC - RESERVED	Reserved for LCD manufacturer's use
35	NC - RESERVED	Reserved for LCD manufacturer's use
36	BL_PWR	Backlight power (+Vin)
37	BL_PWR	Backlight power (+Vin)
38	BL_PWR	Backlight power (+Vin)
39	BL_PWR	Backlight power (+Vin)
40	NC - RESERVED	RESERVED for LCD manufacturer's use

2.11 Display Emulation

The Intel® NUC Rugged Board Element 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 Intel® NUC Compute Element 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.

2.12 Power

The NUC Rugged Board Element requires a 12-24 ± 8% V DC input via the back-panel power jack or the internal power connector. Both inputs provide delayed AC start as well as transient voltage suppression (TVS) at 26 V.



NOTE

Total power required will need to consider the NUC Compute Element power requirements, the NUC Rugged Board Element power requirements and any devices or peripherals that are plugged into the board.



CAUTION

It is strongly recommended to make sure that the NUC Rugged Board Element is powered off and AC power is removed before removing the NUC Compute Element from the board connector. Removing the NUC Compute Element from the board connector while powered on may cause damage to the NUC Compute Element, operating system corruption, create a no boot condition or result in data loss. If the Blue LED on the board is illuminated, do not remove the NUC Compute Element from the board connector.

2.13 Intel® vPro® Technology

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

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



NOTE

Intel® vPro® Technology is only supported on the Intel® NUC Rugged Board Element if an Intel NUC Compute Element with Intel® vPro® Technology support is connected.

2.14 Wireless Enable/Disable Jumper

CAUTION

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

The jumper position determines whether the wireless module on the NUC Compute Element is enabled or disabled. See Figure 8 for the location of the jumper. Table 14 describes the jumper settings.

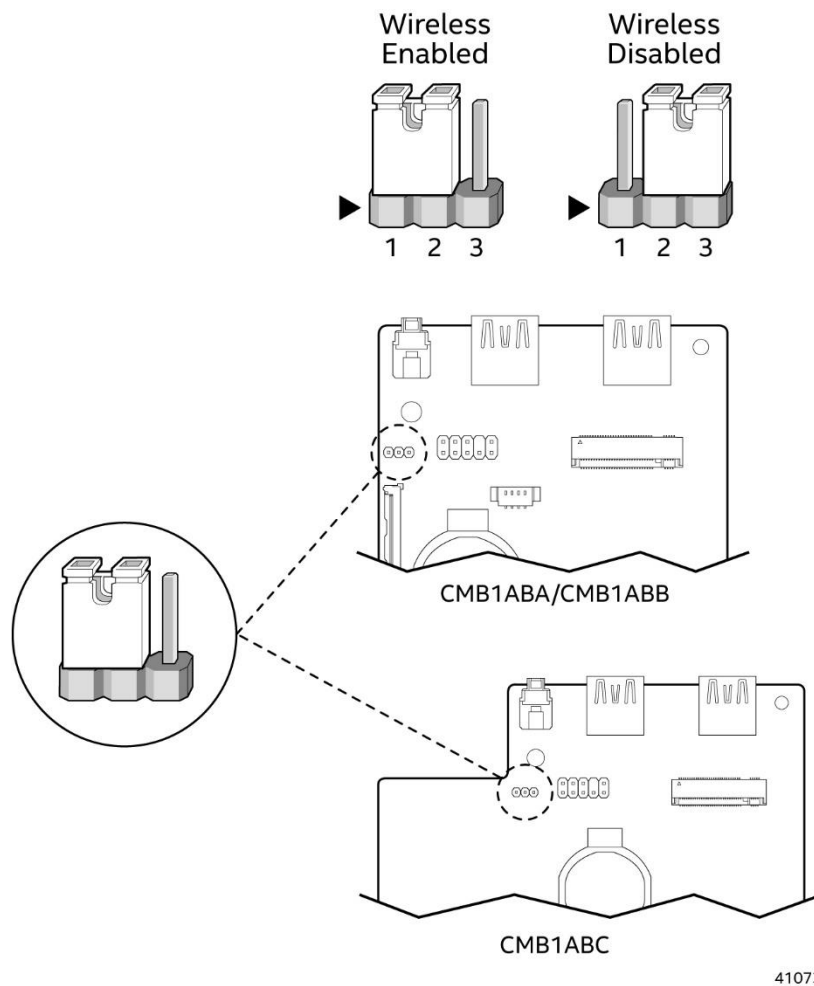


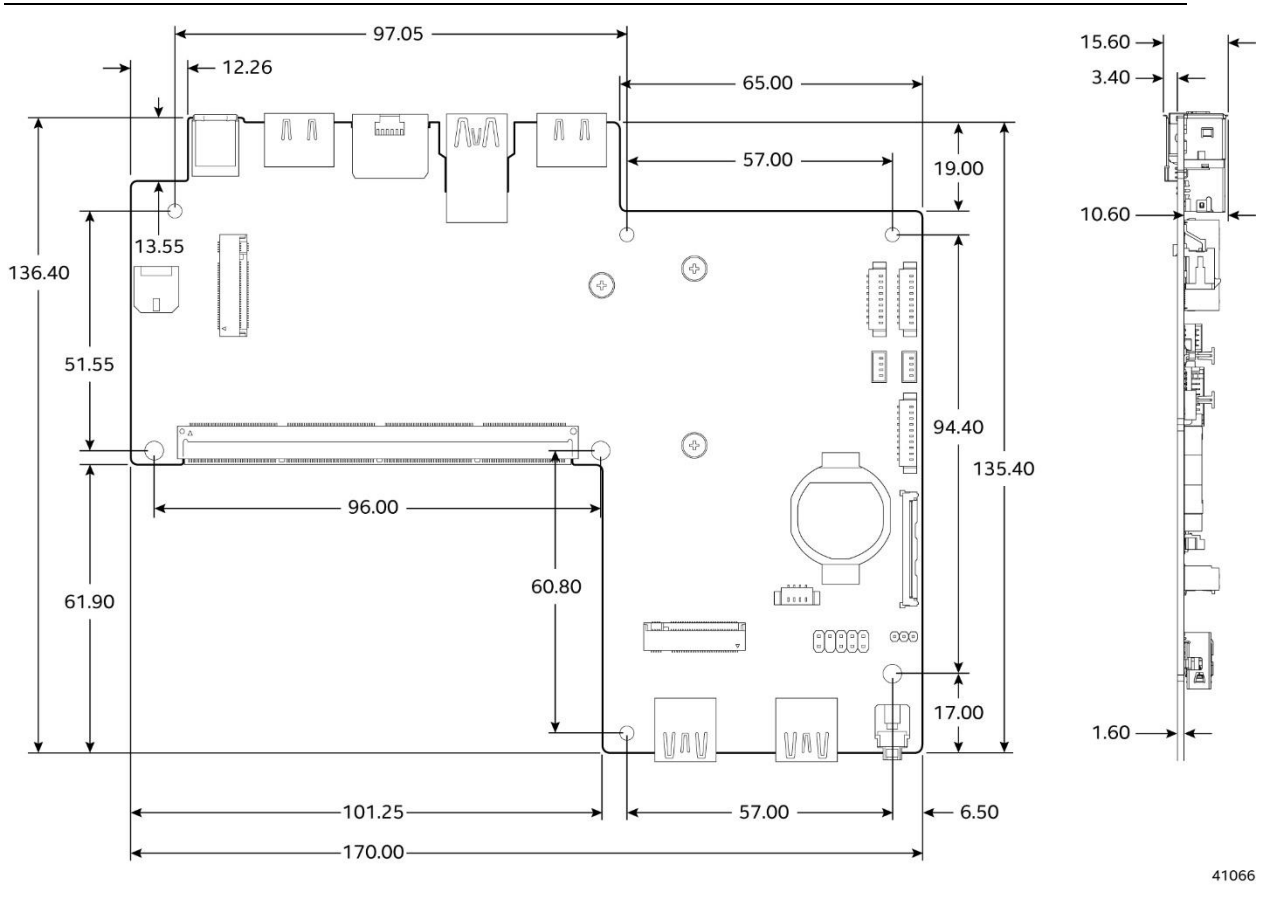
Figure 8. Wireless Enable/Disable Jumper Location

Table 14. Wireless Enable/Disable Jumper Settings

Function/Mode	Jumper Setting	Configuration
Enable	1-2	Wireless and Bluetooth will be enabled on the NUC Rugged Compute Element
Disable	2-3	Wireless and Bluetooth will be disabled on the NUC Rugged Compute Element

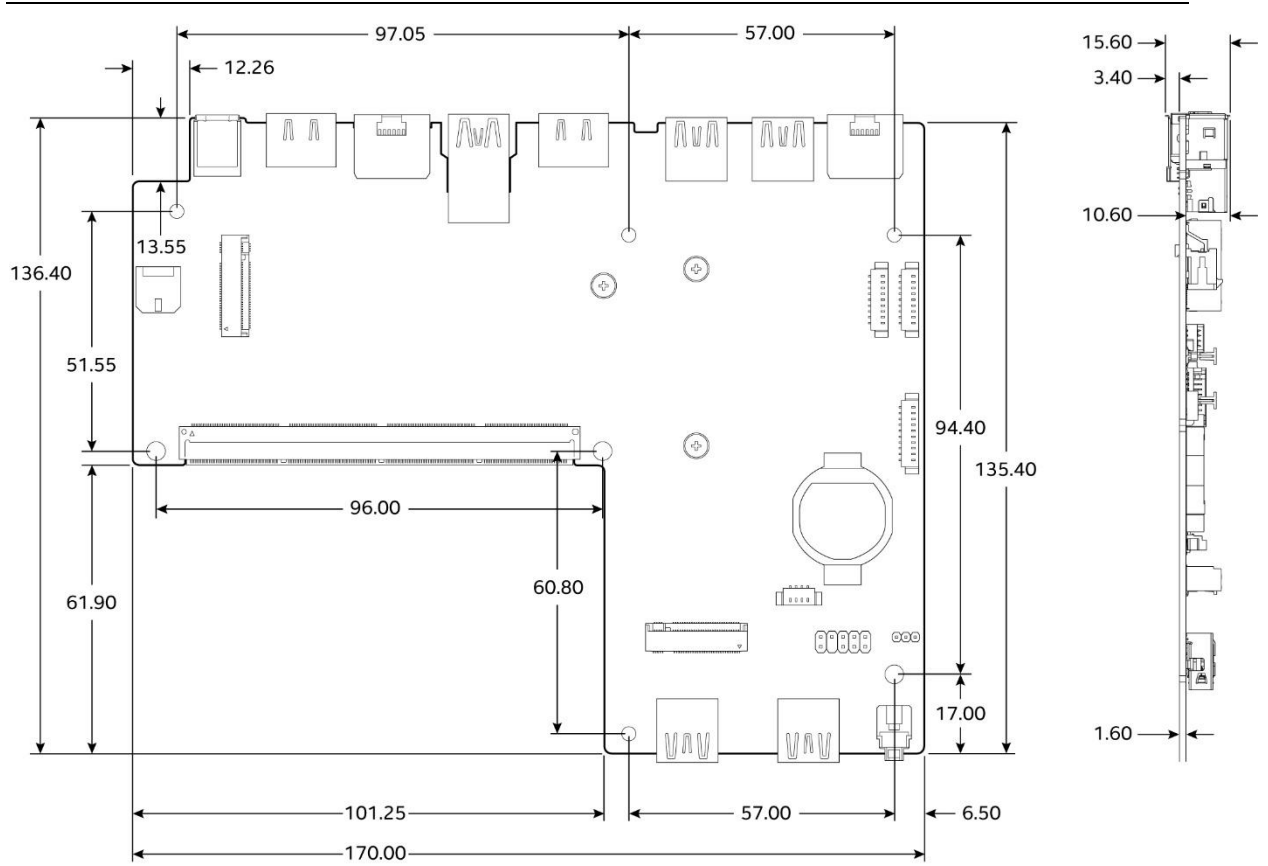
Mechanical

The following figures illustrate the mechanical form factor for the Intel® NUC Rugged Board Elements. Dimensions are given in millimeters (mm).



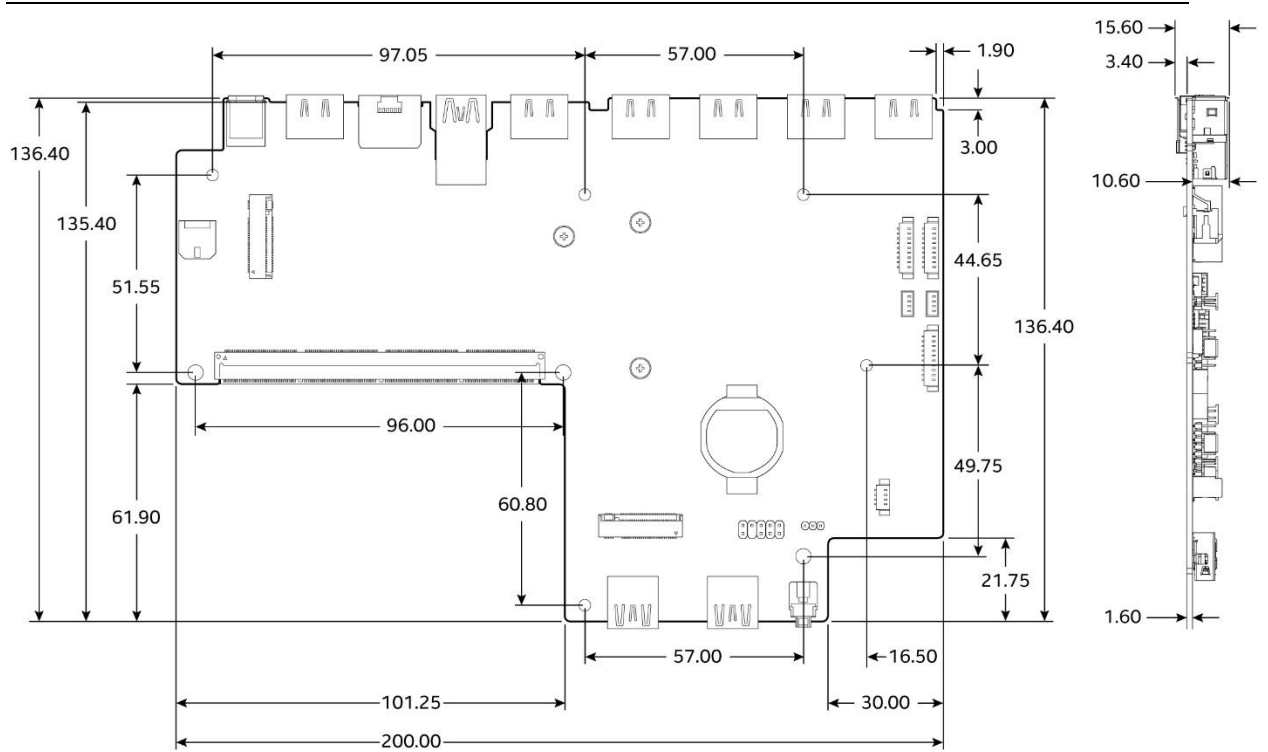
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Figure 9. CMB1ABA Dimensions



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Figure 10. CMB1ABB Dimensions



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Figure 11. CMB1ABC Dimensions

2.15 Thermal

The fundamental design of the Intel® NUC Compute Element relies on the chassis that the Intel® NUC Rugged Board Element is installed into for proper cooling. Both internal components and external skin temperatures are critical parameters in proper cooling and should be considered in any design. For best cooling performance, direct contact with a thermal management device to the bottom of the NUC Compute Element such as a heatsink or enclosure surface is recommended. This can be accomplished with active or passive cooling design approaches. Non-contact convection only cooling may be possible but will likely result in performance limitations or compromises in skin temperature levels relative to a conductive design approach.

The Integrated Heat Spreader side of the NUC Compute Element is the primary heat source. To provide adequate cooling of the NUC Compute Element while maintaining safe skin temperatures a thermal solution that contacts the entire metal portion of the Integrated Heat Spreader is recommended. Localized contact with the primary heat source on the NUC Compute Element bottom is not recommended as the location is subject to change with different generations of the NUC Pro Compute Element. The Mylar side of the NUC Compute Element does not typically require contact with a thermal solution, however proper air flow over the top of the NUC Compute Element is recommended.

For more detailed thermal design information, refer to the NUC Compute Element Carrier Board Design Guide available at [MyIntel](#).

2.16 Environmental

Table 15 lists the environmental specifications for the Intel® NUC Rugged Board Elements.

Table 15. Environmental Specifications

Parameter	Specification	
Temperature		
Non-Operating	-40 °C to +50 °C	
Operating	0 °C to +50 °C	
Shock		
Unpackaged	25 g trapezoidal waveform	
	Velocity change of 250 inches/s ²	
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

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

3 Characterized Errata

This section of the document communicates product Errata for the Intel® NUC Rugged Board Element CMB1ABA, CMB1ABB and CMB1ABC.

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

There are no known characterized errata.