



# Intel® NUC 12 Compute Element Product Specification

Revision 1.0

Regulatory Model: ELM12HB

*June 2022*

Intel® NUC 12 Compute Element ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 or ELM12HBV7 may contain design defects or errors known as errata that may cause the product to deviate from published specifications. Current characterized errata, if any, are documented in this product specification

# Revision History

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Revision	Revision History	Date
0.1	Draft	8 March 2022
0.2	Added Figures	15 March 2022
0.3	Fixed Broken URL	10 June 2022
1.0	Updated Processor Stepping and Spec Code, Official Release	22 June 2022

## Disclaimer

This product specification applies only to the standard Intel® NUC 12 Compute Element with BIOS identifier TBD or TBD.

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# Preface

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This Product Specification specifies the layout, components, connectors, power, and environmental features for the Intel® NUC 12 Compute Element ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7, or ELM12HBV7.



## NOTE

In this document, the use of “Intel® NUC 12 Compute Element” will refer to the ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7, or ELM12HBV7 versions.

## Intended Audience

This document is intended to provide technical information about Intel® NUC 12 Compute Element ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 or ELM12HBV7 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 ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7, or ELM12HBV7 features
2	A technical description of the ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7, or ELM12HBV7

## Typographical Conventions

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

## Notes, Cautions, and Warnings



### NOTE

*Notes call attention to important information.*



### CAUTION

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

## Other Common Notation

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

# Intel® NUC 12 Compute Element Identification Information

## Intel® NUC 12 Compute Element Identification Information

AA Revision	Product Code	Original BIOS Revision	Notes
TBD	ELM12HBCE04W	HBADL357.0046	1,2
TBD	ELM12HBCE08W	HBADL357.0046	1,2
TBD	ELM12HBI308W	HBADL357.0046	1,3
TBD	ELM12HBI316W	HBADL357.0046	1,3
TBD	ELM12HBI508W	HBADL357.0046	1,4
TBD	ELM12HBI5016W	HBADL357.0046	1,4
TBD	ELM12HBV508W	TBD	1,5
TBD	ELM12HBV516W	TBD	1,5
TBD	ELM12HBI716W	TBD	1,6
TBD	ELM12HBI732W	TBD	1,6
TBD	ELM12HBV716W	TBD	1,7
TBD	ELM12HBV732W	TBD	1,7

Notes:

1. The AA number is found on the Mylar cover.

2. The Intel® Celeron® 7305 processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Celeron® 7305	R0	SRLFY

3. The Intel® Core™ i3-1215U processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i3-1215U	R0	SRLFU

4. The Intel® Core™ i5-1235U processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel Core™ i5-1235U	R0	SRLFQ

5. The Intel® Core™ i5-1245U processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i5-1245U	R0	SRLWY

6. The Intel® Core™ i7-1255U processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i7-1255U	R0	SRLFP

7. The Intel® Core™ i7-1265U processor is used on this AA revision consisting of the following component:

Device	Stepping	Spec Code
Intel® Core™ i7-1265U	R0	SRLFN

## Specification Changes or Clarifications

The table below indicates the Specification Changes or Specification Clarifications that apply to the Intel® NUC 12 Compute Element ELM12HBCE, ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 or ELM12HBV7.

### Specification Changes or Clarifications

Date	Type of Change	Description of Changes or Clarifications

## Errata

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

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# 1 Product Description

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## 1.1 Overview

The Intel® NUC 12 Compute Elements are System-on-Module architecture optimized for integrated designs. The NUC 12 Compute Element consists of the processor, memory, wireless, Bluetooth\*, integrated heat shield and depending on the model may include discrete TPM. See Table 1 for a summary.

The Intel® NUC 12 Compute Elements require a compatible carrier board in order to operate.

For information on compatible devices for use with the Intel® NUC 12 Compute Element see <https://www.intel.com/content/www/us/en/products/details/nuc/elements.html>

## 1.2 Version Summary

There are twelve different versions of this model of Intel® NUC 12 Compute Element available which are summarized in Table 1. Unless otherwise noted in this document, not all features are available on all versions.

**Table 1. Version Summary**

Version	Intel® vPro™	Discrete TPM	Memory	Processor
ELM12HBCE04W	No	No	4 GB	Intel® Celeron® 7305
ELM12HBCE08W	No	No	8 GB	Intel® Celeron® 7305
ELM12HBI308W	No	No	8 GB	Intel® Core™ i3-1215U
ELM12HBI316W	No	No	16 GB	Intel® Core™ i3-1215U
ELM12HBI508W	No	No	8 GB	Intel® Core™ i5-1235U
ELM12HBI5016W	No	No	16 GB	Intel® Core™ i5-1235U
ELM12HBV508W	Yes	Yes	8 GB	Intel® Core™ i5-1245U
ELM12HBV516W	Yes	Yes	16 GB	Intel® Core™ i5-1245U
ELM12HBI716W	No	No	16 GB	Intel® Core™ i7-1255U
ELM12HBI732W	No	No	32 GB	Intel® Core™ i7-1255U
ELM12HBV716W	Yes	Yes	16 GB	Intel® Core™ i7-1265U
ELM12HBV732W	Yes	Yes	32 GB	Intel® Core™ i7-1265U



### NOTE

Intel® NUC 12 Compute 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.



### NOTE

An Intel® NUC 12 Compute Element a carrier board design [overview](#) is available.

**NOTE**

For information on how to design a carrier board and/or an enclosure for the Intel® NUC 12 Compute Element a design guide is available on [MyIntel](#).

## 1.3 Feature Summary

Table 2 summarizes the major features of the Intel® NUC 12 Compute Elements.

**Table 2. Feature Summary**

<b>Size</b>	95 millimeters by 65 millimeters by 6 millimeters
<b>Processor</b>	<ul style="list-style-type: none"> <li>• Soldered-down Intel® processor             <ul style="list-style-type: none"> <li>○ Integrated graphics</li> <li>○ Integrated memory controller</li> <li>○ Integrated PCH</li> </ul> </li> <li>• The following processors are supported             <ul style="list-style-type: none"> <li>○ Intel® Celeron® 7305</li> <li>○ Intel® Core™ i3-1215U</li> <li>○ Intel® Core™ i5-1235U</li> <li>○ Intel® Core™ i5-1245U</li> <li>○ Intel® Core™ i7-1255U</li> <li>○ Intel® Core™ i7-1265U</li> </ul> </li> </ul>
<b>Memory</b>	<ul style="list-style-type: none"> <li>• Soldered-down single channel LPDDR5 5200 MHz memory for ELM12HBCE</li> <li>• Soldered-down dual-channel LPDDR5 5200 MHz memory for ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 and ELM12HBV7</li> <li>• 4 GB total memory for ELM12HBCE04W</li> <li>• 8 GB total memory for ELM12HBCE08W, ELM12HBI308W, ELM12HBI508W, ELM12HBV508W</li> <li>• 16 GB total memory for ELM12HBI316W, ELM12HBI516W, ELM12HBV516W, ELM12HBI716W, ELM12HBV716W</li> <li>• 32 GB total memory for ELM12HBI732W, ELM12HBV732W</li> </ul>
<b>Graphics</b>	<p>Integrated graphics support with Intel® Iris® Xe Graphics</p> <ul style="list-style-type: none"> <li>• Three Digital Display Interface (DDI) lanes are available from the Compute Element connector that are configured as DisplayPort++ (HDMI can be supported on the carrier board)</li> <li>• High-Bandwidth Digital Content Protection support for content protection             <ul style="list-style-type: none"> <li>○ HDCP 2.3 supported via DisplayPort* and HDMI*</li> </ul> </li> <li>• Resolutions and refresh rates supported             <ul style="list-style-type: none"> <li>○ Up to 7680x4320 30 Hz 36 bpp or 5120x3200 60 Hz 24 bpp via DisplayPort 1.4a</li> <li>○ Up to 3840x2160 48-60 Hz 24 bpp (RGB/YUV444) or 3840x2160 48-60 Hz 12 bpp (YUV420) via HDMI 2.1 TMDS Compatible</li> <li>○ Up to 4096x2304 60 Hz 36 bpp or 5120x3200 60 Hz 24 bpp via eDP 1.4b</li> </ul> </li> <li>• Quad Display Support using eDP, DDI x2, TBT/DP (not supported when using ELM12HBCE)</li> </ul>
<b>Audio</b>	Intel® High Definition (Intel® HD) Audio via the Digital Display Lanes using either DisplayPort or HDMI
<b>BIOS</b>	<ul style="list-style-type: none"> <li>• Intel® BIOS resident in the Serial Peripheral Interface (SPI) Flash device</li> <li>• Support for Advanced Configuration and Power Interface (ACPI), Plug and Play, and System Management BIOS (SMBIOS)</li> </ul>
<b>Wireless</b>	<p>Soldered-down Intel® WiFi 6E AX211</p> <ul style="list-style-type: none"> <li>• 802.11a/b/g/n, 802.11ac, 802.11ax, Bluetooth* 5.2</li> <li>• Antennas are not included</li> </ul>

<b>Interfaces Supported via the Edge Connector</b>	<ul style="list-style-type: none"> <li>• 4 USB 3.2 (Gen 2)</li> <li>• 3 USB 2.0</li> <li>• 1 PCIe x1 (Gen 3)</li> <li>• 1 PCIe x4 (Gen 4)</li> <li>• 1 PCIe x4 (Gen 3) or SATA III (configurable)</li> <li>• 1 Thunderbolt™ 4 (supports USB 4 and DP 1.4a)</li> <li>• 1 GbE PHY</li> <li>• Intel® HD Audio</li> </ul>
<b>Advanced Technologies</b>	<ul style="list-style-type: none"> <li>• Intel® vPro™ Technology (ELM12HBV5 and ELM12HBV7only)</li> <li>• Intel® Virtualization Technology (VT-x)</li> <li>• Intel® Virtualization for Directed I/O (VT-d)</li> <li>• Intel® Speed Shift Technology</li> <li>• Intel® Turbo Boost Technology 2.0</li> <li>• Intel® Hyper-Threading Technology</li> <li>• Intel® Deep Learning Boost (Intel® DL Boost)</li> <li>• Intel® 64 Architecture</li> <li>• Intel® SSE4.1, Intel® SSE4.2, Intel® AVX2, Intel® AVX-512</li> <li>• Intel® Platform Trust Technology (Intel® PTT) – (ELM12HBCE, ELM12HBI3, ELM12HBI5 and ELM12HBI7)</li> </ul>
<b>Security and Reliability</b>	<ul style="list-style-type: none"> <li>• Intel® Active Management Technology 15 (Intel® AMT) – (ELM12HBV5 and ELM12HBV7)</li> <li>• Intel® Trusted Execution Technology (Intel® TXT) – (ELM12HBV5 and ELM12HBV7)</li> <li>• Intel® AES New Instructions</li> <li>• Intel® Boot Guard</li> <li>• Intel® OS Guard</li> <li>• Intel® Software Guard Extensions (Intel® SGX)</li> <li>• Intel® AES New Instructions</li> <li>• Mode-based Execute Control (MBE)</li> <li>• ST Micro ST33TPHF2XSPI Discreet Trusted Platform Module 2.0 (TPM) – (ELM12HBV5 and ELM12HBV7)</li> </ul>
<b>Operating Systems Support (64-bit only)</b>	<ul style="list-style-type: none"> <li>• Windows* 11 Home 64-bit</li> <li>• Windows 11 Pro 64-bit</li> <li>• Windows 11 Education 64-bit</li> <li>• Windows 11 IoT Enterprise 64-bit</li> <li>• Windows 10 Pro 64-bit</li> <li>• Some Linux* operating systems may be compatible. Check with the specific Linux distribution to make sure that support is available for this platform.</li> </ul>
<b>Supported Connectors</b>	<ul style="list-style-type: none"> <li>• Lotes APCI0468-P001A01 Edge Mount Connector</li> <li>• Lotes APCI0468-P002A01 Edge Mount Connector</li> <li>• Lotes APCI0480-P001A01 Surface Mount Connector</li> <li>• Lotes APCI0480-P002A01 Surface Mount Connector</li> </ul>

**To find information about...**

- Intel® NUC Elements
- Intel® NUC Element Support
- Intel® NUC Element Warranty Information
- Available configurations for Intel® NUC 12 Compute Element
- Intel Processors
- Intel Graphics
- Intel Wireless
- Intel Technologies

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- <http://ark.intel.com>
- <http://www.intel.com/processors>
- <http://www.intel.com/graphics>
- <http://www.intel.com/wireless>
- <http://www.intel.com/technology>

## 2 Technical Reference

### 2.1 Block Diagram

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

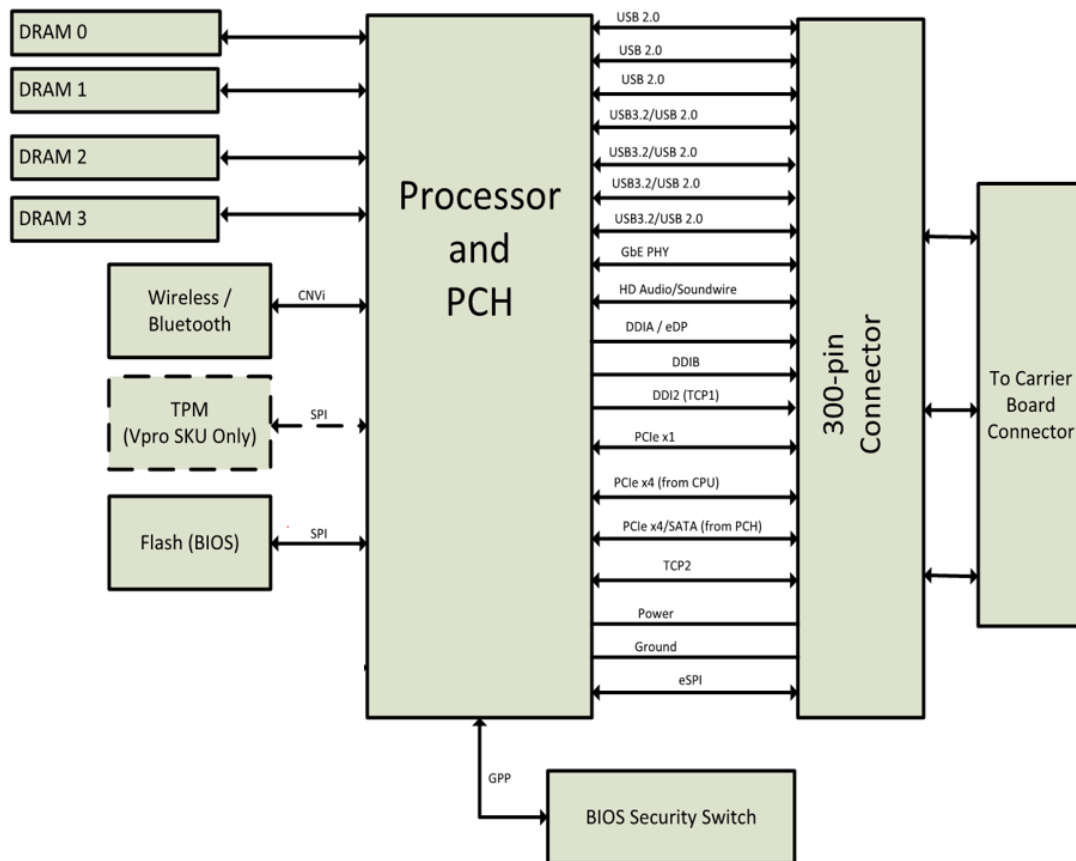
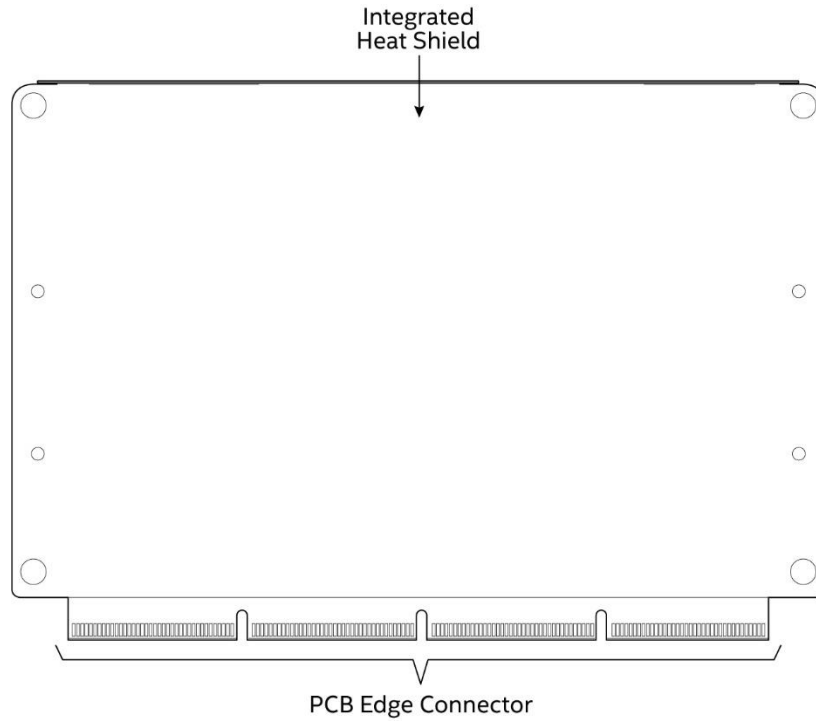


Figure 1. Block Diagram

## 2.2 Compute Element Exterior

The NUC 12 Compute Element has a set of gold fingered connections along one edge. On one side is the Integrated Heat Shield (IHS). On the other side is a Mylar cover for the PCB. See Figure 2 and Figure 3.



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**Figure 2. Integrated Heat Shield Side**

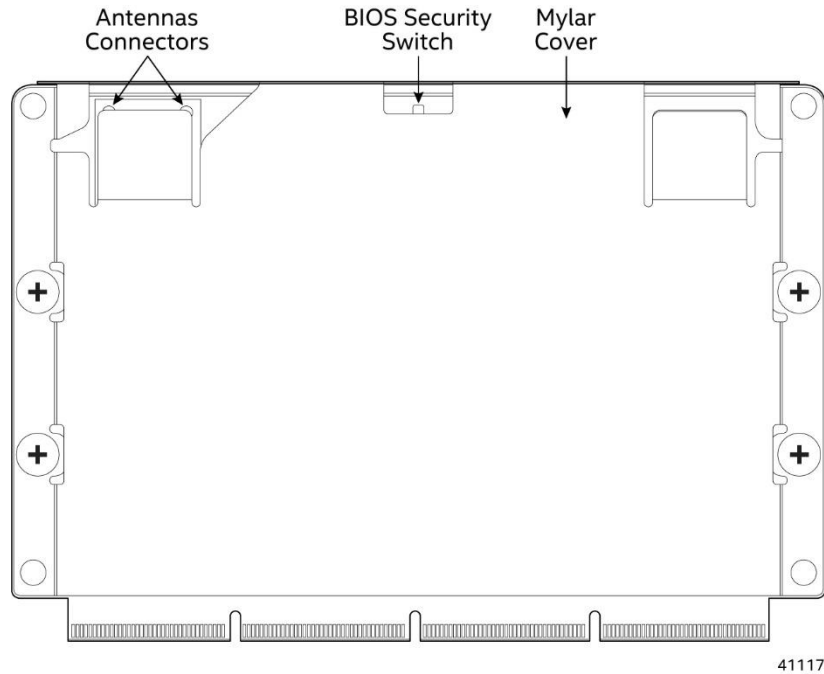


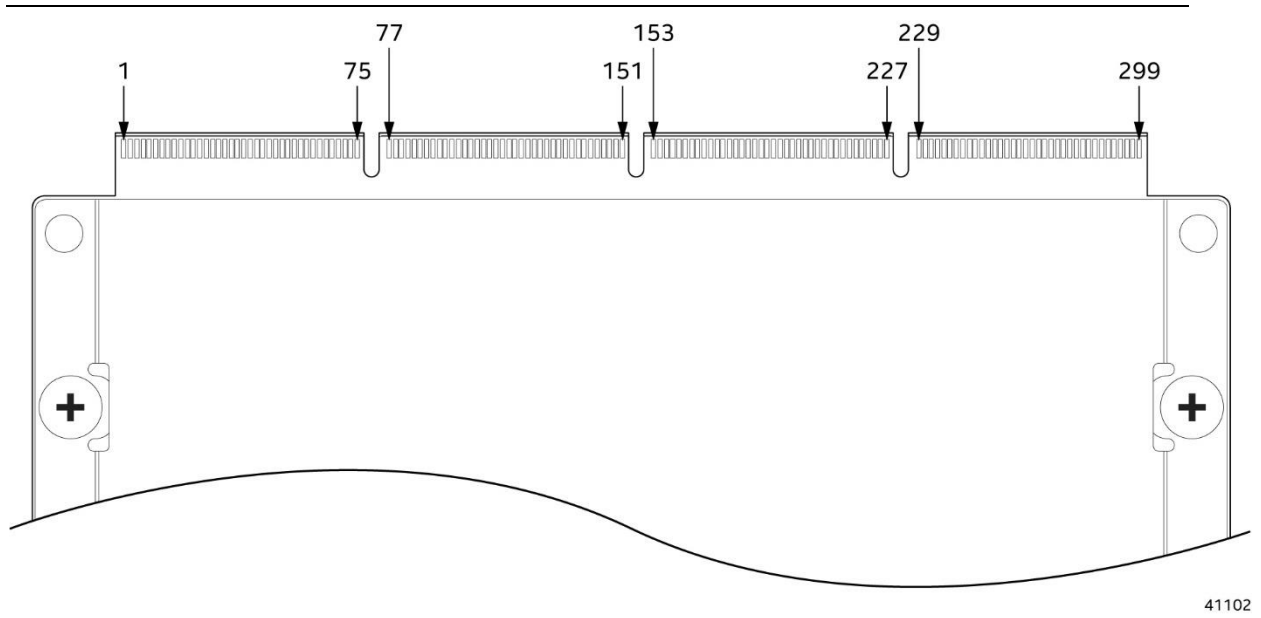
Figure 3. Mylar Side

## 2.3 Connector

The NUC 12 Compute Element gold finger edge connector mates with the following LOTES\* connectors shown in Table 3.

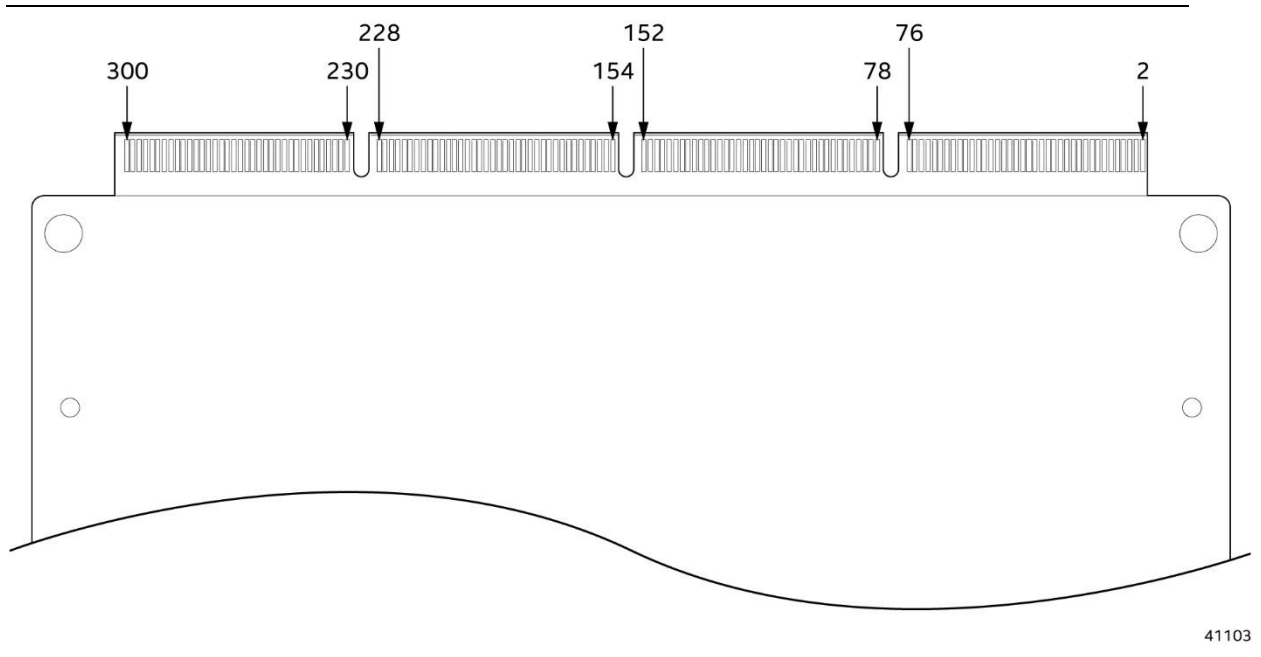
Table 3. LOTES Connector Options

Part Number	Description
APCI0468-P001A01	Edge Mount, LCP_Black, Copper Alloy, Au_15u"
APCI0468-P002A01	Edge Mount, LCP_Black, Copper Alloy, Au_30u"
APCI0480-P001A01	Surface Mount, LCP_Black, Copper Alloy, Au_15u"
APCI0480-P002A01	Surface Mount, LCP_Black, Copper Alloy, Au_30u"



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**Figure 4. Connector with Pinout – Mylar Side**



41103

**Figure 5. Connector with Pinout – IHS Side**

## 2.3.1 Connector Pin-Out

The below tables list the pin numbers and their signals:

**Table 4. Connector Segment One with Pin Numbers and Signals**

Segment 1			
Pin	Signal	Pin	Signal
1	VBAT_PWR	2	GND
3	VBAT_PWR	4	DDI2_Lane0_Dn
5	VBAT_PWR	6	DDI2_Lane0_Dp
7	VBAT_PWR	8	GND
9	VBAT_PWR	10	DDI2_Lane1_Dn
11	VBAT_PWR	12	DDI2_Lane1_Dp
13	VBAT_PWR	14	GND
15	VBAT_PWR	16	DDI2_Lane2_Dn
17	VBAT_PWR	18	DDI2_Lane2_Dp
19	VBAT_PWR	20	GND
21	No Connect	22	DDI2_Lane3_Dn
23	COIN_RTC_3p3V_IN	24	DDI2_Lane3_Dp
25	HDA_3p3_1p8_SEL	26	GND
27	PCIE_SRC0_CLK_Dn	28	DDIB_Lane0_Dn
29	PCIE_SRC0_CLK_Dp	30	DDIB_Lane0_Dp
31	GND	32	GND
33	PCIE_SRC1_CLK_Dn	34	DDIB_Lane1_Dn
35	PCIE_SRC1_CLK_Dp	36	DDIB_Lane1_Dp
37	GND	38	GND
39	PCIE_SRC2_CLK_Dn	40	DDIB_Lane2_Dn
41	PCIE_SRC2_CLK_Dp	42	DDIB_Lane2_Dp
43	GND	44	GND
45	PCIE_SRC3_CLK_Dn	46	DDIB_Lane3_Dp
47	PCIE_SRC3_CLK_Dp	48	DDIB_Lane3_Dp
49	GND	50	GND
51	TCP2_CTRL_CK_TBT_LSX2_TXD	52	DDIB_AUX_Dn
53	TCP2_CTRL_DATA_TBT_LSX2_RXD	54	DDIB_AUX_Dp
55	GND	56	DDIB_HPD_Q
57	CLKREQ_SRC0_N	58	BT_LED
59	CLKREQ_SRC1_N	60	TBT_Force_PWR
61	CLKREQ_SRC2_N	62	GND
63	CLKREQ_SRC3_N	64	SUSCLK
65	DDIA_eDP_SEL	66	GND
67	GND	68	ACPRESENT
69	DDI2_AUX_Dp	70	BATLOW#
71	DDI2_AUX_Dn	72	INTRUDER
73	TCP1_HPD_Q	74	THRMTRIP#
75	GND	76	Psys_Input



<b>Segment 2</b>			
<b>Pin</b>	<b>Signal</b>	<b>Pin</b>	<b>Signal</b>
77	GND	78	GND
79	PCIE13_M2_SSD_RX_Dn	80	eDP_Tx0_Dn/DDIA_Lane0_Dn
81	PCIE13_M2_SSD_RX_Dp	82	eDP_Tx0_Dp/DDIA_Lane0_Dp
83	GND	84	GND
85	PCIE13_M2_SSD_R_TX_Dn	86	eDP_Tx1_Dn/DDIA_Lane1_Dn
87	PCIE13_M2_SSD_R_TX_Dp	88	eDP_Tx1_Dp/DDIA_Lane1_Dp
89	GND	90	GND
91	PCIE14_M2_SSD_RX_Dn	92	eDP_Tx2_Dn/DDIA_Lane2_Dn
93	PCIE14_M2_SSD_RX_Dp	94	eDP_Tx2_Dp/DDIA_Lane2_Dp
95	GND	96	GND
97	PCIE14_M2_SSD_R_TX_Dn	98	eDP_Tx3_Dn/DDIA_Lane3_Dn
99	PCIE14_M2_SSD_R_TX_Dp	100	eDP_Tx3_Dp/DDIA_Lane3_Dp
101	GND	102	GND
103	PCIE15_M2_SSD_RX_Dn	104	eDP_AUX_Dn/DDIA_AUX_Dn
105	PCIE15_M2_SSD_RX_Dp	106	eDP_AUX_Dp/DDIA_AUX_Dp
107	GND	108	eDP_HPD_Q/DDIA_HPD_Q
109	PCIE15_M2_SSD_R_TX_Dn	110	GND
111	PCIE15_M2_SSD_R_TX_Dp	112	eDP_VDD_En/DDCA_CTRL_CK
113	GND	114	eDP_BKLT_CRTL
115	PCIE16_SATA2_M2_SSD_RX_Dn	116	eDP_BKLT_En/DDCA_CTRL-DATA
117	PCIE16_SATA2_M2_SSD_RX_Dp	118	GND
119	GND	120	DDCB_CTRL_CK
121	PCIE16_SATA2_M2_SSD_R_TX_Dn	122	DDCB_CTRL_DATA
123	PCIE16_SATA2_M2_SSD_R_TX_Dp	124	TCP1_CTRL_CK_TBT_LSX1_TXD
125	GND	126	TCP1_CTRL_DATA_TBT_LSX1_RXD
127	TCP2_TX0_Dn	128	EKB_ID/GND
129	TCP2_TX0_Dp	130	GND
131	GND	132	HDA_SYNC
133	TCP2_TXRX0_Dn	134	HDA_BCLK
135	TCP2_TXRX0_Dp	136	HDA_SDO
137	GND	138	HDA_SDI0
139	PCIE10_P1_SLOT1_RX_Dn	140	HDA_SDI1/SNDW1_DATA
141	PCIE10_P1_SLOT1_RX_Dp	142	HDA_RSTB/SNDW1_CLK
143	GND	144	RSVD
145	PCIE10_P1_SLOT1_TX_Dn	146	GND (CARD_DET_N)
147	PCIE10_P1_SLOT1_TX_Dp	148	TCP2_AUX_Dp
149	GND	150	TCP2_AUX_Dn
151	RTCRST_CTRL	152	TCP2_HPD_Q

<b>Segment 3</b>			
<b>Pin</b>	<b>Signal</b>	<b>Pin</b>	<b>Signal</b>
153	SML0_CLK	154	SML0_DATA
155	GND	156	GND
157	TCP2_TX1_Dn/DDI3_Lane2_Dn	158	USB2_P1_Dn
159	TCP2_TX1_Dp/DDI3_Lane2_Dp	160	USB2_P1_Dp
161	GND	162	GND
163	TCP2_TXRX1_Dn/DDI3_Lane3_Dn	164	USB2_P2_Dn
165	TCP2_TXRX1_Dp/DDI3_Lane3_Dp	166	USB2_P2_Dp
167	GND	168	GND
169	PCIE9_LAN_RX_Dn	170	USB2_P3_Dn
171	PCIE9_LAN_RX_Dp	172	USB2_P3_Dp
173	GND	174	GND
175	PCIE9_LAN_TX_Dn	176	USB2_P4_Dn
177	PCIE9_LAN_TX_Dp	178	USB2_P4_Dp
179	GND	180	GND
181	PCIE5_X4_RX_Dn	182	USB_OC_0_N
183	PCIE5_X4_RX_Dp	184	LAN_WAKE_N
185	GND	186	PCH_EC_SLPSUS_L
187	PCIE5_X4_TX_Dn	188	PCH_EC_SLP_S0
189	PCIE5_X4_TX_Dp	190	WIFI_DISABLE_N
191	GND	192	LAN_DISABLE_N
193	PCIE6_X4_RX_Dn	194	GND
195	PCIE6_X4_RX_Dp	196	ESPI_IO_0
197	GND	198	ESPI_IO_1
199	PCIE6_X4_TX_Dn	200	ESPI_IO_2
201	PCIE6_X4_TX_Dp	202	ESPI_IO_3
203	GND	204	ESPI_CS_N
205	PCIE7_X4_RX_Dn	206	ESPI_RESET_N
207	PCIE7_X4_RX_Dp	208	GND
209	GND	210	ESPI_CLK
211	PCIE7_X4_TX_Dn	212	GND
213	PCIE7_X4_TX_Dp	214	DMIC_CLK_1/SNDW2_CLK
215	GND	216	DMIC_DATA_1/SNDW2_DATA
217	PCIE8_X4_RX_Dn	218	GND
219	PCIE8_X4_RX_Dp	220	DMIC_CLK_0/SNDW3_CLK
221	GND	222	DMIC_DATA_0/SNDW3_DATA
223	PCIE8_X4_TX_Dn	224	GND
225	PCIE8_X4_TX_Dp	226	PECI
227	GND	228	GND

Segment 4			
Pin	Signal	Pin	Signal
229	SML1_CLK	230	SMB_CLK
231	SML1_DATA	232	SMB_DATA
233	GND	234	SMB_ALERT_N
235	USB32_P1_TYPEA_TX_Dp	236	GND
237	USB32_P1_TYPEA_TX_Dn	238	SML0_ALERT_N
239	GND	240	SML1_ALERT_N
241	USB32_P1_TYPEA_RX_Dp	242	GND
243	USB32_P1_TYPEA_RX_Dn	244	PMCALERT_N
245	GND	246	PCH_SATA2_PEDET
247	USB32_P2_TYPEA_TX_Dp	248	RSVD
249	USB32_P2_TYPEA_TX_Dn	250	PCH_M2_DEVSLP
251	GND	252	PCH_PCIE_WAKE_N
253	USB32_P2_TYPEA_RX_Dp	254	PCH_SATA_LED_CTRL
255	USB32_P2_TYPEA_RX_Dn	256	PROCHOT_N
257	GND	258	PCH_EC_ME_CONFIG
259	USB32_P3_TYPEA_TX_Dp	260	RSVD
261	USB32_P3_TYPEA_TX_Dn	262	SYS_RESET_N
263	GND	264	PWRBTN_N
265	USB32_P3_TYPEA_RX_Dp	266	GND
267	USB32_P3_TYPEA_RX_Dn	268	ISH_I2C0_SDA
269	GND	270	ISH_I2C0_SCL
271	USB32_P4_TYPEA_TX_Dp	272	GND
273	USB32_P4_TYPEA_TX_Dn	274	ISH_I2C1_SDA
275	GND	276	ISH_I2C1_SCL
277	USB32_P4_TYPEA_RX_Dp	278	GND
279	USB32_P4_TYPEA_RX_Dn	280	ISH_GPIO_0
281	GND	282	ISH_GPIO_1
283	USB_P5_Dp	284	ISH_GPIO_2
285	USB_P5_Dn	286	ISH_GPIO_3
287	GND	288	ISH_GPIO_4/I2C1_IRQ_N
289	USB_P6_Dp	290	GND
291	USB_P6_Dn	292	I2C0_SDA
293	GND	294	I2C0_SCL
295	USB_P7_Dp	296	GND
297	USB_P7_Dn	298	I2C1_SDA
299	GND	300	I2C1_SCL

## 2.4 Power

The Intel® NUC 12 Compute Element requires a DC input from the carrier board via the connector. The carrier board must provide the proper voltage and current as listed below:

- Voltage: 5.7-20 V DC +/-5%
- Current (RMS max): 3.0-10.6 A
- Current (Peak): 12 A



### CAUTION

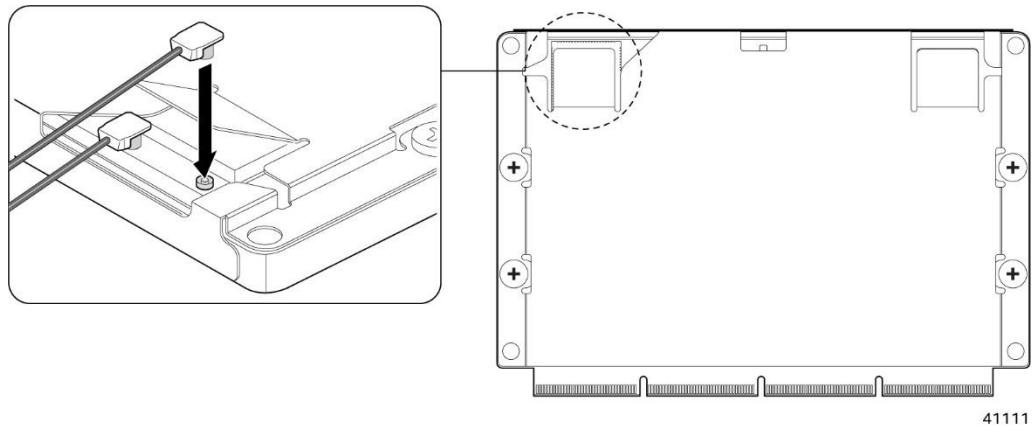
*Do not remove the AC power source without correctly powering down the NUC Element. Removing the AC power source while the NUC Element is operating may cause damage to the system, operating system corruption, create a no boot condition, result in data loss or result in unexpected conditions.*

**CAUTION**

*It is strongly recommended to make sure that the carrier board power source is disconnected before installing or removing the Intel® NUC 12 Compute Element into the carrier board connector. Installing or removing the Intel® NUC 12 Compute Element while a power source is connected to the carrier board may cause damage to the Intel® NUC 12 Compute Element, operating system corruption, create a no boot condition or result in data loss.*

## 2.5 Antenna Connection

The NUC 12 Compute Element wireless module does not have any antennas connected. For wireless and Bluetooth operation appropriate antennas will be required. Depending on the enclosure design internal or external antennas can be supported. Figure 6 shows the location of the two antenna connectors on the Mylar side.



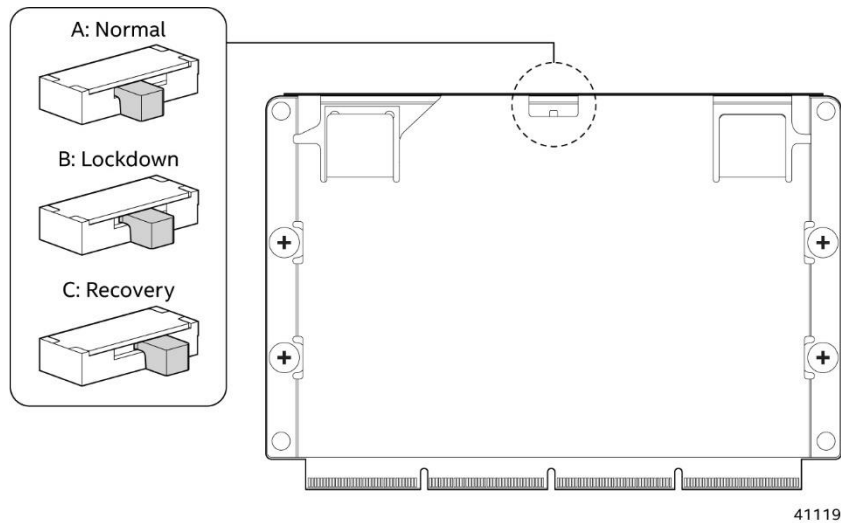
**Figure 6. Location of the Antenna Connectors**

The wireless module uses a standard 2x2 mm size RF micro coaxial receptacle (connector) with an outer diameter of 1.5 mm as defined in the PCI-E M.2 Specification. Specific plugs should be selected to suit the assembly allowable mating height and cable diameter. Refer to the PCI-E M.2 Specification for the minimum requirements of the compatible RF connectors and mating plugs.

- Receptacle physical outline is 2mm x 2mm x 0.6mm
- Receptacle outer diameter is 1.5mm

## 2.6 BIOS Security Switch

Figure 7 shows the location of the BIOS Security Switch. The 3-position switch determines the BIOS Security program's mode.



**Figure 7. Location of the BIOS Security Switch**

Table 5 lists the switch settings for the three modes: normal, lockdown, and recovery/configuration.

**Table 5. BIOS Security Switch Settings**

Function/Mode	Switch Setting	Configuration
Normal	A	The BIOS uses current configuration information and passwords for booting.
Lockdown	B	The BIOS uses current configuration information and passwords for booting, except: <ul style="list-style-type: none"> <li>All POST Hotkeys are suppressed (prompts are not displayed, and keys are not accepted. For example, F2 for Setup, F10 for the Boot Menu).</li> <li>Power Button Menu is not available.</li> </ul> BIOS updates are not available except for automatic Recovery due to flash corruption.
Recovery / Configuration	C	BIOS Recovery Update process if a matching *.CAP file is found. Recovery Update can be cancelled by pressing the Esc key. If the Recovery Update was cancelled or a matching *.CAP file was not found, a Configuration Menu will be displayed. The Configuration Menu consists of the following options: <ol style="list-style-type: none"> <li>[1] Suppress this menu until the BIOS Security Switch is set to normal.</li> <li>[2] Clear BIOS User and Supervisor Passwords.</li> <li>[3] Clear Trusted Platform Module (vPro SKU only)</li> </ol> Warning: Data encrypted with the TPM will no longer be accessible if the TPM is cleared <ol style="list-style-type: none"> <li>[F2] BIOS Setup</li> <li>[F4] BIOS Recovery</li> </ol>



### 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.

## 2.7 Thunderbolt™ 4

Thunderbolt™ 4 is supported with up to 40 Gbps of data throughput, 5K (60Hz) monitor output, USB 4 connection, charging output capabilities up to 5V at 3A or 9V at 2A via the connector.

## 2.8 Mechanical

The following figures illustrate the mechanical form factor for the NUC 12 Compute Element. All dimensions are shown in millimeters (mm).

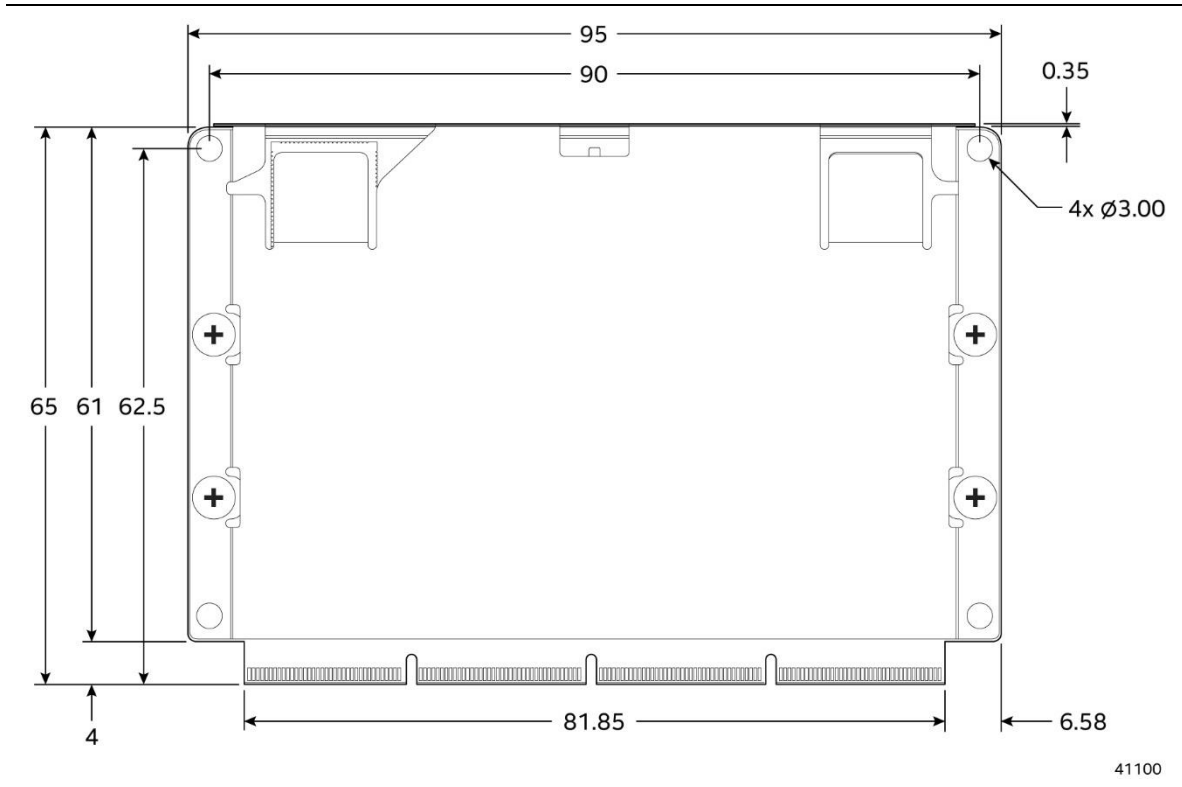


Figure 8. Mylar Side

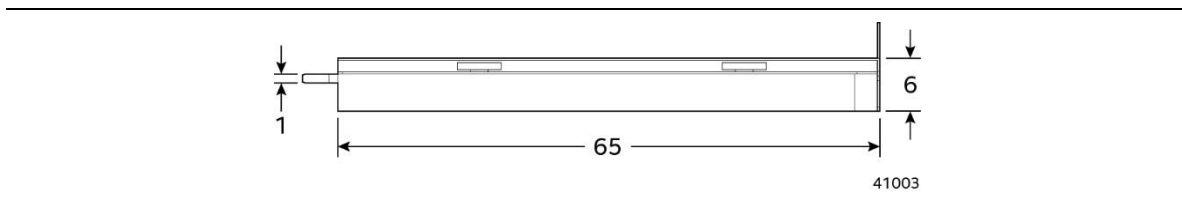


Figure 9. Left

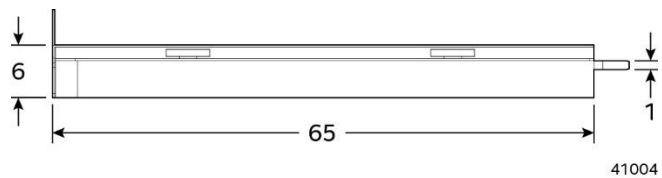


Figure 10. Right

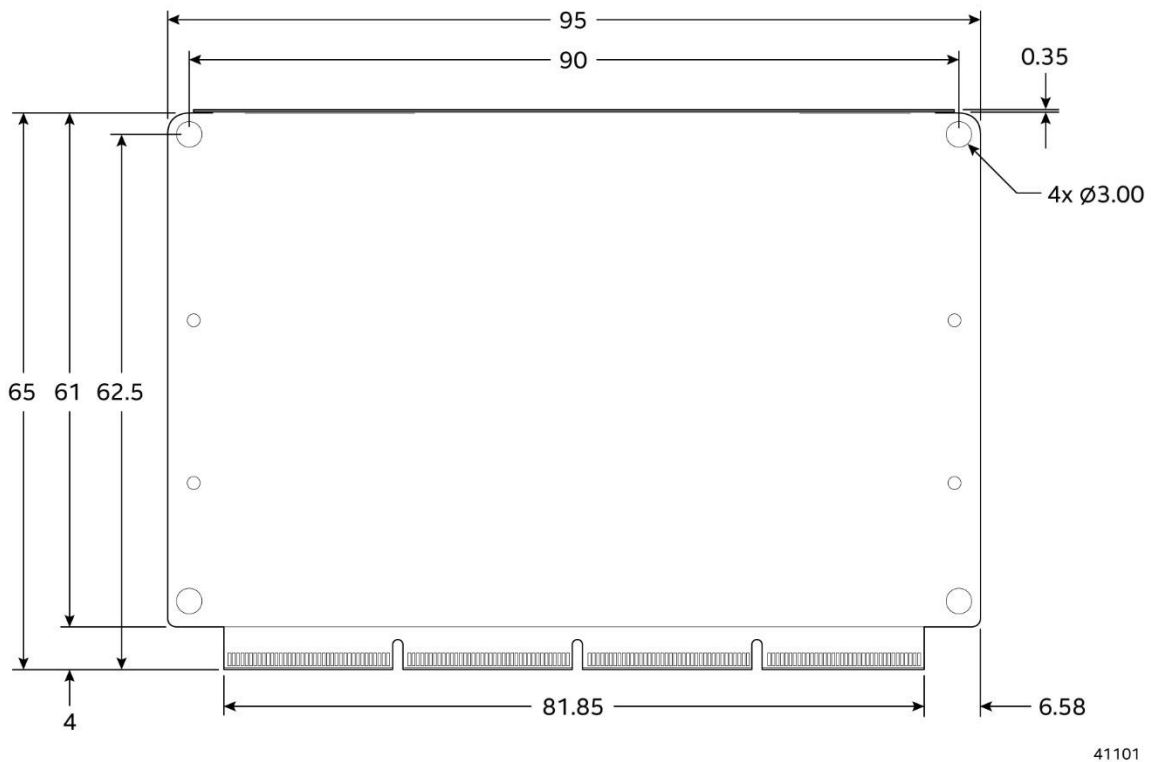


Figure 11. Integrated Heat Shield Side

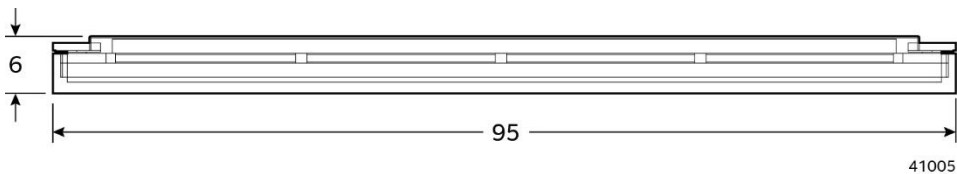


Figure 12. Front (Showing Connector)

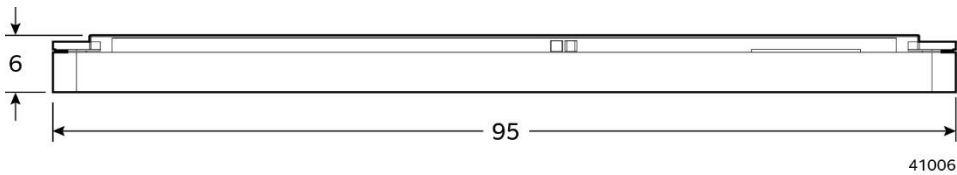


Figure 13. Back





## 2.9 Thermal

The fundamental design of the Intel® NUC 12 Compute Element relies on the carrier board enclosure 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 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 Compute Element is the primary heat source. To provide adequate cooling of the 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 Compute Element bottom is not recommended as the location is subject to change with different generations of the Compute Element. The Mylar side of the Compute Element does not typically require contact with a thermal solution, however proper air flow over the top of the Compute Element is recommended. The below information is critical for the design of a thermal solution.

- The Thermal Design Power (TDP) of the processors used in the NUC 12 Compute Element ELM12HBCE is 15W.
- The Thermal Design Power (TDP) of the processors used in the NUC 12 Compute Element ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 and ELM12HBV7 is configurable from 12W-28W.
- The Power Limit 1 (PL1) default setting in the BIOS of the NUC 12 Compute Element ELM12HBCE is 15
- The Power Limit 1 \*PL1) default setting in the BIOS of the NUC 12 Pro Compute Element ELM12HBI3, ELM12HBI5, ELM12HBV5, ELM12HBI7 and ELM12HBV7 is 28.
- The Junction Temperature Range ( $T_j$ ) of the processor used in the NUC 12 Compute Element is 0°C -100°C.
- The TDP specification temperature range of the processor used in the NUC 12 Compute Element is 35°C -100°C

## 2.10 Environmental

Table 6 lists the environmental specifications for the Intel® NUC 12 Compute Element.

**Table 6. Environmental Specifications**

Parameter	Specification	
<b>Temperature</b>		
Non-Operating	-40 °C to +60 °C	
Operating	Minimum of 0 °C. Maximum local ambient operating temperature limitations are a function of the carrier board and carrier board enclosure design and as such a specific number cannot be provided.	
<b>Shock</b>		
Unpackaged	25 g trapezoidal waveform	
	Velocity change of 250 inches/s <sup>2</sup>	
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
<b>Vibration</b>		
Unpackaged	5 Hz to 20 Hz: 0.01 g <sup>2</sup> /Hz sloping up to 20 Hz @ 0.02 g <sup>2</sup> /Hz	
	20 Hz to 500 Hz: 0.02 g <sup>2</sup> /Hz (flat)	
	Input acceleration is 3.13 g RMS	
Packaged	40 Hz to 500 Hz: 0.015 g <sup>2</sup> /Hz sloping down to 0.00015 g <sup>2</sup> /Hz	
	Input acceleration is 1.09 g RMS	

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

## 3 Characterized Errata

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This section of the document communicates product Errata for the Intel® NUC 12 Compute Element.

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

There are no characterized errata currently.