



# Intel® NUC 12 Compute Element Product Specification

Revision 1.3

Regulatory Model: ELM12HB

*April 2023*

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            |
|----------|---|-----------------|
| 1.0      | Updated Processor Stepping and Spec Code, Official Release. | 22 June 2022    |
| 1.1      | Updated block diagram and identification information.       | 11 October 2022 |
| 1.2      | Added UEFI and EFI Shell versions to table 2.               | 11 January 2023 |
| 1.3      | Clarified quad display support. Added wake events section   | 28 April 2023   |

## Disclaimer

This product specification applies only to the standard Intel® NUC 12 Compute Element with BIOS identifier HBADL357 or HBADLMIV.

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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

| Original AA Revision | Product Code  | Original BIOS Revision       | Notes |
|----------------------|---------------|------------------------------|-------|
| M47322-302           | ELM12HBCE04W  | HBADL357.0046.2002.0504.2138 | 1,2   |
| M47320-302           | ELM12HBCE08W  | HBADL357.0046.2002.0504.2138 | 1,2   |
| M47318-302           | ELM12HBI308W  | HBADL357.0046.2002.0504.2138 | 1,3   |
| M47317-302           | ELM12HBI316W  | HBADL357.0046.2002.0504.2138 | 1,3   |
| M47316-302           | ELM12HBI508W  | HBADL357.0046.2002.0504.2138 | 1,4   |
| M47315-303           | ELM12HBI5016W | HBADL357.0046.2002.0504.2138 | 1,4   |
| M47313-302           | ELM12HBV508W  | HBADLMIV.0049.2022.0601.1900 | 1,5   |
| M47310-302           | ELM12HBV516W  | HBADLMIV.0049.2022.0601.1900 | 1,5   |
| M47307-303           | ELM12HBI716W  | HBADL357.0046.2002.0504.2138 | 1,6   |
| M47306-302           | ELM12HBI732W  | HBADL357.0046.2002.0504.2138 | 1,6   |
| M47305-302           | ELM12HBV716W  | HBADLMIV.0049.2022.0601.1900 | 1,7   |
| M47304-302           | ELM12HBV732W  | HBADLMIV.0049.2022.0601.1900 | 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 |
|-------------|----------------|--|
| 28 Apr 2023 | Clarification  | Clarified quad display support           |
|             |                |  |

## 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, HDMI*, DisplayPort*/mini-DisplayPort* and Thunderbolt™ Type-C is supported on all SKUs             <ul style="list-style-type: none"> <li>○ Four 4K@60Hz video is only supported on SKUs with Intel® Core™ processors</li> </ul> </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> <li>• Support for UEFI version 2.8B and Integrated EFI Shell version 2.2</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* 5.3</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
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- Intel Graphics
- Intel Wireless
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- <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.

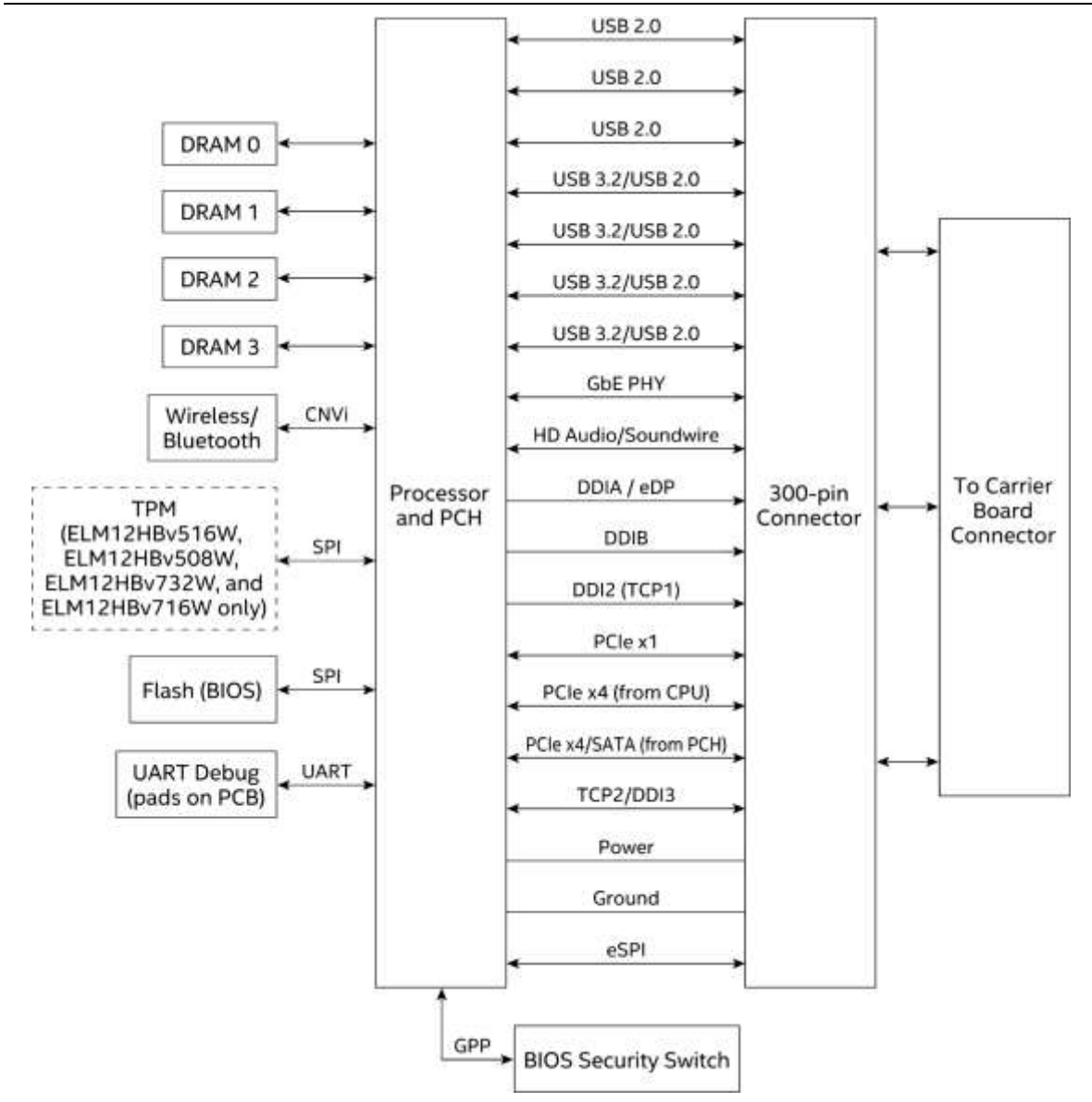
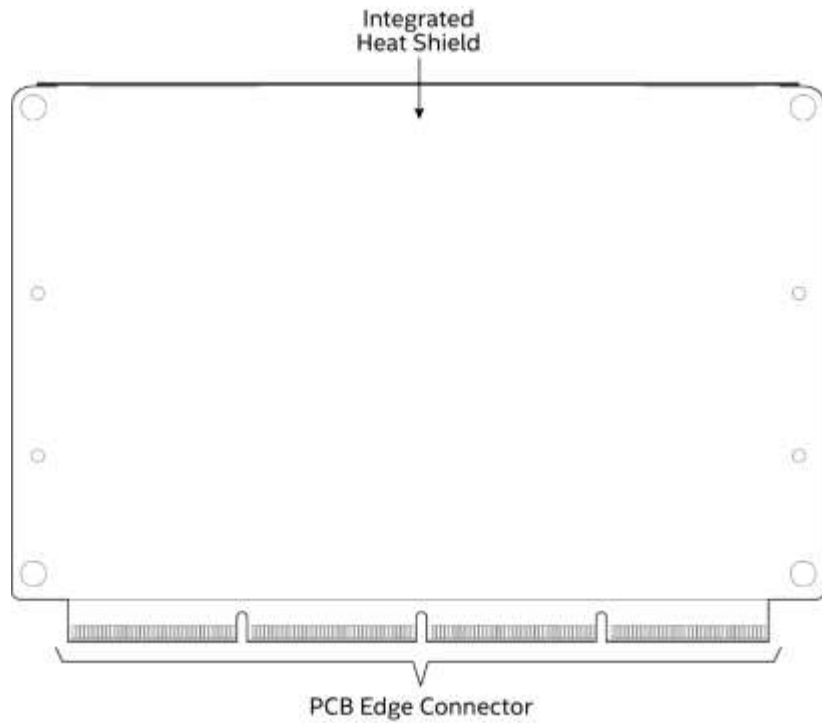


Figure 1. Block Diagram

## 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**

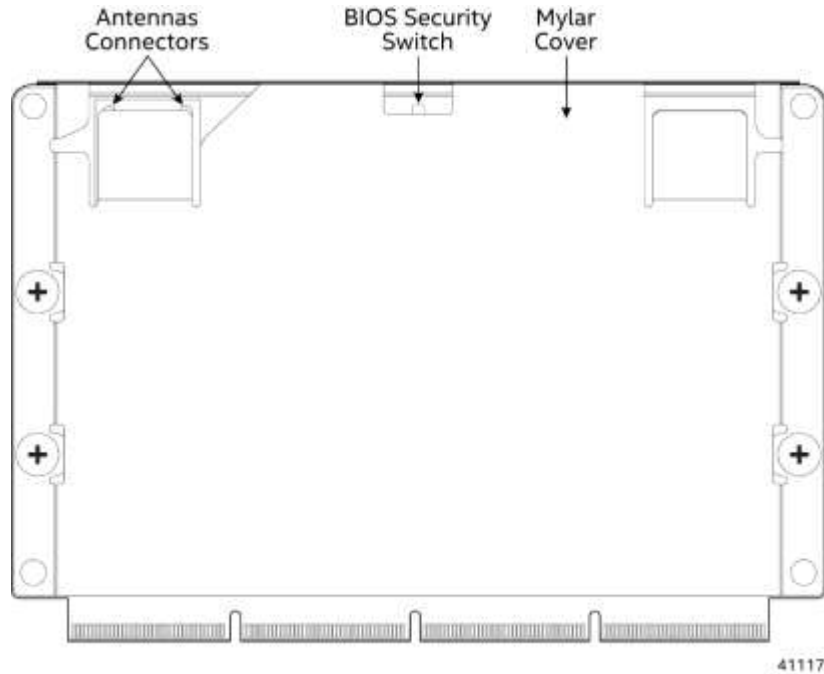


Figure 3. Mylar Side

## 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" |

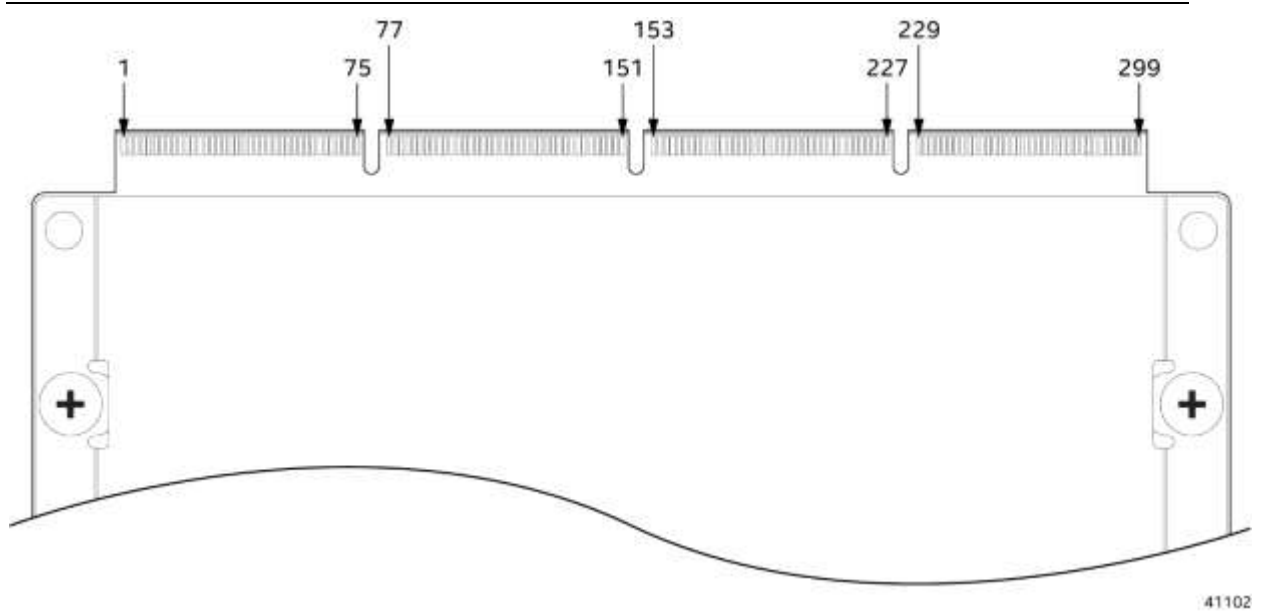


Figure 4. Connector with Pinout – Mylar Side

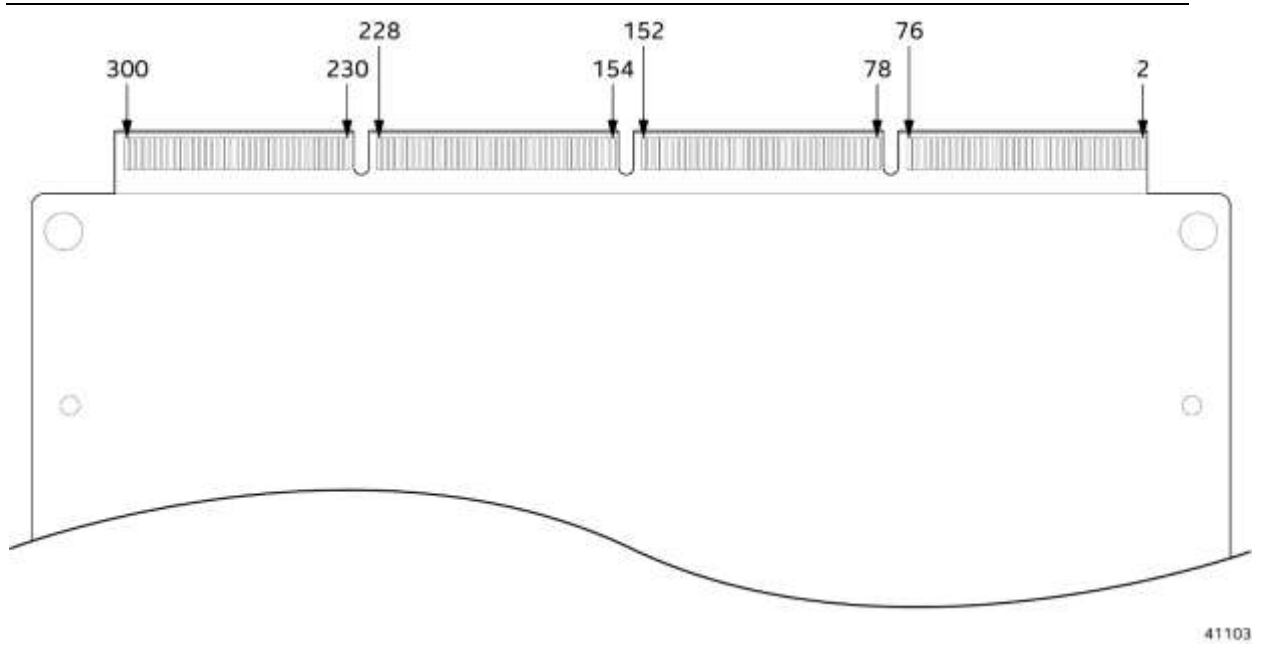


Figure 5. Connector with Pinout – IHS Side

## 2.3.1 Connector Pin-Out

The below tables list the pin numbers and their signals:

**Table 4. Connector 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 Wake Events

Table 5 and Table 6 lists the devices or specific events that can wake the computer from specific states.

**Table 5. Wake-Up Events**

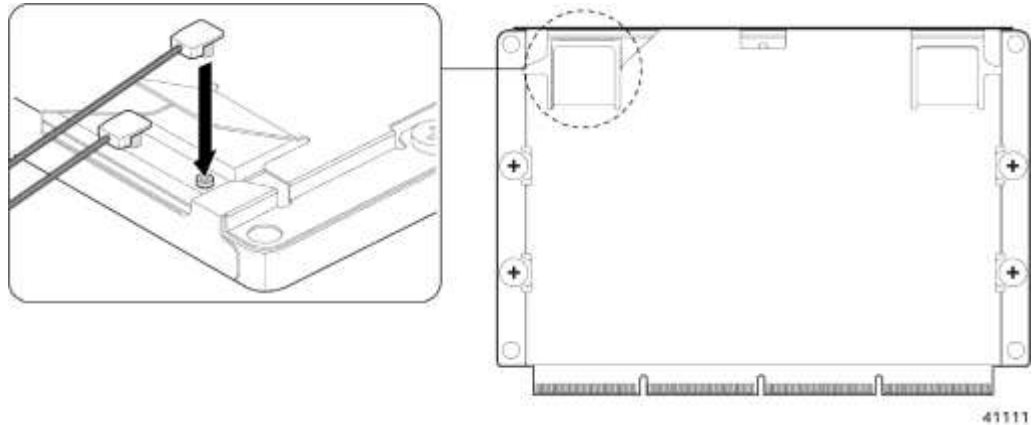
| Wake-Up Event | Supported ACPI State | Comments   |
|---------------|----------------------|--|
| Power Button  | S0, S0ix, S4, S5     |  |
| RTC Alarm     | S0, S0ix, S4, S5     | Display to remain in sleep state                     |
| USB           | S0, S0ix             | Wake S4, S5 controlled by BIOS option (not after G3) |
| AC Resume     | S4, S5               |  |
| PCIe          | S0, S0ix, S4         | Via WAKE; display to remain in sleep state           |
| Wireless LAN  | S0, S0ix             | Display to remain in sleep state                     |
| Bluetooth*    | S0, S0ix             |  |

**Table 6. Wired LAN Wake-Up Events**

| Wake-Up Event | Supported ACPI State | Comments  |
|---------------|----------------------|---|
| 225/226       | S0ix, S4, S5         | NetAdapterCx driver is needed; display to remain in sleep state |
| 219           | S0ix and S5          | Display to remain in sleep state                                |
| 210/211       | S5                   | Display to remain in sleep state                                |

## 2.6 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.



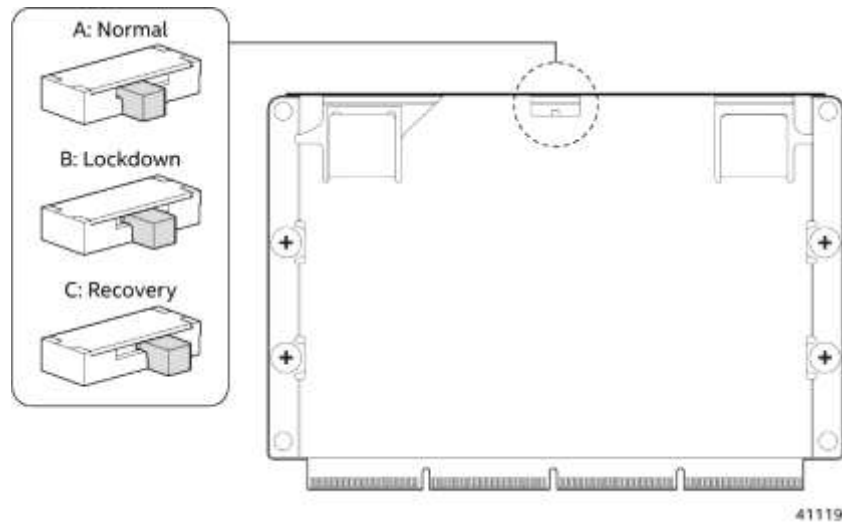
**Figure 6. Location of the Antenna Connectors**

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

## 2.7 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 7 lists the switch settings for the three modes: normal, lockdown, and recovery/configuration.

**Table 7. 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.

## 2.8 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.

## 2.9 Mechanical

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

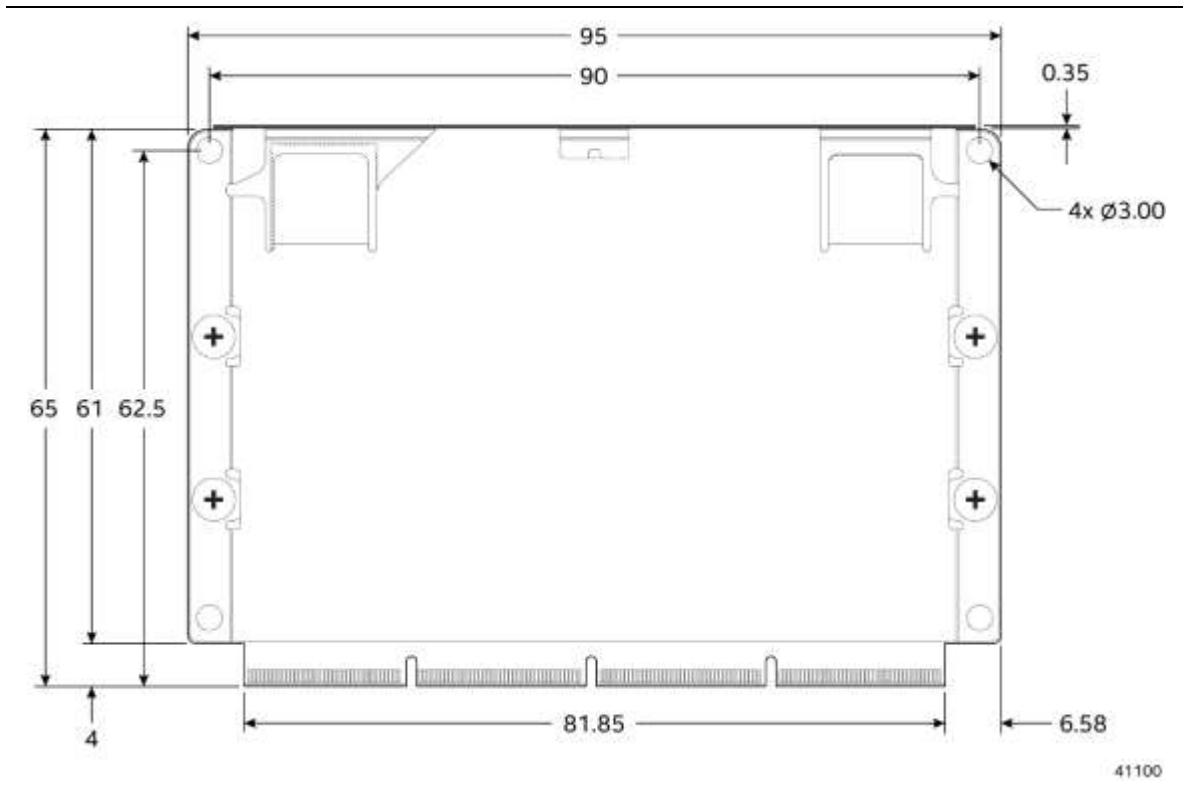


Figure 8. Mylar Side

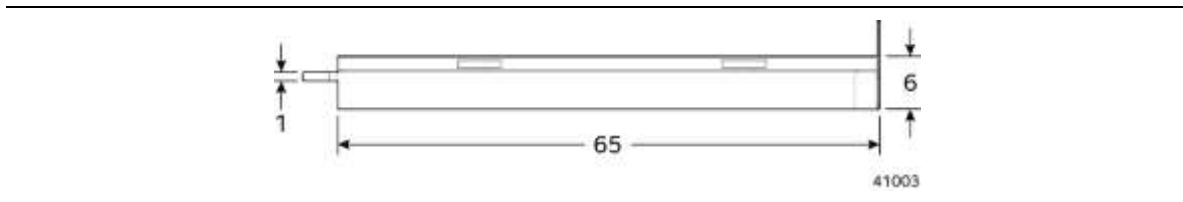


Figure 9. Left

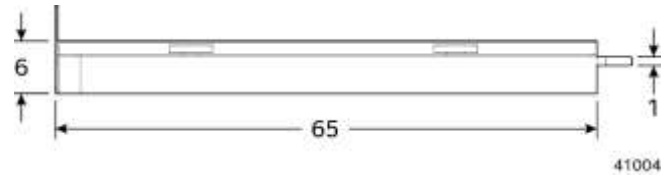


Figure 10. Right

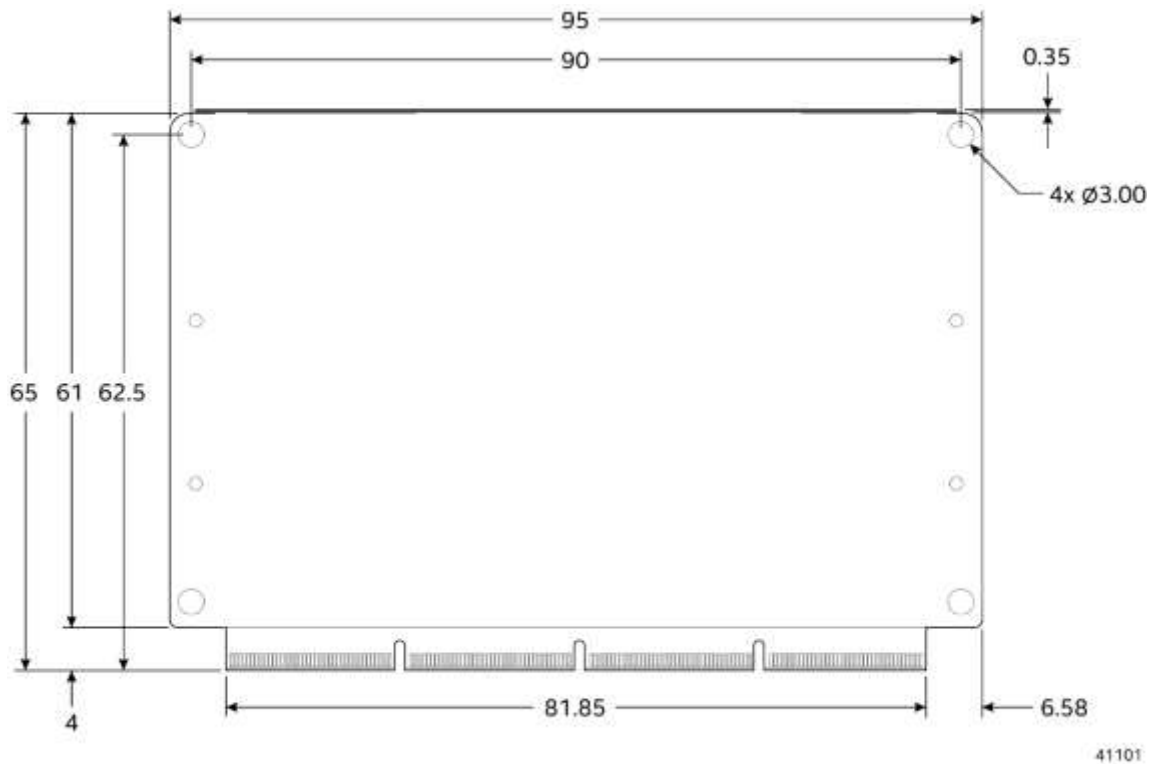


Figure 11. Integrated Heat Shield Side

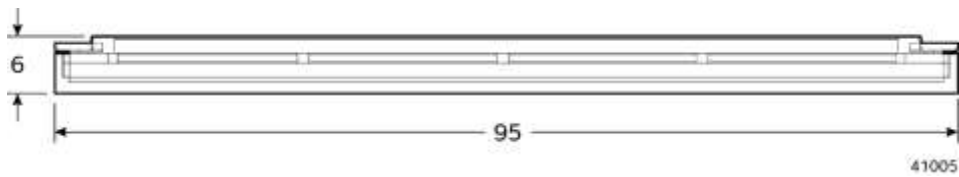


Figure 12. Front (Showing Connector)

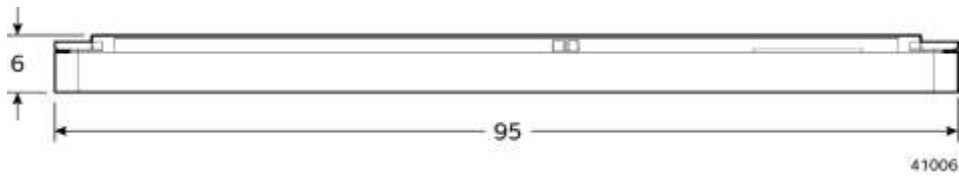


Figure 13. Back



## 2.10 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

## 2.11 Environmental

Table 8 lists the environmental specifications for the Intel® NUC 12 Compute Element.

**Table 8. 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.