Topaz Technical Product Specification

NUC11i7TZ

NUC11i7TZB

NUC11i5TZ

NUC11i5TZB

NUC11i3TZ

NUC11i3TZB

Version 1.2, 5/31/2022

Preface

The purpose of this document is to provide a technical reference for customers and developers of the Simply NUC Topaz family of products. Topaz kit SKUs include NUC11i7TZ, NUC11i5TZ and NUC11i3TZ with board SKUs NUC11i7TZB, NUC11i5TZB and NUC11i3TZB.

Contents

Tables

Figures

1   Description

1.1   Overview

The Simply NUC NUC11i7TZ, NUC11i5TZ and NUC11i3TZ (code named Topaz) is a mini computer built with an 11ᵗʰ Generation Intel® Core i7, i5 and i3 processor, respectively.

Featuring the new 11th Gen Intel Core mobile processor with Xe graphics and support for high-speed 3200 MHz DDR4 memory, Topaz is a new performance-driven small form factor PC. At home, it enables you to stream 4K video, play games, or finish your homework. At work, Topaz keeps you productive -- perfect for content creation, multitasking, and video conferencing. The Tiger Lake-based processors and high-speed memory remove bottlenecks, keeping you on task or helping you relax while tucked behind a TV or monitor.

Topaz supports up to four displays simultaneously, with up to 4K resolution at 60Hz for each monitor. Intel dual Ethernet with 2.5Gbps and 1Gbps speeds allow you to connect to multiple networks. Topaz also features TPM for sensitive communications where encryption is required. Take advantage of Intel® Wi-Fi 6 (802.11ax) with high-speed connectivity enhanced for efficient bandwidth usage in environments with many connected devices. Topaz has ample accommodation for all your peripheral devices with four front 10Gbps SuperSpeed USB ports plus two rear SuperSpeed USB type-A ports. If six USB ports is not enough, you can add a functional lid to your configuration for more I/O connections.

Topaz is built on Intel 11th Gen architecture, providing greater system performance over previous generations with advanced hyperthreading technologies driving faster speeds and enhanced graphics. Cloud computing, immersive gaming, and streaming all demand increasing computing performance with optimal energy efficiency, and Intel designed its "Tiger Lake" core to meet those demands with more core throughput, larger caches, and powerful multi-threading capabilities.

Topaz has the following features:

- Intel® Core™ i7-1165G7, i5-1135G7 or i3-1115G4 Processor
- Intel Iris Xe (for i7 and i5 variants) and Intel UHD for 11ᵗʰ Gen (for i3) Integrated Graphics
- Two DDR4-3200 SO-DIMM Socket
- M.2 Slot for PCIe or SATA SSDs
- One 10/100/1000/2500Mbps Ethernet Port
- One 10/100/1000Mbps Ethernet Port
- M.2 Slot for Wi-Fi/ Bluetooth Radio
- One DisplayPort (4k, 60Hz)
- One HDMI Port (4k, 60Hz)
- Two Front USB 3.2 Gen 2 Type-C Ports (both supporting DP Alt Mode)
- Two Front USB 3.2 Gen 2 Type-A Ports
- Two Rear USB 3.2 Gen 2 Type-A Ports
- 3.5mm Combination Microphone/Headphone Jack
- Internal SATA III Connector
- Internal Dual USB 2.0 Header
- Internal Serial Port Header Supporting RS-232

- Replaceable Lid for Expandable Functionality
- Simply NUC Universal Chassis
- 19VDC 90W Power Supply Adapter
- 12V – 19V Input Power Supply Range

1.2   Processor

The Topaz CPUs have the following features.

Table 1: CPU Features

Topaz	NUC11i7TZ	NUC11i5TZ	NUC11i3TZ
Intel CPU	i7 1165G7	i5-1135G7	I3-1115G4
Cores	4	4	2
Threads	8	8	4
L1 Cache	4x 32KB (8-way) I-cache, 4x 48KB (12-way) D-cache	4x 32KB (8-way) I-cache, 4x 48KB (12-way) D-cache	2x 32KB (8-way) I-cache, 2x 48KB (12-way) D-cache
L2 Cache	2x 1280KB (8-way) Unified	4x 1280KB (8-way) Unified	2x 1280KB (8-way) Unified
L3 Cache	12MB (16-way) Unified	8MB (16-way) Unified	6MB (16-way) Unified
Base Speed (Turbo) [MHz]	2800 (4700)	2400 (4200)	3000 (4100)
TDP (Configurable)[W]	25 (12-28)		
Integrated Graphics	Intel Iris Xe	Intel Iris Xe	Intel UHD for 11th Gen

1.3   Integrated Graphics Processing Unit

The Topaz CPU has an integrated Intel graphics processing unit with the following features.

Table 2: GPU Features

Topaz	NUC11i7TZ	NUC11i5TZ	NUC11i3TZ
GPU	Intel Iris Xe	Intel Iris Xe	Intel UHD for 11th Gen
GPU Speed [MHz]	1300	1300	1250
GPU Compute Units	96 (768 Shader Processors)	80 (640 Shader Processors)	48 (384 Shader Processors)
GFLOPs	1690	1408	896
Maximum 1080p Displays	4	4	4

Topaz	NUC11i7TZ	NUC11i5TZ	NUC11i3TZ
Maximum 4k Displays	4	4	4
Maximum Single Display Resolution	7680 x 4320, 60Hz		
Display Interfaces	HDMI 2.0a, DP 1.4, 2x USB-C (DP 1.4 via DP Alt Mode)		
Memory Size	System-Shared DDR4		
API Support	DirectX 12 (12_1), OpenGL 4.6, OpenCL 2.0, Vulkan 1.1, Shader Model 6.4		

1.4   Memory

Topaz has two SO-DIMM sockets for system memory with the following features:

- 1.2V LP-DDR4 SDRAM SO-DIMMs supported
- Two memory channels with interleaved support
- Serial Presence Detect
- Unbuffered SO-DIMM support (both single- and dual-sided)
- Minimum 4GB SO-DIMM supported
- Up to 32GB SO-DIMMs supported per socket for a maximum total of 64GB of system memory
- Support for DDR4-3200 data rates

1.5   Storage

Topaz has one M.2 key-M slot for a 2280 storage module supporting either a SATA or PCIe SSD.

1.5.1 SATA Interface

The M.2 slot is a key-M slot for a SATA 2280 M.2 module, up to 2TB in density. The SATA III port has a theoretical maximum transfer rate of 6Gbps.

1.5.2 PCIe Interface

The M.2 slot is a key-M slot for an PCIe 2280 M.2 module, up to 8TB in density. The PCIe 4.0 x4 interface on the port has a theoretical maximum transfer rate of 8GBps.

1.6   Networking

1.6.1 RJ-45 Connector for Networking Interface (LAN1)

Topaz has an Intel I225LM gigabit controller that interfaces to on-board RJ-45 Ethernet connector (LAN1) to provide gigabit Ethernet connections. The I225LM controller features

- Integrated MAC + BASE-T PHY
- MDI standard IEEE 802.3 Ethernet interface for 2500BASE-T, 1000BASE-T, 100BASE-TX, and 10BASE-TE
- MDI lane swap
- IEEE 802.3 auto-negotiator
- IEEE 802.3x and IEEE 802.3z compliant flow control support with software-controllable Rx thresholds and Tx pause frames
- Automatic cross-over detection function (MDI/ MDI-X)
- IEEE 1588 protocol and 802.1AS implementation
- Supporting Time Sensitive Networking (TSN) Capabilities (IEEE 802.1Qbu, 802.3br, 802.1Qbv, 802.1AS-REV, 802.1p,Q, and 802.1Qav)
- Supports IEEE 802.3az – Energy Efficient Ethernet (EEE)
- Smart Power Down (SPD) at S0 no link/Sx no link
- Full wake up support (APM an ACPI)
- MAC Power Management controls
- Power Management Protocol Offload (Proxying)
- Latency Tolerance Reporting (LTR)
- TCP/UDP, Ipv4 checksum offloads (Rx/ Tx)
- Transmit Segmentation Offloading (TSO) (Ipv4, Ipv6)
- Legacy, Message Signal Interrupt (MSI) and Message Signal Interrupt Extension (MSI-X)
- Support for packets up to 9.5 KB (Jumbo Frames)
- Descriptor ring management hardware for Transmit and Receive

1.6.2 RJ-45 Connector for Networking Interface (LAN2)

Topaz also has an Intel I219LM gigabit controller that interfaces to on-board RJ-45 Ethernet connector (LAN2) to provide gigabit Ethernet connections. The I219LM controller features

- 10 BASE-T IEEE 802.3 specification compliance
- 100 BASE-TX IEEE 802.3 specification compliance
- 1000 BASE-T IEEE 802.3 specification compliance
- Energy Efficient Ethernet (EEE)
- IEEE 802.3az support [Low Power Idle (LPI) mode]
- IEEE 802.3u auto-negotiation conformance
- Supports carrier extension (half duplex)
- Advanced digital baseline wander correction
- Automatic MDI/MDIX crossover at all speeds of operation
- Automatic polarity correction
- MDC/MDIO management interface
- 802.1as/1588 conformance
- Power Optimizer Support
- Network proxy/ARP Offload support ●
- Jumbo Frames (up to 9 kB)
- 802.1Q & 802.1p

- Receive Side Scaling (RSS)
- Two Queues (Tx & Rx)
- Ultra Low Power at cable disconnect
- Reduced power consumption during normal operation and power down modes
- Low Power Link-Up (LPLU)
- Supports APM (Wake on LAN) an ACPI

1.6.3 Wireless Networking Interface

Topaz has one M.2 key-E slot for a removeable 2230 wireless module supporting a dual-banded radio with wireless and Bluetooth protocols. The radio module included with Topaz is the Intel Wi-Fi 6 AX200 that features

- 2.4Ghz and 5Ghz bands
- Maximum bandwidth of 2.4Gbps
- 2x2 transmit/receive streams
- Supports IEEE WLAN standards IEEE 802.11a/b/d/e/g/h/i/k/n/r/u/v/w/ac/ax
- Supports authentications WPA and WPA2, 802.1X EAP-TLS, EAP-TTLS/MSCHAPv2, PEAPv0-MSCHAPv2 (EAP-SIM, EAP-AKA, EAP-AKA')
- 64-bit and 128-bit WEP,TKIP, 128-bit AES-CCMP, 256-bit AES-GCMP encryptions supported
- Bluetooth® 5.1, BLE

2   Technical Reference

2.1   Motherboard Headers

2.1.1 Headers – Top of Board

Headers on the top side of the motherboard are defined below.
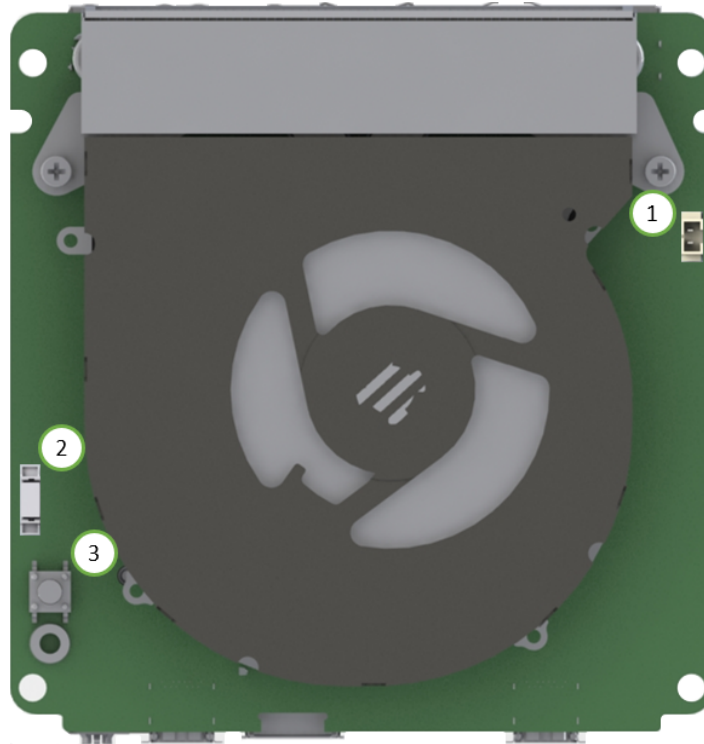
Figure 1: Top Side Header Locations

Table 3: Top Side Header Definitions

Identifier	Header
1	Battery Header
2	APU Fan Header
3	Power Button

2.1.1.1 Battery Header

The battery header is a 1.25mm, 1x2 2-circuit, male header. The battery header is an input power supply from a coin-cell battery to power CMOS memory.

2.1.1.2 APU Fan Header

The APU fan header is a 1.25mm, 1x4 4-circuit, male header. The header is for a CPU cooling fan that can be speed detected and controlled, as well as displayed in the Hardware Monitor section of the BIOS.

Table 4: CPU Fan Header Pinout

Pin	Signal Definition
1	GND
2	5V
3	Fan Speed
4	Fan Speed Control

2.1.1.3   Power Button

The power button on the APU side of the Topaz board can be used to power on and off the system in the absence of a Power-ON solution via the Front Panel header

2.1.2 Headers – Bottom of Board

Headers on the top side of the motherboard are defined below.

Figure 2: Bottom Side Header Locations
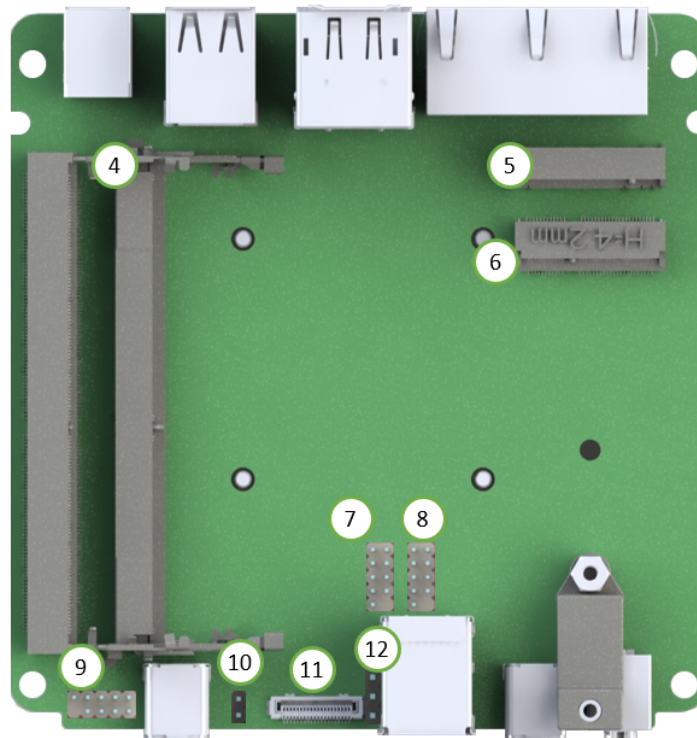
Table 5: Bottom-Side Header Definitions

Identifier	Header
4	DDR4 SO-DIMM Socket
5	M.2 for Storage
6	M.2 for Radio
7	COM Header
8	USB2 Header
9	Front Panel Header
10	ATX/AT Jumper
11	SATA-III Connector
12	Clear CMOS Jumper

2.1.2.1   DDR4 SO-DIMM Sockets

The Red Oak motherboard has two 260-pin SO-DIMM sockets for DDR4 memory and supports the following features:

- 1.2v DDR4 DIMMs with dual channel architecture
- DDR4-3200 speeds for a peak transfer rate of 25600MBps
- Non-ECC, unbuffered, single- or dual-sided SO-DIMMs
- 4GB to 64GB of total system memory
- Serial Presence Detect (SPD)
- DDR4 SDRAM organizations 1Rx8, 1Rx16 and 2Rx8 supported

2.1.2.2   M.2 for Storage

The M.2 storage socket supports both SATA III and PCI Express (PCIe) drives in a 2280 key-M module. SATA drives support a theoretical maximum transfer rate of 6Gbps, and PCIe drives utilizing PCIe Gen 4 can deliver up to 8GBps bandwidth.

Table 6: M.2 Key-M SSD Pinout

Pin	Signal	Signal	Pin
74	3.3V	GND	75
72	3.3V	GND	73

Pin	Signal	Signal	Pin
70	3.3V	GND	71
68	SUSCLK(32kHz) (O)(0/3.3V)	PEDET (NC-PCIe/GND-SATA)	69
66	CONNECTOR KEY	N/C	67
64	CONNECTOR KEY	CONNECTOR KEY	65
62	CONNECTOR KEY	CONNECTOR KEY	63
60	CONNECTOR KEY	CONNECTOR KEY	61
58	N/C	CONNECTOR KEY	59
56	N/C	GND	57
54	PEWAKE# (I/O)(0/3.3V) or N/C	REFCLKp	55
52	CLKREQ# (I/O)(0/3.3V) or N/C	REFCLKn	53
50	PERST# (O)(0/3.3V) or N/C	GND	51
48	N/C	PETp0/SATA-A+	49
46	N/C	PETn0/SATA-A-	47
44	N/C	GND	45
42	SMB_DATA	PERp0/SATA-B-	43
40	SMB_CLK	PERn0/SATA-B+	41
38	DEVSLP (O)	GND	39
36	N/C	PETp1	37
34	N/C	PETn1	35
32	N/C	GND	33
30	N/C	PERp1	31
28	N/C	PERn1	29
26	N/C	GND	27
24	N/C	PETp2	25

Pin	Signal	Signal	Pin
22	N/C	PETn2	23
20	N/C	GND	21
18	3.3V	PERp2	19
16	3.3V	PERn2	17
14	3.3V	GND	15
12	3.3V	PETp3	13
10	DAS/DSS# (I/O)/LED1# (I)(0/3.3V)	PETn3	11
8	USB_D-	GND	9
6	USB_D+	PERp3	7
4	3.3V	PERn3	5
2	3.3V	GND	3
		GND	1

2.1.2.3   M.2 for Radio

The M.2 radio socket supports a wireless radio in a 2230 key-E module. The system includes an Intel AX200 dual-band Wi-Fi 6/Bluetooth v5.1 radio which can be removed, if necessary.

Table 7: M.2 Key-E Pinout

Pin	Signal	Signal	Pin
74	3.3V	GND	75
72	3.3V	RESERVED/REFCLKn1	73
70	UIM_POWER_SRC/GPIO1/PEWAKE1#	RESERVED/REFCLKp1	71
68	UIM_POWER_SNK/CLKREQ1#	GND	69
66	UIM_SWP/PERST1#	RESERVED/PERn1	67
64	RESERVED	RESERVED/PERp1	65
62	ALERT# (I)(0/3.3V)	GND	63

Pin	Signal	Signal	Pin
60	I2C_CLK (O)(0/3.3V)	RESERVED/PETn1	61
58	I2C_DATA (I/O)(0/3.3V)	RESERVED/PETp1	59
56	W_DISABLE1# (O)(0/3.3V)	GND	57
54	W_DISABLE2# (O)(0/3.3V)	PEWAKE0# (I/O)(0/3.3V)	55
52	PERST0# (O)(0/3.3V)	CLKREQ0# (I/O)(0/3.3V)	53
50	SUSCLK(32kHz) (O)(0/3.3V)	GND	51
48	COEX1 (I/O)(0/1.8V)	REFCLKn0	49
46	COEX2 (I/O)(0/1.8V)	REFCLKp0	47
44	COEX3 (I/O)(0/1.8V)	GND	45
42	VENDOR DEFINED	PERn0-	43
40	VENDOR DEFINED	PERp0	41
38	VENDOR DEFINED	GND	39
36	UART CTS (O)(0/1.8V)	PETn0	37
34	UART RTS (I)(0/1.8V)	PETp0	35
32	UART RXD (O)(0/1.8V)	GND	33
30	CONNECTOR KEY	CONNECTOR KEY	31
28	CONNECTOR KEY	CONNECTOR KEY	29
26	CONNECTOR KEY	CONNECTOR KEY	27
24	CONNECTOR KEY	CONNECTOR KEY	25
22	UART TXD (I)(0/1.8V)	SDIO RESET# (O)(0/1.8V)	23
20	UART WAKE# (I)(0/3.3V)	SDIO WAKE# (I)(0/1.8V)	21
18	GND	SDIO DATA3(I/O)(0/1.8V)	19
16	LED2# (I)(OD)	SDIO DATA2(I/O)(0/1.8V)	17
14	PCM_IN/I2S SD_IN (I)(0/1.8V)	SDIO DATA1(I/O)(0/1.8V)	15

Pin	Signal	Signal	Pin
12	PCM_OUT/I2S SD_OUT (O)(0/1.8V)	SDIO DATA0(I/O)(0/1.8V)	13
10	PCM_SYNC/I2S WS (O/I)(0/1.8V)	SDIO CMD(I/O)(0/1.8V)	11
8	PCM_CLK/I2S SCK (O/I)(0/1.8V)	SDIO CLK(O)(0/1.8V)	9
6	LED1# (I)(OD)	GND	7
4	3.3V	USB_D-	5
2	3.3V	USB_D+	3
		GND	1

2.1.2.4 COM Header

The COM header is a 2.00mm, 2x5 9-circuit, male header. This header is intended to connect to a serial RS-232 interface.
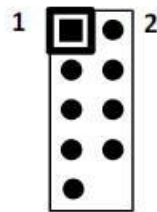

Figure 3: COM Header

Table 8: COM Header Pinout

Pin	RS-232 Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS

Pin	RS-232 Signal
8	CTS
9	RI#
10	Empty

2.1.2.5   USB 2.0 Header

The motherboard has one on-board 2.00mm, 2x5 9-circuit, male header that can be used to connect to two external USB 2.0 devices.
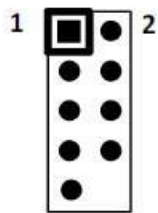
Figure 4: USB 2.0 Header

Table 9: USB 2.0 Header Pinout

Pin	Signal
1	VCC
2	VCC
3	USB0-
4	USB1-
5	USB0+
6	USB1+
7	GND
8	GND
9	No Connect
10	Empty

2.1.2.6　　Front Panel Header

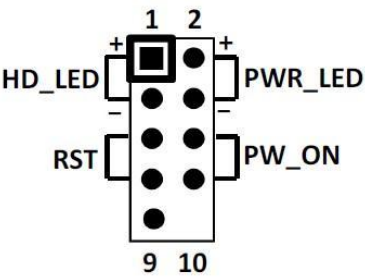The front panel header is a 2.00mm, 2x5 9-circuit, male header. It connects to the front panel switches and LEDs.

Figure 5: Front Panel Header

Table 10: Front Panel Header Pinout

Pin	Header	Signal
1	HD_LED	HD_PWR
3		HD_Active
2	PWR_LED	PWR LED+
4		PWR LED-
5	RESET	GND
7		RST BTN
6	PW_ON	PWR BTN
8		GND
9	No Connect	+5V
10	Empty	Empty

The HD_LED pins attach to a hard disk drive indicator LED to show the activity status of the hard disks.

The Power LED lit by the PWR_LED pins indicates the status of the system.

Table 11: Power LED System Status

System Status	Power LED status
S0	LED is on

System Status	Power LED status
S1	LED will blink
S3	LED is off
S4	LED is off
S5	LED is off

The RESET pins attach to a front panel RESET switch to restart the system when the switch is pressed.

The PW_ON pins attach to the front panel Power switch to turn the system on and off when the switch is pressed.

2.1.2.7 ATX/AT Jumper

The motherboard has a 2.54mm, 1x2 jumper to select between ATX and AT mode. The default mode for the board is ATX mode with the jumper open. In AT Mode, the Restore after AC Power Loss function will enable automatically without any BIOS setting, and the system will automatically boot when power is applied. AT mode is selected if the pins are shorted together.

2.1.2.8 SATA-III Connector

The motherboard has a 0.5mm 20-pin WTB LVDS connector with which to attach a SATA-III storage device.

Figure 6: SATA Connector

Table 12: SATA Connector Pinout

Pin	Signal
1	GND
2	TX+
3	TX-
4	GND
5	GND

Pin	Signal
6	RX-
7	RX+
8	GND
9	GND
10	GND
11	No Connect
12	5V
13	5V
14	5V
15	5V
16	5V
17	No Connect
18	GND
19	GND
20	GND

2.1.2.9 Clear CMOS Jumper

The motherboard has a 2.54mm, 1x3 3-circuit, male header for a 2-pin jumper that can be used to clear the CMOS data and reconfigure the system back to the default values stored in the ROM BIOS.
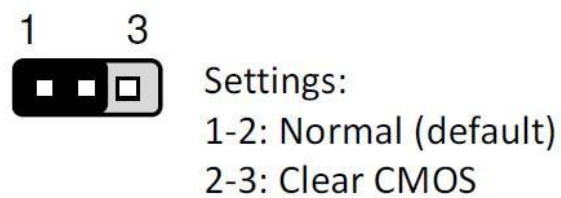

Settings:
1-2: Normal (default)
2-3: Clear CMOS

Figure 7: CMOS Header Settings

To clear the CMOS,

1. Turn off the system. Disconnect power to the unit.
2. Move the jumper from the "1-2" position to the "2-3" position for a few seconds.
3. Replace the jumper back to the "1-2" position.
4. Reconnect power to the unit, turn on the system and hold down the <DELETE> key to enter the BIOS setup.

2.2 Chassis I/O Connectors

2.2.1 Connectors – Front Panel
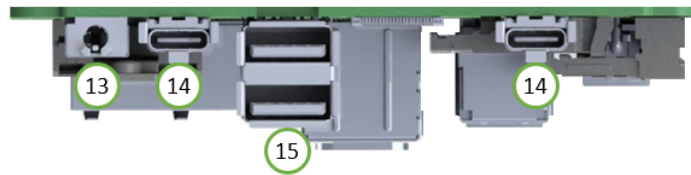
Front-side connector locations are shown below.

Figure 8: Front Side Connector Locations

Table 13: Front Side Connections Defined

Identifier	Connector
13	Audio Jack
14	Dual USB 3.2 Gen2 Type-C
15	Dual USB 3.2 Gen2 Type-A

The 3.5mm audio jack supports two-channel high-definition audio output and a microphone input in both TRRS (CTIA/AHJ and OMTP) standards. The TRRS standard used is auto-detectable by the hardware.

The two USB 3.2 Gen2 Type-A and Type-C ports on the front of the board support transfer speeds up to 10Gbps. The dual Type-C ports also support DP 1.4 via DP Alt Mode to display output with a maximum output resolution of 4096 x 2160, 60Hz.

2.2.2 Connectors – Rear Panel

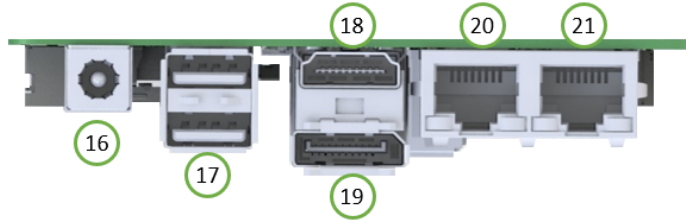Connector locations shown on the back side of the motherboard are shown below.

Figure 9: Back Side Connector Locations

Table 14: Back Side Connections Defined

Identifier	Connector
16	DC Power Input
17	Dual USB 3.2 Gen2 Type-A
18	HDMI Port
19	DisplayPort
20	RJ-45 for Gigabit Ethernet (LAN2)
21	RJ-45 for 2.5 Gigabit Ethernet (LAN1)

The system has a 12-19VDC input with 10% tolerance.

The two USB 3.2 Gen2 Type-A ports support transfer speeds up to 10Gbps.

The HDMI 2.0a port can support a maximum output resolution of 4096 x 2160, 60Hz.

The DisplayPort 1.4 port can support a maximum output resolution of 7680 x 4320, 60Hz.

The on-board RJ-45 gigabit Ethernet port is controlled by an Intel I219LM gigabit controller. For more information on the controller refer to RJ-45 Connector for Networking Interface (LAN2).

The on-board RJ-45 2.5 gigabit Ethernet port is controlled by an Intel I225LM gigabit controller. For more information on the controller refer to RJ-45 Connector for Networking Interface (LAN1).

2.3　Mechanical Dimensions

2.3.1　PCB Chassis Mount

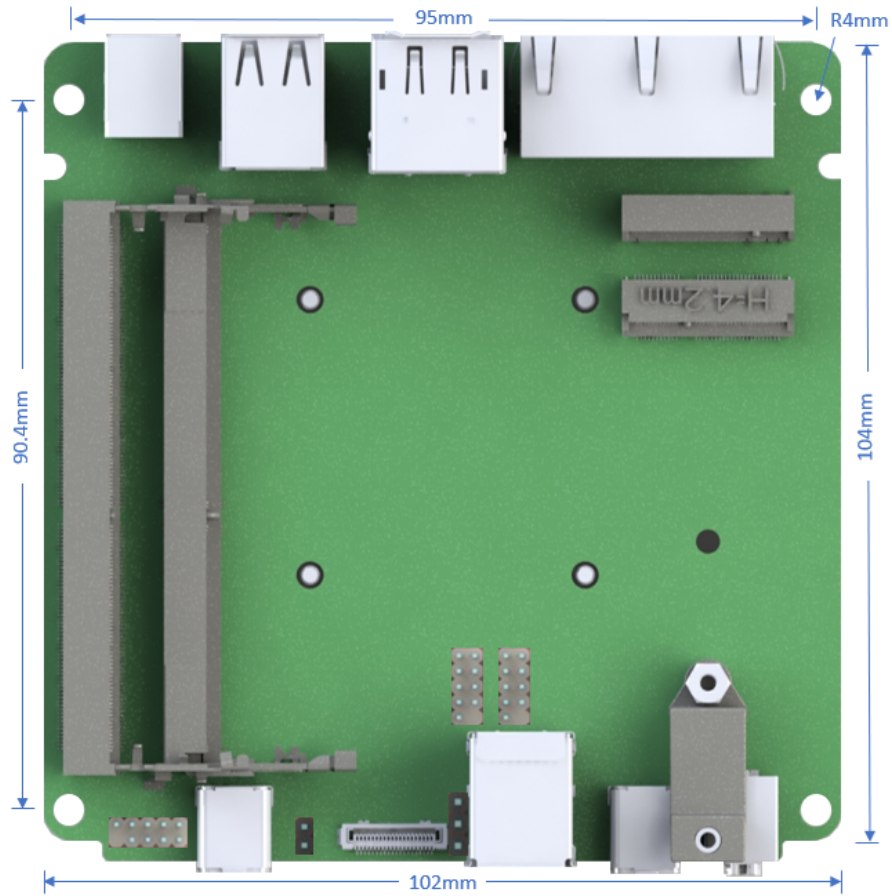The dimensions for the PCB to securely mount into a chassis are given in Figure 10.

Figure 10: Motherboard Dimensions

2.3.2 System Height

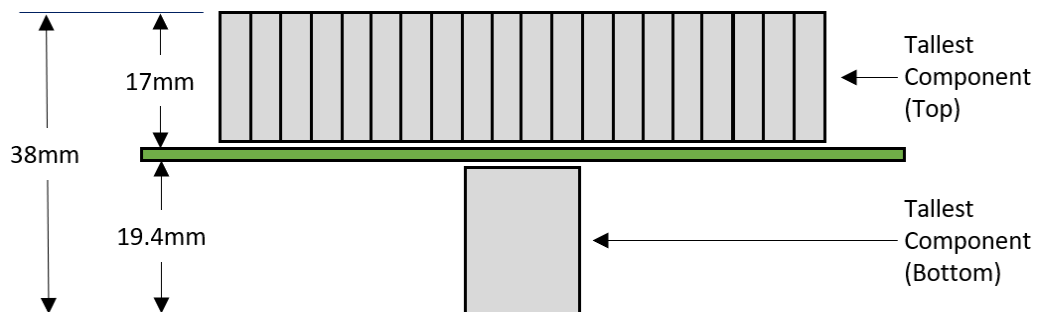The maximum height of a populated system is shown below.

Figure 11: System Height

3 Environmental Specifications

Table 15: Environmental Specifications

Condition	Specification
Input Voltage	12V – 19V ±10%
Input Voltage Connector	5.5 x 2.5mm Barrel Plug
Recommended PSU Wattage	90W
Operating Temperature	0°C– 60°C
Operating Humidity	5% – 90%
Storage Temperature	-40°C – 85°C
Storage Humidity	5% – 90%

4 Version History

Version	Date	Comments
1.0	01/15/2021	Initial release
1.1	05/12/2021	Updated description in 2.1.2.3 M.2 for Radio Updated dual-USB description in Table 13: Front Side Connections Defined Updated dual-USB description in 2.2.2 Connectors – Rear Panel
1.2	05/31/2022	Updated rear dual-USB bullet in 1.1 Overview Updated DP video display resolution in 2.2.2 Connectors – Rear Panel