



Topaz-2 Technical Product Specification

NUC12TZi7

NUC12TZi7B

NUC12TZi5

NUC12TZi5B

NUC12TZi3

NUC12TZi3B

Version 0.3, 05/31/2022

● Preface

The purpose of this document is to provide a technical reference for customers and developers of the Simply NUC Topaz-2 family of products. Topaz-2 kit SKUs include NUC12TZi7, NUC12TZi5 and NUC12TZi3 with board SKUs NUC12TZi7B, NUC12TZi5B and NUC12TZi3B.

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1 Description

1.1 Overview

The Simply NUC Topaz-2 is a mini computer equipped with the brand new 12th Gen Intel® Core™ processors, Intel® Xe Graphics and your choice of DDR4-3200 memory and Gen4 NVMe drive, delivering an even more polished experience than its predecessor while keeping you at the forefront of technology. Topaz-2 offers up to 12 cores and 16 threads paired with the new Intel® Thread Director keeping you running smoothly, no matter the application or workload, thanks to its hybrid core architecture.

Enjoy jaw-dropping visuals driven by Intel Xe Graphics. Topaz-2 can control an 8K display, or up to four 4K displays to give your Digital Signage or home workstation the visual flair and immersion you are looking for. Hard-wire Topaz-2 with ease to your router or home network with lightning-fast dual 2.5Gb Ethernet ports or go wireless with Intel Wi-Fi 6 giving you superior download and transfer speeds while enjoying total security with the on-board TPM 2.0.

From your ideal home computing set-up to a brilliant 8K home cinema with 7.1 surround sound support, Topaz-2 has you covered with its substantial range of ports, providing a truly versatile experience. You will never be caught without the ports you need, thanks to the replaceable lid for I/O expansion on Topaz-2, with add-ons like extra HDMI or USB ports, or a quad HDTV tuner. Perfect your everyday computing today with Topaz-2.

Topaz-2 has the following features:

- Intel® Core™ i7-1260P, i5-1240P or i3-1215U Processor.
- Intel Iris Xe (for i7 and i5 variants) and Intel UHD for 12th Gen (for i3) Integrated Graphics.
- Two DDR4-3200 SO-DIMM Sockets.
- M.2 Slot for PCIe Gen4 x4 for SSD.
- Two 10/100/1000/2500Mbps Ethernet Ports.
- M.2 Slot for Wi-Fi/ Bluetooth Radio.
- One DisplayPort (4k, 60Hz).
- One HDMI Port (4k, 60Hz).
- One Front USB 3.2 Gen 2 Type-C Port (supporting DP Alt Mode).
- One Front USB 3.2 Gen 2 Type-C Port (supporting Thunderbolt 4).
- 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-2 CPUs have the following features.

Table 1: CPU Features

Topaz-2	NUC12TZi7	NUC12TZi5	NUC12TZi3
Intel CPU	i7-1260P	i5-1240P	i3-1215U
Performance Cores	4	4	2
Efficiency Cores	8	8	4
Total Cores	12	12	6
Threads	16	16	8
L1 Cache	4x 48KB + 8x 32KB I-cache, 4x 32KB + 8x 64KB D-cache	4x 32KB + 8x 64KB I-cache, 4x 48KB + 8x 32KB D-cache	2x 32KB + 4x 64KB I-cache, 2x 48KB + 4x 32KB D-cache
L2 Cache	4x 1.25 + 2x 2MB	4x 1.25MB + 2x 2MB	2x 1.25MB + 2MB
L3 Cache	18MB Unified	12MB Unified	10MB Unified
Base Speed (Turbo) [MHz]	2500 (4700)	2100 (4400)	2500 (4400)
TDP (Configurable)[W]	28	28	15
Integrated Graphics	Intel Iris Xe Graphics	Intel Iris Xe Graphics	Intel UHD for 12 th Gen Processors

1.3 Integrated Graphics Processing Unit

The Topaz-2 CPU has an integrated Intel graphics processing unit with the following features.

Table 2: GPU Features

Topaz-2	NUC12TZi7	NUC12TZi5	NUC12TZi3
GPU	Intel Iris Xe (96EU)	Intel Iris Xe (80EU)	Intel UHD (64EU)
GPU Speed [MHz]	1400	1300	1100
GPU Compute Units	96 (768 Shader Processors)	80 (640 Shader Processors)	64 (512 Shader Processors)
GFLOPs	1690	1408	1434
Maximum 1080p Displays	4	4	4

Topaz-2	NUC12TZi7	NUC12TZi5	NUC12TZi3
Maximum 4k Displays	4	4	4
Maximum Single Display Resolution	7680×4320, 60Hz		
Display Interfaces	HDMI 2.0a, DP 1.4a, 1x USB-C (DP 1.4a via DP Alt Mode), 1x USB-C (Thunderbolt 4)		
Memory Size	System-Shared DDR4		
API Support	DirectX 12 (12_1), OpenGL 4.6, OpenCL 3.0, Vulkan 1.3, Shader Model 6.4		

1.4 Memory

Topaz-2 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 Detection.
- 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-2 has one M.2 key-M slot for a 2280 storage module supporting PCIe SSD and a SATA III port connector supports SATA data cables for internal storage devices.

1.5.1 SATA Interface

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 Connectors for Networking Interface (LAN1/LAN2)

Topaz-2 has dual Intel I225LM 2.5 gigabit controllers that interfaces to on-board RJ-45 Ethernet connectors (LAN1/LAN2) to provide 2.5 gigabit Ethernet connections. The I225LM controller features:

- Integrated MAC + BASE-T PHY.
- MDI (Copper) standard IEEE 802.3 Ethernet interface for 2500BASE-T, 1000BASE-T, 100BASE-TX, and 10BASE-TE applications (802.3, 802.3u, 802.3bz, and 802.3ab).
- 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 Wireless Networking Interface

Topaz-2 has one M.2 key-E slot for a removable 2230 wireless module supporting a dual-banded radio with wireless and Bluetooth protocols. The radio module included with Topaz-2 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 WEPTKIP, 128-bit AES-CCMP, 256-bit AES-GCMP encryption supported
- Bluetooth® 5.2, 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.

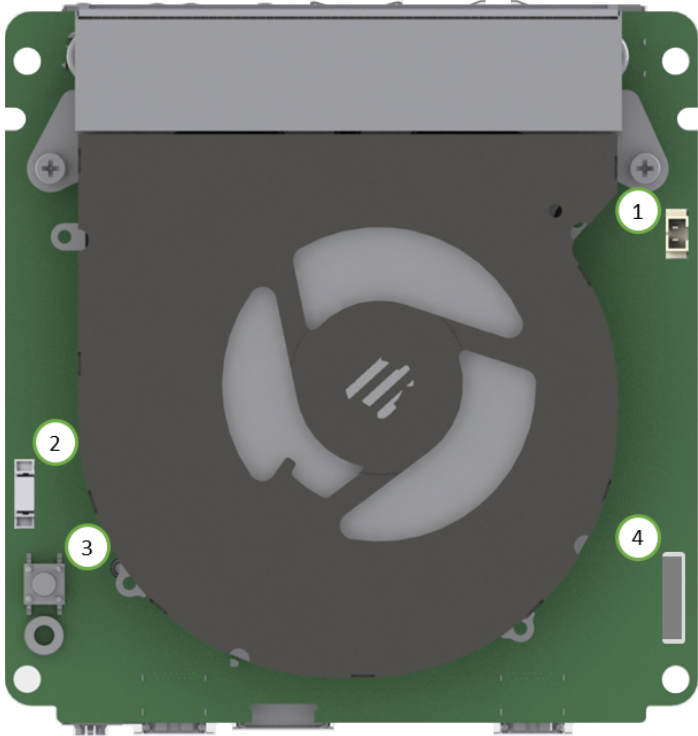


Figure 1: Top Side Header Locations

Table 3: Top Side Header Definitions

Identifier	Header
1	Battery Header
2	APU Fan Header
3	Power Button
4	eSPI Connector

2.1.1.1 Battery Header

The battery header is a 1.25mm, 1×2 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, 1×4 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-2 board can be used to power on and off the system in the absence of a Power-ON solution via the Front Panel header.

2.1.1.4 eSPI Connector

eSPI is an all-in-one bus that was designed to replace the LPC bus as well as the SPI bus, SMBus and sideband signals.

2.1.2 Headers – Bottom of Board

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

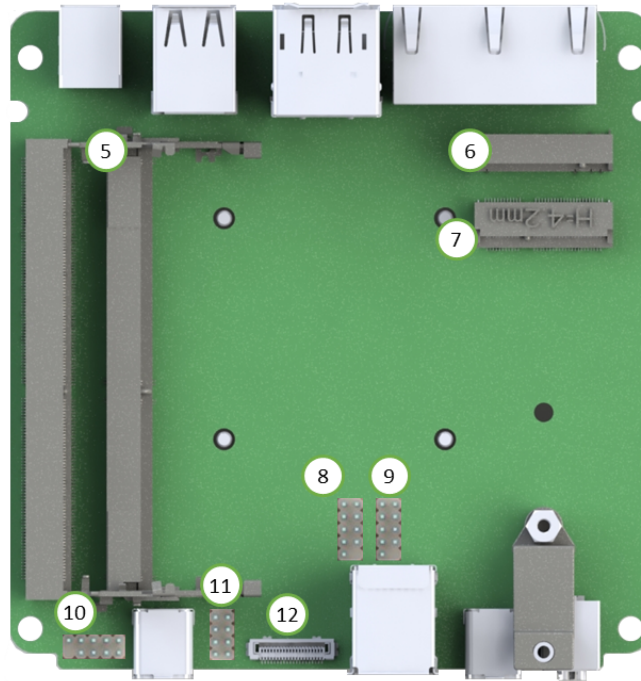


Figure 2: Bottom Side Header Locations

Table 5: Bottom-Side Header Definitions

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

2.1.2.1 DDR4 SO-DIMM Sockets

The Topaz 2 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-CC, 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 PCI Express (PCIe) drives in a 2280 key-M module. 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
70	3.3V	GND	71
68	N/A	PEDET	69
66	CONNECTOR KEY	N/A	67
64	CONNECTOR KEY	CONNECTOR KEY	65
62	CONNECTOR KEY	CONNECTOR KEY	63
60	CONNECTOR KEY	CONNECTOR KEY	61
58	N/A	CONNECTOR KEY	59
56	N/A	GND	57
54	WAKE#	PEFCLKp	55
52	CLKREQ#	PEFCLKn	53
50	PERST#	GND	51
48	N/A	PETp0	49

Pin	Signal	Signal	Pin
46	N/A	PETn0	47
44	N/A	GND	45
42	SMB_DATA	PERp0	43
40	SMB_CLK	PERn0	41
38		GND	39
36	N/A	PETp1	37
34	N/A	PETn1	35
32	N/A	GND	33
30	N/A	PERp1	31
28	N/A	PERn1	29
26	N/A	GND	27
24	N/A	PETp2	25
22	N/A	PETn2	23
20	N/A	GND	21
18	3.3V	PERp2	19
16	3.3V	PERn2	17
14	3.3V	GND	15
12	3.3V	PETp3	13
10		PETn3	11
8	N/A	GND	9
6	N/A	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 v5.2 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	CNV_WT_CLK+	73
70	N/A	CNV_WT_CLK-	71
68	N/A	GND	69
66	N/A	CNV_WT_D0+	67
64		CNV_WT_D0-	65
62	N/A	GND	63
60	SMB_CLK	CNV_WT_D1+	61
58	SMB_DATA	CNV_WT_D1-	59
56	W_DISABLE2#	GND	57
54	W_DISABLE1#	WAKE#	55
52	PERST0#	CLKREQ#	53
50	SUSCLK	GND	51
48	N/A	PEFCLKn	49
46	N/A	PEFCLKp	47
44	N/A	GND	45
42	N/A	PERn	43
40	N/A	PERp	41
38	N/A	GND	39
36	CNV_BRI_DT	PETn	37
34	CNV_RGI_RSP	PETp	35

Pin	Signal	Signal	Pin
32	CNV_BGI_DT	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	CNV_BRI_RSP	CNV_WGR_CLK+	23
20	N/A	CNV_WGR_CLK-	21
18	GND	GND	19
16	N/A	CNV_WGR_D0+	17
14	MODEM_CLKREQ	CNV_WGR_D0-	15
12	N/A	GND	13
10	CNV_RF_RESET	CNV_WGR_D1+	11
8	N/A	CNV_WGR_D1-	9
6	N/A	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.

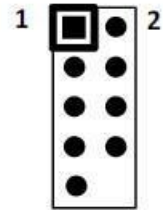


Figure 3: COM Header

Table 8: COM Header Pinout

Pin	RS-232 Signal
1	DCD
2	RXD
3	TXD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI#
10	Empty

○

○

2.1.2.5 USB 2.0 Header

The motherboard has one on-board 2.00mm, 2×5 9-circuit, male header that can be used to connect to two external USB 2.0 devices.

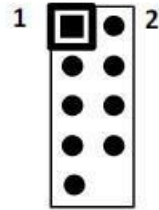


Figure 4: USB 2.0 Header

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.

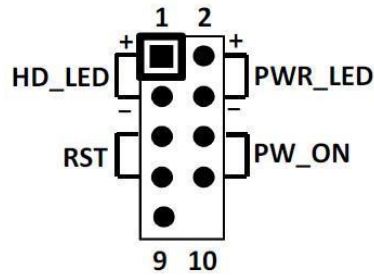


Figure 5: Front Panel Header

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.

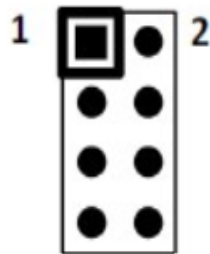
Table 11: Power LED System Status

System Status	Power LED status
S0	LED is on
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 & Clear CMOS Jumper

The motherboard has a 2.54mm, 2x4 8-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.



- 1-2: SIO AT Mode
(Default Open: SIO ATX Mode)
- 4-6: Clear CMOS
- 3-4: Auto Clear CMOS
- 5-7: DACC*

○

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
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

2.2 Chassis I/O Connectors

2.2.1 Connectors – Front Panel

Front-side connector locations are shown below.

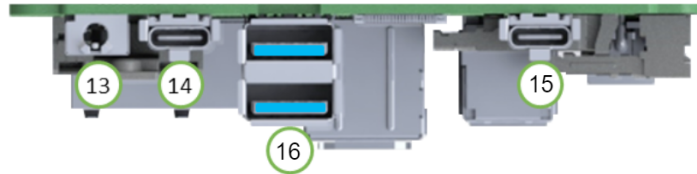


Figure 7: Front Side Connector Locations

Table 12: Front Side Connections Defined

Identifier	Connector
13	Audio Jack
14	USB 3.2 Gen2 Type-C
15	Thunderbolt 4 Type-C Port
16	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 and Thunderbolt 4 to display output with a maximum output resolution of 4096×2160, 60Hz.

2.2.2 Connectors – Rear Panel

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

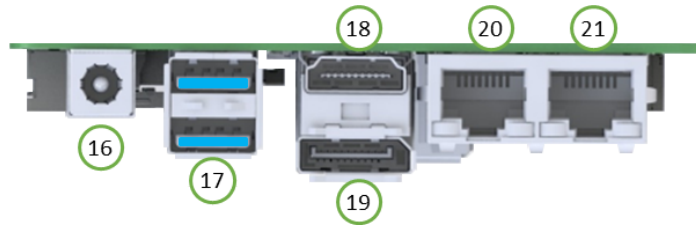


Figure 8: Back Side Connector Locations

Table 13: 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 2.5 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. Two USB 3.2 Gen2 Type-C ports support transfer speeds up to 10Gbps. The dual Type-C ports also support DP 1.4 via DP Alt Mode and Thunderbolt 4 to display output with a maximum output resolution of 4096×2160, 60Hz.

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

The DisplayPort 1.4 port can support a maximum output resolution of 4096×2160, 60Hz.

The dual on-board RJ-45 2.5 gigabit Ethernet ports are controlled by an Intel I225LM gigabit controller. For more information on the controller refer to RJ-45 Connector for Networking Interface (LAN1/LAN2).

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 9.

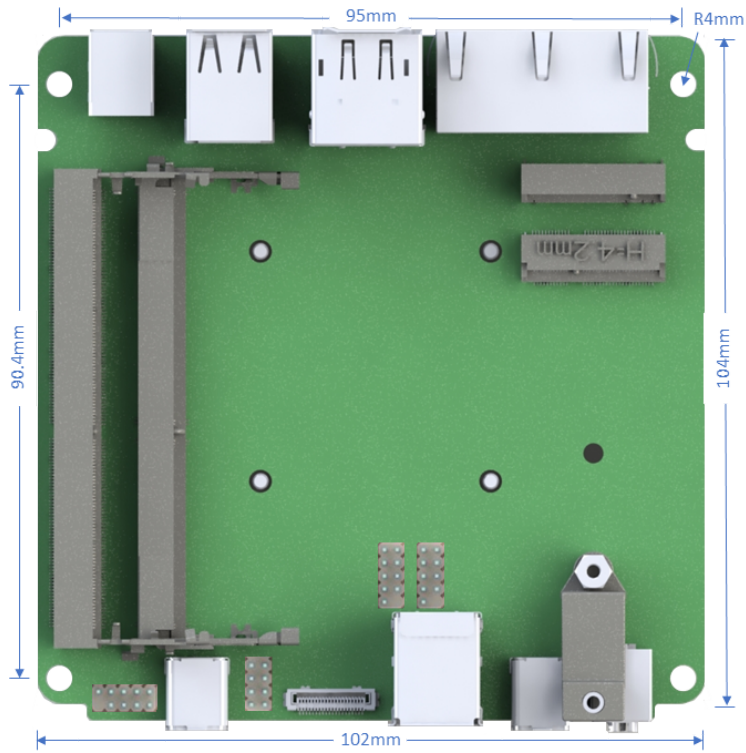


Figure 9: Motherboard Dimensions

2.3.2 System Height

The maximum height of a populated system is shown below.

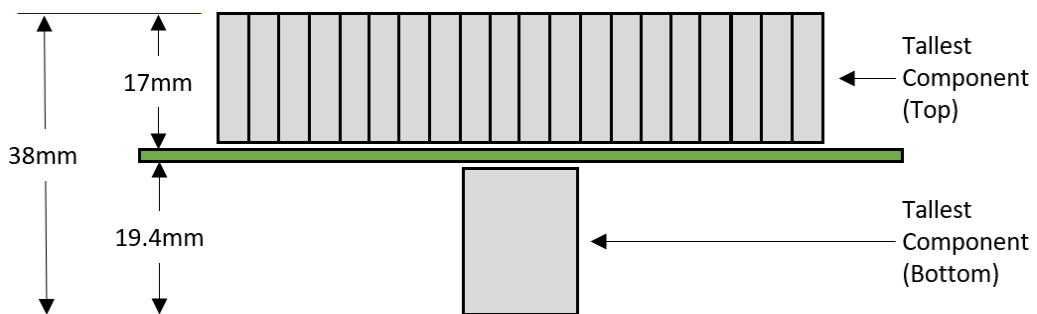


Figure 10: System Height

3 Environmental Specifications

Table 14: Environmental Specifications

Condition	Specification
Input Voltage	12V – 19V ±10%
Input Voltage Connector	5.5×2.5mm 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
0.1	05/26/2022	<i>Copied from Topaz v1.0. Updated Title Page Updated TOP, BOTTOM, FRONT, REAR and motherboard-dimensions images Updated Table 3: Top Side Header Definitions to include eSPI header Updated Table 5: Bottom-Side Header Definitions for new jumpers</i>
0.2	5/27/2022	<i>Replaced all “NUC11i*TZ” references with “NUC12TZi*” Replaced all “Topaz” references with “Topaz-2” Replaced mislabeled Table 2 header from “CMB1r*RB” to “NUC12TZi*” Updated text in 1.1 Overview</i>
0.3	5/31/2022	<i>Updated rear dual-USB bullet in 1.1 Overview Updated description in 2.1.2.3 M.2 for Radio Updated dual-USB description in Table 13: Back Side Connections Defined Updated dual-USB description in 2.2.2 Connectors – Rear Panel</i>
0.4	7/19/2022	<i>CPU data for Table 1: CPU Features GPU data for Table 2: GPU Features “Features” update for 1.1 Overview Verify controllers for 1.6 Networking Updated TOP and BOTTOM motherboard images.</i>
1.0	7/20/2022	Initial release, update system images and formatting.