



Red Oak Technical Product Specification

LLM1r5RK

LLM1r5RKB

LLM1r3RK

LLM1r3RKB

LLM1r1RK

LLM1r1RKB

Version 1.1, 11/2020

Preface

The purpose of this document is to provide a technical reference for customers and developers of the Simply NUC Red Oak family of products. Red Oak kit SKUs include the LLM1r5RK, LLM1r3RK and LLM1r1RK, with board SKUs LLM1r5RKB, LLM1r3RKB and LLM1r1RKB.

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1 Description

1.1 Overview

The Simply NUC LLM1r5RK, LLM1r3RK and LLM1r1RK (code named Red Oak) are mini-computers built with an AMD® Ryzen™ Embedded R1505G, R1305G or R1102G accelerated processing unit, respectively, delivering innovation in a small space for embedded solutions. A wireless-AC card is installed into one of two M.2 slots, leaving the other available slot for a lightning fast SSD. The bottom of the chassis is designed to accommodate mounting options including DIN rail and VESA plate. There are also board SKU options available for embedded designs. Finally, whether its Windows® 10, Linux, or another OS, these systems are verified to run a wide range of operating systems so exact customer solutions can be built.

Red Oak is a mini-computer that is small in size with features that make it optimal for embedded solutions. Its price point makes Red Oak affordable for mainstream performance usages with a tight budget. It supports a wide power supply range (12 to 19VDC), offers a gigabit Ethernet port, and four USB ports for I/O flexibility. With two mini-DisplayPort outputs Red Oak is ideal for dual-display digital signage usages.

Built to stand the test of time, Simply NUC is committed to supporting the manufacture and sales of Red Oak in the same form, fit, and function for seven years from launch (August 2020). Red Oak also comes in a board SKU option with a USB header enabling other embedded usages such as kiosk, vending machines, and Point-of Sale.

The Red Oak system has the following features:

- AMD® Ryzen™ R1505G, R1305G or R1102G Processor
- AMD® Radeon™ Vega 3 Graphics
- Two DDR4-2400 SO-DIMM Sockets
- M.2 Slot for PCIe or SATA SSDs
- One 10/100/1000 Mbps Ethernet Port
- M.2 Slot for Wi-Fi/ Bluetooth Radio
- Two mDP++ (4K, 60Hz)
- Two Front USB 2.0 Type-A Ports
- Two Rear USB 3.2 Gen 2 Type-A Ports
- Combination Microphone/Headphone 3.5mm Jack
- One On-Board USB 2.0 Header
- Replaceable Lid for Expandable Functionality
- Simply NUC Universal Chassis
- 19VDC 65W Power Supply Adapter
- 12V – 19V Input Power Supply Range

1.2 Processor

The processor is the main differentiating factor among the Red Oak family of products. The APU features of the Red Oak family are found in [Table 1](#)

Table 1: Red Oak APU Features

Red Oak Version	LLM1r5RK	LLM1r3RK	LLM1r1RK
AMD APU	R1505G	R1305G	R1102G
Cores	2	2	2
Threads	4	4	2
L1 Cache	2x 64KB (4-Way) I-Cache, 2x 32KB (8-Way) D-Cache		
L2 Cache	2x 512KB (8-Way)		
L3 Cache	4MB (16-way) Unified		
Base Speed (Turbo) [MHz]	2400 (3300)	1500 (2800)	1200 (2600)
TDP [W]	15	8	6
Integrated Graphics	Radeon Vega 3		

1.3 Integrated Graphics Processing Unit

The Red Oak's Ryzen APU has an integrated Radeon Vega 3 graphics processing unit with features listed in [Table 2](#).

Table 2: Red Oak GPU Features

GPU Speed [MHz]	1000
GPU Compute Units	3 (192 Shader Processors)
GFLOPs	384
Maximum Displays	4
Maximum Single Display Resolution	3840 x 2160, 60Hz
Display Interfaces	DP 1.4
Memory Size	System-Shared DDR4
API Support	DirectX 12 (12_1), OpenGL 4.6, OpenCL 2.0, Vulkan 1.2.131, Shader Model 6.4

1.4 Memory

The Red Oak board 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-DIMMs support (both single- and dual-sided)
- Minimum 4GB SO-DIMMs supported
- Up to 32GB SO-DIMMs support per socket for a maximum total of 64GB of system memory
- Support for DDR4-2133 and DDR4-2400 data rates

1.5 Storage

The Red Oak board 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 2TB in density. The PCIe 3.0 x4 interface on the port has a theoretical maximum transfer rate of 4GBps.

1.6 Networking

1.6.1 RJ-45 Connector Networking Interface

The Red Oak board has a RealTek RTL8111H gigabit controller that interfaces to an on-board RJ-45 Ethernet connector to provide a gigabit Ethernet connection. The controller features

- Integrated 10/100/1000M transceiver
- Supports Giga Lite (500M) mode
- Auto-Negotiation with Next Page capability
- Supports pair swap/polarity/skew correction
- Crossover Detection & Auto-Correction
- Embedded OTP memory
- Supports hardware ECC (Error Correction Code) function
- Supports hardware CRC (Cyclic Redundancy Check) function
- Transmit/Receive on-chip buffer support
- Supports PCI MSI (Message Signaled Interrupt) and MSI-X
- Supports 25MHz or 48MHz Oscillator

- Built-in LDO regulator
- Supports power down/link down power saving/PHY disable mode
- Supports EMAC-393 ECMA ProxZzy Standard for sleeping hosts
- XTAL-Less Wake-On-LAN
- Supports LTR (Latency Tolerance Reporting)
- Supports PCIe L1.Off and L1.Snooze
- Fully compatible with IEEE 802.3, IEEE 802.3u, IEEE 802.3ab
- Supports IEEE 802.1P Layer 2 Priority Encoding
- Supports IEEE 802.1Q VLAN tagging
- Supports IEEE 802.3az-2010 (EEE)
- Supports Full Duplex flow control (IEEE 802.3x)

1.6.2 Wireless Networking Interface

The Red Oak board 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 in Red Oak is the Intel Dual-Band Wireless-AC 3168 whose features are

- 2.4Ghz and 5Ghz bands
- Maximum bandwidth of 433Mbps
- 1x1 transmit/receive streams
- Supports standards IEEE 802.11a/b/g/n/ac, 802.11d, 802.11e, 802.11i, 802.11h, 802.11w
- Supports seamless roaming between respective access points (802.11b, 802.11g, 802.11a/b/g, 802.11a/b/g/n, and 802.11ac)
- Supports authentications WPA and WPA2, 802.1X (EAP-TLS, TTLS, PEAP), EAP-SIM, EAP-AKA with protocols PAP, CHAP, TLS, GTC, MS-CHAP, MS-CHAPv2
- 64-bit and 128-bit WEP, AES-CCMP encryptions supported
- Dual Mode Bluetooth® 4.2, BLE

2 Technical Reference

2.1 Motherboard Headers

2.1.1 Headers – Top of Board

Headers on the top side of the motherboard in [Figure 1](#) are defined in [Table 3](#).

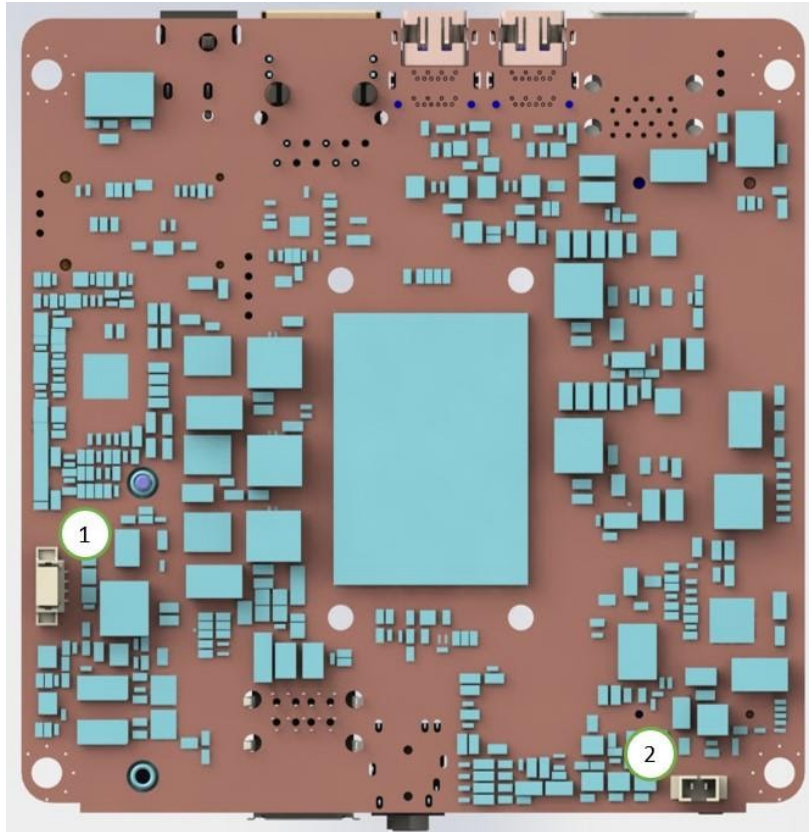


Figure 1: Top Side Header Locations

Table 3: Top Side Header Definitions

Identifier	Header
1	APU Fan Header
2	Battery Header

2.1.1.1 APU Fan Header

The APU fan header is a 1.25mm, 1x4 4-circuit, male header. The fan header is intended for a CPU cooling fan that can be speed detected and controlled, as well as displayed in the Hardware Monitor section of the BIOS. The fan is automatically powered off when the system enters S3, S4 or S5 mode.

Table 4: CPU Fan Header Pinout

Pin	Signal Definition
1	Sense
2	GND
3	Control

4	5V
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2.1.1.2 Battery Header

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

2.1.2 Headers – Bottom of Board

Headers on the bottom side of the motherboard in [Figure 2](#) are defined in [Table 5](#).

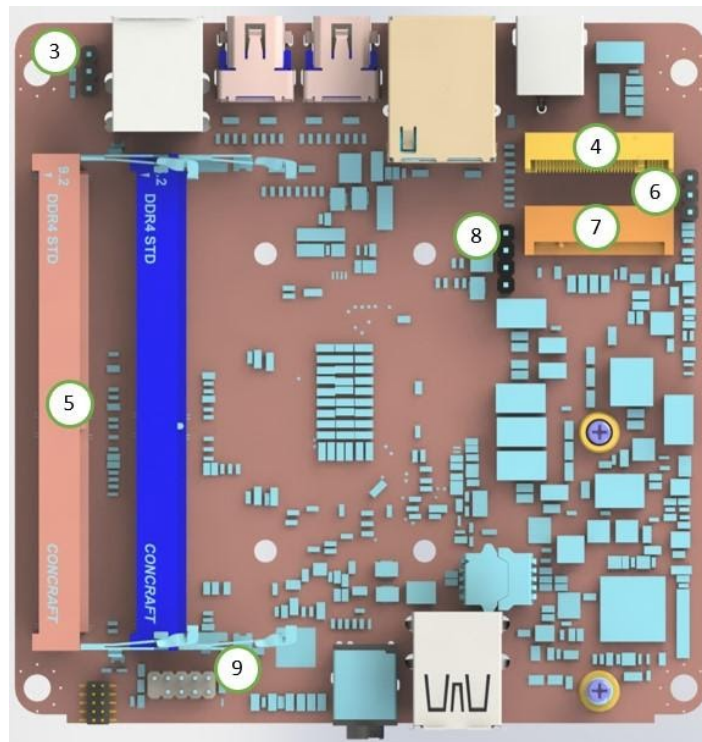


Figure 2: Bottom-Side Header Locations

Table 5: Bottom-Side Header Definitions

Identifier	Header
3	Clear CMOS Jumper
4	M.2 for Storage
5	DDR4 SO-DIMM Sockets
6	Auto Power On Jumper
7	M.2 for Radio

8	USB 2.0 Header
9	Front Panel Header

2.1.2.1 Clear CMOS Jumper

The Red Oak motherboard has a three pin (2.54mm pitch) 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.

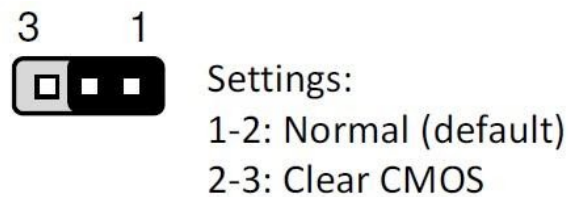


Figure 3: CMOS Header Settings

To clear the CMOS,

1. Turn off the system.
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. Turn on the system and hold down the <DELETE> key to enter the BIOS setup.

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 on PCIe Gen 3 and can deliver up to 4Gbps 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	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	N/C	PERp0/SATA-B-	43
40	N/C	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
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	N/C	GND	9
6	N/C	PERp3	7
4	3.3V	PERn3	5
2	3.3V	GND	3
		GND	1

2.1.2.3 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
- DDR4-2400 speeds for a peak transfer rate of 19200MBps
- Non-ECC, unbuffered, single- or dual-sided SO-DIMMs
- 4GB to 64GB of total system memory
- Serial Presence Detect (SPD)
- Single rank DDR4 SDRAM organizations 1Gx8 or 512Mx16
- Dual rank DDR4 SDRAM organizations 1Gx8 or 512Mx8

2.1.2.4 Auto Power On Jumper

The Red Oak motherboard has a three pin (2.54mm pitch) male header for a 2-pin jumper that can be used to enable or disable the auto power on feature.



Figure 4: Auto Power On Header

Table 7: Auto Power On Header Settings

Pins	Setting
1-2	<i>DISABLE</i> : Press power button manually to power on after power input is connected to power source (Default)
2-3	<i>ENABLE</i> : Automatically power on when power is applied to the power input

2.1.2.5 M.2 for Radio

The M.2 radio socket supports a wireless radio in a 2230 key-E module. The Red Oak system comes with an Intel 3168 dual-band Wireless-AC/Bluetooth v4.2 radio which can be removed, if necessary.

Table 8: 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
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
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

2.1.2.6 USB 2.0 Header

The Red Oak motherboard has one on-board 2.54mm pitch, 1x4 4-circuit, male header that can be used to connect to one external USB 2.0 device.

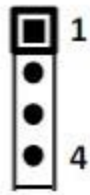


Figure 5: USB 2.0 Header

Table 9: USB 2.0 Header Pinout

Pin	Signal
1	VCC
2	USB0-
3	USB0+
4	GND

2.1.2.7 Front Panel Header

The front panel male header (2x5 9-circuit, 2.00m pitch) on the Red Oak motherboard is intended to connect the front panel switches and LEDs.

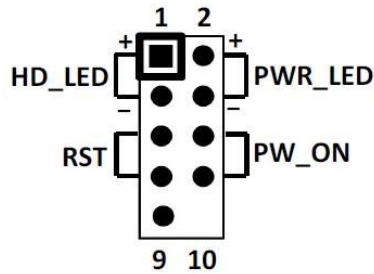


Figure 6: Front Panel Header

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
8	No Connect	+5V
10	Empty	Empty

The HD_LED pins attach to the hard disk drive indicator LED to show the activity status of the hard disks. Note that the HD_LED supports SATA HDD only.

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

Table 11: Power LED System Status

System Status	Power LED status
S0	LED is on
S3	LED will blink
S4	LED is off
S5	LED is off

The RESET pins attach to the 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.

2.2 Chassis I/O Connectors

2.2.1 Connectors - Front Panel

Connector locations shown on the front side of the motherboard in [Figure 7](#) are defined in [Table 12](#).

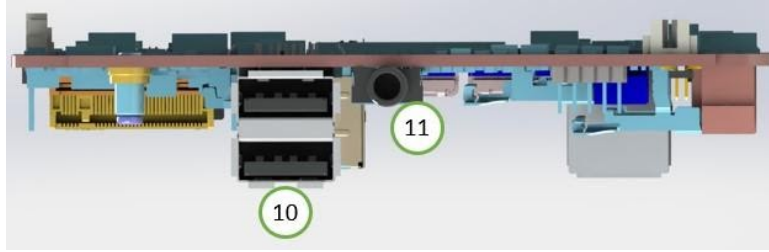


Figure 7: Front Side Connections

Table 12: Front Side Connections Defined

Identifier	Connector
10	Dual USB 2.0 Type-A
11	Audio Jack

The two USB 2.0 Type-A ports support transfer speeds up to 480Mbps.

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.

2.2.2 Connectors - Rear Panel

Connector locations shown on the back side of the motherboard in [Figure 8](#) are defined in [Table 13](#).

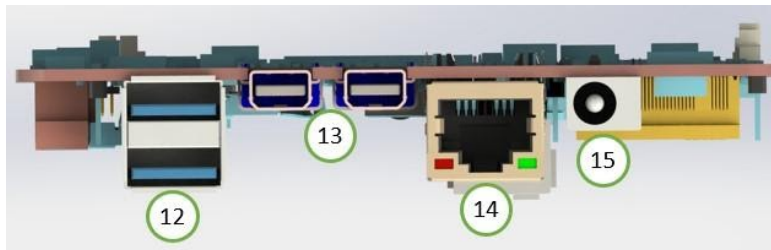


Figure 8: Back Side Connections

Table 13: Back Side Connections Defined

Identifier	Connector
12	Dual USB 3.2 Gen2 Type-A
13	Dual Mini DisplayPort
14	RJ-45 for Gigabit Ethernet

15	DC Power Input
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The two USB 3.2 Gen 2 Type-A ports support transfer speeds up to 10Gbps.

The two Mini DisplayPort (mDP) 1.4 ports can support a maximum resolution 3840 x 2160, 60Hz.

The on-board RJ-45 gigabit Ethernet port is controlled by a Realtek RTL8111H gigabit controller.

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

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](#).

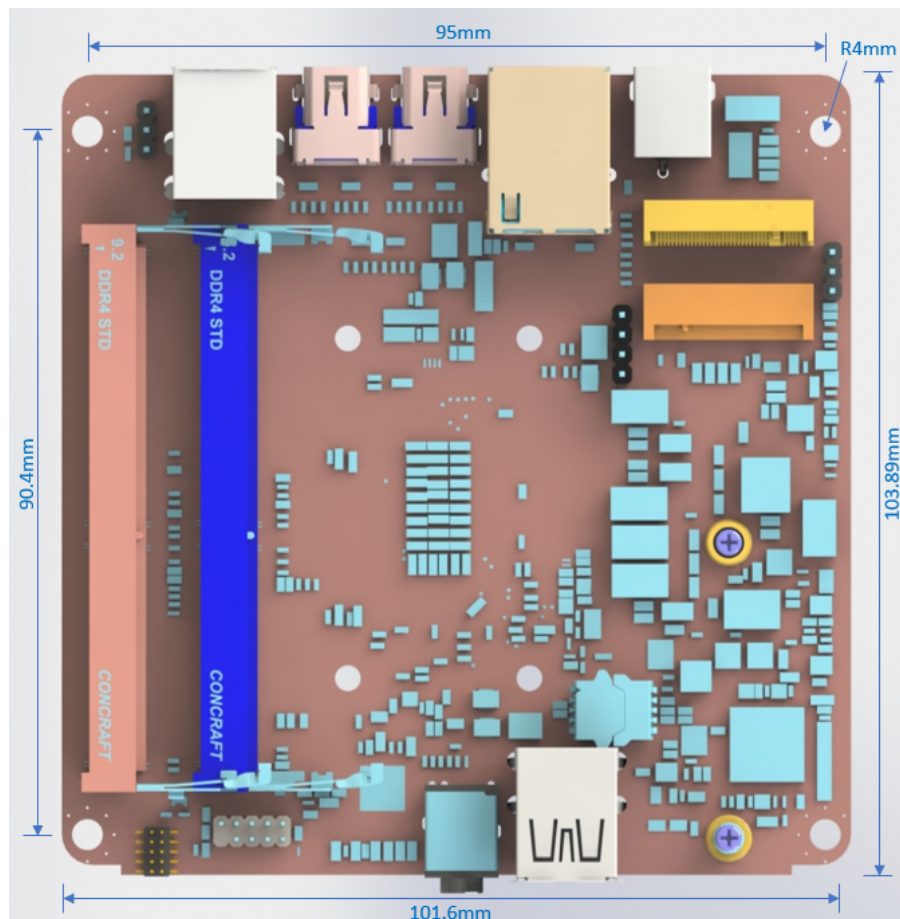


Figure 9: Motherboard Dimensions

2.3.2 Motherboard Height

The maximum height of a populated Red Oak system is shown in [Figure 10](#).

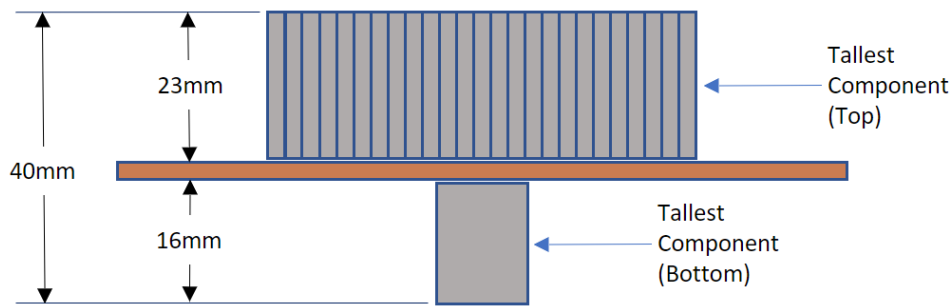


Figure 10: Motherboard Height Dimensions

3 Version History

Version	Date	Comments
1.0	Sep 2020	Initial release.
1.1	Nov 2020	Updated dimensions in Figure 9: Motherboard Dimensions

