Technical Product Specification

ONYX 4 x 4 System

CPU Models / SKUs:

13500H / NUC13OXi5

13600H / NUC13OXv5

13700H / NUC13OXi7

13900H / NUC13OXv9

Preface

The purpose of this document is to provide technical reference for customers and developers for the Onyx family of products. Onyx SKUs include NUC13OXv9, NUC13OXi7, NUC13OXv5 and NUC13OXi5

Contents

Tables

Figures

1. Description

1.1. Overview

The ONYX system is an Intel based 4 x4 NUC that is configurable, i.e. memory, storage, and software. It serves a number of usage models ranging from 4K multi-monitor or wall of monitors, performance applications, graphic centric applications and more.

1.2. Processor

Table 1: CPU Features

Intel	13500H **Raptor Lake**	13600H **Raptor Lake**	13700H **Raptor Lake**	13900H **Raptor Lake**
P/N	i5-13500H	i5-13600H	i7-13700H	i9-13900H
Max Turbo Frequency	5.70GHz	4.80GHz	5.0GHz	5.40GHz
T junction	100°C	100°C	100°C	100°C
Cores	12	12	14	14
Threads	16	16	20	20
Preformance Cores	4	4	6	6
Efficiency Cores	4	4	8	6
L3 Cache	16 MB	16 MB	24 MB	24 MB
TDP [W]	45 W	45 W	45 W	45 W
Integrated Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics	Intel® Iris® Xe Graphics

1.3. Integrated Graphics Processing Unit

Table 2: Integrated Graphics

Intel Integrated	Intel® Iris® Xe Graphics
Graphics Max Dynamic Frequency	1.50 GHz
Graphics Output	eDP 1.4b, DP 1.4a, HDMI 2.1
Max Resolution (HDMI	4096 x 2304 @ 60Hz
Max Resolution (DP)	7680 x 4320 @ 60Hz
Max Resolution (eDP - Integrated Flat Panel)	4096 x 2304 @ 120Hz
DirectX* Support	12.1
OpenGL* Support	4.6 / 3.0
Multi-Format Codec Engines	2
Intel® Quick Sync Video	Yes
Number Of Displays Supported	4

1.4. Memory / DDR5 SO-DIMM Socket

Onyx has two 262-pin 1.2V DDR5 SDRAM SODIMMS sockets:

- Support for DDR5 up to 5200
- Support for minimum 8GB single channel
- Support for maximum 64GB dual channel (32GB SO-DIMM per socket)

Processor / 13500H

- Up to DDR5 5200 MT/s
    - Maximum 2 Channel
    - 96 GB (Dependent upon memory type)
    - ECC not supported

Processor / 13600H

- Up to DDR5 5200 MT/s
- Up to LPDDR5/x 6400 MT/s
    - Maximum 2 Channel
    - 96 GB (Dependent upon memory type)
    - ECC not supported

Processor / 13700H

- Up to DDR5 5200 MT/s
- Up to LPDDR5/x 6400 MT/s
    - Maximum 2 Channel
    - 96 GB (Dependent upon memory type)
    - ECC not supported

Processor / 13700H

- Up to DDR5 5200 MT/s
- Up to LPDDR5/x 6400 MT/s
    - Maximum 2 Channel
    - 96 GB (Dependent upon memory type)
    - ECC not supported

1.5. Storage

Onyx has a M.2 PCIe Gen3/4 connector supporting M.2 22x80 (key type M) for Nvme Only. One SATA 6.0 Gb/s combined data and power connector for 2.5 inch SSD

1.6. SATA Interface

The SATA III port has a theoretical maximum transfer rate of 8Gbps.

1.7. 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.

1.8. Networking

Onyx has an Intel i226LM / 2.5 gigabit ethernet controller that interfaces to the onboard RJ-45 connector that provides up to 2.5 gigabit ethernet connection. The i226LM 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 crossover 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 and 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.

1.8.1. RJ-45 Connector Networking Interface

The Ony system has an RJ-45 connector which can run up to 2.5Gb speed. Refer to section 1.8 above for additional details.

1.8.2. Wireless Networking Interface

- 2.4Ghz, 5Ghz, and 6E support.
- 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 encryption supported
- Bluetooth® 5.2, BLE.

2. Technical Reference

2.1.1. Battery Header

Figure 1: Top Side Header Locations

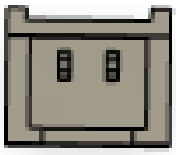


Table 3: Top Side Header Definitions

Pin	Signal
1	3V Positive (Right)
2	Ground

2.2. COMs Header

Figure 2: COMs Header

Table 4: COMs Header Pinout

Pin	Signal
1	DCD_1
2	RxD1
3	TxD1
4	DTR_1
5	GROUND
6	DSR_1

Pin	Signal
7	RTS_1
8	CTS_1
9	RI_1

Note: The COMs header outputs ``RS-232 TTL" level signaling…

2.3. CPU Fan-Blower Header

Figure 3: CPU Fan - Blower Header

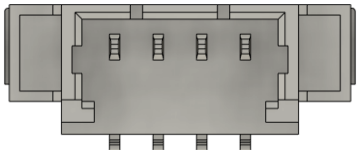


Table 5: CPU Fan-Blower Header Pinout

Pin	Signal Definition
1	5V
2	FAN_TAC2
3	FAN_CRL2
4	GROUND

2.4. M.2 For Storage / nVME

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
46	N/A	PETn0	47
44	N/A	GND	45
42	SMB_DATA	PERp0	43
40	SMB_CLK	PERn0	41
38	N/A	GND	39
36	N/A	PETp1	37
34	N/A	PETn1	35

Pin	Signal	Signal	Pin
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

2.5. M.2 for Radio

Table 7: M.2 Key-E 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
46	N/A	PETn0	47
44	N/A	GND	45
42	SMB_DATA	PERp0	43
40	SMB_CLK	PERn0	41
38	N/A	GND	39
36	N/A	PETp1	37
34	N/A	PETn1	35

Pin	Signal	Signal	Pin
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

2.6. SATA Header

Figure 4: Front Panel Header

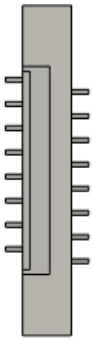


Table 8: Front Panel Header Pinout

Pin	Signal	Signal	Pin
1	5V	Ground	9
2	5V	Ground	10
3	5V	SATA_RX0P	11
4		SATA_RX0N	12
5		Ground	13
6		SATA_TX0P	14
7		SATA_TX0N	15
8	SATA_DEVSLP0	Ground	16

2.7. RGB Header Header

Figure 6: RGB Header

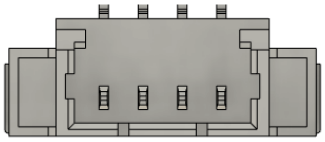


Table 9: RGB Pinout

Pin	Signal
1	12V Power (Left)
2	Red
3	Green
4	Blue (Right)

2.8. Front Panel Header

Figure 6: Front Panel Header

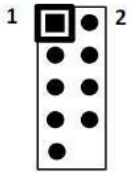


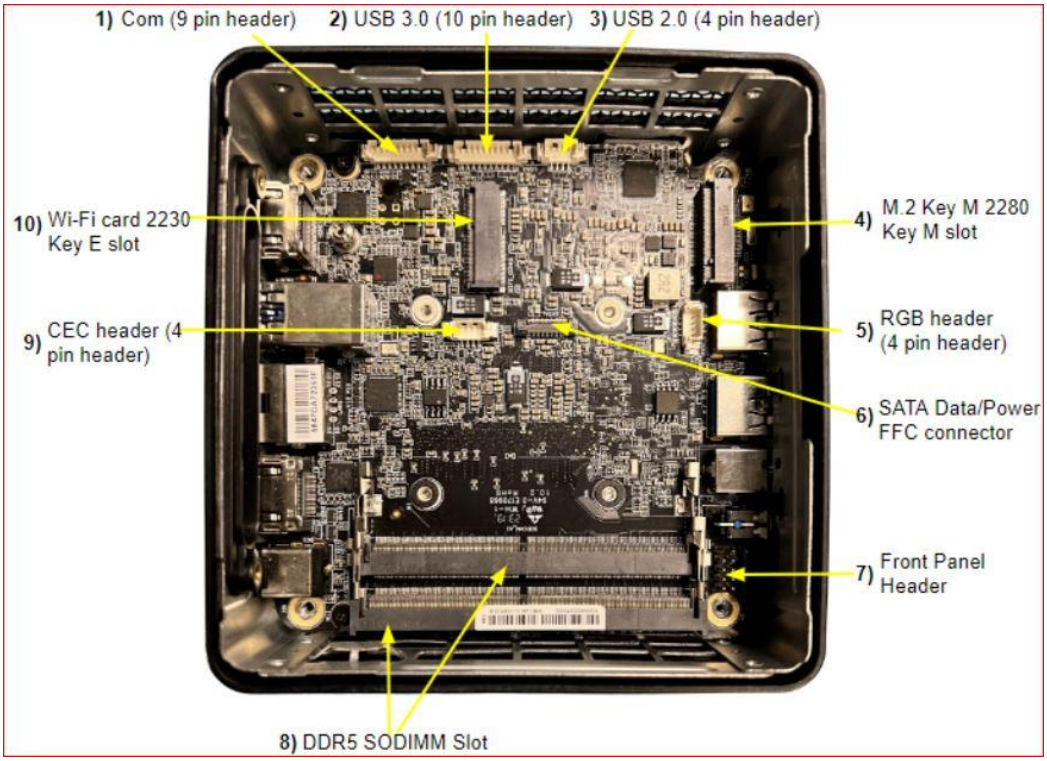
Table 10: Front Panel Header Pinout

Pin	Signal
1	HLED+
2	PWR_BTN_LED+
3	HLED-
4	PWR_BTN_LED-

Pin	Signal
5	GROUND/RESET
6	PANSHW
7	SYS_RST
8	GROUND
9	NOT USED
10	INTENTIONALLY BLANK

2.9. System / Motherboard

Figure 7: Top Down View In Chassis



2.10. Front & Back I/O Connectors

Figure 8: Front Side Connections

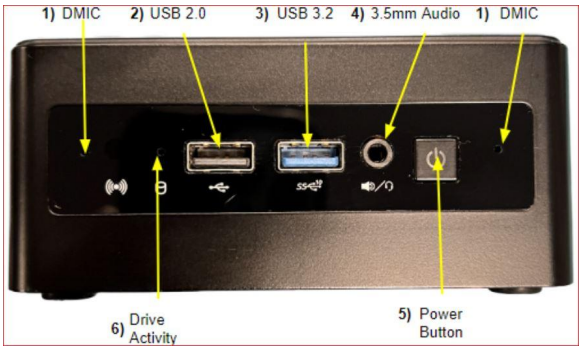


Table 11: Front Side I/O Connections Details

Identifier	Connector
1	Digital MIC
2	USB 2.0 Type A
3	USB 3.2 Type A
4	3.5mm Combination Jack
5	Power Button
6	Drive Activity LED

Front & Rear I/O Connectors (continued)

Figure 9: Back Side I/O Connections

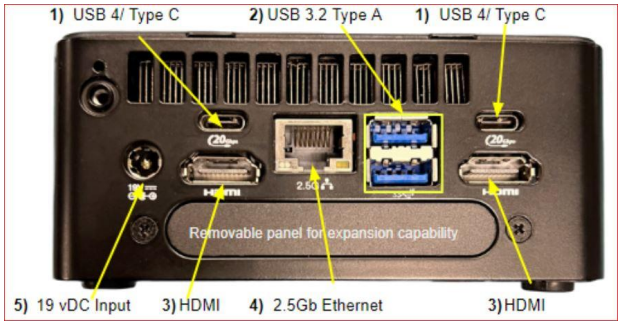
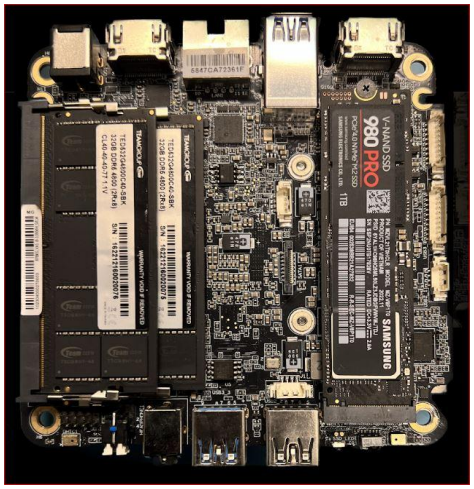


Table 12: Back Side I/O Connections Details

Identifier	Connector
1	USB 4 / Type C
2	USB 3.2 Type A / Stacked
3	HDMI
4	2.5Gb Ethernet / RJ-45
5	DC Input Voltage

3. PCB Mechanical Dimensions

Figure 10: Top Side View of PCB



PCBWidth: 111.0mm PCB Length: 111.0mm

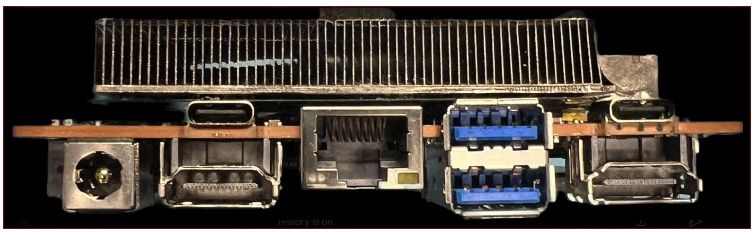
Board & Fan Assembly Height (Max): 27mm

3.1. PCB - Motherboard Height

Figure 11: Motherboard Front Height

PCB 12.0mm / PCB & Fan-Blower 24mm

Figure 11: Motherboard Rear Height



PCB 15mm / PCB Fan-Blower 27mm

3.2. System / Chassis Dimensions

Figure 13: System / Chassis Dimensions

4. Version History

Version	Date	Comments
0.1	09/05/13	Initial Draft for internal review.
1.0	09/06/23	Release Version
1.1	09/07/23	Minor updates to the Networking section, clarifying controller version, removal of the reference to a different system, and wordiong change to a figure label.
1.2	10/18/23	Formatting improvements for additional clarity Adeded clarification on operational status of CECE and COMMs header operating at TTL level.