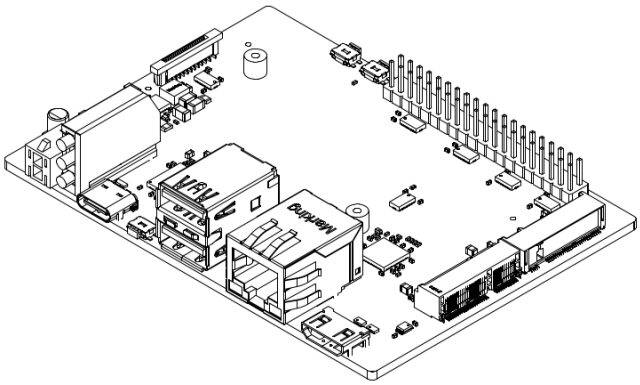


1 Features

- Pico-ITX form factor (100 mm × 72 mm)
- Synaptics Astra platform with 4× Arm® Cortex®-A73 64-bit @ 2.1 GHz
- Integrated NPU delivering up to 8 TOPS for real-time edge AI
- Integrated GRINN ASTRA-SOM-1680: 2×2 GB LPDDR4, 16 GB eMMC
- mini-HDMI video output
- 10/100/1000 Mb/s Ethernet (RJ-45)
- 3× USB (including dual USB 3.0)
- CSI (MIPI CSI-2) camera input
- Dual M.2 slots (PCIe Gen2 and USB/UART/SIO)
- 40-pin expansion header
- Input power: 12–24 V DC via right-angle 2-pin power socket; passive cooling
- ARM TrustZone® technology; Infineon OPTIGA secure element
- 3 status LEDs
- Industrial temperature range: −40°C to +85°C

2 Applications

- Industrial automation & Industry 4.0
- Robotics & autonomous systems
- Smart vision & surveillance
- Precision farming & agriculture
- Smart building systems
- Advanced IoT/edge devices

3 Description

Grinn **AstraOneSBC-1680** is a Pico-ITX single board computer designed for demanding industrial and AI applications. With mini-HDMI, Gigabit Ethernet, dual USB 3.0, CSI camera input, dual M.2 slots (PCIe Gen2 and USB/UART/SDIO), and a 40-pin expansion header, it provides the flexibility to connect vision systems, storage, and communication modules.

Powered by the Synaptics Astra platform, **AstraOneSBC-1680** combines a quad-core CPU with an integrated 8 TOPS NPU—delivering real-time AI performance directly at the edge. Operating from a wide 12–24 V DC input and featuring low power consumption with passive cooling, it is ideal for industrial automation, robotics, smart vision, and IoT deployments.

The board integrates the **Grinn AstraSOM-1680** (4× Arm® Cortex®-A73 @ 2.1 GHz, 2×2 GB LPDDR4, 16 GB eMMC, NPU 8 TOPS) and includes ARM TrustZone® technology alongside an Infineon OPTIGA secure element for hardware-based key storage and cryptographic operations.

Mechanical and I/O highlights include a right-angle 2-pin power socket, RJ-45 for Ethernet, 3× USB (including dual USB 3.0), mini-HDMI, two M.2 slots for expansion, and a 40-pin header. Three status LEDs provide at-a-glance system indication. The design targets harsh environments with an industrial temperature range from −40°C to +85°C.

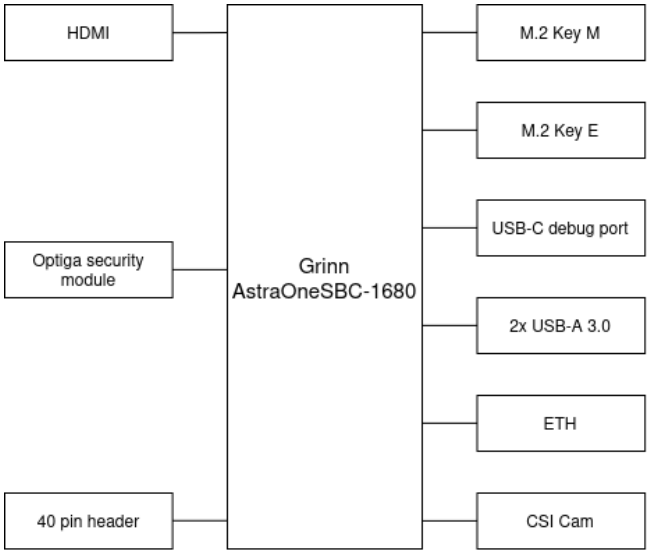


Figure 1: Functional block diagram

Contents

4 Functional Description

4.1 Power Supply

The Grinn AstraOneSBC-1680 is powered through a **12...24 V DC input** using a **WR-MPC3 (662102230822)** right-angle two-pin connector. On-board high-efficiency converters generate two main power rails: **5 V** (up to 5 A) and **3.3 V** (up to 4 A). Additional local regulators provide lower voltages (such as 1.8 V and 1.1 V) required by specific subsystems.

Main power distribution

- **5 V rail:** Powers the AstraSOM, USB ports, HDMI interface, and the 5 V pin on the 40-pin header.
- **3.3 V rail:** Powers the M.2 Key E and Key M slots, Ethernet interface, CSI camera, and the 3.3 V pin on the 40-pin header.

Power input A regulated **12...24 V / 2A DC power supply** connected through the WR-MPC3 jack is recommended for full functionality of all onboard peripherals. Typical power consumption is notably lower in most use cases and depends on the connected modules and peripherals.

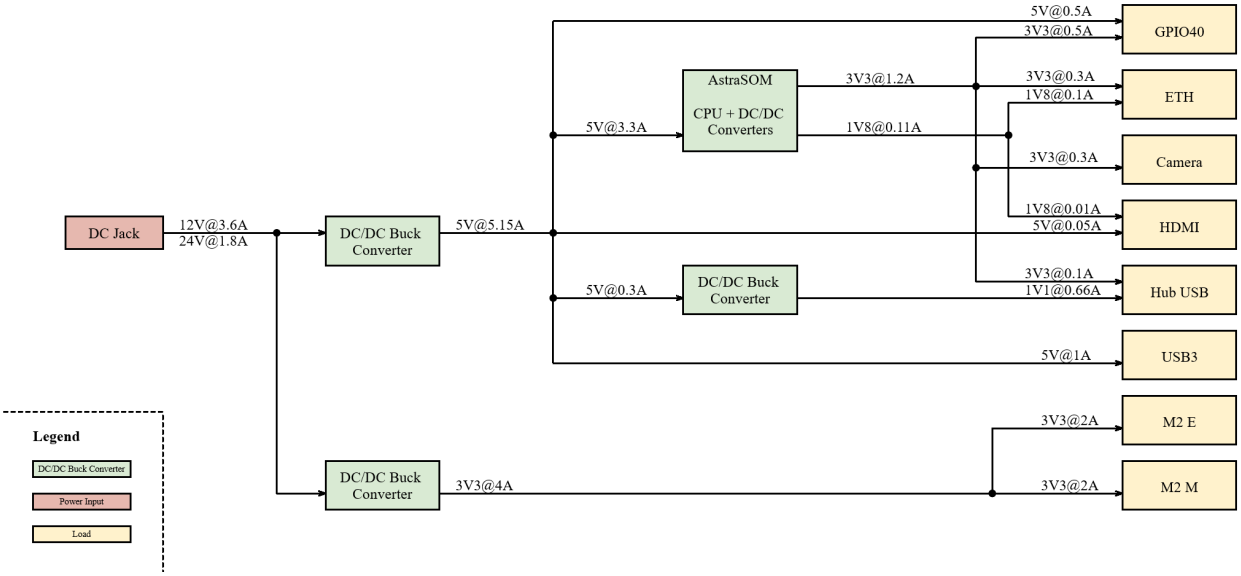


Figure 2: Simplified power distribution diagram.

4.1.1 40 PIN Header

The Grinn AstraOneSBC-1680 supports the 40 PIN connector, as shown in the schematic below. All pins are 3.3V compatible.

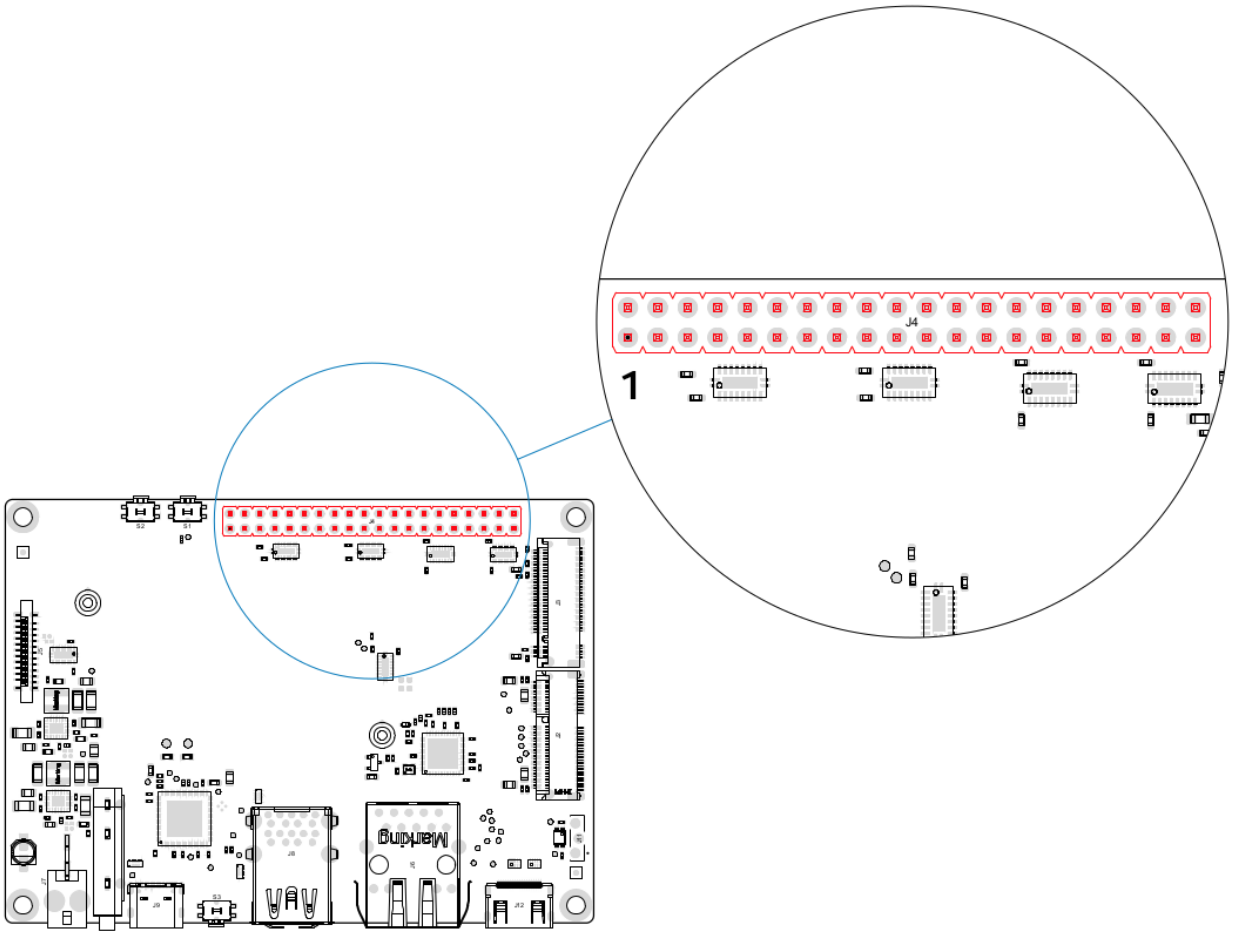


Figure 3: Grinn AstraOneSBC-1680 40 pin GPIO header

Table 1: Grinn AstraOneSBC-1680 40 pin GPIO header connections

Pin	Net Name	SOM Pin	CPU Pin
1	3.3V		
2	5V		
3	GPIO_2	B1	AR53
4	5V		
5	GPIO_3	B2	AR51
6	GND		
7	GPIO_4	AJ7	P60
8	GPIO_14	AH1	R51
9	GND		
10	GPIO_15	AJ2	W47
11	GPIO_17	B3	BF59
12	GPIO_18	B15	CA58
13	GPIO_27	B11	BM59
14	GND		
15	GPIO_22	AH2	W49
16	GPIO_23	AJ1	R53
17	3.3V		
18	GPIO_24	M1	AF59
19	GPIO_10	AJ11	K61
20	GND		
21	GPIO_9	AJ10	M59
22	GPIO_25	L2	AD59
23	GPIO_11	AH11	L59
24	GPIO_8	AJ9	H59
25	GND		
26	GPIO_7	AH10	F59
27	GPIO_0	AH3	L47
28	GPIO_1	AJ3	J47
29	GPIO_5	B9	BK59
30	GND		
31	GPIO_6	A9	BL59
32	GPIO_12	AH9	R57
33	GPIO_13	AH8	R55
34	GND		
35	GPIO_19	A15	BV59
36	GPIO_16	D2	AV59
37	GPIO_26	A10	BM60
38	GPIO_20	AJ16	CA59
39	GND		
40	GPIO_21	B16	BY59

4.2 HDMI

The Grinn AstraOneSBC-1680 is equipped with a **Mini HDMI** connector, allowing direct connection to an external monitor or display with an HDMI interface.

HDMI Transmitter

- Up to **2160p60 YUV 4:4:4**; up to **1080p60** with **12-bit** deep color
- **HDMI 2.1**–compliant HDR schemes, including **HDR10+**
- **HDCP 2.3**, **CEC**
- **HBR** audio output; **ARC Rx** and **eARC Rx**
- **VRR**, Auto Lip Sync Correction, **QMS**, **QFT**, **ALLM**
- Enhanced DDC (EDDC) interface.

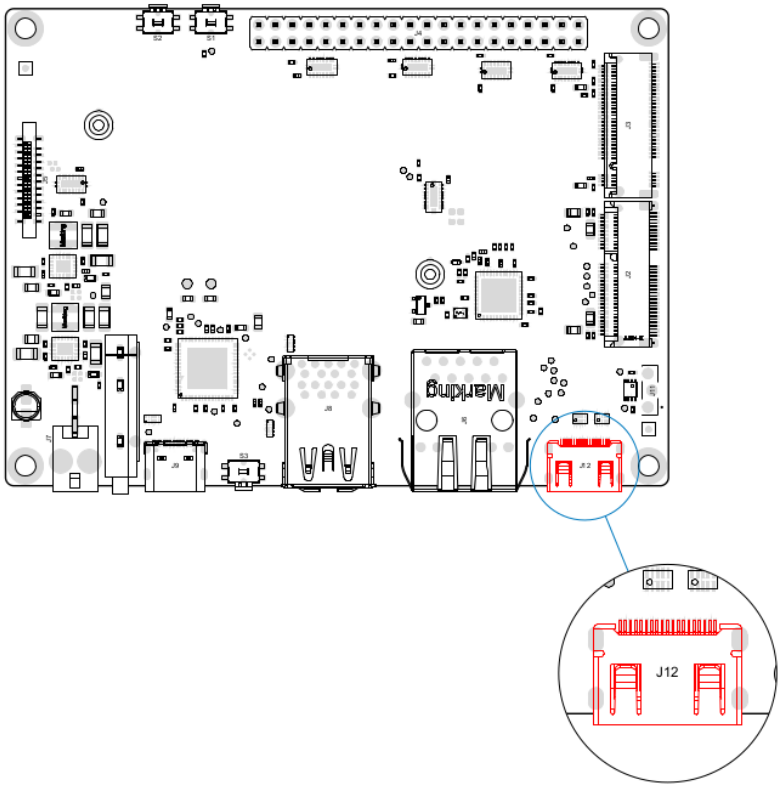


Figure 4: Grinn AstraOneSBC-1680 mini-HDMI connector placement

4.3 OPTIGA™ Trust M Security Module

The Grinn AstraOneSBC-1680 is equipped with the Infineon OPTIGA™ Trust M SLS32AIA010M, a hardware security module designed to support advanced security use cases in embedded systems and IoT applications.

This discrete secure element enables a wide range of security functions, including:

- Secure storage of cryptographic keys and certificates
- Hardware-accelerated RSA and ECC cryptographic operations
- Mutual authentication and secure TLS channel establishment
- Device identity protection and attestation
- Platform integrity verification
- Tamper-resistant key provisioning

The module connects to the main processor over an I²C interface and operates independently of the host system, enabling isolated execution of cryptographic functions. It complies with Common Criteria EAL6+ (hardware) and supports X.509 certificates for identity and authentication tasks.

I²C Interface Configuration

- **I²C Bus:** TW3_I2C
- **I²C Address:** `0x30` (7-bit)

Table 3: OPTIGA™ Trust M I²C Pinout

Pin	Signal	CPU Pin	SOM Pin
SDA	TW3_SDA	B1	AR53
SCL	TW3_SCL	B2	AR51
RSTn	Optiga_RSTn	L1	AP59

Its integration on the Grinn AstraOneSBC-1680 makes it a robust choice for applications requiring strong trust anchors, such as secure boot, encrypted firmware updates, cloud onboarding, and secure communications in industrial or consumer-grade devices.

Warning: The OPTIGA™ Trust M security module does *not* respond to standard I²C scan tools such as `i2cdetect`, because it does not acknowledge general read requests. To verify its presence on the bus or communicate with it, use the Infineon-provided tool `trustx_scan` instead.

4.4 CSI

The Grinn AstraOneSBC-1680 board includes one 4-lane CSI interface, capable of supporting a maximum bit rate of **2.5 Gbps**. Camera sub-boards connect to the board using the WR-FPC 687322124422 connector.

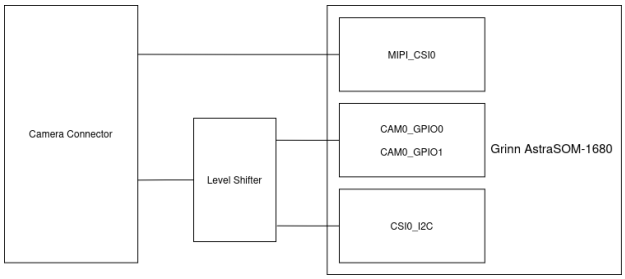


Figure 5: Grinn AstraOneSBC-1680 CSI diagram

Table 4: Grinn AstraOneSBC-1680 CSI camera connector

Pin	CSI Connector	SOM Pin	CPU Pin
1	GND		
2	CSI0_D0_N	AH16	BL3
3	CSI0_D0_P	AJ16	BM3
4	GND		
5	CSI0_D1_N	AH15	BK3
6	CSI0_D1_P	AJ15	BK2
7	GND		
8	CSI0_CK_N	AH17	BP1
9	CSI0_CK_P	AJ17	BP2
10	GND		
11	CSI0_D2_N	AH13	BD3
12	CSI0_D2_P	AJ13	BF3
13	GND		
14	CSI0_D3_N	AH12	BH1
15	CSI0_D3_P	AJ12	BH2
16	GND		
17	3V3_CAM0_-GPIO0	E1	AR61
18	3V3_CAM0_-GPIO1	G1	AR55
19	GND		
20	3V3_CSI0_SCL	A7	AC47
21	3V3_CSI0_SDA	B7	AC49
22	3V3		

Make sure to insert the FPC cable in the correct orientation. Pay close attention to the **"Pin 1"** marking on GRINN FPC cable — improper insertion may damage the camera.

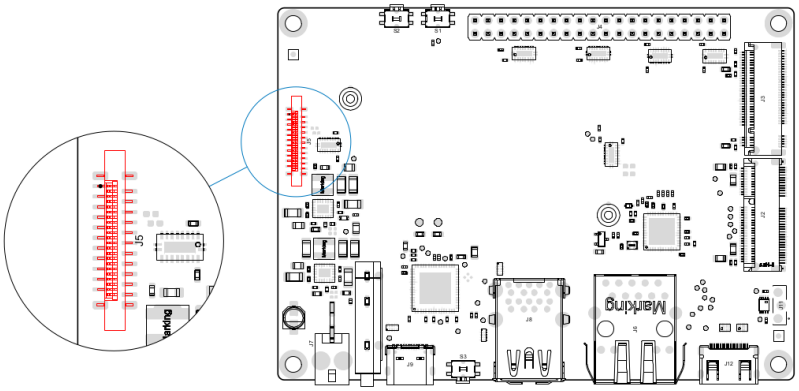


Figure 6: Grinn AstraOneSBC-1680 CSI connector placement

4.5 M.2 Connectors

The Grinn AstraOneSBC-1680 is equipped with two M.2 connectors for system expansion:

- **M.2 E-key slot (J2)** – intended for Wi-Fi and Bluetooth modules
- **M.2 M-key slot (J3)** – designed for AI accelerators over PCIe

The M.2 E-key slot supports USB connectivity for wireless modules; however, PCIe is not available on this connector. The remaining pins follow the standard M.2 E-key layout.

The M.2 M-key slot supports x2 PCIe gen2 lane and does not support SATA interfaces and does not include card detection functionality, meaning that the presence of a module cannot be automatically sensed by the system.

The board includes threaded metal standoffs (marked in Figure 7) for secure mechanical mounting of M.2 modules. These standoffs are compatible with M3 screws and use part number **9774040243R** (Würth Elektronik). They ensure stable attachment of E-key and M-key cards, preventing mechanical stress on the connectors during installation or operation.

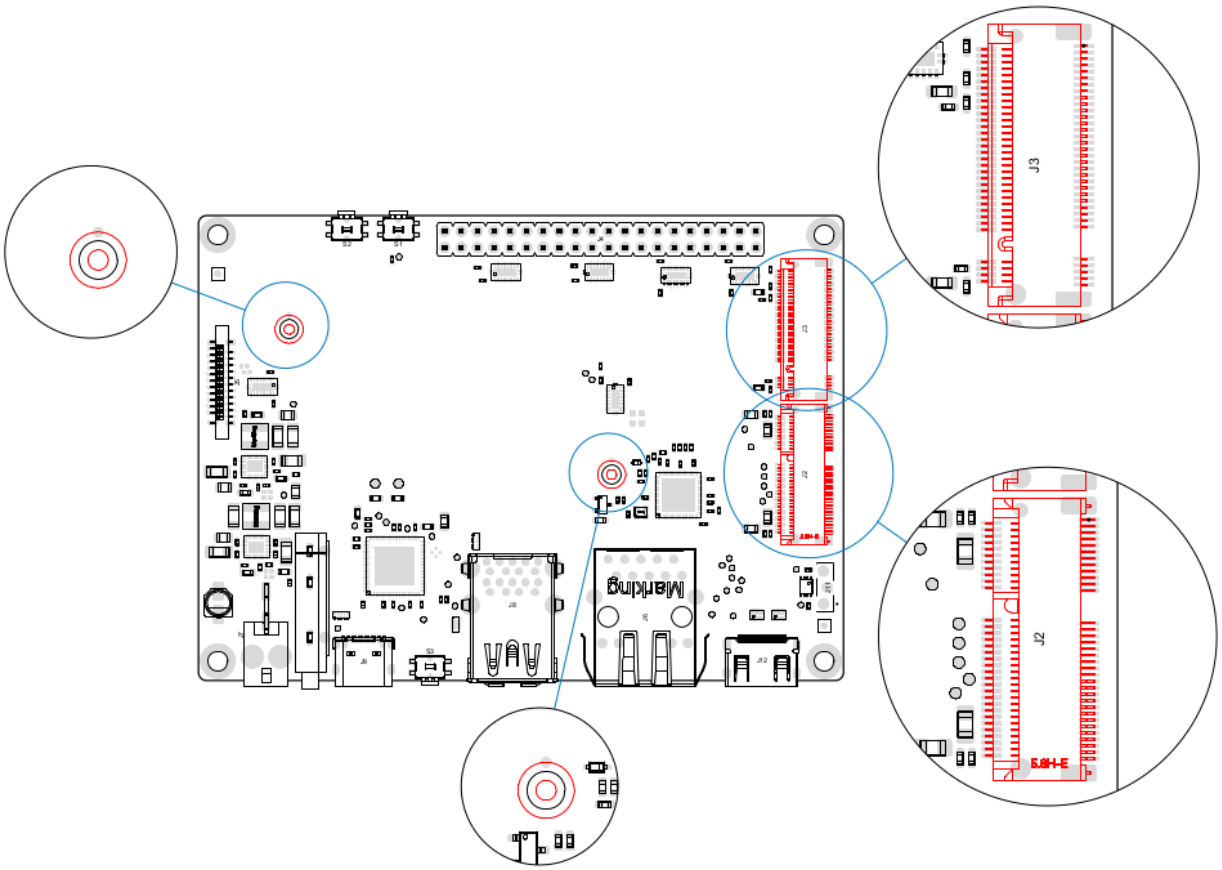


Figure 7: Grinn AstraOneSBC-1680 M.2 connectors

Table 6: Grinn AstraOneSBC-1680 M.2 Key E slot pinout

Pin	Pin name	SOM pin	CPU pin	Description
1	GND			
2	3V3_M.2			
3	USB_DN1_D_P			
4	3V3_M.2			
5	USB_DN1_D_N			
6	NC			
7	GND			
8	NC			
9	SDIO.CLK	AJ5	B48	
10	NC			
11	SDIO.CMD	AH5	B50	
12	NC			
13	SDIO.DATA0	AH4	N43	
14	NC			
15	SDIO.DATA1	AJ4	C44	
16	NC			
17	SDIO.DATA2	AH6	C46	
18	GND			
19	SDIO.DATA3	AJ6	G46	
20	3V3_UART_WAKEn	A6	BH61	via level shifter
21	SDIO_WAKEn	A3	BF60	
22	UART2.RXD	C1	AY59	
23	SDIO_RESETn	B4	BD59	
24-31	Key E			Pins removed to act as physical key
32	UART2.TXD	C2	AT59	
33	GND			
34	UART2.CTSn	E1	AW57	
35	NC			
36	UART2.RTSn	D1	AY60	
37	NC			
38	NC			
39	GND			
40	NC			
41	NC			
42	NC			
43	NC			
44	NC			
45	GND			
46	NC			
47	NC			
48	NC			
49	NC			
50	NetJ2_50			Oscillator 32.768kHz
51	GND			
52	NC			
53	NC			
54	3V3_WIFI1_BT_-DISABLEn	B12	BP60	via level shifter
55	NC			

Pin	Pin name	SOM pin	CPU pin	Description
56	3V3_WIFI1_WF_-DISABLEn	B13	BP61	via level shifter
57	GND			
58	NC			
59	NC			
60	NC			
61	NC			
62	NC			
63	GND			
64	NC			
65	NC			
66	NC			
67	NC			
68	NC			
69	GND			
70	NC			
71	NC			
72	3V3_M.2			
73	NC			
74	3V3_M.2			
75	GND			
76	GND			

Table 8: Grinn AstraOneSBC-1680 PCIe M.2 Key M slot pinout

Pin	Pin name	SOM pin	CPU pin	Description
1	GND			
2	3V3_M.2			
3	GND			
4	3V3_M.2			
5	NC			
6	NC			
7	NC			
8	NC			
9	GND			
10	NC			
11	NC			
12	3V3_M.2			
13	NC			
14	3V3_M.2			
15	GND			
16	3V3_M.2			
17	NC			
18	3V3_M.2			
19	NC			
20	NC			
21	GND			
22	NC			
23	NC			
24				

Pin	Pin name	SOM pin	CPU pin	Description
25	NC			
26				
27	GND			
28				
29	PCIE_RX1_N	Y23	BW14	
30				
31	PCIE_RX1_P	Y24	BW12	
32	NC			
33	GND			
34	NC			
35	PCIE_TX1_N	AB23	CA16	
36	NC			
37	PCIE_TX1_P	AB24	BY16	
38	NC			
39	GND			
40	NC			
41	PCIE_RX0_N	U23	BW18	
42	NC			
43	PCIE_RX0_P	U24	BY18	
44	NC			
45	GND			
46	NC			
47	PCIE_TX0_N	V23	BW19	
48	NC			
49	PCIE_TX0_P	V24	BW20	
50	3V3_PCIE_RSTn	A12	BT60	via level shifter
51	GND			
52	3V3_PCIE_CLKREQn	A13	BT59	via level shifter
53	PCIE_CLK_N	R23	BY22	
54	3V3_PCIE_WAKEn	A11	BT61	via level shifter
55	PCIE_CLK_P	R24	CA22	
56	NC			
57	GND			
58	NC			
59–66	Key M			Pins removed to act as physical key
67	NC			
68	NC			
69	NC			
70	3V3_M.2			
71	GND			
72	3V3_M.2			
73	GND			
74	3V3_M.2			
75	GND			
76	GND			

4.5.1 DEEPX DX-M1 M.2 Module

The DEEPX DX-M1 M.2 Module is an extenal AI accelerator that enhances the Grinn AstraOneSBC-1680 AI performance when higher inference throughput is required.

The module integrates the DEEPX DX-M1 SoC, delivering 25 TOPS of native INT8 compute (equivalent to 200 eTOPS). It features a dedicated deep-learning accelerator architecture with an integrated high-bandwidth memory subsystem and supports model conversion from TensorFlow, ONNX, Keras, and PyTorch through the DEEPX dataflow compiler.

Thermal operating limits are –25°C to +85°C with throttling, and –25°C to +65°C without throttling. Power consumption ranges from 2 W (minimum) to 5 W (maximum) when running DEEPX-optimized AI models.

The module interfaces with the Grinn AstraOneSBC-1680 via the PCIe Gen2 x2 link provided on the M.2 Key M slot (J3). Mechanical mounting is supported by the integrated M3 standoffs.

The DX-M1 supports a wide range of state-of-the-art neural networks, including ResNet, MobileNet v1–v3, EfficientNet, EfficientDet, SSD, YOLOv5/7/8 and later variants, DeepLabv3, PIDNet, and vision-language models such as CLIP, enabling high-performance inference for embedded vision, robotics, and edge-AI systems.

The Grinn AstraOneSBC-1680 can be ordered with the DEEPX DX-M1 module pre-installed. See Section 8 for detailed ordering information.

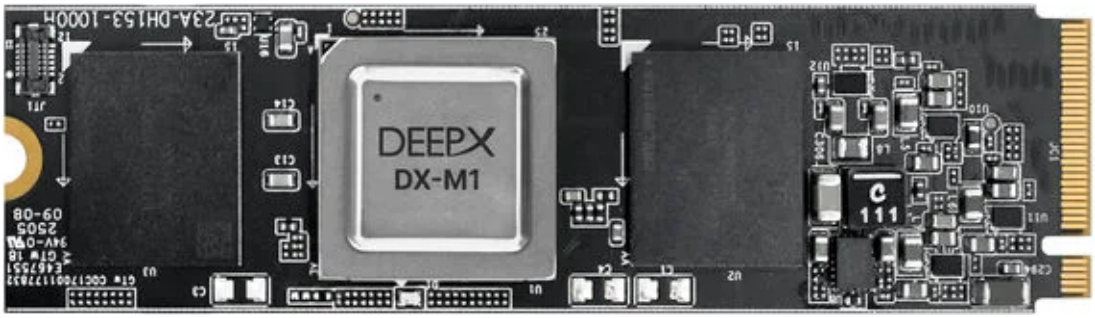


Figure 8: DX-M1 M.2 Module

4.6 Ethernet

The Grinn AstraOneSBC-1680 board integrates a Microchip KSZ9031RNXI Ethernet transceiver, enabling reliable 10/100/1000 Mbps Ethernet connectivity. This transceiver connects to the Grinn AstraSOM-1680 processor via an RGMII (Reduced Gigabit Media-Independent Interface), ensuring efficient, high-speed data transfer. The KSZ9031RNXI is designed for robust network performance, providing low latency and stable communication ideal for data-intensive applications. With its built-in Ethernet PHY, the board is ready for seamless network integration, making it a solid choice for projects requiring high-speed wired connectivity.

The RJ45 Ethernet connector on the Grinn AstraOneSBC-1680 includes two integrated indicator LEDs driven directly by the KSZ9031RNXI PHY. These LEDs provide a clear indication of link status, activity, and connection speed, allowing quick visual diagnostics without additional software support.

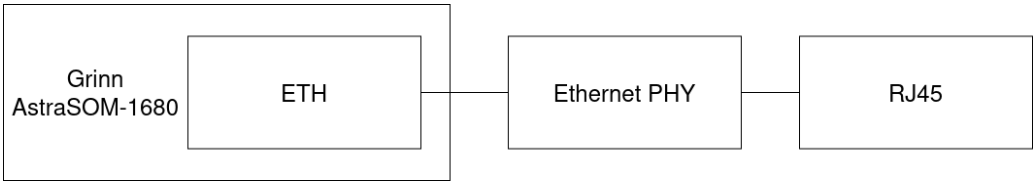


Figure 9: Grinn AstraOneSBC-1680 Ethernet diagram

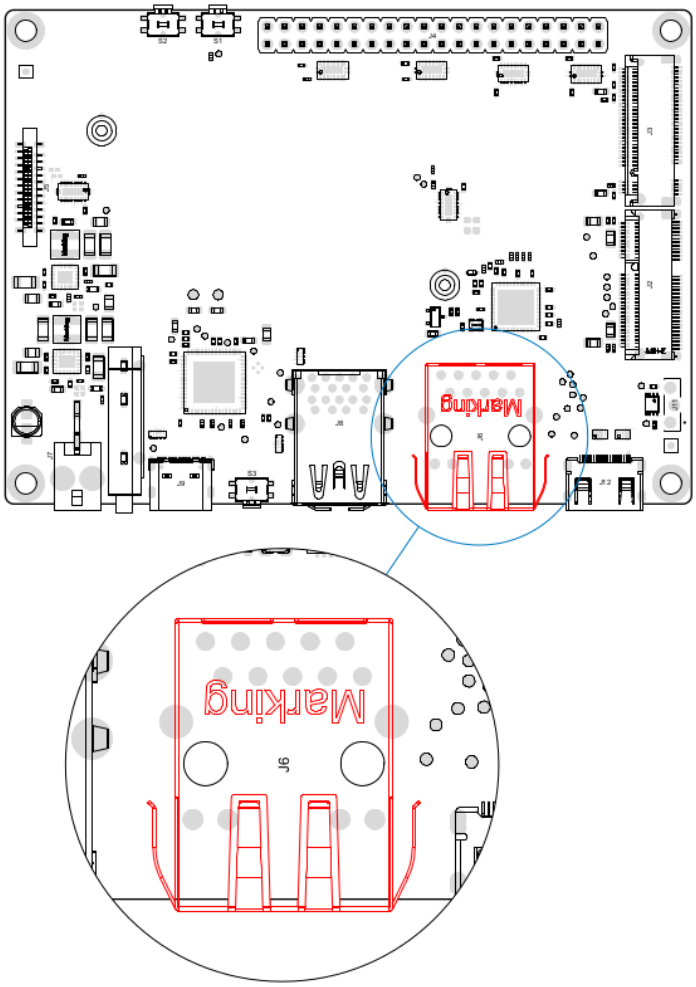


Figure 10: Grinn AstraOneSBC-1680 ETH placement

4.7 USB Architecture

The Grinn AstraOneSBC-1680 exposes two USB root ports from the Grinn AstraOneSBC-1680 **USB 3.0** (SuperSpeed) and one **USB 2.0** (High-Speed). These are routed as shown in Figure 11.

4.7.1 USB 3.0

The **USB 3.0** interface is connected to a USB 3.0 hub. Its downstream ports provide:

- **Two USB-A 3.0** connectors for high-bandwidth peripherals (e.g., storage, cameras).
- **A connection to the M.2 Key E** slot (wired to a hub downstream port). This allows the M.2 module to use a USB interface where required (e.g., Bluetooth on combo Wi-Fi/BT cards).

This path delivers full USB 3.0 bandwidth to the external Type-A ports while also supplying a USB link to the M.2 Key E socket.

4.7.2 USB 2.0 — Type-C port

The **USB 2.0** interface from the Grinn AstraSOM-1680 is routed *directly* to the **USB-C** receptacle (no hub in the path). This port exposes USB 2.0 data lines and is intended for standard High-Speed peripherals. **It is primarily designed for flashing and debugging tasks.** The Grinn AstraOneSBC-1680 must be powered through the **VIN connector (J7)** during such operations, as the **USB-C port (J9) does not provide +5 V power**.

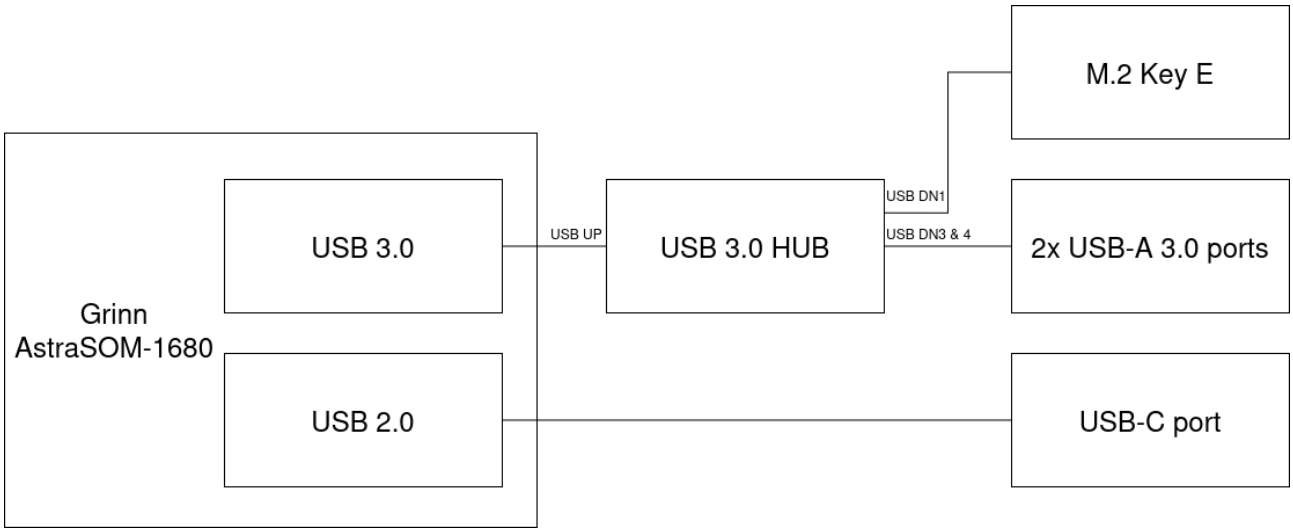


Figure 11: Grinn AstraOneSBC-1680 USB architecture

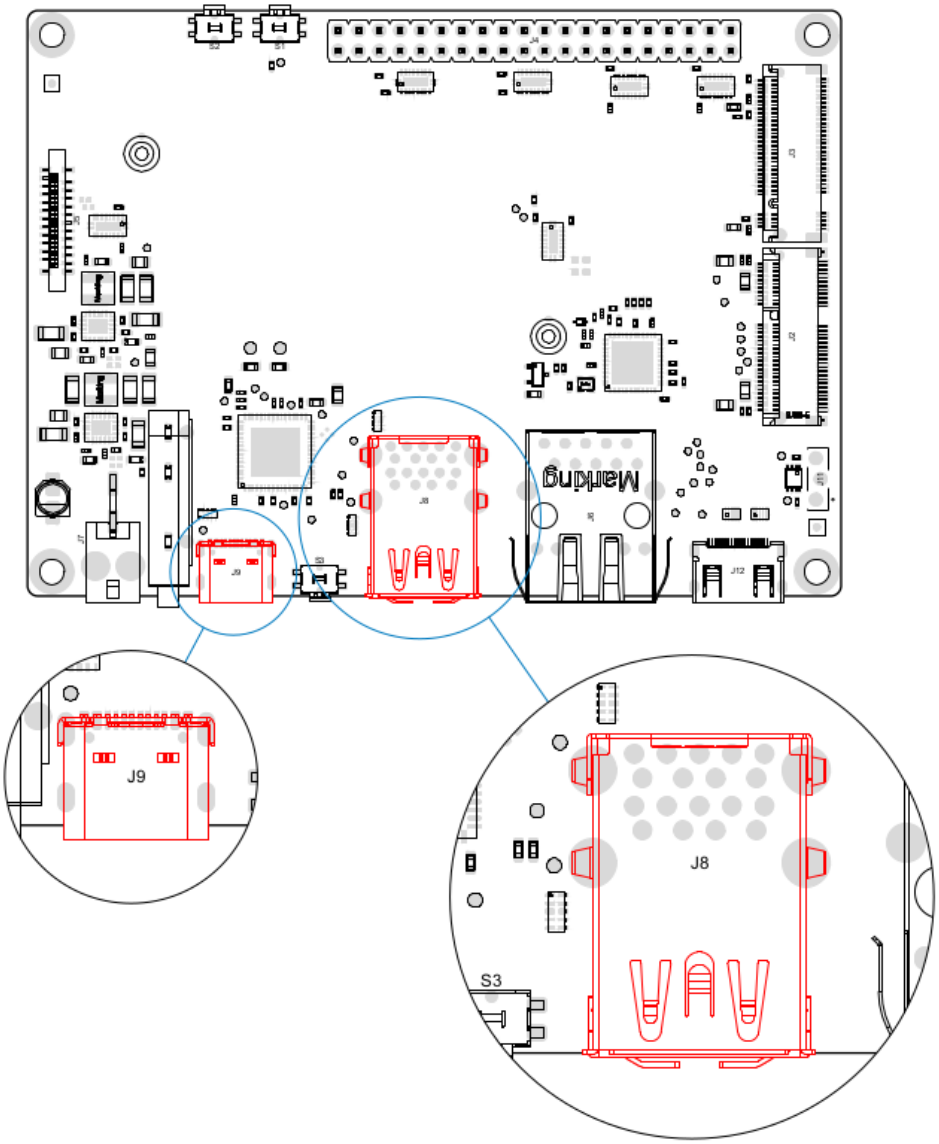


Figure 12: Grinn AstraOneSBC-1680 USB connectors

4.8 User Interface

The Grinn AstraOneSBC-1680 provides a set of user interface components for controlling and monitoring the board during development and integration.

4.8.1 Boot Button (BOOT)

The **BOOT** button (S2) is used to control the boot mode of the Grinn AstraOneSBC-1680 during power-up or reset.

This button is typically used in conjunction with the **RESET** button during software updates or recovery procedures.

4.8.2 Reset Button (RESET)

The **RESET** button performs a hard reset of the SOM. Pressing it will restart the SOM without removing power, and it resets all peripherals and processor state. It is commonly used to recover from software hangs or to restart the board after flashing new firmware.

4.8.3 User Button (USER)

The **USER** button (S3) is software-defined. It is connected to SOM pin `B3` (CPU pin `GPIO15`). Its behavior is not fixed in hardware and can be assigned by firmware or user-space software (e.g., triggering application actions, diagnostics, or a safe-shutdown handler via a GPIO interrupt).

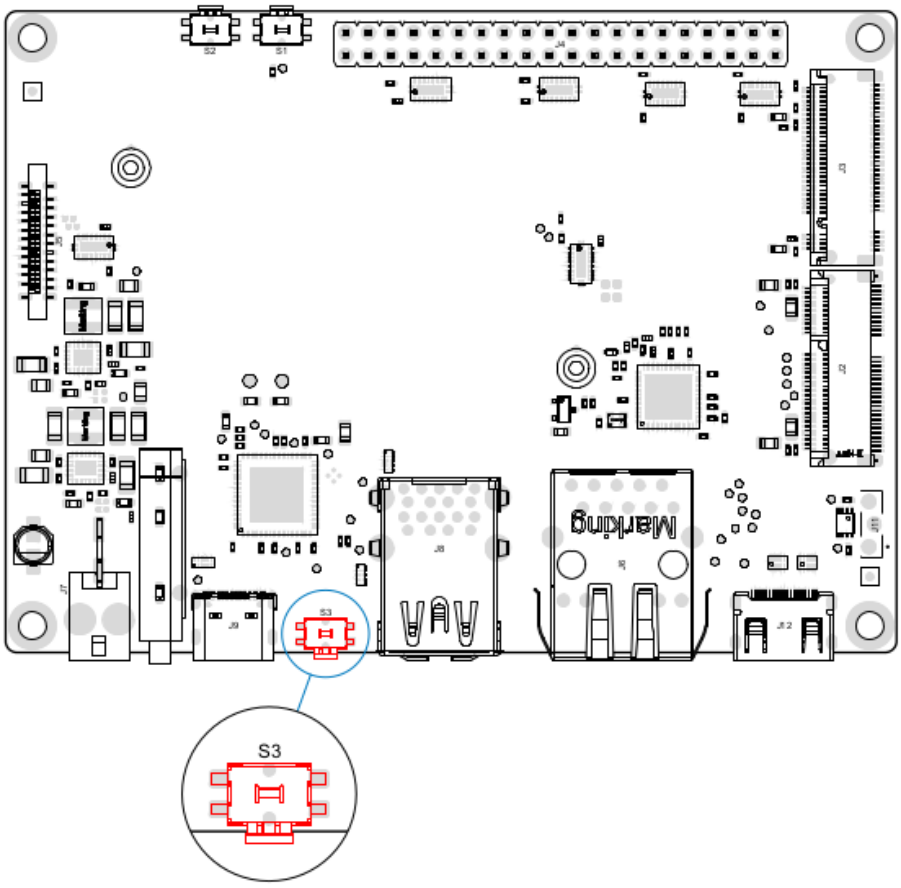


Figure 13: Grinn AstraOneSBC-1680 user button placement

4.8.4 LED Indicators

The board includes two power status LEDs and three user defined LEDs:

- **D12 (green LED)** – Indicates a **5.0V power fault**. Connected to the 5.0V power domain and lights up when the Grinn AstraSOM-1680 is not properly powered.
- **D13 (green LED)** – Indicates a **3.3V power fault**. Connected to the 3.3V power domain and lights up when the Grinn AstraSOM-1680 is not properly powered.
- **D1 (red LED)** – General-purpose LED connected to SOM pin `B5` (CPU pin `GPIO18`); can be toggled by software.
- **D2 (green LED)** – General-purpose LED connected to SOM pin `A4` (CPU pin `GPIO21`); can be toggled by software.
- **D3 (yellow LED)** – General-purpose LED connected to SOM pin `A5` (CPU pin `GPIO20`); can be toggled by software.

The user LEDs (D1–D3) are **routed outside the PCB via a light pipe** (`DIALIGHT_515-1064-804F`) for visibility at the enclosure surface.

5 Boot options

The Grinn AstraOneSBC-1680 board supports booting from its internal memory, providing a reliable and streamlined startup process. Upon power-up, the system initializes the hardware and executes the bootloader stored in the internal memory. This bootloader is responsible for loading the operating system or firmware, enabling the board to begin executing user-defined tasks.

5.1 Supported OS

The Grinn AstraOneSBC-1680 supports a custom Linux Yocto build. Yocto Git repository

5.2 Flashing

To flash the Grinn AstraOneSBC-1680, one needs a Linux or Windows host PC with usb-tool, a power adapter, and a USB-C cable.

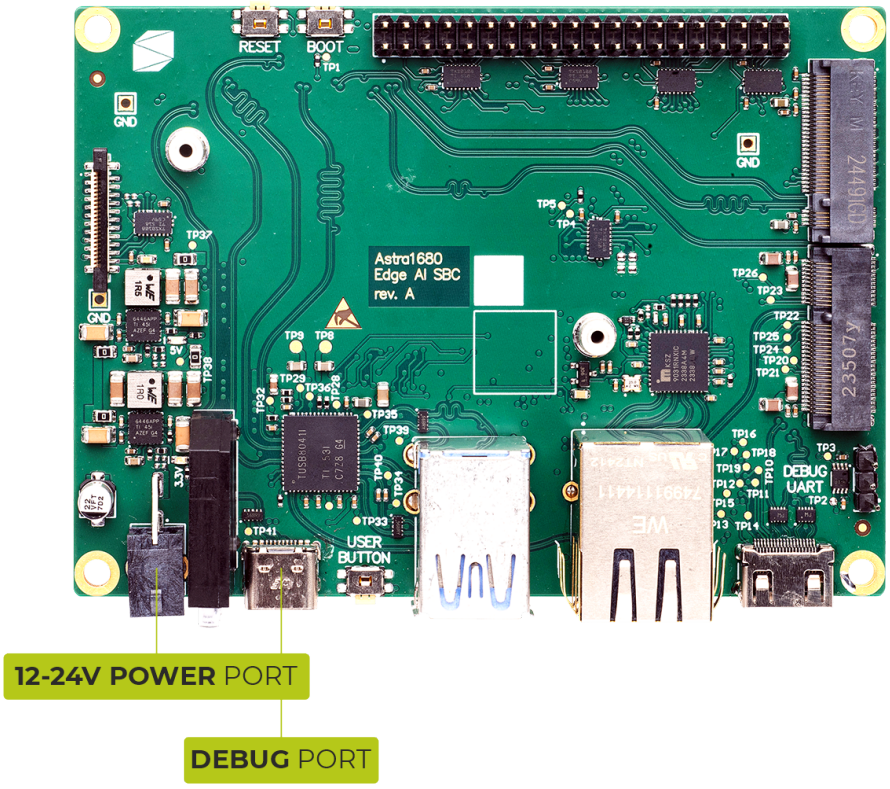


Figure 14: Grinn AstraOneSBC-1680 USB debug & power placement

Here's a high-level overview of the process:

- Connect the Board: Use the power adapter to power the board and connect the board to the host PC via the USB-C cable.
- Launch the astra-update script.
- Enter Flash Mode: Follow these steps:
  - Press and hold the BOOT button.
  - Press and release the RESET button.
  - Release the BOOT button.
  - Wait for flash process to finish.

For a more detailed description of the process, please refer to the flashing instructions.

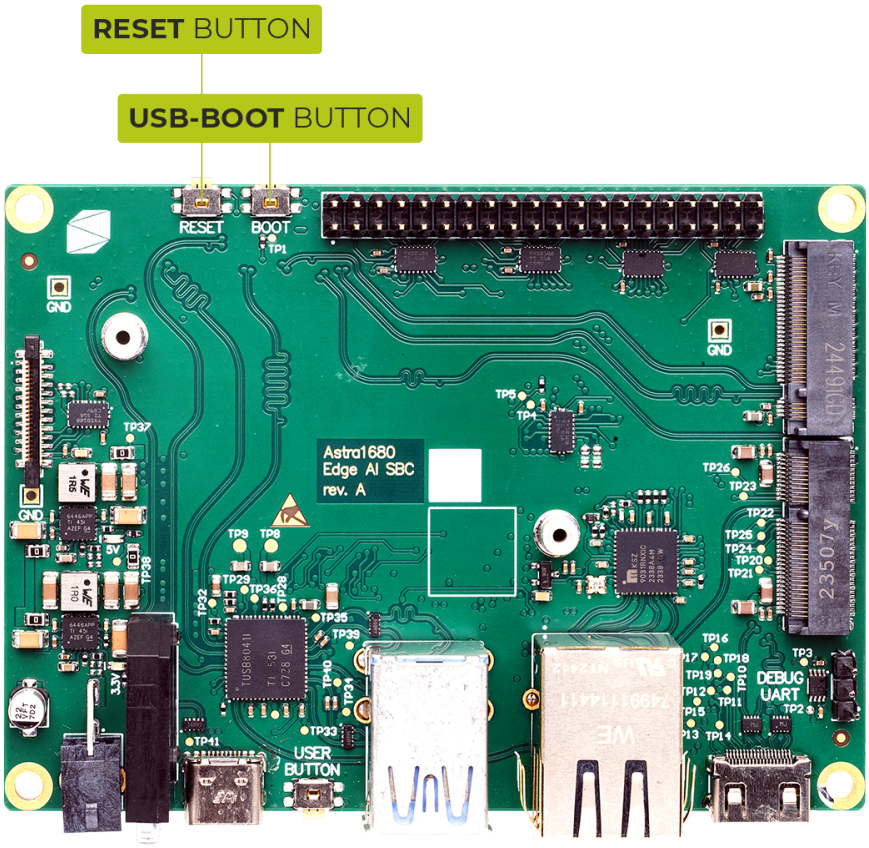


Figure 15: Grinn AstraOneSBC-1680 USB debug & power placement

5.3 CLI Access

The Grinn AstraOneSBC-1680 provides serial console access through a dedicated **DEBUG UART** header on the board. The USB-C debug port on board is used for ADB (Android Debug Bridge) connectivity.

5.3.1 DEBUG UART - CLI

The UART header provides access to the serial console of the board. Depending on the boot stage, it can be used to interact with the U-Boot command line, the Linux login shell. Connect a USB-to-UART adapter (3.3V logic level) to the header to establish a terminal session with the following configuration:

- Baud rate: `115200`
- Data bits: `8`
- Parity: `None`
- Stop bits: `1`

5.3.2 USB-C Port - ADB Interface

The USB-C connector on the Grinn AstraOneSBC-1680 is used for ADB (Android Debug Bridge) communication. When connected to a host PC, it enumerates as an ADB device and provides access to the Android shell and development tools.

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Table 10: Grinn AstraOneSBC-1680 absolute maximum ratings

Parameter	Minimum	Maximum	Unit
Supply voltage VIN	-0.3	32	V
Supply current[1]		3.6	A
GPIO port input voltage	-0.5	6.5	V
GPIO port continuous current[2]		0.5	A
USB 3.0 ports continuous current		2×0.5	A
M.2 cards power consumption		2×6.5	W
Operating ambient temperature	-40	+85	°C

[1] Measured at 12V VIN with Linux and all peripherals running.
[2] 0.5 A from 5V rail and 0.5 A from 3.3V rail.

6.2 Recommended Operating Conditions

Table 11: Grinn AstraOneSBC-1680 recommended operating conditions

Parameter	Minimum	Typical	Maximum	Unit
Supply voltage VIN	12 (-10%)	12–24	24 (+10%)	V
Supply current	0.08[3]	0.45[4]	1.8[5]	A
Operating ambient temperature	-20	+25	+70	°C

[3] Measured at 24V VIN, system idle, no operating system.
[4] Measured at 12V VIN with Yocto Linux and Ethernet interface active.
[5] Measured at 24V VIN with Linux and all peripherals running.

7 Mechanical Characteristics

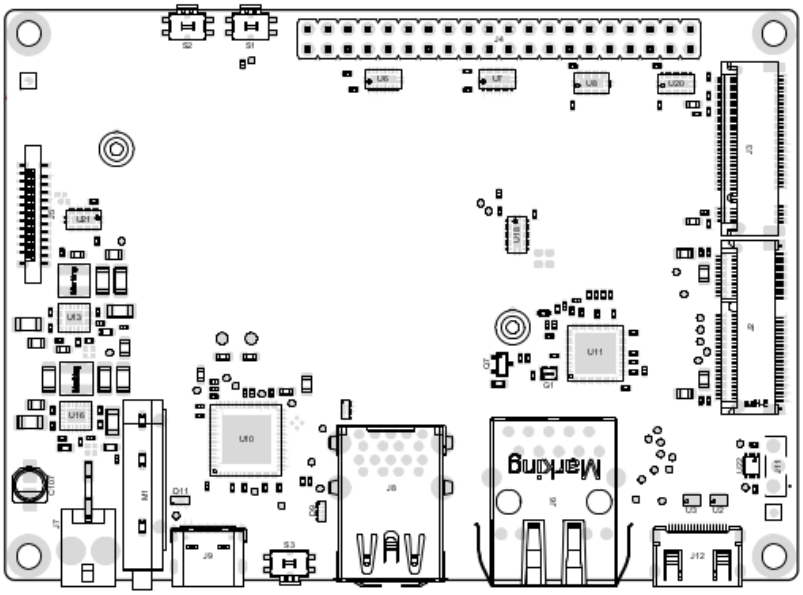


Figure 16: Grinn AstraOneSBC-1680 top view

Figure 17: Grinn AstraOneSBC-1680 bottom view

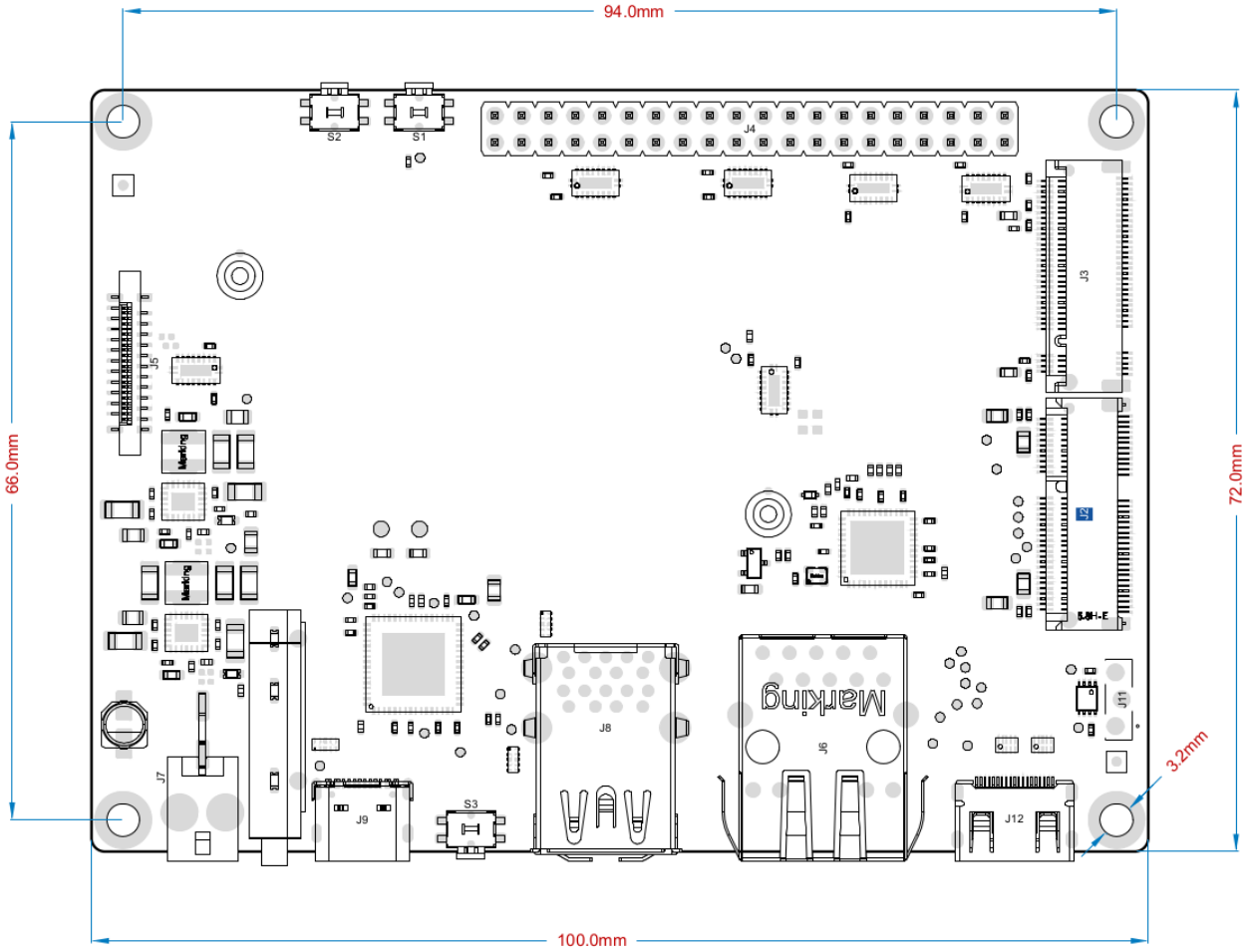
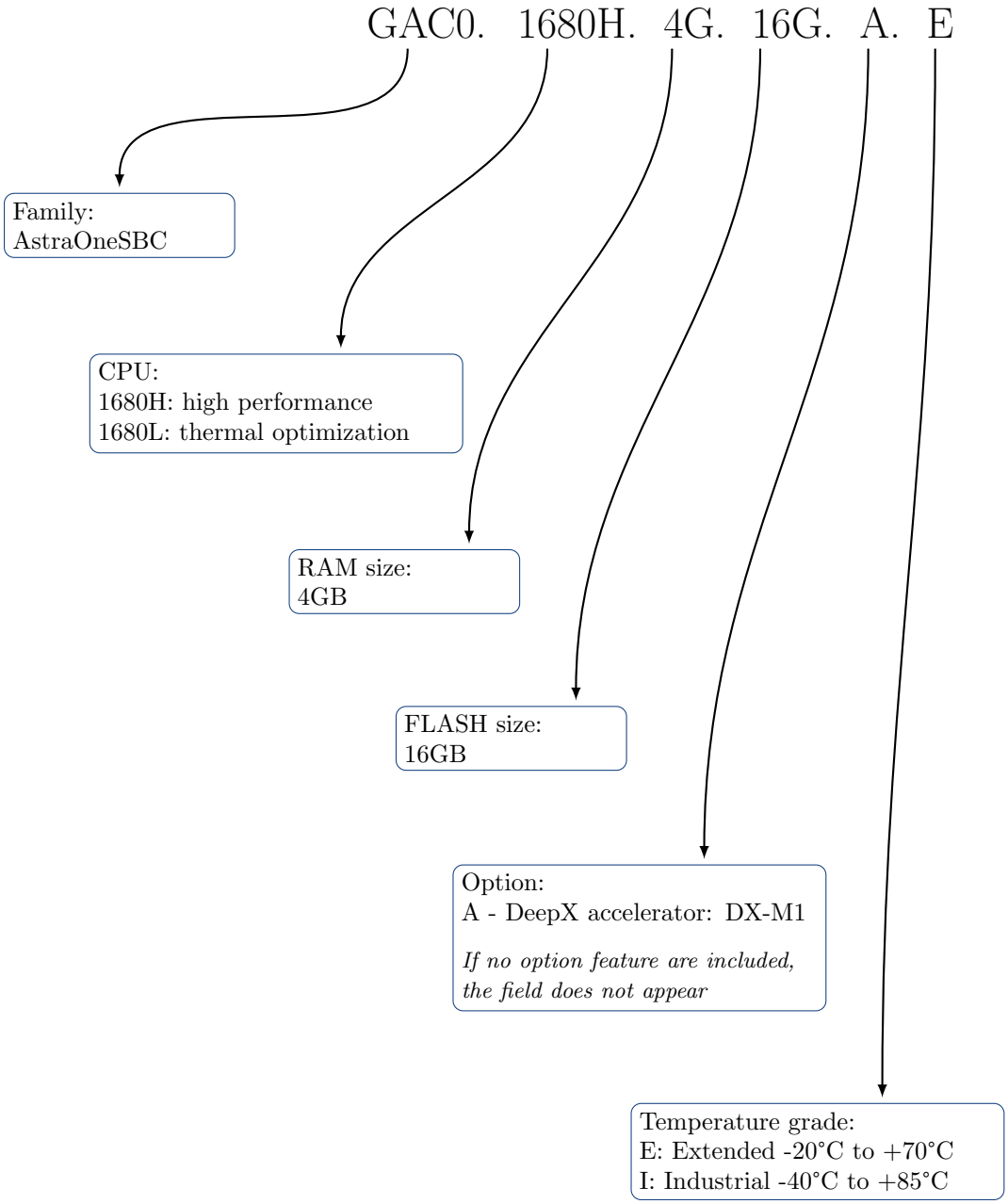
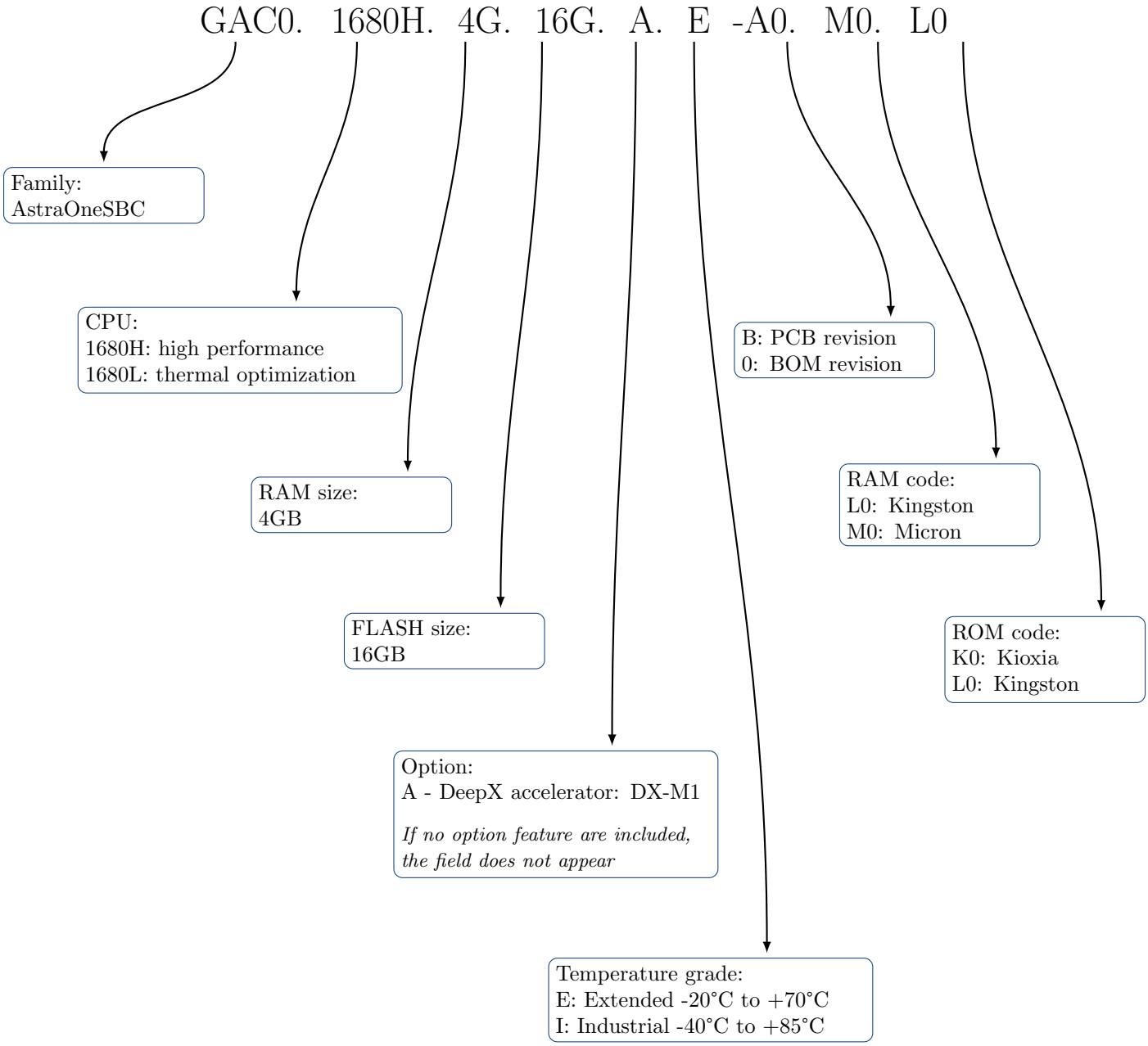


Figure 18: Grinn AstraOneSBC-1680 top view dimensions

8 Ordering Part Number



9 Full Part Number



10 Revision History

Revision	Date	Changes
1.0	09.10.2025	Initial revision.
1.1	09.12.2025	Changed chapter 8, added chapter 9.

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