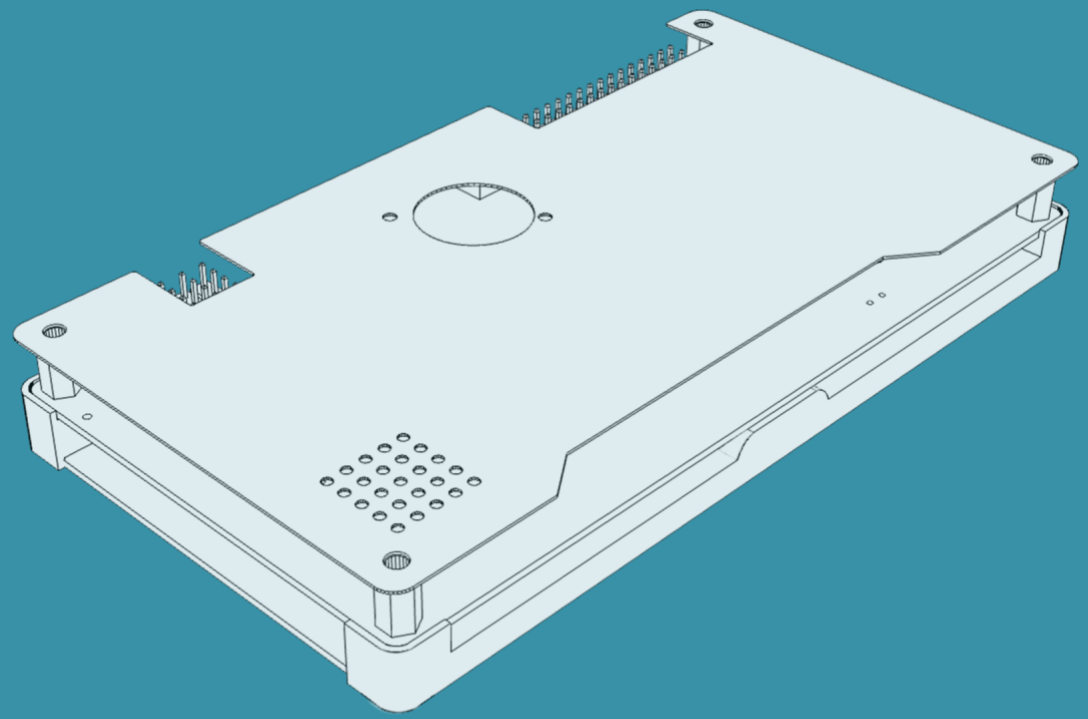
Vivid Unit Expansions Specification

Revision: 1.01



DUN CAT B.V. (UUGEAR)

COLOPHON

This document outlines the specifications for developing expansion boards for the Vivid Unit, a high-performance single-board computer (SBC) by Dun Cat B.V., marketed under the UUGear trade name. It serves as a reference guide for hardware developers aiming to create compatible expansions that seamlessly integrate with Vivid Unit's core capabilities.

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1. Introduction

1.1. Purpose of this specification

The purpose of this specification is to provide a comprehensive guideline for the design, development, and implementation of expansion boards for the Vivid Unit platform. This document outlines the technical requirements, design considerations, and recommended practices for creating compatible expansions that enhance the functionality and versatility of the Vivid Unit system.

By establishing a clear framework for both direct 40-pin expansions and those utilizing the Vivid Unit Extender, this specification aims to facilitate innovation while ensuring compatibility and reliability. It serves as a resource for developers, engineers, and hobbyists to create high-quality expansions that can seamlessly integrate with the Vivid Unit, promoting a collaborative ecosystem of hardware development.

This specification also emphasizes the importance of flexibility in design, allowing for diverse applications and functionalities without imposing unnecessary constraints, ultimately fostering a vibrant community of creators around the Vivid Unit platform.

1.2. Why follow this specification?

Following this specification is crucial for several reasons:

Compatibility: Adhering to the guidelines ensures that expansion boards are fully compatible with the Vivid Unit platform. This compatibility allows users to mix and match various expansions without facing connectivity or functionality issues, enhancing the overall user experience.

Standardization: This specification promotes a standardized approach to expansion board design, which simplifies development processes for manufacturers and hobbyists alike. A common framework reduces the learning curve for new developers and fosters consistency across products, making it easier for users to understand and utilize different expansions.

Quality Assurance: By following the recommended practices outlined in this document, developers can ensure a higher level of quality and reliability in their expansions. This reduces the likelihood of failures or malfunctions, which can lead to costly repairs or negative user experiences.

Easier Integration: Developers who adhere to this specification will find that their expansions can be integrated more easily into existing projects and systems. Clear guidelines for electrical and mechanical interfaces streamline the development process, allowing for quicker prototyping and deployment.

Community Support: By aligning with this specification, developers can tap into a growing community of users and creators who share knowledge, troubleshoot issues, and collaborate

on new projects. This collective support can significantly enhance development efforts and provide valuable resources for troubleshooting and innovation.

Future-Proofing: As the Vivid Unit platform evolves, this specification will serve as a living document that adapts to new technologies and user needs. Following it will help ensure that expansions remain relevant and functional in the face of future advancements, protecting the investment made in development.

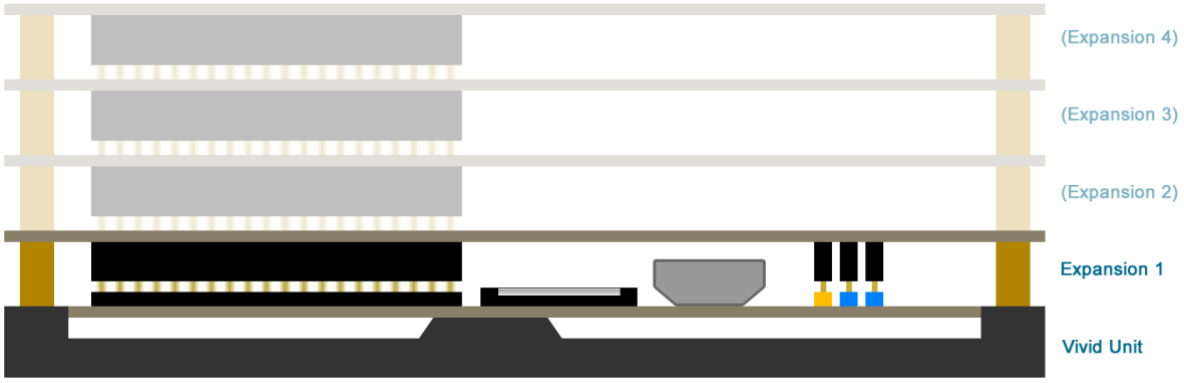
In summary, following this specification not only benefits individual developers by providing clear guidelines and resources but also strengthens the overall Vivid Unit ecosystem, paving the way for innovation and collaboration.

2. Two Different Expansion Methods

2.1. Stackable expansion using the 40-pin connector

The Vivid Unit features a Raspberry Pi-compatible 40-pin GPIO header, allowing you to stack one or more expansion boards on top of it.

This expansion method offers almost limitless flexibility, enabling you to combine multiple expansion boards to create a device tailored to your specific needs.



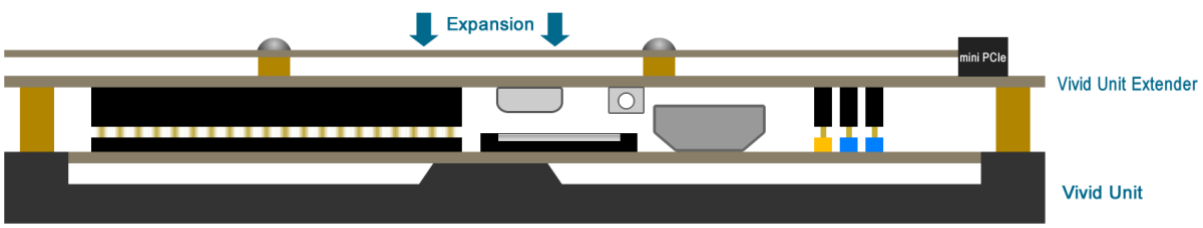
However, a potential drawback is that the final device may become quite thick due to the height of the stacking headers. Additionally, the stacking headers occupy a significant area near the edge, which may complicate or even prevent certain applications.

2.2. Expansion through the Vivid Unit Extender

The Vivid Unit Extender is a base expansion board designed to be mounted on the back of the Vivid Unit. It routes all 28 GPIOs from the GPIO header and several signal lines (including USB 2.0, ADC, Vol+, Vol-, Power Key etc.) from the Vivid Unit to its mini PCIe connector, allowing you to connect an additional expansion board to implement the desired functionality.

One of the standout features of the Vivid Unit Extender is that it comes with commonly required functionalities already built in, such as active and passive cooling, under-voltage and over-voltage protection, an RTC backup battery, and a watchdog timer. This allows the expansion board connected to the mini PCIe connector to focus solely on its specific functionality.

All GPIO resources and signal lines are accessible to the expansion board, resulting in a relatively low-profile final device (Vivid Unit + Vivid Unit Extender + expansion board).



However, a limitation of this setup is that you can only attach one expansion board to the Vivid Unit Extender.

2.3. Which method should you choose?

Each expansion method offers distinct advantages, so the choice depends on your specific project requirements.

If your project involves cumulative expansion—where you plan to stack multiple boards to add diverse functionalities—the stackable expansion using the 40-pin connector is likely the better option. This approach offers greater flexibility and allows you to customize and expand the system over time as your needs evolve.

However, if you have a clear idea of the specific functionality you need now and prefer a more streamlined, low-profile setup, the Vivid Unit Extender is an ideal choice. With essential features already built into the Extender (such as cooling, power protection, and an RTC backup battery), this method minimizes the effort required to create a fully functional and compact device without the need for additional layers.

3. Power States

A Vivid Unit device operates in the following power states:

3.1. OFF

No power supply is connected to the Vivid Unit, and the device is completely off.

3.2. POWERED

The device is connected to a power supply via either the USB-C connector, RJ45 connector (PoE), or the 40-pin connector. In this state, the system has not yet booted up, and the device draws around 10~12mA of current.

3.3. ACTIVE

The system on the Vivid Unit has booted up, making the device fully operational. If the system shuts down, the device returns to the POWERED state.

3.4. EXTENDER STANBY

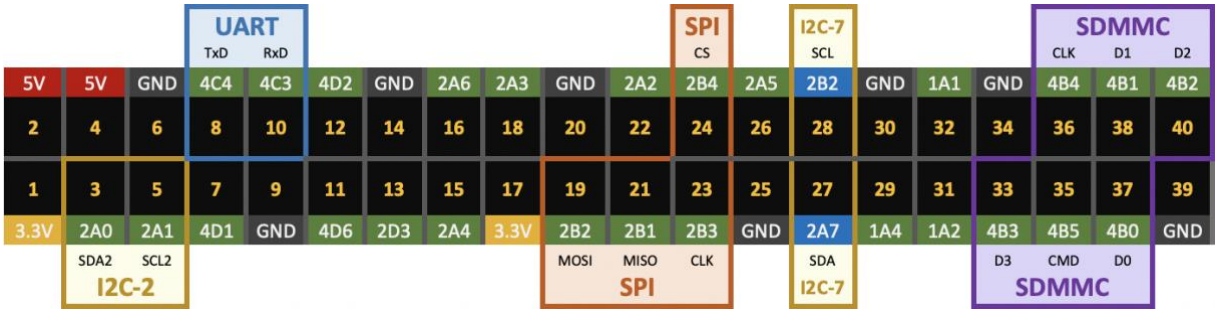
When a Vivid Unit Extender is mounted on the Vivid Unit, an additional USB-C power input and power button become available on the Extender, adding an extra layer of power management.

In this configuration, if the Vivid Unit system shuts down, the power supply to the Vivid Unit will also be disconnected, placing the device in the OFF state. The Extender, however, remains in the EXTENDER STANDBY state, drawing less than 1mA of current. Pressing the power button on the Extender will reconnect the power, booting the Vivid Unit and transitioning its state to POWERED, and then to ACTIVE.

4. Electrical Specifications

4.1. For expansions using the 40-pin (stackable) connector

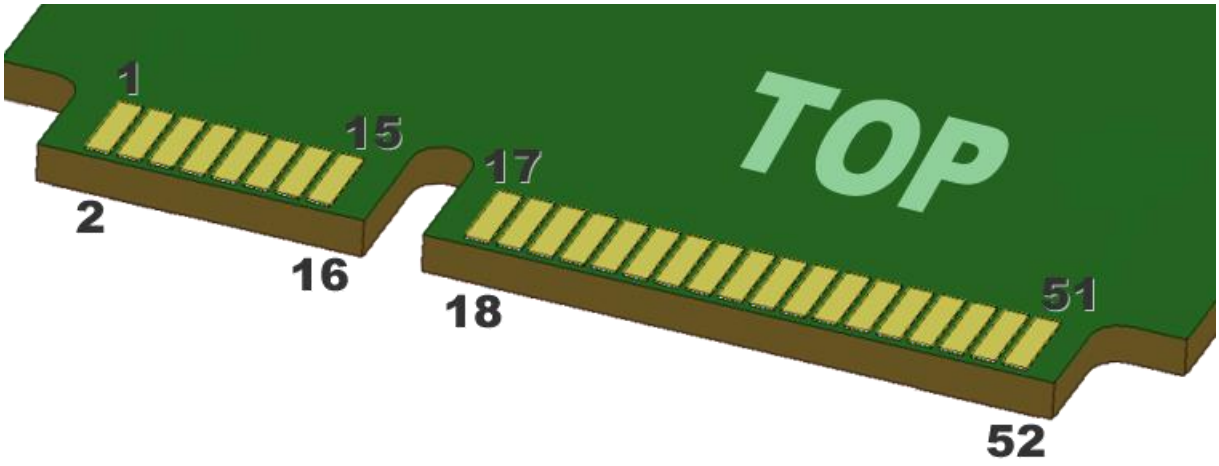
The 40-pin GPIO header on the Vivid Unit provides the following pinout (shown below). All pins operate at 3.3V, except for the designated 5V power pins. When using the 40-pin stackable connector for expansion, ensure that all pins are correctly wired.



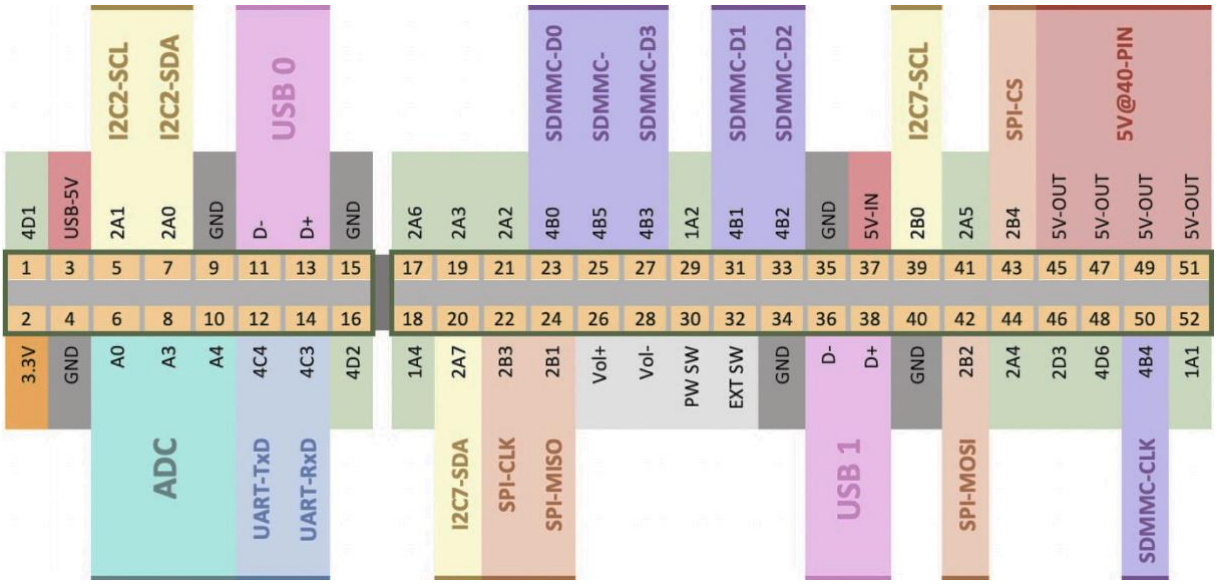
- **5V Pins:** These can either supply power to the expansion board or, if the expansion board acts as a power source, supply power to the Vivid Unit. If the expansion board provides power via the 5V pins, it should supply a minimum of 2.5A to support device requirements.
- **3.3V Pins:** These are strictly for input power to the expansion board, and any expansion board connected to these pins should not draw more than 500mA to avoid overloading.

4.2. For expansions through the Vivid Unit Extender

Expansions through the Vivid Unit Extender require the expansion board to be designed as a Mini-PCIe compatible board with a 1mm thickness.



The expansion board connects through 52 edge contacts, as shown in the pinout diagram below:



- **USB-5V Pin:** This pin connects to the V_{USB} pin in the USB 2.0 header, providing approximately 5V shortly after the system boots. It can serve as a signal to detect if the system is powered on, or as a delayed power source for the expansion board.
- **5V-IN Pin:** Connected to the extra USB-C power input or VIN pad on the Vivid Unit Extender, this pin provides an “always-on” 5V power source. The expansion board should limit its current draw from this pin to 500mA.

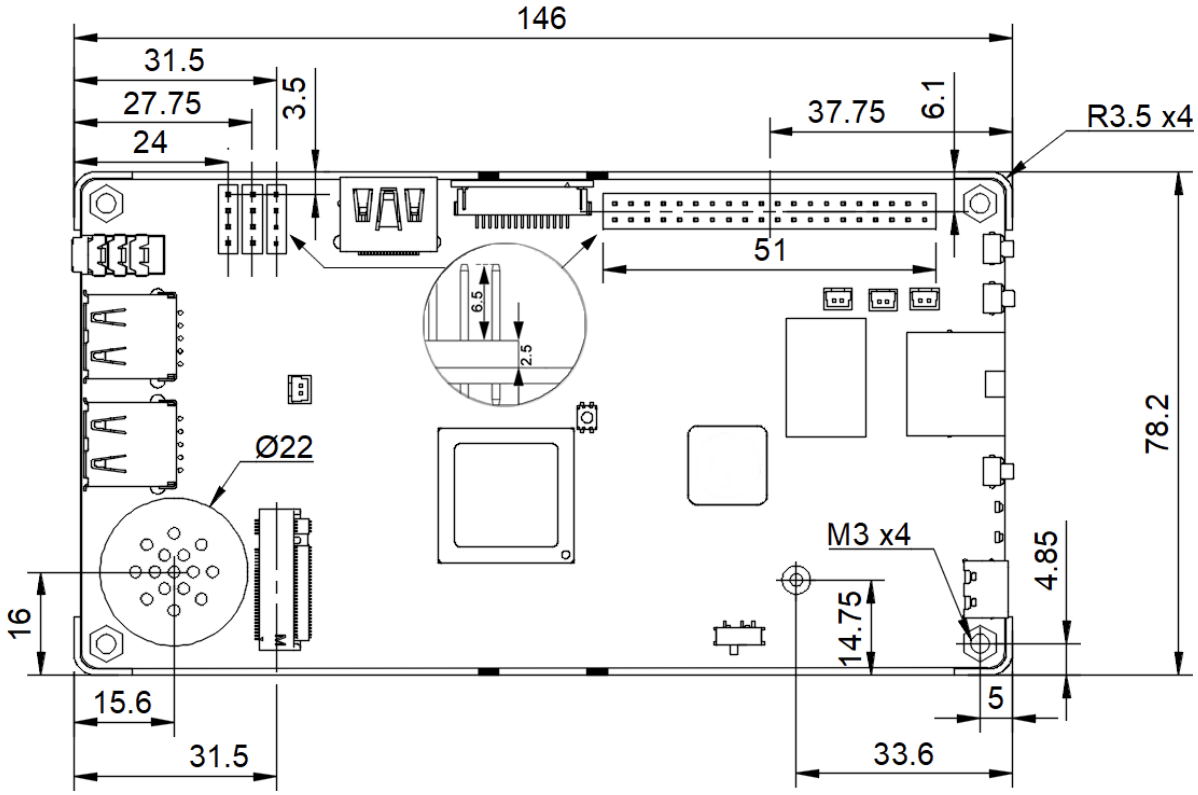
  Although the Vivid Unit Extender provides over-voltage and under-voltage protection for the Vivid Unit, it does not extend this protection to the extension board. If the extension board draws power from this pin, it is responsible for safeguarding itself against over-voltage, under-voltage, or reverse polarity, as these conditions may occur in real-world use.
- **3.3V Pin:** Connected to the 3.3V line from the 40-pin header, this pin serves as an input power source only. Current draw from this pin should also not exceed 500mA.
- **5V-OUT Pins:** These pins connect to the 5V line in the 40-pin header and can provide power input for the expansion board, or as power output to Vivid Unit. If the expansion board is a power source, it should supply a minimum of 2.5A through these pins to ensure sufficient power for the Vivid Unit.
- **ADC Pins:** The A0, A3, and A4 pins connect to the yellow 4-pin ADC header, providing 3 separate 10-bit ADC inputs. Each pin supports measurements up to 5V
- **Vol+ and Vol- Pins:** These pins connect to the "Vol+" and "Vol-" connectors on the Vivid Unit, allowing you to connect external push buttons for audio volume adjustment. Shorting the pin to GND simulates pressing the corresponding button.
- **PW SW Pin:** This pin connects to the "Power Key" connector on the Vivid Unit, enabling an external push button for turning the Vivid Unit on or off (when powered). Shorting this pin to GND simulates pressing the power key on the Vivid Unit.

- **EXT SW Pin:** This pin connects to the extra power button provided by the Vivid Unit Extender. Shorting this pin to GND simulates pressing the Extender's power button.
- **D- and D+ for USB0 and USB1:** These signal lines correspond to the USB 2.0 ports, accessible as pin headers on the Vivid Unit. Expansion boards using these lines should adhere to USB 2.0 design specifications. The D- and D+ pairs must be routed as 90-ohm differential pairs, with matched lengths.

5. Mechanical Specifications

5.1. For expansions using the 40-pin (stackable) connector

When designing an expansion that uses the 40-pin stackable connector, ensure that the pin header is positioned accurately to align with the Vivid Unit. If your expansion board also requires connections to the USB 2.0 header(s) or the ADC header, align these headers precisely as well. The drawing below illustrates the Vivid Unit's dimensions and the positions of critical connectors and components.



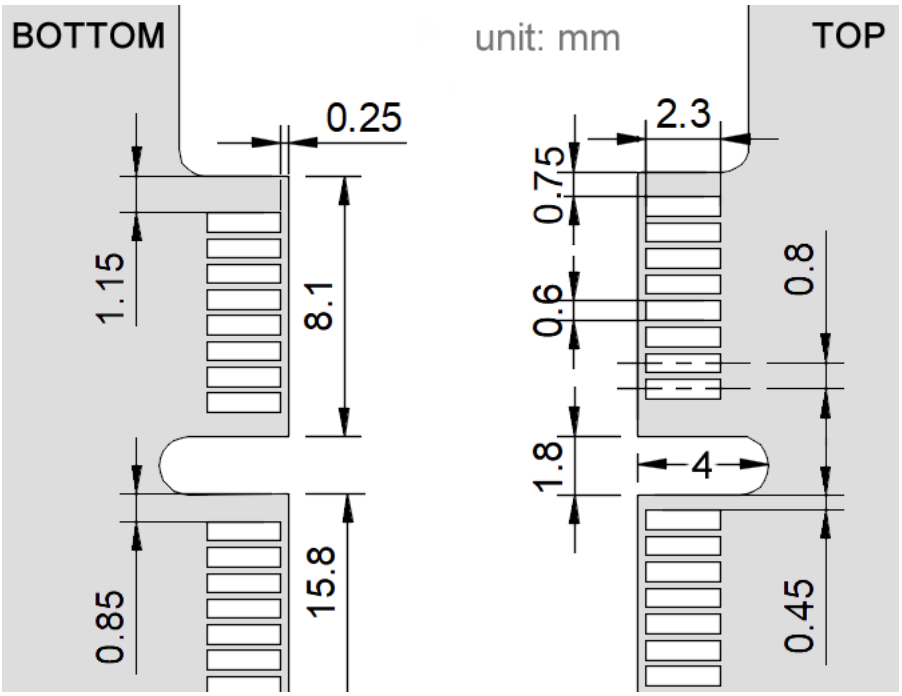
Your expansion board does not need to match the exact dimensions of the Vivid Unit; however, to secure installation, it should utilize at least one of the four mounting holes provided on the Vivid Unit.

Depending on your specific use case, consider the following design factors:

- Avoid fully covering the speaker located on the back of the Vivid Unit to maintain audio output quality.
- Reserve access to the NVMe SSD slot to facilitate easy installation and removal.

5.2. For expansions through the Vivid Unit Extender

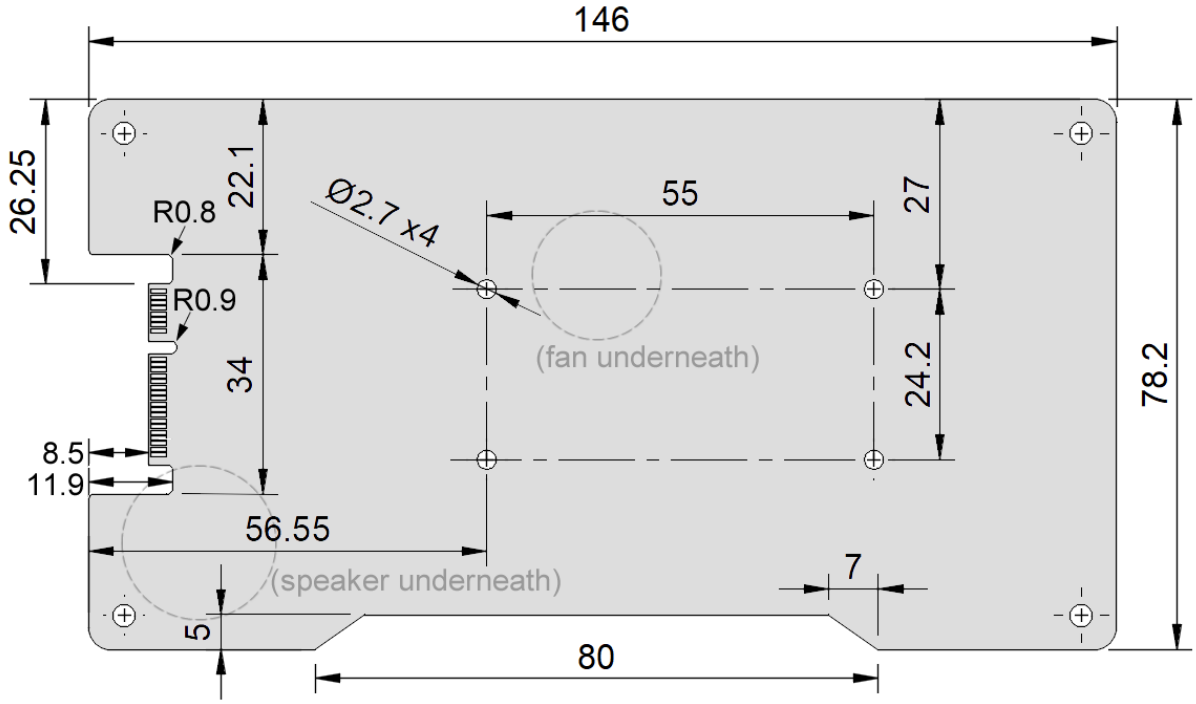
When expanding through the Vivid Unit Extender, design your expansion board as a Mini-PCIe compatible board with a thickness of 1mm. The drawing below provides dimensions for the connecting edge of the expansion board.



The Vivid Unit Extender includes four copper standoffs with M2 screw holes. For secure attachment, the expansion board should be mounted using at least one of these screw holes.

Beyond these specifications, the size of the expansion board is flexible; it can be either smaller or larger than the Vivid Unit's PCB. If your expansion board is larger, you may also consider using the mounting holes on the Vivid Unit itself to enhance mechanical stability.

Below is an example drawing of an expansion board with the same dimensions as the Vivid Unit and Extender. This illustration provides sufficient information to guide you in designing expansion boards of various sizes, from compact to larger configurations.



6. Revision History

Revision	Date	Description
1.00	2024.11.07	Initial revision
1.01	2024.11.11	Chapter 4.2: Additional description about protection for expansion board that draws power from 5V_IN pin in mini PCIe connector. Chapter 4.2: Add description for ADC pins.