Horizon Product Line MCU’s Board

H-PIC32 User's Guide

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Singular SOFTWARE

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1 Board Overview

The H-PIC32 MCU board is part of the Horizon product line. H-PIC32 is the main board with Microchip's PIC32MZ2048EHF MCU. The H-PIC32 features two USB-C ports, one Virtual COM port (Serial to USB) and a USB2 software configured as device/host, additionally on board are 32Mbit flash memory and SD card slot, four 40 pins connectors for accessing the remaining available MCU pins. The connectors accept any of the Horizon product line extensions(TBD). Users can design their own extenuation boards to create and customize their own applications. Figure 1-1 shows a photo of the H-PIC32 MCU board with key features highlighted.

Figure 1-1. H-PIC32 PIC32MZ2048PFE microcontroller

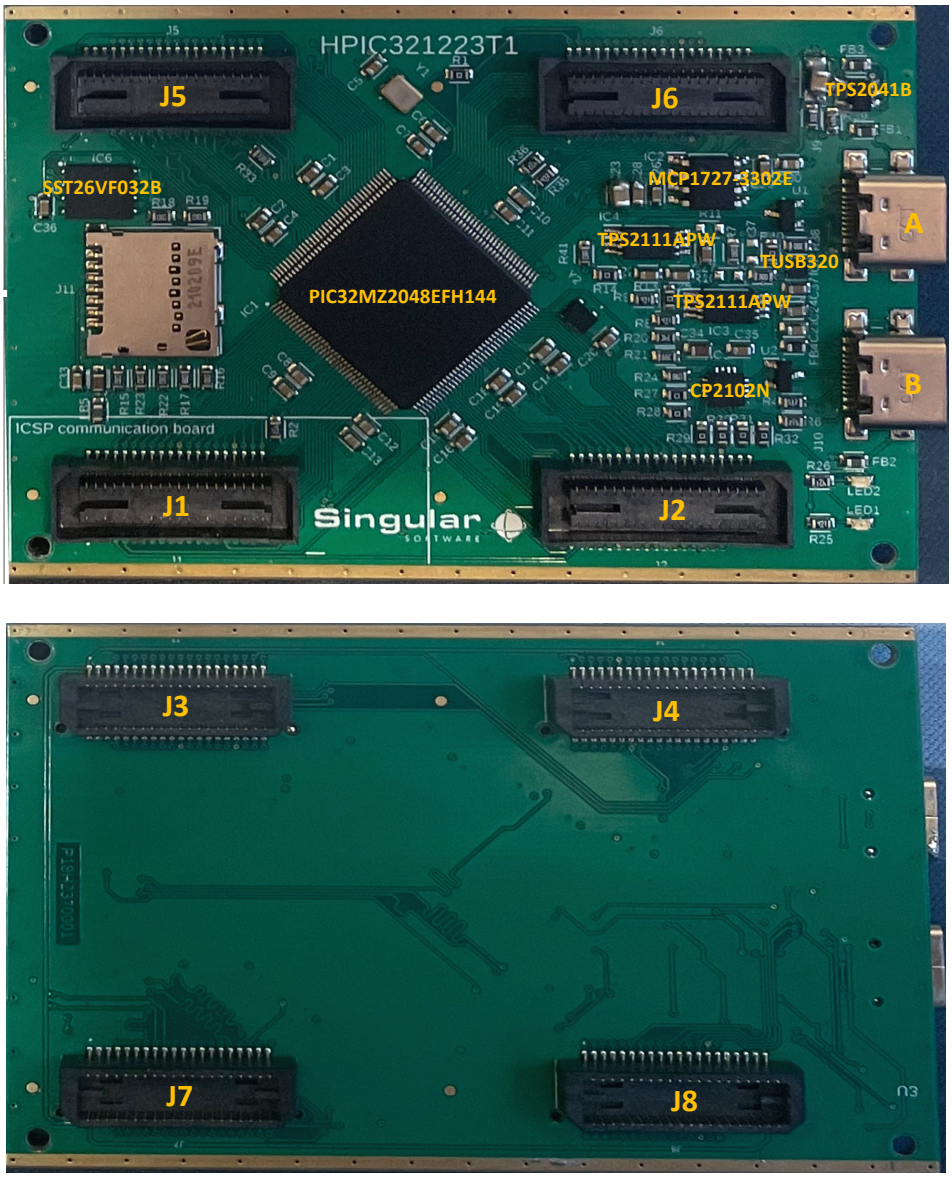


Figure 1 H-PIC32 PIC32MZ2048PFE MCU

1.1 Kit Contents

The Horizon MCU's board kit contains the following items:

- MCU's board (PIC32MZ2048EFH144).
- ICDI interface adapter.
- USB-C cable.
- Quick start guide.

1.2 Using the Horizon MCU's board

Follow the Quick start guide document. The Quick start guide helps you get started in minutes. Within just a few minutes you can run the demo firmware flashed on the board.

After running the demo firmware, you can proceed with development by:

- Add functionality with Horizon expansion boards(TBD). Adding WIFI, Ethernet, LCD and more. Or develop your own expansion boards.
- Developing your own applications with the help of demo applications available on https://github.com/singularsoftware/horizon.

1.3 Features

- Microchip PIC32MZ2048EFH144 MCU.
- Flash.
- SD card slot.
- USB-C connector host/device (USB A).
- USB-C connector – USB to serial (USB B).

1.4 Addon boards.

The H-PIC32 is ready to accept addon boards designed to extend the capability of the board with WIFI connectivity LAN connectivity LCD and more(TBD).

You can also build your own addon by following the design guidelines is this documented.

1.5 Specifications

- 5V Power supply from either USB connectors or external 5V using H-E5V board.
- Dimensions : 78.95mm X 50.0mm X 10.0mm (LxWxH)
- Max current available from USB: 0.5A

2 Hardware Description

The H_PIC32 includes a PIC32MZ2048EFH144 microcontroller. This Microchip PIC32 MCU has a wide range of peripherals that are made available to users via the on-board components and the board-to-board connectors. This chapter explains how those peripherals operate and interface to the microcontroller.

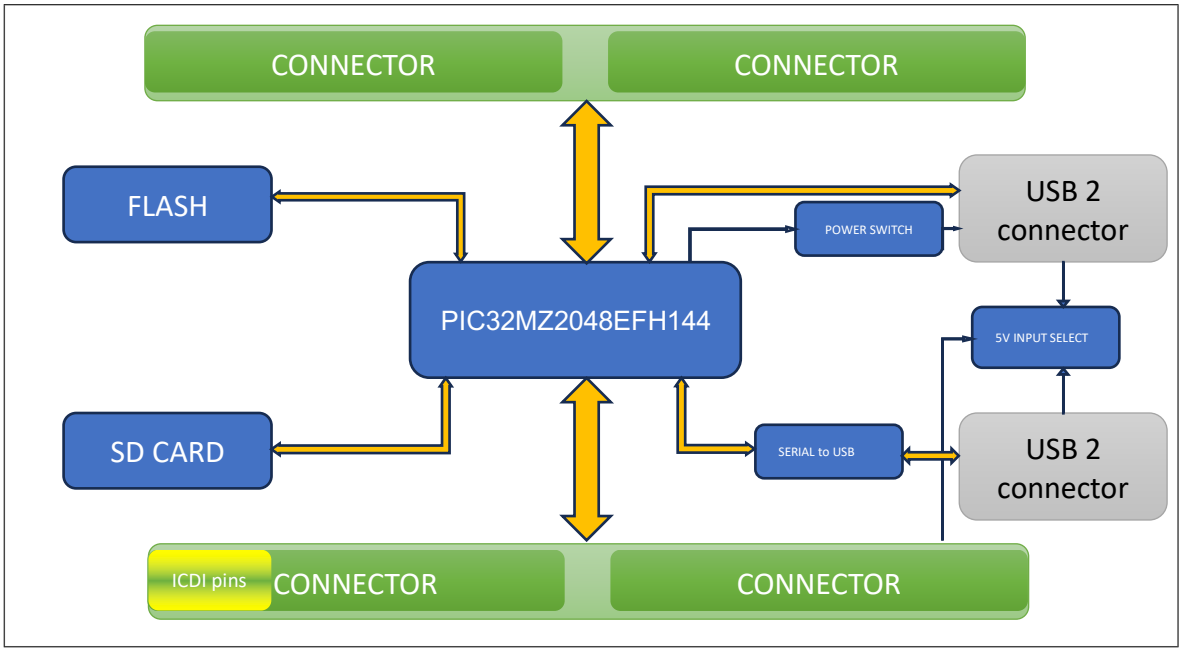


Figure 2 block diagram.

2.1 Microcontroller

The PIC32MZ2048EFH144 is a 32-bit MCUs with 2 MB Live-Update Flash and 512 KB SRAM, FPU, Audio and Graphics Interfaces, HS USB, Ethernet, and Advanced Analog. See the PIC32MZ2048EFH144 microcontroller data sheet for more details.

Most of the microcontroller's signals are routed to four board to board connectors. When adding external circuitry, consider the additional load on the board power rails.

The PIC32MZ2048EFH144 microcontroller is factory-programmed with a demo firmware. Unless the demo firmware has been replaced with a user program the demo firmware will run each time power is applied.

2.2 USB Connectivity

The PIC32MZ2048EFH144 processor's USB 2.0 interface is connected to a USB-C connector, the USB can be configured either as a USB 2.0 host or as a USB 2.0 device. On board USB management chip can be used to automatically identify the connected interface (HOST/Device). A power switch can be used to supply 5V to connected USB Device.

2.3 Serial to USB Connectivity

The second USB-C connector is a connection to UART6 of the PIC32MZ2048EFH144 processor using CP2102N a serial to USB chip, when connected to you PC it will show as virtual COM port. Please see the demo source code for an example how to use this feature.

2.4 Flash

The 32Mbit flash chip on board is Microchip's SST26VF032B. Please see the demo source code for an example how to use this feature.

2.5 SD CARD

Micro-SD card slot on board. Please see the demo source code for an example how to use this feature.

2.6 CONNECTORS

Most of the MCU pins can be accessed through the four connectors. Figures 6 and 7 show the MCU pins mapping to the connectors. (Note: top part number: BSE-020-01-F-D-A, bottom part number: BTE-020-01-L-D-A-K).

2.7 Power Management

The 5V power input is automatically selected from the three possible sources: USB-C A, USB-C B, and VBAT input (through the connector).

3 Software Development

3.1 Software Description

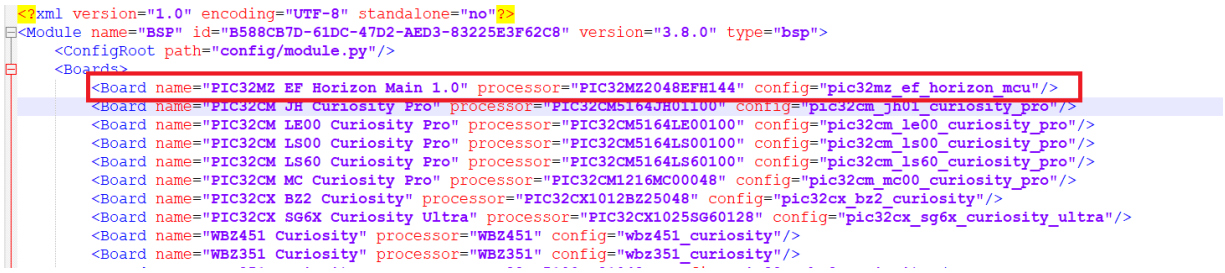
The board has the demo firmware already flashed on to it. Use the demo Windows application to explore the board features. For more information, please see the Windows demo application instruction file provided with the demo application.

3.2 Source Code

The complete source code can be download from https://github.com/singularsoftware/horizon.

The demo firmware was developed using Microchip's MPLAB-X IDE and Microchip's Harmony library. To configure Harmony with the Horizon board create new directory "pic32mz_ef_horizon_mcu" under "<Harmony3>\bsp\boards\" and copy "bsp.py" to it. Edit "<Harmony3>\bsp\boards\ module.xml" file add the horizon board:

<Board name="PIC32MZ EF Horizon Main 1.0" processor="PIC32MZ2048EFH144" config="pic32mz_ef_horizon_mcu"/>



3.3 Debugger

Use the supplied adapter to connect to the ICDI interface pins of the PIC32MZ2048EFH144.

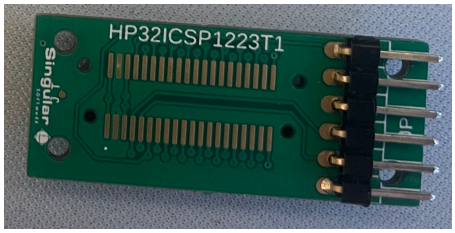


Figure 3 adapter.

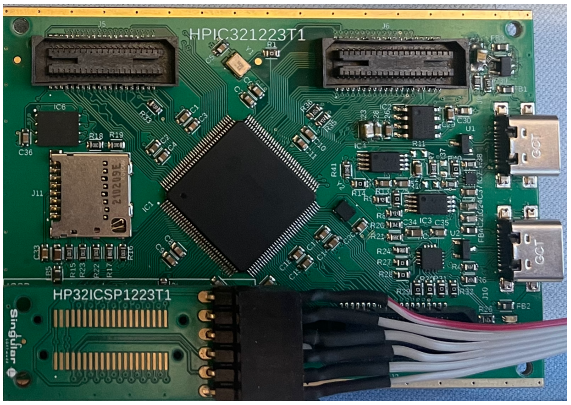


Figure 4 connection.

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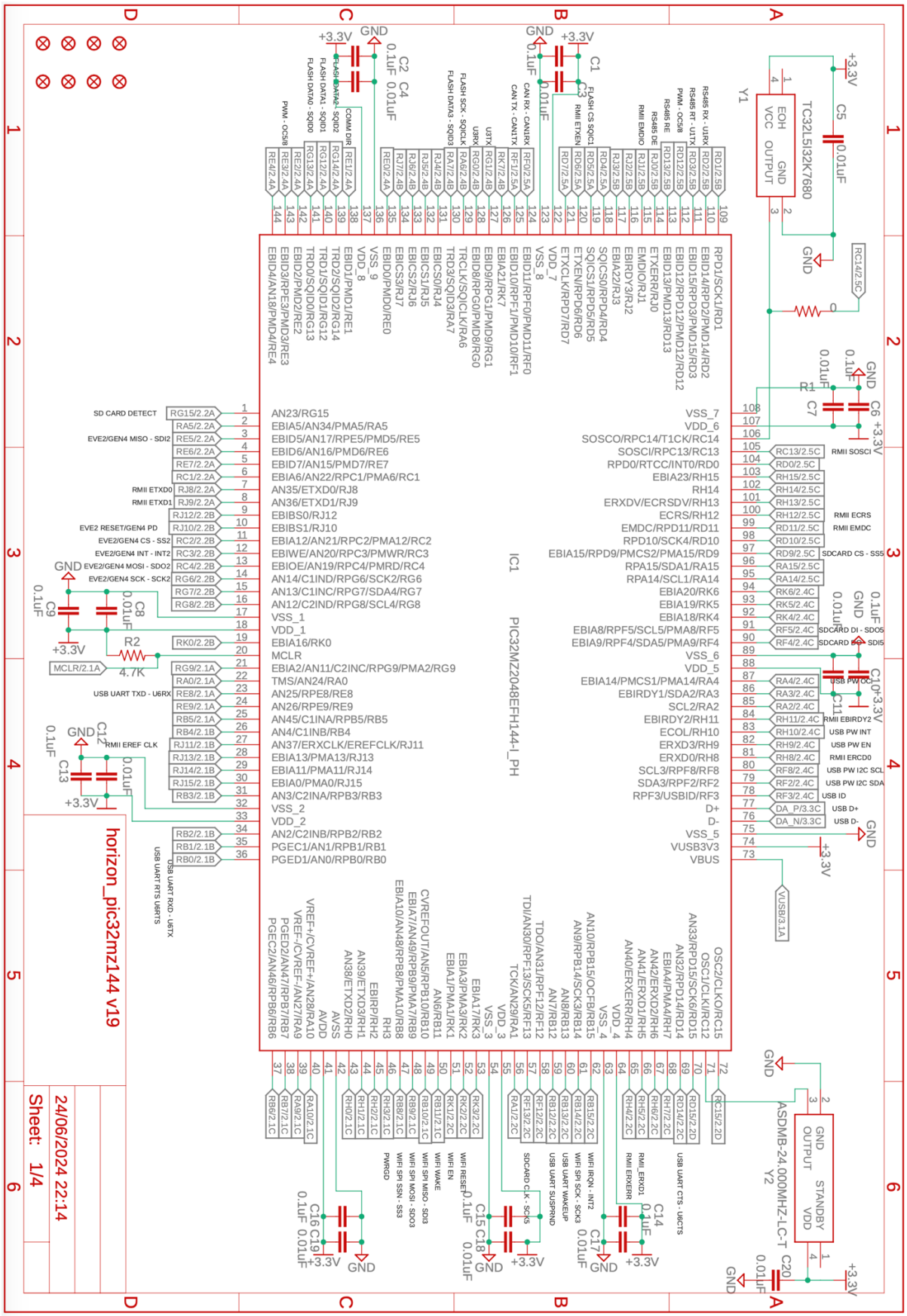
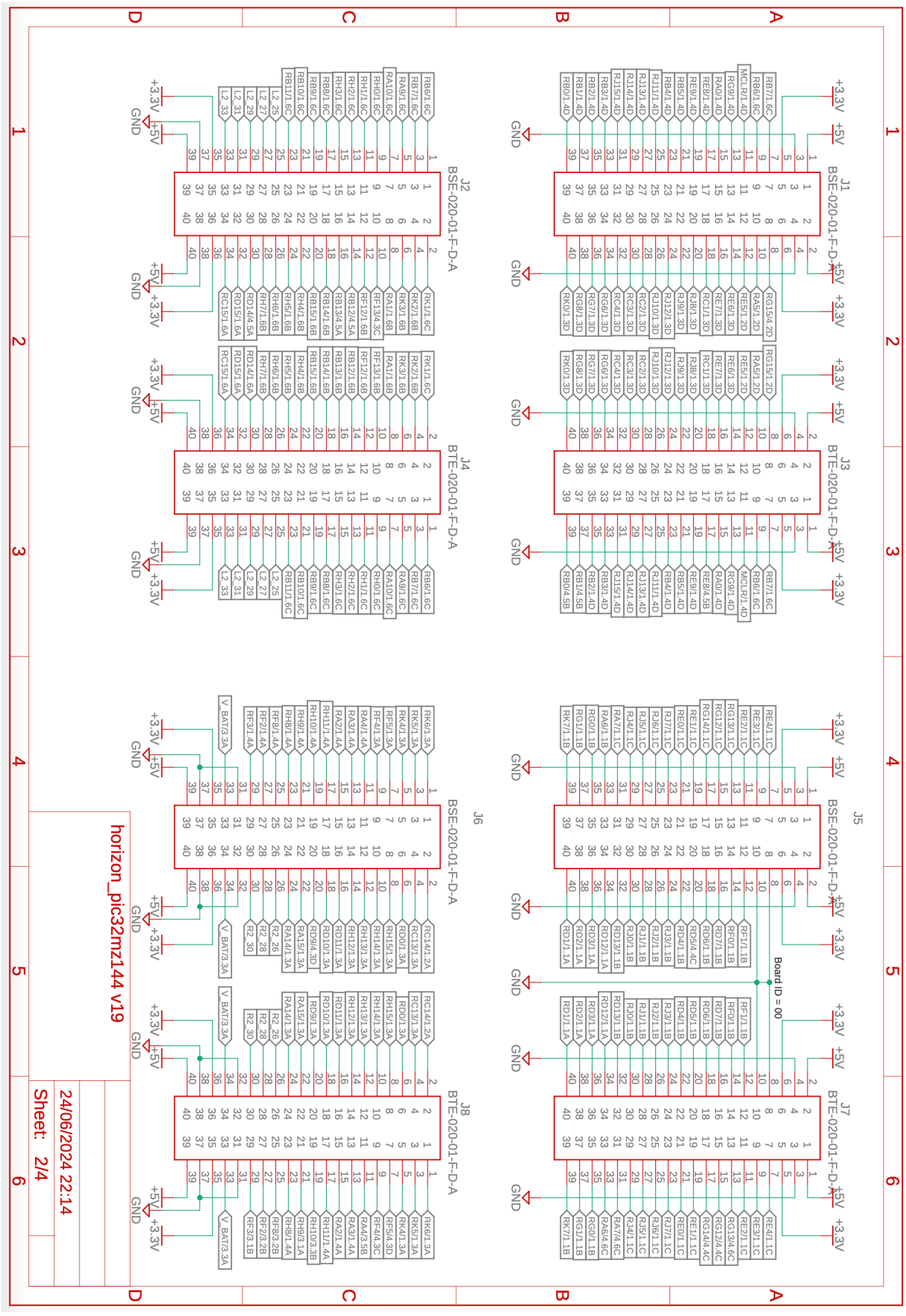
4 Schematics, and PCB Layout




horizon_pic32mz144 v19
24/06/2024 22:14
Sheet: 2/4
Board ID = 00
J1 BSE-020-01-F-D-A
J2 BSE-020-01-F-D-A
J3 BTE-020-01-F-D-A
J4 BTE-020-01-F-D-A
J5 BSE-020-01-F-D-A
J6 BSE-020-01-F-D-A
J7 BTE-020-01-F-D-A
J8 BTE-020-01-F-D-A

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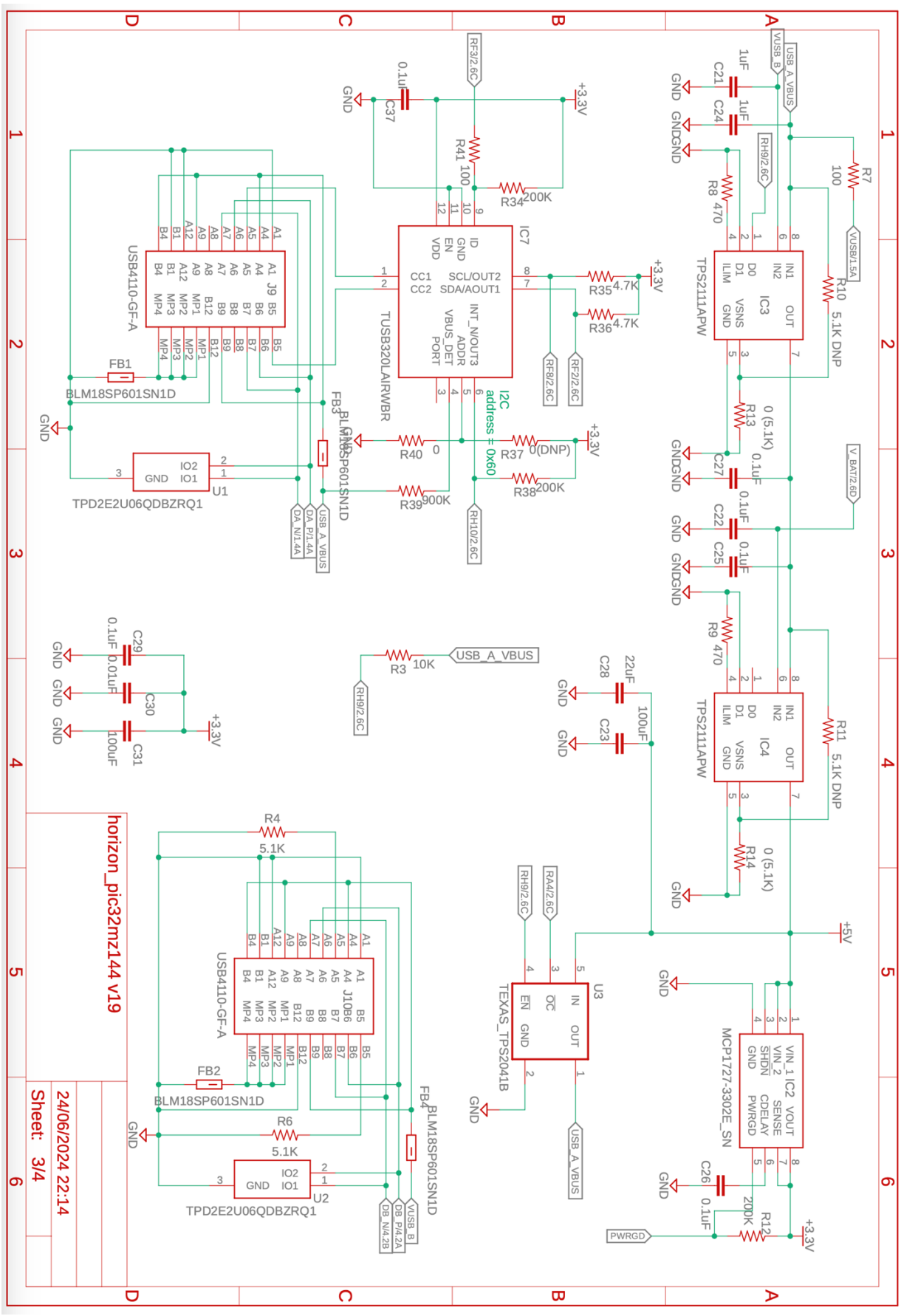
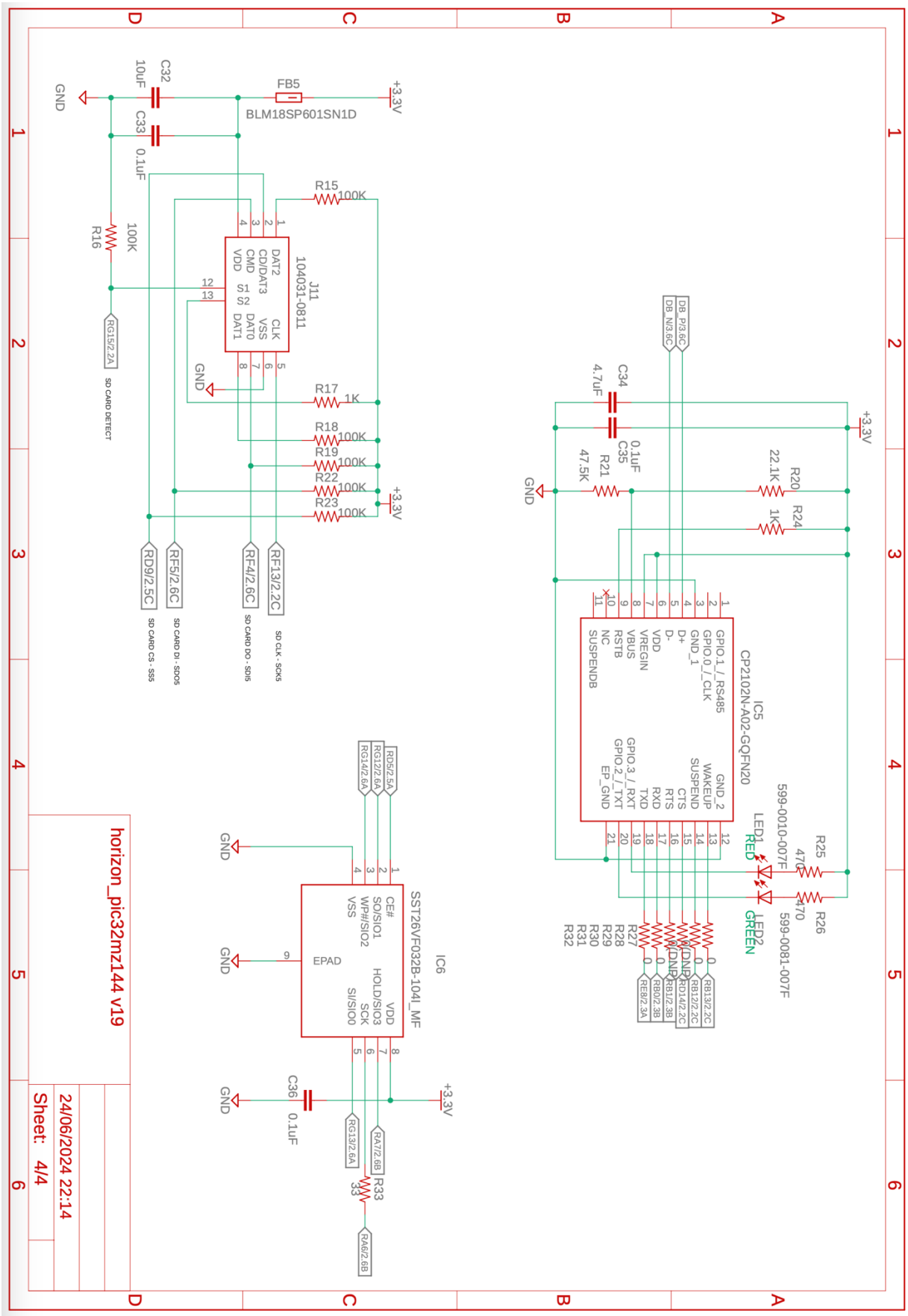



horizon_pic32mz144 v19
24/06/2024 22:14
Sheet: 4/4
IC5
CP2102N-A02-GQFN20
IC6
SST26VF032B-104I_MF
J11
104031-0811
FB5
BLM18SP601SN1D
LED1
RED
LED2
GREEN
599-0010-007F
599-0081-007F
SD CARD DETECT
SD CARD DI - SDO5
SD CARD CS - SS5
SD CARD DO - SDI5
SD CLK - SCK5

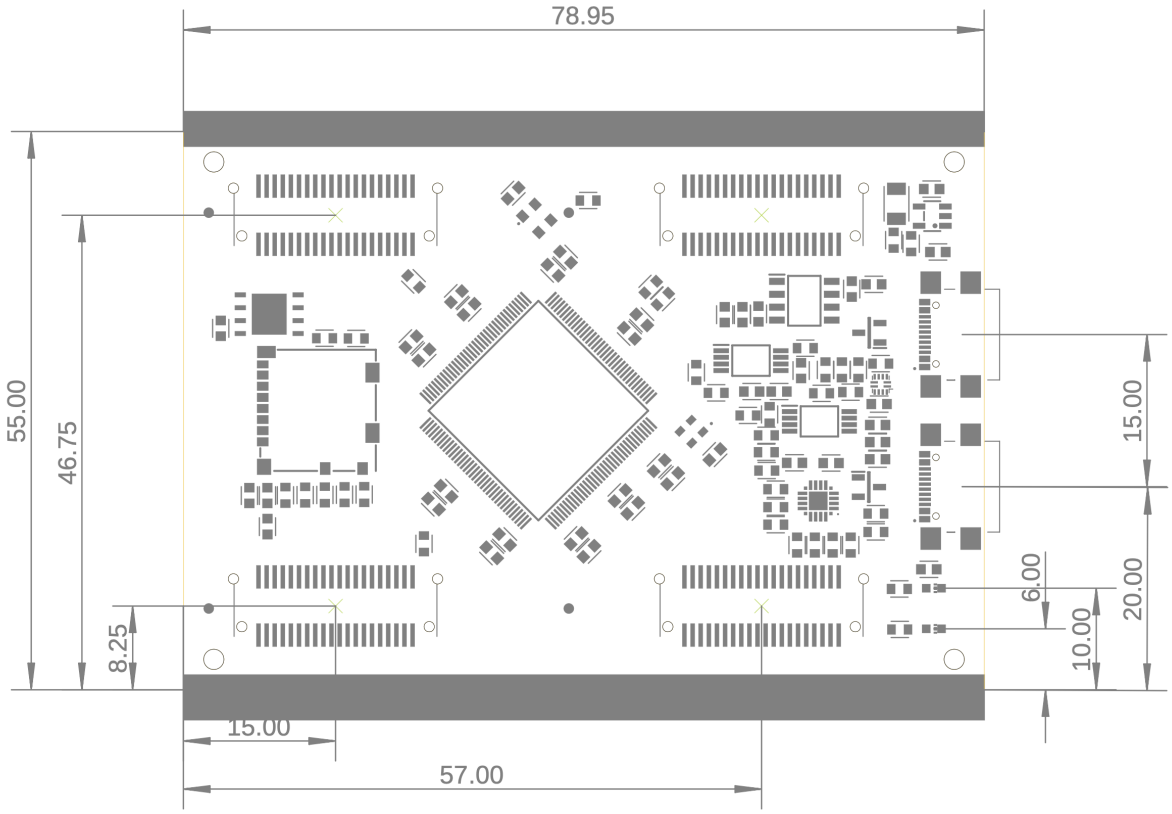


Figure 5 Dimensions.

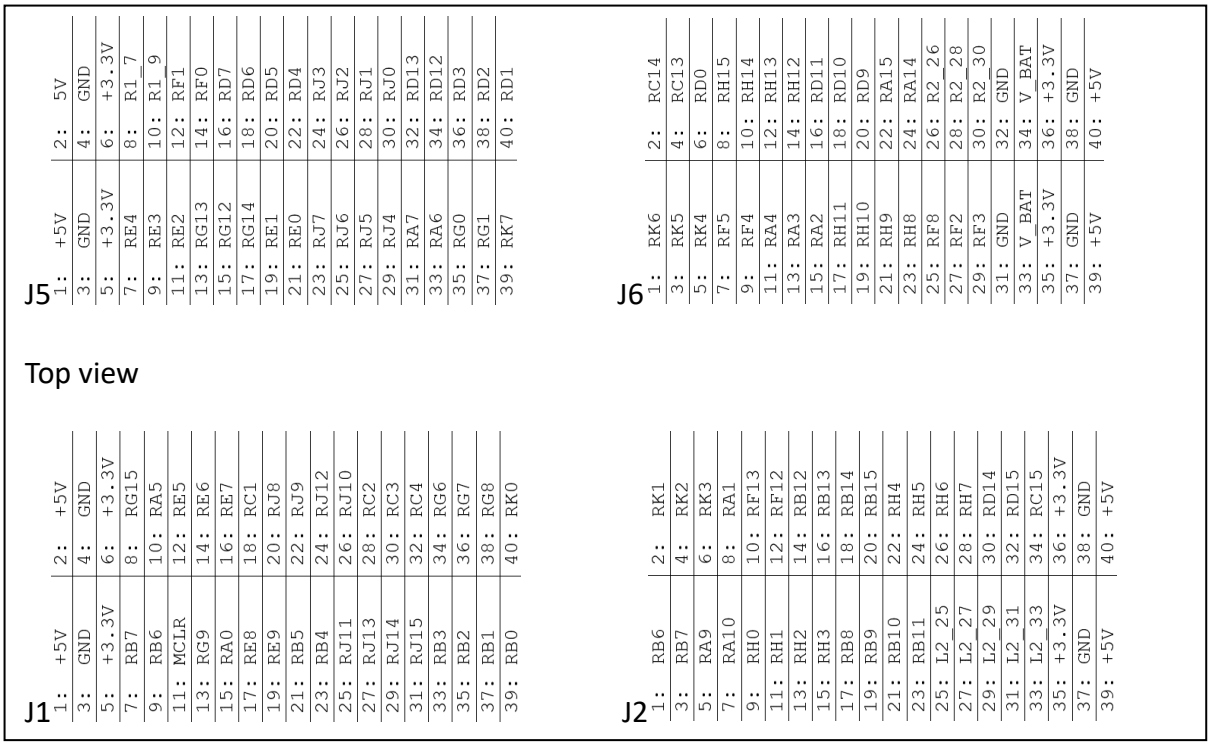


Figure 6 Connectors Top view.

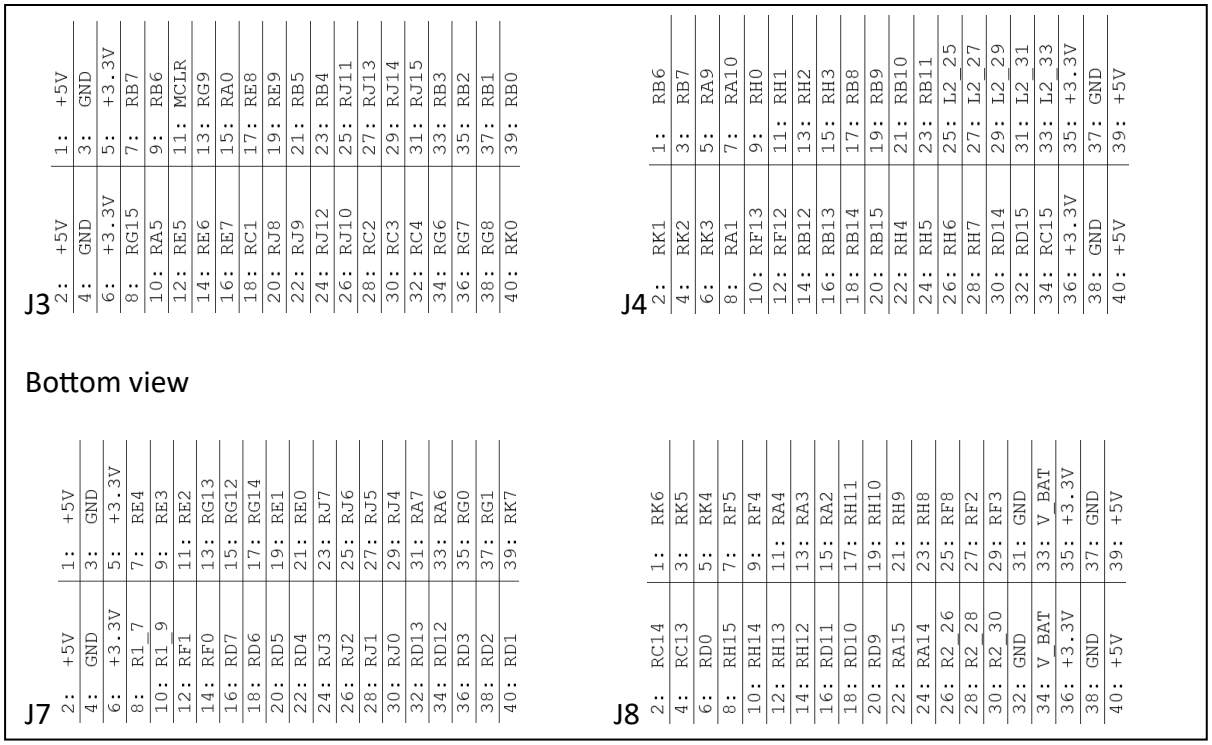
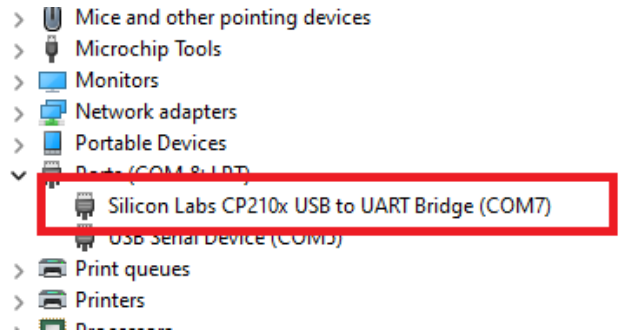


Figure 7 Connectors Bottom view.

5 Demo

5.1 Serial interface

When connecting the board USB-C B port to PC a virtual COM port will be added:



Open terminal on this port and type help to see the command available.

```
>help


------- Supported command groups ------

 *** flash: flash-SST26 commands ***
 *** sdcard: SD-Card commands ***

---------- Built in commands ----------

 *** reset: Reset host ***
 *** q: quit command processor ***
 *** help: help ***
>
```

```
>flash help

-e [address] [count]: Erase flash blocks.
-ea: Erase all blocks.
-w [address] [data]: Write test string to flash.
-wa: Fill flash with test data.
-r [address] [size] [toFile?]: Read  from flash.
-ra [toFile?]: Read all flash.
>
```

```
>sdcard help

-o [file name]: Open file(default=horizon.info).
-d [file name]: Delete file(default=horizon.info).
-n [file name]: Create new file(default=horizon.info).
-c: Close file.
-w: Write to file.
-r [count]: Read from file.
>
```

Command line reading flash:

```
>
>flash -r 0 256


Address: 00000000
4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00
B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 00
0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68
69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F
74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20
6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00
50 45 00 00 4C 01 03 00 A0 31 A0 CC 00 00 00 00
00 00 00 00 E0 00 22 00 0B 01 30 00 00 CC 00 00
00 1A 00 00 00 00 00 00 86 08 00 00 00 20 00 00
00 00 01 00 00 00 40 00 00 20 00 00 00 02 00 00
04 00 00 00 00 00 00 00 06 00 00 00 00 00 00 00
00 40 01 00 00 02 00 00 00 00 00 00 02 00 60 85
00 00 10 00 00 10 00 00 00 00 10 00 00 10 00 00
00 00 00 00 10 00 00 00 00 00 00 00 00 00 00 00


>
```

Command line erasing flash:

```
>
>flash -e 0 2

Erasing 2 blocks from 00000000
38

0

Erase successful.
>
```

Command line writing to flash:

```
>
>flash -w 100 "HORIZON"

Writing to address: 00000064
Write successful. 7
>
```

Command line reading from flash:

```
>
>flash -r 100 10


Address: 00000064
48 4F 52 49 5A 4F 4E FF FF FF
>
```

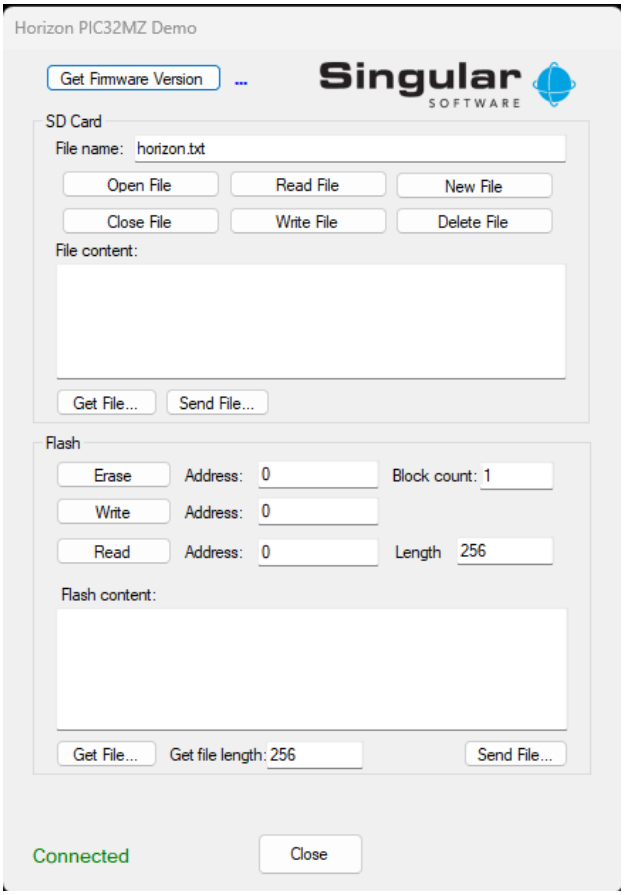
5.2 USB interface

5.2.1 HID device

The windows demo program communicates with the board over HID USB connection. Demonstrate the access to the on-board flash and SD card.

The demo software (executable and code) is available at https://github.com/singularsoftware/horizon.

Run the setup program, follow the on-screen instruction. The install program will create shortcut on your desktop. Use the included USB cable to connect the Horizon board to your pc then run the Horizon Demo program. When the demo program connects to the Horizon board the connected string is displayed.



Get Firmware Version:

- get on board firmware version.

SD Card actions:

To open a file that is already on the SD card enter the file name and click open file then read file to read count bytes from the file. The read bytes are displayed I the text box. To close the file, click close file.

You can create new file on the SD card and write to it (note: to read the content that was just written the file must be close and reopen) Use deletes file button to delete a file.
The program also demonstrates file transfer, use send file to send a file to the board SD card or get file button to transfer a file from the SD card to toy pc.

Open File:
- Open the “File Name” on the SD card.

Read File:
- Read from the previously open file (advancing file position pointer)

New File:
- Create new “File Name” file on the SD card.(if exists the file will be overwrite)

Close File:
- Close the current open file.

Write File:
- Write to the current open file. (advancing file position pointer)

Delete File:
- Delete the “File Name” file on the SD card.

Get File:
- Copy complete file on the SD card to the PC.

Send File:
- Copy complete file from PC to SD card.

Flash actions:

Erase:
- Erase “Block count” of 256 byte each starting at “Address”

Write:
- Write “Flash content” to flash starting at “Address”

Read:
- Read “Length” bytes from flash starting at "Address”

Get File:
- Copy flash content to a PC file starting “Read Address” with “Get file length”.

Send File:
- Copy complete file from PC to flash staring at “Write Address”.

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