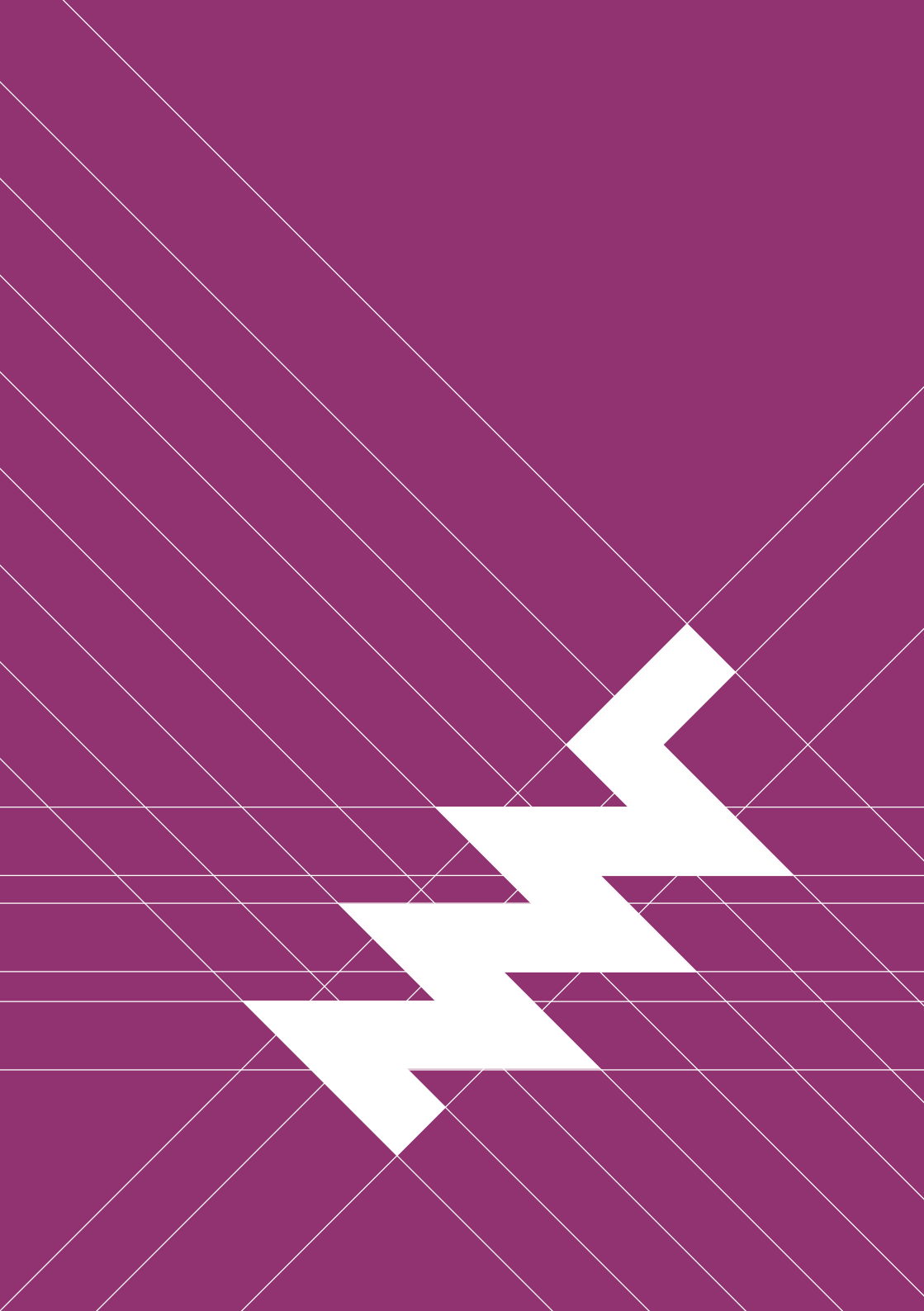

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Preface to the First Edition

It's quite something to get the chance to release not only one, but two open hardware laptops into the world. After two roller coaster years of development, we've finally started shipping MNT Pocket Reforms (not yet two weeks before I'm writing this preface, on a Pocket Reform, of course). Pocket Reform is a reaction to years of scrolling on glass, longing for physical buttons to press, looking for escape hatches from the digital gated communities of corporations. It is about the desire to have a small, yet unconstrained computer. In the words of El-P: "Let's boil it down to the simplest." This computer is in your hands against all odds, again (swimming upstream, MNT Reform was already improbable). There are three groups who made this happen: on the one hand, my small but relentless team of people who always did their best, and did not give up until it was finished. On the other hand, you, the owners of and contributors to MNT (Pocket) Reforms, who we have to thank for your endless support. And on the third hand, Crowd Supply, for believing in us and trusting that we'll actually deliver.

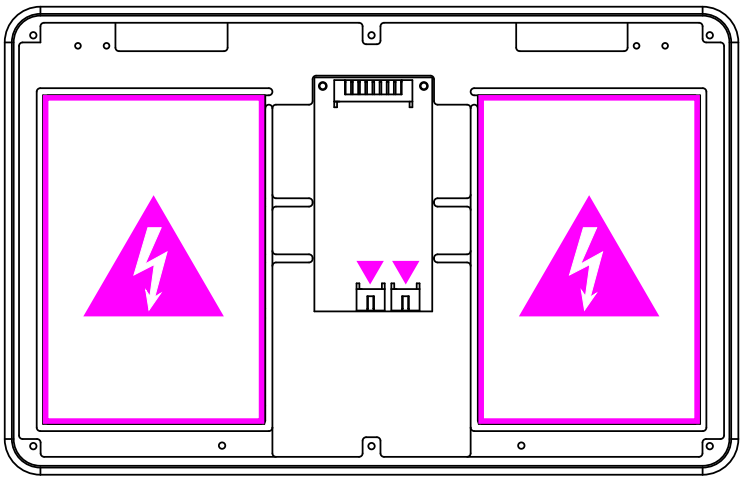
But enough of the sentimentalities—enjoy this computer, take it to places, take it apart, connect, customize, hack, and most importantly, have fun.

—Lukas "minute" Hartmann, Berlin, 2024-05-31

Chapter 1

Safety & Recycling

1.1 Hazards



Before you get started with your MNT Pocket Reform, please read these safety instructions carefully to prevent harm to yourself and your environment.

Electrical Shock and Fire Hazard: Please be extra careful while and after opening the case of the device. MNT Pocket Reform uses 2 Li-ion pouches. Do not touch anything connected to the batteries or the charger board with metal tools. Refer to the Hardware chapter for instructions on how to replace the batteries safely.

Pinch Point Hazard: The case closes with strong magnets and the top half has sharp edges. Hazard of fingers pinching! Keep out of reach of children!

Before servicing anything on the inside, make sure that the wall power is unplugged and remove the battery cells.

Damage to Hearing: The headphone output of MNT Pocket Reform can be forced to extreme volume which may damage your hearing if you are not careful. Please make sure to set the volume to 30% or less before connecting headphones to MNT Pocket Reform, and then adjust the volume to a comfortable level.

1.2 Recycling

Don’t throw any MNT Pocket Reform parts in the trash! Batteries and electronics contain materials that are harmful to the environment if not properly disposed of.

You can mail any of the parts back to MNT Research, and we will recycle them for you. Alternatively, you can recycle batteries at a local battery collection facility and dispose of electronics and cables at a local e-waste facility.

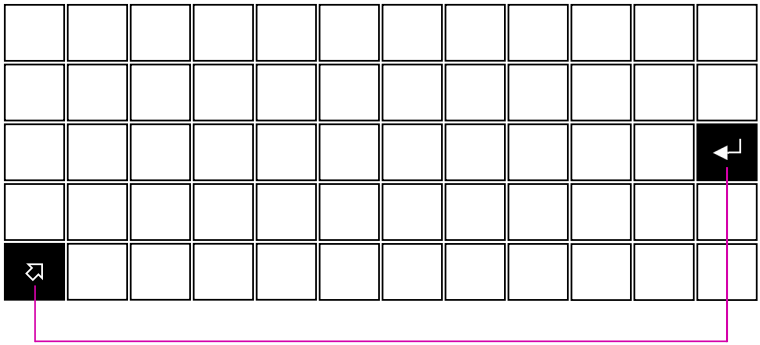
Chapter 2

Quick Start

2.1 Step 1: Standby Power Switch

The batteries are connected by default. There is a small Standby Power Switch located on the left hand side of the upper case part. Turn it on using a pointed object such as a SIM card ejector.

2.2 Step 2: Turn On



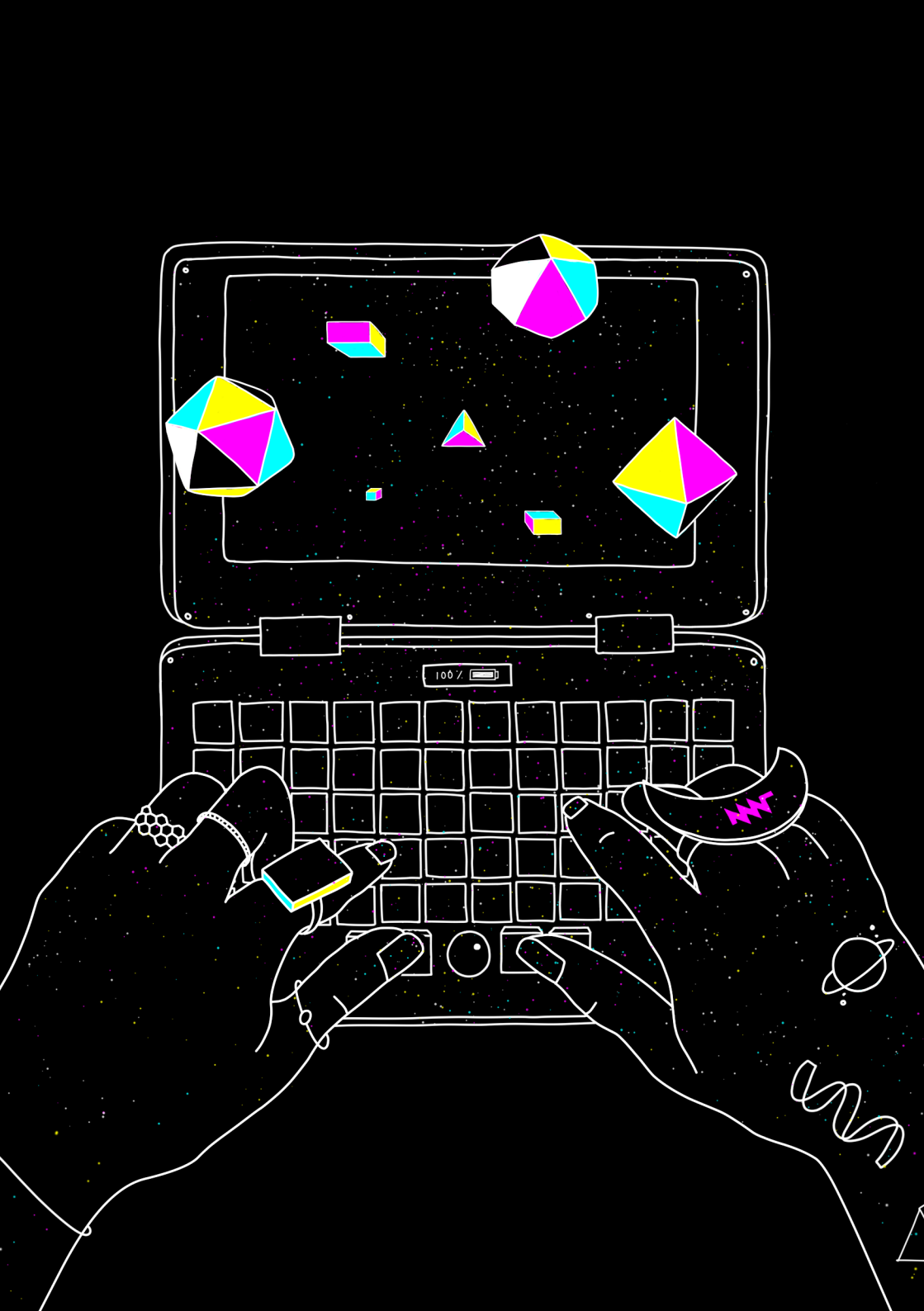
Hold HYPER + ENTER for more than 2 seconds.

To turn on Pocket Reform, hold *Hyper* + *Enter* for more than 2 seconds.

2.3 Step 3: Log In

After being powered on, the main processor will boot the operating system installed on the built-in eMMC flash. The operating system's kernel will show diagnostic information as it activates all the devices in the system until finally arriving at the login prompt. On first boot, the Setup Wizard will walk you through the configuration process. You'll select your keyboard layout and your time zone, choose a desktop environment, and finally, create a user account. Once everything is set up, you can start installing software and using MNT Pocket Reform. If you are new to the Debian GNU/Linux operating system or want to learn about specifics of the system software shipped with MNT Pocket Reform, please refer to the chapters "Linux Console Basics", "Graphical Desktops", and "Software".

The following chapter will introduce you to the input devices of MNT Pocket Reform.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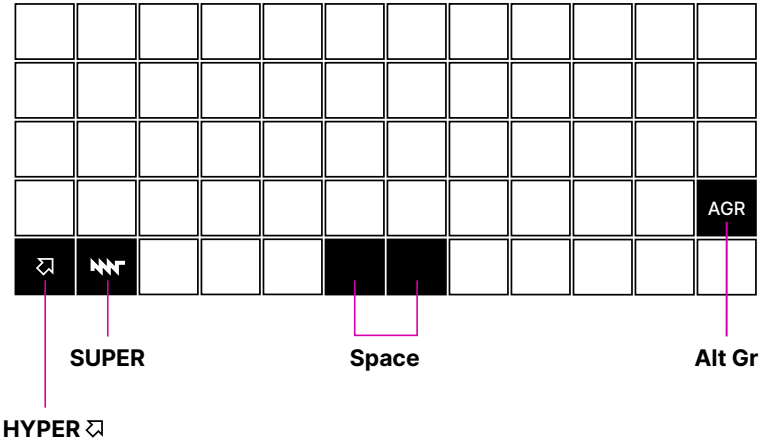
Chapter 3

Input Devices

MNT Pocket Reform comes with a keyboard and a trackball preinstalled.

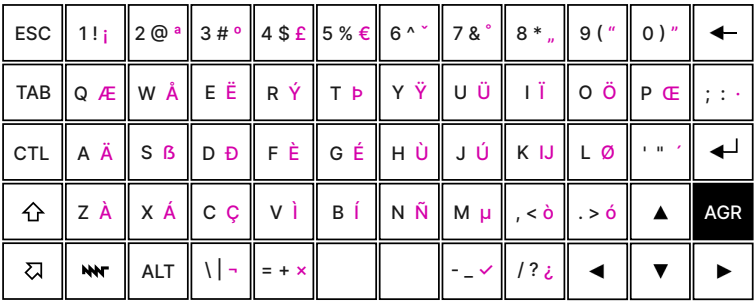
3.1 Keyboard



Pocket Reform has a mechanical ortholinear[1] keyboard with 60 keys.

Because many advanced users remap the traditional Caps Lock key to a different function, we swapped Caps Lock for a CTRL key. This makes the use of CTRL key combinations more ergonomic.

Another handy key is the *AGR* key, short for "Alternate Graphic [Alt Gr]". Holding this key and a key of your choice gives you the option to create international characters such as Umlauts and other special characters. If you are a non-English native speaker, we recommend the so-called "EurKEY"[2] keyboard layout. This layout is based on the QWERTY-US layout and can be activated in your keyboard settings. See the graphic below for characters that can be created on Pocket Reform holding the *AGR* key and the corresponding key:



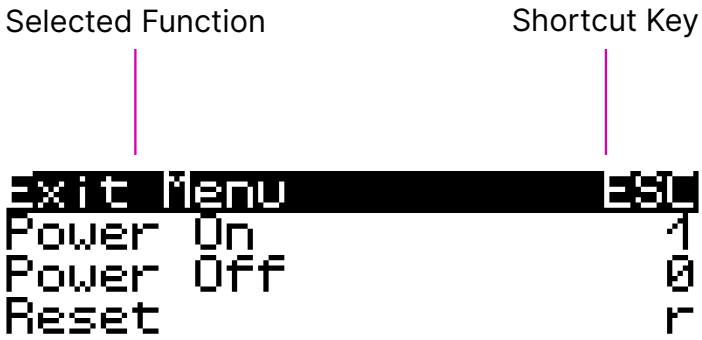
Lastly, MNT Pocket Reform features an additional modifier key, the *HYPER* key, in the lower left. *HYPER* provides an additional layer of key combinations. Here is the list of shortcuts you can use with *HYPER*:

Shortcut	Function
HYPER+ENTER (hold)	Turn on Pocket Reform
HYPER+ENTER (press)	Turn on OLED Menu

[1] Ortholinear means that all keys are aligned in a perfect grid.
[2] Created by Steffen Brüntjen.

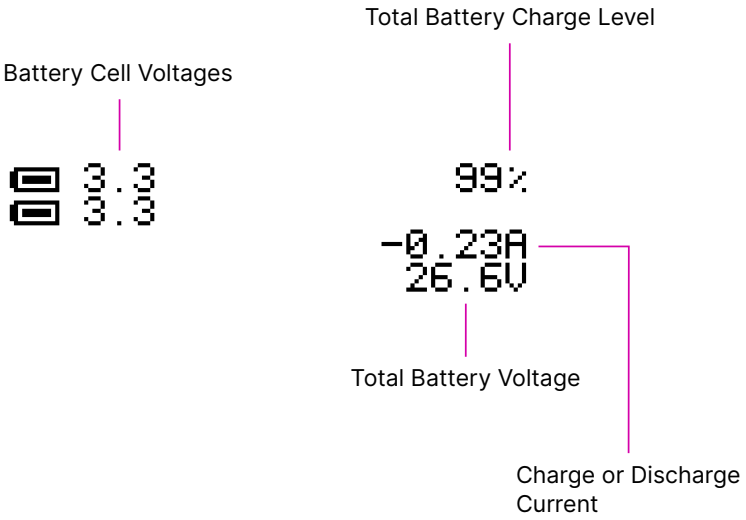
Shortcut	Function
HYPER+1	F1
HYPER+2	F2
HYPER+3	F3
HYPER+4	F4
HYPER+5	F5
HYPER+6	F6
HYPER+7	F7
HYPER+8	F8
HYPER+9	F9
HYPER+10	F10
HYPER+Q	F11
HYPER+W	F12
HYPER+←	Home
HYPER+→	End
HYPER+↑	Page Up
HYPER+↓	Page Down
HYPER+O	[
HYPER+P	]
HYPER+SHIFT+O	{
HYPER+SHIFT+P	}
HYPER+SHIFT+ESC	~
HYPER+ESC	‘

3.2 OLED Menu

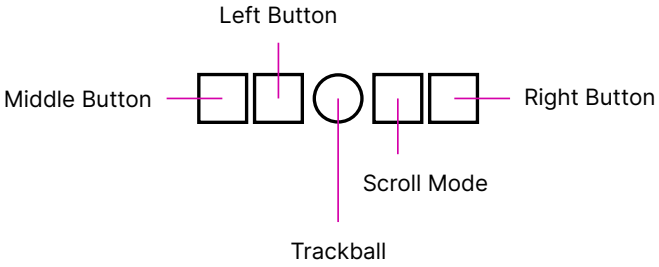


The keyboard has a built-in OLED display for interaction with the System Controller on the motherboard. You can highlight an option and scroll through the menu by using the ↑ and ↓ keys. To trigger the highlighted option, press *ENTER*. Alternatively, you can press the shortcut key that is displayed on the right hand side of each menu option. For example, to show the Battery Status, press *B* when the menu is active. To leave the menu, press *ESC*.

You can see detailed battery information including the estimated total charge percentage on the Battery Status screen reachable through the OLED menu. Each cell icon corresponds to one of the two battery cells. The upper icon represents the battery pack on the left side of the device, and the lower icon represents the battery pack on the right—assuming you look at MNT Pocket Reform when flipped on its back and the batteries closest to you.

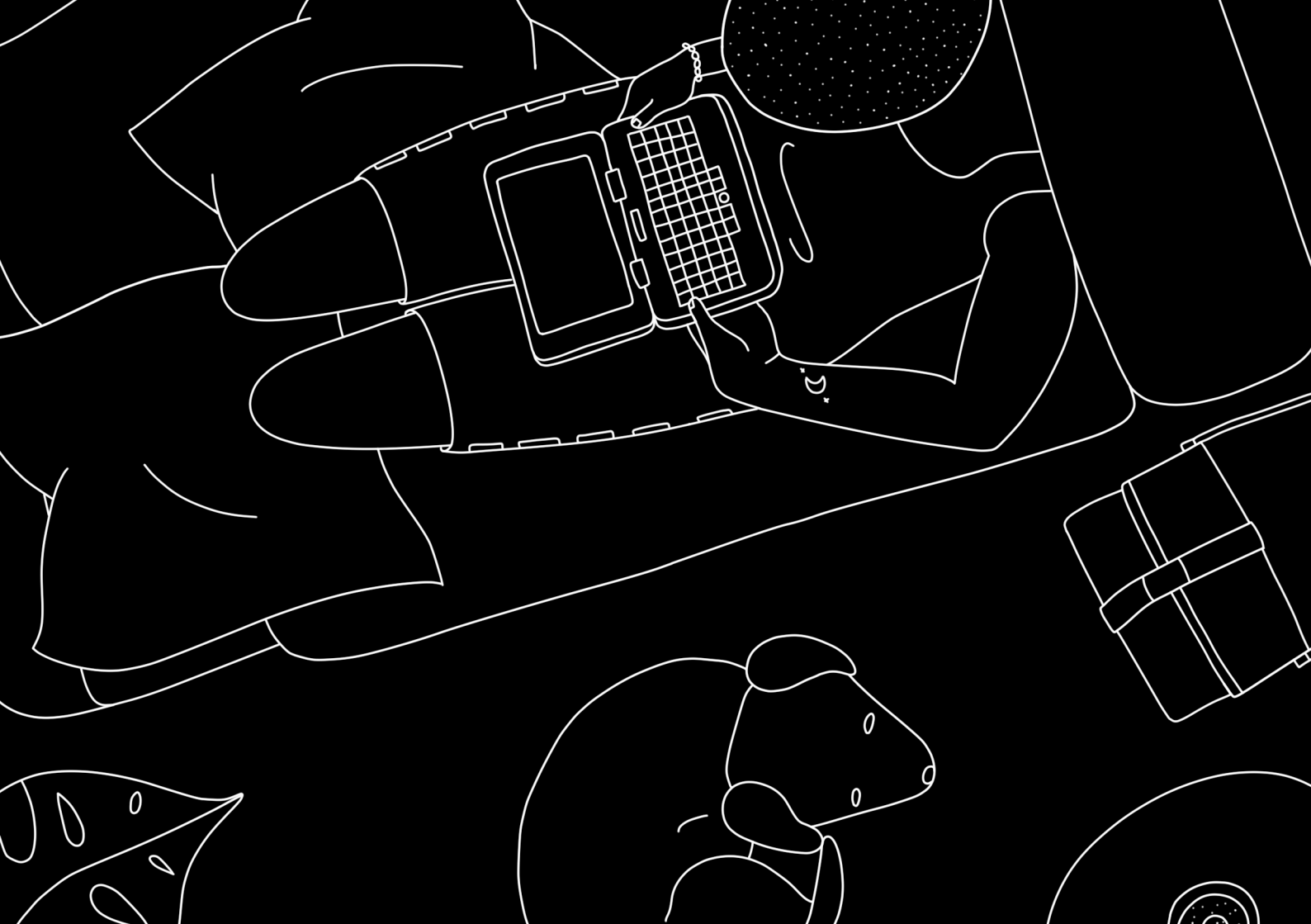


3.3 Trackball



The trackball works like a mouse with four buttons: middle button, left click, scroll button, and right click. Roll the ball to move the cursor. Pressing the *Middle Button* and the *Scroll Mode* button simultaneously activates *Sticky Scroll Mode*, so

that you can scroll through a longer text without needing to hold down a button.



Chapter 4

Linux Console Basics

4.1 Console and Shell

MNT Pocket Reform ships with a lightly customized Debian GNU/Linux distribution on the integrated eMMC flash.

From here, you can reach a graphical desktop or the Linux console. If something goes wrong, you can always go back to the console and fix things—if you know a few basics of Linux administration. To reach the console from the login screen, you can use the key combination *ALT+F1*, or *ALT+F2* to go to the second console, etc.

After logging in on the console, you are in control of a shell. The default shell is called `bash`[1], but there are many other shells available. You can use the shell to type in commands for your computer to execute, but also to write programs (scripts) that combine commands to do more complex tasks. For example, this handbook is generated by a `bash` script combining a few text and graphics related tools.

This chapter will introduce you to the basics of exploring and administering your MNT Pocket Reform system using the

[1] The "GNU Bourne-Again Shell".

shell first and then a graphical desktop. You can also launch shells on the desktop to use tools that don't have a graphical user interface. Using these tools, you can troubleshoot some problems with the operating system by yourself.

4.2 Root User

The most powerful user in the system is `root`. When logged in as `root`, you can modify but also destroy any file in the system. To prevent others from logging in as `root`, you should protect the account with a password (the Setup Wizard asks you to do this). In the shell, you execute all commands by typing them in and pressing *ENTER*. To set your password, execute this command:

```
passwd
```

The `passwd` command will ask you for a new password two times, but will not display it while typing (so it cannot be gleaned by onlookers).

During normal Linux usage you will rarely want to be `root`—only when performing changes to the system configuration, which includes adding or removing users or software and controlling background services. Instead, you should create a less privileged user account for yourself.

4.3 Create a New User and Password

You have created a user in the Setup Wizard after powering on your MNT Pocket Reform for the first time. In order to add another user account to the system, log in as `root` and execute the `adduser` command:

```
adduser kim
```

This will create a new user named `kim`, and add a new home directory for `kim` at `/home/kim`. The `adduser` command will ask

you for a password and a few questions that you can skip by just pressing *ENTER*.

If you want to change the password for the user `kim` later, you can use the `passwd` command as before:

```
passwd kim
```

4.4 Logging In and Out

You can log out of the console or a terminal window by pressing *CTRL+D*. Alternatively, you can type `exit` in the terminal.

When logged out, you will see the login prompt. Type the username that you added in the previous step and press *ENTER*. Next, type your password (it is not displayed). Press *ENTER* to complete the login.

4.5 Sudo

To make bigger changes to the system you will often need to use a command that requires `root` (superuser) privileges. Logging out of your user account just to log back in as `root` is inconvenient. Instead, you can temporarily become `root` by either switching to it as `su` (switch user) or give your regular user account `sudo` privileges[2].

Sudo allows you to use a command as `root` by typing `sudo command`—but only if you are a member of the `sudo` group. To add your user to the `sudo` group, first log out and login as `root`. Then you can execute the following command:

```
usermod -a -G sudo kim
```

(Substitute your username for `kim` here).

[2] `sudo` means “switch user and do”.

The `-a` flag means "Append the user to the group", while the `-G` option specifies the name of the group you want to add the user to: `sudo`.

Log out and login as your regular user again. From now on, you can execute commands which require root privileges using `sudo`. For example, to shut down your computer safely before turning it off, you can type:

```
sudo shutdown now
```

4.6 File System

Your system's file storage is organized in a tree of directories. To move around in it, you use the `cd` command to change the current directory. The top of the hierarchy is called root (not to be confused with the superuser of the same name), but written as the symbol `/`. To go to the root directory, enter:

```
cd /
```

To see what's here, use the `ls` (list) command:

```
ls
```

If you want to know more details, such as the modification times and permissions of files, use:

```
ls -l
```

You can also add the flag `-h` to get "human readable" file sizes instead of the raw number of bytes:

```
ls -lh
```

There are two virtual files in every directory, called ".." (two dots) and "." (one dot). The single "." means "here" (i.e. the current directory), and you can use it if you ever want to specify the current directory explicitly. For example, if you want to copy the file `/tmp/myfile` to the current directory, you can type:

```
cp /tmp/myfile .
```

To go to the parent directory (a top-level directory that contains subdirectories, the so-called "children"), use:

```
cd ..
```

Commands like `ls` have many options. To learn about them, you can read the built-in manual pages:

```
man ls
```

With `man` you can learn more about any command. You should make yourself familiar with the most important commands like `cp` (copy), `mv` (move), `rm` (remove), `mkdir` (make directory), `mount` and `ln` (link). Armed with this knowledge, you will be able to navigate any UNIX-like system, not only Linux.

4.6.1 Filesystem Hierarchy

When you issue `ls` at the root of the filesystem (`/`), you will see the following directories:

Directory	Purpose
/	Top ("root") of the filesystem
/bin	Commands ("binaries"), such as `ls`, `cp`
/sbin	Commands usually only used by `root`
/lib	Libraries (common code shared between binaries)
/usr	Files managed only by the package manager
/boot	Boot loader related files (like Linux kernel[3])
/etc	System configuration files
/home	Home directories of user accounts
/root	Special home directory for `root`
/mnt	A place to mount other filesystems
/media	Another place to mount filesystems
/proc	Live information about processes
/sys	More live information from the kernel
/dev	Device files providing access to hardware
/run	Temporary files related to background services
/tmp	Temporary files—deleted on restarts

[3]The kernel is the privileged core of the operating system.

Directory	Purpose
/srv	Files used by servers such as web servers

A good way to explore files and directories that take up disk space is using the `ncdu` program. It calculates the size of each (sub)directory and allows you to browse your filesystem and even delete unwanted files (you should only do this in your home directory, though):

```
ncdu /
```

4.6.2 Home Directory

If your username is `kim`, your home directory is located at `/home/kim`. There's a shortcut for your home directory using the tilde symbol `~`. To go to your home directory, you can type:

```
cd ~
```

If you list the contents of your home directory, you will see a number of directories with self-explanatory names, such as `Pictures`, `Music`, `Documents` and `Downloads`. The last one is used by web browsers to store downloaded files, for example. Feel free to create your own subdirectories in your home directory as needed.

4.6.3 Dot Files

Your home directory also contains a number of hidden files and directories called "dot files". Their names start with a dot (`.`) and for tidiness, are usually hidden. To see them, use the `-a` flag with `ls`:

```
ls -a
```

Often times, dot files contain your personal configuration for certain programs. Many programs collect configuration files in the `~/.config` subdirectory.

4.6.4 Permissions

As you are the owner of your home directory, your user account is allowed to modify any files and subdirectories contained in it. But you cannot change system configuration files in `/etc` or delete a command in `/bin`, except if you're `root`. This is because of the ownership and permission settings on these files and directories.

If you list the contents of your home directory with `ls -l`, you will see your username twice in each row, after a cryptic-looking column of letters and dashes and a number:

```
drwxr-xr-x  4 kim kim 4096 Nov  2 20:52  Music
rw-r--r--   1 kim kim    8 Jan  9 20:03  notes.txt
```

The letters and dashes at the beginning describe the file mode bits of the file or directory. A "d" at the beginning signifies a directory. The following 9 letters are three triplets describing "user" (owner), "group", and "all" permissions, in that order. "r" means read, "w" write and "x" execute. An "x" on a file means that this is an "executable", a program that can be run, or in the case of a directory, that it can be entered.

The first occurrence of a username in each row is the owner of the file or directory. The first triplet of mode bits on `notes.txt` tells you that you, the owner, can read and write but not execute this file (after all, it is just a text file).

The second occurrence of `kim` names the group `kim`, not the user. When you create a new user, the system also creates a group with the same name and only you as a member. You could add other users to your group to share files with them, for example. The second triplet of mode bits, `r--`, tells you that members of this group can only read your file, not change it.

Lastly, the third mode triplet (`r--` in this example) says that any other user logged into your system can read this file.

To change the mode bits of a file, you can use `chmod`. For example, to give nobody but yourself (assuming you're the

owner) the permission to read and write the file `notes.txt`, execute:

```
chmod a=,u=rw notes.txt
```

This invocation first sets an empty list of modes for all users (`a=`) and then read and write modes for the user/owner (`u=rw`) on the file.

To learn more about managing modes and ownership, be sure to read the `man` pages for `chmod`, `chown`, and `chgrp`.

4.6.5 Pipes

Linux features some advanced concepts that are central to the UNIX philosophy (Linux is a flavor of UNIX). One that you will often encounter is the pipe, symbolized by `|`. You can use pipes to feed the output of one program to the input of another program. For example, you can use the pager `less` to paginate a long stream of text, such as the output of `dmesg`. This tool prints all diagnostic messages of the operating system kernel, and using `less` lets you view it page-by-page instead of having to scroll back to the beginning:

```
dmesg | less
```

Or page through a long list of files:

```
ls -la ~/Downloads | less
```

You can also build more complex pipelines. The following command will output the last 5 lines containing the word "usb" in the kernel log:

```
dmesg | grep usb | tail -n 5
```

4.6.6 Links

If you list the contents of `/usr/lib` with `ls -l` you will see a number of files that point to another file with an arrow (`->`). This is because the file on the left hand side is a "symbolic link" to the "real" file on the right hand side. Symbolic links

and “hard links” can be created using the `ln` command as a means to point to a file using another name. This can be useful to create shortcuts. Refer to the manual page with `man ln` to learn about the details of links.

4.6.7 Finding Files

If you don’t remember where you put a file, or want to search a complex hierarchy of directories for something specific, you can use `find`:

```
find -name "notes*"
```

This will display any file or subdirectory whose name starts with “notes” in the current directory. `man find` will reveal many more options for finding files.

The `rgrep` command will look for words in the content of a file:

```
rgrep --color spice
```

This will look for any occurrence of the word “spice” in files in the current directory and its subdirectories, and display each line in which the word was found, with the word itself highlighted.

4.6.8 Mount Points

The root directory `/` is actually a collection of filesystems “mounted” into one virtual filesystem. These can be located on different disks, media or even the network—or be purely virtual in the case of `/dev`, `/proc` or `/sys`.

For example, if you want to access files stored on a USB stick, you would first mount one of the filesystems contained on the USB stick into an empty directory called a mount point. This could be something like `/mnt` or `/media/usb-stick`. Usually, desktop environments can help you to automatically mount removable media, but it’s useful to know how to do the same process manually.

First, you need to find the block device of the media you want to mount. For this, you can use the command `lsblk`. An example (partial) `lsblk` output could be:

```
NAME          MAJ:MIN RM   SIZE RO TYPE  MOUNTPOINT
sda             8:0    1  28.9G  0 disk
  sda1          8:1    1  28.9G  0 part
```

Here, `sda1` is the block device of the first partition on the USB stick. If you are unsure which is the right device, you can issue `dmesg -w` and then plug in the USB stick. You'll see something like this appear in the kernel log:

```
[...] sd 0:0:0:0: [sda] Attached SCSI removable disk
```

Which tells you that `sda` (or in your case, something else) is the block device you're looking for.

To mount the partition on the USB stick at `/mnt`, do:

```
sudo mount /dev/sda1 /mnt
```

If successful, this will—in UNIX tradition—output nothing, and you can find your files by navigating to `/mnt` with the usual commands.

Before unplugging your USB stick, you should unmount it. This makes sure any pending changes are written to the device (note that the command is `umount`, not "unmount"):

```
sudo umount /mnt
```

4.7 Environment Variables

As the shell is not only a command interpreter but also a programming environment, it supports variables. These are placeholder names that contain a value that can be changed at any time. For example, you could make a universal greeting command like this:

```
echo Hello, $name.
```

The output of this command changes depending on the value of the variable `$name`. To change the variable:

```
name=World
```

If you now execute the same `echo` line as before, you'll see this output:

```
Hello, World.
```

Variables are often used to define an environment for other programs. This means that a program can change its behavior according to these variables. These so called environment variables are set before starting the program. To see all currently defined environment variables, you can use the `env` command. You will see a few specific ones among the output:

```
HOME=/home/kim
PWD=/home
SHELL=/bin/bash
USER=kim
```

This means that another way to reach your home directory is `cd $HOME`, and another way to refer to your username is `$USER`. A critically important variable is `$PATH`, which is a list of directories (separated by ":") that the shell searches when looking for a command that you want it to execute. For example, when you type `ls`, your shell will only find it if `/bin` is in your `$PATH`, because `ls` actually resides at `/usr/bin/ls`.

4.8 Working with Text Files

Most system configuration is done by editing text files.

The two most common text editors in Linux are `vim` and `emacs`, which both have a steep (but rewarding) learning curve. Thus, Pocket Reform system provides an editor more suited for beginners called `micro`.

You can create, view, and edit files using the `micro` text editor. To edit a file in the current directory named `file.txt`, use:

```
micro file.txt
```

While in micro, you can use *CTRL+S* to save, *CTRL+Q* to quit, and *CTRL+G* to display a help menu.

4.9 Scripts

By now you know most of the ingredients to be able to write shell scripts: programs interpreted by the shell. By writing shell scripts, you can create your own commands to extend the capabilities of your computer. Here is an example script that greets the user:

```
#!/bin/bash

day=$(date +%A)
echo Hello, $USER. Today is $day.
```

The first line of the script, called the "shebang" line is important to tell the operating system that this script is to be interpreted by the shell `/bin/sh`. Save the script to a file named `greet.sh`. Mark the file executable and execute it:

```
chmod a+x ./greet.sh
./greet.sh
```

You can learn more about programming the shell by reading its manual page `man sh`. The more advanced `bash` shell is documented in `man bash`.

4.10 What Is My Computer Doing?

You can check your RAM usage, CPU usage, and processes currently running by using `htop`:

```
htop
```

Hit *F1* to display the built-in help screen.

You will see that there are a few processes running that you didn't start yourself. These are background processes, also

called services, daemons, or units. They are controlled by `systemd`, the so-called "init system". It is the first program started by the Linux kernel, and it spawns all other programs including services. You can learn more about systemd by reading the manual page:

```
man systemd
```

The most important commands to manage systemd are `systemctl` and `journalctl`. Their manual pages are worth a look, too. To see the list of known units and their status, you can use:

```
systemctl
```

To inspect a unit in more detail, you can pass its name to `systemctl`. For example:

```
systemctl status ssh
```

Instead of `status`, you can use verbs like `start`, `stop` or `restart` to control units.

The Linux kernel itself outputs a lot of diagnostic information at boot and when hardware changes (e.g. new devices are plugged in). To see the kernel log, you can (as superuser) use:

```
sudo dmesg -H
```

4.11 Inspect Hardware

The following commands are useful to inspect devices connected internally or externally:

Command	Description
`lsblk`	List block devices (storage).
`lsusb`	List USB devices.
`lspci`	List devices connected to PCIe ports.
`lscpu`	Get information about the processors.
`free -h`	Get information about system memory.

4.12 Clock

To see the current date and time, you can use the `date` command. The date and time are set by the `ntp` ("Network Time Protocol") service by synchronizing to time servers on the internet.

The motherboard of MNT Pocket Reform has a battery-backed real-time clock chip (PCF8523T, U5). This chip saves the date and time even if your system is shut down or loses power. You can interact (as `root`) with the clock using the `hwclock` tool. Review `man hwclock` for the details.

4.13 Network

MNT Pocket Reform has a built-in Gigabit Ethernet (1 GbE) port for networking. Additionally, you can install a Wi-Fi card in the mPCIe slot (depending on your Processor Module), or the module itself comes with a Wi-Fi chip.

Usually, you want to use a convenient management tool like `network-manager` (preinstalled) and the tool `nmtui` to manage your network connections.

To see and change details of your network connections, you can use the `ip` tool:

Command	Meaning
`ip addr`	Show the status of the network interfaces[4].
`ip route`	Show the network routing table.

You can trigger an automatic configuration of an interface via DHCP by executing `dhclient eth0`, and you can change the DNS servers by editing the file `/etc/resolv.conf`.

To connect to a remote computer via a secure shell connection, try `ssh` followed by the IP address of the computer

[4] `eth0` is the built-in Ethernet; `wlp1s0` is a Wi-Fi interface.

you want to connect to. If you want to login to MNT Pocket Reform over the network, you can enable the secure shell daemon service as follows:

```
sudo systemctl enable sshd
```

You can then login to MNT Pocket Reform from another computer on your local network by executing:

```
ssh kim@192.168.1.242
```

Replace the username `kim` with your own username and the IP address `192.168.1.242` with your own IP address. You can find your IP address by looking for the `inet` entries in the output of the `ip addr` command.

Before using SSH functionality, you should generate a public/private key pair by executing `ssh-keygen`.

4.14 Bluetooth

Some Processor Modules, such as the RCM4 with A311D, feature integrated Bluetooth. This technology lets you connect to wireless devices that are close to your MNT Pocket Reform (usually a few meters), such as headsets, speakers or mobile phones. If you ever need to troubleshoot Bluetooth, you can try restarting its service using `systemctl restart bluetooth` or interact with `blueman` on the command line using `bluetoothctl`.

4.15 Dual Display

MNT Pocket Reform has an HDMI connector that has different functions depending on the installed Processor Module:

Module	Dual Display
i.MX8MPlus	Yes
RCM4 with A311D	No

Module	Dual Display
RK3588	Yes

Modules that support dual display activate a second display automatically when connected.

4.16 Shutdown

To turn off MNT Pocket Reform, you should shut down the system cleanly by executing:

```
systemctl poweroff
```

or

```
sudo shutdown -h now
```

On the graphical desktop, you can click the `reform-tray` icon and select `shutdown`.

In the Debian system shipped with MNT Pocket Reform, the shutdown process will ask the System Controller to turn off the power. The OLED display will then show an animation of a disappearing MNT Research logo. In case you have to turn off the power manually (for example if the system is unresponsive or you are using an alternative OS), press *Hyper* and *Enter* to open the OLED menu, then press 0 (zero) to power down.

4.17 Installing and Removing Software

The Debian GNU/Linux distribution has access to a large number of software packages. No matter which desktop you use, these are centrally managed by `apt`, the package manager. Generally, on a Linux system you rarely download executables from the internet and launch them. Instead, you can cleanly install and remove software packages by using

the package manager. `apt` also has the ability to search for keywords (or regular expression patterns):

```
apt search browser
```

This will list all packages in the `apt` cache that contain the keyword "browser". To refresh `apt`'s list of packages available in the online Debian *repository* (the library of packages), use the following command:

```
sudo apt update
```

If you have found a package you would like to install:

```
sudo apt install firefox
```

To remove (uninstall) the package from your system:

```
sudo apt remove firefox
```

To explore all of `apt`'s functionality, read the man pages for `apt` and `apt-cache`. If you are more comfortable with a graphical user interface for managing apt packages, you can use the command `reform-synaptic`.

Chapter 5

Graphical Desktops

5.1 Sway and Wayfire

MNT Pocket Reform ships with two graphical environments called “desktops”. The Debian distribution, which the system on the eMMC is based on, has a number of additional desktops in its package manager (see section “Alternative Desktops” at the end of this chapter).

1. **Sway** emphasizes the concept of “tiling”. This means that normally, windows don’t overlap, but instead the screen space is automatically divided to make space for new windows. This desktop consumes minimal system resources, but relies heavily on keyboard shortcuts, which makes it harder to learn.
2. **Wayfire** features classic overlapping windows, a point-and-click driven interface, and a modern look. In Wayfire, you can drag windows to the corners or edges of the screen and they will be snapped. They also have minimize, maximize, and close buttons. If you’re accustomed to GNOME, Windows, or macOS desktops, you’ll find Wayfire quite intuitive.

You initially choose between Sway and Wayfire in the MNT Pocket Reform Setup Wizard. This choice will be reflected as the default on the login screen, but you can change it by pressing *F3*.

Sway and Wayfire look and work differently, but they share the following functionalities and keyboard shortcuts with *SUPER*[1]:

Key Combinations	Function
SUPER+ENTER	Open a terminal
SUPER+ESC	Close active window
SUPER+D	Find and launch programs
SUPER+SHIFT+S	Take screenshot (in ~/Pictures)
SUPER+SHIFT+X	Take screenshot of an area
SUPER+1...	Go to workspace 1–9
SUPER+SHIFT+1...	Move active window to workspace 1–9

5.1.1 Launching Applications

Pocket Reform's Sway and Wayfire desktops include the `wofi` launcher, a popup menu for launching an application by typing a part of its name. Press *SUPER+D* to open the menu. Over time, `wofi` will remember the applications you regularly launch and will sort them by frequency of use.

5.1.2 Top Bar

Both desktops come with an information bar at the top of the screen provided by the `waybar` package. The bar is divided into the following sections:

Section	Action on click
MNT Research logo	Open the launcher
Icons of running applications	Switch to application
Workspace numbers (only on Sway)	Switch to workspace
Tray icons	Settings for network, volume, etc.

[1] *SUPER* is the key with the MNT Research logo next to the *HYPER* key.

Section	Action on click
Clock	Toggle date/clock

You can completely customize the top bar by editing the config file `~/.config/waybar/config` and the CSS-based styling file `~/.config/waybar/style.css`.

`man waybar` explains the available configuration options.

5.1.3 Workspaces

If you have a lot of windows open, they might not all fit on the screen at once. For this purpose, multiple set of windows can be arranged in workspaces.

You can change your active workspace with the number keys, for example:

Shortcut	Function
SUPER+2	Go to workspace 2
SUPER+1	Go back to workspace 1
SUPER+SHIFT+5	Move active window to workspace 5

You can open different spaces for different programs. For example, you might want to put your code-editing programs in workspace 1, a web browser in workspace 2, and some instant messaging programs in workspace 3.

5.1.4 Display Brightness

You can set the display's brightness using the `brightnessctl` command or, more conveniently, use one of these keyboard shortcuts:

Shortcut	Function
HYPER+F1	Decrease display brightness
HYPER+F2	Increase display brightness

5.1.5 Network and Wi-Fi

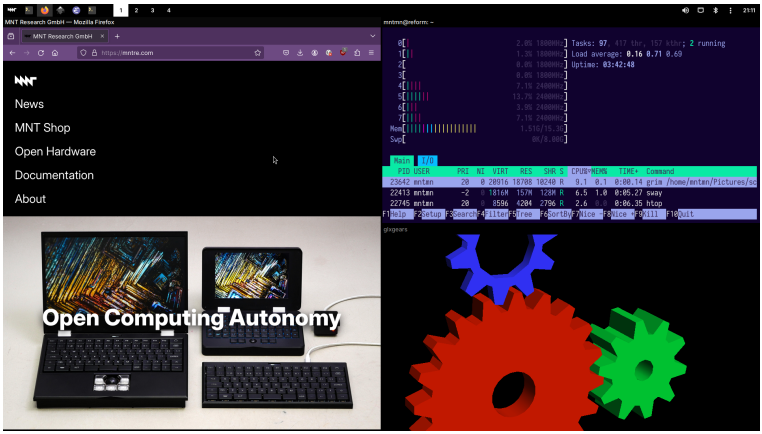
You can connect to Wi-Fi networks and configure Ethernet as well as VPN connections by clicking the network icon in the top bar.

5.1.6 Bluetooth

If your system has Bluetooth, you'll see a Bluetooth icon in the tray area of the top bar. This icon is powered by the `blueman` package behind the scenes and clicking on it with the left mouse button will open the *Bluetooth Devices* window, where you can search for nearby devices to connect to. Right clicking on a Bluetooth device will give you the options to connect, pair, or get more information. You can also right-click on the Bluetooth icon in the top bar itself to open a context menu with more options, like toggling the Bluetooth visibility of your MNT Pocket Reform, sending files or reestablishing recent connections.

Note that any Bluetooth audio devices, when connected, will appear in *Volume Control* (started by launching it from the speaker icon in the top bar or manually from the launcher). Here you can choose them as the default output or input device and adjust the volume.

5.2 Sway Specifics



5.2.1 Tiling

You can start a new terminal window by using the shortcut *SUPER+ENTER*. When you press *SUPER+ENTER* multiple times to open several terminals, you'll notice that your currently open windows will be resized to accommodate for the new window. You can switch between these windows by holding the *SUPER* key and pressing the cursor (arrow) keys in the desired direction.

If you keep adding windows, they will continuously shrink horizontally, but if you would rather have a window split vertically, you can. Use these shortcuts for deciding:

Shortcut	Function
SUPER+H	Split window horizontally
SUPER+V	Split window vertically

Note that the window is not split instantaneously. You're just telling Sway "The next time I create a window, put it below/beside my current window."

You may also use *SUPER+W* to tell Sway to use tabs. You can switch your tab using the same shortcuts for switching between windows. You can end this function by pressing *SUPER+E*.

You can use *SUPER+ESC* to close the currently selected window.

5.2.2 Sway Config File

You can tailor Sway's behavior and keyboard shortcuts by editing the file `~/.config/sway/config` or one of the included files in the `~/.config/sway/config.d` directory.

All configuration options are documented in the manual page that you can access by typing `man 5 sway` in a terminal. More information is also available in the Sway Wiki: `https://github.com/swaywm/sway/wiki`

Some of the most important configuration options are explained in the following sections.

5.2.3 Keyboard Layout

The keyboard layout is normally configured by the MNT Pocket Reform Setup Wizard. Should you want to configure it manually, you can edit the `~/.config/sway/config.d/input` file. For example, the following snippet will change the layout to the EU layout for any connected keyboard:

```
input * {
  xkb_layout eu
  xkb_options lv3:ralt_switch
}
```

5.2.4 Trackball/Trackpad Speed

A common thing that people want to tune to their particular taste is the speed of the trackball (or trackpad) on MNT Pocket Reform. For Sway, you could add an `input` section (or

extend the existing one) to the `~/.config/sway/config.d/input` file as such:

```
input * {
  accel_profile adaptive
  pointer_accel 1.0
}
```

Where `pointer_accel` can be a number between -1.0 and 1.0.

You can find out about all of the details of Sway's input configuration by opening its manual page using `man sway-input`.

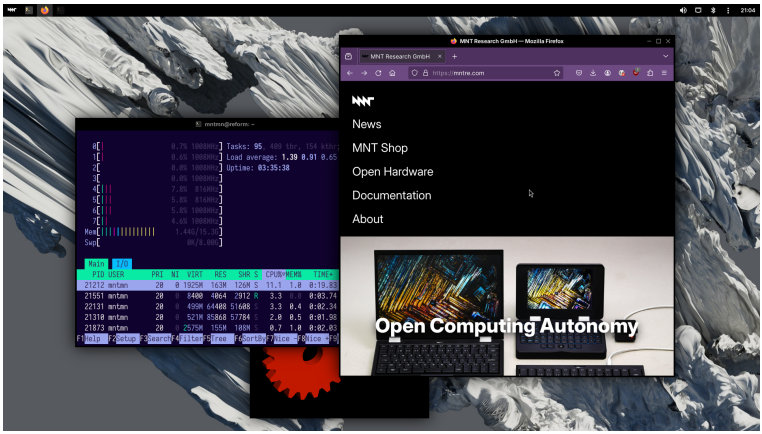
5.2.5 External Displays

Some Processor Modules allow you to connect an external display on the HDMI port, but not all of them can drive both the internal and the external display at the same time. If your module supports dual display, plugging in an external monitor should just work. If you want to configure the placement and resolution of this monitor, take a look at `man sway-output` and create an `output HDMI-A-1` section in your Sway config file. Other helpful tools that you can install for these purposes are `kanshi` and `wlr-randr`.

You can also use `swaymsg` to control your displays on the fly or when pressing certain key combinations. The following example script will switch from internal to external display and force a standard 1080p mode:

```
#!/bin/sh
swaymsg output eDP-1 disable
swaymsg output HDMI-A-1 enable
swaymsg output HDMI-A-1 modeline 148.50 1920 2448 2492\
                                 2640 1080 1084 1089\
                                 1125 +hsync +vsync
```

5.3 Wayfire Specifics



Wayfire supports a range of keyboard shortcuts to speed up working with the desktop:

Shortcut	Function
SUPER+← or →	Tile window to left or right
SUPER+↑ or ↓	(Un)maximize window
SUPER+TAB	Overview of all windows
ALT+TAB	Cycle through windows

5.3.1 Wayfire Config File

You can customize Wayfire in depth by editing the file:

`~/.config/wayfire.ini`

Some common configuration options are explained in the following sections.

5.3.2 Keyboard Layout

Wayfire's keyboard layout is normally configured by the MNT Pocket Reform Setup Wizard. Should you want to configure it

manually, you can edit the file `~/.config/wayfire.ini`. Look for the line `xkb_layout` in the section `[input]`. For example, to change it to the "EurKEY" layout, change the value after the = sign to `eu`.

5.3.3 Trackball/Trackpad Speed

To change the speed of the trackball (or trackpad) cursor under Wayfire, look for the lines in the `[input]` section of `~/.config/wayfire.ini` that start with `touchpad`. To achieve a high acceleration speed, set the `touchpad_accel_profile` to `adaptive` and adjust the `touchpad_cursor_speed` value to `1.0` (it can be a number between `-1.0` and `1.0`).

You can learn all the details of Wayfire's configuration in its wiki: `https://github.com/WayfireWM/wayfire/wiki`

5.4 Alternative Desktops

On MNT Pocket Reform, you are not restricted to Sway or Wayfire—you can also use other desktops.

You can choose an established desktop such as KDE Plasma and GNOME, or you can go down the rabbit hole of arcane desktops and discover a hidden gem this way.

We don't ship either of the big desktops as they require a lot of resources and we want to keep our system minimalistic, but here is how you can install them yourself:

GNOME Command: `sudo apt install gnome`

KDE Plasma Command: `sudo apt install kde-plasma-desktop`

Chapter 6

Software

We ship the Pocket Reform system in a minimalist form to give you the freedom to decide what you want to install. As we want the device to be practical out of the box, we preinstalled some essential tools, which are listed in the following section. We also included a section about the so-called “Reform Tools”, which are Pocket Reform specific helpers and scripts.

MNT Pocket Reform can run most Linux applications that are available for 64bit ARM-based computers (also called AArch64 or ARM64).

6.1 Preinstalled Software

Evince View PDFs and other documents.

Command: `evince`

`https://wiki.gnome.org/Apps/Evince`

Firefox Mozilla’s open-source web browser.

Command: `firefox`

`https://www.mozilla.org/firefox`

foot A terminal emulator that is fast, minimalistic and lightweight.

Command: `foot`

Keyboard shortcut: *SUPER+ENTER*

`https://codeberg.org/dnkl/foot`

GNOME Disks Partition, format, and manage internal and external disks.

Command: `gnome-disks`

`https://wiki.gnome.org/Apps/Disks`

Grim & Slurp Grim is a wayland-based screenshot tool, and Slurp lets you select the region of the screen you want to capture.

Command: `grim -g "$(slurp)"`

Keyboard shortcut: *SUPER+SHIFT+X*

`https://wayland.emersion.fr/grim`

htop A terminal-based look at system processes, CPU and memory usage.

Command: `htop`

`https://htop.dev`

micro An accessible, fresh terminal-based text editor.

Command: `micro`

`https://micro-editor.github.io/`

Minetest An 3D block-based open-world game focused on exploration, resource gathering, and construction.

Command: `minetest`

`https://minetest.net`

MPV A versatile, terminal-based media player.

Command: `mpv a-movie-file.mp4`

`https://mpv.io`

NCurses Disk Usage Terminal-based disk usage analysis utility.

Command: `ncdu`

`https://dev.yorhel.nl/ncdu`

Neverball This 3D game lets you guide a ball through 24 challenging levels.

Command: `neverball`

`https://neverball.org`

Sxiv A simple and fast image viewer.

Command: `sxiv`

`https://github.com/muennich/sxiv/`

Thunar Lightweight file manager.

Command: `thunar`

Keyboard shortcut: *SUPER+T*

`https://docs.xfce.org/xfce/thunar/start`

Vim The other major open text editor.

Command: `vim` (Exit by typing `:q` followed by *ENTER*)

`https://www.vim.org`

Wayland Event Viewer Useful when debugging input devices under wayland-based compositors such as Sway.

Command: `wev`

`https://git.sr.ht/~sircmpwn/wev`

Wayvnc Access your MNT Pocket Reform desktop remotely from VNC clients on other platforms using this server application.

Command: `wayvnc`

`https://github.com/any1/wayvnc`

wf-recorder Record MP4 video of your desktop with this program.

Command: `wf-recorder` (Stop with *CTRL+C*. The resulting video is named "recording.mp4")

`https://github.com/ammen99/wf-recorder`

6.2 Updating Software

We recommend updating your software on a regular basis as bugs get fixed, new features are introduced and improvements are made. For this purpose, Debian has an integrated package manager called `apt`. You can stay up to date by executing the following command: `sudo apt update`. This will show you how many packages can be updated. You can either update individual packages or everything at once with one command: `sudo apt upgrade`.

6.3 Flashing the System Image

Pocket Reform will (try to) boot from a microSD card if one is inserted. If you want to reinstall your system or set up a new system (for example when upgrading to a new Processor Module), you can download the "System Image" from: `https://mnt.re/system-image`

First of all, back up all your important data! The following process will erase everything that is on the microSD card you decide to flash.

From the link above, download the file whose name matches the Processor Module in your MNT Pocket Reform:

Processor Module	Filename
NXP i.MX 8M Plus	`pocket-reform-system-imx8mp.img.gz`

Processor Module	Filename
RCM4 with BPi CM4/A311D	`pocket-reform-system-a311d.img.gz`
Rockchip RK3588	`pocket-reform-system-rk3588.img.gz`

Unzip the image using gunzip (substitute your actual image file name, also in the following steps):

```
gunzip reform-system-imx8mp.img.gz
```

Identify the device name of your microSD card. For example, you can check the output of `lsblk` before and after you insert the card and compare which new device appears. Below we use the device sdX, but it will be a different one on your computer.

Copy the image to your microSD card **(Warning: all data on the microSD card will be erased!)**:

```
sudo dd if=reform-system-imx8mp.img of=/dev/sdX \
        bs=8M status=progress
```

That's it—now you can boot your Pocket Reform from the freshly flashed microSD card.

As new modules become available, you can refer to our online guide: `https://source.mnt.re/reform/reform-system-image#downloading-and-flashing-a-system-image`

6.4 Reform Tools

We have our own Debian package called `reform-tools`. These tools are designed to automate otherwise tedious system configuration tasks, so we encourage you to check them out.

Command	Function

Command	Function
`reform-check`	Tries to analyze what's wrong with your OS.
`reform-flash-uboot`	This updates the bootloader (rarely needed).
`reform-help`	Shows you a list of useful commands.
`reform-migrate`	Helps you with OS migration from microSD card to NVMe or eMMC flash.

More information about reform-tools: `https://source.mnt.re/reform/reform-tools`

6.5 Binary (In)compatibility

A popular architecture for computers is x86-64 (a.k.a. AMD64). Binaries compiled for this architecture are incompatible with ARM processors. If you want to use binary software, you have to make sure that it is built for AArch64. The vast majority of open-source software is available for AArch64, but there can be subtle problems when x86 is implicitly expected, for example:

- Optimizations written in assembler (machine code), targeting specific SIMD/vector instructions
- JIT (just-in-time) compilers

Generally, instead of using inline assembler or targeting a single architecture directly, use cross-platform libraries and code-emitting backends.

6.6 Running x86 Software

Until RISC architecture will change everything, many games and proprietary closed-source applications are only available

as x86 or x86-64 binaries. If you need to run such a binary, you can try binary translators such as `box64` (available in `apt`) or `DEX`:

```
box64 ./my-game
```

You can even run some Microsoft Windows applications on MNT Pocket Reform by chaining `box64` and `wine`, which is a Linux compatibility layer for Windows binaries:

```
box64 wine64 ./my-game
```

Emulating 32-bit x86 binaries is a bit more complicated, but possible on a 64-bit ARM platform. You can leverage Debian's "multiarch" feature to add the `armhf` architecture to your system and install `box86` (`box64`'s 32-bit sibling) this way. For troubleshooting such setups, don't hesitate to get in touch with the MNT Community.

6.7 GPU Hacks

At the time of writing, most MNT Pocket Reform Processor Modules are based on ARM System-on-Chips that contain a GPU meant for mobile or "embedded" use. Multiple factors define the limits of the versions of OpenGL, OpenGL ES and Vulkan APIs that software can use on MNT Pocket Reform: for example, the space- or energy-saving architecture of these GPUs, or the capabilities of the often reverse-engineered open-source drivers such as `etnaviv` or `panfrost`.

Sometimes, graphics heavy applications or 3D games are written with large and power hungry desktop GPUs in mind and require a GL or Vulkan version that is out of reach of your device. In some cases the developers do not really require the features available for higher OpenGL versions, though, and you can try to work around the limitation by pretending that your system supports a higher version than it really does. To do this, you can set the following environment variables in a terminal and then launch your application or game from this same terminal:

```
export MESA_GL_VERSION_OVERRIDE=4.2
export MESA_GLSL_VERSION_OVERRIDE=420
my-game
```

If this fails, you can always fall back to software emulation of OpenGL, which will be slow but sometimes usable:

```
export LIBGL_ALWAYS_SOFTWARE=1
my-game
```

Mesa is the collection of Linux 3D graphics drivers. You can learn more about various Mesa environment variables at `https://docs.mesa3d.org/envvars`

Chapter 7

Hardware

7.1 Case Parts

The case consists of the following parts:

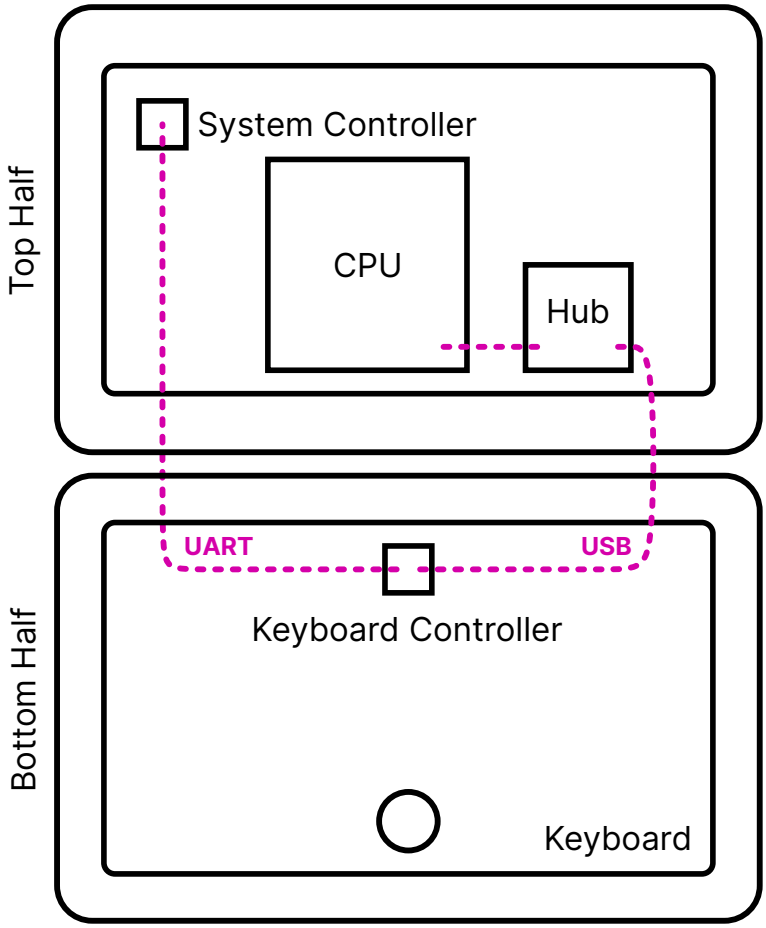
1. The **Two Halves** are the chassis of MNT Pocket Reform, milled from sand-blasted and anodized 6061 aluminum. The top half houses the motherboard and the display, while the bottom half contains the keyboard, the batteries, and the charger.
2. The **Top Back Cover:** is made from PCB material and serves as a heatsink.
3. The **Bottom Back Cover:** is made from PCB material and displays regulatory information.
4. The **Display Frame** is made from PCB material. It encloses the display and the upper half of the hinges.
5. The **Keyboard Frame** is milled from sand-blasted and anodized 6061 aluminum. It comprises the speakers and the display bezel.
6. The **Port Covers** are located on the top half and give access to a variety of ports that can be used to connect

MNT Pocket Reform to other devices.

For easy (dis)assembly, Pocket Reform uses M2 screws with Phillips-head everywhere—with one exception: M4×5 on the top half of the hinges.

7.1.1 Two Halves

The top half contains the actual computer and the display. That's also why the ports are located at the sides of the top half.



How are the two halves communicating? The keyboard (and its separate OLED display) are a direct user interface to the motherboard's system controller and in turn, the power system—independently from the core computer part of the system. This way, you can always directly control the core system's power and check on the batteries and charging level, even when the CPU is off. This architecture facilitates a convenient upgrade process of your older processor modules to new ones or to change your operating system, for example.

Technically, this works by decoupling the system control from the USB functionality of the input device. The keyboard and the trackball are combined into a single unified module in Pocket Reform. This unified module talks to the motherboard's system controller via a dedicated UART and is always supplied with 3.3V standby power. It has a secondary connector for its USB function. This USB line is routed to the CPU module via a USB hub on the motherboard, and it is only active when the CPU itself is powered and active.

7.1.2 Top Half

The top half is made of anodized milled aluminum and houses the actual computer, i.e. the motherboard with its processor module, and the display. Additional parts are mounted to it:

- Switch board with headset and standby power switch
- Wi-Fi antenna
- Mono speaker

- Port covers
- Keyboard frame and display frame
- Upper half of the hinges

If you open the top half of Pocket Reform you will encounter various internal cables. Here is what they do:

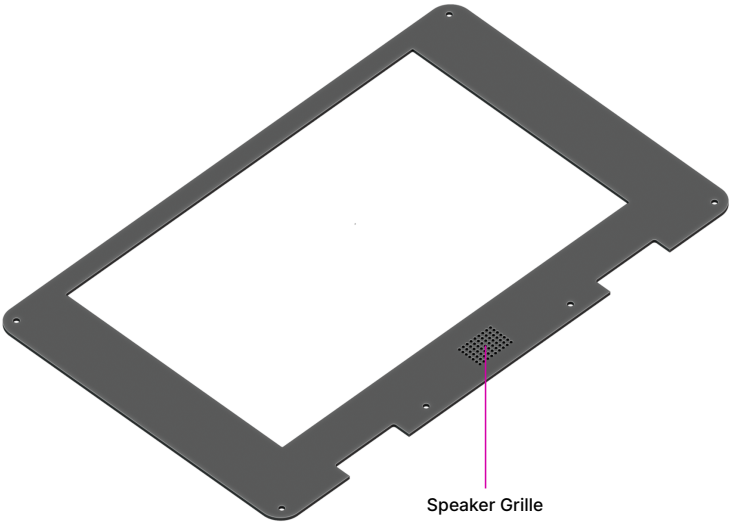
- 2-pin JST-SH (4 cm) cable: connects the standby power switch to the motherboard
- 5-pin JST-SH (4 cm) cable: connects the headset jack (headphone and microphone signals) to the motherboard
- 2x 4-pin JST-SH (8 cm) cables: connect the keyboard module's USB and UART ports to the motherboard, through the hinges
- 2x 4-pin JST-PH (22 cm) cables: connect the charger module's power port to the motherboard's 9-pin JST-PH power connector (split into a ground and a voltage cable)
- MIPI-DSI FPC cable: connects the display to the motherboard

7.1.3 Bottom Half

The bottom half is also made of anodized milled aluminum and contains several components:

- Keyboard/trackball module and OLED display on the front side
- 3D printed (SLA) battery holders on the back side (mounted to it with M2 screws)
- Two 606090 Li-ion batteries in total (one on each side)
- Charger board in the middle between the batteries
- Bottom half of the hinges

7.1.4 Display Frame

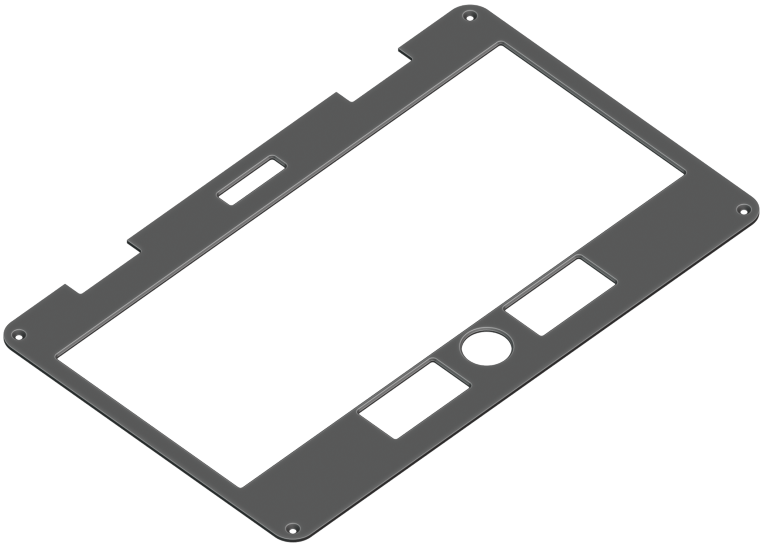


The display frame is a 1.2 mm PCB and acts as a bezel for the display and the speaker. It is attached with 6 M2 screws.

7.1.5 Top Back Cover

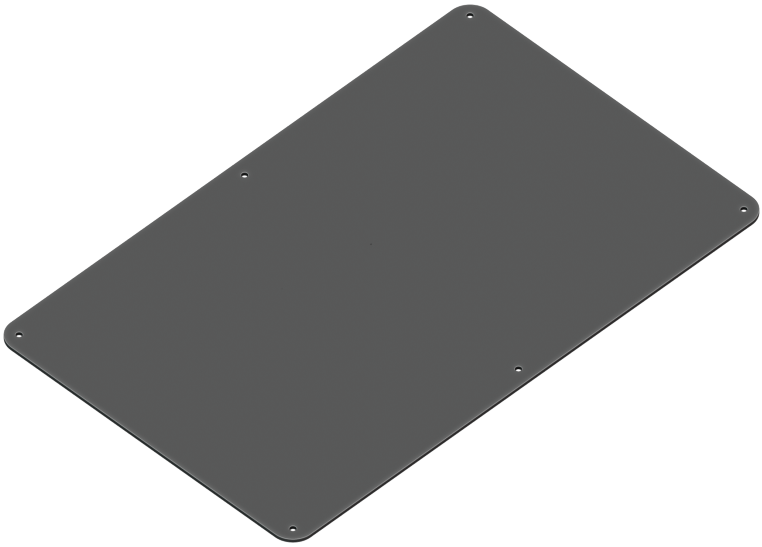
The top back cover is a 1.2 mm PCB that covers the motherboard. There is a large exposed copper area in the middle of the cover. It serves as the heatsink and has to be thermally attached to the CPU processor module using a square of a 2 mm thick thermal pad. It is attached with 7 M2 screws.

7.1.6 Keyboard Frame



The keyboard frame is a 1.2 mm thick anodized milled aluminum plate that acts as the bezel for the keyboard, trackball, and the OLED display. It is attached with 4 M2 screws.

7.1.7 Bottom Back Cover

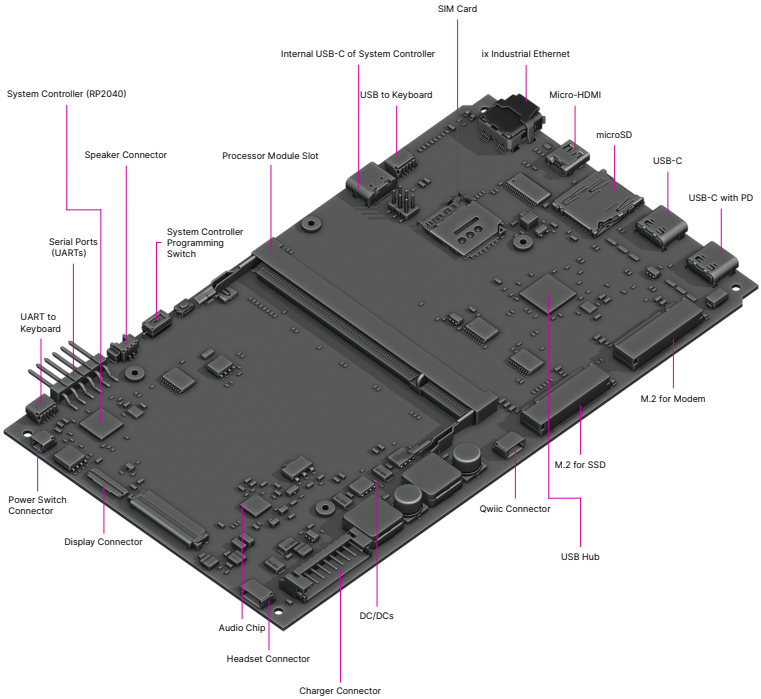


The bottom back cover is a 1.2 mm PCB that covers the batteries and the charger. It is attached with 6 M2 screws.

7.1.8 Port Covers

The Port Covers are two 1 mm thick PCBs that cover the side openings of the Top Half (mounted with two black M2×5 countersunk screws each). You can exchange these to fit a future motherboard or an expansion that requires a different port layout.

7.2 Motherboard



The Motherboard spans the inner width of the device and has outward-facing ports on both sides. It is mounted to the Main Box with two M2×3.5 and two M2×5 countersunk screws. The Motherboard has the following main features:

- **System controller:** based on a RP2040 chip, it implements the high level state machine for the USB-C Power Delivery handling. The lowest levels of the PD protocol are handled in a dedicated chip on the motherboard, the Onsemi FUSB302B, which connects to the first USB-C port's CC lines. The system controller can also decide to switch that USB-C port's power line to output instead of input (or Source instead of Sink in PD parlance). This way, you can connect a USB device instead of a charger to the port and have it powered by

Pocket Reform.

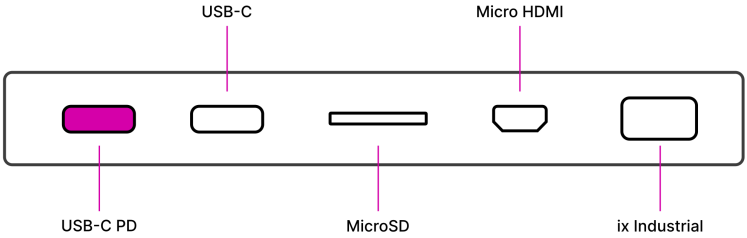
- **USB 3.0 hub:** The Processor Modules themselves have two USB ports. To provide for a total of four USB ports (two internal and two external), there is a TUSB8041 USB hub chip on the motherboard that provides the extra ports.
- **Sound chip:** A TI TLV320AIC3100 audio DAC (digital-to-analog converter)/amplifier interfaces to the headphone/microphone jack and powers one speaker housed below the main display.
- **M.2 Key M slot:** An NGFF slot (Key M) that can house an NVMe SSD (solid state disk).
- **M.2 Key B slot:** An NGFF slot (Key B) for installing USB-based cards such as cellular modems. We recommend Quectel EM06.
- **Internal USB-C Port:** This port is for flashing the system controller if flashing from the processor module is not possible or in case the system controller is bricked. For this to work, 2 jumpers need to be moved on the header J21 (see chapter "Advanced Topics").
- **Internal Qwiic Connector:** This 4-pin JST-SH connector offers I2C signals and 3.3V power compatible with Sparkfun's Qwiic sensors, displays etc. See chapter "Advanced Topics" for more details.

7.2.1 Left Side Ports

The Left Port Cover exposes the ports of the headset/standby

power switch board. The board has a 3.5 mm TRRS connector where you can plug in headphones or a headset with microphone. The board also has a little DIP switch for turning the standby power on/off. The cover is attached with 2 M2 screws.

7.2.2 Right Side Ports



The Right Port Cover is also attached with 2 M2 screws and exposes the 5 ports of the motherboard:

- **2x USB-C:** The leftmost of the USB-C Ports has Power Delivery (PD) functionality which charges the device. Both ports support the connection of USB 3.0/2.0/1.0 devices. There are no alternative modes—it is not possible to connect DisplayPort monitors.
- **microSD:** You can insert a microSD card in this slot. Warning: The system can be booted from microSD cards if a system image is on that card!
- **Micro-HDMI:** Using an adapter, it is possible to connect a HDMI monitor. Note that this is an output port, not an input port.
- **ix Industrial:** This connector supports direct connectivity to wired networks. There are passive adapters for RJ45 Ethernet available.

7.2.3 System Controller

Independent from the main Processor Module, a low-power processor sits on MNT Pocket Reform's motherboard. The RP2040 is a 32-bit ARM Cortex-M0+ processor that uses very little power and is always on as long as there is battery or wall power present. We call this processor the System Controller.

The System Controller runs a program in an endless loop that has the following jobs:

- Taking care of USB-C Power Delivery
- Powering the individual voltage rails of the system on and off
- Hard resetting the main processor on demand
- Monitoring the voltage of each battery cell
- Reporting total current flowing in and out of the batteries

Your main way of communicating with the System Controller is with the keyboard. The keyboard has, aside from its USB connection to the main processor, a second serial (UART) connection/cable to the motherboard's SYSCTL port. A 57600 bps connection is always established between the keyboard and the System Controller.

It accepts commands in the form of a single letter followed by carriage return (`0x0d`). A command can also be prefixed with a single argument, a positive integer of up to 4 digits. The most important commands are:

Command	Function
1p	Turn the computer on
0p	Turn the computer off
a	Get current flowing into/out of batteries in mA
v	Get cell voltage statistics
V	Get combined battery voltage
s	Get System Controller state (a message string)

Command	Function
g	Get estimated “fuel gauge” of batteries (percentage)

To understand the available commands in more detail, you can take a look at the System Controller’s `handle_commands()` function.

The System Controller is connected to the Processor Module through a SPI interface and through an auxiliary UART. The System Image ships with a kernel module called `reform2-lpc` which makes battery information available to the OS. The source code for this module is available in the reform2-lpc-driver directory of the MNT Reform repository.

7.2.4 Flashing the Firmware

You can build and update (flash) the firmware of the System Controller on Pocket Reform itself without opening the device. Should you ever end up in a situation where the System Controller is malfunctioning because of a firmware bug and you can’t turn the device on, you can re-flash it using another computer and a USB-C cable.

You can find the source code of the firmware and a script that guides you through the flashing process in MNT Pocket Reform’s source folder pocket-reform-sysctl-fw. There’s a convenience script for installing all build dependencies in the root of the repository.

If the System Controller is “bricked” and you need to flash it from another computer, follow these steps:

1. Prepare a roughly postcard sized piece of cardboard or plastic for isolating the motherboard.
2. Carefully unscrew and open the Top Half’s back cover.
3. Unscrew the right port cover and the motherboard’s four screws.

4. Lift the motherboard out of the case while not causing any shorts/contact with the case or tools, and place the isolation material from step 1 in between the motherboard and the case.
5. Set the 2 jumpers on the motherboard to the position that is further away from the internal USB-C port.
6. Connect a USB-C cable to the motherboard's internal USB-C port and the other side to your computer.
7. Set DIP switch *PROG* on Pocket Reform's motherboard to "ON".
8. Press *RESET* button next to the DIP switch.
9. System Controller's memory appears as a virtual flash drive on your computer.
10. Execute flashing command (see below) without `bus --3` argument.
11. Unplug the USB-C or Micro-USB cable.
12. Set DIP switch *PROG* to "OFF" (labelled "1" on the switch).
13. Reassemble the device.

On Pocket Reform or your other computer, execute the following commands:

```
git clone https://source.mnt.re/reform/pocket-reform
cd pocket-reform
./install-fw-dependencies.sh
cd pocket-reform-sysctl-fw
./build.sh
sudo picotool load build/sysctl.uf2 --bus 3 -f
```

Note the `--bus 3` argument to `picotool`. This instructs `picotool` to look for the RP2040 on the third USB bus, so you don't actually flash the System Controller's firmware onto the keyboard, which has the same type of chip. If you're flashing the controller from another computer, you have to remove this `--bus 3` argument.

7.2.5 M.2 Socket (Key M)

All Processor Modules feature at least one PCIe controller which is connected to the M.2 socket J10. The standard use for the M.2 Key M port is a NVMe SSD (solid state disk). To install an SSD card, plug it into the socket at an angle and then press down the opposing side into the latch. To remove the card, just pull on the two protruding metal springs of the latch and the card will pop out. An SSD is already installed in Hyper models of MNT Pocket Reform.

The reference clock of the M.2 Key M slot is provided by the Processor Module.

7.2.6 M.2 Socket (Key B)

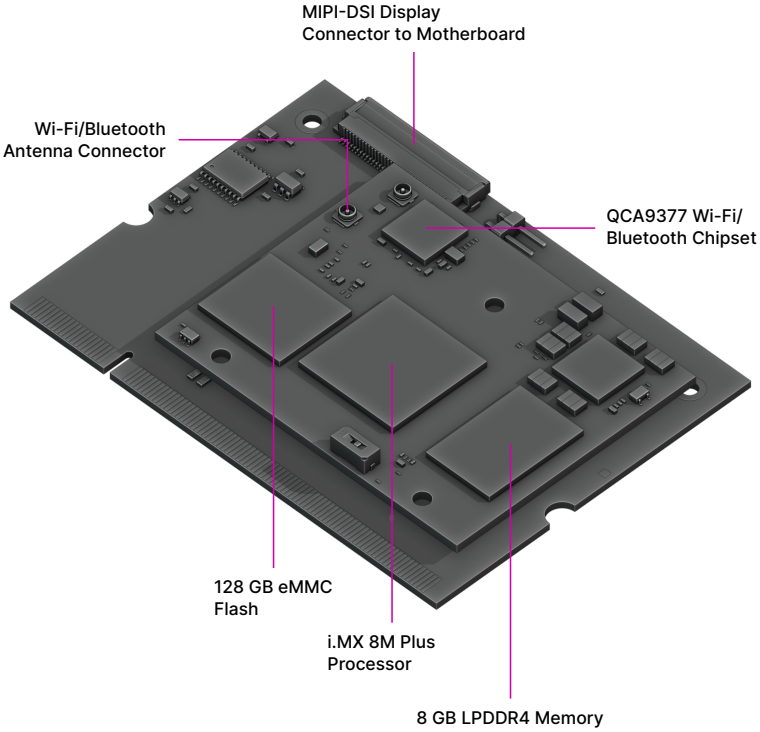
The shorter M.2 slot with a B Key has USB 2.0 and I2S audio signals. It is intended for cell modems (WWAN) like the Quectel EM06 LTE card. There's a matching SIM card slot above it on the motherboard. You can set up modem connections using the `modem-manager-gui` package.

7.2.7 Expansion Port (Qwiic)

On the left side next to the M.2 card slots there's a port labelled "I2C". This port (J5) conforms to Sparkfun's Qwiic standard and features standby 3.3V power as well as I2C clock and data lines which are connected to the RP2040 System Controller. You can extend the System Controller with sensors or display from the Qwiic ecosystem or connect your own custom expansions here and modify the System Controller's open-source firmware to drive them.

More information about Qwiic: `https://www.sparkfun.com/qwiic`

7.3 Processor Module

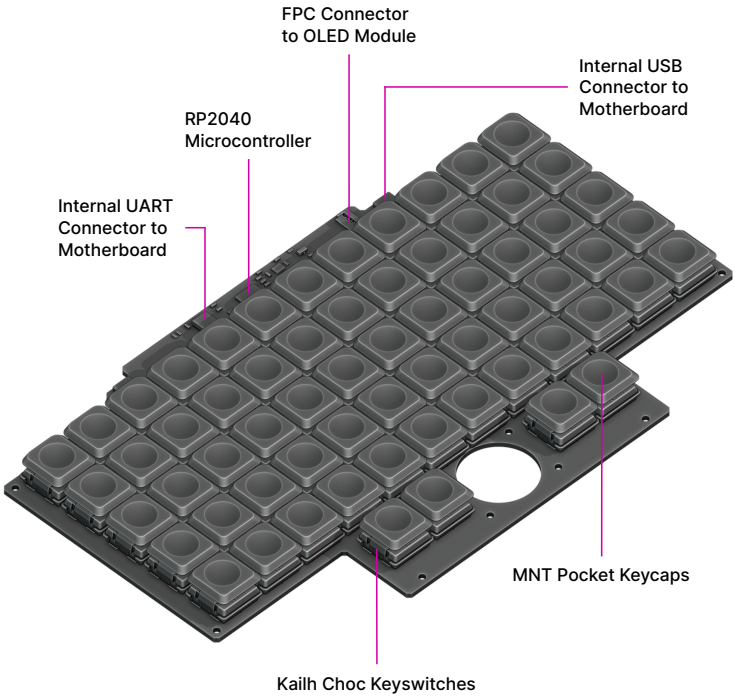


The first version of the MNT Pocket Reform ships with an NXP i.MX8M Plus Processor Module. We are constantly developing new modules for Pocket Reform with different features to accommodate individual preferences, like the fast and cost-effective RCM4-BPI module with Amlogic A311D or the latest drop, RCORE with RK3588—a powerful Processor Module that gives you 4x performant ARM Cortex-A76 cores, 4x power-efficient ARM Cortex-A55 cores, and up to 32 GB RAM.

The Processor Module is plugged into motherboard connector U1 which has 200 pins. If you want to learn more about

Pocket Reform's Processor Modules, take a look at the schematics and source KiCad projects in our GitLab repository.

7.4 Keyboard



The keyboard is mounted to the top of the Bottom Half with six M2×4 pan head screws. It is powered by an RP2040 32-bit microcontroller. The controller scans the row/column matrix of keyswitches and reports key presses via USB HID (human interface device) to the motherboard. Each switch has a diode to prevent ghosting, so you can press multiple

keys at once. The microcontroller runs a firmware based on TinyUSB, which is an open source library for implementing USB devices.

The second role of the keyboard is to serve as a user interface to the System Controller on the motherboard, even when the main SoC is turned off. To make this possible, the keyboard connects via a separate UART cable to the motherboards SYSCTL header.

7.4.1 Backlight

The MNT Pocket Reform keyboard features an RGB backlight. Press the *Hyper* key and roll the trackball horizontally to change the hue. You can change the brightness level by rolling the trackball vertically. Press *Hyper+Shift* and roll the ball vertically to adjust saturation.

7.4.2 Keyboard/Trackball Firmware

You can find the MNT Pocket Reform keyboard firmware in the source folder pocket-reform-keyboard-fw.

You can update the firmware of the keyboard on MNT Pocket Reform itself, but make sure to read this section in full to avoid ending up in a situation where you have to disassemble the laptop. The full procedure to build and flash the firmware is as follows (in a terminal window):

```
git clone https://source.mnt.re/reform/pocket-reform
cd pocket-reform
./install-fw-dependencies.sh
cd pocket-reform-keyboard-fw/pocket-hid
./build.sh
sudo picotool load build/pocket-hid.uf2 -f --bus 1
```

To be able to flash the firmware to the keyboard, its microcontroller has to be in a special programming mode. You can put the keyboard into programming mode by pressing the *X* key when the OLED menu is opened. Note that you

won't be able to use the keyboard for typing after this step– so if you're flashing the keyboard inside of the laptop and something goes wrong, you'll need another external USB keyboard to continue the process. So only do this when the flashing script asks you to do so. You can recover from a stuck keyboard by toggling Pocket Reform's Standby Power Switch off and on.

To modify the scancodes of individual keys (i.e. to swap keys on the firmware level), you can edit the file `src/matrix.h` and rebuild the firmware.

7.4.3 Replacing a Keycap

MNT Pocket Reform comes with custom *MNT Pocket* keycaps by FKcaps, which are smaller than regular Choc keycaps so that the keyswitches can be placed closer together than usual. You can pull out individual keycaps with your fingernails—or better, using a keycap puller—and swap them around. Blank replacement keycaps are available at the MNT Research online shop.

7.4.4 Replacing a Keyswitch

Should a keyswitch ever break, you can replace it with any Kailh Choc Switch.

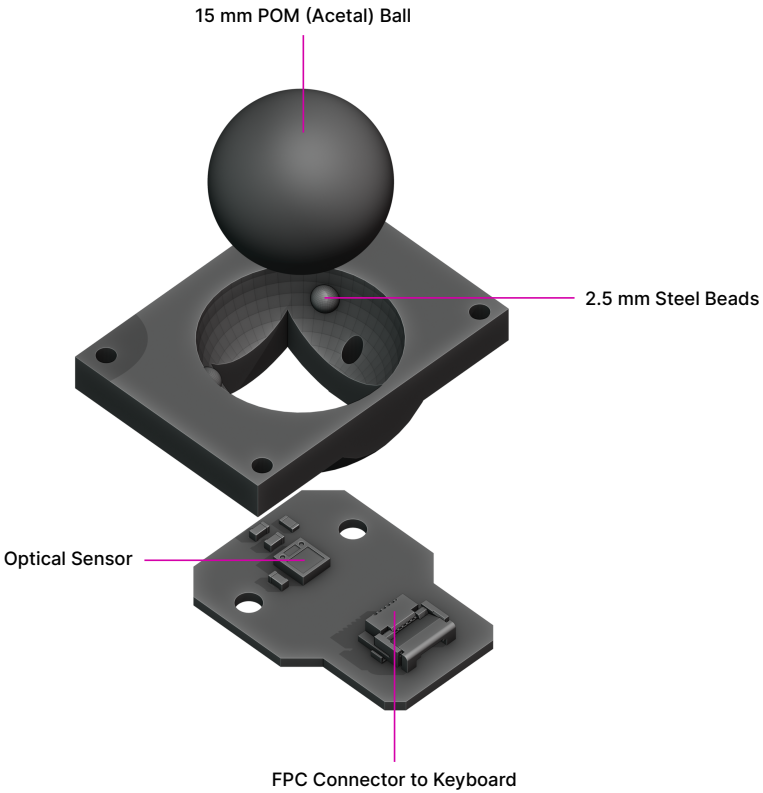
The best way to desolder the switch is a desoldering gun. If you don't have one, use a soldering iron and solder wick to remove the solder of one pin. Try to pull out the corresponding side of the switch from the top while continuing to heat the pin. Repeat the same for the other pin and go back and forth until you can remove the switch.

7.5 OLED Module

The OLED display sits on the OLED Module which is connected to the keyboard through a 4-pin, 1 mm pitch flex cable. The communication protocol is I²C. The module is mounted in the Main Box on top of the keyboard with two M2×4 pan head screws.

If you're feeling creative and want to customize your OLED with text, images or even animations, we've got you covered. Check the MNT Reform source repository and navigate to the reform2-keyboard-fw/kbdgfx-demo directory (this part of MNT Reform is compatible with MNT Pocket Reform). This directory contains example code that serves as a starting point for developing your own custom OLED graphics.

7.6 Trackball



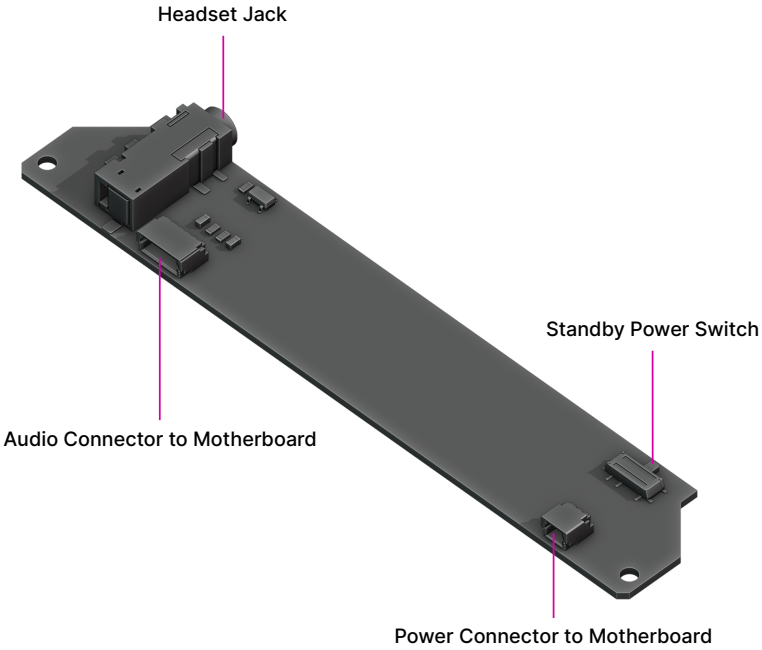
The trackball uses an RP2040 microcontroller to convert X and Y movement coordinates from the PAT9125EL optical sensor that is connected via I²C to the USB HID Mouse protocol. The electronic connection between trackball sensor and controller is made with a 6-pin 0.5mm pitch flex cable.

The trackball has four buttons. These make use of the same Kailh Choc keyswitches as the keyboard. The cup of the trackball is SLA printed.

7.6.1 Trackball Cleaning

From time to time, you should clean dust and debris from the trackball. To do this, unscrew the keyboard frame. Then remove the ball. Clean the inside of the cup with a soft cloth. Don't use detergents as these can dissolve the cup's material.

7.7 Headphone Board



The headphone board is a rectangular PCB that has the following features:

- Headset Jack
- Standby Power Switch
- Audio Connector to Motherboard
- Power Connector to Motherboard

- Wi-Fi Antenna (not visible in graphic above)

7.8 Battery Cells

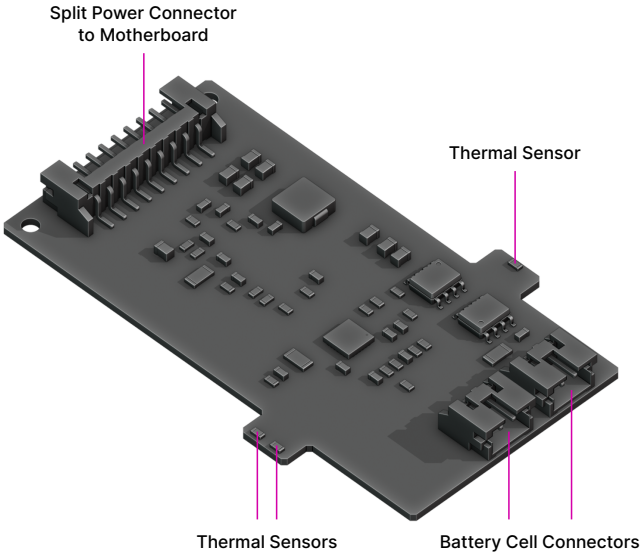
MNT Pocket Reform has two identical battery cells (Li-ion pouches), referred to as the Left and Right cells. The cells are held in place with two SLA printed battery holders each.

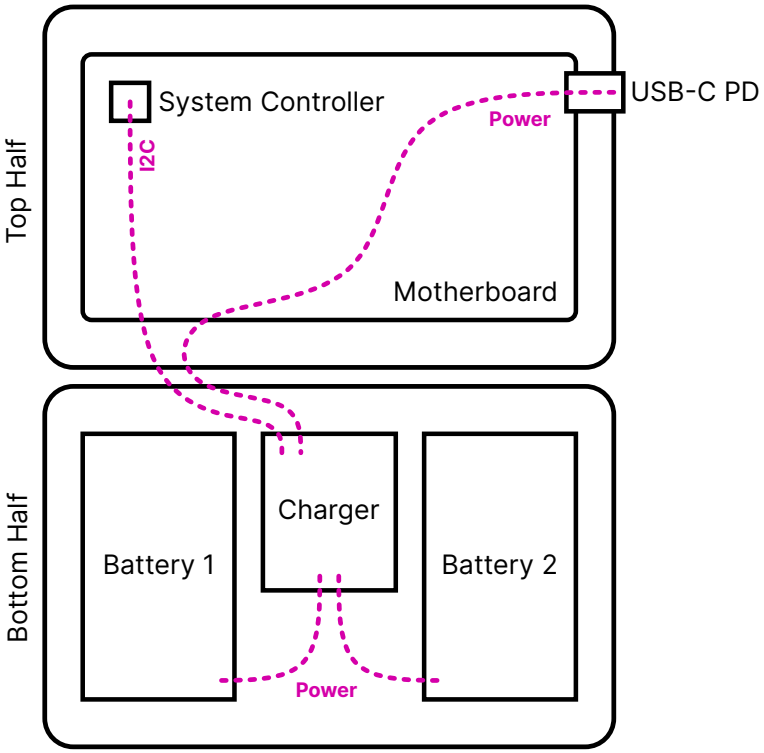
7.8.1 Compatible Battery Cells

The following table lists compatible Li-ion cells. It is not recommended to mix cells of different capacities, as the lowest capacity cell will dictate the lowest safe point of discharge.

Brand	Model	Capacity
EREMIT	606090	3.7V 4000mAh LiPo

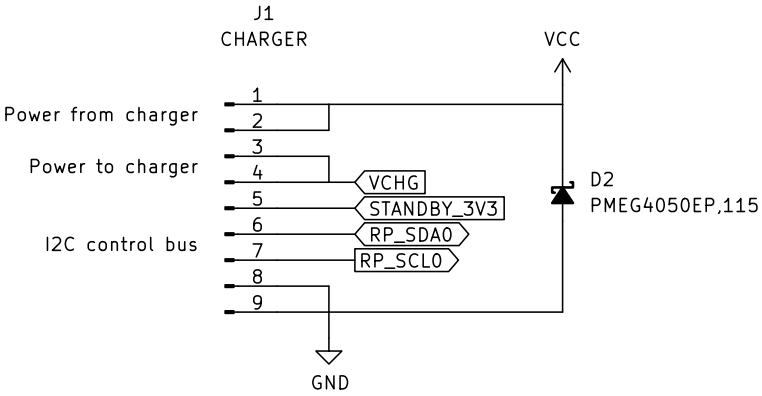
7.9 Charger Board





Underneath the keyboard reside two LiPo battery cells with 606090 form factor. In their middle: the charger board. This little PCB mainly contains two chips: one is a fuel gauge with battery protection (MAX17320G20+), and one is the actual charger, the MPS MP2762A. These chips are decoupled from the motherboard to allow for future flexibility in terms of battery architectures and chemistries, and to allow both the motherboard and the charger to be reused in other contexts.

The interface between charger and mainboard is a 9-pin JST PH connector with the following pinout:



"Raw power" from an external source—in this case, from a USB-PD charger—enters the charging board, and system power, sourced and regulated by the MPS from either the batteries or the external input, comes out and goes back to the motherboard. The I2C bus is for communication with the charger and protector chips.

The charger has 2x 2-pin JST-PH battery cell connectors. It also has 2 small "arms" on each side with temperature sensing resistors that touch the battery cells.

7.10 Compatible Displays

MNT Pocket Reform was designed to be compatible with a number of 7 inch (diagonal) 1200×1920 pixel MIPI-DSI displays. We tested the following display models successfully:

Brand	Model
JDI	LT070ME05000
Wisecoco	TOP070F01A (with adapter)

Please note that the display is physically rotated by 90 degrees. The console and desktops of the standard System

Image are configured for this, but if you install an alternative desktop environment, you'll have to adjust the display settings to compensate for this rotation.

Chapter 8

Advanced Topics

A computer is a complex system where hardware and software interact, and sometimes, unpredicted problems may appear. Most issues can be fixed, and in this chapter we will show you how.

This is for advanced users only. If you are unsure about what you are doing, we encourage you to get in touch with our MNT Community or our email support (`support@mntre.com`).

8.1 Troubleshooting

There are some steps you can try if MNT Pocket Reform should stop booting. As always, before working with MNT Pocket Reform internals, first disconnect the internal batteries and external power and peripherals.

8.1.1 Boot Issues

What can you do if your MNT Pocket Reform doesn't boot?

There are several steps you can take to determine the cause.

First of all, check if it has power. If you are in luck, a cable or a connector is just loose and you can plug it back in.

If this doesn't work, take a look at the OLED screen. Does it show anything when you press the *Hyper* key together with *Enter*? If not, this could have several reasons: the OLED module or the two cables of the keyboard may not be fully connected. It is also possible that the keyboard or the motherboard are defective.

If the keyboard is working, but your MNT Pocket Reform doesn't boot, it could be that the bootloader on the eMMC flash encountered an error. If you have another computer at hand, install the latest System Image to a microSD card. Refer to the chapter "Software" and the section "Flashing the System Image" in this handbook.

Insert the freshly flashed microSD card and try to boot MNT Pocket Reform. If this isn't successful, the motherboard or the Processor Module or even the display could be defective. If you have another Processor Module and knowledge of how to swap it, you could try that. We recommend getting in touch with our customer support as you have a 2-year warranty on your device. Warranty repairs are free within this period. Please refer to our FAQ (`https://mntre.com/faq.html`) for more details.

8.1.2 Serial Console

If you have good Linux knowledge and surmise the boot issue is not hardware related, you can try fixing it using the serial console.

The motherboard connectors labeled *S1* and *S2* are serial ports (UART) to which U-Boot and the Linux kernel output diagnostic information on startup. The correct serial port depends on your Processor Module:

Module	Port	Baud
i.MX 8M Q	S1	115200

Module	Port	Baud
i.MX 8M Plus	S2	115200
RCM4-BPi/A311D	S2	115200
RCM4-RPi	S1	115200
RK3588	S1	1500000

Wire up a 3.3V USB-to-UART adapter to 3 of the following pins of connector J17:

Pin	Function
1	S2 UART2_TXD, connect to RX of your adapter
2	S2 UART2_RXD, connect to TX of your adapter
3	S2 GND, connect to GND of your adapter
4	S1 UART1_TXD, connect to RX of your adapter
5	S1 UART1_RXD, connect to TX of your adapter
6	S1 GND, connect to GND of your adapter

Then, use a terminal program such as `tio` on your host computer:

```
tio /dev/ttyUSB0 -b 115200 # Check Module manual
                           # for baud rate
```

If you then switch on Pocket Reform, you should see the U-Boot console in `tio`. Please note that most kernel output is suppressed by the default kernel parameter `loglevel=3`. Override this parameter if you need to see more output.

8.1.3 Electronics Repair

Before attempting an electronics fix, please contact our customer support at `support@mntre.com`. Additionally, please consult the MNT Community forum (`https://community.mnt.re`) for similar issues. Check our repair guides if you are knowledgeable with electronics. Open the respective KiCad file, for example the motherboard file, and take a look at the schematics and PCB layout. You can trace the power rails and

measure them at different points on the board. You need a digital multimeter for this.

8.1.4 Software Issues

If you suspect software issues, run the `reform-check` command (see “Software” chapter, “Reform Tools” section in this handbook).

8.2 System Boot

Unlike a PC that uses BIOS, Pocket Reform utilizes U-Boot, a bootloader commonly used on ARM processors. At the time of writing, Pocket Reform only supports ARM based modules.

The Processor Module will try to load boot code (U-Boot) from eMMC. If that fails, the standard i.MX8M Plus Module can only be booted using a special USB bootloader mode, which currently requires the Ezurio Nit8MP_ENC_CAR carrier board, a USB connection to another computer and the uuu tool from NXP. Please be careful when modifying the boot partition on eMMC because it is hard to recover without a carrier board. Other Processor Modules may have different boot device options—please refer to their specific documentation.

U-Boot is like a mini operating system and shell that allows you to inspect parts of the system (like PCIe, USB devices or Ethernet) and set up parameters to be passed to the real operating system kernel such as Linux, and start it. Every module has its own U-Boot version, specifically adapted for Pocket Reform. The sources and build instructions for all versions can be found at: `https://source.mnt.re/reform`

U-Boot needs 3 files to boot Linux:

- The Linux kernel itself, named `vmlinuz-...-reform2-arm64`.
- The device tree blob (DTB). The file has a Processor Module specific file name ending with `.dtb`. The device

tree is a data structure that lists the addresses of and parameters for all the devices in the system that Linux needs to initialize drivers for.

- U-Boot looks for a file called `boot.scr` on the boot medium, which is a script of commands that performs the actual loading of the OS. This script is normally managed by Debian and has a binary header. Usually, you never need to edit it yourself. If you really need to and know what you're doing, a tool called `mkimage` is required to update it.

Theoretically, you can boot other operating systems and Linux distributions besides Debian, such as FreeBSD, NetBSD, OpenBSD—if they include all necessary drivers for your Processor Module and provide an `extlinux.conf` file for U-Boot. Refer to `https://docs.u-boot.org` for details. Booting another Linux distribution can be achieved by combining the MNT Pocket Reform Linux kernel and DTB on the boot partition with the distribution's root file system extracted to the second partition.

Chapter 9

Schematics

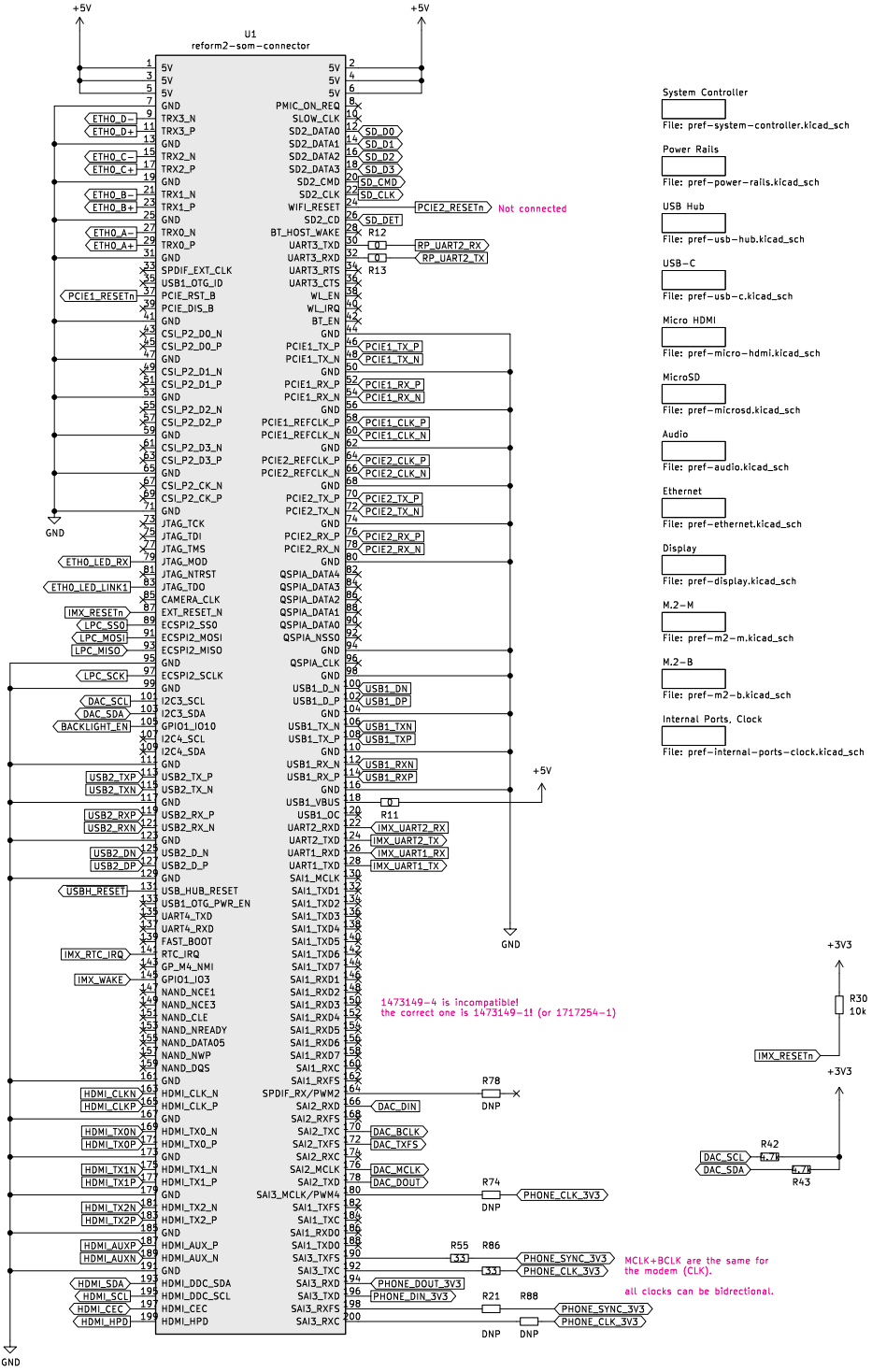
All of our Pocket Reform-related schematics, design files and documentation are publicly available on our GitLab instance:

`https://source.mnt.re/reform/pocket-reform`

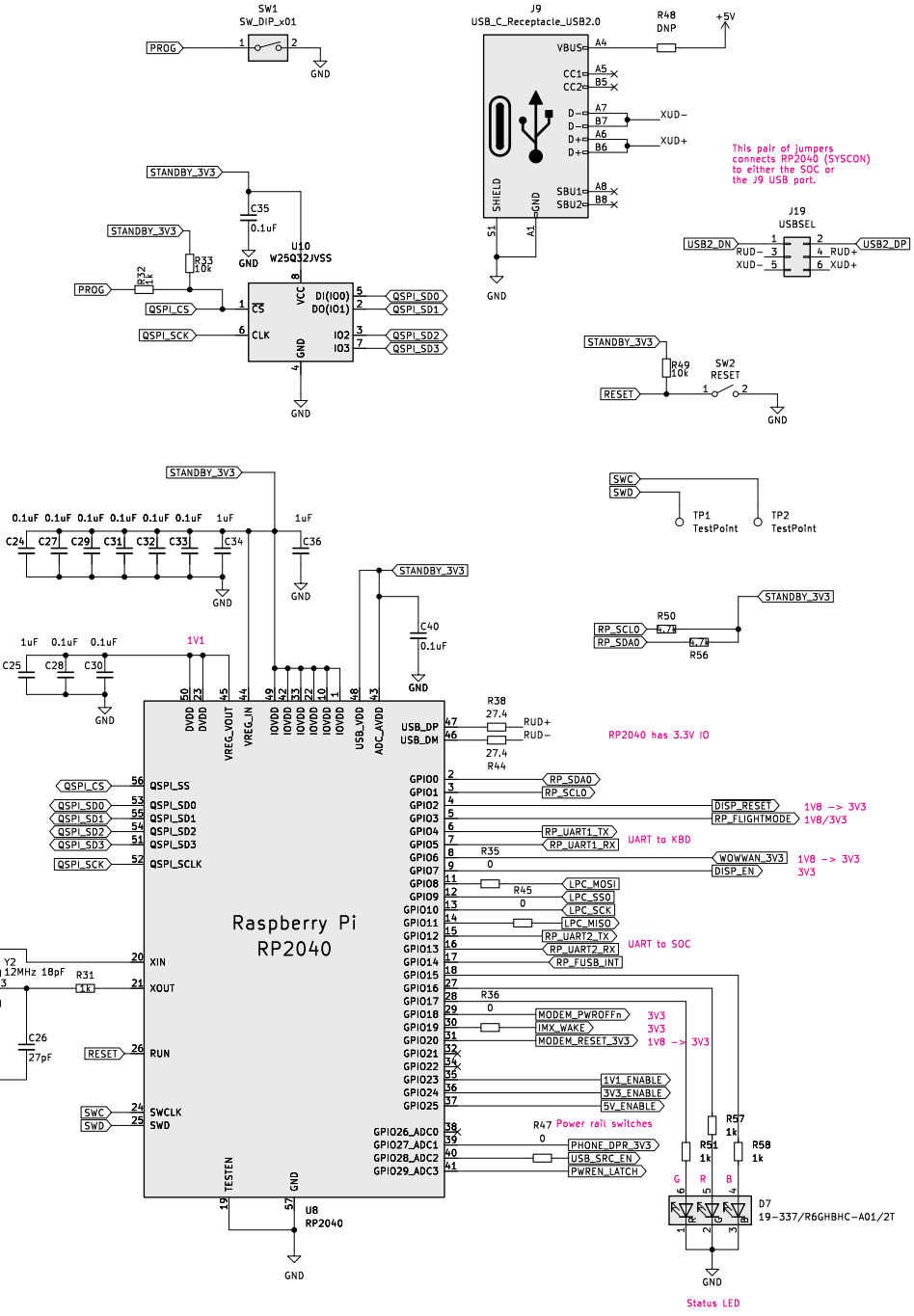
The following sections link to KiCad projects of the circuit boards that you can explore interactively.

9.1 Motherboard Schematics

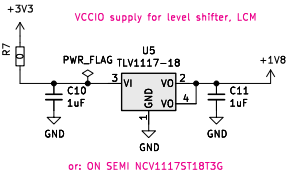
Processor Module Slot

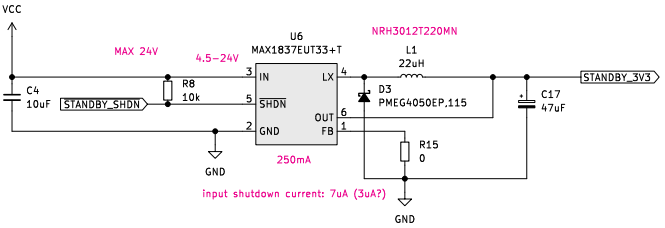


System Controller

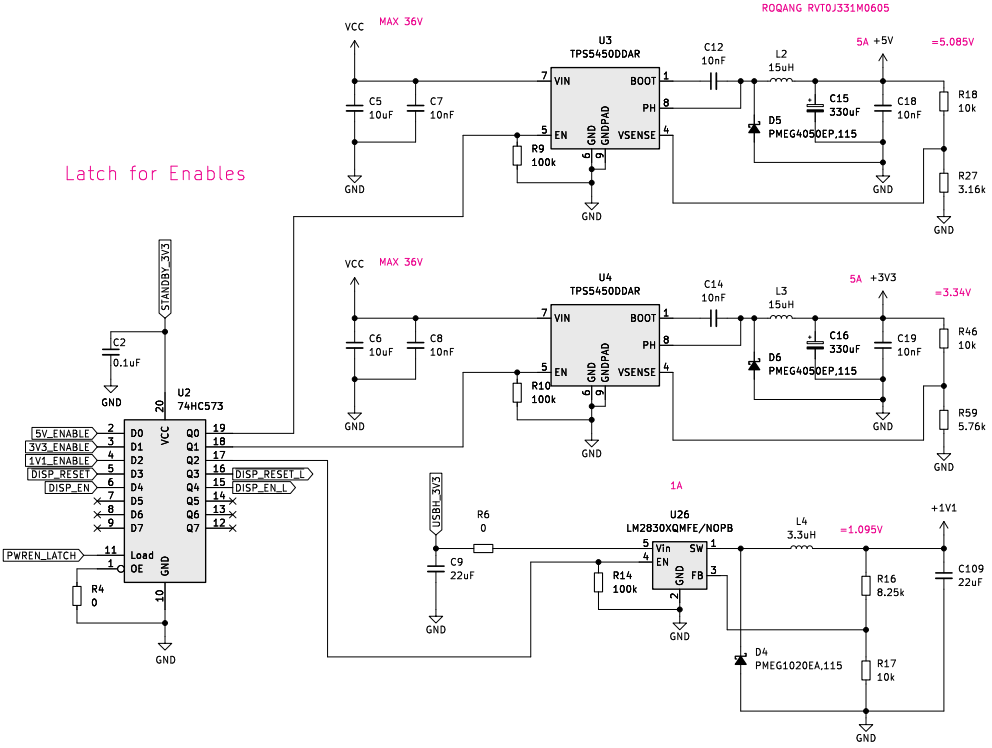


Power Rails

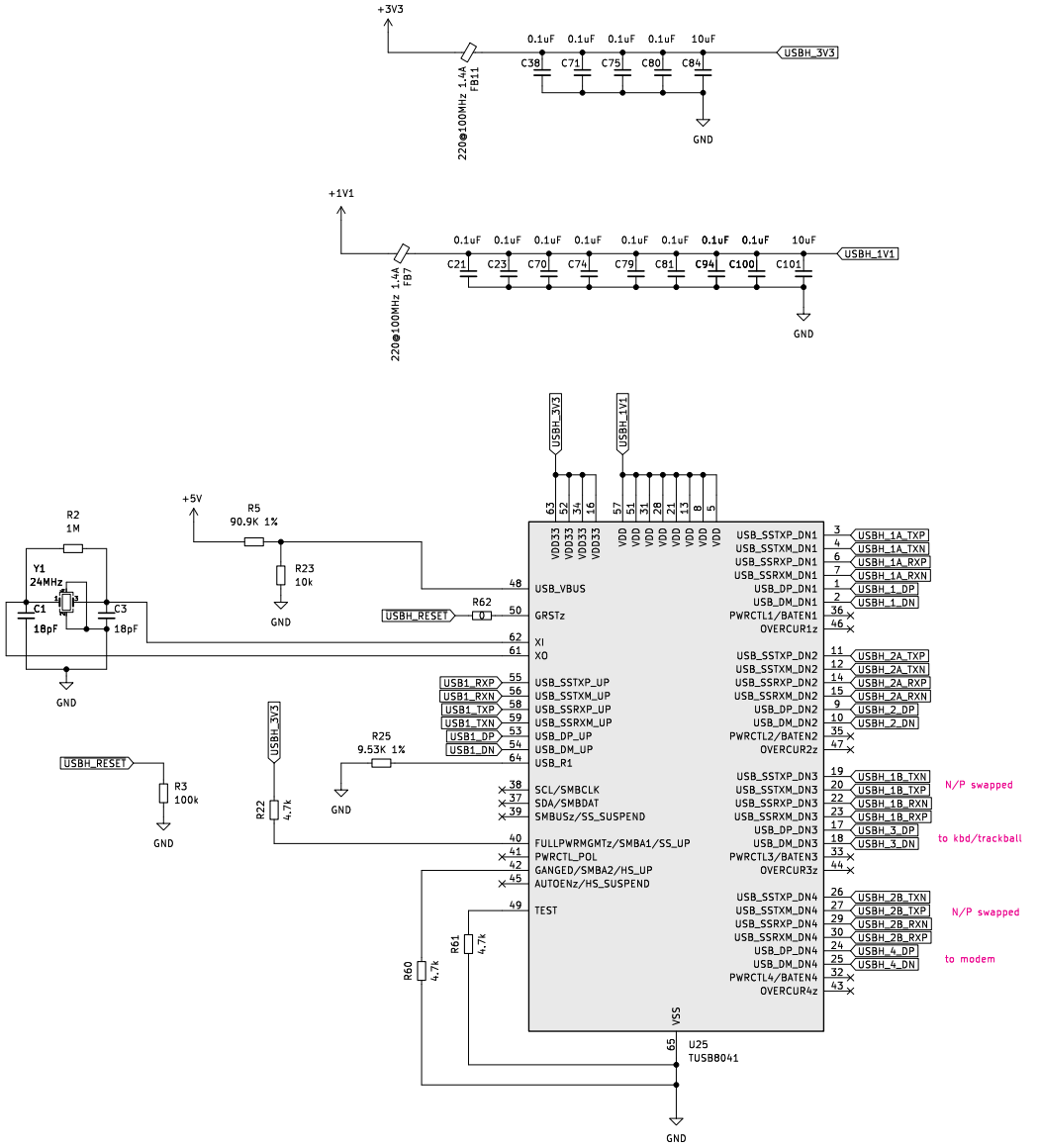




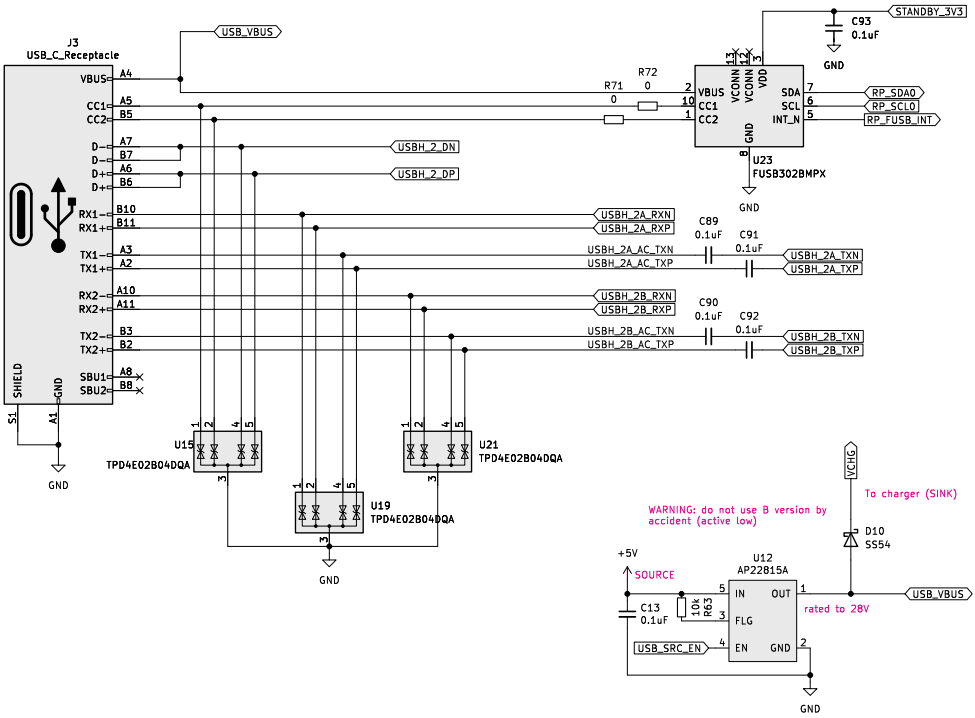
Latch for Enables



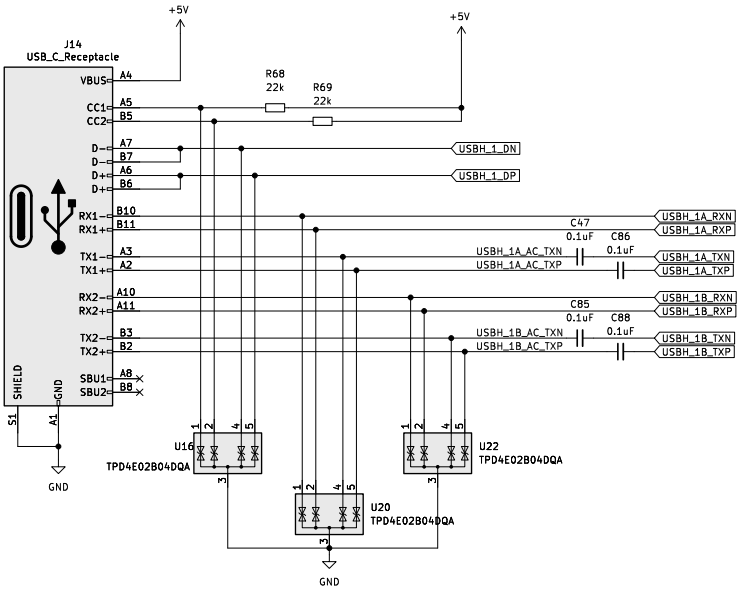
USB Hub

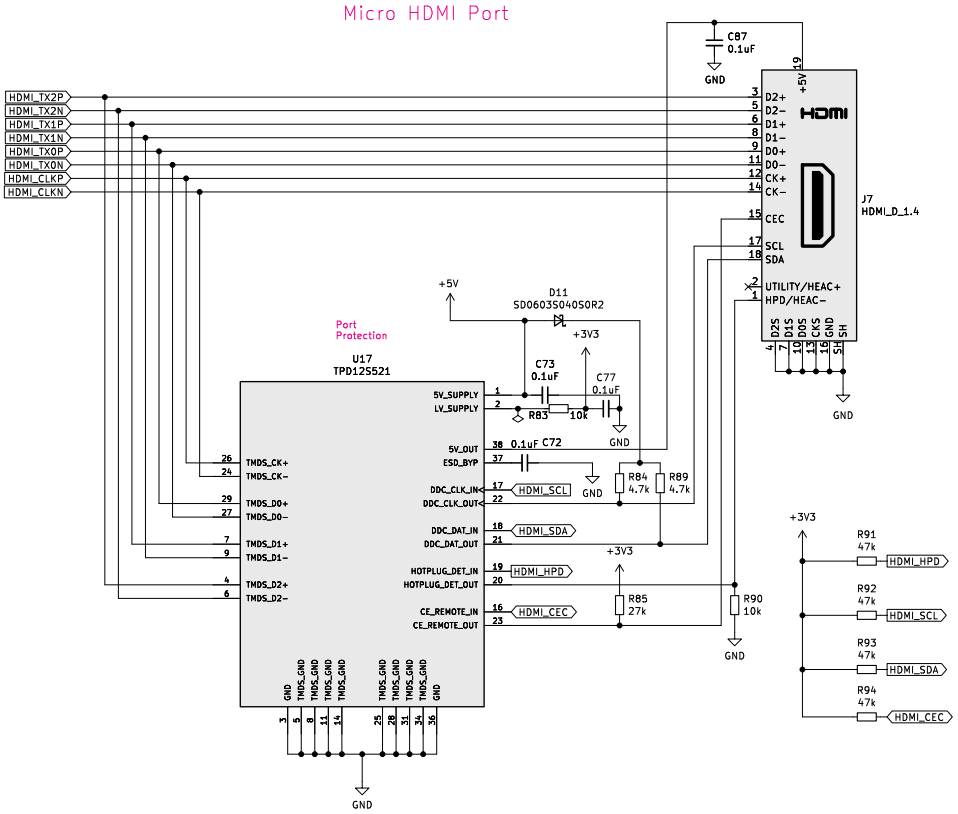

+3V3
0.1uF
0.1uF
0.1uF
0.1uF
10uF
C38
C71
C75
C80
C84
USBH_3V3
220@100MHz 1.4A
FB11
GND
+1V1
0.1uF
0.1uF
0.1uF
0.1uF
0.1uF
0.1uF
0.1uF
0.1uF
10uF
C21
C23
C70
C74
C79
C81
C94
C100
C101
USBH_1V1
220@100MHz 1.4A
FB7
GND
USBH_3V3
USBH_1V1
+5V
R5
90.9K 1%
R2
1M
Y1
24MHz
C1
18pF
C3
18pF
R23
10k
GND
R62
0
USBH_RESET
USB1_RXP
USB1_RXN
USB1_TXP
USB1_TXN
USB1_DP
USB1_DN
R25
9.53K 1%
USBH_RESET
R3
100k
R22
4.7k
R60
4.7k
R61
4.7k
VDD33
VDD
VSS
USB_VBUS
GRSTz
XI
XO
USB_SSTXP_UP
USB_SSTXM_UP
USB_SSRXP_UP
USB_SSRXM_UP
USB_DP_UP
USB_DM_UP
USB_R1
SCL/SMBCLK
SDA/SMBDAT
SMBUSz/SS_SUSPEND
FULLPWRMGMTz/SMBA1/SS_UP
PWRCTL_POL
GANGED/SMBA2/HS_UP
AUTOENz/HS_SUSPEND
TEST
USB_SSTXP_DN1
USB_SSTXM_DN1
USB_SSRXP_DN1
USB_SSRXM_DN1
USB_DP_DN1
USB_DM_DN1
PWRCTL1/BATEN1
OVERCUR1z
USB_SSTXP_DN2
USB_SSTXM_DN2
USB_SSRXP_DN2
USB_SSRXM_DN2
USB_DP_DN2
USB_DM_DN2
PWRCTL2/BATEN2
OVERCUR2z
USB_SSTXP_DN3
USB_SSTXM_DN3
USB_SSRXP_DN3
USB_SSRXM_DN3
USB_DP_DN3
USB_DM_DN3
PWRCTL3/BATEN3
OVERCUR3z
USB_SSTXP_DN4
USB_SSTXM_DN4
USB_SSRXP_DN4
USB_SSRXM_DN4
USB_DP_DN4
USB_DM_DN4
PWRCTL4/BATEN4
OVERCUR4z
USBH_1A_TXP
USBH_1A_TXN
USBH_1A_RXP
USBH_1A_RXN
USBH_1_DP
USBH_1_DN
USBH_2A_TXP
USBH_2A_TXN
USBH_2A_RXP
USBH_2A_RXN
USBH_2_DP
USBH_2_DN
USBH_1B_TXN
USBH_1B_TXP
USBH_1B_RXN
USBH_1B_RXP
USBH_3_DP
USBH_3_DN
N/P swapped
to kbd/trackball
USBH_2B_TXN
USBH_2B_TXP
USBH_2B_RXN
USBH_2B_RXP
USBH_4_DP
USBH_4_DN
N/P swapped
to modem
U25
TUSB8041
GND

USB-C port 1 with PD charging

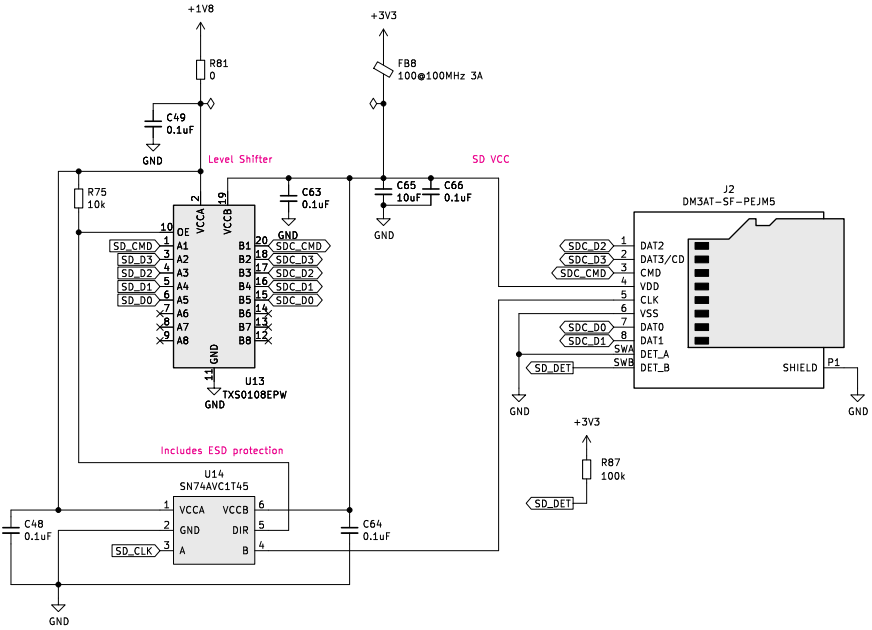


USB-C port 2

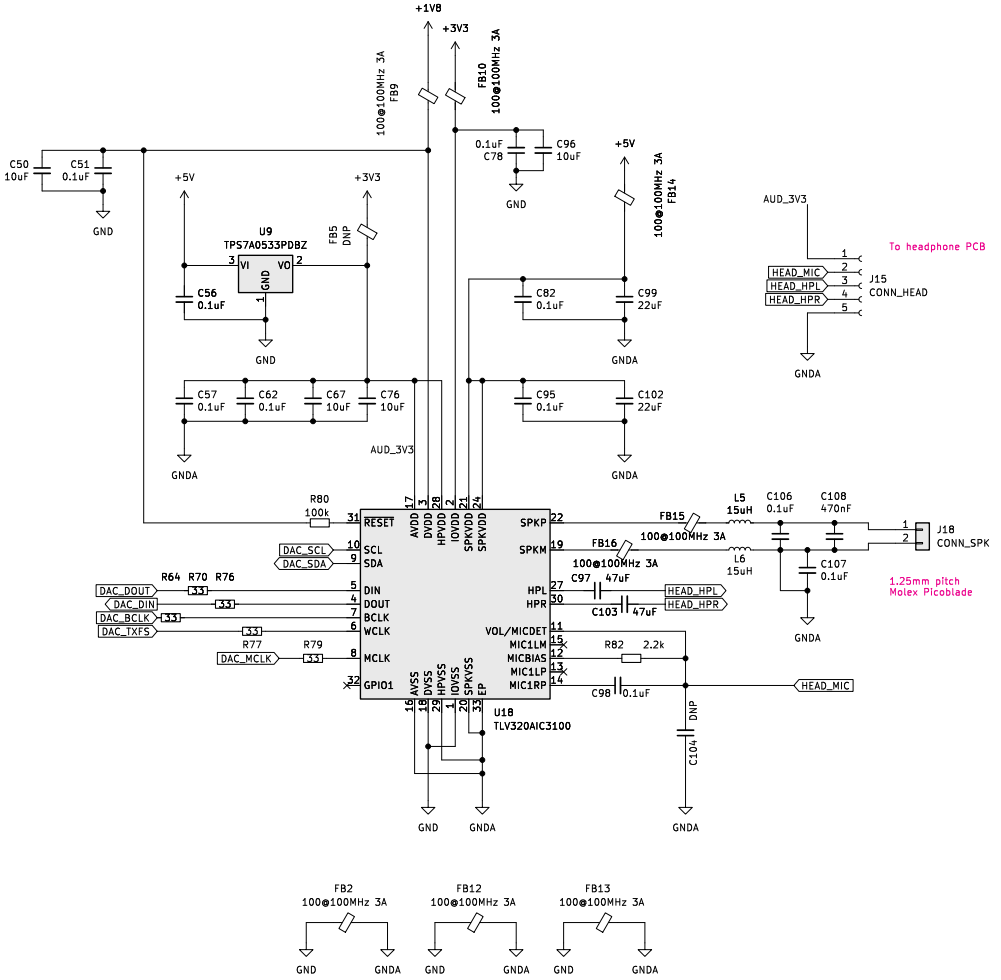



Micro HDMI Port
HDMI_TX2P
HDMI_TX2N
HDMI_TX1P
HDMI_TX1N
HDMI_TX0P
HDMI_TX0N
HDMI_CLKP
HDMI_CLKN
C87
0.1uF
GND
+5V
J7
HDMI_D_1.4
D2+
D2−
D1+
D1−
D0+
D0−
CK+
CK−
CEC
SCL
SDA
UTILITY/HEAC+
HPD/HEAC−
DDS
D1S
D0S
CKS
GND
SH
Port
Protection
U17
TPD12S521
D11
SD0603S040S0R2
+3V3
C73
0.1uF
C77
0.1uF
R83
10k
5V_SUPPLY
LV_SUPPLY
5V_OUT
ESD_BYP
C72
0.1uF
DDC_CLK_IN
DDC_CLK_OUT
DDC_DAT_IN
DDC_DAT_OUT
HOTPLUG_DET_IN
HOTPLUG_DET_OUT
CE_REMOTE_IN
CE_REMOTE_OUT
HDMI_SCL
HDMI_SDA
HDMI_HPD
HDMI_CEC
R84
4.7k
R89
4.7k
R85
27k
R90
10k
R91
47k
R92
47k
R93
47k
R94
47k
TMDS_CK+
TMDS_CK−
TMDS_D0+
TMDS_D0−
TMDS_D1+
TMDS_D1−
TMDS_D2+
TMDS_D2−
TMDS_GND
GND

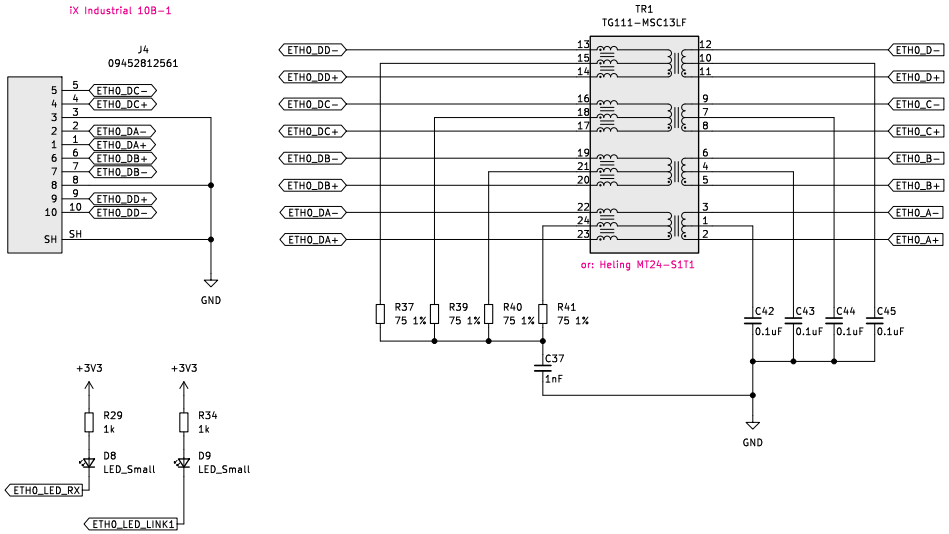
MicroSD Slot



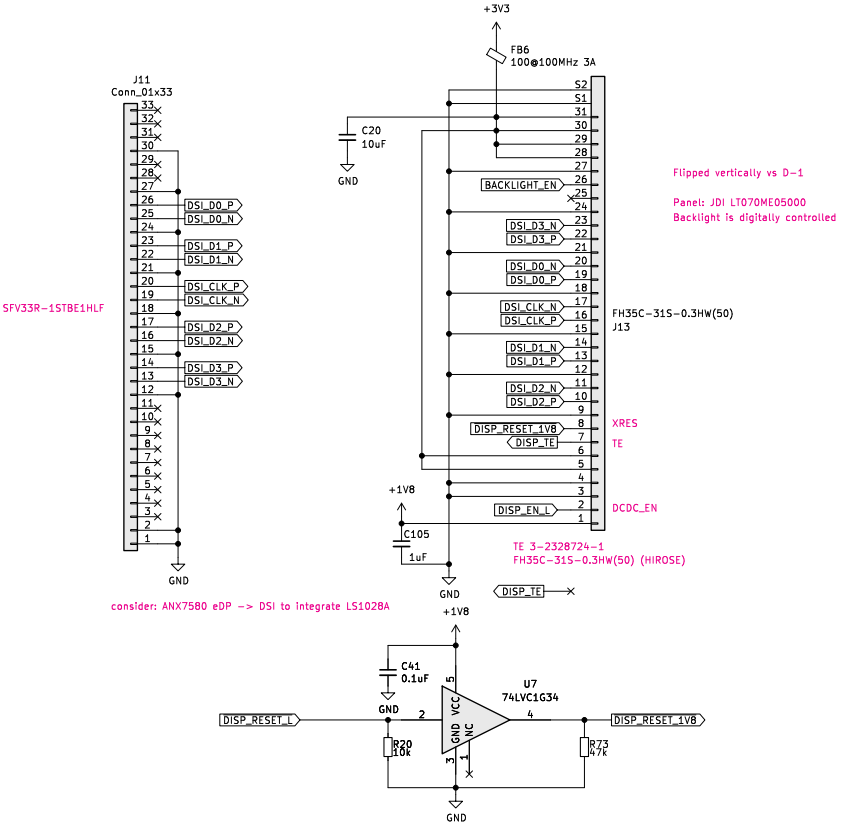
Audio


+1V8
+3V3
100@100MHz 3A
FB9
FB10
100@100MHz 3A
C50
10uF
C51
0.1uF
GND
0.1uF
C78
C96
10uF
GND
+5V
100@100MHz 3A
FB14
+5V
+3V3
U9
TPS7A0533PDBZ
VI
GND
VO
C56
0.1uF
FB5
DNP
GND
C82
0.1uF
C99
22uF
GNDA
AUD_3V3
HEAD_MIC
HEAD_HPL
HEAD_HPR
J15
CONN_HEAD
To headphone PCB
GNDA
C57
0.1uF
C62
0.1uF
C67
10uF
C76
10uF
GNDA
AUD_3V3
C95
0.1uF
C102
22uF
GNDA
R80
100k
RESET
SCL
SDA
DAC_SCL
DAC_SDA
DAC_DOUT
DAC_DIN
DAC_BCLK
DAC_TXFS
R64 R70 R76
33
DIN
DOUT
BCLK
WCLK
R77
R79
DAC_MCLK
33
MCLK
GPIO1
AVDD
DVDD
HPVDD
IOVDD
SPKVDD
SPKVDD
SPKP
SPKM
FB15
100@100MHz 3A
FB16
100@100MHz 3A
L5
15uH
L6
15uH
C106
0.1uF
C108
470nF
C107
0.1uF
J18
CONN_SPK
1.25mm pitch
Molex Picoblade
HPL
HPR
C97
47uF
C103
47uF
HEAD_HPL
HEAD_HPR
VOL/MICDET
MIC1LM
MICBIAS
MIC1LP
MIC1RP
R82
2.2k
C98
0.1uF
HEAD_MIC
C104
DNP
AVSS
DVSS
HPVSS
IOVSS
SPKVSS
EP
U18
TLV320AIC3100
GND
GNDA
GND
GNDA
FB2
100@100MHz 3A
FB12
100@100MHz 3A
FB13
100@100MHz 3A
GND
GNDA
GND
GNDA
GND
GNDA

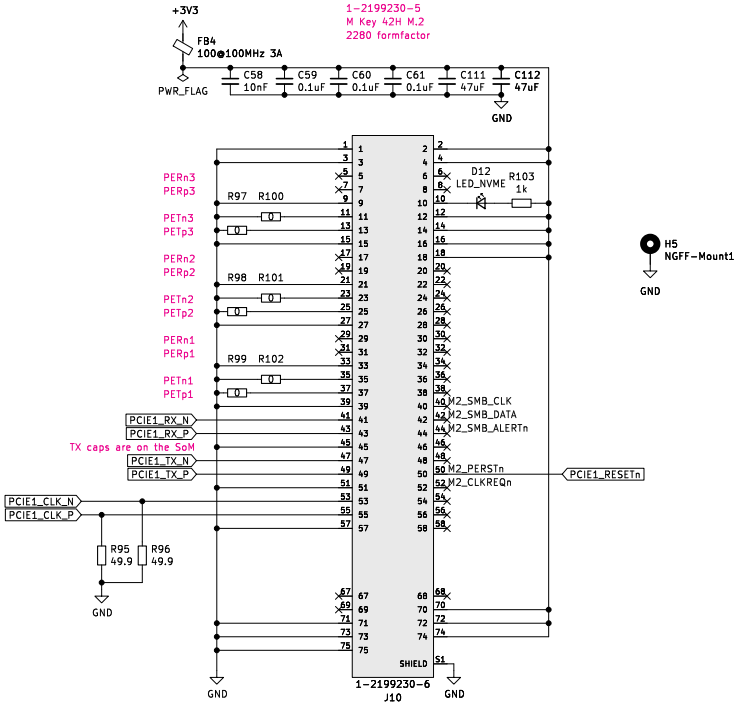
1Gb Ethernet



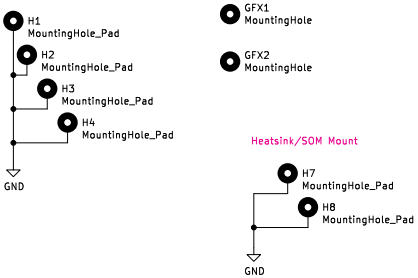
MIPI–DSI / Display Connector



SSD M.2 Card Slot

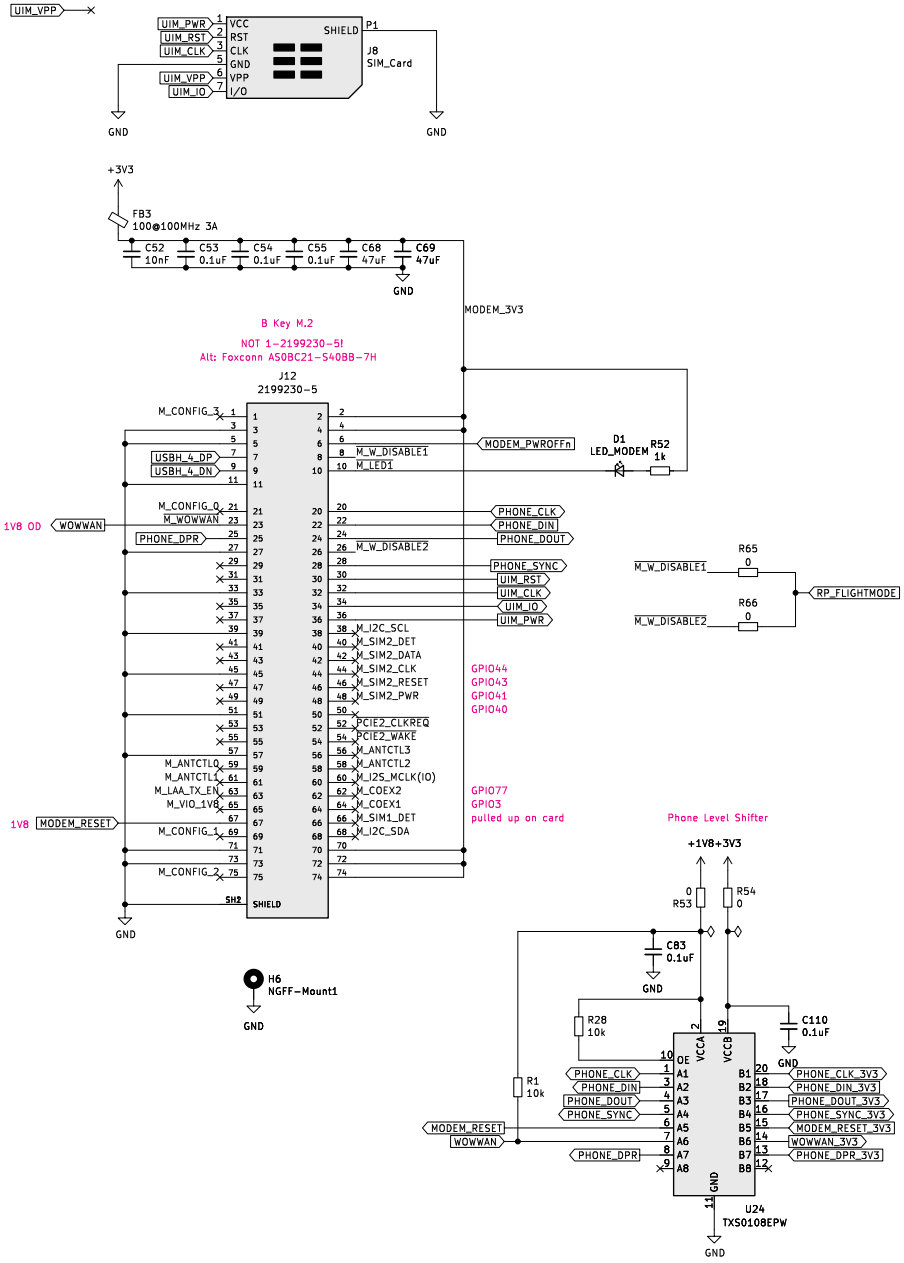


Mounting Holes Etc

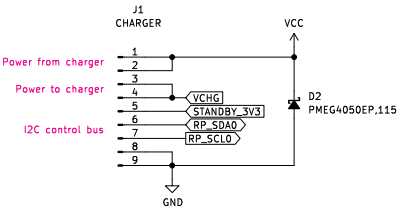


WWAN M.2 Card Slot

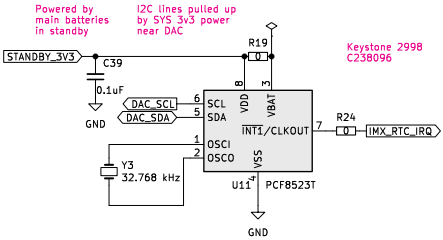
Lift up the Receiver



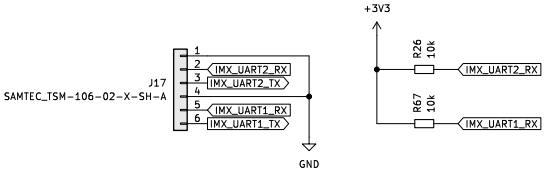
Charger Interface



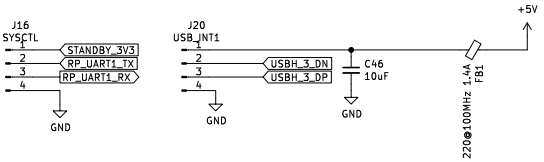
Realtime Clock



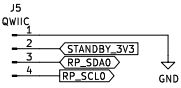
Serial Ports



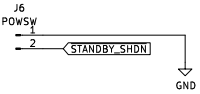
Internal USB/UART (Keyboard/TB Interface)



Qwiic I2C Interface



Hard Powerdown Interface



9.2 Motherboard Bill of Materials

Designator	Qty	Value	Brand	Part Number
C1 C3 C13 C20 C25 C27-C33 C35 C38 C40 C42-C50 C53-C55 C57 C59-C64 C66 C68-C81 C84-C93 C95 C97 C99 C101 C104 C108-C109	66	0.1uF	Samsung	CL05B104KO5NNNC
C2 C4-C5 C39 C51 C56 C65 C98 C105 C107	10	10uF	Samsung	CL10A106MO8NQNC
C6 C17	2	22uF	Samsung	CL10A226MP8NUNE
C7-C8 C11-C12 C18-C19 C52 C58	8	10nF	Samsung	CL10B103KB8NNNC
C9-C10 C26 C34 C36 C41	6	1uF	Samsung	CL10A105KB8NNNC
C14	1	47uF	Murata	GRM188R60J476ME15D
C15-C16	2	330uF	Lelon	VZT331M0JTR-0606ACS
C21 C23	2	18pF	Yageo	CC0603JRNPO9BN180
C22 C24	2	27pF	Yageo	CC0603JRNPO9BN270
C37	1	1nF	Yageo	CC0603KRX7R9BB102
C67 C106	2	22uF	Samsung	CL10A226MP8NUNE
C82	1	470nF	Samsung	CL10B474KA8NNNC

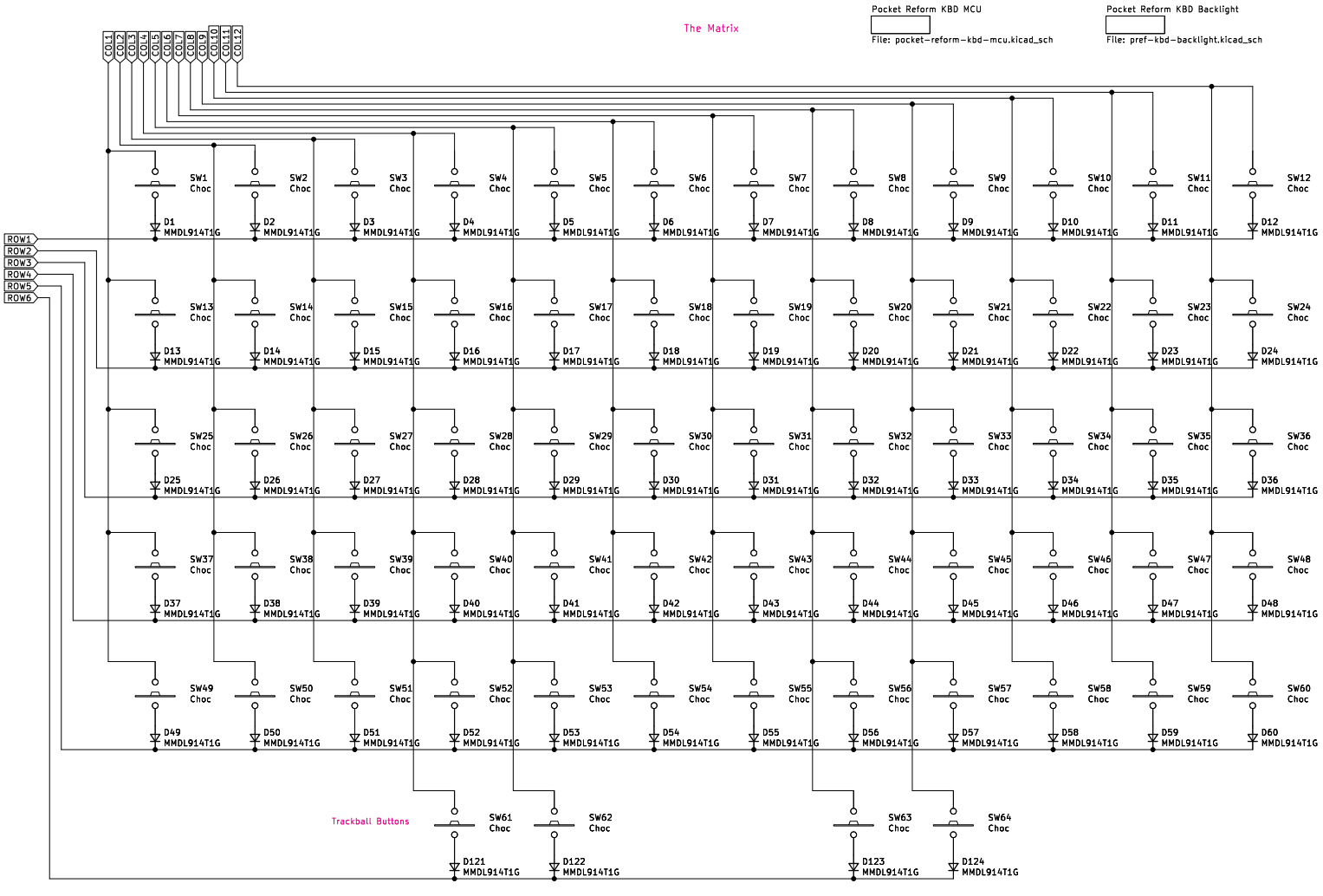
Designator	Qty	Value	Brand	Part Number
C83 C123-C124 C126	4	47uF	Murata	GRM188R60J476ME15D
C94 C100	2	10uF	Samsung	CL05A106MP5NUNC
C96	1	DNP	Samsung	CL05B104KO5NNNC
C102-C103	2	47uF	Murata	GRM31CR61A476ME15L
D1	1		Everlight	19-217/R6C-AL1M2VY/3T
D2 D4-D6	4		Nexperia	PMEG4050EP,115
D3	1		Nexperia	PMEG1020EA,115
D8-D9	2		Everlight	19-217/R6C-AL1M2VY/3T
D10	1		Everlight	19-337/R6GHBHC-A01/2T
D11	1		MDD	SS54
D12	1		AVX	SD0603S040S0R2
D23	1		Everlight	19-217/R6C-AL1M2VY/3T
FB1 FB7 FB11	3		Murata	BLM18KG221SN1D
FB2 FB8-FB10 FB12-FB16	9		Murata	BLM18PG121SN1D
FB3-FB4 FB6	3		Murata	BLM18PG121SN1D
FB5	1		Murata	BLM18PG121SN1D
H5 H7	2		Wurth	9774020243R
H8-H9	2		Wurth	9774025243R
J1	1		HR(Joint Tech Elec)	A2001WR-S-09PD01
J2	1		Hirose	DM3AT-SF-PEJM5
J3 J14	2		Molex	105450-0101
J4	1		HARTING	9452812561
J5	1		JST	SM04B-SRSS-TB(LF)(SN)
J6	1		JST	SM04B-SRSS-TB(LF)(SN)
J7	1		Molex	467650001
J8	1		Molex	788000001
J9	1		Korean Hroparts	TYPE-C-31-M-12

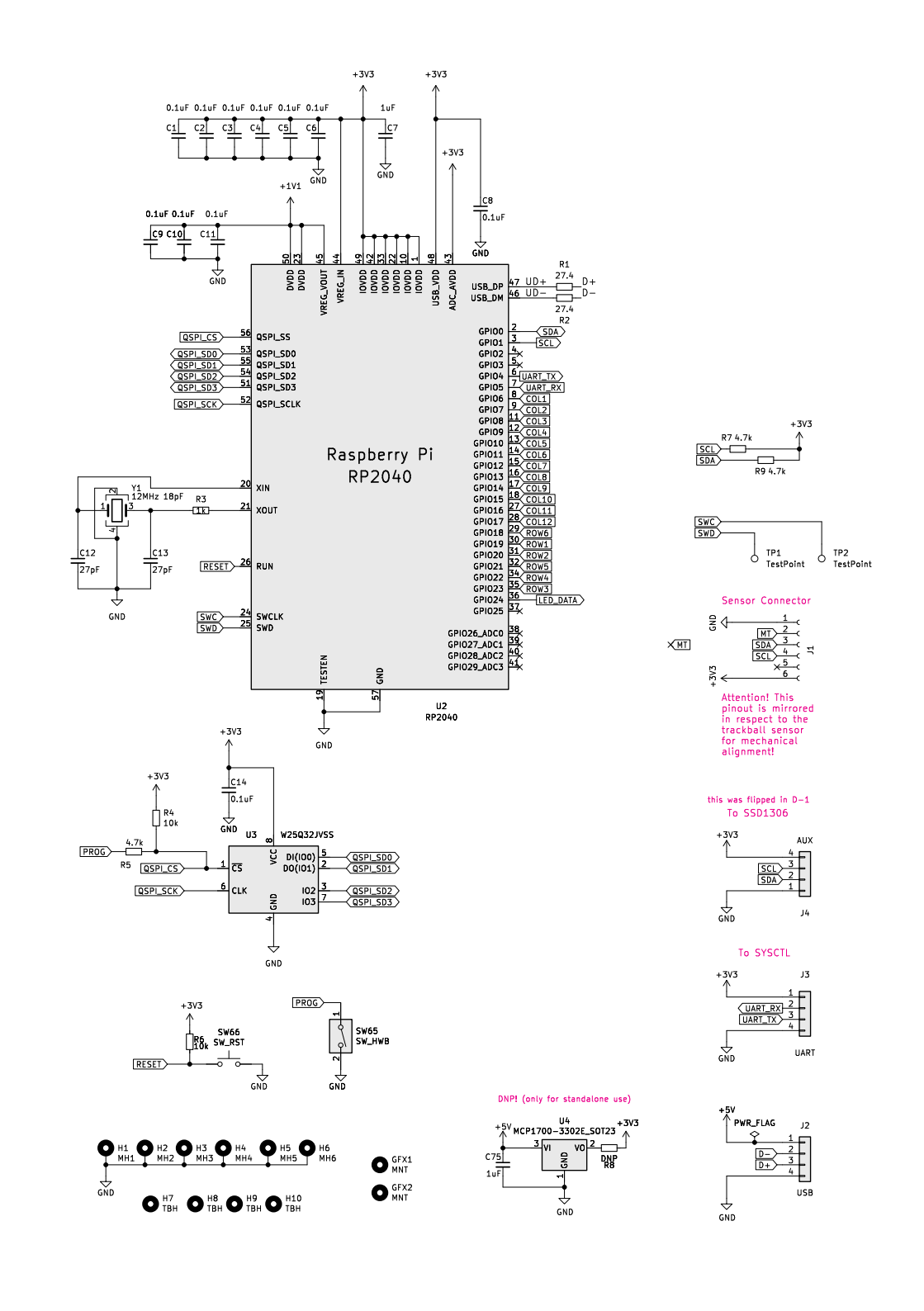
Designator	Qty	Value	Brand	Part Number
J10	1		TE	1-2199230-6
J11	1		Jushuo	AFC07-S33FCC-00
J12	1		TE	1-2199230-5
J13	1		TE	3-2328724-1
J15	1		Molex	53261-7002
J16	1		Samtec	TSM-106-01-T-SH
J17	1		JST	SM02B-SRSS-TB(LF)(SN)
J18	1		JST	SM05B-SRSS-TB(LF)(SN)
J20	1		JST	SM04B-SRSS-TB(LF)(SN)
J21	1		Harwin	M22-5320305
L1	1	22uH	YJYCOIN	YNR3015-150M
L2	1	3.3uH	Murata	LQH32PN3R3NN0L
L3-L4	2	15uH	Vishay	IHLP4040DZER150M11
L5-L6	2	15uH	Taiyo Yuden	NRH3012T150MN
R1 R29 R34-R36 R58 R60-R61 R110	9	1kΩ	Yageo	RC0402FR-071KL
R2	1	1MΩ	Yageo	AC0402FR-071ML
R3	1	90.9kΩ 1%	UNI-ROYAL	0402WGF9092TCE
R4-R5 R9 R11-R13 R19 R27 R33 R44-R46 R50 R53-R54 R65-R67 R81 R103-R109 R111	27	0Ω	Panasonic	ERJ2GE0R00X
R6-R8 R69-R70 R87	6	100kΩ	Yageo	RC0402FR-07100KL

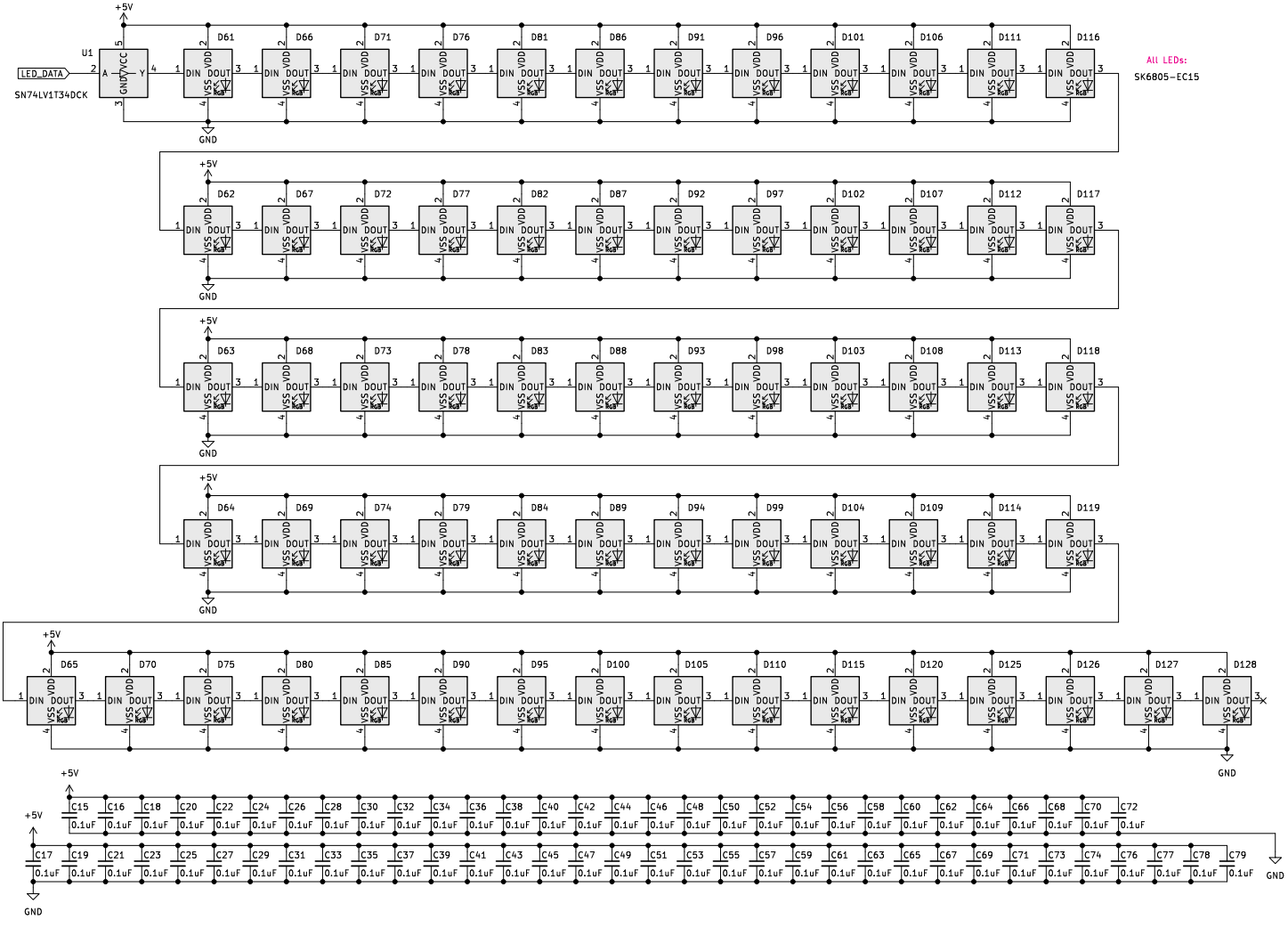
Designator	Qty	Value	Brand	Part Number
R10 R15 R17 R20 R22 R24 R26 R28 R30 R38 R52 R56 R68 R72 R75 R85 R96	17	10kΩ	Yageo	RC0402FR-0710KL
R14	1	8.25kΩ	UNI-ROYAL	0402WGF8251TCE
R16	1	3.16kΩ	Yageo	RC0402FR-073K16L
R18	1	5.76kΩ	UNI-ROYAL	0402WGF5761TCE
R21 R55 R62 R74 R78 R86 R88	7		DNP	DNP
R23	1	9.53kΩ 1%	FH	RC-02W9531FT
R25 R42-R43 R57 R59 R89 R93 R95 R101	9	4.7kΩ	Yageo	RC0402FR-074K7L
R37 R39-R41	4	75Ω 1%	Panasonic	ERJ2RKF75R0X
R47-R48	2	27.4Ω	UNI-ROYAL	0402WGF274JTCE
R64	1	2.2kΩ	Yageo	RC0402FR-072K2L
R73 R97-R100	5	47kΩ	Yageo	AC0402FR-0747KL
R76-R77 R79-R80 R82	5	33Ω	Yageo	RC0402FR-0733RL
R83-R84	2	22kΩ	Yageo	AC0402FR-0722KL
R90	1	27kΩ	Panasonic	ERJ2RKF2702X
R198-R199	2	49.9Ω	Yageo	RC0402FR-0749R9L
SW1	1		Dongguan Guangzhu	DSIC01LSGET
SW2	1		XKB	TS-1185EC-C-D-B
TR1	1		Heling	MT24-S1T1
U1	1		TE	1473149-1
U2	1		Maxim	MAX1837EUT33+T
U3	1		Texas Instruments	LM2830XQMFE/NOPB
U4	1		ON	NCV1117ST18T3G

Designator	Qty	Value	Brand	Part Number
U5-U6	2		Texas Instruments	TPS5450DDAR
U7	1		Texas Instruments or UMW	SN74LVC1G34DCKR
U8	1		Raspberry Pi	RP2040
U9	1		Texas Instruments	TPS7A0533PDBZ
U10	1		Winbond	W25Q32JVSS
U11	1		NXP	PCF8523T/1,118
U12	1		Diodes, Inc.	AP22815AWT-7
U13 U24	2		Texas Instruments	TXS0108EPW
U14	1		Texas Instruments	SN74AVC1T45DBVR
U15-U16 U19-U22	6		Texas Instruments	TPD4E02B04DQAR-TP
U17	1		Texas Instruments	TPD12S521
U18	1		Texas Instruments	TLV320AIC3100
U23	1		ON Semi	FUSB302BMPX
U25	1		Texas Instruments	TUSB8041
U26	1		Nexperia	74HC573PW,118
Y1	1	24MHz	Seiko Epson	X1E0000210264
Y2	1	12MHz 18pF	Seiko Epson	Q22FA23V0041800
Y3	1	32.768 kHz	Seiko Epson	Q13FC1350000200

9.3 Keyboard Schematics


The Matrix
Pocket Reform KBD MCU
File: pocket-reform-kbd-mcu.kicad_sch
Pocket Reform KBD Backlight
File: pref-kbd-backlight.kicad_sch
COL1
COL2
COL3
COL4
COL5
COL6
COL7
COL8
COL9
COL10
COL11
COL12
ROW1
ROW2
ROW3
ROW4
ROW5
ROW6
SW1 Choc
D1 MMDL914T1G
SW2 Choc
D2 MMDL914T1G
SW3 Choc
D3 MMDL914T1G
SW4 Choc
D4 MMDL914T1G
SW5 Choc
D5 MMDL914T1G
SW6 Choc
D6 MMDL914T1G
SW7 Choc
D7 MMDL914T1G
SW8 Choc
D8 MMDL914T1G
SW9 Choc
D9 MMDL914T1G
SW10 Choc
D10 MMDL914T1G
SW11 Choc
D11 MMDL914T1G
SW12 Choc
D12 MMDL914T1G
SW13 Choc
D13 MMDL914T1G
SW14 Choc
D14 MMDL914T1G
SW15 Choc
D15 MMDL914T1G
SW16 Choc
D16 MMDL914T1G
SW17 Choc
D17 MMDL914T1G
SW18 Choc
D18 MMDL914T1G
SW19 Choc
D19 MMDL914T1G
SW20 Choc
D20 MMDL914T1G
SW21 Choc
D21 MMDL914T1G
SW22 Choc
D22 MMDL914T1G
SW23 Choc
D23 MMDL914T1G
SW24 Choc
D24 MMDL914T1G
SW25 Choc
D25 MMDL914T1G
SW26 Choc
D26 MMDL914T1G
SW27 Choc
D27 MMDL914T1G
SW28 Choc
D28 MMDL914T1G
SW29 Choc
D29 MMDL914T1G
SW30 Choc
D30 MMDL914T1G
SW31 Choc
D31 MMDL914T1G
SW32 Choc
D32 MMDL914T1G
SW33 Choc
D33 MMDL914T1G
SW34 Choc
D34 MMDL914T1G
SW35 Choc
D35 MMDL914T1G
SW36 Choc
D36 MMDL914T1G
SW37 Choc
D37 MMDL914T1G
SW38 Choc
D38 MMDL914T1G
SW39 Choc
D39 MMDL914T1G
SW40 Choc
D40 MMDL914T1G
SW41 Choc
D41 MMDL914T1G
SW42 Choc
D42 MMDL914T1G
SW43 Choc
D43 MMDL914T1G
SW44 Choc
D44 MMDL914T1G
SW45 Choc
D45 MMDL914T1G
SW46 Choc
D46 MMDL914T1G
SW47 Choc
D47 MMDL914T1G
SW48 Choc
D48 MMDL914T1G
SW49 Choc
D49 MMDL914T1G
SW50 Choc
D50 MMDL914T1G
SW51 Choc
D51 MMDL914T1G
SW52 Choc
D52 MMDL914T1G
SW53 Choc
D53 MMDL914T1G
SW54 Choc
D54 MMDL914T1G
SW55 Choc
D55 MMDL914T1G
SW56 Choc
D56 MMDL914T1G
SW57 Choc
D57 MMDL914T1G
SW58 Choc
D58 MMDL914T1G
SW59 Choc
D59 MMDL914T1G
SW60 Choc
D60 MMDL914T1G
Trackball Buttons
SW61 Choc
D121 MMDL914T1G
SW62 Choc
D122 MMDL914T1G
SW63 Choc
D123 MMDL914T1G
SW64 Choc
D124 MMDL914T1G

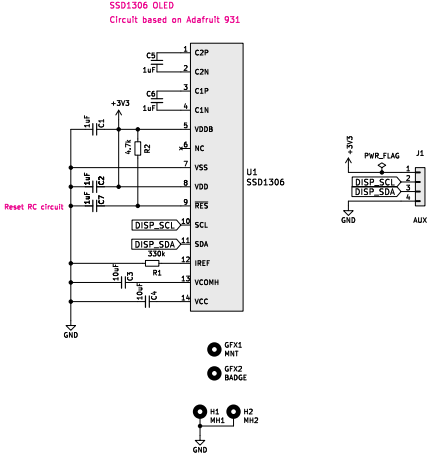

Raspberry Pi
RP2040
U2
RP2040
+3V3
+1V1
GND
0.1uF 0.1uF 0.1uF 0.1uF 0.1uF 0.1uF
C1 C2 C3 C4 C5 C6
1uF
C7
C8
0.1uF
0.1uF 0.1uF 0.1uF
C9 C10 C11
DVDD DVDD VREG_VOUT VREG_IN IOVDD IOVDD IOVDD IOVDD IOVDD IOVDD USB_VDD ADC_AVDD
USB_DP USB_DM
R1 27.4
R2 27.4
UD+ UD−
D+ D−
QSPI_CS QSPI_SS
QSPI_SD0 QSPI_SD1 QSPI_SD2 QSPI_SD3
QSPI_SCK QSPI_SCLK
GPIO0 SDA
GPIO1 SCL
GPIO4 UART_TX
GPIO5 UART_RX
GPIO6 COL1
GPIO7 COL2
GPIO8 COL3
GPIO9 COL4
GPIO10 COL5
GPIO11 COL6
GPIO12 COL7
GPIO13 COL8
GPIO14 COL9
GPIO15 COL10
GPIO16 COL11
GPIO17 COL12
GPIO18 ROW6
GPIO19 ROW1
GPIO20 ROW2
GPIO21 ROW5
GPIO22 ROW4
GPIO23 ROW3
GPIO24 LED_DATA
GPIO25
GPIO26_ADC0
GPIO27_ADC1
GPIO28_ADC2
GPIO29_ADC3
Y1 12MHz 18pF
R3 1k
C12 27pF
C13 27pF
XIN XOUT
RESET RUN
SWC SWCLK
SWD SWD
TESTEN
R7 4.7k
R9 4.7k
TP1 TestPoint
TP2 TestPoint
Sensor Connector
J1
MT
SCL SDA
Attention! This pinout is mirrored in respect to the trackball sensor for mechanical alignment!
this was flipped in D−1
To SSD1306
J4 AUX
To SYSCTL
J3 UART
R4 10k
R5 4.7k
PROG
U3 W25Q32JVSS
CS CLK DI(IO0) DO(IO1) IO2 IO3 VCC
R6 10k
SW66 SW_RST
SW65 SW_HWB
H1 MH1
H2 MH2
H3 MH3
H4 MH4
H5 MH5
H6 MH6
H7 TBH
H8 TBH
H9 TBH
H10 TBH
GFX1 MNT
GFX2 MNT
DNP! (only for standalone use)
U4 MCP1700-3302E_SOT23
C75 1uF
DNP R8
J2 USB
PWR_FLAG
+5V


LED_DATA
U1
SN74LV1T34DCK
+5V
GND
All LEDs:
SK6805-EC15
D61 D66 D71 D76 D81 D86 D91 D96 D101 D106 D111 D116
D62 D67 D72 D77 D82 D87 D92 D97 D102 D107 D112 D117
D63 D68 D73 D78 D83 D88 D93 D98 D103 D108 D113 D118
D64 D69 D74 D79 D84 D89 D94 D99 D104 D109 D114 D119
D65 D70 D75 D80 D85 D90 D95 D100 D105 D110 D115 D120 D125 D126 D127 D128
C15 C16 C18 C20 C22 C24 C26 C28 C30 C32 C34 C36 C38 C40 C42 C44 C46 C48 C50 C52 C54 C56 C58 C60 C62 C64 C66 C68 C70 C72
C17 C19 C21 C23 C25 C27 C29 C31 C33 C35 C37 C39 C41 C43 C45 C47 C49 C51 C53 C55 C57 C59 C61 C63 C65 C67 C69 C71 C73 C74 C76 C77 C78 C79
0.1uF

9.4 Keyboard Bill of Materials

Designator	Qty	Value	Brand	Part Number
C1-C6 C8-C11 C14-C74 C76-C79	75	0.1uF	Yageo	CC0603JPX7R9BB104
C7 C75	2	1uF	Yageo	CC0603KRX5R8BB105
C12-C13	2	27pF	Yageo	CC0603JRNPO9BN270
D1-D60 D121-D124	64		ON	MMDL914T1G
D61-D120 D125-D128	64		OPSCO	SK6805-EC15
J1	1		Hirose	FH12-6S-0.5SH(55)
J2	1		JST	SM04B-SRSS-TB(LF)(SN)
J3	1		JST	SM04B-SRSS-TB(LF)(SN)
J4	1		XFCN	F1002-B-04-20T-R
R1-R2	2	27.4Ω	Yageo	RC0603FR-0727R4L
R3	1	1kΩ	Yageo	RC0603JR-071KL
R4 R6	2	10kΩ	Yageo	RC0603JR-0710KL
R5 R7 R9	3	4.7kΩ	Yageo	RC0603FR-074K7L
R8	1	DNP	Yageo	RC0603JR-070RL
SW1-SW64	64		Kailh	CPG135001D02
SW65	1		XKB	TS-1185EC-C-D-B
SW66	1		XKB	TS-1185EC-C-D-B
U1	1		Texas Instruments	SN74LV1T34DCKR
U2	1		Raspberry Pi	RP2040
U3	1		Winbond	W25Q32JVSS
U4	1		Microchip	MCP1700T-3302E/TT
Y1	1	12MHz 18pF	Seiko Epson	Q22FA23V0041800

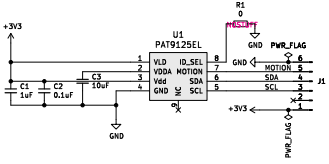
9.5 OLED Schematics


SSD1306 OLED
Circuit based on Adafruit 931
C5
1uF
C6
1uF
+3V3
1uF
C1
4.7k
R2
Reset RC circuit
1uF
C2
1uF
C7
DISP_SCL
DISP_SDA
330k
R1
10uF
C3
10uF
C4
GND
C2P
C2N
C1P
C1N
VDDB
NC
VSS
VDD
RES
SCL
SDA
IREF
VCOMH
VCC
1
2
3
4
5
6
7
8
9
10
11
12
13
14
U1
SSD1306
+3V3
PWR_FLAY
GND
J1
DISP_SCL
DISP_SDA
AUX
GFX1
MNT
GFX2
BADGE
H1
MH1
H2
MH2
GND

9.6 OLED Bill of Materials

Designator	Qty	Value	Brand	Part Number
C1-C2 C5-C7	5	1uF	Yageo	CC0603KRX5R8BB105
C3-C4	2	10uF	Taiyo Yuden	LMK107BJ106MALTD
H1	1			DNP
H2	1			DNP
J1	1		XFCN	F1002-B-04-20T-R
R1	1	330kΩ	Yageo	RC0603FR-07330KL
R2	1	4.7kΩ	Yageo	RC0603FR-074K7L
U1	1		Enrich Electronics	ENH-OB00910003

9.7 Trackball Sensor Schematics



H1
MountingHole

H5
MountingHole

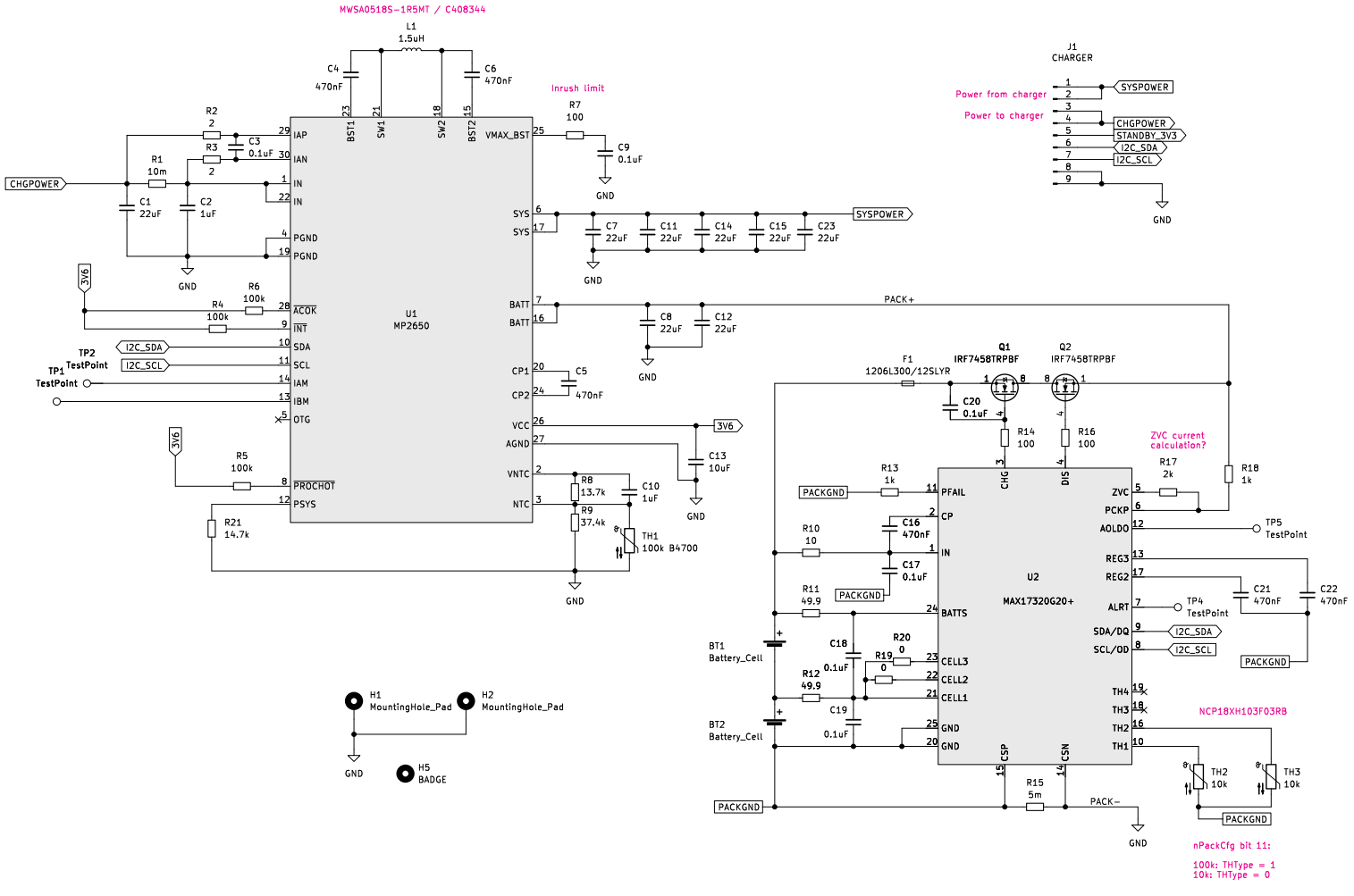
H7
LOGO

H8
LOGO

9.8 Trackball Sensor Bill of Materials

Designator	Qty	Value	Brand	Part Number
C1	1	1uF	TDK	C1608X8L1C105K080AC
C2	1	0.1uF	Yageo	CC0603JPX7R9BB104
C3	1	10uF	Taiyo Yuden	LMK107BBJ106KALT
J1	1		Hirose	FH12-6S-0.5SH(55)
R1	1	0Ω	DNP	DNP
U1	1		PixArt Imaging	PAT9125EL

9.9 Charger Schematics


MWSA0518S-1R5MT / C408344
L1
1.5uH
C4
470nF
C6
470nF
BST1
SW1
SW2
BST2
Inrush limit
R7
100
C9
0.1uF
R2
2
R3
2
C3
0.1uF
R1
10m
C1
22uF
C2
1uF
CHGPOWER
IAP
IAN
IN
IN
PGND
PGND
VMAX_BST
SYS
SYS
C7
22uF
C11
22uF
C14
22uF
C15
22uF
C23
22uF
SYSPOWER
3V6
R6
100k
R4
100k
ACOK
INT
U1
MP2650
BATT
BATT
C8
22uF
C12
22uF
PACK+
TP2
TestPoint
TP1
TestPoint
I2C_SDA
I2C_SCL
SDA
SCL
IAM
IBM
OTG
CP1
CP2
C5
470nF
VCC
AGND
3V6
C13
10uF
R5
100k
PROCHOT
PSYS
VNTC
NTC
R8
13.7k
C10
1uF
R9
37.4k
TH1
100k B4700
R21
14.7k
GND
J1
CHARGER
Power from charger
Power to charger
SYSPOWER
CHGPOWER
STANDBY_3V3
I2C_SDA
I2C_SCL
F1
1206L300/12SLYR
Q1
IRF7458TRPBF
Q2
IRF7458TRPBF
C20
0.1uF
R14
100
R16
100
ZVC current calculation?
R17
2k
R18
1k
R13
1k
PACKGND
PFAIL
CP
IN
BATTS
CELL3
CELL2
CELL1
GND
GND
CHG
DIS
ZVC
PCKP
AOLDO
REG3
REG2
ALRT
SDA/DQ
SCL/OD
TH4
TH3
TH2
TH1
CSP
CSN
U2
MAX17320G20+
TP5
TestPoint
TP4
TestPoint
C21
470nF
C22
470nF
R10
10
C16
470nF
C17
0.1uF
R11
49.9
R12
49.9
C18
0.1uF
R19
0
R20
0
C19
0.1uF
BT1
Battery_Cell
BT2
Battery_Cell
R15
5m
PACK-
NCP18XH103F03RB
TH2
10k
TH3
10k
nPackCfg bit 11:
100k: THType = 1
10k: THType = 0
H1
MountingHole_Pad
H2
MountingHole_Pad
H5
BADGE

9.10 Charger Bill of Materials

Designator	Qty	Value	Brand	Part Number
BT1-BT2	2		JST	S2B-PH-SM4-TB
C1 C7-C8 C11-C12 C14-C15 C23	8	22uF	Murata	GRM21BR61E226ME44L
C2 C10	2	1uF	Samsung	CL10A105KB8NNNC
C3 C9 C17-C20	6	0.1uF	Taiyo Yuden	GMK107B7104KAHT
C4-C6 C16 C21-C22	6	470nF	Taiyo Yuden	UMK107B7474KAHTE
C13	1	10uF	Taiyo Yuden	TMK107BBJ106MA-T
F1	1		Littelfuse	1206L300/12SLYR
J1	1		HR(Joint Tech Elec)	A2001WR-S-09PD01
L1	1	1.5uH	Sunlord	MWSA0518S-1R5MT
Q1-Q2	2		Infineon	IRF7458TRPBF
R1	1	10mΩ	FH	MFJ06HR010FT
R2-R3	2	2Ω	Panasonic	ERJ3GEYJ2R0V
R4-R6	3	100kΩ	Panasonic	ERJ3EKF1003V
R7 R14 R16	3	100Ω	Walsin	WR06X101JTL
R8	1	13.7kΩ	Bourns	CR0603-FX-1372ELF
R9	1	37.4kΩ	Bourns	CR0603-FX-3742ELF
R10	1	10Ω	Panasonic	ERJ3EKF10R0V
R11-R12	2	49.9Ω	Panasonic	ERJ3EKF49R9V
R13 R18	2	1kΩ	Walsin	WR06X1001FTL
R15	1	5mΩ	prosemi	LMJ12MF1P0R005
R17	1	2kΩ	Walsin	WR06X104JTL
R19-R20	2	0Ω	Generic	0Ohms 0603
R21	1	14.7kΩ	LIZ	CR0603FA1472G
TH1	1		Panasonic	ERTJ1VV104J
TH2-TH3	2		Murata	NCP18XH103F03RB
U1	1		MPS	MP2650
U2	1		Maxim	MAX17320G20+

9.11 Assembly Parts

Designator	Qty	Brand	Part Number
Charger Green Cable JST-SH 4P	1	MNT Research	PREF-CBLCG-10R01
Charger Black Cable JST-SH 4P	1	MNT Research	PREF-CBLCB-10R01
MIPI-DSI Cable FPC 0.5mm 33P 50mm	1	Würth Elektronik	687733050002
OLED Cable 1mm Pitch 50mm	1	Würth Elektronik	686704050001
Power Switch Cable JST-SH 2P	1	MNT Research	PREF-CBLPWR-10R01
Sensor Cable 6P 50mm 0.5mm Pitch	1	Würth Elektronik	687606050002
SYSCTL Cable JST-SH 4P	1	MNT Research	PREF-CBLPWR-10R01
Speaker Cable JST-SH 5P	1	MNT Research	PREF-CBLSPK-10R01
USB Cable JST-SH 4P	1	MNT Research	PREF-CBLUSB-10R01
Display Panel with Flex Cable	1	JDI	LT070ME05000
Battery Cell LiPo 4000mAh	2	Eremit	606090
Battery Holder A (SLA Ledo 6060)	2	MNT Research	PREF-BATHLA-10R01
Battery Holder B (SLA Ledo 6060)	2	MNT Research	PREF-BATHLB-10R01
Hinge	1	Smooth Technology	SMS-ZZ-219-L
Hinge	1	Smooth Technology	SMS-ZZ-219-R
Keycap 1U	64	FKcaps	MNT Pocket
Neodymium Bar Magnet	8	MNT Research	PREF-MAGNET-10R01
POM Ball Black 15mm	1	MNT Research	PREF-TBBALL-10R01
Shunt 2mm Pitch	2	Adam Tech	MS2B-G
Speaker	1	CUI Devices	CES-361811-18PM-67
Thermal Pad 25×25mm	1	Würth Elektronik	40016020

Designator	Qty	Brand	Part Number
Trackball Cup (SLA Ledo 6060)	1	MNT Research	PREF-TBCUP-10R01
Trackball Bearing Steel 2.5mm	3	Generic	Various

Chapter 10

Online Resources

Get the latest news and additional resources for MNT Pocket Reform at:

- The MNT Research website: `https://mntre.com`
- The MNT Community forum: `https://community.mnt.re`
- Source code repositories (including electronics design files and 3D models for printing and laser cutting): `https://source.mnt.re/reform/pocket-reform`
- MNT Research on Crowd Supply: `https://www.crowdsupply.com/mnt`
- MNT Research Shop: `https://shop.mntre.com`
- For email support, contact: `support@mntre.com`
- Modularity explained (including a comparison table of Processor Modules): `https://mntre.com/modularity.html`
- PDF and web versions of manuals, including this handbook: `https://mntre.com/docs-pocket-reform.html`

You can join fellow MNT Pocket Reform enthusiasts in the official IRC channel `#mnt-reform` on `irc.libera.chat`.

Discover more about the main software building blocks of the MNT Pocket Reform system:

- Debian GNU/Linux: `https://debian.org`

- U-Boot: `https://docs.u-boot.org/en/latest/`
- Sway: `https://swaywm.org`
- Wayfire: `https://wayfire.org`

Chapter 11

Credits

The MNT Pocket Reform Operator Handbook, First Edition. Berlin, April 2024. Written by Lukas F. Hartmann and Anri Paul Hennies. Published by MNT Research GmbH.

Concept, Electronics, Software Lukas F. Hartmann

Industrial Design Ana Beatriz Albertini Dantas

Quality & Assembly, Sleeve Design Greta Melnik

Assembly & Testing Liaizon Wakest

Handbook Design 100rabbits, Lukas F. Hartmann

3D Illustration Lukas F. Hartmann, Philipp Brömme

2D Illustration Anri Paul Hennies

Accounting Christian 'plomlompom' Heller

Debian Integration & Tooling Johannes Schauer Marin Rodrigues

Contributions & Thanks Pooja Channaveerappa, Katharina Withelm, Brendan Nystedt, Birute Mazeikaite, timonsku, Dirk Eibach, F. Schneider, Marek Vasut, Zoé & Elen (Fully Automated)

Therapy Dog Tina

Crowdfunding Partner Crowd Supply

Additional Funding NLNet

Printed Circuit Boards PCBWay, JLCPCB

Milling JPR

Inter Font @rsms

Lab Tools Rigol DS1054Z, Fluke 117, Weller WD-1, Puhui T-962C, AmScope SM-4T, BCN3D Sigma R17, Formlabs Form2, Epilog Mini 18, Prusa i3 MK3S+

Software Debian GNU/Linux, KiCad, Inkscape, GIMP, Emacs, Vim, GitLab, Blender, FreeCAD, OpenSCAD, Fusion, Sphinx, Pandoc, XeTeX, Scribus

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