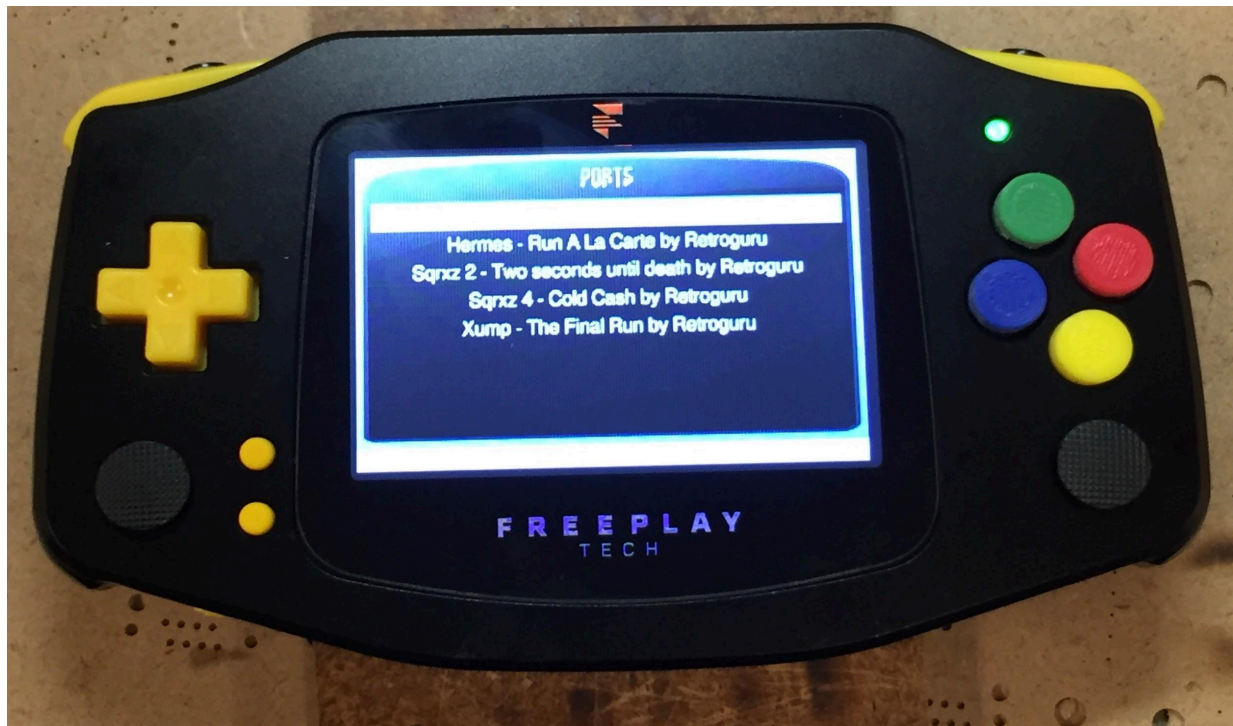


Assembling BoxyPixel Dual Analog Build with Freeplay CM3

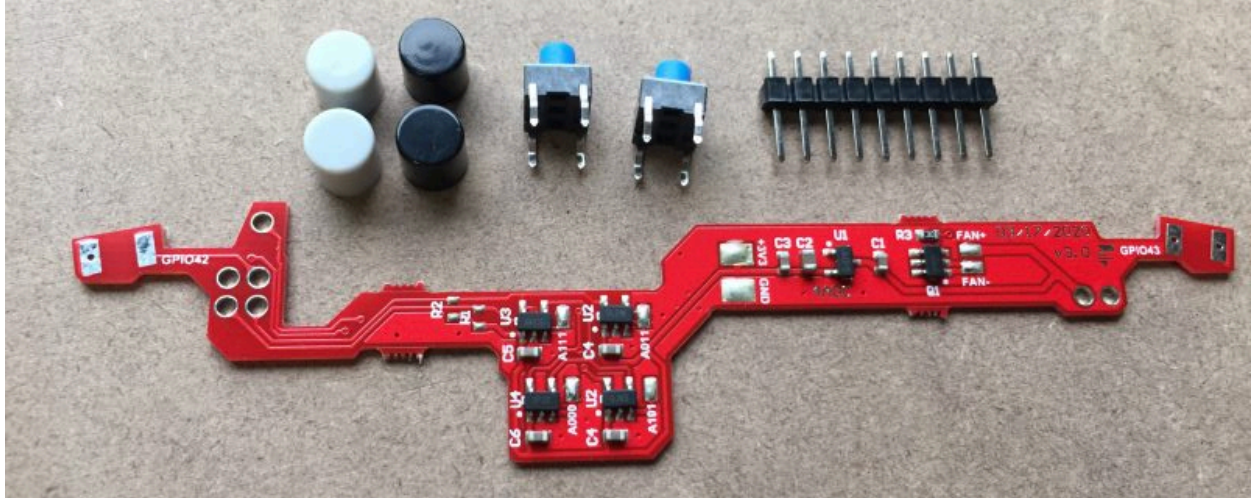
This is a living document. It may change at any time.

(Sprechen Sie **Deutsch**? There is also a [“fan translation” German Version](#) of this document.)



Parts that come with the “Freeplay CM3 L2R2 Boxy Pixel Dual Analog (4 ADC) Add-On Board”

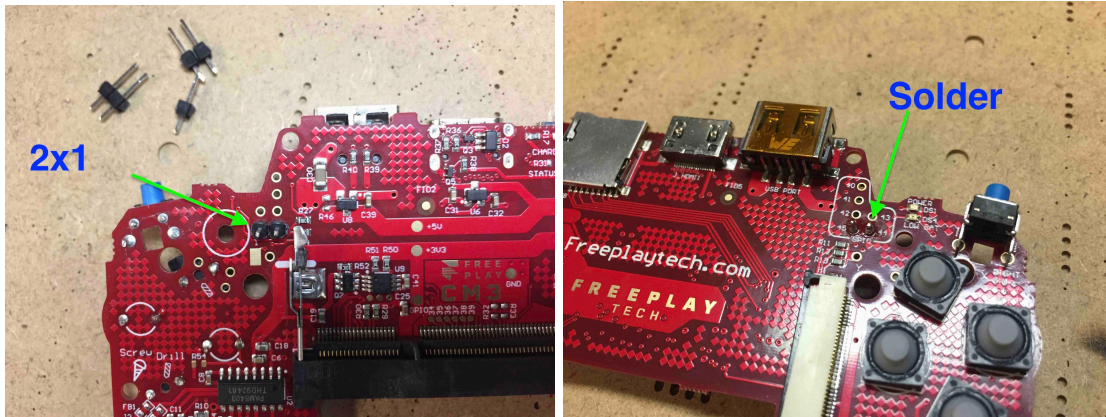
- 2x - Grey Buttons
- 2x - Black Buttons
- 2x - Momentary Buttons
- 1x - Male Header
- 1x - 4ADC add-on PCB



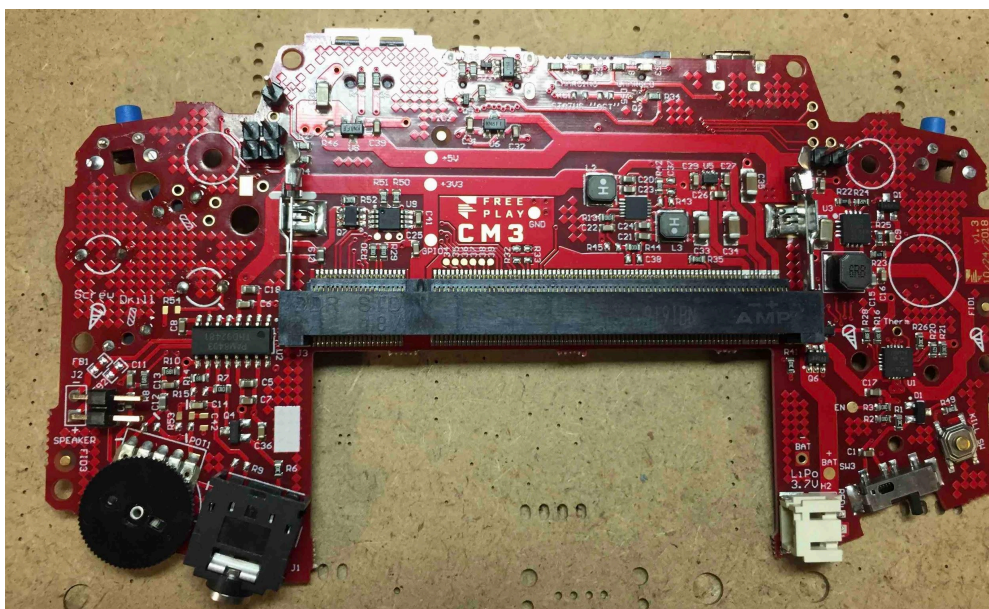
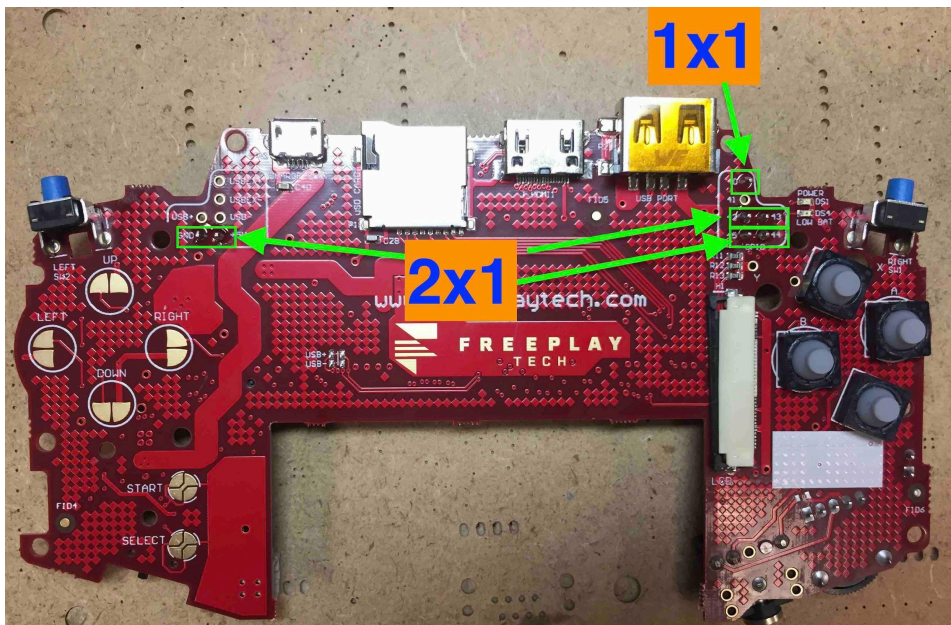
Other items that are needed for this build:

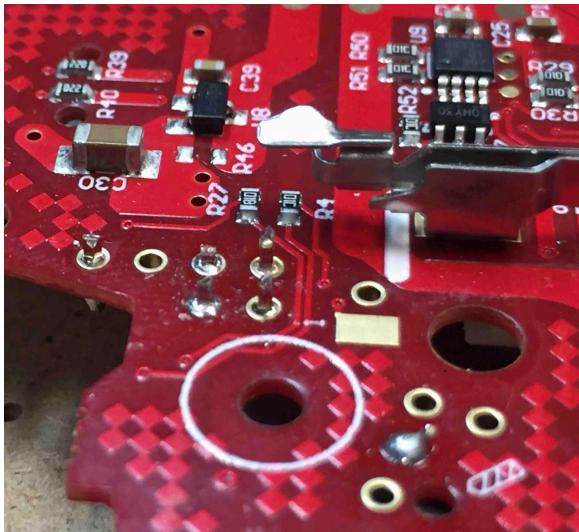
- 1x - Freeplay CM3 Kit
- 1x - BoxyPixel 2 dual Analogy Shell
- 1x - Freeplay Fan (optional)
- 2x - PSP-1000 Joystick
- Small Wire
- Double-sided sticky tape
- Soldering Iron
- GBA shoulder plastics, D-pad rubber, and Power switch plastic

Break up the header strip so you have 3 strips of size 2x1 and 1 of a singular 1x1. Place the first 2x1 horizontally like the figure below on the left. Then flip it over and solder the pins.

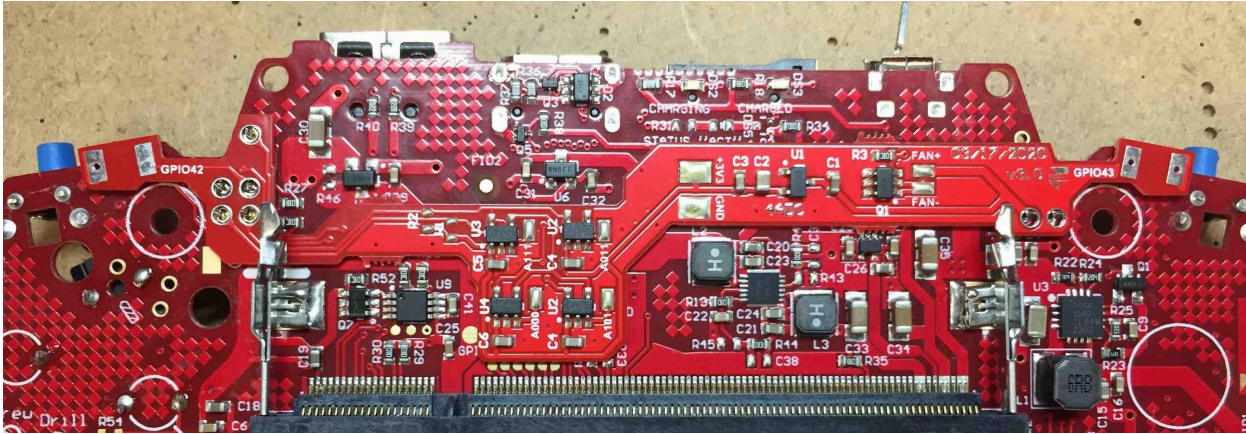


Now solder 5 more pins so it appears like the following 2 figures.

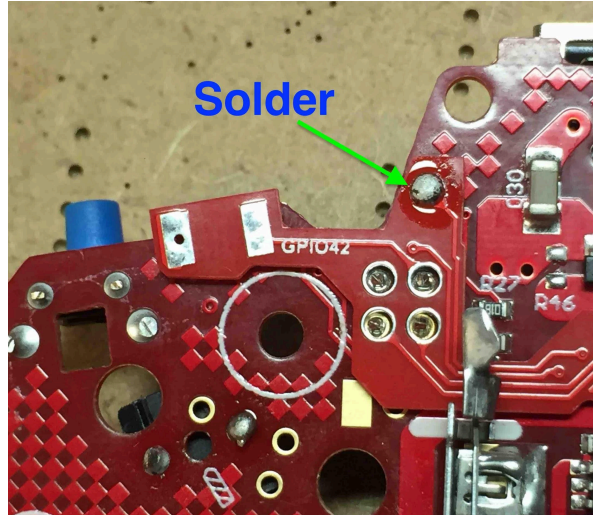
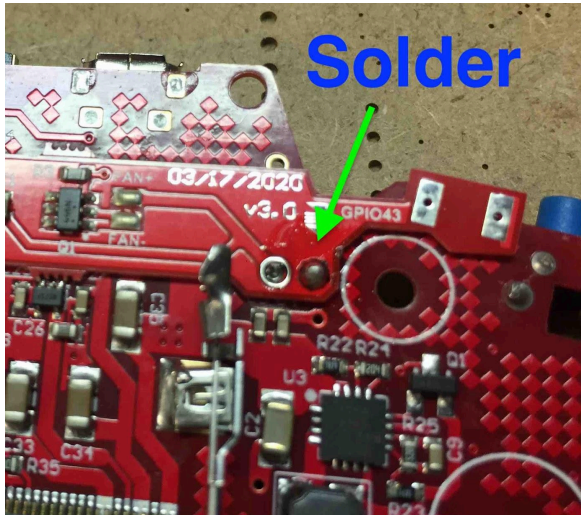




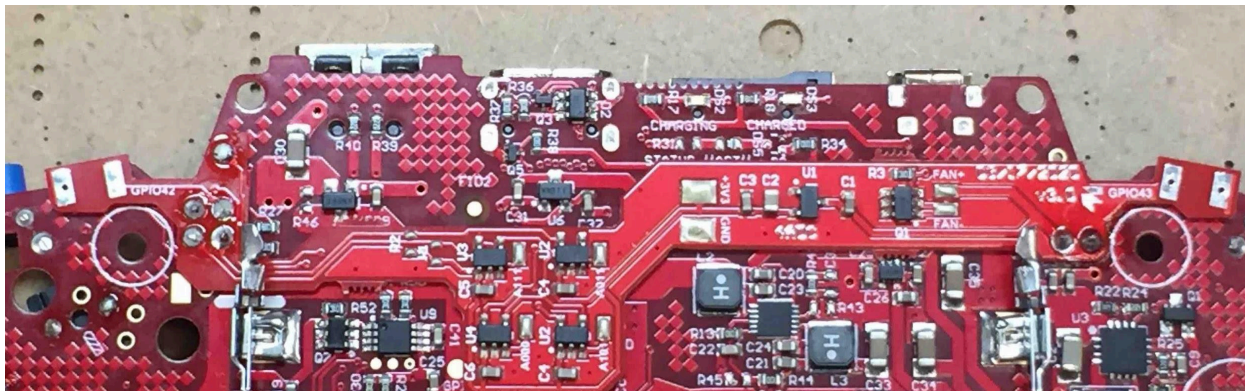
Now, place the 4ADC board on the CM3 as shown below. **Note: if the pins are not cut short enough, the board will not fit into the slot.**



Next, solder the far right pin shown in the next figure on the left. Then, solder the upper left pins of the add-on board, shown in the figure on the right.



If the other pins look aligned after soldering the end pins, then solder the rest of the add on board pins.

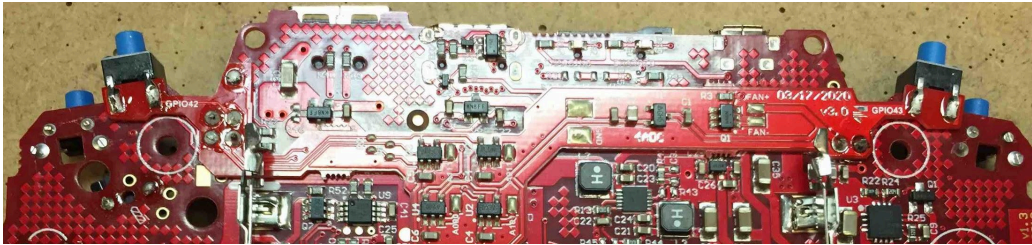
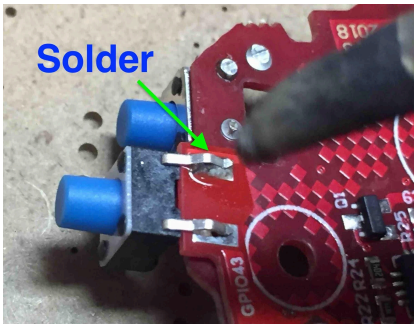


NOTE: Make sure that you also cut off any excess pin sticking out the opposite side of the main circuit board when you're done. You may also need to cover this area with kapton/electrical tape to make sure that it does not contact the LCD or shell.

Now, cut two legs off the buttons that came with the add on kit. *Note: It does not matter which side of the switch you cut, but make sure when you cut two legs that they are on the same side as each other.*



Next, solder on the 2 L2/R2 buttons as shown in the next two photos.

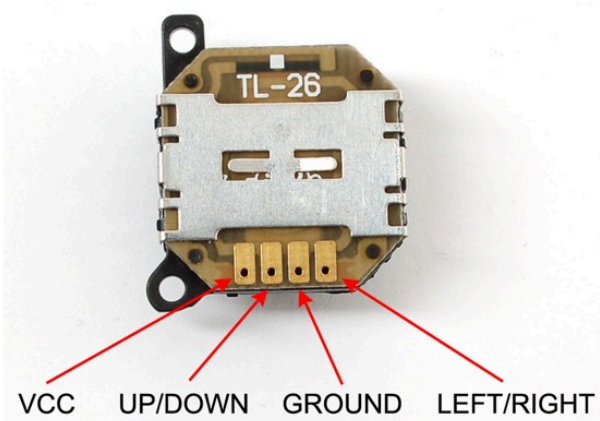


Now take your PSP sticks and cut the mounting holes off.



Remove the cap and play around with the tolerance of the joystick in the BoxyPixel shell and decide if you want to add some shims or double-sided tape. We added the grey double-sided tape on the side well shown in the next photo.





The BoxyPixel housing was designed so that the PSP sticks are to be placed in the same direction as each other. The solder pads on the joystick will face to the right when looking at the backside of the faceplate. Next find some small wire and solder wires to the joystick (pictured below). *Note: remember your color and pin out of your connections. I would suggest you keep both joysticks the same color of wires for each respective pin.*



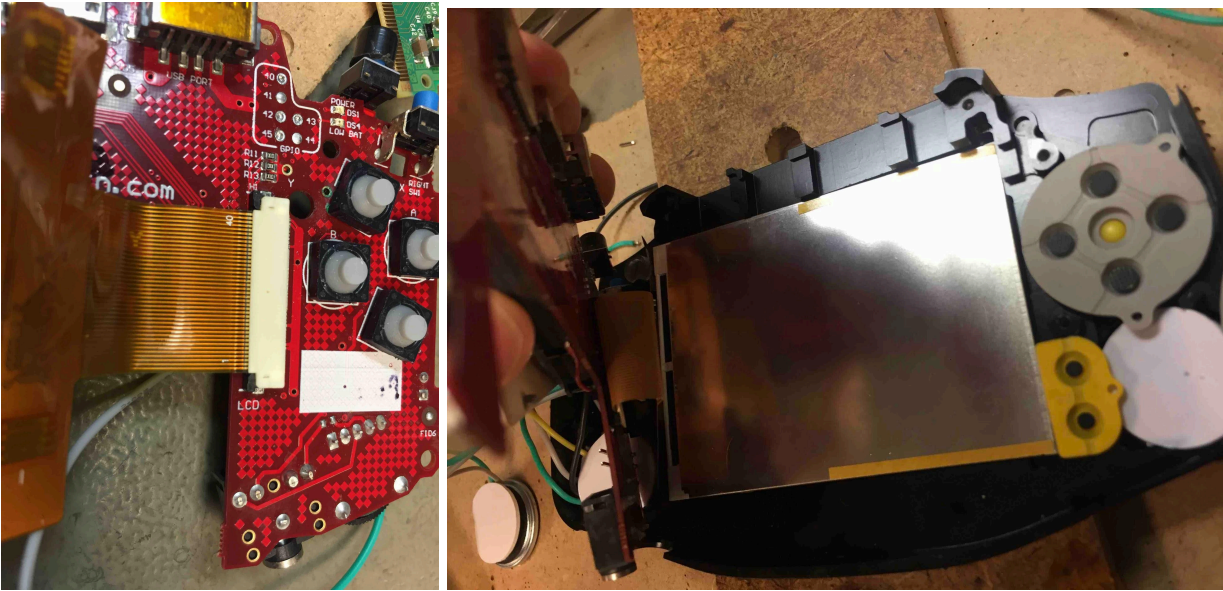
Now add the light pipe, ABXY if you have not already, D-PAD, rubber pads and some foam pads to the back of the PSP sticks. When fully assembled, the PSP sticks will be pushing up against the front of the CM3 PCB, which is what we don't want, so you will need to add a small foam pad or something similar to take up that gap. We used the same foam that is used on the back of the CM3 speaker.



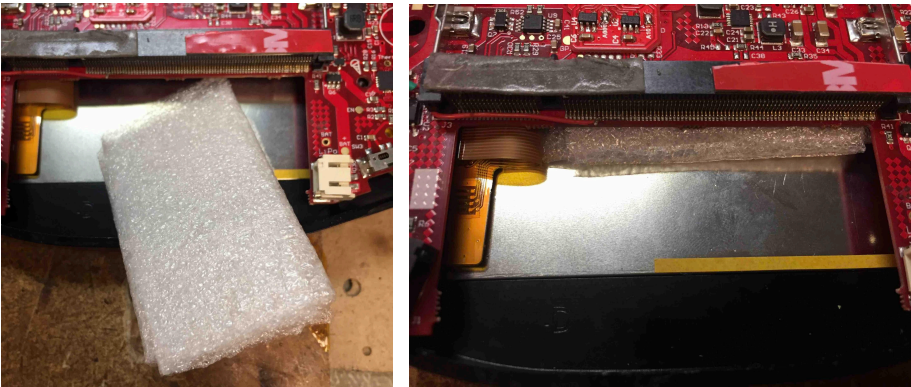
At this point I would make sure that your Freeplay works outside of the shell laying on your workbench before you go any further. If you have not done this go here and find the appropriate setup for your build. This would include preparing a SD card and verifying that your unit boots, LCD display is working, your buttons work (excluding analog input).

<https://www.freeplaytech.com/support/setup/>

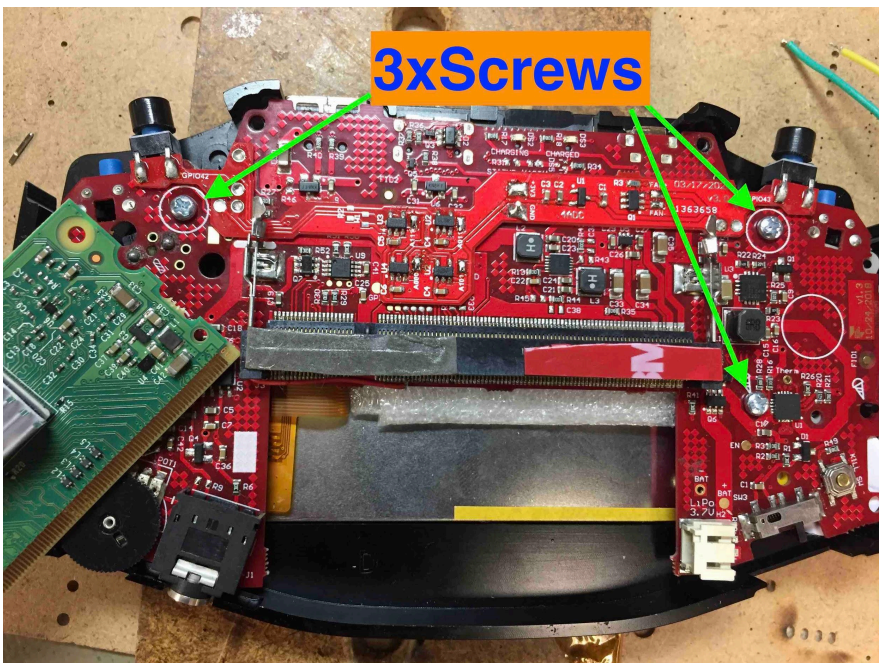
Next, attach the LCD and place it in the front plate.



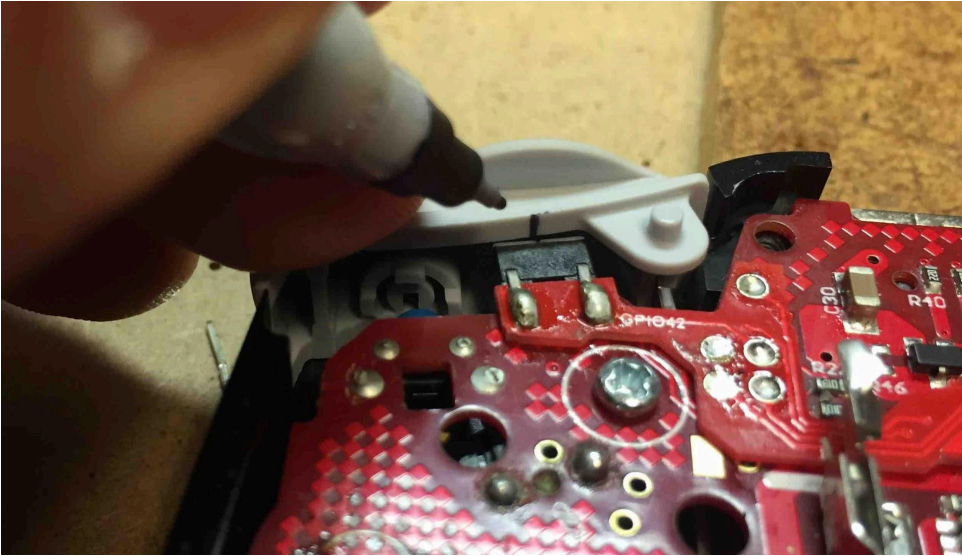
Then, use a piece of foam or something to take up the gap between the LCD and the Freeplay CM3 board.



Next, place 3 screws to hold the Freeplay to the BoxyPixel faceplate.



Take the shoulder plastics and place them in their mounting spots. Mark the center of the button for the new L2/R2 add on.



Take the shoulder plastics off and make a dot in-line with the mark you made in the last step and in the middle of the walls.

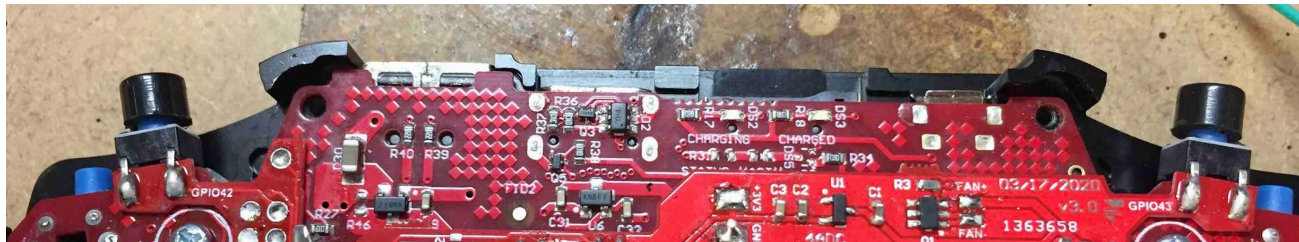


Next make a small drill hole where you made a dot in the last set and then increase the bit size to $\frac{1}{4}$ " if you want to use the Black or Grey buttons that came with the kit. If you need to move the hole or adjust, use an Exacto knife where needed.

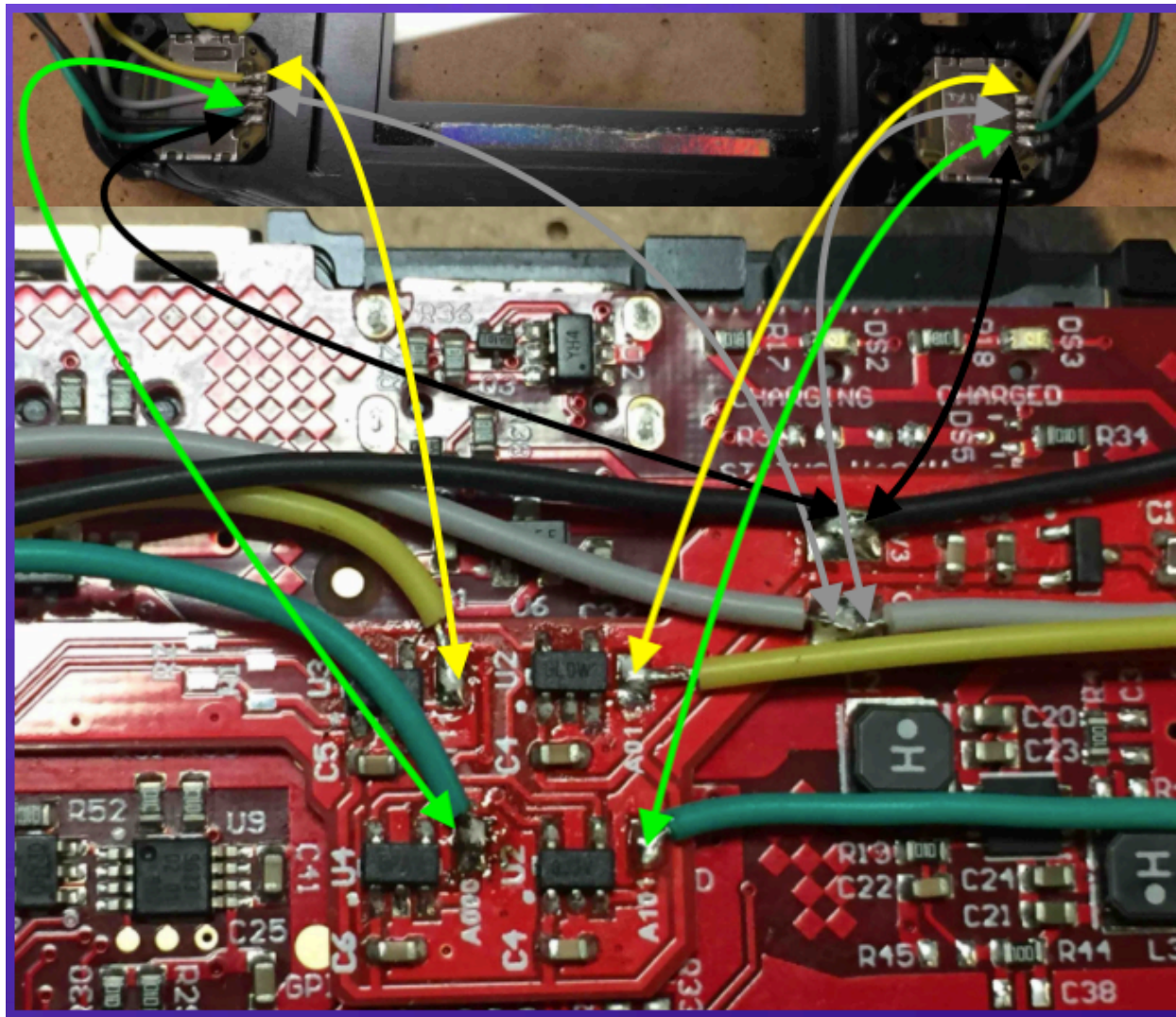




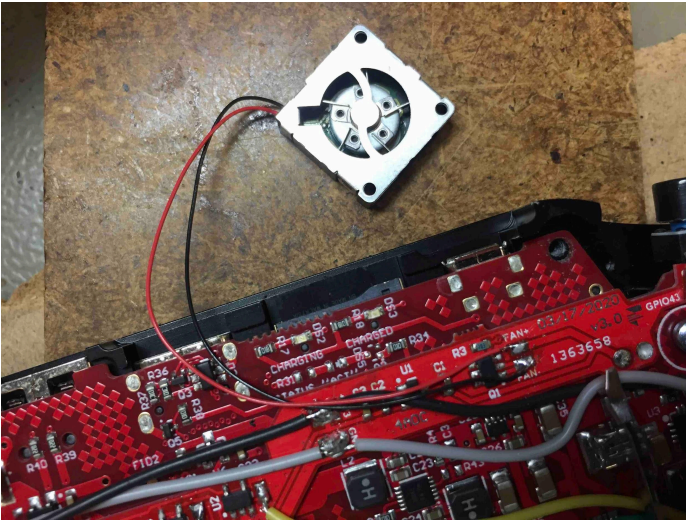
Play around with the shoulder buttons If you want the L2/R2 buttons to not stick out as much, then we suggest cutting the button to about 60% of the original height.



Now solder the ADC pins for the PSP Analog joystick. In this photo, gray is GND, black is 3V3 (3.3 volts DC), and green and yellow are the ADC lines.

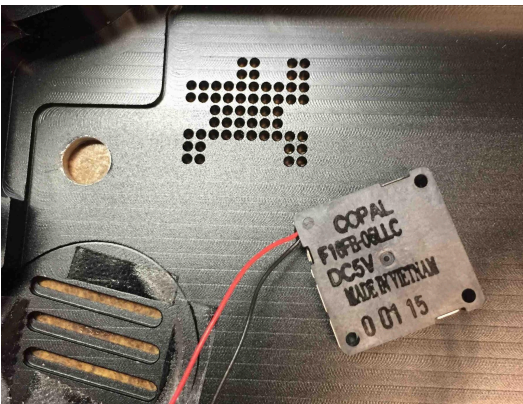
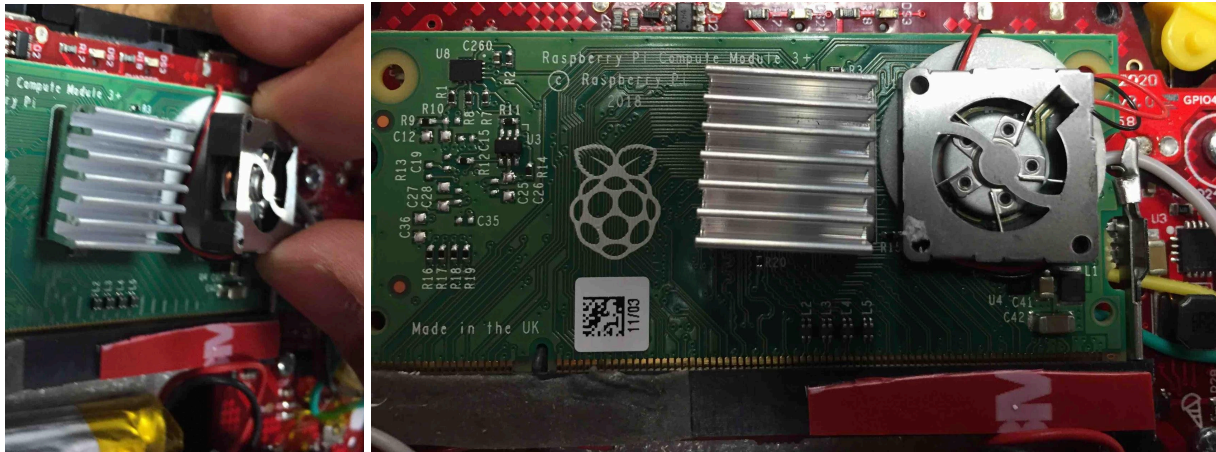


If you ordered a Fan now is the time to solder that in. Red wire to Fan+ and Black wire to Fan-.

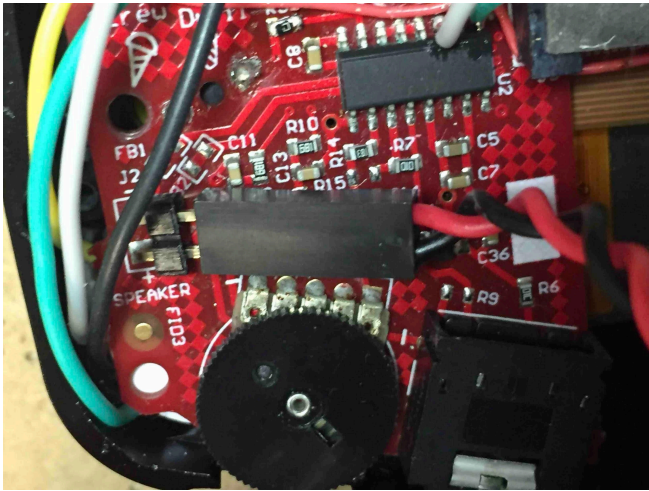


Install the CM3 + Lite and make sure this is no added stress due to the wires being underneath the Pi. If there is stress on the Pi then try r- routing the wires and grouping them differently. Once the Pi is installed you can add the Heatsink. If you are using a fan I would recommend putting the heatsink horizontally.

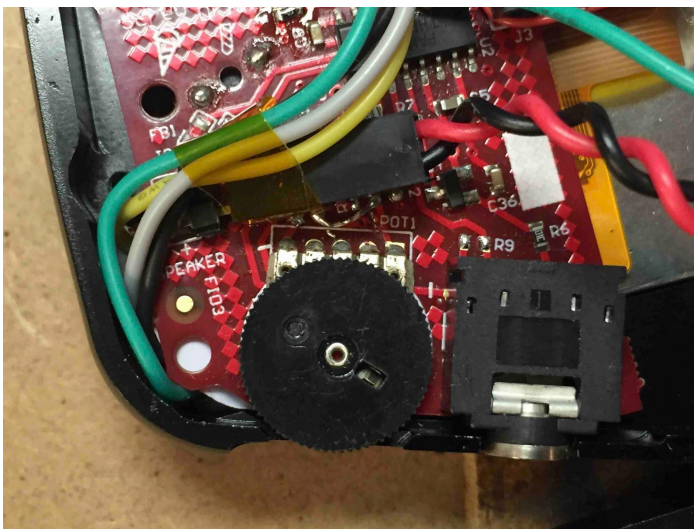
For the fan, you could mount it in several places, one being on the backplate, another on the pi on either side of the CPU. We decided to put it to the right and attached it with double stick foam shown below. Make sure the blower is facing the heatsink if you install like we did.



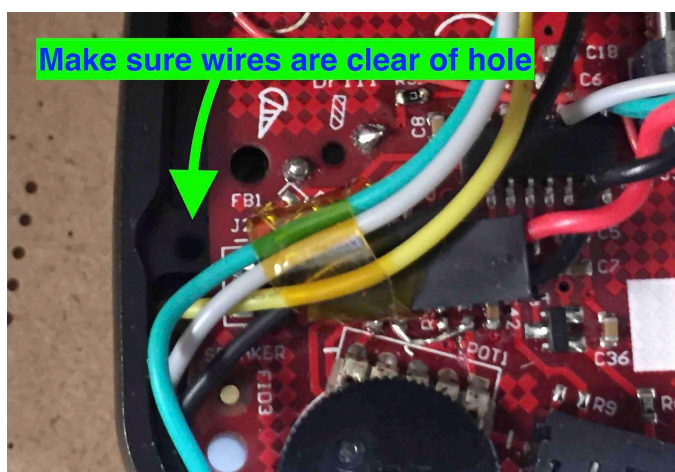
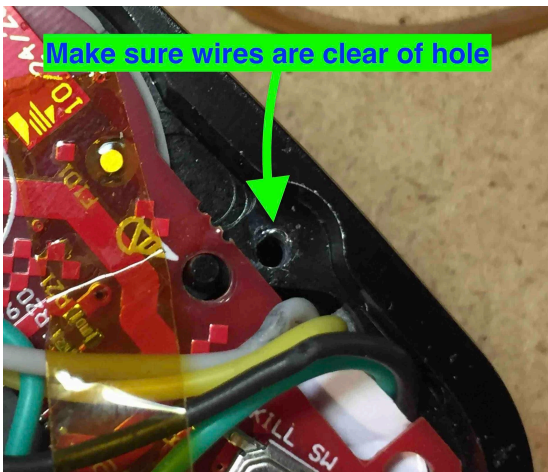
Next, install the speaker in J2. Add some double-sided sticky tape or something else to retain the speaker on the back of the shell.



Add tape and cluster wires near speaker pins and tape on the other side near the kill button. This will make it easier to close the shell.



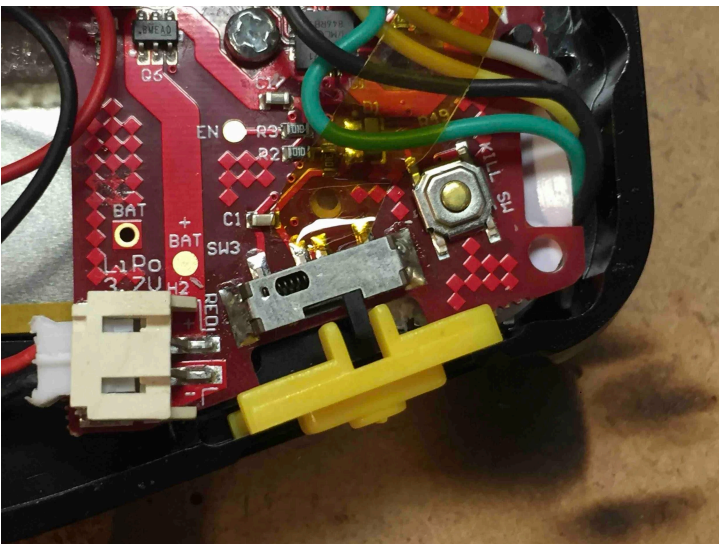
Take note of where the wires are.



Install the battery.



Add and clip the small contour in the power switch. If this small cut is not made, the power switch will get stuck to an indent in the case, while the power switch on the circuit board is designed to turn on by being held for a few seconds and released.



At this point the unit should be able to be put together with the 4 screws on the back. Boot the unit up.



Software Setup

SSH into your Freeplay CM3 and run these commands

```
cd /home/pi/Freeplay
mv mk_arcade_joystick_rpi mk_arcade_joystick_rpi_old
git clone https://github.com/TheFlav/mk\_arcade\_joystick\_rpi.git
cd /home/pi/Freeplay/mk_arcade_joystick_rpi
./install.sh
```


Make sure it says “DKMS: install completed.” near the end of the output. If you see the word **FATAL** or **ERROR** near the bottom, it could be that the script installed a new kernel, and it can’t complete until you are running that kernel. Reboot the system and run the install script (the previous two commands) again. If that doesn’t fix the problem, please post a copy of the output at <https://forum.freeplaytech.com/showthread.php?tid=4669>

After that, shut the machine down and boot it back up.

```
sudo shutdown -h now
```

After the machine shuts down, ssh back in and run these commands:

```
cd /home/pi/Freeplay/mk_arcade_joystick_rpi
make config
```

We recommend using hotkey toggle mode and the POWER button as the hotkey toggle, but you don’t have to.

The command will ask you to select which MCP to use. Our boards have the MCP3021A, which the command should detect.

That should allow you to configure and define all of your buttons. At the end of that process, it should output something like “Saved: /etc/modprobe.d/mk_arcade_joystick.conf”

For more details about this setup process, refer to https://github.com/TheFlav/mk_arcade_joystick_rpi.

After configuring the options you need for your setup, reboot. When you are back at the main menu, go through this process:

- Press Start (or SPACE on the keyboard if it’s plugged in)
- Choose CONFIGURE INPUT
- Hold down the A button to begin the process
- Set up the buttons however you wish
- The last item will be the hotkey. If you chose to use the hotkey toggle mode, double-tap the POWER button to define it as the hotkey.

Optional Fan Attachment

You can use several things to attach your fan to the add-on board. We recommend using the included double-stick foam tape. You can cut a square piece of tape, attach it, and then cut out the circular middle before sticking the fan to the circuit board. Be sure to attach the fan such that it sucks air from the open circle and blows air out the side toward the heatsink.

Contact us at support@freeplaytech.com if you are adding a fan and need some assistance. You have some options about how to set it up to run constantly or for it to be software controlled.

The fan will be controlled by GPIO 40 of the Raspberry Pi Compute Module 3.

To use the official fan control software, run the following over ssh:

```
ls /boot/overlays/gpio-fan.dtbo
    To see if you already have the proper device tree blob overlay.
```

If you don't have the overlay file, you can try to just download it or download the source and compile it.

--- Download it ---

```
cd /boot/overlays/
sudo wget https://github.com/raspberrypi/firmware/raw/master/boot/overlays/gpio-fan.dtbo
```

--- Download Source and Compile ---

```
wget https://raw.githubusercontent.com/raspberrypi/linux/rpi-4.19.y/arch/arm/boot/dts/overlays/gpio-fan-overlay.dts
sudo dtc -W no-unit_address_vs_reg -@ -I dts -O dtb -o /boot/overlays/gpio-fan.dtbo gpio-fan-overlay.dts
```

Then, to configure it:

```
sudo nano /boot/config.txt
```

add one line that looks like this near the bottom, or edit a line that has `dtoverlay=gpio-fan` if it exists:

```
dtoverlay=gpio-fan,gpiopin=40,temp=60000
```

You could also change the temperature at which the fan switches on using the *temp* parameter. The parameter is in millicelsius, and the default is 55000 (AKA 55 degrees celsius).

Also, I would say that the default gpio-fan temp is somewhat aggressive. It will basically run the fan anytime the CPU is in use at all. I think 60C or 65C may be better if you don't want the fan to run as often. Our "old" way of doing it would turn the fan on at 60C and then turn it off when it got down to 55C (if I recall correctly). The gpio-fan module will turn the fan on at the specified temp and then turn it off at 10C less than the turn on setting, and this would be 55C on and 45C off by default.

Alternatively, if you would like our version that will require more tweaking but give you the opportunity to edit code to your liking, you can use <https://github.com/TheFlav/rpi-fan>.