5" Display Kippah Portable Raspberry Pi

Created by Ruiz Brothers

https://learn.adafruit.com/portable-kippah-pi

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Overview

Portable Pi

There are many applications where a portable Raspberry Pi can be really useful. In most general use-cases, it's convenient to have a Raspberry Pi, display and battery contained in a nice package. In this project, we'll put together a portable Raspberry Pi with a battery and display. This project is relatively simple to put together and only requires a few wired connections.

Touch screen UPDATE

New version of enclosure now works with 5" 40-pin TFT Display with Touchscreen and Adafruit DPI TFT Kippah for Raspberry Pi with Touch Support
http://www.adafruit.com/product/1596 ()
http://www.adafruit.com/product/2453 ()

Follow the Kippah Touch tutorial () for setting up the software. The 3D printed parts are on thingiverse (labeled v2).
Kippah Sauce

This project utilizes the Adafruit DPI Display Kippah "hat-like" board to drive a 5" TFT display without the extra cost and baggage of an HDMI decoder. Kippah gives you nice ultra-fast 18-bit color display. This works great with the 5" displays at 800x480. This display is 'native' so it gets all the graphics acceleration capabilities, instant refresh, etc. you would get from an HDMI display.
PowerBoost 1000C

The PowerBoost 1000C provides 5V @ 1A of regulated power to the Raspberry Pi, Kippah and PAM8302 amplifier. On board charging let's you recharge a lipo battery over microUSB. In this project we are able to comfortably fit a 2500mAh lipo battery in the 3D printed enclosure.

![Image of PowerBoost 1000C](image)

Built-in Audio (Optional)

There's enough room in the enclosure to fit a thin plastic speaker and a mono Class D audio amplifier. We can wire up an audio cable (3.5mm jack) to the amp and plug it into the audio jack on the Raspberry Pi. This portion can be optional, but the keep in mind there's no access to the audio jack on this 3D printed enclosure.

In most cases (with terminal), there is noticeable audio interference. The interference is minimized with the use of startx and emulationstation.

3D Printing

This project enclosure was designed specially to fit the components listed in the sidebar and below. The parts unfortunately will not fit on smaller print beds (like the Printrbot Simple). To print the parts, you'll need access to a printer with a minimum build plate of 100mm x 168mm x 30mm.
No 3D printer? You could send the parts to be printed by a service like 3D Hubs, MakerXYZ or shapeways. You could also try checking out your local hacker/maker space or library.

Prerequisite Guides

Check out the guides below to get a better understanding of the Kippah and the Raspberry Pi 2 or B+ (The enclosure is compatible with both).

- Adafruit DPI Display Kippah
- Introducing Raspberry Pi 2
- Introducing Raspberry Pi B+

Parts

- Adafruit DPI Display Kippah
- Raspberry Pi 2
- Raspberry Pi B+
- 5" TFT display 40-pin
- PowerBoost 100C
- PAM8302 Amplifier
- Thin plastic speaker
- 2500mAh lithium polymer battery
- Slide switch
- Right-angle 3.5mm stereo plug to pigtail cable
- 3/8" to 1/4" Adapter Screw [Adafruit website](http://adafruit.it/2392)
- Swivel-Head Pan Tilt [Adafruit website](http://adafruit.it/2464)
Tools and Supplies

- 3D Printer
- Filament
- Wire Strippers/Cutters
- 30/26AWG silicone-coated stranded wire
- Soldering Iron
- Solder
- Helping-third hands
- Panavise Jr.
- 6 #2-56 3/8 flat Phillips machine screws
- 8 #4-40 3/8 flat Phillips machine screws

Circuit Diagram

The slide switch connects to the EN and GND pins on the PowerBoost1000C.
Connect 5V and GND on the Kippah to the 5V and GND pins on the PowerBoost 1000C.

The Vin and GND pins audio amplifier will connect to a set of positive+ and negative- pins on PowerBoost1000C.

The speaker connects to the positive+ and negatives- audio out pin on the PAM8302 amplifier.

Stereo audio cable plugs into the audio jack on the Raspberry Pi and connects to A+ and A- on the amp.

The 5" TFT display connects to a 40-pin FPC extension connector. An included 40-pin cable connects from the Kippah to the extension to the 5" display.

JST cable from the lipo battery connects directly to the JST port on the PowerBoost1000C.

Installation

If you just plug in the DPI Kippah, it won't work on a fresh installation of Raspbian! You must set up the special device tree overlay configuration!

However, its not too bad, check it out below!

We've only tested this device tree overlay/firmware with Raspbian. Since its a bit of a hack, it doesn't work with the native pre-boot 'NooBS' screen. However, it does come up immediately with Raspbian (e.g. you get to see the rainbow square screen)

Note these instructions are tested to work with Raspbian Stretch as of 2019/04/11

Connect Display

The DPI Kippah has a 40-pin TFT connector. This is a semi-standard connector. A majority of 3.5", 4.3", 5.0" and 7.0" dot-clock DPI displays have this 'standard 40-pin' connector.
Check the Downloads page for an example datasheet so you can check if your display is compatible. All Adafruit 40-pin TFT TTL displays work, we do not guarantee any other displays work.

In fact, if you connect a display that does not match the right pinout, you could easily fry the display if the 20V backlight pin ends up connected to a logic pin!

To connect, gently pull on the two black 'ears' on the FPC connector, and plug in the display so the gold/silver metallic pins are facing 'up' away from the PCB.

Update & Upgrade

Start by updating and upgrading your Raspberry Pi to the latest software.
We want to get the most recent kernel and firmware, so run

```
sudo apt-get install rpi-update
```

and then

```
sudo rpi-update
```
Then reboot with `sudo reboot`

Install and Try raspi-gpio

To help us debug/make sure we have the right device tree blob, we'll use a tool called raspi-gpio

Install it with

`sudo apt-get install raspi-gpio`

Then you can run it with
When you run it this time, you'll see the first 'bank' of GPIO pins set to, essentially

GPIO nn: level=1 fsel=0 alt= func=INPUT

Install Device Tree Blob

Now download and install the DPI device tree blob (tip o' the hat to aBUGsworstnightmare ()) from github by running:

% cd ~
% wget https://raw.githubusercontent.com/adafruit/Adafruit-DPI-Kippah/master/dt-blob.bin
% sudo cp dt-blob.bin /boot/

in your Pi's command line, to change directories to the home directory, download the blob, then copy it in /boot
Update configuration

Finally, we'll tell the Pi to use the attached DPI display. The following will work for our 5" and 7" 800x480 displays. Both touch and non-touch displays use the same setup here.

Start by editing with

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

and add the following lines at the bottom:

```
# Disable spi and i2c, we need these pins.
dtparam=spi=off
dtparam=i2c_arm=off

# Set screen size and any overscan required
overscan_left=0
overscan_right=0
overscan_top=0
overscan_bottom=0
framebuffer_width=800
framebuffer_height=480

# enable the DPI display
enable_dpi_lcd=1
display_default_lcd=1

# Enable DPI overlay
dtoverlay=dpi24

# set up the size to 800x480
dpi_group=2
dpi_mode=87

# set up the hsync/vsync/clock polarity and format
dpi_output_format=454661

# set up the size to 800x480
hdmi_timings=800 0 40 48 88 480 0 13 3 32 0 0 60 0 32000000 6
```

For 4.3" TFT use the following:
This sets up the screen, if you ever want to temporarily 'undo the DPI Hat install' just delete these lines

```
enable_dpi_lcd=1
display_default_lcd=1
```

To finish installation, just run `sudo reboot`

**Touch screen support**

If you have a DPI HAT with touchscreen circuitry installed and a touch-screen display, you can easily use it for touch screen support

A microUSB cable is required (not included) connect it from the MicroUSB connector on the HAT into one of the Pi’s USB port
No drivers are required! However, you'll likely want to calibrate the screen. We have a calibration helper python script. Start by installing python-pip and pyusb version 1.0.0b1

```bash
sudo apt-get install python-pip
sudo pip install pyusb==1.0.0b1
```

Then grab the code and example gradient

```bash
cd ~
wget http://adafru.it/ar1100py
mv ar1100py ar1100.py
wget http://adafruit-download.s3.amazonaws.com/gradient800x480.jpg
```

If you are running it on a 5" display, continue as is.

If you are running it on a 7" display, edit with nano ar1100.py and change this line:

```python
writeeeprom = CALIBRATED_5IN_800x480;
```

to

```python
writeeeprom = CALIBRATED_7IN_800x480;
```

Then run the calibrator with:

```bash
cd ~
chmod +x ar1100.py
sudo python ar1100.py
```
Its normal for the first time you run it, it will complain "Couldn't find generic either" just run it again!

Just hit the up arrow on your keyboard and return, to rerun sudo python ar1100.py

This time it will continue, program the AR1100 with the calibration data, and give you a rainbow display.

When done, hit Escape on your keyboard

---

3D Printing
The parts are optimized to print with no support material. The two enclosure parts are held together with machine screws. They're oriented in center and should be good to print as is.

To print the parts, you'll need access to a printer with a minimum build plate of 100mm x 168mm x 30mm.

Customize Design

You can modify the original solids in the CAD files to make a custom project.

Materials

The parts can be printed in different types of filament. The most common filaments like PLA and ABS will do just fine but you can of course experiment with copperFill, bambooFill, Semiflex, PET and Nylon.

Tolerances

The parts were tested with common printing settings (listed in the table). With a parameter of 2 shells, there's only a few areas where tolerances really matter - the port cutouts and the mounting holes.
Test fit the parts by inserting the top enclosure part over the Raspberry Pi. Check to see if the cutouts fit over the USB and ethernet ports. If the cutout is too tight, you can loosen it with a filing tool.

The standoffs with counter bores should fit the machine screws listed in the BOM. These can be threaded by fastening in the appropriate sized screw.

**Bed Leveling**

Any parts with large surface require a well leveled build plate. If you're using a heated bed, you can minimize warping. Blue painters tape, build tak, and sticky adhesives can help keep your part flat and adhere to the bed.

**Clean up**

If there's any string or artifacts left over from retraction and oozing, clean up the part by trimming them off using a pair of flush snips.

**Assembly**

**Wiring**

First section of the assembly requires measuring wires, cutting, stripping, tinning and soldering. It's a good idea to connect the component and test the circuit before mounting anything to the enclosure.

**Testing**

With the components wired up, we'll test power to ensure all the connections are solid. We connect the display to the kippah and the Raspberry Pi to ensure the circuit is working properly before mounting.

**Mounting**

Once the components are wired up, you'll mount sections of the circuit to the enclosure using machine screws. This will keep everything secured in place.
Process

This assembly is segmented and formatted linearly to make the build an easy experience. Keeping the circuit modular allows you to trouble shoot more easily and makes mounting parts more optimal.

Slide Switch

Prep Wires
Measure, cut and strip two pieces of 30AWG silicone-coated stranded wire.
Tin Wires and Switch
Use a pair of helping third hands to secure wires/switch in place. Apply small amount of solder to the tips of the wires and the terminals on the slide switch.
Connect Wires to Switch
Solder both wires to two terminals on the slide switch (one in the center, and another next to that). Cut a piece of shrink tubing and slide that onto the wire to cover it up. Apply some heat to secure the connections.

Trim off the unused terminals on the side switch.
Slide Switch

The slide switch is now ready for some action! Let's set it aside and get to the next section.

Audio Cable

Measure and Cut

Grab the right-angled stereo plug to pigtail cable and measure up the length you'll need. If you cut it too short, you can always extend by splicing with a longer wire.
Strip It!

You'll want to remove about 10mm of insulation from the audio cable. Use wire cutters or a hobby knife to strip the wire. Carefully bundle the stranded wire and twist it together to make a uniform wire - this is the ground connection.

Tin Wire

Secure the audio cable to third-helping hands. Apply solder to the ground connection. Trim one of the insulated wires (red or white, doesn't matter these are the 'left' and 'right' channels). We only need one channel and the ground connection. Strip and tin the remaining wire.
Extend Ground
Trim off about half of the tinned ground connection (it's too long). Prep a new piece of AWG30 silicone-coated stranded wire by measuring, cutting and stripping. Solder it to the ground connection.
Insulate Ground
Slide a piece of shrink tubing over the ground connection and apply heat to secure the connection. Cut the ground wire to match the length of the channel wire and tin the tip.

Audio Cable
This pigtail is ready for baking!
Amplifier

Prep Wires

You can lay down the Powerboost 1000C and PAM8302 amplifier on the enclosure to get an idea for how long the power and ground wires need to be. Cut two pieces of 26AWG silicone-coated stranded wires.
Tin Wires
Strip the tips of both wire using wire strippers and secure the wires to third-helping hands. Apply a small amount of solder to tin the tips.
Connect Wires to Amp
Apply solder to the pins on the amplifier. To solder the wires to the pins, hold the tip of the soldering iron to the solder joint and insert the wire.

Solder Audio Cable to Amp
Connect the audio cable to the amp by heating A+ and A- pins with the tip of the soldering iron. Insert the white channel wire to A+ and the ground wire to A-.
Connect Speaker to Amp
Apply solder to the positive and negative pins on the amplifier and insert the + and - wires from the speaker to the amp.

Audio Circuit
This beastly audio setup is ready for some thumpin' beats!
Prep Wires

Lay Kippah and Powerboost 1000c on the enclosure to get an idea of wire length. A bit of extra slack is OK, you can shorten it later. 26AWG silicone-coated stranded wire is recommend for power.
Tin Kippah and Wires
Strip and tin the two wires then, apply solder to the 5V and GND pins on the Kippah.

Connect wires to Kippah
Apply heat to the solder joints on Kippah and place the tip of the wires to the 5V and GND pads.
Wired Kippah

This stylin' Kippah is ready for sum Raspberré Pi!

Powerboost 1000C
Install Switch
Insert the wires from the switch to the cutout near the bottom of the enclosure. Press the switch into the cutout to snap it into place.

Machine Screws
You'll need two #4-40 3/8th flat phillips machine screws to secure the PowerBoost 1000C to the enclosure.
Install Screws

Insert the two screws to the bottom of the enclosure and fasten them in until the tip of the thread pokes through the top of the standoff. Lay the PowerBoost 1000C over the screws and fasten the screws all the through while holding the PCB in place.
Connect Switch to PowerBoost 1000C

Solder the two wires from the slide switch to pins EN and GND on the PowerBoost 1000C.
Mounting Components

Install Amp
Lay the PAM8302 PCB over the standoffs on the enclosure and hold it in place while you fasten a single machine screw to the bottom of the enclosure.
Connect PAM8302 to PowerBoost 1000C

Get the power and ground wires from the PAM8302 amplifier and solder them to the positive and negative pins on the PowerBoost 1000C.

Install Speaker

Insert the thin plastic speaker into the cylindrical cavity. Press it down until it snaps into place. Tolerances should be pretty tight.
Plug Audio Cable

Insert the 3.5mm connector from the audio cable into the audio jack on the Raspberry Pi.

Install Raspberry Pi

Lay the PCB over the standoffs with the ports facing the cutout. Line up the mounting holes on the Pi with the holes on the standoffs. Insert four #4-40 3/8 flat Phillips machine screws and fasten them into place from the top of the Pi.
Circuit Checkpoint

The bottom half of the project is pretty much finished. The Rasp Pi and audio setup is installed, mounted and wired!

Kippah Display

Install 40-pin FPC cable

Open the latch from the Kippah PCB and insert the 40-pin FPC cable. Close the latch to secure it in place.
Install Kippah

Lay the Kippah over the Raspberry Pi and line up with socket with the header pins. Press the PCB down to secure it into place.

Connect Kippah to PowerBoost 1000C

Solder the 5V wire from the Kippah to the 5V pin on the PowerBoost 1000C, then solder ground to ground.
Install Display
Insert the display into the top enclosure part at an angle, with the corners going into the clips.

Mount Display
Careful bend the enclosure back until the clips allow the display panel to fit under the clips. These clips will hold the TFT panel in place.
Connect Extension to Display

Pop open the latch from the 40-pin extension and insert the 40-pin cable from the display to the extension board, then close the latch to secure it in place.

Connect 40-pin cable to Extension

Open the latch from the other side of the extension and insert the extension cable connected to the Kippah into the extension board.
Plug in Battery

Connect the JST cable from the lipo battery to the JST connector on the PowerBoost 1000C.

Test Circuit

It's a good idea to check your wiring before closing everything up! Power the circuit on with the slide switch and see if it lights ups.
Closing it up

Cable Management

The wiring should be pretty tight, with the exception of the 40-pin FPC cable. You’ll need to fold this cable and make sure it stays inside the case while closing it up.

Ports

Insert the ports on the Raspberry Pi into the cut outs on the top half of the enclosure. If you find the cutouts too tight, you can open them up with a filing tool.
Fasten Shut

Insert #2-56 3/8 flat phillips machine screws into the six counter bores on the bottom of the enclosure. Hold the two half together while fastening the screws. Fasten them in until you feel they’re completely joined.

Closed Up

The enclosure is now secured shut!
Portable Kippah Pi

This build is pretty much done! You can optionally insert a tripod screw thread to make it mount to any standard tripod.

Tripod Adapter
Insert the tripod screw into the hole and fasten it with a flat phillips screw driver. Fasten it in until the screw is flush with the surface of the enclosure.
Mountable Pi

This is screw thread is a 1/4" to 3/8" adapter for Tripods.

Use and Commence Pi

Boot up the Pi and hook up your favorite keyboard. The 2500mAh battery should give you about 2 hours of use, but it'll vary depending on your application.

What's that orange keyboard?

It's from the Raspberry Pi Kano kit.
Made This? Let us know!

If you made this project, please post a make on our Thingiverse page (). It'll let us know you're awesome and we'll feature it on our 3D Hangout show!