



# Adafruit DPI Display Kippah

Created by lady ada



<https://learn.adafruit.com/adafruit-dpi-display-kippah-ttl-tft>

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# Overview



A TFT panel connected to a Raspberry Pi without the use of an HDMI decoder? What is this sorcery??? It's the DPI Kippah from Adafruit! This HAT-like\* board snaps onto a Raspberry Pi B+, A+, Pi 2, Pi 3 or Zero and with a little software configuration, allows you to have what normally would go out the HDMI port come up on a nice little flat screen. \* Its not technically a HAT due to the lack of an on-board EEPROM, but its the same shape as a Pi HAT and its a covering of sorts, so we call it a kippah

Compared to our lovely HDMI backpacks, you don't have the extra cost or expense of an HDMI encoder/decoder. And you get a nice ultra-fast 18-bit color display with optional touch support. We tested it and it works great with our 5" and 7" 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

The Kippah will also generate the backlight drive voltage (up to ~24V) from the 5V USB power on the Raspberry Pi

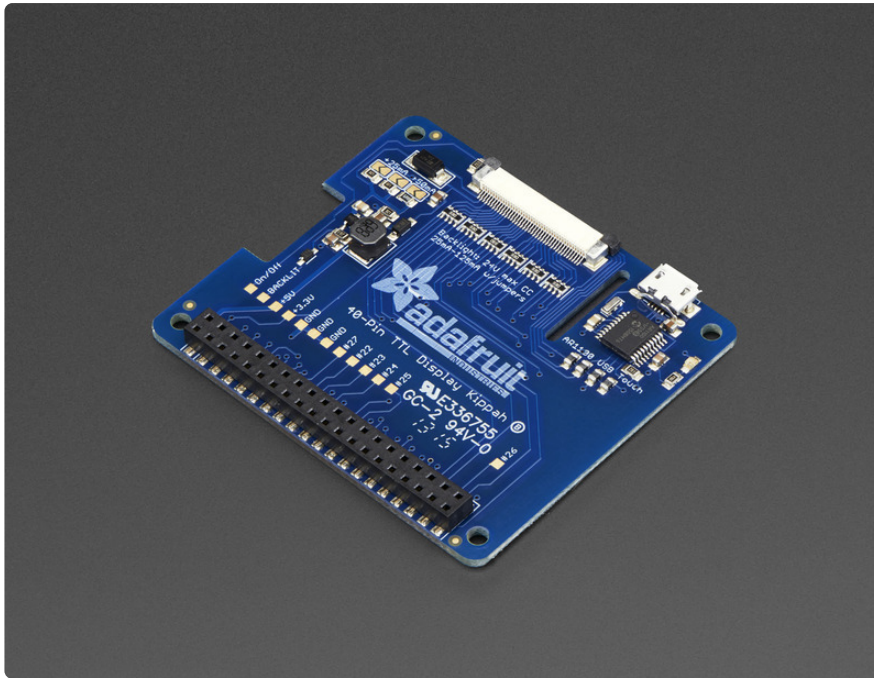


OK so, exciting right? But, what's the catch? The catch is **this add on board uses nearly every pin available on the Raspberry Pi and those pins are hardcoded, they cannot be moved or rearranged.** The pins used are GPIO 2 through 21 inclusive. That means you don't get the UART RX/TX pins (no console cable) and you don't get the standard user I2C pins, the EEPROM I2C pins, or hardware SPI pins. You do get to use pins #22, #23, #24, #25, #26 and #27, and the USB ports are fine to use too.

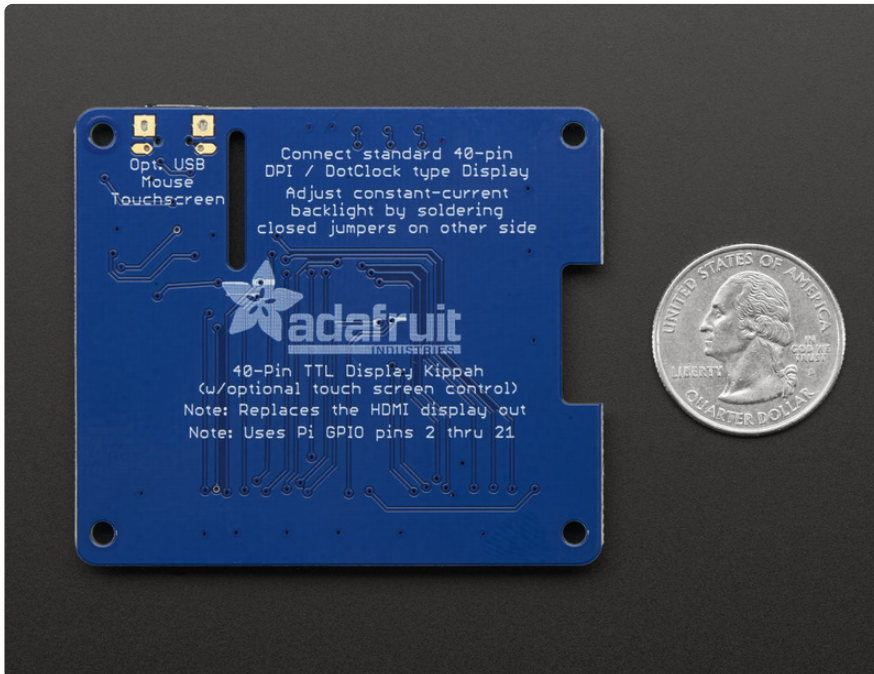
**The other catch is that this display replaces the HDMI/NTSC output,** so you can't have the DPI HAT and HDMI working at once, nor can you 'flip' between the two.

Also, there's no PWM's available so you can't have precision backlight control unless you somehow rig up an external PWM generator with a 555 or something.

Finally, we did test this setup with a straight-up Raspbian and after the software installs, it works great. However, we don't guarantee it will work with any other Raspberry Pi operating system or setup.



That said, if you don't need a bunch of GPIO, it's very easy to add a high quality display. Pick and choose whether you want a touch-screen or not, then choose the size of the display - 5" or 7" is best. You can also grab an FPC extension board and extend the display away from the Pi. For power-users, this is a very nice little accessory



Comes as one fully assembled and tested DPI Kippah circuit board. You may need a soldering iron to adjust the backlight by soldering closed a PCB jumper (check the tutorial on this). [TFT display \(https://adafru.it/eVY\)](https://adafru.it/eVY), [USB micro-B cable \(http://adafru.it/592\)](http://adafru.it/592), [FPC extension cable \(http://adafru.it/2098\)](http://adafru.it/2098), [bent wire stand \(http://adafru.it/1679\)](http://adafru.it/1679), and Raspberry Pi not included (but we do carry them in the shop!)



## 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!

Note these instructions are tested to work with Raspbian Bookworm as of  
2024/04/2

## Connect Display

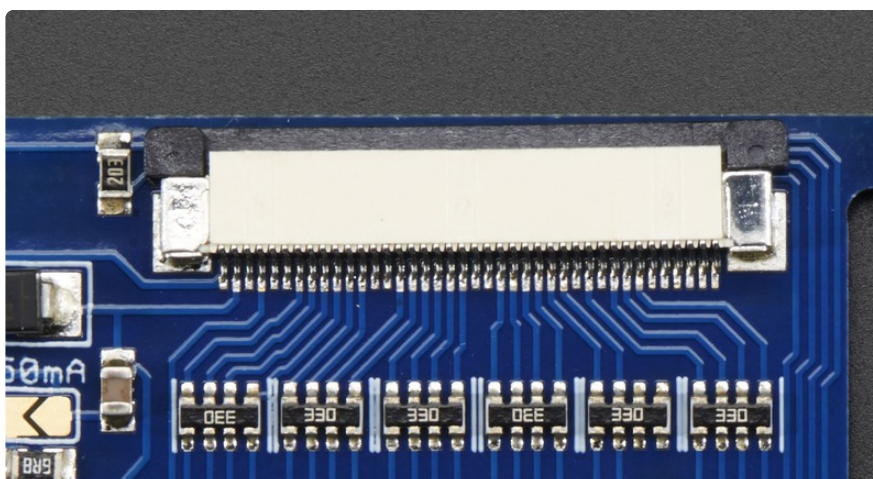
The DPI Kippah has a 40-pin TFT connector. This is a semi-standard connector. A majority of 3.5", 4.3", 5.0" and 7.0" dot-clock DPI displays have this 'standard 40-pin' connector.



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.

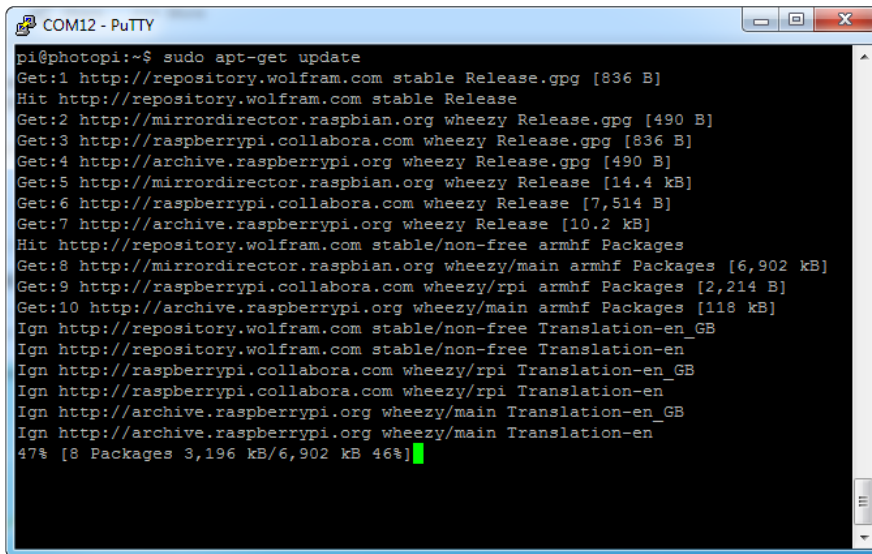


## Update & Upgrade

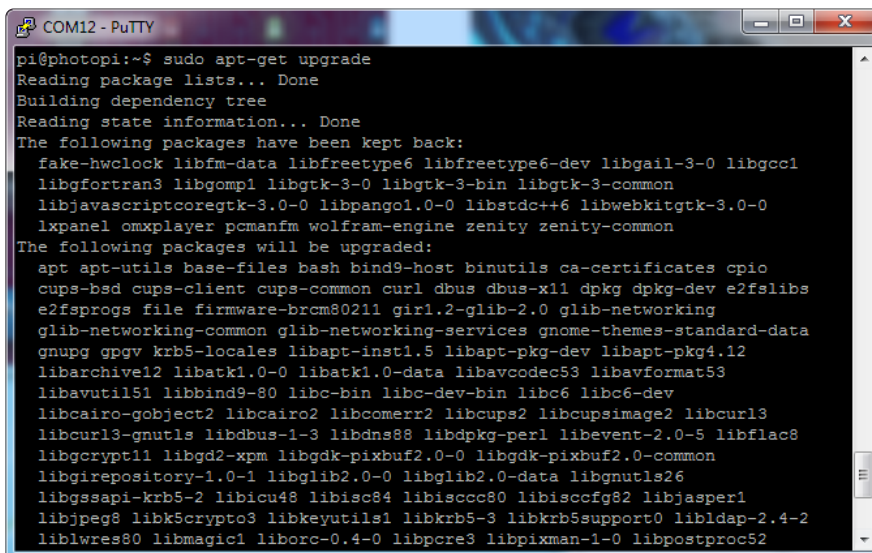
Start by updating and upgrading your Raspberry Pi to the latest software.

```
sudo apt-get update
```

```
sudo apt-get upgrade
```



```
pi@photopi:~$ sudo apt-get update
Get:1 http://repository.wolfram.com stable Release.gpg [836 B]
Hit http://repository.wolfram.com stable Release
Get:2 http://mirrordirector.raspbian.org wheezy Release.gpg [490 B]
Get:3 http://raspberrypi.collabora.com wheezy Release.gpg [836 B]
Get:4 http://archive.raspberrypi.org wheezy Release.gpg [490 B]
Get:5 http://mirrordirector.raspbian.org wheezy Release [14.4 kB]
Get:6 http://raspberrypi.collabora.com wheezy Release [7,514 B]
Get:7 http://archive.raspberrypi.org wheezy Release [10.2 kB]
Hit http://repository.wolfram.com stable/non-free armhf Packages
Get:8 http://mirrordirector.raspbian.org wheezy/main armhf Packages [6,902 kB]
Get:9 http://raspberrypi.collabora.com wheezy/rpi armhf Packages [2,214 B]
Get:10 http://archive.raspberrypi.org wheezy/main armhf Packages [118 kB]
Ign http://repository.wolfram.com stable/non-free Translation-en_GB
Ign http://repository.wolfram.com stable/non-free Translation-en
Ign http://raspberrypi.collabora.com wheezy/rpi Translation-en_GB
Ign http://raspberrypi.collabora.com wheezy/rpi Translation-en
Ign http://archive.raspberrypi.org wheezy/main Translation-en_GB
Ign http://archive.raspberrypi.org wheezy/main Translation-en
47% [8 Packages 3,196 kB/6,902 kB 46%]
```



```
pi@photopi:~$ sudo apt-get upgrade
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages have been kept back:
 fake-hwclock libfm-data libfreetype6 libfreetype6-dev libgail-3-0 libgcc1
 libgfortran3 libgomp1 libgtk-3-0 libgtk-3-bin libgtk-3-common
 libjavascriptcoregtk-3.0-0 libpangol.0-0 libstdc++6 libwebkitgtk-3.0-0
 lxpanel omxplayer pcmanfm wolfram-engine zenity zenity-common
The following packages will be upgraded:
 apt apt-utils base-files bash bind9-host binutils ca-certificates cpio
 cups-bsd cups-client cups-common curl dbus dbus-x11 dpkg dpkg-dev e2fslibs
 e2fsprogs file firmware-brcm80211 glib-networking glib-networking-common
 glib-networking-services gnome-themes-standard-data
 gnupg gpgv krb5-locales libapt-inst1.5 libapt-pkg-dev libapt-pkg4.12
 libarchive12 libatk1.0-0 libatk1.0-data libavcodec53 libavformat53
 libavutil51 libbind9-80 libc-bin libc-dev-bin libc6 libc6-dev
 libcairo-gobject2 libcairo2 libcomerr2 libcups2 libcupsimage2 libcurl3
 libcurl3-gnutls libdbus-1-3 libdns88 libdpkg-perl libevent-2.0-5 libflac8
 libgcrpt11 libgd2-xpm libgdk-pixbuf2.0-0 libgdk-pixbuf2.0-common
 libgirepository-1.0-1 libglib2.0-0 libglib2.0-data libgnutls26
 libgssapi-krb5-2 libicu48 libisc84 libisccc80 libisccfg82 libjasper1
 libjpeg8 libk5crypto3 libkeyutils1 libkrb5-3 libkrb5support0 libldap-2.4-2
 liblwsres80 libmagic1 liborc-0.4-0 libpcre3 libpixman-1-0 libpostproc52
```

## 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/firmware/config.txt
```

and add the following lines at the bottom

```
dtoverlay=vc4-kms-dpi-panel,kippah-7inch
```

For 4.3" TFT use the following:

```
dtoverlay=vc4-kms-dpi-generic,hactive=480,vactive=272,width-mm=95,height-mm=54
```

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 additional drivers are required! The touchscreen should just work. However, you'll likely want to calibrate the screen. We have a calibration helper python script. Start by installing **python-pip** and **pyusb**.

```
sudo apt-get install python3-pip python3-venv
python3 -m venv env --system-site-packages
source env/bin/activate
pip3 install pyusb
```

Then grab the code and example gradient



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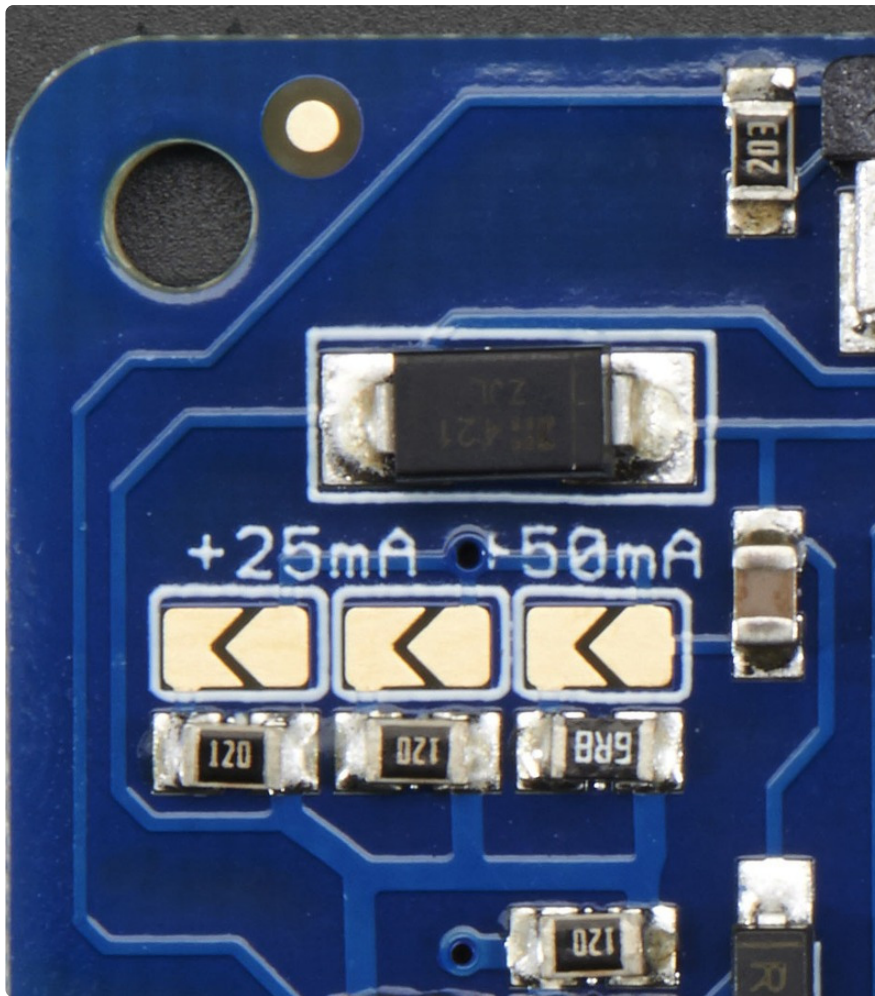
# Backlight

The DPI Kippah has a backlight booster that can support any 40pin TFT display we carry. However, since backlights do vary from display to display, you may need to configure the backlight to match your display. Here's the constant-current draws of our displays

- 4.3" 480x272 - 1 strand of 7 LEDs in series, **25mA** constant current
- 5.0" 800x480 - 2 strands 6 LEDs in series, **50mA** constant current
- 7.0" 800x480 - 6 strands of 3 LEDs in series, **150mA** constant current (although 100-150mA can be used)

By default, we ship the DPI Kippot with 25mA backlight. You'll still be able to see the display on a 5" or 7" display, **but it will be dim!** That's OK, all you have to do is configure the Kippah to match your display.

Since we dont know what display you're going to use, we leave this up to you. It's easy to do, just grab your soldering iron and heat it up, then grab some solder and melt it to short out the jumpers on the Kippah here:



The left and middle jumper each add 25mA to the default 25mA. The right jumper adds 50mA. So if you want to have a 50mA backlight, short only the left jumper. For 75mA, short the right most. For 100mA solder short the left and right and for 125mA short all three!

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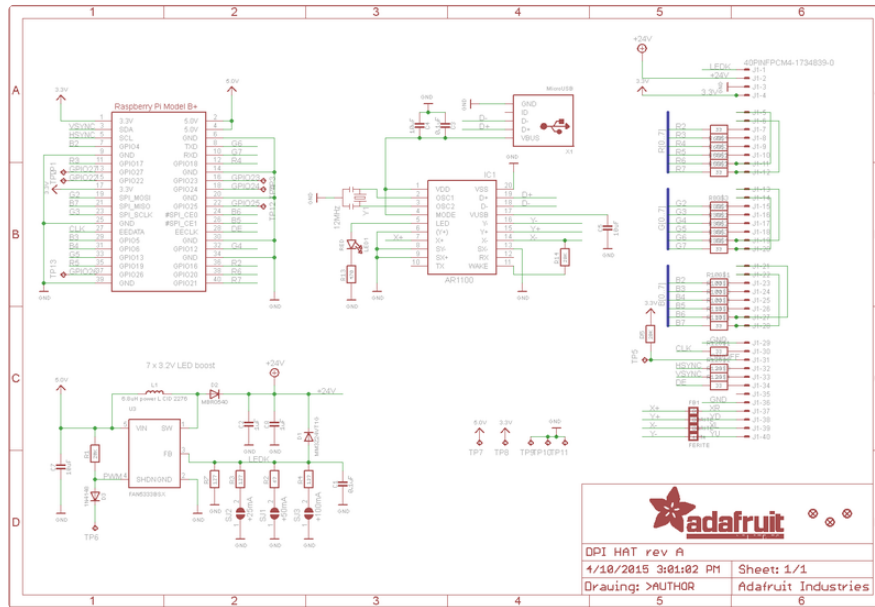
## Downloads

## Files

- [5.0" Display \(https://adafru.it/dWZ\)](https://adafru.it/dWZ) Datasheet (example of 40-pin interface pinout)
- [Configuration files on GitHub \(https://adafru.it/rEE\)](https://adafru.it/rEE)
- [EagleCAD PCB files on GitHub \(https://adafru.it/rF2\)](https://adafru.it/rF2)

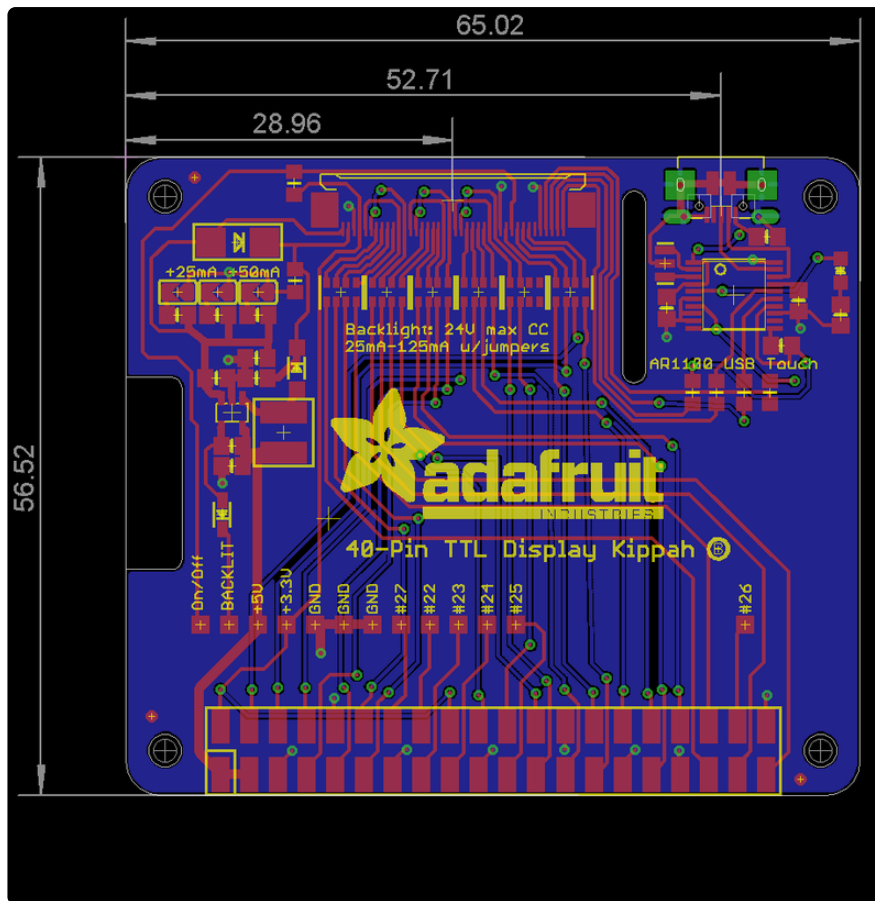
# Schematic

The middle section with the touch screen controller is not placed on the non-touch version!



# Fabrication print

This PCB fits the electrical 'HAT' specification. Dimensions in mm



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## F.A.Q.

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Can I use the DPI interface and HDMI or TV out at the same time?

Yes! With bookworm, the DPI/HDMI/TV outputs use a separate hardware driver so you can only have multiple enabled at a time.

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How is that DTO blob made?

If you'd like to check out the device tree overlay and how to customize, you can read some more here: <http://blog.reasonablycorrect.com/raw-dpi-raspberry-pi/> (<https://adafru.it/rEn>)

Run:

```
sudo apt-get install device-tree-compiler
wget https://raw.githubusercontent.com/robertely/dpi666/master/
setup/dt-blob-dpi.dts
sudo dtc -I dts -O dtb -o /boot/dt-blob.bin dt-blob-dpi.dts
```

to create your own!