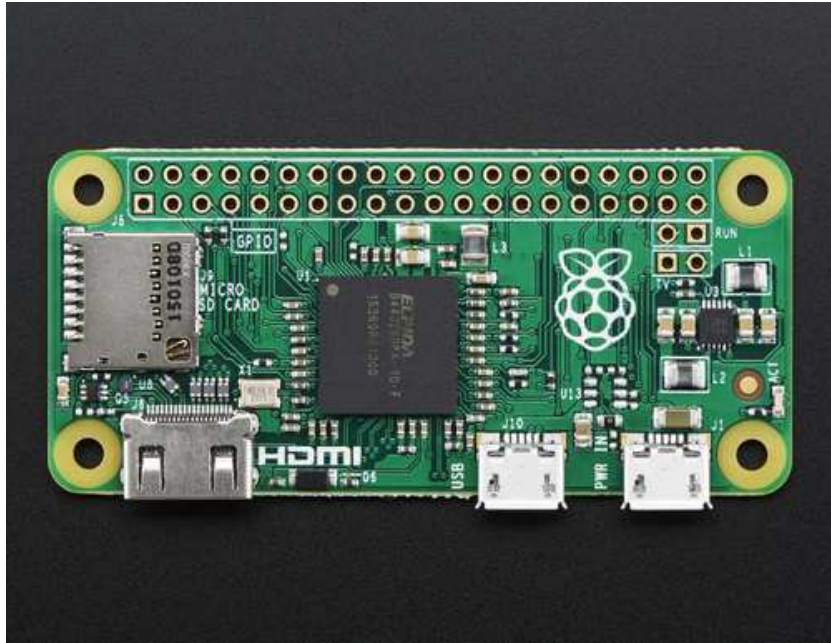




Introducing the Raspberry Pi Zero

Created by lady ada



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A Tour of the Pi Zero

It's Thanksgiving 2015 - the turkey's brining, the potatoes not-yet-mashed...and from Pi Towers the call goes out **A NEW PI IS BORN! LONG LIVE THE PI!**

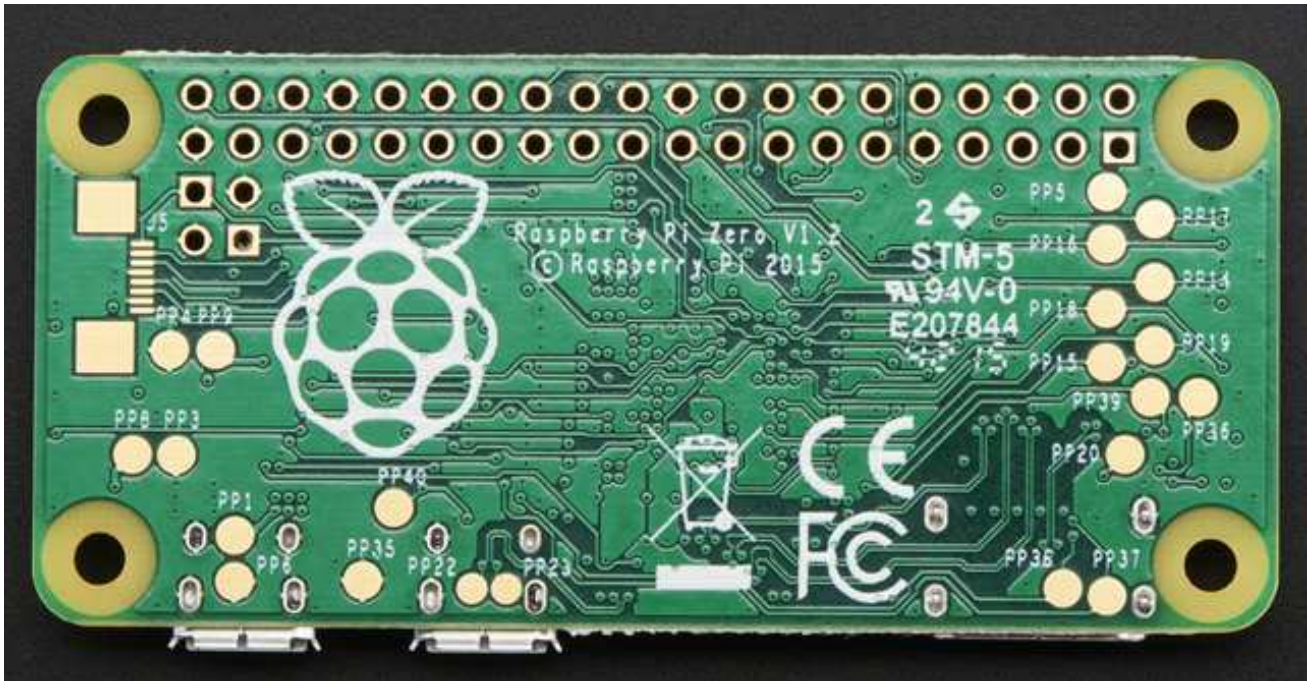
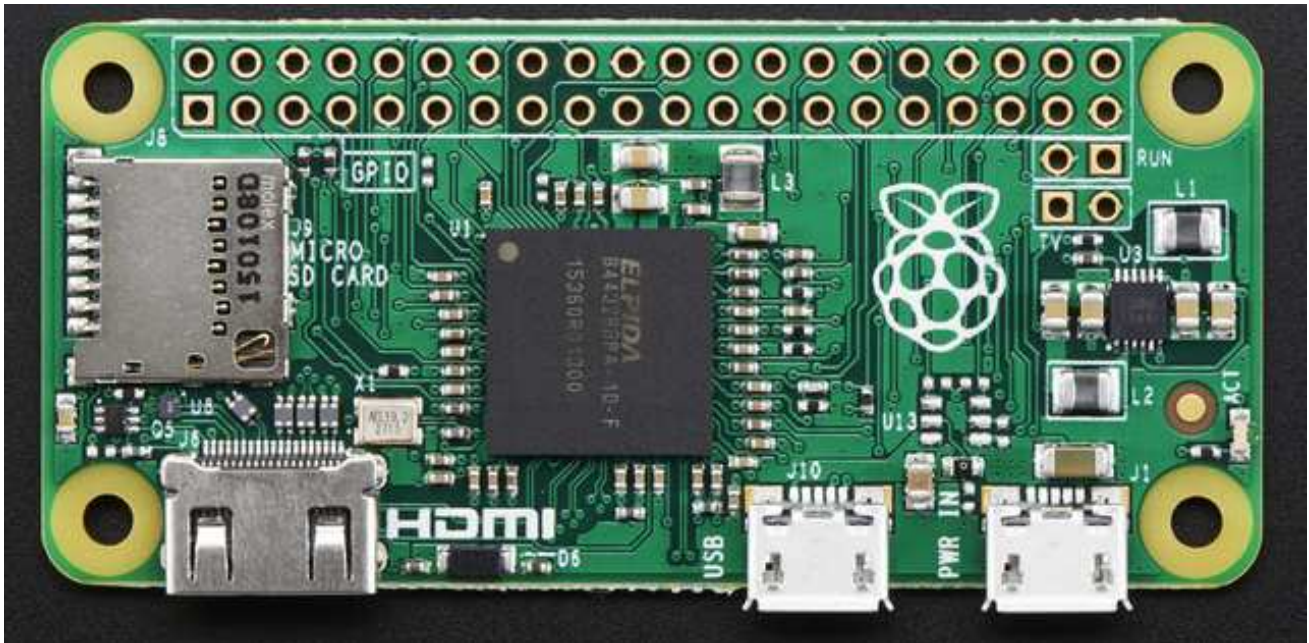
The Pi Zero - the smallest, thinnest, most-affordable Pi ever. So much so, it comes free with every issue of MagPi #40.

Want to get your own? **Pick up a Raspberry Pi Zero starter kit, basic kit or just the bare computer board at the adafruit shop. (<http://adafru.it/jEe>)**



What's new? What's different?

Wow a new Pi - so exciting! The Pi Zero is the smallest, most affordable Pi ever. Wonder what's new & different? Let's check it out!

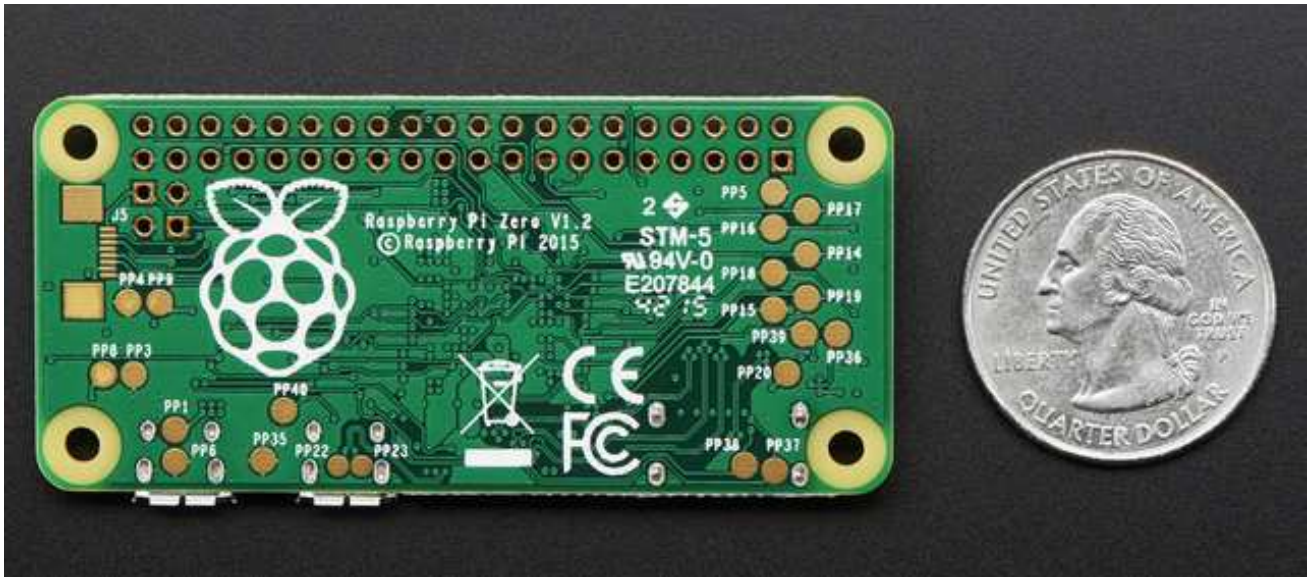


Size

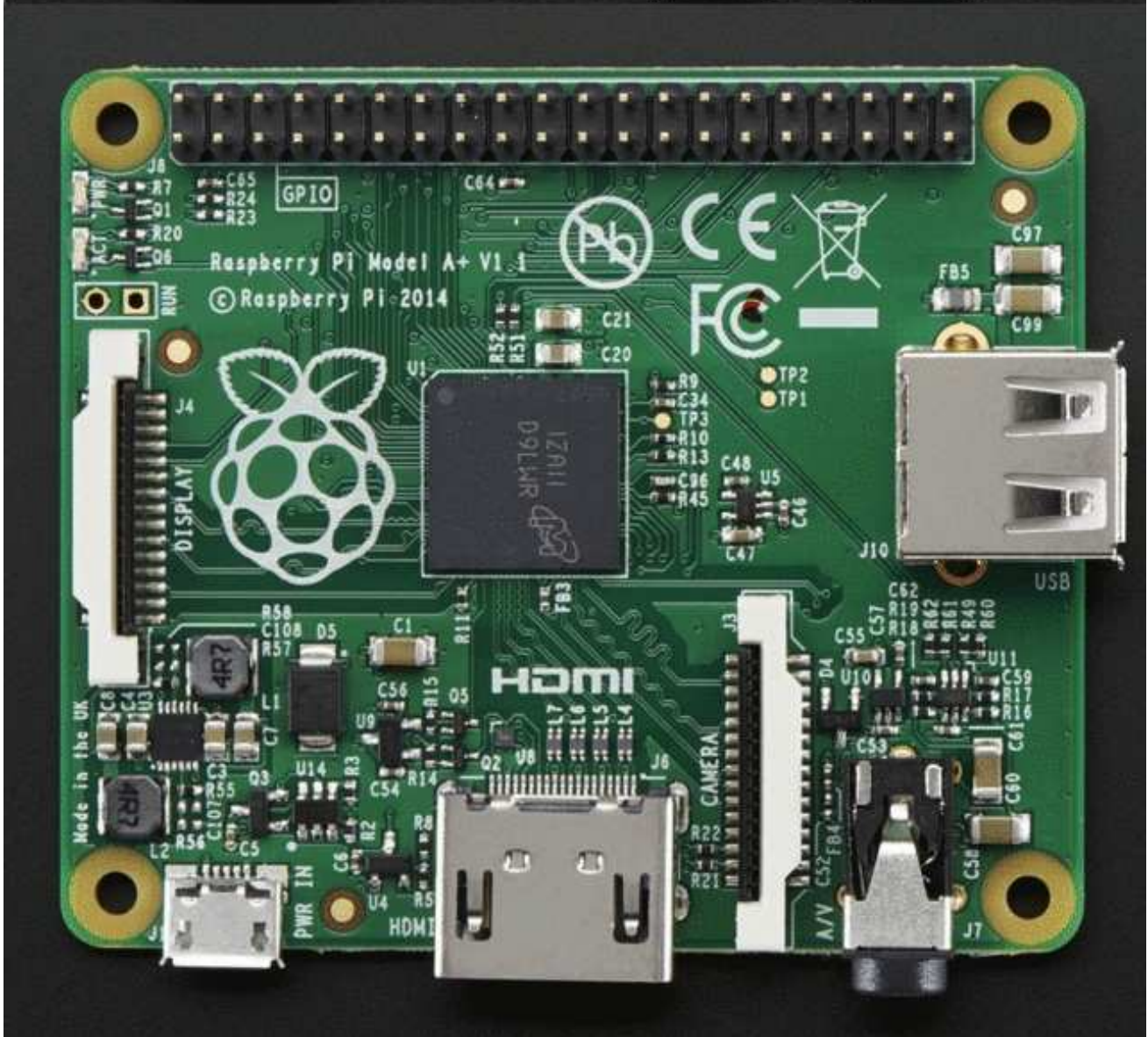
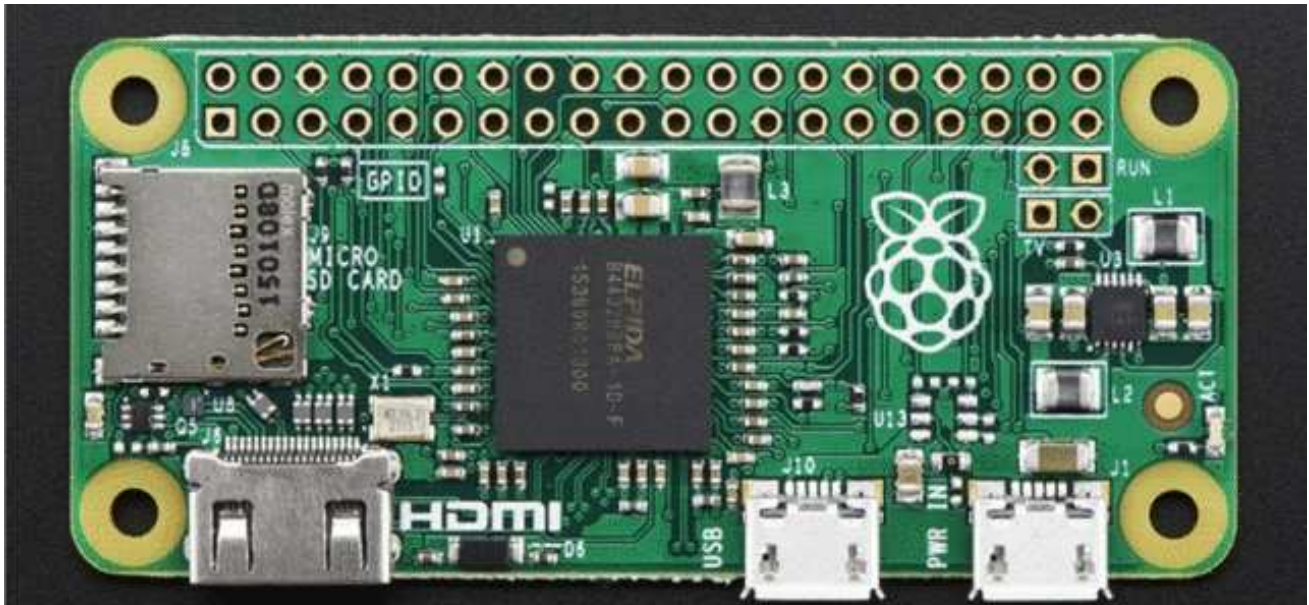
First up, the Pi Zero is **small** and **thin**

65mm long x 30mm wide x 5mm thick

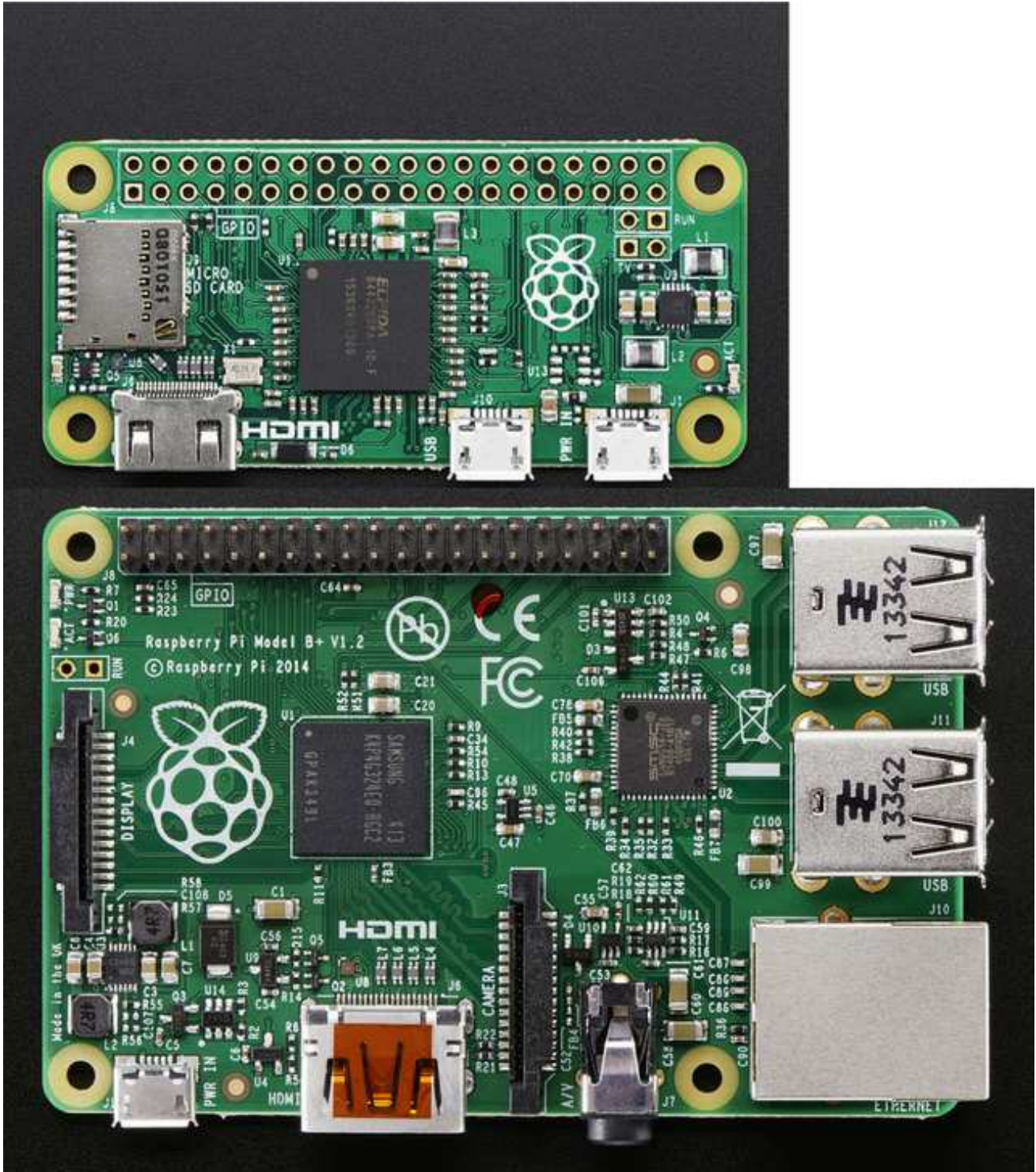
(31mm if you include the little sticky-out bits of the microUSB jacks)



Way smaller than the Pi 2 or B+ and even smaller than the A+, its 60% the size of the A+: same length, and about half the width:



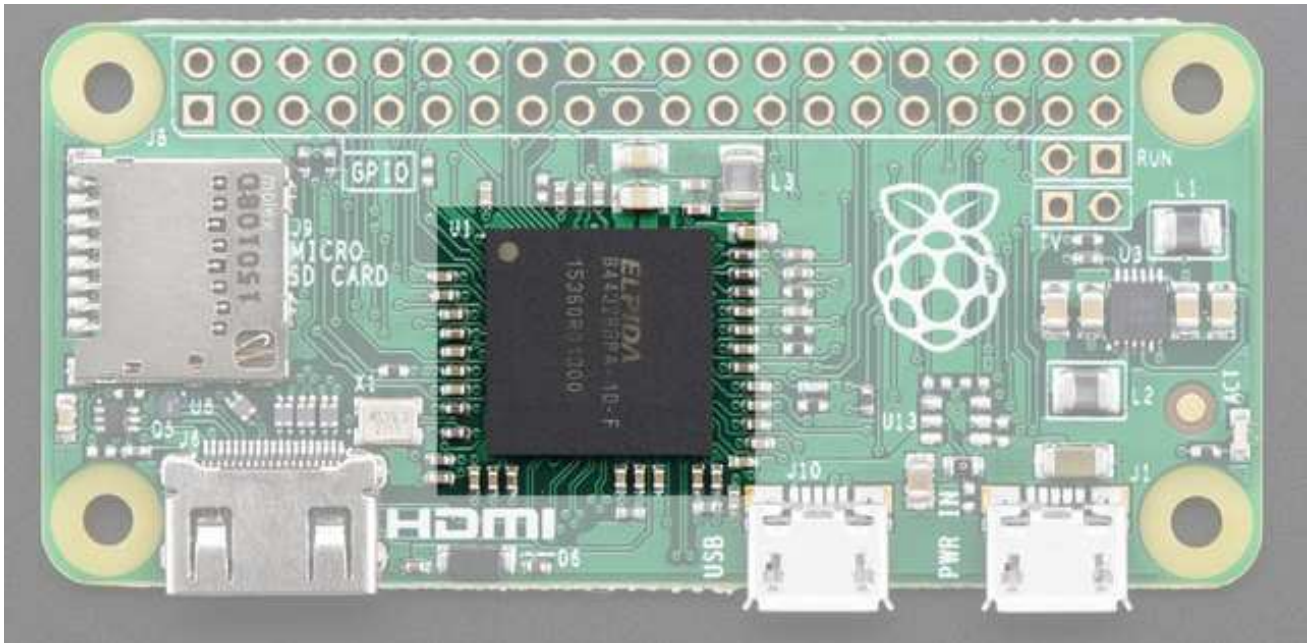
And about 40% the size of the Pi 2 or B+



Processor and Speed

To keep the Pi Zero low cost, the processor and RAM are kept pretty basic. Instead of the Pi 2's zippy quad core ARM v7, we're back to a single-core 1GHz ARM (same processor in the Pi Model

B+ and A+). We also have 512 MB of RAM with a 'package-on-package' setup. The chip shown here:

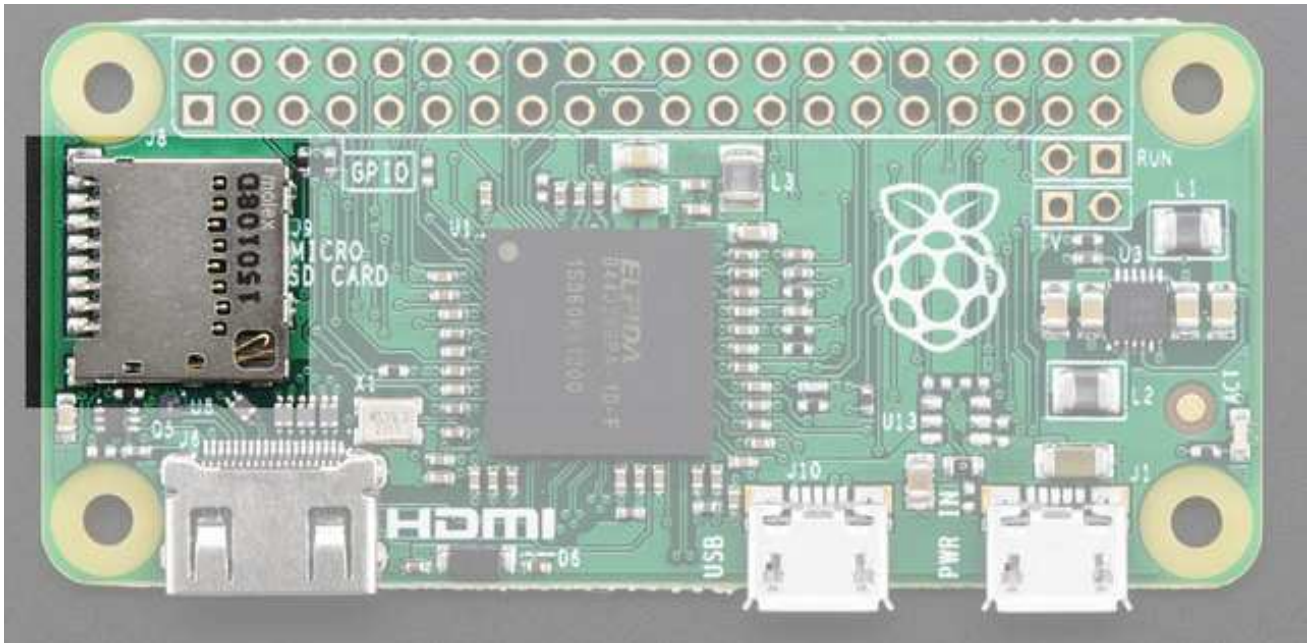


Is the RAM that is sitting *on top* of the main processor.

For maker and hacker projects, this isn't a big deal. You're essentially going to get the same performance as the Pi A+ or B+. If you're looking for something that can do some more serious processing, [check out the Pi 2](http://adafru.it/2358) (<http://adafru.it/2358>)

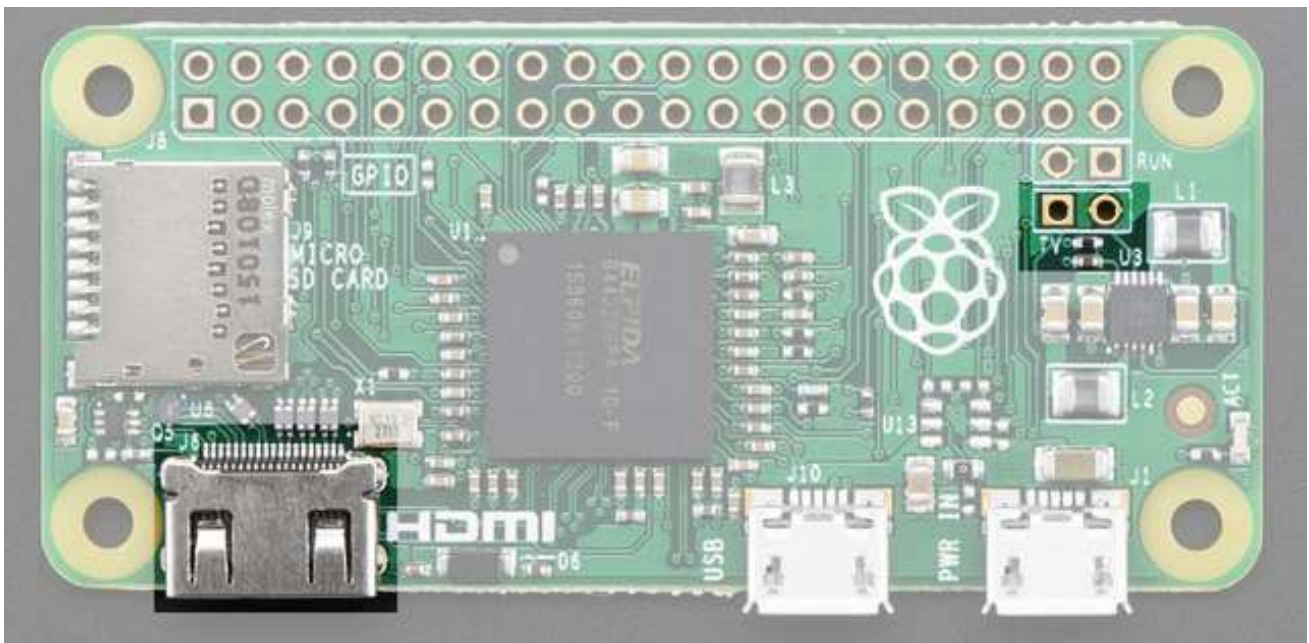
Micro SD Card Holder

Not much has changed here, we're still going with MicroSD for size and ease of use (they're the most common card size these days!) This time the card holder is up top and is **push-pull** style not **push-push**. Honestly, I prefer it this way since you won't accidentally 'push-pop' the card out



Video Out

HDMI Video is still available, you'll to use a [Mini to Standard HDMI adapter \(http://adafru.it/2819\)](http://adafru.it/2819) to connect an HDMI cable. There's no 3.5mm jack with composite out, however you can get PAL or NTSC out via two 0.1" pads. [We've got a bigger writeup here about Pi Zero video outputs. \(http://adafru.it/jEf\)](http://adafru.it/jEf)



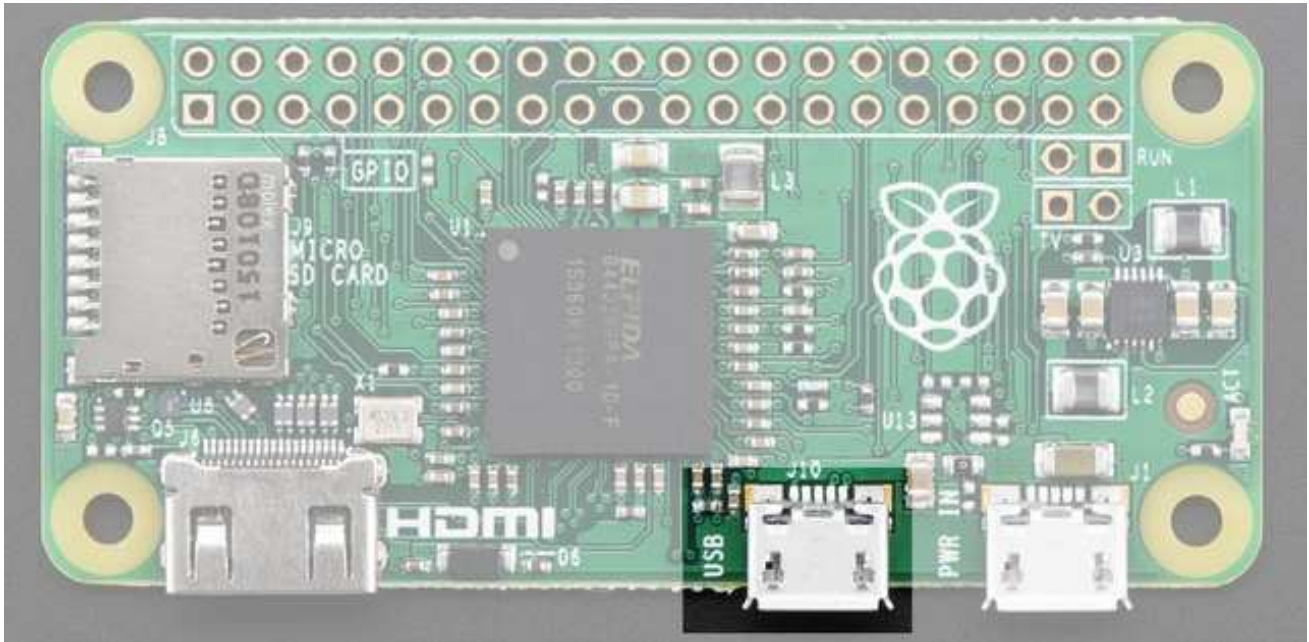
Audio out

No analog audio out, but if you connect HDMI to a monitor with speakers you will get HDMI digital

audio. It's also possible to hack analog audio out with a few passive components, [see our more detailed look at Pi Zero audio output options](http://adafru.it/jEh). (<http://adafru.it/jEh>)

USB Port

Like the Pi Model A+, the Pi Zero **does not have a USB Hub built in** which means you get **one USB port!** Moreover that USB port is not a standard type A port, instead it is a 'USB On-The-Go' port



In order to connect a USB device (mouse, keyboard, WiFi) etc you'll need a [USB OTG micro B to A cable](http://adafru.it/1099) (<http://adafru.it/1099>):



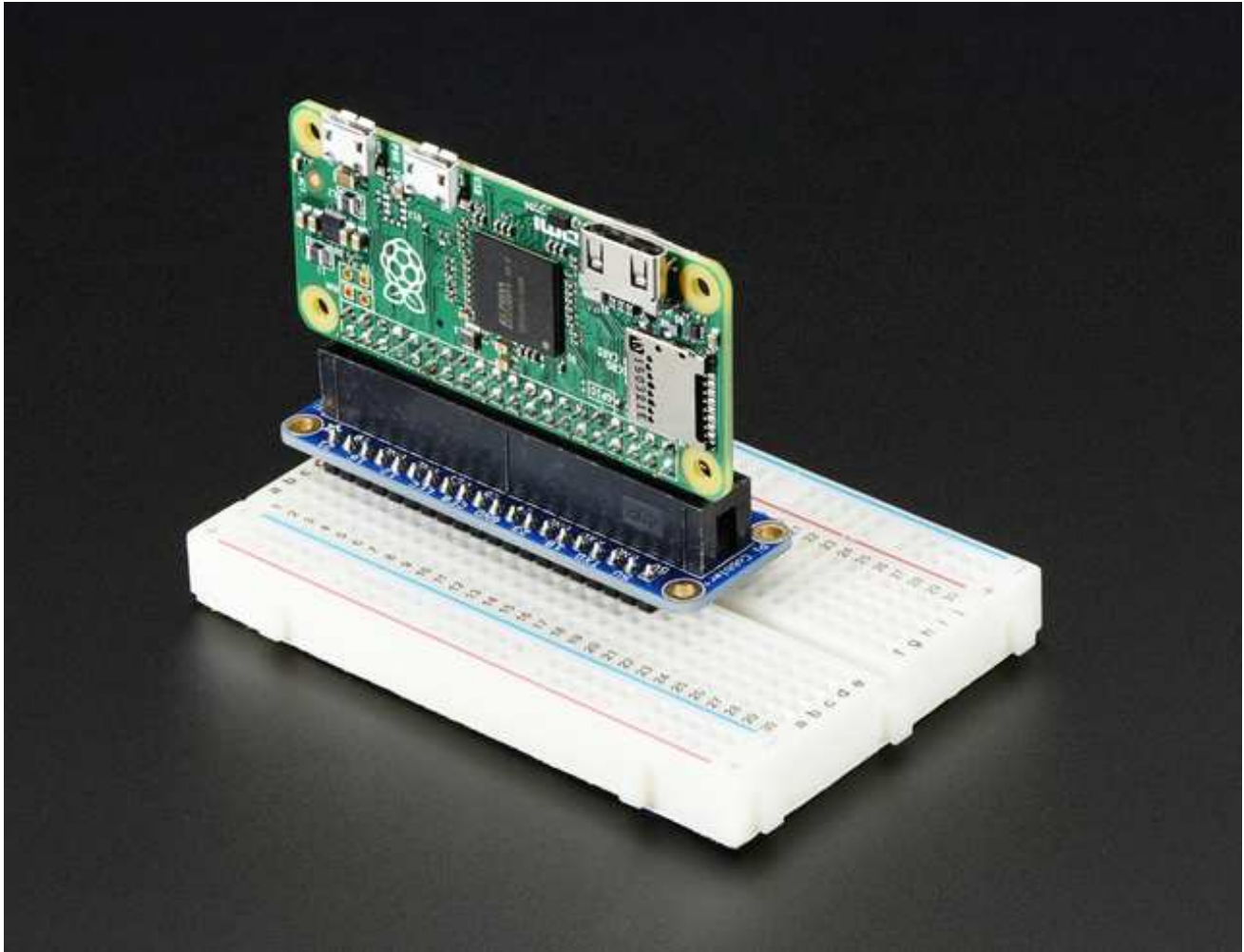
If you need to connect multiple USB devices, a simple USB hub will do what you need. [A powered hub is even better \(http://adafru.it/961\)](http://adafru.it/961), and will let you power high-current USB devices like WiFi adapters and even external USB hard-drives.



As a bonus you can power the Pi Zero *from* the hub (the power cable does not pass any data) - just plug the power micro USB cable into one of the ports.

GPIO Header

To keep the Zero as simple and small as possible, the 'normal' GPIO header spot has been left blank! Normally, [a 2x20 male header is soldered in there \(http://adafru.it/2822\)](http://adafru.it/2822). While you could grab one of those and solder them in, the empty spot has a lot of potential. For example, you can solder in right-angle socket header, and turn the Pi Zero it a sort of 'daughter card'



We've got more ideas and suggestions on our GPIO header detail page (<http://adafru.it/jEi>)

Setting up your SD card



Before you can power up your Pi Zero, you will need to program in the SD card with an **Operating System**

Much like your computer has Windows, Mac OS X or Linux on it to make it run, the Raspberry Pi needs something to help it boot and run software. That software is **Raspbian Linux** (a *flavor* of Debian Linux). [You can check out our tutorial on What Is Linux if you're curious to learn more \(http://adafru.it/jDZ\)](http://adafru.it/jDZ)

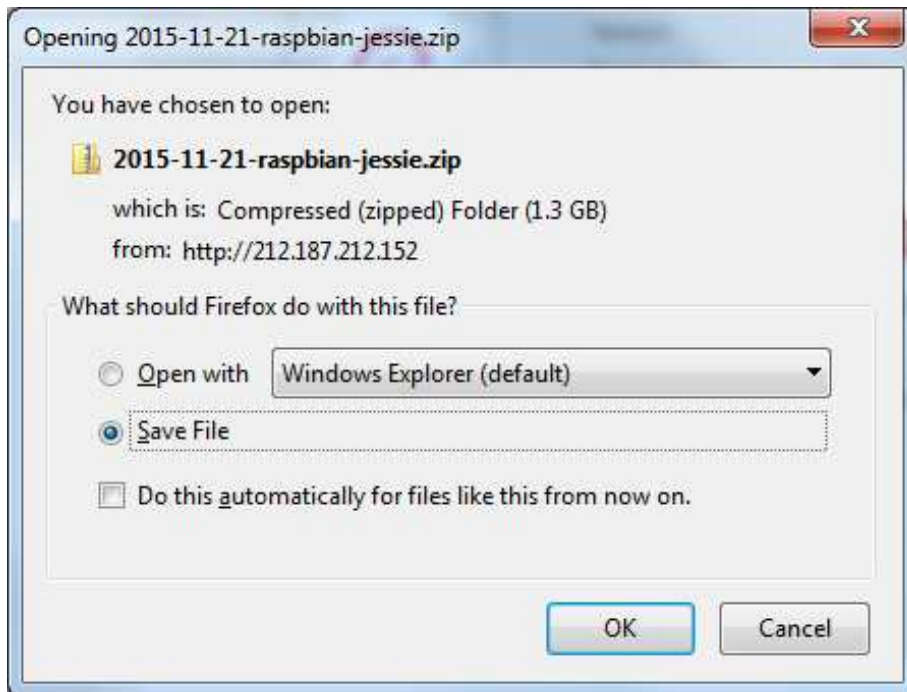
If you just want to get rockin, grab the [latest \(http://adafru.it/fQi\)](http://adafru.it/fQi) **Raspbian Jessie** operating system [from the Raspberry Pi downloads page \(http://adafru.it/fi7\)](http://adafru.it/fi7)

Just click the button below!

Download Latest Raspbian

<http://adafru.it/jE0>

Raspbian Wheezy 5-15 or earlier do not support the Zero! Try Jessie instead

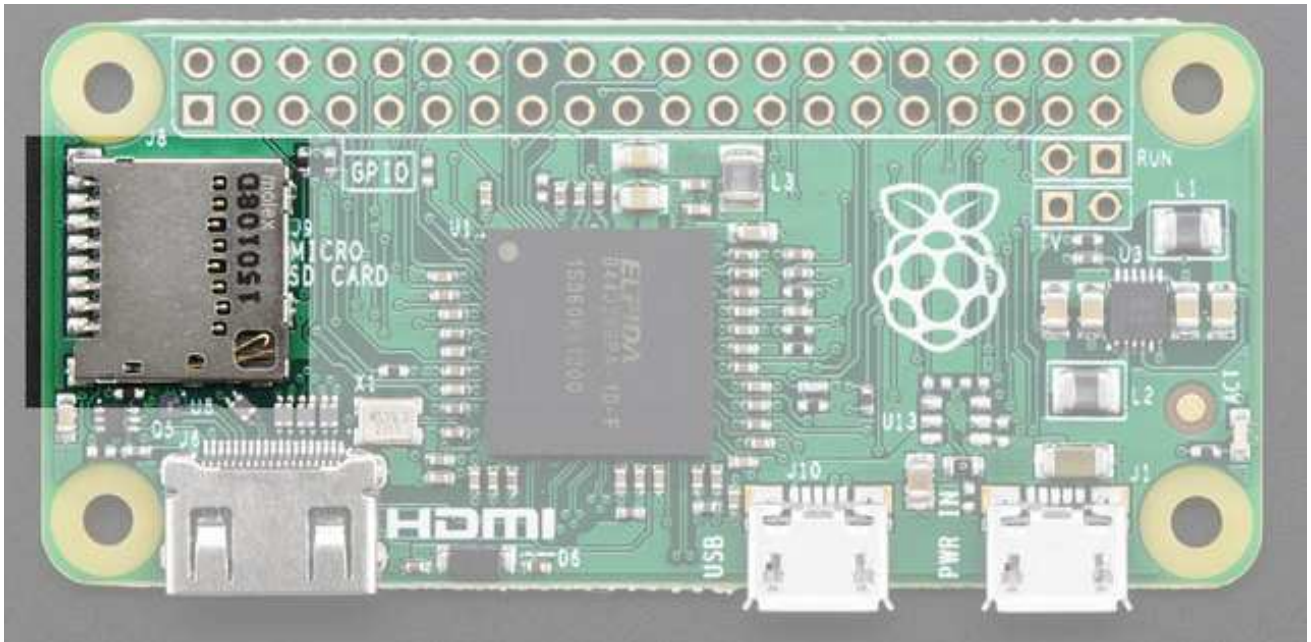


Once downloaded, unzip the zip file, the full image is about 4.5 Gigabytes.

Next up grab your SD or micro SD card reader and plug it into your computer



Now follow our guide for [Windows](http://adafru.it/jE4) (<http://adafru.it/jE4>) or [Mac OS X](http://adafru.it/jE5) (<http://adafru.it/jE5>) to burn the image



Once you're done, plug the micro SD card into the slot indicated. It will fit snugly in place but you won't hear or feel a 'click'

Making an SD Card – Using a Windows Vista / 7

There is a very useful utility that we can use to write a SD card available for Windows 7 and Vista. It is not unfortunately available for Windows XP.

Step 1.

Download Fedora ARM Installer from:

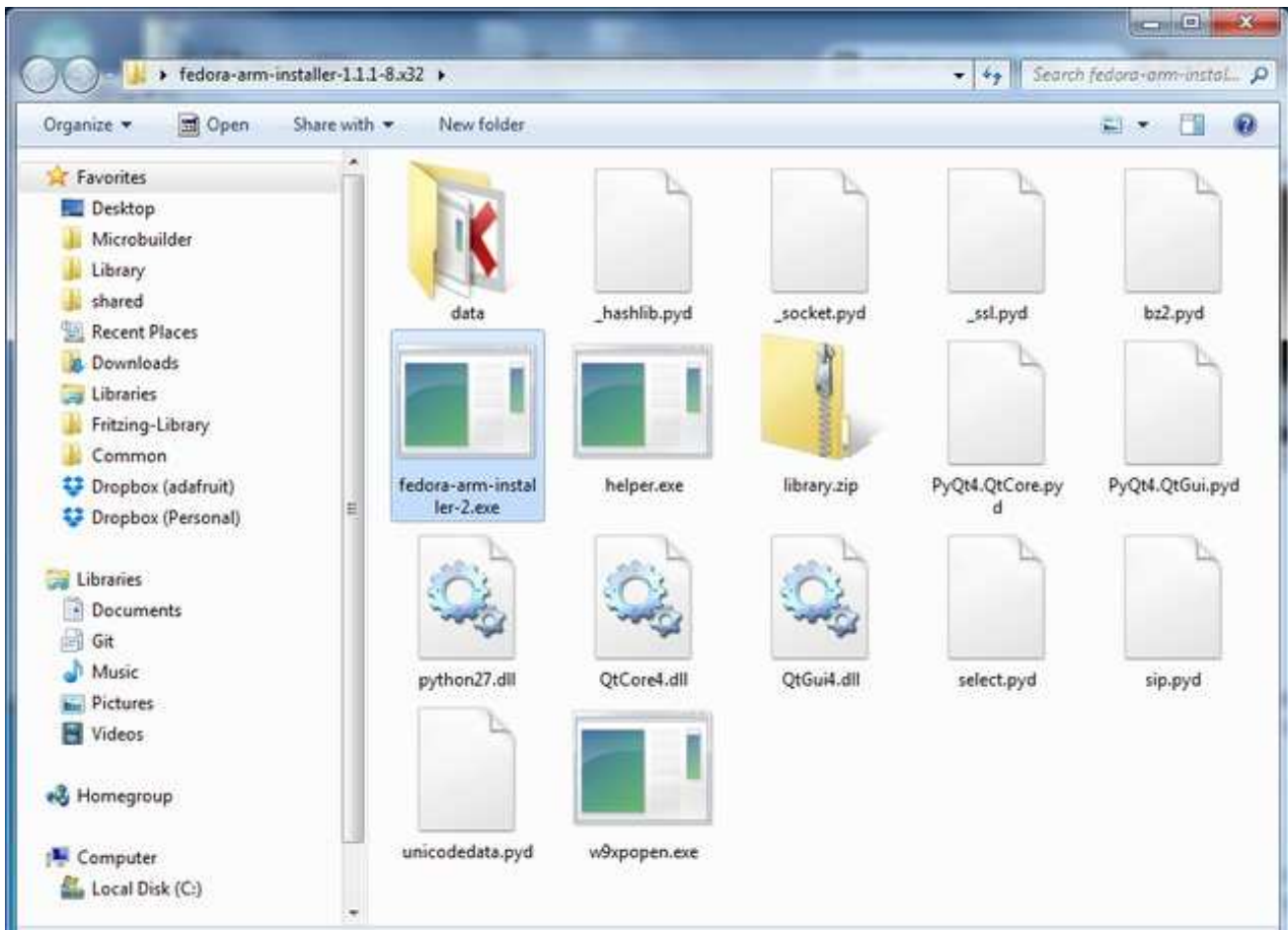
http://fedoraproject.org/wiki/Fedora_ARM_Installer#Windows_Vista_.26_7 (<http://adafru.it/aTd>)

Download the Fedora ARM Installer
program

<http://adafru.it/jE1>

Step 2.

This will download a zip file that you must extract. The result will be a folder with the following contents:



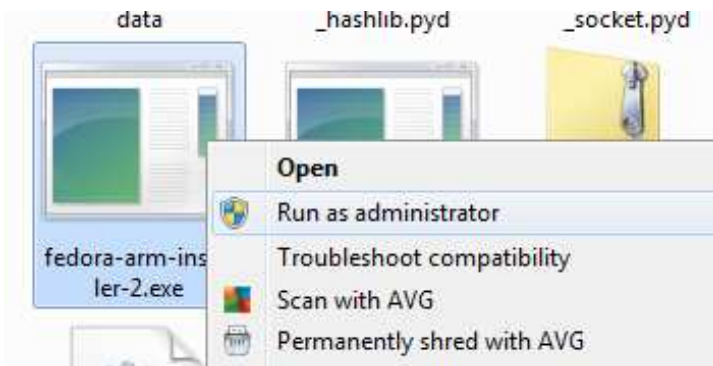
If you keep this outside of the Program Files area then you will be able to run it without changing its privileges. You can just leave it on your Desktop.

Step 3.

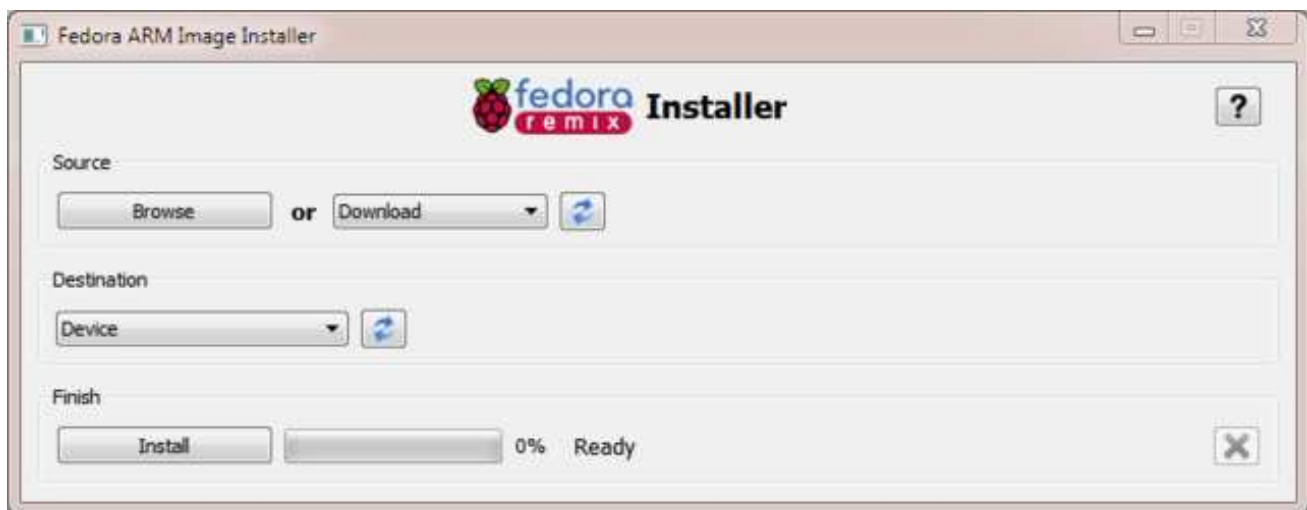
Eject any external storage devices such as USB flash drives and backup hard disks. This makes it easier to identify the SD card. Then insert the SD card into the slot on your computer or into the reader.

Step 4.

Right click to run the file **fedora-arm-installer.exe** as an administrator.



This will launch the following application.



Step 5.

Select the image file and device.

To do this, click the Browse button and navigate to the .img file for the distribution that you want to install and then select the device from the drop-down.



Check that you have the right device, as it will be reformatted, and then click Install.

It will take a few minutes to install, but once the SD card is ready, you will see the following.



That's all there is to it. Your SD card is ready for use in your Raspberry Pi.

Making an SD Card – Using a Mac

Ray Vijoen has created a useful script that makes it really easy to make an SD card using a Mac. It is a shell script that takes all the necessary steps to create the SD card, including formatting it. You still have to run it from the command line.

Step 1.

Download Raspberry-PI-SD-Installer-OS-X from <https://github.com/RayViljoen/Raspberry-PI-SD-Installer-OS-X> (<http://adafru.it/aTe>)

Look for the 'zip' button at the top and download it as a single zip file.

Step 2.

Extract the zip file. It will expand into a folder called 'Raspberry-PI-SD-Installer-OS-X-master'.

Step 3.

Use Finder to move the img file that you downloaded earlier into the Raspberry-PI-SD-Installer-OS-X-master folder.

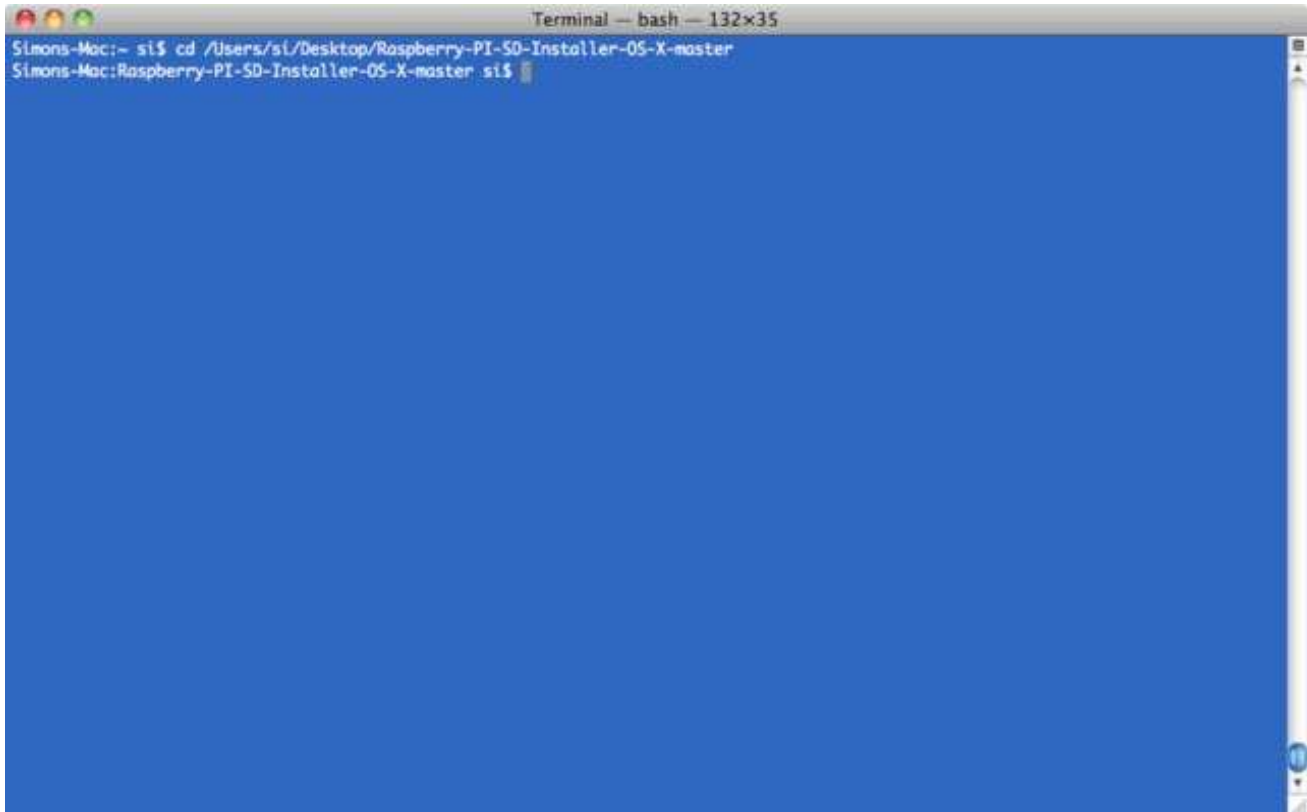
You can see here that I have multiple images in the folder. That is fine, you can have as many images as you like in the folder.



Step4.

Open the Terminal app – you will find this in the Utilities folder of your Applications folder on your Mac.

Then type the command 'cd' followed by the path of your Raspberry-PI-SD-Installer-OS-X-master folder.



Step 5.

Eject any external drives that you have connected to your computer. This just makes it easier to identify the correct drive that corresponds to your SD card.

Insert the SD card that you want to use. Note that all data on this card will be erased.

Step 6.

Run the Pi Installer by typing the following command into the Terminal:

```
sudo ./install Occidentalis_v02.img
```

Where `Occidentalis_v02.img` is the name of the img file for the distribution that you want to install.

You will be prompted for your Mac password and then should see this:


```
Terminal — bash — 132x35
Simons-Mac:Raspberry-PI-SD-Installer-05-X-master si$ sudo ./install Occidentalis_v02.img

-----
                    Occidentalis
-----

-----
Filesystem      Size  Used Avail Capacity  Mounted on
-----
1) /dev/disk0s2 233Gi 198Gi 34Gi   86%    /
2) devfs        111Ki 111Ki   0Bi   100%  /dev
3) map -hosts   0Bi    0Bi   0Bi   100%  /net
4) map auto_home 0Bi    0Bi   0Bi   100%  /home
5) /dev/disk1s1 59Mi  37Mi  19Mi   66%   /Volumes/Untitled
-----

Select the disk to use by entering the disk number.
*** MAKE SURE YOU SELECT THE CORRECT DISK ***
*** Refer to the README if uncertain ***

Use disk [ 1, 2, 3, 4, 5 ] #5
Unmounting Disk
Volume (null) on disk1s1 unmounted
Writing image
Ctrl+T to see progress..
2479+1 records in
2479+1 records out
2600000000 bytes transferred in 1694.691979 secs (1534282 bytes/sec)
Ejecting Disk
Disk /dev/disk1 ejected
All Done!
Simons-Mac:Raspberry-PI-SD-Installer-05-X-master si$
```

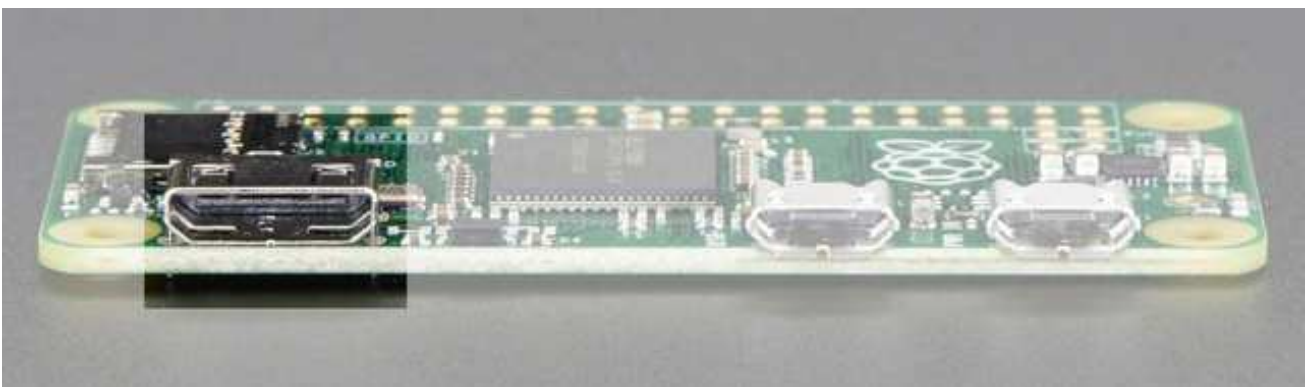
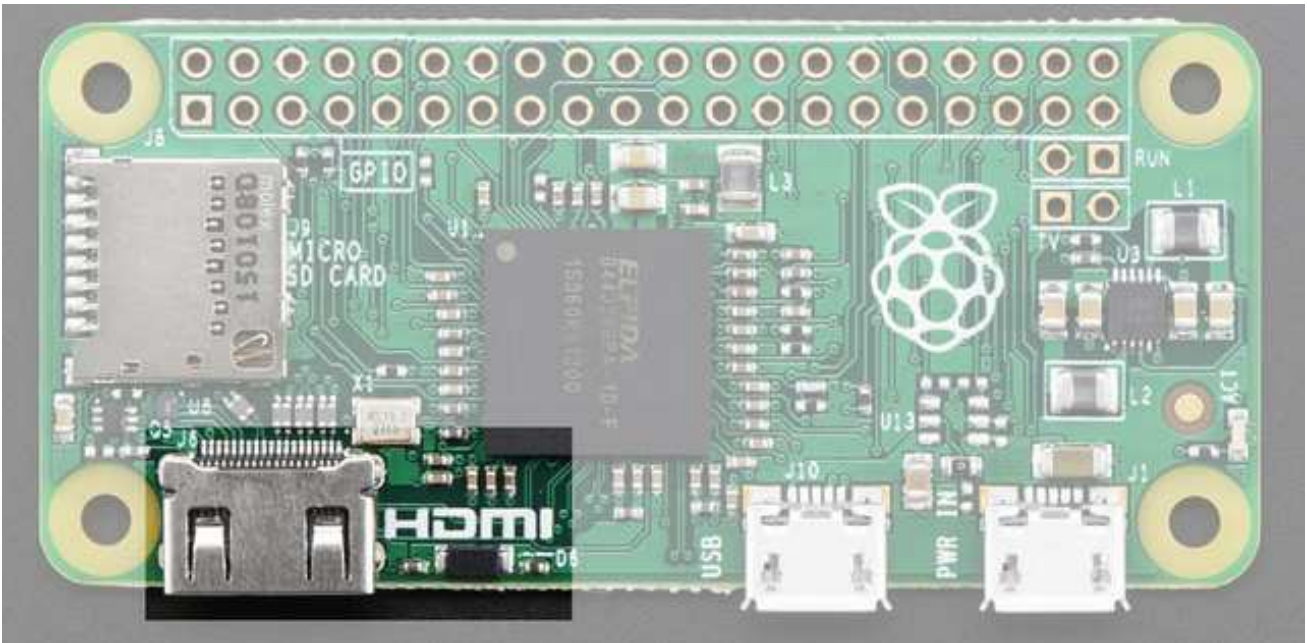
That's all there is to it, the SD card is now ready to use with your Raspberry Pi.

Video Outputs

The Raspberry Pi chipset was originally designed to be a HDMI/graphics co-processor for mobile devices. For that reason, it has quite a bit of 'HDMI horsepower' and can, despite it's small size, play 1080p video at full screen.

HDMI Video Out

The easiest & fastest way to get video going is to connect up an HDMI display (<http://adafru.it/jsb>). We have a ton of options, and any HDMI display size from 640x480 up to 1920x1080 will work. The Mini HDMI port is conveniently labeled and shown below:



For example, our 5" HDMI touch backpack which is the smallest all-in-one display we carry can be powered from the Pi Zero's USB port and provide a touchscreen at the same time (<http://adafru.it/2260>)



(Shown here with a Pi 2 because, well, the Pi Zero wasn't out at the time)

To connect an HDMI device, you'll need 2 things, a [Mini HDMI to HDMI Adapter](http://adafru.it/2819) and an [HDMI Cable](http://adafru.it/608)

The HDMI cable is pretty straight-forward to understand, and you can get one anywhere. The HDMI adapter is required because the Pi Zero does not have a standard size HDMI port, instead the port is slimmer and smaller to keep the Zero petite. The adapter is pretty straight forward to use - plug it into the Pi Zero and the port is now large enough for any standard HDMI cable

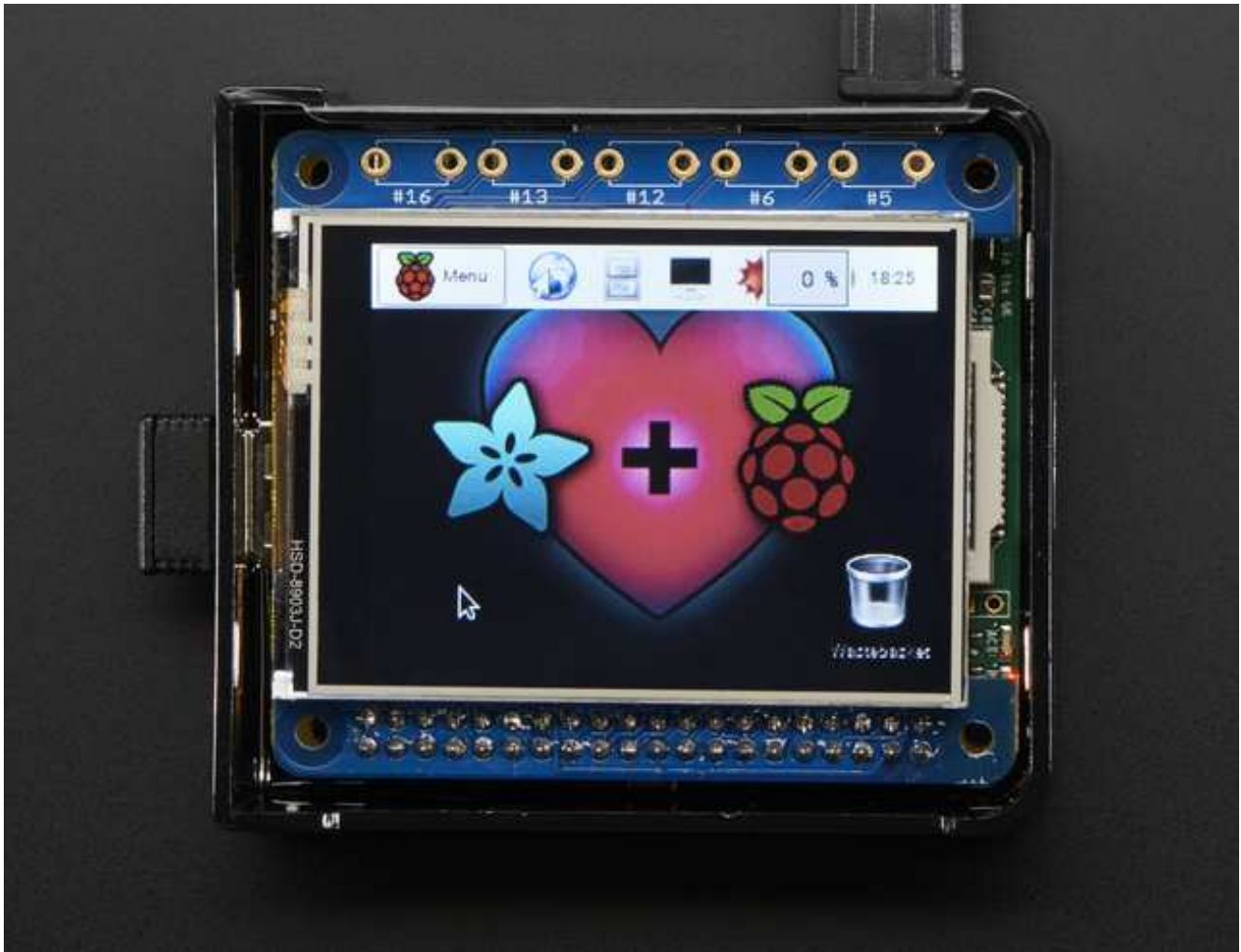


PiTFT Video

Even though it is 'half size' of the A+, [you can still use any of our PiTFT's on the Pi Zero](http://adafru.it/jE7) (<http://adafru.it/jE7>) You can use any size from our 2.2" 320x240 PiTFT HAT, up to our 3.5" Touchscreen 480x320.

Before you can plug in a HAT or PiTFT [you'll need to solder in the 2x20 male header](http://adafru.it/2822) (<http://adafru.it/2822>)

Then follow the tutorial for the PiTFT of your choice! Be sure to pick the Jessie install image



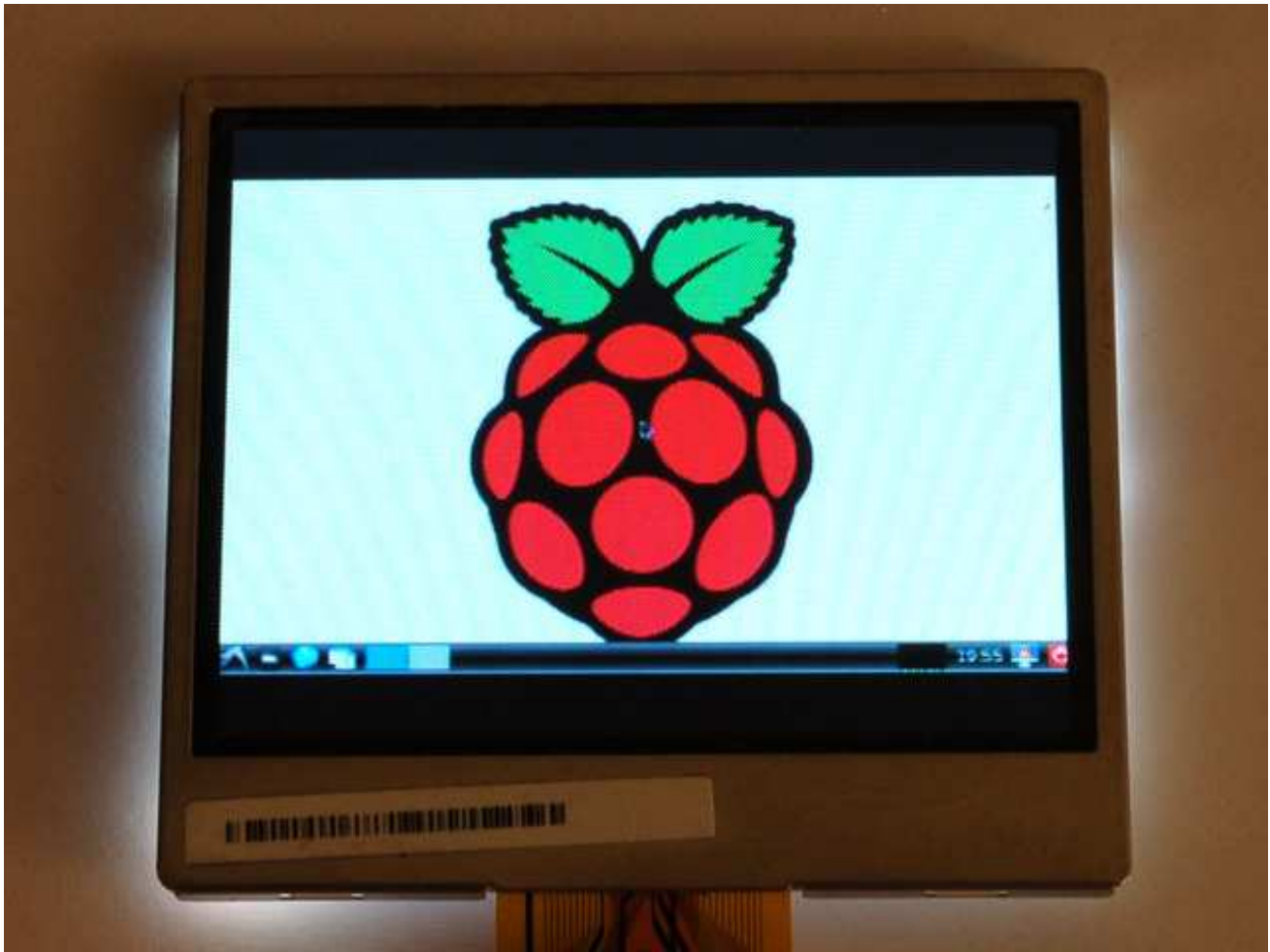
VGA Video Out

This one is pretty easy, just use the HDMI adapter above, and an [HDMI to VGA adapter](http://adafru.it/1151) (this also has the benefit of giving you an audio output) (<http://adafru.it/1151>)

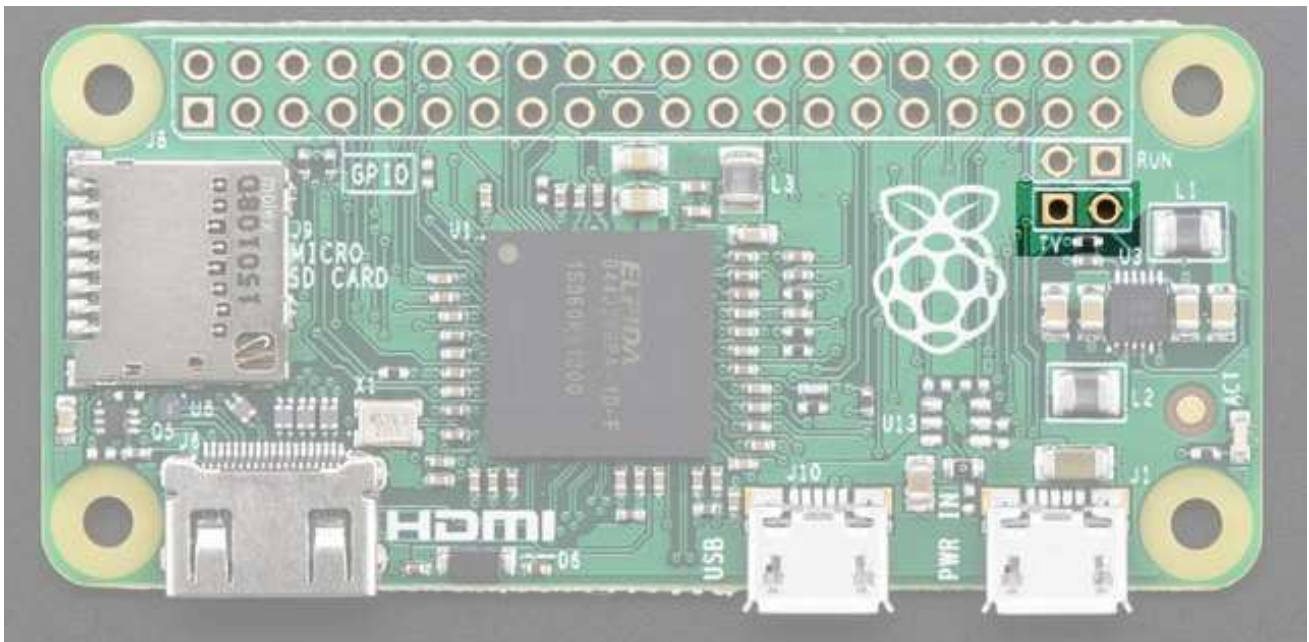


NTSC/PAL Composite Video

OK so you want TV video? Maybe for one of our [very tiny composite video screens](http://adafru.it/jE8) (<http://adafru.it/jE8>)?



Well, the quality is not going to be nearly as nice as with VGA or HDMI but you can do it. Find the two pads marked **TV** on the 'Zero



The hole on the left, nearest to the **TV** text, is the signal (+) line, the pin to the right of it is the ground (-) line. Solder two wires to these pads and connect them to an [RCA Jack \(http://adafru.it/2792\)](http://adafru.it/2792) like this one



Make sure to not have HDMI plugged in, it should auto-switch to TV out. If you have somehow set your Pi for HDMI out only, plug your HDMI screen back in, or use a console cable to connect and log into the Pi. Then run **sudo raspi-config** at a command line to set video output to composite! [You'll also want to tweak your Pi to use composite in the nicest resolution possible \(http://adafru.it/diN\)](http://adafru.it/diN)

Audio Outputs

Uh, well, there aren't any! That's right, to keep the Pi Zero small and low cost, the headphone audio filter isn't included

You can still get digital audio out via HDMI so if you plug it your Pi into a monitor with speakers, that will work fine.

Well, ok that's not the whole truth

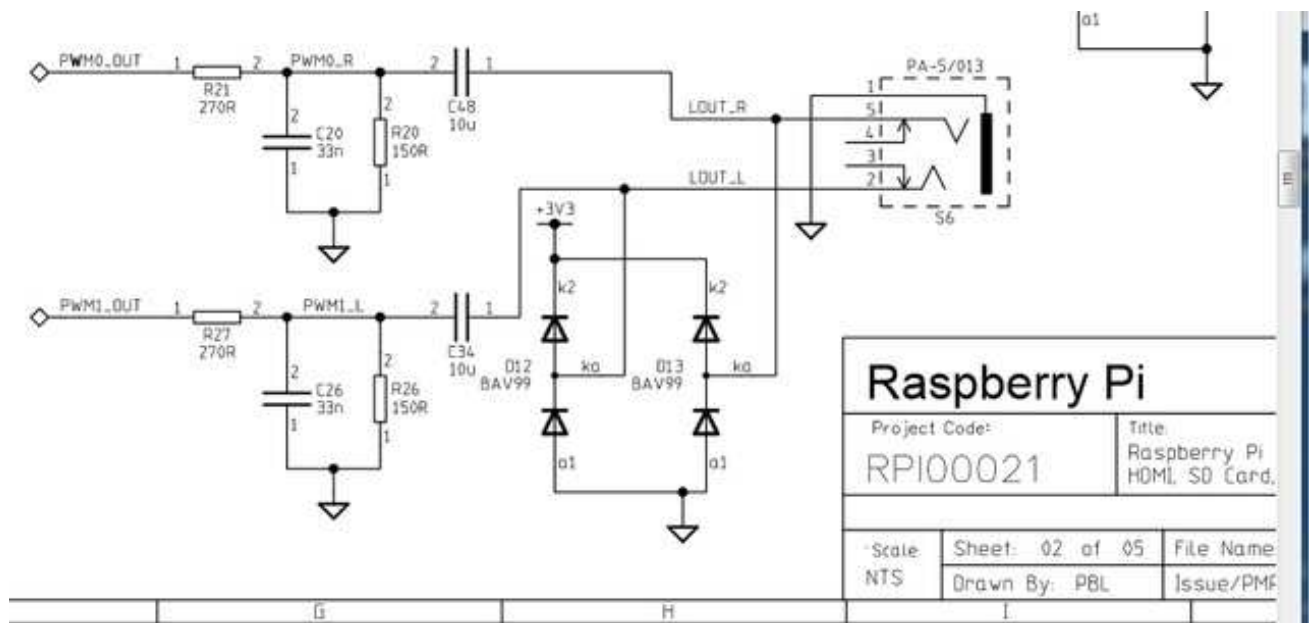
How to Add Audio Outputs to your Pi Zero

Hey, wanna do the below but with step-by-step instructions? We wrote a tutorial!

Click here to do the thing @ <https://learn.adafruit.com/adding-basic-audio-ouput-to-raspberry-pi-zero> (<http://adafru.it/jZD>)

How Other Pi's Create Audio

GPIO #18 is also known as PWM0 and in the original Pi was coupled with a very basic RC filter to create the audio output:



If you don't mind getting a few 150 and 270 ohm resistors, and two each of about 33nF (also known as 0.033uF) and 10uF capacitors, you can basically recreate those two filters.

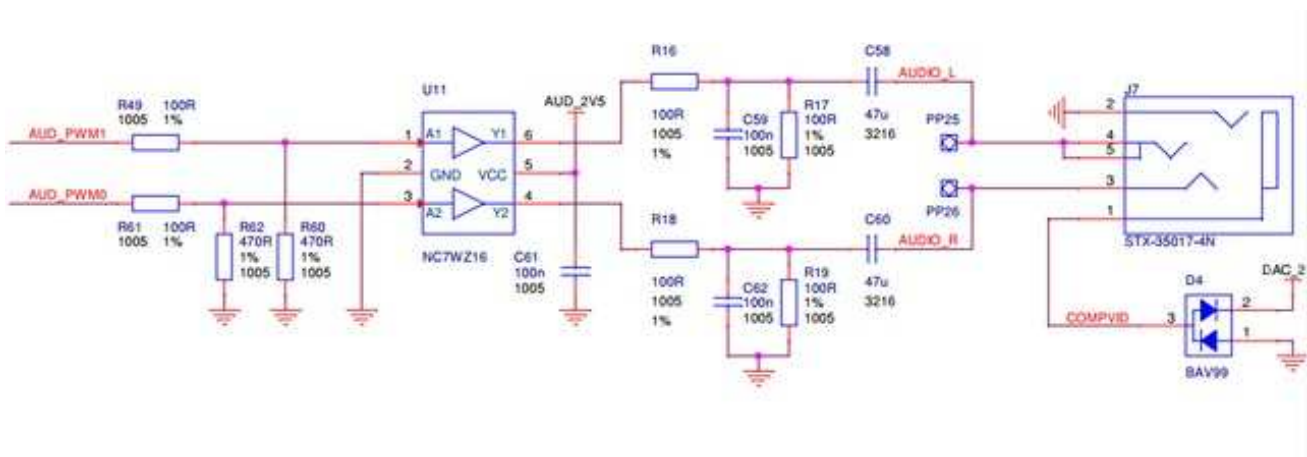
Now all you need is access to PWM0_OUT and PWM1_OUT, which are...on GPIO #40 and #45 and

are not brought out on the Pi Zero. Tragedy? Give up? No! You can get to **PWM0** on GPIO #18 (ALT5) and **PWM1** on GPIO #13 (ALT0) or GPIO #19 (ALT5) - [see the full list of pins and alternate functions here](http://adafru.it/jEa) (<http://adafru.it/jEa>)

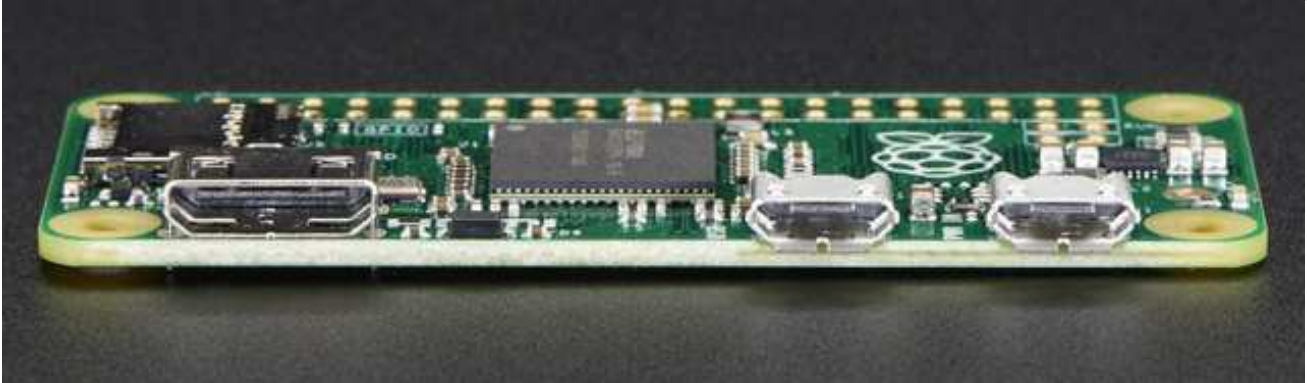
You can do *that* by adjusting the device tree overlay to change the PWM audio pins from pins #40 and #45 (which are not accessible) to pins #18 and #13 [This very nice Pi forum thread will tell you how!](http://adafru.it/jEb) (<http://adafru.it/jEb>)

See here for a [program that will let you set the alt forms of GPIO pins](http://adafru.it/jEc) (<http://adafru.it/jEc>)

If you want a higher quality audio output, the B+ and Pi 2 use this schematic - it has a driving buffer on the audio PWM lines for better current drive *and* it uses a cleaner 2.5V reference for better quality audio.



GPIO header options



The most intriguing difference for hackers and makers is that the Pi Zero does not come with the soldered GPIO header. Partially this is to save cost, but it also allows the Pi Zero to be very thin and gives you the option of embedding it easily into a project box.

Cons:

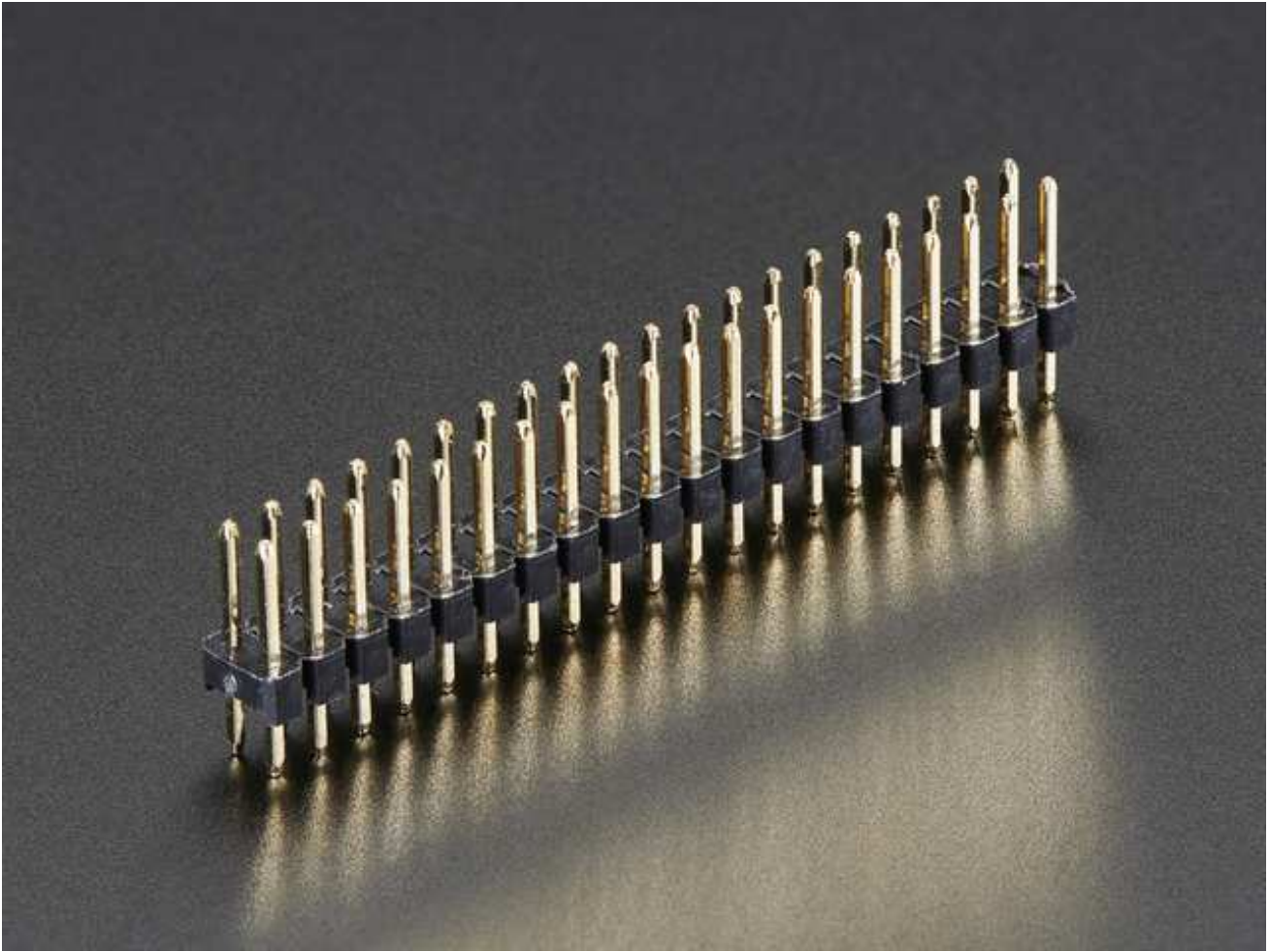
- You have to solder in the header to use Pi HATs and Pi toppers

Pros:

- You can practice your soldering!
- Can skip the GPIO header to keep the Pi Zero super slim
- Solder wires directly into the GPIO pads, use only what you need
- Try different, exotic headers such as right angle or socket header

Go Classic with 2x20 Male Header

Like blue jeans and Coca-Cola, [the 2x20 male header is the classic option.](http://adafru.it/2822) (<http://adafru.it/2822>)



Once soldered in, you can plug in any HAT or topper. The pinout is completely identical to the 2x20 headers on the Pi 2 and Pi A+ & B+

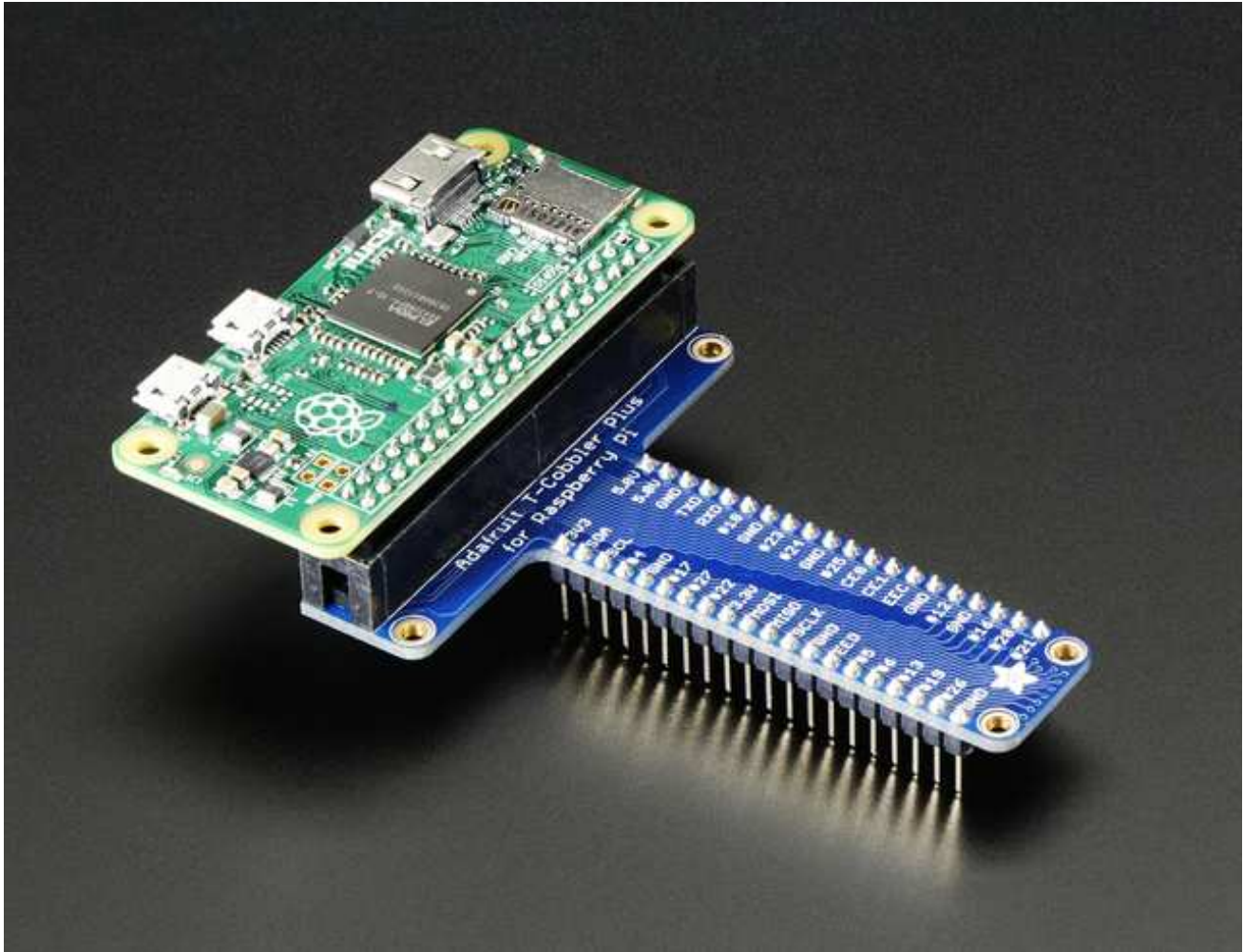


Or 2x20 Female Socket Header

This one is interesting, [if you solder in a 2x20 female socket header \(http://adafru.it/2222\)](http://adafru.it/2222)



and attach it upside down you can plug it right into a T-Cobbler!



Advanced 2x20 Right-Angle Female Socket Header

Or, take it even more *extreme* with [2x20 right angle female header \(http://adafru.it/2823\)](http://adafru.it/2823)



Now you can stick it into a Cobbler or T-Cobbler and it will sit sort of like a computer daughtercard!

