sparkfun

Raspberry Pi 2 Starter Kit Hookup Guide

Introduction

There's a lot of Raspberry Pi information going around lately. Whether it's Pi A, A+, B, B+, or Pi 2 B, any forum will have thousands of people giving all the answers possible to a problem. Though most methods work for any version, it can be tough to decide which information to choose. This is a reference of what is known to work for the Pi 2 and specifically, the Raspberry Pi 2 Starter Kit bundle.

Covered in This Tutorial

- Kit Assembly
- What to expect on the first boot
- Methods of working with the pi
- Configuring the Pi
- Resources for working with the GPIO
- Troubleshooting
    - Serial
    - Monitor
    - Starting with a blank microSD card
    - Performing a full system upgrade

Materials Required

There are a few methods to getting the RPi 2 running. You can operate the pi from its own peripherals, or you can use another computer with a serial link. Once any link is established, you can connect it to any network with DHCP hosting and use Telnet/SSH to operate the Pi.

Using the Pi 2 as a desktop:

- Pi 2 Starter kit -or- Pi 2 Accessory Kit and your own Pi
- USB Mouse
- USB Keyboard
- HDMI monitor/TV/adapted VGA

Configuring through the serial port / using Telnet/SSH:

- Pi 2 Starter kit -or- Pi 2 Accessory Kit and your own Pi
- 2nd computer with available USB port
- Terminal software such as HyperTerm or Tera Term

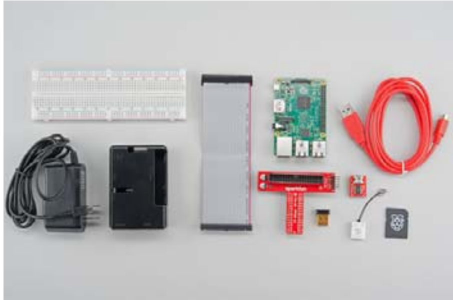
You’ll also need an internet connection to get resources! This link can be wired or wifi and must be available for the Pi.

Suggested Reading and Viewing

- Serial Terminal Basics
- Raspberry gPIo – Also linked-in later
- Pi Wedge Hookup Guide
- Getting Started With The Raspberry Pi – **video series**
  - Part 1
  - Part 2
  - Part 3

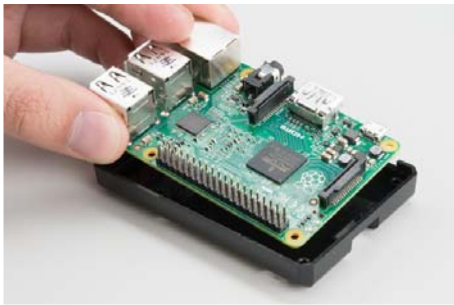
Assembly

The Pi is pretty straight-forward and easy to put together, but, in the event that something doesn’t look right, this section will give you an idea of what it is supposed to look like.

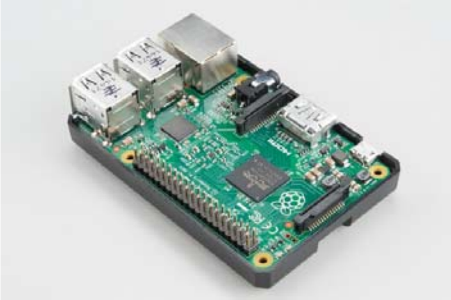


Unbox and gather these components before beginning the assembly

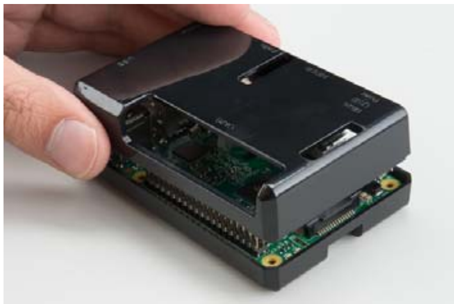
1. Snap the pi into the base of the ‘tin’, snap on the top part



Fit the Pi into the base of the tin

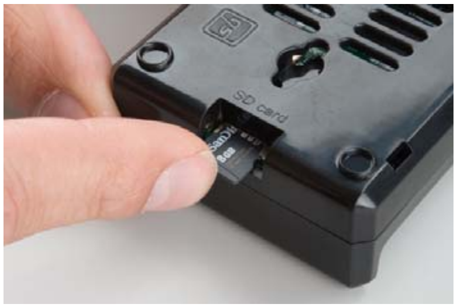


Make sure the Pi is fully seated. Check that the PCB is evenly recessed about the perimeter.

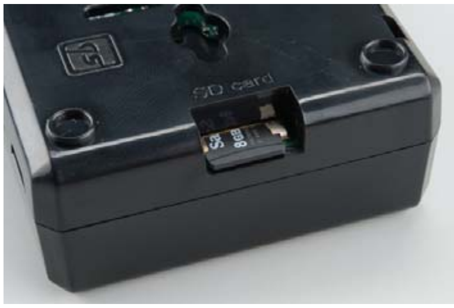


Click the two halves together

2. Add the SD card

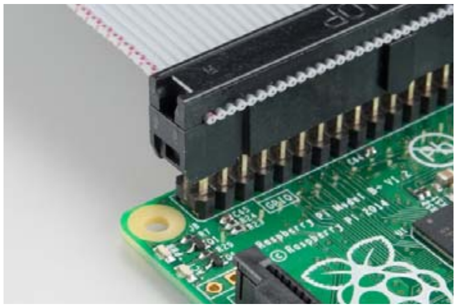


Installing an SD card – make sure the "cliky pen" action of the card is in the depressed position prior to adding power

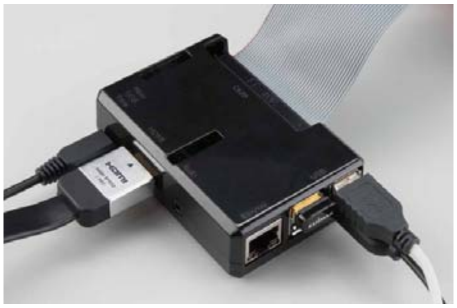


The microSD card should be flush with the side of the case when inserted properly.

3. Connect the ribbon cable to the Pi – notice that the pin 1 marking is very subtle. Orient the red stripe on the cable towards the SD card. Alternately, pin 1 can be identified by finding the missing/beveled corner of the header's silkscreen, on the pi.

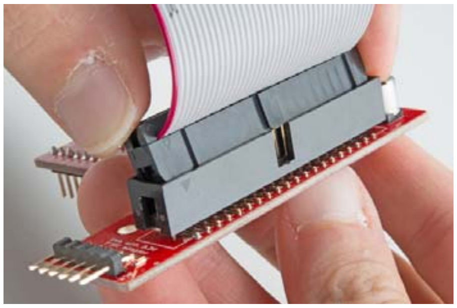


The pin 1 location and silkscreen is the same between the Pi B+ ad Pi B. This image shows a partially inserted ribbon cable without the case in the way.



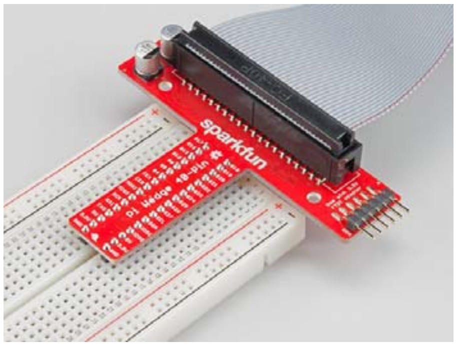
The ribbon cable is orinted with the red “pin 1” marking towards the SD card slot

4. Attach the ribbon cable to the wedge. Pin 1 is towards the FTDI adapter



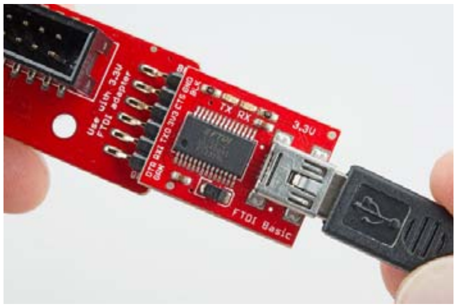
Socket the end of the ribbon cable into the Wedge. It is keyed, but each end of the cable is different. Make sure the ribbon extends away from the breadboard connection.

5. Socket the wedge into your breadboard



Wedge inserted in breadboard.

6. Attach the FTDI connector matching “GRN” to “GRN” between the boards

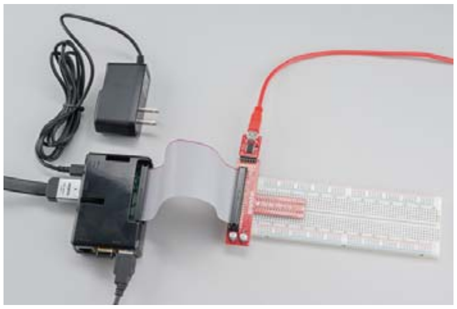


The FTDI serial adapter is connected matching GRN and BLK connections

7. Add the Edimax WiFi dongle, any USB

Inserting the Edimax wireless dongle. In this picture, the Edimax is fully seated.

8. Attach desired consumer computer equipment



The fully assembled kit. Additional to the kit, user supplied monitor, mouse, and keyboard are shown. This Pi is now a desktop computer.

First Boot

Before you apply power for the first time, run through this pre-flight checklist.

- Is the micro SDcard installed and depressed?
- If using a monitor (stand-alone PC usage),
  - Is the HDMI attached and the monitor powered on?
  - Are the mouse and keyboard plugged in?
  - Are the mouse and keyboard standard USB, not wireless?
- If using serial
  - Is the wedge and ribbon cable connected and secure?
  - Is the FTDI “BLK to BLK” and “GRN to GRN”?
  - Is the FTDI connected to your computer with a USB cable?
  - Is your terminal software configured to 115200 baud?
- Lastly, is the whole setup secure on your desk and not liable to jump onto the floor at the first touch?

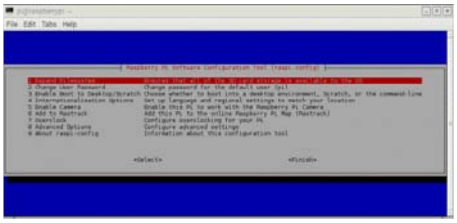
Ok, you’re ready to apply the power to the Pi.

Power Adapter Requirement! Make sure the power being supplied is from a the included 5V, 2A power supply and not your USB connection. The USB most likely won't have enough current supplying capacity and will result in a brown-out of the Pi that can damage it, and will likely mess up the files on your SD card.

What to expect on first boot with a monitor

First you should see a color chart that indicates the Pi has power and is doing something, but doesn't have software loaded yet. Next, the Pi "Hold shift to enter setup" screen appears briefly. Holding shift lets you get in and do Noobs level maintenance which is not covered by this guide.

Next, linux starts booting and the log rolls down the screen. After it's gotten the system loaded, the raspi-config text window pops up and asks you questions. The card comes pre-expanded to fill the space so no actions need to be taken to get straight to a prompt, just select "Finish".



```
Raspberry Pi Software Configuration Tool (raspi-config)

1 Expand Filesystem              Ensures that all of the SD card storage is available to the OS
2 Change User Password           Change password for the default user (pi)
3 Enable Boot to Desktop/Scratch Choose whether to boot into a desktop environment, Scratch, or the command-line
4 Internationalisation Options   Set up language and regional settings to match your location
5 Enable Camera                  Enable this Pi to work with the Raspberry Pi Camera
6 Add to Rastrack                Add this Pi to the online Raspberry Pi Map (Rastrack)
7 Overclock                      Configure overclocking for your Pi
8 Advanced Options               Configure advanced settings
9 About raspi-config             Information about this configuration tool

              <Select>                    <Finish>
```

*This dialog is used to configure the basic linux experience - for now select "Finish". If settings need to be changed later, it can be invoked later by running **"sudo raspi-config"**.*

After that, you will be auto-logged in as user "pi", password "raspberry".

If the screen remained dark, check out the troubleshooting section of this hookup guide – it shows a method of manually invoking the raspiConfig. With some monitors this can happen, but, usually after it's fixed, it's no problem until SDcards, power, or monitor changes.

What to expect on first boot with only serial

Without a monitor, the first boot should happen with a serial connection to monitor what is going on.

First boot instructions for serial:

1. Open up a serial terminal and configure to 115200 buad.
2. Send a few characters out the port and watch the FTDI. One of the LEDs should flash with each character.
3. Plug in the micro usb power to the Pi.

Now, the boot log should start scrolling as the system boots.

This time, no raspi-config tool pops up, and you are not auto-logged in. Log in with "pi" and "raspberry" to get to a prompt.

Note: If, from here, an HDMI cable and monitor is attached, the raspi-config dialog may appear, though in a really big graphical mode. This is because audo-detecting your monitor is part of the boot routine. Without it, the graphics mode has defaulted to the most compatible, and lowest, resolution.

Methods of Working with the Pi

Once the Pi is configured, there are a few methods of using it depending on if you want to use it like a desktop or manage it remotely.

This section covers using the Pi in the following ways

- Using HDMI-out – Operate your Pi like a desktop computer.
- Using the serial terminal – Operate through a serial link to another computer.
- Using SSH – Operate through a network linked to another computer.

Using HDMI-out

This is the easiest method and is great if you have a HDMI monitor lying around. After the system boots, log in with “pi” as the user name and “raspberry” as the password. Then, enter `startx` to enter a graphical environment where you are presented with a desktop-type menu driven operating system.

If you need to get back to text land, you can either

- log off through the Task Bar Menu – drops back to the shell, closing down the X window system
- open xterm from the Task Bar – opens a shell in a graphical window
- Use CTRL-ALT-1 through CTRL-ALT-8 – gives you a number of shells, with 7 being the graphic environment (if loaded).

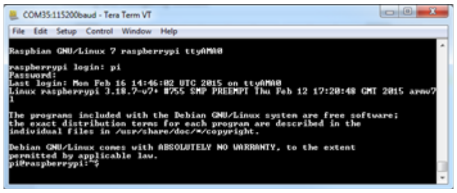
Remember, shutdown with the menu item or enter `sudo shutdown -h now` from a shell, and wait for the system to halt, before removing power.

Using the serial terminal without a monitor

Connect the FTDI to the mini-usb cable and plug into a usb port on your computer.

Set the serial settings to **115200** baud, 8 bit, no parity, 1 stop and no flow control.

Power on the pi – wait 45 seconds for boot (30 second boot time plus margin).



```
Raspbian GNU/Linux 7 raspberrypi ttyAMA0

raspberrypi login: pi
Password:
Last login: Mon Feb 16 14:46:02 UTC 2015 on ttyAMA0
Linux raspberrypi 3.18.7-v7+ #755 SMP PREEMPT Thu Feb 12 17:20:48 GMT 2015 armv7
l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
pi@raspberrypi:~$
```

Everythings A-OK on my end, Captain

From here, you can’t use `startx` because there is no graphic driver through the serial terminal. However, you *can* configure your wireless/lan, use apt-get to get programs, do all your coding and operate the Pi’s hardware.

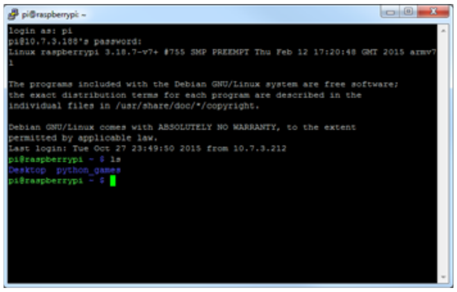
If you don’t see a login, start troubleshooting.

Using SSH

A good way to operate a Pi is to attach it to the local network somewhere, then manage it from another computer connected to that network.

> **Note:** This method relies on a local internet connection. Work through the configuration process with the monitor/mouse/keyboard or serial terminal (described below), then come back here.

To do this, download PuTTY or a similar SSH terminal for your system and connect to the Internet port used by the pi. The TTY interface gives you a serial interface but with colors that make it a little nicer to use.



```
login as: pi
pi@10.7.3.188's password:
Linux raspberrypi 3.18.7-v7+ #755 SMP PREEMPT Thu Feb 12 17:20:48 GMT 2015 armv7
l

The programs included with the Debian GNU/Linux system are free software;
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Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Tue Oct 27 23:49:50 2015 from 10.7.3.212
pi@raspberrypi ~ $ ls
Desktop  python_games
pi@raspberrypi ~ $
```

A PuTTY terminal looks nicer than serial and can be used over networks

To obtain your IP, get to a terminal, and use the command `ifconfig` .

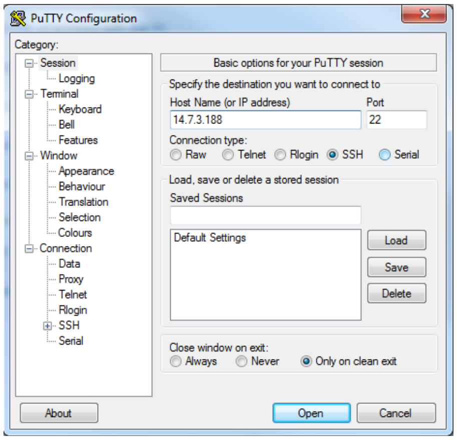
With Ethernet and wireless attached, `ifconfig` returns something like the following. If it looks similar but the IP addresses aren't present, that link hasn't been established.

```
pi@raspberrypi:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr b8:a8:3b:56:1a:f7
        inet addr:14.7.3.188  Bcast:14.7.3.255  Mask:255.255.2
55.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:3026 errors:0 dropped:0 overruns:0 frame:0
        TX packets:462 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:229516 (224.1 KiB)  TX bytes:60888 (59.4 KiB)

lo        Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
        RX packets:8 errors:0 dropped:0 overruns:0 frame:0
        TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:0
        RX bytes:1104 (1.0 KiB)  TX bytes:1104 (1.0 KiB)

wlan0     Link encap:Ethernet  HWaddr 74:df:21:5b:a3:9c
        inet addr:32.8.0.142  Bcast:32.8.0.255  Mask:255.255.2
55.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:120 errors:0 dropped:40 overruns:0 frame:0
        TX packets:12 errors:0 dropped:4 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:20955 (20.4 KiB)  TX bytes:9956 (9.7 KiB)
```

Now that I know that my Ethernet is on IP 14.7.3.188 and my wireless on 32.8.0.142, I can enter it into the PuTTY configuration window to begin the session. From here, it just works like the serial link!



Specify the destination you want to connect to

Host Name (or IP address): 14.7.3.188

Port: 22

Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Saved Sessions: Default Settings

Close window on exit: ○ Always ○ Never ● Only on clean exit

Configuring PuTTY

Configuring the Pi

This section goes over configuring the keyboard, ethernet, and wireless (Edimax) modules.

Configuring the keyboard layout

The raspbian distribution comes defaulted to European hardware. For us Yanks, we find the " (quotation mark) symbol is replaced by @ (commercial at) and our number sign # is replaced by the european pound sign £. This can made it aggravating when trying to #define things. Invoke the config tool with "sudo raspi-config" and take the following actions.

Set the default locale for the system

- Select "Internationalisation Options"
- Select "Change Locale"
- Deselect en_GB.UTF-8 UTF-8
- Select en_US.UTF-8 UTF-8, (Ok)
- Set default to en_US.UTF-8, (Ok)

Change the keyboard layout – from the Internationalisation Options menu,

- Change Keyboard Layout
- Leave set as: Generic 105-key (Intl) PC (Ok)
- Select Other (Ok)
- Select English (US) (Ok)
- Select English (US) (Ok)
- Select default (Ok)
- Select No compose key (Ok)
- Set Ctrl+Alt+Bksp function (Ok)

Finish with the dialog and get back to the shell

Try the " and # keys at the prompt. It may be necessary to restart the pi at this point.

Configuring the Internet interfaces

A single configuration file, `interfaces` , configures both wired and wireless devices. Settings that work for the EdiMax 7811Un card were found in a blog post by Jason Theobald. His configuration also enables DHCP listening for the wired connection, which is what we want for most networks.

```
sudo nano /etc/network/interfaces
```

replace “nano” with “leafpad” if you are in x and prefer graphics

```
auto lo
iface lo inet loopback
iface eth0 inet dhcp

allow-hotplug wlan0
auto wlan0

iface wlan0 inet dhcp
   wpa-ssid "Your Network SSID"
   wpa-psk "Your Password"
```

A note on DHCP: The Ethernet port is default configured to manual IP configuration. Make sure the eth0 line specifies the dhcp rather than manual ("iface eth0 inet dhcp") if you plan on using the wired port.

Applying the changes (turning it off and then back on again)

The link should be cycled for the new configuration to take. Rather than shutting down the pi and restarting, use ‘ifdown’ and ‘ifup’ to bring the link down and back up.

For **wireless** connections, use

```
sudo ifdown wlan0
```

and

```
sudo ifup wlan0
```

For **wired** connections, use

```
sudo ifdown eth0
```

and

```
sudo ifup eth0
```

Reading Inputs and Toggling the LEDs

This section contains instructions for getting the software necessary to compile programs that use the GPIO, then redirects to our **Raspberry gPIo tutorial**.

Getting WiringPi for Using C++

The wiringPi library is required to operate the GPIO with C++. There are two methods to get it. Either way, it will have to be built before use.

Get From the WiringPi Website

The first way to obtain it is to download from a direct link to the WiringPi website: http://wiringpi.com/download-and-install/.

Get Using Git (Preferred)

Another way to obtain it is through apt-get to obtain git, then by using git to get the repository.

- Install Git – Enter `sudo apt-get install git-core`
- Git the wiringPi repo – Enter `sudo git clone git://git.drogon.net/wiringPi`

This will make a folder in your current directory called wiringPi.

Build WiringPi

However it was obtained, the first step is to build the WiringPi library. The source comes with a script to do all this for you.

- Go to the wiringPi directory – Enter `cd wiringPi`
- build the wiringPi resources – Enter `sudo ./build`

This builds the helper files, modifies some paths in linux and gets wiringPi ready to rock.

At this point, the library should work. Try it out

- Enter `gpio readall`

A ascii table of pins and states should appear.

Getting Python

Raspian comes with Python pre-installed. Continue to the gPIo tutorial to find out how to use it.

Using the GPIO.

This excellent tutorial on the INs, OUTs, and PWMs of GPIO with the Pi platform. It includes operation of the Pi 2 Model B!

Raspberry gPIo

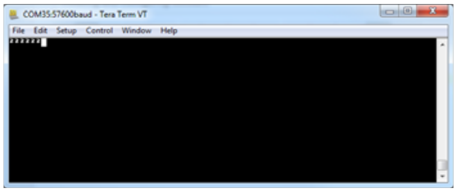
OCTOBER 29, 2015

How to use either Python or C++ to drive the I/O lines on a Raspberry Pi.

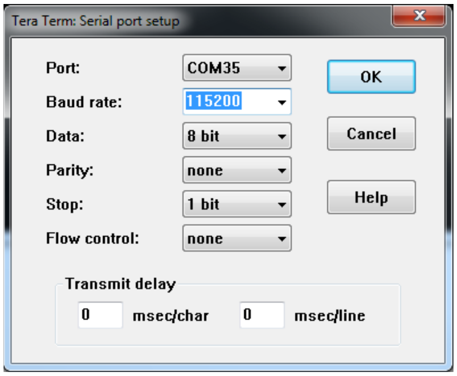
Troubleshooting

Uh oh! Something must have gone wrong. Here's the common problems I ran into.

The serial is garbage!

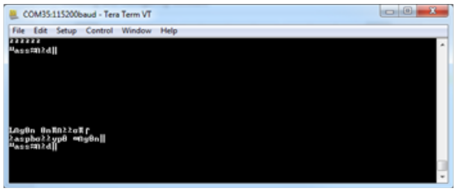


Here, I have selected the wrong settings and see these funny small 2's.



Port: COM35
Baud rate: 115200
Data: 8 bit
Parity: none
Stop: 1 bit
Flow control: none
Transmit delay
0 msec/char 0 msec/line

I change the settings to be correct, but the problem isn't solved.


COM35:115200baud - Tera Term VT
File Edit Setup Control Window Help

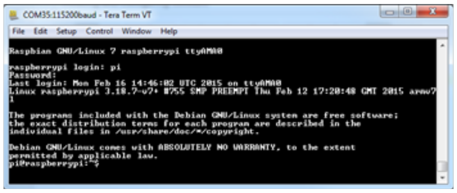
```
??????
ªass≡ñ?d‖




Løg0n 0nñn??σπΓ
?asphe??yp0 ≡ñg0n‖
ªass≡ñ?d‖
```

Now, with the correct settings, the formatting looks OK but the characters are all wrong!

One thing that can happen while trying to find out the serial settings is that, after trying a few, even the correct settings show garbage. What happens is that with the wrong settings, some of the transmitted characters get time-scaled and resemble terminal control characters. These characters end up telling the server side to change its behavior! If the screen formatting looks OK but the characters are all garbage, this is probably what is up. Either close and re-open the serial terminal program or send terminal reset (Reset terminal and reset remote title for Tera Term) if available.


COM35:115200baud - Tera Term VT
File Edit Setup Control Window Help

```
Raspbian GNU/Linux 7 raspberrypi ttyAMA0

raspberrypi login: pi
Password:
Last login: Mon Feb 16 14:46:02 UTC 2015 on ttyAMA0
Linux raspberrypi 3.18.7-v7+ #755 SMP PREEMPT Thu Feb 12 17:20:48 GMT 2015 armv7
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permitted by applicable law.
pi@raspberrypi:~$
```

Resetting both ends of the terminal link gets everything looking good

Monitor remains blank after inserting a card

I've found that when working with SD cards and another computer, *sometimes* I plug the card into the pi but it the monitor never comes up. In the few cases I've seen the activity lights by pin 1 of the ribbon connector are active but no display appears.

If this is the case,

- First try resetting the pi.

If that doesn't work,

- Log in through another computer with the serial interface.
- Invoke the raspi-config dialog with "sudo raspi-config"
- Expand the partition – even if has been done before!
- Finish the dialog and reboot.

This has solved the problem every time.

Starting from a blank microSD card

With any development, things can go pear-shaped. Sometimes it can be good to just start from a known state and try again. The process isn't covered by this guide, but the raspberrypi folks have done an excellent job at documenting it. These two steps can get you back to the beginning.

1. Download the NOOBS image. As of this writing, it's at version 1.4.2.
2. Follow the official installation instructions.

Performing a full system upgrade

Once connected to the internet, it can be a good idea update all the packages that are currently installed. Usually, new packages replace old ones that are faulty, but sometimes new packages have bugs on their own. If your current system is stable and all the funtions are good, maybe don't upgrade. If you're starting a frest project though, get everthing up-to-date *before* you start putting in the work.

Enter the following commands in the shell (process takes about 10 minutes)

- `sudo apt-get update` – go fetch the latest package information.
- `sudo apt-get upgrade` – And answer Y. Upgrades all the packages. This stage will take a while.
- `sudo shutdown -r now` – Reboot the machine.

Resources and Going Further

You've completed boot-camp for the Pi 2. Hopefully your Pi is screaming along, toggling outputs and is chomping through all your available bandwidth. The kit has been designed to give you everything you need to start a project…

Now get out there and make us proud!

Here are some links to our other Pi resources.

- The gPIo tutorial
- The SPI and I2C tutorial

Need some inspiration?

- Raspberry Pi Twitter Monitor
- Hackers in Residence: Sound visualizer
  - Part 1
  - Part 2