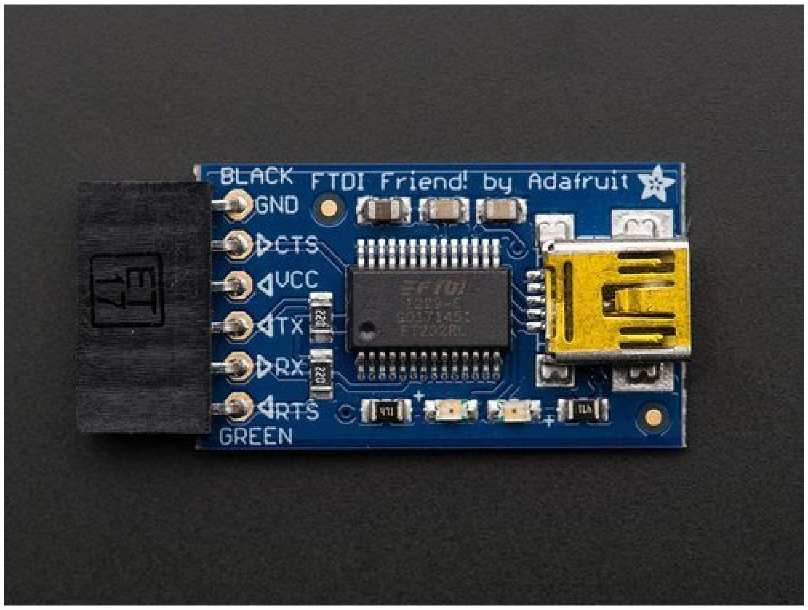
adafruit learning system

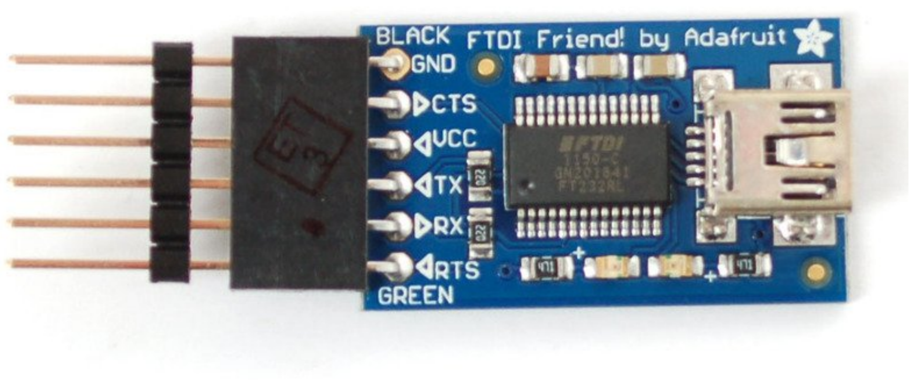
FTDI Friend

Created by lady ada



Last updated on 2019-07-17 08:21:26 PM UTC

Overview



Long gone are the days of parallel ports and serial ports. Now the USB port reigns supreme! But USB is hard, and you just want to transfer your every-day serial data from a microcontroller to computer. What now? Enter the FTDI Friend!

The FTDI Friend is a tweaked out FTDI FT232RL chip adapter. Sure, like the well-known FTDI cable, it can provide power to your project and there are 4 signal lines for sending data back and forth. But the Friend can do much more! For example, you can change the signal and power lines to be either 3.3V or 5V. Arduino-derivatives and XBees use the RTS line for programming but what if you need that DTR line? Its there for you.

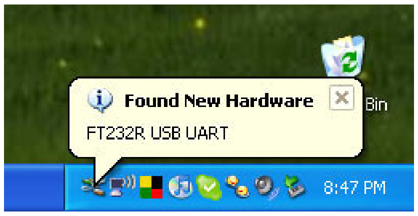
By default, we've set it up so that it matches our FTDI cables. The 6th pin is RTS (as of Arduino IDE v18 this will work perfectly for uploading to 'inos), the power wire is +5V and the signal levels are 3.3V (they are 5V compliant, and should work in the vast majority of 3.3V and 5V signal systems).

Installing FTDI Drivers

Step #1 is to plug in your FTDI adapter and install the driver (in case it isnt on there already). If you have an FTDI cable proper, there is already a USB A connector on the end. If you have an FTDI adapter, you'll need a standard mini-B cable, pretty much everything uses these so steal your camera's or cell phone's data cable.

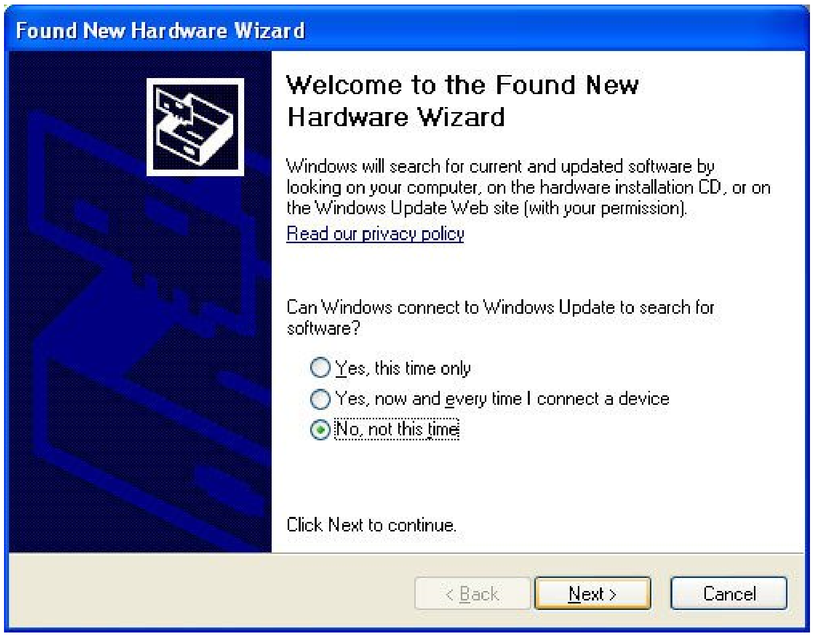
If you are using **Windows or Mac OS**, you may need to need to download the FTDI driver (https://adafru.it/aJv) if you haven't already installed it for another project. **If you are using Linux, the driver is already built in to the operating system (handy!)**

Next up, plug it into your computer! If you are using Windows you may hear a sound from the computer and a little popup bubble in the bottom right corner of the screen that says **Found New Hardware FT232R USB UART.**



Found New Hardware
FT232R USB UART

After a few seconds, the new hardware wizard will start. Select **"No not this time"** and click **Next>**


Found New Hardware Wizard

Welcome to the Found New Hardware Wizard

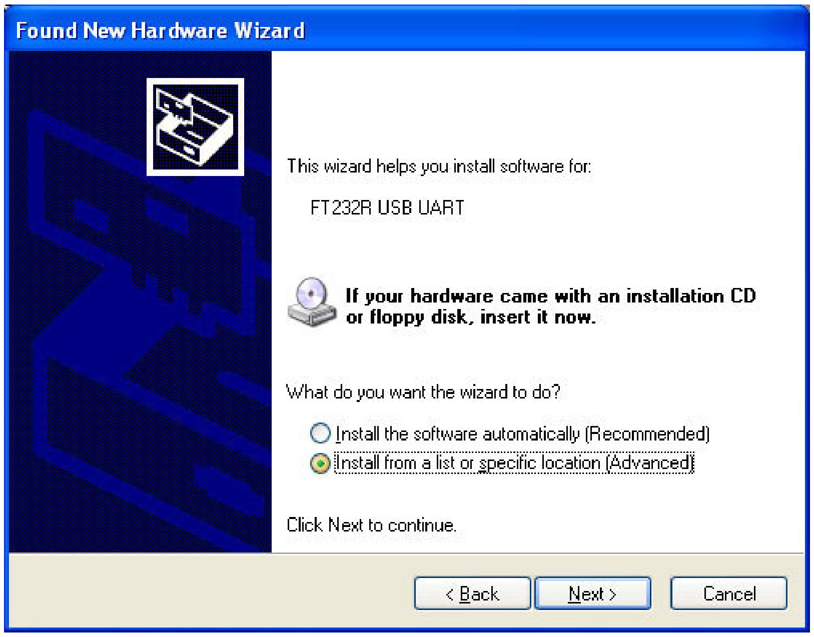
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy

Can Windows connect to Windows Update to search for software?

- Yes, this time only
- Yes, now and every time I connect a device
- [✓ No, not this time]

Click Next to continue.

At the next screen, select **Install from a list or specific location**


Found New Hardware Wizard

This wizard helps you install software for:

FT232R USB UART

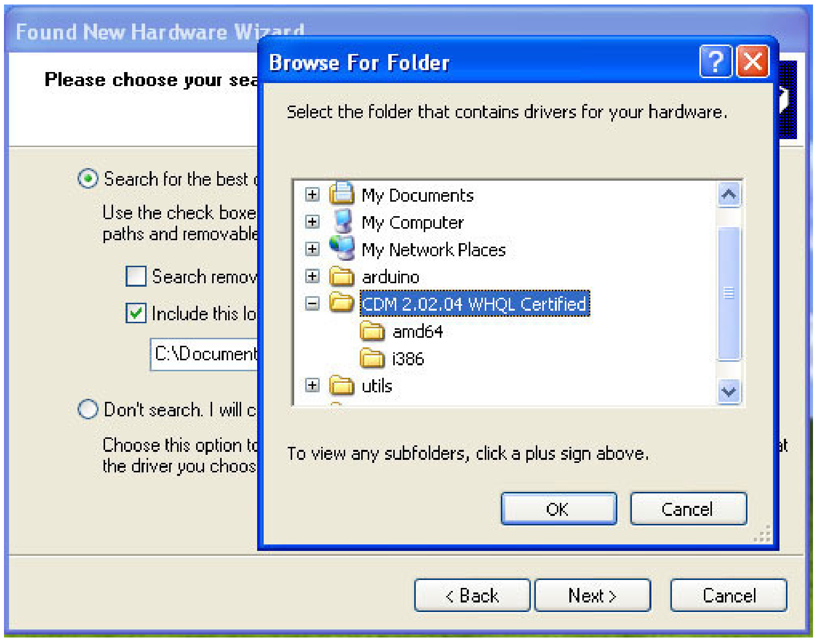
If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

- Install the software automatically (Recommended)
- [✓ Install from a list or specific location (Advanced)]

Click Next to continue.

At the next screen make sure **Include this location** is selected and browse to the folder that contains the driver you downloaded. Select the folder and click **OK**


Found New Hardware Wizard

Please choose your sea

Search for the best

Use the check boxe
paths and removable

☐ Search remov

☑ Include this lo

C:\Document

Don't search. I will c

Choose this option to
the driver you choos

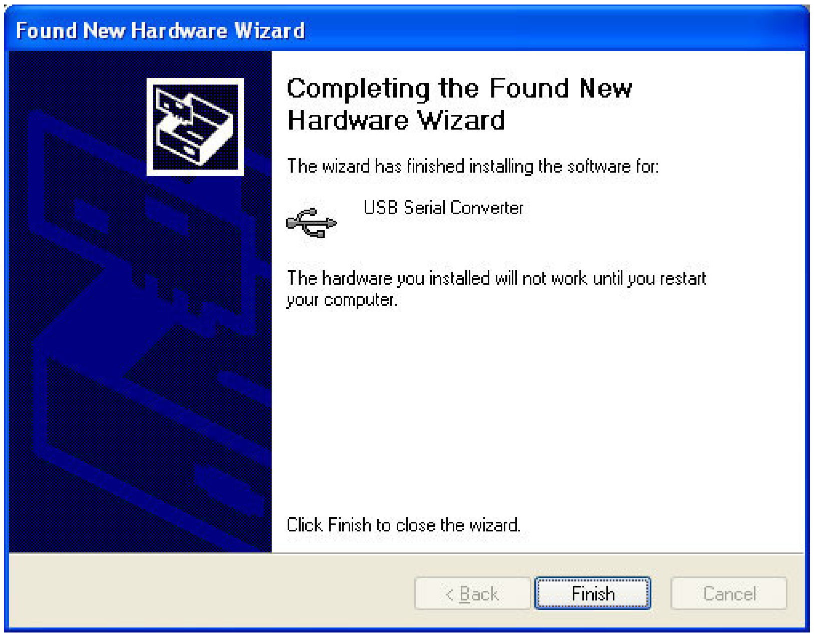
Browse For Folder

Select the folder that contains drivers for your hardware.

```
⊞ My Documents
⊞ My Computer
⊞ My Network Places
⊞ arduino
⊟ CDM 2.02.04 WHQL Certified
      amd64
      i386
⊞ utils
```

To view any subfolders, click a plus sign above.

It should copy some files and then come up with this window. Click **Finish**


Found New Hardware Wizard

Completing the Found New Hardware Wizard

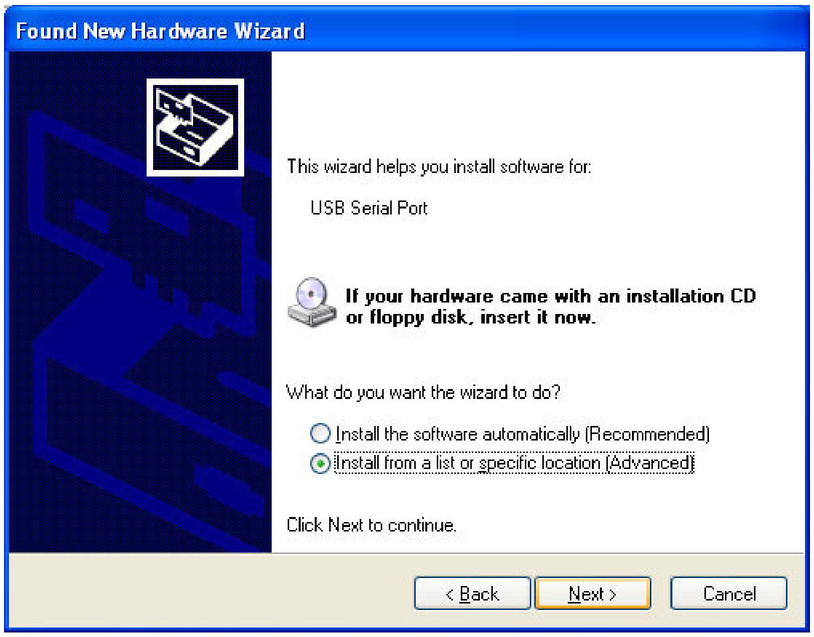
The wizard has finished installing the software for:

USB Serial Converter

The hardware you installed will not work until you restart your computer.

Click Finish to close the wizard.

Almost immediately, another window will pop up, this time it will say **USB Serial Port**. As before, click **Install from a list or specific location**



This wizard helps you install software for:

USB Serial Port

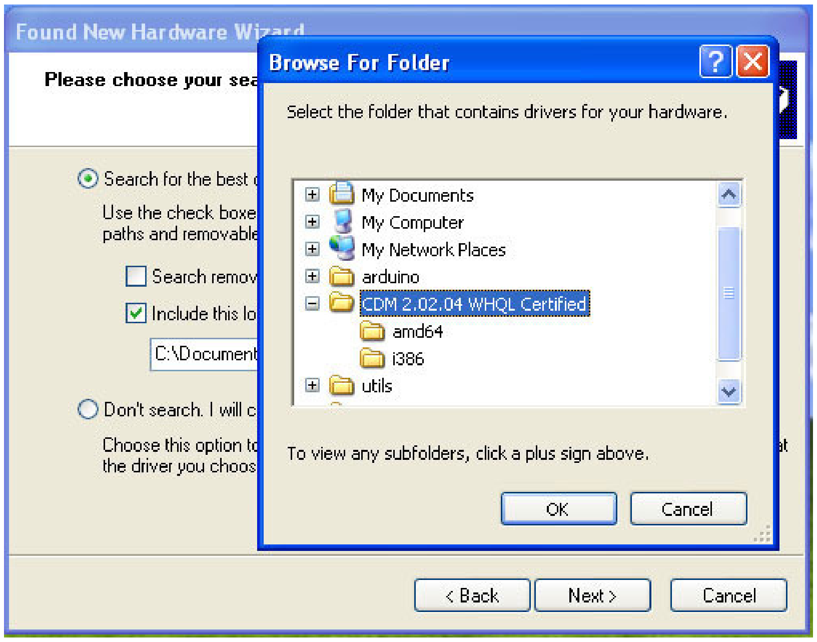
If your hardware came with an installation CD or floppy disk, insert it now.

What do you want the wizard to do?

- [ ] Install the software automatically (Recommended)
- [✓] Install from a list or specific location (Advanced)

Click Next to continue.

Browse to the same folder again...

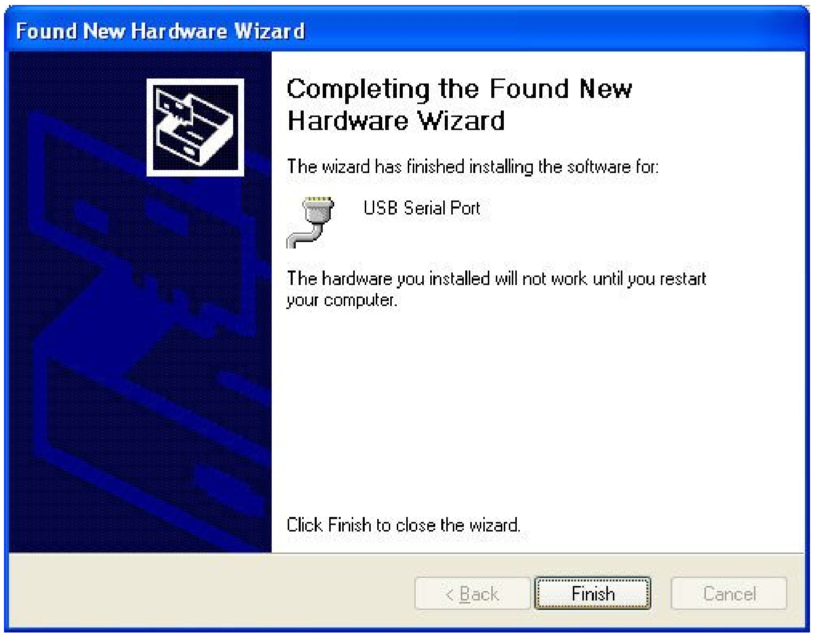


Please choose your sea

Select the folder that contains drivers for your hardware.

To view any subfolders, click a plus sign above.

And it should complete successfully!


Found New Hardware Wizard

Completing the Found New Hardware Wizard

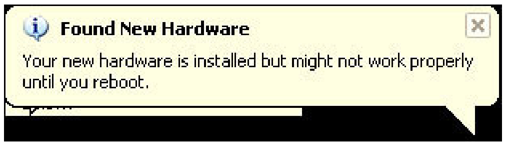
The wizard has finished installing the software for:

USB Serial Port

The hardware you installed will not work until you restart your computer.

Click Finish to close the wizard.

You may need to reboot the computer.

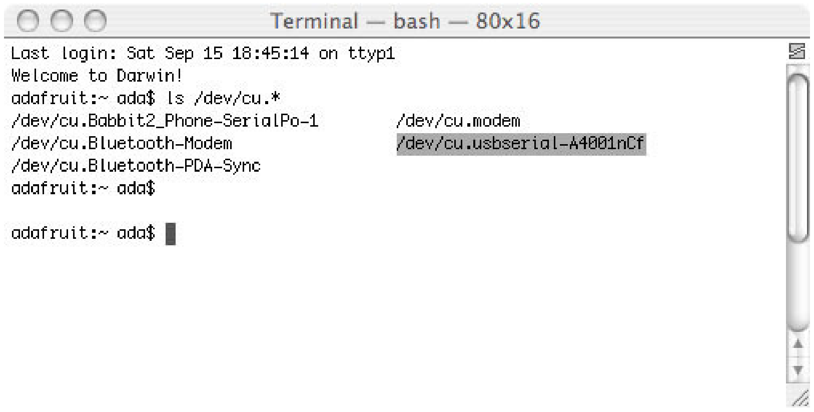

Found New Hardware

Your new hardware is installed but might not work properly until you reboot.

COM / Serial Port Name

OK now we will verify that the driver installed properly.

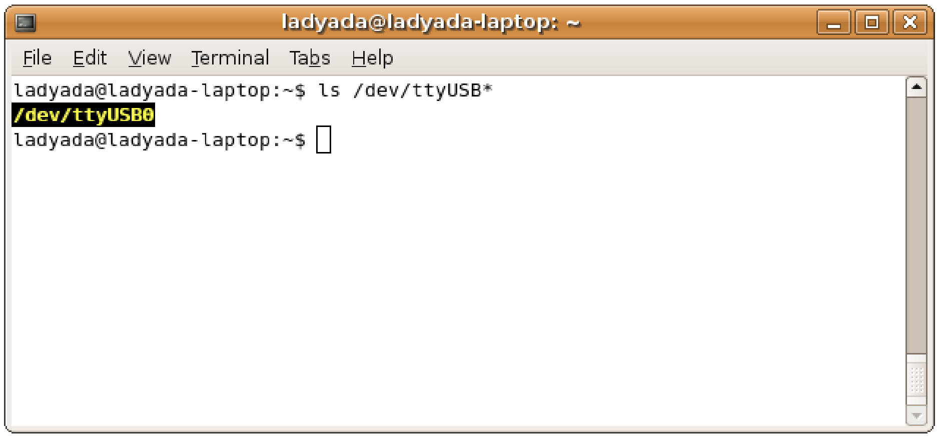
Under Mac, in the **Terminal** window, type in **ls /dev/cu.*** which should give the following responses or so



```
Last login: Sat Sep 15 18:45:14 on ttyp1
Welcome to Darwin!
adafruit:~ ada$ ls /dev/cu.*
/dev/cu.Babbit2_Phone-SerialPo-1       /dev/cu.modem
/dev/cu.Bluetooth-Modem                /dev/cu.usbserial-A4001nCf
/dev/cu.Bluetooth-PDA-Sync
adafruit:~ ada$

adafruit:~ ada$ 
```

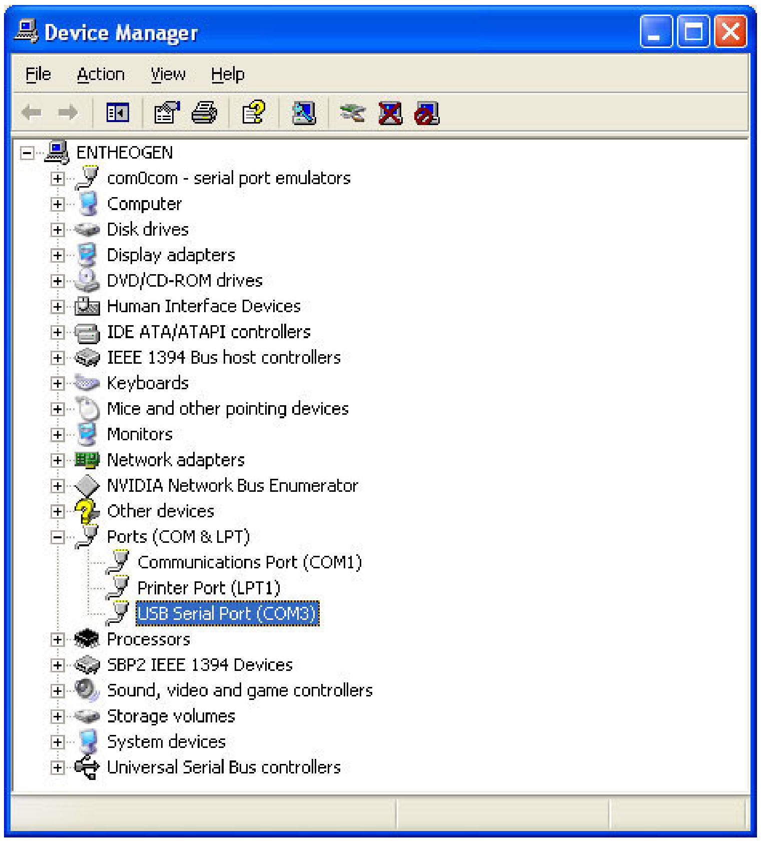
The name we are looking for is **/dev/cu.usbserial-XXXX** where the X's are going to be unique for each cable. Copy and paste the name into a text file so you'll remember it for later.

For Linux/Unix type **ls /dev/ttyUSB*** into a terminal window, you should see a device file called something like ttyUSB0



```
ladyada@ladyada-laptop:~$ ls /dev/ttyUSB*
/dev/ttyUSB0
ladyada@ladyada-laptop:~$ 
```

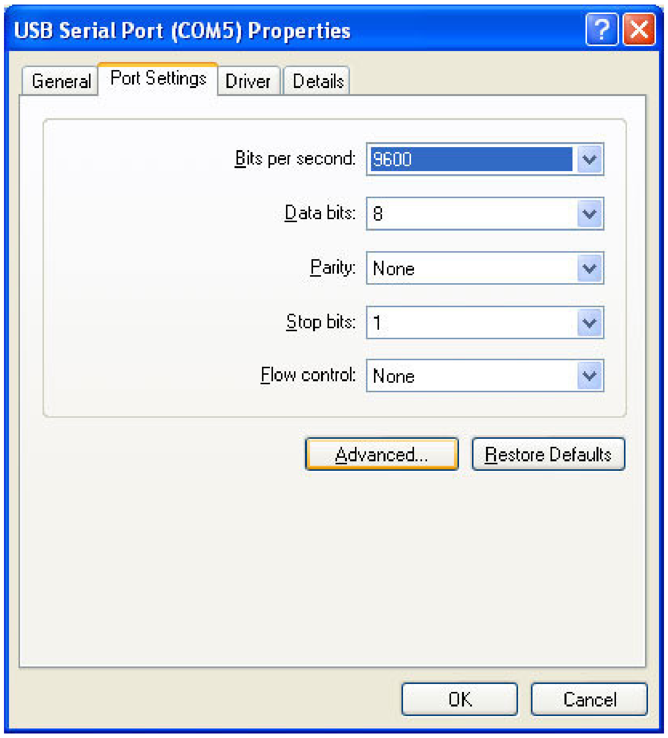
If you are using Windows, go to the **Device Manager** (From the **Start Menu**, select Settings→Control Panel. Double click on **System** and select the **Hardware** tab. Then click on the **Device Manager** button)



ENTHEOGEN
com0com - serial port emulators
Computer
Disk drives
Display adapters
DVD/CD-ROM drives
Human Interface Devices
IDE ATA/ATAPI controllers
IEEE 1394 Bus host controllers
Keyboards
Mice and other pointing devices
Monitors
Network adapters
NVIDIA Network Bus Enumerator
Other devices
Ports (COM & LPT)
Communications Port (COM1)
Printer Port (LPT1)
USB Serial Port (COM3)
Processors
SBP2 IEEE 1394 Devices
Sound, video and game controllers
Storage volumes
System devices
Universal Serial Bus controllers

Look for an entry under **Ports (COM & LPT)** that says **USB Serial Port (COM)** the COM number may vary but it should be something like **COM3** or **COM4** the COM number may be as high as **COM99** so just look for the USB serial port. The COM stands for "communication", and each one has a unique number, known as the **COM Port number**. In this case the COM Port number is **COM3**. If you don't see the COM port verify the cable is plugged in, and check that you installed the VCP FTDI driver.

Then right click and select **Properties**


USB Serial Port (COM5) Properties

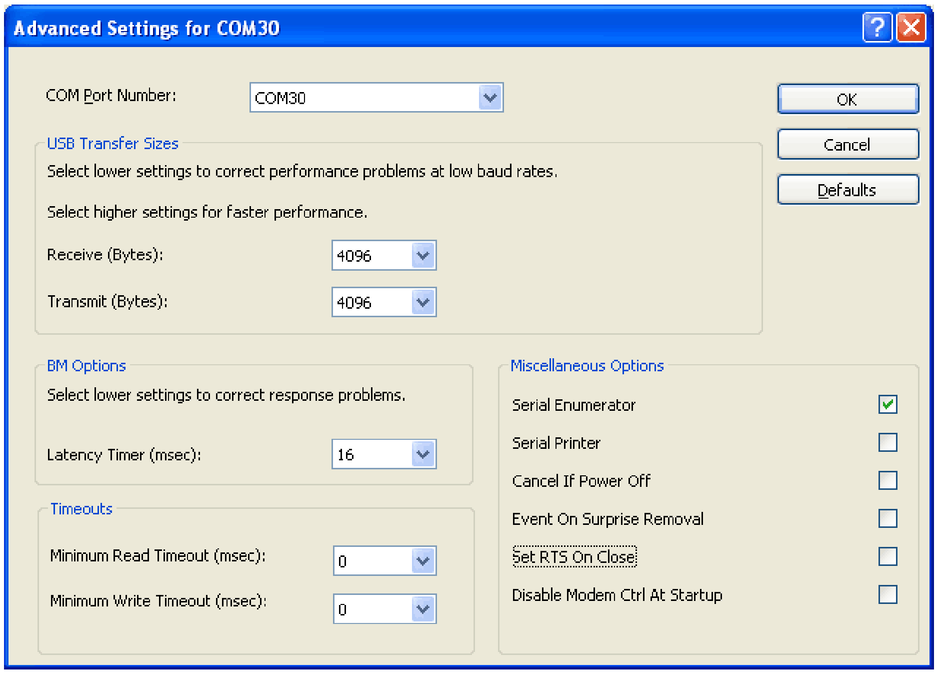
General | Port Settings | Driver | Details

Bits per second: 9600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

Advanced... | Restore Defaults

OK | Cancel

Click on the **Port Settings** tab, and click on **Advanced...**


Advanced Settings for COM30

COM Port Number: COM30

USB Transfer Sizes
Select lower settings to correct performance problems at low baud rates.
Select higher settings for faster performance.
Receive (Bytes): 4096
Transmit (Bytes): 4096

BM Options
Select lower settings to correct response problems.
Latency Timer (msec): 16

Timeouts
Minimum Read Timeout (msec): 0
Minimum Write Timeout (msec): 0

Miscellaneous Options
Serial Enumerator ✓
Serial Printer ☐
Cancel If Power Off ☐
Event On Surprise Removal ☐
Set RTS On Close ☐
Disable Modem Ctrl At Startup ☐

OK | Cancel | Defaults

Make sure **Set RTS On Close** used to be required for people using the Arduino IDE before like version 18 or so. Now you dont need it so make sure its not selected!

FTDI vs. AVR Programmer

Whats the difference between an FTDI cable/adapter & AVR programmer?

FTDI Cable / Adapter AVR Programmer

There are two ways to program an AVR microcontroller. One is to reprogram the entire chip using an AVR programmer. The other is to use a **bootloader** that is pre-programmed onto the chip that allows the chip to re-program itself. An AVR programmer is more powerful: you can really mess with anything on the chip and the entire 32K of memory is available. Using the bootloader is safer: there's no way to mess with the fuse settings (which could brick the chip) but you only get 30K of memory since 2K is used by the bootloader. Not a big deal, but if you are working on a big project which requires tons of flash space, you may need it

For a lot more information about AVR programmers and bootloaders, I strongly recommend reading this short article (https://adafru.it/aI4)

Note that to program an AVR you need an AVR programmer (like a USBtinyISP (https://adafru.it/aI4)), but to upload using the bootloader you need a computer-serial connection (such as an FTDI cable). Unfortunately, they are not the same device! If you're not a microcontroller wiz, I suggest going with the bootloader (FTDI) method. Its as fast (or faster), allows you to debug as well, and theres virtually no way to damage/brick the chip by messing with the fuses. If you're familiar with microcontroller programming, and you have a programmer, then feel free to go that direction.

SO!

- **AVR programmers** are more powerful in that you can program any AVR, even blank ones from the factory. But that also means you have a pretty good chance of 'bricking' the chip!
- **FTDI adapters** can send any serial data back and forth including updating AVRs with a bootloader on them. But you need to get that bootloader on there first, which basically requires an AVR programmer.

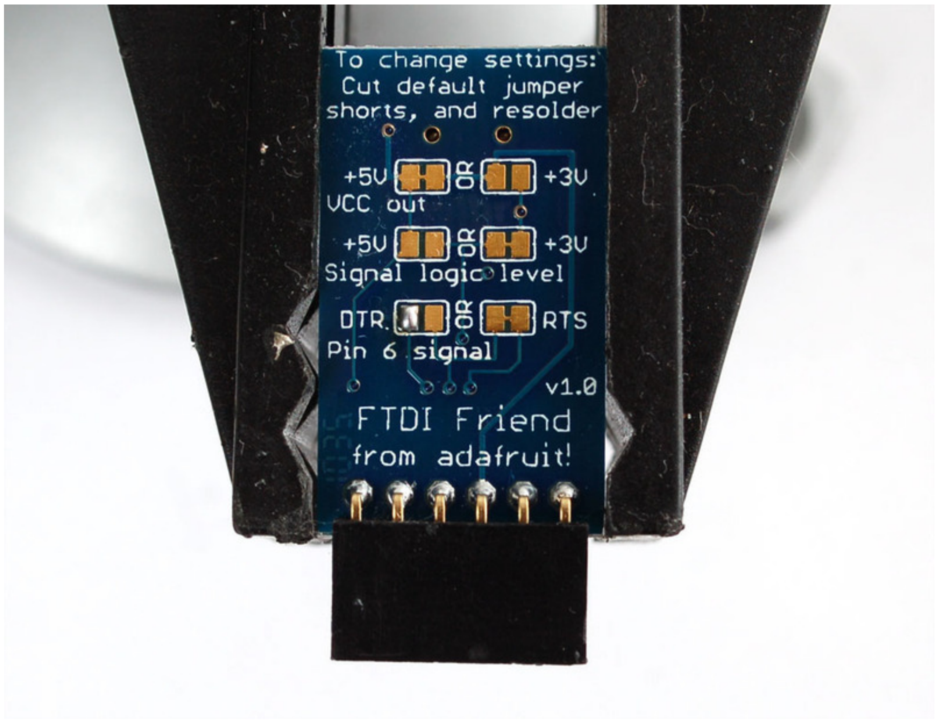
If you use an AVR programmer to write to chip with a bootloader on it, you'll overwrite the bootloader so just be aware of that!

Programming Blank AVRs

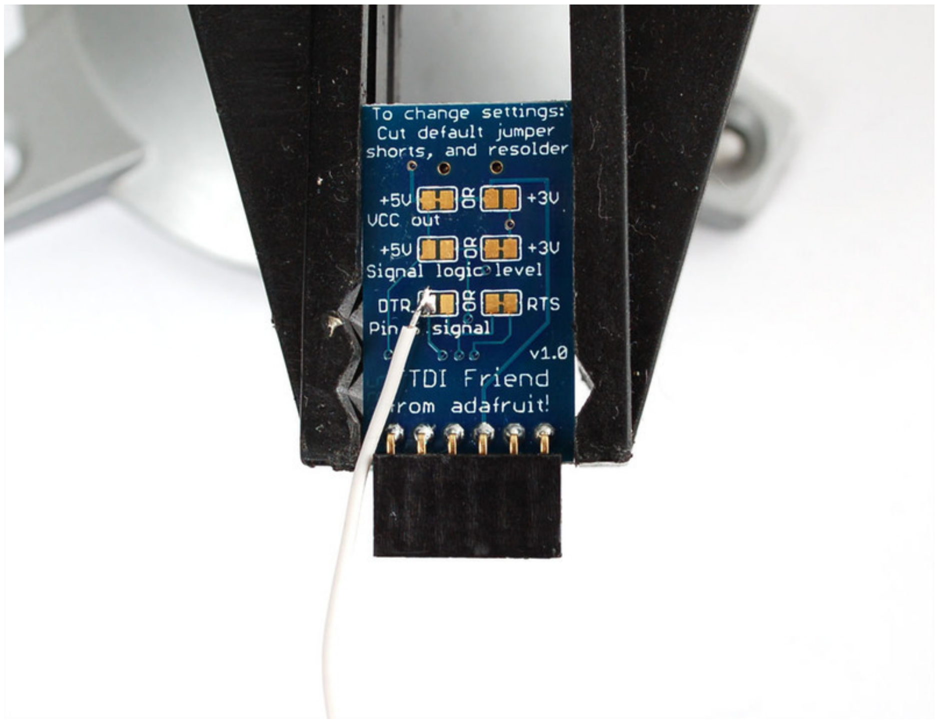
So even though I said FTDI adapters are not for programming 'raw' AVRs, it turns out you can 'convince' the chip to do it with a bit of manipulation. One way that is documented so far doesnt require soldering but it does require updating the AVRDUDE software and installing a different driver (https://adafru.it/aVA) . (see also this post (https://adafru.it/aWU) and this link for using an FTDI adapter instead of an Arduino (https://adafru.it/aWV))

If you have an FTDI friend or other breakout where you can get to the DTR line, I found a way to do it that requires soldering a wire but no AVRDUDE/driver messing. The trade off is that it is **really** slow - good for maybe burning a bootloader on, not good for day-to-day AVR development

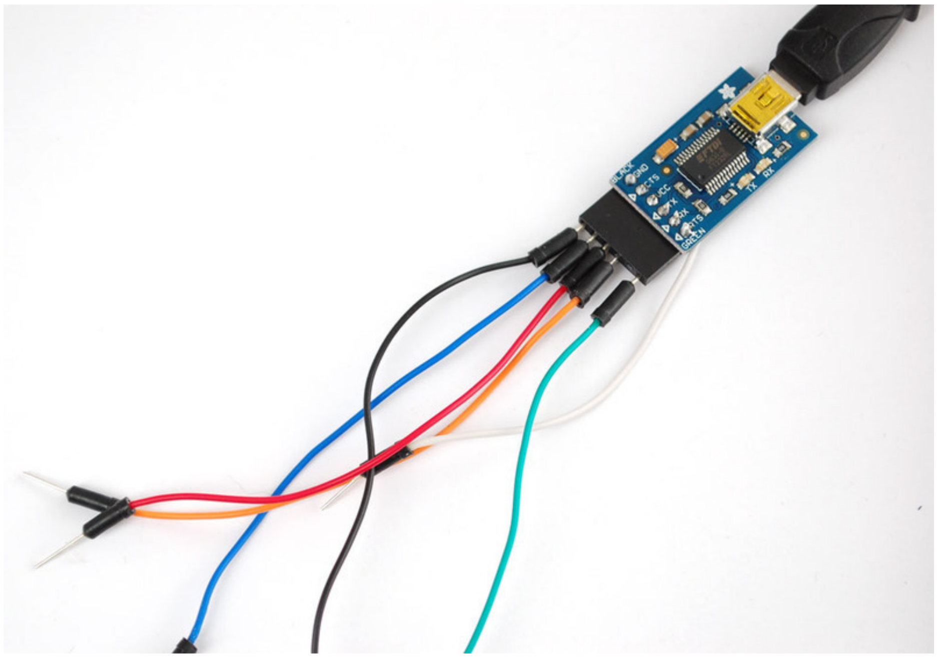
Turn over the FTDI friend, and solder a dot of solder onto the DTR pin on the bottom left.

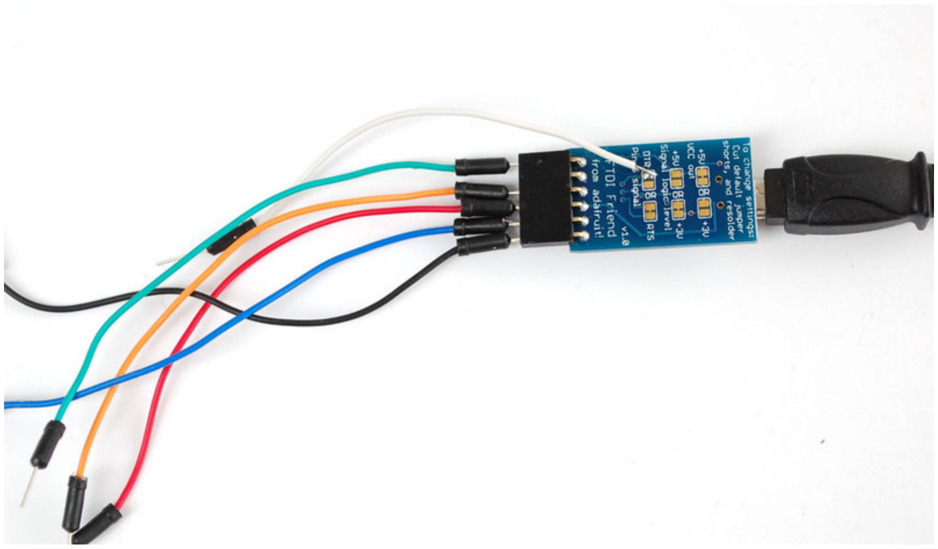


Solder a wire onto it, making sure you dont short it to the gold square just to the right. We'll use a **white** wire.



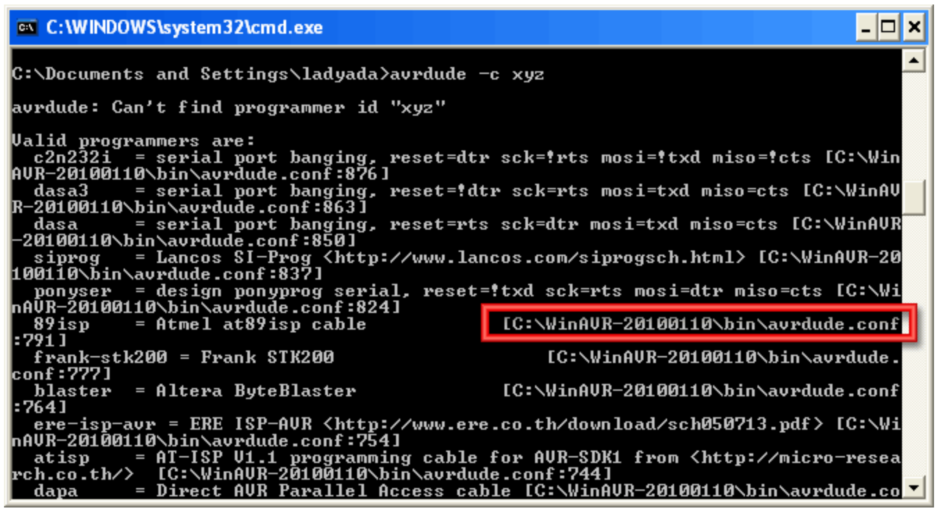
Plug in wires into the FTDI breakout, **black** is ground, **blue** is CTS, **red** is VCC, **orange** is TX and **green** is RTS.





Now you have to make a text edit to your **avrdude.conf**.

If you've installed **WinAVR (https://adafru.it/aI2)** or similar (say for Mac (https://adafru.it/aI1) or Linux (https://adafru.it/aWW)) , it'll be in something like **C:\WinAVR\bin\avrdude.conf** or **C:\WinAVR\etc\avrdude.conf** if you aren't sure where it is, but you have **avrdude** installed, you can run**avrdude -c xyz**which will dump the programmer list, if you look to the right, the name of the conf file will be printed



```
C:\Documents and Settings\ladyada>avrdude -c xyz

avrdude: Can't find programmer id "xyz"

Valid programmers are:
  c2n232i   = serial port banging, reset=dtr sck=!rts mosi=!txd miso=!cts [C:\Win
AVR-20100110\bin\avrdude.conf:876]
  dasa3     = serial port banging, reset=!dtr sck=rts mosi=txd miso=cts [C:\WinAV
R-20100110\bin\avrdude.conf:863]
  dasa      = serial port banging, reset=rts sck=dtr mosi=txd miso=cts [C:\WinAVR
-20100110\bin\avrdude.conf:850]
  siprog    = Lancos SI-Prog <http://www.lancos.com/siprogsch.html> [C:\WinAVR-20
100110\bin\avrdude.conf:837]
  ponyser   = design ponyprog serial, reset=!txd sck=rts mosi=dtr miso=cts [C:\Wi
nAVR-20100110\bin\avrdude.conf:824]
  89isp     = Atmel at89isp cable                 [C:\WinAVR-20100110\bin\avrdude.conf
:791]
  frank-stk200 = Frank STK200                         [C:\WinAVR-20100110\bin\avrdude.
conf:777]
  blaster   = Altera ByteBlaster                  [C:\WinAVR-20100110\bin\avrdude.conf
:764]
  ere-isp-avr = ERE ISP-AVR <http://www.ere.co.th/download/sch050713.pdf> [C:\Wi
nAVR-20100110\bin\avrdude.conf:754]
  atisp     = AT-ISP V1.1 programming cable for AVR-SDK1 from <http://micro-resea
rch.co.th/>  [C:\WinAVR-20100110\bin\avrdude.conf:744]
  dapa      = Direct AVR Parallel Access cable [C:\WinAVR-20100110\bin\avrdude.co
```

A common reason for wanting to program an AVR is to put the Arduino bootloader on there, in which case, you may not have WinAVR installed. Luckily, avrdude is there, its just 'hidden' in the IDE package (for Mac users,you need to actually "explore" the App) if you're running windows, go to the folder where you have the IDE installed and go into the **hardware\tools\avr\etc** folder to open up **avrdude.conf**

OK! Now that you have **avrdude.conf** open, find the string **ponyser**, then add the following bold text right before hand so the **avrdude.conf** looks like this:

```
# some ultra cheap programmers use bitbanging on the
# serialport.
#
# PC - DB9 - Pins for RS232:
#
# GND   5   -- |O
#              |   O| <-   9   RI
# DTR   4   <- |O   |
#              |   O| <-   8   CTS
# TXD   3   <- |O   |
#              |   O| ->   7   RTS
# RXD   2   -> |O   |
#              |   O| <-   6   DSR
# DCD   1   -> |O
#
# Using RXD is currently not supported.
# Using RI is not supported under Win32 but is supported under Posix.

# serial ponyprog design (dasa2 in uisp)
# reset=!txd sck=rts mosi=dtr miso=cts
programmer
  id    = "ftdifriend";
  desc  = "design ftdi adatper, reset=dtr sck=tx mosi=rts miso=cts";
  type  = serbb;
  reset = ~4;
  sck   = ~3;
  mosi  = ~7;
  miso  = ~8;
;
# serial ponyprog design (dasa2 in uisp)
# reset=!txd sck=rts mosi=dtr miso=cts

programmer
  id    = "ponyser";
  desc  = "design ponyprog serial, reset=!txd sck=rts mosi=dtr miso=cts";
  type  = "serbb";
  reset = ~3;
  sck   = 7;
  mosi  = 4;
  miso  = 8;
;
```

Save the file.

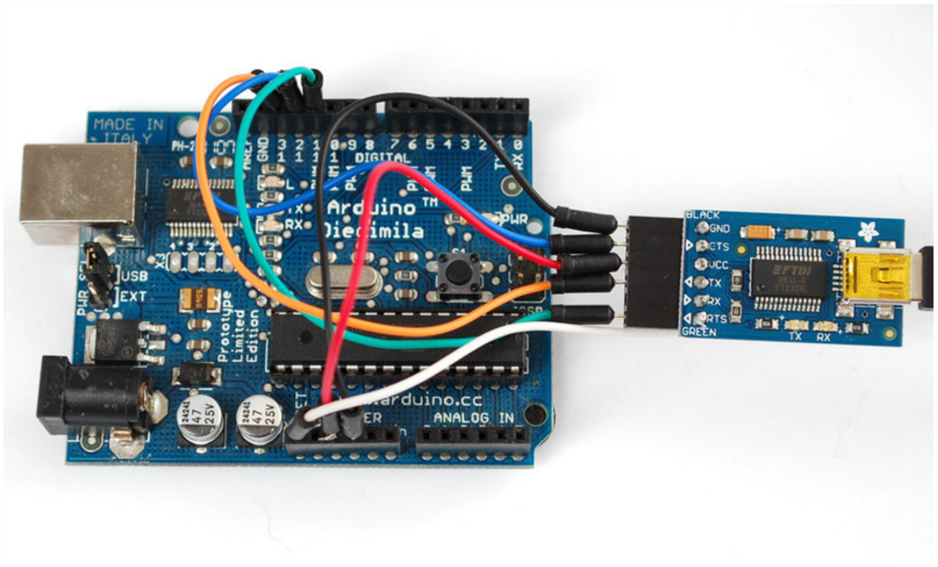
Programming the Arduino Bootloader

Don't forget, if you have two 'duinos, you can turn one into an ISP programmer, check out this tutorial which runs much faster than the below. (https://adafru.it/aVl)

You can burn chips right from the Arduin IDE with one more edit, open up the **programmers.txt** file (its in **hardware\arduino** in the IDE installation) and add the following text to the bottom.

```
ftdifriend.name=FTDI Friend bitbang
ftdifriend.communication=serial
ftdifriend.protocol=ftdifriend
```

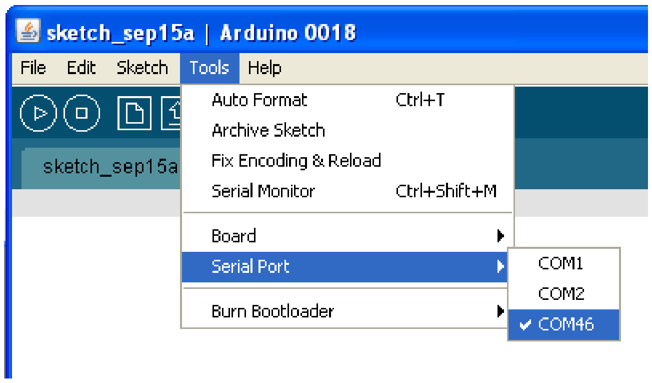
Save **programmers.txt**



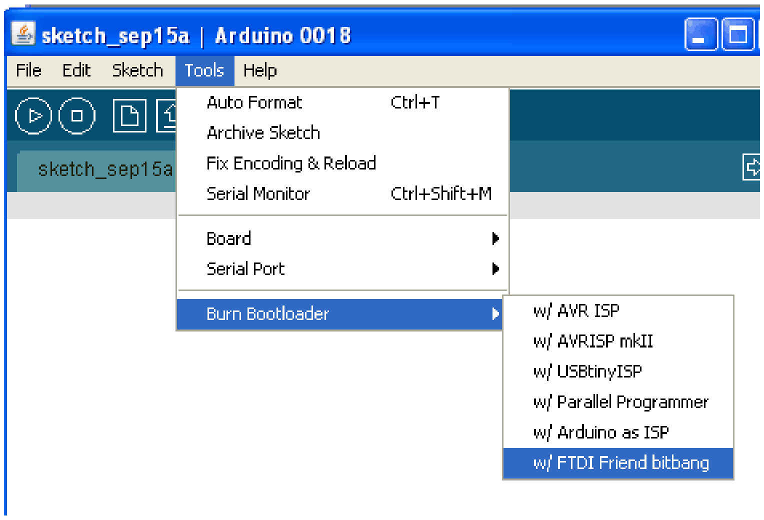
Its time to wire it up!

- Connect the Black (Ground) wire to the ground of your chip
- Connect the Red (VCC) wire to the power/VCC/5V pin of your chip
- Connect the White (DTR) wire to the Reset pin
- Connect the Orange (TX) wire to SCK pin (Arduino pin 13)
- Connect the Blue (CTS) wire to the MISO pin (Arduino pin 12)
- Connect the Green (RTS) wire to MOSI pin (Arduino pin 11)

Start up the IDE and select the COM port of the FTDI friend



Make sure you have the right **Board** selected, for whatever you want to burn. Then select **Burn Bootloader→FTDI Friend**



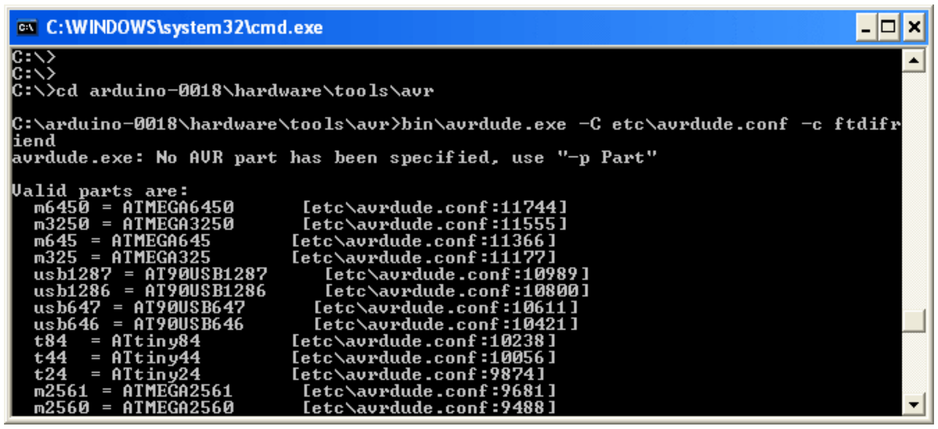
It will take a really really long time to program the chip, about two hours!

Its taking forever because its programming very inefficiently. It takes 4 bytes to program one byte of the AVR, and data is sent as a single bit in two USB packet, each packet takes 3 milliseconds and an AVR has 32768 bytes = 262144 bits. 262144 bits * 2 packet/bit * 3 ms/packet * 4 bytes/byte = 6291456 ms = 6300 seconds = 104 minutes! If you used a real AVR programmer, it would take maybe 15 seconds so thats why its nice to have one.

Do this before you go to bed or watch a movie! The **L** (pin 13) LED will be on 'solid' while its programming. When it goes out you're done. Its very slow but if you're in a pinch, it may come in handy!

Using the Command Line AVRdude

Now if you open up a terminal and try running **avrdude -c ftdifriend** If you are using the avrdude installation thats inside the Arduino IDE, you can open up a **cmd** terminal and **cd** to the directory where you have the IDE installed and then go to **hardware\tools\avr**. Then you can run **bin\avrdude.exe -C etc\avrdude.conf -c ftdifriend** so for example, my installation is in **C:\arduino-0018\ I cd** to **C:\arduino-0018\hardware\tools\avr.**



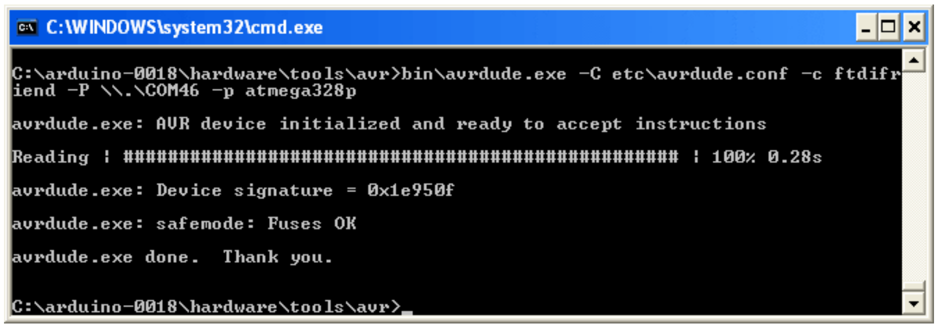
```
C:\>
C:\>
C:\>cd arduino-0018\hardware\tools\avr

C:\arduino-0018\hardware\tools\avr>bin\avrdude.exe -C etc\avrdude.conf -c ftdifr
iend
avrdude.exe: No AVR part has been specified, use "-p Part"

Valid parts are:
  m6450  = ATMEGA6450       [etc\avrdude.conf:11744]
  m3250  = ATMEGA3250       [etc\avrdude.conf:11555]
  m645  = ATMEGA645        [etc\avrdude.conf:11366]
  m325  = ATMEGA325        [etc\avrdude.conf:11177]
  usb1287 = AT90USB1287       [etc\avrdude.conf:10989]
  usb1286 = AT90USB1286       [etc\avrdude.conf:10800]
  usb647 = AT90USB647       [etc\avrdude.conf:10611]
  usb646 = AT90USB646       [etc\avrdude.conf:10421]
  t84   = ATtiny84         [etc\avrdude.conf:10238]
  t44   = ATtiny44         [etc\avrdude.conf:10056]
  t24   = ATtiny24         [etc\avrdude.conf:9874]
  m2561  = ATMEGA2561       [etc\avrdude.conf:9681]
  m2560  = ATMEGA2560       [etc\avrdude.conf:9488]
```

You should get a note that **No AVR part has been specified** (not that it **Can't find programmer id "ftdifriend"**)

Great, now its time to program!

- Connect the Black (Ground) wire to the ground of your chip
- Connect the Red (VCC) wire to the power/VCC/5V pin of your chip
- Connect the White (DTR) wire to the Reset pin
- Connect the Orange (TX) wire to SCK pin
- Connect the Green (RTS) wire to MOSI pin
- Connect the Blue (CTS) wire to the MISO pin We suggest verifying the wiring! We'll verify the connection by running **avrdude -c ftdifriend -P** \\.**COMxx -p atmega328p** Replace the \\.**COMxx** with the COM port you found in the earlier part of this tutorial via the Device Manager. If you're using linux or mac, the COM port should be **/dev/cu.usbserialXXX** or **/dev/ttyUSBx** to match the name. For the device, we're testing with an **Atmega328p** chip which is found in the latest Arduinos. If you're using some other chip, substitute the name right after the **-p**

If you are using the avrdude in the Arduino IDE, you'll need to use **bin\avrdude -C etc\avrdude.conf -c ftdifriend -P \\.\COMxx -p atmega328p** etc.



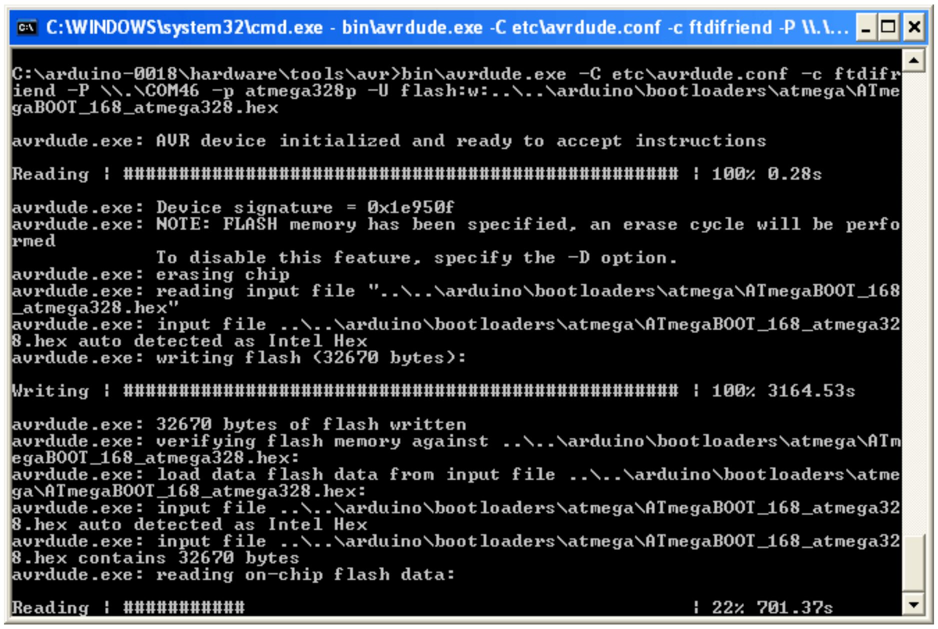
```
C:\arduino-0018\hardware\tools\avr>bin\avrdude.exe -C etc\avrdude.conf -c ftdifr
iend -P \\.\COM46 -p atmega328p

avrdude.exe: AVR device initialized and ready to accept instructions

Reading | ################################################## | 100% 0.28s

avrdude.exe: Device signature = 0x1e950f

avrdude.exe: safemode: Fuses OK

avrdude.exe done.  Thank you.


C:\arduino-0018\hardware\tools\avr>_
```

Once you have the hashbar show up nicely, that means you are talking to the chip all right. Yay! You can now program the chip using the **-U flash:w:** command.

Press the up arrow to get back the command you wrote and tack onto the end a **-U flash:w:firmware.hex** (where **firmware.hex** is the hex file you want to burn in) For example, if you want to burn a bootloader on, make it easy on yourself by copying the file from use:

bin\avrdude.exe -C etc\avrdude.conf -c ftdifriend -P \\.\COM46 -p atmega328p -U flash:w:..\..\arduino\bootloaders\atmega\ATmegaBOOT_168_atmega328.hex

(you can also copy your file to C:\ so its not so long to type. Hit return and grab a beer, it'll take about 5 minutes per byte of data you want to write&verify)



C:\WINDOWS\system32\cmd.exe - bin\avrdude.exe -C etc\avrdude.conf -c ftdifriend -P \\.\...

```
C:\arduino-0018\hardware\tools\avr>bin\avrdude.exe -C etc\avrdude.conf -c ftdifr
iend -P \\.\COM46 -p atmega328p -U flash:w:..\..\arduino\bootloaders\atmega\ATme
gaBOOT_168_atmega328.hex

avrdude.exe: AVR device initialized and ready to accept instructions

Reading | ################################################## | 100% 0.28s

avrdude.exe: Device signature = 0x1e950f
avrdude.exe: NOTE: FLASH memory has been specified, an erase cycle will be perfo
rmed
             To disable this feature, specify the -D option.
avrdude.exe: erasing chip
avrdude.exe: reading input file "..\..\arduino\bootloaders\atmega\ATmegaBOOT_168
_atmega328.hex"
avrdude.exe: input file ..\..\arduino\bootloaders\atmega\ATmegaBOOT_168_atmega32
8.hex auto detected as Intel Hex
avrdude.exe: writing flash (32670 bytes):

Writing | ################################################## | 100% 3164.53s

avrdude.exe: 32670 bytes of flash written
avrdude.exe: verifying flash memory against ..\..\arduino\bootloaders\atmega\ATm
egaBOOT_168_atmega328.hex:
avrdude.exe: load data flash data from input file ..\..\arduino\bootloaders\atme
ga\ATmegaBOOT_168_atmega328.hex:
avrdude.exe: input file ..\..\arduino\bootloaders\atmega\ATmegaBOOT_168_atmega32
8.hex auto detected as Intel Hex
avrdude.exe: input file ..\..\arduino\bootloaders\atmega\ATmegaBOOT_168_atmega32
8.hex contains 32670 bytes
avrdude.exe: reading on-chip flash data:

Reading | ###########                                        | 22% 701.37s
```

Downloads

- You can get the schematic and layout files over at GitHub (https://adafru.it/aWX), they're licensed CC attrib/sharealike
- Fritzing object in the Adafruit Fritzing Library (https://adafru.it/aP3)