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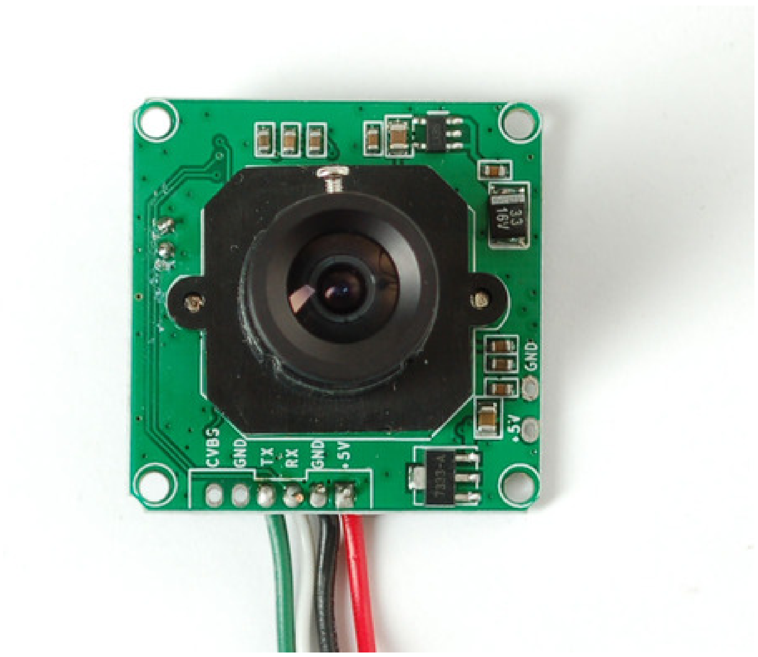
adafruit learning system

TTL Serial Camera

Created by lady ada

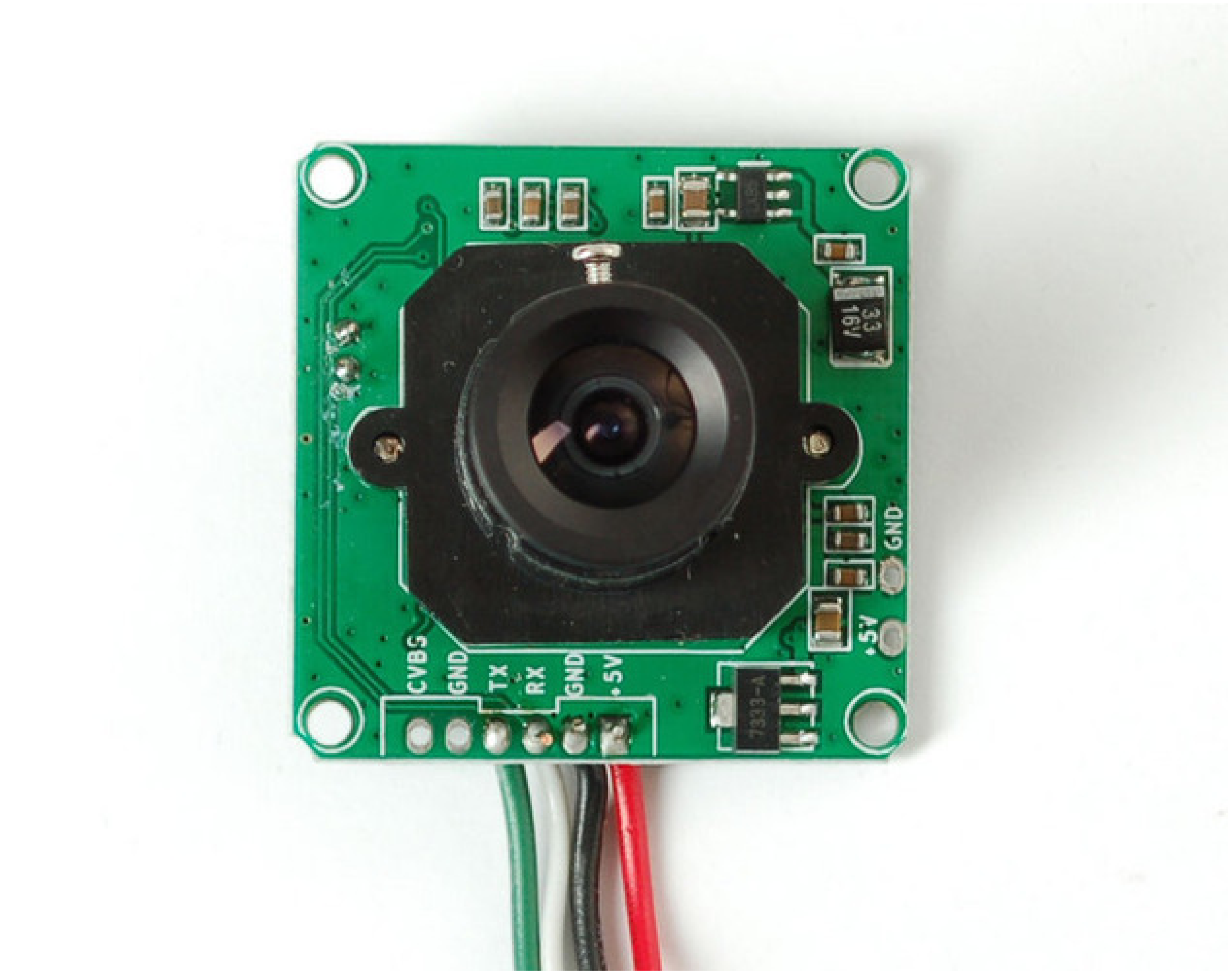


Last updated on 2014-07-12 09:15:08 AM EDT

Guide Contents

Overview

This tutorial is for our new TTL serial camera module with NTSC video output. These modules are a nice addition to a microcontroller project when you want to take a photo or control a video stream. The modules have a few features built in, such as the ability to change the brightness/saturation/hue of images, auto-contrast and auto-brightness adjustment, and motion detection.



Since it is a little confusing how this is both a snapshot and video camera, we'd like to explain it in detail now. The module was initially designed for surveillance purposes. Its meant to constantly stream TV-resolution video out of the Video pin (this is NTSC monochrome format) and also take commands from the serial port. The serial port commands can request that the module freeze the video and then download a JPEG color image. So for example, normally its just displaying video to a security monitor. When motion is detected, it would take a photo and save it to a disk for later analysis.

The module is admittedly not extremely high resolution - the maximum image size it can take is 640x480 pixels. And it is sensitive to infrared light, which alters the color rendition somewhat. The reason for all this is that it's meant for surveillance, not for nature photography. However, as far as we can tell, this is the best module on the market.

- **Module size:** 32mm x 32mm
- **Image sensor:** CMOS 1/4 inch
- **CMOS Pixels:** 0.3M
- **Pixel size:** 5.6um*5.6um
- **Output format:** Standard JPEG/M-JPEG
- **White balance:** Automatic
- **Exposure:** Automatic
- **Gain:** Automatic
- **Shutter:** Electronic rolling shutter
- **SNR:** 45DB
- **Dynamic Range:** 60DB
- **Max analog gain:** 16DB
- **Frame speed:** 640*480 30fps
- **Scan mode:** Progressive scan
- **Viewing angle:** 60 degrees
- **Monitoring distance:** 10 meters, maximum 15meters (adjustable)
- **Image size:** VGA (640*480), QVGA (320*240), QQVGA (160*120)
- **Baud rate:** Default 38400 (the datasheet claims you can change the baud rate with a command but it does not work reliably)
- **Current draw:** 75mA
- **Operating voltage:** DC +5V
- **Communication:** 3.3V TTL (Three wire TX, RX, GND)

Sample Images

Here are two example images, one of outside during a cloudy day, and one inside on a sunny day.

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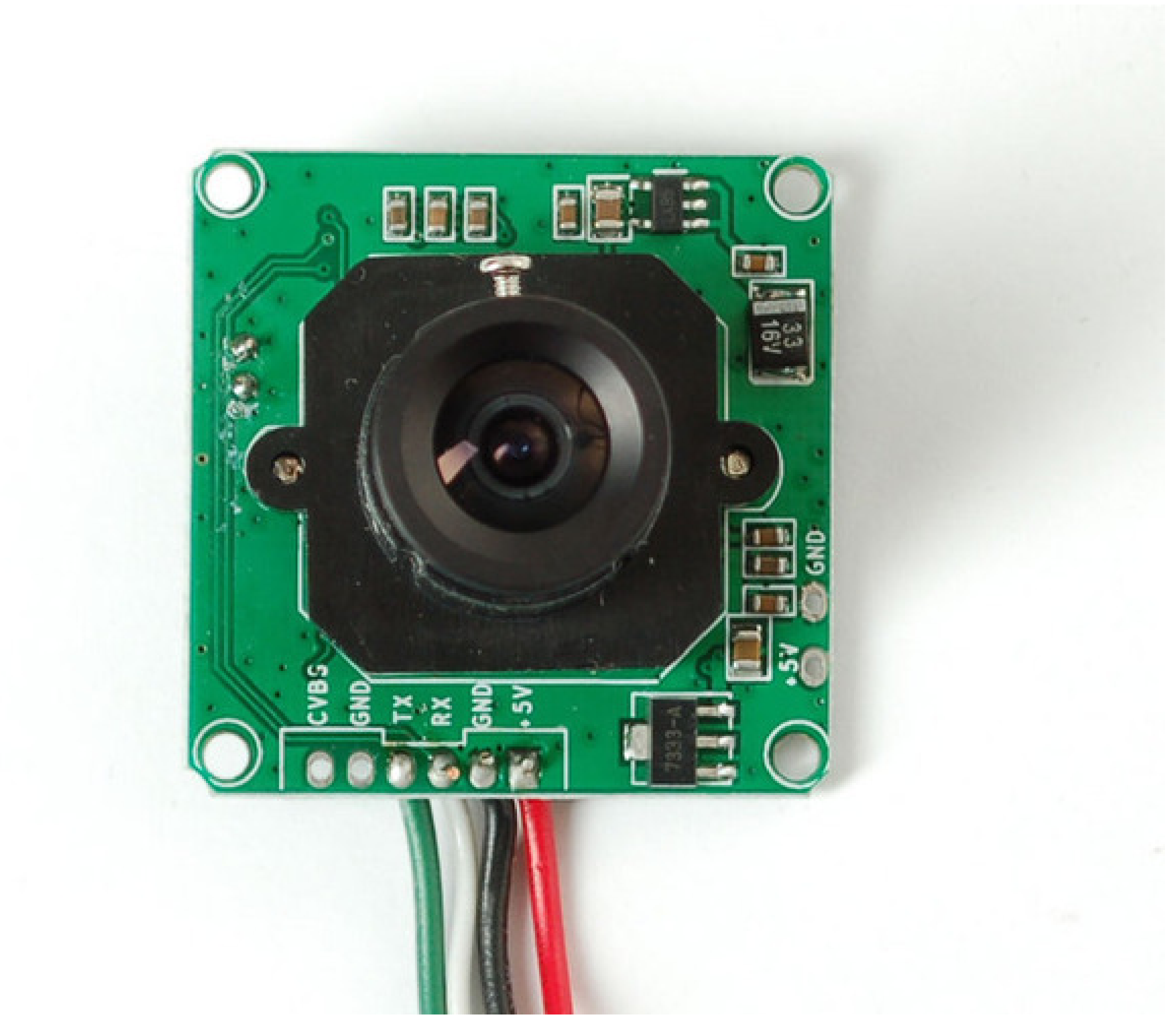
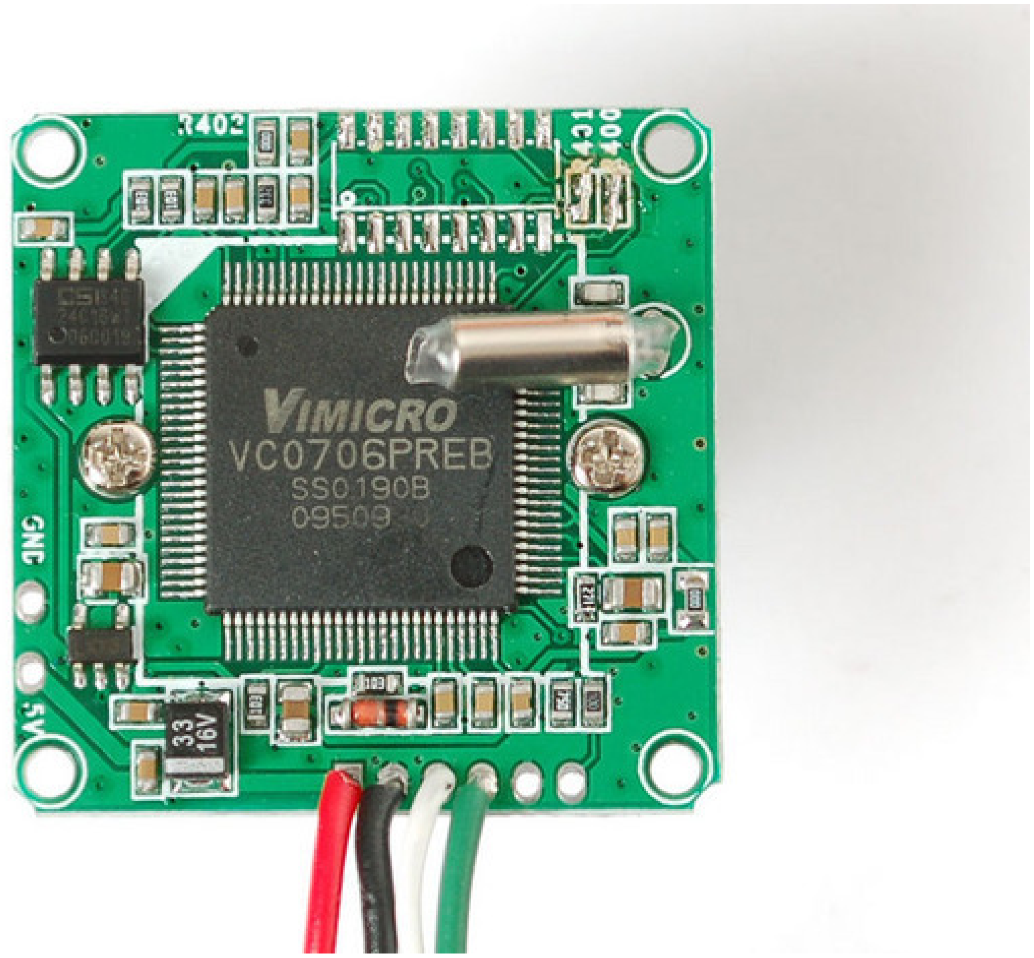
of the world.
NEW YORK & COMPANY
NEW YORK & COMPANY
Wendy's

Wiring the Camera

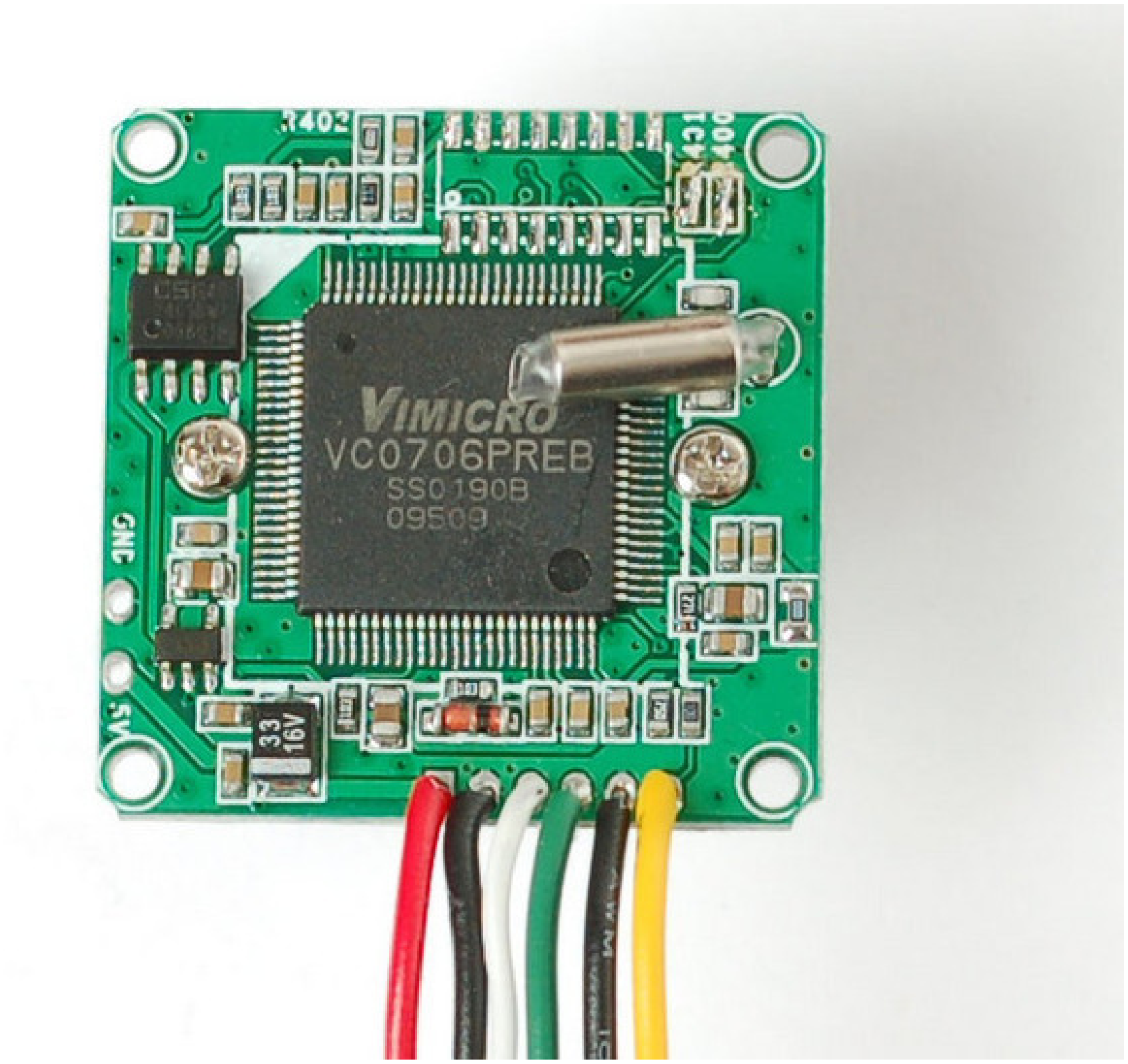
The module comes without any connector so you'll need to solder wires into the connection pads. The good news is the pads are not too close togehter (about 2mm) and you can use any stranded or solid-core wire.

If you aren't planning to use the video output abilities, you can use 4 wires. We will use red for the +5V pin, black for the Ground pin, white for the RX pin (data ***into*** the module) and green for the TX pin (data from the module)





If you'd like to get NTSC video out to connect to a TV or monitor, solder another black wire to the second Ground pin, and a yellow wire to the CVBS pin.


VIMICRO
VC0706PREB
SS0190B
09509
GND
5V
33
16V
R402

If you have the weatherproof version of this camera, it comes prewired with the following:

- Red is connected to +5V in
- Black is connected to Ground
- **Green is RX**
- **White is TX**
- Yellow is NTSC Video signal out
- Brown is NTSC Video ground

Testing the Camera

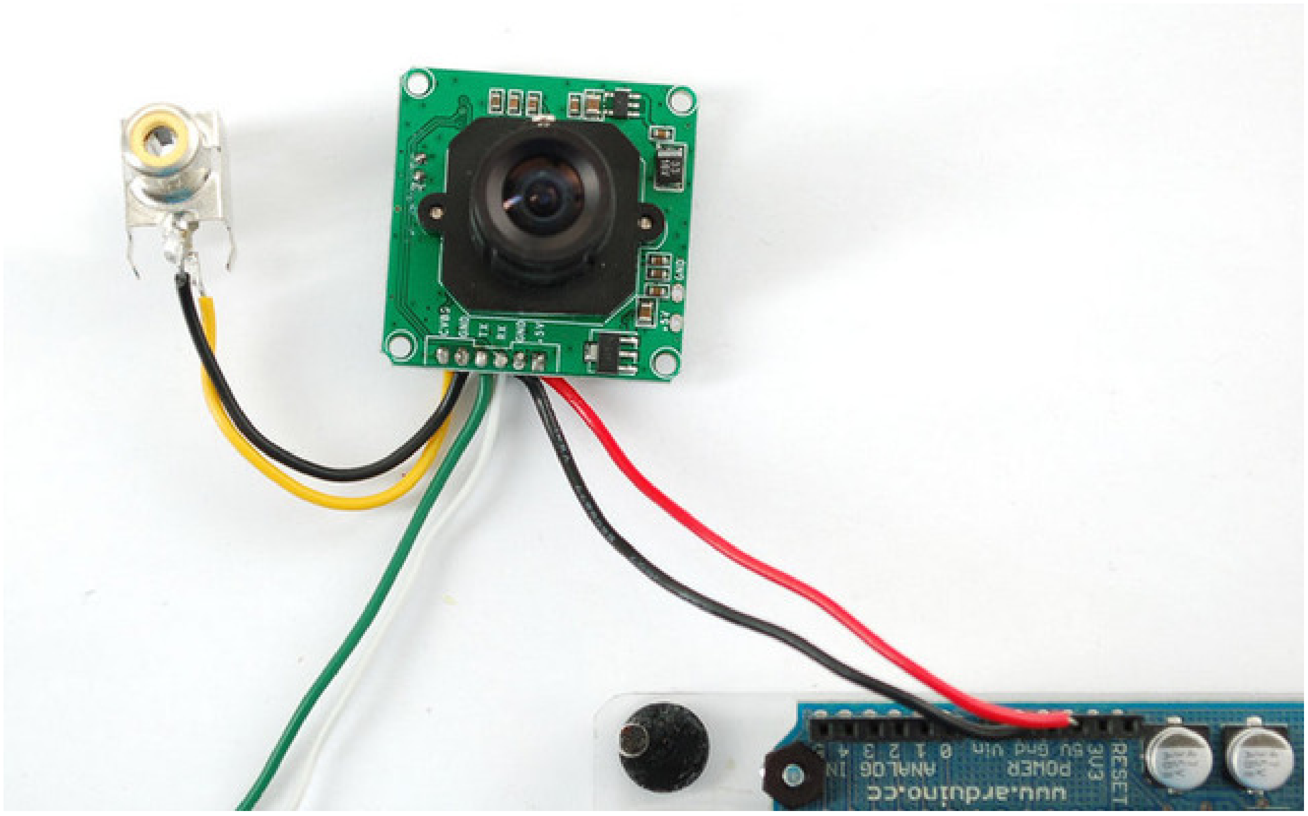
The quickest way to test out the modules is to use the NTSC video out connection. That way, when you adjust the view & focus you can immediately see the results. Paired with the next section (using the Comm Tool), its the ideal method of introducing yourself to the module.

Most TV's and monitors require an RCA jack or plug input. We just soldered a spare RCA jack to the camera, with black being the case ground and yellow signal. You can get RCA cables and accessories in any hobby/electronics shop like Radio Shack.

Unfortunately, it is not possible to change the camera from NTSC to PAL - its hardcoded by a pin soldered to the board and there's no easy way to extract it and change it (we tried!)

Plug in the NTSC cable to your monitor, and connect the red and black power wires to +5V supply - you should get monochrome video output on the monitor immediately!

We have some NTSC television modules in the Adafruit shop you can use to test with (http://adafru.it/aM5)



PS one
SONY

Using CommTool

To use the Comm Tool, a windows utility, we need to set up a serial link to the camera. There's two ways we suggest doing this. One is to use something like an FTDI friend or other USB/TTL serial converter. If you have an Arduino you can 'hijack' the serial chip (FTDI chip or similar) by uploading a blank sketch to the Arduino:

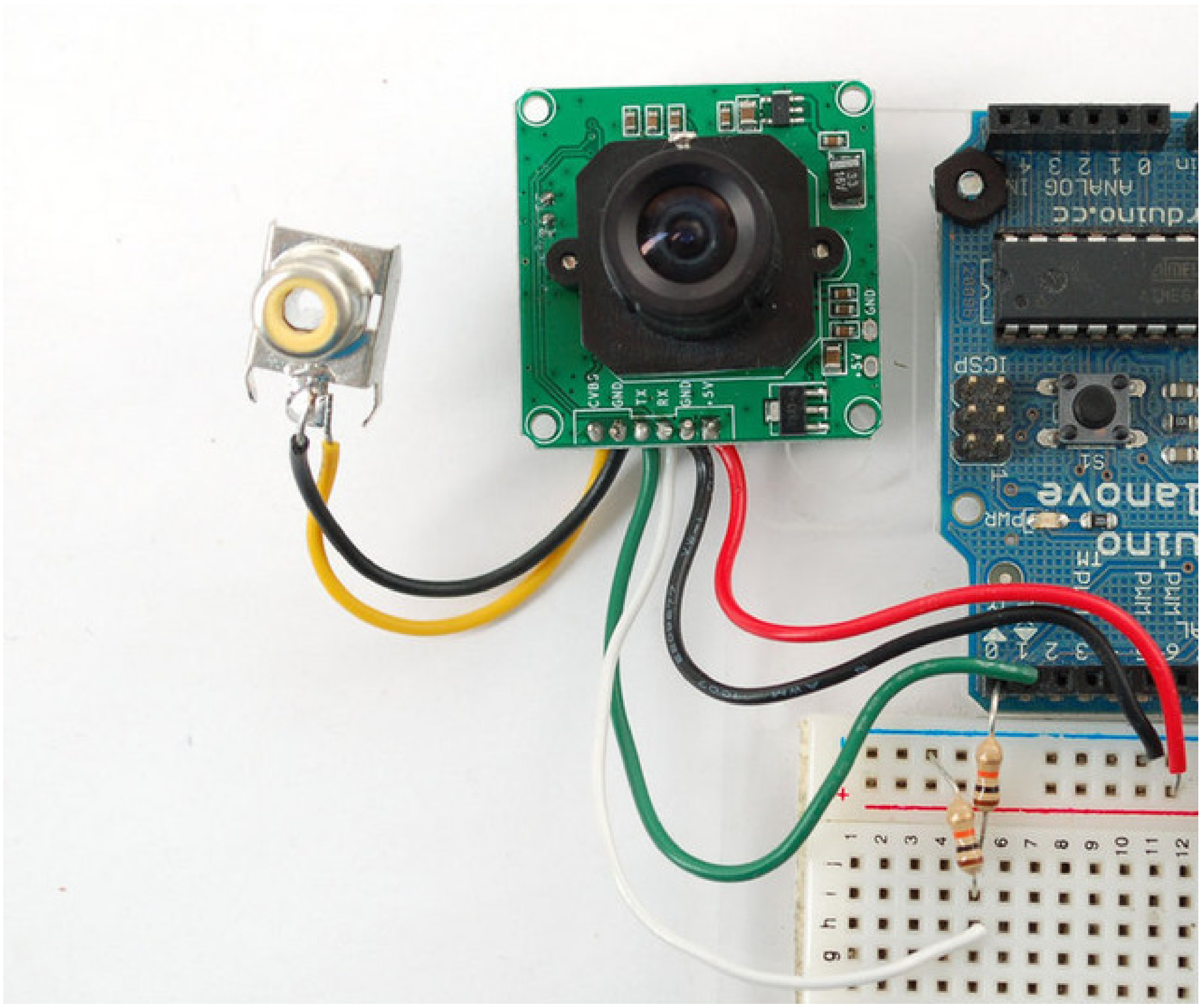
```
// empty sketch

void setup()
{
}

void loop()
{
}
```

Note: 'Hijacking' the serial port only works on Arduinos with a separate USB interface, like the Uno. It won't work on a Leonardo!

If you're using a Leonardo, Micro, Yun, or other ATmega32U4-based controller, use this Leo_passthru sketch instead of the "blank" sketch.

```
//Leo_passthru
// Allows Leonardo to pass serial data between
// fingerprint reader and Windows.
//
// Red connects to +5V
// Black connects to Ground
// Green goes to Digital 0
// White goes to Digital 1

void setup() {
  Serial1.begin(57600);
  Serial.begin(57600);
}

void loop()
{
  while (Serial.available())
    Serial1.write(Serial.read());
  while (Serial1.available())
    Serial.write(Serial1.read());
}
```

Now, wire it up as follows:

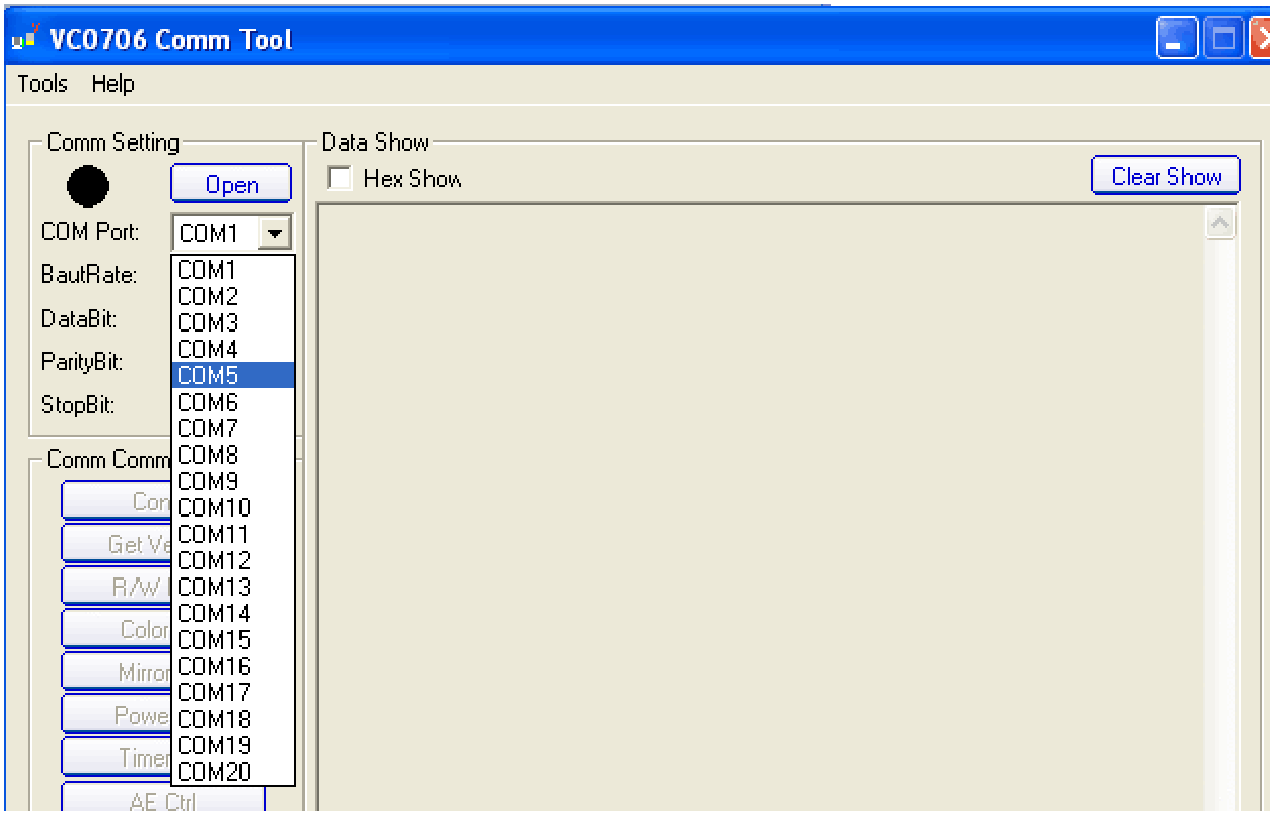


For the weatherproof camera, the white and green wires are swapped on some cameras! So please flip the white and green wires indicated if using the metal camera. Red should still be connected to +5 and Black to Ground

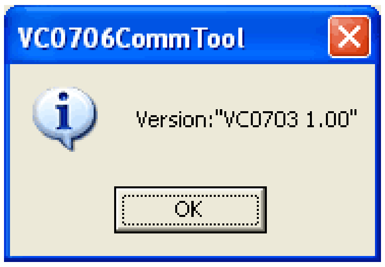
Note the 10K resistor divider, the camera's serial data pins are 3.3v logic and its a good idea to divide the 5V down so that its 2.5V. Normally the ouput from the digital 0 pin is 5V high, the way we connected the resistors is so the camera input (white wire) never goes above 3.3V

Now download and install the VC0706 CommTool software (see below in the Download section)

Start up the software and select the COM port that the Arduino is on.



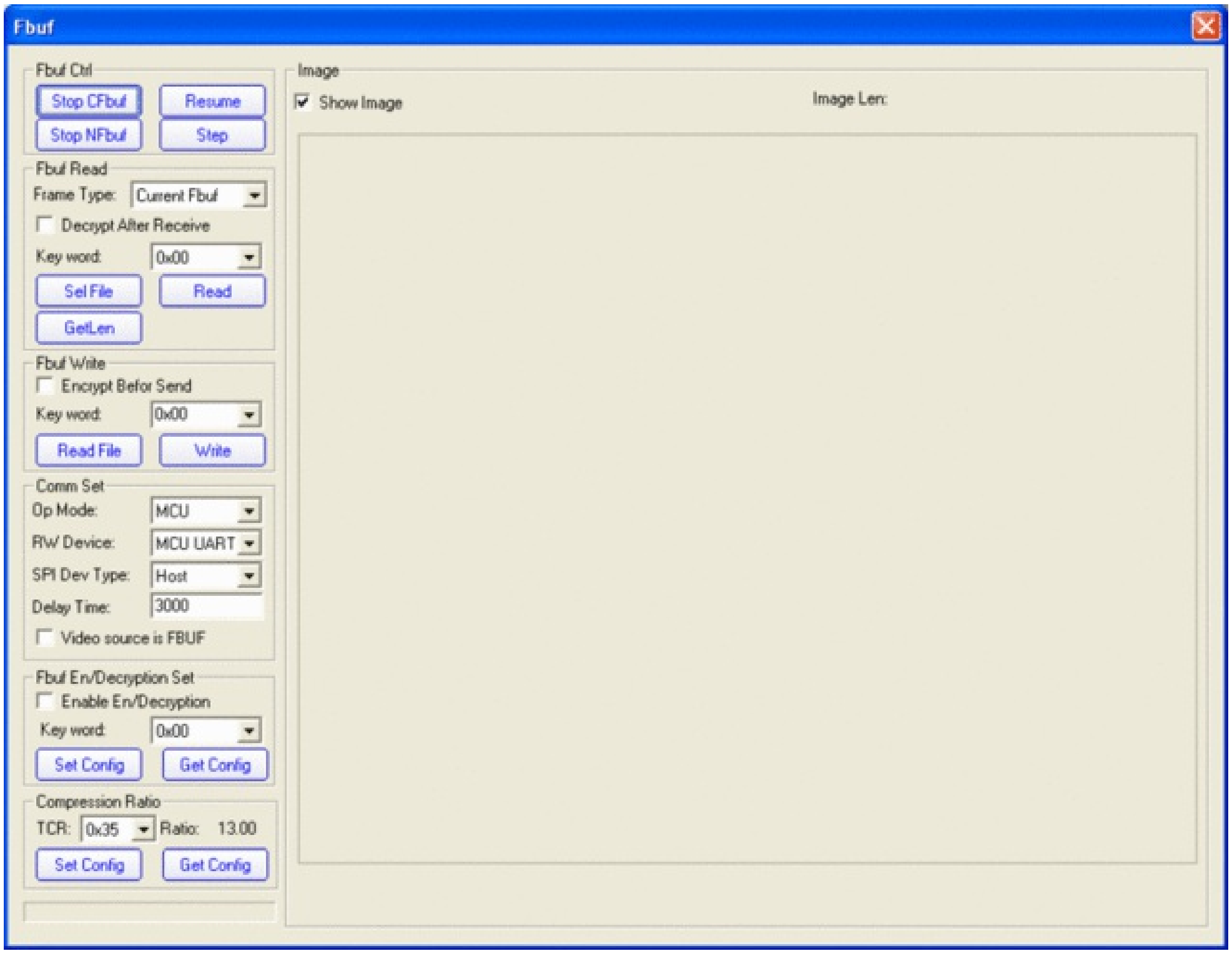
Then **Open** the port and click **Get Version**



Version:"VC0703 1.00"

Note it says VC0703 - we don't know precisely why the DSP is programmed with a different number - its one of those mysteries! Still, you should get a response

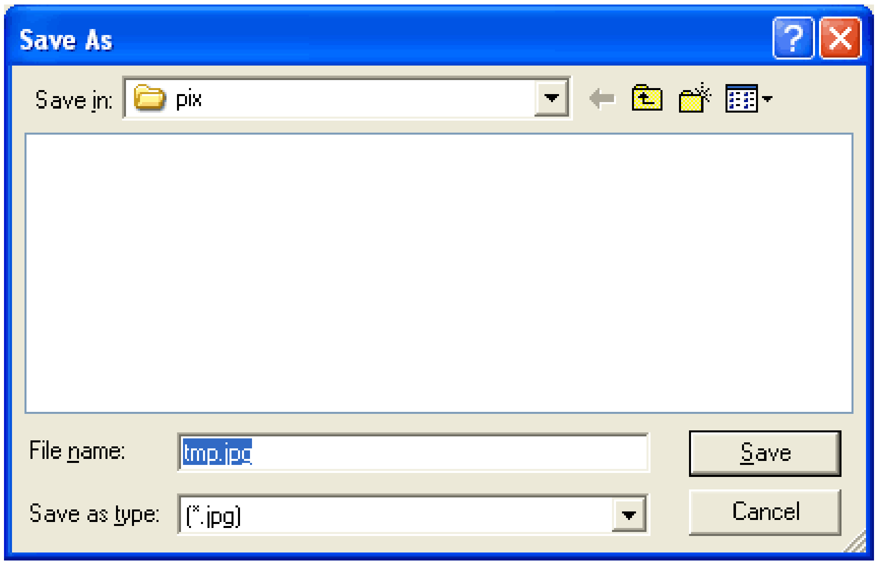
The next button you should press is near the bottom **FBUF CTRL**.



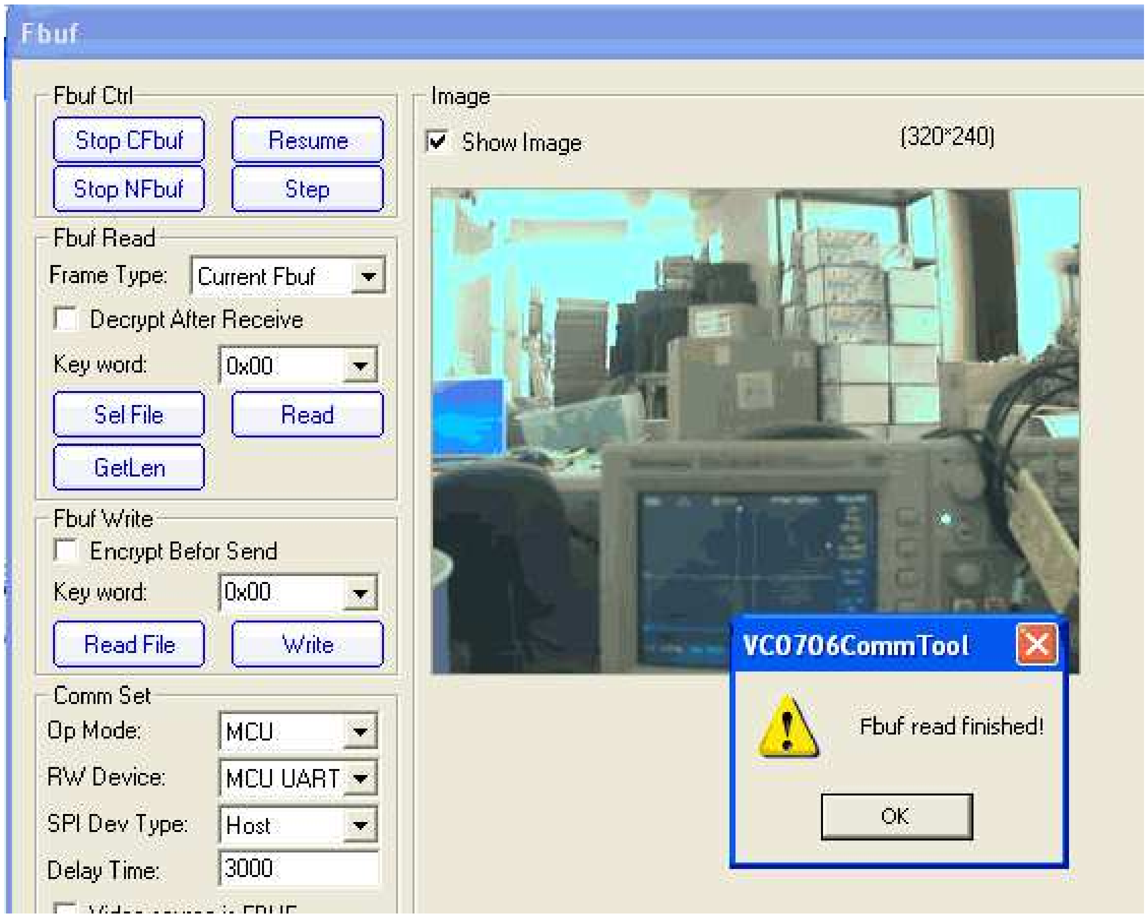
Frame Type: Current Fbuf
Decrypt After Receive
Key word: 0x00
Encrypt Befor Send
Key word: 0x00
Op Mode: MCU
RW Device: MCU UART
SPI Dev Type: Host
Delay Time: 3000
Video source is FBUF
Enable En/Decryption
Key word: 0x00
TCR: 0x35 Ratio: 13.00
[✓ Show Image]

This is quite a panel, but we can use this to get images directly from the camera which is good for debugging.

- Point the camera at something you want to take a photo of
- Click **Stop FBuf** to freeze the frame buffer
- Click **Sel File** to select the file to save the JPG as



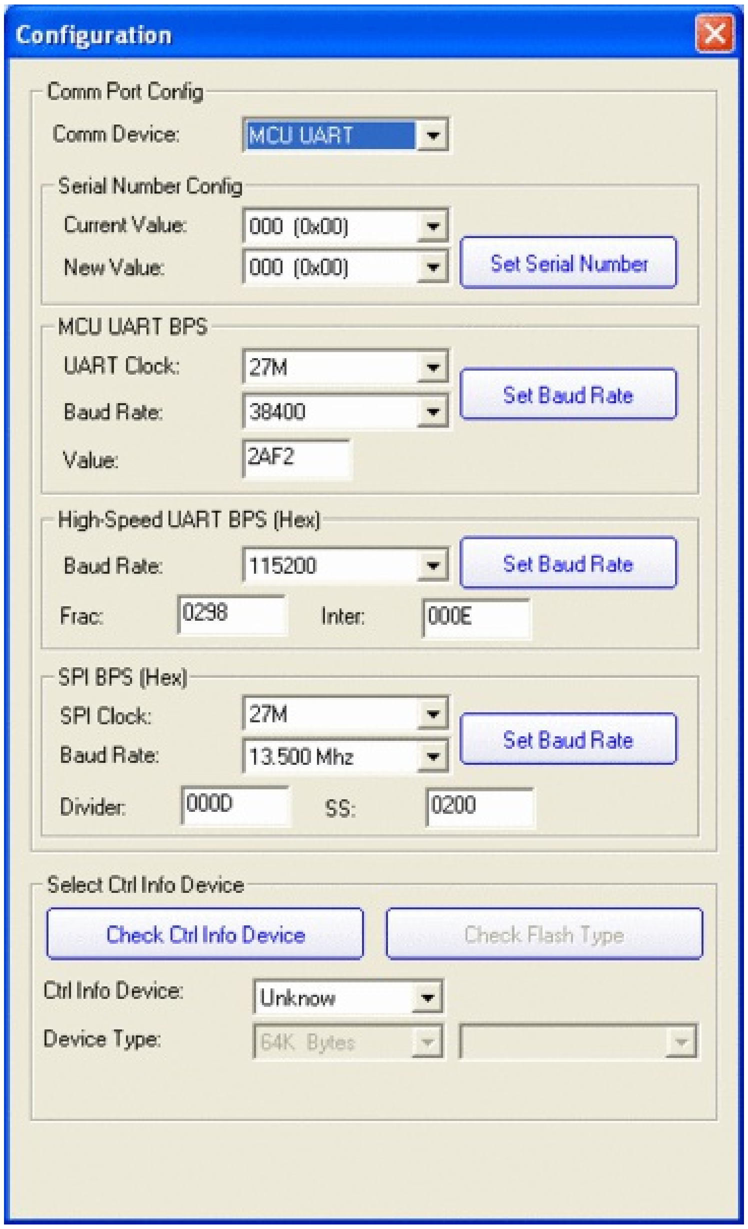
Next press **Read** (next to **Sel File**) to read the jpeg image off the camera



Thats it! You can now easily test reading camera images. To take another photo. Press **Resume** up at the top to have the video start up again. Then click **Stop CFbuf** when you want to snap another photo. Finally you can select the **Compression Ratio** which will improve or degrade the image quality but also change the image transfer time. There's no way to change the image size from this program (easily) but we can do it using the Arduino sketch so just try it out here to start.

You might notice there's a dropdown for changing the baud rate. By default the baudrate is 38400 baud.

Despite the software letting you change the baud rate this is a very flaky setting and even if it works, when you power up the camera again it will reset. Some experimenters have accidentally disabled their cameras by trying to change the baud rate. We do not suggest you mess with the baud rate settings. If you do, you may permanently disable your camera and we will not replace it!



Comm Port Config

Comm Device: MCU UART

Serial Number Config

Current Value: 000 (0x00)

New Value: 000 (0x00)

MCU UART BPS

UART Clock: 27M

Baud Rate: 38400

Value: 2AF2

High-Speed UART BPS (Hex)

Baud Rate: 115200

Frac: 0298 Inter: 000E

SPI BPS (Hex)

SPI Clock: 27M

Baud Rate: 13.500 Mhz

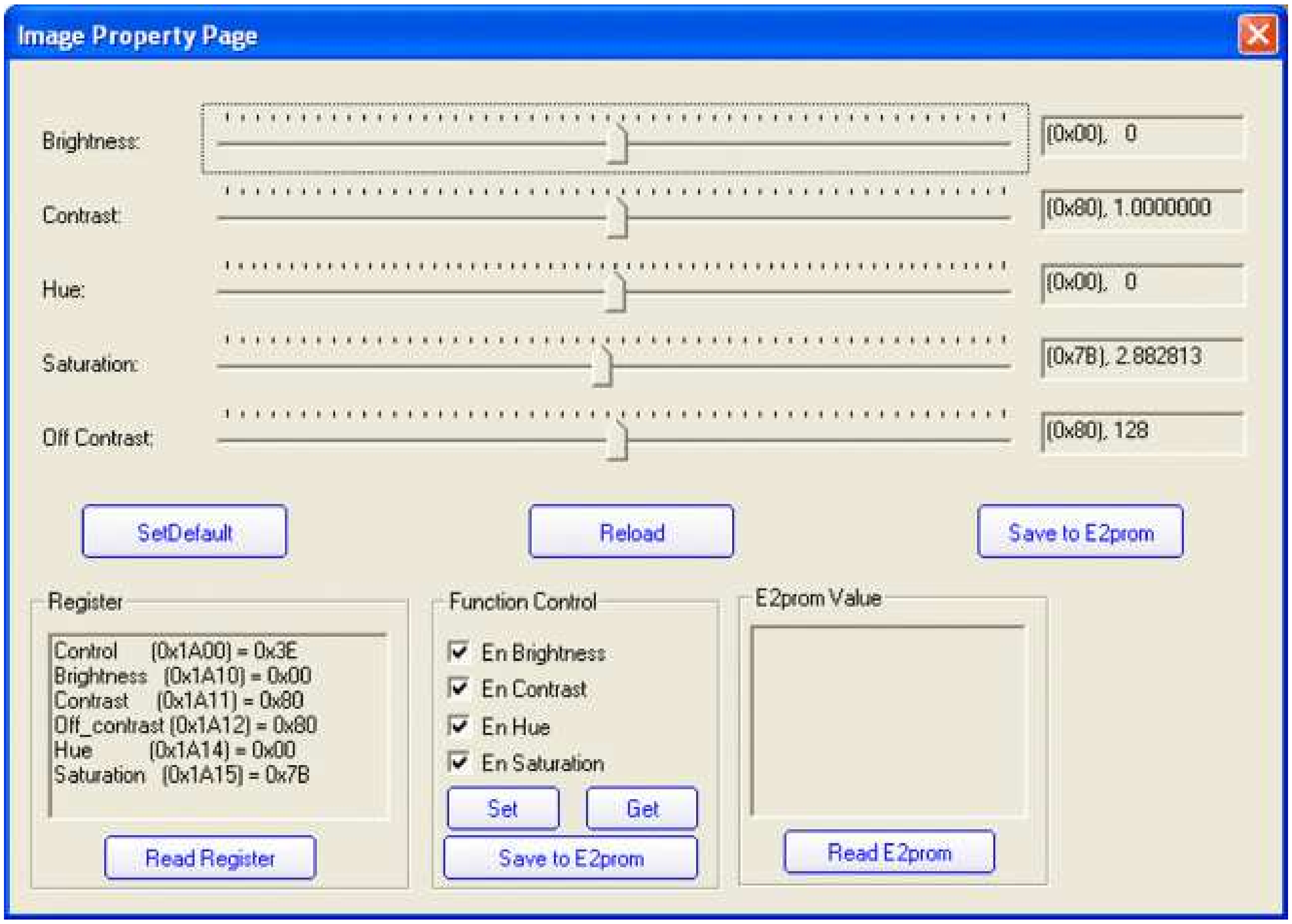
Divider: 000D SS: 0200

Select Ctrl Info Device

Ctrl Info Device: Unknow

Device Type: 64K Bytes

The only other thing we suggest checking out is the **Image Property** button, which will let you adjust settings for the camera, we bumped up our saturation a bit to get better images. Dragging the sliders will make the video output change immediately so this is a handy place to get a TV connected up so you can check out how it works



Brightness: (0x00), 0
Contrast: (0x80), 1.0000000
Hue: (0x00), 0
Saturation: (0x7B), 2.882813
Off Contrast: (0x80), 128

Register

```
Control     (0x1A00) = 0x3E
Brightness  (0x1A10) = 0x00
Contrast    (0x1A11) = 0x80
Off_contrast (0x1A12) = 0x80
Hue         (0x1A14) = 0x00
Saturation  (0x1A15) = 0x7B
```

[✓] En Brightness
[✓] En Contrast
[✓] En Hue
[✓] En Saturation

There are many options for this software, here's what we think of the other buttons. Personally, we don't suggest going in to any of them unless you really need to.

- **Config - see above**
- **Get Version - see above**
- **R/W Data** - this is for writing raw data to the DSP chip processor. Don't do this unless you're sure you know what you're doing since it will mess with the camera's ability. Even we don't know what it would be good for
- **Color Ctrl -** this is for selecting Color or Black&White or Auto select (probably based on lighting conditions). You probably want to keep it at Auto
- **Mirror Ctrl** - we think this is so you can flip the display (if its bouncing off a mirror)
- **Power Ctrl** - this is for testing the power down mode, and it seems like you might be able to have it auto-power down when there's no motion.
- **Timer Ctrl** - there is an RTC built into the DSP which you can set, however there's no battery backup so if power is lost the RTC will be reset so we don't think its terribly useful
- **AE Ctrl** - this is for controlling the auto-contrast/brightness. By default its set to auto-select for indoor or outdoor use. Probably best to leave it as is
- **Motion Ctrl** - this is for the motion detection system. You can tweak the settings and also test it. We have an Arduino sketch for interacting with the motion detection system. By default it works pretty good but you can super tweak it out if you want to.
- **OSD Config -** The protocol sheet and this seem to imply you can do on-screen-

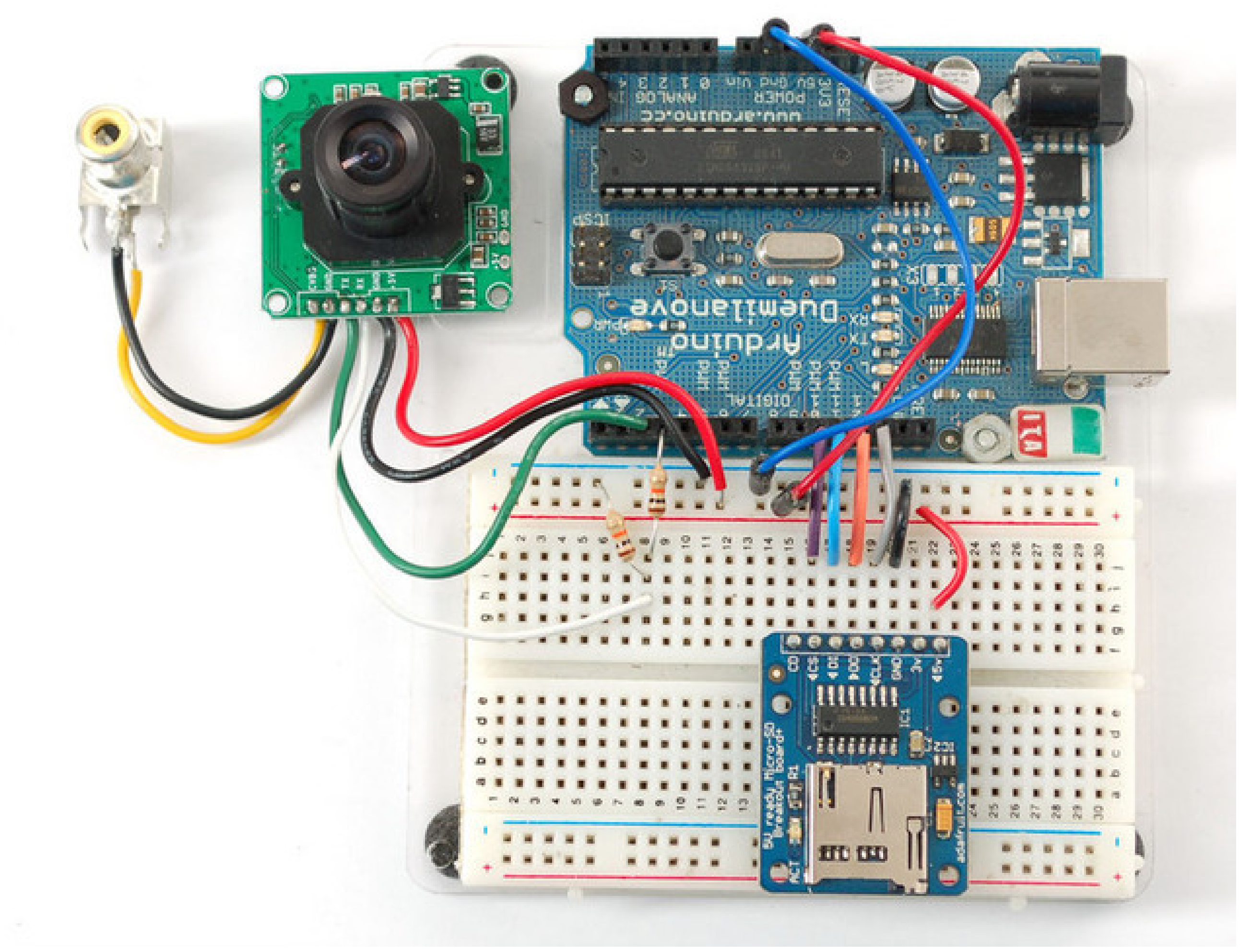
display but after much time spent on it, we determined its not activated somewhere in the DSP. We've never seen a VC0706 camera that could do it. :(

- **Image property - see above**
- **Gamma -** this is for more precise gamma control of the CMOS sensor. It seems to be preset to be OK but you can mess with this if you'd like
- **SPI Flash** - for reading/writing to the SPI storage? Not sure if its a good idea to mess with this
- **Other Ctrl** - for playing with the DAC? No idea what this is for.
- **Up/Down Load** - this is for reading and writing to the flash probably to upload new DSP code. We dont suggest messing with this
- **System Reset -** does a reset of the module. Press this if its not responding
- **FBuff Ctrl - see above**
- **Zoom Ctrl -** The module has built in 'Pan Tilt Zoom' ability BUT its for video only and wont affect photos snapped. You can play with the PTZ here, its pretty basic but could be useful for someone

Using the Camera

Next up, we will wire the camera to our microcontroller (in this case an Arduino). This is pretty similar to the above except we will be using two digital pins and a software serial port to talk to the camera. To save images, you'll need some sort of external storage like our microSD breakout board (http://adafru.it/254).

Connect up the camera like this:



For the weatherproof camera, the white and green wires are swapped on some cameras! So please flip the white and green wires indicated if using the metal camera. Red should still be connected to +5 and Black to Ground

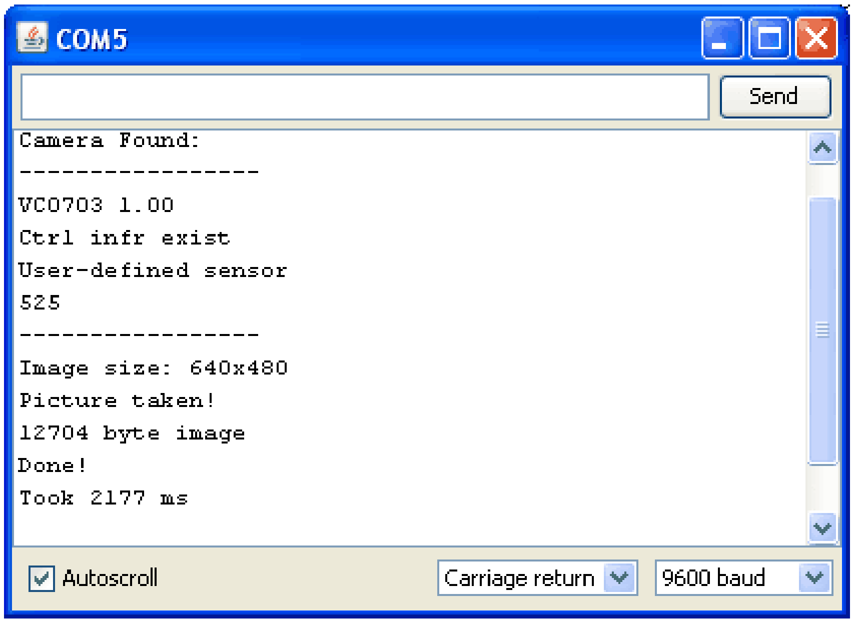
We suggest testing the microSD card first. Check out our microSD breakout board tutorial and verify that you can read from the card by listing the files. Once you have verified the microSD card wiring, you can come back here and install the VC0706 camera library.

Visit the Github repository here. (http://adafru.it/aM6) To download. click the DOWNLOADS button in the top right corner, rename the uncompressed folder Adafruit_VC0706. Check that the Adafruit_VC0706 folder contains Adafruit_VC0706.cpp and Adafruit_VC0706.h Place the Adafruit_VC0706 library folder your *arduinosketchfolder*/libraries/ folder. You may need to create the libraries subfolder if its your first library. Restart the IDE.

If you're using Arduino v23 or earlier, you'll also need to install the NewSoftSerial library. Download it by clicking this link (http://adafru.it/aM7) and install it as you did the Adafruit_VC0706 library. Arduino 1.0 has this built in now (called SoftwareSerial)

Taking a Snapshot

OK now you're finally ready to run the snapshot demo. Open up the Arduino IDE and select **File-> Examples-> Adafruit_VC0706-> Snapshot** sketch and upload it to the Arduino. Open up the serial monitor and you can see the sketch will take a 640x480 photo and save it to the microSD card. You can then pop the card into your computer to see the JPG file



```
Camera Found:
-----------------
VC0703 1.00
Ctrl infr exist
User-defined sensor
525
-----------------
Image size: 640x480
Picture taken!
12704 byte image
Done!
Took 2177 ms
```

There are a few things you can change once you get it working. One is changing the pins the camera uses. You can use any two digital pins, change this line:

```
// This is the camera pin connection. Connect the camera TX
// to pin 2, camera RX to pin 3
NewSoftSerial cameraconnection = NewSoftSerial(2, 3);
```

You can also change the snapshot image dimension to 160x120, 320x240 or 640x480 by changing these lines:

```
// Set the picture size - you can choose one of 640x480, 320x240 or 160x120
```

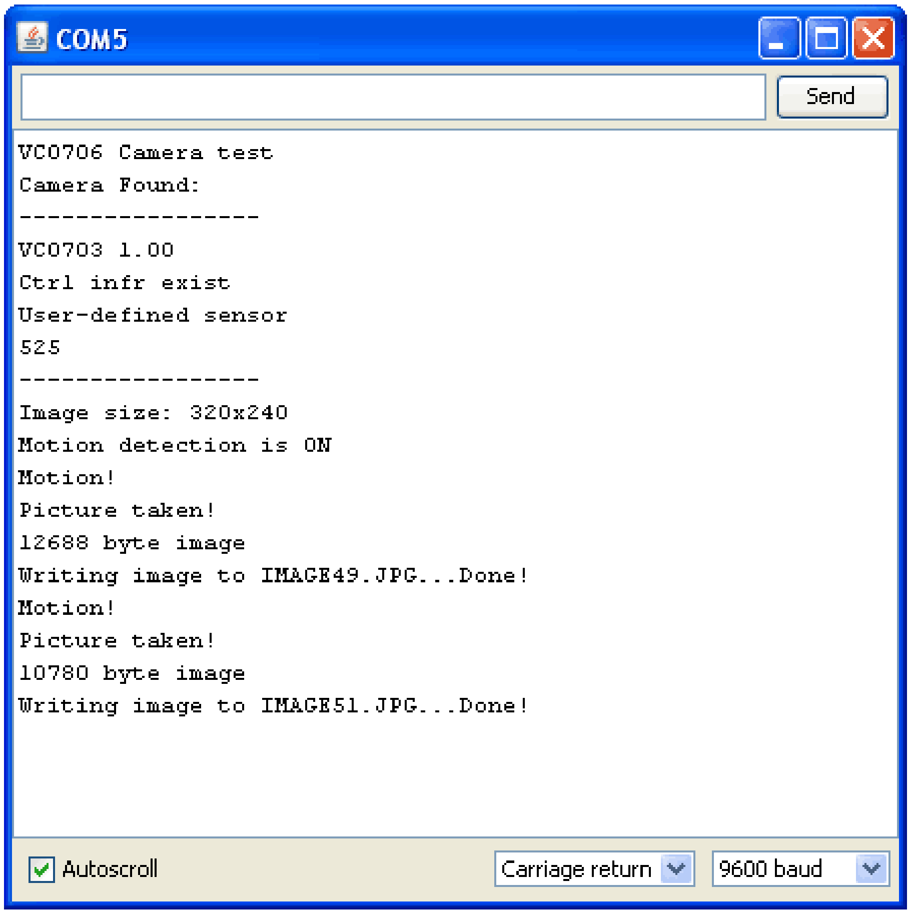
```
  // Remember that bigger pictures take longer to transmit!

  cam.setImageSize(VC0706_640x480);        // biggest
  //cam.setImageSize(VC0706_320x240);        // medium
  //cam.setImageSize(VC0706_160x120);          // small
```

Simply uncomment the size you want, and comment out the others. Bigger pictures will take longer to snap, so you will want to think about how fast you need to grab data and save it to the disk

Detecting Motion

A neat thing that the camera has built in is motion detection. It will look for motion in the video stream and alert the microcontroller (by sending a serial data packet) when motion is detected. IN this way you can save a bit of cash and skip on having a PIR sensor (although a PIR sensor will be better at detecting warm mammalian things).

Load up the **File-> Examples-> Adafruit_VC0706-> MotionDetect** sketch and upload it to the Arduino. It will take a photo immediately because it just turned on. Then wait a few minutes and wave you hand in front of the camera, it will take another photo.



```
VC0706 Camera test
Camera Found:
-----------------
VC0703 1.00
Ctrl infr exist
User-defined sensor
525
-----------------
Image size: 320x240
Motion detection is ON
Motion!
Picture taken!
12688 byte image
Writing image to IMAGE49.JPG...Done!
Motion!
Picture taken!
10780 byte image
Writing image to IMAGE51.JPG...Done!
```

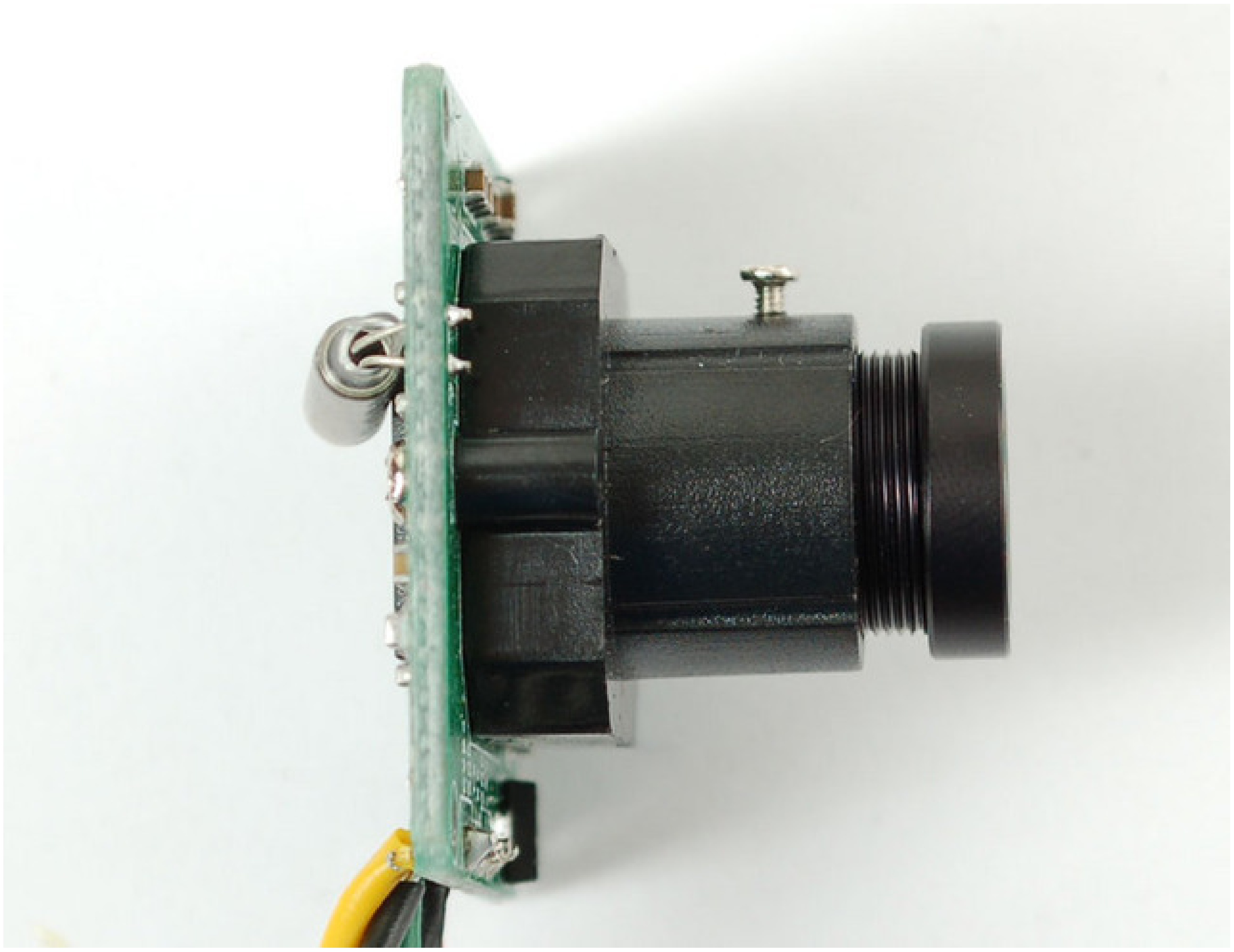
You can turn motion detection on or off by calling **setMotionDetect()**

```
//  Motion detection system can alert you when the camera 'sees' motion!
  cam.setMotionDetect(true);           // turn it on
  //cam.setMotionDetect(false);        // turn it off   (default)
```

You'll need to 'poll' the camera to ask it when motion is detected, by calling **motionDetected()**- it will return true if motion was recently detected, and false otherwise.

Adjusting the Manual Focus

One last thing, the camera modules use a manual focus system - there's no auto focus. This can be good or bad. The camera comes with a far depth of focus which is good for most stuff. If you want to change the focus, we strongly recommend plugging it into a video monitor as shown above so you can see exactly how the camera focus looks. You can then lock the focus with the set screw



The version in the weatherproof housing is a little tougher to adjust but it can be done by