# AlexMos Gimbal Controller
Setup and Tuning Guide

Hardware

Viacopter/Flyduino board - If you are running higher than 2S, you will need to jumper the JP1 pads. A simple solder bridge is all you need. You also will need to solder in the header pins. The minimum required is to solder the servo input pins for the tilt channel and the two sets of motor output pins. Connect the I2C cable to the board. If the IMU does not have a similar small connector you will need to solder the I2C cable wires to the IMU, but make sure you connect to the right pins. The pin order on the IMU is different than on the board.

Now, mount the board near the gimbals. (on provided space on AG gimbals) Connect the motor and the servos.

bridge if more than 2S
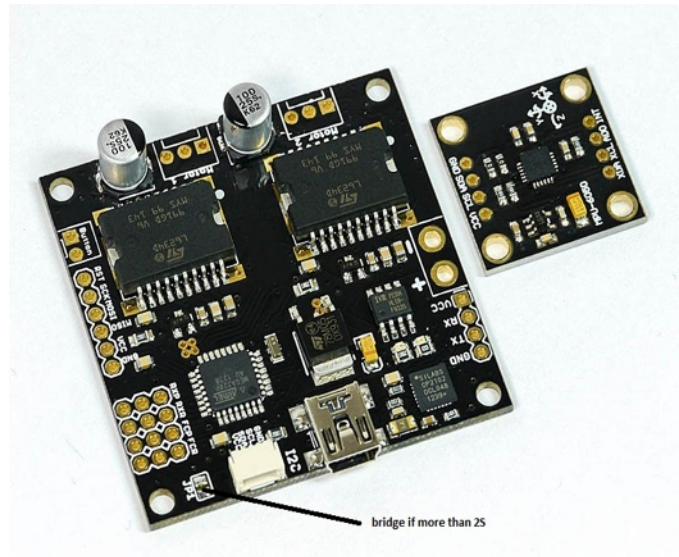
Firmware and SimpleBCG GUI download available from :
http://www.simplebgc.com/eng/downloads/

Firmware:
http://www.simplebgc.com/files/v10/SimpleBGC_2_0b3.enc.hex

GUI:
http://www.simplebgc.com/files/v10/SimpleBGC_GUI_2_0b3.zip

Firmware loader:
http://www.simplebgc.com/files/AvrdudeR.zip

Alex's tuning manual is available from:
http://www.simplebgc.com/files/v10/SimpleBGC_manual_1_2_eng.pdf

Extract all the compressed file. Move the AvrdudeR directory into the simpleBGC_GUI subdirectory. Move the latest hex file into the AvrdudeR subdirectory. Now connect the SimpleBGC board to the computer using mini USB cable. The first time it connects, it may look for the CP2101 driver. If Windows requires the driver, it can be downloaded here:

http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx

You will also need the Java runtime installed if you don't have it, as the SimpleBGC GUI is Java application. It can be downloaded here:

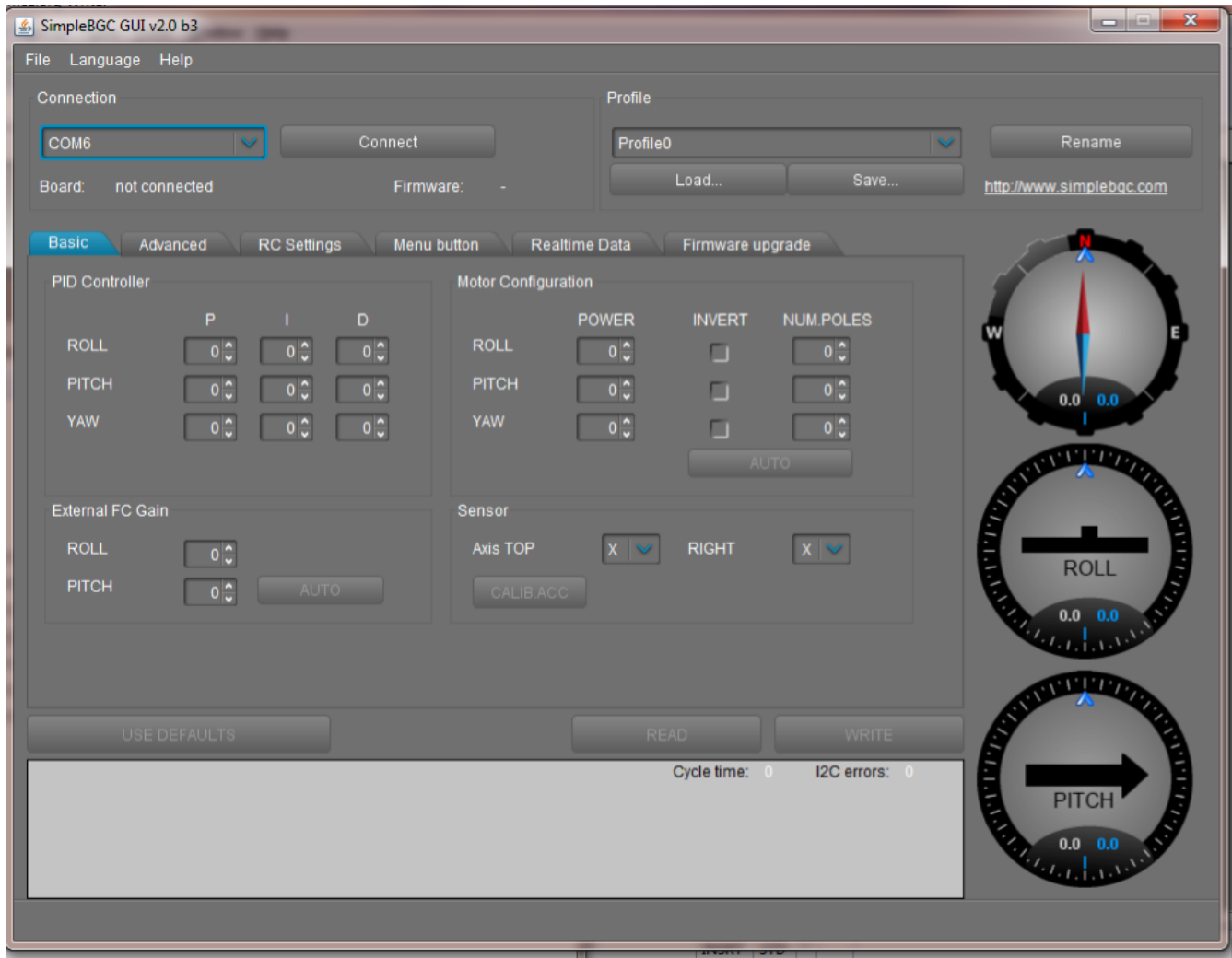http://www.java.com/en/download/windows_xpi.jsp

Now, connect the AlexMos SimpleBCG board to the computer using mini USB cable (not included).

Starting the SimpleBGC_GUI

Open the SimpleBGC_GUI subdirectory.   You will see something like this.
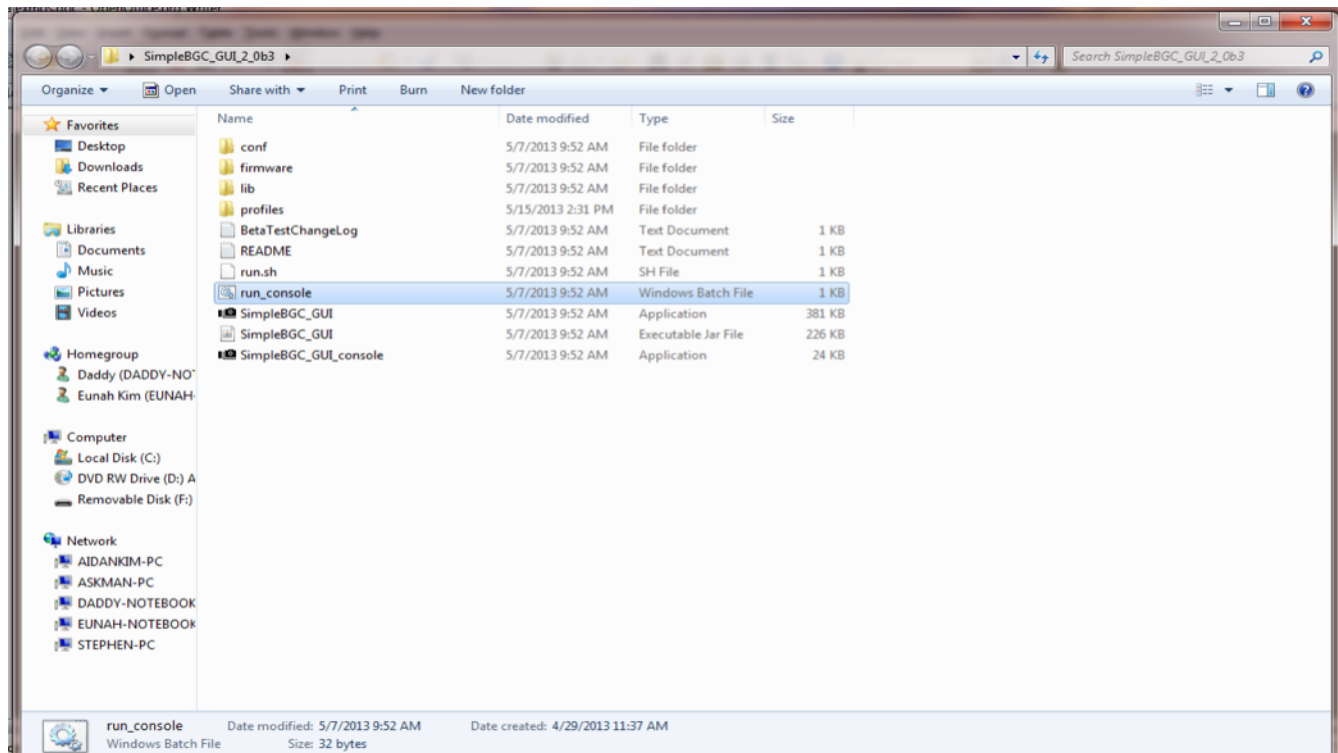
Click on **run_console** and it will start the batchfile to run the SimpleBCG_GUI

Now click on the **Connection** drop-down arrow (usually it will be something beside 1). In the example above, it is COM6. Hit **Connect**. If nothing happens, you will need to update the firmware.
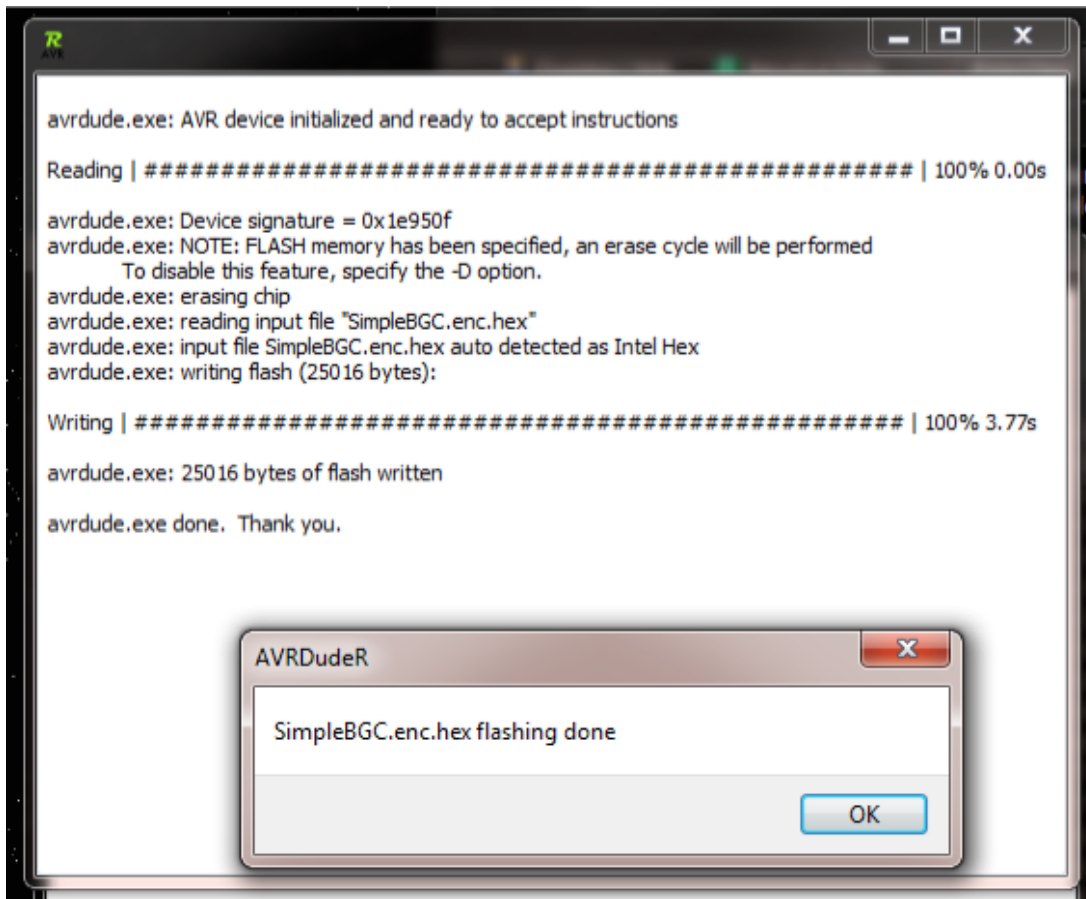
Firmware Update

Go to the AVRDudeR sub-directory and click on the batch file "run".
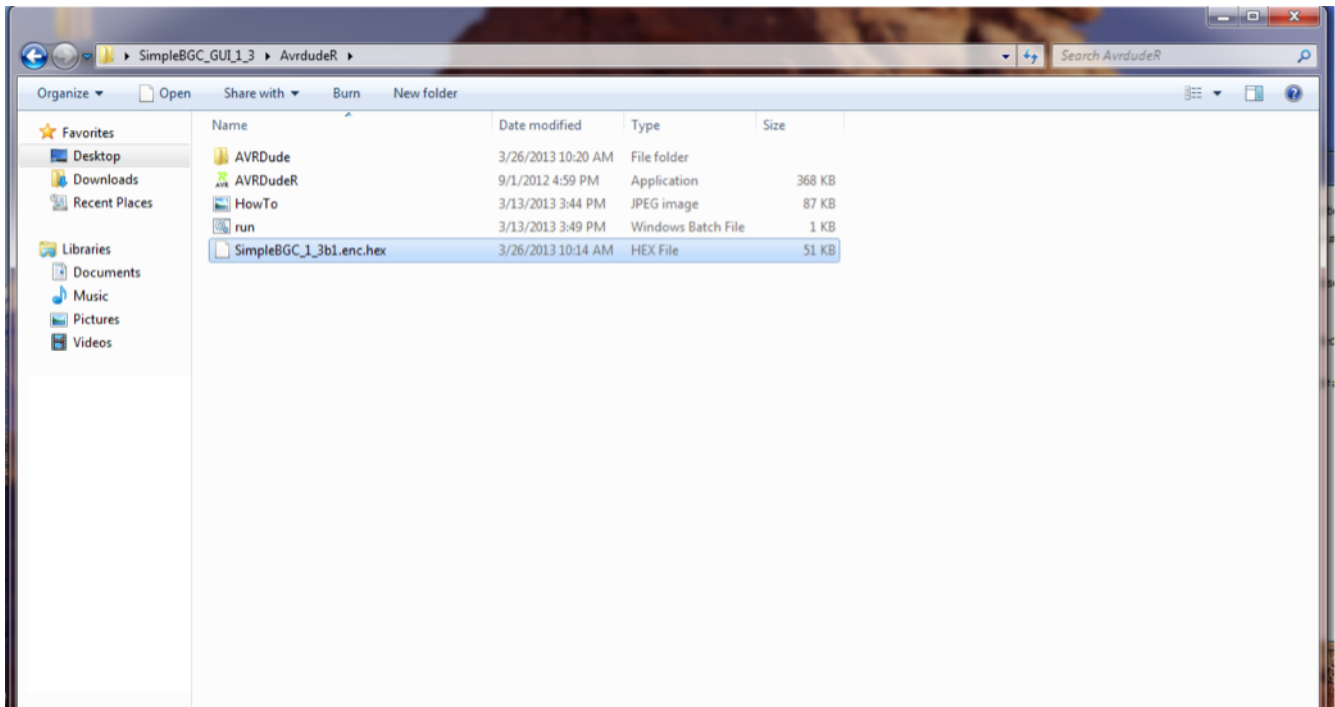
This will start the firmware loader program, and you should see the following:
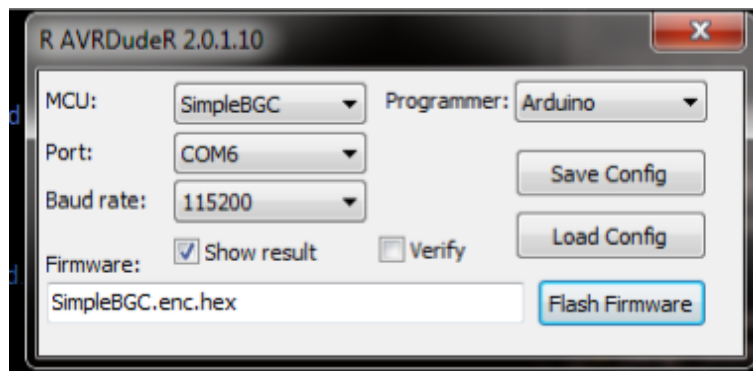
Copy the name of the new firmware file and select the **Port**. Click the **Flash Firmware** button and you will see a window open up with the following:


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

Reading | ############################################## | 100% 0.00s

avrdude.exe: Device signature = 0x1e950f
avrdude.exe: NOTE: FLASH memory has been specified, an erase cycle will be performed
        To disable this feature, specify the -D option.
avrdude.exe: erasing chip
avrdude.exe: reading input file "SimpleBGC.enc.hex"
avrdude.exe: input file SimpleBGC.enc.hex auto detected as Intel Hex
avrdude.exe: writing flash (25016 bytes):

Writing | ############################################## | 100% 3.77s

avrdude.exe: 25016 bytes of flash written

avrdude.exe done.  Thank you.
```

AVRDudeR

SimpleBGC.enc.hex flashing done

OK

This means you have successfully updated the firmware.

Now, go back to the GUI and start it again. You will now be able to connect and see the settings as well as firmware version.
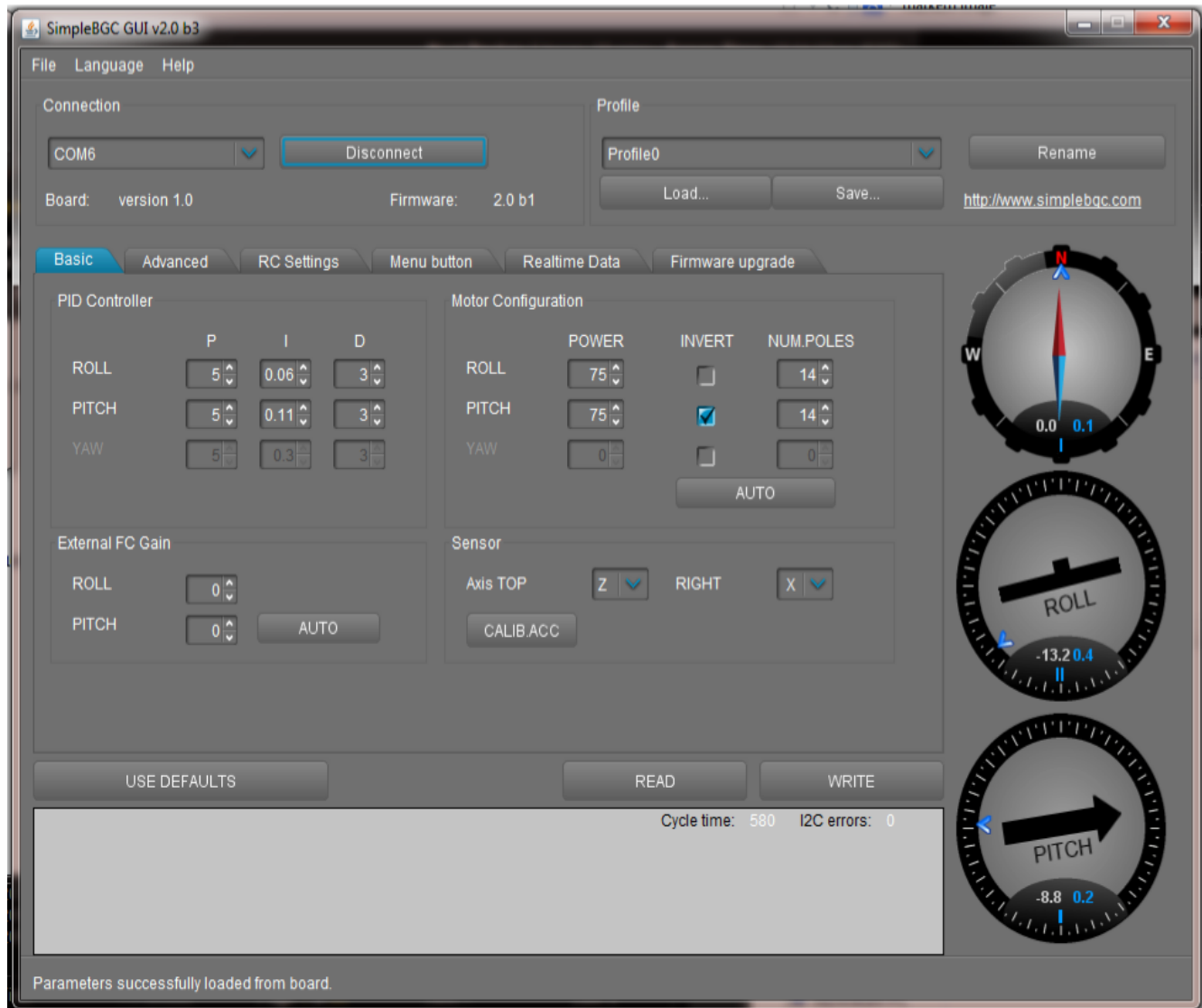
Setting up the Direct-Drive Gimbal

Note: The gimbal needs to be perfectly balanced in order for it to work properly. This can't be stressed enough. Proper tuning will be impossible if you don't have it balanced perfectly with the camera and accessories installed.

Once IMU is mounted, the camera needs to be installed on the gimbal. You should roughly balance the roll as you center the lens. Balance is more important the centering of the lens. Balance the tilt first with camera upright. You can move the camera forward/back till the load is balanced. Next, tilt the camera down and balance it with camera pointing down. You may need to add washer or spacer to move the camera tray up and down. You can also add weight as needed. Once the tilt axis is perfectly balanced, fine-tune the roll balance once again. You basically want it so that camera is balance in all position as close as possible. Once good balance is achieved, lock all the screws down so it does not move.

Once you are satisfied with the balance, the AM Controller can be setup, using the SimpleBCG GUI. In general, bigger camera/gimbals are easier to balance but it is critical that the correct balance is achieved for **all** gimbal setups. The toughest to balance well is the AG400DD due to irregular shape of the case.

Next, you will want to start with the default settings. If there is any issue with the operation of the gimbal, you should go back and start with the default settings. You will need to power the gimbal with voltage that you will run the gimbal at (recommended at 2-4S depending on gimbal)

We also recommend that you read Alex's guide to tuning as basic primer. For current AG DD gimbals, we have preloaded the board with PID and Power settings to run on 4S.

New Setup

Load the default settings by clicking the **USE DEFAULTS** button then hitting **WRITE** button.
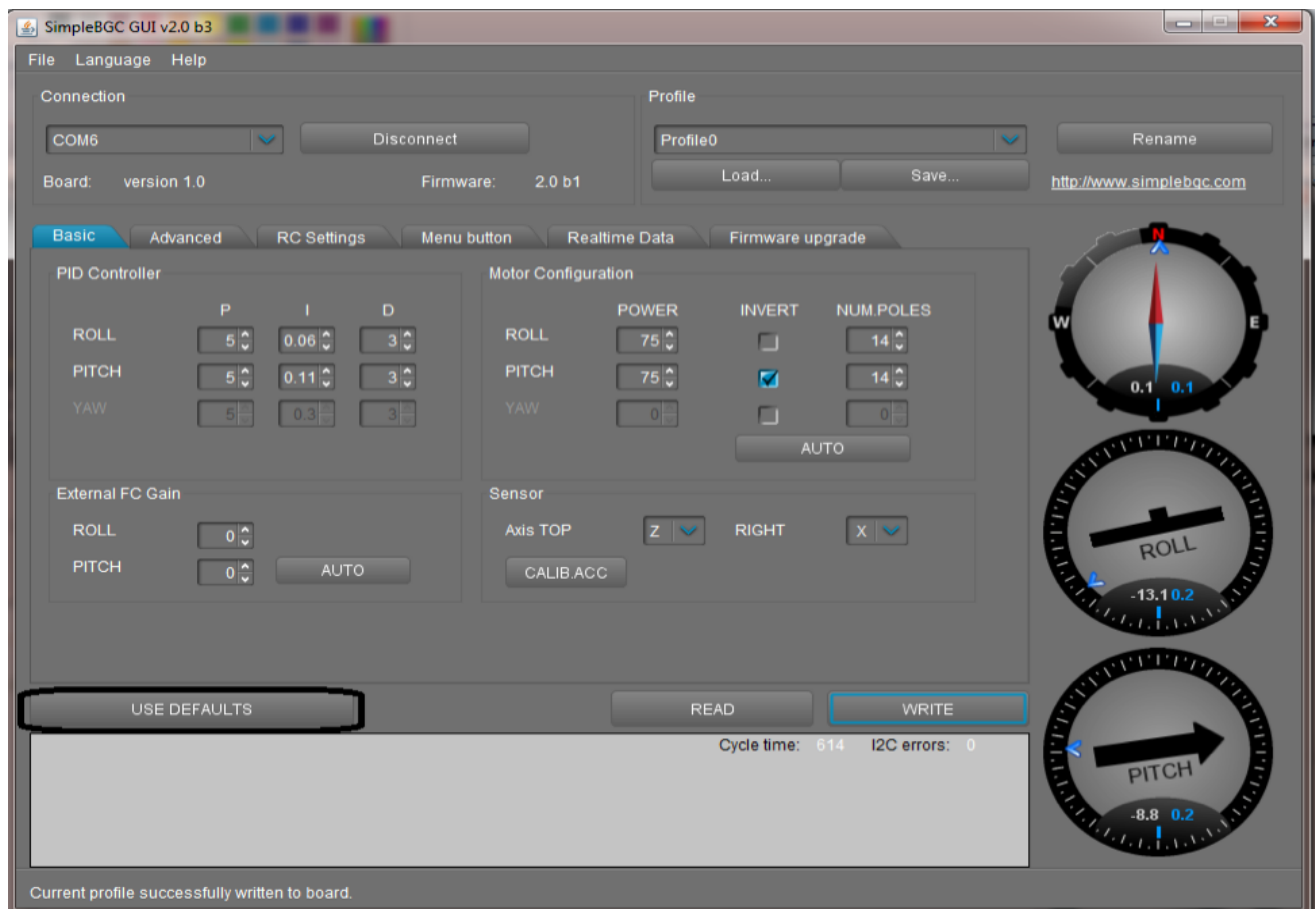
Define the IMU Sensor Orientation - All AG gimbals work with default positioning of the **Sensor** settings (**Axis TOP**: **Z** and **RIGHT**: **X**)   For other gimbals, this can change depending on how you have the IMU mounted.

![TPpacks.com logo]

Accelerometer Calibration - With the camera mounted and the multi-copter placed on level ground, level the gimbal and press the **CALIB ACC** button. Once calibration is done, hit **WRITE** button to save the calibration data.
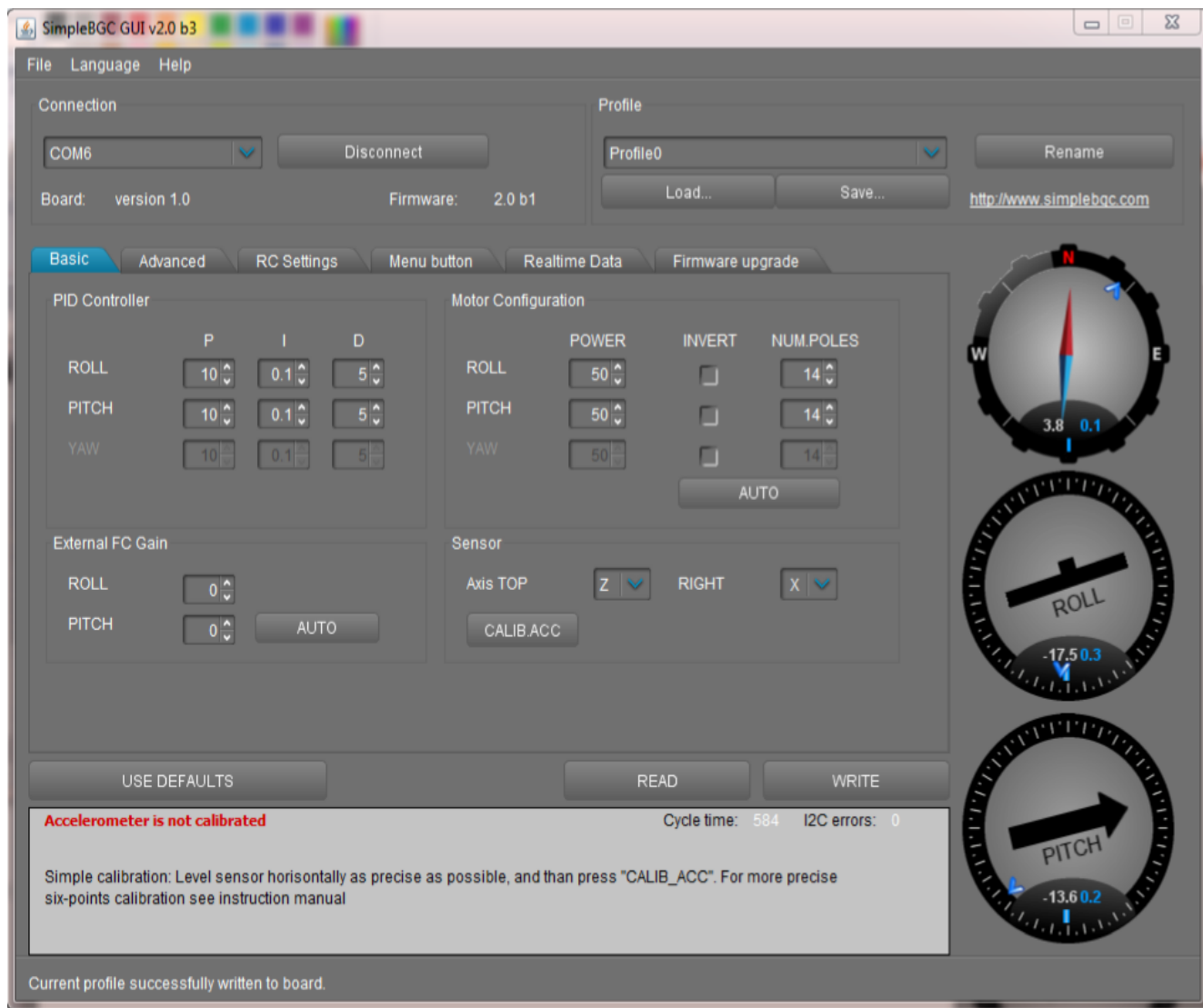
Motor Configuration - Start by hitting the **AUTO** button below **NUM POLES**. This process will take bit of time and you will see the gimbal move. It is finding the orientation of the motor and the number of poles. Once this is done, you may see one or both of the **INVERT** checkboxes selected, and the number of poles shown in **NUM POLES** might change. The AG400DD and AG500DD gimbal motors have 14 poles, so if this does not match, enter **14** in each box. Click on **WRITE** to save the calibrated motor configuration.

You may want to change the **PWM frequency** drop-down to the **HIGH (silent**) setting, to get rid of the annoying 8kHz noise. Be sure to click **WRITE** to save the settings.
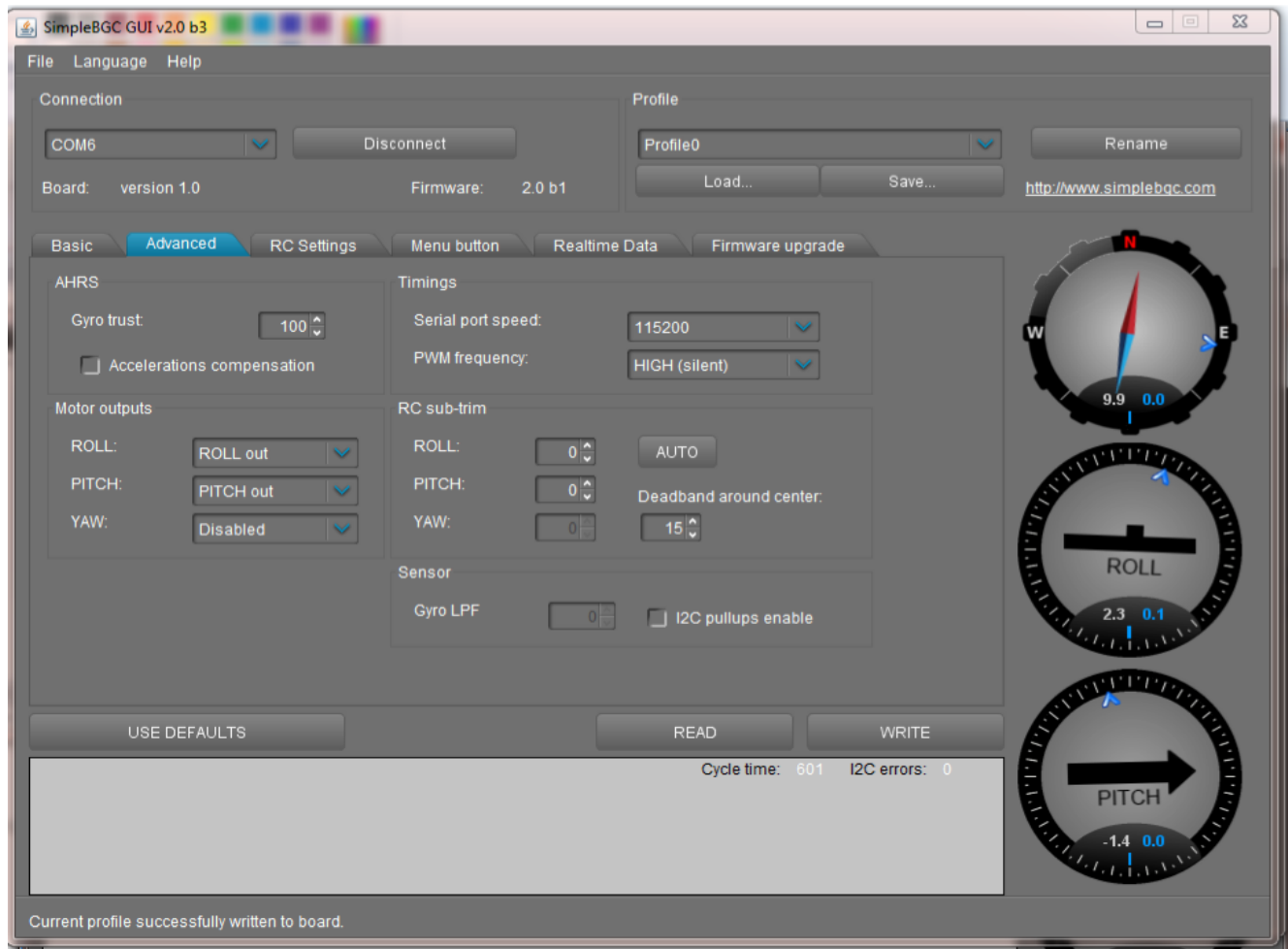
The **Realtime Data** tab page lets you view the various raw sensor data inputs in a moving graph format. The idea is that after proper PID tuning, the lines should be smooth.

PID Tuning

Start by setting the **ROLL P**, **I** and **D** values to **0**, as the tilt axis will be tuned first. Set **TILT P** to **10**, **I** to **0.10** and D to **10**, to start. The scope trace of **ACC_X** should have minimal oscillation. If you see any type of oscillation, you need to change settings until it is gone.   Higher voltage gives more torque, but you lose sensitivity of the PID settings, so it is much harder to tune. You can lower input voltage to improve the sensitivity of PID settings. Also, keep an eye on the temperature of the motor. Higher **POWER** settings means more current. As long as you can keep your finger on the motor, it is cool enough. Once the tilt axis is set, the roll axis can be tuned. While doing roll tuning, you need to test the tilt axis to make sure it does not cause issues. Repeat the tuning procedure for the roll axis until it is stable. The roll axis values should have similar values as the tilt axis, but typically you might end up with lower I and D values, due to extra loading. Poor balance can cause lot of issue with oscillation, so if you cannot get dialed in, you may need to check balance again.

In general, tune the **P** value first, then dial in the **I** setting to reduce response time. Generally, the **I** value should be around **10**. The **D** value should usually be between **5** and **10**. Everything is a tradeoff though. It will take quite a bit of trial and error to get the best results. If you have lot of fast jitter, you will need to lower the **P** and/or **I** value. If you have slow oscillation, you will need to raise the **P** and/or **I** settings. The **D** value should be adjusted after the P and I values are fine-tuned.

Once the PID settings have been tuned, so that you have smooth stabilization at different tilt angles, without oscillation being present in the scope data, you are ready for a flight test. Vibration can cause lot of issues with jitters, so make sure you have platform vibrations minimized. Certain issues may only show up when there are vibrations from the motor present, so you may need to do further tuning after initial flight tests.

Tuning is an art and will require quite a bit of time and effort to get the performance just right.

Keys to Tuning

1) Perfect balance.
2) See number 1.
3) Smooth mechanical setup without anything binding.
4) Making sure there are no oscillations

All PID settings are subject to change and there could be other settings that are more optimum for a particular setup.

APPENDIX

Current AG400DD tuning setup (as loaded from the factory) for 4s.
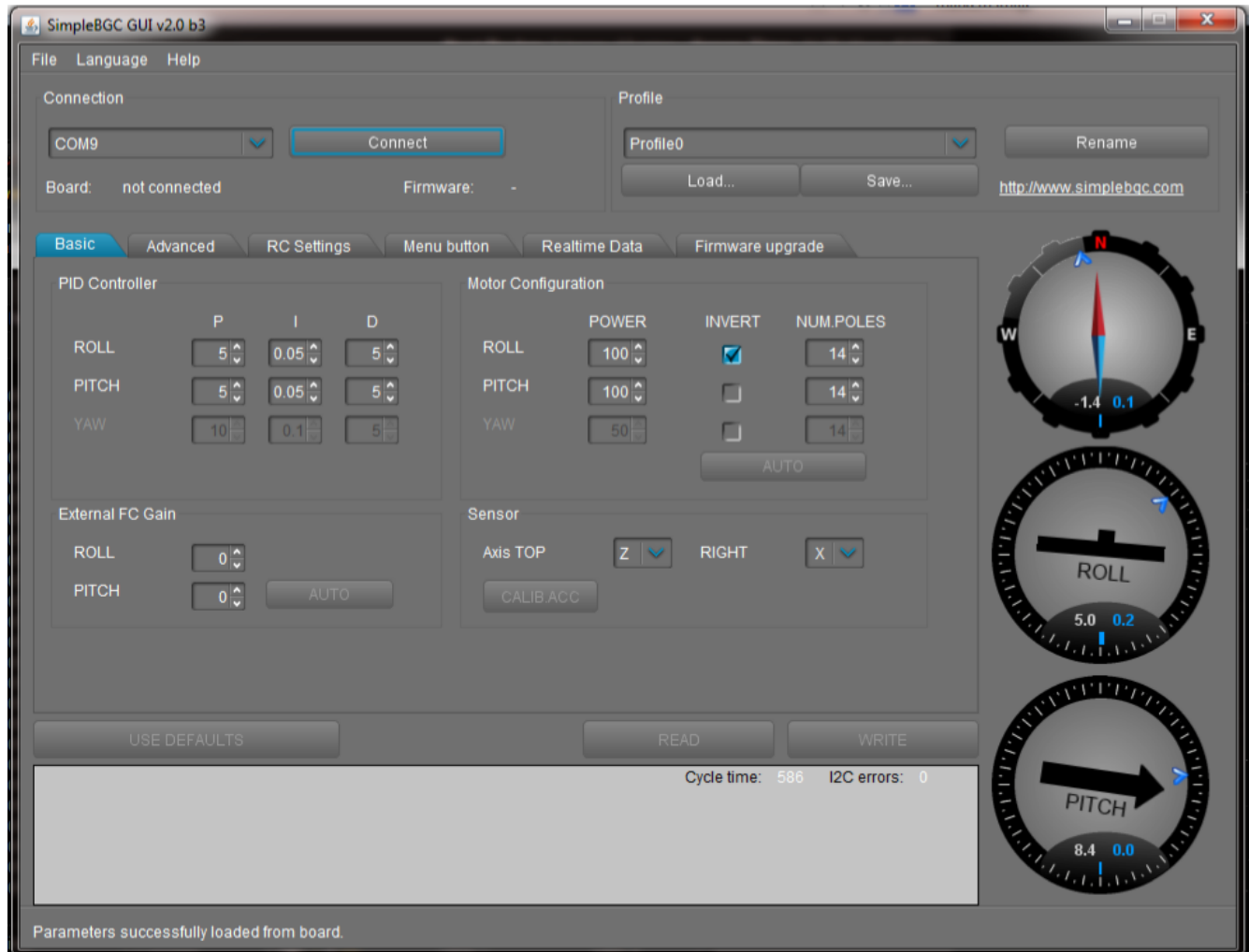
For the AG400DD, we have added a small counterweight to the roll axis arm for tw reasons
1) It allow the camera to be positioned closer to centerline
2) It adds a bit of extra dampening to kill a potential resonance oscillation.

Current AG500DD tuning setup for a Sony NEX-5N with the 18-55mm kit lens, running on 4s.
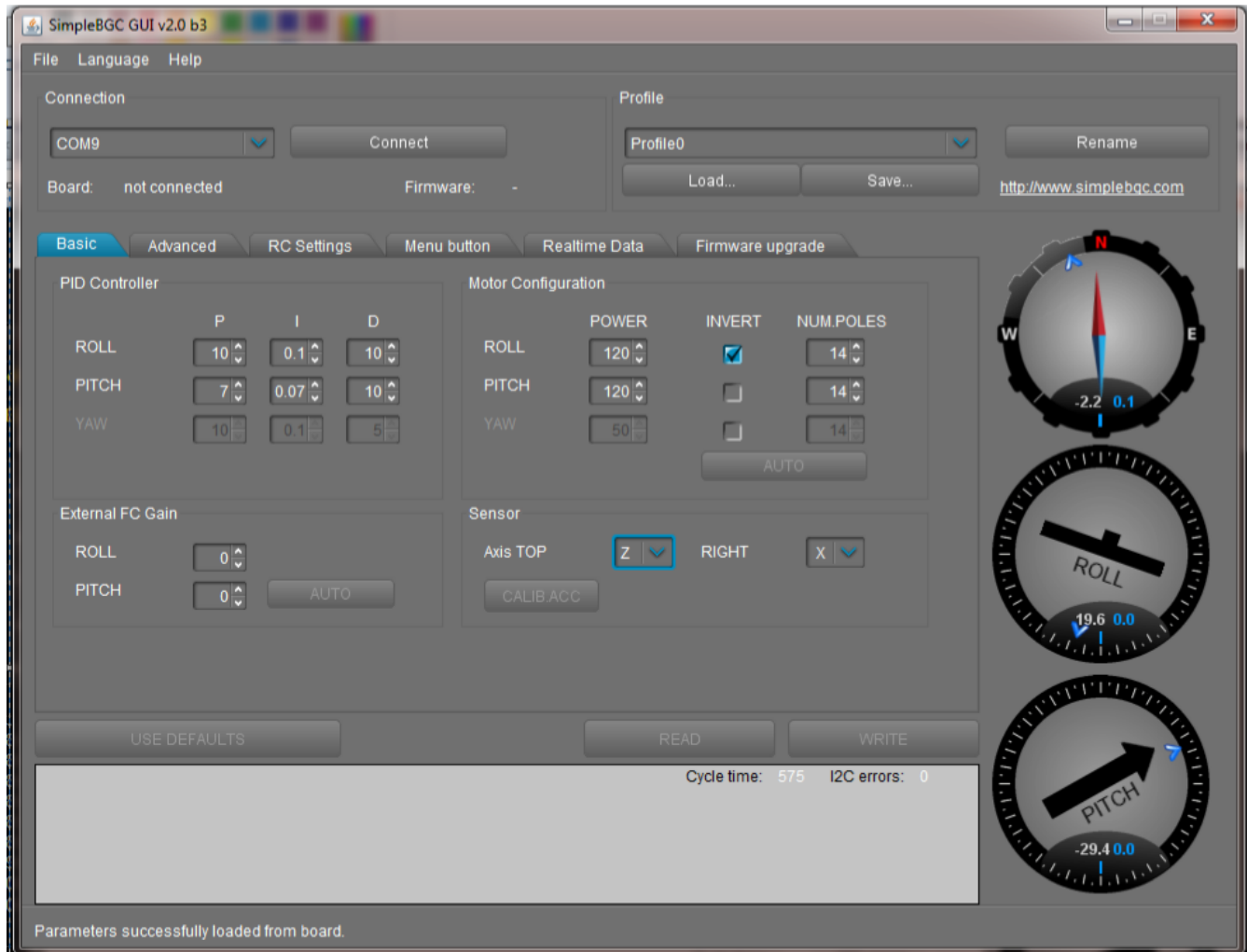
This is the default AG500DD tuning setup that comes pre-loaded. Other camera setups are available on request.

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