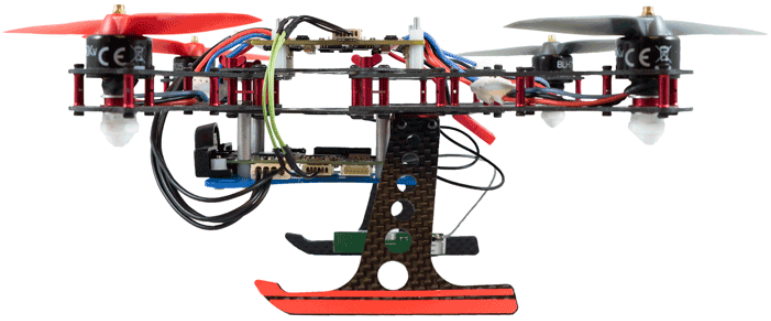

Build your drone and fly it! Walkthrough instructions

[Document: ITC-01IMP1209-WI-001 Version: 1.1]

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IDENTIFICATION

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1. INTRODUCTION

1.1 Purpose

The purpose of this user guide is to provide instructions to assemble a quadcopter using the Qualcomm® Snapdragon™ Flight Kit, program it and finally fly it!

In a nut shell there are 3 flight configurations:

1) **Spektrum or similar remote control connected to a PC with control over Wi-Fi**
   A PC or laptop can be used to fly the drone, but it requires the followings:
   - AeroSIM simulator with Trainer link USB adapter.
   - QGroundControl
   - Spektrum RC transmitter or similar.

   To fly the drone with a PC, the Spektrum RC transmitter must be connected to the PC via the USB trainer interface. This allow data to be passed to the PC so it can be used by QGroundControl.
   QGroundControl, when configured appropriately will relay the data to the drone over Wi-Fi. It is important to understand the RF transmitter on the remote controller is not active in this configuration.

2) **Tablet running Android apk over Wi-Fi**
   The apk file for the Android application is provided as part of the build process. The apk file needs to be installed on a Android tablet or phone.
   When the drone is powered and mainapp is running, the drone will act as a server and provide an IP address over Wi-Fi.
   The tablet or phone needs to connect to it, then the application needs to be started. From there, if configured properly, the app will allow control of the drone.
   Streaming onto the tablet or phone is also possible.

3) **Spektrum or similar remote control connected to RC RF receiver**
   The Spektrum remote controller can be used to fly the drone without the need of a PC. For this configuration to work, the Spektrum Remote Controller must be paired with a compatible RC receiver. The model number of the RC receiver is specific.
   The 2.4GHz RC receiver is directly connected to the eagle board over a UART interface. Each channel of the Spektrum RC controller is sent and received over the 2.4GHz band and once processed by the receiver is carried out to the UART which the Eagle board can then process. It is to be noted the wifi interface is not used in this configuration, at least not as an attempt to control the drone. It should be possible however to stream video to a tablet or phone as indicated in configuration 1).
   This configuration has not been validated by Intrinsyc at this point.

For more technical information, visit: **http://support.intrinsyc.com/projects/snapdragon-flight**

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2. COMPONENTS

2.1 Content of the Qualcomm Snapdragon™ Flight Kit

- A Snapdragon Flight board with 4K and Optic Flow cameras
- A power Adapter Board
- A serial Debug Adapter Board

2.2 Additional off the shelve components

The following are the additional components needed to build a quadcopter flying platform around the Snapdragon Flight:

- BLADE 200 QX frame kit; aluminum/carbon fiber: Red (MHE20QX105QK) or Blue(MHE20QX005QK)
- Qualcomm 4-in-1 Electronic Speed Controller (ESC): available from http://shop.intrinsyc.com
    - ESC serial communication cable (might need to be extended if too short)
- 2x Brushless motors: 200 QX (BLH7705) CW Rotation
- 2x Brushless motors: 200 QX (BLH7706) CCW Rotation
- Gray propellers: 200 QX (BLH7707). Package includes a pair of blades for CW and CCW rotation, plus 1 CCW nut and 1 CW nut
- Red propellers: 200 QX (BLH7708). Package includes a pair of blades for CW and CCW rotation, plus 1 CCW nut and 1 CW nut
- Battery 800 mAh 2S 7.4 V 20C LiPo 20 AWG JST (EFLB8002SJ)
- 1 x Wi-Fi antenna (Taoglas-Limited FXP522.A.07.A.001)
- 1 x GPS Antenna (Taoglas-Limited ALA.01.07.0095A)

2.3 Optional components

- PX4 User Guide for Qualcomm Snapdragon Flight, 80-H9631-2 Rev. G, available from http://support.intrinsyc.com/projects/snapdragon-flight
- Li-Po Battery charger - Any 2S Li-Po charger with balancing would do, such as the Celectra 2S 7.4V DC Li-Po charger (EFLUC1007) and AC to 12 VDC, 1.5-amp power supply (EFLC4000)
- Remote Controller - Spektrum Dx6i transmitter
- AeroSIM RC dongle http://www.aerosimrc.com/en/home.htm

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3. ASSEMBLING

3.1 Frame Instructions

The instructions for the BLADE 200 QX QUADCOPTER CNC Aluminum/Carbon Fiber Quadcopter Frame Kit are included with the frame but some changes are necessary to mount the Flight board, see instructions in sections below.

3.2 Tools

3.2.1 Necessary tools

- Small Phillips head screwdriver
- Precision tweezers
- 2 mm hex key
- Soldering iron and solder
- Loctite® Threadlocker BLUE 242 or equivalent

3.2.2 Recommended tools

- 5.0 mm nut driver (for Snapdragon Flight mounting nuts)
- 5.5 mm nut driver (for M3 nuts)
- 7 mm nut driver or small pliers (for M4 nuts)
- Curved tweezers

3.3 Step 0 – Unpacking the 200QX

Figure 1 - What comes with the 200 QX frame kit

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3.4 Step 1 – Adding Standoffs to the Snapdragon® Flight

Before building the 200QX frame, the Snapdragon Flight must be modified to attach to the bottom plate of the quadcopter.

Warning: Do not remove all the screws at once. Trying to reinstall them can be difficult with the bottom camera.

Note: Only 3 standoffs are required. A 4th standoff would interfere with the Serial Debug Board. See Figure 3 – Where to add standoffs

1. Unscrew one nut.
2. Remove screw from top and reinstall from bottom. Try to prevent the spacer from moving, otherwise there is extra work to realign.
3. Screw on ¾" standoffs.
4. Repeat for other 2 screws.
5. See Figure 4 – Alter one screw at a time

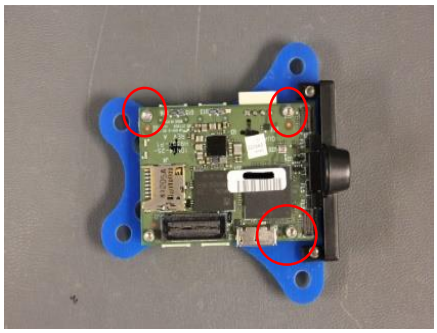

Figure 3 – Where to add standoffs

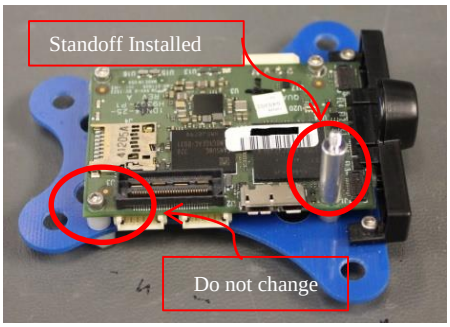

Figure 4 – Alter one screw at a time

Figure 2 - Snapdragon Flight with standoffs

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3.5 Step 2 – Attaching the arms to the bottom plate

Attaching the arms to the bottom plate requires the bottom screws near the attachment point (the 3 near the wingnut) to be removed. After the bottom screws are removed, line up each arm such that the wingnut is on the corner most through-hole. Re-attach the screws through both the arm and bottom plate, such that the arms are to end of the slide-hole. Repeat for each arm.

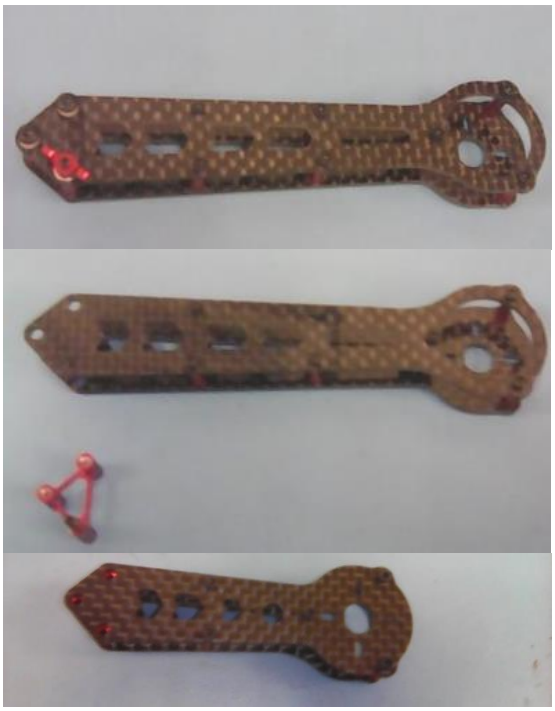

Figure 5 - Remove the bottom and top screws from each arm

Figure 6 - Attach each arm to the bottom plate

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The rear arms (Long) are attached. Make sure each arm is oriented ‘upwards’ such that the motors can drop into the arm. **The left arm in this picture is incorrect and had to be flipped.**

Figure 7 - All arms attached to bottom plate, short arms are front, long arms are rear

3.6 Step 3 – Attaching Flight to bottom plate

The 200QX frame has to be modified to accommodate the Snapdragon Flight. This involves drilling 3 holes through the bottom frame and arms to accommodate the modified Flight board.

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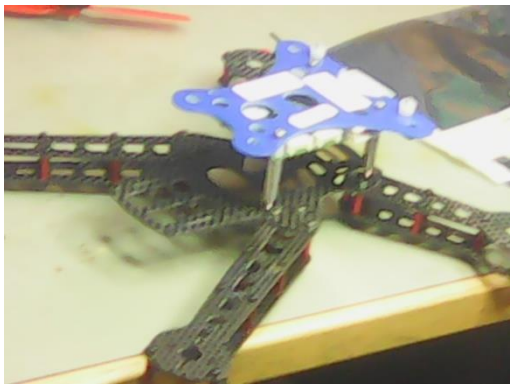

Figure 8 - Lineup the Snapdragon Flight such that the top standoffs intersect the top arms, and the bottom standoff is just above where the legs would attach

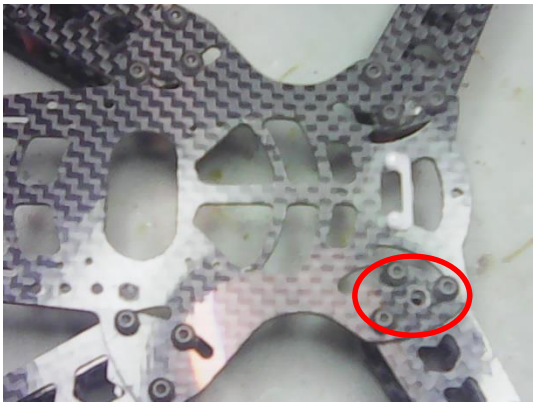

Figure 9 - The 200QX bottom plate must be modified(drilled) to accommodate the Flight board, note the suggested location for drilling through-holes

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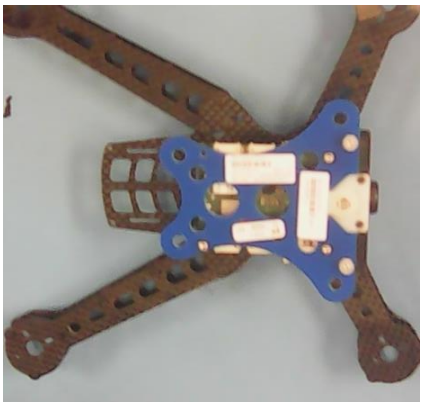

Figure 10 - Attach the flight board to the bottom plate. Ensure the standoff threads pass through the newly drilled holes.

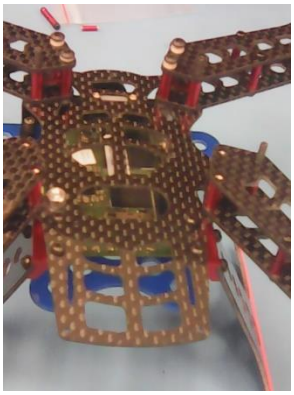

Figure 11 - Be sure to attach a nut to lock the flight in place

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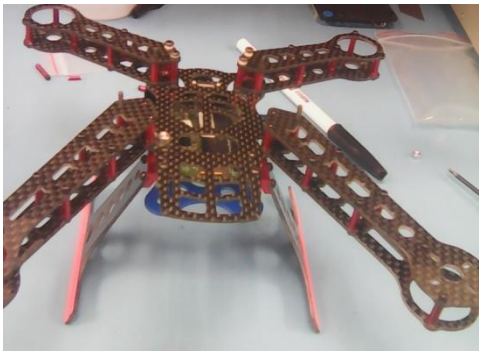
3.7 Step 4 – Attaching the legs

Figure 12 - Remove 200QX legs from packaging and attach to frame



3.8 Step 5- The Top plate

Figure 13 - Add 2 large struts from the 200 QX frame to support the top plate

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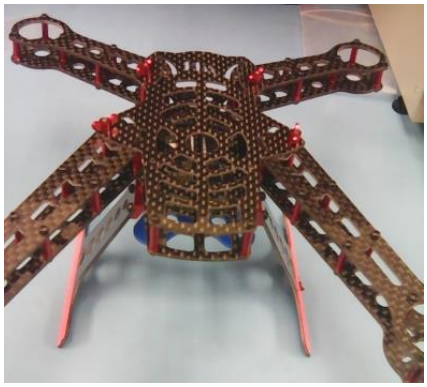
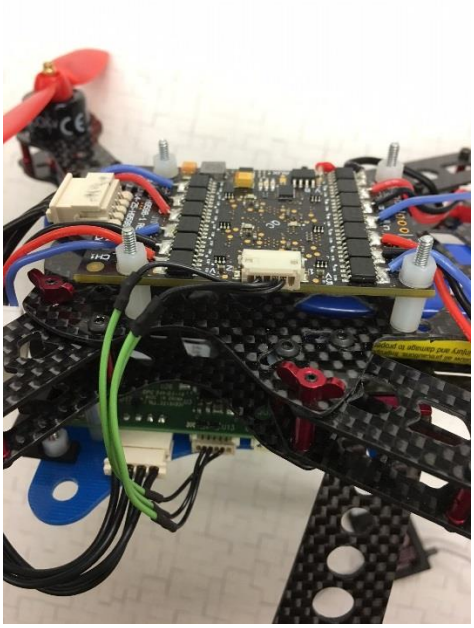
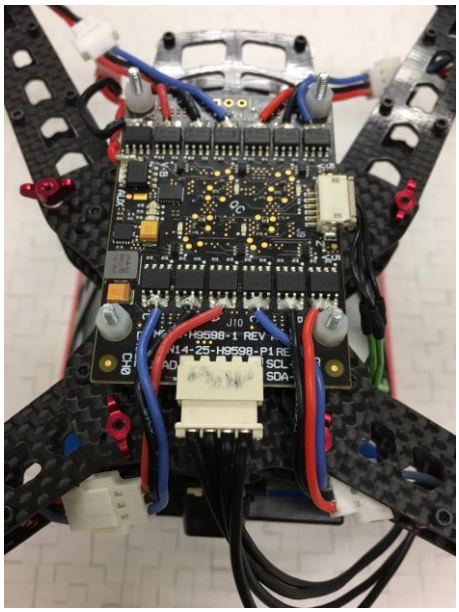


Figure 14 - Slide the top plate over the lower arms/struts and re-screw the wingnuts back on

3.9 Qualcomm ESC mounting





3.10 Finished Drone

Mount the motors into each arm of the quadcopter. If using CW and CCW motors, the motors are mounted on opposite arms.

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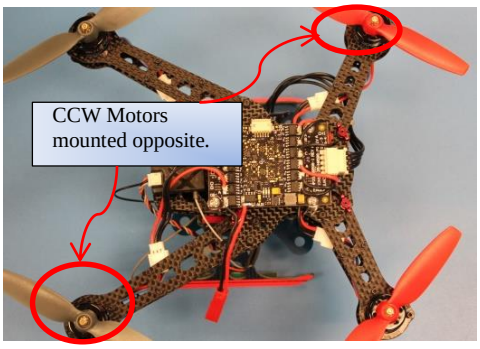

Figure 15 Motor arrangement when using CW and CCW motors.

The propellers are configured for CW and CCW rotation. As the CW and CCW motors are opposite, so should be the propellers. Observe the orientation of the blades in Figure 16.

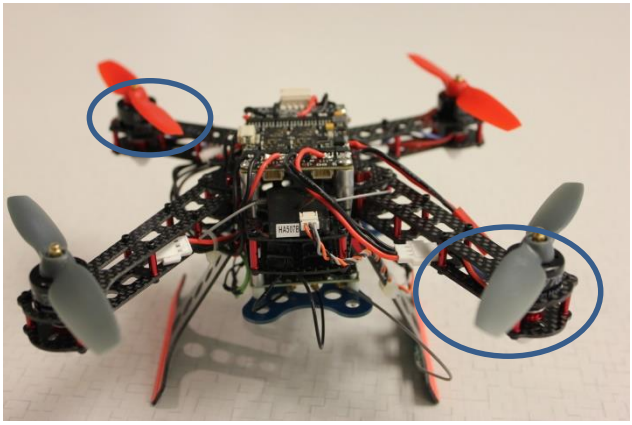

Figure 16 Propeller matching.

See Figure 17 for connection of the power cable from the ESC board to the Flight board, J14. Also, the ESC communication connector to J13 of Flight.

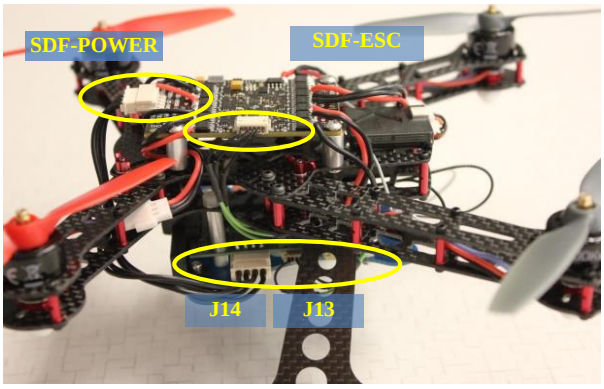

Figure 17 Cable Connection View

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Note the wiring from the ESC board to each propeller in Figure 17. Orienting the ESC board in a different manner would cause the motor configuration to change.

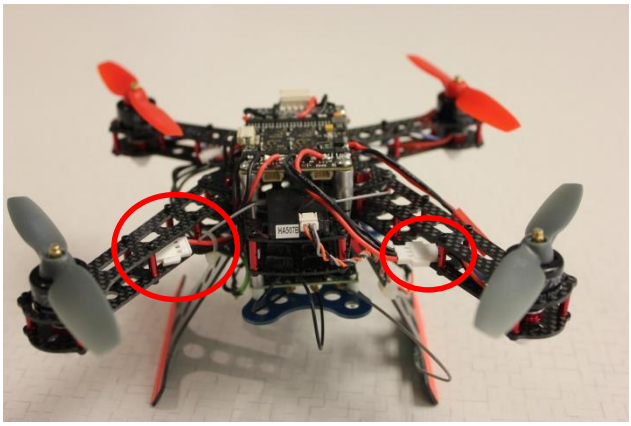

Figure 18 Connection of Motors to ESC Board

See Figure 19 for mounting location of the GPS antenna.

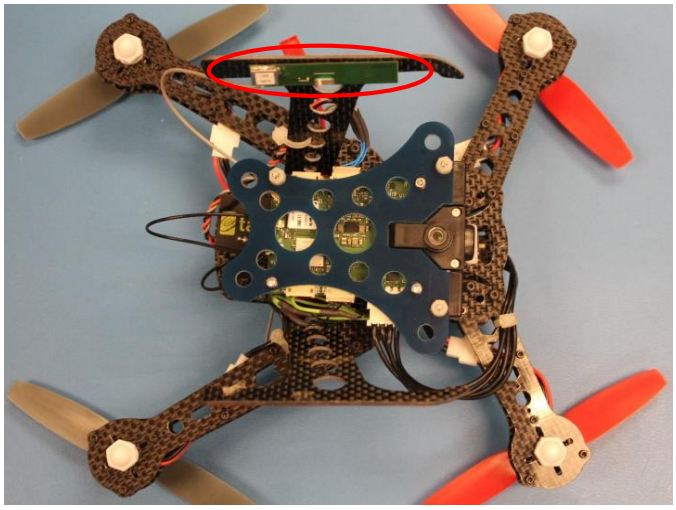

Figure 19 Snapdragon Flight with 200 QX Frame: Bottom View

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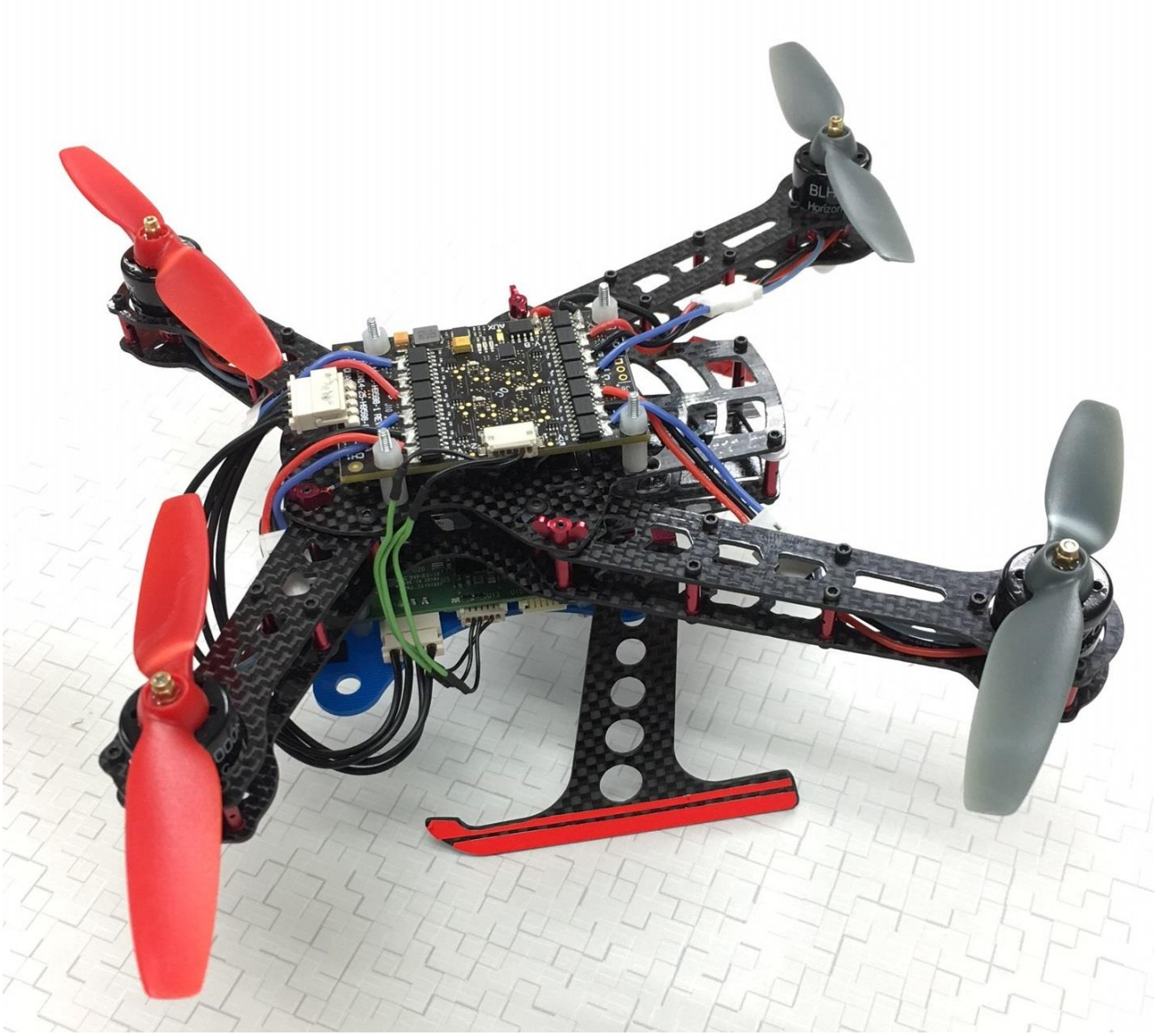

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4. PROGRAMMING

To re-program the Flight board, download and extract
"**Flight_BSP_3.0_apq8074-le-1-0_r00015.zip**" from support.intrinsyc.com.

The download includes the binary image for the board, the compiled PX4 flight stack and the Android tablet app that can be used to control the drone. For more information, see README.txt in **Flight_3.0_apq8074-le-1-0_r00015**.

Detailed instructions to re-flash the BSP (base operating system, no flight stack) can be found in the README in **Flight_3.0_apq8074-le-1-0_r00015.zip**

Instructions to install the PX4 flight stack onto the device for flight or HIL simulation can be found in the *PX4 User Guide for Qualcomm Flight*.
Instructions on how to create programs that run on the device using the ARM applications processor, aDSP, IMU and system update, refer to the *Qualcomm Snapdragon Flight Developer Guide.*

The SDK for the ARM applications processor is **qrlSDK.zip** and the SDK for the aDSP can be found on Qualcomm's website: https://developer.qualcomm.com/software/hexagon-dsp-sdk/tools and also the **qcom_flight_controller_hexagon_sdk_add_on_for_Flight_3.0.zip**

Instructions on how to use the camera API can be found in *Snapdragon Linux Camera Interface Specification.*

Instructions on how to perform the IMU calibration and set up the DroneController app can be found in the *Qualcomm Snapdragon Flight Reference Platform User Guide*.

Instructions on how to set up the Wi-Fi hotspot and use the camera to make a video recording can be found in the *Qualcomm Snapdragon Flight User Guide*.

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5. FLYING

5.1 Motor Configuration

The configuration files in Flight_3.0_apq8074-le-1-0_ap_standard_oem_r00015 contain code for the orientation of the mounted Flight board.

5.2 Starting the PX4 Flight Stack

Pre-requisite:

To allow the drone to become flight ready, PX4 Flight Stack must be running.
PX4 Flight Stack is running and communicating with the ESC whenever the 4 blue LED's on the ESC board are blinking steadily.

The best approach to handle flight readiness of the drone in the field is to establish a SSH connection over Wi-Fi.
Shortly after a fully charged battery is plugged-in, the Flight will act as a server and will broadcast its SSID in the form of Atlanticus_XXXXX.
While on the PC or laptop, the SSID should be made available shortly after power up.
The PC or laptop must establish a connection to the drone.

Connecting to Atlanticus_XXXXX will require a password. The password is "password" (excluding the quotes).
Connection should now have been allowed. There is going to be a warning message indicating the lack of Internet connection. This is normal and expected as the drone is not providing such service.

It is now time to access the drone over SSH.
To do so you need either PUTTY (http://www.putty.org/) or Bitvise installed for which a profile can be created and called anytime as necessary.

Use the following credentials:

Host: 192.168.1.1 (This is the address advertised by the drone).
Port: 22
Username: linaro
Password: linaro

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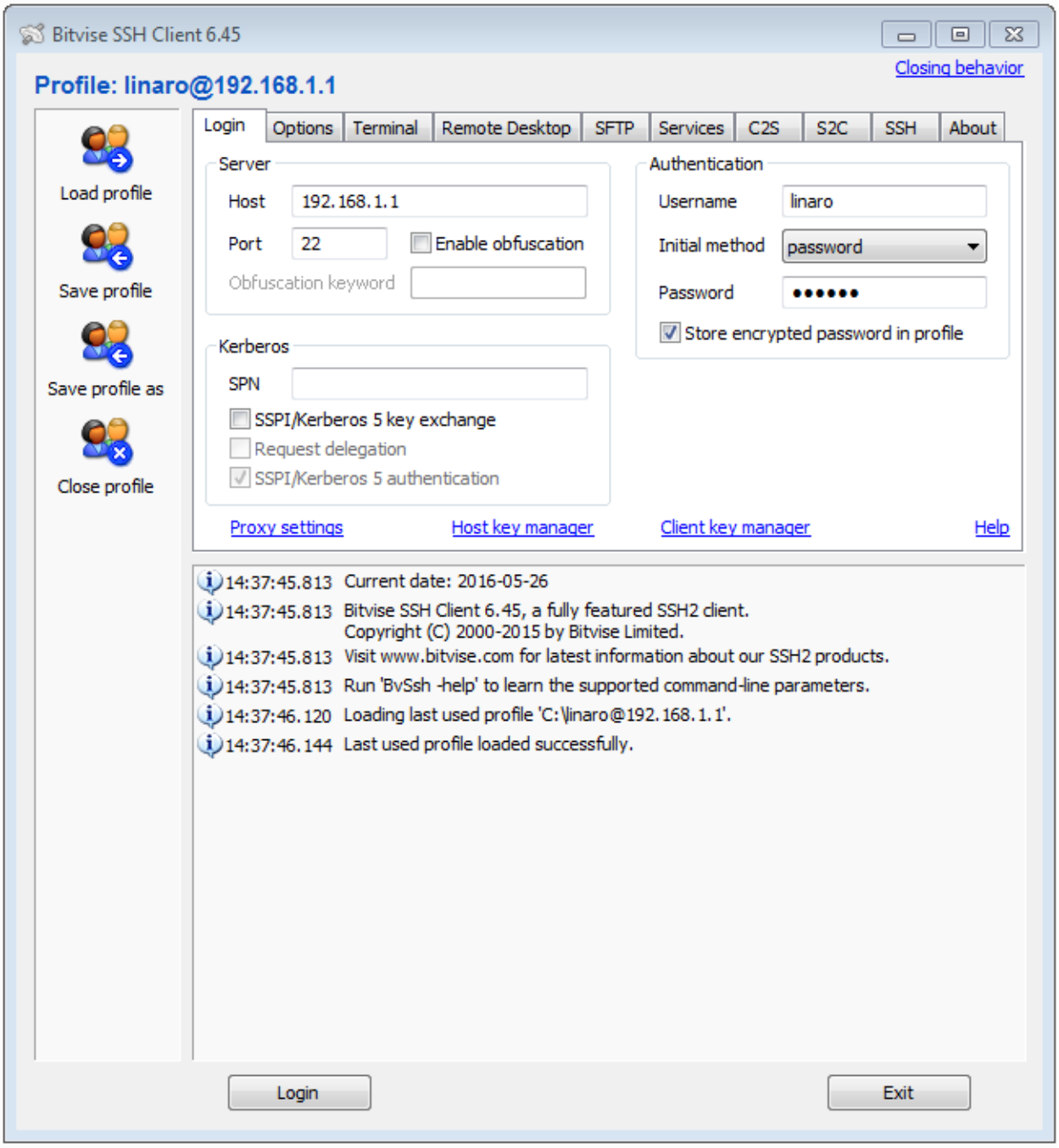

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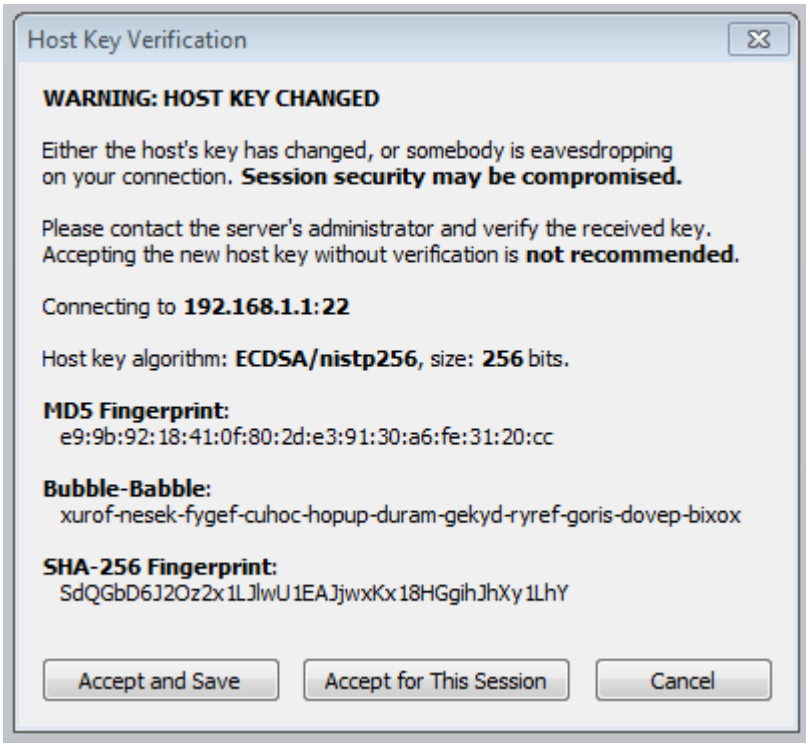
Pressing the “Login” button will initiate connection over SSH.
If it is the first time the drone is being accessed from this PC, a Host Key Verification window will pop-up such as below:



Press “Accept and Save” to proceed ahead.

A new terminal console needs to be opened from Bitvise in order to be able to enter commands.
Upon successful connection, login should be similar to the following screen:

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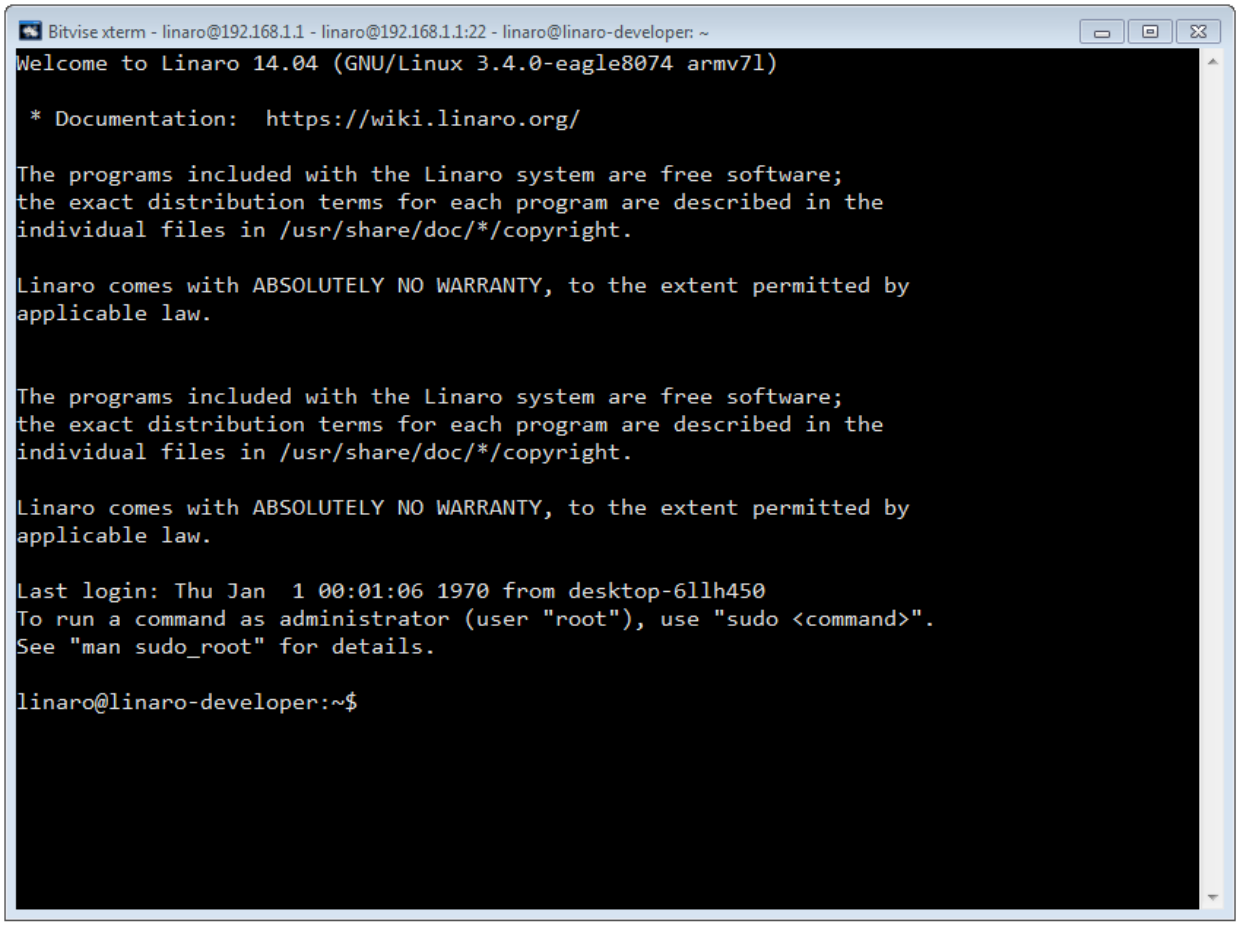

While the drone has been connected over SSH, the 4 ESC LED's should still be OFF.
To place the drone in flight ready status, the following commands need to be executed:

cd /home
sudo ./mainapp mainapp.config &

Upon proper start of the drone application, the 4 ESC LED 's should now be toggling.
The drone is now in "flight ready" status.

NOTE: It is important to not forget the ampersand character at the end of the sudo command. If ampersand character "&" has been omitted, closing the terminal window, pressing "Ctl+C" or terminating the connection over SSH will cause the mainapp application to be terminated.

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5.3 Using Spektrum Remote Control and QGroundControl

Flying the drone with Spektrum Remote Control and QGroundControl.

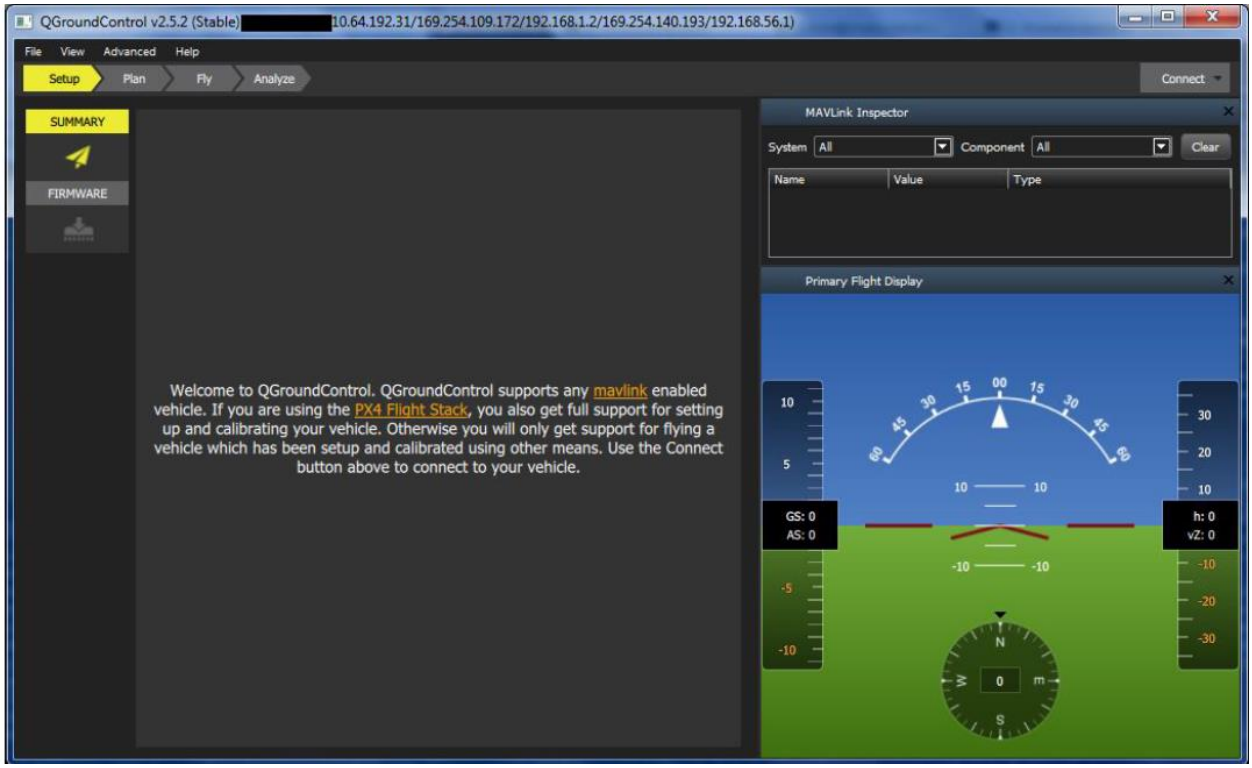
AeroSIM simulator and USB dongle must have been installed:
If not, proceed by installing AeroSIM.
Follow the instruction provided from AeroSIM.

Installing QGroundControl:

Download QGC from https://github.com/mavlink/qgroundcontrol/releases and install using the Windows executable; v2.7.1 is recommended.

Once installed, start QGroundControl:

1. Launch the QGroundControl (QGC) application.



2. Set up the communication to Snapdragon Flight:
a. Select **File** > **Settings** > **CommLinks**.

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b. Click **Add.**

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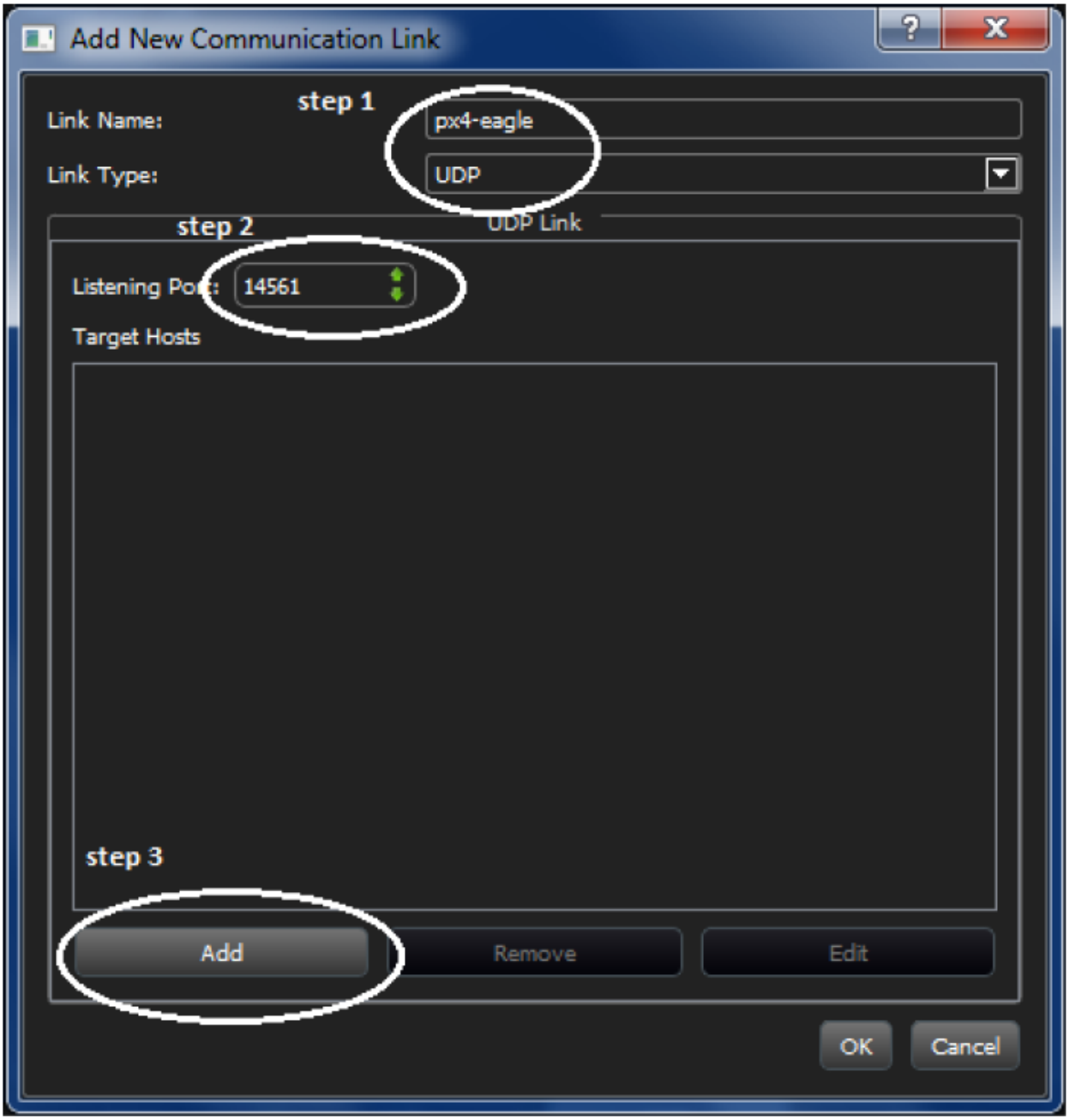

c. Enter a Link Name of your choice.

d. Under Link Type, select **UDP.**

e. Set the listening port to an unused port, for example, 14561.

3. Click **Add**.
a. Enter the IP address and port of the PX4 Mavlink app:

b. <IPADDR>:14556
– Where <IPADDR> = IP address of the Qualcomm Snapdragon Flight board

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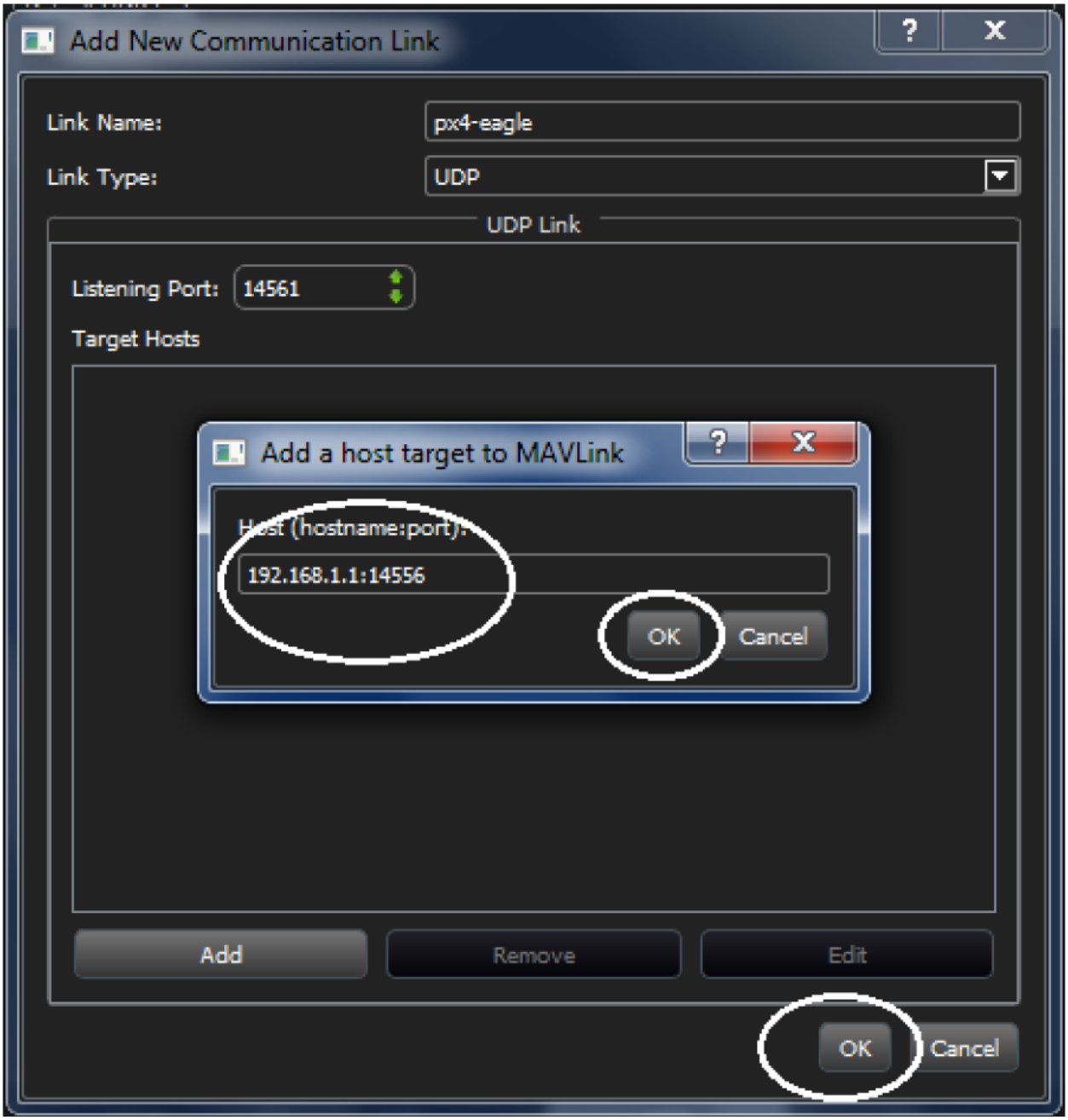
c. Click **OK**.



Joystick setup

Spektrum Controller (DX6i) with AeroSIM RC dongle (recommended).

NOTE: This procedure may vary based on the profile settings of the Spektrum transmitter. Refer to the Spektrum documentation for managing/setting up user profiles.

1. Obtain the AeroSIM RC dongle and software from http://www.aerosimrc.com/en/home.htm
2. Connect the AeroSIM RC USB to the host that will run QGC.

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3. Connect the other end of the USB cable into the trainer port of the Spektrum transmitter.
4. Start QGC.
5. Connect to the UAV based on the configuration done in Start QGroundControl.
6. Navigate to File > Settings > Controllers.

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7. Select the box next to **Enable controllers**.
8. Select AeroSIM RC v2.
9. Select Manual.

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10. Set the axes/channel mapping to:

    0 > Throttle

    1 > Roll

    2 > --

    3 > Yaw

    4 > Pitch

    5 > --
11. Check **Inverted** for the Roll axis.
12. Check **Inverted** for the Yaw axis.
13. Check **Inverted** for the Pitch axis.

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14. Click **Calibrate range**.
15. Move the right joystick through its full range of motion (in a complete circle).
16. Move the left joystick through its full range of motion (in a complete circle).

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17. Click, **End calibration**.

18. Click **OK**.

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Click **Connect**, located at the upper right-hand corner to connect the flight stack.
a. Select the px4-eagle profile created during the "Add New Communication Link".
The following errors appear when connecting to Snapdragon Flight. These errors are normal.
b. Click **OK** for all.

The error message in Figure 20 might appear when Snapdragon Flight is connected. Click **OK**.

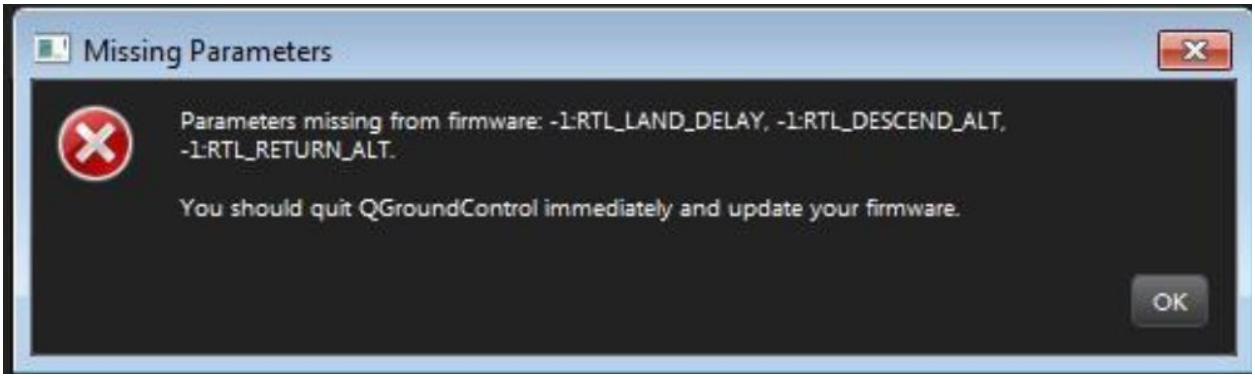

Figure 20 - Error message

After the error messages close, the display appears as in Figure 21. Click **Analyze**.

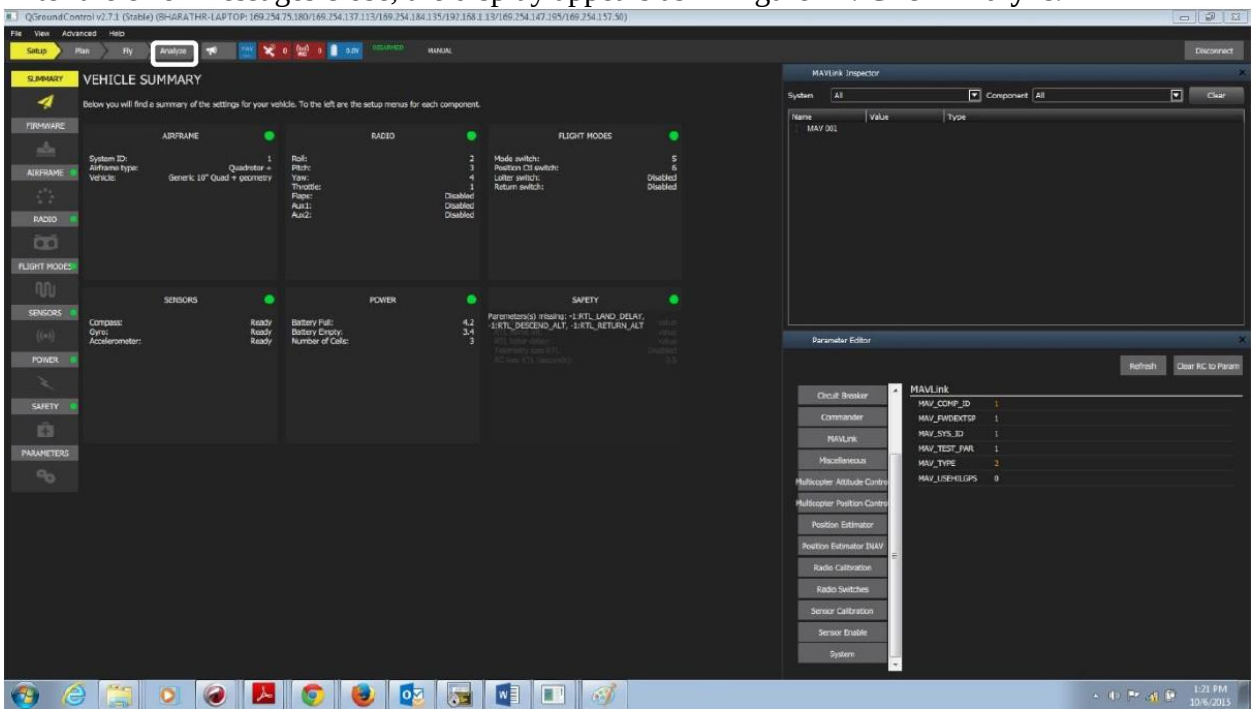

Figure 21 - Snapdragon Flight connection (1 of 2)

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Figure 22 - displays a final snapshot after connection to the Snapdragon Flight.

To arm the system, placing the throttle stick on the lower right position will arm the drone and allow ESC to drive the motors. This is done while keeping the stick in the lower right position and maintaining it for approximately 2 seconds.
To disarm the drone and disable the ESC to drive the motors, maintain the throttle stick in the lower left position for about 2 seconds. Motors should stop.

5.4 Starting the PX4 Flight Stack and using an Android device

Start the PX4 flight stack by following instructions in 5.2

To start streaming video, run the following command:
sudo qcamvid –t 600

From an Android tablet running the drone controller APK, connect to the Snapdragon flight.
Go to Settings->Background and ensure that FPV Stream is selected. Back out of the app and re-enter. The DroneController application should be streaming video.

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6. ADVANCED CONFIGURATION AND TROUBLESHOOTING

See PX4_User_Guide_for_Qualcomm_Snapdragon_Flight.pdf for more details on PX4, QGroundControl and other configurations.

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