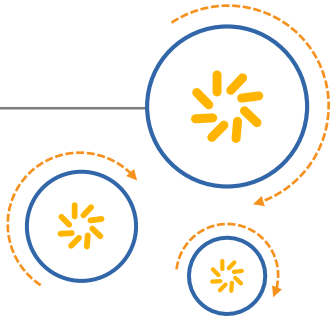
Qualcomm Technologies, Inc.



Qualcomm® Snapdragon Flight™ Reference Platform

User Guide

80-H9631-1 Rev. F

January 28, 2016

Qualcomm Technologies, Inc.
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Revision history

Revision	Date	Description
A	July 2015	Initial release
B	August 2015	▪ Updated Sections 1, 2, and Section 7.1 to include reference to Spektrum transmitter/receiver. ▪ Updated Chapter 4 with new assembly diagram. ▪ Updated Section 5.2 with new IMU calibration procedure. ▪ Removed Appendix A (PX4 Guide and moved it to release notes).
C	October 2015	Update title and content to refer to Snapdragon Flight
D	November 2015	▪ Updated Section 6.2.1.1 Wi-Fi Control section ▪ Updated Section 5.1 ESC Calibration ▪ Replaced the use of DroneController application (not yet supported) with QGroundControl application for Wi-Fi control.
E	December 2015	Added Sections 6.2.1.3 and 6.2.1.4 on Drone Controller Application
F	January 2016	▪ Updated Section 6.2.1.4 Run DroneController application ▪ Updated Section 5.1 Electronic speed control calibration ▪ Cleaned up content in several sections

Contents

Figures

Tables

1 Introduction

This user guide describes a possible flight system using the Qualcomm® Snapdragon Flight™ board.

See *Qualcomm Snapdragon Flight User Guide (*80-H9581-1) for additional information on the setup and features of the Snapdragon Flight platform and *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2) for information on enabling the PX4 flight stack.

1.1 Software image

To obtain software image and build procedures, see the release notes for the Snapdragon Flight platform image. For information on obtaining the PX4 flight stack, see *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2).

1.2 References

Table 1-1 provides a list of references used in this document.

Table 1-1 References

Document	DCN or URL
Qualcomm Technologies, Inc. (QTI)	
Qualcomm Snapdragon Flight User Guide	80-H9581-1
PX4 User Guide for Qualcomm Snapdragon Flight	80-H9631-2
Resources	
3DR IRIS – Calibrating the Accelerometer	https://www.youtube.com/watch?v=8TWjZLlATIE
FlyCam NaviBoard v1.2 – Calibrating the magnetometer (compass)	https://www.youtube.com/watch?v=4Q0424lNyoo
AR6210 Manual	http://www.spektrumrc.com/ProdInfo/Files/SPMAR6210_Manual.pdf
DX6i Instruction Manual	http://www.spektrumrc.com/ProdInfo/Files/DX6i-Manual_EN.pdf

2 Components

The Snapdragon Flight kit contains:

- Snapdragon Flight board with the following integrated components:
  - Optic Flow camera (installed)
    - Omnivision OV7251 on Sunny Module MD102A-200
  - 4K high-resolution camera (installed)
    - Sony IMX135 on Liteon Module 12P1BAD11
    - Invensense MPU-9250 9-Axis Sensor, 3x3mm QFN
      - SPI via aDSP BLSP1
    - Bosch BMP280 barometric pressure sensor
      - I2C via aDSP BLSP2
- APM board
- Console adapter board
- USB FTDI cable
- Power supply and cables

3 Setup and Operation

3.1 Orientation

Figure 3-1 shows a sample flight platform using the Microheli 200QX.

The frame was modified to move the battery mount plate from the underbelly to the top of the airframe. The Snapdragon Flight is mounted on the underside with the camera sensor facing towards the nose of the platform.

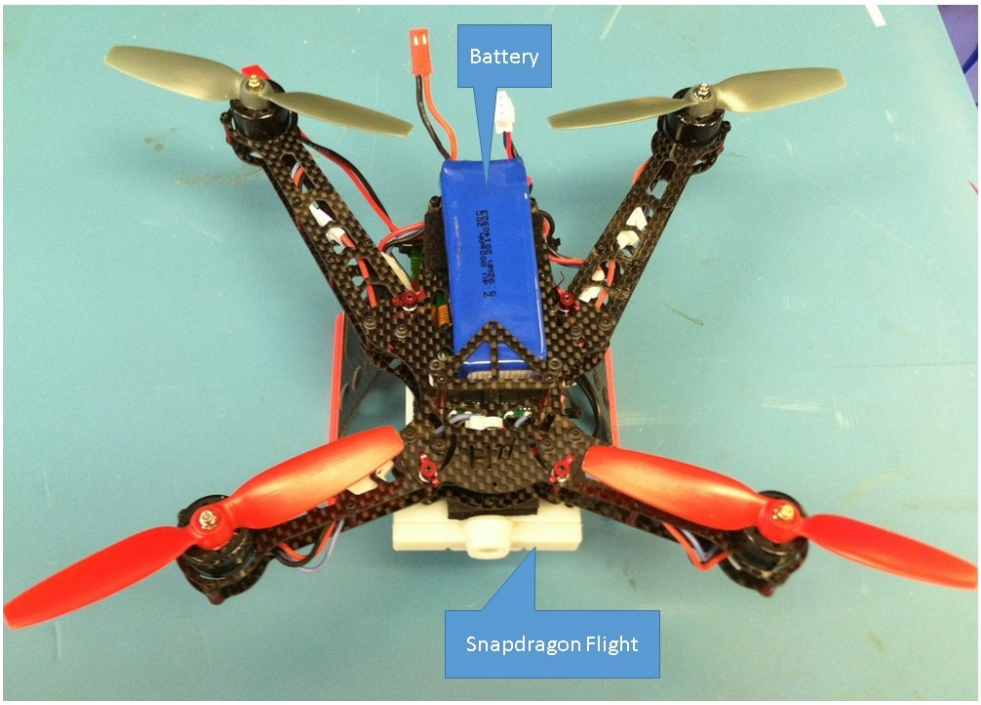


Figure 3-1 Microheli 200QX with under-mounted Snapdragon Flight

Figure 3-2 shows another perspective of the Microheli 200QX with the mounting location of the Wi-Fi antenna.

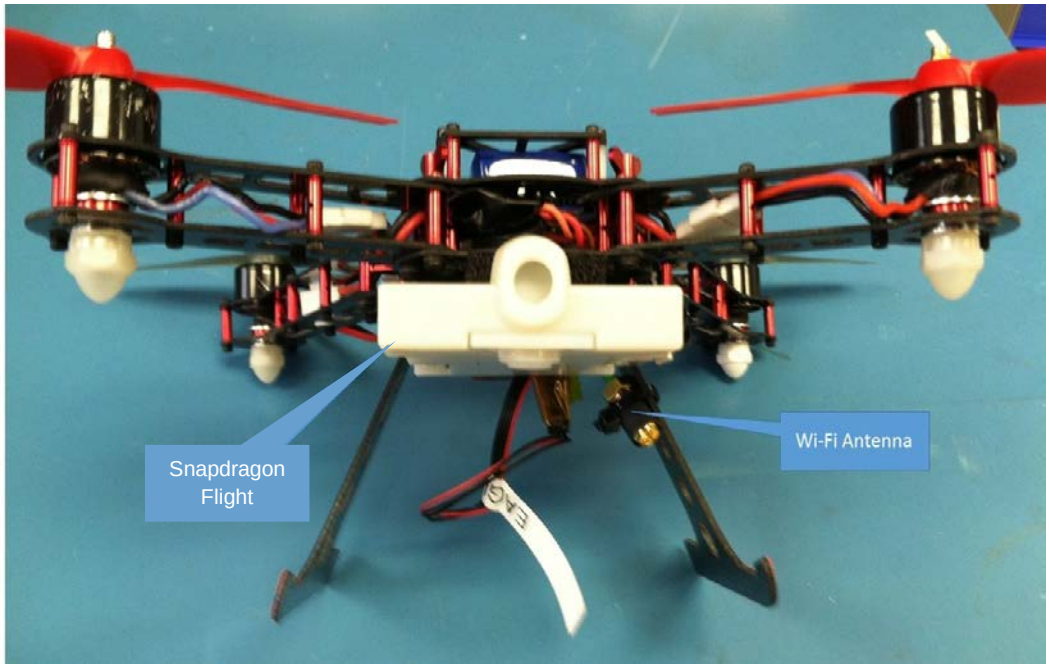


Figure 3-2 Microheli 200QX showing under-mounted Snapdragon Flight and connection for Wi-Fi antenna

Figure 3-3 shows a sample flight reference system with the Snapdragon Flight top-mounted airframe.

NOTE: To make use of the Optic Flow sensor Snapdragon Flight should be mounted to the bottom of the frame.

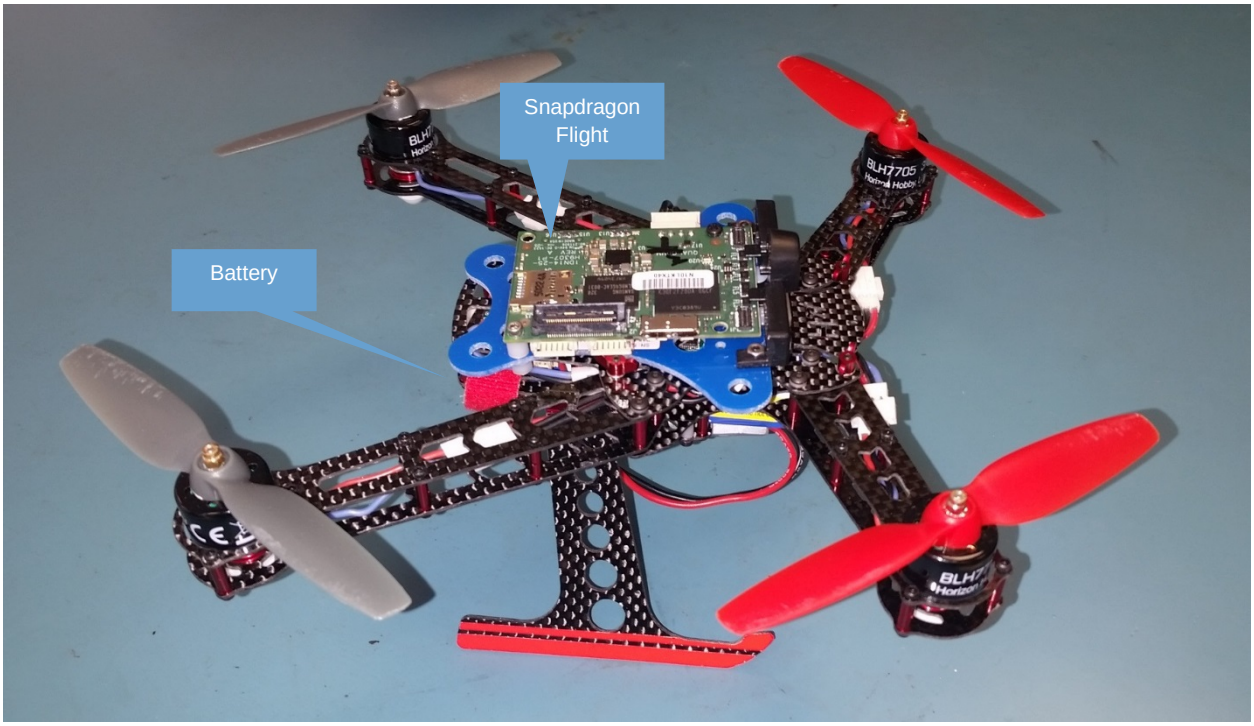


Figure 3-3 Microheli 200QX showing top-mounted Snapdragon Flight

4 Assembly

Motors, propellers, and battery were installed to complete the assembly.

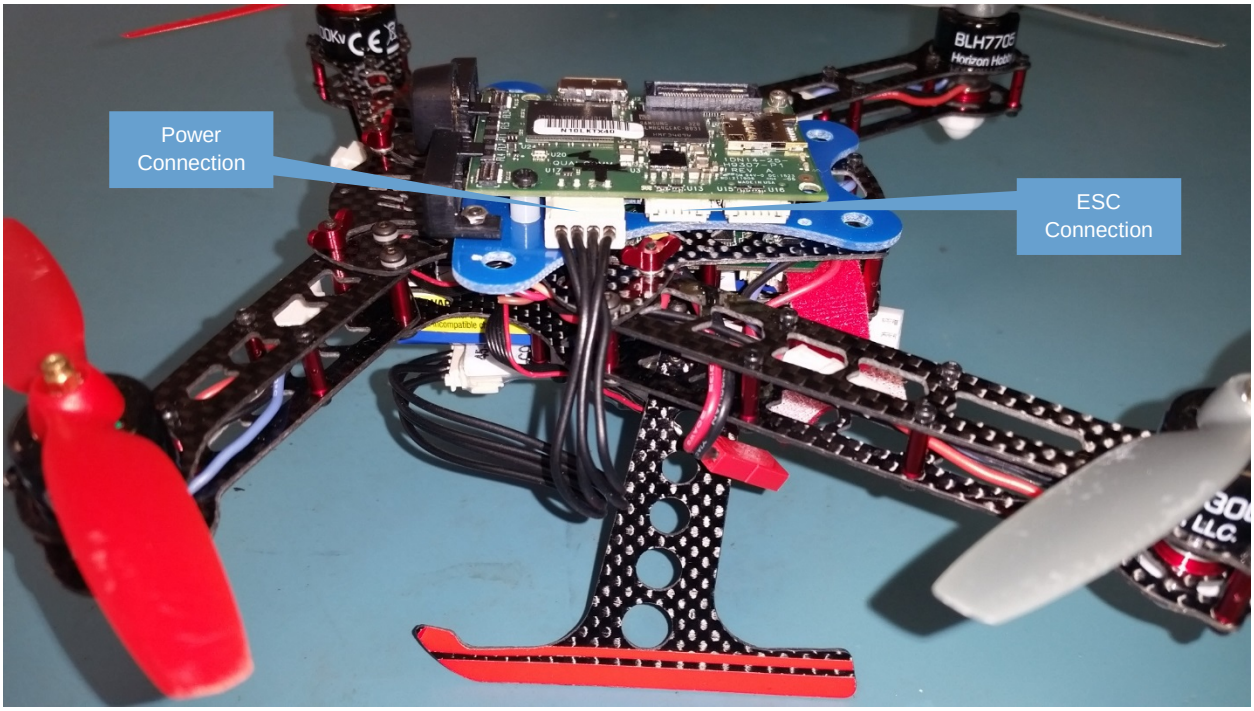


Figure 4-1 Snapdragon Flight board connections for power and ESC

4.1 Connecting Spektrum receiver and APM

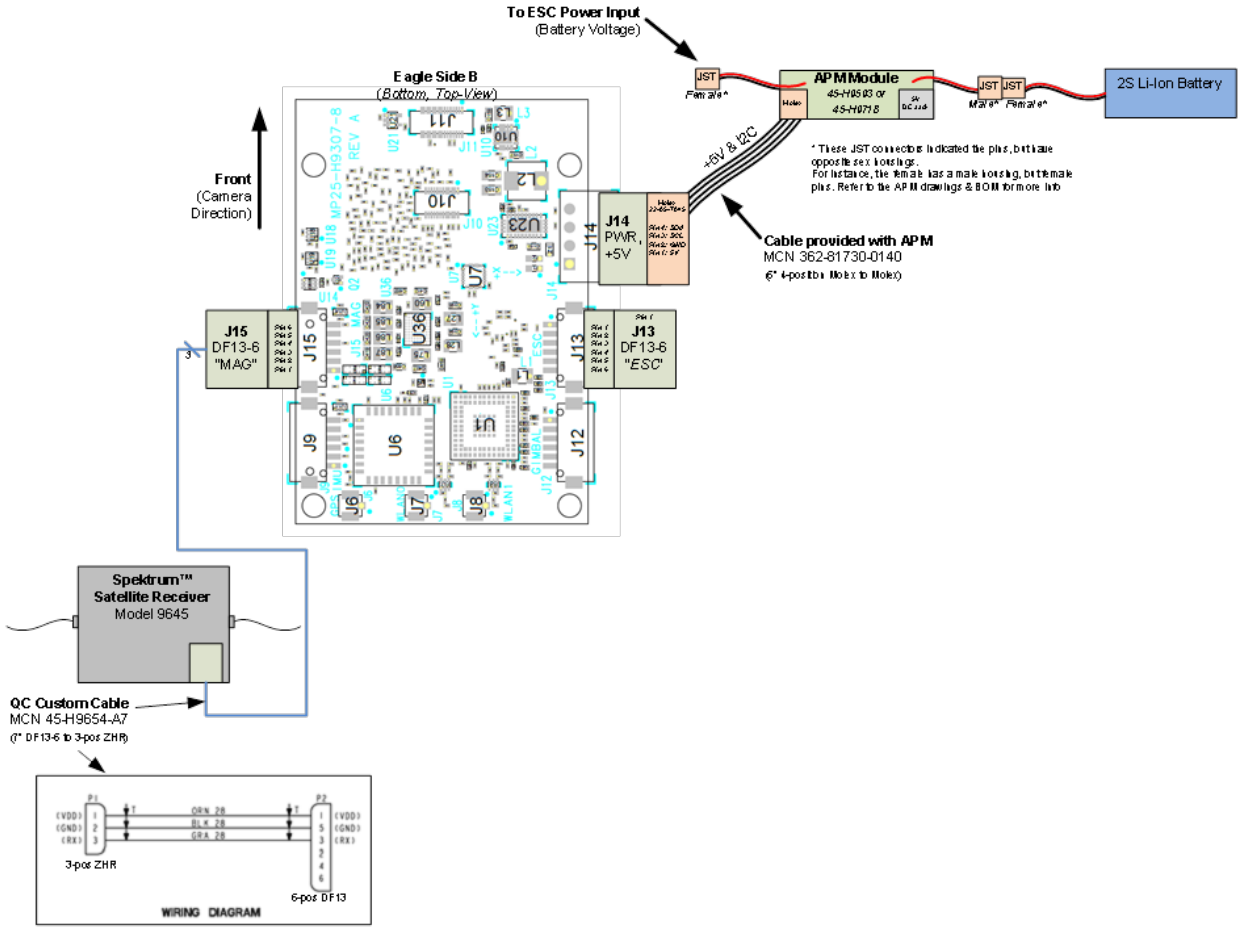


Figure 4-2 Wiring schematic for connecting Spektrum receiver and APM

5 Calibration

5.1 Electronic speed control calibration

The ESCs were precalibrated for the following motors and propellers:

Motor	Propeller	Comment
T-Motor 1804	GemFan 5030 (5 inch)	Total takeoff weight less than 285 grams
200QX	200QX props (4 inch)	Total takeoff weight less than 230 grams

5.1.1.1 ESC model number variable setting

Two ESC *models* are currently supported matching vehicle size: 200 mm and 350 mm. Models are defined in the PX4 flight controller addon source code *uart_esc.h* as enumerated types. The models are implemented in *uart_esc_main.cpp* driver source code. To change the type, reinitialize the *model* variable to your chosen ESC in the *task_main* function. The system default is set for the 200 QX.

5.1.1.2 ESC baud rate

- 200 mm baud rate: 250000
- 350 mm baud rate: 115200

  To change the baud rate, reinitialize the baud_rate variable to the associated ESC model value in the task_main function.

5.1.1.3 ESC motor map for PX4

To change the motor mapping for a specific ESC update *uart_esc_main.cpp* by modifying *uart_esc_rotate_motors* function in the ESC driver. Set the *motor_mapping array to the following:*

- 200 mm: motor_mapping[4]= {2, 4, 1, 3}
- 350 mm: motor_mapping[4]= {4, 2, 1, 3}

5.1.1.4 ESC parameters

Support for updating ESC models by modifying parameters will be made available in an upcoming release.

5.2 Inertial measurement unit (IMU) calibration

5.2.1 Update the sensor board rotation parameter

Prior to performing the IMU calibration or flight procedure, the SENS_BOARD_ROT parameter in the PX4 flight software needs to be updated, based on the relative orientations of the Snapdragon Flight hardware platform, the IMU, and the airframe (set to 0 by default for this reference design). For more details, see the appropriate section in *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2) and/or https://pixhawk.org/sensor_orientation.

5.2.2 IMU calibration procedure

For the inertial measurement unit (IMU) sensor calibration procedure, refer to *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2).

5.3 Proportional integral derivative configuration

After running the IMU calibration, additional attitude control parameters are determined and included for a specific platform. Refer to *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2) for details.

6 Flight Control

Flight control commands are transmitted over a Wi-Fi communication link.

6.1 Spektrum transmission over Wi-Fi

A Spektrum transmitter can send control commands over Wi-Fi.

6.2 Wi-Fi control setup

The Wi-Fi communication link can transmit commands to the unmanned aerial vehicle (UAV). This section documents the control of the UAV with a soft joystick application.

A standard RC transmitter is connected to a windows laptop computer running the QGroundControl application. The RC transmitter relays commands to the QGroundControl application, which are then transmitted to the UAV over Wi-Fi.

For information on installation of antennas, see *Qualcomm Snapdragon Flight User Guide (*80-H9581-1).

6.2.1 Set up the UAV

6.2.1.1 Enable Wi-Fi control

By default, the system should come up in SoftAP mode. If the default is not set, this configuration can be enable with the following steps:

1. Enable AP mode and reboot (see *Qualcomm Snapdragon Flight User Guide (*80-H9581-1) for additional information).
2. The AP mode defaults with automatic channel selection (ACS), which selects a 2.4 GHz channel with the least interference. If this is not the desired provisioning, this can be configured manually. Scan for other APs in the vicinity and configure SoftAP with a channel unlikely to suffer from interference with other devices. See *Qualcomm Snapdragon Flight User Guide (*80-H9581-1) for additional information.
3. Once SoftAP mode is enabled, run the following command (through adb or serial console to the UAV) to determine its server set identifier (SSID):

   ```
   /usr/local/qr-linux/wificonfig.sh –g
   ```

4. When the PX4 flight stack is installed, this should include provisioning for MavLink communication to allow commands to be received and used by the flight stack. See *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2) for additional details.

6.2.1.2 Setup QGroundControl application

The QGroundControl application running on a Wi-Fi-enabled Windows laptop computer needs to be set up per the instructions in *PX4 User Guide for Qualcomm Snapdragon Flight* (80-H9631-2).

6.2.1.3 Install DroneController application

NOTE: The following is set up on an Android 4.4.4 (KitKat) or later device.

1. Obtain the DroneController APK file to install on the Android device.
2. Connect a USB cable between the device and a host machine to install DroneController.

   This sets up a device ID for Android to facilitate ADB communication.
3. Check that the device is available. From the command line of the host machine, run:

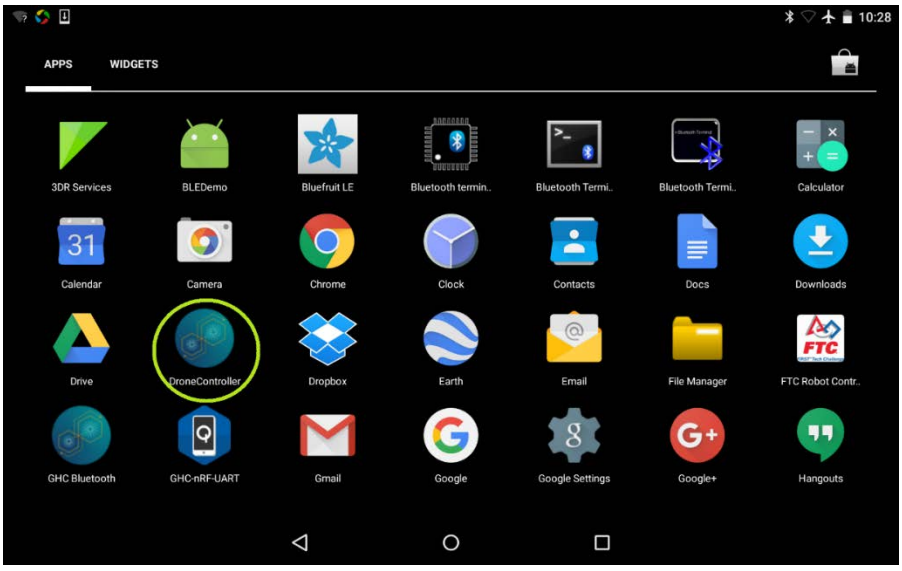
   adb devices
4. From a host machine, navigate to DroneController APK and install the application:

   adb install app-debug.apk
5. Enable Wi-Fi and connect to the UAV board's SSID.

6.2.1.4 Run DroneController application

NOTE: DroneController is an engineering test application used to demonstrate Wi-Fi command control. If the application is closed or sent to the background during flight, the UAV recognizes that communication has been lost, and disarms. This may cause the UAV to stop its motors during flight, lose altitude, and drop.

1. On the Android device, go to the application launch screen and open the DroneController application.

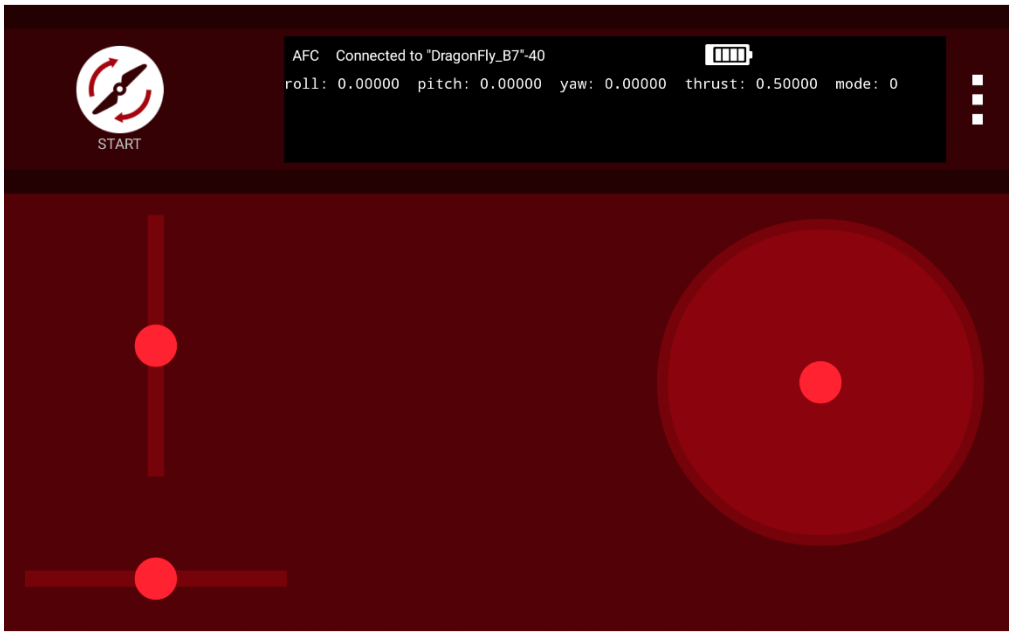


NOTE: This version of the application supports only assisted manual flight mode.

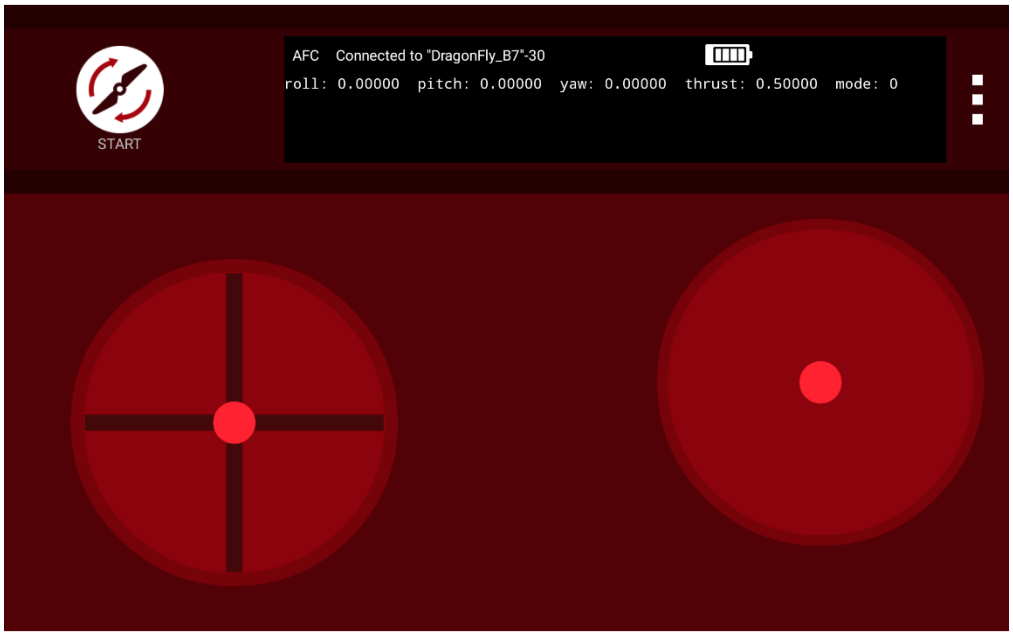
There are several different options for the type of joysticks available.

- Sliders: Two separate sliding joystick controls.
- CrossStick: Two sliding joystick controls mounted on lines in the shape of a cross.
- Full Joystick: The left joystick matches the right joystick.

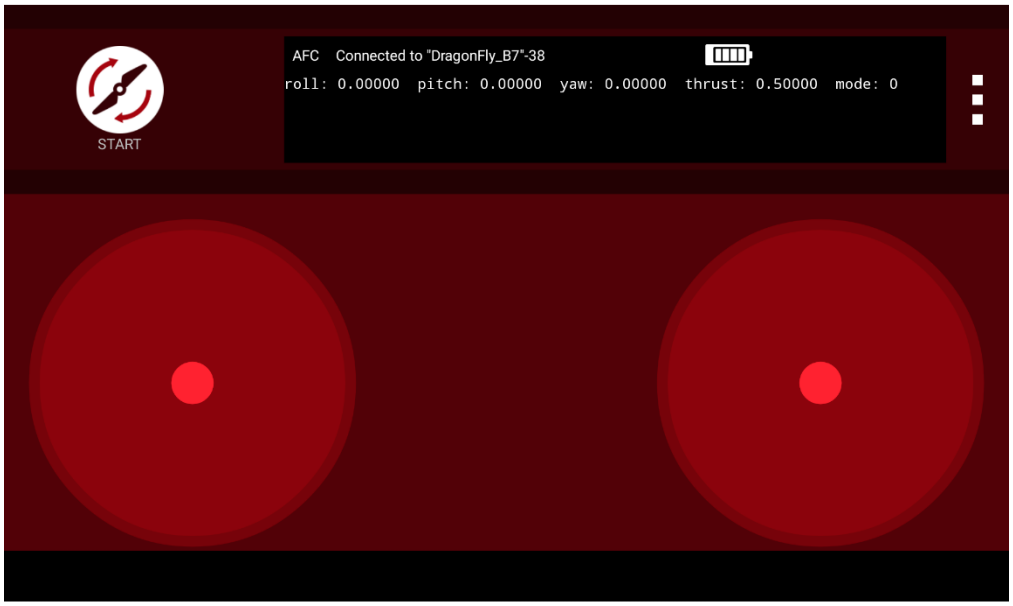
Sliders



CrossStick

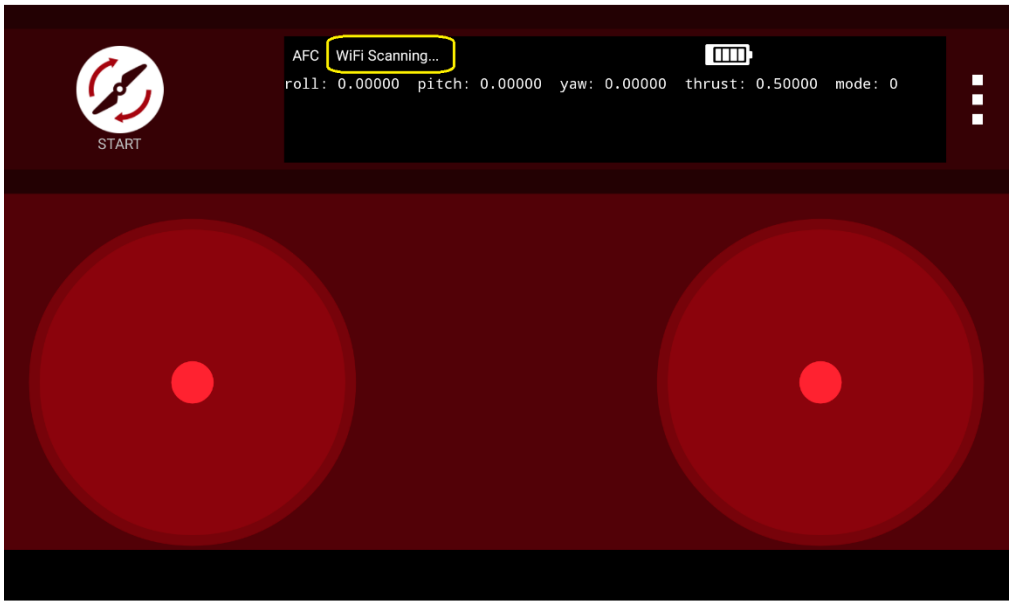


Full joystick



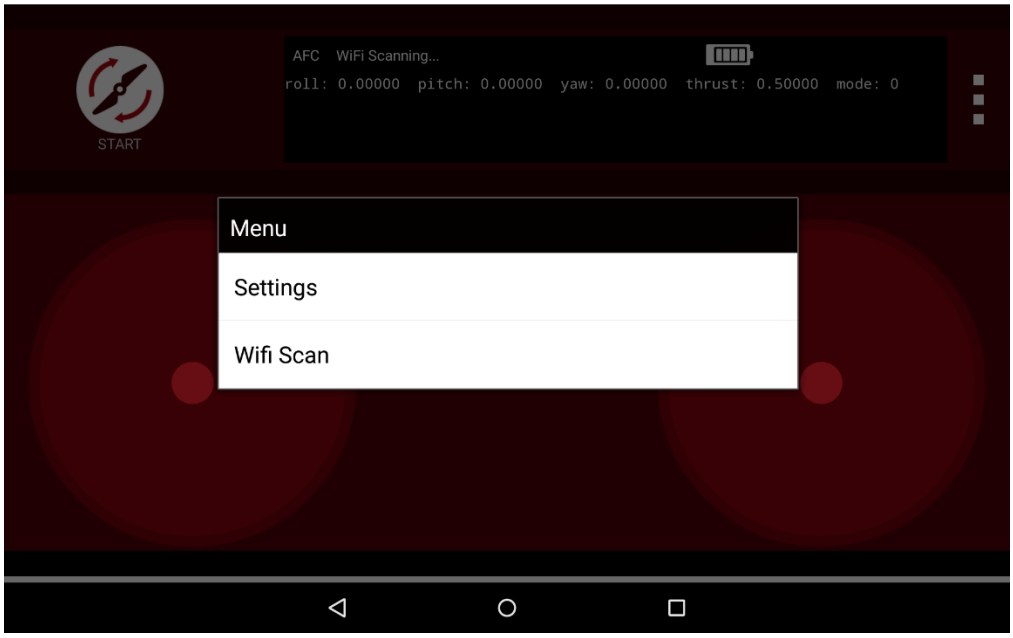
2. After DroneController launches, the initial screen prompts *Waiting for SSID*. The message then changes to *Wi-Fi Scanning*.

   This message remains until the application connects successfully to the UAV application.

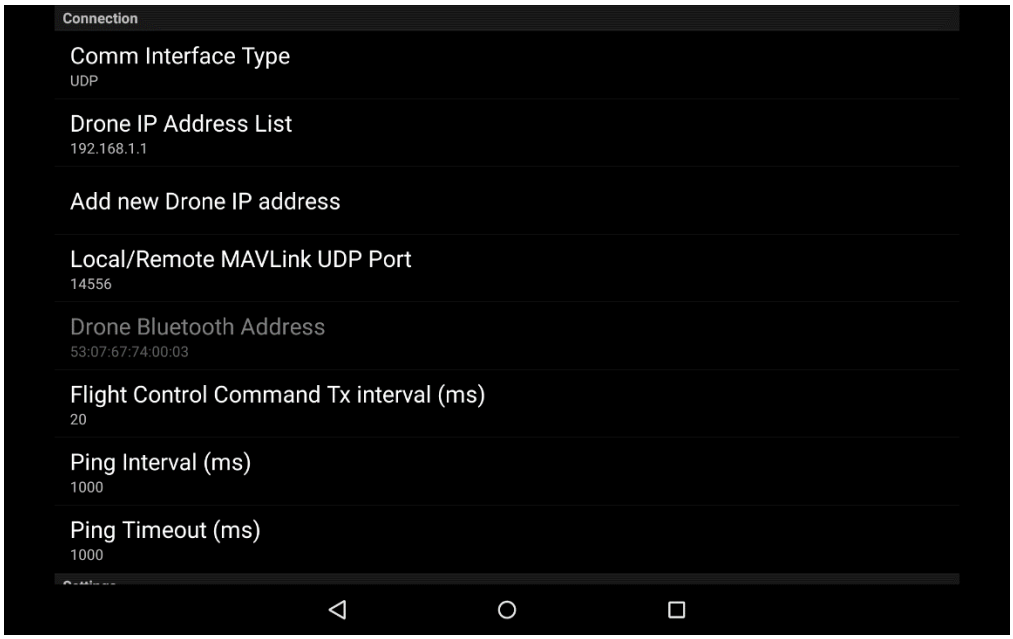


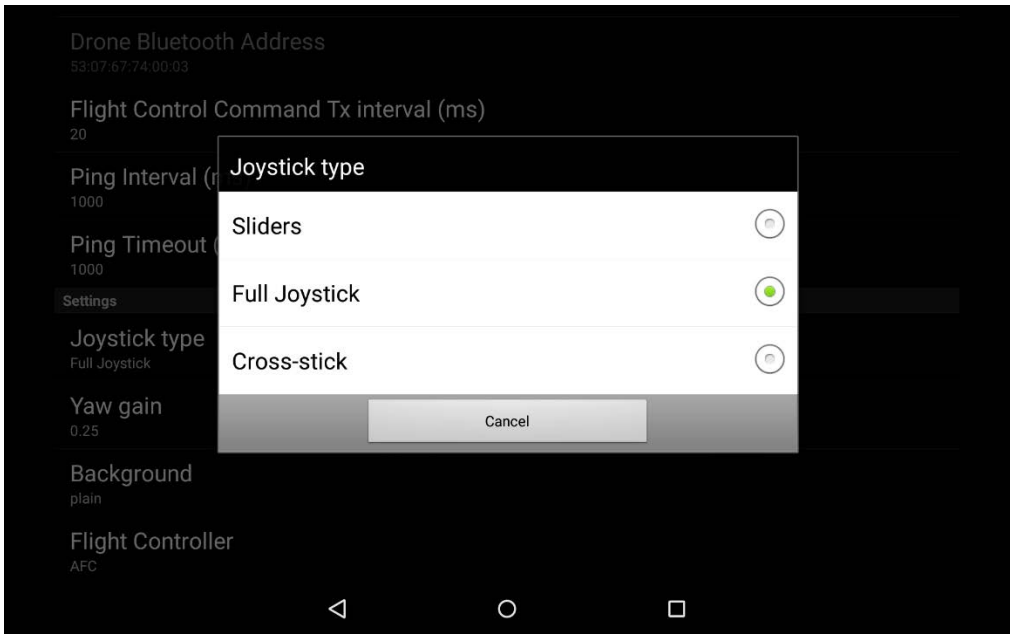
3. When communication is established between DroneController and the UAV, the status message changes to Connected to <name of drone AP> - <rssi>. Note that if the drone is in Station mode, the name of the Wi-Fi that both the drone and the tablet are connected to is displayed. In the following screenshot, the drone is in AP mode and is advertising a Wi-Fi network named DragonFly_B7. If the drone is in Station mode, go to the Settings and input the IP address of the drone.

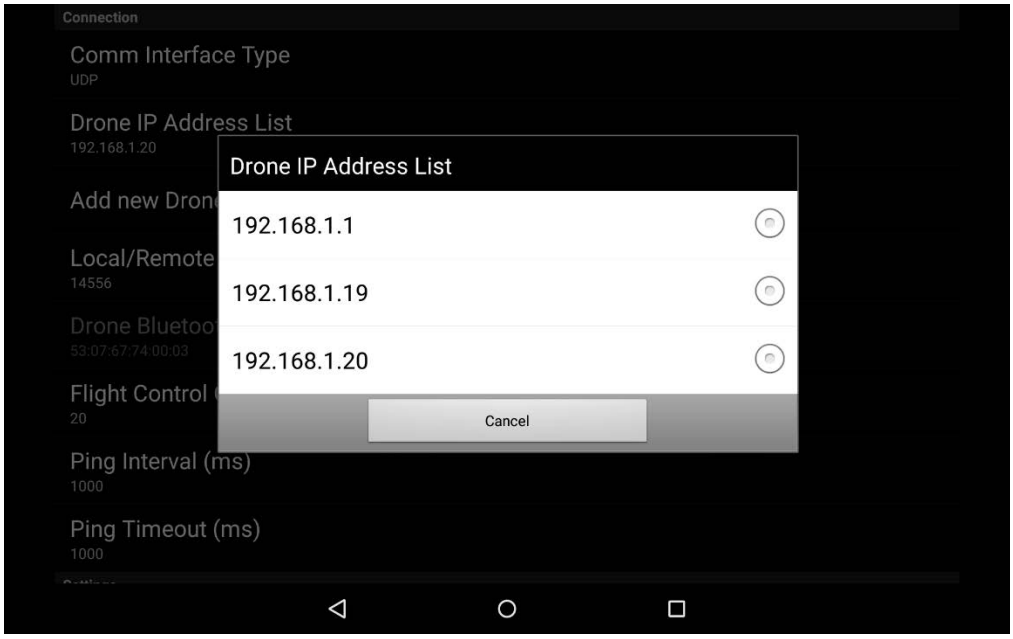
4. To change the joystick type, the yaw gain, or any other settings, click the three buttons in the upper right-hand corner of the app, then click **Settings**.



5. All of these settings are editable by the user. Scroll down to change the joystick type, flight controller, or other settings like the *Yaw Gain* value.





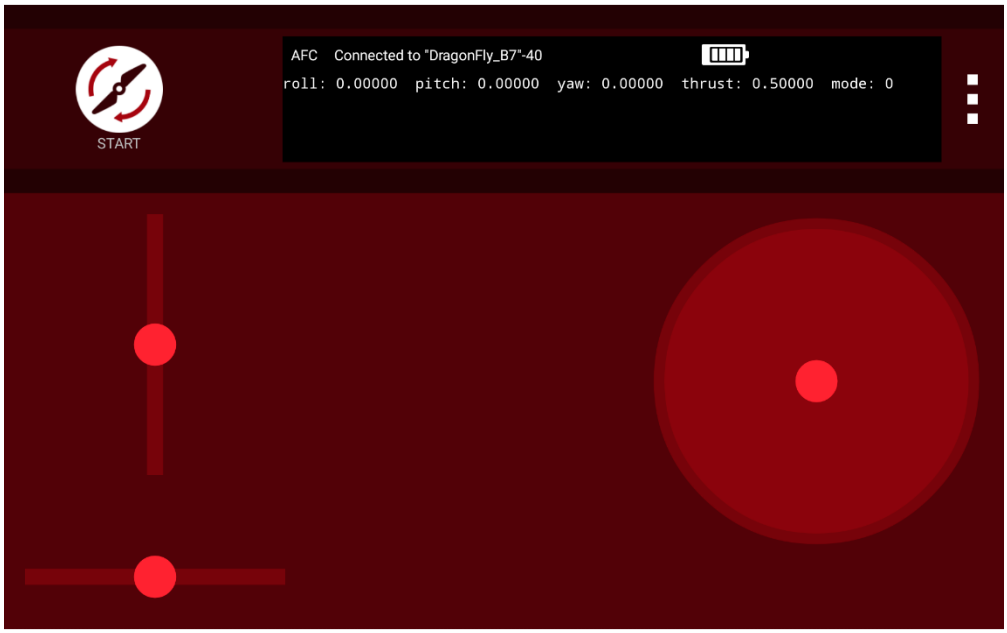


6. If the drone is running the Snapdragon Navigator flight software, change the flight controller to *AFC* and the appropriate buttons will appear. If the drone is running the PX4 flight software, change the flight controller to *PX4* and the appropriate buttons will appear. These options are located in the **Settings** menu.

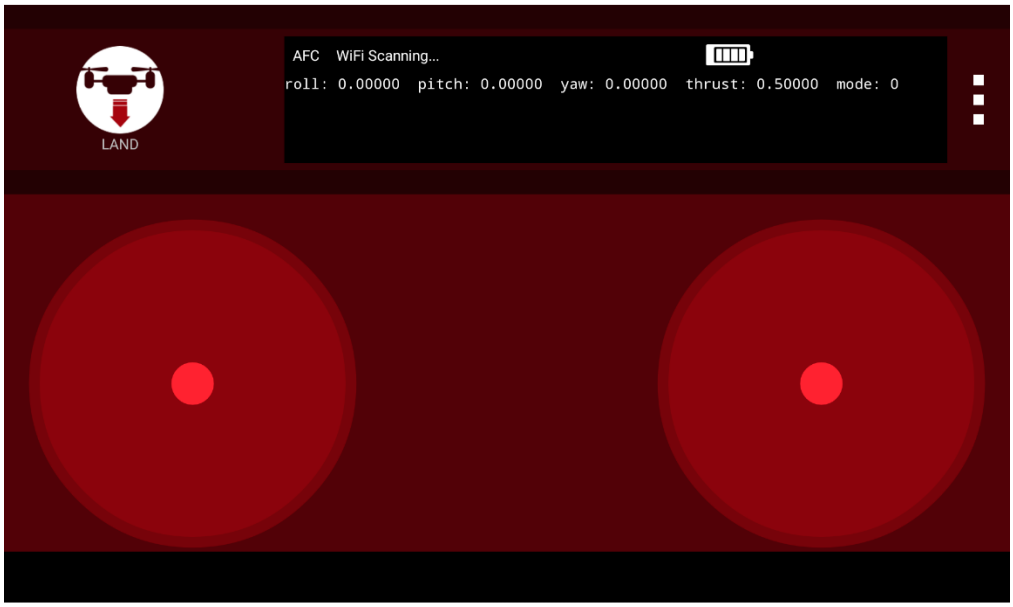
   To arm the UAV running Snapdragon Navigator, press **Arm Motors** (this button only works if using AFC) or manually move the joystick. Note that the type of joystick may need to be changed to successfully complete the arming maneuver. To manually arm a drone running Snapdragon Navigator, move the joystick to the lower left corner, then to the lower right corner, then back to the lower left corner. To manually arm a drone running PX4, hold the joystick in the lower right corner. *Yaw gain* must be set to *1f* for this maneuver to be successful.

No indication is provided on the application when the UAV is armed. Check the UAV to verify.

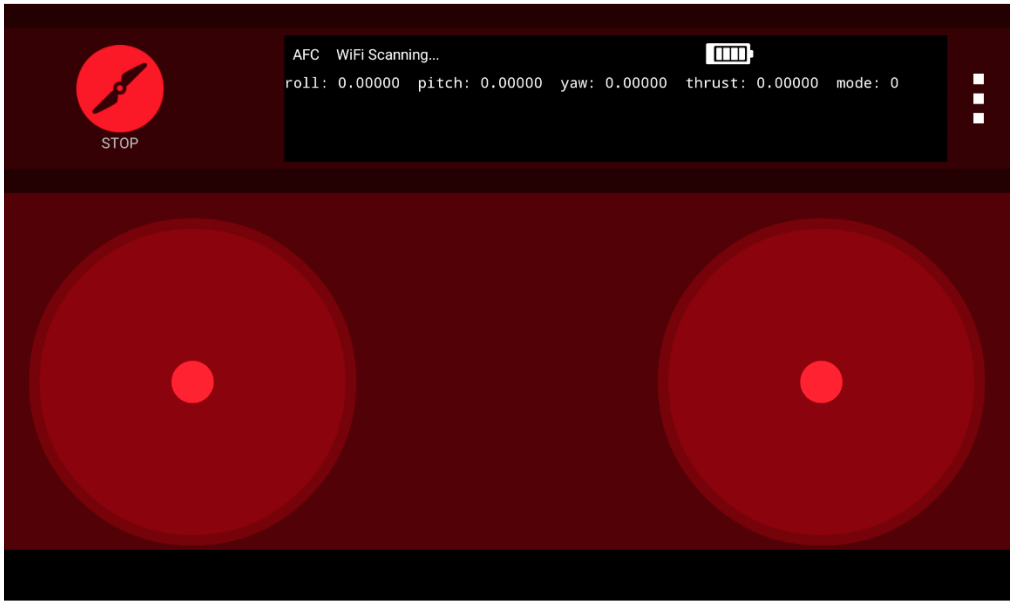
NOTE: The application provides virtual joysticks to control roll, pitch, yaw, and thrust. The left stick controls the thrust and yaw. The right stick controls the pitch and roll. Scaled means the normalized values for roll, pitch, yaw, and thrust.



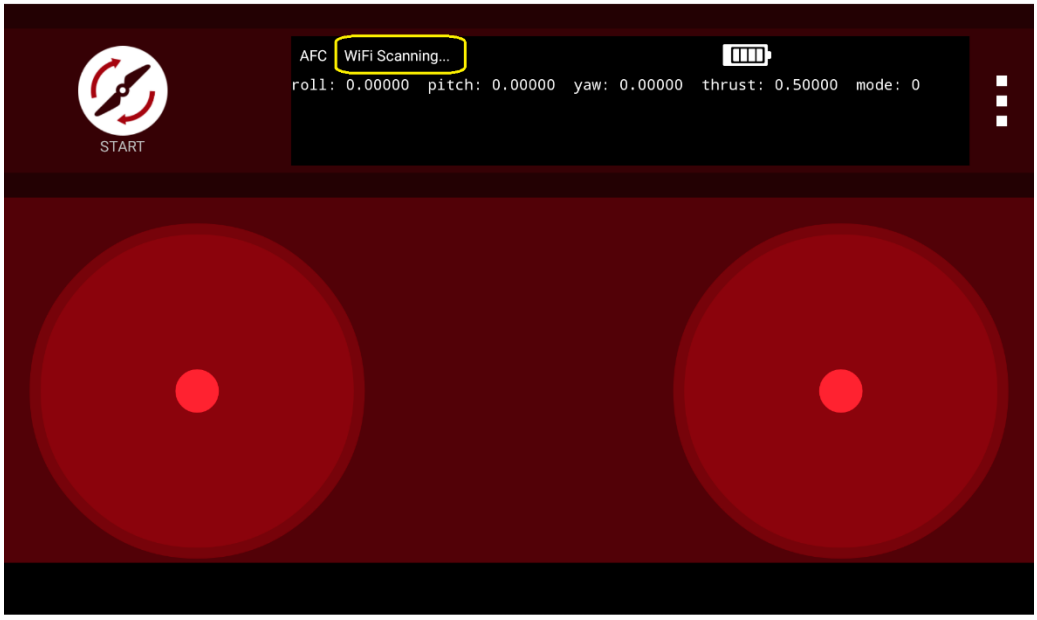
7. To land, tap **Land**. The **Land** button changes to display the **STOP** icon.



8. Once the UAV lands, tap **Stop**. The icon will change back to the **START** icon. There is no indication on the app about the state of the UAV. Check the UAV to confirm that it has landed. The props do not stop spinning until the app has closed.

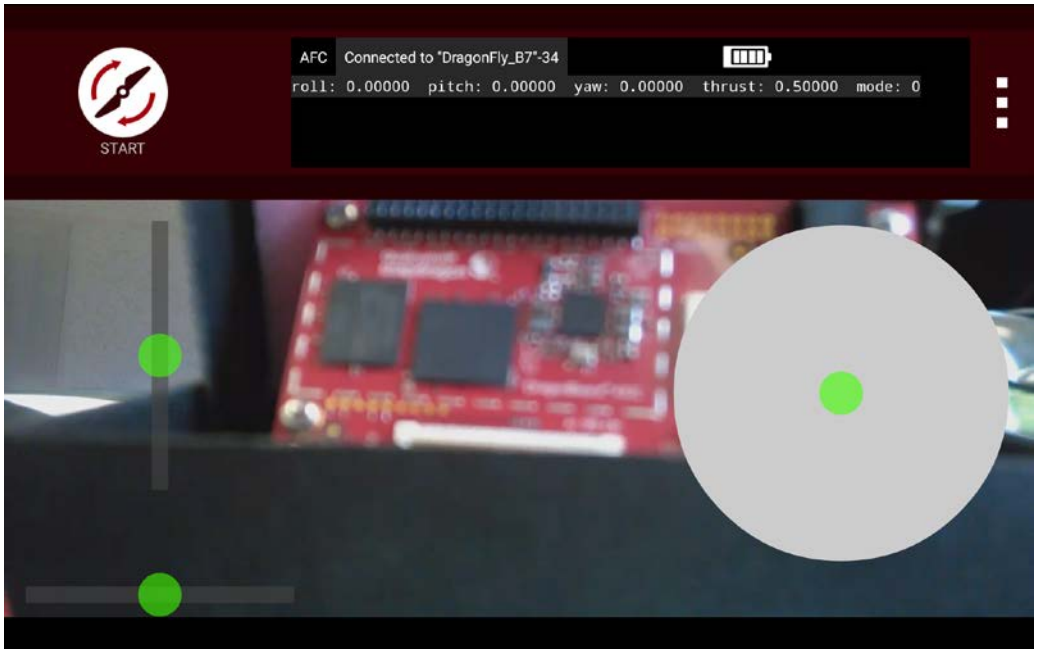


9. If command communication is lost between the DroneController and the UAV, the status messages change back to *Wifi Scanning.*



10. It also is possible to stream FPV from the drone. This feature currently is in alpha state.

NOTE: The FPV functionality has been confirmed to work on the Nexus 7.



7 RC Radio Transmitter

See the DX6i Instruction Manual (http://www.spektrumrc.com/ProdInfo/Files/DX6i-Manual_EN.pdf) for additional transmitter details.

7.1 Arm/disarm for flight

Once the system has powered up, the UAV can be armed for Flight mode using the transmitter.

7.1.1 Arm flight

To arm a flight, pull the throttle lever down to the lower right corner and hold it for 3 sec.

7.1.2 Disarm flight

To disarm a flight, pull the throttle lever down to the lower left corner and hold it for 3 sec.

7.2 Transmitter operation

7.2.1 Attitude control

Transmitter joysticks operate the UAV.

The left stick controls the throttle and yaw. The right stick controls the pitch and roll.

Set the left stick to center to maintain altitude.

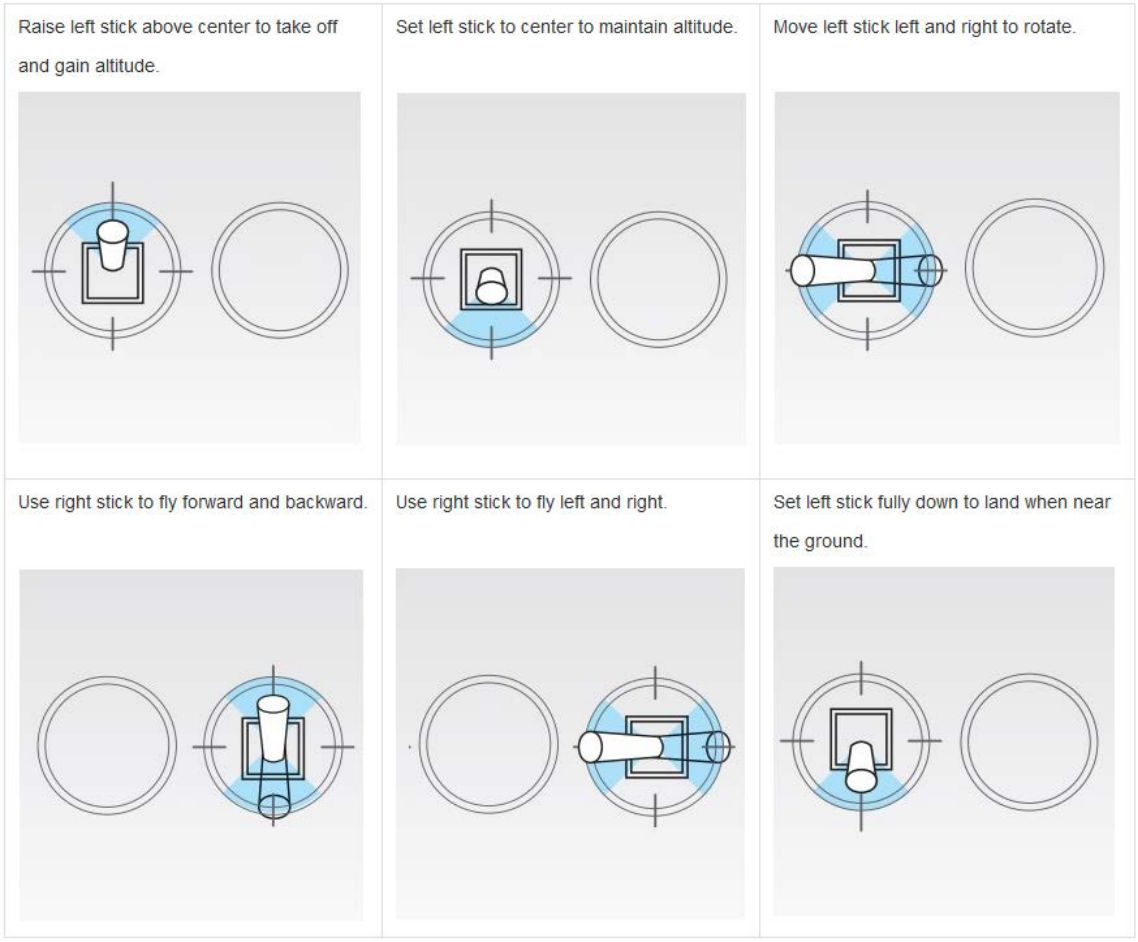


Figure 7-1 Left and right joystick controls

8 System Features

For details on system features such as First Person View and Video Recording, see *Qualcomm Snapdragon Flight User Guide (*80-H9581-1).