AntennaTracker

AntennaTracker Home

Tip

The ArduPilot Developer Ecosystem is Evolving! Find out more here …
The *AntennaTracker* Project delivers firmware which allows you to use a supported flight controller board (Pixhawk, APM2, etc.) as the controller for an Antenna Tracker.

The tracker calculates the position of a remote vehicle using its own GPS position and GPS telemetry from a vehicle running Copter, Rover or Plane. It then uses this information to aim a directional antenna at the vehicle.

Using a correctly aligned directional antenna *significantly improves* the range over which signals can be both sent and received from a ground station.

If your a developer wanting to work on AntennaTracker please join the ArduPilot gitter chat channel which can be found in the Community menu above.

If your a user looking for support on the AntennaTracker please go to the support forums which can be found under the Community menu above.

Below is Canberra UAV's tracker used during the 2014 OutBack Challenge.

This manual will guide you through setup and configuration process.

Choosing an Antenna

Your choice of directional antenna will most likely be based upon:

- size and weight limitations
- desired transmission distance
- radio frequency (the antenna should be designed for the radio's frequency)
- cost

Images courtesy of moonblink.com

Antenna dBi and transmission distance

Antennas with higher dBi values will be able to transmit further. A general rule of thumb (gathered from fpvlab.com and zytrax.com) is:

- increasing the antenna gain by 6dBi (i.e. from 2dBi to 8dBi) will double the range
- increasing the transmitter power by 4x (i.e. from 20mW to 80mW) will double the range

The standard 3DR radio comes with a 2dBi antenna.

Where to buy

Below are some retailers/antennas that users have reported success with:

- AirMax 900 16dBi Yagi antenna from ubiquitiwarehouse.com.au (Australia)
- L-Com 900Mhz 8dBi flat patch antenna from readymaderc.com (USA) (requires RP SMA female to SMA female adapter)

Frame Assembly

Any servo based Pan & Tilt gimbal should work. Ideally the system should allow 180 degrees of pan rotation in both directions and 90degrees of pitch both up and down.

The servos used can either be regular servos that translate the PWM input into an absolute angle or

continuous rotation servos.

Recommended Frames

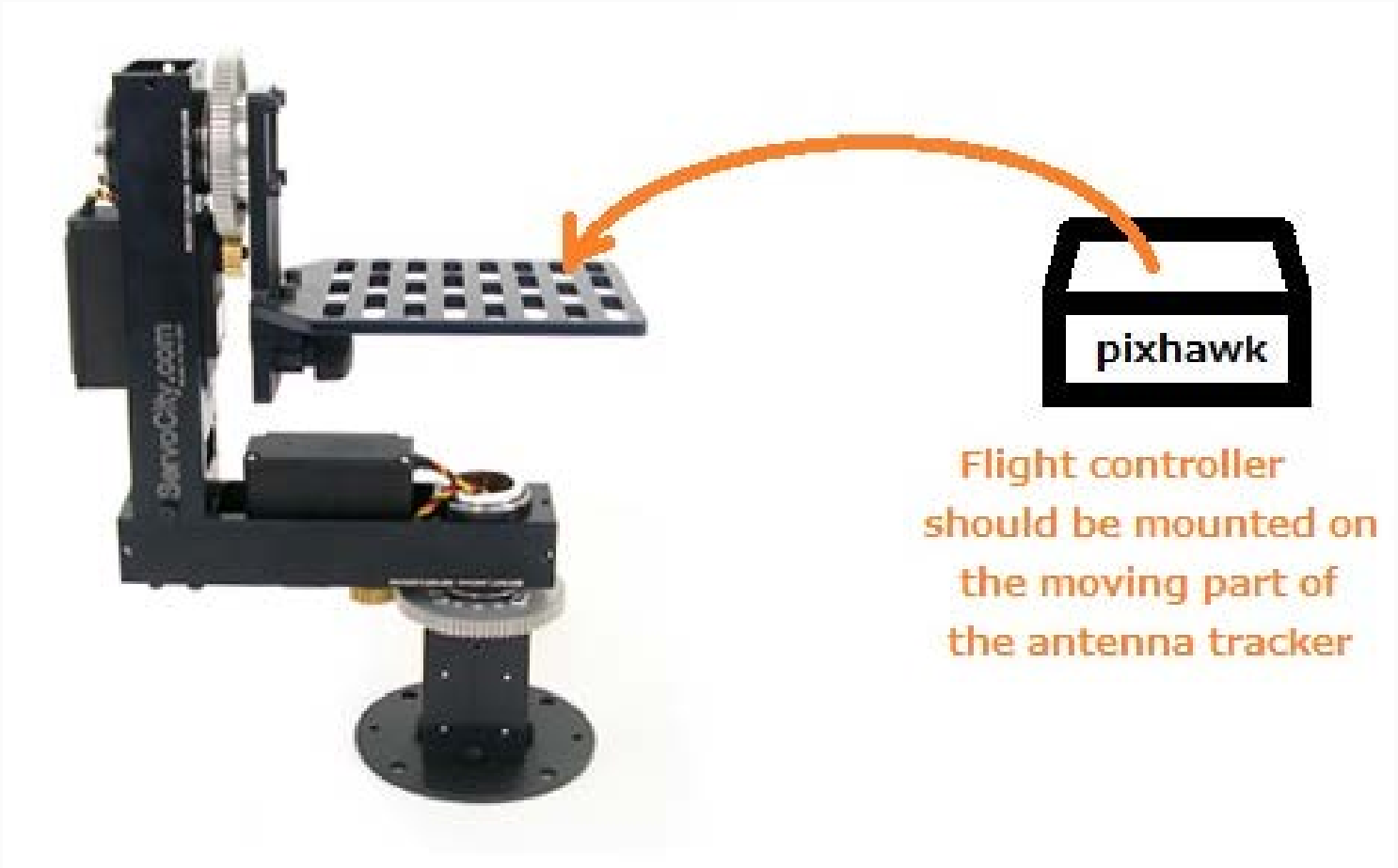
The following have been tested and shown to work:

- Eagle Eyes Antenna Tracker

These systems also likely work:

- Servo City PT785-S Pan & Tilt System

Mounting the flight controller board

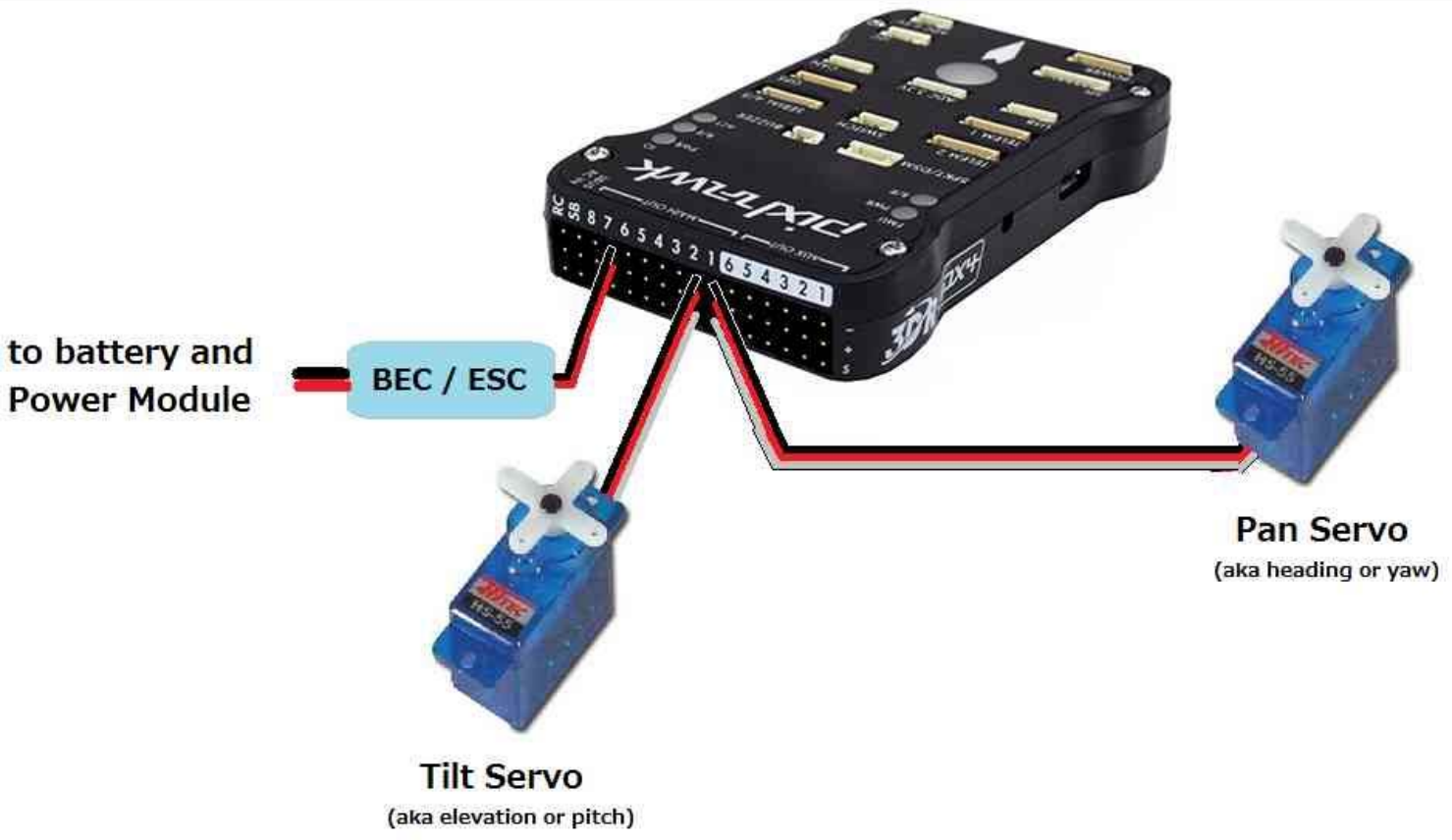


The flight controller board (i.e. Pixhawk, APM2, etc) should be mounted on the moving part of the antenna tracker.

If possible align the front of the flight controller so that it points exactly in the direction that the antenna is most sensitive. So for example, if using a Pixhawk controller and a Yagi antenna, the arrow on the top of the Pixhawk should point in the same direction as the antenna.

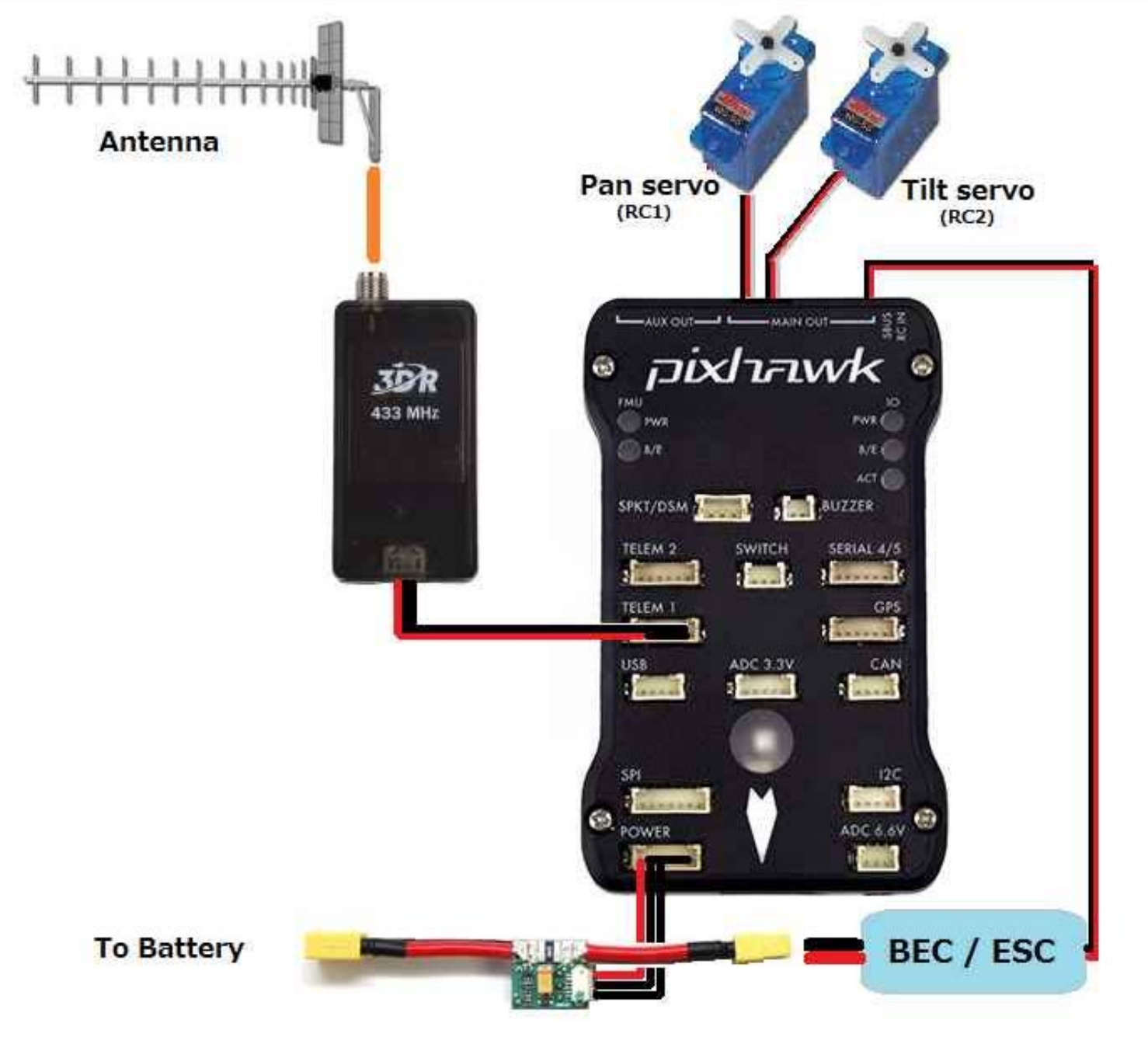
Alternatively the flight controller can be mounted at any 45deg or 90deg angle to the antenna and then the AHRS_ORIENTATION parameter can be changed to account for the difference. See the configuration page for more details.

Connecting the servos



The Pan servo (controls the tracker's heading or yaw) should be connected to RC1, the Tilt servo (controls elevation or pitch) should be connected to RC2. A BEC or ESC should be connected to any of the other RC outputs as shown to provide power for the servos.

Connecting the radio and antenna



The Antenna should be attached to the radio after first removing the radio's di-pole antenna. Note that the 3DR and RFD900 radios have a RP SMA Male adapter (RP = reverse polarity) while antennas can come with a number of different connectors meaning an adapter (such as this RP SMA Female to SMA Female adapter) may be required.

Mounting the GPS and external compass

If using a GPS+compass module it should be mounted so that the arrow on the module points in the same direction as the antenna. If this is not convenient, the COMPASS_ORIENT parameter can be used to account for this. See the configuration page for more details. Care should be taken to ensure the compass is not close to any metal objects.

If using a stand-alone GPS (i.e. not an integrated GPS+compass) the GPS should be positioned so that it's antenna has a clear view of the sky. It's heading is not important. Some care should be taken to ensure the cable connected to the flight controller cannot become tangled.

Loading the Firmware

The antenna tracker firmware can be loaded from the Mission Planner's **Initial Setup | Install Firmware** very much like Copter.

Use Mission Planner's Install Firmware screen to load the firmware

- Connect the flight control board to the computer using the mini USB cable
- Select the appropriate COM port on the top right of the screen but do not push the Connect button
- From the **Initial Setup | Install Firmware** page click on the "Antenna Tracker" icon on the bottom left. Follow any instructions that appear and after a minute or so the firmware should be uploaded and you should be able to connect with the mission planner and see the Flight Data screen's HUD update.

Note

Because the EEPROM format is different between the Antenna Tracker firmware and any flight controller software that was previously installed on the board (i.e. Copter or Plane) it is likely the EEPROM will have been erased by the firmware upload.
Note

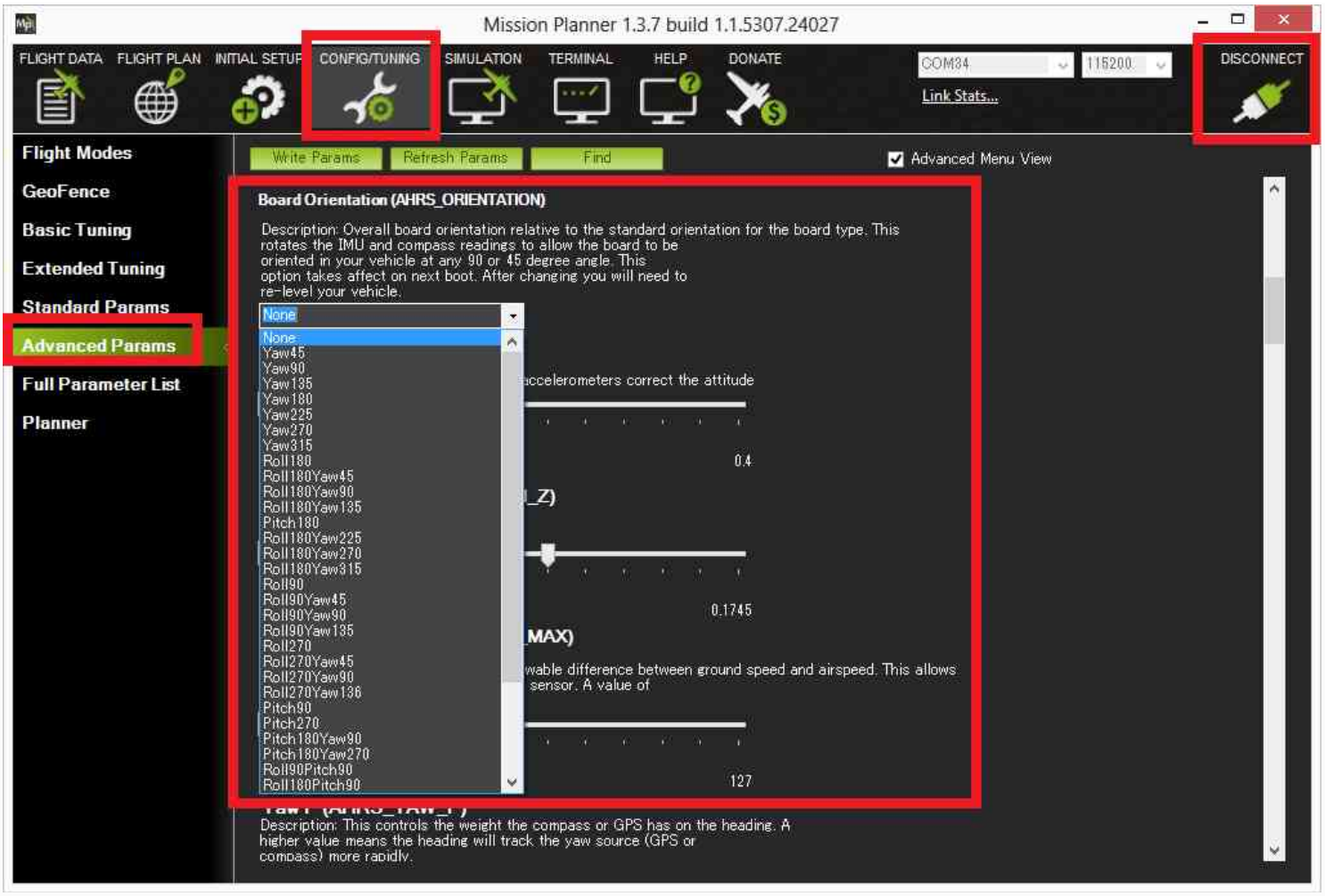
Firmware for other boards (APM1, Flymaple, etc) cannot be loaded directly from the mission planner but must be compiled and loaded onto the board more manually.

Configuration

The antenna tracker requires much of the same basic configuration as Copter and Plane and then some specific configuration specific to the antenna tracker. Below are the details of this set-up.

Setting the AHRS orientation

If the flight controller board could not be mounted so that it's forward direction aligned with the antenna (as mentioned on the Assembling a frame page) the AHRS_ORIENTATION parameter should be set from the Mission Planner's Config/Tuning >> Advanced Params screen.



Some commonly used values include:

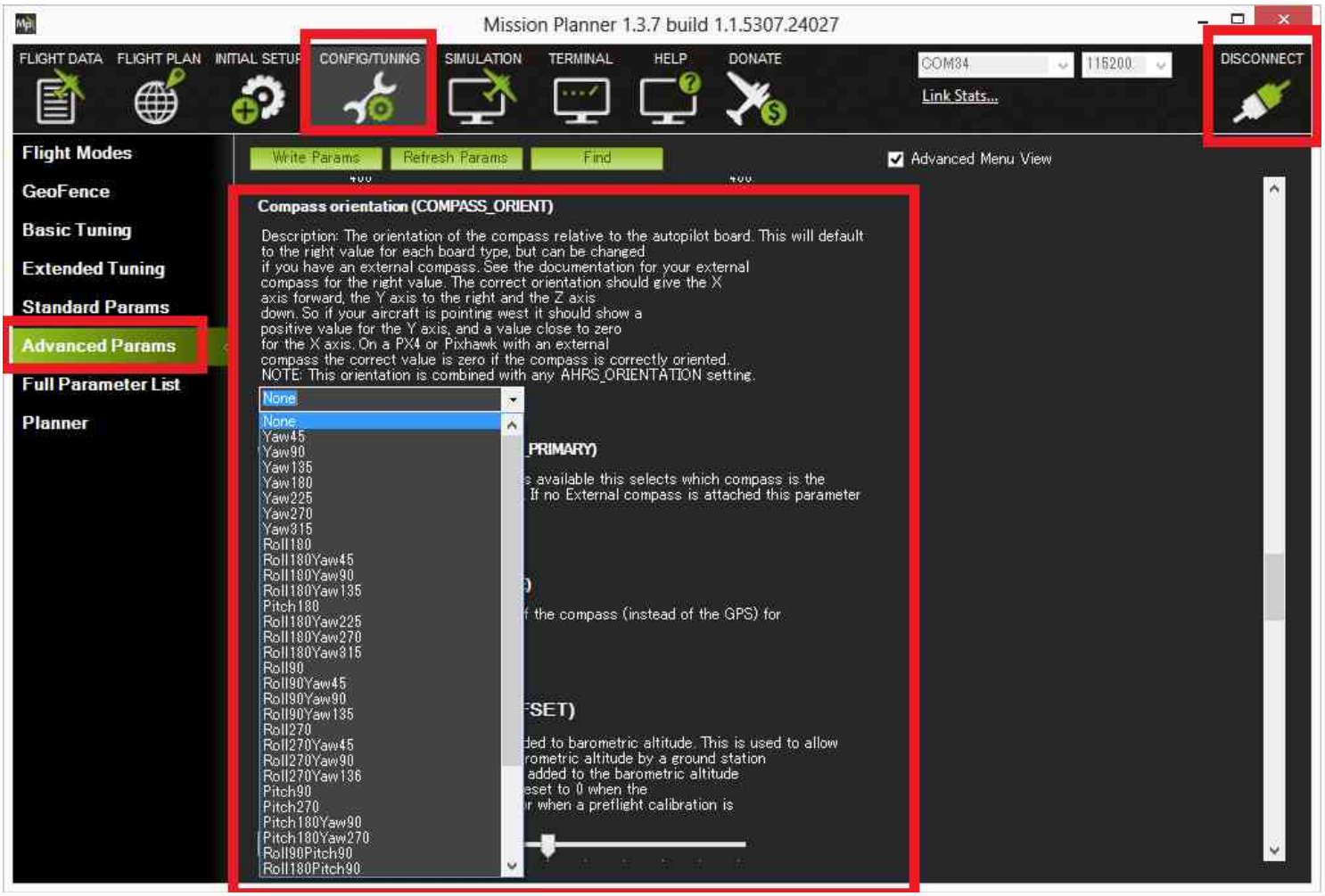
- Pitch90 : the flight controller is pointing up at 90 degrees compared to the direction of the antenna
- Pitch270 : the flight controller is pointing down at 90 degrees compared to the direction of the antenna

Accelerometer Calibration

The accelerometer calibration is the same as for Copter meaning the flight controller board should be connected to the Mission planner and then the **Initial Setup | Mandatory Hardware | Accel Calibration** routine should be run which involves holding the board in 6 separate orientations positions so that offsets and scaling can be calculated.

Setting the Compass orientation

If an external GPS+compass module is being used but the arrow on the case could not be aligned so as to point in the same direction as the antenna, the COMPASS_ORIENTATION parameter should be set.



Some more commonly used values include:

- Yaw 90 : the arrow on the compass module is pointing off to the right at a 90 degree angle clockwise from the direction the antenna is pointing.
- Yaw 270: the arrow is pointing to the left at 90degrees from the antenna. I.e. the arrow is rotated at 90deg counter-clockwise from where the antenna is pointed.

Compass Calibration

The compass calibration can be done using the same method as Copter. Open the Mission Planner's Initial Setup >> Mandatory Hardware >> Compass screen and push the "Live Calibration" button and rotate the board until the mission planner says it has captured enough points to correctly calculate the offsets.

Setting the servo and range of movement

For this section it is best to plug in the battery so that the servos are powered and push the "arming switch" if present. Connect with the Mission Planner, go to the CONFIG/TUNING >> Extended Tuning page.

Setting the Yaw servo's min and max pwm values

The green "Test" buttons on this screen work in conjunction with the Min, Max field values and the slider position. If the slider is pushed all the way to the left and the Test button is pushed, the pwm value in the "Min" field will be sent to the servo. If the slider is pushed all the way to the right and the Test button is pushed, the pwm value in the Max field will be sent to the servo.

If the Yaw (aka pan) servo's minimum and maximum pwm values are known, they can simply be entered into the Yaw Servo Min and Max fields. If they are not know, you can discover them through experimentation. For example to discover the minimum, push the slider all the way to the left and then enter progressively lower pwm values (pushing the Test button after each change) until you discover the lowest value that causes the servos to move. Repeat for the Max field by pushing the slider all the way to the right and entering progressively higher pwm values.

Normally lower pwm values should cause the tracker to point to the right (i.e. clockwise), higher values will point to the left (i.e. counter-clockwise). If this is not the case, the "Reverse" checkbox should be checked. Note that changing this checkbox will not affect how the tracker operates when using the Test button.

The Neutral field is the value that will be output to the servos when the tracker first begins controlling them after startup.

Setting the Yaw servo's range of movement

In this step we want to discover the heading change that comes from moving the servos between their minimum and maximum values. One way to do this is to:

- Put the slider all the way to the left (if the Reverse checkbox is unchecked) or right (if the Reverse checkbox is checked) and push the Test button
- Rotate the tracker so that it's heading (on the MP's Flight Data screen) shows close to "0" (i.e. North)
- Return to the extended tuning page, push the slider all the way to the other extreme and push Test
- The new heading back on the Flight Data screen is the range of movement and should be entered into the "Range of movement field".

Setting the Pitch servo's range of movement pwm values

Repeat the procedures described above to discover the Yaw servo's min and max values except using the fields and buttons in the "Pitch Servo" section of the Extended Tuning screen.

Lower pwm values should cause the tracker to aim down, higher pwm values to aim up. If this is not the case, the "Reverse" checkbox should be checked.

Setting the Pitch servo's range of movement

Repeat the procedures used to discover the Yaw servo's range of movement except that the difference in the Pitch values shown on the Mission Planner's Flight Data screen should be used.

Manually setting the parameters

If the mission planner is not being used the parameters below can be updated manually:

RC1_ parameters control the pan (aka yaw) servo

RC1_MIN : min pwm value that can be sent to the pan servo

RC1_MAX : max pwm value that can be sent to the pan servo

RC1_REV : set to "-1" if the tracker rotates in the wrong direction

RC2_ parameters control the tilt (aka pitch) servo

RC2_MIN : min pwm value that can be sent to the tilt servo

RC2_MAX : max pwm value that can be sent to the tilt servo

RC2_REV : set to “-1” if the tracker tilts in the wrong direction (i.e. tilts down when vehicle is above tracker)

Tip

For continuous rotation set YAW_RANGE equal to 360. Make sure you hardware setup (i.e. the cabling) can handle the tracker turning continuous circles.

Tuning

YAW2SRV_P, I and D values are set the pan control’s gains.

PITCH2SRV_P, I and D values are set the tilt control’s gains.

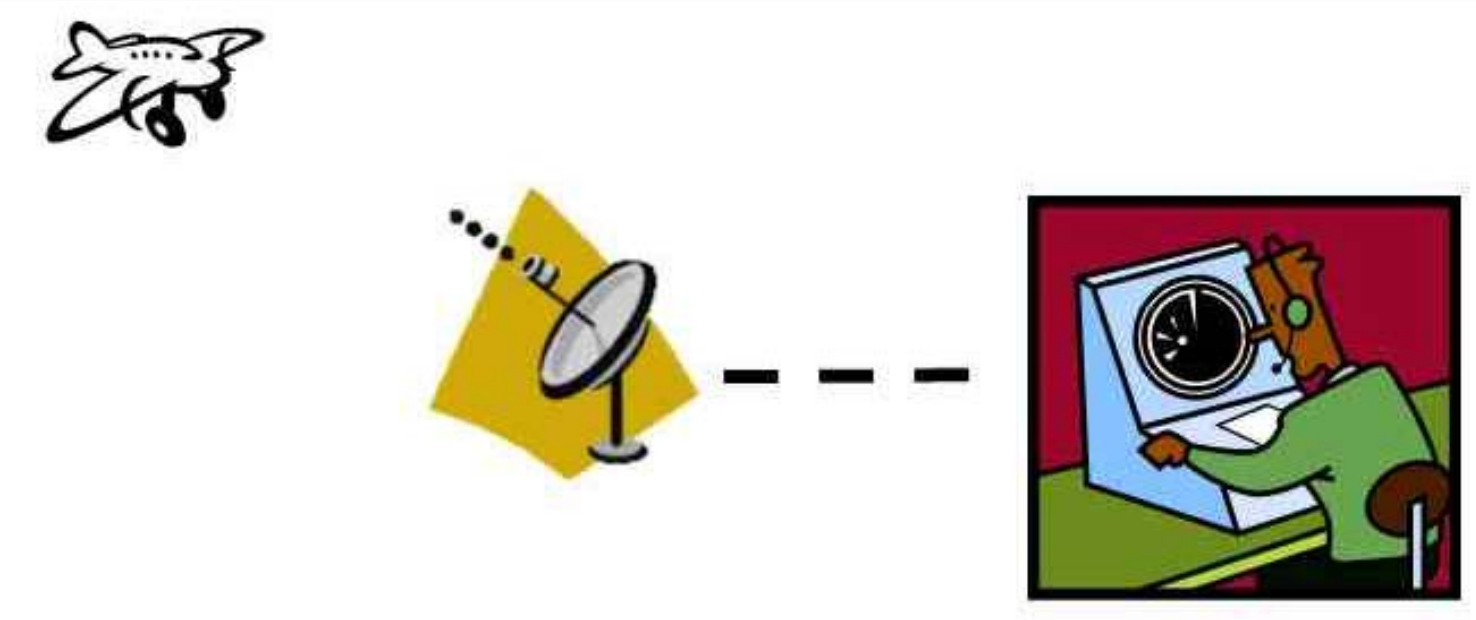
Connecting with GCS

This article explains the different mechanisms for connecting the Antenna Tracker to a GCS (or even multiple GCSs at the same time).

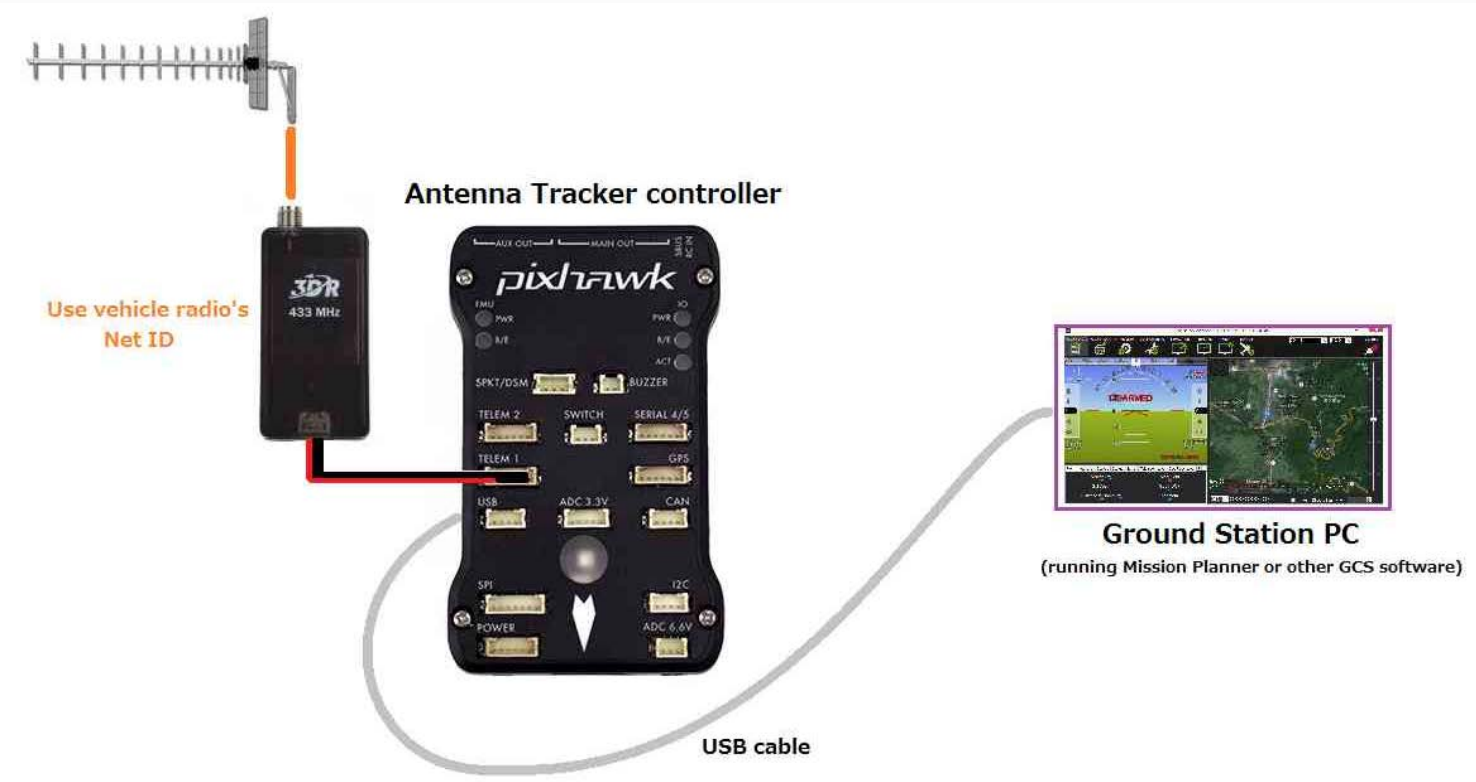
Overview

There are a number ways that the Antenna Tracker’s connection with the vehicle can be made accessible to a GCS:

- Connect a USB cable from the antenna tracker control board to the GCS machine
- Connect a 2nd pair of radios between the antenna tracker control board and the GCS machine
- Connect one additional radio and use the experimental multi-point SiK radio software
- Connect a companion computer and set-up a WiFi access point



Connect with a USB cable



If the antenna controller is a Pixhawk you can simply connect your ground station computer to the Pixhawk using a long micro USB cable (like these from ebay).

On an APM2 the micro USB port and Telemetry port cannot be used at the same time which means that to connect with a USB cable, the radio must be moved to use UART2 (aka Serial2). The UART2's TX, RX 5V and GND pins are on the right side of the APM2 as shown on this wiki page.

Connect a 2nd pair of radios

A second pair of radios (or even a bluetooth data link) can be used to connect the Antenna Tracker controller to the PC running the ground station. If using a SIK radio the Net IDs of the radios connecting the Antenna Tracker to the PC should be different to the Net IDs for the radio connecting the vehicle to the Antenna Tracker.

Connect one more radio and use multi-point SiK radio software

Connect a companion computer and set-up a wifi access point

How to Operate

This page shows how to control the antenna tracker, mostly using the Mission Planner.

Control Modes

There are five modes that you can place the antenna tracker in:

- **Manual**: the operator directly controls the pan and tilt of the antenna tracker to manually point it at the vehicle
- **Stop**: the tracker does not move
- **Scan**: the tracker automatically scans looking for the vehicle
- **Auto**: the tracker attempts to track the vehicle, scanning if it ever loses contact
- **Servo_Test**: the servos are moved to the pwm values specified by a do-set-servo mavlink

command. Used by the mission planner's extended tuning screen when the user pushes the "test" buttons.

The operator can set the current mode from the Mission Planner's Flight Data screen's Actions tab's Set Mode button..