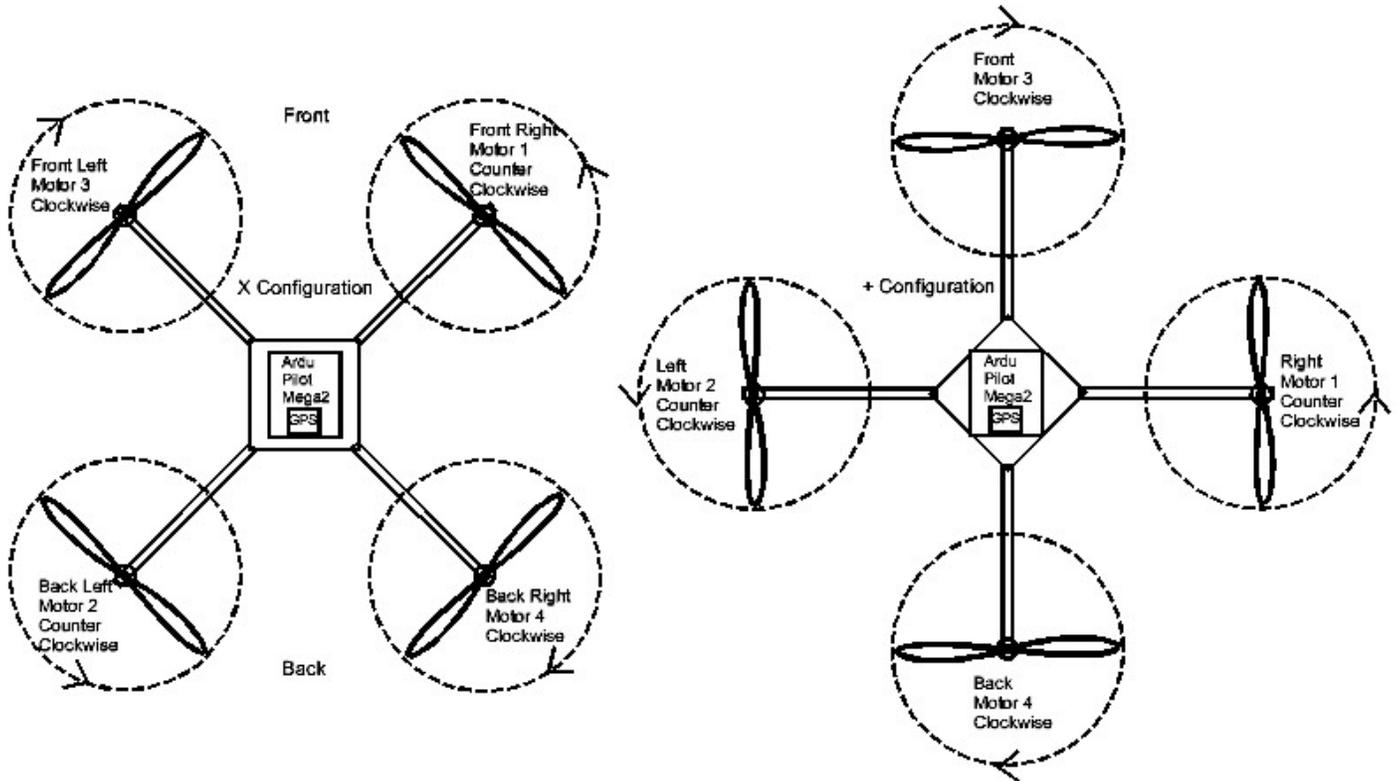


# Install and Setup the ArduPilot Mega 2 in a Quadcopter

Guide to Installation and Setup of the ArduPilot Mega 2 (APM2) controller in a Quadcopter.



## A. For an assembled Quad with motors and ESC's but no control or power board begin here.

1. You need: Quad power distribution board, appropriate battery for your Quad, battery retention strap, 12 gauge wire, battery connector, four ½" nylon standoffs and necessary hardware.
2. Solder The ESC power leads to the Power distribution board.
3. Solder 12 gauge positive and negative battery wire leads to the power distribution board.
4. Solder a battery connector correctly to the leads from the power distribution board.
5. Mount the power distribution board on standoffs over the top center of the Quad.
6. Attach the battery retention strap to the bottom of the Quad and install the battery.

## B. For an assembled Quad with control and power distribution boards begin here

1. You need: APM2 flight control board and USB cable, 5+ channel receiver to use with your 2.4GHz transmitter, Five 3 wire servo leads with female connectors to connect your receiver to your APM2, an oversize plastic or fiberglass APM2 mounting plate with aluminum tape on the bottom, four 1.5" nylon standoffs and Velcro or double sided foam tape.
2. Disconnect and remove any existing flight control board.
3. Drill and mount the plastic mounting plate for the APM2 board in the center of the Quad over the power distribution board on 4 standoffs and aligned with the front of the Quad in your choice of X or + configuration. (X configuration has the front between 2 motors and + has a motor in front.)
4. Using double sided shock absorbing tape or Velcro mount the APM2 board on to the fiberglass mounting plate aligned in the direction of travel (GPS to the back, SDI card toward the front).
5. Retention can be improved by attaching a rubber band over the APM2 board.
6. A clear (not black) plastic bowl cover over the APM2 board can reduce damage in a crash.
7. Install your receiver onto the Quad with Velcro tape and with the antenna exposed externally.
8. Install channels 1 – 5 servo leads to the receiver.

9. Install channels 1 – 5 servo leads to the front connector on the APM2 board, Channel 1 is next to the white GPS connector. The white or yellow signal wire goes towards the center of the board. (Red and black wires on all but one connector can be clipped but this is generally not necessary since power and ground are common bussed at both the receiver and APM2 board.)
10. Install The 4 ESC control leads on the connector at the back of the APM2 board with the white or yellow signal lead towards the center of the board.
11. For X Quad frame configuration:
  - a. The Front Right motor goes to the right most (first) connector position next to the LEDs.
  - b. The Left Rear motor goes to the second connector position.
  - c. The Front Left motor goes to the third connector position.
  - d. The Rear Right motor goes to the fourth connector position.
12. For + Quad frame configuration:
  - a. The Right motor goes to the right most (first) connector position next to the LEDs.
  - b. The Left motor goes to the second connector position.
  - c. The Front motor goes to the third connector position.
  - d. The Rear motor goes to the fourth connector position.
13. The BEC plus (red) and ground (black) wires can be cut on all but one of the ESC control leads.

**C. Install the Mission Planner program and Arducopter firmware and Set initial parameters.**

1. Your RC transmitter should initially be set up for a Quad as follows:
  - a. Four primary channels are Aileron (roll), Elevator (pitch), Rudder (yaw) and Throttle.
  - b. Channel 5 is set to a 3 position switch for in flight mode changing.
  - c. All channels are set to plus and minus 100 percent servo travel range.
  - d. Set the throttle, roll, pitch and yaw trims to zero. (May need to trim throttle down to arm).
  - e. Some minus expo (-40%) is a good idea on the pitch and roll channels to start.
2. Go to the ArduPilot website at <http://code.google.com/p/ardupilot-mega/downloads/list> and download the most recent “Mission Planner” and install it on your computer.
3. Ensuring that the battery is NOT connected, start the “Mission Planner” and hook up your USB cable between your PC and the APM2 board.
4. If you get a message indicating “New hardware found” select install driver when asked. If you are told “No driver found” you will need to load the driver from the Arducopter web site. Go to the Arducopter web site and in the search projects page search for “apm2code”. At the top of the list select the “APM2Code” item and then load the USB driver as instructed. You should get a confirming message indicating that the USB driver is installed.
5. In the Mission Planner, ensure that on the top right of the screen that 115200 is selected for baud rate and the new driver Com? (But not Com1, TCP or UDP) is selected. Fix if necessary.
6. In the Mission Planner click on the Firmware tab then click on the Connect Icon at the top right of the Mission Planner screen to open the MavLink connection.
7. It is possible you may still get an error indicating that your serial rate is too low. If you do you will need to open your PC’s Control Panel -> System -> Device Manager -> Hardware and set the 2650 Com device to 115200 baud. (Windows 7 has a different method for setting up the port.)
8. Once connected; select the Firmware tab and Click on the bottom center “APM Setup” button.
9. Turn on your transmitter with your Quad set up selected. (Mode 2 is shown, adapt for Mode 1).
10. In the “Radio Calibration” menu, select “Calibrate Radio” and move the control sticks to all limits.
  - a. Right stick Left (Roll Left) should equal low PWM. If not reverse the transmitter channel.
  - b. Right stick Up (Pitch Forward) should equal low PWM. If not reverse transmitter channel.
  - c. Left stick Down (Throttle Low) should equal low PWM. If not reverse transmitter channel.
  - d. Left stick Left (Yaw Left) should equal low PWM. If not reverse the transmitter channel.

11. Move the three position mode select switch to all 3 positions to calibrate it too.
12. When you are done calibrating, select the “Finished” button at the bottom right of the screen.
13. Select “Flight Modes” on the left side of the Mission Planner screen and set all 6 of the Flight Modes to “Stabilize”, uncheck all the “simple” mode boxes and click the “Save Modes” box.
14. Now select “Hardware Options” and click on “Enable Compass”.
15. Select the “Go to the Declination Web Site” box and retrieve your locations magnetic declination.
16. Enter your home declination in the Declination window as described and hit the tab key to exit.
17. Select “Arducopter Level” on the Mission planner left edge. With your Quad sitting very level, click on the “Level Arducopter” item then select the X or + Quad to set your frame orientation.

**D. ESC calibration sets the ESC endpoints to be equal and is essential for correct operation.**

1. There are 2 modes for adjusting ESC endpoints. Automatic adjusts ESCs all at once and is easiest. Manual individually adjusts each ESC. Try Automatic mode first then Manual if that fails.
2. Automatic Setup (all ESCs at once) (Remove the Props and disconnect the USB cable).
  - a. Turn on your transmitter and put the throttle full on then connect the Quads battery.
  - b. When the APM2 boots the LEDs will cycle continuously.
  - c. Disconnect the battery and then reconnect it initiating ESC calibration.
  - d. Drop the throttle stick to the lowest position. There should be 1 or 2 confirming beeps and when you move the throttle up the motors should start and turn in sync.
  - e. Disconnect the battery. The ESCs should now be calibrated.
3. Manual ESC Calibrate (Each ESC calibrated individually). (Remove props and disconnect USB).
  - a. With the battery not connected, plug the 3 wire plug of the ESC you wish to calibrate into the throttle channel of your RC receiver.
  - b. Turn on your transmitter and put the throttle full on.
  - c. Connect the battery and after you hear 2 beeps drop the throttle to full down, you should now hear 3 beeps and then a longer beep indicating the ESC is calibrated.
  - d. Disconnect the battery then repeat the above for each ESC.
4. Even after Manual calibration occasionally the ESCs will not initialize (continuous loud beeping). If this is the case try one additional automatic calibration.
5. Normally if the ESCs are properly calibrated, when you power up the Quad and APM2 by plugging in the battery, there should be a slow ticking and the motors may “twitch” just a bit.
6. Once you have the slow twitch / motor tick on battery connection, arm the motors by holding all the way down and to the right on the throttle for at least 4 seconds. The red LED should come on solid and the motors should respond to throttle and turn on at the same time in sync.
7. Disarm by holding the throttle down and to the left for 4 seconds.
8. If the APM2 board failed to arm set the throttle trim a few clicks lower and try again. The bottom throttle setting must be below zero to permit arming.
9. Once armed, the motors should start at the same time and run at the same speed with only the throttle being moved. If not, you need to go through ESC calibration again.

**E. Setting Prop Direction and checking the sensors for correct operation.**

1. A Quadcopter has two props turning clockwise and two turning counter clockwise which keeps it from inadvertently turning on its own axis, but permits it to turn (Yaw) when it is commanded to.
2. You need 2 matched clockwise propellers usually marked R or P and 2 counter clockwise ones.
3. The 2 clockwise propellers are opposite each other as are the 2 counter clockwise propellers.
4. Without propellers installed, turn on your transmitter, plug in the battery and verify and correct each motor so it is turning in the direction as indicated below then install the propellers. Reverse any 2 of the ESCs 3 motor lead connections to reverse the direction of the motor.

5. Disconnect the battery before installing propellers. The clockwise (usually marked R or P) or counter clockwise propeller should be installed on each motor with the printing on the front (top).
6. For X configuration: (Check and correct motor directions before installing propellers)
  - a. On Front Right and Back Left motors install counter clockwise propellers.
  - b. On Front Left and Back Right motors install clockwise (R or P mark) propellers.
7. For + configuration: (Check and correct motor directions before installing propellers)
  - a. On Right and Left motors install counter clockwise (R or P mark) propellers.
  - b. On Front and Back motors install clockwise propellers.
8. With battery unplugged, connect a USB cable, start Mission Planner and select "Connect".
  - a. The heads up the flight display on the left will show the current attitude of your Quad.
  - b. The compass display at the top will show the direction your Quad is facing. (If it is near metal objects or electronic devices it may cause a significant deviation).
  - c. Unless you are outside with GPS lock it will NOT show your current GPS position.
  - d. Tilt your Quad to various positions to see if the Heads up display follows your expectations also rotate about the center axis to make sure the compass display follows.
  - e. When the Quad is tilted forward the green horizon should rise
  - f. When the Quad is tilted to the left the green horizon should angle down to the left.
  - g. This only verifies that the sensors are functioning properly, if the motors and propellers are hooked up properly, the Quad should be capable of flight, if they are not it will crash.
9. Make sure that transmitter control directions match expected results. There are various methods that can be used to do this, but the one I have found to be most reasonable and successful is:
  - a. On a calm day set the Quad outside facing away from you on a flat level spot with at least 20 feet of flat clear space in every direction.
  - b. Turn on the transmitter and then plug in the Quad's battery.
  - c. Stand at least 10 feet behind the Quad and arm the APM2 by holding the throttle down and to the right for at least 4 seconds. (GPS lock is not important at this time).
  - d. Slowly turn the throttle up until the motors just turn on (should all start simultaneously).
  - e. Now advance the throttle till the Quad is not quite taking off or moving.
  - f. Use the rudder (Yaw) stick to yaw left and right in place. If working correctly proceed.
  - g. Now move the Elevator (Pitch) stick to pitch slightly forward and back. When the stick is moved forward (up) the Quad should try and tilt forward and try and move away from you. When the stick is moved down it should try and tilt and move towards you.
  - h. Move the Aileron (Roll) stick to roll slightly right and left. When the stick is moved to the right the Quad should try and tilt and move to the right. When the stick is moved to the left it should try and tilt and move to the left. Fix any problems before proceeding.

**F. First Flights. (Stabilize is the basic and startup mode and is necessary for arming).**

1. Try a short flight in Stabilize mode. Arm the APM2 by holding the throttle down and to the right for at least 4 seconds (Red LED solid). (GPS lock is not needed at this time).
2. Advance the throttle till the Quad takes off. Hold altitude to 4 to 8 feet above the ground with the Throttle. Compensate for drift with the Pitch stick. Reduce throttle and land.
3. If the Quad is very twitchy or has too much power: Disconnect the battery and connect the USB cable between the APM2 and your computer then start the Mission Planner and select Connect then select the Configuration tab and then the PID List item in the left column. Reduce the Pitch Angle "P" value.
4. Repeat several times adding rotation correction with the Yaw stick and making short excursions.
5. Gain considerable flight experience in "Stabilize" before undertaking the more advanced modes.