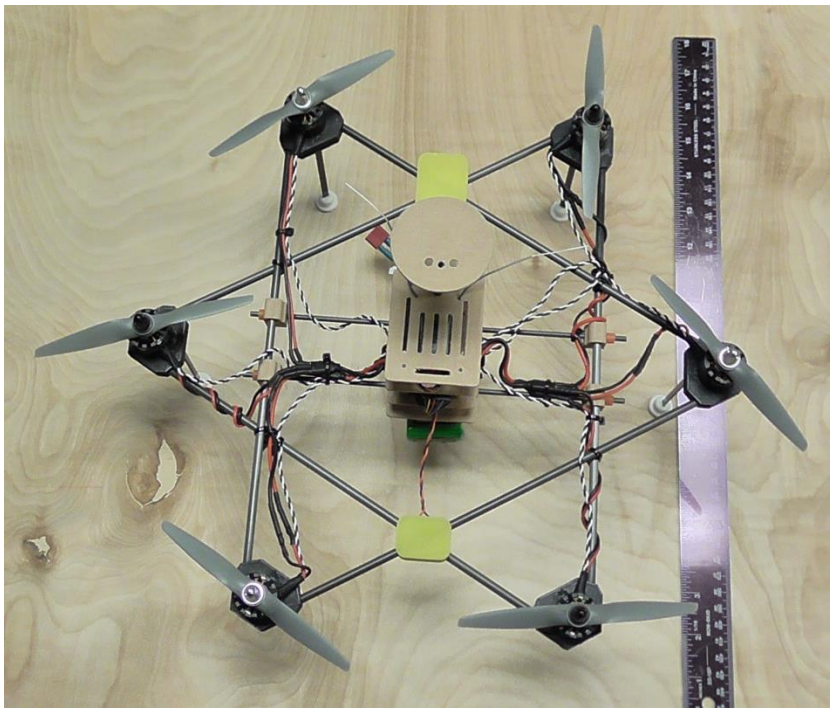
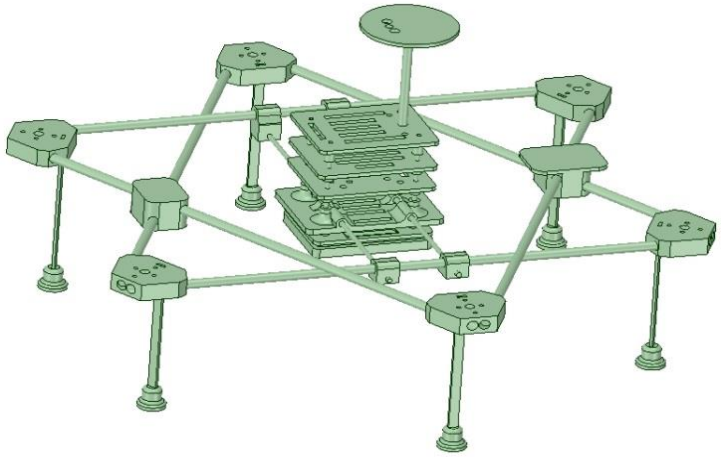
X6MR MANUAL



X6MR Airframe



Introduction

This manual is intended to provide broad guidance on the X6MR Hex Copter kit construction and descriptive information on accessory application and use. In addition to the kit version described herein, a complete turnkey assembly with flight electronics is available and a "short kit" that includes the necessary 3D printed fittings and platforms is also available (user supplies standard carbon fiber tubes, rods, and strips available from any RC hobby shop).

The X6MR is a multi-configuration flying platform designed to mount video and/or sensor devices for use in a variety of applications such as:

- Law Enforcement
- Military
- Commercial
- Hobby

Simplicity, versatility and durability in a well thought out design make this the ideal platform for tactical applications in addition to commercial and hobbyist use. The principle focus of operational characteristics was on development of a multirotor platform with the maximum flight time achievable while still being able to carry a variety of sensor devices. Secondary considerations were to maintain a small size sufficient to be readily operated both inside structures and outdoors in moderate to windy environments. Lastly, there was considerable thought given to keeping consumer costs to a minimum.

Most end-user applications can incorporate inexpensive off-the-shelf "hobby grade" electronics and components to make the assembled unit very economical to construct and maintain. The hobby industry continues to out-pace all other industries with regard to advancing technology of low-cost quality electronics used in small UAS multi-rotor applications. Losses or damage in field operations can easily be tolerated from a budgetary perspective. This minimizes the need for personnel exposure to potentially hostile environments in attempts to "save the equipment". All of these factors resulted in a streamlined and light weight frame with some very unique and diverse physical configurations.

The modular and symmetric design of the X6MR allow for multiple configurations only limited by the imagination.

Design Attributes

1. Simplicity
    a. Symmetry from front to back and top to bottom
    b. Carbon fiber tube and rods for structural strength
    c. Frame hardware minimized
        i. CF Tubes and rods press fit into 3D Printed brace fittings – held by friction and adhesives and/or Tie Wraps
        ii. Standard electronic board mounting (30.5mm and 20mm spacing)
    d. Variety of frame platform plates supplied
2. Versatility
    a. Maximum use of all surface areas

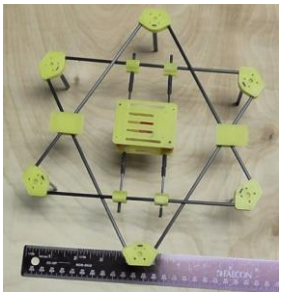
b. Multiple frame platforms (supplied) added vertically to provide additional sensor protection and/or room for more equipment if necessary
c. Small footprint and diameter sized for outdoor or indoor use
d. Multiple possible board mounting configurations
e. Many component mounting possibilities
    i. screws & standoffs
    ii. double backed tape
    iii. glue/epoxy
    iv. hook & loop

3. Unique
    a. Symmetric configuration of CF arm tubes and fittings allow for:
        i. Variable motor spacing for different prop sizes (max size limited by selected tube length) – ie, 12" CF Tubes produce spacing for up to 6" Props as shown in manual example pics)
        ii. Electronics mounted on stacked platforms in the center of the airframe.
        iii. FPV camera and transmitter mounts incorporated into cross-tube bracing fittings in front and back
        iv. Landing gear placement spread maximized providing very stable platform
        v. Minimized prop wash
            1. maximizing lift capability
            2. Increased flight time
    b. Flat overall profile and light weight
        i. Streamlined for less drag
        ii. Easy and compact transport and storage
    c. Multiple fitting and platform colors available – some examples shown in pics

4. Durability & Quality
    a. Quality carbon fiber tubes and solid carbon fiber rod
    b. Rigid structure attachment fittings minimize torsion
    c. Landing gear using semi rigid flat CF strip material to absorb vertical and lateral impacts

Recommended Motors: Flight testing for endurance and maneuverability and in keeping with the intended multiple design applications led to the selection of certain common motor styles. Current production models described in this manual can use motor sizes that use the industry standard 12X16mm and 16X19mm motor base mount configurations. These are typical of motors of the 18XX through 22XX class sizes. Pictured example photos show a 12X16mm motor configuration. It is also recommended that integrated motor/ESCs be used to simplify the wiring and reduce overall weight. All photos referenced in this manual show this design although sufficient platforms are supplied to mount ESCs centrally. Alternately, ESCs may be attached near the motors to their respective CF tube braces.

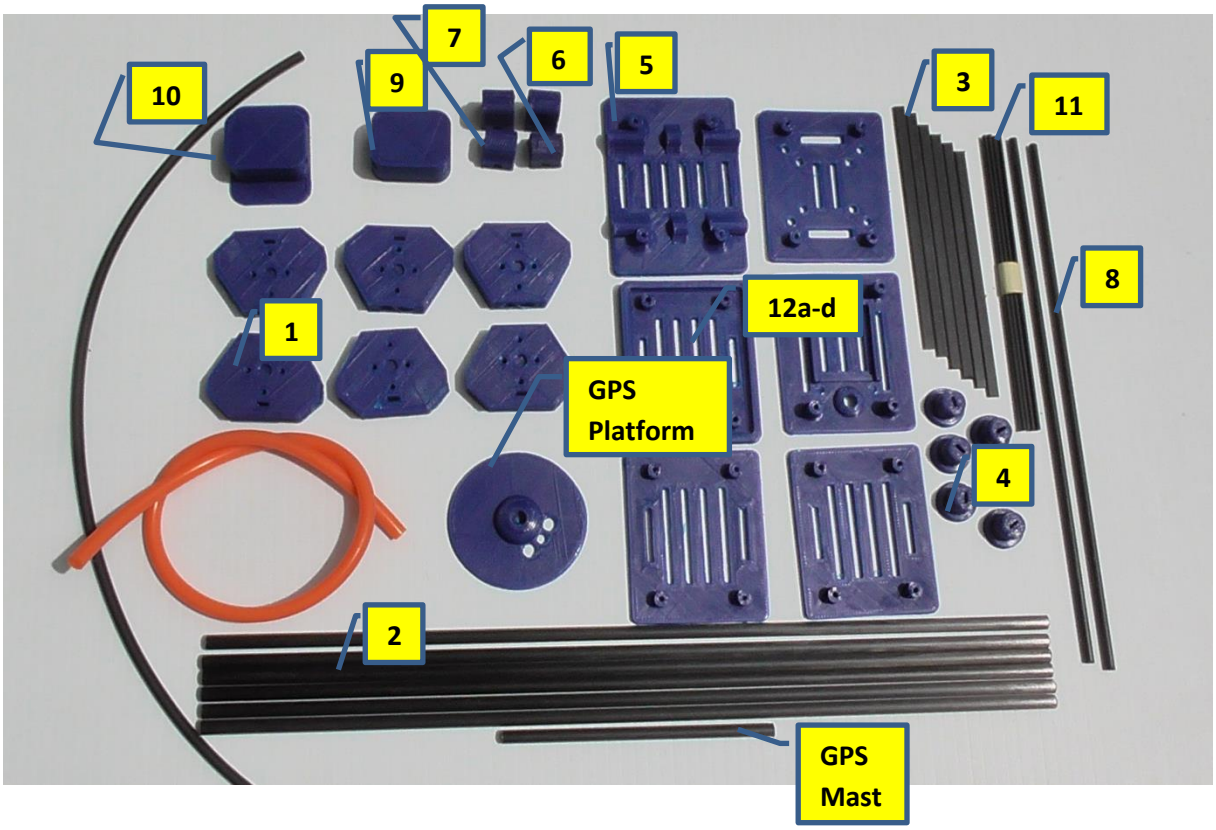
A mini X6MR version using 9X9mm motor mounting and 3-4" props is also available for 11XX and 13XX motors. The mini version comes with two additional platforms for central mounting of ESCs.



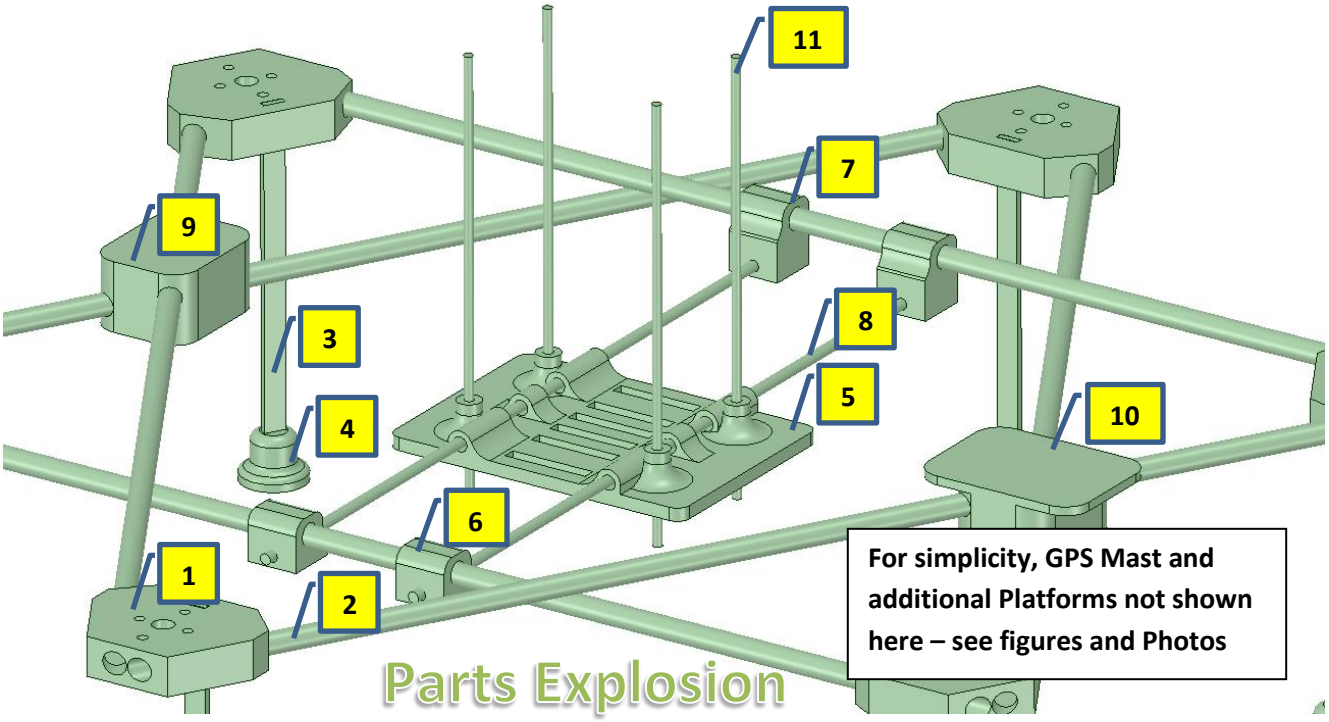
The Mini X6MR is near identical to its larger brothers, except scaled down for 11XX and13XX motors.

Kit Contents

The X6MR kit includes all the frame components necessary to construct a multi-purpose Hex Copter airframe. In addition to the basic frame components, the kit also includes landing gear and a variety of platforms to mount electronics – stacked centrally near the CG. The flight battery can be mounted on the underside or between any two platforms, depending on your desired configuration. A single quick-attach battery strap and hook & loop tape is provided for this purpose. LEDs for visual line-of-site orientation are included but not necessary for certain tactical applications. Turn-key builds typically include a Power Distribution Board (PDB) with a non-regulated LED power output with a switch so the LEDs can be turned on/off as the situation warrants. The supplied LEDs use battery voltage up to a maximum of 4 cells although most builds will typically use a 2 or 3 cell LiPo.



See Parts Explosion Figure and Parts List Below to Cross Reference Parts IDs



Principle Kit Contents (quantity)

1. Motor Mount / Tube Fitting (6)
2. CF Frame Tube (6)
3. Landing Gear CF Strip (6)
4. Landing Gear Button / Foot (6)
5. Main Frame Platform (1)
6. Cross-Tube Fitting (Short) (2)
7. Cross-Tube Fitting (Tall) (2)
8. Solid CF Frame Rod (2)
9. Front Tube Fitting / FPV Camera Platform (1)
10. Rear Tube Fitting / FPV Transmitter Platform (1)
11. Solid CF Platform Rod (4)
12. Multiple Electronics Mounting Platforms {12a – 12e)

Additional Items Included:

1. Silicon Tubing (to make Platform Spacers}
2. Heat Shrink Tubing
3. Battery Strap (1) [Not Shown in Pics]
4. LED set - consists of four 3-LED Light strips (red, white, green, blue) [Not Shown in Pics]
5. Hook & Loop (for battery mounting) [Not Shown in Pics]

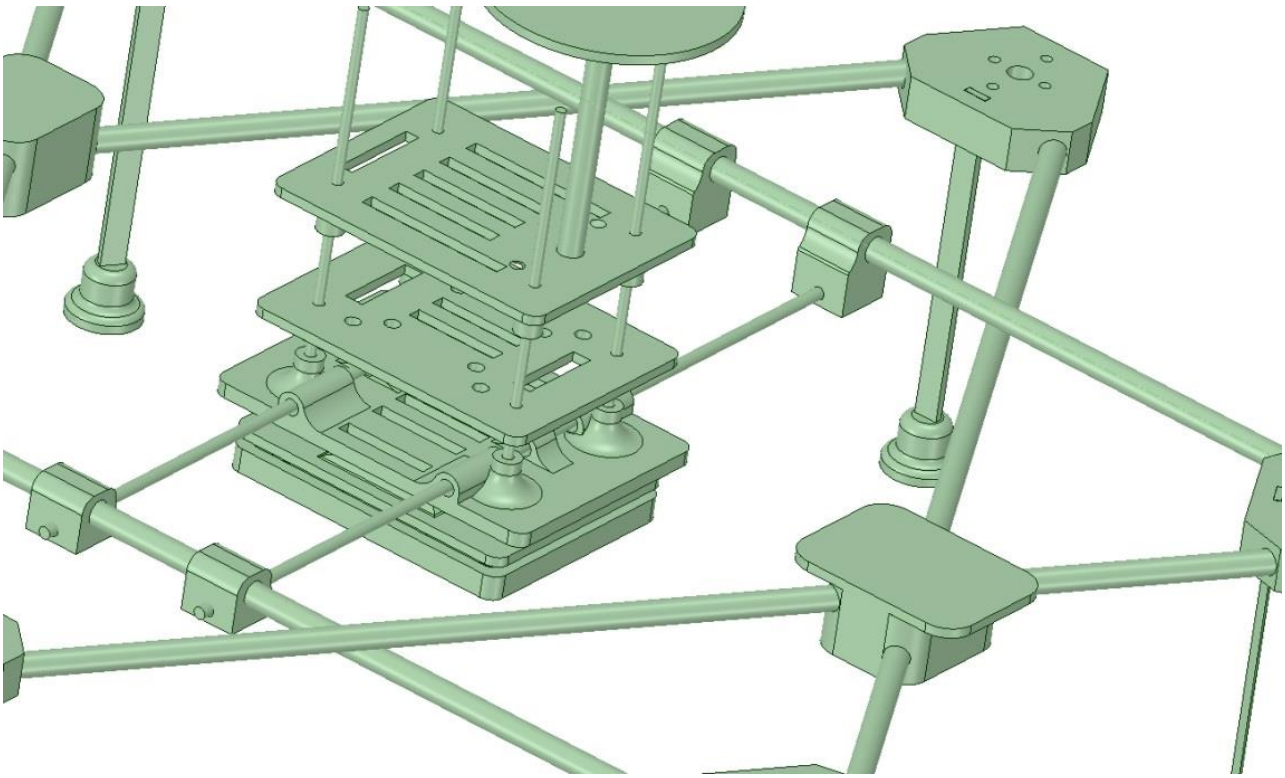
Needed to Complete (Items listed based on a typical build):

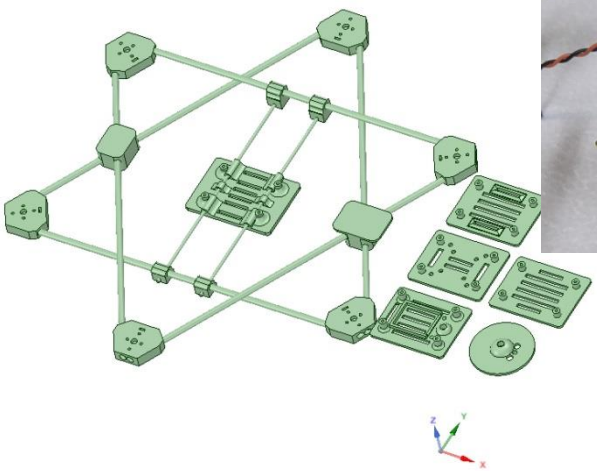
1. Motors (6) [18XX or 22XX, 1900KV – 2300KV) with integral ESCs (Hitec Propel or Black Widow recommended) *OR*
2. ESCs to Match Power System
3. Props sized for power system and CF tube length selected
4. Flight Controller [with 30.5mm or 20X20mm 4-hole mounting pattern]
5. Power Distribution Board (PDB)
6. Receiver – keep it small [Spektrum SPM4648 or SPM4649T or equivalent recommended]

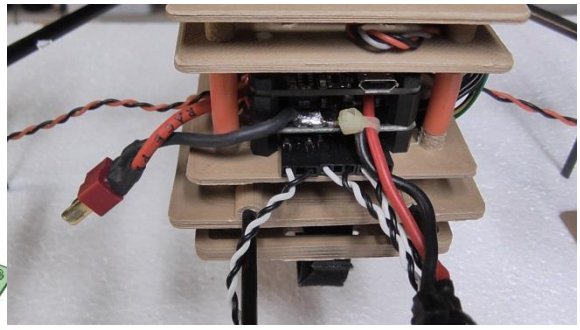
7. Assorted wiring & connectors
8. Tie Wraps
9. Flight Battery
10. Optional Video & Sensor Electronics specific to your application
11. Optional GPS System

Assembly (see accompanying photos and diagrams)
Assembly is performed with simple press fitting of major components and use of common hand tools. Press fit motor mounts and tube fittings may be additionally glued to the carbon fiber tubes/rods to provide a very secure assembly. If an adhesive is used, a quality silicone sealant is recommended to allow for disassembly if needed. Thin CA wicked between the fittings and carbon fiber components may be used if a very permanent installation is desired. It should be noted that excessive CA can stain the frame material – so care in application should be exercised.

The fittings and platforms come pre-formed to mount a flight controller and power distribution board using standard mount spacing (30.5mm) or the newer 20X20mm micro boards. Electronics are mounted to the supplied platforms and stacked vertically in the center of the build. Additional electronics may be mounted on any platform by using simple double backed tape, Velcro, or tie-wraps. Multiple platforms are supplied to accept a variety of electronics, including a GPS sensor on the supplied GPS mast and platform. Most builds do not need all platforms, although they are provided for multiple possible configurations.

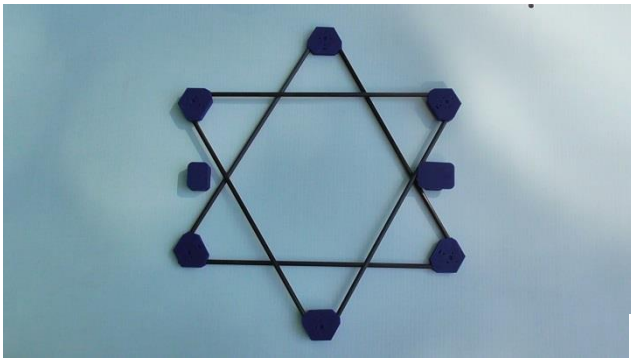




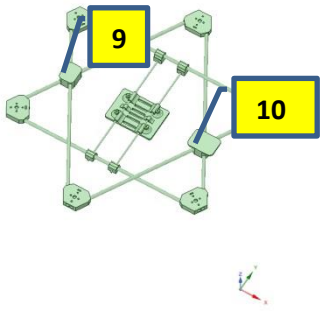


Frame Assembly:

1. Dry fit two carbon fiber “triangle” sections each using three 5mm CF tubes (2) and three motor mount fittings (1).



2. Place one section above the other noting the relative positions of where the front (9) and rear (10) tube/FPV fittings will be placed to lock the two frame assemblies together (These fittings are the “Yellow” camera and Transmitter Mount Fittings shown in cover page photo).



3. Disassemble both sections into individual pieces and continue to step 4 below.

Note: Steps 4 & 5 must be completed prior to attempting to combine the two triangular sections into one assembly. If attempted out of sequence, you will have a difficult time with assembly since the fittings and their placement are the “keys” to locking the assembly together.

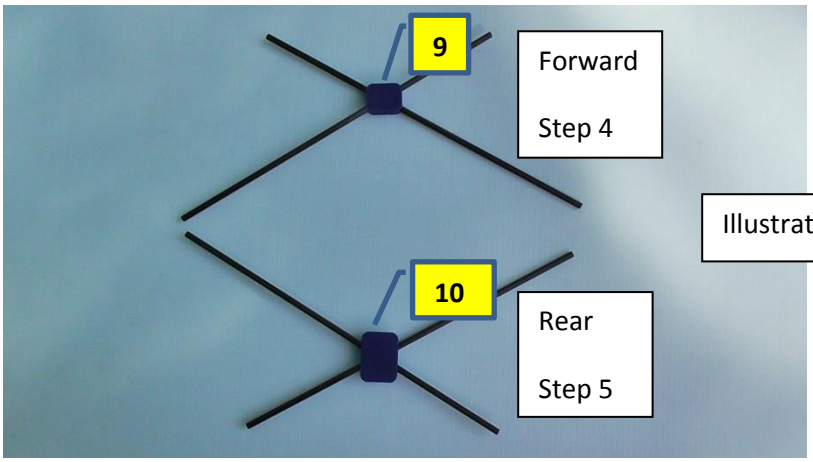
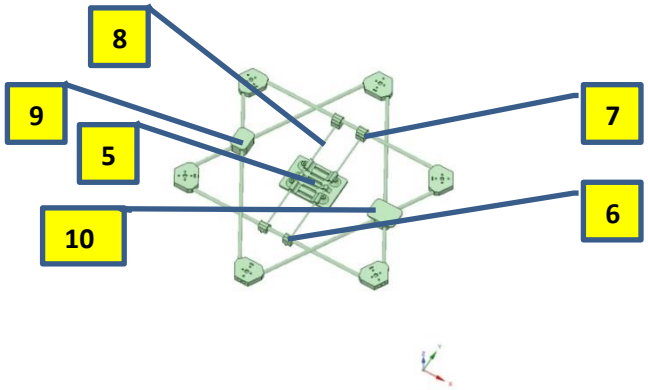
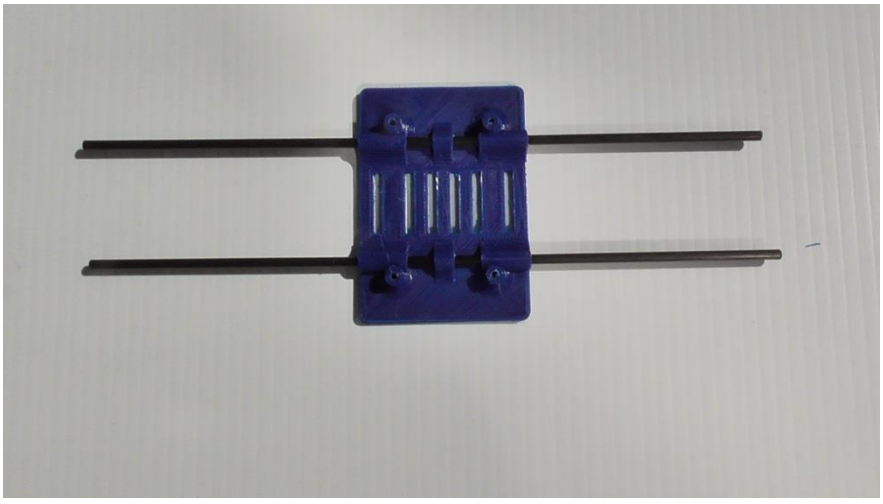


Illustration for steps 4 and 5 below

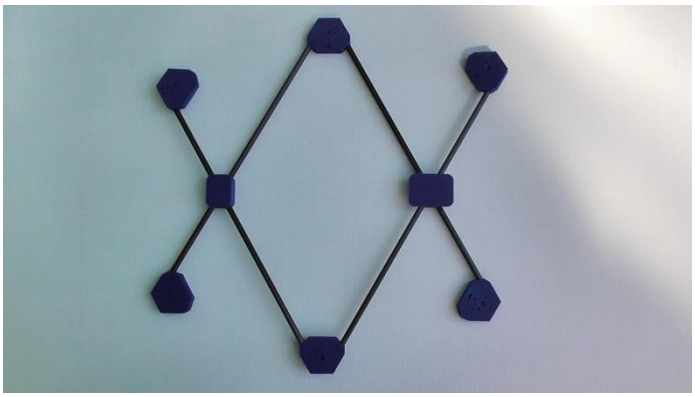
4. Using two 5mm CF tubes and the forward fitting (Camera Mount) slide (press fit) one tube into the lower tube hole and about 1/3 on to the tube. Repeat this with a second tube in the upper fitting hole 1/3 inward from the opposite side.
5. Repeat the above with the rear tube fitting (Transmitter Mount) and two additional tubes.
6. Place two short Cross Tube Fittings (6) on one remaining tube (not the CF solid rods yet) and two Tall Cross Tube fittings (7) on the last tube. See below figure for approximate placement *and* orientation.

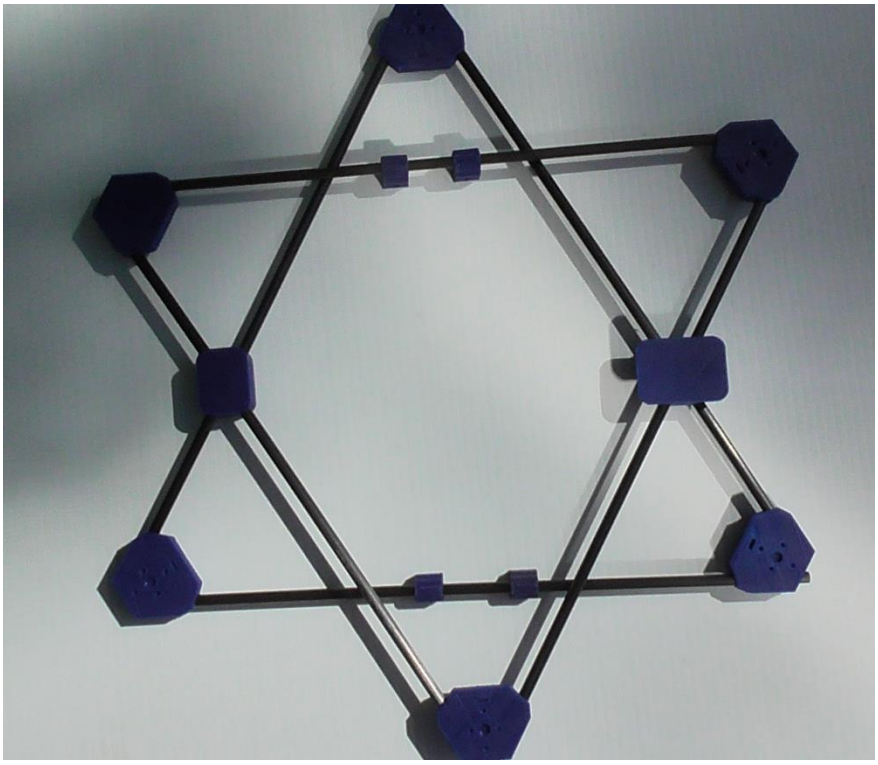


7. Slide two CF Rods (8) into the Main Frame Platform (5) holes as shown. Set aside for now.

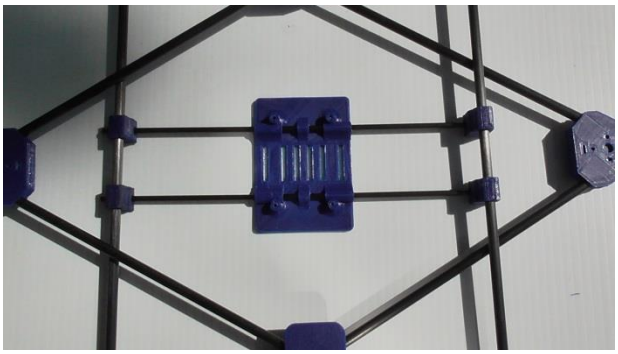


8. Assemble the motor mount fittings by pressing each on to the ends of their respective two CF tubes. The short Cross Tube Fittings will be on the CF tube used in the bottom triangle and the tall ones on the upper triangle as shown. Also note that the motor mount fitting has an "up" side (motor shaft depression in the middle of the top). You *will* encounter misalignment of symmetry as you assemble the sections together. The tubes should barely be visible at the outer hole position of each motor mount. When done exactly the same for each mount, the assembly will align correctly. You will likely need to readjust the tube fittings previously placed in steps 4 and 5 above. This may take a bit of prodding to get symmetry between the two triangle assemblies. With all parts properly fitted, there should be very little bend/strain on the CF tubes. The fittings are intended to fit snugly so some moderate force may be required to slide them into place.

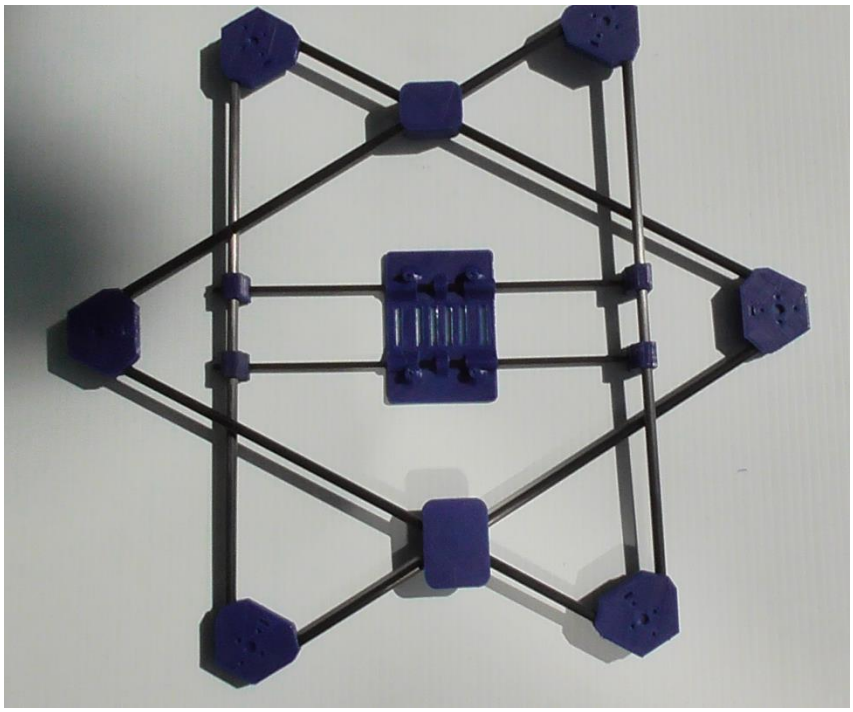




9. Using the subassembly set aside in step 7, (see previous Parts Explosion), slide the Main Frame Platform subassembly into their respective Cross Tube Fittings. Approximately center the platform on the rods. This will be secured in place after the complete frame is aligned.

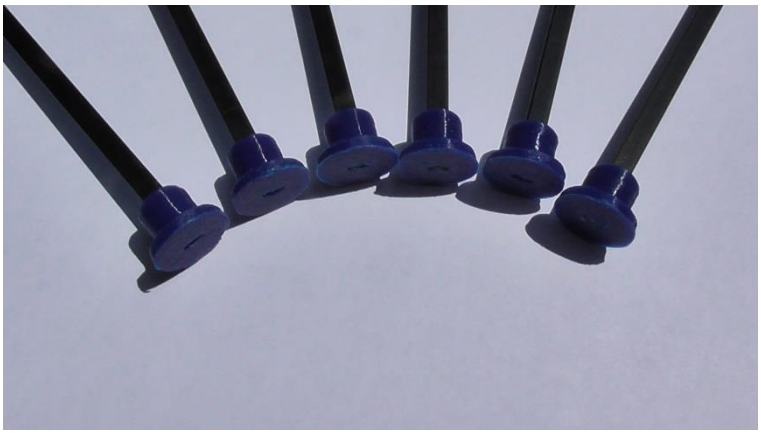


10. At this time you should be able to manipulate the forward (9) and rear (10) tube fittings as the motor mounts are holding the sections together. The intent is to make sure the two triangle sections are symmetrical. If the CF tubes are properly within their respective motor mount fittings (ends just visible at the outer edge of the fitting by the same amount) and there is very little or no bend force from the CF tubes on the forward and rear tube fittings, the symmetry is assured. It may also be necessary to slide the Main Frame Platform subassembly rod Cross Tube fittings along the CF tubes during this alignment.



11. When symmetry is obtained, you may wish to permanently glue or apply silicone sealant to fix the motor mounts to their respective tubes. It is NOT recommended to apply any glue to either forward (9) or rear (10) tube fittings. These should hold the sections together and fit firmly without any glue.

12. Press fit the six Landing Gear Buttons (4) into the six flat CF landing gear (3). Note that there are two sizes of landing gear. The long set is used for the upper triangle and the shorter set for the lower. It should be flush with the bottom. It may require some light tapping using a small hammer to set the gear into the slot. Use a block of wood or other pad to prevent marring the Landing Gear Button or damaging the CF gear.



13. At any time PRIOR TO mounting the motors, press the landing gear into the bottom of the motor mount slot. It should be pressed flush with the upper mount surface. It may be necessary to file or trim the motor mount slot entry slightly to be able to start fitting. It may require some light tapping using a small hammer to set the gear into the slot. Use a block of wood or other pad to prevent marring the mount or damaging the CF gear. When inserted flush with the top, apply a very small amount of THIN CA from the bottom (holding the mount up-side-down) and allow the CA to wick into the slot. DO NOT USE CA ACCELERATOR since it may stain the mount and is unnecessary. Alternately, silicon sealant can be used for a more removable assembly. If silicon is used, squeeze a sufficient amount into the slot prior to inserting the landing gear. Wipe any excess prior to curing.
14. Center the Main Frame Platform and rods. At this time you should still be able to slide the assembly out and away from the balance of the model so you can mount all electronics to their platforms. This can be done at any time. After mounting electronics, the platform rods can be held firmly in place by slipping small pieces of heat shrink tubing (supplied with kit) over the inner and outer sides of the fittings. Alternately, silicon tube (supplied) rings can be placed on both sides of the fittings to hold the rods in place.
15. When selecting platforms for your application, note the several styles of platforms supplied. Of the specialized platforms, one has holes spaced for mounting 30.5mm and 20X20mm boards, one has added rims for strength and battery strap slots (usually used at the bottom and below the main frame board, and one (usually mounted as the top platform) has a recess to mount a receiver to the underside, angled holes for diversity antennas, and a GPS mast hole. Other "general purpose" platforms are also provided.
16. After mounting electronics on their platforms, they may be stacked in the desired position using the four small diameter CF rods (11). Silicon tubing is supplied for additional spacing between platforms. Simply cut the tubing into appropriate lengths and slide onto the four CF rods between the platforms for the proper spacing. There is sufficient CF rod length to mount several platforms. Leave a slight excess of rod protruding out of the uppermost and lowest platform. The rods may be secured at the ends by any of several methods, including CA, heat

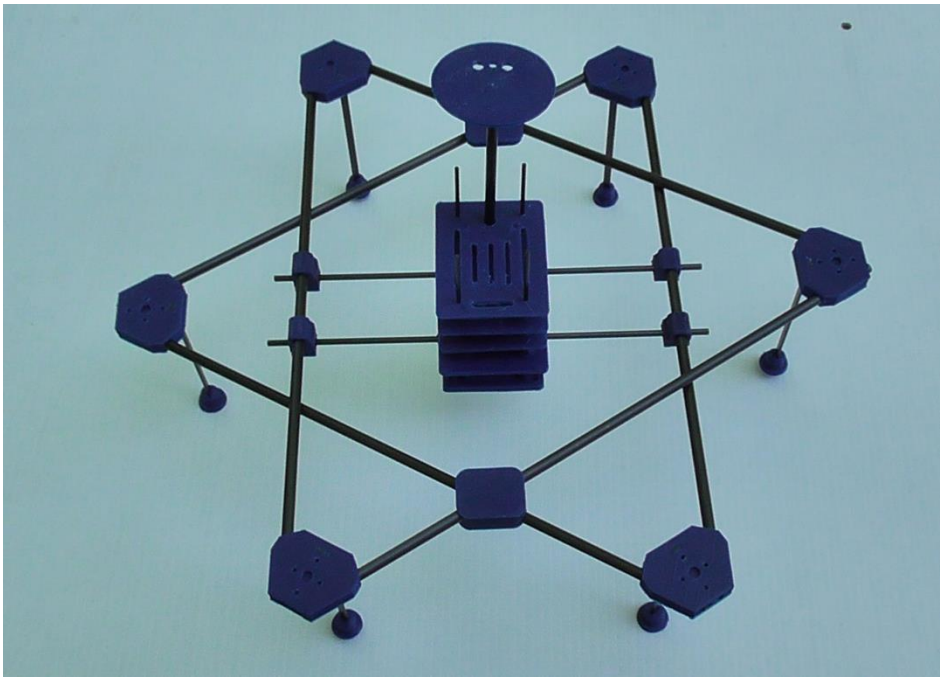
shrink, silicon cement, or silicon tubing. Trim excess rod, if desired, with a high speed cut-off wheel or fine tooth hobby saw.

> **CAUTION: When securing motors to the motor mounts, do not insert the screws too far into your motor housing or damage may occur to the motor. "Blue" thread lock should be used to prevent screws from backing out.**

17. Mount the motors using the appropriate length fasteners. For the example motors shown in the accompanying pictures, 2mmX12mm screws are used. The motor mount is 9mm thick so this leaves 3mm for attachment into the motor housing. Any longer and the screw may damage the inner motor plate. For kits designed for larger motors, the motor mount will be sized for 3mm screws and may need a slightly longer screw – depending on your choice of motor.
18. Complete all wiring and secure wires to frame as appropriate to your configuration.
19. If using the supplied GPS platform and mast, the mast should be glued to the round platform. It may not be necessary to glue the mast to the GPS mount platform (the rectangular platform below the mast). The mast can then be removed for more compact storage or transportation, if desired.

General Guidance to make assembly faster, easier and safer:

1. Read through the assembly instructions completely PRIOR to beginning construction.
2. Inventory all kit supplied parts, your electronics and tools, organizing them according to your intended build. Do not forget about any general supplies such as solder, heat shrink, small tools, etc.
3. Use small amounts of blue loctite thread locker on all metal-to-metal screw contact surfaces, especially motor mounting screws.
4. "Dry-fit" and test all electronics and sensor gear, to the extent possible during the build, so disassembly will not be required after you have completed the frame assembly.
5. Take care in soldering components to prevent shorting between solder pads or overheating any sensitive electronic components.
6. Although the skills, techniques, and "hazards" associated with this build are typical for many hobby related activities, we always strive for safe and efficient construction techniques. We therefore repeat here what you have likely learned from your previous experiences:
    a. The kit does not require any drilling for the typical build. Should a camera be attached using self tapping screws to secure it to the front camera tube fitting (9), use a slow speed drill (or hand drill) to drill the mounting holes. High speeds can melt the fitting material. Take care not to penetrate the carbon fiber tube.
    b. Always wear appropriate safely gear or take other precautions during any operation that could create a hazardous condition – including soldering, drilling, cutting and grinding.
7. ***Carbon fiber is a conductive material. Never allow bare battery terminals or other powered connections to physically come into contact with the carbon fiber. Contact may create short circuits that may damage electrical components and/or become a fire hazard. Always insulate powered terminals from the frame using nonconductive materials such as electrical insulating tape, heat shrink tubing, or plastic/nylon standoffs or mounts.***



Assembled Airframe (prior to trimming excess CF rods)

For questions, custom fittings and mounts, and orders:

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(Yes – There truly is a "Mexico" in New York)