

Assembly and Use Guide for the KAPtery [Titan 2 Rig Kit](#)

Parts List and 3D Printing Guide at KAPtery.com/guides

For spare parts: KAPtery.com Technical support: <http://kaptery.com/contact/>

The Titan 2 Rig holds two small cameras pointed in the same direction. Intended uses for this rig include:

1. Synchronized photos from normal and [infrared cameras for vegetation analysis](#).
2. Synchronized photos from two normal cameras with different exposure settings.
3. One camera recording photos, one recording video.
4. One camera capturing wide angle stills, one capturing zoomed in stills.

The raised lips at the back of the camera trays allow both cameras to be easily attached and immediately aligned to capture the same scene. The tilting tray allows oblique photography as well as vertical mapping photos. The shoulders of the upper frame can hold electronics for synchronizing camera shutters or other tasks. All camera controls and the LCD are always accessible. Twelve brackets allow attachment of legs and bumpers in many configurations for camera protection. Legs and bumpers are easily removed or reconfigured for changing conditions (wind) or requirements (kite vs. balloon). In effect the tray has three camera platforms and is therefore reversible; this can make it easier to drill tripod screw holes for multiple camera models. Also included is a single-camera tray which can replace the dual-camera tray. This converts the Titan 2 Rig into a Redstone Rig for single-camera photography. The Titan 2 Rig is easily attached to either a [Picavet](#) or [pendulum](#) suspension and is best used with one or the other for aerial photography.



The Titan 2 Rig Kit will build a rig to hold two cameras, and has an extra tray for use with a single camera.

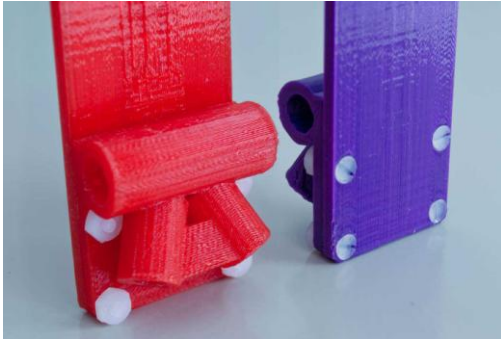
Assembly (time: 2 hours)

Assembly is easy except for drilling holes in the camera platforms for the tripod screws. Allow plenty of time for that task.

Tools needed

- ruler
- electric drill and various bits (e.g., 1/8", 1/4", 13/64", 9/32", 5/16")
- small flat screwdriver
- small pliers
- pocket knife or X-acto knife
- crayon or Sharpie

Attach leg brackets to upper frame



Attach each leg bracket with four nylon bolts & nuts.

1. Legs or bumpers can be attached directly to the dual camera tray, so these leg brackets on the upper frame are optional. For use with the single camera tray, these leg brackets are the only way to attach legs.

2. Fasten four nylon screws and bolts (size 4-40) as shown. Tighten firmly.

3. The included bolts are nylon, but the nuts may be either nylon or steel.

Drill camera platforms for tripod screws

The goal is to fasten the cameras to the platforms with their backs snug along the platform's lip and their mass centered side to side (along the long axis of each platform). Almost every camera will require a hole drilled in a different location. If that's not all you need to know, the following instructions are for you.

The cameras are not centered side-to-side – their mass is. The tripod holes must be drilled so the camera backs are snug against the tray lips and the whole tray is balanced side-to-side. The smaller red thumb screw is for the center platform.



Mark the lengthwise position of the hole for the tripod screw:

1. Lay a camera (with batteries inserted) on its back on a pencil or crayon to determine its center of mass along its long axis. Mark the center on the back of the camera (e.g., with a crayon).
2. Mark the position of the tripod socket on the back of the camera (e.g., with crayon).
3. On each camera platform, measure and mark the center of each platform's long axis (e.g., with crayon).
4. Align a camera on the platform so its center of mass is at the center of the platform's long axis, and mark on the platform the lengthwise location of the tripod socket.

Mark the front-back position of the hole for the tripod screw:

1. Measure the distance from the center of the camera's tripod socket to the back of the camera body. If the lower part of the camera is rounded, measure to the place the camera touches the platform lip when in position.
2. Measure on the top of the camera platform this distance (1) from the inside of the lip to where the center of the tripod hole should be. Mark the spot on the platform where the lengthwise and front-back position of the tripod socket meet. Mark it with a large plus so it remains visible after drilling starts. Precision is required, so scratching a plus with a sharp blade works well.
3. Scratch a lead hole with a knife to get the drill bit started.

Drill the holes for the tripod thumb screws:

1. The center platform is much harder to drill because it must be addressed at an angle (unless you have a right angle drill). Use a small bit and carve the hole gradually.
2. Drill a hole with a small bit (~1/8"). The plastic has a low melting point and will quickly soften during high speed drilling. Drill carefully because the bit will start to "swim" through the plastic when it gets warm.
3. Enlarge the hole with the 1/8" bit and cut away any melted plastic. Place the camera in position on the platform and look through the new hole into the tripod socket. If it looks like it is close, proceed.
4. Enlarge the hole with a 13/64" bit. Clean up the hole and check again that it is properly aligned by sighting through it from the bottom into the camera's tripod socket.
5. Enlarge the hole until it is almost 1/4" diameter. The plastic is soft enough that this can be done with the 13/64" bit and you can carve the hole closer or farther from the lip so the camera will be snug against the lip when it is screwed on.

6. Try to insert the tripod thumb screw into the hole. The thumb screw must turn freely in the hole before you try to thread it into the camera or you risk stripping the threads in the camera's tripod socket. Ideally, the screw will thread itself through the plastic, but then turn freely when it is all the way in. This will strip the threads you just made in the plastic, but the screw will stay inserted in the platform when the camera is not attached, which is convenient. If the hole gets too big for this, that's okay.
7. If the camera mounts too far from the lip, enlarge the hole so the camera can be screwed on snug against the lip. This is important so that both cameras are pointed in the same direction whenever they are mounted and capture the same scene (e.g., for VIS/NIR pairs). It is also important so the cameras cannot rotate and begin to loosen the thumb screws (bad thing for flying cameras, but the camera's wrist strap or other lanyard should always be looped around the rig for safety).
8. If the hole gets too big to hold the thumb screw, you can make the hole smaller by melting some PLA with a soldering iron and adding material to the inside of the hole. Use the piece of plastic filament that came with your rig parts.

Attach camera tray to upper frame:

With both cameras mounted on the big tray, the center of mass will not be the center of the tray (the cameras are closer to one end). The upper frame must be attached over the new center of mass. Bolt holes are present in both the camera tray and upper frame and these provide good balance for most camera pairs. If your cameras are not balanced using the existing holes, new holes can be drilled in the tray (use the existing holes in the upper frame).



The large toothed lock washer goes between the camera tray and the upper frame. The wing nut and lock nut go on the outside of the frame.

1. Attach the hardware as shown. The nylon insert lock nut should be threaded onto the end of the thumb screw just far enough so the screw end is flush with the outside of the nut. It ensures that the wing nut cannot come off and should allow the wing nut plenty of room to be loosened.
2. When assembled correctly with the large lock washer between the upper frame and tray, the wing nut can be tightened by hand so that the weight of the cameras will not change the angle of the camera tray. Do not try to rotate the tray when the wing nut is tight, loosen it first.
3. The small tray for a single camera can be attached with the same hardware. It replaces the larger tray for flights with one camera.

Configuring legs and bumpers

There are 12 brackets for holding legs or bumpers, making many configurations possible with the included tubing. However, to save weight, no legs, leg brackets, or bumpers are necessary.

1. Use a blade to clean the inside edges of the ends of the bracket tubes.
2. There are two sizes of polyethylene tubing — the thicker one (3/8") is only for leg loops at the lower end of the upper frame (on the bolt-on leg brackets).
3. The angled tubes of the bolt-on brackets have a smaller inner diameter (1/4") than the others. Insert short (3 cm) pieces of 1/4" oak dowel to attach the larger size tubing. Use pliers to twist the dowels into the brackets, but do not force them or the bracket could split.
4. If the dowels are too tight the brackets can be reamed with a 1/4" drill. Use caution if drilling the leg bracket — a drill bit can pull itself in quickly. If the dowels fit loosely, they could fall out in flight. So don't enlarge the brackets too much!
5. For all other brackets, 5/16" tubing can be inserted as legs or bumper loops. The tubing loops are better for balloon photography because they avoid hooking the vertical balloon line better than straight legs.
6. The 5/16" tubing should slide through the horizontal plastic tubes with concerted effort. If the fit is too tight, use a 9/32" bit to ream the holes a bit. It is good to have a tight fit.
7. Where the ends of a loop of tubing meet inside a horizontal plastic tube, insert a 1 inch (2.5 cm) piece of 3/16" dowel rod (plastic or wood) in the ends to join the tubing more securely.



This configuration with all loop bumpers is good for balloon flights because a vertical balloon line is less likely catch on loops than on legs.

Attaching the rig to a suspension system

The shaft for a Picavet or pendulum suspension can be inserted into the vertical, cylindrical bracket at the top of the Titan 2 Rig frame. A single hole through the side of the bracket is for a cotter pin.

1. Insert the shaft so one of the holes through it is below the frame and the other hole aligns with the hole through the cylindrical bracket.
2. Insert a cotter pin through the bracket and the shaft.
3. Always insert a second cotter pin below the frame.



The upper cotter pin prevents spinning and the lower pin might prevent disaster.

Connecting electronics

External electronics for triggering camera shutters can be mounted on the shoulders of the upper frame. USB cables can reach the cameras through the oval holes in the sidewalls of the tray. If the alignment of USB port and hole is not right, the oval holes can be enlarged. The plastic is easy to grind away with a Dremel tool, drill, or file, or carve with a knife.

Safe flying

Always secure the cameras to the rig with lanyards. The wrist loops on point & shoot cameras work well for this. Wrap the loop around the frame and pass the camera through the loop (before plugging in the USB cable or screwing the camera to the platform).

Caution: The plastic parts of the Titan 2 Rig are 3D printed from polylactic acid (PLA) which will deform if it gets too hot. Don't leave the rig in a closed car in direct sunlight on a hot day.



Use the small tray for flights with one camera. The camera wrist strap is used as a safety lanyard.