Shoot the Shot: Cameras and Rockets

ARTICLE 2: ONBOARD SHOTS

Introduction

Onboard shots can be some of the most dramatic and eye catching of all rocket images. And in no other way can we see some of the events that occur during flight. Only with cameras onboard can we get these shots and this article will present some methods and solutions to the challenge of getting great onboard shots.

By TR Garman

Rocket Introduction

What type of camera we use and how we mount that camera determines the shot that we make. In this article I'll present a number of ways to mount a couple of different cameras and what the cameras will view during launch.

Each of the rockets below illustrate different mounting methods and camera types. I'll expand on each model on the following pages.

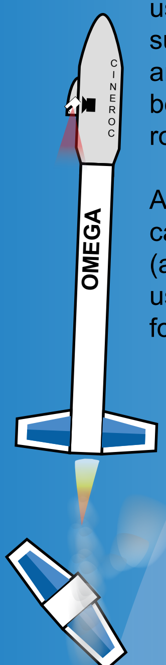
Non-Integrated vs Integrated

Non-Integrated rocket/camera systems can be added to existing designs. A non-integrated system will use "complete" cameras that contain batteries, cases and switches for control.

Integrated rocket/camera systems use "incomplete" cameras (aka, Split) and the cameras are Integrated into the rocket design from the beginning.

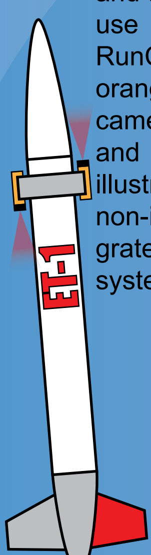
The *RunCam Split* model is well suited for an **Integrated** design installation.

The basic *RunCam* orange model is well suited for a **Non-Integrated** installation.



The CINEROC / OMEGA from Estes used an integrated super 8 film camera and shot down the body tube of the rocket.

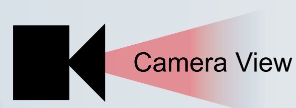
As this is the first camera ship for me (amongst others), I use it as a baseline for comparison



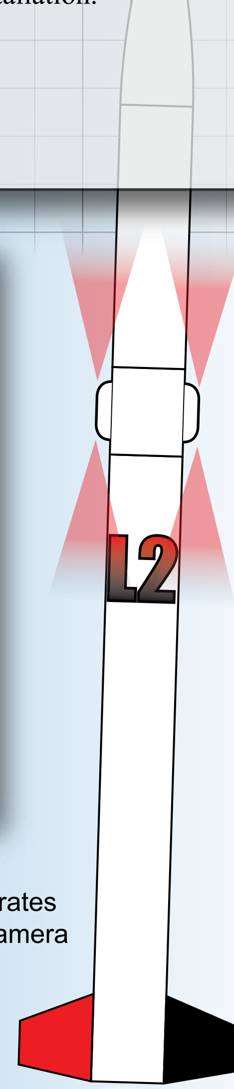
The ET-1 and the L1 use RunCam orange cameras and illustrate non-integrated systems.

Camera Symbol

Throughout this article I'll use the standard symbol for a camera to indicate location and direction. The red cone indicates what the camera "sees" in its view. The Camera View angle in the illustrations will not necessarily be to scale or accurate to the different lenses that we may use.



Camera Symbol



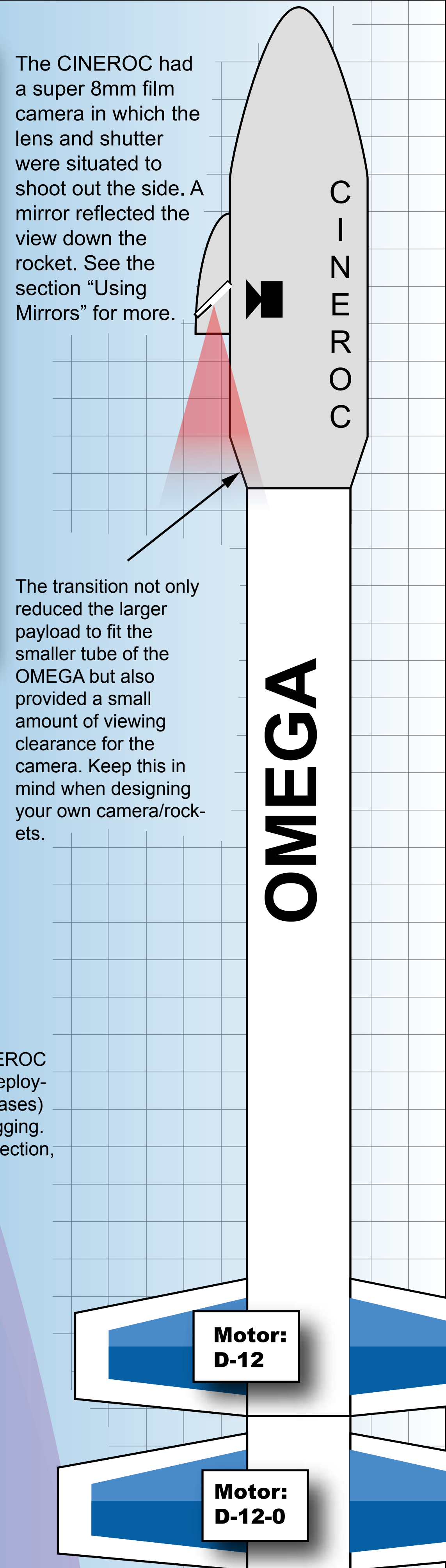
The L2 illustrates integrated camera systems.

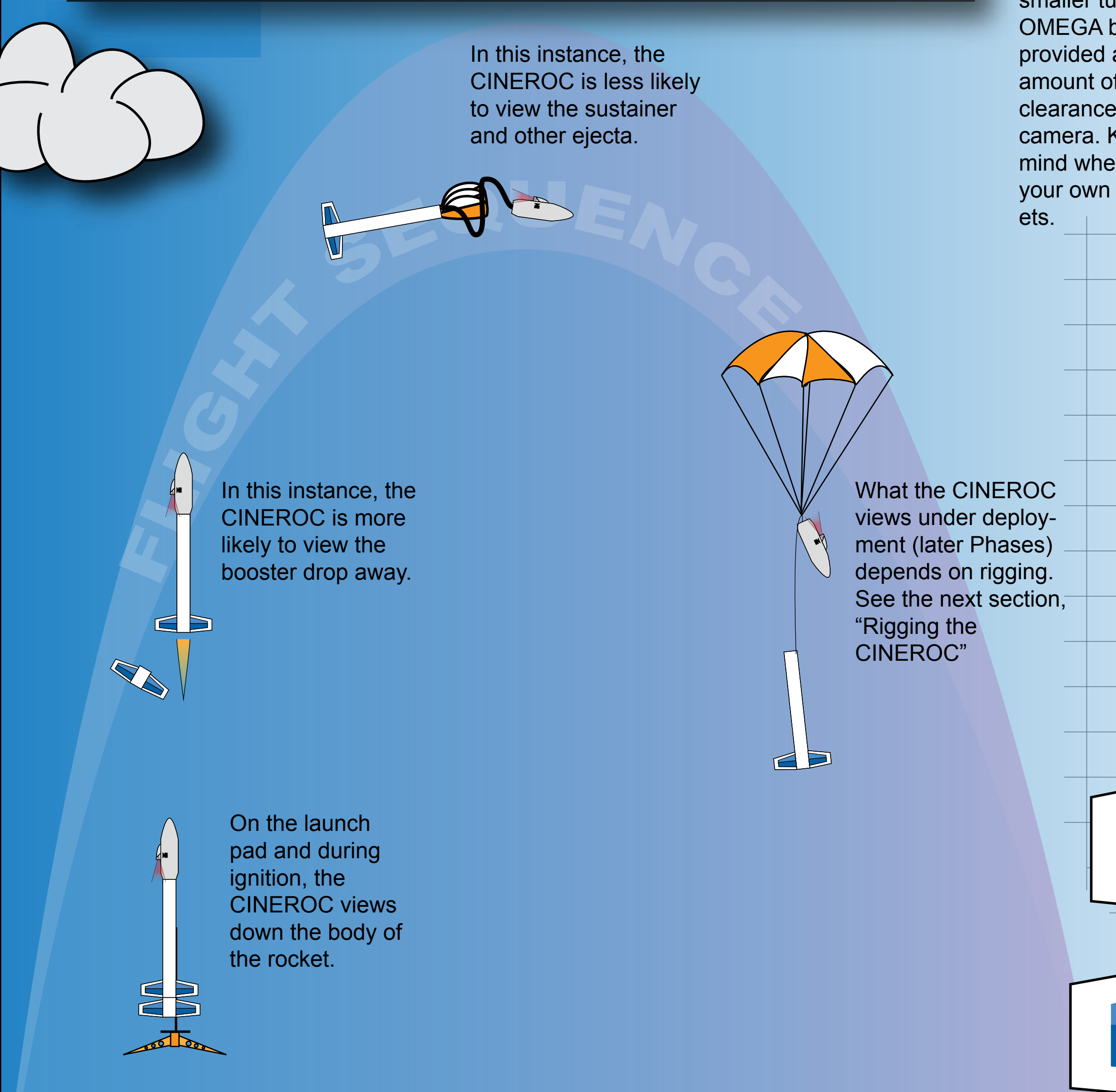
The CINEROC

The CINEROC shot views down the body of the rocket from the nose cone. We have all seen this classic view of rocketry.

The CINEROC was offered by Estes back in the mid 70’s and is a good example to use to illustrate mounting a camera in the nose of a rocket. The CINEROC could be purchased alone or coupled with a two stage, D motor rocket kit called the OMEGA. Semroc Industries offers a reproduction of the OMEGA with a dummy CINEROC nose cone today.

For me (and others, I imagine) the CINEROC was my introduction to onboard photography (motion picture film), despite my lack of success. I mentioned the CINEROC in the previous introductory article and I’ll use it as an example throughout this article, and others.



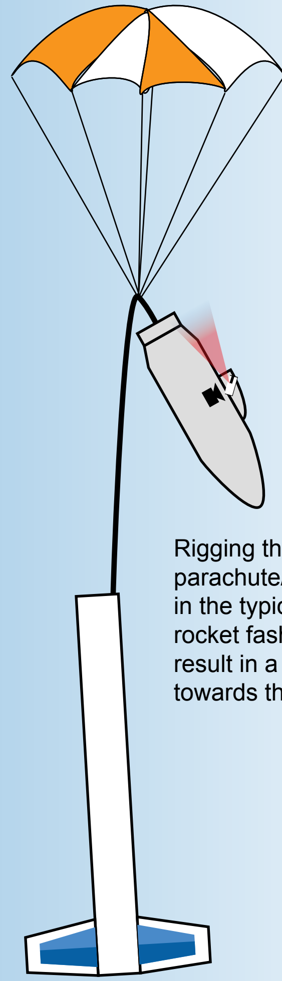


Rigging The CINEROC

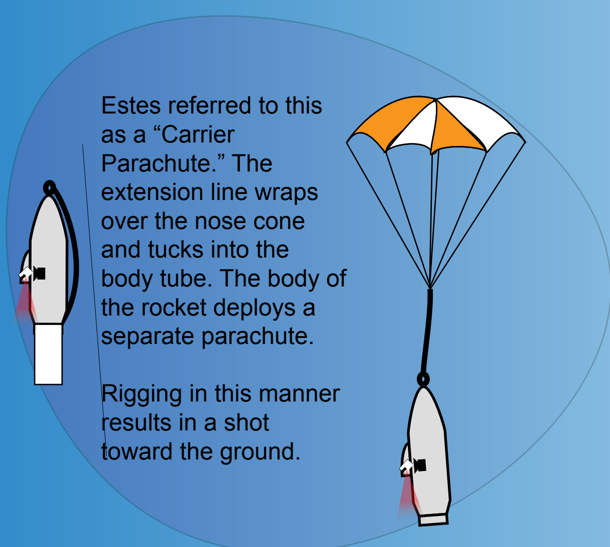
During launch the CINEROC views down the body of the rocket but what it views during/after deployment depends on the rigging of the parachute/CINEROC nose cone.

While few of us will actually fly a CINEROC, the principles illustrated here apply to any type of downward viewing, nose cone mounted camera.

Personally, I don't prefer the nose mounted camera. The rigging issues illustrated here are some of my gripes. The following designs/pages will show some of my solutions.



Rigging the parachute/shock cord in the typical "Model" rocket fashion will result in a view up towards the parachute.



Estes referred to this as a "Carrier Parachute." The extension line wraps over the nose cone and tucks into the body tube. The body of the rocket deploys a separate parachute.

Rigging in this manner results in a shot toward the ground.

Estes called this rigging method "Panorama View."

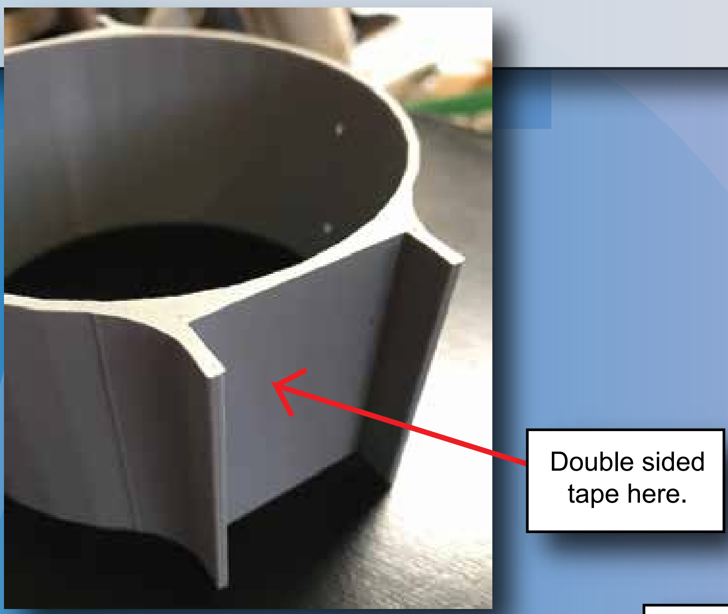
Stick and Tape

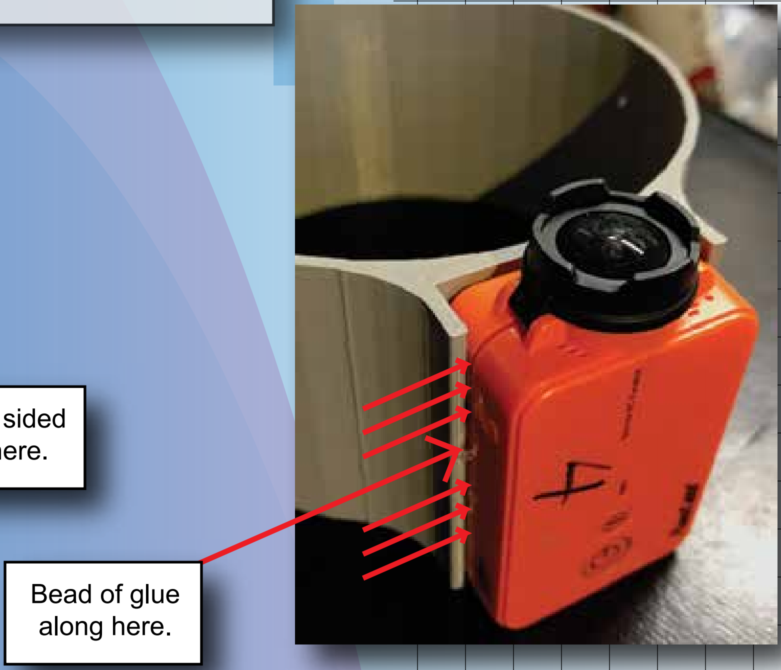
The most basic way of mounting a camera on a rocket booster or nose cone is what I call the *Stick and Tape* method. Use some double sided tape and stick the camera on the side of the rocket. Done. Well almost. Double sided tape will often not be enough to hold the camera in place, so wrapping electrical tape or duct tape around the entire diameter of the rocket will be enough for fairly high power type sport/club flights. I have seen this method work on J powered flights, and have heard of larger.

CAUTION: Any tape strong enough to hold our cameras will likely remove paint/decals/finish/sanity.

A slightly improved model of the *Stick and Tape* is shown here. In the selfie shot, the author can be seen holding the L1, a typical 4" diameter certification type rocket.

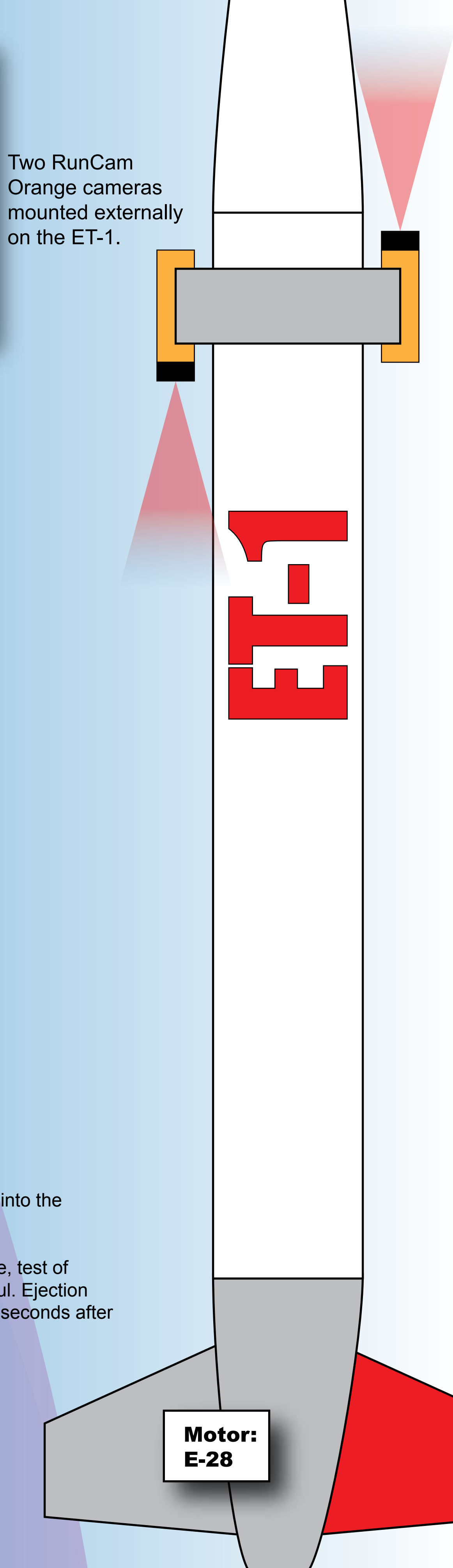
The grey 3D printed ring holds two basic orange Runcam cameras. The black version of this ring in the selfie holds four cameras. For the flight, double sided tape was used on the large flat area of the ring and a bead of hot melt glue was added along the seam between the camera and the mount. For a hard hitting H motor flight, this setup worked flawlessly.

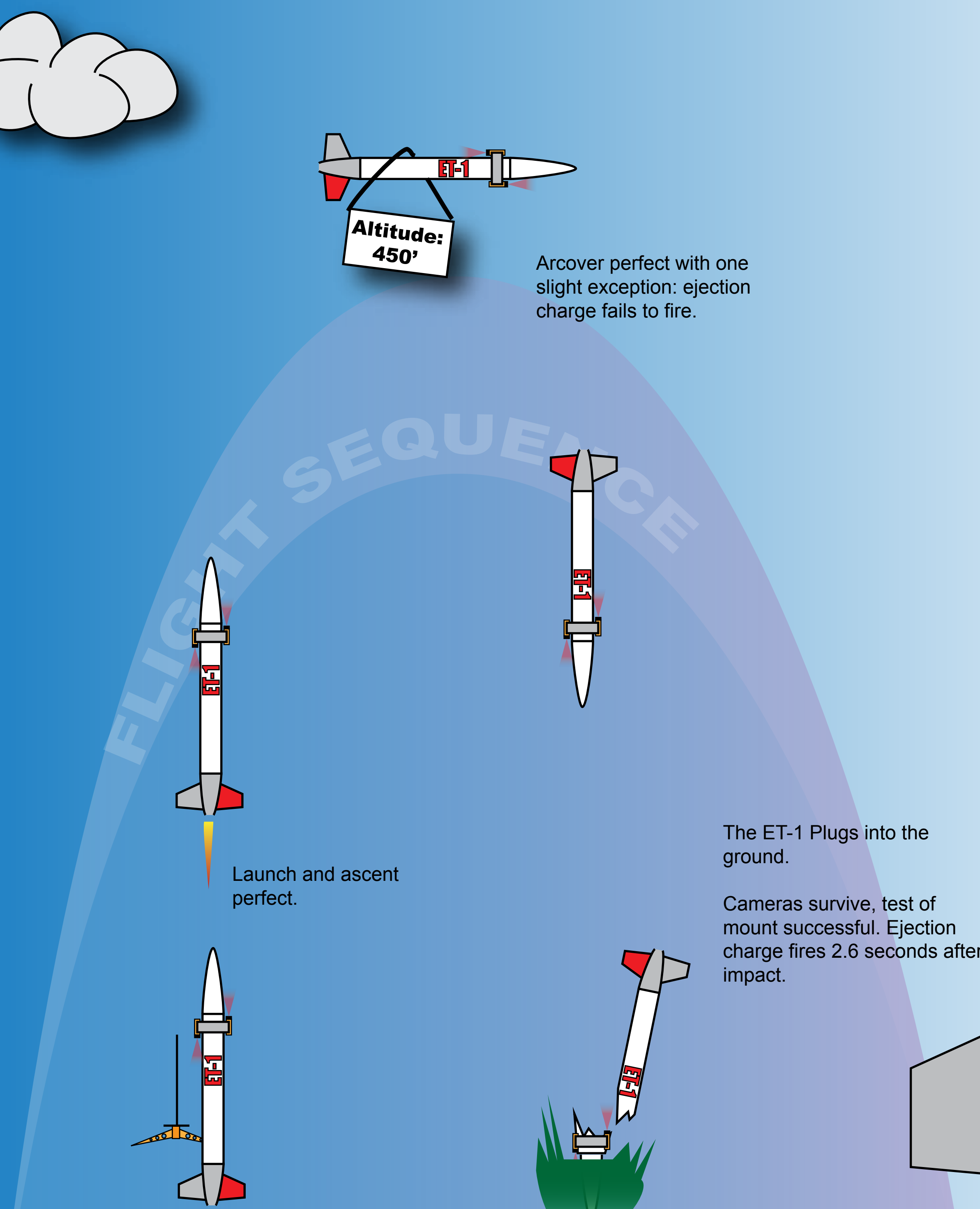




THE Flight of the ET-1

I wanted to a test an idea I had for a 3D printed mount for the basic RunCam orange so I designed a variant on a system of rockets that I have been working with over the last year+. This model I dubbed the ET-1 and it carried two RunCam orange cameras mounted near the top of the booster, one pointed up and one down.





The Flight of the ET-1...End

Of course the drive home was filled with “Why this...” and “What that...” running through my head, and more that I shouldn’t even save for a later article. But in the end I learned a great deal from the one and only flight of the ET-1.

One of the things that I learned was that the RunCam cameras that I used could take quite a beating. Of the two onboard cameras, one of them continued to record after impact, the other recorded just until a point before impact. This page shows some of the results.

I learned quite a bit more from the ET-1, but that I really will reserve for a later article.

Take pictures before launch, it may not look quite the same minutes later.

The Elephant in the Room

A photographer shooting a herd of elephants gets caught up in the stampede. Awakening in the hospital, the doctor says,

"You have two broken arms, a broken leg, 3 fractured ribs, a punctured...," when the photographer interrupts,

"Yeah, but did I get the shot?"

OK, so what does an elephant gag have to do with our rockets? Well, there is an unfortunate reality to photo/video work: the riskiest situations can create some of the most interesting images. And in order to capture those images we must risk life and limb. Well, our cameras anyway. Please don't risk limb.

Sometimes rockets don't work quite right and they get a little scratch here and there. Some of you might know what I mean (see the ET-1 page).

In order to get some of the best shots of our rockets, we must sometimes put cameras in risky situations. But if we treat them as just another piece of onboard equipment, then the risk is no more than the rest of the rocket. I realize this does not help much when our rocket noses over at apogee and picks up speed.

Years ago while hiking through the woods to find the smoldering remnants of my time/effort/money/sanity a buddy remarked,

"Did you bring a bag to take it home?"

Once the chuckles and snickers calmed, sheepishly I responded, "Yes."

Back in the shop another buddy commented,

"That was a beauty this morning... looks like a pile of *s*!%* now."

To which I replied, while sifting through the wreckage,

"Yeah, but did I get the shot?"

An *unscheduled reconfiguration* of a Yi Action cam.

Right and Wrong way of doing it

I must admit that I tend to bristle when I hear someone refer to something as the Right way or the Wrong way. To me, there is no Right or Wrong way.

I like to look at it as there are ways of making it work and ways that don't work. Everything is in the Doesn't Work category until we make them work. Everything starts in the Doesn't Work category. Only once we make it work does it move into the Works category.

For me, in order for something to move into the Works category it has to work well enough that I can check it off the list and move on to the next challenge of the project. How well it works and how we accept its success can be interpreted as preferential. Which is my whole point here.

What I present in this article works for me to get what I want (well, it is about the best I can get for now but I am rarely happy with ANYTHING. Future article perhaps.) And while it works for me, it may not work the same for you. Perhaps you prefer a different camera. Maybe you would rather use mirrors (see page on Mirrors.). I say "Great."

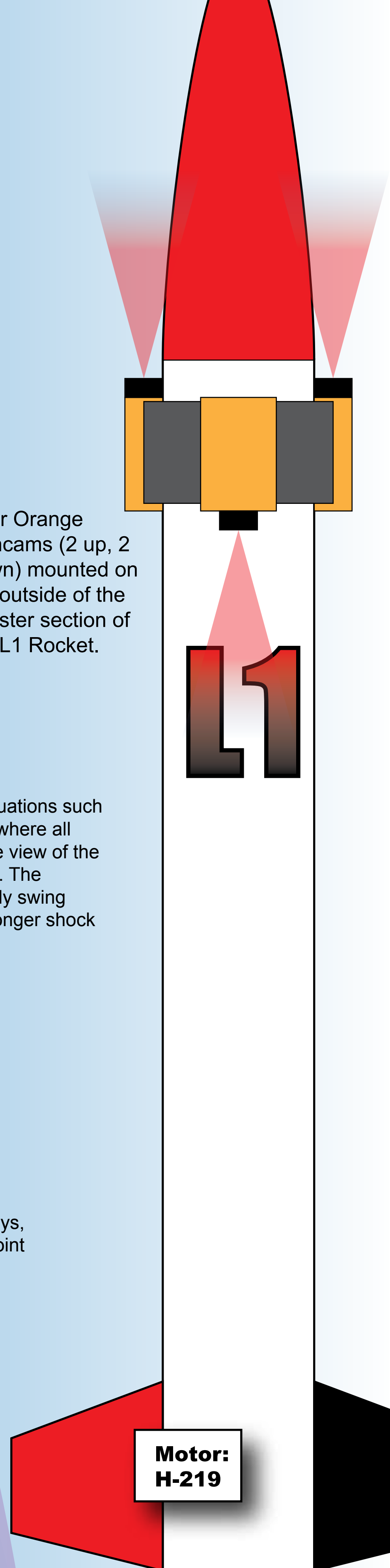
The L1 Rocket

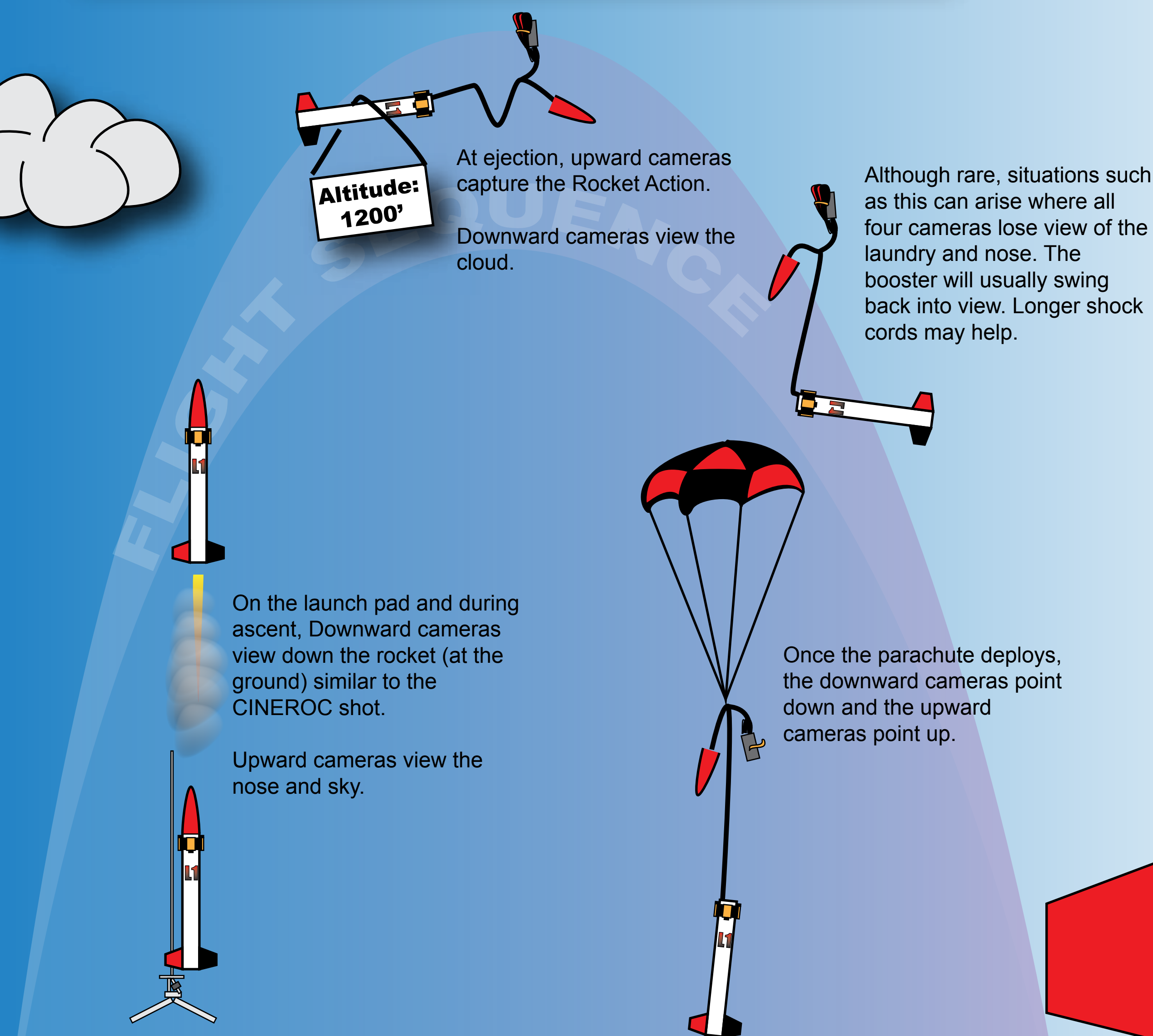
The L1 is based upon a 4" diameter tube with a 38mm motor mount and illustrates a non-integrated camera design.

Four basic orange Runcam cameras are mounted on the booster section of the L1. A 3D printed mount was used (see next page) that houses each camera in a slot that allows the camera to be mounted either up or down.

One feature of this type of design/installation is that it can be used on existing rockets or easily added to kits prior to building. Integrating into the design is not necessary (although helpful).

Using a 3D printed mount (as is used here on the L1) is a slightly improved version of the Stick and Tape method of camera mounting.

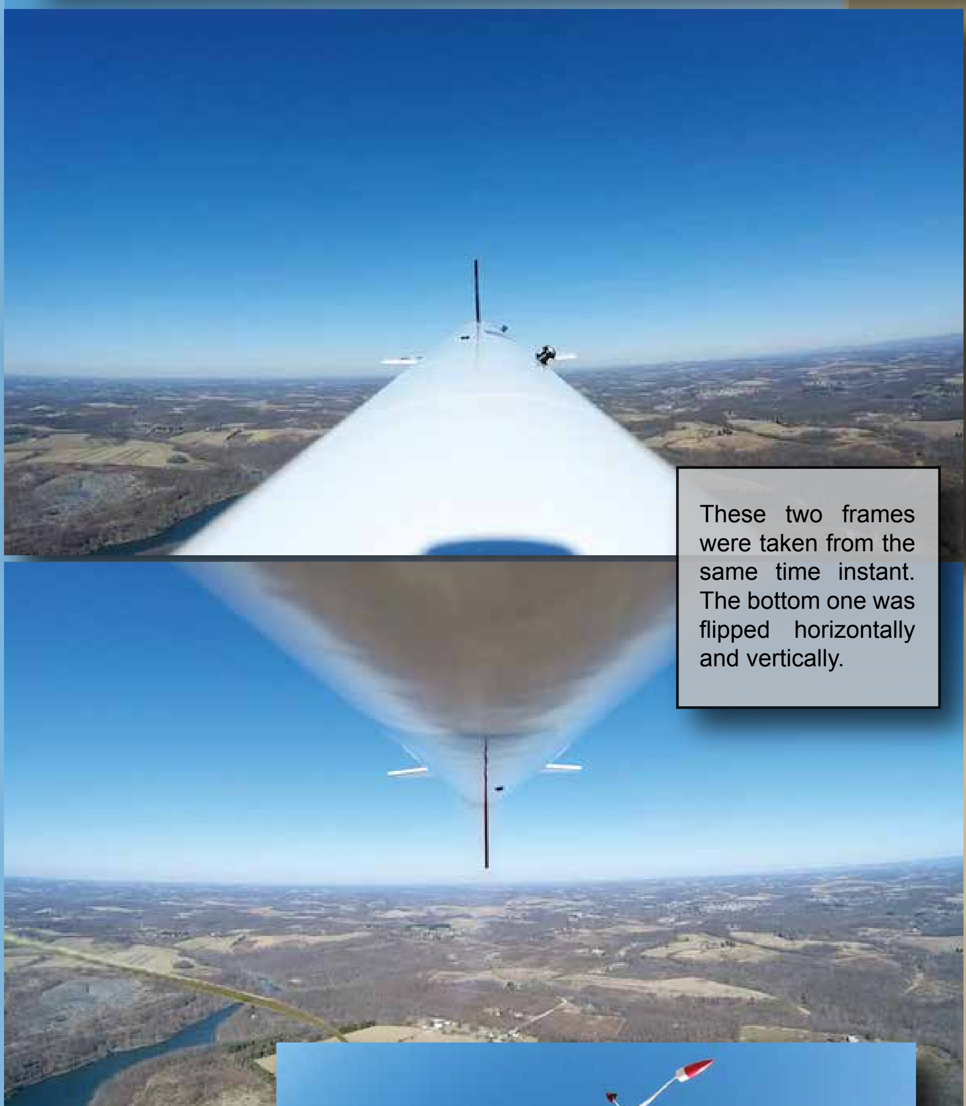




The L1 Rocket - Downward Cameras

The L1 has two downward (and two upward) facing cameras mounted towards the top of the booster. During ascent the downward shots are similar to the CINEROC type of shot but differ once the ejection charge fires.

Note that the position of the rocket within the frame NEVER changes during this entire video. If your rocket moves within the frame, check your camera/mount as it might be loose.



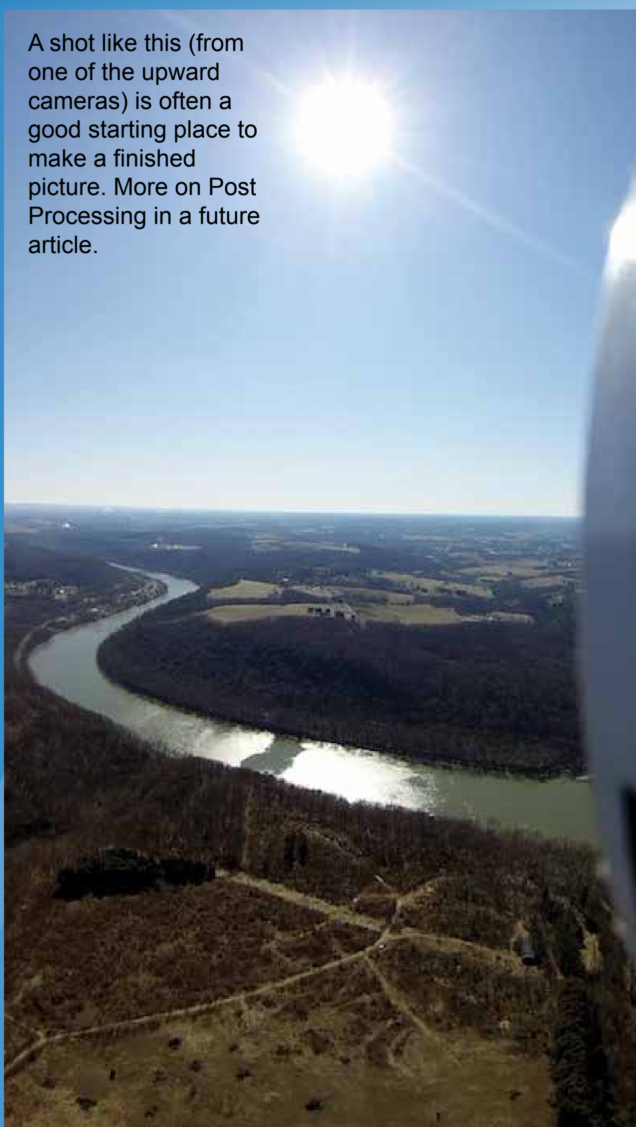
These two frames were taken from the same time instant. The bottom one was flipped horizontally and vertically.

Oops... the shock cord wraps around the rear and hooks onto a fin. Luckily it slipped clear.

The L1 Rocket - Upward Cameras

The L1 has two upward (and two downward) facing cameras mounted towards the top of the booster. Sitting on the launchpad we see the rail and sky, and during ascent we see sky. We see sky for about half of the flight. It is once the ejection charge fires that the upward cameras capture the action.

If the flight goes as planned, only the upward cameras will capture the rocket action of the goodies blasting out of the top on this type of rocket/installation (see "L1 Downward" page for more).

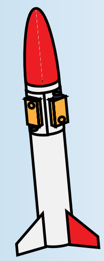


A shot like this (from one of the upward cameras) is often a good starting place to make a finished picture. More on Post Processing in a future article.

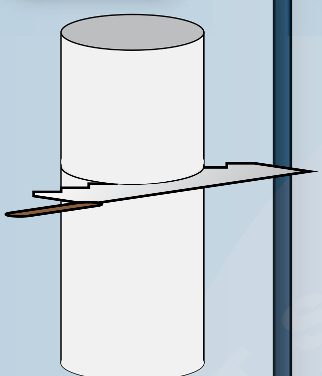
Make a Camera Sled

In lieu of 3-D printed solutions, a sled type mount can be made easily with a section of body tube. Note that this may not work with all tubes but the sled can be made with other materials as the design idea is sound.

Another method uses dowels and plywood or fiberglass plate (see below).

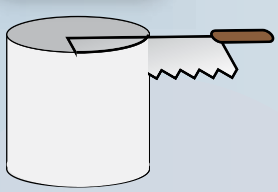


Step 1



Cut a section of tubing that is the same diameter (or optimally slightly larger) as your rocket.

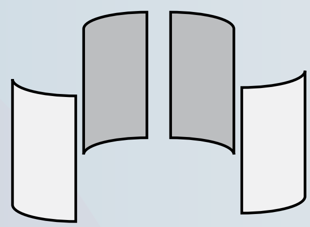
Step 2



Cut the section down along the length.

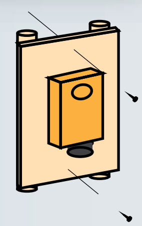
This may be all that you need. A single cut makes a ring that can be slipped over the existing rocket tube. If not, proceed...

Step 3



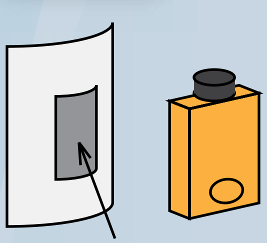
Continue cutting into quarters (or whatever size works for your application).

Alternate



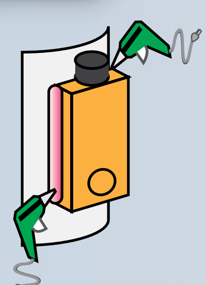
Use dowels and thin plywood or fiberglass plate .

Step 4



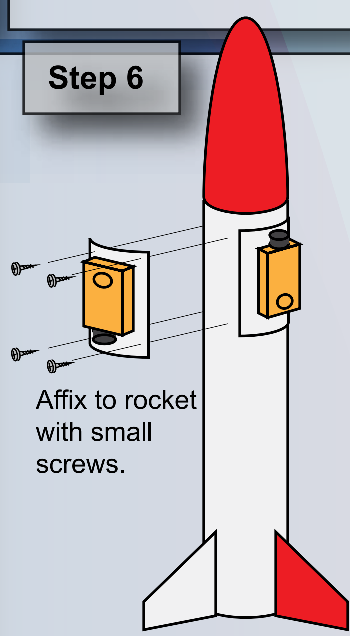
Double sided tape works well to position and hold the cam in place for gluing.

Step 5



Apply a bead of hot melt glue or epoxy to both sides where the camera intersects with the sled.

Step 6



Affix to rocket with small screws.

Step 7

Fly and MAKE PICTURES!

The Case for Multiple Cameras

There are a number of reasons to use multiple cameras.

1. Coverage. A single camera may not capture the action. In the case where a single camera is mounted in the CINEROC fashion, the action can be blocked by the nose itself. A second camera mounted on the opposite side in the same orientation will increase our chances of getting the shot that we want.

2. Individual Perspctive. Each camera views or "sees" its own perspective. The same action may appear different from different views and camera angles. A ground shot does not look the same as an onboard shot.

3. The Singular Event. Each rocket launch is an individual, one-of-a-kind, Singular Event. It CANNOT be repeated. You may be able to load up the same motor and launch it again, but it is a different flight. If you are looking for footage of a particular flight, you can only get it once. And if you don't have a working camera pointing in the right direction and recording the action that you want, you miss it.

4. Balance. Onboard installations benefit from cameras mounted in pairs as mass distribution (weight) and aerodynamic drag balance.

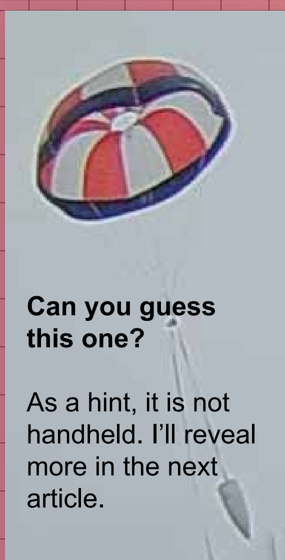
2 shots from the L2

The L2 rocket has two cameras on each side of the payload bay, one looking up and one looking down, for a total of four. The two images here are from the upward facing cameras. Note that the two images are taken from the same time (a few frames after the MAIN ejection charge fired).

Once the laundry dumps out of the top of the upper tube, it all swings toward one side of the rocket. One camera (right) catches all of the action, the other misses it completely (left).

3 Shots of the Same Chute

Each of these shots (below) came from almost the exact point in time. From left to right: ground shot handheld looking upward, onboard looking straight up, drone shot tilted slightly downward.



Can you guess this one?

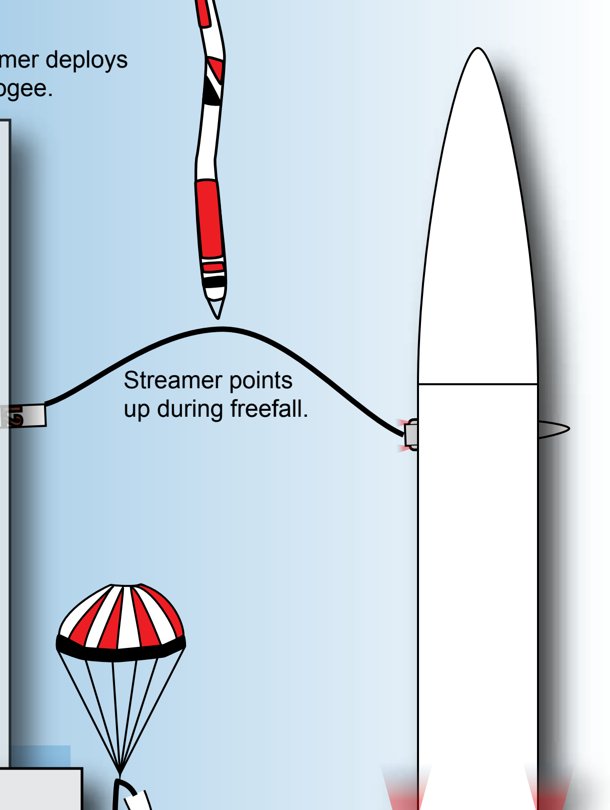
As a hint, it is not handheld. I'll reveal more in the next article.

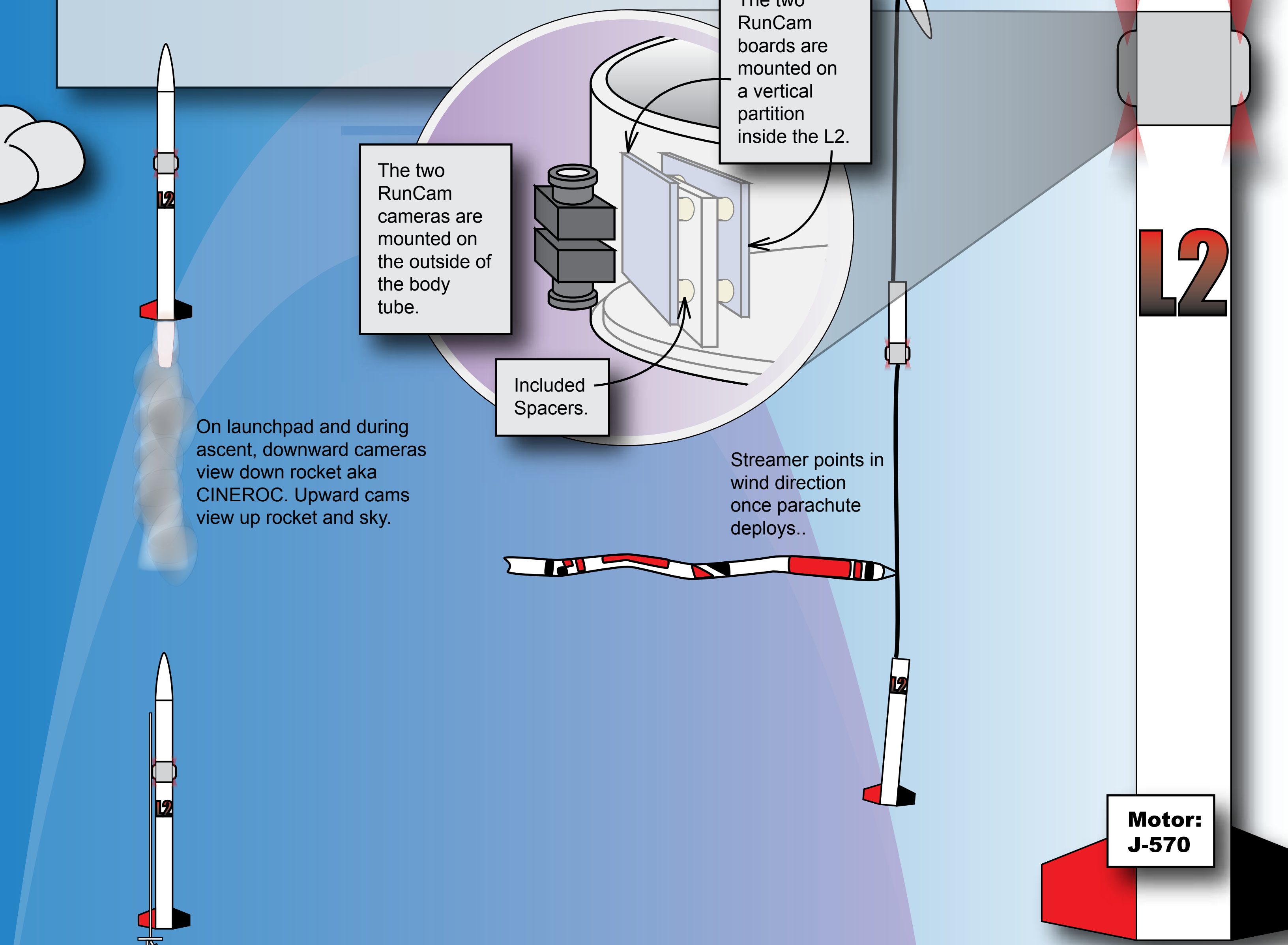
The L2 Rocket

The L2 Rocket has four external RunCam Split Nano 3 cameras integrated into the central payload bay. The cameras are located on opposite sides of the bay, one up and one down on each side. Deployment of the lower section occurs at apogee and the upper section deploys at 500’ for the main parachute.

Integrating the cameras into the design allows for reduced protuberances on the outside of our rockets. In addition, all of the cameras can be powered by a single switch (see wiring diagram).

I wanted something that would provide good visibility on camera for my apogee event, so I chose a long streamer over a drogue chute. The streamer changes depending on the flight phase and the wind and is easier to see at a distance. Something like a streamer can add one more element to our imaging toolbox. Think about these things as you design/build/rig your own rockets.





Same Shot, Different Day

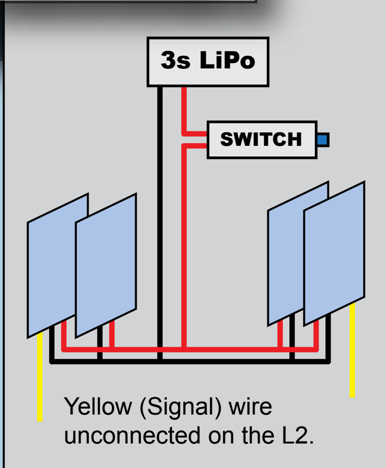
These two images from the L2 were shot on different days and at different times of the year. Note the differences between the clear day on the right and the grey day on the left. Furthermore, the landscape is bright green during the summer shot on the right and dominated by autumn colors in the shot on the left. Like many of us, I too am working on a weather machine to control atmospheric conditions (waiting on parts), but until it is complete, I'll have to stick with what I have. In other words, sometimes I have to do one of the hardest things any of us can do and that is not fly. At least if I am looking for that pretty postcard shot. There are some benefits to shooting on the grey day which I'll leave for a future article.

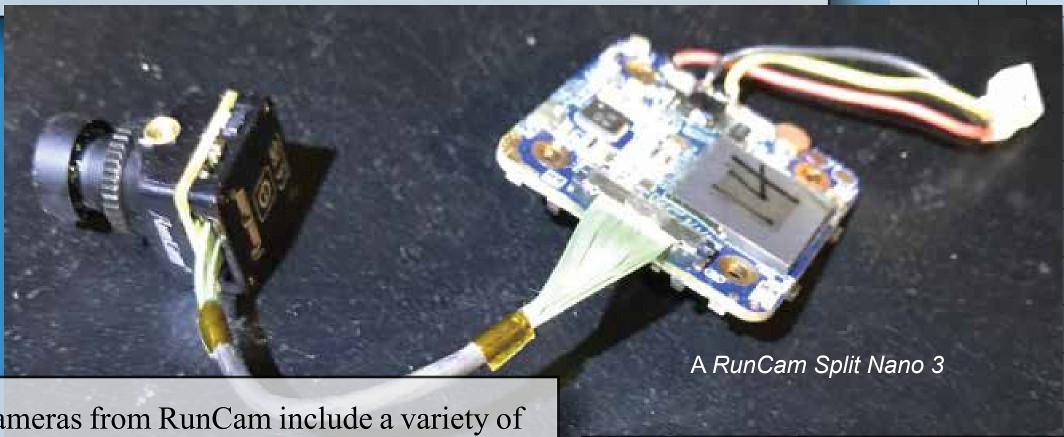
The "Split" Camera

Small and lightweight, the "Split" type of camera is particularly well suited for integrated camera/rocket designs. Split cameras consist of a camera module and a small circuit board. If we remove all of the non-essential components of a camera, we have a Split.

Split type cameras require us to provide a battery and switching. We can use a 2 or 3 cell Lithium battery or other various powering methods (check your cameras' requirements.) By wiring all onboard cameras together, all can be powered up with a single switch. For the L2 I used a latching push button (diagram at right.) Note that this wiring method has no safeguard against battery drain. If the system runs long enough to drain the LiPo batteries completely, the LiPo's may require replacement. So don't get stuck in the tree overnight.

The L2 Wiring





A RunCam Split Nano 3

Split cameras from RunCam include a variety of mounting hardware and other goodies.

One of which is a cable that can be used when wiring your own system. The wires that I received had a micro JST, 3 pin plug on each end. In order to use it for our systems, the wire needs to be clipped somewhere in the middle. While the plugs are standard micro JST, be aware of wiring if you use third party connectors. I purchased some that had the same color wires but in the wrong order.

The Split Nano 3 also comes with a clip for the micro SD card. This clip holds the memory card in place and while not required for recording, it is highly recommended.

Be cautious of heat! Split cams are designed for racing drones so airflow is assumed. Heat sinks and/or small fans may be required to keep the temps down. A tiny heat sink stuck on the main processor may be all that is needed for your installation. I used sinks and fans on the L2 (one fan per pair of boards) and all is kept cool.

Connecting the red (+) and black (GROUND) wires to battery power is all that is necessary for the camera to function. The yellow signal wire outputs a composite video signal that can be connected to a video transmitter for live viewing. More on that in a future article.

Tips and Tricks

Don't forget extra batteries and memory cards.

Flash your phone at the camera before launch. It will act like a Hollywood clapboard recording date, time, and whatever you like (here I have the weather).

Mirrors

Mirrors can be used to get shots that would not ordinarily be possible. We can use a mirror to redirect our camera view from a side view to a CINEROC type view down the rocket. This is in fact how the CINEROC works.

That being said, I do not recommend working with mirrors unless you have a specific application that requires a mirror.

Mirrors have a number of issues to consider:

1. Obtain Mirror. Finding or making a mirror of just the right size and shape can be difficult. Also, using a cheap mirror can be like looking through a dirty window. A high quality mirror should be used.

2. Position and Alignment. There are a number of factors to consider: distance from camera to mirror, angle of mirror relative to camera, angle of mirror relative to rocket, angle of camera relative to rocket, etc. It may be tricky to determine some of these values let alone align them onboard.

3. One more lens to clean. Mirrors make lens cleaning difficult if not impossible. And the mirror has to be cleaned also.

4. Mirrors flip images. This is less of an issue as our computers and software can transform our images as we please but it's one more thing that we must deal with.

While mirrors can be a great way of diverting our image, users should be aware of the issues involved.

WiFi

Many newer cameras come with WiFi connectivity. WiFi provides us with the ability to control a number of functions of the camera wirelessly with a smartphone or other device. Like anything, WiFi has its advantages and its disadvantages.

On the plus side, we have the ability to control various functions of the camera without the necessity of a physical button.

On the minus side, WiFi EATS batteries. Most of the WiFi cameras that I tested had increased current consumption on the order of 2-3 times. This translates to less time before the battery goes dead on us. For me, that is usually just as the igniter is about to fire.

I find the electrical cost to be excessively high for my own uses, but give WiFi a try when you fly. You may prefer using WiFi.

We don't TAKE photographs, We MAKE photographs.

We choose the type and make and model of camera that we shoot the picture with. We choose the subject matter, composition, lighting, camera orientation and other factors affecting the image. We choose when to press the shutter button. We press the shutter button. We post-process the image. We choose how and in what format to view and display our images.

All of these decisions contribute to the final image, MADE by us.

Conclusion

Onboard shots are some of my favorites. And the only way to get onboard shots is with onboard cameras. Whether you integrate the cameras into your rocket design from the beginning or you stick a camera on the side of an existing bird you can get great shots. I hope this article has demonstrated this in a useful way.

In future articles I'll bring back the L1, the L2 and eventually the L3. The L2 has additional cameras and systems that I'll detail later. Even the old core digger ET-1 may have some secrets to reveal.

Upcoming articles will feature ground shots, handheld and drone shots with more coming in future articles.

I hope that the material I have presented in this article and the series itself is helpful to any who read to this point and I appreciate your time. I give you credit if you have made it this far. There will be an exam later.

Contact Information:

In the previous article I neglected to include my contact info. Feel free to get in touch with me at:

trgar@pitt.edu

Can you tell how this picture was shot? A couple of hints:

1. It is not a composite. That is, it was not put together with multiple images. This is what it looked like out of the camera, I just selected a part of the frame to make this pic.

2. There are hints in the photo itself. If you study it a little, you may be able to figure out quite a bit.

I'll reveal more in the next article!