PEAK OF FLIGHT NEWSLETTER

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APOGEE COMPONENTS

PEAK OF FLIGHT

Alternative to a Traditional E-Bay Install

By Joshua Drummond

In this article I will talk about an alternate design for an electronics bay, which ducts a motor mount tube through the electronics bay. The goal I had was to have the option to use either a motor ejection charge to push out the main parachute, or use altimeters for recovery. This design allows you to build one rocket that can do both.

FIGURE 1: EXAMPLE OF WHERE I STARTED WITH MY IDEA

I started scratch building rockets years ago, and worked on incorporating the electronics bay into the rocket body. As shown in Figure 1, I built an 11.4" diameter rocket weighing eighty pounds, which flew on an Aerotech L1120 White Lightning motor for a top altitude of 1564 feet. The 2 altimeters worked very well in this setup, but I wanted more recovery options.

The next section will go over my new version of an electronics bay, with the motor mount tube going through it, allowing for motor ejection.

Apogee Parts List used on E-Bay/Airframe section:

- #11027 - LOC 7.51 Body Tube (Lower and Upper airframe)
- #13168 - LOC 7.51 Coupler (airframe for electronics bay)
- #13175 - LOC 7.51 Stiffy Coupler (to support tube inside the coupler)
- #11018 - LOC 75mm Motor Mount Tube (MMT that goes through the E-bay)
- #09190 - Nine Volt Battery Connector
- #09095 - RRC3 Sport Altimeter
- #09191 - Terminal Block
- #01250 - RockSim Software (simulation)

Additional Parts:

- U-bolts, wire, switch and ejection charge canister from local hardware store but also can be found on Apogee's website.
- Thin seal foam tape for electronics bay hatch
- Epoxy used is JB Weld 6 hour and 10-minute cure

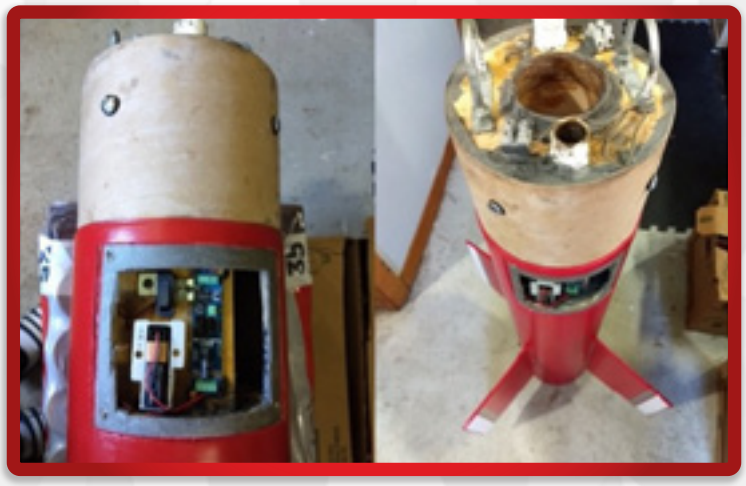

FIGURE 2: NEW DESIGN FOR ALTIMETER BAY

Many launch fields in the New England area have either a low FAA waiver, or some clubs have been losing their launch fields with higher waivers due to changes in farmer's situation. The couple of clubs close to me that do allow J impulse motors must fly under 2500 feet, which makes this a challenge. In an attempt to build a rocket that could fly on these lower limit fields but still be used when I was able to fly at a location with a higher waiver, I thought of an alternate design for the electronics bay to allow motor ejection for the main chute and still have altimeter as a backup or vice versa. This rocket I designed in RockSim using 7.51 LOC airframes, weighing 21 pounds. Figure 3 shows altitudes ranging from just over 600 ft all the way to 1700ft from an I to a K motor.

With this setup you can fly on a J435W and just use motor ejection at the 870 feet peak max altitude, keeping it in the field. This makes a very simple Level Two rocket launch, keeping under low FAA waivers and inside smaller fields.

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Newsletter Staff

Writer: Joshua Drummond
Cover & Layout: Derek Villar
Proofreader: Michelle Mason

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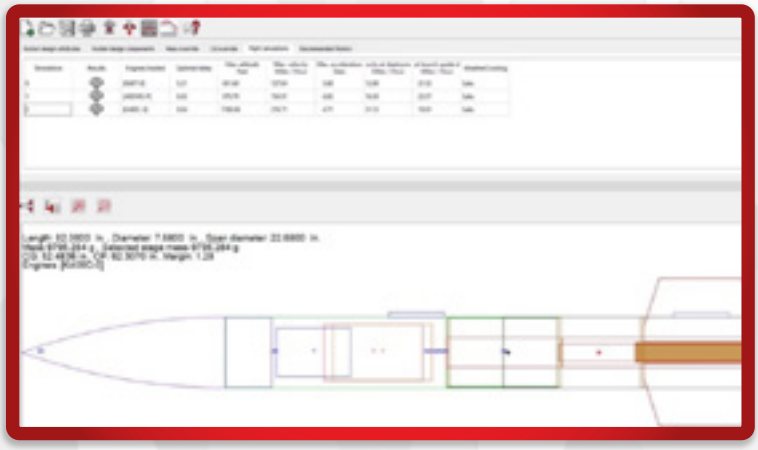

FIGURE 3: ROCKSIM OF THE 7.51 ROCKET

Comparison

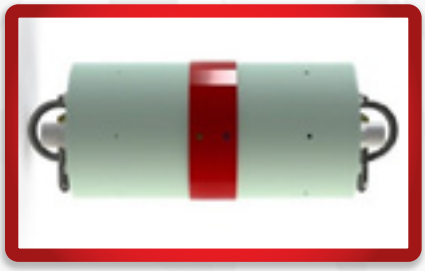

FIGURE 4: TRADITIONAL E-BAY

1: If you compare a traditional electronics bay to my built-in style, you can see two very different designs. I call this a traditional electronics bay since it is the most common way it's used in rocket recovery. At apogee the altimeter separates the rocket in half deploying the drogue parachute, then at a set altitude the altimeter fires off a charge to push out the main parachute. Motor ejection can be used here, but it would only separate the rocket in half and still needs an altimeter to push out the main parachute. This electronics bay also has U-bolts, altimeter wiring, and ejection charge canisters on both sides, and can be separated into several pieces. The restriction on this is that there is no way to use the motor ejection to fire the main parachute without removing the entire ebay from the rocket.

FIGURE 5: CHUTE RELEASE

2: Another setup that can be used for recovery for rockets without an electronics bay section is the Jolly Logic Chute Release (Apogee # 09157). The Chute Release is a device that uses a rubber band that wraps around a rolled-up parachute and holds it closed. A pin secures the band to the Chute Release device till a chosen altitude then releases the pin/band, allowing the chute to open up and inflate . This type of recovery uses no pyro charges and just relies on motor ejection to push the parachute and Chute Release out of the airframe.

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Chute Release Specifications

Size	54 x 31 x 11.5 mm (2.1 x 1.2 x 0.45 in)
Weight	17.5 g (0.6 oz)
Minimum Altitude	For flights higher than 200 feet (60m) above ground level
Release altitudes	100, 200, 300, 400, 500, 600, 700, 800, 1000 feet (30, 60, 90, 120, 150, 180, 210, 240, 300 meters)
Rocket requirements	Requires the use of motor ejection, and enough space for Chute Release and parachute, at least BT-60 1.6″ (41.6mm) diameter tube. May work in some 38mm rockets.
Battery	Built-in rechargeable battery and USB charging cord included.

FIGURE 6: ALTERNATIVE E-BAY

3: Here is my design showing the electronics bay built into the lower airframe section of the rocket. As you can see, the motor mount tube travels from the base of the rocket all the way through the electronics bay, stopping at the top centering ring. The electronics bay is completely sealed with epoxy around the centering rings and motor tube, to prevent any motor ejection charge from entering the bay. The coupler used is a LOC 7.51” coupler and LOC 7.51” Stiffy for inside the coupler . I used a piece of ⅜” thick plywood to mount the altimeter, battery and arming switch. The plywood is screwed and glued into place. The cutout hatch for the electronics bay has a foam lining that seals when it is bolted to the body tube. I also drilled a quarter inch hole in the hatch cover for the altimeter to sample the air and also to access the arm switch. Only the top of the electronics bay has U-bolts to secure parachute lines, as well as altimeter pyrotechnics wires, terminal blocks and ejection charge canisters. This setup is a fixed permanent installation into the rocket.

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Flight Recovery Examples

Simple Recovery

You can use just the motor ejection to push out the parachute at apogee and still keep recovery possible in smaller fields, but there are no backups if the motor ejection fails.

Complex Recovery

So as an example again, using an electronics bay set-up, I have launched a rocket weighing 21 pounds using the Aerotech J435W motor. The rocket flies to about 870 feet (in RockSim), and I have set the altimeter to fire at apogee for drogue and main chute. The motor ejection charge can be adjusted to go off 2 seconds after apogee as a backup for the drogue and main parachute. Then using the "main Channel" on the altimeter you can set that pyro charge to go off at 500 feet as a third backup for the main parachute. I also plan on using the Chute Release as a parachute backup to open a second main parachute at 300 feet. So, by having all these redundancies it makes this flight much safer.

Higher Altitude Recovery

For flying higher altitudes, you can use the motor ejection with or without the altimeters to eject the drogue/main parachute out at apogee and use Jolly Logic Chute Release to open main at a selected height.

You can see how nice it is to have a lot of options to mix and match the recovery setups. Rocket clubs I have talked to like the redundant backups as it does make a safer flight.

Construction

I used the 7.51" LOC coupler's full length at 15 inches for the electronics bay in this rocket. I started out by fiberglassing the body of the rocket for added strength, but it is not a necessity for this project.

FIGURE 7: LOC AIRFRAME FIBERGLASSED

Next, I measured a cutout on the upper end of the lower airframe for the hatch. The hatch cutout measures 6½ inches wide by 5 inches high. Use a saw to carefully cut it out.

FIGURE 8: HATCH CUTOUT

After the cut-out is made in the rocket airframe, draw a line on the coupler to divide it evenly in half. Slide the coupler into the 7.51" LOC airframe until the line drawn meets the top of the airframe. Then mark the cutout on the coupler ¾ inch smaller than the hatch window. This allows the hatch door to be bolted to the coupler, sealing the electronics bay.

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FIGURE 9: DRAWING DIVIDING LINE

Then pull out the coupler and make sure the LOC Stiffy tube is 1" shorter in length, which allows the top and bottom bulk plates to recess into the coupler, flush against the coupler. Add glue to the inside of the LOC coupler and slide the LOC Stiffy tube into the coupler leaving ½ inch space from the coupler edge at the top and bottom. After the glue dries, cut the window that was marked earlier. This is the opening for the electronics bay.

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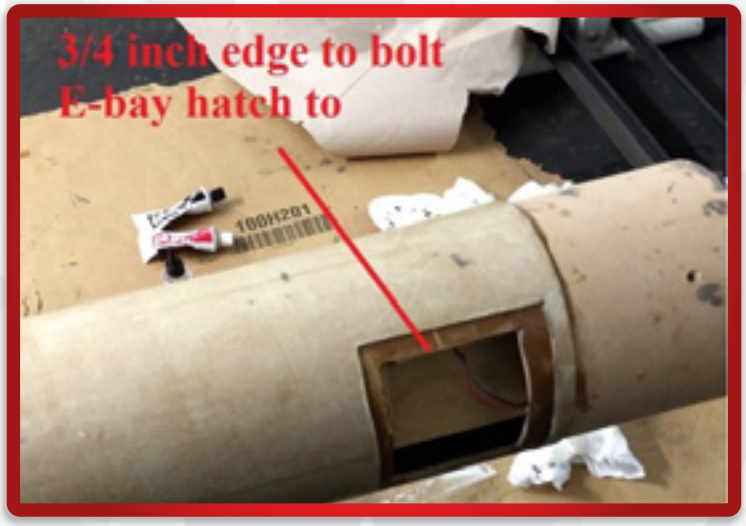

FIGURE 10: EDGE TO BOLT HATCH

FIGURE 11: STIFFY TUBE RECESSED

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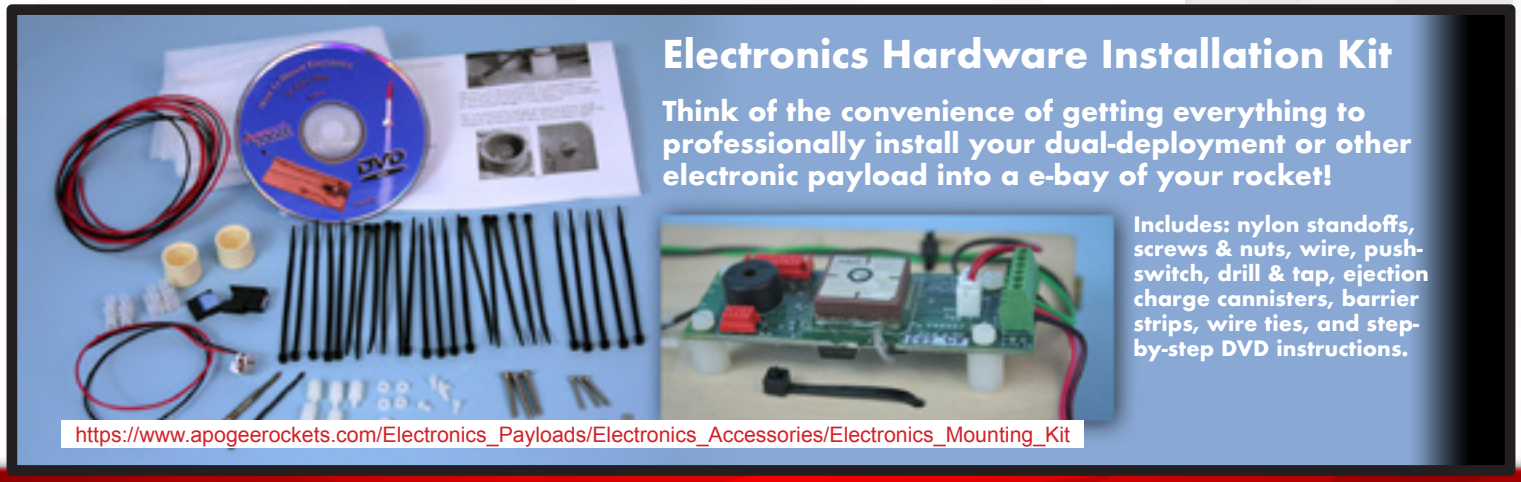

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FIGURE 12: CENTERLINE MARK AND BOLTS WITH O-RINGS

Mounting for upper airframes

Slide the coupler with the hatch cut out into the lower airframe tube and center up both cutouts. Then slide the upper section airframe onto the coupler. Also, at this point make a line up mark on the upper and lower airframe to make it easier to line up the sections together. I make four even marks around the body tube several inches up, for the bolts to secure the upper airframe. Then drill these marks out to put in t-nuts. The t-nuts install through the inside of the coupler/stiffy so I can put a bolt through the airframe and secure it to the t-nuts in the coupler. I press the t-nuts into the holes with a clamp and then apply epoxy to secure them. Carefully apply the epoxy on the backside of t-nut so as not to get any glue into any of the threads. The bolt and t-nut size I used are ¼ inch but anything close to that would work. Also, I used rubber O-rings, or you could use rubber washers on the bolts to make an air tight fit.

Another method of securing the upper airframe to the coupler would be the Removable Plastic Rivets (Apogee #13076).

FIGURE 13: CENTERLINE MARK AND BOLTS WITH O-RINGS

Centering Rings

Next, I made my own custom ½ inch thick centering rings out of plywood to fit inside the LOC coupler and fit the 75mm LOC Motor mount tube. I glued one of the centering rings in the bottom of the coupler and let it cure. Then I cut out a sled from 3/8” plywood, 4 inches wide and the height the same as the LOC Stiffy Coupler, so that the sled can fit snugly between the upper and lower centering rings. Then glue the sled into place facing it towards the cutout window on the bottom centering ring, being careful not to cover the hole for the motor mount tube.

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FIGURE 14: SLED FACING WINDOW

Next drill holes to fasten 2 U-bolts on opposite sides of the motor mount tube hole. Install the U-bolts with the nuts and place some glue so the nuts don't back out. Now glue the other centering ring to the top of the coupler and sled. I also secured the sled with wood screws through the centering rings into the sled.

FIGURE 15: U-BOLT INSTALL

Motor Mount and Lower Airframe Section

At this point I used the whole 34-inch length of the LOC motor mount tube so it can run from the base of the rocket all the way through the electronics bay section at the top. Slide the motor mount tube through the electronics bay so the tube sticks out ½ inch. Use epoxy to glue the motor mount tube to the centering rings on the outside, and reach through the hatch window to spread glue on the other side of centering rings.

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FIGURE 16: MMT INSTALL

FIGURE 17: E-BAY CENTERED

After the glue on the motor mount tube is cured, glue a centering ring in the lower airframe just above the top of the fin slots and let it dry. Then apply glue to the motor mount hole in the centering ring, on the motor mount tube where it will intercept with the centering ring, and glue the inside of the top section of the lower airframe tube where the electronics bay will be. Now slide the motor mount tube and electronics bay into the lower airframe tube till the coupler reaches the halfway mark that has been drawn. Double check to make sure the cutout windows on the airframe and coupler are lined up and centered. Check to see if any glue is on the other half of the coupler where the upper airframe slides on to and clean it up.

Hatch

Now we need to be able to secure the hatch to the coupler sealing the electronics bay, Place the hatch piece into the cut out area. Drill a hole through the hatch cover and coupler in each corner, making 4 holes total. You can make 4 more bolt points by drilling a hole at the midpoint of each side but I find a bolt in each corner works well. Remove the hatch plate and press in the t-nuts through the holes from the inside going out. I used a smaller #6-32 t-nut for the hatch. Carefully apply epoxy to the back side of the t-nut so as not to get any glue in the threads.

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FIGURE 18: HATCH COVER BOLTED ON WITH O-RINGS

To make the electronics bay sealed air tight, use seal foam tape. The seal foam tape will have a sticker side and foam on the other which makes a great seal. Apply the seal tape to the coupler by peeling the sticker side off and placing it on the ¾ edge of the coupler. Depending how wide the tape is you may have to trim it to the ¾ inch width. Make sure to cut a hole in each spot for the hole to the t-nut so the foam does not get in the way of the bolt.

FIGURE 19: U-BOLT INSTALL

The altimeter needs a breather hole to sample the air, so I made a ¼ inch hole in the hatch plate. Make sure the hole will line up with the placement of the arm switch that gets mounted on the sled.

The bolts that screw into the t-nuts need to have no leaks so use rubber O-rings or washers.

Outside Electronics Bay Hardware

Take the top centering ring and drill two 1/8“ holes on opposite sides of the motor mount hole for the 22-gauge wire going to the altimeter. Then run the wires through the

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holes leaving enough wire to hook into the terminal blocks and reach the pyro channels of the altimeter. Seal the wires where they go through the centering ring with epoxy to keep those holes airtight. Next, mount and secure terminal blocks on each side of the motor mount tube near the wires by using epoxy and a wood screw to keep them in place. Next, install the wires on each side to the terminal blocks. Then install the ejection charge canisters near the terminal blocks on each side. I used pvc ¾ inch caps from a local hardware store but you can also find them on Apogee's website (#03068).

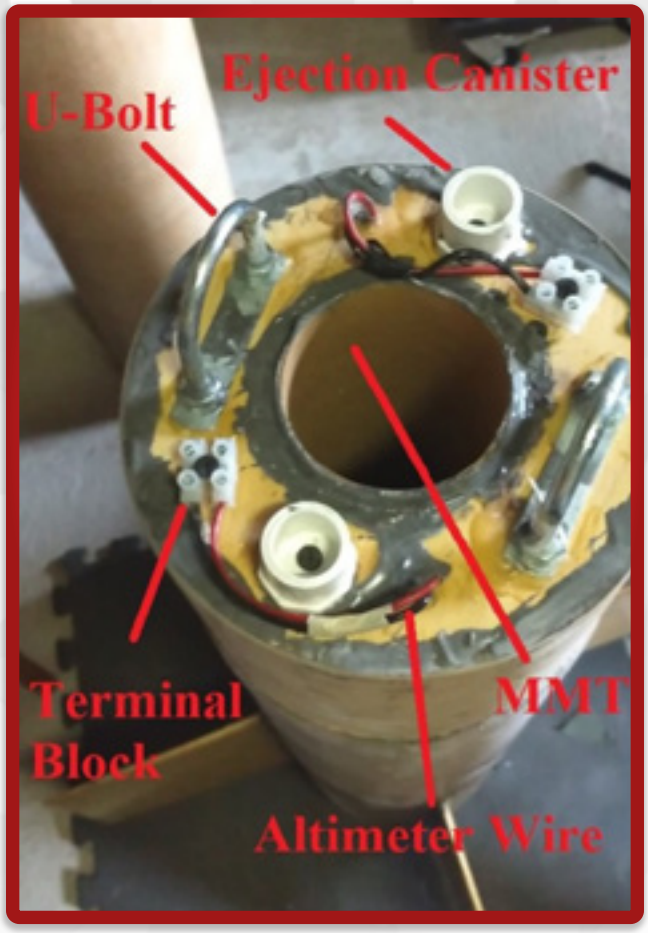

FIGURE 20: U-BOLT INSTALL

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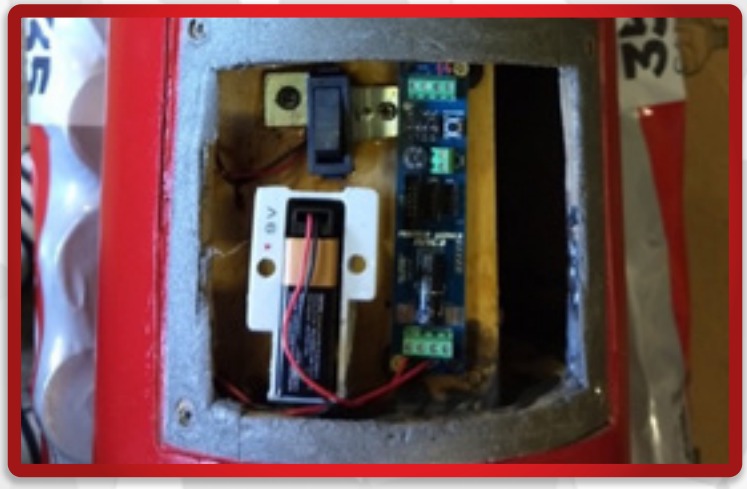

FIGURE 21: INSIDE E-BAY SETUP

Inside Electronics Bay Hardware

The arm switch has to be positioned directly behind the air sample hole on the hatch cover for the altimeter bay. This will allow access to arm the altimeter on the launch field. So position and secure the switch first. Mount the altimeter on the sled by using ¼" rubber grommets with a small #4 wood screws to hold it in place. Rubber grommets are great for absorbing shock on acceleration and descent of the rocket. Or you can use altimeter mounting posts from Apogee (#13084). They are made out of nylon and also can help with absorbing some shock and electrical shorts. The battery holder is a custom piece I made and secured to the sled with screws. The battery is zip tied onto the battery holder to keep it from moving around, potentially disconnecting power to the altimeter.

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www.ApogeeRockets.com/RockSim/RockSim_Information

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Ground Testing the Electronics Bay

I tested the altimeter in the electronics bay to make sure it was sealed tight by using a shop vacuum, with only the ¼ inch breather hole letting air in. I loaded a black powder charge in one of the ejection charge canisters and placed a FireWire e-match (#89866). I secured the e-match in the canister with tape and connected it to the terminal block. I secured the hatch cover by bolting down snugly against the seal foam tape on the coupler. Next, I bolted the upper airframe and loaded the parachute protector, drogue chute, main chute and nose cone. Then I turned the arm switch on, activating the altimeter and listened for the ready beep. I taped the vacuum nozzle over the hole on the hatch cover and turned on the vacuum for a few seconds, then shut it off. The test was a success, because the altimeter was able to read pressure changes and fired the ejection charge pushing out the nose cone and parachutes when I turned the vacuum off.

FIGURE 22: VACUUM TEST

FIGURE 23: SUCCESSFUL TEST

Conclusion

The ultimate plan for this project was to have a wide range of options to adapt the recovery system for weather changes in wind, field size, low FAA waivers or any combination of the three. This does not have to be used on just heavy rockets but any rocket to give more recovery options. Living in New England, the ability to launch level 2 motors is very difficult with most clubs having a J impulse limit with a 2000–2500-foot altitude limit. This led me to design an electronics bay that would allow motor ejection charges for the main parachute but also the ability to have an altimeter as a backup. Add other systems like the Jolly Logic Chute Release and this opens a lot of redundant recovery for safer flights. If I want to have a flight using a heavy rocket with a J motor, using the motor ejection charge without worrying about losing it on smaller fields, this makes a fun simple flight. This is what I love about rocketry - coming up with new ideas, improving on existing ones or learning from other people.

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This 7.51 inch rocket I built with this electronics bay setup has a 75mm motor mount for future plans of bigger flights. I still could use the altimeter in the lower airframe to separate the rocket at apogee and make another interchangeable upper body airframe to house a second altimeter to deploy the main at a chosen altitude.

About the Author

My name is Joshua Drummond and I live in Massachusetts with my wife and 3 kids. My first job was an upholsterer which fit me well since I love to build and put things together. Hobbies at the time were working on cars, building chain mail armor, sewing costumes and constructing custom speakers. In Spring of 2001 I found a new hobby, model rocketry, as a way to spend time outdoors with my family. A friend of mine had a small field to launch Estes rockets at Eaton Farms in Sutton, MA. As my hobby skills and interests grew I got into larger mid power projects and needed a bigger field to fly in. I transitioned from buying kits to designing scratch built projects. I designed a rocket called Jupiter and was a 29mm 6 cluster rocket on a 7.5" airframe that later I made into an 8 29mm cluster. Then realized I needed a high power certification for projects like this. In the Summer of 2001 I found the Cato Rocket Club in Connecticut getting my level 1 cert and level 2 cert by December 2001. I had stepped away from the hobby for personal reasons and now back certified level 1 again and going for cert 2 soon. I still love to designing custom rockets and now use my Upholstery skills to make parachutes. Some of my other interests for fun is on the computer playing World of Warcraft, World of Tanks and designing rockets on RockSim.

FIGURE 24: JUPITER 3.0 7.51-INCH DIAMETER ROCKET COMPLETE