Edge of Space Sciences PROMOTING SCIENCE AND EDUCATION THROUGH AMATEUR RADIO AND HIGH ALTITUDE BALLOONS

Stratosphere

Volume 4, Issue 2 June 1994 Denver, Colorado

Summer Edition

Presidents Corner

by Merle McCaslin

As expected we have had a busy year so far, two more launches since the last newsletter, EOSS-16 on May 1st and E0SS-17 on June 4th. This makes three launches so far in 1994. All have been good flights with a few anomalies to work on. We participated in the Channel 4 Expo in March and have given three presentations to various organizations. Automatic Packet Reporting System (APRS) was flown on flights sixteen and seventeen and it worked well. Brian Thomas took the lead on this and has become very familiar with APRS operations. Bob Schellhorn modified the controller to incorporate the APRS data in the packet downlink. A big thanks to Brian and Bob for their efforts. Plotting the real time path of the balloon at the ground station has been very interesting to our visitors.

On EOSS-17 we had planned to fly Shuttle II with Magellan GPS on board, but the GPS board failed several days before the flight. The good news is that we were able to keep the flight schedule using Shuttle I. Nice to have a back up unit.The GPS board is being returned to the vendor for failure analysis and repair.

I received very few comments on my list of things to do for EOSS in the future. One person who did read it was Marty Tressell, a member from Pueblo, Co. (see Marty's article). He wants to organize a balloon group in Pueblo. Marty's organization has donated monies for a color camera and they plan to sponsor an EOSS flight next fall with a middle school. You will find many good articles in this issue to explain the details of what is happening within EOSS.

JUST A LITTLE MORE GAS

Special Visitor at EOSS-17

by Jack Crabtree

We had a great crowd at the launch site of EOSS-17 thanks in part to some advertising of the flight in the Institute of Navigation (ION), Rocky Mountain Chapter Newsletter. Among these was Mr. Phil Wildhagen of Aerospace Corporation in Los Angeles. Aerospace is the civilian technical arm of the Air Force.

Phil made the trip solely to witness the balloon flight and especially the dynamics (movement) experienced by the payload package. While the Air Force already use balloons for wind profiling, they are not yet using GPS and present methods are not as accurate as they desire. In the near future, GPS will be aboard balloon-borne packages, but the swaying and swinging motion is a concern in that it may induce unacceptable errors. Wind profiling is the precise measurement of wind velocity versus the numerous differing levels of the atmosphere. This is valuable data that the Air Force (and NASA) need just prior to a rocket or Space Shuttle launch. During the flight Phil took many notes. He commented to me that from the ATV data and some data from the NAVSYS GPS package, he felt GPS was the way to go and errors due to the payload dynamics should be minimal. He even asked us for a copy of the video tape. He was especially exuberant over the slow motion re-play of the balloon burst.

As Phil left for the airport, he stated he was very much impressed with the organization and professionalism of the entire EOSS team and wanted to keep in touch with our activities.

Oh yes, he is also a ham.

NOW THAT'S A SWITCH!

by Jack Crabtree

Some of you may have noticed that on EOSS-17, the experiment temperature monitor telemetry had only two states, +175 deg C and -80 deg C. Actually this corresponds to a short and open across the temperature monitor A/D input. We were testing an altitude switch that had been given to us by Norm Kjome of the University of Wyoming. The switch was built from the bellows of a surplus Radiosonde barometric pressure sensor. The bellows had been installed in a aluminum sheet metal frame along with a micro switch. As pressure dropped and the bellows expanded, it eventually contacted and closed the micro switch contacts. On EOSS-17, the switch closed at 27,000 feet on the ascent and 25,000 feet on the descent. We think this is pretty good and probably is not too much less accurate than

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Newsletter of
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Nets

The weekly on the air net is held on the Colorado Repeater Association's 147.225/825 MHz Repeater each Tuesday evening at 8:00 PM.

Meetings

The monthly meeting of E.O.S.S is held at the Castlewood Library at the southwest corner of the intersection of Arapahoe ave. and Uinta st. This is just west of I-25 on Arapahoe ave. Talk-in is on the 146.640/040 MHz repeater.

Membership

Edge of Space Sciences Membership is open to all interested parties. Student Membership is $2.00 per year. Regular Membership is $10.00 per year.

To join, send a check to:

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Send articles for publication to the editor of *Stratosphere*:

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the hysteresis in our barometric pressure-altitude measurement system. Where the switch closes can be controlled by varying the gap between the bellows and the micro switch. Applications for this type of switch include: to enable the operation of experiments after a preset altitude is attained or, to activate an emergency back-up release system should a balloon become a derelict and enter controlled flight space. There are probably many more applications. If you have one, we would like to hear from you. This is also an example of how simple ideas can solve big problems. You probably can think of a few yourself!

International Balloon Activity

By Mike Manes, W5VSI

The high altitude balloon bug has spread beyond our borders. Through the magic of amateur packet radio and the internet, we've learned of some recent flights by our peers in Canada and Argentina. Interestingly, these flights were truly international in that they crossed national borders. EOSS has a pretty well equipped Tracking and Recovery team, but I doubt that all of them carry passports on the chases!

CANADA: Ronald VE2JOR heads up an informal balloon group in the Montreal area. Their first launch was on May 4, 1994, it was pretty sophisticated. Although there was no ATV aboard, their payload sported an in-band odd-split 2m FM repeater, 144.35 MHz up and 147.55 MHz down, a tracking beacon on 147.455 and a packet down-link on 145.07 MHz.

The packet rig comprised a Magellan GPS board, home-brew GPS antenna and a HandiPacket TNC configured to down-link lat./lon. in APRS format, similar to the last two EOSS flights. (See Brian Thomas's piece in the last "Stratosphere" for further on APRS). Ronald provided an interesting new twist to APRS, though. He set his home station up with a multiport Kam TNC connected to his 2 meter station and his 30 meter HF station so that the APRS beacon down-link was retransmitted on 10.151 MHz well beyond the balloon's radio horizon. The beacon text included GPS-derived altitude as well. Any station which could receive the 30 meter signal and was equipped with APRS was able to monitor the progress of the flight every bit as well as Ronald's home station could. This seems to be a pretty slick substitute for the HF net which EOSS has operated with less regularity than we would like.

Gerry, VE2AW, served as net control on the repeater, and he logged contacts with over 320 stations as far as 400 miles away during the flight. Ronald indicated that none of the three on-board 2m transmitters caused any problems for the repeater receiver, since its antenna was 40 feet up the payload string from the transmit antennas.

The flight launched from Hawksbury, Ontario, between Ottawa and Montreal, around 10:00 AM and cruised southeast. Using only the APRS display on his laptop and familiarity with local geography, Ronald & his son tracked the payload across the St. Lawrence river into extreme northeast NY state. US border guards waved him through when he described his mission and demonstrated APRS. They recovered their payload just west of I-87 near Mooer's Forks, NY, from a tree about a mile off the road. The dairy farmer who had observed the landing led them in.

Ronald hopes to include a Balloon Controller in upcoming launches, and we have sent him data on our Shuttle I Controller along with a copy of the EOSS Handbook. Like EOSS, the Montreal group wants to get local students involved in the flights, and in his profession as a photographer for Canadian National TV, Ronald is in an excellent position to put high-altitude ballooning and amateur radio in the public spotlight.

Bon Voyage and many happy landings to our friends north of 44-40! Ronald can be contacted via the packet network as VE2JOR through:

`VE2WNF@VE2WNF.#MTL.PQ.CAN.NA`

ARGENTINA: Gustavo Carpignano, LW2DTZ, is active not only in high altitude ballooning and an EOSS member, he also is a major player in the Argentine AmSat group and is busy preparing VoxSat for launch in the coming months. Contact with Gustavo has been almost exclusively on the Internet, where he can be reached at `GUSTAVOC%EZE8A@ITINET.NET`. Rick NØKKZ has sent him a .GIF image of our EOSS-13 photo from The Edge of Space in an Internet Email enclosed file.

May was a busy month for the Argentina balloon group, with two launches in the same week.

The first was on Wednesday May 25, 1994 at 0950 local time from the campus of La Plata Engineering University in La Plata, about 30 miles southeast of Buenos Aires. The payload was a 0.3 W cross-band FM repeater, 29.13 MHz up and 144.910 down built by Jose Machao, LU7JCN and Hugo Lorente, LU4DXT. Surface winds were calm, but visual contact was lost in the overcast soon after launch.

Although Argentina's overall climate is much like that in the US, the seasons are reversed from ours, so the Buenos Aires weather in May is more like US coastal cities' in November.

The Kaysam 78G balloon burst at an estimated 20 km altitude (66,000 feet) two hours after launch. Although lower than our customary 1200 gram balloon apogees, nearly 100 contacts were logged through the repeater between hams in Argentina and Uruguay as much as 700 miles apart.

The balloon was tracked by fixed DF stations reporting their bearings on both 2 m and 40 m nets. DF plots revealed an easterly course across Rio De La Plata toward Montvideo, Uruguay until LOS was reported about 45 minutes after burst. The flight was almost entirely over the waters of the 50-mile-wide Rio De La Plata, which looked more like bay than a river.

Bill Brown's Balltrak program was run post-flight with actual winds aloft data from Ezeiza International Airport. The results indicated that the payload probably traveled over 150 miles east and landed in the water just south of Piriapolis City, Uruguay, about 50 miles east of Montevideo.

Having GPS on board would have told them precisely where all of their payload investment had sunk! A modest payload is a prudent choice for them.

Gustavo's second flight was launched 4 days later, on Sunday, May 29 from Cordoba, a large city in the north-central Pampas region about 350 miles northwest of Buenos Aires. The terrain around Cordoba may feel like home to the EOSS Recovery Team. It's a high, flat, dry plain used mainly for grazing cattle.

The payload was constructed by students from the Catholic University of Cordoba. It was a meteorological radiosonde which down-linked inside temperature, outside temperature, barometric pressure and humidity using four audio tones via a 146.05 MHz 50 mW FM transmitter.

The balloon launched at 1102 local and burst at an estimated 15 km (49,500 ft). As in the earlier flight, hams reported bearings over 2 m and 40 m nets until LOS only 2 hours after launch. Gustavo didn't mention the plotted course or whether this payload was recovered, but it's unlikely that it landed in water.

Gustavo has tentatively agreed to prepare a paper on Argentina's high altitude balloon program in time for the 2nd Balloon Symposium in Des Moines this July, although I expect his priorities are pretty well directed toward getting VoxSat ready for launch. David WP4IJR has agreed to translate from Gustavo's native Spanish if needs be.

I for one am looking forward to learning more about how the southern hemisphere winds affect their flight profiles. From what I understand, the low altitude winds blow mainly from the east due to reversal of the Coriolis Effect, but the jet stream is still westerly and driven by the sun.

EOSS-17 Flight

by Brian Thomas, NØVSA

The flight started promptly at 16:00 UTC from the NAVSYS INC. facility just south of Monument, Colorado. The weather was excellent and we had a great launch site with a big gazebo for the ground station.

APRS performed perfectly until Loran-C lost lock on the descent. The spectators were treated to the "realtime" updates of the balloon's position. The ATV video also was good until we lost an antenna on descent. We captured a great shot of the balloon burst. Dave Radomski, KTØH, video taped the balloon burst with a camcorder from his ground position out in the field. During the descent of the payload the ATV antenna was forcefully separated from its short coax lead and plummeted to the ground from about 70,000 feet.

The tracking and recovery team did another great job. During the descent phase of the flight at about 44,000 feet, Loran-C lost its lock and did not regain it for the remainder of the flight. The balloon's position was followed using direction finding techniques and several of the tracking team had the balloon in site and some saw it burst from the ground.

The tracking and recovery team consisted of:

Paul Ternlund WB3JZV (computerized triangulation)
Marty Griffin WAØGEH (field coordinator/net control)
Ed Boyer NØMHU air mobile
Richard Shaw WB5YOE
Tom Isenberg NØKSR
Bob Ragain WB4ETT
Colleen Ragain NØQGH
Dawn Ragain NØQCW
Greg Burnett KØELM
Greg DeWit NØJMH
Larry Cerney NØSTZ
Roger Smith NØLEQ
Bill Andrus NØEUL
Rick von Glahn NØKKZ (back at the ground station)

Flight Sysopsis
Date: June 4,1994
Launch time: 16:00 UTC
Launch site: Monument, Colorado
Launch site Coordinates:
Latitude 39 deg 02.67'N
Longitude 104 deg 52.53'W
Balloon Burst Altitude: 94,000 feet
Balloon Burst Coordinates:
Latitude 39 deg 08.22'N
Longitude 104 deg 40.08'W
Landing Site Coordinates:
Latitude 39 deg 11.52'N
Longitude 104 deg 25.99'W
Ascent Rate: 550 fpm
Descent Rate: 1113 fpm
Payload Frequencies:
Telemetry: 144.340 MHz
ATV : 426.250 MHz
Beacon : 147.555 MHz

EOSS-17 Flight Anomalies

by Jack Crabtree

Flying balloons is like playing golf: You get better with time but you never really get it right. EOSS-17 was an excellent flight and with the BAR-B-Q it was a heck of a lot of fun. Among our crowd of visitors however, Murphy once again made his presence known.

Loss of ATV

At about 70,000 feet on the descent, all of a sudden we lost ATV at the ground station. We soon verified that ATV had been lost in the field as well. While there seemed to be more tumbling and spinning of the payload this time, up till we loss ATV, the system had been working very well (We have some great video of the balloon burst - see photo 1). When the payload packages were recovered, the reason for the loss of ATV become apparent, the antenna was gone! It seems all that was left was the center pin of the BNC connector. While both the connector and the stabilizer bar had been taped, it had worked itself loose. The stabilizer bar by the way, s a plastic stick that attaches to the antenna element and to the nylon string going down to the beacon. The purpose is to dampen out the swinging of the ATV antenna. It is obvious that the dynamics, perhaps compounded by the extreme cold is worst than we thought and corrective action will have to be implemented. This should not be too complex now we know of the problem.

Loss of Loran C - This has plagued us on previous flights. Everything is working fine for most of the flight than all of a sudden we experience loss of position data. On other times it apparently was caused by the breakage of the dangling antenna wire (very brittle with the extreme cold). This time however, the antenna was intact. This one remains a mystery. It was also reported (more than once) that the position data was approximately two miles in error. We've also observed this before. It seems that this distance approximates a wavelength at 100 KHz. The offset could be caused by a cycle-slip in the zero-crossing time measurement scheme that LORAN C uses. If we note this in the future at the launch site, and believe it will remain constant, we do have the option of programming an offset in the position data. Wonder why the LORAN C people included this option in the design?

We had a few other minor nuisances on EOSS-17 and have corrective action planned or already in place. All in all though, it was a great flight and special thanks to the tracking and recovery team, 17 for 17!

Photo 1 - EOSS-17 Burst

Balloon Tidbits

by Merle McCaslin

Popular Science July 1994 has two articles on balloons. The first one is under What's New. The two-ton Flare Genesis observatory is the most powerful solar telescope ever flown. It will go to 125,000 feet over the South Pole this December mapping magnetic fields on the suns surface.

The second article is under the Science & Technology section . Scientist at Space Telescope Science Institute, which operates the Hubble Space Telescope have proposed a new telescope that will have twice the resolution of Hubble at about one-tenth the cost. The Polar Stratospheric Telescope, or POST would be a test bed for optical systems. It would hover seven miles above the earth, dangling below a football-field-size helium balloon anchored to the ground by a tether. The helium balloons are similar to those used to monitor drug trafficking along the border between the U.S. and Mexico. These balloons could be reeled in on its half-inch-diameter Kevlar tether for servicing.

Jack Crabtree has been in touch with the NASA balloon group out of Palestine, Texas and they sent him some video tapes of NASA launches. The balloon train is 900 feet long and the balloon reaches a diameter of 400 feet at 120,000 feet. The payloads weigh up to 5000 pounds and the instruments on board are gathering data on the ozone layer. It is very interesting to see their operation at that size. The video show both launches in New Mexico and at the South Pole.

Paul Ternlund loaned me a book Japan's WW II Balloon Bomb Attacks on North America. It is part of the Smithsonian Annals of Flight and is very interesting. It covers the development of the hardware and the flying of the balloons. The balloon were made of paper and much more sophisticated than I thought when I first heard about them. They carried ballast in sand bags and would drop bags to keep at the proper altitude during the temperature swings from day to night. There were 9,300 launched from November of 1944 till April of 1945.

Ranum High Students Measure Ozone Concentrations

EOSS-Sweet 16

by Andy Kellett NØSIS

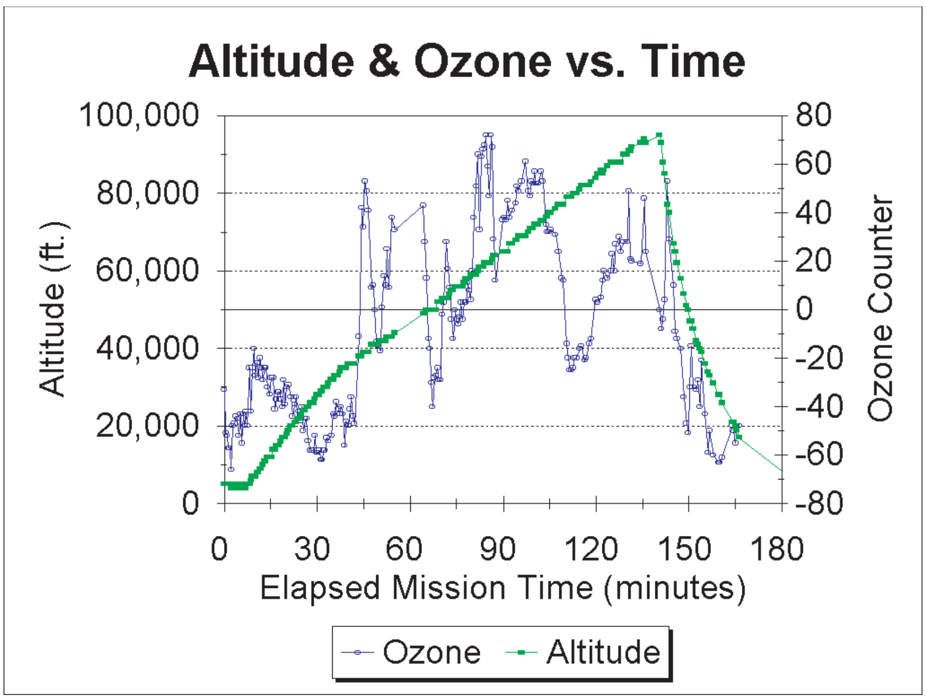
I wish I could say that I felt totally confident on launch day as EOSS-16's balloon train was slowly fed into the sky. As liaison between EOSS and the MESA (Math, Engineering and Science Advancement) group at Ranum High School, I had seen the student's payload work under worst-case RFI situations, but more than once I had seen it choke.

The students proposed an experiment to measure the concentration of ozone at different altitudes at the December EOSS meeting, but most of the work began once the students received an ozonesonde from Dr. William Komhyr, founder of EN-SCI Corp. and a scientist at the National Oceanographic and Atmospheric Administration (NOAA). The sonde comprised a small air pump and an electrochemical cell mounted on an aluminum frame. The pump pushes air through the cell, which contains a potassium iodide solution. When an ozone molecule encounters a negative iodide ion it oxidizes it to elemental iodine, giving up an electron. By counting these electrons, you can determine how much ozone is in the air that was pushed through the cell.

Because we were now just two months from our scheduled launch at the end of April, I decided to provide the MESA students with a design for an interface between their sonde and the shuttle. Anyone who attended the April membership meeting knows what happened to that design. Some obvious design flaws were pointed out. Luckily the technical expertise of EOSS is pretty deep, and Mike Manes (W5VSI) suggested using the same design he used in the last stage of the interface he designed for EOSS-15.

Using Mike's design, a prototype circuit was built and cold tested. It seemed to work OK. So the next step was to let the students construct a printed circuit board version of the prototyped circuit. In one evening the students were able to layout and etch a circuit board, test out the ozonesonde using a calibration unit supplied by EN-SCI, and apply aluminum foil to the inside of the ozonesonde's box for RFI shielding.

By this time we were less than a week from our scheduled launch date of April 23rd. On the Tuesday-night net I reported that we would be ready for a launch that Saturday. By Friday afternoon, the interface circuit had been completely built, but was untested. At Ranum High School the sonde and interface were tested for basic operation, but we still hadn't hooked the whole payload up to see if it would work.



Friday evening the sonde and payload were hooked up and transmitting reasonable telemetry. However, when a plastic bag that had been filled with ozone from an arcing motor was placed over the sonde, there was no response in the telemetry. Now the problem was to figure out what wasn't working. Did the bag really have ozone in it? Was the electrochemical cell working? Was the interface working? Without the ozonesonde calibrator, (a big box containing an ozone source, a test electrochemical cell and meters to measure everything), there was no quick way to tell what was at fault. So the Saturday launch was scrubbed. (Incidentally, after the launch was scrubbed, I found out first hand what happens when lithium batteries are shorted - they get VERY hot, they split open and steam. According to Mike Manes I'm lucky the batteries split instead of exploding.)

Tuesday evening I was back at Ranum. This time Rick von Glahn was nice enough to bring up his portable packet station so that we could monitor the payload telemetry. As I helped Rick bring his stuff inside I believe my words were, "We'll be copying telemetry in half an hour."

Five hours later, at 11 PM, we had determined why the thing still wasn't working.

First of all, the electrochemical cell was working, but that fact was masked by a faulty meter on the ozonesonde calibrator. The meter which should have shown the sonde current going up and down with the ozone concentration would not go up to the right reading. The students and I connected and disconnected things, trying to get the reading to where it should be until Rick came over to the table and rapped it a few times with his HT. Brilliant!!! The meter needle was stuck! It was actually more than stuck, it swung wildly whenever you touched the calibrator. Now we had to try to measure the output without the calibrator's meter. No problem, I had just bought a super-duper new meter and was ready to try it out. We hooked it up, and again, the current would not go as high as it should. As a double check we simply connected a 1000 ohm resistor across the output of the cell and measured the voltage. We expected a few microamps of output current which would produce a few milliamps voltage across the resistor. Using Rick's pocket voltmeter we read tens of milliamps instead of three or four. More confusion. By this time (about 9 PM) we had called-in Dr.

Komhyr to see what he could do. When he arrived he cannibalized the meter from the calibrator's test cell and hooked up the cell. Now it worked perfectly. This is what happened. Because I believed the spiffy new meter was measuring the correct current, we kept putting more and more ozone through the cell. However, for some reason the meter was NOT reading correctly. When we hooked up the resistor and the voltmeter we really WERE seeing the correct output. Good thing we weren't operating a nuclear power plant.

So now we were ready to test the interface output with real ozone levels. The next problem to crop up was that when the gain was set for maximum dynamic range, the DC offset level could not be set low enough. The answer to that problem was to increase the interface's first-stage gain.

Friday afternoon Sandro Marcantonio (one of the students) calibrated the interface and got a nearly perfect straight line. Next we hooked up the sonde and its interface to the shuttle. After a few packet bursts and reports from Bob Schellorn (W6ORE) it was clear that the telemetry was responding to changing ozone concentrations, but only barely. Measuring the output of the interface showed that everything was normal until the payload transmitted. Somehow, the RF was "desensing" the interface and pulling the readings down.

Moving the 2 meter antenna far away solved the problem, but that would be no help to a payload that had to be just a few feet from the shuttle. Tightly closing the ozonesonde package so that the aluminum shielding was well connected didn't help, and neither did placing small bypass capacitors on the interface's input and output.

So, Saturday morning the whole set-up, including ozonesonde, shuttle and calibrator made the trip to Mike Manes' QTH. Pretty quickly we decided to take the shotgun approach. Since Mike, Merle McCaslin (KØYUK) and I were all there we had enough hands to try ALL the possible fixes. While Mike extended the shielding in the ozonesonde's container, I soldered a capacitor across the first-stage feedback resistor. The three of us put it back together, strung it up and listened to it play. When we put more ozone in, the telemetry readings went up, when we put less in, they went down. We put the ATV antenna right up against the seam where the interface cable emerged from the ozonesonde box, and it still worked perfectly. The whole thing finally worked from end to end.

Sunday morning as the long balloon train snaked up into the partly cloudy sky I knew the MESA payload was acceptably solid for the flight, but I thought about how unmercifully the laws of physics had pounced on all the previous oversights. However, the telemetry received by the ground station showed reasonable numbers right from the start, and the MESA payload continued to send down good data for the whole flight.

The raw data from the flight is shown in the graphic plot contained in this article (courtesy Rick von Glahn NØKKZ). The data show some expected features and some that were unexpected. There is a small peak in ozone concentration near the ground, which corresponds to the production of ozone by the photochemical reaction between hydrocarbons and O2. The data roughly peaks somewhere around 80,000 ft, which is where the ozone layer has its maximum concentration. The source of the deep dips in the data are unknown by the author. Sandro Marcantonio is currently analyzing this raw data, and his findings should be ready by next Fall, if not before.

The full details of the experiment will be available in a paper to be written by the MESA students.

EN-SCI donated the ozonesonde and the calibration unit (worth about $1000) to the MESA group, so expect more ozone experiment proposals from Ranum High.

To anyone contemplating being a liaison for a student experiment I have the following suggestions.

1. Start early and have the students take small, but frequent steps towards goals. (Only plan on getting an hour or so out of a high schooler's time on any one day.)

2. Make sure everyone, including yourself, is aware of project milestones that must be met before the flight. (Had

EOSS-16 Flight

by Andy Kellett

EOSS-16 was released under partly cloudy skies from Thunder Ridge Middle school at 9:05 am on May 1, 1994. Packages in the balloon train included a "tidget" from NAVSYS Corp., the EOSS shuttle, an ozonesonde from the Ranum High School MESA group, and the trusty, Bob Ragain (WB4ETT) beacon. After a relatively slow ascent, the balloon reached a maximum altitude of about 95,000 ft, at which point the balloon burst. After a normal descent, the balloon landed about 60 miles east northeast from the launch point. The recovery was accomplished in less than an hour after touch-down 1.3 miles SE of the town of Woodrow, Co. by the tracking and recovery team.

The "tidget" flown by NAVSYS was completely independent of EOSS electronics, relying on EOSS only for a lift up and down. The "tidget" (yes, that really is what they call it) is a GPS "cross-band repeater". According to NAVSYS, the flight was a great success for them.

The Ranum High MESA experiment (see accompanying article for more details) flew above the shuttle, but was connected to it by a length of shielded, four-conductor cable. Five Ranum students, along with MESA sponsor Mark Zarn and Ranum High Assistant Principal Sam Sakurada prepared the ozonesonde and kept tabs on the ozone measuring experiment.

The shuttle flew in its normal configuration - 2m command receiver and telemetry transmitter, along with the 426.250 MHz ATV transmitter. The LORAN receiver flew and sent down positioning information the entire flight except for a brief loss of LORAN lock from about 44,000 ft to 49,000 ft.

This was the first time EOSS has flown the Automatic Packet Reporting System and it worked perfectly during the entire flight. An APRS station was running at the ground control station and provided a graphic map display of the location of the balloon during its flight over eastern Colorado. Larry Cerney and Rick von Glahn ran APRS as well as GPS in their vehicles during the recovery operations.

Despite (or because of) a week delay, the flight was very smooth, the only glitches being two unexpected controller resets prior to launch and the cracking of the LORAN antenna cable cladding.

I subjected my initial interface design to a design review as outlined in the experimenter's handbook, I would have saved a few weeks of getting another design to work.)

3. Unless you've managed lots of projects before, double the amount of time and trouble you initially estimate for any job.

Despite the gloom and doom above, it really was worth the time and effort.

BALLOON LAUNCH IN PUEBLO OCTOBER 22, 1994

By William M. Tressell, NØQFZ

The last few months has seen some major new additions to the educational opportunities in Pueblo. Lou Lile a middle school teach at Pitts Middle School proposed a "new" concept of a "school within a school" program at his school. Basically it will be 60 students, one third each of 6th, 7th 8th graders that will be in the program for up to three years. The program will include students from "at risk" to "gifted". Two teachers will be responsible for these students. Lou's emphasis will be math and science and Cathy Blackmore's will be responsible for English and social studies. All core classes will be a 'non traditional' mixture of the students with special emphasis on integration of all subject matters with an emphasis in math and science. The program will not be a "normal" school day approach but will include activities after school and during the summer months.

Other changes in education that are occurring in Pueblo include Haaff Elementary moving toward a Environmental Science Magnet School and Centennial High School establishing a Applied Technology Curriculum. The district has also established a Charter School oriented towards arts and sciences.

In conjunction with the Alliance that has been created and just renewed between School District 60 and the University of Southern Colorado the University's Center of Teaching and Learning is expressing strong support for this program thus includes all levels of education in Pueblo.

With this background in mind we have requested EOSS do a launch October 22, 1994 and have committed to provide EOSS $300 toward a color camera to make it's maiden voyage at that launch. $220 was presented to EOSS at the June meeting. This is a key opportunity to lay the ground work for establishing a balloon program in Pueblo.

FLIGHT SYNOPSIS OF EOSS-16

by Brian Thomas, NØVSA

Launch date: May 1, 1994
Launch time: 15:05 UTC
Launch site: Thunder Ridge Middle School
Aurora, Colorado USA
Launch coordinates:
39 deg 37.383 minutes NORTH
104 deg 44.127 minutes WEST
Touchdown time: 18:03 UTC +- 5 minutes
Touchdown site: 1.31 Miles South East of Woodrow, Colorado USA
Touchdown coordinates:
39 deg 58.223 minutes NORTH
103 deg 35.012 minutes WEST
Touchdown bearing from launch: 68 degrees
Touchdown distance from launch: 65.8 Statute Miles
Maximum Altitude: 95,000 feet
Maximum Speed: 50.5 mph
Payload Systems:
ATV - 426.250 MHz
Beacon - 147.555 MHz
Telemetry - 144.340 MHz
GPS sonde - 400 MHz approximately (commercial system test)
Ozone Detector downloaded on telemetry frequency
Pressure Sensor used to determine altitude
Temperature sensors (internal and external)
LORAN-C position determining receiver

The payload was recovered about 3 hours after launch. George Reidmuller and Paul Ternlund ran a tight ship. Under their skilled leadership were RDF stations:

ALPHA - Paul Ternlund WB3JZV (computerized triangulation station)
BRAVO - Geroge Reidmuller NØNJM (net control), Marty Griffin WAØGEH
CHARLIE - Dan Meyer NØPUF
DELTA - Dave Galpin KBØLP
ECHO - Bob Ragain WB4ETT, Dawn Ragain NØQCW, Colleen Ragain NØQGH
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EOSS Payload Spin Stabilization Package

by Larry Cerney NØSTZ

Overview:

The propose of this package is to reduce horizontal rotation of the payload during both the ascent and descent phases of the flight. In passed flights of the EOSS payload the ground station, and others equipped to receive Amateur Television (ATV), have been able to view the flight real time. These television pictures have also been captured to tape to record the successes of EOSS. While these television pictures are spectacular, the motion of the payload at time makes it difficult to watch for those with weak stomachs.

I, being one with a weak stomach, thought that some sort of spin stabilization would increase the enjoyment of watching future television pictures from space. If this spin stabilization project does in fact work, it may be the basis for continued work on being able to also steer the payload to point in a selected direction.

Package Description:

The reduction of spin is centered around (no pun intended) the use of a Futaba rate gyro which is sold as a stabilizer for radio control helicopters. This rate gyro frees the pilot of the helicopter from having to maintain constant control of the craft to prevent unwanted rotation. We will integrate this rate gyro into the ATV module of the payload.

The rate gyro senses rotation of the payload and modifies a pulse

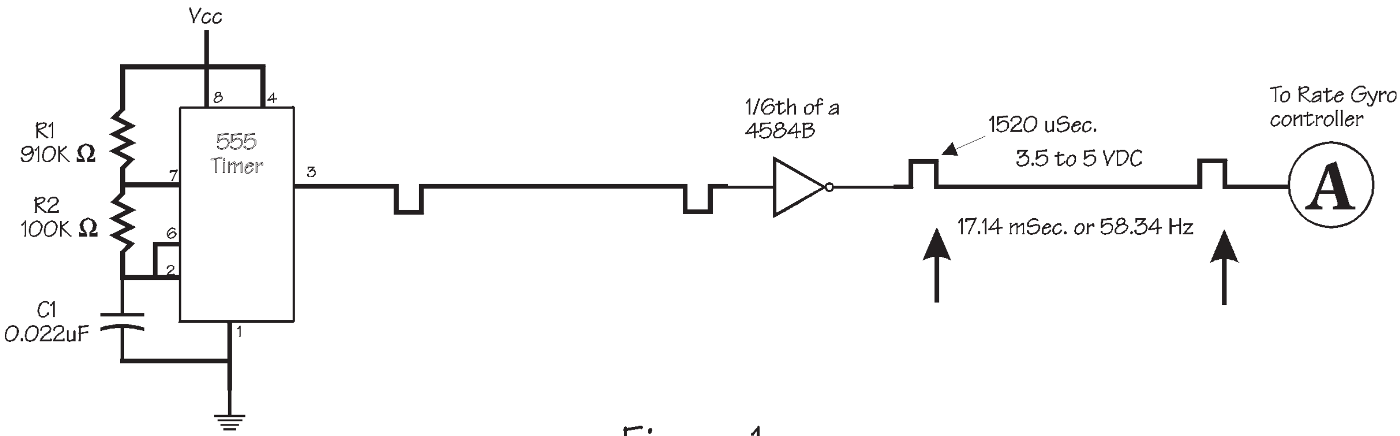

Figure 1.

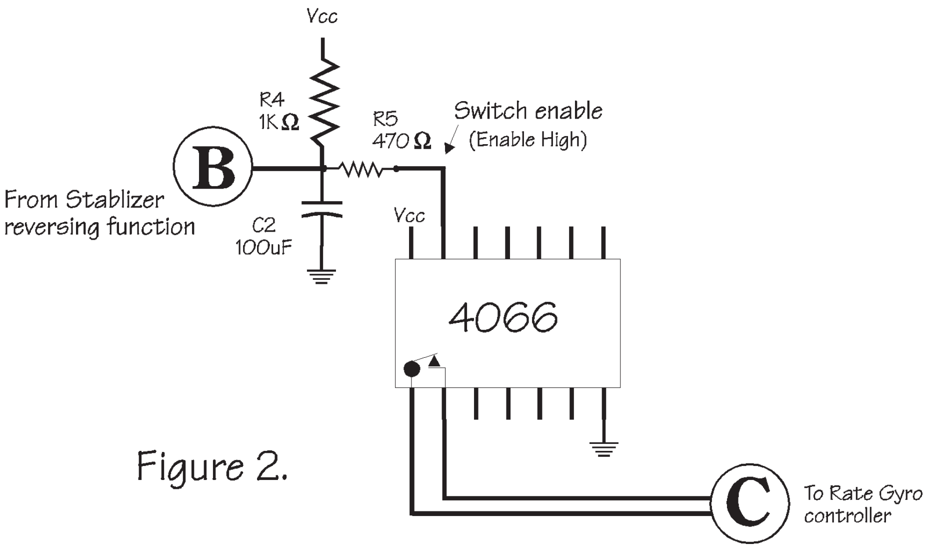

Figure 2.

stream going to a servo which rotates a stabilizer panel mounted to extend into the air stream. Rotation of the payload one way will cause the stabilizer panel to rotate to counter act it. Rotation of the payload the other way will cause the stabilizer to rotate in the opposite direction.

The package itself is made up of the rate gyro, a servo to control the stabilizer, a controller board for the rate gyro and a logic board to provide the pulse stream, the gyro power control and the ascent/descent reversing circuitry.

The rate gyro is a spinning gyroscope which senses the rotation of the payload and sends the direction of spin and velocity to the controller. The rate gyro spins the whole time the package is powered up and is the largest consumer of power in the package (200 milliamperes in an idle state, in excess of 350 milliamperes while operating the servo). The size of this gyro is approximately 2"(50.8mm) square and 3"(76.2mm) high.

The controller board receives the information from the rate gyro and modifies the pulse width of the pulse stream which is sent to the servo. The controller also has controls for fine tuning how sensitive to spin the rate gyro will be and how much travel the servo will make in response to rotation.

The servo receives the pulse stream for the controller and rotates its output shaft in response to changes in the pulse stream. An increase in the width of the pulses in the stream causes the rotation of the shaft in one direction and a decrease in the width of pulses in the stream causes the shaft to rotate in the opposite direction. No change in the pulse stream is recognized by the servo as a centered (vertical) position. The shaft on the servo is capable of rotating +/- 45o of the centered (vertical in this application) position.

The logic board is a custom designed board which will provide four functions. The first function is to replace the RC receiver which produces the pulse stream which is passed through the controller

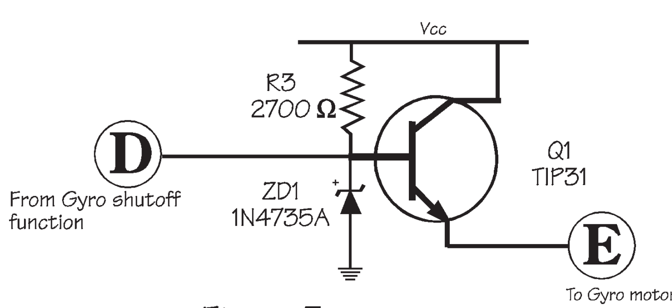

Figure 3.

to the servo. The pulse stream is provided by a simple 555 a stable multivibrator timer circuit with its output run through a inverting Schmitt trigger. It produces a pulse of 1520 uSeconds about 58 times a second.

It is the change in the width of this 1520 uSec. pulse that the servo responds to.(See Fig. 1)

The second function of the logic board is to switch the control of the servo from the ascent mode to the descent mode after the balloon bursts or a cutdown. The rotation of the stabilizer panel needs to be reversed to maintain the stability of the payload as the airstream changes from ascent to descent. A clockwise rotation of the stabilizer panel during ascent (air stream from top of payload) as a result of a clockwise horizontal rotation will cause a counter clockwise horizontal rotation of the payload thus minimizing the spin. During descent, the airstream is reversed (airstream from bottom of payload). If the stabilizer panel rotation were not reversed on descent, a clockwise horizontal rotation of the payload would cause a clockwise rotation of the stabilizer panel which in turn would cause additional clockwise spin in the payload putting the payload into an unrecoverable spin.

EOSS Payload Spin Stabilization Package

The reversing is done through a command from the ground station to the payload controller. In the ascent mode, the reversing circuitry will have to be activated through the use of a CMOS 4066 quad bilateral switch.(See Fig. 2)

The switch enable (pin 13 for switch pins 1 and 2) is held high for ascent by capacitor C2 charging to near Vcc. When the payload controller receives the command to reverse the stabilizer, a ground is applied by the controller to “B” which will drain capacitor C2 and place pin 13 low which in turn opens the switch at pins 1 and 2 placing the stabilizer in the descent mode.

The third function is the gyro power switch. To save battery power, and during the stabilizer reversing procedure, the motor to the gyro can be commanded off. Switching the gyro off will cause the stabilizer control panel to return to a vertical position. The protocol for reversing the stabilizer will be to command the gyro off to bring the stabilizer to a vertical position and then to command the stabilizer to reverse and then command the gyro on again. The reason for this is to prevent the stabilizer panel from swinging from full rotation one way to full rotation the other way possibly causing the stabilizer panel to be damaged or misaligned.

The rate gyro motor will be powered through a power switching transistor Q1. A 6.2 volt zener diode will divide Vcc to provide the approximately 5 VDC required by the gyro motor. When commanded by the ground station, the payload controller will apply a ground to “D” which will cause the transistor to switch to cutoff stopping current flow from Vcc to the gyro motor.(See Fig. 3)

The last function is a voltage regulator to convert the payload power to a 5 volt supply for the timer and reversing circuitry. A simple 7805 provides that function.

Hopefully, this project will be able to fly on the next flight, EOSS-18, which should be ready in late summer or early fall of 1994. If the stabilizer proves to be effective and reliable, improvements may be made to provide some form of payload steering to be able to point the payload at a specific bearing and maintain that position. If that is possible, experiments to study the Sun or Moon or other space objects may be possible. Imagine flying to twenty miles to be able to get telephoto or live ATV pictures of the MIR spacecraft or a space shuttle flight passing by. It maybe far fetched, but they laughed at the Flash Gorden movies as being far fetched too.

Parts List

Rate Gyro:	Futaba Model # ????
Servo:	Futaba Model # ????
PC board:	Radio Shack Part # ??????
IC Chips:	LM555CM-ND Timer
	CD4584B Inverting Schmitt Trigger
	CD4066BE Quad Bilateral Switch
	7805 Voltage Regulator
Transistors:	TIP31 Power Switching Transistor
Zener Diode:	1N4735A 6.2 volt Zener
Capacitors:	0.022 uF Polyester
	100 uF Electrolytic 35 Volt
	10 uF Tantalum 25 Volt
Resistors:	910 K Ohms 1/8 Watt
	100 K Ohms 1/8 Watt
	2700 Ohms 1/4 Watt
	1000 Ohms 1/4 Watt
	470 Ohms 1/4 Watt

Shuttle II Status

by Jack Crabtree

We had hoped to fly Shuttle II with GPS on EOSS-17. Several days prior to the flight however, it was evident there were technical problems that would preclude Shuttle II from flying just yet. Here is a summary of the status of Shuttle II as of June 14th.

The structure is composed of three-sixteenths foam-core material that is covered with foil. The structure is organized so that four modules can me mounted, two on each side. The four modules are the W6ORE Balloon Controller based on the 80C552 Micro-controller chip, a Midland VHF transceiver module (same as Shuttle I), the Magellan 5-channel GPS board and last, a board that has power conditioning (7.2 VDC and 5.0 VDC), the barometric pressure sensor, a temperature sensor and a memory back-up battery for the GPS . Also in the structure, is a cavity for mounting up to 5 D Lithium cells for power.

The modules have been checked out individually and have been installed in the Shuttle II structure. Module-to-module wiring has been completed, at least for the immediate needs. The Shuttle I ATV module has been interfaced to Shuttle II and ATV operation has been verified. A few minor software glitches have been noted but these will be corrected in the next firmware update.

During system level testing of the GPS however, is where the present problem is. Shuttle II was sitting on my pop-up trailer in front of my house. I was inside monitoring packet telemetry. Just a few seconds after GPS locked up, the telemetry indicated loss of GPS data. I brought the unit in and troubleshot it to the point that I verified the data interface from the GPS to the controller was dead. Subsequent to this I removed the GPS module and checked it out on the bench and again verified no signal from the GPS data output. The module is now at Magellan having the problem diagnosed.

I hope to have the Magellan unit back in a couple of weeks after which system level testing will resume. These will include a cold soak test in the EOSS temperature chamber. We will not set a flight date for Shuttle II until it is up and running. Once we have Shuttle II going, I think we are going to have a much more capable Shuttle and it will serve us well.

Submissions to the *Stratosphere*

Stratosphere welcomes any and all articles pertaining to High Altitude Ballooning and Amateur Radio.

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Should you submit any hard copy materials, be sure to get them in early as they will have to be typed in or sent out for image scanning.

The preferred route for submission is via electronic mail. This will speed our receipt of your materials and give us a return address where we can contact you regarding any questions we might have on your article.

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