The AMSAT® Journal

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AMSAT Announcements

Fox-1Cliff Ready for Launch!

On Monday, September 24th, Jerry Buxton, NØJY, AMSAT Vice-President Engineering, delivered and performed the integration of AMSAT's Fox-1Cliff CubeSat in preparation for launch.

Unlike AO-85 and AO-91, AMSAT purchased a commercial launch for Fox-1Cliff. Please consider a donation to help replenish the coffers for GOLF and other future AMSAT projects!

- www.amsat.org/product-category/amsat-general-donations/
- www.amsat.org/product-category/amsat-membership/
- www.amsat.org/product-category/amsat-presidents-club-donations/

Uplink: 435.300 MHz FM voice (67.0 Hz CTCSS tone) / 1267.300 MHz FM voice (67.0 Hz CTCSS tone)
Downlink: 145.920 MHz FM voice; AFSK digital data up to 9600 bps
Transmit power: 600 mW nominal

Because only one uplink frequency can be active at a time, the use of the Mode-L uplink will be limited to experimental periods announced in advance.

AMSAT's Mission
AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision
Our Vision is to deploy satellite systems with the goal of providing wide-area and continuous coverage. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.

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The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPG formats. Kindly do not embed graphics or photos in your manuscript. We prefer receiving those as separate files. AMSAT reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations.

Apogee View

Joe Spier, K6WAO
President

It's with great sadness that I have to report the passing of William "Bill" Tynan, W3XO. I refer you to the detailed article inside this month's Journal, but I need to reiterate what a loss not only to AMSAT but to amateur radio his passing truly is. The AMSAT Board of Directors is considering naming a GOLF satellite in his honor. We have all lost a friend. Godspeed, W3XO (SK).

By the time you are reading this, this year's 36th Annual AMSAT Space Symposium and General Meeting will be very near. The Symposium will be held on Friday through Sunday, November 2-4, 2018 in Huntsville, Alabama. The location will be at the U.S. Space and Rocket Center, One Tranquility Base, Huntsville, Alabama (www.rocketcenter.com/). Hotel accommodations will be next door at the Marriott at Space & Rocket Center, 5 Tranquility Base, Huntsville, Alabama USA. I hope to see you there.

Hotel Reservations for the Symposium may be made by individual attendees directly with Marriott reservations at 1-(800) 228-9290 or (256) 830-2222, Please mention the Radio Amateur Satellite Corporation (AMSAT), Reference Number M-BIHHXTA. Reservations must be made by October 17th. This year the Proceedings book will be supplied on an AMSAT USB stick. If you would like a printed copy, the cost will be an additional $25.

If you have missed APRS and packet radio from ISS (as ARISS has), you'll be happy to hear that a replacement system is on its way. When the packet module aboard ISS died in late 2017, the ARISS hardware team was heavily involved in design and safety certification of the new Interoperable Radio System (IORS).

Basic troubleshooting and a few attempts to revive the failed module. However, the mysteries of space gremlins continue with the packet module on the ISS unexpectedly coming back to life this summer. Though it is currently operating, it could fail again at any time, and the planned replacement is warranted.

We decided to dedicate our time to IORS and get it - with its packet and other capabilities - aboard ISS as soon as possible. Early this year, thermal testing of the first flight-identical IORS power supply showed that some changes to air flow were needed. This change looked likely to delay our expected IORS deployment from late 2018 to early 2019.

With some newly available time, the hardware team was able to dig up an original duplicate of the packet module, replace its battery, and test the module to verify that it still works. Fortunately, NASA has approved flight of this identical unit with minimal paperwork, so ARISS is asking to be on the manifest for supply mission 71P (a Progress spacecraft). Launch currently is scheduled for October 31st, with docking on November 2nd. The installation will depend on the crew's busy schedule, but we expect the module to be installed by the end of November 2018.

AMSAT and ARISS currently are supporting a FundRazr campaign to raise $150,000 for a critical radio infrastructure upgrade on ISS to enable students to talk to astronauts in space via amateur radio. Donation premiums are available at certain levels. As AMSAT is a 501(c)(3) organization, donations are fully tax-deductible within the U.S. Go to: **fundrazr.com/arissnextgen**j.

At the Duke City Hamfest, AMSAT hosted the AMSAT® Academy at the ARRL Rocky Mountain Division Convention in Albuquerque, New Mexico, along with Skyler Fennell, KD0WHB, and Bill Ripley, KY5Q. I hope to use the presentations as a starting point for the AMSAT Ambassadors program. In October, I'll attend the AMSAT-UK Colloquium at the RSGB Convention in Milton Keynes, England, the ARISS International Meeting in College Park, MD, and the Symposium in Huntsville, AL.

I appeared on the September 26, 2018,

episode of TWiT.tv's Ham Nation (episode #369) and discussed the latest news from AMSAT and ARISS. The episode can be seen at **twit.tv/shows/ham-nation/episodes/369**.

AMSAT is pleased to announce a new storefront on Zazzle. Currently, we have several products available with the AMSAT logo, including t-shirts, hooded sweatshirts, mugs, mousepads, and stickers. Colors and styles for each product are fully customizable. Even kids sizes and athletic wear are available through the customization options. Now you can outfit the whole family in AMSAT logo gear!

25% of the purchase price of each product goes towards Keeping Amateur Radio in Space. The storefront can be accessed at **www.zazzle.com/amsat_gear**.

AMSAT has two more Fox series CubeSats ready for launch by the end of the year (if schedules hold) and development on GOLF is proceeding. But it takes donations and contributions to build and launch our satellites, so please give what you can. 73-Joe, K6WAO

AMSAT Board of Directors Election Results

As a result of the 2018 Board of Directors Election, Tom Clark, K3IO; Mark Hammond, N8MH; and Bruce Paige, KK5DO; will serve on the board for two years.

The First Alternate is Peter Portanova, W2JV. The Second Alternate is Scott Harvey, KA7FVV. Both will serve for a term of one year.

The results of the voting with 698 ballots cast are as follows:

Tom Clark, K3IO……574
Mark Hammond, N8MH…507
Scott Harvey, KA7FVV……176
Bruce Paige, KK5DO……402
Peter Portanova, W2JV……359

Submitted by:
Martha Saragovitz, Manager
Clayton Coleman, W5PFG, Secretary

Engineering Update

Jerry Buxton, N0JY
Vice President, Engineering

The Fox satellite program was split into two paths early on, with the demise of AO-51 bringing about a challenge to get a replacement to orbit with similar capability as soon as possible. Thus, Fox-1 became the project for a simpler CubeSat than the overall Fox idea initially being worked, and that would be followed by a Fox-2 to fulfill the plans being developed. Fox-1 quickly became a popular platform for launch opportunities for a growing number of interested partners, resulting in all four planned Fox-1 flight models being built in about a two-year span. Fox-1E was added to the family because of popular demand.

Serious discussion of the next satellite design resumed in 2016 among some of us who had the opportunity to be together for Fox-1 events such as environmental testing. Sharing a fair amount of time sitting around waiting during the tests, we talked about the future of Fox-2. We worked with ideas from the original Fox ideas, Eric Skoog's 2015 Future Fox paper submitted in the Design the Next AMSAT Satellite challenge, our experience with the Fox-1 CubeSats, and our current abilities, opportunities, and desire to return to HEO.

Over time, we further expanded these ideas with research and development undertaken by the ASCENT team, including some of the design that had been done for the CQC project (aka Phase 5 to AMSAT) that was ultimately eliminated in the project selection process. From all of this, the shape of what would be next, as well as the time elapsed since the first work on Fox, led me to move forward with a new program rather than calling it Fox-2.

The name GOLF comes along as we follow the progression of satellite naming that goes back at least 14 years to AMSAT's Echo, which is phonetic for the letter E. Upon launch, Echo became AO-51. The next step was Fox, which is the abbreviated phonetic Foxtrot for the letter F.

The phonetic for the letter G, which is Golf , seemed to many of us a bit weird for a satellite. We considered several suggestions that sounded more satellite-related, or aerospace, or majestic, but I didn't like any of them.

With the 2017 Dayton Hamvention upon us, I came up with an acronym for GOLF, Greater Orbit, Larger Footprint, which I used on the one slide about the next LEO satellites for the forum. Nobody else knew about it, and I figured that I would see what feedback or objections I got about the name, but nobody complained. By the 2017 symposium, neither the AMSAT board nor officers had taken exception to that acronym, so it became official when I presented it at the board meeting.

The name is appropriate, as the GOLF program calls for a series of 3U CubeSats that require increased complexity as we work toward HEO in steps, or increments, of both engineering hardware and knowledge in higher orbits.

Engineering would like to achieve several goals to be able to produce HEO-worthy and long life satellites again but in the new CubeSat form factor rather than the relatively much larger designs of our previous HEO satellites. Attitude control, increased power through deployable/steerable solar panels, lower cost radiation mitigation, propulsion, and de-orbit capability are essential to putting a satellite in orbit above about 700 km. While much or all of this capability is available on the commercial market, the cost of even one of these systems can easily far exceed what AMSAT can afford. More importantly, in my opinion, all of our engineering volunteers participate to have fun and share their skills in building satellites, not so much to be handed a bag of pre-assembled parts with a manual in five languages and told that we're building a satellite. Innovation and learning are things that will allow us to know how to operate and be able to archive the knowledge for future AMSAT Engineering generations.

Our free time discussions of the next design brought about the stepped approach, with several missions that offered various science

opportunities for partners as well as a platform for our experimenting with the aforementioned systems development. Solar power and radios were at the top of the list for the first mission, but an opportunity came along in late summer 2017 that would jump"us up to the attitude control phase.

Ragnarok Industries, with whom we collaborated in the CQC/Phase 5 opportunity came to us with an offer of a version of their attitude determination and control system (we typically call it ADAC in engineering) that they were working on for CQC. While we will purchase this system and I cannot comment here on our specific agreement, it is an attractive offer and it includes the opportunity to learn much more about their system such that we gain much more understanding of the design, operation, and control than we would find in a manual in five languages. In addition, we have the option to acquire the systems for future GOLF missions, which would extend our learning opportunities and enhance our ability to use them.

This jump-started my presentation and request to the AMSAT Board of Directors at the 2017 Symposium in which I asked for the budget to begin work on the GOLF-T project in 2018. That name was chosen because this opportunity accelerated the original timeline and progression that we had been laying out for GOLF, hence the "tee off" of the GOLF program. I later changed it to GOLF-TEE for the CSLI proposal submitted in November 2017. Not having a suitable public explanation for the "-T," I added to the GOLF acronym with "Technology Exploration Environment," which is a pretty good description of how we envisioned the evolution of GOLF anyway.

With the Ragnarok opportunity came the thought at the annual symposium that there might be a way to reach an orbit up around 1300 km altitude, in the range of FO-29 and AO-7. That thought would require a quick successor to GOLF-TEE, and so I also briefed the board while still at the symposium of the need for a 2019 budget estimation above that which I had presented for GOLF-TEE alone. With their approval, I also submitted a CSLI proposal for GOLF-1 in November 2017.

Both proposals were accepted by NASA in February 2018. Please note that "accepted" here does not mean approved for launch. In truth, all CSLI proposals are either accepted into the program or not. Whether and when you get a launch depends on your ranking in the list of accepted proposals, and where and when you want to go.

GOLF-TEE will be a relatively rapid deployment with two major mission components, one being to test and learn the ADAC system and the other being to test the AMSAT-designed and built deployable solar panel array. As such, a few TRL-9 systems will fly to have a failsafe way to communicate with the ADAC and to be able to receive telemetry about the ADAC and solar panel array under test. These systems by default will bring an amateur radio transponder with them, so if the whole thing goes to pot (except some solar and battery power), we have the AMSAT staple, an amateur radio satellite. Those systems for this purpose are the Fox-1E-type IHU, ICR, and transponder. When I say TRL-9 here, it is a bit of an optimistic prediction that Fox-1E will launch soon, and the IHU, ICR, and transponder will all work. They did when I approved it and sent it off for environmental testing, and they did in the post-environmental short functional test, anyway.

Regarding future systems, we have what we call the RT-IHU, which stands for Radiation Tolerant Internal Housekeeping Unit, which you may have heard about and seen some of at the 2017 symposium. This started as an ASCENT project and the incredible progress of the ASCENT engineers with fit well with the lower cost radiation mitigation that I mentioned before. The IHU resets of the Fox-1 series are well known and were expected and handled in the Fox-1 hardware and software design. Future satellites with systems such as ADAC, steerable solar panels, propulsion and so forth will likely require more uptime stability from an IHU, and so in following the stepped approach of GOLF, RT-IHU is looking toward achieving that. Much higher orbits probably will require much more expensive radiation hardening, but for LEO, which includes the 1300 km range of GOLF-1, RT-IHU could fill the bill. Given the resources, both volunteer time and money, AMSAT does not intend to abandon LEO projects, and we will likely conduct a few GOLF missions in LEO before we make the stretch to MEO and HEO.

Another objective in the future systems department is a return to SDR. ARISSat-1 had an SDR, and the original Fox/Fox-2 design included SDR. SDR is versatile and desirable in many ways, but it is also more susceptible to radiation upsets than the analog radios in the Fox-1 series and can draw much more power than those analog designs depending on the amount of fun you want to have with the signals going in and out of the SDR. While we aspire to design our own SDRs based on FPGA, here too, we don't yet have the knowledge and resource base to put one together as we have with the analog radios. GOLF-TEE will use a commercial SDR, with the Ettus B210 being the target as a result of CQC work and development done in ASCENT. Many questions remain about the long-term function of such a device in space, especially as we go to higher orbits, but here again, GOLF-TEE is the exploration environment and will provide the opportunity to find out some of the space environment unknowns. It is also the opportunity to learn the use of SDR in a relatively power-constrained environment of a 3U CubeSat with fixed solar panels.

As such, the SDR on GOLF-TEE has only one mission objective: to downlink telemetry at a minimum speed of 1 Mbps in the 10 GHz amateur satellite band. This serves as a starting point for handling much more telemetry, useful for both satellite control and experiment results, and for the "Five and Dime" 5 GHz uplink /10 GHz downlink band plan. AMSAT Engineering doesn't think small, and we have ideas on how to incorporate a possible mode V/X transponder from the standard Fox-1E transponder 2-meter uplink. Stay tuned for that.

GOLF-TEE will also carry a Vanderbilt University low-energy proton radiation experiment like those flown on some of the Fox-1 missions. The purpose of the experiment in this mission, beyond being another opportunity for Vanderbilt, is to provide radiation data similar to that gathered by the Fox-1 satellites for a possible comparison to the environments where Fox-1 satellites have their upsets/resets, in studying the operation of the RT-IHU.

We expect GOLF-TEE expect to be ready for delivery and integration by the end of 2019, for a possible 2020 launch. Current plans call for an orbit around 650 km altitude, with an inclination between 63 degrees (approximate AO-85 inclination) and 98 degrees (approximate AO-92 and AO-92 inclination).

GOLF-1 is dependent on the development and hopefully the on-orbit performance data of many of the newer GOLF-TEE systems. The GOLF-1 primary mission purpose is educational, rather than GOLF-TEE, which has an overall focus on technology. Within the educational purpose, the primary mission objective is Vanderbilt University's radiation experiment that will be flying at a much higher altitude than those previously flown. As a secondary mission objective, camera experiments including a daylight video and an infrared imager provided Albuquerque

Public Schools and built through their Stem Trajectory Initiative in cooperation with Virginia Tech, will be flown.

GOLF-1 has a technology component as a secondary overall mission purpose, continuing development of radiation tolerant systems and SDR, as well as solar power capability. The SDR on GOLF-1 is expected to be the primary radio system, adding 5 GHz uplink capability for a "Five and Dime" mode C/x transponder, as well as other possible combinations with the 70 cm, 23 cm, and 13 cm bands. With the higher altitude, we intend a more extensive range of contacts than FO-29 and AO-7.

The altitude of GOLF-1 is our first incursion into orbital altitudes that will exceed the 25-year maximum lifetime orbital debris requirements imposed by international treaty. That means that we need the capability to ensure that GOLF-1 either re-enters the atmosphere and burns up or is moved to a disposal orbit above 2000 km, within 25 years of the end of its mission. This poses some significant challenges, and to even get a launch for GOLF-1 will require approval by the FCC and satisfaction of NASA as to our ability to meet the requirements. For those not familiar, the FCC holds the hammer in meeting orbital debris requirements by the fact that they will not issue a license if you do not meet the requirements. We will have to incorporate a reliable de-orbit mechanism, or propulsion, to fly.

Given the stepped approach we have planned, the likely choice is the de-orbit mechanism, and we expect to include a de-orbit device on GOLF-TEE for some practice and knowledge, even though it is not required. Propulsion is both unknown (unless we get some experienced propulsion volunteers real soon!) and expensive. Along with that, the 25-year rule as I generally refer to it, is currently understood to mean just that. While the requirement is to comply within 25 years after the end of a mission, CubeSats have a relatively long record of having pretty short missions, and that has caused the 25 years to be applied literally, that means 25 years after launch. While AMSAT some of AMSAT's missions provide good examples of satellites lasting much longer than one year or so, and in some cases even more than 25 years as in the AO-7, we are seeking to supplement. Convincing Washington of that will be an uphill battle. I don't think they will settle for "long after we're all dead, so who cares?"

AMSAT will figure it out if we all, ever, want to leave LEO. Look forward to more GOLF, at the 2018 symposium!

Educational Relations Update

Alan B. Johnston, KU2Y
Vice President, Educational Relations

For this month's educational relations update, I'm pleased to report more progress on the new AMSAT CubeSat Simulator, thanks to the continued work of Pat Kilroy, N8PK, and his interns at NASA Goddard. Look for more details at the AMSAT Space Symposium in November. I look forward to meeting many of you in person in Huntsville!

In August, I started a new position as Assistant Professor of Electrical and Computer Engineering at Villanova University. I've been introducing my new students to amateur radio and satellites. So far they seem interested. It will be an exciting autumn with hopefully two more Fox satellite launches that I will share with them in real time!

For this month's column, I'm going to look at satellite telemetry and how it relates to education. I believe that copying and interpreting satellite telemetry can be a great entry into getting involved with amateur radio satellites.

Today, we assume that any amateur radio satellite will transmit telemetry, but the first amateur radio satellite with multi-channel telemetry was Australis-OSCAR-5 or AO-5. OSCAR 5 was also the first satellite launched by the newly formed AMSAT in 1970. While researching OSCAR 5 telemetry, I uncovered a personal connection. OSCAR 5 was designed and built in 1967 by students at the University of Melbourne in Australia, where I got my bachelors degree in electrical engineering. (My family immigrated to the United States when I was a baby but I returned there for college, where I operated as VK3DQA for four years.) The amazing story of how AO-5 was designed, built, and ultimately launched with the help of AMSAT is detailed in a new book, *Australis-OSCAR 5,* by Owen Mace, who was a member of the team. (Figure 1 shows the book cover photograph of the team with their bird.) A short video " THE SATELLITE: The improbable true story of Australia's first spacecraft" is available on Vimeo, **www.vimeo.com/191605076** (Figure 2). The video includes interviews with Owen and other builders and Jan King, W3GEY, a founding member of AMSAT, who was involved with the launch. Both are worth checking out if you enjoy the history of our hobby. On my next visit, I will definitely try to see the OSCAR 5 engineering model, which is part of the Museum's Victoria Collections.

Besides being the first amateur satellite launched by AMSAT and the first to have multi-channel telemetry, OSCAR 5 also was the first launch as a secondary payload by NASA, and the first to use magnets for passive magnetic attitude stabilization. In addition, the mission demonstrated the first ground station control of an amateur radio satellite by successfully turning on and off the 29 MHz beacon.

The legacy of OSCAR 5 continues to this day as the command and control circuitry


WIRELESS INSTITUTE OF AUSTRALIA PROJECT AUSTRALIS
RADIO AMATEUR SATELLITE CORPORATION

AUSTRALIS - OSCAR 5

AUSTRALIA'S FIRST AMATEUR RADIO SATELLITE
LAUNCHED FROM CALIFORNIA, U.S.A., 23rd JANUARY, 1970

Confirming Reception by WA3CPH of the ~~29.450~~ 144.050 MHz Beacon

on 25th January 1970 2217 hrs. G.M.T.

ACKNOWLEDGES THIS REPORT AND YOUR SUBSEQUENT REPORTS.

Figure 3 — OSCAR 5 QSL

Figure 2 —"THE SATELLITE: The improbable true story of Australia's first spacecraft" movie on Vimeo, www.vimeo.com/191605076.

for AO-7, partially operational today, was actually designed and built by this same team in Melbourne who built OSCAR 5. The team had a reunion in 2017 for the 50th anniversary of building the satellite.

The details of the multi-channel telemetry of OSCAR 5 are nicely explained in Stratis Caramanolis's 1976 book, *OSCAR: Amateur Radio Satellites*. The book also provides an excellent introduction to orbital mechanics at a high school physics level. After the "hi hi" in CW, tone frequencies were used to convey information in the different channels.

In my research on OSCAR 5, I corresponded with Thomas Varmecky, WA3CPH, who copied the telemetry from OSCAR 5 in 1970 and received a QSL card to prove it! (Figure 3). He used two quad Yagi stacked arrays, each with 8 elements, to receive OSCAR 5 as it was low on the horizon. He used information published in magazines at the time to track and receive 2 m band OSCAR 5 telemetry two days after the launch.

My copied telemetry from OSCAR 8 over a decade after Tom was very similar, except the telemetry information was encoded numerically in the CW beacon. Some amateur satellites still send CW telemetry today, including CAS-3A (Chinese Amateur Radio satellite 3A) through CAS-3F (also known as XW-2A through XW-2F - Xi Wang means "hope" in Chinese). Of course, many modern amateur radio satellites use digital encoding for telemetry download. Those who used the internet over dial-up modems in the 1980s and '90s will recognize the sound of FSK (Frequency Shift Keying) audio-encoded digital data. Some new satellites transmit at 9600 bps, sending packets in short pulses, but these pulses just sound like noise. Decoding this digital telemetry requires software, and you will find applications at blogs and sites run by DK3WN, PE0SAT, and UZ7HO, among others.

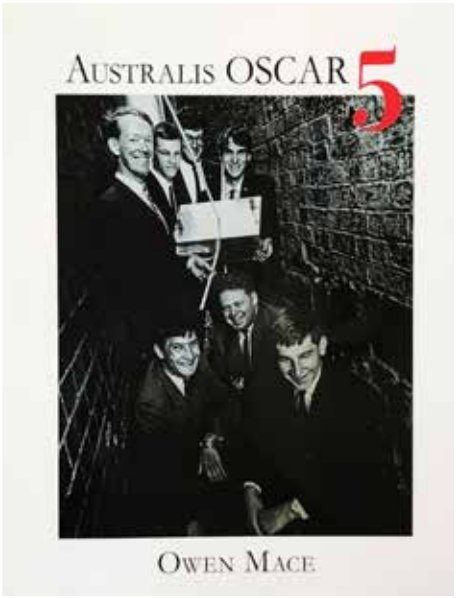


Figure 1 — Australis-OSCAR 5 book by Owen Mace. Card from 1970.

AMSAT's Fox series of CubeSats send telemetry as Data Under Voice (DUV), which is a technique that uses the low-frequency spectrum of the downlink FM audio transponder signal to encode telemetry as 200 bps FSK. This allows FM QSOs to occur at the same time as telemetry is downloading. Decoding is simple; it just requires a computer and a radio which does not filter the audio or an SDR (Software Defined Radio) USB dongle on a computer. I obtain very satisfactory results from the ultra-cheap RTL-SDR dongle, available for around $20 on Amazon.

The resulting audio is then decoded by the excellent FoxTelem software, written by Chris Thompson, AC2CZ (**www.g0kla.com/foxtelem**). This Java software, which runs on many different operating systems and computers, decodes the telemetry, displays it, and also uploads it to AMSAT's servers for analysis. In fact, using FoxTelem, you can download the whole archive of Fox satellite telemetry for analysis (look under File, then Fetch Server Data). Chris has some excellent blog articles describing ways in which you can analyze and plot Fox telemetry data (**www.g0kla.com/workbench/2018-01-26.php**).

Telemetry is a great way to introduce newcomers to amateur satellites and to teach concepts of space and communication. Building antennas and configuring radios teaches the basics of radio receiving. Locating and tracking the satellites provides an opportunity to learn about orbital mechanics. And finally, examining the telemetry data offers a wealth of information about the physical conditions in space, and how a device can operate autonomously for long periods by generating its own electricity and managing all the systems and resources available.

I am not alone in thinking along these lines. At the ARRL Teacher's Institute (TI), instructor Matt Severin, N8MS, reported using FoxTelem to introduce teachers to the basics of satellite telemetry as part of his TI-2: Remote Sensing and Data Gathering course (**www.arrl.org/ti-2-remote-sensing-and-data-gathering**). Matt said, "We included the unit on satellite telemetry for two reasons. First, to introduce our teachers to amateur satellites. It's fun from an operator's perspective, and also has a bit of the wow-factor when demonstrated in the classroom. Secondly, our TI session was about remote sensing. Collecting data from satellites is the ultimate remote data."

How can an educator capture satellite telemetry? One approach is to use the "NextGen Crystal Radio" kits developed by AMSAT President Joe Spier, K6WAO, and presented at the AMSAT Space Symposium in October 2017. Many of these kits have been produced and shared with educators. An educator could also set up a SatNOGS station (**satnogs.org**) as well, but more on this in a future column!

Other CubeSats have also made their telemetry accessible. For example, AMSAT-UK's Funcube project was designed around education. Schools planning to monitor AO-73 can request a special message be included in the Funcube telemetry which they can then decode in real-time during a pass.

Another interesting example is EQUiSat, a new 1U CubeSat built by Brown University in Providence, RI, by its Brown Space Engineering (BSE) group (**brownspace.org/outreach/#Education**) and deployed from the ISS on July 13, 2018. EQUiSat was designed as a low-cost CubeSat, costing less than $5000 to build, with all plans and designs available for free online. BSE's excellent website and application (Figure 4) displays telemetry information and also whether the high powered LEDs on the CubeSat are currently flashing. (Yes, you can see the flashing lights of EQUiSat – an actual satellite observation.) Brown University student Mckenna Cisler, the Technical Lead of BSE stated, "The primary mission of EQUiSat is to promote the accessibility of space to people from all backgrounds, by combining the accessibility of the satellite itself with educational outreach. At BSE, we have been working towards this by designing lesson plans and programs directly related to the scientific and space concepts that EQUiSat demonstrates."

All this makes me think about GOLF, AMSAT's next phase of satellites. What new and innovative things can we do with telemetry on these satellites? What are the additional educational opportunities that we can take advantage of? I have some thoughts that I'll share in the future, but I hope we all can start to think about this and plan our future telemetry design with educational outreach in mind.

As always, if you have an interest or desire to get involved in educational outreach programs such as these, I'd love to hear from you at **ku2y@amsat.org** or on Twitter **@alanbjohnston**.

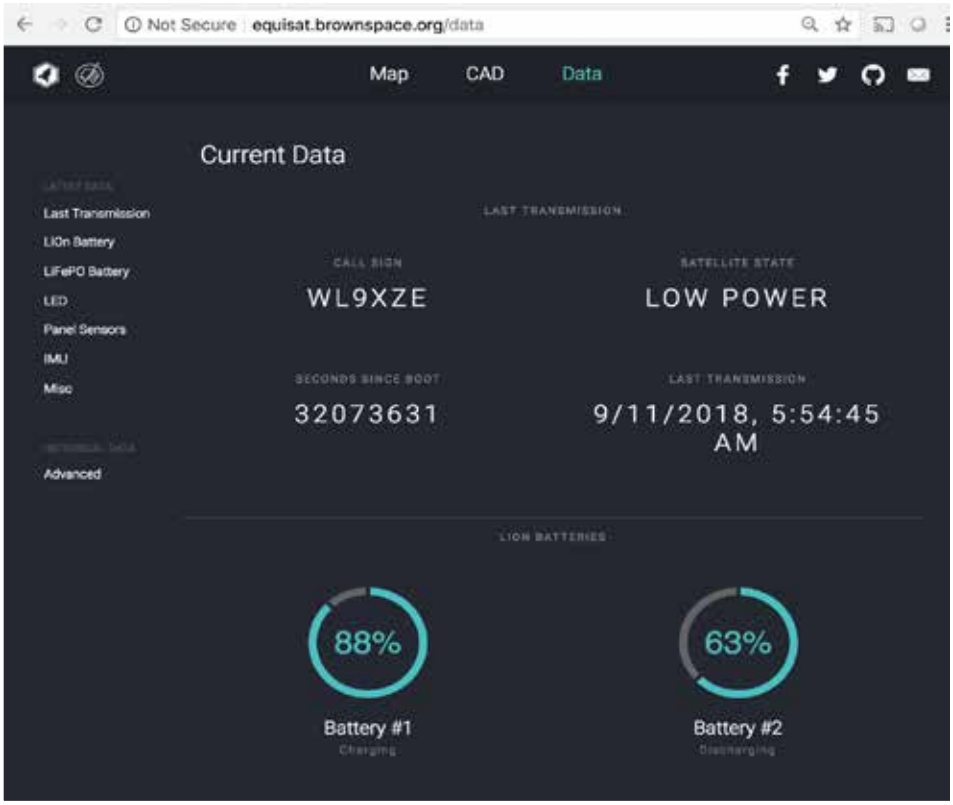


Figure 4 — EQUiSat Telemetry Data Web Page equisat.brownspace.org/data.

William A. (Bill) Tynan, SK

Keith Baker, KB1SF/VA3KSF
Treasurer

It is with great sadness that AMSAT reports one of its founding directors, charter members and past presidents, William A. (Bill) Tynan, W3XO, passed away peacefully at his home on Tierra Linda Ranch in Kerrville Texas, on August 7, 2018.

Bill left an indelible mark not only on AMSAT, but on all of Amateur Radio with a long list of firsts in our service since becoming licensed as W3KMV in early 1946. Indeed, Bill was in the forefront of Amateur Radio's growth and importance in many ways. And to say that his singularly distinctive accomplishments to Amateur Radio were, quite literally, "out of this world" is an understatement.

Bill was born October 12, 1926, in Saint Paul, Ramsey County, Minnesota. For the first ten years of his life, Bill lived in Saint Paul, then moved to the Washington, D.C. area when his father received a position with the U.S. government. Living in the Maryland suburbs of D.C., He attended elementary, junior high and high school in Montgomery County, Maryland, then completed one year at Washington College in Chestertown, Maryland. Soon thereafter, Bill enrolled at Rensselaer Polytechnic Institute, Troy, New York, graduating with degrees in both Electrical and Management Engineering in 1950. Starting in 1951, and for most of his adult working life, he was employed by The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, retiring in 1988. At JHU/APL he participated in the development of several U.S. Navy missiles including the Tomahawk Cruise Missile.

His active amateur radio interest really began in the mid-1930s when he was a young boy. As a boy, Bill was absolutely fascinated by radio. Even before moving to the D.C. area, he acquired a Philco mantle model radio with shortwave capability that allowed him to listen to overseas broadcasts from London, Berlin, and other foreign capitals, as well as to amateur radio operators.

Then, during the Second World War, and after obtaining a Restricted Radio Telephone Permit, he operated in the War Emergency Radio Service (WERS),

Bill Tynan, W3XO.

donating his time for the effort to the citizens of Montgomery County, Maryland and, later, to the District of Columbia by operating WERS systems on 2 1/2 meter VHF (then called UHF). Of course, this occurred during a time when all amateur radio activity had been suspended for the duration of the war.

His wartime activity would later spark his interest in the frequencies above 30 MHz, and he became an active VHF/UHF enthusiast almost since obtaining his first ham ticket. However, it was his work in helping others exploit the VHF/UHF spectrum that best characterized Bill's numerous accomplishments and contributions to Amateur Radio.

In addition to his amateur activities, Bill also obtained a First-Class Radiotelephone license and worked as an engineer at several broadcast stations. This led him, along with a friend, to apply for a commercial radio station license for the Washington, D.C. area. In November 1961, WHFS, the Washington area's very first FM stereo radio station began operation at 102.3 on the FM dial. One of his employees at WHFS started publishing a monthly Washington/Baltimore magazine Forecast FM, that listed classical music selections to be played by various area stations. For 12 years, Bill also contributed a hi-fi equipment column for that magazine.

A Charter Member of AMSAT

Then, in early 1969, Bill attended the charter meeting in Washington, D.C. to investigate the feasibility of carrying on the work of Project OSCAR, a group of west coast hams that had built and launched the very first satellites carrying amateur radio. The meeting later led to the establishment of today's Radio Amateur Satellite Corporation (AMSAT). At that first meeting, Bill was immediately elected to the Board of Directors of the new organization and later named Vice President for Operations.

Bill performed yeoman service in this position during the OSCAR-6 era, principally because that particular satellite had a nasty habit of unexpectedly changing operating modes on its own. Bill's superb efforts coordinated the work of dozens of worldwide command stations to keep OSCAR 6 (then the only OSCAR satellite in orbit) up and running for the world's amateur radio operators to use. His outstanding work allowed critical amateur radio propagation and other experiments, as well as more routine communications, to continue virtually unabated. His direct efforts extended use of a critical, space-based experimental amateur radio resource that otherwise would have been given up for lost.

QST's "World Above 50 MHz" Column

Later, Bill's strong reputation for getting things done, and his expertise as a leading expert in the VHF/UHF arena, led to a request from the American Radio Relay League (ARRL) that he assume duties as contributing editor for *QST Magazine's* "World above 50 MHz" column. Under his superb guidance, and during the next 18 years, Bill kept the column both fresh and alive, while providing hams worldwide with a powerful forum to advocate and nurture such new amateur radio technologies as long-haul VHF/UHF, moonbounce, DX and contest work, as well as emerging meteor scatter and satellite communications.

Work with his column also kept him in at the center of developments in operating activities in the VHF/UHF spectrum. Soon after taking over as editor of the *QST* column, it became evident to Bill that the VHF contest rules in the U.S.A. were very unfair to those not living in the populous Northeast. At the time, VHF contest rules were modeled after the League's HF Sweepstakes in that ARRL sections were being used as contest multipliers. Thus, those living in the Northeast part of the U.S. had a dual advantage over others residing elsewhere because hams living in the Northeast not only had a higher number of stations living nearby (within several hundred miles), their ARRL sections were also smaller than in other parts of the nation.

Using his *QST* column as a vehicle, Bill began running features about the "QRA Locator" system that was being used in Europe at the time, and freely gave column space to others who advocated proposals suggesting the adoption of a similar system worldwide. His strong support for changes in this arena led to his being hand-picked by the ARRL to serve on an ad hoc VHF contest committee to look for ways to make the contest more appealing for people in all parts of the country, as well as for ways to stimulate use of VHF and UHF during non-contest periods.

Primarily as a result of Bill's tireless advocacy of this idea by way of his *QST* column and through his persuasive efforts on this committee, the ARRL later adopted use of the Maidenhead system of grid squares for use in all future ARRL sponsored VHF contests. In addition, the committee recommended that a new award be established by the League to recognize contacts with a certain number of grids via the various bands above 50 MHz. This became the now very popular VUCC Award that has contributed greatly to the activity and interest for using the bands above 50 MHz, not to mention the coveted "VUCC Satellite" Award for satellite enthusiasts.

Having noted the usefulness of beacon stations in other parts of the world, Bill also urged his radio club at the time (the John's Hopkins Applied Physics Laboratory Amateur Radio Club) to mount a club project to request a Special Temporary Authority (STA) from the FCC to operate a beacon station on the 2 meter band. At that time, the only U.S. stations that could legally operate unattended were repeaters. Bill authored the club's proposal and helped install the equipment. Later, after the utility of their idea was confirmed by an overwhelmingly positive response by numerous reception reports of their beacon throughout the eastern U.S. and maritime provinces of Canada, Bill drew up the first successful petition to the FCC to allow unattended beacon operation on the amateur bands from 10 meters and up.

So, today, many beacon stations operate on 10 meters and on the bands above 50 MHz in all parts of the country. They have become a critical and reliable indicator for hams in gauging VHF and UHF band conditions.

And, once again, Bill Tynan's unquestioned reputation for advancing innovative ideas to improve the amateur radio hobby for others was at the very heart of that effort.

Later, again using his *QST* column as a forum for discussion, Bill championed the idea of designating a small portion of the 6 meter band for working weak signal DX stations. As a direct result of his tireless efforts in this cause, the ARRL band plan was eventually changed to reflect a DX "window" on 6 meters and to also designate 50.125 MHz as the calling frequency in place of 50.110.

His Work with SAREX

However, while Bill Tynan's first love was VHF and UHF work, his heart and soul were always with AMSAT. Not surprisingly, with AMSAT Bill's positive impacts on ham radio were destined to become some of his longest-lasting contributions to our service.

For example, since his earliest days in AMSAT, Bill was intrigued with the possibility of hams on the ground being able to talk to hams in space. Later, in the mid-1970's, he actively explored the idea of amateur radio operation from aboard the Skylab space station while Owen Garriott, W5LFL, was a part of that crew. Unfortunately, NASA did not approve this proposal, stating that it was too late to modify the station to provide for an antenna.

However, later, as the shuttle program was beginning (and on behalf of AMSAT), Bill authored the very first draft proposal to allow amateur radio operation from the Space Shuttle. His idea was soon picked up by the ARRL, and it resulted in a formal, joint AMSAT/ARRL proposal to NASA to allow this activity. Bill's superb vision led directly to Owen Garriott's historic first use of ham radio from space during the STS-9 mission, thus marking the birth of the then very popular SAREX program.

Phase 3-D (OSCAR 40)

In 1986, Bill was again elected to the AMSAT Board of Directors, and, in 1991, just as the Phase 3-D project (which later became AMSAT-OSCAR 40 on orbit) was beginning to gain momentum, Bill assumed duties as president of the organization at a most critical period in its history. As with his previous callings, Bill wasted no time in making his lasting mark on the organization. As one of his first efforts, he was instrumental in helping to pull a team of over two hundred volunteer people from 13 different countries together with the common goal of building and launching the largest, most complex, and most expensive amateur radio satellite ever attempted. When he finally stepped down from his post as AMSAT President in late 1998, his repeated, annual re-election to this high post made his one of the longest-running terms as president in the organization's history.

The first AMSAT Board.

In addition to his substantial accomplishments in furthering Amateur Radio, Bill remained a very active radio amateur. He was a life member of the ARRL, a life member of AMSAT (membership number 10), and was an active member of the Central States VHF Society, also serving on its Board of Directors. He was its president in 1992 and put on the organization's annual conference that year. Bill was also a member of the Quarter Century Wireless Association, the Radio Club of America, the Institute for Electrical and Electronic Engineers (IEEE) as well as the National Space Society. Locally, he was the Program Chairman of the Hill Country Amateur Radio Club at his home on the Terra Linda Ranch in Kerrville, Texas, and also served on the ranch's cable TV advisory committee.

During his lifetime, Bill also received several prestigious awards, including "Ham of the Year" in 1996 from the Dayton Amateur Radio Association (DARA) and, in 2012, the Barry Goldwater Amateur Radio Award from the Radio Club of America.

A Final Word

The examples I've included here are but a few of the long list of excellent contributions Bill Tynan made to Amateur Radio over his many years as a ham. By now, there should be no doubt in anyone's mind that Bill made a very lasting and exceedingly positive mark on our wonderful hobby, often working out of the limelight and at the very highest levels. Moreover, hams everywhere should be indebted to him for the phenomenal work he did to help insure Amateur Radio continues to occupy its solid place in the forefront of both aerospace and electronic technology as we now move forward into this century.

Indeed, many critical activities in our hobby that we now point to with great pride (like SAREX and ARISS) or use to justify our continued access to valuable frequency spectrum (like AMSAT's satellites) or, probably more frequently, simply take for granted (like VUCC, grid squares, VHF/UHF DX "windows", beacons, calling frequencies and such) only came to fruition because Bill's unseen hand was quietly working behind the scenes to make all of them a reality. I know I speak for many of his friends when I now say, "Bill, we are forever in your debt!"

Bill is survived by his wife of 51 years, the former Mattie LeNoir of Kilgore, Texas, along with numerous cousins, brothers and sisters-in-law. No services will be held. However, his ashes are to be scattered in two locations: the cemetery in Elgin, Texas, where his wife will be interred and the cemetery in Hagersville, Ontario, Canada, which is his mother's birthplace, and where his parents are buried. In lieu of flowers, the family requests that donations be made in his name to the charity of your choice.

Statement of AMSAT President Joe Spier, K6WAO, on the passing of Bill Tynan, W3XO

I can only second the many comments and condolences that are coming in from around the world on the passing of Bill Tynan, W3XO. From the many remembrances of Bill's past accomplishments, it is clear that AMSAT and amateur radio have lost a dear friend.

Friend is a perfect epithet to honor Bill. Bill was a friend to AMSAT, a friend to ARISS, a friend to the ARRL, a friend to amateur radio, a friend to his community, and lifelong friend to his dear wife, Mattie. Bill's friendship extended to me when I became AMSAT President. After hearing me present on some subject, I received a three-page treatise from Bill on the proper use of the pronoun "me." His keen ear had picked up on my error, and the improvement came in a paper titled "What's the Matter with Me?"

Bill had a way of looking at issues from a different perspective. Last October's AMSAT Board of Directors meeting was in the middle of a heated discussion on the verbiage of a proposal when Bill walked in and sat down. After another 15 minutes of discussion, further discussion on the proposal was tabled until the following day. Bill's comment after listening to all this was "Wow, sounds just like the board meetings we used to have 40 years ago!"

Recently, Bill asked to step down as the AMSAT OSCAR Number Administrator. Bill has been granting applicants who qualify OSCAR numbers for over two decades, since the late-1990s. Even Bill could not remember the first number he issued, but he believed it was either TO-31 or SO-35. In any case, Bill had issued at least 57 OSCAR numbers. This is over 60%, or very close to two-thirds, of all the OSCAR numbers currently issued at this time.

Bill liked to keep busy with his passion for amateur radio, whether this was working in the foreground or background. Recently, Bill proposed to AMSAT the use of FT-8 as a digital mode on a future satellite. My friend, Bill Tynan, W3XO, was always thinking ahead.

Ad astra.

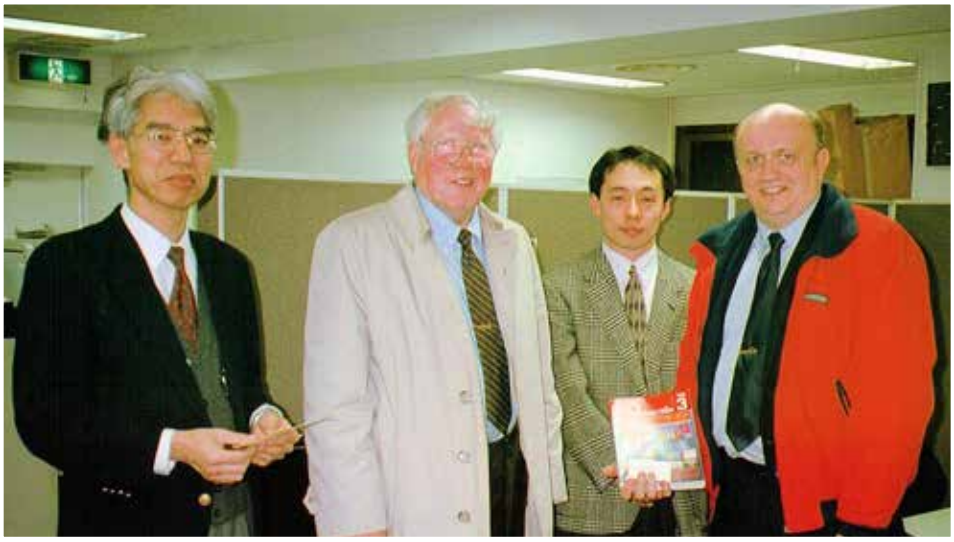
Bill Tynan, W3XO, (Center) discusses Phase-3D issues in the mid-1990s with other members of the Spacecraft Integration Team at the Phase-3D Integration Facility in Orlando, Florida. Phase 3-D later became AMSAT-OSCAR 40 on orbit. (All of the following photos courtesy of Keith Baker, KB1SF, unless otherwise noted.)

In 1996, Bill received a memento on behalf of AMSAT from Masa Machida, JA1DM (then the Vice President of the Japan Amateur Radio League, JRRL) at their headquarters in Tokyo, Japan.

In 1996,Keith Baker (left) and Bill (second from left) met with senior officers of the Japan Amateur Radio League at their headquarters in Tokyo, Japan.

Bill and his wife Mattie made their home on the Tierra Linda Ranch in Kerrville, Texas.

Bill maintained an impressive "ham shack" at his home on the Tierra Linda Ranch in Kerrville, TX.



While in Japan in 1996, Bill and Keith Baker also visited the editorial offices of CQ Ham Radio, the Japanese equivalent of the ARRL's *QST Magazine*.

Also while in Japan, Keith and Bill attended and addressed an annual meeting of the Japan AMSAT organization (JAMSAT).

Bill and Keith (left) briefed members of the Japan Amateur Industry Association (JAIA), a consortium of amateur radio equipment manufacturers in Japan) about the planned capabilities of the Phase 3-D satellite that was then in development.

Also in Japan, Bill and Keith visited the ground control station for the JARL's Fuji-Oscar 29 (FO-29) satellite.

Bill was a fervent fund-raiser for the AMSAT Phase-3D satellite project. Here, your author (left) and Bill (right) along with other members of the Phase-3D team share a moment with retired U.S. Senator Barry Goldwater, K7UGA (SK) (center) in the "ham shack" of his home in Arizona.

In the mid-1990s, Bill (center) and his wife Mattie graciously opened their home in Texas to entertain members of the ARRL Board of Directors while raising funds for the AMSAT Phase 3-D (AO-40) satellite program.

Bill (left) and AMSAT then-President Robin Haighton, VE3FRH (SK), (right) share a moment with our venerable, long-time Office Manager, Martha, outside the AMSAT office in Silver Spring, MD.

Bill and Robin Haighton, along with long-time office volunteer Bob Carpenter, W3OTC (SK) share a moment with AMSAT's Office Manager, Martha, in the old AMSAT office in Silver Spring, MD.

During 1996 visit to JAMSAT Annual Meeting, Kyoto, Japan, Bill outlined the planned capabilities of AMSAT's Phase 3-D satellite at the.

AMSAT OSCAR Numbering System

Drew Glasbrenner, KO4MA
OSCAR Number Administrator

Since the beginning of amateur radio satellites, it has been tradition for satellites to adopt a new name once in orbit and functional. Beginning with our first ham radio satellite, "OSCAR" has been used as part of that new name, an acronym for "Orbiting Satellite Carrying Amateur Radio". Taking over from the original Project OSCAR group, AMSAT issues an OSCAR number to any satellite according to the following guidelines:

1) The spacecraft's use of frequencies in the amateur bands must have been coordinated before launch through established IARU/AMSAT frequency coordination.

2) The spacecraft must have successfully achieved orbit and/or have been successfully deployed.

3) Once in orbit, one or more transmitters must have been successfully activated in the amateur satellite service.

4) After the above requirements have been met, the organization or organizations which are the builders/owners of the spacecraft must request that AMSAT assign a consecutive OSCAR number to the spacecraft as follows:

a) The request must be in writing (e-mail or fax is acceptable also) and be signed by the chief executive officer of the organization making the request. If more than one organization was responsible for building/owning the spacecraft, all must participate in this request.

b) The request must certify that the above three requirements have been met.

c) In addition, it must certify that the organization or organizations making the request are familiar with the IARU paper Information for Developers of Satellites Planned to Use Frequency Bands Allocated to the Amateur-Satellite Service, which can be found on the IARU satellite frequency coordination page, and that the spacecraft's operation in the amateur satellite service is and will remain consistent with the intent of this IARU paper, and the laws of the responsible national administration.

d) The request must specify the country under whose laws the spacecraft is operating.

e) It is customary to refer to OSCAR satellites by a hyphenated name, of which the first part is typically selected by the owner/builder, e.g., UoSAT-OSCAR 11. For some purposes, such as Keplerian tracking bulletins, such names are commonly abbreviated to initials, e.g., UO-11. The request should indicate preferred name in this format; AMSAT will assign the number.

f) The request should be addressed to the Board of Directors of AMSAT at:
Email: **bod@amsat.org** or

Radio Amateur Satellite Corporation (AMSAT)
10605 Concord St, #304
Kensington, MD 20895

While an amateur radio satellite is not required to have an OSCAR number, we encourage all amateur satellite builders to consider one for their satellite. Having an OSCAR number for their satellite continues a proud tradition within the amateur satellite community.

Smile for AMSAT at Amazon.com

When making purchases from Amazon, you can select a charity and Amazon will donate .5% of a qualified purchase towards that charity. Select smile.amazon.com when making your Amazon purchases and make Radio Amateur Satellite Corporation (AMSAT) your chosen charity.

Having selected a charity, when you go to amazon.com, you will be prompted to go to smile.amazon.com. However, you can put everything you want in your cart at the original amazon.com site, then leave the site and go to smile.amazon.com and all your items will still be in your cart.

Girls, STEM and Satellites

Joe Kornowski, KB6IGK
Editor

A recent *New York Times* article, "Role Models Tell Girls That STEM's for Them in New Campaign" (September 9, 2018), cites Department of Commerce data showing that women constitute 50 percent of the college-educated U.S. work force, but only 25 percent of the STEM (science, technology, engineering and math) workforce. According to the Girl Scout Research Institute and National Center for Education Statistics, many girls start to lose interest in STEM subjects in middle school, which continues through high school and college.

The article describes a new public service campaign, "SheCanSTEM," launched in September 2018 to encourage girls 11 to 15 years old to get involved in STEM. The campaign features videos on the campaign website of seven women discussing with girls their occupations and the opportunities in their fields. One of those seven is Lucianne Walkowicz, an accomplished astronomer at the Adler Planetarium. As her video plays, one of the displayed messages reads, "Girls with role models in STEM are more likely to stick with it."

Space offers girls an increasing number of good STEM role models. In 1983, Sally Ride became the first American woman in space. Today, Peggy Whitson currently holds the U.S. record for total days in space at 665, which places her eighth on the all-time space endurance list.

When she was three years old, Alyssa Carson told her father she wanted to become an astronaut. Now a high school senior, she has accumulated an impressive list of accomplishments towards that goal. According to her website, Alyssa's list of "firsts" includes the first person to attend all three NASA Space Camps in the world and to have completed the NASA Passport program, visiting all 14 NASA Visitor's Centers across 9 states. In 2016, Alyssa became the youngest person to graduate the Advanced Possum Academy, officially making her certified to go to space and an astronaut trainee.

In this issue, the *AMSAT Journal* highlights the amateur radio satellite achievements of six girls, who perhaps represent role models that will encourage other girls to pursue space and radio-related STEM studies and activities, either professionally or as an avocation. The first and oldest is Ruth Willet, KM4LAO, who at age 19 was selected as the recipient of the 2018 ARRL Hiram Percy Maxim Memorial Award by the ARRL Board of Directors in July. The award is given to a radio amateur under age 21 whose accomplishments and contributions to both Amateur Radio and the local community are exemplary. Ruth has spoken at amateur radio events, written articles, and mentored other hams, including fellow AMSAT member, Samantha, which she describes. ARRL wrote of Hiram Percy Maxim award winners, "As models for their peers, and inspirations to us all, these fine young people are highly visible boosters of Amateur Radio awareness."

Next, James Lea, WX4TV, profiles his three daughters — Hope, KM4IPF, Faith Hannah, AE4FH, and Grace, KM4TXT. Amateur radio is a Lea family passion that also includes mother, Michelle, N8ZQZ, and brother, Zachariah, WX4TVJ. At age 8, Hope made her first amateur radio QSO on FO-29. The girls worked a cargo ship captain, Yuri, UT1FG, and later toured his ship with the rest of the family in Norfolk, VA. The girls activated national parks as part of the NPOTA activity, and they have participated in satellite demonstrations and presentations at hamfests.

On August 7, 2016, Faith Hannah and Ruth Willet were part of a team, PJ6Y, that broke the then distance record for SO-50 from the Caribbean Island of Saba as part of the Dave Kalter Youth DX Adventure (see "QSL Delta Mike Three Four," *AMSAT Journal*, March/April 2017, p. 23). The Lea girls, with their dad, will be operating amateur radio from the Dry Tortugas National Park in December 2018.

Finally, back in January 2018, two dads arranged for a satellite meet-up for their daughters on AO-91. Jeff Johns, WE4B, tweeted about the satellite contact via AO-91 between his daughter, Marissa, W4AQT, and Alyssa with her dad Charlie Azofeifa, TI2CDA, as control operator. Alyssa had found Marissa's QRZ page and noted their similar interests. Jeff observes how, though the girls' QSO was short and sweet, he enjoys sharing father and daughter time through amateur radio while providing his daughter a STEM educational experience.

Ruth Willet, KM4LAO

Last July, Ruth Willet, KM4LAO (age 19, from Cana, Virginia), was named as the recipient of the 2018 ARRL Hiram Percy Maxim Memorial Award by the ARRL Board of Directors. The board gives the award annually to a radio amateur under the age of 21 for exemplary accomplishments and contributions to both Amateur Radio and the local community.

Ruth shared with the *AMSAT Journal* her thoughts and experiences with amateur radio satellites, getting more young women interested in amateur radio satellites, her preferred operating modes, and her observations about AMSAT and ARISS. Ruth also described her service as an amateur radio satellite mentor to another YL, Samantha, KM4NSF.

What attracted you to satellite operation?

I have always been interested in space and satellites, so when I got my amateur radio license, I knew I wanted to operate on the birds. I was fascinated by the idea of using minimal equipment to make contacts through actual satellites orbiting the earth. I made my first satellite contacts as PJ6Y, during the 2016 Dave Kalter Memorial Youth DX Adventure, where I was a part of the team that set a new SO-50 distance record. I had already been gathering satellite equipment before the trip and listening to passes. I completed my first individual satellite QSO under my own callsign, in February 2017. I love satellites because they require operators to use their skills in a fast-paced, always-changing environment. The minimal equipment needed to be successful has been perfect for my busy lifestyle as a college student. I am often on the road traveling, and I can quickly put my equipment in my car. This allows me to be flexible when I choose to get on the air and allows me to operate from lots of grid squares and states on numerous birds.

What modes have you worked? Any digital?

I regularly operate on the FM and linear satellites. I have earned Satellite VUCC and have operated from over a dozen grid squares using voice communications. I hope to make some linear QSOs using CW soon. I have received SSTV image transmissions from the International Space Station (ISS) and am learning how to make APRS contacts through the ISS digipeater.

Have you used satellites during contests?

I have operated on satellites during the 13 Colonies Special Event Station as K2G (Georgia) and regularly make satellite QSOs for the Gwinnett Amateur Radio Society during Field Day.

What equipment do you personally use for satellite operation?

Operating on FM satellites from FM25 on the Cape Hatteras National Seashore in North Carolina. [Sharon Willet, KM4TVU, photo.]

I use an Arrow antenna for portable satellite operations. When I am on FM satellites, I use two HTs - a Kenwood TH-D74A for transmit and an Icom ID-51A for receive. When I am on linear satellites, I operate on two FT-817s.

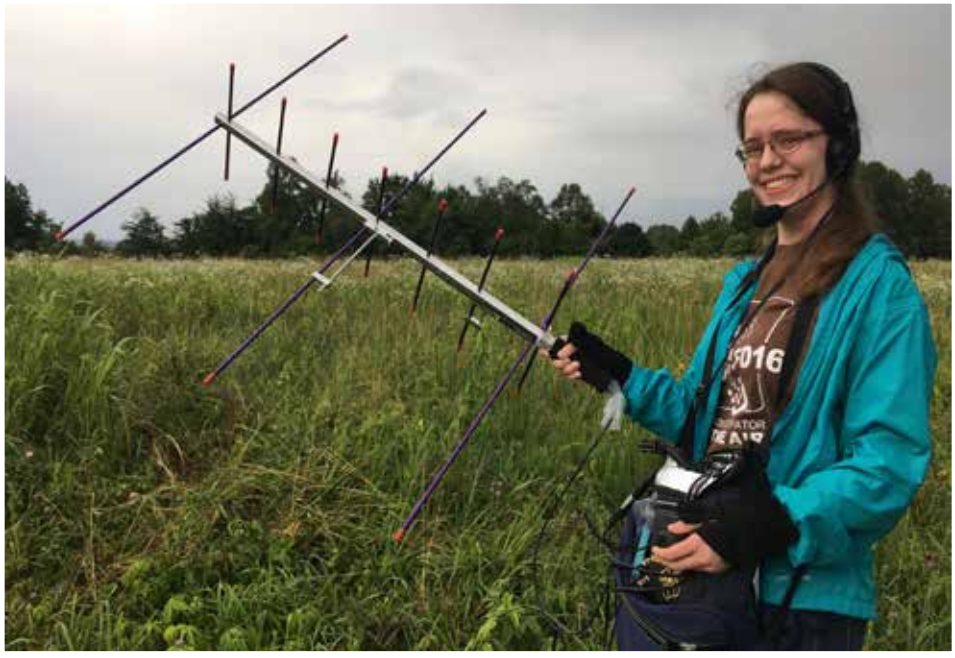
Do you find your fellow students are interested in satellites?

Yes, I find a lot of students who are interested in amateur radio satellites. I operate outside portable all the time, and when I am at school, students stop to ask what I am doing. They are fascinated by the idea of communicating through satellites and like the fact that doing so is portable and not too expensive. I am the president of the amateur radio club at Kettering, and will be giving an amateur radio satellite workshop to students this year. I think that they will be interested in learning more about satellites and how to communicate through them.

What would attract more hams, and especially young women, to operating amateur radio satellites?

Communicating with hams around the world through orbiting satellites is a great way to show people how radio is relevant, modern, personal, and necessary in our globalized world of today.

For younger people, we need to show the connection between both communicating using satellites and using the internet. For example, Hams use



Having fun on FO29 from EM96 in Virginia. [Sharon Willet, KM4TVU, photo.]

Operating beachfront in FM25 on the Cape Hatteras National Seashore. [Sharon Willet, KM4TVU, photo.]

the internet to track the satellites we want to talk through, read online resources to determine the frequencies to use to make QSOs, use social medial to connect with other hams about upcoming passes and better operating techniques. Showing young people how they can use their already acquired internet skills to explore the cutting edge industry of satellites is an important approach for AMSAT to take to promote this hobby.

There are so many ways to utilize the satellites in orbit, and it is important to advertise this fact! FM and linear satellites allow users to operate on SSB, CW, and digital modes. In addition, we can listen to ARISS contacts, and decode SSTV transmissions and make contacts through the digipeter on ISS. Two amazing things about the FM satellite AO-92 are the ability to communicate through it on U/V or L/V modes, and take pictures using the Virginia Tech camera. I think it would be awesome to better promote the availability of the AO92 pictures and advertise how hams can download these photos for themselves. It is really cool that a small camera built at a college is now in space taking photos of earth, and exposure to this aspect of ham radio can attract more people into the hobby.

Regarding young women specifically, it is important to encourage women to explore this mode of operation and for the current members to be excited about them getting on the air through satellites. It can be intimidating transmitting your call if there are only male voices. Encourage the female satellite ham radio operators to take the time to mentor other young women. AMSAT should consider sponsoring a YL satellite forum or workshop at different hamfests, timed around a possible satellite pass which can then be used as a hands-on demonstration. Another idea is for AMSAT to explore how to make the equipment used for this aspect of the hobby easier for youth and women to use. We have smaller frames than most males, and equipment modifications do make it more comfortable for us. The antennas often feel heavier and bigger to our shorter arm lengths and body frames compared to men. Seeing this need, one ham drilled out the boom of an arrow antenna, so Marissa W4AQT, a YL youth operator in Alabama, could handle it better. I personally use wrist guards to help me hold my arrow antenna steady for longer passes. Making sure to interact positively with YLs that may be interested in satellites and helping them to operate comfortably on satellites will go a long way in ensuring there are more active women on the birds.

Amateur radio satellites are just a small portion of the numerous satellites orbiting the Earth and learning to operate on them is applicable to daily life. Learning about and operating on them could lead to careers or interests that would be otherwise undeveloped. Satellites are vital in determining weather, maps, GPS, radio, emergency communications, etc. Satellites are integral in the modern world, and operating on amateur radio satellites is both educational and fun! If these uses are actively promoted, I believe more people would be drawn into the hobby.

Operating as W4GR in EM83 during the 2017 ARRL Field Day. [Joe Biddle, AD4PZ, photo.]

Are you a member of AMSAT? What do you think AMSAT could do to attract more members and create more interest in keeping amateur radio satellites in space?

I have been a proud member of AMSAT since 2017. AMSAT is doing a good job of promoting satellites through social media, which is excellent. I would suggest possibly sharing the AMSAT bi-monthly newsletter online at some point after it is mailed to AMSAT members. This will allow us to show hams and non-hams what we are doing on the birds in a newsletter form.

Since AMSAT is wanting to attract more younger members, I would highly suggest stocking some smaller sized t-shirts and polo shirts. The designs that the AMSAT comes up with are wonderful, and printing youth and adult smalls sizes would make AMSAT able to reach even more people through this advertising. I see that the AMSAT Zazzle store has men and women sizes starting at size small. I would suggest that the annual AMSAT shirts being displayed and ready for sale at the AMSAT booth at Dayton also have this variety of sizes, from small to large, including some youth sizes.

For science minded students, the study of Keplerian Elements is really cool. Making the extremely interesting page on the AMSAT website regarding Keplerian elements a little more accessible would be very useful. Also, the more teachers we can expose to and teach about this hobby within STEM, the more our hobby will be promoted to students. Not only are satellites are fun, but they also require only a Technician class license and are easily communicated through with minimal equipment. Developing workshops for teachers to do with their students on ham radio topics has been proven a success, and adding tools for satellite communications would be wonderful. Some science teachers already incorporate ham radio into the classroom, and making the tools available for teachers and students to operate on satellites would be a great learning experience.

I would encourage AMSAT to continue working with college clubs. Being a college club president myself, I want the support of AMSAT so I can better expose ham radio to my peers. It is important to have new members not only making contacts on satellites, but also helping with the engineering of the satellites. Figuring out a way to advertise to college students and professionals of all ages and encouraging them to volunteer their time to help with satellite engineering and/or other issues is important for keeping these satellites in space and adding new ones in the future.

Samantha, KM4NSF, and Ruth at the 2018 Dayton Hamvention. [Sharon Willet, KM4TVU, photo.]

It is essential to showcase the technology that goes into the ham radio satellites, as well as the people who are designing and constructing them. AMSAT should promote the many activities possible using satellites as well as their great importance in reliable communications. Doing these things will attract more members and make it possible to keep amateur radio in space.

Tell us about your involvement with ARISS.

I absolutely love the ARISS program! I have had a couple of different experiences with ARISS. In 2016, I helped Martha Muir, W4MSA, and the North Fulton Amateur Radio League during an ARISS contact at the Atlanta Science Festival. Martha and that club have an excellent record in promoting and mentoring young hams. I enjoyed introducing students to ham radio at an educational booth and listening to the ARISS contact. It was amazing to see the students' faces light up when they got to hear and speak with an astronaut.

In 2017, I had the opportunity to be a co-host alongside Chris Brault, KD8YVJ, in the new ARISS Introduction Video. I loved getting to work with Tom Delaney and the video directors to create an exciting and informative video for students to watch before contacts begin. I was also able to be part of the May 2018 ARISS contact at Mill Springs Academy in metro Atlanta through this introduction video and a personal pre -recorded video I made for the attendees. I told the students about my friendship with Martha and the organizers of the ARISS contact and encouraged them to get involved in amateur radio. My mom

Samantha and Ruth on a satellite rove to EM93 in South Carolina. [Samantha Clayborn, KM4NSF, photo.]

Samantha and Ruth operating on satellites from EM83.

Sharon, KM4TVU, attended that ARISS contact in person and she witnessed the great excitement the students had in being part of the contact with an astronaut. It is a great educational tool and can be a life changing experience for youth.

Tell us about your mentoring of Samantha, KM4NSF.

"KM4NSF, this is KM4LAO in FM25. You are sounding great!" That concluded my first satellite QSO with my friend Samantha this past July, and we both were thrilled. I love sharing how to operate on satellites with other hams, and at her request, I had been mentoring Samantha in the satellite aspects of the hobby for many months. Mentoring Samantha has been a wonderful experience. It has allowed me to share my delight and knowledge about operating through satellites with her, while also learning how to operate on satellites using gear that is different than mine. At the same time, we have been able to spend time together building our friendship and our radio skills while having fun.

In January 2017, I had just started my co-op job at Textron Specialized Vehicles, in Augusta, GA, and I was eager to meet the local ham radio operators in the area. I discovered that the Amateur Radio Club of Columbia County (ARCCC) had a meeting scheduled nearby, so I planned to attend. When I arrived, I was greeted warmly and was soon introduced to Samantha, KM4NSF. We hit it off right away, since we had much in common, including us both being sophomores in college. We were both delighted to find another active YL in ham radio. Over the next few months, we spent time building our friendship and sharing our interests in exploring this hobby. During that time, in February 2017, I made my first satellite QSOs under my own callsign. I was very excited about it and shared my experiences with the club members. That sparked many conversations between Samantha and me about satellites and how fun they are to operate on. We continued to build our friendship through social media once we both returned to our separate college campuses for our next term.

I returned to Augusta that summer for another co-op term. I had regularly been operating through satellites since I made my first QSO, enjoying interacting with other satellite operators on how to better tweak my equipment and make operating changes so that I could achieve better satellite communications. I was delighted to find that AMSAT has many people willing to productively answer my many questions and suggest ways to better succeed in this aspect of the hobby.

Knowing I was now regularly on the birds and that members of ARCCC were interested in trying out satellites themselves, I was asked by the club president if I would be willing to present a satellite workshop for the club. All interested club members met up on a Saturday for a hands-on workshop, including a "how to" presentation, satellite pass demonstration, and then question and answer with time to program radios and discuss antennas. Many operators came to the workshop, and it was a fun way for me to give back to the club and encourage others to get on the birds.

As Samantha's satellite interests grew, she started saving up for some gear of her own. She bought an arrow antenna in early 2018 and put together a portable station with two Baofengs and the Arrow antenna. By the time she finished putting her station together, I was already back at Kettering University in Michigan, but we continued to interact regularly. She had lots of questions, and I answered as many of her questions as I could. Members of her club were able to help her program her two radios. It was exciting mentoring her as she tested out her equipment to confirm they were operating correctly and then to hear her reactions to listening to passes. I encouraged her to listen regularly so she could learn the routine of a normal pass and etiquette. Listening also gave her the opportunity to start to get a feel for speed and interactions of satellite passes. She often listened, including every day the last week of June, and by

Field Day 2018 she was ready to give it a complete try. ARCCC, located in EM83, had a team of satellite operators trying on almost every FM pass to make the bonus QSO. Of course, the Field Day passes were extremely busy, but Samantha kept at it and persevered. On the last FM pass of Field Day 2018, she completed her first satellite QSO as K4KNS! Her club got the bonus points, and she received the thrill of finally hearing someone reply to her call and completing a QSO.

Samantha continued getting on the air, practicing tracking and listening to passes over the next few weeks. I knew I would have extra time to operate during my vacation week, so we made the goal to work each other while I was in the rare North Carolina grids of FM25 and FM26. On July 4th, during a pass neither of us knew the other would be on beforehand, I heard her on SO-50. It was so exciting to be a part of her completing her first QSO using her own callsign while I was in FM25! Samantha had achieved her goal through asking lots of questions of me and others, researching her equipment options and saving for them, listening, learning and then putting in the work needed to get on the birds and make successful contacts. It is delightful to have another YL operator to listen for when I'm on satellites.

I was so excited to return to Augusta, Georgia, this past July to resume my co-op job and operate satellites in person with Samantha after work hours. It is much easier

to mentor someone while you are with them, instead of remotely, and much more fun! The first weekend I was in Georgia, we met up on a Saturday for a satellite mini-workshop.

While she wasn't able to make any QSOs during a morning pass, I was able to help her to develop a better technique for operating, and she learned how to hear herself through the satellite more clearly. After the pass, I helped her finish setting up LOTW so she could efficiently confirm the QSOs she had already completed and the many more she will be making.

Samantha was officially hooked on satellites by this point and recognized that an upgrade in her equipment would make it all the more enjoyable. After considering her radio options, she decided to purchase a Kenwood TH-D72A. We took a fun road trip together in early August, to Ham Radio Outlet in Atlanta, GA, to buy it. On the way home, we stopped for a satellite pass where she made three more QSOs with her first setup.

Mentoring Samantha has been beneficial to me because it has taught me how to program and operate on satellites using different radios. I have a Kenwood TH-D74A, and although it is similar to the D72A, it does not have full duplex. When I operate on FM satellites, I am using two handhelds. As a result, it has been a good learning experience for me regarding how to set up and operate on one full-duplex HT. We have asked a lot of questions from operators who use these radios, especially Patrick WD9EWK, and Samantha has successfully programmed and made some QSOs with her new D72A! It is exciting to see her become more experienced as a satellite operator and it is great to now be able to work each other on passes when we are at different locations. To add to the fun, we have also met up to go on roving trips to other grids in GA. Mentoring Samantha has been a learning experience for both of us, and we are enjoying the fun of operating on satellites with a friend!

Samantha has come a long way on satellites, and it has been a pleasure mentoring her. She is the type of YL we want to get into satellites, one who enjoys the hobby, puts in the work to get on the birds, and asks for help when needed. Operating on amateur radio satellites is so much fun, and it's a joy for me to mentor and work other YLs on the birds! I would encourage all operators to find someone they can mento this aspect of the amateur radio hobby.

Faith Hannah (AE4FH), Hope (KM4IPF), and Grace (KM4TXT) Lea

James Lea, WX4TV

K4YYL, this is Kilo Mike Four India Papa Foxtrot, Kilo Mike Four India Papa Foxtrot, over. The bits on then eight-year-old Hope Lea's newly-issued amateur radio license (KM4IPF) had hardly settled into their respective places in the FCC database when this young lady made her first amateur radio QSO, on the FO-29 satellite. Hope is the third of the four Lea children, who all have earned their amateur radio licenses, and her older brother and sister, Zechariah (WX4TVJ) and Faith Hannah (AE4FH) had been invited to Richard (W4BUE) Siff's shack to get a taste of the amateur radio satellites. While waiting for AOS, Hope's license showed up in the database, and she was given the honor of making the first call of the day, which was also her first amateur radio QSO.

This contact kindled a love of getting out into the field with Dad (WX4TV) to activate grids with her Yaesu FT-60R and Arrow antenna. In the months following, she and dad stayed up late and rose early to catch SO-50 and activate the grids that were within a reasonable driving distance. They would drive to the oceanfront in Virginia Beach and to the Outer Banks of North Carolina to work the satellite from different grid squares. Months before NPOTA, Hope climbed to the top of the hill at the Wright Brother's Memorial to work a satellite pass and she drew a large crowd of onlookers who were introduced amateur radios and AMSAT. From time to time, her sisters Faith Hannah and Grace (KM4TXT) would come along with Hope and their dad, and they quickly developed an interest in working the birds as well. Grace would have to wait to make her first contact, as she was still unlicensed at the time.

Hope was excited to work satellites from the Chesapeake Amateur Radio Service's 2015 ARRL Field Day, and she tugged Dad out to the field with the gear as SO-50 was about to come overhead. They both expected the pass to be busy and that it might be hard to get a call in edgewise, but they weren't prepared never to make it into the satellite; dad had programmed the wrong uplink

Zachariah, WX4TVJ (top left), Hope, KM4LAO (bottom left), Grace, KM4TXT (bottom second from left), Faith Hannah, AE4FH (center), Michelle, and working a and James, WX4TV.

frequency into the handheld! Undaunted, Hope went to the main satellite station to look up other passes that would take place that weekend, and she discovered that there would be several passes during the early morning hours. "Daddy, can we get up at three in the morning to work the satellite passes?" she asked. Dad agreed, and they both returned to the Field Day site early the next morning. Hope made many contacts that morning on the linear satellites, and she still considers that early morning to be one of her favorite times on the birds.

During this time, Yuri (UT1FG), who is a ship captain, was making runs up and down the East Coast of the U.S. and Caribbean. The girls were anxious to work Yuri, and they would get up early and stay up late to attempt to make contact. After a couple weeks of effort, they achieved their goal when Yuri came back first to Faith Hannah and then to Hope on SO-50. A few weeks later, Yuri made a port call to Norfolk, VA and John (K8YSE) was able to coordinate a visit to Yuri's ship for a tour.

The entire family made their way to the port and were warmly greeted by Yuri. The ship was in its final stages of being loaded with cargo bound for the Caribbean and Yuri had to attend to the details of preparing for the ship's departure, so he assigned his first mate to give the family a tour of the entire ship, from stem to stern. The tour even took the family into the engineering spaces and engine room, where Mom (N8ZQZ) marveled at the narrow and quite steep, stairways!

Once the tour was complete, the family was led to the bridge, where the girls and their brother Zechariah (WX4TVJ) made a few contacts on the local repeater with their handheld radios. The first mate answered Mom and Dad's questions about the operation of the ship while everyone waited for Yuri to return from his duties. He soon arrived on the bridge and took the family to his ham shack, where he proudly showed how he used a marine VHF radio to call up to the bridge where the first mate would have to stand outside to turn the Elk antenna that was mounted to the ship, by hand. Yuri ended the tour with a visit to his cabin, where he pulled out his logbook and filled out QSL cards for Hope and Faith Hannah, hand delivering them personally.

Shortly after the visit with Yuri, the family moved to Florida, where opportunities to work the satellites from new grids awaited. Trips to the beach were made so the girls could work DX stations out in the Caribbean

Morgan Croucher (KD8ZLK), Faith Hannah Lea (AE4FH), and Ruth Willet (KM4LAO) working a satellite pass from the rooftop in Saba.

on low passes. National Parks were activated all over the state. Numerous contacts and lots of friends were made through the little repeaters that circle the earth every 90 minutes. Hundreds of people were introduced to amateur radio by the girls' operations in the field. Hope and Faith Hannah gave satellite demonstrations at the 2016 Orlando Hamcation and Hope made a presentation about satellites at the 2016 Dayton Hamvention. The skills that the girls gained from all of their satellite operations would serve Faith Hannah well when she traveled to the island of Saba with the Dave Kalter Youth DX Adventure.

Faith Hannah, Ruth Willet, and Morgan Croucher operating an FO-29 pass in Saba.

"WD9EWK, this is PJ6Y, fox kilo eighty-seven."

The youth operators, Ruth (KM4LAO), Morgan (KD8LZK), and Faith Hannah worked close to one hundred satellite contacts from this small island which lies in the Caribbean about twenty miles south of Sint Maarten. The youth found out that they could routinely work the satellites at very low angles from their island location–sometimes they were able to get into SO-50 when it was below the horizon. The team put this knowledge and their skills to use early in the morning of August 7, 2016, when they made contact with Patrick (WD9EWK) in DM-34 and broke the SO-50 distance record. The contact from FK87 to DM34 was 5168.752 km or nearly 3212 miles. The entire PJ6Y team contributed to making this record-breaking contact by working stations from around the island and contributing to the knowledge of how to work the satellite as it was close to or below the horizon.

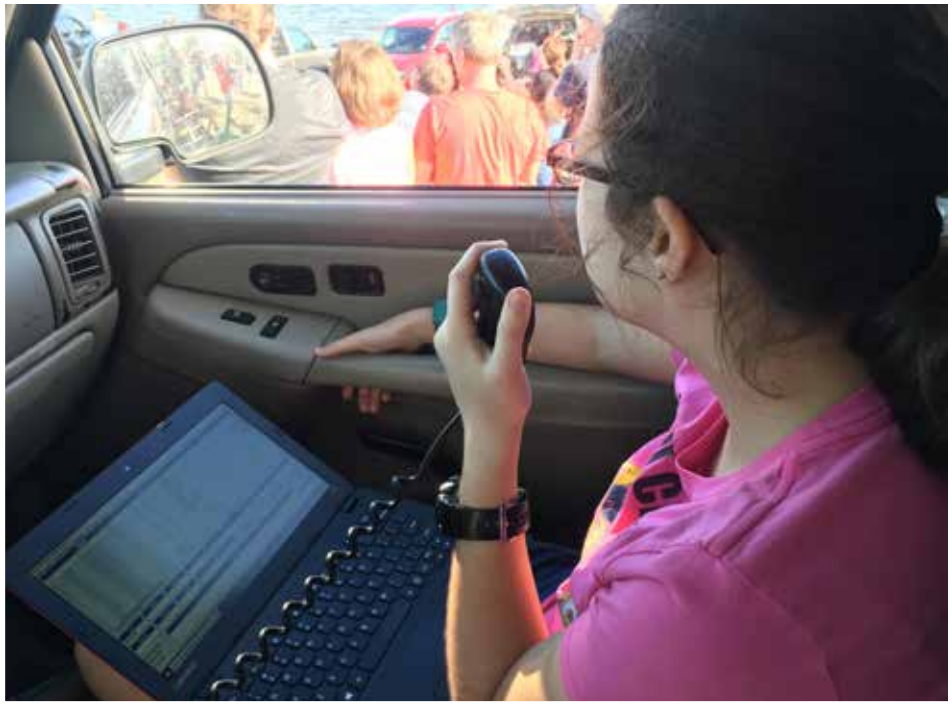
Sometime along the way, back in Florida, the girls were invited by Jerry (N0JY) to visit the Fox-1 Cliff and Fox-1D satellites as they were prepared for "shake and bake" testing in Orlando, FL. The girls, along with Mom, Dad, and their brother Zechariah, spend a few hours talking with the AMSAT technical team about how the satellites are made and how they work. Hope and Jerry shot an interview for the kids' YouTube channel while there as well. This visit took place many months before the launch of Fox-1D, and the girls excitedly waited for their opportunities to make contacts through the small CubeSat that they had seen with their own eyes.

In January 2018, the wait was finally over. The girls stayed up late to watch Fox-1D lift off from the Satish Dhawan Space Centre in India. The subsequent two weeks passed slowly as the AMSAT engineering team made their tests and calibrations on the satellite. Soon, the satellite was declared open for amateur use by Drew (KO4MA) and the girls got to make their first contacts through the newly-minted AO-92. These first contacts weren't made in the way that the girls were typically used to, though. All three of the girls made their first AO-92 contacts from the family Chevy Suburban on a Larson dual band mobile antenna. More contacts have been made since then, using their Elk antenna and satellite go box. Grace, who earned her license in May 2016 at the age of eight, has made quite a few DX contacts on both AO-92 and AO-91.

On February 6, 2018, the Lea family activated the Falcon Heavy Special Event at Kennedy Space Center. They used Faith Hannah's callsign, AE4FH, which they thought was appropriate because of the "FH" in the suffix that represented Falcon Heavy. They operated from a "go-box" they had built days before.

During the special event, they made 100 QSOs, both HF and satellite (via AO-85, AO-91, AO-92 and SO-50). Their friend, Ricardo, KV4OP, actually made his first satellite contact during the event. The next day, Faith Hannah and Hope, were interviewed about the event on Ham Nation (episode #337).

Falcon Heavy Launch Special Event, Hope, KM4IPF.



Falcon Heavy launch, Faith Hannah, AE4FH, on the air while watching the launch.

Faith Hannah and Hope are planning a mini DXpedition to the Dry Tortugas with Dad in December 2018 where they will operate as N4T. They plan to work FM and linear satellites with the go boxes that they built for the trip. This trip is intended to serve as a dry run for providing other youth amateur radio licensees the opportunity to experience what it is like to go on a DXpedition. Listen for them on HF as well!

AMSAT and the amateur radio satellite community have welcomed the youth YL operators such as Ruth, Marissa (W4AQT), and the Lea girls with open arms. While this is fantastic, we need to get more young ladies into the hobby and on the satellites. Reach out to the young YLs in your area and showing them the ropes. Get them licensed, on the air, and talking through the birds.

Hope at Falcon Heavy Launch Special Event.

The Lea family (except the photographer, James) at Falcon Heavy Launch Special Event.

Two YLs Meet on the Air

[From AMSAT-BB Digest, Vol. 13, Issue 42, January 28, 2018.]

Jeff Johns, WE4B, tweeted about the satellite contact via AO-91 his daughter Marissa, W4AQT, completed with Alyssa and her dad Charlie Azofeifa, TI2CDA.

Jeff said Alyssa had seen Marissa's QRZ page and it turns out they are both Harry Potter, Pete the Cat and Minecraft fans and she wanted to get Marissa's QSL card. Charlie and I looked for favorable passes and decided the 18:16z pass of AO-91 on 1/20/2018 would be our first attempt to have the girls make contact.

Marissa and dad Jeff went outside with radios and our Arrow antenna and waited for AO-91 to crest the horizon. As soon as they could hear the bird, W4AQT started calling TI2CDA. After a few calls, there was Alyssa with Charlie serving as the control op. The girls had a very sweet, quick QSO.

Jeff wrote, "Ham radio is supposed to be about learning and progressing the radio art but it's also about forming friendships, even if they are long distance friendships. I have no doubt that this will not be the last time that Marissa and Alyssa have a QSO and I am confident that Alyssa will soon get her own license as Marissa is almost ready to take her General exam.

I was fortunate that my daughter became interested in amateur radio when she would go outside with me and listen to me talking to other hams with my Arrow antenna pointed at the sky. Now that she's licensed, it's allowed us to have some great father and daughter time together, as well as, providing her some excellent STEM education."

Jeff's post on the QRZ.com satellite forum and photos can be seen at:
tinyurl.com/ANS-028-AO91-YL-QSO.

AO-92 L/V Adventure

Patrick Stoddard, WD9EWK/ VA7EWK
wd9ewk@amsat.org

Over the past decade or so since I started working satellites, I have expanded my knowledge and tried different modes and configurations. After beginning with FM satellites in late 2005, I added SSB/CW and packet (1200bps and, with FalconSAT-3, 9600bps), as well as working ISS packet on 70cm in late 2016 and early 2017. Starting in 2006 with AO-51's V/S mode, I used an S-band down-converter to work that mode when it was active. I wrote an article about my first AO-51 V/S experiences, which appeared in the November/December 2006 AMSAT Journal. With AO-92's arrival early in 2018, I am now working the L/V mode. So far with AO-92, I have found it doesn't take much to be heard in this mode and to be successful making contacts.

After AO-92's launch and testing before the satellite was opened for general use, stations were testing the L/V mode with a variety of station configurations. Some had purchased the 16-element Comet CYA-1216E Yagi, and adding the 2m elements from the Arrow dual-band Yagi, to make a dual-band L/V Yagi. A few were using HTs like the Alinco DJ-G7T with 1W transmitter power, and one station even worked the L/V mode with a DJ-G7T and its stock duckie. As I saw these reports, I started digging through my garage to cobble together something for the 1.2 GHz uplink. I didn't want to buy the Comet antenna, if I could get on the 1.2 GHz uplink with equipment I already had.

I bought an Alinco DJ-G7T HT when they debuted at Dayton in 2009. Not a great performer for V/U FM satellites, OK for U/V FM satellites, but the 1.2 GHz part is what I was interested in with AO-92. I also found a Diamond tri-band 2m/70cm/23cm whip antenna, an RH951S, and was ready for the first day when AO-92 was open for general use in the L/V mode, a Sunday morning - 4 February 2018 (Super Bowl Sunday). I hoped I might have some success, based on seeing reports of others using the same HT during the earlier testing, but I was not successful on the first pass. I went back to my garage, trying to see if I could find a box with more 1.2 GHz stuff I had, and found a very old Comet CY-1205 5-element Yagi I bought in the 1990s. My CY-1205 had a BNC connector on it, and there also was a version sold in the late 1980s and early 1990s with a TNC connector instead of a BNC. I put this on my DJ-G7T, and proceeded to try a western pass late that morning. No QSOs then, but there were a couple of passes that evening I wanted to try with the Alinco HT and short Yagi.

WD9EWK holding Alinco DJ-G7T HT with Comet CY-1205 5-element Yagi in left hand and Elk log periodic in right hand (onnected to TH-D74 clipped on belt).

I wanted to park at a freeway rest area north of Phoenix along I-17 in grid DM34, where I go when I want a clearer view of the sky with virtually no noise or interference. One problem - with the Super Bowl in progress, all of the parking spaces were filled with cars and trucks, and I could see some TVs in those vehicles tuned to the game. I had to go another 10 miles north, still in DM34, and park in a large lot behind a truck stop to get a good spot. I had a 7-degree pass to the east and heard several stations on as AO-92 rose from behind some hills. Around the midpoint of the pass, I made two quick QSOs with Glenn, AA5PK, in Texas and Jeff, WB8RJY, in Michigan. I waited 90 minutes for the next pass, which had a maximum elevation of 61 degrees. I heard Jerry, N0JY, in Texas early in the pass, but was not able to make contact with him. A couple of minutes later, I started hearing Greg, KO6TH, in northern California and made a contact with him. After that, I made a brief contact with Patrick, AD5MT, in southern California, and resumed talking with KO6TH. Greg and I were calling out the elevation and uplink frequency as AO-

AO-92 footprint on 5 February 2018 at 0318 UTC. Most of the continental USA is covered, favoring the east coast.

92 approached LOS for our locations, and I was still getting through as the elevation approached 5 degrees. Since I wasn't watching the Super Bowl, this was a fun way to spend a Sunday evening.

Since that Sunday, I have tried to get on at least one AO-92 L/V pass every weekend. Most of the time, I have worked these L/V passes from home. For one pass in mid-March, I was in Tucson at a science fair on the University of Arizona campus and worked a couple of stations from there. I have also added a Chinese-made 10-element Yagi I ordered from eBay, which cost about $50 including shipping from the Far East. I have to be more accurate in pointing the larger antenna, but it has worked as an uplink antenna with my DJ-G7T.

There are also designs for 1.2 GHz Yagis on the Internet. As with the "Cheap Yagis" many use for V/U and U/V satellites, two of these articles were written by Kent Britain, WA5VJB. One of these articles has a design for smaller 1.2 GHz Yagis, of 4 to 10 elements: **www.n5dux.com/ham/files/pdf/D-STAR%20Antennas.pdf.**

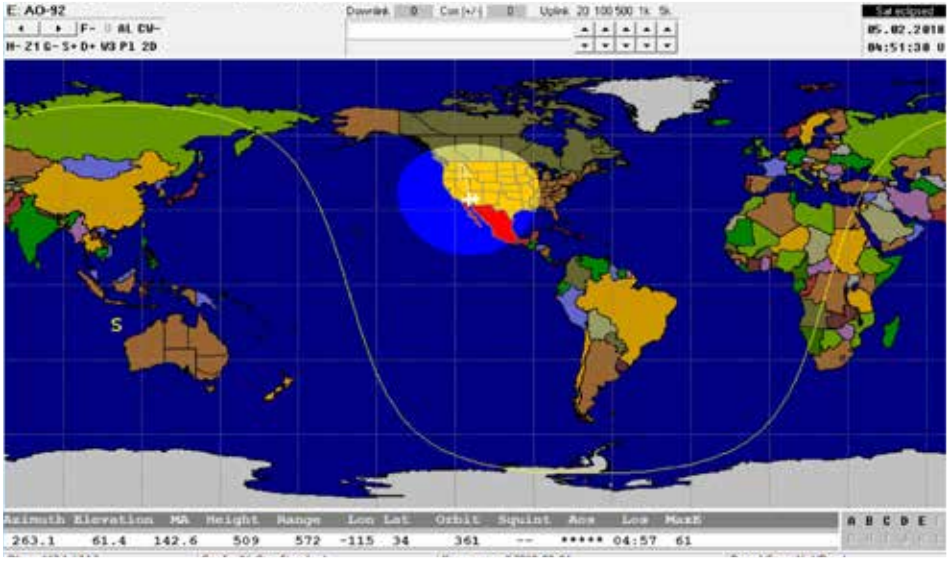
The other WA5VJB article has a design for a 17-element 1.2 GHz Yagi: **wa5vjb.com/references/LBand-Yagis-for-AMSAT.pdf.**

Along with the radio and antennas, tuning the 1.2 GHz uplink is a challenge. I tune across 60 kHz in a matter of 10 to 12 minutes. Unlike how I tune for Doppler with V/U or U/V satellites, I find I have to go slower with the tuning near AOS and LOS, but tune faster as the satellite goes through the middle of the pass.

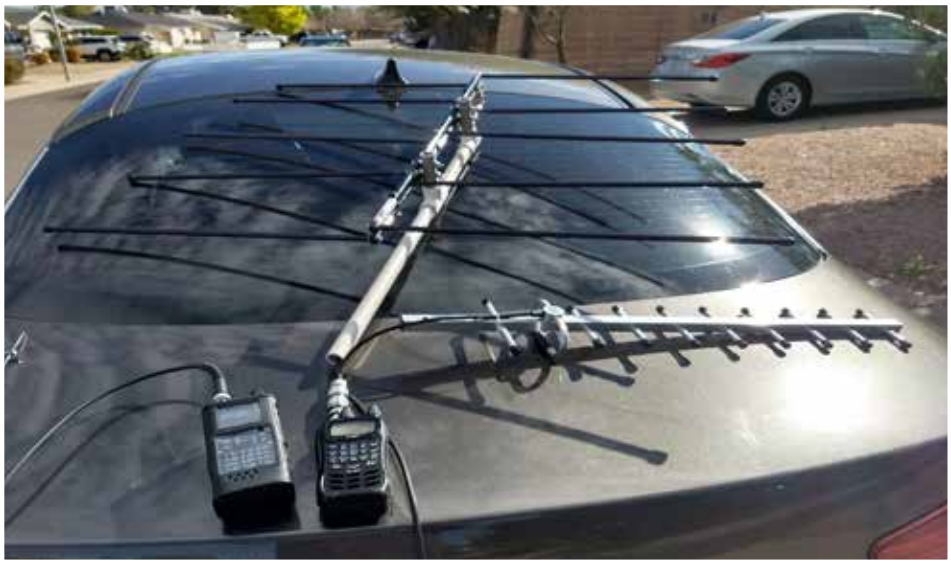
Also keeping in mind that the center frequency for AO-92 is around 1267.358 MHz instead of 1267.350 MHz which was published before AO-92's launch, helps with tuning. For the radios like my DJ-G7T with 5 kHz steps, I consider 1267.360 MHz as the center frequency for my tuning. When I realized I had to change how I tuned for Doppler, in addition to tuning across a larger range than I would for 70 cm, I have been able to work most passes even at lower elevations.

After 3 months of AO-92's L/V mode, I still see questions like: "Can AO-92 L/V be worked with a 1-watt HT?" in different venues. The answer is definitely "yes," provided some antenna gain is added to the 1 W transmitter power, and preferably a directional antenna is used with the HT. At home and from a few locations away from home, I have worked 18 different stations around the continental USA so far in the L/V mode. Most are in the west, but I have had QSOs with stations near the east coast like N8HM in Washington DC and N1JEZ in Vermont from central Arizona, and have heard a couple of Canadian stations on some L/V passes.

With Fox-1Cliff and the European ESEO satellites due to be launched later in 2018, we may have 3 different satellites with L/V capabilities. Fox-1Cliff will be like AO-92, where the L/V mode can be turned on by a command station, but ESEO will only have an FM repeater in L/V mode. If these satellites can hear the uplink signals from stations like mine, there will be more L/V fun in the near future.

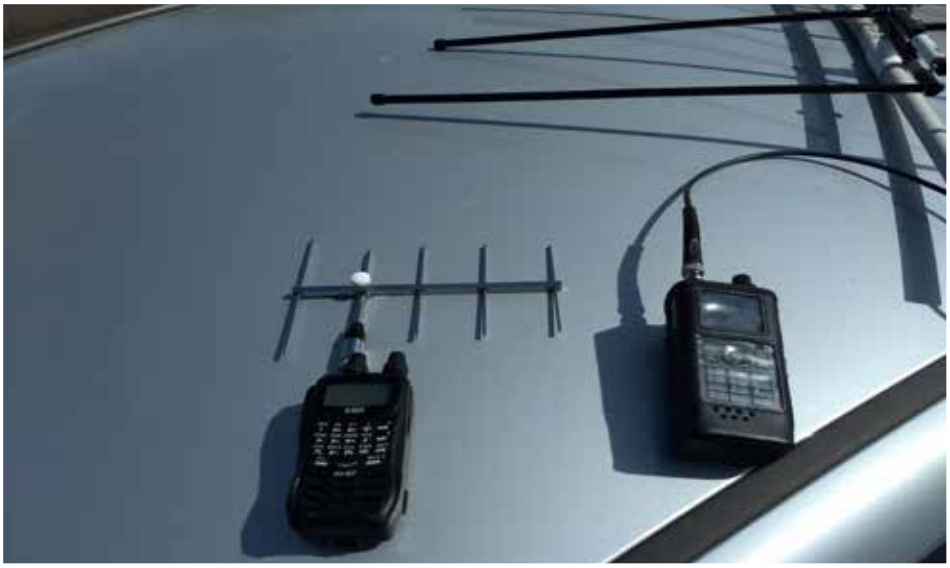


AO-92 footprint on 5 February 2018 at 0451 UTC. The west coast, and much of the continental USA, are covered.



Kenwood TH-D74 connected to Elk log periodic, Alinco DJ-G7T connected to 10-element 1.2 GHz

Alinco DJ-G7T with Comet CY-1205 1.2 GHz Yagi, Kenwood TH-D74 with Elk log periodic



Closeup of Alinco DJ-G7T with Comet CY-1205 1.2 GHz Yagi, Kenwood TH-D74 with Elk log periodic. This pass favored the west coast.

WD9EWK standing in front of his house, working AO-92 L/V. The DJ-G7T is in his left hand, with the Comet CY-1205 Yagi. The Elk log periodic is in his right hand, connected to a TH-D74 on his belt. This pass favored the west coast.

ARISS Gains a New Team Member

Dave Jordan, AA4KN
ARISS PR

Ryan Boyette, the newest ARISS technical team member, gave up his last few weeks of summer break to give Lou McFadin, W5DID, a hand with some much-needed ARISS assembly work.

Ryan came to Lou's attention through a family friend who thought Ryan might be interested in some of the ISS projects Lou was working on. By the way, I don't mean summer break from college. I mean summer break from middle school. Actually, Ryan just started school this year as a ninth-grader at Timber Creek High School in Orlando.

Once Lou and Ryan met, Lou didn't waste any time training Ryan on how to operate his lathe and milling machine. Ryan quickly acquired the technique and was off producing hardware for replacement antennas to be mounted on the Columbus Module.

Next, he learned to operate Lou's grinder and then developed soldering skills under Lou's direction. With the new school year having started on August 13, Ryan's time to work with ARISS was limited, but we hope to keep Ryan involved with our projects when he can spare the time.

Decoding DSLWP-B Satellite Telemetry

Red Willoughby, KC4LE
Assistant Editor

DSLWP-B (aka LongJiang 2) is an amateur radio satellite that was placed in lunar orbit by students at the Harbin Institute of Technology in Shenzhen, China. The satellite transmits telemetry using the GMSK format. The telemetry may be received using a high gain 70 cm antenna pointed at the Moon and an RTL-SDR. The I/Q stream from the RTL-SDR is decoded through the use of GNU Radio flowgraphs running under Linux. A typical, modern Windows PC may be used to run the Linux/GNU environment, but several configuration steps are required to do so.

Some satellite aficionados find that it is particularly fascinating to receive and decode data from near the Moon. Any received telemetry may also be uploaded for use by the sponsors at the Harbin Institute. To assist those who would like to experiment around this unique project, a detailed, step-by-step guide has been documented by Red Willoughby, KC4LE, with assistance from Scott Chapman, K4KDR.

The procedures are divided into three parts as follows:

Part I — Procedures for preparation of a Live CD for booting Linux on a Windows PC

Part II — Procedures for decoding telemetry from a test file that is available for download

Part III — Procedures for decoding telemetry live, over the air, using an RTL-SDR

Windows PC users must execute the procedures in Part I just one time. Experimenters who have a dedicated Linux PC will not need to execute the Part I procedures at all. Then, both the Windows users and the Linux users can execute either the procedures in Part II or Part III as desired again and again when satellite visibility permits. It is suggested that you read over the detailed procedures before diving in, just to gain an overview of the processes.

The detailed procedures are available online at **tinyurl.com/DSLWP**. Questions about the procedures for establishing the Linux/

GNU decoding environment may be addressed as follows:

Red Willoughby, **kc4le@arrl.net**
Scott Chapman, **scott23192@gmail.com**

Several individuals have successfully decoded DSLWP GNU Radio telemetry from the test file, as evidenced on the Contributors page at the Harbin Institute's DSLWP-B website. And a subset of those hams has successfully decoded telemetry from lunar orbit. The link budget for a 2-watt signal over a 240,000-mile path produces a pretty low SNR result. So successful reception requires a capable 70 cm antenna. At the following link, the DSLWP project team has posted information about the successful configurations that are in use at stations around the world. **lilacsat.hit.edu.cn/wp/?page_id=844**

More GNU Radio applications will probably be developed in the future, so this is an excellent opportunity to gain some experience in this area.

eBay Sellers Donate to AMSAT

Are you an eBay seller? One item, ten items, or a full-time business you can donate a percentage of your winning bid to AMSAT.

To do so, do not list your item with the basic listing tool, select advanced tools. eBay will give you a warning message that it is for large volume sellers, however this is where the eBay for Charity tool is found.

You can "select another nonprofit you love" and search for either AMSAT or Radio Amateur Satellite Corporation. Choose the percentage amount of the sale you would like to donate to AMSAT, and boom!.

When your item sells and the winning bidder pays, eBay will deduct the percentage from your take and forward it to AMSAT.

Sometimes we are getting rid of our old equipment, sometimes selling something new. In any case, please consider giving a piece of the pie to a new satellite and choose AMSAT for your eBay Charity.

Donations Needed for Critical ISS Radio Infrastructure Upgrade

AMSAT and ARISS are currently supporting a FundRazr campaign to raise $150,000 for critical radio infrastructure upgrade on ISS to enable students to talk to astronauts in space via amateur radio.

Please help by donating today
https://fundrazr.com/arissnextgen?ref=ab_e7Htwa_ab_47IcJ9

ARISS is in critical need of the infrastructure upgrade to ensure that programs like talking in space using amateur radio can continue. Through your donations ARISS seeks the following upgrades:

Next Generation radio system will support easier radio mode transition, to enable new, exciting capabilities for hams, students and the general public including:

- New amateur radio communication and experimental capabilities, including an enhanced voice repeater and updated digital packet radio (APRS) capabilities
- Slow Scan TV (picture up and downlinks) in both US and Russian segments of ISS
- New multi voltage power supply will support present and future radio capabilities and allow wireless experiments to be conducted
- ARISS needs to build ten Next Generation radio systems to support our development on orbit operations, training and long term maintenance.
- This includes on-orbit (two units, one unit each in US and Russian segment), flight spares (two units), training (three units), testing (one unit), and ground-based maintenance and troubleshooting (two units)

Donations are fully tax deductible within the U.S. as AMSAT IS A 501(c)(3) organization.

Support AMSAT

AMSAT is the North American distributor of SatPC32, a tracking program for ham satellite applications. Version 12.8c is compatible with Windows 7, 8/8.1 & 10 and features enhanced support for tuning multiple radios.

Version 12.8c features:

- SatPC32, SatPC32ISS, Wisat32 and SuM now support rotor control of the M2 RC-2800 rotor system.
- The CAT control functions of SatPC32, SatPC32ISS and Wisat32 have been expanded. The programs now provide CAT control of the new Icom transceiver IC-9100.
- The accuracy of the rotor positions can now be adjusted for the particular rotor controller. SatPC32 therefore can output the rotor positions with 0, 1 or 2 decimals. Corrections of the antenna positions can automatically be saved. In previous versions that had to be done manually.
- The tool "DataBackup" has been added. The tool allows users to save the SatPC32 program data via mouse click and to restore them if necessary. •
- The rotor interfaces IF-100, FODTrack, RifPC and KCT require the kernel driver IOPort.SYS to be installed. Since it is a 32-bit driver it will not work on 64-bit Windows systems.
- SuM now outputs a DDE string with azimuth and elevation, that can be evaluated by client programs. Some demo files show how to program and configure the client.

Minimum Donation is $45 for AMSAT members, $50 for non-members, on CD-ROM.
A demo version may be downloaded from http://www.dk1tb.de/indexeng.htm

A registration password for the demo version may be obtained for a minimum donation of $40 for members and $45 for non-members. Order by calling 1-888-322-6728. The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.

AMSAT Fox-1Cliff & Fox-1D $125,000 Launch Initiative Goal

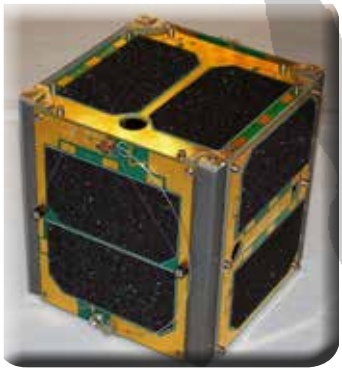
AMSAT is excited about the upcoming launch opportunities for the Fox-1Cliff and Fox-1D CubeSats. Fox-1Cliff and Fox-1D will provide selectable U/V or L/V repeater capabilities on separate frequencies once in orbit, and will be capable of downlinking Earth images from the Virginia Tech camera experiment.

AMSAT has an immediate need to raise funds to cover both the launch and related expenses for Fox-1Cliff and Fox-1D. We have set a fundraising goal of $125,000 to cover these expenses and help us to continue to keep amateur radio in space.

Fox-1Cliff will launch on Spaceflight's SSO-A dedicated rideshare mission aboard a SpaceX Falcon 9 scheduled to launch from Vandenberg Air Force Base in California in 2018.

Fox-1D rode to orbit on an Indian PSLV vehicle launched from Satish Dhawan Space Centre in Sriharikota, India on January 12, 2018.

Donations may be made through the AMSAT webpage at **www.amsat.org**, by calling (888) 322-6728 or by mail to the AMSAT office at 10605 Concord Street, Kensington, MD 20895, USA. Please consider a recurring, club, or corporate donation to maximize our chance of success with this mission.



Your help is needed to get the AMSAT Fox-1Cliff and Fox-1D 1U Cubesats launched.

For the latest news on Fox-1 watch our website at www.amsat.org, follow us on Twitter at "AMSAT", or on Facebook as "The Radio Amateur Satellite Corporation" for continuing news and opportunities for support.

AMSAT President's Club
Support Fox-1Cliff and Fox-1D

Contribute to AMSAT directly through easy, automatic charges to your credit card. Since AMSAT is a 501(C)(3) organization donations may be USA tax deductible. (Check with your tax advisor.) To join contact Martha at the AMSAT Office by phone (888) 322-6728 in the US, or (301) 822-4376; e-mail **martha@amsat.org**.

Titanium Donors contribute at least US $400 per month	❒	$400 / month
	❒	$4800 one time
Platinum Donors contribute at least US $200 per month	❒	$200 / month
	❒	$2400 one time
Gold Donors contribute at least US $100 per month	❒	$100 / month
	❒	$1200 one time
Silver Donors contribute at least US $50 per month	❒	$50 / month
	❒	$600 one time
Bronze Donors contribute at least US $25 per month	❒	$25 / month
	❒	$300 one time
Core Donors contribute at least US $10 per month	❒	$10 / month
	❒	$120 one time

AMSAT is Amateur Radio in Space ... and YOU are AMSAT!

Seize opportunities to launch your amateur radio experience to new heights!

AMSAT Ambassadors - NEW

AMSAT Ambassadors program is looking for satellite operators to share enthusiasm for Amateur Radio in Space with others by:

- Promoting AMSAT at in-person events, practical demonstrations, online, or in written communications
- Offering personal mentoring and coaching to new enthusiasts either in-person or via online means
- Connecting members and potential enthusiasts with proper resources at AMSAT.

To volunteer, send an e-mail to Clayton Coleman, W5PFG at: **w5pfg@amsat.org**

AMSAT Internet Presence

AMSAT's information technology team has immediate needs for volunteers to help with development and on-going support of our internet presence:

- Satellite status updating and reporting.
- Add/delete satellites to ANS and the web as needed.
- Research and report satellite details including frequencies, beacons, operating modes.
- Manage AMSAT's Facebook and Twitter presence.

To volunteer, send an e-mail to Drew Glasbrenner, KO4MA at: **ko4ma@amsat.org**.

AMSAT Engineering Team

AMSAT Engineering is looking for hams with experience in the following areas:

- Attitude Determination and Control, and Thermal Engineering, to help in the design of high orbit CubeSats.
- Power systems, for CubeSats from 1U through 6U and LEO to HEO.
- Help with solar, power supply, and battery design for both LEO and HEO missions.
- Logistics, for parts procurement, inventory, and distribution.
- Documentation, for designs, tests, and public relations.

To volunteer, please describe your expertise using the form at **www.amsat.org/contact-amsat-engineering/.**

AMSAT User Services

AMSAT is looking for an on-line store co-manager to update and refresh the AMSAT Store web page when new merchandise becomes available or prices and shipping costs change.

- Add new merchandise offerings
- Delete merchandise no longer available
- Update shipping costs as needed
- Add periodic updates for event registrations
- Interface with the AMSAT Office.

To volunteer, send an e-mail to Joe Kornowski, KB6IGK at: **kb6igk@amsat.org**

AMSAT Educational Relations Team

AMSAT's Educational Relations Team needs volunteers with a background in education and classroom lesson development ...

- Engage the educational community through presentations of how we can assist teaching about space in the classroom.
- Create scientific and engineering experiments packaged for the classroom.
- Create methods to display and analyze experimental data received from Fox-1.

To volunteer send an e-mail describing your area of expertise to Joe Spier, K6WAO at: **k6wao@amsat.org**.

ARISS Development and Support

AMSAT's Human Space Flight Team is looking for volunteers to help with development and support of the ARISS program:

- Mentors for school contacts
- Support for the ARISS web
- Hardware development for spaceflight and ground stations
- Help with QSL and awards certificate mailing.

To volunteer send an e-mail describing your area of expertise to Frank Bauer at: **ka3hdo@amsat.org.**

Find more information at amsat.org. Click AMSAT – then click Volunteer.