The AMSAT® Journal

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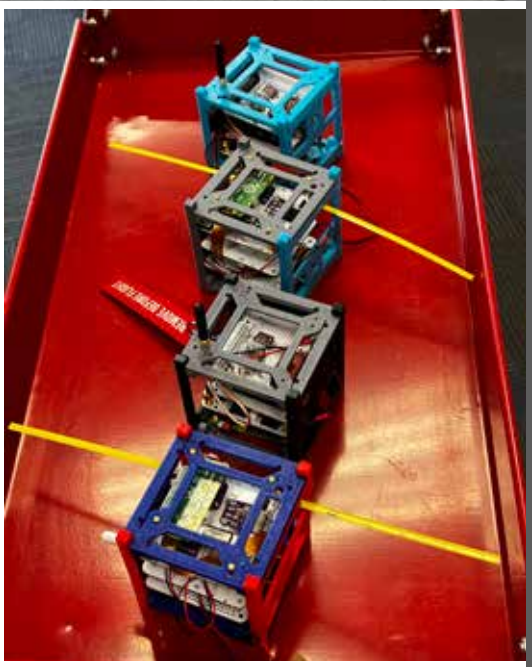
Get Ready for Field Day



In this issue —

Your 2022 Hamvention Photos and Stories Wanted

The AMSAT Journal is ***looking for interesting stories, experiences and photos*** to share with other AMSAT members about your experiences at this year's Hamvention. Relive and share your favorite moments — meeting face-to-face with old and new friends and other operators, gaining new DIY or operational tips and insights, getting updated on the latest from AMSAT, remembering Bob Bruninga at the dinner.

While your experiences are still fresh, find a quiet place, sit yourself down, get out your laptop and tell us what was notable and quotable. Who or what made the trip to Ohio most memorable this year? Did you learn anything new from the presentations you attended? What was different this year compared to prior years?

Don't worry about the length. We don't care if you write five sentences or a thousand words.

Send your photos and stories to: journal@amsat.org.

Our editors are standing by!

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.

Radio Amateur Satellite Corporation (AMSAT)
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AMSAT Club Callsign: W3ZM
AMSAT Websites: www.amsat.org, launch.amsat.org (Member Portal)

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The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec) by AMSAT.

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

Robert Bankston, KE4AL
President

Hamvention – Here We Come!

After a two-year hiatus due to COVID-19 cancellations, we are excited about the opportunity to all get together again and share our passion for amateur radio in space at Hamvention. The 2022 Hamvention will be held May 20 – 22 at the Greene County Fairgrounds and Expo Center in Xenia, Ohio:

- Friday, May 20th, 9:00 am – 5:00 pm
- Saturday, May 21st, 9:00 am – 5:00 pm
- Sunday, May 22nd, 9:00 am – 1:00 pm

AMSAT Engineering, Education, Youth Initiative, Member Services, Getting Started, and, of course, the popular AMSAT Store will be located in Building 1, booths 1007-1010 and 1107-11100. In addition, AMSAT will be hosting live satellite communication demonstrations just outside of our booths, as satellite passes allow.

I will be hosting a forum on Saturday, May 20th, from 12:00 to 1:30 pm, in Room 2, sharing AMSAT's vision, mission, and plan to make it happen. In addition, AMSAT Engineering, Education, and Youth Initiative will provide updates on their programs. AMSAT also will be hosting an informal social event on Thursday evening and co-hosting the AMSAT/TAPR Banquet on Friday night. Also, please join us for informal get together at Tickets Pub & Eatery, located at 7 W Main St, Fairborn, OH, on Thursday night, May 19th, 6-8 pm.

We are happy to once again partner with our friends at Tucson Amateur Radio Packet Radio on the 13th annual AMSAT/TAPR Banquet, to be held in conjunction with Hamvention. This year's AMSAT/TAPR banquet will be held at the Kohler Presidential Banquet Center on Friday, May 20th at 18:30 EDT and honor the life and accomplishments of long-time amateur satellite and amateur packet pioneer Bob Bruninga, WB4APR, who passed away in February. The Kohler Presidential Banquet Center is located at 4548 Presidential Way, Kettering, Ohio – about 20 minutes away from the Greene County Fairgrounds.

Tickets ($57 each) may be purchased from the AMSAT store. The banquet ticket purchase deadline is Friday, May 13th. Banquet tickets must be purchased in advance and will not be sold at the AMSAT booth. There will be no tickets to pick up at the AMSAT booth. Tickets purchased on-line will be maintained on a list with check-in at the door at the banquet center. Seating is limited to the number of meals reserved with the Kohler caterers based on the number of tickets sold by the deadline.

For more information, to view the menu options, and purchase your tickets, please visit **www.amsat.org/product/amsat-tapr-joint-hamvention-banquet-registration/**. We look forward to seeing you at Hamvention.

AMSAT Receives ARDC Grant

If you have not already heard, AMSAT received a generous grant of $93,975 from Amateur Radio Digital Communication (ARDC) to develop a 3U spaceframe with deployable solar panels. This standardized 3U CubeSat spaceframe will serve as the mechanical platform for our Greater Orbit, Larger Footprint (GOLF) series of satellites, as well as for a new generation of low-Earth orbit (LEO) FM satellites. In addition, the 3U CubeSat spaceframe design, to include engineer drawings and source files, will be shared publicly, so that other CubeSat developers may freely use our spaceframe as a basis for their next satellite.

Help Wanted

Although AMSAT is a small organization, we have big dreams. To bring those dreams to reality, we, as an all-volunteer organization, need your help. Engineering expertise is always a top priority, but our volunteer needs span the entire gamut, from administrative to program management, education to website development, and public relations to finance. Please consider donating your time and expertise to help us continue on our path Onward & Upward!

Educational Relations Update

Alan Johnston, Ph.D., KU2Y
V.P. Educational Relations

In this month's *Journal*, look for an update from the CubeSatSim Educational Materials Team. I mentioned in the past that the team had formed and was meeting. We update what we have been working on and our future plans. I am extremely pleased with the team's work so far and can't wait to see more results later this year! If you have comments or feedback, don't hesitate to share them with me or Paul Graveline, K1YUB, the lead author of the article.

With spring drawing to a close, my students have just finished building CubeSatSims. We built six across three classes. I had five weeks of construction planned, with a week off to build tape measure Yagi-Uda antennas and a listening activity where we used them outdoors to listen to the ISS as it flew over. We also did a "hidden transmitter hunt" across campus, which was fun.

Four of the CubeSatSims are shown in the figure at right. In the end, we were a little rushed for time. Two of these are fully functional, while the other two don't yet have the battery charging and 5V regulator circuits installed. I think the students had some fun and improved their soldering, 3D printing, and troubleshooting skills. Maybe I'll write an article for the Journal over the summer discussing how the class was organized and what we learned.

This month, we also had some CubeSatSim Lite boards available on the AMSAT Store, but they sold out very quickly. We will have more at Hamvention and in the store later in the year.

CubeSatSims built by freshman electrical and computer engineering students.

For the latest CubeSat Simulator news, follow our dedicated Twitter account **@CubeSatSim**.

If you are interested in doing a demo for a group or school, such as a hamfest or club meeting, I can ship you a CubeSatSim loaner. Contact me via email at **ku2y@arrl.net** or on Twitter **@alanbjohnston**.

Share Your Experiences as an AMSAT Member

The AMSAT Journal is looking for you to share your satellite radio experiences, likes and dislikes, how you work the birds, and what you like about *The AMSAT Journal*. We'll publish a selection of responses in upcoming issues of the Journal under a column we're calling "Members Footprints." Photos are strongly encouraged! Thanks!

Please send the information requested below to journal@amsat.org --

- Your Name
- Call Signs Held
- Primary Grid Square
- Favorite Satellite Contact
- First Satellite Contact
- First Satellite Ground Station Description
- Current Satellite Ground Station Description
- Reasons You Are an AMSAT Member
- Favorite AMSAT Memory (a satellite contact, symposium, engineering project, event that would never have happened without AMSAT, etc.)
- Favorite Topics Appearing in The AMSAT Journal (could include things like building a homebrew antenna, assembling a ground station, using tablets and smartphones, news of upcoming launches, portable operations, ARISS, etc.

Please Provide a Hi-Resolution Photograph (see www.amsat.org/?page_id=1709).

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.

2022 AMSAT Field Day

Bruce Paige, KK5DO
AMSAT Director Contests and Awards

It's that time of year again — summer and Field Day! Each year the American Radio Relay League (ARRL) sponsors Field Day as a "picnic, a campout, practice for emergencies, an informal contest and, most of all, FUN!" The event takes place during a 23-hour period on the fourth weekend of June. For 2022, the event takes place during a 27-hour period from 1800 UTC on Saturday, June 25, 2022, through 2100 UTC on Sunday, June 26, 2022. Therefore, those who set up before 1800 UTC on June 25 can operate only 24 hours. In addition, the Radio Amateur Satellite Corporation (AMSAT) promotes its own version of Field Day for operation via the amateur satellites, held concurrently with the ARRL event.

This year should be as easy as last year since we have more than 10 transponders and repeaters available. Users should check the AMSAT status page at http://www.amsat.org/status/ and the pages at https://www.amsat.org/two-way-satellites/ for what is available in the weeks leading up to field day. To reduce the time spent researching each satellite, see the current FM satellite table at https://www.amsat.org/fm-satellite-frequency-summary/ and the current linear satellite table at https://www.amsat.org/linear-satellite-frequency-summary/.

If you are considering ONLY the FM voice satellites, those are the International Space Station (ISS), SO-50, AO-91, PO-101, and possibly LilacSat. This year, it might be easier to make that one FM contact for the ARRL bonus points with so many FM birds. The congestion on FM LEO satellites is always so intense that we must continue to limit their use to one-QSO-per-FM-satellite. This includes the ISS. You will be allowed one QSO if the ISS is operating voice.

It was suggested during past field days that a control station be allowed to coordinate contacts on the FM satellites. Nothing in the rules would prohibit this. This is simply a single station working multiple QSOs. If a station were to act as a control station and give QSOs to every other field day station, the control station would still only be allowed to turn in one QSO per FM satellite, while the other station would submit one QSO.

The format for the message exchange on the ISS or other digital packet satellite is an "unproto" packet to the other station (3-way exchange required) with all the same information as usually exchanged for ARRL Field Day, such as:

> W6NWG de KK5DO 2A STX
> KK5DO de W6NWG QSL 5A SDG
> W6NWG de KK5DO QSL

If you have worked the satellites on Field Day in recent years, you may have noticed a lot of good contacts can be made on some of the less-populated, LEO satellites like FO-29, AO-7, EO-88, or the XW satellites. During Field Day, the transponders come alive like 20 meters on a weekend. The good news is that the transponders on these satellites will support multiple simultaneous contacts. The bad news is that you can't use FM, just low-duty-cycle modes like SSB and CW.

THE 2022 AMSAT FIELD DAY RULES

The AMSAT Field Day 2022 event is open to all Amateur Radio operators. Amateurs must use the exchange as specified in ARRL rules for Field Day. The AMSAT competition encourages the use of all amateur satellites, both analog and digital. Note that no points will be credited for any contacts beyond the ONE allowed via each single-channel FM satellite. Operators are encouraged not to make extra contacts via these satellites (e.g., SO-50). CW contacts and digital contacts are worth three points, as outlined below.

1. Analog Transponders

ARRL rules apply, except:

- Each phone, CW, and digital segment ON EACH SATELLITE TRANSPONDER is considered a separate band.

- CW and digital (RTTY, PSK-31, etc.) contacts count THREE points each.

- Stations may only count one (1) completed QSO on any single channel FM satellite. If a satellite has multiple modes, such as V/u and L/s modes, both turned on, one contact is allowed. If the PBBS is on — see Pacsats below, ISS (one phone and one digital), contacts with the ISS crew will count for one contact if they are active. PCSat (I, II, etc. — one digital),

- The use of more than one transmitter simultaneously on a single satellite transponder is prohibited.

2. Digital Transponders

We have only APRS digipeaters and 10 m to 70 cm PSK transponders (see Bob Bruninga's article in the March/April 2016 issue of *The AMSAT Journal*).

Satellite digipeat QSOs and APRS short-message contacts are worth three points each, but must be complete verified two-way exchanges. The one contact per FM satellite is not applied to digital transponders.

The use of terrestrial gateway stations or internet gateways (i.e., EchoLink, IRLP, etc.) to uplink/downlink is not allowed.

For the Pacsats (FalconSat-3) or "Store and Forward" hamsats, each satellite is considered a separate band. Do not post "CQ" messages. Simply upload ONE greeting message to each satellite and download as many greeting messages as possible from each satellite. The subject of the uploaded file should be posted as Field Day Greetings, addressed to ALL. This portion of the competition aims to demonstrate digital satellite communications to other Field Day participants and observers. Do not reply to the Field Day Greetings addressed to ALL.

The following uploads and downloads count as three-point digital contacts.

> (a) Upload of a satellite Field Day Greetings file (one per satellite).
> (b) Download of Satellite Field Day Greetings files posted by other stations. Downloads of non-Field Day files or messages not addressed to ALL are not to be counted for the event. Save DIR listings and message files for later "proof of contact."

Please note that AMSAT uploaded messages do not count for QSO points under the ARRL rules.

Sample Satellite Field Day Greetings File:

Greetings from W5MSQ Field Day Satellite station near Katy, Texas, EL-29, with 20 participants, operating class 2A, in the AMSAT-Houston group with the Houston Amateur Television Society and the Houston QRP club. All the best and 73!

Note that the message stated the call, name of the group, operating class, where they were located (the grid square would be helpful), and how many operators were in attendance.

3. Operating Class

Stations operating portable and using

emergency power (as per ARRL Field Day rules) are in a separate operating class from those connected to commercial power at home. Therefore, on the report form, simply check off Emergency or Commercial for the Power Source, and be sure to specify your ARRL operating class (2A, 1C, etc.).

AND FINALLY...

The Satellite Summary Sheet should be used to submit the AMSAT Field Day competition to be received by KK5DO (e-mail) by 11:59 P.M. CDT, Friday, July 15, 2022. This deadline is earlier than the due date for the ARRL submissions. The only method for submitting your log is via e-mail to kk5do@amsat.org or kk5do@arrl.net. (I have not had a mail-in entry in over five years, probably even longer than that.)

Add photographs or other interesting information that can be used in an article for *The AMSAT Journal*.

You will receive an e-mail response (within one or two days) from me when I receive your e-mail submission. If you do not receive a confirmation message, I have not received your submission. Try sending it again or send it to my other e-mail address.

Certificates will be awarded for the first-place emergency power/portable station at the AMSAT General Meeting and Space Symposium in the fall of 2022. Certificates will also be awarded to the second and third place portable/emergency operation and the first-place home station running on emergency power. A station submitting high, award-winning scores will be requested to send in dupe sheets for analog contacts and message listings for digital downloads.

You may have multiple rig difficulties, antenna failures, computer glitches, generator disasters, tropical storms, and there may even be satellite problems. Still, the goal is to test your ability to operate in an emergency situation. Try different gear. Demonstrate satellite operations to hams that don't even know the HAMSATS exist. Test your equipment. Avoid making more than ONE contact via the FM-only voice HAMSATS or the ISS, and enjoy the event!

[This form is designed to allow for easy editing in a word processor.]

AMSAT Satellite Summary Sheet - 2022

Satellite and number of Voice QSOs (1 point each)
SO-50 1 (example)

Satellite and number of CW/RTTY/PSK31 etc. QSOs (3 points each)
AO-07 5 (example)

Satellite and Up/Downloads (3 points each)
FalconSat3 3 (example)

Score Calculation
Total Voice QSO's 1 x 1 = 1
Total CW/RTTY/PSK31 QSO's x 3 =
Total Up/Downloads 8 x 3 = 24
Grand Total = 25

Please provide the following information:

Your Field Day Callsign

Your Group Name

ARRL Field Day Classification
ARRL Section
Power Source (Select 1)
Emergency
Commercial

Your name and home call

Home address

Any Comments

And… please attach pictures.

President's Club Recognition

Frank Karnauskus, N1UW
V.P. Development

AMSAT wishes to recognize these generous donors who have become members of the AMSAT 2022 President's Club during the first quarter of this year. Collectively, they have contributed over $46,000 toward AMSAT's commitment to Keeping Amateur Radio in Space!

Titanium ($4,800+)
Barry A. Baines, WD4ASW
Alan P. Biddle, WA4SCA
John D. Botti, KC8OKB
William G. Brown, K9LF

Platinum ($2,400+)
Ronald Parsons, W5RKN

Gold ($1,200+)
Burns Fisher, WB1FJ
John R. Kludt, K7SYS
Joseph Lynch, N6CL
Douglas B. Tabor

Silver ($600+)
Bruce Paige, KK5DO
David A. Vine, WA1EAW

Bronze ($300+)
Thomas Talley, K0CFI
Dave Taylor, W8AAS

Core ($120+)
Steve Bachhuber, K9SJB
Robert Brennan, KC3CKV
George Carr, WA5KBH
Richard Dittmer, KB7SAT
David Grebe, WA4LM
Nels E. Knutzen, W0PEC
David Hartrum, WA3YDZ
Stephen Howard, AB0XE
Gailen Marshall, N5GDM
Brendan McNeill, ZL3BAM
Ottawa Valley Mobile Radio Club
Maxwell Rathbone, W3POI
Alton Simpson, WA5TJB
Carl Starnes, W4EAT
Paul Stoetzer, N8HM
Christopher Wachs, WA2KDL
Stefan Wagener, VE4SW

More information about the President's Club can be found on the inside back cover of this issue.

Progress Report: Curriculum Development to Accompany the AMSAT CubeSat Simulator

Paul Graveline, K1YUB
Assistant Editor, The AMSAT Journal

Alan Johnston, KU2Y
V.P. Educational Relations, AMSAT
Associate Professor Villanova University

Fredric Raab, KK6NOW
Adjunct Faculty, College of the Desert

Mark Samis, KD2XS
Manager, Data Services, Lower Hudson Regional Information Center (Ret.)

David White, WD6DRI
Professional Geologist
Lifetime Amateur Radio Enthusiast
STEM Advocate

Introduction

For over a half-century, AMSAT has been planning, financing, building and successfully launching satellites for use by the amateur radio community. Concurrent with these launch efforts, AMSAT has always focused on promoting education as one of its most significant activities. That is as true today as it was over a half-century ago.

As there has been an increase in the number of telemetry modes transmitted by the AMSAT satellites, there is an increasing need for educating both new and experienced users on how to interpret them.

Until recently, there has not been an engaging way of training people, whether experienced satellite operators, college students or Girl and Boy Scouts, on how to receive and interpret the satellite-generated data. AMSAT is now attempting to improve this situation by introducing the AMSAT CubeSatSim, the CubeSat Simulator, to be accompanied by the education material that our working group is developing.

The main educational goal is to provide an opportunity to learn about telemetry and image reception for as many potential users as possible across a broad spectrum of experience without having to wait until an active satellite is overhead. Since many of

Figure 1 — AMSAT CubeSat Simulator. For more information, see CubeSatSim.org.

these instructional sessions will take place inside a building, AMSAT has developed the CubeSatSim, the CubeSat Simulator, to help interested parties learn about the satellites and engage in meaningful exercises in decoding telemetry.

To this end, a number of CubeSatSims have been constructed and distributed. The challenge of providing proper instruction on deploying them and using them most efficiently as an educational tool remains.

Team Members

To foster curriculum development, AMSAT has established a working group whose mission is to produce accompanying curriculum material to use with the CubeSatSims.

Leading this effort is Dr. Alan Johnston, KU2Y, AMSAT Vice President of Educational Relations and an electrical engineering professor at Villanova University in suburban Philadelphia. Other members of the working group are:

Fredric Raab, KK6NOW, is on the faculty of the College of the Desert, Palm Desert, CA, where he ran a computer engineering workshop, taught a summer STEM camp for middle and high school students, and now is opening the college's maker space. Since retiring from UCSD's Qualcomm Institute, he has devoted his time to STEM education, focusing on amateur rocketry, CubeSats, and high-altitude balloon tracking.

Mark Samis, KD2XS (formally WA2GCS & WN2GCS), has been a ham for 56 years. He has been a former science teacher, college adjunct professor and K-12 Ed Tech administrator for 30 years. He was also a member of the original Teacher in Space program 1984-86.

David White, WD6DRI, has been collaborating on STEM-related projects since 2010 as a mentor to the Mt. Carmel High School Amateur Radio Club, W6SUN, in San Diego, California. Along with several other hams, David continues to mentor at the high school, where the students are actively launching high-altitude balloon (HAB) flights with various amateur radio-equipped payloads. In addition, he has participated in some ARISS (Amateur Radio on the International Space Station) events from local elementary schools and from the Ruben H. Fleet Science Center in San Diego's Balboa Park that have allowed students to talk directly with astronauts onboard the ISS via ham radio. In 2019 he built his first CubeSat Simulator and has been working with Alan and the CubeSatSim project ever since.

Paul Graveline, K1YUB, is an Assistant Editor for *The AMSAT Journal*.

Goals

The AMSAT CubeSatSim, the CubeSat Simulator consists of two distinct parts. One is a replica of a 1U cube satellite which is battery operated and designed to transmit telemetry and images over a short distance. Since the CubeSatSim transmits telemetry in formats used by real satellites in orbit,

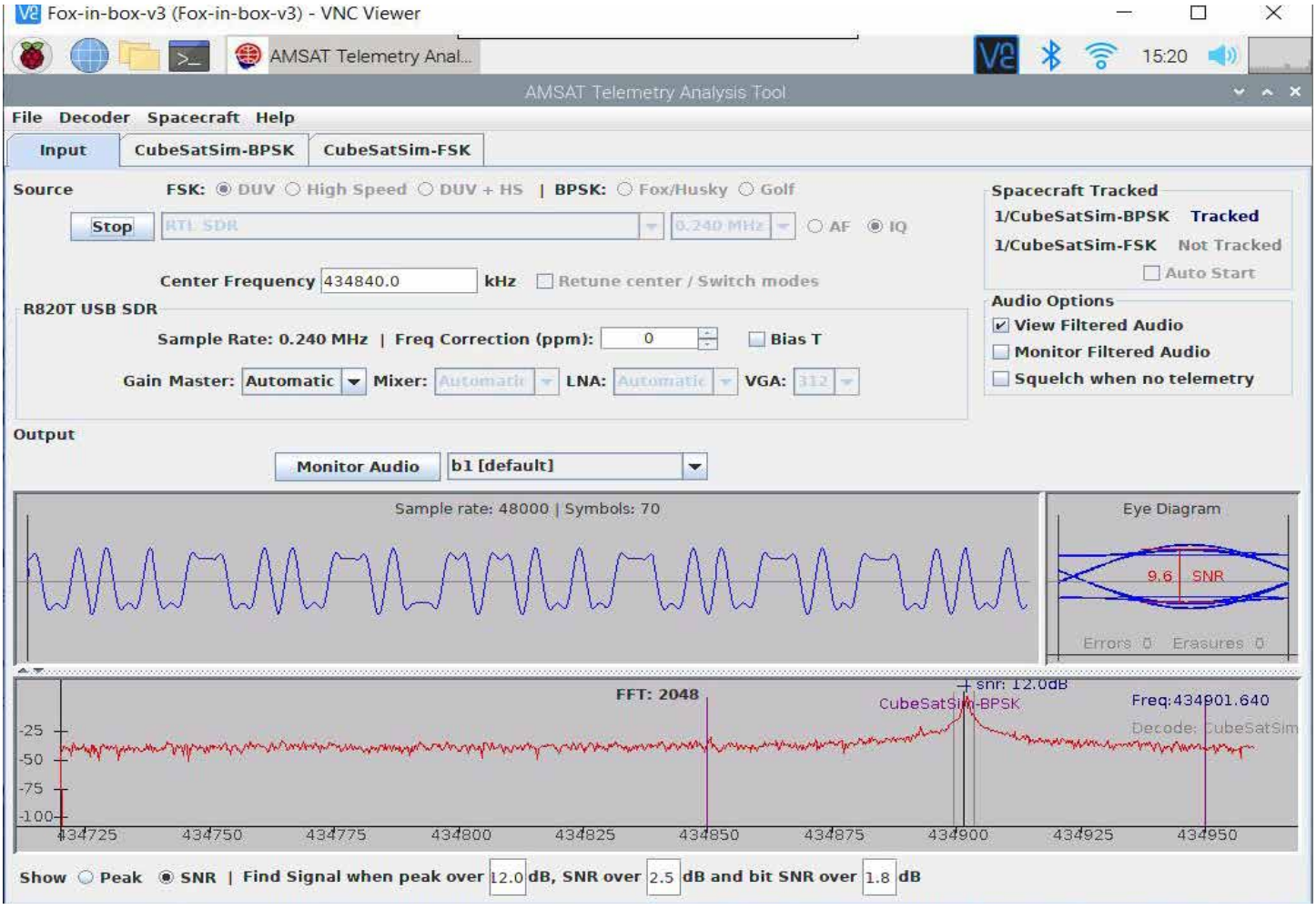


Figure 2 — Raspberry Pi ground station using the Fox-in-a-Box v3 (image, burnsfisher.com/AMSAT/FoxInABox/).

AMSAT members and others can use station software to receive and decode the signals. The Raspberry Pi ground station includes software for every mode pre-installed and is pre-configured to use an RTL-SDR USB dongle. The station is built around the popular Raspberry Pi single-board computer attached to a small screen that displays the data transmitted by an active orbiting AMSAT satellite or the CubeSatSim. The ground station can receive live signals from orbiting satellites with a proper antenna connected.

One of the main challenges for the group was determining how to provide appropriate curriculum material for a wide range of audiences. The group decided to develop the curriculum as a series of modules from which users could choose the most relevant ones. The modules can also double as a marketing tool. For example, if you are trying to convince a school or maker space leader to use the CubeSats satellites, you could select which modules to emphasize depending on your audience.

Several modules currently are under development:

Module 1

This module is intended mainly for high school and college-level satellite communications. The module probably would not be relevant for veteran satellite operators. However, it will highlight the standard terms associated with satellites, such as "uplink" and "downlink," among others.

Module 2

This module is intended to explain AMSAT and its mission. We thought it a good idea to mention AMSAT's history and success in launching satellites for the last half-century to build confidence in AMSAT's long history of success. The module is designed for anyone who is not familiar with AMSAT. This audience might include HF or VHF operators who are unaware of AMSAT's existence and history.

A unique feature of AMSAT projects is that they involve two-way transmit/receive functionality that provides full satellite communication capabilities for the users.

Module 3

A third module addresses potential users who are unaware of the advantages of operating a satellite ground station and understanding the data it generates. This audience would include high school students desiring to add radio communications skills to their college resume and people in the space industry seeking job advancement by learning more sophisticated skills.

Module 4

This module will provide background information for those considering building a CubeSatSim. This includes an overall summary of the requirements, costs and tools, such as:

- Fabrication involving soldering, 3D printing and assembling the parts.

- Parts cost about $300, almost half sourced from electronics distributors such as Digikey, another half from Amazon, and a few specialized parts from other sources

- Choices when building your CubeSatSim include:
  - o SMA antenna or tape measure antenna?
  - o Order your PCBs using open source Gerber files or acquire PCBs from AMSAT with surface mount components already mounted.
  - o Raspberry Pi ground station or set up your own ground station on your PC.

- Soldering skill level: Intermediate. We don't recommend soldering a CubeSatSim as a first soldering project. Many solder practice kits are cheap and gradually increase in difficulty. But the CubeSatSim is an excellent second soldering project after successfully completing another project. The project requires a few SMD (Surface Mount Device) components, but the AMSAT Store PCB offers them already mounted, leaving only through-hole components. **www.amsat.org/product/amsat-cubesatsim-pcb/**.

- 3D printing skill level: beginner. The STL files for the frame are provided (Hosted on Thingiverse: **www.thingiverse.com/thing:4333605**), so you just need Slicing software to generate a file for your specific 3D printer. Any intro to 3D printing will explain the simple steps to do this. If you don't have access to a 3D printer (or a school or library or maker space that has one), there are online services to which you upload the STL files and get your 3D print in the mail.

- Computer Skills Needed: the CubeSatSim software is open source and available on Github (**github.com/alanbjohnston/CubeSatSim**) and runs on a Raspberry Pi. Minimal Raspberry Pi skills are needed. A disk image with all software installed and configured is available to download - the instructions are in the Wiki: **github.com/alanbjohnston/CubeSatSim/wiki/2.-Software-Install**. The AMSAT Store also has an SD card with all the software available: **www.amsat.org/product/amsat-cubesatsim-raspberry-pi-sd-card/**.

- Tools needed will also be listed.

The instructions to build a CubeSatSim are on a GitHub wiki: **CubeSatSim.org/wiki.**

The Bill of Materials (BOM) is available as a Google spreadsheet: **CubeSatSim.org/bom**. You can either export and download it, print it, or, if you have a Google account, you can make an online copy.

This module will be helpful for makers and other non-ham hobbyists who enjoy 3D printing, building and soldering.

Module 5

This module will explain what you can do with your CubeSatSim, assuming you have either built one or borrowed a loaner from AMSAT. The basic operations are summarized in the CubeSatSim Quick Start Guide (**CubeSatSim.org/qsg)**. It includes topics such as:

(1) Powering up/down, charging the battery.
(2) Introduction to the basic telemetry modes — aimed at introducing the idea of different communications modes sent by satellite and specific instruction in the modes employed on the CubeSatSim. A popular mode for demos is the Slow Scan TV (SSTV) mode. The modes are summarized in Figure 3.
(3) Explanation of how to use the ground station.
(4) Other ancillary parts such as the antennas, SDRs, etc.

Module 6

We thought we should conclude with a module dedicated to educating non-hams about obtaining a ham license and the fun you can derive from operating a ham station. This module will focus on providing

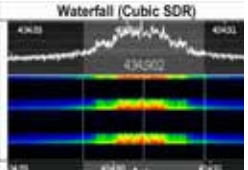
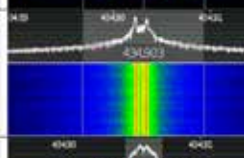
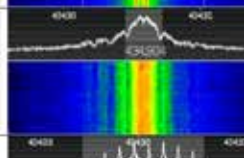
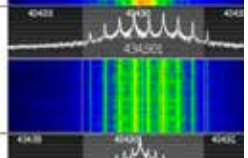
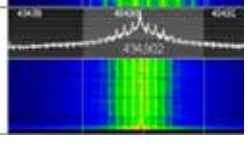
Blinks	Mode	Description	Decoding	Command	Audio	Waterfall (Cubic SDR)
1	APRS	Automatic Packet Reporting System. This digital mode sends a packet of data with AFSK or Audio Frequency Shift Keying modulation.	Windows: SoundModem or Direwolf Raspberry Pi/Linux: OpenWebRX or Direwolf with spreadsheet http://cubesatsim.org/telem	config -a	CubeSatSim.org/a	
2	FSK	Frequency Shift Keying. This mode transmits a continuous signal that makes a rumbling sound that emulates the AMSAT Fox CubeSats such as Fox-1C or AO-95. Also known as DUV or Data Under Voice.	Windows/Raspberry Pi/Linux: FoxTelem	config -f	CubeSatSim.org/f	
3	BPSK	Binary Phase Shift Keying. This mode transmits a continuous signal that sounds like noise that emulates the AMSAT Fox-1E or HuskSat-1 CubeSats. You need to demodulate using USB.	Windows/Raspberry Pi/Linux: FoxTelem	config -b	CubeSatSim.org/b	
4	SSTV	Slow Scan TeleVision. This mode transmits stored images in Scottie 2 format which sounds like a series of tones.	Windows: MMSSTV Raspberry Pi/Linux: QSSTV	config -s	CubeSatSim.org/s	
5	CW	Continuous Wave or Morse Code. This mode transmits a FM modulated tone at 20 words per minute Morse Code telemetry.	Windows/Raspberry Pi/Linux: fldigi with spreadsheet http://cubesatsim.org/telem	config -m	CubeSatSim.org/m	

Figure 3 — CubeSatSim telemetry modes table.

information about the licensing requirements and level of licenses with a reference to both AMSAT and the ARRL. Specifics for this Module have not yet been developed but will include the usual introduction to ham radio and links to appropriate videos about obtaining a license.

Conclusion

We would encourage you to seek out groups who might be willing to participate in the CubeSatSim project. This might include high school science clubs or private schools looking to differentiate themselves from similar institutions. It might also include maker groups that might find the challenge and skill development opportunities in building a CubeSatSim appropriate for their members. Maybe you can add some others which we have not yet considered.

As we keep emphasizing, this is a work in progress and, keeping that in mind, the working group solicits your comments and suggestions. We will keep you informed about our progress in future editions of *The AMSAT Journal*.

Participating in the CubeSatSim Project

You can participate in the AMSAT CubeSatSim Project! Here are some of the ways:

- Document your CubeSat Simulator build and testing on social media
- Offer to demonstrate your CubeSat Simulator to local schools, your ham club, Makerspace or Hackerspace gatherings, or other STEM events

The official CubeSatSim Project Twitter account is **@CubeSatSim**, and we use the hashtag #CubeSatSim to highlight our activities.

If you are interested in doing a demo for a group or school or at a club meeting or event, we can ship you a loaner. Contact Alan via email, **ku2y@arrl.net**, or on Twitter **@alanbjohnston**.

Please send any comments on this article to Paul Graveline, K1YUB, **paulK1YUB@gmail.com**, and Alan Johnston, KU2Y, **ku2y@arrl.net**.

An EZ Lindenblad for UHF

Grant Zehr, AA9LC
Tom Planer, KJ9P

After completing work on our 2-meter Lindenblad antenna (1) we discussed building a UHF version for the 435 MHz satellite band. The 2-meter Lindenblad worked great for ARISS communication on VHF, but nearly all the active amateur satellites use both UHF and VHF links. Using an omnidirectional VHF Lindenblad for 2-meters does not make much sense if you still need antenna rotors and computer tracking for the UHF link. Another EZ Lindenblad for the 435 MHz band was the obvious choice as a companion antenna for our 2-meter Lindenblad. Or was it? Would the EZ Lindenblad design work well at UHF? Tony Monteiro, AA2TX, who designed the EZ Lindenblad, described the antenna in *QST* (2). He pointed out that construction of an antenna using the EZ Lindenblad matching technique is "challenging on 70 cm due to the much higher tolerances required." Tony elected to build instead a parasitic Lindenblad, which he also described in *QST* (3). A classic article by Howard Sodja W6SHP describes building VHF and UHF Lindenblad antennas using twin lead to create folded dipoles (4). But those are quite different antennas, and the question remained: could the EZ Lindenblad matching scheme work on the 435 MHz satellite band? Perhaps, with the new antenna analyzers and design software now available, a UHF EZ Lindenblad might be practical. Tom KJ9P decided to go ahead and experiment with materials left over from our 2-meter Lindenblad antenna construction and was able to build a working UHF antenna. It performed well on the local repeaters, but that antenna was never thoroughly tested on the satellite bands.

To explore the question further, we built another antenna based on our 2-meter design but scaled down in size for operation in the satellite portion of the 70 cm band. Copper plumbing pipe is used for the dipoles and support structure. CPVC plumbing fittings support the dipole elements. A section of aluminum angle stock supports the antenna structure, and short lengths of coaxial transmission line serve as matching transformers. Except for the BNC connector, Belden 8241 coaxial cable and the toroids, all parts can be found at your local home center for around $20.

Design

We began with the dimensions from our earlier 2-meter antenna and scaled those to a design frequency of 435 MHz. The method is described in the ARRL Antenna Book and is not difficult. Dimensions of the original antenna are converted to wavelengths at the original frequency, and those values are converted to inches, feet, or centimeters at the new frequency. The new antenna should perform like the original if both antennas are perfectly efficient, with no loss, and built with the same geometry and materials. In the real world, of course, a certain amount of experimenting is needed to build a working antenna using scaled dimensions. Our actual antenna, built to dimensions scaled from our 2-meter antenna, tuned up nicely but was resonant well below the design frequency. It was necessary to shorten both the dipole elements and the coaxial matching transformers for operation at 435 MHz (5).

Construction

Construction of this antenna follows the methods used to construct our 2-meter antenna (1). Being much smaller, constructing the UHF Lindenblad is both easier and more difficult than the VHF version. The smaller elements are easier to handle, but measurements are more critical, and the smaller size coaxial cable is less forgiving of errors with the soldering iron. Antenna dimensions are shown in Figures 12 & 13.

Begin by cutting the cross-arms (dipole spacers) to the correct length (7 ¾ inches). The ½ inch tubing is easily cut with a small tubing cutter. Drill a hole at the center of the two cross arms and join them with a 1 ½ inch long number 6 machine screw. Be sure to center the holes accurately to align the cross-arms (Figure 1). The cross-arms are then attached to the aluminum angle stock, supporting the antenna. Use 1-inch-long number 6 machine screws. Again, mark and drill carefully to ensure the cross-arms are square and level when attached to the vertical support. Small angle brackets are used to help hold the cross-arms square with the aluminum angle antenna mast (Figure 2).

Next, cut one dipole pair (two dipole halves, each 3 3/8 inches long) and drive the elements into a CPVC fitting. Measure the dipole's full length to ensure that the length is correct. Dipole halves should be within 1/16 inch of each other for best results. Repeat these steps for all four dipoles. After the four dipoles have been assembled, mount each dipole assembly onto the end of one of the cross-arms. Leaving the CPVC fitting slightly "loose" on the cross-arm will make

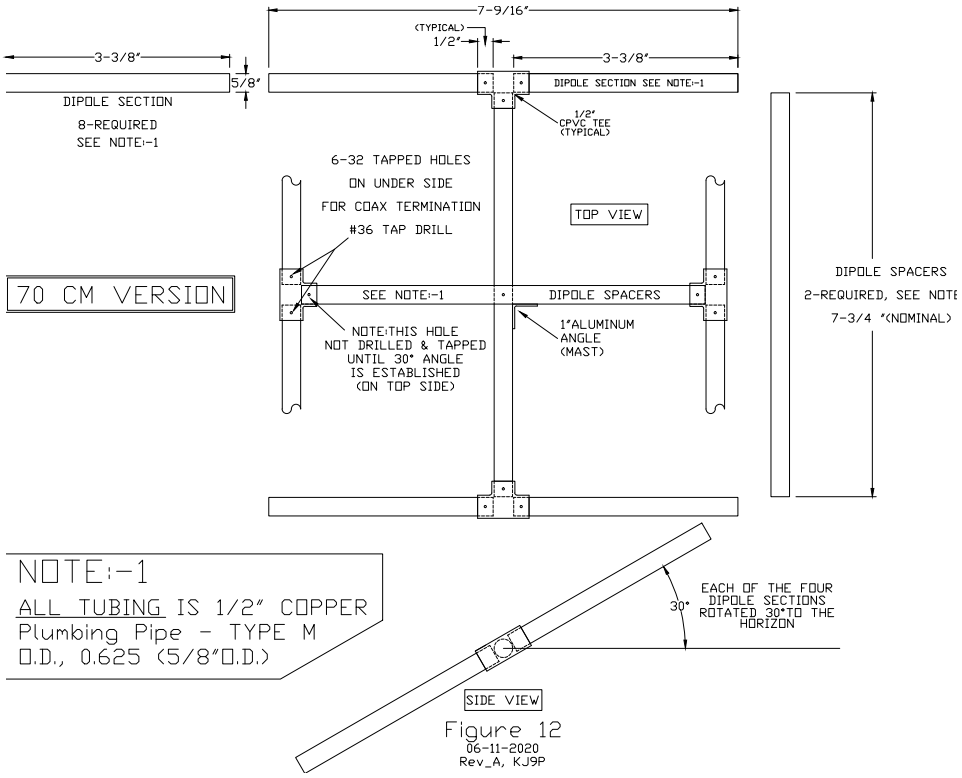


Figure 12.

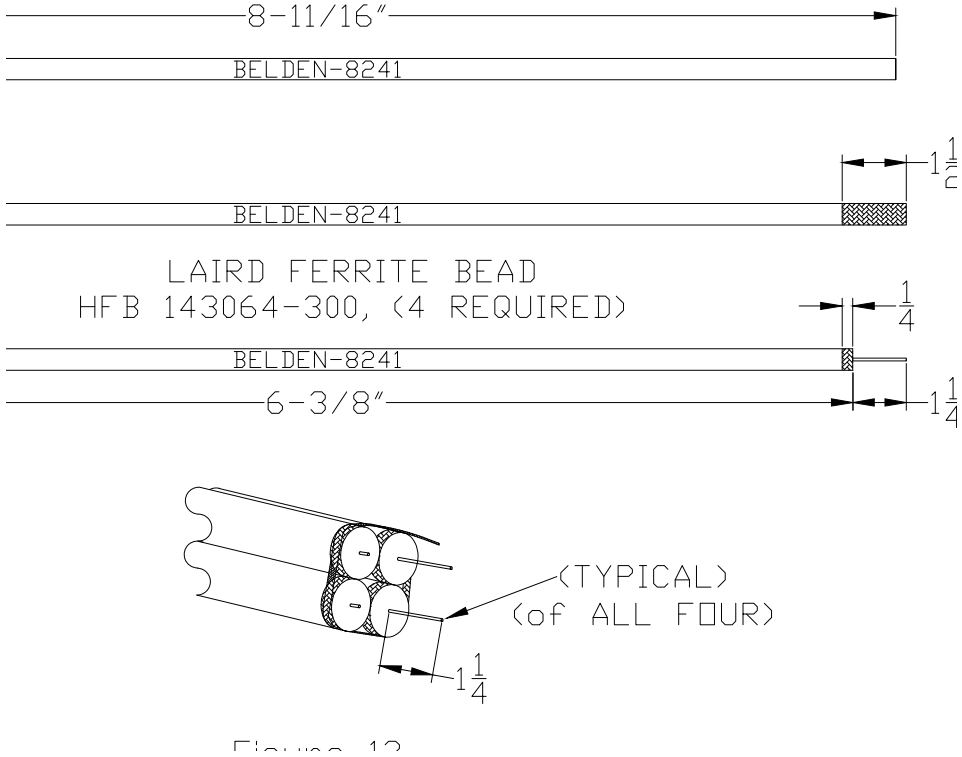


Figure 13.

Figure 1.

it easier to twist the dipole to the correct 30-degree angle needed for the antenna. Just leave about 1/16 inch of space between the end of the cross-arm and the base of the CPVC tee fitting.

Now adjust each dipole so it is tilted up thirty degrees from horizontal. You can use a drafting triangle or a homemade angle gauge cut from plywood or cardboard. For right-handed circular polarization, start with the dipoles all in the horizontal position. Look into the center of the antenna across one of the horizontal dipoles and along the length of one of the cross-arms. Next, rotate the dipole counterclockwise by 30 degrees. As you view the dipole, you will be raising the half dipole on your right-hand side by 30 degrees. Rotating the dipoles in the other direction will result in a left-handed circular polarized antenna. Right-hand circular polarization is used more often and is generally recommended for amateur satellites. But currently available amateur satellites have simple antennas with linear polarization. Since the satellites are transmitting linearly polarized signals from a constantly varying angle, either right or left-handed circular polarization will provide a benefit at the ground station. If you plan to receive signals from satellites with stable circularly polarized antennas, it is important to match your antenna's polarity with the satellite antenna's polarity. After the dipoles are oriented correctly on the cross-arms, secure each dipole with a #6 machine screw on the top of the cross-arm. Drill a hole through the CPVC fitting and the copper tubing of the cross-arm while carefully maintaining the 30-degree angle (Figure 3). Tap the CPVC fitting and the copper tubing to accept a #6 machine screw. Do not substitute sheet metal screws. They will not provide reliable contact.

Figure 2.

The matching transformers are built from a 75-ohm coaxial cable. AA2TX discusses the principle behind 75-ohm transmission line matching sections in his article, "An EZ Lindenblad for 2 meters." We used RG-11 coaxial cable for our 2-meter Lindenblad, but the smaller Belden 8241 cable was selected for this antenna. Belden 8241 is an RG-59 type cable and is easier to bend around the small frame of the UHF antenna. It should not be confused with the generic RG-59 found in home centers for use in home entertainment systems. Belden 8241 has heavy-duty copper shielding, which is easily soldered, essential for this project. Many consumer-type RG-59 cables have aluminum and foil shields that work well with crimp connectors but do not solder well. Although Belden 8241 has a higher loss at UHF than a good quality RG-11 type cable, those losses are small in this project because of the short lengths of cable used. Building this antenna with RG-11 would reduce signal loss by less than 0.2 dB (calculated using published 400 MHz data). However, if you plan to run high power (over 120 watts at the antenna), RG-11 or another 75-ohm coaxial cable rated for higher power is recommended (6).

Before cutting any cable, examine the diagrams and photographs illustrating the construction technique. One end of each cable is fitted with screw terminals that attach to a dipole arm. The other end of each cable is routed to the BNC coaxial connector mounted on the antenna mast. The four transmission line sections are clustered together. The shields are grounded, and the center conductor of each coaxial cable is routed to the center of the BNC connector. Begin by cutting a length of 8241 cable to 9 ½ inches. First, prepare the end which is attached to the BNC antenna connector. Measure 1 1/2 inches and remove the outer

Figure 3.

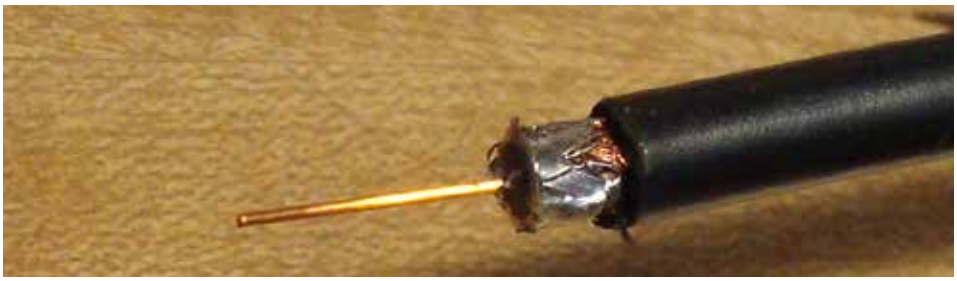


Figure 4.

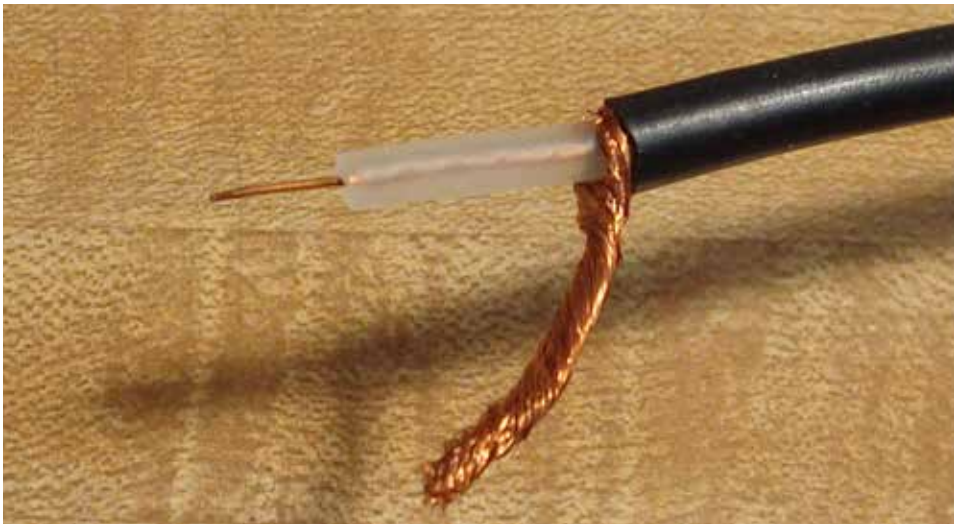


Figure 5.

black cover from the cable, exposing the copper braid beneath. Using a large soldering iron or gun, tin the first 3/8 of an inch of the copper shield adjacent to the black insulation. A 140-watt Weller soldering iron gave good results. Be careful not to melt the dielectric inside the coaxial cable as you apply solder. One way to manage this is to use an air compressor and cool the braid with a blast of air after each application of solder. After applying solder all around the circumference of the cable, cut away the excess braid and dielectric, leaving ¼ inch of tinned copper shield protruding beyond the remaining black cable covering (Figure 4). A Dremel-type rotary tool with a small circular blade can be used to make a clean cut. Be careful not to nick the center conductor. If the solid center conductor is damaged, it will probably fail when it is bent into its final position and should be discarded and replaced. Now measure 6 3/8 inches back from the cut edge of the shield and remove the black outer cover of the coaxial cable from that point to the other end of the cable. At the point where the black exterior insulation ends, the copper braid is combed apart (not cut) and twisted into a single conductor. Measure the center conductor and the shield to 1 1/16 inches and cut off any excess at that point (Figure 5). Attach crimp-on solder lugs and solder them in place. Shrinkwrap over the cable ends is recommended (Figure 6).

To attach each transmission line to a dipole, drill and tap the bottom of the CPVC tee fitting to accept a ½ inch long #6 machine screw. Securing the transmission line to the bottom of the CPVC fitting will avoid contacting the position stabilizing screw on the top of the fitting, which is grounded, and will also simplify routing the transmission lines to the BNC connector (Figure 7). Do not over-tighten the machine screws! In this design, the electrical contact to each dipole depends on the #6 screw maintaining solid contact into the copper pipe (and CPVC fitting), and it is easy to strip the threads. Fortunately, both the copper pipe and the CPVC fittings are inexpensive, so if repairs are needed, they are not costly. Another repair option is to drill and tap the stripped hole to a larger (#8) size and use a #8 machine screw.

The twisted copper braid will go to one of the lower dipole halves. The center conductor (with its insulating dielectric still in place) goes to the upper dipole half. This could be reversed but be sure that you are consistent. The center conductor must go to the same half of each dipole (either upper or lower) if you want to get the classic Lindenblad antenna radiation pattern.

A Laird Performance ferrite core (HFB143064-300) is used as a choke balun on each transmission line cable. A Fair-Rite (part 2661665702) ferrite core could be substituted and has somewhat better specifications (higher impedance at UHF) but was not available when this project was begun. The ferrite core should be positioned

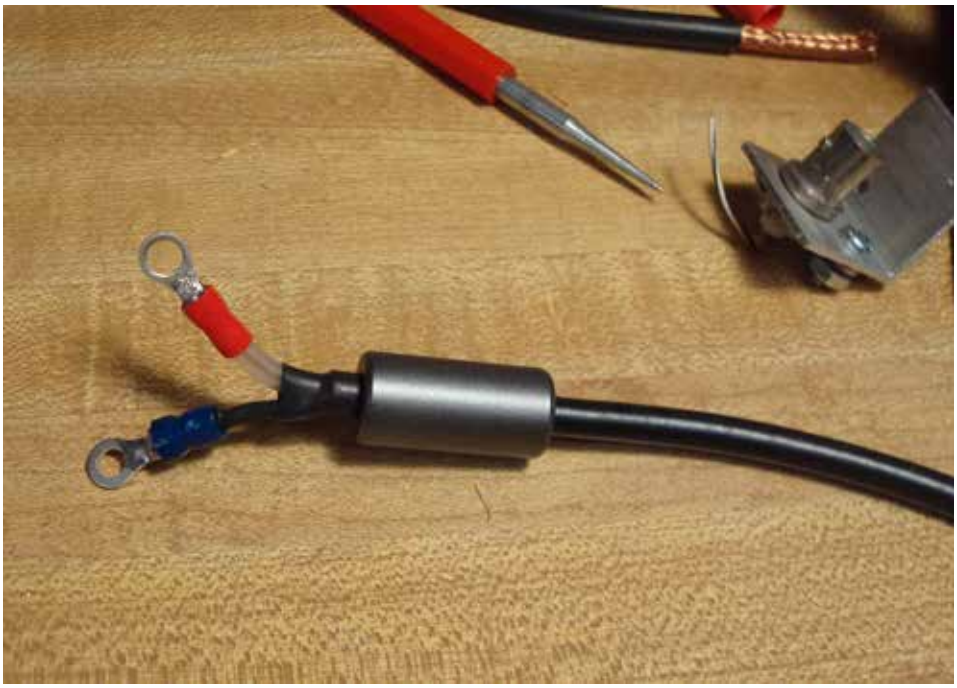


Figure 6.

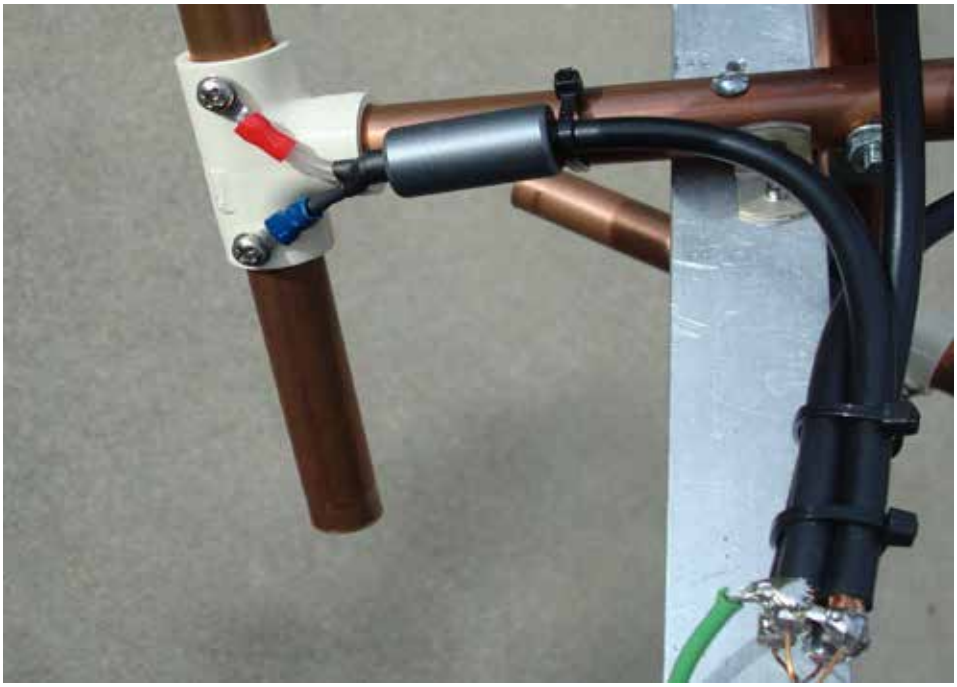


Figure 7.

near the dipole (Figure 7). It can be held in place with a cable tie.

A BNC coaxial connector is attached to the vertical angle stock below the cross-arms, as shown in Figure 8. Final positioning of this connector should be delayed until the transmission lines have been grouped and prepared for attachment. We chose a BNC connector because of its improved performance at UHF frequencies instead of the SO-239 connector used in the 2-meter antenna. If use of high power is anticipated, an N-connector can be substituted for the BNC connector used here. SO-239 connectors do not present a 50-ohm load at UHF and should be avoided.

Now attach the transmission lines to the coaxial connector. The tinned shields of the four transmission lines need to be connected. Wrap the shields of the four matching cables with a short length of solder wick or stranded copper wire, and solder the four shields together. A short wire with an attached ground lug connects these joined shields to the ground at the base of the BNC connector (Figures 7 and 8). The center conductors of the four coaxial cables are bent together, twisted, and soldered. One of those leads is selected and connected to the center terminal of the BNC connector (Figure 8). After testing is complete, be sure to waterproof both ends of the coaxial cable transformers and their junction to the BNC connector. Ordinary hot glue from the home center works well, with only minimal effects on the tuning of the antenna.

Testing

Your antenna should now be ready for testing (Figure 9). Position your antenna on a temporary mast about 7-10 feet above a smooth surface, such as a driveway. Check the SWR across the satellite band (430 to 440 MHz). Your SWR should be less than 1.5:1 across that range (Figure 10). Be sure to use good quality transmission line (such as RG-400) for accurate results at 70 cm. If you have measured carefully and your final antenna looks like the one illustrated here, your performance should be similar.

If your antenna is resonant but off frequency, you can probably correct the problem by shortening or lengthening each dipole. During testing, we found that changing the length of the dipoles by ¼ inch (1/8 inch from each half) moved the resonant frequency by about 5 MHz. Each dipole half should be changed by the same amount. Keep in mind that small changes in construction can make significant changes in performance at UHF. We originally planned to use plumbing-type CPVC end caps to keep water from the antenna dipoles. After tuning up the antenna, the CPVC caps were installed as the 'final' step. Imagine our surprise when we found the resonant frequency was now 3 MHz lower than before! Even the paint used to protect the CPVC tee fittings moved the antenna's resonant frequency a bit.

Performance

This little antenna works well as an omnidirectional, circularly polarized antenna for amateur satellite use. An EZNEC model of this antenna was developed, and the radiation pattern is shown in Figure 11. Having the two cross-arms arranged above and below at the center of the antenna creates a slight asymmetry in the pattern (7). As Figure 11 shows, however, the asymmetry is minimal and scarcely affects the pattern. This is confirmed by on-the-air experience, where the antenna is functionally omnidirectional.

Figure 8.

Figure 9.

The antenna has an SWR of less than 1.5:1 across the satellite portion of the 70 cm band. Higher in the band, where most 70 cm repeaters are located, the antenna works well with an SWR below 2:1.

A mast-mounted preamp is highly recommended for best results. An Advanced Receiver Research SP432VDG (in a weatherproof box) has been used here for many years, and it has always performed well. Testing was done with an unmodified Yaesu FT-847 transceiver.

For antenna evaluation, the CW telemetry beacon on FO-99 is useful. The FO-99 beacon sends CW on 437.075 MHz at 0.1 watts (8). The FO-99 beacon can be heard at 1-2 degrees of elevation, with good signals (90% copy) above 5 degrees elevation and strong signals (95% copy) above 10 degrees. During the first week of operation, two-way contacts were made on AO-7, SO-50, XW2B, XW2F, CAS4A, CAS4B, RS-44, and AO-92. As an uplink antenna, the low SWR makes transmitter tune-up easy. Using 75 ft. of 9913 coaxial cable, access to the linear transponder satellites is usually possible at about 10-15 degrees elevation.

Conclusions

This small, rugged Lindenblad antenna works well at UHF. While building a Lindenblad looks challenging, it is no more difficult than a crossed loop design while offering better performance. In addition, the cost of materials is low, making it a good experimenter's project. This antenna would be an excellent choice for users interested in monitoring UHF telemetry signals, for temporary operation at a portable location (such as Field Day), or for any fixed location operation where cost and space considerations rule out larger directional antenna systems.

End Notes

1."The Two Meter EZ Lindenblad Revisited," Tom Planer, KJ9P, and Grant Zehr, AA9LC, *The AMSAT Journal,* November/ December 2018, reprinted in the CD published with the 24th edition of the *ARRL Antenna Book*.

2. "An EZ-Lindenblad Antenna for 2 Meters", Anthony Monteiro AA2TX, *QST*, August 2007.

3. "A Parasitic Lindenblad Antenna for 70 Cm", Anthony Monteiro AA2TX, *QST*, February 2010.

4. **www.amsat.org/amsat/articles/w6shp/lindy.html.**

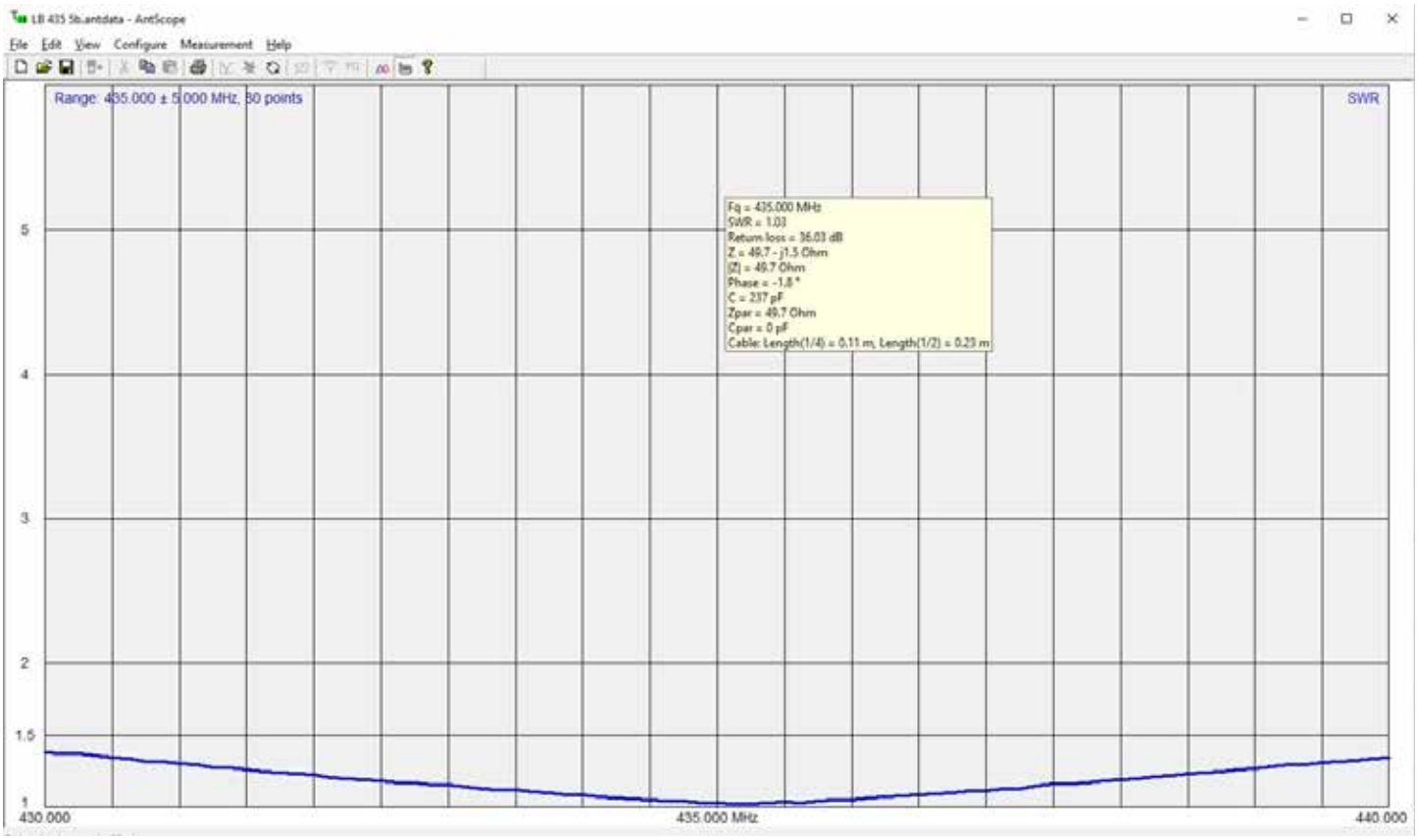


Figure 10.

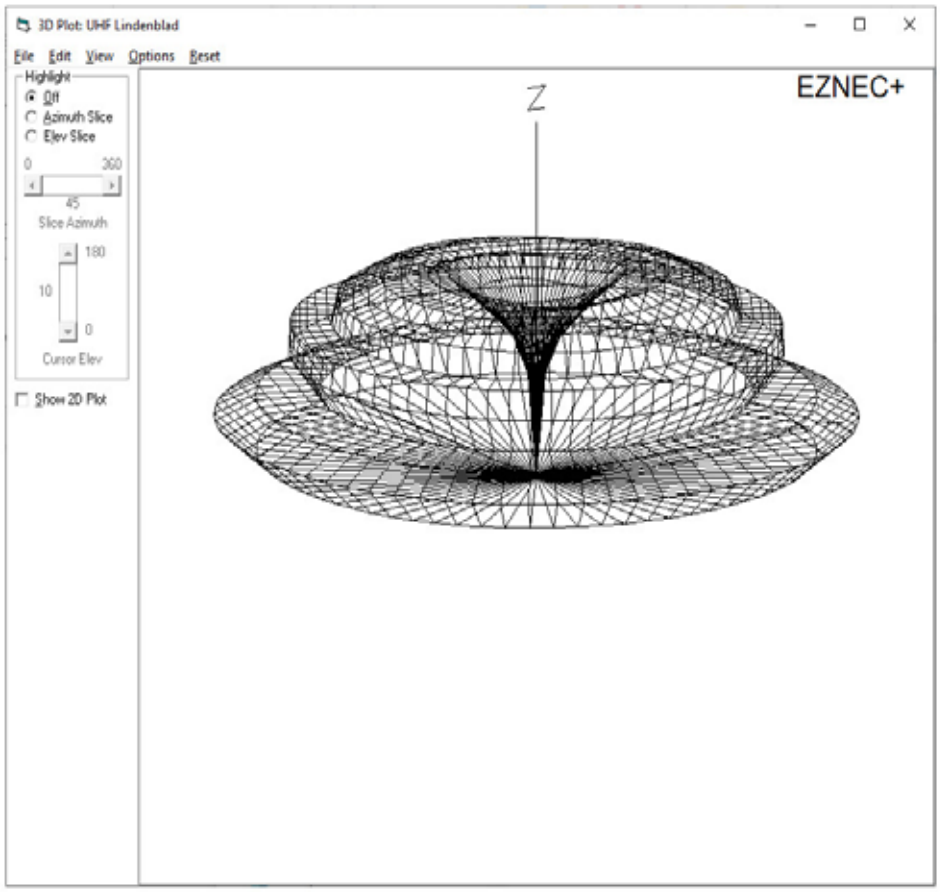


Figure 11.

5. The coaxial transformers in this antenna are 0.356 lambda (wavelengths) long. This figure is different from the value used in our earlier 2-meter antenna (0.367) or by AA2TX (0.374).

6. Remember that your transmission line will attenuate your signal significantly at 70 cm. So if you are running 200 W into a 75 ft. length of "low loss" coaxial cable, you will probably deliver less than 100 W to the antenna terminals. Measure the power at the antenna end of your transmission line if there is any question.

7. Looking at the elevation plot of the antenna pattern, at 45 degrees, there is a 0.44 dB difference between zero degrees and 90 degrees azimuth. Below 45 degrees elevation, the difference is much smaller. At 23 degrees elevation, for example, there is only a 0.04 dB difference between zero and 90 degrees of azimuth.

8. Nexus, FO-99 website: **sat.aero.cst.nihon-u.ac.jp/nexus/E1_AboutSat.html.**

STEM Presentation to Bear Valley Elementary

Craig Bledsoe, P.E., CSP, KL7H

Of the many things that Professional Engineers do during Engineers Week every year to engage with the public, one of the most rewarding is to reach out to eager students who are ready and excited to learn about the STEM professions at a young age. I was asked to engage with the entire 5th grade class of Bear Valley Elementary School on the Anchorage Hillside and demonstrate Amateur Radio communications as relayed through homemade repeater satellites operating in various orbits around the Earth.

On Thursday, March 3d, I visited the classrooms of teachers Priya Lindeen and Kylie Lake. I was introduced to throngs of students looking forward to talking to ham radio operators across Alaska via outer space. Due to the orbital parameters of our satellite, SO-50, the plan was to escort the crowd of students out to the north-facing parking lot of the school, where they could hear and speak to amateur radio operators through my Yaesu VX-5R walkie-talkie. This modest handheld radio was connected to an amplified Arrow antenna pointed toward the satellite as it traversed the heavens at approximately 18,000 miles per hour, taking ten minutes to race from horizon to horizon.

During the one hundred minutes between satellite passes, we returned to the classroom, where I summarized the physics and mathematics needed to calculate the orbits of a variety of objects ranging from Low Earth Orbiting (LEO) satellites such as SO-50 and Elon Musk's Starlink constellation up to giant satellites in 24-hour geostationary orbits like those used for Dish Network's Direct TV broadcasts or weather observatories focused over a single location on Earth. I played the AMSAT student slide show. We talked about how ham radio operators with STEM interests like our Bear Valley 5th graders have created small LEO CubeSats in their home workshops for space-available launch opportunities into the void beyond our atmosphere.

We all returned to the Bear Valley parking lot following our classroom session, where we conducted our second and final satellite pass of the school day. During both passes, students using the KL7H (my callsign) portable radio station heard and spoke with a variety of ham radio stations relayed by SO-50, including AL7ID in Two Rivers near Chena Hot Springs, KL7XJ in Soldotna, KL7G at the Anchorage Amateur Radio Club's Radio Science and Operations Center (RSOC) near Kincaid Park, NL7S and KL2S in Wasilla, NL7B in Fairbanks, and many more.

At the end of our adventures, dozens of kids approached me. They said they wanted to learn more about amateur radio and get involved with all of the exciting things that professional engineers do daily. Both of the 5th-grade teachers have my contact information, plus we looked up the websites for ham radio training and FCC licensing offered by several volunteer organizations statewide.

This was a great day for reaching out to the next generation of professional engineers, and I felt privileged to have been able to do my part to help these kids learn about STEM careers that will welcome and challenge them in the years to come.

AMSAT-LU WSPR beacon in Antarctica

AMSAT Argentina has prepared and donated to Cocoantar (Antarctic Joint Command), a beacon in WSPR mode (WSPR = emission of signals of minimum power 200mW and long range)

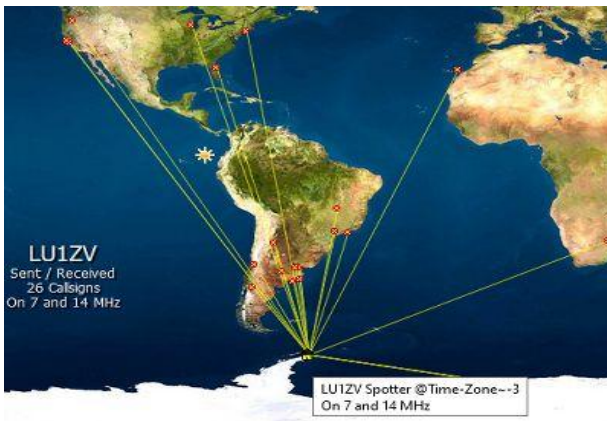
On March 22, 2022, when the winter south hemisphere solstice occurred (passage of the sun over the equator to the north), this beacon was installed and began its operation at 40, 20, 15 and 10m from the Esperanza (Hope) Antarctic base, emitting with his Call Sign LU1ZV.

In just one day, this permanent beacon has already been received and confirmed by multiple stations, allowing real-time viewing of propagation and range conditions in the bands that are broadcasted.

This reaffirms and makes known to the world the will and commitment of Argentina of its permanent presence in Antarctica together with the Argentine Amateur Radio in the white continent by the hand of AMSAT-LU.

To track, maps, graph and details see http://lu7aa.org/dx.asp?call=LU1ZV or by radio.

AMSAT Argentina, LU7AA, thanks Cocoantar and AMSAT Argentina members and friends for being part and driving force of this special event, including its President LU4BMG, the President of CETRA LU8YY/Q, members of its Board of Directors and its 2,500 members for accompany this adventure.



Member Melissa Pore, KM4CZN, Recognized as Teacher of the Year

Support AMSAT

AMSAT is the North American distributor of SatPC32, a tracking program for ham satellite applications. Version 12.8d features enhanced support for tuning multiple radios. Features include:

1. The CAT commands of the IC-9100 have been extended again. The program now also controls the DV mode (DV for 'Digital Voice') of the radio. With the FT-817 the program now additionally supports the CWR mode.

2. All SatPC32 programs now process significantly larger Keplerian element source files. Especially because of the numerous new Cubesats, the number of data sets contained in the source files has increased significantly. For example the file Cubesat.txt currently contains data for nearly 400 satellites.

3. In all programs (SatPC32, SatPC32ISS, Wisat32, WinAOS and WinListen), the list of satellites contained in the source file ('Available' list in menu Satellites) is now displayed in alphabetical order to facilitate locating individual satellites.

4. The program SatPC32ISS now also allows the creation of up to 12 satellite groups. The new Cubesats have also increased the number of 'in-band' satellites. Originally, in-band operation in amateur radio was only available at the ISS.

5. In order to accelerate a change between the individual satellite groups, the 'Groups' window can now be called up by clicking on vacant areas of the main window, except in the Satellite menu. Such free positions are located on the right and left of the frequency window.

6. In the Satellites menu the data sets of the satellites contained in the active source file can now be displayed. When called, the data set of the currently selected satellite is displayed. The feature helps you to immediately know the identifier of the satellite.

7. The program has improved control of the sub-audible tone required by some satellites. The program can now automatically switch the sub tone on/off when switching between PL tone satellites and others, changing between u/v and v/u satellites, changing the group, closing the program, etc.

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.

MacDoppler

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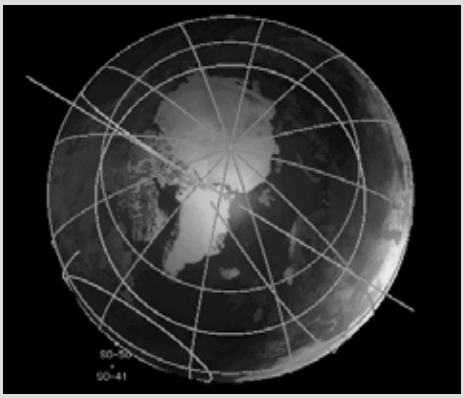

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AMSAT is excited about developing and launching the next generation of Greater Orbit Larger Footprint ("GOLF") satellites. AMSAT has an immediate need to raise funds to cover development, launch and related expenses to *Keep Amateur Radio in Space*. We have set a fundraising goal of $125,000 to help keep AMSAT viable and effective in the competitive world of space communications.

GOLF-TEE (Technology Exploration Environment) is a rapid development satellite headed for LEO to fly and validate ADAC, deployable solar panel wing, radiation tolerant IHU, SDR and other technologies.

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TAPR/AMSAT Dinner @ Dayton				**X**	**X**	**X**
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