The AMSAT Journal

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Volume 37, Number 5 September/October 2014

AMSAT Reveals Fox-1 Challenge Coin

Commemorating AMSAT's 45th and AO-7's 40th Anniversaries

in this issue ....

AMATEUR RADIO IN SPACE AMSAT®

Periodicals
POSTAGE PAID
At Kensington, MD
and at additional
mailing offices

AMSAT-NA
10605 Concord St., Suite 304
Kensington, MD 20895-2526

AMSAT Announcements

Results of the AMSAT Board of Directors Election 2014

As a result of the 2014 AMSAT-NA Board of Directors Election the following members were elected to serve for two years: Tom Clark, K3IO; JoAnne Maenpaa, K9JKM; and Lou McFadin, W5DID.

Jerry Buxton,N0JY will serve the remaining year of SK Tony Monteiro, AA2TX's term.

The First Alternate is Drew Glasbrenner, KO4MA,. The Second Alternate is Frank Griffin, K4FEG.

The results of the voting with635 ballots cast are as follows:

Tom Clark, K3IO........................457
JoAnne Maenpaa, K9JKM.........439
Lou McFadin, W5DID...............421
Jerry Buxton, N0JY....................268
Drew Glasbrenner, KO4MA......261
Frank Griffin, K4FEG................232
Steve Coy, K8UD.......................178
Bryan Klofas, KF6ZEO.............132

Submitted by
Martha Saragovitz
Manager

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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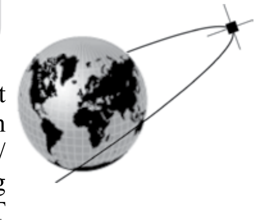
The AMSAT Journal (ISSN: 1407-3076) is published bi-monthly (Jan/Feb, Mar/Apr, May/Jun, Jul/Aug, Sep/Oct, Nov/Dec) by AMSAT-NA, 10605 Concord St., Suite 304, Kensington, MD 20895-2526. Telephone: 301-822-4376, fax: 301-822-4371. Periodicals postage paid at Kensington, MD and additional mailing offices.

Postmaster: Send address changes to *The AMSAT Journal*, 10605 Concord St., Suite 304, Kensington, MD 20895-2526.

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 JPEG formats. Kindly do not embed graphics or photos in your manuscript - we prefer receiving those as separate files. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal*.

APOGEE VIEW

by Barry Baines, WD4ASW • wd4asw@amsat.org



I am writing just a few weeks before the 32nd AMSAT Space Symposium at the BWI Doubletree. This is a significant event for a number of reasons, including the celebration of AMSAT's 45th Anniversary. We expect to highlight the progress of the Fox-1 class spacecraft as we prepare Fox-1A and Fox-1C for launches currently scheduled for the 3rd quarter of 2015.

The results of the recent Board of Directors election were announced in mid-September. Congratulations to Tom Clark, K3IO and Lou McFadin, W5DID on their re-election. Congratulations to JoAnne Maenpaa, K9JKM on her election to a seat on the Board after being elected as a Board Alternate in 2013-2014 and then serving as a full member in February to replace Gould Smith, WA4SXM when he had to resign due to medical concerns. We also welcome Jerry Buxton, N0JY upon his first election as a voting member to the Board to fulfill the remaining year of the seat formerly held by Tony Monteiro, AA2TX (SK). We also welcome Drew Glasbrenner, KO4MA and Frank Griffin, K4FEG as Board Alternates. The new board was seated immediately upon certification of the ballot results and will be meeting at the BWI Doubletree on Thursday, 9 OCT and Friday morning, 10 OCT. Board meetings are open to anyone wishing to attend unless there is a need to go into closed session to handle a particular matter.

Symposium is also an opportunity for recognition of those that volunteer their time and talent in support of AMSAT. Department Heads have submitted their recommendations of those that they'd like to highlight for their impacts on AMSAT in the past year. We're also commemorating Anthony "Tony" Monteiro, AA2TX who passed away earlier this year. Members of Tony's family will be attending the banquet on Saturday evening and they will receive a keepsake from AMSAT expressing our appreciation for Tony's service to AMSAT as VP-Engineering and Board member.

We also note the 40th anniversary of the launch of AO-7, which "returned to life" in 2002 and has been providing service while in daylight ever since. The longevity of this satellite is simply amazing, and while it does suffer some of the visages of "old age", AO-7 continues to provide significant benefits to the amateur satellite community. Who would have imagined back in 1974 that a satellite placed in orbit in the fifth year of AMSAT's existence would still have a lasting impact today?

The banquet speaker at this year's Symposium is Jan King, W3GEY/VK4GEY a founding member of AMSAT who served for many years as AMSAT's VP-Engineering and an AMSAT board member. Jan's impact on AMSAT was substantial, reflected in AO-7 that still is semi-operational but starting with securing a launch and finalizing AO-5 in 1970 through the microsats launched in 1991. As we celebrate 45 years of AMSAT, Jan's keynote is titled "Never, Never, Never Give Up!" where he expects to note the changing environment which AMSAT finds itself and to offer observations on the potential impact of AMSAT in today's environment. Jan is an excellent speaker who tells it as he sees it; his remarks will certainly be thought-provoking.

Looking forward, we anticipate the completion of the Fox-1 class spacecraft, with three of the four flight units already accepted for future launches and Fox-1D ready for any opportunity that comes our way. As our engineering team completes the Fox-1 construction program by mid-2015, we will be looking to how AMSAT should transition to the next program which we've been calling "Fox-2". We will be taking time to assess the lessons learned from the Fox-1 program so that those experiences will better enhance our ability to engineer and manage the Fox-2 program. We also need some time to step back and evaluate what options we might consider in terms of defining the purpose of Fox-2, what features it should include, and what the flight opportunities look like in the next few years that will provide opportunities for placement in orbit. It has been five years since the Board accepted the recommendations of the Engineering Task Force led by Tony Monteiro, AA2TX in 2009 to focus on cubesats placed in Low Earth Orbit as the best approach for keeping amateur radio in space. It is appropriate at this time to review the current environment to determine what if any adjustments may be appropriate to make to our strategy before we engage in the creation of the next generation satellite design. I expect that conversations taking place in Symposium will initiate those discussions and help us to define the process for making these critical decisions.

One change in the external environment is the overall impact of the NASA ELaNa (Educational Launch of Nanosatellites) program on launch opportunities, both in

continued on page 4 ...

Apogee View - continued from page 3 ...

terms of defining missions that will garner NASA launch support, as well as, the potential for placement in orbit that will broaden the footprint for amateur satellite communications. We also are hopeful that with the successful flights of Fox-1A, Fox-1C and eventually Fox-1B and Fox-1D, universities will become interested in using the Fox-1 design to fly their payloads which would allow them to utilize a successful design to support their payloads. Such an approach will benefit the amateur radio satellite community as “An OSCAR in every cubesat” increases the number of amateur satellites in orbit. While it is premature to predict the overall impact of such an approach, we are starting to see interest in our Fox-1 design as our projects gain greater attention.

One of my responsibilities at Symposium is to conduct the Annual Meeting of Radio Amateur Satellite Corp. I haven’t yet prepared my remarks for presentation to the membership, so I can’t specifically comment on what I intend to present. However, I do want to note the increasing interest in amateur satellites as demonstrated by the full attendance at the Amateur Satellite Workshop given on the Thursday before the ARRL Centennial Convention this past July where there were over 100 attendees as well as the significant attendance of AMSAT Forums at the Dayton Hamvention and larger hamfests such as the Orlando HamCation and the Huntsville Hamfest. Our challenge is to translate this interest into new satellite operators as well as building AMSAT membership. The key to organizational longevity is maintaining the relevance of an organization that translates into membership support. While we celebrate 45 years of amateur radio’s premier satellite organization, we cannot sit on our laurels. We are continually challenged in retaining memberships, recruiting volunteers to make things happen in all facets of the organization, and moving forward to “keep amateur radio in space.” We are dependent upon you as an AMSAT member to encourage new operators to work the satellites and join AMSAT. Please “talk up” AMSAT and the work it is doing as we move forward towards celebrating our 50th anniversary in 2019.

AMSAT Fox-1 Challenge Coin Revealed at 2014 Space Symposium

AMSAT is excited to announce that a new premium collectable is now available for qualifying donations to the Fox satellite program. AMSAT has commissioned a unique challenge coin for donors who have contributed at the $100 level or higher. This challenge coin is shaped as an isometric view of a Fox-1 cubesat, complete with details such as the stowed UHF antenna, solar cells, and camera lens viewport. Struck in 3mm thick brass plated with antique silver, and finished in bright enamel, the coin is scaled to be approximately 1:4 scale, or 1 inch along each of the six sides. The reverse has the AMSAT Fox logo.

The coins are scheduled for delivery just prior to the 2014 AMSAT Space Symposium, and will be first distributed to donors attending the Symposium. Coins will also be made available to qualifying donors that have contributed since the Fox-1C announcement on July 18, 2014 *upon request*. Donations may be made via the:

- AMSAT website at **http://www.amsat.org**
- FundRazr crowdsourcing app at: **http://fnd.us/c/6pz92**
- AMSAT office at (888) 322-6728

The Fox program is designed to provide a platform for university experiments in space, as well as provide FM repeater capability for radio amateurs worldwide. Fox-1A and 1C are set to launch in 2015, and Fox-1B (also known as RadFXSat) is awaiting NASA ELaNa launch assignment. Further information on the Fox project can be found at:

http://www.amsat.org

Visit the FundRazr crowdsourcing app at: http://fnd.us/c/6pz92

Contract to Build Es'hailSat Includes AMSAT-DL Phase 4 Transponders

Gunter Krebs reports on his Space Pages on the web that Es'hailSat has signed a contract with MELCO to build the Es'hail-2 geostationary comsat. Es'hail 2 is a planned communication satellite operated by Es'hailSat, the Qatar Satellite Company. It will also feature an radio amateur payload.

The new satellite will be positioned at the 26° East hotspot position for TV broadcasting and significantly adds to the company's ability to provide high quality, premium DTH television content across the Middle East and North Africa. It will feature Ku-band and Ka-band transponders to provide TVdistribution and government services to strategic stakeholders and commercial customers who value broadcasting and communications independence, interference resilience, quality of service and wide geographical coverage. Es'hail 2 is expected to be launched at the end of 2016.

In September 2014, a contract with MELCO was signed to build the satellite based on the DS-2000 bus.

Es'hail 2 will also provide the first Amateur Radio geostationary communication capability linking Brazil and India. It will carry two "Phase 4" Amateur Radio transponders. The payload will consist of a 250 kHz linear transponder intended for conventional analogue operations in addition to another transponder which will have an 8 MHz bandwidth. The latter transponder is intended for experimental digital modulation schemes and DVB amateur television. The uplinks will be in the 2.400-2.450 GHz and the downlinks in the 10.450-10.500 GHz amateur satellite service allocations.

Both transponders will have broad beam antennas to provide full coverage over about third of the earth's surface. The Qatar Amateur Radio Society and Qatar Satellite Company are cooperating on the amateur radio project. AMSAT-DL is providing technical support to the project. Refer to:

http://space.skyrocket.de/doc_sdat/eshail-2.htm

http://amsat-uk.org/2014/09/21/eshail-2-ham-radio-transponders/

ISS Antenna Constructed by AMSAT Key Factor in Sea Rescue

Since 2010, the International Space Station has been equipped with a space-based Vessel ID System receiver that allows it to track ships at sea by way of a ship's Automatic Identification System (AIS) signal. Since then, the system aboard the ISS has been receiving as many as 400,000 ship position reports from more than 22,000 different ships every single day.

According to Horst Koenig, retired Head of ESA's ISS System Engineering Section, "We had very close cooperation with NASA and the Radio Amateur Satellite Corporation (AMSAT). The AIS antenna was provided to ESA by AMSAT, along with an additional antenna for the Amateur Radio on International Space Station (ARISS) group."

This is the story of how this experimental system was used in 2012 to rescue the sole surviving crewmember of a fishing vessel after it overturned in the North Atlantic during a storm. See:

http://tinyurl.com/ANS250-gCaptian

More on NASA's Vessel ID System experiment can be found at:

http://tinyurl.com/ANS250-VesselID

More on the AIS on ISS and Assembling the Experiment can be found at:

http://tinyurl.com/ANS250-AISonISS

Congratulations to the ARISS hardware team that was responsible for the development of the ISS AIS antenna system!

(Credit: gCaptain.com and the European Space Agency)

ARISS
Amateur Radio on the International Space Station

73 on 73 Award Announcement

Paul Stoetzer, N8HM

Paul is pleased to announce that he will be sponsoring a new award to promote activity on AO-73 (FUNcube-1).

The requirements for this award are simple:

1. Work 73 unique stations on AO-73.
2. Contacts must be made on or after September 1, 2014.
3. There are no geographic restrictions on your operating location.

There will be no cost for this award (donations to AMSAT-UK and AMSAT-NA's Fox program are encouraged though).

No QSLs are required. When you complete the requirements, email your log extract including the callsign of each station worked, UTC, and date to:

n8hm@arrl.net

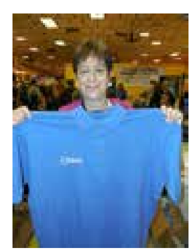
Also include the address where you'd like the award certificate sent.

Enjoy AO-73's transponder!

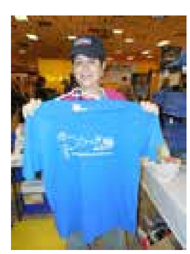
Fashion for the Well Dressed Satellite Operator

http://store.amsat.org/catalog/

2014 AMSAT Hat



2014 AMSAT Golf Shirt



2014 AMSAT Tee Shirt

Using SatPC32 with HDSDR - Part 1: The DDE Interface

Steve Belter, N9IP
n9ip@amsat.org

SatPC32 is a powerful tool for calculating the orbits of satellites. In addition to predicting the locations of earth-orbiting satellites, it will control the aiming of antennas towards those satellites and will tune one or two radios to compensate for the Doppler effect (or Doppler shift).

HDSDR is also a powerful tool when combined with the hardware portion of a Software Defined Radio (SDR) like the FUNcube Dongle Pro+ (FCDPP). When used with SatPC32 and a conventional radio for a transmitter, you get an amazing station for satellite communication.

You can view the entire satellite passband at once, see when the satellite has risen above the local horizon, recognize CW, SSB, and FM signals, and view your own signal's frequency and modulation. You can find yourself in the passband almost instantly, and you can quickly move to an active frequency rather than slowly tuning up and down the passband looking for someone calling CQ.

The first installment of this article gives an overview of integrating SatPC32 and HDSDR, and contains instructions on getting the programs to communicate using a DDE interface. In the second installment, the use of serial interfaces for program communication will be explained.

This article was written and the screen shots were taken using SatPC32 V.12.8c, HDSDR V2.70 with a FUNcube Pro+ dongle, and an Icom IC-821 transceiver as the test platform. See the sidebar "Downloading the Software" for where to find the SatPC32 and HDSDR programs.

DDE vs. Serial Line Connection Comparison

SatPC32 and HDSDR can communicate with each other using either a direct Dynamic Data Exchange (DDE) connection, or by a serial line connection. Here, in Part 1, I'll discuss the DDE connection technique. Each method has its strengths and weaknesses. Table 1 summarizes these to help you choose the best option for your application and operating technique.

With both options (DDE and serial), HDSDR is being used as the receiver. A separate Icom, Yaesu, or Kenwood transceiver is used as the transmitter. The result is a full-duplex setup, allowing you to receive while you transmit.

Table 1: Comparison Chart

Operation Permitted	DDE Connection	Serial Connection
Use SatPC32 to automatically tune HDSDR and the Tx radio for the selected satellite, and adjust both for Doppler?	Yes	Yes
Use SatPC32 keys and mouse to adjust the tuning of HDSDR and the Tx radio?	Yes	Yes
Use HDSDR's waterfall and spectrum display to view the entire satellite passband?	Yes	Yes
Use HDSDR shortcut keys and mouse clicks in the waterfall or spectrum display to tune SatPC32 and Tx radio?	No [1]	Yes
Use HDSDR keys and mouse to tune HDSDR?	No [1]	Yes
Use the Tx tuning knob to tune SatPC32 and HDSDR?	Yes [2]	No [3]
Use Tx knob to tune the Tx?	Yes [2]	No [3]
Need two free serial ports or serial port null modem software?	No	Yes [4]
Ease of installation?	Easy	Challenging

Note 1: HDSDR reads the receive frequency and mode from SatPC32 using DDE. However, HDSDR doesn't provide user input changes to the receive frequency to SatPC32 (it could), and even if it did, SatPC32 doesn't poll the DDE for frequency changes. SatPC32 does poll the Rx VFO frequency of Radio 1 (the transceiver being used as the transmitter in this case), so the tuning knob can be used to change the receive frequency. If you try to change the Tune frequency of HDSDR using the mouse or keyboard, HDSDR will override the change when it gets the receive frequency from SatPC32 via DDE.

Note 2: You can tune SatPC32 and HDSDR using the physical radio's tuning knob if the transmitter is actually a satellite transceiver.

Note 3: SatPC32 polls the Rx VFO frequency of Radio 1 (HDSDR emulating a Kenwood TS-2000), so clicking in the waterfall or spectrum display, or otherwise changing the Tune frequency of HDSDR changes the receive frequency of SatPC32, which in turn changes the Tx frequency. However, SatPC32 does not poll the Tx VFO of Radio 2, so the tuning knob of the transceiver has no effect because SatPC32 is sending CAT commands to override the tuning knob.

Note 4: When using a serial connection, SatPC32's Radio 1 is configured to talk to a Kenwood radio via a COM port, and HDSDR is configured to emulate a Kenwood radio using a COM port. So the serial connection needs two real hardware COM ports connected by a null-modem cable. Or you can use software like VSP Manager or com0com to simulate two COM ports connected by a null-modem cable.

With the DDE Connection option, the separate transceiver is used for SatPC32's "Radio 1". The transceiver can be a full-duplex satellite radio or a half-duplex radio, as it is only used as the transmitter (Tx).

With the Serial Connection option, HDSDR emulates a Kenwood TS-2000 and is used as a receiver for SatPC32's "Radio 1". Your Icom, Yaesu, or Kenwood transceiver is used as a transmitter for SatPC32's "Radio 2". The next installment of this article will explain the configuration of the Serial Connection option.

To summarize, there isn't a way to have HDSDR tune both the receiver and transmitter and have the radio-tuning knob tune both the receiver and transmitter.

Using a DDE Connection between HDSDR & SatPC32

Of the two options for connecting HDSDR and SatPC32, the DDE option is the easiest to get working. SatPC32 has a DDE Server that is always enabled, and HDSDR has a DDE Client that is easily enabled. The process is explained below.

Step 1: Connect your PC to your Transceiver

If you haven't already, make the serial line connection between your PC and your Icom, Yaesu, or Kenwood transceiver. SatPC32 will use the CAT (Computer Aided Transceiver) commands to set the transmitter frequency and mode, and to read the receiver frequency as set by the tuning knob. (You won't be using the receiver section of your transceiver, but you may use the tuning knob.)

Make sure the radio has CAT control enabled, and determine the baud rate setting for the radio (for example, 9,600 baud or 19,200 baud). If you have an Icom radio, verify the CI-V address for your radio. For example, the IC-821 has a hexadecimal address of "4C" which is written $4C in SatPC32.

Use the Windows "Device Manager" to determine or verify the COM port number for the serial connection between the PC and your radio, for example, COM4.

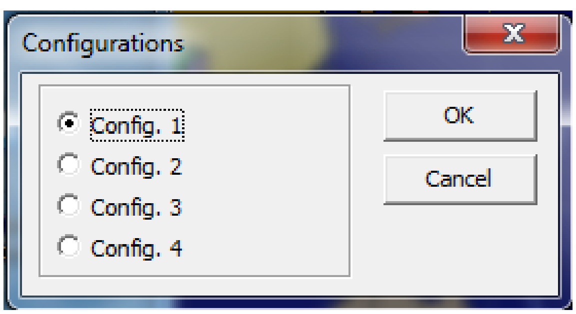
Step 2: Configure SatPC32 for your Transceiver

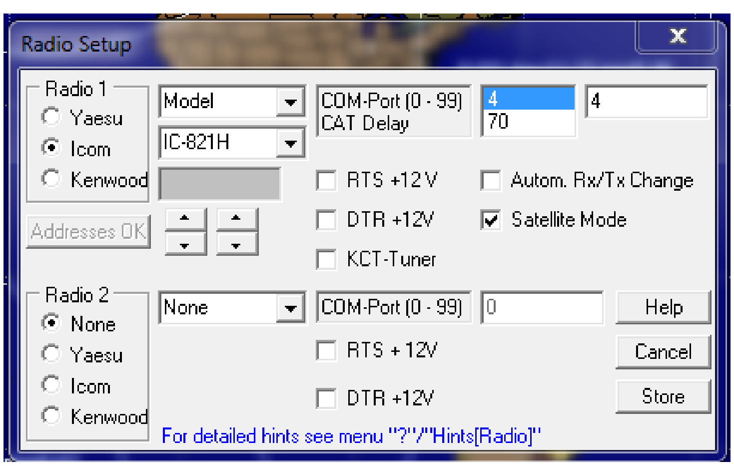
SatPC32 supports four "Configurations" which can be very convenient when you're experimenting with HDSDR. Since there are few if any SatPC32 configuration differences with or without a DDE connection to HDSDR, I've chosen to use "Config. 1" for the DDE connection. (I use Config. 2 for the serial connection.)

From the menu bar of SatPC32, choose Setup > Configuration, then pick "Config. 1" and click OK as shown in Figure 1.

(right) Figure 1: SatPC32 Configuration menu.

(below) Figure 2: SatPC32 Radio Setup menu.





Sidebar: Downloading the Software

SatPC32 was written by Erich Eichmann, DK1TB. You can download the SatPC32 software suite from his website:

http://www.dk1tb.de/indexeng.htm .

The demo and full version files are identical. Install the files you find on DK1TB's website, then upgrade to the full version by purchasing a registration code from AMSAT-NA, AMSAT-UK, or AMSAT-DL. The entire purchase price of the registration code goes to the AMSAT organization. Visit the software section in the on-line AMSAT store to purchase a registration code ($45) from AMSAT-NA.

http://store.amsat.org/catalog/

The only restriction of the demo version is that your QTH coordinates are not stored, but have to be entered at every program start.

HDSDR is a versatile program designed to work with multiple SDR hardware platforms. It takes the I/Q data from an SDR, displays waterfall and spectrum graphs, and demodulates the signals. It has a number of significant features, all implemented in software. HDSDR runs in a Microsoft Windows environment, including XP, Windows 7 and 8.1.

Additional information on HDSDR and downloading instructions can be found at:

http://www.hdsdr.de

Version 2.70 is current as this article is being written. You will also need to download a hardware-specific ExtIO.dll file for your SDR. This is found by clicking on the "Hardware" button on the HDSDR home page. HDSDR is freeware.

While you can use many different SDR receivers for satellite reception (as long as they tune the 2 meter and 70 centimeter bands), I've had excellent results using the FUNcube Dongle Pro+. You can order one from:

http://www.funcubedongle.com

A portion of the purchase price is donated to support the launch of additional amateur radio satellites.

SatPC32 will close all of its windows, then open them again.

From the menu bar, choose Setup > Radio Setup. The Radio Setup dialog box will appear as shown in Figure 2.

Configure Radio 1 by first choosing the manufacturer of your transceiver, Yaesu, Icom, or Kenwood. Note that the appearance of the Radio Setup dialog box will change depending on the manufacturer that you choose.

For a Yaesu radio, you'll need to choose the "Model" of your radio and the "Baudrate" of the CAT serial interface.

For an Icom radio, you'll need to choose the "Model" of your radio, the "Baudrate", and the CI-V address of your radio. For example, the IC-821 has a hexadecimal address of "4C" which is written $4C in SatPC32.

For a Kenwood radio, the selections are "Model", "Baudrate", "S-Store", and "Trace".

Then choose the Radio 1 COM port and the CAT Delay time. Check to be sure these values now appear in the middle box, which shows "4" and "70" in the screen capture shown in Figure 2.

Finish the configuration of Radio 1 by unchecking the "Autom. Rx/Tx Change" box and checking the "Satellite Mode" box. The "RTS +12V" and "DTR +12V" boxes are only used in the rare cases when your serial cable between your radio and PC is using the RTS or DTR pins of the PC's RS-232 interface to power the interface electronics.

Configure Radio 2 by selecting "None".

Finish the Radio Setup by clicking on the "Store" button.

Step 3: Configure SatPC32 to Simplify Testing

By default, SatPC32 only updates the DDE frequency information when the selected satellite is above the horizon. Testing your configuration goes much faster if you tell SatPC32 to always update the frequencies.

From the menu bar of SatPC32, choose "?" > Auxiliary Files > DivOptions.SQF. This will start the Window's Notepad editor with the file DivOptions.SQF.

If necessary, change the first five lines of this file so that they look like this:

```
- (1)
+ (2)
+ (3)
- (4)
- (5)
```

Changing line 2 from "-" to "+" tells SatPC32 to update the DDE frequency regardless of the location of the satellite (above or below the horizon).

Save your changes by selecting File > Save, then File > Exit.

Step 4: Restart SatPC32

Many of the basic configuration options for SatPC32, including the Radio and Rotor setups and the DivOptions.SQF file are only read when the program starts.

To have the changes you've just made take effect, restart SatPC32 by first choosing File > Quit or click the "X" in the upper right corner of the main SatPC32 window.

Once the program has closed, start SatPC32 again.

Step 5: Configure HDSDR for DDE

Start HDSDR.

Now use the mouse to select the "Options [F7]" button, or press the "F7" key. Choose "DDE to HDSDR" and this dialog box will appear:

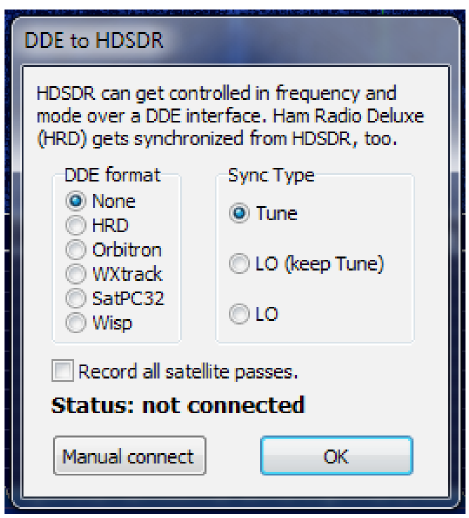


Figure 3: Initial view of the DDE to HDSDR configuration screen.

Note that the Status is "not connected".

Choose the DDE format "SatPC32" and the Sync Type "Tune".

If you have SatPC32 running, the Status will change to "connection ok ☺" as shown in Figure 4.

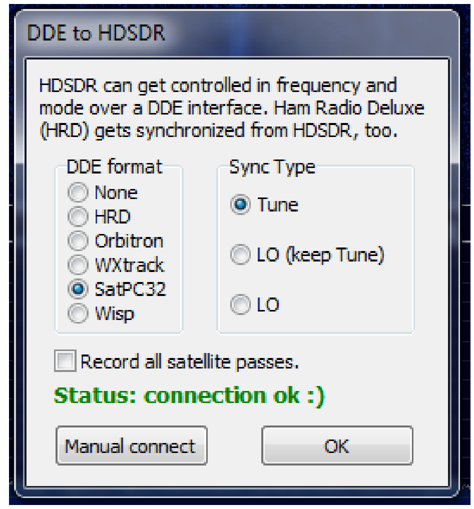


Figure 4: HDSDR is now communicating with SatPC32.

Step 6: Testing

To test this setup, we want to verify that SatPC32 can tune both the receiver (i.e., HDSDR) and the transmitter (e.g., IC-821). You should have both SatPC32 and HDSDR running for these tests.

SatPC32, using a CAT command, can switch some transceivers to Satellite Mode. Other transceivers, including the Icom IC-821, can only be placed in Satellite Mode manually. If your transceiver doesn't switch to Satellite Mode automatically, put it into Satellite Mode for these tests.

On SatPC32, choose an SSB/CW satellite (for example, FO-29) by clicking on the letter ("A" – "L") in the lower-right corner of the screen that corresponds to the satellite you want to use as shown in Figure 5. (Some of the functions we'll be testing are disabled for FM satellites.) The satellite you use for testing does not need to be above the horizon.

Next, turn on CAT Control and VFO polling by verifying that "C+" and "V+" are enabled in the upper-left corner of the screen. If "C-" or "V-" are displayed, click on them to toggle back to "C+" and "V+" as shown in Figure 6.

From the menu bar, select "CAT". The CAT Tuning dialog box will appear (Figure 7). You may move this window on the desktop so that it doesn't obstruct the world map, and leave it open for later adjustments.

Set the SSB/CW and FM/PKT Intervals to "10" and "Store" them. Also set the "Speed" to "x 5". Both the Interval and Speed settings affect how fast SatPC32 updates the tuned frequency of the attached radios.

Now look at the Observer Frequency (abbreviated "Obs.") at the top of the SatPC32 main window as shown in Figure 8.

Compare the Downlink Obs frequency (435857.069 kHz in the screen shot in Figure 8.) to the Tune frequency of HDSDR. They should be the same, although the HDSDR display frequency is in Hertz. If the frequency is changing rapidly, the HDSDR frequency may lag the SatPC32 frequency. In our example, the Tune frequency would be 435.857.069.

If they are not the same, check to be sure CAT control is enabled in SatPC32 (the "C+" button) and that HDSDR shows "Status: connection ok" on the DDE to HDSDR dialog box.

The HDSDR demodulation mode should be "USB" (the accepted convention is to transmit using lower sideband and receive using upper sideband).

Compare the Uplink Obs frequency (145946.886 in the screen shot) to the transmit frequency of your transceiver. They should be the same, although your radio may not show all nine digits of the frequency.

If they are not the same and the SatPC32 "C+" button is shown, you'll need to debug the CAT connection between SatPC32 and your transceiver. See Steps 1-4 above.

The transmitter modulation mode should be "LSB", as the accepted convention is to transmit using lower sideband.

Now test to be sure you can use SatPC32 to change the Tune frequency of HDSDR by clicking on the up-arrow under the "1k" legend as shown in the screen shot in Figure 8. The Downlink Obs frequency should increase by 1 kHz (from 435857.069 to 435858.069 in the example shown). The Tune frequency on HDSDR should also increase by 1 kHz.

Note that only the HDSDR Tune frequency should change, not the LO frequency. If the LO frequency changes, make sure you chose "Sync Type" of "Tune" in Step 5 above.

Using the SatPC32 buttons to change the receive frequency will also cause the transceiver's transmit frequency to change, although not by the 1 kHz steps.

Finally, adjust the tuning knob on the transceiver. The Uplink Obs frequency

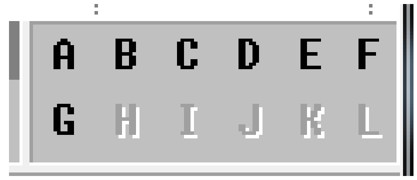


Figure 5: Selection of satellite on SatPC32.

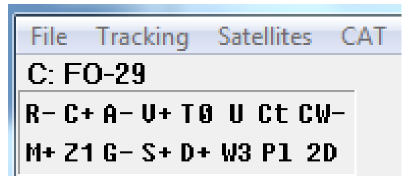


Figure 6. SatPC32 CAT control and VFO polling.

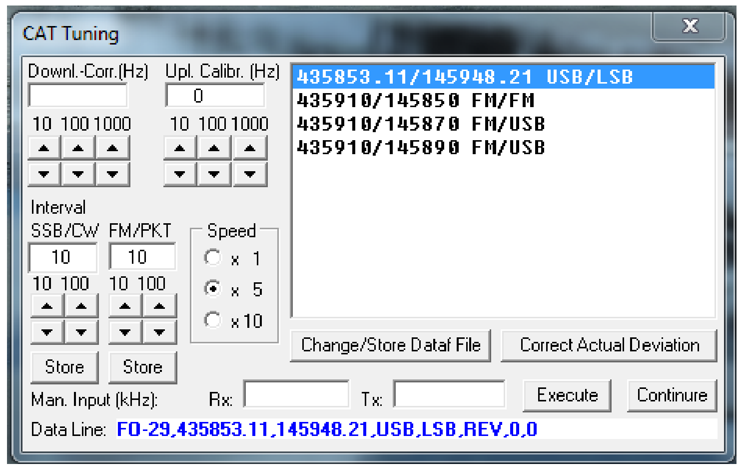


Figure 7: SatPC32 CAT tuning box.

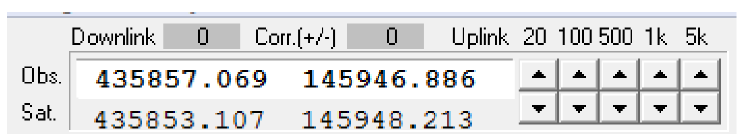


Figure 8: SatPC32 Downlink Obs Frequency display

should change to track the radio. It is normal for there to be some delay or latency in this operation.

If the Uplink Obs frequency doesn't change, make sure the SatPC32 "V+" button (VFO polling) is showing.

You should also see the HDSDR Tune frequency change and the passband on the upper spectrum display move as you change the tuning knob on the transceiver. So you can tune the HDSDR receive frequency using either the SatPC32 controls or the transceiver tuning knob.

As explained in the Comparison Chart above, you cannot tune HDSDR by using the HDSDR controls when you use the DDE connection.

If all of these tests work, congratulations! See the section "Operating Hints" for additional suggestions and observations.

Connecting SatPC32 & HDSDR with a Serial Cable

Of the two options for connecting SatPC32 and HDSDR, the serial connection option is tougher option to get working. However, if you succeed, the ability to click in the HDSDR waterfall to tune the receiver and transmitter is the fastest and most satisfying way to operate. See someone in the satellite passband sending CW or SSB? Just click to tune and work them!

The next installment of this article will explain the configuration of the serial connection option.

Full Duplex and Desense

Running your radios "full duplex", that is, listening to the satellite with your receiver at the same time you are transmitting is the best technique for satellite communications. Doing so allows you to hear your transmitted signal to verify that you are on frequency and that your modulation level and power levels are correct. On an FM satellite, you can verify that you've captured the receiver and aren't just QRM'ing someone else. On a CW or SSB satellite, you can hear if another station is transmitting on the same frequency with you or if the station you're calling didn't hear you.

However, if too much of your transmitted signal gets into the receive chain (preamp and receiver input), the received signal will be reduced or blocked entirely, a problem called "desense" (short for desensitization).

Do the waterfall and spectrum graphs on HDSDR change radically when you transmit? If so, you have a desense problem.

You can reduce or eliminate desense by using all or a combination of the following:

1. Increase the separation between the transmit and receive antennas.
2. If the antennas are linearly polarized, place antenna elements at right angles to each other.
3. If the antennas are circularly polarized and if you can switch between RHCP and LHCP, try different combinations of polarity direction.
4. Use a diplexer like a Comet CF-416 between the antenna and the input to the preamp (if you are using one) or SDR to attenuate the out-of-band energy (typically 60 dB attenuation). For a detailed discussion on this technique refer to: **http://www.amsat.org/?page_id=2136**
5. Use a preamp with a good input filter.

Operating Hints

When using the DDE option, it is generally best to start SatPC32 first, then start HDSDR. This will have the DDE Server running (SatPC32) before the DDE Client (HDSDR) tries to connect to the server. If you start HDSDR first, or if you restart SatPC32 after HDSDR is running, you can trigger HDSDR to attempt the DDE connection again by clicking on the "Manual connect" button in HDSDR's "DDE to HDSDR" dialog box as shown in Figure 4.

Remember to connect the correct antenna to your Software Defined Radio and to your transceiver for the selected satellite! You may want to construct a switch matrix to automate the swapping of coax between the radios. Note that most manual coax switches short the unused inputs!

The latency or delay in the hardware and software of a Software Defined Radio can be significant. This latency is typically a combination of buffering in the SDR, buffering in the PC drivers, and implementation of the filters in the software. When using full duplex, your transmitted signal may arrive at your ears 0.5 to 1 second after it was sent. Without practice and a conscious effort, it is very easy to get tongue-tied while talking and to have similar difficulties when trying to send CW.

Acknowledgments

My sincere thanks to the following for their invaluable assistance:

- Erich Eichmann, DK1TB, for writing SatPC32, and for helping me understand the underlying logic behind the operation of the program suite.
- Tom Doyle, W9KE, for his notes on how he got the programs to work together.
- Mark Hammond, N8MH, for several conversations on how SatPC32 could be used with software-defined radios.

AMSAT Vice-President Engineering, Jerry Buxton, N0JY, posed with the Fox-1 Engineering Unit at the Hood County (TX) Amateur Radio Club. He also demonstrated the transponder. Jerry said the club members were very interested and had a lot of good questions.

AMSAT Awards Update

Bruce Paige, KK5DO
AMSAT Director Contests and Awards

Here is a report on our latest inductions into the AMSAT awards community.

Satellite Communicators Club

This award is given to any operator for having made their first contact. To apply for this award you need to send a report of your contact (no QSL card is required) to AMSAT Director of Contests and Awards, Bruce Paige, KK5DO..

The following have entered into the Satellite Communicators Club for making their first satellite QSO.

- Kelly Davis, KC3CGT
- David Coutts, VE3KLX
- Michael Parrott, N4MEP
- Michael Jones, W6GYC
- Richard Weil, KW0U

AMSAT Sexagesimal Award.

The Sexagesimal Award is for working 60 contacts on any satellite. A contact is defined as one with a station in another state, DXCC country or Canadian Province. The following have earned their AMSAT Sexagesimal Award.

- Paul Stoetzer, N8HM, #166

Robert W. Barbee Jr., W4AMI Award

This award is awarded for the submission of 1,000 satellite contacts on OSCAR-6 or later satellites. There is an endorsement for each additional 1,000 and a special certificate at 5,000. The following have earned their Robert W. Barbee Jr., W4AMI Award.

- Hector Martinez, CO6CBF, #81 (Basic 1,000 plus endorsements through 4,000)
- Paul Stoetzer, N8HM, #82

The following have earned their Robert W. Barbee Jr., W4AMI 5,000 Award.

- Hector Martinez, CO6CBF, #31

To see all the awards available and requirements visit:

http://www.amsat.org

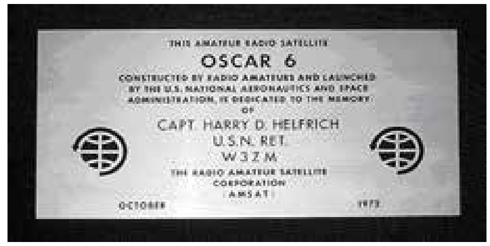
Award costs and method of payment can be found in the AMSAT on-line store:

http://store.amsat.org/catalog/

Bill Tynan, W3XO, AMSAT LM-10

Editor's Note: This year marks AMSAT's 45th anniversary. In order to tell the story of AMSAT over the years Bill Tynan wrote a book for the 40th Anniversary Annual Meeting and Space Symposium held in Baltimore in October, 2009. Bill assembled the information contained in his book with the invaluable assistance of Dick Daniels, W4PUJ, Keith Baker, KB1SF/VA3KSF, Bob Bruninga, WB4APR, Lou Mc Fadin, W5DID, Ray Soifer, W2RS and Bill Hook, W3QBC.

In order to share the story of how AMSAT developed over the decades the author has released portions of his book for publication to the wider audience of the *AMSAT Journal*. This is the second of a series of *AMSAT Journal* articles chronicling AMSAT's history. The first appeared in the November/December 2012 issue.

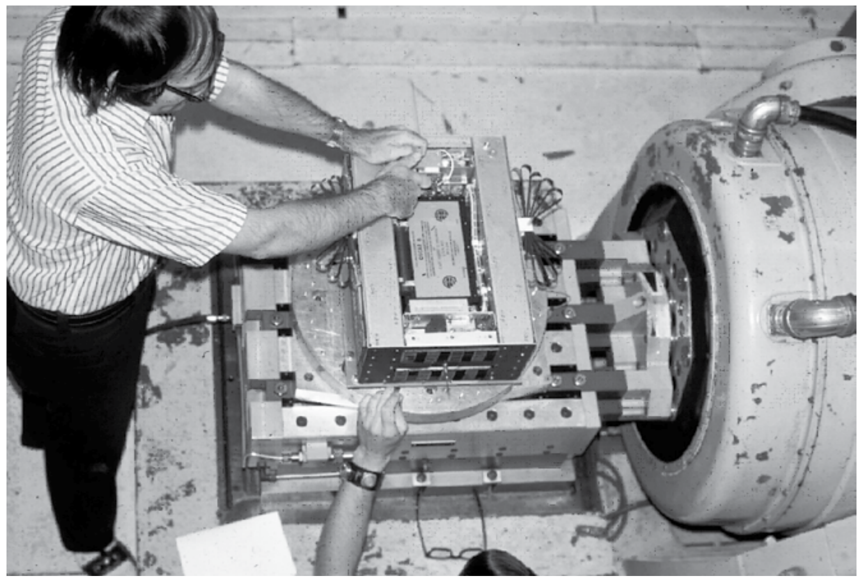


This plaque dedicating AMSAT OSCAR 6 to Harry Helfrich, W3ZM, flew with the spacecraft

AO-6, The First Wideband, Multiple-user Transponder Satellite

Once the AO-5 mission was complete, design and construction began on AMSAT's first from-the-ground-up project. In orbit, it would be AMSAT OSCAR 6, or AO-6, the first of AMSAT's Phase 2 birds. The first OSCARs, including OSCAR 5, carrying only beacons, were referred to as Phase 1, Future, high altitude spacecraft would be referred to as Phase 3. The term, Phase 4, is reserved for geostationary satellites.

This first Phase 2 satellite contained a 2 meter up/10 meter down transponder, a 21 channel command decoder, a 435.1 MHz beacon and a Morse code telemetry system developed by John Goode, W5CAY.

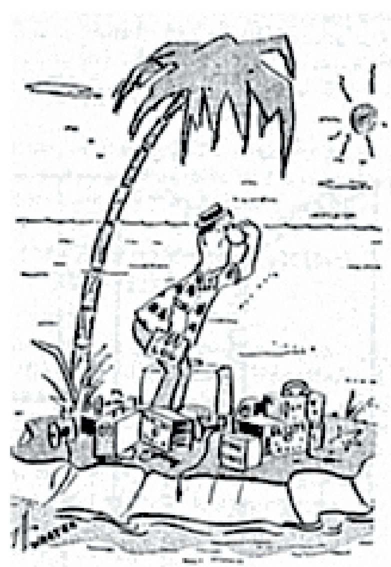


AO-B (AO-6) is prepared for vibration testing.

Since no information existed on how a multiple-user transponder would behave when exposed to many signals in its passband simultaneously, a prototype of the 2 to 10 meter transponder was built and flown in a light plane. With Jan King, W3GEY, occupying the rear seat monitoring the transponder on a small HF receiver and a pilot and copilot at the controls, the plane took off one Saturday morning from Friendship Airport, now referred to as, Baltimore Washington International Airport (BWI).

The route took them up the East Coast to near Boston, then west over New York State, and across the Niagara Peninsula of Canada. They landed late that afternoon at

Pontiac, Michigan - a logical place to stop as Jan's parents lived in the area, thus providing the plane crew a free place to stay overnight. The following day, they resumed the flight, proceeding to near Chicago, making it a point to fly over Kokomo, Indiana, where AMSAT already had several loyal members eager to participate in the experiment. The flight ended Sunday afternoon where it had begun.



The future of DXpeditions? From QST for June, 1969 (Reproduced by permission of ARRL)

AMSAT even sponsored a contest in connection with the flight. A total of 66 logs were entered with the winner Rich Zwirko, K1HTV, in Connecticut. Rich, later moved to the DC area and served as AMSAT's Vice President for Operations during the late 1970s.

A group of ground-based volunteers tracked the plane, communicating with Jan via 2 meter FM and relaying the aircraft's position and other information to W3KMV in Silver Spring, Maryland on 40 meters, who then reported the information to the other AMSAT folks in the DC area via one of the local 2 meter FM repeaters.

Two unfortunate events occurred during OSCAR-6's construction and testing. In conducting a thermal test on the flight transponder in his wife's oven, Dick Daniels, W4PUJ, inadvertently left the oven on too long and burned the thing to a crisp - necessitating construction of another unit. Worse, was the sudden death of Harry Helfrich, W3ZM, who suffered a heart attack while jogging one very cold January morning. Harry had been such an inspiration and great help to AMSAT in arranging for environmental testing at Goddard Space Flight Center and obtaining a launch for AO-5. AMSAT later obtained Harry's call, W3ZM, as its "Club Station" call.

Dick Daniels, a long-time AMSAT member and supporter left this world in November, 2011.

Harry's death left both technical and administrative voids in AMSAT. Since he had been serving a Treasurer, that position had to be filled immediately. Bill Hook, W3QBC, of the National Institutes of Health Amateur Radio Club, an early member, stepped up and took over this vital post. Bill has been helping AMSAT ever since, assisting Martha at the office and acting as an Assistant Editor for The AMSAT Journal.

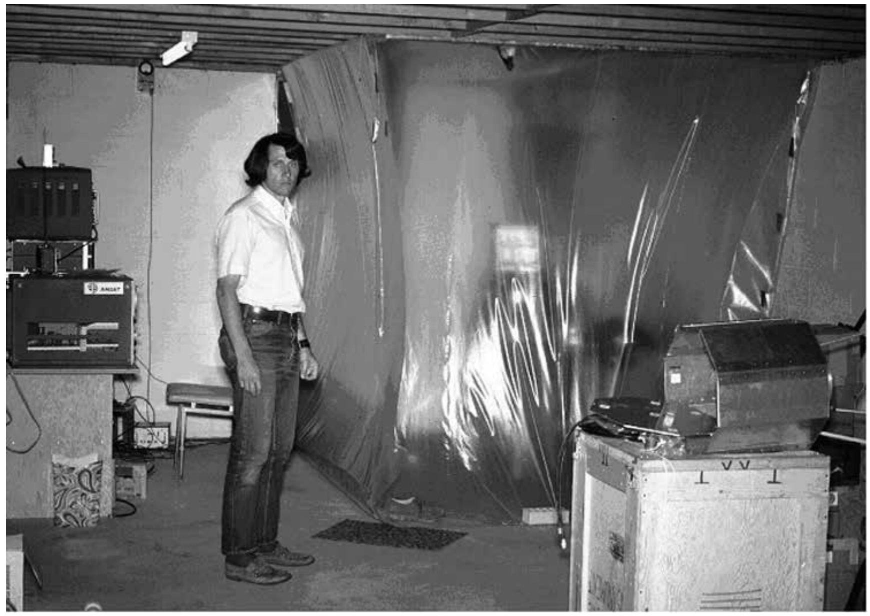
Despite the magnitude of the job and these setbacks, AMSAT OSCAR 6 was launched on October 15th, 1972. However, a problem with the new satellite became apparent almost immediately. Although it was heard by European stations soon after launch, when it came over Australia, the down-under command station reported no signals.

Jan quickly flashed word to send an ON command, whereupon the spacecraft immediately again came to life.

It didn't take long to conclude that AO-6 had a mind of its own. Even though it contained no on-board computer, only logic control circuitry, its transponder would turn on and off for no apparent reason.

To overcome this pesky situation, Jan initiated what he termed, "intensive use of ground command." In other words, to maintain the bird in the desired mode, commands had to be sent to it by the various command stations around the world at every opportunity.

Several dedicated volunteers, including Randy Smith, VE2BYG, (later VE3SAT), and Larry Kayser, VE3QB (later VA3LK), automated their stations to accomplish this arduous task even when they could not be present. Larry, who was



The "clean room" in Jan King's basement home of AO-7

(right) Karl Meinzer, DJ4ZC, displays one of the two modules for AO 7's Mode B 70 cm to 2 meter HELAPS transponder.

(left) AO-7 completed and ready for launch.

AMSAT Life Member Number 3, became a silent key in 1998.

The first DXpeditions involving amateur satellite operation took place during AO-6's lifetime. One such DXpedition was to Penrhyn Island (also known as Tongariva) in the North Cook chain. Though HF operation was the group's main objective, some of them wanted to try the new satellite as well. Thanks to Chip Angle, N6CA, they had the appropriate equipment. But, the on-again/off-again nature, AO-6 continued to display, represented a real challenge to their success in making satellite contacts.

By the time of the AO-6 launch, the writer had been designated Vice President for Operations and therefore had the responsibility to coordinate the various command stations around the world. In that position, I endeavored to support the Penrhyn Island DXpedition by having the satellite on when it was in the vicinity of the Cook Islands. To accomplish this, I depended principally on our New Zealand command station operated by Bruce Rowlings, ZL1WB. Bruce came through and the Penrhyn group was able to work a couple of US West Coast stations via AO-6, thus demonstrating that satellite operation could be a useful addition on future DXpeditions.

During AO-6's lifetime, a request came from the Boeing Amateur Radio Club, asking AMSAT to make the satellite available so that they could attempt to command a radio controlled model airplane through it – an interesting experiment indeed, with implications applicable to the present-day world.

Two Twin City hams, John Fox, W0LER, and Ron Dunbar, W0MJS, reported an odd effect on reception of AO-6's 435.1 MHz beacon. As the satellite traveled away from them toward the south, they noted that, at one point in the pass, the frequency rose rather than fell, as one would expect for a departing object. They did not observe this "inverted Doppler effect" on AO-6's lower frequency beacons, or on other satellites, but did note it on some U.S. Navy navigational spacecraft with beacons in the vicinity of 400 MHz. John's and Ron's observations elicited much speculation in scientific circles as to the cause of the strange phenomenon.

AO-6 supported the first satellite Worked All States (WAS). Jack Colson, W3TMZ, had worked diligently to put all fifty states into his log and finally lacked only Hawaii. KH6 is about a 4,400 mile hop from Maryland - close to the limit of the range afforded by AO6's 900 mile high orbit. That, plus the fact that the satellite was often not on when it was supposed to be, made completing of that last contact seem doubtful. Many times, when the bird was in the right spot, the transponder was silent.

But one evening, the satellite gods were with Jack. The satellite was in the right position. The transponder was on. W3TMZ, and Butch Miller, KH6HLK (now NN2T), the Hawaii station he had been scheduling, were both on deck. The first satellite WAS went into the record books. Some dozen more joined Jack before AO-6 ceased to function in June 1977.

AO-7 - DJ4ZC Arrives on the Scene

AO-7 followed AMSAT OSCAR-6, This spacecraft, built in an improvised clean room in Jan King's basement, carried two transponders. One was a 2 meter to 10 meter unit like the one on AO-6. This combination of bands had been dubbed, Mode A. The other transponder, a 70 cm to 2 meter unit (Mode B) was supplied by a German group led by Karl Meinzer, DJ4ZC, of the University of Marburg. Karl had earlier provided an in-band 2 meter transponder to Project OSCAR, which had never flown. The 70 centimeter to 2 meter transponder on AO-7 proved very successful.

AO-7's Mode B transponder employed HELAPS (High Efficiency Linear Amplification through Parametric Synthesis) which had been the subject of Karl's doctoral thesis. Although signals from AO-7's Mode A transponder were not as robust as those from the one on AO-6, its Mode B transponder produced very strong downlink signals, making AO-7 very popular with hams throughout the world.

Inter-satellite Relaying Demonstrated

The overlapping lifetimes of AO-6 and AO-7 provided amateurs an opportunity to accomplish something never before achieved with any other satellites,

government or commercial – relaying signals from one satellite to another. This satellite-to-satellite mode of communication has since found application in non-amateur spacecraft, including NASA's Tracking and Data Relay Satellites (TDRS).

Such satellite-to-satellite link-ups became possible when AO-6 and AO-7 were within line-of-sight of each other so that the 2 meter signals from AO-7's Mode B transponder could be received by AO-6's Mode A transponder and thus sent back to Earth on 10 meters. A number of satellite operators took advantage of these opportunities to complete QSOs via this cross-satellite route. The first to do so, were Ray Soifer,W2RS, and Ben Stevenson, W2BXA.

Ben later became the first to earn a satellite DXCC. While he was the first to actually receive the Satellite DXCC award, Pat Gowen, G3IOR, was the first to work the required 100 countries. But, Pat was slow to collect QSLs, so he eventually received Satellite DXCC No. 4.

Incidentally, G3IOR was elected to the AMSAT Board in October, 1976, the first non-US citizen to serve. Over the years, other non-US board members have been Haruo Yoneda, JA1ANG, Junior de Castro, PY2BJO, Larry Kayser, VE3QB, (later VA3LK) and John Henry, VE2VQ.

Satellites to the Rescue

An experiment conducted using both AO-6 and AO-7 involved sending signals through the each of the satellites, then computing the location of the sending station by the Doppler shift. Confirmation of the utility of this technique to locate ground-based transmitters, eventually led to initiation of the international Search And Rescue SATellite) (SARSAT) Project to locate downed aircraft and lost mariners.

Back from the Dead

Though AO-7 was launched in November, 1974, and went silent in the summer of 1981, its signals were suddenly and unexpectedly received again one evening in June, 2002, by G3IOR. Reappearance of long-departed AO-7, produced much excitement and many theories as to why and how it had happened. It had been surmised that, although the satellite's batteries had long since ceased to furnish power, its solar cells were still able to provide power when in sunlight. Apparently, AO-7's original demise was caused by a short in one or more battery cells, and that opening of the short, made the solar panel power available to run the transponders - bringing the old bird back to life after so many years. But, since AO-7 can no longer be easily commanded, one can never be sure which transponder will be active. Many satellite enthusiasts make a special game of using this derelict spacecraft.

AO-8 - ARRL Does Its Part

To replace the by-then dead AO-6 and provide a Mode A capability superior to that offered by AO-7, the League funded AMSAT to build AO-8. In addition to a Mode A transponder, AO-8 carried a 2 meter up/70 centimeter down transponder built by the Japanese AMSAT group, JAMSAT. As a result of its Japanese origin, this combination of bands became know as Mode J. AO-8 was launched in March, 1978 and performed well under stewardship of ARRL volunteer controllers for five years.

Satellites from Around the World

The U. S. based AMSAT was not the only organization contributing to the construction and launch of spacecraft designed to serve the world's licensed radio amateurs. In addition to the considerable effort put into the Phase 3 satellites by representatives from the German AMSAT group, AMSAT-DL, various citizens of other countries have built and launched amateur spacecraft.

The RS Satellites: The Soviets Contribute to Amateur Space

In October, 1978, amateurs from the Soviet Union did their part to provide satellites for the world's licensed radio amateurs. Radio Sputnik 1 (RS-1) and Radio Sputnik 2 (RS-2) were sent into orbit simultaneously on a single launch vehicle. Both of these satellites carried Mode A transponders and remained popular for a number of years.

With the Cold War still on, it was always difficult to learn much about the state of amateur satellite activity in the Soviet Union. But, in 1981 rumors began to creep out of another coming launch.

When it happened it was a whopper.

On December 17, 1981, a Soviet launcher carried a cluster of six RS satellites into orbit: RADIOs 3 through 8. RADIOs 3 and 4 provided telemetry information, while RADIOs 5 through 8 carried 2 to 10 meter transponders - keeping ground-based satellite enthusiasts happy for some time to come.

With their slightly higher orbits than AO-6 and AO-7, the RS birds made it possible to work longer distances. Nick Laub, W0CA, took advantage of this to earn the first Satellite Worked All Continents (WAC) award. Nick was soon followed by several others, and more than a dozen hams (including W2BXA and G3IOR) achieved Satellite DXCC by this means.

During the decade of the 1990s, our Russian radio amateur compatriots continued the Mode A tradition by launching and operating a whole series of very popular so-called “RS” (Short for “Radio Sputnik”) satellites.

RS-10 (and RS-11, which was usually turned off), were mounted on the same space frame, which also included a Russian navigation satellite. This satellite was in a low Earth (about 600 miles) polar orbit, and was quite easily worked with low power and simple antennas. Many amateurs came to refer to the RS series the easy birds because many would-be satellite operators got their first taste of amateur satellite operation using RS-10 and 11’s Mode A transponders. The birds’ uplink receivers were quite sensitive and the downlink transmitters quire powerful, making them relatively easy satellites to use. Standard HF gear using simple dipole or vertical antennas usually produced a workable Mode A 10 meter downlink signal, particularly on near overhead passes.

A Russian ROBOT

Another exiting feature of RS-10 was its ROBOT transponder. The ROBOT was an automatic on-board QSO-generating computer whereby one could send one’s call sign on CW to the satellite and if it heard you, it would respond with a serial numbered reply.

Launched in February 1991, RS-12 and RS-13 (which was usually turned off) were “kissing cousins” of RS-10 and 11 in most respects. They were also “hitchhikers” on a Russian navigation satellite. Because its HF (Mode K, 15 to 10 meter) transponder was the one activated most of the time, RS-12 soon became a very popular entry point for budding satellite operators who lacked VHF or UHF equipment.

The UK Does its Part

Soviet hams were not alone in serving the world’s amateur satellite enthusiasts. Great Britain did its part too. Martin Sweeting, G3YJO, and his group at the University of Surrey in England had earlier established a key command station needed to support the continuous commanding of AO-6, were eager to become satellite builders themselves. UoSat-1 was what they came up with. It was a scientific and educational spacecraft stabilized by a gravity gradient boom and magnetic torquing with a payload that included an earth-pointing CCD camera, radio propagation experiments and radiation monitoring equipment.

A NASA Delta rocket carried UoSAT-1 into orbit on October 6, 1981. Once in space, it became UO-9. But, the mission got off to a rocky start when both 2 meter and 70 centimeter transmitters were inadvertently switched on at the same time. It took some time and a large radio astronomy dish to finally blast commands into an overwhelmed command receiver and correct the problem. From that point on, all went well and pictures of the Earth began to stream down.

With the success of UO-9, Sweeting and his University of Surrey team began looking for a ride for a follow-on mission. On checking, it was found that another Delta launch was available but they would have to deliver a spacecraft in six months. With a collective big gulp, the Surrey folks took off running to build and test a spacecraft similar to UoSAT-1, but with an enhanced payload including an improved version of the previous charge-coupled-device Earth pointing camera, a particle wave experiment, a synthesized speech experiment, a space dust experiment (microphone), and a digital communications experiment (DCE), that represented an early digital packet radio demonstration. With unbelievable speed and luck, the Surrey team was able to deliver on time and the UoSAT-2 became UO-11 upon reaching orbit on March 1, 1984.

But, the space gremlins again came awake. Shortly after reaching orbit, UO-11 went silent. Immediate recovery efforts failed to bring it to life, and, as time went by, it appeared to have been a total failure. Ten weeks later, a group using large radar dish in Greenland, heard faint signals. Renewed efforts to command the spacecraft were finally successful on May 15, and the bird was found to be healthy. Low-temperature sensitivity of a critical device appeared to have been the problem. UO-11 was checked out, commissioned and ready for a long and useful life.

The success of Uo-11 encouraged Dr. Sweeting and his University of Surrey Satellite Technology organization to further enhance the technology of packet radio satellites. This led them to build a series of packet radio birds. Two of these, UoSats 14 and 15, were launched along with the four original AMSAT Microsats (to be covered in a later article),

Each carried a non-amateur transponder as well as an open access amateur radio packet transponder. The non-amateur transponders were for a packet communications experiment (PCE) for use by VITA, Volunteers In Technical Assistance, an organization focused on development of data exchange technologies that could be easily used at the village level in poor countries around the world. VITA people had already been experimenting with amateur radio packet networks for communications in rural areas. UO-14 also included experiments on space radiation effects on spacecraft components, while UO-15 carried a CCD video camera to transmit views of Earth from orbit. Unfortunately, the camera ceased operating soon after launch.

UO-22 later joined the other two UoSats. Its original purpose was to support both amateur and non-amateur operation. Its primary non-amateur mission was to provide store-and-forward communications for a group called SATELLIFE, a non-profit organization formed in 1985 to provide an electronic mail network for health professionals in developing countries. In this mode, UO 14, provided much-needed emergency communications after a tragic Indian earthquake, later leading the government of India to support the construction and launch of VUSat, OSCAR 52.

This store-and-forward medical communications technique is but one of several direct commercial applications of communications technology developed and first demonstrated using the Surrey’s UoSats. and the AMSAT-NA Microsats.

Once its non-amateur transponder was no longer needed for other purposes, UO-14 was turned over entirely to the hams, who were able to use it very successfully as a bent pipe FM repeater until the satellite was declared dead due to low battery voltage in November, 2003.

The University of Surrey, in conjunction with students from Korea both helping and learning, later constructed KO-23 and KO-25. Both of these satellites were used primarily to handle high speed (9600 baud) amateur packet traffic, via satellite gateway nodes set up by dedicated ham operators around the world. Those operating these nodes generously donated their time and effort, not to mention substantial personal financial investment, to allow everyday users of the then quite active amateur radio terrestrial packet radio network to send and receive traffic via the packet satellites. In most cases, overseas packet traffic routed via the PACSATS arrived at its destination hours (and sometimes days) ahead of traffic routed via the normal terrestrial packet network.

The Fuji Sats

In 1984 a joint effort was undertaken in Japan by the Japanese AMSAT group, JAMSAT, the Japanese Amateur Radio League (JARL), NASDA (the Japanese equivalent of NASA) and a commercial company, NEC; to develop an amateur radio satellite for launch on a Japanese launch vehicle. The Japanese spacecraft included two separate Mode J transponders; one a linear transponder and the other a digital store and forward transponder. Both employed Mode J (2 meters up and 70 centimeters down), that mode favored because of the high density of terrestrial 2 meter activity in Japan.

On August 12, 1986, JAS-1 was successfully placed in orbit. Signals were first heard in South America and soon by other amateurs around the world. Telemetry confirmed that all was well and, after checkout in orbit. Designated Fuji-OSCAR 12, it was open for business. With the success of this mission, the JAMSAT team immediately turned to construction of a follow-on satellite, JAS-2, aimed for launch in 1989.

Our Japanese friends continued to add to the array of amateur satellites with Fuji OSCAR 20, another low Earth satellite, also carrying both a linear and a packet radio transponders, was launched on February 7, 1990. It was designed and built by a joint team from JAMSAT and JARL. When its Mode J transponder was activated, FO-20 provided very strong downlink signals, and thus became very popular.

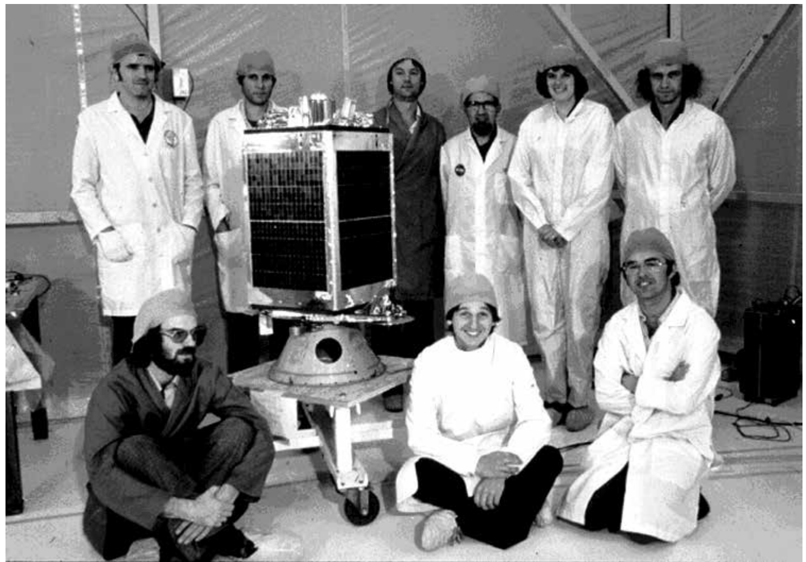
FO-29, or JAS-2 as it was known before launch, was an upgraded replacement for FO-20 and was successfully launched into a low Earth orbit by NASDA, the Japanese National Space Development Agency, from their Tanegashima Space Center in southern Japan on 17 August 1996. The satellite was principally designed by a team from JARL and was later built almost entirely by NEC (a large Japanese firm) under JARL contract. It carries two Mode J transponders, one an inverting a linear transponder similar to the one on FO-20, and the other a packet radio, transponder. FO-29 also included a magnetic torque system to spin stabilize the satellite in a planned attitude perpendicular to the orbit's plane. Also incorporated were many electronic improvements. One was the 9600 baud FSK transponder, in addition to a 1200 baud AX.25 packet modem and BBS system, plus a "digitalker" to store, and then repeat on the 435.91 MHz FM downlink, about 25 seconds of speech uplinked from the satellite's command station. Another, less obvious, but very important, improvement is the use of much higher efficiency gallium-arsenide solar cells. While the FSK transponder and the AX.25 packet system no longer function, hams are occasionally still able to use FO-29's Mode J linear transponder.

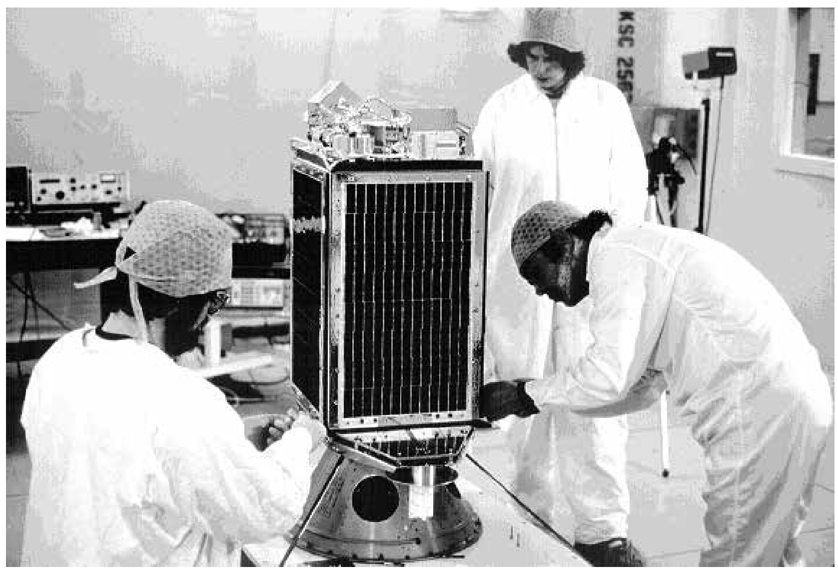
More Recent Phase 2 Birds

In addition to satellites provided by organizations other than AMSAT-NA, such as the UK's University of Surrey UoSats, the Soviet Union's RS birds and the Japanese Fuji satellites; a number of simple easy-to-use spacecraft have been produced well into the 21st century by several domestic and overseas groups that derive much of their inspiration and technology from earlier AMSAT-NA projects. Examples are the satellites built at the U.S. Naval Academy at Annapolis, Maryland by Bob Bruninga, WB4APR, and his students.

Bruninga, many will recall, is the father of APRS (Automatic Position Reporting System). Many hams use APRS to continually report the position of their vehicle or even themselves, as well as for sending short messages back and forth. Commercial equipment of both the mobile/portable, and even the handheld variety are available with APRS built in. Of course, in order to function, APRS depends on the availability of the GPS constellation of satellites.

Bob popularized APRS in the early 1990s when the GPS constellation was beginning to come in for general use. One of his projects, that attracted


The UoSat Team with UoSat-1 (UO-9)


Putting the finishing touches on UoSat-2 (UO-11)


Working on JAS-1 (Fuji OSCAR 20)

a lot of attention, was tracking a football helmet from Annapolis to Philadelphia just before the annual Army/Navy football game.

As well as having a wide network of terrestrial stations in the US and most of the developed countries, APRS has taken advantage of the packet radio satellites, including the Microsats, of which AO-51 is the latest example, the UoSats and even equipment installed on the International Space Station; to relay data around the globe.

Although APRS is designed for local situational awareness of ham radio activities, it also has global connectivity via I-gates through a wide network of terrestrial stations in the US and most of the developed countries,

Recent enhancements of this global APRS connectivity have come from the Naval Academy APRS satellites, including, PCSat-1, launched in 2001 carrying two AX-25 transponders and a GPS unit designed by DLR in Germany. The satellite downlinks both 1200 baud APRS packets and also MITEL formatted data at 9600 baud. Operating for over 11 years, it is the longest surviving "student built" satellite to date. Once in orbit, PC-Sat-1 became NAV-OSCAR 44, or NO-44.

PCSat-2 was similar to PCSat-1 and followed it in 2005. But instead of being a free-flyer, it was attached to the outside of the ISS for one year and then returned to Earth. Both space systems used dual Kantronics Terminal Node Controllers (TNCs) and dual Hamtronics transmitters and receivers. The reason the Hamtronics units were used is because there were no other ready-made RF units available that used direct crystal control. Bob and his crew did not want to take any chances of a shift of frequency as a result of a bit error problem in a frequency synthesizer.

Both PCSat-1 and the later RAFT satellites used standard terrestrial solar cells rather than space-rated cells. Although 50% less efficient, they cost only 2% as much as high efficiency space rated cells.

PCSat-1 and PCSat-2 supported thousands of users. PCSat-1 (NO-44) continues marginal operation when in full midday sun in the Northern Hemisphere. The downlink used by all of the APRS satellites is 145.825 MHz and is tied into the international network of Internet linked ground stations feeding the live Web page http://pcsat.aprs.org.

The third satellite built at the Naval Academy was the Atmospheric Neutral Density Experiment (ANDE), the Academy's third APRS satellite. The ANDE launch opportunity came by way of the Naval Research Lab which was preparing to orbit a series of 19 inch hollow spheres to precisely measure orbital decay using laser tracking stations. Since these spheres could not have any external antennas or solar panels, for ANDE the Academy used the two halves of the sphere as the antenna with an insulator between them. Power was supplied by 112 "D" size lithium primary cells. These provided a battery life of one and a half years – the mission requirement. ANDE was launched from the Space Shuttle using the Canister for All Payload Ejections (CAPE). Following its ejection, ANDE became NAV-OSCAR 61 or NO-61.

ANDE's digital communications equipment was similar to that of PCSat-1 and PCSat-2, except ANDE's use of non-rechargable batteries required the on-board logic to maximize energy conservation. The dual redundant digital transponders in ANDE provided not only mission telemetry and command/control, but also real-time message, position, and status relay to a worldwide Internet-linked amateur radio tracking system. The objective was to have all such AX.25 satellites able to work together as a constellation of digital transponders providing global coverage. ANDE also carried a text-to-speech module so that packets on the uplink could be spoken on the downlink.

The fourth and fifth Naval Academy satellites were together called RAFT, a mission to deploy two CubeSat-size satellites from the Space Shuttle on Shuttle Mission STS-116 in December 2006. The purpose of RAFT (Radar Fence Transponder) was to solve a problem that has been becoming particularly difficult for NORAD in recent years with the simultaneous launch of numbers of small CubeSats. When a number of small satellites are sent aloft at one time, NORAD can track them all, but has no way of identifying which one is which. One of the tools on which NORAD depends for obtaining satellite orbital data is the Space Surveillance System (SSS) The SSS, sometime called the "radar fence," consists of three high power transmitters emitting fan beams from locations across the US and a number of receive sites at other locations. The SSS provides critical orbiting object data to NORAD which uses it, along with other tracking information, to generate the Keplerian elements on which we all depend for our satellites tracking programs.

To mitigate the problem of identifying individual satellites launched in clusters, the Naval Academy conceived RAFT to test the ability of SSS radar to track such small CubeSats. To accomplish this, a pair of small CubeSats, one heavier than the other, so that after launch, one would drift to the front of a pack and the other would drift behind. One of the RAFT spacecraft included a transponder built by three AMSAT volunteers in Boston. Receiving on the SSS frequency of 217.98 MHz, it transmitted the signals back to Earth in the amateur 2 meter band. The other RAFT carried only passive radar cross-section augmentation. The active RAFT satellite also was used, just like its predecessors, as an APRS transponder with up and downlinks on the 145.825 MHz frequency. It also includes an interesting PSK-31 experiment, allowing as many as 40 simultaneous PSK-31 users to be heard on the 2 meter downlink. But, unfortunately, an assumed separation anomaly caused both of the two CubeSats to tumble at a high rate, resulting in a failure of the four foot long HF antennas to fully extend. Thus, it required very high power to obtain a copyable PSK-31 downlink signal. Also in RAFT is a text-to-speech synthesizer that allows anyone to send a packet and have the packet spoken on the FM downlink. The idea is to use brief packet uplinks to minimize congestion on the uplink while providing a simple FM voice downlink for students and simple ground stations to hear.

A number of Microsat-style satellites have been built for various purposes by a small company called SpaceQuest, located in Virginia, near DC. Among these are Saudi-Sat (SO-50) and AMSAT's Echo, AO-51. SO-50 was built in cooperation with the King Abdulaziz University for Science & Technology in Saudi Arabia. Launched 20 December, 2002 from Baikonur Cosmodrome aboard a Russian Dnepr launch vehicle, it carries a Mode J (145 to 435 MHz FM repeater.

SpaceQuest, with assistance from several AMSAT-NA volunteers, built Echo under contract to AMSAT-NA. It contains an FM repeater with both a 144 MHz and 1.2 GHz uplink and 435 MHz and 2.4 GHz downlinks. Additionally, there is a digital subsystem to transmit telemetry on 70 centimeters and provide a complete PacSat BBS that can be configured via an L band uplink. Also, a digital store-and-forward communication unit capable of speeds up to 76.8 kbps is part of the payload. A separate wideband receiver able to be used for a variety of experiments is also on board. Echo, which became AO-51 once in orbit, was launched June 29, 2004, like SO-50, aboard a Russian Dnepr launch vehicle.

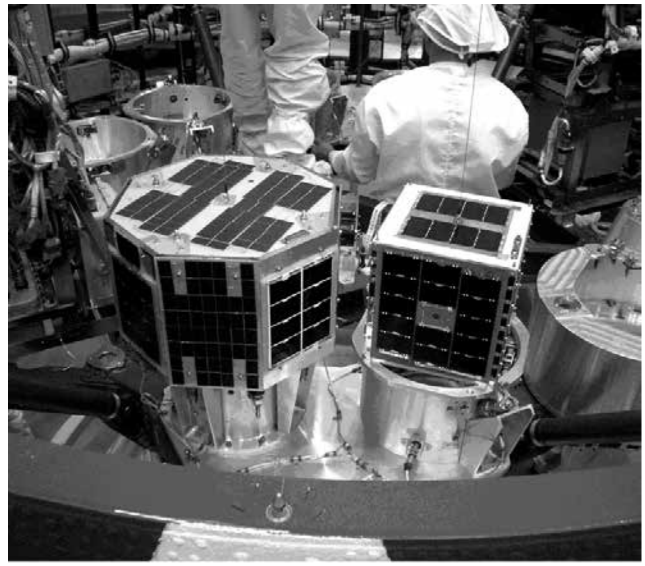
In November, 2011, the AO-51 Command Team reported with a heavy heart that AO-51 had ceased transmission and was not responding to commands. The last telemetry data indicated that the third of six batteries was approaching failure and observations indicated that the voltage from three cells was insufficient to power the UHF transmitters. It was thought that the IHU might continue to be operative. Initial tests with the S band transmitter were also not positive, although more attempts were planned. The command team plans regular attempts to communicate with the satellite over the coming months and years with the possibility that one of the shorted cells may open, as happened with AO-7, making AO-51 usable while in sunlight.

Satellite status information can be found at:

http://www.amsat.org/

Follow the links on the Satellite Info pull-down menu.

U.S. Naval Academy's ANDE



AMSAT-NA's Echo with fellow passengers on a Russian Dnepr launch vehicle

ARRL Centennial QSO Party W1AW/P Operations Include Satellite Activations

The ARRL Centennial QSO Party is a year-long operating event that celebrates hams making contacts.

The Centennial QSO Party includes W1AW operating portable in each state and most territories. Many stations included amateur satellite operations in their W1AW/P activities.

The photos here are from the W1AW/5 satellite operation from Louisiana. Operators for this event included George Carr, WA5KBH, Joe Fouquet, N5JF, and Angelo Glorioso, N5UXT.

We would like to include as much coverage as possible of the W1AW/P events on the satellites. Please send your commentary and photos (JPG hi-res files work best) to the Journal at k9jkm@comcast.net or journal@amsat.org.

(photo top) George, WA5KBH

(photo bottom) Joe, N5JF

RTL-SDR + SDR Radio + FUNcube Sat = Fun!

Jason T. Charles, N4JTC
jason@n4jtc.com

Editor's Note: This article is based on the author's original on-line postings at:

http://n4jtc.wordpress.com/2012/06/12/dvb-dongle-makes-a-great-vhf-uhf-sdr-radio/

- and -

http://n4jtc.wordpress.com/2013/11/23/rtl-sdr-sdr-radio-funcube-sat-fun/

These web pages contains all of the links to the URLs referenced in the text.

SDR Radios are the latest and greatest things to come along in ham radio since solid state was invented. OK, well that may be a stretch, but it certainly has made some incredible advances in SWL and ham radio. Thanks to the ingenuity of some super-smart people we can all enjoy an inexpensive alternative to some of the VHF and UHF dongles out on the market. Interesting enough a product that was meant to be a DVB-T (Digital Video Broadcasting - Terrestrial), DAB (Digital Audio Broadcasting) and DAB+ tuner actually makes a great SDR Radio!

There is a specific model chipset that is required to utilize the SDR tuner. It requires the **e4000** tuner and the Realtek **RTL2832** chipset. Unfortunately, on my first try, I received an upgraded DVB dongle that had a newer chipset that is not compatible with any SDR software. I was a little disappointed at first, but I am using it for local ATSC channels (Advanced Television Systems Committee for digital television transmission) for my PC so no big loss.

I later found that Reddit maintains a list of compatible tuners:

http://www.reddit.com/r/RTLSDR/wiki/compatibility

I ended up ordering a Newsky TV28T from Aliexpress.com which had the correct tuner/chipset and worked perfectly.

I was surprised at how well it actually worked, I was receiving the NOAA weather radio broadcast, our local airport tower communications, APRS, neighborhood weather stations, and some FRS chatter. I originally wanted to use it for the reception of amateur radio satellites and cubesats. This is pretty amazing stuff considering it was less than $30 shipped.

Using the Windows software was the easiest way to get this SDR to tick.

Many RTL-SDR offerings come as a kit which contains the RTL-SDR dongle, a small antenna and coax cable, and a TV remote control. You will need to use an external antenna for best results (see text). The remote control is not used in this application of the Dongle.

Installation instructions to use Windows and the DVB dongle are posted on the Ham Radio Science Blog:

http://www.networkedblogs.com/zGkVF

With the recent record number of cubesat launches most amateur radio enthusiasts been busy, myself included. There hasn't been a better time to get into receiving these satellites. With the inexpensive hardware, free software, a ton of information and an active community it is easy and quite a thrill to get into this hobby.

I will focus on one satellite and one method of receiving and decoding in this article. There are so many ways to do this but I think this method is the least expensive and provides really good results.

You will need:

1. RTL-SDR Dongle – E4000 or R820T model (I prefer the R820T model and they are the easiest to find now)

   http://www.amazon.com/RTL-SDR-RTL2832U-Popular-Software-Packages/dp/B00C37AZXK/ref=sr_1_1

2. SO-239 pigtail adapter for the dongle - This is great if you don't want to cut and solder on a connector like I did!

   http://www.amazon.com/coaxial-cable-SO239-female-connector/dp/B00C20FV78

3. Zadig drivers - For the RTL-SDR USB

   http://zadig.akeo.ie/

4. RTL-SDR libraries for SDR-Radio.com V2 software – Choose SDR-Radio.com.RTLUSB-20130209.zip

   http://www.aa5sh.com/?page_id=65

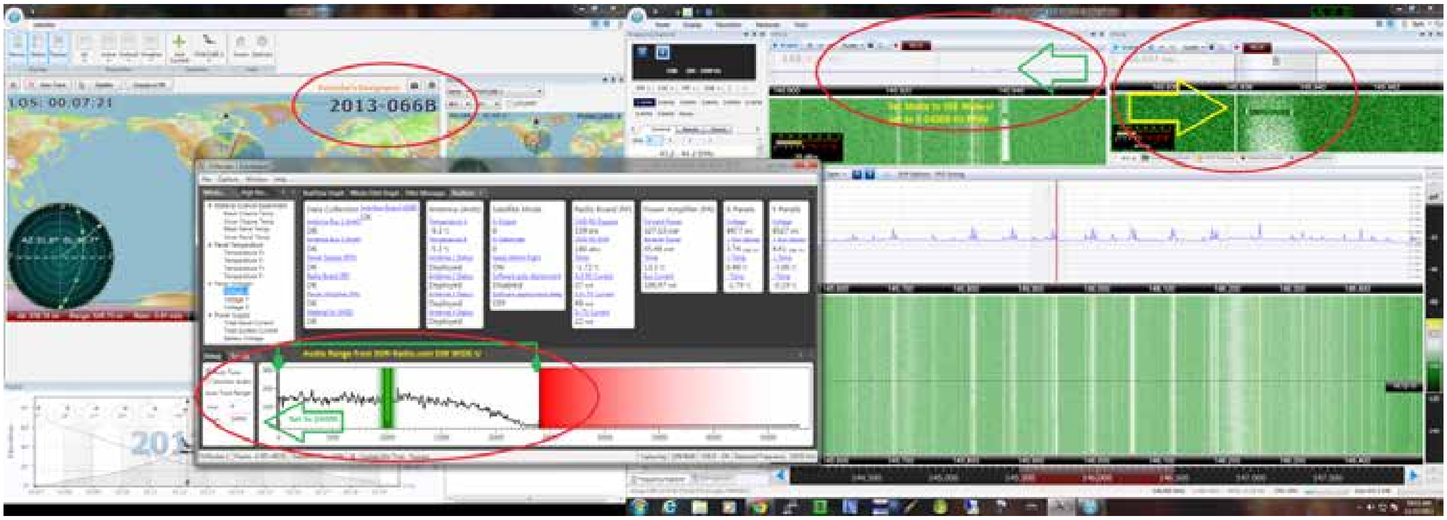
5. SDR-Radio.com V2 software available from:

   http://v2.sdr-radio.com/Download.aspx

   I used the November 15th, 2013. Version 2.1 build 1571.

6. Good receiving antenna – 2 meter Yagi, quadrifilar helicoidal (QFH), ground plane, etc. See some examples at:

- **http://nt1k.com/blog/2012/homebrew-5-element-vhf-yagi/**
- **The Cheap Yagi at: http://www.wa5vjb.com**
- **http://jcoppens.com/ant/qfh/index.en.php**
- **http://www.eham.net/articles/7005**



The tracking software, SDR-Radio software, and the FUNcube dashboard shown operating together with the RTL-SDR Dongle.

1. VB-Cable Driver – Virtual Audio cable (Center Column) available at:

   http://vb-audio.pagesperso-orange.fr/Cable/

   Please Donate if you use it. As a bonus once you donate you get to download A and B Channels. I am glad I did - the extra channels are nice to have!

2. FUNcube Dashboard software from:

   http://funcube.org.uk/working-documents/funcube-telemetry-dashboard/

3. Time to put it all together!

The total cost, depending on what antenna you have or choose to build, can be as low as $11. A minimum investment is required to receive and decode the FUNcube telemetry. This is fantastic for everyone, especially those on a budget who would like to experience this hobby first-hand. If there are any educators reading this, please take the time to show your students how much fun this can be. After all, it is part of the FUNcube mission!

I must say this as well: if you can afford to buy a Funcube dongle, please do! It has better performance than the RTL-SDR and the money goes back to funding the FUNcube initiatives, like the FUNcube satellites. For further information see:

http://www.funcubedongle.com/

I won't go into detail on each and every installation. For further instructions, please read these pages at this URL:

http://www.networkedblogs.com/zGkVF

Installing the Software and Drivers

1. Install SDR-Radio.com V2 Beta available from:

   http://v2.sdr-radio.com/Download.aspx

2. Plug RTL-SDR USB dongle into computer.
3. Install ZaDig Drivers – Note: You may need to click *Options* and then *List All Devices*. Select *Bulk-in, (Interface 0),* then click the *Replace Driver* button.
4. Extract and copy the three RTL-SDR DLL's for SDR-Radio.com V2. Note**:** Overwrite existing files in the SDR-Radio.com's directory and use the correct architecture!
5. Install VB-Cable Virtual Audio interface
6. Install the Funcube Dashboard

Configuring SDR-Radio.com V2 Software

1. Launch *SDRConsole (V2).*
2. On the home tab click the *Select* button from the *Radio Group.*
3. Click *Definitions.*
4. Click *Search* and select the *RTL SDR (USB)* option. If that option does not exist, please check to make sure you copied the correct DLL's into the SDR-Radio.com program folder
5. Click *Yes* on the *1 Entry Found* alert and Click *OK.*
6. Highlight the new entry (ezcap USB2.0 DVB-T/DAB/FM dongle)
7. Click *Start.*
8. Tune into a known frequency like the National Weather Service. This is required to adjust the PPM.
9. On the *Home* tab again, click the *Radio Configuration* button
10. Click the + or – buttons to adjust the PPM. For example, one of my dongles is +82 and the other is -133, so they vary widely.
11. Click the more options selection and click the *Internal AGC* box. (You can experiment with this. Mine worked better with it on)
12. Select the frequency to 145.927 MHz and set the mode to *SSB Data-U* OR *Wide-U*, it doesn't seem to matter.
13. Drag the bandwidth bar out to 24000 Hz to get full coverage. Note: This is required so that you don't have to track the satellite because of the Doppler effect - FUNcube will always be in the bandwidth coverage. The FUNcube Dashboard will autotune on the transmission (see screenshots).
14. On the *VFO-A* box click the *Audio* dropdown located next to the little audio speaker.
15. Click the *Playback* device and select *VB-Cable* for the output. It took me a while to find this one!!!
16. For satellite data, you can use whatever you are used to, but the SDR-Radio's

works great. The satellite designation is AO-73 in the two-line element sets (TLE).

Configuring the FUNcube Dashboard

Note: Be sure to register at the FUNcube Data Warehouse to be able to submit your decoded packets automatically. The URL is:

http://warehouse.funcube.org.uk/

If you only want to decode and not send, you can still use the software with making a contribution. The more contributors the better though!

1. Click *File*; then *Settings.*
2. Select the *Audio* tab and select the Input Device as the *Cable Output VB-Audio.*
3. Click the *Warehouse* tab and fill in your *Site ID* and *Auth Code* and click the *Stream data to warehouse* and click *Save.*
4. Click *Capture* from the menu and select *Capture from Soundcard.*
5. On the tuning panel change the *High Value* to 24000 and make sure the *Auto Tune* check box is checked.
6. You should see a sudden drop off in the tuning window around 24000 Hz (see screenshots).

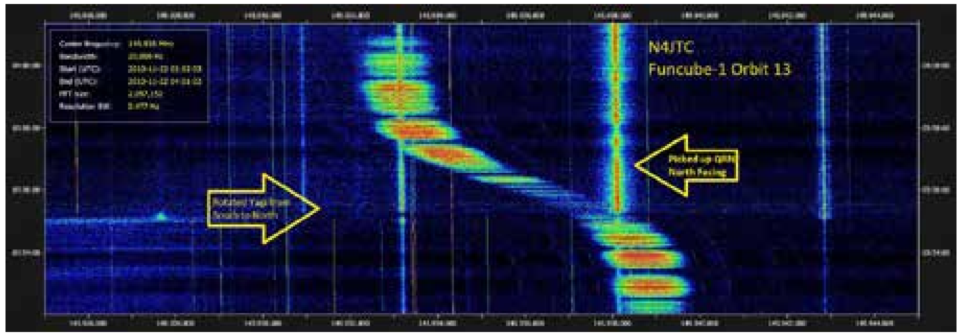
Final Thoughts

This should get you started on receiving and sending the telemetry back to the FUNcube Data Warehouse. There are other great options out there like *Analog receive to Soundcard*, FUNcube dongle but, to get started, this seems to be the most inexpensive one. Now that you have your station setup for the FUNcube, you can go chase other satellites as well! There are other folks doing much more that I am and have great resources available. Please visit the links sections for more information.

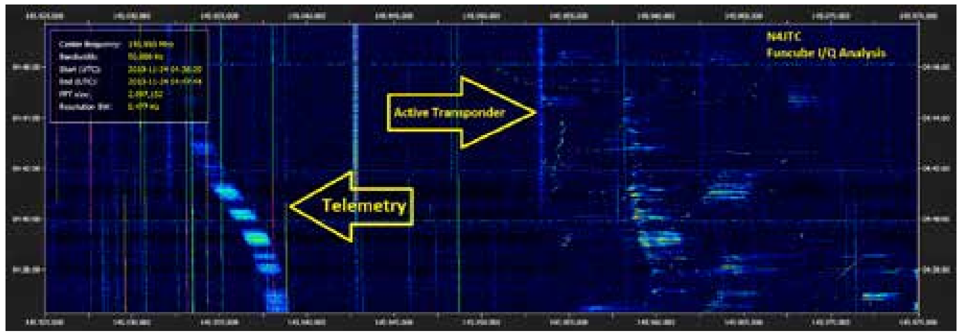
I hope this helps you get started and most importantly have fun!

Linux installations for the **RTL2832** are documented at:

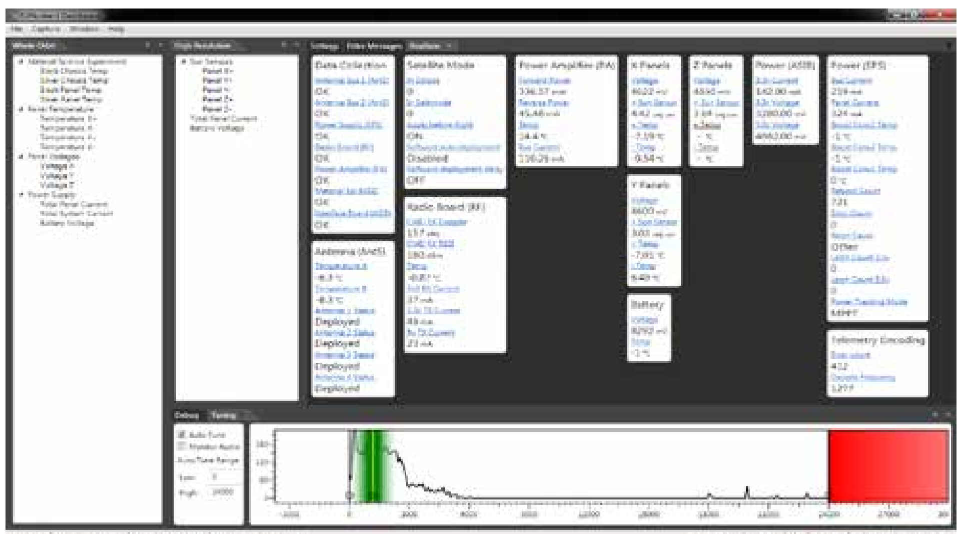
http://www.ab9il.net/software-defined-radio/rtl2832-sdr.html



FUNcube Doppler shift



FUNcube AO-73 with active transponder. The 32.5 MB I/Q for this is available at: http://www.solargap.com/downloads/N4JTC-funcube-24-Nov-2013-0436UTC_North_America_pass.zip - Note: This file only works with the SDR-Radio.com software. If you try to use SDR# or other program, it most likely will not work.



The FUNcube Dashboard software shows realtime decoded telemetry and also sends your received data to the FUNcube Data Warehouse.

(right) The FUNcube Data Warehouse shows the received data from contributing stations worldwide. See:

http://warehouse.funcube.org.uk/

LVB Tracker Box

- Reasonably priced and all profits go to AMSAT
- Serial interface standard
- USB interface may be easily added by user
- Open software
- Open architecture
- Built-in rotor interface cable with DIN connector
- Power supplied via the rotor controller cable
- Bi-directional interface allows the unit to read the rotor position
- LCD position readout
- Front panel manual control
- Self-programmable, allows for easy software upgrades
- Supported by the major tracking programs
- Uses GS-232A or Easycomm I/II protocols

Contact Martha at the AMSAT office 301-822-4376 to order.

The complete units will be built in groups, so get your orders in early. Units will be shipped as they become available.

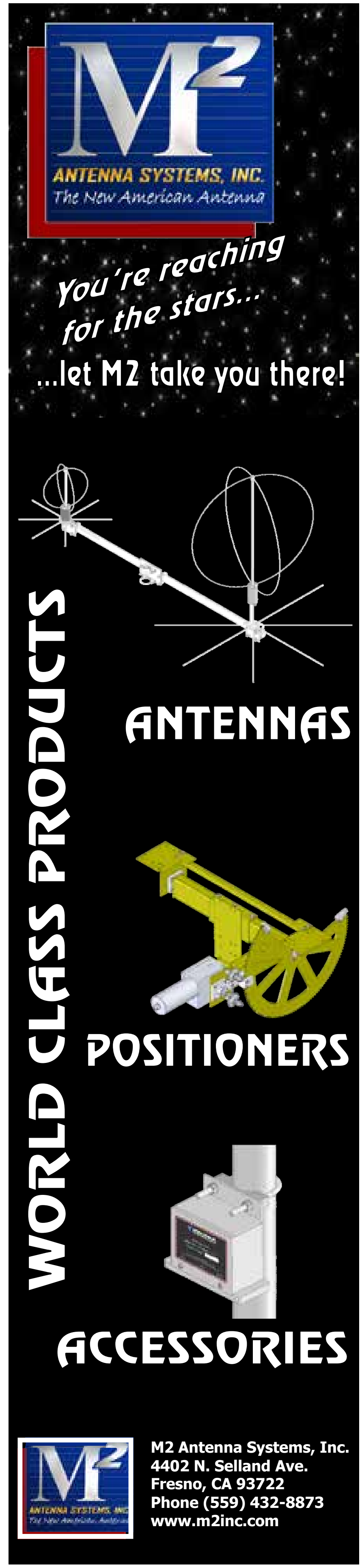
Minimum donations requested for various configurations:

1) Bare board - $20 + S&H – no parts kits available
2) Custom Enclosure powder coat, silk-screened, drilled/punched - $50 + S&H
3) Complete unit - board, serial output, rotor cable, LCD, enclosure - $200 + S&H **our most popular

Documentation for the LVB Tracker can be found at: http://www.LVBTracker.com

Boards and complete units may be ordered from the AMSAT office at 301-822-4376 or from martha@amsat.org

Visit the AMSAT On-Line Store for details on the updated LVB Tracker Box: http://store.amsat.org/catalog



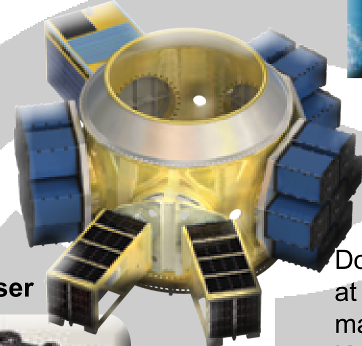
AMSAT Fox-1C $125,000 Launch Initiative Goal ... Your Help is Needed!

AMSAT is excited to announce a launch opportunity for the Fox-1C Cubesat. AMSAT has teamed with Spaceflight for integration and launch utilizing Spaceflight's SHERPA system to a sun-synchronous orbit in the third quarter of 2015.

Fox-1C is the third of four Fox-1 series satellites under development, with Fox-1A and RadFXsat/Fox-1B launching through the NASA ELaNa program. Fox-1C will carry an FM repeater system for amateur radio use by radio hams and listeners worldwide. Further details on the satellite and launch will be made available as soon as released.

AMSAT has an immediate need to raise funds to cover both the launch contract and additional materials for construction and testing for Fox-1C. We have set a fundraising goal of $125,000 to cover these expenses over the next 12 months, and allow us to continue to keep amateur radio in space.

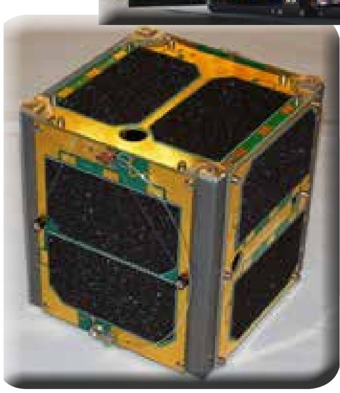
Spaceflight's SHERPA System



Spaceflight's SHERPA will deploy multiple cubesat payloads on-orbit

ISIS QuadPack Nanosatellite Dispenser

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-1C 1U Cubesat launched on the Spaceflight's initial SHERPA flight in 3Q 2015.

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-1C ... Join Now!

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
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South Texas Balloon Launch Team BLT-41 Flight

Andy MacAllister W5ACM
w5acm@amsat.org

The South Texas Balloon Launch Team launched their latest flight to the edge of space on Saturday, August 9, 2014 from the Wharton Regional Airport which the team has renamed as Wharton Intergalactic Spaceport.

The team has been flying curious, experimental, amateur-radio payloads to the Edge of Space, since BLT-1 on December 8, 1992.

The BLT-41 payload included a crossband FM repeater, a real-time flight video downlink. 144.390 MHz APRS as W5ACM-9, an audio locator beeper, and an onboard still camera programmed to snap a photo once every 15 seconds. Stations all over Texas made flawless, full-quieting contacts via BLT-41 crossband repeater.

The chase team reported following a ground track of over 50 miles, almost directly due west.

The team says there is already talk of how to send digital, high-definition ATV to the edge of space on a future flight.

Kirk, KK2Z coordinated the flight with the FAA before, during, and after the flight. Tom, K5SAF located and procured a full tank of helium. Walter, K5WH worked out details for on-site streaming video. Payload Coordinator Mike, WA5TWT ensured that all payloads were ready for launch. Bill, WA5VQH, Darrell, KC5JAR and Teresa, W5MOM, got BLT-41 into the sky.

Mike Scarcella, WA5TWT, prepares the electronics for the BLT-41 mission.

The Texas coastline as seen from near apogee around 110,000 feet.

Mark Spencer, WA8SME (mspencer@arrl.org)
ARRL Education and Technology Program

I have been engaged in collecting and utilizing FUNCube telemetry with the intention of including this resource as part of the ARRL Teachers Institute-2 Space curriculum. As part of this process, I investigated the minimum station requirements to receive usable data from the satellite. In evaluating various antennas, I used the minimalist preamp that has been previously detailed in the November/December 2012 issue of *The AMSAT Journal*. The bottom line of my evaluation was that an antenna-mounted preamp dramatically improves the probability of receiving FUNcube telemetry with the required quality to produce usable data…not a particularly novel conclusion. While this was going on, I received an e-mail notification from Analog Devices of a new ADL5545, 30 MHz to 6 GHz RF/IF Gain Block, integrated circuit. This device piqued my interested and I thought it might be an opportunity to revisit the minimalist preamp.

The ADL5545 has an advertised gain of 24 dB, draws 54 mA of current at 5 volts, and is matched to 50 ohms on the input and output of the device. Though it only comes in a surface mount package, the device is small enough to be a challenge for surface mount devices (SMD) novice builders. But, it is large enough that you have a chance of working with it if you have a magnifying lens and an almost stead hand (I am speaking from experience). The supporting circuitry for the device is straightforward and is detailed in the ADL5545 documentation.

So how does it perform?

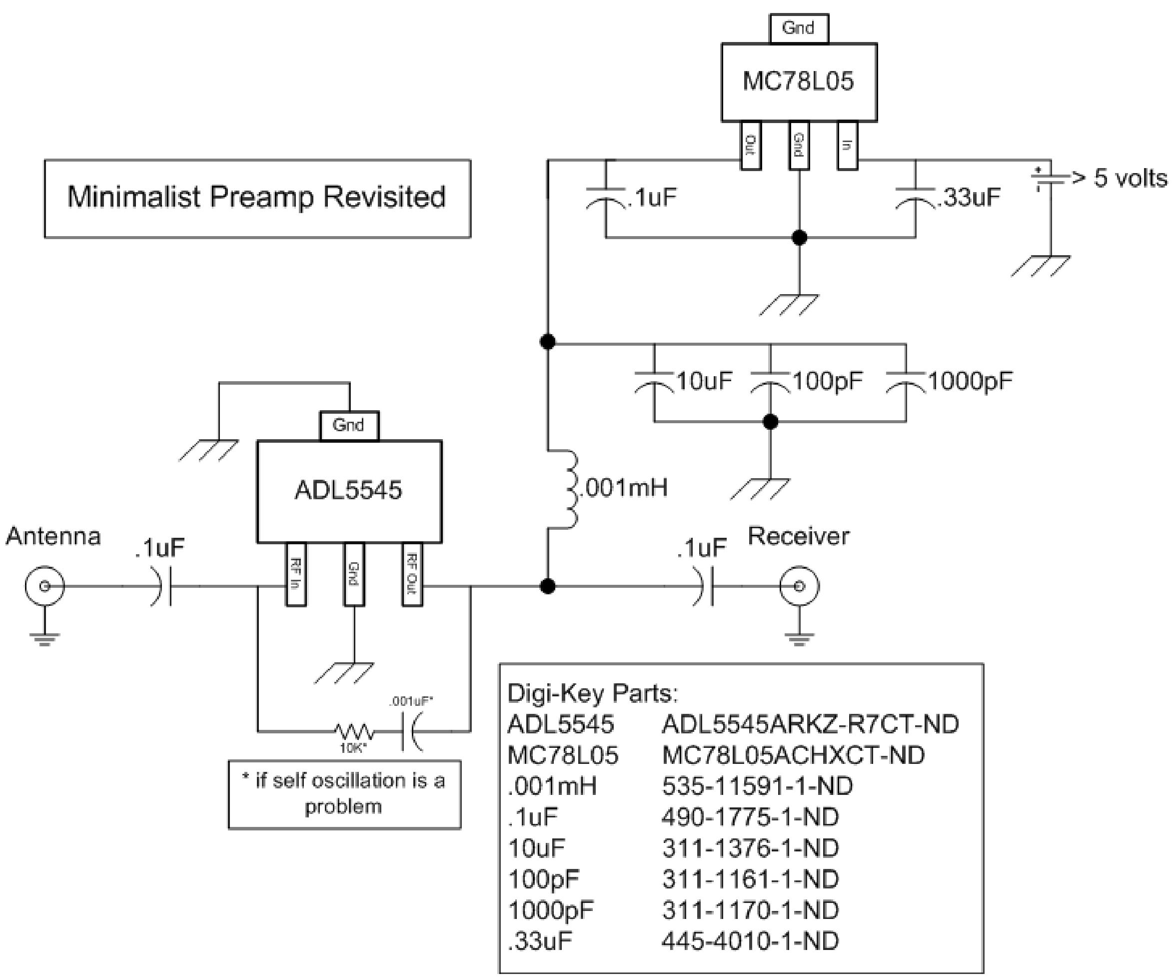
I don't have professional test equipment, so my evaluation of performance should be considered anecdotal. The revisited preamp seemed to perform a little better in a side-by-side comparison with the original minimalist preamp. I measured the gain over the air using constant strength signal sources, at 23 dB near 2-meters, and 30 dB near the 70-cm band. There is probably a significant noise figure, so a preamp made with this device would be disappointing for weak signal work, but for improving satellite signal reception, I think you will find the revisited preamp performance worth the effort. I didn't detect an objectionable background noise figure, but I could tell the preamp was in line.

Editor's Note: Two versions of the Broadband Preamp are available in the AMSAT Store:

- Original Broadband Satellite RX Preamp
- Broadband Satellite RX Preamp with Antenna Polarization Switch

Visit the AMSAT Store:

http://store.amsat.org/catalog/



Circuit diagram of the minimalist preamp - Revisted

From AMSAT's History Archive - November 15 is AO-7 + 40 Years

Thanks to the efforts of many volunteers AMSAT has been able to preserve our publications from 1969 through 2013 on a DVD disk. Les Rayburn, N1LF collected, scanned, and electronically archived the documents first stored in Phil Karn, KA9Q's archive to also include PDF copies of the AMSAT Journal since the first issue. See:

http://www.ka9q.net/newsletters.html

The DVD contains the AMSAT Newsletters, *Orbit* Magazine, *Satellite Report*, and the *AMSAT Journal.* Introduced at the 2014 AMSAT Symposium in Baltimore, watch the AMSAT on-line store for availability.

Re-live the excitement 40 years ago when AO-7 was launched on November 15, 1974. This article is from the AMSAT Archives, AMSAT-Newsletter published in December, 1974.

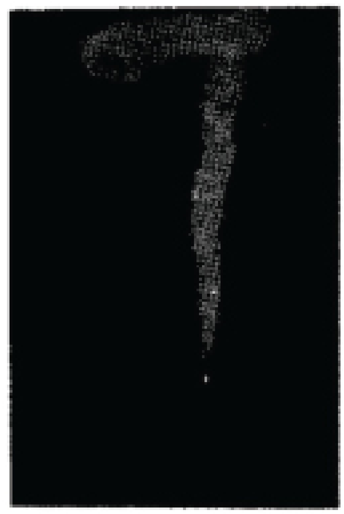
SEVENTH AMATEUR SPACECRAFT IN ORBIT

OSCAR 7 LAUNCHED

by Joe Kasser, G3ZCZ/W3

November 15, 1974, was a special day for Perry Klein, K3JTE, the president of AMSAT, the Radio Amateur Satellite Corporation, for not only was it the day on which the AMSAT-OSCAR 7 spacecraft was launched, it was his birthday.

To cover the launch, two telephone circuits and a number of short wave radio frequencies were employed. The Spacecraft command station conference circuit linked VK3ZDH in Australia, VE3QB in Ottawa, VE2BYG in Bagotville, with K3JTE and W3GEY at the Goddard Spaceflight Center in Maryland. The Net conference circuit linked W3ZM (operated at W3KMV), the AMSAT net control station, W1AW, the American Radio Relay League net station, WA3NAN, the club station at the Goddard Spaceflight Center, W6AB the club station at the Western Test Range and WA4DGU at the Goddard Spaceflight Center. W6AB, W3ZM and WA3NAN between them, transmitted the launch proceedings on the 15, 20, 40, and 75 Meter Bands, while on 20 Meters, WA4JID relayed W3ZM towards Europe.



The condensation trail of the launch vehicle is shaped by the wind. (photo by K6PGX)

In the Washington, D.C. area, where AMSAT has its headquarters, the proceedings were also transmitted on the 2 Meter repeater maintained by AMSAT. This link was used as an intercom circuit and a special receiver was set up by WA3JDY (now W4ART) so that some FCC officials could listen in to the launch proceedings. Unfortunately, a tube failed in the W3ZM two meter transmitter and all that the FCC officials heard was an apparently unmodulated repeater carrier. When this was discovered, WA3NAN took over the 2 Meter relay and all the remaining activity was available in the D.C. area.

At 1711 GMT the voice of Dick Daniels (WA4DGU) echoed around the world, "5, 4, 3, 2, 1, 0 . . . we have lift off!" and AMSAT-OSCAR 7 was off. Up, up and away flew the Delta rocket carrying AMSAT-OSCAR 7, the NOAA 4 weather satellite and the Spanish INTASAT.

The first spacecraft to be separated from the rocket was the NOAA 4 weather satellite, then came the turn of AMSAT-OSCAR 7. Separation was confirmed, and all frequencies became silent as everyone waited for confirmation of telemetry reception.

Within a minute of separation G3IOR who was in contact with W3ZM on 20 Meters, reported that he was receiving telemetry from the 435.1 MHz beacon. GB2SM then confirmed reception of signals from AMSAT-OSCAR 7. Conditions on 20 Meters were not very good and so DJ3OS, DL9GU, and DJ8IM telephoned in to the AMSAT phone operated by W3ASK, with telemetry information. Minutes later DK2ZF telephoned in a complete telemetry frame, reporting that he had first acquired signals from the spacecraft at 1828:46 GMT. His telemetry data were,

183	175	195	199	244	201	201	270	300	370	344	351		
455	450	456	456	544	501	548	550	602	655	602	651	HI.	HI.

showing that all values were nominal and the spacecraft was performing as anticipated. The first report of reception from North America came from K7RBO who reported receiving signals at 1846:37 GMT.

(Continued on Page 7)

3

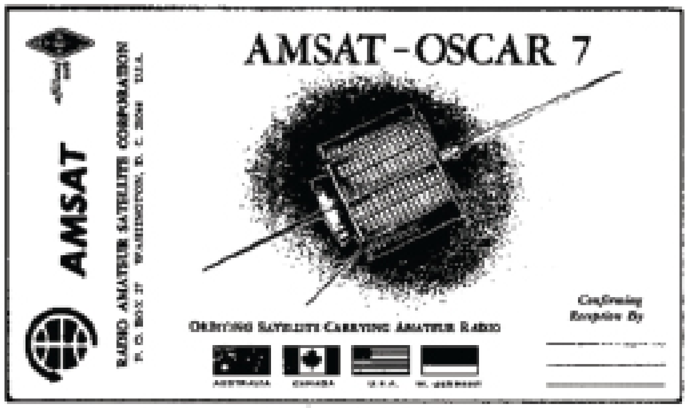
however, the count should vary about a mean value. The clock should increment approximately one count every 15 minutes, since there are 96 fifteen-minute intervals per day.

Repeater Test Points - Channels MC-5B, TT-54, 55, 56, 57, and 59. Test points are provided from both repeaters which monitor critical performance parameters. Some, such as the oscillator test points, will indicate a constant value whenever the 70cm-to-2m repeater is on, while others, such as the two-to-ten meter repeater P.A. emitter current, or the modulator output or envelope level of the 70cm-to-2m repeater, will indicate accurately the user activity on the active repeater.

Calibration Channels - Channels MC-6D, TT-18 and 40. A precision, temperature compensated, voltage reference is generated by the instrumentation switching regulator and is provided as the reference voltage for the thermistors as well as the calibration input to both telemetry encoders. The value of this reference is 0.497V and should be accurate to within ±0.001 volts. An additional channel is used on the teletype telemetry encoder to verify the zero point of the dual slope integrator utilized as part of the analog-to-digital converter.

AMSAT-OSCAR 7 QSL CARDS

This beautiful multicolored QSL card is available from AMSAT in return for your reception report of the AMSAT-OSCAR 7 satellite. The cards were donated by K3ZJU and the Messe Envelope Company of Dallas, Texas.



(Continued from Page 3)

A special RTTY Link took place on the 20 Meter band between K3IVO and PAØAA. The amateurs at PAØAA, the club station of VERON, the Netherland Amateur Radio Soci-Club, had built a special computer that would receive the telemetry from the spacecraft which was being transmitted in Morse code, automatically convert the Morse code to RTTY code and transmit it on the 20 Meter band. K3IVO monitored their transmissions and relayed the data on 2 Meters into the Washington area.

The Spanish built INTASAT was placed into orbit a few minutes after the separation of AMSAT-OSCAR 7.

AMSAT-OSCAR 7 is an international spacecraft in the true sense of the word for it was designed and built by amateurs in the USA, Canada, Germany and Australia. The design was coordinated by AMSAT and final assembly took place in the basement of Jan King, W3GEY.

7

Eyewitness Report - AMSAT at the ARRL Centennial Convention

E. Mike McCardel, KC8YLD
kc8yld@amsat.org

AMSAT's presence at the ARRL Convention in Hartford, Connecticut July 17-19 was the culmination of several months effort. AMSAT President Barry Baines, WD4ASW, committed to develop a Satellite Workshop in conjunction with the ARRL Centennial Convention Training Tracks, shortly after Labor Day 2013. To the best of anyone's knowledge it has over been over 10 years since such a work has been presented. The last known one was when Larry Brown, W7LB did a similar effort in 2001 for the Southwestern Division ARRL Convention in Riverside, California. At the time he was hoping to get upward of fifty people interested in attending. As we approached the deadline date we were informed that registration for the workshop had met its maximum number of allowable registrants at 100, the maximum occupancy for our assigned room.

AMSAT Satellite Training Track presenters posed at the completion of the Satellite Workshop (L-R) Joe Spier, K6WAO; Barry Baines, WD4ASW; Burns Fisher, W2BFJ; Patrick Stoddard, WD9EWK; Peter Portanova, W2JV; and E.Mike McCardel, KC8YLD.

Barry spent the autumn gathering a team of people to assist with the presentation and the team began meeting regularly in late winter in preparation for the workshop. The presentation team included AMSAT President Barry Baines, WD4ASW, Area Coordinator and Congressional Liaison Peter Portanova, W2JV, Fox-1 Software Team Co-Leader Burns Fisher, W2BFJ, Director of Field Operations Patrick Stoddard, WD9EWK, Director of Education Relations Joe Spier, K6WAO, and V.P. Educational Relations E. Mike McCardel, KC8YLD.

Adele Portanova, KD2CYL was pressed into service to watch over booth operations, provided significant "schlepping" expertise and served as unofficial "cat herder" over the entire team. Needless to say we needed her exceptional skills to pull off our involvement at the Convention.

Peter Portanova, W2JV; Adele Portanova, KD2CYL; and Barry Baines, WD4ASW, staff the table and are surrounded by interested hams.

The team met over dinner on Wednesday, the day before the convention, to go over plans one more time. Up early on Thursday, we set up and had everything in place and ready to go for training by its 8:30 AM starting time. In addition to materials used during the training, several posters depicting AMSAT history and Fox-1 were on display both during the training and at the AMSAT booth during the Convention. The League lent us their OSCAR 1 prototype which was set up to transmit its historic "HI" telemetry through a TS-790. Peter brought his model of AO-7 for display. Burns brought a full-scale model of Fox-1 as well as some prototype Fox-1 boards assembled into a working U/V transponder. We also demonstrated the WRAPS antenna rotor running with SATPC32. These items were big hits during training breaks and later at the display on the Convention floor.

Barry opened the training with a greeting and introduced the presentation team. He gave a history of AMSAT of amateur radio in space. Joe presented an in depth explanation of "Orbital Mechanics", including historical background. E. Mike concluded the morning session with Satellite Tracking and Tracking Software with an emphasis on SATPC32", including how tracking was done before the ready availability of computers using the Satelabe and Oscar Locator. The real meat of the program took place after lunch with the "Station Configuration and Satellite Operation" segment of the training. Peter presented on "Easy Sats, FM Birds". This was an entertaining presentation that outlined getting started. Patrick presented "CW and SSB Birds and Telemetry" advancing the class through more advanced techniques. Burns closed the official part of the training with "Overview of AMSAT's Fox-1 Satellite", whetting everyone's anticipation of what is to come. Each attendee received a copy of Gould Smith's "Getting Started in Amateur Satellites 2014". The cost of these were underwritten by the ARRL for which AMSAT greatly appreciates their support.

The training session was scheduled to end at 4:30 PM so the team stuck to their rigorous schedule to complete the presentation early to allow time for the group to reconvene outside the convention center for a working demonstration of an AO-7 contact. Patrick was able to connect with AO-7 with an audience of 70 or so people in attendance. He was able to work stations from coast to (almost) coast. Patrick and Peter continued doing demonstrations and making contacts throughout the weekend.

An unexpected treat happened on Saturday morning. Patrick had planned on being outside the convention center for ISS passes, prepared to show off the ISS digipeater, and, if a voice was heard on 145.800 MHz, to talk to an ISS crewmember. The first of the three workable passes from Hartford came a little while before the convention officially opened for the day at 0835 local/1235 UTC. The ISS was passing across the northern sky, with maximum elevation of 25 degrees.

In Patrick's words, "I heard only packet on 145.825 MHz, and was able to bounce a few packets through the ISS digipeater using a TH-D72A and Elk dual-band log periodic antenna.

Recently published in *QST* and the *AMSAT Journal*, the WRAPS Rotor demonstration running with SatPC32 generated a lot of interest.

Peter, W2JV brought along his scale models of AO-7 and AO-51. The OSCAR 1 prototype was set up to transmit its historic "HI" telemetry through a TS-790. The Fox-1 model featured a working U/V transponder.

There is no doubt that similar impressions were made throughout the weekend. One of our most telling comments came in the form of an email addressed to the AMSAT Board of Directors:

From: Jason Tetlow <jason.tetlow@xxxxx.com>
Telephone:
Subject: ARRL Centennial Convention

Message Body:
To whom it may concern,

I was in attendance at the convention on Saturday 19 July. With me I had my three and a half year old son, and out of everything that stuck in his mind the one thing he continually asked me about after we left was "sat-lites". We visited the AMSAT booth, and a gentleman that was staffing the booth allowed Issy to actually hold one of the satellites, and even took a photo of him posing with it.

I just wanted to take a moment and say thank you, as that's something that's left a pronounced impression of the wonders of science in my child's mind.

Best regards,
Jason Tetlow

"The next pass, around 1010 local/1410 UTC, was the best of the passes for the morning - going across the southwestern sky with maximum elevation of 59 degrees. I had a radio listening to both 145.800 and 145.825 MHz. I heard nothing on 145.825 MHz, but thought I heard something on 145.800 MHz."

"I started calling for NA1SS using my TH-D72A/Elk combination, and Reid Wiseman (the same astronaut who was on for Field Day in June) answered my call. My audience went crazy, and I was happy to make contact and have a nice 3- to 4 minute chat. I asked Reid if he might be on the microphone for the next pass over the eastern USA around 1200 local/1600 UTC. He said he would try, and we were outside for that as well."

Once word of the successful contact traveled through the convention hall, the ARRL made sure there was a larger crowd outside for this pass. Several minutes before AOS, I was out there again, this time answering lots of questions from different people. After AOS, I started calling for NA1SS, but never heard anything on 145.800 MHz during the shallow (maximum elevation 6 degrees) pass.

After the training the presenters immediately tore down the displays and began to set up our booth on the convention floor, then broke for supper and some needed rest. The booth was well attended. We received many kudos on the displays and the team had an opportunity to answer a myriad of questions, sell AMSAT paraphernalia, Arrow Antennas and most importantly memberships. A number of students stopped by and spent time in the booth. Joe was a master at greeting youth and made sure every child who stopped by got his or her picture taken while holding the model of Fox-1.

While at the convention, the team of presenters took the opportunity to drop in on several of the forums and took the time to visit and relate to a number of people to tell and sell the AMSAT story. In the author's opinion, the biggest moment of the weekend took place at the Forum Friday afternoon. The room was jammed with people interested in learning about amateur radio satellite AMSAT. Barry briefed the attendees on what was happening at AMSAT. Patrick filled the role for Drew Glasbrenner to present an updated "Satellites on the Horizon" that Drew presented at Dayton. The big highlight came when Barry flipped to a slide titled, "One more thing..." This is when he announced that AMSAT had signed a letter of agreement with Spaceflight, Inc. to fly our Fox-1C cubesat in the 3rd quarter of 2015 as part of their "SHERPA" system.

Unfortunately we were not allowed to record any of our activities within the Convention Hall. However, powerpoint slides of all the Training Track presentation can be found at:

http://www.amsat.org/?page_id=2914

Outdoor recording during the ARRL Centennial Convention was allowed so Patrick was able to record the satellite demonstrations done outside the convention center on Thursday, July 17. These can be viewed on the web by following these links:

https://www.youtube.com/watch?v=G5TjXbuLv5s

Video of Patrick's AO-7 contact, recorded by Bill Chellis, KB1ROP, can be seen at:

https://www.youtube.com/watch?v=BnhUAkRjp4E

This video shows an example of AO-7's recent behavior, where it will switch from mode B to mode A during a pass. Unfortunately, this switch took place around the time AO-7 was directly over Hartford.

https://www.youtube.com/watch?v=BHd91H_t88o

Patrick's audio of his short contact with NA1SS with an added photo slideshow can be viewed at:

https://www.youtube.com/watch?v=yoFbhPXsUx0

I would like to thank the Convention team for all their hard work and effort preparing for and taking care of business at the Convention. In addition they each contributed content to making this article possible.

(ab0ve) At the conclusion of the Satellite Workshop, Patrick gave a demonstration working AO-7 from outside the convention center. Shown here is Patrick holding the Elk antenna. Peter Portanova, W2JV (to the left of Patrick) assisted with the demonstration.

(right) Patrick making contact with astronaut Reid Wiseman, KF5LKT, via NA1SS aboard the International Space Station (photo by Ben Garelick, KC2ULR).

Ms. Elizabeth Tracey from Orilla, Ontario, Canada

Youth Group from Tyngsboro, MA. With the FOX full scale model, WRAPS rotor, and the AO-7 model.

Adele, KD2CYL helps "dust off" Oscar-1 before returning it to the ARRL.

Space News Via ARRL - ARLS005 Amateur Radio Transponder Will Accompany Japanese Asteroid Mission into Deep Space

According to a news report, the Japan Aerospace Exploration Agency (JAXA) Hayabusa 2 asteroid mission, now scheduled to launch in December, will carry the Abyss 2 (Shin'en 2) Amateur Radio satellite.

A 17 kg, 50 cm diameter polyhedron, Shin'en 2, built by students at Kyushu Institute of Technology, makes extensive use of carbon-fiber reinforced plastic materials that can be bonded by heat to reduce its weight and the number of hardware fasteners. In addition to a Mode J linear transponder for Amateur Radio communication, Shin'en 2 will include CW and WSJT beacons. The inclusion of the transponder will offer an opportunity for earthbound radio amateurs to test the limits of their communication capabilities.

"For confirming the operational status of the spacecraft in deep space, the know-how of the Moon-reflecting communication technology can be applied. By using an Amateur Radio service transponder, amateur stations can communicate with each other when the spacecraft is in near-Moon orbit," a project outline on the Shin'en 2 website explains. "Beyond this distance, signal detection by Morse code and telemetry data transmitted from the spacecraft will be performed."

The project is expected to help pave the way for future lunar rover missions. The outline is on the web at:

http://kit-okuyama-lab.com/en/sinen2/sinen2-outline/

Hayabusa 2 will make a round trip to the C-type asteroid 1999 JU3, arriving at the asteroid in mid-2018. It then would survey and take samples of the asteroid before departing in December 2019, and return to Earth in December 2020.

Shin'en 2 will be placed into an elliptical orbit around the Sun and travel into a deep space between Venus and Mars. Its inclination will be almost zero, which means Shin-En2 will stay in the Earth's equatorial plane. The distance from the Sun will be between 0.7 and 1.3 AU (an astronomical unit is 149,597,871 km).

IARU-coordinated frequencies for Shin'en 2	
Mode	Frequency
CW beacon	437.505 MHz
WSJT telemetry	437.385 MHz
Inverting SSB/CW transponder	
Uplink (LSB)	145.940-145.960 MHz
Downlink (USB)	435.280-435.260 MHz

The project also is hoping to gather listener reports.

The ARTSAT2:DESPATCH satellite will be on the same launch. The satellite, a joint project by students at Tama Art University and Tokyo University, will carry a 30 kg "deep space sculpture" developed using a 3D printer, as well as an Amateur Radio payload, a CW beacon in the 435 MHz band.

At its maximum operational distance, it will be some 3 million km (1.86 million miles) from Earth about a week after launch.

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

Here are opportunities to launch your amateur radio experience to new heights ...

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.

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's web presence needs a site content editor and authors for content development for technical articles and feature development.

To volunteer send an e-mail to Alan Biddle, WA4SCA at: wa4sca@amsat.org.

AMSAT Engineering Team Satellite Development

AMSAT's Engineering Team is looking for volunteers with a passion for electronic hardware and software development ...

- Analog circuit & power design
- RF circuit design
- Software development
- Electronic construction
- System integration
- Testing and debug
- Must have commitment to deliver on your part of the project.
- U.S. ITAR restrictions apply to many positions..

To volunteer send an e-mail describing your area of expertise to Jerry Buxton, N0JY at: n0jy@amsat.org. Jerry requests that you include your AMSAT member number and a phone number for him to contact you.

AMSAT Publications

AMSAT has immediate needs for volunteers to help with publications on the web, weekly bulletins, and printed materials.

- Join the AMSAT News Service (ANS) team as a weekly editor on a rotating basis.
- Be an assistant Editor for the AMSAT Journal magazine developing and publishing print articles on amateur radio in space.
- Graphics and photo editor

To volunteer send an e-mail to JoAnne Maenpaa, K9JKM at: k9jkm@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 E. Mike McCardel, KC8YLD at: kc8yld@amsat.org.

AMSAT Field Operations

AMSAT's Field Operations Team is looking for satellite operators to promote amateur radio in space with hands-on demonstrations and presentations.

- Promote AMSAT at hamfests
- Setup and operate satellite demonstrations at hamfests.
- Provide presentations at club meetings.
- Show amateur radio in space at Dayton, Pacificon, Orlando Hamcation.

To volunteer send an e-mail to Patrick Stoddard, WD9EWK at: wd9ewk@amsat.org

You can find more information on the web ...
www.amsat.org ... click AMSAT ... then click Volunteer