

Amateur Satellite

AMSAT and an Introduction to Operation

Holland Amateur Radio Club

August 14, 2018

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About AMSAT

The Radio Amateur Satellite Corporation, or AMSAT, is a worldwide group of Amateur Radio Operators (Hams). It was formed in the District of Columbia in 1969 as an educational organization.

For over 48 years AMSAT groups in North America and elsewhere have played a key role in significantly advancing the state of the art in space science, space education, and space technology. The work now being done by AMSAT volunteers throughout the world will continue to have far-reaching, positive effects on the future of both Amateur Radio, as well as other governmental, scientific and commercial activities in the final frontier.

AMSAT Mission

AMSAT's goal is to foster Amateur Radio's participation in space research and communication. The Organization was founded to continue the efforts, begun in 1961, by Project OSCAR, a west coast USA-based group which built and launched the very first Amateur Radio satellite, OSCAR, on December 12, 1961, barely four years after the launch of Russia's first Sputnik.

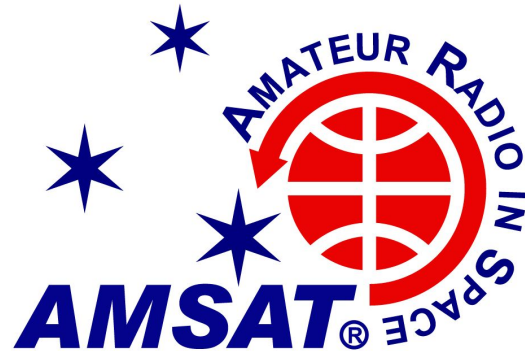
Today, the "home-brew" flavor of these early Amateur Radio satellites lives on, as most of the hardware and software now flying on even the most advanced AMSAT satellites is still largely the product of volunteer effort and donated resources. Though we are fond of traditions our designs and technology continue to push the outside of the envelope. [ie. Jerry Buxton N0JY's "Fox Labs" in Granbury, TX]

Join AMSAT

Membership includes the AMSAT® Journal and discounts on purchases made through the AMSAT store. Membership also supports many AMSAT activities including:

- OSCAR satellite operations!
- Amateur Radio on the ISS!
- Hamfest forums!
- Technical achievement awards!
- Educational support!
- Beginner materials!
- Future satellites!

<https://www.amsat.org/join-amsat/>



Satellites

The first amateur radio satellite (OSCAR 1) was launched in 1961 and since then more than 90 amateur radio satellites have made it to space and were successfully operated. Unfortunately, many of those have since failed and are no longer useful.

Today we have 19 functioning amateur radio satellites (repeater/transponder) including: *UKube-1, FalconSat-3, AO-7, AO-92*, FO-29, XW-2A, XW-2B, XW-2C, XW-2D, XW-2F, CAS-4A, CAS-4B, SO-50*, AO-73, AO-85*, IO-86*, EO-88, AO-91*, NO-84.* *FM satellites.

There are also many telemetry only satellites that use amateur radio frequencies to send data back to earth that are currently operational; these do not provide 2-way communication, but can be fun and educational to track.

Satellites

Types of amateur satellites include:

- Linear Transponder (SSB/CW)
- FM Repeater
- Digital (Packet, BPSK, PSK31, DSTAR, etc..)

Satellite is *crossband*, meaning transmit (uplink; to satellite) and receive (downlink; from satellite) frequencies are on different bands, typically:

- Mode B (U/V): 70cm uplink, 2m downlink
- Mode J (V/U): 2m uplink, 70cm downlink

Satellite Frequency Allocations

2m 145.800-146.000 MHz

70cm 435.000-438.000 MHz

23cm 1260.000-1270.000 MHz (uplinks only)

Anyone with a Technician Class license is able to use the amateur satellites!

Note: avoid using these frequencies for other purposes (ie. simplex, Echolink node input/output, etc..) as they have been specifically set aside for satellite use. These frequencies may appear unused however, any transmission that the satellite can hear will be retransmitted likely resulting in QRM to satellite users.

The AMSAT Fox-1 Satellites (FM, *SSB/CW)

AO-85 (Fox-1A) was launched on a NASA ELaNa flight on October 8, 2015.

AO-91 (Fox-1B/RadFxSat) was launched aboard a Delta II on November 18, 2017

AO-92 (Fox-1D) was launched aboard Indian PSLV-C40 on
January 12, 2018

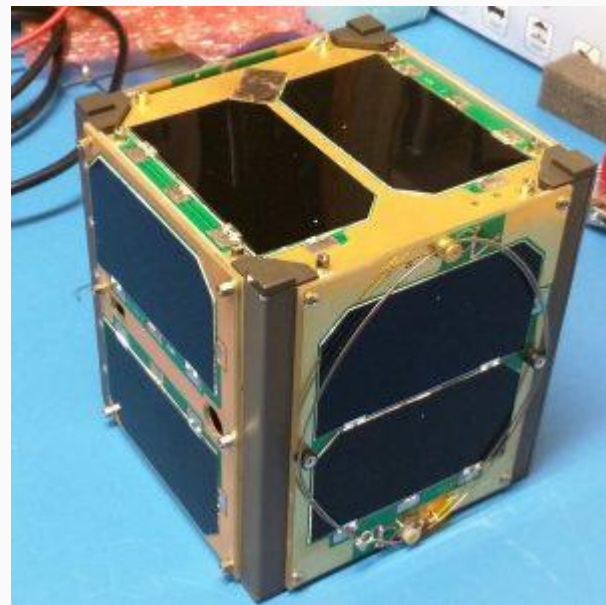
Fox-1C (Fox-1Cliff) date TBD (2018), planned launch via SpaceX
Falcon 9 from Vandenberg AFB

***Fox-1E (RadFxSat-2)** date TBD (2018), planned launch via Virgin
Galactic LauncherOne



Fox-1 [A,B,C,D] Satellite Overview

- 1u CubeSat 10x10x10cm (4in³)
 - Standardized Space Frame
 - Fixed Solar Panels
 - Deployable Antenna
- Low Earth Orbit (LEO)
 - Nominal 600- 800 km, circular, depending on launcher.
- Single channel FM transponder; Mode B (U/V)
- Fox-1C and D include L-Band “downshifter” Mode L/V
- 500 mW EIRP
- Experiments
 - Radiation/Gyroscope/Camera
- Data Under Voice (DUV) FSK telemetry



Fox-1 [A,B,C,D] Frequencies

	Uplink FM (67 Hz CTCSS)	Downlink FM	Comments
AO-85 (Fox-1A)	435.170 MHz	145.980 MHz	Operational
AO-91 (RadFxSat / Fox-1B)	435.250 MHz	145.960 MHz	Operational
AO-92 (Fox-1D)	435.350 MHz & 1267.359 MHz*	145.880 MHz	Operational
Fox-1Cliff	435.300 MHz & 1267.300 MHz*	145.920 MHz	Launch By End of 2018

* Switchable by command station. Not operational simultaneously.

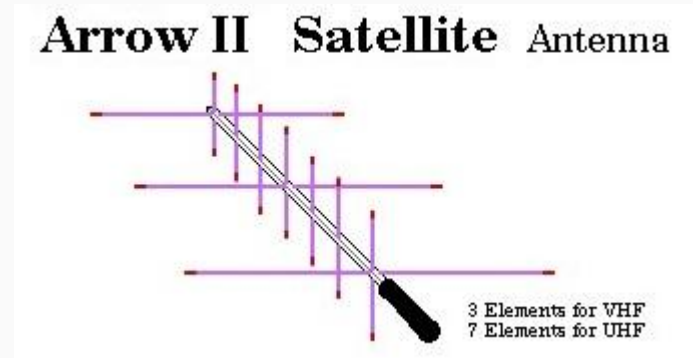
What Do I Need? Radio

- A dual band radio capable of TX/RX on 2m and 70cm
 - Capable of TX'ing 67.0Hz CTCSS
 - Memory to store satellite frequencies (5 memories per satellite)
- A full-duplex transceiver is recommended to permit RX while simultaneously TX'ing
 - *Alternately a 2nd radio can be used to accomplish full-duplex operation*
- Current Production Full-Duplex HT for Satellite Use
 - Kenwood TH-D72A
- Other Popular Radios
 - Yaesu FT-817/818 (use a pair for full-duplex)
 - Icom IC-910, IC-9100, IC-W32AT
 - Kenwood TS-2000/2000X, TH-D7A(g2.0)



What Do I Need? Antenna

- A Directional Antenna
 - Yagi or Log Periodic
 - Arrow Antenna 146/437-10
 - Elk Antennas 2M/440L5 Dual-Band Antenna
 - Build your own
 - WA5VJB Cheap Yagi
 - EA4CYQ ioIO Dual Band
 - CJU Variant (70cm only)
 - W6NBC Tape Measure Dual Band Beam



What Do I Need? Prediction/Tracking

- Satellite prediction/tracking software/apps
 - Windows
 - SatPC32*
 - Full Station Control--Radio & Rotators
 - Orbitron
 - Basic, Pass Prediction

- MacOS/OSX

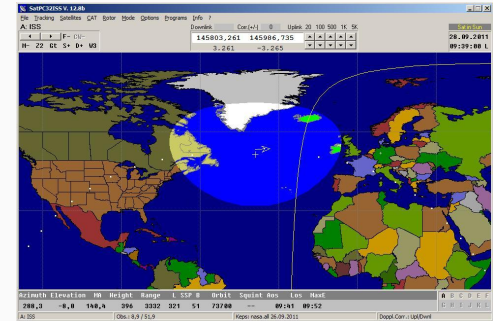
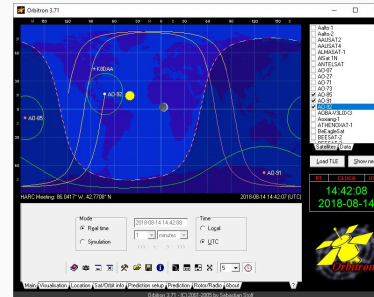
- MacDoppler*

- iPhone

- SatSat

- Android

- AmsatDroid FREE



*Available through AMSAT Store

Other Useful Items/Equipment

- CHIRP Radio Programming Software
- Headphones
- Digital Voice Recorder
- Compass (App)
- Diplexer (for Mode J V/U desense)
- Preamplifier
- Smartphone



A Basic QSO

- Listen first & during your transmission (full-duplex)
- Do not call CQ on FM satellites
- Exchanges will be short--callsign and grid square
- Wait for other stations to complete their QSO

Typical Exchange

- You hear KD8CAO
- Call KD8CAO by saying, “KD8CAO [this is] K8DAA EN62”
- You receive, “K8DAA [this is] KD8CAO EN62 QSL?”
- You say, “QSL K8DAA [73]”

Operating Hints

- Programmed radio memories make tuning for Doppler easier (5 per satellite)
 - +/-10kHz on 70cm, +/-3kHz on 2m
- Open the squelch--satellite is weak signal and typically will not break the squelch threshold
- Choose an operating position free from obstructions such as trees, buildings, etc. to provide maximum operating time (satellite is line-of-sight)
- For handheld antennas, twist/rotate the antenna to peak the received signal as you point antenna toward the satellite
 - Rotating the antenna 90 degrees when you transmit may help for Fox-1 satellites due to the satellite's antenna orientation.
- Use Digital Voice Recorder to Record the pass and log QSO's after the fact

Awards

AMSAT Awards:

- Satellite Communicators Club - First QSO
- Oscar Satellite Communications Achievement - 20 States/Provinces/Countries
- Oscar Sexagesimal - 60 States/Provinces/Countries
- Oscar Century - 100 States/Provinces/Countries
- South Africa AMSAT Satellite Communication Achievement - 25 unique station QSO's
- Robert W. Barbee Jr. (W4AMI) Satellite Operator Achievement - 1k, 2k, 3k, 4k and 5k QSO's
- Rover - 25 Points per Rules

ARRL Awards:

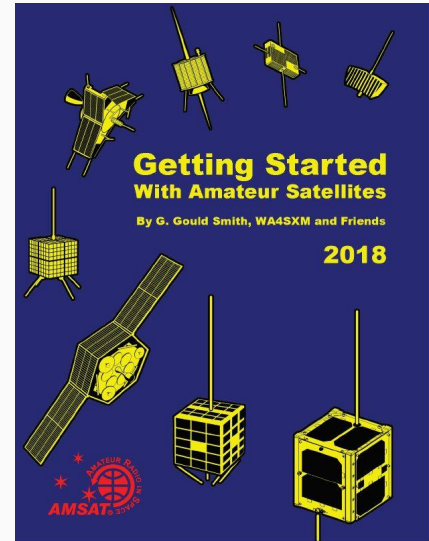
- VUCC - 100 Grids
- WAS - 50 States
- DXCC - 100 Countries

Recommended Reading

2018 Edition of Getting Started with Amateur Satellites

This definitive reference is written for the new satellite operator by Gould Smith, WA4SXM, but includes discussions for the experienced operator who wishes to review the features of amateur satellite communications. The new operator will be introduced to the basic concepts and terminology unique to this mode. Additionally, there are many practical tips and tricks to ensure making contacts, and to sound like an experienced satellite operator in the process.

<https://www.amsat.org/product/2018-edition-of-getting-started-with-amateur-satellites/>



Resources

AMSAT Links

- The Radio Amateur Satellite Corporation AMSAT <http://www.amsat.org/>
- AMSAT Store <https://www.amsat.org/shop/>
- Station and Operating Hints <https://www.amsat.org/station-and-operating-hints/>
 - Fox Operating Guide - AMSAT-NA
https://www.amsat.org/wordpress/wp-content/uploads/2018/04/FoxOperatingGuide_2018_Hi.pdf
 - Getting Ready For Fox-1D <https://www.amsat.org/getting-ready-for-fox-1d/>
 - FM Satellite Frequency Summary <https://www.amsat.org/fm-satellite-frequency-summary/>
 - Best Practices for FM Satellite Operating - Sean Kutzko, KX9X
<https://www.amsat.org/wordpress/wp-content/uploads/2017/12/FM-Satellites-Best-Practices.pdf>
 - Mode J Desense Filter <https://www.amsat.org/a-simple-desense-filter-for-mode-j-satellites/>

Resources

Antennas

- Arrow Antennas <http://www.arrowantennas.com/>
- Elk Antennas <https://elkantennas.com/>
- EA4CYQ ioIO Antenna <http://www.ea4cax.com/paginaea4cyq/Antenaioio/ioioingles.pdf>
- WA5VJB Cheap Yagi <http://www.wa5vjb.com/references/Cheap%20Antennas-LEOs.pdf>
- W6NBC Tape Measure Antenna <http://w6nbc.com/articles/2011-12QSTtapemeasure.pdf>

Prediction/Tracking

- SatPC32 <http://www.dk1tb.de/indexeng.htm>
- Orbitron <http://www.stoff.pl>
- MacDoppler <https://www.dogparksoftware.com/MacDoppler.html>

Logging

- Logging Satellite QSOs with Logbook of the World
<https://www.amsat.org/logging-satellite-qsos-with-logbook-of-the-world/>

Q&A

Questions?