Portable Satellite Tracking

Introduction and Build Options by AD0WE

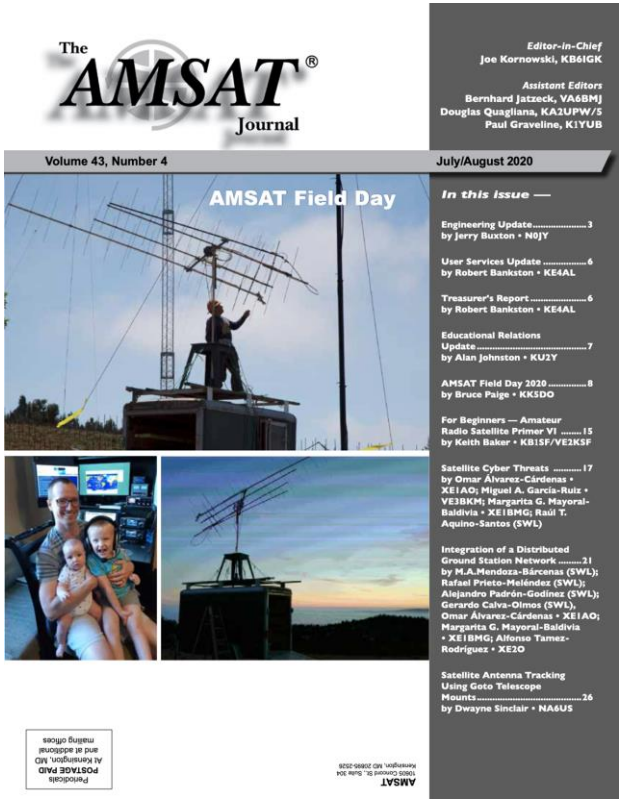
AMATEUR RADIO IN SPACE
AMSAT®

AD0WE Introduction

- Author of Morse Code Ninja
  - Website – https://morsecode.ninja
  - YouTube Channel – https://www.youtube.com/channel/UCXrTMfMEhkC9rVyQNU5aZlA
  - Morse Code Course
  - 3,000+ hours of Morse code practice (15 to 100 wpm)
- Work for Kansas State University as Application Architect
- Re-licensed 2016 as Amateur Extra
- AMSAT Member
  - Researched, but not yet built any of the portable satellite tracking options

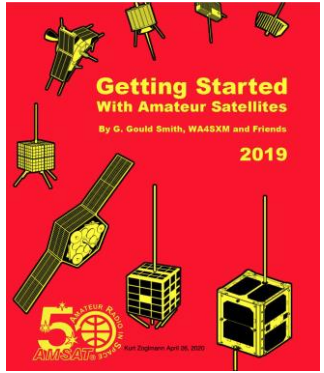
AMSAT Membership Benefits and Resources

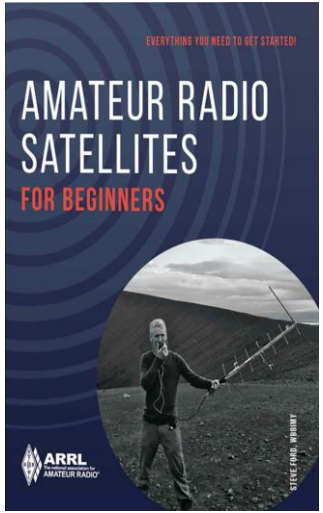
- Support future satellite launches
  - Working towards GOLF (Greater Orbit Larger Footprint)
- AMSAT Journal
  - Bi-monthly magazine
  - High-quality and typically 50+ pages
  - Access to previous issues
- AMSAT-BB Mailing list (Free)
  - https://www.amsat.org/amsat-new/tools/maillist/maillist.php
  - Very active and helpful support of satellite veterans
- Website – https://www.amsat.org
  - Status of satellites - https://www.amsat.org/status/



Recommended Books

- Getting Started with Amateur Satellites (AMSAT)
  - https://www.amsat.org/product/2020-edition-of-getting-started-with-amateur-satellites-digital-download/
  - Updated every year - $15
- Amateur Radio Satellites for Beginners
  - ARRL Store - http://www.arrl.org/shop/Amateur-Radio-Satellites-for-Beginners/
  - Amazon $10 - https://www.amazon.com/Amateur-Radio-Satellites-Beginners-ARRL-ebook/dp/B086H3NKBQ



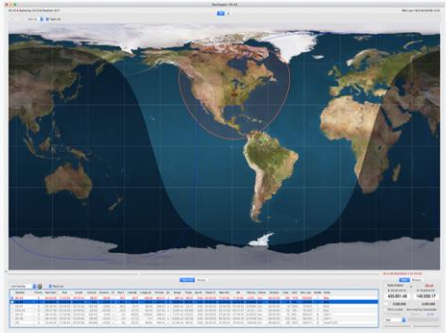


SDR and Satellite Radio Demo

- See article title Exploring Satellite Radio with SDR at https://morsecode.ninja
  - Scroll down a bit
- Record passband and play back!
  - Demonstration on YouTube -- https://www.youtube.com/watch?v=FY9adU6pmrM

Morse Code Ninja

Exploring Satellite Radio with SDR:



I had fun exploring Software Defined Radio and Amateur Radio Satellites! On the morning of May 10th, there was a great opportunity to catch a bird. RS-44 (aka DOSAAF-85), a satellite built by students at Siberian State Aerospace University and launched in December 2019, passed nearly overhead and would transit the sky for over 21 minutes from horizon to horizon. The Amateur Radio transponder had been activated only a couple of weeks prior.

The satellite is in orbit at an altitude of 775 miles! For a low earth-orbiting satellite, the satellite has a vast footprint and can be seen across North, Central, and parts of South America at the same time! It is one of the best opportunities to work DX, given the currently available satellites in operation.

At 11:13 am, I pointed my handheld arrow antenna at RS-44 and hit the record button on my SDR software, SDRUno. While recording, it captures 2MHhz worth of raw spectrum as I/Q data.

After a few minutes, I could see and hear the satellite beacon on my laptop. The doppler shift from the speeding satellite was quite noticeable on the Morse code sidetone. (Think about how a train sounds as it blows its whistle approaching and then passing you.) And almost immediately, I could see that the satellite passband was filled with amateur radio operators contacting each other using SSB voice! (The satellite has a 60kHz inverting transponder. Uplink 145.965 MHz +- 30kHz and Downlink 435.640 Mhz +- 30kHz.)

It was difficult to watch the trajectory on my phone, keep the antenna pointed to where I thought the satellite was, adjust the antenna's polarization by twisting it one way or the other, find a station to listen to, and continuously adjust the frequently for doppler shift! That is a lot of multi-tasking, but I managed to listen to a couple of amateur radio operators working each other!

Handheld Antennas

- Arrow Antenna 2m/70cm 3/7 element Yagi
  - http://www.arrowantennas.com/arrowii/146-437.html

- Elk Antenna 2m/440L5 Dual-Band Antenna
  - https://elkantennas.com/product/dual-band-2m440l5-log-periodic-antenna/
  - Does not require a diplexer
  - Easier to mount to tracker / tripod

Two types of Amateur Radio Satellites

- FM Satellites
  - Pros:
    - Simple operation
    - Can use a dual-band HT
      - Ideally radio that can simultaneously TX & RX - You can to hear yourself
    - Doppler shift is less of a problem
  - Cons:
    - Very busy! / Difficult to get a turn
- Linear Transponder Satellites
  - Pros:
    - Multiple users at once
    - SSB & CW
    - Can exchange more than grid squares
  - Cons:
    - Lots of multi-tasking (Pointing antennas, dealing with doppler shift)
      - Automation to the rescue!

Published Build Options

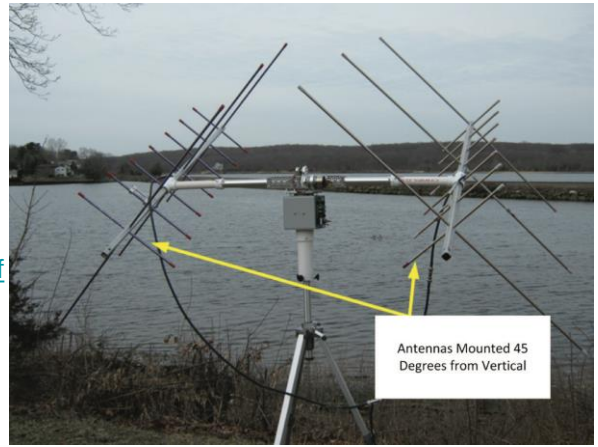
1. Autonomous Satellite Tracker (WB0OEW Elwood)
2. Tricked-Out WRAPS Satellite Antenna Rotator (Mark Spencer)
3. Repurposed Telescope Alt/Az Mount (Dwayne NA6US)

Autonomous Satellite Tracker

- Project details - http://clearskyinstitute.com/ham/AST/
  - Featured in the March/April 2016 QEX magazine
  - Elwood Downey (WB0OEW) also author of HamClock
  - Can support Arrow Antenna
- Build featured on Ham Radio Concepts YouTube channel
  - Part 1 - https://www.youtube.com/watch?v=KiPubPpx9hQ
  - Part 2 - https://www.youtube.com/watch?v=euTAgImcm0A
  - Part 3 - https://www.youtube.com/watch?v=-4tNm383ogo
- Pros
  - Configure / select satellite over Wifi with phone or tablet
  - Continuing to be refined
  - Continuing to see hams build them in 2020

Tricked-Out WRAPS Satellite Antenna Rotator

- Project details
  - Featured in the January 2014 QST magazine
    - http://www.arrl.org/files/file/QST%20Binaries/Jan2014/WRAPS.zip
  - Mark Spencer (WA8SME)
    - Short video from 2014 Dayton Hamvention - https://www.youtube.com/watch?v=NHI34kG1Y-0
    - HamRadioConcepts Demo - https://www.youtube.com/watch?v=kpgV8P6ocLE
  - WRAPS = **W**obbler, **R**adFx, **A**ntenna **P**ointing **S**ystem
  - Cost $300-400
- Pros
  - Updated project supports two beams to support left/right circular polarization - https://www.amsat.org/wordpress/xtra/WRAPSArticlewithStoreAd.pdf
- Cons
  - PCB no longer for sale - Schematics available



Repurposed Telescope Alt/Az GoTo Mount

- Project details
  - Featured in AMSAT Journal July-August issue Pages 26 thru 29
  - Dwayne Sinclair (NA6US)
  - Cost perhaps as low as $500
    - Orion StarSeeker IV GoTo Altazimuth Mount and Tripod
      - $380 - https://tinyurl.com/yyarbrft
    - Orion SynScan V5 Computerized GoTo HandController for Altaz
      - $130 - https://tinyurl.com/yywfpq9c
    - SkyTrack Satellite Tracking Software
      - $9 - https://heavenscape.com/download.html
      - Will work with any ASCOM compatible mount
  - KD0UHS Example -- https://www.youtube.com/watch?v=BDTjnJm41mc
- Pros
  - Mechanics are simplified by using off the shelf pointing solution
- Cons
  - Increased complexity with software solution to drive the mount

Question & Answers

- Keep in mind - Only researched and not built yet
- Happy to answer Morse code related questions
- Contact me at zoglmannk@yahoo.com