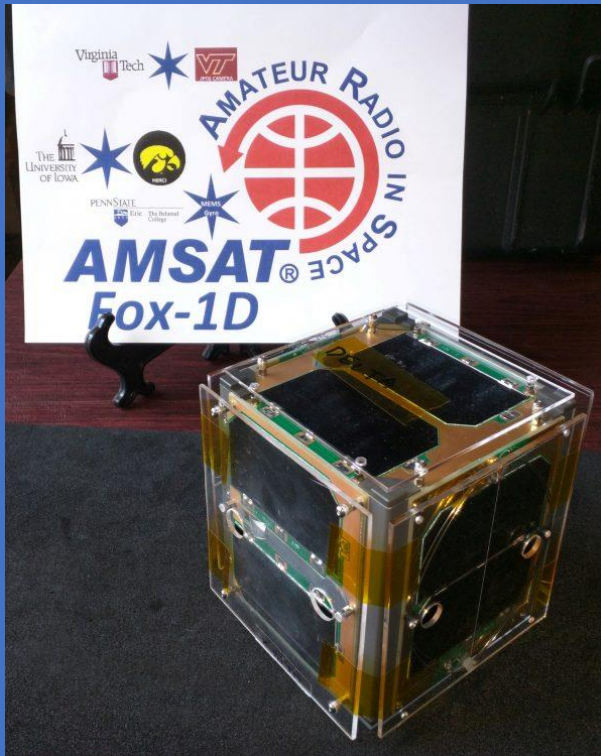
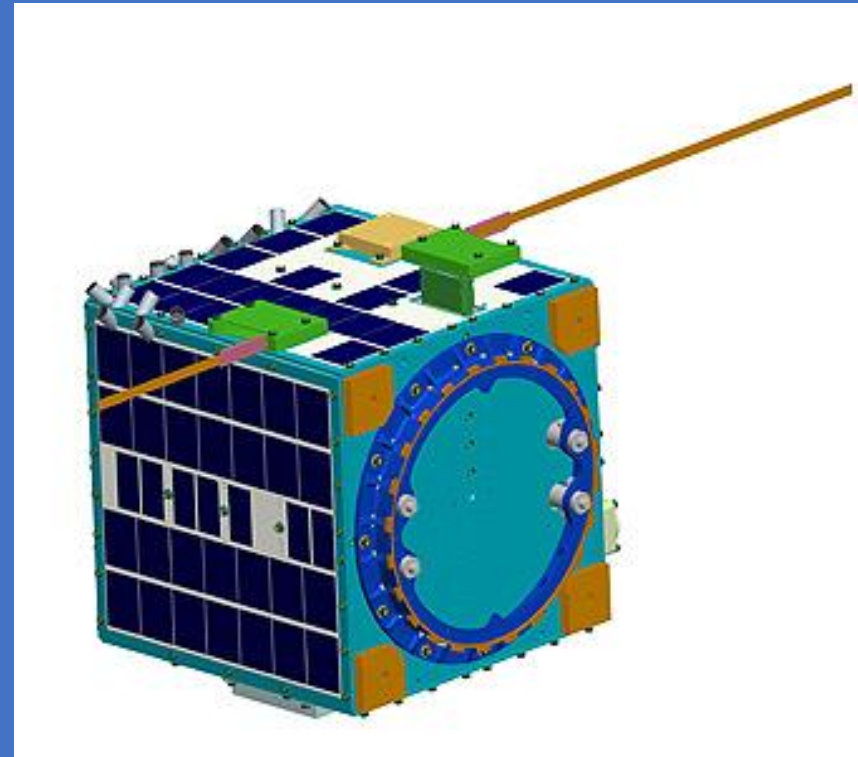


N9FN

Satellite operations



Fox-1D = AO-92 - Cube Sat
Approx 4" cube, 2.9 lbs



XW-2B - Camsat
Approx 9.7" cube, 22 lbs

AO-07 history

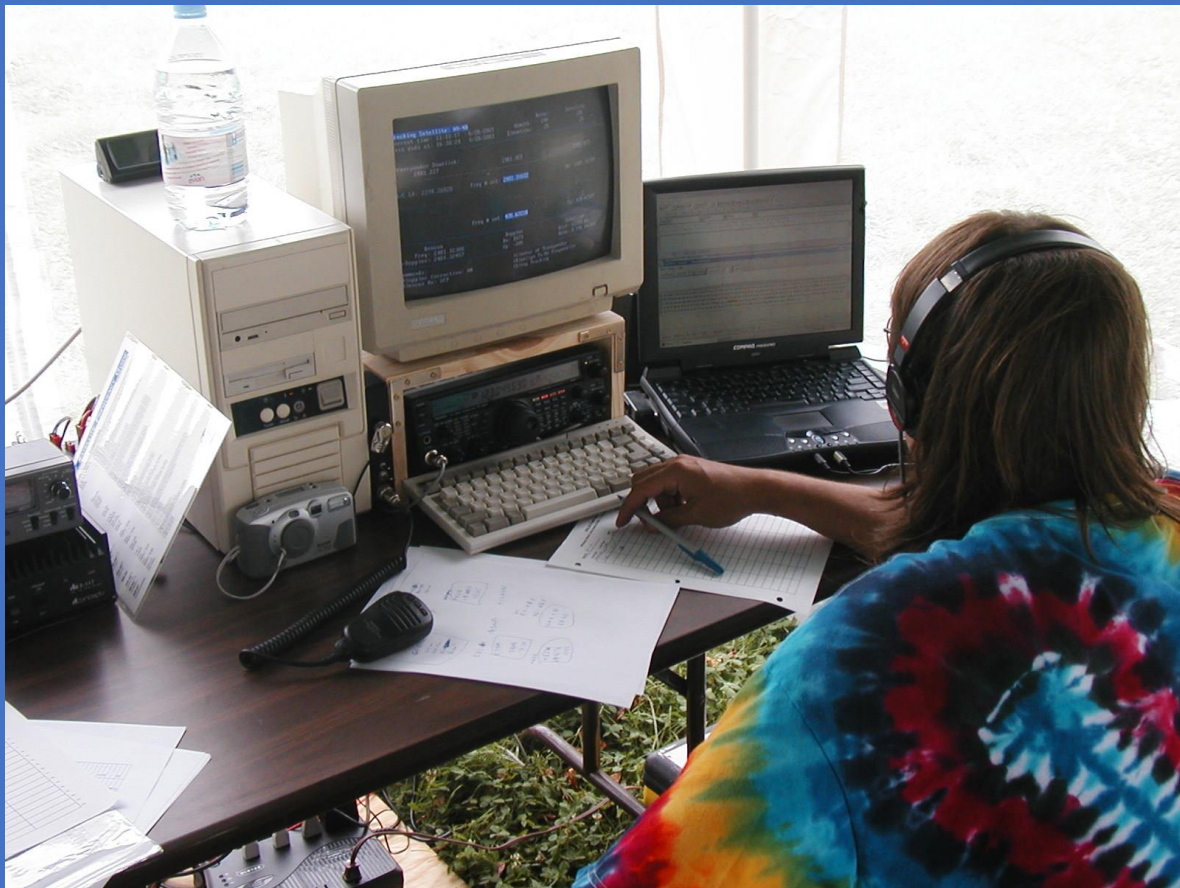
- AO-07 was launched on November 15, 1974
- In 1981 the Ni-Cd batteries shorted so the satellite was dead
- On June 21, 2002, after 27 years in space and 21 years of silence the shorted batteries opened and the satellite became operational again when in sunlight
- When in continuous sunlight the satellite alternates between mode A (2m uplink, 10m down) and mode B (70cm uplink, 2m down) every day. When it eclipses it resets and usually comes up in mode B
- AO-7 is in a higher orbit, about 900 miles up so it has a larger footprint than the current LEO satellites
- It is about 14.2" x 16.7" octahedron format and weighs 63 lbs

Challenges in working satellites

- Most of the current amateur radio satellites are in Low Earth Orbit (LEO) which are on average 200 to 350 miles up. The International Space Station orbit averages about 250 miles up
- LEO satellites are traveling roughly 17,000 miles per hour, almost 5 miles per second.
- The first challenge in working someone through a satellite is knowing when the satellite will be above the horizon and then where to point your antenna to track it
- Since the satellites are moving so fast doppler shift becomes an issue that must also be addressed

- I saw my first operating satellite station at W9YB around 1980
- I saw my next operating satellite station at Field Day in 2003
- A computer drove both Azimuth and Elevation rotors to track the satellites as they crossed the sky
- The computer continually adjusted the transmit and receive frequency of the radio to compensate for doppler shift during the entire pass
- The antennas were circularly polarized and could be switched between right-hand circular and left-hand circular

W9LDX satellite station at Field Day 2003



W9LDX satellite antennas at Field Day 2003



- Satellite operations at Field Day continued from 2003 through 2016 with N9IP and W9TN as the primary operators
- Most of the equipment was owned by Steve – N9IP
- In 2017 N9IP retired. He and his wife began traveling with a 5th wheel camper/trailer and he let us know that he would not be at Field Day. He was also taking his satellite equipment with them to use on the road.
- It was time for me to step up and learn something new so that we didn't lose the Satellite bonus for Field Day

- I bought some used satellite and EME equipment from Jim - W9VNE, including an Icom 910H all mode satellite radio, M2 2 Meter and 70 cm circularly polarized satellite antennas and an Elk log periodic handheld satellite antenna
- I was told that you can make FM Satellite QSO's 364 days per year, but on Field Day it's too crowded so don't waste your time trying
- I joined AMSAT at Dayton/Xenia, read a lot, talked to several other satellite operators and experimented a bit at home
- It didn't take long to realize that the previous satellite operators had put a LOT of time, work and money into building their satellite stations

Field Day 2017

N9KT aiming W9TN's arrow antenna



W9TN looking for the next satellite pass, K9WX taking pictures, N9KT ready with the antenna



- We struggled, but succeeded in making a handful of satellite QSO's and earned the 100 point bonus for Field Day
- We made a lot of notes of what we did and what we needed to do better next year
- It was obvious that we needed to have a computer driving the radio to compensate for doppler shift on the linear satellites
- We needed a better way to know where to point the antenna during a pass
- We needed the station to be in some form of shelter to protect the equipment (and us) from bugs and rain.

Field Day 2018

Laptop, MicroHam interface and SatPC32



N9KT using ISS Detector, an app that tracks the satellites and shows where to point the antenna



Field Day 2018

- We accomplished several goals
- We had SatPC32 controlling the radio to automate doppler frequency corrections
- The ISS Detector app told us when each satellite pass would be and showed us where to point the antenna during each pass
- We were in a shelter
- We made 57 satellite QSO's, a significant improvement over our 2017 QSO total
- We sent our scores and some pictures to AMSAT for their Field Day contest and came in 5th place

Field Day 2018

Our picture on the cover of AMSAT Journal



Field Day 2019

Additional improvements

- I bought M2 LEO Pack antennas
- I added a tripod and Yaesu G-5500 rotors controlled by SatPC32 software through the LVB Tracker interface
- N9KT's arm no longer ached after holding the antenna for each satellite pass
- We went from 57 Satellite QSO's in 2018 to 114 in 2019, exactly doubling our efforts from the previous year
- We moved up from finishing #5 in the AMSAT contest in 2018 to finishing #2 in 2019

Field Day 2019

M2 LEO Pack antennas and Az/El rotors



Field Day 2019

Computer rotor control and Icom 9700



Field Day 2019

Ops: N9KT – N9FN – W9TN



Field Day 2019

We made the cover of AMSAT Journal again



And we received a certificate from AMSAT



N9FN home satellite station

- I really enjoyed operating satellites at Field Day, but I also wanted to operate from home under my own call
- I had done reasonably well making a good portable satellite station for Field Day, but setting up a fixed station was a new technical challenge with some new learning opportunities
- I had most of the equipment already, so it was time to start on a home satellite station

N9FN Satellite tower installation

Start out with a 4' x 4' x 4' hole



Add Concrete



Get the antennas ready



Dig a trench to house, install a box for cables
and get ready for conduit



Measure cables very carefully and slide conduit over cables and carefully glue



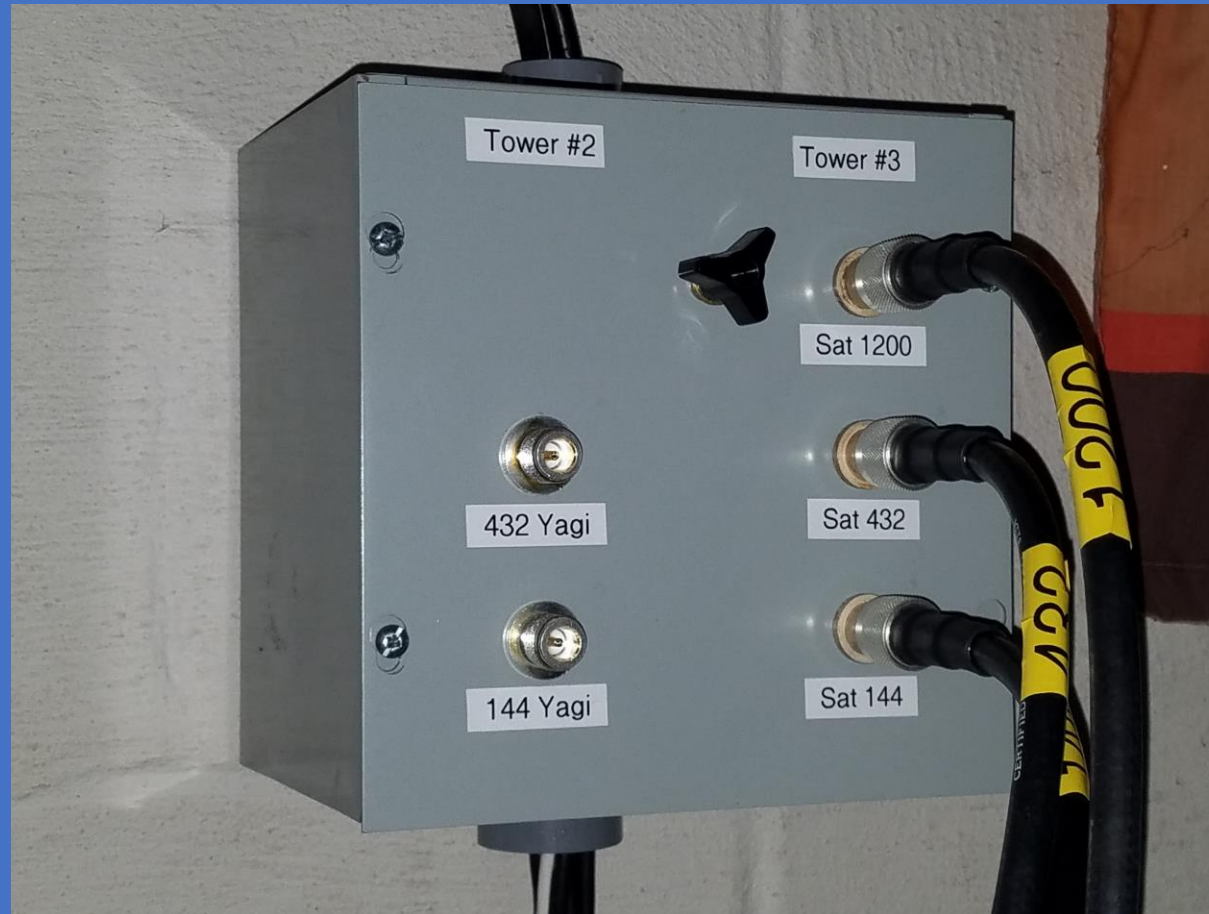
Put tower and rotors on tilt base



The finished satellite antenna installation
70cm, 23cm, 2M antennas with AzEl rotors



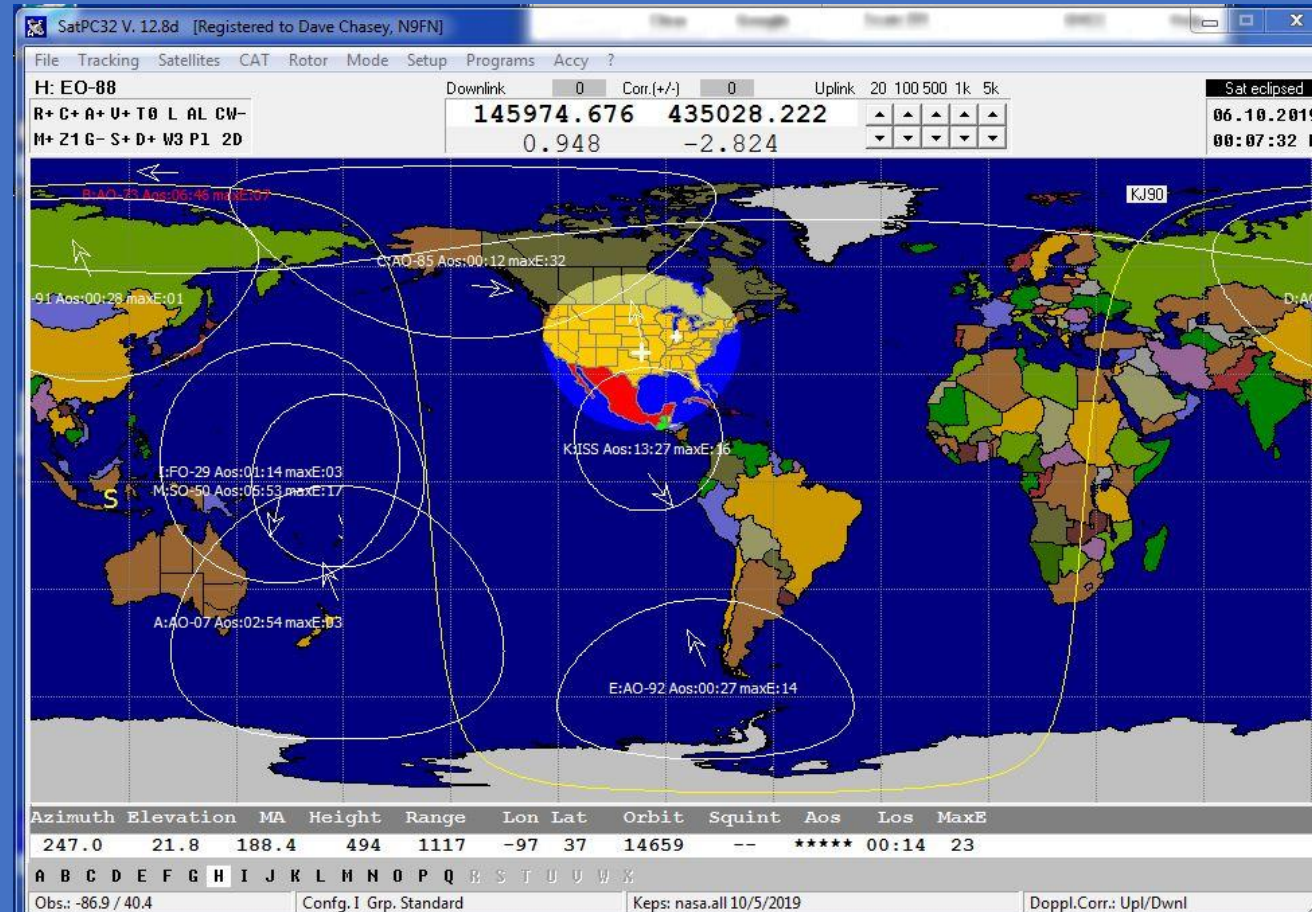
The antenna patch panel in the shack



The station: Icom 9700, Yaesu G5500 Az/El rotor, LVB Tracker, SatPC32, DXLab logging software



SatPC32 Tracking software screen



First Satellite QSO from the new home station was made on September 4, 2019

- Satellite statistics from 9/4/2019 to 10/10/2019 *
 - 429 Satellite QSO's
 - 160 grids worked
 - 100 grids confirmed in LoTW
 - 45 states worked
 - 42 states confirmed in LoTW
 - 8 DXCC Countries worked
 - 6 DXCC Countries confirmed in LoTW

* I was off the air while in Montana 9/26 – 10/1

Satellite QSO counts as of 3/1/2022

- 2159 Satellite QSO's
- 574 grids worked
- 567 grids confirmed
- 50 states confirmed thanks to KL7TN/P in KH6 and KL7TN in AK
- 488 Continental US grids confirmed
- 32 DXCC Countries worked
- 30 DXCC Countries confirmed

What do Satellite QSO's sound like?

- AO-7 SSB QSO with 2M0SQL



- AO-92 FM QSO with VE2FFS on HT




- CAS-4A SSB QSO with AB1OC



- AO-92 FM QSO with AD0HJ



A couple of memorable QSO's

- KE0WPA QSO on 12/21/2019 - 
- Received her QSL card 1/16/2020 – She's 12 years old!
- Daughter of ND0C and just licensed August 2019



KE0WPA				
Date	UTC	MHz	RS(T)	2-way
N9FN		21/Dec/2019		
Time: 04:07		Bnd: 70 435.350		
Mode: FM		RST: 59		

Confirming QSO(s) with
N9FN

QSL via

Kylee Shirbroun
1745 N. Douglas Avenue
Worthington, MN 56187
U.S.A.

Thanks!!
73, Kylee

See QSL Trx

☐ Yaesu FT897 D - 100 watts output
☐ Yaesu FT DX 3000 - 5 watts output
☒ Yaesu FT-4XR - 5 watt handheld (VHF/UHF)
☐

☐ Inverted Yee - balanced line fed with MFJ tuner
☐ Cycle 24 TX38 triband Yagi - at 40 ft
☒ Arrow II hand-held VHF/UHF Yagi
☐ M' 6MSX1 IP - 5 element Yagi at 45 ft
☐

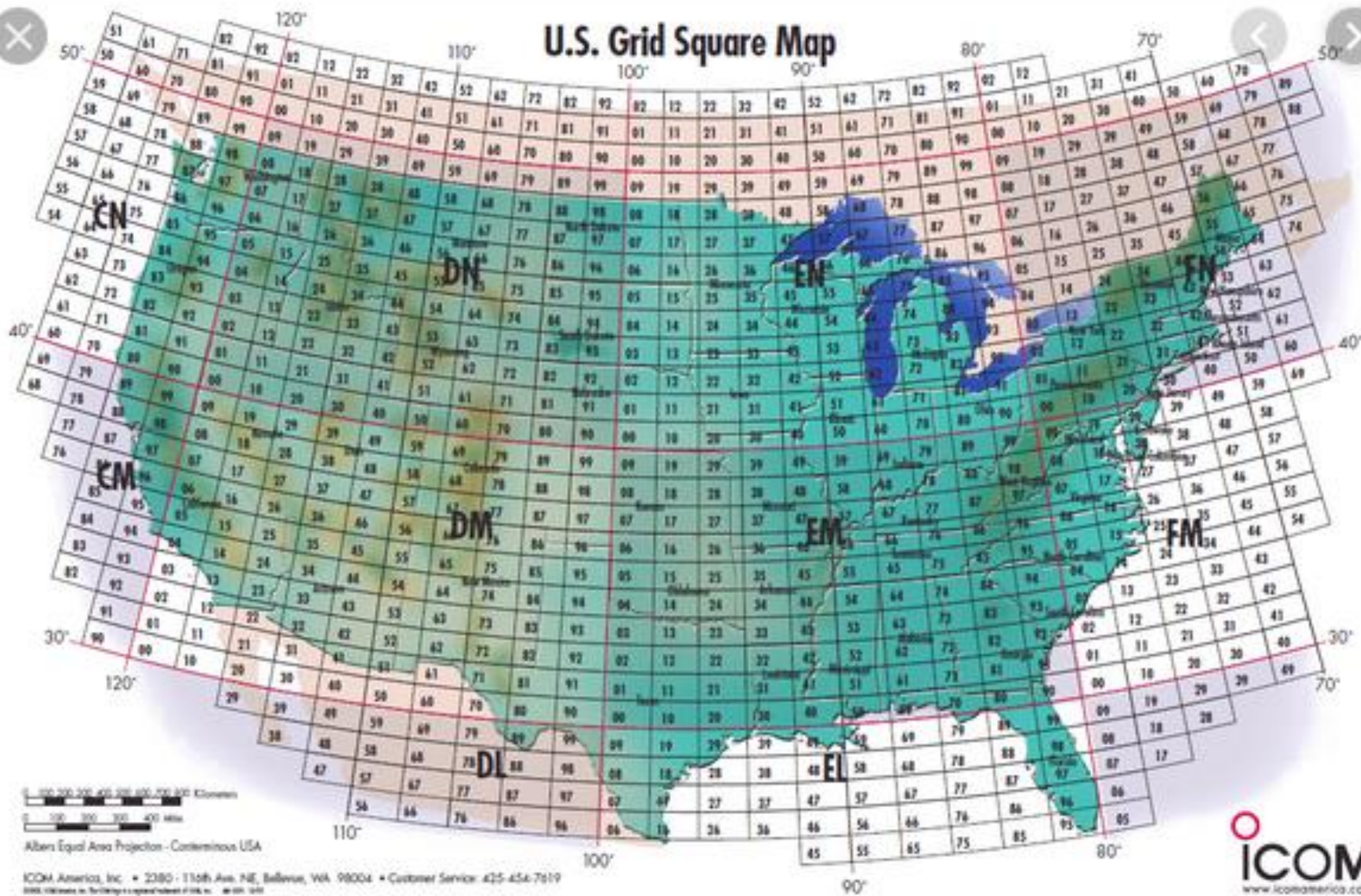
A couple of memorable QSO's

- My Dad – WA9GAA (SK 1996) was collecting parts to build a satellite station. He had antennas up but was still working on the rotor controls and gathering equipment when he passed away
- Mom and I returned from Montana on 10/1/2019 and I made a satellite QSO to demonstrate my station and show her what Dad would have done with his station had he completed it
- That QSO was with N0WBV – Cheryl – and she indicated it was her very first Satellite QSO. She is also heavily involved in the YLRL.
- That demo QSO turned out to be my 100th grid worked
- Side trivia, N0WBV was in Colorado, and Mom and I changed planes in Denver Colorado less than 6 hours earlier

What are Grids?

- A maidenhead grid locator is a 2 degree longitude by 1 degree latitude “box”
- There are 488 grids in the contiguous 48 states. A few grids have almost no land and are very difficult to access. These are the same grids that the FFMA 6 meter award uses
- You can earn the AMSAT Gridmaster award by working and confirming all 488 of those grids, however all of those QSO's must be made from locations no more than 200 KM apart
- Many grids have no hams living in them, but many satellite ops like to go to these grids and operate as “rovers” to give others the rare grids

U.S. Grid Square Map



0 100 200 300 400 500 Kilometers

0 100 200 300 400 Miles

Albers Equal Area Projection - Continuous USA

ICOM America, Inc. • 2380 • 115th Ave. NE, Bellevue, WA 98004 • Customer Service: 425-454-7619

©2008 ICOM America, Inc. All rights reserved. ICOM is a registered trademark of ICOM, Inc. All other marks are the property of their respective owners.

ICOM
www.icomamerica.com

Grid Square: EN60

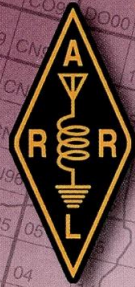


As of 2022/03/02		Total	
Confirmed in LOTW	488	565	
Confirmed by QSL	0	0	2
Worked/Unconfirmed	0	4	

Now that we're making satellite QSO's, what new goals can you work on?

- DXCC – You can get the DXCC award for Satellite by working and confirming 100 different countries. That's nearly impossible to obtain from the Midwest at this time due to the footprint of the existing satellites, but quite a few countries can still be worked
- WAS – You can get WAS Satellite – Hawaii is difficult from the Midwest but is possible on AO-7 or RS-44. Some states don't have (m)any active satellite ops, but it is doable with rovers
- VUCC – VHF/UHF Century Club – Satellite – basic award at 100 maidenhead grids confirmed, endorsements for each 25 additional grids confirmed on Satellite

VHF/UHF Century Club



VUCC Award

Satellite

Presented to

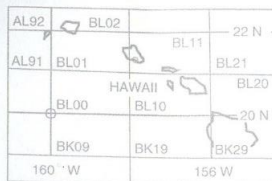
100 Grid Locators

David Chasey, N9FN

For submitting confirmation of two-way communication with amateur stations in 2° longitude × 1° latitude grid squares on the frequency band indicated. This outstanding achievement has earned the above membership in the exclusive VHF/UHF Century Club (VUCC).

Certificate #457

October 11, 2019



ARRL The national association for
AMATEUR RADIO

Ru Rukuh

K5UR

ARRL President

KILOMETERS 100 0 100 200 300 400 500 600 700

MILES 50 0 100 200 300 400

GridMaster



Certificate No. 33

THIS CERTIFIES THAT

Dave Chasey, operating Amateur Radio Station N9FN

has submitted evidence to AMSAT Headquarters of having worked and confirmed the 488 maiden-head grids in the contiguous United States of America. This certificate is awarded by AMSAT in recognition of this outstanding achievement in Amateur Satellite Communication.

August 28, 2021

DATE

Bruce Poig KK5DO

AWARDS MANAGER

Robert Zambrotta KE4AL

PRESIDENT

AMSAT Live OSCAR Satellite Status Page

This web page was created to give a single global reference point for all users in the Amateur Satellite Service to show the most up-to-date status of all satellites as reported by users around the world. Please help others and keep it current every time you access a bird.

Transponder/Repeater active	Telemetry/Beacon only			No signal	Conflicting reports		ISS Crew (Voice) Active	
Name	Mar 2	Mar 1	Feb 28	Feb 27	Feb 26	Feb 25		
AO-109			1				1	
AO-27		1	11	2	21	1	1	2
AO-73			1		1	1	1	11
AO-7[A]	111			211	1			31
AO-7[B]		11	111	1	21	1	11	1
AO-91	1	1421	21	1	21	2	1	1121112
AO-92_U/v								
AO-95_U/v		11	13	11	131	1	1	111
CAS-4A		11	3	11122	1	112		222
CAS-4B		13	1	112	1124	1	21	12
CubeBel-1				1				1
CUTE-1			1		1		1	1
EO-88		1	2	1	3		21	1
FO-29	1	1	111	1	1	1	111	13313211
FO-99							1	1
FS-3	1	1	4	11	11	211	1111	1
HO-113	2	1	1	2	2	1	3	12
HO-68								
IO-86	111	211			1			1
ISS-FM	1	1	11111	1	152	12	1	3422531
JO-97	1		2	1	1	22	1	1
LilacSat-2		11	23		111	1	1	2
LO-19			1		1			1
NO-44								
PO-101[FM]		1	21	1	12	111	211	3
QO-100_NB		1		1			1	
RS-44	12	111	2	1	213	1	2	1
SO-114								
SO-115								
SO-33								
SO-50	1	1	1	21	5	112	1	1
TO-108	11	1	2		2			2
UO-11[B]		1		1		1		1
UVSQ-SAT								
XI-IV			1		1			1
XI-V		1		1			1	1
XW-2A		13	1	1	1	22	1	31
XW-2B								1
XW-2C								11
XW-2D	1							
XW-2E								1
XW-2F								2

What if I want to try satellites but not spend much money or have antenna restrictions?

- FM Satellites can be worked with an HT and handheld antenna such as an Arrow antenna, or an ELK log periodic antenna
- Doppler shift is less of an issue with FM, and programming a few memories or tuning in VFO mode on the 432 side of the HT can adequately compensate for Doppler
- SSB/CW is a little more complicated as slight changes in frequency due to Doppler shift are more apparent on those modes
- It's best to use a computer with software to compensate for Doppler on the linear satellites, but some guys are very good at manually tuning their radios especially when operating portable

- To get started with FM satellites all you need is a 2M/70cm handheld or mobile rig, an antenna and an app for your smart phone
- It's best if your radio is full duplex capable. Next best is to use 2 radios: one for transmit and a second one for receive.
- The Arrow II 146/437-10 split boom satellite antenna with duplexer is \$159. You can connect 2 radios, or a radio with separate antenna ports directly to this antenna without using the duplexer
- The Elk satellite antenna is \$130 and does not require a duplexer when used with a single antenna port radio such as a handheld radio
- ISS Detector satellite app (Android or iOS) will show you when the satellite passes are and where to point your antenna

The Arrow antenna can be handheld or mounted on a on tripod



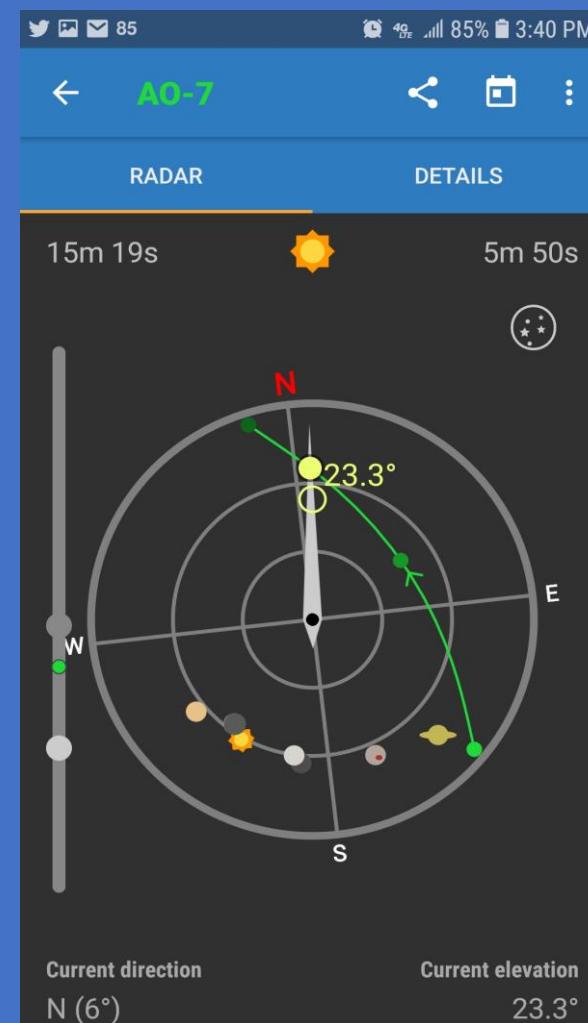
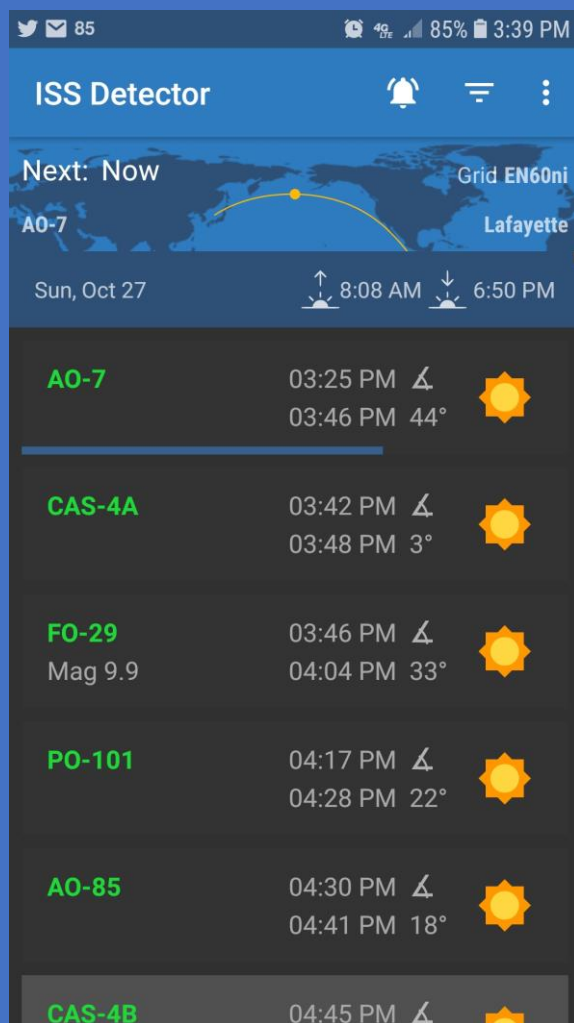
The Arrow is easy to take apart for transportation and storage



The Elk antenna can also be used handheld or on a tripod and it disassembles easily for storage



ISS Detector Pro



Using satmatch.com to find a satellite pass with a common footprint with someone else

SatMatch

Satellite(s):
AO-07,XW-2A

☒ Show Extra Options (All extra inputs are optional)

Grid1:
BL01IX09 (western grid) Altitude MSL (km) Horizon (±degrees)

Grid2:
CN87uo05 (eastern grid) Altitude MSL (km) Horizon (±degrees)

Search Start
2020-12-31T16:22:52Z UTC, format: 2020-12-31T16:22:52Z

Search Duration
24 (hours)

Submit

Using satmatch.com to find a satellite pass with a common footprint with someone else

SatMatch

Amateur Radio Satellite Pass Match

Overlapping passes between cn72 and en60 (3171km) using AO-07,XW-2A,XW-2B,XW-2C,XW-2D,XW-2F,CAS-4A,CAS-4B

Searching for 24 hours starting 2020-12-31 at 16:28:43Z



AO-07-2020-12-31 19:48:27Z(+9 min 22 seconds)



AO-07-2020-12-31 21:34:08Z(+17 min 39 seconds)



AO-07-2020-12-31 23:28:44Z(+12 min 39 seconds)



XW-2B-2020-12-31 23:36:16Z(+4 min 23 seconds)



XW-2D-2020-12-31 23:43:54Z(+6 min 44 seconds)



XW-2F-2021-01-01 00:29:33Z(+7 min 59 seconds)



XW-2C-2021-01-01 00:36:26Z(+7 min 55 seconds)



XW-2A-2021-01-01 03:52:09Z(+6 min 59 seconds)



CAS-4B-2021-01-01 05:02:36Z(+5 min 42 seconds)

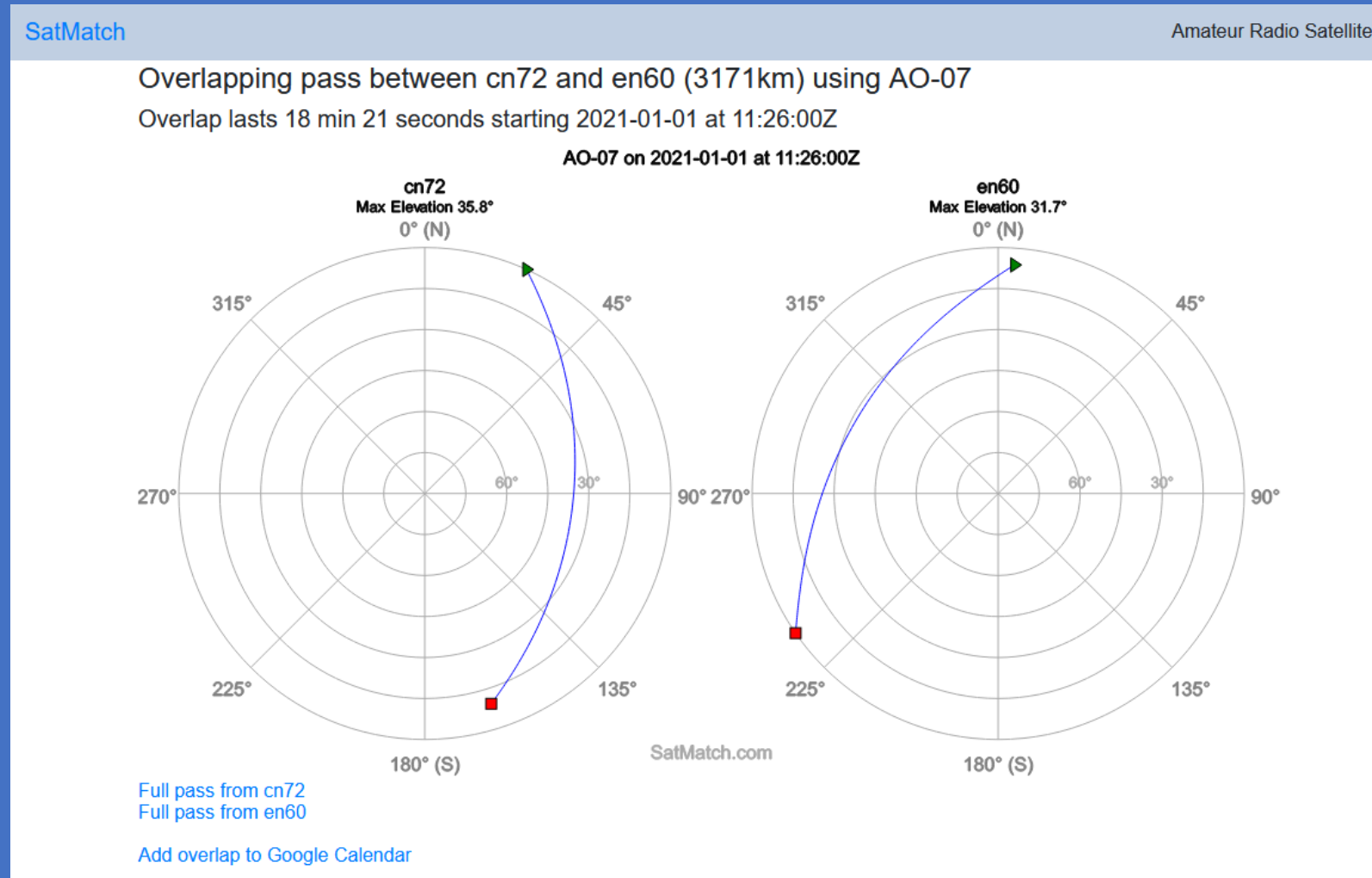


CAS-4A-2021-01-01 05:02:52Z(+5 min 44 seconds)



CAS-4B-2021-01-01 06:43:02Z(+5 min 52 seconds)

Using satmatch.com to find a satellite pass with a common footprint with someone else



What else can I use a satellite station for?

- ISS QSO's – Astronaut hams on the ISS occasionally get on the air and work hams on 2M FM.
- ARISS – Astronaut hams have schedules to work school students to encourage their participation in STEM programs
- SSTV images are occasionally transmitted down from the ISS
- Download live weather satellite images from NOAA satellites
- With larger tower mounted antennas, you could try EME

SSTV images from the ISS in December 2019



Field Day 2021 near disaster



Helpful links

- AMSAT <http://amsat.org>
- ARISS <http://ariss.net>
- M2 Antennas <https://www.m2inc.com/>
- Arrow Antennas <http://www.arrowantennas.com/>
- Elk Antennas <https://elkantennas.com/>
- SatPC32 <http://www.dk1tb.de/indexeng.htm>
- Satellite info and tutorials <http://work-sat.com/Home.html>

- Questions?

- Comments?