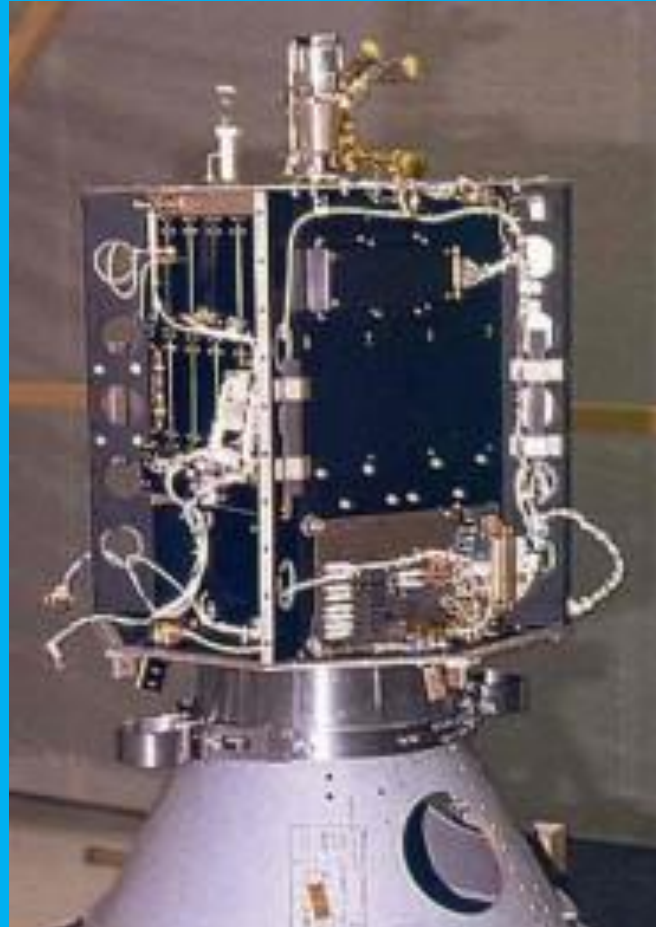


AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR



**AO-7 SATELLITE LESS
SOLAR PANELS**

**DOM MALLOZZI – N1DM
APRIL 9, 2026**

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

- **Today's talk is mostly on the FM voice and linear satellites**
- **These comments will also apply to the International Space Station operations**
- **I will only mention the 'data' only satellites**

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

All this satellite stuff is far from new.

- **First ham satellite was OSCAR 1 in 1961 which carried a beacon transmitter only.**
- **First ham satellite that had an onboard repeater was Oscar 3 launched in 1965. It had a 2-meter repeater with 1 watt output.**

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

- **Satellites are not hard**
- **Well in the capability of all hams, many hams in the area have been on satellites over the years**
- **There are many satellites available**
- **Tracking a satellite and doppler shift should not scare you**
- **Radios do not need to be specialized**

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

HAM SATELLITE SUBBANDS

<u>BAND</u>	<u>MHz</u>
15	21.245 TO 21.415 (UPLINK)
10	29.4 TO 29.5 (AO7 DOWNLINK)
2	144.3 TO 144.5 AND 145.8 TO 146.0 (SOME SATS DOWN TO 145.655)
70 CM	435.0 TO 438.0 (AND 432.125 TO 432.175 FOR AO-7)
23 CM	1260 TO 1270 (UP)
13 CM	2400 TO 2410
5 CM	5640 TO 5670 (UP) AND 5830 TO 5850 (DOWN)
3 CM	10450 TO 10500

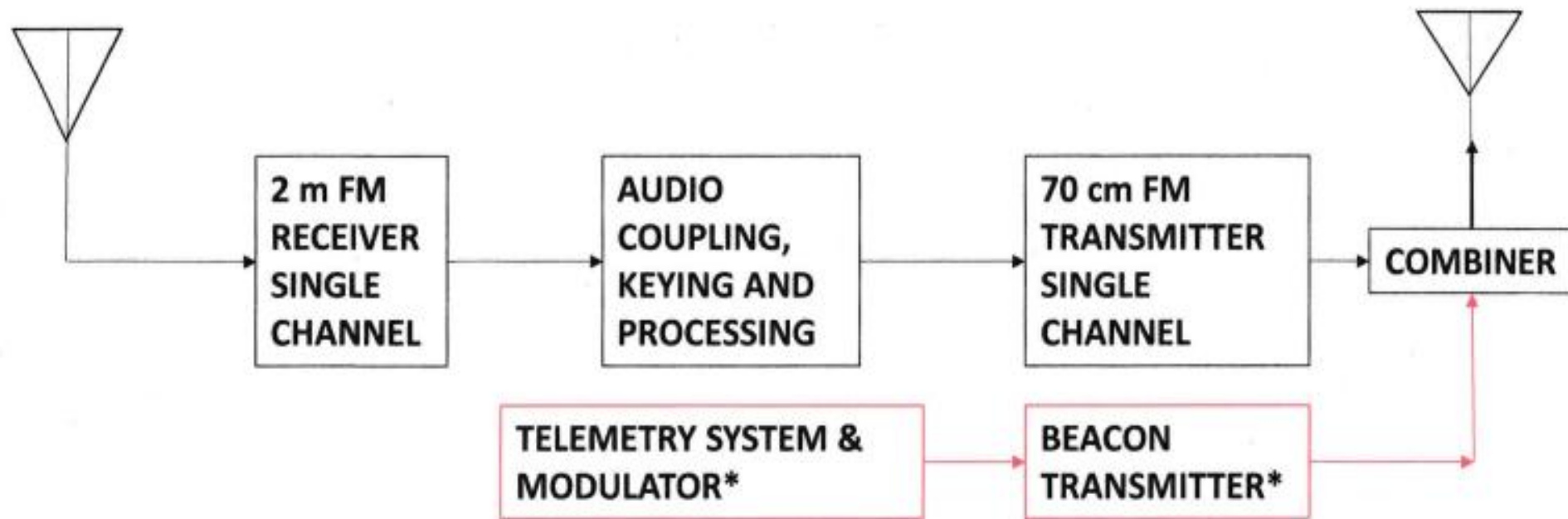
2M AND 70 CM ARE THE MOST POPULAR BANDS BY FAR

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

	FM	LINEAR (SSB/CW)
SATELLITES AVAILABLE	AT LEAST 6 (and 8+ DIGITAL)	AT LEAST 5
DIFFICULTY	EASY	MEDIUM
POWER NEEDED	5 WATTS	5 WATTS
ANTENNAS	HEMISPHERICAL OMNI, HANDHELD SMALL BEAMS AND AZ-EL BEAMS	HEMISPHERICAL OMNI, HANDHELD SMALL BEAMS AND AZ-EL BEAMS
EQUIPMENT	DUAL BAND FM TRANSCEIVER OR TWO SINGLE BAND FM TRANSCEIVERS	DUAL BAND SSB/CW TRANSCEIVER (DUPLEX CAPABLE PREFERRED OR TWO SINGLE BAND RADIOS)
COST	LOW	MEDIUM
SIMULTANEOUS SIGNALS	ONLY ONE	MORE THAN 5 QSO'S ARE POSSIBLE AT ONE TIME ON ALL LINEAR SATELLITES. ALL HAVE AT LEAST 20 KHZ OF AVAILABLE BANDWIDTH

SATELLITES FOR THE RADIO AMATEUR

- WHAT IS IN A FM SATELLITE ?

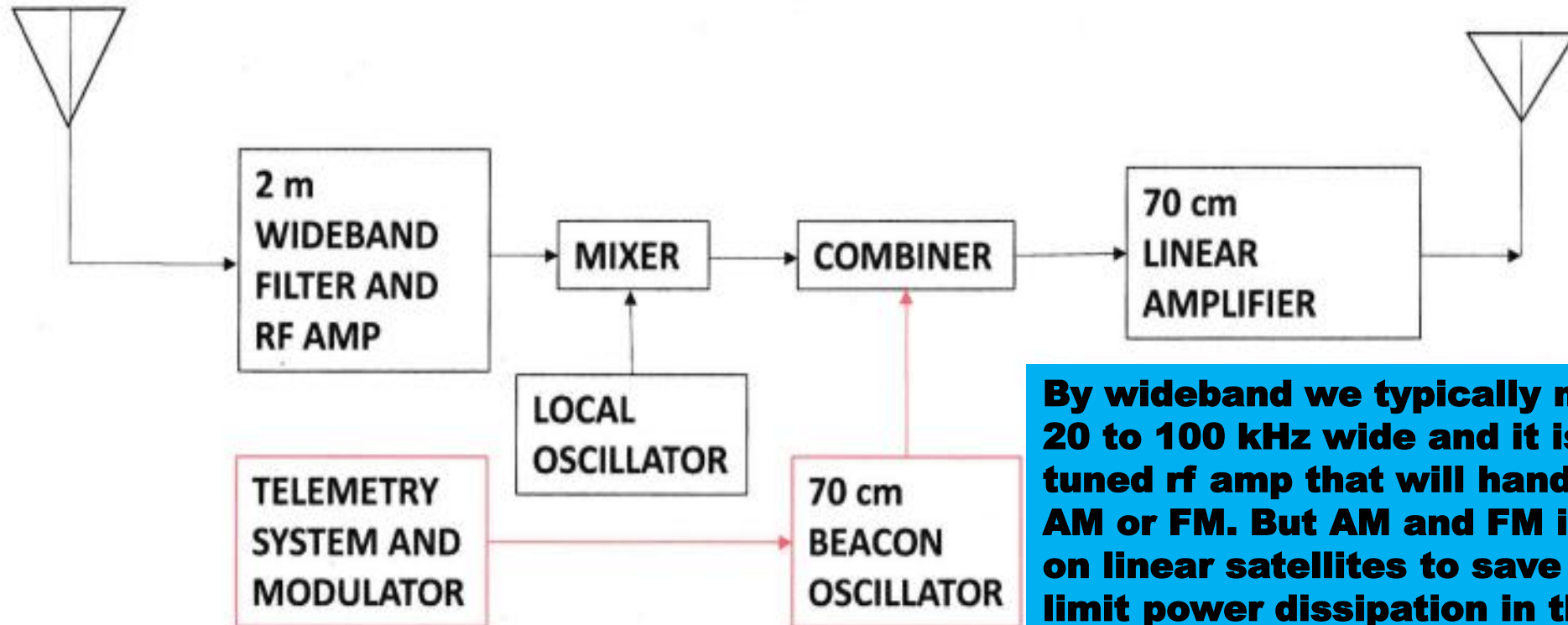


- OBVIOUSLY THESE ARE SINGLE CHANNEL REPEATERS, LOOK FAMILIAR?
- NOT ALL FM SATELLITES HAVE A BEACON*

SATELLITES FOR THE RADIO AMATEUR

- **WHAT IS IN A LINEAR SATELLITE ?**

LINEAR REPEATERS ARE ALSO KNOWN AS 'TRANSPONDERS'



By wideband we typically mean 20 to 100 kHz wide and it is basically a tuned rf amp that will handle CW, SSB, AM or FM. But AM and FM is prohibited on linear satellites to save power and limit power dissipation in the amplifiers.

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

Many of the newer satellites are in a Cube Sats configuration and are very small compared to traditional satellites

Cube Sats are 10 cm (3.9 inches) on a side and weigh about 2.2 lbs. They can be stacked with 16 modules for a typical larger satellite.

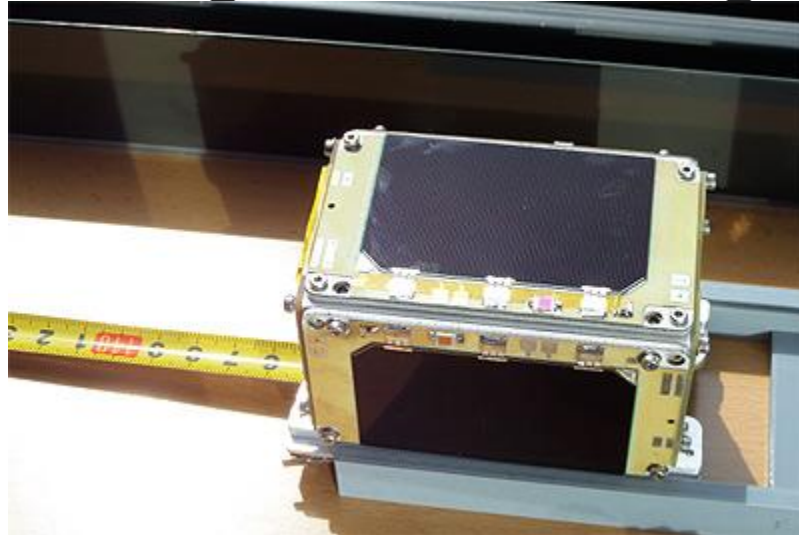
As a comparison the AO-7 satellite launched November 15, 1974 was approx. 14.17 inches high and 16.69 inches major diameter and weighed 62 lbs.



FROM: WIKIPEDIA

AN INTRODUCTION TO SATELLITES FOR THE RADIO AMATEUR

PocketQube are a newer series of microsatellites. They are 2 X 2 X 3 inches and weigh under 500 grams (17.6 oz.).



SO-125 (HADES-ICM) launched by AMSAT-EA has a FM transponder.

FROM: AMSAT SPAIN

SATELLITES FOR THE RADIO AMATEUR

SOME OF THE COMMUNICATION SATELLITES AVAILABLE FROM NORTHEAST FOR HAM RADIO

FM SATELLITES	LINEAR SATELLITES
AO-91 (U/V)*	AO-7 (U/V) AND (V TO 10M)
IO-86 (V/U)	AO-73 (U/V) <i>Has frequency stability issues</i>
ISS (V/U)	JO-97 (U/V)
SO-50 (V/U)	FO-29 (V/U) <i>in sunlight and commanded</i>
SO-125 (V/U)	RS-44 (V/U)
AO-123 (V/U)	

V/U MEANS 2M TO 70 cM

U/V MEANS 70 cM TO 2 M

SATELLITES FOR THE RADIO AMATEUR

DIGITAL SATELLITES AX.25 / APRS PACKET

**NO-44, ARISS, SONATE-2, CroCube, Foresail-1p, GRBBeta*, IO-86,
LASARSat**

Some of these have limited operating schedules

SATELLITES FOR THE RADIO AMATEUR

Live Digipeater Satellites

Updated Mar 26, 2026. Updates, changes, or suggestions: email [David, N9KT](mailto:David.N9KT).

For current status, see the [AMSAT Status page](#) and the [SatNOGs Digipeater Dashboard by DL7NDR](#).

Satellite	Frequency	Via	Comment
CroCube	436.775 MHz (9k6 GFSK/G3RUH)	9A0CC	
Foresail-1p	437.125 MHz (9k6 GMSK/ Skylink)		How to use the special Skylink protocol digipeater. Further information about this satellite.
GRBBeta	145.935 MHz +436.785 MHz (9k6 GFSK/G3RUH)	HA2GRB	
ISS	145.825 MHz (1k2 APRS)	RS0ISS or NA1SS or ARISS	See AMSAT Status and ARISS ISS Ham Radio Status . For other modes and frequencies, see this and this .
IO-86 (LAPAN-A2)	145.825 MHz (1k2 APRS)	YBOX (without SSID), additionally ARISS	Schedule
LASARsat	436.925 MHz (9k6 GFSK/G3RUH)	OK0LSR	
NO-44	145.825 MHz (1k2 APRS)	W3ADO-1	
SONATE-2	145.825 MHz (1k2 APRS)	DPOSNX	

SATELLITES FOR THE RADIO AMATEUR

These satellites are provided by AMSAT, educational and governmental organizations in various countries.

Thirty countries have launched over 125 amateur satellites since the 1960's.

All are freely available for use to hams of every country.

SATELLITES FOR THE RADIO AMATEUR

There are new satellites launched quite regularly and quite a few satellites are scheduled to be launched in the next couple of years.

Best source is *'AMSAT News Service'* on the AMSAT website which provides timely info on these new satellites.

ARRL also makes announcements on their bulletins.

SATELLITES FOR THE RADIO AMATEUR



**Is this the antenna I
need for satellites?**

PHOTO FROM RSGB WEBSITE

SATELLITES FOR THE RADIO AMATEUR



**Is this the antenna I
need for satellites?**

NO

PHOTO FROM RSGB WEBSITE

SATELLITES FOR THE RADIO AMATEUR

Do I need to have azimuth and elevation tracking antennas to use the satellites?

- **No**

Why not?

- **You do not need high gain antennas to work satellites**
- **It is possible to work satellites with specifically designed omni antennas**

SATELLITES FOR THE RADIO AMATEUR

TRACKING, ROTATOR AND RADIO CONTROL SOFTWARE

Do you need computer-controlled equipment to work the satellites?

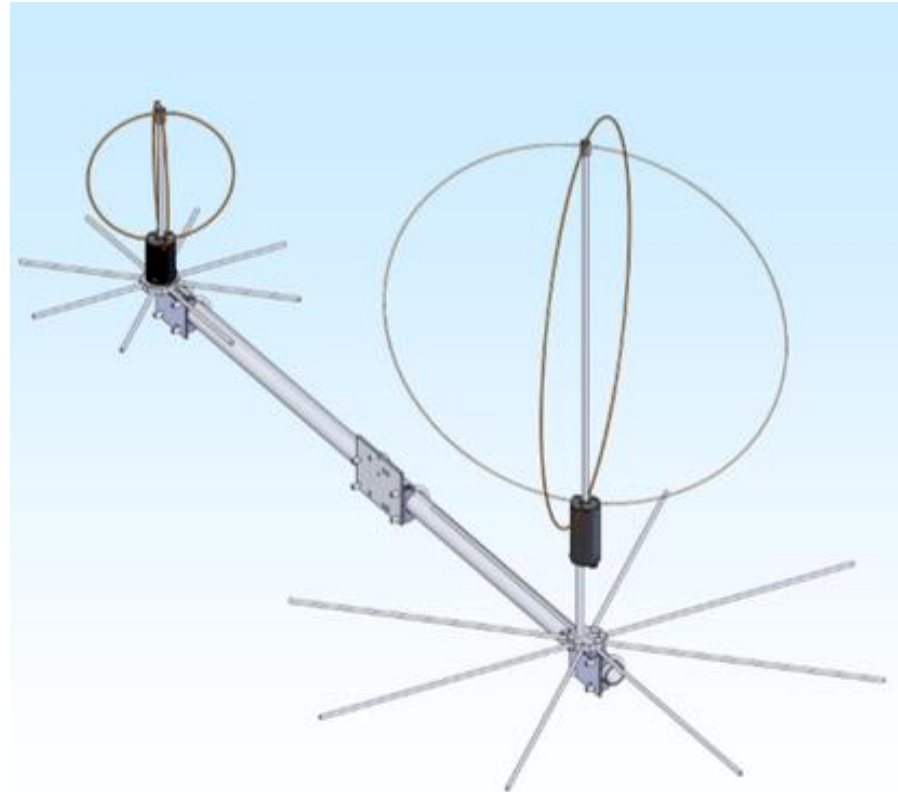
NO

Does it make it easier?

YES

SATELLITES FOR THE RADIO AMATEUR

For those who want to buy a commercially made antenna that doesn't require rotation, M2 Antennas offer this dual bander which they call a SATPACK #1.



SATELLITES FOR THE RADIO AMATEUR

**This is N8SGZ's M2
SATPACK antenna from his
QRZ page.**

**I have worked him on SSB
via the RS-44 satellite with
a good signal.**



SATELLITES FOR THE RADIO AMATEUR

Homebrew omni antenna possibilities are Lindenblad and quadrifilar antennas.

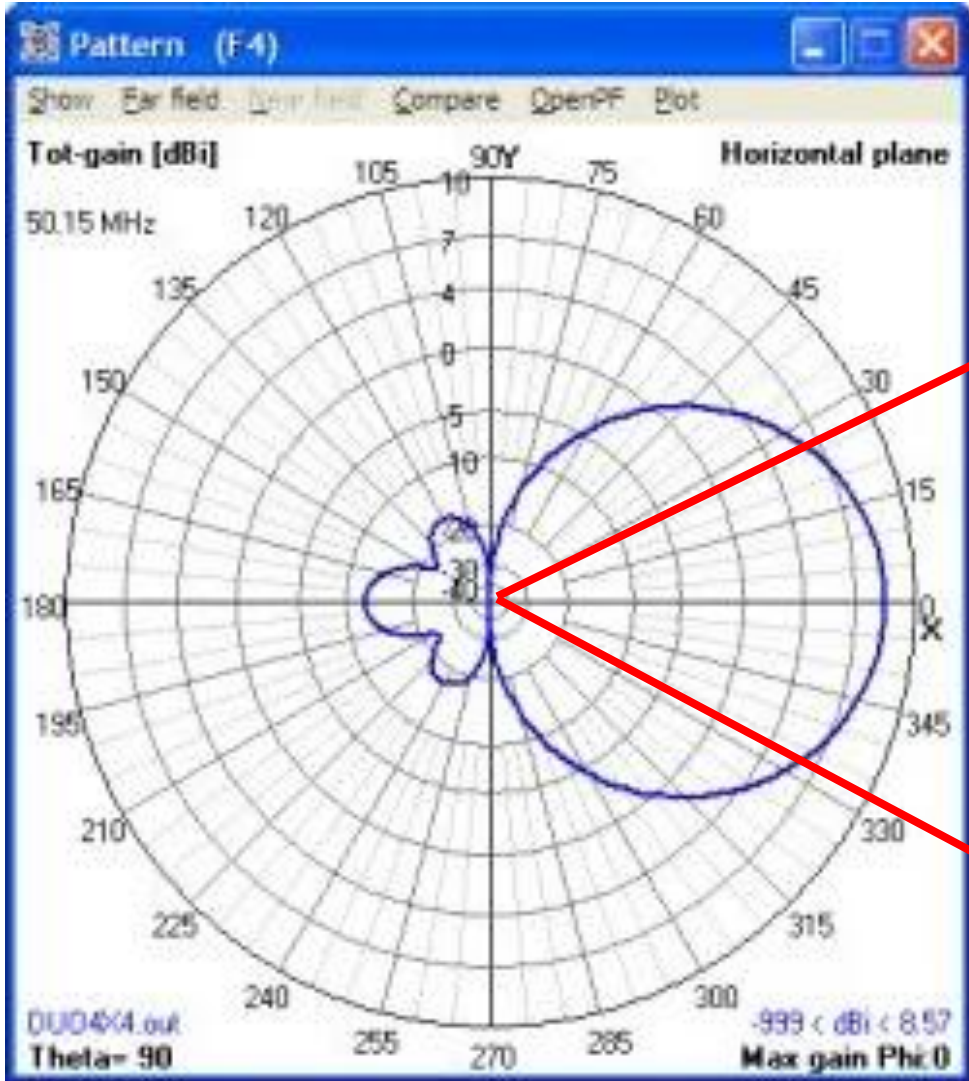
For those who want a little better antenna there are many options

Let's talk about that?

SATELLITES FOR THE RADIO AMATEUR

Let's talk antennas.....

This 8 element Yagi antenna has a 50 degree half power beamwidth. So, when you are using it the beam shape is like an ice cream cone, not like a laser.



From WIMO website 8 element Yagi

SATELLITES FOR THE RADIO AMATEUR

MY HOMEBREW FIXED ANTENNAS FOR LOW ALTITUDE SATELLITES

SEE WHAT YOU CAN
MAKE WITH THE JUNK IN
YOUR GARAGE



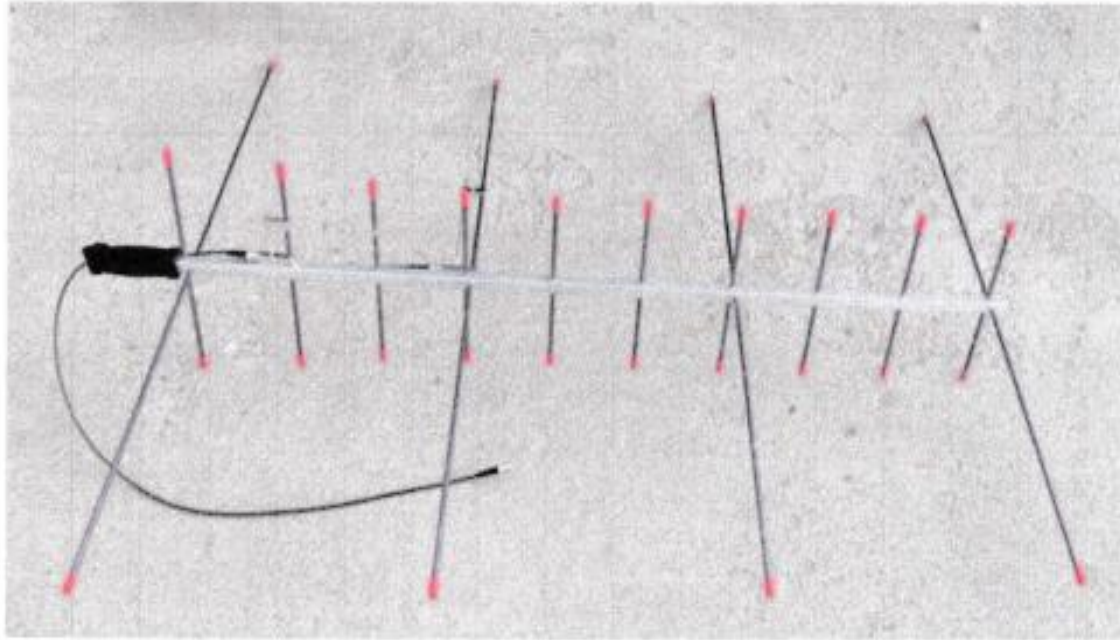
3.5 TURN HELICAL
FOR 435 MHZ

2 ELEMENT CROSSED MOXON
FOR 2M FROM QST AUGUST 2001

SATELLITES FOR THE RADIO AMATEUR

HANDHELD ANTENNAS WORK FOR LOW ALTITUDE SATELLITES

THIS IS A VERSION OF THE ARROW ANTENNA



K6LK USING ELK ANTENNA



ONE CANADIAN HAM I HAVE WORKED ON THE LINEAR SATELLITES USES A ELK ANTENNA FIXED AT 30 DEGREES ELEVATION WITH A SMALL TV ROTATOR FOR AZIMUTH

SATELLITES FOR THE RADIO AMATEUR

HANDHELD ANTENNAS WORK FOR LOW ALTITUDE SATELLITES

IS ANYONE ACTUALLY USING THESE ANTENNAS AT LOW POWER ?

NDØC VUCC QRP WAZ QRP DXCC 319

Date	UTC	MHz	RS(T)	2-way
Confirming QSOs with N1DM				
04/May/2021	01:50	2 CW	579	
01/May/2021	12:18	2 SSB	59	

Confirming QSO(s) with
N1DM

QSL via

Randy Shirbroun
1745 N. Douglas Avenue
Worthington, MN 56187
U.S.A. *Thanks for the RS-44 QSOs!*

Ten Tec Argonaut 509 - 3 watts output
 Yaesu FT897 D - 5 watts output
 Yaesu FT DX 3000 - 5 watts output
 Yaesu FT817/818 combo ←

Cycle 24 TX38 triband Yagi at 12.2 meters
 Cushcraft D40 - rotatable dipole at 12.6 meters
 M² 6M5XHP - 5 element Yagi at 14 meters
 Wire dipole (balance line fed with MFJ tuner)
** Arrow II Yagi* ←

73,
Randy
Pse QSL Tnx

KB3IFH QSL Cards

RANDY HAS 605 GRID SQUARES CONFIRMED FOR HIS SATELLITE VUCC AWARD

SATELLITES FOR THE RADIO AMATEUR

What about using a FM (vertical) or horizontal beam pointed at the horizon

They will work for low angle passes but for anything above 30 degrees elevation they will be a poor performer.

SATELLITES FOR THE RADIO AMATEUR

WHAT TO AVOID

Avoid the typical dual band vertical antennas

They are designed to squirt energy at the horizon and little else. Being dual band their patterns are not always clean.

It is possible to work satellites as they come over the horizon but only for a short time. It is very demanding to have a QSO with these antennas.

SATELLITES FOR THE RADIO AMATEUR

Do you need high power VHF and UHF equipment to work the satellites?

NO, NO, NO

5 watt to 25 watt radios are just fine

SATELLITES FOR THE RADIO AMATEUR

HOW DO I FIND SATELLITE ORBITAL PREDICTION

WWW.AMSAT.ORG Allows you to generate tracking information for active ham satellites for your QTH. They also sell satellite tracking programs.

[HAM RADIO DELUXE](#) has a satellite tracking module that works well and has all current satellites.

WWW.N2YO.COM and **[HTTPS://SAT.FG80J.COM](https://SAT.FG80J.COM)** also provide excellent tracking prediction capabilities

SATELLITES FOR THE RADIO AMATEUR

**TO GET SATELLITE ORBIT
PREDICTIONS FOR YOUR
LOCATION GO TO**

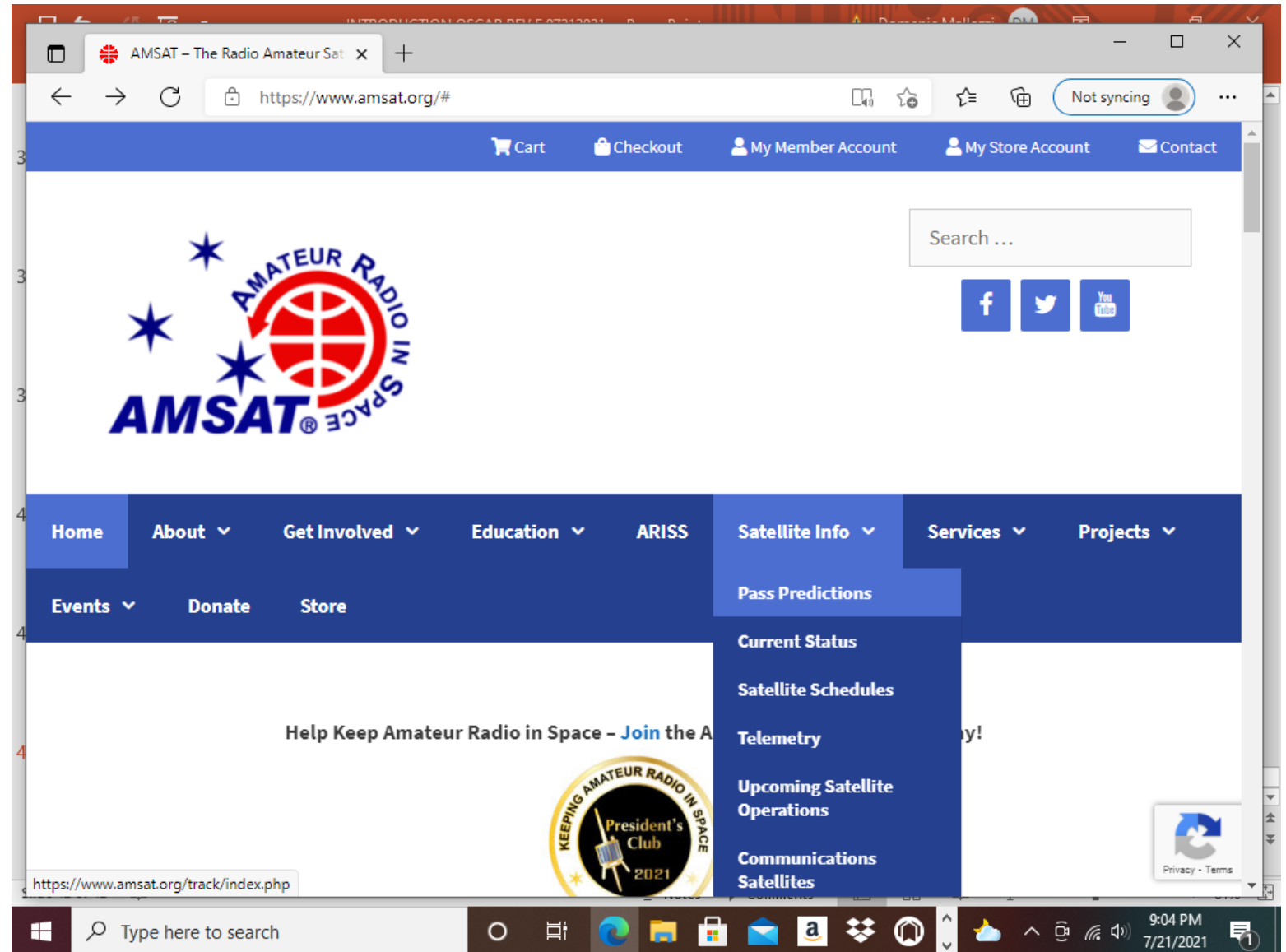
WWW.AMSAT.ORG

CLICK ON

THE 'SATELLITE INFO' TAB

AND THAN

**SELECT 'PASS
PREDICTIONS' FROM THE
PULL-DOWN MENU**



The screenshot shows a web browser window displaying the AMSAT website. The browser's address bar shows the URL <https://www.amsat.org/#>. The website's header includes a navigation bar with links for 'Cart', 'Checkout', 'My Member Account', 'My Store Account', and 'Contact'. Below the header is a search bar and social media icons for Facebook, Twitter, and YouTube. The main navigation menu is open, showing options like 'Home', 'About', 'Get Involved', 'Education', 'ARRIS', 'Satellite Info', 'Services', and 'Projects'. The 'Satellite Info' menu is expanded, highlighting 'Pass Predictions' and listing other options: 'Current Status', 'Satellite Schedules', 'Telemetry', 'Upcoming Satellite Operations', and 'Communications Satellites'. The website's logo, 'AMSAT AMATEUR RADIO IN SPACE', is prominently displayed in the center. At the bottom of the page, there is a banner for the 'President's Club 2021' with the text 'Help Keep Amateur Radio in Space - Join the A...'. The browser's taskbar at the bottom shows the Windows logo, a search bar, and various application icons, with the system clock indicating 9:04 PM on 7/21/2021.

**YOU WILL
THAN GET
THIS SCREEN
FROM THE
WEBSITE**


INTRODUCTION OSCAR REV K 07252021 - PowerPoint

Domenic Mallozzi DM

AMSAT - AMSAT Online Satellite x

https://www.amsat.org/track/index.php

Not syncing



AMSAT
AMSAT Online Satellite Pass Predictions

PO Box 27
Washington, DC 20044-0027
1-888-322-6728

AMSAT Online Satellite Pass Predictions

Please select a satellite and provide your latitude, longitude and elevation or calculate them from your grid square. If you choose we will save your position information in a cookie on your system for future predictions.

Show Predictions for:	ISS	for Next	10	Passes
Calculate Latitude and Longitude from Gridsquare:	<input type="text"/>	Calculate Position		
Or				
Enter Decimal Latitude:	<input type="text"/>	North		
Enter Decimal Longitude:	<input type="text"/>	West		
Elevation in meters AMSL:	<input type="text"/>			
Predict				
<input type="checkbox"/> Save my location for later use				

For the best in full featured tracking software visit [The AMSAT Store](#)

Slide

Type here to search

9:39 AM
7/25/2021

PICK A SATELLITE FROM THE PICK LIST

PICK THE NUMBER OF PASSES FROM 10 TO 50 YOU WANT A TABLE FOR

INSERT YOUR SIX FIGURE GRID SQUARE (I.E.: FN42HG)

AFTER MAKING ALL THE SELECTIONS 'PRESS' THE 'PREDICT' BUTTON

ENTER YOUR ALTITUDE IN METERS

AMSL MEANS ABOVE MEAN SEA LEVEL

The screenshot shows the AMSAT Online Satellite Pass Prediction website. The browser address bar shows 'amsat.org/track/index.php'. The page title is 'AMSAT Online Satellite Pass Prediction'. Below the title, there is a form with the following fields and callouts:

- Show Predictions for:** A dropdown menu with 'CAS-4B' selected. Callout: 'PICK A SATELLITE FROM THE PICK LIST'.
- for Next:** A dropdown menu with '10' selected. Callout: 'PICK THE NUMBER OF PASSES FROM 10 TO 50 YOU WANT A TABLE FOR'.
- Calculate Latitude and Longitude from Gridsquare:** A text input field with 'fn42hg' and a 'Calculate Position' button. Callout: 'INSERT YOUR SIX FIGURE GRID SQUARE (I.E.: FN42HG)'.
- Or**
- Enter Decimal Latitude:** A text input field with '42.2709' and a 'North' dropdown menu.
- Enter Decimal Longitude:** A text input field with '71.375' and a 'West' dropdown menu.
- Elevation in meters AMSL:** A text input field with '50.9'. Callout: 'ENTER YOUR ALTITUDE IN METERS' and 'AMSL MEANS ABOVE MEAN SEA LEVEL'.
- Predict** button. Callout: 'AFTER MAKING ALL THE SELECTIONS 'PRESS' THE 'PREDICT' BUTTON'.
- Save my location for later use

At the bottom of the page, there is a link to 'The AMSAT Store' and a copyright notice: 'Copyright©The Radio Amateur Satellite Corporation 2004, 2020 - All Rights Reserved'.



THIS IS WHAT THE AMSAT WEB PAGE RETURNS AFTER YOU PRESS 'PREDICT'

AMSAT Online Satellite Pass Predictions - CAS-4B

[View the current location of CAS-4B](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
08 Mar 21	04:00:42	00:11:44	250	22	225	145	04:12:26
08 Mar 21	08:42:50	00:05:21	254	2	228	202	08:48:11
08 Mar 21	12:34:29	00:05:22	157	2	121	108	12:39:51
08 Mar 21	21:10:21	00:11:05	213	22	157	89	21:21:27
08 Mar 21	22:48:32	00:12:42	245	59	131	78	23:02:14
08 Mar 21	00:29:40	00:12:48	272	77	33	80	00:42:28
08 Mar 21	00:09:52	00:12:32	283	82	209	115	00:22:24
08 Mar 21	02:50:13	00:11:18	278	19	222	152	03:01:31
08 Mar 21	06:33:08	00:02:40	240	6	228	215	06:35:48
08 Mar 21	18:22:45	00:07:09	199	4	129	100	18:29:54

Your results are shown above

Use the form below to request more pass predictions

Show Predictions for: for Next Passes

Calculate Latitude and Longitude from Gridsquare:

Or

Enter Decimal Latitude:

Enter Decimal Longitude:

Elevation in meters AMSL:

Save my location for later use

SEE THE NEXT PAGE FOR AN EASIER TO READ THE TABLE

SATELLITES FOR THE RADIO AMATEUR

AMSAT Online Satellite Pass Predictions - CAS-4B

[View the current location of CAS-4B](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
08 Mar 21	04:00:42	00:11:44	280	22	225	145	04:12:26
08 Mar 21	05:42:50	00:05:21	254	2	228	202	05:48:11
08 Mar 21	19:34:29	00:05:22	157	2	131	106	19:39:51
08 Mar 21	21:10:21	00:11:36	213	22	157	80	21:21:57
08 Mar 21	22:49:32	00:12:42	248	69	181	78	23:02:14
09 Mar 21	00:29:40	00:12:46	272	77	33	90	00:42:26
09 Mar 21	02:09:52	00:12:33	283	63	209	115	02:22:25
09 Mar 21	03:50:13	00:11:18	278	19	222	152	04:01:31
09 Mar 21	05:33:39	00:02:40	240	0	228	215	05:36:19
09 Mar 21	19:22:45	00:07:06	169	4	129	100	19:29:51

**WHAT DOES
THIS ALL
MEAN ?**

**SEE THE
NEXT SLIDE**

SATELLITES FOR THE RADIO AMATEUR

**THIS IS ONE LINE OF THE AMSAT ORBITAL PREDICTION PAGE
WHAT DOES IT MEAN ?**

AMSAT Online Satellite Pass Predictions - CAS-4B
[View the current location of CAS-4B](#)

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
08 Mar 21	04:00:42	00:11:44	280	22	225	145	04:12:26

**ACQUISITION OF SIGNAL
(AOS) TIME IN UTC**

**IF YOU POINT YOUR ANTENNA AT 225 DEGREES
AND A ELEVATION OF 22 DEGREES THIS IS THE
MIDDLE OF THE PASS (CLOSEST APPROACH)**

**LOSS OF SIGNAL
(LOS) TIME IN UTC**

IN SATELLITE LITERATURE 'AZ' MEANS AZIMUTH AND 'EL' MEANS ELEVATION. APOGEE IS THE HIGH POINT OF THE ORBIT AND PERIGEE IS THE LOW POINT OF THE ORBIT. SATELLITE ORBITS ARE NOT TYPICALLY PERFECTLY CIRCULAR.

SATELLITES FOR THE RADIO AMATEUR

YOU MIGHT ASK HOW FAST DOES THE SATELLITE MOVE BY YOU.

14:12 NNW

14:20 OVERHEAD

14:24 AT 150° AZ

Pass beginning

Date: 30-Jan 14:10:40

Az: 325.85° (NW)

Ei (alt): 0.13°

Mag: -

Dist to sat: 3019.9 km

Eclipsed?: NO

Max altitude

Date: 30-Jan 14:17:50

Az: 95.38° (E)

Ei (alt): 87.61°

Mag: -

Dist to sat: 673.8 km

Eclipsed?: NO

Pass ending

Date: 30-Jan 14:24:30

Az: 147.42° (SE)

Ei (alt): 1.07°

Mag: -

Dist to sat: 2840.6 km

Eclipsed?: NO

SO-50 1/30/2026

FROM WWW.N2YO.COM



SATELLITES FOR THE RADIO AMATEUR

WORKING A FM QSO

- **Satellite QSO's on FM are contest style 'callsign and grid square'**
 - **Use a 4-character grid square like FN42**
- **If you have a newer FM radio where you can program wide and narrow bandwidths. Use WIDE for satellites as you would for your local FM repeater.**

SATELLITES FOR THE RADIO AMATEUR

WORKING A LINEAR (CW/SSB) QSO

- **On the linear satellites there is some rag chewing along with contest style QSO's**
- **There is CW FT4 activity on the linear satellites (limited)**
- **Some stations on linear satellites also send signal reports**
- **FT4 has been heard on the linear satellites but AMSAT is discouraging this as it is a continuous duty mode.**

SATELLITES FOR THE RADIO AMATEUR

WORKING A LINEAR (CW/SSB/FT4) QSO

You may also hear digital QSO's using various modes on the linear satellites, FT4 is popular.

Announcements for DX and rare grid square operations can be found on AMSAT's weekly *'AMSAT News Service'* bulletins on their website. These are found on the AMSAT websites *'services'* tab. These bulletins also announces availability of new satellites.

SATELLITES FOR THE RADIO AMATEUR WORKING DX

ANALOG SATELLITES DX RANGES

SATELLITES	ORBIT APOGEE MILES	DX RANGE MILES	MAXIMUM PASS TIME MINUTES
SATELLITES SHOWN IN GREEN ARE FM.			
AO-7 & RS-44	915 - 948	4942 - 5019	23
FO-29 (JAS-1)	830	4741	20
AO-73, AO-91, CAS-3H, IO-86, JO-97, PO-101, SO-50, AO-123	322 - 554	3125 - 3825	11 - 15
INTERNATIONAL SPACE STATION, SO-124, SO-125	237 - 283	3000	10

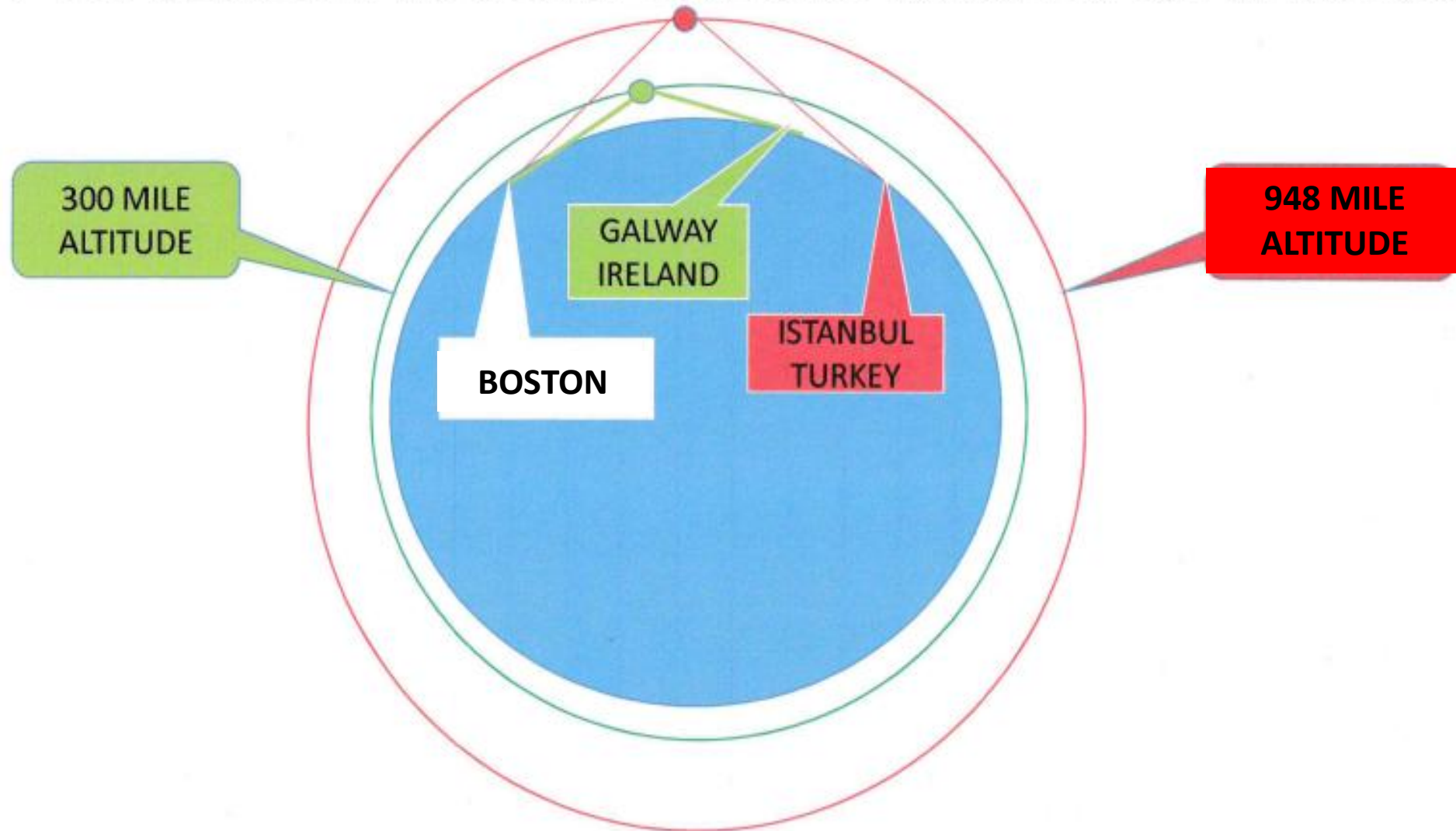
SATELLITES FOR THE RADIO AMATEUR WORKING DX

DIGITAL SATELLITES DX RANGES

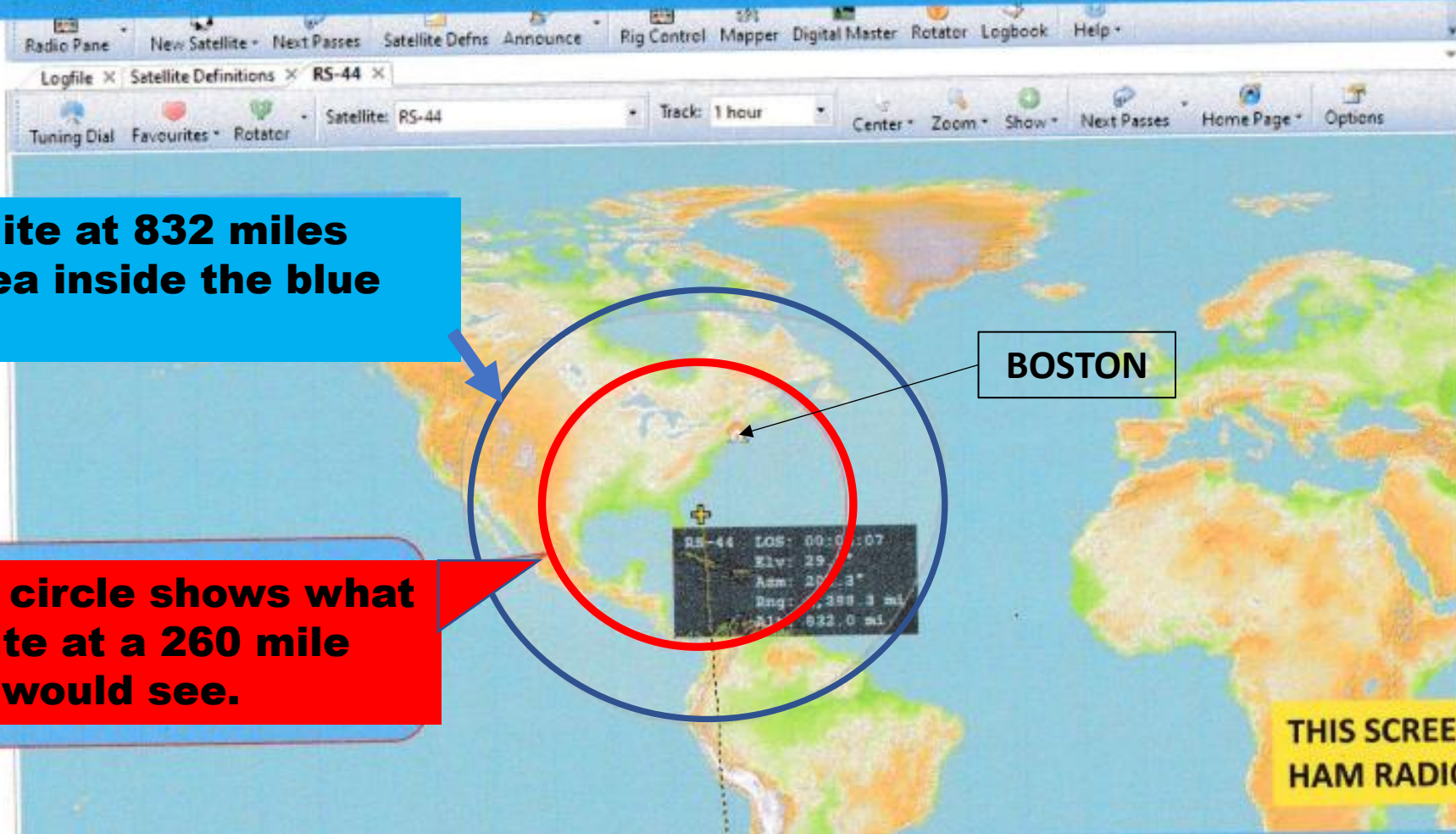
SATELLITES	ORBIT APOGEE MILES	DX RANGE MILES	MAXIMUM PASS TIME MINUTES
NO-44	498	3741	15
ARISS	260	3000	10

SATELLITES FOR THE RADIO AMATEUR

WHY DIFFERENT HEIGHT ORBITS MAKE A DIFFERENCE



SATELLITES FOR THE RADIO AMATEUR

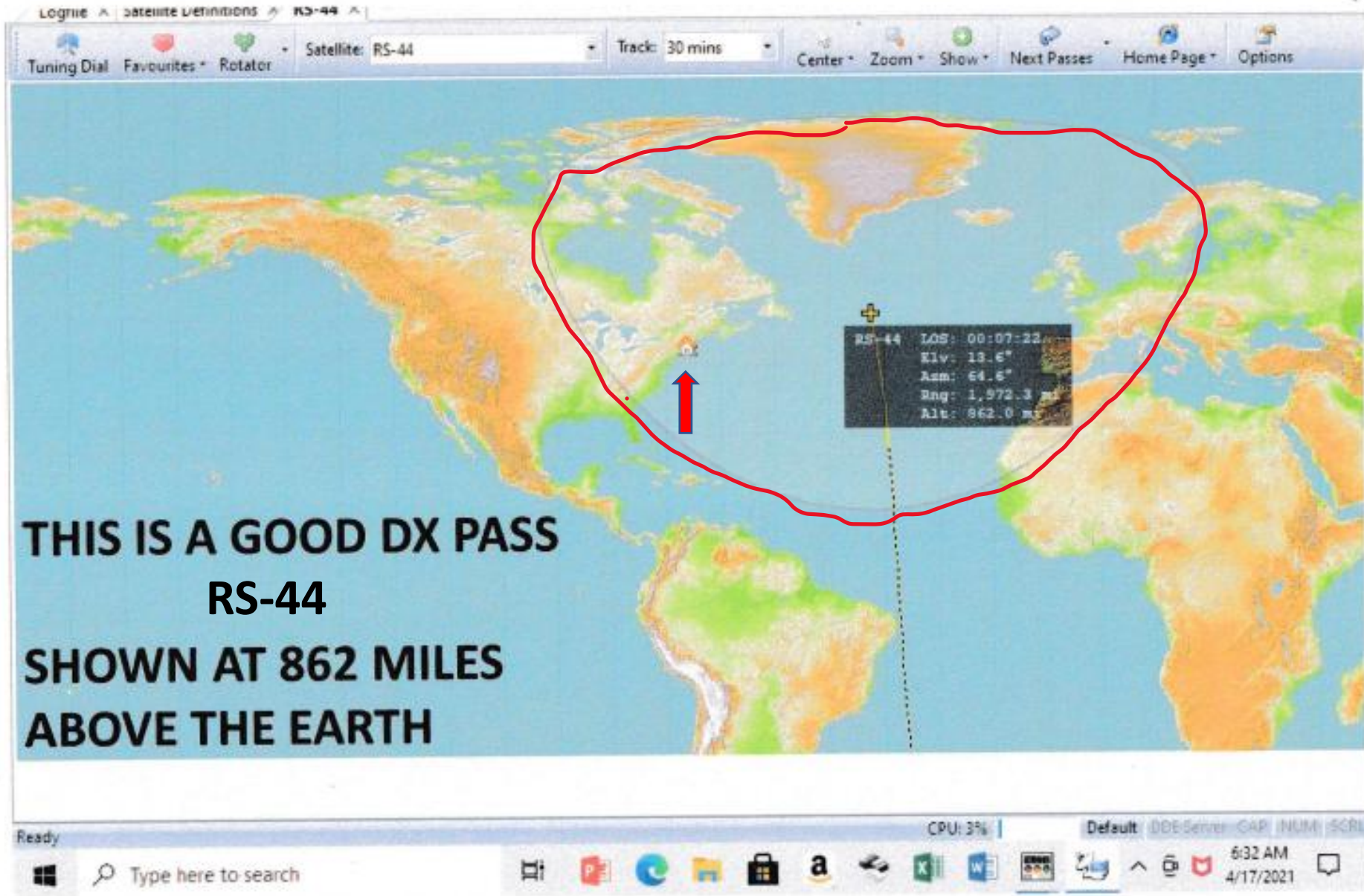


RS-44 satellite at 832 miles sees the area inside the blue ellipse

The red circle shows what a satellite at a 260 mile apogee would see.

The blue circle is the “footprint” for this RS-44 pass as it is over the Miami area. This is what the satellite sees (its ‘footprint’) at a minute in time. Obviously, as the satellite moves this coverage circle moves across its ground path. (Which in this case is south to north)

SATELLITES FOR THE RADIO AMATEUR WORKING DX



SATELLITES FOR THE RADIO AMATEUR WORKING DX

N1DM Since 9/2020

WHAT CAN YOU WORK FROM NORTHEAST U.S.

- **ALL US STATES (EXCEPT HI FOR EASTERN NEW ENGLAND)**
- **EUROPE**
- **CENTRAL AMERICA**
- **NORTHERN HALF OF SOUTH AMERICA**
- **NORTH ATLANTIC (OX, FP AND TF)**
- **NORTHWESTERN AFRICA (INCL. EA8)**

DXCC Entity	Satellite
BERMUDA	VE1CWJ/VP9
BRAZIL	PR8KW
BRITISH VIRGIN ISLANDS	VP2V/K3TRM
CANADA	VE1VOX
CANARY ISLANDS	EA8TL
CAYMAN ISLANDS	ZF2RM
CEUTA & MELILLA	EA9/DL4EA
COLOMBIA	HK4SAN
CUBA	CO8LY
ENGLAND	M0NPT
FEDERAL REPUBLIC OF GERMANY	DL5GAC
FRANCE	F4DXV
GUADELOUPE	FG8OJ
ITALY	IW3HRT
MEXICO	XE1HG
NORTHERN IRELAND	MI0LE
PANAMA	HP2VX
PORTUGAL	CT1CAD
PUERTO RICO	WP4QEC
SABA & SAINT EUSTATIUS	PJ5/K3TRM
SCOTLAND	2M0SQL
SPAIN	EA5WA
UNITED STATES OF AMERICA	KE8FZT
VENEZUELA	YV5KTM

SATELLITES FOR THE RADIO AMATEUR

DOPPLER SHIFT

(OR WHY AM I DRIFTING ?)

Doppler shift is a physical effect that the velocity of the satellite relative to your location on the globe causes an apparent frequency shift that varies as the satellite progresses in its orbit over time. This is due to the satellites velocity, which for ham satellites varies between 15,400 and 16,000 mph.

On 435 MHz this doppler shift is up to 20 kHz, on 2m it is about 7.5 kHz.

SATELLITES FOR THE RADIO AMATEUR

DOPPLER SHIFT

(OR WHY AM I DRIFTING ?)

Doppler shift is worse on direct overhead passes and is especially noticeable on linear satellites at lower altitudes

To compensate for some of this and keep the ‘apparent drift’ to a minimum designers use “inverting” transponders. This means that the transponder receives you on LSB but the output down to the ground is on USB.

SATELLITES FOR THE RADIO AMATEUR

DOPPLER SHIFT

(OR WHY AM I DRIFTING ?)

You need to correct for doppler shift by adjusting your receive vfo to 'follow' the satellite signal.

Many tracking software packages will do this automatically with a transceiver that offers computer control.

Please **do not adjust your transmit frequency**

To compensate for doppler.

SATELLITES FOR THE RADIO AMATEUR

How do I set up a radio for FM satellites to compensate for Doppler ?

Use 5 adjacent MEMORIES to track the Doppler shift

Example for SO-50

ORBIT POSITION	VHF uplink	UHF downlink
Approaching at the horizon	145.855	436.805
Early pass	145.850	436.800
Overhead	145.850	436.795
Late Pass	145.850	436.790
Receding at the horizon	145.845	436.785

SATELLITES FOR THE RADIO AMATEUR

DOPPLER SHIFT

(OR WHY AM I DRIFTING ?)

Not all 'drift' from the center frequency of the satellite is Doppler shift.

Of course, the drift in your radio's local oscillators is a contributor.

The satellites local oscillator will also exhibit drift and especially temperature related drift. As the satellite goes from sunlight to darkness the local oscillator will exhibit this temperature related drift. AO-91 and JO-97 are especially prone to this.

SATELLITES FOR THE RADIO AMATEUR

WHAT RADIO DO I NEED ?

Ideally, you need a multiband VHF/UHF radio that can run full duplex. Full duplex means it can receive on one band while its transmitting on another.

The other option is two radios operating on different bands.

This allows you to hear your signal coming back from the satellite, which is a major advantage when doing satellite operation.

Two old Kenwood TH-F6A HT's work fine as do dual band mobiles like the old Yaesu FT8900 which has duplex operation available.

SATELLITES FOR THE RADIO AMATEUR

WHAT RADIOS DO I NEED FOR LINEAR SATELLITES ?

Multiband, multimode radios useful for linear satellites have been available for over 35 years

Some examples of older radios are:

KENWOOD TS2000

ICOM IC-820

YAESU FT-736R (1987)

YAESU FT-847

YAESU FT-817*

ICOM IC-910

Available today are:

ICOM IC-9700

YAESU FT-818*

ICOM IC-7100

YAESU FTX-1*

ICOM IC-705*

ICOM IC-905*

You need two radios with an * for full duplex operation

SATELLITES FOR THE RADIO AMATEUR

TRACKING, ROTATOR AND RADIO CONTROL SOFTWARE

➤ FOR PC USERS

***SATPC32* supports current and some legacy radios & rotators**

➤ FOR MAC USERS

***MACDOPPLER* is available and supports current and some legacy radios & rotators**

➤ For *Ham Radio Deluxe* users there is a satellite module

➤ Also, CSN Technologies makes an independent **Sat-Tracker**

SATELLITES FOR THE RADIO AMATEUR

TRACKING, ROTATOR AND RADIO CONTROL SOFTWARE

ALL IN ONE CSN TECHNOLOGIES SAT TRACK



Works with Icom Multi-mode, multi-band Radios with CI-V Interface.

Works with Yaesu Az-el rotators

Accessed using any device with a modern web browser.

Updates satellite data via your and position by internal GPS and using your local WIFI connection.

SATELLITES FOR THE RADIO AMATEUR

TRACKING, ROTATOR AND RADIO CONTROL SOFTWARE

ALL IN ONE
CSN TECHNOLOGIES
S.A.T. TRACK

The screenshot displays the S.A.T. TRACK software interface, which is divided into several functional panels:

- MAP:** A world map showing satellite orbits and ground stations.
- POLAR:** A polar projection map showing the satellite's path relative to the Earth's poles. It includes a legend for Antenna (pink square), AOS (green circle), LOS (red circle), and Satellite (black diamond). The text "©CSN Technologies S.A.T." and "N1DM-FM42hz" is visible.
- GROUND:** A graph showing the satellite's elevation angle over time. The y-axis ranges from 15° to 75°, and the x-axis shows time from 240 to 345. A yellow curve shows the satellite's path.
- TRACK:** A panel for satellite selection and tracking. It includes a text input field for the satellite name (currently "SO-50"), a "SEARCH" button, and links for "Satellite Status", "SatNOGS Map", and "OrbTrack". It displays the following data:
 - SAT: AZ: 320.8° /
 - POS: EL: 0.8°↑*
 - ANT: AZ: 90.0° /
 - POS: EL: 180.0° (REVERSE)
 - RANGE: 2813.5 Km / 1748.2 Mi
- RADIO:** A control panel for the radio. It features several buttons: "ENABLE", "LOCK VFO", "CENTER", "ADD", "QUICK CW", and "Report Status" (with a dropdown arrow). It also includes controls for power (PWR 10%), bandwidth (TBW WIDE), and transmit power level (TX PL 67). Below these are dropdown menus for "MAIN" (FM) and "SUB" (FM). The status bar shows "ACTIVE Mode V/U FM Voice CTCSS 67." and frequency information: "FREQ 45.847 / 436.805" and "DOP -3218Hz / 9638Hz". At the bottom, there is a table for active satellites:

Descr	Up / Mode	Down / Mode
Mode V/U FM	145.850	436.795

SATELLITES FOR THE RADIO AMATEUR

THE CURRENTLY AVAILABLE BOOKS THAT ARE MOST HELPFUL FOR A BEGINNER ARE:

AMSAT'S GETTING STARTED WITH AMATEUR SATELLITES

AVAILABLE FROM AMSAT ON THEIR WEBSITE

(ONLY AVAILABLE AS AN E-BOOK)

AND

AMSATS AND HAMSATS BY ZL3DW

PUBLISHED BY THE RSGB AVAILABLE ON AMAZON

SATELLITES FOR THE RADIO AMATEUR

**THERE ARE A LOT OF RESOURCES FOR GETTING ON THE BIRDS
INCLUDING YOUTUBE AND THE PREVIOUSLY MENTIONED BOOKS**

BUT DON'T FORGET THE AMSAT AND AMSAT UK WEBSITES.

WWW.AMSAT.ORG

WWW.AMSAT-UK.ORG

**THEY HAVE A LOT OF GOOD INFO AND ALSO HAVE UP TO DATE SATELLITE
STATUS INFORMATION**

SATELLITES FOR THE RADIO AMATEUR

**Info on the International Space Station operations is best found at the
ARISS program website**

WWW.ARISS.ORG

**The ISS has 4 operating modes using two Kenwood D710GA transceivers.
The website tells you what modes from the list below are currently active:**

- **FM voice from the astronauts**
- **The FM crossband repeater from VHF to UHF (145.990 to 437.800 MHz)
which is very active and very easy to hear**
 - **Slow scan television from the ISS**
 - **Packet digipeater**

SATELLITES FOR THE RADIO AMATEUR

N1DM's 2026 SATELLITE STATION

ANTENNAS: DIAMOND A144SR2 FIVE ELEMENT YAGI (2M)
CUSHCRAFT A432-20T TWENTY ELEMENT YAGI (70 cm)
EA ANTENNAS EA270ZB9 (2/70) FOR PORTABLE USE

PREAMPS: **JANEL QSA5 2 METER PREAMP**
ADVANCED RECEIVER RESEARCH P432VDG 70 cm PREAMP

ROTATOR: **KENPRO KR-5400 AZ-EL SYSTEM**

RIG FOR FM: **YAESU FT-8900R (10W VHF/10 W UHF) SET FOR MID1 POWER**
OR ICOM IC-9700 SET FOR 10 WATTS WITH CSN SAT-TRACKER

RIG SSB/CW: ICOM IC-9700 SET FOR 10 WATTS WITH CSN SAT-TRACKER

EVERYTHING IN RED HAS BEEN OBSOLETE FOR MANY YEARS

BEST DX WITH THIS STATION WAS 3977 MILE QSO WITH IW3HRT ON RS-44 SATELLITE

**THIS IS MY SATELLITE
ANTENNA ARRAY AT A
HUGE 12 FEET ABOVE
THE GROUND**

**PREAMPS ARE
MOUNTED IN
THIS BOX**



WHY USE PREAMPS ?

**ON VHF AND UHF COAX
CABLES HAVE NOTICEABLE
LOSS.**

**THE 50 FEET OF CABLE
FROM MY SHACK TO THE
ANTENNAS MEANS A LOSS
ON 70 CM OF 1.4 dB AND
ON 2 M OF ABOUT 0.7 dB.**

**FOR THE WEAK SIGNALS OF
SOME SATELLITE PASSES
THIS IS AN ISSUE. PREAMPS
NEAR THE ANTENNAS
COMPENSATE FOR THIS.**

WHAT'S IN THAT PREAMP BOX

2 PREAMPS (2m & 70 cm)
2 DPDT TRANSFER RELAYS
1 FILTER (NOT IN USE)
1 DIPLEXER
1 MONITOR CARD

WHITE COAX CABLES
INSIDE BOX ARE FOR 70 cm
AND THE BLACK CABLES
ARE FOR 2 M.

THE RED CABLE COMING
INTO THE BOX ON THE
LEFT SELECTS WHICH
PREAMP IS ACTIVE AND
PROVIDES POWER FOR
EVERYTHING.

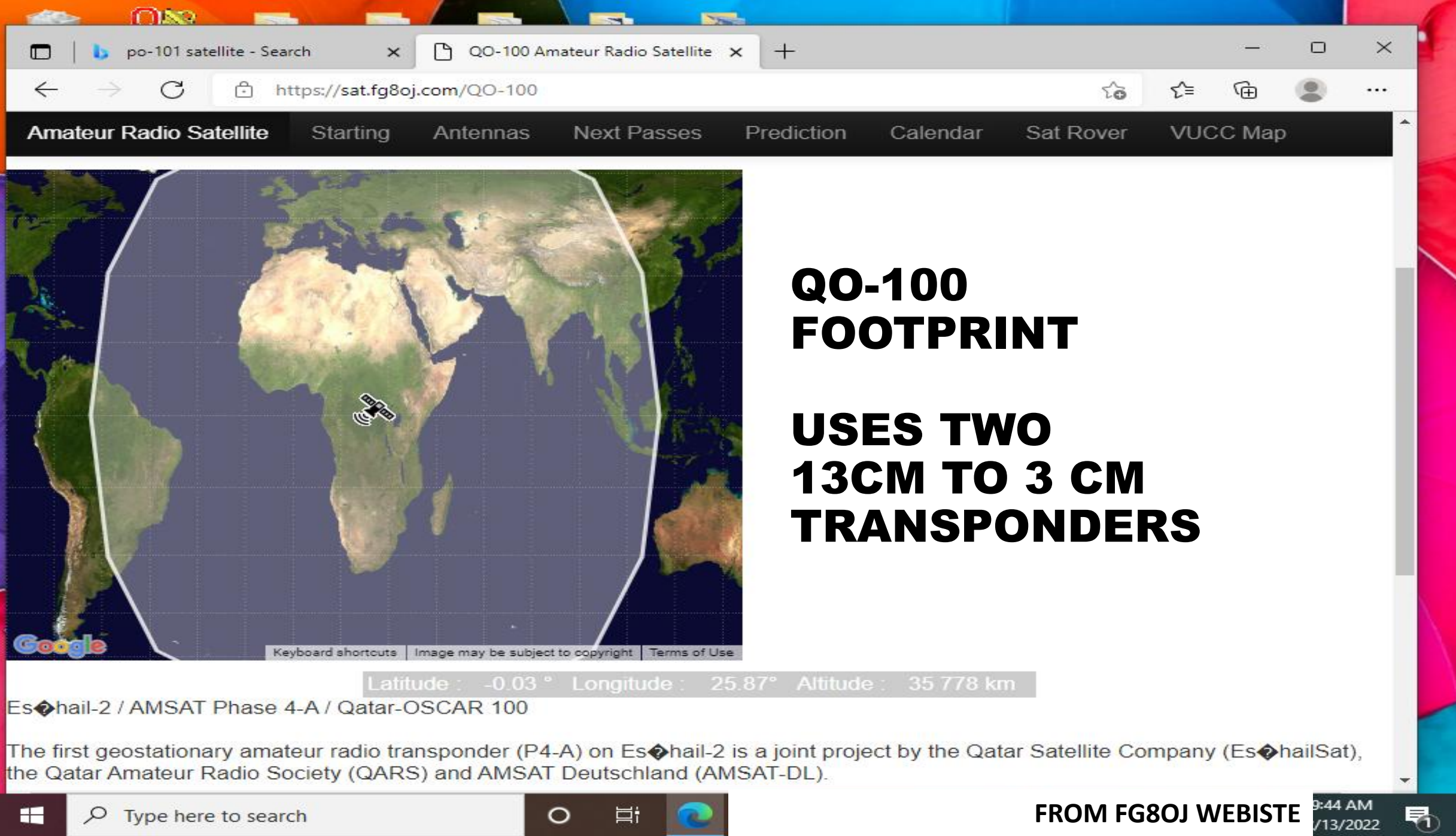


ABOUT HALF THE STUFF IN THIS BOX WERE FLEA MARKET FINDS

SATELLITES FOR THE RADIO AMATEUR

What about amateur geosynchronous satellites ?

Only one currently operational is QO-100 over Africa, which is not workable from the us.



QO-100 FOOTPRINT

USES TWO 13CM TO 3 CM TRANSPONDERS

Latitude : -0.03 ° Longitude : 25.87° Altitude : 35 778 km

Es-hail-2 / AMSAT Phase 4-A / Qatar-OSCAR 100

The first geostationary amateur radio transponder (P4-A) on Es-hail-2 is a joint project by the Qatar Satellite Company (Es-hailSat), the Qatar Amateur Radio Society (QARS) and AMSAT Deutschland (AMSAT-DL).

FROM FG8OJ WEBISTE

SATELLITES FOR THE RADIO AMATEUR

SOME TERMS:

AZ is azimuth which is the point on the compass that the satellite appears at

EL is elevation which is the angle above the horizon that the satellite appears at.

APOGEE is the maximum altitude of the satellite

PERIGEE is the minimum altitude of the satellite

SATELLITES FOR THE RADIO AMATEUR

SOME TERMS:

A **TRANSPONDER** is a linear repeater which takes input signals on a portion of one band and moves them to another band.

DOPPLER SHIFT is the apparent change in frequency of signals from the satellite as it moves relative to your station.

FOOTPRINT is the instantaneous visibility of the satellite on the earth's surface. This determines which stations can talk to each other. Both stations wishing to communicate must be in the satellite's footprint.

UPCOMING SATELLITES FOR THE HAM

Satellite	Uplink	Downlink	Comments
<u>RS83S</u> (Lobachevsky)	435.500 MHz (67 Hz CTCSS)	145.910 MHz	Telemetry and image downlink on 436.320 MHz. It has sent a picture! Experimental X-band downlink on 10.470 GHz.
<u>HADES-SA (SpinnyONE)</u>	145.875 MHz (FSK 200 bps)	436.875 MHz (FSK 200–1600 bps (including CODEC2 and SSDV).	Launched 2026-03-30 11:20 UTC in commissioning.
<u>Lilium-4</u>	145.825 MHz (APRS)	145.825 MHz (APRS)	Launched 2026-03-30 11:20 UTC in commissioning. Satellite Call Sign: BN0YCA Supported Paths: ARISS, WIDE2-1 V/U repeater: Up: 145.980 MHz Downlink: 435.250 MHz.
<u>PARUS-6U1</u>	145.825 MHz (APRS)	145.825 MHz (APRS)	Launched 2026-03-30 11:20 UTC in commissioning. APRS 145.825 MHz, 9k6 GMSK 437.195 MHz. S Band downlink for image data using 2402.000 MHz
<u>Ten-Koh 2</u>	145.895 MHz through 145.935 MHz	435.875 MHz through 435.915 MHz	March 19, 2026: "It is clear that the satellite has some transmission issues, maybe due to not deployed antennas or something else." CW beacon: 5.839 GHz.

SATELLITES FOR THE RADIO AMATEUR

AND NOW FOR YOUR QUESTIONS?