

Amateur Radio Satellites: A General Overview and Understanding of FUNcube 1 and Saudi-Sat 1c

Presented by:

Mike Parkin

GØJMI

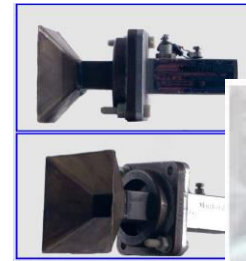
Alton Antenna Arrays



Introduction

Mike Parkin:

- First licensed as G8NDJ in 1977.
- Became GØJMI in 1988.
- Interests in Radio have included:
 - Microwave Bands (Built from 23cm to 6mm)
 - 6m, 10m and 12m operating SSB/CW
 - 60m and 80m CW QRP
 - Building equipment (Tx, Rx, PSU)
 - Antennas (Designing, Building and Using)
 - Operating as /P
 - Propagation
 - Satellites
- QTH: Alton, Hampshire.
- BSC(Hons) MIET CEng MCGI (Electrical, Telecoms & Radio Engineer)



Introduction

Background:

I was asked by Karl, MOICR, if it would be possible to develop a Mini-Beam Antenna for 70cm to be used to work the FUNcube satellite.

The result was the 70MBA 2 element mini-beam covering 432 to 438MHz.

While trying out the prototype 70MBA, I got interested in working satellites.



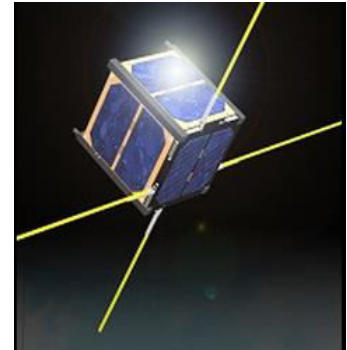
Presentation Content

1. FUNcube 1 Overview.
2. Saudi-Sat Overview.
3. What is Needed to Use Satellites?
4. Tracking Amateur Satellites.
5. Results.
6. Other Satellites.
7. Summary and Q&A Session.

1. FUNcube 1 Overview

FUNcube 1:

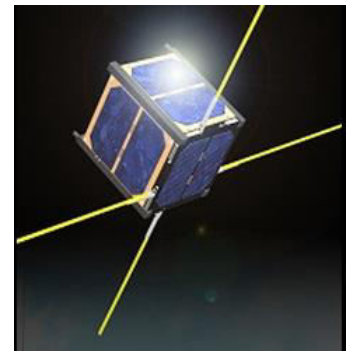
- Built by AMSAT-UK (from 2009).
- Satellite was launched via a Russian DNEPR rocket on 21st November 2013.
- AMSAT-UK closely are associated with the University of Surrey.
- Has designation AO-73.



1. FUNcube 1 Overview

Two Modes of Operation:

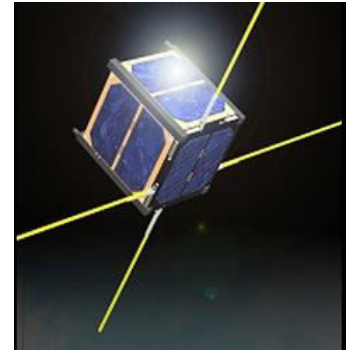
- **Educational Mode.**
Available when the satellite is in sunlight.
- **Amateur Radio Mode (Transponder Mode).**
Available when the satellite is in darkness.



1. FUNcube 1 Overview

Educational Mode.

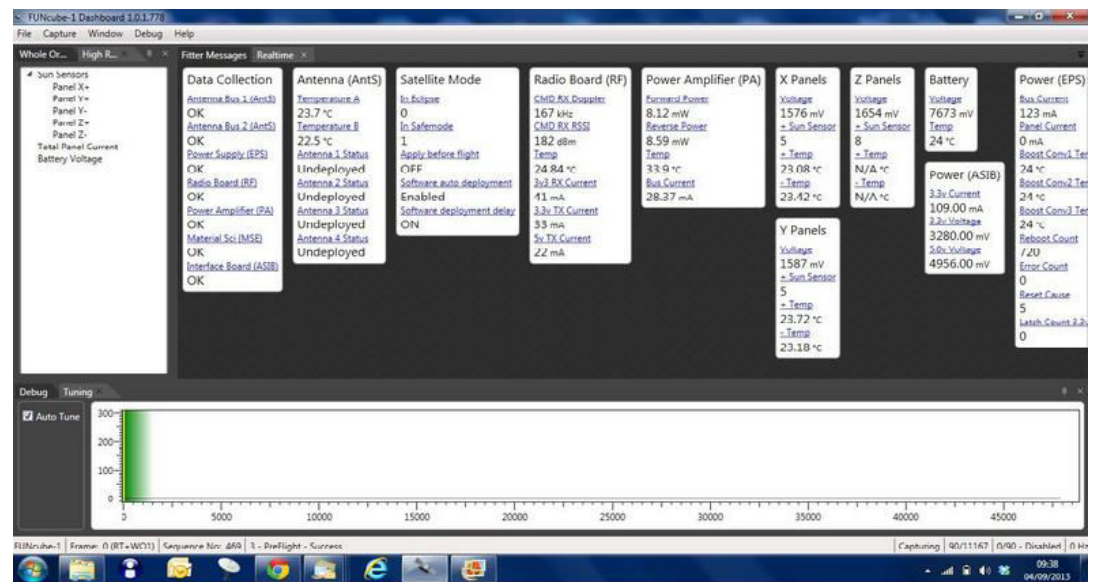
- Available when the satellite is in sunlight on **145.935MHz**.
- Beacon on 145.935MHz supports 1200bps BPSK, power 300mw.
- 58 channels of Telemetry.
- Amateur Radio Mode. Available when the satellite is in darkness.



1. FUNcube 1 Overview

Educational Mode includes:

- Presented to user as a 'Dashboard'.
- Internal and External Temperatures.
- Solar Panel power.
- Altitude and spin.
- Solar Radiation.
- Demonstration of Doppler Effect.



1. FUNcube 1 Overview

Educational Mode:

FUNcube 1, Dongle SDR Receiver:

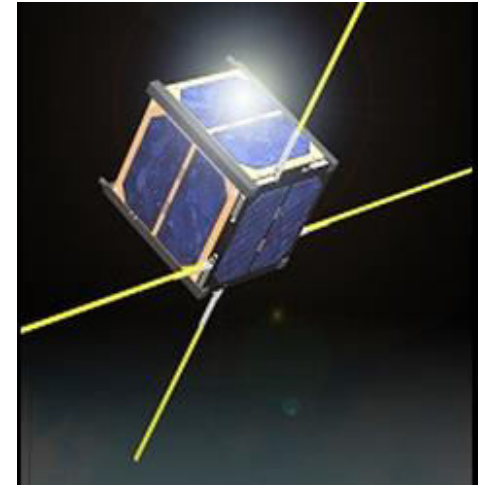


Available online from the FUNcube Dongle Shop or from eBay.

1. FUNcube 1 Overview

Amateur Radio Mode (Transponder Mode):

- Mode of operation:
Single Sideband.
- Uplink Frequency Band:
435.15MHz to 435.13MHz LSB.
- Downlink Frequency Band:
145.950MHz to 145.970MHz USB.
- The satellite's transponder inverts the 70cm uplink signals on the 2m downlink: 435.150Mhz LSB translates to 145.950MHz USB.



1. FUNcube 1 Overview

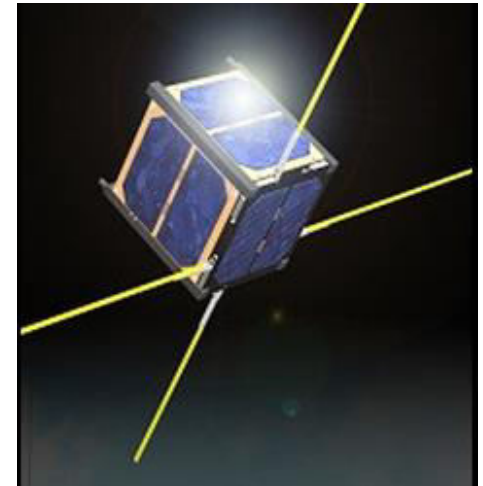
Amateur Radio Mode:

Summary of Radio Details:

- The satellite's transponder runs about 300mW PEP on the 2m downlink to a dipole.
- The uplink antenna uses a separate 70cm dipole.

Physical Details:

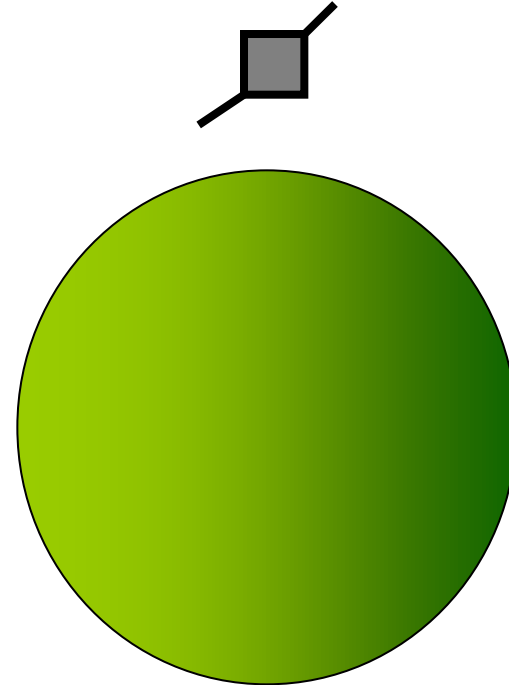
- Dimensions: A cube of 10cm x 10cm x 10cm.
- Weight: About 1kg.
- Power: Solar panels are mounted on the cube's outer six surfaces and charge two internal Lithium Ion cells, providing sufficient power during when the cube is in darkness.



1. FUNcube 1 Overview

Orbit:

- Orbit: Approximately 95 minutes.
- Height: Approximately 670km above the earth's surface.
- Velocity: Approximately 18,000 miles/hour.
- Time in Darkness: Approximately 30 minutes.



2. Saudi-Sat 1c Overview

Saudi-Sat 1c (Saudi-Oscar 50):

- Built by King Abdulaziz City for Science and Technology.
- Launched on 20th December 2002 by a Dnepr Vehicle (converted Russian R-36N Voevoda ICBM, or SS-18 Satan) from the Baikonur Cosmodrome.
- Has designation SO-50 and is the only FM operational satellite.



2. Saudi-Sat 1c Overview

Transponder Mode Summary:

- Mode of operation:
Frequency Modulation.
- Uplink Frequency:
145.850MHz FM using CTSS 67Hz
- Downlink Frequency:
436.8MHz FM.



2. Saudi-Sat 1c Overview

Summary of Radio Details:

- Satellite is really an FM Repeater (Mode J).
- The satellite runs about 250mW on the 70cm downlink to a $1/4\lambda$ vertical set at 45° .
- The uplink antenna uses a separate 2m $1/4\lambda$ vertical mounted on one corner of the satellite.
- Has a 10 minutes timer, transmit 145.85MHz FM using 74.4Hz CTSS to unlock.

Physical Details:

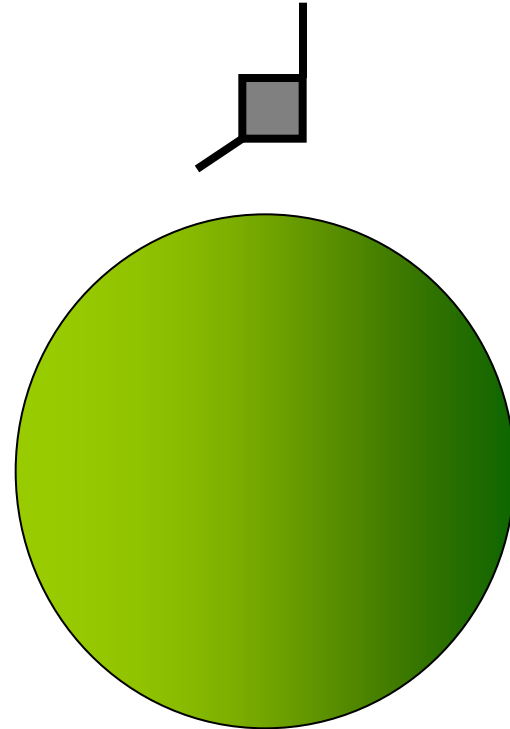
- Dimensions, about 25cm cubed.
- Weight: About 10kg.
- Power: Solar panels are mounted on the outer surfaces and charge internal batteries to provide sufficient power during when the satellite is in darkness.



2. Saudi-Sat 1c Overview

Orbit:

- Orbit: Approximately 98 minutes.
- Height: Approximately 640km above the earth's surface.
- Velocity: Approximately 18,000 miles/hour.
- Time in Darkness: Approximately 30 minutes.



3. What is Needed to Use Satellites?

Antennas:

- Satellite Operators recommend Maximum 7dBi directive gain.
- This equates to about a 5 element beam on 2m or a 7 element on 70cm.

Transmit Power Levels:

- Satellite Operators recommend using 5 to 10 watts.

Radio Equipment:

- Able to transmit and receiver SSB and FM modes,
- CTSS capability for FM transmissions.

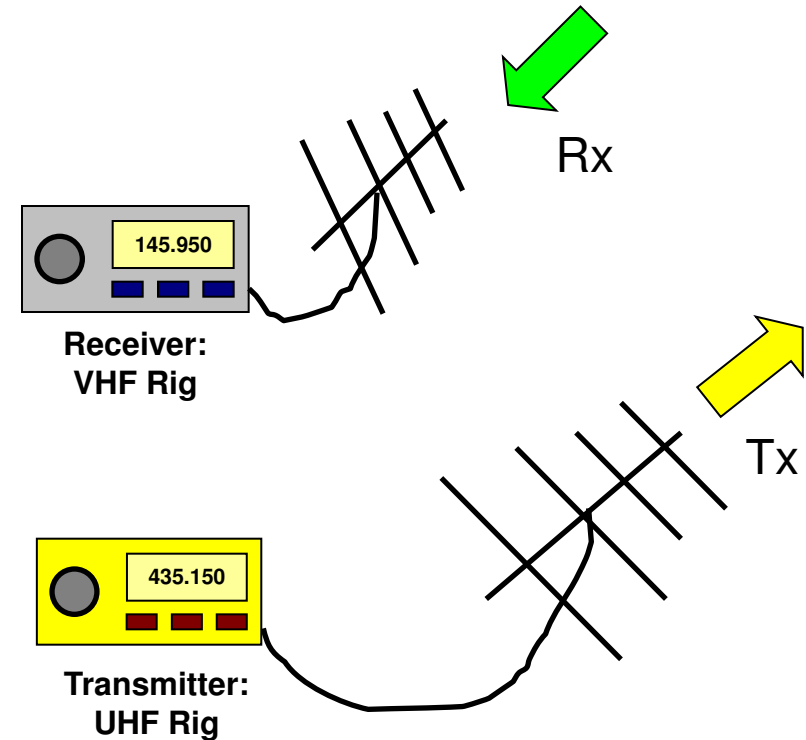


3. What is Needed to Use Satellites?

Receiving Arrangements:

A separate transmitter and receiver can be an advantage so that you can hear your signal coming back on the downlink.

Example shows an arrangement for working through FUNcube.



Actual Operating Time Length:

From about 6 to 8 minutes, depends upon the satellite's elevation.

3. What is Needed to Use Satellites?

Example antennas:



2MBA and 70MBA
antennas (2 Element
Mini-Beams).



2m 4 Element and 70cm 7 Element
combined Yagi Antennas on Tracking
System (based on an old rotator).



3. What is Needed to Use Satellites?

Basic Guidance:

If the propagation conditions on 2m and 70cm are poor, then the lower atmosphere's conditions towards the satellite will tend not be to good.

If propagation conditions are fine for 2m and 70cm, then the lower atmosphere's conditions towards the satellite tend to be fine.

The lower atmosphere can be considered as up to about 10 to 20km above ground level.



23/12/2013



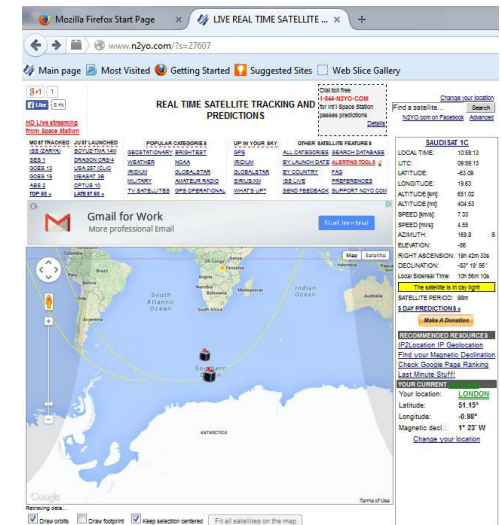
13/02/2014

Pictures from Met Office website

4. Tracking Amateur Satellites.

Several websites available to track satellites.

- A commonly used website is run by N2YO
- This website contains tracking details for many satellites including ISS and NOAA for example.
- A brief summary for a selected satellite is also provided.
- The Link is <http://www.n2yo.com/>



4. Tracking Amateur Satellites.

Enter satellite

REAL TIME SATELLITE TRACKING AND PREDICTIONS

Change your location

Search

N2YO.com on Facebook

Advanced

Select Tracking

Track it now

5-day predictions

Add it to your tracking list

View Track

View track



Select flight

Select flight

View Track

View track

4. Tracking Amateur Satellites.

Start 		Max altitude			End 		Visible passes		
Date, time	Az	Time	Az	EI	Time	Az	Mag	Map	Action
10/6 20:58	ESE 118°	21:03	NE 58°	18°	21:09	N 358°	-	<input type="checkbox"/>	Details
10/6 22:33	S 169°	22:39	W 259°	75°	22:46	N 345°	-	<input type="checkbox"/>	Details
10/7 00:11	SW 225°	00:17	W 276°	11°	00:22	NW 327°	-	<input type="checkbox"/>	Details
10/7 21:18	SE 130°	21:25	ENE 63°	26°	21:31	N 355°	-	<input type="checkbox"/>	Details



Date, Entry
Time and
Bearing

Maximum
Elevation and
Bearing

Exit Time
and
Bearing

5. Results. From March 2014 To Date.

My QTH IO91MD ●

FUNcube 1 ●

Saudi-Sat ●

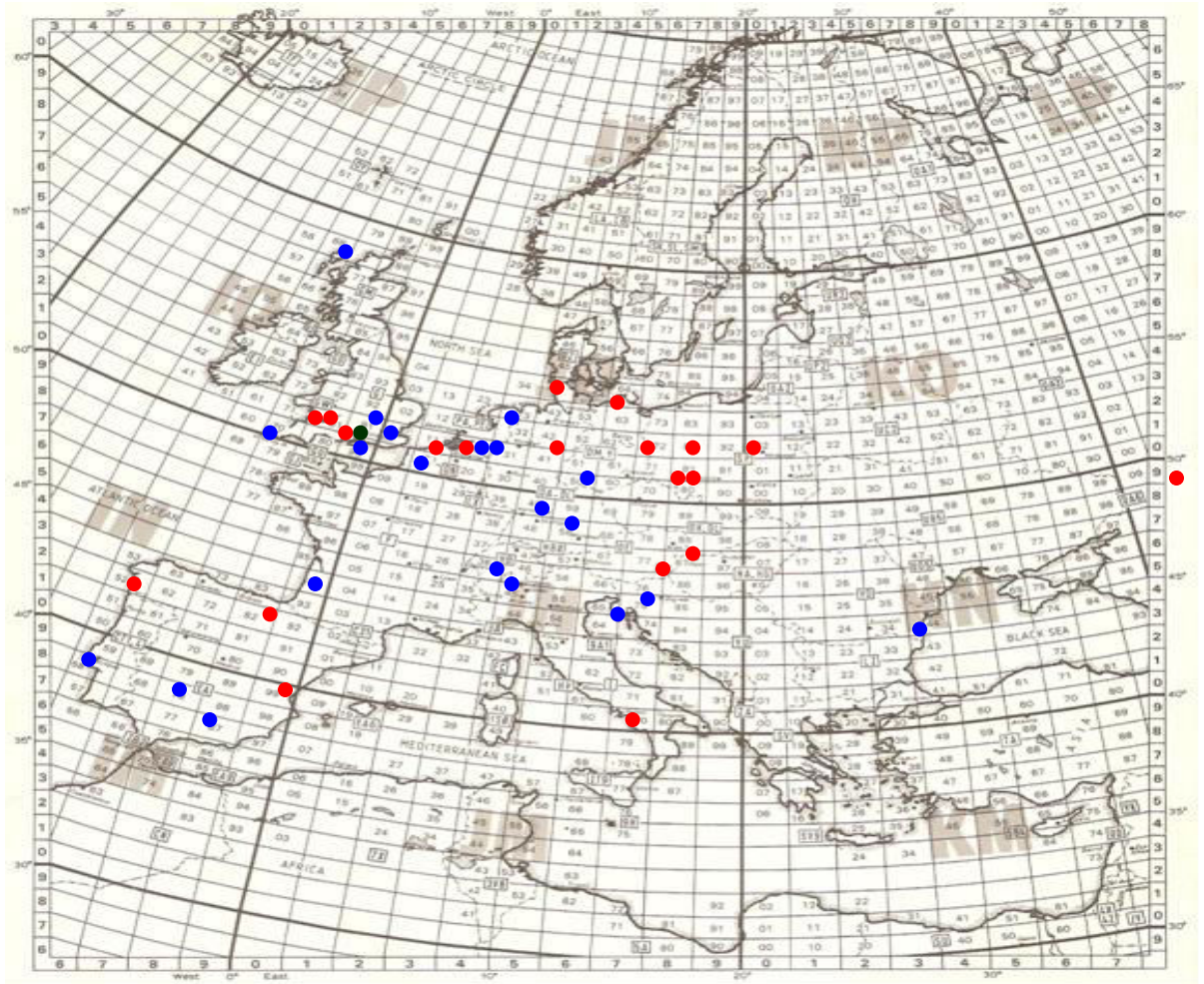
Best Dx:

East: EM200BT KN29LK
via FUNCube (1836km)

North: GS3PYE/P
IO68UL via Saudi-Sat

South: IK8XLD JO70VS
via FUNcube

West: CT2GOY IM58KP
via Saudi-Sat



6. Other Satellites.

Other operational satellites available include:

FO-29 or JAS-2: Launched by Japan on 17/08/1996.

Uses 2m for the Uplink and 70cm for the Downlink. SSB.

Orbits at about 1000km up.

AO-7 or OSCAR 7: Launched by USA on 15/11/1974.

Uses 2m for the Uplink and 10m for the Downlink. SSB.

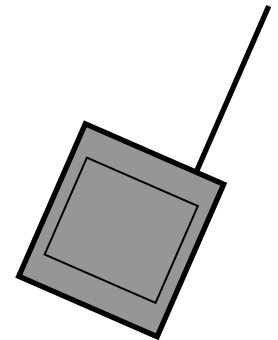
Is only operational in 'Daylight' (has recently come back to life!).

Orbits at about 1450km up.

Sprout, Callsign JQ1ZJQ: Launched by Japan on 24/05/2014.

Operates using Digital Modes and Slow Scan TV.

Orbits at about 650km up.



Presentation Summary

1. FUNcube 1 Overview.
2. Saudi-Sat Overview.
3. What is Needed to Use Satellites?
4. Tracking Amateur Satellites.
5. Results.
6. Other Satellites.
7. Summary and Q&A Session.

Amateur Radio Satellites: A General Overview and Understanding of FUNcube 1 and Saudi-Sat 1c

Questions and Answers Session

- End -

Thank you for Listening

Website: <http://aaa001.webeden.co.uk/>

Note: FUNcube 1 and Saudi-Sat 1c pictures sourced from AMSAT – UK website and ‘Work the Oscars’ blog-spot.