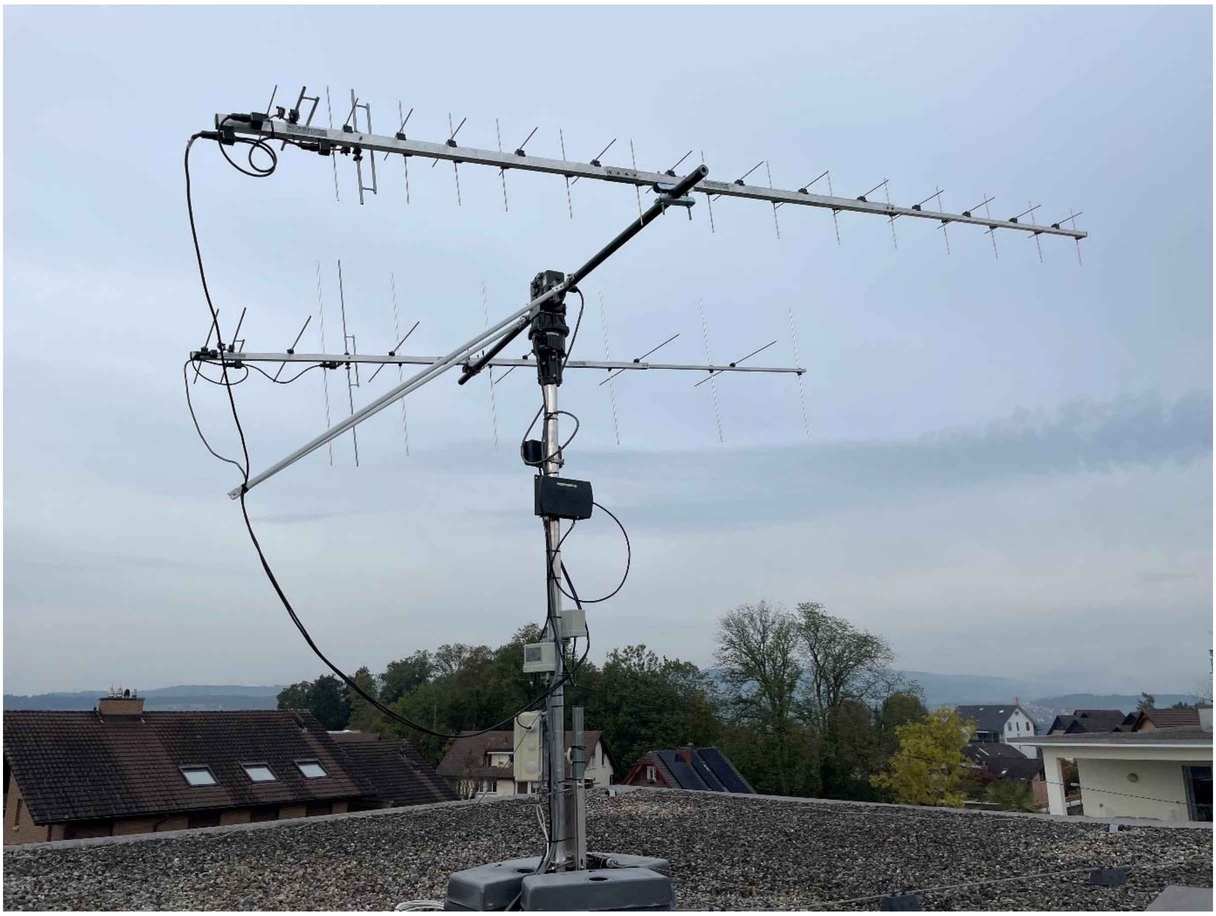
SATELLITEN ÜBERSICHT

Amateurfunk-Station HB9RYZ

Hünenberg, Zug



Dokumentinformationen

Projektname	SAT Bodenstation HB9RYZ
Referenzen	keine

Änderungs-/Versionenkontrolle

Version	Datum	Status	Autor	Bemerkung
0.9	19.02.2022	Entwurf	Wolfgang Sidler HB9RYZ	Initialversion
1.0	17.10.2022	Final	Wolfgang Sidler HB9RYZ	Update

Verteiler

Empfänger	HAM-Community

Zweck des Dokuments

Ziel ist, eine Übersicht über die aktuellen LEO Amateurfunk-Satelliten zu erstellen und mit persönlichen Erfahrungen mit der eigenen SAT Bodenstation zu ergänzen.

Inhalt

1 Zweck

Ziel ist, eine Übersicht über die aktuellen LEO Amateurfunk-Satelliten zu erstellen und mit persönlichen Erfahrungen mit der eigenen SAT Bodenstation zu ergänzen.

Verwendete Quellen:
www.sat.fg8oj.com
www.dk3wn.info/wp/satelliten
https://www.satblog.info/status-2/
https://www.amsat.org/status/
https://amsat-dl.org/satelliten-gestartet
https://amsat-dl.org/satelliten-geplant
www.amsatuk.me.uk/iaru
https://www.n2yo.com/satellites/?c=18

2 Einleitung

Hier eine kurze Übersicht über die verschiedenen Erd-Umlaufbahnen bzw. Satelliten Typen.

MEO (Medium Earth Orbit):
Satelliten mit einer Flughöhe von 6.000 - 36.000 km und einer Umlaufdauer von 4-24 Stunden. Beispiele: GPS, GLONASS, Galileo

HEO (Highly Elliptical Orbit):
Satelliten bewegen sich auf elliptischen Bahnen mit großer Exzentrizität, das heisst grossem Verhältnis von Perigäum (erdnächstem Punkt) und Apogäum (erdfernstem Punkt). Beispiele: Molniya, **AO10**, **AO13 (defekt), AO40 (offline seit 2004).**
Zurzeit gibt es keine HEO Amateurfunk-Satelliten.

LEO (Low Earth Orbit):
Satelliten mit einer Flughöhe von 200 - 1.500 km und einer Umlaufdauer von 1,5 - 2 Stunden. Beispiele: AO 7, FO 29, AO 51, ISS, Wettersatelliten NOAA, Iridium

GEO (Geostationary Orbit):
Geostationäre Satelliten mit einer Flughöhe von 36.000 km. Die Umlaufzeit beträgt genau einen Tag. In Bezug auf die Erdoberfläche sind diese Satelliten ortsfest. Beispiele: Astra, Eutelsat, Inmarsat, Meteosat, in Zukunft **Es'hail 2 (Oscar-100 seit Feb. 2019 aktiv).**

Es gibt viele aktive Satelliten mit Lineartranspondern:
AO 7, FO 29, AO 73, CAS 3G, CAS3 I, CAS 4A, CAS 4B, XW 2A, XW 2B, XW 2C, XW 2D, XW 2F, FUNCUBE 1, FUNCUBE 2 (ON UKUBE 1), EO 88 (NAYIF 1

Aktuell aktive Satelliten mit FM Transpondern sind:
SO 50 (SAUDISAT 1C), AO 73, EO 80, AO 85 (FOX 1A), CAS 3H (LILACSAT 2), LAPAN ORARI

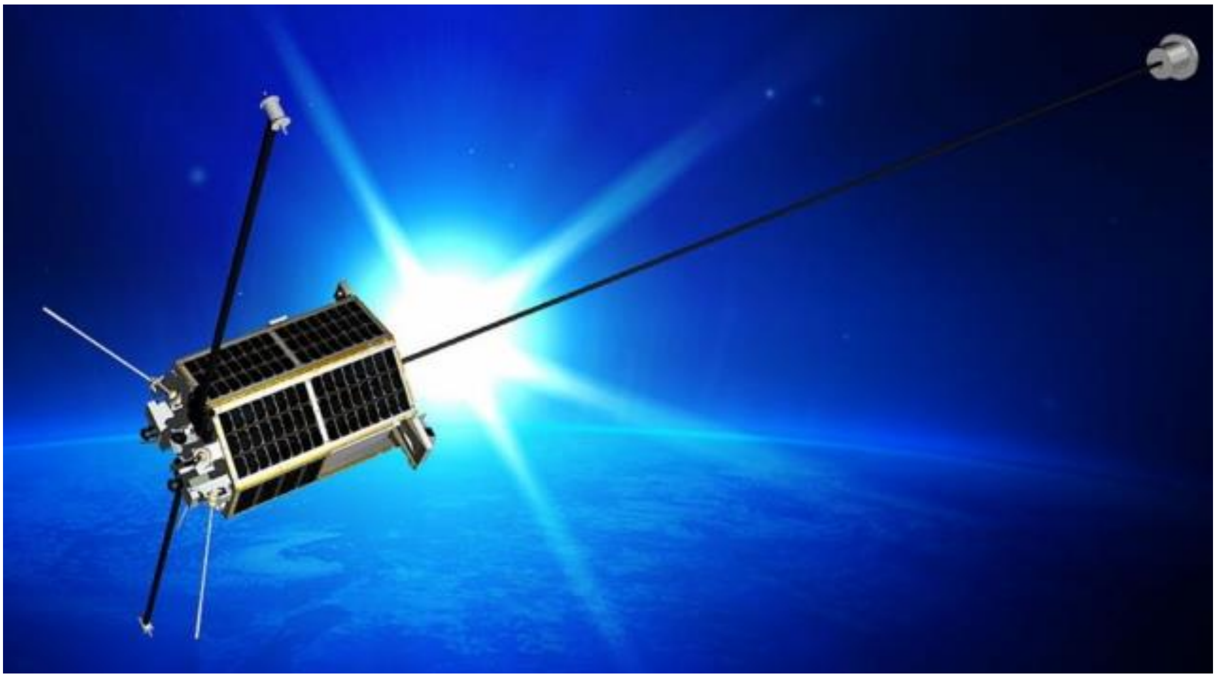
3 RS-44 (DOSAAF-85) -- SSB

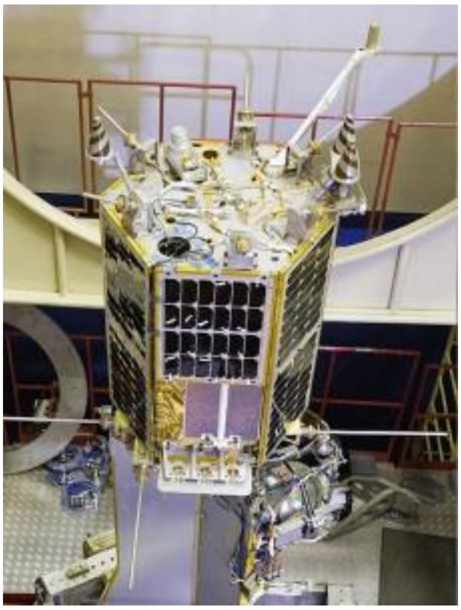
Artist impression of DOSAAF-85/RS-44 flying free but seems to be still attached to Breeze K/M rocket body. The amateur radio linear transponder (SSB/CW) payload on the Russian satellite DOSAAF-85 (RS-44) has been activated.

DOSAAF-85 is a small scientific satellite created by specialists of the company Information Satellite Systems (ISS) Reshetnev and students of the Siberian State Aerospace University (SibSAU) Krasnoyarsk.

The satellite is named after the 85th anniversary of the Voluntary Society for the Assistance to the Army, Aviation and Navy, the organization responsible for the military training of Soviet youth.

The DOSAAF-85 satellite is designed to provide amateur radio communications, as well as to develop promising technologies. This is the third satellite that was created by specialists of ISS-Reshetnev and is based on the Yubileyniy platform, which features a hexagonal prism structure with body mounted solar cells.



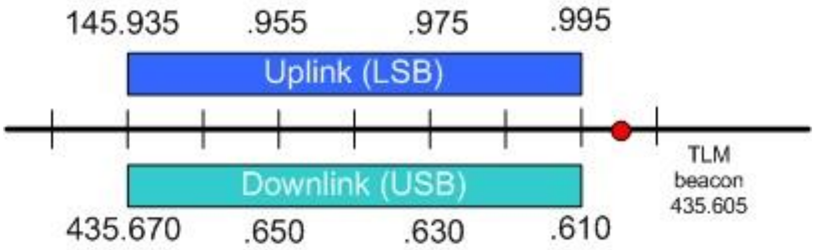
 

The satellite was launched into orbit on December 26, 2019 from the Plesetsk Cosmodrome and is in an elliptical orbit with a perigee of 1175 km, an apogee of 1511 km and an inclination of 82.5 degrees.

Transmitter power:	5 watts
Beacon:	435.605 MHz – transmits CW call sign RS44

Inverting transponder:

Earth-to-Space:	145.965 MHz +/- 30 kHz
Space-to-Earth:	435.640 MHz +/- 30 kHz



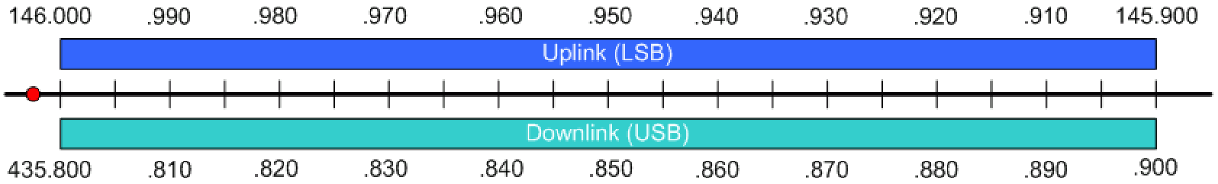
https://amsat-uk.org/tag/rs-44/
https://www.amsat.se/2020/04/30/dosaaf-85-rs-44-aktiv/

4 FO-29 (JAS 2) -- SSB

JAS-2 was successfully launched on August 17, 1996, by H-II rocket No.4, along with the earth observation platform satellite ADEOS, from Tanegashima Space Center of NASDA. Lift-off time was 1053 JST, or 0153 UTC, and after some 38 minutes, JAS-2 was separated. Separation was first reported by NASDA, and then a few minutes later report of signal reception of JAS-2 was transfered to the Space Center from Showa Base at Antarctica through INMARSAT. It orbits the Earth in a polar orbit at 1300 km altitude in a time of 112 minutes. The inclination is 98°. The transmission power of the beacon is 100 mW, the transponder 1 watt.

Orbital parameters

Name	FO-29
NORAD	24278
COSPAR designation	1996-046-B
Inclination (degree)	98.542
RAAN	241.950
Eccentricity	0.0351436
ARGP	103.754
Orbit per day	13.52913747
Period	1h 46m 26s (106.43 Min)
Semi-major axis	7440 km
Perigee x apogee	800 x 1323 km
Drag factor	0.000002448 1/ER
Mean Anomaly	260.297



Mode V/U (J) Linear Transponder (Inverting):
Uplink: 145.9000 – 146.0000 MHz SSB/CW
Downlink 435.8000 – 435.9000 MHz SSB/CW

Mode U Beacon:
Downlink 435.7950 MHz CW

Mode U Digitalker (Rarely Used):
Downlink 435.9100 MHz FM

Mode and Antenna Polarization:
V: RHCP
U: RHCP

https://www.jarl.org/English/5_Fuji/ejasmenu.htm
https://www.dk3wn.info/wp/satelliten/fuji-oscar-fo-29/

5 EO-88 -- SSB

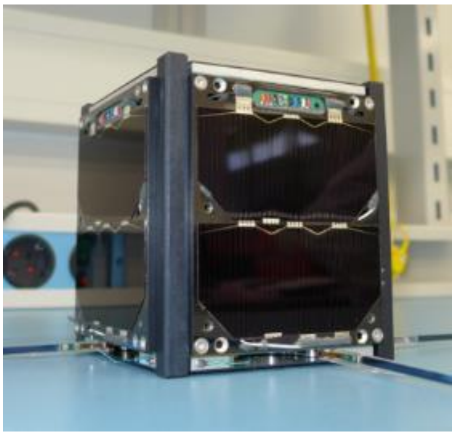
Nayif 1 is the UAE's first 1U CubeSat mission, developed by the Dubai based Emirates Institution for Advanced Science and Technology (EIAST), in partnership with American University of Sharjah (AUS).

The development program aims at investing and developing capabilities of Emirati engineering students in space technologies. A group of Emiratis consisting of seven students from various engineering disciplines at AUS, including computer engineering, electrical engineering and mechanical engineering, have been assigned to the project. Students will go through an intense systems design and testing training and will partake in the program as their Senior Engineering Design project and participate in the design, assembly, integration and testing of the CubeSat. Nayif-1 will carry out a communication mission with development taking place in AUS, EIAST's facilities and Delft in the Netherlands.

Nayif 1 carries the FUNcube 5 amateur communications payload.

Nayif-1 was originally scheduled to be launched piggy-back on board a Falcon-9 v1.2 rocket by the end of 2015. Due to delays, it was moved to a PSLV-XL launch. A ground station will be built at AUS and operated by Emirati engineering students, responsible for mission planning and operations.

After reaching orbit, Nayif 1 received the designation Emirates OSCAR 88 (EO 88).



Mode :	**B** (70cm -> 2m) SSB/CW
Uplink	435,015 - 435,045 LSB
Downlink :	145,960 - 145,990 USB
Mode :	**GMSK Telemetry** Data rate: 1200bps
Downlink :	145,940 FM
Status :	**Active** - Change the status :

6 XW-2A -- SSB

The CAMSAT orchestrated XW-2 (formerly known as CAS-3) amateur satellite system was successfully launched on Saturday, September 19, 2015 at 23:01:14 UT on Beijing's new Chang Zheng 6 (CZ-6) rocket from the Taiyuan Satellite Launch Center (TSLC) in Shanxi.

The XW-2 constellation comprises six satellites of different mass, a 20 kg, three 10 kg and two 1 kg. All six satellites are equipped with substantially the same amateur radio payloads, a 435/145 MHz linear transponder for SSB/CW communications, a CW telemetry beacon and an AX.25 19.2k/9.6k baud GMSK telemetry downlink. Each set of amateur radio equipment has the same technical characteristics, but operates on different frequencies in the 435 MHz uplink band and 145 MHz downlink band.

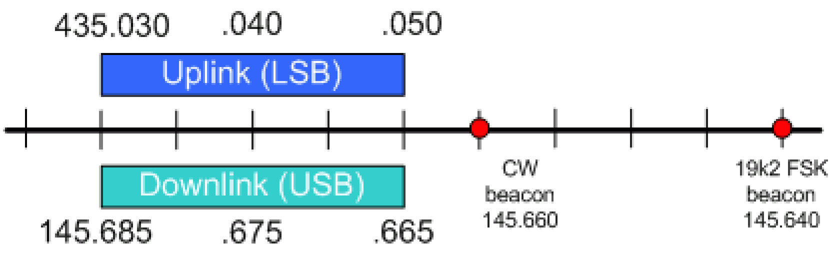
In addition to the XW-2 satellites three other satellites with amateur radio payloads were on the same launch. LilacSat-2 (CAS-3H) which has an APRS digipeater, 144/437 MHz FM voice transponder and SSB/CW linear transponder. DCBB (CAS-3G) and NUDT-Phone-Sat (CAS-3i) have telemetry downlinks.

CAMSAT has released these documents for the satellites:
• XW-2/CAS-3 Frequency Information Chart
• XW-2 CW Telemetry Encoding Format

Corrections to Frequency Information Chart:
– Frequency Allocation Diagram 453.000 MHz should read 435.000 MHz.
– LilacSat-2 FM voice downlink should read 437.200 MHz.
– LilacSat-2 has a Non-Inverting linear transponder not shown in the document

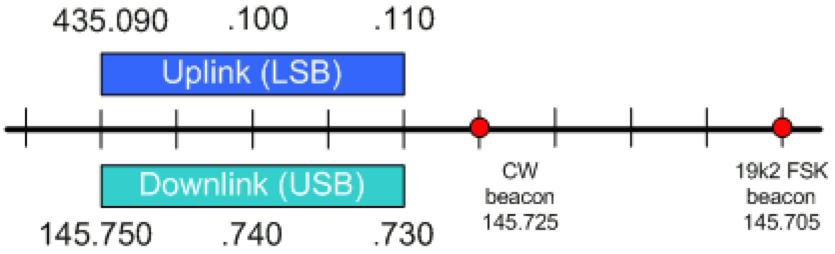
• 144.3425-144.3825 MHz Uplink
• 437.180-437.220 MHz Downlink

XW-2A

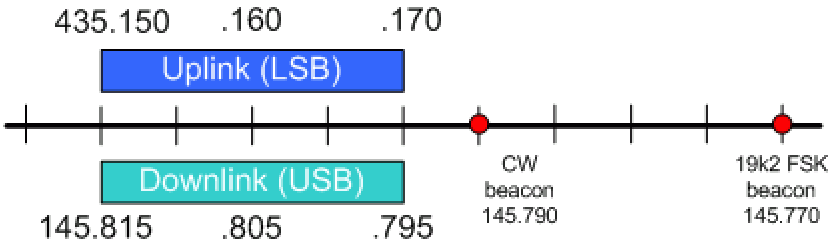


CAMSAT has worked closely with DFH Satellite Co. Ltd (government aerospace contractor) over several years to complete the project. Here are the technical details:

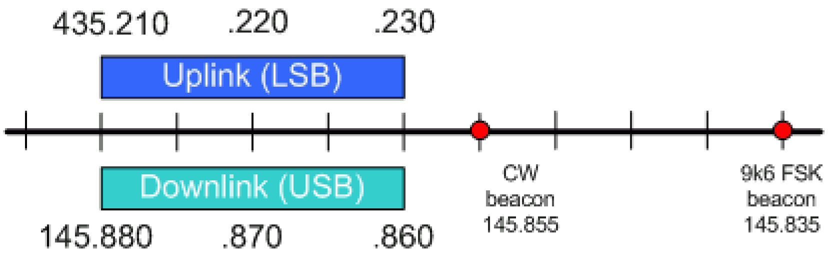
XW-2B



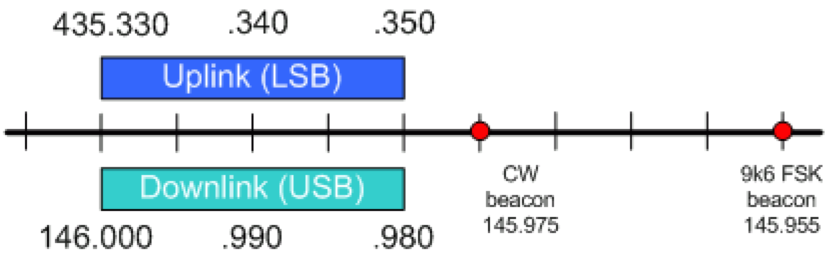
XW-2C

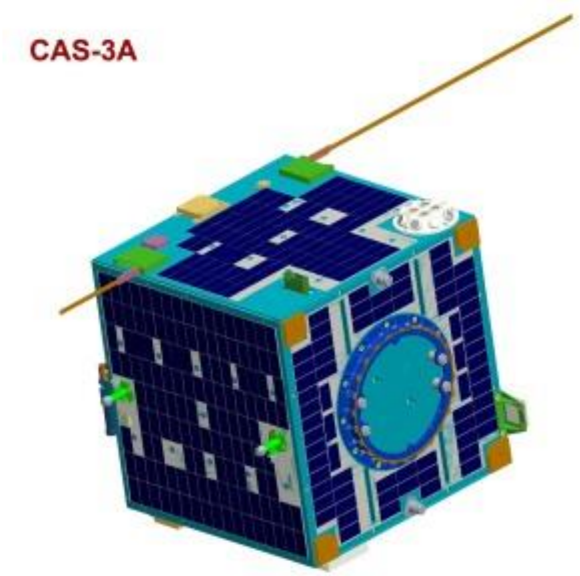


XW-2D



XW-2F





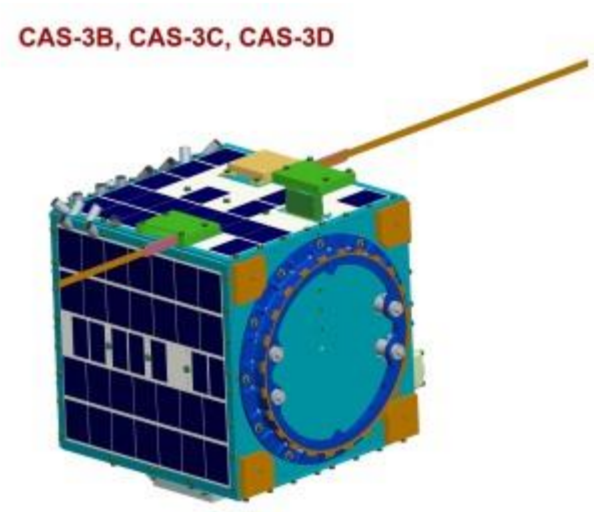
CAMSAT XW-2A formerly known as CAS-3A

XW-2A (formerly known as CAS-3A):
– Micro-satellite architecture
– Dimensions: 400Lx400Wx400H mm
– Mass: 20kg
– Stabilization: three-axis stabilization system with its +Y surface facing the earth
– Antenna: Deployable antenna, one 1/4λ monopole VHF antenna with max.0dBi gain is located at +Z side and one 1/4λ monopole UHF antenna with max.0dBi gain is located at –Z side, close to the each edge of satellite body

– Uplink: 435 MHz band
– Downlink: 145 MHz band
– Amateur radio payloads:

Callsign: BJ1SB
CW Telemetry Beacon: 50 mW, 22 wpm
435/145 MHz Linear Transponder: 100 mW, 20 kHz bandwidth, spectrum Inverting
AX.25 telemetry: 100 mW, 19.2k/9.6 kbps GMSK

https://www.amsat.org/wordpress/wp-content/uploads/2015/09/XW-2CAS-3-Sats.pdf

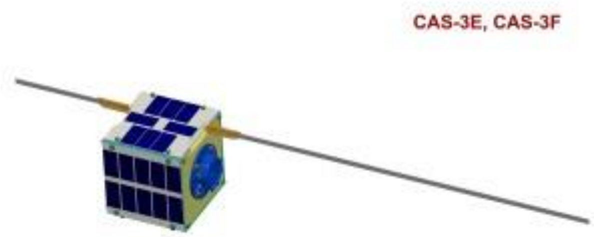


XW-2B, XW-2C and XW-2D:
– Micro-satellite architecture
– Dimensions: 250Lx250Wx250H mm
– Mass: 9kg
– Stabilization: three-axis stabilization system with its +Y surface facing the earth
– Antenna: Deployable antenna, one 1/4λ monopole VHF antenna with max.0dBi gain is located at +Z side and one 1/4λ monopole UHF antenna with max.0dBi gain is located at –Z side, close to the each edge of satellite body

– Uplink: 435 MHz band
– Downlink: 145 MHz band
– Amateur radio payloads:

Callsign: BJ1SC (for XW-2B), BJ1SD (for XW-2C), BJ1SE (for XW-2D)
CW Telemetry Beacon: 50 mW, 22 wpm
435/145 MHz Linear Transponder: 100 mW, 20 kHz bandwidth, spectrum Inverting
AX.25 telemetry: 100mW, 19.2k/9.6 kbps GMSK

XW-2E and XW-2F:

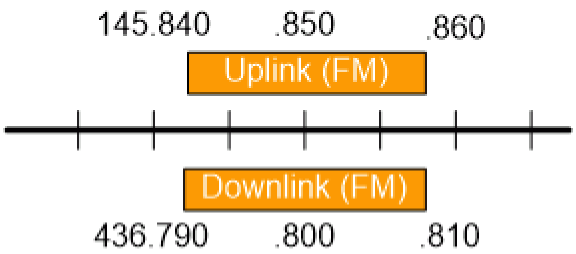


– Cube-satellite architecture
– Dimensions: 110Lx110Wx110H mm
– Mass: 1.5kg
– Stabilization: Spinning stabilization using permanent magnet torquer
– Antenna: Deployable antenna, one 1/4λ monopole VHF antenna with max.0dBi gain is located at +Z side and one 1/4λ monopole UHF antenna with max.0dBi gain is located at –Z side, close to the each edge of satellite body
– Uplink: 435 MHz band
– Downlink: 145 MHz band
– Amateur radio payloads:

Callsign: BJ1SF (for XW-2), BJ1SG (for XW-2)
CW Telemetry Beacon: 50 mW, 22 wpm
435/145 MHz Transponder: 100 mW, 20 kHz bandwidth, spectrum Inverting
AX.25 telemetry: 100 mW, 9.6 kbps GMSK

7 SO-50 (Saudisat 1C) -- FM

Saudisat 1C is a Saudi Arabian picosatellite that was launched by a Dnepr rocket from Baikonur at 17:00 UT on 20 December 2002. SO-50 carries several experiments, including a mode J FM amateur repeater experiment operating on 145.850 MHz uplink and 436.795 MHz downlink. The repeater is available to amateurs worldwide as power permits, using a 67.0 Hertz PL tone on the uplink, for on-demand activation. SO-50 also has a 10 minute timer that must be armed before use. Thus, first transmit an initial carrier with a PL tone of 74.4 to arm the timer. The repeater consists of a miniature VHF receiver with sensitivity of -124dBm, having an IF bandwidth of 15 KHz. The receive antenna is a 1/4 wave vertical mounted in the top corner of the spacecraft. The receive audio is filtered and conditioned then gated in the control electronics prior to feeding it to the 250 mW UHF transmitter. The downlink antenna is a 1/4 wave mounted in the bottom corner of the spacecraft and canted at 45 degrees inward.



Downlink
SAUDISAT-1A 436.775 MHz

Uplink
SAUDISAT-1A 145.850 MHz

Calls
SAUDISAT-1A SASAT1-11 , SASAT1-12

https://www.amsat.org/two-way-satellites/so-50-satellite-information/
https://www.dk3wn.info/wp/satelliten/saudisat-1a-1b-1c/

8 CAS-4A and CAS-4B -- SSB

On Wednesday, October 18, 2017, the amateur radio linear (SSB/CW) transponders on the CAS-4A and CAS-4B satellites were activated.

CAMSAT's amateur radio payloads piggybacked on the optical remote sensing micro-satellites ZHUHAI-1 01 (OVS-1A / CAS-4A) and ZHUHAI-1 02 (OVS-1B / CAS-4B) that were launched at 0300 GMT on Thursday, June 15, 2017 from the Jiuquan Satellite Launch Center, on the CZ-4B launch vehicle. The primary payload of the launch was a hard X-ray modulation telescope satellite (HXMT).

Satellite CAS-4A/OVS-1A/ZHUHAI-1 01:
● Architecture: Micro-satellite
● Dimensions: 494Lx499Wx630H mm
● Mass: 55 kg
● Stabilization: three-axis stabilization system with its +Y surface facing the earth
● Primary Payload: optical Camera with 1.98m resolution

CAS-4A Orbit:
● Orbit type : Sun synchronization orbit
● Apogee: 524 km
● Inclination: 43°
● Period: 95.1 minutes

CAS-4A Amateur Radio Payload:
● Call sign: BJ1SK
● VHF Antenna: one 1/4λ monopole antenna with max. 0 dBi gain located at +Z side
● UHF Antenna: one 1/4λ monopole antenna with max. 0 dBi gain located at -Z side
● CW Telemetry Beacon: 145.855 MHz 17 dBm
● AX.25 4.8k Baud GMSK Telemetry: 145.835 MHz 20 dBm

- U/V Linear Transponder Downlink: 145.870 MHz 20 dBm, 20 kHz bandwidth, Inverted
- U/V Linear Transponder Uplink: 435.220 MHz

CAS-4 Satellite
Satellite Name: CAS-4B/OVS-1B/ZHUHAI-1 02:
- Architecture: Micro-satellite
- Dimensions: 494Lx499Wx630H mm
- Mass: 55 kg
- Stabilization: three-axis stabilization system with its +Y surface facing the earth
- Primary Payload: optical Camera with 1.98m resolution

CAS-4B Orbit:
- Orbit type : Sun synchronization orbit
- Apogee: 524 km
- Inclination: 43°
- Period: 95.1 minutes

CAS-4B Amateur Radio Payload:
- Call sign: BJ1SL
- VHF Antenna: one 1/4λ monopole antenna with max. 0 dBi gain located at +Z side
- UHF Antenna: one 1/4λ monopole antenna with max. 0 dBi gain located at -Z side
- CW Telemetry Beacon: 145.910 MHz 17 dBm
- AX.25 4.8k Baud GMSK Telemetry: 145.890 MHz 20 dBm
- U/V Linear Transponder Downlink: 145.925 MHz 20 dBm, 20 kHz bandwidth, Inverted
- U/V Linear Transponder Uplink: 435.280 MHz

N2YO online real-time tracking:
CAS-4A http://www.n2yo.com/satellite/?s=42761
CAS-4B http://www.n2yo.com/satellite/?s=42759

https://amsat-uk.org/2017/06/15/cas-4a-and-cas-4b-launched/
https://amsat-uk.org/2017/03/13/cas-4a-cas-4b-transponder-sats-2/
https://www.amsat.org/camsat-cas-4a-4b-linear-transponder-payloads-launched/
https://ukamsat.files.wordpress.com/2017/03/camsat-cas-4a-and-cas-4b-news-release.pdf
https://ukamsat.files.wordpress.com/2017/03/camsat-cas-4a-and-cas-4b-news-release.pdf

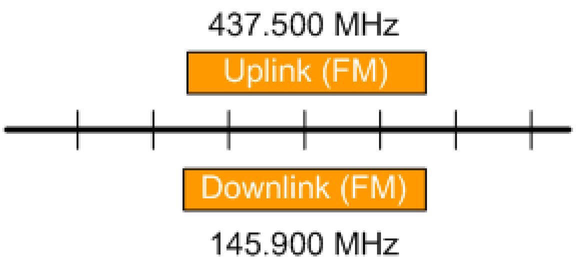
9 PO-101 (DIWATA 2B) -- FM

The Amateur Radio Unit (ARU) introduced in the Philippine microsatellite Diwata-2 is a Philippine-designed and manufactured payload. It mainly operates in the amateur radio band and has the following communication capabilities:

- FM voice repeating (uplink/downlink)
- APRS message repeating (uplink/downlink)
- Morse-based beacon (downlink)
- APRS-based beacon (downlink)

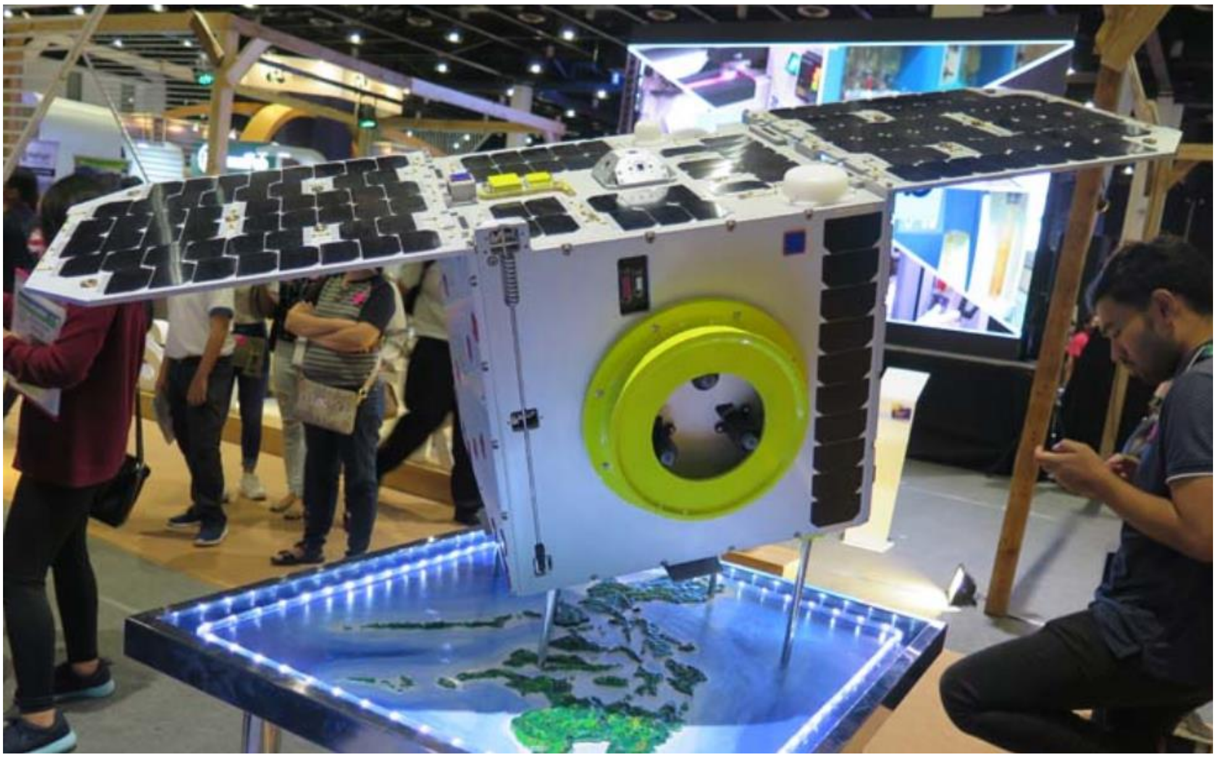
Because of the ARU, Diwata-2 is now designated by AMSAT as Philippines-OSCAR 101 (PO-101). Essential information about the ARU are summarized below.

Parameter	**Value**	**Remarks**
Callsign	**DW4TA -1**	Space character (0x20 hex) is between 'A' and '-1'. The character '-1' is actually 0x01 in hex. Hence, the character array for the callsign is: 'D' 'W' '4' 'T' 'A' [0x20] [0x01]
Downlink frequency (APRS, VR, beacon)	145.9 MHz	PL tone at 141.3 Hz
Uplink frequency (APRS, VR)	437.5 MHz	1200 bps AFSK



FM voice repeater usage
This section assumes that the ARU is operating as an FM voice repeater (FMVR). To listen to voice messages transmitted through ARU, simply tune your device/station to 145.9 MHz. The transmission of voice using ARU entails setting PL tone at 141.3 Hz (if applicable), and transmitting the voice message. The procedure for setting the PL tone varies from device to device, hence it is recommended to refer to your respective device's documentation for more information. After setting the PL tone, the user can simply turn on the PTT signal and talk as s/he needs.

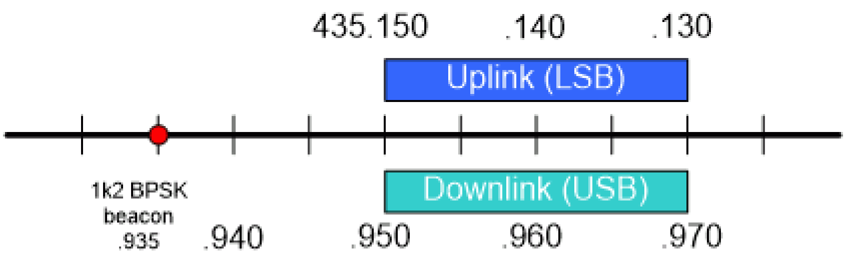
https://blog.phl-microsat.upd.edu.ph/amateur-radio-unit-information-and-usage-db62a589531d
https://amsat-uk.org/2018/08/13/diwata-2-fm-transponder/
https://businessmirror.com.ph/2018/08/12/diwata-2-microsatellite-nears-completion-hando-ver-to-jaxa/



10 ARCHIV

10.1 AO-73 (AMSAT-OSCAR-73 FUNcube-1) -- SSB

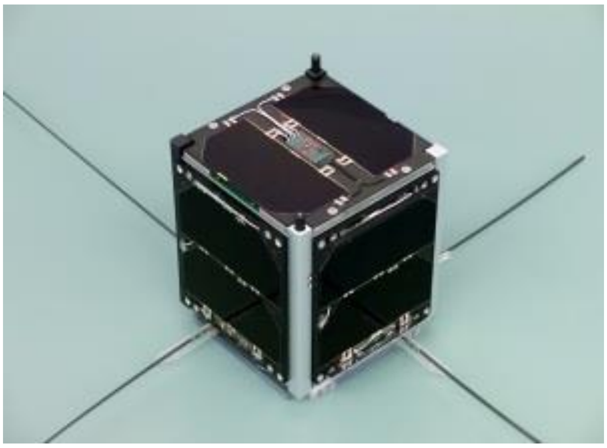
FUNcube-1 was AMSAT-UK's first CubeSat project designed to provide educational outreach for schools and colleges around the world and a two-way SSB/CW communications transponder for radio amateurs.

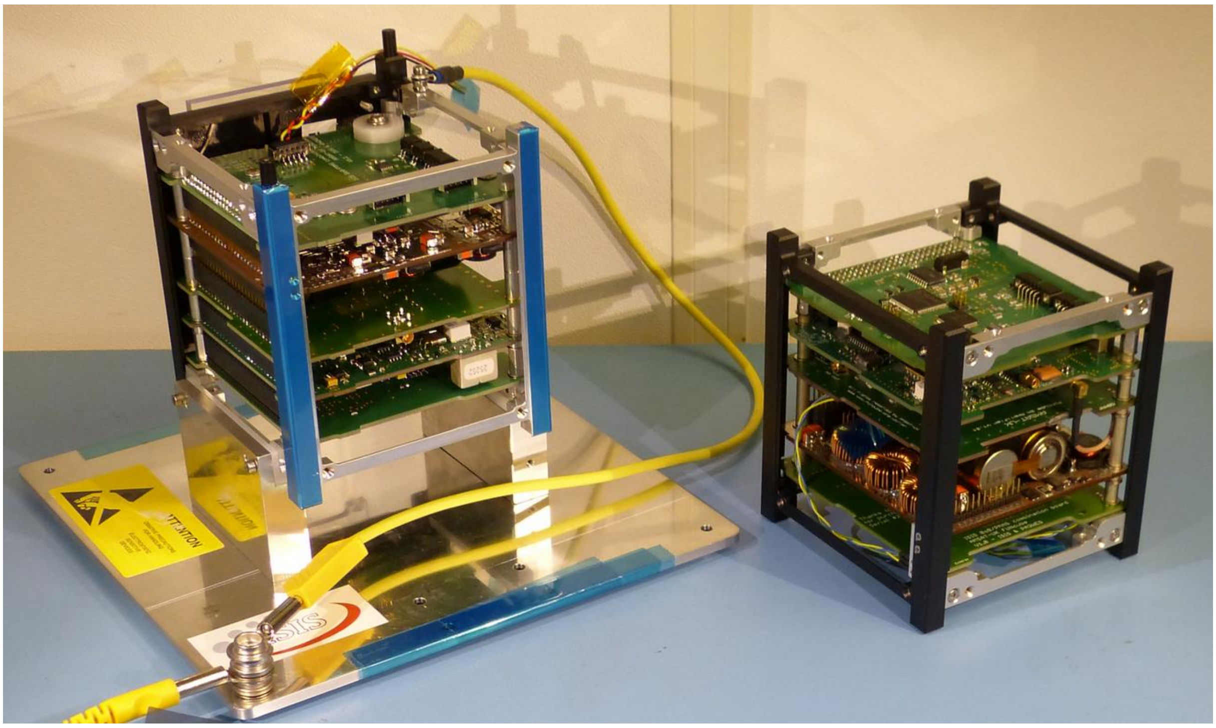


Communication subsystem:

- 145.935 MHz BPSK Telemetry 30/300 mW
- Inverting SSB/CW transponder 300 mW
- 435.150 – 435.130 MHz Uplink
- 145.950 – 145.970 MHz Downlink

The passband may be up to 15 kHz higher depending on on-board temperatures. Low temperatures give higher frequencies. The transponder is usually only active during night passes and at weekends. During holidays such as Christmas, New Year, Easter, the transponder maybe activated for extended periods.





https://amsat-uk.org/funcube/funcube-cubesat/
https://funcube.org.uk/
https://groups.io/g/FUNcube/
https://amsat-uk.org/funcube/funcube-slides/

10.2 AO-07 (AMSAT-OSCAR-7) -- SSB

AMSAT-OSCAR 7 was launched November 15, 1974 by a Delta 2310 launcher from Vandenberg Air Force Base, Lompoc, California. AO-7 was launched piggyback with ITOS-G (NOAA 4) and the Spanish INTASAT. and was the second Phase 2 satellite (Phase II-B).

Weight:	28.6 kg.
Orbit:	1444 x 1459 km.
Inclination:	101.7 degrees.

Octahedrally shaped 360 mm high and 424 mm in diameter.

Circularly polarized canted turnstile VHF/UHF antenna system and HF dipole.

Similar to AO-6. Built by a multi-national (German, Canadian, United States, and Australian) team of radio amateurs under the direction of AMSAT-NA. It carried Mode A (145.850-950 MHz uplink and 29.400-500 MHz downlink) and Mode B (432.180-120 MHz uplink and 145.920-980 MHz downlink (inverted)) linear transponders and 29.500 and 145.700 MHz beacons. The 2304.1 MHz was never turned on because of international treaty constraints.

Four radio masts mounted at 90 degree intervals on the base and two experimental repeater systems provided store-and-forward for morse and teletype messages (Codestore) as it orbited around the world. The Mode-B transponder was designed and build by Karl Meinzer, DJ4ZC and Werner Haas, DJ5KQ. The Mode-B transponder was the first using “HELAPS” (High Efficient Linear Amplification by Parametric Synthesis) technology was developed by Dr. Karl Meinzer as part of his Ph.D.

Spacecraft Description
AMSAT-OSCAR 7 contains two basic experimental repeater packages, redundant command systems, two experimental telemetry systems, and a store-and-forward message storage unit. The spacecraft is solar powered, weighs 65 pounds, and had a three-year anticipated lifetime at the time it was launched, but it has far outlived this expectation. It contains beacons on 29.50, 145.975, 435.10 and 2304.1 MHz.

Communications Repeaters
Two types of communications repeaters are aboard the spacecraft, only one of which operates at a time. The first repeater is a higher power, two-watt version of the one-watt two-to-ten meter linear repeater that flew on the OSCAR 6 mission. This non-inverting transponder receives uplink signals between 145.85 and 145.95 MHz, and retransmits them between 29.4 and 29.5 MHz on the downlink. A 200 milliwatt telemetry beacon provides telemetry data on 29.502 MHz. Approximately -100 dBm is required at the repeater input terminals for an output of 1 watt. This corresponds to an EIRP from the ground of 90 watts for a distance to the satellite of 2,000 miles and a polarization mismatch of 3 dB.

The second repeater, constructed by AMSAT Deutschland e.V., AMSAT’s affiliate in Marbach, West Germany, is a 40-kHz* bandwidth inverting linear repeater. It employs an 8-watt PEP power amplifier using the envelope elimination and restoration technique to maintain linear operation over a wide dynamic range with high efficiency. This repeater has an uplink from 432.125 to 432.175 MHz, and a downlink from 145.975 to 145.925 MHz. Since the uplink band in shared with the radiolocation service, an experimental pulse suppression circuit is incorporated in the repeater to reduce the effects of wideband pulsed radar interference in the uplink. Developmental versions of this repeater have flown in high-altitude balloon experiments in Germany, and aircraft flight tests of the repeater prototype unit. A 200 milliwatt telemetry beacon on 145.975 provides telemetry data. Approximately 50 watts EIRP is required to produce 3 watts of repeater output at a range of 2,000 miles assuming a polarization mismatch of 3 db.

The two repeaters are operated alternately by means of a timer arrangement, but repeater selection and output power control can also be accomplished by ground command. Each of the repeaters includes a keyed telemetry beacon at the upper edge of the downlink passband to provide housekeeping data and to provide a frequency and amplitude reference marker to assist the amateur in antenna pointing, Doppler frequency compensation, and setting uplink power level. The cross-band 146-to-29.5 and 432-to-146 design of the two repeaters will permit the amateur to monitor his own downlink signal easily, and consequently, he can adjust his power and frequency to continually compensate for changing path loss, repeater loading and Doppler shift.

Command System
Redundant command decoders of a design similar to the unit proven highly successful in OSCAR 6 were flown. The decoder has provisions for 35 separate functions, and is designed to provide a reliable means of controlling the emissions of the repeaters, beacons and other experiments aboard the spacecraft.

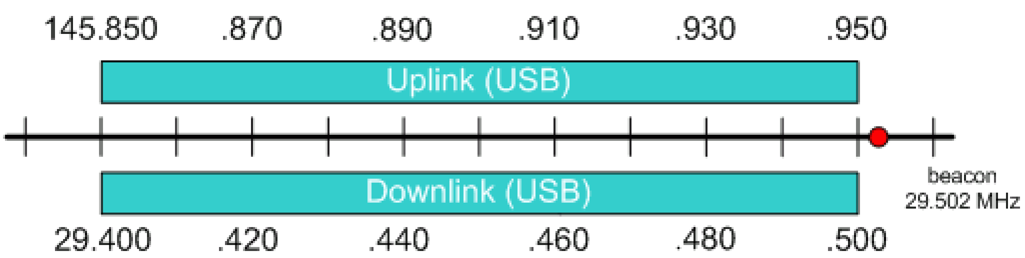
Telemetry and Message Storage Systems
AMSAT-OSCAR 7 contains two experimental telemetry systems designed for use with simple ground terminal equipment. The first system, developed by the WIA-Project Australis group in Australia, telemeters 60 parameters in 850-Hz shift, 60 WPM five-level Baudot teletype code to permit printout on standard teletype equipment in a format readily convertible for direct processing by small digital computer. The second system telemeters 24 parameters as numbers in standard Morse code and can be received with pencil and paper. This system was used on OSCAR 6 and proved highly successful as a reliable means of obtaining real-time telemetry data.

An experimental Morse code message storage unit, Codestore, capable of storing and repeatedly retransmitting 18-word Morse code messages loaded by ground stations is also aboard AMSAT-OSCAR 7. This unit was first flown on OSCAR 6. This unit is not currently in use, and it is unclear if it is still operational.

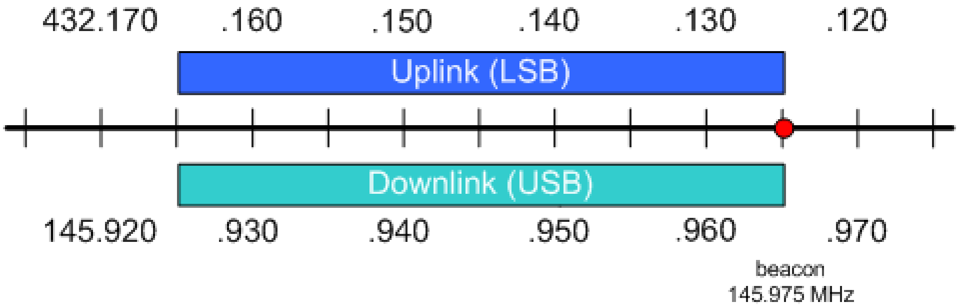
The teletype telemetry encoder amplitude-modulates telemetry beacons on 29.50 MHz (200 mW), 145.98 MHz (200 mW) and frequency-shift keys the beacon on 435.10 MHz (300-400 mW), as selected by ground command. The Morse code telemetry encoder and Codestore message storage unit directly key these beacons as selected by ground command. However, at the present time, the satellite is not being actively commanded by a ground station, so these telemetry systems are not being activated.

Current Operational State
AO-7 became non-operational in mid 1981 due to battery failure . In 2002 one of the shorted batteries became an open circuilt and now the spacecraft is able to run off solar panels. For this reason it is not usable in eclipse and may not be able to supply enough power to the transmitter to keep from frequency modulating the signal. When continuously illuminated, the mode will alternate between A and B every 24 hours.

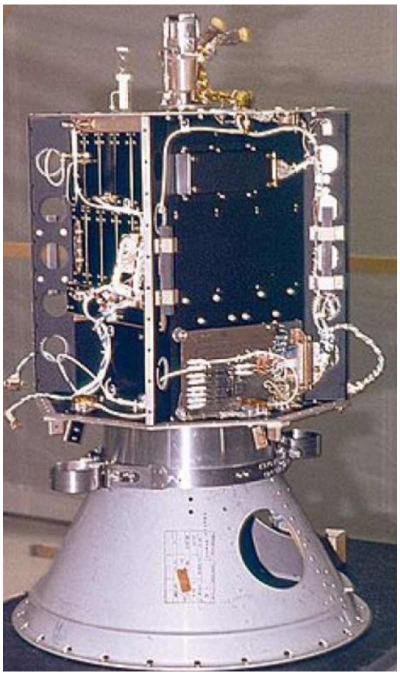
AO-7 – Mode A



AO-7 – Mode B



Mode V/A (A) Linear Transponder (Non-Inverting):
Uplink: 145.8500 – 145.9500 MHz SSB/CW
Downlink 29.4000 – 29.5000 MHz SSB/CW



Mode V/A (A) TLM Beacon:
Downlink 29.5020 MHz CW

Mode U/V (B) Linear Transponder (Inverting):
Uplink: 432.1250 – 432.1750 MHz SSB/CW
Downlink 145.9750 – 145.9250 MHz SSB/CW

(Note: The 432 MHz uplink on AO-7 was designed before implementation of the 435-438 MHz satellite subband. Operation in the US is currently grandfathered under a waiver from the FCC, included at the bottom of this page.)

Mode U/V (B) TLM Beacon:
Downlink 145.9775 MHz CW

Mode U TLM Beacon
Downlink 435.1000 MHz CW

https://www.amsat.org/wordpress/wp-content/uploads/2018/10/AMSAT-OSCAR-7-Guide.pdf
https://www.dk3wn.info/wp/satelliten/amsat-oscar-7-ao-7/

10.3 AO-27 -- FM

AO-27 is an amateur satellite constructed by the Amateur Radio Research and Development Corporation (AMRAD) at the facilities of Interferometrics in McLean, Virginia.

It was originally designed as a commercial satellite known as EYESAT-1 but its completion was halted part way through the project. An agreement was made for AMRAD to finish the construction of the satellite and add an amateur satellite transponder. AO-27 is an “FM Repeater” in space. It essentially consists of a crystal controlled FM receiver operation at 145.850 MHz and a crystal controlled FM transmitter operating at approximately 436.795 MHz. Output power of the transmitter can be set to over 1 watt (rarely used), 0.5 watts (normal operation), or under 0.1 watts (exciter only). The uplink antenna is the linear polarized whip on the top face of the spacecraft and is shared with the commercial payload’s receivers. The downlink antenna is a 1/4 wave whip mounted on the bottom face of the spacecraft. Polarization is nominally linear, the rotation and revolution of the spacecraft and propagation effects will cause the actual signal polarization at a ground station to vary widely during a pass.

Orbital parameters

Name	AO-27
NORAD	22825
COSPAR designation	1993-061-C
Inclination (degree)	98.251
RAAN	190.750
Eccentricity	0.0008681
ARGP	171.364
Orbit per day	14.29136207
Period	1h 40m 45s (100.75 Min)
Semi-major axis	7173 km
Perigee x apogee	788 x 801 km
Drag factor	-0.000009537 1/ER
Mean Anomaly	188.766

Downlink
436.795 MHz (FM)

Uplink
145.850 MHz (FM)

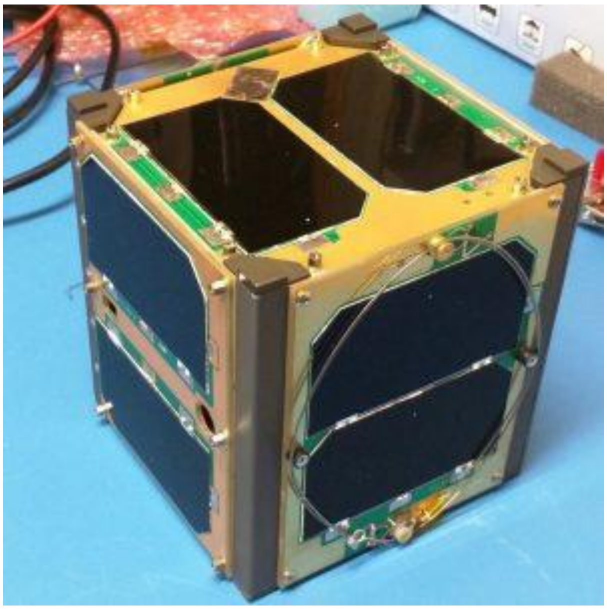
Mode and Antenna Polarization:
V: Linear
U: Linear

Telemetry
Decoding is possible with a 1200 bps AFSK (packet) modem in kiss mode. The kiss output can be used as input to for example the AMRAD AO-27 decoder from DK3WN.

https://www.pe0sat.vgnet.nl/decoding/block-diagram/
https://www.dk3wn.info/wp/satelliten/2084-2/

10.4 AO-91 (RadFxSat Fox-1B) -- FM

The Delta II rocket carrying RadFxSat (Fox-1B) launched at 09:47:36 UTC on November 18, 2017 from Vandenberg Air Force Base, California.



Following a picture-perfect launch, RadFxSat was deployed at 11:09 UTC. Then the wait began. At 12:12 UTC, the AMSAT Engineering team, watching ZR6AIC’s WebSDR waterfall, saw the characteristic “Fox Tail” of the Fox-1 series FM transmitter, confirming that the satellite was alive and transmitting over South Africa. Shortly after 12:34 UTC, the first telemetry was received and uploaded to AMSAT servers by Maurizio Balducci, IV3RYQ, in Cervignano del Friuli, Italy. Initial telemetry confirmed that the satellite was healthy.

After confirmation of signal reception, OSCAR Number Administrator Bill Tynan, W3XO, sent an email to the AMSAT Board of Directors designating the satellite AMSAT-OSCAR 91 (AO-91). Bill’s email stated:

“RadFxSat (Fox-1B) was launched successfully at 09:47 UTC today November 18, 2017 from Vandenberg Air Force Base in California and has been received by several amateur stations.

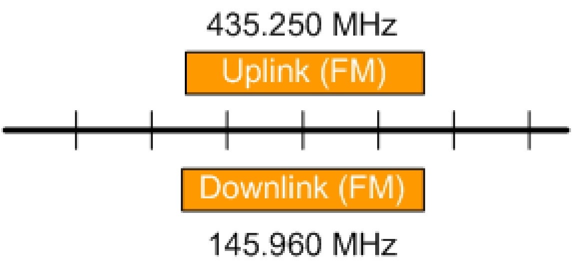
RadFxSat (Fox-1B), a 1U CubeSat, is a joint mission of AMSAT and the Institute for Space and Defense Electronics at Vanderbilt University. The Vanderbilt package is intended to measure the effects of radiation on electronic components, including demonstration of an on-orbit platform for space qualification of components as well as to validate and improve computer models for predicting radiation tolerance of semiconductors.

AMSAT constructed the remainder of the satellite including the spaceframe, on-board computer and power system. The amateur radio package is similar to that currently on orbit on AO-85 with a FM uplink on 435.250 MHz (67.0 Hz CTCSS) and a FM downlink on 145.960 MHz. Experiment telemetry will be downlinked via the DUV subaudible telemetry stream, which can be decoded using the FoxTelem software.

RadFxSat (Fox-1B) was sent aloft as a secondary payload on the United Launch Alliance (ULA) Delta II rocket that will transport the Joint Polar Satellite System (JPSS)-1 mission. RadFxSat (Fox-1B) is one of four CubeSats making up this NASA Educational Launch of Nanosatellites (ELaNa) XIV mission, riding as secondary payloads aboard the JPSS-1 mission.

Since RadFxSat (Fox-1B) has met all of the qualifications necessary to receive an OSCAR number, I, by the authority vested in me by the AMSAT President, do hereby confer on this satellite the designation AMSAT-OSCAR 91 or AO-91. I join amateur radio operators in the U.S. and around the world in wishing AO-91 a long and successful life in both its amateur and scientific missions.

I, along with the rest of the amateur community, congratulate all of the volunteers who worked so diligently to construct, test and prepare for launch the newest amateur radio satellite.



AO-91 Doppler Shift Correction

Memory	Your Transmit Frequency(With 67 Hz Tone)	Your Receive Frequency
Acquisition of Signal (AOS)	435.240 MHz	145.960 MHz
Approaching	435.245 MHz	145.960 MHz
Time of Closest Approach (TCA)	435.250 MHz	145.960 MHz
Departing	435.255 MHz	145.960 MHz
Loss of Signal (LOS)	435.260 MHz	145.960 MHz

https://www.amsat.org/ao-91-commissioned-declared-open-for-amateur-use/
https://amsat-uk.org/2017/11/18/radfxsat-fox-1b-ao-91/
https://www.amsat.org/foxtelem-software-for-windows-mac-linux/

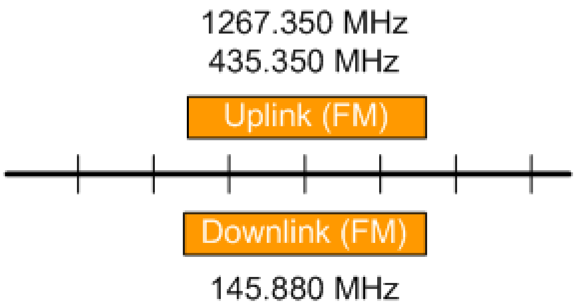
10.5 AO-92 (FOX-1D) -- FM

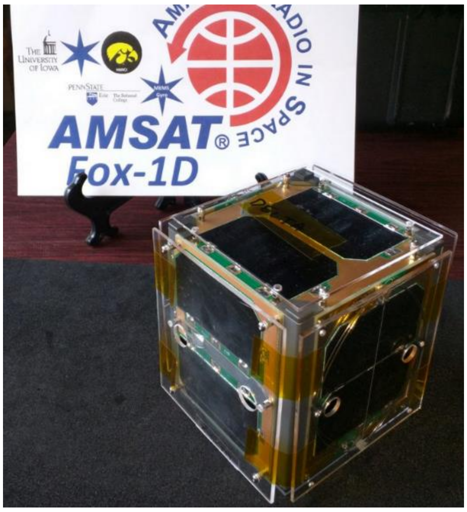
AMSAT's next Fox-1 satellite, Fox-1D, is scheduled for launch on January 12, 2018 from Satish Dhawan Space Centre in Sriharikota, India. Fox-1D will launch as part of the PSLV-C40 mission on board a Polar Satellite Launch Vehicle with a Cartosat-2 series imaging satellite for the Indian government and 29 other payloads. ISRO's mission brochure can be found at

https://www.isro.gov.in/pslv-c40-cartosat-2-series-satellite-mission/pslv-c40-cartosat-2-series-satellite-brochure

In addition to the Fox-1 U/v FM transponder, Fox-1D carries several university experiments, including a MEMS gyro from Pennsylvania State University – Erie, a camera from Virginia Tech, and the University of Iowa's HERCI (High Energy Radiation CubeSat Instrument) radiation mapping experiment. Fox-1D also carries the AMSAT L-Band Downshifter experiment which allows the utilization of a 1.2 GHz uplink for the FM transponder. Telemetry, experiment data, and pictures from the Virginia Tech camera can be decoded using the FoxTelem software (https://www.amsat.org/foxtelem-software-for-windows-mac-linux/).

When enabled, the L-Band Downshifter will utilize an uplink of 1267.350 MHz. This device converts signals received at 1267.350 MHz and injects them into the satellite's 435 MHz receiver. Since the 435 MHz uplink antenna is used to receive the 1267 MHz signals and may present a mismatch at that frequency, pre-launch estimates suggest that a power level of 100 watts ERP will be required for horizon-to-horizon access in Mode L/v. AMSAT Engineering will issue further guidance after in-orbit testing. Look for future articles on the AMSAT website and in The AMSAT Journal for equipment ideas and tutorials for accessing the L-band uplink.





Radio Programming Chart – Fox-1D Doppler Shift Correction
Memory 1 (AOS) – TX 435.340 MHz (67.0 Hz Tone), RX 145.880 MHz
Memory 2 (Rise) – TX 435.345 MHz (67.0 Hz Tone), RX 145.880 MHz
Memory 3 (TCA) – TX 435.350 MHz (67.0 Hz Tone), RX 145.880 MHz
Memory 4 (Descend) – TX 435.355 MHz (67.0 Hz Tone), RX 145.880 MHz
Memory 5 (LOS) – TX 435.360 MHz (67.0 Hz Tone), RX 145.880 MHz

https://amsat-uk.org/tag/ao-92/
https://www.amsat.org/getting-ready-for-fox-1d/

11 Quellen

www.amsat-hb.org	AMSAT-HB
www.amsat-dl.de	AMSAT-DL
www.dd1us.de	Matthias Bopp
www.p3e-satellite.org	
http://de.wikipedia.org/wiki/Satellitenorbit	
www.dk3wn.info/wp	Mike Rupprecht
www.amsat.org/status	
www.satblog.info	
http://uz7.ho.ua/packetradio.htm	TNC Software Version
http://satellitenwelt.de/index.htm	
https://scotthather.weebly.com/satscape.html	SAT Tracking Software
http://www.stoff.pl/	SAT Tracking Software
https://satnogs.org	