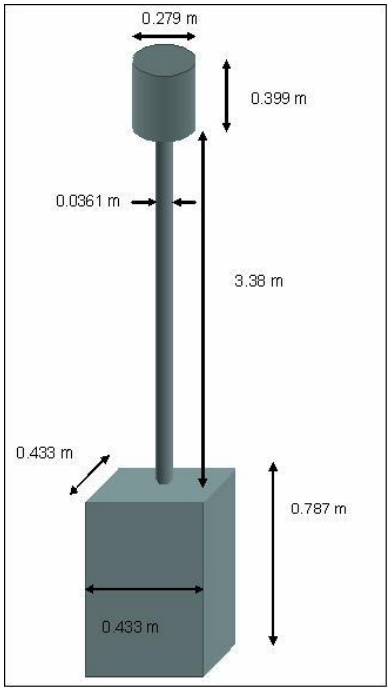
FalconSat-3

Name(s):	FalconSat-3, FS-3
NASA catalog number:	30776
Launch:	March 9, 2007, Atlas-5, Cape Canaveral Air Force Station, Florida
Orbit:	LEO
Inclination:	35.4°
Period:	94.5 minutes
Altitude:	469 km x 466 km
Size:	43.3 cm x 43.3cm x 78.7 cm with 334 cm gravity stabilization boom
Shape:	Rectangular
Weight:	54.3 kg (120 pounds)
Transponder:	9600 baud digital
Digipeater Callsign	PFS3-1
Broadcast Callsign	PFS3-11
BBS Callsign	PFS3-12
Uplink	145.840 MHz
Downlink	435.103 MHz
Transmit power:	1.25 watts continuous (5 watts intermittent)

FALCONSAT-3

(Image Courtesy USAFA)

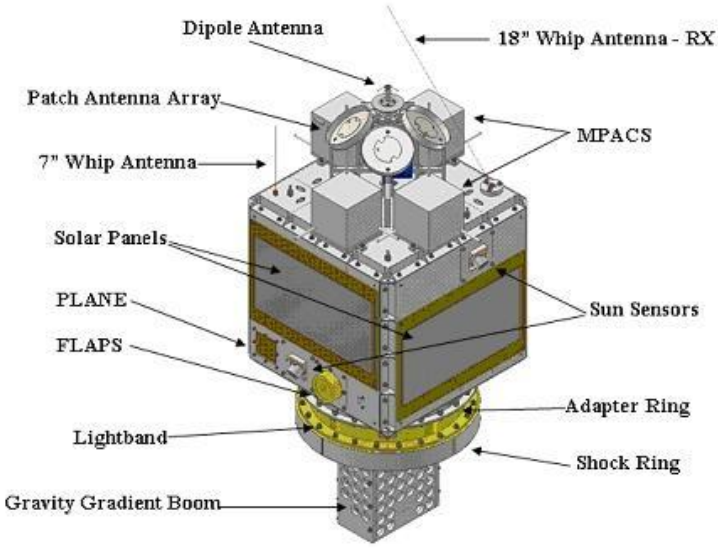
FalconSat-3 is the 3rd in a series of United States Air Force Academy (USAFA) student-built microsatellites. Its primary mission was to test a gravity gradient boom for stabilization of the spacecraft in the Z direction, with magnetorquers control the rotation about the Z axis. Primary and secondary payloads include Micro Propulsion Attitude Control System (MPACS), Flat Plasma Spectrometer (FLAPS), and Plasma Local Anomalous Noise Environment (PLANE). The basic spacecraft bus is a Commercial of the Shelf (COTS) manufactured by SpaceQuest Ltd, thus allowing primary attention to be directed at the individual experiments and equipment.



FalconSat-3 with Gravity Gradient Boom (Image Courtesy USAFA)

In addition to the experiments themselves, FalconSat-3 has functioned as a practical training platform to allow USAFA cadets to familiarize themselves with the operation of a functioning spacecraft, including the need to resolve hardware and software issues detected or developed after deployment. The spacecraft has finished its USAFA mission, and been released to AMSAT-NA for the remainder of its estimated 4-5 year remaining lifetime as a digital communications satellite. Because of the low inclination of 35 degrees, coverage is limited to approximately between 58 degrees North and South latitudes. For a typical station around 35-40 degree latitude, there will be approximately 5 passes a day. The footprint will be slightly larger than the ISS.

The primary features of the satellite for amateurs are the digipeater, and the PACSAT Broadcast Protocol (PBP). The digipeater is similar in function to that used on the ISS and other satellites, but has some significant differences in implementation. It differs in four primary ways. First, it uses different uplink and downlink bands. The 2 m uplink will not need to be adjusted for Doppler, but the 70 cm downlink will. In a sense, it is a cross between the 2 m and 70 cm ISS operations.



FalconSat-3 Antenna Locations

(Image Courtesy of USAFA)

Second, it is full duplex. The satellite transmitter is on constantly to support the PBP, much like the typical FM voice repeater, and unlike the ISS and other packet satellites which only key the transmitter when it has a packet to repeat. This means that in order to transmit, you must be able to disable the APRS squelch in order to transmit at all. To hear your echoed packets, you will need to be able to hear the downlink while transmitting. Otherwise, your digipeated packed may be sent while your rig is switching from transmit to receive.
Note that the APRS squelch is usually not the same as the normal voice squelch settings. Depending on the manufacturer, it may be referred to as APRS Squelch, or Data Carrier Detect (DCD). It must be set to Off or Ignore. Otherwise, your transmitted packets will be held until LOS. As a practical matter, a standard 2 band rig should be adequate **so long as the squelch can be disabled** since you are only concerned with hearing packets from other stations. Full duplex however is highly recommended to reduce the need for repeats due to collissions.

The third difference is that unlike the ISS and most other digipeater satellites, it operates at 9600 baud rather than 1200 baud. Modern software such as MixW, HS Soundmodem, and AGW all support this standard. Many newer rigs which support packet, such as the Kenwood TH-D72, have the ability to use the higher speed by menu selection. However, some rigs do not, so insure that your rig explicitly supports 9600 baud. Please see the chapters Your Radio System and Digital Modes for more detailed discussions.

Finally, it does not use the standard ARISS as the spacecraft address. Instead, it uses PFS3-1, which was the standard adopted when the original software was written. Like other satellite digipeaters, it only supports UNPROTO packets, so you cannot connect to yourself or another station directly. Use a path of CQ VIA PFS3-1 for a conventional TNC, or the equivalent for your software package.

For use with a typical HT, it will not be necessary to tune the uplink, but the downlink will need to be adjusted through the pass. Depending on your equipment, there may well be brief periods

where the standard 5 KHz spacing will be outside the usable range. This situation will be brief as the satellite orbit shifts. These are the recommended frequency selections.

	Downlink	**Uplink**
Beginning of pass	435.115 MHz	145.840 MHz
Early pass	435.110 MHz	145.840 MHz
Mid pass	435.105 MHz	145.840 MHz
Late pass	435.100 MHz	145.840 MHz
End of pass	435.095 MHz	145.840 MHz

In the standard Packet BBS (PBBS), a single user connects and then interacts via keyboard in real time. These used to be common for terrestrial packet, but are unusable for space operations such as the ISS due to multiple interfering packets, the short periods of visibility, and the requirement to download a directory or file again, even if the previous user did so. In contrast, the PBP is designed to support a number of users at a time. It was extensively used by PacSats in the early 1990s, and continues to be used for special purposes today. Even when not interacting directly, a ground station can gather information requested by other stations such as directory, messages, and telemetry information. The ground station prepares any uplinked messages off line, and then uplinks them automatically during a pass. Since **all** stations will received the downloaded packets, it is only necessary to request, if needed, any existing "holes" and the software assembles the completed messages for reading off line. Along with message traffic, information such as telemetry is also broadcast. Note that unlike the digipeater, full duplex capability is necessary since you will be interacting directly with the satellite. While half duplex capability may work, it will result in unnecessary interference with other stations. As with the digipeater, the squelch **must** be disabled.

The software which supports this is called WiSP and is available from AMSAT-NA. Though written 25 years ago, it can be used with the latest version of Windows. While fully functional, a registration number is necessary to remove a small nag. This will be provided at no cost by AMSAT-NA to encourage operation. Please see the installation and operating instructions provided with the software. Support will be available through AMSAT-BB.

Software for Linux machines, PacSatTools and PB/PG, is also available from AMSAT-NA. As with WiSP, these software packages were also written many years ago but should compile and install on modern Linux distributions.

Please see the FalconSat-3 page on the AMSAT website (https://www.amsat.org/falconsat-3/) for software download links.

Resources

Earth Observation Portal: https://directory.eoportal.org