National Aeronautics and Space Administration

NASAfacts

Fast, Affordable, Science and Technology SATellite (FASTSAT) Minisatellite

FASTSAT is NASA's first minisatellite designed to create a capability that increases opportunities for secondary scientific and technology payloads, or rideshares, to be flown at lower cost than previously possible.

The overall objective of the FASTSAT mission was to demonstrate the capability to build, design and test a minisatellite platform to enable government, academic and industry researchers to conduct low-cost scientific and technology experiments on an autonomous satellite in space. Such research is intended to support NASA's Science Mission Directorate and Exploration Systems Mission Directorate, led by NASA Headquarters in Washington.

FASTSAT has established a proven platform and environment in which science and technology experiment payloads of low- and mid-level complexity can be flown responsively and affordably in low-Earth orbit.

The FASTSAT minisatellite design supports the standards of the Evolved Expendable Launch Vehicle Secondary Payload Adaptor, or ESPA — an adapter ring developed by the U.S. Department of Defense, or DoD, specifically for accommodating secondary spacecraft launch opportunities.

The FASTSAT spacecraft bus outfitted with six payloads. Credit: NASA

The Mission

Gaining access to space is a costly endeavor with limited opportunities for small launch payloads. Delayed access to space impacts science and technology research that could bring advancements or solutions to real-world problems.

FASTSAT, leveraging the ESPA accommodations, enables opportunities for multiple users to conduct research on numerous launch vehicles in space at lower cost and with greater frequency than previously possible.

The ESPA accommodates up to six, 400-pound secondary satellites to “share a ride to space” with an additional primary payload up to 15,000 pounds. The ESPA ring attaches between the primary payload and the expendable upper stage on an Atlas V or Delta IV. This configuration provides a “virtually free” ride for ESPA-class satellites and increased opportunities for launch ridesharing with DoD ESPA configurable launch vehicles for science and technology experiments.

The FASTSAT-Huntsville project began in late 2008, when NASA’s Marshall Space Flight Center in Huntsville, Ala., and the Department of Defense Space Test Program at the Space Development and Test Wing at Kirtland Air Force Base, N.M., formed a partnership to develop a high-risk, low-cost technology demonstration experiment. The development pace was fast because the Space Test Program had received notification just 14 months prior to launch that a secondary payload had been cancelled on the STP-S26 mission, opening up a payload vacancy.

FASTSAT was selected as an “outside-the-box” solution that afforded a highly synergistic concept which satisfied experiment, payload and launch schedule requirements. The minisatellite was designed, assembled and tested in-house at the Marshall Center using off-the-shelf commercial hardware by NASA and a group of industry partners.

FASTSAT serves as a scientific laboratory platform containing all the resources needed to carry out scientific and technology research operations for the mission time period. It was approved by the Department of Defense’s Space Experiments Review Board, a group of defense organizations and NASA personnel assigned to maintain the defense department’s experiment priority list. Potential space experiments are reviewed and ranked by priority. The highest ranking experiments are flown by the Space Test Program as budget and resources permit.

FASTSAT and all six experiments successfully passed all phases of flight operations and fulfilled all science requirements.

Mission Profile

FASTSAT, one of three secondary minisatellite payloads approved to fly on a Minotaur IV launch vehicle built and operated by Orbital Sciences Corporation, was launched from the Alaska Aerospace Development Corporation’s Kodiak Launch Complex on Kodiak Island, Alaska.

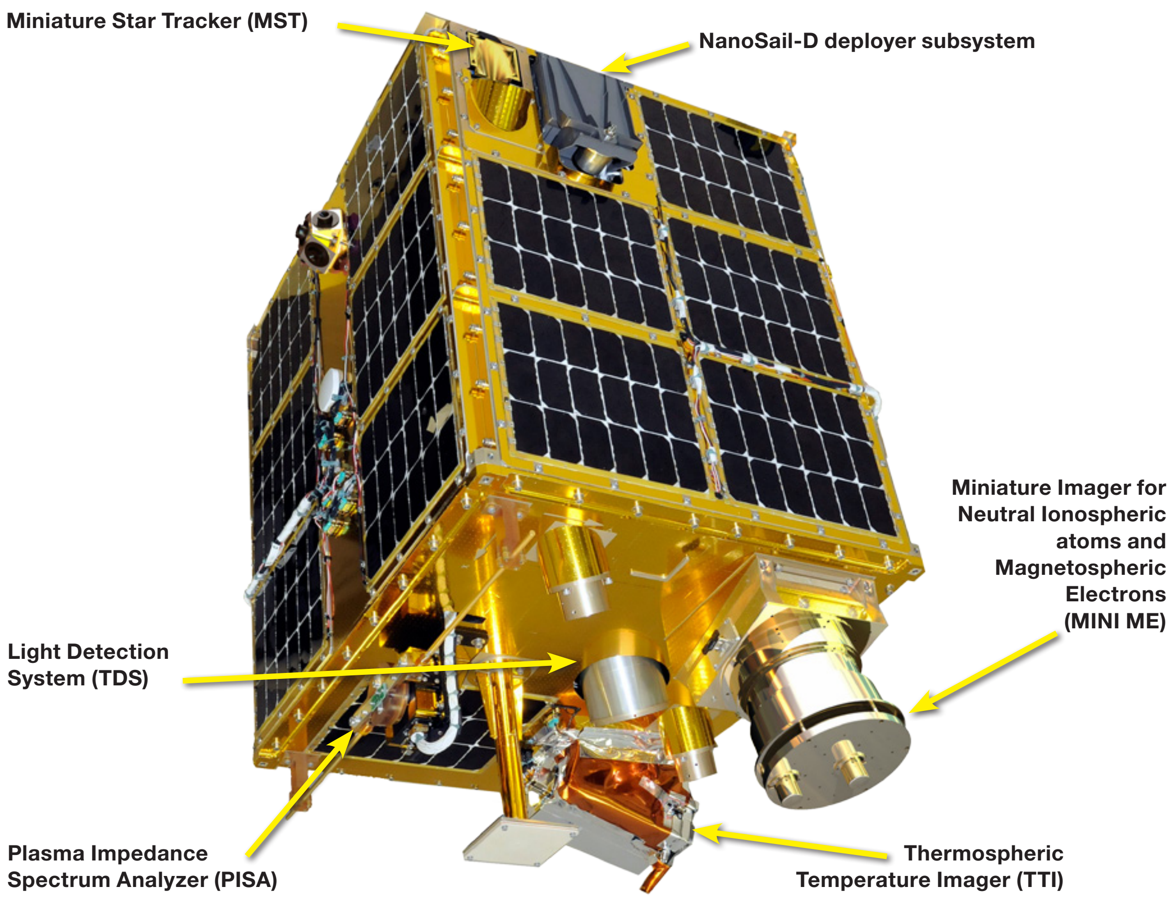
Outfitted with six technology and atmospheric experiments, FASTSAT lifted off from Kodiak in late fall 2010. Approximately 20 minutes after launch, FASTSAT separated from the launch vehicle for orbital insertion. Thirty minutes later, FASTSAT automatically powered up to begin initial checkout operations, and the Marshall Center contacted the spacecraft and began on-orbit operations. For the first 11 days after launch, the spacecraft and the experiments went through an on-orbit commissioning phase.

The next 180 days were focused on science operations. A checkout and performance analysis of each science instrument was performed. Then, one by one, each experiment was turned on to perform its science objectives. Upon completion of the science phase, additional characterization of the spacecraft was performed to test additional flight objectives. The experiments were performed in parallel to test the overall abilities of the spacecraft. This lasted approximately 120 days.

Mission control for FASTSAT and its onboard experiments was managed from the small satellite-mission control room at the Marshall Center’s Huntsville Operations and Science Control Center. Experiment operations also were performed using the control center’s capabilities for managing remote science operations by investigators at their own facilities.

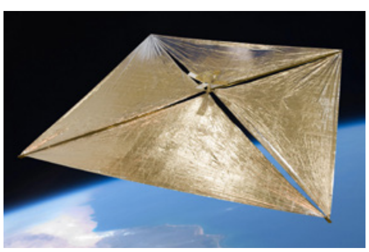
Spacecraft Overview:

FASTSAT enables both NASA and military opportunities to conduct innovative research missions that gain unique scientific insights or mature the readiness of new technology components, subsystems or systems by increasing the Technology Readiness Level for future missions. FASTSAT was developed with simplicity in the design of the spacecraft subsystems that provide power management, onboard storage of experiment data, control of experiments, communications with ground stations, propellantless mechanisms for attitude control and a GPS system for navigation.



Experiments Overview:


NanoSail-D stowed


NanoSail-D deployed

NanoSail-Demonstration (NanoSail-D)

NanoSail-D demonstrated deployment of a compact solar sail boom system and led to further development of this alternative propulsion technology, with FASTSAT's ability to eject a nanosatellite from a minisatellite — a NASA first — without re-contacting the FASTSAT satellite bus. NanoSail-D, managed by the Marshall Center, was the first NASA solar sail successfully deployed in low Earth orbit.

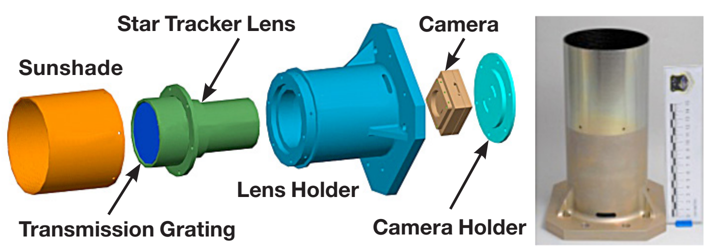
NanoSail-D was designed and built by NASA engineers at Marshall, in collaboration with the Nanosatellite Missions Office at NASA's Ames Research Center in Moffett Field, Calif., and Nexolve in Huntsville. The experiment is a joint effort by the U.S. Air Force Research Laboratory at Kirtland Air Force Base, N.M.; NASA; and the U.S. Army Space and Missile Defense Command and the Von Braun Center for Science & Innovation, both in Huntsville.


Miniature Star Tracker

Light Detection System and Miniature Star Tracker

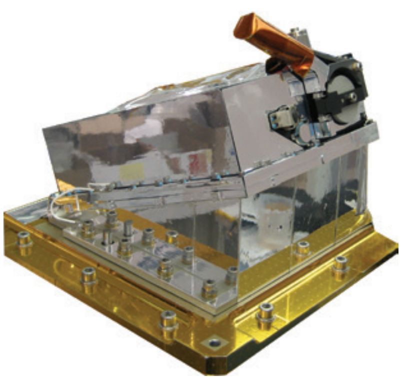
The Light Detection System and the Miniature Star Tracker are managed by the Air Force Research Laboratory.

The Light Detection System evaluated techniques for measuring the atmospheric propagating characteristics on coherent light generated from known ground stations.



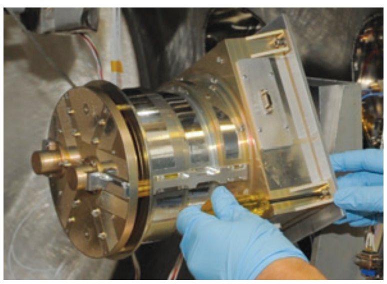
Light Detection System

The FASTSAT spacecraft carried three atmospheric instruments built at NASA's Goddard Space Flight Center in Greenbelt, Md., in partnership with the U.S. Naval Academy in Annapolis, Md. The instruments included the Thermosphere Temperature Imager, designed to measure remotely the temperature, atomic oxygen and molecular nitrogen densities of the thermosphere; the Miniature Imager for Neutral Ionospheric Atoms and Magnetospheric Electrons, a low-energy neutral atom imager that detected neutral atoms formed in the plasma population of Earth's outer atmosphere to improve global space weather prediction; and the Plasma and Impedance Spectrum Analyzer, a device that tested a new measurement technique for the temperature and density of thermal electrons in the ionosphere — which can interfere with radio-based communications and navigation.



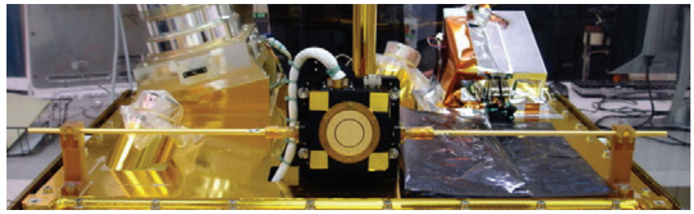
Thermosphere Temperature Imager

The Thermospheric Temperature Imager provided the first global-scale measurements of thermospheric temperature profiles in the 56-162 miles region. The temperature profile sets the scale height of the thermosphere which determines the density at orbital altitudes and the resulting aerodynamic drag experienced by low-altitude, Earth-orbiting spacecraft.



Miniature Imager for Neutral Ionospheric Atoms and Magnetospheric Electrons

The Miniature Imager for Neutral Ionospheric Atoms and Magnetospheric Electrons, or MINI-ME, is a low-energy neutral atom imager which detected neutral atoms formed in the plasma population of the Earth's outer atmosphere to improve global space weather prediction. Low-energy neutral atom imaging is a technique first pioneered at Goddard. It allows scientists to remotely observe trapped charged-particle populations around Earth that we would normally only be able to observe in situ — or in the immediate vicinity of the instrument. Measurements made by instruments like MINI-ME will enable more accurate prediction of space weather.



Plasma and Impedance Spectrum Analyzer

The Plasma and Impedance Spectrum Analyzer tested a new measurement technique for the thermal electron populations in the ionosphere, calculating their density structuring, which can interfere with or scatter radio signals used for communication and navigation. The analyzer determined when and where the ionosphere became structured or turbulent, permitting better predictive models of space weather effects on GPS signals.

The FASTSAT Team

FASTSAT flew on the STP-S26 mission — a joint activity between NASA and the U.S. Department of Defense Space Test Program. The satellite was designed, developed and tested at the Marshall Center, in partnership with the Von Braun Center for Science & Innovation and Dynetics, both of Huntsville. Dynetics provided key engineering, manufacturing and ground operations support for the new minisatellite. Thirteen local firms and the University of Alabama in Huntsville also were part of the project team.

For more information, visit:
http://www.nasa.gov/mission_pages/smallsats/fastsat

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