National Aeronautics and Space Administration

NASAfacts

Technical Education Satellite Series: TechEdSat-5

Technologies for Passive Re-entry, Future Sample Return and Mars Missions

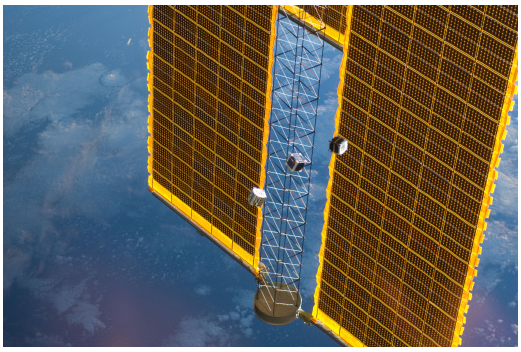
Big results can come from small satellites, and the latest in the productive TechEdSat series of CubeSats continues development of multiple key technologies for small sats – controlled de-orbit and re-entry; wireless sensors; and ISM-band communications links.

Launched December 9, 2016, on Japan's H-II Transfer Vehicle from Tanegashima Space Center in Japan, the Technology Educational Satellite-5 (TES-5) nanosatellite is the fifth generation of the continuing TechEdSat series.

About the TechEdSat Series

The TechEdSat project is a STEM collaborative activity that pairs advanced university students with NASA Ames researchers for two semesters. TES not only provides a platform for testing planetary mission concepts and development of state-of-the-art technology, but also provides engineering and management experience for NASA early-career employees, interns and students from several universities including San Jose State University, University of Idaho, University of California at Riverside, and California Polytechnic State University, San Luis Obispo.

The overarching goals of the TES series are to develop the requisite technologies for 1) entry, descent and landing capabilities for small payloads and 2) on-demand sample return capabilities from orbit.



Photograph of TechEdSat-1 (far left), the first US CubeSat jettisoned from the International Space Station

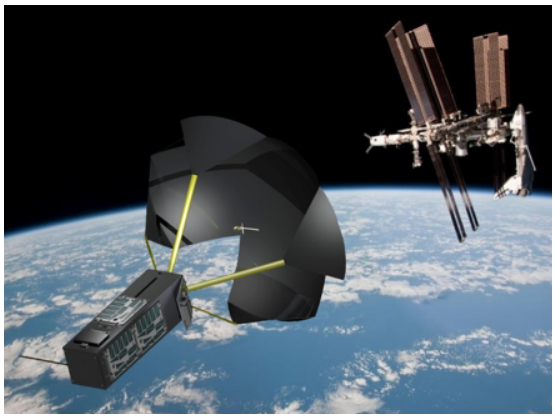
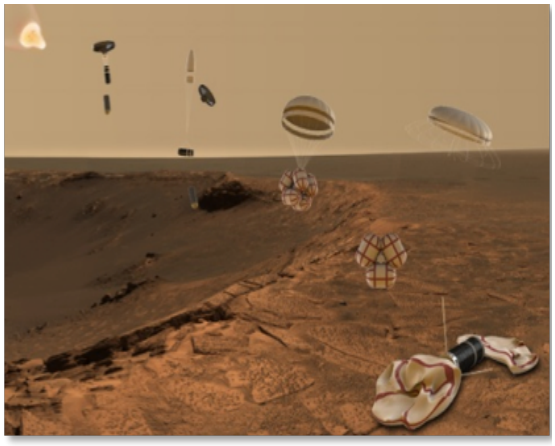


Illustration of TechEdSat-3p post-jettison from the International Space Station

Goals of TES-5

TechEdSat-5 built upon the success of TES-1, 2, 3 and 4 by demonstrating increasing capability for CubeSats in the areas of communications and satellite re-entry. TES-5, with a 3U (10 x 10 x 10 cm) volume and weight of 2.69 kg, tested several technologies, including the latest version of Exo-Brake, a tension-based, flexible braking device resembling a cross-parachute that deploys from the rear of the satellite to increase its drag. Exo-Brake is replaces the more complicated rocket-based systesms typically employed during the de-orbit phase of re-entry.

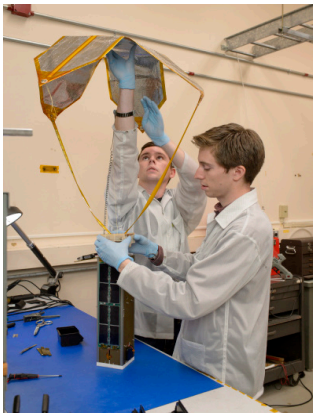


Future step: Building the elements for nanosatellite technology to be placed on the surface of Mars

Several additional technologies have been demonstrated on TES-5:

- The Cricket wireless sensor module, using a mesh wireless network that supports multiple wireless sensors to provide real-time data for TES-5.
- Use of the commercial off-the-shelf (COTS) Intel Edison microprocessor imbedded in the TES-5 bus element's avionics board.
- Use of anISM-band "Wi-Fi" communications link to send data to a ground station.
- Two-way communications using an Iridium L-band transceiver for data.

Past TechEdSat Missions



Engineers pack TechEdSat-5 with Exo-Brake payload

The TES-1, a 1U and the first in the series, successfully demonstrated the use of a radiation-tolerant nano-Remote Terminal Unit (nanoRTU) to control a StenSat radio that provided basic TES housekeeping data. TES-1 deployed from the Internatioal Space Station's Japanese Experiment Module (JEM, or "Kibo") utilizing the Small Satellite Orbital Deployer (J-SSOD) and the JEM Remote Manipulator System (JEMRMS) on October 4, 2012. It functioned for seven months until it re-entered Earth's atmosphere.

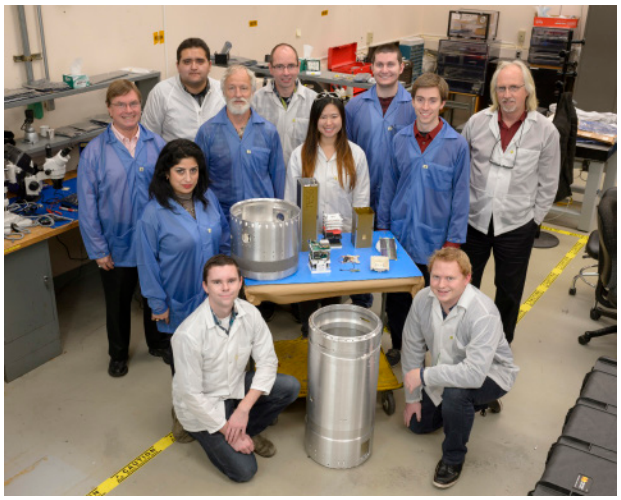
The TES-2 mission was launched on the first Antares-1 launch vehicle on August 21, 2013, successfully demonstrating the use of an Iridium Short-Burst Data modem for greatly improved satellite communication.

TES-3 was deployed from the JEM utilizing the J-SSOD and the JEMRMS on Nov. 20, 2013, and successfully performed the first passive Exo-Brake flight test.

TES-4 further developed the capability of the Exo-Brake passive de-orbiting system by adding an incremental development step to the controlled de-orbit technique for more accurate de-orbit and eventual re-entry control. TES-4's demonstration of a satellite-to-satellite communications system allowed for more frequent communication sessions with the satellite, leading to more accurate satellite altitude and position predictions that are important for the optimal operation of the Exo-Brake. The satellite's structure, avionics and payload were custom-designed by the TES-4 team to utilize its 3U volume. The TES-4 hardware consisted mostly of off-the-shelf components, allowing for easily reproducible future flight variations.

Partners in TechEdSat

The TechEdSat mission is supported by the Ames Engineering Directorate, the Ames Safety and Mission Assurance Directorate, and the Ames Chief Technologist Office Center Innovation Fund. Both TechEdSat and Exo-Brake are funded by the Entry Systems Modeling project within the Space Technology Mission Directorate's Game Changing Development program and the NASA Engineering and Safety Center.



The TechEdSat team at NASA Ames Research Center

For more information about the Ames Engineering Directorate, visit:
http://www.nasa.gov/centers/ames/engineering/

For more information on the TES Series, please visit:
http://www.nasa.gov/centers/ames/engineering/techedsat/

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