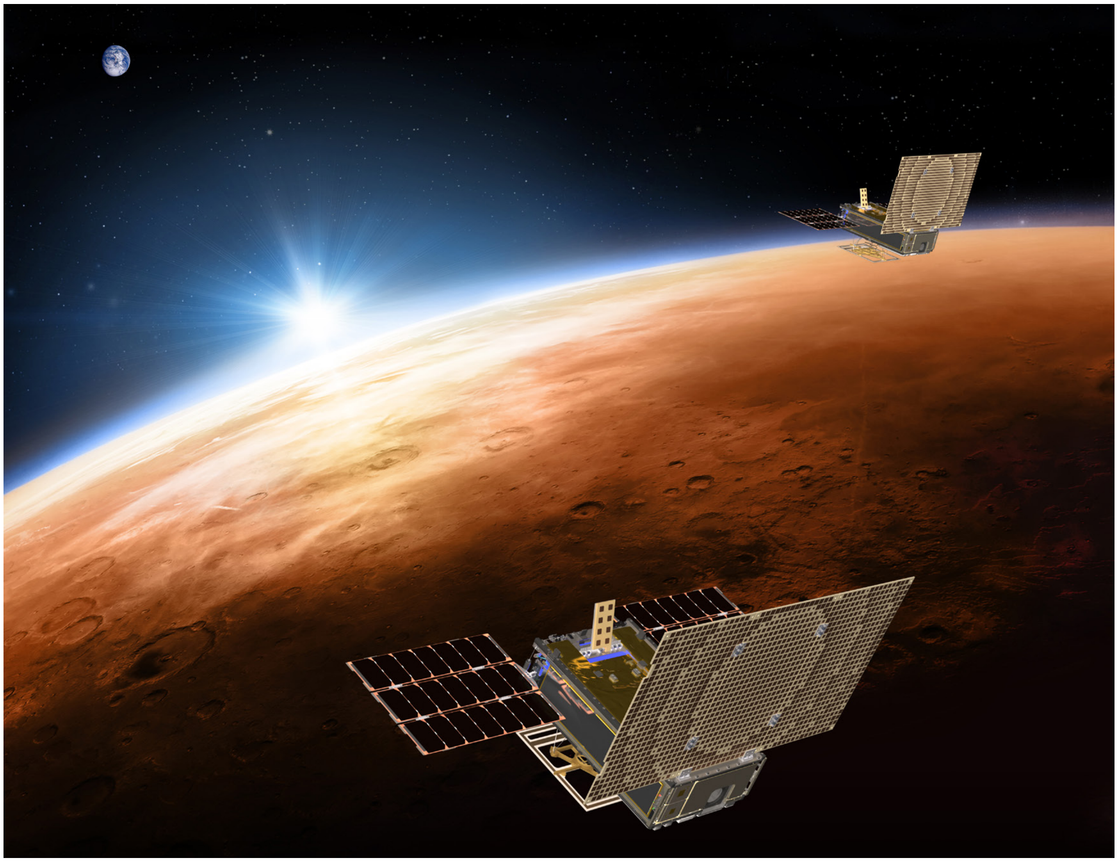
National Aeronautics and Space Administration

NASA facts

Mars Cube One (MarCO)



An artist's rendering of the twin MarCO spacecraft flying over Mars with Earth in the distance. The MarCOs are the first CubeSats, a kind of modular mini-satellite, to fly to deep space. They were designed to fly along with NASA's InSight lander on its cruise to Mars. Should they make it all the way to Mars, they will provide relay of data about InSight's entry, descent and landing back to Earth. Image credit: NASA/JPL-Caltech

Mission Overview

On May 5, 2018, NASA launched Mars Cube One, or MarCO, the first two CubeSats to fly to deep space. They piggybacked on the launch of NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) Mars lander. The low-cost CubeSats successfully tested out new miniaturized space technologies during their trip, which will open up access to new destinations in the solar system for science and exploration. If they make it all the way to Mars, they could also relay news in real-time about InSight's landing back to Earth.

The twin MarCO spacecraft were built by NASA's Jet Propulsion Laboratory, Pasadena, Calif., as a technology demonstration. Many CubeSats have flown in low-Earth orbit, and use commercial off-the-shelf components. MarCO uses a mix of such components that are screened for use in deep space, and other specially designed hardware and software. In Earth orbit, the solar arrays generate about 35 watts of power but at Mars, which has about half as much sunlight, they are expected to produce 17 watts of power.

At launch, the MarCOs separated from the launch vehicle only after InSight was safely on its way. They are traveling independently to the Red Planet with their own course adjustments along the way. After release from the launch vehicle, they deployed two radio antennas and two solar panels each. When they reach Mars, which will be 88 million miles (about 146 million km) away, the MarCOs expect to send data back at 8 kilobits per second.

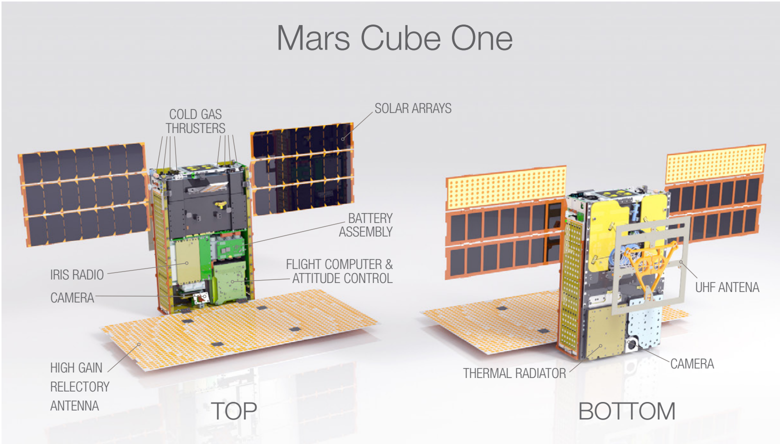
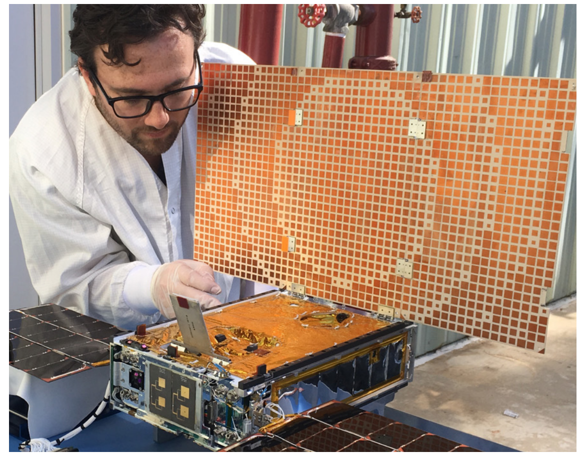


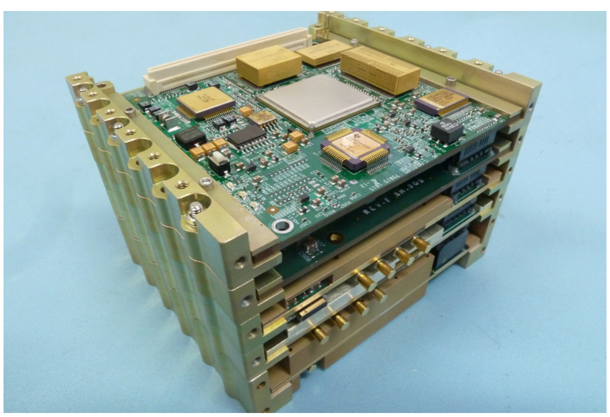
Illustration of the twin MarCO spacecraft with some key components labeled. The top cover is left out to show some internal components. Antennas and solar arrays are shown deployed. Image credit: NASA/JPL-Caltech



Engineer, Joel Steinkraus, uses sunlight to test the solar arrays on one of the MarCO spacecraft at NASA's Jet Propulsion Laboratory. Image credit: NASA/JPL-Caltech

Landers and rovers on other planets regularly relay information back to Earth via orbiters. InSight will send information about its landing to NASA's Mars Reconnaissance Orbiter (MRO). MRO receives this information in the UHF band, but the orbiter cannot simultaneously send it back to Earth.

Both MarCOs are designed to provide near-real-time relay by receiving in the UHF band, and simultaneously transmitting to Earth in the X-band. They do this using a new JPL-designed radio called Iris. This relay capability puts them in a good position to possibly relay the first news of InSight's landing.



One of the Iris radios being flown on MarCO Image credit: NASA/JPL-Caltech

If the MarCO demonstration succeeds, it could open up a new dimension for interplanetary exploration; one where small interplanetary spacecraft go on scientific missions to new destinations for much lower cost.

MarCO's Miniature Technology

Size:

- When stowed for launch the MarCOs occupy six (CubeSat) units, or about the size of a briefcase. One CubeSat unit is a box roughly 4 inches (10 centimeters) square. The actual dimensions are 14.4 x 9.5 x 4.6 inches (36.6 x 24.3 x 11.8 centimeters)

Deep Space Communication and Navigation:

- Flat-panel X-band antenna reflectarry that works like a parabolic dish
- Iris, a new miniaturized X-band transponder compatible with the Deep Space Network, can transmit 8 kbps from Mars and also do radiometric navigation

Micro-Propulsion System:

- Compressed R236FA gas, commonly used in fire extinguishers
- Eight thrusters for trajectory adjustments and to desaturate the reaction wheels

Attitude Control System:

- A star tracker for fine orientation
- Sun sensors for course orientation
- Gyroscopes to sense rotation speed
- Three-axis reaction wheels that adjust orientation

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