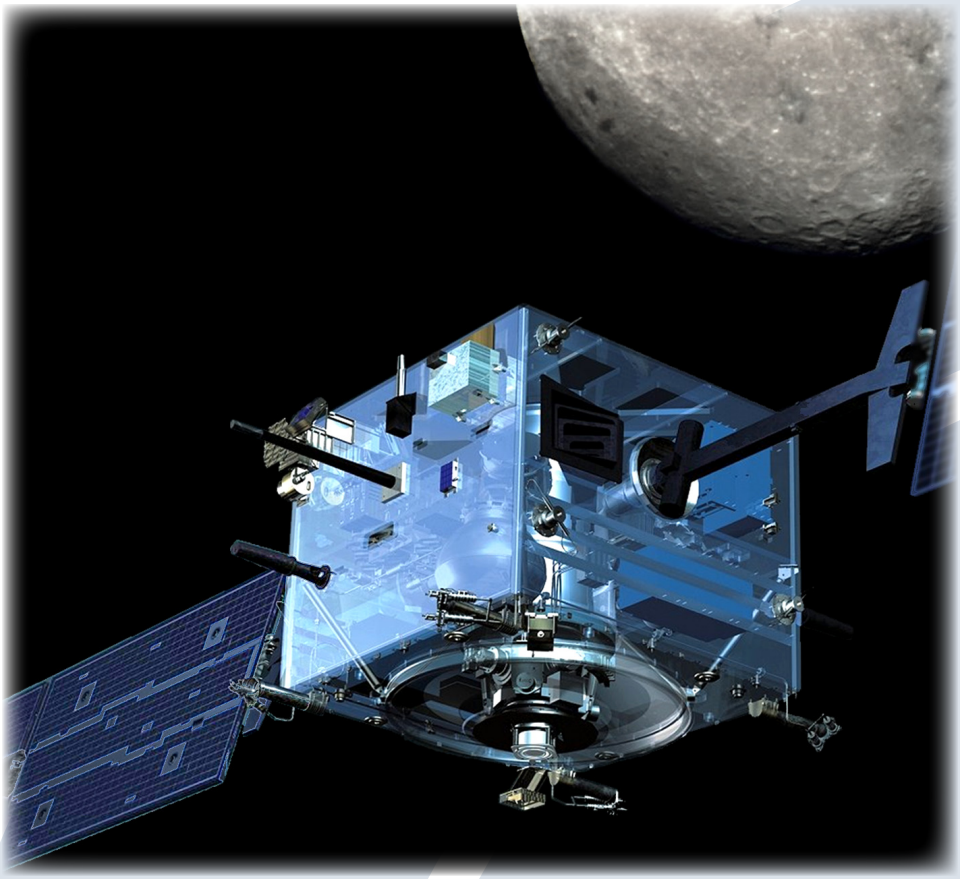
SMART-1



SMART-1, the first European spacecraft to the moon, was developed by the Swedish Space Corporation on behalf of the European Space Agency (ESA). In addition to the prime contractor task, SSC was responsible for the system engineering, the development of the onboard system unit based on the CAN (Controller Area Network) protocol, the star tracker based attitude control system, onboard application software, spacecraft simulator and EGSE. The platform concept can be used for a wide range of future missions, from Earth observation to science.

satellite systems




Swedish Space Corporation
www.ssc.se

A Technological and Scientific Success

SMART-1 was the first of ESA's Small Missions for Advanced Research and Technology (SMART). It was the first European spacecraft to travel to and orbit the Moon. The main mission objective was to demonstrate innovative and key technologies for scientific deep-space missions. One of the objectives was the flight demonstration of Electric Primary Propulsion for a scientific lunar orbiting spacecraft delivered in a standard geostationary transfer orbit.

However, SMART-1 contained other technology elements both in the spacecraft bus and in the instruments carried onboard. The spacecraft also carried a scientifically relevant payload. SMART-1 was designed with regard to the power needed for the electric propulsion, the severe radiation environment that was the consequence of the slow Earth escape trajectory and the need for onboard autonomy. SMART-1 reached lunar orbit from geostationary transfer orbit by use of electric propulsion. The duration to reach the Moon from geostationary transfer orbit was 12.5 months. The Earth escape was done by gradually expanding the orbit apogee height and eventually phasing with the Moon. The Lunar observation phase was planned for 6 months but was extended several times and lasted for 17 months.

Technical Characteristics

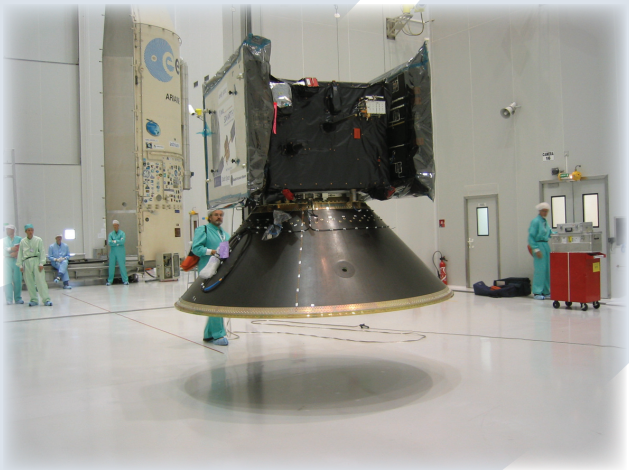
- Platform: 3-axis stabilised
- Launch mass: <350 kg
- Scientific payload mass: <15 kg
- One <75mN electric thruster (PPS-1350)
- Xenon propellant mass: 82 kg, to provide 3500 m/s delta V
- Launched: September 2003 on Ariane V
- Lunar capture: November 2004
- Lifetime: Designed for two years, actual lifetime almost three years
- Moon impact: September 2006

System Unit

- Processor: ERC32 single-chip processor, 20 MHz
- Memory: 2 Mbyte EEPROM permanent storage, 3Mbyte static RAM EDAC, 4Gbit mass memory Samsung DRAM
- Bus system: based on CAN protocol

Power System

- 50±0.5V fully regulated power bus
- ~1850W BOL solar array power
- ~1500W EOL energy storage (Li-Ion cells)
- 41 power switches providing over-current/under-voltage protection



TT&C

Antennas:

- Low gain conical helix, 2p coverage, >-3dBi, typical 0 dBi
- Medium gain, patch excited cup, 47° 3 dB beamwidth, +12 dBi

Downlink:

- Frequency: S-band 2235.1 MHz
- Data rate: 2,06 kbps/33 kbps
- Modulation: PM, different schemes for the two bit rates
- RF output: 5 W

Uplink:

- Frequency: S-band 2058.15 MHz
- Data rate: 2 kbps
- Modulation: PM

Attitude Control System

Sensors:

- Two autonomous star trackers
- Five single axis angular rate sensors
- Three sun sensors

Actuators:

- Four reaction wheels
- Eight 1N hydrazine thrusters
- Two BAPTAs for rotating solar arrays
- Electric propulsion gimbal, thruster orientation mechanism and electric propulsion thruster

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