



Chandrayaan-3

[Home](#) / [Activities](#) / [Future Missions](#) / [Chandrayaan-3](#)

Chandrayaan-3 is a follow-on mission to Chandrayaan-2 to demonstrate end-to-end capability in safe landing and roving on the lunar surface. It consists of Lander and Rover configuration. It will be launched by LVM3 from SDSC SHAR, Sriharikota. The propulsion module will carry the lander and rover configuration till 100 km lunar orbit. The propulsion module has Spectro-polarimetry of Habitable Planet Earth (SHAPE) payload to study the spectral and Polari metric measurements of Earth from the lunar orbit.

Lander payloads: Chandra's Surface Thermophysical Experiment (ChaSTE) to measure the thermal conductivity and temperature; Instrument for Lunar Seismic Activity (ILSA) for measuring the seismicity around the landing site; Langmuir Probe (LP) to estimate the plasma density and its variations. A passive Laser Retroreflector Array from NASA is accommodated for lunar laser ranging studies.

Rover payloads: Alpha Particle X-ray Spectrometer (APXS) and Laser Induced Breakdown Spectroscope (LIBS) for deriving the elemental composition in the vicinity of landing site.

More Details

[Chandrayaan-3](#)

[Gallery](#)

[Appraisal](#)

Chandrayaan-3 consists of an indigenous Lander module (LM), Propulsion module (PM) and a Rover with an objective of developing and demonstrating new technologies required for Inter planetary missions. The Lander will have the capability to soft land at a specified lunar site and deploy the Rover which will carry out in-situ chemical analysis of the lunar surface during the course of its mobility. The Lander and the Rover have scientific payloads to carry out experiments on the lunar surface. The main function of PM is to carry the LM from launch vehicle injection till final lunar 100 km circular polar orbit and separate the LM from PM. Apart from this, the Propulsion Module also has one scientific payload as a value addition which will be operated post separation of Lander Module. The launcher identified for Chandrayaan-3 is GSLV-Mk3 which will place the integrated module in an Elliptic Parking Orbit (EPO) of size ~170 x 36500 km.

The mission objectives of Chandrayaan-3 are:

1. To demonstrate Safe and Soft Landing on Lunar Surface
2. To demonstrate Rover roving on the moon and
3. To conduct in-situ scientific experiments.

To achieve the mission objectives, several advanced technologies are present in Lander such as,

1. Altimeters: Laser & RF based Altimeters
2. Velocimeters: Laser Doppler Velocimeter & Lander Horizontal Velocity Camera
3. Inertial Measurement: Laser Gyro based Inertial referencing and Accelerometer package
4. Propulsion System: 800N Throttleable Liquid Engines, 58N attitude thrusters & Throttleable Engine Control Electronics
5. Navigation, Guidance & Control (NGC): Powered Descent Trajectory design and associate software elements
6. Hazard Detection and Avoidance: Lander Hazard Detection & Avoidance Camera and Processing Algorithm
7. Landing Leg Mechanism.

To demonstrate the above said advanced technologies in earth condition, several Lander special tests have been planned and carried out successfully viz.

1. Integrated Cold Test - For the demonstration of Integrated Sensors & Navigation performance test using helicopter as test platform
2. Integrated Hot test – For the demonstration of closed loop performance test with sensors, actuators and NGC using Tower crane as test platform
3. Lander Leg mechanism performance test on a lunar simulant test bed simulating different touch down conditions.

The overall specifications for Chandrayaan-3 is provided below:

SI No.	Parameter	Specifications
1.	Mission Life (Lander & Rover)	One lunar day (~14 Earth days)
2.	Landing Site (Prime)	4 km x 2.4 km 69.367621 S, 32.348126 E
3.	Science Payloads	Lander: <ol style="list-style-type: none"> 1. Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA) 2. Chandra's Surface Thermo physical Experiment (ChaSTE) 3. Instrument for Lunar Seismic Activity (ILSA) 4. Laser Retroreflector Array (LRA) Rover: <ol style="list-style-type: none"> 5. Alpha Particle X-Ray Spectrometer (APXS) 6. Laser Induced Breakdown Spectroscope (LIBS) Module: <ol style="list-style-type: none"> 7. Spectro-polarimetry of HAbitable Planet Earth (SHAPE)
4.	Two Module Configuration	<ol style="list-style-type: none"> 1. Propulsion Module (Carries Lander from launch injection to Lunar orbit) 2. Lander Module (Rover is accommodated inside the Lander)
5.	Mass	<ol style="list-style-type: none"> 1. Propulsion Module: 2148 kg 2. Lander Module: 1752 kg including Rover of 26 kg 3. Total: 3900 kg
6.	Power generation	<ol style="list-style-type: none"> 1. Propulsion Module: 758 W

		2. Lander Module: 738W, WS with Bias 3. Rover: 50W
7.	Communication	1. Propulsion Module: Communicates with IDSN 2. Lander Module: Communicates with IDSN and Rover. Chandrayaan-2 Orbiter is also planned for contingency link. 3. Rover: Communicates only with Lander.
8.	Lander Sensors	1. Laser Inertial Referencing and Accelerometer Package (LIRAP) 2. Ka-Band Altimeter (KaRA) 3. Lander Position Detection Camera (LPDC) 4. LHDAC (Lander Hazard Detection & Avoidance Camera) 5. Laser Altimeter (LASA) 6. Laser Doppler Velocimeter (LDV) 7. Lander Horizontal Velocity Camera (LHVC) 8. Micro Star sensor 9. Inclinator & Touchdown sensors
9.	Lander Actuators	Reaction wheels – 4 nos (10 Nms & 0.1 Nm)
10.	Lander Propulsion System	Bi-Propellant Propulsion System (MMH + MON3), 4 nos. of 800 N Throttleable engines & 8 nos. of 58 N; Throttleable Engine Control Electronics
11.	Lander Mechanisms	1. Lander leg 2. Rover Ramp (Primary & Secondary) 3. Rover 4. ILSA, Rambha & Chaste Payloads 5. Umbilical connector Protection Mechanism, 6. X- Band Antenna
12.	Lander Touchdown specifications	1. Vertical velocity: ≤ 2 m / sec 2. Horizontal velocity: ≤ 0.5 m / sec 3. Slope: ≤ 120

The objectives of scientific payloads planned on Chandrayaan-3 Lander Module and Rover are provided below:

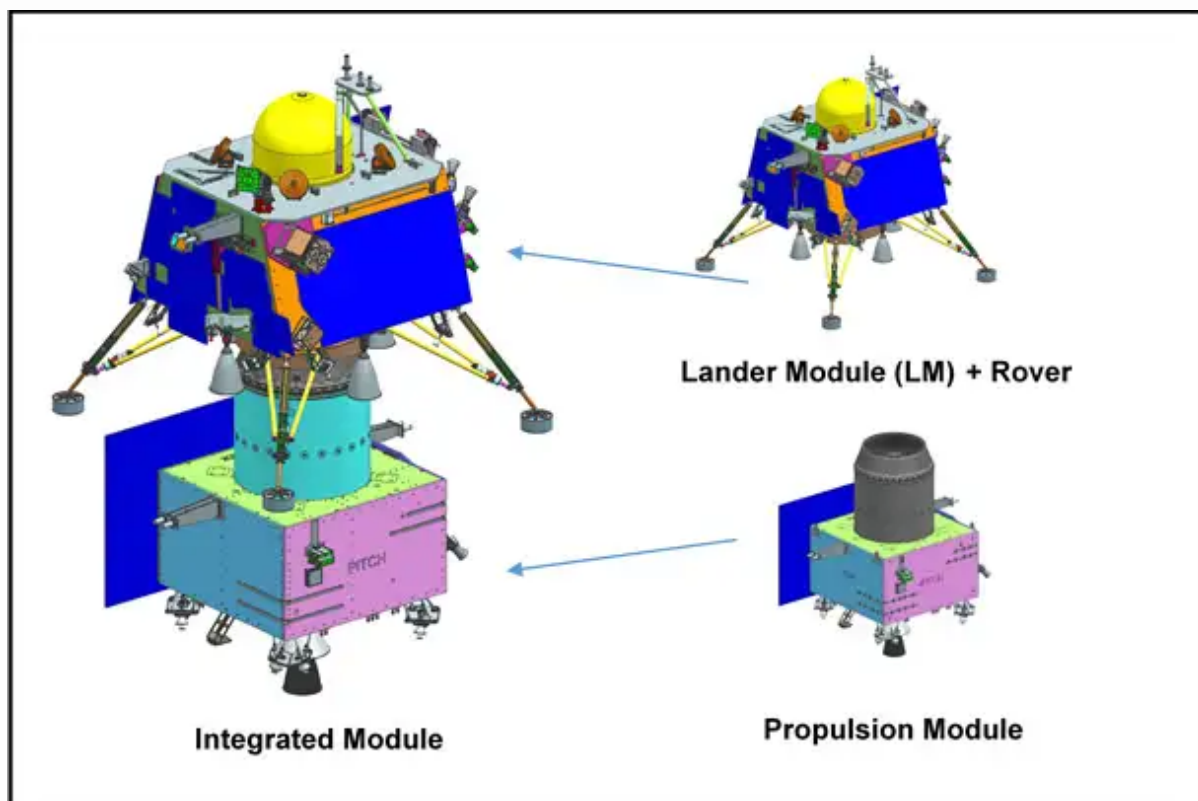
Sl. No	Lander Payloads	Objectives	
1.	Radio Anatomy of Moon Bound Hypersensitive ionosphere and Atmosphere (RAMBHA)	Langmuir probe (LP)	To measure the near surface plasma (ions and electrons) density and its changes with time
2.	Chandra's Surface Thermo physical Experiment (ChaSTE)	To carry out the measurements of thermal properties of lunar surface near polar region.	
3.	Instrument for Lunar Seismic Activity (ILSA)	To measure seismicity around the landing site and delineating the structure of the lunar crust and	

		mantle.
4.	LASER Retroreflector Array (LRA)	It is a passive experiment to understand the dynamics of Moon system.

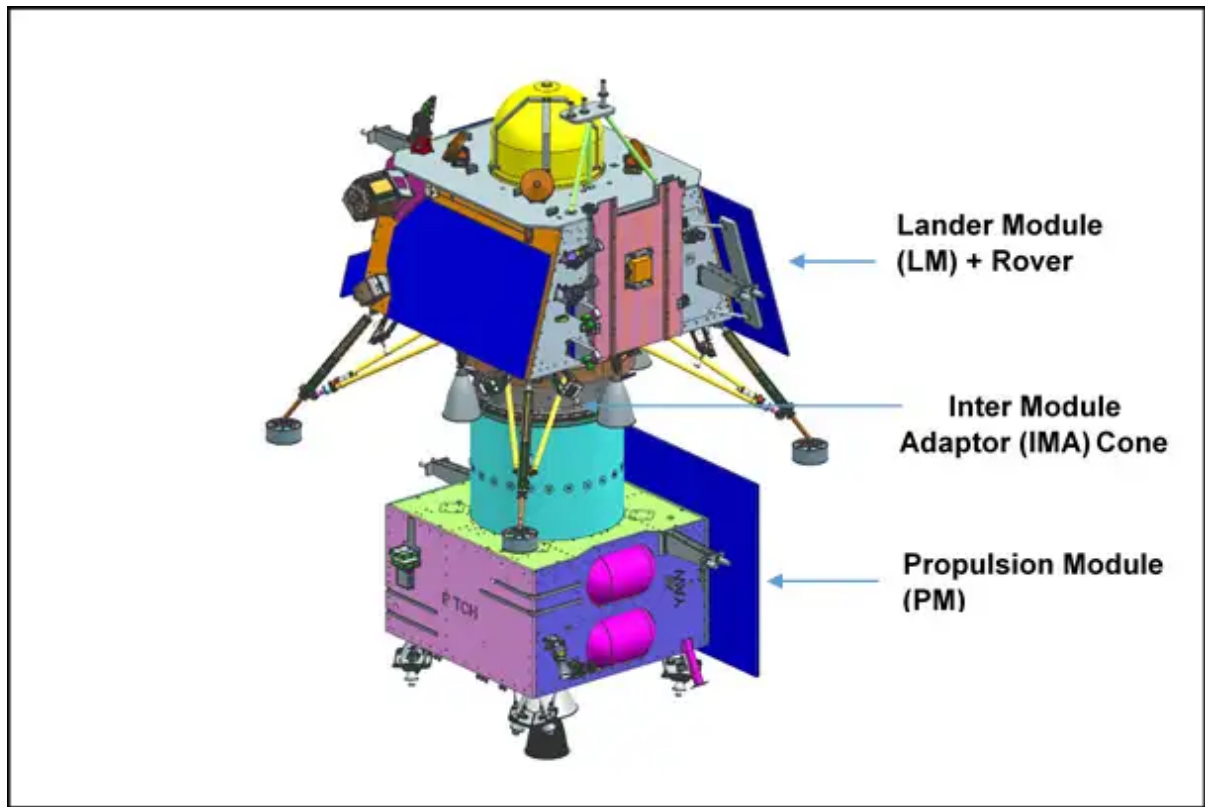
Sl. No	Rover Payloads	Objectives
1.	LASER Induced Breakdown Spectroscope (LIBS)	Qualitative and quantitative elemental analysis & To derive the chemical Composition and infer mineralogical composition to further our understanding of Lunar-surface.
2.	Alpha Particle X-ray Spectrometer (APXS)	To determine the elemental composition (Mg, Al, Si, K, Ca,Ti, Fe) of Lunar soil and rocks around the lunar landing site.

Sl. No	Propulsion Module Payload	Objectives
1.	Spectro-polarimetry of HAbitable Planet Earth (SHAPE)	Future discoveries of smaller planets in reflected light would allow us to probe into variety of Exo-planets which would qualify for habitability (or for presence of life).

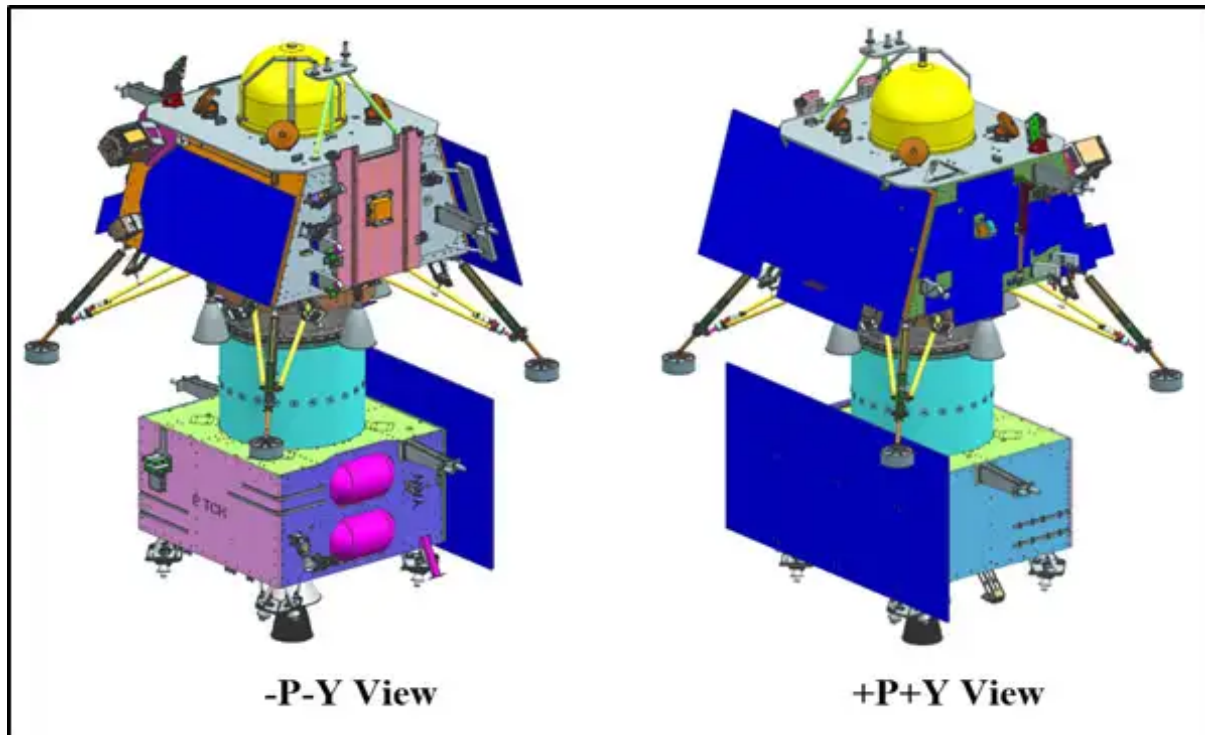
Three dimensional views of Chandrayaan-3 modules are provided below:



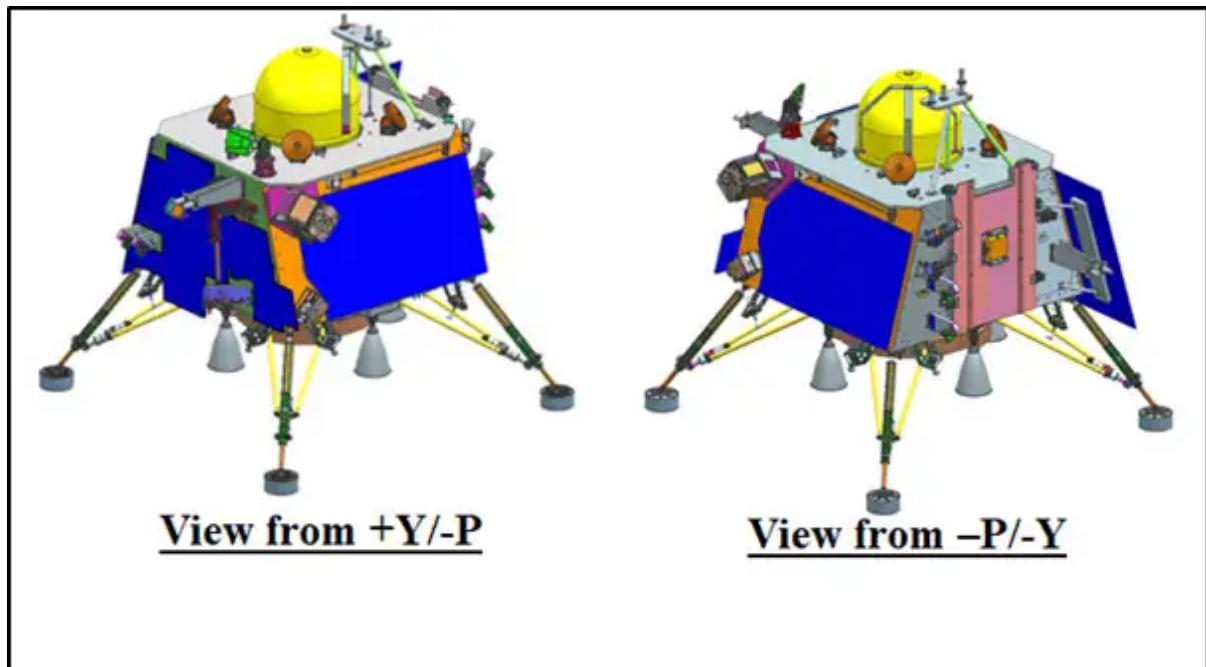
Chandrayaan-3 – Elements



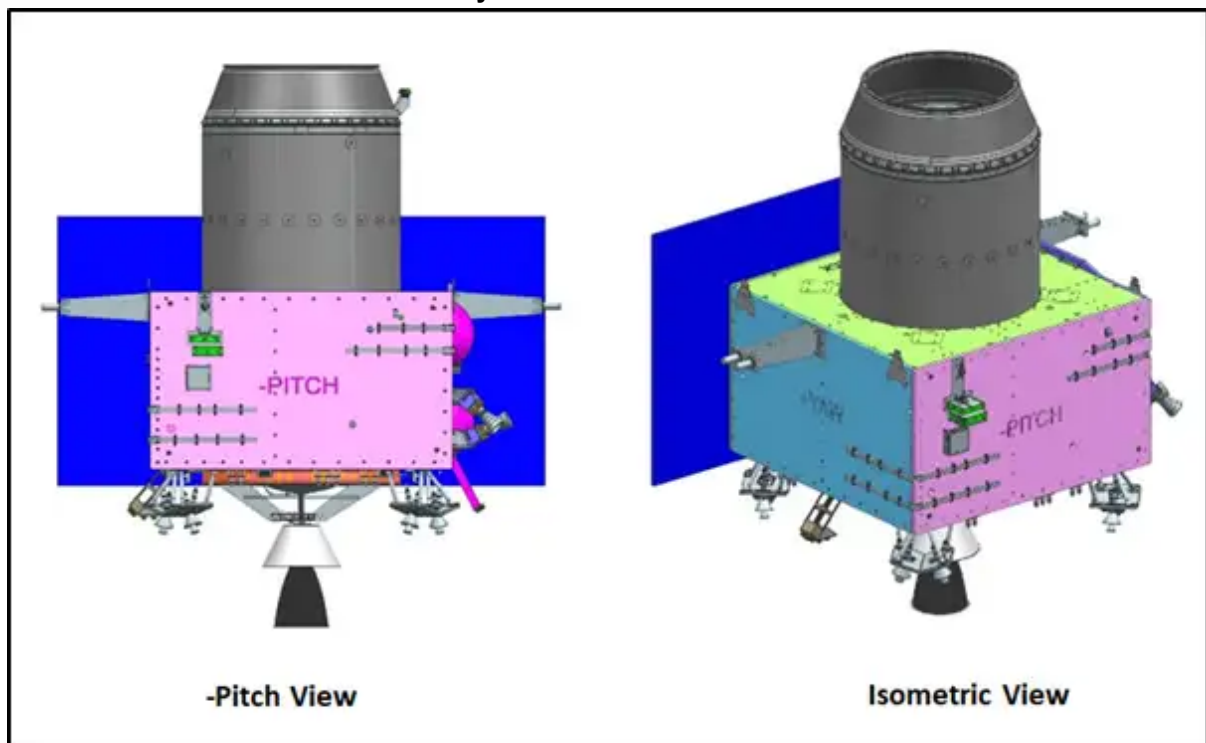
Chandrayaan-3 – Integrated Module



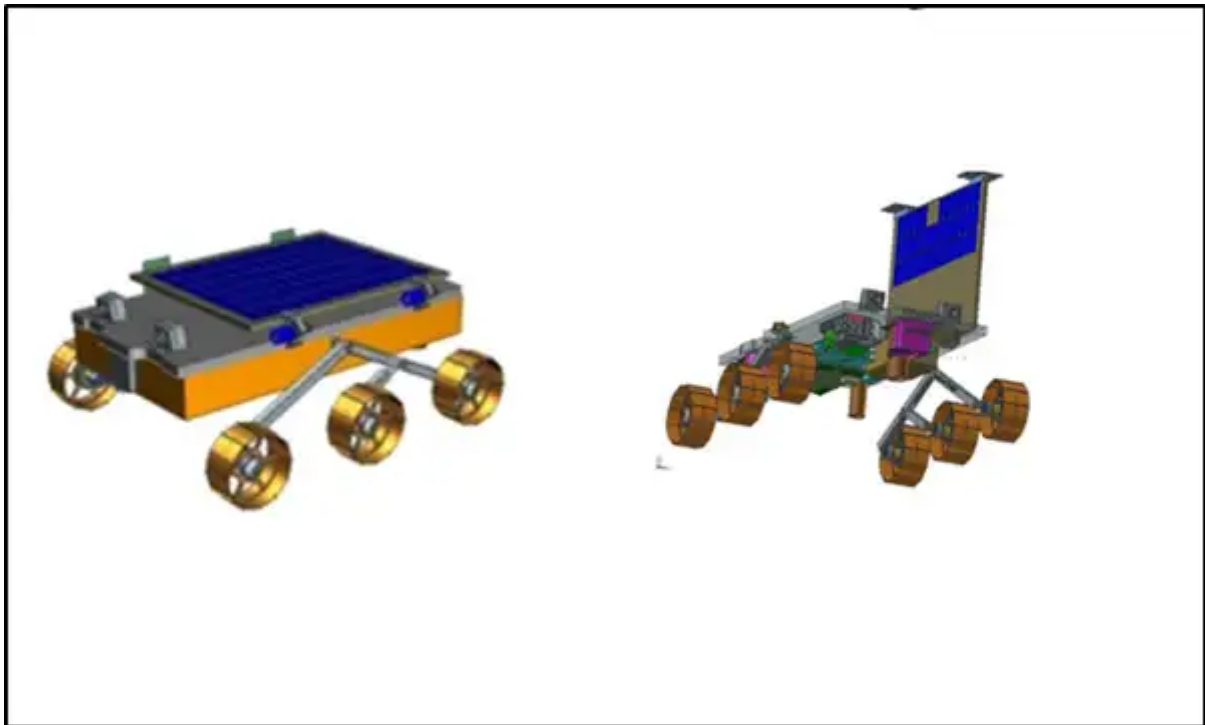
Chandrayaan-3 Integrated Module - Views



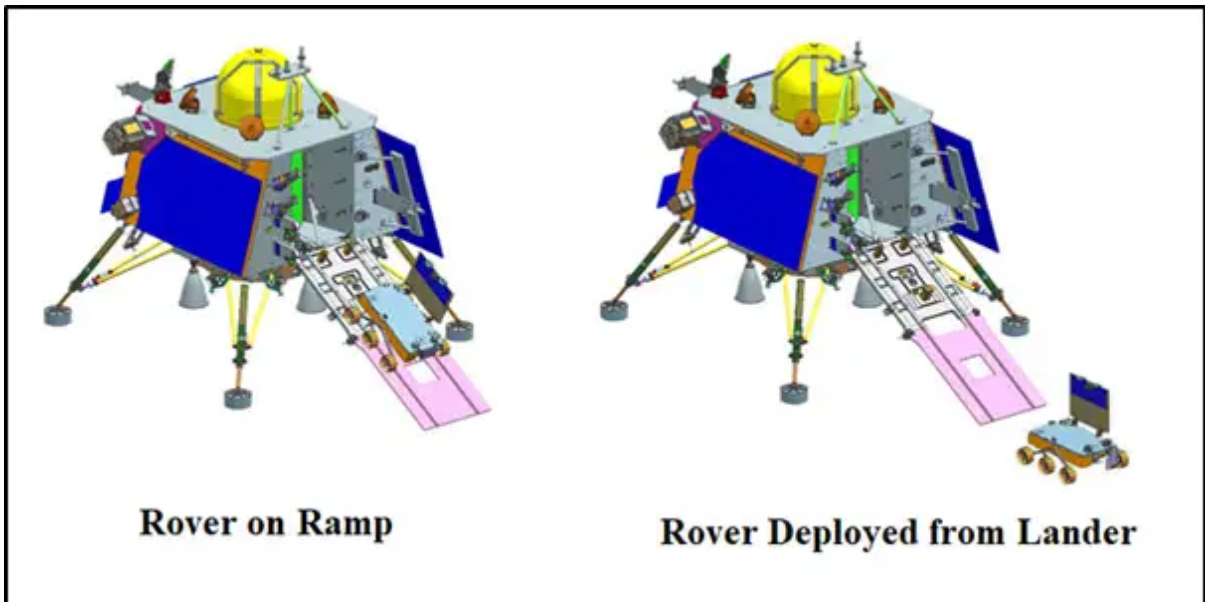
Chandrayaan-3 Lander Module -Views



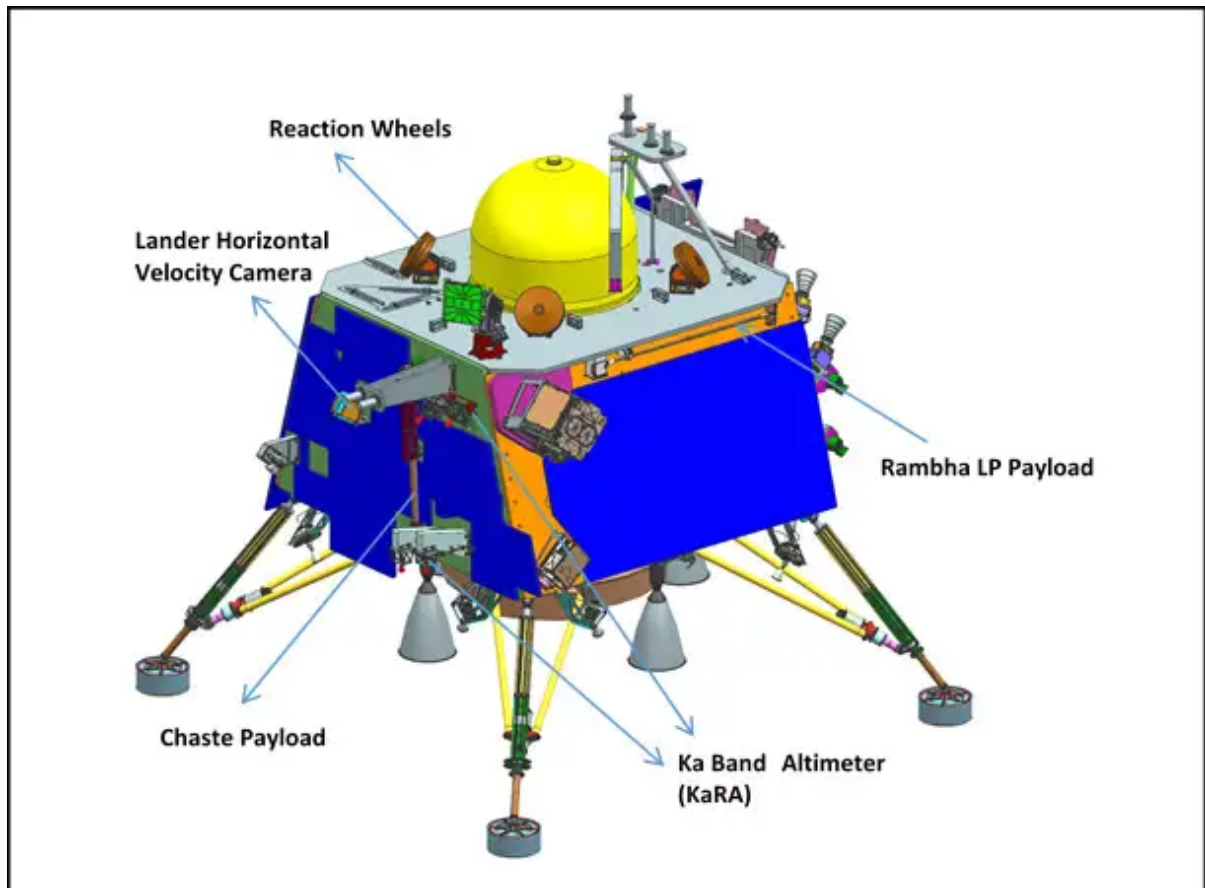
Chandrayaan-3 Propulsion Module - Views



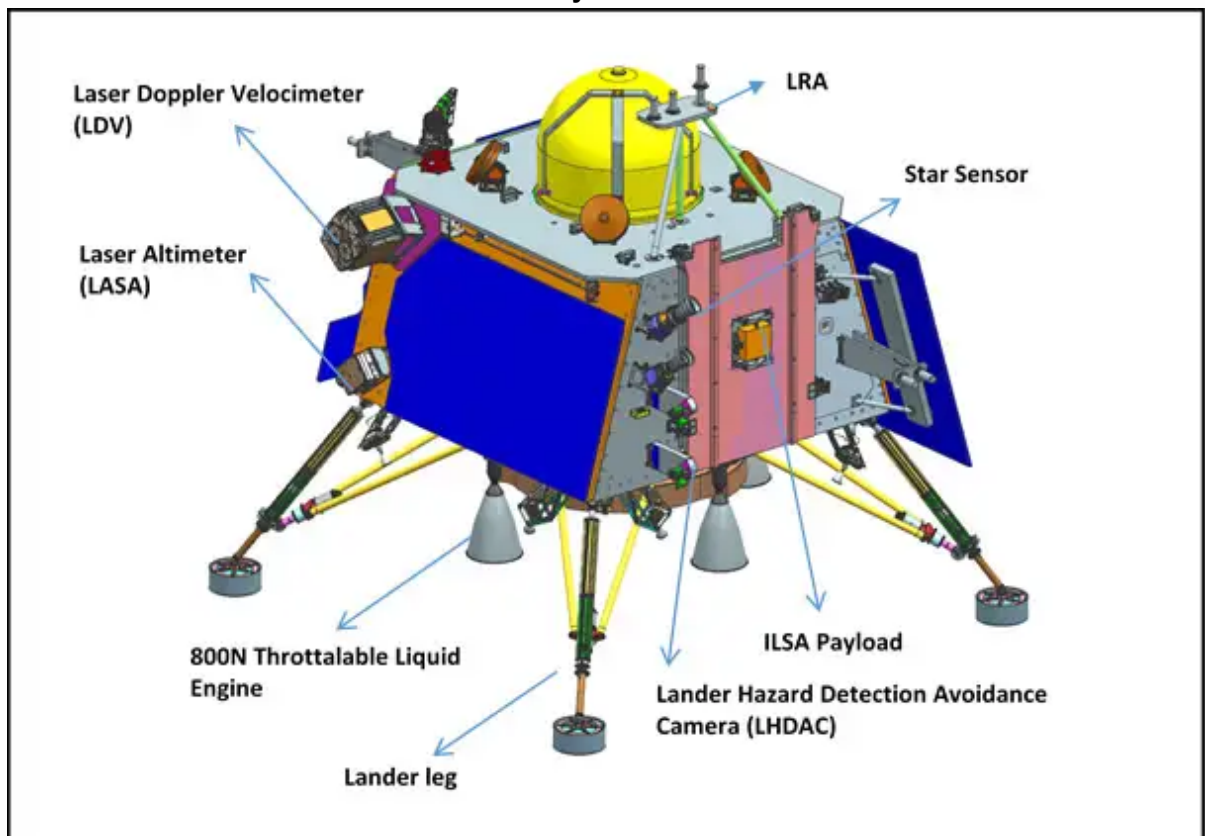
Chandrayaan-3 Rover on Ramp and Deployed Views



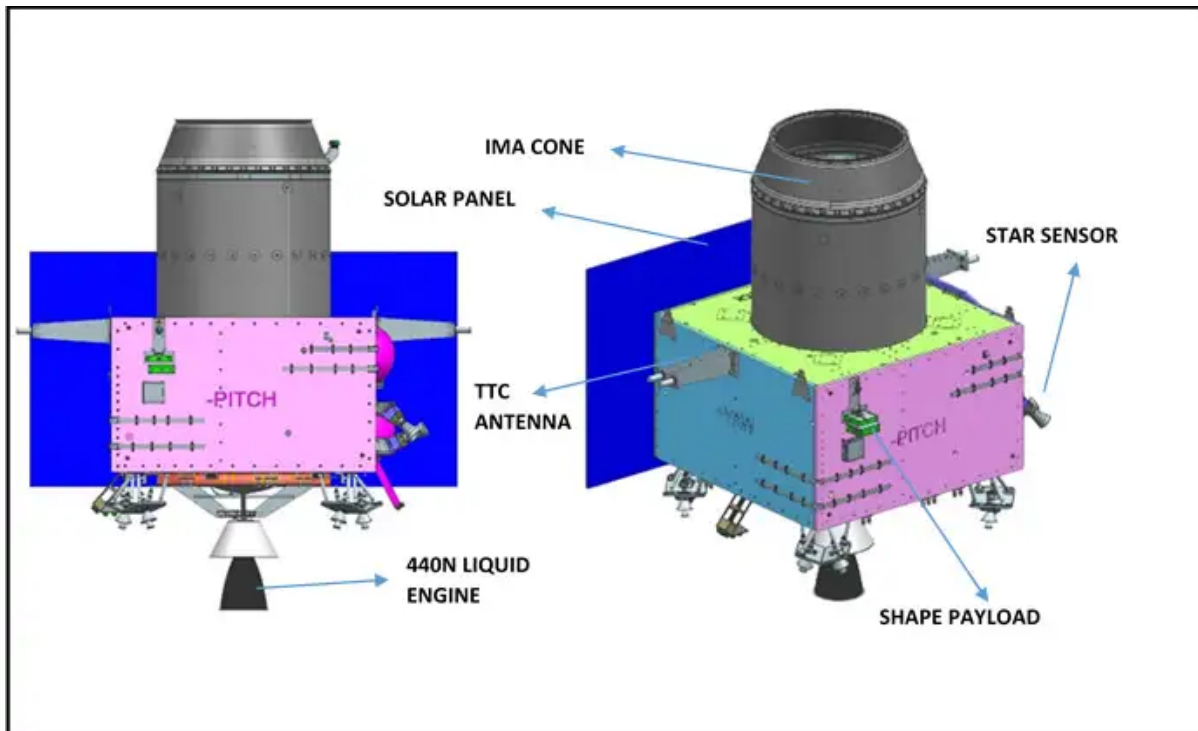
Chandrayaan-3 Rover -Views



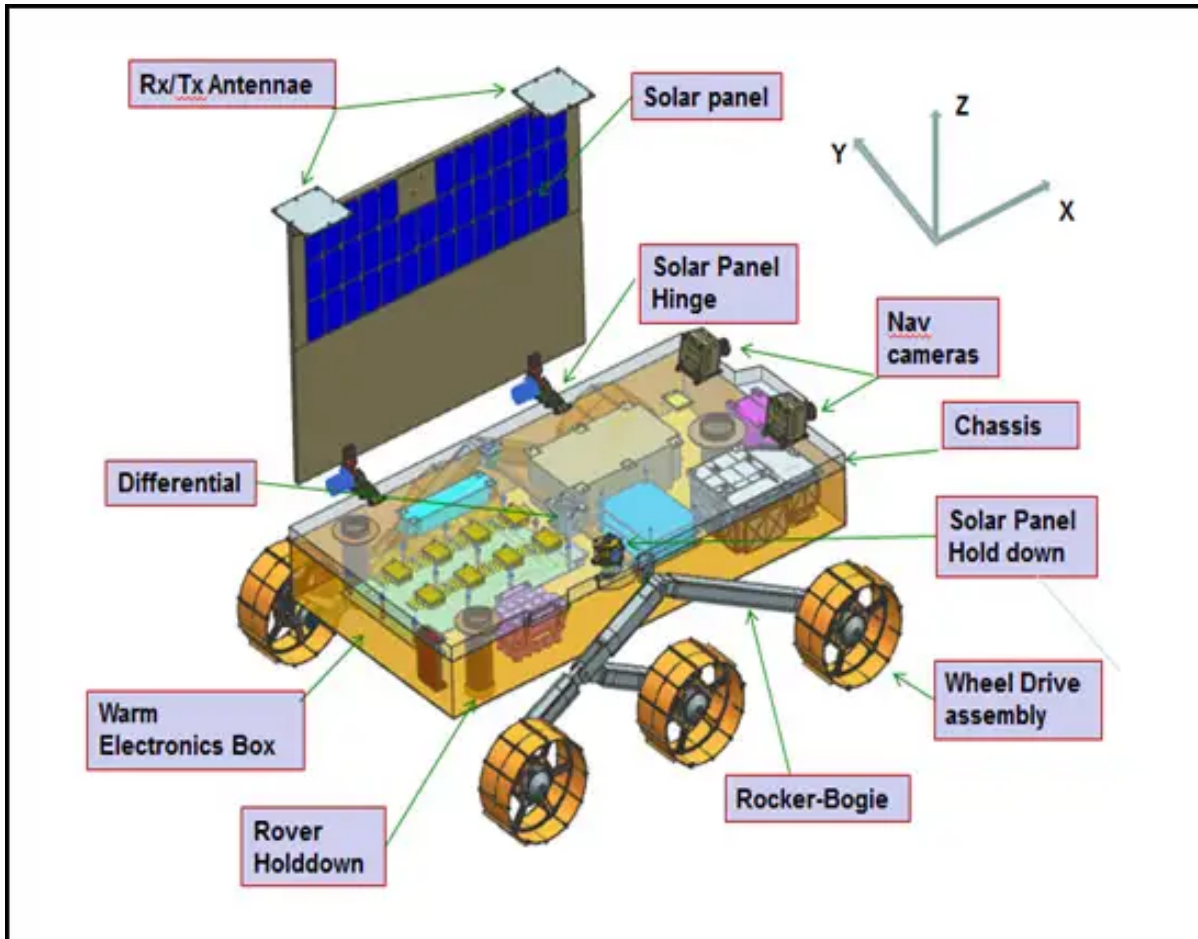
Chandrayaan-3 Lander



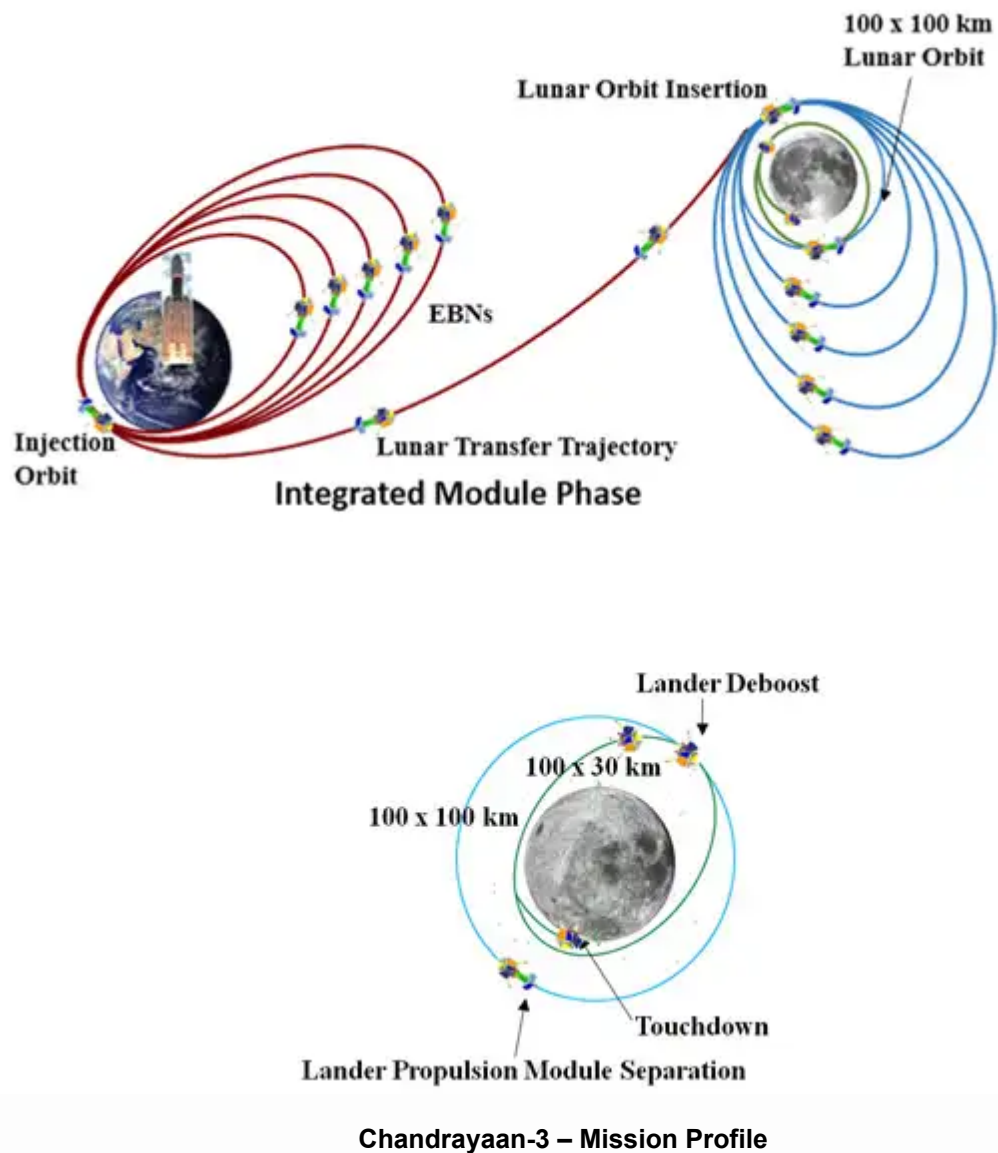
Chandrayaan-3 Lander



Chandrayaan-3 Propulsion Module



Chandrayaan-3 Rover



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