



# PSLV-C37

## CARTOSAT-2 Series Satellite

**INS-1A**

**Dove Satellites (88) [USA]**

**INS-1B**

**LEMUR Satellites (8) [USA]**

**BGUSat [Israel]**

**Al-Farabi-1 [Kazakhstan]**

**PEASSS [The Netherlands]**

**DIDO-2 [Switzerland]**

**Nayif-1 [UAE]**

# PSLV-C37



PSLV-C37 at the First Launch Pad

India's Polar Satellite Launch Vehicle, in its thirty ninth flight (PSLV-C37), will launch the 714 kg Cartosat-2 series satellite for earth observation and 103 co-passenger satellites together weighing about 664 kg at lift-off into a 505 km polar Sun Synchronous Orbit (SSO). PSLV-C37 will be launched from the First Launch Pad (FLP) of Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota. It will be the sixteenth flight of PSLV in 'XL' configuration (with the use of solid strap-on motors).

The co-passenger satellites comprise 101 International Customer nano satellites, viz., Israel, Kazakhstan, The Netherlands, Switzerland, United Arab Emirates (UAE) and the USA, as well as two nano satellites from India. The total weight of all the satellites carried onboard PSLV-C37 is about 1378 kg.

The 101 nano satellites are being launched as part of the commercial arrangement between the International Customer and Antrix Corporation Limited (Antrix), a Government of India company under Department of Space (DOS), the commercial arm of ISRO.

## PSLV-C37 at a glance (Vehicle lift-off Mass: 320 tonne Height: 44.4 m)

	Stage-1	Stage-2	Stage-3	Stage-4
Nomenclature	Core Stage PS1 + 6 Strap-on Motors	PS2	PS3	PS4
Propellant	Solid (HTPB based)	Liquid (UH25 + N <sub>2</sub> O <sub>4</sub> )	Solid (HTPB based)	Liquid (MMH + MON-3)
Propellant Mass (T)	138.2 (Core), 6 x 12.2 (Strap-on)	42.0	7.6	2.5
Stage Dia (m)	2.8 (Core), 1 (Strap-on)	2.8	2.0	1.3
Stage Length (m)	20 (Core), 12 (Strap-on)	12.8	3.6	3.0

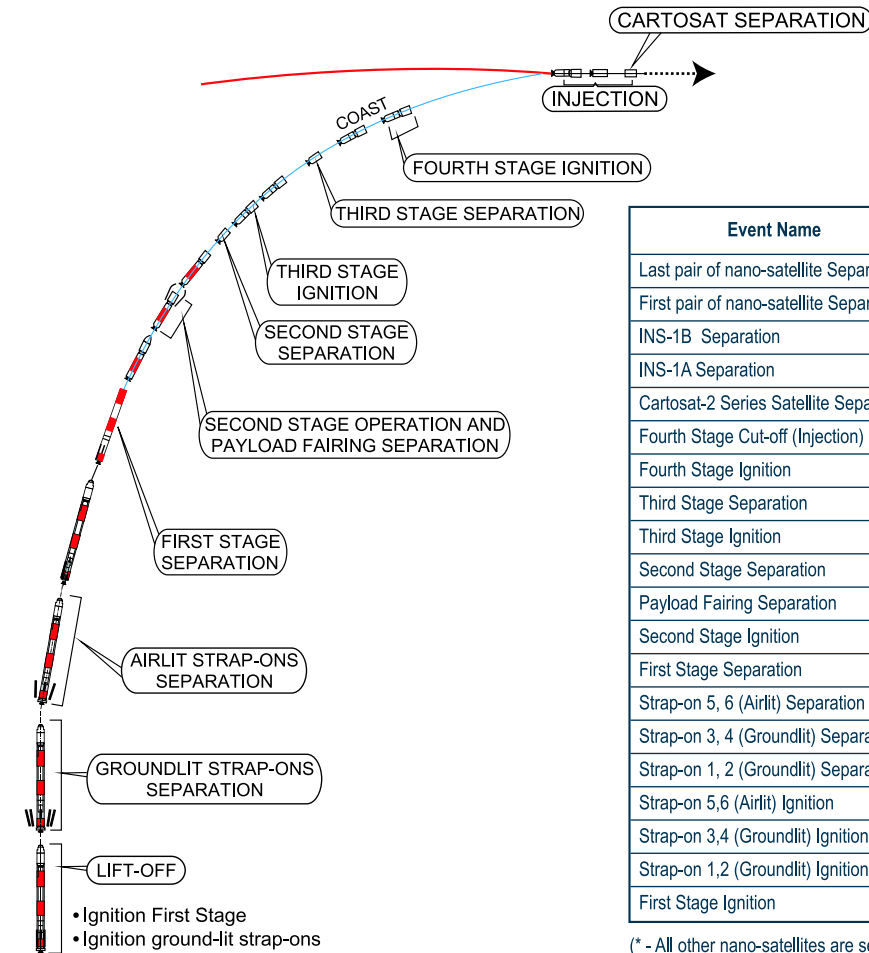
HTPB : Hydroxyl Terminated Poly Butadiene

UH25 : Unsymmetrical Dimethyl Hydrazine + 25% Hydrazine Hydrate

N<sub>2</sub>O<sub>4</sub> : Nitrogen Tetroxide

MMH : Mono Methyl Hydrazine, MON-3: Mixed Oxides of Nitrogen

# PSLV-C37



Height: 505 km  
Inclination: 97.46 deg

Event Name	Time after lift-off	Altitude (kilometre)	Velocity (metre per second)
Last pair of nano-satellite Separation	28 min 42.80 sec	524.075	7602.96
First pair of nano-satellite Separation *	18 min 32.80 sec	511.719	7608.96
INS-1B Separation	17 min 40.30 sec	510.601	7609.41
INS-1A Separation	17 min 39.80 sec	510.590	7609.42
Cartosat-2 Series Satellite Separation	17 min 29.80 sec	510.383	7609.52
Fourth Stage Cut-off (Injection)	16 min 47.80 sec	509.536	7605.59
Fourth Stage Ignition	8 min 22.22 sec	435.029	5824.10
Third Stage Separation	8 min 12.22 sec	428.300	5834.03
Third Stage Ignition	4 min 24.12 sec	220.068	4045.16
Second Stage Separation	4 min 22.92 sec	218.846	4047.94
Payload Fairing Separation	2 min 38.28 sec	116.975	2457.93
Second Stage Ignition	1min 51.08 sec	67.461	2165.16
First Stage Separation	1min 50.88 sec	67.241	2165.97
Strap-on 5, 6 (Airlit) Separation	1 min 32.0 sec	46.295	1858.84
Strap-on 3, 4 (Groundlit) Separation	1 min 10.1 sec	26.611	1324.52
Strap-on 1, 2 (Groundlit) Separation	1 min 9.9 sec	26.457	1319.92
Strap-on 5,6 (Airlit) Ignition	25.0 sec	2.761	575.97
Strap-on 3,4 (Groundlit) Ignition	0.62 sec	0.024	451.89
Strap-on 1,2 (Groundlit) Ignition	0.42 sec	0.024	451.89
First Stage Ignition	0.00	0.024	451.89

(\* - All other nano-satellites are separating in between 18 min 32.80 sec and 28 min 42.80 sec)

## PSLV-C37 Typical Flight Profile



Hoisting of Nozzle End Segment of PSLV-C37 core stage during vehicle integration



PSLV-C37 Liquid second Stage at Stage Processing Facility

# Primary Satellite

The Cartosat-2 series satellite is the primary satellite carried by PSLV-C37. This satellite is similar to the earlier four satellites of the Cartosat-2 series. After its injection into a 505 km polar Sun Synchronous Orbit by PSLV-C37, the satellite will be brought to operational configuration following which it will begin providing regular remote sensing services using its Panchromatic and Multispectral cameras.

The imagery sent by the satellite will be useful for cartographic applications, urban and rural applications, coastal land use and regulation, utility management like road network monitoring, water distribution, creation of land use maps, change detection to bring out geographical and manmade features and various other Land Information System (LIS) and Geographical Information System (GIS) applications.



Cartosat-2 series satellite undergoing panel deployment test

## Salient features

<b>Satellite mass</b>	714 Kg
<b>Orbit type</b>	Circular polar Sun Synchronous
<b>Orbit height</b>	505 km
<b>Orbit inclination</b>	97.46 degree
<b>Orbit period</b>	94.72 min
<b>Local time of Equator crossing</b>	9:30 am
<b>Power</b>	Solar arrays generating 986 Watts; Two Li-Ion batteries
<b>Attitude control</b>	Reaction wheels, Magnetic torquers and Hydrazine thrusters
<b>Design life</b>	5 years

# Co-passenger Satellites

## International Customer Satellites

Of the 101 nano satellites from foreign countries, 96 are from USA and the other five are from Israel, Kazakhstan, The Netherlands, Switzerland and UAE.

### DOVE (Flock-3P) [USA]

DOVE Flock-3P nano satellites are a fleet of remote sensing satellites that will image the entire Earth every day for commercial, environmental and humanitarian purposes. The Dove satellites are designed, built and operated by Planet Inc., headquartered in San Francisco, USA.



DOVE (Mass: 4.7 kg each)



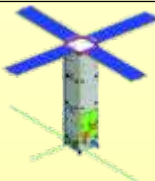


### LEMUR [USA]

LEMUR nano satellites of Spire Global Inc. (San Francisco, CA), USA are meant for providing vessel tracking using Automatic Identification System (AIS), besides carrying out weather measurement using GPS Radio Occultation.



LEMUR (Mass: 4.6 kg each)

## Nano satellites from The Netherlands, Switzerland, Israel, Kazakhstan and UAE

Nano Satellite	Country	Built by	Objective
PEASSS (3 kg) 	The Netherlands	European consortium of Partners owned by Innovative Solutions In Space BV	Technology demonstrator nano satellite
DIDO-2 (4.2 kg) 	Switzerland	SpacePharma	Microgravity research nano satellite
BGUSat (4.3 kg) 	Israel	Israeli Aerospace Industries (IAI), in cooperation with the Ben Gurion University	Technology demonstrator for nano satellite avionics systems
Al-Farabi-1 (1.7 kg) 	Kazakhstan	Al-Farabi Kazakh National University (KazNU named after Al-Farabi)	Technology demonstrator nano satellite
Nayif-1 (1.1 kg) 	UAE	Mohammed bin Rashid Space Centre, Dubai	Technology demonstrator nano satellite

# Co-passenger Satellites

## Indian Satellites

PSLV-C37 carries two ISRO Nano Satellites – INS-1A and INS-1B. ISRO Nano Satellite (INS) is a versatile and modular Nano satellite bus system envisioned for future science and experimental payloads. The INS system is developed as a co-passenger satellite to accompany bigger satellites on PSLV.

The primary objectives of INS system are to:

- Design and develop a low cost modular Nano satellite in the weight range of 10 kg capable of carrying payloads up to a weight of 5 kg
- Provide an opportunity for ISRO technology demonstration payloads
- Provide a standard bus for launch on demand services
- Provide an opportunity to carry innovative payloads for Universities / R&D labs

### INS-1A and 1B Specifications

**INS-1A** Lift-off Weight: 8.4 kg Overall Size: 304 x 246 x 364.3 mm<sup>3</sup> (stowed)  
304 x 670 x 364.3 mm<sup>3</sup> (deployed)

#### **Payloads:**

**Surface Bidirectional Reflectance Distribution Function Radiometer (SBR)** payload from Space Applications Centre (SAC), Ahmedabad measures the BRDF (Bidirectional Reflectance Distribution Function) of the Earth surface and will take readings of the reflectance of different surface features due to Sun albedo.

**Single Event Upset Monitor (SEUM)** payload from SAC monitors Single Event Upsets occurring due to high energy radiation in the space environment in COTS (Commercial Off The Shelf) components.

Mission Life: 6 months



*INS-1A Deployed Configuration with SBR/Single Event Upset Monitor (SEUM) payload*

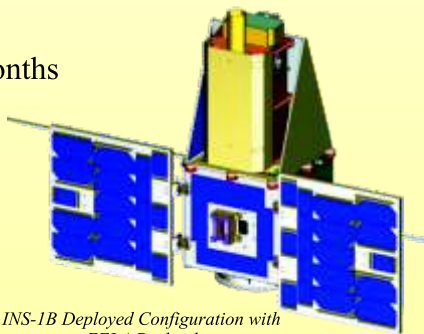
**INS-1B** Lift-off Weight: 9.7 kg Overall Size: 304 x 246 x 510 mm<sup>3</sup> (stowed)  
304 x 670 x 510 mm<sup>3</sup> (deployed)

#### **Payloads:**

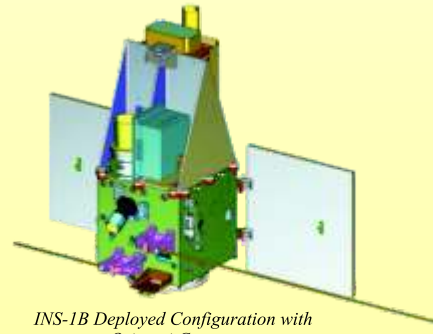
**Earth Exosphere Lyman Alpha Analyser (EELA)** payload from Laboratory for Electro-Optics Systems (LEOS), Bengaluru Registers terrestrial exospheric line-of-sight neutral atomic hydrogen Lyman Alpha flux. Besides, it will estimate the interplanetary hydrogen Lyman-alpha background flux by means of deep space observations.

**Origami Camera** payload from SAC is a Remote Sensing Colour camera with a novel lens assembly for optical realisation in a small package. There is scope for its future scalability and utilisation in regular satellites.

Mission Life: 6 months



*INS-1B Deployed Configuration with EELA Payload*



*INS-1B Deployed Configuration with Origami Camera*