PSLV-C24

IRNSS-1B

PSLV-C24

PSLV-C24 Carrying IRNSS-1B at the first Launch pad

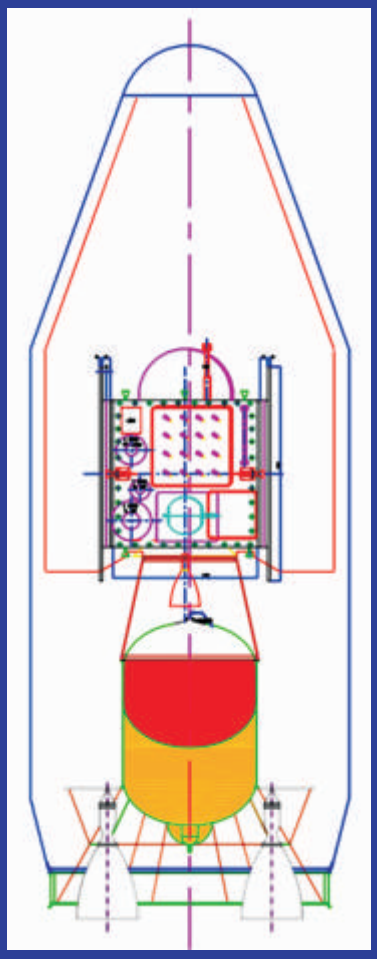
Polar Satellite Launch Vehicle, in its twenty sixth flight (PSLV-C24), will launch IRNSS-1B, the second satellite of the Indian Regional Navigation Satellite System (IRNSS). The launch will take place from the First Launch Pad (FLP) of Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota. PSLV-C24 will use 'XL' version of PSLV. This is the sixth time 'XL' configuration is being flown, earlier five being PSLV-C11/Chandrayaan-1, PSLV-C17/GSAT-12, PSLV-C19/RISAT-1, PSLV-C22/IRNSS-1A and PSLV-C25/Mars Orbiter Spacecraft missions.

PSLV-C24 AT A GLANCE

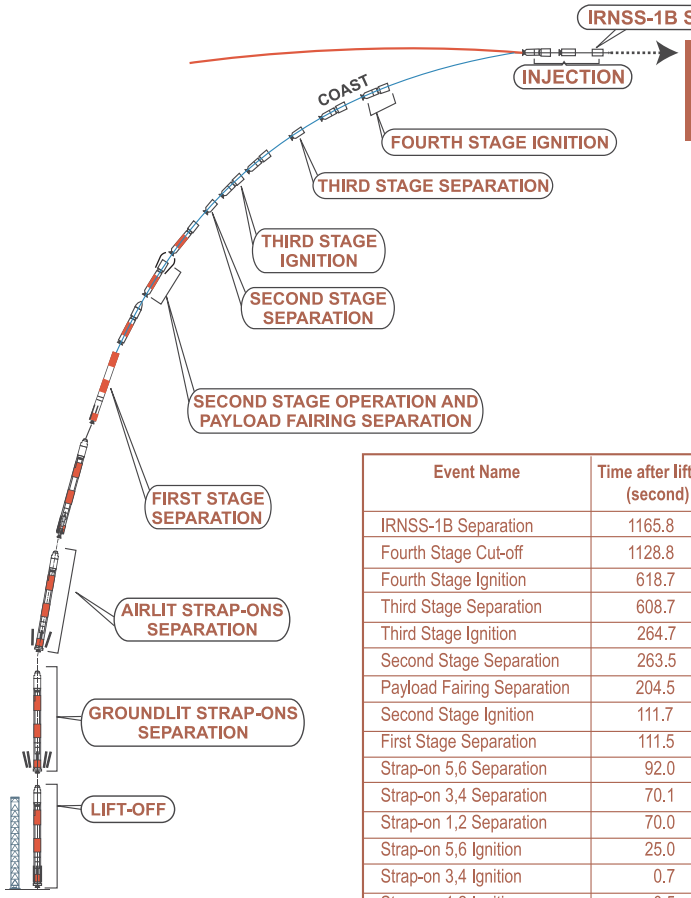
Lift-off Mass: 320 tons Height: 44.4 metres

	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_2O_4)	Solid (HTPB based)	Liquid (MMH + MON-3)
Mass (T)	138 (Core), 6 x 12 (Strap-on)	41.7	7.6	2.5
Max Thrust (kN)	4819 (Core), 6 x 716 (Strap-on)	804	240	7.3 x 2
Burn Time (s)	101.5 (Core), 49.5 (Strap-on)	149	112.1	513
Stage Dia (m)	2.8 (Core), 1 (Strap-on)	2.8	2.0	2.8
Stage Length (m)	20 (Core), 14.7 (Strap-on)	12.5	3.6	2.6

HTPB : Hydroxyl Terminated Poly Butadiene
UH25 : Unsymmetrical Dimethyl Hydrazine + 25% Hydrazine Hydrate
N_2O_4 : Nitrogen Tetroxide
MMH : Mono Methyl Hydrazine, MON-3: Mixed Oxides of Nitrogen



IRNSS-1B in PSLV-C24 Envelope



Apogee	20,650 ± 675 km
Perigee	284 ± 5 km
Inclination	19.2 ± 0.2 deg

Event Name	Time after lift-off (second)	Altitude (kilometre)	Velocity (metres per second)
IRNSS-1B Separation	1165.8	506.3	9598.9
Fourth Stage Cut-off	1128.8	454.2	9638.4
Fourth Stage Ignition	618.7	186.1	7732.0
Third Stage Separation	608.7	184.3	7734.1
Third Stage Ignition	264.7	130.1	5376.3
Second Stage Separation	263.5	129.9	5376.7
Payload Fairing Separation	204.5	112.8	3709.6
Second Stage Ignition	111.7	56.4	2389.9
First Stage Separation	111.5	56.3	2390.4
Strap-on 5,6 Separation	92.0	39.4	2026.7
Strap-on 3,4 Separation	70.1	23.4	1429.3
Strap-on 1,2 Separation	70.0	23.3	1424.6
Strap-on 5,6 Ignition	25.0	2.6	606.5
Strap-on 3,4 Ignition	0.7	0.02	452
Strap-on 1,2 Ignition	0.5	0.02	452
First Stage Ignition	0.0	0.02	452

PSLV-C24 TYPICAL FLIGHT PROFILE

PSLV-C24 Second Stage in the Stage Prepartion Facility

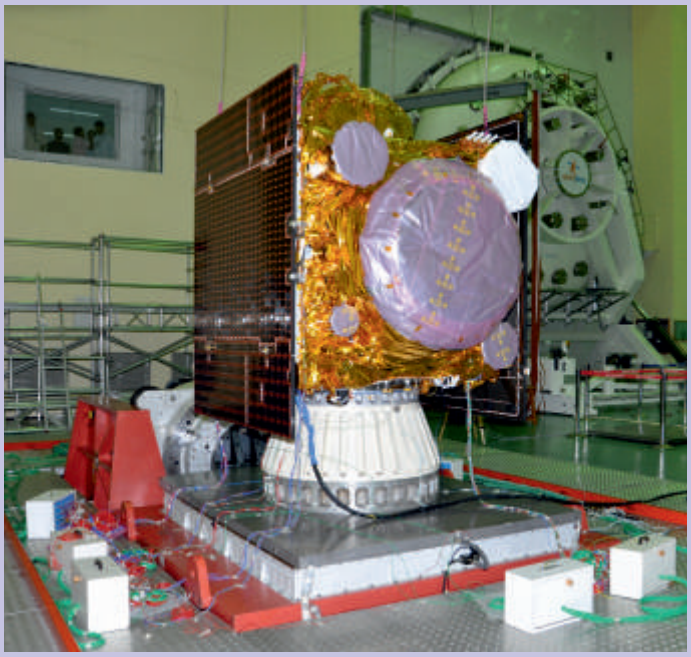
PSLV-C24 Third and Fourth Stages

PSLV-C24 in the Mobile Service Tower prior to Satellite Integration

IRNSS-1B

IRNSS-1B is the second navigation satellite of the seven satellites constituting the IRNSS space segment. Its predecessor, IRNSS-1A, was launched by PSLV-C22 in July 2013. IRNSS-1B has a lift-off mass of 1432 kg. The configuration of IRNSS-1B is similar to that of IRNSS-1A. The satellite has been realised in less than seven months after the launch of its predecessor.

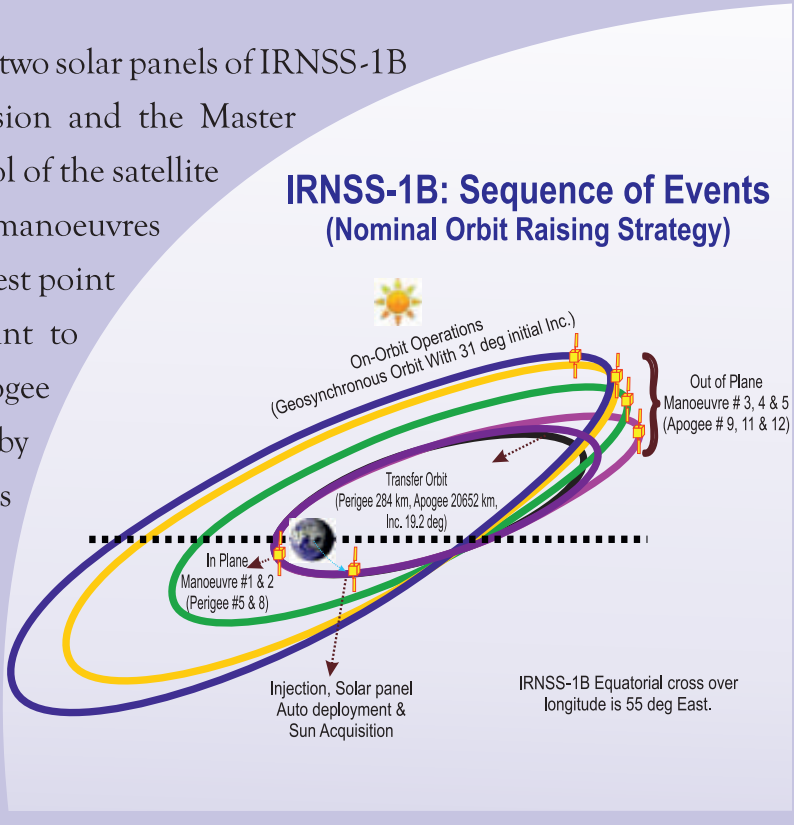
The two solar panels of IRNSS-1B consisting of Ultra Triple Junction solar cells generate about 1660 Watts of electrical power. Sun and Star sensors as well as gyroscopes provide orientation reference for the satellite. Special thermal control schemes have been designed and implemented for some of the critical elements such as atomic clocks. The Attitude and Orbit Control System (AOCS) of IRNSS-1B maintains the satellite's orientation with the help of reaction wheels, magnetic torquers and thrusters. Its propulsion system consists of a Liquid Apogee Motor (LAM) and thrusters.



IRNSS-1B undergoing vibration test

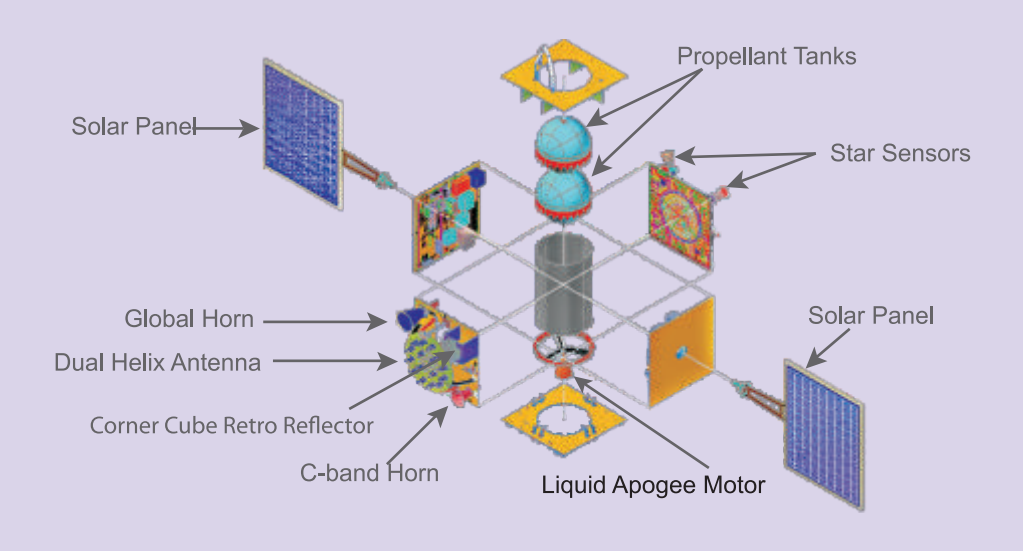
IRNSS-1B will be launched into a sub Geosynchronous Transfer Orbit (sub GTO) with a 284 km perigee (nearest point to Earth) and 20,652 km apogee (farthest point to Earth) with an inclination of 19.2 deg with respect to the equatorial plane.

After injection into this preliminary orbit, the two solar panels of IRNSS-1B are automatically deployed in quick succession and the Master Control Facility (MCF) at Hassan takes control of the satellite and performs the initial orbit raising manoeuvres consisting of two manoeuvres at perigee (nearest point to earth) and three at apogee (farthest point to earth). For these manoeuvres, the Liquid Apogee Motor (LAM) of the satellite is used, thereby finally placing it in the circular geosynchronous orbit at 55 deg East location with an initial inclination of 31 deg with respect to the equator.

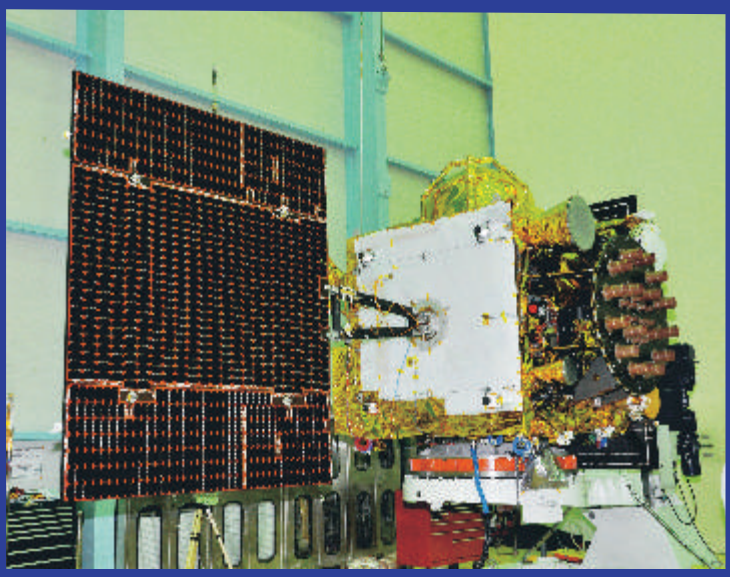


IRNSS-1B Salient Features:

ORBIT	: Geosynchronous, at 55 deg East longitude with 29 deg inclination
LIFT -OFF MASS	: 1432 kg
DRY MASS	: 614 kg
PHYSICAL DIMENSIONS	: 1.58 metre x 1.50 metre x 1.50 metre
POWER	: Two solar panels generating 1660 W, one Lithium-ion battery of 90 Ampere-Hour capacity
PROPULSION	: 440 Newton Liquid Apogee Motor, twelve 22 Newton Thrusters
CONTROL SYSTEM	: Zero momentum system: orientation input from Sun & Star Sensors and Gyroscopes; Reaction Wheels, Magnetic Torquers and 22 Newton thrusters as actuators
MISSION LIFE	: Ten years



IRNSS-1B Disassembled View



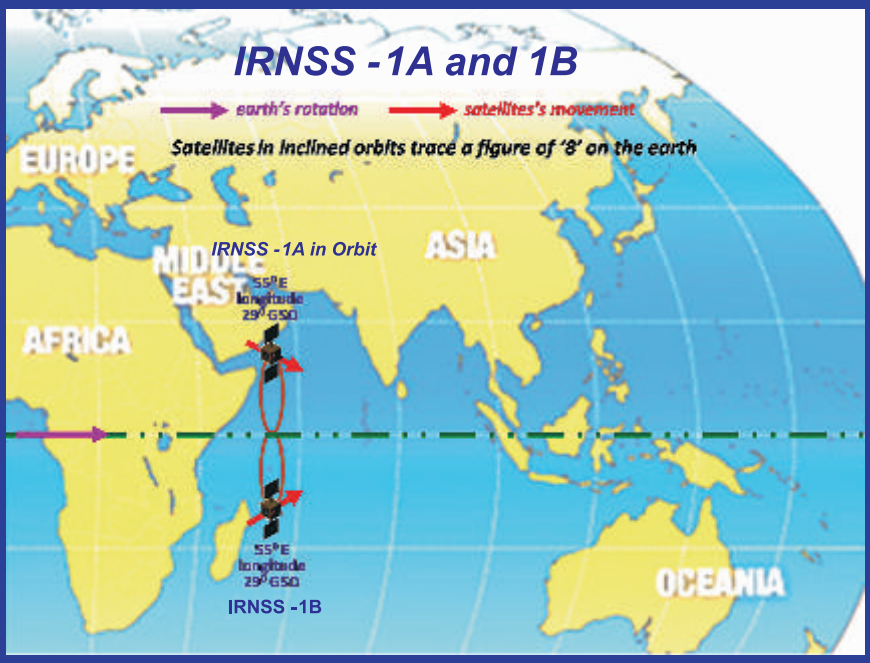
IRNSS-1B at clean room with one of its solar panels deployed

PAYLOADS:

IRNSS -1B carries two types of payloads – navigation payload and ranging payload.The navigation payload of IRNSS-1B will transmit navigation service signals to the users. This payload will be operating in L5 band (1176.45 MHz) and S band (2492.028 MHz). A highly accurate Rubidium atomic clock is part of the navigation payload of the satellite. The ranging payload of IRNSS-1B consists of a C-band transponder which facilitates accurate determination of the range of the satellite. IRNSS-1B also carries Corner Cube Retro Reflectors for laser ranging.

IRNSS Overview:

IRNSS is an independent regional navigation satellite system being developed by India. It is designed to provide accurate position information service to users in India as well as the region extending up to 1500 km from its boundary, which is the primary service area of IRNSS. The Extended Service Area lies between primary service area and area enclosed by the rectangle from Latitude 30 deg South to 50 deg North, Longitude 30 deg East to 130 deg East.



IRNSS will provide two types of services, namely, Standard Positioning Service (SPS) which is provided to all the users and Restricted Service (RS), which is an encrypted service provided only to the authorised users. The IRNSS System is expected to provide a position accuracy of better than 20 m in the primary service area.

IRNSS comprises of a space segment and a ground segment. The IRNSS space segment consists of seven satellites, with three satellites in geostationary orbit and four satellites in inclined geosynchronous orbit. IRNSS-1A, the first satellite of the IRNSS constellation, has already started functioning from its designated orbital slot after extensive on orbit test and evaluation to confirm its satisfactory performance.

IRNSS ground segment is responsible for navigation parameter generation and transmission, satellite control, ranging and integrity monitoring as well as time keeping.

The constituent elements of the IRNSS ground segment are:

- ISRO Navigation Centre (INC) at Byalalu, is the nerve center of the IRNSS Ground Segment. INC primarily generates navigation parameters.
- IRNSS Range and Integrity Monitoring Stations (IRIMS) perform continuous one way ranging of the IRNSS satellites and are also used for integrity determination of the IRNSS constellation.
- IRNSS CDMA Ranging Stations (IRCDR) carry out precise two way ranging of IRNSS satellites.
- IRNSS Network Timing Centre (IRNWT) at Byalalu generates, maintains and distributes IRNSS Network Time.
- Spacecraft Control Facility (SCF) controls the space segment through Telemetry Tracking & Command network. In addition to the regular TT&C operations, IRSCF also uplinks the navigation parameters generated by the INC.
- IRNSS Data Communication Network (IRDCN) provides the required digital communication backbone to IRNSS network.
- International Laser Ranging Service (ILRS) is planned to be used periodically to calibrate the IRNSS orbit determined by other techniques.

Applications of IRNSS:

- Terrestrial, Aerial and Marine Navigation
- Disaster Management
- Vehicle tracking and fleet management
- Integration with mobile phones
- Precise Timing
- Mapping and Geodetic data capture
- Terrestrial navigation aid for hikers and travellers
- Visual and voice navigation for drivers

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