

# GSLV-F05 / INSAT-3DR Mission

08 September, 2016

## THE MISSION

GSLV-F05 carrying on-board the INSAT-3DR Satellite lifted-off from the Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota at rescheduled time of 04:50 AM (IST) on September 08, 2016. The 40 minute delay in the launch was due to an anomaly observed in the functioning of a pressure release valve in the liquid oxygen filling ground segment which was later resolved.

About 17 minutes after lift-off, INSAT-3DR was successfully placed into a Geostationary Transfer Orbit (GTO). INSAT-3DR satellite orbiting the Earth in the oval shaped GTO with a perigee of 169.76 km and an apogee of 36,080.5 km at an orbital inclination of 20.62° with respect to the Equator.

INSAT-3DR similar to INSAT-3D, is an advanced Meteorological Satellite of India, configured with an Imaging System and an Atmospheric Sounder. It provides a variety of inputs essential for accurate weather forecasting.





# GSLV - F05

## THE LAUNCH VEHICLE

In its 10<sup>th</sup> flight, GSLV-F05 is significant since it is the first operational flight of GSLV carrying indigenously developed Cryogenic Upper Stage (CUS) for the fourth time.

The CUS being flown in GSLV-F05 is designed as CUS-07. A cryogenic rocket stage is more efficient and provides more thrust for every kilogram of propellant it burns compared to solid and Earth-storable liquid propellant rocket stages. But, a cryogenic stage is technically a very complex system compared to solid or Earth-storable liquid propellant stages due to its use of propellants at extremely low temperatures and the associated thermal and structural challenges. Oxygen liquefies at  $-183^{\circ}\text{C}$  and Hydrogen at  $-253^{\circ}\text{C}$ . The propellants, at these low temperatures, are to be pumped using turbo pumps running at around 40,000 rpm.

The main engine and two smaller steering engines of CUS together develop a nominal thrust of 73.55 kN in vacuum. During the flight, CUS fires for a nominal duration of 720 seconds.

S-band telemetry and C-band transponders enable GSLV-F05 Performance Monitoring, Tracking, Range Safety and Preliminary Orbit Determination (POD).



## SPECIFICATIONS

<b>Height</b>	49.1 m
<b>Lift-Off Mass</b>	415.2 t
<b>No of Stages</b>	3
<b>Payloads</b>	INSAT-3DR
<b>Inclination (deg)</b>	$20.61^{\circ}$
<b>Apogee</b>	35,975 km
<b>Perigee</b>	170 km
<b>Launch Pad</b>	Second Launch Pad (SDSC, SHAR)

Parameters	STAGE CHARACTERISTICS			
	Stages			
	First Stage (GS1)	Second Stage (GS2)	Third Stage (GS3)	
	(4) L40Hs	S139		
<b>Length (m)</b>	19.68	20.18	11.57	8.72
<b>Diameter (m)</b>	2.1	2.8	2.8	2.8
<b>Propellants</b>	UH25 & N <sub>2</sub> O <sub>4</sub>	HTPB	UH25 & N <sub>2</sub> O <sub>4</sub>	LH <sub>2</sub> & LOX
<b>Propellant Mass (t)</b>	4 x 42.67	138.21	39.44	12.83

# INSAT-3DR

## THE SATELLITE

INSAT-3DR similar to INSAT-3D is an advanced Meteorological (Weather Observation) Satellite of India configured with an Imaging System and an Atmospheric Sounder. The significant improvements incorporated in INSAT-3DR are:

- Imaging in middle infrared band to provide night time pictures of low clouds and fog
- Imaging in two thermal infrared bands for estimation of Sea Surface Temperature (SST) with better accuracy
- Higher Spatial Resolution in the visible and thermal infrared bands

INSAT-3DR carries a Data Relay Transponder as well as a Search and Rescue Transponder. Thus, INSAT-3DR will provide service continuity to earlier meteorological missions of ISRO and further augment the capability to provide various meteorological as well as search and rescue services.

INSAT-3DR is based on ISRO's two tonne class platform (1-2K bus) employing light-weight structural elements like Carbon Fibre Reinforced Plastic (CFRP).

## SPECIFICATIONS

<b>Weight</b>	2211 kg
<b>Power</b>	1700 W, One 90 Ah Li-Ion battery
<b>Stabilisation</b>	3-axis body stabilised in orbit using Sun Sensors, Star Sensors, Gyroscopes, Reaction Wheels, Magnetic Torquers and Thrusters
<b>Antennae</b>	0.9 m and 1.0 m body mounted antennae
<b>Propulsion</b>	440 Newton Liquid Apogee Motor (LAM) and twelve 22 Newton thrusters with Mono Methyl Hydrazine (MMH) as fuel and Mixed Oxides of Nitrogen (MON-3) as oxidizer
<b>Type of Satellite</b>	Earth Observation
<b>Payloads</b>	<ul style="list-style-type: none"><li>• Multi-spectral Imager</li><li>• 19 Channel Sounder</li><li>• Data Relay Transponder</li><li>• Search &amp; Rescue Transponder</li></ul>
<b>Mission Life</b>	10 Years





## Payloads of INSAT-3DR

**Imager:** For meteorological observations, INSAT-3DR carries Multi-spectral Imager (optical radiometer) capable of generating the images of the Earth in six wavelengths bands significant for meteorological infrared regions. The Imager will generate images of the Earth disk from Geostationary altitude of 36,000 km every 26 minutes and provide information on various parameters, namely, outgoing long-wave radiation, quantitative precipitation estimation, sea surface temperatures, snow cover, cloud motion winds, etc. The Imager payload is an improved version of VHRR flown on INSAT-3A and Kalpana-1 satellites with significant improvements in spatial resolution, number of spectral channels and functionality.

**Sounder:** INSAT-3DR also carries 19 Channel Sounder, which was earlier flown in INSAT-3D. The sounder has 18 narrow spectral channels in shortwave infrared, middle infrared and long wave infrared regions and one channel in the visible region. It will provide information on the vertical profiles of temperature, humidity and integrated ozone. These profiles will be available for selected region over Indian landmass every one hour and for the entire Indian Ocean Region in every six hours.

**Data Relay Transponder (DRT):** DRT on-board INSAT-3DR will be used for receiving meteorological, hydrological and oceanographic data from remote uninhabited locations over the coverage area from Data Collection Platforms (DCPs) like Automatic Weather Stations (AWS), Automatic Rain Gauges (ARG) and Agro Met Stations (AMS). The data is relayed back for downlinking in extended C-band. For extreme weather related disasters such as cyclone, floods and drought, real-time observations of the associated parameters with appropriate network density is very important. Satellite enabled Data Collection Platforms provide a unique solution for gathering meteorological data from all over the country including remote and inaccessible places. India Meteorological Department (IMD) and ISRO have established more than 3000 Data Collection Platforms. INSAT-3DR provides continuity of services of DRT which is currently carried by INSAT-3A and INSAT-3D.

**Satellite Aided Search and Rescue (SAS & R) Transponder:** INSAT-3DR is equipped with a Search and Rescue payload (operating in 406.05 MHz) that picks up and relays the alert signals originating from the distress beacons of maritime, aviation and land based users to the Indian Mission Control Centre located at ISRO's



Telemetry, Tracking and Command Network (ISTRAC), Bangalore. The major users of Satellite Aided Search and Rescue service in India are the Indian Coast Guard, Airports Authority of India (AAI), Directorate General of Shipping, Defense Services and Fishermen. The Indian Service region includes a large part of the Indian Ocean Region covering India, Bangladesh, Bhutan, Maldives, Nepal, Seychelles, Sri Lanka and Tanzania for rendering distress alert services.

**INSAT METEOROLOGICAL DATA PROCESSING SYSTEM (IMDPS)**

IMDPS will cater to the processing of all data transmitted by the Imager and Sounder payloads. IMDPS comprises three major sub-systems — Data Acquisition, Quick Look Display System and Data Products System.

These geophysical parameters and products will be derived and ingested into the operational weather forecasting activities at IMD. In addition, some of these parameters, particularly the Atmospheric Motion Vectors (AMVs) from the Imager, as well as the temperature and humidity profiles from the Sounder will be ingested in numerical weather forecast models in real-time for accurate weather prediction.

PAYLOAD	Geophysical Parameters and Derived Products
IMAGER	<ul style="list-style-type: none"> <li>• Outgoing Longwave Radiation (OLR)</li> <li>• Quantitative Precipitation Estimate (QPE)</li> <li>• Atmospheric Motion Vector (AMV)</li> <li>• Upper Troposphere Humidity (UTH)</li> <li>• Sea Surface Temperature (SST)</li> <li>• Land Surface Temperature (LST)</li> <li>• Water Vapour Wind Vector</li> <li>• Insolation</li> <li>• Snow Cover</li> <li>• Fog, Forest Fire, Smoke and Aerosol Identification</li> <li>• Tropical Cyclone Position and Intensity Estimation</li> </ul>
SOUNDER	<ul style="list-style-type: none"> <li>• Temperature, Humidity profiles and Integrated Ozone</li> <li>• Geo-perceptible Water</li> <li>• Layer Perceptible Water</li> <li>• Total Perceptible Water</li> <li>• Lifted Index (LI)</li> <li>• Wind Index (WI)</li> <li>• Dry Microburst Index (DMI)</li> <li>• Potential Temperature Differential</li> <li>• Ozone Estimate</li> </ul>

