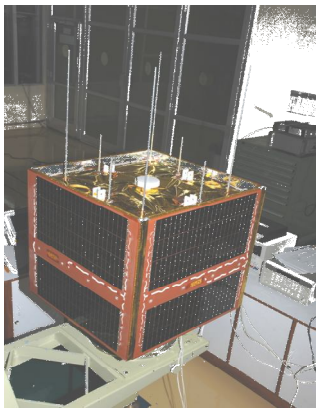


ANUSAT

Launched on 20.04.09

SPECIFICATIONS

1.	APPLICATION	:	Digital Communication using Store & Forward Techniques
2.	SIZE	:	600 mm x 600 m x 600 mm Cuboid
3.	MASS	:	40 Kg
4.	SOLAR ARRAY	:	Body Mounted Ga As Solar Cells Generating 40 Watts
5.	BATTERY	:	LI ion (4 x 5) 20 Cells 10 Ah Capacity ; 13 – 16 V
6.	TELECOMMAND	:	ON/OFF and Data commands VHF PCM/FSK/AM 100 bps 149.2 MHz
7.	TELEMETRY	:	VHF/PCM/FSK/AM 512 bps 137.4 MHz
8.	STORE AND FORWARD	:	VHF 145.8 MHz Uplink UHF 435 MHz Downlink
9.	ATTITUDE CONTROL STABILISATION	:	Spin stabilised with spin axis orientation using magnetic torquer
10.	SPIN RATE	:	8 ± 0.5 rpm (Automatic SRC)
11.	SPIN AXIS ORIENTATION	:	$\pm 3^{o}$ (SAOC) Sun normal or Orbit normal
12.	SUN SENSOR	:	$\pm 75^{o}$ with 0.5^{o} resolution
13.	MAGNETOMETER	:	$\pm$ 60,000 Gamma with 500 gamma resolution.
14.	TORQUERS	:	4.5 Am^2 capacity (2 Nos. Z Axis), 1 each in X Y axis
15.	LAUNCH	:	PSLV C-12

ANUSAT

ANUSAT (Anna University Satellite) is the first University Satellite of India to be launched by Polar Satellite Launch Vehicle (PSLV). The 40 Kg micro satellite developed by the Anna University carries a Store and Forward Payload. Apart from this secondary payloads are MEMS Gyro, MEMS Magnetometer and Satellite Positioning System.

ISRO supports development of Micro satellites in universities for technology development and space science studies. This is to enthuse among university students interest in space technology education programmes.

ANUSAT is launched into 41 degree inclined orbit. Major accomplishments of student community are:

- Design and build a spacecraft by the university.
- Spacecraft power system of 40 W provided by GaAs solar cells with a backup of 10 Ah Li ion battery.
- Telemetry system in VHF with data for house keeping and auxiliary payloads.
- Telecommand system in VHF to command the spacecraft.
- AOCS system consisting of Sensor systems, Magnetometer and Twin slit sensors and actuators consisting of torquers along the three axes.
- Control spin rate to 8 rpm $\pm$ 0.5 rpm.
- Up link data in VHF band for store and forward payload.
- Store and Forward payload data down link transmission in UHF.

ORBIT

547 Kms Orbit 41^{o} Inclination
Four Orbits
10 – 12 Minutes

LIFE TIME

1 Year

INITIAL SATELLITE USERS

- MIT (Madras Institute of Technology)
- College Of Engineering, Guindy
- Pune University

STRUCTURE

600 x 600 x 600 mm Honeycomb cuboid

- Body mounted solar panels
- Three deck arrangement
- Inter connecting shear webs
- Subsystems on deck and low mass subsystems on shear web.

THERMAL

- Passive Thermal Control; Paints, Low emittance tapes, MLI
- Temperature sensors for monitoring temperatures.

POWER

- 40 W Body mounted GaAs Cells
- 10 AH Li ion Battery
- Three DC DC Converters
- Battery with UTP LTP and ETP logic (Upper trip point, Lower trip point, Emergency trip point)

TELEMETRY

- Telemetry data rate 512 bps
- 10 Bit resolution
- PCM PSK / PM
- 8 Calibration voltages monitored
- On board timer (OBT) with 1 msec. resolution
- Play back telemetry interleaved with real time.
- Play back telemetry for magnetometer (Mems Based) Gyro Micro Electro Mechanical System (MEMS) based and Satellite Positioning System (SPS)
- Storage of real time telemetry in sub sampled mode during non visible period.

TELECOMMAND

- On/Off commands
- Data commands
- Payload operation only over visible ground stations with TC (Telecommand) capability.

ATTITUDE ORBIT CONTROL SYSTEMS

- 80 C 186 Processor for spin rate and spin axis control
- Torquers 4 Nos.
  2 Along Z Axis (4.5 Am2 x 2)
  1 Along X Axis
  1 Along Y Axis
- Detumbling and spin up mode to $8 \pm .5$ rpm.
- Spin axis orientation control for solar panel pointing.

SENSORS

- Tri Axial Magnetometers
- Twin slit sun sensor to provide spin rate and spin axis orientation.
- Spin rate to be maintained at 8 $\pm$ 0.5 RPM
- Spin axis orientation 90 ± 3^{o} in sun pointing mode.

COMMUNICATIONS

1.
   - VHF Telemetry transmitter 137.4 MHz
   - PCM / PSK / PM
   - Power level 27 dbm
   - Main and redundant transmitter

2.
   - Receiver (Store & Forward Receiver)
   - 145.8 MHz
   - FSK Receiver with -105 dbm sensitivity

3. VHF Telecommand receiver
   - 149.522 MHz
   - PCM / FSK / AM
   - 6.25 & 3.57 KHz FSK
   - 100 bps Manchester encoded data
   - -107 dbm sensitivity

4.
   - UHF S&F data transmitter 435 MHz

FSK Manchester Encoded Data
36 dbm Power Output

ANTENNA

VHF Monopole 4 Nos.
UHF Monopole 4 Nos

COMMUNICATION PAYLOAD

- UHF Freq. 435 MHz.
- Store and forward data rate 1.2 Kbps

Store and Forward Payload:

Store and forward payload has two modes of operation.

- ❖ Broadcast mode
- ❖ Store and Forward mode.

Broadcast Mode: Super user (Madras Institute of Technology) has the capability of Broadcast mode. The messages transmitted will be received by all receiving stations (Clients). Maximum No. of pages about 36 in 12 minutes.

Store and Forward Mode:

- ❖ Satellite requests from clients their intention to participate in the visible pass.
- ❖ Clients on their request booking, get an acknowledgement frame indicating their reservation.
- ❖ Polling phase satellite polls client for data transfer of mails.
- ❖ In Allocation phase satellite indicates the clients the number of mails.
- ❖ In acknowledgement frame client indicates to the satellite readiness for data transfer.
- ❖ In data transfer phase data is transmitted to clients.

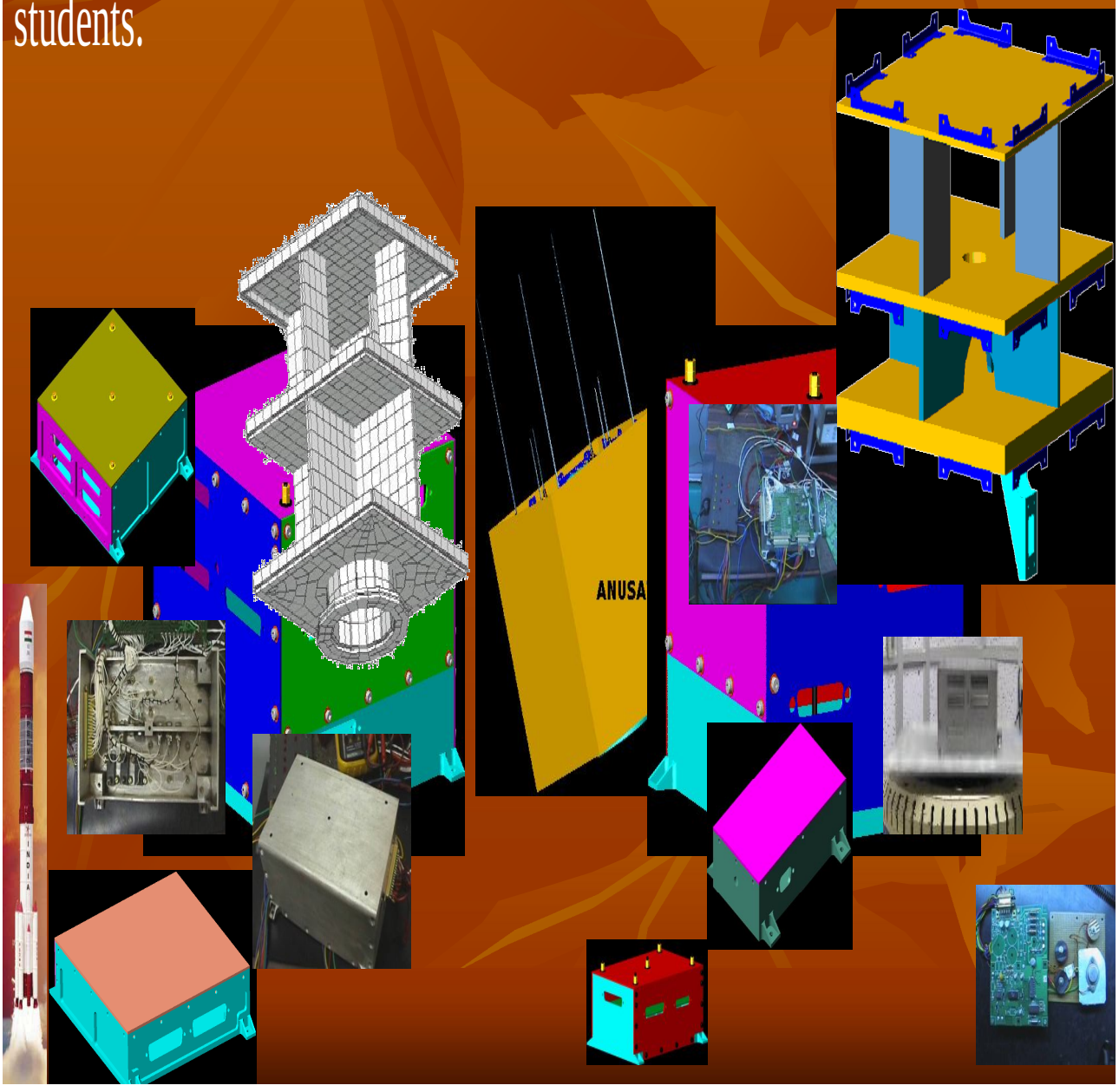
In this mode for 4 users data transfer of 4 pages for each user is possible. Maximum data storage is for 10 orbits for a client.

CONTACT ADDRESSES:

1. Anna University
   CHENNAI – 600 025.
2. University of Pune
   PUNE-411 007.
3. Small Satellite Projects
   ISRO Satellite Centre
   Vimanapura Post
   BANGALORE-560 017.

MICRO SATELLITE PROJECT

This is the first time in the country, development of a micro-satellite has been taken up in the University environment. The development of a Micro-satellite is being undertaken, under the sponsorship of the **Indian Space Research Organization**. This Project is carried out by an interdisciplinary team of faculty, researchers and students.




SATELLITE TRACKING FACILITY
GROUND STATION

EXPECTED OUTCOME OF THE PROJECT

- To establish centre of excellence in the development and usage of micro satellites
- To provide qualified and trained manpower for country's space programmes
- To initiate research activities towards development of microsatellite

MICROSATELLITE SUBSYSTEMS AND TASK TEAM MEMBERS

Mr.K.Seshadri, ANUSAT Project Director, ISRO
Dr. P.V.Ramakrishna, Project Director, Anna University, Chennai

S. No	TASK	TASK TEAM MEMBERS	AFFILIATION
1.	STRUCTURE	Dr. K. JAYARAMAN	AEROSPACE, MIT
2.	THERMAL	Dr .R.DHANARAJ	AEROSPACE, MIT
3.	POWER	Dr. B.UMAMAHESWARI	EEE, CEG
4.	BUS ELECTRONICS, S & F PAYLOAD HARDWARE, COMMUNICATION, AUXILLARY PAYLOADS, INTEGRATION	Dr.P.V.RAMAKRISHNA	ECE, CEG
5.	ATTITUDE CONTROL SYSTEM	Dr. J. SHANMUGAM	ELECTRONICS, MIT
6.	ANTENNA	Dr.N. GUNASEKARAN,	ECE, CEG
7.	STORE AND FORWARD PAYLOAD SOFTWARE	Dr.V.VAIDEHI	ELECTRONICS, MIT
8.	ORBITAL MECHANICS	Dr. J. PANDURANGAN	MATHS, MIT
9.	TELEMETRY BASE BAND GROUND STATION • TELEMETRY • TELECOMMAND MISSION	DR.MALAJOHN	ELECTRONICS, MIT