

Space Engineering Education through Pakistan National Student Satellite

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1. Background/ Introduction

- In Pakistan, SUPARCO(The National Space Agency of Pakistan) has been pursuing close cooperation and collaboration with academia of the country, through the following initiatives:
 - Undertaking of cooperative/ collaborative research projects
 - Supervising and supporting student projects
 - Offering student internships
 - Guidance on the development of Space Science and Technology related curriculum and faculty support for its teaching
 - Creating and enhancing of Space Science and Technology – WSW
- As the next major step in this direction, SUPARCO has taken initiative in the form of Pakistan National Student Satellite (PNSS)

1. Background/ Introduction cont'd

- This project has been envisioned to involve, train and impart knowledge to university students in the high-tech and sophisticated domain of satellite technology.
- Pakistan National Student Satellite -1 (PNSS-1) is being designed and developed by young and vibrant students of the motherland.
- The proposed program is a way forward for sustainable and progressive student satellite developments under the umbrella of SUPARCO.

2. Objectives of the Program

- To create Space Science and Technology related awareness and interest at the national level, particularly amongst the academia
- To inculcate Space/ Satellite Engineering and Technology related research culture amongst the academia
- To foster and promote close cooperation/ collaboration, with leading universities and institutes of the country, in Space/ Satellite Engineering and Technology related areas of mutual interest

2. Objectives of the Program cont'd

- To provide an opportunity to Space enthusiastic students to:
 - Deeply understand and appreciate the challenges of and constraints imposed by Space environment
 - Acquire inter-disciplinary knowledge and work experience
 - Apply their theoretical knowledge to solve real-world engineering problems
 - Work with SUPARCO scientists and engineers
- To impart specialized hands-on training to bright space enthusiastic students of leading universities and institutes of the country, before their possible induction in SUPARCO

3. PNSS-1 Mission Objectives

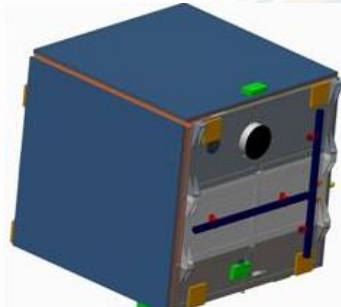
- To design, develop and successfully deploy a fully functional 50 kg class satellite in low earth orbit,
- To demonstrate capability of acquiring low resolution images
- To demonstrate the utility for high speed communication
- To validate low cost micro satellite platform
- The mission shall demonstrate the platform technology that could be used as a baseline for the future missions under National Student Satellite Program



PART 2
PNSS-1 System Overview

PNSS-1 System

PNSS-1 Space Segment



UHF/VHF



PNSS-1 Launch Segment



PNSS-1 Ground Segment

PNSS-1 Platform Specifications

- Communication : UHF and VHF
- Structure : Cuboid, Body mounted Solar Panels
- Envelop : 500 (mm) x 500 (mm) x 500 (mm)
- Orbit : LEO (500 km)
- Attitude Control : 3-axis stabilized
- Power : > 50 Watts
- CDHS : Distributed Architecture CAN Bus

PNSS-1 Payload Specifications

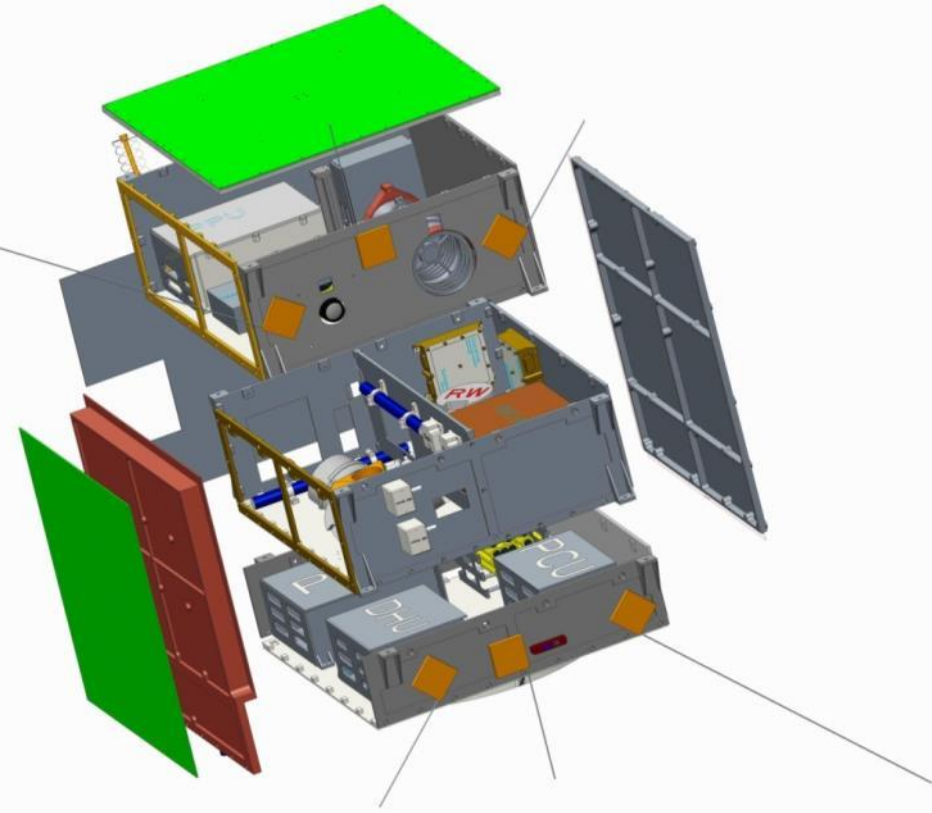
- **High Resolution Camera**
 - Swath Width 29 km- 25 km
 - Spectral Range 450nm-750nm (Visible)
- **Low Resolution Camera**
 - Swath Width 66 km- 49 km
 - Spectral Range 400nm-1000nm (Visible)
- **Lightening Detector Unit.**
 - Detects the variations caused by the Lightening Effect

PNSS-1 Philosophy

- Incorporation of maximum indigenously developed hardware and software by the university students without affecting reliability, quality, cost and schedule requirements,
- To demonstrate the mission through use of low cost technology using COTS components
- Modularity
- Scalability
- Simplicity
- Maximum utilization of existing heritage

Configuration and Layout

- Modularity
- Expandability
- Simplicity
- Accessibility for AIT
- Manufacturability
- Cost effectiveness

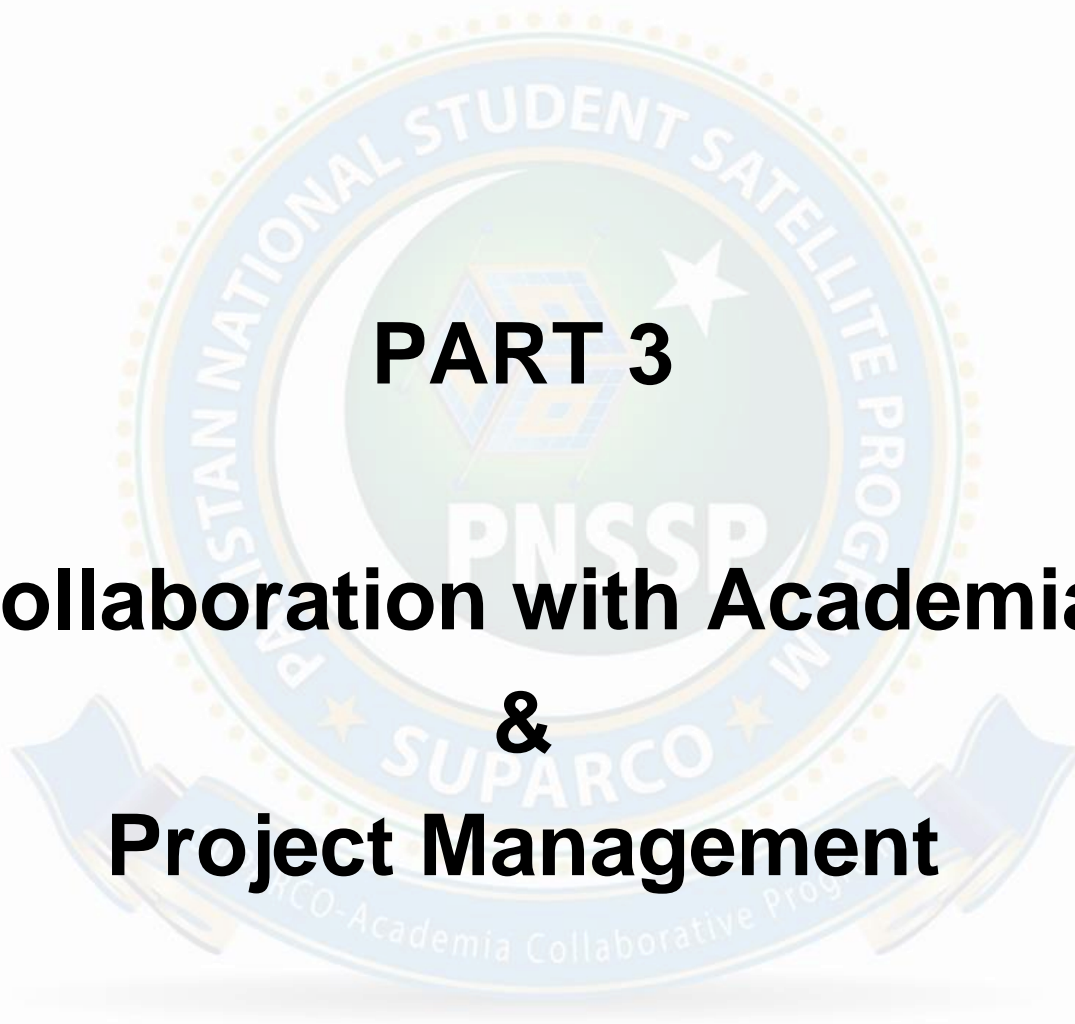


PNSS-1 Ground Segment

- Satellite Ground Control Station(s):** Three VHF/UHF-band TT&C stations are envisaged which will act as control stations. Payload data reception and processing will also be integral part of these stations.

Lahore	SRDC-L	Established
Karachi	SRDC-K	Will be established (Replica)
Islamabad	Already established IST station will be used.	

- Payload Processing Facility:** A basic facility to receive Telemetry and Payload data be set up at universities/ institutes who keenly take part in the PNSS-1 program and successfully pass the CDR stage.



PART 3

**Collaboration with Academia
&
Project Management**

Participating Universities



- Memorandum of Understanding (MoU) has been signed with 16 universities/institutes from all over the country:
 - Institute of Space Technology, Islamabad (IST) (8 units)
 - University of Engineering and Technology, Lahore (UET) (2 units)
 - Government College University, Lahore (GCU) (2 units)
 - University of the Punjab, Lahore (PU) (1 units)
 - University of Lahore, Lahore (UOL) (2 units)
 - Mirpur University of Science and Technology, AJ&K (MUST) (1 units)
 - University of Engineering and Technology, Peshawar (UET, Peshawar) (6 units)
 - COMSATS Institute of Information Technology (CIIT), Islamabad (2 units)

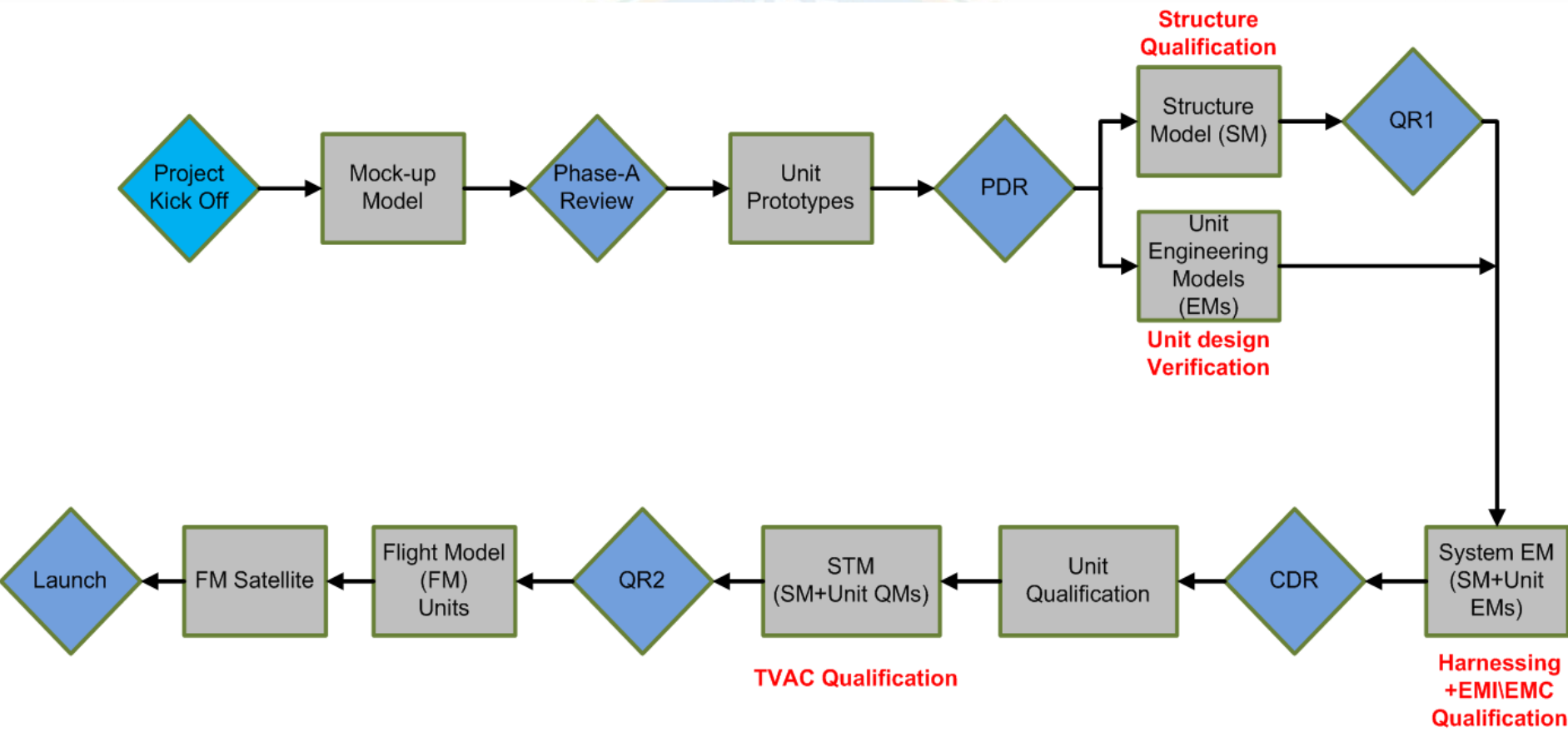
Participating Universities with number of Satellite units



- National University of Computer and Emerging Sciences, Islamabad (FAST-NU) (8 units)
- Air University, Islamabad (AU) (2 units)
- National University of Science & Technology (NUST) (2 units)
- Sir Syed University of Engineering and Technology, Karachi (SSUET) (2 units)
- NED University of Engineering & Technology, Karachi (NEDUET) (8 units)
- Baluchistan University of Engineering & Technology, Khuzdar (BUETK) (1 units)
- Baluchistan University of Information Technology, Engineering and Management Sciences, Quetta (BUITEMS) (5 units)

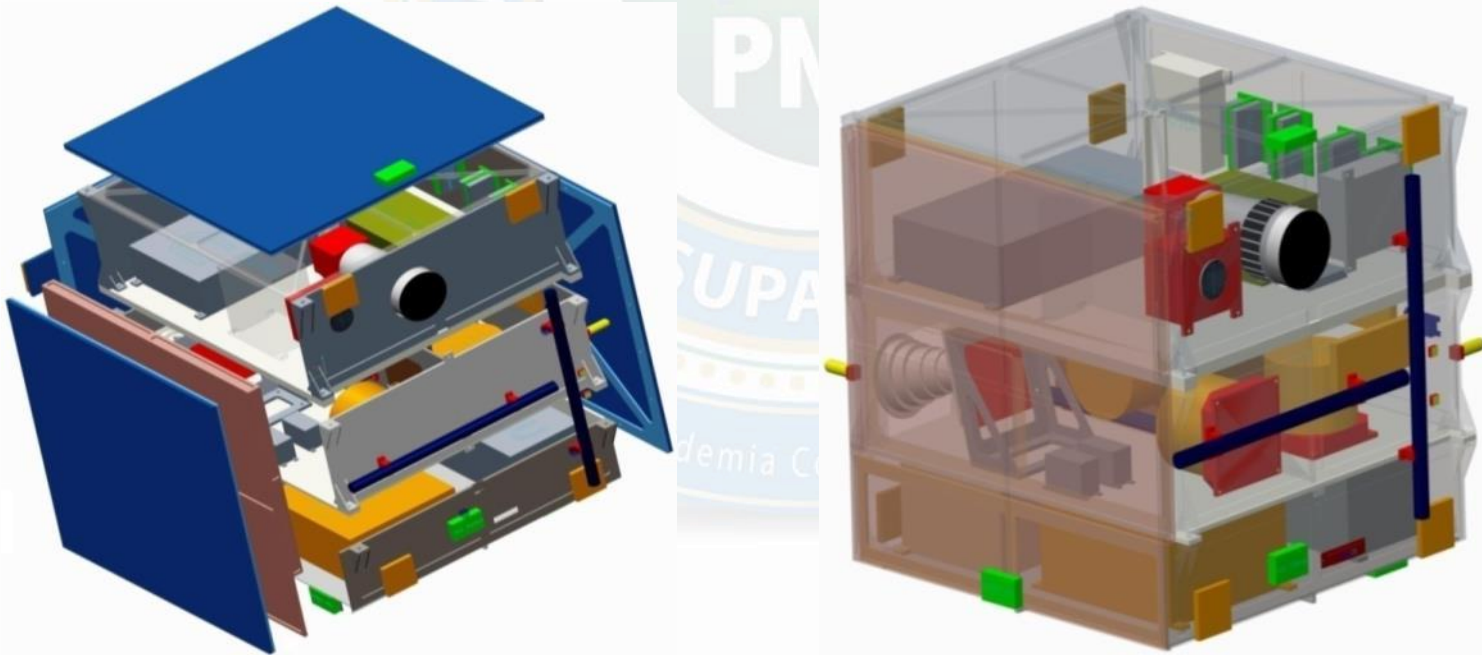
National University of Science & Technology (NUST) (2 units)

PNSS-1 Development Plan



Current Development Status

- Mission Design and Analysis has been completed.
- Preliminary Design of Satellite successfully completed
- Prototype Developments completed.
- **Engineering Model Development under progress**



PNSS-1 Space Design Seminars



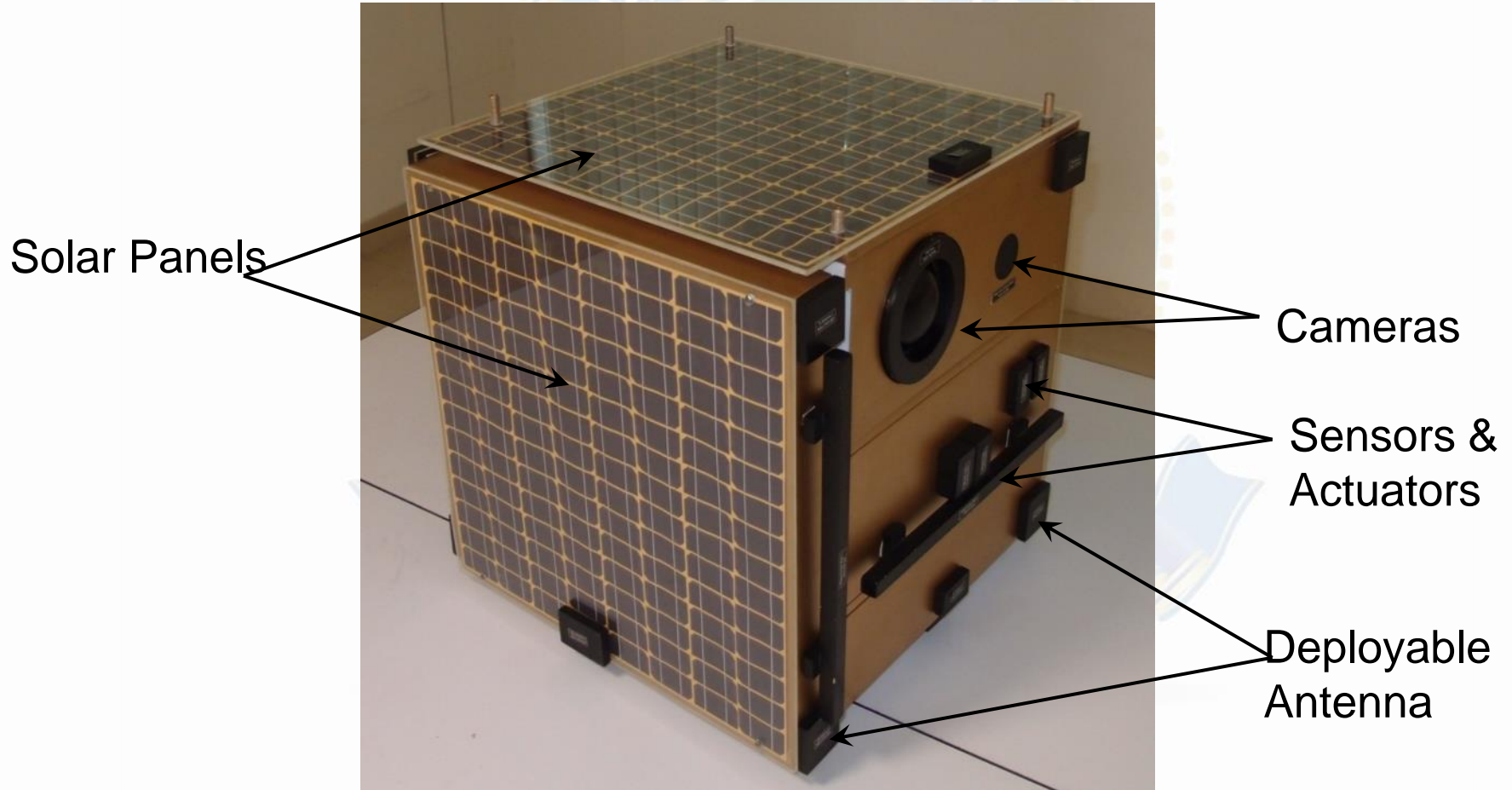


PART 4

PNSSP

PNSS-1 Units Development by Universities

PNSS Mock-Up Model

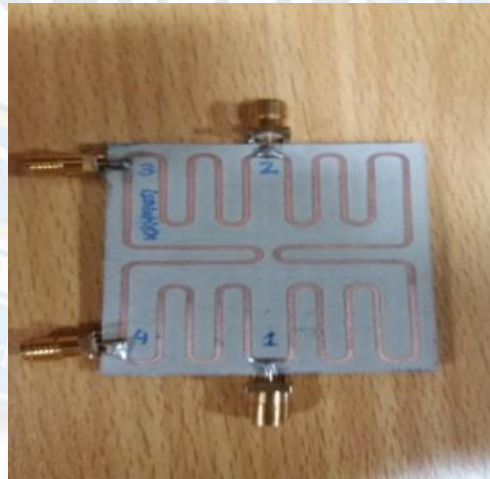


Development of PNSS-1

Magnetometer (MGM)

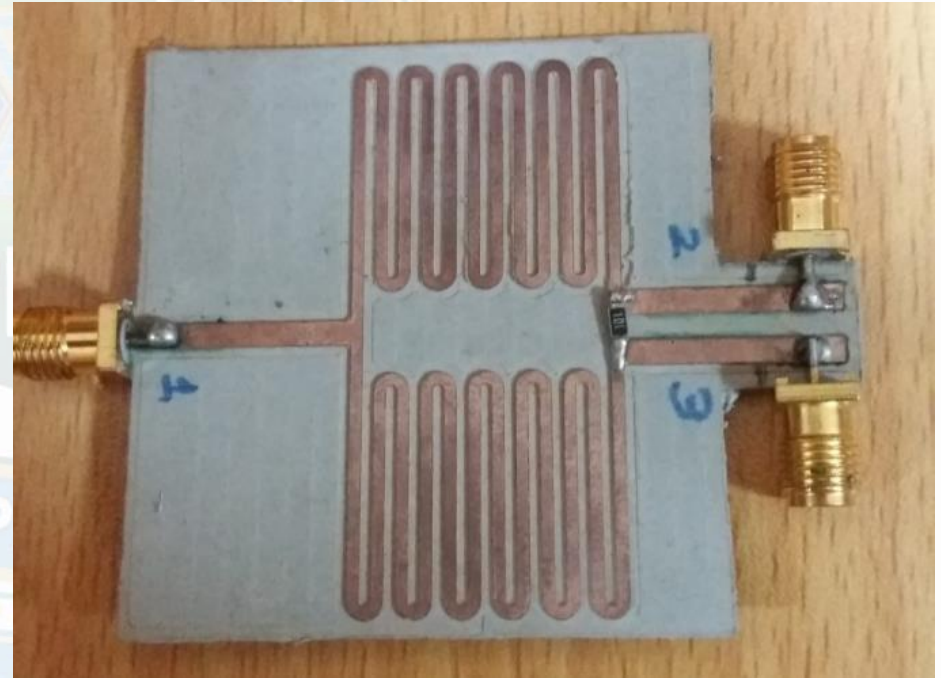
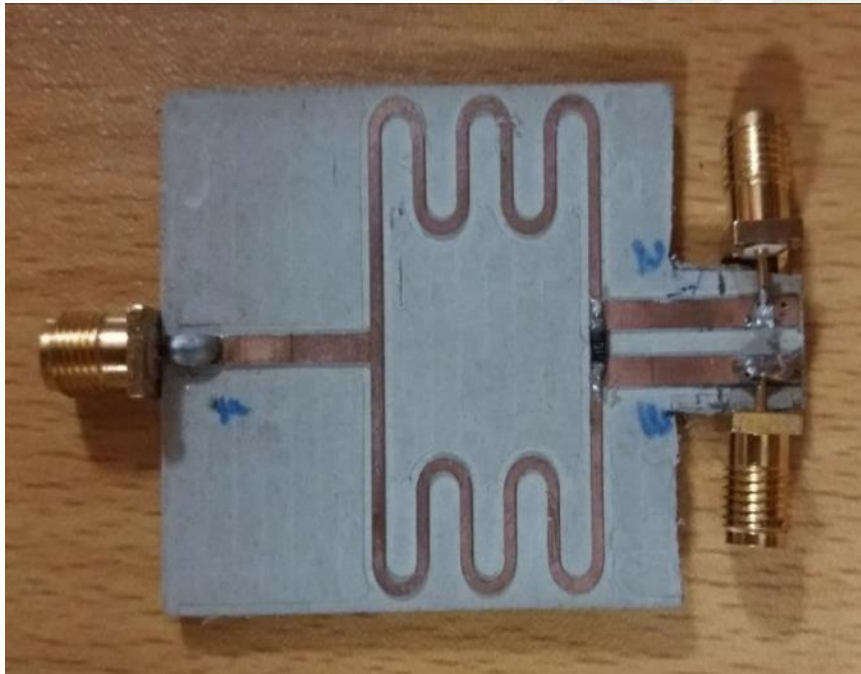


RF Hybrid (HYB)



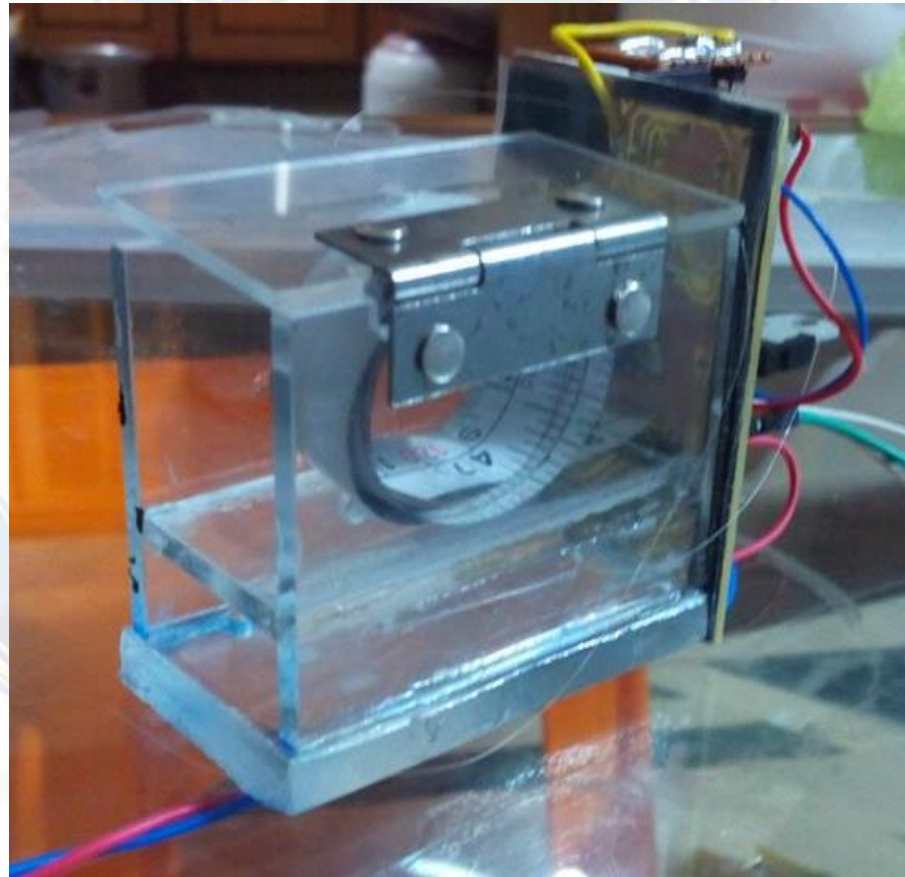
Development of PNSS-1

Power Divider and Combiner (PDC)



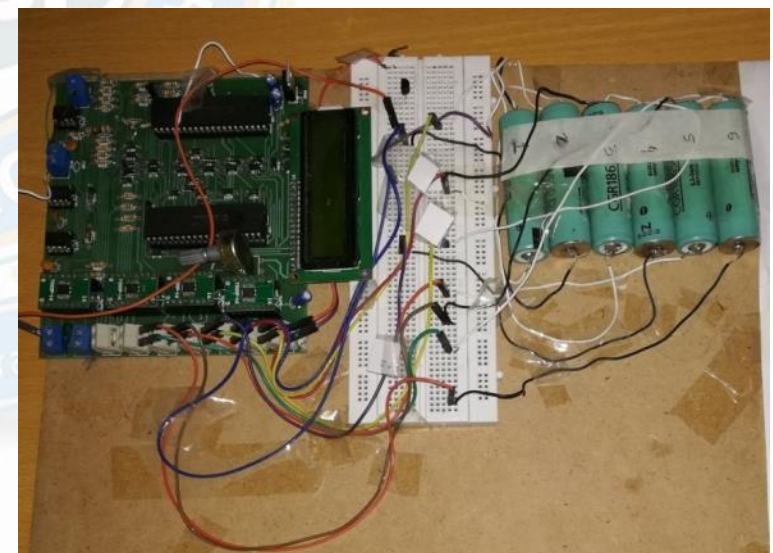
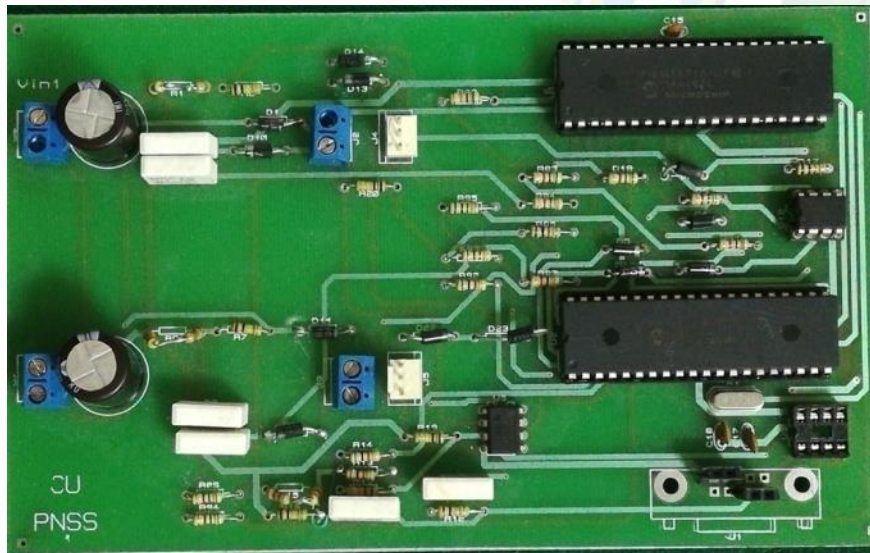
Development of PNSS-1

Deployable Transmit Antenna (DTA)



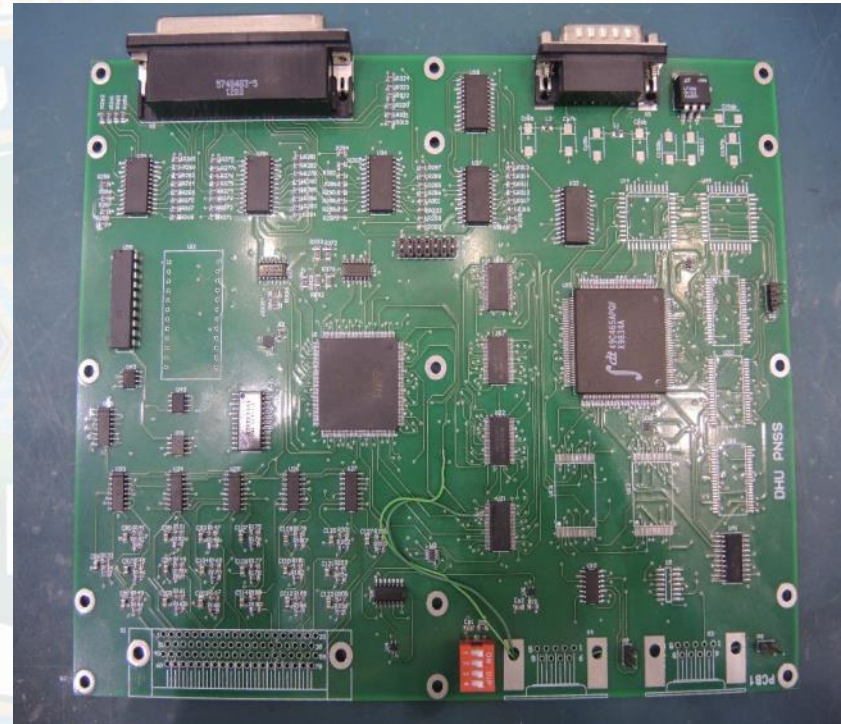
Development of PNSS-1

EPS Units



Development of PNSS-1

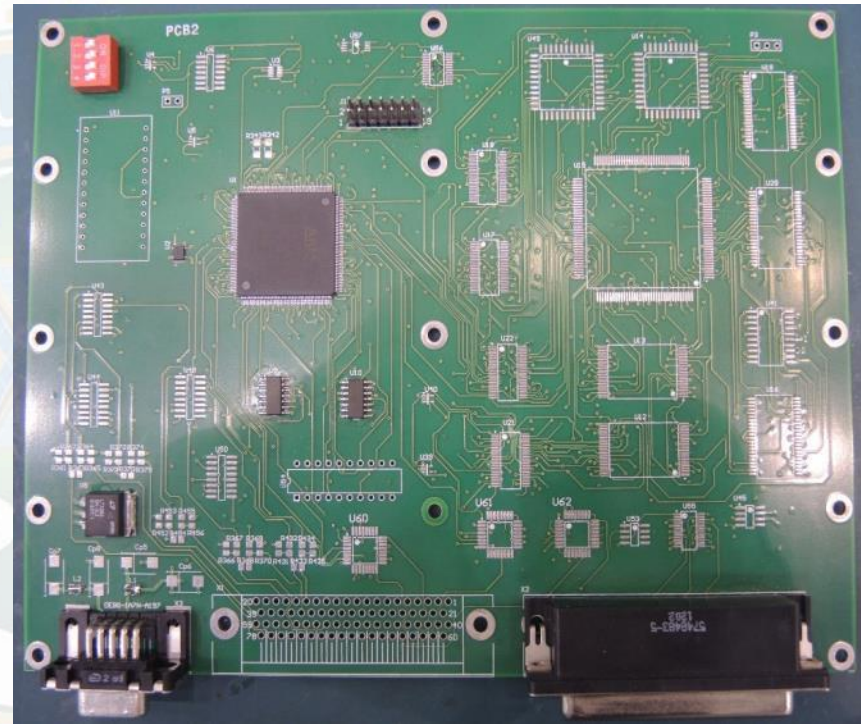
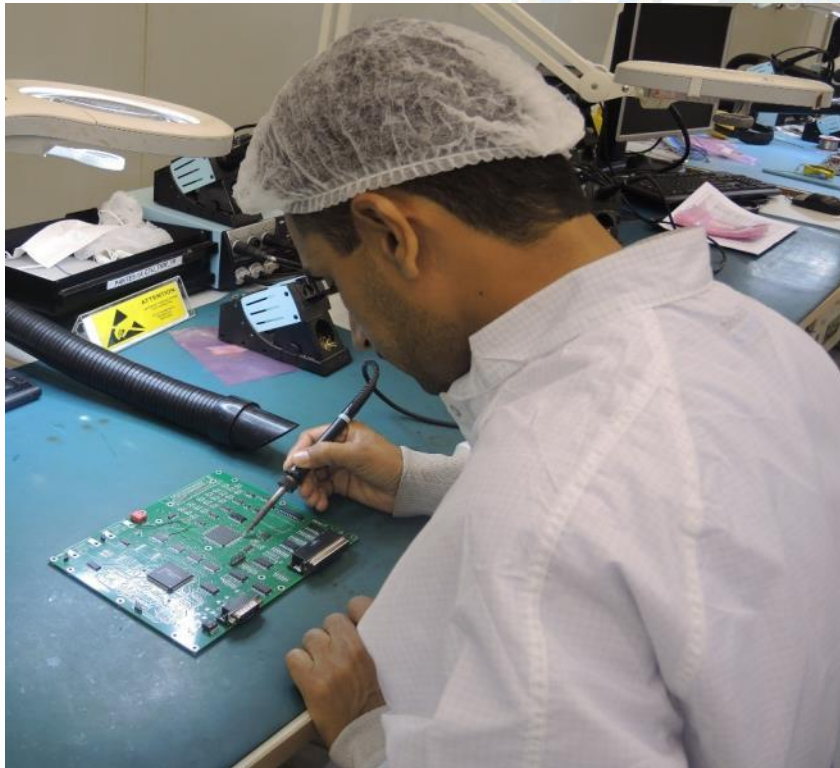
Data Handling Unit (DHU)



ARCO
Collaborative Program

Development of PNSS-1

On-Board Computer (OBC)



Development of PNSS-1

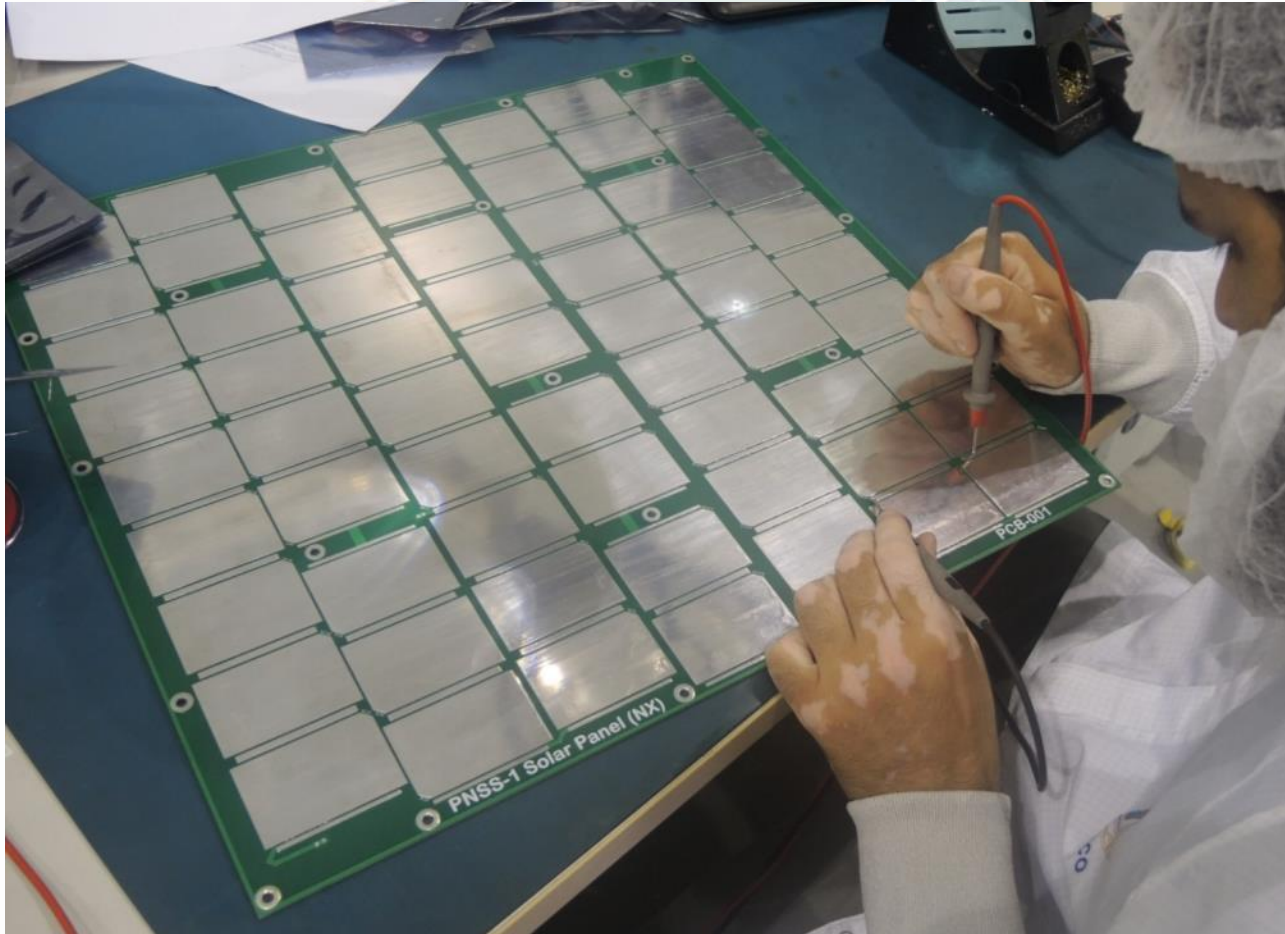
Prototype Model of Solar Panel



Power Distribution Unit Prototype

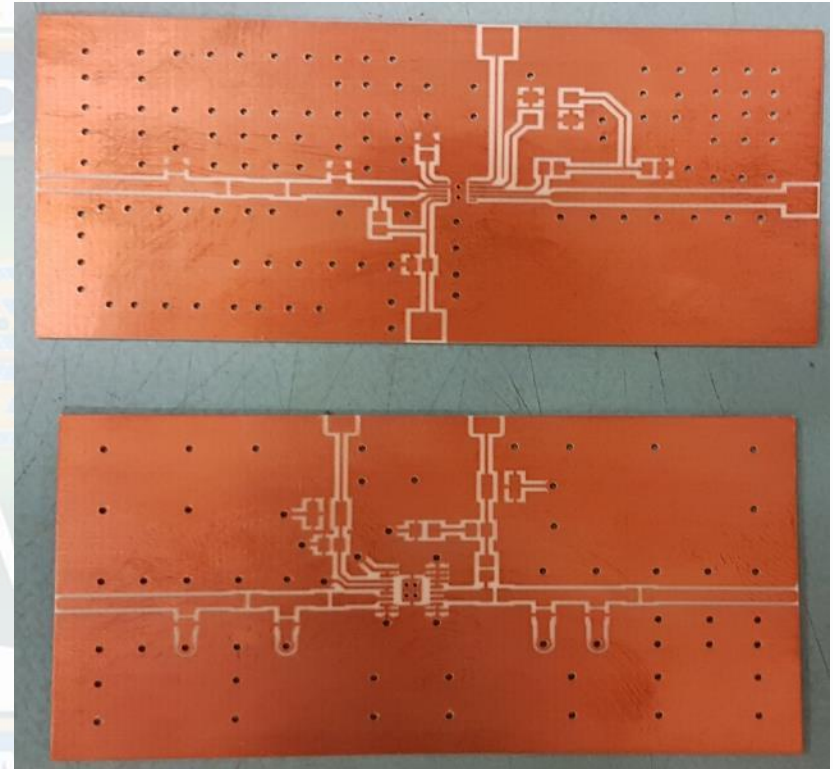
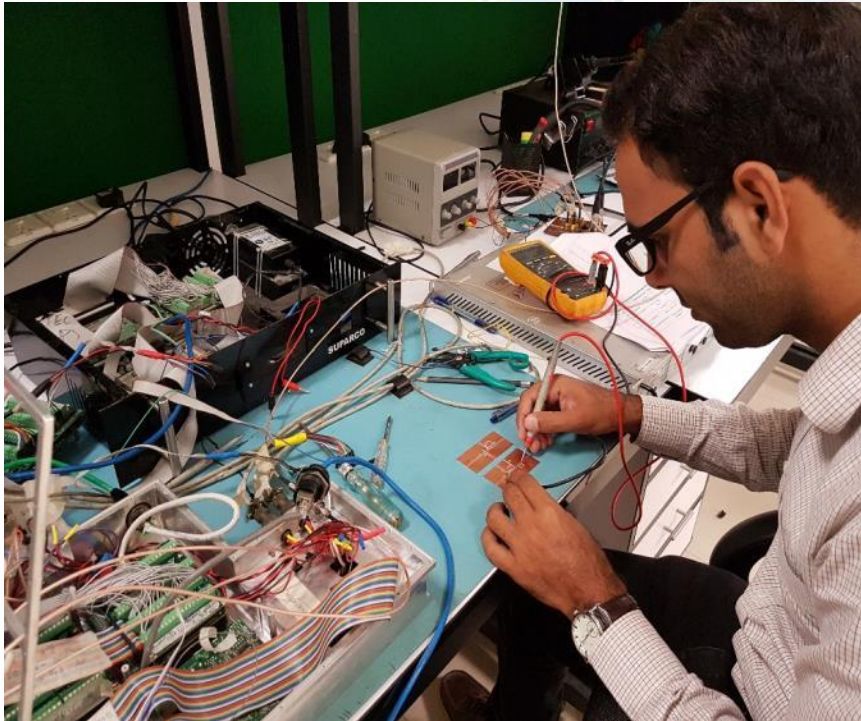


PNSS-1 Solar Panel *Engineering Model*

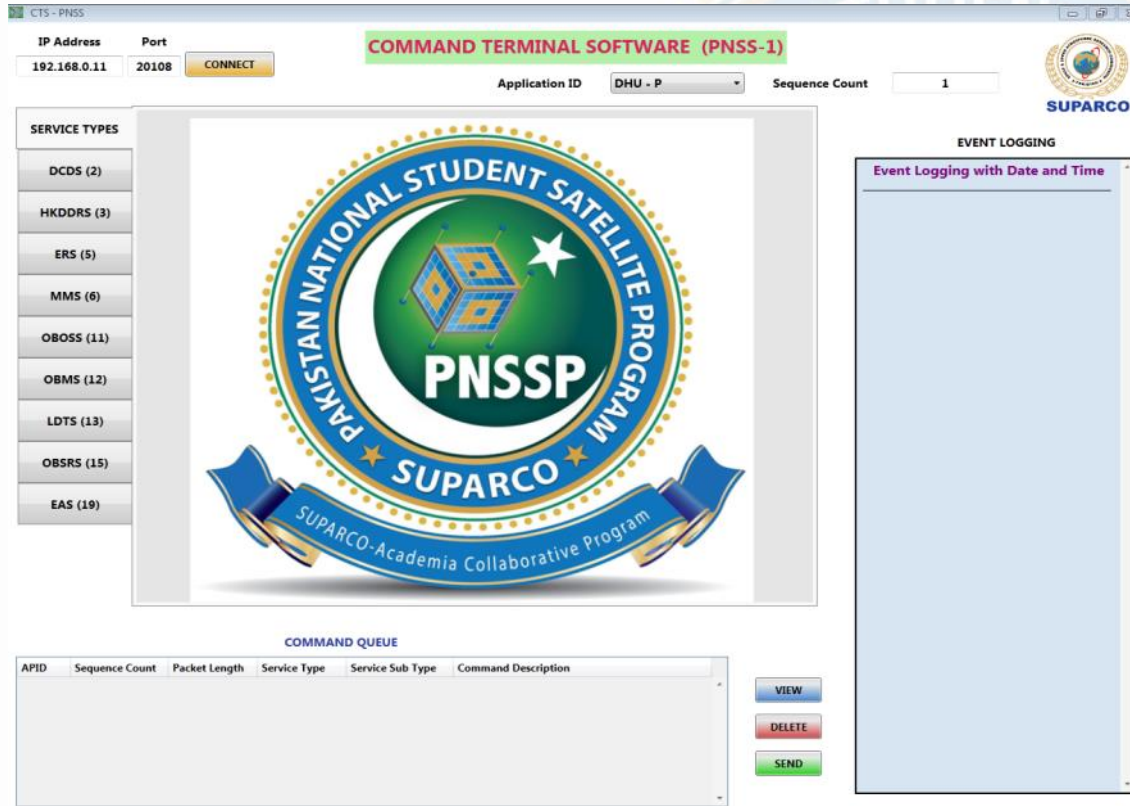


Development of PNSS-1

Telemetry Transmitter and Receiver Prototypes



Ground Segment Software Design & Development



CTS - PNSS

IP Address: 192.168.0.11 Port: 20108 **CONNECT**

Application ID: DHU - P Sequence Count: 1

COMMAND TERMINAL SOFTWARE (PNSS-1)

PAKISTAN NATIONAL STUDENT SATELLITE PROGRAM
PNSSP
SUPARCO
SUPARCO-Academia Collaborative Program

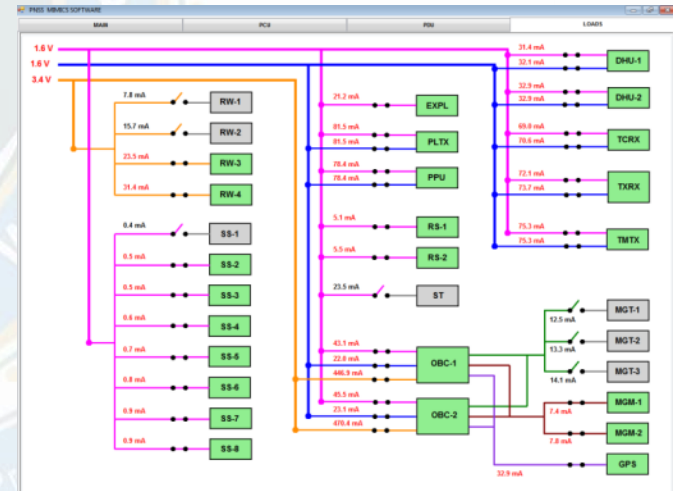
EVENT LOGGING
Event Logging with Date and Time

COMMAND QUEUE

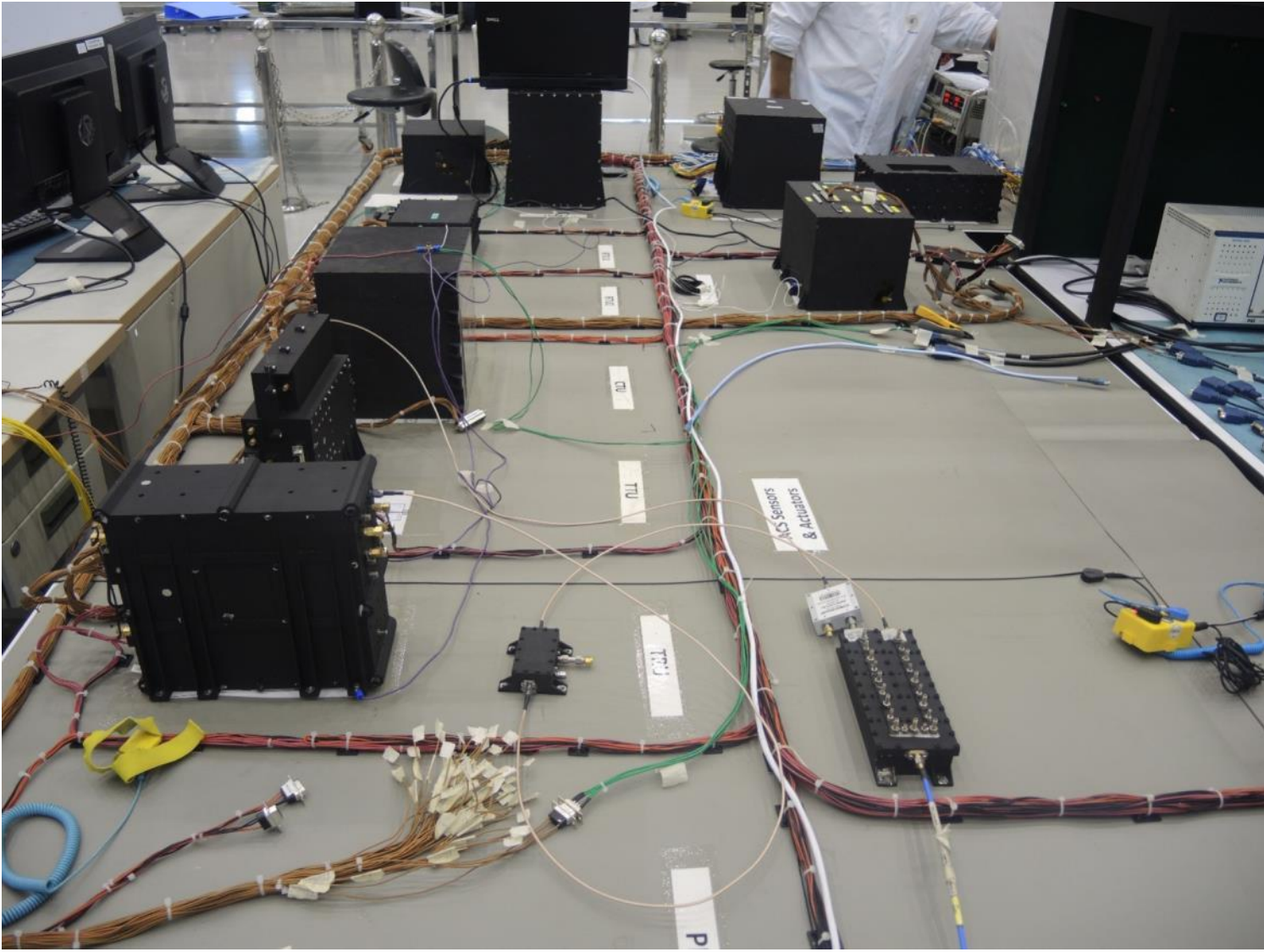
APID	Sequence Count	Packet Length	Service Type	Service Sub Type	Command Description
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VIEW
DELETE
SEND

- ❑ Command Terminal Software (CTS)
- ❑ Mimics Software
- ❑ Telemetry Display Software



Next Step – Integrated Testing



Conclusions and Training glimpses

Space Engineering education is being provided in this project thru the following means

- More than 50 space design related URDs(Unit Requirements Documents) has been explained/provided to participating Faculty and students before undertaking their unit design.
- EyasSat based hands-on workshops has conducted to new student teams.
- One to one design review meetings are being held and student queries and problems are being resolved.
- 100s of Videocon/Telecons has been held between student teams and SUPARCO .
- Student with faculty frequently visiting suparco and availing the labs and test facilities easily like for final unit PCB Development/BOM finalization are being conducted at SUPARCO .
- More than 100 students has been passed while contributing their design share in satellite units.
- This project is laying foundation for future collaboration between SUPARCO and academia in the field of space technology & associated research.

