

## **Architecture Design of CubeSat «PolyITAN-1» with Honeycomb Paneled Frame**

B. Rassamakin, N. Buyskov, S. Ostapchuk, S. Khairnasov, N. Pershin, V. Khominych, D. Smakovsky, A. Rassamakin, Ye. Kovalenko, Y. Ostrovsky

National Technical University of Ukraine “Kiev Polytechnic Institute”, Kiev, Ukraine

Since 2011 the team of researchers and students from NTUU “KPI” have been developing the first in Ukraine amateur and educational 1Unit CubeSat – “PolyItan-1”. On 2013 it would be launched by “Dnepr-1” launcher into the orbit of 668 km. The main peculiar feature of the PolyItan-1 would be its electronic platform for multipurpose space exploration and data handling. GPS/GLONASS receiver originally made in Ukraine would be used for high precision navigation system.

The project tasks are:

- Training of specialists for space engineering,
- Development of a small-size platform for space exploration,
- Refining new design and technology solutions,
- Building up of a training laboratory at the University for the control, data acquisition and processing system of small satellites,
- Upgrading of the on ground facilities for the environmental testing of satellites, including thermal vacuum tests.

The mission objectives are:

- Educational objectives,
- Refining technological solutions,
- Flight tests of payloads.

PolyITAN-1 1UCubeSat consists of the aluminum frame, 4 PCBs, 4 honeycomb panels, 4 solar arrays and electric power storage battery, 4 RF antennas- two of them are deployable.

Honeycomb panels are fastened to the ribs of the frame in order to ensure thermal regimes and electrical shielding of the CubeSat devices. Honeycomb panel is a lightweight multi-layer sandwich design made of two CFRP (carbon fiber reinforced plastic) panel and aluminum filler of honeycomb meshed foil between them. Dielectric polyimide film is glued to CFRP panels. They are of 5 mm thickness and very low specific weight - not more than 0.45 kg/ m<sup>2</sup>.

Photovoltaic solar cells would be fixed to the outer surfaces of the honeycomb panels. Solar arrays are made of GaAs cells with 26.0 ... 27.0 % efficiency. Peak power consumption of satellite is up to 4.0 W. Its minimal power consumption (sleep mode) is 0.5 W. Average power consumption per day is 1.3 W.

Electric Power Supply Subsystem (EPCS) control is placed on a separate PCB and is highly efficient due its own microcontroller. Power storage batteries are arranged in a single unit.

Moreover, each of the PolyITAN-1 subsystems has its own microcontroller for performing their functions, keeping log-file, and self-diagnosis as well as two local buses are used. Due to such architecture satellite survivability is increased and probability of receiving data from partly failed satellite is high.

Attitude Determination and Control Subsystem (ADCS), Orbital Dynamics (Navigation) Subsystem (ODS), as well as On-Board Data Handling Subsystem (OBDH) with Central Processing Unit (CPU) are placed on the main PCB.

Attitude Determination and Control Subsystem consists of:

- 3-axis magnetometer;
- 3-axis gyroscope;
- sun sensors (5 units);
- electromagnets (3 units).

Peculiar feature of satellite's orbital navigation is computation of the orbit using data from GPS/GLONASS receiver.

2.4 GHz high-baud –rate downlink and sensors of degradation, temperature, ultraviolet, and dust are placed to the Payload PCB.

One PCB unit is used for 144 MHz uplink and 435 MHz telemetry downlink.

All RF links operate within AX.25 protocol.

Ground station for satellites' observation and control is located in Kiev at National Technical University of Ukraine "KPI".