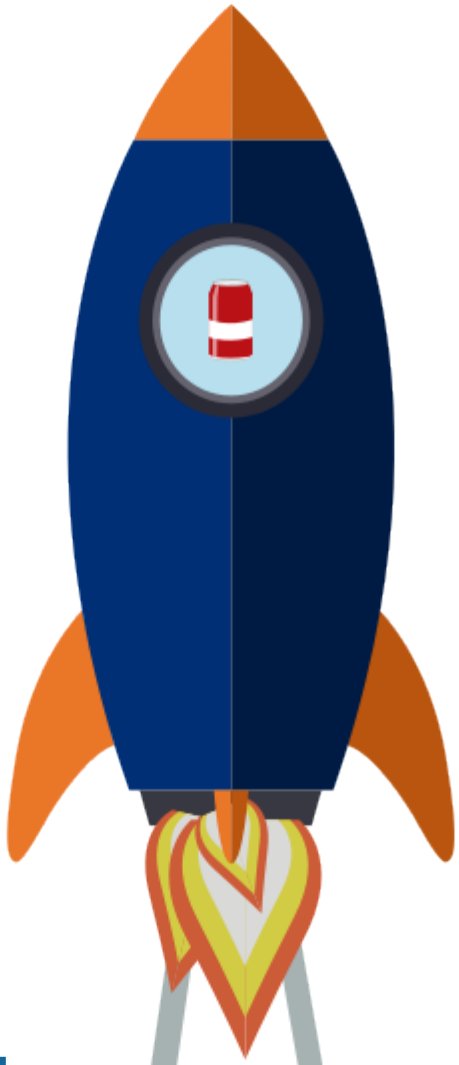
EUROPEAN CANSAT COMPETITION

Regulation rev. B



IEEE Student Branch of Brixia

IEEE

Contents

1 Introduction **2**
1.1 Definition 2

2 Schedule **4**

3 Competition **5**
3.1 Technical Requirements 5
3.2 On site regulations 7

4 Evaluation and scoring **8**
4.1 Scoring 8
4.1.1 Technical achievement 8
4.1.2 Scentific Value 9
4.1.3 Professional Competence 9

5 Registration **10**

6 Contacts **11**

A Battery location identification **13**

B Allowed Frequencies for communications **14**

C Rocket specifications **15**

D List of revisions **16**

1 — Introduction

The European CanSat competition is a competition among teams composed of university students, organized by the Student Branch IEEE Brescia STB1019 in collaboration with the World CanSat/Rocketry Championship (WCRC), funded by the University of Brescia. Each team consists of 2 to 5 members. The competition will take place on October 12th and 13th, 2023, in Brescia, Italy. A maximum of 10 teams can participate in the competition, and the registration is free. Accommodation and travel expenses and organization are the responsibility of the participants.

1.1 – Definition

CanSat is a simulation of a real satellite. All components are housed inside a can up to 350 ml.

CanSat provides an affordable way to gain basic knowledge and skills in Space engineering for teachers and students, as well as experience engineering challenges when designing Satellites.

Students are able to design and build a small electronic payload that can fit into the cans to 350 ml. CanSat is launched by Rocket, Balloon, Planeor Drone and delivered in apogee. With the Parachute, the CanSat slowly descends to the ground and carries out its mission during descent (for example: measures air pressure and temperature and sends telemetry).

By analyzing the data collected by CanSat, students will explore the reasons for the success or failure of its mission.

Space engineering learning, based on the CanSat/Rocketry concept, enables students to gain hands-on experience through a specific interdisciplinary project. Since this is a Space engineering project, teachers and students will gain experience from mission defining, conceptual design, through integration and testing, to launching and actual system operation, i.e. experience from the whole Space project cycle and then participate in the CanSat/Rocketry competition with its peers at home country and abroad.

One of the main advantages of the CanSat/Rocketry concept is its interdisciplinariety: as a combination of mathematics, physics, informatics/programming,

mechatronics, telecommunications, aviation, rocketry, and mechanics, etc..

CanSat is a simulation of a real, large Satellite and contains all the components of a real Satellite, but with limited complexity.

Benefits of CanSat/Rocketry-Based Education: CanSat/Rocketry is an effective educational tool for:

- Learning by doing
- Involving students in technology and engineering as a practical complement to other fundamental subjects they study, such as mathematics and physics;
- Emphasizing teamwork where each student has a specific task/role that creates a sense of responsibility for them;
- Students gain experience of the complete process: defining the mission, designing, development/constructing, programming, testing, launching and analysis;
- Simple conducting experiments with balloon/rocket/plane/drone;
- Learning methods can be adapted to the age level of students, or to their needs and abilities;
- Students are able to analyze the reasons for success or failure after descending CanSat and Rocket to the ground;
- Acquired knowledge and experience can be applied to other projects as this concept enables obtaining of ideas and stimulates students' thinking;
- Useful for a further education/career guidance process;
- Provide Opportunities and Network for Launching their Own Small Satellites to Low Earth Orbit in a frugal way!
- Provide Opportunities and Network for Sharing and Learning from each other teams from various countries.

2 — Schedule

Day 0

Day 0 is Wednesday, October 11, 2023, and is dedicated to welcoming teams. On day 0, visits to the city of Brescia will also be organized.

Presence on day 0 is **not** mandatory to participate in the competition.

Day 1

At 9:00 AM the day will start from the University of Brescia Engineering department which is located in *Via Branze 38, Brescia (BS)*.

Participants will be taken by free bus to the launch site which is **Aviosuperficie Santa Lucia** at the address: *Via Rudiana, 6, 25030 Comezzano-Cizzago BS*.

Arriving at the Santa Lucia airfield, a briefing will take place to prepare the rockets for the CanSat launch and perform 1 launch per team. The duration of the launch phase may vary according to the weather conditions.

By 18:00 PM the coach will bring the participants back to Brescia to the same place of departure.

Day 2

During the morning the teams will present their report to the judges and the other teams with the presentation of their CanSat and the analysis of the data collected during the launch the day before.

During the afternoon the judges will announce the ranking and award the participants.

Day 2 will be held at the Engineering department of the University of Brescia in *Via Branze 38, Brescia (BS)*. In case of bad weather, the launch will take place on day 2 and the presentation of the projects will take place on day 1.

3 — Competition

The Rockets for the launch campaign will be provided by the organizer.

The Rocket would deploy its parachute at apogee, together with the CanSat. Just after the apogee (0-2 seconds later), the CanSat would separate from the Rocket and make separate parachute descent.

The CanSat will reach a height of between 100 and 250 meters.

The CanSat shall measure the air pollution after release and during descent and transmit these data as telemetry to the Ground Station at least once every 2 seconds.

All extra data collected and analyzed by CanSat will be evaluated positively.

3.1 – Technical Requirements

The CanSat hardware and mission must be designed following these requirements and constraints:

1. All the components of the CanSat must fit inside a standard soft drink with height 115mm and a diameter of 66mm, except for the CanSat parachutes. The parachutes will be placed above the CanSat inside the rocket. Radio antennas and GPS antennas can be mounted externally on the top or bottom of the can, depending on the design, but not on the sides and must not exceed the imposed height.

2. The antennas, transducers and other elements of the CanSat cannot extend beyond the can's diameter until it has left the launch vehicle.

3. The mass of the CanSat must be between a minimum of 100g and a maximum of 150g.

4. Explosives, detonators, pyrotechnics, and inflammable or dangerous materials are strictly forbidden. All materials used must be safe for the personnel, the equipment, and the environment. In case of doubt, please contact the organizer.

5. The CanSat must be powered by a battery. It must be possible for the systems to remain switched on for four continuous hours.

6. The battery must be easily accessible in case it has to be replaced/recharged. The location of the battery must be identified by a standard symbol, as reported in appendix A.

7. The device battery must not contain hazardous liquids (Solid state batteries like LiPo are allowed). The maximum allowed capacity is 2000mAh.

8. The CanSat must have a visual indication for the power state. This can be done with a LED or a physical indicator.

9. The CanSat must have a main physical power switch or battery kill switch (preferred). The CanSat power state when inside the rocket must follow the following requirements.

   (a) No wireless communications can be entertained with any external device

   (b) Actuators must be in a rest position, eventually powered, but they cannot move while inside the rocket.

   (c) The device must be capable of being in this power state for at least 4 hours.

   (d) It is recommended to install a photosensitive device in order to detect if the CanSat is inside the rocket, or it has been expelled. The device is free of any power state restriction once it has been deployed.

10. Inclusion of a positioning system for retrieval (beeper, radio beacon, GPS, etc.) is required.

11. The CanSat must have a recovery system consisting of at least 3 parachutes attached to the CanSat, with the capability of being reused after launch. It is recommended to use bright-coloured fabric, which will facilitate recovery of the CanSat after landing. The system must be capable of delivering the device safely to ground with at least one parachute of redundancy. Parachute weight is included in the CanSat weight limit.

12. The opening of the CanSat parachutes will be scoring. The strength of the parachute must be tested to ensure that the system will operate nominally. Technical inspection personnel reserves the right to test the parachute systems.

13. It is recommended that teams pay attention to the design of the CanSat in terms of hardware integration and interconnection, so the radio frequency can be easily modified if necessary. Allowed frequency bands are detailed in appendix B

14. Communication encryption is not required, but can be evaluated positively by the judges.

15. The CanSat must be flight-ready upon arrival at the launch campaign.

To verify that the CanSats are suitable for launch, a technical inspection will take place at Aviosuperficie Santa Lucia.

Requirements will be evaluated on site by a specially appointed CanSat technical team. Teams that don't pass some requirements during evaluation can be disqualified.

3.2 – On site regulations

Once at the launch campaign site, all the team must pass the technical inspection. The teams will be granted one hour to prepare all their instruments and devices before starting the technical inspection.

After this 1-hour period, no wireless communication can be performed by non-launching teams in order to limit interference. All the devices must be in a power down state after the technical inspection and can be activated only upon launch. The requirements for the power state while waiting to launch are

1. Uptime of at least 8 hours.

2. No actuator powered

3. No wireless transmission.

4 — Evaluation and scoring

The Jury will be composed of CanSat experts, education experts, or engineers and scientists who will evaluate the team's performances.

The Jury members will score the teams during the launch campaign and announce the results from their scoring during the last day of the competition. The Jury will typically have 3-5 members, and their fields of expertise can vary from science to engineering or education.

The Jury board is usually comprised of:

- Space science/engineering expert
- IT/Electronics expert
- Education expert
- Radio communication expert
- Rocketry expert

4.1 – Scoring

Performance in the following areas will be evaluated:

4.1.1 – Technical achievement

The Jury will take into account how the teams obtained the results, how reliable and robust the CanSat was, visual appearance and how the CanSat performed.

Innovative aspects of the project will be judged (e.g. the tools selected and the hardware/software used).

The aspects evaluated will be:

- Mission's technical complexity: The CanSat's technical level, understanding of the technical concepts and the originality of the engineering aspects of the mission.
- Performance of the Primary mission: The CanSat's technical performance in terms of deployment and data collection for the Primary Mission. Number of CanSat's parachutes opening etc.

4.1.2 – Scentific Value

The scientific value of the team's missions and the team's scientific skills will be evaluated. This includes the scientific relevance of the mission, the quality of the echnical reporting and the team's scientific understanding that will be assessed from the team's ability to analyze and interpret results appropriately.

The aspects evaluated will be:

- Scientific relevance: Assessment of whether measurements are done with a clear and well-founded scientific purpose, the extent to which the CanSat is used in an original way and if the data collection is appropriate for reaching the objective.
- Scientific understanding: Level of understanding of the scientific principles that underlie the project.
- Technical reporting.

4.1.3 – Professional Competence

The Jury will assess the team's collaboration and coordination, adaptability and communication skills.

The aspects evaluated will be:

- Teamwork: Collaborative effort of the team in order to complete the tasks in the most effective and efficient way.
- Adaptability: Attitude towards continual improvement and ability to adapt to new conditions.
- Communication: Oral presentation skills, the ability to provide a captivating presentation.

5 — Registration

In order for a student team to be accepted in the International competition the following conditions have to be fulfilled:

1. Each team must have 3-5 members, respecting one of the following conditions:
    - All 3-5 team members are students enrolled in a University or similar Higher educational institution and come to the competition without a Professor/Mentor.
    - All 3-5 team members are students enrolled in a University or similar Higher educational institution and come to the competition with a Professor/Mentor. Which means: 3-5 team members + 1 Professor/Mentor. *(RECOMMENDED)*
2. Each team is expected to do the following:
    - Define a team name
    - Bring 1 state flags to the competition
    - Appoint a team leader
3. Elementary and secondary education students cannot participate in this competition

In order to subscribe, write to this email:
stb1019_executive@googlegroups.com

For registration, you must indicate your Country, the identity of the team members, your University, and the identity of the mentor (if there is one).

Participation is limited to 10 teams; it is possible to register until August 31st or until 10 teams are registered.

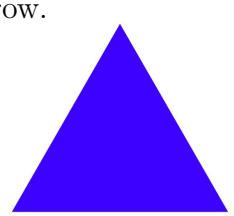
6 — Contacts

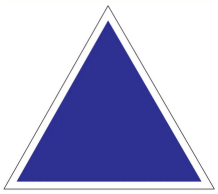
For any doubt or question, do not hesitate to contact us at this email:
stb10109_executive@googlegroups.com

The main objective of the event is to learn and spread knowledge, the competition is a chance to develop them through healthy competitiveness.

A — Battery location identification

Battery location identification must be made possible with a visual aid. In order to provide the visual aid you should use one of the following standard symbols or alternatively you can add a fairly readable writing indicating the location with an arrow.





B — Allowed Frequencies for communications

Available frequencies are defined in the region ISM allocation. Frequency utilization is defined with ETSI [EN300.220] standard. All frequency usage must conform the regulation entity document.

Table B.1 lists some of the available frequency bands. Additionally, 2.4GHz and 5GHz technologies can be used (Wi-Fi/Bluetooth) within the region limitations. Since GPS is recommended, GPS frequencies are allowed.

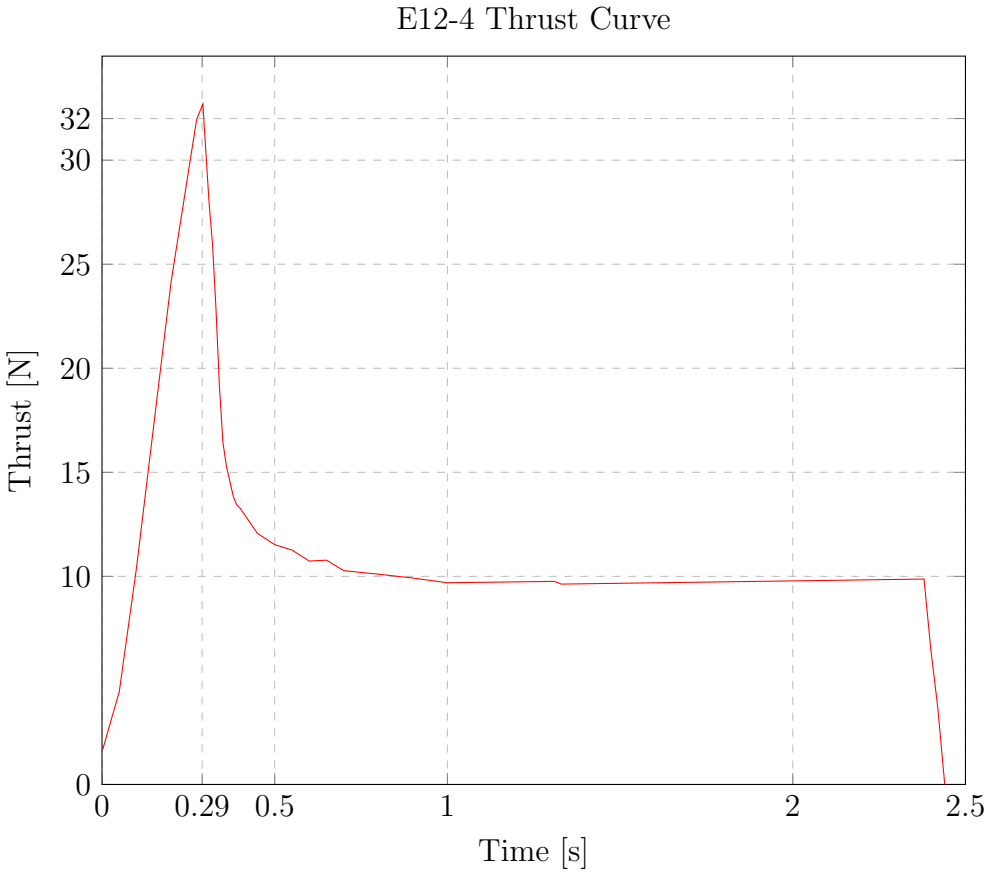
Any communication system compliant to Italy RF regulation can be used. For LoRa users, note the European channel allocation is at 868MHz band.

Start Freq.	**Stop Freq.**	**Max EIRP**
13.5530 MHz	13.5670 MHz	
26.9570 MHz	27.2830 MHz	
40.6600 MHz	40.7000 MHz	
433.0500 MHz	434.7900 MHz	
868.0000 MHz	868.6000 MHz	
869.4000 MHz	869.6500 MHz	

Table B.1: List of allowed frequency bands and relative maximum transmission power

C — Rocket specifications

Rocket engine will be a standard E12-4. Specifications will follow.



Total Impulse	30.00 N/sec
Max Thrust	30.60 N
Thrust Duration	2.70 sec
Deployment Time Delay	4 sec

D — List of revisions

Revision	Date	Notes
A	July 10th, 2023	First release
B	July 20th, 2023	Detailed frequency allocation and tx power. Revision of points 7, 8 and 10 of section 3.1. Added points relative to communication encryption and battery capacity limits and technologies.