WORLD SPACE WEEK 2026

SOLID FUEL-ROCKETRY CHALLENGE

COLLEGE-LEVEL COMPETITION

ORGANISED BY

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OFFICIAL COMPETITION GUIDELINES

Technical Specifications, Rules & Regulations, and Judging Criteria

Document Type	Competition Guideline — Official Release
Category	College Level
Event Window	5th October 2026
Venue	Haldwani, Uttarakhand
Organized By	Astroverse Experience Pvt Ltd

1. Preamble & Purpose

This document defines the technical, safety and operational requirements for the Solid Fuel Rocketry Competition 2026. It is intended to provide students and mentors with a clear and consistent framework for designing, inspecting and launching compliant model rockets.

The competition emphasizes safe engineering, aerodynamic stability, recovery, technical documentation and responsible participation. All launches shall take place under the supervision and authorization of the designated technical and safety officials.

2. Objective

To engineer a solid-propellant launch vehicle optimized for maximum apogee, demonstrating rigorous aerodynamic stability during powered ascent, and executing a reliable parachute recovery sequence.

3. Scope, Class & Motor Classification

3.1 Competition Scope

The competition is limited to the solid-fuel model rocket configuration approved by the Organizing Committee. **Only certified propulsive units specifically provided by the organizer are applicable for launching.**

3.2 Motor Specification

The organizer will provide the certified Rocket Motor on paid basis (~2500 INR) and a purchase link will be sent after registration. (Registration ID mandatory). The below details are for preliminary research. The accurate motor specification will be provided.

Parameter	Competition Requirement
Approx Solid propellant Weight	~ 435 gm
Total Motor Weight	~ 929 gm
Diameter of the Motor	65 mm
Length of the Motor	240 mm
Approx. Impulse	400 N.s

3.3 Rocket Specification

Parameter	Competition Requirement
Body material	PVC / cardboard / kraft paper tube / 3D-printed plastic/High performing plastic & composite
Recovery	Parachute or streamer mandatory
Metal body	Not permitted
Ignition	Approved wireless/electric remote ignition only (Launching setup will be provided by the organizer)
Fin Gap	Maintain a minimum clearance of **40–50 mm between the fins**, ensuring adequate space for the guide rail and preventing any obstruction or interference during launch.

4. Eligibility & Participant Conditions

• Teams must register within the official registration period (15 August – 15 September 2026) and Each team may comprise a **minimum of one** and a **maximum of five** participants.

• Participants must be currently enrolled college/university students, subject to the organiser's registration rules.

• Each team shall nominate one Team Leader or any Faculty/Institutional Mentor (not mandatory)

• Teams must comply with all technical, safety and launch instructions issued by the Organising Committee.

• Teams must declare their propulsion class and submit the required technical and safety documentation.

• The final rocket and propulsion configuration presented for launch must match the declared competition entry

5. Technical Specifications for the Rocket

5.1 Airframe & Structural Requirements

- Permitted body materials: PVC, cardboard, kraft paper tube or 3D-printed plastic.
- Metal body: strictly prohibited.
- Only certified motors are allowed. It will be provided by the organizer.

5.4 Rocket Motor Dimensions

Refer section 3.2

5.5 Aerodynamic Stability

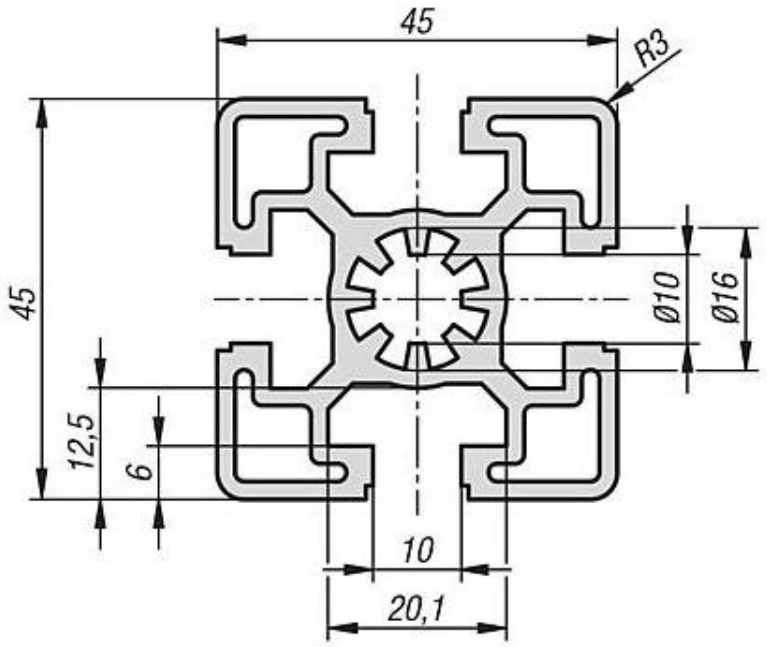
- The rocket shall be aerodynamically stable, with the appropriate balance of Centre of Gravity (CG), Centre of Pressure (CP) and Centre of Mass (COM) to ensure stable flight.

5.6 Recovery System Requirements

- A parachute or streamer recovery system is mandatory on every rocket.
- The recovery system must be capable of providing a controlled descent with velocity <6 m/s
- A rocket designed to descend without the required recovery system shall not be cleared for launch.
- Recovery components must be securely installed and inspected before launch.
- The recovery system should be triggered by the Avionics module.

5.6 Launcher Specification

Refer the Launcher Guideline (Annexure-I)



6. Safety Guidelines

6.1 Materials & Propulsive Units

- No metal rocket body/casing is permitted.
- Only organizer-approved propulsive units may be used.
- The rocket should be assembled before reaching the launch site.No student shall manufacture, mix, cook, cast, load, modify or prepare propellant at the competition site.
- Any damaged, leaking, altered or otherwise unsafe propulsive unit shall be removed from the launch process by authorized safety personnel.

6.2 Pad & Ignition Procedure

- Manual ignition using a matchstick or fuse is strictly prohibited.
- Launch shall be performed only through the approved wireless/electric remote ignition system.
- Only the designated launch authority may authorize ignition.
- All spectators and non-essential personnel shall remain outside the exclusion zone.

6.3 Emergency & Medical Preparedness

- If a launch fails, misfires or results in an abnormal flight, no participant shall approach the rocket until authorized safety personnel declare the area safe.

6.5 Weather & Range Conditions

• The Organizing Committee / Range Safety Officer may postpone or stop launch operations whenever weather, visibility, wind, lightning, site conditions or any other factor creates an unsafe situation.

IMPORTANT	A rocket may be launched only after technical inspection is complete, the launch area is declared clear, the approved ignition system is ready, and the designated launch authority gives explicit clearance.

7. Competition Compliance & Disqualification Conditions

• Use of a metal rocket body/casing.
• Exceeding the 500 g maximum solid propellant event limit.
• Preparing, mixing, cooking, casting, loading or modifying propellant at the competition site.
• Launching without the required parachute/streamer recovery system.
• Failure to meet the prescribed dimensions or mandatory launch-guide requirement.
• Use of manual matchstick/fuse ignition.
• Failure to follow the prescribed safety perimeter or launch-site controls.
• Failure to follow mandatory technical or safety instructions issued by competition officials.
• Unsafe construction, deliberate rule violation, misconduct or interference with another team's equipment.
• You need to submit the progress report on or before 20th September.

8. Judging Criteria & Scoring

Each eligible rocket shall be evaluated on the following competition parameters. The Organizing Committee shall publish the final marks/weightage and official flight-measurement method before the competition.

Judging Parameter	Evaluation Focus
Height	Maximum vertical altitude achieved by the rocket during flight, measured using the official event measurement method.
Recovery Performance	Successful parachute/streamer deployment and controlled descent.
Aerodynamic Stability	Stable trajectory, controlled ascent and minimal wobbling.

Rocket Engineering	Structural quality, alignment, material selection and engineering execution.
Technical Documentation	Integrated CAD File

IMPORTANT NOTE	Teams that submit a **CAD (Computer-Aided Design) model/drawing of their rocket** along with the project documentation may be awarded **additional bonus points** under the judging criteria. The CAD model should clearly represent the final rocket design and major components. Bonus of 10 score will be credited for successful design of CAD file.

ANNEXURE - I

ROCKET MOUNT & LAUNCH ATTACHMENT SPECIFICATIONS

MANDATORY REQUIREMENT: EXACTLY TWO (2) MOUNTS REQUIRED

Every rocket body must be fitted with strictly two (2) launch attachments (either 2 Rail Buttons or 2 Launch Lugs). Mounting fewer than 2 or more than 2 attachments is strictly prohibited.

1. LAUNCH MOUNT OPTIONS

Teams may choose **ONE** of the following three options to mount their rocket onto the launch rail:

Option A: Standard Rail Buttons (Recommended)

Fix two standard cylindrical Rail Buttons directly onto the rocket body tube using appropriate screws. Ensure the standoff height allows smooth sliding inside the rail slot with proper clearance.

Option B: Custom Manufactured Launch Lugs

Fabricate two Polypropylene (PP) Launch Lugs according to the exact dimensional drawing specifications provided below.

Option C: Pre-Purchased Commercial Launch Lugs

Procure pre-made Polypropylene launch lugs online that strictly match the technical drawing dimensions.

2. GUIDE RAIL SPECIFICATIONS (45 MM × 45 MM PROFILE)

The launch system uses a standard 45 mm × 45 mm aluminum guide rail. All hardware must fit smoothly inside the T-slot cavity.

Parameter	Specification
Rail Profile Size	45 mm × 45 mm
Outer T-Slot Opening	10.0 mm
Inner T-Slot Cavity Width	20.1 mm
Slot Depth to Flange	6.0 mm (12.5 mm total depth)
Corner Radius	R3 mm

3. POLYPROPYLENE LAUNCH LUG SPECIFICATIONS (DRAWING REF: LL-01)

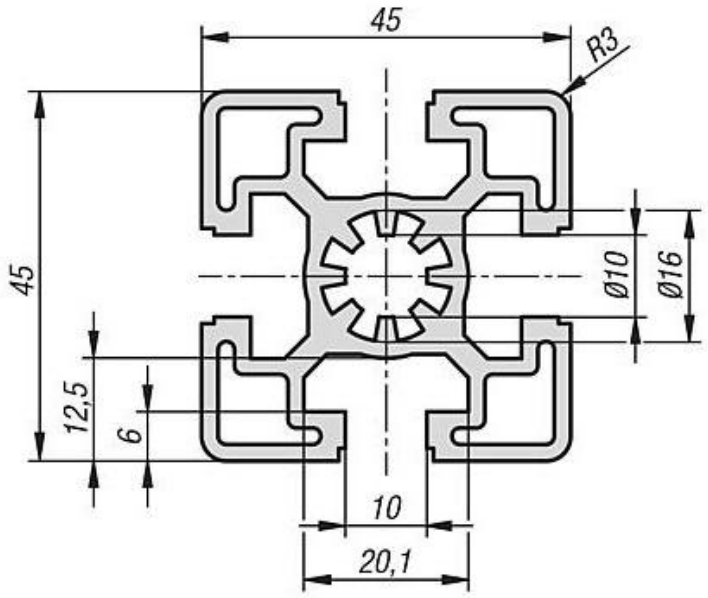
Feature	Dimension / Specification
Material	Polypropylene (PP)
Weight	12.5 g per lug
Base Length	75 mm
Top Edge Length	39 mm (135° side chamfer angle)
Total Height	18 mm
Base Width / Top Width	22 mm (Base) / 18 mm (Top Flange)
Guide Channel Slot Width	8.2 mm (Upper neck) / 11 mm (Internal recessed channel)
Mounting Hole Distance	28 mm center-to-center distance
Mounting Hole Diameter	Ø4.2 mm (Countersunk for flush fitting)

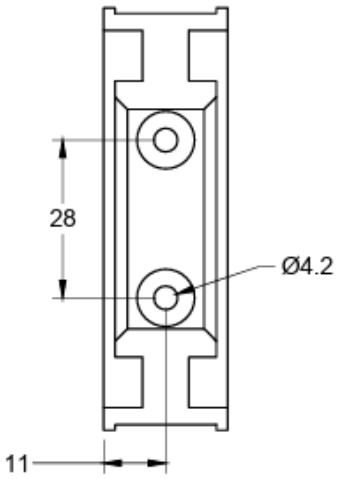
4. INSTALLATION RULES

Longitudinal Alignment: Both mounts must be placed in a perfectly straight line along the center axis of the rocket body tube.

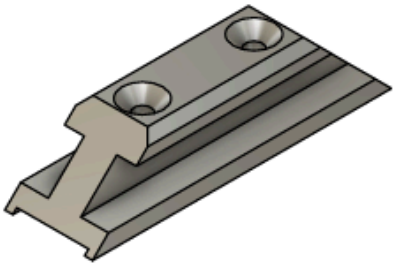
Positioning: Place one mount on the lower body tube section (above the fins) and the second mount on the upper section (below the nose cone / payload bay junction).

Clearance Verification: Ensure there is sufficient space/clearance between the rocket body and the guide rail face to avoid friction or binding during launch.

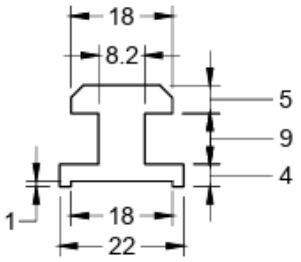




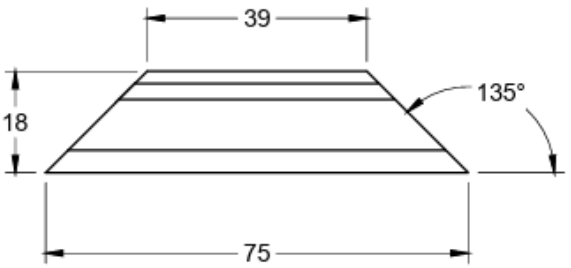
Top View



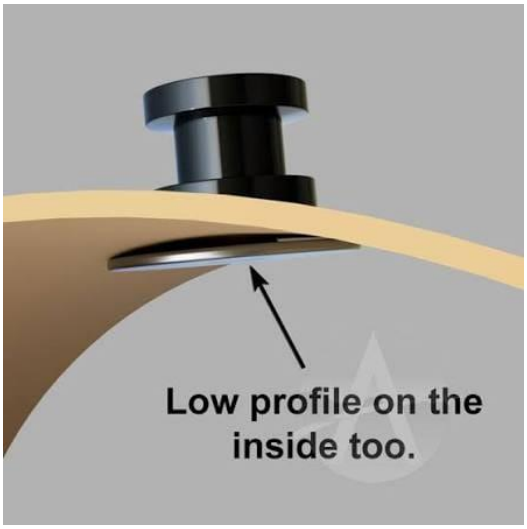
Isometric View

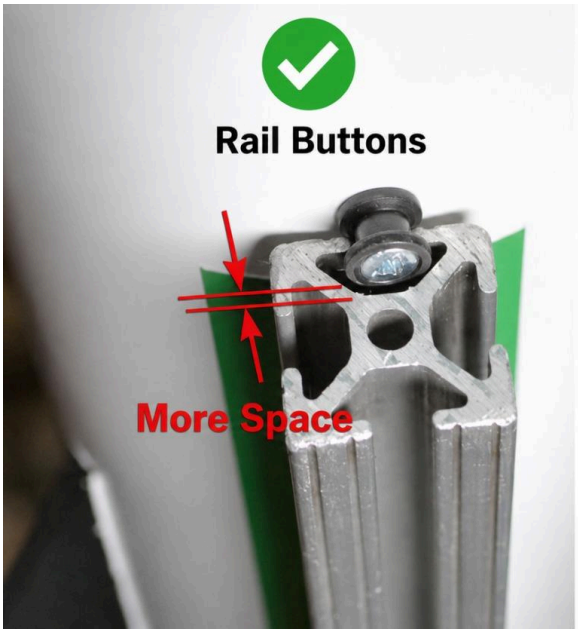


Front View



Side View




Rail Buttons
More Space


Rail Buttons
Less
Space

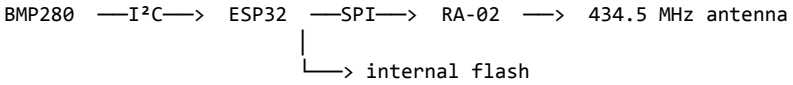
ANNEXURE-II

STANDARD ALTITUDE TELEMETRY SYSTEM

Document item	Specification
Purpose	Build and integrate the standardized rocket altitude telemetry subsystem.
Primary telemetry	433-MHz LoRa link using sx1278 RA-02.
Secondary record	ESP32 internal flash.
Firmware	Official competition firmware installed by organizers at inspection.
Student responsibility	Hardware procurement, assembly, power, pressure port, antenna and mechanical integration.

1. What You Must Build

Each team shall build the complete flight telemetry hardware using the components and interfaces in this specification. The organizers will install the official firmware at the competition site.



Do not substitute components, change standardized pin assignments, or alter the competition radio configuration without organizer approval.

2. Required Hardware

Component	Required specification	Notes
Microcontroller	ESP32-WROOM-32 based DevKit	Original ESP32 family; USB programming required.
Pressure sensor	Bosch BMP280	I²C interface.
LoRa radio	Ai-Thinker RA-02 / SX1278	3.3-V SPI interface.
Antenna	434.500-MHz antenna	Securely mounted; final geometry must match tested design.
Power	Team-provided regulated supply	Must remain stable during LoRa transmission.
Storage	ESP32 internal flash	No external SD/flash required.

3. Exact ESP32 Pinout

ESP32 pin	Function	Connect to
3V3	3.3-V supply	BMP280 VCC; RA-02 VCC
GND	Common ground	BMP280 GND; RA-02 GND
GPIO 21	I²C SDA	BMP280 SDA
GPIO 22	I²C SCL	BMP280 SCL
GPIO 23	SPI MOSI	RA-02 MOSI
GPIO 19	SPI MISO	RA-02 MISO
GPIO 18	SPI SCK	RA-02 SCK
GPIO 5	LoRa chip select	RA-02 NSS/CS
GPIO 14	LoRa reset	RA-02 RESET
GPIO 26	LoRa interrupt	RA-02 DIO0

Do not use GPIO6–GPIO11 for external peripherals; these are associated with the ESP32's internal flash interface. Avoid unnecessary use of boot-strapping pins.

4. Wiring Requirements

- All modules shall share a common ground.
- BMP280 and RA-02 shall be supplied from a suitable 3.3-V rail.
- Verify polarity before powering the system.
- Keep signal wiring short and mechanically secured.
- Final flight wiring shall use soldered, connectorized, PCB or otherwise mechanically reliable connections.
- Loose breadboard contacts are not recommended for the flight configuration.

5. Power Supply

The team is responsible for the flight power system. The regulator must provide a stable supply for the ESP32, BMP280 and RA-02 without causing brownout or reset during radio transmission.

- Test the complete electronics using the actual flight battery and regulator.
- Do not connect the RA-02 directly to a battery voltage outside its specified supply range.
- Secure battery and power wiring against launch vibration.
- Verify the system remains stable during repeated LoRa transmissions.

6. LoRa Configuration — Fixed

Parameter	Standard
Frequency	434.500 MHz
Bandwidth	125 kHz
Spreading factor	SF7
Coding rate	4/5
Preamble	8 symbols
CRC	Enabled
Header	Explicit
Normal telemetry	2 packets/second
TX power	10dbi

The 434.5-MHz frequency is within the Indian 433.05–434.79-MHz low-power band. The organizers will determine and configure the compliant conducted power/antenna combination. Teams must not change RF parameters.

7. Antenna — Rocket-Side Requirements

The competition does not require every team to use an identical antenna. Teams may use a commercially manufactured or student-built antenna intended for operation in the 433–434 MHz region, provided it meets the requirements below and passes organizer inspection.

7.1 Operating frequency

The telemetry system operates at 434.500 MHz. The rocket antenna shall be suitable for operation at or around this frequency.

For reference, the free-space wavelength at 434.500 MHz is approximately 690 mm and a quarter-wave radiator has an ideal electrical length of approximately 172.5 mm. Actual physical dimensions depend on construction, conductor diameter, insulation and nearby materials.

7.2 Permitted antenna types

- ¼-wave monopole or whip antenna.
- ¼-wave ground-plane antenna.
- Dipole antenna.
- Commercial 433/434-MHz antenna designed for the operating frequency.
- Other antenna designs only with organizer approval.

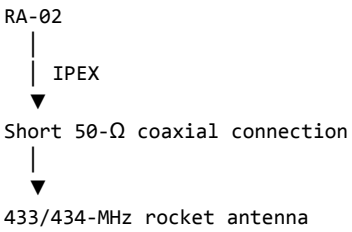
The antenna must be intended for the 433–434 MHz region. Random or unverified antennas are not recommended.

7.3 Restrictions

- No intentional high-gain directional antenna on the rocket.
- No active RF amplifier or RF power booster.
- No modification intended to increase transmitter power.
- The antenna shall remain electrically connected throughout flight.
- The antenna shall be mechanically secured against launch vibration and recovery loads.
- The antenna shall not be coiled, folded around the electronics, or deliberately concealed against conductive material.

7.4 RF connection and mounting

- The RA-02 uses an external IPEX antenna connection.
- Use an appropriate 50-Ω RF connection between the RA-02 and the antenna.
- If a coaxial pigtail is used, keep it as short as practical and secure it mechanically.
- Keep the antenna away from large conductive structures, batteries, motor casings and other RF-obstructing components where practical.
- The final antenna configuration used in RF testing should be the same configuration used during flight.



7.5 Antenna verification

Teams are strongly recommended to test the antenna in its final installed rocket configuration. Where a VNA is available, verify the antenna around 434.500 MHz. An SWR of ≤ 2:1 at the operating frequency is a recommended engineering target, not a requirement for a specific antenna type unless separately announced by the organizers.

7.6 Ground receiver compatibility

The ground station architecture, antenna gain, receiver configuration and decoding system are organizer-controlled and are not part of the student hardware specification.

7.7 Recommended student approach

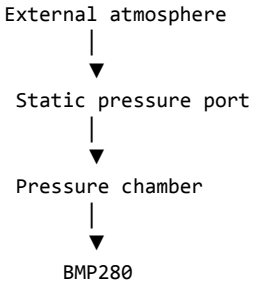
For a simple and repeatable build, a ¼-wave antenna with a defined RF counterpoise is recommended. Teams may instead use an approved commercial 433/434-MHz antenna if its mechanical installation is suitable for the rocket.

8. BMP280 Pressure Measurement

The BMP280 provides the atmospheric pressure used by the official firmware to calculate relative altitude. The launch-site pressure reference is established by the official firmware before flight.

Teams must provide a reliable static-pressure path. Do not place the pressure inlet directly in a high-speed airflow path or expose it to motor exhaust.

9. Static Pressure Port



- Use a small side-facing/flush pressure port connected to a pressure chamber.
- Initial engineering target: approximately 2–3 mm port diameter.
- Keep the internal pressure path short and unobstructed.
- Do not seal the sensor inside an airtight enclosure.
- Do not allow tape, adhesive, epoxy or potting material to block the pressure inlet.
- Keep the port away from direct motor exhaust and strong local aerodynamic disturbances.

The organizer may publish a final standardized port geometry after validation testing. Teams should test their design before competition.

10. Telemetry Packet

The official firmware generates a compact 6-byte application payload:

Field	Size	Meaning
Rocket ID	1 byte	Organizer-assigned rocket identifier.
TYPE	1 byte	0x01 = altitude; 0x02 = apogee.
SEQ	2 bytes	16-bit packet sequence number.
ALTITUDE	2 bytes	Unsigned altitude in 0.1-metre units.

Example: an altitude value of 8237 represents 823.7 m. LoRa hardware CRC is enabled. The sequence number allows the telemetry system to identify missing packets. Teams do not need to implement or modify the packet protocol.

11. Apogee Telemetry

The official firmware detects apogee and repeatedly transmits the apogee result to increase the probability of successful reception. Teams do not implement the apogee algorithm.

```
Example:
ID = 37
TYPE = 0x02
SEQ = 221
ALT = 8237
```

```
Meaning: Rocket 37, apogee = 823.7 m
```

12. Internal Flight Data

The official firmware may store a higher-rate flight record in ESP32 internal flash. No external SD card, EEPROM or flash device is required.

- Do not modify the flash layout used by the official firmware.
- The onboard record is secondary to the LoRa telemetry path.
- Design the electronics so the controller can reasonably survive landing and be recovered for inspection if required.

13. Official Firmware

The organizers will install the official competition firmware at the launch site. The firmware controls sensor configuration, altitude calculation, filtering, apogee detection, radio configuration, telemetry and flight logging.

- Teams shall not modify the competition firmware.
- Teams shall arrive with hardware ready for firmware installation.
- The organizer-assigned Rocket ID will be associated with the system at inspection.

14. Mechanical Integration

- Secure the ESP32, BMP280 and RA-02 against vibration and acceleration.
- Prevent connectors and wires from loosening during launch.
- Protect electronics from impact and conductive debris.
- Keep the pressure port unobstructed.
- Keep electronics away from direct motor exhaust and excessive heat.
- Secure the LoRa antenna so it cannot detach or change configuration during flight.

15. Pre-Competition Test Procedure

Test	Pass condition
ESP32 power/programming	Board powers reliably and USB programming works.
BMP280	Sensor detected; pressure reading stable; altitude/pressure response verified.
RA-02	Radio initializes and successfully transmits using the intended antenna.
Power integrity	No ESP32 reset or brownout during repeated LoRa transmission.
Pressure port	Stable atmospheric reading; inlet unobstructed.
Mechanical	No module, wire or connector can move/disconnect under vibration.
Full system	Complete electronics operates continuously on flight power.

16. Competition Inspection Checklist

- ☐ ESP32-WROOM-32 based board installed.
- ☐ Bosch BMP280 installed.
- ☐ RA-02/SX1278 installed.
- ☐ Correct pinout verified.
- ☐ Common ground verified.

- ☐ 3.3-V supply verified.
- ☐ Antenna connected and mechanically secured.
- ☐ Static pressure port unobstructed.
- ☐ Power system ready for test.
- ☐ USB cable available for firmware installation.
- ☐ Hardware is accessible for inspection.

17. Troubleshooting

Symptom	Check
BMP280 not detected	3.3 V, GND, SDA→21, SCL→22, sensor/module orientation and wiring.
RA-02 not detected	3.3 V, GND, MOSI→23, MISO→19, SCK→18, NSS→5, RESET→14, DIO0→26.
ESP32 resets during TX	Regulator/current capability, wiring, battery voltage, grounding and supply stability.
Altitude unstable	Pressure-port airflow, blocked inlet, sensor mounting, power stability and wiring.
No telemetry	RA-02 power, antenna connection, official firmware, assigned ID and physical RF path.

18. Quick Reference — Build This

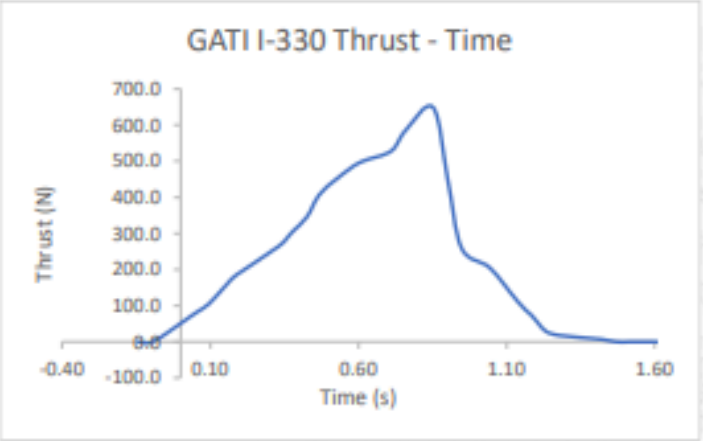
Item	Fixed value
MCU	ESP32-WROOM-32
Pressure sensor	BMP280
LoRa	RA-02 / SX1278
Frequency	434.500 MHz
Bandwidth	125 kHz
SF	7
CR	4/5
Preamble	8
CRC	ON
Telemetry	2 Hz
Storage	ESP32 internal flash
BMP280 SDA	GPIO21
BMP280 SCL	GPIO22
RA-02 MOSI	GPIO23
RA-02 MISO	GPIO19
RA-02 SCK	GPIO18
RA-02 NSS	GPIO5
RA-02 RESET	GPIO14
RA-02 DIO0	GPIO26
Antenna	434.500 MHz; nominal λ/4 ≈ 172.4 mm

ANNEXURE - III

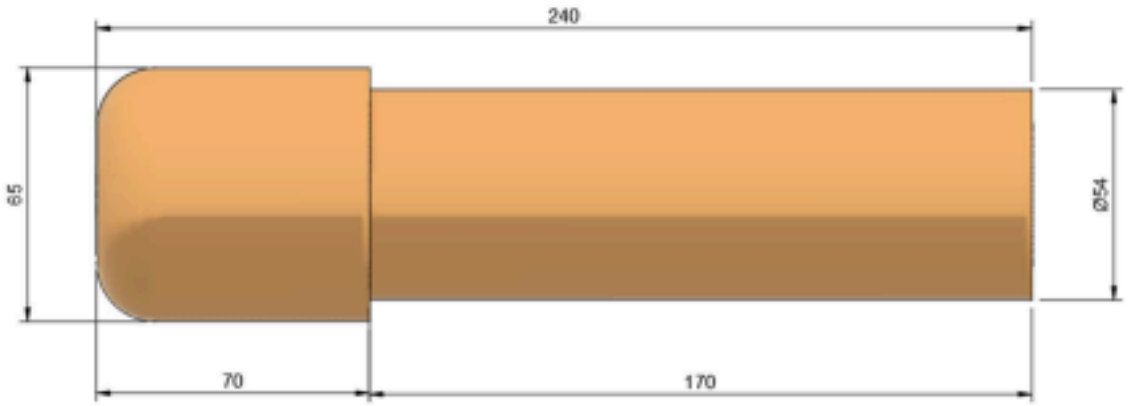
Product Datasheet

GATI I-333

MODEL	GATI I-330
SIZE	54 MM
BURN TIME	1.2 Second
TOTAL IMPULSE	400 Newton – Second
MOTOR LENGTH	240 MM
MAX THRUST	649 Newton
TOTAL MASS	929 Grams
PROPELLANT MASS	435 Grams



MOTOR DIMENSIONS



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