Mission Concept

Overview

The CanSat project that we have designed aims to act as a probe which can be used for terrestrial or planetary atmosphere expeditions. This probe will be released from a predetermined altitude, where it will land smoothly by using its landing systems (e.g., the parachute) and will operate on the surface of the planet. For the reliability and sustainability of the mission, the probe has been equipped with solar panels that will prolong the mission's duration. The utility of the project extends to terrestrial missions as well, as it will be able to access hazardous and difficult environments, and its long-term data collection abilities will increase the scientific value of the data this probe records without risking human safety. For example, it could be useful in volcanic regions, disaster zones and polar environments to measure environmental parameters over time. Furthermore, our project includes various test devices and atmospheric sensors to provide comprehensive data about the environment that the CanSat is surrounded by. This may also be employed in space missions on other planets to provide vital data, such as surface conditions and weather-related information, and could serve as an invaluable source of data in unsafe and impractical environments for humans to be in.

Our mission diagram, as shown below, describes the journey of the satellite from the preflight stage to the post-landing stage.

1. CanSat installation & parameter calibration
2. Launch and telemetry monitoring
3. Model rocket separation & parachute-assisted descent
4. Touchdown; parachute detached for stability; auto solar orientation

#Mission progress and telemetry monitored at Ground Control throughout all phases

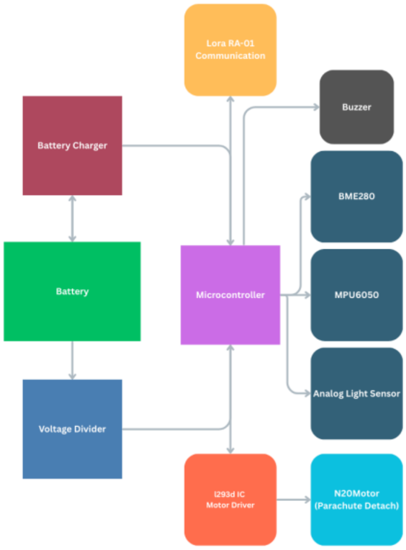
Figure 1 Stages of the CanSat Mission

Electronics

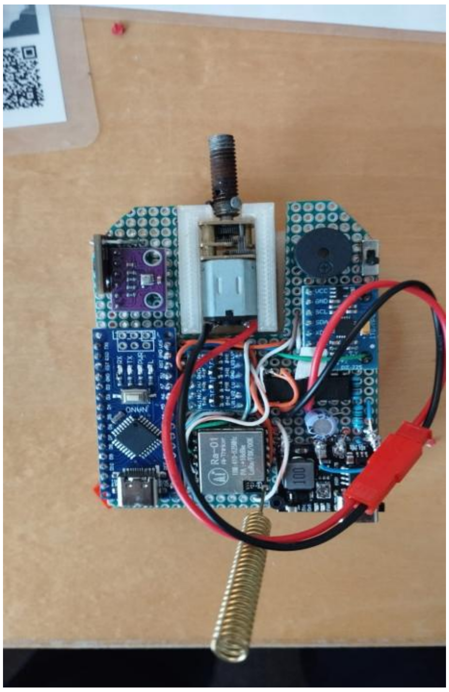
Our CanSat project has an advanced electronics system with communication module, atmospheric sensors, as well as actuator and energy systems for sustainable and durable missions. The list of electronic components has been added below for further information.

Component	Role in the CanSat System
Arduino Nano	Acts as the main microcontroller of the CanSat; coordinates sensor readings, LoRa communication, and control signals.
BME280	Sensor used to measure atmospheric pressure, temperature, and humidity for environmental monitoring.
Analog Light Sensor	Measures ambient light intensity, useful for detecting surface exposure or planetary day/night cycles.
MPU6050	Inertial Measurement Unit (IMU)

	providing acceleration and gyroscopic data to track motion and orientation.
TP4056	Lithium-ion charging module; used for safe and efficient charging of the 18650 battery. *(Assuming you meant TP4056, as TP4050 is not standard.)*
Buzzer	Emits audio signals for alerts (e.g., landing confirmation, low battery, system boot).
L293D Motor Driver	Controls the N20 motor for deployment actions like door mechanisms or scientific payload release.
N20 Motor	Small DC motor used for mechanical movements, such as opening doors or extending instruments.
18650 Battery	Rechargeable lithium-ion battery that powers the entire CanSat during flight and surface operation.
LoRa RA-01 Module	Long-range wireless communication module used to transmit telemetry data to the ground station.
Logic Level Shifter	Converts voltage levels (e.g., from 3.3V LoRa to 5V Arduino logic) to ensure compatibility and prevent damage.
Voltage Divider	Used to safely measure battery voltage using the Arduino's analog pin.
Arduino Uno (Ground Station)	Receives and decodes telemetry data sent from the CanSat via LoRa for live monitoring and control.



To use space efficiently, we designed and manufactured our own PCB. This allowed us to integrate all required electronics into a compact form factor, ensuring seamless operation within the system. You can see the image of our PCB below.



Operation Details

After launch, our CanSat will be released from the rocket at a predetermined altitude. Upon separation, it will begin its descent with the aid of a parachute, ensuring a controlled landing speed of approximately **5 m/s**.

Once safely on the ground, the CanSat will pause its operation briefly to stabilize and verify proper landing. After confirming a secure and stationary position, the system will **automatically detach from the parachute**. This is done to prevent wind from dragging the CanSat on the surface, ensuring data integrity and mechanical safety.

Following detachment, the CanSat enters its **surface operation mode**. It begins to **collect atmospheric and environmental data** using its onboard sensors, which include:

- **Temperature**
- **Humidity**
- **Pressure**
- **Altitude (via barometric calculations)**
- **Light intensity**
- **3-axis Accelerometer**
- **3-axis Gyroscope**

Communication

Communication between the CanSat and the ground station is achieved using **LoRa RA-01** modules operating in **half-duplex mode**. This allows the CanSat to:

- **Continuously transmit telemetry data** to the ground station.
- **Receive command packets** from the ground station when needed (e.g., to trigger the buzzer or detach systems manually).

This communication setup ensures both real-time monitoring and limited remote control capabilities.

Telemetry Packet Structure (Satellite to Ground)

Field	Description	Units	Example
<packetID>	Packet number (auto-incremented)	—	<42>
<teamID>	Constant team identifier	—	<1>
<uptime>	Time since boot	seconds	<128>
<statusFlags>	Binary flags for system health/errors	bitfield	<18>
<altitude>	Altitude from BME280	meters	<73.2>
<velocity>	Vertical velocity (difference in altitude)	m/s	<-1.4>
<temperature>	Temperature from BME280	°C	<28.4>
<humidity>	Relative humidity from BME280	%	<41>
<pressure>	Atmospheric pressure from BME280	hPa	<1009.4>
<accX,Y,Z>	Accelerometer data from MPU6050	m/s^2	<0.1,0.0,9.8>
<gyroX,Y,Z>	Gyroscope data from MPU6050	rad/s	<-0.1,0.0,0.2>
<light>	Analog light sensor value	raw units	<378>
<parachute>	Parachute status (currently unused = 0)	flag	<0>

<battery>	Battery voltage	volts	<4.2>

Alert System (Status Flags)

The Status Flags field is a single-byte (8-bit) value included in each telemetry packet. Each bit represents a specific system condition or operational state. This allows efficient encoding of up to 8 statuses in just one byte.

Bit	Name	Description
0	Low Battery	Set if battery voltage falls below a safe threshold (< 3.3V)
1	Parachute Attached	Indicates parachute is still connected to the CanSat
2	Buzzer Active	Buzzer is currently sounding (e.g., for location signal)
3	Sensor Fault	One or more onboard sensors are malfunctioning
4	Manual Mode	CanSat is operating in manual control mode
5	Data Recording	Data logging is active
6	Command Pending	A command has been received and is queued for execution
7	Critical Error	Indicates a high-priority fault requiring attention

Command Packet Structure (Ground to Satellite)

Field	Size	Description	Example
<packetID>	1 byte	Unique packet ID (increments or arbitrary)	<17>

<teamID>	1 byte	Constant team identifier (e.g., 1)	<1>
<buzzer>	1 byte	2-bit command (only values 0–3 used)	<3>
<parachute>	1 byte	2-bit command (only values 0–3 used)	<1>

Accepted Buzzer Values:

Value	Meaning
0	No beep
1	Short beep
2	Double beep
3	Long beep

Accepted Parachute Values:

Value	Meaning
0	No action
1	Detach Parachute
2	Attach Parachute (by the team member on ground)
3	Reserved (can define later)

Success Criteria

To evaluate the success of our CanSat mission, we’ve defined a set of key criteria based on both the competition requirements and our own project goals. These criteria reflect the technical and scientific aims of using a solar-powered probe designed to operate on the surface of the Earth.

Our CanSat meets the specified size constraints: its length does not exceed 124 mm, the diameter is within 66 mm, and the total mass — including the parachute — is between 250 and 300 grams.

We consider the mission successful if the structure remains intact throughout all mission phases — from launch to landing. Deployment must occur smoothly: the probe should be released correctly, the parachute must open on time, and the descent speed should remain safe. The landing system should effectively protect the probe from damage upon touchdown.

Once deployed, all systems should start up properly. This marks the beginning of the second part of our success criteria — the part focused on project objectives. The solar panels should generate enough energy when exposed to light to reliably charge the battery and extend operational time.

After landing, the probe should continue running stably, simulating long-term data collection. All onboard sensors and measurement systems must function reliably.

The most critical component is communication between the probe and the ground station. A major success will be achieving continuous and reliable two-way communication.

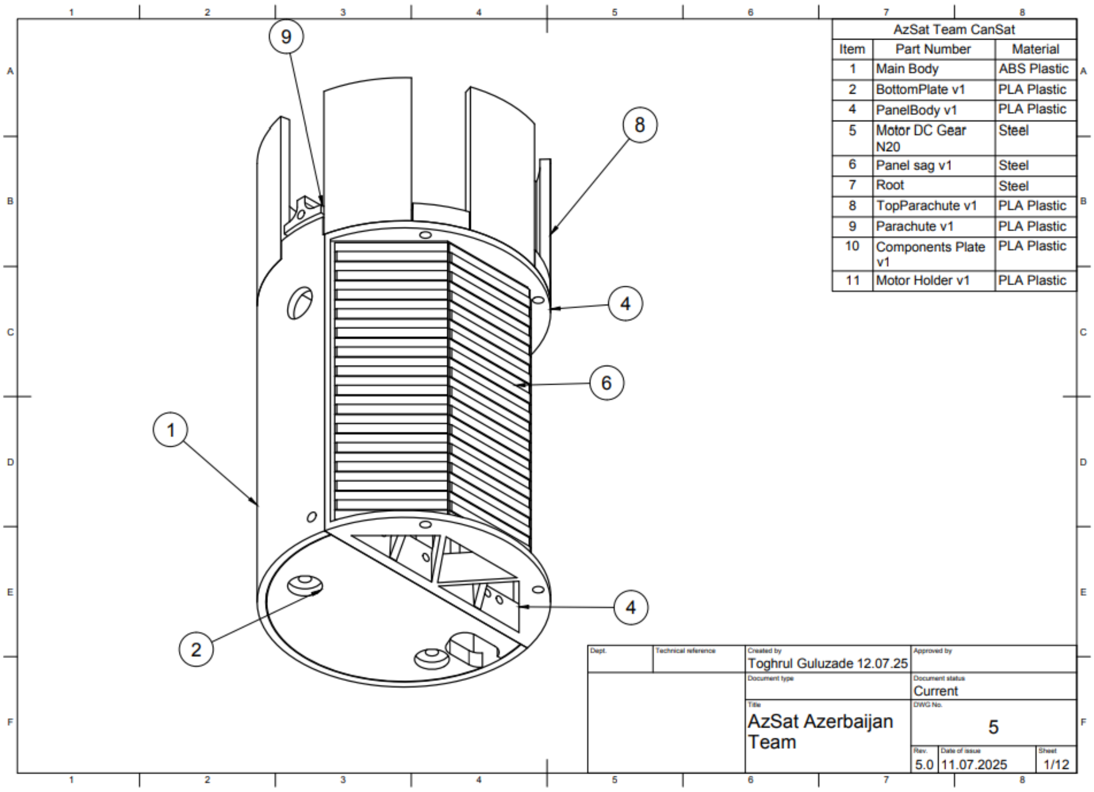
If all these criteria are met, we can confidently say that our mission was successful — and that our CanSat has proven itself as a reliable tool for exploring extreme or hard-to-reach environments here on Earth.

＜various factors or elements＞

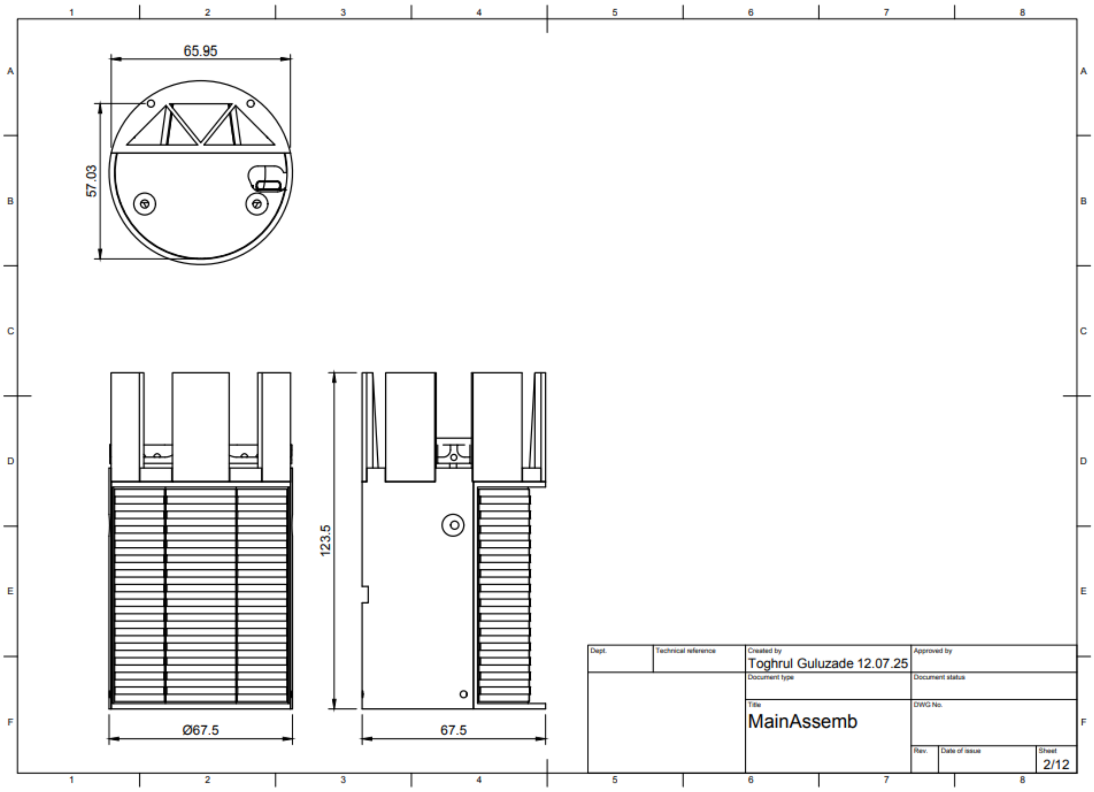
	design value	Unit	
Mounting size including Cansat, parachutes, and all other attachments) when mounted on the rocket			
Maximum length	124	mm	Under 124mm
Maximum diameter	64	mm	Under 68 mm
Total weight	252	g	250 – 300g
speed reducer			
method	parachute		
design drop speed	5.2	m/s	5 – 10 m/s
Power Supply			

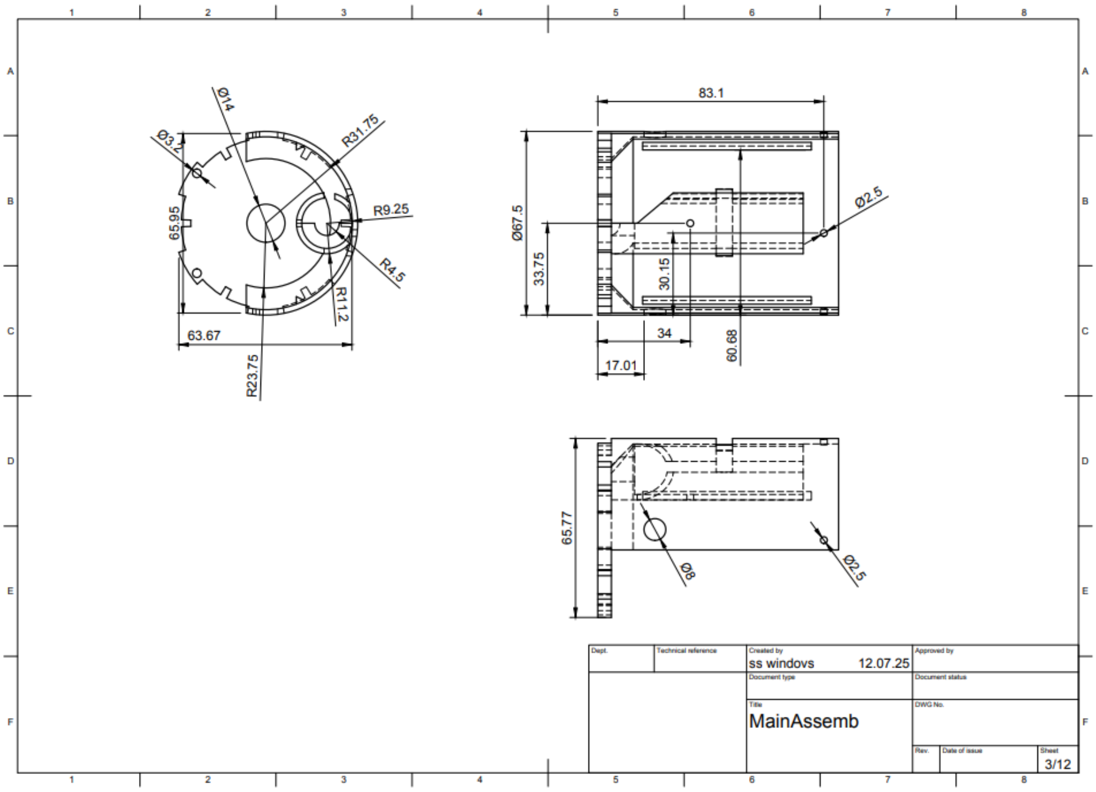
Supply voltage	3.7	V	
Battery capacity	2400	mAh	
available running time	900+	m	
precautions	Protected 2400 mAh Li-ion, secured placement, insulated terminals, voltage divider, low-voltage cutoff, telemetry, limited LoRa TX, solid wiring		
radio			
Mounted or not	yes / no		yes
Permission for use in Japan (prior confirmation with the Secretariat)	yes / no		yes
Radio Type	LoRa RA-01 (Semtech SX1278-based)		
Operating frequency	433	Hz	
Channel	433	ch	
precautions	Set spreading factor and sync word carefully, avoid high-power interference, test range before flight, use antenna matching.		

＜Can Sat Drawing＞



Item	Part Number	Material
1	Main Body	ABS Plastic
2	BottomPlate v1	PLA Plastic
4	PanelBody v1	PLA Plastic
5	Motor DC Gear N20	Steel
6	Panel sag v1	Steel
7	Root	Steel
8	TopParachute v1	PLA Plastic
9	Parachute v1	PLA Plastic
10	Components Plate v1	PLA Plastic
11	Motor Holder v1	PLA Plastic

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30.15
Ø2.5
34
17.01
60.68
65.77
Ø8
Ø2.5
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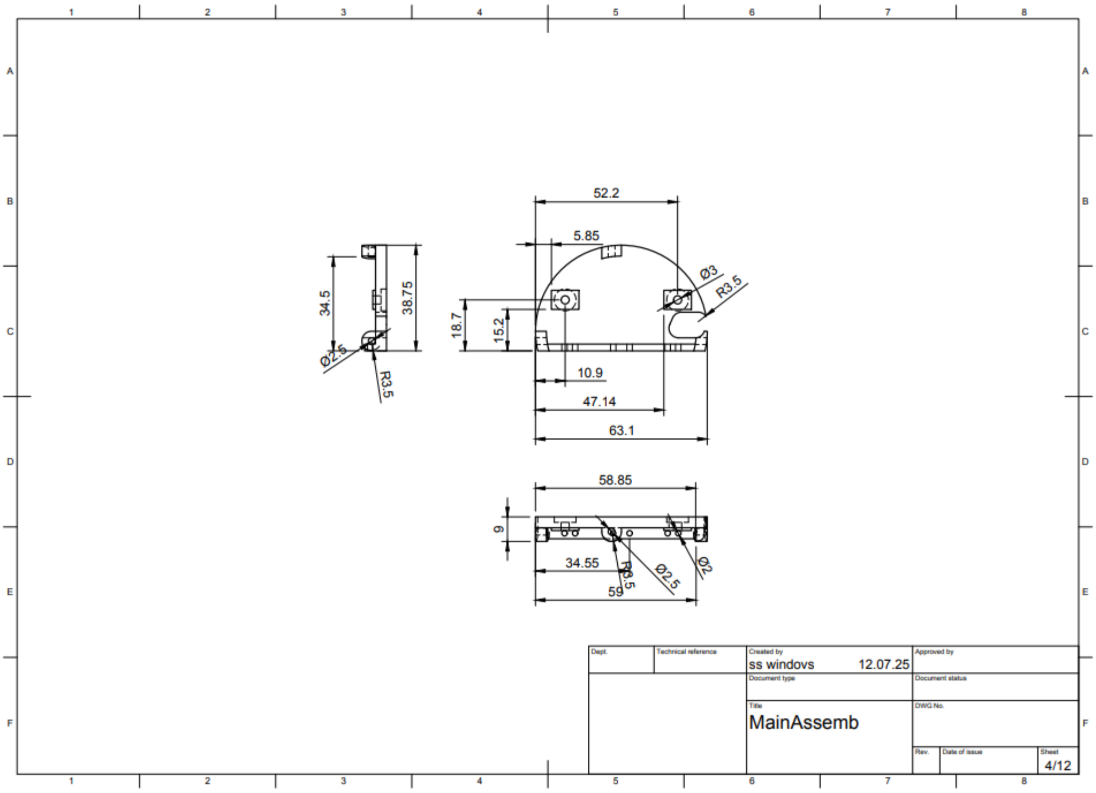
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R3.5
34.5
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18.7
15.2
Ø2.5
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58.85
9
34.55
R3.5
Ø2.5
Ø2
59
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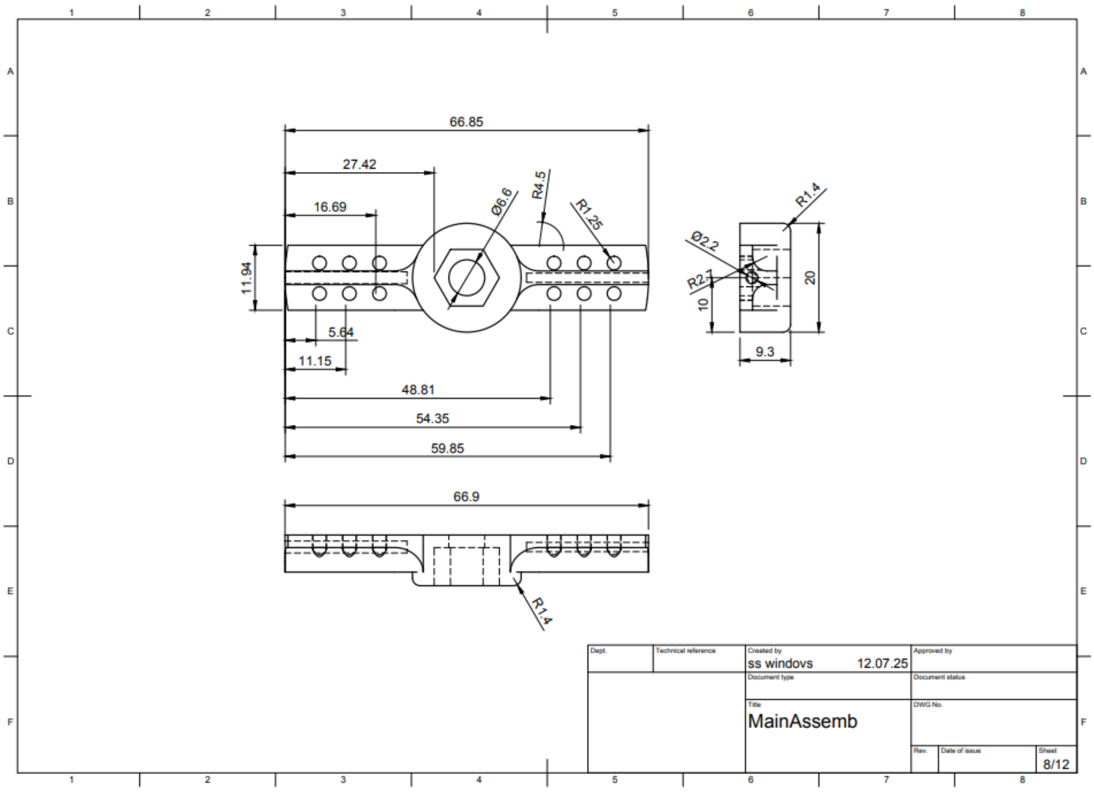
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R4.5
R1.25
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Ø2.2
R2.7
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66.9
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