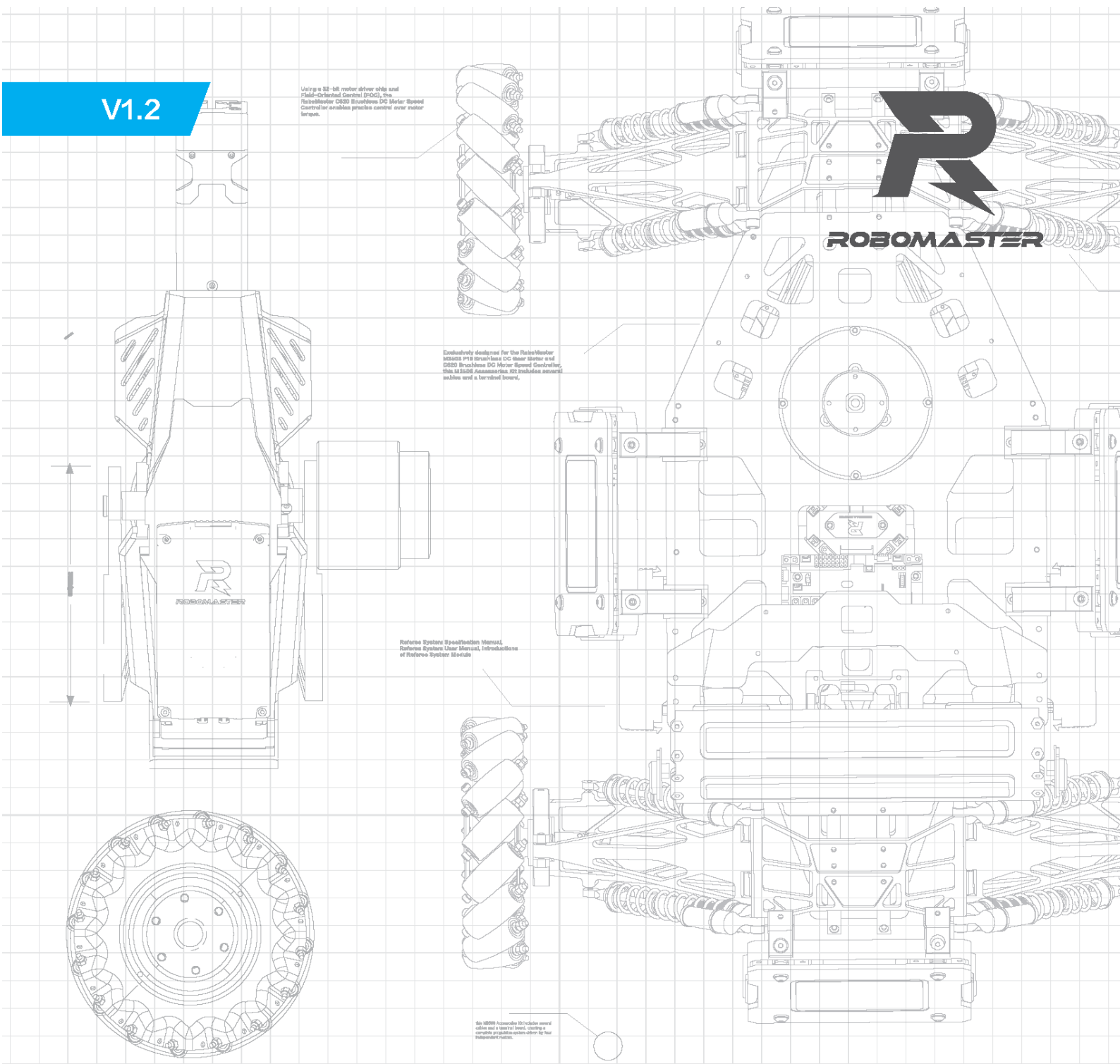
V1.2



ROBOMASTER

ROBOMASTER 2020
ROBOTICS COMPETITION

ROBOT BUILDING SPECIFICATION MANUAL

Prepared by the RoboMaster Organizing Committee

Released on May, 2020

Using this Manual

Legend

Penalty zone	Important notes	Hints and tips	Definitions and references

Related Document

1. RoboMaster Referee System User Manual
2. Referee System Module Instructions

Users should preferably read the Referee System Module Instructions first to understand the functions of and mounting methods for each Referee System module, and mount each module on the Robot Side of the Referee System correctly. Thereafter, users can read the Referee System User Manual to learn about the functions of the entire Referee System.

Release Notes

Date	Version	Changes
May 27, 2020	V1.2	1. Adding the Supercapacitor Management Module and specifications for the Video Transmission Remote Controller link. 2. Revising specifications for armor stickers, Aerial, Hero, the Supercapacitor Management Module, Dart System, and Radar. 3. Revising the installation requirements for the Speed Monitor Module (42mm projectile) and Speed Module, and specifications for the RFID Interaction Module.
December 31, 2019	V1.1	1. Updating technical specifications. 2. Updating the installation specifications for the Referee System, specifically adding installation requirements for the 17mm Fluorescent Projectile Energy-Charging Device.
October 15, 2019	V1.0	First Release

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1. Foreword

RoboMaster participating teams are required to develop and create their robots, which must fulfill all the specifications in this document, failing which the team will not pass the Pre-Match Inspection. If any safety incident has occurred due to a violation of rules, the RoboMaster Organizing Committee ("RMOC") reserves the right to hold the violating party legally responsible. Any dispute arising from this Specification Manual will be settled based on interpretations provided by the RMOC.

The information of the basic parts, modules, educational products, sponsorship, discounts and other details relating to robots shall be subject to the announcements released on the official RoboMaster website.

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2. Technical Specifications

2.1 General Technical Specifications

2.1.1 Energy Source

- The use of combustion engines, explosives, hazardous chemicals, etc. is forbidden
- Except for Radar, players in the Competition Area are not allowed to connect to mains electricity.

S1 Robots can be powered only by electricity and air pressure

2.1.1.1 Power Supply

- The batteries designated for use in this Season's competition shall be those produced by DJI.
- Lithium batteries not manufactured by DJI can be used in darts.

S2 Robots are required to use battery products designated by the RMOC or dry cells produced by other official manufacturers. Only dart may use lithium batteries produced by other official manufacturers.

S3 A Supercapacitor Management Module cannot be mounted on the chassis of a Sentry Robot. The total nominal energy of the Single Supercapacitor Modules of Standard and Hero Robots must not exceed 2000 J, and their actual measured energy must not exceed 2200 J.

2.1.1.2 Gas Source

Robots using compressed gas for their propulsion system must meet the following requirements:

S4 The compressed gas pressure inside the cylinder must not exceed 20 Mpa. The cylinder used should have a nominal pressure of no less than 30 MPa. A double-gauge constant pressure valve should be mounted directly at the outlet of the cylinder. The working pressure must not exceed 0.8 Mpa.

S5 The working gas must be inflammable, non-toxic and non-polluting, such as air, nitrogen, and carbon dioxide.

S6 The cylinder must have an approval certificate or a steel plate stamp. The certificate and plate stamp should be easily visible during Pre-Match Inspection.

S7 The cylinder meets all the pressure requirements, and has been issued an approval certificate by an officially recognized approving institution in its country of manufacture.

S8 The cylinder and gas tube must be protected to avoid any damage caused by tumbling over, collision, rotation or faulty moving parts. The cylinder's opening must not be exposed, so as to prevent it from being hit and

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damaged by projectiles.

S9 The gas cylinder should be mounted in a way that the cylinder and the gas pipe never touch the ground, regardless of how the robot spins around.

S10 The cylinder must be mounted safely and firmly on the robot body. To ensure safety, the cylinder's opening must be kept horizontal or facing up. The cylinder must be stabilized with at least two fixed points that are more than 1/5 of its length apart or with one fixed surface that is more than 1/5 of its length.

S11 The cylinder must be insulated from any possible heat source.

S12 All gas tubes and parts must be able to withstand the maximum working pressure of the system. It is recommended for a safety relief valve to be installed on the low pressure gas circuits

2.1.2 Wireless Equipment

- The remote controllers designated for use in this Season's competition shall be those produced by DJI.
- The Xiao Bai Remote Controller and the Video Transmission Remote Controller link can be used to control robots in this competition season.
- The Video Transmission Remote Controller link refers to the link in the Video Transmitter Module used to transmit remote controller-related data. It can replace the Xiao Bai Remote Controller and has superior stability than the Xiao Bai Remote Controller.

S13 Only remote controller products specified by the RMOC may be used, i.e., no remote controllers other than the Xiao Bai Remote Controller may be used, except the Video Transmission Remote Controller link.

S14 A remote controller must correspond to only one receiver.

S15 Robots are not allowed to carry wireless communication equipment other than the remote controller (RC) and Referee System Module.

2.1.3 Optical Equipment

Infrared sensor and emissive class I depth camera can be used.

S16 The laser beam from the laser sight must be red and the optical power consumption of the laser beam must be less than 35 mW. The projection angle of the laser sight must not exceed 5° (i.e. the diameter of the laser spot enclosing circle perpendicularly projected by the laser sight on a vertical wall with a horizontal distance of one meter must be less than 9 cm).

S17 Apart from laser sights, Engineer may install visible light launching equipment, to use as supplement lights to

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enhance visual recognition features when procuring Projectile Containers. Other ground robots are not allowed to mount any other obvious visible light-launching equipment.

For the definition of ground robots, please refer to RoboMaster 2020 Robotics Competition Rules Manual.

S18 The optical equipment used by a robot must not cause any physical harm to any person.

2.1.4 Computer Vision Features

On both sides of the Referee System Armor Module are clear lighting effects to enable robots to develop automatic recognition and sighting algorithms. The environment in and around the Competition Area is relatively complex. The RMOC cannot guarantee that the Computer Vision features of the Battlefield will not cause visual interference. The Computer Vision algorithm should adapt to the changes of the lighting of the venue and other possible interferences around the venue.

The following specifications must be followed when designing a robot's computer vision features:

S19 Armor Module cannot be blocked.

S20 Do not project light onto an Armor Module and do not mount any structure or device that interferes with Computer Vision feature recognition of the Armor Module by reflecting or refracting light on both sides of the Armor Module on the robot.

2.1.5 Robot Numbering

During Pre-Match Inspection and the match, staff from the RMOC will provide each robot with a corresponding armor sticker according to the robot numbering rules. For the numbering rules please refer to the Robot Lineup chapter in RoboMaster 2020 Robotics Competition Rules Manual; for the sticker images please refer to "Appendix 2 - Reference Drawings".

The following specifications must be followed when attaching armor stickers on robots:

S21 Armor sticker and serial number of a robot must match one another according to the numbering rules. The number and symbol must be placed in the correct direction, with no visible air pockets. One Armor Module must be attached with one armor sticker.

S22 Except for the exclusive armor stickers provided by the RMOC, no other stickers that resemble the exclusive armor stickers in their patterns may be attached on a robot's Armor Module or its other external structures.

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The symbols on the armor stickers of the Sentry, Base and Outpost shall be their corresponding patterns. No armor stickers shall be attached on Aerial.

2.1.6 Aesthetic Design

To ensure the protective shells of robots do not affect the shootout battles in the Competition Area and the match-viewing experience, the following specifications must be followed when designing and creating a robot's exterior:

Basic Requirements:

S23 The lines of robot are neat and not exposed. Exposure that is unavoidable requires line protection using materials such as drag chains and cable managers.

S24 Do not use materials that will have an obvious impact on the aesthetics of the robot, such as washbasins, plastic bottles, corrugated paper, bed sheets, white foam boards, bubble wrap, etc.

S25 Fish nets should not be used as external design materials, unless absolutely necessary for functional reasons.

S26 Avoid sharp structures that may damage the site or harm any person.

Gloss:

S27 The place where the robot's protective shell surface is at a distance that is not more than 100 mm from the sidelight edge of the Armor Module must not have gloss exceeding 15 Gs.

Paint Color:

All the robots of a team should preferably have a consistent aesthetic style.

S28 The Red Team's robots may use a color from the red spectrum for their protective shell, while the Blue Team may use any color from the blue spectrum. However, neither team should use the opposing team's color, to avoid confusion.

S29 A robot must display two school badges or team badges, each facing a different side. The size of a single school badge or team badge must not be larger than 100mm*100mm. The school badges or team badges must be displayed prominently on a robot, and their distance with the Armor light bar must be more than 30 mm. If the exterior of a robot does not meet specifications, an Inspector may require the position or size of a school badge or team badge to be altered.

S30 Reverse type can be applied on a school badge or team badge, or its original colors can be retained.

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Mounting of Protective Shells:

It is recommended that teams use tough materials that are not easily damaged for the protective shell and conduct reliability tests, to avoid any violation of rules caused by breakage of the protective shell from battles in the Competition Area.

Aesthetic Requirements:

S31 Reverse type can be applied for advertising spaces, or their original colors can be retained.

S32 The advertising spaces should be displayed on the left and right sides of the robot, and their distance with the Armor light bar must not be less than 30 mm.

S33 The inkjet or stickers of the advertising spaces must not affect the robot's Computer Vision recognition effect, and cannot be illuminated.

S34 The size of a single robot advertising space shall not be more than 100mm*100mm. Each robot can be set with up to two advertising spaces for the display of sponsor information. If the exterior of a robot does not meet specifications, an Inspector may require the position or size of an advertising space to be altered.

2.1.7 Launching Mechanism

Launching Mechanism: A mechanism capable of launching a projectile from a robot on a fixed trajectory to inflict damage on another robot (judge according to the mechanical structure, regardless of the power-on situation of the mechanism).

S35 Robots using compressed gas as the propellant for projectiles must not have an acceleration length (defined as the lineal length of the barrel that can provide acceleration to projectiles) exceeding 200 mm.

S36 Except Aerial and Sentry, robot Launching Mechanism must stably launch projectiles.

During the Pre-Match Inspection, each ground robot that is mounted with Launching Mechanism must be able to launch ten rounds of 17mm projectile or five rounds of 42mm projectiles in a stable manner.

S37 Each Launching Mechanism must be mounted with a corresponding Speed Monitor Module according to specifications, and must be equipped with not more than one laser sight. 17mm Launching Mechanism must be mounted with a 17mm Fluorescent Projectile Energy-Charging Device according to specifications.

S38 Each team is allowed to mount at most a mobile 17mm Launching Mechanism on a ground robot. Any robot mounted with this mobile 17mm Launching Mechanism will gain 0.2 kg for its weight in the Referee System.

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2.1.8 Miscellaneous

S39 Fragile materials must not be used in the design and creation of robots. No glue or adhesive materials may be used to attach robots to the battlefield or battlefield components.

S40 Rescue robots must not grab any of the Referee System Modules on the robot being rescued.

2.2 Robot Technical Specifications

2.2.1 Hero

The building parameters for Hero are as follows:

Table 2-1 Hero Building Parameters

Parameter	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than one remote controller.	-
Maximum Total Power Supply Capacity (Wh)	200	-
Maximum Power Supply Voltage (V)	30	-
Launching Mechanism	One 42mm Launching Mechanism	Existing 42mm Launching Mechanism and mobile 17mm Launching Mechanism cannot be at an altitude of more than 600 mm from the ground (based on the center of the pitch axis of the gimbal)
Projectile Supply Capability	Can receive but cannot supply	-
Maximum Weight (kg)	35	Includes battery weight, but not the weight of the Referee System

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Parameter	Limit	Remarks
Maximum Initial Size (mm, L*W*H)	800*800*800	Its orthographic projection on the ground should not exceed a 800*800 square
Maximum Expansion Size (mm, L*W*H)	1200*1200*1200	Its orthographic projection on the ground should not exceed a 1200*1200 square
Referee System	Four Large Armor Modules, and a Speed Monitor Module (42mm projectile), Video Transmitter Module (Transmitter), RFID Interaction Module, Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module, and 17mm Fluorescent Projectile Energy-Charging Device	Weight is 4.20 kg

- Maximum Expansion Size: The maximum size of a robot during its transformation.
- L*W*H: Length * Width * Height.

2.2.2 Engineer

The building parameters for Engineer are as follows:

Table 2-2 Engineer Building Parameters

Parameter	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than one remote controller.	-

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Parameter	Limit	Remarks
Maximum Total Power Supply Capacity (Wh)	200	-
Maximum Power Supply Voltage (V)	30	-
Projectiles Obtain Mechanism	● Only one Projectile Obtain Mechanism can be mounted ● No adhesive materials can be used ● When the Projectiles Obtain Mechanism is extending forward, the size protruding out of the body must not exceed 470mm	-
Launching Mechanism	-	If Engineer is mounted with a mobile 17mm Launching Mechanism, the Launching Mechanism cannot be at an altitude of more than 600 mm from the ground (based on the center of the pitch axis of the gimbal)
Rescue Method	● Can revive a robot using a RFID Interaction Module Card ● Can revive a robot by dragging it to the Restoration Zone	An Engineer Robot is allowed to carry at most one RFID Interaction Module Card to interact with its own team's Standard and Hero Robots. If an Engineer Robot is going to carry an RFID Interaction Module Card, the Module Card must be fixed securely on the Engineer Robot to ensure it does not fall off during a match and is easily replaced.
Projectile Supply Capability	Can receive and supply	-

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Parameter	Limit	Remarks
Maximum Weight (kg)	35	Includes battery weight, but not the weight of the Referee System
Maximum Initial Size (mm, L*W*H)	800*800*800	Its orthographic projection on the ground should not exceed a 800*800 square
Maximum Expansion Size (mm, L*W*H)	1200*1200*1200	● Its orthographic projection on the ground should not exceed a 1200*1200 square ● Except the RFID Interaction Module Card carried by the Engineer, all other mechanisms of the Engineer are not allowed to go beyond the Maximum Expansion Size during transformation
Referee System	Four Small Armor Modules, and a Video Transmitter Module (Transmitter), RFID Interaction Module, Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module, and RFID Interaction Module Card	Weight is 3.06 kg

Since the overlapping of multiple RFID Interaction Module Cards will affect the sensing distance of RFID Interaction Module, it is recommended that when building Engineer, teams should place its RFID Interaction Module Card right below and within a distance of not more than 3 cm of the RFID Interaction Module of the robot being rescued.

2.2.3 Standard

The building parameters for Standard are as follows:

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Table 2-3 Standard Building Parameters

Parameter	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than one remote controller.	-
Maximum Total Power Supply Capacity (Wh)	200	-
Maximum Power Supply Voltage (V)	30	-
Strength	Free-falling from a vertical altitude of 0.2 m three times without any damage to any part of the body	-
Launching Mechanism	One 17mm Launching Mechanism	-
Projectile Supply Capability	Can only receive projectiles	-
Maximum Weight (kg)	25	Includes battery weight, but not the weight of the Referee System
Maximum Initial Size (mm, L*W*H)	600*600*500	Its orthographic projection on the ground should not exceed a 600*600 square
Maximum Expansion Size (mm, L*W*H)	800*800*800	Its orthographic projection on the ground should not exceed a 800*800 square

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Parameter	Limit	Remarks
Referee System	Four Small Armor Modules, and a Speed Monitor Module (17mm projectile), Video Transmitter Module (Transmitter), RFID Interaction Module, Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module, and 17mm Fluorescent Projectile Energy-Charging Device	Weight is 3.25 kg

2.2.4 Aerial

The building parameters for Aerial are as follows:

Table 2-4 Aerial Building Parameters

Parameter	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than two remote controllers	-
Maximum Total Power Supply Capacity (Wh)	800	-
Maximum Power Supply Voltage (V)	48	-
Launching Mechanism	A 17mm Launching Mechanism	-
Projectile Supply Capability	Can receive but cannot supply	-
Maximum Weight (kg)	15	Includes battery weight, but not the weight of the Referee System

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Parameter	Limit	Remarks
Maximum Size (mm, L*W*H)	1700*1700*800	Its orthographic projection on the ground should not exceed a 1700*1700 square (not including the size of the vertical rigid safety rod)
Referee System	Speed Monitor Module (17mm projectile), Video Transmitter Module (Transmitter), Positioning System Module, Main Controller Module, Power Management System, 17mm Fluorescent Projectile Energy-Charging Device	Weight is 0.64 kg

2.2.4.1 Building Requirement

The following requirements must be adhered to when building an Aerial:

The landing gear of an Aerial should be attached with the official sticker, which is given out on-site during Pre-Match Inspection and should be attached by the teams themselves. The distance between the lower edge of the sticker and the surface of the Landing Pad must not exceed 50 mm.

S41 An Aerial must be mounted with a fully covered propeller cage, where the propellers must not be exposed. The Aerial should be able to strike a rigid surface at a horizontal speed of (1.2 ± 0.1) m/s without suffering significant damage.

Fully covered propeller guard: A structure that fully protects each propeller.

The grid dimension constraint of the fully covered propeller guard will be updated subsequently. DJI Mavic Pro Propeller Guard is displayed as below for reference:

S42 After the fully enclosed propeller cage is shot by a 42mm projectile at the speed of 12m/s from a distance of 2

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meters, no part of the propeller cage is allowed to transform and touch the propeller nor interfere with its normal spinning. The 42mm projectile cannot penetrate the mesh of the propeller cage, which should not have a surface area bigger than 9 cm^2.

S43 If Aerial crashes into a tall cylindrical object of any diameter from any angle and at a certain horizontal speed, its propeller guard should protect its propellers from making direct contact with the cylindrical object, and should not suffer any significant deformation.

S44 Cables, slip rings and retractable Aerial Safety Ropes are in place above the Battlefield to ensure the flying safety of Aerial. The top of an Aerial must be mounted with a vertical rigid protective rod that is 350±5mm higher than the surface on which the robot propeller blades' center of gravity is located (for coaxial robot models, the surface on which the center of gravity of the upper propeller blades is located shall be the reference point). The bottom end of the vertical rigid protective rod must be joined with the Aerial, and its top end hooked with the Aerial Safety Rope of the Battlefield Components. The vertical rigid protective rod and its top and bottom connection points are able to withstand the weight of the robot. During inspection, attach the robot to a pull string, raise it vertically by 50 mm, and release it into free fall once - the robot should not suffer any significant deformation and damage.

S45 Teams should reasonably evaluate and fully test whether the propulsion system and power supply system of Aerial can meet the requirements of loading and combat, to prevent safety incidents or accidents during the competition.

S46 Teams can mount light indicators on Aerials to indicate their current flight status. Light indicators shall not be installed in more than six places. The max luminance of each light at 100 mm away must not exceed 3,500 Lux. Light indicators shall not disturb the match in the battlefield (for example, installing high-power LED lights that beam directly into the battlefield, etc.).

Reference data: The maximum luminance of the flight status indicators on a DJI Matrice 100 Drone is 3200 Lux at a distance of 100 mm.

S47 Teams are required to design and mount their own external navigation lights on their Aerial to enhance its visual recognition. External navigation lights must ensure the projection planes on the front and back, left and right, and top of an Aerial can be effectively monitored. The specific requirements are as follows:

a) The distance from external navigation lights to the edge of the maximum outer dimension of an Aerial must not be more than 2/3 of the robot's maximum outer dimension.

b) External navigation lights must use light bars and be joined with the Aerial securely, but cannot be mounted on propeller blades. The light bars must not be shorter than 90 mm, must appear aesthetic and symmetrical, and must not create any parallel light rays.

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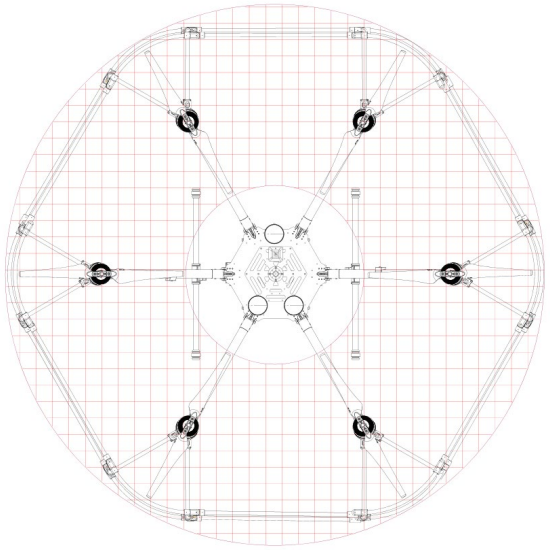
c) External navigation lights must be mounted facing up or on the side, and must not be mounted facing down. The external navigation lights of Aerial should be able to switch to red and blue, so as to be consistent with the team color during a match. For instance, the external navigation lights on a Matrice 600 should have an effective illumination area shown as the red grid below.



S48 A single area of external navigation light of Aerial must have a luminance at 100 mm away ranging between 500 - 2,000 Lux.

S49 The batteries and battery frame on Aerial must be fixed in position using a mechanical structure. After being fixed in place, batteries should not wobble.

S50 Aerial should have a corresponding structure to keep projectiles secure in the magazine. Projectiles should not be allowed to fall out of the magazine in flight.

S51 The Remote Controller used by an Aerial must have a propeller stopping function, to ensure the Aerial Robot is able to stop its propellers instantly through the Remote Controller in an emergency.

2.2.5 Sentry

The building parameters for Sentry are as follows:

Table 2-5 Sentry Building Parameters

Parameter	Limit	Remarks
Operating Mode	Fully automatic; to be equipped with no more than one remote controller for debugging	-

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Parameter	Limit	Remarks
Maximum Total Power Supply Capacity (Wh)	200	The total capacitance of the robot does not exceed 10mF
Maximum Power Supply Voltage (V)	30	-
Launching Mechanism	At most two 17mm Launching Mechanism	-
Projectile Supply Capability	Can receive but cannot supply	-
Maximum Weight (kg)	15	Includes battery weight, but not the weight of the Referee System
Maximum Size (mm, L*W*H)	Choose one of the following two methods: ● 500*600*800 ● 800*500*600	● The Light Indicator Module and the Positioning System Module and its mounting bracket are not included in the size restriction. Other Referee System modules must be included in the size restriction. ● The Maximum Size of Sentry below the top surface of the Sentry Rail is no more than 450 mm (including the Maximum Expansion Size)
Referee System	Two Large Armor Modules, two Speed Monitor Modules (17mm projectile), and Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module, and 17mm Fluorescent Projectile Energy-Charging Device	Weight is 2.63 kg

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2.2.6 Dart System

- A dart will land in the Battlefield after it is launched and may collide with or be crushed by other robots. In addition, a dart will receive a rather large impact when it hits a subject. It is recommended that teams should incorporate buffer and strength designs to avoid damage to their darts.
- When a dart strikes the object, it must strike the small Armor Module on the Dart Detection Module via the Dart Trigger Device. A dart attack will not be determined until the dart attack detection condition is fulfilled. Otherwise, it will be seen as other damage according to the impact force.

- Dart Trigger Device has built-in red-blue bicolor LED light beads, which will be set as the corresponding color according to the team during the match. Staff at the Inspection Area will set the color.
- A Dart Trigger Device will enter normal work mode after being powered on for 3 seconds or going through Pre-Match Inspection setup. A Dart Trigger Device will emit a light of the corresponding team's color after being subject to an acceleration of 2 g. Each trigger lasts for 5 seconds, at the end of which the light will turn off. If the acceleration of 2 g occurs again during the trigger period, the trigger time will be refreshed.

- The use of compressed air is prohibited in propelling a dart.

- If a Dart Trigger Device emits red-and-blue alternating lights, it means that the Dart Trigger Device is damaged. Please request for a replacement from the Inspection Unit immediately, or any consequent losses shall be borne solely by the team.

Dart System consists of Dart and Dart Launcher. A Dart Launcher is the carrier of Darts and provides them with initial propulsion.

A Dart uses its own Visionary Intelligence to locate objects, and controls its flight direction using a propeller (maximum one allowed to be used), rudders, air jets and other means, to strike and attack the object.

A Dart Launcher must be mounted with a Referee System, where the Aerial Gimbal Operator can control the client interface and transmit data through the student's data terminal to control the Dart Launcher. A Dart Launcher can be equipped with a laser sight.

The building parameters for a Dart is as follows:

Table 2-6 Dart Building Parameters

Parameter	Limit	Remarks
Maximum Total Power Supply Capacity (Wh)	4	-

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Parameter	Limit	Remarks
Maximum Power Supply Voltage (V)	8.4	-
Maximum Weight (kg)	0.15	not including Dart Trigger Device
Maximum Size (mm, L*W*H)	200*120*80	● The flight length of a Dart is no more than 200 ● The wingspan of a Dart is no more than 120

S52 Dart can only be in the ready-to-launch state during the 7-minute match.

The building parameters for Dart Launcher are as follows:

Table 2-7 Dart Launcher Building Parameters

Parameter	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than one remote controller for debugging	During the 7-minute match, remote controllers are not allowed to use
Rotation Angle (°)	● Yaw angle: No limits ● Pitch angle: 25-45	-
Maximum Total Power Supply Capacity (Wh)	200	-
Maximum Power Supply Voltage (V)	30	-
Maximum Operating Power (W)	No limits	-
Maximum Dart Load	4	-
Maximum Weight (kg)	25	Includes battery weight, but not the weight of the Referee System
Maximum Size (mm, L*W*H)	1000*600*1000	Its orthographic projection on the ground should not exceed a 1000*600 square

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Parameter	Limit	Remarks
Referee System	Main Controller Module and Power Management Module	Weight is 0.22kg

Ready-to-launch state: Energy storage element, which is used to provide initial kinetic energy for darts, is in states of tension, air inflation and rotation. Energy storage element includes but not limited to rubber band, cylinder, friction wheel, etc.

2.2.6.1 Mounting Specifications

During a match, infrared light is emitted from a Dart Trigger Device evenly across its surrounding space. When a Dart Trigger Device collides with the Small Armor Module area of the Dart Detection Module, the infrared light emitted from the Dart Trigger Device is received by the infrared light receiving device of the Dart Detection Module, while the collision triggers detection by the Small Armor Module. A dart attack is confirmed when both happen at the same time.

Dart must be mounted with Dart Trigger Device provided by the RMOC. A Dart Trigger Device is a milky translucent shell made of TPU, with a mass of 20 g. Its external form and dimensions are shown below.

Drill in mounting holes on the dart head according to the size of Dart Trigger Device.

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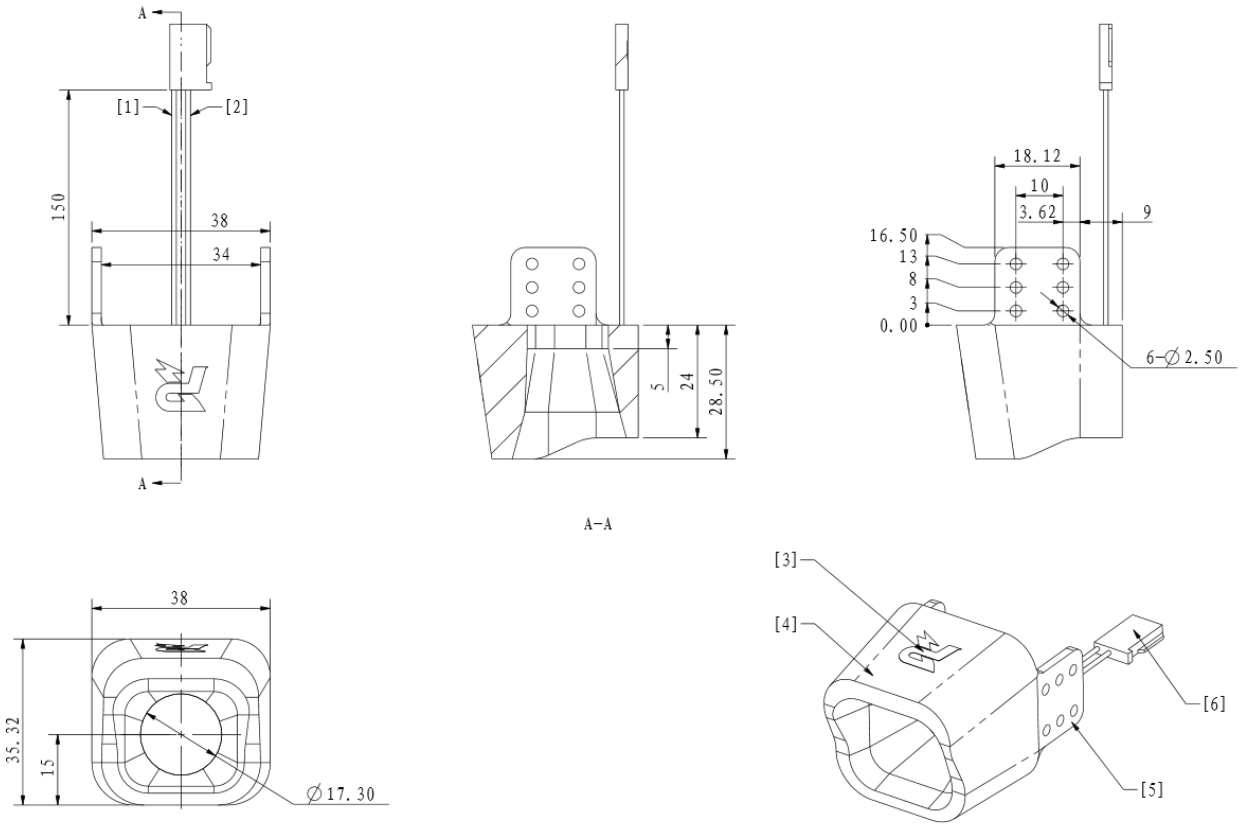

[1] GND Cable [2] +5V Cable [3] LOGO (this side up when dart is flying)

[4] Dart Trigger Device [5] Installation Lug [6] 3P 2.54mm cable

Figure 2-1 Dart Trigger Device

2.2.6.1.1 Installation Steps

1. Secure the Dart Trigger Device on the dart head position using at least four M2.5 screws (two for each installation lug). It is recommended to use gasket when mounting screws.
2. Connect the power port of Dart Trigger Device with 5V power supply.

2.2.6.1.2 Installation Requirements

S53 After mounting Dart Trigger Device, its up and down, left and right sides must not be blocked by the dart structure, as shown below.

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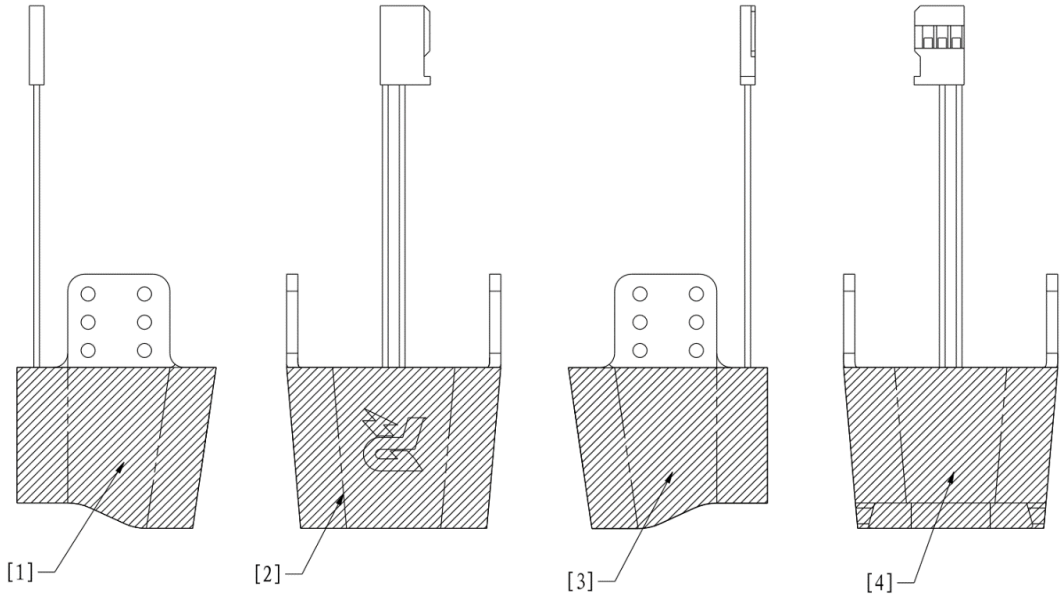
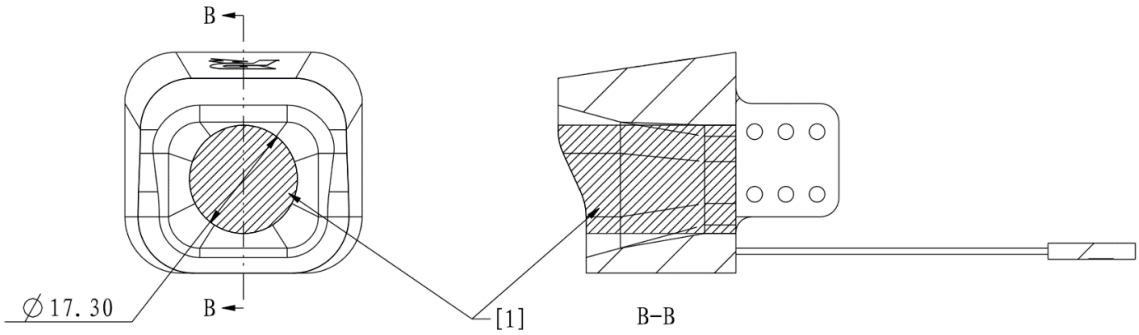


[1] Left side [2] Upward side [3] Right side [4] Downward side

Figure 2-2 Dart Trigger Device is blocked

S54 Dart camera or other devices can be mounted in the internal cavity of Dart Trigger Device. The mounting area of dart camera or other devices must not exceed the shadow area as shown below.



[1] Shadow Area

Figure 2-3 Dart Trigger Device internal cavity is blocked

2.2.6.2 Guidance Feature

Guidance feature, which is used to assist the Dart System to aim, is the green LED integrated light beads mounted on the Dart Detection Module. The light beads emit a green visible light within the frequency band of 520 nm. Its power is about 2W and the diameter of the luminous part is 55mm. Please refer to the relevant descriptions of Outpost and Base in the RoboMaster 2020 Robotics Competition Rules Manual.

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2.2.6.3 Dart Launching Station

A Dart Launching Station is an official Battlefield Component. A Dart Launch Opening should be aimed at the middle point of the connecting line between the enemy Base and Outpost. A Launch Opening can either be in an open or closed state. The Dart Launcher is set within the Dart Launching Station. For details please refer to the relevant description of the Dart Launching Station in the RoboMaster 2020 Robotics Competition Rules Manual.

2.2.7 Radar

A Radar consists of two components: the computing platform and the sensor. Both ends need to be connected by an electric cable.

The production parameters for a Radar Computing Platform are as follows:

Table 2-8 Radar Computing Platform production parameters

Parameter	Limit	Remarks
Operating Mode	Fully automatic	-
Maximum Power (W)	750	-
Power Supply Voltage (V)	220	These are based on the electrical power standards in mainland China. Users in other countries or regions may refer to their local electrical power standards. Other universal power standards can also be applied
Power Supply Frequency (Hz)	50	These are based on the electrical power standards in mainland China. Users in other countries or regions may refer to their local electrical power standards.
Maximum External Dimensions (mm, L*W*H)	500*250*500	Its orthographic projection on the ground should not exceed a 500*250 rectangle
Referee System	Main Controller Module and Power Management Module	Weight is 0.22 kg

The parameters for a Radar Sensor are as follows:

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Table 2-9 Radar Sensor parameters

Parameter	Limit	Remarks
Maximum Weight (kg)	10	Not including Radar sensor mounting bracket
Maximum External Dimensions (mm, L*W*H)	1200*300*300	● Its orthographic projection on the ground should not exceed a 1200*300 rectangle ● Not including Radar sensor mounting bracket

2.2.7.1 Mounting Specifications

- The surface of the Radar Base is made of iron. Teams are advised to use magnetic materials to fix the Radar sensor mounting bracket on the installation surface of the Radar Base.
- The Radar sensor is relatively far away from the installation position of the Radar computing platform. Teams are advised to prepare connecting cables with an effective length of at least 3 m.
- The portability of the Radar sensor mounting bracket will be checked during the Pre-Match Inspection, i.e. whether the bracket can be easily lifted with one hand.

2.2.7.2 Computing Platform

During the 3-minute Setup Period, teams shall place their computing platforms on a designated surface near the Radar Base. The surface should provide at least two 10A five-hole power outlets supplying utility power and a video signal transmission cable to the operator's room (with an HDMI Type A male connector). A monitor not larger than 23 inches and some input devices such as a mouse and keyboard for the computing platform can also be placed on the surface.

A monitor will be placed in the Operator's Room, with the source image provided by the Radar and the signal format must be 1080P60.

S55 No wireless receiving device can be used on computing equipment. If a receiving device cannot be removed, it must be set as disabled in the operating system.

S56 The Main Controller Module and Power Management Module should be firmly installed on the radar computing platform. The referee system and the computing platform can share the same power supply or use the batteries designated by the Organizing Committee for this season.

The alternating current provided by the organizer is 220V 50Hz, and the power outlets are based on the Chinese national standards. Teams shall prepare their own power supply adapters as needed.

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2.2.7.3 Sensor

S57 Sensors must be fixed on the radar sensor mounting bracket and placed on the radar base.

S58 Teams must design their own radar sensor mounting bracket to increase the elevation for the installation of sensors. The height of the radar sensor mounting bracket should be between 1 to 1.5 m.

S59 The size of the radar sensor mounting bracket should allow for proper installation on the surface of the radar base and be portable. The specifications of the Radar Base should follow the relevant description of the Radar Base in the RoboMaster 2020 Robotics Competition Rules Manual. The signal transmission and power supply of the sensor must be handled by the teams themselves.

In the case of an emergency such as a short circuit or fire in the Radar area, the referee may power it off or perform other necessary operations.

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3. Referee System Mounting Specifications

3.1 Overview

A Referee System is a fully automatic electronic system that can monitor the state of a robot and make a determination. During the competition, the Referee System monitors each robot's HP, projectile initial firing speed, chassis power consumption, status, location and other details and then sends real-time information to the computer of the corresponding Operator Room and Referee System server. It also automatically determines the outcome of the competition, ensuring the fairness of the competition.

The robots designed by each team must have reserved mechanical and electrical ports, and each Module of the Referee System must be correctly mounted according to the requirements stated in this chapter.

A Referee System consists of the following modules:

Table 3-1 Referee System Component Modules

Module	Description
Main Controller Module	A Main Controller Module is the core control module of a Referee System. It can monitor the operation of the entire system, and integrates functions such as human-machine interaction, wireless communication and status display.
Power Management Module	A Power Management Module has such functions: control the chassis, gimbal, and power supply for the Launching Mechanism of a robot; transmit data; detect chassis power; etc.
Light Indicator Module	A Light Indicator Module indicates statuses such as the red/blue side of robot, robot HP, buff, module going offline through the LED light bar.
Armor Module	An Armor Module is used to detect situation where the robot is attacked by projectiles and collisions. There are Small Armor Module and Large Armor Module.
Speed Monitor Module	A Speed Monitor Module is used to detect the initial firing speed and launch speed of projectile of robot. There are Speed Monitor Module (17mm projectile) and Speed Monitor Module (42mm projectile).

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Module	Description
RFID Interaction Module	An RFID Interaction Module can exchange information with RFID Interaction Module Card in the Battlefield or on robots, to perform corresponding functions.
Video Transmitter Module	A Video Transmitter Module consists of a Transmitter and a Receiver. The Transmitter is mounted on the robot while the receiver is mounted on the client in the Operator Room. Its function is to capture the view in front of the robot through the camera, and transmit the first-person view image back to the monitor in the Operator Room.
Positioning System Module	A Positioning System Module can detect a robot's location on the Battlefield.
17mm Fluorescent Projectile Energy-Charging Device	The 17mm fluorescent projectile charging device provides light energy to 17mm fluorescent projectiles.
Supercapacitor Management Module	The Supercapacitor Management Module is used to test the capacitance of the Supercapacitor Module and the energy of the Supercapacitor Module during the competition.

3.2 Configuration of Robot Referee System

The configuration of Referee System Modules for each robot is as follows:

Table 3-2 Configuration of Robot Referee System Modules

Quantity / Robot Type	Main Controller Module	Power Management Module	Light Indicator Module	Large Armor Module	Small Armor Module	Video Transmitter Module (Transmitter)	RFID Interaction Module	Speed Monitor Module (17mm Projectile)	Speed Monitor Module (42mm Projectile)	Positioning System Module	17mm Fluorescent Projectile Energy-Charging Device
Standard Robots	1	1	1	0	4	1	1	1	0	1	1
Sentry	1	1	1	2	0	0	0	2	0	1	2
Hero	1	1	1	4	0	1	1	0	1	1	0
Aerial Robots	1	1	0	0	0	1	0	1	0	1	1

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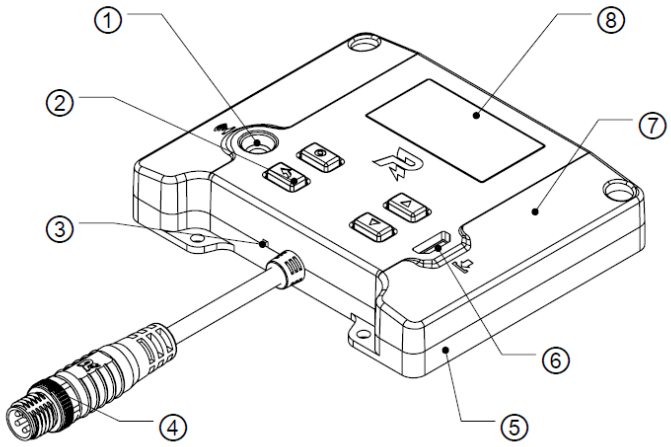
Engineer Robots	1	1	1	0	4	1	1	0	0	1	0
Dart System	1	1	0	0	0	0	0	0	0	0	0
Radar	1	1	0	0	0	0	0	0	0	0	0

3.3 Mounting Main Controller Module

Drill in mounting holes on specified positions on the robot according to the size of the Main Controller Module.



[1]	IR Receiver	[2]	Button	[3]	Power Indicator	[4]	Black Metal Ring Aviation Connector
[5]	Metal Bottom Cover	[6]	Level Up Interface	[7]	Plastic Top Cover	[8]	Screen

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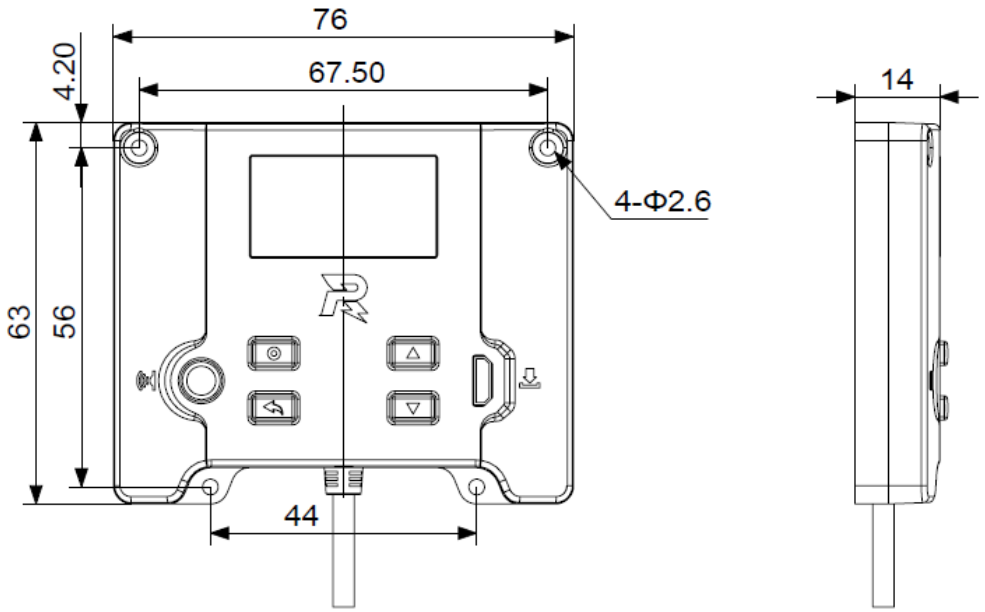
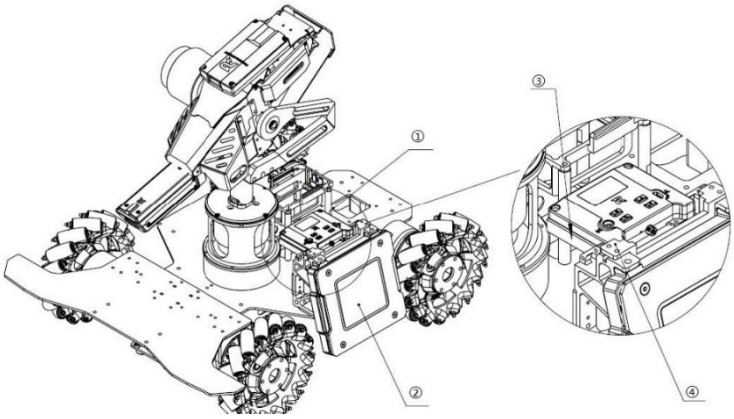


Figure 3-1 Main Controller Module

3.3.1 Installation Steps

1. Secure the Main Controller Module on the specified position on the robot using four M2.5 screws.

> Mounting reference: Teams may design parts by themselves (not including those in the items list), and install them on the back of the edge of the Armor Module (the reserved M3 threaded hole on the Armor Module support frame can be used), with non-metal guards installed around them to prevent attacks by projectiles.



[1]	Main Controller Module	[2]	Armor Module	[3]	Self-Designed Protective Guard	[4]	Self-designed Part

Figure 3-2 Mounting Main Controller Module

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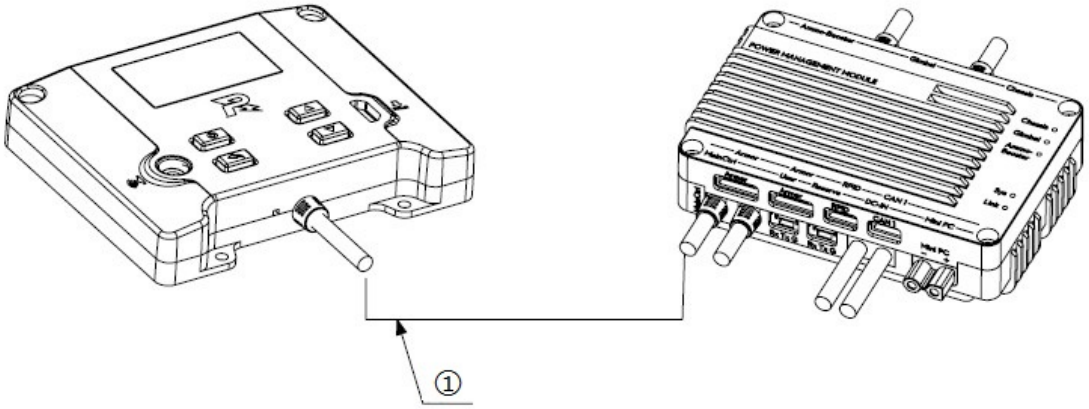
2. Use the aviation connector cable inside the package to connect the Main Controller Module to the aviation connector with the black metal ring on the Power Management Module.

When Main Controller Module connects with Power Management Module, between them, there should be no other Referee System modules serially connected.



[1] Aviation Connector Cable

Figure 3-3 Main Controller Module Connection

3.3.2 Installation Requirements

The mounting of a Main Controller Module must meet the following requirements:

When mounting a Sentry on the rail, the main controller of the Sentry must also satisfy the mounting requirements for the main controller.

S60 Ensure the top surface of the Main Controller Module of a robot faces up when it is in working condition.

S61 The area above the interface of the Main Controller Module (screen, press key) for 50 mm is not blocked by any metal. Protective devices (such as foam rubber, non-metallic board) that can open easily should be installed for easy interaction.

S62 The circular center of the mounting position should be the center of the logo. No motor or electromagnetic device that may interfere with the Main Controller Module should be within a hemisphere measuring 70 mm from the center of the logo, to avoid blocking any Wi-Fi signals.

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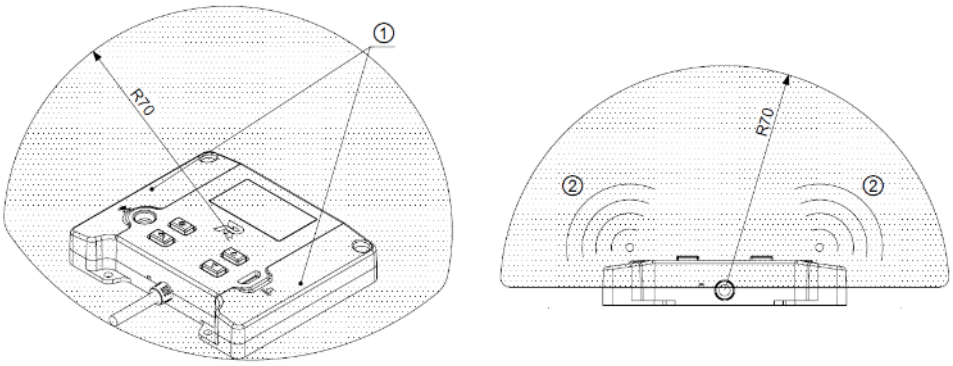

[1] Antenna Position [2] Signal Direction

Figure 3-4 Main Controller Module mounting position

S63 The infrared receiver of the Main Controller Module must not be blocked, to make it easy to manually connect to the server during the competition.

S64 The mounting position of a Main Controller Module must make it easy for staff to operate the press key, check information on the screen, and upgrade firmware.

S65 After being mounted on a Sentry Rail, the Main Controller Module of Sentry should also not be blocked by the Rail.

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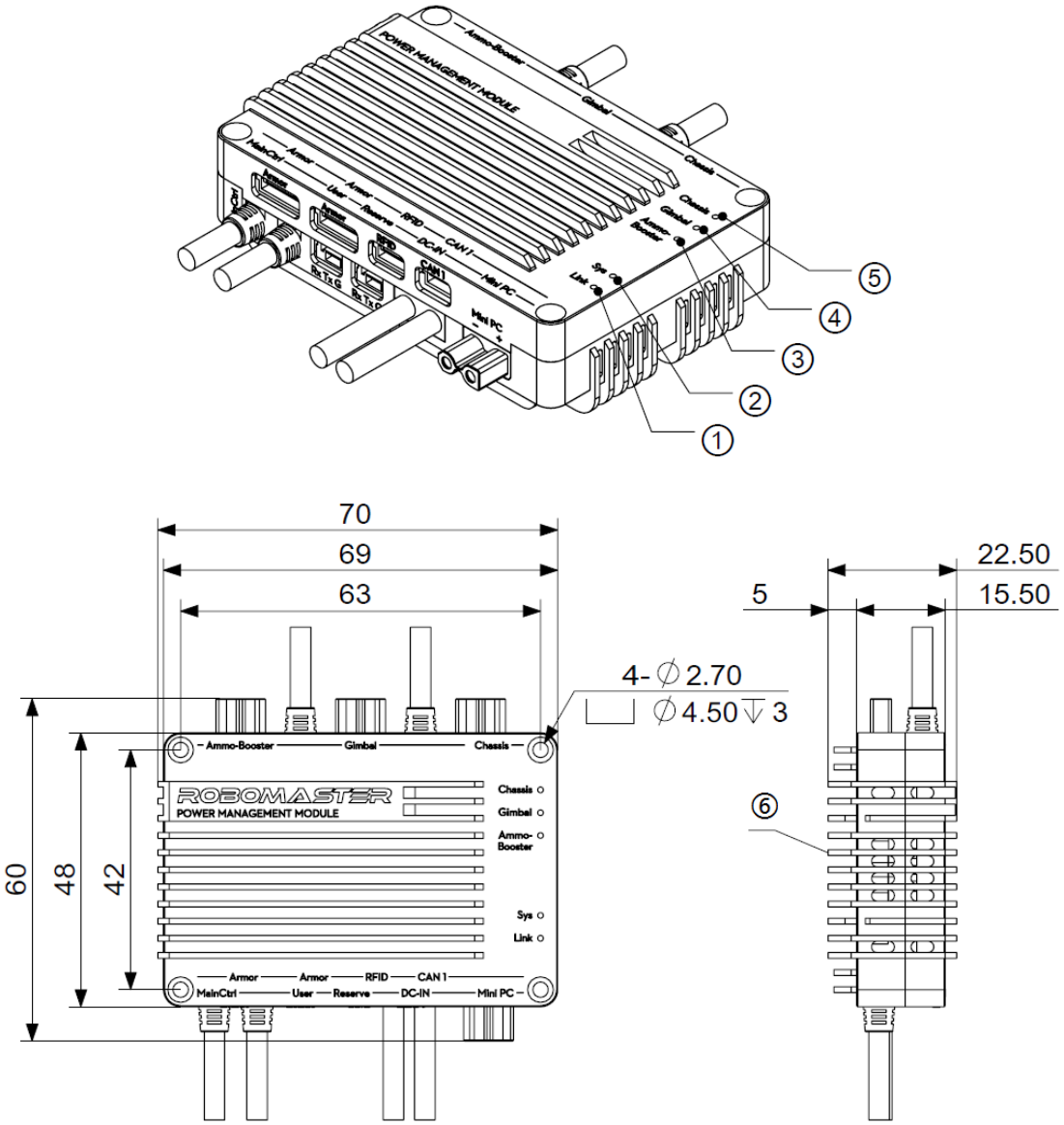
3.4 Mounting Power Management Module

Drill in mounting holes on specified positions according to the size of the Power Management Module.



[1]	Connection Status Indicator	[2]	System Status Indicator	[3]	Launching Mechanism Power Output Indicator
[4]	Gimbal Power Output Indicator	[5]	Chassis Power Output Indicator	[6]	Bottom Mounting Surface

Figure 3-5 Power Management Module

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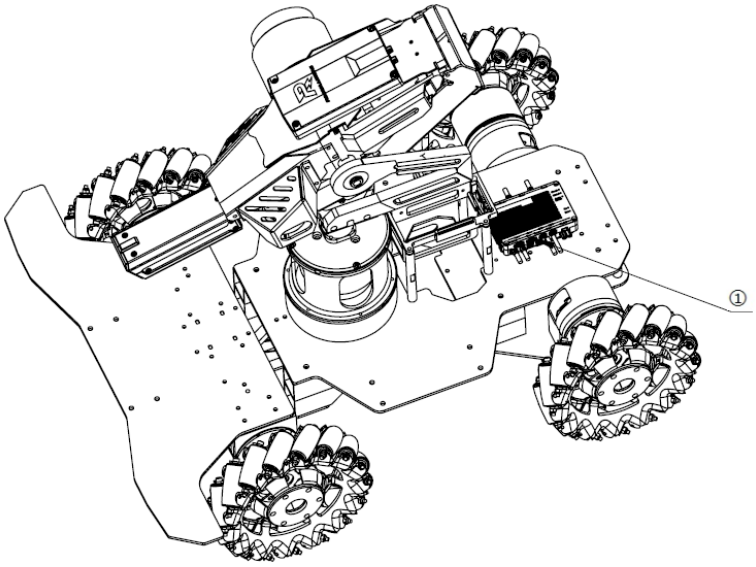
3.4.1 Installation Steps

The aviation plugs of the Light Indicator Module, Video Transmitter Module (Transmitter), Speed Monitor Module and Positioning System Module are all equivalent ports and can be serially connected to each other.

1. Secure the Power Management Module on the robot using four M2.5 screws.



[1] Power Management Module

Figure 3-6 Power Management Module Mounting

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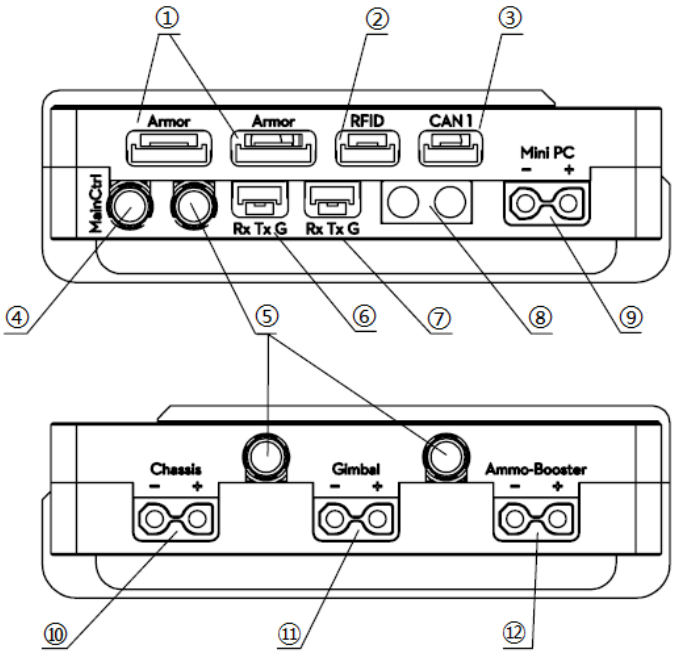

[1] Armor Module SM06B-GHS-TB Port

[2] RFID Interaction Module SM04B-GHS-TB Port

[3] CAN Communication SM04B-GHS-TB Port

[4] Main Control Module Port (the metal ring of the aviation plug is black)

[5] Ports of other Referee System Modules (Speed Monitor, Positioning, Video Transmitter, and Light Indicator; the metal ring of the aviation plug is silver in color)

[6] User SM03B-GHS-TB Port

[7] System Level Up SM03B-GHS-TB Port

[8] Referee System Power Supply XT60 Port (input)

[9] Mini PC Power Supply XT30 Port (output)

[10] Referee System Power Supply XT30 Port (output) - connects to the chassis

[11] Referee System Power Supply XT30 Port (output) - connects to the gimbal

[12] Referee System Power Supply XT30 Port (output) - connects to the Launching Mechanism

Figure 3-7 Power Management Module Port

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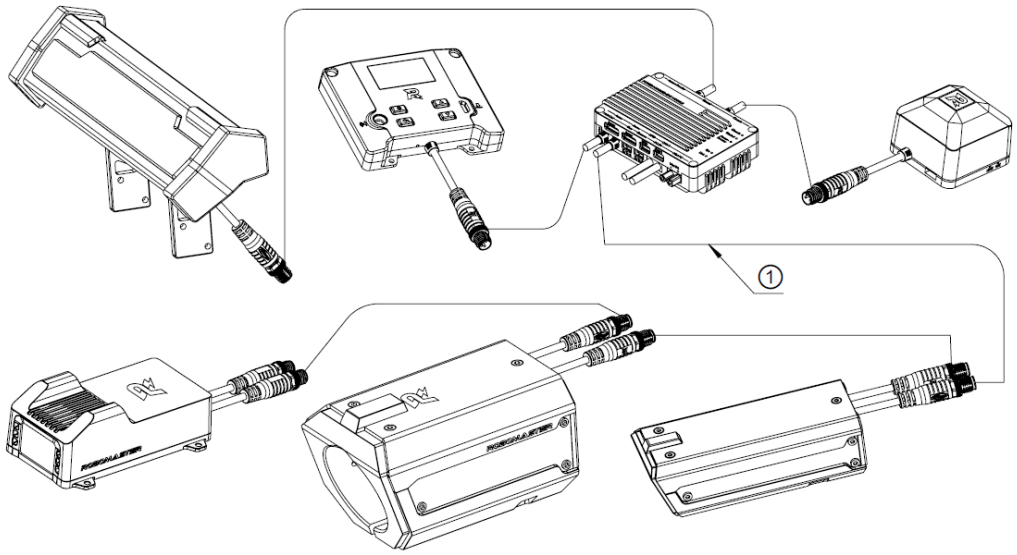

[1] Aviation Connector Cable

Figure 3-8 Power Management Module Connection

3.4.2 Installation Requirements

Any team that participates in the 2v2 Technical Challenge must connect the Launching Mechanism Power Supply of all its robots to the "Ammo-Booster" port on the Power Management Module. Any connection not made according to the rules is deemed cheating.

The mounting of a Power Management Module must meet the following requirements:

S66 The status indicators of the Power Management Module are not blocked.

S67 Each port on the Power Management Module is protected, to prevent damage by projectiles. However, the outer casing cannot be completely wrapped, so as to ensure good heat dissipation.

S68 Do not use glue such as 3M glue to secure the Power Management Module.

S69 For a robot with a power limit, the electric power for the power limiting mechanism must not bypass the monitoring of the Power Management Module.

S70 Carefully differentiate between the ports on the Power Management Module to ensure correct cabling. The chassis power supply for all ground robots and Sentry must be connected to the "Chassis" port of the Power Management Module, while the gimbal power supply must be connected to the "Gimbal" port. The power source of the Launching Mechanism of Aerial and Sentry must be connected to the "Ammo-Booster" port on the Power Management Module

S71 For a robot without a power limit, if the maximum continuous current of the chassis or gimbal power supply

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exceeds 10A, it can be powered by the robot's battery and controlled using a relay. The relay must be powered by the corresponding interface to ensure that after the robot is defeated, the Referee System can control the power to all devices connected to the "Referee System Power Port (Output)". Otherwise, it would be considered cheating.

S72 The circuit board and circuit of a robot with a power limit must meet the following requirements:

- The circuit board related to the chassis power supply must be independent of the gimbal and Launching Mechanism power supply. A circuit board powered through the "Chassis" port on the Power Management Module cannot be connected to other power ports on the Power Management Module.
- All chassis-related circuits of a robot must be clearly laid out. A referee may conduct random inspections on a robot after a match, and, where required, the team must cooperate in the random inspection and disassemble the relevant robot parts to show the relevant circuits. It is strongly recommended that teams should consider the random inspection requirements of referees when designing the layout of circuits, as any loss of preparation time due to disassembling of robots for circuit inspections will be borne by the team itself.
- A robot's circuit connected to the "Chassis" port on the Power Management Module, i.e. a chassis-related circuit, and other circuits connected to other ports on the Power Management Module can only be connected using cables with sizes of or smaller than 24 AWG, and can only be used for communication, with the total current flow equal to or smaller than 50 mA.

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- Input voltage requirements for a Power Management Module: 22V-26V. Power output ports No. 10, 11 and 12 in the graph can be connected and disconnected by the Referee System. No. 10“Chassis” and No. 11 “Gimbal” ports is 10A, and the longest duration for its peak value of 30A is 500 ms. As for No.12 “Ammo-Booster” port, the maximum continuous payload for a single circuit is 8A, and the longest duration for its peak value of 20A is 500 ms. The total maximum continuous payload for ports No. 10, 11 and 12 is 20A. The maximum continuous payload for a single circuit connected to power output port No. 9 in the graph is 6A.
- For power out ports no. 10-12 on the Power Management Module, overload protection will be triggered when a single circuit payload reaches the hardware maximum, causing the Power Management Module to disconnect power output. Reasonable payload distribution must be considered when designing circuits.
- Take care to protect the power output ports no. 9-12 on the Power Management Module, where frequent plugging and unplugging may cause the ports to loosen.
- The voltage on the power output ports no. 9-12 will fluctuate if the system load experiences large fluctuations. Teams are advised to take voltage-regulating measures for loads that are sensitive to voltage (such as Mini PC).
- The outer casing of the Power Management Module heats up under high power conditions. Do not touch it with your hands. Avoid installing the Power Management Module on non-heat resistant materials, such as 3D printing materials.

Actual test results for reference: When a continuous current of 20A has been running for a working period of 30 minutes, the temperature of the outer casing is around 70°.

A Launching Mechanism Power Supply refers to the power supply for launching projectiles. If only a friction wheel power supply is connected to the “Ammo-Booster” port of the Power Management Module, care should be taken to avoid the situation where the loading mechanism continues running after the friction wheel has powered off, which may lead to projectiles becoming stuck and damaging the loading mechanism.

3.5 Mounting Light Indicator Module

Mount the Light Indicator Module on the robot using a mounting bracket according to the size of the module.

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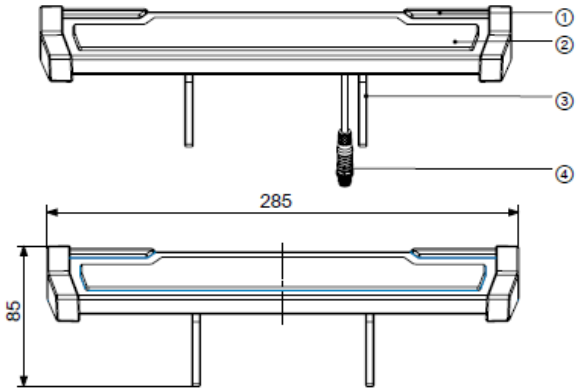


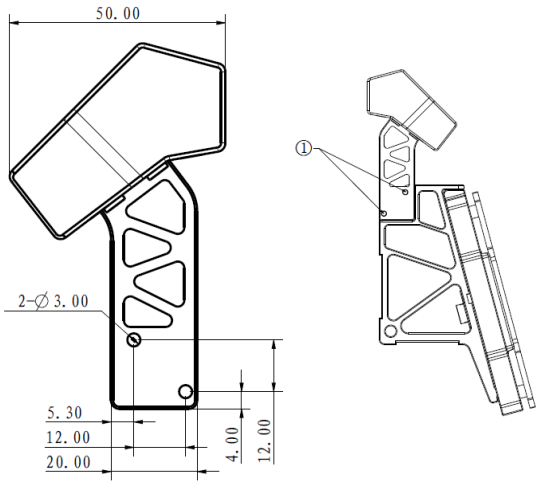
[1] Auxiliary Light Bar [2] Main Light Bar [3] Mounting bracket [4] Aviation plug

Figure 3-9 Light Indicator Module

3.5.1 Installation Steps

1. A Light Indicator Module can be mounted on an Armor Module and secured to the armor support frame using ten M3 screws.

> The position for installing a Light Indicator Module on a Sentry is different. A mounting bracket must be used to mount the Light Indicator Module onto the Sentry through the mounting holes on the side or the screw holes on the bottom.



[1] Screw Hole Mounting Position

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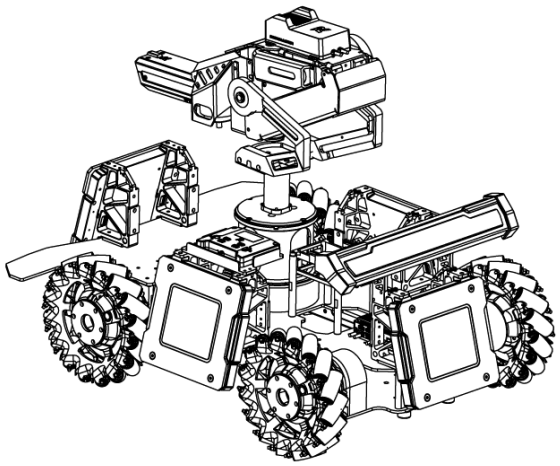


Figure 3-10 Mounting Light Indicator Module

2. Optional Mounting: The Light Indicator Module can be secured using the bottom screw hole of the mounting bracket and installed on a suitable position on the robot.

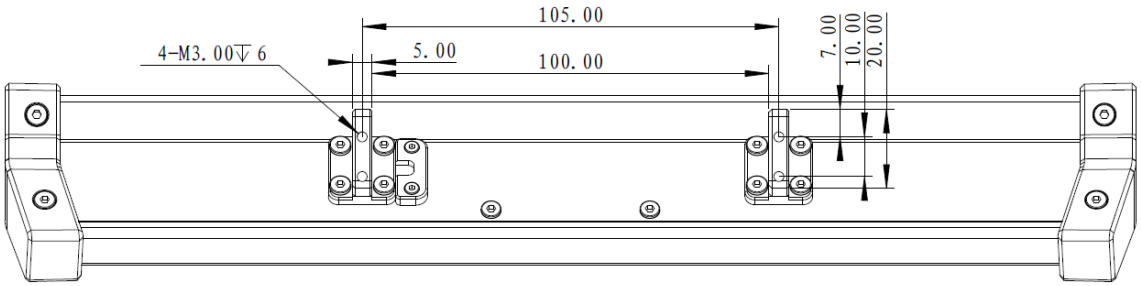
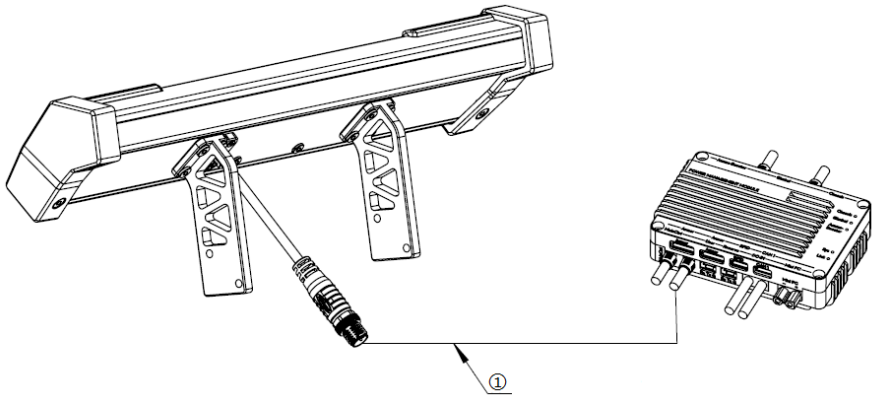


Figure 3-11 Bottom of Light Indicator Module

3. Use the aviation connector cable inside the package to connect the Light Indicator Module to the aviation connector with the white metal ring on the Power Management Module.



[1] Aviation Connector Cable

Figure 3-12 Light Indicator Module Cable Connection

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3.5.2 Installation Requirements

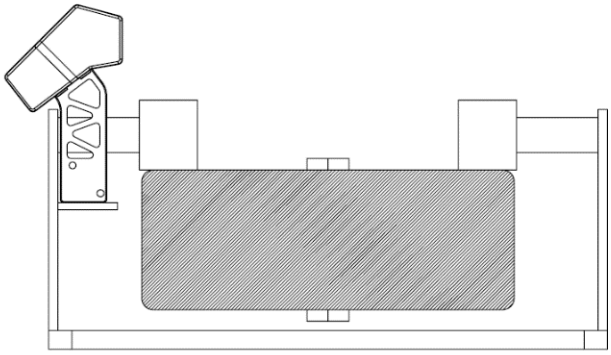
The Mounting of a Light Indicator Module must meet the following requirements:

S73 The connection cables of the left and right auxiliary light bars are parallel to the ground.

S74 The main and auxiliary light bars should be fully visible from at least one viewing angle.

S75 When installing the Light Indicator Module of a Standard, the main light bar must be higher than the upper edge of the Armor Module.

S76 A Sentry is mounted onto the rail. After its mounting, the Light Indicator Module should be situated on one side of the rail, and the illuminated parts of the Light Indicator Module (the main and auxiliary light bars) are above the top surface of the rail, as shown below.



3.6 Armor Module Mounting Specifications

The Armor Support Frame designated for use in this season shall be Armor Support Frame Type A.

An Armor Module is mounted on a robot using a designated armor support frame. Below shows the designated armor support frame:

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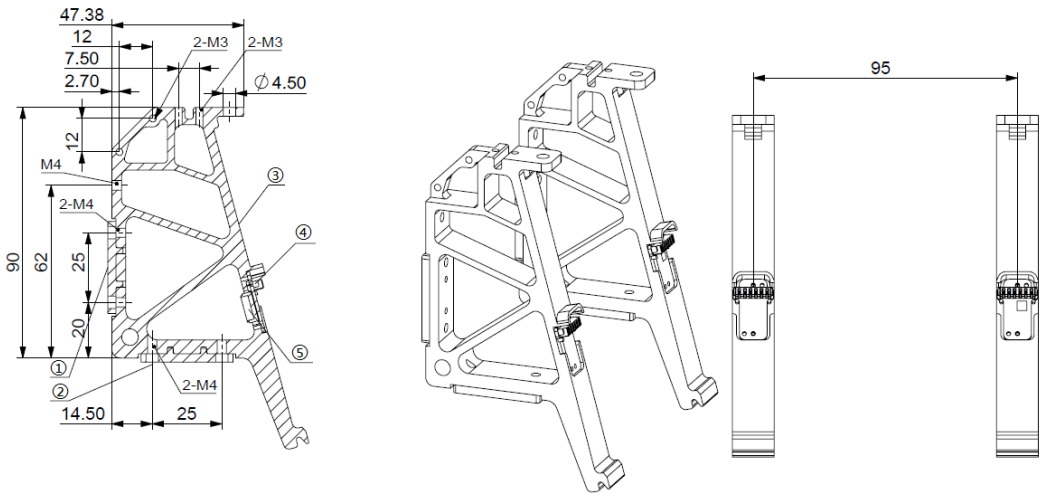


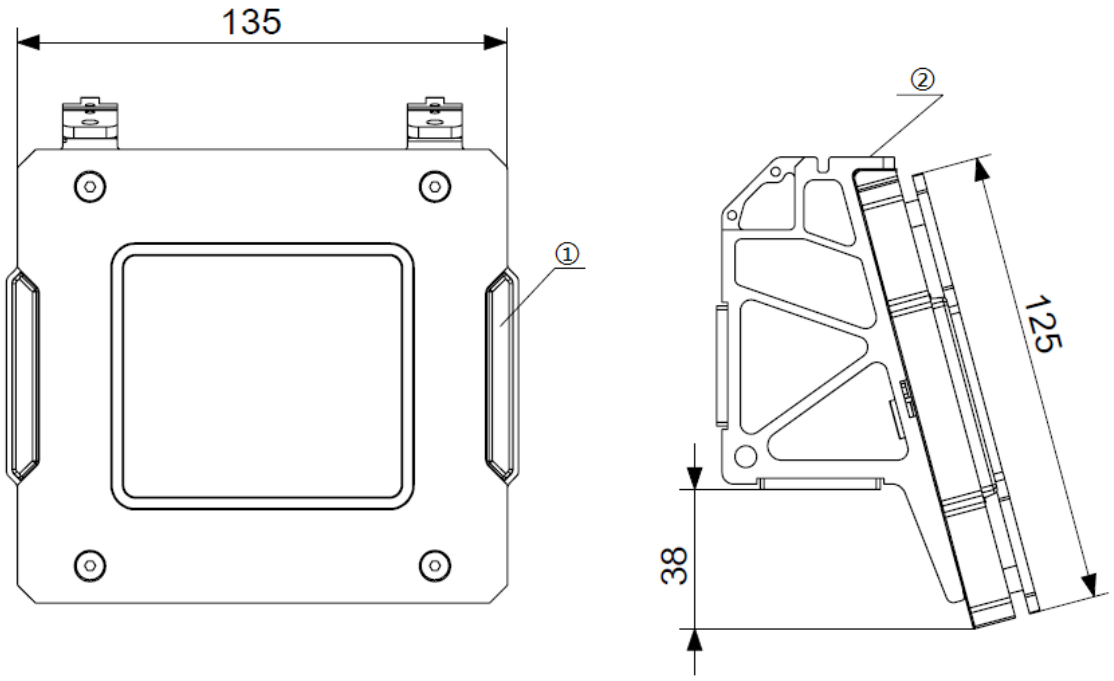
[1] Back Mounting Surface [2] Bottom Mounting Surface [3] Armor Module Mounting Surface

[4] Electrical Connection Point [5] JST 6-pin Port

Figure 3-13 Designated Armor Support Frame

S77 The Armor Module can only be mounted on an Armor Support Frame provided by the RMOC. The Armor Support Frame must not be tampered with or damaged.

Below shows the small armor support frame:



[1] Side Light Bar [2] The top is secured with vertical M4 screws

Figure 3-14 Small Armor Module

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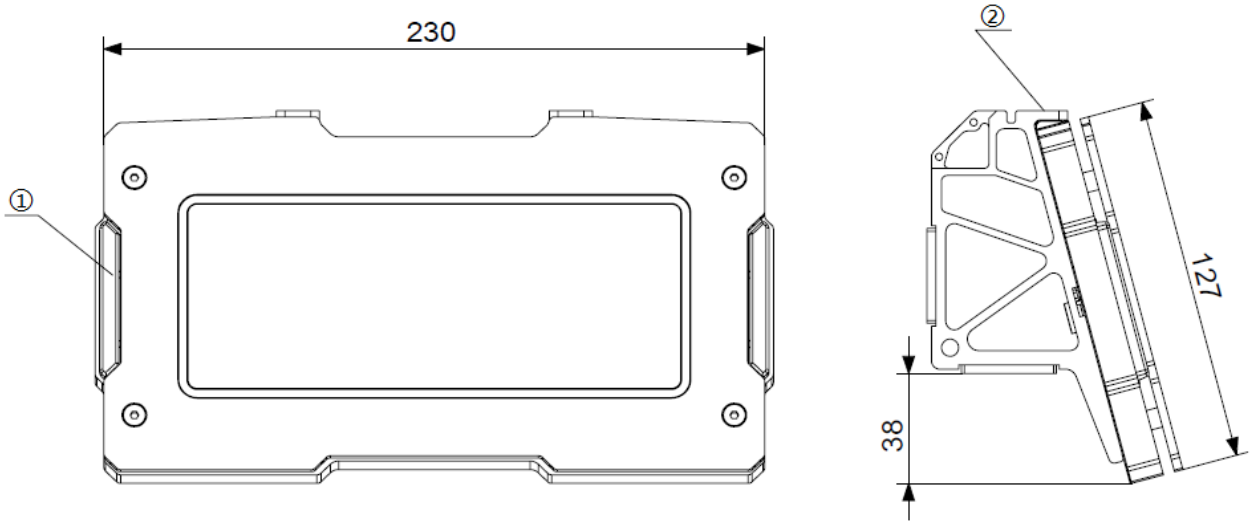
The Large Armor Module is shown in the figure below:



[1] Side Light Bar [2] The top is secured with vertical M4 screws

Figure 3-15 Large Armor Module

S78 Do not modify or decorate the Armor Modules.

3.6.1 General

- The height limit from the lower edge of a robot's armor module to the ground can be exceeded only when the robot is climbing the road or stairs on the road.
- When the plane that supports the robot body is no longer be ground, the requirement of the armor mounting height should be subject to the robot body support plane.

The description below uses the Cartesian coordinate system (X, Y and Z axes) as the robot's coordinate system, and the origin is the robot's center of mass. According to the armor module installation requirements for ground robots, the front-facing direction of the Video Transmitter Module (VTM) of a robot at the beginning of a match should be set as the positive direction of the X-axis and the earth-pointing Z-axis of the robot's coordinate system, as shown below.

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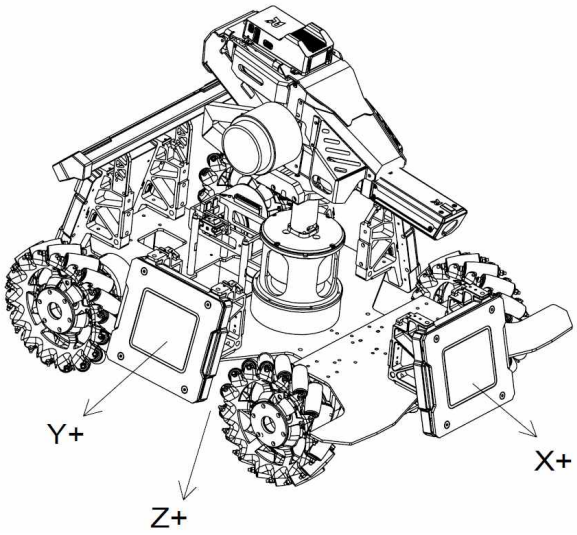

Figure 3-16 Robot Coordinate System

The kinematic equations of the robot should be based on the Cartesian coordinate system. If a robot's kinematic model is established using a non-Cartesian coordinate system, the body coordinate system is defined as follows: Based on the X-axis and the Z-axis pointing towards the earth's center, the Y-axis is generated according to the right-hand rule, and the origin is the robot's center of mass.

3.6.1.1 Mounting the Armor Module

S79 When an Armor Module is mounted on a robot, the Armor Module and the Armor Module Support Frame must be connected firmly together. The bottom connecting surface of the Armor Module Support Frame must be parallel to the XY plane, so that the acute angle between the normal vector of the plane on which the force-bearing surface of the Armor Module lies and the straight line in the negative direction of the Z-axis is 75°. The two sides of the Armor Module without sidelights should be parallel to the XY plane. Define the projection of the normal vector of the plane of the impact surface (forming an acute angle with the negative Z-axis) of the mounted Armor Module on the XY plane as the mounted Armor Module's direction vector. The direction vectors of the four Armor Modules must be in a one-to-one correspondence between the positive X-axis, the negative X-axis, the positive Y-axis, and the negative Y-axis of the robot's body coordinate system, and the angular error between the direction vector and the corresponding coordinate axis vector cannot exceed 5°.

S80 The kinematic equations of the robot should also be based on the above reference coordinate system. The mounting procedures for the Armor Modules must use the same reference coordinate system as the robot's own structural or kinematic characteristics. The geometric center point line of the Armor Modules mounted on the X-axis and the geometric center point line of the Armor Modules mounted on the Y-axis should be perpendicular to each other. The offset of the armor module from the geometric center of the robot must not exceed 50 mm on the X or Y axis.

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3.6.1.2 Rigid Connection

S81 A mounted Armor Module and Support Frame must be rigidly connected to the chassis to form a whole body. During the competition, the Armor Module and the chassis must not shift relative to each other. The rigid connection of the Armor Module is defined in the figure below. A vertical upward force of 60N is applied to the midpoint of the lower edge of the Armor Module. Angle α of the Armor Module's impact surface must not change by more than 2.5°.

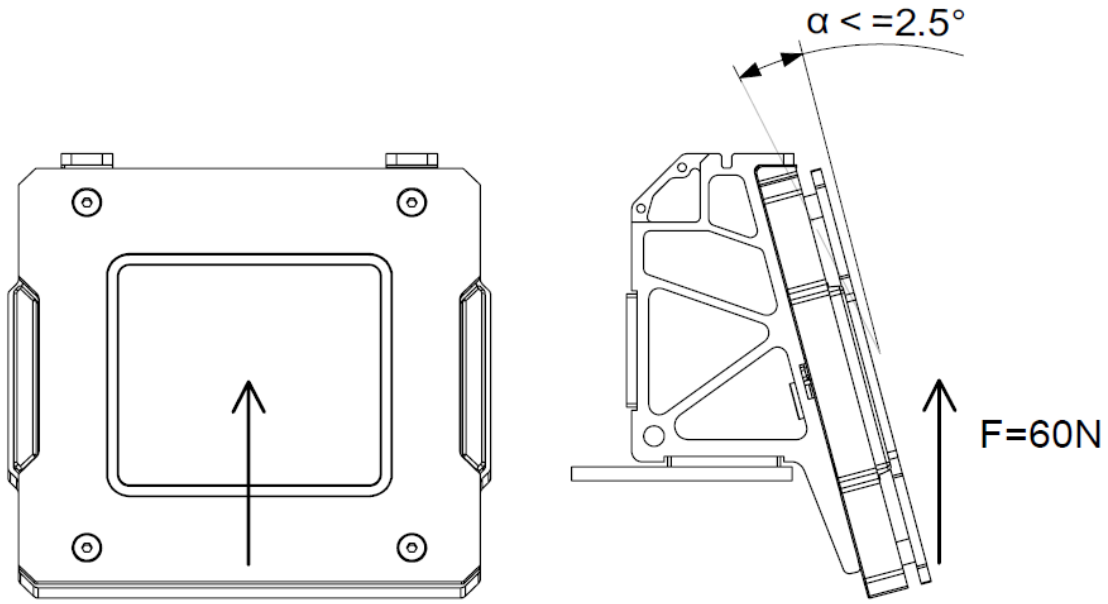

Figure 3-17 Application of Force on Armor Module

3.6.1.3 Robot Transformation

S82 In principle, after a competition has started, any Armor Module must not actively move relative to the robot body's center of mass. If a robot's shape is transformable due to its structural design, the requirements for Armor Modules are as follows:

S83 At no time can any Armor Module move fast, continuously and reciprocally with respect to the robot's center of mass as a whole. The definition of moving fast is the movement speed exceeds 0.5 m/s.

S84 For Standard, the altitude of the lower edge of its Armor Module from the ground before and after transformation must be within the range of 60 mm - 150 mm.

S85 For Engineer, the altitude of the lower edge of its Armor Module from the ground before and after transformation must be within the range of 60 mm - 400 mm.

S86 For Engineer, the altitude of the lower edge of its Armor Module from the ground before and after transformation must be within the range of 60 mm - 200 mm.

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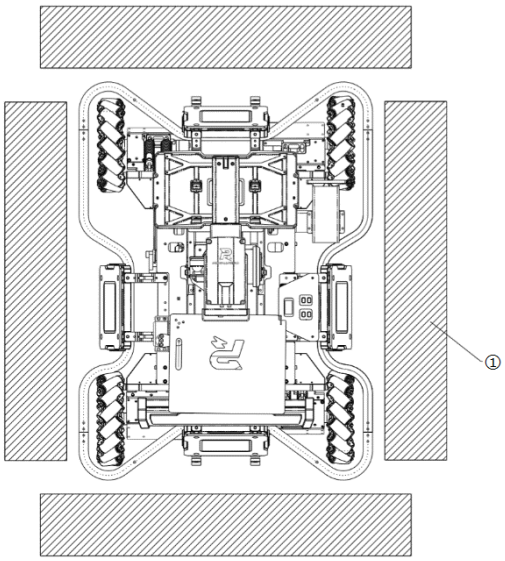
S87 For Hero and Engineer, the altitude difference between the lower edges of any two Armor Modules must not exceed 100 mm.

S88 For Sentry, the upper edge of any of its Armor Modules before and after transformation must be at an altitude within ±100 mm of the plane of the Sentry Rail's top surface on which it is located. The altitude of the Armor Module relative to the rail plane must remain the same throughout the competition. Any horizontal movement relative to the Sentry's main structure is not allowed.

3.6.1.4 Armor Module Protection

S89 Teams should design safety rods for ground robots to reduce any damage caused by collision of Armor Modules.

S90 When a robot is mounted with a safety rod and when it is facing and close to a vertical rigid plane (wall), its Armor Module must not have any direct contact with the rigid plane (wall), as shown below:



[1] Wall

Figure 3-18 Robot Protection

S91 Self-designed protective shells cannot have any contact with the Armor Modules provided by the RMOC.

3.6.2 Installation Steps

Ground Robots:

The installation steps for the Armor Modules of all ground robots are the same. Below is an illustration of the installation steps using the Armor Modules of Standard as an example.

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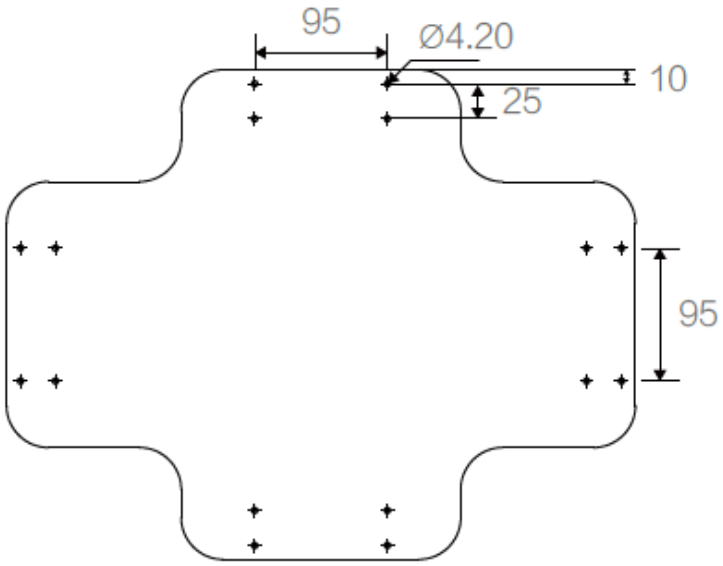
1. As per the dimensions in the drawings below, the chassis shall preserve four sets of built-in holes, each of which corresponds to one armor module. The sizes and locations of the four holes in each set must be kept aligned.



2. Secure Armor Support Frame on the chassis using M4 screws. Each Armor Support Frame must be secured using two screws. The completed installation should be as shown in the figure below.

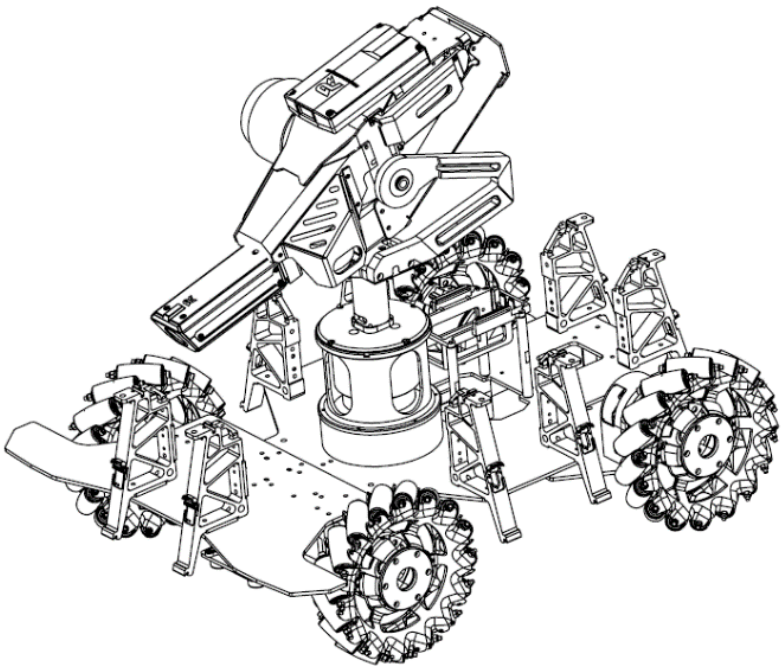


Figure 3-19 Mounting Armor Support Frame

3. Mount the Armor Module on the Armor Support Frame, and secure using M4 screws.

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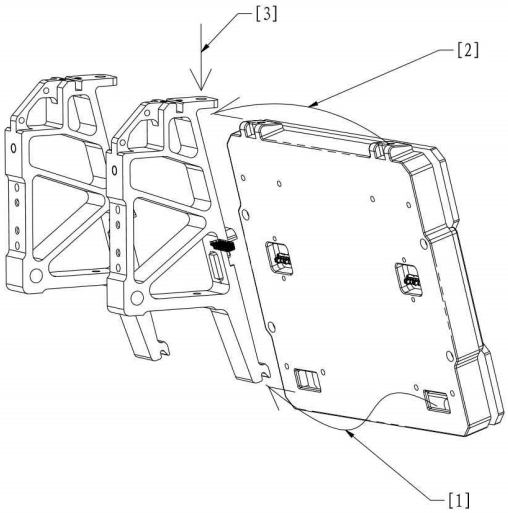


[1] Insert the lower slot of the Armor Module into the lower buckle of the Armor Support Frame

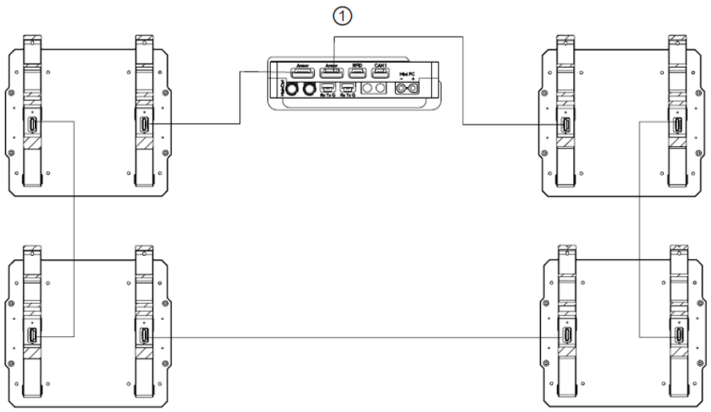
[2] Insert the upper surface of the Armor Module into the upper buckle of the Armor Support Frame

[3] Secure with screws

Figure 3-20 Armor Module Mounting

4. Use the 6-pin cables provided in the package to connect the Armor Modules serially to the Armor Module port of the Power Management Module. The two 6-pin ports of the Armor Support Frame are equivalent ports. The number of Armor Modules in series on the two 6-pin ports of the Power Management Module should preferably be equally distributed, to divide the current on the ports evenly.

Connect the robots reasonably based on their design and ensure that the cables are connected securely to prevent damage and wear.



[1] Power Management Module

Figure 3-21 Armor Module Cabling Diagram

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Sentry:

1. As per the dimensions in the drawings below, the chassis shall preserve two sets of built-in holes, each of which corresponds to one Armor Module. The sizes and locations of the four holes in each set must be kept aligned.

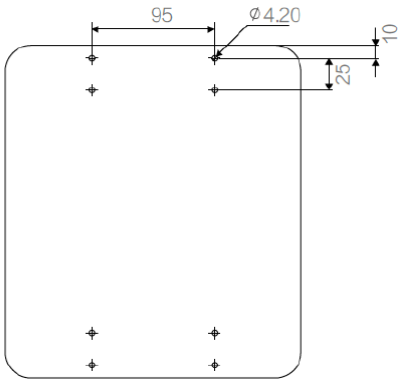

Figure 3-22 Reserved mounting holes on chassis

2. Secure Armor Support Frame on the chassis using M4 screws. The threaded holes on the installation surface at the bottom of the armor supporting frame should be used to fasten the framework. The threaded holes at the bottom of a correctly installed armor supporting frame should be perpendicular to the horizontal plane.

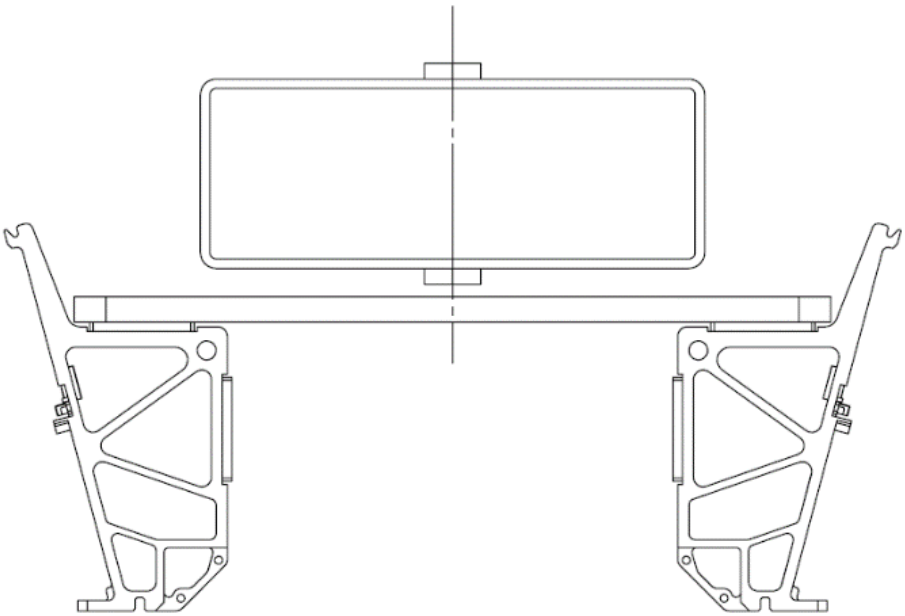

Figure 3-23 Mounting Sentry Armor Support Frame

3. Mount the Large Armor Module on the Armor Support Frame, and secure with M4 screws.

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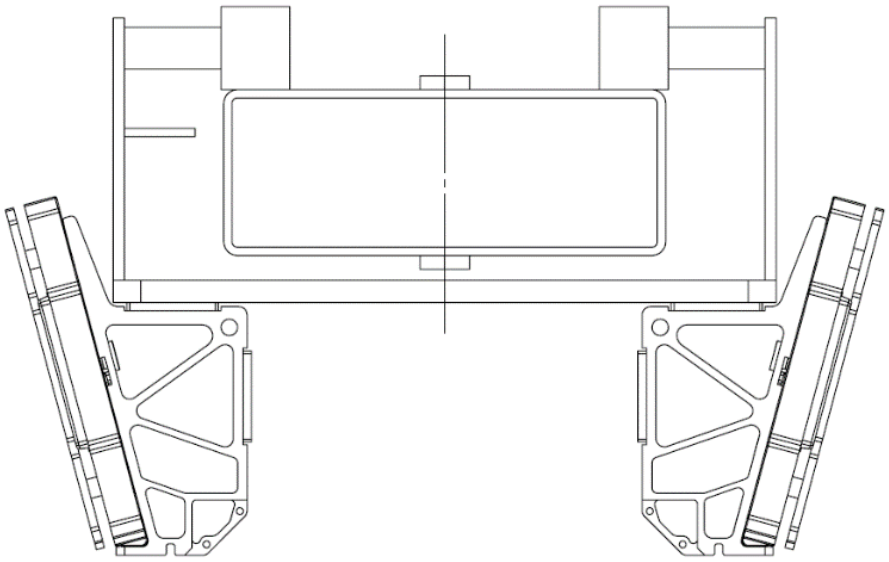
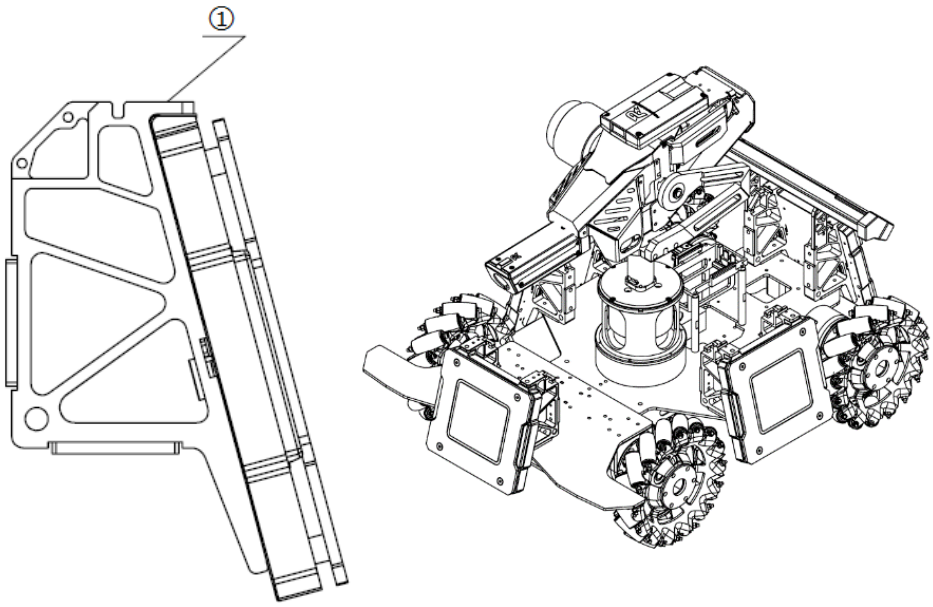


Figure 3-24 Sentry Armor Module Mounting Graph

3.6.3 Installation Requirements

Ground Robots:

S92 The lower 105° area, and the upper, left and right 145° areas of the impact surface on the Armor Modules of Standard and Hero must not be blocked.



[1] The top is secured with vertical M4 screws

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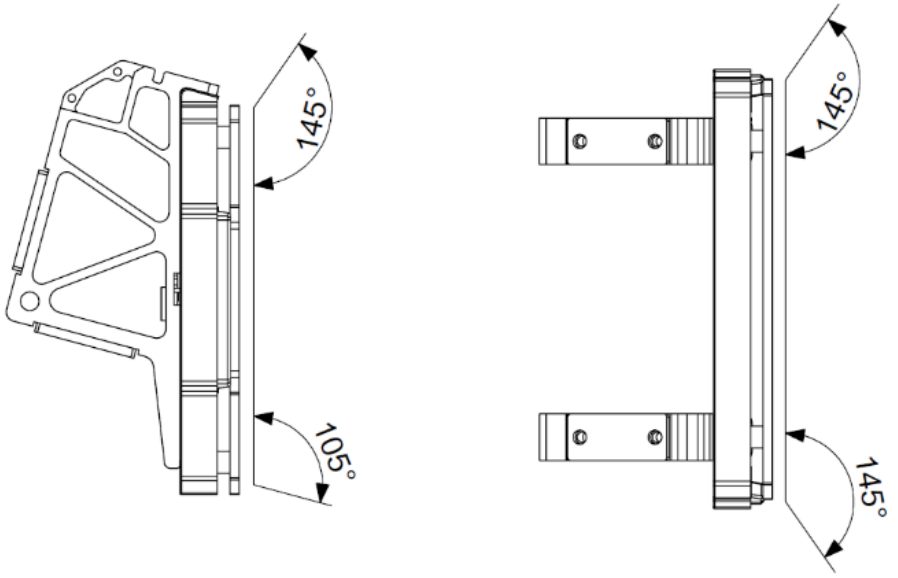
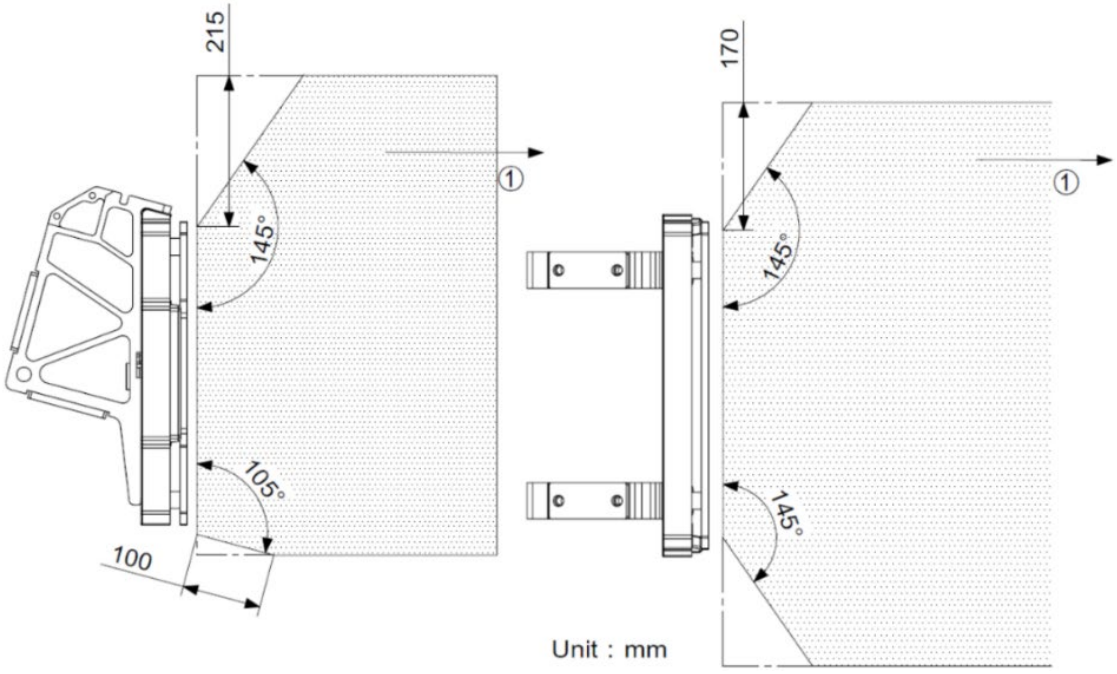


S93 For the armor modules of Engineers, the area within 105° of the lower edge of their impact surface must not be blocked. The vertical distance between the outer edge of a robot below its armor module and the lower edge of the module must be smaller than 100mm. The areas within 145° of the upper, left and right edges of at least three of four armor modules must not be blocked. Max one armor module is conditionally allowed to be blocked in the above-mentioned areas, including: On the plane of the impact surface of the armor module, the area beyond 215 mm from the upper edge or the area beyond 170 mm from the left and right edges of the armor module can be blocked, i.e. the grey areas in the following drawings cannot be blocked.



[1] Unlimited extension

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Sentry:

S94 When a Sentry is mounted on the Sentry Rail, the long side of the Large Armor Module on the Sentry shall remain parallel to the length of the rail.

S95 The top edge of the Armor Module of a Sentry must be within the altitude range of ±100 mm from the plane of the upper surface of the Sentry Rail.

S96 The impact surface of the Armor Module is at an angle of 75° to the horizontal plane of the Battlefield ground, and the normal line of the Armor Module's impact surface points towards the Battlefield ground.

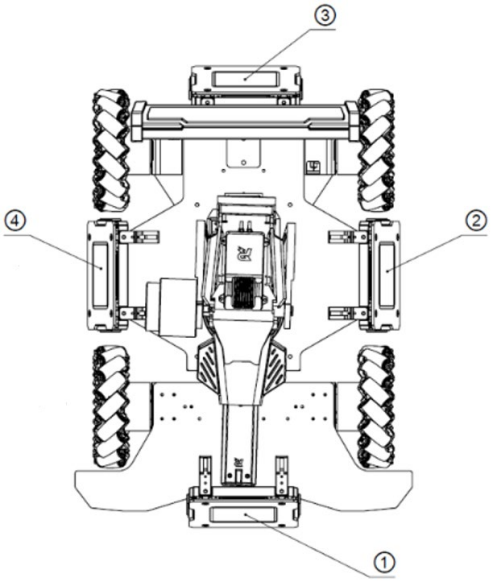
S97 The 145° area of the impact surface on the Armor Module must not be blocked.

3.6.4 ID Number Configuration

The Armor Module must be configured with the correct ID number before the Pre-Match Inspection. The specific requirements are as follows:

Ground Robots:

S98 According to the armor module installation requirements for ground robots, after activating the ID setting mode, the Armor Module facing the Video Transmitter Module (VTM) (transmitter) of a robot at the beginning of a match shall be Armor 0. Armors 0, 1, 2 and 3 should be tapped sequentially in the counterclockwise direction as viewed from the top, to complete the ID setting for all the robot's Armor Modules. Armor Modules with correct ID setting should appear as shown in the drawings:



[1] Armor Module No. 0 [2] Armor Module No. 1 [3] Armor Module No. 2 [4] Armor Module No. 3

Figure 3-25 Ground Robot Armor Module ID Setting

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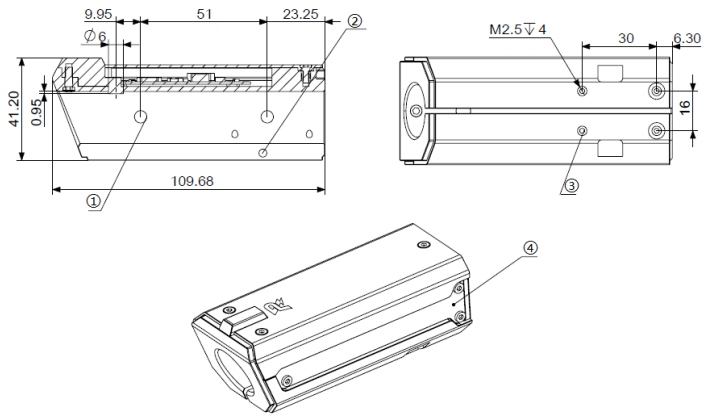
Sentry:

S99 Sentry has two Armor Modules, the ID configuration for the Armor Module facing the Base Zone is 0, and that for the Armor Module facing the other side is 1.

3.7 Mounting Speed Monitor Module

Speed Monitor Modules consist of two types: 17mm and 42mm.

Speed Monitor Module (17mm projectile):



[1] Phototube

[2] Barrel Clamping Screw Hole

[3] M2.5 mounting screw hole for Laser Sight 4

[4] LED Light Indicator

Figure 3-26 17mm Speed Monitor Module

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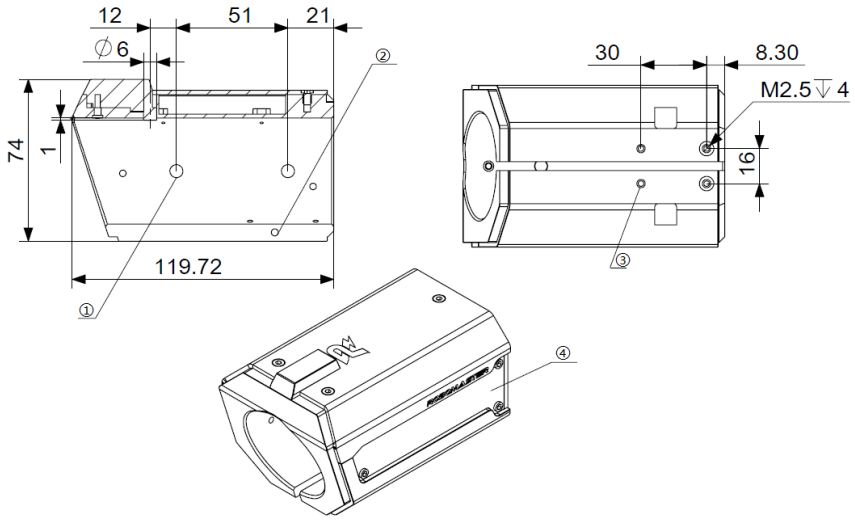
Speed Monitor Module (42mm projectile):



[1] Phototube

[2] Barrel Clamping Screw Hole

[3] M2.5 mounting screw hole for Laser Sight 4

[4] LED Light Indicator

Figure 3-27 Speed Monitor Module (42mm projectile)

3.7.1 Installation Steps

To improve the aiming accuracy of robots, three securing methods are available for the Speed Monitor Module (17mm projectile). Three securing methods meet the mounting specifications for Speed Monitor Modules (17mm projectile). Teams may choose to adopt any one of the securing methods.

3.7.1.1 Speed Monitor Modules (17mm projectile) Securing Method 1

17mm barrel size restrictions (* denotes the key dimensions that teams must adhere to):

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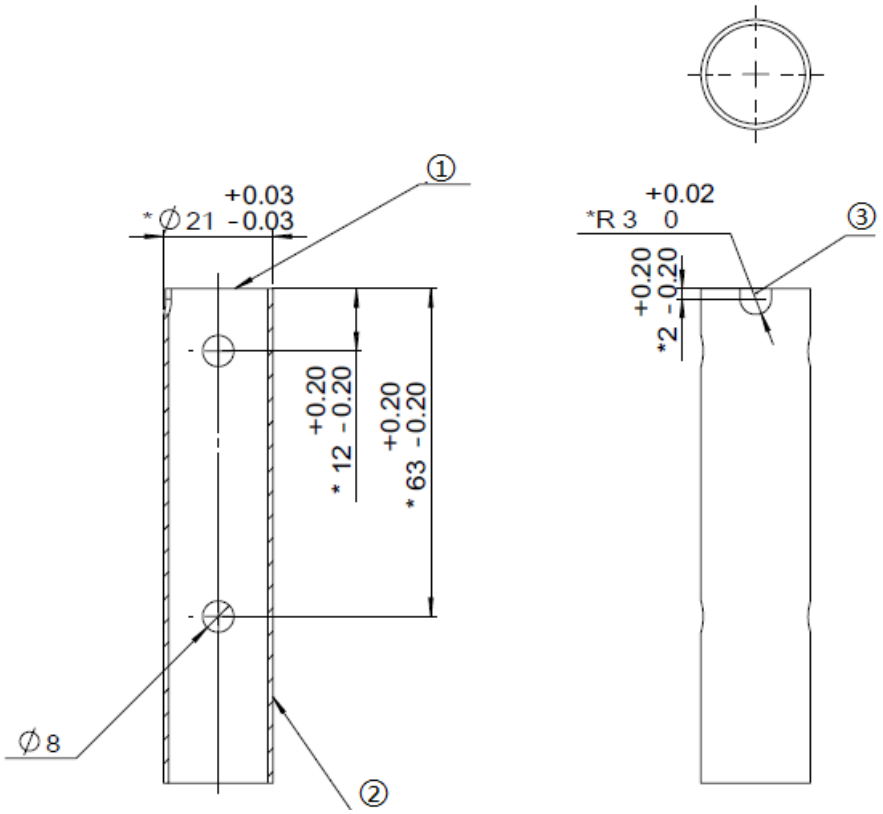

[1] Barrel [2] * Wall thickness must be no less than 1 mm [3] The U-shaped groove must face upward after installing the barrel

Figure 3-28 17mm Barrel

Production requirements for 17mm barrel:

S100 The phototube must not be blocked.

S101 Transparent and luminous materials and use of infrared ray sensors near the barrel are forbidden.

S102 The inner wall of a barrel should preferably be given a matte treatment. In the case of any error in recognition by the Speed Monitor Module caused by reflection of light, the consequences shall be borne by the team itself

Mounting Steps for Securing Method 1:

1. Place the Speed Monitor Module on the barrel and ensure that the U-shaped step of the barrel is on the cylindrical positioning boss within the module's inner diameter.
2. Insert M3 screws through the screw holes in the rear of the Speed Monitor Module to clamp the barrel.
3. Aviation connector of the Speed Monitor Module should be connected to the aviation connector of the Power Management Module using an aviation connector cable.

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The completed mounting is shown in the figure below:

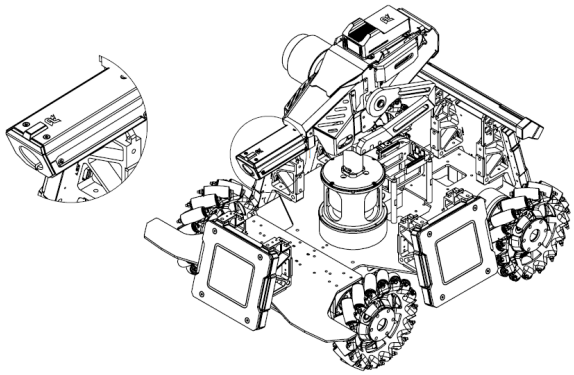


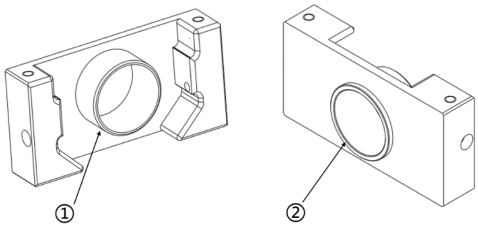
Figure 3-29 Mounting Speed Monitor Module

3.7.1.2 Speed Monitor Modules (17mm projectile) Securing Method 2

The team designs and develops its own transfer block, to connect the Speed Monitor Module (17mm projectile) and Launching Mechanism and replace the securing method for the long barrel.

See “Appendix 1 - Drawing of Transfer Block for Speed Monitor Module (17mm projectile)” for the specifications of transfer block parts. Its 3D model can be downloaded from the Speed Monitor Module product page on RoboMaster’s official website as a reference.

The reference graph for a transfer block is shown below:



[1] Front Protrusion [2] Back Protrusion

Figure 3-30 17mm Transfer Block

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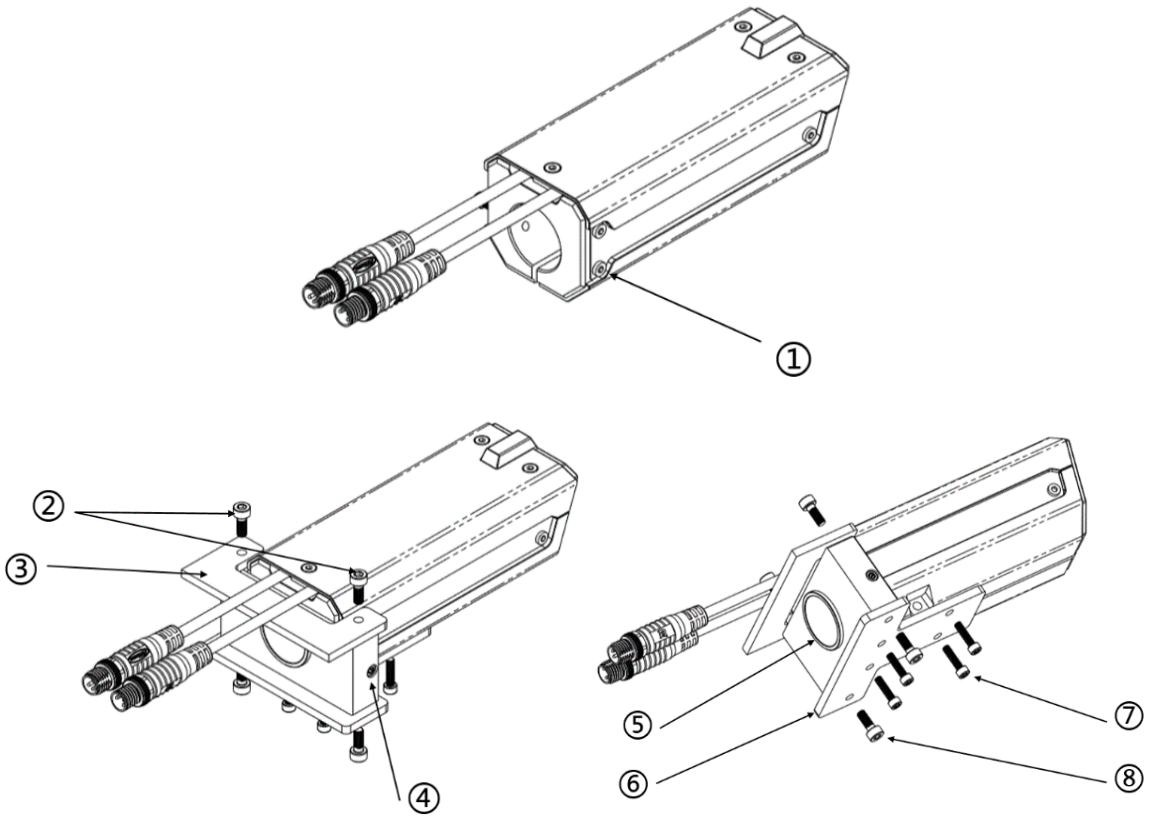

[1]	M2.5 Securing Screw for LED Light Bar	[2]	M3 Screws	[3]	Robot's Original Board Part 1 (self-produced)
[4]	Side Securing Hole	[5]	Back Protrusion	[6]	Robot's Original Board Part 2 (self-produced)
[7]	M2.5 Screw	[8]	M3 Screws		

Figure 3-31 Securing Method for 17mm Transfer Block

Mounting Steps for Securing Method 2:

1. Remove the M2.5 screw on each LED light bar on both left and right of the Speed Monitor Module. The position of one side is as shown in [1] in the figure below.
2. Use two M2.5 x14 screws to secure the transfer block on the Speed Monitor Module, through the securing holes on both left and right sides (the position of one side is as shown in [4] in the figure below).
3. Use two M3 screws to secure the robot's original board part 1 on the top of Speed Monitor Module.
4. Use two M3 screws and four M2.5 screws to secure the robot's original board part 2 on the bottom of the Speed Monitor Module.

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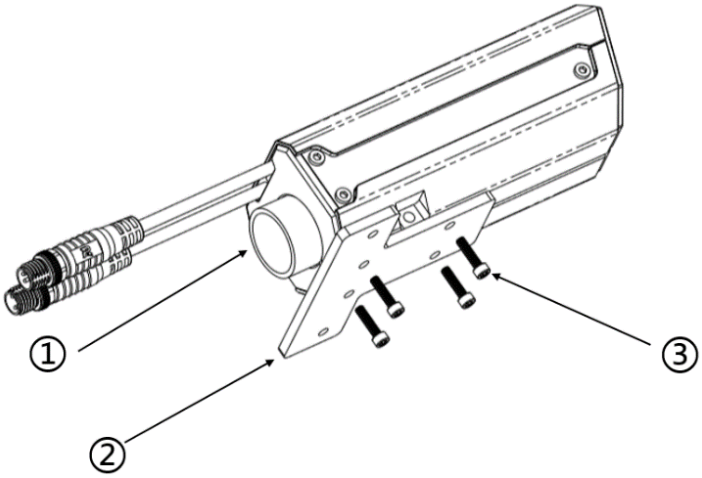
5. Aviation connector of the Speed Monitor Module should be connected to the aviation connector of the Power Management Module using an aviation adapter cable.

- The back protrusion of the transfer block must work well with the gimbal's original parts, to ensure the concentricity of the projectile's axis with the transfer block's axis.
- The front protrusion of the transfer block can on the one hand ensure the concentricity of the transfer block's axis with the Speed Monitor Module's axis, and on the other hand absorb some of the force when the Speed Monitor Module is impacted on the front.
- Except for the two screws to be removed as in Step 1 to secure the transfer block and the Speed Monitor Module, the rest of the screws on the Speed Monitor Module must not be removed without permission. Any violation will be deemed as sabotaging the Referee System.

3.7.1.3 Speed Monitor Modules (17mm projectile) Securing Method 3

The team designs and develops its short barrel spare parts, to connect the Speed Monitor Module (17mm projectile) and Launching Mechanism to replace the securing method for the long barrel.



[1] Short Barrel [2] Robot's Original Board Part 1 (self-produced) [3] M2.5 Screw

Figure 3-32 Mounting 17mm Short Barrel

Mounting Steps for Securing Method 3:

1. Insert the Speed Monitor Module into the short barrel.
2. Use four M2.5 screws to secure the robot's original board part 1 on the bottom of the Speed Monitor Module.
3. Aviation connector of the Speed Monitor Module should be connected to the aviation connector of the Power Management Module using an aviation connector cable.

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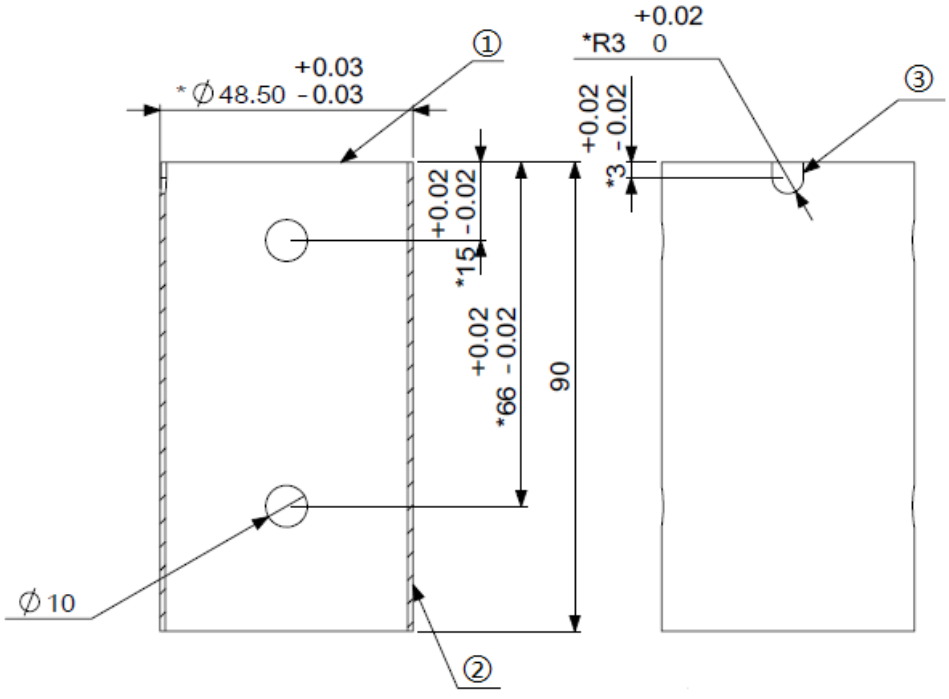
- The length of the Speed Monitor Module's barrel inserted must not be more than 23 mm, to avoid blocking the speed-monitoring phototube.
- The outer diameter of the barrel should preferably be kept within the range of 21 mm +0.05. A barrel diameter that is too small will create a bigger gap between the outer wall of the barrel and the inner wall of the Speed Monitor Module, which may result in the axis of a projectile not overlapping with the axis of the Speed Monitor Module, therefore increasing the projectile's dispersion area.
- With this securing method, a lack of mutual positioning between the Speed Monitor Module and parts of the Launching Mechanism may cause the axis of the Speed Monitor Module to not overlap with the axis of a projectile, therefore leading to some projectiles hitting the inner wall of the Speed Monitor Module. Teams may add gaskets between the robot's original board part 1 and the Speed Monitor Module as required, to adjust the mounting angle of the robot's original board part 1 on the Speed Monitor Module.

3.7.1.4 Speed Monitor Modules (42mm projectile) Securing Method

The three securing methods for the Speed Monitor Module (17mm projectiles) can serve as a reference for the securing method for the Speed Monitor Module (42mm projectile).

42mm barrel size restrictions (* denotes the key dimensions that teams must adhere to):



[1] Barrel [2] * Wall thickness must be no less than 1 mm [3] The U-shaped groove must face upward after installing the barrel

Figure 3-33 42mm Barrel

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Production requirements for 42mm barrel:

S103 The phototube must not be blocked.

S104 Transparent and luminous materials and use of infrared ray sensors near the barrel are forbidden.

S105 The inner wall of a barrel should preferably be given a matte treatment. In the case of any error in recognition by the Speed Monitor Module caused by reflection of light, the consequences shall be borne by the team itself.

Mounting Steps for Securing Method:

1. Place the Speed Monitor Module on the barrel and ensure that the U-shaped step of barrel is stuck in cylindrical location protrusion within the module inner diameter.
2. Insert M3 screws through the screw holes in the rear of the Speed Monitor Module to clamp the barrel.
3. Aviation connector of the Speed Monitor Module should be connected to the aviation connector of the Power Management Module using an aviation connector cable.

3.7.2 Installation Requirements

The mounting of a Speed Monitor Module must meet the following requirements:

S106 A Speed Monitor Module must be installed at the end of the Launching Mechanism. Measure the launch speed of a projectile after it has fully accelerated.

S107 When performing horizontal calibration on a Speed Monitor Module, its logo should be facing up.

S108 The Speed Monitor Module should be firmly secured to ensure that the Module and the barrel do not move relative to each other during movements of the robot.

S109 Apart from two Speed Monitor Modules blocking each other, the blocked area for the light effects on both sides of the robot's Speed Monitor Module must be smaller than 1/5 of the area of the LED light bar.

S110 As shown in the mounting specification drawing of Speed Monitor Module, no large magnetic conductive materials (like iron barrels, heat transfer fans on the VTM (Transmitter), friction wheel motors, etc.) should be placed within an area measuring 70 mm in diameter with the logo as the center, so that the magnetometer inside the Speed Monitor Module will not be interfered.

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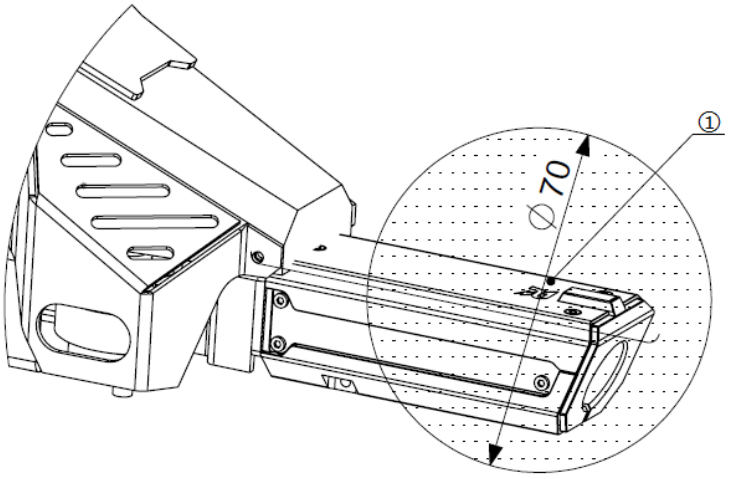

[1] Circular center

Figure 3-34 Speed Monitor Module Mounting Specification

- Four M2.5 screw holes should be available for installing the RoboMaster Laser Sight or the laser sight prepared by your own team.
- Do not look directly at the laser without eye protection. Safety goggles are recommended during operation.
- Do not block the phototube holes. Otherwise the initialization of the Speed Monitor Module may fail.
- The aviation connector cable of the Speed Monitor Module is close to the friction wheel. The cable should be protected from wear when used.
- In the case of two Speed Monitor Modules, they can be installed in parallel to one another, which means that the light panel on one side of the modules is allowed to be blocked.
- It shall be deemed a violation if a mesh-like or other similar structure is used to block more than 1/5 of the surface area of a Speed Monitor Module's light panel.

3.8 Mounting RFID Interaction Module

Drill in mounting holes on the robot's chassis according to the size and mounting port of the RFID Interaction Module.

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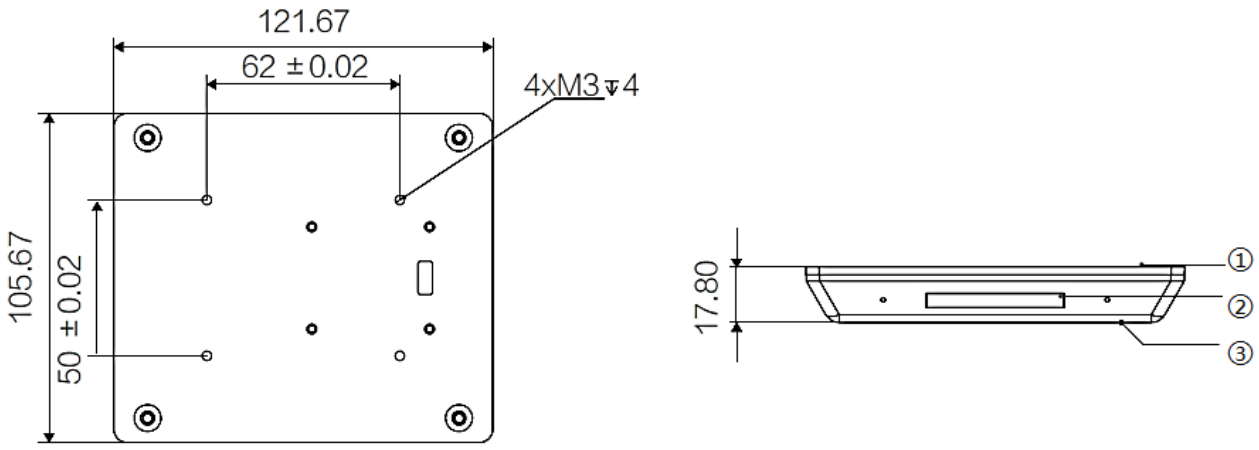

[1] Back [2] LED Light Indicator [3] Front

Figure 3-35 RFID Interaction Module

3.8.1 Installation Steps

1. Connect the RFID Interaction Module to the RFID port on the Power Management Module using the 4-pin cable provided in the package.

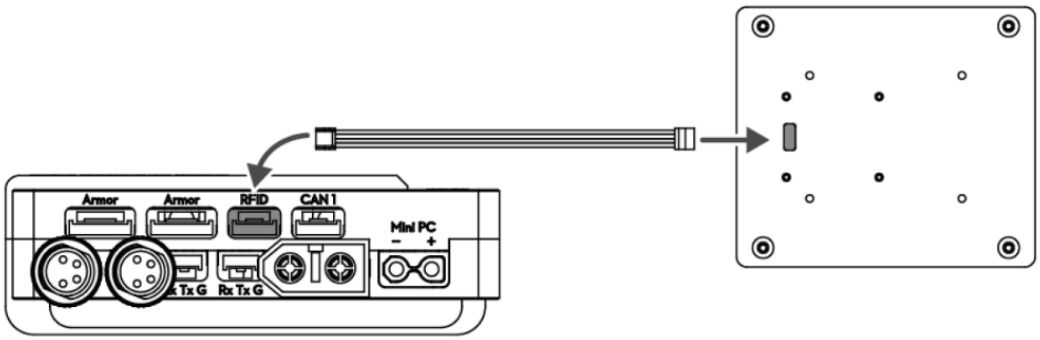

Figure 3-36 RFID Interaction Module Cable Connection

2. Use M3 screws to secure the RFID Interaction Module on the chassis. Do not press the cable during mounting, and make sure to keep the RFID Interaction Module at an appropriate distance from the ground.

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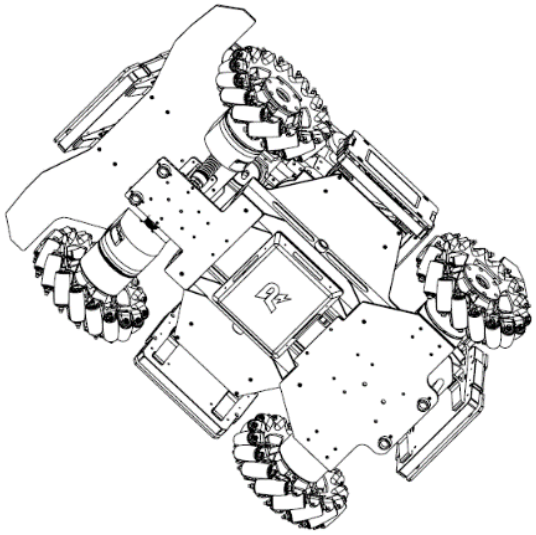

Figure 3-37 Mounting RFID Interaction Module

3.8.2 Installation Requirements

- The effective detection distance of the RFID Interaction Module is 100 mm (±5%). The actual detection distance after mounting is subject to testing. If the effective detection distance has reduced, please check whether the module is installed properly
- The transformation of an RFID Interaction Module must not exceed the expansion and transformation dimensions of the robot. An RFID Interaction Module is allowed to extend out of the robot's body when transforming.

S111 The back side of the RFID Interaction Module should be free of interference from strong currents or high-frequency signals (such as motor cables, RoboMaster Center Board and CAN cables).

S112 The front side of the RFID Interaction Module should not be blocked by any metal objects.

3.8.3 RFID Interaction Module Card

RFID Interaction Module Cards are functional cards. They are laid in corresponding locations in the Battlefield. During the competition, robots that detect RFID Interaction Module Cards using their own RFID Interaction Modules will gain the corresponding buffs.

The size of a RFID Interaction Module Card is as follows:

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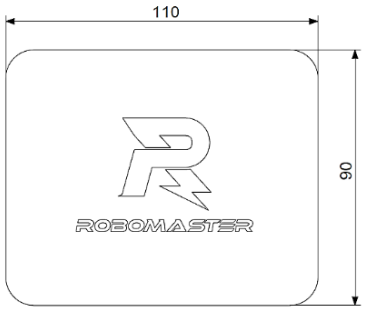
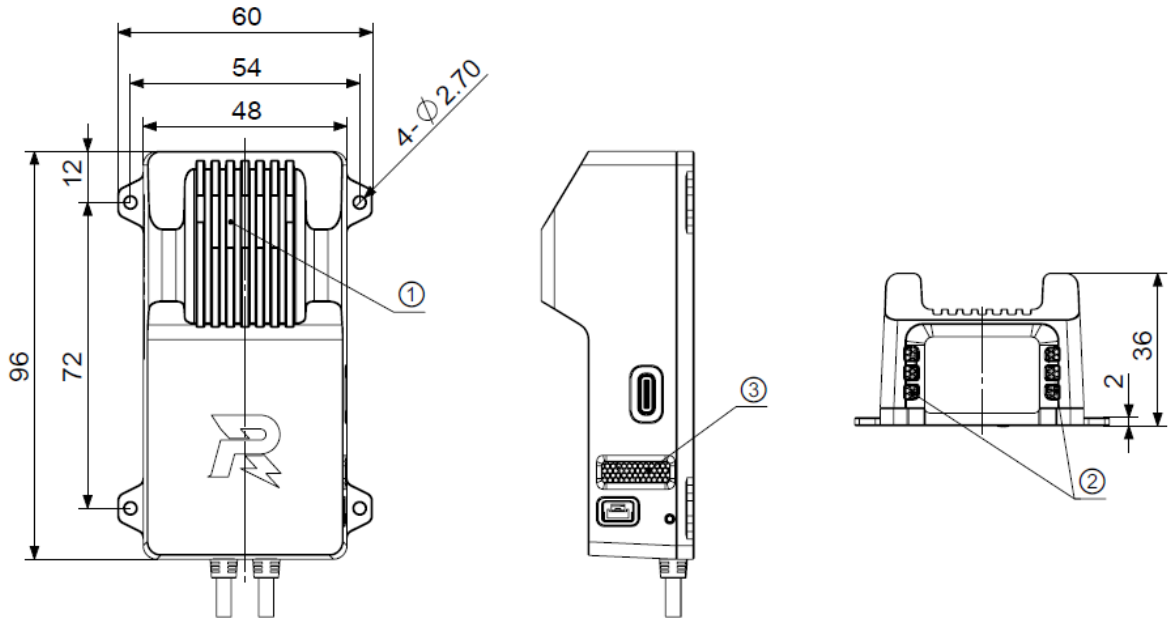


Figure 3-38 RFID Interaction Module Card

3.9 Mounting Video Transmitter Module (Transmitter)

- Video Transmission Remote Controller link data are output from the UART serial port of a Video Transmitter Module (Transmitter).
- The UART serial port of a Video Transmitter Module (Transmitter) supports the 3.3v TTL logic level. The UART serial port supports the RX, TX and GND pins. Please do not connect the anode of a power supply to the UART serial port.

Drill in mounting holes at the necessary positions according to the size and mounting port of the Transmitter structure.



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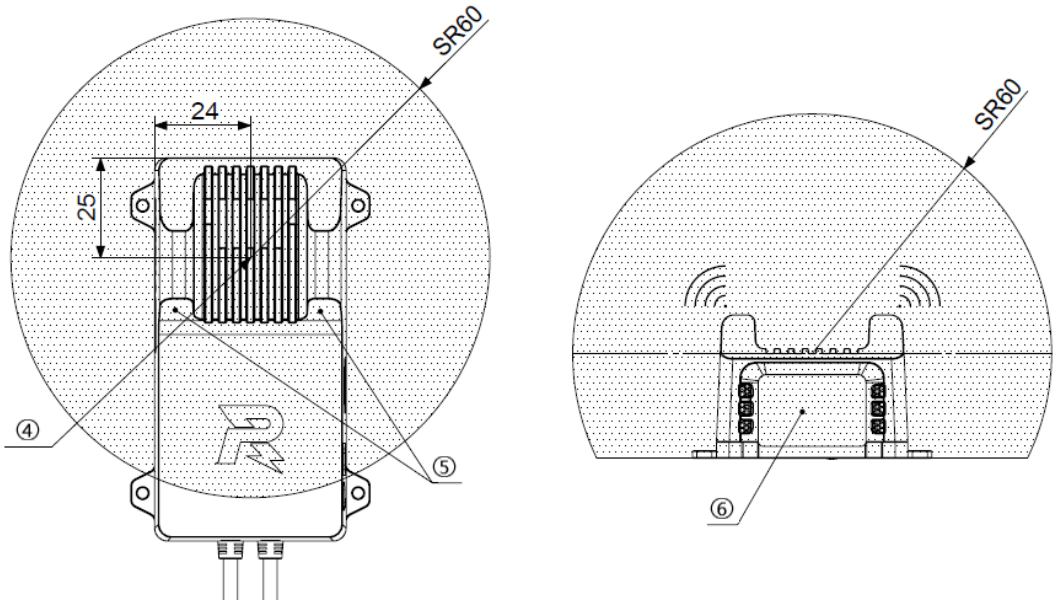
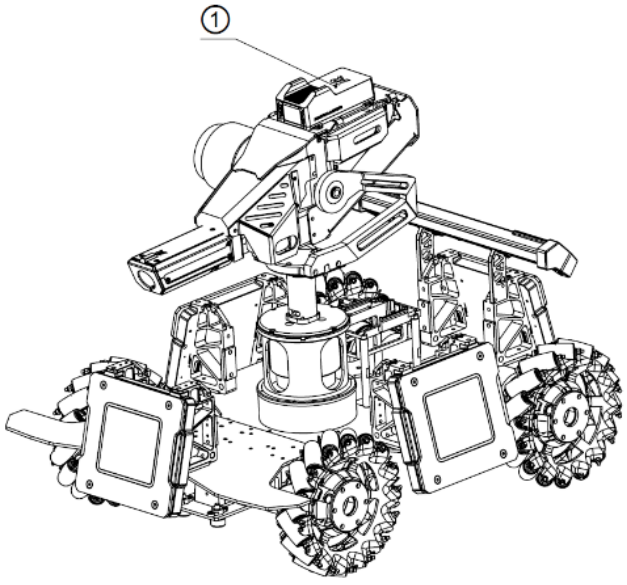


[1] Air Inlet [2] Air Inlet [3] Air Outlet [4] Circular center [5] Antenna [6] Camera

Figure 3-39 Video Transmitter Module (Transmitter)

3.9.1 Installation Steps

1. Use four M2.5 screws to secure the Transmitter at the appropriate position on the robot.



[1] Video Transmitter Module (Transmitter)

Figure 3-40 Mounting Video Transmitter Module (Transmitter)

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2. Aviation connector of the Video Transmitter Module (Transmitter) should be connected to the aviation connector of the Video Transmitter port on the Power Management Module using an aviation connector cable.

3.9.2 Installation Requirements

The mounting of a Video Transmitter Module (Transmitter) must meet the following requirements. Failure to do so may result in the reduced quality of Video Transmitter Module images, even operational irregularities.

S113 The inlet and outlets of the Transmitter must not be blocked.

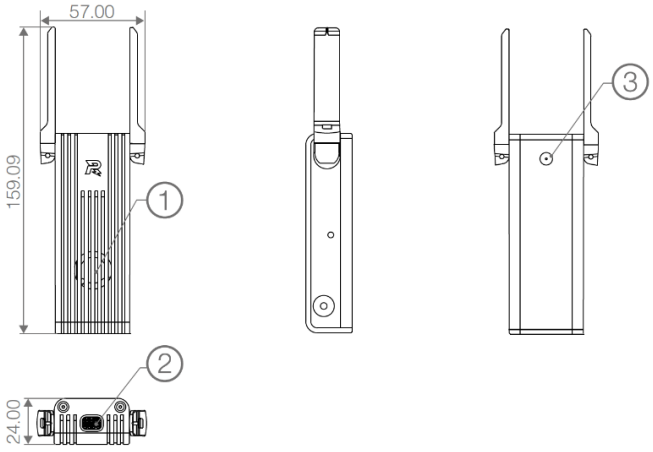
S114 As the Transmitter's antenna is located at the top of the Module, the top should not be blocked by any metal.

S115 As shown in the Video Transmitter Module (Transmitter) drawing, set the center of the Video Transmitter Module (Transmitter) be the circular center, no motor or electromagnetic device that may interfere with the Module should be within a hemisphere measuring 60 mm from the center, to avoid interfering with Video Transmitter signals.

S116 If the Video Transmitter Remote Controller link is used, the UART serial port of the Video Transmitter Module (Transmitter) needs to be partially protected, by using protective devices such as foam and non-metallic guards.

3.10 Mounting Video Transmitter Module (Receiver)

According to the size and mounting port of the Video Transmitter Module structure, the Receiver should be secured using self-purchased mounting clamps. The securing position can be on a monitor or other support structure.



[1] Air Outlet [2] Air Inlet [3] Inch-based Threaded Hole 1/4 20×6

Figure 3-41 Video Transmitter Module (Transmitter)

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3.10.1 Installation Requirements

The mounting of a Video Transmitter Module (Receiver) must meet the following requirements. Failure to do so may result in the reduced quality of Video Transmitter Module images, even operational irregularities.

S117 The distance between the fixed position of a Video Transmitter Module (Receiver) and the ground must not be less than 1 m, and it must not be blocked by any metal.

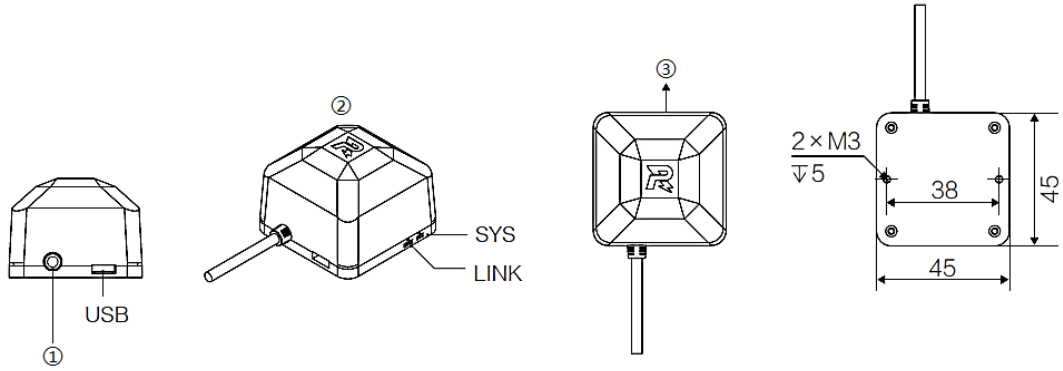
S118 Ensure that the cooling inlet and outlet ①② are not blocked.

S119 The rotation angle for the antenna is 0°-190°. Please fold it gently. The distance to the antenna's center point should preferably be larger than 60 mm.

S120 The specific mounting position and angles can be confirmed by checking the quality of receiver images.

3.11 Mounting Positioning System Module

Drill in mounting holes on specified positions on the robot according to the size of the Positioning System Module.



[1] Referee System Connection Cable [2] Top [3] Front

Figure 3-42 Positioning System Module

3.11.1 Installation Steps

1. Use two M3 screws to secure the Positioning System Module at a specific position as shown below:

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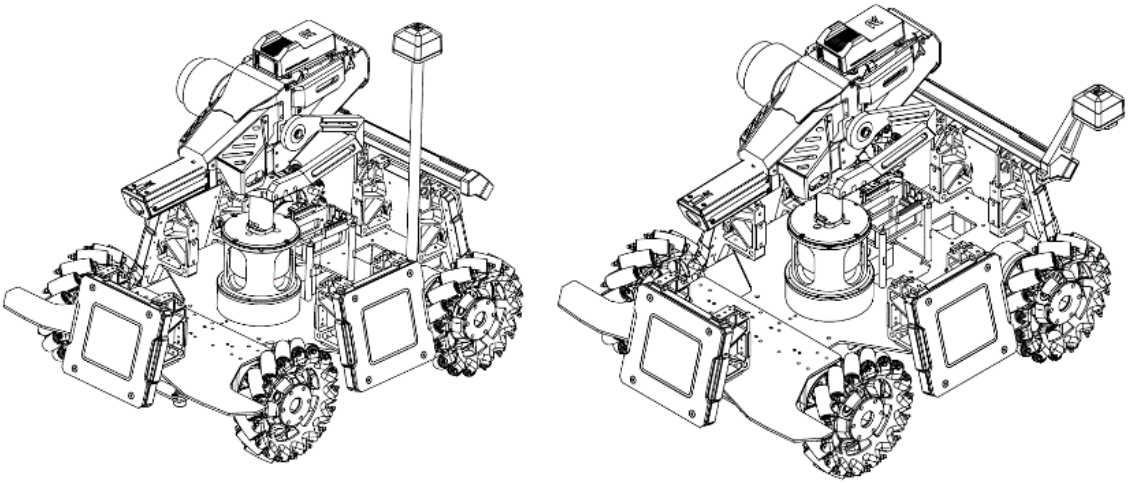

Figure 3-43 Positioning System Module

2. Use the aviation connector cable inside the package to connect the Positioning System Module to the aviation plug with the white metal ring on the Power Management Module.

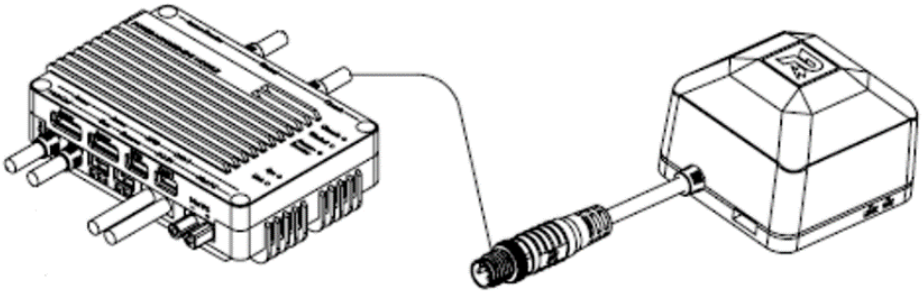

Figure 3-44 Positioning System Module Cable Connection

3.11.2 Installation Requirements

The installation of Positioning System Module should meet the following requirements. Otherwise, the position function might not work properly.

S121 Positioning System Module should be horizontally installed with the top facing up. The 145° area above the Positioning System Module must not be blocked by any conductor, as shown below:

According to the above mounting specifications, only one out of the front, back, left and right horizontal directions of an Aerial's Positioning System Module is allowed to be blocked by a conductor at a horizontal distance of 100 mm away.

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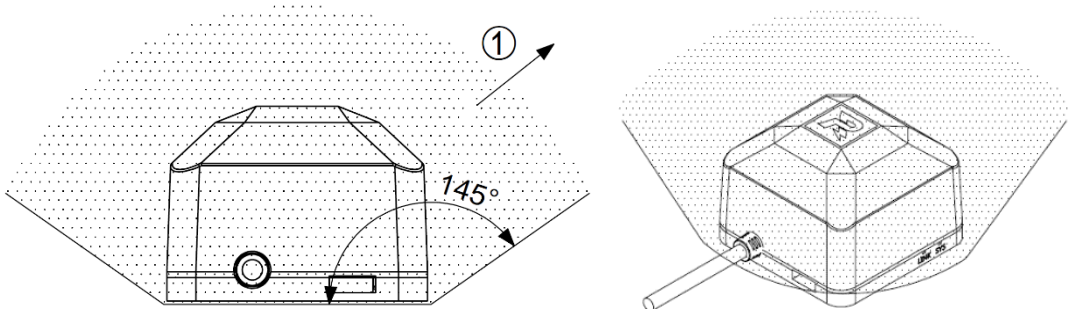
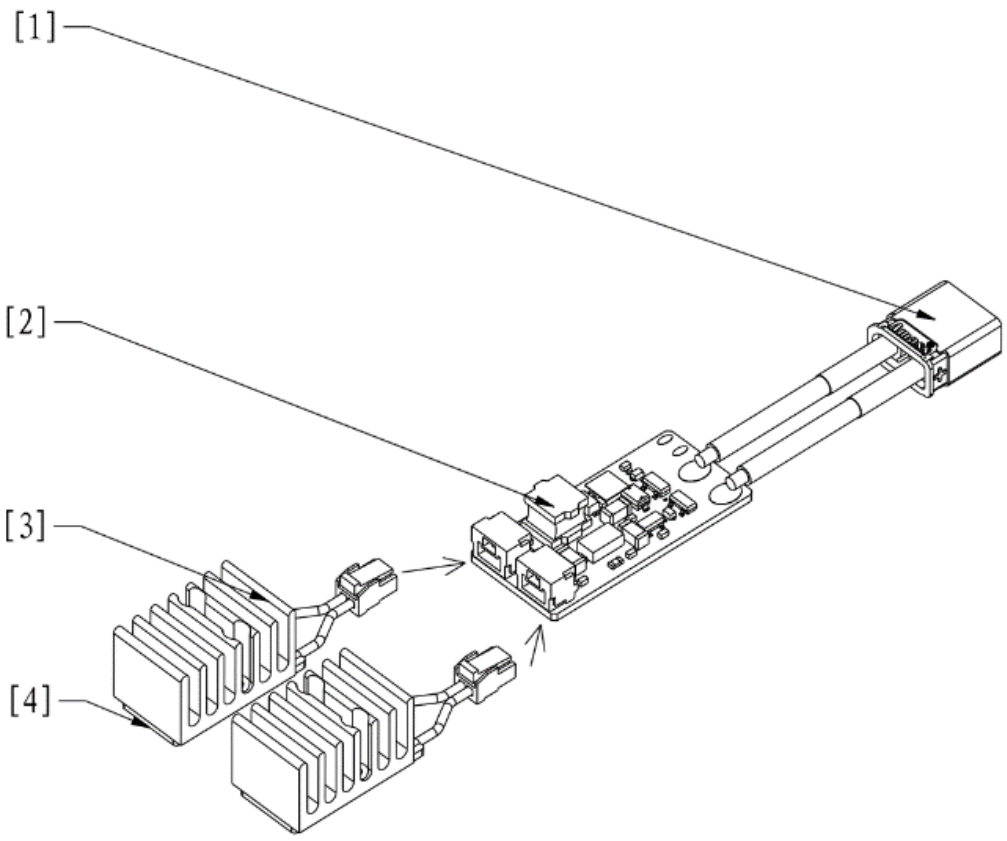


[1] Unlimited extension

S122 The Positioning System Module must be at a distance of at least 100 mm from any motor, Video Transmitter Module or parts that are magnetic or create a magnetic field when operating. Such parts should preferably be installed at a distance of at least 200 mm away.

3.12 Installation Specifications for 17mm Fluorescent Projectile Energy-Charging Devices

The robot should have built-in holes on specific parts of its body, as per the dimensions of a 17mm Fluorescent Projectile Energy-Charging Device.



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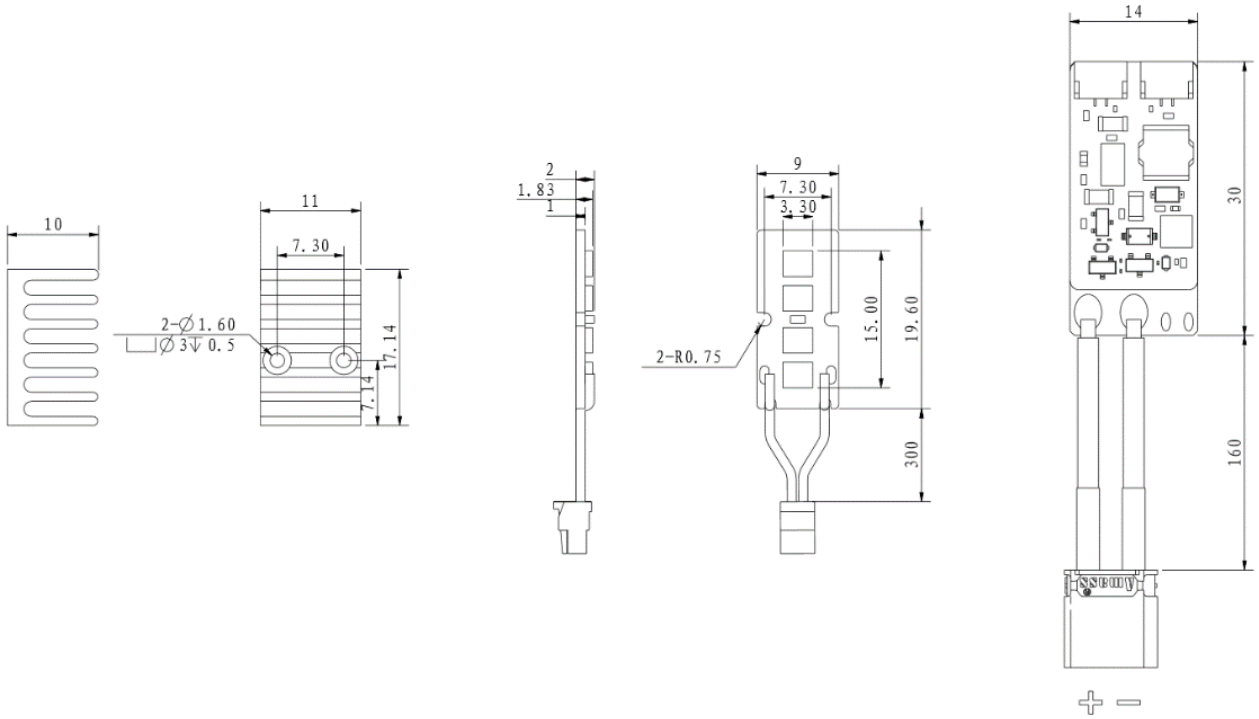

[1] XT30 port [2] LED actuator [3] Heat dissipation panel [4] UV light panel

Figure 3-45 17mm Fluorescent Projectile Energy-Charging Device

3.12.1 Installation Steps

⚠ UV light panels must be light-tight to prevent the emission of harmful UV rays.

1. The UV light panel should be installed on a specific part of the robot, and should cover the standby projectile next to the launching projectile, as shown in the drawings below.
2. If the projectile supply tube is metal, its area in contact with the light panel should be maximized as much as possible, and the screw should be tightly fastened for easy conduction. Non-metal projectile supply tubes must be properly mounted with heat dissipation panels.
3. After the wiring for the UV light panel is completed, the XT30 port can be connected to a 12V or 24V power supply.

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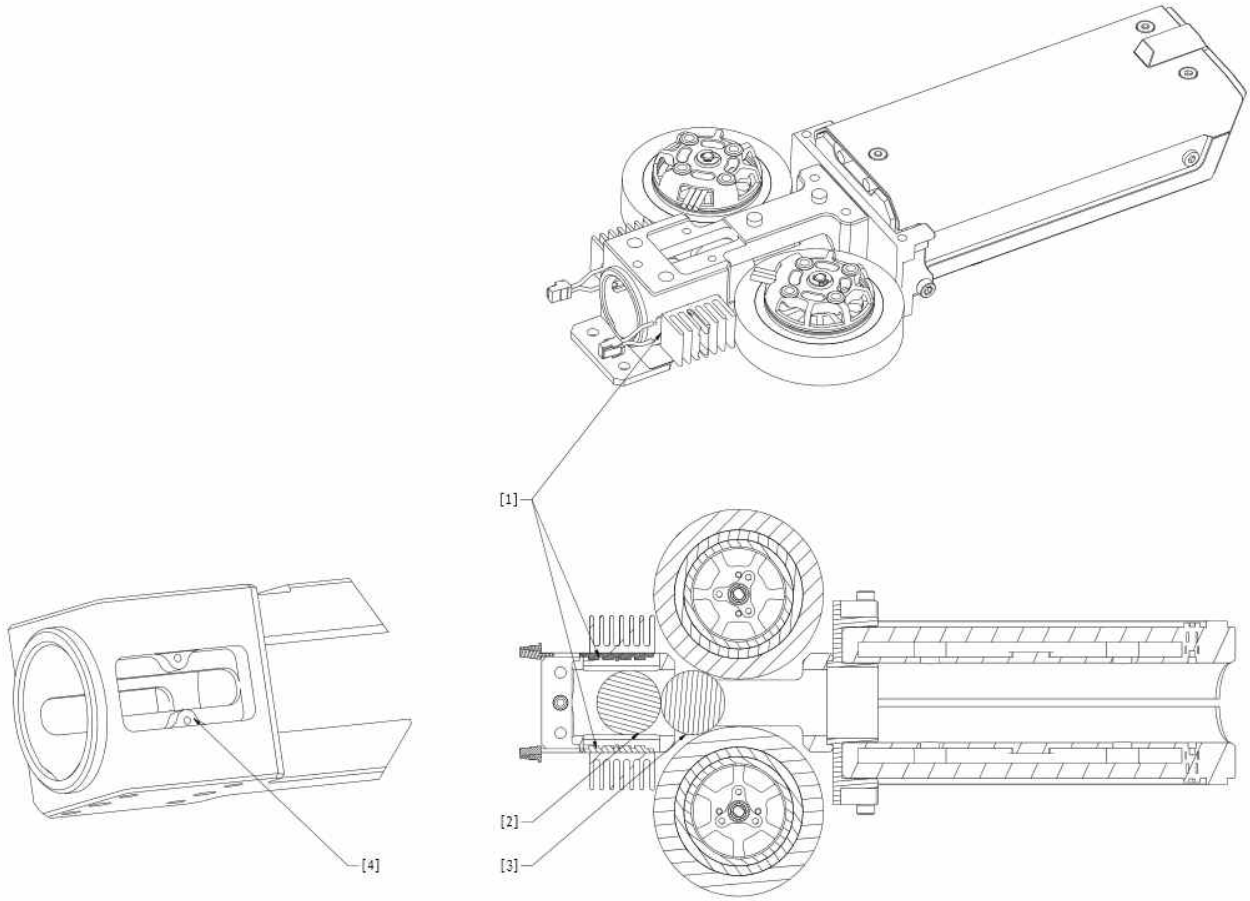

[1] UV light panel [2] Standby projectile [3] Launching projectile [4] Diagram of slot

Figure 3-46 Mounting UV Light Panel

3.12.2 Installation Requirements

S123 The UV light panel must be in close contact with the metal parts, or heat dissipation panels should be installed to extract heat. Heat dissipation panels used can be those provided with the equipment or self-produced.

S124 The back of the UV light panel or the surface of the heat dissipation panels must not be covered with any material that prevents heat dissipation such as tapes or plastic.

S125 The UV light panel must cover the standby projectile next to the launching projectile to ensure the proper charging of the projectile.

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3.12.3 Instructions and Requirements for Production of UV Light Panels

- Light beads or panels should be heated and dried at 120℃ for 2 hours to eliminate humidity, followed by soldering which should be completed within 12 hours after heating.
- Soldering any light bead with moisture will create water vapor that will damage the packaging structure of the LED and render it unstable.

S126 The UV light beads used should be 390-410 nm with a 2835 packaging. The beam angle should be 120°, the power of each bead should be 0.2 W, and the total power of the light panels should not be smaller than 1.5W. The panels should refer to the official design for the competition, with the total length no less than the official panel length.

S127 Aluminum or copper boards are required to be used for the circuit boards of the light beads for heat conduction. Meanwhile, proper heat dissipation measures should also be used for light panels to avoid overheating and damage to the light beads.

3.13 Supercapacitor Management Module Installation Specifications

- The model number for the XT30 female connector is XT30PW-F.
- The model number for the XT30 male connector is XT30PW-M.

The Supercapacitor Management Module (hereinafter referred to as the “Capacitor Management Module”) is used to detect the capacitance of the Supercapacitor Module and the energy of the Supercapacitor Module during the competition. The estimated size of a Capacitor Management Module is 60*30*7.5 mm(L*W*H), and heat-shrink tubing is used as external protection for the module.

The hardware interface includes one XT30 male connector, two XT30 female connectors, and one Capacitor Management Module communication interface.

3.13.1 Installation Steps

The power control panel regulates the output power of the chassis interface of the Power Management Module and the input power and output power of the Supercapacitor Module, to comply with module power limits in the rules. This module should be built by the teams themselves.

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1. Install the Capacitor Management Module between the output interface of the Supercapacitor Module and the input interface of the power control panel.
2. Connect the Supercapacitor Module and Capacitor Management Module using a XT30-connector cable.
3. Connect the power control panel and Capacitor Management Module using a XT30-connector cable.
4. Connect the communication interface of the Capacitor Management Module and the CAN1 port of the Power Management Module using a 4-pin cable.

The connection of the Capacitor Management Module is shown below:

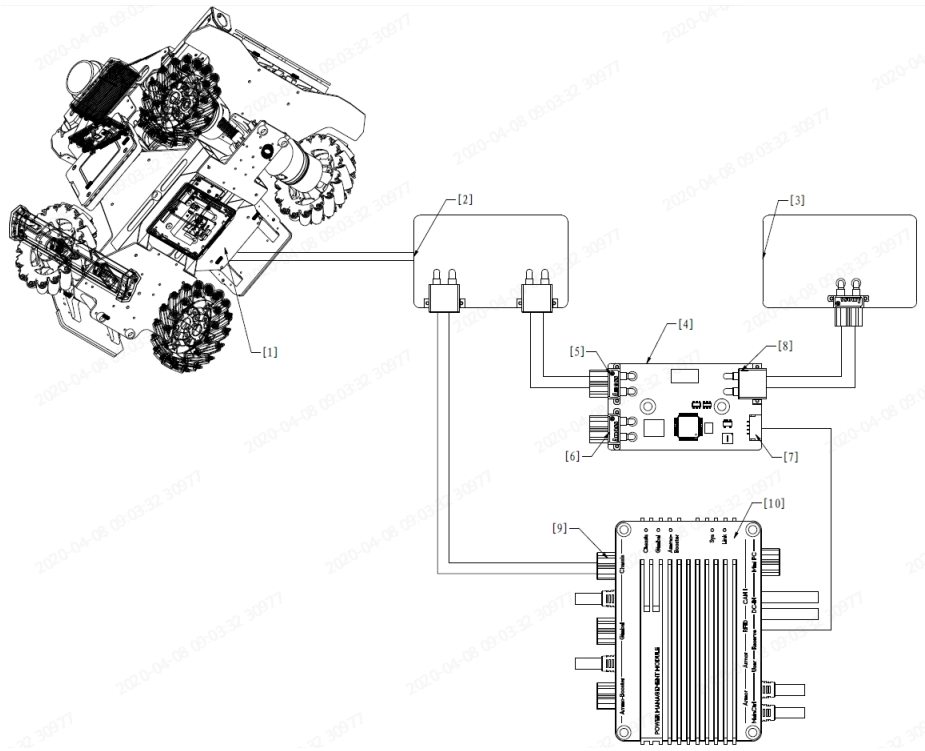

Figure 3-47 Power Management Module Connection

[1]	Robot chassis power supply interface	[2]	Power control panel
[3]	Supercapacitor Module	[4]	Capacitor Management Module
[5]	Capacitor Management Module interface (output, XT30 female connector) – connecting to power control panel		
[6]	Inspection interface of Capacitor Management Module (output, XT30 female connector) – for Pre-Match Inspection only		
[7]	Communication interface of Capacitor Management Module (Can, SM04B-GHS-TB interface) –		

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connecting to Power Management Module

[8] Capacitor Management Module interface (input, XT30 male connector) – connecting to Supercapacitor Module

[9] Chassis output interface of Power Management Module

[10] Power Management Module

3.13.2 Installation Requirements

- The communication interface of a Capacitor Management Module must be connected to the CAN1 port of the Power Management Module in order to operate normally.
- During Pre-Match Inspection, the current load of the Supercapacitor Module is discharged in order to test the capacitance of the Supercapacitor Module. The Pre-Match Inspection steps are as follows:

  1. Before Pre-Match Inspection, the team must charge the Supercapacitor Module to its maximum voltage.

  2. During the inspection of the supercapacitor, the team must switch the chassis' power supply to the supercapacitor.
  3. Lift up the robot, and the team's operator controls the movement of the robot's chassis to discharge current from the supercapacitor.

- Considering the potential issues that may occur with the current discharge from the supercapacitors of a team's robots, an XT30 female-connector cable of a length of at least 10cm should be used on the inspection interface of the Capacitor Management Module.
- The weight limit for the installation of a Capacitor Management Module on a robot shall be the weight of one Capacitor Management Module added to the robot's default weight.

S128 Standard and Hero Robots whose chassis have a Supercapacitor Module must be installed with a Capacitor Management Module.

S129 The Capacitor Management Module must be installed on a place easy for the robot to operate, so that it can be operated during Pre-Match Inspection.

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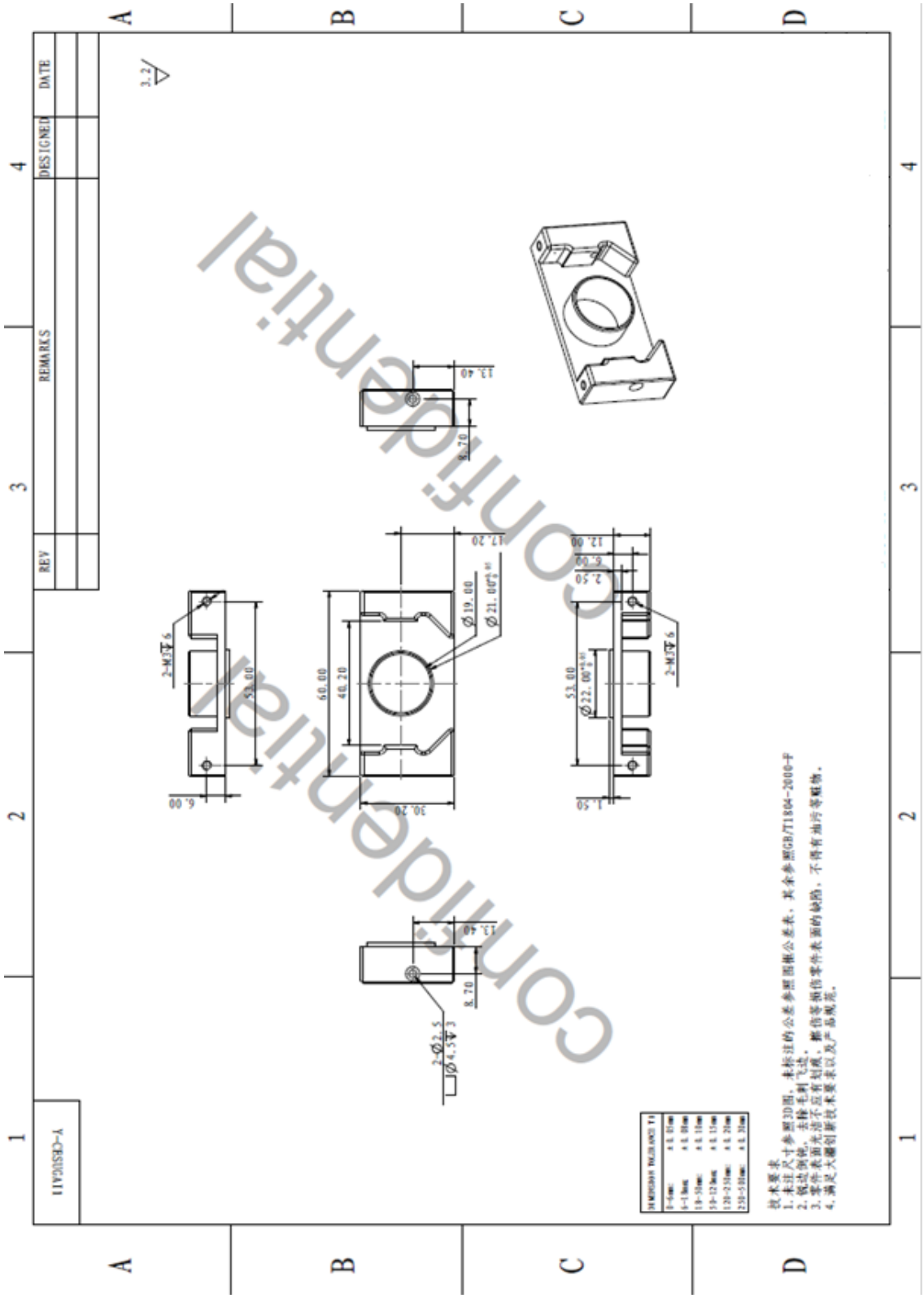
Appendix 1 Drawing of Transfer Block for Speed Monitor Module (17mm projectile)



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Appendix 2 Reference Drawings

Appendix Diagram 1 Engineer Armor Sticker - No. 2

Appendix Diagram 2 Standard Armor Sticker - No. 3

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Appendix Diagram 3 Standard Armor Sticker - No. 4

Appendix Diagram 4 Standard Armor Sticker - No. 5

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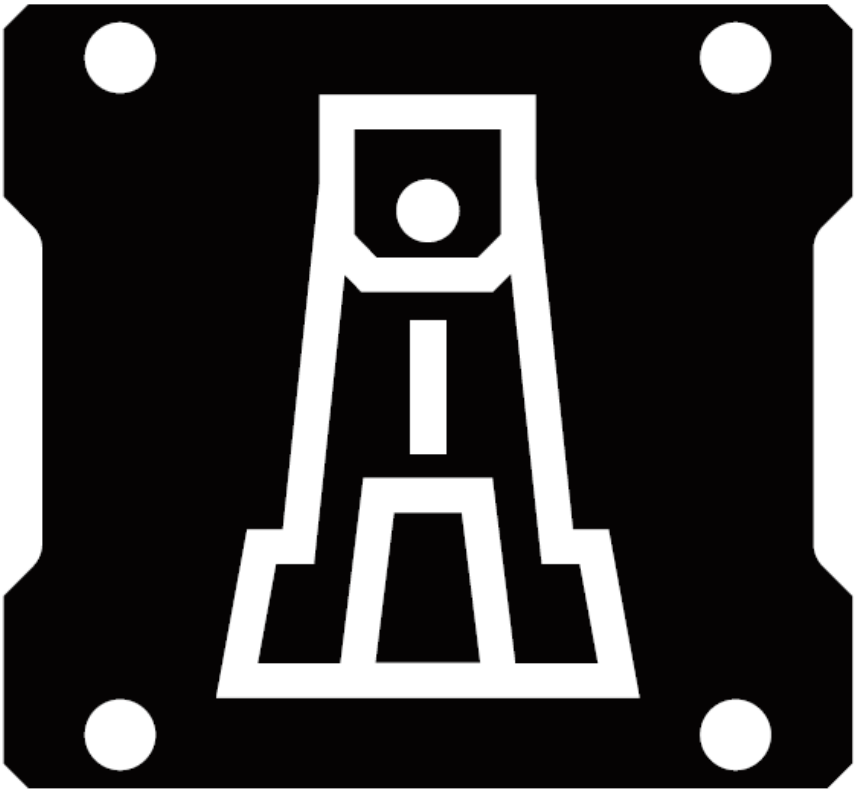
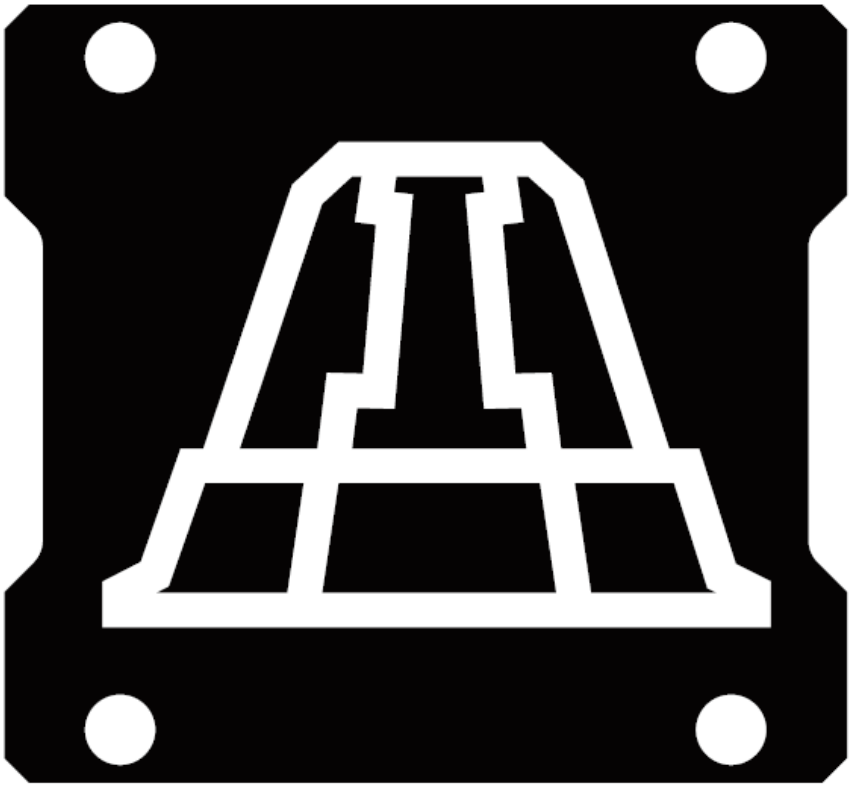


Appendix Diagram 5 Outpost Armor Sticker



Appendix Diagram 6 Small Base Armor Sticker

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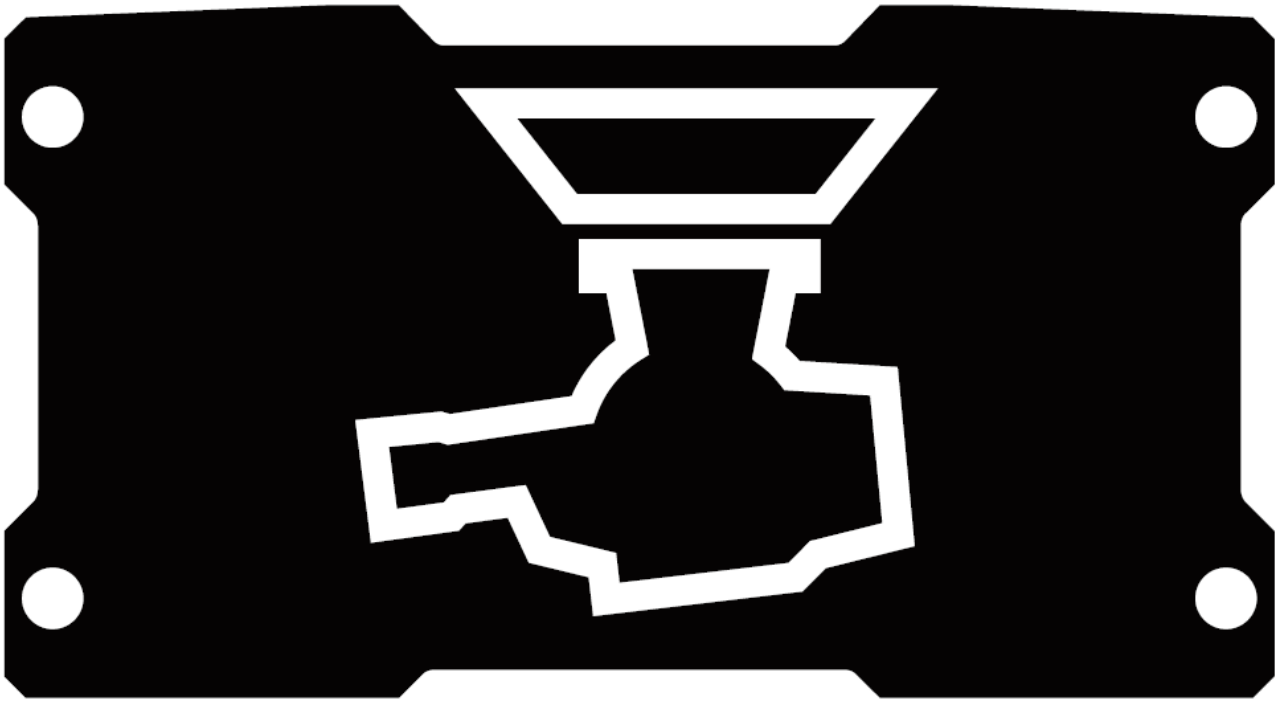
Appendix Diagram 7 Hero Armor Sticker - No. 1



Appendix Diagram 8 Sentry Armor Sticker

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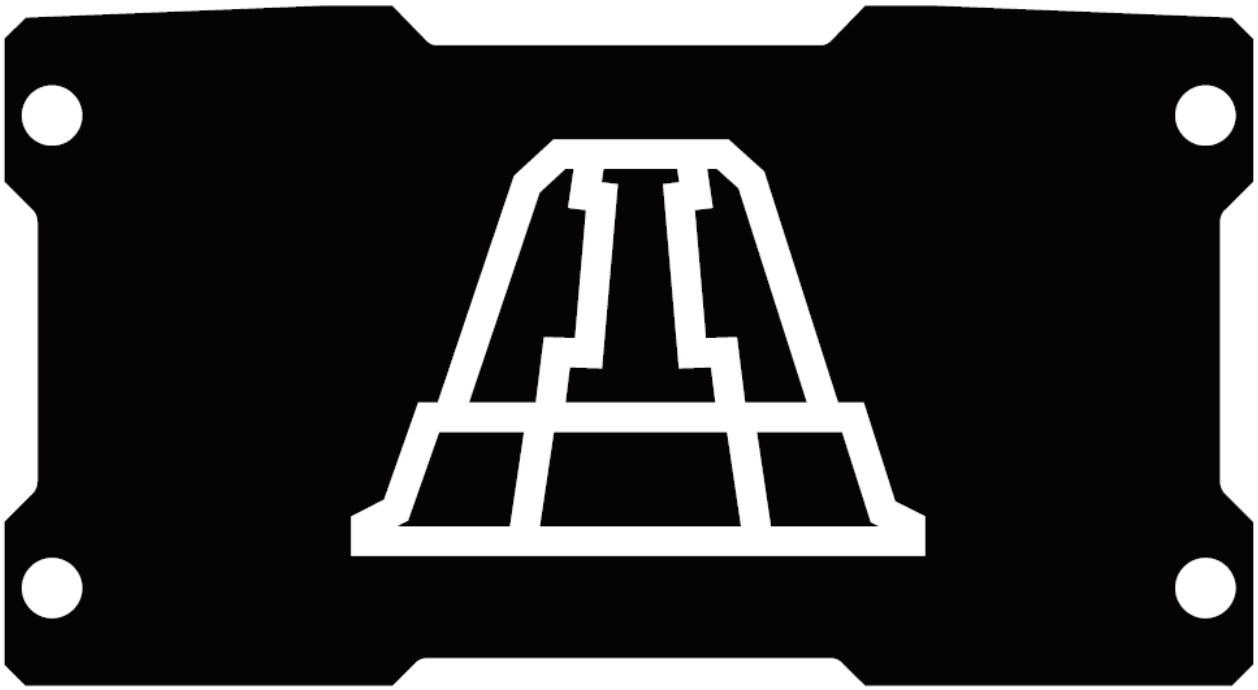

Appendix Diagram 9 Large Base Armor Sticker

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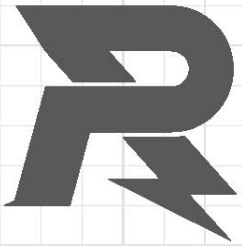

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