

V1.0

Using a 5V-5A motor driver chip and Field-Oriented Control (FOC), the RoboMaster G300 Brushless DC Motor Speed Controller enables precise control over motor torque.



Exclusively designed for the RoboMaster robot, this 1700mAh LiPo battery and G300 Brushless DC Motor Speed Controller, this 1700mAh LiPo battery includes several safety and a terminal board.

Reference System Specification Manual, Reference System User Manual, Introduction of Reference System Module

600 10000 Assembly Kit includes several cables and a terminal board, ensuring complete assembly system return for this Reference System.

The 23rd China University Robot Competition

ROBOMASTER 2024

University Series

Robot Building Specifications Manual

Prepared by RoboMaster Organizing Committee

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Release Notes



The manual will take effect from the specified date after its release.

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TABLE OF CONTENTS

Release Notes	2
1. Foreword.....	9
2. Technical Specifications	10
2.1 General Technical Specifications	10
2.1.1 Energy Source.....	10
2.1.2 Communication Equipment.....	11
2.1.3 Optical Equipment.....	13
2.1.4 Vision Feature	14
2.1.5 Armor Stickers	14
2.1.6 Aesthetic Design	14
2.1.7 Launching Mechanism.....	16
2.1.8 Custom Controller	16
2.1.9 Other.....	18
2.2 Rules of Usage for Fully Assembled Robots and Open-Source Robots.....	19
2.2.1 Complete Redesign.....	20
2.2.2 Partial Redesign	21
2.2.3 Minimal Redesign	22
2.3 Robot Technical Specifications.....	22
2.3.1 Hero Robots.....	22
2.3.2 Engineer Robots.....	24
2.3.3 Standard Robots	25
2.3.4 Aerial Robots.....	27
2.3.5 Sentry Robots.....	31
2.3.6 Dart System	33
2.3.7 Radars	37
3. Referee System Mounting Specifications	40
3.1 Overview	40
3.2 Configuration of Robot Referee System	42
3.3 Mounting Specifications for Main Controller Module.....	43
3.3.1 Installation Steps	44
3.3.2 Installation Requirements.....	46
3.4 Mounting Specifications for Power Management Module.....	47
3.4.1 Installation Steps	49
3.4.2 Installation Requirements.....	51
3.5 Mounting Specifications for Light Indicator Module	54
3.5.1 Installation Steps	55
3.5.2 Installation Requirements.....	57

3.6	Mounting Specifications for Armor Module.....	57
3.6.1	General.....	59
3.6.2	Installation Steps	63
3.6.3	Installation Requirements.....	67
3.6.4	ID Number Configuration	69
3.7	Mounting Specifications for Speed Monitor Module.....	70
3.7.1	Installation Steps	72
3.7.2	Installation Requirements.....	77
3.8	Mounting Specifications for RFID Interaction Module	79
3.8.1	Installation Steps	80
3.8.2	Installation Requirements.....	81
3.9	Mounting Specifications for Video Transmitter Module (Transmitter)	82
3.9.1	Installation Steps	83
3.9.2	Installation Requirements.....	84
3.10	Mounting Specifications for Video Transmitter Module (Receiver)	84
3.10.1	Installation Requirements.....	85
3.11	Mounting Specifications for Positioning System Module	85
3.11.1	Installation Steps	85
3.11.2	Installation Requirements.....	86
3.12	Mounting Specifications for 17mm Fluorescent Projectile Energy-Charging Devices.....	88
3.12.1	Installation Steps	89
3.12.2	Installation Requirements.....	90
3.12.3	Instructions and Requirements for Production of UV Light Panels	91
3.13	Mounting Specifications for Super-capacitor Management Module	91
3.13.1	Installation Steps	92
3.13.2	Installation Requirements.....	94
	Appendix 1 Drawing of Adapter Block for Speed Monitor Module (17 mm projectile).....	95
	Appendix 2 Reference Drawings.....	96

Table Directory

Table 2-1 Summary of Control Methods	11
Table 2-2 Summary of Remote Controllers	12
Table 2-3 Custom Controller Building Parameter Instruction.....	16
Table 2-4 Hero Building Parameters	22
Table 2-5 Engineer Building Parameters	24
Table 2-6 Standard Building Parameters	25
Table 2-7 Aerial Building Parameters	28
Table 2-8 Sentry Building Parameters.....	31
Table 2-9 Dart Building Parameters	34
Table 2-10 Dart Launcher Building Parameter Instruction	34
Table 2-11 Radar Computing Platform Building Parameter Instruction.....	37
Table 2-12 Radar Sensor Parameter Instruction	38
Table 3-1 Referee System Component Modules.....	40
Table 3-2 Robot Referee System Module Configuration.....	42
Table 3-3 Power Management Module Port Instruction	52

Figure Directory

Figure 2-1 A Balancing Standard Robot	27
Figure 2-2 Effective Area for External Navigation Light	31
Figure 2-3 Dart Trigger Device	35
Figure 2-4 Areas Not Allowed to Be Blocked on a Dart Trigger Device.....	36
Figure 2-5 Internal Cavity of a Dart Trigger Device.....	36
Figure 3-1 Main Controller Module.....	44
Figure 3-2 Mounting Main Controller Module.....	45
Figure 3-3 Main Controller Module Connection	46
Figure 3-4 Mounting Position of the Main Controller Module	46
Figure 3-5 Power Management Module	48
Figure 3-6 Mounting Power Management Module.....	49
Figure 3-7 Power Management Module Port	50
Figure 3-8 Power Management Module Connection	51
Figure 3-9 Light Indicator Module	55
Figure 3-10 Mounting Light Indicator Module	56
Figure 3-11 Bottom of Light Indicator Module	56
Figure 3-12 Light Indicator Module Connection.....	56
Figure 3-13 Designated Armor Support Frames	58
Figure 3-14 Small Armor Modules	58
Figure 3-15 Large Armor Modules	59
Figure 3-16 Robot Coordinate System	60
Figure 3-17 The X-axes of Different Robot Chassis Structures	60
Figure 3-18 Force Application on Armor Module	61
Figure 3-19 Robot Protection	63
Figure 3-20 Reserved Holes on the Chassis.....	64
Figure 3-21 Mounting Armor Support Frame	64
Figure 3-22 Mounting Armor Module.....	65
Figure 3-23 Armor Module Connection	65
Figure 3-24 Reserved Holes on the Chassis	66
Figure 3-25 Mounting Armor Support Frame	66
Figure 3-26 Mounting Armor Module.....	67
Figure 3-27 Ground Robot Armor Module ID Setting	70
Figure 3-28 Speed Monitor Module (17 mm Projectile)	71
Figure 3-29 Speed Monitor Module (42 mm Projectile)	71

Figure 3-30 17 mm Barrel.....	72
Figure 3-31 Mounting Speed Monitor Module	73
Figure 3-32 17 mm Adapter Block.....	74
Figure 3-33 Securing Method for 17 mm Adapter Block	74
Figure 3-34 Mounting 17 mm Short Barrel	75
Figure 3-35 42 mm Barrel.....	77
Figure 3-36 Mounting Specifications for Speed Monitor Module.....	79
Figure 3-37 RFID Interaction Module.....	80
Figure 3-38 RFID Interaction Module Connection.....	80
Figure 3-39 Mounting RFID Interaction Module	81
Figure 3-40 Video Transmitter Module (Transmitter).....	83
Figure 3-41 Mounting Video Transmitter Module (Transmitter).....	83
Figure 3-42 Video Transmitter Module (Receiver).....	84
Figure 3-43 Positioning System Module	85
Figure 3-44 Mounting Positioning System Module	86
Figure 3-45 Positioning System Module Connection.....	86
Figure 3-46 Mounting Positioning System Module	87
Figure 3-47 17 mm Fluorescent Projectile Energy-Charging Device	89
Figure 3-48 Mounting UV Light Panel.....	90
Figure 3-49 Capacitor Management Module Connection.....	93

Appendix Figure Directory

Appendix Figure 1 Hero Armor Sticker - No. 1	96
Appendix Figure 2 Engineer Armor Sticker - No. 2	96
Appendix Figure 3 Standard Armor Sticker - No. 3.....	97
Appendix Figure 4 Balancing Standard Armor Sticker - No. 3	97
Appendix Figure 5 Standard Armor Sticker - No. 4.....	98
Appendix Figure 6 Balancing Standard Armor Sticker - No. 4.....	98
Appendix Figure 7 Standard Armor Sticker - No. 5.....	99
Appendix Figure 8 Balancing Standard Armor Sticker - No. 5	99
Appendix Figure 9 Sentry Armor Sticker	100
Appendix Figure 10 Outpost Armor Sticker	100
Appendix Figure 11 Base Small Armor Sticker.....	101
Appendix Figure 12 Base Large Armor Sticker	101

1. Foreword

Teams participating in RoboMaster are required to develop and build their robots. Participating robots are required to meet all specifications listed in this document. A pre-match inspection will be carried out against the specifications. If any safety incident has occurred due to a violation of rules, the RoboMaster Organizing Committee (“RMOC”) reserves the right to hold the offending team legally responsible. Any dispute arising from this Specification Manual will be settled based on interpretations provided by the Chief Referee or Head Inspector.

Users are advised to read the manuals for the various Referee System modules to learn about their respective functions and how to install them. After installing the Referee System modules, refer to the Referee System User Manual to understand its overall functions. The document can be downloaded at this link:

<https://www.robomaster.com/en-US/products/components/referee>

2. Technical Specifications

2.1 General Technical Specifications

2.1.1 Energy Source



- The use of combustion engines, explosives, and hazardous chemicals is forbidden.
 - It is prohibited to use mains supply in the competition area (except for radars).
 - Use of hydraulic or other propulsion methods capable of causing pollution is forbidden.
 - For robots limited by their chassis power, the horizontal movements of their chassis can only be propelled by electricity.
-

S1 Robots can be powered only by electricity and gas.

S2 With the exception of custom controllers and darts in the dart system, the rest of the robots will need to retrieve a battery identification sticker at Pre-Match Inspection and stick it near the battery.

2.1.1.1 Power Supply

S3 Only batteries produced by DJI or other official manufacturers can be used on robots and Custom Controllers, except only for Darts which may use lithium batteries produced by other official manufacturers.



In subsequent versions of the specification document this season, the committee will probably open up more types of batteries for drones.

S4 The total nominal energy of one supercapacitor module of Standard, Hero and Sentry Robots must not exceed 2000 J, and their actual energy must not exceed 2200 J. The formula to calculate nominal energy for one capacitor module is $E = \frac{1}{2} * C * U^2$ (U is the withstand voltage of the capacitor, C is capacitance).

S5 Only Hero, Standard, and Sentry Robots can use the Supercapacitor Module. Each robot is allowed to use not more than one Supercapacitor Module.

2.1.1.2 Gas Source


S6 The compressed gas pressure inside the gas cylinder (for storage) must not exceed 20 Mpa. The gas cylinder (for storage) used should have a nominal pressure of no less than 30 MPa. A double-gauge regulator should be mounted directly at the outlet of the gas cylinder (for storage). The working pressure must not exceed 0.8 Mpa.

S7 The working gas must be non-flammable, non-toxic and non-polluting, such as air, nitrogen, and carbon

dioxide.

- S8 Any mechanism for using or storing gas (cylinders for storage, cylinders for propulsion, air spring, etc.) must come with an approval certificate or nameplate stamp that is easy to inspect when required.
- S9 If a gas cylinder (for storage) is still within its service life, it must be returned to the factory for maintenance within the period specified by the user manual or product label, after which the proof of maintenance must be submitted.
- S10 The gas cylinder must have been issued an approval certificate by an officially recognized approving institution in its country of manufacture.
- S11 The gas cylinder (for storage) must be firmly and safely mounted on the robot, 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. The gas cylinder (for storage) and pipe 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 damaged by projectiles. To ensure safety, the cylinder’s opening must be kept horizontal or facing up.
- S12 The gas cylinder (for storage) should be mounted in a way that the cylinder and the gas pipe never touch the ground, regardless of how the robot spins around.
- S13 No inflammables are allowed to be within 50 mm from the gas cylinder.
- S14 All gas pipes 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 Communication Equipment

- The RMOC recommends that teams use the Video Transmitter Module Link (hereinafter referred to as “VTM Link”) to control their robots.
-  ● The VTM Link refers to the link in the Video Transmitter Module used to transmit robot control-related data. It can replace the DT7 and offer more superior stability.
- For protocols related to the VTM Link, please refer to the [Referee System Serial Port Protocol Appendix](#).

S15 The control methods specified for this competition season are as shown in the table below.




Table 2-1 Summary of Control Methods


Data Link	Information Transmitted
DT7 Remote Controller	Mouse and keyboard commands, control stick movements
Other Remote Controllers	Control stick movements

Data Link	Information Transmitted
VTM Link	Custom Controller, mouse and keyboard commands
Serial port of the Referee System	Inter-robot communication, Dart launching command

S16 The remote controllers specified for this competition season are as shown in the table below. Only remote controllers within the frequency band of 2.4G are permitted to be used, and only DT7 Remote Controllers may be connected to the client. The RMOC only ensures the stability of the VTM Link.

Table 2-2 Summary of Remote Controllers

Name	Image
DT7	
FS-16X	
WFLY ET08	

Name	Image
WFLY ET16S	

S17 Each remote controller can only be linked to one receiver.

S18 Remote controllers cannot be modified.

S19 Robots are not allowed to carry wireless communication equipment other than the remote controller (RC) and Referee System Module.

2.1.3 Optical Equipment



- Teams are advised not to set up a laser sight when building a robot.
- The use of custom UI is recommended, instead of a laser sight.

S20 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).

S21 Each Launching Mechanism and Dart Launcher can be equipped with a maximum of one laser sight. Engineers can be mounted with not more than three laser sights. Apart from those needed to position the Launching Mechanism, no additional laser sights may be used by other robots.

S22 Besides laser sights, Engineers can also be mounted with a white supplement light and a display not larger than 7 inches. The light can only be used for enhancing computer vision recognition features when the robot is acquiring a mobile component. The display screen must not interfere with the robot's visual features. Other robots must not be equipped with other obvious visible light emitting equipment.

S23 The optical equipment used by a robot must not cause any physical harm to any person.

S24 All infrared light sources must conform to the Class I requirements.

2.1.4 Vision Feature

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 visual 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:

S25 The Armor Module cannot be blocked.

S26 It is prohibited to simulate visual features.

S27 One team must not, through any means, interfere with the detection of its robot visual features by the other team's robot.



Robot visual features: Light indicators on both sides of the Armor Module, and armor stickers.

2.1.5 Armor Stickers

During Pre-Match Inspections and matches, RMOC staff will provide armor stickers to robots based on their robot numberings. For graphs of the stickers, please refer to "Appendix 2: Reference Drawings". For robot numberings, please refer to the "Robot Line-up" chapter in the [RoboMaster 2024 University Championship Rules Manual](#).

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

S28 The armor stickers 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 and no damage to the stickers. One Armor Module may be attached with not more than one armor sticker.

S29 The armor stickers provided by the RMOC can only be attached on the Armor Module. Except for the armor stickers provided by the RMOC, no other stickers that resemble the armor stickers in their patterns may be attached on a robot's Armor Module or its other external structures.

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:

S30 The cables of robots are neat and not exposed. Exposure that is unavoidable requires cables protection using

materials such as drag chains and cable managers.

S31 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.

S32 Fishing net cannot be used as an aesthetic material, but can be used in the protective guard of an Aerial Robot.

S33 Do not design or use sharp structures to avoid causing damage to the battlefield or injury to personnel.

Gloss:

S34 The exterior gloss of robots must not exceed 30Gs.



An exception is made for optical equipment, such as camera lenses and other equipment that cannot be made non-glossy. However, they must be kept more than 100 mm away from the edge of the Armor Module side indicators.

Paint Color:



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

S35 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.

S36 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 100 mm*100 mm. The school badges or team badges must be displayed prominently on a robot, and their distance with the Armor Module side indicators must be more than 30 mm. If the exterior of a robot does not meet specifications, a pre-match inspection staff may require the position or size of a school badge or team badge to be altered.

S37 The inkjet or stickers of the school and team badges must not affect the robot's visual features, and cannot be illuminated.

S38 Inverse colors can be applied on a school badge or team badge, or its original colors can be retained.

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:

S39 Inverse colors can be applied for advertising spaces, or their original colors can be retained.

S40 The advertising spaces should be displayed on the left and right sides of the robot, and their distance with the Armor Module side indicators must not be less than 30 mm.

S41 The inkjet or stickers of the advertising spaces must not affect the robot's visual features, and cannot be illuminated.

S42 The size of a single robot advertising space shall not be more than 100 mm*100 mm. 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, a pre-match inspection staff 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 and at a certain initial speed.

S43 Robots using compressed gas as the propellant for projectiles must not have an acceleration length exceeding 200 mm (the acceleration must be completed before the projectile enters the Speed Monitor Module).

S44 The launching mechanisms of robots must be able to stably launch 10 rounds of 17 mm projectiles or 5 rounds of 42 mm projectiles.

S45 Each Launching Mechanism must be installed with a Speed Monitor Module in accordance with the rules. 17 mm Launching Mechanism must be mounted with a 17 mm Fluorescent Projectile Energy-Charging Device according to specifications.

2.1.8 Custom Controller

The Custom Controller is a set of multi-purpose controllers made by the participating team and is used to control and monitor robot movements and status.

- The Custom Controller includes but is not limited to VR goggles and their supporting control equipment, the joystick, self-built wired controller, and other self-built control modules.
- If the joystick is mapped onto the mouse, the joystick and Remote Controller combo shall be deemed as one set of control equipment and not part of the Custom Controller.
- L*W*H: Length*Width*Height

Table 2-3 Custom Controller Building Parameter Instruction

Item	Limit	Remarks
Target	Each robot may only be equipped with one Custom Controller.	Custom Controllers are not allowed to be used on Sentry Robots.

Item	Limit	Remarks
Maximum Power Supply Capacity (Wh)	265	-
Maximum Power Supply Voltage (V)	30	-
Maximum Initial Size (mm, L*W*H)	500*500*500	-
Maximum Expansion Size (mm, L*W*H)	No restrictions	Excluding the size of data or power cables of any equipment as well as wearable devices such as video glasses
Data Transmission	Serial Port Module	-
Video Transmission	Standard HDMI Type A Plug	The recommended resolution is 1920*1080. Otherwise compression or distortion issues may occur.
Serial Data Transmission	Able to send and receive	<ul style="list-style-type: none"> ● The serial port standard is RS232. ● A device is considered a custom controller when and only when it uses a custom controller link
Protocol	Refer to the "Referee System Serial Port Protocol Appendix"	-

Mounting Requirements:

S46 It is recommended that a non-slip pad is placed under the Custom Controller.

S47 Do not put any sticky or sharp items such as double-sided tape and screws in direct contact with the desk in the operator room.

S48 Keep the cables of the Custom Controller neatly stored in the device without being exposed.

S49 The interface between the custom controller and the computer in the operator room should strictly comply with the requirements specified in "Table 2-3 Custom Controller Building Parameter Instruction". Unauthorized connection is strictly forbidden.

How to Use:

S50 Before you start to use the Custom Controller, you should test whether it functions properly by placing it on

the computer desk corresponding to the robot in the Operator Room and connect it to the data interface available in the room.

S51 The Custom Controller must not be equipped with any wireless transmitter or receiver.

S52 The operator room is equipped with a standard HDMI Type A receptacle, which can be used to connect to the display devices such as video glasses. The operator can display the client images on the video glasses by using the screen mirroring function of the computer.

S53 An RS232 plug is provided in the Operator Room, for connecting Custom Controller signals. The Operator can connect them on their own.



- For self-produced video glasses, the power supply must be provided by the Custom Controller. No battery is allowed to be mounted in the glasses (excluding commercial video glasses which come with batteries).
 - For self-made controllers, only batteries produced by DJI or other official manufacturers can be used. Use of mains electricity (220 V) is strictly forbidden.
-

2.1.9 Other

S54 No materials that are fragile, easy to fall off, and difficult to clean may be used in the production of robots, such as feathers and cotton. No glue or adhesive materials may be used to attach robots to the battlefield or battlefield components.

S55 While acquiring or exchanging a mineral, a robot must not cause any obvious marks on or damage to the mineral.

S56 Robots are not allowed to grab the Referee System Module of any robot.

S57 With the exception of dart launchers in the dart system that fire darts, robots may not disintegrate into sub-robots or multiple subsystems connected by flexible cables, and may not intentionally cast off or launch their own parts.

2.2 Rules of Usage for Fully Assembled Robots and Open-Source Robots

- Only teams that did not qualify for the offline competitions of the RoboMaster 2023 University Series are allowed to deploy a maximum of one non-modified RoboMaster Robot Self-Assembled Version Type A or one RoboMaster AI Robot 2020 Standard Version whose modification meets the new design criteria.
- When building their robots, the remaining teams must not modify the abovementioned robots into a newly designed robot or directly use their frame, material or other important components during the production process, and are only allowed to use the motor coupling, Launching Mechanism, Loading Mechanism, or other such parts of the abovementioned robots.
- 💡 ● When building their robots, participating teams are forbidden from using third-party assembly modules, except for the flight system of Aerial Robots (including the frame, propulsion system, flight control, and perception system).
- Third parties: Entities other than the RMOC and participating teams.
- Assembly modules: Special function components formed by several basic function components, used for assembling a system with full functionality, such as robotic arms, chassis, supercapacitor control panels and their supporting codes, gimbals, Darts, suspension wheels, loading mechanisms, and Launching Mechanisms.

For the RoboMaster University Series, the RMOC have defined the ownership of intellectual property over the participating robots. Only team members involved in the design and production of the robots and the universities or colleges they represent shall own the intellectual property rights related to the robots' design and form. Only the teams representing their colleges or universities having the intellectual property rights over the robots' design and form or teams made up of individuals with such rights are allowed to use the robots' design and form in the competition. Other teams wishing to incorporate such design and form must perform a redesign to their robot by at least satisfying one complete redesign criterion or three partial redesign criteria. Once these criteria are satisfied, the design will be deemed new and the team may use the newly designed robots in the competition. Such redesigns include but are not limited to the examples mentioned in this document.

Meanwhile, the RMOC will conduct random checks on robots during the competition. Participating teams are obligated to show their robots' mechanisms, circuit design drawings and relevant code documents to the RMOC and answer relevant technical questions. The RMOC has the right to photograph/record the configurations and information of the robots of the participating teams.

S58 Before a robot is inspected, the team is required to submit its photographs to the Inspection Area clearly showing the primary structures of the robot. Any protective shell must be removed to capture the robot's main body in the photographs.

S59 Any team using a redesigned fully assembled robot or open-source robot must submit descriptions of the relevant modifications to the Inspection Area.

S60 In the event of a situation where robots do not satisfy each other's redesign conditions and the open-source robot is not referenced, it is stipulated that the owner of the intellectual property rights will be the team that first uses the robot to participate in the official competition. This means that as long as the affiliated team is still participating in the RoboMaster University Series, all subsequent robots from other teams that come on stage must meet the redesign requirements relative to the robots that were once on stage.

2.2.1 Complete Redesign



Complete redesign: An enhancement of the core components of the robot that implicates a broader range of systems.

1. Chassis

- Changes to wheels. For example, Mecanum wheels, steering wheels, omni wheels, Ackermann steering wheels, continuous tracks, etc.
- Changes to wheel transmission. For example, Unsprung power, sprung power, etc.
- Changes to suspension. For example, Double wishbone suspension, torsion beam suspension, double-trailing-arm suspension, lift suspension, etc.
- Changes to chassis power. For example, AC, DC, brushed, brushless, decelerating, direct-drive, etc.
- Changes to chassis form. For example, Body-on-frame, layered, unibody, etc.

2. Gimbal

- Changes to gimbal transmission. For example, subset relationships and quantities of the yaw, pitch and roll axes.
- Changes to projectile supply principle. For example, Changes of robot's projectile supply link from a simple, direct connection to supply to launching mechanism through the yaw-axis joint.
- Changes to positions of magazines. For example, Fixed linkage between magazines and the chassis, yaw axis, pitch axis, etc.;
- Changes to transmission from the gimbal's motor. For example, Changes to direct drive, pulleys, connecting

rods, and gears (not including swapping between pulleys, gears, and sprockets);

- Increased quantity of effective Launching Mechanisms.

3. Actuators

- Changes to the topological structures of mechanisms other than the terminal executive mechanisms. For example: The combined sequences, quantities and types of revolute pairs and sliding pairs;
- Increasing the power efficiency of actuators. For example: Reduced power value when the functions remain the same; power value remains consistent after an increase of effective functions; increase in power value after an increase of effective functions.

2.2.2 Partial Redesign



Partial redesign: Enhancements involving fewer systems

- More than 10% change in the suspension's hard point parameter;
- Changes to the quantity of effective power wheels;
- More than 10% change in the axle track and wheelbase;
- Changes to the gear ratio of the chassis motor;
- Changes to the positions of at least three Referee System Modules;
- Adding new independent functional modules. For example, adding an independent rescue device, image transmission turntable, mineral diverter, or visual module;
- Changes to the vertical and horizontal positions of the friction wheels;
- Changes to transmission from the gimbal's motor. For example, swapping between pulleys, gears, and sprockets.
- Changes made to the power supply. For example, pneumatic, electrical;
- Changes to the types and solutions of terminal executive mechanisms. For example, changing rotational grabbing to lateral grabbing;
- Layout of core electronic devices (main controller, power supply, computing platform, and sensor modules). For example, changing their position from the gimbal to the chassis;
- Change of the gimbal's rotating range from limited to unlimited.

2.2.3 Minimal Redesign



Minimal redesign: Modifications with a small impact on the core functions.

Minimal redesign includes but is not limited to the following modifications:

- Changes to secondary load-bearing and shielding structures. For example, a hollowed space or their shape.
- Changes to the quantities of models for standard parts;
- Switching the gas cylinder (for propulsion) and the electric actuator;
- Change of material of the same characteristics. For example, switching between fiberglass and carbon fiber sheets.
- Non-principle changes. For example, changing the hardness of the projectile supply tube, such as by replacing it with a soft tube.

2.3 Robot Technical Specifications

- L*W*H: Length*Width*Height



- Maximum Initial Size: A robot's maximum size before transformation.
- Maximum Expansion Size: A robot's maximum size at any time, and is the maximum size the robot's mechanisms can possibly expand to.

2.3.1 Hero Robots

S61 A Hero Robot must have the functions for horizontal movement and launching 42 mm projectiles.

S62 The production parameters for Hero are as follows:

Table 2-4 Hero Building Parameters

Item	Limit	Remarks
Operating Mode	There are no restrictions. One remote control and one Custom Controller can be configured at most.	-
Maximum Power Supply Capacity (Wh)	265	-

Item	Limit	Remarks
<p>Maximum Power Supply Voltage (V)</p>	<p>30</p>	<p>-</p>
<p>Launching Mechanism</p>	<p>One 42 mm Launching Mechanism</p>	<p>-</p>
<p>Maximum Weight (kg)</p>	<p>35</p>	<p>Includes battery weight, but not the weight of the Referee System</p>
<p>Maximum Initial Size (mm, L*W*H)</p>	<p>800*800*800</p>	<p>Its orthographic projection on the ground should not exceed an 800*800 square</p>
<p>Maximum Expansion Size (mm, L*W*H)</p>	<p>1200*1200*1200</p>	<p>Its orthographic projection on the ground should not exceed a 1200*1200 square</p>
<p>Referee System</p>	<ul style="list-style-type: none"> ● Large Armor Module ● Speed Monitor Module (42 mm Projectile) ● Video Transmitter Module (Transmitter) ● RFID Interaction Module ● Positioning System Module ● Main Controller Module ● Power Management Module ● Light Indicator Module ● Supercapacitor Management Module 	<p>Weight is 4.21 kg</p>

2.3.2 Engineer Robots

S63 An Engineer Robot must have the functions for horizontal movement and grabbing minerals at any resource island.

S64 The production parameters for Engineer Robots are as follows:

Table 2-5 Engineer Building Parameters

Item	Limit	Remarks
Operating Mode	There are no restrictions. One remote control and one Custom Controller can be configured at most.	-
Maximum Power Supply Capacity (Wh)	265	-
Maximum Power Supply Voltage (V)	30	-
Launching Mechanism	No Launching Mechanism is allowed to be installed	-
Maximum Weight (kg)	35	Includes battery weight, but not the weight of the Referee System
Maximum Initial Size (mm, L*W*H)	600*600*600	Its orthographic projection on the ground should not exceed a 600*600 square
Maximum Expansion Size (mm, L*W*H)	1200*1200*1100	<ul style="list-style-type: none"> ● Its orthographic projection on the ground should not exceed a 1200*1200 square ● All components of an Engineer cannot exceed their Maximum Expansion Size during its transformation.
Referee System	<ul style="list-style-type: none"> ● Small Armor Module 	Weight is 3.04 kg

Item	Limit	Remarks
	<ul style="list-style-type: none"> ● Video Transmitter Module (Transmitter) ● RFID Interaction Module ● Positioning System Module ● Main Controller Module ● Power Management Module ● Light Indicator Module 	

2.3.3 Standard Robots

S65 A Standard Robot must have the functions for horizontal movement and launching 17 mm projectiles.

S66 The production parameters for Standard are as follows:

Table 2-6 Standard Building Parameters

Item	Limit	Remarks
Operating Mode	There are no restrictions. One remote control and one Custom Controller can be configured at most.	-
Maximum Power Supply Capacity (Wh)	265	-
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	A 17 mm Launching Mechanism	-

Item	Limit	Remarks
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 an 800*800 square
Referee System	<ul style="list-style-type: none"> ● Small Armor Module (Balancing Standard Robots shall be installed with Large Armor Modules) ● Speed Monitor Module (17 mm Projectile) ● Video Transmitter Module (Transmitter) ● RFID Interaction Module ● Positioning System Module ● Main Controller Module ● Power Management Module ● Light Indicator Module ● 17 mm Fluorescent Projectile Energy-Charging Device ● Supercapacitor Management Module 	<p>The Referee System of a Balancing Standard Robot weighs 2.60 kg, while those of Regular Standard Robots weigh 3.25 kg.</p>

The definition of Balancing Standard Robots:

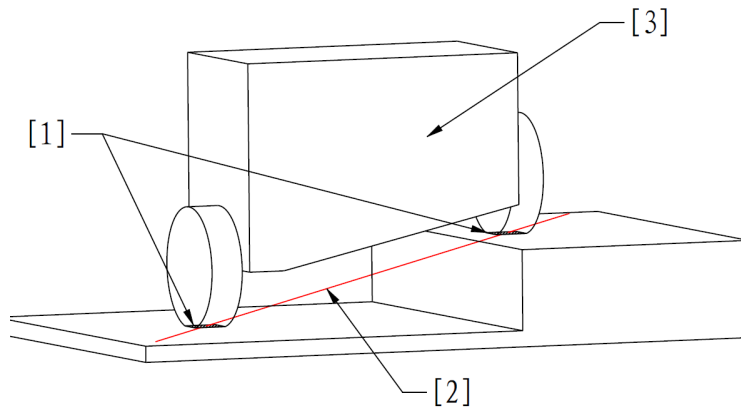
A robot’s contact surface shall be any bordered battlefield surface that it has contact with. Any robot that meets all the following criteria is deemed a Balancing Standard Robot:

Criterion 1: When the robot is alive, the largest axial projections of all its wheels in contact with a horizontal surface are always round in shape.

Criterion 2: When the robot is alive, there is at least one straight line intersecting all the contact surfaces.

Criterion 3: When the power is off, the robot’s z-axis cannot remain vertical against a horizontal surface.

Example: As shown below, the robot, when alive, has two wheels in contact with the battlefield, and their largest axial projections are round in shape. There are only two contact surfaces, one on the step and the other parallel with the first surface, with a 200 mm height difference in between. A straight line also intersects with the two contact surfaces. As such, the robot is a Balancing Standard Robot.



[1]	Contact surface between the wheels and the battlefield	[2]	The straight line intersecting with the contact surfaces	[3]	Balancing Standard Robot
-----	--	-----	--	-----	--------------------------

Figure 2-1 A Balancing Standard Robot



When alive, a Balancing Standard Robot may use other propulsion mechanisms to balance itself only when it is in an unbalanced state (i.e. the robot has any contact surface that does not meet the definition of a Balancing Standard Robot) and it is regaining its balance. After the robot has regained its balance, the propulsion mechanisms must be retrieved immediately.

2.3.4 Aerial Robots

S67 An Aerial Robot must have the function for sustained flight for 10 seconds and the participating team must provide a video of that robot in flight at pre-match inspection.



- The video needs to make it clear that the robot shown is the one under pre-match inspection.

- The video should show the Aerial Robot flying for at least 10 seconds and include content that proves the video's timeliness and authenticity, such as the time the video was shot and a photo that contains both the robot and the pilot.
- The video should be shot in advance. The competition venue will not provide a dedicated space for video shooting.

S68 The production parameters for Aerial Robots are as follows:

Table 2-7 Aerial Building Parameters

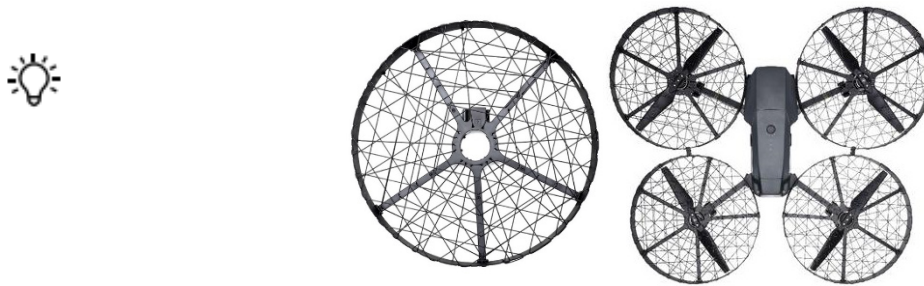
Item	Limit	Remarks
Operating Mode	There is no limit. Only a maximum of two remote controls and one Custom Controller can be configured.	-
Maximum Total Power Supply Capacity (Wh)	800	-
Maximum Power Supply Voltage (V)	48	-
Launching Mechanism	A 17 mm Launching Mechanism	-
Maximum Weight (kg)	15	Includes battery weight, but not the weight of the Referee System
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	<ul style="list-style-type: none"> ● Video Transmitter Module (Transmitter) ● Positioning System Module ● Main Controller Module 	Weight is 0.84 kg

Item	Limit	Remarks
	<ul style="list-style-type: none"> ● Power Management Module ● Speed Monitor Module (17 mm Projectile) 	

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

S69 An Aerial must be mounted with a fully covered propeller guard, 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.
- DJI Mavic Pro Propeller Guard is displayed as below for reference:

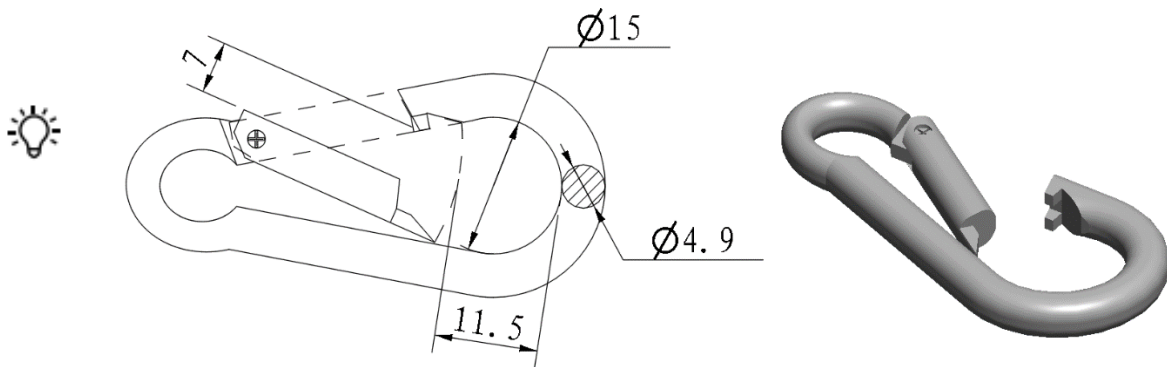


S70 While the fully enclosed propeller guard is being shot by a 42 mm projectile at the speed of 12 m/s from a distance of 2 meters, no part of the propeller cage is allowed to transform and touch the propeller nor interfere with its normal spinning. The 42 mm projectile must not penetrate the mesh of the propeller cage from any angle, which should not have a surface area bigger than 9 cm².

S71 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.

S72 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 safety rod that is 350±5 mm 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 safety rod must be joined with the Aerial, and its top end must have a rigid ring to be hooked onto the Aerial Safety Rope. The vertical rigid safety 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.

Teams must ensure the rigid ring on the protective rod can be joined normally with the Aerial Safety Rope hook. The dimensions of the Aerial Safety Rope hook are as follows:



S73 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.

S74 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 illuminance 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 illuminance of the flight status indicators on a DJI Matrice 100 Drone is 3200 Lux at a distance of 100 mm.

S75 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 between the external navigation lights and the center of an Aerial must exceed 1/3 of the radius of the maximum top view field of the robot.
- b) External navigation lights must use Light Indicators and be joined with the Aerial securely, but cannot be mounted on propeller blades. The Light Indicators must be at least 180 mm in total length, and must appear aesthetic, symmetrical and not create any parallel light rays.
- 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.

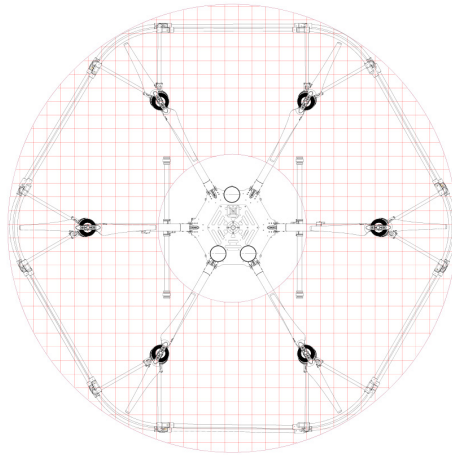


Figure 2-2 Effective Area for External Navigation Light

- S76 A single area of external navigation light of Aerial must have an illuminance at 100 mm away ranging between 500 - 2,000 Lux.
- S77 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.
- S78 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.
- S79 The Remote Controller used by an Aerial must have an Emergency Cut-Off function, to ensure the Aerial Robot is able to stop its propellers instantly through the Remote Controller in an emergency.

2.3.5 Sentry Robots

- S80 In RMUC, a Sentry Robot must have the functions for horizontal movement and launching 17 mm projectiles.
In RMUL, a Sentry Robot must have the functions for horizontal movement.

S81 The building parameters for Sentry are as follows:

Table 2-8 Sentry Building Parameters

Item	Limit	Remarks
Operating Mode	Fully automatic, with no more than one remote controller for debugging	-
Maximum Power Supply Capacity (Wh)	265	-

Item	Limit	Remarks
Maximum Power Supply Voltage (V)	30	-
Launching Mechanism	Maximum two 17 mm Launching Mechanisms	Two Speed Monitor Modules (17 mm projectile) must be installed
Maximum Weight (kg)	25	Includes battery weight, but not the weight of the Referee System
Maximum Initial Size (mm, L*W*H)	700 x 700 x 700	Its orthographic projection on the ground should not exceed a 700*700 square area
Maximum Expansion Size (mm, L*W*H)	800*800*800	Its orthographic projection on the ground should not exceed an 800*800 square
Referee System	<ul style="list-style-type: none"> ● Small Armor Module ● Speed Monitor Module (17 mm Projectile) ● RFID Interaction Module ● Positioning System Module ● Main Controller Module ● Power Management Module ● Light Indicator Module ● 17 mm fluorescent projectile energy-charging device ● Supercapacitor Management Module ● Video Transmitter Module (Transmitter) 	Weight is 3.47 kg

S82 During the inspection, participating teams are required to demonstrate functions of their Sentry Robots, such

as projectile launching, chassis movement, and gimbal movement, using remote controllers, custom controllers, and other devices.

2.3.6 Dart System

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

S83 A dart launcher must have the functions for loading darts and launching them for more than 5 meters, and must be mounted with a dart trigger device. Participating teams are required to provide a video of the dart launching system firing darts over 5 meters at pre-match inspection.

S84 A Dart uses its own vision system to locate a Dart Detection Module, 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 Dart Detection Module.

S85 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 Referee System port or Remote Controller to control the Dart Launcher.

S86 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. The colors of all Darts taken into the Competition Area must be set by staff at the Inspection Area.



- 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.
- 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.
- If the Dart Trigger Device experiences irregularities such as red-and-blue alternate lights and faulty light beads, it means the trigger device is damaged and the Base and Outpost are unable to detect Dart hits. Please replace with a backup Dart Trigger Device, otherwise all resulting losses shall be borne by the team.
- The use of compressed air is prohibited in propelling a Dart.

S87 The production parameters for a Dart is as follows:

Table 2-9 Dart Building Parameters

Item	Limit	Remarks
Maximum Power Supply Capacity (Wh)	4	-
Maximum Power Supply Voltage (V)	8.4	-
Maximum Weight (kg)	0.35	Not including the Dart Trigger Device (0.02 kg)
Maximum Size (mm, L*W*H)	250*250*150	<ul style="list-style-type: none"> ● The flight length of a Dart is no longer than 250 ● The wingspan of a dart is not greater than 250

S88 Dart can only be in the ready-to-launch state during the Seven-Minute Round.



Ready-to-Launch State: The energy storage component used for providing initial kinetic energy for Darts is in a tense, inflated, and rotating state. Energy storage component includes but not limited to rubber band, cylinder, friction wheel, etc.

S89 The production parameters for Dart Launcher are as follows:

Table 2-10 Dart Launcher Building Parameter Instruction

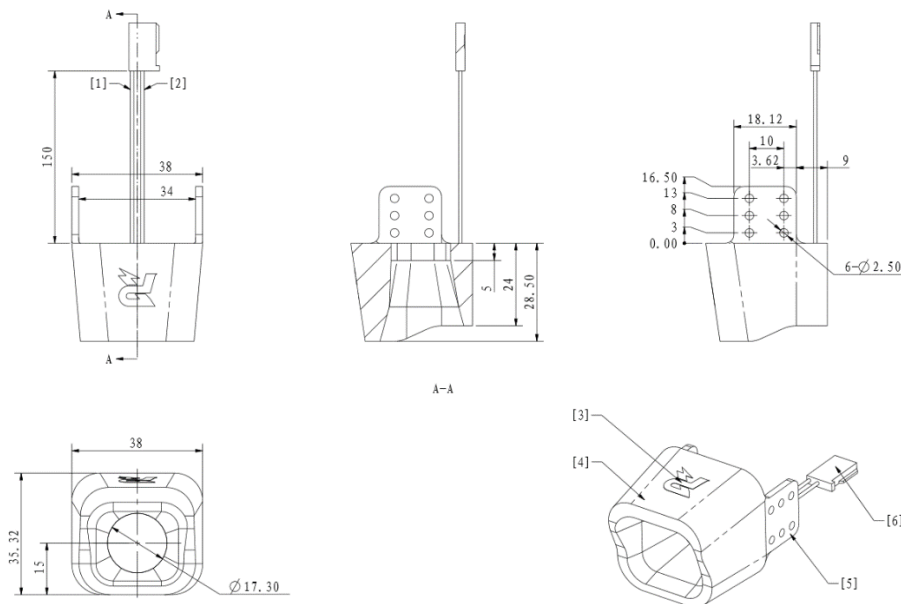
Item	Limit	Remarks
Operating Mode	No limits; to be equipped with no more than one remote controller.	Use of the Referee System Serial Port is recommended.
Rotation Angle (°)	<ul style="list-style-type: none"> ● Yaw angle: No restrictions ● Pitch angle: 25-45 	-
Maximum Total Power Supply Capacity (Wh)	265	-
Maximum Power Supply Voltage (V)	30	-
Maximum Operating Power (W)	No restrictions	-
Maximum Dart Load	4	-

Item	Limit	Remarks
Maximum Weight (kg)	25	Includes battery weight, but not the weight of the Referee System
Maximum Size (mm, L*W*H)	1000*600*1000	<ul style="list-style-type: none"> The Maximum Size shall be the size of the Dart Launcher after being loaded with 4 darts. The orthographic projection of the dart system on the ground shall in no case exceed a square area of 1000*600.
Referee System	Main Controller Module and Power Management Module	Weight is 0.22 kg

2.3.6.1 Mounting Specifications

Dart must be mounted with Dart Trigger Device provided by the RMOC. A Dart Trigger Device is a cream-white 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.



[1] GND Cable [2] +5 V Cable [3] Logo

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

Figure 2-3 Dart Trigger Device

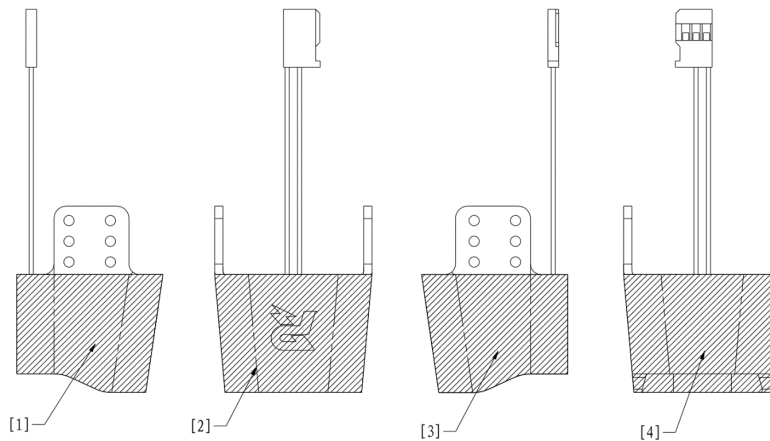
2.3.6.1.1 Installation Steps

1. Secure the Dart Trigger Device on the Dart head position using at least four M2.5 screws (two for each installation lug). Gaskets should be used when mounting screws.
2. Connect the power port of Dart Trigger Device with 5 V power supply.

2.3.6.1.2 Installation Requirements

S90 The dart trigger device will be dimmed when the battery voltage is low, and the participating teams need to ensure that the battery voltage used for the darts during the competition is at least 4 V.

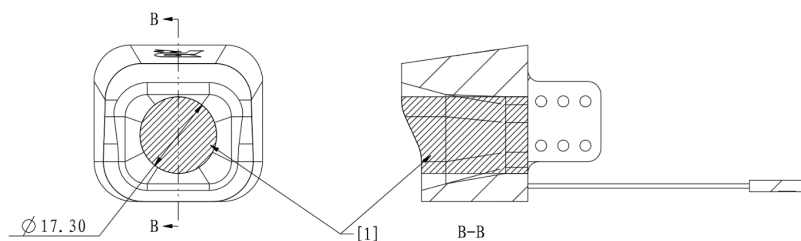
S91 After mounting Dart Trigger Device, its up and down, left and right sides must not be blocked by the Dart structure, as shown below.



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

Figure 2-4 Areas Not Allowed to Be Blocked on a Dart Trigger Device

S92 Dart camera or other devices can be mounted in the internal cavity of Dart Trigger Device. The mounting area must not exceed the shadow area as shown below.



[1] Shadow Area

Figure 2-5 Internal Cavity of a Dart Trigger Device

2.3.6.2 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. Please refer to the relevant descriptions of Outpost and Base in the [RoboMaster 2024 University Championship Rules Manual](#).

2.3.6.3 Dart Launching Station

A Dart Launching Station is considered official battlefield component. The gate of a Dart Launching Station can be in either the open or closed status. The Dart Launching Station is set within the dart launching station. For details, please refer to the relevant descriptions of the dart launching station in the [RoboMaster 2024 University Championship Rules Manual](#).

2.3.7 Radars

S93 A Radar consists of two components: the computing platform and the sensor. Both ends need to be connected by an electric cable. A radar must include a computing platform and sensor, and be able to display commissioning images.

S94 The production parameters for a Radar Computing Platform are as follows:

Table 2-11 Radar Computing Platform Building Parameter Instruction

Item	Limit	Remarks
Operating Mode	Fully automatic, with no more than one remote controller for debugging	-
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.

Item	Limit	Remarks
Maximum Expansion Size (mm, L*W*H)	600*350*600	Its orthographic projection on the ground should not exceed a 600*350 rectangular area.
Referee System	<ul style="list-style-type: none"> ● Main Controller Module ● Power Management Module 	Weight is 0.22 kg

S95 The parameters for a Radar Sensor are as follows:

Table 2-12 Radar Sensor Parameter Instruction

Item	Limit	Remarks
Maximum Weight (kg)	30	-
Maximum Expansion Size (mm, L*W*H)	1200*1200*1500	<ul style="list-style-type: none"> ● Its orthographic projection on the ground should not exceed a 1200*1200 rectangular ● The recommended height for the mounting bracket of Radar sensor is at least 1.2 m.

2.3.7.1 Mounting Specifications



- The surface of the Radar Foundation 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 Foundation.
- 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.

2.3.7.2 Computing Platform

During the Three-Minute Setup Period, teams shall place their computing platforms on a designated surface near the Radar Foundation. The surface should provide at least two 10 A five-hole power outlets supplying utility power, a video signal transmission cable for connecting the official display devices (with an HDMI Type A plug), and an official display device. 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.

S96 The Referee System of a Radar can only be mounted on the Computing Platform.

S97 No wireless devices shall be installed or used on the computing platform. If the wireless device cannot be removed, it needs to be set to disabled in the operating system.

S98 The Main Controller Module and Power Management Module must conform to the module installation standards and 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 RMOC for this season.



- The alternating current provided by the organizer is 220 V 50 Hz, and the power outlets are based on the Chinese national standards. Teams shall prepare their own power supply adapters as needed.
 - The RMOC only ensures the normal operation of the official display device on the Radar Foundation and the HDMI cable provided by the RMOC. Teams must resolve connection issues on their own.
-

2.3.7.3 Sensor



Teams need to install their own protective guards on their equipment, to prevent damage caused by projectile impact during the competition.

S99 Sensors must be fixed on the Radar sensor mounting bracket and placed on the Radar Foundation.

S100 Teams must design their own Radar sensor mounting bracket to increase the elevation for the installation of sensors.

S101 The size of the radar sensor mounting bracket should allow for proper installation on the surface of the Radar Foundation and be able to be lifted with one arm. The specifications of the radar foundation should follow the relevant descriptions of the Radar Foundation in the [RoboMaster 2024 University Championship Rules Manual](#). The signal transmission and power supply of the sensor must be handled by the participating teams themselves.

S102 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.

3. Referee System Mounting Specifications

3.1 Overview

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 specifications stated in this chapter.

- The RMOC provides Referee Systems for loan. Teams will obtain permissions to borrow the Referee System through passing technical assessments. See the "Season Schedule" in the [Participant Manual](#) for details.
- Chassis Power: The power propulsion system that enables a robot to conduct translational and rotational motion in the horizontal direction, not including the power used for special tasks (e.g. power consumption for functional movements such as moving the upper mechanical structure, climbing steps or overcoming obstacles). Therefore, the power generated by the power supply used by the power system actuator for mechanical structures related to chassis horizontal movements counts as chassis power. For example, the motors, steering gears, electromagnetic switches and other components for regulating the direction of chassis motors or other energy storage mechanical structures (including but not limited to springs, pneumatic systems, rubber bands, and tension springs).
- Any equipment used by the participating teams must not interfere with the normal operation of the referee system. If interference exists, the participating teams must cooperate with the committee to deal with the source of interference until no more interference is generated.



A Referee System consists of the following modules:

Table 3-1 Referee System Component Modules

Module	Introduction
<p>Main Controller Module</p>	<p>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.</p>

Module	Introduction
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 Indicator.
Armor Module	An Armor Module is used to detect situation where the robot is hit by projectiles. There are Small Armor Module and Large Armor Module.
Speed Monitor Module	A Speed Monitor Module is used to detect the Initial Projectile Speed and Barrel Heat of robots. They are divided into Speed Monitor Module (17 mm projectile) and Speed Monitor Module (42 mm projectile).
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 display in the Operator Room.
Positioning System Module	A Positioning System Module can detect a robot's location on the Battlefield.
17 mm Fluorescent Projectile Energy-Charging Device	The 17 mm fluorescent projectile energy-charging device provides light energy to 17 mm fluorescent projectiles.

Module	Introduction
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 Robot Referee System Module Configuration

Robot Type Quantity	Hero Robots	Engineer Robots	Standard Robots	Balancing Standard Robots	Aerial Robots	Sentry Robots	Dart System	Radars
Main Controller Module	1	1	1	1	1	1	1	1
Power Management Module	1	1	1	1	1	1	1	1
Light Indicator Module	1	1	1	1	0	1	0	0
Large Armor Module	4	0	0	2	0	0	0	0
Small Armor Module	0	4	4	0	0	4	0	0
Video Transmission Module (Transmitter)	1	1	1	1	1	1	0	0
RFID Interaction	1	1	1	1	0	1	0	0

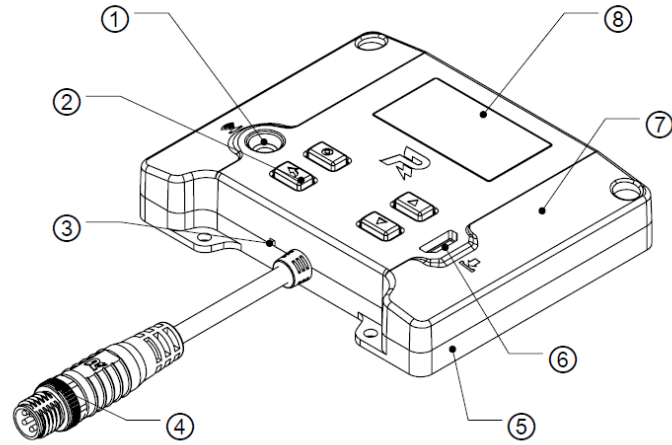
Robot Type Quantity	Hero Robots	Engineer Robots	Standard Robots	Balancing Standard Robots	Aerial Robots	Sentry Robots	Dart System	Radars
Module								
Speed Monitoring (17 mm) Module	0	0	1	1	1	2	0	0
Speed Monitor Module (42 mm) Module	1	0	0	0	0	0	0	0
Positioning System Module	1	1	1	1	1	1	0	0
Supercapacitor Management Module	1	0	1	1	0	1	0	0



Positioning system modules do not have to be mounted on robots in RUML.

3.3 Mounting Specifications for 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] Aviation connector with black metal ring |
| [5] Metal Bottom Cover | [6] Upgrade Interface | [7] Plastic Top Cover | [8] Screen |

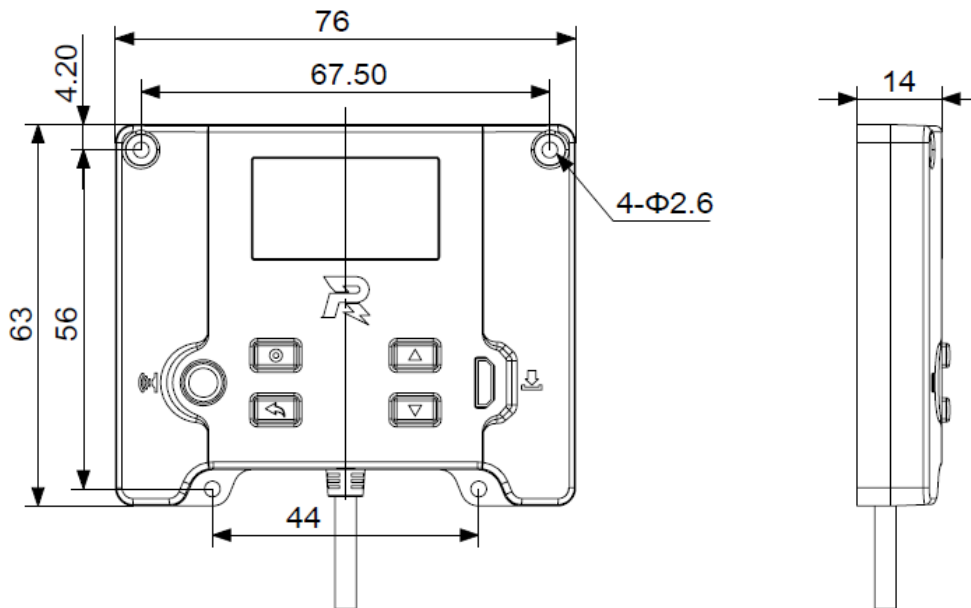


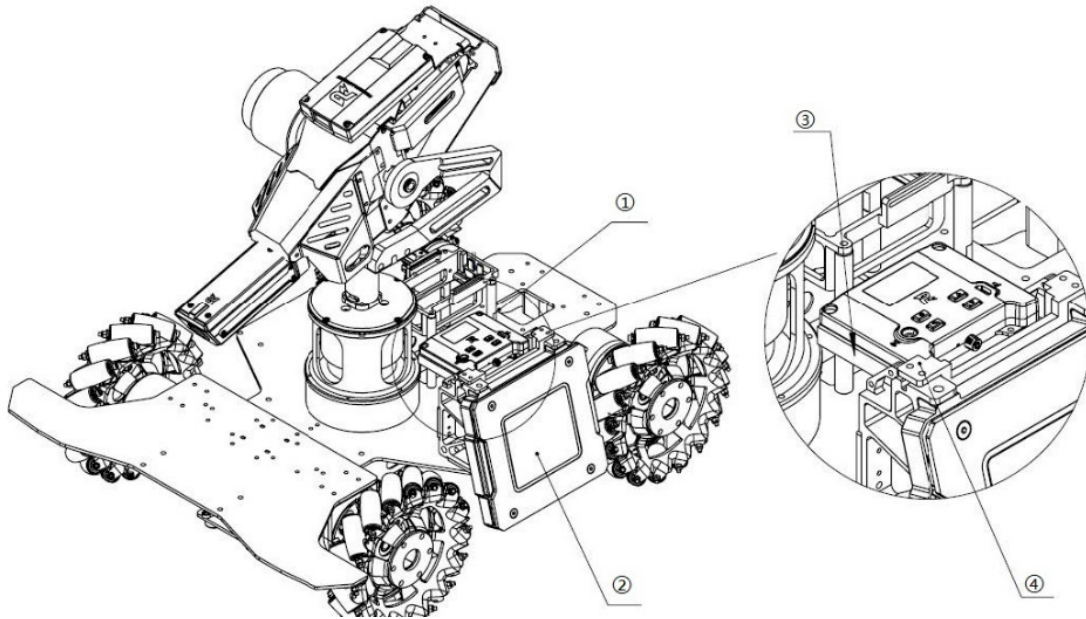
Figure 3-1 Main Controller Module

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 and install them on the back of the upper edge of the Armor Module (the reserved M3 threaded hole on the armor support frame can be used), with non-metal guards installed around them to prevent projectile hits.



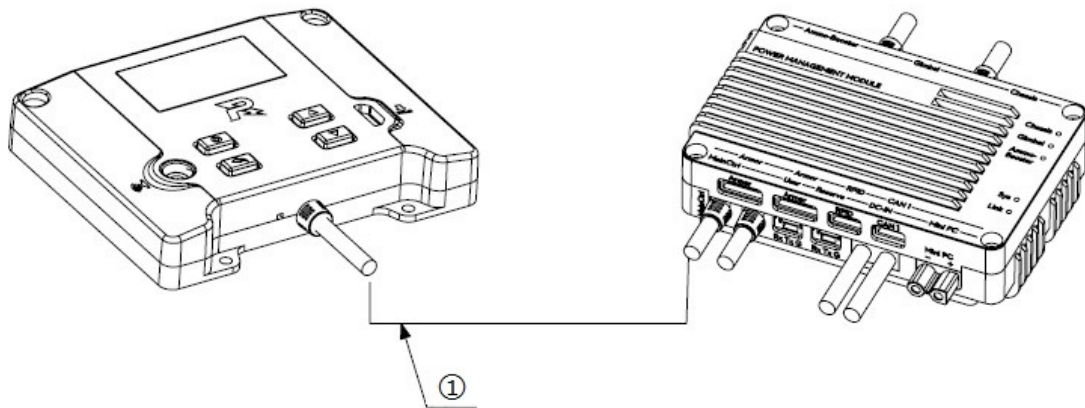
- | | | | | | | | |
|-----|------------------------|-----|--------------|-----|--------------------------------|-----|--------------------|
| [1] | Main Controller Module | [2] | Armor Module | [3] | Self-Designed Protective Guard | [4] | Self-designed Part |
|-----|------------------------|-----|--------------|-----|--------------------------------|-----|------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

Figure 3-2 Mounting Main Controller Module

- Use the aviation cable inside the package to connect the Main Controller Module to the aviation connector port 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.



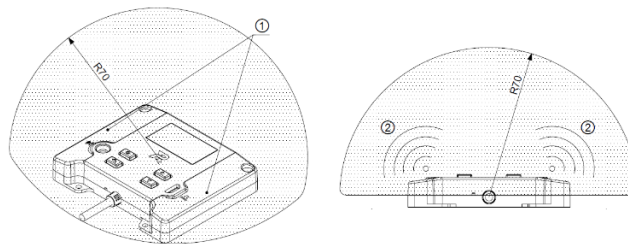
[1] Aviation Cable

Figure 3-3 Main Controller Module Connection

3.3.2 Installation Requirements

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

- S103 Ensure the top surface of the Main Controller Module of a robot faces up horizontally when it is in working condition.
- S104 The space above the main controller module screen, keys, ports, and infrared receiver must not be obstructed. When designing a protective device, only transparent materials that are easy to open can be used. If it cannot be opened, the screen, keys, ports, and infrared receiver need to be fully exposed for easy operation by staff.
- S105 No electromagnetic shielding material (including but not limited to metals, carbon fiber, conductive rubber, wave-absorbing materials, and conductive complexing agents) or other equipment carrying electromagnetic interference should be placed within a 70 mm radius to avoid interfering with the WiFi signal, with the center being 14.5 mm directly below the center point of the logo.



[1] Antenna Position [2] Signal Direction

Figure 3-4 Mounting Position of the Main Controller Module

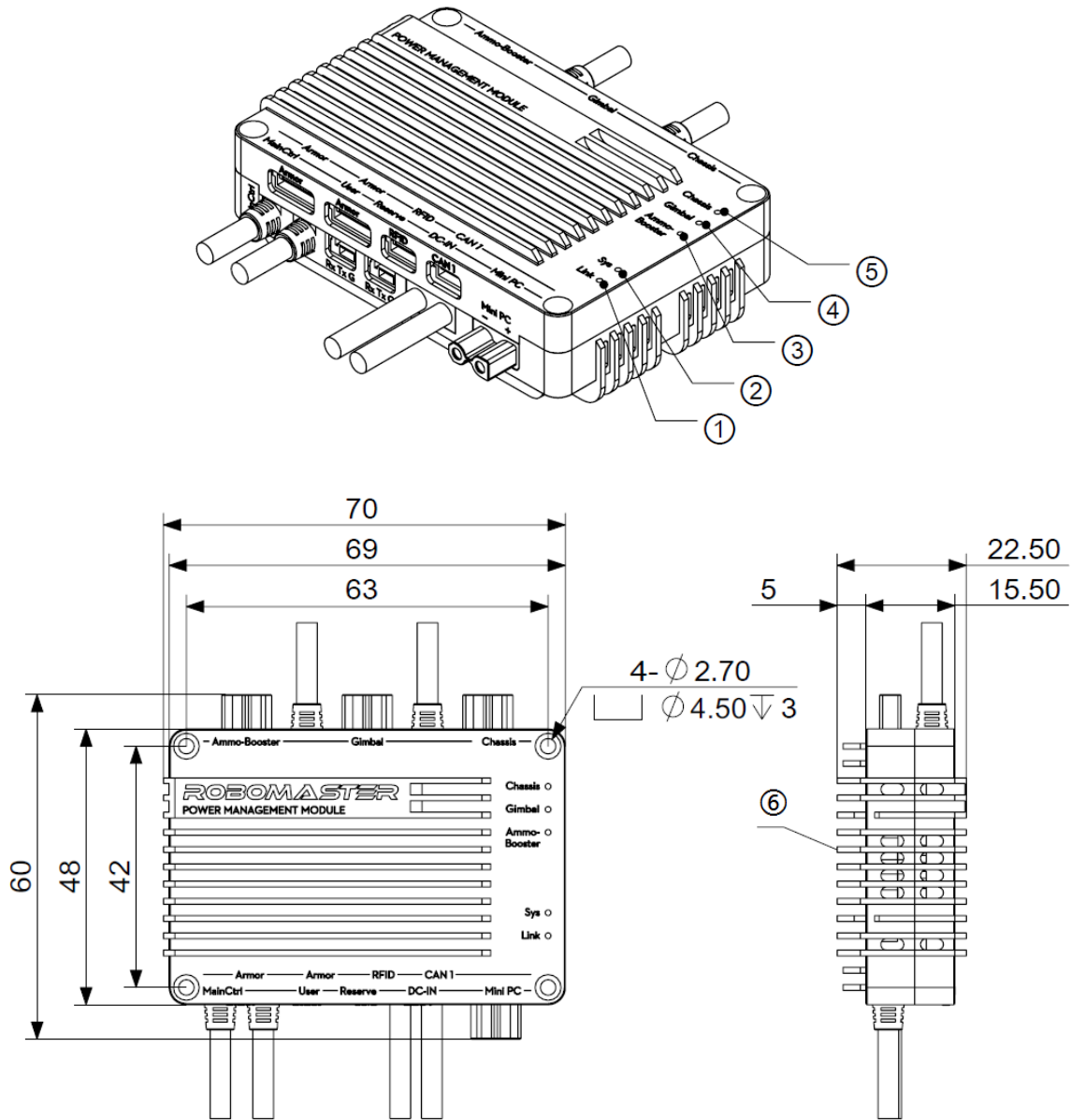
S106 During a match, participants must use the Main Controller Module installed by the RMOC on the site for their Dart Systems and Radars.



During the official competition, the dart system and radar should use the main controller module installed at the venue by the committee; when designing the mounting position of the robot's main controller module, it is not necessary to follow the above requirements, but it is necessary to reserve an aerial cable for connection with the main controller module provided by the committee.

3.4 Mounting Specifications for 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

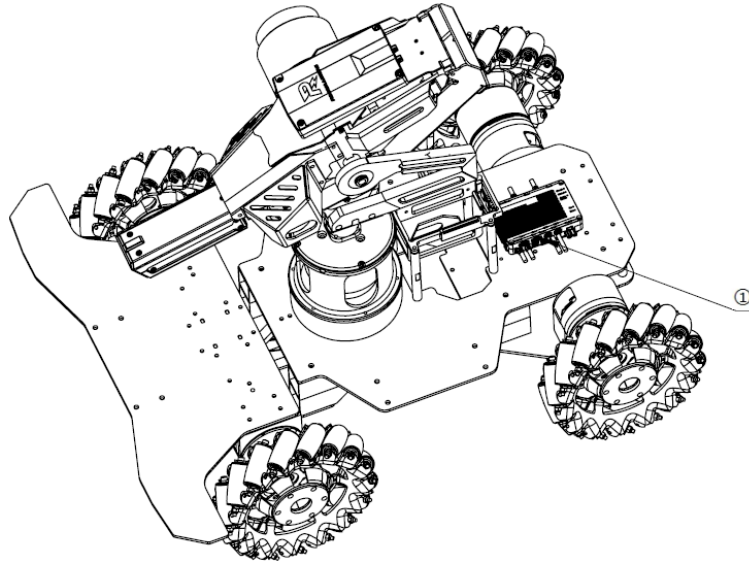
Figure 3-5 Power Management Module

3.4.1 Installation Steps



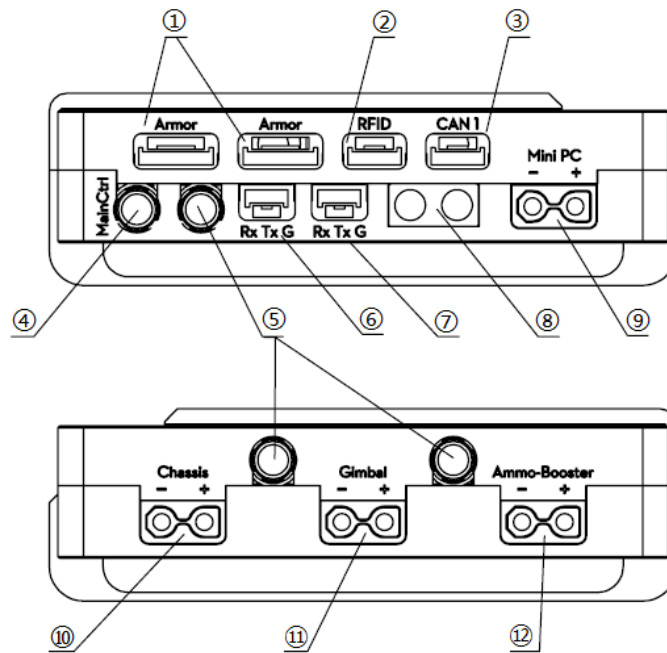
The aviation connector port of the Light Indicator Module, Video Transmitter Module (Transmitter), Speed Monitor Module and Positioning System Module are all equivalent ports and can be serially connected to each other.

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



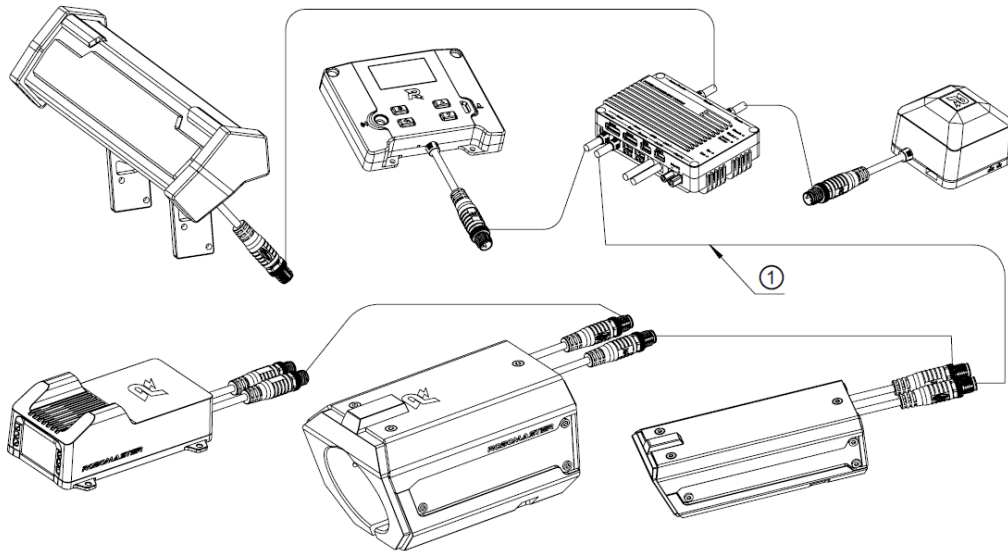
[1] Power Management Module

Figure 3-6 Mounting Power Management Module



- [1] Armor Module SM06B-GHS-TB Port
- [2] RFID Interaction Module SM04B-GHS-TB Port
- [3] Capacitor Management Module SM04B-GHS-TB Port
- [4] Main Controller Module Port (the metal ring of the aviation connector port is black)
- [5] Ports of other Referee System Modules (Speed Monitor, Positioning System, Video Transmitter, and Light Indicator; the metal ring of the aviation connector port is silver in color)
- [6] Referee System Serial Port 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



[1] Aviation Cable

Figure 3-8 Power Management Module Connection

3.4.2 Installation Requirements

The mounting of a power management module must meet the following requirements:

- S107 The status indicators of the Power Management Module are not blocked.
- S108 Each port on the Power Management Module is protected, to prevent projectile hits. However, the outer shell cannot be completely wrapped, so as to ensure good heat dissipation.
- S109 Do not use glue such as 3M tape to secure the Power Management Module.
- S110 For a robot with a chassis power limit, the electric power consumed by the chassis power mechanism must be taken into account to ensure it does not bypass the monitoring of the Power Management Module.
- S111 Participants must use the Main Controller Module installed by the RMOC on the site for their Dart Systems and Radars. As such, teams are required to meet the following requirements when designing their robots:
- Expose the Power Management Module and Main Controller Module port when designing the Dart System and Radar.
 - Have the Power Management Module installed close to the portal of the Dart Launching Station when designing the Dart System.
- S112 Carefully differentiate between the ports on the Power Management Module to ensure correct cabling.

Except for the chassis power supply for Standard, Sentry and Hero Robots, the other power supply interfaces of a robot may be connected to a battery to ensure a stable power supply for these interfaces (such as for the gimbal or 42 mm Launching Mechanism). The power may be controlled through a relay or other method, but its on-off control must be operated via the corresponding Power Management Module interface shown in the table below (the relay or other method must be powered through the corresponding interface; make sure the Referee System is able to turn on and off all power supply connected to the robot’s Referee System Power interface (Output); any failure to do so will be considered as cheating).



- The supercapacitor module is not allowed to power the robot when the Chassis port of the chassis power supply is disconnected.
- If a Hero Robot is not installed with a 17 mm Launching Mechanism, the Gimbal interface will not receive any power supply, meaning the robot’s gimbal power supply will have to be connected to the Chassis port of the Power Management Module.
- If the Radar or Dart Launcher requires a 24 V power interface, it can be powered directly through the "Mini PC" interface of the Power Management Module or the battery.
- The symbol "-" in the table signifies a non-power supply interface.


Table 3-3 Power Management Module Port Instruction

Robot type/power supply	Chassis power supply	Gimbal power supply	17 mm Launching Mechanism power supply	42 mm Launching Mechanism power supply	Mini PC Power Supply
Hero Robots	Chassis	Gimbal	-	Ammo-Booster	Mini PC
Engineer Robots	Chassis	Chassis or Gimbal	-	-	Mini PC
Standard Robots	Chassis	Gimbal	Ammo-Booster	-	Mini PC
Aerial Robots	-	Gimbal	Ammo-Booster	-	Mini PC
Sentry Robots	Chassis	Gimbal	Ammo-Booster	-	Mini PC

Robot type/power supply	Chassis power supply	Gimbal power supply	17 mm Launching Mechanism power supply	42 mm Launching Mechanism power supply	Mini PC Power Supply
Dart Launcher	-	-	-	-	-
Radars	-	-	-	-	-

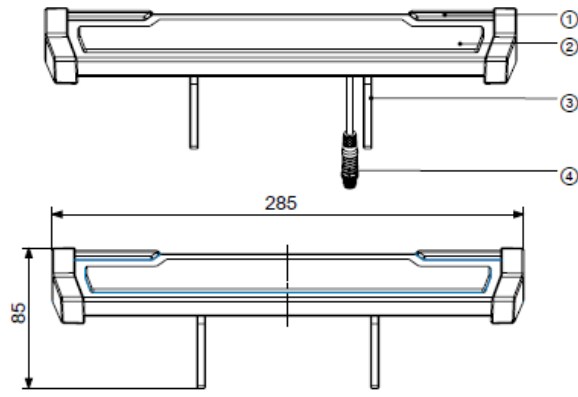
S113 The circuit board and circuit of a robot with a chassis power limit must meet the following requirements:

- 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 recommended that teams 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 are connected using only cables with a diameter specification of 24 AWG or smaller, and can only be used for communication, with the total current flow equal to or smaller than 50 mA.

- Input voltage requirements for a Power Management Module: 22 V-26 V. Power output ports No. 10, 11 and 12 in the graph can be connected and disconnected by the Referee System. The highest single-channel load of No. 10 "Chassis" and No. 11 "Gimbal" ports is 10 A, and the longest duration for its peak value of 30 A is 500 ms. As for No.12 "Ammo-Booster" port, the maximum continuous payload for a single circuit is 8 A, and the longest duration for its peak value of 20 A is 500 ms. The total maximum continuous payload for ports No. 10, 11 and 12 is 20 A. The maximum continuous payload for a single circuit connected to power output port No. 9 in the graph is 6 A.
- 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 20 A 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 Specifications for Light Indicator Module

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

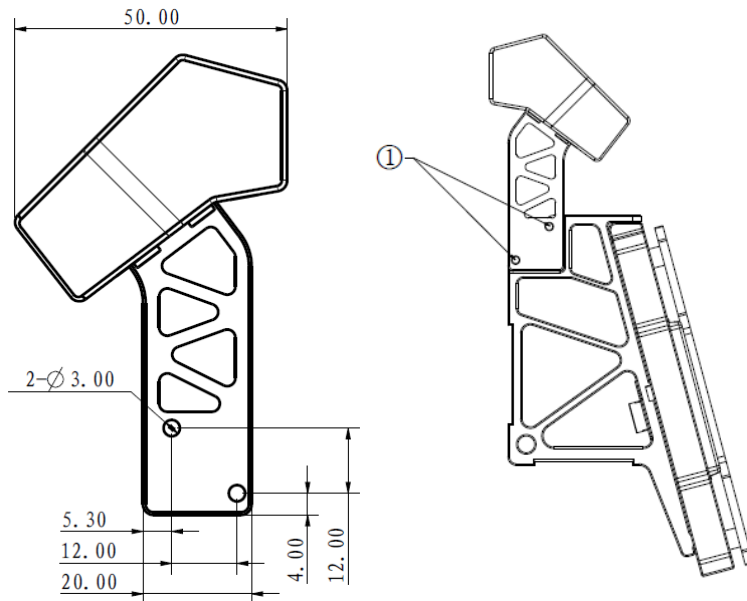


- [1] Auxiliary Light Indicator
- [2] Main Light Indicator
- [3] Mounting bracket
- [4] Aviation connector port

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.



[1] Screw Hole Mounting Position

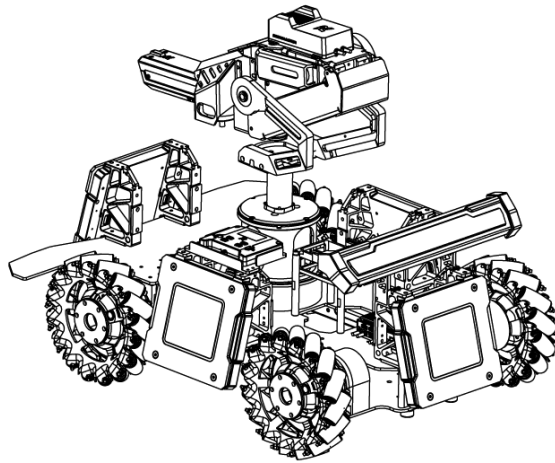


Figure 3-10 Mounting Light Indicator Module

- 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.

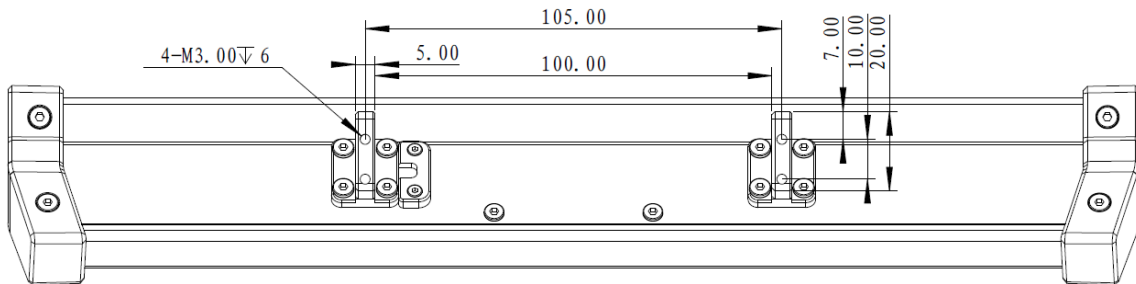
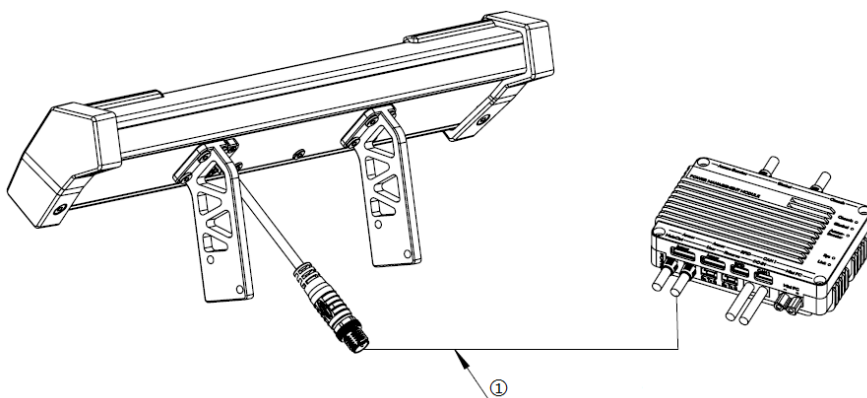


Figure 3-11 Bottom of Light Indicator Module

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



[1] Aviation Cable

Figure 3-12 Light Indicator Module Connection

3.5.2 Installation Requirements

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

- S114 The connection cables of the left and right auxiliary Light Indicators are parallel to the ground.
- S115 The main and auxiliary Light Indicators should be fully visible from at least one horizontal viewing angle.
- S116 Except for Sentry and Engineer Robots, the Light Indicator Module must be installed firmly on the robot chassis mechanism.
- S117 When mounting Light Indicator Modules on a Ground Robot, the illuminant part must be at least 200 mm from the ground.
- S118 When mounting Light Indicator Modules on a Sentry, the modules are always situated at the highest point of the robot (except for the Positioning System Module and its mounting bracket), and at least 80% of their illuminant part must be exposed when viewed from the top of the robot.

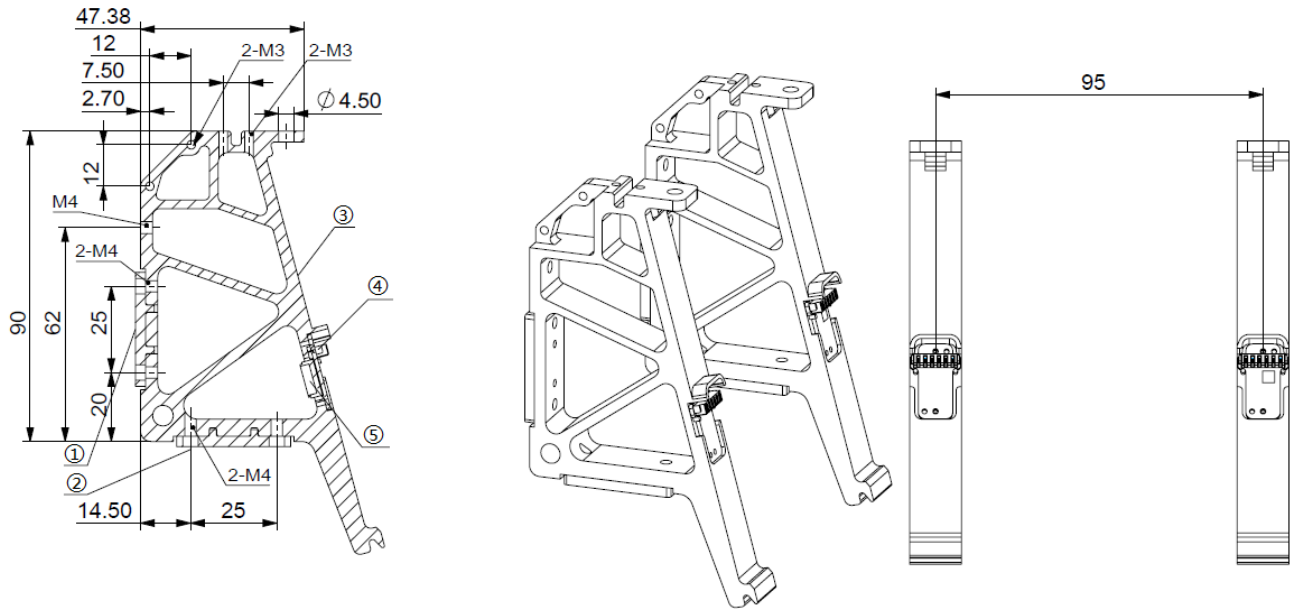
3.6 Mounting Specifications for Armor Module

An Armor Module is mounted on a robot using a designated armor support frame.



- The Armor Support Frame designated for use in this season shall be Armor Support Frame Type A.
- The 17 mm Speed Monitor Module is not considered a blockage of the armor. However, it must not be used to obstruct the Armor Module or interfere with the armor's visual features intentionally.

Below shows the designated armor support frame:

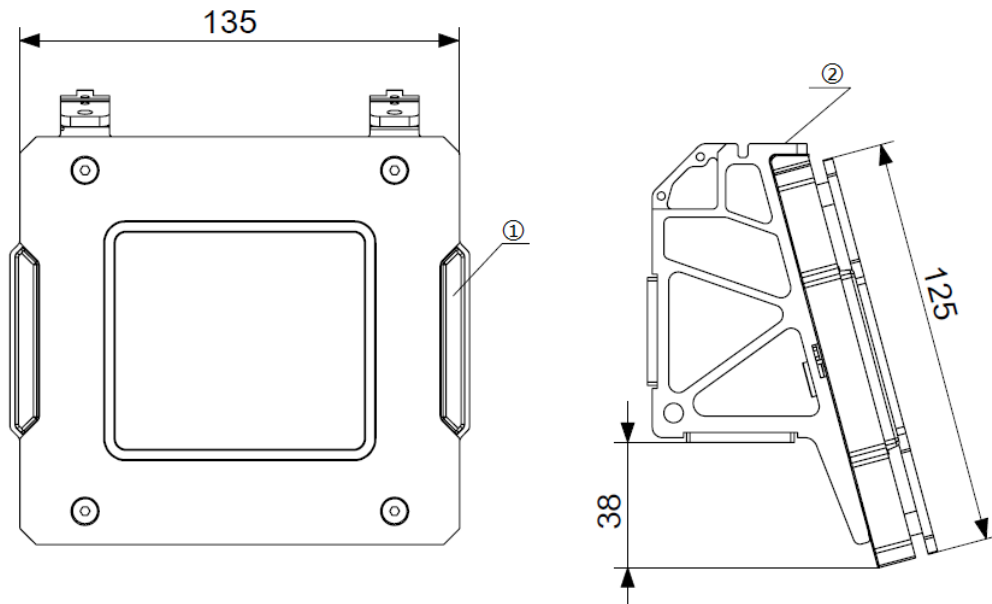


- [1] Back Mounting Surface
- [2] Bottom Mounting Surface
- [3] Armor Module Mounting Surface
- [4] Electrical Connection Point
- [5] JST 6-pin Port

Figure 3-13 Designated Armor Support Frames

S119 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.

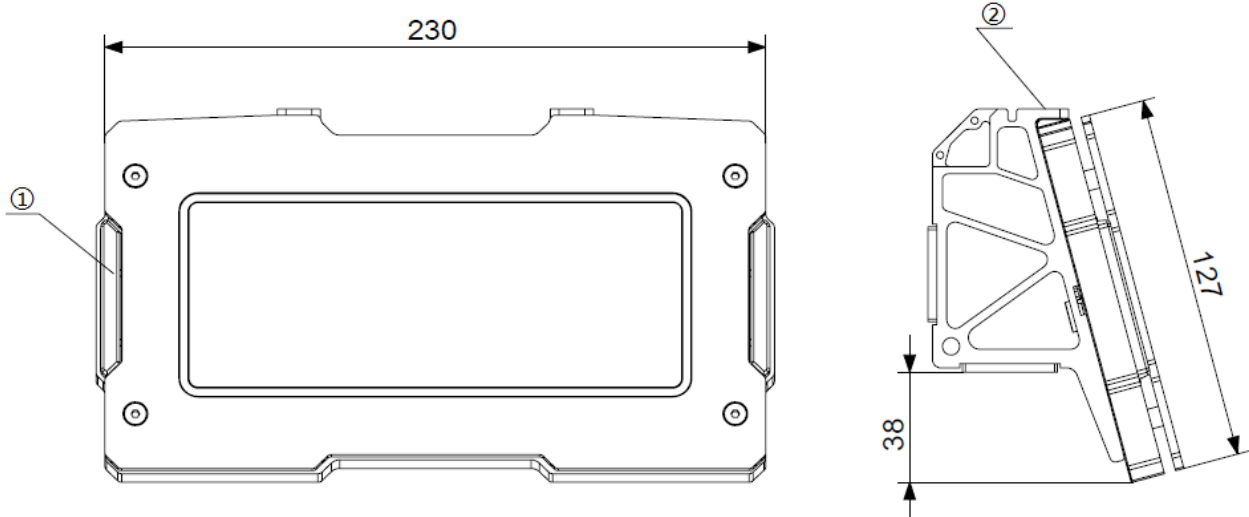
Below shows the small armor support frame:



- [1] Side Light Indicator
- [2] The top fastened with M4 screws

Figure 3-14 Small Armor Modules

The Large Armor Module is shown in the figure below:



[1] Side Light Indicator [2] The top fastened with M4 screws

Figure 3-15 Large Armor Modules

S120 Do not modify or decorate the Armor Modules.

3.6.1 General



Robot Chassis: A mechanism that carries the robot propulsion system and its accessories; a mechanism that supports the body of a robot.

In the below description, the standard Cartesian coordinate system consisting of x, y and z axes is used for the robot, and the origin is the robot’s center of mass. According to the installation requirements for Armor Modules on ground robots, the direction with theoretically the greatest efficiency based on the robot’s chassis structure shall be the robot’s X-axis (if multiple directions with the greatest efficiency exist, then any of them may be fixed as the X-axis), and the direction pointing to the center of the earth shall be the Z-axis. Together, these will form the robot’s coordinate system. The X-axes for various chassis structures are shown below:

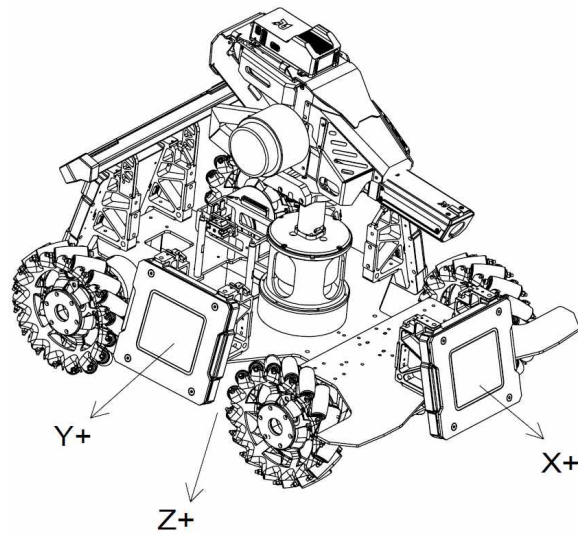


Figure 3-16 Robot Coordinate System

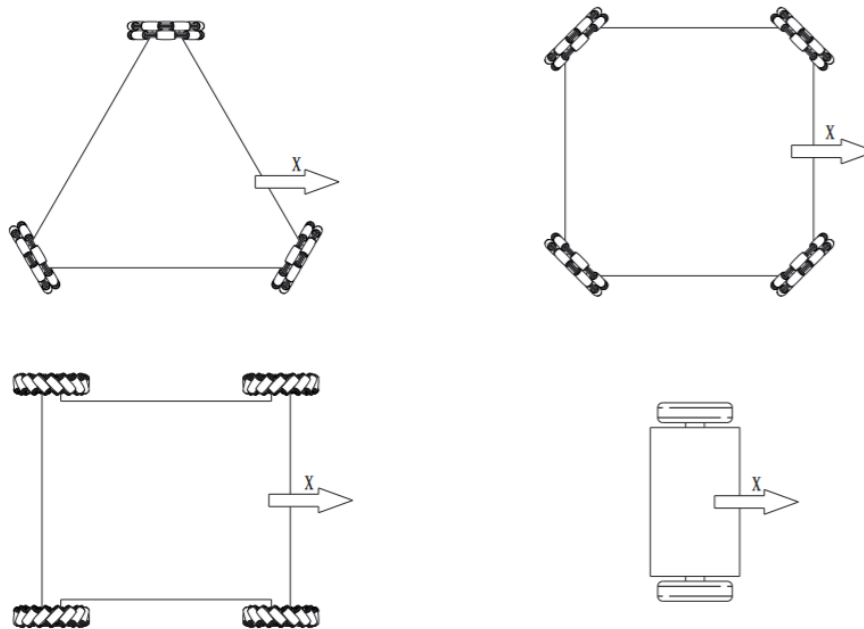


Figure 3-17 The X-axes of Different Robot Chassis Structures

3.6.1.1 Mounting the Armor Module

S121 When an Armor Module is mounted on a robot, the Armor Module and the Armor Support Frame must be connected firmly together. The bottom connecting surface of the Armor 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 (the positive X-axis and negative X-axis for Balancing Standard Robots), and the angular error between the direction vector and the corresponding coordinate axis vector cannot exceed 5° .

S122 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.

3.6.1.2 Rigid Connection

S123 A mounted Armor Module and Support Frame must be rigidly connected to the chassis. 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 60 N 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° .

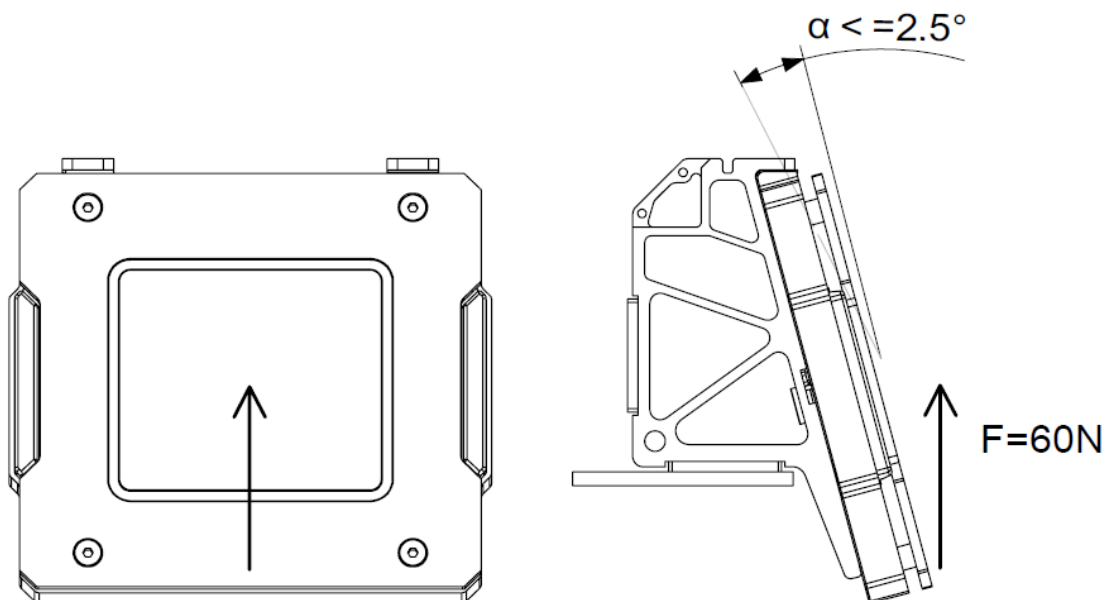


Figure 3-18 Force Application on Armor Module

3.6.1.3 Robot Transformation

S124 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, its Armor Modules must meet the following requirements: No Armor Module is allowed to move rapidly, continuously and reciprocally relative to the robot's chassis. The definition of moving fast is the movement speed exceeding 0.5 m/s.

S125 The difference in height between the lower edges of any two armor modules of the Ground Robot should not be more than 100 mm.

S126 For a Ground Robot, 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.

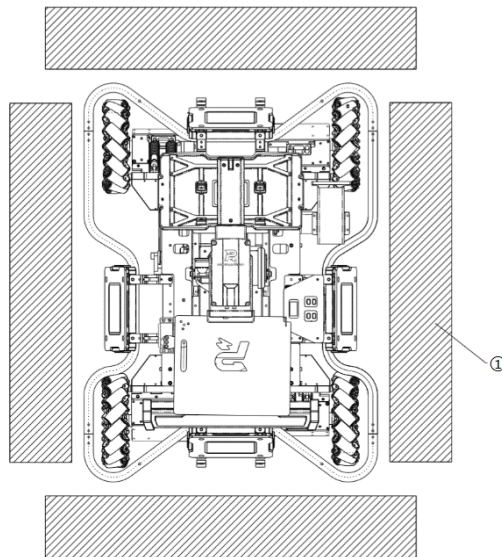


- When the plane that supports the robot body is no longer be ground, the requirement of the Armor Module mounting height should be subject to the robot body support plane.
 - The height limit from the lower edge of a robot's Armor Module to the ground can be exceeded only when the robot is climbing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

3.6.1.4 Armor Module Protection

S127 Teams should design safety rods for ground robots to reduce any damage caused by collision of Armor Modules.

S128 When any side of a robot is closely up against 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 3-19 Robot Protection

S129 Self-designed protective shells cannot have any contact with the Armor Modules provided by the RMOC.

3.6.2 Installation Steps

Ground Robots (excluding Balancing Standard Robots):

The installation steps for the Armor Modules of Ground Robots (excluding Balancing Standard Robots) are the same. Below is an illustration of the installation steps using the Armor Modules of Standard as an example.

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

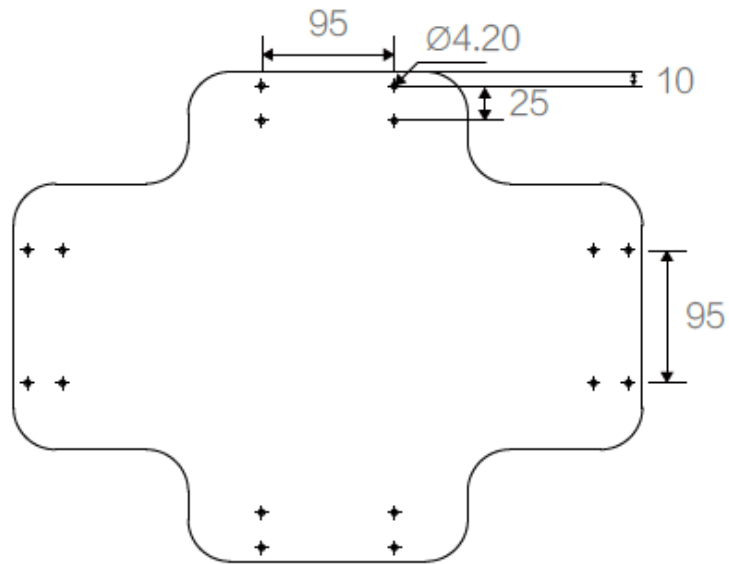


Figure 3-20 Reserved Holes on the Chassis

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

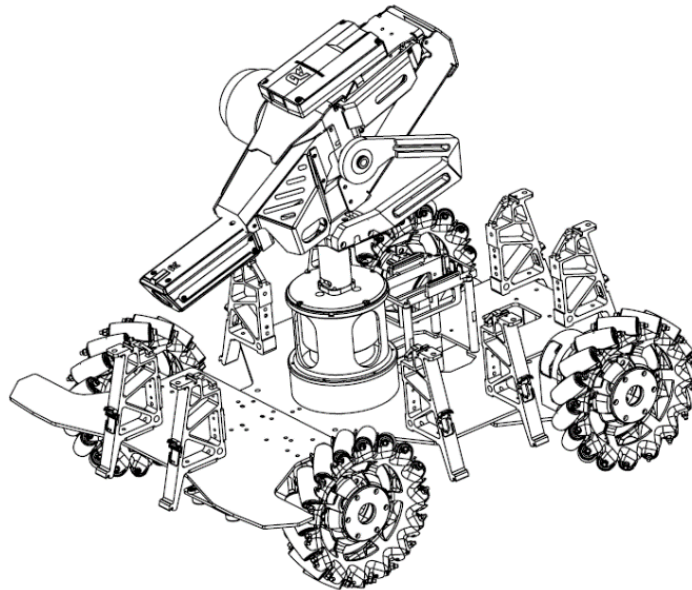


Figure 3-21 Mounting Armor Support Frame

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

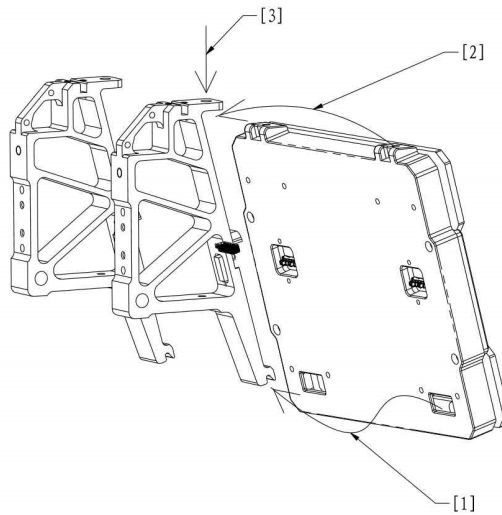
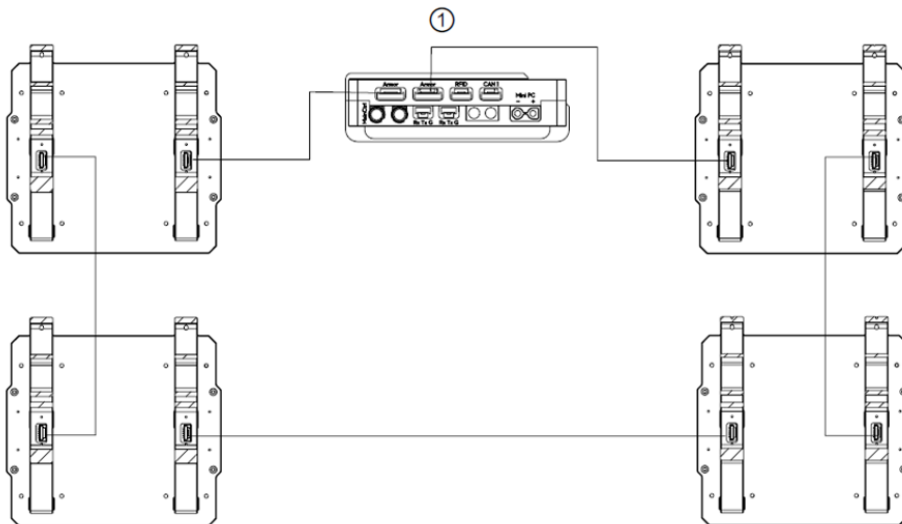


Figure 3-22 Mounting Armor Module

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.



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



[1] Power Management Module

Figure 3-23 Armor Module Connection

Balancing Standard Robot:

1. As per the dimensions in the drawings below, two sets of built-in holes shall be preserved on the chassis, with each corresponding to one Armor Module.

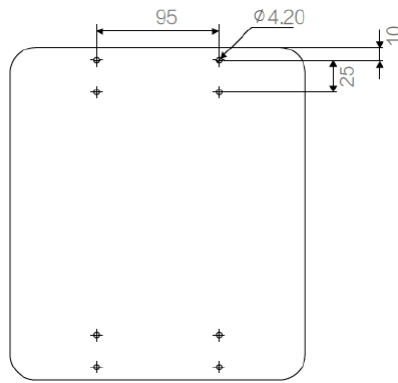


Figure 3-24 Reserved Holes on the Chassis

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

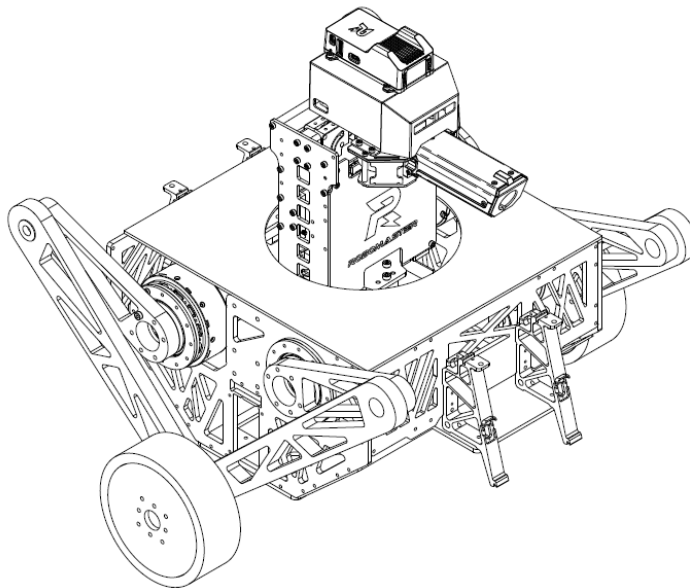


Figure 3-25 Mounting Armor Support Frame

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

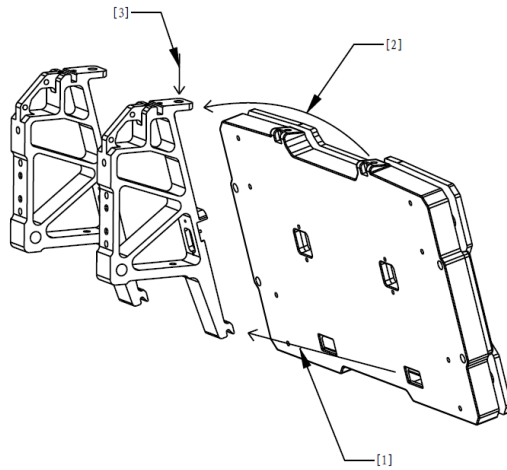
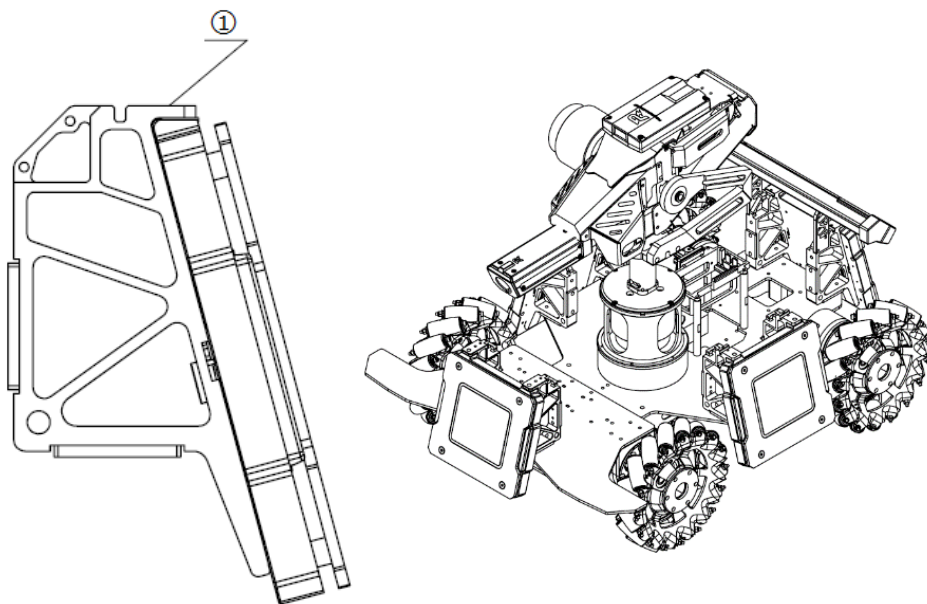


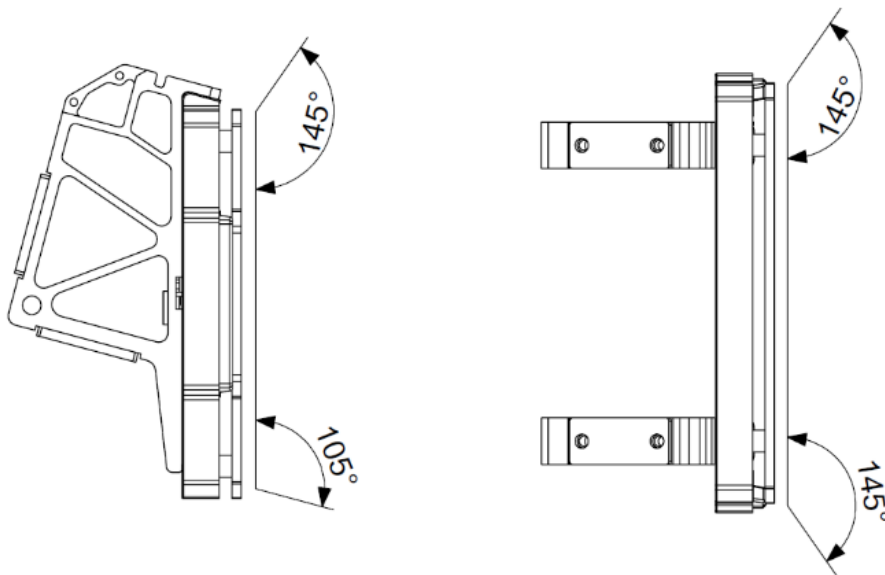
Figure 3-26 Mounting Armor Module

3.6.3 Installation Requirements

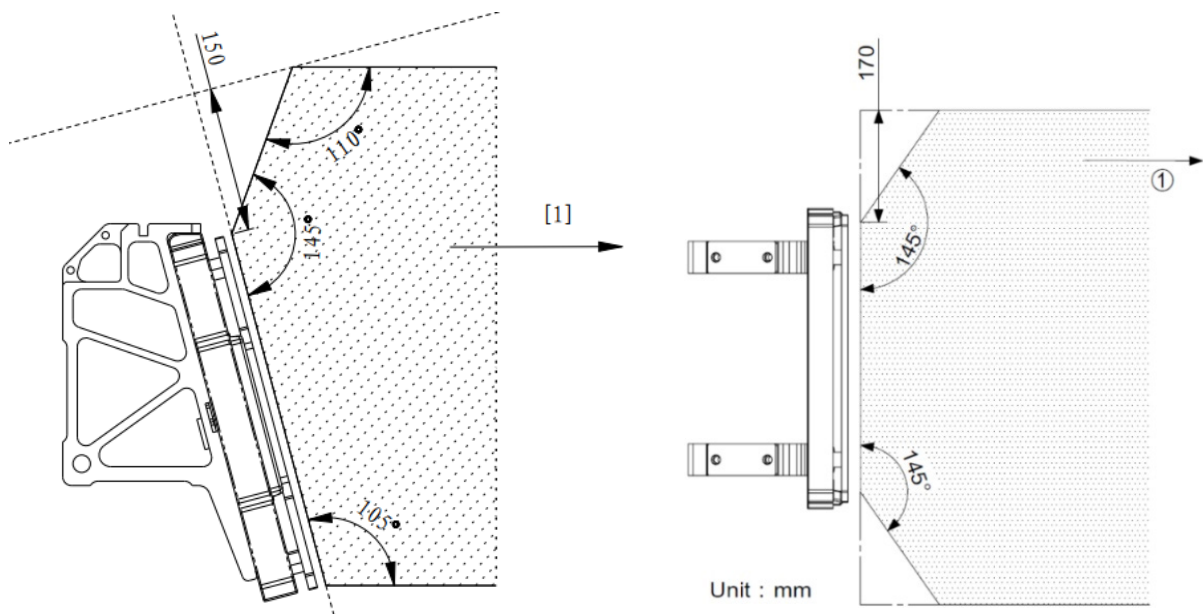
S130 The lower 105° area, and the upper, left and right 145° areas of the impact surface on the Armor Modules of Hero, Standard and Sentry Robots must not be blocked.



[1] The top fastened with M4 screws

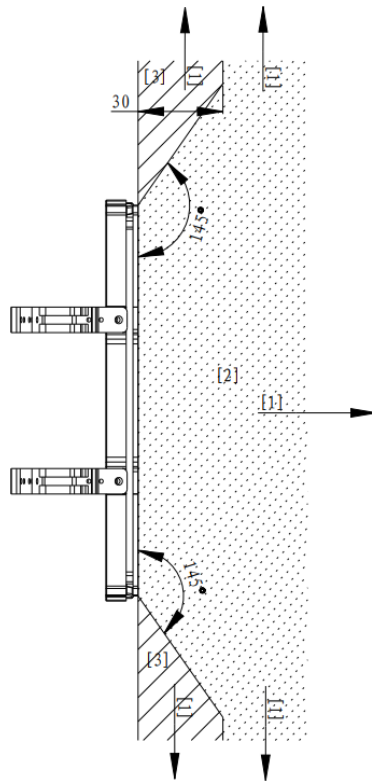


S131 For the armor modules of Engineers, the area within 105° of the lower edge of their impact surface must not be blocked. The vertical distance between the outer edge of a robot below its armor module and the lower edge of the module must be smaller than 100 mm. The areas within 145° of the upper, left and right edges of at least three of four Armor Modules must not be blocked. At most one Armor Module is allowed to be blocked in the above-mentioned areas under certain conditions, including: On the plane of the impact surface of the Armor Module, the area beyond 150 mm from the upper edge or the area beyond 170 mm from the left and right edges of the Armor Module can be obstructed, i.e. the grey areas in the following drawings cannot be obstructed.



[1] Unlimited extension

S132 The space extending 30 mm to the left and right of any impact surface on a Balancing Standard Robot’s armor module must not be blocked, that is, the areas shown in the below image must not be blocked.



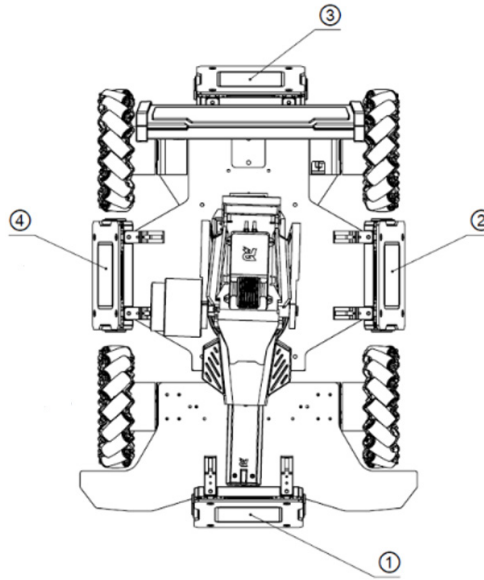
- [1] Unlimited extension
- [2] Area not allowed to be blocked
- [3] Area allowed to be blocked

3.6.4 ID Number Configuration

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

Grounds Robots (excluding Balancing Standard Robots):

S133 According to the armor module installation requirements for Ground Robots, after activating the ID setting mode, the Armor Module facing the Video Transmitter Module (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 3-27 Ground Robot Armor Module ID Setting

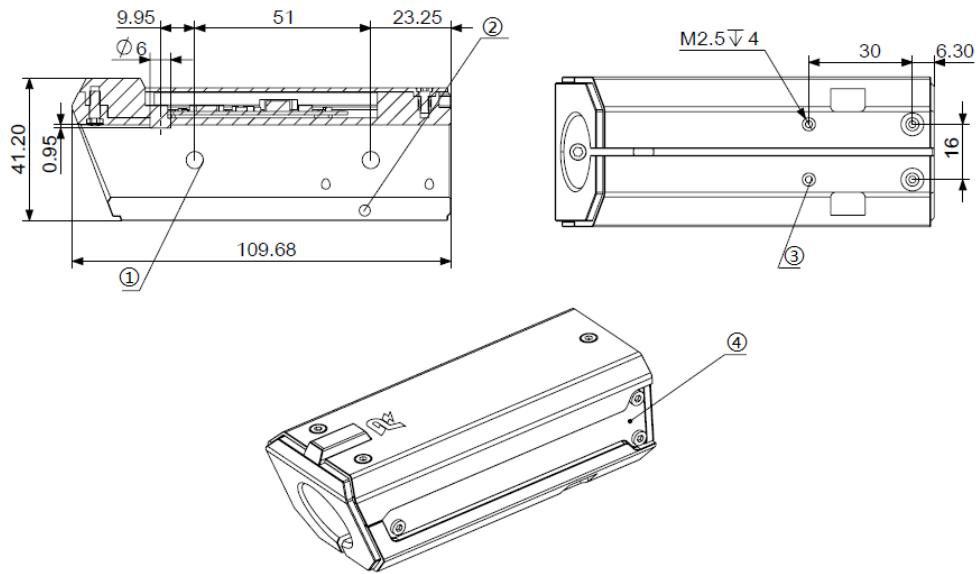
Balancing Standard Robot:

S134 The ID configuration for a Balancing Standard Robot’s Armor in the positive x-axis direction is 0, and the one for the Armor in the negative x-axis direction is 1.

3.7 Mounting Specifications for Speed Monitor Module

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

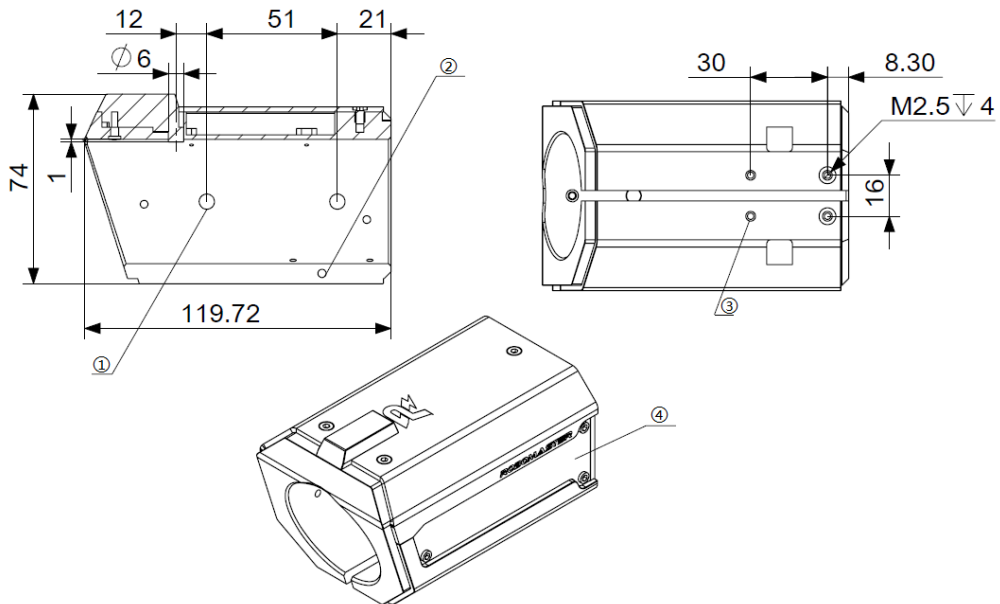
Speed Monitor Module (17 mm projectile):



- [1] Phototube
- [2] Speed Monitor Module's clamping screw hole
- [3] Laser Sight's mounting screw hole
- [4] LED Light Indicator

Figure 3-28 Speed Monitor Module (17 mm Projectile)

Speed Monitor Module (42 mm projectile):



- [1] Phototube
- [2] Speed Monitor Module's clamping screw hole
- [3] Laser Sight's mounting screw hole
- [4] LED Light Indicator

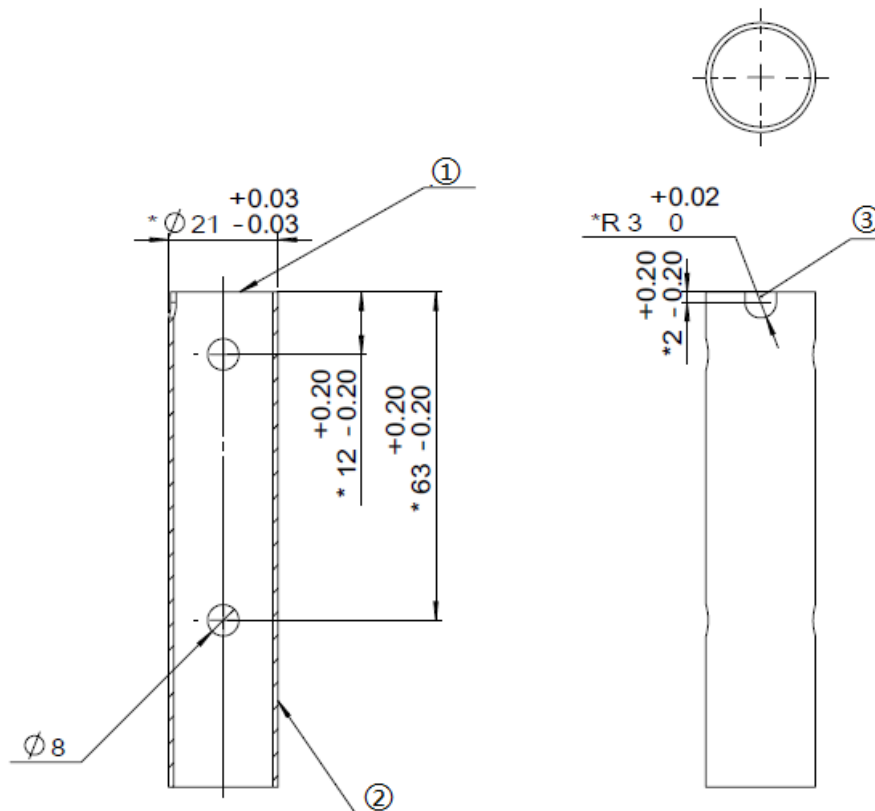
Figure 3-29 Speed Monitor Module (42 mm Projectile)

3.7.1 Installation Steps

Three securing methods are available for the Speed Monitor Module (17 mm projectile). Three securing methods meet the mounting specifications for Speed Monitor Modules (17 mm projectile). Participating teams may choose to adopt any one of the securing methods.

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

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



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

Figure 3-30 17 mm Barrel

Building requirements for 17 mm barrels:

- S135 The phototube must not be blocked.
- S136 Transparent and luminous materials and use of infrared ray sensors near the barrel are forbidden.
- S137 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 barrel is stuck in cylindrical location protrusion within the module inner diameter.
2. Insert M3 screws through the clamping screw holes on the Speed Monitor Module to clamp the barrel.
3. The aviation connector port of the Speed Monitor Module should be connected to the aviation connector port of the Power Management Module using an aviation cable.

The completed mounting is shown in the figure below:

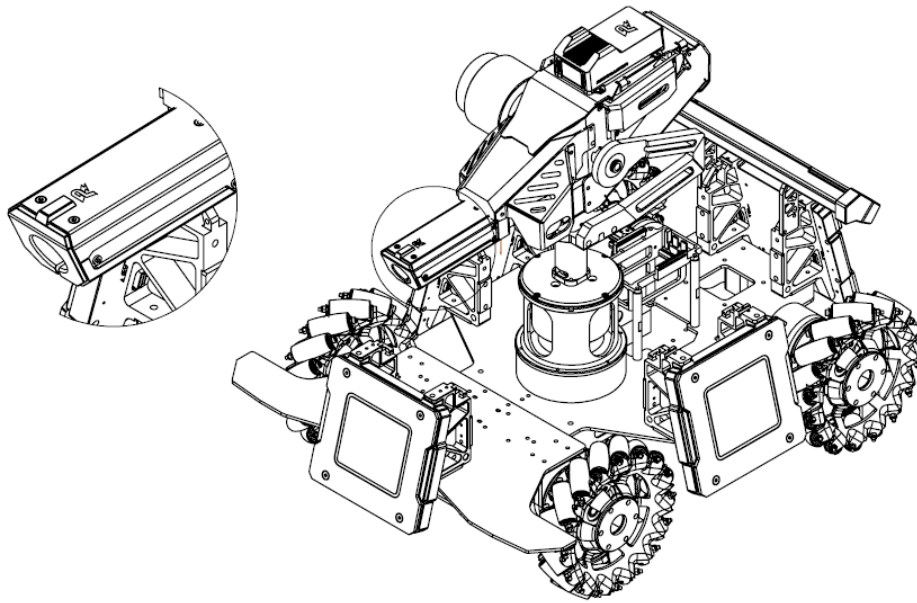


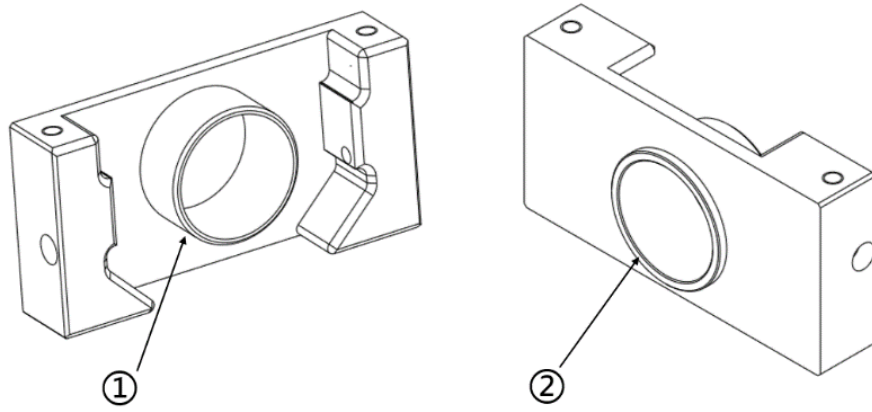
Figure 3-31 Mounting Speed Monitor Module

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

The team designs and develops its own adapter block, to connect the Speed Monitor Module (17 mm projectile) and Launching Mechanism.

See "Appendix 1 - Drawing of Adapter Block for Speed Monitor Module (17 mm Projectile)" for the specifications of an adapter block. Its 3D model can be downloaded from the speed monitor module product page on RoboMaster's official website as a reference.

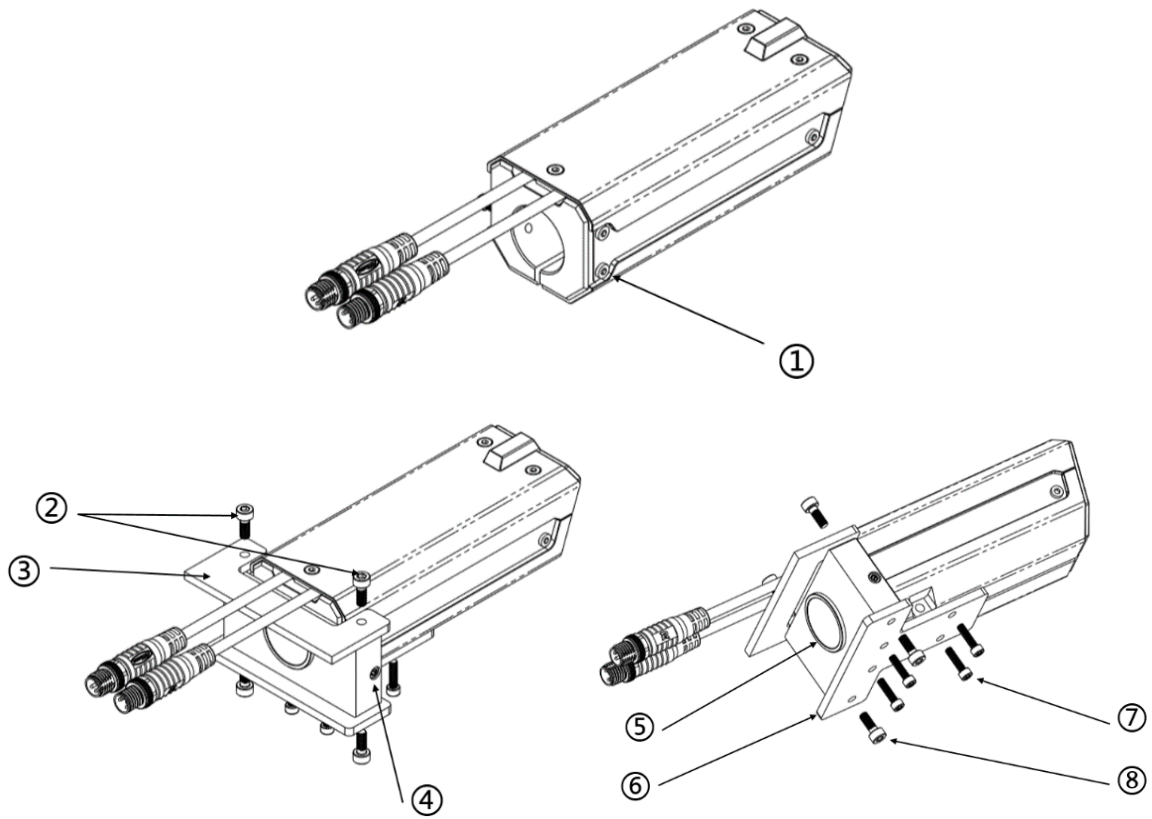
An adapter block is as shown below:



[1] Front Protrusion

[2] Back Protrusion

Figure 3-32 17 mm Adapter Block



[1] M2.5 Securing Screw for LED Light Indicator

[2] M3 Screws

[3] Self-produced Part 1

[4] Side Securing Hole

[5] Back Protrusion

[6] Self-produced Part 2

[7] M2.5 Screw

[8] M3 Screws

Figure 3-33 Securing Method for 17 mm Adapter Block

Mounting Steps for Securing Method 2:

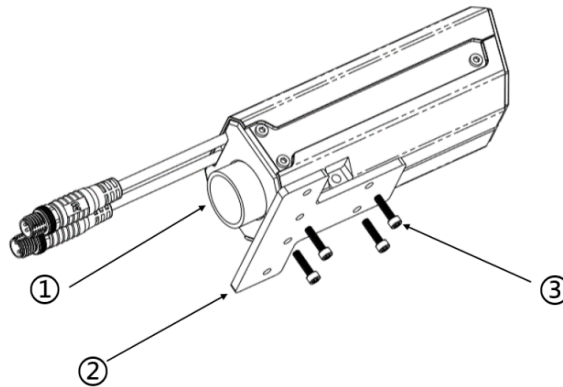
1. Remove the M2.5 screw on both left and right of the Speed Monitor Module for securing the LED Light Indicator. The position of one side is as shown in [1] in the figure below.
2. Use two M2.5x14 screws to secure the adapter block on the Speed Monitor Module, through the securing holes on both left 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.
5. The aviation connector port of the Speed Monitor Module should be connected to the aviation connector port of the Power Management Module using an aviation cable.



Except for the two screws and the cylindrical positioning protrusion which can be removed as in Step 1, the rest of the screws on the Speed Monitor Module must not be removed without permission. Otherwise, it will be deemed as sabotaging the Referee System.

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

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



[1] Barrel [2] Self-produced Part 1 [3] M2.5 Screw

Figure 3-34 Mounting 17 mm 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. The aviation connector port of the Speed Monitor Module should be connected to the aviation connector port of the Power Management Module using an aviation cable.

- The length of the barrel installed into the Speed Monitor Module must not exceed 23 mm, to avoid obstructing the speed-monitoring phototube.
- The outer diameter of the barrel should preferably be kept within the range of $21+0.05$ mm. Insufficient launching mechanism diameter will create a gap between the outer wall of the barrel and the inner wall of the Speed Monitor Module, causing the expansion of the projectile's dispersion area.



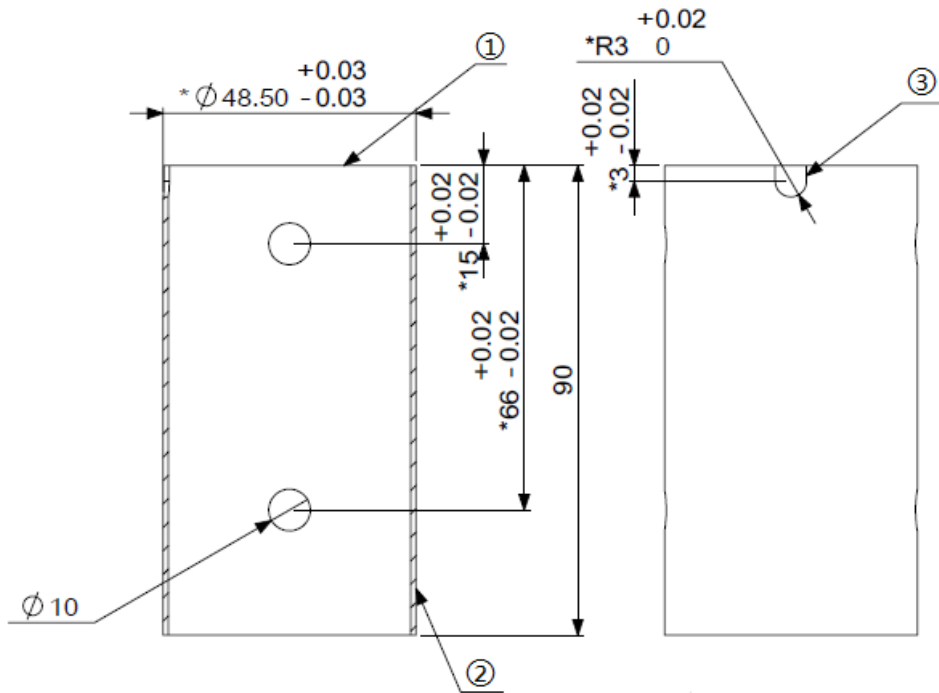
- With this securing method, a lack of mutual positioning between the Speed Monitor Module and parts of the Launching Mechanism may cause the axis of the Speed Monitor Module to not overlap with the axis of a projectile, therefore leading to some projectiles hitting the inner wall of the Speed Monitor 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 (42 mm projectile) Securing Method



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

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



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

Figure 3-35 42 mm Barrel

Building requirements for 42 mm barrels:

- S138 The phototube must not be blocked.
- S139 Transparent and luminous materials and use of infrared ray sensors near the barrel are forbidden.
- S140 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 clamping screw holes on the Speed Monitor Module to clamp the barrel.
3. The aviation connector port of the Speed Monitor Module should be connected to the aviation connector port of the Power Management Module using an aviation cable.

3.7.2 Installation Requirements

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

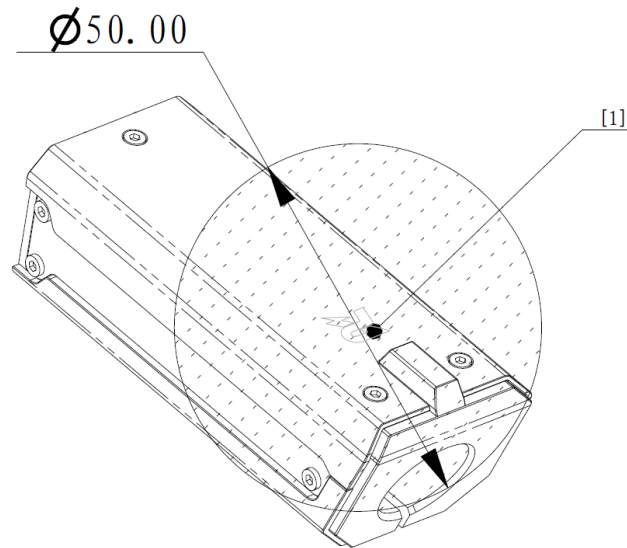
- S141 A Speed Monitor Module must be installed at the end of the Launching Mechanism to measure the projectile initial speed after it has fully accelerated.
- S142 When performing horizontal calibration on a Speed Monitor Module, its logo should be facing up.
- S143 The Speed Monitor Module should be firmly secured to ensure that the Module and the barrel do not move relative to each other during movements of the robot.
- S144 Except for the two speed monitor modules blocking one another, the pre-match inspection personnel must be able to see 80% of the light indicator's surface area when looking directly at the speed monitor module from at least one horizontal direction at a distance of 1 m away from it.
- S145 It is prohibited to use iron barrels or barrels made of materials susceptible to magnetization.
- S146 For ferromagnetic materials or devices that generate strong magnetism during operation, the angle of the magnetic force on the speed monitor module when stationary or during operation must be within 2° (It is not required to follow this specification in RMUL).

After calibrating the speed monitor module, press OK on the main controller module and then press PgDn. Follow the instructions below to observe the real-time coordinate changes of the main controller module robot (please refer to the Robot Side section in [Referee System User Manual](#) for details):



- After rotating the gimbal by 90°, 180° and 240° respectively, compare the actual rotation angles to see if the error values are less than 15°.
- For ferromagnetic materials, after installing them in accordance with the above specifications, observe if the angle of the speed monitor module fluctuates within 2°.
- For devices that generate strong magnetism during operation, when the device is powered on and in both stationary and running states (For example, when the friction wheel motor is powered on and in both stationary and rotating states), observe if the angle of the speed monitor module fluctuates within 2°.

-
- S147 As shown in the Mounting Specifications for Speed Monitor Module graph, with the Logo position as the center of the sphere, it is prohibited to use substances that are easily magnetized (products containing iron, cobalt and nickel, the cooling fan at the transmitter of the transmitter module, and industrial camera bodies, etc.) within a diameter of 50 mm. Within a diameter of 100 mm, magnetic materials such as friction wheel motors and gimbal motors (except for video transmitter modules and industrial camera bodies) are not allowed in order to avoid interference with the magnetometer inside the speed monitor module.



[1] Circular center

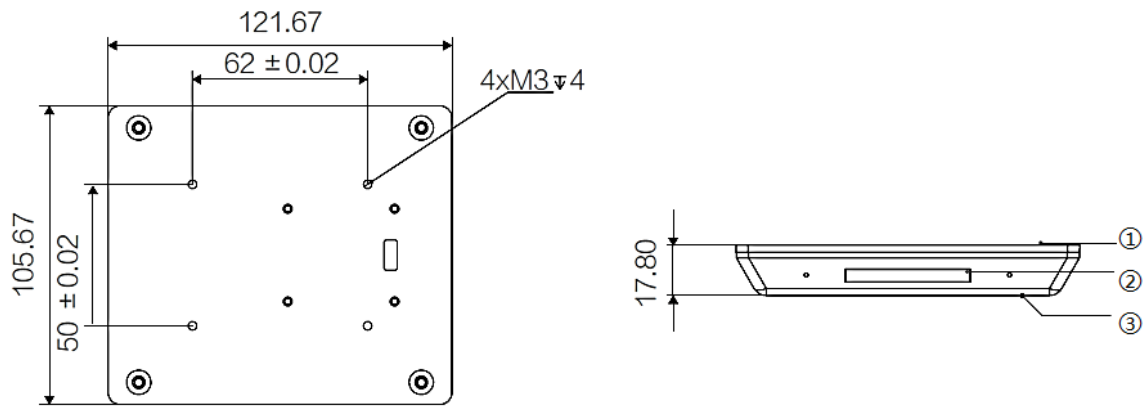
Figure 3-36 Mounting Specifications for Speed Monitor Module



- Four M2.5 threaded 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. 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.
- If two Speed Monitor Modules are installed parallel to each other, then one light panel of each module may 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 Specifications for RFID Interaction Module

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



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

Figure 3-37 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.

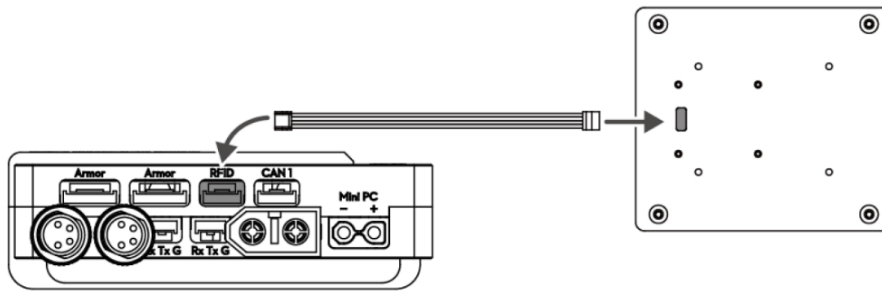


Figure 3-38 RFID Interaction Module Connection

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.

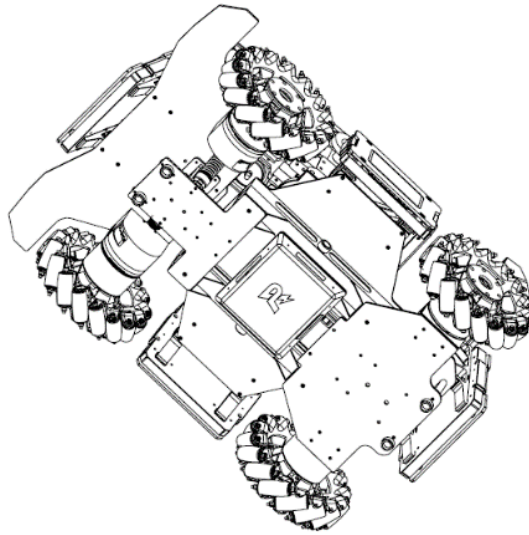


Figure 3-39 Mounting RFID Interaction Module

3.8.2 Installation Requirements



- The effective detection distance of the RFID Interaction Module is 100 mm ($\pm 5\%$). The actual detection distance after mounting is subject to testing. If the effective detection distance is reduced or the Module does not function properly, please check if it was installed correctly.
- The transformation of an RFID Interaction Module must not exceed the maximum expansion size of the robot. An RFID Interaction Module is allowed to extend out of the robot's body when transforming.
- Due to the complex electromagnetic environment in a robot, the testing of the effective detection distance of an RFID Interaction Module must be carried out when all the modules of the robot are working properly (e.g. when the supercapacitor, power motor and wireless charging coil, etc. are in operation). If multiple operation modes are involved with the robot (e.g. the charging or discharge of the capacitor, or the motor at variable or uniform speed), the effective detection distance of the RFID Interaction Module will have to be tested under the different operation modes.

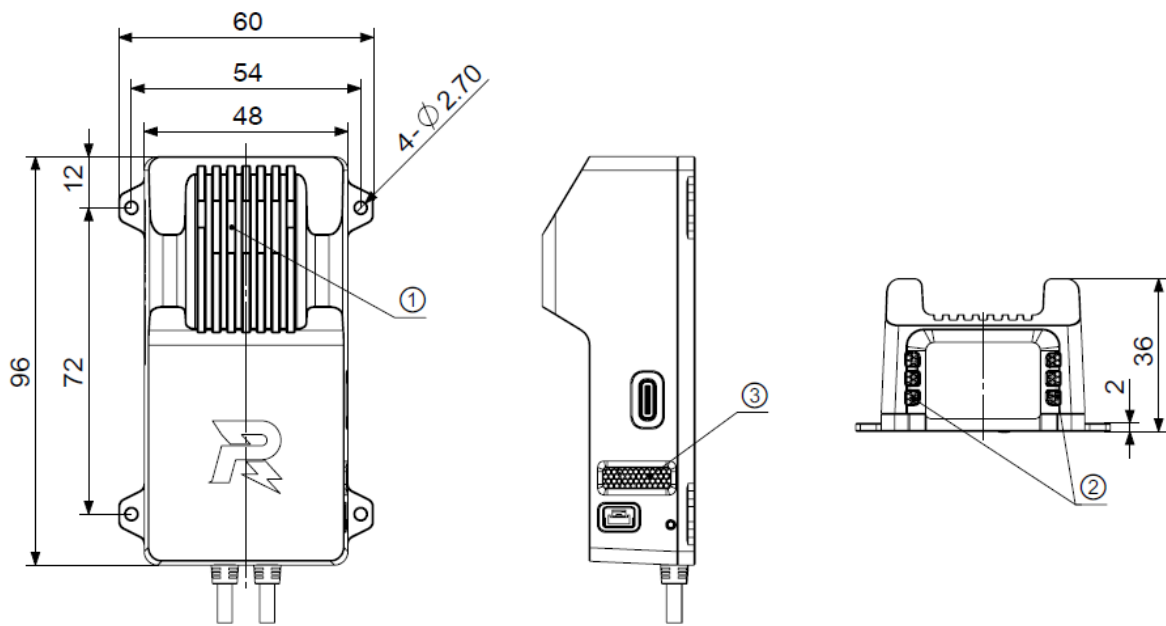
S148 The rear of the RFID Interaction Module should be free of interference from strong currents or high-frequency signals (such as motor cables, RoboMaster Center Board, CAN cables and supercapacitors).

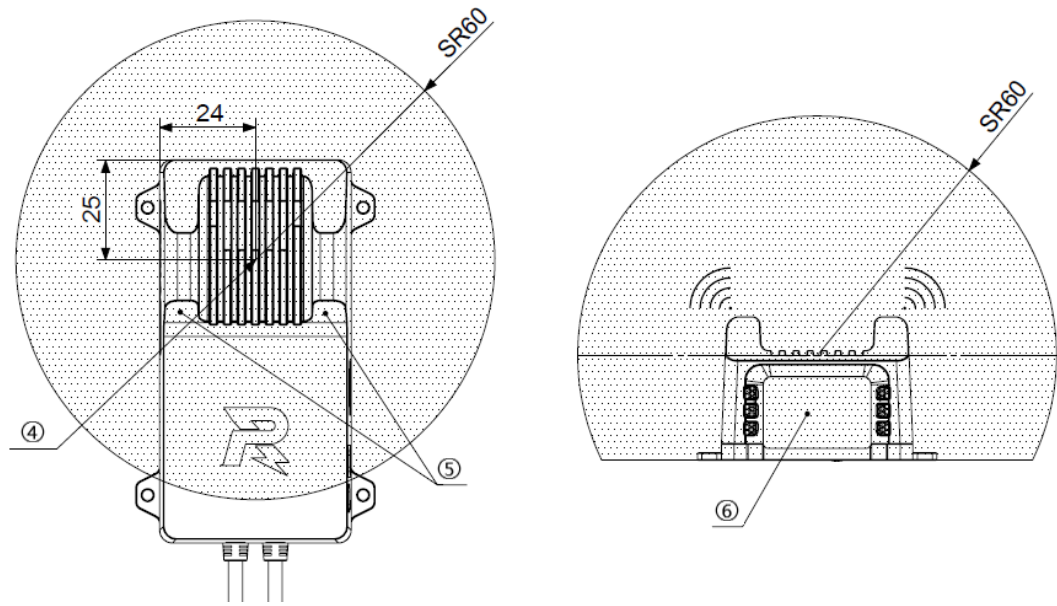
S149 The front and rear of the RFID Interaction Module must not be obstructed by any conductive materials, and the rear surface must be kept at least 30 mm away from conductive materials such as the metal and carbon plates.

3.9 Mounting Specifications for Video Transmitter Module (Transmitter)

- VTM 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 3.3 V 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.



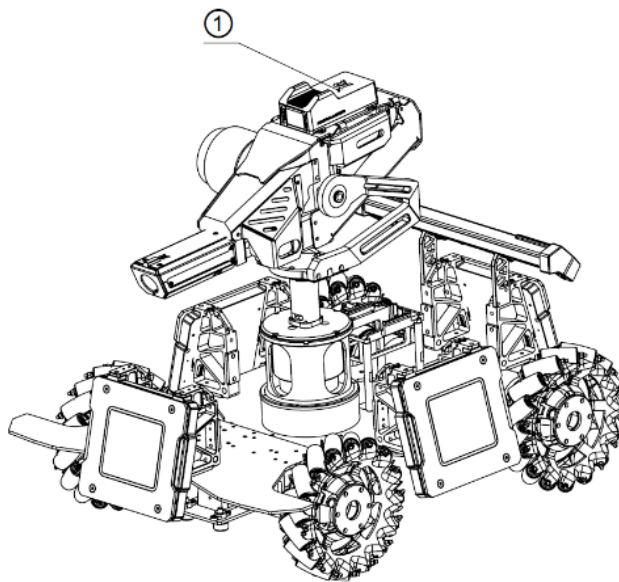


[1] Air Inlet [2] Air Inlet [3] Air Outlet [4] Circular center [5] Antennas [6] Camera

Figure 3-40 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 3-41 Mounting Video Transmitter Module (Transmitter)

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

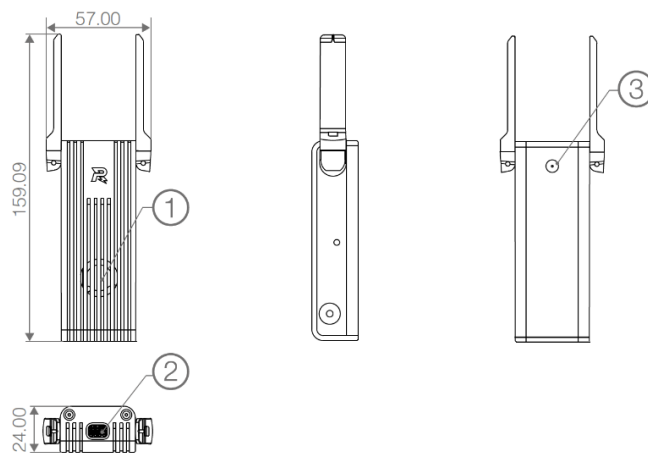
3.9.2 Installation Requirements

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.

- S150 The inlet and outlets of the Transmitter must not be blocked.
- S151 As the Transmitter’s antenna is located at the top of the Module, the top should not be blocked by any metal.
- S152 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.
- S153 If the VTM 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 Specifications for Video Transmitter Module (Receiver)

According to the size and mounting port of the Video Transmitter Module (Receiver) 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 3-42 Video Transmitter Module (Receiver)

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.

- S154 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.
- S155 Ensure that the cooling inlet and outlet ①② are not blocked.
- S156 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.
- S157 The specific mounting position and angles can be adjusted by checking the quality of receiver images.

3.11 Mounting Specifications for Positioning System Module

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

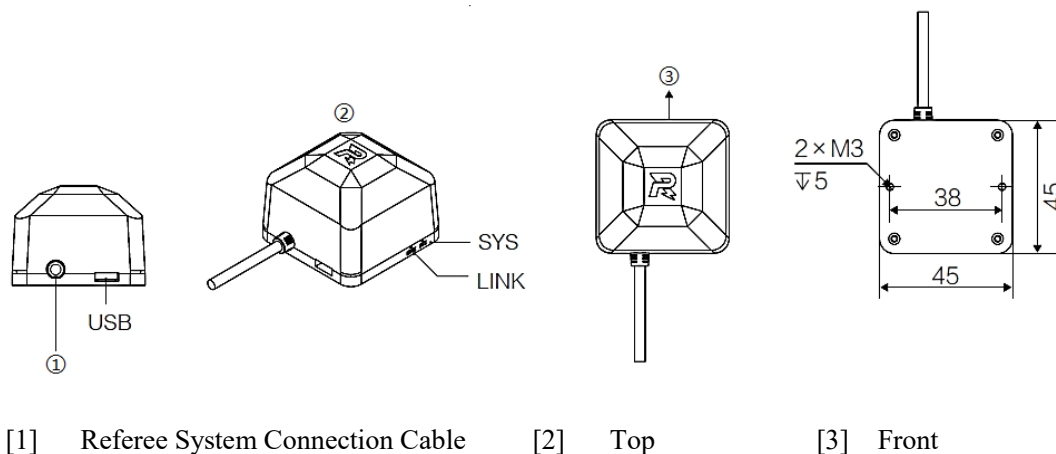


Figure 3-43 Positioning System Module

3.11.1 Installation Steps

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

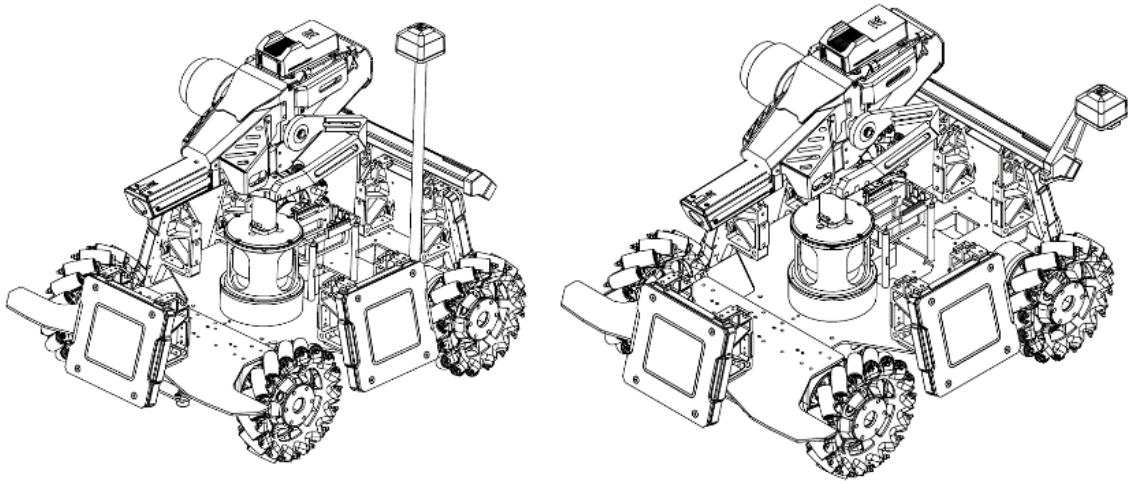


Figure 3-44 Mounting Positioning System Module

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

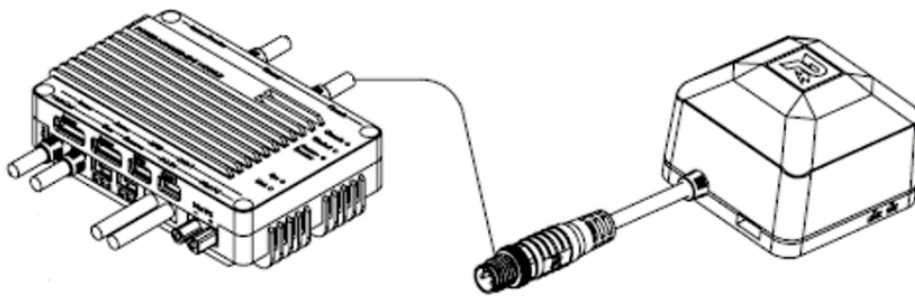


Figure 3-45 Positioning System Module Connection

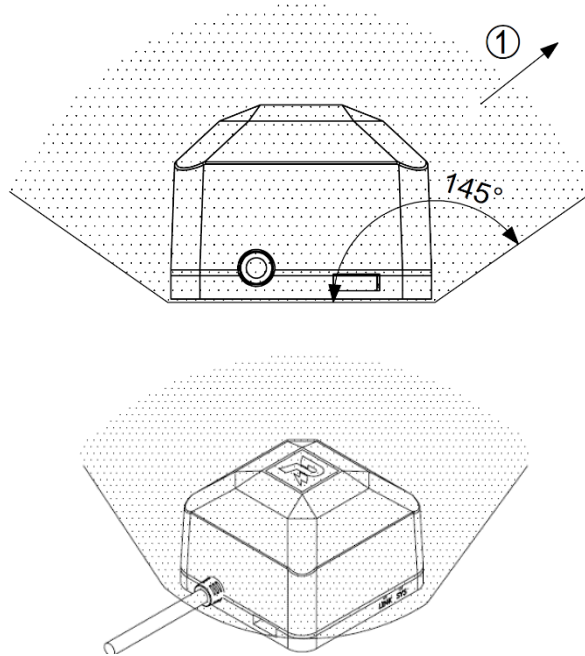
3.11.2 Installation Requirements

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

- S158 The mounting bracket for the positioning system module needs to be rigidly connected to the robot, i.e., when a force of 40 N perpendicular to the bracket is applied at any position on it, there should be no noticeable deformation.
- S159 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.
- Requirements related to positioning system module blockage need to be met before, during and after robot transformation.



[1] Unlimited extension

Figure 3-46 Mounting Positioning System Module

S160 The positioning system module must always be mounted at least 100 mm away from motors, parts that are magnetic or generate strong magnetic fields during operation, and at least 150 mm away from the Video Transmitter Module. When using a sensor at 200 mm away from the Positioning System Module, tin foil, metal covering, or barriers of other materials shall be used to ensure the sensor does not interfere with the Positioning System Module.

S161 The use of magnets or magnetic materials is prohibited when securing the positioning system module to avoid interfering with the positioning system module. It is recommended to use materials that will not be magnetized, such as aluminum products, pure titanium products, or plastic products. Adhesive materials must not be used to secure the positioning system module.

S162 When mounting an infrared laser rangefinder or other sensors, ensure that they do not generate wireless signal interference in the frequency range of 4.2 to 4.8 GHz, and that the maximum noise intensity within the operating frequency range in this band should not continuously exceed -60 dBm. When using a spectrum analyzer, it is recommended to have the robot's full functionality enabled. Measurements using a spectrum

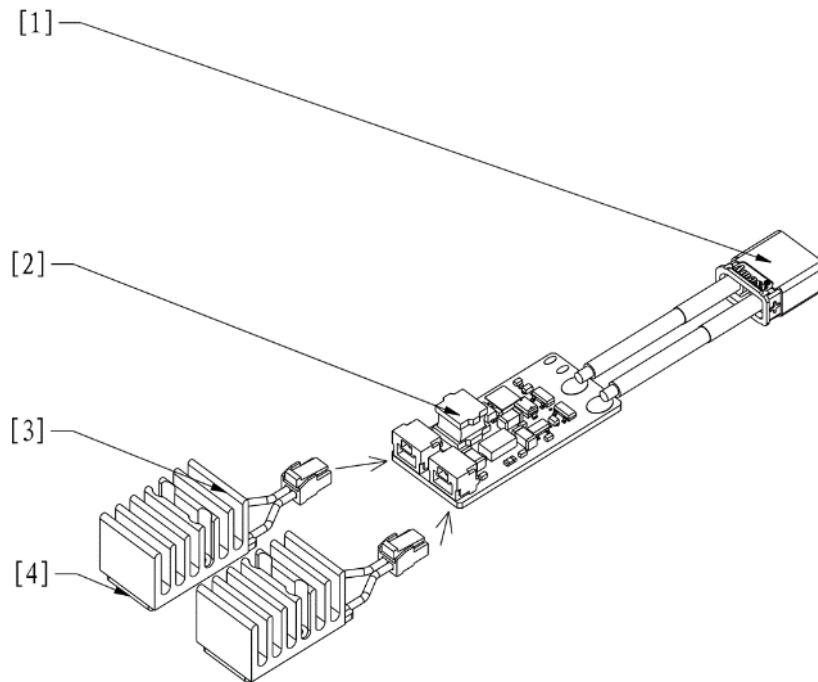
analyzer in close proximity to the device may generate wireless signal interference.

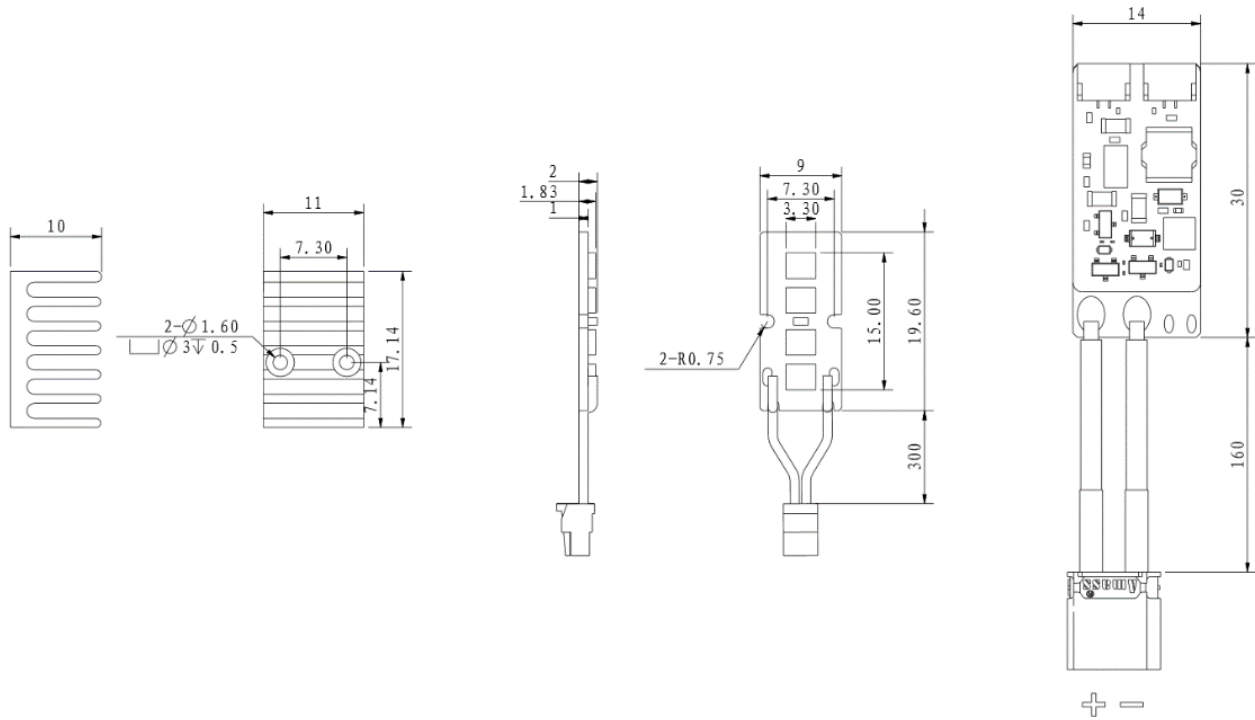


It is recommended to take the measurements in an environment with minimal wireless interference.

3.12 Mounting 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 17 mm Fluorescent Projectile Energy-Charging Device.





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

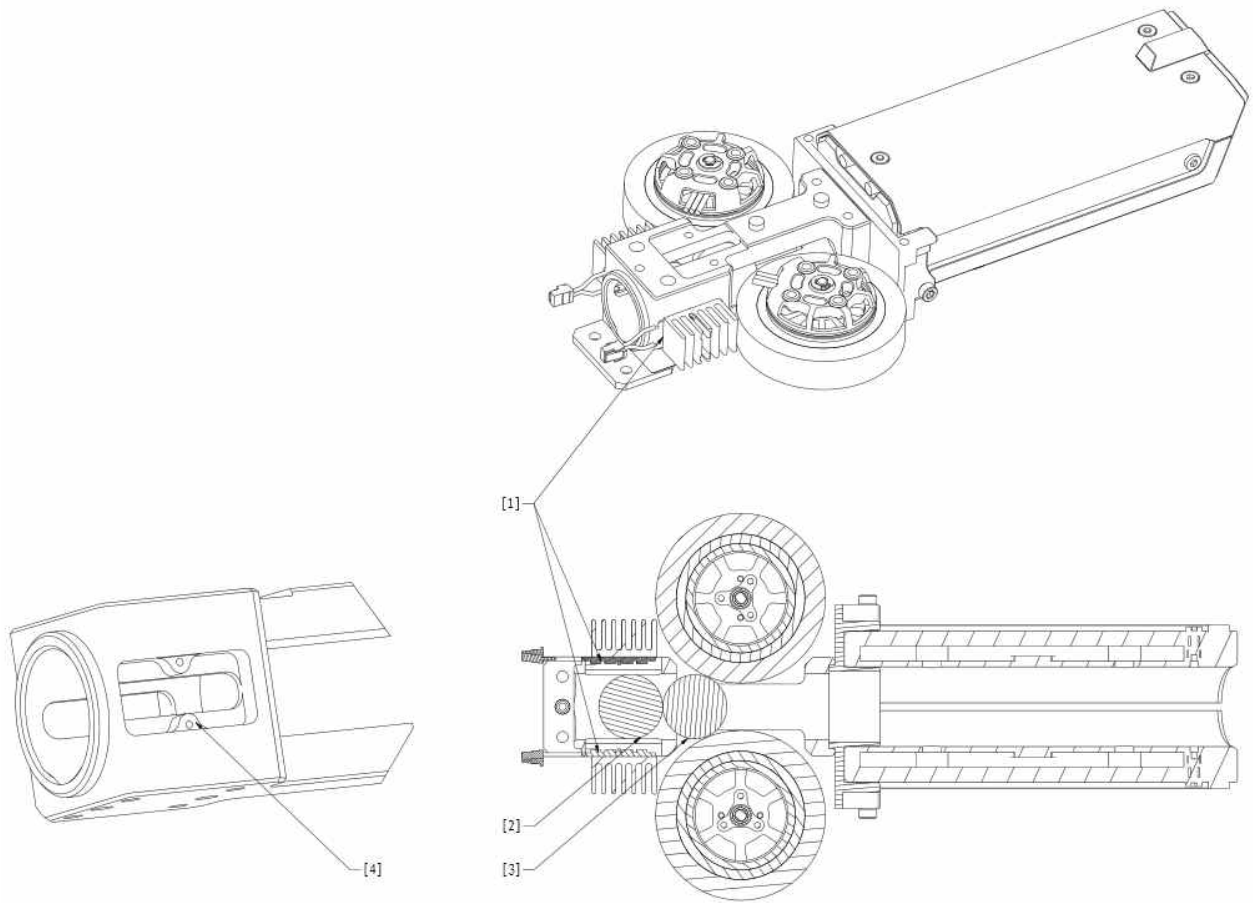
Figure 3-47 17 mm Fluorescent Projectile Energy-Charging Device

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 12 V or 24 V power supply.



[1] UV light panel [2] Standby projectile [3] Launching projectile [4] Slot

Figure 3-48 Mounting UV Light Panel

3.12.2 Installation Requirements

S163 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.

S164 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.

S165 The UV light panel must cover the standby projectile next to the launching projectile to ensure the proper charging of the projectile. After charging, the brightness of the projectile must be greater than that of the Speed Monitor Module in the "Bullet Test" of the Referee System.



- Steps for entering the "Bullet Test" mode on the Main Controller:

1. Press and hold OK on the Main Controller module of the Referee System

2. Select “Debug Settings”

3. Press OK

4. Select "Bullet Test" from the list and press OK

- In the subsequent versions of this season, the installation requirements for fluorescent energy-charging devices will remain the same and need to be followed to the letter. However, there will be updates to the lux standards for illuminance after the projectile is launched in the match, as well as the self-testing methods.
-

3.12.3 Instructions and Requirements for Production of UV Light Panels

S166 The UV light beads used must be the 390-410 nm variety with a 2835 packaging. The beam angle should be 120°, the power of each bead 0.2 W, and the total power of the light panels no smaller than 1.5 W. Participants should refer to the competition’s official design for light panels. Their total length must be at least 19.60 mm which is the official panel length.

S167 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.



- Light beads or light panels should be heated and dried at 120°C 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.
-

3.13 Mounting Specifications for Super-capacitor Management Module

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 interfaces include one XT30 plug, two XT30 receptacles, and one Capacitor Management Module communication port.



- The model number for the XT30 receptacle is XT30PW-F.
 - The model number for the XT30 plug is XT30PW-M.
-

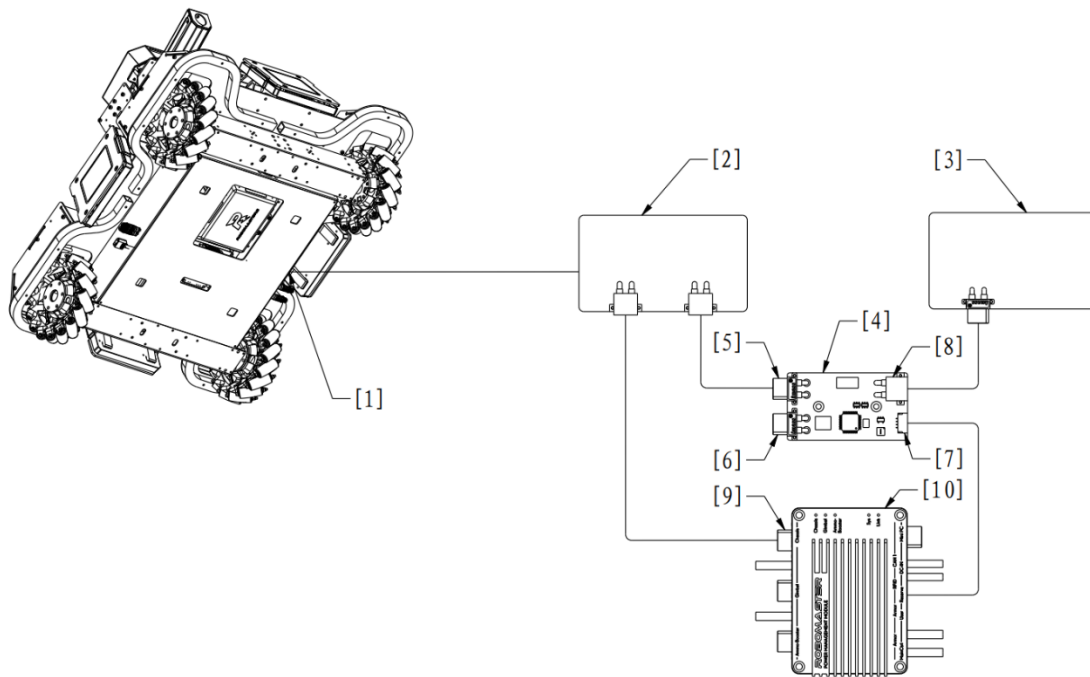
3.13.1 Installation Steps



- The power control panel regulates the output power of the Chassis port 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.
 - The XT30 of the Supercapacitor Management Module can withstand a maximum peak current of 30 A and a continuous current of 15 A.
 - For the chassis power source of a robot limited by its power, the maximum total capacity of all capacitors shall be 10 mF, except for the Supercapacitor Module.
-

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 port 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:



- [1] Robot chassis power supply interface
- [2] Power control panel
- [3] Supercapacitor Module
- [4] Capacitor Management Module
- [5] Capacitor Management Module interface (output, XT30 receptacle) – connecting to power control panel
- [6] Inspection port of Capacitor Management Module (output, XT30 receptacle) – for Pre-Match Inspection only
- [7] Communication port of Capacitor Management Module (CAN, SM04B-GHS-TB interface) – connecting to Power Management Module
- [8] Capacitor Management Module interface (input, XT30 plug) – connecting to Supercapacitor Module
- [9] Chassis output port of Power Management Module
- [10] Power Management Module

Figure 3-49 Capacitor Management Module Connection

3.13.2 Installation Requirements

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



1. Before 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. The inspection staff can measure the energy value of the supercapacitor by connecting an electronic load to the inspection port of the Capacitor Management Module to carry out discharge measurement.

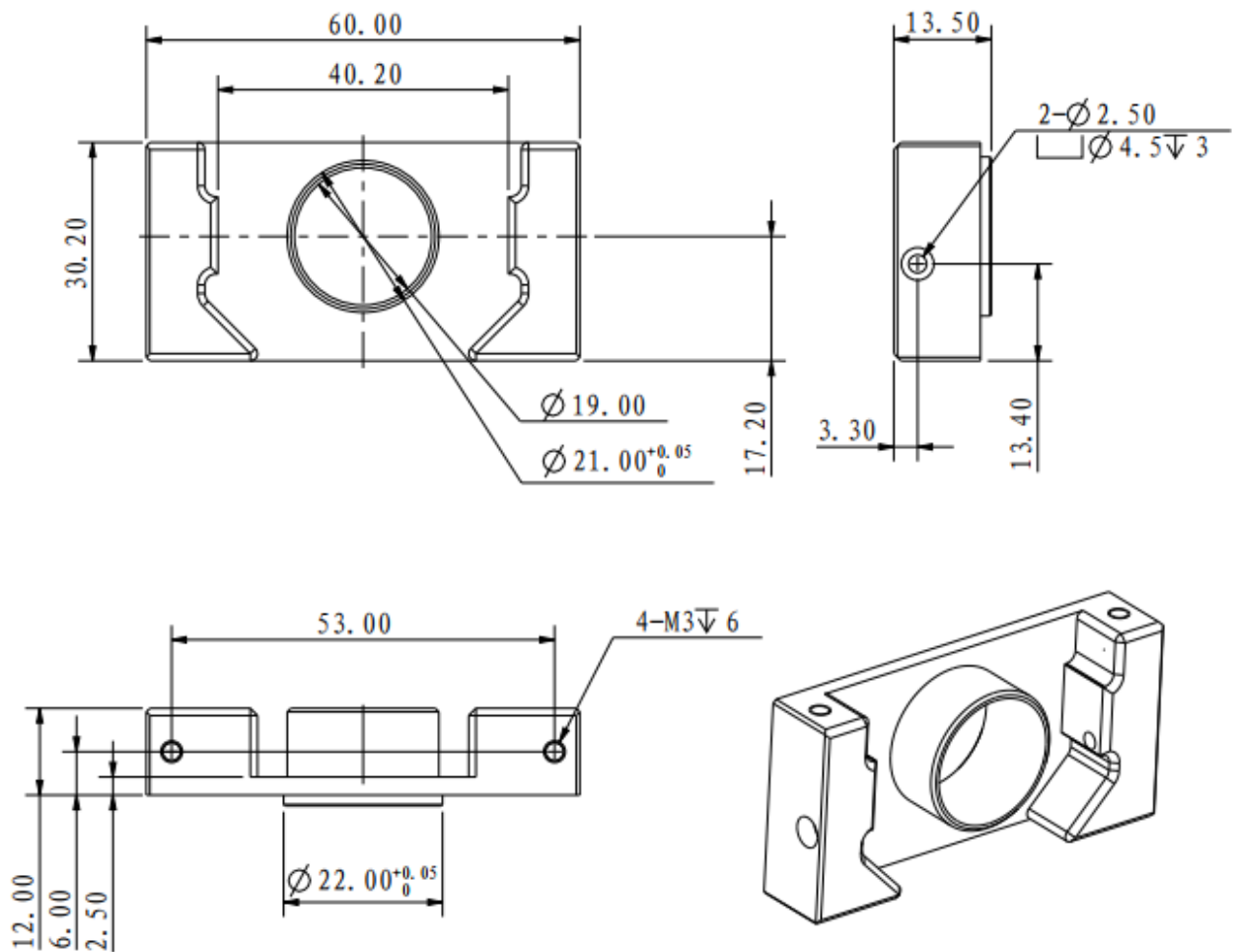
S168 From a fully charged state, the capacitor's voltage needs to drop past 1 V. If the capacitor's voltage drops at an unusually rapid pace, it is deemed to have failed the inspection.

S169 An XT30 receptacle cable of a length of at least 10 cm should be attached to the inspection port of the Capacitor Management Module.

S170 Standard, Hero and Sentry Robots must be mounted with Capacitor Management Modules. If a robot does not have a Supercapacitor Module, a Capacitor Management Module can be connected to the Power Management Module using a 4-pin cable.

S171 The Capacitor Management Module must be installed on a place easy for the robot to operate, so that it can be operated during the Inspection.

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



Appendix 2 Reference Drawings



Appendix Figure 1 Hero Armor Sticker - No. 1



Appendix Figure 2 Engineer Armor Sticker - No. 2



Appendix Figure 3 Standard Armor Sticker - No. 3



Appendix Figure 4 Balancing Standard Armor Sticker - No. 3



Appendix Figure 5 Standard Armor Sticker - No. 4



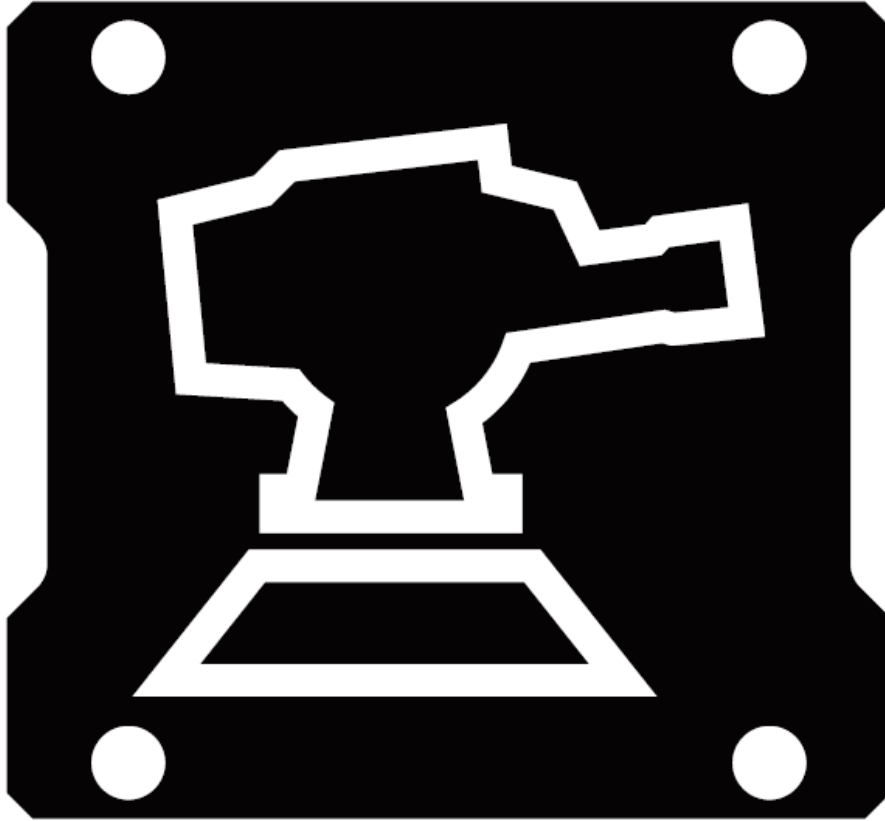
Appendix Figure 6 Balancing Standard Armor Sticker - No. 4



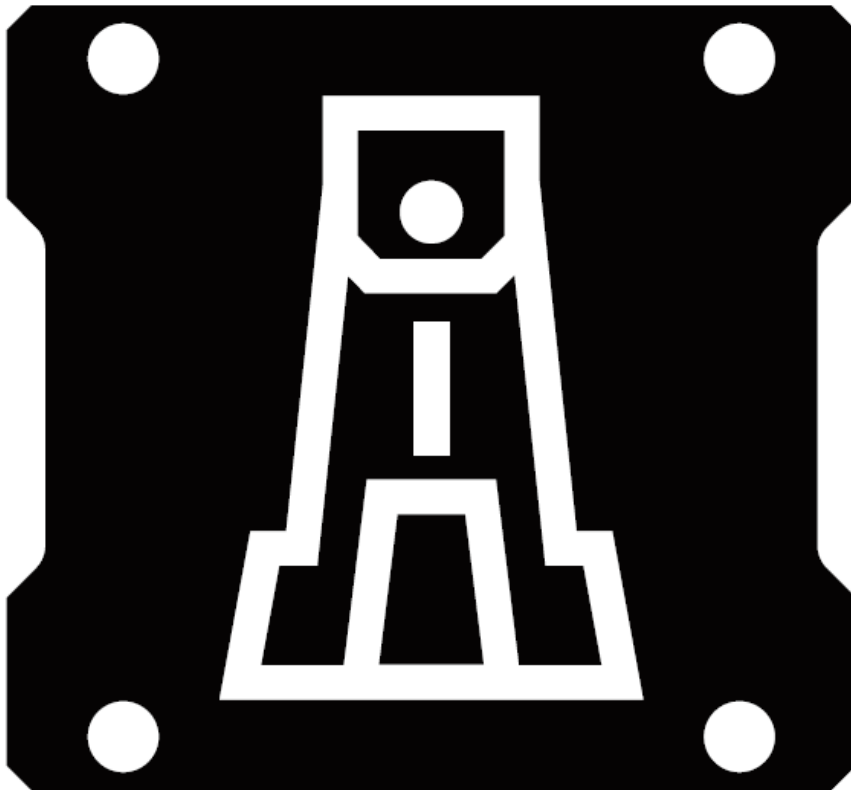
Appendix Figure 7 Standard Armor Sticker - No. 5



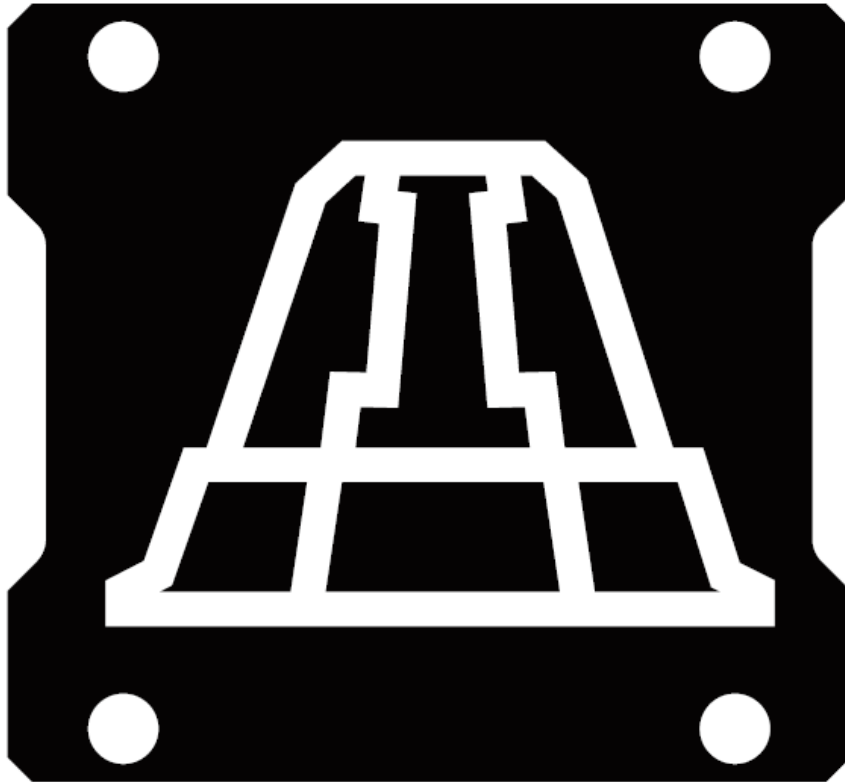
Appendix Figure 8 Balancing Standard Armor Sticker - No. 5



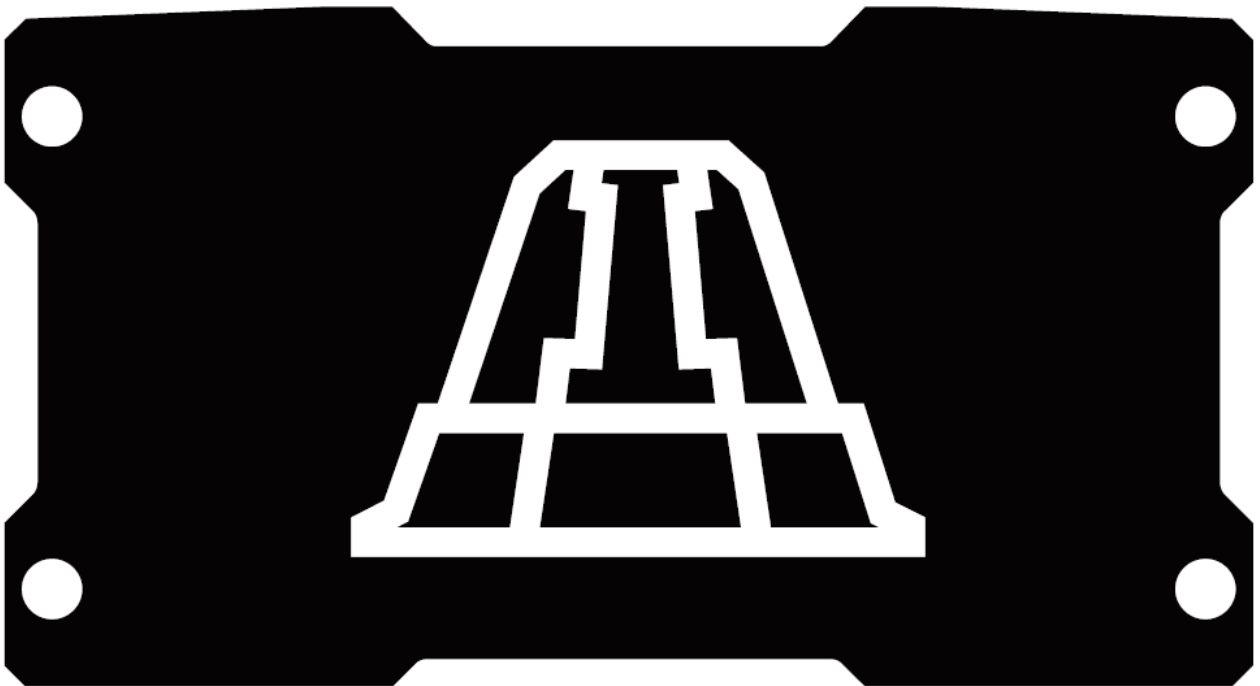
Appendix Figure 9 Sentry Armor Sticker



Appendix Figure 10 Outpost Armor Sticker



Appendix Figure 11 Base Small Armor Sticker



Appendix Figure 12 Base Large Armor Sticker



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