

V1.0

Using a 32-bit motor driver chip and Field-Oriented Control (FOC), the RoboMaster C600 Brushless DC Motor Speed Controller enables precise control over motor torque.



Exclusively designed for the RoboMaster M3009 P18 Brushless DC Gear Motor and C620 Brushless DC Motor Speed Controller, the M3208 Accessory Kit includes several cables and a terminal board.

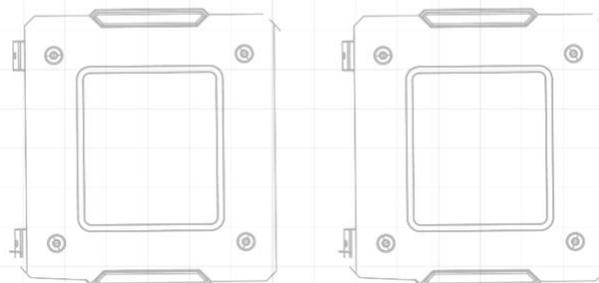
Refer to System Specification Manual, RoboMaster User Manual, Introduction of RoboMaster System Module.

As a 32-bit motor driver chip and FOC, the RoboMaster C600 Brushless DC Motor Speed Controller enables precise control over motor torque.

# ICRA RoboMaster 2019 AI CHALLENGE

## REFEREE SYSTEM SPECIFICATION MANUAL

The RoboMaster Organizing Committee  
January 10, 2019



# Disclaimer

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## Product Usage Precautions

1. Please ensure that the robot's onboard Referee System is installed correctly and firmly before use.
2. Please ensure that the wiring connection is correct before use.
3. Please ensure that the components are intact before use. Replace any worn or damaged components.
4. The Referee System specifications mentioned in this manual apply only to the ICRA 2019 RoboMaster AI Challenge.

## Related Documents

1. ICRA 2019 RoboMaster AI Challenge Referee System User Manual
2. Referee System Module Instructions

# Using This Manual

## Legend

 Important

## Release Notes

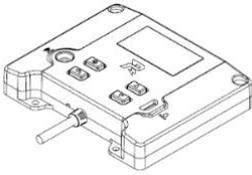
Date	Version	Changes
1/10/2019	1.0	Release

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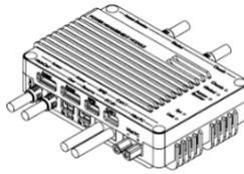
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## In the Box

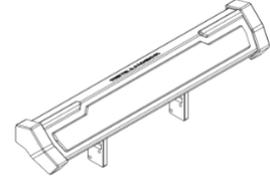
Main Controller  
Module MC02



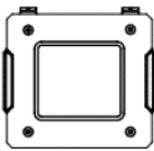
Power Management  
Module PM01



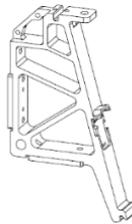
Light Indicator  
Module LI01



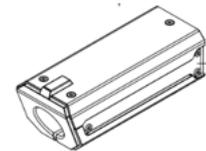
Armor Module AM02



Armor Module  
Support Frame A



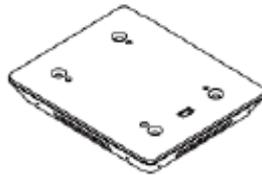
Speed Monitor Module  
(17 mm Projectile) SM01



RFID Interaction  
Module Card



RFID Interaction  
Module FI02



### Note:

1. The product code for each module will not be stated again later in the document. For example, the Main Controller Module MC02 will be directly referred to as the Main Controller Module.
2. The RoboMaster referee system inventory list mentioned above applies only to the ICRA 2019 RoboMaster AI Challenge.

## Referee System Usage Specification

In order to ensure the fairness and justness of the ICRA 2019 RoboMaster AI Challenge, the robot's battle results are automatically evaluated by the electronic referee system.

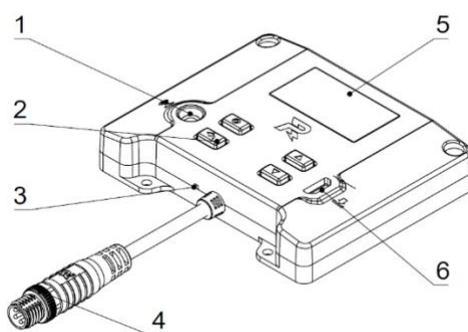
The referee system is provided by the RoboMaster 2019 Organizing Committee (RMOC). It records a robot's HP, projectile firing speed and chassis power consumption and sends real-time data to the referee system server, which determines the result of each round.

Robots purchased from the RMOC have reserved mechanical and electrical interfaces for installing modules of the referee system. Each module must be installed at the preset position. Each team must follow the instructions stated in the Usage Specifications and correctly install the referee system. In case of any violations, the team shall bear the consequences of failing the pre-match inspection.

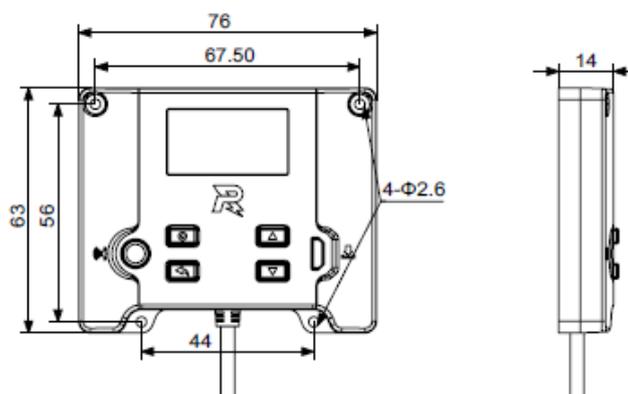
## Configuration of the Robot Referee System

Quantity Robot Type	Main Controller Module	Power Management Module	Light Indicator Module	Small Armor Module	RFID Interaction Module	Speed Monitor Module
Standard	1	1	1	4	1	1 (17 mm projectile)

### Main Controller Module

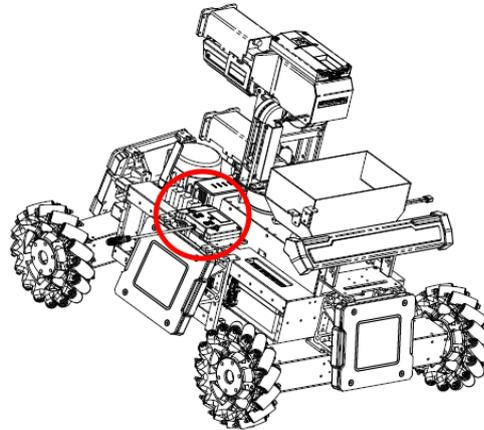


- 1. IR Receiver
- 2. Button
- 3. Power Indicator
- 4. Black Metal Ring Aviation Connector
- 5. Screen
- 6. Upgrade Interface

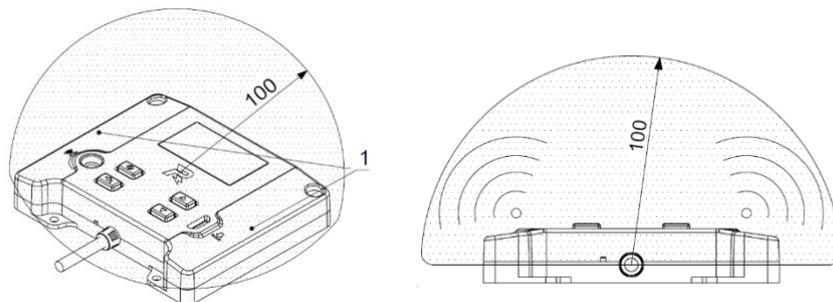


### Installation Procedure:

1. Use four M2.5 screws to mount the Main Controller Module to the specified position on the robot, and ensure that the upper surface of the Module is level and faces up when the robot is operating.

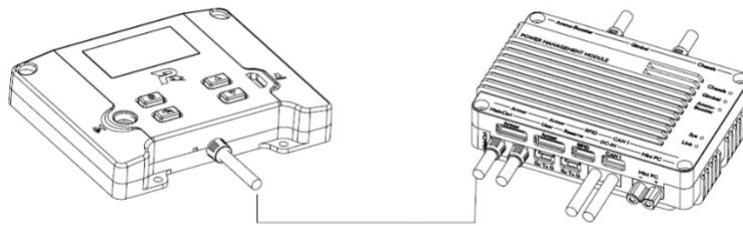


2. The installation of the Main Controller Module must meet the following requirements:
  - 1) The interactive surface (screen and buttons) has no shielding within 50 mm above it, so that operators can press button and check information on the screen easily.
  - 2) Make it easy to plug the cable into the upgrade interface for firmware upgrade.
  - 3) The infrared receiver is not blocked, which is easy to manually connect to the server during the competition.
  - 4) The logo is at the center and there are no motors or other devices with electromagnetic interference within a hemisphere of 100 mm, to prevent the Wi-Fi signal from being blocked. If the protective shielding for the Main Controller Module is made of metal, it cannot be higher than the upper edge of the bottom cover of the Main Controller Module so as to avoid blocking the signals.

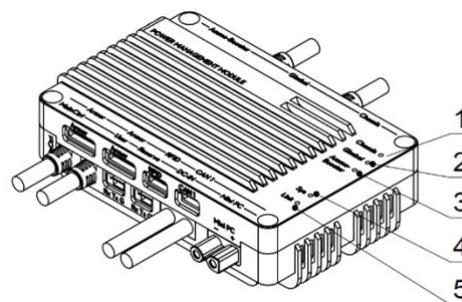


1. Antenna position

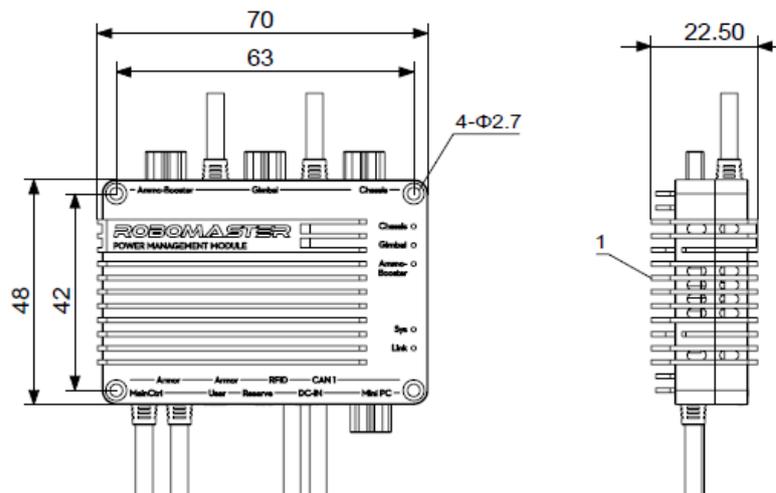
3. Use the aviation connector cable inside the package to connect the Main Controller Module to the aviation connector with the black metal ring on the Power Management Module as shown.



## Power Management Module



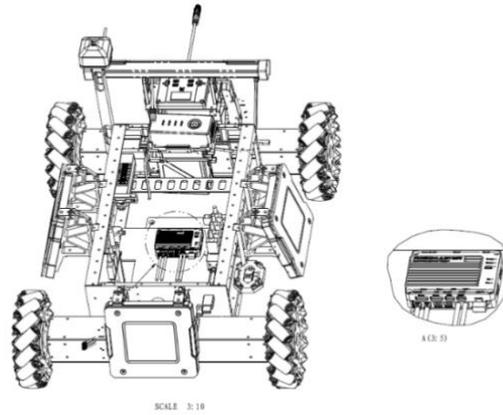
- |   |                                  |
|---|----------------------------------|
| 1. Chassis Power Output Indicator             | 2. Gimbal Power Output Indicator |
| 3. Launching Mechanism Power Output Indicator | 4. System Status Indicator       |
| 5. Connection Status Indicator                | -                                |



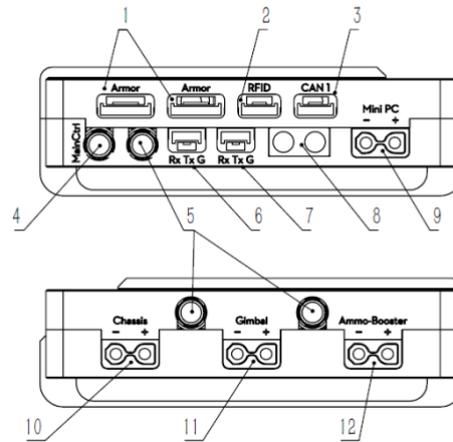
1. Bottom Installation Surface

### Installation Procedure:

1. Use four M2.5 screws to mount the Power Management Module to the robot.



2. When installing the Power Management Module, do not completely cover its outer case to ensure good heat dissipation.
3. Carefully distinguish the interfaces of the Power Management Module to ensure correct cabling.



- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Armor Module SM06B-GHS-TB interface</li> <li>3. CAN communication SM04B-GHS-TB interface</li> <li>5. Interfaces for other Referee System Modules (Speed Monitor, UWB, VTM and Light Indicator; the metal ring of the aviation connector is silver)</li> <li>7. System upgrade SM03B-GHS-TB interface</li> <li>9. Mini PC power supply XT30 interface (output)</li> <li>11. Referee System power supply XT30 interface (output) - connects to the gimbal and Launching Mechanism</li> </ol> | <ol style="list-style-type: none"> <li>2. RFID Interaction Module SM04B-GHS-TB interface</li> <li>4. Main Controller Module interface (the metal ring of the aviation connector is black)</li> <li>6. User SM03B-GHS-TB interface</li> <li>8. Referee System power supply XT60 interface (input)</li> <li>10. Referee System power supply XT30 interface (output) - connects to the chassis</li> <li>12. Referee System power supply XT30 interface (output)</li> </ol> |
|--|---|

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⚠ ● Power Management Module input voltage requirements: 22V-26V. In the figure, the power

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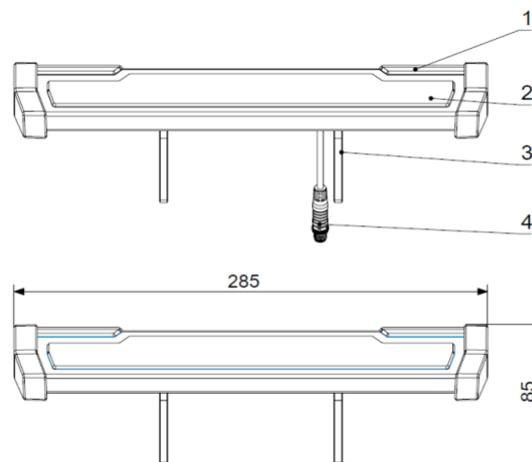
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output interfaces of No. 10, No. 11, and No. 12 can be turned on and off by the Referee System. The single continuous output of No. 10 and No. 11 is 10A. The peak value is 30A and it lasts a maximum duration of 500ms. The maximum continuous load for No.12 is 8A. The peak value is 20A and it lasts a maximum duration of 500ms. The total continuous output current for the three power outlet interfaces is 20A. The power output interface No. 9 has a single continuous output current of 6A.

- Powered devices with a current greater than 10A can be powered directly from the robot' battery and controlled by a relay. The relay must be powered by the Gimbal interface to ensure that after the robot is destroyed, the Referee System can cut the power to all devices connected to the "Referee System power interface (output)", otherwise it is considered cheating.
  - The case of the Power Management Module becomes hot under high power conditions. Do not touch it with your hands. The measured results are as follows: current of 20A, working time of 30 minutes, and case temperature of about 70 degrees. It is therefore necessary to avoid installation on non-heat-resistant materials, such as 3D printed materials.
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## Light Indicator Module

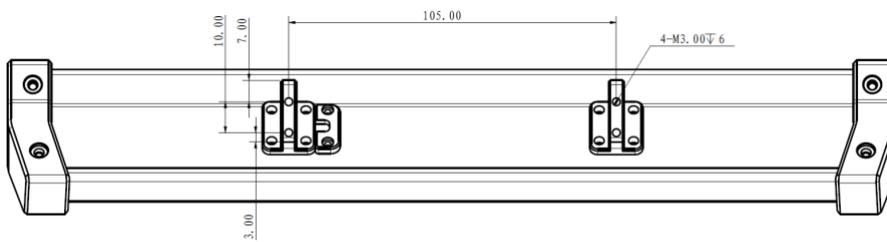
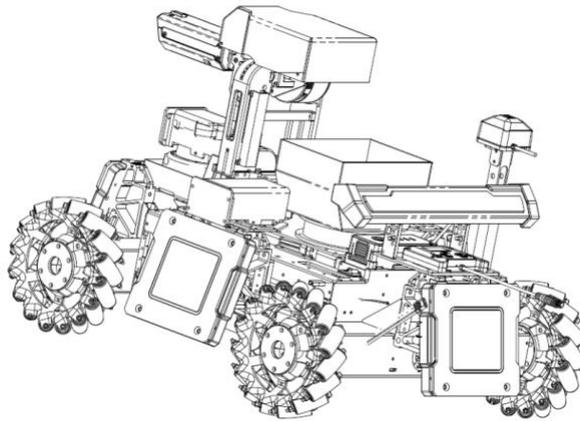
The Light Indicator module is mounted on the Armor Module of the robot via a mounting bracket.



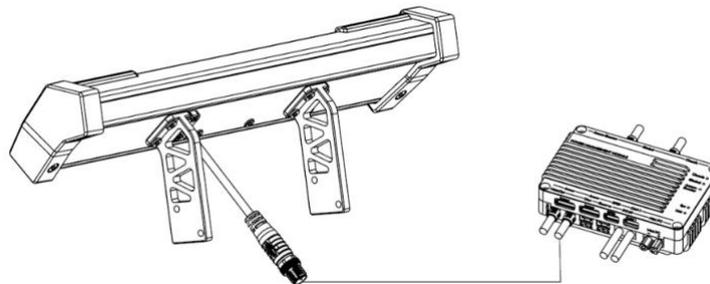
- |                              |                         |
|------------------------------|-------------------------|
| 1. Auxiliary Light Indicator | 2. Main Light Indicator |
| 3. Mounting Bracket          | 4. Aviation Connector   |

### Installation Procedure:

1. The Light Indicator Module can be fixed using the bottom screw hole of the mounting bracket and installed in the position shown in the figure below:



2. The Light Indicator Module must be installed so that the left and right auxiliary Light Indicators are parallel to the ground. The main Light Indicator and the auxiliary Light Indicators must be completely visible when looking at the robot from at least one horizontal direction.
3. Use the aviation connector cable inside the package to connect the Light Indicator Module to the aviation connector with the white metal ring on the Power Management Module.



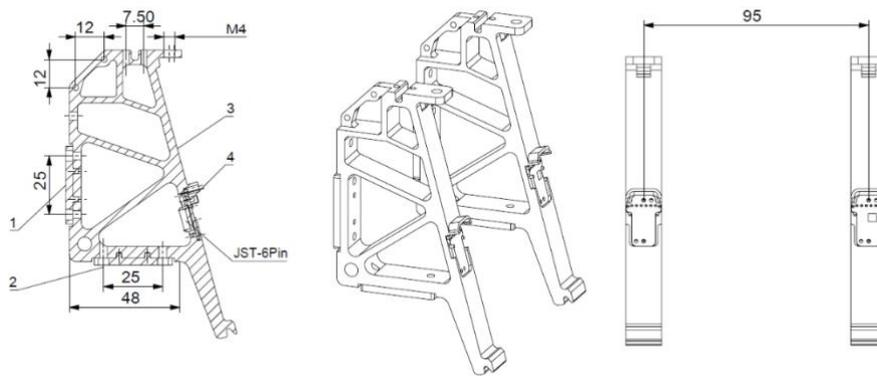

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⚠ When installing the Light Indicator Module of Standard, the position of the main Light Indicator must be higher than the upper edge of the Armor Module.

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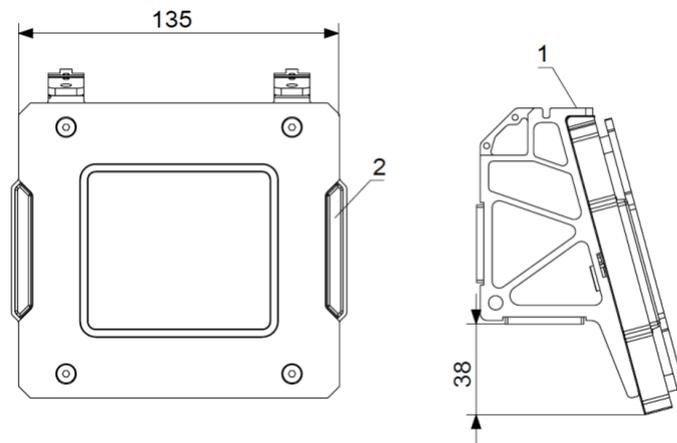
## Armor Module

The Armor Module needs to be mounted to the robot via an Armor Support Frame. The Armor Support Frame is shown in the figure below:



- 1. Back Installation Surface
- 2. Bottom Installation Surface
- 3. Armor Module Installation Surface
- 4. Electrical Connection Contact Point

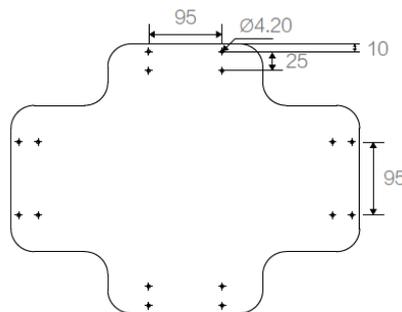
A total of four Armor Modules are required for a single robot in the ICRA challenge. The Armor Module is shown in the figure below:



- 1. M4 screw mounting hole on the top of the Armor Support Frame
- 2. Armor Indicator

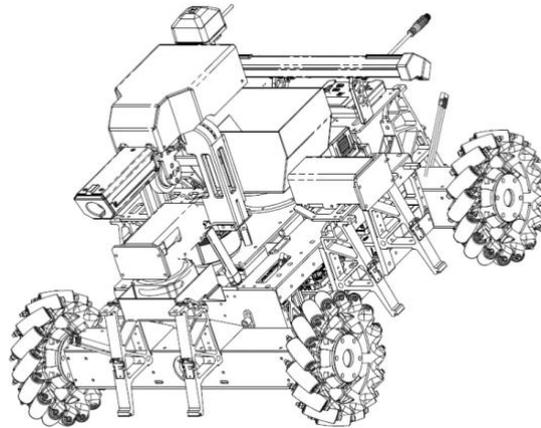
**Installation Procedure:**

- 1. Locate the mounting holes on the Armor Support Frame.



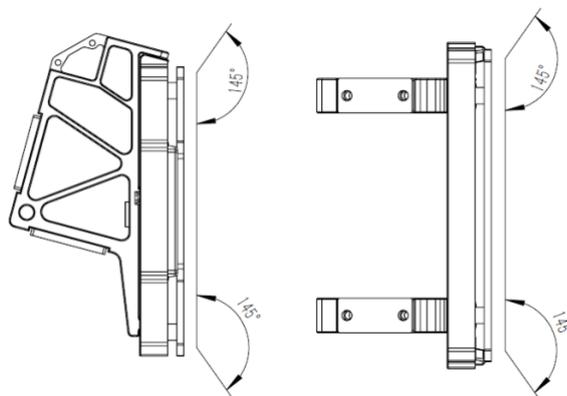
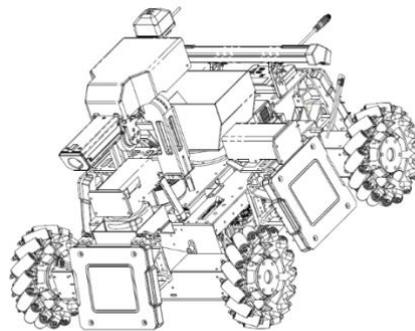
Unit: mm

- Use M4 screws to mount the Support Frame A to the chassis.

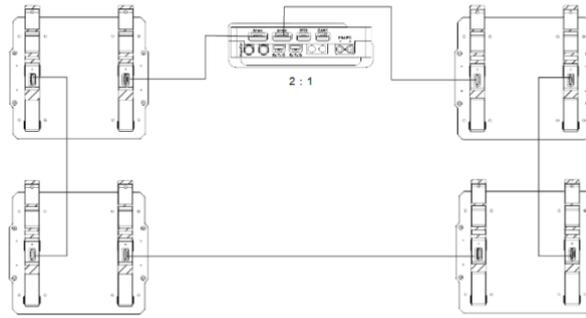


- Use M4 screws to mount the Armor Module to the Support Frame.

**Note:** When correctly installed, the threaded hole on top of the Armor Support Frame is perpendicular to the horizontal ground, not perpendicular to the top surface of the Support Frame. Ensure that the front 145° of the Side Armor Module's exposure surface is not blocked.



- Use the 6-pin cable provided in the package to connect the Armor Modules in sequence to the Armor Module interface on the Power Management Module. The two 6-pin interfaces on the Armor Support Frame are equivalent to each other. It is recommended to split the total number of Armor Modules in sequence between the two equivalent interfaces of the Power Management Module to balance the current load.



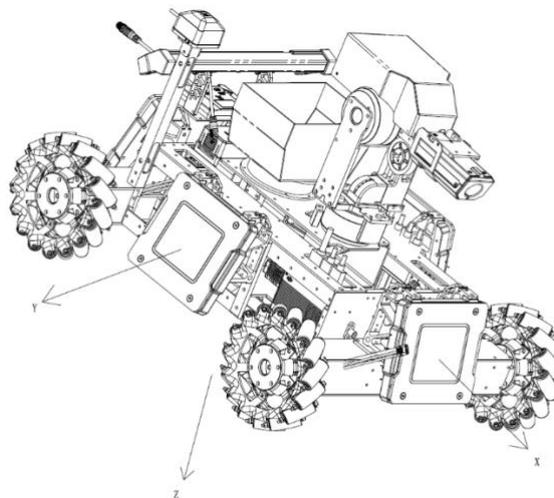

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⚠ The lower edge of the Side Armor Module on the robot should be 50 mm to 140 mm above the ground.

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**Installation Specification and Requirement:**

In the following section, the robot body coordinate system is a standard XYZ Cartesian coordinate system, with the origin being the robot's center of mass, as shown in the following figure:



The kinematics equation of the robot should be based on the Cartesian coordinate system. If a team chooses to use a non-Cartesian coordinate system, the robot's coordinate system is defined using the following guidelines: Imagine that the Launching Mechanism of the robot's largest caliber in its initial state launches a projectile. Define the positive X direction as the projected vector on the XY plane of this projectile's projective direction. Establish the positive Y direction by using the positive X direction and the positive Z direction (pointing to the earth's core) according to the right-hand rule, with the robot's center of mass as the origin.

**Installation on the Side**

When an Armor Module is mounted on the side, its exposure surface must be firmly connected to the Support Frame. Keep the bottom surface of the Armor Support Frame parallel to the XY plane, so that

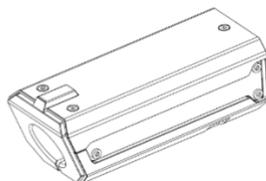
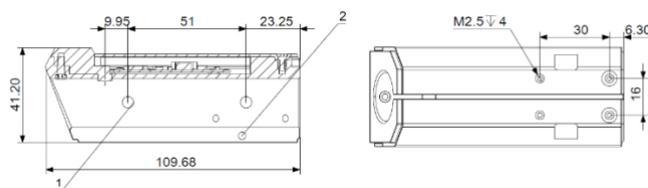
the acute angle between the normal vector of the Armor Module's exposure surface and the negative Z-axis is 75°. Keep the two sides without the indicator light parallel to the XY plane. The Armor Module should be firmly set after the installation. Define the directional vector of any Armor Module as the projected vector of the exposure surface's normal vector (forming an acute angle with the negative Z-axis) on the XY plane. The unit vectors of the direction vectors of the four Armor Modules must be equal to the positive X-axis, negative X-axis, positive Y-axis, and negative Y-axis of the robot's coordinate system respectively. The angular error between the direction vector and the corresponding coordinate vector cannot exceed 5°. The kinematics equations of the robot should also be based on the Cartesian coordinate system in this case. Armor Modules must use the same reference frame as the robot's own structural or kinematic characteristics. The imaginary connection line between the geometric centers of the Armor Modules mounted on the X-axis should be perpendicular to the counterparts of those mounted on the Y-axis. The two imaginary lines should also pass through the robot's geometric center. Armor Modules mounted on the X- or Y- axis can deviate by  $\pm 50$  mm from the geometric center.



- Self-designated protective armor cannot have any contact with the official Armor Module provided by the RoboMaster 2019 Organizing Committee.
- DO NOT change or decorate the official Armor Module provided by the RoboMaster 2019 Organizing Committee.
- Wire the robot reasonably based on its design and ensure that wires are connected securely to prevent damage and wear.

## Speed Monitor Module

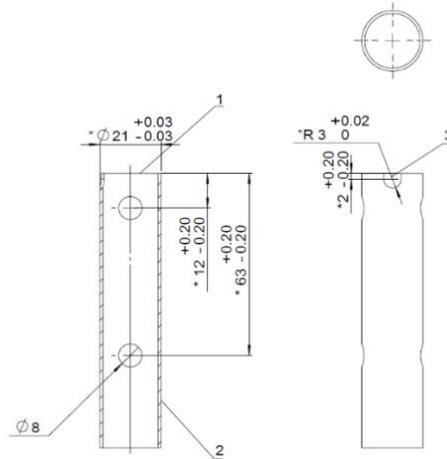
### Speed Monitor Module (17 mm Projectile):



1. Phototube

2. Barrel Clamping Screw Hole

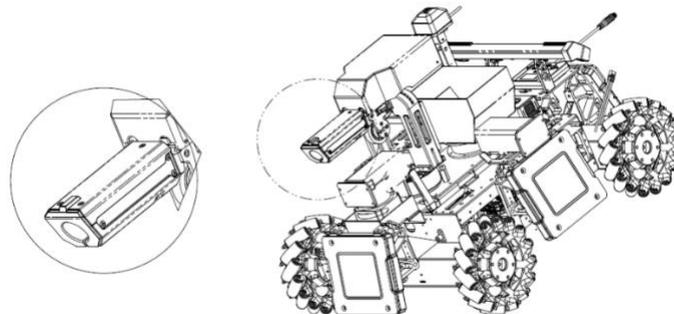
17 mm barrel size restrictions:



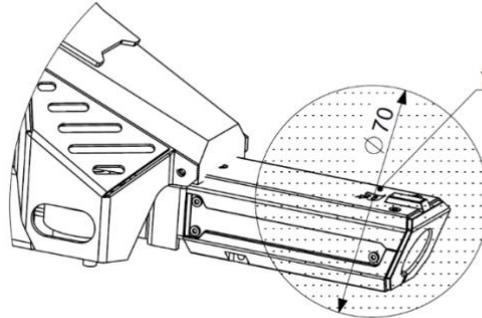
1. Barrel
2. Pipe Wall Thickness must be greater than 1 mm
3. The U-shaped groove faces up after the installation of the barrel

#### Installation Procedure:

1. Set the Speed Monitor Module on the barrel with its cable pointing at the Main Controller Module and the cylindrical step aligning with the U-shaped groove on the barrel.
2. Use M3 screws to tighten the barrel through the screw holes in the rear of the Speed Monitor Module.
3. Connect the aviation plugs on the Speed Monitor Module to the plug on the Main Controller Panel's Speed Monitor interface. The completed installation is shown in the figure below.



- 
- ⚠ ● The Speed Monitor Module contains a magnetometer, which is sensitive to electromagnetic environment. Therefore, with the logo at the center, no large magnetic conductive material (devices like iron barrel, cooling fan of VTM Transmitter, friction wheel motor are forbidden in Area 1) should be placed within an area measuring 70 mm in diameter.
-

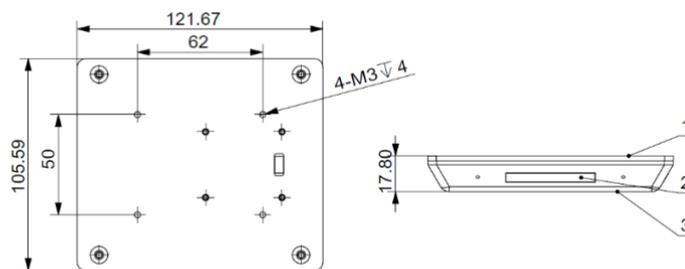


- DO NOT block the mounting holes for the infrared LEDs. Otherwise, the Speed Monitor Module will be unable to initialize.
- The Speed Monitor Module should be firmly secured to avoid relative displacement between the module and the barrel.
- Since the aviation connector cable of the Speed Monitor Module is close to the friction wheel, the cable should be protected from wear when used.

## RFID Interaction Module

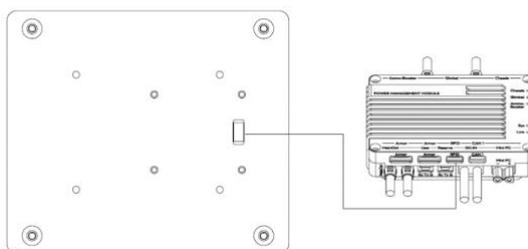
### Installation Procedure

1. Locate the mounting holes reserved on the robot.



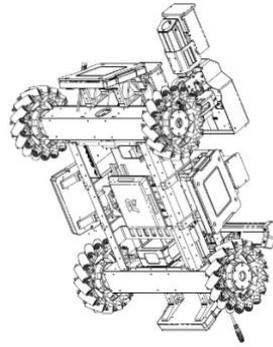
1. Back      2. LED Light Indicator      3. Front

2. Use the 4-pin cable provided in the package to connect the RFID Interaction Module to the RFID interface on the Power Management Module.



3. Use M3 screws to mount the RFID Interaction Module to the chassis. Do not press or bend the 4-

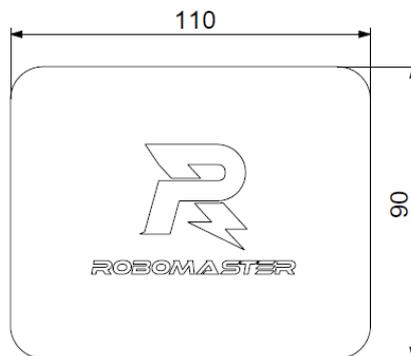
pin cable during installation, and choose a mounting position away from the ground.



- 
- ⚠ Ensure that the logo side of the RFID Interaction Module is not blocked by any metal object, and that the side without a logo is free of current interference (such as motor wire or RM center plate). Test the effective detection distance of the module after installation. If the distance decreases, check whether the module is installed properly.
- 

## RFID Interaction Module Card

The RFID Interaction Module Card is a function card of the Battlefield Components and is buried in corresponding locations in the Battlefield. During the competition, the robot will obtain the corresponding gains after detecting RFID Interaction Module Card through its installed RFID Interaction Module. The dimensions of the RFID Interaction Module Card are as follows:





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