

Preview

Using a 32-bit motor driver chip and Field-Oriented Control (FOC), the RoboMaster C60 Brushless DC Motor Speed Controller enables precise control over motor torque.



Exclusively designed for the RoboMaster M8008 P19 Brushless DC Motor and C600 Brushless DC Motor Speed Controller, this M8008 Accessory Kit includes several cables and a terminal board.

RoboMaster System Specification Manual, RoboMaster System User Manual, Introduction of RoboMaster System Manual

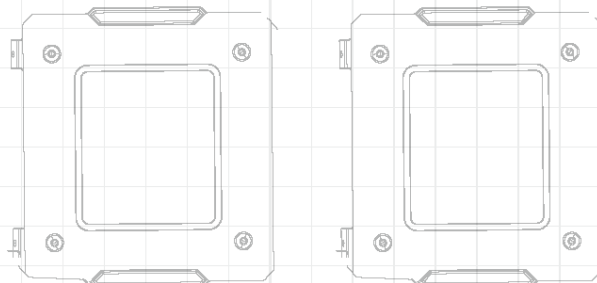
The M8008 Accessory Kit includes several cables and a terminal board, ensuring a complete product solution for your RoboMaster system.

# ROBOMASTER 2021

## UNIVERSITY CHAMPIONSHIP

# RULES MANUAL

Prepared by the RoboMaster Organizing Committee  
Released on September 2020



# Table of Contents

Reading Tips.....	5
Legend.....	5
Foreword.....	5
<b>1. Introduction .....</b>	<b>6</b>
<b>2. Robot Types .....</b>	<b>7</b>
2.1 Robot Technical Specifications.....	7
2.2 Robot Lineup.....	7
2.3 Hero Robot.....	8
2.4 Engineer Robot.....	9
2.5 Standard Robot .....	9
2.5.1 Automatic Standard Robot.....	10
2.5.2 Balancing Standard Robot.....	11
2.6 Aerial Robot.....	11
2.7 Sentry Robot .....	12
2.8 Dart System.....	13
2.9 Radar.....	13
<b>3. Competition Area .....</b>	<b>14</b>
3.1 Resource Island .....	14
3.2 Official Projectile Supplier.....	15
3.3 Bricks and applicable battlefield components .....	15
3.4 Localization points .....	16
3.5 Waste Land .....	16
<b>4. Competition Mechanism .....</b>	<b>17</b>
4.1 Level-Up Mechanism .....	17
4.1.1 Experience System.....	17
4.1.2 Performance System.....	17
4.2 Economic System .....	20
4.3 HP Deduction Mechanism .....	21
4.3.1 Attack Damage.....	21
4.4 Relationship between a Sentry Robot, Outpost and Base .....	22
4.5 Power Rune Mechanism .....	22
4.6 Battlefield Buff Mechanism .....	22
4.7 HP Recovery and Revival Mechanism.....	22
4.8 Winning Criteria .....	22

## Table Directory

Table 2-1 Robot lineup .....	7
Table 2-2 Basic parameters for Hero Robots .....	8
Table 2-3 Basic parameters for Engineer Robots .....	9
Table 2-4 Basic parameters for Standard Robots .....	9
Table 2-5 Basic parameters for Automatic Standard Robots .....	10
Table 2-6 Basic parameters for Aerial Robots .....	11
Table 2-7 Basic parameters for Sentry Robots .....	12
Table 2-8 Basic parameters for Dart System .....	13
Table 4-1 Types of chassis and Launching Mechanisms .....	17
Table 4-2 Attributes of Standard Robot Chassis .....	18
Table 4-3 Attributes of Hero Robot Chassis .....	18
Table 4-4 Attributes of 17mm Launching Mechanisms .....	19
Table 4-5 Attributes of 42mm Launching Mechanisms .....	20
Table 4-6 Item prices .....	20
Table 4-7 HP Deduction from Armor Attack .....	21

## Diagram Directory

Figure 3-1 Front view of Resource Island.....	14
Figure 3-2 Axonometric view of Resource Island.....	14
Figure 3-3 The shape of a brick.....	15
Figure 3-4 Steps to the trapezoid elevated ground .....	15

## Reading Tips

This document is for preview only. Please refer to the officially released manual for the final version of the rules.

## Legend

 Prohibitions	 Important notes	 Hints and tips	 Definitions and references
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## Foreword

All participants should abide by the rules and the relevant documents of the competition. The key specifications for the 20<sup>th</sup> RoboMaster 2021 University Championship ("RMUC 2021") are contained in the following documents: "RMUC 2021 Rules Manual", "RMUC 2021 Participant Manual" and "RMUC 2021 University Series Robot-Building Specifications Manual". All documents are subject to the latest version officially released by the RoboMaster Organizing Committee (hereinafter referred to as "the RMOC").

# 1. Introduction

The RMUC 2021 takes the format of shooting battles between robots. Two teams compete by launching projectiles to attack the enemy team's base in a round of 7 minutes. Participating teams are required to design, develop and create multiple robots in compliance with specifications to form a battle team.

The RMUC 2021 will differ from the RMUC 2020 in the following areas:

## **Robots**

- The performance upgrading mechanisms of Standard and Hero Robots have been updated
- The projectile supply mechanism has been replaced with an economic system
- Engineer Robots are no longer required to procure projectile containers. Their tasks now are to mine for minerals and carry bricks
- Two new robot types, the Balancing Standard Robot and Automatic Standard Robot, and their relevant mechanisms have been introduced
- The Fixed Launching Mechanism of Aerial Robots has been removed. Aerial Robots can now be installed with a Mobile 17mm Launching Mechanism

## **Competition Area**

- New features have been added to the Resource Island
- Changes have been made to the functions of the Official Projectile Supplier
- Bricks have been added
- The shape of the ring-shaped elevated ground has been modified
- Tactile paving and steps have been added to certain parts of the competition area

## 2. Robot Types

### 2.1 Robot Technical Specifications

All robots used in the competition must fulfill the technical specifications set out by the RMOC. For details, please refer to the "Robot Building Specifications Manual" to be released.

A Mobile 17mm Launching Mechanism can be mounted on either one of the Aerial, Standard and Hero Robots, provided that it meets the technical specifications of all robots. All Launching Mechanisms must meet the relevant requirements for Initial Firing Speed Limit for Projectiles. Each Launching Mechanism can be mounted with a laser sight.

**Example 1: According to the parameters for Standard Robots in "2.5 Standard Robot", Standard Robots can be mounted with a 17mm Launching Mechanism. A team can mount a mobile 17mm Launching Mechanism on a Standard Robot as needed. The Robot will then have two 17mm Launching Mechanisms.**

**Example 2: According to the parameters for Aerial Robots in "2.6 Aerial Robot", Aerial Robots do not have any Fixed Launching Mechanism. A team can mount a Mobile 17mm Launching Mechanism on an Aerial Robot as needed. The Robot will then have a 17mm Launching Mechanism.**

### 2.2 Robot Lineup



Teams that meet the robot lineup requirements are eligible to participate in the competition. For details, please refer to the "RMUC 2021 Rules Manual" to be released.

Participants at the RMUC 2021 are encouraged to ensure their robots work together seamlessly and efficiently as a team. The required robot lineup is as follows:

Table 2-1 Robot lineup

Robot Type	Full Lineup Quantity	Competition Stage
Hero Robot	1	Regional competitions (mainland China and international), final tournament
Engineer Robot	1	
Standard Robot	2	Regional competitions (mainland China)
	3	Region competition (international), final tournament

Robot Type	Full Lineup Quantity	Competition Stage
Aerial Robot	1	Regional competitions (mainland China and international), final tournament
Sentry Robot	1	
Dart System	1	
Radar	1	

## 2.3 Hero Robot

Table 2-2 Basic parameters for Hero Robots

Item	Limit	Remarks
Initial HP	150	-
Maximum HP	Depends on the chassis type and robot level	For details, refer to "4.1.2 Performance System"
Operating Mode	Manual, with no more than one remote controller	-
Maximum Chassis Power Consumption (W)	Depends on the chassis type and robot level	For details on buffer energy, refer to the "RMUC 2021 Rules Manual" to be released
Launching Mechanism	One 42mm Launching Mechanism	A Mobile 17mm Launching Mechanism can be mounted
Initial Projectile Quantity (round)	0	-
Initial Firing Speed Limit for Projectiles (m/s)	Depends on the type of the Launching Mechanism and robot level, but not exceeding 16	For details, refer to "4.1.2 Performance System"



## 2.4 Engineer Robot

### Major changes:

- Engineer Robots are no longer required to procure projectile containers. Instead, they must now mine for minerals which can be exchanged for gold coins at the Official Projectile Supplier. For details, refer to "4.2 Economic System"
- Engineer Robots now have to grab, move and place bricks
- Engineer Robots cannot be mounted with Mobile 17mm Launching Mechanisms

Table 2-3 Basic parameters for Engineer Robots

Item	Limit	Remarks
Initial HP	300	-
Maximum HP	300	-
Operating Mode	Manual, with no more than one remote controller	-
Maximum Chassis Power Consumption (W)	No limit	-
Initial Projectile Quantity (round)	0	-

## 2.5 Standard Robot

### Major changes:

Two special Standard Robot types have been introduced

Table 2-4 Basic parameters for Standard Robots

Item	Limit	Remarks
Initial HP	100	
Maximum HP	Depends on the chassis type and robot level	For details, refer to "4.1.2 Performance System"

<b>Item</b>	<b>Limit</b>	<b>Remarks</b>
<b>Operating Mode</b>	Options available for manual or automatic mode  Only one remote controller allowed for manual operation	-
<b>Maximum Chassis Power Consumption (W)</b>	Refer to "4.1.2 Performance System"	For details on buffer energy, refer to the "RMUC 2021 Rules Manual" to be released
<b>Launching Mechanism</b>	One 17mm Launching Mechanism	A Mobile 17mm Launching Mechanism can be mounted
<b>Initial Projectile Quantity (round)</b>	0	-
<b>Initial Firing Speed Limit for Projectiles (m/s)</b>	Depends on the type of the Launching Mechanism and robot level, but not exceeding 30	For details, refer to "4.1.2 Performance System"

## 2.5.1 Automatic Standard Robot

Teams can choose to convert no more than one Standard Robot into an Automatic Standard Robot. In terms of overall performance, an Automatic Standard Robot has significant advantages over a regular Standard Robot. An Automatic Standard Robot cannot be controlled by an operator. It may receive commands from other robot controllers through inter-robot communication.

Table 2-5 Basic parameters for Automatic Standard Robots

<b>Robot Level</b>	<b>Maximum HP</b>	<b>Barrel Heat Limit</b>	<b>Barrel Cooling Value per Second</b>	<b>Chassis Power (W)</b>	<b>Initial Firing Speed Limit for Projectiles (m/s)</b>
<b>1</b>	200	120	40	120	30
<b>2</b>	300	180	60		

3	400	240	80		
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## 2.5.2 Balancing Standard Robot

A team can choose to convert a Standard Robot into a Balancing Standard Robot. A Balancing Standard Robot is superior to a regular Standard Robot in some aspects of its performance. For an idea of how the robot should look like, you may refer to the form of a Segway. For further details, refer to the "Robot-Building Specifications Manual" to be released.



If a team turns a Standard Robot into a Balancing Standard Robot that operates automatically, the Robot shall be deemed as an Automatic Standard Robot.

## 2.6 Aerial Robot

### Major changes:

- The Fixed 17mm Launching Mechanism has been removed. A Mobile 17mm Launching Mechanism can now be installed
- The charging mechanism has been replaced with one where gold coins are used to call for aerial support and launch projectiles

Table 2-6 Basic parameters for Aerial Robots

Item	Limit	Remarks
Initial HP	None	-
Maximum HP	None	-
Operating Mode	No restrictions, but with no more than two remote controllers	-
Launching Mechanism	None	A Mobile 17mm Launching Mechanism can be mounted

Item	Limit	Remarks
Initial Projectile Quantity (round)	500	Projectiles can only be launched after aerial support has been requested
Initial Firing Speed Limit for Projectiles (m/s)	30	

## 2.7 Sentry Robot

Table 2-7 Basic parameters for Sentry Robots

Item	Limit	Remarks
Initial HP	600	-
Maximum HP	600	-
Operating Mode	Fully automatic, with no more than one remote controller for debugging	Moves on a Sentry Rail
Maximum Chassis Power Consumption (W)	30	Buffer energy is 200J
Launching Mechanism	Two 17mm Launching Mechanisms	During each round, when the total number of projectiles launched from the two Launching Mechanisms reaches 500 rounds, both Launching Mechanisms will be powered off
Initial Projectile Quantity (round)	500	-
Initial Firing Speed Limit for Projectiles (m/s)	30	-

## 2.8 Dart System

### Major changes:

- The position of the Dart Launcher has been changed
- Darts can be used to attack the outpost and base. They can inflict great damage when they hit the corresponding Dart Detection Module

Table 2-8 Basic parameters for Dart System

Item	Limit	Remarks
<b>Operating Mode</b>	No restrictions, but with no more than one remote controller for debugging	-
<b>Maximum Dart Load</b>	4	-
<b>Initial Firing Speed Limit for Darts (m/s)</b>	18	-

## 2.9 Radar

The radars are mounted on the radar bases on both sides of the Battlefield. They provide a full view of the field for the teams and relay images back to the Operator Rooms. An AC of 220V is provided by the RMOC as power supply for the radars.

## 3. Competition Area

For the dimensions of the battlefield components, refer to the "RMUC 2021 Rules Manual" to be released.

### 3.1 Resource Island

The Large Resource Island is located at the center of the battlefield and contains 5 large minerals. The Small Resource Islands are each located in one half of the battlefield. Each contains 3 small minerals.

At the start of the match, the 5 claws at the top of the Large Resource Island each carries a large mineral. During the match, the large minerals will each drop at a given point in time. For the specific time and logic of when and how the minerals are dropped, refer to the "RMUC 2021 Rules Manual" to be released. In the absence of any interference, the minerals will fall into the groove at the bottom of the Large Resource Island.



The minerals can land on the groove in any position.

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Each claw has an indicator light on either side. Before a large mineral drops, the indicator lights on its claw will turn on.

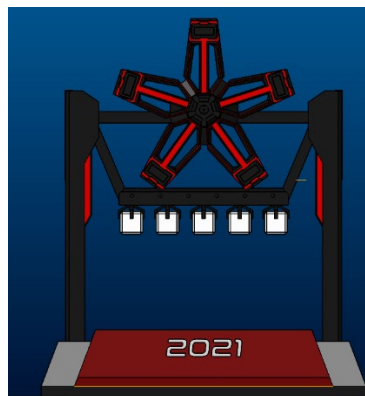


Figure 3-1 Front view of Resource Island

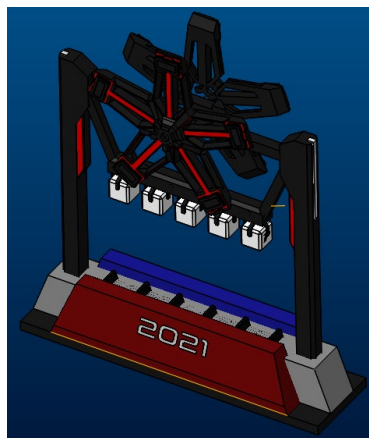


Figure 3-2 Axonometric view of Resource Island

## 3.2 Official Projectile Supplier

The Official Projectile Supplier now has an exchange point, where Engineer Robots can deliver minerals and redeem them for gold coins.

Standard and Hero Robots can exchange their gold coins at the Official Projectile Supplier for 17mm and 42mm projectiles.

## 3.3 Bricks and applicable battlefield components

The bricks are in the shape of a triangular prism. Each half of the battlefield has 3 bricks. During the match, Engineer Robots can move the bricks around and use them strategically to create an advantage for their teams.

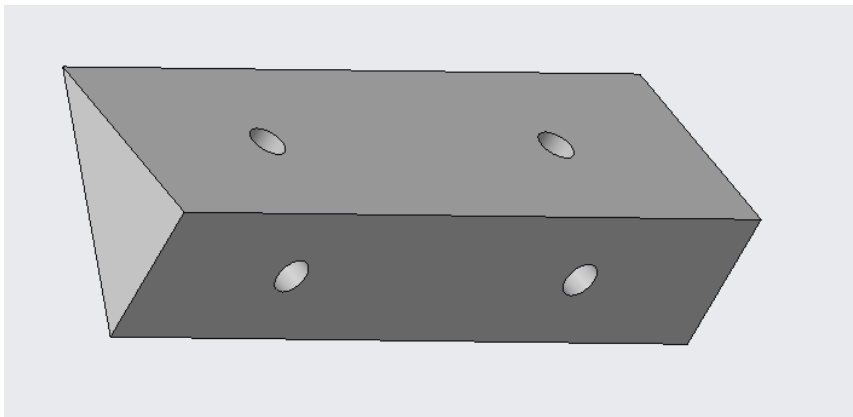


Figure 3-3 The shape of a brick

### Example: Steps to the trapezoid elevated ground

The trapezoid elevated ground has been designed with steps on its side. An Engineer Robot can place bricks on them to form a ramp, enabling other ground robots to get on the elevated ground quickly.

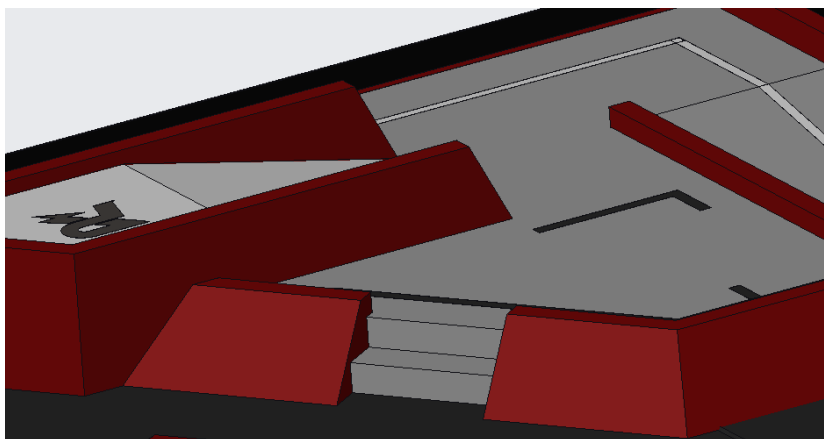


Figure 3-4 Steps to the trapezoid elevated ground

## **3.4 Localization points**

There are several points in the battlefield that enable the localization of robots. Each localization point is attached with a visual tag with patterns that are non-recurring and asymmetrical from all angles.

## **3.5 Waste Land**

The center of the battlefield ground is mostly covered with a blister surface, which is a test of the chassis suspension performance and gimbal stability of ground robots. For the dimensions and arrangements of the blister surface, refer to the relevant national requirements for tactile paving.



## 4. Competition Mechanism

### 4.1 Level-Up Mechanism

At the start of the match, Standard and Hero Robots have a robot level of 1 and performance level of 0. After an operator has selected the type of chassis and Launching Mechanism for a robot, the performance and robot levels will remain the same. If a Standard or Hero Robot is to be installed with a Mobile 17mm Launching Mechanism, the type of Launching Mechanism will also need to be selected.



The chassis and Launching Mechanism, once selected, cannot be changed during a competition round.

#### 4.1.1 Experience System

A robot can gain experience points by attacking or assisting in an attack, or through natural growth. Experience points can be used to advance a robot to the next level.

#### 4.1.2 Performance System

An operator may choose the type of chassis and Launching Mechanism for a robot based on the tables below.

Table 4-1 Types of chassis and Launching Mechanisms

Robot Type	Chassis Type	Launching Mechanism Type
Standard Robot	HP-focused	Burst-focused
	Power-focused	Cooling-focused
		Projectile speed-focused
Hero Robot	HP-focused	Burst-focused
	Power-focused	Projectile speed-focused

- No selections need to be made for Automatic Standard Robots as they are not controlled by operators. If an Automatic Standard Robot is installed with a Mobile 17mm Launching Mechanism, the attributes of the Launching Mechanism will remain the same as those of the fixed Launching Mechanism.



- Chassis do not have to be selected for a Balancing Standard Robot. The system will automatically set its chassis as power-focused, and the barrel cooling value per second of the Standard Robot will be increased by 50%.

Table 4-2 Attributes of Standard Robot Chassis

Chassis Type	Performance Level	Maximum HP	Maximum Chassis Power Consumption (W)
Initial setting	0	100	40
Power-focused	1	150	60
	2	200	80
	3	300	100
HP-focused	1	200	45
	2	300	50
	3	400	55

Table 4-3 Attributes of Hero Robot Chassis

Chassis Type	Performance Level	Maximum HP	Maximum Chassis Power Consumption (W)
Initial setting	0	150	50
Power-focused	1	200	70
	2	250	90

Chassis Type	Performance Level	Maximum HP	Maximum Chassis Power Consumption (W)
	3	300	120
HP-focused	1	250	55
	2	350	60
	3	450	65

Table 4-4 Attributes of 17mm Launching Mechanisms

Launching Mechanism Type	Performance Level	Barrel Heat Limit	Barrel Cooling Value per Second	Initial Firing Speed Limit (m/s)
Initial setting	0	50	10	15
Burst-focused	1	150	15	15
	2	280	25	15
	3	400	35	15
Cooling-focused	1	50	40	15
	2	100	60	18
	3	150	80	18
Projectile speed-focused	1	50	10	30
	2	100	20	30
	3	150	30	30

Table 4-5 Attributes of 42mm Launching Mechanisms

Launching Mechanism Type	Performance Level	Barrel Heat Limit	Barrel Cooling Value per Second	Initial Firing Speed Limit (m/s)
-	0	100	20	10
Burst-focused	1	200	40	10
	2	350	80	10
	3	500	120	10
Projectile speed-focused	1	100	20	16
	2	200	60	16
	3	300	100	16

## 4.2 Economic System

During the match, both teams will receive gold coins regularly. They can also mine for additional coins. Gold coins can be used for activities such as purchasing projectiles, calling for aerial support, etc.

Each team has 200 gold coins at the start of the match. For every following minute, 100 gold coins will be given to each team until the fifth minute (when countdown is at 1:59). Both teams will receive 200 gold coins at the sixth minute (when countdown is at 0:59).

A small mineral is worth 75 gold coins. A large mineral is worth 300 gold coins.

Table 4-6 Item prices

Item Name	Price
17mm projectile	50 coins/50 rounds
42mm projectile	75 coins/5 rounds
Aerial support	400 coins/time

Item Name	Price
	After aerial support has been requested, the Aerial Robot will be able to launch 500 rounds of 17mm projectiles over 30 seconds (no gold coins need to be spent for the projectiles)

No projectiles need to be purchased for Automatic Standard Robots at the Official Projectile Supplier. They can be pre-loaded with a certain amount of 17mm projectiles before the competition. During the match, the Referee System will automatically deduct one gold coin from the relevant team for each launched 17mm projectile detected.

### 4.3 HP Deduction Mechanism

The HP of ground robots and Sentry Robots will be deducted in any of the following situations: the Barrel Heat limit, Initial Firing Speed limit or Maximum Chassis Power Consumption of a Launching Mechanism is exceeded; an Armor Module is attacked by a projectile or struck in a collision; an important module of the Referee System goes offline; penalty imposed for violation of rules; etc. For any mode of deduction that is not mentioned, refer to the "RMUC 2021 Rules Manual" to be released.

#### 4.3.1 Attack Damage

An Armor Module detects projectile attacks using the pressure sensor combined with the armor's vibration frequency. A Dart Detection Module detects dart attacks using the Armor Module combined with the phototube. A Dart Detection Module can detect attacks from darts and 42mm projectiles. The time interval required for the detection of a dart attack by a Dart Detection Module is 1 second.

The table below sets out the HP deductions for different armors assuming no buff points are received:

Table 4-7 HP Deduction from Armor Attack

Damage Type	HP Damage Value
42mm projectile	<ul style="list-style-type: none"> <li>● Robot's Armor Module: 100</li> <li>● Base and Outpost Armor Modules: 200</li> <li>● Base and Outpost Triangular Armor Modules: 300</li> </ul>
17mm projectile	<ul style="list-style-type: none"> <li>● Robot's Armor Module: [10]</li> <li>● Base and Outpost Armor Modules: 5</li> </ul>
Collision	2

Damage Type	HP Damage Value
Dart	1/5 of the Maximum HP of the base or outpost

## 4.4 Relationship between a Sentry Robot, Outpost and Base

The outpost is located near the ring-shaped elevated ground, and is open to attack after the start of the match. At this point the Sentry Robots of both teams have a defense buff of 100%, and the bases are in the invincible status.

If the outpost of one team has been destroyed, the 100% defense buff of its Sentry Robot and the invincible status of its base will be disabled. At this point, the robots of the other team can choose whether to attack the Sentry Robot or the enemy base.

Where an outpost has been destroyed, and if the Sentry Robot has not entered the Battlefield or has not been destroyed or ejected, the armor of the team's base will expand. At this point the base will be defenseless.

## 4.5 Power Rune Mechanism

The Power Rune is located at the center of the Battlefield. It can be activated by being hit with a projectile. The whole team will receive a certain amount of buff points once it is activated.

## 4.6 Battlefield Buff Mechanism

All buff point zones are laid with RFID Interaction Module Cards. A robot that occupies a Buff Point zone will receive the corresponding buff points.

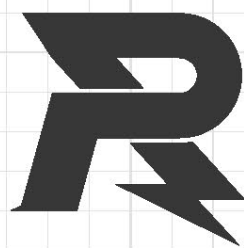
## 4.7 HP Recovery and Revival Mechanism

A ground robot that occupies its team's Restoration Zone will receive recovery or revival buff points.

An Engineer Robot can earn recovery or revival buff points for its team's robots through an RFID Interaction Module Card.

## 4.8 Winning Criteria

The winner will be the team with the highest remaining HP for its base, Sentry Robot and outpost (in the stated order) at the end of the match.



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