

RoboMaster AI Robot 2020 Standard Version User Manual

V2.0 2020.2

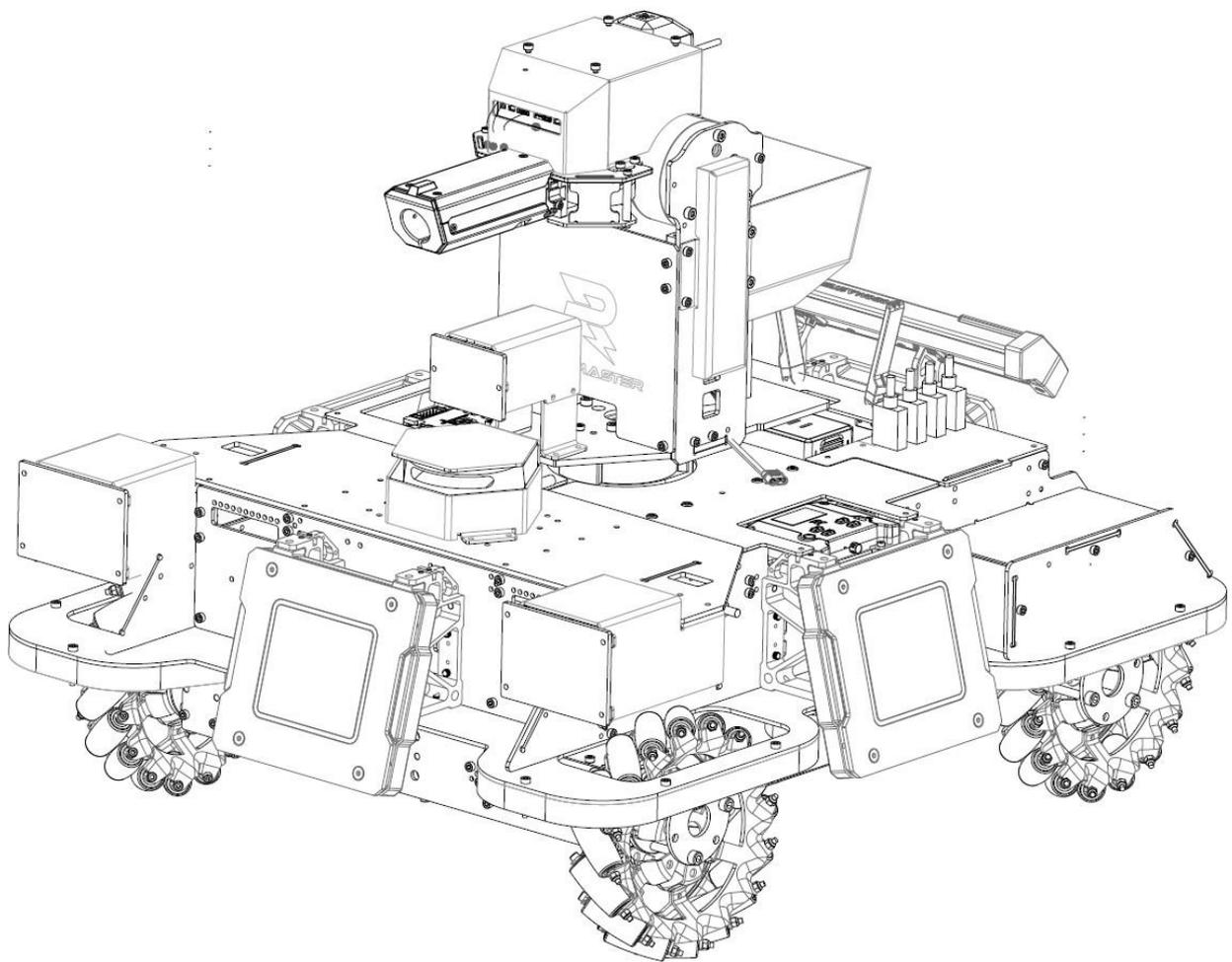


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Using this Manual

Legend

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Declaration

The RoboMaster AI Robot 2020 Standard Version does not include sensors such as the RoboMaster UWB Positioning System Module and LiDAR as well as relevant computing devices such as Manifold 2. Teams needing such devices are required to configure them on their own.

Usage recommendations

The following documents are provided by RoboMaster to users:

1. “RoboMaster AI Robot 2020 Standard Version Items List”
2. “RoboMaster AI Robot 2020 Standard Version User Manual”
3. “M600-Series Intelligent Flight Battery User Safety Guidelines v1.0”

RoboMaster has consolidated the manuals for all the accessories (including the motor and ESC) used in the RoboMaster 2020 AI robot into the compressed “RoboMaster 2020 AI Robot Document Pack” for the reference of users.

Users are advised to first perform checks using the “RoboMaster AI Robot 2020 Standard Version Items List” After that, users may familiarize themselves with the entire process of use by referring to the “RoboMaster AI Robot 2020 Standard Version User Manual”. More developer documents can be found in the “RoboMaster 2020 AI Robot Document Pack” compressed file. Kindly read the “M600-Series Intelligent Flight Battery User Safety Guidelines v1.0” in detail before using an intelligent flight battery. For more information, visit <https://robomaster.com> to download the relevant documentations or contact RoboMaster.

Disclaimer and Warnings

Thank you for using RoboMaster AI Robot 2020 Standard Version. Please read this disclaimer carefully before using this product. By using this product, you acknowledge that you have read and agreed to all content herein. Please install and use this product in strict accordance with the User Manual, product instructions, and relevant laws, regulations, rules and policies. Users are responsible for their behavior and any resulting consequences when using this product. DJI™ will not bear any legal responsibilities for any losses caused by improper use, installation or modification.

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The disclaimers are subject to the final interpretation of DJI.

Important notes for product usage

The high-speed moving chassis, high-speed rotating friction wheel and the projectiles launched by them may cause a certain amount of personal injury and property damage. Please exercise caution during use.

The "notes" mentioned in this manual are important and should be strictly followed.

1. The robot is not waterproof. It must not come into contact with any liquid.
2. After it is powered on, the robot performs an internal self-check, and can only be operated after the self-check is completed.
3. To move the AI robot at high speed, operate it in a spacious, unmanned area. The robot must not collide with hard objects, such as walls, at full speed.
4. Projectiles must not be launched at people. After the projectile speed is adjusted, the optimal testing environment is to launch it at a box with shock-absorbing materials such as cloth bags.
5. After projectiles have been launched and if the robot will not be used for a long time and personnel are present in front of the muzzle, the friction wheel motor should be turned off to prevent any accidents.
6. Any shooting battle must be carried out in a sealed area with a two-meter high fence in the presence of a skilled operator.
7. After each use, projectiles must be emptied from the magazine to prevent any personal injury caused by improper operation.
8. The battery must be removed during long periods of non-use and stored in accordance with the storage methods described in the “M600-Series Intelligent Flight Battery User Safety Guidelines v1.0”
9. The standard intelligent battery must be used (battery model no.: TB47S).
10. When disassembling, the screws should be tightened using appropriate force. The blue gel used on the screws is a disposable thread-locking fluid, which must be used in appropriate amounts for fastening the screws during disassembly.
11. During transportation, the gimbal must be fixed for two degrees of freedom and the chassis with four drive wheels. The battery must also be removed and the magazine emptied.

If you experience any problems during use that cannot be solved, please contact RoboMaster for assistance.

I. Introduction

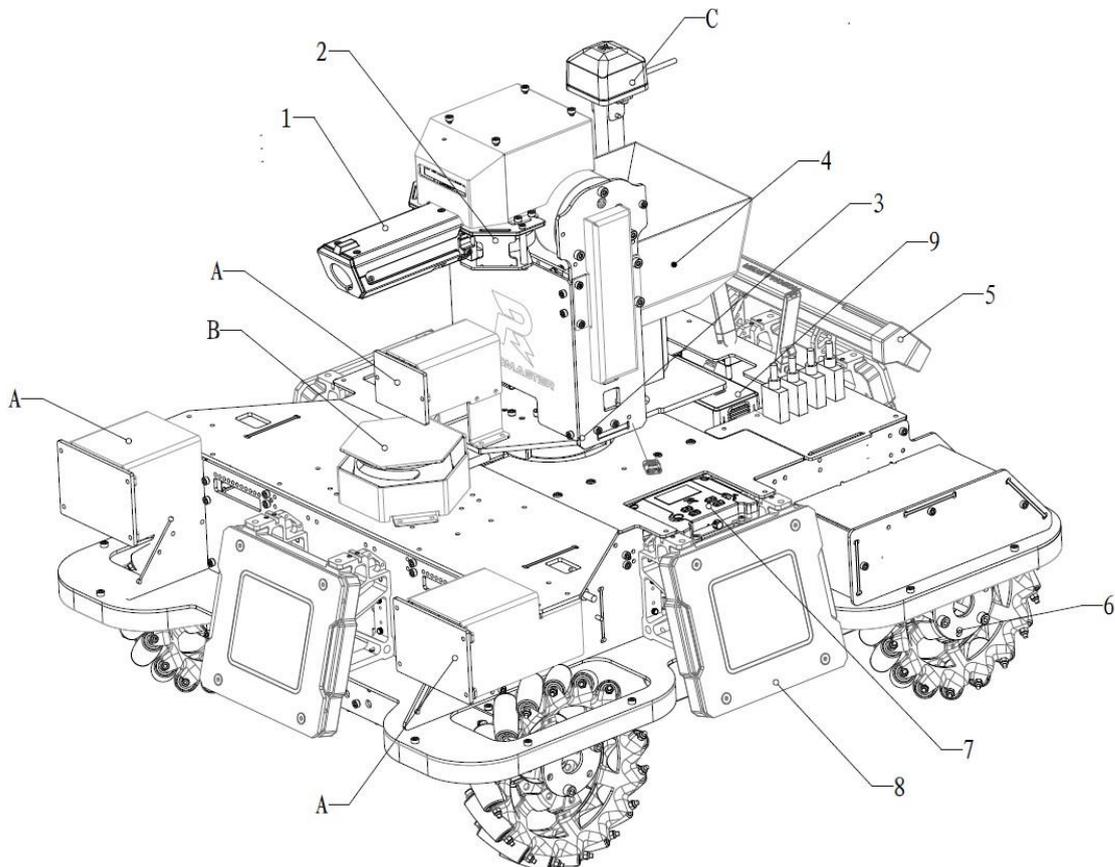
The RoboMaster AI Robot 2020 Standard Version is comprised of the Chassis Module, Expansion Module, Gimbal Module, Launch Module and Referee System Module.

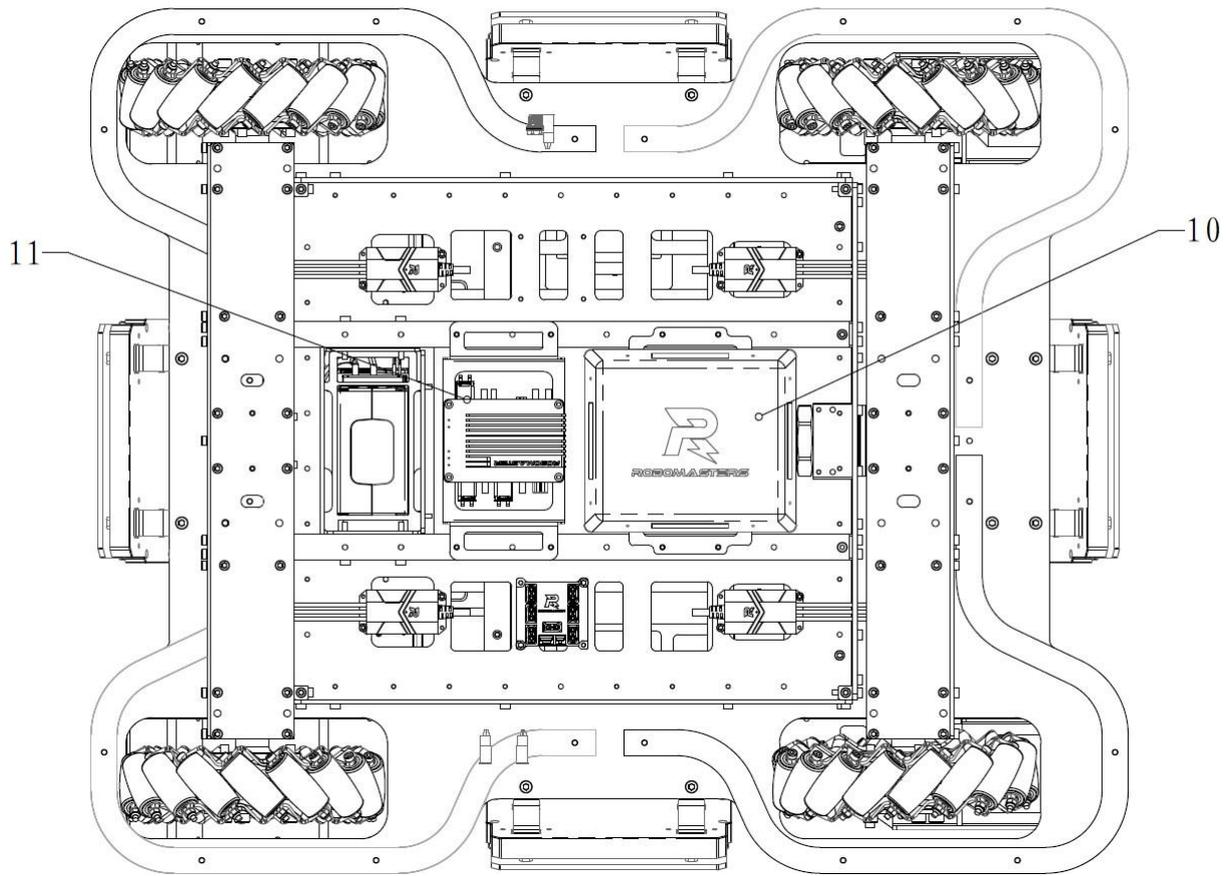
The robot's Chassis Module includes a set of Mecanum wheels which provide omni-directional movement to the robot. The robot's Expansion Module is an expansion platform installed on the Chassis Module that can be equipped with external controllers (e.g. MiniPC, Manifold, etc.) and sensors (e.g. cameras, LiDAR, etc.), and includes a set of bumpers around the robot that effectively mitigate the impact of any collision on the robot and significantly enhance the robot's service life. The robot's Gimbal Module is able to complete rotational movements in the pitch and yaw degrees of freedom, which enhances the flexibility and battle ability of the robot. The robot's Launch Module is able to launch RoboMaster 17mm projectiles. The robot's Referee System Module contains sensors that can detect the value of HP deduction suffered by the robot, and the Referee System Module will automatically power off and simulate the robot's defeat when the robot's HP has been reduced to zero. It can operate multiple robots on the designated site when engaging in designed battles.

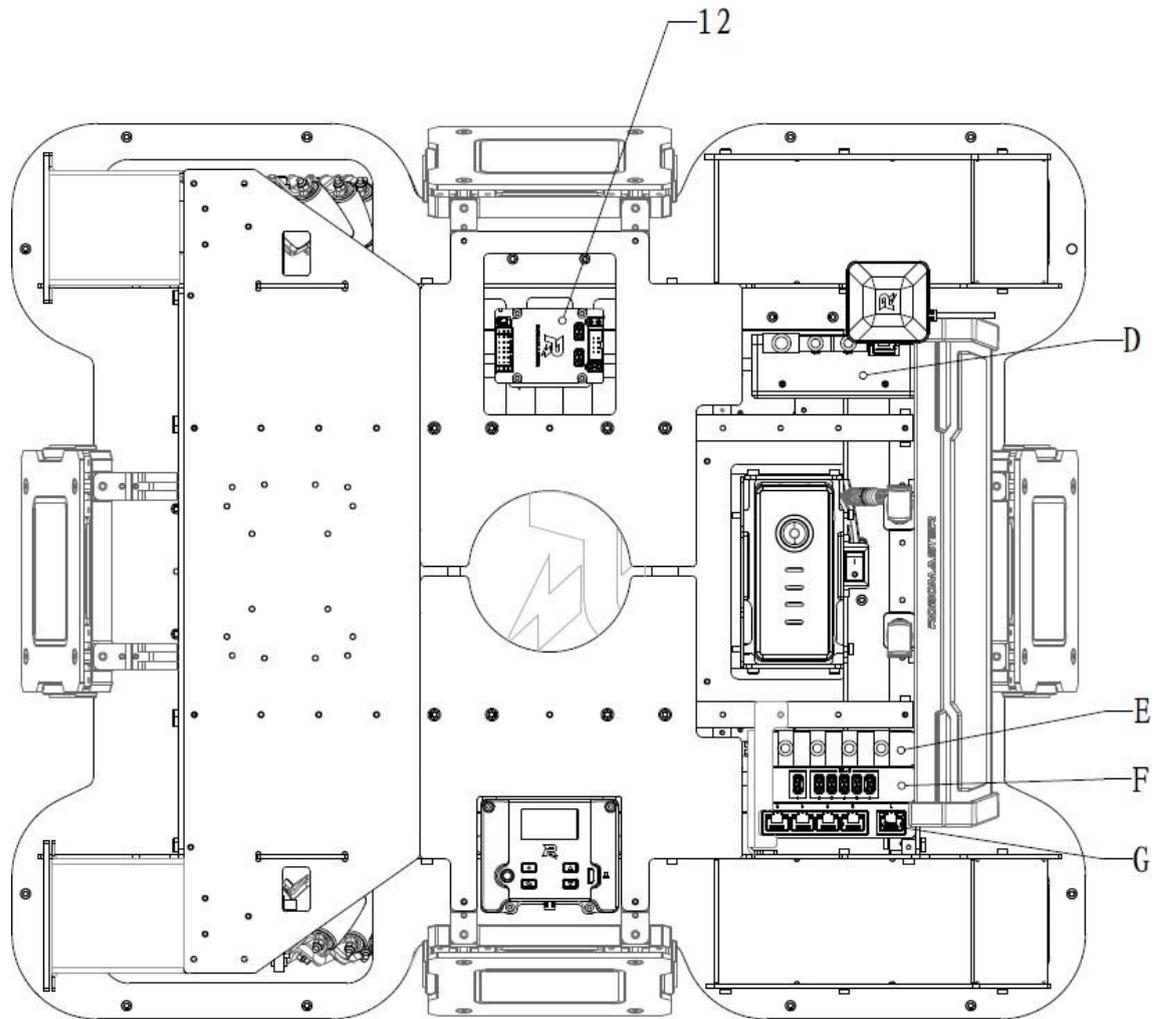
Open-source control programs and complete development documents should be provided for the robot to facilitate the developer in carrying out secondary development. The use of USB, CAN and UART as external communication interfaces is supported, as external controllers (e.g. MiniPC, Manifold, etc.) can be used more easily to control robots, as users will thus have more flexibility and be able to create a unique and fully automated robot solution.

II. Hardware Modules and Methods of Use

2.1 Complete hardware functions







- | | |
|--|--|
| 1. Referee System Speed Monitor
Module SM01 | 8. Referee System Armor Module AM02 |
| 2. Launching Mechanism Module | 9. TB47S Battery |
| 3. 2-Axis Gimbal Module | 10. Referee System RFID Interaction
Module FI02 |
| 4. Projectile Supply Module | 11. Referee System Power Management
Module PM01 |
| 5. Referee System Light Indicator
Module LI01 | 12. RoboMaster Development Board Type
C |
| 6. Power Module | |
| 7. Referee System Main Controller
Module MC02 | |

The following modules are not included in the sale list:

A. Camera

B. LiDAR

C. Referee System Positioning Module

D. Manifold 2

UW01

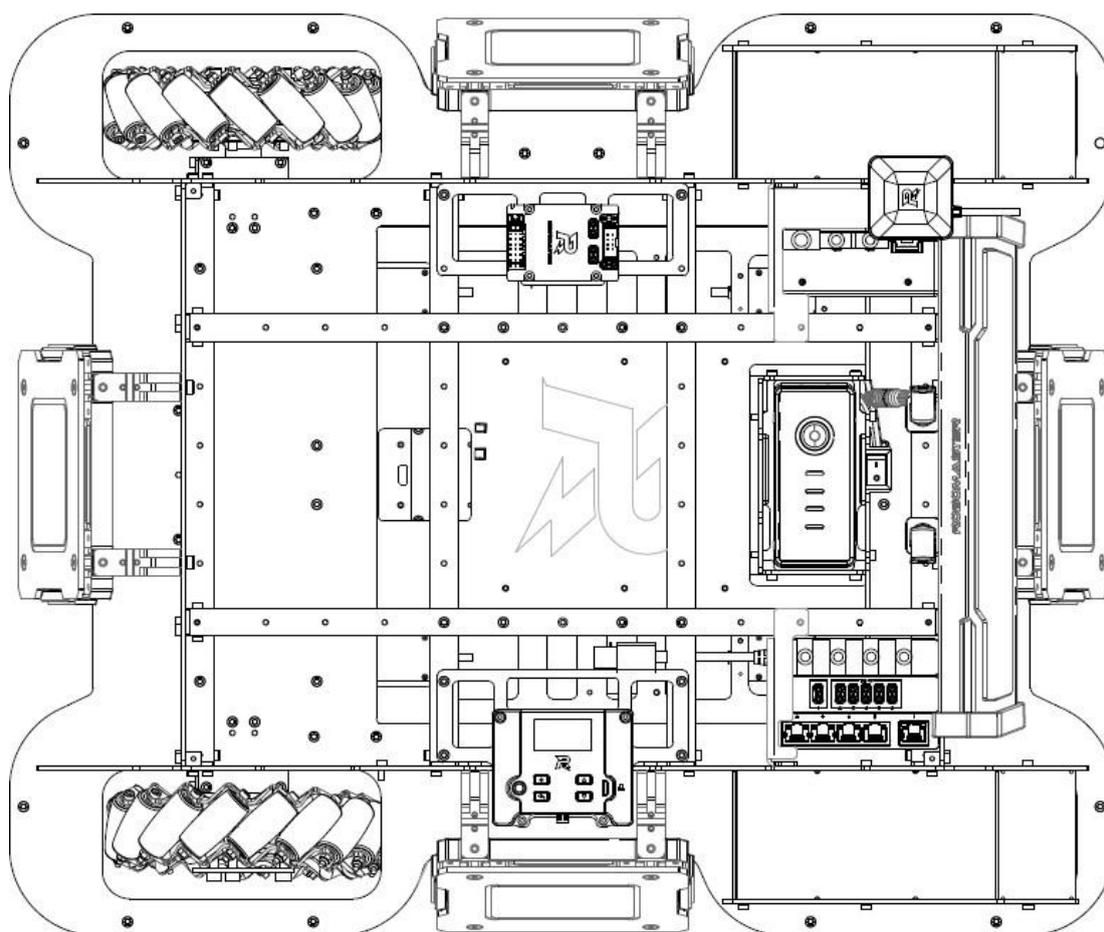
F. Manifold 2 - Power Hub

E. Manifold 2 - USB HUB

G. Manifold 2 – Gigabit Switch

2.2 Chassis

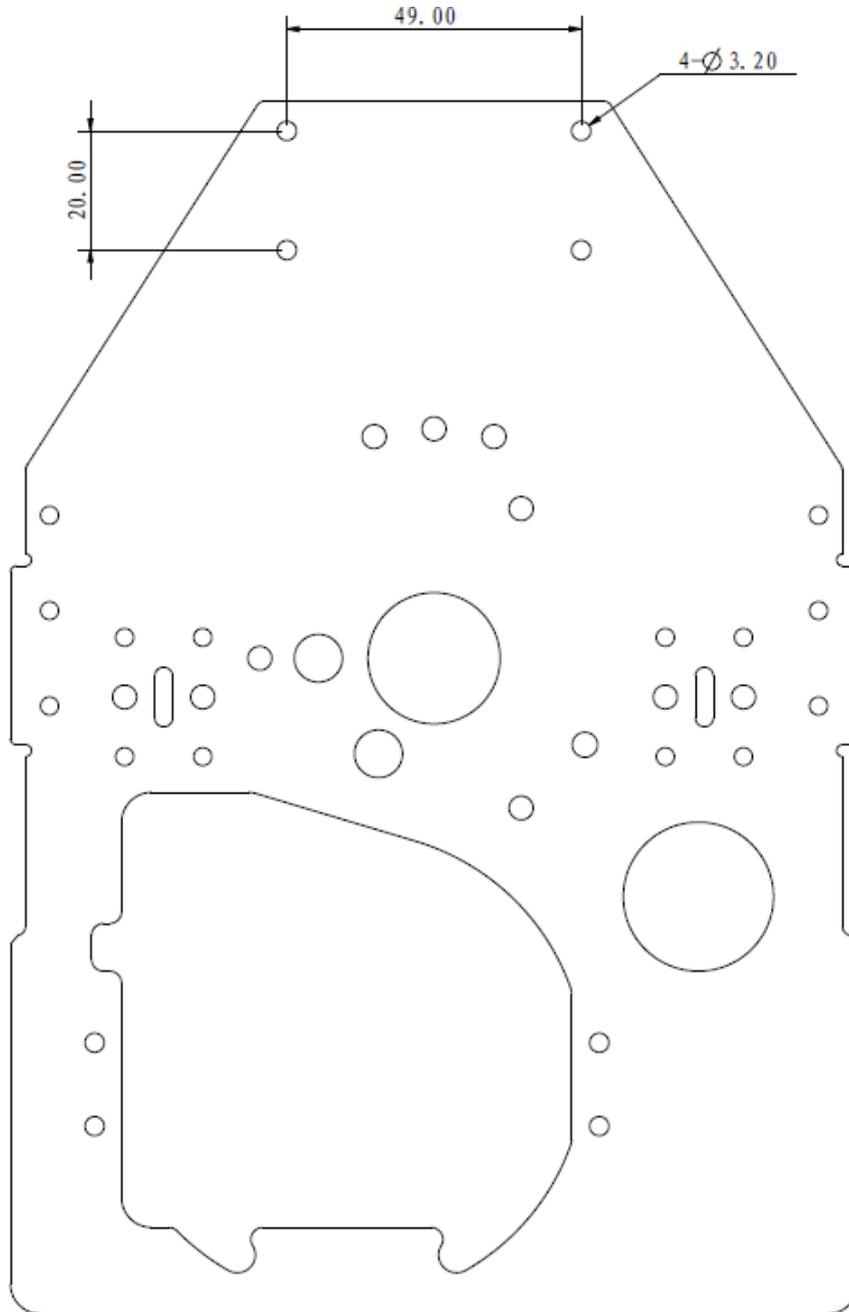
The robot's chassis is a motion platform based on the omni-directional movement technology of Mecanum wheels, which enables movements in multiple directions including forward, traversing, diagonal, rotational movements and their combinations.



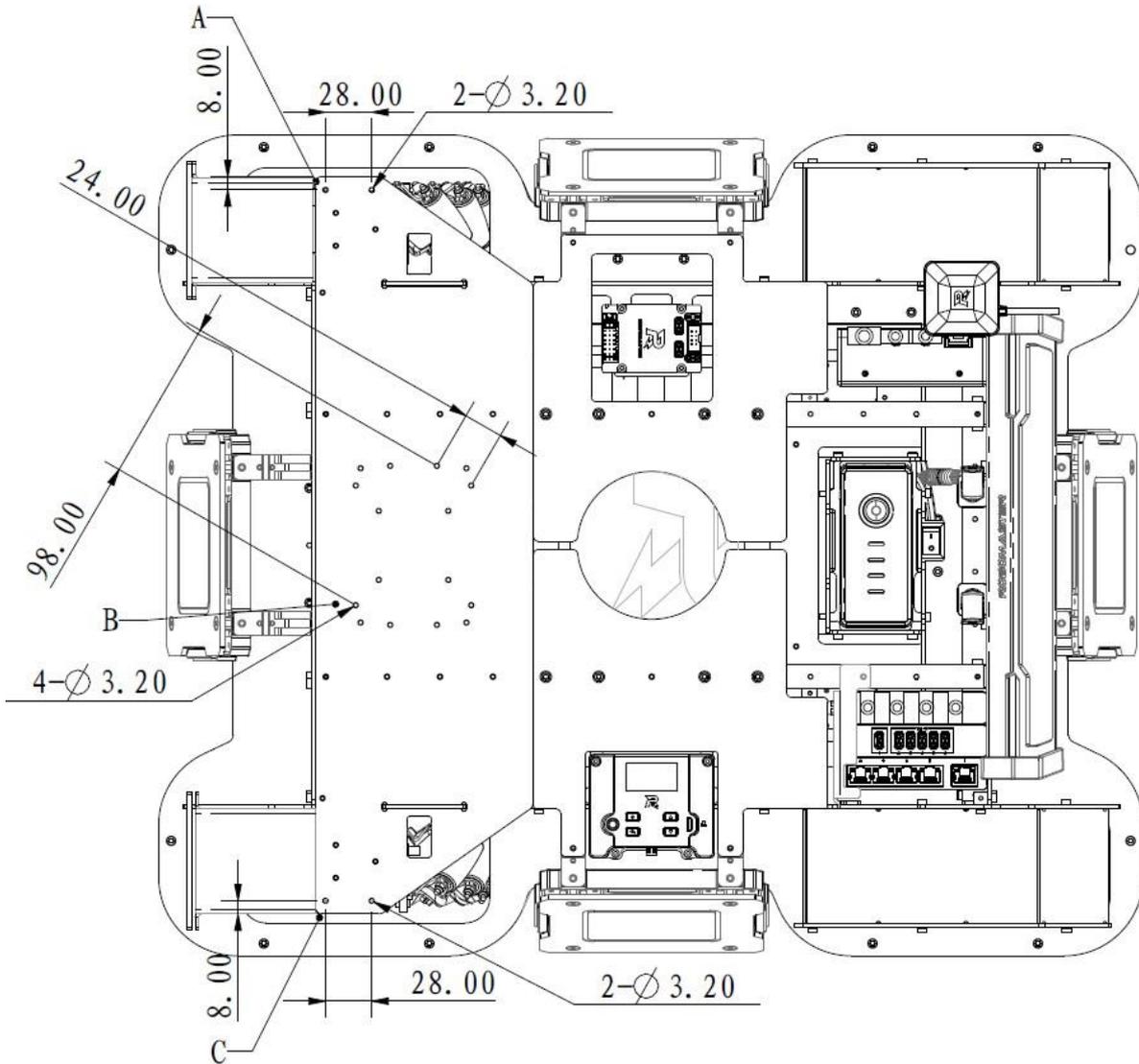
The Chassis Module powers four-wheel drive using the RoboMaster M3508 P19 Brushless DC Gear Motor. For the technical specifications of the motor and the ESC, please see the “RoboMaster M3508 P19 Brushless DC Gear Motor User Guide” and “RoboMaster C620 Brushless DC Motor Speed Controller User Guide” in the reference document pack.

2.3 Installation of Sensors

Mounting holes for the sensor holder are available on the yaw axis of the gimbal. You can install the bracket based on the following mounting hole arrangement.



Mounting holes for the sensor holder are available on both the side (above the armor plate) and front of the chassis. You can install the bracket based on the following mounting hole arrangement.



A:Mounting hole for installing bracket of right sensor B: Mounting hole for installing bracket of front sensor
 C:Mounting hole for installing bracket of left sensor

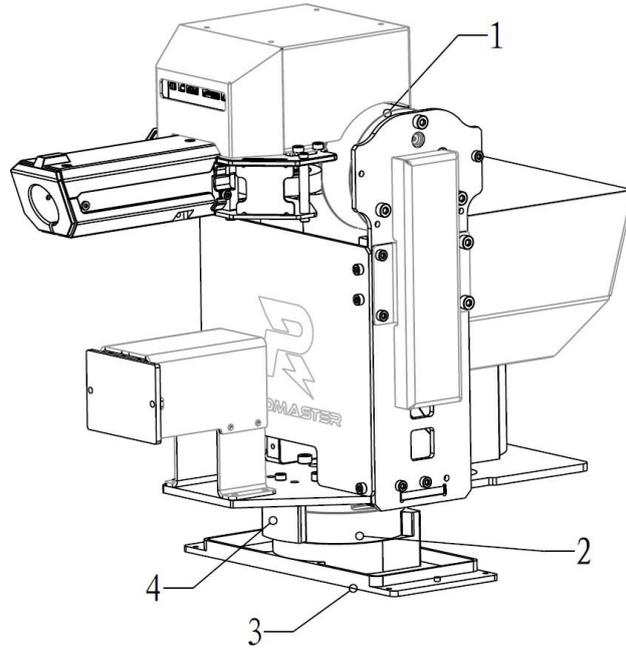
2.4 2-Axis Gimbal

A 2-axis gimbal is installed between the robot's chassis and Launching Mechanism. The robot moves around the pitch axis and the yaw axis.

Pitch axis motion range: $\pm 25^\circ$ (mechanical limit of rotating angle).

Yaw axis motion range: $\pm 90^\circ$ (mechanical limit of rotating angle).

The 2-axis gimbal uses mechanical limits to control the motion range, as shown in the figure below:



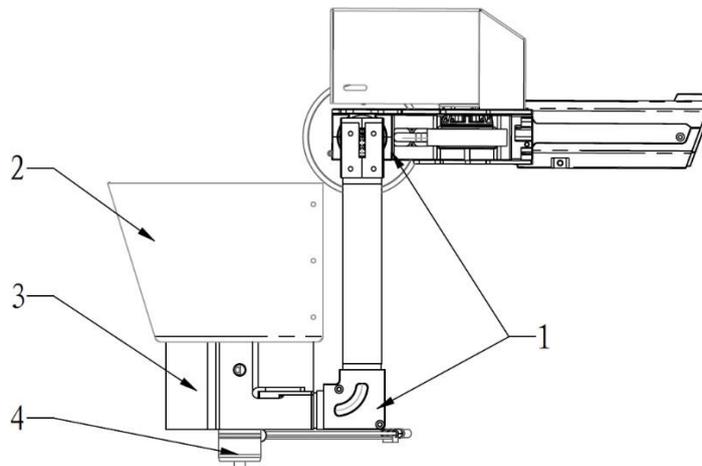
1. Pitch-axis motor 2. Yaw-axis motor
3. Gimbal base fastening fixture 4. Yaw-axis mechanical limit

There are four connectors linking the 2-Axis Gimbal Module and Chassis Module. The XT30 power cable is connected to the Gimbal XT30 interface of the Referee System Power Management Module. The 2-pin CAN connector is linked to the CAN interface of the Development Board Type C on the chassis. The aerial connector is linked to the aerial interface of the Referee System Power Management Module. The RoboMaster C610 Brushless DC Motor Speed Controller is connected to the Ammo-Booster XT30 interface of the Referee System Power Management Module.

The 2-Axis Gimbal Module is propelled by direct drive. The driving motor is the RoboMaster GM6020 Brushless DC Motor, and the ESC is integrated in the motor. For the detailed technical specifications of the motor and ESC, see the “RoboMaster GM6020 Brushless DC Motor User Guide” in the reference document pack.

2.5 Projectile Supply Module

The robot receives projectile supplies through the lower section. The magazine is separated from the Launching Mechanism, to increase the flexibility of the Launching Mechanism and the projectile load. The projectile load is about 300 rounds, which can be partially modified as required. After the initial loading, you must wait for the feed sprocket to fill the pipeline so that projectiles can be fired from the muzzle.

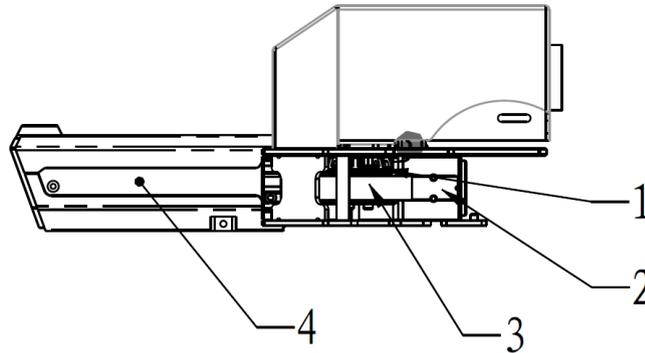


1. Projectile-loading link
2. Magazine
3. Loading mechanism
4. Loading motor

The feed motor is the combination of the RoboMaster M2006 P36 Brushless DC Gear Motor and RoboMaster C610 Brushless DC Motor Speed Controller. For the detailed technical specifications of the motor and ESC, please see the “RoboMaster M2006 P36 Brushless DC Gear Motor User Guide” and the “RoboMaster C610 Brushless DC Motor Speed Controller User Guide” in the reference document pack.

2.6 Launching Mechanism

The friction wheel is driven by two reverse-rotating DC brushless motors. During operation, the projectile is subjected to the squeezing friction of the two rotating friction wheels to obtain the kinetic energy for launching.



1. Snail 2305 Brushless DC Motor
2. UV light panel
3. Friction wheel
4. Referee System Speed Monitor Module SM01

⊗ Do not aim the muzzle at persons or animals during firing to prevent damage caused by high-speed projectiles and lasers (if any).

The friction wheel-propelled motor is the RoboMaster Snail 2305 Brushless DC Motor equipped with the RoboMaster C615 Brushless DC Motor Speed Controller.

2.7 Referee System

The Referee System is an electronic penalty system used for robotic competitions that integrates computation, communication, and control features. The Referee System includes the onboard terminal installed on the robot, as well as the server and client software installed on the PC. The onboard terminal includes the Main Controller, Power Management, Armor, Speed Monitor, and RFID Interaction Modules. This system can detect the damage suffered by the robot during the competition and the speed and frequency of projectile launching. You can use the server and client software to view the real-time status of all robots and automatically determine the outcome of the competition according to the competition rules. Meanwhile, you can use the server and client software to instruct the robot to complete corresponding operations.

The server (RoboMaster Server) is the service center of the Referee System. It collects data from all robots, battlefield components, and clients during the competition, visually presents these data to the referees, and automatically handles the identification logic to determine the competition outcome.

For the usage guidelines on the Referee System, please see the “DJI RoboMaster 2020 AI Challenge Referee System Manual”. For instructions on how to install the client, construct the server, and other details about the Referee System, see the “RoboMaster 2020 Referee System User Manual”.

To download the Referee System Software Installation Pack (2020 Version) please visit:

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

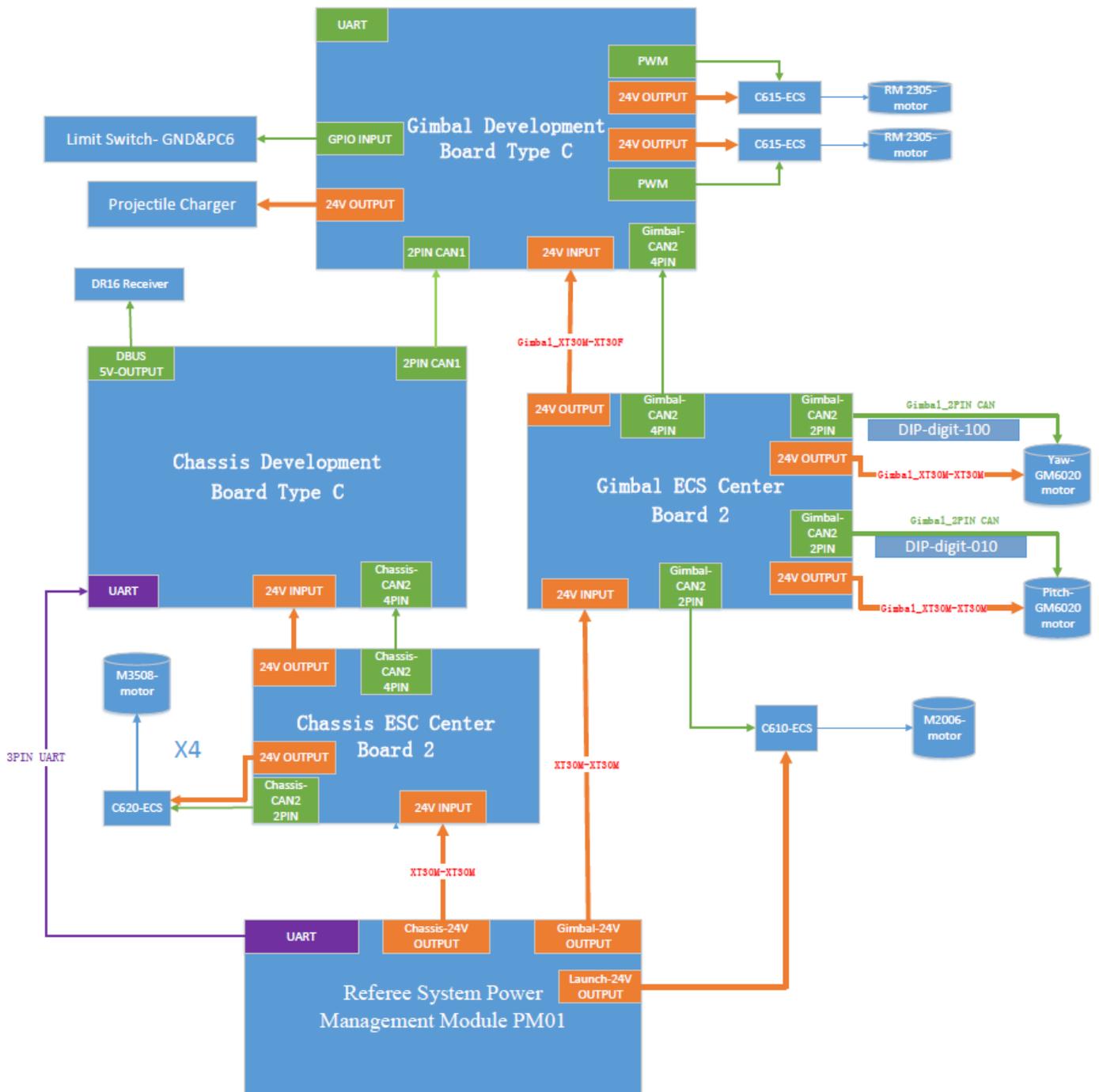
To download the documents relevant to the Referee System, please visit:

<https://www.robomaster.com/en-US/resource/download>.

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- △ • The Speed Monitor Module is subject to the relevant information in the “DJI RoboMaster 2020 AI Challenge Referee System Specification Manual”.
 - The server installation pack will be released later on RoboMaster’s official website:
<https://www.robomaster.com/en-US/resource/download>.
 - Check in regularly for updates.
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2.8 Hardware Circuit System

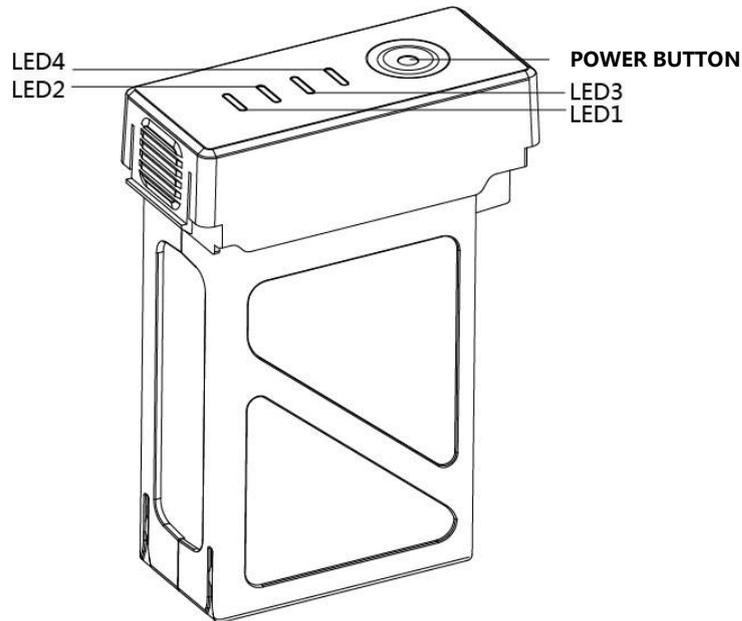
The robot hardware circuit system uses standard CAN bus communication. The overall circuit topology diagram is as follows:



Note: The following configuration demonstrates the wiring diagram of the official test prototype.

IV. Intelligent Battery

The intelligent battery (model: TB47S) is the smart flight battery used by DJI’s Matrice 600 drone. Its capacity is 4500 mAh with a voltage of 22.2 V. It also comes with the charging and discharging function. This battery adopts high-energy battery cells and uses an advanced battery management system to power the robot. Always use the RoboMaster official charger to charge the robot. Please read the “M600-Series Intelligent Flight Battery User Safety Guidelines v1.0” in detail before use.



4.1 Powering On/Off

To switch the intelligent battery on or off, short-press the power switch once and then press and hold the power switch for more than two seconds. When the battery is on, the capacity indicator shows the current battery capacity. When the battery is off, the indicator is off.

4.2 Checking Battery Level

To view the current capacity, short-press the power switch once when the battery is off.

	The capacity indicator displays the power and life of the flight battery during charging and discharging. The statuses of the indicator are defined as follows:	
	indicates that the LED indicator is on	indicates that the LED indicator is flashing
	indicates that the LED indicator is off	

Battery Level LEDs				
LED1	LED2	LED3	LED4	Current capacity
				87.5%-100%
				75%-87.5%

				62.5%-75%
				50%-62.5%
				37.5%-50%
				25%-37.5%
				12.5%-25%
				0%-12.5%
				= 0%

4.3 Battery Charging

Be sure to fully charge the smart battery before using it for the first time.

1. Connect the charger to an AC power supply (100-240V, 50/60 Hz; use a power adapter if necessary).
2. When the battery is on or off, connect it to the charger. If the current capacity is greater than 95%, you must switch on the battery before it can be charged.
3. During charging, the capacity indicator flashes and indicates the current capacity.
4. When the capacity indicator turns off, the battery is fully charged. In this case, disconnect the battery from the charger to finish charging.



Use the RoboMaster designated special charger as the standard charger.

- The battery temperature becomes high after a period of use. In this case, you must wait for the battery to drop to room temperature before charging it.
 - The optimal charging temperature range for the battery is 0 °C to 40 °C. If the battery cell temperature is beyond this range, the battery management system will disable charging.
-

4.4 Charging Protection Indicator

The battery LED indicator can display battery protection notifications triggered by abnormal charging conditions.

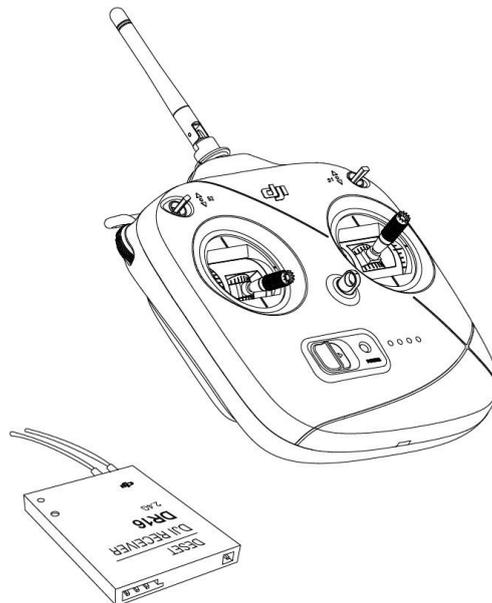
Charging indicator					
LED1	LED2	LED3	LED4	Indicator status	Cause
○	⚡	○	○	LED2 indicator flashes twice per second	Charging current is too high
○	⚡	○	○	LED2 indicator flashes three times per second	A short circuit has occurred during charging
○	○	⚡	○	LED3 indicator flashes twice per second	Battery voltage is too high due to overcharging
○	○	⚡	○	LED3 indicator flashes three times per second	Charger voltage is too high
○	○	○	⚡	LED4 indicator flashes twice per second	Charging temperature is too low
○	○	○	⚡	LED4 indicator flashes three times per second	Charging temperature is too high

After fixing the issue (the charging current is too high, there is a short circuit, the battery voltage is too high due to overcharging, or the charger voltage is too high), press the power button to cancel the LED indicator protection notifications, and then unplug and plug the charger in again to resume charging. If the charging temperature is abnormal, wait for the charging temperature to return to normal, and the battery will automatically resume charging without the need to unplug and plug in the charger again.

V. Remote Controller Set

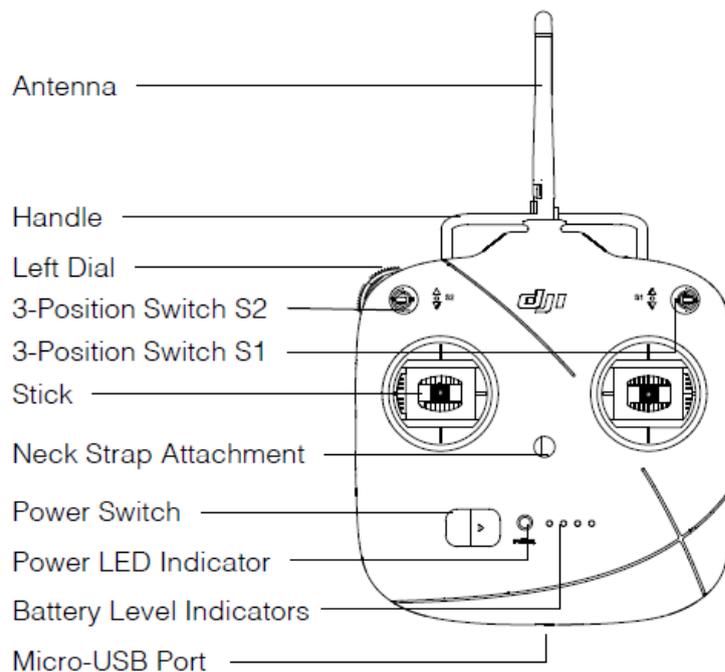
5.1 Description of Kit

The kit includes the remote controller and receiver. The receiver is installed next to the Development Board Type C on the robot's Chassis Module, and completes the frequency pairing between the remote controller and receiver.



5.2 Remote Controller

The robot uses the DJI Flight Remote Controller DT7. DT7 is a radio communication device operating in the 2.4 GHz band. This remote controller can only work with the DR16 receiver. The maximum control range of the remote controller is up to 1,000 meters in an open area (you can control



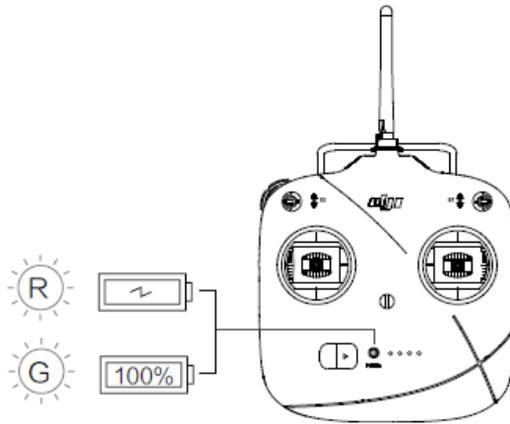
the robot in completing various actions from the ground at a distance of up to 100 meters). The controller has a built-in lithium battery with a maximum operating time up to 12 hours.

5.2.1 Powering On/Off

1. Toggle the S1 switch to the uppermost position and check that the two joysticks are in the middle.
2. Toggle the power switch to the right to power on the remote controller. Toggle the power switch to the left to power off the remote controller.
3. When the remote controller is powered on, it emits a warning tone, and the power indicator becomes solid green and a buzzer sounds.

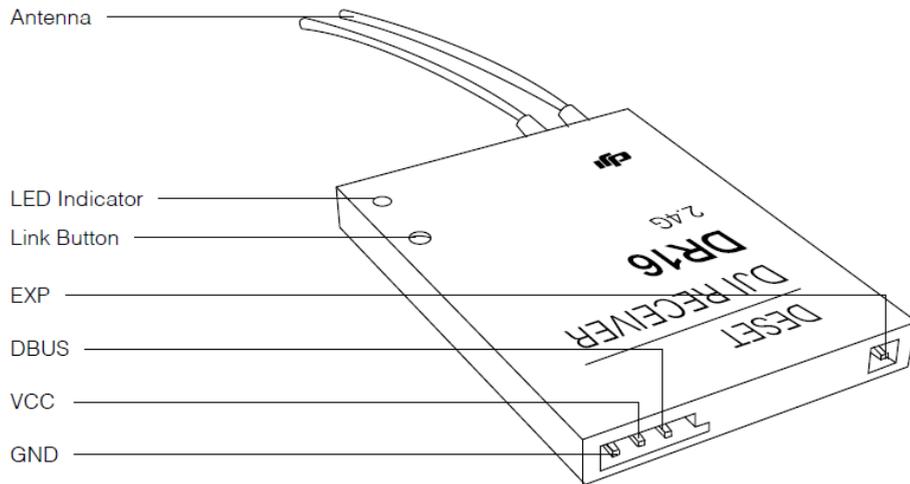
5.2.2 Battery Charging

When charging the controller, connect the USB charger to the parameter adjustment port located at the lower end of the remote controller using the supplied Micro USB cable. During charging, the power indicator is solid red and the capacity indicator flashes green. When the charging is completed, both the power and capacity indicators are solid green.



5.3 Receiver

The DR16 Receiver is a 16-channel receiver with an operating frequency of 2.4 GHz. It can work with the RoboMaster DT7 Remote Controller.



Linking Between the Controller and the Receiver

The receiver is installed next to the Development Board Type C on the robot's chassis. Linking between the remote controller and the receiver is performed prior to factory shipping so that you can use them directly after power-on. To link the controller with the receiver, complete the following steps:

1. Locate the linking hole on the right of the Development Board Type C on the chassis, where the receiver linking button is located.
2. Power on the robot and check that the receiver is on. If no controller nearby has been powered on, the LED indicator on the receiver is solid red.
3. Power on the remote controller to be linked and bring it close to the receiver until the receiver LED indicator flashes green.
4. Press and hold the linking button on the receiver for two seconds. The receiver LED indicator flashes red during pairing.
5. Release the linking button to finish linking. The receiver LED indicator should be solid green upon completion.



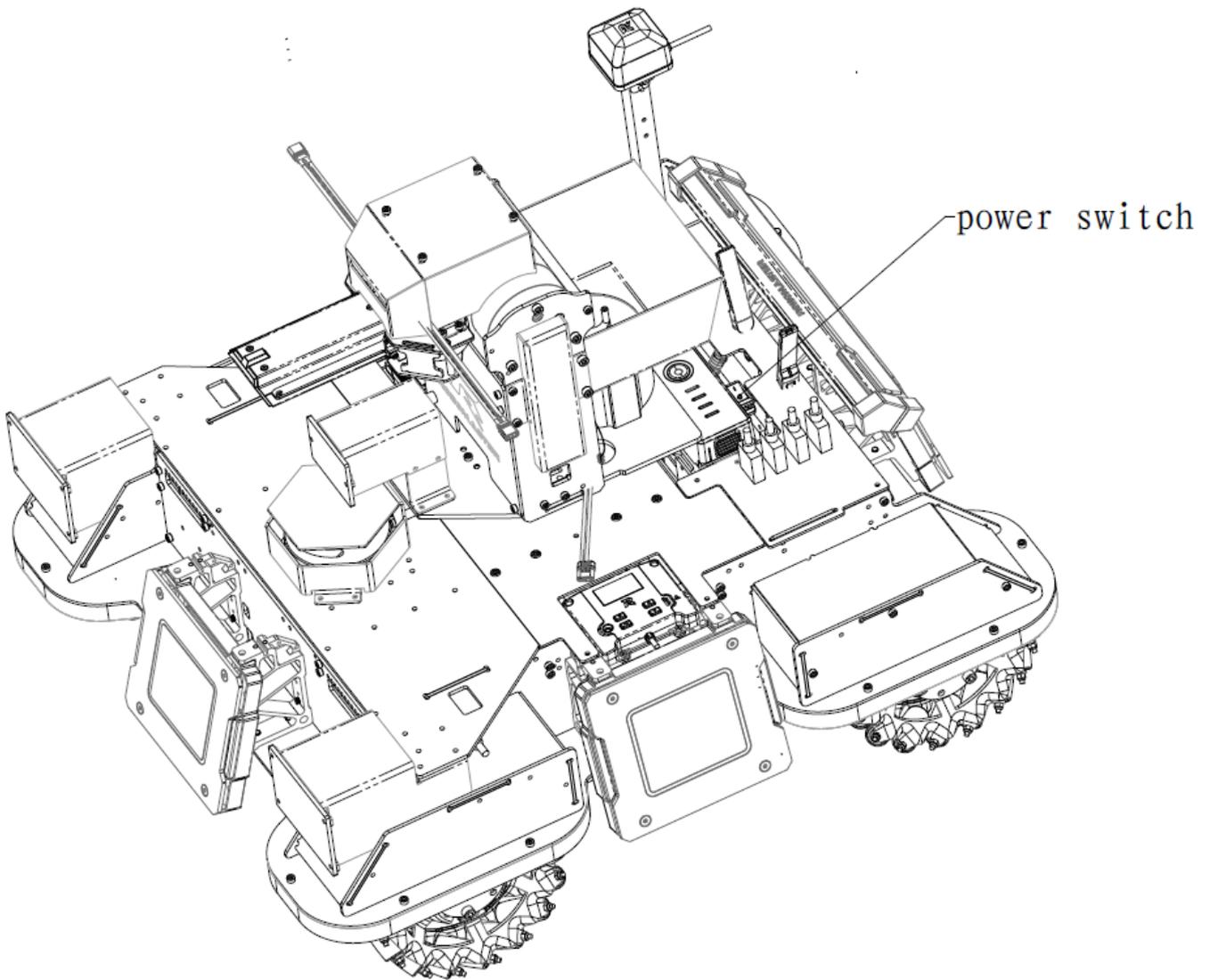
When linking the controller with the receiver, keep them as close as possible and ensure that no other nearby remote controllers are on.

For the communications protocol between the DT7 Remote Controller and the DR16 Receiver, please see the “RoboMaster Robot Remote Controller (Receiver) User Manual” in the reference document pack.

VI. Robot Activation and Control

6.1 Battery Installation and Removal

The battery rack is located at the center of the robot's chassis and behind the gimbal. To use the robot, vertically mount the battery into the battery rack. The following figure shows the mounting position:



6.2 Robot Activation/Deactivation

After mounting the battery into the battery rack, power on the intelligent battery and switch on the robot (as shown in the preceding figure). The switch is located between the battery rack and the rear armor and is fixed on the battery rack. After the robot is powered on, it performs a self-check, during which the HP displayed on the main controller indicator column of the Referee System gradually increases from 0% to 90%. If the self-check is completed successfully, the HP increases to 100%. The remote controller is inoperable during the self-check.

6.3 Operating Modes

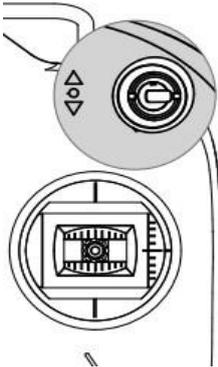
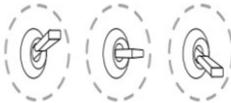
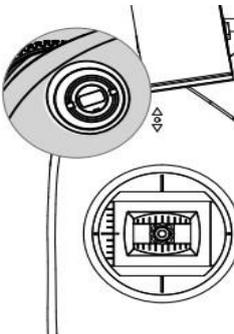
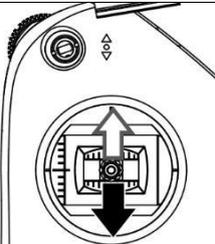
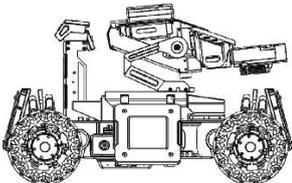
The robot supports two user operating modes:

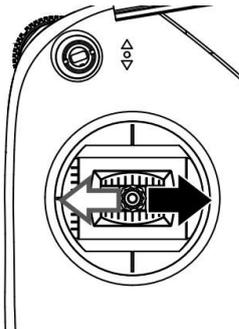
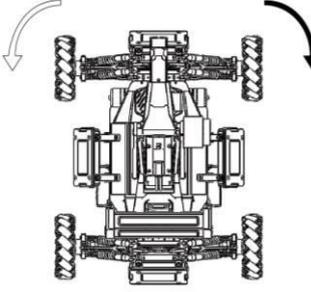
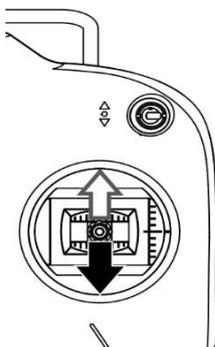
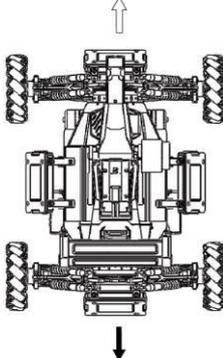
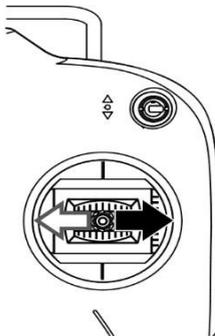
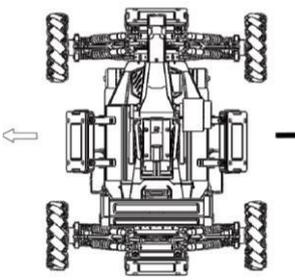
1. **Manual operating mode:** The robot is controlled manually using the remote controller. Operation is easier and is immediately available after power-on. It is suitable for demonstration and debugging.

2. **Automated control mode:** The onboard computer receives data and controls the robot's movement through the interactions between the USB serial ports and the Development Board Type C. Select either mode based on actual scenario requirements by toggling the S1 switch on the remote controller.

Operating the Remote Controller

Control the robot by powering on and using the remote controller. When the remote controller is off, the entire robot is under locked status. The various functions can be executed as follows:

Remote Controller	Robot	Controlling method
	 <p>P-1 P-2 P-3</p>	<p>Switch S1 is the mode control switch. When S1 is in position -3, the automated control mode is on;</p> <p>When S1 is in position -1 or -2, the manual operating mode is on. Position -1 indicates that the chassis is rotating according to the gimbal's yaw axis. Position -2 indicates that the gimbal's yaw axis is rotating according to the chassis.</p>
	 <p>P-1 P-2 P-3</p>	<p>S2 controls the switching of states through the shifting of the joystick. When you turn S2 from position -2 to position -1, the friction wheel of the Launching Mechanism is enabled or disabled.</p> <p>When the friction wheel is enabled, turning S2 from position -2 to position -3 and then quickly back to position -2 instructs the robot to fire a projectile.</p> <p>When S1 remains in position -3, the robot continuously fires projectiles. You can use the remote controller in either mode.</p>
		<p>Push the joystick up to tilt up (+) the gimbal, and push the joystick down to tilt down (-) the gimbal;</p> <p>Gimbal rotation range: -20° 20°</p>

		<p>Determine whether the chassis is rotating according to the gimbal's yaw axis or the gimbal's yaw axis is rotating according to the chassis based on the position of S1.</p> <p>When the joystick is pushed to the left, the robot rotates anticlockwise; when the joystick is pushed to the right, the robot rotates clockwise; when the joystick is in the middle position, the robot remains stationary.</p>
		<p>When the joystick is pushed up, the robot moves forward; when the joystick is pushed down, the robot moves backward; when the joystick is in the middle position, the robot remains stationary.</p>
		<p>When the joystick is pushed to the left, the robot makes a parallel left shift; when the joystick is pushed to the right, the robot makes a parallel right shift; when the joystick is in the middle position, the robot remains stationary.</p>

The operation methods for the above operating modes are the official definitions. You can customize them to meet your requirements.

Appendix

Specifications

Structure	
Overall dimensions	600 × 450 × 460 mm
Weight (with battery)	17.1 Kg
Performance	
Maximum forward speed	3 m/s
Maximum translational speed	2 m/s
Gimbal's pitch axis rotation range	-25 °- 25 °
Gimbal's yaw axis rotation range	-90 °- 90 °
Projectile's launch frequency	6 rounds/s
Projectile's launch speed (muzzle)	25 m/s
Projectile load	300 rounds
Power System	
Chassis power motor model	RoboMaster M3508 P19 Brushless DC Gear Motor
Gimbal power motor model	RoboMaster GM6020 Brushless DC Motor
Launch power motor model	RoboMaster SNAIL 2305 Brushless DC Motor
Launch power motor ESC	RoboMaster C615 Brushless DC Motor Speed Controller
Feeding power motor model	RoboMaster M2006 P36 Brushless DC Gear Motor
Feeding power motor ESC	RoboMaster C610 Brushless DC Motor Speed Controller
Battery	

Model	TB47S
Type	LiPo 6S
Voltage	22.2 V
Capacity	4500mAh
Remote Controller	
Model	DT7
Operating frequency	2.4 GHz
Communication distance	1000 m
Power supply	Built-in lithium battery
Charging port	Micro USB
Battery Capacity	2000 mAh
Charger	
Model	Inspire 1 Part 13 180W Charger (without AC cable)
Input	100-240 V, 50-60 Hz
Output	26.3 V
Projectile	
Model	RoboMaster 17mm Fluorescent Projectile
Color	Yellow-green
Size	17 mm
Weight	3.2±0.1g

Partial List of Components

Module name	Component name	Quantity
Robot chassis	RoboMaster M3508 P19 Brushless DC Gear Motor	4
	RoboMaster Mecanum Wheel (left)	2
	RoboMaster Mecanum Wheel (right)	2
	RoboMaster Development Board Type C	1
	RoboMaster ESC Center Board 2	1
2-Axis Gimbal Module, Launching Mechanism Module	RoboMaster M2006 P36 Brushless DC Gear Motor	1
	RoboMaster C610 Brushless DC Motor Speed Controller	1
	RoboMaster GM6020 Brushless DC Motor	2
	RoboMaster Development Board Type C	1
	RoboMaster SNAIL 2305 Brushless DC Motor	2
	RoboMaster C615 Brushless DC Motor Speed Controller	2
	RoboMaster ESC Center Board 2	1
Referee System	Referee System Armor Module AM02	4
	Referee System Main Controller Module MC02	1
	Referee System Speed Monitor Module SM01	1
	Referee System RFID Interaction Module FI02	1
	RFID Interaction Card	1
	Referee System Power Management Module PM01	1
Remote Controller	RoboMaster Robot Remote Controller	1
Battery	Matrice 600 Part46 - Intelligent Battery TB47S	1
	Inspire 1 Part 13 180W Charger (without AC Cable)	1



Contact us

RoboMaster's official website: www.robomaster.com

RoboMaster's official forum: bbs.robomaster.com

RoboMaster's official email: robomaster@dji.com

