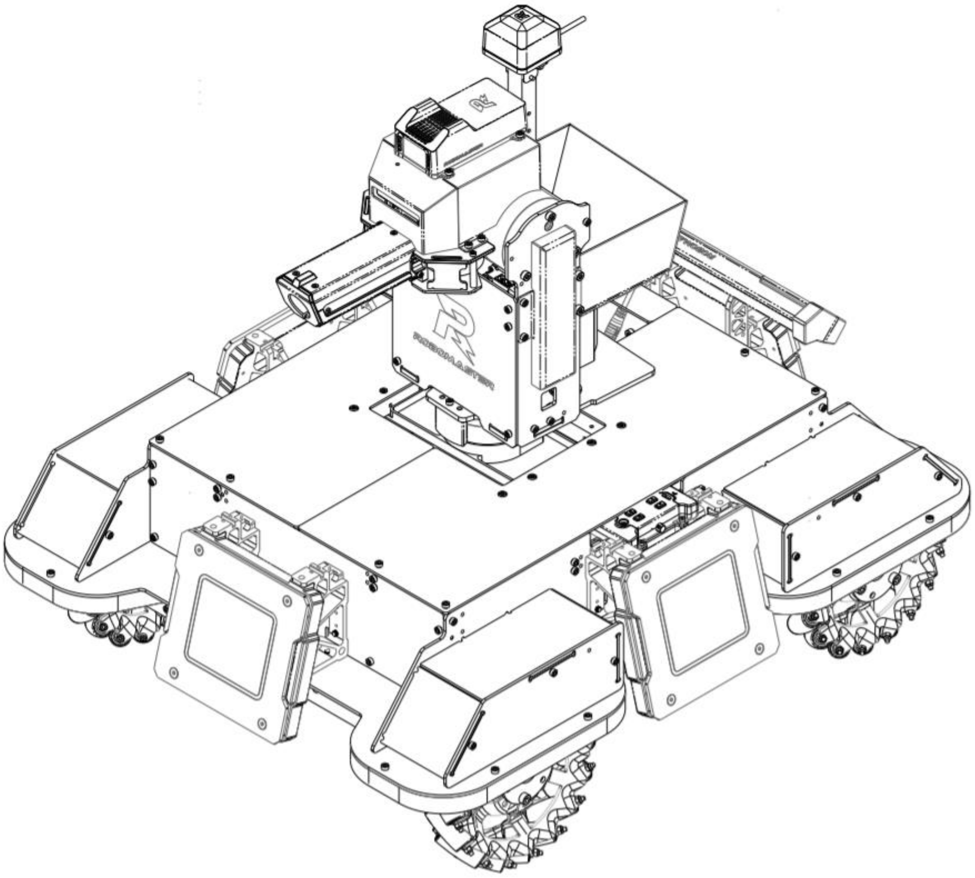
RoboMaster
2020 Standard A Unassembled kit
User Manual

V2.0 2020.2



Using this Manual

Legend

⊘ Prohibition ⚠ Important notes 💡 Hints and tips 📖 Definition and reference

Declaration

The RoboMaster 2020 Standard A Unassembled kit 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.

Disclaimer and Warnings

Thank you for using RoboMaster 2020 Standard A Unassembled kit. 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.

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 disassemblage.

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

Contents

Introduction

RoboMaster 2020 Standard A Unassembled kit (hereinafter referred to as "the robot") consists of a chassis, a two-axis gimbal, a launching mechanism and a smart battery system. The robot chassis uses Mecanum wheels for omnidirectional movement. In addition, the two-axis gimbal can complete two-DOF rotation to enhance the flexibility and resistance of the robot, while the launching mechanism can fire RoboMaster 17mm projectiles.

Frequency Pairing Between the Remote Control and the Receiver

The receiver is installed on the side of the launching mechanism of the robot. For frequency pairing between the remote control and the receiver, please complete the following steps:

1. Find the frequency pairing hole in the corresponding position on the side of the gimbal's launching mechanism, with the receiver's frequency pairing key located in the frequency pairing hole.
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.

Powering On and Operating the Robot

Installation and Removal of the Battery

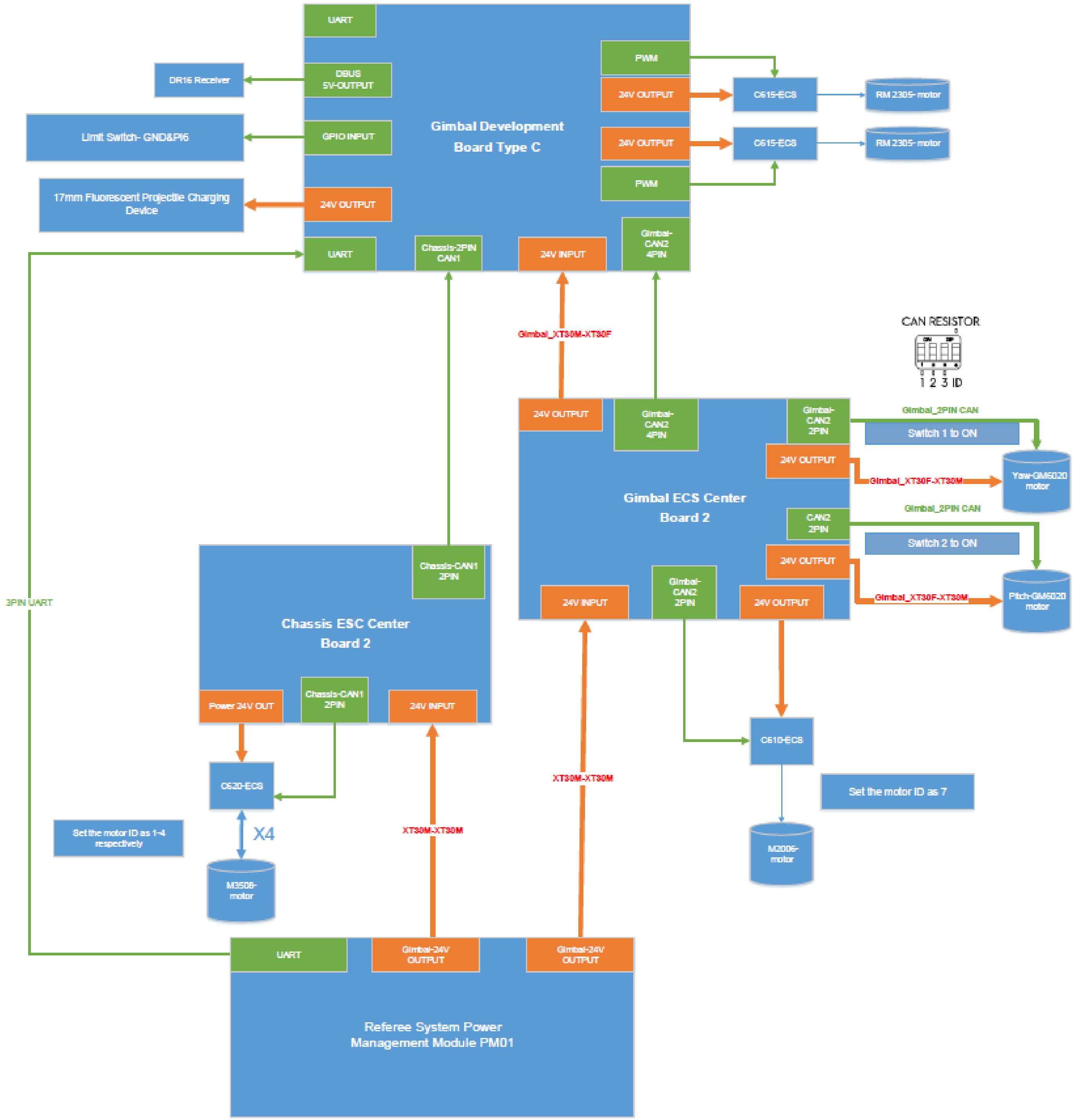
The battery rack is located in the middle of the robot chassis and behind the gimbal. Before use, please insert the battery vertically into the battery rack.

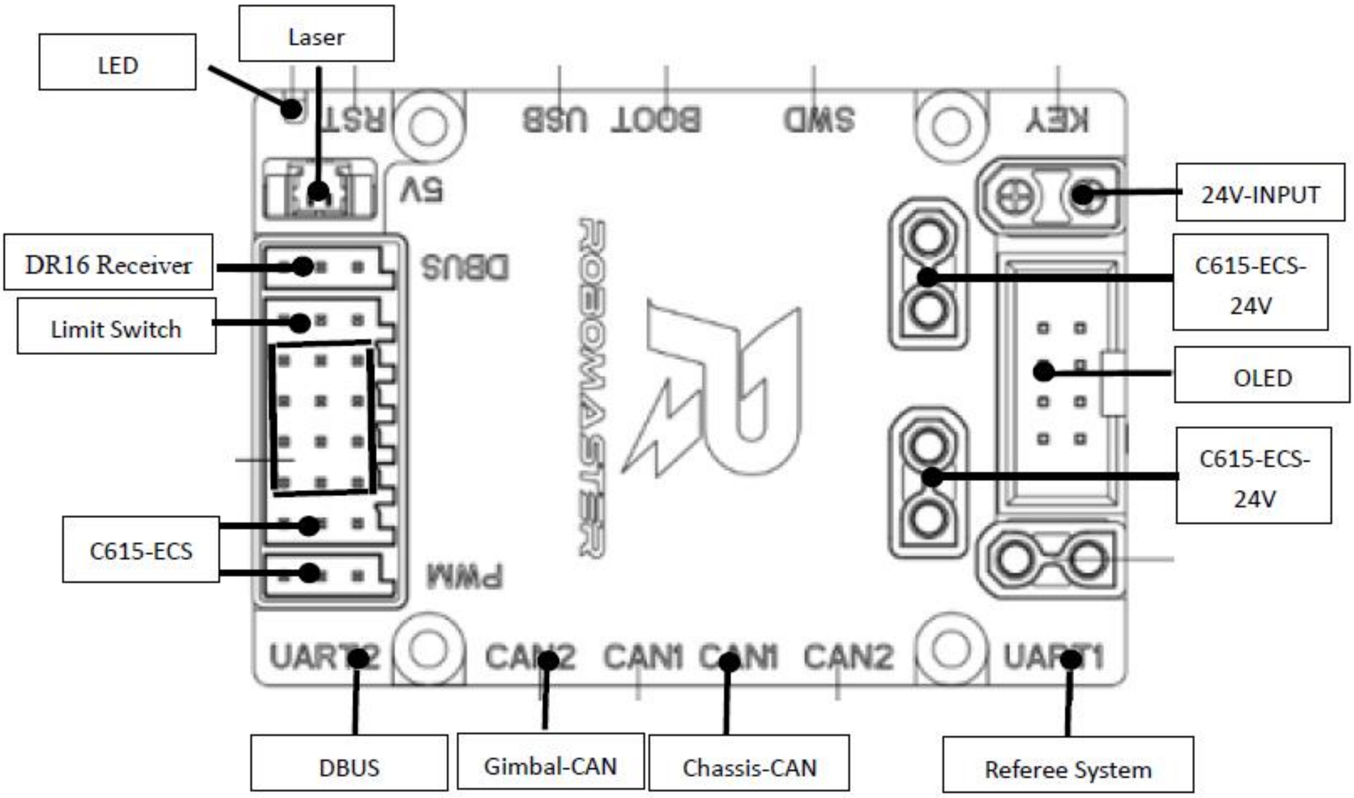
Powering On/Off

After the smart battery is installed into the battery rack, turn it on by short pressing once and long pressing for 3 seconds. Switch on the robot by pressing the power button located between the battery rack and the rear armor, which is fixed on the battery rack.

Initial Assembly and Operation of the Robot

After the robot is assembled, conduct wiring according to the hardware block diagram, and check whether the cables are properly connected. The wiring diagram is shown below. OLED screen, servo and laser module are in the scope of supply by the users themselves.


UART
DBUS 5V-OUTPUT
DR16 Receiver
GPIO INPUT
Limit Switch- GND&PI6
24V OUTPUT
17mm Fluorescent Projectile Charging Device
Gimbal Development Board Type C
PWM
24V OUTPUT
C615-ECS
RM 2305- motor
24V OUTPUT
C615-ECS
RM 2305- motor
PWM
UART
Chassis-2PIN CAN1
24V INPUT
Gimbal-CAN2 4PIN
Gimbal_XT30M-XT30F
CAN RESISTOR
1 2 3 ID
24V OUTPUT
Gimbal-CAN2 4PIN
Gimbal-CAN2 2PIN
Gimbal_2PIN CAN
Switch 1 to ON
24V OUTPUT
Gimbal_XT30F-XT30M
Yaw-GM6020 motor
Gimbal ECS Center Board 2
Gimbal_2PIN CAN
CAN2 2PIN
Switch 2 to ON
24V OUTPUT
Gimbal_XT30F-XT30M
Pitch-GM6020 motor
24V INPUT
Gimbal-CAN2 2PIN
24V OUTPUT
3PIN UART
Chassis-CAN1 2PIN
Chassis ESC Center Board 2
Power 24V OUT
Chassis-CAN1 2PIN
24V INPUT
C620-ECS
X4
Set the motor ID as 1-4 respectively
M3508-motor
XT30M-XT30M
XT30M-XT30M
C610-ECS
Set the motor ID as 7
M2006-motor
UART
Gimbal-24V OUTPUT
Gimbal-24V OUTPUT
Referee System Power Management Module PM01



Make sure that you check the wire sequence at the 3PIN serial port of the power management module of the referee system. Please refer to the detailed description on UART interface in the "Instructions to Users of RoboMaster Development Board Type C". In addition, check whether you have updated the referee system to the latest version, otherwise the muzzle heat control and chassis power control will not function properly. For more details on the update, please refer to "RoboMaster 2020 Referee User Manual v1.2". Once the version is confirmed, calibrate gyroscope, gimbal and chassis respectively as follows.

1. Calibrate the gyroscope. If you download the program for the first time, there won't be any zero drift data for gyroscope calibration saved in the system, so the development board will start to calibrate the gyroscope. Make sure that the robot remains stationary and there is no vibration interference source around.
2. Calibrate the gimbal. If you download the program for the first time, there won't be any median value for the gimbal saved in the system. Turn on the remote control with the two rods kept in the lower position. Make sure that the motor is connected properly. The calibration process is: lift the pitch and lower the pitch, followed by rotating the yaw counterclockwise, and finally rotate the yaw clockwise.
3. Calibrate the chassis. Use the remote control to manually turn it on. Please refer to the chassis calibration in the "Calibration Operation" for more details.

Error Alert

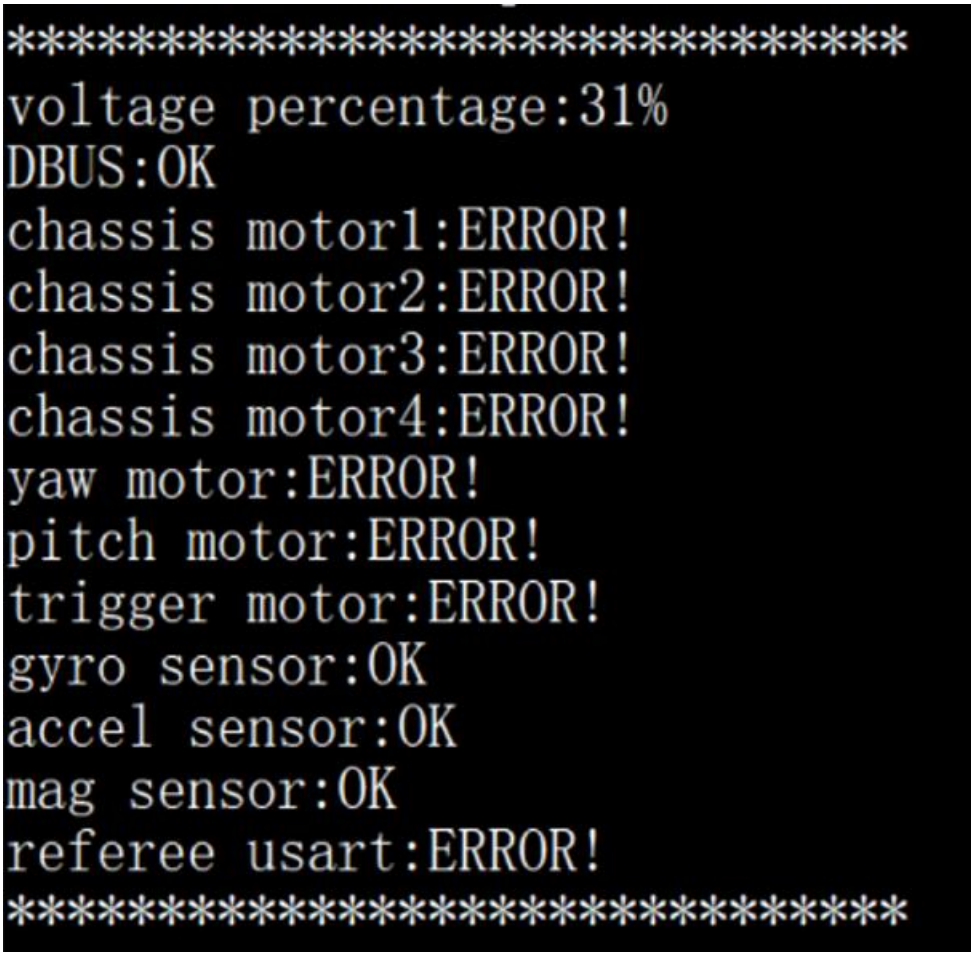
The error alert function is intended to inform the users of the current online status of the device by three ways including buzzer alert, USB serial port alert and OLED display alert.

1. Buzzer alert

A buzzer is used to alert the users to different errors through how many times that it rings, as shown in the following table

Number of alerts	Error type
1	Remote control receiver
2	Chassis motor 1
3	Chassis motor 2
4	Chassis motor 3
5	Chassis motor 4
6	Yaw motor
7	Pitch motor
8	Trigger motor
9	On-board gyroscope
10	On-board accelerometer
11	On-board magnetometer

2. USB serial port alert
3. The USB serial port is connected to the development board through USB, so the serial port tool can be launched on the PC to receive error alerts, as shown in the following table.



```
******************************
voltage percentage:31%
DBUS:OK
chassis motor1:ERROR!
chassis motor2:ERROR!
chassis motor3:ERROR!
chassis motor4:ERROR!
yaw motor:ERROR!
pitch motor:ERROR!
trigger motor:ERROR!
gyro sensor:OK
accel sensor:OK
mag sensor:OK
referee usart:ERROR!
******************************
```

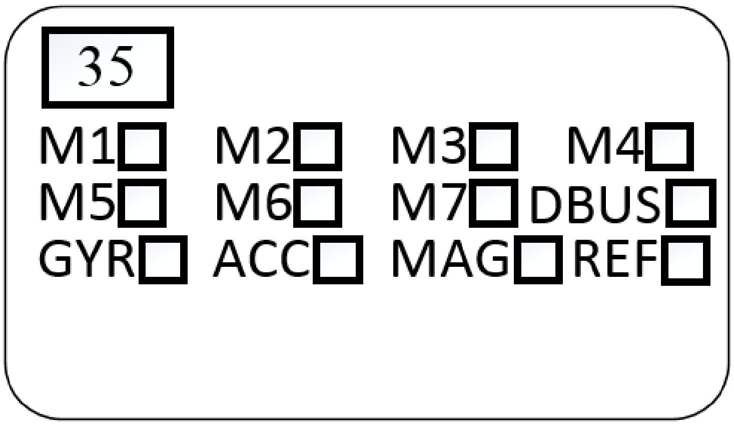
Voltage percentage	Battery percentage
DBUS	Remote control receiver

Chassis motor 1	Chassis motor 1
Chassis motor 2	Chassis motor 2
Chassis motor 3	Chassis motor 3
Chassis motor 4	Chassis motor 4
Yaw motor	Yaw motor
Pitch motor	Pitch motor
Trigger motor	Trigger motor
Gyro sensor	On-board gyroscope
Accel sensor	On-board accelerometer
Mag sensor	On-board magnetometer
Referee usart	Serial port of the referee system

4. OLED display

OLED display is achieved via the external OLED module as shown in the figure. The meaning of each icon is shown in the table below.

☐ means that the device is offline, while ☑ means online.



Icon	Stands for
Box+35 at top left	35% battery percentage
M1	Chassis motor 1
M2	Chassis motor 2
M3	Chassis motor 3
M4	Chassis motor 4
M5	Yaw motor
M6	Pitch motor
M7	Trigger motor
DBUS	Remote control receiver
GYR	On-board gyroscope
ACC	On-board accelerometer
MAG	On-board magnetometer

REF	Serial port of the referee system

Control Mode

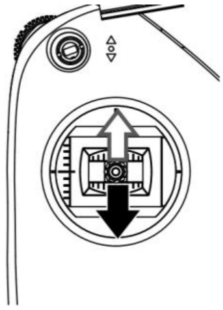
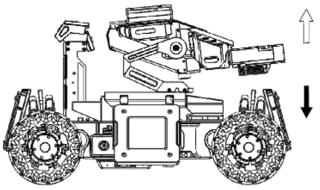
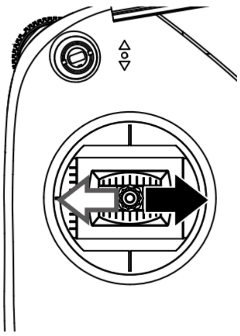
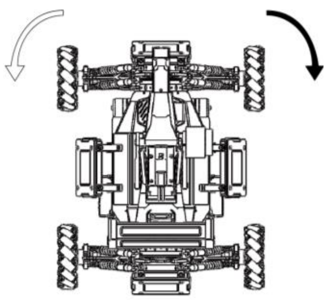
The robot is based on a Mecanum wheel chassis to achieve omnidirectional movement. Given that the chassis is linked with the gimbal, steering the gimbal steers the chassis. The robot supports two user operating modes:

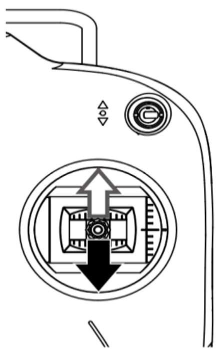
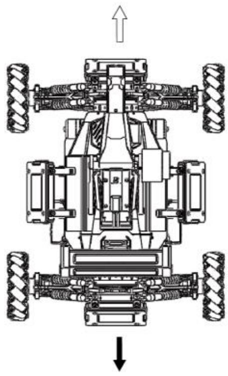
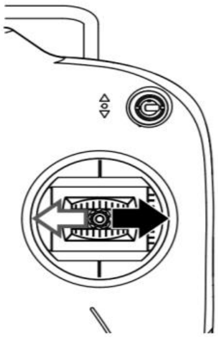
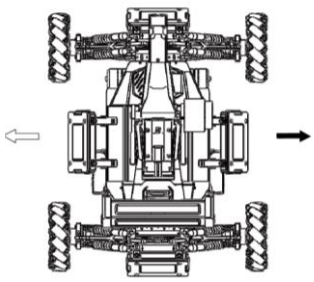
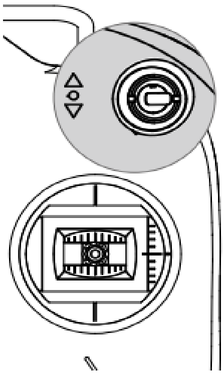
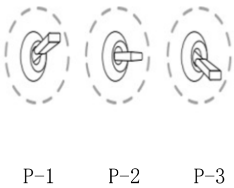
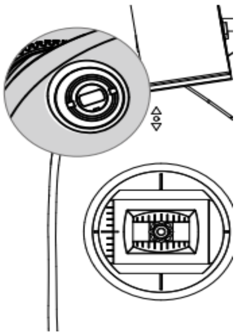
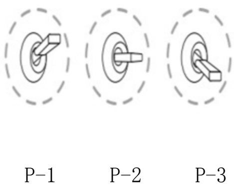
1. Remote control only: this mode is simple and convenient, ready to use upon power-on, and suitable for demonstration and debugging.
2. Remote control + PC: this mode controls the robot by sending data to the chassis from the PC.

Select the mode based on the requirements of the actual scenario by toggling the S1 switch on the remote control. You can use the remote control in either mode.

Remote Control

To control the robot with the remote control, switch it on and turn the three-position switch S1 on the upper-right side to -1 (top) or -2 (middle). Methods for implementing different functions are as follows:

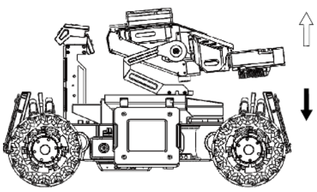
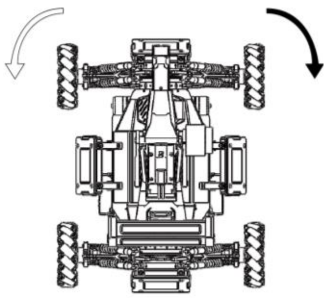
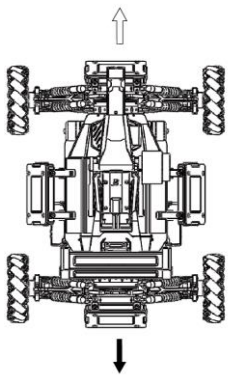
Remote control	Fighting vehicle	Instruction
		Push the rod up to tilt up (+) the gimbal. Push the rod down to tilt down (-) the gimbal; Rotation range of the gimbal: - 25 °~25 °
		By pushing the rod to the left, the gimbal rotates counterclockwise, and the chassis rotates along the same direction; By pushing the rod to the right, the gimbal rotates clockwise, and the chassis rotates along the same direction; When the rod stays in the middle, the robot remains stationary.

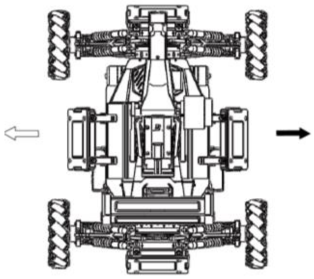
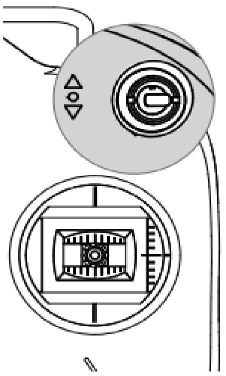
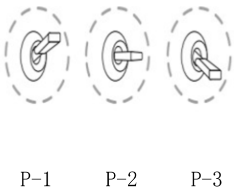
		Push the rod up and the robot moves forward; Push the rod down and the robot moves backwards; When the rod stays in the middle, the robot remains stationary.
		Push the rod to the left and the robot moves leftwards in parallel; Push the rod to the right and the robot moves rightwards in parallel; When the rod stays in the middle, the robot remains stationary.
		Switch S1 is the mode control switch. When S1 is set at -1 and -2, it is possible to control the chassis movement by PC and the remote control. When S1 is set at -3, the chassis is at zero control speed and the gimbal is in stop mode. When the remote control is offline, both chassis and gimbal are in stop mode.
		When you turn S2 from -2 to -1, the friction wheel of the launching mechanism is enabled. In this condition, turning S2 from -2 to -3 and then quickly back to -2 instructs the robot to fire a projectile. When S2 remains at -3, the robot continuously fires projectiles. Set S1 at -2 and use a PC to operate the robot.

S1 is the mode control switch. When S1 is set at -1, the Euler angle control mode of the gyroscope will be enabled, so the gimbal will be controlled based on the Euler angle. Upon achieving closed loop of the angle, the chassis rotates alongside the gimbal to complete the centering operation. When S1 is set at -2, the gimbal encoder control mode will be enabled, so the gimbal will be controlled based on the angle fed back from the motor. The gimbal and chassis both responds to the operation of the left rod.

PC control

In addition to remote control, keyboard control is also available as follows.

Remote control	Fighting vehicle	Instruction
Move the mouse vertically along the Y axis		Push the rod up to tilt up (+) the gimbal, and push the rod down to tilt down (-) the gimbal; Rotation range of the gimbal: - 25°~25°
Move the mouse radially along the X axis		By pushing the rod to the left, the gimbal rotates counterclockwise, and the chassis rotates along the same direction; By pushing the rod to the right, the gimbal rotates clockwise, and the chassis rotates along the same direction;
Key W or S		Press W and the robot will move forward; Press S and the robot will move backward; When S1 is set at -2, the robot can be controlled by PC.

Key A or D		Press A and the robot will move leftward in parallel; Press D and the robot will move rightward in parallel;
		Switch S1 is the mode control switch. When S1 is set at -1 and -2, it is possible to control the chassis movement by PC and the remote control. When S1 is set at -3, the chassis is at zero control speed and the gimbal is in stop mode. When the remote control is offline, both chassis and gimbal are in stop mode.
Key Q or E		Press Q to enable the friction wheel; Press E to disable the friction wheel; Please set S1 at -2.
Key Z, X, C or V		Add servo PWM, where, Z controls the first PWM under the touch control; X controls the second PWM under the touch control; C controls the third PWM under the touch control; and V controls the fourth PWM under the touch control. The output range of PWM is [500, 2500]

Shift + Key Z, X, C or V		Reduce servo PWM, where, Z controls the first PWM under the touch control; X controls the second PWM under the touch control; C controls the third PWM under the touch control; and V controls the fourth PWM under the touch control. The output range of PWM is [500, 2500]

Calibration Operation

Gyroscope Calibration

A BMI088 gyroscope is mounted in the main control board of the robot. When the mode switch is set at -2, it is controlled by calculating its Euler angle. There can be some drift at the yaw angle. In order to reduce the drift, it is necessary to collect the angular velocity while the robot remains stationary to properly complete the calibration. The calibration process is as follows:

1. Set both switch S2 and S1 at -3.

2. Push the left rod to the right and the right to the left. After 2 seconds, the on-board buzzer will make intermittent (1s interval) alerts. Make sure that you perform the third step within 20 seconds, otherwise you'll have to repeat the previous two steps.

3. Push the left rod to the left and the right to the right. After 2 seconds, the gyroscope calibration will be activated together with continuous low-frequency buzzer alert. Only after the gyroscope temperature rises to the set level (the set level is the real-time temperature collected by the master control MCU plus 10℃, and is stored in flash as the constant temperature for later control), can the gyroscope data be collected for about 20s. During the data collection, the robot should remain stationary, otherwise you'll have to re-collect the data. The whole process of temperature rise and gyroscope data collection will last for about 1 minute. The time of temperature rise may vary depending on the environment. Please be patient if it takes longer than expected.

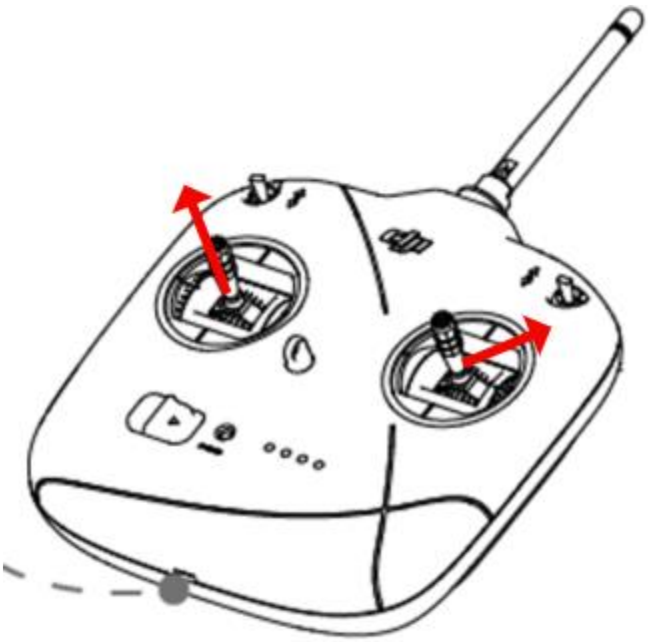
Gimbal Calibration

Calibrating the gimbal: The feedback from the gimbal motor mounted on the robot is an absolute value. Therefore, if the motor is removed and then reinstalled, there may be inconsistency with the median value of the gimbal saved in the system, so calibration is required in accordance with the process as follows:

1. Set both switch S2 and S1 at -3.

2. Push the left rod to the right and the right to the left. After 2 seconds, the on-board buzzer will make intermittent (1s interval) alerts. Make sure that you perform the third step within 20 seconds, otherwise you'll have to repeat the previous two steps.

3. Push the left rod to the upper left and the right to the upper right. After 2 seconds, the gimbal calibration will be activated together with continuous high-frequency buzzer alert. The gimbal will begin to move downwards, upwards, leftwards and rightwards respectively. During calibration, do not interfere with the movement of the gimbal.



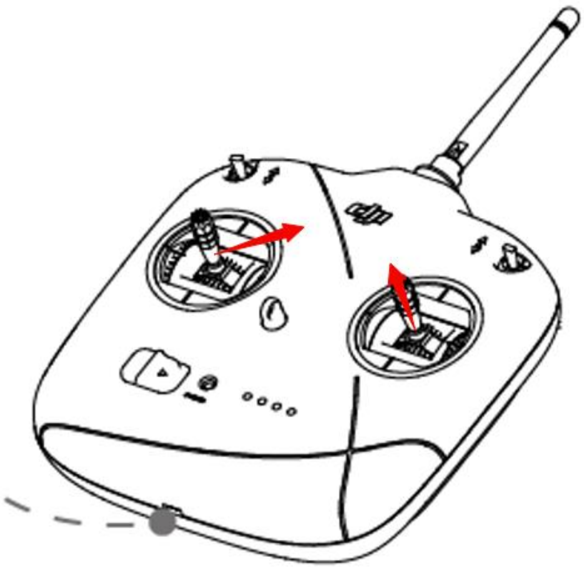
Chassis Calibration

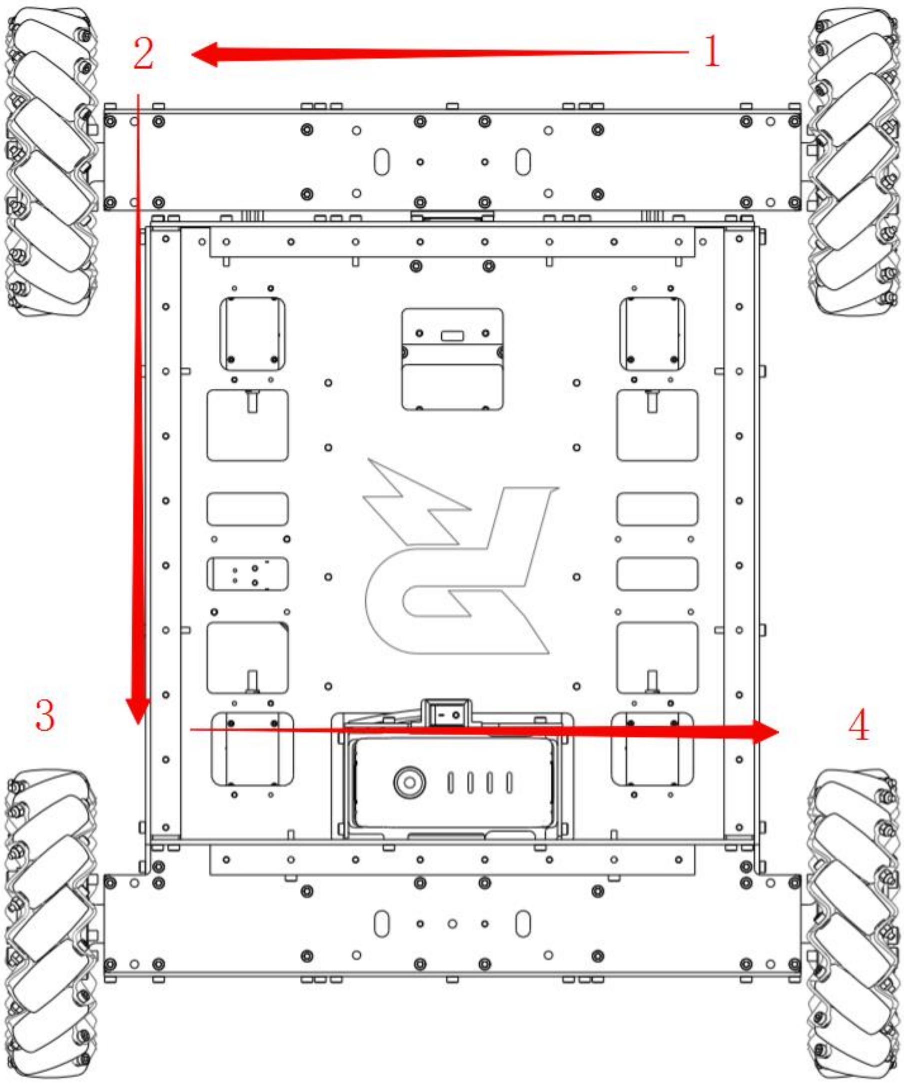
To calibrate the chassis of the robot, you have to reset the chassis motor ID. To enable the chassis motor to enter the fast ID setting mode, see below to operate before manually rotating the wheels respectively to complete the calibration. The calibration process is as follows:

1. Set both switch S2 and S1 at -3.

2. Push the left rod to the right and the right to the left. After 2 seconds, the on-board buzzer will make intermittent (1s interval) alerts. Make sure that you perform the third step within 20 seconds, otherwise you'll have to repeat the previous two steps.

3. Push the left rod to the upper right and the right to the upper left. After 2 seconds, the chassis calibration will be activated and there will be a solid orange light in the ESC. Rotate the right front, left front, left rear as well as the right rear wheels respectively to complete the calibration.




2
1
3
4

Appendix

Specifications

Structure	
Overall dimensions	600 ×500 ×420 mm
Performance	
Programmed maximum forward speed*	2 m/s
Programmed maximum translatory speed*	1.5 m/s
Gimbal Pitch axis rotation range	-25 °~ 25 °
Gimbal Yaw axis rotation range	-97.5 °~ 97.5 °
Programmed projectile launching frequency*	6 projectiles/second
Programmed projectile launching speed (muzzle)*	25 m/s
Projectile load	300
Power System	
Chassis power motor model	RoboMaster M3508 P19 Brushless DC Gear Motor
Chassis Power Motor ESC	RoboMaster C620 Brushless DC Motor Speed Controller
Gimbal Power Motor Model	RoboMaster GM6020 Brushless DC Motor
Launching Power Motor Model	RoboMaster Snail 2305 Brushless DC Motor
Launching 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	22.8 V
Capacity	4500mAh
Remote control	

Model	DT7
Operating frequency	2.4 GHz
Communications distance	1000 m
Power supply	Built-in lithium battery
Charging port	Micro USB
Battery capacity	2000 mAh
Charger	
Model	Inspire PART13 180W charger (AC cable not included)
Input	100-240 V, 50-60 Hz
Output	26.3 V
Projectiles	
Model	RoboMaster 17mm Fluorescent Projectile
Color	Yellow-green
Dimensions	17 mm
Weight	3.2 g

*The performance parameters refer to the maximum values programmed in the software. Users can re-program the parameters as needed.

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