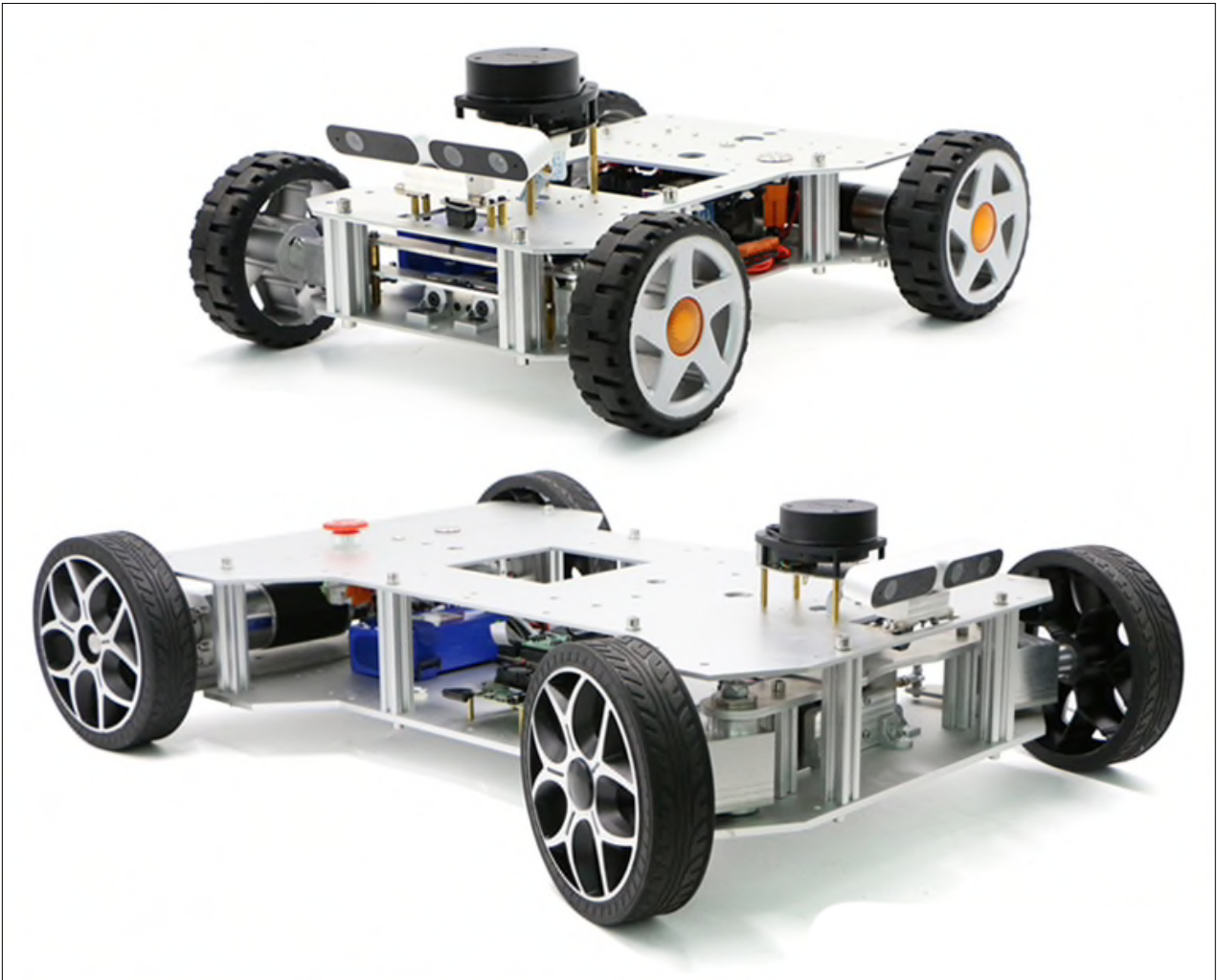




# Rosbot User Manual

Prepared by: Wayne Liu, Zijie Li, Reilly Smithers & Tara Hercz

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## Summary

Rosbot is designed for ROS (Robot Operating System) developer, educator and students. The heart of Rosbot is the fully programmable software framework and configurable hardware architecture based on the most popular robotic platform - ROS.

Rosbot comes with four models:

**Rosbot 2** - Suitable for ROS beginners and low budget projects.

**Rosbot Pro** - Suitable for ROS developers and educators who need a versatile system for rapid prototyping or teaching.

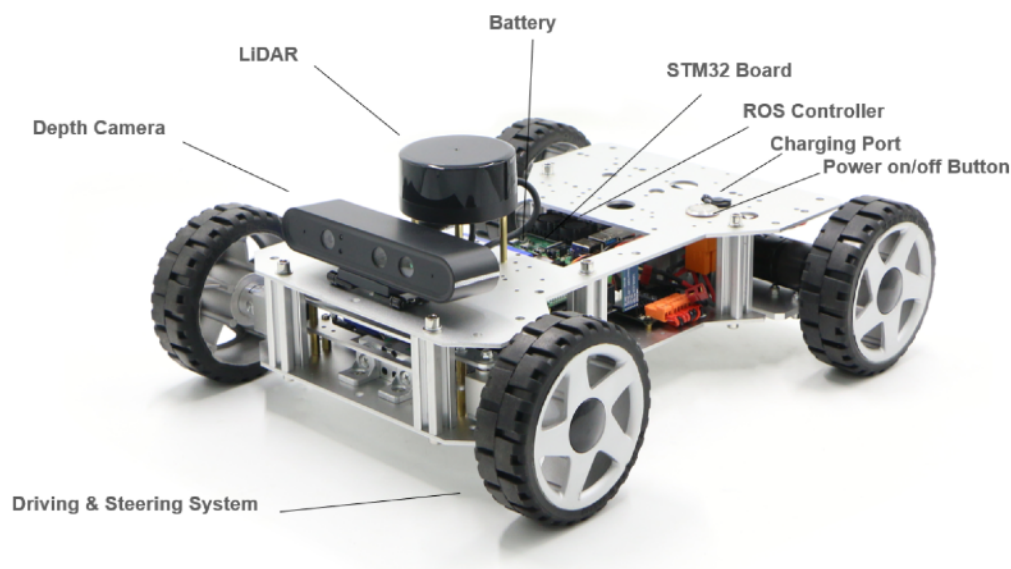
**Rosbot Plus** - This is the 4WD version of Rosbot with Independent Suspension Systems. This category is serious enough to be considered for industrial and commercial development.

**Rosbot Plus HD** - This is Heavy Duty version of the Rosbot Plus which maximum payload is up to 45 kg.

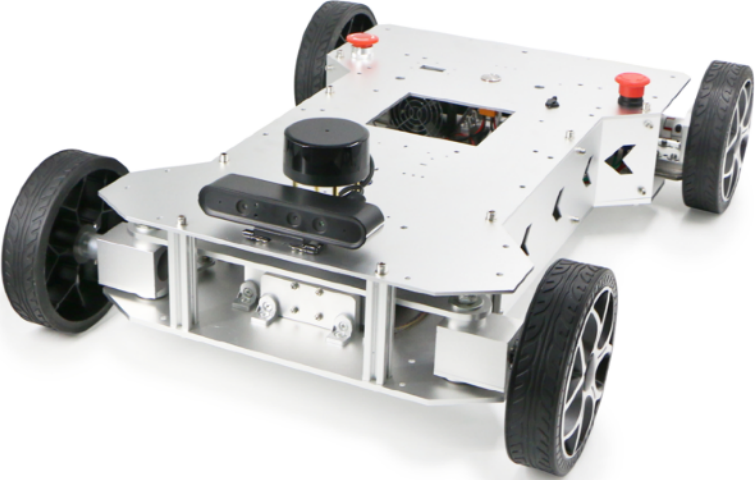
Rosbot comes with popular ROS controllers such as:

- Jetson Orin Nano
- Jetson Orin NX

1. Key Component



| Variation | Image                                                                                                                                                                                                                                                                                           |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rosbot 2  | A side view of the Rosbot 2 robot. It is a four-wheeled robot with a white metal frame. The robot has a black battery mounted on top. The wheels are black with white rims. The robot is shown from a side angle, highlighting its compact design and the placement of the battery and sensors. |

|             |                                                                                     |
|-------------|-------------------------------------------------------------------------------------|
| Rosbot Pro  |   |
| Rosbot Plus |  |

2. Product Specifications

|                |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Product Matrix |  |  |  |  |
|----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|

| Product Name           | Rosbot 2                                                            | Rosbot Pro                                                | Rosbot Plus                      | Rosbot Plus HD |
|------------------------|---------------------------------------------------------------------|-----------------------------------------------------------|----------------------------------|----------------|
| Motor Reduction Ratio  | 1:27                                                                | 1:18                                                      | 1:18                             | 1:47           |
| Max Speed              | 1.3m/s                                                              | 1.65m/s                                                   | 2.33m/s                          | 0.89m/s        |
| Weight                 | 9.26 kg                                                             | 19.54kg                                                   | 35.16kg                          | 35.18kg        |
| Max Payload            | 16 kg                                                               | 20kg                                                      | 22kg                             | 45kg           |
| Size                   | 445*360*206mm                                                       | 774*570*227mm                                             | 766*671*319mm                    | 766*671*319mm  |
| Minimal Turning Radius | 0.77m                                                               | 1.02m                                                     | 1.29m                            | 1.29m          |
| Battery Life           | About 9.5 hours (no load),<br>About 8.5 hours (20% payload)         | About 4.5 hours (no load),<br>About 3 hours (20% payload) |                                  |                |
| Power Supply           | 24v 6100 mAh LFP battery + 3A current smart charger                 |                                                           |                                  |                |
| Steering Gear          | S20F 20kg torque digital servo                                      | DS5160 60kg torque digital servo                          |                                  |                |
| Wheels                 | 125mm diameters solid rubber wheels                                 | 180mm diameters solid rubber wheels                       | 254 mm inflatable rubber wheels  |                |
| Encoder                | 500 line AB phase high precision encoder                            |                                                           |                                  |                |
| Suspension System      | Coaxial Pendulum Suspension System                                  |                                                           | 4W Independent Suspension System |                |
| Control Interface      | iOS & Android App via Bluetooth or Wifi, PS2, CAN, Serial Port, USB |                                                           |                                  |                |

### 3. Introduction of ROS Controllers

There are 2 types of ROS Controllers available for use with the Rosbot based on Nvidia Jetson platform. Jetson Orin Nano is suited more towards research and education. Jetson Orin NX is ideal for product prototyping and commercial applications. The following table illustrates the main technical differences between the various controllers available from Roboworks. Both boards allow high level computation and are suited towards advanced robotic applications such as computer vision, deep learning and motion planning.

| Jetson Orin NX series                                         |                    | Jetson Orin Nano series                                       |                      |                                                              |
|---------------------------------------------------------------|--------------------|---------------------------------------------------------------|----------------------|--------------------------------------------------------------|
| Jetson Orin NX 16GB                                           | Jetson Orin NX 8GB | Jetson Orin Nano Developer Kit                                | Jetson Orin Nano 8GB | Jetson Orin Nano 4GB                                         |
| 100 TOPS                                                      | 70 TOPS            | 40 TOPS                                                       |                      | 20 TOPS                                                      |
| 1024-core NVIDIA Ampere architecture GPU with 32 Tensor Cores |                    | 1024-core NVIDIA Ampere architecture GPU with 32 Tensor Cores |                      | 512-core NVIDIA Ampere architecture GPU with 16 Tensor Cores |
| 918MHz                                                        | 765MHz             | 625MHz                                                        |                      |                                                              |

#### 4. Sensing System: LiDAR & Depth Camera

A Leishen LSLiDAR is installed on all Rosbot variations with either the N10 or M10 model being used. These LiDAR's offer a 360 degree scanning range and surroundings perception and boast a compact and light design. They have a high Signal Noise Ratio and excellent detection performance on high/low reflectivity objects and perform well in strong light conditions. They have a detection range of 30 metres and a scan frequency of 12Hz. This LiDAR integrates seamlessly into the Rosbots, ensuring all mapping and navigational uses can be easily achieved in your project. The below table summaries the technical specifications of the LSLiDARs:

| LS LIDAR           | N10                                       | M10                      | C16 (3D)                                              |
|--------------------|-------------------------------------------|--------------------------|-------------------------------------------------------|
| Detection Range    | 25m                                       | 30m                      | 70/120/150 m                                          |
| Scan Frequency     | 10Hz                                      | 12Hz                     | 5/10/20Hz                                             |
| Samples Frequency  | 4,500Hz                                   | 20,000Hz                 | 240,000Hz                                             |
| Output Contents    | Angular, Distant and Light Intensity Data | Angular and Distant Data | Angular, Distant, Time Stamp and Light Intensity Data |
| Angular Resolution | 0,8                                       | 0,22                     | 1~2                                                   |
| Interface Type     | Serial Port                               | Ethernet Port            | Ethernet Port                                         |

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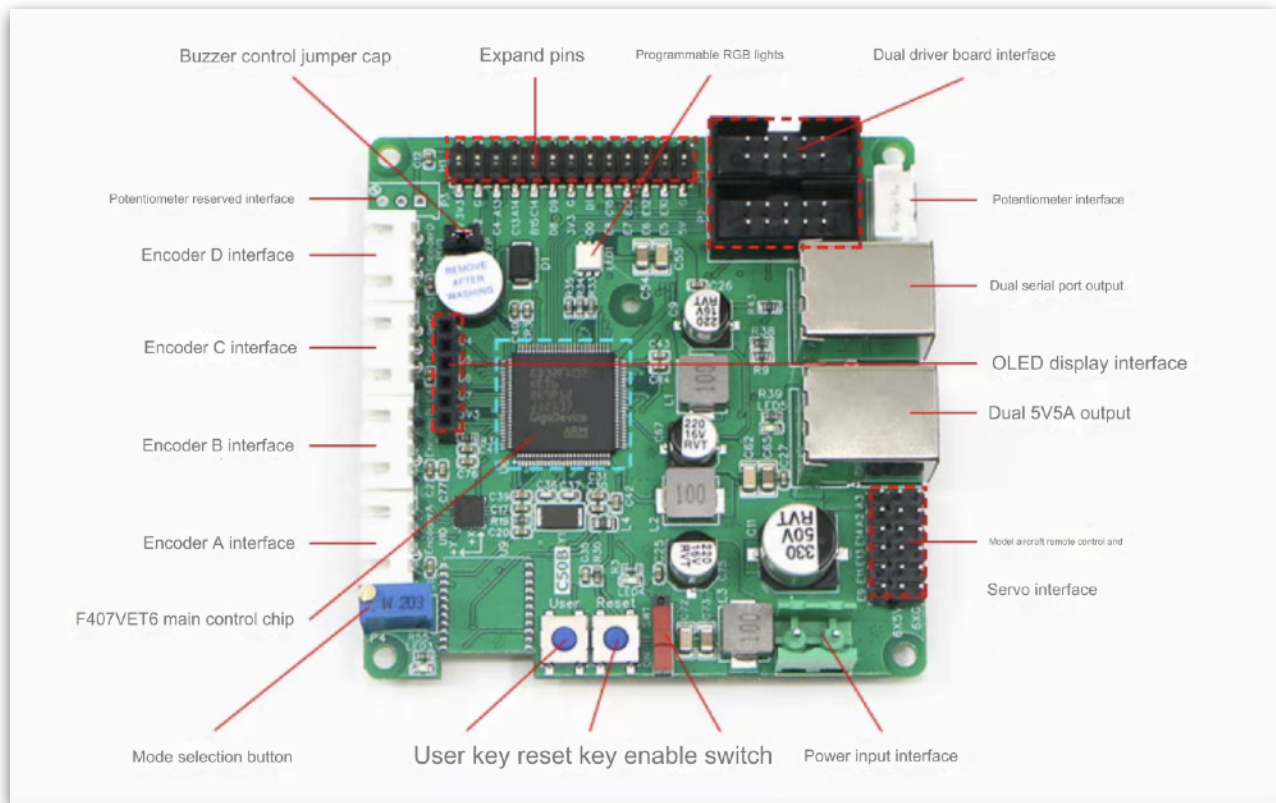
Additionally, all Rosbots are equipped with an Orbbec Astra Depth Camera, which is an RGBD camera. This camera is optimized for a range of uses including gesture control, skeleton tracking, 3D scanning and point cloud development. The following table summarizes the technical features of the depth camera.

| <b>Orbbec Astra Depth Camera</b>            | <b>Specs</b>                               |
|---------------------------------------------|--------------------------------------------|
| <b>Depth Resolution</b>                     | 640x480                                    |
| <b>RGB Resolution</b>                       | 640x480                                    |
| <b>RGB Sensing Angle</b>                    | 63.1x49.4 degree                           |
| <b>Depth Sensing Angle</b>                  | 58.4x45.5 degree                           |
| <b>Monocular/Binocular Structural Light</b> | Monocular Structural Light + Monocular RGB |
| <b>Depth Frame per Second</b>               | 640x480@30fps                              |
| <b>RGB Frame per Second</b>                 | 640x480@30fps                              |
| <b>Depth Range</b>                          | 0.6~4m                                     |
| <b>Data Transfer Interface</b>              | USB2.0 or above                            |

## 5. STM32 Board (Motor Control, Power Management & IMU)

The STM32F103RC Board is the micro-controller used in all Rosbots. It has a high performance ARM Cortex-M3 32-bit RISC core operating at a 72MHz frequency along with high-speed embedded memories. It operates in -40°C to +105°C temperature range, suiting all robotic applications in worldwide climates. There are power-saving modes which allow the design of low-power applications. Some of the applications of this microcontroller include: motor drives, application control, robotic application, medical and handheld equipment, PC and gaming peripherals, GPS platforms, industrial applications, alarm system video intercom and scanners.





| STM32F103RC                               | Features                                                                                                                                                                                                       |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Core</b>                               | ARM32-bit Cortex –M3 CPU<br>Max speed of 72 MHz                                                                                                                                                                |
| <b>Memories</b>                           | 512 KB of Flash memory<br>64kB of SRAM                                                                                                                                                                         |
| <b>Clock, Reset and Supply Management</b> | 2.0 to 3.6 V application supply and I/Os                                                                                                                                                                       |
| <b>Power</b>                              | Sleep, Stop and Standby modes<br>V <sub>BAT</sub> supply for RTC and backup registers                                                                                                                          |
| <b>DMA</b>                                | 12-channel DMA controller                                                                                                                                                                                      |
| <b>Debug Mode</b>                         | SWD and JTAG interfaces<br>Cortex-M3 Embedded Trace Macrocell                                                                                                                                                  |
| <b>I/O ports</b>                          | 51 I/O ports (mappable on 16 external interrupt vectors and 5V tolerant)                                                                                                                                       |
| <b>Timers</b>                             | 4x16-bit timers<br>2 x 16-bit motor control PWM timers (with emergency stop)<br>2 x watchdog timers (independent and Window)<br>SysTick timer (24-bit downcounter)<br>2 x 16-bit basic timers to drive the DAC |
| <b>Communication Interface</b>            | USB 2.0 full speed interface<br>SDIO interface<br>CAN interface (2.0B Active)                                                                                                                                  |



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## 6. Steering & Driving System

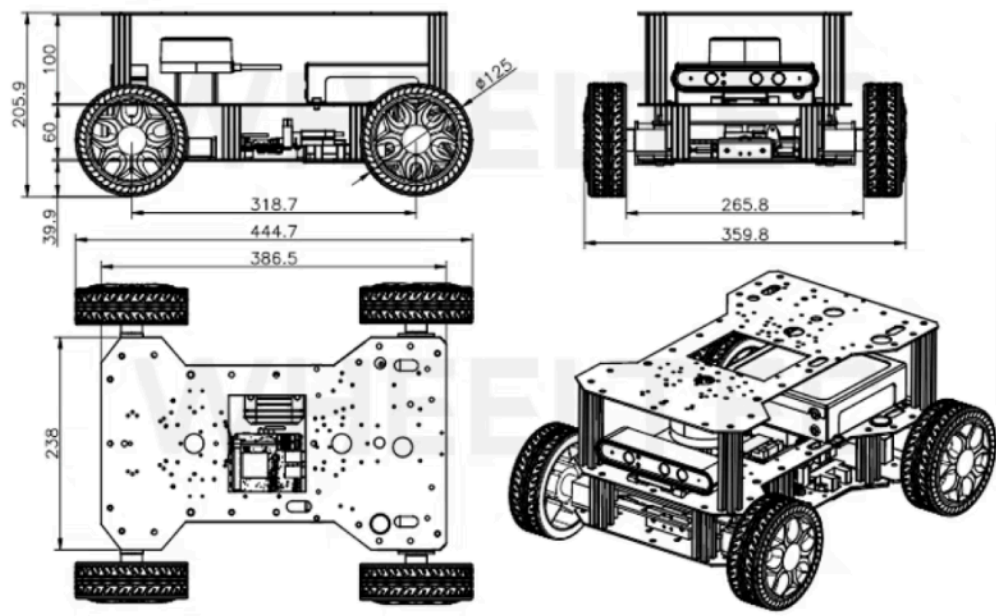
The Steering and Driving system is integrated with the design and build of the Rosbot. Depending on the model purchased it will be either a 2 wheel or 4 wheel drive, with both options being suitable to a variety of research and development purposes. The wheels on all Rosbots are solid rubber with snow protection grade tires. There is a coaxial pendulum suspension system, and the top range Rosbots are equipped with shock absorbers with independent suspension systems, ensuring it is able to successfully navigate difficult terrain.

### Steering and Driving Technical Specifications:

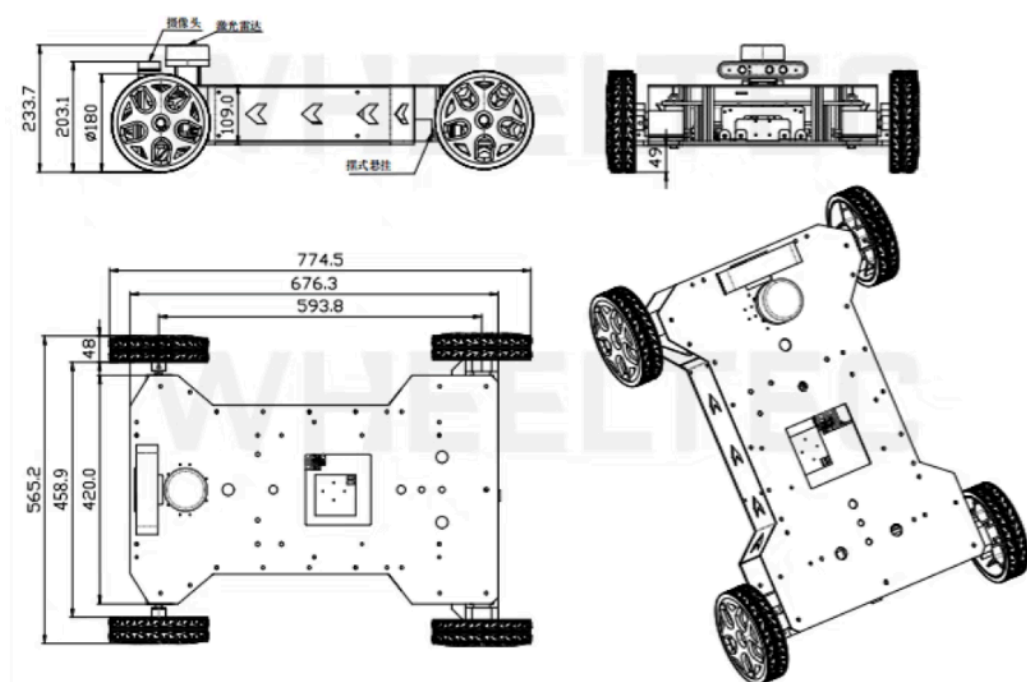
| Steering and Driving Aspect | Features                                                              |
|-----------------------------|-----------------------------------------------------------------------|
| <b>Wheels</b>               | 4 x 125mm diameter solid rubber wheels<br>Snow protection grade tires |
| <b>Motors</b>               | 1 x HWZ020 20kg Torque Digital Servo<br>2 x MD36N 35W DC Brush Motors |
| <b>Brackets</b>             | 2 x Simple L-shaped Motor brackets                                    |
| <b>Chassis Material</b>     | Aluminium Alloy plates                                                |
| <b>Encoder</b>              | 2 x 500 Line AB phase Photoelectric Encoders                          |
| <b>Linear guide</b>         | 1 x Mini linear guide                                                 |
| <b>Suspension System</b>    | 1 x Coaxial pendulum suspension system                                |

## Rosbot Chassis Design Diagram:

### Rosbot 2

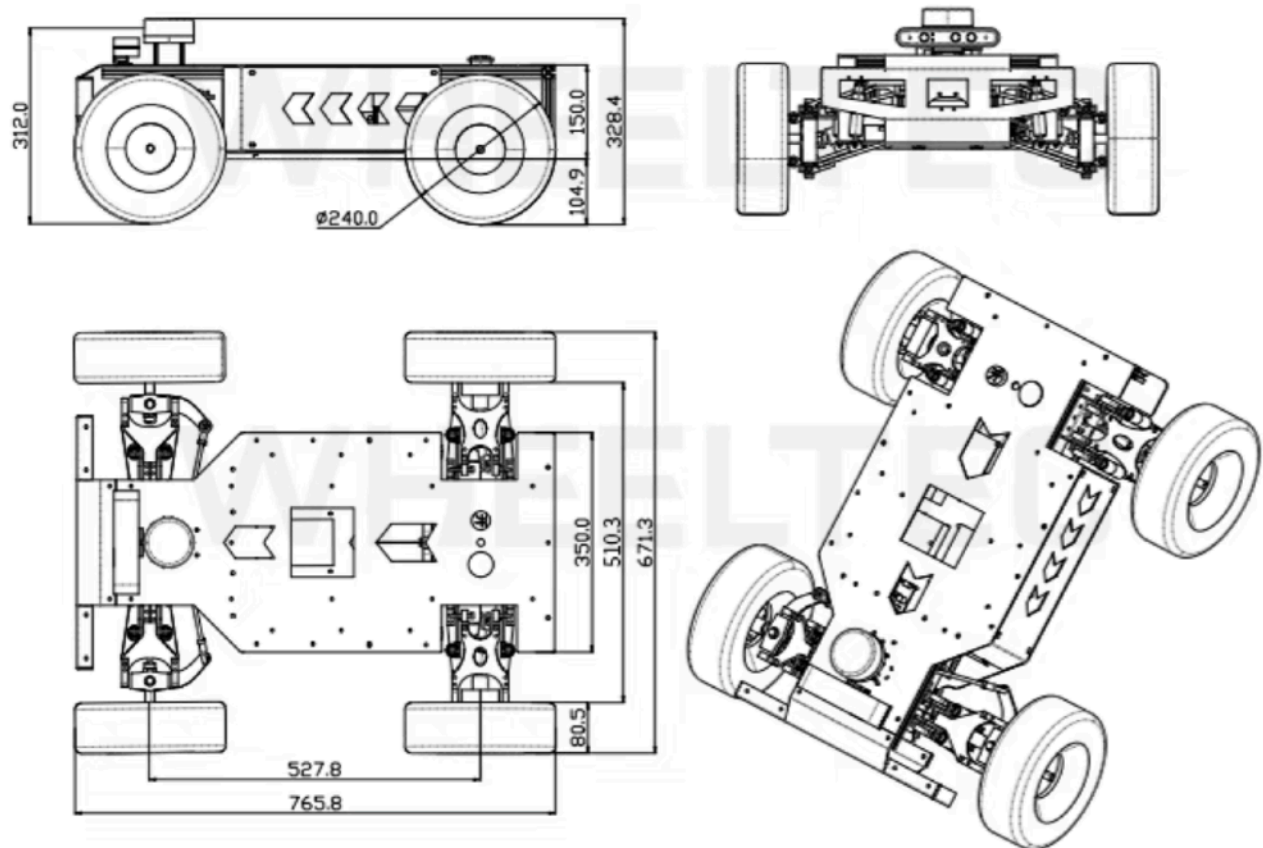


### Rosbot Pro



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## Rosbot Plus



## 7. Power Management

### Power Mag - Magnetic LFP Battery:

All Rosbots come with a 6000 mAh Power Mag, a magnetic LFP (Lithium Iron Phosphate) battery and a Power Charger. Customers can upgrade the battery to 20000 mAh with additional cost. LFP batteries are a type of lithium-ion battery known for their stability, safety, and long cycle life. Unlike traditional lithium-ion batteries, which use cobalt or nickel, LFP batteries rely on iron phosphate, offering a more sustainable and less toxic alternative. They are highly resistant to thermal runaway, reducing the risk of overheating and fire. While they have a lower energy density compared to other lithium-ion batteries, LFP batteries excel in durability, with

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longer lifespan, faster charging, and better performance in extreme temperatures, making them ideal for electric vehicles (EVs) and energy storage systems. Power Mag can be attached to any metal surfaces of a robot due to its magnetic base design. It makes swapping batteries quick and easy.

#### Technical Specifications:

| Model                 | 6000 mAh                                                                    | 20000 mAh                                                                   |
|-----------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Battery Pack          | 22.4V 6000mAh                                                               | 22.4V 20000mAh                                                              |
| Core Material         | Lithium Iron Phosphate                                                      | Lithium Iron Phosphate                                                      |
| Cutoff Voltage        | 16.5 V                                                                      | 16.5 V                                                                      |
| Full Voltage          | 25.55 V                                                                     | 25.55 V                                                                     |
| Charging Current      | 3A                                                                          | 3A                                                                          |
| Shell Material        | Metal                                                                       | Metal                                                                       |
| Discharge Performance | 15A Continuous Discharge                                                    | 20A Continuous Discharge                                                    |
| Plug                  | DC4017MM female connector (charging) XT60U-F female connector (discharging) | DC4017MM female connector (charging) XT60U-F female connector (discharging) |
| Size                  | 177*146*42mm                                                                | 208*154*97mm                                                                |
| Weight                | 1.72kg                                                                      | 4.1kg                                                                       |

#### Battery Protection:

Short circuit, overcurrent, overcharge, over-discharge protection, support charging while using, built-in safety valve, flame retardant board.

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## Super Charge:

Super Charge is an Auto Charging Station bundled with Rosbot 2S, Rosbot Pro S, Rosbot Plus S models and can be purchased separately to work with Rosbot 2, Rosbot Pro and Rosbot Plus.

## 8. Tele-operation

There are 4 ways to tele-operate the robot:

### 8.1 Controlled by PS2 controller:

8.1.1. Connect the PS2 controller to the PCB board

8.1.2. Wait until the indicator turns red on the controller and then press the Start button.

8.1.3. On the pcb board screen, push the left joystick forward and change it from ros to ps2 control mode.

The following photo shows the two different control modes: ROS or PS2:



### 8.2 Controlled by ros2 node and keyboard

8.2.1. Change the control mode to ros

8.2.2. Make sure robot bring up is running (see section 9)

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8.2.3. Run this command:

```
python3 ros2/src/wheeltec_robot_keyboard/wheeltec_robot_keyboard/wheeltec_keyboard.py
```

4. Alternatively, you can run this command:

```
ros2 run wheeltec_robot_keyboard wheeltec_keyboard
```

### 8.3 Controlled by ros2 node and a USB A controller

8.3.1. Connect a USB A controller

8.3.2. Change the control mode to ros

8.3.3. Make sure robot bring up is running (see section 9)

8.3.4. Run this command:

```
ros2 launch wheeltec_joy wheeltec_joy.launch.py
```

### 8.4 Controlled by Mobile App via Wifi or Bluetooth connection

Visit Roboworks' App Station website and navigate to the Remote Control Mobile Apps section to download the Mobile App for your mobile phone:

<https://www.roboworks.net/apps>

## 9. ROS 2 Quick Start

When the robot is first powered on, it is controlled by ROS by default. Meaning, the STM32 chassis controller board accepts commands from the ROS 2 Controller such as Jetson Orin.

Initial setup is quick and easy, from your host PC (Ubuntu Linux recommended) connect to the robot's Wi-Fi hotspot. Password by default is "**dongguan**".

Next, connect to robot using SSH via the Linux terminal, IP address is 192.168.0.100, default password is **dongguan**.

```
~$ ssh wheeltec@192.168.0.100
```

With terminal access to the robot, you can navigate to the ROS 2 workspace folder, under "wheeltec\_ROS 2"

Prior to running test programs, navigate to wheeltec\_ROS 2/turn\_on\_wheeltec\_robot/ and locate wheeltec\_udev.sh - This script must be run, typically only once to ensure proper configuration of peripherals.

You are now able to test the robot's functionality, to launch the ROS 2 controller functionality, run:

---

“roslaunch turn\_on\_wheeltec\_robot turn\_on\_wheeltec\_robot.launch”

**~\$ ros2 launch turn\_on\_wheeltec\_robot turn\_on\_wheeltec\_robot.launch**

In a second terminal, you can use the keyboard\_teleop node to validate chassis control, this is a modified version of the popular ROS 2 Turtlebot example. Type (more tele-op control is available in section 8 ):

**“ros2 run wheeltec\_robot\_keyboard wheeltec\_keyboard”**

```
Control Your Turtlebot!
-----
Moving around:
  u      i      o
  j      k      l
  m      ,      .

q/z : increase/decrease max speeds by 10%
w/x : increase/decrease only linear speed by 10%
e/c : increase/decrease only angular speed by 10%
space key, k : force stop
anything else : stop smoothly

CTRL-C to quit

currently:      speed 0.2      turn 1
```

## 10. Pre-installed ROS 2 Humble Packages

Below are the following user-oriented packages, whilst other packages may be present, these are dependencies only.

### **turn\_on\_wheeltec\_robot**

This package is crucial for enabling robot functionality and communication with the chassis controller. The primary script “turn\_on\_wheeltec\_robot.launch” must be used upon each boot to configure ROS 2 and controller.

### **wheeltec\_rviz2**

Contains launch files to launch rviz with custom configuration for Pickerbot Pro.



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### **wheeltec\_robot\_slam**

SLAM Mapping and localisation package with custom configuration for Pickerbot Pro.

### **wheeltec\_robot\_rrt2**

Rapidly exploring random tree algorithm - This package enables Pickerbot Pro to plan a path to it's desired location, by launching exploration nodes.

### **wheeltec\_robot\_keyboard**

Convenient package for validating robot functionality and controlling using the keyboard, including from remote host PC.

### **wheeltec\_robot\_nav2**

ROS 2 Navigation 2 node package.

### **wheeltec\_lidar\_ros2**

ROS 2 Lidar package for configuring Leishen M10/N10.

### **wheeltec\_joy**

Joystick control package, contains launch files for Joystick nodes.

### **simple\_follower\_ros2**

Basic object and line following algorithms using either laser scan or depth camera.

### **ros2\_astra\_camera**

Astra depth camera package with drivers and launch files.