# BUNKER PRO2 USER MANUAL

## BUNKER RRO 2.0 User Manual


**UNKER MINI**

**AgileX Robotics Team**

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| 1 | V.1.0.0 | 2025/5 | Dennis | | first draft |

This chapter contains important safety information that must be read and understood by any individual or organization before using the equipment when the robot is powered on for the first time. You can contact us at support@agilex.ai if you have any questions about usage. It is very important that all assembly instructions and guidelines in other chapters of this manual are followed and implemented. Particular attention should be paid to text associated with warning signs.

# Safety Information

The information in this manual does not include the design, installation and operation of a complete robotic application, nor does it include any peripherals that may affect the safety of

this complete system. The design and use of this complete system requires compliance with the safety requirements established in the standards and specifications of the country where the robot is installed.

It is the responsibility of BUNKER PRO 2.0's integrators and end customers to ensure compliance with relevant specifications and effective laws and regulations, so as to ensure that there are no major hazards in the complete robot application example. This includes but is not limited to the following:

**Validity and Responsibility**

- Make a risk assessment of the complete robot system.
- Link together the additional safety equipment for other machinery as defined by the risk assessment.。
- Confirm that the design and installation of the peripherals of the complete robot system, including software and hardware systems, are accurate.
- This robot does not have relevant safety functions of a complete autonomous mobile robot, including but not limited to automatic anti-collision, anti-falling, biological approach warning, etc. These functions require integrators and end customers to conduct safety assessments in accordance with relevant rspecifications and effective laws and regulations, so as to ensure that the developed robot does not have any major dangers and safety hazards in practical applications.
- Gather all documents in the technical file: including the risk assessment and this manual.
- Be aware of possible safety risks before operating and using the equipment.

**Environment**

- When using it for the first time, please read this manual vehicleefully to understand the basic operation contents and operation specifications.
- For remote operation, choose a relatively open area for use, and the vehicle itself does not have any automatic obstacle avoidance sensors.
- Use in an ambient temperature of -20℃~60℃.
- If the vehicle does not have an individually customized IP protection level, the vehicle's waterproof and dustproof capabilities are IP67.

**Inspection**

- Make sure that each device has sufficient power.
- Make sure there is no obvious abnormality in the vehicle.
- Check that the remote control's batteries are fully charged.

- Ensure the emergency stop switch is released before operation.

### Operation

- Make sure the surrounding area is relatively clear during operation
- Remote control within sight range
- The maximum load capacity of BUNKER PRO 2.0 is 120KG. When using it, make sure the payload does not exceed 120KG.
- When installing external extensions on BUNKER PRO 2.0, confirm the position of the center of mass of the extension to ensure it is at the center of rotation
- Please charge the device promptly when the voltage drops below **72V**.
- Please use the device in an environment that meets the protection level requirements according to the IP protection level of the device.
- Please do not push the cart directly
- Ensure the ambient temperature is above **0℃** during charging.
- If the device malfunctions, stop using it immediately to prevent further damage or injury.
- In the event of a malfunction, contact qualified technical personnel. Do not attempt to repair it yourself.

### Maintenance

- Regularly check the tension of the suspension tracks. Track tensioning is required every 150—200 hours of operation.
- After 500 hours of operation, inspect and tighten all bolts and nuts on the chassis. Any looseness must be corrected immediately.
- To maintain battery capacity, store the battery with a charge, and recharge it periodically even when not in use for extended periods.

### ATTENTION

Important Notes for Using and Developing BUNKER PRO 2.0

Battery Precautions

- The battery of the BUNKER PRO 2.0 is not fully charged when it leaves the factory. The current battery level can be read via the voltage display panel on the rear of the chassis or through the CAN bus interface.
- Do not wait until the battery is fully depleted before charging. If the rear voltage display shows below 48 V, please charge the battery promptly.
- Static storage conditions: The recommended storage temperature is –10 ℃ to 45 ℃. When

not in use, the battery should be charged and discharged approximately once a month, then stored in a fully charged state. Do not throw the battery into fire, heat it, or store it in high–temperature environments.

- Charging: Always use the designated lithium battery charger provided with the product. Do not charge the battery at temperatures below 0 ˚C, and do not use non–original batteries, power supplies, or chargers.

**Environmental Usage Guidelines**

- The operating temperature range for BUNKER PRO 2.0 is –20 ˚C to 60 ˚C. Do not operate the unit outside of this temperature range.
- The acceptable relative humidity is 30% to 80%. Avoid environments with corrosive or flammable gases, or near combustible materials.
- Keep the unit away from heating elements, such as heaters or large wire–wound resistors.
- Recommended operating altitude: below 1000 m.
- Recommended daily temperature variation: no more than 25 ˚C.
- Regularly inspect and maintain the track tensioner system.

Electrical Extension Guidelines

- The rear expansion power interface supports a maximum current of 20 A and total power not exceeding 1440 W.

**Safety Precautions**

- If you have any questions during operation, please refer to the user manual or consult qualified technical personnel.
- Always assess the operating environment before using the device to avoid accidental injury caused by misuse.
- In case of emergency, press the emergency stop button to power down the system.
- Do not modify the internal structure of the device without official authorization or technical support.

**Other Notes**

- During transport or setup, do not drop or invert the device.
- Unauthorized disassembly by untrained personnel is strictly prohibited.

# CONTENTS

# 1 Introduction to BUNKER PRO 2.0

**BUNKER PRO 2.0** is a versatile tracked mobile chassis designed for a wide range of industrial and specialized applications. It features **responsive and intuitive control**, a **large development space**, and compatibility with various custom solutions across multiple industries. With its **independent suspension system**, **heavy-duty shock absorption**, **strong climbing ability**, and **stair-climbing capability**, it delivers excellent adaptability in challenging environments. BUNKER PRO 2.0 is ideal for the development of special-purpose robots in areas such as **inspection and exploration**, **rescue and explosive ordnance disposal (EOD)**, **specialized filming**, and **tactical transportation**, providing a reliable and robust **mobility platform** for robotic solutions.

## 0.1 Product List

| Name | Quantity |
|---|---|
| BUNKER PRO 2.0robot body | 1 PCS |
| Battery charger (AC 220V) | 1 PCS |
| Aviation plug male （4Pin) | 1 PCS |
| USB to CAN communication module | 1 PCS |
| FS remote control (optional) | 1 PCS |

## 1.2 Performance parameters

| Parameter Types | Items | Parameter |
|---|---|---|
| Mechanical specifications | L × W × H (mm) | 1080 x 785 x 470 |
| | Wheelbase (mm) | 575 |
| | Track Width(mm) | 150 |
| | Curb weight (kg) | 225 |
| | Battery Type | Lithium Iron Phosphate |
| | Battery parameters | 72V 50AH |
| | Power drive motor | 2x1800W brushless servo motors |

| | | |
|---|---|---|
| | Steering | Track type differential steering |
| | Suspension Type | Christie Suspension & Matilda Four–Wheel Balanced Suspension |
| | Drive Motor Gear Ratio | 1:7.5 |
| | Drive Motor Sensor | 2500 PPR Optical Incremental Encoder |
| Performance parameters | Maximum Loaded Speed (m/s) | 1.5 |
| | Minimum turning radius (mm) | Can turn in place |
| | Maximum Climbing Ability (Unloaded) (°) | 30° (Capable of stair climbing) |
| | Maximum obstacle crossing (mm) | 180 |
| | Maximum Ground clearance (mm) | 120 |
| | Rated Endurance Time (h) | 2.5 h (Fully loaded on concrete)<br>3.5 h (Unloaded on concrete) |
| | Maximum distance (km) | 15KM (full loaded)<br>20KM (Unloaded) |
| | Charging time (h) | 2.5 |
| | Working temperature (℃) | –20~60℃ |
| | **Braking Distance**<br>(Unloaded, friction coefficient 0.5) (m) | 0.7 |
| | IP Grade | IP67 |
| Control | RC transmitter | 2.4G/extreme distance 200M |

| | | |
|---|---|---|
| | System interface | CAN |
| | Control mode | Remote control Control<br>Command control mode |

## 1.3 Required for development

FS RC transmitter is provided (optional) in the factory setting of BUNKER PRO 2, which allows users to control the chassis of robot to move and turn; CAN and RS232 interfaces on BUNKER PRO 2 can be used for user's customization.

# 2 The Basics

This section provides a brief introduction to the BUNKER PRO 2 mobile robot platform. It is convenient for users and developers to have a basic understanding of BUNKER PRO 2 chassis.

## 2.1 Description of electrical interface

The rear electrical interface is shown in **Figure 2.1**, with the components labeled as follows:

- **Q1**: Aviation connector for **CAN** communication and **60—80 V power input**
- **Q2**: **Power switch**
- **Q3**: **Charging port**
- **Q4**: **Antenna**
- **Q5**: **Emergency stop switch**
- **Q6**: **Status indicator light**

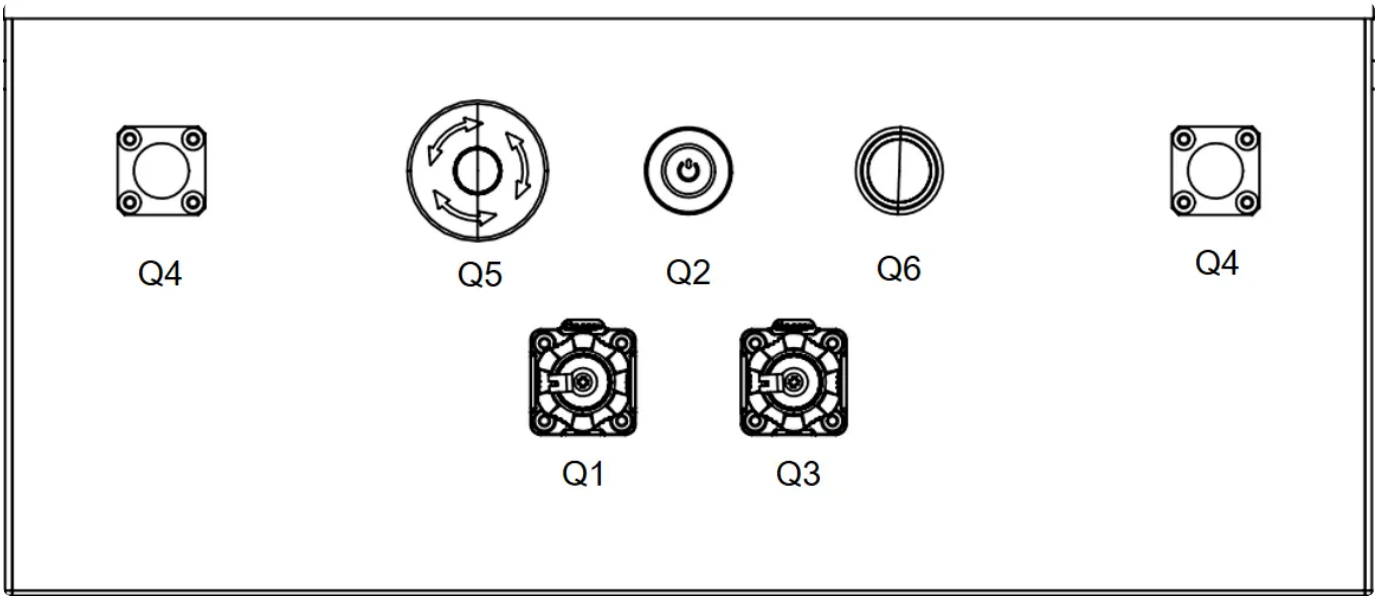
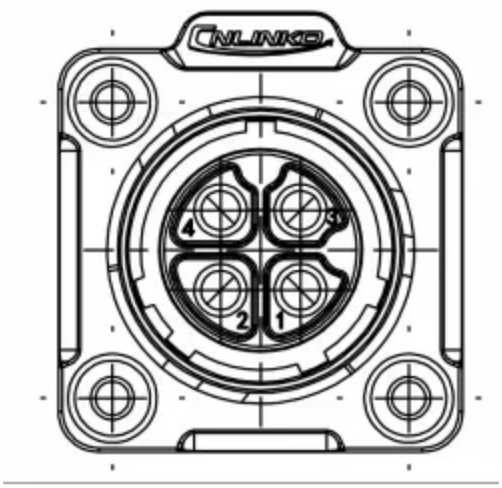



Figure 2.1

The definitions of Q1 communication and power interface as shown in Figure 2–2.




| Pin NO. | Pin type | Definition | Remark |
|---|---|---|---|
| 1 | Power | VCC | Power positive,<br>voltage range46 –54V,<br>maximum current 10A |
| 2 | Power | GND | Power negative |
| 3 | Can | Can_H | CAN bus high |
| 4 | Can | Can_L | CAN bus low |

Figure 2.2 Pin definition figure of tail aviation expansion interface

Status Indicator Light Meaning:

| Color | State | Meaning |
|---|---|---|
| Green | Solid On | Battery level > 50% |
| Yellow | Solid On | Battery level between 25%—50% |
| Red | Solid On | Battery level between 10%—25% |
| | Slow Blink | Battery level < 10% |
| | Fast Blink | ERROR — System fault detected |

## 2.2 Instructions on remote control

FS RC transmitter is an optional accessory for the **BUNKER PRO 2.0** and can be selected by users based on their specific needs. The remote control allows for easy and intuitive operation of the BUNKER PRO 2.0 universal tracked chassis. This model adopts a **left-hand throttle design**.

The button layout and functionality are illustrated in **Figure 2.3**, with definitions as follows:

- **SWA, SWB, SWC, SWD**: Function switches
  - **SWD**: Currently unused
  - **SWB**: Mode selection switch
    - **Top position**: Command control mode
    - **Middle position**: Remote control mode
- **S1**: Throttle control (forward and backward movement)
- **S2**: Rotation control
- **POWER**: Power button; press and hold to power on

**Important Note:**

When powering on the remote controller, ensure that **SWA, SWB, SWC, and SWD** are all in the **top position** to avoid initialization errors.


Figure 2.3 Schematic Diagram of Buttons on FS RC transmitter

Remote control interface description:

Bunker: model

Vol: battery voltage

Car: chassis status

Batt: Chassis power percentage

P: Park

Remoter: remote control battery level

Fault Code: Error information (Represents byte [5] in 211 frame)

## 2.3 Instructions on control demands and movements

A reference coordinate system can be defined and fixed on the vehicle body as shown in Figure 2.4 in accordance with ISO 8855.

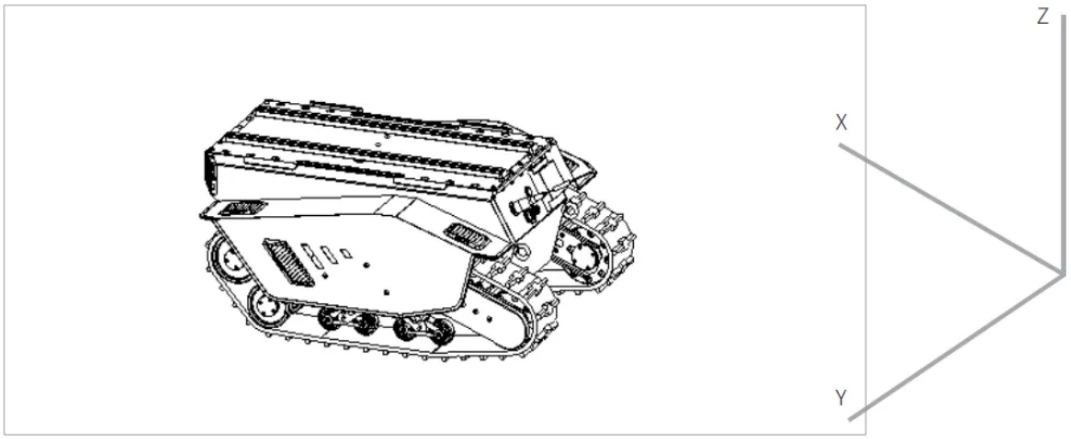



Figure 2.4 Schematic Diagram of ReferenceCoordinate System for Vehicle Body

As shown in **Figure 2.4**, the **BUNKER PRO 2.0** chassis is aligned such that its body is **parallel to the X-axis** of the established reference coordinate system.

**Remote Control Mode:**

- **S1 Joystick (Forward/Backward Movement)**:
  - Pushing **S1 forward** → Moves the chassis in the **positive X direction**.
  - Pushing **S1 backward** → Moves the chassis in the **negative X direction**.
  - The further S1 is pushed, the greater the linear speed:
    - **Max forward** → Maximum speed in +X
    - **Max backward** → Maximum speed in –X
- **S2 Joystick (Rotational Movement)**:
  - Pushing **S2 left** → Rotates the chassis **counterclockwise**, from the **+X axis toward the +Y axis**.
  - Pushing **S2 right** → Rotates the chassis **clockwise**, from the **+X axis toward the –Y axis**.
  - The more S2 is pushed, the greater the angular velocity:
    - **Max left** → Maximum counterclockwise rotation
    - **Max right** → Maximum clockwise rotation

**Command Control Mode:**

- A **positive linear velocity** indicates movement in the **+X direction**.

- A **negative linear velocity** indicates movement in the **–X direction**.
- A **positive angular velocity** represents **counterclockwise rotation** (from +X to +Y).
- A **negative angular velocity** represents **clockwise rotation** (from +X to –Y).

# 3 Getting Started

This section introduces the basic operation and development of the BUNKER platform using the CAN bus interface.

## 3.1 Use and operation

**Inspection**

- **Chassis Status Check**:
  Inspect the chassis for any visible abnormalities. If any issues are found, please contact after–sales support.
- **Initial Use Confirmation**:
  Check the rear electrical panel and ensure the **Q2 (Power Switch)** is in the **released** state. If it is pressed, press and release it again to return it to the released state.

**Startup Procedure**

- **Power On**:
  Press the **power switch (Q2)** on the rear electrical panel. If functioning normally, the power indicator light will turn on, and the **voltage display** will show the current battery voltage.
- **Battery Voltage Check**:
  - Normal voltage range: **60—80 V**
  - If the voltage drops below **55 V**, the **BUNKER PRO 2.0** may not operate properly.

**Shutdown Procedure**

- Press the **power switch** to cut off the power supply.

**Remote Control Operation**

- After powering on the **BUNKER PRO 2.0**, turn on the **remote controller**.
- Switch to **remote control mode** to control the movement of the robot platform using the remote.

**Expansion**

- The **BUNKER PRO 2.0** chassis supports **secondary development** on the top platform.
- It features **standard aluminum profile rails** and **T-slot nuts** for mounting.
- For optimal balance, mount expansions **near the rotation center** of the platform.
- The chassis **center of gravity** is shown in **Figure 2.5**.

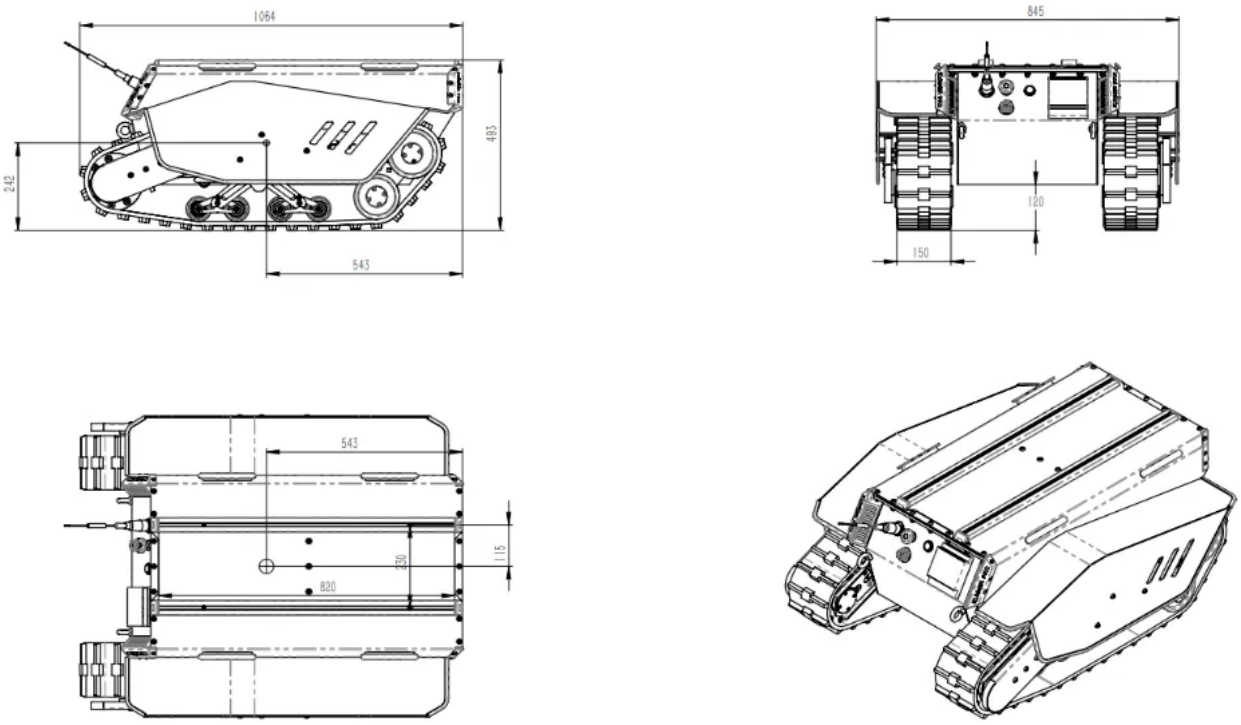



Figure3.1 Chassis Center of Gravity Diagram

## 3.2 Charging

The BUNKER PRO 2.0 comes equipped with a **standard charger** by default, which meets basic charging requirements.

Follow the steps below to charge the vehicle:

Ensure the BUNKER PRO 2.0 chassis is **completely powered off**.

Before charging, confirm that the **Q2 (Power Switch)** on the rear electrical panel is in the **OFF** position.

Plug the charger into the **Q3 charging port** on the rear electrical control panel.

Connect the charger to an AC power source and switch on the charger to begin the charging process.

During charging, **no indicator lights** will appear on the chassis.

The charging status must be confirmed via the **indicator on the charger itself**.

## 3.3 Development

BUNKER PRO 2.0 provides a **CAN interface** for users to perform secondary development and custom control.

The system follows the **CAN 2.0B standard**, with a **baud rate of 500Kbps**.

The **data frame format** adopts the **MOTOROLA format**.

Through the external CAN bus interface, users can send commands to control the **linear velocity** and **angular velocity** of the chassis.

The BUNKER PRO 2.0 will also provide **real-time feedback** on its motion status and chassis condition.

The communication protocol includes:

**System Status Feedback Frames**, **Motion Control Feedback Frames**, **Command Frames**, **System Status Feedback Frames** provide:

Current chassis status, Control mode status, Battery voltage status, Error or fault information

Refer to **Table 3.1** for the structure of the system status feedback frame.

**Table 3.1** — BUNKER PRO 2.0 Chassis System Status Feedback Frame

Table 3.1 Bunker Chassis Status Feedback Frame

| Command Name | System Status Feedback Command | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle(ms) | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x211 | 200ms | None |
| Data length | 0x08 | | | |
| Position | Function | Data type | Description | |

| | | | |
|---|---|---|---|
| byte [0] | Current status of vehicle body | unsigned int8 | 0x00 Normal condition<br>0x01 Emergency stop<br>0x02 System Error |
| byte [1] | Mode control | unsigned int8 | 0x00 Stand by<br>0x01 CAN command control<br>0x03 Remote control |
| byte [2]<br>byte [3] | Battery voltage upper 8 bits<br>Battery voltage lower 8 bits | unsigned int16 | Actual voltage × 10(with an accuracy of 0.1V) |
| byte [4] | Reserve | – | 0x00 |
| byte [5] | Failure Information | unsigned int8 | Refer to Table3.2 Failure Information Description |
| byte [6] | Reserve | – | 0x00 |
| byte [7] | Count Parity bit (Count) | unsigned int8 | 0~255 Loops counting. Count is incremented once<br>while single command sent every time |

Table 3.2 Description of Failure Information

| Description of Failure Information | | |
|---|---|---|
| Byte | Bit | Description |
| byte [5] | bit [0] | Low-voltage failure |
| | bit [1] | Low-voltage warning |
| | bit [2] | Remote control signal lost protection(0: Normal 1: Lost signal) |
| | bit [3] | Reserve, default value 0 |
| | bit [4] | Drive 2 communication failure(0: Normal 1: Failure) |

| | | |
|---|---|---|
| | bit [5] | Drive 3 communication failure(0: Normal 1: Failure) |
| | bit [6] | Reserve, default value 0 |
| | bit [7] | Emergency Stop (0: Normal, 1: Emergency Stop Triggered) |

The motion control feedback frame includes the feedback of linear and angular speed of chassis. The specific protocol details are shown in Table 3.3.

| Command Name Movement Control Feedback Frame | | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle(ms) | Receive–timeout(ms) |
| Steer–by–wire chassis | Decision–making control unit | 0x221 | 20ms | None |
| Data length | 0x08 | | | |
| Position | Function | Data type | Description | |
| byte [0]<br>byte [1] | Moving speed upper 8 bits<br>Moving speed lower 8 bits | signed int16 | Actual speed X 1000 (with an accuracy of 0.001m/s) | |
| byte [2]<br>byte [3] | Rotation speed upper 8 bits<br>Rotation speed lower 8 bits | signed int16 | Actual speed X 1000 (with an accuracy of 0.01°) | |
| byte [4] | Reserved | – | 0x00 | |
| byte [5] | Reserved | – | 0x00 | |
| byte [6] | Reserved | – | 0x00 | |
| byte [7] | Reserved | – | 0x00 | |

The mode setting frame is used to configure the control interface of the terminal. The specific protocol details are shown in Table 3.4.

| Command Name: Movement Control mode Frame | | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle (ms) | Receive-timeout(ms) |
| Decision-making control unit | Steer-by-wire chassis | 0x421 | 20ms | 500m/s |
| Data length | 0x01 | | | |
| Location | Function | Data type | Description | |
| byte [0] | CAN Command Mode | Unsigned int8 | 0x00 Stand by<br>0x01 CAN Command mode<br>By default, the device enters standby mode when powered on. | |

**Note [1] Control Mode Description**

When the **BUNKER PRO 2.0** is powered on and the remote controller is not turned on, the system defaults to **standby mode**. It must be switched to **command mode** before any motion control commands can be executed. If the remote controller is turned on, it takes the highest control priority and overrides command inputs. Even when the remote is set to command mode, a **control mode setting command** must still be sent first before the system will respond to speed commands.

The **motion control frame** includes linear velocity and angular control commands. The detailed protocol is described in **Section 3.5**.

| Command Name | Motion Command Control Frame | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle(ms) | Receive-timeout(ms) |
| Decision-making control unit | Steer-by-wire chassis | 0x111 | 20ms | 500ms |
| Data length | 0x08 | | | |
| Position | Function | Data type | Description | |

| | | | |
|---|---|---|---|
| byte [0]<br>byte [1] | Linear velocity upper 8 byte<br>Linear velocitylower 8 byte | Signed int16 | Linear moving speed mm/s(unit)<br>Range[−1850,1850] |
| byte [2]<br>byte [3] | Linear speed percentage Angular speed percentage | Signed int16 | Rotation angular speed 0.001rad/s(unit)<br>Range [−1000,1000] |
| byte [4] | Reserved | — | 0x00 |
| byte [5] | Reserved | — | 0x00 |
| byte [6] | Reserve | — | 0x00 |
| byte [7] | Reserve | — | 0x00 |

[Note] Sample data, the following data is only for testing. (Set the control mode to command mode before testing)

1.The chassis moves forward at 0.15m/s.

| byte [0] | byte [1] | byte [2] | byte [3] | byte [4] | byte [5] | byte [6] | byte [7] |
|---|---|---|---|---|---|---|---|
| 0x00 | 0x96 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 |

2.The chassis steering 10°

| byte [0] | byte [1] | byte [2] | byte [3] | byte [4] | byte [5] | byte [6] | byte [7] |
|---|---|---|---|---|---|---|---|
| 0x00 | 0x00 | 0x03 | 0xe8 | 0x00 | 0x00 | 0x00 | 0x00 |

The **Status Reset Frame** is used to clear system errors. Its specific protocol details are shown in **Table 3.6**.

Table 3.6 — Status Reset Frame

| Command | Status Clear Frame | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle（ms） | Receive-timeout(ms) |

| Key Unit | Steer-by-wire chassis | 0x441 | None | None |
|---|---|---|---|---|
| Data length | 0x01 | | | |
| Location | Function | Data type | Description | |
| byte [0] | Failures clear command | Unsigned int8 | 0x00 Clear all failures<br>0x01 Clear motor1 failures<br>0x02 Clear motor2 failures | |

In addition to the feedback of chassis status, there are also feedback data from the motors and sensors.

Table 3.7 Motor Rotational Speed Feedback Frame

| Command | High-Speed Feedback Frame of Motor Driver | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle (ms) | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x252~0x253 | 20ms | None |
| Data length | 0x08 | | | |
| Position | Function | Data type | Description | |
| byte [0]<br>byte [1] | Motor rotational speed upper 8bits<br>Motor rotational speed lower 8bits | signed int16 | **Current Motor Speed** (unit: RPM) | |
| byte [2]<br>byte [3] | Motor rotational speed upper 8bits<br>Motor rotational speed lower 8bits | signed int16 | **Current Motor Current** (unit: 0.1 A) | |

| | | | |
|---|---|---|---|
| byte [4]<br>byte [5]<br>byte [6]<br>byte [7] | Most Significant Byte<br>Second Most Significant Byte<br>Second Least Significant Byte<br>Least Significant Byte (LSB) | signed int32 | **Current Motor Position** (unit: pulse count) |

Table 3.8 Motor Temperature, Voltage, and Status Feedback

| Command | Low-Speed Feedback Frame of Motor Driver | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle (ms) | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x262~0x263 | 20ms | None |
| Data length | 0x08 | | | |
| Position | Function | Data type | Description | |
| byte [0] | Driver Voltage upper 8 bits | unsigned int16 | Current Driver Voltage(Unit: **0.1 V**) | |
| byte [1] | Driver Voltage lower 8 bits | | | |
| byte [2] | Drive temperature upper 8 bits | signed int16 | Unit: 1℃ | |
| byte [3] | Drive temperature lower 8 bits | | | |
| byte [4] | Moto Temperature | signed int8 | Unit: 1℃ | |
| byte [5] | Drive status | unsigned int8 | Refer to Table 3.9 for detail | |
| byte [6] | Reserved | - | 0x00 | |
| byte [7] | Reserved | - | 0x00 | |

Table 3.9 Drive Status Byte

| Byte | Bit | Description |
|---|---|---|
| byte [5] | bit [0] | Low-voltage (0: Normal 1: Low) |
| | bit [1] | Motor over- temperature (0: Normal 1: Over-temperature) |
| | bit [2] | Overcurrent Status (0: Normal 1: Overcurrent detected) |
| | bit [3] | Overtemperature Status (0: Normal 1: Overtemperature detected) |
| | bit [4] | Sensor Status (0: Normal 1: Sensor fault) |
| | bit [5] | Driver Error Status (0: Normal 1: Error present) |
| | bit [6] | Driver Enable Status (0: Enabled 1: Disabled) |
| | bit [7] | Reserved |

Table 3.10 Odometer Feedback Frame

| Command Name | Odometer Feedback Command | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle（ms） | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x311 | 20ms | None |
| Data length | 0x08 | | | |
| Location | Function | Data type | Description | |

| | | | |
|---|---|---|---|
| byte [0]<br>byte [1]<br>byte [2]<br>byte [3] | Left wheel odometer highest bit<br>Left wheel odometer second highest bit<br>Left wheel odometer second lowest bit<br>Left wheel odometer lowest bit | Signed int 32 | Left wheel odometer feedback (Unit: mm) |
| byte [4]<br>byte [5]<br>byte [6]<br>byte [7] | Right wheel odometer highest bit<br>Right wheel odometer second highest bit<br>Right wheel odometer second lowest bit<br>Right wheel odometer lowest bit | Signed int 32 | Right wheel odometer feedback<br>(Unit: mm) |

Table 3.11 Remote Control Information Feedback Frame

| Command Name | Remote Control Information Feedback Command | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle（ms） | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x241 | 20ms | None |
| Data length | 0x08 | | | |

| Location | Function | Data type | Description |
|---|---|---|---|
| byte [0] | SW feedback | Unsigned int8 | bit[0–1]: SWA ： 2– Up 3–Down<br>bit[2–3]: SWB : 2–Up 1–Middle 3–Down<br>bit[4–5]: SWC : 2–Up 1–Middle 3–Down<br>bit[6–7]: SWD： 2–Up 3–Down |
| byte [1] | Right joystick left and right | Signed int8 | Range[–100,100] |
| byte [2] | Right joystick up and down | Signed int8 | Range[–100,100] |
| byte [3] | Left joystick up and down | Signed int8 | Range[–100,100] |
| byte [4] | Left joystick left and right | Signed int8 | Range[–100,100] |
| byte [5] | Left knob VRA | Singed int8 | Range[–100,100] |

Table 3.12 Battery BMS Data Feedback

| Command Name | Remote Control Information Feedback Command | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle（ms） | Receive–timeout(ms) |
| Steer–by–wire chassis | Decision–making control unit | 0x361 | 500ms | None |
| Data length | 0x08 | | | |
| Location | Function | Data type | Description | |
| byte [0] | Battery SOC | Unsigned Int8 | Range: 0~100 | |
| byte [1] | Battery SOH | Unsigned Int8 | Range: 0~100 | |
| byte [2]<br>byte [3] | Battery Voltage | Unsigned Int16 | Unit: 0.01 V (High byte first) | |

| | | | |
|---|---|---|---|
| byte [4]<br>byte [5] | Battery Current | Unsigned Int16 | Unit: 0.1 A (High byte first) |
| byte [6]<br>byte [7] | | Unsigned Int16 | Unit: 0.1 ℃ (High byte first) |

Table 3.13 Battery BMS Data Feedback

| Command Name | | | | |
|---|---|---|---|---|
| Sending node | Receiving node | ID | Cycle（ms） | Receive-timeout(ms) |
| Steer-by-wire chassis | Decision-making control unit | 0x362 | 500ms | None |
| Data length | 0x04 | | | |
| Location | Function | Data type | Description | |
| byte [0] | Alarm Status 1 | unsigned int8 | BIT1: Overvoltage<br>BIT2: Undervoltage<br>BIT3: Overtemperature<br>BIT4: Undertemperature<br>BIT7: Discharge Overcurrent | |
| byte [1] | Alarm Status 2 | unsigned int8 | **BIT0**: Charge Overcurrent | |
| byte [2] | Warning Status 1 | unsigned int8 | BIT1: Overvoltage<br>BIT2: Undervoltage<br>BIT3: Overtemperature<br>BIT4: Undertemperature<br>BIT7: Discharge Overcurrent | |
| byte [3] | Warning Status 2 | unsigned int8 | BIT0: Charge Overcurrent | |

## 3.3.2 CAN Cable Connection

BUNKER PRO 2 ships with the vehicle and provides a male aviation plug as shown in Figure 3.2. The definition of the wires is: yellow is CAN_H, blue is CAN_L, red is the positive power supply, and black is the negative power supply.

**Note: In the current BUNKER PRO2 version, only the tail interface is open to external expansion interfaces. The power supply in this version can provide a maximum current of 10A.**


Figure 3.2 Schematic diagram of aviation plug male connector

### 3.3.3 Implementation of CAN

Correctly start the chassis of BUNKER PRO 2mobile robot, and turn on FS RC transmitter. Then, switch to the command control mode, i.e. toggling SWB mode of FS RC transmitter to the top. At this point, BUNKER chassis will accept the command from CAN interface, and the host can also parse the current state of chassis with the real-time data fed back from CAN bus. For the detailed content of protocol, please refer to CAN communication protocol.

## 3.4 Firmware upgrades

In order to facilitate users to upgrade the firmware version used by BUNKER PRO 2and bring customers a more complete experience, BUNKER PRO 2 provides a firmware upgrade hardware interface and corresponding client software.

**Upgrade Preparation**

Agilex CAN debugging module X 1

Micro USB cable X 1

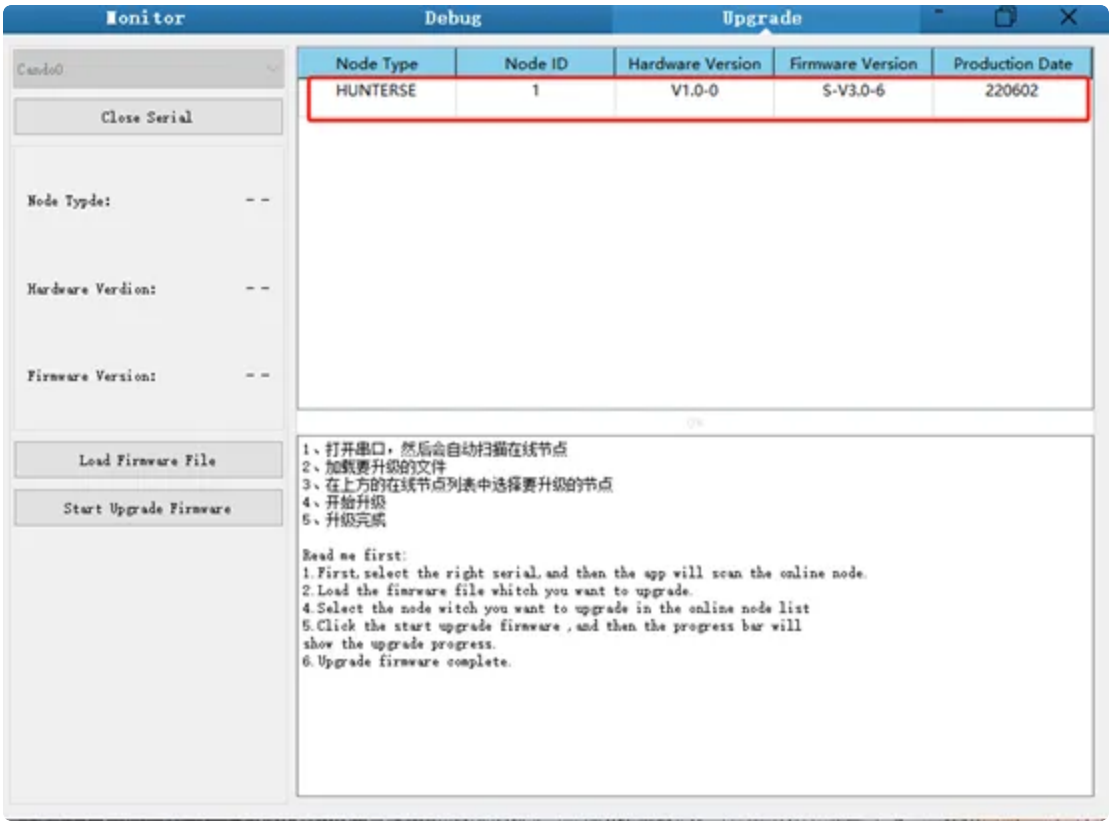
BUNKER PRO 2 chassis X 1

A computer (WINDOWS OS (Operating System)) X 1

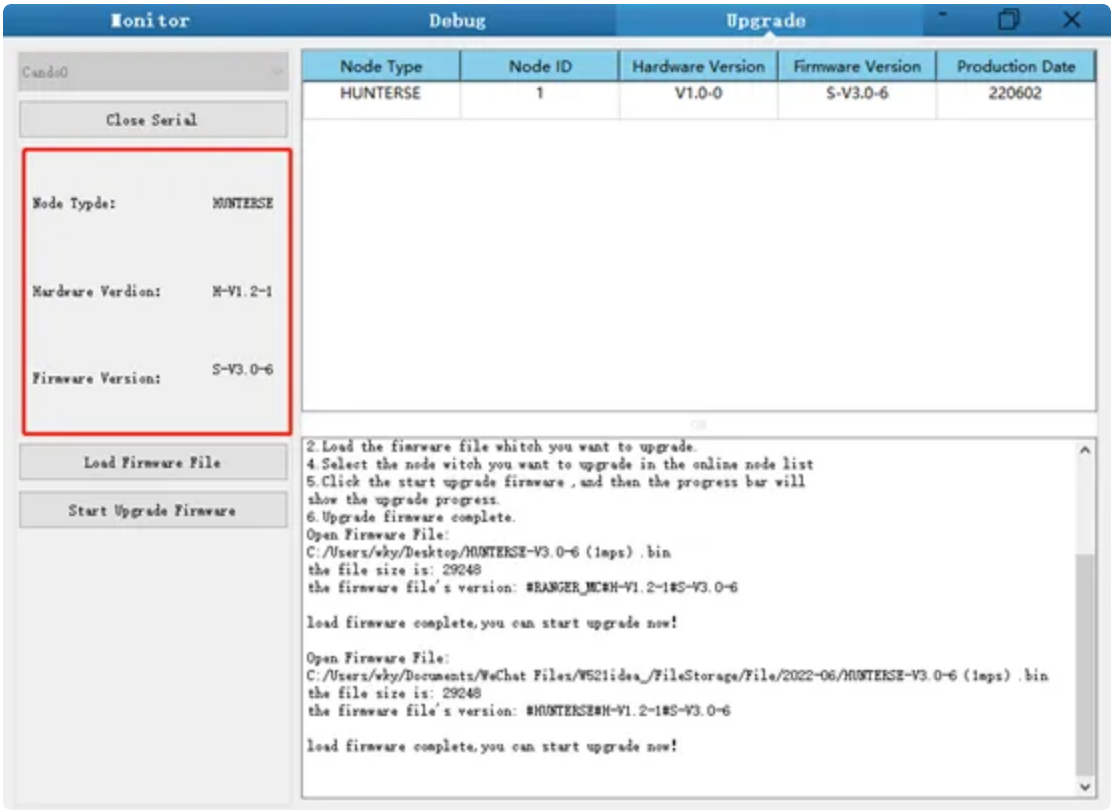
**Upgrade Process**

1.Plug in the USBTOCAN module on the computer, and then open the AgxCandoUpgradeToolV1.3_boxed.exe software (the sequence cannot be wrong, first open the software and then plug in the module, the device will not be recognized).

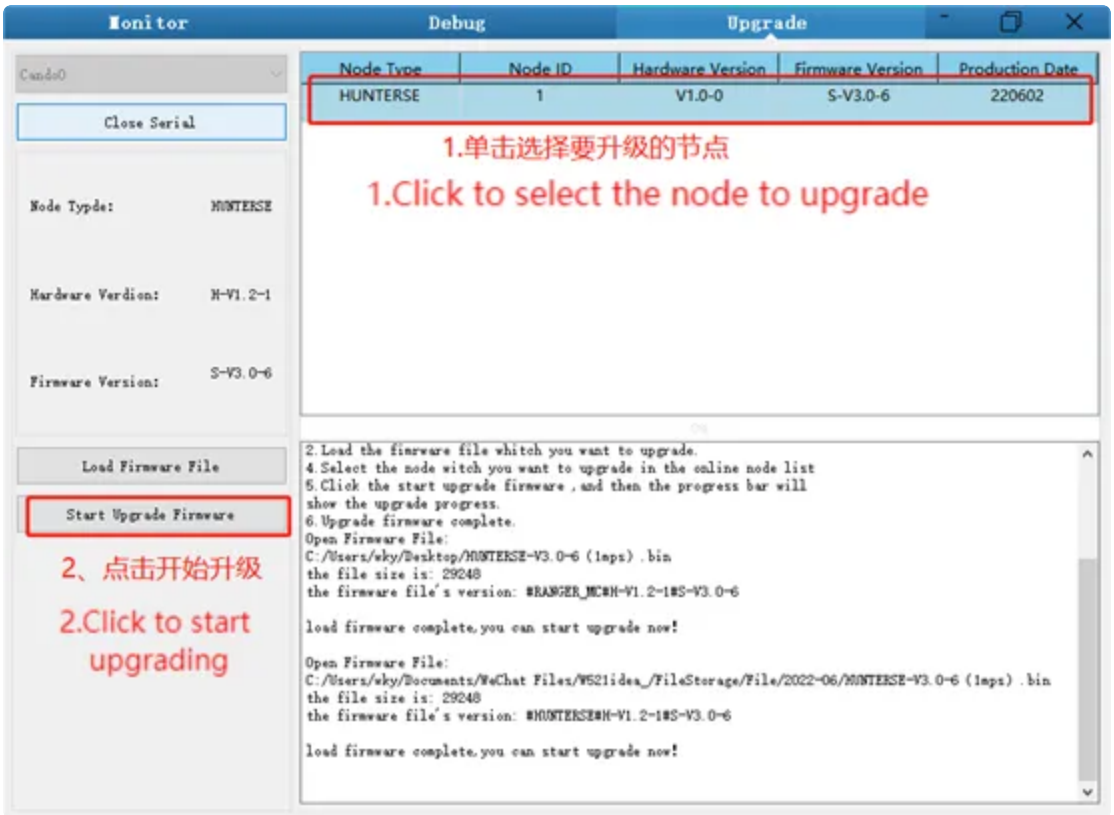
2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

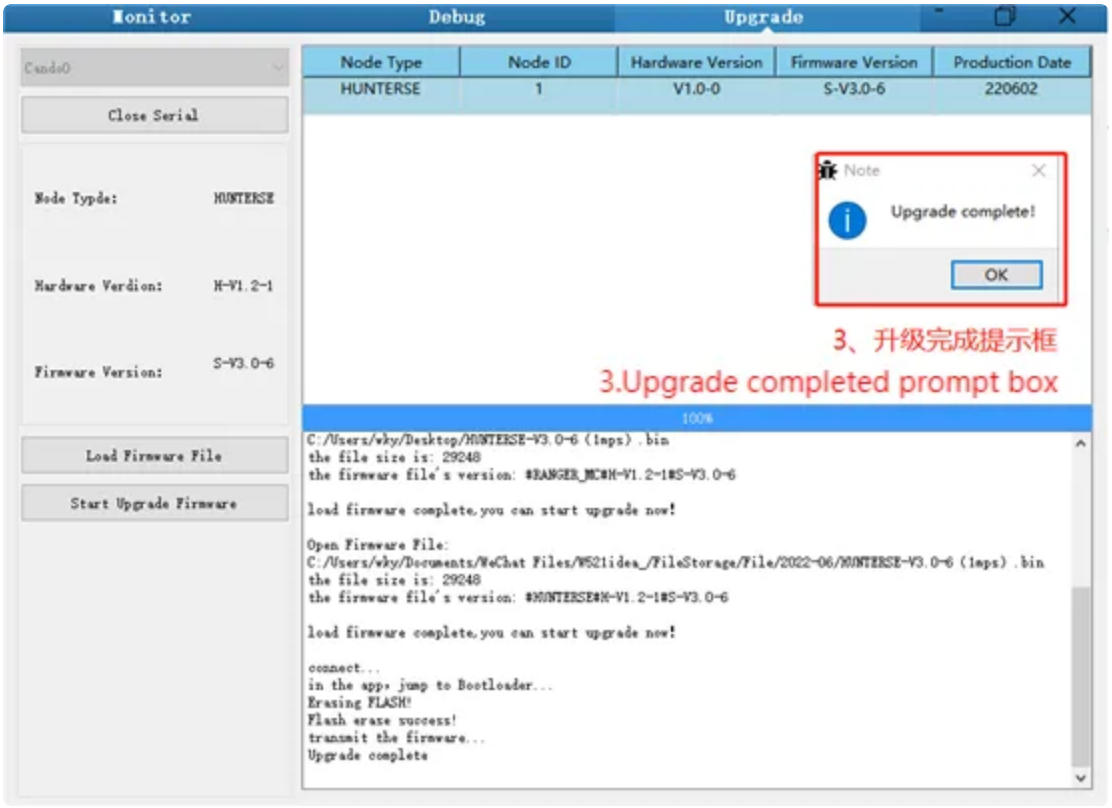



3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure




4.Click the node to be upgraded in the node list box, and then click Start Upgrade Firmware to start upgrading the firmware. After the upgrade is successful, a pop-up box will prompt.






## 3.5 BUNKER ROS Package Use Example

ROS provide some standard operating system services, such as hardware abstraction, low-level device control, implementation of common function, interprocess message and data packet management. ROS is based on a graph architecture, so that process of different nodes can receive, and aggregate various information (such as sensing, control, status, planning, etc.) Currently ROS mainly support UBUNTU.

**Preparation**

**Hardware preparation**

CANlight can communication module ×1

Thinkpad E470 notebook ×1

AGILEX BUNKER PRO 2 mobile robot chassis ×1

AGILEX BUNKER PRO 2remote control FS-i6s ×1

AGILEX BUNKER PRO 2 top aviation power socket ×1

**Use example environment description**

Ubuntu 18.04

ROS melodic

Git

**Hardware connection and preparation**

Lead out the CAN wire of the BUNKER PRO 2 top aviation plug or the tail plug, and connect CAN_H and CAN_L in the CAN wire to the CAN_TO_USB adapter respectively;

Turn on the knob switch on the BUNKER PRO 2mobile robot chassis, and check whether the emergency stop switches on both sides are released;

Connect the CAN_TO_USB to the usb point of the notebook. The connection diagram is shown in Figure 3.4.

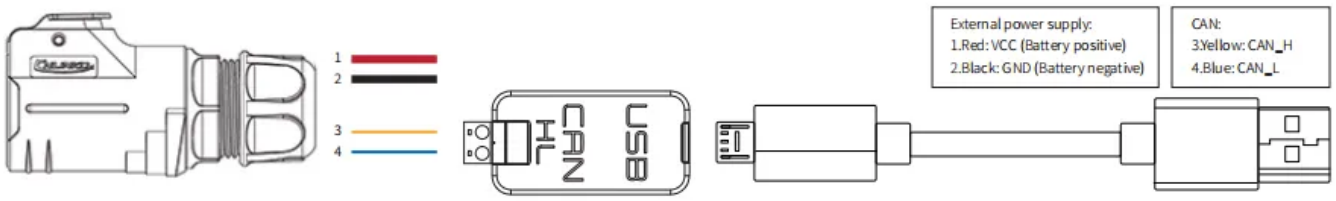



Figure 3.4 CAN connection diagram

**ROS installation and environment setting**

For installation details, please refer to

http://wiki.ros.org/kinetic/Installation/Ubuntu

**Test CANABLE hardware and CAN communication**

Setting CAN-TO-USB adaptor

Enable gs_usb kernel module

```
sudo modprobe gs_usb
```

Setting 500k Baud rate and enable can-to-usb adaptor

```
sudo ip link set can0 up type can bitrate 500000
```

If no error occurred in the previous steps, you should be able to use the command to view the can device immediately

```
ifconfig -a
```

Install and use can-utils to test hardware

```
sudo apt install can-utils
```

If the can-to-usb has been connected to the BUNKER PRO 2robot this time, and the car has been turned on, use the following commands to monitor the data from the BUNKER PRO 2 chassis

candump can0

Please refer to:

[1]https://github.com/agilexrobotics/agx_sdk

[2]https://wi-ki.rdu.im/_pages/Notes/Embedded-System/Linux/-can-bus-in-linux.html

AGILEX BUNKER ROS PACKAGE download and compile

Download ROS dependency packages

$ sudo apt install -y ros-$ROS_DISTRO-teleop-twist-keyboard

Clone and build the bunker_ros source code

mkdir -p ~/catkin_ws/src

cd ~/catkin_ws/src

git clone  https://github.com/agilexrobotics/ugv_sdk.git

git clone https://github.com/agilexrobotics/bunker_ros.git

cd ..

catkin_make

source devel/setup.bash

Please refer to: https://github.com/agilexrobotics/bunker_ros

Start the ROS node

Start the based node

roslaunch bunker_bringup bunker_robot_base.launch

roslaunch bunker_bringup bunker_teleop_keyboard.launch

Start the keyboard remote operation node

roslaunch bunker_bringup bunker_teleop_keyboard.launch

*_base:: The core node for the chassis to send and receive hierarchical CAN messages. Based on the communication mechanism of ros, it can control the movement of the chassis and read the status of the BUNKER PRO 2 through the topic.

*_msgs: Define the specific message format of the chassis status feedback topic.

*_bringup: startup files for chassis nodes and keyboard control nodes, and scripts to enable the usb_to_can module

# 4.Q&A

**Q: BUNKER PRO 2.0 starts up normally, but the robot does not move when using the remote controller?**

**A:**

First, verify whether the power switch has been released (Q2 on the rear electrical panel). Then, check if the mode selection switch (top–left of the remote controller) is set to the correct control mode.

**Q: Remote control works normally and the chassis feedback (status and motion data) is received correctly, but the vehicle does not respond to CAN control commands or mode switch instructions?**

**A:**

If the remote controller works correctly and chassis feedback is received properly, this indicates the motion control and CAN communication are functioning. Please verify whether the control mode has been successfully switched to CAN mode before sending control commands.

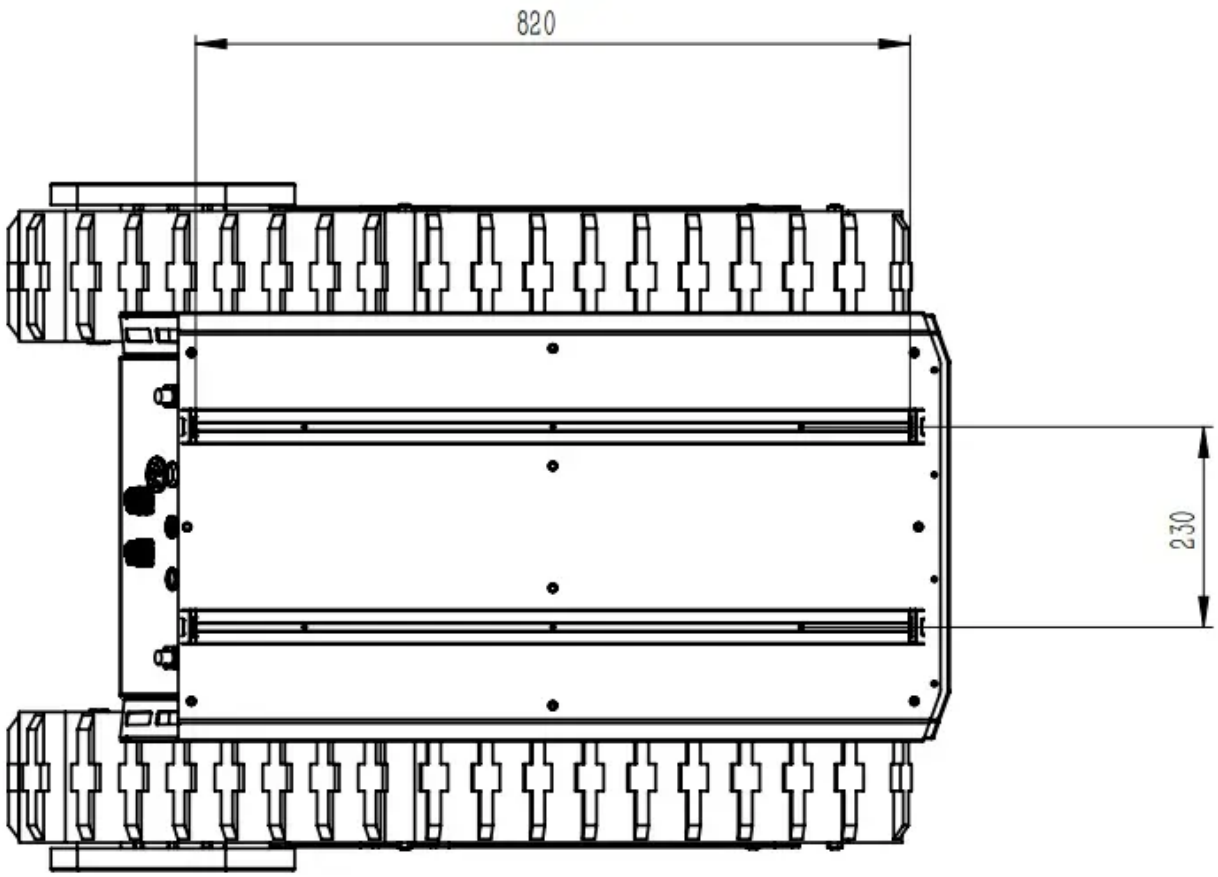
**Q: When using CAN bus communication, the chassis feedback is normal, but the robot does not respond to the control commands?**

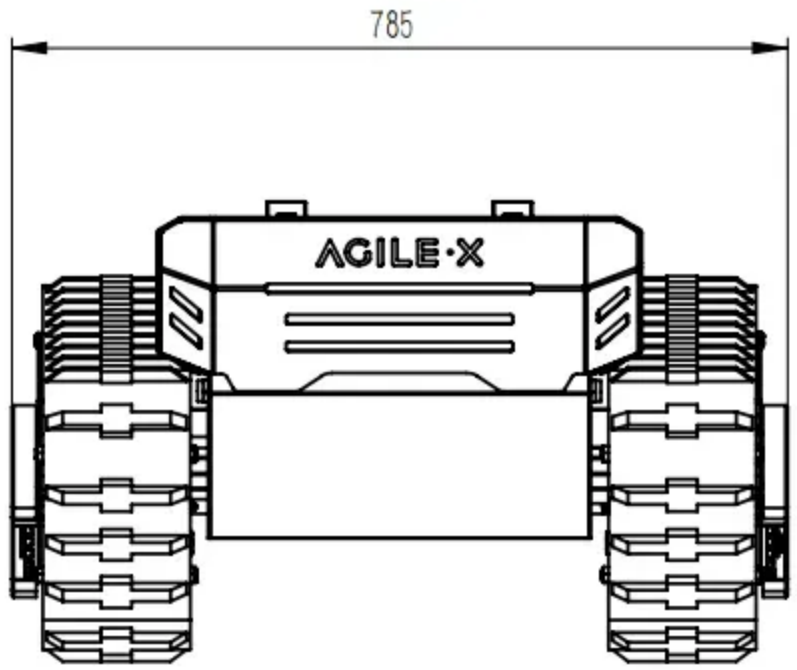
**A:**

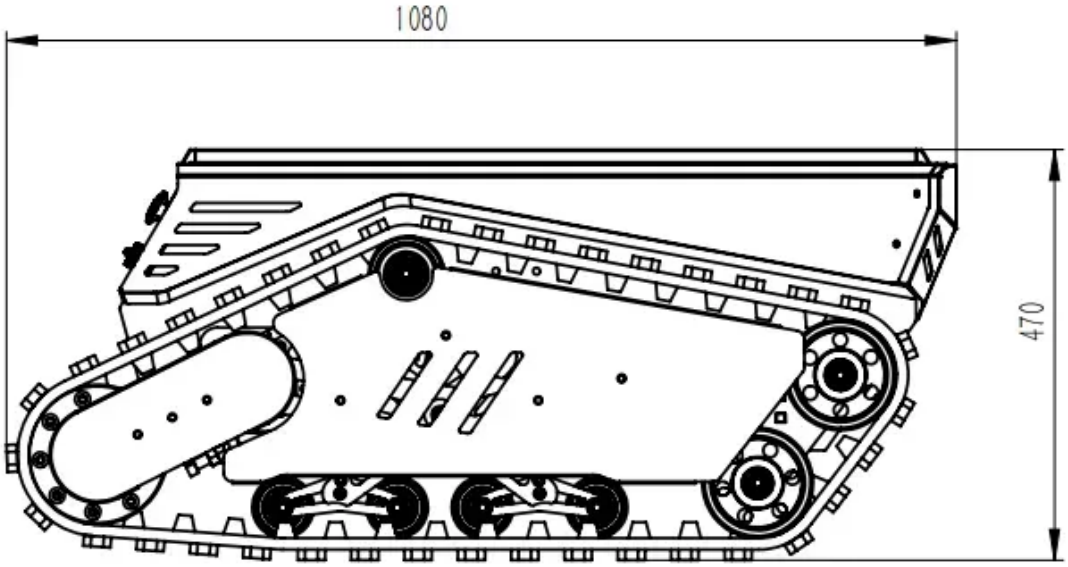
BUNKER PRO 2.0 has a built–in communication protection mechanism. If the chassis receives a CAN control frame and does not receive a subsequent control frame within **500 ms**, it will enter a **communication protection state**, and the robot will stop (speed = 0). Therefore, control commands from the upper computer **must be sent cyclically**.

# 5. Product Dimensions

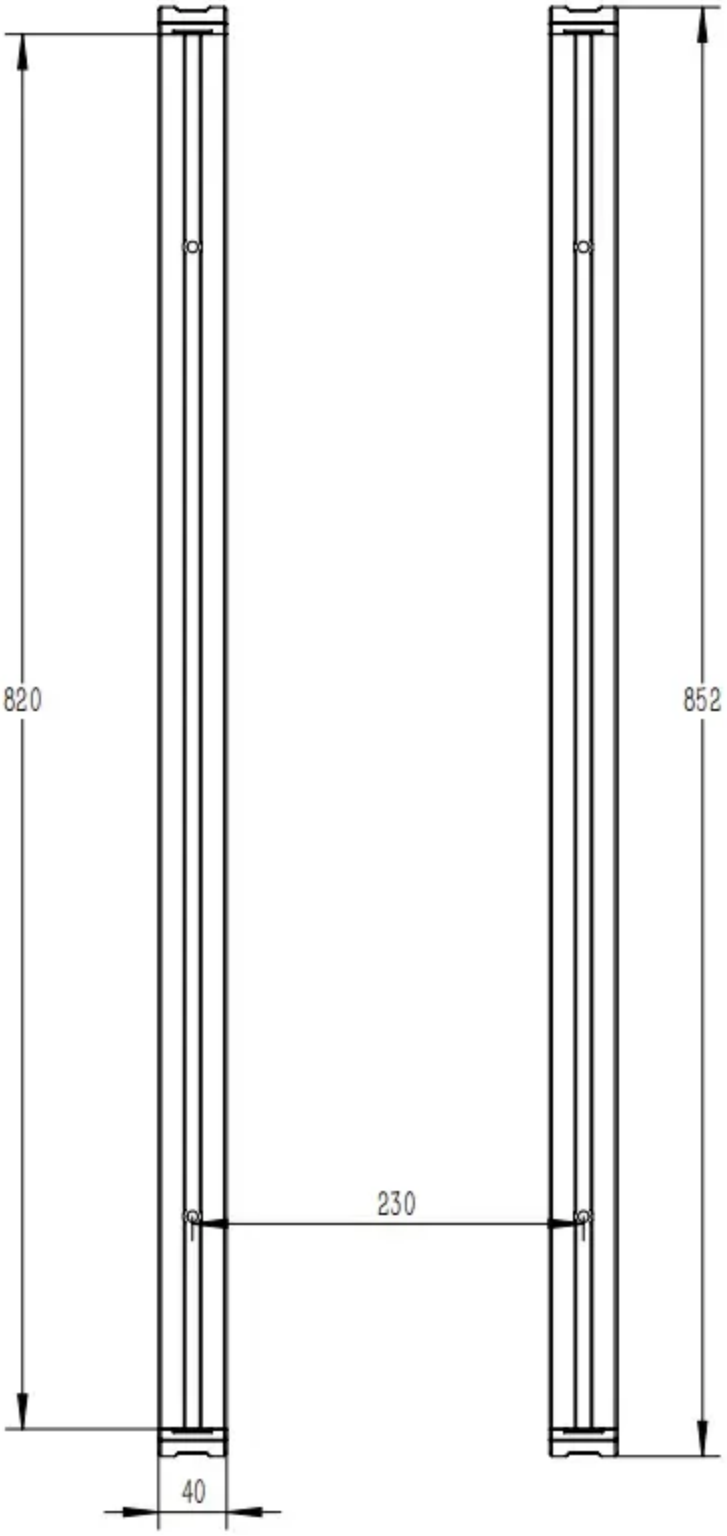
## 5.1 External Dimension Diagram


820
230


785
AGILE·X




## 5.2 Top Expansion Bracket Dimensions Diagram


820
852
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40