BUNKER PRO2 USER MANUAL

BUNKER RRO 2.0 User Manual

Safety Information

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BUNKER RRO 2.0 User Manual



BUNKER PRO 2.0

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 °C** 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 °C to 45 °C. 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.

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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) 3.5 h (Unloaded on concrete)
	Maximum distance (km)	15KM (full loaded) 20KM (Unloaded)
	Charging time (h)	2.5
	Working temperature (℃)	-20~60℃
	Braking Distance (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 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**

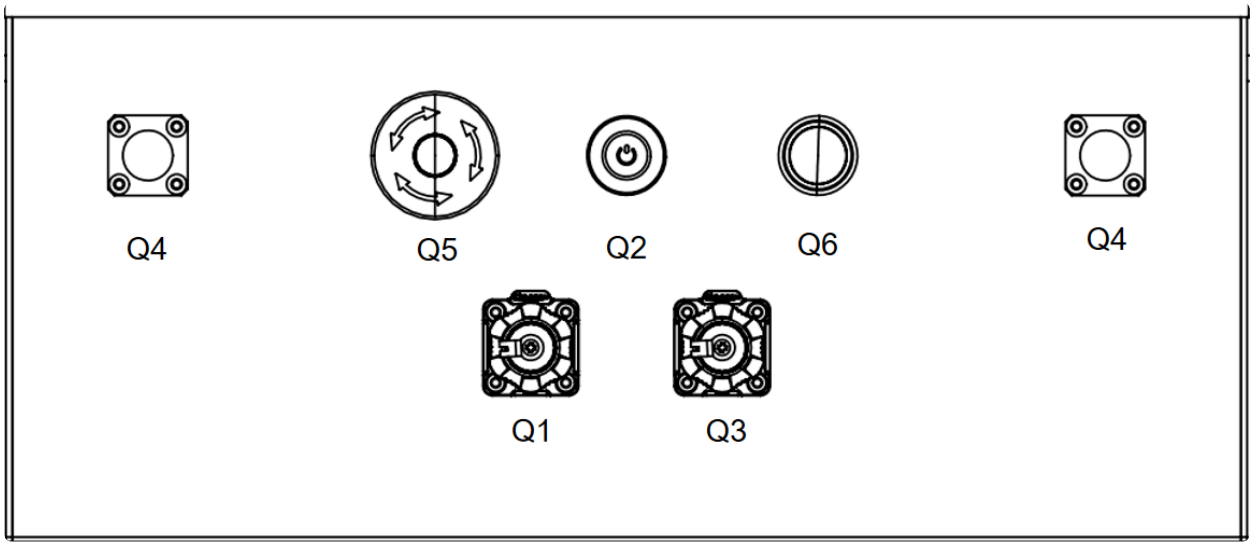
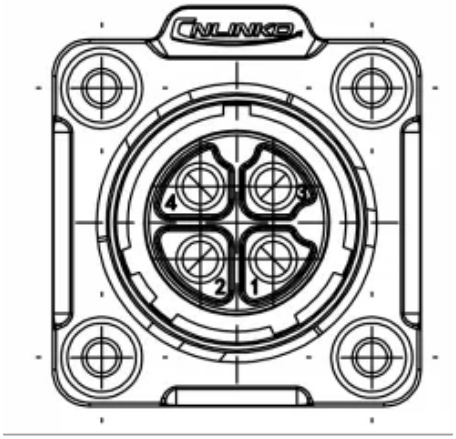


Figure 2.1

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, voltage range 60-80V, maximum current 20A
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.

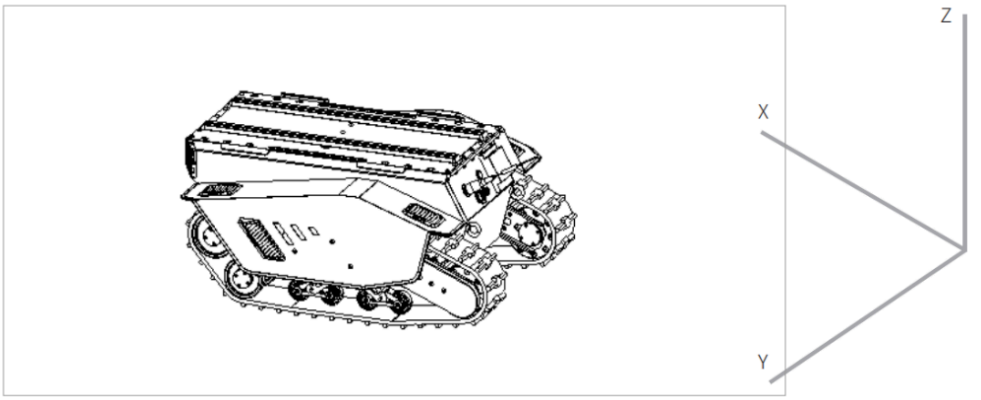


Figure 2.4 Schematic Diagram of ReferenceCoordinate System for Vehicle Body

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**.

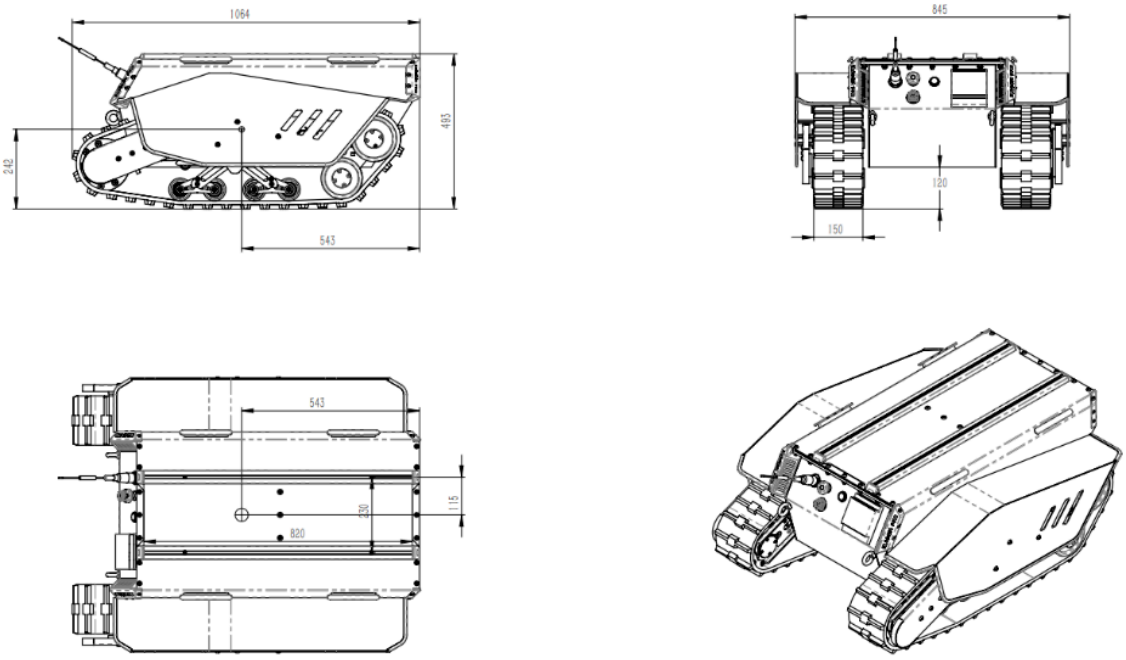


Figure3.1 Chassis Center of Gravity Diagram

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 0x01 Emergency stop 0x02 System Error	
byte [1]	Mode control	unsigned int8	0x00 Stand by 0x01 CAN command control 0x03 Remote control	
byte [2] byte [3]	Battery voltage upper 8 bits 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 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] byte [1]	Moving speed upper 8 bits Moving speed lower 8 bits	signed int16	Actual speed X 1000 (with an accuracy of 0.001m/s)
byte [2] byte [3]	Rotation speed upper 8 bits Rotation speed lower 8 bits	signed int16	Actual speed X 100 (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 0x01 CAN Command mode 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] byte [1]	Linear velocity upper 8 byte Linear velocitylower 8 byte	Signed int16	Linear moving speed mm/s(unit) Range[-1300,1300]	
byte [2] byte [3]	Linear speed percentage Angular speed percentage	Signed int16	Rotation angular speed 0.001rad/s(unit) Range [-2000,2000]	
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 0x01 Clear motor1 failures 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] byte [1]	Motor rotational speed upper 8bits Motor rotational speed lower 8bits	signed int16	**Current Motor Speed** (unit: RPM)	

byte [2] byte [3]	Motor rotational speed upper 8bits Motor rotational speed lower 8bits	signed int16	**Current Motor Current** (unit: 0.1 A)
byte [4] byte [5] byte [6] byte [7]	Most Significant Byte Second Most Significant Byte Second Least Significant Byte 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] byte [1] byte [2] byte [3]	Left wheel odometer highest bit Left wheel odometer second highest bit Left wheel odometer second lowest bit Left wheel odometer lowest bit	Signed int 32	Left wheel odometer feedback (Unit: mm)
byte [4] byte [5] byte [6] byte [7]	Right wheel odometer highest bit Right wheel odometer second highest bit Right wheel odometer second lowest bit Right wheel odometer lowest bit	Signed int 32	Right wheel odometer feedback (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 bit[2-3]: SWB : 2-Up 1-Middle 3-Down bit[4-5]: SWC : 2-Up 1-Middle 3-Down 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] byte [3]	Battery Voltage	Unsigned Int16	Unit: 0.01 V (High byte first)	
byte [4] byte [5]	Battery Current	Unsigned Int16	Unit: 0.1 A (High byte first)	
byte [6] 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 BIT2: Undervoltage BIT3: Overtemperature BIT4: Undertemperature BIT7: Discharge Overcurrent	
byte [1]	Alarm Status 2	unsigned int8	**BIT0**: Charge Overcurrent	
byte [2]	Warning Status 1	unsigned int8	BIT1: Overvoltage BIT2: Undervoltage BIT3: Overtemperature BIT4: Undertemperature 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 20A.



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

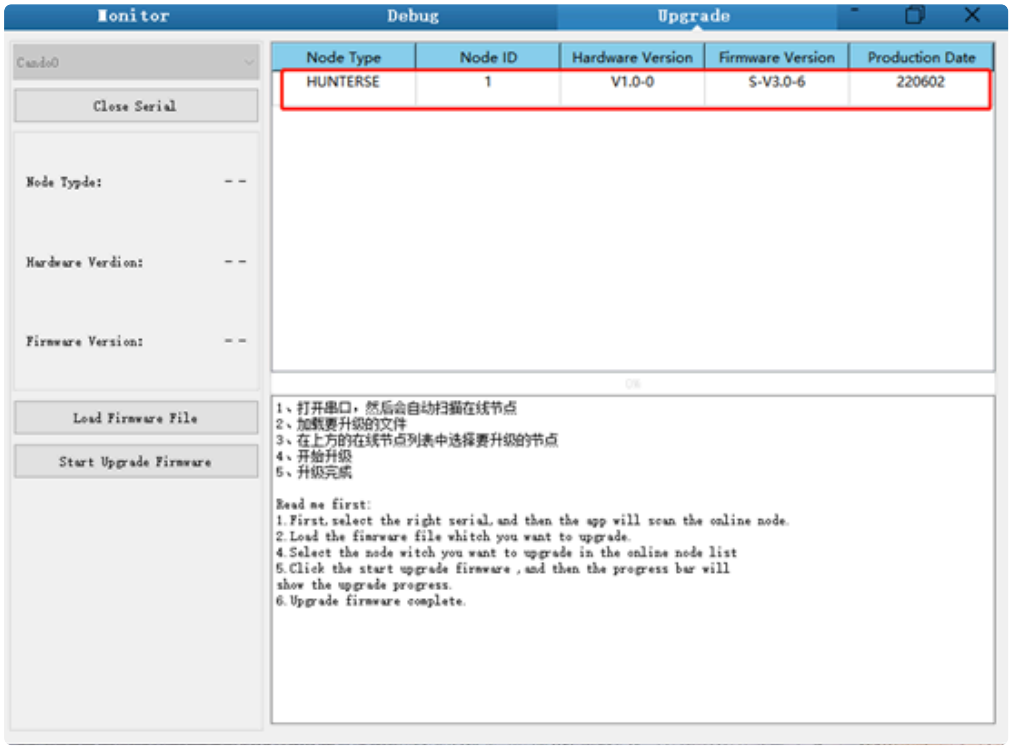
BUNKER PRO 2 chassis X 1

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

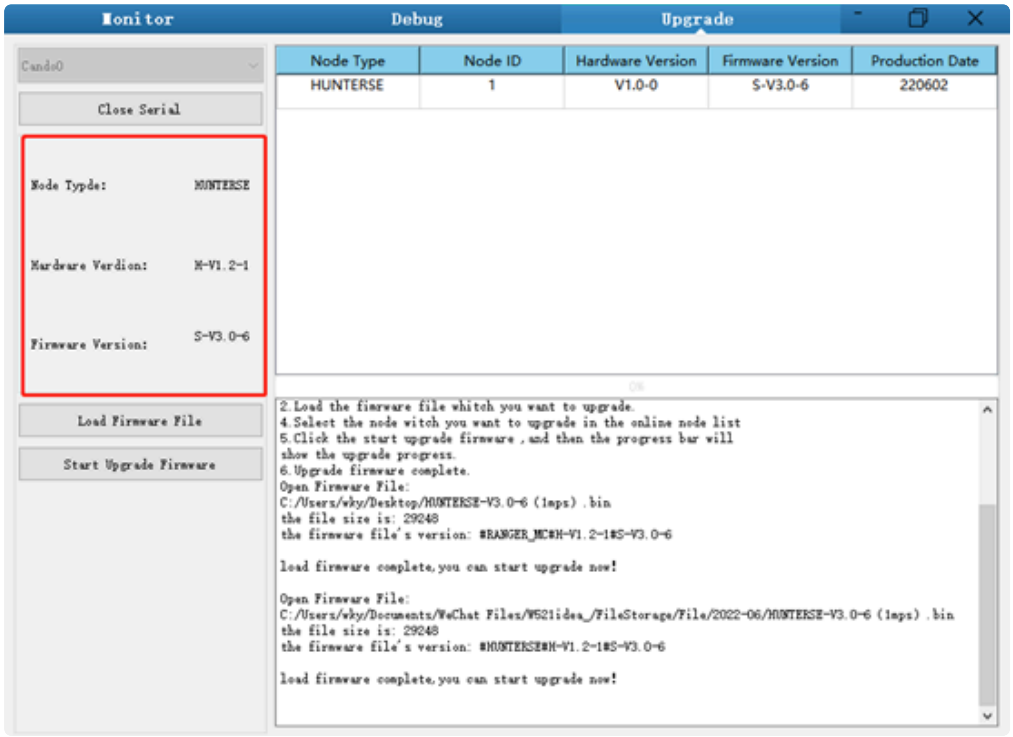
Upgrade Process

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).

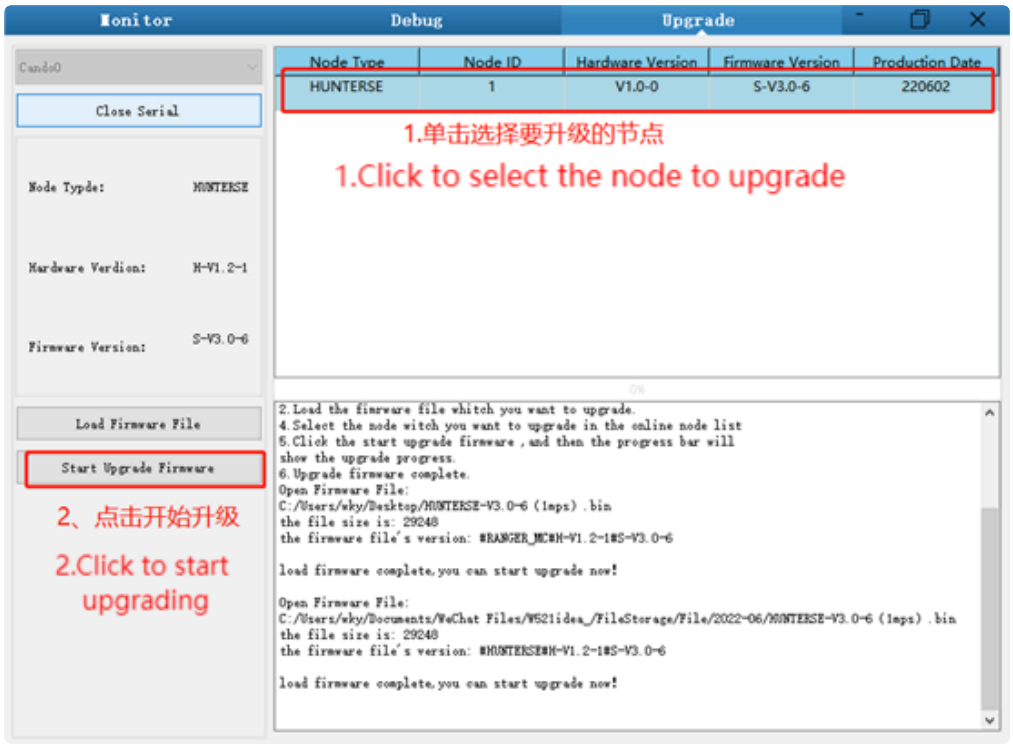
2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

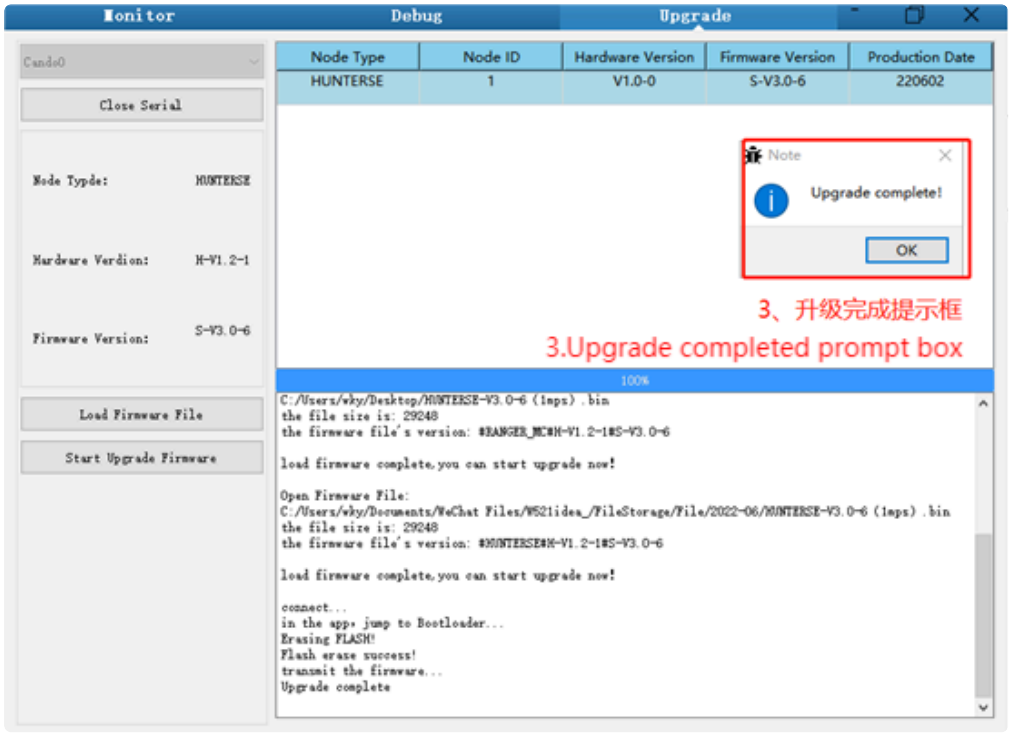


3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure



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.

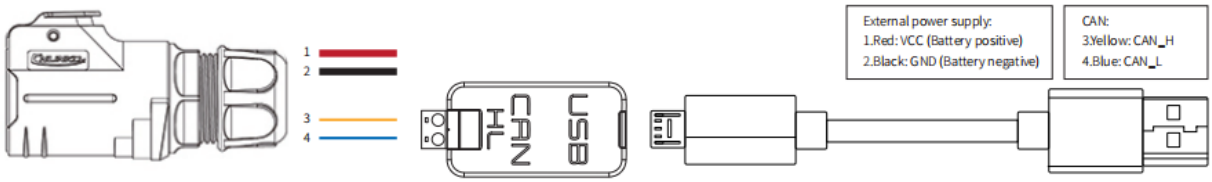


Figure 3.4 CAN connection diagram

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.

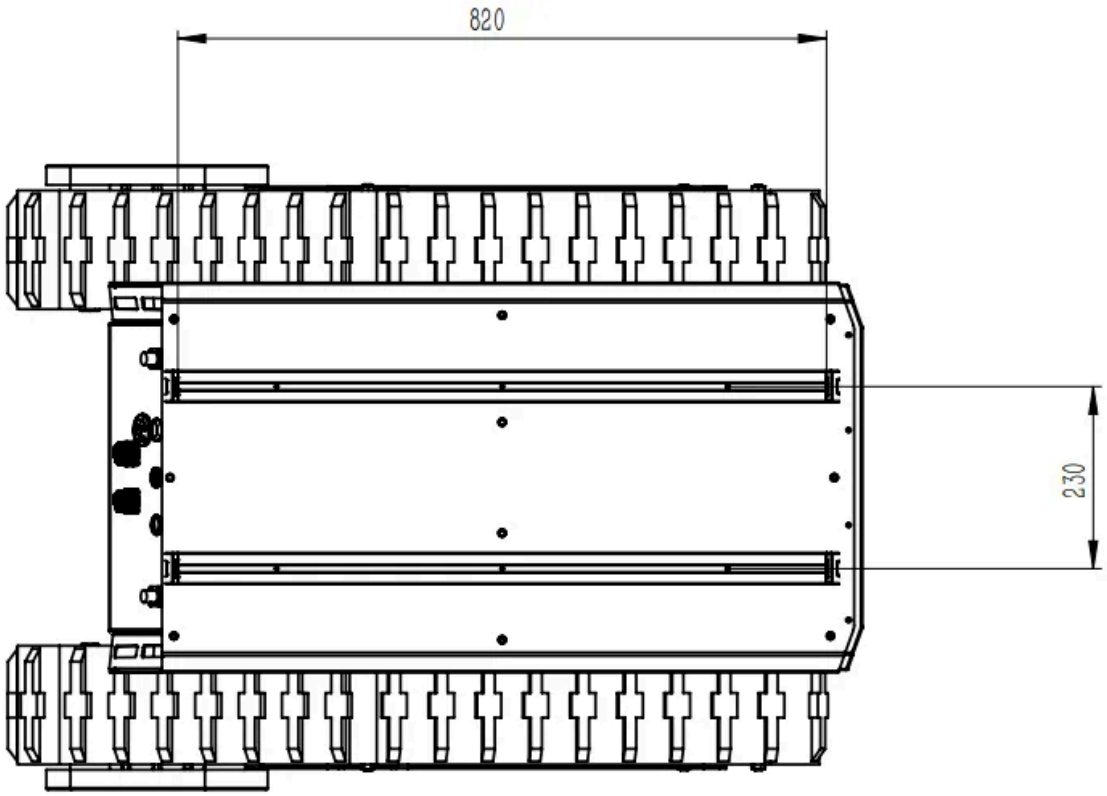
Q: When using CAN bus communication, the chassis feedback is normal, but the robot does not respond to the control commands?

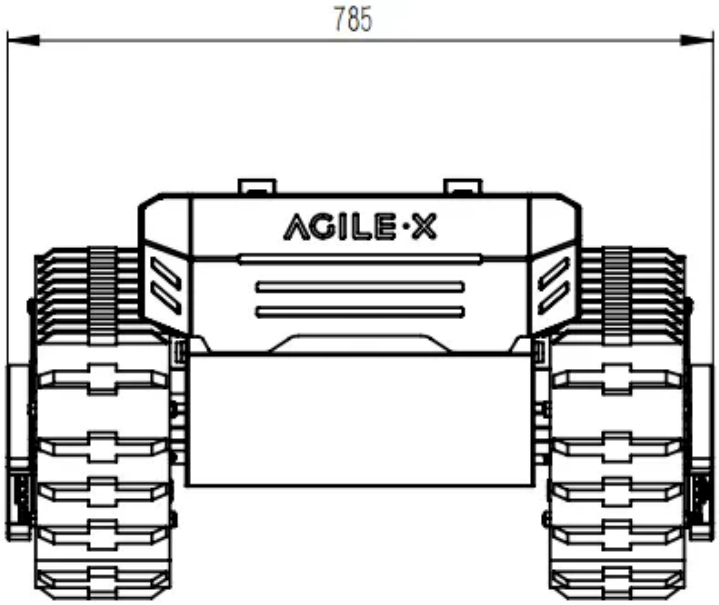
A:

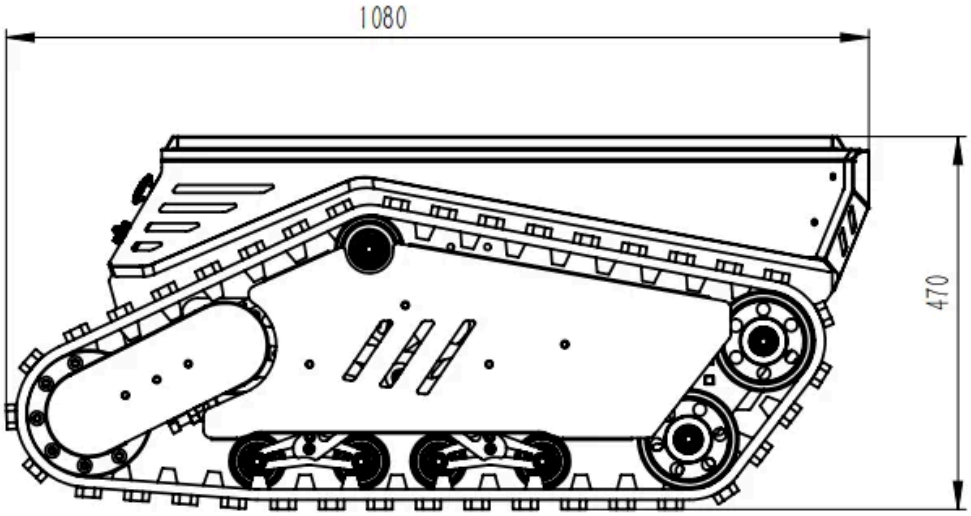
BUNKER PRO 2.0 has a built-in communication protection mechanism. If the chassis receives a CAN control frame and does not receive a subsequent control frame within **500 ms**, it will enter a **communication protection state**, and the robot will stop (speed = 0). Therefore, control commands from the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

5. Product Dimensions

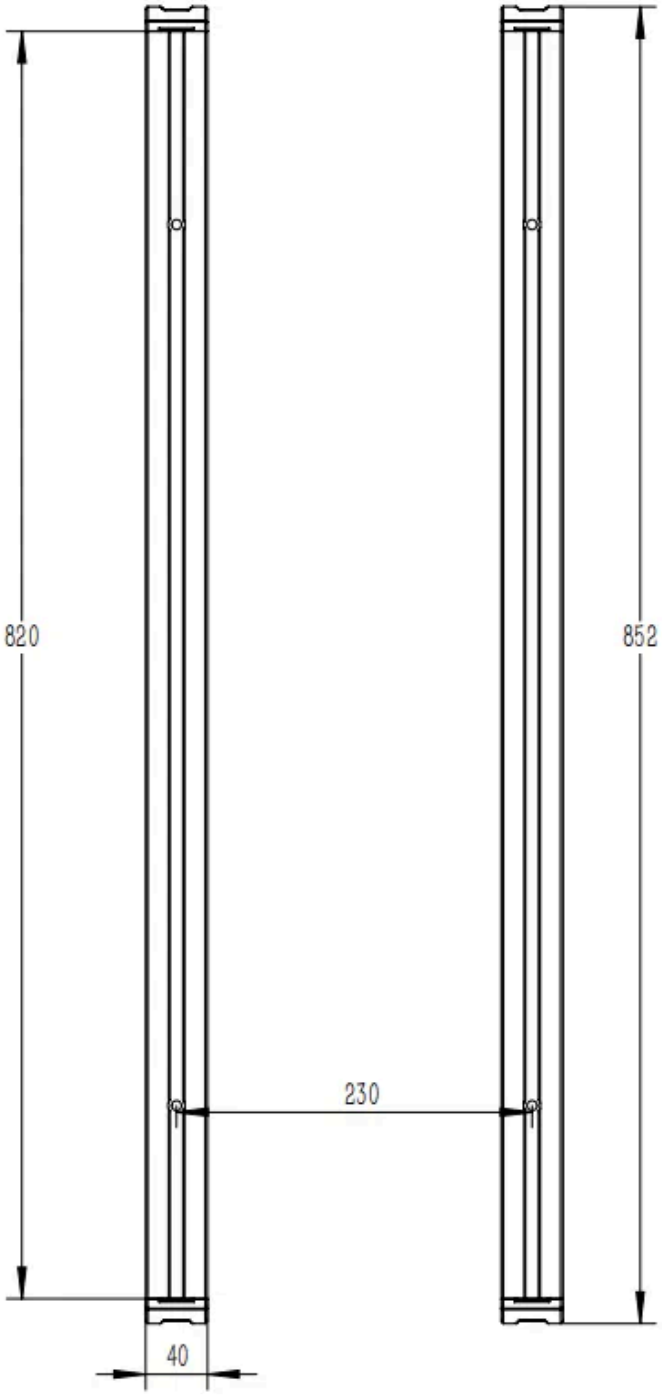
5.1 External Dimension Diagram


820
230


785
AGILE·X



5.2 Top Expansion Bracket Dimensions Diagram


820
852
230
40