BUNKER MINI 2.0 User Manual

BUNKER MINI

AgileX Robotics Team

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Document version

No.	Version	Date	Edited by	Reviewer	Notes
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2	V2.0.0	2023/3/21	何士玉		1. Modify the ros driver readme 2. Change bunkermini three views 3. Added remote control information feedback 4. Added mileage information feedback 5. Added bms information feedback 6. Optimize page layout
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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 BUNKERMINI'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 0℃~40℃.

- 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.

Operation

- Make sure the surrounding area is relatively clear during operation
- Remote control within sight range
- The maximum load capacity of BUNKERMINI is 25KG. When using it, make sure the payload does not exceed 25KG.
- When installing external extensions on BUNKERMINI, confirm the position of the center of mass of the extension to ensure it is at the center of rotation
- When the device alarms for low battery, please charge it in time.
- 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
- The tail extension power supply current does not exceed 10A, and the total power does not exceed 240W.

Battery precautions

- The battery of BUNKER MINI products is not fully charged when it leaves the factory. The specific battery voltage and power can be displayed through the voltage display meter at the rear of the BUNKER MINI chassis or through the vol and batt on the remote control.
- Please do not charge the battery after it is used up. Please charge it in time when the BUNKER MINI remote control battery is lower than 15% or the tail voltage display is lower than 25V.
- Static storage conditions: The optimal storage temperature is -10°C~40°C. When the battery is not in use, it must be charged and discharged once every month, and then stored at full voltage. Do not store the battery Place in fire, or heat the battery. Do not store batteries at high temperatures.

- Charging: You must use the matching dedicated lithium battery charger for charging. Do not charge the battery below 0°C. Do not use non-original standard batteries, power supplies, and chargers.

Precautions for use environment

- The working temperature of BUNKER MINI is -10°C~40°C. Please do not use it in environments with temperatures below -10°C or above 40°C.
- Do not use it in an environment with corrosive or flammable gases or near flammable substances.
- Please do not use it near heating elements such as heaters or large coil resistors.
- BUNKER MINI is IP67 waterproof and dustproof. Please do not use it soaked in water for a long time. Check and remove rust regularly.
- It is recommended that the operating environment altitude does not exceed 1000M
- It is recommended that the temperature difference between day and night in the use environment does not exceed 25°C
- Regularly inspect and maintain track tensioners

Safety Precautions

- If you have any questions about the use process, please follow the relevant instruction manual or consult relevant technical personnel.
- Before using the equipment, pay attention to the on-site conditions to avoid improper operation that may cause personal safety problems.
- In case of emergency, press the emergency stop button to power off the equipment.
- Please do not modify the internal device structure without technical support and permission.
- When something goes wrong with the equipment, please stop using it immediately to avoid secondary damage.
- When an abnormality occurs in the equipment, please contact the relevant technical personnel and do not handle it without authorization.

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1 Introduction of BUNKER MINI 2.0

BUNKER MINI 2.0is an all-round tracked chassis vehicle for industrial applications. It is featured with simple and sensitive operation, large development space, adaptability to development and application in various fields, IP67 dustproof and waterproof, and great gradeability, etc. It can be used for the development of special robots such as inspection and exploration, EOD rescue, special shooting, and special transport, and is a solution to robot movement.

1.1 Product List

Name	Quantity
BUNKER MINI 2.0robot body	x1
Battery charger (AC 220V)	x1
Aviation plug male（4Pin）	x1
FS remote control (optional)	x1
USB to CAN communication module	x1

1.2 Performance parameters

Parameter Types	Items	Values
Mechanical specifications	L × W × H (mm)	690 x 570 x 335

	Wheelbase (mm)	-
	Front/rear wheel base (mm)	-
	Chassis height	80
	Track width	100
	Curb weight (kg)	56
	Battery Type	Lithium battery
	Battery parameters	30AH
	Power drive motor	2×250W DC brush motor
	Steering drive motor	-
	Parking mode	-
	Steering	Track type differential steering
	Suspension form	-
	Steering motor reduction ratio	-
	Steering motor encoder	-
	Drive motor reduction ratio	19.7：1
	Drive motor sensor	Magnetic braiding 1024
Performance parameters	IP Grade	IP22
	Maximum speed (km/h)	1.0
	Minimum turning radius (mm)	Can turn in place
	Maximum gradeability (°)	30°

	Maximum obstacle crossing	120mm
	Ground clearance (mm)	410
	Maximum battery life (h)	8
	Maximum distance (km)	14KM
	Charging time (h)	3
	Working temperature (°C)	-10~40°C
Control	Control mode	Remote control Control Command control mode
	RC transmitter	2.4G/extreme distance 200M
	System interface	CAN

1.3 Required for development

BUNKER MINI 2.0is equipped with FS remote control from the factory, through which users can control the chassis of the BUNKER MINI 2.0mobile robot to complete the movement and rotation operations. Besides, BUNKER MINI 2.0 is equipped with a CAN interface, through which users can conduct secondary development.

2 The Basics

This part will give a basic introduction to the BUNKER MINI 2.0 mobile robot chassis, so that users and developers can have a basic understanding of BUNKER MINI 2.0chassis.

2.1 Electrical interface description

The rear electrical interface is shown in Figure 2.1, in which Q1 is the emergency stop switch, Q2 is the power switch, Q3 is the power display interaction, Q4 is the charging interface, and Q5 is the CAN and 24V power aviation interface.

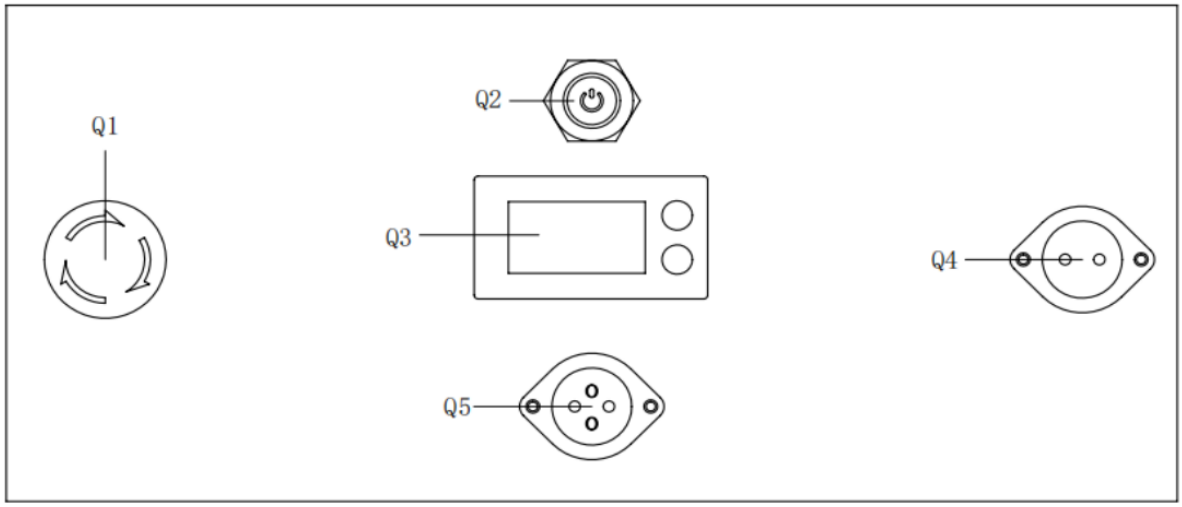


Figure2.1 Rear electrical interface

The definition of the communication and power interface of Q5 is shown in Figure 2-2.

Pin No.	Pin Type	Function and Definition	Remarks
1	Power	VCC	Positive power supply, voltage range 24~29V, maximum current 10A
2	Power	GND	Negative power supply
3	CAN	CAN_H	CAN bus high

4	CAN	CAN_L	CAN bus low

Figure 2.2 Pin definition diagram of the rear aviation extension interface

2.2 Remote control instructions

The Fuss remote control is an optional accessory for BUNKER MINI products. Customers can choose according to actual needs. Using the remote control can easily control the BUNKER MINI universal robot chassis. In this product, we use the design of the left-hand accelerator. Its definition and functions can be referred to Figure 2.3. The functions of the buttons are defined as follows: SWA and SWD are temporarily not enabled. SWB is the control mode selection button. Push it to the top for command control mode. Push it to the middle for remote control mode. SWC is the car light mode button. Push it to the top. It is the normal-on mode of the car lights. Dial it to the middle to turn the lights on when the car is moving. Dial it to the bottom to switch the lights to the normally-off mode. S1 is the throttle button, which controls BUNKER MINI to move forward and backward; S2 controls rotation, and POWER is the power button. Press and hold at the same time to turn it on.

Please note: SWA, SWB, SWC, and SWD all need to be at the top when the remote control is turned on.

Figure 2.3 Schematic diagram of FS remote control buttons

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 Control command and motion description

We establish the coordinate reference frame of the ground mobile vehicle according to the ISO 8855 standard as shown in Figure 2.4.

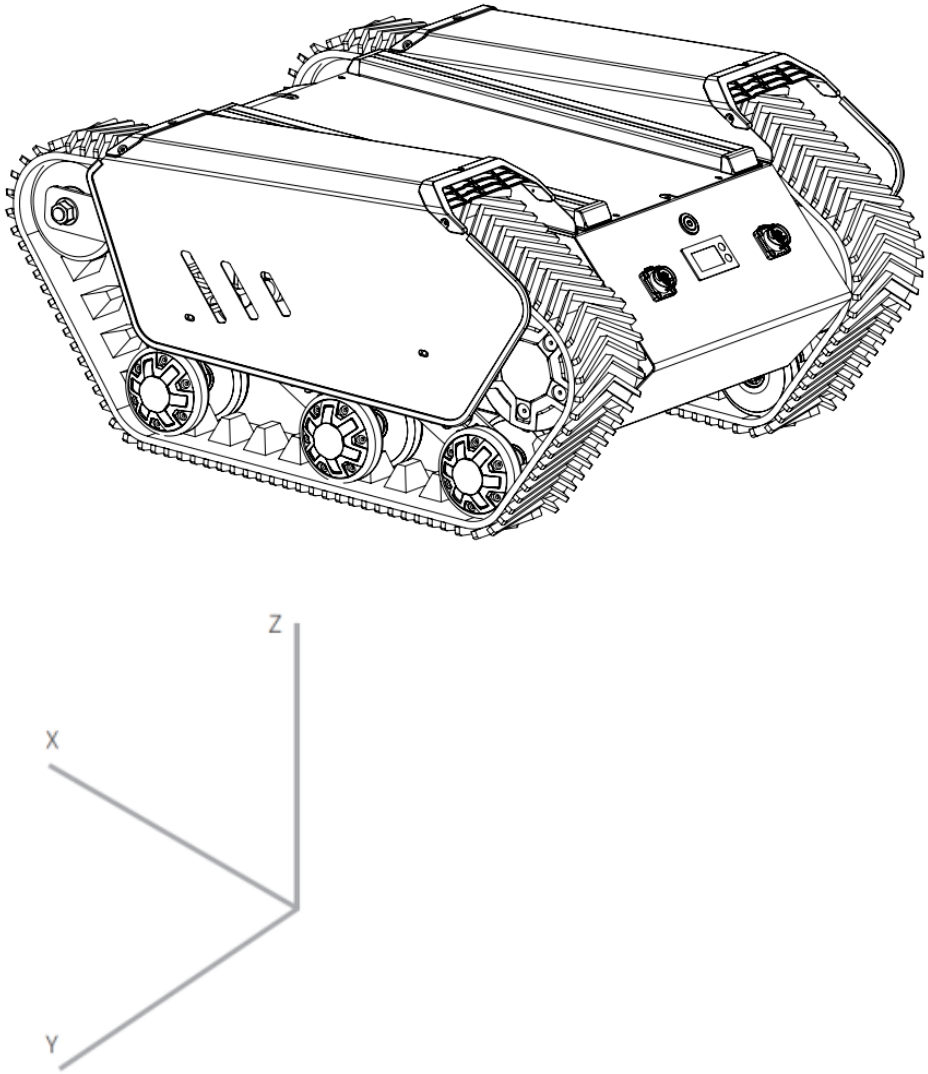


Figure 2.4 Schematic diagram of the vehicle body reference frame

As shown in 2.4, the BUNKER MINI 2.0 body is parallel to the X-axis of the established reference frame.

In the remote control mode, the remote control joystick S1 moves in the positive direction of X when pushed forward, and moves in the negative direction of X when pushed backward. When S1 is pushed to the maximum value, the movement speed in the positive direction of X is the largest, and when pushed to the minimum value, the movement speed in the negative direction of the X direction is the largest. The remote control joystick S2 controls the rotation of the vehicle body left and right. When S2 is pushed to the left, the vehicle body rotates from the positive direction of the X axis to the positive direction of the Y axis. When S2 is pushed to the right, the vehicle body rotates from the positive direction of the X axis to the negative direction of the Y axis. When S2 is pushed to the left to the maximum value, the linear velocity of counterclockwise rotation is the largest, and when it is pushed to the right to the maximum value, the linear velocity of the clockwise rotation is the largest.

In the control command mode, the positive value of the linear velocity means moving in the positive direction of the X-axis, and the negative value of the linear velocity means moving in the negative direction of the X-axis. The positive value of the angular velocity means that the vehicle body moves from the positive direction of the X-axis to the positive direction of the Y-axis, and the negative value of the angular velocity means that the vehicle body moves from the positive direction of the X axis to the negative direction of the Y axis.

3 Getting Started

This part mainly introduces the basic operation and use of the BUNKER MINI 2.0 platform, and introduces how to carry out the secondary development of the vehicle body through the external CAN port and the CAN bus protocol.

3.1 Use and operation

Check

- Check the vehicle body condition. Check whether there is any obvious abnormality in the vehicle body; if so, please contact after-sales support;
- Check the emergency stop switch status. Confirm that the Q1 emergency stop button at the rear is in a released state;
- When using for the first time, confirm whether Q2 (power switch) in the rear electrical panel is pressed; if so, please press and release it, and it will be in a released state

Start up

- Press the power switch (Q2 in the electrical panel), under normal circumstances, the light of the power switch will be on, and the voltmeter will display the battery voltage normally;
- Check the battery voltage. If the voltage is greater than 24V, it indicates that the battery voltage is normal. If it is less than 24V, the battery is low, please charge it;

Power off

- Press the power switch to cut off the power;

Emergency stop

- Press the emergency stop switch at the rear of the BUNKER MINI 2.0 body;

Basic operation process of remote control

- After the BUNKER MINI 2.0 robot chassis is started normally, turn on the remote control and select the control mode as the remote control mode, so that the motion of BUNKER MINI 2.0 platform can be controlled by the remote control.

3.2 Charging

BUNKER MINI 2.0 products are equipped with a standard charger by default, which can meet the charging needs of customers.

The specific operation process of charging is as follows:

- Make sure that the BUNKER MINI 2.0 chassis is in a power-off state.
- Before charging, please confirm that Q2 (power switch) in the rear electrical console is turned off；
- Insert the plug of the charger into the Q4 charging interface in the rear electrical control panel；
- Connect the charger to the power supply and turn on the charger switch to enter the charging state.
- When charging by default, there is no indicator light on the chassis. Whether it is charging or not

- depends on the status indication of the charger.

3.3 Development

3.3.1 CAN Cable Connection

BUNKER MINI is shipped with the vehicle and provides a male aviation plug as shown in Figure 3.1. The definition of the wires is yellow as CANH, blue as CANL, red as power positive, and black as negative.

Note: In the current BUNKER MINI 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 3.1 Schematic diagram of aviation plug

3.3.2 CAN protocol description

BUNKER MINI products provide a CAN interface for user development, through which users can command and control the car body. The CAN communication standard in BUNKER MINI products adopts the CAN2.0B standard, the communication baud rate is 500K, and the message format adopts MOTOROLA format. The moving linear speed and rotation angular speed of the chassis can be controlled through the external CAN bus interface; BUNKER MINI will feedback the current motion status information and the status information of the BUNKER MINI chassis in real time. The protocol includes system status feedback frames, motion control feedback frames, and control frames. The protocol content is as follows:

The system status feedback command includes current car body status feedback, control mode status feedback, battery voltage feedback and fault feedback. The protocol content is shown in Table 3.1:

Table 3.1 BUNKER MINI 2.0 Chassis State Feedback Frame

Command name	System state feedback command			
Sending node	Receiving Node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x211	200ms	None
Data length	0x08			
Location	Function	Data Type	Description	
byte [0]	Current vehicle body state	unsigned int8	0x00 System normal 0x01 Emergency shut-down mode 0x02 System exception	
byte [1]	Mode control	unsigned int8	0x00 Standby mode 0x01 CAN command control mode 0x03 Remote control mode	
byte [2]	The upper eight bits of battery voltage	unsigned int16	Actual voltage X10 (accurate to 0.1V)	
byte [3]	The lower eight bits of battery voltage			
byte [4]	Reserved	-	0x00	
byte [5]	Fault information	unsigned int8	For details, see [Fault Information Description]	
byte [6]	Reserved	-	0x00	
byte [7]	Count check(count)	unsigned int8	0~255 loop count, count up once every time a command is sent	

Table 3.2 Explanation table of fault information

Fault information description		
Byte	Bit	Meaning
byte [5]	bit [0]	Battery undervoltage fault
	bit [1]	Battery undervoltage warning
	bit [2]	Remote control disconnection protection（0: normal, 1: remote control disconnection）
	bit [3]	Reserved, default 0
	bit [4]	Drive 2 communication fault (0: no fault, 1: fault)
	bit [5]	Drive 3 communication fault (0: no fault, 1: fault)
	bit [6]	Reserved, default 0
	bit [7]	Reserved, default 0

The motion control feedback frame command includes the feedback of current vehicle body's motion linear velocity and motion angular velocity. The specific content of the protocol is shown in Table 3.3.

Table 3.3 Motion Control Feedback Frame

Command name	Motion control feedback command			
Sending Node	Receiving Node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x221	20ms	None

Data length	0x08		
Location	Function	Data Type	Description
byte [0] byte [1]	The upper eight bits of the movement speed The lower eight bits of the movement speed	signed int16	Actual speed X 1000 (accurate to 0.001m/s)
byte [2] byte [3]	The upper eight bits of the rotation speed The lower eight bits of the rotation speed	signed int16	Actual speed X 100 (accurate to 0.01rad/s)
byte [4]	Reserved	-	0x00
byte [5]	Reserved	-	0x00
byte [6]	Reserved	-	0x00
byte [7]	Reserved	-	0x00

The control frame includes the linear velocity control opening, the angular velocity control opening and the checksum. The specific protocol content is shown in Table 3.4.

Table 3.4 Motion Control Command Control Frame

Command name	Control command			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Decision control unit	Chassis node	0x111	20ms	500ms

Data length	0x08		
Position	Function	Data Type	
byte [0]	The upper eight bits of the linear velocity	signed int16	Travel speed of the vehicle body, unit mm/s, value range [-1300,1300]
byte [1]	The lower eight bits of the linear velocity		
byte [2]	The upper eight bits of the angular velocity	signed int16	Rotational angular velocity of the vehicle body, unit 0.001rad/s, value range [-2000, 2000]
byte [3]	The lower eight bits of the angular velocity		
byte [4]	Reserved	—	0x00
byte [5]	Reserved	—	0x00
byte [6]	Reserved	—	0x00
byte [7]	Reserved	—	0x00

The mode setting frame is used to set the control interface of the terminal, and its specific protocol content is shown in Table 3.5

Table 3.5 Control Mode Setting Frame

Command name	Control mode setting command			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)

Decision control unit	Chassis node	0x421	None	None
Data length	0x01			
Position	Function	Data type	Description	
byte [0]	CAN control enabling	unsigned int8	0x00 Standby mode 0x01 CAN command mode It enters standby mode by default after power-on	

Note[1] Control mode description

When the remote control for BUNKER MINI 2.0 is not turned on, the default control mode is the standby mode, and you need to switch to the command mode to send the motion control command. If the remote control is turned on, it has the highest authority and can block the control of commands. When the remote control switches to the command mode, it still needs to send the control mode setting command before responding to the speed command.

The state setting frame is used to clear system errors, and its specific protocol content is shown in Table 3.6.

Table 3.6 State setting frame

Command name	State setting command			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Decision control unit	Chassis node	0x441	None	None
Data length	0x01			
Position	Function	Data type	Description	
byte [0]	Error clearance command	unsigned int8	0x00 Clear all non-critical faults 0x01 Clear motor 1 error 0x02 Clear motor 2 error	

Note 3: Example data, the following data is for testing use only

1. The vehicle moves forward at a speed of 0.15/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 vehicle rotates at 0.2RAD/S

byte [0]	byte [1]	byte [2]	byte [3]	byte [4]	byte [5]	byte [6]	byte [7]
0x00	0x00	0x00	0xc8	0x00	0x00	0x00	0x00

In addition to the feedback of the chassis state information, the chassis feedback information also includes motor data and sensor data.

Table 3.7 Feedback of motor speed current position information

Command name	Motor driver high-speed information feedback frame			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x251~0x254	20ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	The upper eight bits of motor speed	signed int16	Current Motor speed unit RPM	
byte [1]	The lower eight bits of motor speed			

byte [2]	The upper eight bits of motor current	signed int16	Current motor current unit 0.1A
byte [3]	The lower eight bits of motor current		
byte [4]	The current position of the motor is the highest	signed int16	The current position of the motor Unit: number of pulses
byte [5]	The current position of the motor is the second highest	signed int16	
byte [6]	The current position of the motor is the second lowest	signed int16	
byte [7]	The current position of the motor is the lowest	signed int16	

Table 3.8 Feedback of motor temperature, voltage and state information

Command name	Motor driver low-speed information feedback frame			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x261~0x264	20ms	None

Data length	0x08		
Position	Function	Data type	Description
byte [0]	The upper eight bits of driver voltage	signed int16	Current driver voltage unit0.1v
byte [1]	The lower eight bits of driver voltage		
byte [2]	The upper eight bits of driver temperature	signed int16	unit 1°C
byte [3]	The lower eight bits of driver temperature		
byte [4]	Motor temperature	signed int8	unit1°C
byte [5]	Driver state	unsigned int8	See Table 3-9 for details
byte [6]	Reserved	-	0x00
byte [7]	Reserved		0x00

Table 3.9 Actuator sate

Fault information description		
byte [5]	bit [0]	Whether the power supply voltage is too low (0: normal 1: too low)
	bit [1]	Whether the motor is over-temperature (0: normal 1: over-temperature)
	bit [2]	Whether the driver is over-current (0: normal 1: over-current)

	bit [3]	Whether the driver is over-temperature (0: normal 1: over-temperature)
	bit [4]	Sensor state (0: normal 1: abnormal)
	bit [5]	Driver error state (0: normal 1: abnormal)
	bit [6]	Driver enabling state (0: Enabling 1: Disabling)
	bit [7]	Reserved

Table 3.10 Odometer Feedback Frame

Command name	Odometer information feedback frame			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x311	20ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	The highest bit of the left wheel odometer	signed int32	The odometer feedback of the left wheel of the chassis Unit：mm	
byte [1]	The second highest bit of the left wheel odometer			
byte [2]	The second lowest bit of the left wheel odometer			

byte [3]	The lowest bit of the left wheel odometer		
byte [4]	The highest bit of the right wheel odometer	signed int32	The odometer feedback of the right wheel of the chassis Unit：mm
byte [5]	The second highest bit of the right wheel odometer		
byte [6]	The second lowest bit of the right wheel odometer		
byte [7]	The lowest bit of the right wheel odometer		

Table 3.11 Remote control information feedback

Command name	Remote control information feedback frame			
Sending node	Receiving node	ID	Cycle（ms）	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x241	20ms	None
Data length	0x08			
Position	Function	Data type	Description	

byte [0]	Remote control SW feedback	unsigned int8	bit[0-1]: SWA ： 2-up 3-down bit[2-3]: SWB：2-up 1-mid 3-down bit[4-5]: SWC：2-up 1-mid 3-down bit[6-7]: SWD：2-up 3-down
byte [1]	Right joystick left and right	signed int8	Value range：[-100,100]
byte [2]	Right joystick up and down	signed int8	Value range：[-100,100]
byte [3]	Left joystick up and down	signed int8	Value range：[-100,100]
byte [4]	Left joystick left and right	signed int8	Value range：[-100,100]
byte [5]	Left knob VRA	signed int8	Value range：[-100,100]
byte [6]	Reserved	--	0x00
byte [7]	Count check	unsigned int8	0-255 loop count

Table 3.12 Battery BMS data feedback

Command	The feedback data of BMS			
Node for sending	Node for receiving	ID	Period （ms）	Receive timeout (ms)
Drive-by-wire chassis	Decision-making and control unit	0x361	500ms	None
Data length	0x08			
Byte	Meaning	Data type	Note	

byte [0]	Battery SOC (State of Charge)	unsigned int8	Range 0~100
byte [1]	Battery SOH (State of Health)	unsigned int8	Range 0~100
byte [2] byte [3]	High order byte of battery voltage Low order byte of battery voltage	unsigned int16	Unit: 0.01 V
byte [4] byte [5]	High order byte of battery current Low order byte of battery current	signed int16	Unit: 0.1 A
byte [6] byte [7]	High order byte of battery temperature Low order byte of battery temperature	signed int16	Unit: 0.1 °C

Table 3.13 Battery BMS data feedback

Command	The feedback data of BMS			
Node for sending	Node for receiving	ID	Period （ms）	Receive timeout (ms)
Drive-by-wire chassis	Decision-making and control unit	0x362	500ms	None

Data length	0x04		
Byte	Meaning	Data type	Note
byte [0]	Alarm Status 1	unsigned int8	BIT1: Overvoltage; BIT2: Undervoltage; BIT3: High temperature; BIT4: Low temperature; BIT7: Discharge overcurrent
byte [1]	Alarm Status 2	unsigned int8	BIT0: Charging overcurrent
byte [2]	Warning Status 1	unsigned int8	BIT1: Overvoltage; BIT2: Undervoltage; BIT3: High temperature; BIT4: Low temperature; BIT7: Discharge overcurrent
byte [3]	Warning Status 2	unsigned int8	BIT0: Charging overcurrent

3.3.3 BUNKER MINI 2.0 ROS Package Usage Example

ROS provides some standard operating system services, such as hardware abstraction, low-level device control, implementation of common functions, inter-process messaging, and data packet management. ROS is based on a graphical architecture, so that processes of different nodes can receive, publish, and aggregate various information (such as sensing, control, state, planning, etc.). Currently ROS mainly supports UBUNTU.

Development preparation

Hardware preparation

- CANlight can communication module X1
- Thinkpad E470 Laptop X1
- AGILEX BUNKER MINI 2.0 mobile robot chassis X1

- AGILEX BUNKER MINI 2.0 supporting remote control FS-i6s X1
- AGILEXBUNKER MINI 2.0 top aviation receptacle X1

Environment description of usage example

- Ubuntu 18.04
- ROS
- Git

Hardware connection and preparation

- Pull out the CAN line of the BUNKER MINI 2.0 4-core aviation or rear plug, and connect the CAN_H and CAN_L in the CAN line to the CAN_TO_USB adapter respectively;
- Turn on the chassis knob switch of the BUNKER MINI 2.0 mobile robot, and check whether the emergency stop switches on both sides are released;
- Connect CAN_TO_USB to the USB port of the laptop. The connection diagram is shown in Figure 3.4.

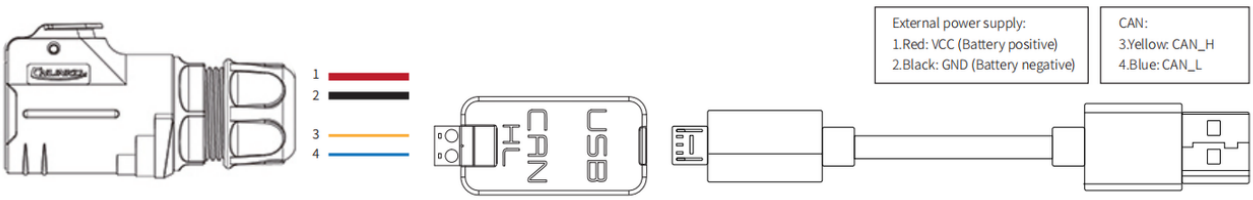


Figure 3.4 CAN line connection diagram

ROS Installation and Environment Setup

- For installation details, please refer to http://wiki.ros.org/kinetic/Installa-tion/Ubuntu

Test CANABLE hardware and CAN communication

Set the CAN-TO-USB adapter

- Enable the gs_usb kernel module

```
sudo modprobe gs_usb
```

- Set baud rate to 500k and enable the CAN-TO-USB adapter

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

- If there is no error in the previous steps, you can check the CAN devices with the command below

```
ifconfifig -a
```

- Install and use can-utils to test hardware

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

- If the CAN-TO-USB adapter has been connected to the TITAN and the TITAN has been powered on, the command below can be used to monitor the data from the TITAN.

```
candump can0
```

- Please refer to:

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

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

AGILEX BUNKER ROS PACKAGE Download and compile

- Download ros dependencies

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

- Clone and compile 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
```

- Reference： https://github.com/agilexrobotics/bunker_ros

Start the ROS node

- Start the base node

```
roslaunch bunker_bringup bunker_robot_base.launch
```

- Run the keyboard_control node

```
roslaunch bunker_bringup bunker_teleop_keyboard.launch
```

Github ROS development package directory and usage instructions

*_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 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 Use and operation

In order to facilitate users to upgrade the firmware version of BUNKER MINI 2.0 and bring to customers more perfect experience, BUNKER MINI 2.0 provides the hardware interface for firmware upgrade and the corresponding client software.

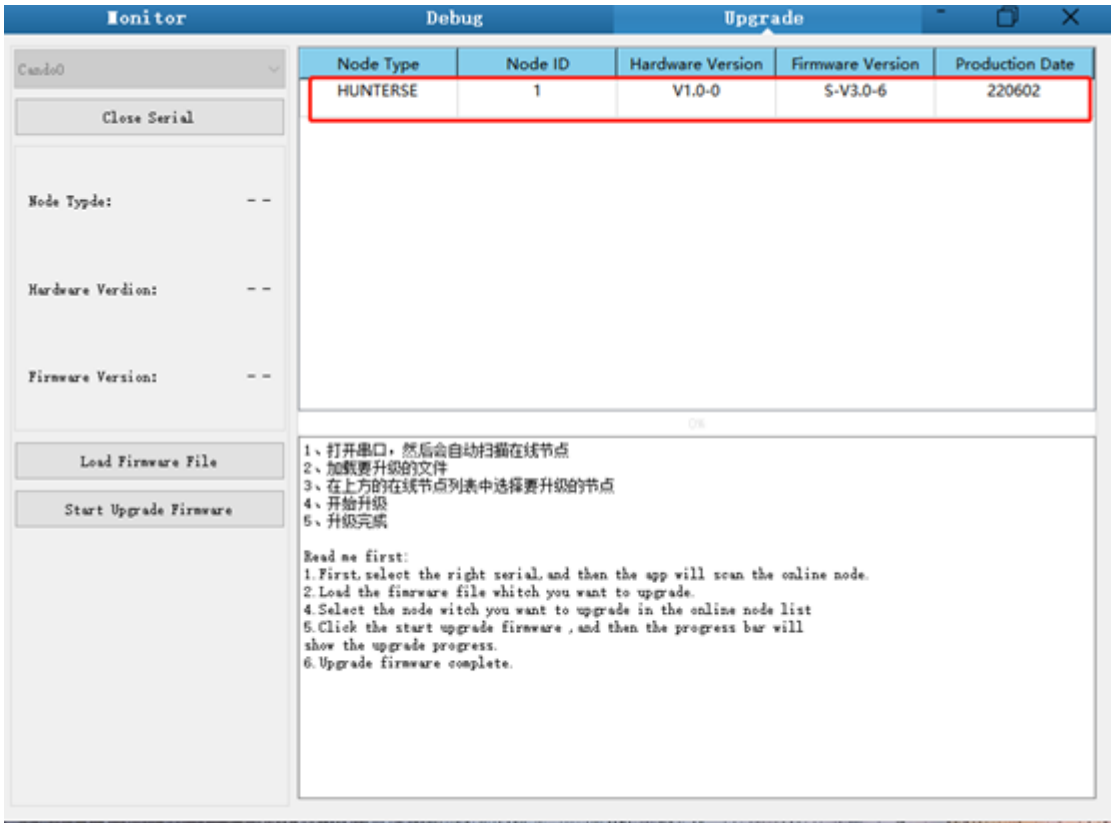
Upgrade Preparation

- Agilex CAN debugging module X 1
- Micro USB cable X 1
- BUNKER MINI chassis X 1
- A computer (WINDOWS OS (Operating System)) X 1

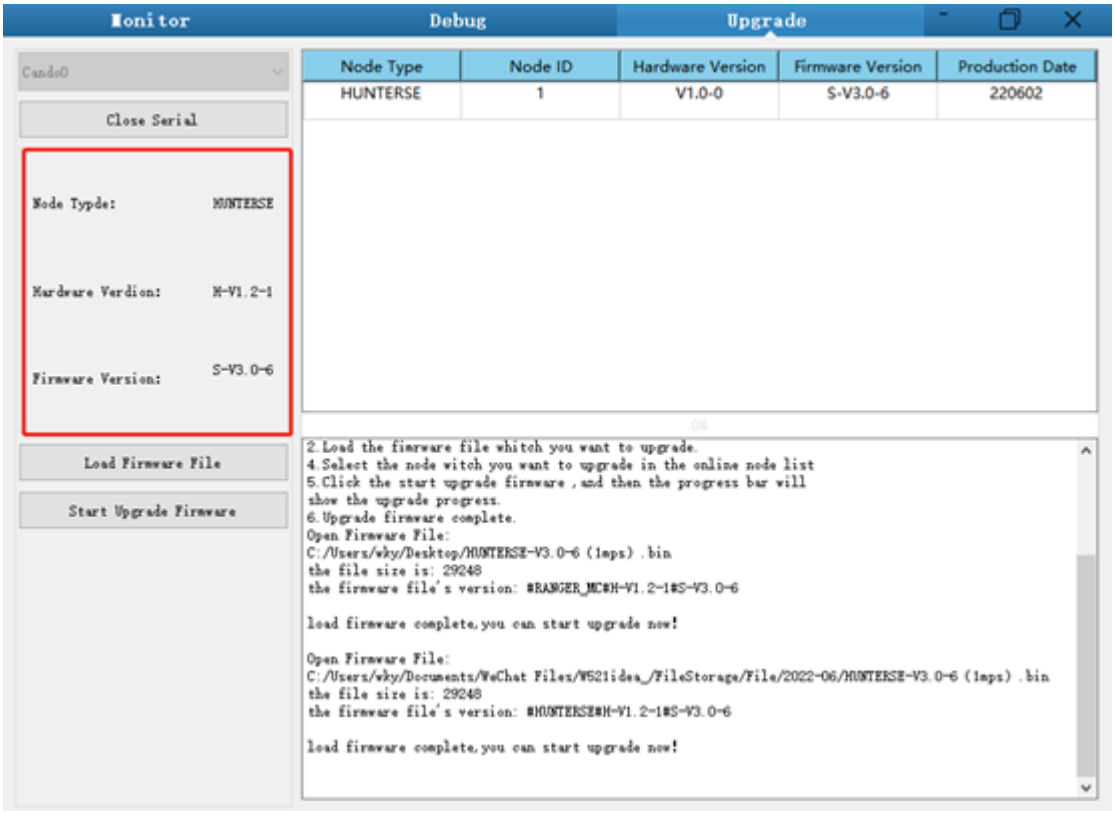
Upgrade Process

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).

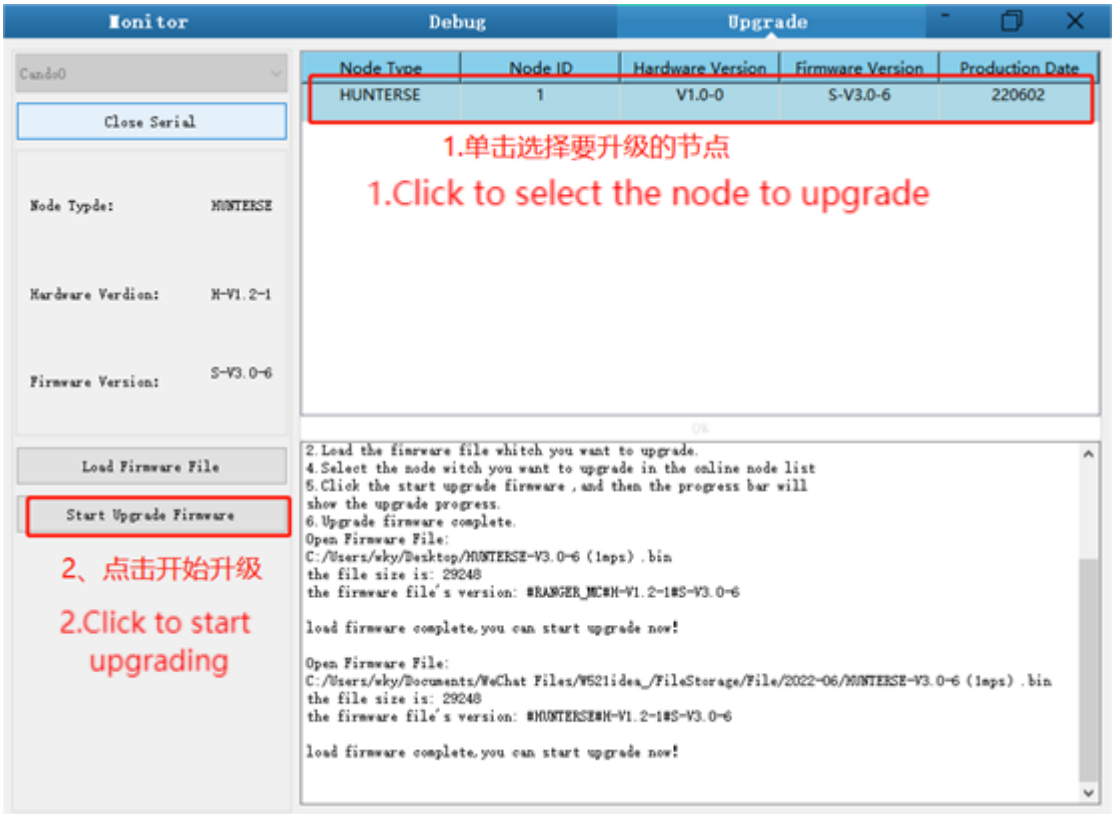
2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

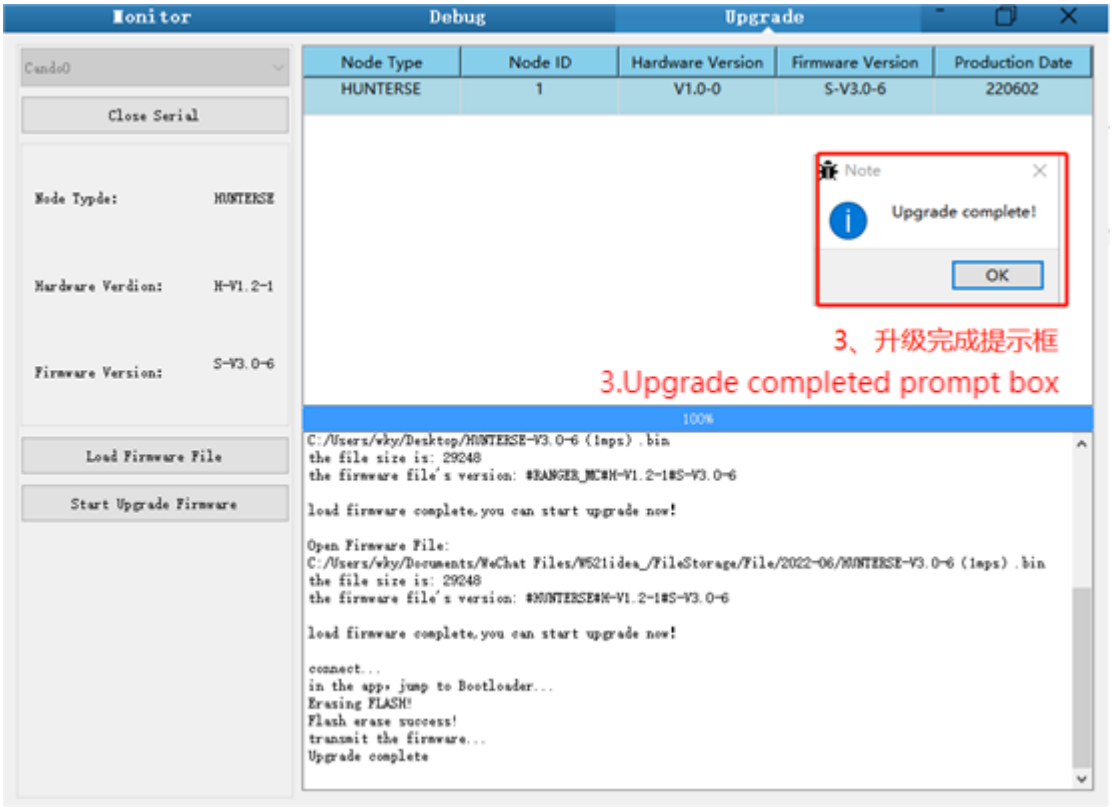


3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure



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.





5 Q&A

Q: BUNKER MINI 2.0 starts normally, but the vehicle body does not move with the remote control?

A: First, determine whether the power switch is pressed and whether the emergency stop switch is released, and then confirm whether the control mode selected by the mode selection switch on the upper left side of the remote control is correct.

Q: When the BUNKER MINI 2.0 remote control is normal, the chassis state and motion information feedback is normal, and the control frame protocol is issued, why the vehicle body control mode cannot be switched, and the chassis does not respond to the control frame protocol?

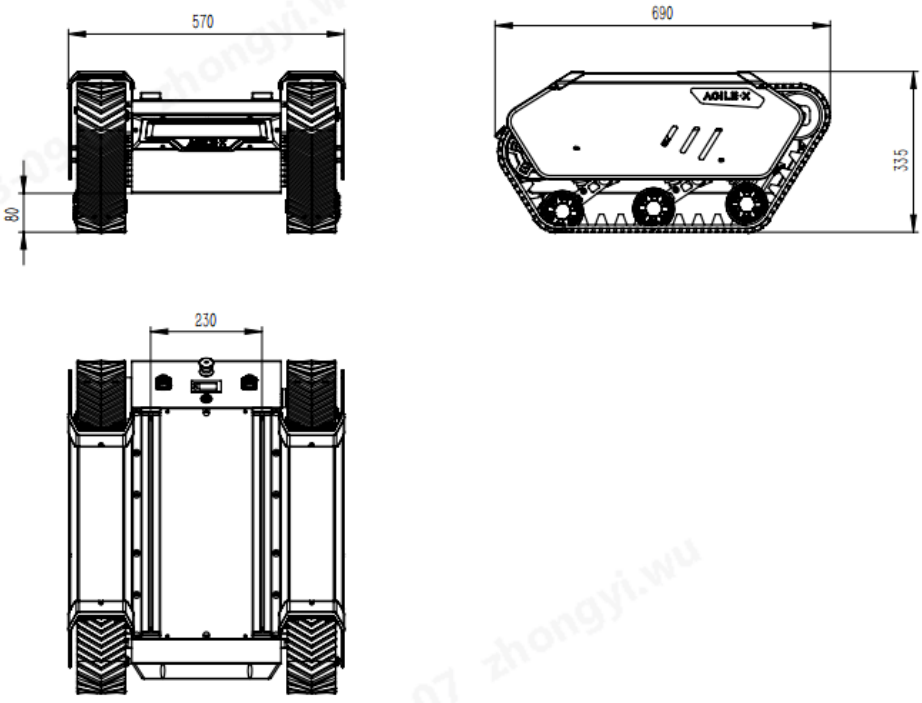
A: Under normal circumstances, if BUNKER MINI 2.0 can be controlled by the remote control, it means that the chassis motion control is normal, and it can receive the feedback frame of the chassis, which means that the CAN extension link is normal. Please check whether the command is switched to CAN control mode..

Q: When the relevant communication is carried out through the CAN bus, and the chassis feedback command is normal, why does the car do not respond after the control is issued?

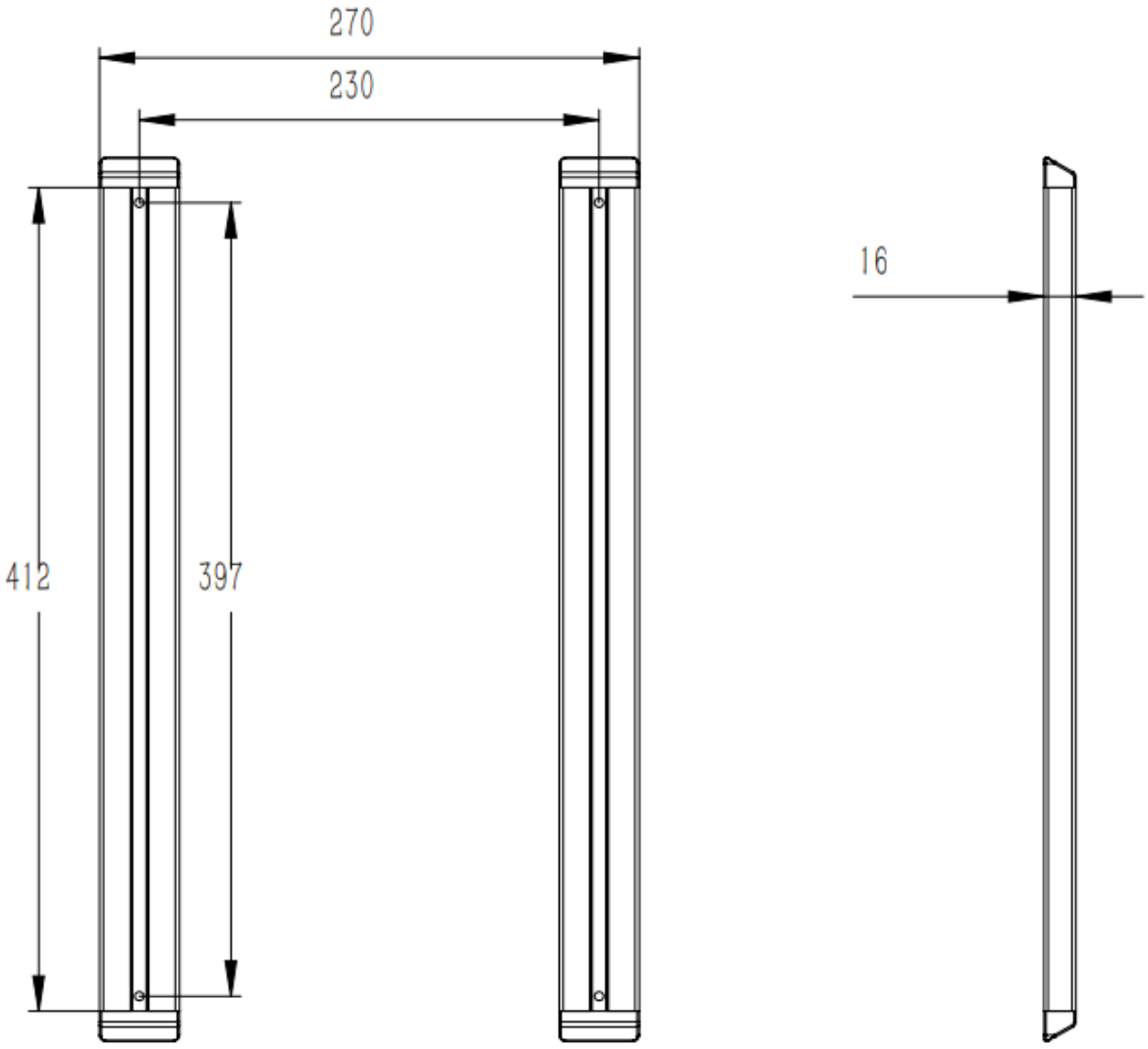
A: BUNKER MINI 2.0 has a communication protection mechanism inside. Chassis has a timeout protection mechanism when dealing with external CAN control commands. Assuming that after the vehicle receives a frame of communication protocol, it does not receive the next frame of control commands for more than 500MS, and it will enter the communication protection with a speed of 0, so the command from the host computer must be periodically issued.

6 Product Dimensions

6.1 Illustrations of product outline dimensions



6.2 Illustrations of top expansion bracket dimensions



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