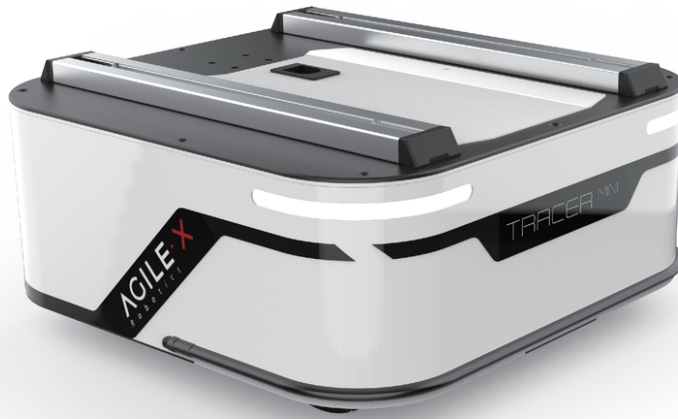


# TRACER MINI User Manual



TRACER  
AgileX Robotics Team  
User Manual V.2.0.1 2023.09

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## Document version

No.	Version	Date	Edited by	Reviewer	Notes
1	V.2.0.0	2023/09/02	谢瑞亲		<ul style="list-style-type: none"><li>• Removed RS232 support<ul style="list-style-type: none"><li>• Add rendering</li><li>• Format adjustment</li></ul></li></ul>
2	V.2.0.1	2023/09/08	吴忠义		<ul style="list-style-type: none"><li>• Align the cart parameter list</li></ul>

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This chapter contains important safety information. Before the robot is powered on for the first time, any individual or organization must read and understand this information before using the equipment. If you have any questions about use, please contact us support@agilex.ai all assembly instructions and guidelines in other chapters of this manual must be observed and implemented, This is very important. Special attention should be paid to the text related to the warning sign.

## **Important security Information Safety Information**

The information in this manual does not include the design, installation and operation of a complete robot application, nor does it contain all peripheral equipment that may affect the safety of this complete system. The design and use of the complete system must meet the safety requirements established in the standards and specifications of the country where the robot is installed.

TRACER MINI integrators and end customers have the responsibility to ensure compliance with the practical laws and regulations of relevant countries, Ensure that there are no major risks in the complete robot application instance. This includes but is not limited to the following:

### **Effectiveness and responsibility**

- Make a risk assessment for the complete robot system.
- Connect additional safety equipment of other machinery defined by risk assessment.
- Confirm that the design and installation of peripheral equipment including software and hardware systems of the entire robot system are correct.
- The robot does not have a complete autonomous mobile robot with automatic anti-collision, anti-drop, biological approach warning and other related security functions, but is not limited to the above description. The related functions require the integrator and end customers to follow the relevant regulations and practical laws and regulations for safety assessment, to ensure that the developed robot does not have any major risks and potential safety hazards in practical application.
- Collect all documents in technical documents: including risk assessment and this manual.

### **Environment**

- For the first time, please read this manual carefully to understand the basic operation content and operation specifications.

- Remote control operation, choose relatively open area to use, the car itself is without any automatic obstacle avoidance sensor.
- Used at ambient temperatures of -10°C ~ 45°C.
- If the vehicle does not have a separate IP protection level, the vehicle's waterproof and dustproof capabilities are IP22.

## Check

- Make sure the power of each equipment is sufficient.
- Make sure there is no obvious abnormality in the vehicle.
- Check whether the battery of the remote controller is sufficient.

## Operation

- Ensure that the surrounding area is relatively empty during remote control.
- Remote control within sight distance.
- The maximum load of the TRACERMINI is 50kg. When in use, ensure that the payload does not exceed 50kg.
- TRACERMINI install the external extension, confirm the center of mass of the extension and make sure it is in the center of rotation.
- When the device voltage is lower than 22.5V, please charge it in time.
- When the equipment is abnormal, please stop using it immediately to avoid causing secondary damage.
- If the equipment is abnormal, please contact the relevant technical personnel and do not handle it without authorization.
- Use it in an environment that meets the protection level requirements based on the IP protection level of the device.
- Do not push the cart directly.
- When charging, ensure that the ambient temperature is greater than 0°C.

## Maintenance

- In order to ensure the power storage capacity of the battery, the battery should be stored with electricity, and it should be charged regularly even if it is not used for a long time.

## Attention

This part contains some points that should be paid attention to when using and developing TRACER MINI.

## **Battery precautions**

- The battery supplied with SCOUT MINI is not always fully charged in the factory setting, but its specific power capacity can be displayed on the voltmeter at tail end of SCOUT MINI chassis or read via CAN bus communication interface. Once the green indicator light of charger is switched on, it means the battery recharging is completed, but after this indicator light is on, the battery will still be charged slowly with 0.1A current for possibility about 30 minutes;
- Static storage conditions: The best temperature for battery storage is  $-10^{\circ}\text{C}$  to  $45^{\circ}\text{C}$ ; in case of storage for no use, the battery must be recharged and discharged once about every 2 months, and then stored in full voltage state. Please do not put the battery in fire or heat up the battery, and please do not store the battery in high-temperature environment;
- Charging: The battery must be charged with a dedicated lithium battery charger; please do not charge the battery below  $0^{\circ}\text{C}$  and do not use non-originally standard batteries, power supplies and chargers.

## **Application environment precautions**

- The operating temperature of SCOUT MINI is  $-10^{\circ}\text{C}$  to  $45^{\circ}\text{C}$ ; please do not use it below  $-10^{\circ}\text{C}$  and above  $45^{\circ}\text{C}$  ;
- The requirements for relative humidity in the use environment of SCOUT MINI are: maximum 80%, minimum 30%;
- Please do not use it in the environment with corrosive and flammable gases or closed to combustible substances;
- Do not place it near heaters or heating elements such as large coiled resistors, etc.;
- Except for specially customized version (IP protection class customized), SCOUT MINI is not water-proof, thus please do not use it in rainy, snowy or water-accumulated environment;
- The elevation of recommended use environment should not exceed 1,000m;
- The temperature difference between day and night of recommended use environment should not exceed  $25^{\circ}\text{C}$ ;

## **Precautions for electrical external extension**

- The tail extension power supply current does not exceed 10A, and the total power does not exceed 240W;
- When the system detects that the battery voltage is lower than the safe voltage class, external power supply extensions will be actively switched to. Therefore, users are suggested to notice if

external extensions involve the storage of important data and have no power-off protection.

## **Safety precautions**

- In case of any doubts during use, please follow related instruction manual or consult related technical personnel;
- Before use, pay attention to field condition, and avoid mis-operation that will cause personnel
- Without technical support and permission, please do not personally modify the internal equipment structure.

## **Other notes**

- When handling and setting up, please do not fall off or place the vehicle upside down;
- For non-professionals, please do not disassemble the vehicle without permission.

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# 1 TRACER MINI Introduction

TRACER MINI is an all-round industrial application UGV(UNMANNED GROUND VEHICLE). It is a multi-functional modular industrial application mobile robot development platform adopting modular and intelligent design concepts. It has a wide range of application fields with strong load capacity and strong power system. The combination of two-wheel differential speed and hub motor enables it to move flexibly indoors. Stereo camera, laser radar, GPS, IMU, manipulator and other equipment can be installed to TRACER as extension application. TRACER MINI can be applied to unmanned inspection, scientific research, logistics and other fields.

## 1.1 Product List

Name	Number
TRACER MINI robot body	x1
Charger 220V	x1
Remote Control (optional)	x1
Aviation plug male (4 Pin)	x1
USB to CAN communication module	x1

## 1.2 performance parameters

Parameter type	Project	Indicator
Mechanical parameters	Length x width x height (mm)	427.5X 416X 194
	Wheel spacing (mm)	245
	Body weight (Kg)	18~21

	Battery Type	Lithium battery 24v 15Ah
	Electric motor	DC brushless 2X150W
	Driver form	Independent Driver
	Suspension form	Swing arm independent suspension
	To turn to	Differential steering
	Safety equipment	Servo brake/safety touch edge
Performance parameter	No-load maximum speed (m/s)	1.67
	Minimum turning radius	Can turn in situ
	Code disk parameters	1024 lines
	Minimum ground clearance (mm)	30
	Maximum climbing capacity	8°
Control parameters	Control mode	Remote control command mode
	Remote control	2.4G/limit distance 200m
	Communication Interface	CAN

Parameter Types	Items	Values
Mechanical specifications	L × W × H (mm)	427.5X 416X 194
	Wheelbase (mm)	245
	Front/rear wheel base (mm)	-



	Curb weight (kg)	18~21
	Battery Type	Lithium battery
	Battery parameters	24V 15Ah
	Power drive motor	DC brushless 2X150W
	Steering drive motor	-
	Parking mode	Servo brake/safety touch edge
	Steering	Differential steering
	Suspension form	Swing arm independent suspension
	Steering motor reduction ratio	-
	Steering motor encoder	-
	Drive motor reduction ratio	-
	Drive motor sensor	Optoelectronics 1024
Performance parameters	IP Grade	IP22
	Maximum speed (km/h)	1.67
	Minimum turning radius (mm)	Can turn in place
	Maximum gradeability (°)	8°
	Ground clearance (mm)	30
	Maximum battery life (h)	8
	Maximum distance (km)	40km
	Charging time (h)	1.5

	Working temperature (°C)	-10~45°C
Control	Control mode	Remote control Control Command control mode
	RC transmitter	2.4G/extreme distance 200M
	System interface	CAN

### 1.3 Development Requirements

The TRACER MINI CAN be equipped with a remote controller when leaving the factory. The user CAN control the chassis of the TRACER mobile robot through the remote controller to complete the moving and rotating operations; The TRACER MINI is equipped with CAN, and the user CAN conduct secondary development through the CAN interface.

## 2 Basic introduction The Basics

This section will give a basic introduction to the TRACER MINI mobile robot chassis, so that users and developers can have a basic understanding of the TRACER chassis. As shown in Figure 2.1 and 2.2 below, the overview view of the entire mobile robot chassis is displayed.

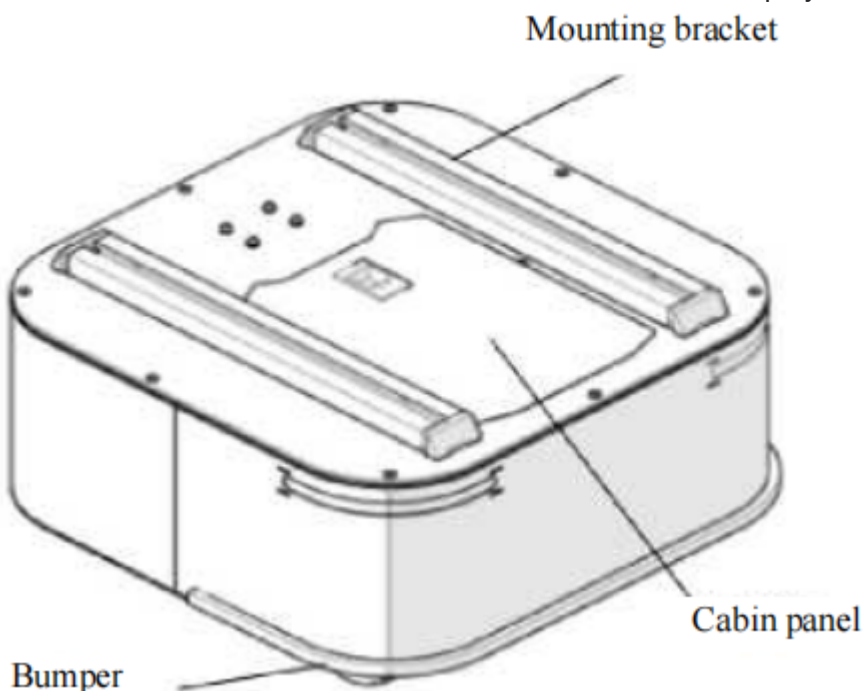


Figure 2.1 front overview view

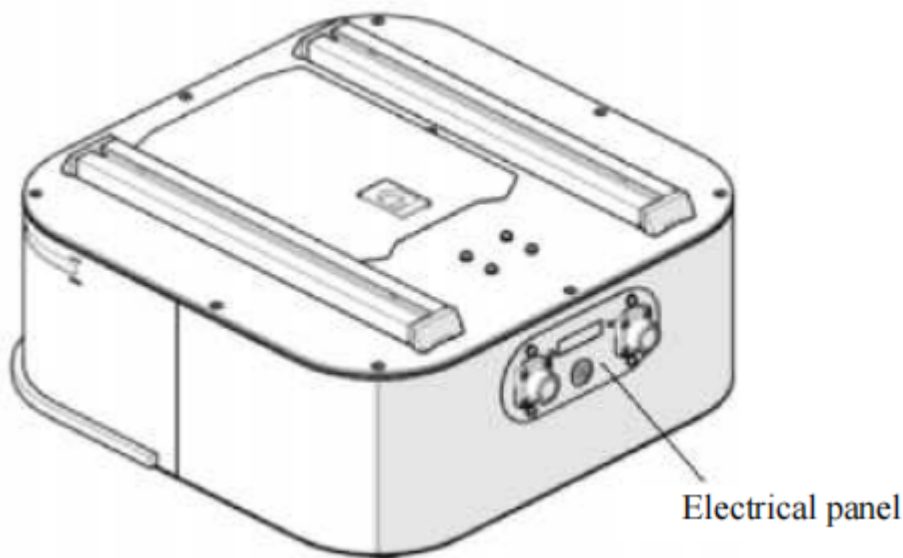


Figure 2.2 tail overview view

The TRACER MINI adopts the modular and intelligent design concept as a whole, and the powerful DC hub motor makes the TRACERMINI robot chassis development platform move flexibly on the indoor flat ground. The front end of the car body is installed with a safe edge, so that in the event of an emergency, Cut off the motor power to reduce the damage to the car body. The front of the car body is equipped with lights, and the front side is designed with blue light, which can be used for lighting.

The end of the TRACER MINI is equipped with an open electrical interface and communication interface, which is convenient for customers to carry out secondary Development. The electrical interface adopts aviation waterproof connector in design and selection, On the one hand, it is conducive to the expansion and use of users; On the other hand, it enables the robot platform to be used in some harsh environments.

## 2.1 Status Indication

Users can determine the state of the car body through the voltmeter, light and buzzer installed on the TRACER MINI. For more information, see Table 2.1.

Status	Description
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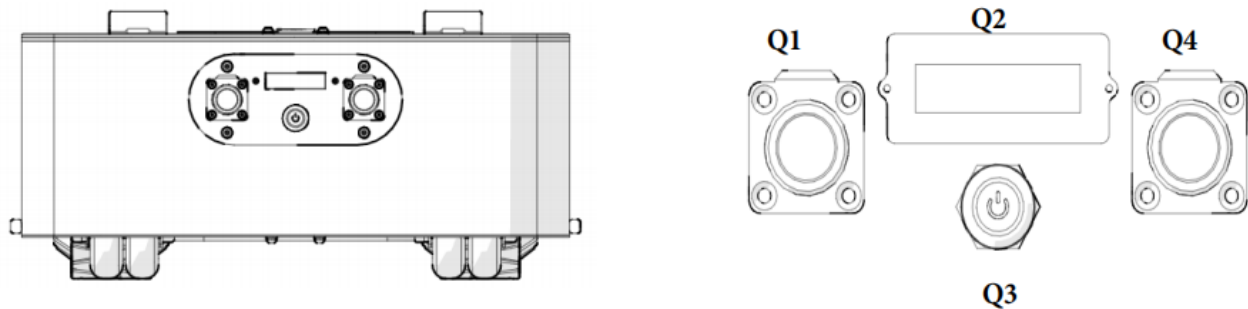
Current voltage	Power-on rear voltmeter lights up, the current battery voltage can be checked through the voltmeter in the rear electrical panel, accurate to 1v
Low voltage alarm	<p>When the battery voltage is lower than 22V, the car will make a harsh sound of "drop-drop-drop" to prompt. When low battery voltage is detected</p> <p>At 21.5V, TRACER MINI will actively cut off external extended power supply and driver power supply to prevent battery damage.</p> <p>At this time, the chassis will not be able to carry out motion control and accept external command control.</p>
Buzzer alarm	<p>A sound (DRIP) indicates a low-voltage warning. Two rings indicate that the crash bar is triggered or the remote control is disconnected. Three sounds represent Motor overcurrent. Four rings indicate that the drive communication is disconnected. Five-sound low-voltage fault. Six rings indicate an external 12v overcurrent.</p>

Table 2.1 vehicle body status description table

## 2.2 Electrical Interface Description

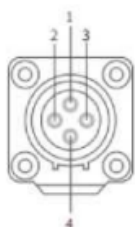
### 2.2.1 Description of tail electrical interface

The extension interface of the tail is shown in Figure 2.3, where Q1 is the extension interface of CAN and 24V power supply; Q2 is the electricity display table; Q3 is the button switch, which is the main switch of the electrical part; Q4 is the charging port of the power supply.



**Figure 2.3 extension interface at the end**

The rear is equipped with CAN communication interface and 24V power interface. The specific definition of the line sequence is shown in Fig. 2.5.



Pin No.	Pin Type	Function and Definition	Remarks
1	Power	VCC	Positive power supply, voltage range 23~29.2v, maximum current 7A
2	Power	GND	Negative power supply
3	CAN	CAN_H	CAN bus high
4	CAN	CAN_L	CAN bus low

Figure 2.5 rear aviation interface pin description

## 2.3 Remote control description

Fusi remote controller is an optional accessory for TRACER MINI products. Customers can select it according to actual needs, and it can be easily controlled by using the remote controller.

TRACER MINI universal robot chassis, we use the design of left-hand throttle in this product. See Figure 2.6 for its definition and functions.

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 the command control mode, and push it to the middle for the remote control mode. SWC is the light control button. S1 is the throttle button. Control TRACER to move forward and backward; S2 controls rotation, and POWER is the power button, press and hold at the same time to turn on and off. The left back button is used for fault clearing, and the fault status will be reset when pressed. In particular, if the anti-collision bar protection is triggered, if the anti-collision bar is not in contact, pressing can reset the fault state; when it is in contact, you need to hold down the button and back off the accelerator to release it.



Figure 2.6 the key diagram of Fusi remote controller

**Remote control interface description:**

Tracer : model

Vol: battery voltage

Car: chassis status

Batt: Chassis power percentage

P: Park

Remoter: remote control battery level

Fault Code: Error information (Refer to the fault information description table)

**2.4 control instruction and motion description**

We will establish the coordinate reference system as shown in Figure 2.7 for the ground moving vehicles according to ISO 8855 standard.

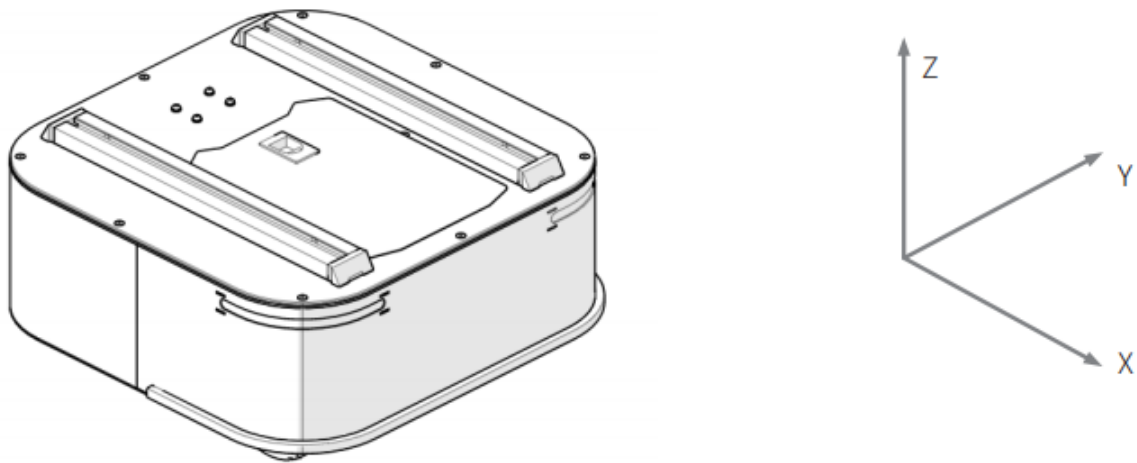


Figure 2.7 schematic diagram of body reference coordinate system

As shown in 2.7, the TRACER MINI body is parallel to the x axis of the established reference coordinate system.

In the control mode of the remote controller, when the rocker S1 of the remote controller pushes forward, it moves in the positive direction of X; When S1 pushes backward, it moves in the negative direction of X; When S1 pushes to the maximum value, The moving speed in the positive direction of X is the largest. When S1 pushes to the minimum value, the moving speed in the negative direction of X is the largest; The rocker S2 of the remote controller controls the rotating motion of the car body on the left, S2 pushes the car body to the left from the positive direction of X axis to the positive direction of Y, S2 pushes the car body to the right from the positive direction of X axis to the negative direction of Y, When S2 pushes to the maximum value from the left, the rotation line in the counterclockwise direction has the maximum speed. When S2 pushes to the maximum value from the right, the rotation line in the clockwise direction has the maximum speed. In the control instruction mode, the positive value of the linear velocity indicates the movement towards the positive direction of the x axis, and the negative value of the linear velocity indicates the movement towards the negative direction of the X axis; The positive value of the angular velocity indicates the movement of the car body from the positive direction of the X axis to the positive direction of the y axis, The negative value of angular velocity indicates that the car body moves from the positive direction of X axis to the negative direction of Y axis.

### 3 Use and develop Getting Started

This section mainly introduces the basic operation and use of TRACER MINI platform, and how to carry out secondary development of car body through external CAN port and CAN bus protocol.

## 3.1 use and operation

### Check

- Check the car body status. Check whether the car body is obviously abnormal; If yes, please contact after-sales support;

### Boot up

- Click the button switch (Q3 in the electrical panel), under normal circumstances, the voltmeter is
- The battery voltage is often displayed, and the headlight is on normally;

### Disable operation

- Click the button switch to cut off the power supply;

### Basic operation process of remote control

- After the machine chassis is moved by the normal start TRACER MINI, start the remote controller and select the control mode as the remote control mode, then the movement of the TRACER MINI platform can be controlled by the remote controller.

## 3.2 Charging

TRACER MINI product is equipped with a 10A charger by default, which can meet the charging needs of customers.

Please. The specific charging procedure is as follows:

- Make sure that the TRACER MINI chassis is in the shutdown state. Before charging, please make sure that Q3 (button switch) in the rear electrical control panel is in the off state;
- Insert the plug of the charger into the Q4 charging interface in the electric control panel of the rear of the car;
- Connect the charger to the power supply and turn on the charger switch to enter the charging state.
- When charging normally, there is no indicator light on the chassis. For more information, see the charger indicator light.

## 3.3 Development

TRACER MINI product provides a CAN interface for user development. Users CAN choose one of the interfaces to control the car body.



### 3.3.1 CAN Interface Protocol

In TRACER MINI product, the CAN communication standard adopts CAN2.0B standard, the communication baud rate is 500K, and the packet format adopts MOTOROLA format. The external CAN bus interface CAN control the linear velocity of chassis movement and the angular velocity of rotation;TRACER will feed back the current motion status information and the status information of the TRACER MINI chassis in real time.

The protocol includes system status feedback frames, motion control feedback frames, control frames, and query configuration frames. The protocol content is as follows:

The system state feedback instruction includes the current vehicle body state feedback, control mode state feedback, battery voltage feedback and fault feedback. The protocol content is shown in Table 3.1.

Table 3.1 TRACER MINI chassis system status feedback frame

Instruction name	System status feedback instruction			
Sending node	Receive node	ID	Period (ms)	Receive timeout (ms)
Wire control chassis	Decision control unit	0x211	20ms	None
Data length	0x08			
Location	Function	Data type	Explain	
byte [0]	Current car body status	unsigned int8	0x00 system normal 0x02 system exception	
byte [1]	Mode control	unsigned int8	0x00 standby mode 0x01 command control mode 0x02 APP control mode (released later) 0x03 remote control mode	
byte [2]	Eight-bit high battery voltage	unsigned int16	Actual voltage X 10 (accurate to 0.1V)	

byte [3]	Battery voltage low eight-bit		
byte [4]	Eight-bit fault information	unsigned int16	For more information, see [fault information description].
byte [5]	Low eight-digit fault information		
byte [6]	Retain		0X00
byte [7]	count	unsigned int8	0~255 loop count

Table 3.2 fault information description table

Fault information description		
byte [4]	bit [0]	Retain
	bit [1]	External Power Supply 12v overcurrent (0: No Fault 1: fault)
	bit [2]	Retain
	bit [3]	Retain
	bit [6]	Retain
	bit [7]	Anti-collision strip protection (0: No Fault 1: fault)
byte [5]	bit [0]	Battery undervoltage failure (0: No failure 1: failure)
	bit [1]	Battery undervoltage warning (0: No warning 1: Warning)
	bit [2]	Remote control disconnection protection (0: No Fault 1: fault)
	bit [3]	Retain
	bit [6]	Retain

	bit [7]	Retain
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The motion control feedback frame instruction includes the motion linear velocity and motion angular velocity feedback of the current car body. The specific content of the protocol is shown in Table 3.3.

Table 3.3 Motion Control feedback frame

Instruction name	Motion control feedback instruction			
Sending node	Receive node	ID	Period (ms)	Receive timeout (ms)
Wire control chassis	Decision control unit	0x221	20ms	None
Data length	0x08			
Location	Function	Data type	Explain	
byte [0]	8-bit high moving speed	signed int16	Vehicle body traveling speed unit: mm/s	
byte [1]	8-bit low moving speed			
byte [2]	Eight-bit high rotation speed	signed int16	Car body rotation angular velocity unit: 0.001rad/s	
byte [3]	Eight-bit low rotation speed			
byte [4]	Retain	-	0x00	
byte [5]	Retain	-	0x00	
byte [6]	Retain	-	0x00	
byte [7]	Retain	-	0x00	

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

Table 3.4 Motion Control Command control frame

Instruction name	Control Instruction			
Sending node	Receive node	ID	Period (ms)	Receive timeout (ms)
Decision control unit	Chassis node	0x111	20ms	500ms
Data length	0x08			
Location	Function	Data type	Explain	
byte [0]	Eight-bit high linear speed	signed int16	The traveling speed of the car body Unit mm/s Valid value $\pm 1800$	
byte [1]	Eight-bit low linear speed			
byte [2]	8-bit high angular velocity	signed int16	Rotation speed of car body Valid value $\pm 1000$ Unit: 0.001rad/s	
byte [3]	8-bit low angular velocity			
byte [4]	Retain	-	0x00	
byte [5]	Retain	-	0x00	
byte [6]	Retain	-	0x00	
byte [7]	Retain	-	0x00	

The light control feedback frame instruction contains the feedback content of the current forward light state, as shown in Table 3.5.

Table 3.5 light control command frame

Instruction name	Light control frame			
Sending node	Receive node	ID	Period (ms)	Receive timeout (ms)
Decision control unit	Wire control chassis	0x121	25ms	None
Data length	0x08			
Location	Function	Data type	Explain	
byte [0]	Light control enable sign	unsigned int8	0x00 control instruction is invalid. 0x01 light control enabled	
byte [1]	Front Light mode	unsigned int8	0x00 normally off 0x01 normally open 0x02 breathing light mode 0x03 customer-defined brightness	
byte [2]	Front Light custom brightness	unsigned int8	[0,100], where 0 is not bright, 100 is the brightest note [5]	
byte [3]	Retain	-	0x00	
byte [4]	Retain	-	0x00	
byte [5]	Retain	-	0x00	
byte [6]	Retain	-	0x00	
byte [7]	count	unsigned int8	0~255 loop count, each time an instruction is sent, the count is increased.	

Note[5]: This value is valid in custom mode

The light control frame command includes the light control mode and opening. The specific content is shown in Table 3.6.

Table 3.6 Light Control Feedback Frame

Command Name	Light Control Feedback Frame			
Sending Node	Receiving Node	ID	Cycle (ms)	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x231	20ms	None
Data length	0x08			
Location	Function	Data type	Description	
byte [0]	Current light control enabling sign	unsigned int8	0x00 Invalid control command 0x01 Light control enabling	
byte [1]	Front light mode	unsigned int8	0x00 Normally off 0x01 Normally open 0x02 Breathing light mode 0x03 Customer-defined brightness	
byte [2]	Current front light custom brightness	unsigned int8	[0,100], where 0 is not bright, 100 is the brightest	
byte [3]	Reserved		0x00	
byte [4]	Reserved		0x00	
byte [5]	Reserved		0x00	
byte [6]	Reserved		0x00	
byte [7]	Count check(count )	unsigned int8	0~255 loop count, count up once every time a command is sent	

The control mode frame package is used to set the control mode of the chassis, as shown in Table 3-7.

Table 3.7 Control mode setting frame description table

Command name	Control mode setting command			
Sending node	Receiving node	ID	Cycle (ms)	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x421	None	None
Data length	0x01			
Position	Function	Data type	Description	
byte [0]	Control mode	unsigned int8	0x00 Standby mode 0x01 CAN command control mode[1] Enter standby mode by default after power on	

Note[1] Control mode description

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 3.8.

Table 3.8 State setting frame description table

Command name	State setting command			
Sending node	Receiving node	ID	Cycle (ms)	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x441	None	None
Data length	0x01			

Position	Function	Data type	Description
byte [0]	Control mode	unsigned int8	0x00 Clear all errors 0x01 Clear motor 1 error 0x02 Clear motor 2 error

Table 3.9 Odometer feedback frame description table

Command name	Odometer feedback command			
Sending node	Receiving node	ID	Cycle (ms)	Receiving Timeout (ms)
Wire-controlled chassis	Decision control unit	0x311	None	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	The highest bit of the left wheel odometer	signed int32	Left wheel odometer data 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	Right wheel odometer data 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		

In addition to the feedback of the state information, the feedback information of the chassis also includes motor information. The following frame feedback is the motor information feedback: in the chassis, the corresponding motor numbers of the two motors are as shown in the following figure:

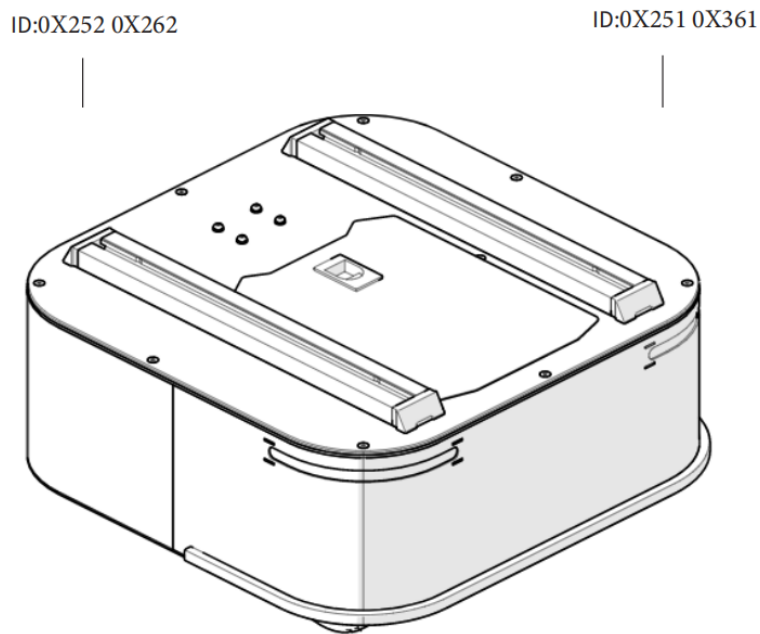


Figure 3.0 Motor Feedback ID Schematic Table  
 Table 3.10 Motor high-speed information feedback frame

Command name	Motor high-speed information feedback frame			
Sending node	Receiving node	ID	Cycle (ms)	Receiving Timeout (ms)

Decision control unit	Wire-controlled chassis	0x251~0x252	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	--	0x00	
byte [3]	The lower eight bits of motor current	--	0x00	
byte [4]	The current position of the motor is the highest	--	0x00	
byte [5]	The current position of the motor is the second highest	--	0x00	
byte [6]	The current position of the motor is the second lowest	--	0x00	

byte [7]	The current position of the motor is the lowest	--	0
----------	---	----	---

Table 3.11 Motor low-speed information feedback frame

Command name	Motor low-speed information feedback frame			
Sending node	Receiving node	ID	Cycle (ms)	Receiving Timeout (ms)
Decision control unit	Wire-controlled chassis	0x261~0x262	100ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Reserve	-	0x00	
byte [1]	Reserve	-	0x00	
byte [2]	Reserve	-	0x00	
byte [3]	Reserve	-	0x00	
byte [4]	Reserve	-	0x00	
byte [5]	Drive status	-	See Table 3-12 for details	
byte [6]	Reserve	-	0x00	
byte [7]	Reserve	-	0	

Table 3.12 Fault information description table

Fault information description		
byte [5]	bit [0]	Reserved
	bit [1]	Reserved

bit [2]	Whether the motor is overcurrent (0: normal 1: overcurrent)
bit [3]	Reserved
bit [4]	Whether the CAN communication is disconnected (0: normal 1: disconnected)
bit [6]	Reserved
bit [7]	Reserved

### 3.3.2 CAN line connection

TRACER MINI provides an aviation plug male as shown in Figure 3.2. For the definition of the line, please refer to Table 3.2.



Blue: CAN\_L  
Yellow: CAN\_H

**Figure 3.2 Schematic diagram of aviation plug male**  
**Note: The power supply in this version can provide a maximum current of 7A.**

### 3.3.3 Realization of CAN command control

Start the TRACER MINI mobile robot chassis normally, turn on the FS remote control, and then switch the control mode to command control, that is, push the SWB mode selection button to the top, then the TRACER chassis will accept the command from the CAN interface, and the host can also analyze the current chassis status through the real-time data fed back by the CAN bus. Refer to the CAN communication protocol for the specific protocol content

## 3.4 Firmware upgrade

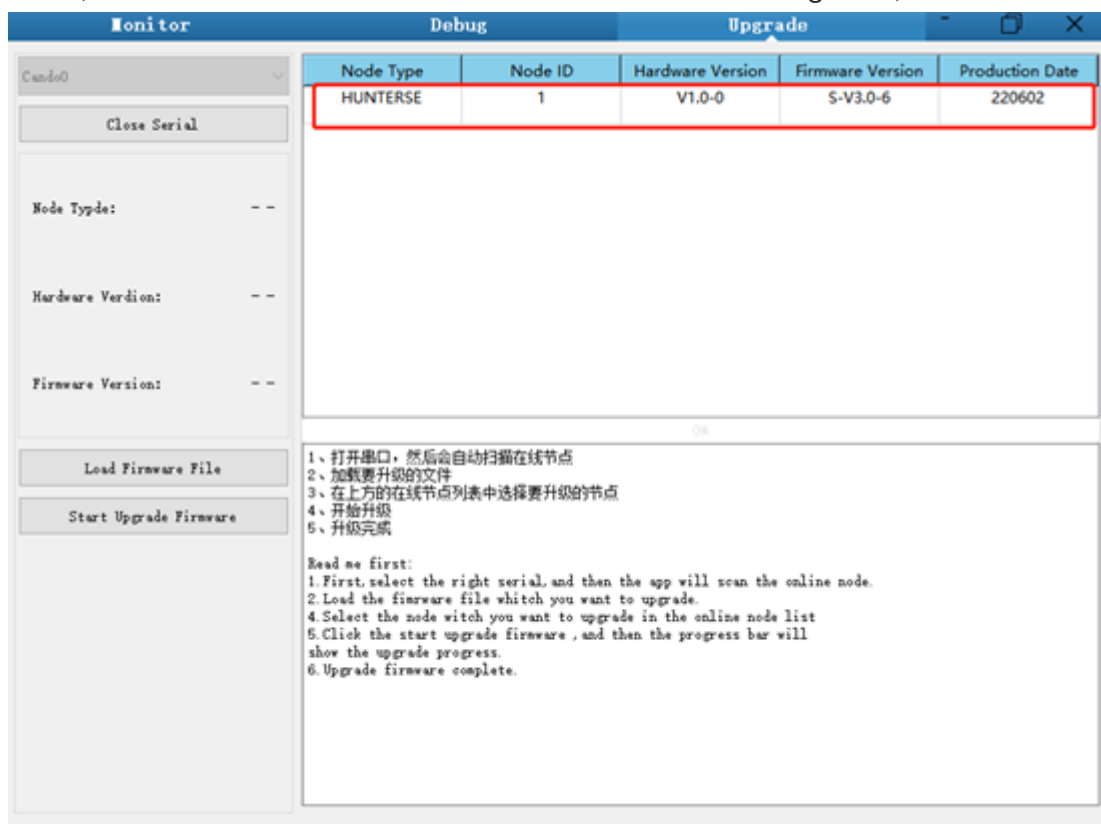
In order to facilitate users to upgrade the firmware version of TRACER MINI and bring to customers more perfect experience, TRACER MINI provides the hardware interface for firmware upgrade and the corresponding client software.

### Upgrade Preparation

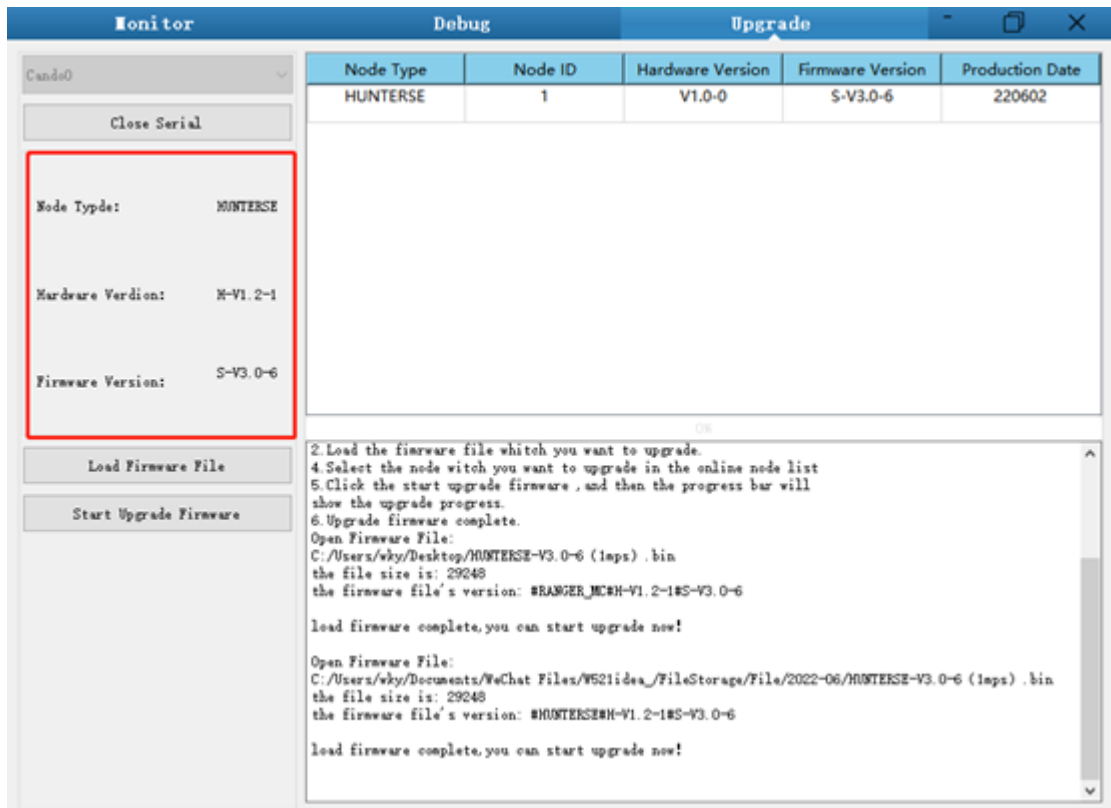
- Agilex CAN debugging module X 1
- Micro USB cable X 1
- TRACER MINI chassis X 1
- A computer (WINDOWS OS (Operating System)) X 1

### Upgrade Process

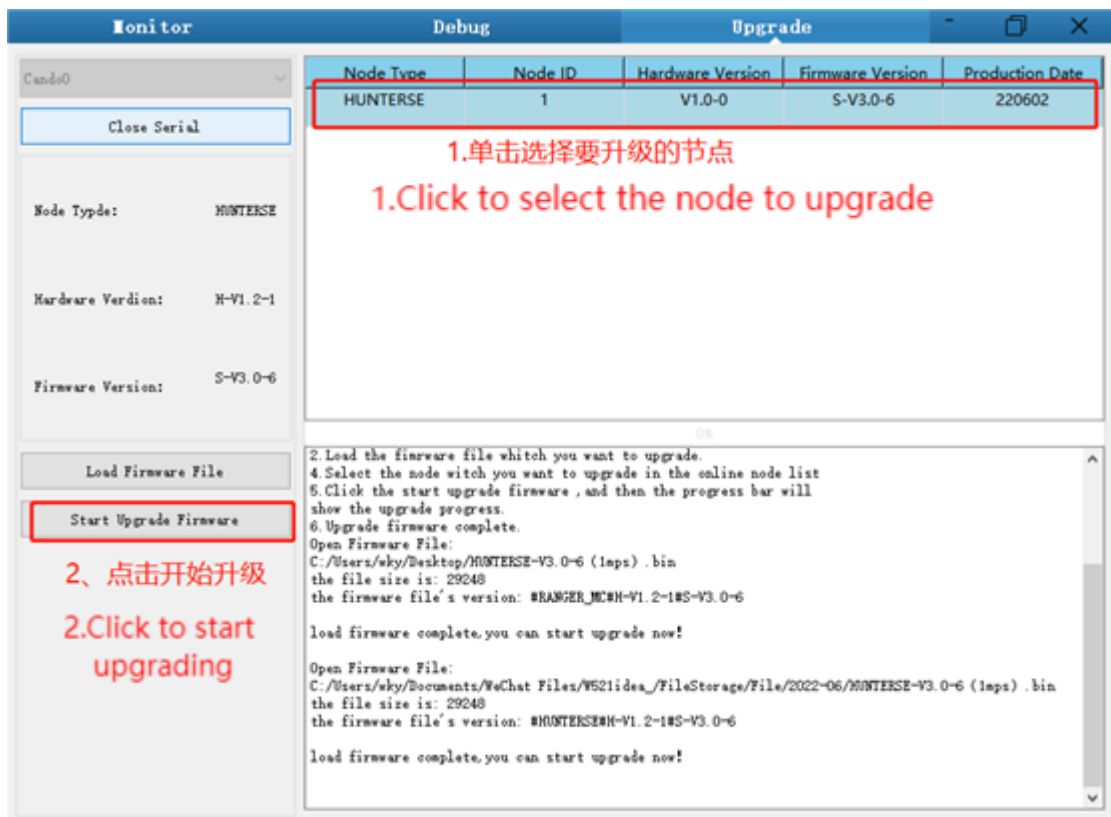
- 1.Plug in the USBTOCAN module on the computer, and then open the AgxCandoUpgradeToolV1.3\_boxed.exe software (the sequence cannot be wrong, first open the software and then plug in the module, the device will not be recognized).
- 2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

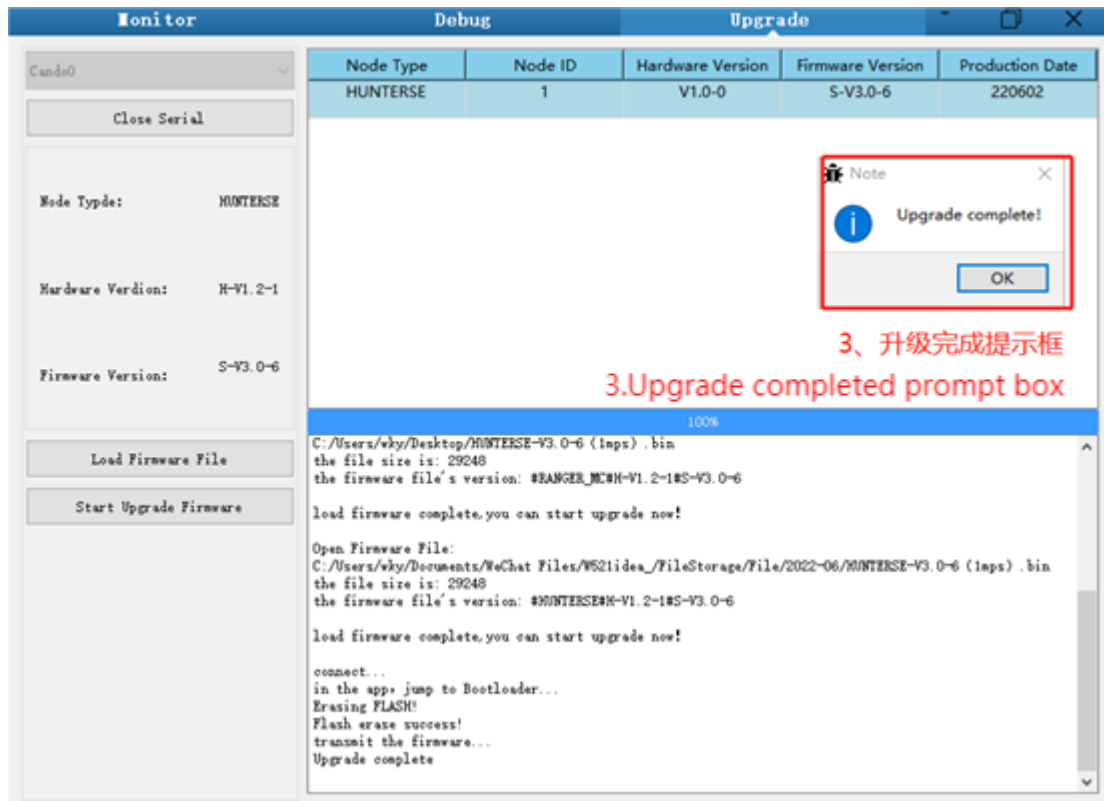


- 3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure



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.





### 3.5 TRACER MINI 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 TRACER MINI mobile robot chassis X1
- AGILEX TRACER MINI supporting remote control FS-i6s X1
- AGILEXTRACER MINI top aviation receptacle X1

## Environment description of usage example

- Ubuntu 18.04 LTS
- ROS Kinetic
- Git

## Hardware connection and preparation

- Pull out the CAN line of the TRACER MINI rear aviation 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 TRACER MINI mobile robot;
- Connect CAN\_TO\_USB to the USB port of the laptop. The connection diagram is shown in Figure 3.4.

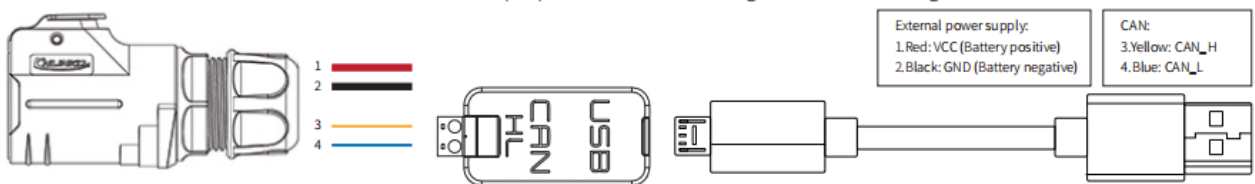


Figure 3.4 CAN line connection diagram

## ROS Installation and Environment Setup

For installation details, please refer to

<http://wiki.ros.org/kinetic/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 robot this time, and the car has been turned on, use the following commands to monitor the data from the BUNKER chassis

∨

```
$ candump can0
```

Please refer to:

[1] [https://github.com/agilexrobotics/agx\\_sdk](https://github.com/agilexrobotics/agx_sdk)

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

## AGILEX TRACER MINI ROS PACKAGE Download and compile

- Download ros dependencies

∨

```
$ sudo apt install ros-$ROS_DISTRO-teleop-twist-keyboard  
$ sudo apt install ros-$ROS_DISTRO-joint-state-publisher-gui  
$ sudo apt install ros-$ROS_DISTRO-ros-controllers
```

- clone and compile tracer\_ros source code

∨

```
$ cd ~/catkin_ws/src  
$ git clone https://github.com/agilexrobotics/ugv_sdk.git  
$ git clone https://github.com/agilexrobotics/tracer_ros.git  
$ cd ..  
$ catkin_make
```

Reference: [https://github.com/agilexrobotics/tracer\\_ros](https://github.com/agilexrobotics/tracer_ros)

## Start the ROS node

- Start the basic node through the can port

∨

```
$ roslaunch tracer_bringup tracer_robot_base.launch
```

- Start the keyboard remote operation node

∨

```
$ roslaunch tracer_bringup tracer_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 Q&A

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

A: First, confirm whether the drive power supply is normal and whether the emergency stop switch is released; 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 TRACER MINI 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 TRACER MINI 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 the sent CAN control frame to see if the command control mode is switched. You can check the status of the error flag in the error bit in the state frame fed back by the chassis.

**Q: TRACER makes a "drip-drip-drip..." sound during operation, what should I do?**

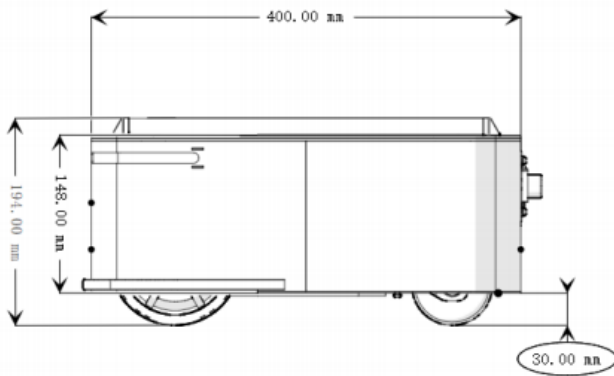
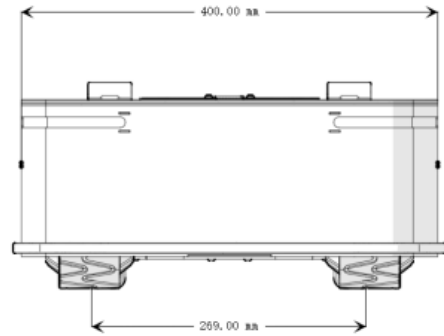
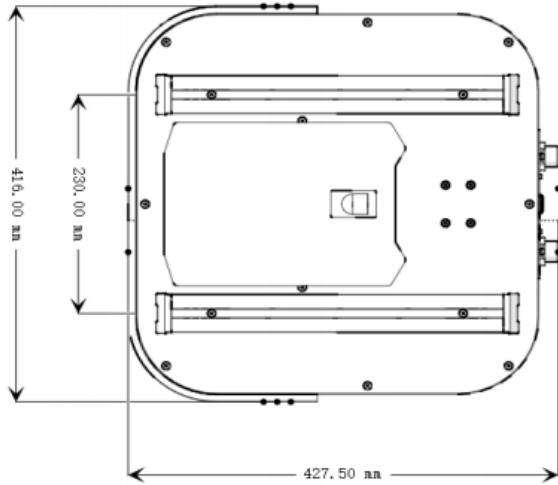
A: If the TRACER MINI emits continuous "drip-drip-drip..." sound, it indicates that the battery is already in the alarm voltage state, please charge it in time; after the relevant sound appears, there may also be an internal related error, you can check the related error through the CAN bus code, or communicate with relevant technical personnel.

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

A: TRACER MINI 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.

## **5 Product Dimensions**

### **5.1 Illustrations of product outline dimensions**



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