TRACER 2.0 User Manual

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AgileX Robotics Team

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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 device. If you have any questions about use, please contact us at support@agilex.ai. Please follow and implement all assembly instructions and guidelines in the chapters of this manual, which is very important. Particular attention should be paid to the text related to the warning signs.

Safety Information

The information in this manual does not include the design, installation and operation of a complete robo t application, nor does it include all peripheral equipment that may affect the safety of the complete syst em. The design and use of the complete system need to comply with the safety requirements established in the standards and regulations of the country where the robot is installed. TRACER 2.0 's integrators and end customers have the responsibility to ensure compliance with the applicable laws and regulations of relevant countries, and to ensure that there are no major dangers in the complete robot application. This includes but is not limited to the following:

Effectiveness and responsibility

- Make a risk assessment of the complete robot system.
- Connect the additional safety equipment of other machinery defined by the risk assessment together.
- Confirm that the design and installation of the entire robot system's peripheral equipment, including software and hardware systems, are correct.
- This robot does not have a complete autonomous mobile robot, including but not limited to automatic anti-collision, anti-falling, biological approach warning and other related safety functions. Related functions require integrators and end customers to follow relevant regulations and feasible laws and regulations for safety assessment. To ensure that the developed robot does not have any major hazards and safety hazards in actual applications.
- Collect all the documents in the technical file: including risk assessment and this manual.

Environmental Considerations

- For the first use,please read this manual carefully to understand the basic operating content and operating specification.
- For remote control operation, select a relatively open area to use TRACER 2.0, because TRACER 2.0 is not equipped with any automatic obstacle avoidance sensor.
- Use TRACER 2.0 always under -10℃~45℃ ambient temperature.

- If TRACER 2.0 is not configured with separate custom IP protection, its water and dust protection will be IP22 ONLY.

Pre-work Checklist

- Make sure each device has sufficient power.
- Make sure TRACER 2.0 does not have any obvious defects.
- Check if the remote controller battery has sufficient power.
- When using, make sure the emergency stop switch has been released.

Operation

- In remote control operation, make sure the area around is relatively spacious.
- Carry out remote control within the range of visibility.
- The maximum load of TRACER 2.0 is 100KG. When in use, ensure that the payload does not exceed 100KG.
- When installing an external extension on TRACER 2.0, confirm the position of the center of mass of the extension and make sure it is at the center of rotation.
- Please charge in time when the device voltage is lower than 22.5V.
- When TRACER 2.0 has a defect, please immediately stop using it to avoid secondary damage.
- When TRACER 2.0 has had a defect, please contact the relevant technical to deal with it, do not handle the
- defect by yourself.
- Always use TRACER 2.0 in the environment with the protection level requires for the equipment.
- Do not push TRACER 2.0 directly.
- When charging, make sure the ambient temperature is above 0℃.

Maintenance

- In order to ensure the storage capacity of the battery, the battery should be stored under electricity, and it should be charged regularly when not used for a long time.

Attention

This section includes some precautions that should be paid attention to for TRACER 2.0 use and development.

Battery

- The battery supplied with TRACER 2.0 is not fully charged in the factory setting, but its specific power capacity can be displayed on the voltmeter at rear end of TRACER 2.0 chassis or read via CAN bus communication interface. The battery recharging can be stopped when the green LED on the charger turns green. Note that if you keep the charger connected after the green LED gets on, the charger will continue to charge the battery with about 0.1A current for about 30 minutes more to get the battery fully charged.
- Please do not charge the battery after its power has been depleted, and please charge the battery in time when low battery level alarm is on; Static storage conditions: The best temperature for battery storage is -10℃ to 45℃; 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; lithium-ion batteries cannot be charged below 0°C (32°F) and modifying or replacing the original batteries are strictly prohibited.

Operational environment

- The operating temperature of TRACER 2.0 outdoors is -10℃ to 45℃;please do not use it below -10℃ and above 45℃ outdoors;
- The requirements for relative humidity in the use environment of TRACER 2.0 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), TRACER 2.0 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℃;

Electrical/extension cords

- The tail extension power supply current does not exceed 5A, and the total power does not exceed 120W;
- When the system detects that the battery voltage is lower than the safe voltage, the external power expansion device will be actively cut off. Therefore, if the external expansion device involves the storage of important data and does not have power-down protection, it is recommended that the user pay attention.

Additional safety advice

- 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 safety problem;
- In case of emergencies, press down the emergency stop button and power off the equipment;
- 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.

CONTENTS

1 TRACER 2.0 Introduction

TRACER 2.0 is designed as a multi-purpose UGV with different application scenarios considered: modular design; flexible connectivity; powerful motor system capable of high payload.The combination of two-wheel differential chassis and hub motor can make it move flexible indoor.Additional components such as stereo camera, laser radar, GPS, IMU and robotic manipulator can be optionally installed on TRACER 2.0 for advanced navigation and computer vision applications. TRACER 2.0 is frequently used for autonomous driving education and research, indoor and outdoor security patrolling and transportation, etc.

1.1 Component list

Name	Quantity
TRACER 2.0 Robot body	x1
Battery charger(AC 220V)	x1
Remote control transmitter(optional)	x1
Aviation plug (male,4-Pin)	x1
USB to CAN communication module	x1

1.2 Tech specifications

Parameter Types	Items	Values
Mechanical specifications	L × W × H (mm)	702x610x169
	Wheelbase (mm)	517.4
	Front/rear wheel base (mm)	-
	Total weight (kg)	54-56
	Battery Type	Lithium iron phosphate battery
	Battery parameters	24V 30Ah
	Power drive motor	DC brushless 2 X 400W
	Parking mode	Servo brake/safety contact strip
	Steering	Differential steering
	Suspension form	Swing arm non-independent suspension
	Drive motor sensor	Magnetic encoder 2500

Performance parameters	IP Grade	IP22
	Maximum speed (m/s)	2.0
	Minimum turning radius (mm)	Can turn in place
	Maximum gradeability (°)	8°
	Ground clearance (mm)	27
	Maximum battery life (h)	10
	Maximum distance (km)	80km
	Charging time (h)	3
	Working temperature (℃)	-10~40℃
Control	Control mode	Remote control Control Command control mode
	RC transmitter	2.4G/extreme distance 100M
	System interface	CAN

1.3 Development requirements

RC transmitter is provided (optional) in the factory setting of TRACER 2.0, which allows users to control the chassis of robot to move and turn; CAN interfaces on TRACER 2.0 can be used for user's customization.

2 The Basics

This section provides a brief introduction to the TRACER 2.0 mobile robot platform, as shown in Figure 2.1 and Figure2.2.

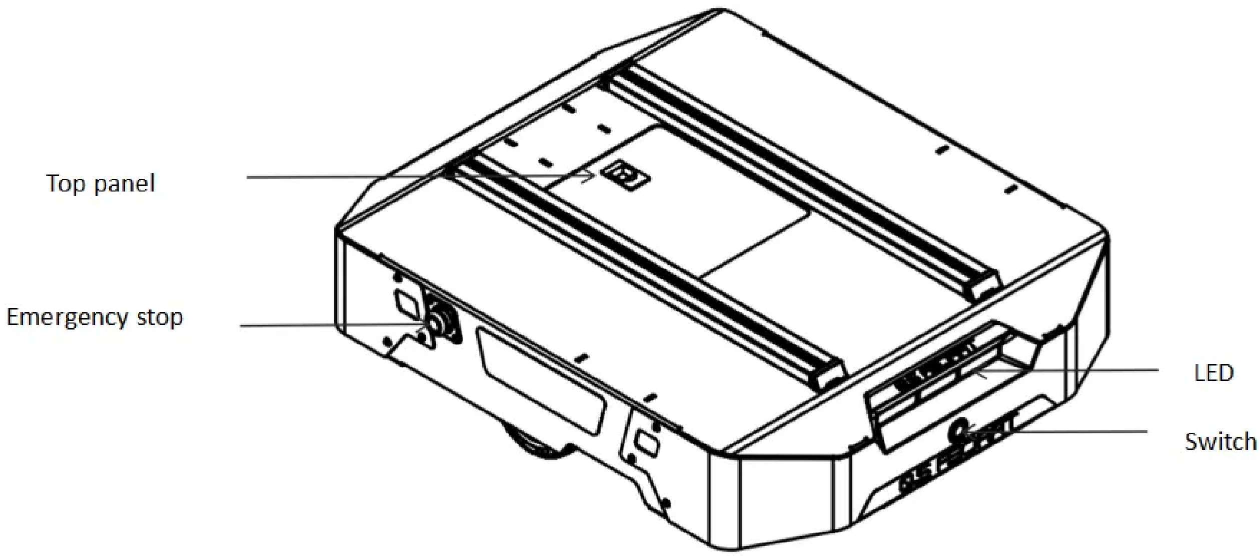


Figure 2.1 Front overview

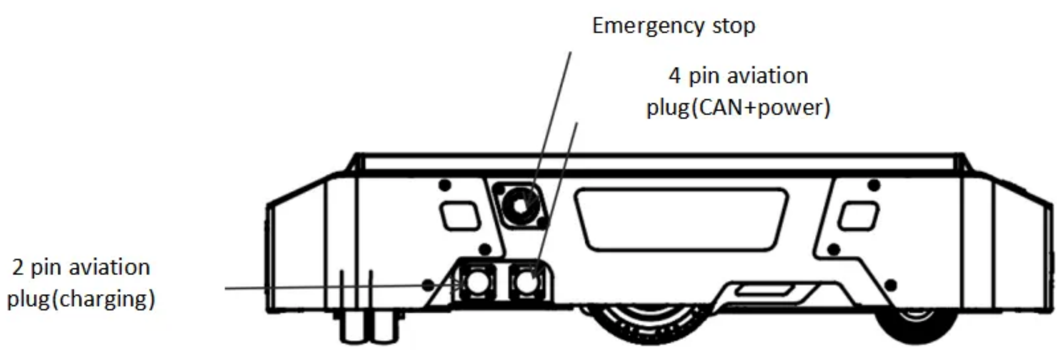


Figure 2.2 Side Overview

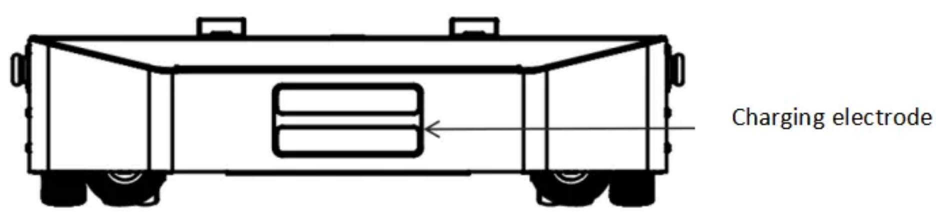


Figure 2.3 Rear Overview

TRACER 2.0 is designed as a complete intelligent module, along with powerful DC hub motor, enabling the chassis of TRACER 2.0 robot to move flexibly on flat ground indoors.

Light is mounted at the front of the vehicle. The white light is designed for illumination in front.

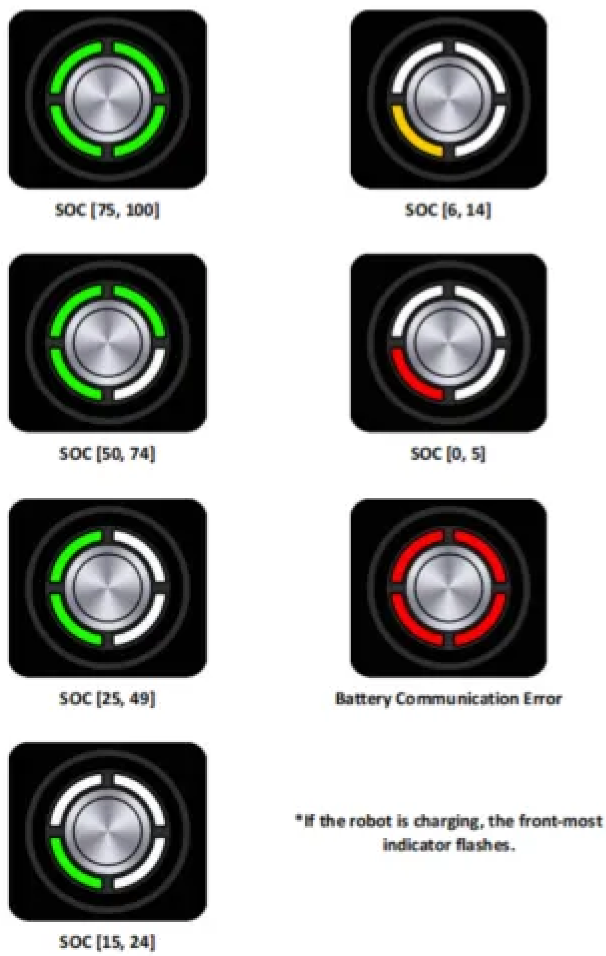
An emergency stop switch is mounted at the rear end of the vehicle body, which can shut down the power of the robot immediately when the robot behaves abnormally.

Water-proof connectors for DC power and communication interface is provided at the rear of TRACER 2.0, which not only allow flexible connection between the robot and external components but also ensure necessary protection to the internal of the robot even under severe operating conditions.

A bayonet open compartment is reserved on the top for users.

2.1 Status indication

Users can check the current power level of the device by the indicator light status on the outside of the switch installed on the front of TRACER 2.0.



2.2 Instructions on electrical interfaces

2.2.1 Rear electrical interface

The expansion interface on the side is shown in Figure 2.2. The upper part is the emergency stop switch; the left side is the power charging port; the right side is the CAN and 24V power expansion interface.

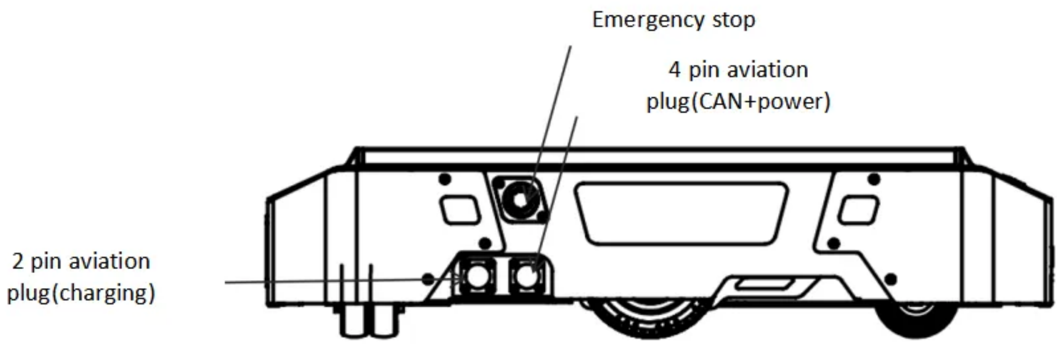
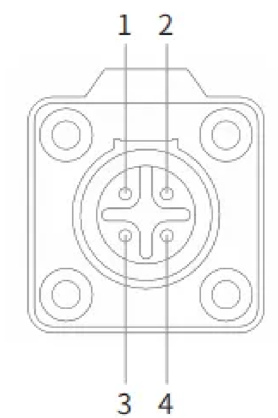


Figure 2.2 Side Overview

There is a CAN communication interface and a 24V power supply interface on the side. The specific definition of its line sequence is shown in the figure



Pin No.	Pin Type	Function and Definition	Remarks
1	Power	VCC	Power positive, voltage range 23 - 29.2V, maximum current 5A
2	Power	GND	Power negative
3	CAN	CAN_H	CAN bus high
4	CAN	CAN_L	CAN bus low

Figure 2.5 Description of Rear Aviation Interface Pins

2.3 Instructions on remote control

FS remote control is an optional accessory for TRACER 2.0 products. Customers can choose according to actual needs. Using the remote control can easily control the TRACER 2.0 universal robot chassis. In this product, we use the design of the left-hand accelerator. Its definition and function can refer to Figure 2.6.

The function of the buttons is defined as follows:

The joysticks of the remote control are SWA, SWB, SWC, and SWD from left to right;

●SWA up: normal mode, SWA down: assist mode. After pushing, the motor will slightly assist in the pushing direction, making it easier to push.

●SWB up: navigation mode, swB middle: remote control mode.

●SWC up: breathing light, swC middle: constant brightness. swC down: turn off the light.

●SWD up: low speed mode, maximum 1.5m/s. swD down: high speed mode, maximum 2m/s

●S1 is the throttle button, which controls TRACER 2.0 to move forward and backward; S2 controls rotation;

●POWER is the power button, which can be turned on and off by pressing and holding at the same time.

●When the chassis emergency stop is restored by pressing the KEY1 button, it is necessary to use the KEY1 button to restore it before it can be controlled again.

●key2 is the button to enter the settings and selection.

Remote control interface description:

TRACER 2.0 : 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 Instructions on control demands and movements

A reference coordinate system can be defined and fixed on the vehicle body as shown in Figure 2.7 in accordance with ISO 8855.

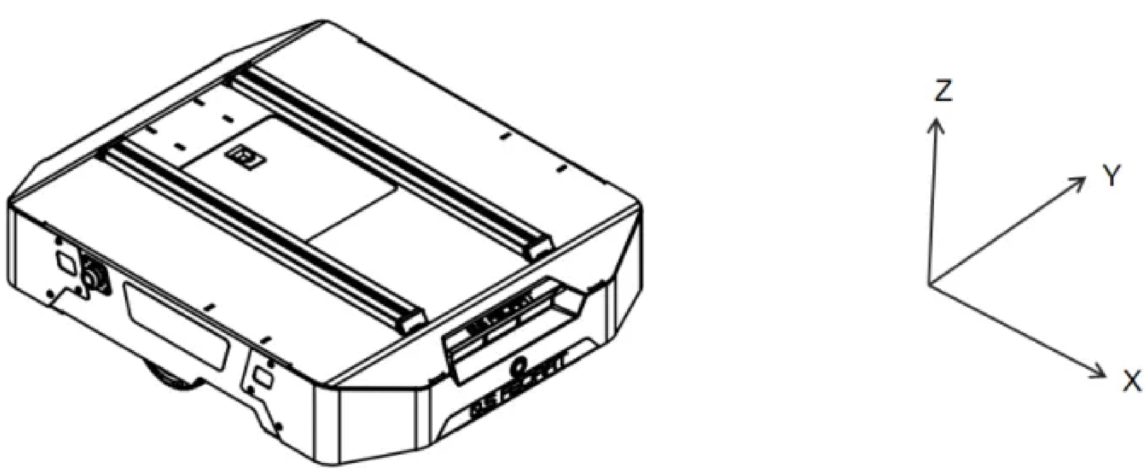


Figure 2.7 Schematic Diagram of Reference Coordinate System for Vehicle Body

As shown in Figure 2.7, the vehicle body of TRACER 2.0 is in parallel with X axis of the established reference coordinate system. In the remote control mode, if the remote control joystick S1 is pushed forward, it moves in the positive direction of X, and if S1 is pushed backward, it moves in the negative direction of X. When S1 is pushed to the maximum value, the speed of movement in the positive direction of X is the maximum, and when S1 is pushed to the minimum value, the speed of movement in the negative direction of X is the maximum; the remote control joystick S2 controls the rotation of the car body left and right. When S2 is pushed to the left, the car body rotates from the positive direction of X axis to the positive direction of Y axis, and when S2 is pushed to the right, the car body rotates from the positive direction of X axis to the negative direction of Y axis. When S2 is pushed to the left to the maximum value, the counterclockwise rotation linear velocity is the maximum, and when S2 is pushed to the right to the maximum value, the clockwise rotation linear velocity is large.

In the control command mode, the positive value of the linear velocity indicates movement in the positive direction of X axis, and the negative value of the linear velocity indicates movement in the negative direction of X axis; the positive value of the angular velocity indicates that the car body moves from the positive direction of X axis to the positive direction of Y axis, and the negative value of the angular velocity indicates that the car body moves from the positive direction of X axis to the negative direction of Y axis.

3 Getting Started

This section introduces the basic operation and development of the TRACER 2.0 platform using the CAN bus interface.

Check

- Check the condition of vehicle body. Check whether there are significant anomalies; if so, please contact the after–sale service personnel for support;

Check the state of emergency stop switches. Make sure both emergency stop buttons are released.

Shut down

- Rotate the key switch to cut off the power supply;

Start up

- Emergency stop switch status. Confirm that the emergency stop buttons are all released;
- Rotate the key switch (Q6 on the electrical panel), and normally, the voltmeter will display

correct battery voltage and front and rear lights will be both switched on.

Emergency stop

- Press down emergency push button both on the left and the right
- of rear vehicle body;

Shut down

- Rotate the key switch to cut off the power supply;

Start up

- Emergency stop switch status. Confirm that the emergency stop buttons are all released;
- Rotate the key switch (Q6 on the electrical panel), and normally, the voltmeter will display correct battery voltage and front and rear lights will be both switched on.

Emergency stop

- After the chassis of TRACER 2.0 mobile robot is started correctly, turn on the RC transmitter and select the remote-control mode. Then, TRACER 2.0 platform movement can be controlled by the RC transmitter.

3.2 Charging

TRACER 2.0 is equipped with a 10A charger by default to meet customers' recharging demand.

The detailed operating procedure of charging is shown as follows:

- Make sure the electricity of TRACER 2.0 chassis is powered off. Before charging, please make sure Q6 (key switch) in the rear control console is turned off;
- Insert the charger plug into side charging interface on the rear control panel;
- Connect the charger to power supply and turn on the switch in the charger. Then, the robot enters the charging state.
- When charging normally, there is no indicator light on the chassis. Please see the charger indicator light instructions for specific instructions.

3.3 Communication using CAN

TRACER 2.0 provides CAN interface for user customization. Users can use it to conduct command control over the vehicle body.

3.3.1 CAN message protocol

TRACER 2.0 adopts CAN2.0B communication standard which has a communication baud rate of 500K and Motorola message format. Via external CAN bus interface, the moving linear speed and the rotational angular speed of chassis can be controlled; TRACER 2.0 will feedback on the current movement status information and its chassis status information in real time.

The protocol includes system status feedback frame, movement control feedback frame and control frame, the contents of which are shown as follows:

The system status feedback command includes the feedback information about current status of vehicle body, control mode status, battery voltage and system failure. The description is given in Table 3.1.

Table 3.1 Feedback Frame of TRACER 2.0 Chassis System Status

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	20ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Current status of vehicle body	unsigned int8	0x00 System in normal condition 0x01 Emergency stop mode 0x02 System is abnormal	
byte [1]	Mode control	unsigned int8	0x00 Standby mode 0x01 CAN command control mode 0x02 Remote control mode	
byte [2] byte [3]	Battery voltage higher 8 bits Battery voltage lower 8 bits	unsigned int16	Actual voltage X 10 (with an accuracy of 0.1V)	

byte [4]	High 8 digits of fault information	unsigned int16	See notes for details【Table 3.2】
byte [5]	Low eight bits of fault information		
byte [6]	Reserved	–	0x00
byte [7]	Count paritybit (count)	unsigned int8	0 – 255 counting loops

Table 3.2 Description of Failure Information

Description of Failure Information		
byte [4]	bit [0]	Motor driver is abnormal
	bit [1:7]	Reserved
byte [5]	bit [0]	Battery under-voltage failure (0: No failure 1: Failure) Protective voltage 22V
	bit [1]	Battery under-voltage alarm (0: No alarm 1: Alarm) Alarm voltage 22.5V
	bit [2]	Remote controller disconnection protection (0: Normal 1: Remote controller disconnected)
	bit [3]	Motor driver 1 lost connection
	bit [4]	Motor driver 2 lost connection
	bit [5:6]	Reserved
	bit[7]	Emergency stop

The command of movement control feedback frame includes the feedback of current linear speed and angular speed of moving vehicle body. For the detailed content of protocol, please refer to Table 3.3.

Table 3.3 Movement Control Feedback Frame

Command Name	Movement Control Feedback Command			
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 higher 8 bits Moving speed lower 8 bits	signed int16	Vehicle speed Unit：mm/s	
byte [2] byte [3]	Rotational speed higher 8 bits Rotational speed lower 8 bits	signed int16	Vehicle angular speed Unit：0.001rad/s	
byte [4]	Reserved	–	0x00	
byte [5]	Reserved	–	0x00	
byte [6]	Reserved	–	0x00	
byte [7]	Reserved	–	0x00	

The control frame includes control openness of linear speed and control openness of angular speed. For its detailed content of protocol, please refer to Table 3.4.

Table 3.4 Control Frame of Movement Control Command

Command Name	Control Command			
Sending node	Receiving node	ID	Cycle (ms)	Receive–timeout (ms)

Steer-by-wire chassis	Decision-making control unit	0x111	20ms	500ms
Data length	0x08			
Position	Function	Data type	Description	
byte [0] byte [1]	Moving speed higher 8 bits Moving speed lower 8 bits	signed int16	Vehicle speed Unit：mm/s Effective value±1800	
byte [2] byte [3]	Rotational speed higher 8 bits Rotational speed lower 8 bits	signed int16	Vehicle angular speed Unit：0.001rad/s Effective value±1000	
byte [4]	Reserved	—	0x00	
byte [5]	Reserved	—	0x00	
byte [6]	Reserved	—	0x00	
byte [7]	Reserved	—	0x00	

The light control frame includes current state of front light. For its detailed content of protocol, please refer to Table 3.5.

Table 3.5 Lighting Control Frame

Command Name	Lighting Control Frame			
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Steer-by-wire chassis	Steer-by-wire chassis	0x121	25ms	500ms
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Lighting control enable flag	unsigned int8	0x00 Control commandinvalid 0x01 Lighting control enable	

byte [1]	Front light mode	unsigned int8	0x00 Always off 0x01 Always on 0x02 breathe light mode 0x03 User-defined brightness
byte [2]	Custom brightness of front light	unsigned int8	[0,100],where 0 refers to no brightness, 100 refers to maximum brightnes 【5】
byte [3]	Reserved	--	0x00
byte [4]	Reserved	--	0x00
byte [5]	Reserved	--	0x00
byte [6]	Reserved	-	0x00
byte [7]	Count paritybit (count)	unsigned int8	0 - 255 counting loops, which will be added once every command sent

Note[5]: This date only valid in custom mode

The light control frame includes light control mode and control openness. For its detailed content , please

refer to Table 3.6.

Table 3.6 Lighting Control Frame

Command Name		Lighting Control Frame		
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Steer-by-wire chassis	Decision-making control un it	0x231	20ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Lighting control enable flag	unsigned int8	0x00 Control command invalid 0x01 Lighting control enable	

byte [1]	Front light mode	unsigned int8	0x00 Always on 0x01 Always off 0x02 Breathe light mode 0x03 User-defined brightness
byte [2]	Custom brightness of front light	unsigned int8	[0, 100], where 0 refers to no brightness, 100 refers to maximum brightness
byte [3]	Reserved	--	0x00
byte [4]	Reserved	--	0x00
byte [5]	Reserved	--	0x00
byte [6]	Reserved	-	0x00
byte [7]	Count paritybit (count)	unsigned int8	0 - 255 counting loops, which will be added once every command sent

The control mode frame include set the control mode of chassis. For its detailed content , please refer to Table 3.7.

Table 3.7 Control Mode Frame Instruction

Command Name	Control Mode Setting Frame			
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Steer-by-wire chassis	Decision-making control unit	0x421	None	None
Data length	0x01			
Position	Function	Data type	Description	
byte [0]	Control mode	unsigned int8	0x00 Remote control mode 0x01 CAN command control mode[1]	

Note 1, Control mode instruction

The default is standby mode, and you need to switch to command mode to send motion control commands. If the remote control is turned on, the remote control has the highest authority and can block command control. When the remote control switches to command mode, it still needs to send a control mode setting command before it can respond to the speed command.

The status position frame includes clear error message. For its detailed content , please refer to Table 3.8.

Table 3.8 Status position Frame Instruction

Command Name		Status position Frame		
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Steer-by-wire chassis	Decision-making 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 errors of motor 1 0x02 Clear errors of motor 2	

Table 3.9 Odometer Feedback Instruction

Command Name		Odometer Feedback Instruction		
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Steer-by-wire chassis	Decision-making control unit	0x311	None	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Left tyre highest odometer	signed int32	Data of left tyre odometer Unit mm	
byte [1]	Left tyre second highest odometer			

byte [2]	Left tyre second lowest odometer		
byte [3]	Left tyre lowest odometer		
byte [4]	Right tyre highest odometer	signed int32	Data of right tyre odometer Unit mm
byte [5]	Right tyre second highest odometer		
byte [6]	Right tyre second lowest odometer		
byte [7]	Right tyre lowest odometer		

The chassis status information will be feed back; what's more, the information about motor. The following feedback frame contains the information about motor :

The serial numbers of 2 motors in the chassis are shown in the figure below:

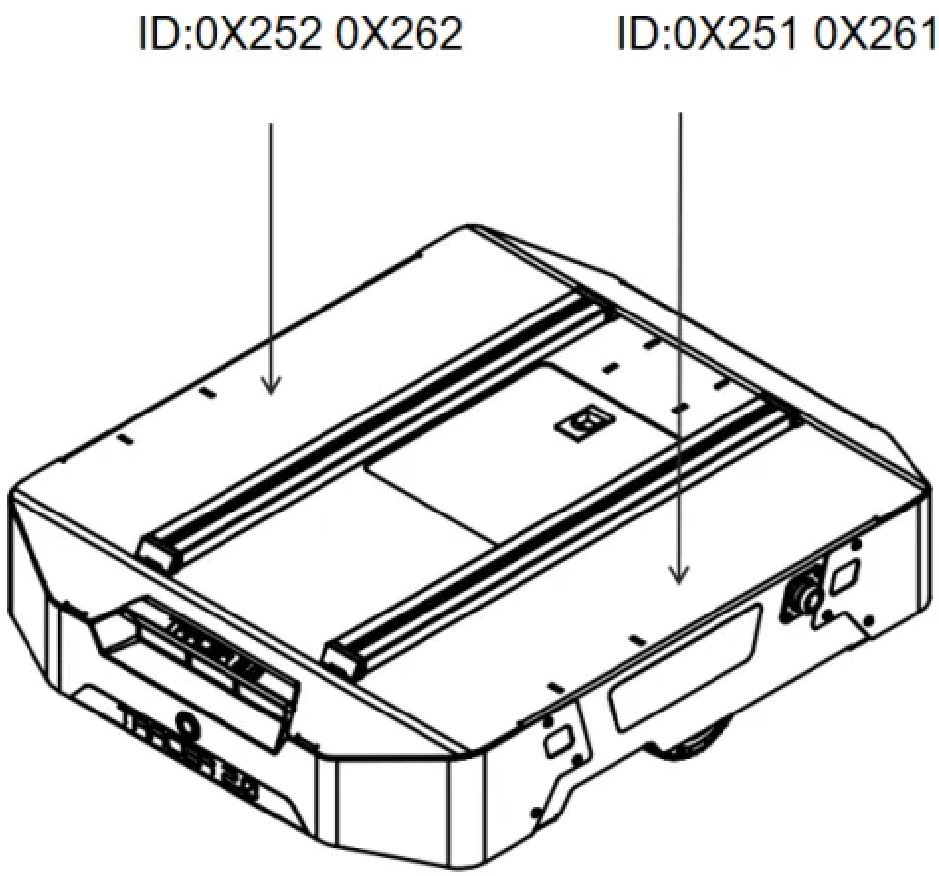


Figure 3.0 Motor Feedback ID schematic diagram

Table 3.10 Motor High-speed Information Feedback Frame

Command Name	Motor High-speed Information Feedback Frame			
Sending node	Receiving node	ID	Cycle (ms)	Receive-timeout (ms)
Decision-making control unit	Steer-by-wire chassis	0x251~0x252	20ms	None
Data length	0x08			
Position	Function	Data type	Description	

byte [0] byte [1]	Motor rotational speed higher 8 bits Motor rotational speed lower 8 bits	signed int16	Motor rotational speed Unit：RPM
byte [2]	Reserved	–	0x00
byte [3]	Reserved	––	0x00
byte [4]	Reserved	––	0x00
byte [5]	Reserved	––	0x00
byte [6]	Reserved	–	0x00
byte [7]	Reserved	–	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)	Receive–timeout (ms)
Decision–making control un it	Steer–by–wire chassis	0x261~0x262	100ms	None
Data length	0x08			
Position	Function	Data type	Description	
byte [0]	Reserved	–	0x00	
byte [1]	Reserved	–	0x00	
byte [2]	Reserved	–	0x00	
byte [3]	Reserved	–	0x00	
byte [4]	Reserved	–	0x00	
byte [5]	Driver status	–	Details are shown in Table 3.12	

byte [6]	Reserved	–	0x00
byte [7]	Reserved	–	0

Table 3.12 Description of Failure Information

Description of Failure Information		
byte [5]	bit [0]	Reserved
	bit [1]	Reserved
	bit [2]	Reserved
	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 cable connection

FOR WIRE DEFINITIONS, PLEASE REFER TO TABLE 2.2.

Figure 3.2 Schematic Diagram of Aviation Male Plug

Note:The maximum achievable output current is typically around 5 A.

3.3.3 Implementation of CAN command control

Correctly start the chassis of TRACER 2.0 mobile 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, TRACER 2.0 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

To facilitate users to upgrade the firmware of the chassis and bring customers a better experience, the TRACER 2.0 chassis provides a hardware interface and a software for upgrading firmware. The GUI (Graphical User Interface) of the software is shown in the figure below.

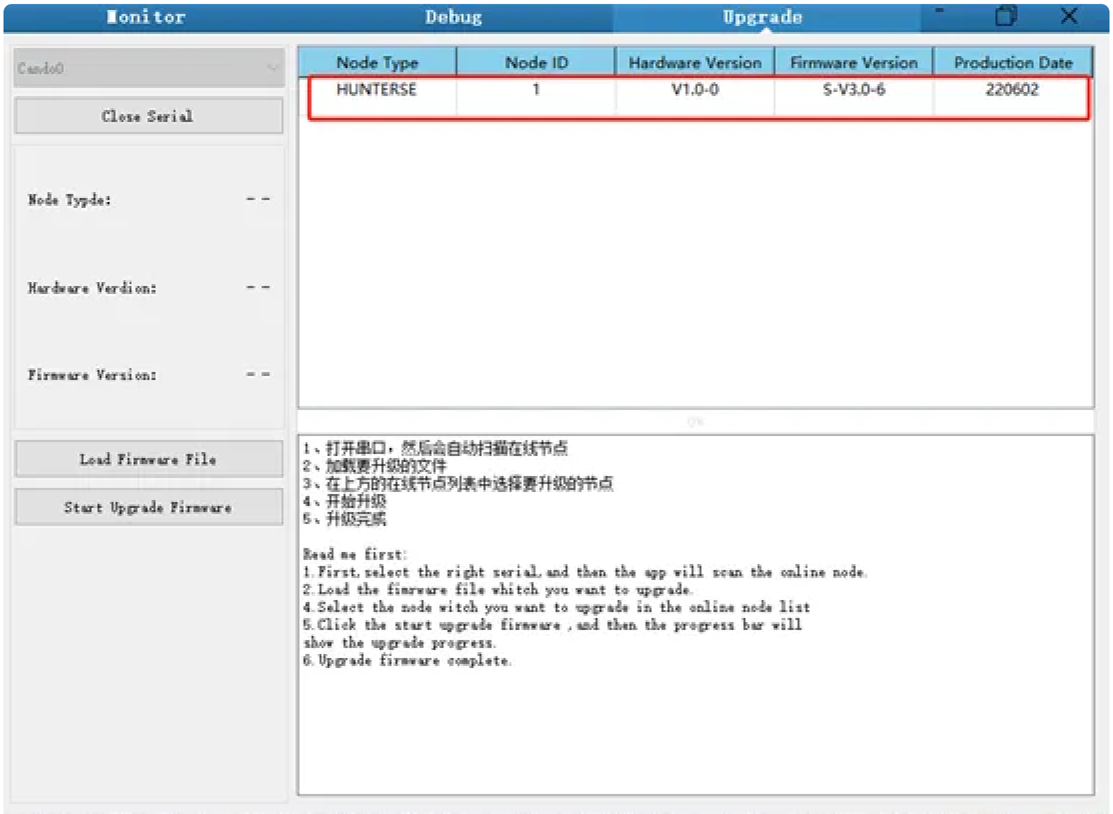
Upgrade Preparation

- Agilex CAN debugging module X 1
- Micro USB cable X 1
- TRACER 2.0 chassis X 1
- A computer (WINDOWS OS (Operating System)) X 1

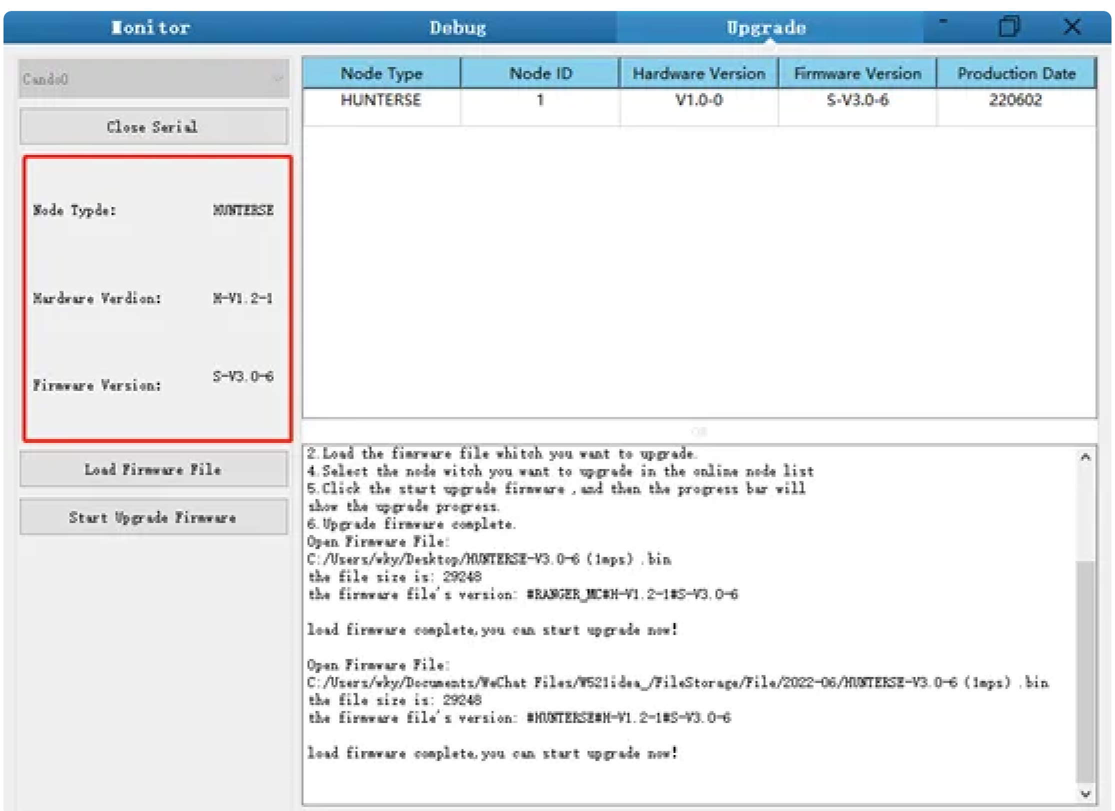
Upgrade Process

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).

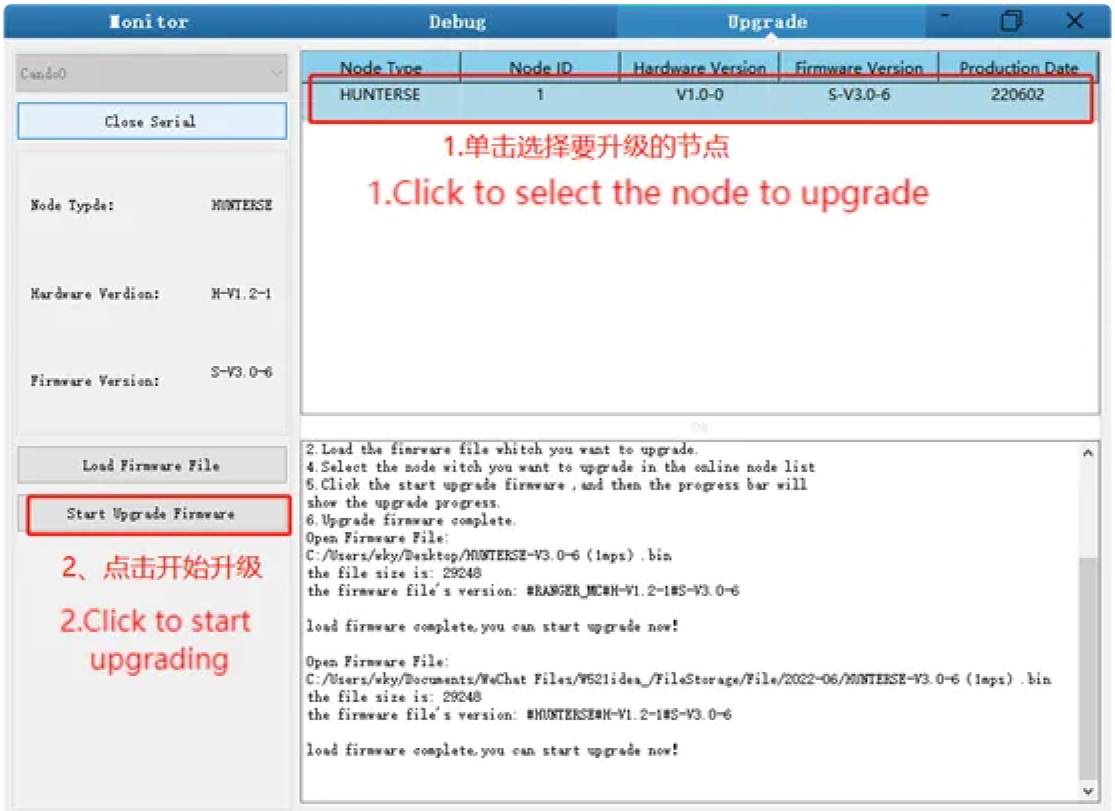
2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

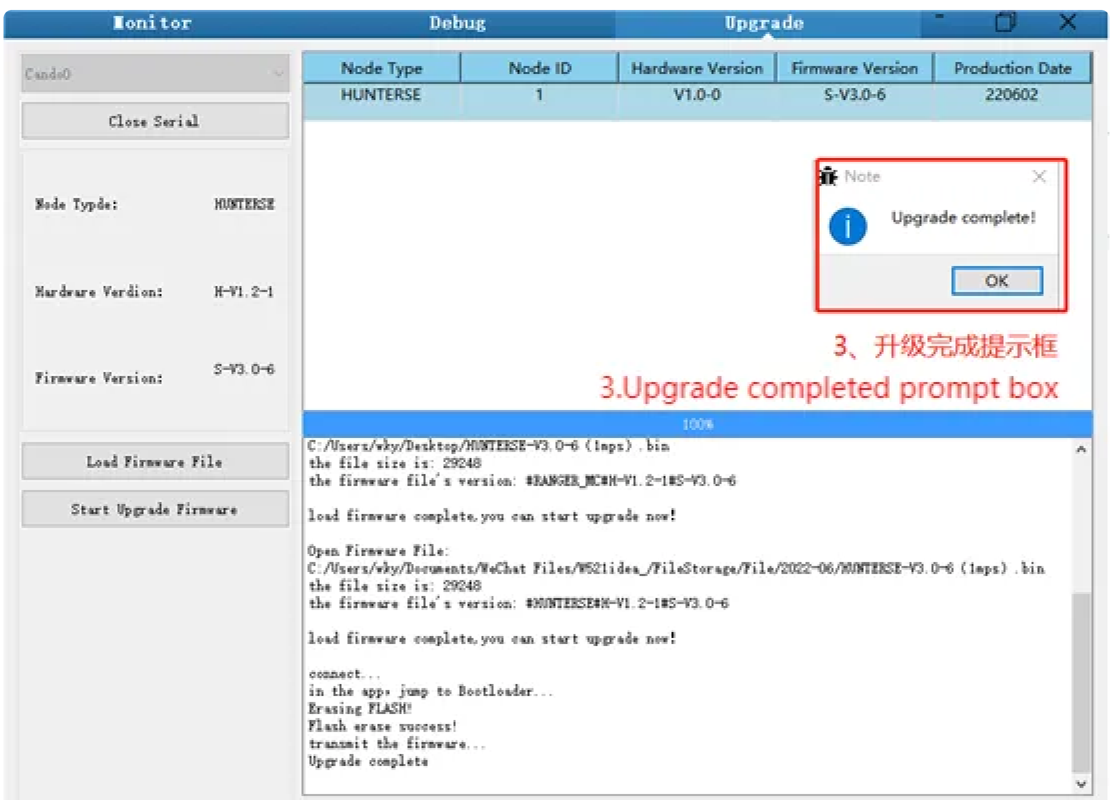


3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure



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 2.0 ROS Package usage 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.

Development Preparation

Hardware preparation

- CANlight can communication module ×1
- Thinkpad E470 notebook ×1
- AGILEX TRACER 2.0 mobile robot chassis ×1
- AGILEX TRACER 2.0 remote control FS-i6s ×1
- AGILEX TRACER 2.0 top aviation power socket ×1

Use example environment description

- Ubuntu 18.04 LTS
- ROS
- Git

Hardware connection and preparation

- Lead out the CAN wire of the TRACER 2.0 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 TRACER 2.0 mobile 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.

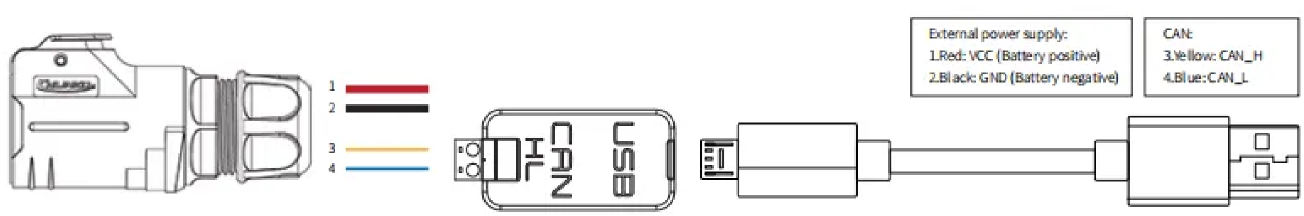


Figure 3.4 CAN connection diagram

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 TRACER 2.0 robot this time, and the car has been turned on, use the following commands to monitor the data from the TRACER 2.0 chassis

$ candump can0

- Please refer to:

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

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

AGILEX TRACER 2.0 ROS PACKAGE download and compile

- Download ros package

$ 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 compile tracer_ros code

$ cd ~/catkin_ws/src

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

$ git clone https://github.com/agilexrobotics/tracer_ros.git –b tracer2.0

$ cd ..

$ catkin_make

Please refer to：https://github.com/agilexrobotics/tracer_ros/tree/tracer2.0

Start the ROS node

- Start the based node

$ 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 2.0 is started up correctly, but why cannot the RC transmitter control the vehicle body to move?

A：First, check whether the drive power supply is in normal condition, whether the drive power switch is pressed down and whether E–stop switches are released; then, check whether the control mode selected with the top left mode selection switch on the RC transmitter is correct.

Q:TRACER 2.0 remote control is in normal condition, and the information about chassis status and movement can be received correctly, but when the control frame protocol is issued, why

cannot the vehicle body control mode be switched and the chassis respond to the control frame protocol?

A:Normally, if TRACER 2.0 can be controlled by a RC transmitter, it means the chassis movement is under proper control; if the chassis feedback frame can be accepted, it means CAN extension link is in normal condition. Please check the CAN control frame sent to see whether the data check is correct and whether the control mode is in command control mode.

Q:TRACER 2.0 gives a “beep-beep-beep...” sound in operation, how to deal with this problem?

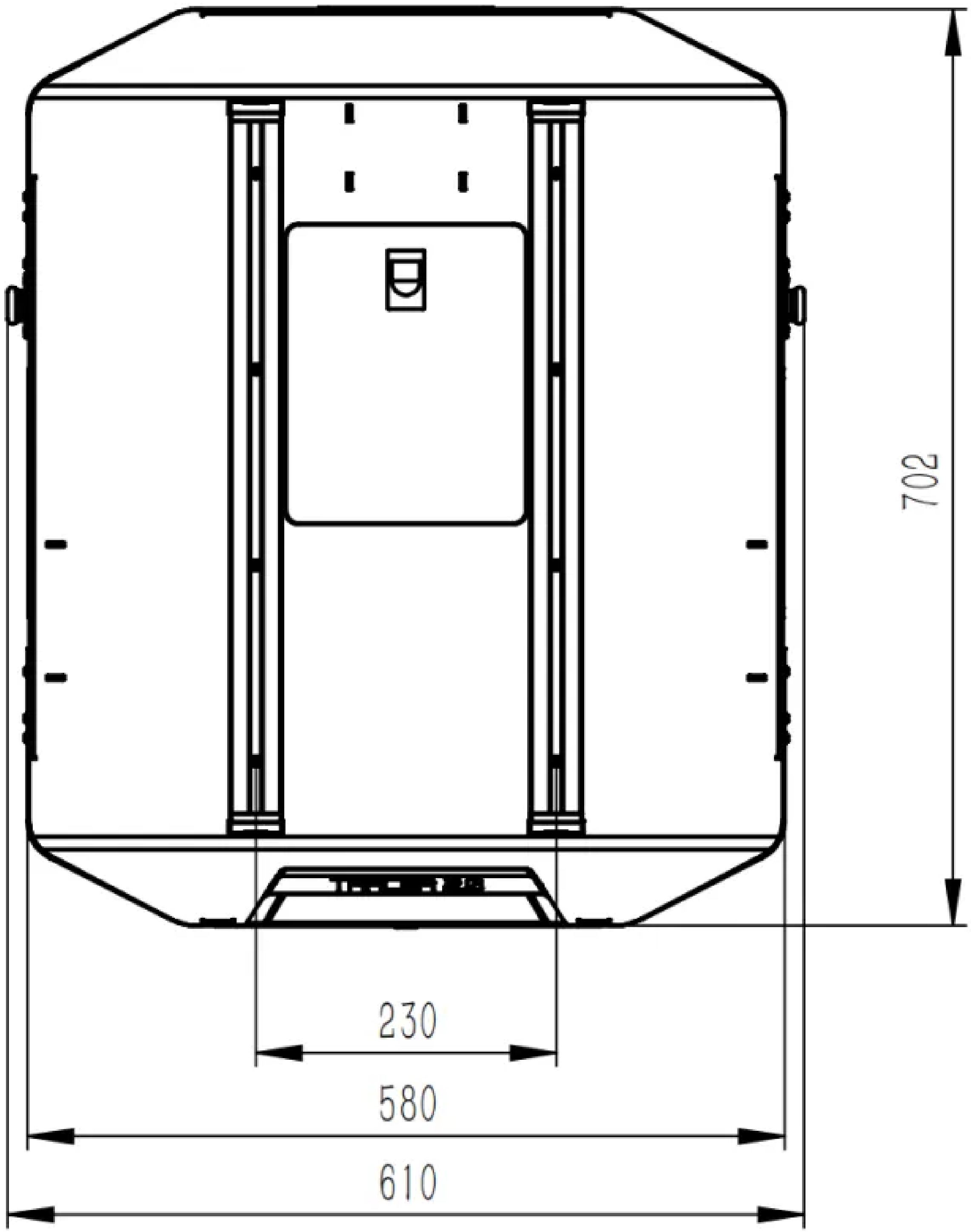
A:If TRACER 2.0 gives this “beep-beep-beep” sound continuously,it means the battery is in the alarm voltage state. Please charge the battery in time. Once other related sound occur, there may be internal errors. You can check related error codes via CAN bus or communicate with related technical personnel.

Q:When communication is implemented via CAN bus, the chassis feedback command is issued correctly, but why does not the vehicle respond to the control command?

A:There is a communication protection mechanism inside TRACER 2.0, which means the chassis is provided with timeout protection when processing external CAN control commands. Suppose the vehicle receives one frame of communication protocol, but it does no receive the next frame of control command after 500ms. In this case, it will enter communication protection mode and set the speed to 0. Therefore, commands from upper computer must be issued periodically.

5 Product Dimensions

5.1 Illustration diagram of product external dimensions


702
230
580
610