HUNTER SE USER MANUAL

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Document version

Safety Information

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HUNTER SE USER MANUAL



HUNTER SE

AgileX Robotics Team

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Document version

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1	V.2.0.0	2023/08/23	谢瑞亲		Update the ROS package usage section Add picture Format adjustment

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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 robot application, nor does it include all peripheral equipment that may affect the safety of the complete system. 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.

HUNTER SE 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 machinerydefined bytheriskassessmenttogether.
- Confirm that the design and installation of the entire robot system's peripheral equipment, including softwareand hardwaresystems,are correct.
- This robot does not have the relevant safety functions of a complete autonomous mobile robot, including but not limited to automatic anti-collision, anti-falling, creature approach warning, etc. Relevant functions require integrators and end customers to conduct safety assessment in accordance with relevant provisions and applicable laws and regulations to ensure that the developed robot is free of any major hazards and hidden dangersin practicalapplication.
- Collect all the documents in the technical file: includingriskassessment andthismanual.

Environmental

- For the first use, please read this manual carefully to understand the basic operating content and operating specification.
- Itisstrictlyforbidden to carry people

- For remote control operation, select a relatively open area to use HUNTER SE, because it is not equipped with any automatic obstacle avoidance sensor.Please keep a safe distance of more than 2 meters when HUNTERSE is moving.
- UseHUNTERSEunder -10°C ~ 45°C ambienttemperature.
- The waterproof and dust-proof capability of HUNTERSEisIP22.

Pre-work Checklist

- Makesureeachequipmenthassufficientpower.
- Make sure the vehicle does not have any obvious defects.
- Check if the remote controller battery has sufficient power.
- When using, make sure the emergency stop switch hasbeen released.

Operation

- Make sure the area around is relatively spacious in use.
- Carry out remote control within the range of visibility.
- The maximum load of HUNTERSE is 50KG. When in use, ensure that the payload does not exceed50KG.
- When installing an external extension, confirm the position of the center of mass of the extension and makesure itisatthecenterofthevehicle.
- Please charge in time when the equipment is low batteryalarm.
- When the equipment has a defect, please immediately stop using it to avoid secondary damage.

Maintenance

- Regularly check the pressure of the tire, and keep the tirepressure atabout2.0BAR.
- If the tire is severely worn or burst, please replace it in time.
- If the battery is not used for a long time, the battery needs to be charged periodically every 2 to 3 months.
- When the equipment has a defect, please contact the relevant technical to deal with it, and do not handle thedefectbyyourself.
- Please use it in an environment that meets the requirements of the protection level according to the IPprotection levelofthe equipment.
- When charging, make sure the ambient temperature isabove 0°C.

Attention

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

Battery

- The battery supplied with HUNTER SE is not fully charged in the factory setting, but its specific power capacity can be displayed on the voltmeter at rear end of HUNTER SE 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 fullycharged.
- Please do not charge the battery after its power has been depleted, and please charge the battery in time when low battery level alarmis 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. Do not charge the battery below 0°C, and do not use batteries, power supplies,and chargers that are not standard.
- HUNTER SE only supports the replacement and use of the battery provided by us, and the battery can becharged separately.

Usage environment

- The operating temperature of HUNTER SE is -10℃to 45℃; please do not use it below -10℃ or above 45℃;
- The requirements for relative humidity in the operational environment of HUNTER SE are: maximum80%,minimum30%;
- Please do not use it in the environment with corrosive and flammable gases or closed to combustible substances;
- Do not store it around heating elements such as heatersorlarge coiled resistors;
- HUNTER SE is not water-proof, thus please do not use it in rainy, snowy or water-accumulated environment;
- It is recommended that the altitude of the operational environmentshould notexceed 1000M;
- It is recommended that the temperature difference between day and night in the operational environment should notexceed 25°C;

Electrical external extension

- For the extended power supply at rear end, the current should not exceed 10A and the total power should not exceed 240W;
- The top and tail extended power supply current, each socket cannot be greater than 24V10A, the total output current cannot be greater than 15A, and the total power cannot exceed 360W.
- When the system detects that the battery voltage is lower than the safe voltage, external power supply extensions will be actively switched off. Therefore, users are suggested to notice if external extensions involve the storage of important data and have no power-offprotection.

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 HUNTER SE Introduction

HUNTERSE is an Ackermann model programmable UGV (UNMANNED GROUND VEHICLE), which is a chassis designed with Ackermann steering, with similar characteristics to cars, and has obvious advantages on ordinary cement and asphalt roads. Compared with the four-wheel differential chassis, HUNTERSE has higher load capacity, can achieve higher movement speed, and at the same time wear less to the structure and tires, suitable for long-term work. Although HUNTERSE is not designed for all-terrain, it is equipped with swing arm suspension and can pass through common obstacles such as speed bumps. Stereo camera, lidar, GPS, IMU, manipulator and other equipment can be optionally installed on HUNTERSE for extended applications. HUNTERSE can be applied to unmanned inspection, security, scientific research, exploration, logistics and other fields.

1.1 Component list

Name	quantity
HUNTERSE robot body	X1

Battery charger (AC 220V)	X1
Aviation plug(4Pin)	X1
FS remote controller(optional)	X1
USBto CAN communicationmodule	X1

1.2 Tech specifications

Type	Items	Parameters
Mechanical	Dimensions (mm)	820×640×310
	Axle Track (mm)	550
	Front/rear track (mm)	520
	Kerb weight (Kg)	42
	Battery type	Lithium battery
	Battery parameters	24V 30Ah
	Power drive motor	DC brushless 2 X 350W
	Steering drive motor	DC brushless150W
	Parking type	Loss of power electromagnetic brake
	Steering type	Front wheel Ackermann
	Suspension	Front wheel non-independent suspension + rear wheel independent suspension
	Drive motor reduction ratio	1：4
	Drive motor sensor	Magnetic encoder 1000

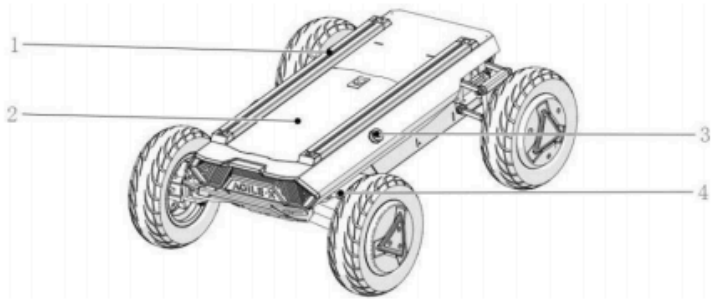
Performation	IP grade	IP22
	Maximum speed（km/h）	4.8
	Minimum turning radius (mm)	1.9
	Maximum gradeability (°)	Full load ≤20°
	Maximum inner wheel steering angle	22°
	Steering accuracy	0.5
	Ground clearance (mm)	120mm
	Maximum endurance (h)	10.5
	Maximum travel (km)	20KM (24V30Ah Battery)
	Charging time (h)	3h (24V30Ah Battery) 1.5h (24V60Ah Battery)
	Working temperature (℃)	-10~40
Control	Control mode	Remote control mode Command control mode
	Remote controller	2.4G/limit distance 100M
	Communication Interface	CAN

1.3 Requirement for development

FS RC transmitter is provided (optional) in the factory setting of HUNTER SE, which allows users to control the chassis of robot to move and turn; HUNTER SE is equipped with CAN interface, and users can carry out secondary development through it.

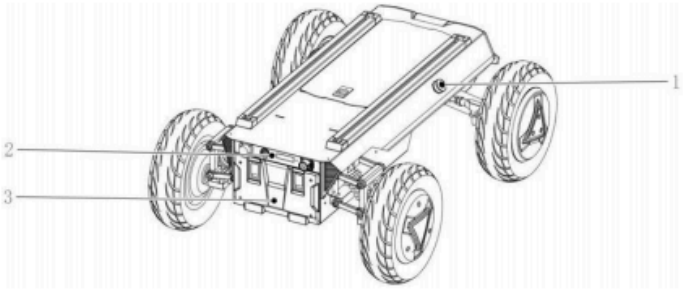
2 The Basics

This section will give a basic introduction to the HUNTER SE mobile robot chassis, so that users and developers have a basic understanding of the HUNTER SE chassis. Figures 2.1 and 2.2 below provide the views of the entire mobile robot chassis.



1.Profile Support
2. Top cabin panel
3. Emergency stop button
4. Steering mechanism

Figure2.1 FrontView



1. Emergency stop switch
2. Rear electrical panel
3. Battery replacement pane

Figure2.2 RearView

HUNTER SE adopts a modular and intelligent design concept as a whole. The vacuum rubber wheel and powerful DC brush-less servo motor are used on the power module, which makes the HUNTER SE robot chassis development platform have a strong pass ability. And it is also easy for HUNTER SE to cross obstacles with the front wheel bridge suspension. Emergency stop switches are installed on both sides of the vehicle body, so that emergency stop operations can be performed quickly in the event of an emergency, so as to avoid safety accidents and reduce or avoid unnecessary losses. The rear of HUNTER SE 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 connectors in the design and selection, which is beneficial to the expansion and use of users on the one hand, and enables the robot platform to be used in some harsh environments on theother hand.

2.1 Status indication

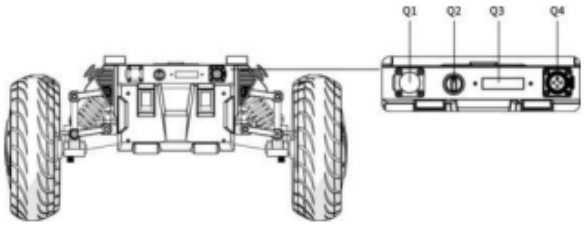
Users can identify the status of vehicle body through the voltmeter, the beeper and lights mounted on HUNTERSE. For details, please refer to Figure 2.1.

Status	Description
Current voltage	The current battery voltage can be viewed throu gh the voltmeter in the rear electrical panel.
Low voltage alarm	When the battery voltage is lower than 24.5V (if the BMS is connected, the SOC is judged to be lower than 15%), the vehicle body will make a harsh sound of "Beep-Beep-Beep" to prompt. When the battery voltage is detected to be lower than 24V (if the BMS is connected, the SOC is judged to be lower than 10%), HUNTER SE will actively cut off the external expansion power supply and driver power supply in order to prevent battery damage. At this time, the chassis will not be able to perform motion control and accept external command control.
Power on display	The tail voltmeter lights up

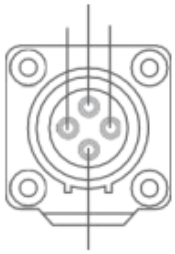
2.2 Instructions on electrical interfaces

2.2.1 Instructions on rear electrical interface

The extension interface at the rear is shown in Figure 2.6, in which Q1 is the charging interface; Q2 is the power switch; Q3 is the power display interaction; Q4 is the CAN and 24V power extension interface.



Thedefinition ofQ4’ sspecific pin isshown in Figure 2.7.



Pin No.	Pin Type	Function and Definition	Remarks
1	Power	VCC	Power positive, voltage range 24.5~26.8v, maximum current 10A
2	Power	GND	Power negative
3	CAN	CAN_H	CAN bus high
4	CAN	CAN_L	CAN bus low

Figure 2.7 Pin Instruction oftheRearAviation Interface

2.3 Instructions on remote control

FS remote control is an optional accessory for HUNTER SE. Customers can choose according to actual needs. The remote control can easily control the HUNTER SE universal robot chassis. In this product, we use the left-hand throttle design. Refer to Figure 2.8 for its definition and function.

The functions of the buttons are defined as: SWA is temporarily not activated. SWB is the control mode selection lever, which is the command control mode when it is turned to the top, and the remote control mode when it is turned to the middle. SWC controls the speed. When it is in the top mode, the linear velocity of the robot is 1.5m/s. If SWC is in the middle mode, the velocity is 3m/s. The bottom mode is 4.8m/s. S1 is the throttle button, which controls the HUNTER SE Forward and backward; S2 controls the steering of the front wheels, and POWER is the power button. Press and hold at the same time to turn on.

Note: The mapping of the remote control has been set before leaving the factory, please do not change it at will.



Figure 2.8 Schematic diagram of the FS remote control buttons

Remote control interface description:

Hunter : 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

We set up a coordinate reference system for ground mobile vehicle according to the ISO 8855 standard as shown in Figure 2.9.

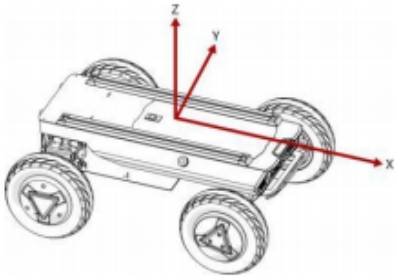


Figure 2.9 SchematicDiagramofReferenceCoordinate SystemforVehicleBody

As shown in Figure 2.9, the vehicle body of HUNTERSE is in parallel with X axis of the established reference coordinate system. In the remote control mode, push the remote control stick S1 forward to move in the positive X direction, and push S1 backward to move in the negative X direction. When S1 is pushed to the maximum value, the movement speed in the positive X direction is the maximum; when S1 is pushed to the minimum value, the movement speed in the negative X direction is the maximum; the remote control stick S2 controls the steering of the front wheels of the vehicle body; push S2 to the left, and the vehicle turns to the left; push it to the maximum,and the steering angle is the largest; push S2 to the right, and the vehicle turns to the right; push it to the maximum, and the right steering angle is the largest at this time. In the control command mode, the positive value of the linear velocity means movement in the positive direction of the X axis, and the negative value of the linear velocity means movement in the negativedirection of the X axis; the steering angle is thesteering angle of the inner wheel.

This section mainly introduces the basic operation and use of the HUNTERSE platform, and how to carry out the secondary development of HUNTERSE through the external CAN interface and the CAN bus protocol.

3 Getting Started

3.1 Use and operation

Thebasic operation process of thestartup operation is as follows:

Check

- Check the condition of HUNTER SE. Check whether there are significant anomalies; if so, please contacttheafter-saleservicepersonalforsupport;
- Check the state of emergency-stop switches. Make suretheemergencystopbuttons arereleased;
- When using for the first time, make sure that Q2 (knob switch) in the rear electrical panel is vertical, and the HUNTER SE is in a power-off state at this time.

Startup

- Turn the knob switch to the horizontal state (Q2); under normal circumstances, the voltmeter normally displaysthebattery voltage;
- Check the battery voltage, and the normal voltage range is 24.5~26.8V; if there is a continuous "beep-beep-beep..." sound from the beeper, it means that the battery voltage is too low, then please charge itintime.

Shutdown

- Turn the knob switchto verticalto cutoffthe power.

Emergency stop

- Press the emergency stop switch on the side of the HUNTER SE vehicle body.

Basic operating procedures of remote control

- After the HUNTER SE mobile robot chassis is started correctly, turn on the RC transmitter and set SWB to the remote controlmode. Then,HUNTER SE platform movement can be controlled by the RC transmitter.

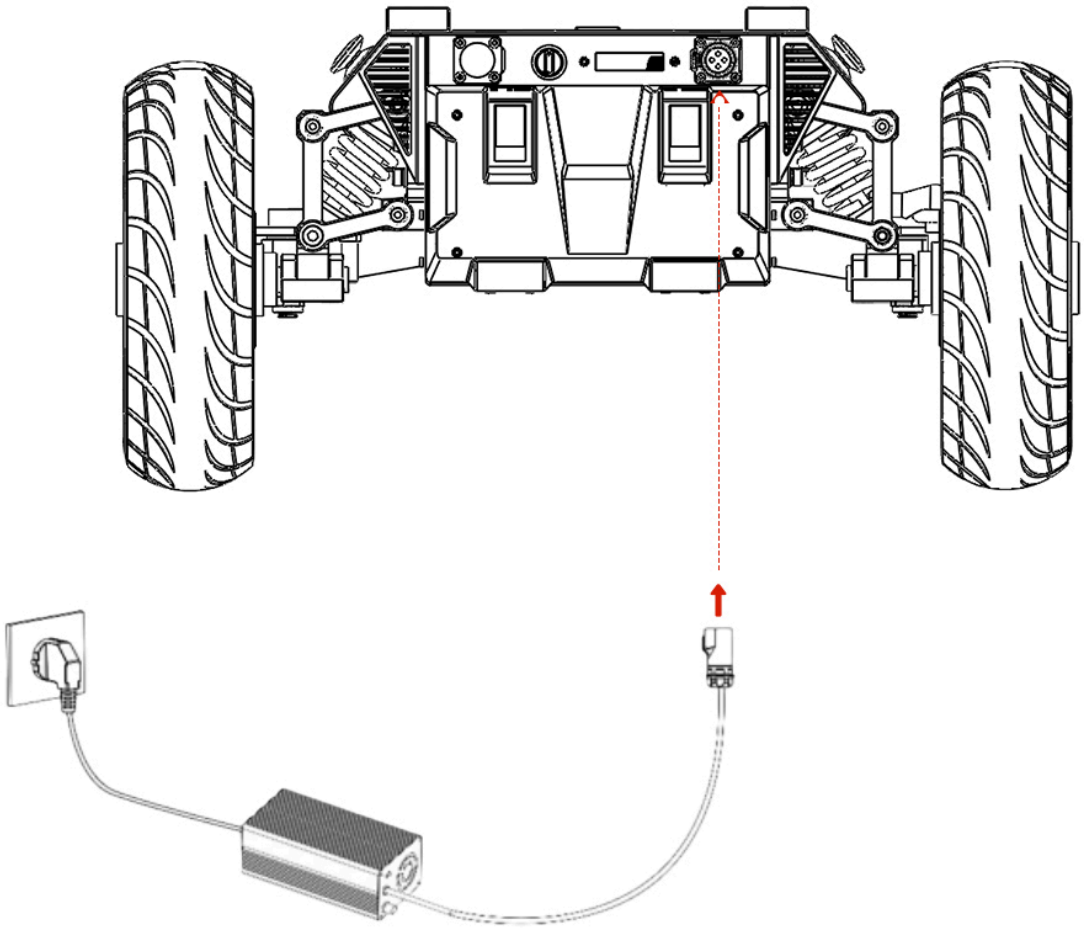
3.2 Charging and battery replacement

HUNTER SE products are equipped with a 10A charger by default in the car, which can meet charging needs. During normal charging, there is no indicator light on the chassis to indicate the charging status of the vehicle. Please judge whether it is currently charging according to the charger status indicator light.

The specific operating procedures of charging are as follows:

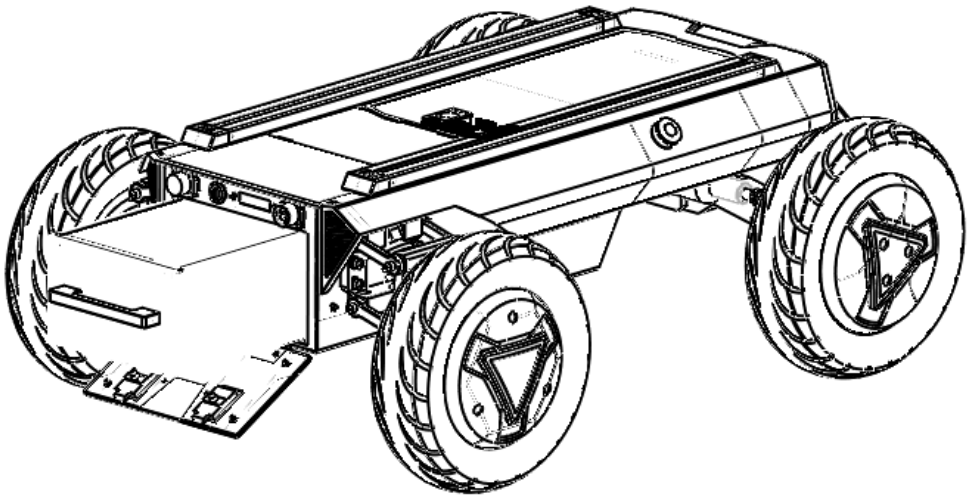
- Make sure that the HUNTER SE chassis is in a shutdown state. Before charging, please make sure that the power switch in the rear electrical console is turnedoff;
- Insert the plug of the charger into the Q1 charging interfacein thereelectricalcontrolpanel;
- Connect the charger to the power supply and turn on the charger switch to enter the charging state.

Note: For now, the battery needs about 3 hours to be fully recharged from 24.5V, and the voltage of a fully recharged battery is about 26.8V



Battery replacement

- Turn off the power switch of the HUNTER SE chassis
- Press the button lock on the battery replacement panel to open the battery panel
- Unplug the currently connected battery interface, respectively (XT60 power connector) (BMS connector) lock
- Take out the battery, note that the battery is not allowed to hit and collide during this process
- Install the battery to be used and plug the connector back into the
- Turn off the power to replace the panel, press the lock



3.3 Development

The CAN communication standard in HUNTER SE adopts CAN2.0B standard, the communication baud rate is 500K, and the message format adopts MOTOROLA format. The linear velocity and steering angle of the chassis movement can be controlled through the external CAN bus interface; HUNTER SE will feedback the current movement status information and the status information of the HUNTER chassis in real time. The system status feedback command includes current vehicle 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 Feedback Frame of HUNTER SEChassis System Status

Command Name	SystemStatusFeedbackCommand			
Sending node	Receiving node	ID	Cycle（ms）	Receive time-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x211	100ms	None
Data length	0x08			
Position	Function	Datatype	Description	

byte[0]	Current status of vehicle body	unsignedint8	0x00 Normal condition 0x01 Emergency stop mode 0x02 System exception
byte[1]	Modecontrol	unsignedint8	0x00 Standby mode 0x01CAN command control mode 0x03 Remote control mode
byte[2] byte[3]	The battery voltageis 8 bits higher The battery voltageis 8 bits lower	unsignedint16	Actual voltage× 10(with an accuracy of 0.1V)
byte[4] byte[5]	The failure information is 8 bits higher The failure information is 8 bits lower	unsignedint16	Refer to remarks [Description of Failure Information]
byte[6]	Reserved	-	0x00
byte[7]	Count check (count)	unsignedint8	0~255 cycle count;every time an instruction issent,the count will increase once

Description of Fault		
byte	Bit	Meaning

byte[4]	bit[0]	Motor over temperature fault (0: No failure 1: failure)
	bit[1]	Driver over current fault (0: No failure 1: failure)
	bit[2]	Driver status error (0:No failure1:Failure)
	bit[3]	Reserved,default 0
	bit[4]	Reserved,default 0
	bit[5]	Reserved,default 0
	bit[6]	Reserved,default 0
	bit[7]	Reserved,default 0
byte[5]	bit[0]	Battery under-voltage failure(0:No failure1:Failure)
	bit[1]	Steering zero setting error (0:No failure1:Failure)
	bit[2]	Remote controller communication connection (0:No failure1:Failure)
	bit[3]	Steering motor driver communication failure (0:No failure 1:Failure)
	bit[4]	Rear right motor driver communication failure(0:No failure1:Failure)
	bit[5]	Rear left motor driver communication failure(0:No failure 1:Failure)
	bit[6]	Reserved,default 0
	bit[7]	Emergency stop (0:No failure1:E-stop is triggerd)

The command of movement control feedback frame includes the feedback of current linear velocity and steering angle of moving vehicle body. The specific protocol content is shown in

Table3.2.

Table 3.2 Movement Control Feedback Frame

Command Name	Movement Control Feedback Frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out (ms)
Steer-by-wire chassis	Decision-making controluni	0x221	20ms	None
Datalength	0x08			
Position	Function	Datatype	Description	
byte[0] byte[1]	The movement speed is 8 bits higher The movement speed is 8 bits lower	signedint16	Actual speed × 1000 (with an accuracy of 0.001m/s)	
byte[2]	Reserved		0x00	
byte[3]	Reserved		0x00	
byte[4]	Reserved		0x00	
byte[5]	Reserved		0x00	
byte[6] byte[7]	The angle is 8 bits higher The angle is 8 bits lower	Signedint16	Actual inner angle X 1000 (unit:0.001rad)	

The movement control frame includesthe linear velocity control command and the front wheel inner angle control command.The specific protocol content is shown inTable 3.3.

Table 3.3 Motion Control Instruction Control Frame

Command Name	Motion Command			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Decision-makingcontrol unit	Chassis node	0x111	20ms	500ms

Datalength	0x08			
Position	Function	Datatype	Description	
byte[0] byte[1]	The linear velocity is 8 bits higher The linear velocity is 8 bit slower	signed int16	Moving speed of vehicle body, unit:mm/s（effective value: +-4800)	
byte[2]	Reserved	—	0x00	
byte[3]	Reserved	—	0x00	
byte[4]	Reserved	—	0x00	
byte[5]	Reserved	—	0x00	
byte[6] byte[7]	The angle is 8 bits higher The angle is 8 bits lower	signed int16	Steering inner angle unit:0.001rad (effective value+-400)	

PS: In the CAN command mode, it is necessary to ensure that the 0X111 command frame is sent in a period less than 500MS (recommended period is 20MS), otherwise HUNTER SE will judge that the control signal is lost and enter an error (0X211 feedback that the upper layer communication is lost). After the system reports an error, it will enter the standby mode. If the 0X111 control frame returns to the normal sending period at this time, the upper layer communication disconnection error can be automatically cleared, and the control mode returns to the CAN control mode.

The mode setting frame is used to set the control interface of HUNTER SE. The specific protocol content is shown in Table 3.4.

Table 3.4 Control Mode Setting Command

Command Name	Control Mode Setting Command			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Decision-mak ingcontrol unit	Chassisnode	0x421	none	none

Datalength	0x01			
Position	Function	Datatype	Description	
byte[0]	Control mode	unsigned int8	0x00 Standby mode 0x01 CAN command mode, enters standby mode by default after power-on	

Description of control mode: In case the HUNTERSE is powered on and the RC transmitter is not connected, the control mode is defaulted to standby mode. At this time, the chassis only receives control mode command, and does not respond to other commands. To use CAN for control, you need to switch to CAN command mode at first. If the RC transmitter is turned on, the RC transmitter has the highest authority, can shield the control of command and switch the control mode.

Thestatus setting frame is used to clear system errors. The protocol content is shown in Table 3.5.

Table 3.5 Status Setting Frame

Command Name	Status Setting Command			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Decision-making control unit	Chassis node	0x441	none	none
Datalength	0x01			
Position	Function	Datatype	Description	
byte [0]	error clearing command	unsigned int8	0x00 Clear all non-critical failures 0x01 Clear battery undervoltage failure 0x04 Clear the communication failure of the steering motor driver 0x05 Clear the communication failure of the rear right motor driver 0x06 Clear the communication failure of the rear left motor driver	

[Note] Sample data, the following data is only for testing

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

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

2.The chassis steering 0.2rad

byte [0]	byte [1]	byte [2]	byte [3]	byte [4]	byte [5]	byte [6]	byte [7]
0x00	0x00	0x00	0x00	0x00	0x00	0x00	0xC8

The chassis status information will be feedback, and what’ s more, the information about motor current, encoder and temperature are also included. The following feedback frame contains the information about motor current, encoder andmotor temperature.

The corresponding motor numbers of the three motors in the chassis are: steering No. 1, right rear wheel No. 2, left rear wheel No. 3

Themotor speed current position information feedback is shown in Table 3.6 and 3.7.

Table 3.6 Motor Drive High Speed Information Feedback Frame

Command Name	Motor Drive High Speed Information Feedback Frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x251~0x253	20ms	None
Datalength	0x08			
Position	Function	Data type	Description	
byte[0] byte[1]	The motor speed is 8 bits higher The motor speed is 8 bits lower	signedint16	Current motor speed Unit RPM	

byte[2] byte[3]	The motor current is 8 bits higher The motor current is 8 bits lower	signedint16	Motor current Unit 0.1A
byte[4] byte[5] byte[6] byte[7]	Reserved	--	0×00

Table 3.7 Motor Drive Low Speed Information FeedbackFrame

Command Name	Motor Drive Low Speed Information Feedback Frame			
Sending node	Receivingnode	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x261~0x263	100ms	None
Datalength	0x08			
Position	Function	Data type	Description	
byte[0] byte[1]	The drive voltage is 8 bits higher The drive voltage is8 bits lower	unsigned int16	Current drive voltage Unit0.1V	
byte[2] byte[3]	The drive temperatureis 8 bits higher The drive temperatureis 8 bits lower	signed int16	Unit1℃	
byte[4]	Motor temperature	signed int8	Unit1℃	
byte[5]	Drive status	unsigned int8	See the details in [Drive control status]	

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

The specific content of the drive status information is shown in Table 3.8.

Table 3.8 Drive Status Description

Drive Status		
Byte	Bit	Description
byte[5]	bit[0]	Whether the power supply voltage is too low(0:Normal1:Too low)
	bit[1]	Whether the motor is over heated (0:Normal1:Overheated)
	bit[2]	Whether the drive is over current(0:Normal1:Overcurrent)
	bit[3]	Whether the drive is over heated (0:Normal1:Overheated)
	bit[4]	Sensor status (0:Normal1:Abnormal)
	bit[5]	Drive error status(0:Normal1:Error)
	bit[6]	Drive enable status(1:Enable 0:Disable)
	bit[7]	Reserved

Steering zero setting and feedback commands are used to calibrate the zero position. The specific contents of the protocol are shown in Table 3.10 and 3.11.

Table 3.10 Steering Zero Setting Command

Command Name	Steering Zero Setting Frame

Sendingnode	Receivingnode	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x432	None	none
Datalength	0x01			
Position	Function	Datatype	Description	
byte[0]	The zero offset is 8 bits higher	signedint16	Zero offset value pulse numbe reference value 22000+-10000	
byte[1]	The zero offset is 8 bits lower			

Table 3.11 Steering Zero Setting Feedback Command

Command Name	Steering Zero Setting Feedback Frame			
Sendingnode	Receivingnode	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x43B	None	none
Datalength	0x02			
Position	Function	Datatype	Description	
byte[0]	The zero offset is 8 bits higher	signedint16	Beyond the settable range, the chassis will use the default value 22000	
byte[1]	The zero offset is 8 bits lower			

Table 3.12 Steering Zero Query Command

Command Name	Steering Zero Query Command			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Decision-making control unit	Steer-by-wire chassis	0x433	None	none
Datalength	0x01			

Position	Function	Datatype	Description
byte[0]	Query the current zero offset value	unsignedint8	Fixed value:0×AA The query successfully returns 0×43B

BMS Data feedback frame is shown as table 3.13 and 3.14.

Table 3.13 BMS Data Feedback

Command Name	BMS Data Feedback Frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x361	500ms	none
Data length	0x08			
Position	Function	Data Type	Description	
byte [0]	Battery SOC	unsigned int8	Range 0~100	
byte [1]	Battery SOH	unsigned int8	Range 0~100	
byte [2]	The battery voltage is 8 bits higher	unsigned int16	unit：0.01V	
byte [3]	The battery voltage is 8 bits lower	unsigned int16	unit：0.01V	
byte [4]	The battery current is 8 bits higher	signed int16	unit：0.1A	
byte [5]	The battery current is 8 bits lower	signed int16	unit：0.1A	
byte [6]	The battery temperature is 8 bits higher	signed int16	unit：0.1℃	

byte [7]	The battery temperature is 8 bits lower	signed int16	unit：0.1℃

Table 3.14 BMS Status Feedback

Command Name	BMS Status Feedback			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x362	500ms	None
Data Length	0x04			
Position	Function	Data Type	Description	
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：charge 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：charge overcurrent	

Light control command is in Table 3.15

Table 3.15 Light control Frame

Command Name	Light control frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Decision-making control unit	Steer-by-wire chassis	0x121	20ms	500ms
Data length	0x08			

Position	Function	Data Type	Description
byte [0]	Light control enabled label	unsigned int8	0x00 Control command is invalid 0x01 Light control is enabled
byte [1]	Light mode	unsigned int8	0x00 Always off 0x01 Always on
byte [2]	Reserved	_ _	0x00
byte [3]	Reserved	_ _	0x00
byte [4]	Reserved	_ _	0x00
byte [5]	Reserved	_ _	0x00
byte [6]	Reserved	_ _	0x00
byte [7]	Reserved	_ _	0x00

Light control feedback frame is in 3.16

Table 3.16 Light control feedback frame

Command Name	Light control feedback frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x231	20ms	None
Data length	0x08			
Position	Function	Data Type	Description	
byte [0]	Current lighting control enable flag	unsigned int8	0x00 Control command is invalid 0x01Control command is enabled	
byte [1]	Current lighting mode	unsigned int8	0x00 Always off 0x01 Always on	
byte [2]	Reserved	unsigned int8	0x00	
byte [3]	Reserved	_ _	0x00	
byte [4]	Reserved	_ _	0x00	

byte [5]	Reserved	_ _	0x00
byte [6]	Reserved	_ _	0x00
byte [7]	Count	unsigned int8	0~255 loop count, the count is incremented every time an instruction is sent.

The odometer information feedback frame is shown in Table 3.17.

Table 3.17 Odometer Feedback Frame

Command Name	Odometer Feedback Frame			
Sending node	Receiving node	ID	Cycle（ms）	Receivetime-out(ms)
Steer-by-wire chassis	Decision-making control unit	0x311	20ms	None
Data length	0x08			
Position	Function	Data Type	Description	
byte [0]	Left wheel odometer highest position	signed int32	Chassis left wheel odometer feedback, Unit: mm	
byte [1]	Left wheel odometer second highest position	signed int32	Chassis left wheel odometer feedback, Unit: mm	
byte [2]	Left wheel odometer second lowest position	signed int32	Chassis left wheel odometer feedback, Unit: mm	
byte [3]	Left wheel odometer second lowest position	signed int32	Chassis left wheel odometer feedback, Unit: mm	

byte [4]	Right wheel odometer highest position	signed int32	Chassis right wheel odometer feedback, Unit: mm
byte [5]	Right wheel odometer second highest position	signed int32	Chassis right wheel odometer feedback, Unit: mm
byte [6]	Right wheel odometer second lowest position	signed int32	Chassis right wheel odometer feedback, Unit: mm
byte [7]	Right wheel odometer lowest position	signed int32	Chassis right wheel odometer feedback, Unit: mm

3.3.2 CAN cable connection

HUNTER SE is shipped with a aviation plug male connector as shown in Figure 3.2. Refer to Table 3.2 for the definition of thecable.



Figure 3.2 Schematic diagram of the male aviation plug

3.3.3 Implementation of CAN command control

Start the HUNTER SE mobile robot chassis normally, turn on the FS remote control, and then switch the control mode to command control, that is, turn the SWB mode selection of the FS remote control to the top. At this time, the HUNTERSE chassis will accept the command from

the CAN interface, and the host can also analyze the current status of the chassis through the real-time data fed back by the CAN bus at the same time. Refer to CAN communication protocol for specific protocol content.

3.4 Firmware upgrade

To facilitate the customer's upgrading of the firmware version used by HUNTER SE and bring the customer a better experience, HUNTER SE provides a hardware interface for the firmware upgrading, and the corresponding client software as well.

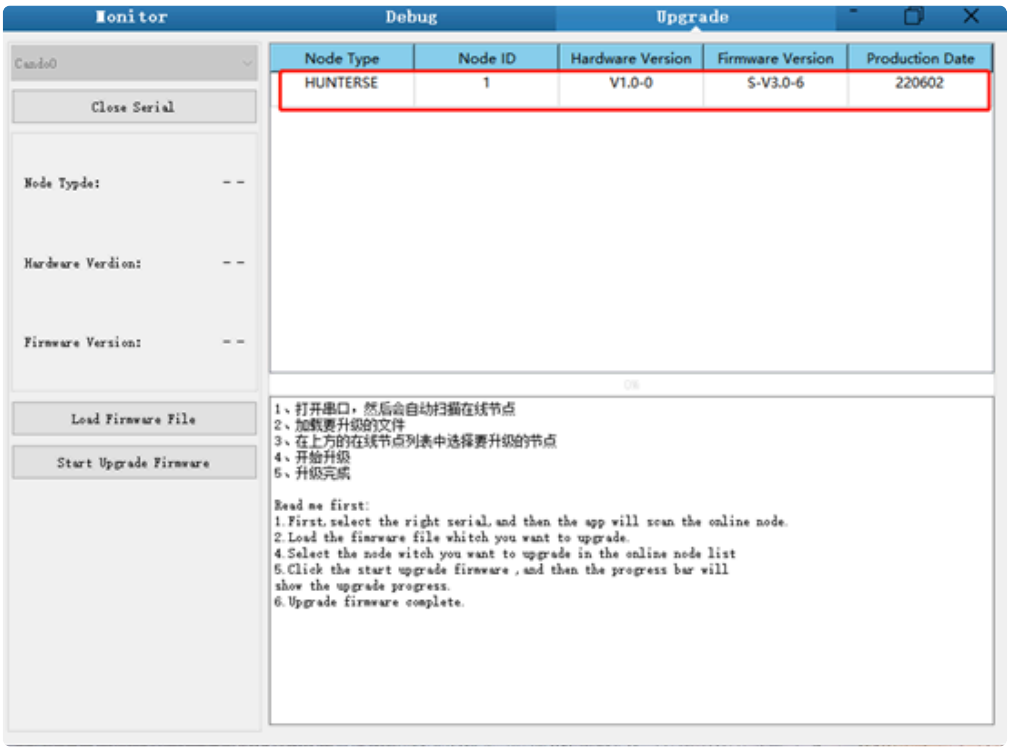
Upgrade Preparation

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

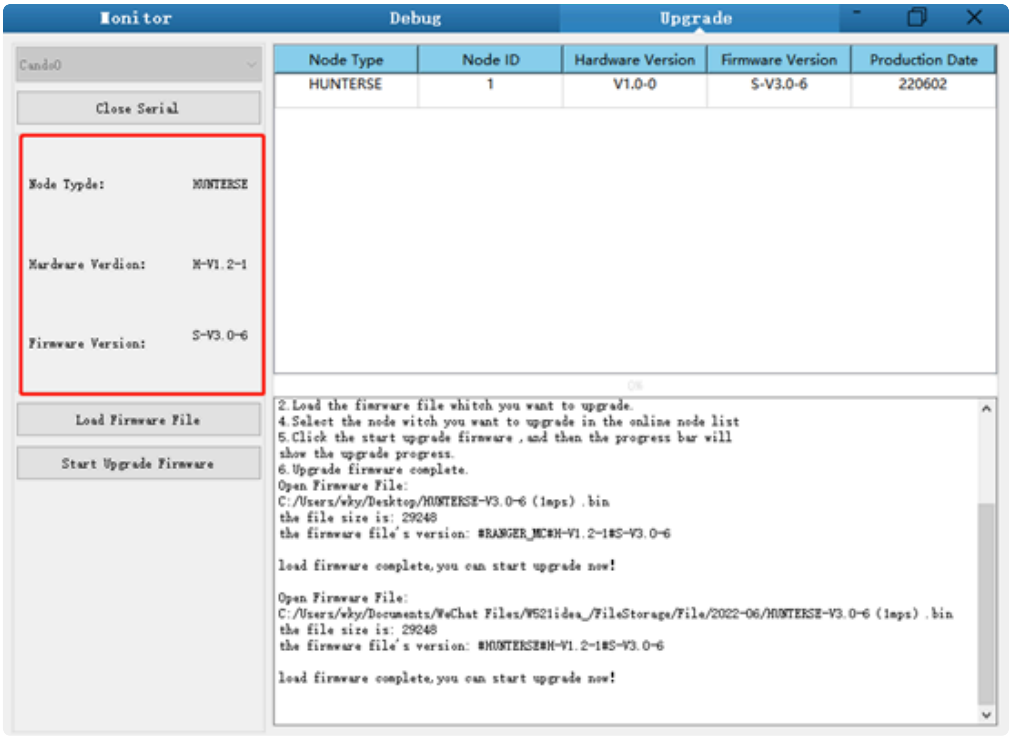
Upgrade Process

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).

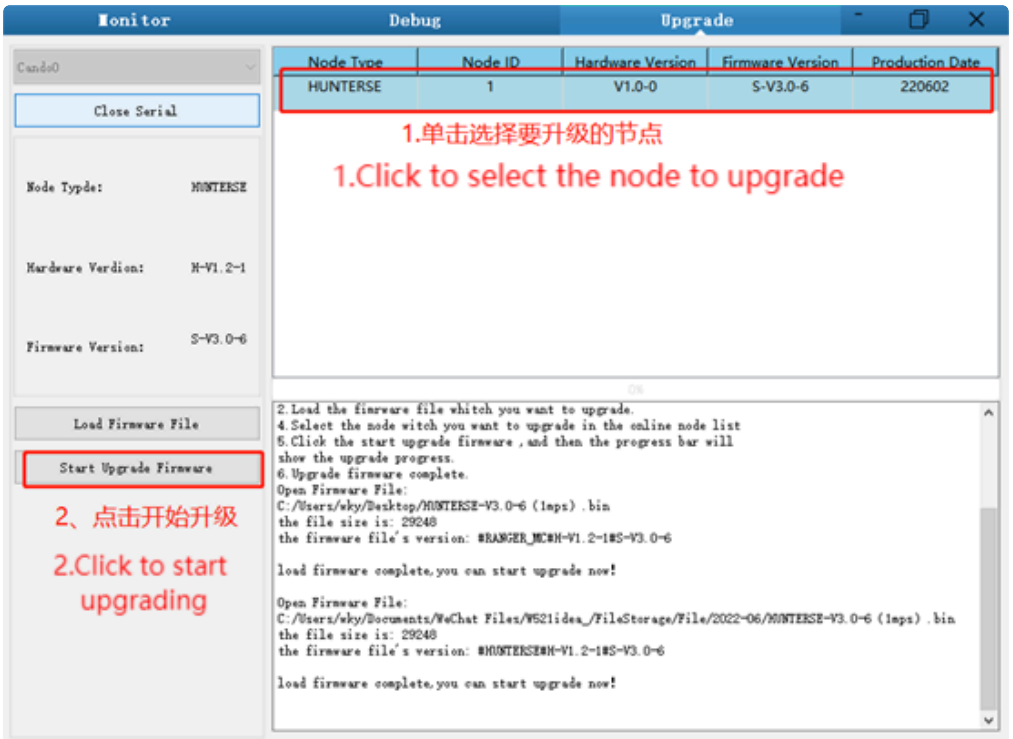
2.Click the Open Serial button, and then press the power button on the car body. If the connection is successful, the version information of the main control will be recognized, as shown in the figure.

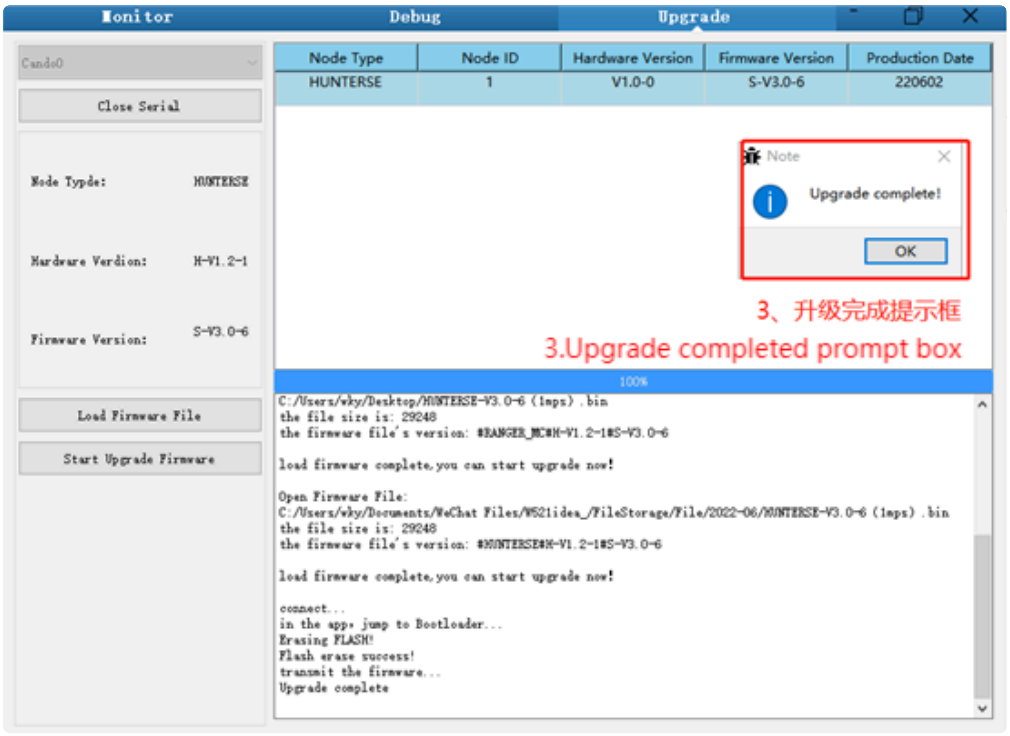


3.Click the Load Firmware File button to load the firmware to be upgraded. If the loading is successful, the firmware information will be obtained, as shown in the figure



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 HUNTERSE ROS Package use example

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

Hardware preparation

- CANlight can communication module X1
- Thinkpad E470 notebook X1
- AGILEX HUNTER SE mobile robot chassis X1
- AGILEX HUNTER SE supporting remote control FS-i6sX1
- AGILEX HUNTER SE rearaviation socket X1

Use example environment description

- Ubuntu 18.04 LTS
- ROS melodic
- Git

Hardware connection and preparation

- Lead out the CAN cable of the HUNTER SE tail plug, and connect CAN_H and CAN_L in the CAN cable to the CAN_TO_USB adapter respectively;
- Turn on the knob switch on the HUNTER SE mobile robot chassis, and check whether the emergency stop switches on both sides are released;
- Connect the CAN_TO_USB to the usb interface of the notebook.The connection diagram is shown in Figure3.4.

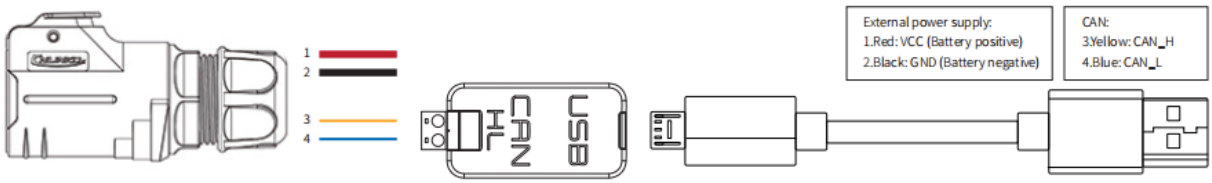


Figure 3.4 CAN Connection Diagram

ROS installation

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

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

HUNTER SE ROS PACKAGE download and compile

- Download ros dependent package

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

- Clone and compile hunter_ros source code

$ cd ~/catkin_ws/src

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

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

$ cd ..

$ catkin_make

- Reference source:

https://github.com/agilexrobotics/hunter_ros

Start the ROS nodes

- Start the base node

$ roslaunch hunter_bringup hunter_robot_base.launch

- Start the keyboard remote operation node

$ roslaunch hunter_bringup hunter_teleop_key-board.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：HUNTER SE 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:HUNTER SE 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?

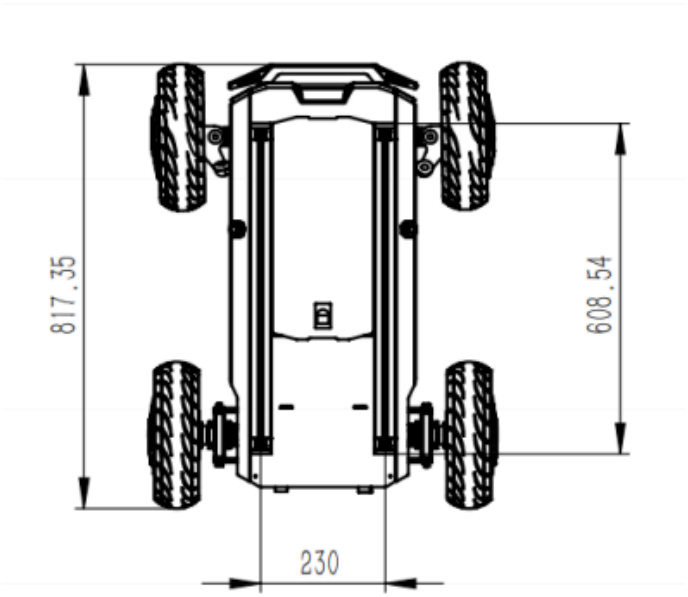
A:Normally, if HUNTER SE can be controlled by a RC transmitter, it means the chassis movement is under proper control; if the chassis feedback frame can be accepted, it means CAN extension link is in normal condition. Please check the CAN control frame sent to see whether the data check is correct and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

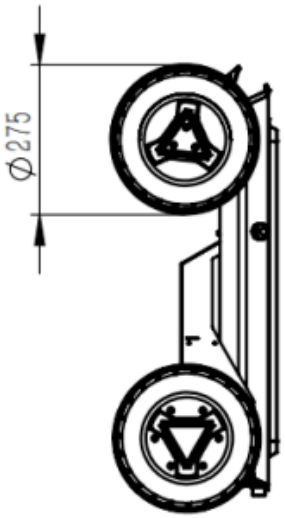
Q:HUNTER SE gives a "beep-beep-beep..."sound in operation; how to deal with this problem?

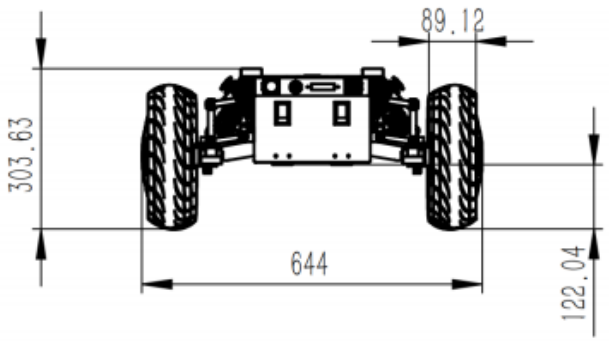
A: If HUNTER SE gives this "beep-beep-beep" sound continuously, it means the battery is in the alarm voltage state. Please charge the battery intime.

5 Product Dimensions

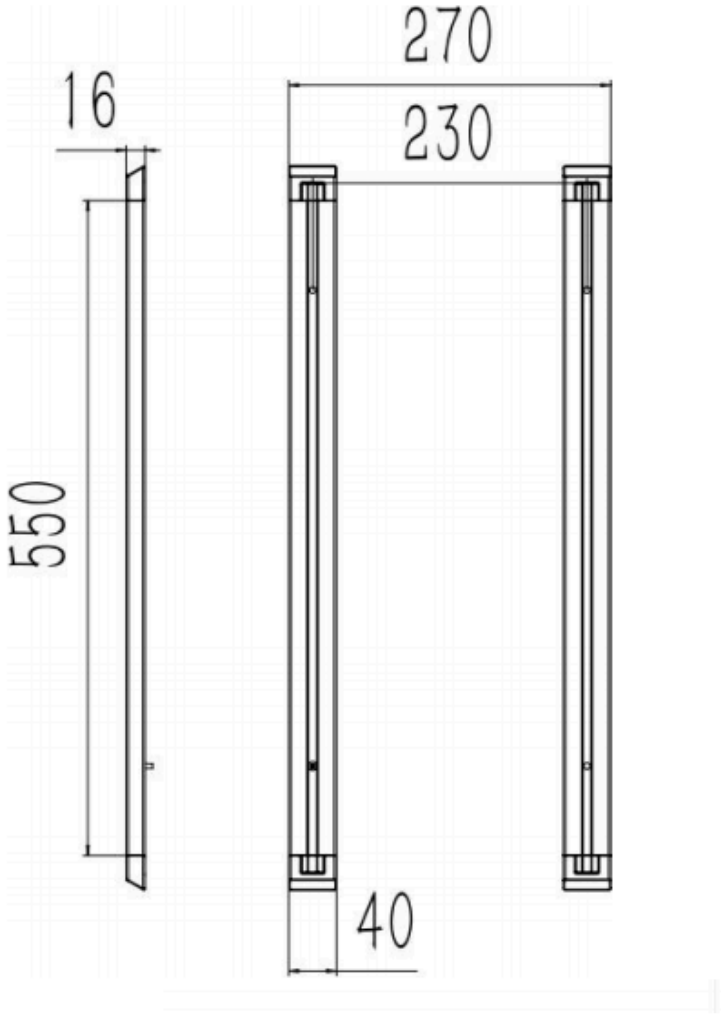
5.1 Illustration diagram of product external dimensions

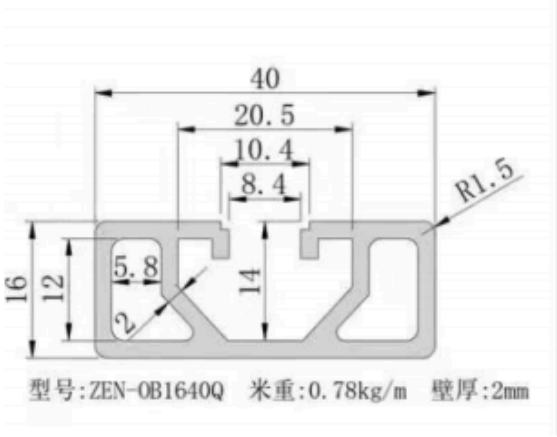






5.2 Illustration diagram of top extended support dimensions





Model：ZEN-OB1640Q Weight per meter：0.78kg/m Wall thickness：2mm