YUHESEN

MK Robot-01 Ackermann Steering Drive-by-wire Chassis

User manual V2.2.1

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CONTENTS

1. Foreword

(1) Thank you for purchasing our product, this user manual is applicable to MK Robot-01 Ackermann Drive-by-wire Chassis (hereby referred to as "MK Robot-01").

(2) Before use, please carefully read this user manual and attentions, and correctly use strictly in accordance with this manual.

(3) For the loses caused by serious violation of this user manual, we undertake no responsibilities.

(4) Please well keep this manual for user reference during your operation.

(5) Professionals are required for commissioning, connection and installation of the chassis equipment to avoid irretrievable loses.

(6) DO NOT install, remove or replace equipment lines with electricity. If it is necessary to commission this product with electricity, please select the special commissioning tools with good insulation.

(7) Please use this product under the conditions allowed by laws and regulations, so that the public property or life safety will not be affected.

(8) We will irregularly update this product, the contents of update will be added into the new manual without notification.

(9) This manual may contain the contents which are not correct in technology or which do not comply with the operation. In case of problems which cannot be solved during use of this manual, please contact with the customer service or technical department of us.

(10) As for the contents of this manual, we will try our best to ensure that they are correct and accurate. In case of any improper or incorrect contents, please contact us for confirmation, thank you!

2. Safety Information

The information herein does not include how to design, install or operate a complete robot, nor the peripheral equipment which may affect the safety of this complete system. The design and use of the complete system comply with the safety requirements formulated in the national standards and specifications. The integrators and end customers of MK Robot-01 are responsible for being sure to comply with practical laws and regulations of relevant countries to ensure that the application of the complete robot will not cause any major danger. These include but are not limited to the following:

■ Effectiveness and responsibilities:

- A risk evaluation shall be conducted to the complete robot system. All the additional safety equipment of other machineries defined by risk evaluation shall be connected. It shall be ensured that, the design and installation of the peripheral equipment of the whole robot system, including software and hardware system, are correct.
- This robot is not equipped with relevant safety functions that a complete autonomously moveable robot shall have, including but not limited to automatic collision avoidance, fall prevention and alarm for creature approaching, etc. For relevant functions, the integrators and end customers are required to conduct safety evaluation in accordance with relevant regulations and feasible laws and regulations to ensure that the developed robot has no any major danger or potential safety hazard during actual application.
- Collecting all the documents of technical files: Including risk evaluation and this manual. Before operation and use of equipment, the existing safety risks may be known.

■ Environments:

- For first use, please carefully read this manual to understand the basic contents and operation specifications.
- For remote operation, please select the areas which are relevantly open. This chassis is not equipped with any sensor for automatic obstacle avoidance.
- This chassis shall be used under the temperature of -20°C~50°C.
- The chassis is not customized for IP protection grade, the IP protection grade of this chassis

is IP42.

■ Inspection:

- Inspecting to ensure that the batteries of the equipment are full. Ensuring that the chassis has no abnormality. Inspecting whether the battery of the remote controller is full.

■ Operation:

- Ensuring that operation is conducted in a relatively open place. And remote control shall be conducted with sight distance.
- MK Robot-01 The maximum load is 80KG. The maximum speed is 2.7m/s.
- In case of alarm of low battery of the equipment, please charge timely. In case of equipment abnormality, please stop use immediately to avoid secondary damage.
- In case of equipment abnormality, please contact relevant technicians, DO NOT process without permission.
- Please use the equipment in the environment which meets the IP protection grade requirements of the equipment.
- DO NOT directly push the chassis.
- During charging, please ensure that the environment temperature is higher than 0°C.

■ Maintenance:

- In case of serious tire wearing, please replace timely.
- If the battery will not be used for a long time, please ensure the battery is under fully charged condition, please charge the battery regularly at least once per month.

3. Introduction

MK Robot-01 is a versatile drive-by-wire robotics mobile platform, it adopts Ackermann front steering, and rear drive form. Compared with the chassis of differential drive form on the ordinary pavement, MK Robot-01 has a faster traveling ability and relatively strong load capacity. At the same time, the wearing of tire is lighter, matching with front and rear double wishbone independent suspension, the chassis has strong stability and excellent shock absorption and the chassis can pass through the common obstacles, such as speed bump, etc. Therefore, it is more applicable for long-term outdoor traveling; And this chassis is a underlayer control system structure based on VCU vehicles control, it uses CAN bus management, having the features of high precision and modularization, etc. By the modules and navigation systems of logistic cabinet, GPS and manipulator, etc., this chassis is widely used in autonomous driving, unmanned patrol, logistics, transportation distribution, scientific research and various new applications and explorations requiring for mobile chassis.

3.1. Product list

After delivery, please carefully confirm the product list:

Chassis *1

Remote controller *1

Charger (48V) *1

Product manual *1

3.2. Performance parameters

Table 2 - 1 MK Robot-01 Performance Parameter Table

Parameter type	Performance	Parameter
Structural size and weight	Dimensions(W*D*L)	920*740*350mm
	Weight	71kg
	Drive	Front Ackermann steering and rear motor drive
	Suspension	Front and rear dual wishbone independent suspension
	Material	Q235 steel/AL6061 aluminium alloy
	Ground clearance	150mm
	Wheelbase	600mm
	Wheel track	600mm
	Tire type/diameter	13*6.50-6，324mm
Basic configuration	Driving motor	2*400W, brushless servo motor
	Reduction Ratio	20 reduction ratio
	Steering motor	400W servo motor
	Battery type	48V/18Ah lithium battery/BMS management system
	Charging time	≤4h
	Charging method	48V/5A, manual charging adapter
	External power supply	48V/10A-24V/15A-12V/15A
	Braking mode	motor brake
	Parking method	Electromagnetic power-off parking
	Turn signal light	√
	Alarm flashing light	√
	Brake lamp/deceleration indicator/fault indicator	√
Safety measures	Emergency stop button	√
	Command check	√
	Heartbeat protection	√
	Fault handling for steering system	√
	Fault handling for driving system	√
	Emergency power down parking protection	√
	Battery fault monitoring and protection	√
	Online detection for whole vehicle CAN node	√
	Whole vehicle fault level division and processing	√

	Vehicle fault warning	√
	Prompt of fast vehicle deceleration	√
	Processing of remote controller disconnection	√
	Charging safety monitoring and protection	√
VCU configuration	Dominant frequency	168MHz
	Hardware floating point acceleration	√
	Kinematic analysis	√
	Communication interface	CAN interface
	Communication protocol	CAN 2.0B
Performance parameters	Remote control distance	100m
	Vertical load (level road)	80kg
	Speed	0-2.7m/s
	Mileage	25km(full load)
	Minimum turning radius	1.6m
	Maximum climbing angle	10° (full load)
	Crossing width	180mm (full load)
	Obstacle surmounting height	50mm (full load)
Performance parameters	Steering accuracy	≤0.5°
	Protection level	IP42
	Operating temperature	-20°C~50°C
	Storage temperature	0°C~40°C

4. Product presentation

The contents in this part are only the basic introductions for MKRobot-01 Ackermann Drive-by-wire Chassis, facilitating the users and developers to know MKRobot-01 chassis basically. As shown in Figure 4-1 and Figure 4-2, there are the front and rear overall figure of the whole Ackermann drive-by-wire chassis.

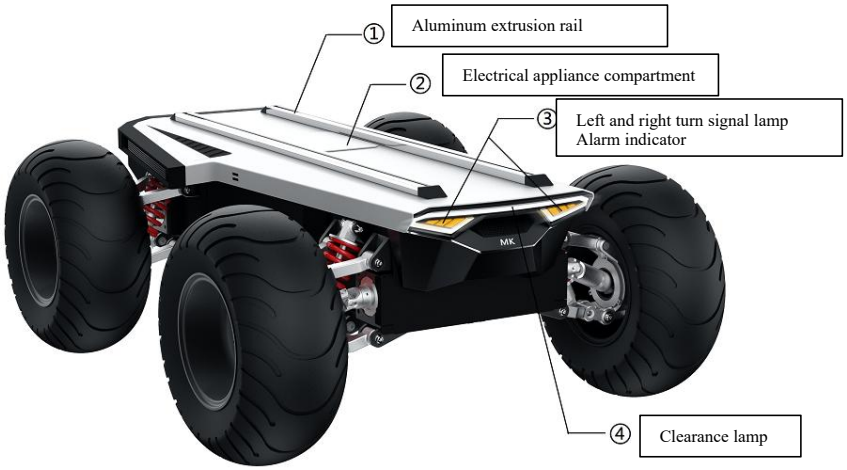


Figure 4 - 1 Front Overall Figure

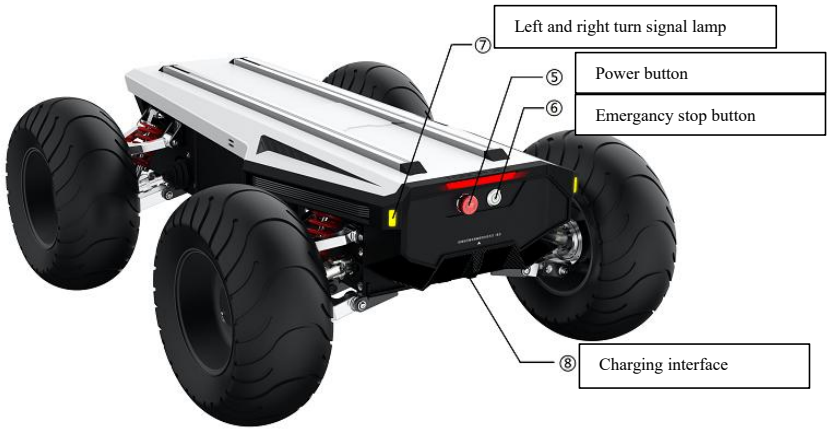


Figure 4 - 2 Tail Overall Figure

Overall, MK ROBOT-01 uses the thought of modular design, resulting in high safety and reliability. In structure, front Ackermann steering structure, rear non independent suspension and non-bearing vehicle body design make high vehicle body strength and high rigidity, so that the safety of the whole vehicle can be improved, bringing relatively strong impact resistance, and can pass through more complex ground environment.

Emergency stop switch is installed at the tail of the vehicle body. The vehicle can be stopped by beating the switch so as to avoid serious accident. Meanwhile, the emergency stop switch supports functional inspection. If the emergency stop switch is damaged or disconnection, VCU will take over and shut down the vehicle's power; Multi-protection, guaranteeing safe driving of vehicles.

The chassis is also equipped with integrated control. VCU analyzes and judges the vehicle signals uniformly, and forms closed-loop control, therefore, the faults can be diagnosed, and corresponding safety protection and processing can be conducted to reliably achieve unmanned vehicle status monitoring remotely. At the top of the vehicle body, there are electrical interfaces and communication interfaces of 48V, 24V and 12V. At the same time, the top is equipped with standard profile fixing support, so that the users can conduct secondary development quickly.

4.1. State indicator

Via voltage display on the remote controller and the starting sound, users can determine the status of the vehicle body. Refer to Figure 4-1 for details.

Status	Description
Battery voltage	The current battery voltage of the vehicle body can be checked by sliding left the displayed on the remote controller (Figure 4-3) Ext.V's value
Fault indicator	The fault status of the of the whole vehicle can be determined in accordance with the flashing frequency of the brake lamp under non-braking status and braking status. Once 1S: level I fault alarm;

Table 4 - 1 Description of Vehicle Body Status

Name	ID	Value
TX. V	0	5.55V
Int. V	0	4.96V
Sig. S	0	10
Ext. V	1	48.62V

Figure 4-3 Interface of Vehicle Voltage on the Remote Controller

Note: The current interface appears by swiping left on the remote control screen. TX.V indicates the current battery voltage of the remote control. Int.V represents the power supply voltage of the receiver. Sig.S indicates the signal strength of the receiver. Ext.V displays the remaining capacity percentage (SOC) of the external battery. ID 0 represents the signal from the remote control transmitter or receiver. ID 1 represents the first sensor connected to the receiver, and so on.

Note:

Fault level classification and handling methods:

Level 1 fault: CAN signal and indicator light alarm.

Level 2 fault: CAN signal, indicator light alarm, and vehicle power reduction.

Level 3 fault: CAN signal, indicator light alarm, and driver shutdown.

4.2. Instructions of electrical interface

MK Robot-01 is equipped with accessible power ports on the top. There are three DT06 plug-ins for 48V, 24V and 12V power supply, with corresponding power supply voltage labels. The red wire of the power supply plug-in is the positive pole, and the black is the negative pole. At the same time, a DB9 female connector is fixed in the electrical cabinet. The connector is for customer's secondary development. The pin definition is shown in Table 4-3. The corresponding power supply plug-in wires and DB9 plug-in wires have been prepared as shown in Figure 4-4, which is convenient for use to provide power for different expansion devices and communication.

Figure 4-4 Power supply and communication wires

The specific pin definitions of top electrical interfaces are shown in Table 4-3 below:

Plug-in	Pin	Type	Definition	Remark
DB9	7	CAN	CAN_H	CAN - bus high
	2		CAN_L	CAN - bus low
DT06	48V	Power supply	Red	Positive pole of 48V power supply
			Black	GND
	24V		Red	Positive pole of 24V power supply
			Black	GND
	12V		Red	Positive pole of 12V power supply
			Black	GND

Table 4-2 Pin Definitions of Top Electrical Interface

Please note that the external power supply is internally controlled, and when the battery voltage is too low, the BMS will protectively stop the battery discharge. Users should be mindful of charging during use. Additionally, please be aware that the 48V is the battery output power, and the output voltage is subject to fluctuations based on the battery voltage

4.3. Remote control instructions

The remote control has been successfully paired before the product leaves the factory and does not require any adjustments. Making arbitrary changes to the remote control settings may result in control confusion, loss of control, and other issues. Please refrain from making changes to the remote control settings without careful consideration. If there are any issues with parameter settings, please contact our customer service or technical support. If adjustments are necessary, it should be done by a professional technician who is experienced in setting up the remote control.

4.3.1. Instructions of remote control

Each MK ROBOT-01 is equipped with an FS-i6S remote control. Users can easily control the MK ROBOT-01 using the remote control. In this product, the FS-i6S remote control is designed with right-hand throttle control for forward and backward movement, as well as left and right steering. Please refer to Figure 4-5 for the definition and functions of the remote control.

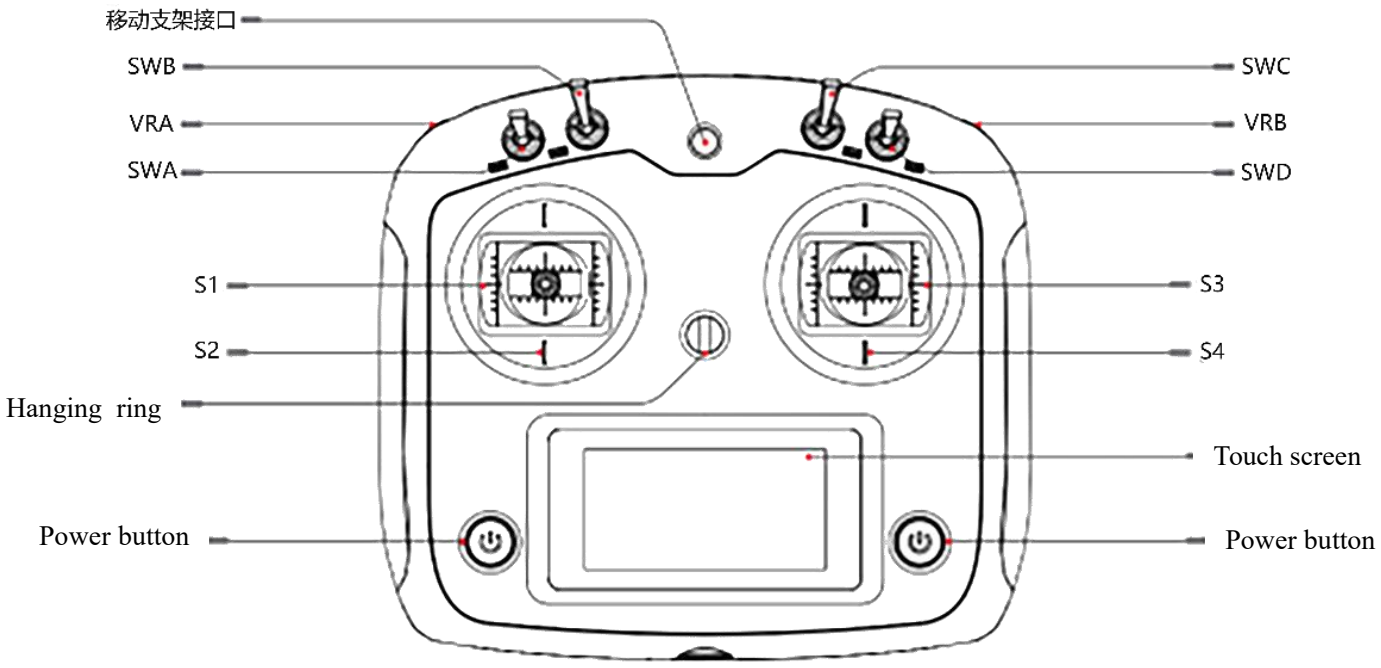


Figure 4-5 Schematic Diagram of FS-i6S Remote Controller Keys

The parameters of the remote controller have been configured before delivery. DO NOT modify the system configuration of the remote controller without permission, or, the robot may be out of

control and in controlling chaos, etc. In case of any question, please contact the customer services or after-sales personnel for answering;

(1) SWA is the control mode switch lever with two positions. Taking the remote control facing upwards as an example: when the SWA lever is in the upper position, it is in remote control mode, and when the SWA lever is in the lower position, it is in command control mode.

(2) SWB is the gear switch lever with three positions. When the lever is in the middle position, the vehicle is in neutral gear and does not receive forward or backward control signals. When the lever is moved upwards to the D position, the chassis can receive forward motion control signals from the S4 joystick and move forward. When the lever is moved downwards to the R position, the chassis can receive backward motion control signals from the S4 joystick and move backward.

(3) VRB is the parking request control knob. When the knob is turned upwards, a parking request is sent to activate the parking brake device. When the knob is turned downwards, a release parking request is sent to release the parking brake device.

(4) S4 joystick is used for throttle control, controlling the speed of forward and backward motion of the FR-07. S3 joystick controls the steering of the front wheels.

(5) SWC is the high-medium-low speed control mode switch for the S4 joystick. Taking the forward gear as an example: when SWC is in the uppermost position, the S4 joystick controls the vehicle to travel at the lowest speed (low-speed mode). When SWC is in the middle position, the S4 joystick controls the vehicle to travel at a medium-speed mode. When SWC is in the lowest position, the S4 joystick controls the vehicle to travel at a high-speed mode.

(6) The power switch is the remote control power control switch. When the remote control is turned off, press and hold the power switches on both sides of the display to turn on the remote control. When the remote control is turned on, press and hold the power switches on both sides of the display to turn off the remote control. If the remote control receiver is powered on, it cannot be turned off by pressing and holding the power switches on both sides of the display. In that case, the battery needs to be removed to turn off the receiver.

4.3.2. Instructions of remote controller buzzer alarm

Power on switch position alarm	If the lever switches SWA/SWB/SWC/SWD are not in their default positions when the power is turned on, an alarm interface will appear, prompting to move all switches upward. When all switches are in their default positions, the system will enter the main interface normally.

Low voltage alarm	When the voltage is below the alarm voltage, the system will emit an alarm, and the remote control screen will start flashing. If the voltage of the remote control is too low, the TX icon will flash. If the chassis voltage is too low, the RX icon will flash.
Remote controller communication error alarm	If the control distance between the remote control and the chassis is too far or there is obstruction in the environment, it can result in a decrease in the remote control signal strength. If the signal strength is below 5, a communication abnormality alarm will occur, indicating that the remote control signal strength is weak.
Remote controller idle alarm	When the remote control is idle for a long time, the remote control buzzer will intermittently emit an alarm.
Power off alarm	When the remote control is being powered off, it will check if the chassis is powered off. If the chassis is not turned off, a warning interface will appear, and the chassis power must be turned off to power off the remote control. (If it is necessary to forcefully turn off the remote control while the chassis is not powered off, the battery can be removed.)

Table 4 - 3 Instructions of Remote Controller Alarm Condition

4.3.3. Instructions of control commands and movement

In accordance with ISO 8855, we establish coordinate system as shown in Figure 4-6 for ground movement of the vehicle.

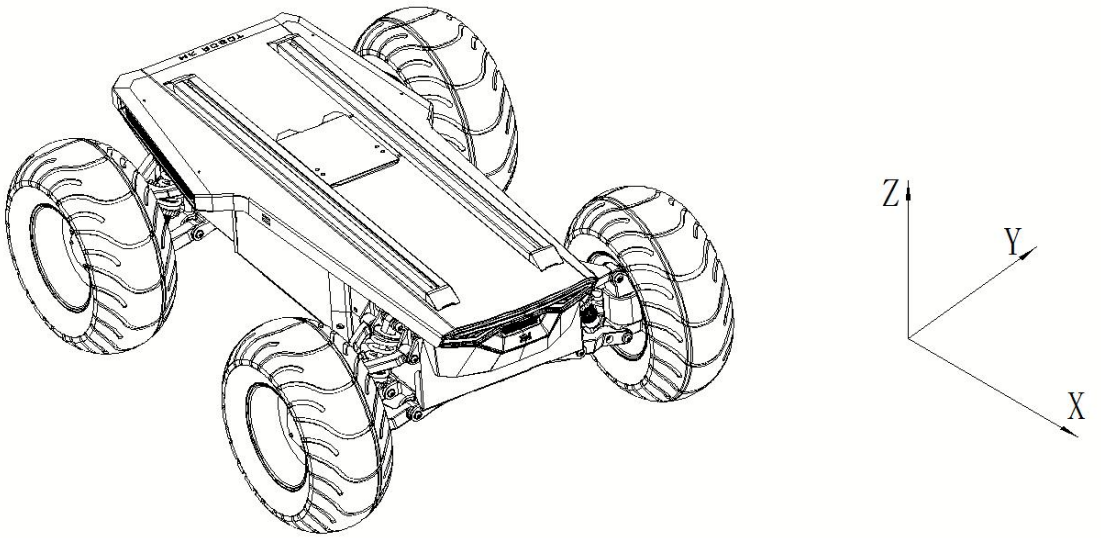


Figure 4 -6

As shown in Figure 4-6, the MK ROBOT-01 chassis is in a parallel state with the established reference coordinate system's X-axis.

In the remote control mode, pulling down the VRB knob releases the parking gear, and switching the SWB lever to the D position. When the remote control's S4 joystick is pushed forward, it moves in the positive X direction. When the SWB lever is switched to the R position, pushing the

S4 joystick backward moves it in the negative X direction. When the S4 joystick is pushed forward to its maximum value, the high, medium, and low-speed control is determined by the SWC setting in the X direction. When the S4 joystick is pushed backward to its maximum value, the high, medium, and low-speed control is determined by the SWC setting in the negative X direction. The remote control's S3 joystick controls the steering motion of the front wheels of the vehicle. Pushing the S3 joystick to the left makes the car turn left. Pushing it to the maximum left position achieves the maximum left turn angle. Pushing the S3 joystick to the right makes the car turn right. Pushing it to the maximum right position achieves the maximum right turn angle.

In the command control mode, under the target gear instruction, a value of 04 represents motion in the positive X-axis direction, and a value of 02 represents motion in the negative X-axis direction..

5. Getting started

This part mainly introduces the basic operation and use of MK Robot-01 platform, and how to conduct secondary development to the vehicle body through CAN bus protocol.

5.1. Use and operation

The basic operations flow of remote operation are as follows:

Inspection

(1) Check the status of the vehicle body. Check that whether the vehicle body has obvious abnormality; If any, please contact after-sales support;

(2) Check the status of the emergency stop button, and confirm that the emergency stop button at the tail is under the released state;

(3) Check that all gears of the remote controller are in neutral position;

Power on chassis

(1) Long press the power switches on both sides of the display to turn on the remote control.

(2) Press the start switch on chassis.

(3) Check the battery voltage of the remote control vehicle and verify if the voltage is normal. If the voltage is below 47.5V, please charge the battery first. Release the parking brake of the vehicle and switch to remote control driving mode.

Observe if the brake lights are flashing and check if there are any faults in the vehicle. If there are any faults, you can connect a CAN card to read the vehicle's fault status and fault signals, then contact the after-sales personnel for assistance in resolving the issues.

Shut down

Press starting switch again and release the switch to turn off the power supply;

Emergency stop

Press the emergency stop switch on the electrical panel at the tail of MK Robot-01.

5.2. Charge

The chassis of the MK Robot-01 mobile robot is equipped with a 48V/5A charger in default, meeting the demands of charging.

The specific operation processes of charging are as follows:

1) Before charging, please make sure that MK Robot-01 is shut down and powered off, and

confirm that starting switch on the electrical board at the tail is closed;

2) First, insert the output plug of the charger into the B1 charging interface on the electrical board at the tail; Then, plug the AC plug of the charger into the 220V AC socket.

3) After charging, operate in accordance with the reserve orders, unplug the AC plug first, and then, unplug the output plug.

4) The working status indicator of the charger is shown in Table 5-1.

Table 5 -1 Instructions of LED Indicator for Charger Status

LED indicator light status	**Charger status**
LED1 is in bright red	The input line plug of the charger has been powered on
LED2 is in bright red	Indicating that the charger is charging
LED2 is in bright green	Indicating that the battery has been fully charged

5) If the temperature of the charging environment is too high, the charger may activate temperature protection. Please move the charger to a cool or ventilated place for use, and resume normal charging when the internal temperature of the charger is lowered to 50°C. Refer to Table 5-2 for the instructions of charger protection status:

Table 5 -2 Instruction of Charger Protection Status

Protection function	**Function description**
Over-temperature protection	When the internal temperature of the charger reaches the over-temperature protection point, the charger stops charging automatically.
Output short-circuit protection	When the charger output is short-circuited unexpectedly, the charger turns off output automatically.
Output reverse connection protection	When the battery is connected in reverse, the charger will cut off the connection between the internal circuit and the battery.
Output over-voltage protection	When the output of the charger is over-voltage, the charger automatically turns off the output.

Note:

When the vehicle is being charged, VCU will protect the charging state of the whole vehicle. If the vehicle is being charged when it is powered on, to ensure the charging safety, the vehicle will enable electromagnetic parking. Meanwhile, the CAN signal will send the corresponding charging flag bit, and when necessary, if release is required, corresponding commands can be sent for release.

5.3. Development

MK Robot-01 product provides CAN interface to users for development, and users can conduct command control to the vehicle body with CAN interface.

5.3.1. CAN interface protocol

The communication of MK Robot-01 product is conducted by CAN2.0B extended frame, and the message format is Intel format with a baud rate of 500K. The gear, vehicle speed, steering angle and parking request of the chassis can be controlled through the external CAN bus interface, . The MK Robot-01 will feed back the current movement state information and the system state information of the MK Robot-01 chassis in real time.

The specific protocol contents are shown as below:

The motion command control frame includes gear control, vehicle speed control, steering angle control, parking request, heartbeat signal and inspection, etc. The specific protocol contents are shown in Table 5-3. Refer to 5.3.2 for wiring instructions, and 5.3.3 for CAN communication transmission requirements and test examples.

Note: The CAN interface is a non-isolated interface. During use, please prevent the CAN line from being wrongly connected or prevent the CAN bus from being connected with the power line of the given type. In case of connection, VCU may be burned out.

CAN protocol is shown as below:

Baud rate: 500K

Table 5-3 Command Control Frame and System Feedback Frame

Control Command									
Message name			ID				Cycle (ms)		(Byte) Message length
ctrl_cmd			0x18C4D2D0				10		8
Signal description	Arrangement format	Starting byte	Start bit	Signal duration	Data type	Precision	Offset	Unit	Signal value description
Target gear	Intel	0	0	4	Unsigned	1	0		00: disable 01: Gear P 02: Gear R 03: Gear N 04: Gear D

Target vehicle speed	Intel	0	4	16	Unsigned	0.001	0	m/s	0.001m/s/bit;
Targeted vehicle steering angle	Intel	2	20	16	signed	0.01	0	°	0.01°/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

I/O Control Command

Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
io_cmd			0x18C4D7D0				50		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
I/O control enabling	Intel	0	0	1	Unsigned	1	0		0 = off 1 = on
Steering lamp switch and alarm flashing lamp switch	Intel	1	10	2	Unsigned	1	0		0 = off 1 = left steering lamp on 2 = right steering lamp on 3 = alarm flashing lamp on(steering lamp is priority to alarm flashing

									lamp)
Clearance lamp switch	Intel	1	13	1	Unsigned	1	0		0 = off 1 = on
Enforced power-on flag bit for charging	Intel	5	40	1	Unsigned	1	0		When the flag bit is forced to be enabled under the charging state, the vehicle can be controlled to be powered on under 48V, and the vehicle can resume control. When the flag bit is enabled, the vehicle cannot reverse under the charging state.
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Control Feedback Command									
Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
ctrl_fb			0x18C4D2EF				10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Target gear	Intel	0	0	4	Unsigned	1	0		00: disable 01: Gear P 02: Gear R 03: Gear N 04: Gear D
Current vehicle speed feedback	Intel	0	4	16	Unsigned	0.001	0	m/s	0.001m/s/bit;
Current vehicle steering angle feedback	Intel	2	20	16	signed	0.01	0	°	0.01°/bit;
Current vehicle operation mode feedback	Intel	5	44	2	Unsigned	1	0		0x0: auto 0x1: remote 0x2: stop
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6
Left Rear Wheel Feedback									
Message name			**ID**				**Cycle (ms)**		**(Byte) Message**

									length
lr_wheel_fb			0x18C4D7EF				10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal Length**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Current left rear wheel speed feedback	Intel	0	0	16	signed	0.001	0	m/s	0.001m/s/bit;
Current left rear wheel pulse count feedback	Intel	2	16	32	signed	1	0		350000 pluses for single wheel turn，2500 lines of encoder, 4 times frequency, 35 reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6
Right Rear Wheel Feedback									
Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
rr_wheel_fb			0x18C4D8EF				10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Current right rear wheel speed feedback	Intel	0	0	16	signed	0.001	0	m/s	0.001m/s/bit;
Current right rear wheel pulse count feedback	Intel	2	16	32	signed	1	0	1	350000 pluses for single wheel turn，2500 lines of encoder, 4 times

									frequency, 35 reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

I/O Status Feedback

Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
io_fb			0x18C4DAEF				50		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
I/O control enabling status feedback	Intel	0	0	1	Unsigned	1	0		0 = off 1 = on
Steering lamp switch status feedback	Intel	1	10	2	Unsigned	1	0		0 = off 1 = left steering lamp on 2 = right steering lamp on 3 = alarm flashing lamp on
Brake lamp switch status feedback	Intel	1	12	1	Unsigned	1	0		0 = off 1 = on
Position lamp switch status feedback	Intel	1	13	1	Unsigned	1	0		0 = off 1 = on
Loudspeaker switch status feedback	Intel	2	16	1	Unsigned	1	0		0 = off 1 = on
Center front bumper strip switch status feedback	Intel	3	25	1	Unsigned	1	0		0 = off 1 = on

Center rear bumper strip switch status feedback	Intel	3	28	1	Unsigned	1	0		0 = off 1 = on
Enforced power-on flag bit for charging	Intel	5	40	1	Unsigned	1	0		When the flag bit is forced to be enabled under the charging state, the vehicle can be controlled to be powered on under 48V, and the vehicle can resume control. When the flag bit is enabled, the vehicle cannot reverse under the charging state.
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Odom Feedback									
Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
odo_fb			0x18C4DEEF				10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal Length**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Accumulated mileage	Intel	0	0	32	signed	0.001	0	m	0.001m/bit

Accumulated angle(reserve)	Intel	4	32	32	signed	0.001	0	rad	0.001rad/bit

BMS Feedback

Message name			ID				Cycle (ms)		(Byte) Message length
bms_Infor			0x18C4E1EF				100		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Current battery voltage	Intel	0	0	16	Unsigned	0.01	0	V	0.01V/bit;
Current battery current	Intel	2	16	16	signed	0.01	0	A	0.01A/bit;
Current remaining battery capacity	Intel	4	32	16	Unsigned	0.01	0	Ah	0.01Ah/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

BMS Flag Bit Status Feedback

Message name			ID				Cycle (ms)		(Byte) Message length
bms_flag_Infor			0x18C4E2EF				100		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Percentage of current remaining battery	Intel	0	0	8	Unsigned	1	0	%	1%/bit;
Single over-voltage protection	Intel	1	8	1	Unsigned	1	0		0 = off 1 = on
Single under-voltage protection	Intel	1	9	1	Unsigned	1	0		0 = off 1 = on

Whole group over-voltage protection	Intel	1	10	1	Unsigned	1	0		0 = off 1 = on
Whole group under-voltage protection	Intel	1	11	1	Unsigned	1	0		0 = off 1 = on
Charging over-temperature protection	Intel	1	12	1	Unsigned	1	0		0 = off 1 = on
Charging low-temperature protection	Intel	1	13	1	Unsigned	1	0		0 = off 1 = on
Discharging over-temperature protection	Intel	1	14	1	Unsigned	1	0		0 = off 1 = on
Discharging low-temperature protection	Intel	1	15	1	Unsigned	1	0		0 = off 1 = on
Charging over-current protection	Intel	2	16	1	Unsigned	1	0		0 = off 1 = on
Discharge over-current protection	Intel	2	17	1	Unsigned	1	0		0 = off 1 = on
Protection against short circuit	Intel	2	18	1	Unsigned	1	0		0 = off 1 = on
Front-end detection IC error	Intel	2	19	1	Unsigned	1	0		0 = off 1 = on
Software locks up MOS	Intel	2	20	1	Unsigned	1	0		0 = off 1 = on
Charging flag bit	Intel	2	21	2	Unsigned	1	0		0 = discharge 1 = charge 2 = charging of front charging point 3 = charging of rear charging point
SOC low alarm	Intel	2	23	1	Unsigned	1	0		0 = normal 1 = low battery power
Low battery capacity alarm	Intel	2	24	1	Unsigned	1	0		0 = normal 1 = low battery power
Current highest temperature of the battery	Intel	1	28	12	signed	0.1	0	℃	0.1℃/bit;
Current lowest temperature of the battery	Intel	1	40	12	signed	0.1	0*	℃	0.1℃/bit;

Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Vehicle Fault Feedback

Message name			**ID**				**Cycle (ms)**		**(Byte) Message length**
Veh_fb_Diag			0x18C4EAEF				10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal duration**	**Data Type**	**Precision**	**Offset**	**Unit**	**Signal value description**
Whole vehicle fault level	Intel	0	0	4	Unsigned	1	0		0: No fault 1: Level 1 fault 2: Level 2 fault 3: Level 3 fault Others are invalid
Auto control CAN communication error	Intel	0	4	1	Unsigned	1	0		0 = normal 1 = fault
Auto IO control CAN communication error	Intel	0	5	1	Unsigned	1	0		0 = normal 1 = fault
EPS disconnection fault	Intel	1	8	1	Unsigned	1	0		0 = normal 1 = fault
EPS fault	Intel	1	9	1	Unsigned	1	0		0 = normal 1 = fault
EPS MOSFET over-temperature	Intel	1	10	1	Unsigned	1	0		0 = normal 1 = fault
EPS alarm fault	Intel	1	11	1	Unsigned	1	0		0 = normal 1 = fault
EPS working fault	Intel	1	12	1	Unsigned	1	0		0 = normal 1 = fault

EPS over-current fault	Intel	1	13	1	Unsigned	1	0		0 = normal 1 = fault
Left wheel motor drive fault	Intel	4	32	6	Unsigned	1	0		Refer to Note: Vehicle fault status feedback note ①
Right wheel motor drive fault	Intel	4	38	6	Unsigned	1	0		Refer to Note: Vehicle fault status feedback note ①
BMS CAN communication disconnection fault	Intel	5	44	1	Unsigned	1	0		0 = normal 1 = fault
Emergency stop fault	Intel	5	45	1	Unsigned	1	0		0 = on I = switch on
Remote controller close alarm	Intel	5	46	1	Unsigned	1	0		0 = normal 1 = fault
Remote controller receiver disconnection fault	Intel	5	47	1	Unsigned	1	0		0 = normal 1 = fault
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Note①: Left wheel motor drive fault and right wheel motor drive fault signal description

Note_Signal_Value 注释信号值	Note_Signal_Name 信号名称	Note_Signal_Description 信号描述	Failure_level 故障等级
0x00		No fault of motor drive	0
0x01	DiagMCU_DisOnlie	Motor drive CAN	3

		communication signal is disconnected	
0x02	DiagMCU_EbrSL	The discharge resistance value of motor drive is too small	2
0x03	DiagSCMCU_EcoUt	Motor drive communication timeout	3
0x04	DiagSCMCU_EcotS	Motor drive offline stop	3
0x05	DiagSCMCU_EcStp	Motor drive autonomous stop	3
0x06	DiagSCMCU_EdnRE	Motor drive no response error alarm	3
0x07	DiagSCMCU_EEnAb	Motor drive encoder AB signal alarm	2
0x08	DiagSCMCU_Eencu	Motor drive encoder UVW signal alarm	2
0x09	DiagSCMCU_EFrAE	Motor drive FRAM data write operation verification error	3
0x0A	DiagSCMCU_EGEAr	Motor drive abnormal parameters of electronic gear	3
0x0B	DiagSCMCU_ELUdc	Motor drive undervoltage alarm	2
0x0C	DiagSCMCU_EocA	Motor drive phase A overcurrent alarm	2
0x0D	DiagSCMCU_EocB	Motor drive phase B overcurrent alarm	2
0x0E	DiagSCMCU_EocC	Motor drive phase C overcurrent alarm	2
0x0F	DiagSCMCU_EoLoad	Motor drive overload alarm	2
0x10	DiagSCMCU_EoSPE	Motor exceeding maximum speed alarm	2
0x11	DiagSCMCU_EoUdc	Motor drive overvoltage alarm	2
0x12	DiagSCMCU_EoUP	Motor drive abnormal phase voltage alarm	2
0x13	DiagSCMCU_EPArA	Motor drive FRAM parameter overflow error	3
0x14	DiagSCMCU_EorEr	Motor drive zeroing timeout alarm	3
0x15	DiagSCMCU_EPEOU	Motor drive position deviation counter overflow	2
0x16	DiagSCMCU_Ehot	Over-temperature of power component of motor drive	2
0x17	DiagSCMCU_EPosE	Motor drive position out-of-tolerance alarm	2
0x18	DiagSCMCU_EPS1E	Motor drive 1 phase current ADC zero point abnormal alarm	3
0x19	DiagSCMCU_EPS2E	Motor drive 2 phase current ADC zero abnormal alarm	3
0x1A	DiagSCMCU_ESPEE	Motor drive exceed speed alarm	3
0x1B	DiagSCMCU_EUSPn	Motor not compliance alarm	3

0x1C	DiagSCMCU_E2LoS	Motor encoder Z pulse loss fault alarm	3
0x1D	DiagSCMCU_E2EtE	motor encoder Z pulse excessive fault alarm	3

Ultrasonic Radar Feedback 1									
Message Name			**Msg ID**				**Type**		**Cycle（ms）**
ultrasonic_1_fb			0x18C4E8EF				100		8
Signal Description	**For-mat**	**Start-ing Byte**	**Start-ing Bit**	**Signal Trans-mission Type**	**Signal Dura-tion**	**Data Type**	**Preci-sion**	**Unit**	**Signal Value Description**
No.1 ultrasonic radar probe's distance	Intel	0	0	12	Unsigned	1	0	mm	Frame signal exists when the ultrasonic radar is connected; otherwise, the frame signal is reserved.
No.2 ultrasonic radar probe's distance	Intel	1	12	12	Unsigned	1	0	mm	
No.3 ultrasonic radar probe's distance	Intel	3	24	12	Unsigned	1	0	mm	
No.4 ultrasonic radar probe's distance	Intel	4	36	12	Unsigned	1	0	mm	
Alive Rolling Counter	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Ultrasonic Radar Feedback 2									
Message Name			**Msg ID**				**Type**		**Cycle（ms）**
ultrasonic_2_fb			0x18C4E9EF				100		8
Signal Description	**For-mat**	**Start-ing Byte**	**Start-ing Bit**	**Signal Trans-mission Type**	**Signal Dura-tion**	**Data Type**	**Preci-sion**	**Unit**	**Signal Value Description**
No.1 ultrasonic radar probe's distance	Intel	0	0	12	Unsigned	1	0	mm	Frame signal exists when the ultrasonic radar is connected; otherwise, the frame signal is reserved.
No.2 ultrasonic radar probe's distance	Intel	1	12	12	Unsigned	1	0	mm	
No.3 ultrasonic radar probe's distance	Intel	3	24	12	Unsigned	1	0	mm	
No.4 ultrasonic radar probe's distance	Intel	4	36	12	Unsigned	1	0	mm	
Alive Rolling Counter	Intel	6	52	4	Unsigned	1	0		For each sent frame, the value will increase by 1, after the maximum value is reached, the value will be reset to 0 to check packet loss and disconnection
Check BCC	Intel	7	56	8	Unsigned	1	0		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

5.3.2. CAN wire connection

CAN wires of MK Robot-01 have been welded out and marked, and users can directly connect them in accordance with the marks, as shown in Figure 5-1 below

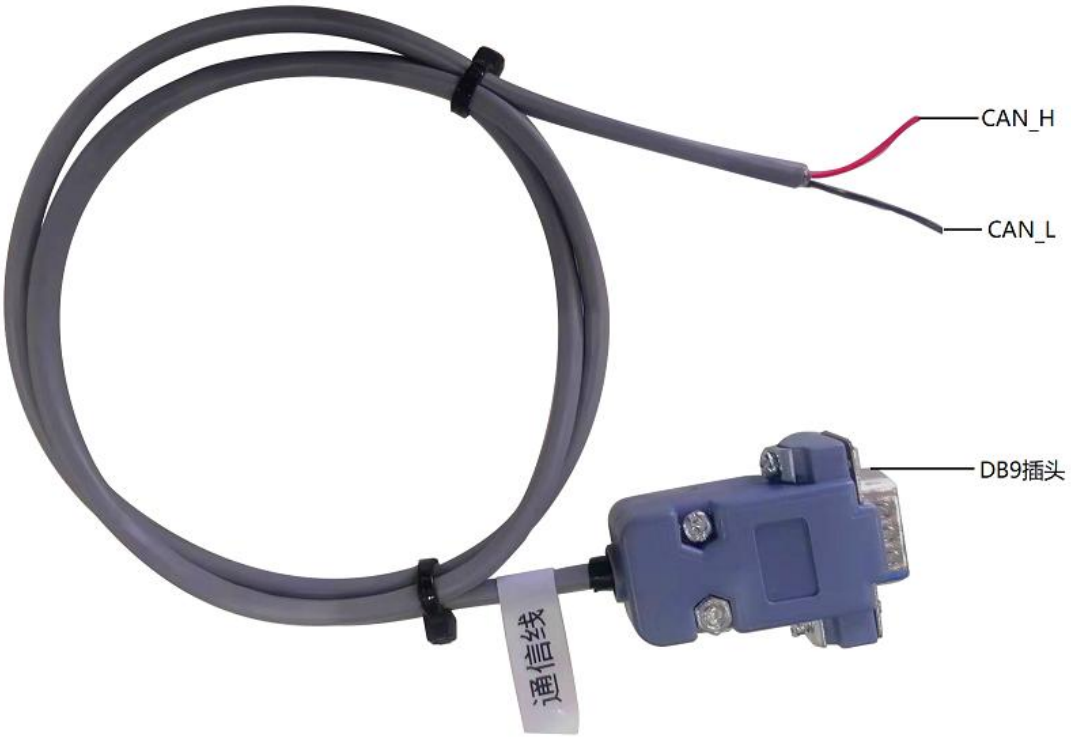


Figure 5-1 Schematic Diagram of CAN Wire Position

Red is CAN_H; Black is CAN_L

5.3.3. Instructions of use of common VCU protocol

1. Attentions during test:

1.1 During transmission, it shall be noted that, AliveCounter requires for continuous change and cycled transmission from 0 to 15.

1.2 During transmission of AliveCounter, it shall be specially noted that, AliveCounter occupies four bits from No. 52 to No. 55.

1.3 BYTE[7] parity bit is the first 7 Byte XOR gates: Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

1.4 The following routine is a simple control command when USB CAN is used. Please control the vehicle in accordance with the communication protocol.

1.5 During the test, the remote controller is switched to automatic driving mode or turned off.

1.6 As the vehicle movement and other conditions may be tested during test by connecting to computer via CAN analyzer, please set up the vehicle during test, and after the vehicle is stably tested, put the vehicle down.

1.7 During the landing test, as the remote controller has the highest priority, it is best to turn on the remote controller for testing, facilitating to switch to the remote control mode at any time during the test.

2. Instructions of vehicle control command ctrl_cmd

The vehicle control command needs to send corresponding command, heartbeat signal and check bit at the same time.

(1) Targeted gear request ctrl_cmd_gear

The command of ctrl_cmd_gear is targeted gear signal, with a physical value range of 01-04. The default gear position is 01 Gear P; When the target gear is given as 03, it is the Gear N; When the target gear is given as 02, it is the Gear R; When the target gear is given as 04, it is the Gear D; When the target gear is given as 01, it is the Gear P.

For example: When target gear requests for forward driving gear, -04 0x04

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2D0	0x04	0x00	0x00	0x00	0x00	0x00	0x10	0x14
0x18C4D2D0	0x04	0x00	0x00	0x00	0x00	0x00	0x20	0x24
0x18C4D2D0	0x04	0x00	0x00	0x00	0x00	0x00	0x30	0x34

Note: The above three frames of signals are circulated at an interval of 10ms, and the gear can be controlled to be switched to the Gear D.

Feedback:

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2EF	0x04	0x00	0x00	0x00	0x00	0x00	0x00	0x04

Note: Checksum and cyclic change of Alivecounter

(2) Target vehicle speed request ctrl_cmd_velocity

The command of ctrl_cmd_velocity is the target value of vehicle speed, and the physical value range of CAN communication is 0-65.535m/s (20 reduction ratio, and the maximum vehicle speed of the vehicle is 2.7m/s, with a wheel diameter of 320mm). The target vehicle speed is determined by vehicle speed precision (0.001m/s/bit). Target vehicle driving speed = 0.001* CANbus signal. Forward and backward movement of vehicle shall be conducted in accordance with the gears.

Vehicle speed feedback is divided into three methods as below:

1) Current vehicle speed feedback: vehicle speed feedback is always positive.
2) Speed feedback of left and right wheels: the speed corresponding to the current left and right wheels. The speed is positive when moving forward and negative when moving backward.
3) Pulse feedback of left and right wheels: pulse accumulation when moving forward, and pulse

inverse accumulation when moving backward.

For example: When the given forward movement vehicle speed is 1m/s, the CANbus signal is 1000 0x03E8

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2D0	0x84	0x3E	0x00	0x00	0x00	0x00	0x00	0xBA
0x18C4D2D0	0x84	0x3E	0x00	0x00	0x00	0x00	0x10	0xAA
0x18C4D2D0	0x84	0x3E	0x00	0x00	0x00	0x00	0x20	0x9A

Note: The above three frames of signals are circulated at 10ms intervals to control the vehicle to move forward at a speed of 1m/s.

Feedback:

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2EF	0x84	0x3E	0x00	0x00	0x00	0x00	0x00	0xBA

Note: The checksum and Alivecounter cycle change, because the automatic adjustment of running speed may not feedback an absolute 1m/s, there is a certain deviation.

Left rear wheel speed and left rear wheel pulse feedback ID: 0x18C4D7EF

Right front wheel speed and right front wheel pulse feedback ID: 0x18C4D8EF

(3) Target steering angle ctrl_cmd_steering

The command of ctrl_cmd_steering is the target steering angle request. The physical range of CAN communication is (-327.68)° to (327.67)°. The internal soft limit angle of the vehicle is (- 27) degrees to (+27) degrees. The left steering is positive and the right steering is negative. Target steering angle is determined by precision 0.01 °/bit. Target steering angle = CANbus signal *0.01

For example: Given a target steering angle of - 25°, the CANbus signal = -2500 0XF63C

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2D0	0x00	0x00	0XC0	0x63	0x0F	0x00	0x00	0xAC
0x18C4D2D0	0x00	0x00	0XC0	0x63	0x0F	0x00	0x10	0xBC
0x18C4D2D0	0x00	0x00	0XC0	0x63	0x0F	0x00	0x20	0x8C

Note: The above three frames of signals are sent in cycles every 10ms, and the steering angle can be requested to be -25°

Back:

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D2EF	0x00	0x00	0XC0	0x63	0x0F	0x00	0x00	0xAC

Note: Checksum and cyclic change of Alivecounter.

5.3.3. Instructions of auxiliary control commands

Take the clearance lamp enabling as an example to illustrate that the control of other auxiliary parts is the same as the clearance lamp enabling control. I/O port enable control needs to send enable flag bit, heartbeat signal and check bit at the same time. (If I/O control does not enable all light control to be controlled by VCU)

For example: io_cmd_clearance_lamp position lamp enabling control 0x01

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D7D0	0x01	0x20	0X00	0x00	0x00	0x00	0x00	0x21
0x18C4D7D0	0x01	0x20	0X00	0x00	0x00	0x00	0x10	0x31
0x18C4D7D0	0x01	0x20	0X00	0x00	0x00	0x00	0x20	0x01

Note: The above three frames of signals are circulated every 50ms, and the high beam lamp can be requested to light up.

Feedback:

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4DAEF	0x01	0x20	0X00	0x00	0x00	0x00	0x00	0x21

Note: Checksum and Alivecounter cycle change.

Auxiliary enabling control supports position light control and left and right turn signal lamp control; Horn control(reserve) can be controlled when the IO port enable signal is set to 1 or 0; The brake lamp is not controlled by the CAN signal, but is completely controlled by the VCU to feedback whether the enable signal is enabled.

6. Attention

This section contains some matters to be noted during use, storage and development of MK-Robot-01.

6.1. Attentions for battery

▲ The battery of MK-Robot-01 products may not be fully charged when they are delivered. The specific situations CAN be read through MK-Robot-01 remote controller vehicle chassis voltage display or CAN bus communication interface. As for charging time, when the green indicator is on, indicating that the product has been fully charged;

▲ Please do not charge the battery after it is used up. When the battery voltage is too low, please charge it in time;

▲ The working temperature of the battery under discharging is -20°C~50°C, the battery can work normally within the specified temperature range, and the capacity loss is within the error range:

▲ Excessive discharge of the battery is prohibited during use to avoid damage to the battery;

▲ Avoid excessive impact on the battery; the impact beyond the specification may damage the battery, which may lead to battery leakage, heat, smoke, fire or explosion;

▲ If the battery is found to be abnormal, please stop using the battery immediately!

6.2. Attentions for charging

▲ Charging can only be conducted by the charger matching with the battery. DO NOT use the non-original battery, power supply or charger;

▲ Charging can only be conducted under 10°C~45°C. Charging out of this temperature range will lead to battery leakage, heating or serious damage, which may lead to deterioration of battery performance and life;

▲ During charging, if the charger or battery is abnormal or damaged, please remove the charger input line and output line immediately;

▲ If charging cannot be completed within the specified time, please stop charging immediately. Or, the battery may heat, have smoke or get on fire (or explode);

▲ It is not allowed charge the battery of the vehicle body in thunderstorm weather;

▲ It not allowed to charge the battery of the vehicle body in the place which is wet or with

rain;

▲ It is not allowed to charge the battery of the vehicle body with high temperature, such as heat source or direct sunlight, etc.;

▲ Charging shall be conducted in the place which is ventilated and without dust;

▲ During charging, it is not allowed to block the air inlet and outlet of the charger, there shall be a space of 10cm at least;

6.3. Attentions for usage environment

▲ The working temperature of MK ROBOT-01 is -20℃~50℃, DO NOT use in the environment with the temperature of lower than -20℃ or higher than 50℃;

▲ The best storage temperature for MK ROBOT-01 is 0℃~25℃;

▲ DO NOT store or user in the environment with corrosive, inflammable and explosive gas;

▲ During use and storage, please keep away from heat resources and fire resources;

▲ Excepting for special edition (with customized IP protection level), the water-proof function of MK-Robot-01 is limited. DO NOT use MK-Robot-01 in the environment with deep ponding;

6.4. Attentions for remote control operation

▲ When using the remote control for debugging, please ensure that the remote control is powered on and that the vehicle can receive remote control commands;

▲ Before turning on the vehicle, make sure all DIP switches are in the upward position; release the emergency stop switch; set the throttle joystick to the neutral position, i.e., the chassis speed is at 0;

▲ When using remote control for control, prioritize using the low-speed gear for control. Once you are familiar with the vehicle, you can proceed with medium-speed or high-speed control tests.

6.5. Attentions for external electrical extension

▲ The top power supply current shall be the battery voltage and current strictly selected. Over-current is not allowed;

▲ When the system detects that the battery voltage is lower than the safe voltage, protection procedure will be started automatically. If the external extension equipment involves storage of important data, and there is not automatic storage function for powering off, please

charge timely.

6.6. Other attentions

▲ During handling or setting, DO NOT fall or invert;

▲ In case of no professionals, DO NOT disassemble without permission;

▲ If the remote controller will not be used for a long time, the battery shall be removed;

▲ The tires shall be replaced timely in accordance with the wearing conditions of the patterns on the wheel tread.

▲ During use, it is important to maintain consistent tire pressure for the robot's wheels. If any tire deflation or air leakage occurs, prompt maintenance or tire replacement should be performed. Failure to do so may result in damage to the robot.

7. Common Q&A

Q: MK-Robot-01 starts normally, however, the vehicle body does not move under the control of the remote controller?

A: Firstly, confirm that whether the emergency stop switch at the tail has been released; And then, check that whether the SWA rocker is remote controller control mode(set to “down”). After that, check that whether the SWB gear switch driving lever is the same as the control command(Gear D or Gear R); Finally, check that whether the VRB parking knob is released to unlock the vehicle.

Q: What should I do that the battery of the remote controller is out of power, and the vehicle body stops running?

A: Please connect the remote controller to the charger for charging, after that, normal communication will recover soon.

Q: Both of charger led1 and led2 are off

A: Please check whether the input line interface of the charger is connected correctly and firmly; Then check whether there is AC input.

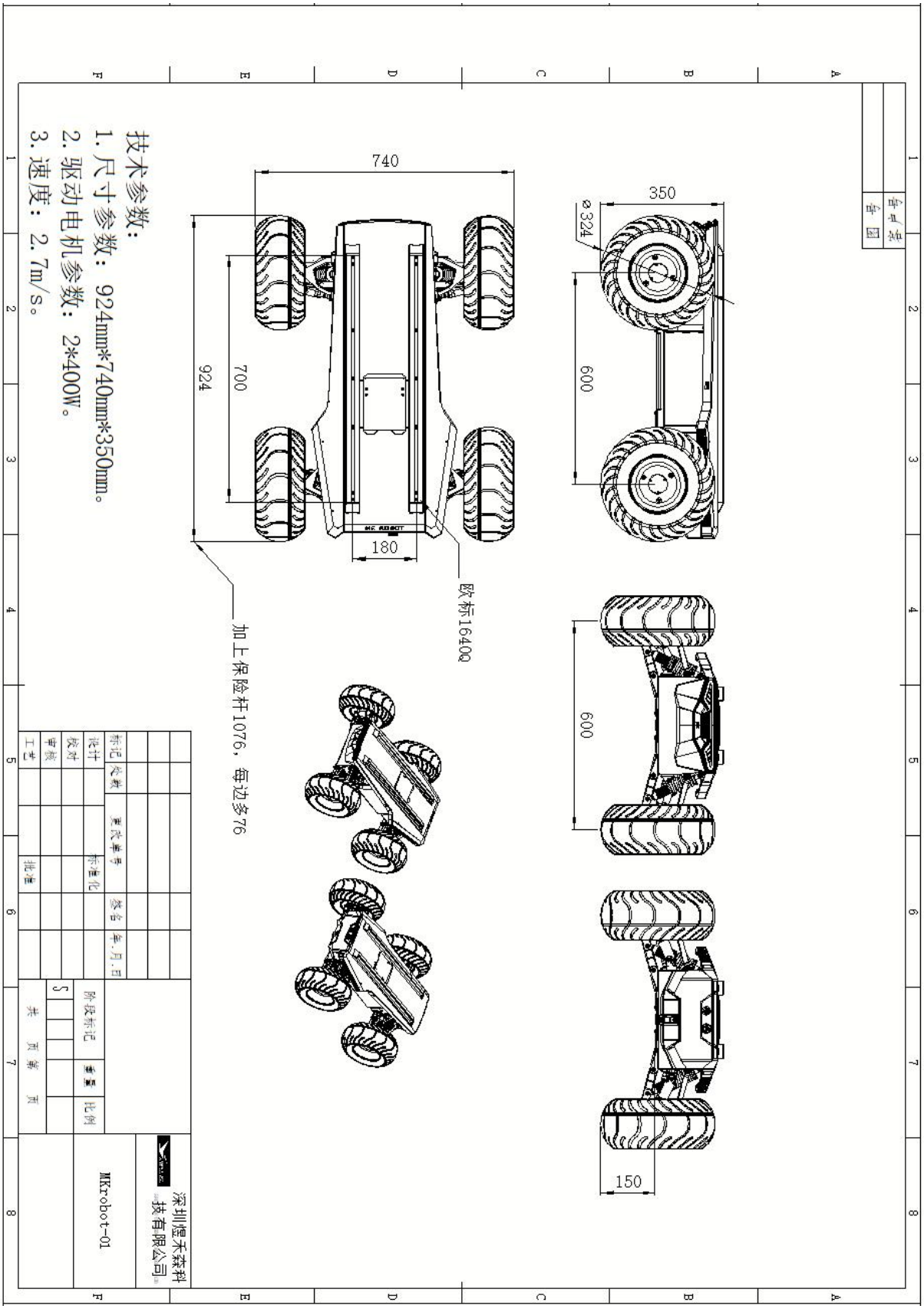
Whether the battery has not been used for a long time, discharged excessively or damaged;

To determine if the charger is in protection mode, try the following steps:

1. Disconnect both the input and output plugs of the charger.
2. Wait for at least 10 seconds.
3. Reconnect the input and output plugs firmly.

If the charger is in protection mode, this process of disconnecting and reconnecting the plugs with a time interval of more than 10 seconds may help reset it. However, if the charger continues to show signs of protection mode or fails to function properly, it is recommended to consult the manufacturer or seek professional assistance for further troubleshooting or repair.

8. Specifications



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