YUHESEN

DGT-01L Four Wheels Differential Steering Drive-by-wire Chassis

User manual V2.2.0

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CONTENT

1. Foreword

(1) Thank you for purchasing our product, this user manual is applicable to DGT-01L Four wheel differential Drive-by-wire Chassis (hereby referred to as "DGT-01L").

(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!

1.1. Safety Information

The information in this manual does not cover the design, installation, and operation of a complete robotic application, nor does it cover all peripheral equipment that may affect the safety of such a complete system. The design and use of the complete system is subject to the safety requirements established in the standards and codes of the country in which the robot is to be installed, and it is the responsibility of the DGT-01L integrator and the end customer to ensure that it is the responsibility of the DGT-01L integrator and end-customer to ensure that the applicable laws and regulations of the country concerned are followed and that no significant hazards exist in the complete robot application. risks in the complete robot application example. This includes, but is not limited to, the following:

■ Effectiveness and Responsibility:

- Do a risk assessment of the complete robotic system. Connect additional safety equipment to other machinery as defined by the risk assessment. Confirm that the design and installation of the peripherals of the complete robotic system, including software and hardware systems, is accurate.
- This robot does not have the automatic collision avoidance, fall prevention, biological proximity warning and other relevant safety functions that a complete autonomous mobile robot has, but is not limited to the above description. This robot does not have the safety functions of a complete autonomous mobile robot, such as automatic collision avoidance, fall prevention, biological proximity warning, etc., but it is not limited to the above descriptions. Ensure that there are no major dangers and potential safety hazards in the actual application of the developed robot.
- Collect all documentation in the technical file: including the risk assessment and this manual. Before operating and using the equipment already Know the possible safety risks.

■ Matrix:

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

- It is operated by remote control, selecting relatively open areas for use, and the car itself does not come with any automatic obstacle avoidance sensors.
- Use in ambient temperatures from -20°C to 50°C.
- Vehicles are not individually customized with IP levels of protection, and the vehicles are water and dust proof to IP44.

■ Inspections:

- Check to ensure that the equipment is fully charged. Make sure there are no obvious abnormalities in the vehicle. Check to make sure the batteries of the remote control are sufficiently charged.

■ Operations:

- Ensure that the surrounding area is relatively empty during operation. Remote control within sight distance.
- The maximum load capacity of DGT-01L is 200KG, make sure the payload does not exceed 200KG when in use.
- Please charge the device in time when it has a low battery alarm. When the device is abnormal, please stop using it immediately to avoid secondary injury.
- When the equipment is abnormal, please contact the relevant technical personnel and do not handle it without authorization.
- Please use the device in an environment that meets the protection level according to the IP protection level of the device.
- Do not push the device directly.
- When charging, make sure the ambient temperature is greater than 0℃.

■ Maintenance:

- If the tires are badly worn, please replace them in time.
- If the battery is not used for a long time, the battery needs to be recharged periodically according to each month under full charge.
- The battery should be recharged at least once in a month.

2. Introduction

DGT-01L is a versatile drive-by-wire robotics mobile platform, it adopts differential steering and motor drive form. DGT-01L has a relatively strong load capacity. 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 equipping with the modules of navigation systems, GPS and IMU, cameras etc., this chassis is widely used in unmanned patrol, logistics, transportation, scientific research and various new applications and explorations requiring for mobile chassis.

2.1. Product list

After delivery, please carefully confirm the product list:

Chassis *1	Remote controller *1
	
Charger (48V) *1	Product manual *1
	

2.2. Performance parameters

Table 2 - 1 DGT-01L Performance Parameter Table

Parameter type	Performance	Parameter
Structural size and weight	Dimensions(W*D*L)	1055*743*540mm
	Weight	150kg
	Drive form	Four wheel differential
	Material	Q235
	Ground clearance	120mm
	Wheelbase	580mm
	Wheel track	643mm
	Tire type/diameter	400mm
Basic configuration	Driving motor	4*1000W, servo motor
	Battery type	48V/70AH lithium battery/CAN communication
	Charging time	4-5h
	Charging method	48V/20A, manual charging by charger
	External power supply	24V/15A-12V/15A-5V/4A
	Braking mode	Motor brake
Safety measures	Emergency stop button	√
	Command check	√
	Heartbeat protection	√
	Electric current protection	√
	Temperature protection	√
VCU configuration	Dominant frequency	168MHz
	Kinematic analysis	√
	Hardware floating point acceleration	√
	Communication interface	CAN interface
	Communication protocol	CAN interface protocol
Performance parameters	Remote control distance	100m
	Vertical load (level road)	200kg
	Speed	0-4km/h
	Mileage	20km (without load)
	Minimum turning radius	0
	Maximum climbing angle	15° (full load)
	Wading depth	100mm
	Crossing width	200mm (full load)
	Obstacle surmounting height	100mm (full load)
	Protection level	IP44
	Operating temperature	-20°C~50°C
	Storage temperature	0°C~40°C

3. Product presentation

The contents in this part are only the basic introductions for DGT-01L Drive-by-wire Chassis, facilitating the users and developers to know DGT-01L chassis basically. As shown in Figure 3-1 and Figure 3-2, there are the front and rear overall figure of the whole drive-by-wire chassis.

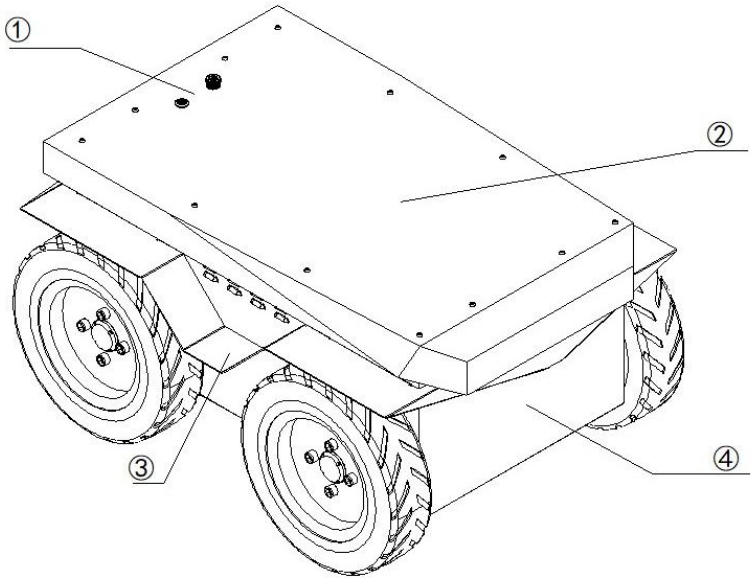


Figure 3 - 1 Front Overall Figure

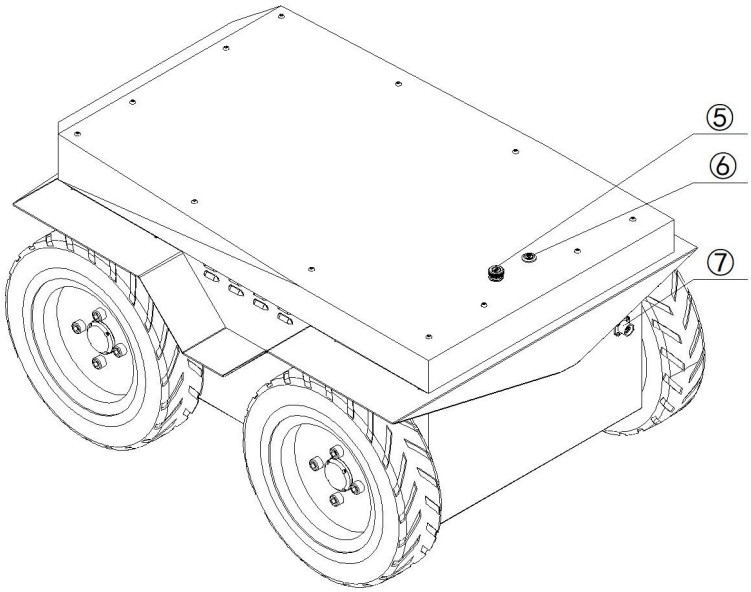


Figure 3 - 2 Tail Overall Figure

Note: ① Top electrical board; ② Top electrical mounting board; ③ Side skirts; ④ Body; ⑤ Emergency stop switch; ⑥ Start switch; ⑦ Charging port.

The product of the utility model belongs to the chassis carrier category, is a four-wheel carrier platform, which can be used to carry precision camera control instruments to realize automatic operation control and detection, and belongs to the actuator. In industrial applications, it is used to carry control equipment, detection equipment and safe operation device for walking and protection. Its working principle is that the embedded computer is connected through the power of the battery, and the walking command is issued. The command drives the pid control motor to rotate, and the motor rotation drives the reducer to control the mechanical movement to realize the walking function.

DGT-01L robot mobile platform is the representative of high flexibility and high reliability products. It has the general multi-scenario application capability both indoor and outdoor, and aims to provide users with a complete, high-performance, reliable, rich interface, simple and easy to use, strict protection level, and long-term uninterrupted working robot system.

DGT-01L is a four-wheel differential steering robot platform. It is equipped with a strong drive system. It can adapt to various application environments and achieve various movements with high performance. The chassis is made of Q235 material, corrosion-resistant paint, driven by four high-power servo motors, and equipped with independent servo drivers, supporting CAN interface. It also provides users with a complete device communication protocol, enabling users to quickly get started with DGT-01L.

3.1. Function description of electrical board

3.1.1. Description of top electrical board

There is an electrical board set on the top of DGT-01L, and the electrical board on the top is shown in Fig. 3-3, in which B1 is the power switch switch; B2 is the emergency stop switch. Beat the emergency stop switch and the vehicle body stops moving; its specific position is shown in Figure 3-3.

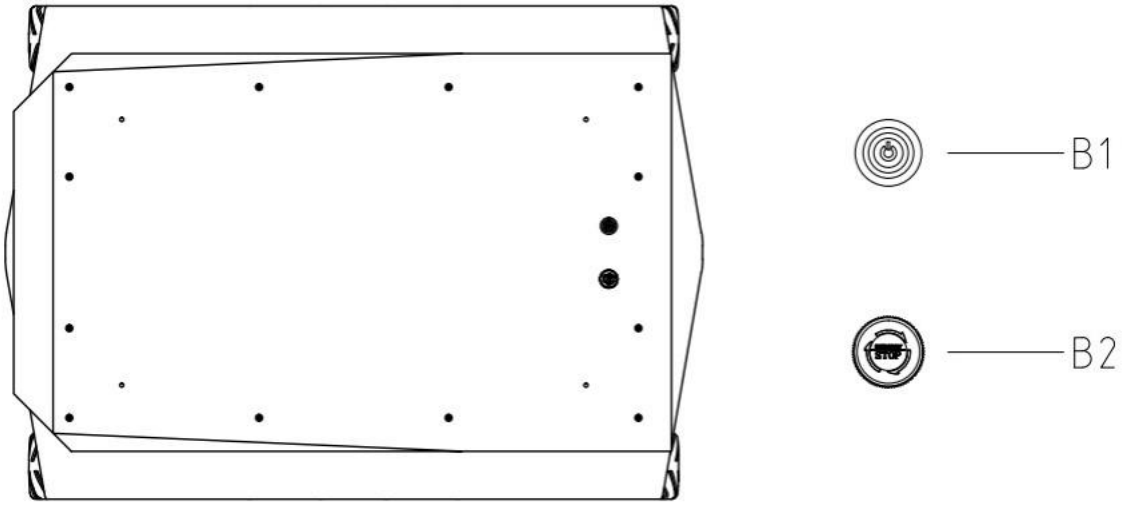


Figure 3-3 Top electrical location diagram

3.1.2. Description of rear electrical board

The electrical board at the rear is shown in Figure 3-4, which is a charging interface.

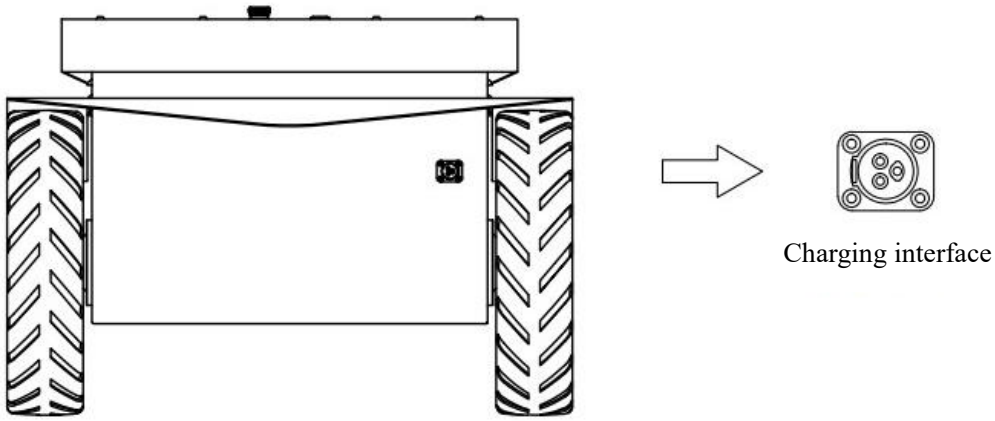


Figure 3-4 Rear view

3.2. Instructions of DGT-01L remote control

3.2.1. Descriptions of DGT-01L Remote Control

Each DGT-01L is equipped with a FS-i6S remote control. Users can easily control the DGT-01L using the remote control. In this product, the FS-i6S remote control is designed with left hand steering and right hand forward and backward movement. Refer to Figure 3-5 for its definition and function.

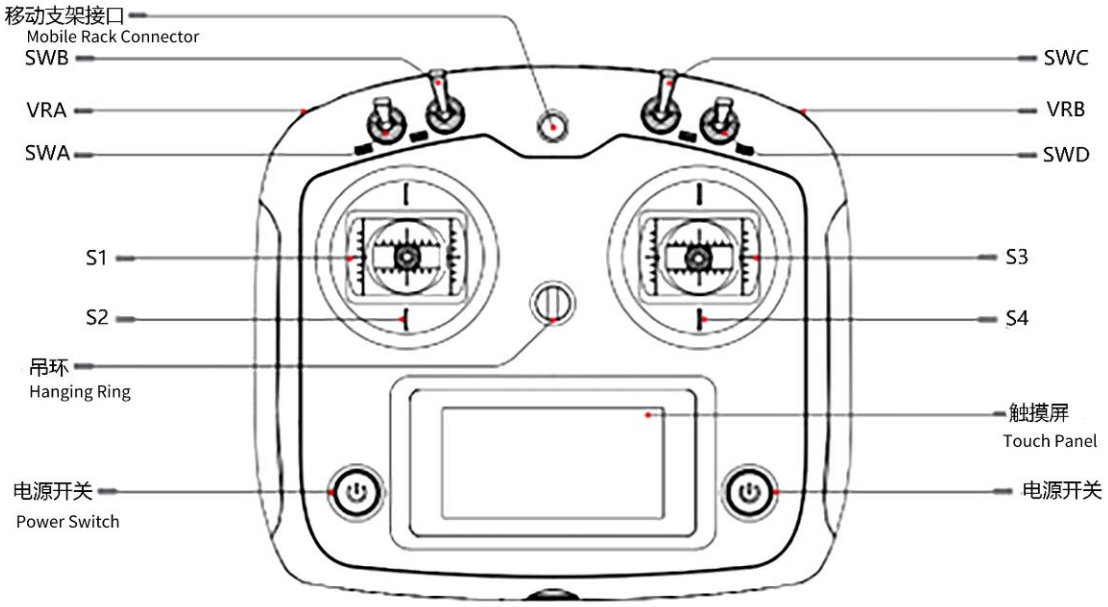


Figure 3-5 FS-i6S Remote Control Button Diagram

Remote control parameters have been set in the factory, please do not modify the system settings, otherwise it may lead to the robot out of control, control chaos and other problems, if there is a problem, it is recommended to return to the factory for maintenance; the remote control detailed operating instructions are as follows:

(1) SWA is the control mode switching toggle, two positions, when the toggle is upward, it is the remote control mode, when the toggle is downward, it is the command control mode.

(2) SWC is the speed switching toggle, three positions, low speed mode when the toggle is up, high speed mode when the toggle is down, and medium speed mode when the toggle is in the center.

(3) VRA is the safety stop unlock dial, used to release the safety stop. When the collision bar senses the collision, it will trigger the safety stop. After the safety stop is triggered, toggle the VRA dial once (or toggle the right lever S4 once in the opposite direction of the collision) to unlock the safety stop and continue the operation.

(4) VRB is the operation protection dial, when operating the rocker, you need to press and hold the VRB dial at the same time, otherwise, the chassis will not receive the motion command from the rocker.

(5) The left rocker is the direction control rocker, the left and right movements of the rocker S1 control the left and right steering of the chassis, the up and down movement control of the rocker S2 is not activated, the up and down toggle has no effect on the movement of the chassis.

(6) The right rocker is the throttle control rocker, rocker S4 controls the chassis' forward and backward movement, rocker S3 is not enabled for left and right movement control, and left and right pivoting has no effect on the chassis' movement.

(7) There is a power button on the left and right side, press and hold the two power buttons at the same time

to switch on and off the chassis.

(8) Display standby interface is described as follows:

The start page is divided into four parts, the upper left is for T1 and T2 timer, the lower left is for flight mode, the upper right is for power display, among which TX is the power of remote control, RX is the power of robot, the lower right is for unlock button and fine adjustment button.

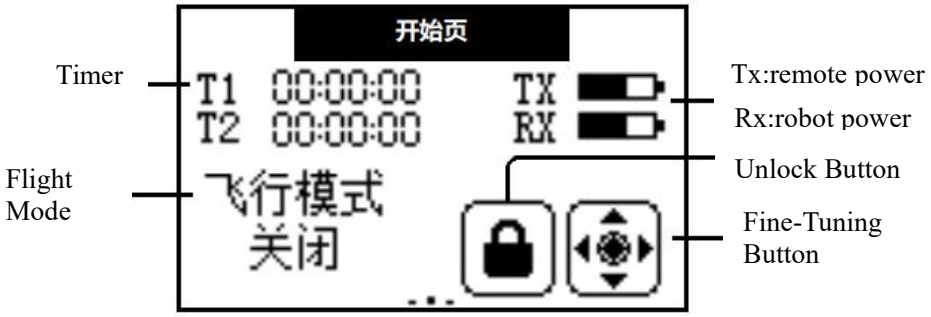


Figure 3-6 Remote Control Start Page

The left page of the remote control start page is the channel interface, as shown:

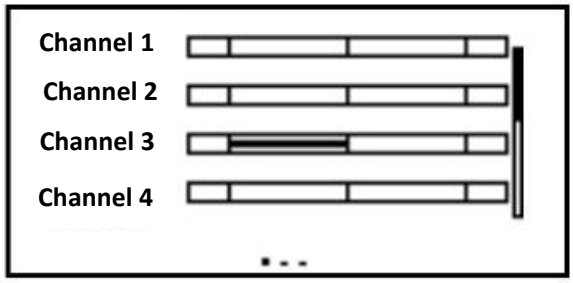


Figure 3-7 Remote Control Channel Page

The correspondence between each channel and the operating parts of the remote control is as follows.

Table 3-1 Correspondence between remote control channels

Channel No.	1	2	3	4	5	6	7	8	9	10
Remote controller parts	S3	S2	S4	S1	VRA	VRB	SWA	SWB	SWC	SWD

The right side of the remote controller's start page is the sensor list page, which includes the following information:

TX.V: Remote Controller Battery Voltage

Int.V: Receiver Voltage

Sig.S: Signal Strength (Normal signal strength is 10)

Ext.V: Robot Chassis Voltage (Note: the unit is V)

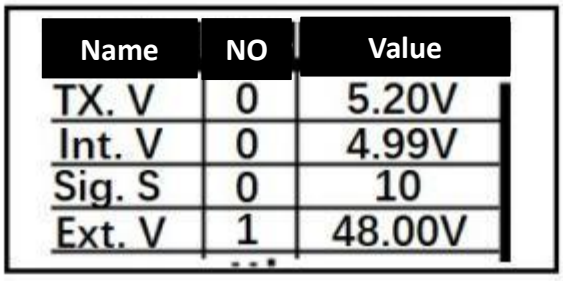


Figure 3-8 Remote Control Sensor List Page

To obtain specific SOC (State of Charge), please refer to Table 3-2.

Table 3-2 Comparison table for vehicle battery voltage and SOC

Vehicle Battery Voltage vs. Remaining Capacity Percentage										
Voltage (V)	51.03	49.8	49.75	49.74	49.68	49.63	49.52	49.29	49.17	48.97
SOC (%)	100	95	90	85	80	75	70	65	60	55
Voltage (V)	48.96	48.95	48.91	48.82	48.65	48.45	48.19	47.83	47.53	42.65
SOC (%)	50	45	40	35	30	25	20	15	10	7(Stop Outputs)

◆ **The control authority regarding the remote controller and communication commands is as follows:**

(1) In scenarios where no remote controller is present: upon startup, the FW-01 mobile robot chassis will receive communication commands and execute them accordingly. It will rely solely on these instructions for its operation.

(2) In scenarios where both the remote controller and communication commands are present: the remote controller takes priority in controlling the FW-01 mobile robot chassis. It will control the device based on the mode set by the SWA switch on the remote controller. The control authority can be easily obtained by using the SWA switch.

(3) When only the remote controller is present: the control of the FW-01 mobile robot chassis is determined by the remote controller's mode, which is controlled by the remote controller itself.

3.2.2. Explanations of the speaker warning of the remote control

Table 3-3 Descriptions of Remote Control Alarm Status

Switch position alarm	When the remote control is turned on and the lever switches SWA/SWB/SWC/SWD are not in their default positions, an alarm interface will appear, prompting the user to move all the switches to the upward position. Once all the switches are in their default positions, the main interface will appear normally.
Low voltage alarm	When the voltage drops 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, and if the voltage of the chassis is too low, the RX icon will flash.
Communication abnormal alarm	When the distance between the remote control and the chassis is too far or there is obstruction interference in the environment, the strength of the remote control signal will decrease. If the signal strength drops below 5, it will trigger a communication abnormal alarm, reminding the user that the remote control signal strength is weak.
Remote control unused alarm	When the remote control is unused for a long time, the remote control buzzer will emit intermittent alarms.
Power off alarm	When the remote control is turned off, it will check whether the chassis is also turned off. If the chassis is not turned off, a warning interface will pop up, and the chassis power must be turned off before the remote control can be turned off. (If it is necessary to force the remote control to shut down while the chassis is still on, the battery must be removed.)

3.2.3. Control commands and motion descriptions

We establish a coordinate reference system for ground moving vehicles according to the ISO8855 standard as shown in Fig. 3-9.

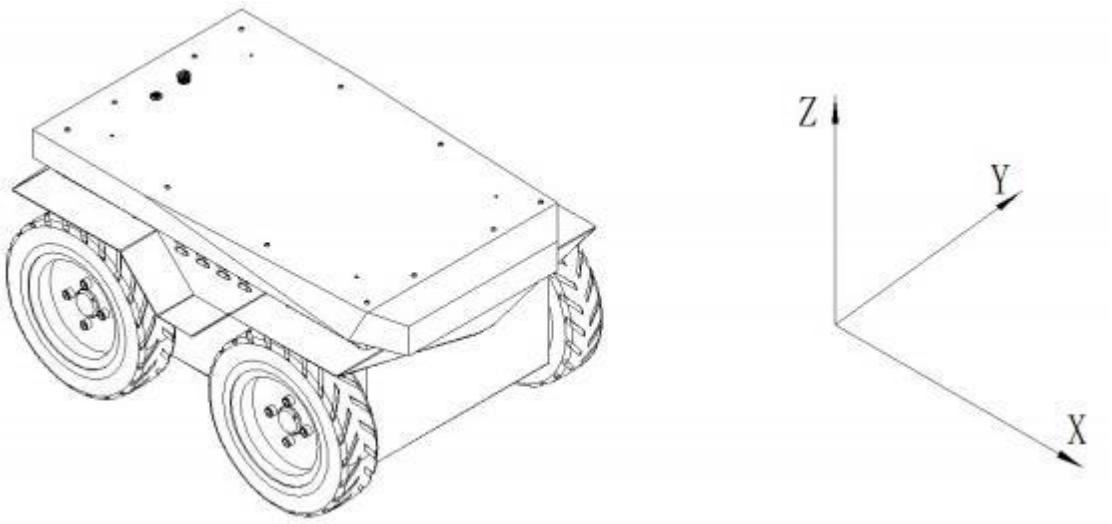


Figure 3-9 Vehicle Body Coordinate System

As shown in Figure 3-9, the DGT-01L body is parallel to the X-axis of the established reference coordinate system.

In remote control mode, press and hold VRB to operate the protection dial, the right hand throttle rocker S4 of the remote control is pushed forward for X-positive direction, and pushed backward for X-negative direction, the speed of X-direction will be maximum when the rocker S4 is pushed to the maximum value, and the speed of X-negative direction will be maximum when the rocker S4 is pushed to the minimum value.

When the remote controller left hand direction rocker S1 is pushed left and right to control the steering movement of the vehicle body, when the direction rocker S1 is pushed left, the chassis will steer left, push left to the maximum, at this time, the left steering angular velocity is maximum, when the direction rocker S1 is pushed right, the chassis will steer right, push right to the maximum, at this time, the right steering angular velocity is maximum.

4. Getting started

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

4.1. Use and operation

4.1.1. Descriptions of remote operation control:

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 default position;

Start-up

(1) Press B2 (starting switch)

(2) Check the vehicle battery voltage of the remote controller to see that whether the battery voltage is normal. If the voltage is lower, please charge first.

(3) Check whether the driver temperature is normal. If the temperature is too high, check the cause first;

Shutdown operation

Press B2 (starting switch) again and release the switch to turn off the power supply;

Emergency stop

Beat the emergency stop switch on the electrical panel at the tail of DGT-01L vehicle body;

4.2. Charging

The chassis of the DGT-01L mobile robot is equipped with a 48V/20A charger in default, meeting the demands of charging of the users.

The specific operation processes of charging are as follows:

(1) Before charging, please make sure that DGT-01L is shut down and powered off, and confirm that A the main power switch on the electrical board at the tail is closed;

(2) Insert the output plug of the charger into the charging interface on the electrical board at the tail, then insert the input plug of the charger into the 220V AC socket;

(3) When charging is complete, reverse the process and unplug the AC plug first, then the output plug;

(4) The charger operating status is indicated in Table 4-1;

Table 4-1 Description of Charger Status LED Indicators

LED indicator status	Charger Status
LED1 bright red	Charger input cable connector is energized
LED2 bright red	Indicates that the charger is charging

LED2 bright green	Indicates that the battery is fully charged

(5) If the charging environment is too high, the charger may enter the temperature protection state, please move the charger to a cool or ventilated place, and resume normal charging when the internal temperature of the charger reaches 60℃. The charger protection status is described in Table 4-2:

Table 4-2 Description of Charger Protections

Protection Functions	Function Description
Overheat protection	When the internal temperature of the charger reaches the overheat protection point, the charger automatically stops charging.
Output Short Circuit Protection	The charger automatically shuts off the output when the output of the charger is accidentally short-circuited.
Output Reverse Connection Protection	When the battery is reversed, the charger will cut off the connection between the internal circuit and the battery.
Output Over-voltage Protection	When over-voltage occurs in the charger output, the charger automatically shuts down the output.

Attention: The charging process must be operated in order to prevent the charger socket from being energized and the battery charging port from short-circuiting, resulting in damage to the robot's battery, charger, or unnecessary personal injury.

4.3. Development

DGT-01L product provides CAN communication protocols for user development, and users can command and control the vehicle body by connecting the CAN interface.

4.3.1. CAN communication protocol

The communication of DGT-01L product is conducted by CAN2.0B extended frame, and the message format is Intel. Through the external CAN bus interface, the vehicle speed, steering angle, brake pedal openness and parking request of the chassis can be controlled. The DGT-01L will feed back the current movement state information and the system state information of the DGT-01L chassis in real time.

The protocol content package control frame and feedback frame are as follows:

There are two control modes of motion command control: kinematics control and freedom control. Users can select the corresponding command control mode according to their needs, and only one mode can be used for control. The specific agreement contents are shown in the table:

Motion Control Command - Control Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
ctrl_cmd			0x18C4D1D0			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Target gear	Intel	0	0	Cycle	4	Unsigned	1		00: disable 01: Gear P 02: Gear N 03: Kinematics control gear
Target speed	Intel	0	4	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Target angular speed	Intel	2	20	Cycle	16	signed	0.01	°/s	(0.01°/s)/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Free Control Instruction - Control Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
free_ctrl_cmd			0x18C4D2D0			Cycle	10		8
Signal description	**Arrange ment form at**	**Star ting byte**	**Start bit**	**Signal trans missio n type**	**Sign al Len gth**	**Data type**	**Accu racy**	**Unit**	**Signal value description**
Target gear	Intel	0	0	Cycle	4	Unsign ed	1		00: disable 01: Gear P 02: Gear N 04: Free control gear
Left front wheel target speed	Intel	0	4	Cycle	16	signed	0.001	m/s	0.001m/s/bit；
Right front wheel target speed	Intel	2	20	Cycle	16	signed	0.001	m/s	0.001m/s/bit；
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsign ed	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsign ed	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Free Control Instruction - Control Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
rear_free_ctrl_cmd			0x18C4D3D0			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Target gear	Intel	0	0	Cycle	4	Unsigned	1		00: disable 01: Gear P 02: Gear N 04: Free control gear
Left rear wheel target speed	Intel	0	4	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Right rear wheel target speed	Intel	2	20	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

I/O Control Instructions - Control Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
io_cmd			0x18C4D7D0			IfActive	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Safe parking unlock switch	Intel	0	1	IfActive	1	Unsigned	1		0 = Invalid 1 = Unlock Enable
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Motion Control Status - Feedback Frame								
Message Name			**ID**			**Type**	**Cycle (ms)**	**Length (Byte)**
ctrl_fb			0x18C4D1EF			Cycle	10	8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current gear feedback	Intel	0	0	Cycle	4	Unsigned	1		00: disable 01: Gear P 02: Gear N 03: Kinematics control gear 04: Free control gear
Current vehicle linear speed feedback	Intel	0	4	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Current vehicle angular speed feedback	Intel	2	20	Cycle	16	signed	0.01	°/s	(0.01°/s)/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Wheel Train Control Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
lf_wheel_fb			0x18C4D6EF			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current left front wheel speed feedback	Intel	0	0	Cycle	16	signed	0.001	m/s	0.001m/s/bit；
Current left front wheel pulse feedback	Intel	2	16	Cycle	32	signed	1	1	N pulses per wheel turn, N=encoder lines * reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Wheel Train Control Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
lr_wheel_fb			0x18C4D7EF			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current left rear wheel speed feedback	Intel	0	0	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Current left rear wheel pulse feedback	Intel	2	16	Cycle	32	signed	1	1	N pulses per wheel turn, N=encoder lines * reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Wheel Train Control Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
rf_wheel_fb			0x18C4D9EF			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current right front wheel speed feedback	Intel	0	0	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Current right front wheel pulse feedback	Intel	2	16	Cycle	32	signed	1	1	N pulses per wheel turn, N=encoder lines * reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Wheel Train Control Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
rr_wheel_fb			0x18C4D8EF			Cycle	10		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current right rear wheel speed feedback	Intel	0	0	Cycle	16	signed	0.001	m/s	0.001m/s/bit;
Current right rear wheel pulse feedback	Intel	2	16	Cycle	32	signed	1	1	N pulses per wheel turn, N=encoder lines * reduction ratio
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

I/O Control Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
io_fb			0x18C4DAEF			Cycle	50		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Safe parking unlock switch	Intel	0	1	IfActive	1	Unsigned	1		0 = invalid 1 = unlock enable
Emergency stop switch status feedback	Intel	5	40	Cycle	1	Unsigned	1		0 = off 1 = on
Remote control status feedback	Intel	5	41	Cycle	1	Unsigned	1		0 = Command control status 1 = Remote control status
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Battery Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
bms_fb			0x18C4E1EF			Cycle	100		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current battery voltage	Intel	0	0	Cycle	16	Unsigned	0.01	V	0.01V/bit；
Battery current	Intel	2	16	Cycle	16	signed	0.01	A	0.01A/bit；
Current battery capacity	Intel	4	32	Cycle	16	Unsigned	0.01	Ah	0.01Ah/bit；
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

Battery Flag Status - Feedback Frame									
Message Name			**ID**			**Type**	**Cycle (ms)**		**Length (Byte)**
bms_flag_fb			0x18C4E2EF			Cycle	100		8
Signal description	**Arrangement format**	**Starting byte**	**Start bit**	**Signal transmission type**	**Signal Length**	**Data type**	**Accuracy**	**Unit**	**Signal value description**
Current remaining battery percentage	Intel	0	0	Cycle	8	Unsigned	1	%	1%/bit;
Individual overvoltage protection	Intel	1	8	Cycle	1	Unsigned	1		0 = off 1 = on
Individual undervoltage protection	Intel	1	9	Cycle	1	Unsigned	1		0 = off 1 = on
Whole group overvoltage protection	Intel	1	10	Cycle	1	Unsigned	1		0 = off 1 = on
Whole group undervoltage protection	Intel	1	11	Cycle	1	Unsigned	1		0 = off 1 = on
Charging over temperature protection	Intel	1	12	Cycle	1	Unsigned	1		0 = off 1 = on
Charging low temperature protection	Intel	1	13	Cycle	1	Unsigned	1		0 = off 1 = on
Discharge over temperature protection	Intel	1	14	Cycle	1	Unsigned	1		0 = off 1 = on
Discharge low temperature protection	Intel	1	15	Cycle	1	Unsigned	1		0 = off 1 = on
Charging overcurrent protection	Intel	2	16	Cycle	1	Unsigned	1		0 = off 1 = on
Discharge overcurrent protection	Intel	2	17	Cycle	1	Unsigned	1		0 = off 1 = on

Short-circuit protection	Intel	2	18	Cycle	1	Unsigned	1		0 = off 1 = on
Fore-end IC error detection	Intel	2	19	Cycle	1	Unsigned	1		0 = off 1 = on
Software locked MOS	Intel	2	20	Cycle	1	Unsigned	1		0 = off 1 = on
Charging flag position	Intel	2	21	Cycle	1	Unsigned	1		0 = discharge 1 = charge
The highest temperature of battery	Intel	3	28	Cycle	12	signed	0.1	℃	0.1℃/bit;
The highest temperature of battery	Intel	5	40	Cycle	12	signed	0.1	℃	0.1℃/bit;
Alive Rolling Counter Heartbeat signal (loop counter)	Intel	6	52	Cycle	4	Unsigned	1		For each frame sent, the value is incremented by 1. After reaching the maximum value, it is counted again from 0 to detect packet loss and disconnection
Check BCC XOR checkout for message	Intel	7	56	Cycle	8	Unsigned	1		Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

4.3.2. Instructions for using CAN communication protocol

1.Precautions during the testing process:

1.1 During the sending process, note that AliveCounter needs to continuously change and send in a cyclic manner.

1.2 During the process of sending AliveCounter, pay special attention to the four bits occupied by AliveCounter ranging from 52 to 55.

1.3 The check bits of BYTE [7] are XOR checks of the first 7 Bytes: Checksum = Byte0 XOR Byte1 XOR Byte2 XOR Byte3 XOR Byte4 XOR Byte5 XOR Byte6

1.4 The following routine is a simple control command for issuing commands using USB CAN. Please control and issue commands according to the communication protocol when controlling the vehicle.

1.5 During the testing process, switch the remote control to command and control mode or turn off the remote control.

1.6 During the testing process of using a computer to connect the CAN analyzer, due to the possibility of testing vehicle movement and other situations, please set up the vehicle during the testing process and let it down when using the program to test after the vehicle has stabilized.

1.7 During the road test, as the remote control has the highest priority, it is best to turn on the remote control for testing to facilitate switching to remote control mode at any time during the testing process.

2.Vehicle control command description ctrl_cmd

The vehicle control command needs to send corresponding commands, heartbeat signals, and check bits simultaneously.

（1）Target gear request ctrl_cmd_gear

ctrl_cmd_gear command is the target gear signal, with a physical value range of 00 to 03. The default gear position is 00, which is the disable gear; When the target gear is set to 01, it is in parking gear; When the target gear is given 02, it is in neutral; When the target gear is set as 03, it is the kinematics control gear.

Example: when the target gear request is kinematics control gear - 03 0x03

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D1D0	0x03	0x00	0x00	0x00	0x00	0x00	0x10	0x13
0x18C4D1D0	0x03	0x00	0x00	0x00	0x00	0x00	0x20	0x23
0x18C4D1D0	0x03	0x00	0x00	0x00	0x00	0x00	0x30	0x33

Note: The above three frames of signals are sent circularly every 10ms, and the control gear can be switched to the kinematics control gear.

Feedback:

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

0x18C4D1EF	0x03	0x00	0x00	0x00	0x00	0x00	0x00	0x03

Note: Checksum and Alivecounter cyclic change.

(2) Target speed request ctrl_cmd_liner

ctrl_cmd_liner command is the target value for driving the vehicle's liner speed. The physical value range of CAN communication is -32.767 to 32.767 m/s. The target line speed is determined by the vehicle speed accuracy (0.001 m/s/bit). The target line speed of the driving vehicle is 0.001 * bus signal. The vehicle is used in combination with gears for forward and backward movement.

There are three types of vehicle speed feedback methods, namely:

1) Current vehicle speed feedback: This vehicle speed feedback is always positive.

2) Left and right wheel speed feedback: The vehicle speed corresponding to the current left and right wheels is positive when moving forward and negative when moving backward.

3) Feedback of left and right wheel pulse number: Forward is the accumulation of pulses, and backward is the accumulative decrease of pulses.

Example: Given a forward speed request of 1m/s, the bus signal is equal to 1000 0x03E8

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D1D0	0x83	0x3E	0x00	0x00	0x00	0x00	0x00	0XBD
0x18C4D1D0	0x83	0x3E	0x00	0x00	0x00	0x00	0x10	0XAD
0x18C4D1D0	0x83	0x3E	0x00	0x00	0x00	0x00	0x20	0x9D

Note: The above three frames of signals are issued in cycles with an interval of 10ms, which can 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	0x83	0x3E	0x00	0x00	0x00	0x00	0x00	0xBD

Note: Checksum and Alivecounter cyclic change. Due to the automatic adjustment of the operating speed, the feedback may not be absolute 1m/s.

The left front wheel speed and left front wheel pulse feedback ID: 0x18C4D6EF

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

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

The right rear wheel speed and right rear wheel pulse feedback ID: 0x18C4D9EF

（3）Target angular speed ctrl_cmd_angular

ctrl_cmd_angular command is the target angular velocity request, with a physical range of (-327.68) degrees

to (327.67) degrees for CAN communication. The left turn is positive, and the right turn is negative. The target angular velocity is determined by the accuracy (0.01 °/s)/bit. Target angular velocity=bus signal * 0.01

Example: Given a target angular velocity of -25 °/s, the bus signal is equal to -2500 0XF63C

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D1D0	0x03	0x00	0XC0	0x63	0x0F	0x00	0x00	0xAF
0x18C4D1D0	0x03	0x00	0XC0	0x63	0x0F	0x00	0x10	0xBF
0x18C4D1D0	0x03	0x00	0XC0	0x63	0x0F	0x00	0x20	0x8F

Note: The above three frames of signals are sent in cycles with an interval of 10ms, and the angular velocity can be requested to be -25 °/s.

Feedback:

ID	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x18C4D1EF	0x03	0x00	0XC0	0x63	0x0F	0x00	0x00	0xAF

Note: Checksum and Alivecounter cyclic change.

5. Attention

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

5.1. Attentions for battery

▲ The battery of DGT-01L. products may not be fully charged when they are delivered. The specific situation can be read through the voltage display meter at the rear of the chassis or the CAN bus communication interface. As for charging time, when the green indicator is on, indicating that the product has been fully charged;

▲ DO NOT charge the battery after it is exhausted, and please charge in time when the battery voltage is too low;

▲ The working temperature of the battery under discharging is -10°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;

▲ In case of obvious battery abnormalities, please stop using the battery immediately!

▲ The battery shall be charged and discharged at least once within a month.

5.2. 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;

▲ The charging process must be operated in order to prevent the charger connector from being electrified and the battery charging port from being short-circuited, resulting in damage to the robot battery and charger, or unnecessary personal injury.

5.3. Attentions for usage environment

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

▲ 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 DGT-01L. is limited. DO NOT use DGT-01L. in the environment with deep ponding.

5.4. Attentions for remote operation

▲ Remote control mode chassis motion control need to hold down the VRB operation protection dial, when release the VRB chassis will automatically stop, no longer respond to the left hand direction, the right hand throttle rocker control;

▲ Emergency stop knob is released; the throttle remote lever returns to zero position, i.e.: the chassis speed is 0 state;

▲ When the remote control S4 remote lever is pushed forward to control the vehicle forward, if you need to backward operation of the vehicle, you should first return the S4 remote lever to zero and then backward operation, and it is forbidden to push it to backward gear directly;

▲ When the remote control S4 remote lever is pushed forward to control the vehicle forward, if you need to backward operation of the vehicle, you should first return the S4 remote lever to zero and then backward operation, and it is forbidden to push it to backward gear directly.

5.5. 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.

5.6. 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 end 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.

6. Q&A

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

A: First, confirm whether the tail emergency stop switch is released;

And check to see if the remote control SWA dial is in remote control mode;

Then check that the VRB operation protection toggle is not held down at the same time during operation.

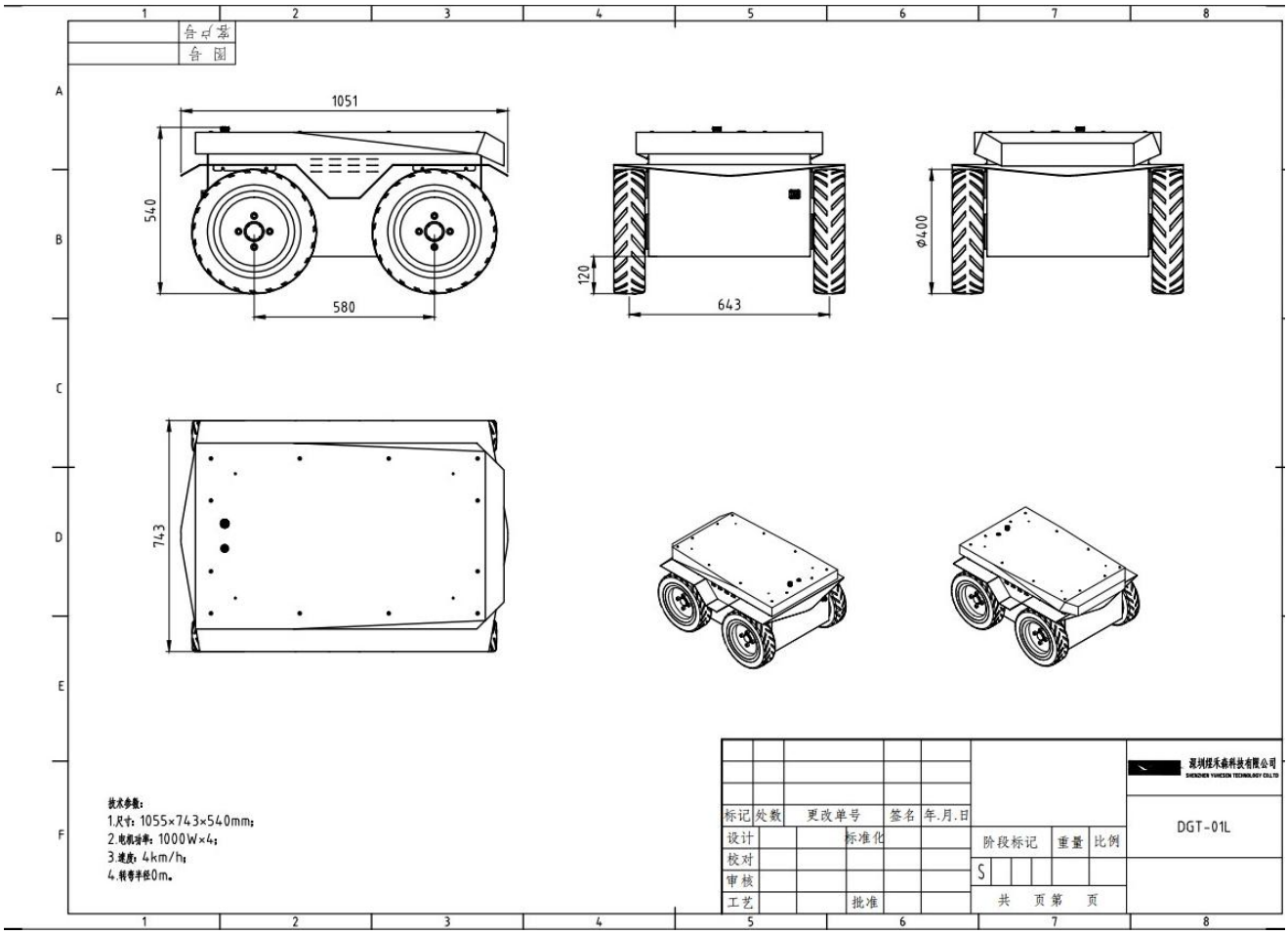
Q: When DGT-01L is controlled with the remote control, what happens after the remote control runs out of power and the car stops running?

A: Please replace the remote control batteries immediately. Normal communication can be resumed after replacing the remote control batteries.

Q: Control interruption during remote control operation?

A: When using the remote control, the control range is 100 meters, please confirm whether it is within the remote control range; Then check whether the remote control handle has sufficient power.

7. Specification



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