SERVICE MANUAL

Starke LiftMaxx Series

PT30L-MINI
Electric Pallet Truck
2022-11

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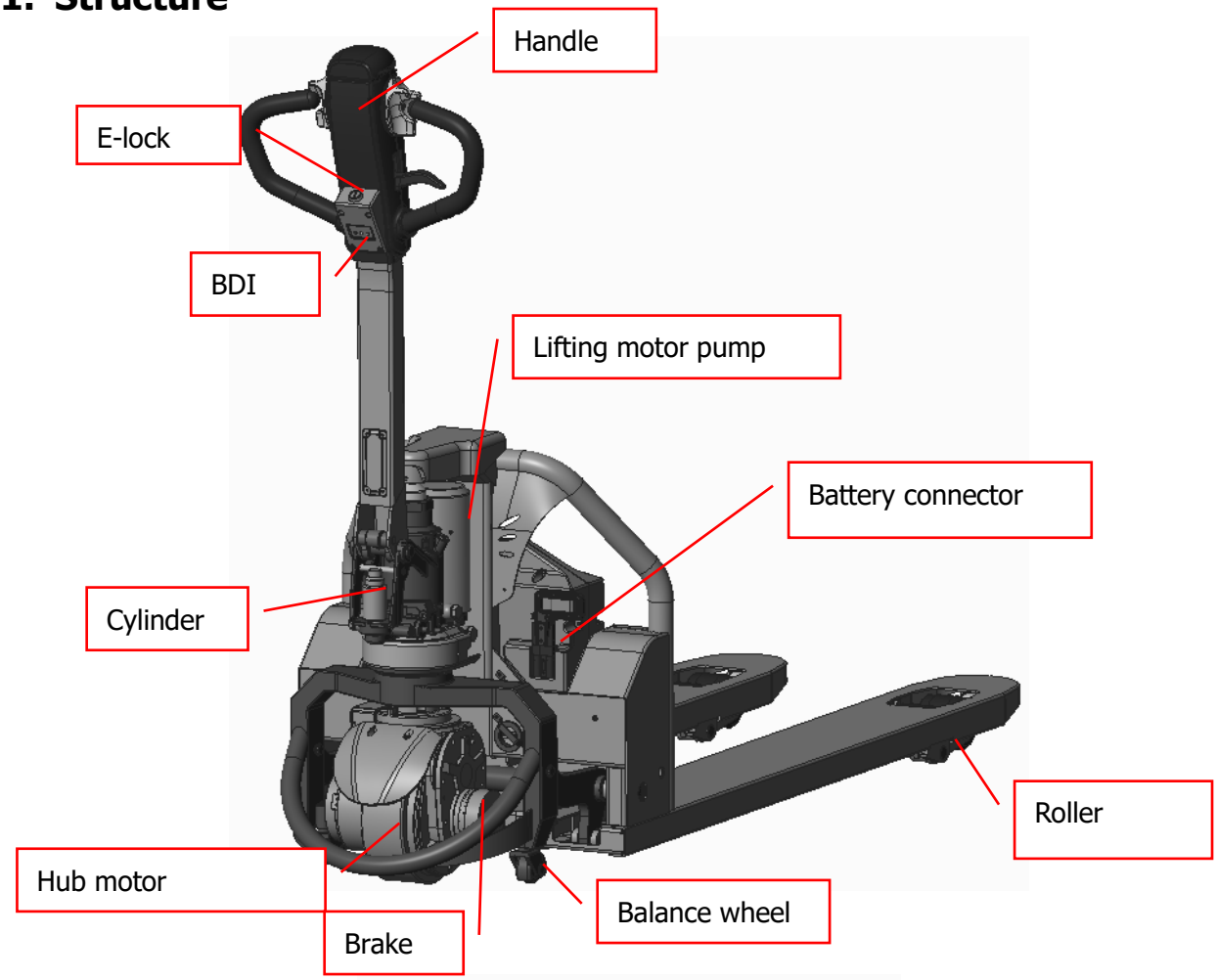
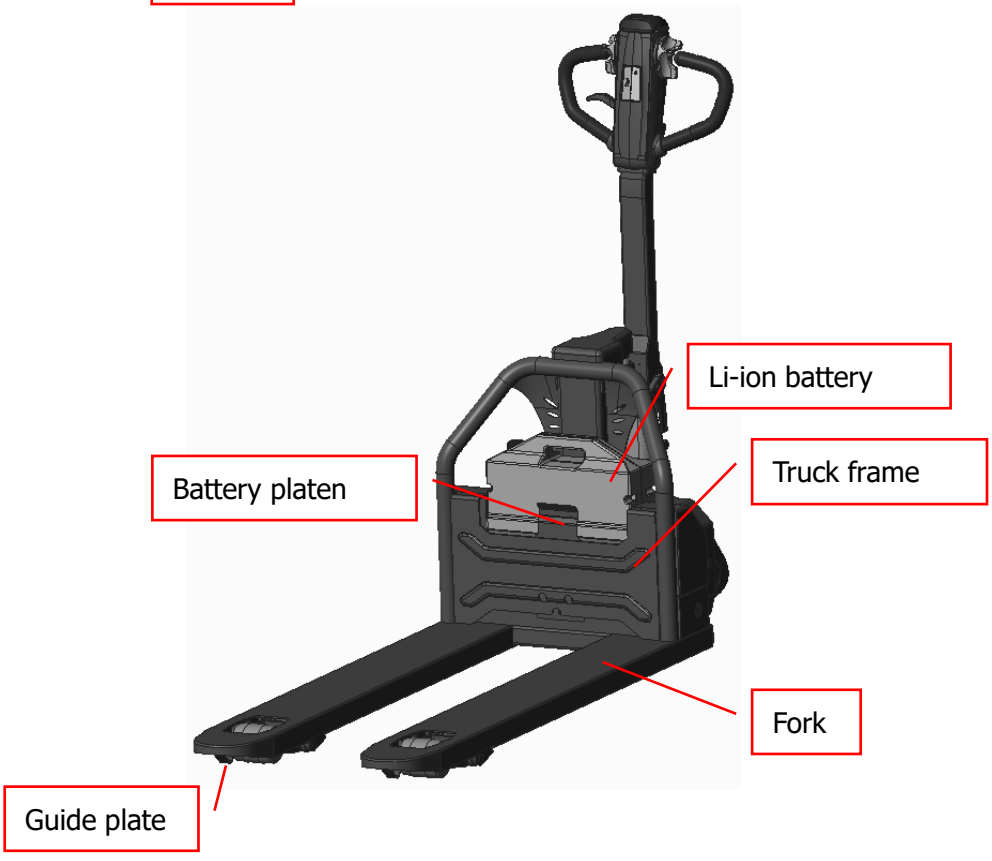
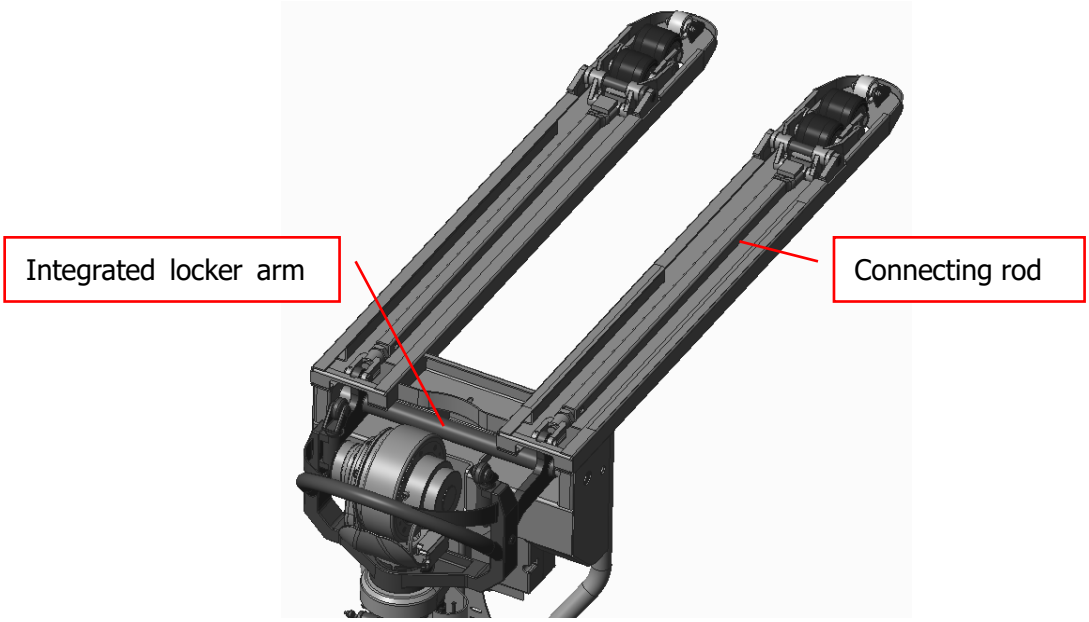
STARKE
LIFTMAXX

1. Structure

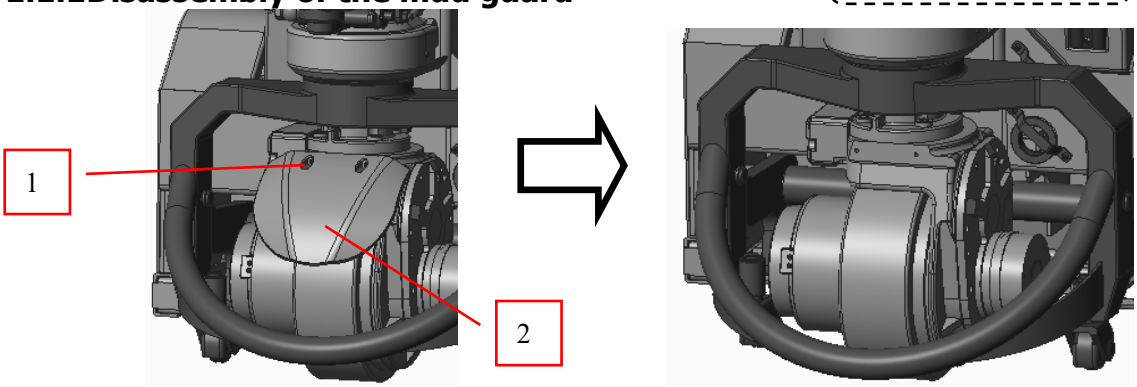

Handle
E-lock
BDI
Lifting motor pump
Battery connector
Cylinder
Roller
Hub motor
Balance wheel
Brake


Li-ion battery
Battery platen
Truck frame
Fork
Guide plate



1.1 Disassembly of the covering parts

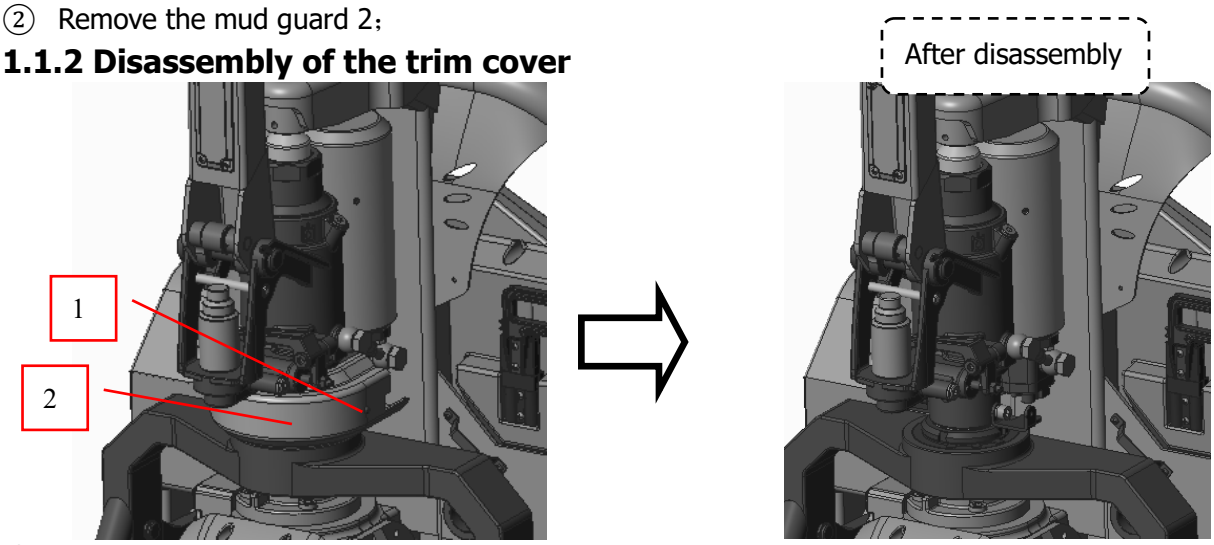
1.1.1Disassembly of the mud guard



① Unscrew 1,2 screws in total；

② Remove the mud guard 2；

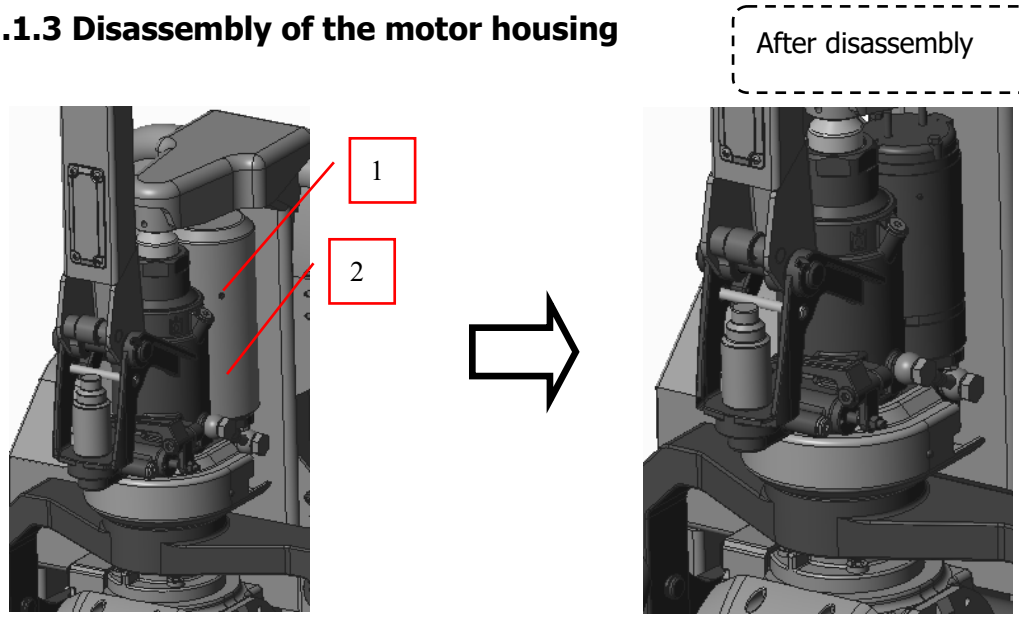
1.1.2 Disassembly of the trim cover



① Unscrew 1，2 screws in total；

② Remove the trim cover 2；

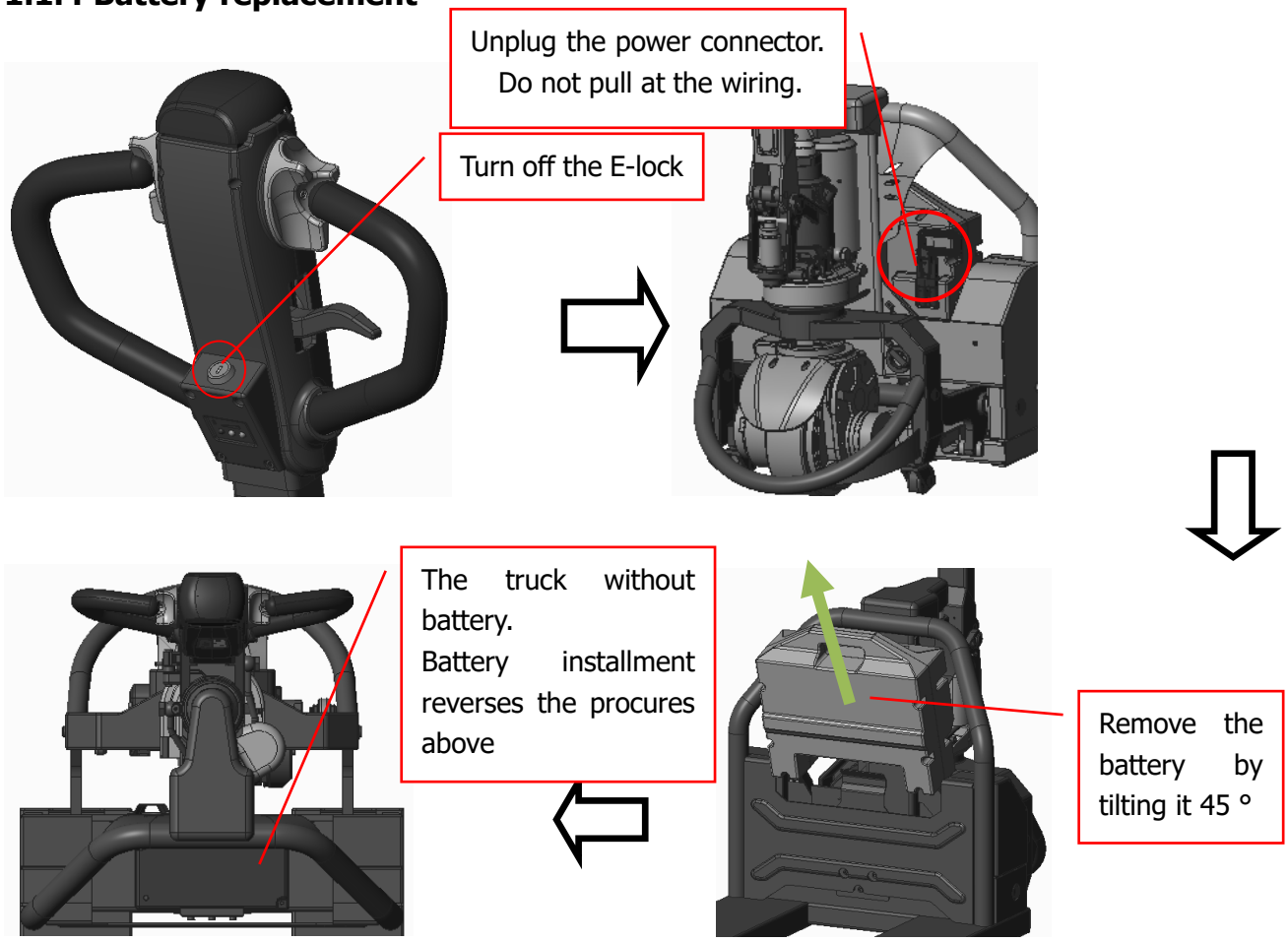
1.1.3 Disassembly of the motor housing



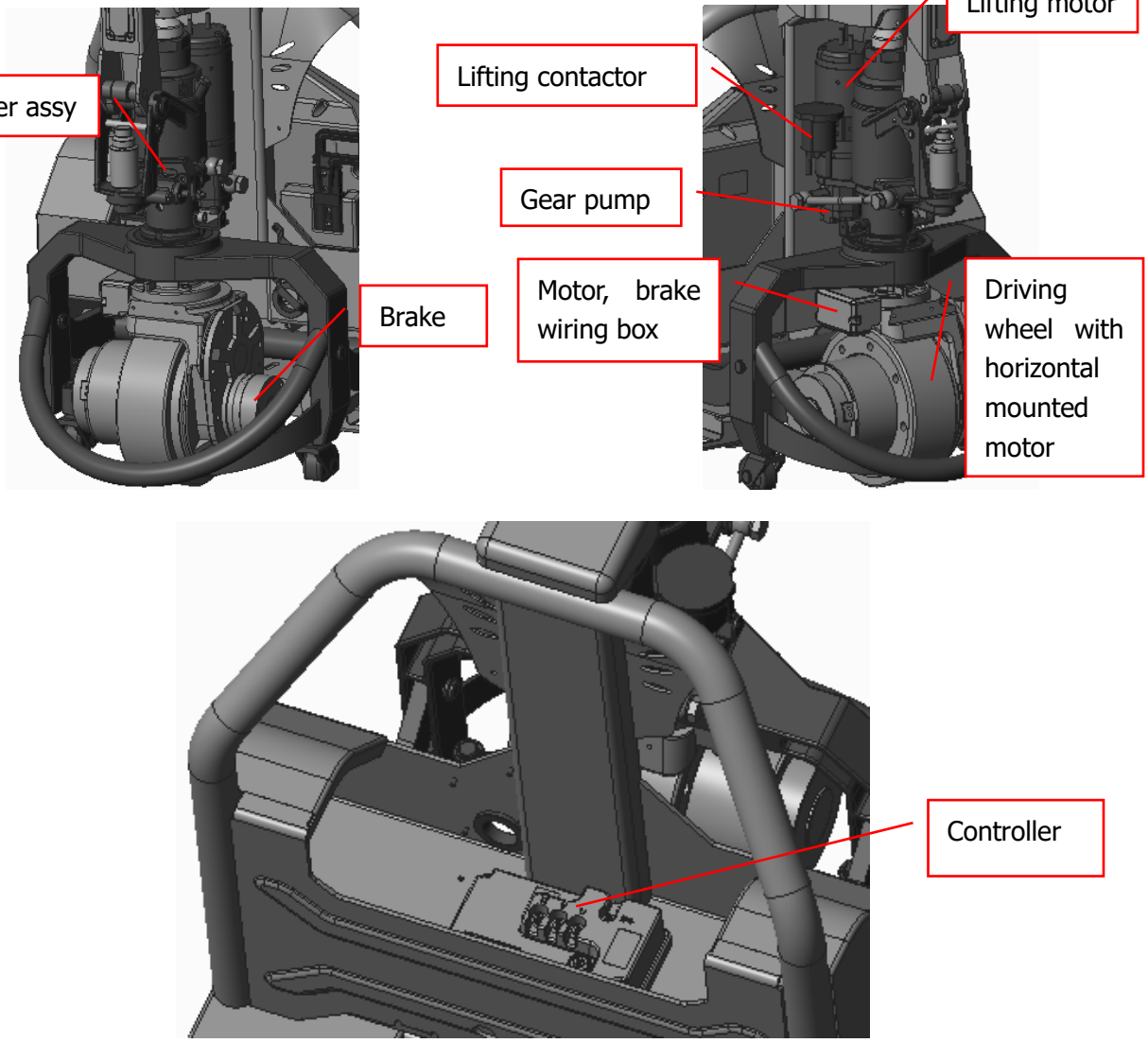
① Unscrew 1,2 screws in total at left and right side respectively;

② Rotate the steering gear 90°to pull out the motor housing.

1.1.4 Battery replacement

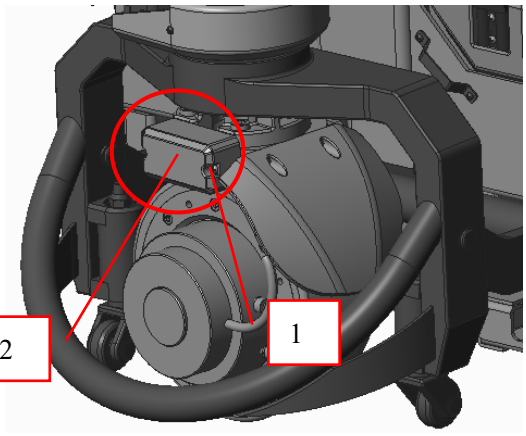


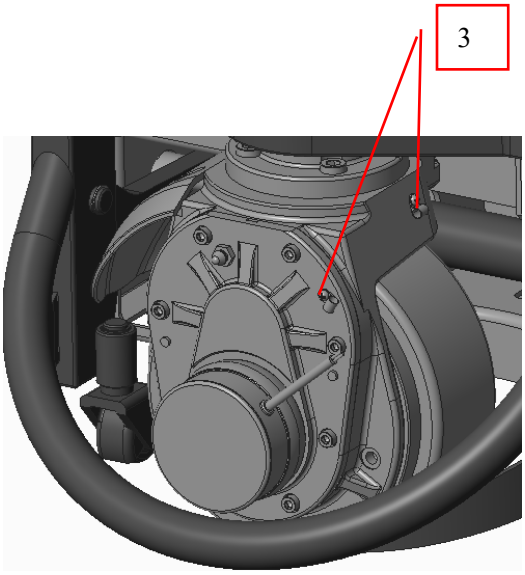
1.2 Detailed structure



2. Mechanical structure

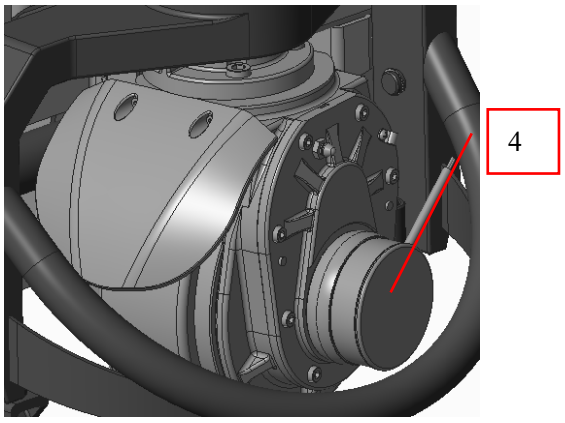
2.1 Disassembly of the brake

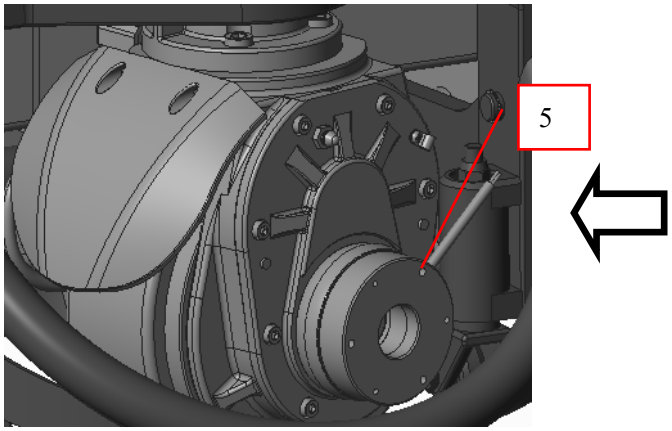




Rotate the steering gear assembly 90 ° to the left with terminal block 2 facing out. Remove the screw 1 with a tool, remove the plastic cover, and remove the internal brake harness connector.

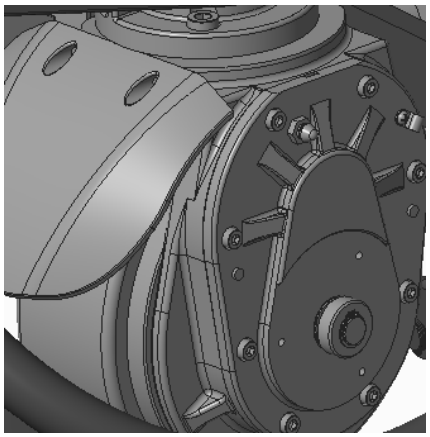
Remove two brake harness clamps 3, 2 in all





Remove the brake screws 5, 3 in total

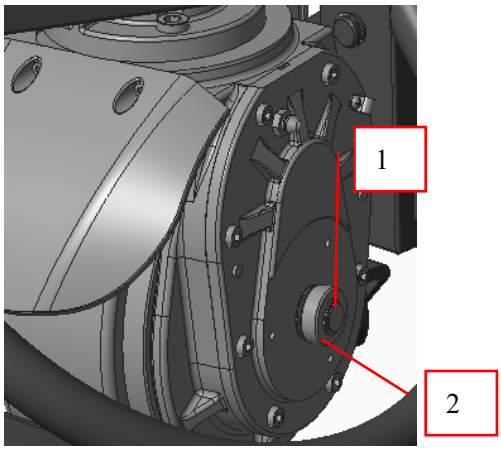
Rotate the steering gear assembly 90° to the right and remove the brake plastic cover 4



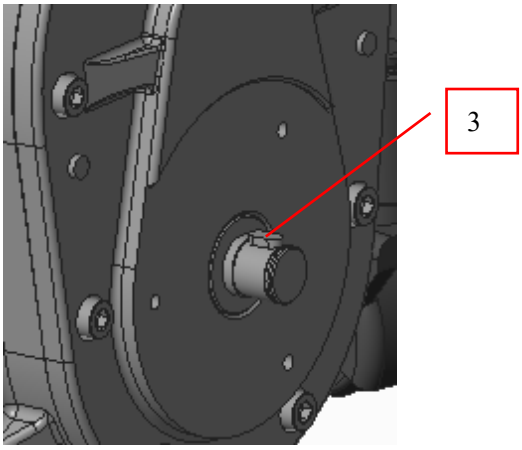
After disassembly

2.2 Disassembly of the brake shaft sleeve

The brake shaft sleeve is matched with the brake, which shall be replaced together. The brake parts include the shaft sleeve parts.



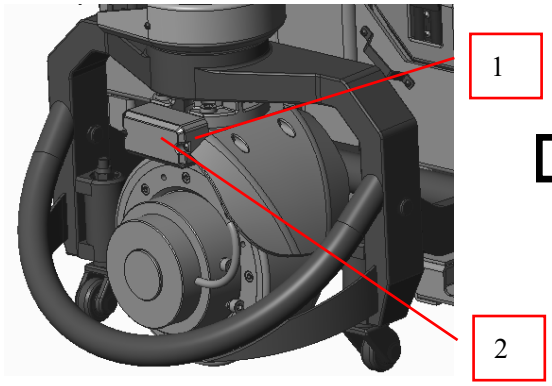
Remove the circlip 1 on the motor shaft and remove the shaft sleeve part 2



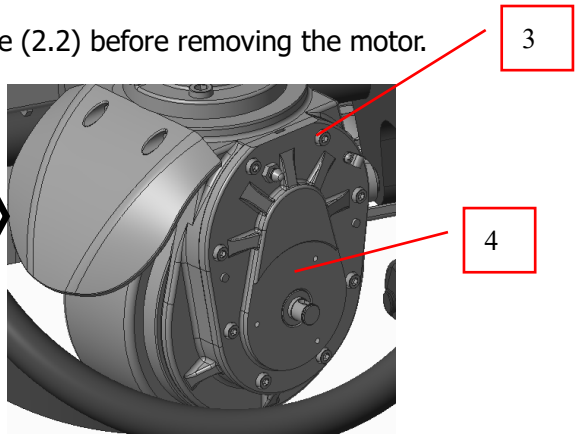
Remove the flat key 3

2.3 Disassembly of the motor

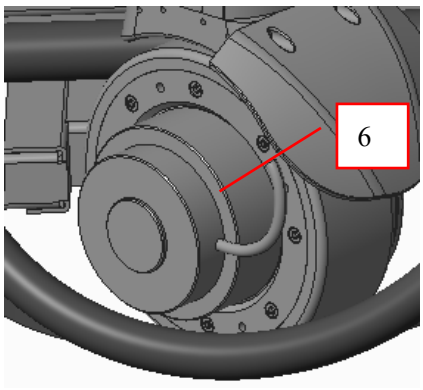
Remove the brake (2.1) and the brake shaft sleeve (2.2) before removing the motor.

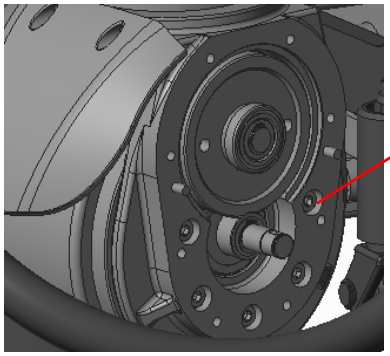


Turn the steering gear 90°to the left, remove the screw 1, remove the plastic cover 2, and separate the motor line inside the plastic cover from the main harness.



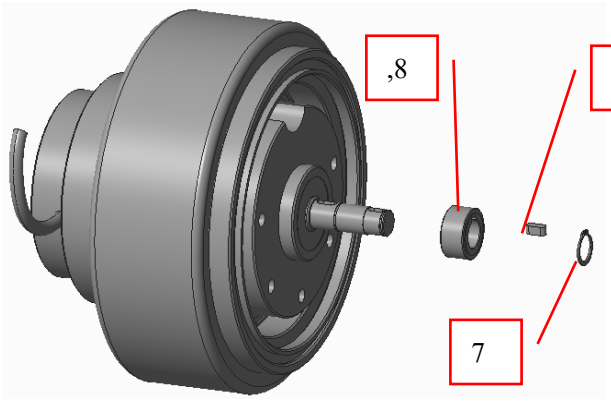
Turn the steering gear 90 degrees to the right and remove the gearbox end cover screws 3, 8 in total. Remove the end cap 4.

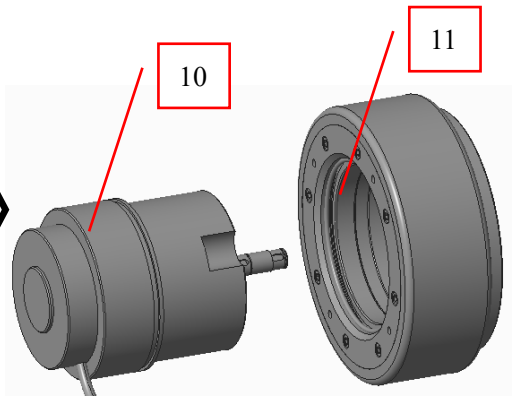




Take out the assembly 6 of motor and wheel

Remove the motor screws 5, 5 in total.

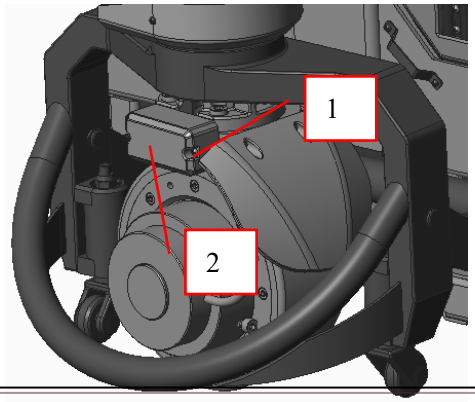


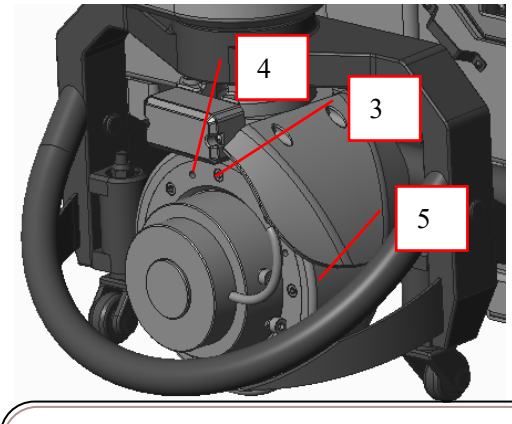


Remove the circlip 7, gear 8 and flat key 9 at the shaft end of the motor

Separate the motor 10 from the wheel assembly 11 and remove the motor

2.4 Disassembly of the wheel



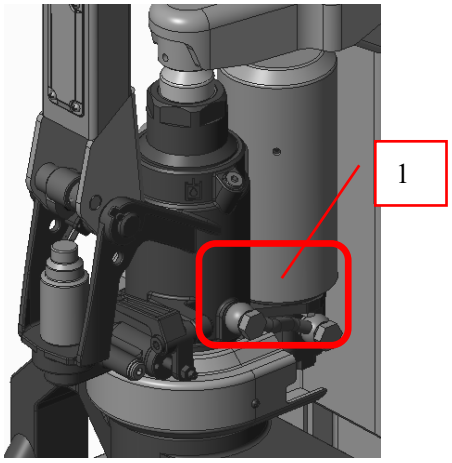


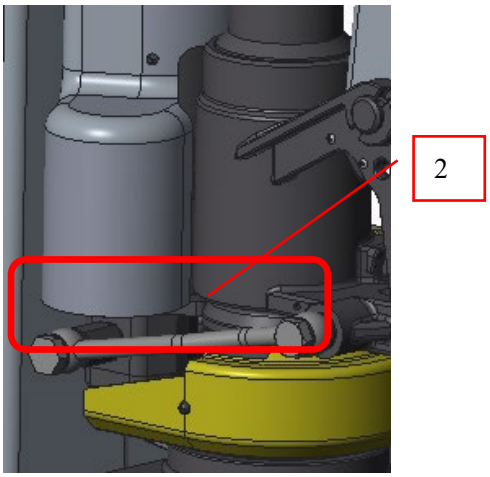
Turn the steering gear 90 degrees to the left, remove the screw 1, remove the plastic cover 2, and separate the motor line inside the plastic cover from the main harness.

Continue to remove the wheel fixing screws 3, a total of 8, using the screws with the length of M6 greater than 30 as an auxiliary, screw into the hole 4, and then remove the wheel 5

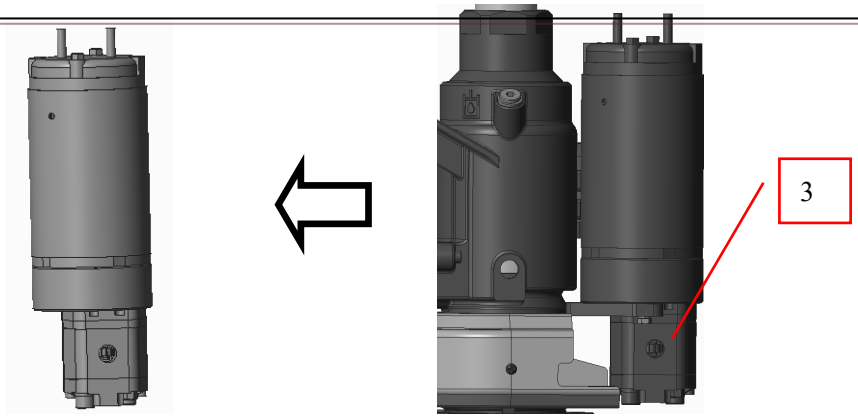
2.5 Disassembly of the motor pump

Remove the motor pump with the motor housing and electrical wiring removed.





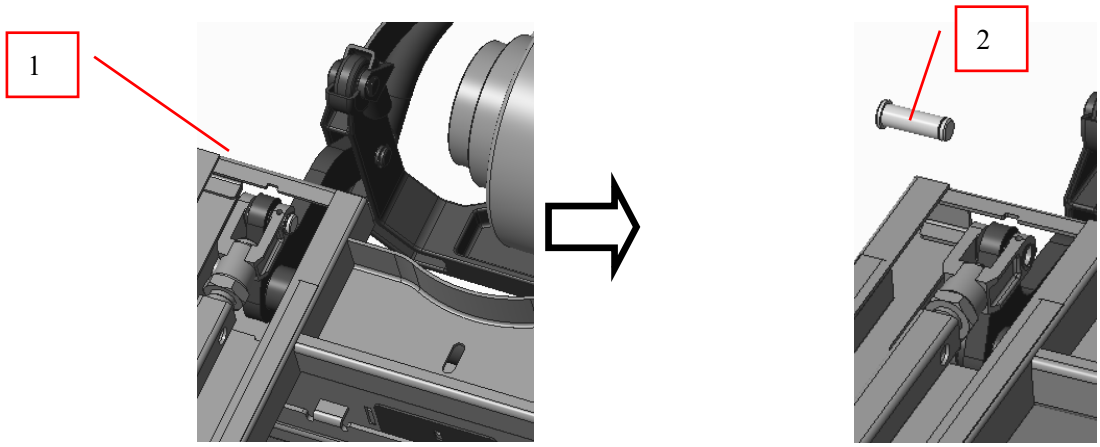
Lower the fork to the lowest position, and remove the oil inlet pipe 1. When removing, the oil in the pump oil tank will flow out . Prepare to collect the leaked oil, and then remove the oil outlet pipe 2.



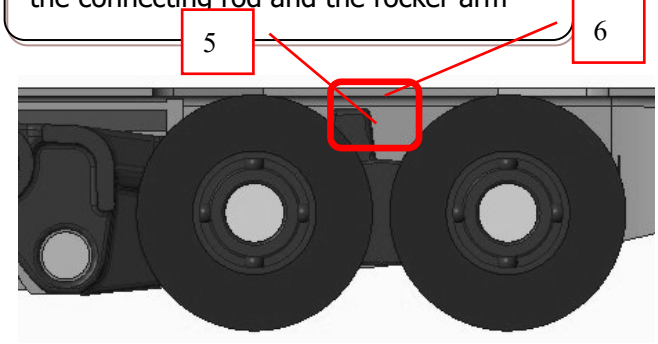
Take out the motor pump assy

Remove the motor pump fixing screw 3, one on the left and one on the right.

2.6 Adjustment of the length of the connecting rod

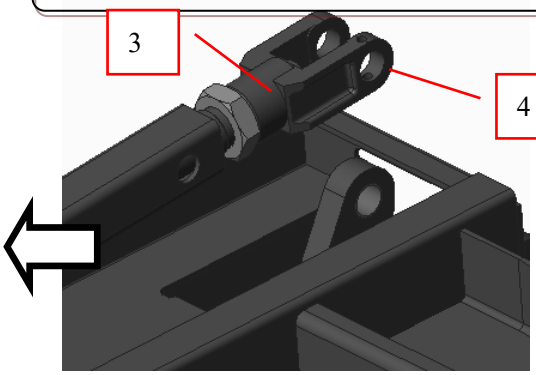


Remove the elastic pin 1 hinged between the connecting rod and the rocker arm



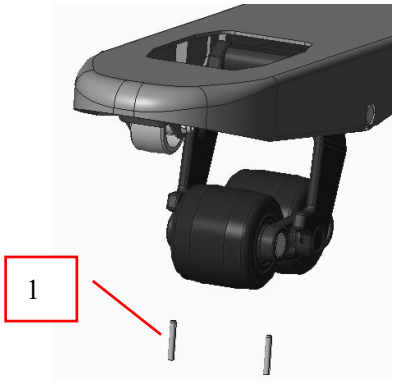
After adjustment, the whole vehicle shall be lifted and leveled, and the clearance between the wheel frame limit point 5 and the lower surface of the fork 6 shall be greater than 1mm

Take pin 2 out of the mounting hole.



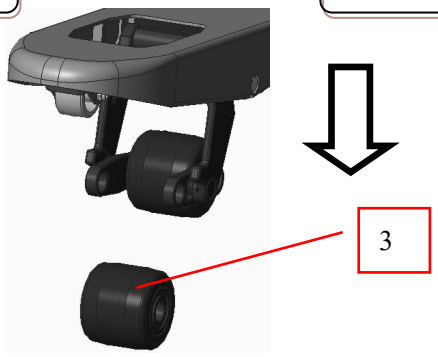
3 Loosen Nut 3, rotate joint 4, and the length reduces clockwise. Tighten the nut afterwards.

2.7 Disassemble of the fork wheel



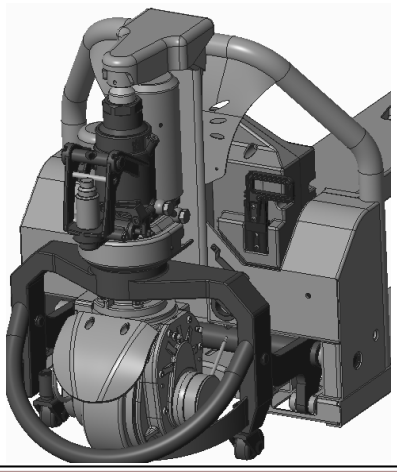
Remove the spring pin 1, two in total

Take out the pin shaft 2

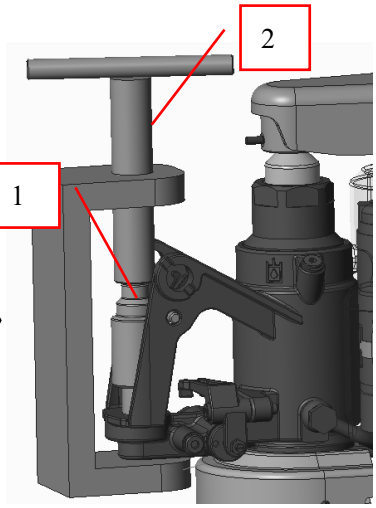


Take out the wheel 3. Disassembly and assembly of single wheel and double wheel are basically the same

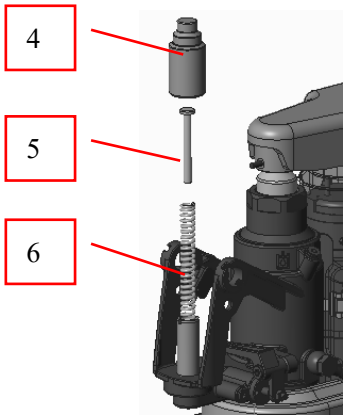
2.8 Disassembly of the handle spring



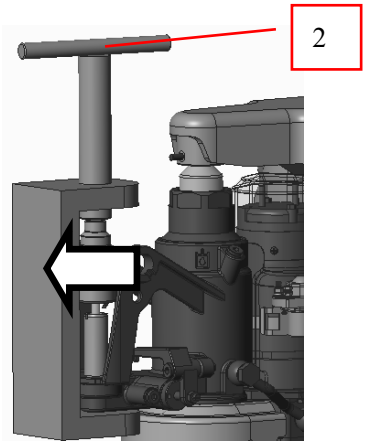
Before removing the spring, remove the handle (mentioned in the manual)



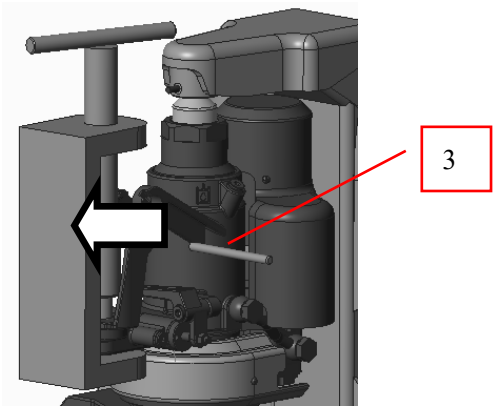
Use the special tool 1 for disassembly, and rotate the handle 2 with force to compress the spring, so as to take out the locking rod in the next step.)



Remove the outer sleeve 4, spring core 5, spring 6, and install in reverse order



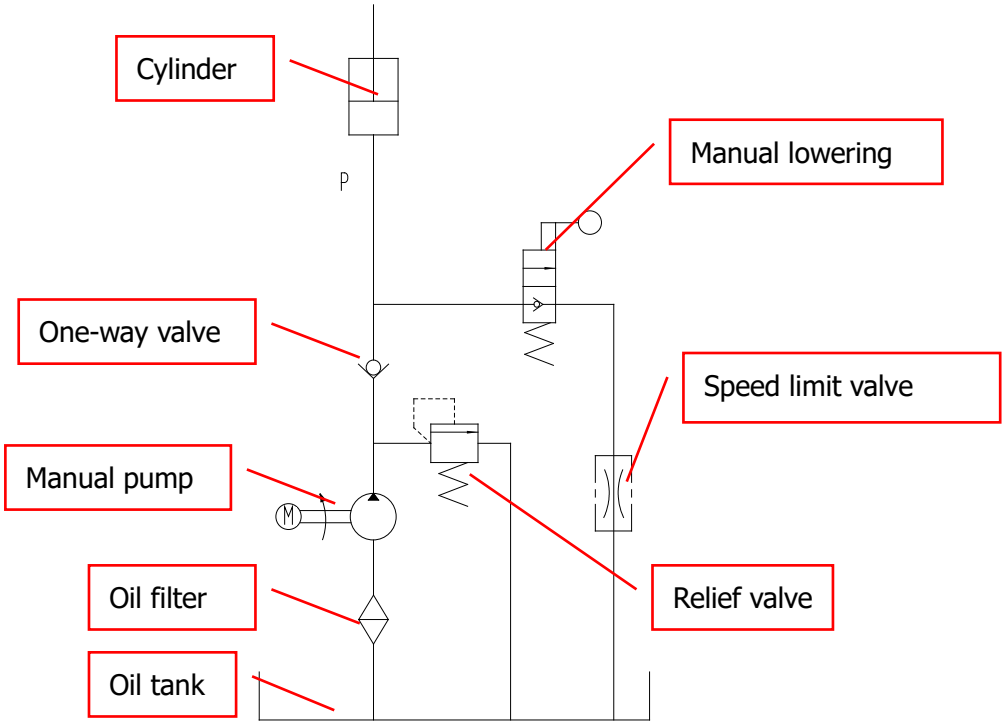
Rotate the handle 2 so that the spring is released and in a free state, and take off the special tool



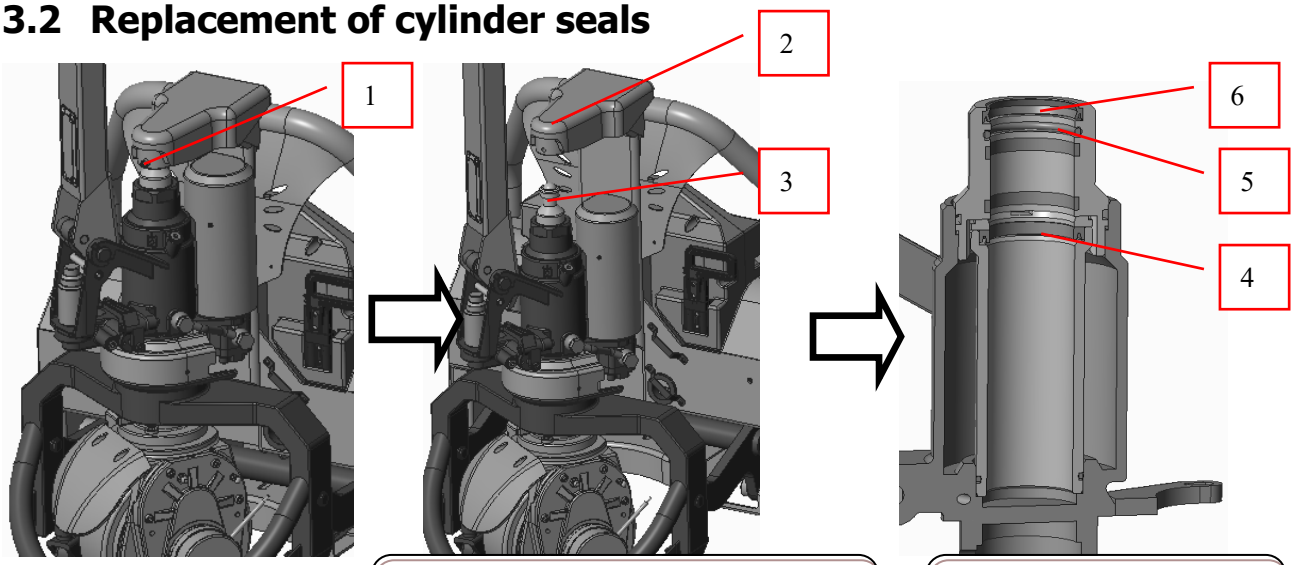
Take out the locking rod 3

3. Hydraulic system

3.1 Hydraulic schematic diagram



3.2 Replacement of cylinder seals

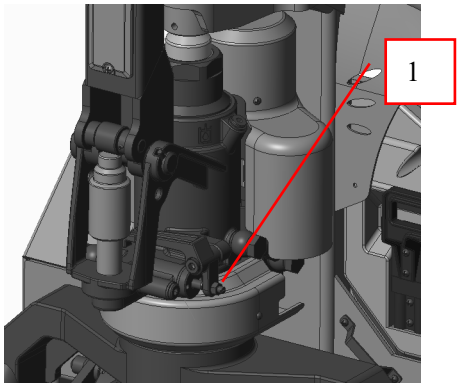


Remove the screw 1

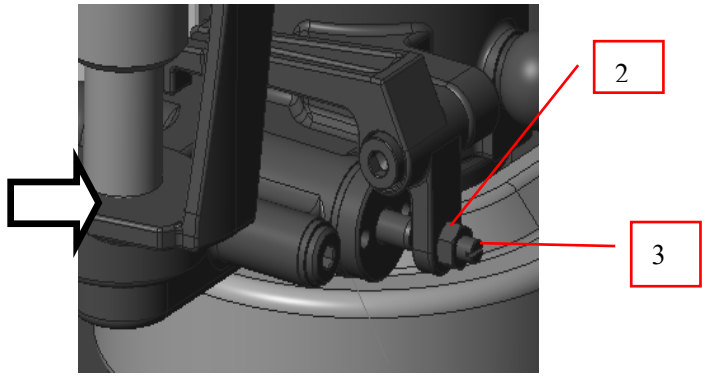
Lift frame 2 so that the frame and the plunger rod are disengaged.

Replace seals 4, 5 and 6; install in reverse order

3.3 Adjustment of the lowering speed

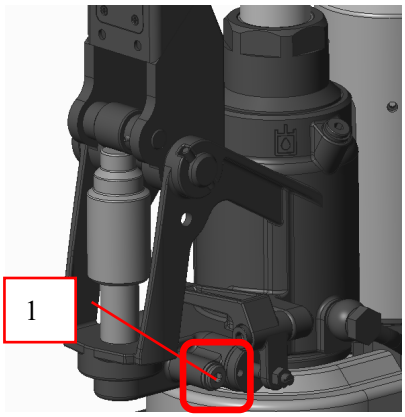


Locate the lowering valve adjusting screw

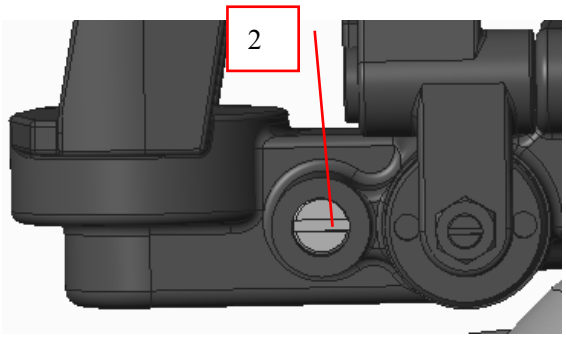


Loosen the screw 2, adjust the screw 3 with a slotted screwdriver. Lowering speed decreases by rotate screw 3 anti-clockwise, while the speed increases by rotating it clockwise.

3.4 Adjustment of the system pressure

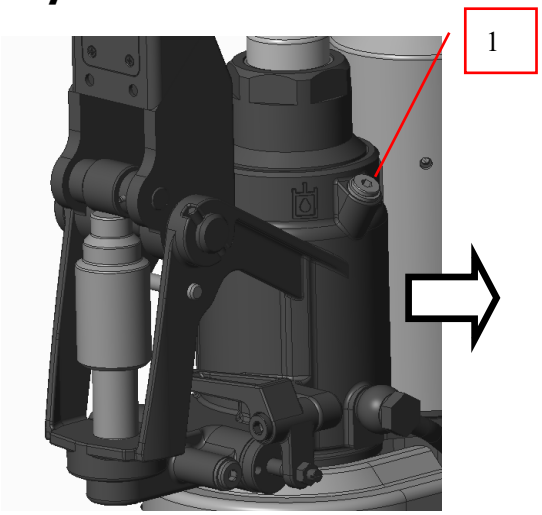


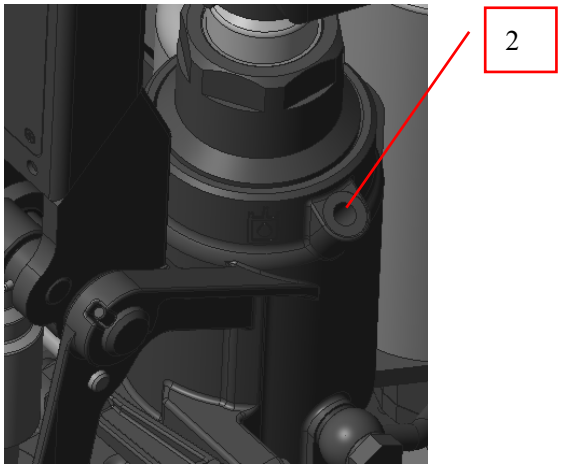
Locate the pressure adjusting valve and remove screw 1.



Use a slotted screwdriver to adjust the screw 2. Increase the pressure clockwise. The maximum pressure is not allowed to exceed 115% of the rated load. After the adjustment, tighten the screw 1.

3.5 Add hydraulic oil





Locate the pump filler and remove screw 1.

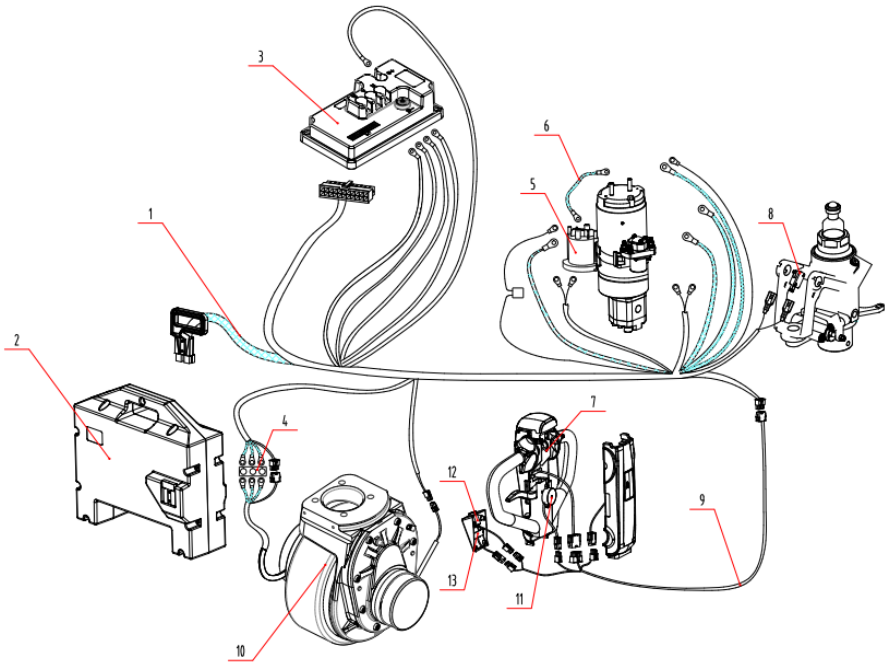
Add hydraulic oil into the oil filler, and the total amount to be replaced shall be 250ml. After refueling, lift the fork three times without load, then lift the fork to the maximum height, and tighten the filler screw.

3.6 ification and usage of lubricating oil

Refueling spot	Specification	Refueling amount	Remark
Hydraulic power unit tank	L-HV32	250ml	
	L-HV15(Low temperature)	250ml	

4. Electric part

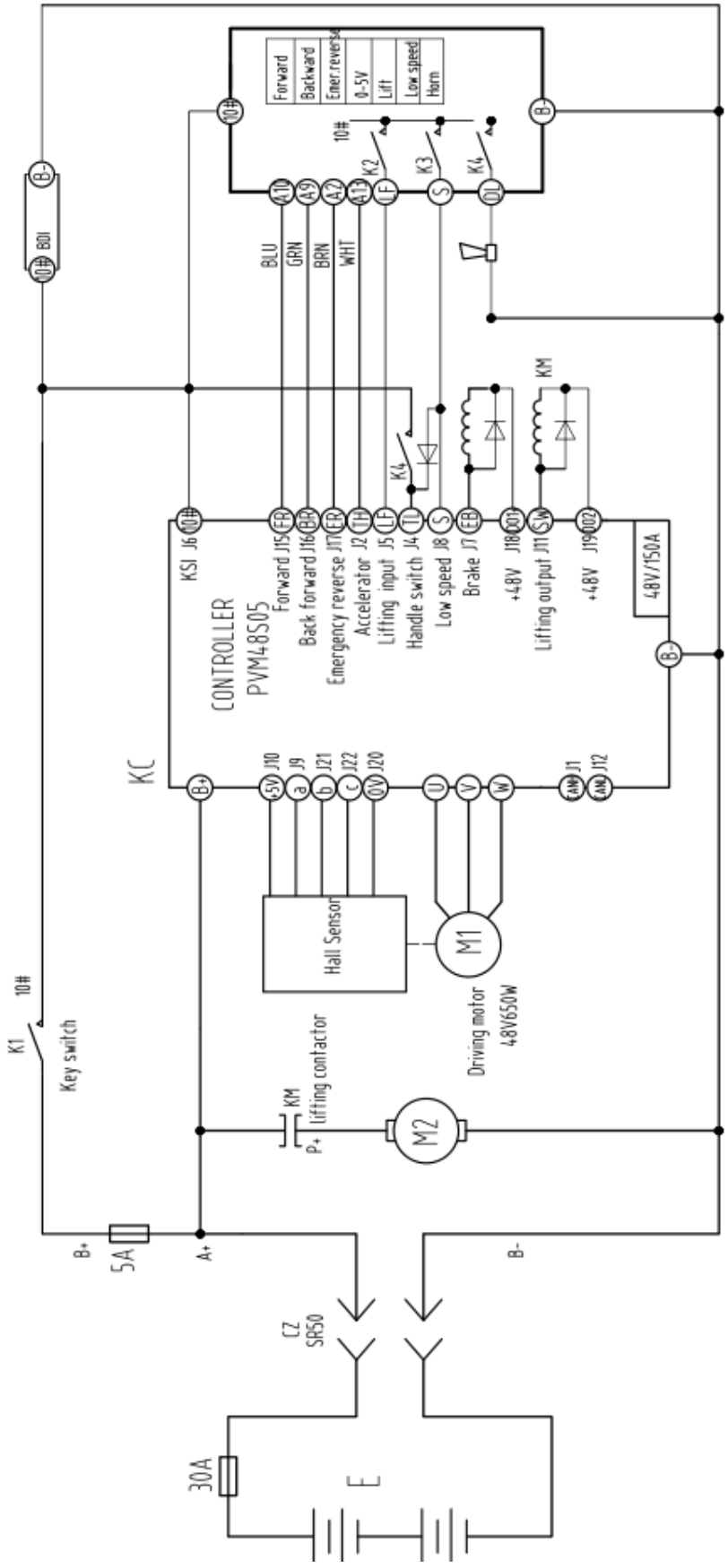
4.1 Electrical system diagram



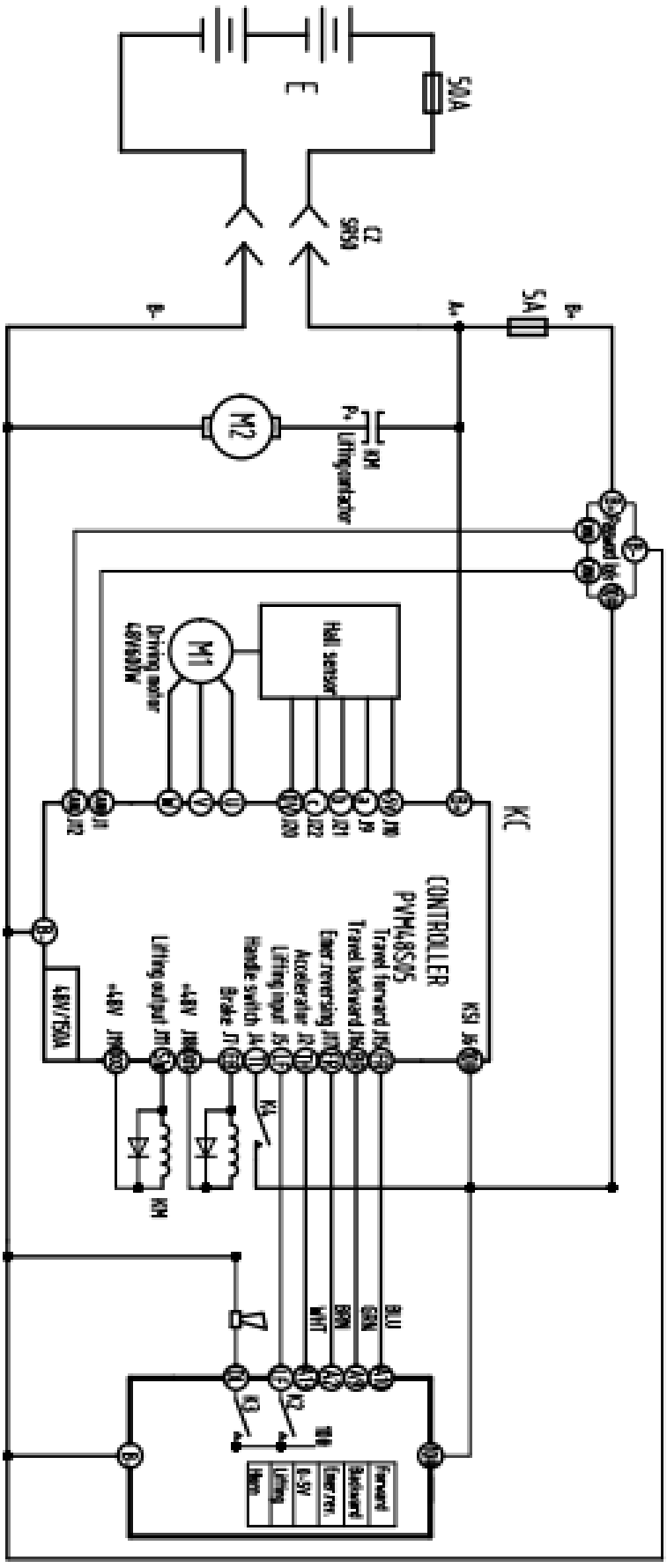
No.	Part no	Part name	No.	Part no	Part name
1	CBD15W-LiX.01A.02-01	Truck body harness	11	CBD12W.13-06	Buzzer
2	CBD12WA.03-00	Lithium battery	12	CBD20KD.01-01	Key assy
3	711.05.4408.04	Controller	13	CBD12W.01.01.01-04	BDI
4	CBD12WA.01-05	Terminal plate			
5	761.02.4200.01	Contactor			
6	CBD12W.13.01-02	P+ connecting wire			
7	XILIN-ACC12	Accelerator			
8	730.12.0201.02	Handle			
9	CBD12W.13.02-01	Handle harness			
10	082.01.0210.01	Driving wheel assy			

4.2 4.2 Electrical schematic diagram

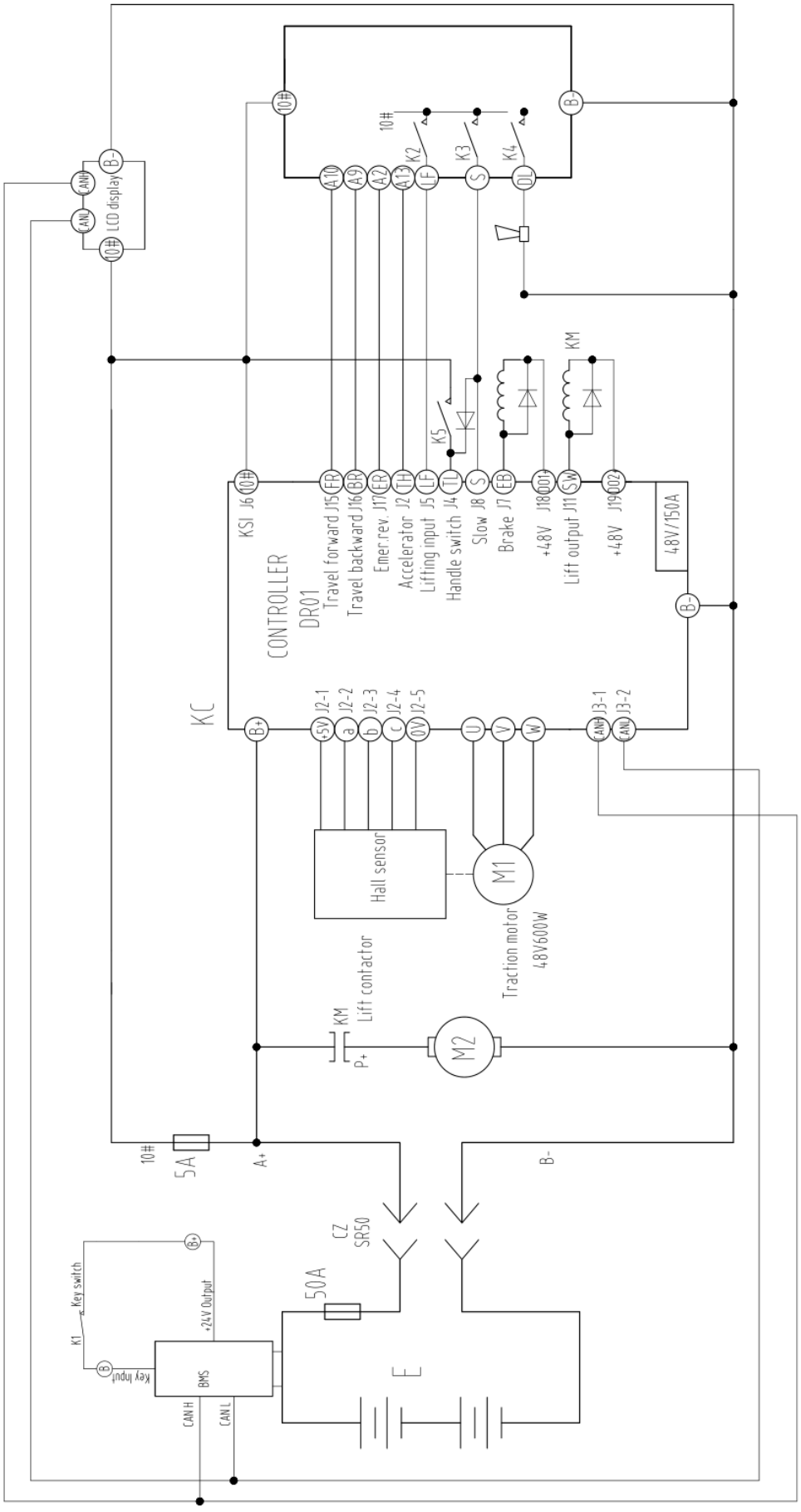
Standard



Optional password lock



New Euro type



Principle description:

1. Walking part

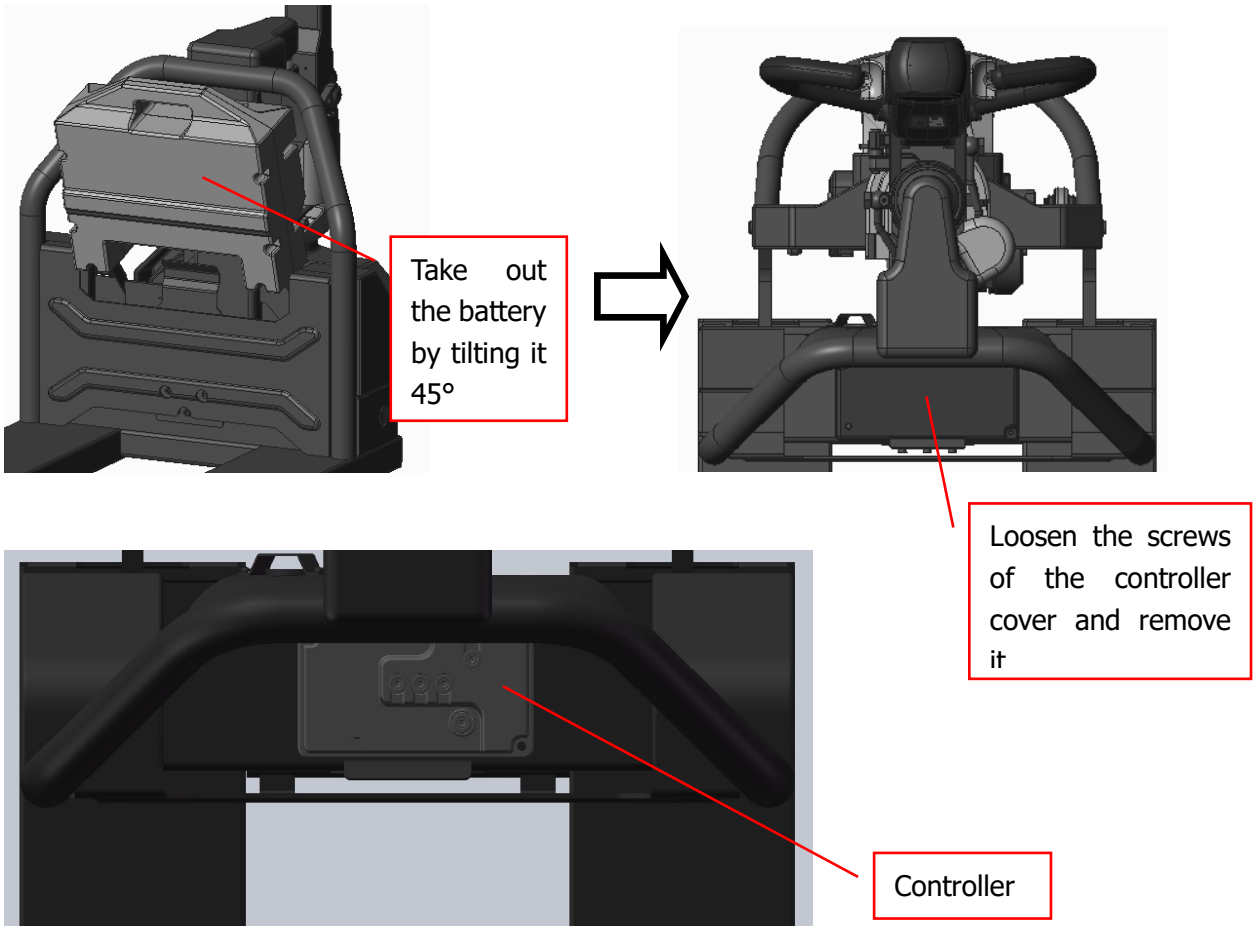
   Plug in the battery connector; turn on the key switch (KEY SW), power on the 10 # cable, and power on the contactor KM2. When the handle is pressed down, tiller SW is closed (TL = 48V). Further forward rotation accelerator, FR = 48V, at the same time, FR accelerator outputs 0-5V analog voltage, brake is on, at the same time, controller power module drives motor forward operation, motor speed is proportional to accelerator output voltage. In reverse direction, the accelerator rotates in reverse direction, Br = 48V. At the same time, the FR accelerator outputs 0-5V analog voltage, the brake is on, the motor rotates in reverse direction, and the speed is proportional to the output voltage of the accelerator.

2. Lifting part

   When lifting SW is closed, LF line is electrified, contactor KM1 is electrified, contact is electrified, motor M2 is electrified, and pump oil rises.

4.3 Description of electrical parts

4.3.1 Controller



4.3.1.1Specifications

1) Standard：PVM48S05 controller

   Battery input voltage（V）：24~48

   2-minute rated current（A）：50

   1-hour rated current（A）：30

   Max. output frequency of the controller: 200

Motor controlling type：Vector control

Communication mode：CAN communication

Working environment temperature：-40℃~50℃

Controller protection temperature：85℃~95℃ cut output,

> 95℃ stop output;

-40℃~-25℃cut output，

< -40℃ stop output.

Cooling mode：self cooling

Protection level：IP65

EMC standard：EN61326, EN61000

Safety standard：EN61010

Certification：CE

2) New Euro type：DR01-048025-01-2-65-001 controller

Rated working voltage: 48V

2 minute working current: 50A

1-hour working current: 35A

10 second working current: 70A

Working environment temperature: -25~50 ℃

Storage temperature: -40~85 ℃

Controller derating range: 85~95 ℃ derating output, stop output if it exceeds 95 ℃- 40~-25 ℃ derating output, stop output below -40 ℃;

Communication by CAN

Working humidity: maximum 95% RH

Protection level: IP65 (except for connector IP54)

Tightening torque of U, V, W, B+, B-terminal blocks: 1.7Nm ± 0.1Nm Mass: 0.72 kg

Design life: ≥ 5000h

EMC standard: EN12895:2015

Safety standards: EN1175, EN13849-1

Vibration standards: EN60068-2-6, EN60068-2-27

4.3.1.2 Wiring

Power line：

B +, connected to battery positive pole

B -, connected to battery negative pole

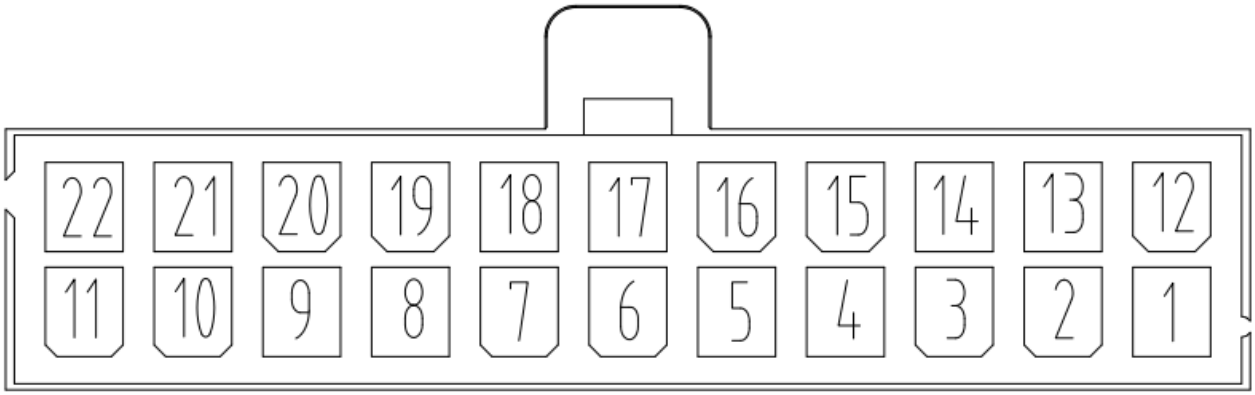
Phase U connected to phase U of the motor

Phase V connected to phase V of the motor

Phase W connected to phase W of the motor

Control wiring

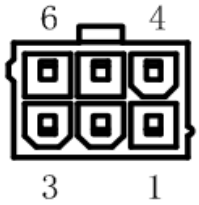
1) Standard



1-CANH CAN communication high level
2-TH-White Accelerator 0 ~ 5V analog input
3- Null
4-TL-Orange Handle switch signal input
5-LF-Purple Lifting input
6-10 # Red 48V
7-EB-Blue Brake output
8- Null
9-a-Yellow Motor encoder a
10 - + 5V - Red Motor encoder + 5V
11-SW-Green Lifting output
12-CANL CAN communication low level
13- Null
14-LED-Black Indicator negative pole
15-FR-Blue Forward signal input
16-BR-Green Back signal input
17-ER-Brown Emergency signal input
18-DO 1 + - Pink Brake + 48V
19-DO 2 + -Yellow Lifting contactor + 48V
20-0V-Black Motor encoder 0V
21-B-Green Motor encoder B
22-C-Blue Motor encoder C

New Euro type

J1 Connector diagram and pin definition



J1

Pin No.	Description
1	**5V**
2	**HALL_A**
3	**HALL_B**
4	**HALL_C**
5	**GND**
6	**TEMP**

Explanation：

1) Equipped with a motor temperature detection port, it can detect motor temperature.

2) The control algorithm realizes the wire break protection function of the motor Hall sensor.

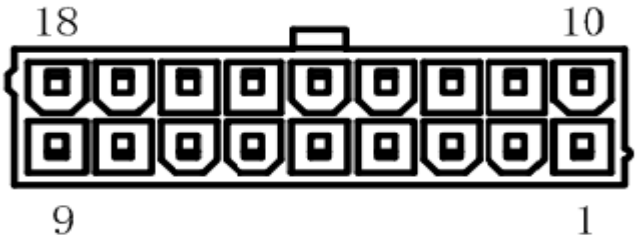
J2 Connector diagram and pin definition

The upper computer can set the operating parameters of the controller through this port。

J2

Pin No.	Description
1	**CANL**
2	**GND**
3	**CANH**
4	**14V**

J3 Connector diagram and pin definition



Pin No.	Description	Pin No.	Description
1	KSI	10	Load circuit
2	Lift pump valve drive	11	Lower pump valve drive
3	Interlock switch	12	Hoop drive
4	Analog/digital port 2	13	Signal ground
5	Power output/fault light output	14	Emer.rev.switch
6	Analog/digital port 1	15	Charging prohibition
7	Throttle sliding end	16	Throttle high level end
8	Backward switch	17	Forward switch
9	Lift switch	18	Analog switch

Explanation：

1) Analog/digital port 1 or analog/digital port 2 can be configured as a lowering valve switch through parameters.

2) The fault light display port can be connected to an external LED, and the fault code display can be achieved by flashing the LED. Slow flashing is ten digits, fast flashing is one digit, and the LED positive pole is connected to the driver.

4.3.1.3 Controller error code table

1) **Standard**

There are fault-indicating lamps on the controller. They flash if the controller finds a fault. The fault display code is composed of two digits. Flashing times of the yellow lamp indicates the ten digit of the fault code; flashing times of the red lamp indicates the one digit of the fault code.

There is also a fault indicator lamp on the truck body. Slow flashing represent the ten digit, while fast frequency flashing represent the one digit.

LED error code

Code	Fault description	Trouble shooting
1	Feedback overspeed	If the controller fails, contact the manufacturer.
2	Kernel running error	If the controller fails, contact the manufacturer.

8	Loss of speed sensor	No speed feedback detected. Treatment method: 1. Check the connection between speed sensor and controller; 2. Check whether the signal of the speed sensor is normal; 3. Check the detection circuit of the controller.
9	The speed sensor is in the wrong direction.	The direction or phase of Hall sensor ABC and motor UVW are inconsistent. Workaround: 1. Adjust Hall phase by controller parameter P47; Every increase 30, until the motor rotates normally. Then adjust 50 each time to find the motor. The range that can rotate normally. Finally, the midpoint of the range is set as the parameter value. 2. If the method of 1 cannot solve the problem, change the parameter P3.0 (feedback After reversing), repeat step 1.
11	2-minute maximum current protection of motor	The current of the motor lasts for more than 2 minutes and the maximum current lasts for more than 2 minutes. 1. The motor is locked; Check whether the brake is turned on or not, and check whether there is any foreign matter. Jam the drive mechanism. 2. Improper setting of controller parameters, see motor parameter adjustment for details.
12	Controller overcurrent	Possible reasons: 1. The motor is short-circuited. 2. The direction or phase of Hall sensor ABC and motor UVW are inconsistent. 3. The motor parameter P15 is set incorrectly in the field weakening base speed.

		4. If the controller fails, contact the manufacturer.
13	Bus charging fault	Bus charging timeout. Workaround: 1. check whether there is a short circuit between the three phases of motor u, v and w. 2. Check whether the battery voltage supply is too low. 3. Check whether the drive coil is short-circuited (DO circuit and battery B-). 4. Check whether the DO+ terminal supplies power to devices other than DO.
14	Main contactor connection failure	The internal contactor of the controller is abnormal.
15	DRIVER1 connection failure	Check whether the DRIVER1 connection is normal.
16	Battery voltage is seriously too low.	Check the battery power; Or the battery voltage level of the controller is set incorrectly.
17	Battery voltage is too high	Check the battery voltage; Or the battery voltage level of the controller is set incorrectly.
18	The power of the board is seriously over-heated.	Controller protection, suspended.
20	Abnormal accelerator/brake pedal input	The accelerator pedal or brake pedal input signal is abnormal. Workaround: 1. Check the connection between pedal and controller for short circuit and open circuit. 2. Check whether the pedal is damaged; 3. Check the parameter settings of the controller related to the pedal, especially the pedal class. Type. (P91, P101)。
21	reserve	
22	5V output fault	1. Short circuit of motor encoder; 2. Other 5V external devices are short-circuited; 3. If the controller fails, contact the manufacturer.
23	MACID detection failed.	The CAN network ID number

		setting of the controller is repeated, and it is reset.
24	Main contactor drive failure	The internal contactor of the controller is abnormal.
25	Power module failure	Controller failure.
26	CAN node lost	1. the controller is configured in parameter P1, and the interlock check is enabled in parameter P2. Check. In practice, the corresponding module was not found. 2. Check the connection between modules and the working status of modules.
29	The internal temperature measuring circuit of the controller is abnormal.	If the controller fails, contact the manufacturer.
31	Battery voltage is slightly too low	The battery is low, so charge it as soon as possible.
32	Slight overtemperature of board power	Because of slight over-temperature, the controller reduces the load.
33	Board low temperature	The environment is too low, and the controller reduces the load.
34	Slight overtemperature of motor	Reduce load usage.
35	reserve	
36	2 Drive2 connection failure	Check the Drive2 connection.
37	3 Drive3 connection failure	Check the Drive3 connection.
38	Error in EEPROM reading and writing parameters	If the controller fails, contact the manufacturer.
39	Parameter overrun error	If the parameter is set up, contact the manufacturer.
40	Operation timing error	After reset, the key signal is not in the original position (throttle switch, direction switch, up Up/down, safety switch, emergency switch). Signal homing, automatic alarm Eliminate.
41	20% remaining power alarm	charge
42	15% remaining power alarm.	charge
43	Unmatched alarm	The matching enable parameter is set, but the matching has not been completed. See automatic

		horse for details. With instructions.

2) **New Euro type**

- Fault code table

After a drive failure occurs, a fault code will be uploaded through the BUS, as follows

Fault code	Fault type	Possible causes	Fault check
1	Power unit protection	1. Motor stalling; 2. The internal wiring of the motor is loose; 3. Abnormal operating conditions	◆ Check whether the motor is stuck; ◆Contact the agent or manufacturer; Manual power ON/OFF reset
2	Accelerating overcurrent	1. The acceleration curve is too steep; 2.The load is too large;	◆ Check the acceleration and deceleration time; ◆ Eliminate the cause of excessive load; ◆ Re conduct motor position self-learning; Manual power ON/OFF reset
3	Deceleration overcurrent	1. The deceleration curve is too steep; 2. The load is too large;	
4	Constant speed overcurrent	1. The load is too large;	
5	Accelerating overvoltage	1.The input voltage is too high; 2.The acceleration curve is too steep;	◆ Adjust the input voltage; ◆ check the acceleration and deceleration time; Manual power ON/OFF reset
6	Deceleration overvoltage	1.The input voltage is too high; 2.The deceleration curve is too steep;	
7	Constant speed overvoltage	1.The input voltage is too high;	
9	Undervoltage fault	1.Instantaneous power failure of input power supply; 2.The input voltage is too low; 3.The power cord is too thin;	◆ Eliminate external power problems; Check whether the power supply is disconnected during operation and whether the power cord is thick enough; ◆Adjust the input voltage; Manual power ON/OFF reset
12	motor overload	1.Improper parameter setting; 2.Excessive load;	◆ Adjust parameters; ◆Reduce load; ◆ Re conduct motor position self-learning; Manual power ON/OFF reset
13	Motor phase loss	1.The internal wiring of the motor is loose;	◆ Check the motor for internal damage caused by external force;

		2.Motor damage;	Manual power ON/OFF reset
14	Drive over temperature	1.Drive temperature too high	◆ Wait for the temperature to drop before operating. Heat dissipation instruments (electric fans, etc.) can be added Manual power ON/OFF reset
23	Parameter setting fault	1. Parameter setting error;	◆ Set parameters correctly; Manual power ON/OFF reset
24	Bus charging fault	1.Charging circuit fault	◆Contact the agent or manufacturer
25	Memory failure	1. Abnormal motor storage data;	◆Contact the agent or manufacturer; Manual power ON/OFF reset
26	Motor Locked Rotor	1.Motor stalling;	◆ Check the load; Manual power ON/OFF reset
27	Motor reverse	1.Too large reverse load;	◆ Check the load; Manual power ON/OFF reset
28	Motor out of step	1.Acceleration time is too fast;	◆ Check the acceleration and deceleration time; Manual power ON/OFF reset
29	Velocity loop saturation	1.Excessive load; 2.The speed setting is too large;	◆ reduce load; ◆ check the set speed; Manual power on / off reset
30	IF start failed	1. Drive loop fault	◆Contact the agent or manufacturer; Manual power on / off reset
36	Hall sensor fault, not data between 1 and 6	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
37	Hall sensor fault, phase sequence error1	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
38	Hall sensor fault, phase sequence error 2	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
39	Hall sensor fault, phase sequence error 3	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset

40	Hall sensor fault, phase sequence error 4	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
41	Hall sensor fault, phase sequence error 5	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
42	Hall sensor fault, phase sequence error 6	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
43	Hall sensor fault, the phase sequence of two consecutive cap acquisition is the same	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
44	Enter cap, the interval is too short	1. Hall sensor inside the motor fails; 2. Caused by interference signal 3. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
45	Enter CAP interrupt, non four channel acquisition signal is abnormal	1. Hall sensor inside the motor fails; 2. Hall detection loop fault	◆ Check whether the Hall level jump inside the motor is normal; ◆Contact the agent or manufacturer; Manual power on / off reset
47	Band brake load detection fault	1.The band brake circuit is open; 2. Band brake circuit short circuit	◆ Check whether the band brake load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset
48	Pump load detection fault	1.Open circuit of lifting pump circuit 2. lifting pump circuit short circuit	◆ Check whether the lifting pump load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset
49	Valve load detection fault	1. The circuit of lowering valve is open 2. Lowering valve circuit short circuit	◆ Check whether the lowering valve load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset

50	Parameter mismatch fault	1. Parameter configuration conflict	◆ Check whether the parameter configuration is correct; ◆Contact the agent or manufacturer; Manual power on / off reset
51	Precharge fault	1. The input voltage is too low; 2. KSI voltage is pulled down during use	◆ Check whether the input voltage is reasonable; ◆ Check whether the Ksi voltage is pulled down during use; ◆Contact the agent or manufacturer; Manual power on / off reset
52	Band brake speed fault	When the brake is held, the speed is higher than the fault threshold;	◆ Check whether there is a phenomenon of sliding down the slope due to insufficient holding force; ◆Contact the agent or manufacturer; Manual power on / off reset
53	Band brake output detection fault	1. The band brake circuit is open; 2. Band brake circuit short circuit	◆ Check whether the band brake load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset
54	Pump output detection fault	1. The lifting pump circuit is open; 2. Lifting pump circuit short circuit	◆ Check whether the lifting pump load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset
55	Lowering valve output detection fault	1. The lowering valve circuit is open; 2. Lowering valve circuit short circuit	◆ Check whether the lowering valve load has been connected; ◆Contact the agent or manufacturer; Manual power on / off reset
56	The input voltage of analog quantity 2 is judged by the slave that the IO port is incorrect	1. Analog quantity 2 input circuit (slave circuit) open circuit 2.Analog quantity 2 input circuit (slave circuit) short circuit	◆ Check whether the slave circuit of analog quantity 2 input circuit is abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
57	The lifting switch slave judges that the IO port is incorrect	1. Lifting switch input circuit (slave circuit) open circuit 2.Lifting switch input circuit (slave circuit) short circuit	◆ whether the lifting switch input circuit and slave circuit are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset

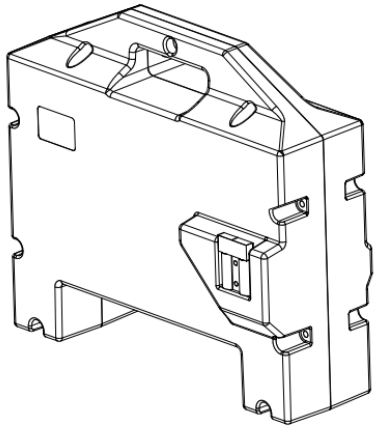
58	The forward switch slave judges that the IO port is incorrect	1. The input circuit of the forward switch and the slave circuit are open 2.Forward switch input circuit (slave circuit) short circuit	◆ whether the input circuit and slave circuit of the forward switch are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
59	The mode switch slave judges that the IO port is incorrect	1. Open circuit of mode switch input circuit and slave circuit 2.Mode switch input circuit (slave circuit) short circuit	◆ whether the mode switch input circuit and slave circuit are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
60	The reverse switch slave judges that the IO port is incorrect	1. The input circuit of the reverse switch and the slave circuit are open 2.Reverse switch input circuit (slave circuit) short circuit	◆ whether the input circuit and slave circuit of the reverse switch are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
61	The input voltage of analog quantity 1 is judged by the slave that the IO port is incorrect	1. analog quantity 1 input circuit (slave circuit) open circuit 2.Analog quantity 1 input circuit (slave circuit) is short circuited	◆ Check whether the input circuit and slave circuit of analog quantity 1 are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
62	The slave of the interlock switch judges that the IO port is incorrect	1. The input circuit of the interlock switch and the slave circuit are open 2.Interlock switch input circuit (slave circuit) short circuit	◆ whether the input circuit and slave circuit of interlock switch are abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
63	The emergency reverse switch slave judges that the IO port is incorrect	1. The input circuit of emergency reverse switch and the slave circuit are open 2.The input circuit of emergency reverse switch is short circuited to the slave circuit	◆ whether the slave circuit of the input circuit of the emergency switch is abnormal; ◆Contact the agent or manufacturer; Manual power on / off reset
64	Slave communication failure	1. Slave MCU is abnormal; 2.Communication circuit fault between MCU	◆Contact the agent or manufacturer; Manual power on / off reset
65	Slave level 3 fault	1. The master MCU control is out of control, and the slave MCU handles the emergency	◆Contact the agent or manufacturer; Manual power on / off reset
66	The slave judges that the rotation speed is too high	1. The speed is out of control, exceeding the maximum speed by 20%	◆Contact the agent or manufacturer; Manual power on / off reset

67	Internal 5V voltage abnormality	1.Internal 5V voltage fluctuation 2.Internal 5V fault threshold parameter setting error	◆ Check whether the parameter setting is correct ◆Contact the agent or manufacturer; Manual power on / off reset
68	Abnormal internal 15V voltage	1.Internal 15V voltage fluctuation 2.Internal 15V fault threshold parameter setting error	◆ Check whether the parameter setting is correct ◆Contact the agent or manufacturer; Manual power on / off reset
69	Abnormal external 5V voltage	1.External 5V voltage fluctuation 2.External 5V fault threshold parameter setting error	◆ Check whether the parameter setting is correct ◆Contact the agent or manufacturer; Manual power on / off reset
70	Communication failure between main controller and battery	1. battery BMS is abnormal; 2. The communication line between the main controller and the battery is disconnected	◆ Check whether the harness is complete ◆Contact the agent or manufacturer; Manual power on / off reset
71	Lithium battery overvoltage fault	1. lithium battery charging leads to overvoltage 2When the battery is fully charged, the voltage rises due to the power generated by the controller braking	◆ Check whether the lithium battery has been charged (overvoltage) ◆Contact the agent or manufacturer; Manual power on / off reset
73	Serious failure of lithium battery	1. The battery BMS detects that it has a serious fault. 2Extremely low battery	◆ Check whether the lithium battery has serious fault ◆ Check whether the battery power is extremely low; Manual power on / off reset
74	Lithium battery low battery warning	1. Low battery warning	◆ Check whether the battery power is low; Replace the battery
75	Drive overvoltage protection fault	1.Instantaneous bus voltage is too high	◆ Check whether the bus voltage rises rapidly during use; Manual power on / off reset
76	Master slave MCU communication fault	1. Master slave MCU communication failure 2.Communication circuit fault between MCU	◆Contact the agent or manufacturer; Manual power on / off reset
77	Loss of Hall signal from MCU	1. Open circuit from MCU Hall circuit	◆Contact the agent or manufacturer; Manual power on / off reset

80	Power on bit interlock switch is not reset	1.Interlock switch is not reset	Reset all switches
81	Power on self-test forward switch is not reset	1. The forward switch is not reset	Reset all switches
82	The power on self-test reverse switch is not reset	1. The reverse switch is not reset	Reset all switches
83	Power on self-test: throttle switch is not reset	1. Throttle switch is not reset	Reset all switches
84	Power on self-test: the emergency switch is not reset	1. The emergency reverse switch is not reset	Reset all switches
85	Power on self-test: lifting switch is not reset	1. Lifting switch is not reset	Reset all switches
86	Power on self-test: lowering valve switch is not reset	1. The lowering valve switch is not reset	Reset all switches
87	Control signal timing fault	1. Operation sequence error	Reset all switches
88	Vehicle running direction key fault	1. Both forward and backward effectively lead to:	Reset all switches
89	Emergency warning	1Triggered after the emergency reaction stops	Reset all switches
90	Timing failure	1. Operation sequence error	Reset all switches

4.3.2 Lithium battery

1) Conventional ternary lithium battery



4.3.2.1 General performance

Test item	Unit	Specification	Test method
Rated Capacity	Ah	20	4A charge and 10A discharge
Min Capacity	Ah	19.0	4A charge and 10A discharge
Nominal voltage	V	48	
Open circuit Voltage	V	≥48	Within 1 hr after standard charge
Internal Resistance	mΩ	≤200	Rest 1-4h after standard charge, test the AC internal resistance of the battery
Weight(Approximately)	kg	5.7	
Appearance		No distortion, no explode, no leakage	by eyeballing
Storage performance		-10℃～30℃	

4.3.2.2 Charge performance

Test item	Unit	Specification	Remarks
Charge mode		CC/CV	standard
Charge current	A	4-8	standard
Charge Cut-off Voltage	V	54.6	standard
Charge Cut-off current	mA	400	standard
Charge time	h	3-5	standard
Ambience temperature	℃	0～45	

4.3.2.3 BMS parameter

No.	Item	Min.	Normal	Max.	Unit
1	Max. charge voltage	54.40	54.60	54.80	V
2	Max. charge current		5	10	A
3	Max. discharge current		15	20	A
4	overcharge protection voltage	4.15	4.20	4.25	V
5	Overcharge release voltage	4.05	4.10	4.15	V
6	delay time of overcharge	0.96	1.20	1.44	S

7	over discharge protection voltage	2.70	2.80	2.88	V
8	over discharge release voltage	2.85	2.90	2.95	V
9	delay time of over discharge	115	144	172	ms
10	release method of Short/ over discharge/ over current protection	Remove the load			
11	release method of over discharge protection	Charge			
12	Normal current MOSFET temperature rise (maximum load)		65	80	ºC
13	Operating Temperature Range	-20	+25	+45	ºC
14	Storage temperature range	-20	+25	+60	ºC

4.3.2.5 Precautions

1. To keep the battery for long time, please charge and discharge it every 3month.
2. Fully charge the battery before use when using a new battery for the first time or after long term storage
3. For charging methods, please refer to our technical handbook
4. Use the correct charger for Li-ion batteries
5. Do not reverse charge battery.
6. Do not short circuit batteries, permanent damage to batteries may be caused.
7. Do not incinerate or mutilate batteries, may burst or release toxic material
8. Do not solder directly to cells or batteries
9. Do not subject batteries to adverse condition such as extreme temperature，deep cycling and excessive overcharge/over-discharge.
10. Store batteries in a dry place
11. Do not use our batteries together with other battery brands or batteries of a different chemistry such as alkaline and zinc carbon
12. Do not mix use new batteries with semi-used batteries, over-discharge may occurred
13. When charging the battery with charger, ensure correct polarity
14. If find any noise, excessive temperature or leakage, please stop use
15. When the battery is very hot, please do not touch and handle it until it cool down
16. Do not remove the outer sleeve from a cell(or battery pack)
17. When finding battery power down during use, please switch off the device to avoid over-discharge
18. When not using a battery, take out from the device
19. Take out the battery by holding the connector itself and not by pulling its cord
20. After use, if the battery is hot, before recharging it, should cool the battery in a well-ventilated place.
21. Never put a battery into water or seawater
22. Do not attempt to take batteries apart, extrusion or impact. Heat may be generated or fire may result. The alkaline electrolyte in battery will be harmful to eyes and skin, and it may damage clothing
23. Keep away from children. If swallowed, contact a physician at once

2) New Euro type /Lithium iron phosphate battery

2) Normal performance

performance	Specification		Remarks
Rated capacity	20	Ah	0.2C charge and 0.5C discharge
Nominal voltage	48	V	
Batteries materials	LFP Lithium iron phosphate battery		
Single cell specifications	3.2V-4000mAh		
series-parallel	15S5P		
Internal resistance	≤250	mΩ	Rest for 1-4h after standard charge,test the AC internal resistance of the battery
Weight	9.2	kg	
Dimension	339× 322× 129	mm	Maximum
Discharge port type	GPS75XFP-G3014G1-R/ GRID POWER		
Cycle life	≥800（60%）		Rest for 10min after standard charge, discharge at 0.5C to 35.25V
communication	CAN		

Charge performance

performance	Specification		Remarks
Charge mode			Special charger for Li-ion battery
Charge current	4	A	Standard（0.2C）
Max charge current	6	A	Standard（0.3C）
Charge cut-off voltage	52.5	V	Standard(3.5V/cell)
	400	mA	

Charge cut-off current			Standard（0.02C）
Overcharge protection	54.00	V	Standard(3.65V/cell)
Charge time	5～8	h	Recommendation
Charging temperature protection	-5～55	℃	
Ambient temperature	0～35	℃	This range is the recommended value, it can actually be charged at 0～45 ℃

Discharge performance

performance	Specification		Remarks
Discharge current	10	A	Standard(0.5C)
Maximum continuous discharge current	≤20	A	Standard(1C)
Peak current	90	A	Standard（1.5C≤5S）
Discharge cut-off voltage	34.5	V	Standard(2.3V/cell)
Overcurrent protection	90±10	A	
Overdischarge protection	34.5	V	Standard(2.3V/cell)
Discharge temperature protection	-25 ～ 70	℃	
Ambient temperature	-10 ～ 45	℃	This range is the recommended value, it can actually be discharged at -20～55 ℃

Protection bard threshold parameters

No.	Test item	Minimum value	Standard value	Maximum	Unit
1	Primary overcharge protection voltage	3.58	3.60	3.62	V
2	Primary overcharge recovery voltage	3.38	3.40	3.42	V
3	Primary discharge protection voltage	2.28	2.3	2.32	V
4	Primary discharge recovery voltage	2.78	2.8	2.82	V

5	Primary charging overcurrent protection	17	20	23	A
6	Primary discharge overcurrent protection	80	90	100	A
7	Secondary overcharge protection voltage	3.78	3.80	3.82	V
8	Secondary overcharge recovery voltage	3.68	3.70	372	V
9	Secondary discharge protection voltage	1.98	2.0	2.02	V
10	Secondary discharge recovery voltage	2.08	2.1	2.12	V
11	Secondary discharge overcurrent protection	150	one hundred and eighty	200	A
12	Secondary charging overcurrent protection	25	30	35	A
13	inherent resistance	\	25	50	mΩ
14	Short circuit protection current	\	350	\	A
15	Continuous discharge current	\	≤20	\	A
16	Temperature rise of discharge mos tube	\	≤30	\	℃
17	Primary charging high temperature protection	fifty-two	55	58	℃
18	First-level charging high temperature protection recovery	47	50	53	℃
19	Primary charging low temperature protection	-8	-5	-2	℃
20	Primary charging low temperature protection recovery	-3	0	three	℃
21	Primary discharge high temperature protection	67	70	73	℃
22	High temperature protection recovery of primary discharge	58	60	63	℃
23	Primary discharge low temperature protection	-28	-25	-22	℃
24	Low temperature recovery of primary discharge	-23	-20	-17	℃
25	Secondary charging high temperature protection	seventy-two	75	seventy-eight	℃
26	Secondary charging high	67	70	73	℃

	temperature protection recovery				
27	Secondary charging low temperature protection	-25	-22	-20	℃
28	Secondary charging low temperature protection recovery	-18	-15	-12	℃
29	Secondary discharge high temperature protection	77	80	83	℃
30	Secondary discharge high temperature protection recovery	seventy-two	75	seventy-eight	℃
31	Secondary discharge low temperature protection	-33	-30	-27	℃
32	Secondary discharge low temperature recovery	-28	-25	-22	℃

Charging connection status

a) When the battery is connected to the charger, it needs to shake hands with the charger, and the handshake is successful before charging.

b) If the battery does not successfully shake hands with the charger within one minute of being connected to the charger, it will be considered as a handshake failure, and the battery will be disconnected from charging.

c) If the battery fails to shake hands with the charger for 4 consecutive times, the battery will be charged and locked, and the ACC needs to be pulled up again to unlock.

d) After the battery is discharged, the number of handshake failures will be cleared.

Discharge connection status

a) After the battery pack is inserted into the vehicle body, the BMS can ensure that the charging and discharging MOS are closed (when the battery meets the discharge conditions).

b) If the battery pack is not taken out of the frame in a timely manner after the battery pack is over released for protection, the battery pack will not be over released.

c) When the battery pack is placed in the frame, it can be discharged and the SOC can be read through communication.

Other

a) Static storage state, battery pack not connected to charging device and chassis

b) BMS enters sleep mode

c) If the ACC is not charged or discharged within 30 minutes of being pulled up, the battery will enter a sleep state and must be pulled up again before use.

WARNING

When the battery is not in use for more than one week,please disconnect the battery from the vehicle and perform a full charge at least one time every 3 months to keep the battery being stored with optimal capacity.

1) The battery should only be used and stored for long term under recommended environment to ensure these rvice life.

2) In order to extend the lifetime of the battery,it is optimal to charge the battery before the charge level falls below 20% capacity.
3) To ensure the safety of charging,it is strictly forbidden to charge the battery below 0℃.
4) Please charge with the original charger for Lithium batteries.
5) Do not reversely charge or short-circuit the battery.
6) Do not abuse batteries,please make sure that the battery is charged and discharged within the required range of voltage and current.
7) Do not incinerate or mutilate batteries, or it may cause the emission of toxic gases or explosion .
8) Neither solder the battery directly， nor disassemble or refit it.
9) Do not place batteries in adverse conditions, such as extreme temperature， deep cycling or excessive overcharge/over-discharge.
10) Store batteries in a dry and cool place.
11) Do not mix our batteries with other battery brands or batteries of a different chemistry, such as alkaline zinc battery.
12) Do not mix new batteries with used batteries.
13) In case of any noise, excessive temperature， peculiar smell or leakage, please stop use.
14) When the battery is very hot, please do not touch or handle it until it cools down.
15) When using the battery pack, it is strictly forbidden to pull the cable directly.
16) Do not put the battery in acid, alkaline or salty liquids， and keep the battery away from rain and water.
17) Do not attempt to separate, extrude or strike batteries. Heat may be generated or fire may result. The alkaline electrolyte in battery will be harmful to eyes and skin.
18) Keep batteries away from children. If swallowed, contact a physician at once.
19) If the battery is used on other instruments, please contact with your manufacturer for confirmation. At least consult its maximum current, fast charge, special application, etc.

4.3.3 BDI

1) General

1. When the green light is on, it means that the battery power is higher than 80%
2. When the yellow light is on, it means the power is 50%
3. When the red light is on, it means the power is 20%
4. When the red light is flashing, the power is less than 10%, please charge in time

Instrument:

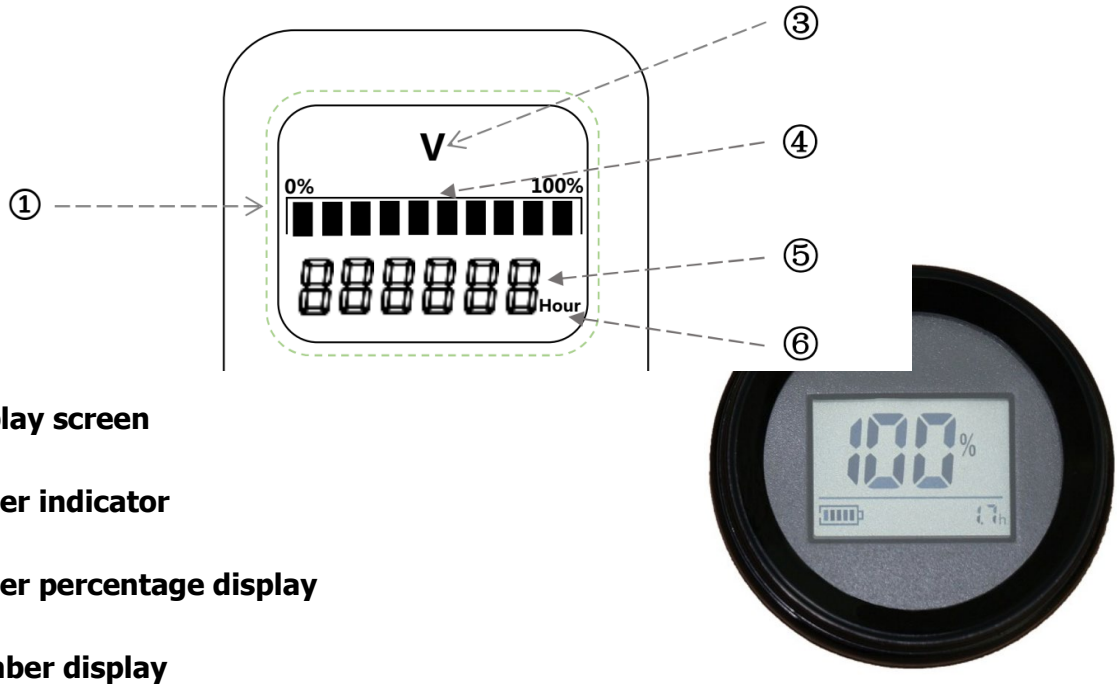
The instrument is powered continuously, B+ and B - are connected to both ends of the power supply, and KSI is connected to the key switch signal. The main area of the screen displays the power and alarm number, and the lower right corner displays the hour meter.

1. KSI access (key switch on)
   - ☐ On screen LCD backlight

- ☐ When there is no alarm, the battery power will be displayed normally in the digital display mode with an interval of 5% for each gear, such as 100%
  95%, 90%... 5%;
- ☐ Overvoltage alarm, the alarm number displays 17, the symbol "AL" flashes, and the backlight flashes;
- ☐ When the remaining 25% of the power is reported, the alarm power is low (early warning), the symbol "AL" flashes, and the backlight flashes;
- ☐ When the remaining 20% of the power is low, the alarm power is low, and RELAY - output is low, and the symbol "AL" flashes, the backlight flashes.

2. KSI off (key switch off)
   - ☐ Turn off the LCD backlight;
   - ☐ Only the hour counter value is displayed on the LCD, and the displayed value is the time when KSI is disconnected.

2) New Euro type



3)

① Display screen

③ Power indicator

④ Power percentage display

⑤ Number display

⑥ Timer unit: Hour

Battery discharge indicator

The LCD can display battery discharge level, fault code information, and hour meter information. When this device receives information from the can bus, it will display the received battery percentage information as a defensive status grid, with a total of 10 grids, each representing 10% of the battery. The specific display division is shown in the table below.

Battery percentage range	Display mode of status grid
0-4%	□□□□□□□□□□
5%-14%	■□□□□□□□□□
15%-24%	■■□□□□□□□□
25%-34%	■■■□□□□□□□
35%-44%	■■■■□□□□□□

45%-54%	■■■■■□□□□□
55%-64%	■■■■■■□□□□
65%-74%	■■■■■■■□□□
75%-84%	■■■■■■■■□□
85%-94%	■■■■■■■■■□
95%-100%	■■■■■■■■■■

Fault display

This device can display three types of fault code information transmitted by the can bus: main controller fault code, steering fault code, and lithium battery fault code. The maximum number of fault codes is 255, and the display priority and display method are shown in the table below.

Fault code	Display(XXX is the fault code)	Display priority
Master controller fault code	A--XXX	1
Steering fault code	b--XXX	2
Lithium battery fault code	C--XXX	3

Display explanation：When the fault code defaults to displaying 3 digits and there is not enough room to display the full code, the code is padded with zeros. For example, if the main controller fault code is 20, it will be displayed as "A--020

Priority explanation：The smaller the priority number, the higher the priority level. When two or more faults occur simultaneously, the fault with the higher priority level will be displayed.

Timer display

This device can display the hour meter information transmitted via the CAN bus, with a maximum value of 65535 hours. The unit is Hour.

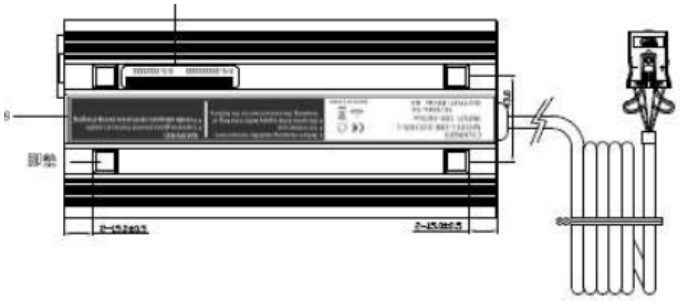
4.3.4 Charger

To charge the ternary lithium battery

When the LED is always red, indicating charging;
The LED turns green to indicate the end of charging;

Input voltage：AC110V/220V
Input frequency：60/50Hz
Output voltage：DC54.6V
Output current：6A
Lithium battery charger

To charge the Lithium iron phosphate

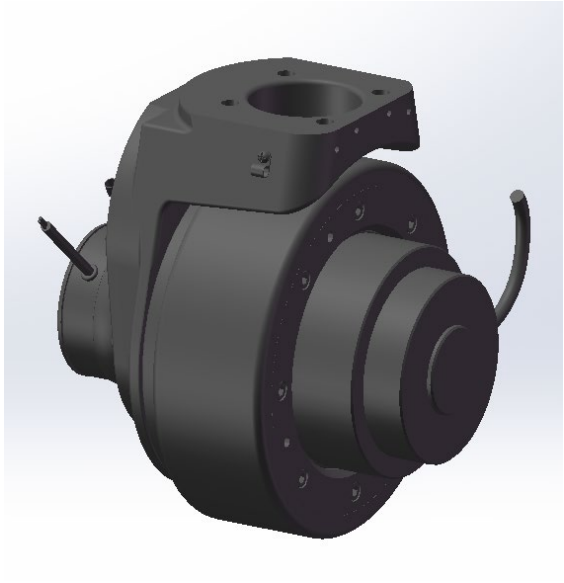


Input voltage: AC110V/220V
Input frequency: 60/50Hz
Output voltage: DC54.6V
Output current: 6A
For Lithium battery ONLY!

Yellow light flashes, indicating normal charging;
Green light flashes, indicating charging completed;

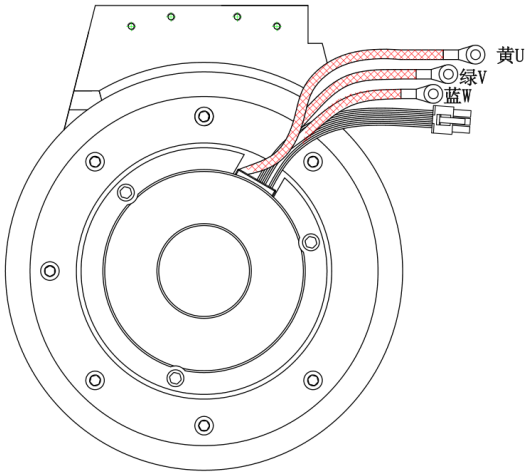
Red light flashes, indicating a fault occurs.

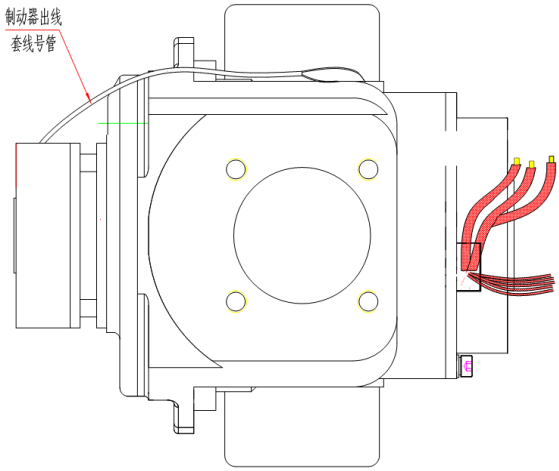
4.3.5 Driving wheel with horizontal mounted motor (driving motor)

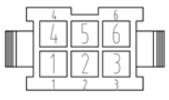


Wiring instruction

1	2	3	4	5	6	7	8
U	V	W	Hu	Hv	Hw	GND	Vcc
Red	White	Black	Yellow	Green	Blue	Black	Red
UL3321 14AWG			24AWG				







1– Red –+5V
2– Null
3 -Black-0V
4- -YEL–a
5- -Green b
6- Blue –c

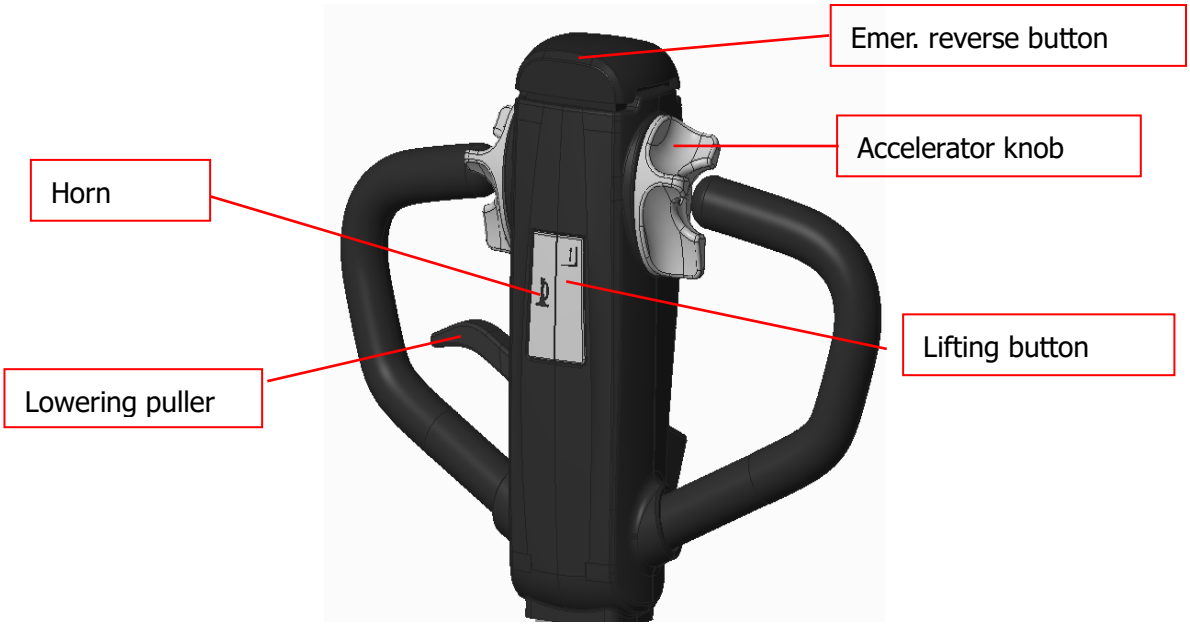
5559-2P

1–10#
2–EB

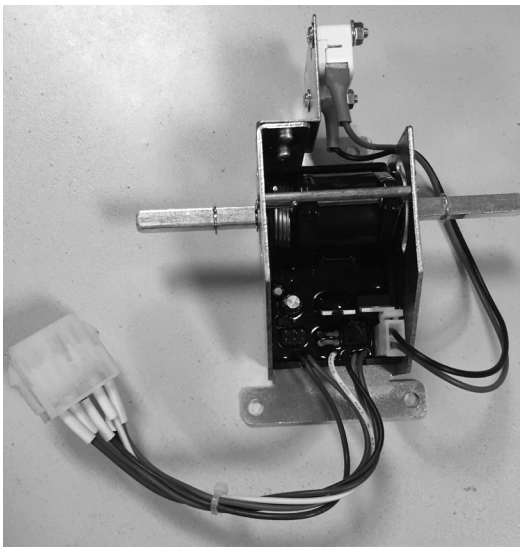
Basic performance parameters of the motor			
Model	Z130BLD650-48A1-30S	Insulation grade	F
Rated voltage	48VDC	Protection level	IP44
Rated power	650W	Reducer model	RY-001
Rated current	18A + 10%	Speed ratio of reducer	24.685K
Rated speed	3000rpm + 10%	Brake voltage	48VDC

Rated torque	2.07N.m	Braking torque	6N.m
Unladen current	Less than 4A	Operating ambient temperature	-10℃~+40℃
Unladen speed	3600rpm + 10%	noise	＜65dB（A）（L=100cm）
Work system	S2（60min）		
insulation resistance	> 20M Omega		
Life	5000h		
Electrical strength	660V/S		

4.3.6 Tiller head



Lead wire color	Function
Red	Power +48V
Black	B- 0V
Blue	Forward
Green	Backward
White	Accelerator 0-5V
Brown	Emer. reverse



Handle accelerator

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