HYUNDAI
MATERIAL HANDLING

66TT / 110TT Electric Stand-in Tow Traction Service Manual

Warning

Understanding to this manual

and all kinds of warning signs on the truck shall be

ensured before use!

Care to these signs shall be taken for future use!

Content

1-1 How to use this manual

1-1-1 Composition of this manual

This service manual mainly provides engineers and technicians service information for forklift repair and maintenance, which excludes vehicle operation instructions.
The introduction section of this manual introduces the functions of the vehicle with attention to its different components. More detailed specific information is available in the main body of this manual for you, including the schematic diagram of the vehicle components, the principle they work, the check lists, the maintenance procedures as well as the data and information as needed for maintenance and repair
To facilitate a quick and easy access to the services and training information as required by the readers, the sections of this manual are categorized as per different systems of the vehicle (Please refer to the table below).

Section	Headings
1	General
2	Electronic System
3	3 Driving/Braking System
4	Steering System
5	Battery Charger

1-1-2 Definitions of Warning Signs

The following three warning signs are applicable to this Manual: "Danger", "Warning" and "Caution". Each label is intended to indicate the severity and nature of the potential hazard, the consequences, as well as preventive measures against hazards. You will find these signs throughout this manual. Please ensure your careful attention to such signs, as they are included for your safety intensively.

⚠ Danger

This signs represents a dangerous situation that could result in death or serious injury if not avoided

⚠ Warning

This signs represents a dangerous situation that could result in death or serious injury if not avoided

⚠ Note

The label indicates a dangerous situation that could result in minor injuries if not avoided

1-2 Glossary

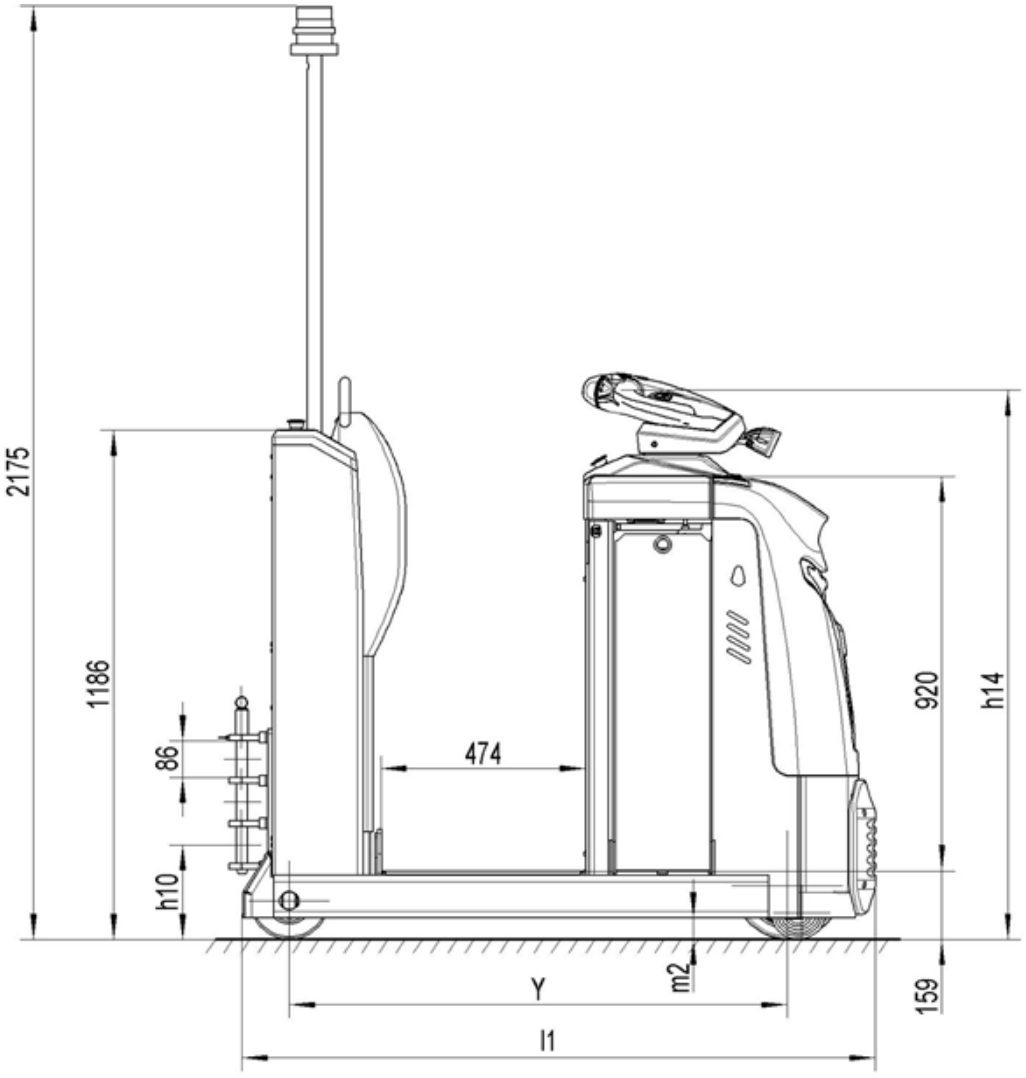
The terms referred in this service manual and their descriptions are as follows.

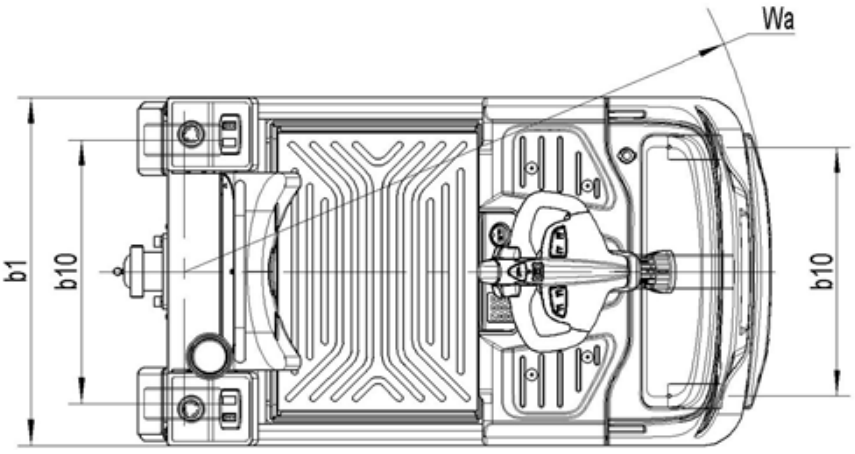
Item	Descriptions
Accelerator	A device that converts mechanical motion to an analog voltage mode and transmit to a controller to control the speed at which a vehicle is driven
Ampere (A)	A measurement unit of current. The current of a voltage passing through an ohmic resistor.
Battery	Two or more batteries which are inter-connected with each other to provide current.
Coulomb meter	(Battery Discharge Indicator) an electrically controlled display that shows the operator the current charge of a battery.
Busbar	A re-conducting conductor that wired to other smaller conductors.
Communication Modes	CAN (Controller Area Network) is the standard for communication among microcontrollers and/or devices.
Condenser	A device for short-time electrical energy storage.
Circuit	A path along which current can travel from the positive (+) side of the source to the negative (-) side. This can be obtained with wires and electrical components.
Connector	A part of a wire assembly or harness wired to another wire assembly or harness to for a easier Disassembly and Assembly operation.
Co-contactor	A switch, relay, or part of a contactor that opens or closes a circuit.
Components of Co-contactor	An electrical element consisting of an electromagnetic coil and a set of heavy contact tips, which controls current flow through the coil, create a magnetic field, and close or open contact tips
Coil of Co-contactor	An electromagnet used to open or close contact tips in a contactor component.
Counterweight	The weight mounted on the back of the forklift to ensure a stable status, especially when lifting heavy loads
Current Limiting	The maximum permissible armature current of the stopped drive motor during the pulse.
DC-DC Convertor	A device that converts a high-voltage DC onto a low-voltage DC.
Digital Signal	A signal in which the element can be either of two different values, e.g. high voltage and low voltage.
Diode	A semiconductor device that allows current to flow from the anode to the cathode in one direction
Instrument	An electrical device that converts voltage input into an visual output.
Drive Axle	A device that receives power from a driving motor
Driving Controller	A control device to drive an electric motor, which includes an inverter and a logic circuit.
Handheld	A maintenance tool program to calibrate and diagnose CURTIS

Programmer	controllers of trucks.
Encoder	A device that detects the direction and speed of a motor to produce a pulse signal.
Fan	A device that generates an airflow to cool an electric motor and a controller.
Friction Plate	When meshing with helical gears, the friction disc stops the drive shaft movement when it is compressed by the steel plate
Fuse	A component of a circuit that opens upon an overloaded current flowing through a given part of the circuit
Fixture	A fitting o secure an assembly consisting of two or more wires
Radiator	A mounting frame for cooling semiconductors.
Mandatory Sign	A symbol indicating the state of a vehicle when it is on or flashing.
Seat Switch	A switch to disable the vehicle movement when the operator leaves the seat.
Portal	The front vertical structure of the forklift extends and retracts to lift and lower the load.
Normal State	A term used with switches or relays. Their "normal state" means that they are not under any control of stress, temperature, pressure or electricity.
Ohm (Ω)	A resistance unit. The resistance will be such that one volt shall push one ampere of current through it only.
Timely	The time it takes for a current to flow through a transistor.
Open Circuit	A connection or component of a circuit without continuity.
Overload	A condition that the existing voltage or current is greater than the capacity of a given circuit or component.
Suffocated	The part of an electric brake in which the current generated is directed back to the armature.
Power Socket	A connecting socket that installed on the forklift.
Pressure	a fluid force as per unit area
Proximity Detector	A sensor which can detect the presence of objects nearby without any physical contact.
Resistance	A component made of a material with a specific current impedance.
Rotor	A part of rotating motor.
Outline	A bar chart of an electrical or electronic component that uses symbols to show the individual components as well as how the wires and connectors work electrically
Serial Port	A port that communicates one-to-one with the controller.
Service Brake	A pair of brakes built into the drive shaft to enable the vehicle when the operator applies the pedal for stationary
Short Circuit	An unwanted electrical connection between two or more components.
Socket	The male contact of the connector which slides over the male contact of

	the other connector (pin).
Magnetic Valve	A directional valve that moves the valve element when the magnetic coil is equipped with a magnetic valve.
Solid State	A term that refers to semiconductor components or circuits that wired without moving parts, e.g. diodes and transistors.
Stator	a fixing part in the motor
Steering Shaft	A column that connects the steering wheel to the steering gear to allow the operator to use steering wheel controller
Steering System	element loop, including steering unit, circuit and actuator
Steering Gear	A axle mounted on the rear wheel of a vehicle
Switch（SW）	The component to control a circuit by opening or closing the circuit.
System	Electrical components, circuits, and connections that provide power for specific tasks.
Thermal Sensor	a sensor activated at a pre-conditioned temperature.
USB	A connecting device providing a power supply of 5V.
Voltage	A measurement unit of electrodynamic force. A volt is the force that required for an ampere of current to pass through an ohmic resistor in a circuit.
Watt	A unit of power measurement. The power for one volt to push one ampere of current through an ohmic resistor. The outcomes of amperage (current) multiplied by volts (voltage) is watts (power).
Wire	A path of conductors to provide for current flow in and out of different electrical components.
Wiring Diagram	A visualized figure that represents a component in the way it actually looks. which is used to show the locations of components, and the connections between them.
Zener Diode	A special diode to regulate voltage or protect a system from overvoltage.

1-3 Appearance and Specifications





Type sheet for industrial truck. To VDI 2198					
Distinguishing mark	1.2	Type		66TT	110TT
	1.3	Power (battery,diseal,petrol gas, manual		Battery	Battery
	1.4	Operator type		Stand-in	Stand-in
	1.5	Load Capacity / rated load	Q(t)	3.0	5.0
	1.7	Rated pull force	F(N)	800	1000
	1.9	wheel base	Y(mm)	1155	1155
Weight	2.1	Service weight	kg	950	1020
	2.3	Diving wheel/loading wheel,unladen	kg	550/400	610/410
Tires, chassis	3.1	Tires		实心橡胶轮	实心橡胶轮
	3.2	Tire size, driving wheel	∅ x w (mm)	∅230×70	∅250×80
	3.3	Tire size, loading wheel	∅ x w (mm)	∅180×76	∅180×76
	3.4	Stable wheel (size)	∅ x w (mm)	-	∅124×60
	3.5	Number of wheels (x= drive wheels) drive side/load-bearing side		1x+2/2	1x+2/2
	3.6	Wheel space, idriving wheel	b10 (mm)	580	580
	3.7	Wheel space, Loading whel	b11 (mm)	614	614
Dimensions	4.9	Height of tiller in drive position min./ max.	h14 (mm)	1280	1280
	4.12	Traction bolt (hook center off ground) height	h10(mm)	230/330/430	230/330/430
	4.19	Overall length	l1 (mm)	14291)	14291)
	4.21	Overall width	b1 (mm)	810	810
	4.32	Ground clearance, centre of wheelbase	m2 (mm)	50	50
	4.35	Turning radius	Wa (mm)	13332)	13332)
Performance	5.1	Travel speed, laden/ unladen	km/h	6/9	7/12
	5.5	Pull capacity, full/no load	N	800	1000
	5.6	Max Pull capacity, full/no load	N	2000	3000
	5.10	Service brake		Electromagnetic	Electromagnetic

Motor	6.1	Drive motor rating	kW	1.9	2.6
	6.3	Battery standards DIN 43531/35/36 A，B，C，no standard		无	无
	6.4	Battery voltage, nominal capacity	V/Ah	24/375	24/465
	6.5	Battery weight	kg	292	352
Other	8.1	Type of drive control		AC- speed control	AC- speed control
	8.4	Sound level at driver’s ear	dB(A)	<70	<70

1-4 Safety Notes

The following safety sections contains the following subsections: general, personal safety, maintenance safety, compressed air hazards, mechanical hazards, electrical hazards, and fire & burning hazards. Each heading are attached with the precautions you should take for your safety while working in your vehicle.

Readers are advised with responsibility to read this manual thoroughly, and understand and follow all the following precautions. Please also note that the safety instructions listed below are not only for the safety of the readers, but also for those around them. Therefore,, please be sure to read the following instructions carefully for the purpose of your own personal safety and the safety of those around you:

General
Safety Instructions

Please be familiar with the visible safety instructions on the vehicle, which includes warning signs, stickers, carvings, etc. Make sure to read the them before operating, lubricating, or repairing the vehicles (Please refer to the safety section of the Operations and Maintenance Manual).

Make sure that all safety rules, regulations and instructions are followed when performing maintenance tasks. Special attention is required to the danger warning in this manual, which will detail you the potential dangerous conditions.

Do not assume that you can replace the steps outlined in this manual with your previous maintenance experience of similar models. Weight and specifications vary from different models and care is required to avoid any dangerous condition, injury and/or component damage.

Personal Safety

Do not operate or service a vehicle without
authorization or training
Do not operate or service a vehicle after alcohol
or drugs taking which will impair your judgement.

If you have any disease or condition that restricts
physical activity, please do not operate or service the vehicle.

Working Garment

If you are wearing baggy clothes or have long hair that is not
handled safely, please do not operate the vehicle or carry out maintenance.
Both can be caught by any moving part and cause serious injuries

Appropriate protective equipment is required when performing maintenance tasks. Protective gear may include a hard helmet, glasses/visor, ear protectors,
gloves and protective shoes.

Masks are required when polishing the body and an air breathing device is advised when painting.

Welder gloves, welding masks/goggles, aprons and other suitable welding clothing are required when welding.

Security of Service
Pre-service
Make sure that the vehicle is kept in a clean, open environment, and is free from any traffic and personnel.

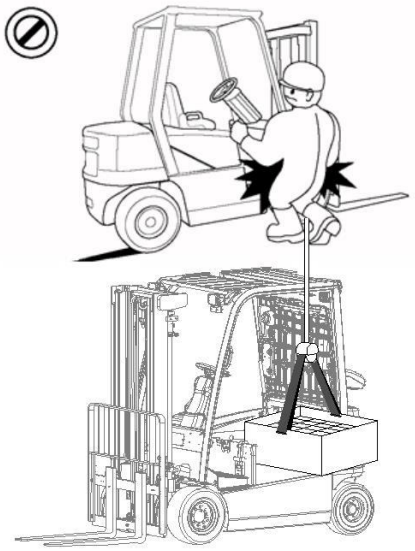
Please ensure that the vehicle is parked safely
and will not move suddenly.
Place the wooden props in front and back of the wheels and make sure that the parking brakes will mesh correctly.

Make sure that the vehicle is empty and unoccupied, all the controls are in neutral position and the key is switched to OFF. Place a "do not operate" or similar warning signs to the start switch or the controller before repairing or servicing the forklift.
Make sure the tools are in good condition.

Disassembly and Installation

Make sure the working environment is clean, clean and dry before installing the vehicle.
When using steps, ladders or walkways for installation or removal,
please face the vehicle.
Please follow these steps and grab the handle to install or remove parts.
When you are unable to follow these steps, please use a ladder, scaffold, or work platform to perform maintenance operations safely.
Work platform is advised to perform maintenance for safe operations.

Lifting



Check the weight of each component before removal. Partial components of the vehicle may so heavy that it may cause serious injuries
When removing any components, please use appropriate lifting procedures
A hoist is required avoid back injuries when lifting parts weighing 23kg (50lbs) or more.

Ensure all chains, hooks, slings and the like are in good condition and in correct capacity. Make sure the hook is positioned correctly. Lifting ring bolts should not be loaded laterally during lifting operation.

Disassembly/Assembly

Make sure that the assembly/disassembly site is kept clean and dry and that hand tools are kept clean.

When tightening/loosening bolts and nuts, please use a properly sized wrench and always pull towards the body. A wrench with the wrong size or pushing off the body to loosen/tighten the bolt or nut may cause an accident as the handle slips.

If two or more people are working together, signs or signals are required for communication so that the work is done in an agile manner as if it were done by one person.

Be careful when removing the cover. Slowly loosen the last bolt or two opposite direction nuts from the cover plate unit, twist the cover plate to loosen tension or other pressure, and then completely remove the last bolt or two nuts.

Re-install all fasteners with the same numbered part. If any fasteners need to be replaced, please use qualified fasteners and be careful to not use metric system fasteners with British fasteners together.

Hazards of Compressed Air

Please wear protective mask, protective clothing and protective shoes in cleaning operation。

The maximum air pressure for cleaning must be less than 205 kPa (30 psi).

Mechanical Hazards

Keep all the objects away from the fan blades, or they will throw or cut any object or tool that falls or is pushed in.
Do not operate the machine when any rotating parts are damaged and do not touch any other parts during the operation. Please check the balance of any damaged or changed high-speed rotating part before re-use.

Debris or other debris will fly away from the object upon impact.
Make sure the flying debris doesn't hurt anyone before hitting the object.

Electrical Hazards

Do not damage any wire during disassembly operation. When re-installing wiring, make sure it is installed correctly
Do not wire to any oily cable.
Do not smoke or expose batteries to any spark or flame when checking, charging or repairing the batteries.
The chain and metal tools shall be kept away from the top of the battery.
Electrolyte is an acid that can cause injury if it comes into contact with the skin or eyes.

Fire and Burning Hazards

Attention shall be paid to the hot parts on the machine that has just stopped and to the hot oil in the pipes and compartments to avoid scalding.
Many lubricants and some coolant mixtures are flammable. If the pipe is loose or damaged, there may be a fire.
Lubricants shall be stored in appropriately marked containers and be away from unauthorized personnel.
Other flammable materials shall be stored in a protective container and kept in a safe place.
Do not weld or flame cut pipes or pipe containing easy fuel.
Before welding or flame cutting, please clean them thoroughly with a nonflammable solvent.
Remove all residual flammable materials from the forklift and then collect, like fuel and oil.

1-5 Maintenance

The following provides the key items and replaceable components to be checked during maintenance intervals.
Note: all maintenance and repair should be carried out by a qualified authorized engineer except for the routine inspection of the vehicle driver.
Note: careless disposal of waste oil is not only harmful to the environment, but also to human health. Waste oil should always be kept in containers and disposed of by authorized personnel at a designated locations.
Necessary Check as Required

Item	Inspection Standard and Method
Instrument Board	Press Enter KEY3 You can access diagnostic mode by pressing this button while driving
The power module	must be fully discharged before contact with any electrical components.
Fuse Holders	Check the removed components fuses and replace if necessary. 5A：Backup/parking light, relay/power supply, fan, strobe, flash, rear/headlight 10 A：key switch 20 A：DC-DC Convertor and Horn 500 A：main fuse
Wheel bolting	Make sure that the wheel bolts and nuts are fixed as follows: Tightening torque of rear wheel : 430 Nm Tightening torque of drive wheel：600±75 N·m（442.5±55 lb·ft）
Drive axle gear box	Check gear box for lubricant Refill the lube oil into the plug opening for shell level inspection.

Check every10 service hours or daily

Item	Inspection Standard and Method
Check by walking around	Check for loose parts and fasteners. Check the indicator lights of instrument board for abnormalities. Check if the speakers and other alarms are working properly. Check tires, valves and wheels for abnormalities. Check driving wheel is oil leakage.

	After adjusting the driver's seat and placing the control lever in neutral, please open the key switch and check the overall operation of the system.
Battery	Check the battery box for loose connections, worn cables and limits on properly secured battery limits. Clean the top of the battery. If necessary, clean the top of the battery with a solution of 0.5 kilograms (1 pound) of baking soda and 4 liters (1 gallon) of hot water. Check the density of the battery. If the specific gravity reading is below 1.150, the battery must be charged. Check the electrolyte levels of all cells. Keep the electrolyte level about 13 mm (0.50 in) above the plate. Add water as needed. Use distilled water only. Water should be added to the battery after charging
Indicator lights of instrument board	Check whether the parking brake light is working normally and all the indicator lights
Tyres and wheels	Check tires and wheels for wear, cutting, grooves and contamination.

First check shall be made after 50-100hours or a week later

Item	Inspection Standard and Method
Gear box	Replace gear oil

Check every 500 service hours or ever 3 months

Item	Inspection Standard and Method
Gear box	Replace gear oil
Control Panel	Clean control panel. Maximum allowable pressure：205 kPa（29.7 psi）
F / R switch	Check the tightness of the F/R switch mounting bracket and adjust as needed. Check for loose wiring and secure it as needed.
Parking Brake	Check the parking brake to ensure that the vehicle is stationary at a 15% gradient and repair or replace if necessary.

Check every 1,000 service hours or every 6 months

Item	Inspection Standard and Method
Drive motor	De-dust and check drive motor and end cover area. Maximum allowable pressure：205 kPa（29.7 psi）
Tyres and wheels	Check tires for worn, cuts, grooves, contaminants and the like. Check the wheel components for cracks, wear, damage, corrosion and the like. Standard torque of drive wheels：180 N·m （133 lb·ft）

Check every2,000 service hours or annularly

Item	Inspection Standard and Method
Rear wheel	Remove and assemble the rear wheels to re-assemble the bearings.
Basic maintenance	A regular check-up shall be made at least every 12 months under normal circumstances. If the vehicle are working with long hours or under heavy load, please check the vehicle every 6 months in regularly. If any of the following conditions are found, please replace: the crack healing on the fork, welding, bracket and the like

1-6 Lube

The following is a detailed description of the lubricant as required.

1-6-1 Lubricating Oil Specification

The following lubricants are recommended for chains and connecting rods:

Item	Specification
1	DIN 51825 Standard Oil and Grease

Gear oil

Failure to comply with recommendations will result in excessive wear of gears leading to shortened service life.
API GL-4 or SAE 80W oil is acceptable

Note: Noblelift does not mix multi-stage oils for transmissions. Multistage oils with high molecular weight polymers as vi improvers lose their viscosity effectiveness due to the permanent and temporary shear of vi improvers and hence are not recommended for use in drives and compartments of drive system

1-7 Instructions of Disassembly/Assembly

The following parts of Disassembly/Assembly include the following sections: the preparation before disassembly,
the inspection and test before disassembly, the matters to be attended during disassembly, the matters to be attended after disassembly, the matters to be attended during assembly, the handling of common parts.
The precautions to be taken for proper disassembly/assembly operations are listed in each heading.

Preparation before disassembly
Remove dust and contaminants from the vehicle before transferring to the maintenance centre. Dust or contaminants that enter the maintenance centre may contaminate parts and enter inside to introduce scratches. The electric machines are operating on an electrical system.
No water shall be allowed inside the system.
To avoid unnecessary disassembly, please prepare necessary tools and place parts inside boxes with priority to site cleaning

Check and test before disassembly
Be sure to record any problems before starting the disassembly, which can prevents unnecessary disassembly, loss of replacement parts, and repeated failures as caused by the same problem.
To prevent failures, record failures and replace required parts are required.
The following information shall be also checked and recorded:
Vehicle model number, serial number and operation hours
Reasons of the vehicle needs to be dismantled
Check for symptoms, locations and causes of failures (repeat the same failure if needed)
Check any part which is not suitable.
Check the parts for damage or looseness.
If possible, check the maintenance condition of the vehicle.

Figure1-17

Notes for disassembly

Disassembly：

Determine the way of parts assembly (front/rear, left/right and up/down) for the sequence of disassembly.
Before starting to disassemble parts, attention shall be paid to the join points of parts with arrow marks to avoid misplacing parts during assembly
Please use the right tools to remove specific parts.
If no part is removed, even when mounting bolts and nuts, do not use excessive force.
Do not overstrain. Check and find the causes
Put the disassembled parts on one side in the order of disassembly, and place signs or marks on similar parts.
Store bolts, nuts and other common parts in an orderly manner.
Check and test in disassembly
The cause of the fault is sometimes found in the process of disassembly. Therefore, it is important to carefully examine the condition of the friction surfaces and the contact parts.
During disassembly, gaps, deformations, projections and other factors that may cause failures shall be measured and recorded.

Keep the distance
Make sure that the installed spacers and gaskets will produce the required specific clearance.

Remove pressure fittings
Remove any dent or mark that caused by area hammering and polishing.
If any pressing part is released, please identify and eliminate the cause to avoid problems during assembly.

Bearing Disassembly
Do not remove the bearing forcibly, and a bearing puller is advised.

Notes after disassembly
Be clean
Clean disassembled parts and keep them away from contaminants.
Special attention should be paid to removing contaminants from the oiling or component lines.
When cleaning special parts, increase the number of detergent containers and clean several times.
Kerosene or neutral anhydride diesel is suitable for cleaning viscous oils in bearings.
When using dangerous chemical cleaners, be careful to avoid a skin or eye contact.
Used oil should be disposed of in designated containers at designated locations.

Dustproof

A dust cover is advised to keep cleaned parts free of dust and contaminants and to block up the ends of all pipes.
Any part you may store should be rust-proof before re-installing.

Notes for assembly

Parts installation

All parts shall be kept clean before assembly. All surfaces shall be checked for defects and repaired if necessary. Any contaminant shall not be smeared or rubbed on the surface, which may shorten the service life of the parts.
Before starting assembly, a cleaner is required to remove the rust inhibitor from the parts.
Before assembly, the markings that put the parts together shall be identified.
Bearings, bushings, and seals shall be assembled with press tools and specific parts shall be handled with specified tools.
Before pressing parts, the surface shall be lubricated with lube.

Tighten the bolts and nuts

To ensure a uniform torque of bolts and nuts, the tighten order shown in figure 1-19 shall be followed and then the other end of the other side shall be tightened. This method is known as the "template method", which gradually repeats loosening and fastening to ensure even contact.

Fix the bolts, nuts or other important fasteners that cannot be visually inspected with wires, cotter pins, lock washers or other components as shown in figure 1-20.

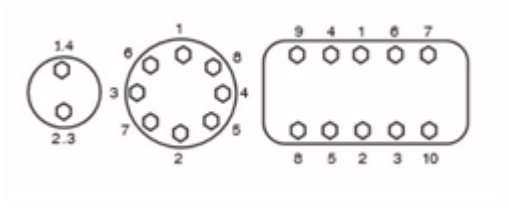


Figure 1-19

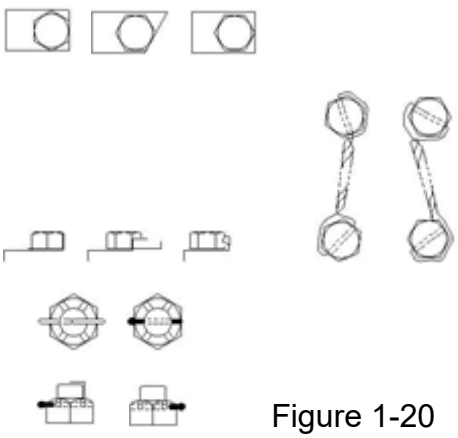


Figure 1-20

Assembly Inspection
At each step of the assembly process, each part's number shall be checked and recorded.

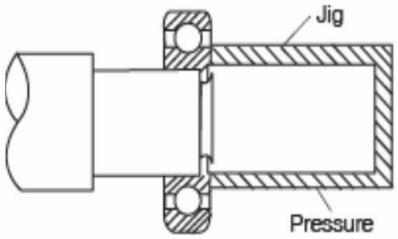
Reassemble the gaskets
Install the gasket and washer in the same position as before, and then check the gap for correctness.

Assembly adjustment
If no adjustments are required, assemble them to the same length as before

Assemble pressed parts
Scratches and dents shall be repaired as needed and be kept clean before insertion.
Please note that press fittings that are not adequately tightened may become loose.

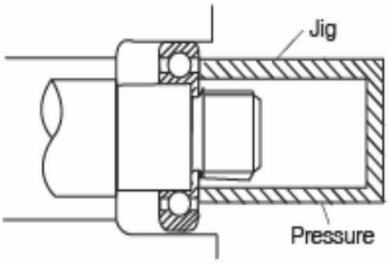
Assemble keys and keyways
Check if the keyway and key are loose and in contact with the key head. If the keyhead touches the keyway, then the rest of the keyhead shall be removed.
Handling the general parts

Handling the packaging
Packing, as well as gaskets &copper packing should be replaced as instructed. After using the adhesive, please assemble the gasket specified in this maintenance manual. The followings shall be noted when applying the adhesive to the gasket:
Old adhesive, scratches, dust, paint and grease shall be thoroughly removed from the washer surface.
Apply appropriate sealant evenly to both sides of the washer and wait a few minutes until dry.
Once the sealant is dry enough to touch, it won't stick to your hand.



Assemble the parts
Please soak the leather package in oil before use.

Handling the O-rings
Please remember to check the condition of the O rings.
Hardened O-rings shall not be stored for long.
The O-rings to be used shall be the specified once in the parts list.
For example, the O rings used in engine oil are made of special materials, such as silicone rubber, and are resistant to heat and aging.
Installing different types of O-rings in this situation can cause serious damage to the system and its components.



The O-rings shall be lubricated to avoid surface scratching during installation. Silicone rubber O rings are prone to damage, hence attention is required to avoid overstretch.

Handling the oil seal

Oil seals shall be prevented from dust sedimentation, especially on the lips, and there shall be no rust or scratch.
Lips opposite to the seal shall be lubricated evenly.
The surface of the shaft where the seal is installed shall be checked for contamination, rust, or scratches and grease or lubricant shall be applied so that the seal can be easily installed.
Oil seal installation.
By gently rubbing the wire on the surface, please check the surface of the oil seal lip for scratches.
If there is any scratch, please replace the oil seal.
When inserting the oil seal, please use the guide device and fixture as shown in figure 1-22 to avoid any damage to the oil seal.
After the oil seal is inserted, the inclination shall be checked (tilt tolerance: 0.2 mm /00 mm, diameter 0.008 in. /3.937 in.).When applying adhesive to oil seal, make sure that there is no adhesive in contact with the lip surface. All residual adhesive shall be removed from the guide and fixture before inserting another seal.

Bearing handling

The followings shall be noted to properly assemble bearings and avoid damage to bearings:
The dust and other contaminants that may shorten the service life of the bearing shall be thoroughly removed.
The bearing shall be kept packaged until it is installed.
Do not affect the bearing.
Do not over-turn the bearing to remove the purifier by compressed air.
The oil seal ring shall be installed in the correct direction.
Please note the following when installing the bearing.
Neither hit the outer ring with a hammer for installation, nor hit the inner ring to insert the outer ring. Such hammer strike may damage the bearing track.

When you are insert the inner ring of the bearing with a reasonable tolerance, the fixture shown in figure 1-23 is required with pressure to the inner ring. For hot insertion, the bearing shall be heated to 120℃（248℉）. However, please note that excessive heating can reduce the hardness of the bearing surface.
When inserting non-split bearings with inner and outer rings with reasonable tolerances, the fixture shown in figure 1-24 shall be applied and both inner and outer rings shall be pressed.

Handle the retainer

When removing or installing the retainer, a pair of right ring tongs is required and attention shall be paid against over-pressure on retainer. After installing the retaining ring, the retaining ring shall be checked for correct insertion.

Fitting assembly with straight thread and O rings (for different applications)
1.Place the lock nut (3), support washer (4) and o-ring seal (5) as far away from the fitting body (2) as possible.
2. Tie the joints to the part it is using until the support washer (4) just touches the surface of the part.
3. Place the joint assembly in the correct position, and turn the joint body (2) outward to 359°(counter-clockwise) .
4. Tighten the locking nut (3) to the torque as shown in the correct diagram for the used fitting.
5. If the end shape of the fitting body is the same as shown in figure 1-25 (elbow or straight), please place the sleeve over the tube before connecting the tube to the end.

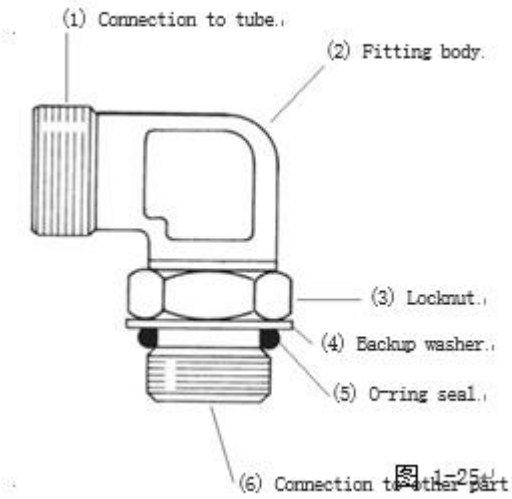


图 1-25

Note: if the joint is a connector (direct connector), then the lock nut on the main body shall be replaced by the hexagon nut. To install this type of joint, the hexagon joint shall be tightened to the surface of the parts into which it enters.

Tighten accessories of other types
Pipe fittings (shear sleeve) of high load: please turn the nut with a wrench until a slight reduction in torque is felt after the pipe passes through the nut and touches the shoulder in the fitting body, which indicates that the sleeve has been removed from the nut

High seal fittings: place the nut and sleeve on the pipes with the short end of the sleeve toward the end of the pipes. Press the pipe end against the counterbore in the body of the

fittings and tighten the nut until it is above the last thread of the body. As soon as the fitting is removed and reinstalled, the remaining space will be available.

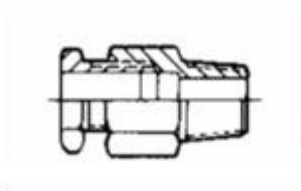


图1-26

Figure

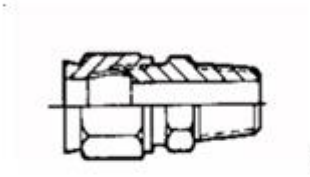


图 1-27

Figure

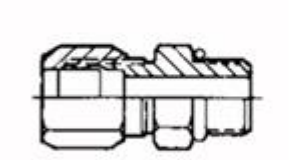


图 1-28

Figure

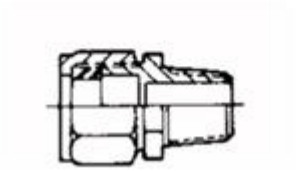


图 1-29

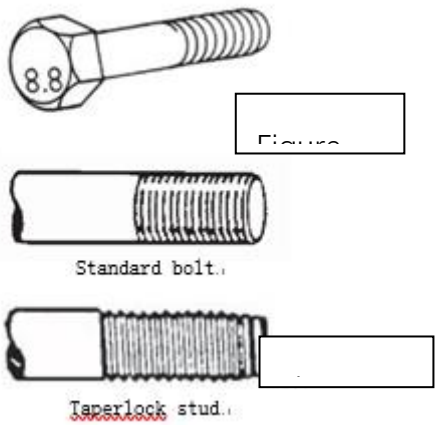
Figure

Flexible fittings: please place the nuts and sleeves on the pipes and push the pipes as far as possible into the countersunk holes of the fitting bodies. Tighten the nut until it touches the hexagonal part of the body.

1-8 Standard Torque

1-8-1 Standard torque of bolts and nuts

Be careful that the metric and British size fasteners shall not be mixed in used. Mismatched or incorrect fasteners may cause damages or malfunctions to the vehicle or personal injuries. Exceptions to these torques may be provided in the service manual if required.
Before installing any hardware, make sure that the components are close to a new state. Threads of bolts and nuts shall not be worn or damaged. Hardware shall be free from rust and corrosion.
Hardware shall be cleaned with a non-corrosive cleaner with oil application to threads and bearing surfaces. Oil shall be not applied if thread locks or other compounds are to be used. The fastener shall be kept in good condition and reused only in fine conditions after



loosening.
Make sure to choose the same size and grade of fasteners for replacement.
Generally, you can identify the strength of the bolts based on the numbers marked on the heads
(e.g. 8.8 or 10.9) as shown in figure 1-30. The following table are listing the standard torques for typical bolts, nuts and the taper bolts as shown in figure 1-31.

For metric fasten .

Thread size(mm)	Metric nuts and bolts		Metric taperlock stud	
	（N · M）	Pounds/feet	（N · M）	Pounds/feet
M6	12 ± 3	9 ± 2	8 ± 3	6 ± 2
M8	28 ± 7	20 ± 5	17 ± 5	13 ± 4
M10	55 ± 10	40 ± 7	35 ± 5	26 ± 4
M12	100 ± 20	75 ± 15	65 ± 10	48 ± 7
M14	160 ± 30	120 ± 22	–	–
M16	240 ± 40	175 ± 30	110 ± 20	80 ± 15
M20	460 ± 60	340 ± 44	170 ± 30	125 ± 22
M24	800 ± 100	600 ± 75	400 ± 60	300 ± 45
M30	1600 ± 200	1200 ± 150	650 ± 80	480 ± 60
M36	2700 ± 300	2000 ± 225	870 ± 100	640 ± 75

For British fasteners

Thread size(inch)	British nuts and bolts		British taperlock stud	
	（N · M）	Pounds/feet	（N · M）	
1⁄4	12 ± 3	9 ± 2	8 ± 3	6 ± 2
5⁄16	25 ± 6	18. 0 ± 4. 5	17 ± 5	13 ± 4
3⁄8	47 ± 9	35 ± 7	35 ± 5	26 ± 4
7⁄16	70 ± 15	50 ± 11	45 ± 10	33 ± 7
1⁄2	105 ± 20	75 ± 15	65 ± 10	48 ± 7
9⁄16	160 ± 30	120 ± 20	–	–
5⁄8	215 ± 40	160 ± 30	110 ± 20	80 ± 15
3⁄4	370 ± 50	275 ± 35	170 ± 30	125 ± 22
7⁄8	620 ± 80	460 ± 60	260 ± 40	190 ± 30
1	900 ± 100	660 ± 75	400 ± 60	300 ± 45
1 1 / 8	1300 ± 150	950 ± 100	500 ± 70	370 ± 50
1 1 / 4	1800 ± 200	1325 ± 150	650 ± 80	480 ± 60
1 3 / 8	2400 ± 300	1800 ± 225	750 ± 90	550 ± 65
1 1 / 2	3100 ± 350	2300 ± 250	870 ± 100	640 ± 75

1-8-2 Standard torques for fastening fittings

Standard torques for O-ring surface seal fittings

Thread size(inch)	Accessories for straight thread o-ring	
	（N · M）	Pounds/feet
5/16-24	5.0±1.5	45±15
3/8-24	12±2	110±20
2/7 -16	20±4	15±3
1/2-20	40±5	30±4
9/16-18	40±5	30±4
3/4-16	100±15	75±10
7/8-14	135±15	100±10
1 1/16-12	200±25	150±20
1 3/16-12	250±25	185±20
1 5/16-12	300±40	225±30
1 5/8-12	300±40	225±30
1 7/8-12	300±40	225±30
2 1/2-12	300±40	225±30

Thread size(inch)	Sealing joint nuts for O-ring face	
	（N · M）	Pounds/feet
9/16-18	16±3	12±2
11/16-16	30±4	22±3
13/16-16	50±7	37±5
1 1/4-14	90±10	65±7
1 3/16-12	120±15	90±10
1 7/16-12	160±20	120±15
1 11/16-12	190±20	140±15
2-12	215±25	160±20

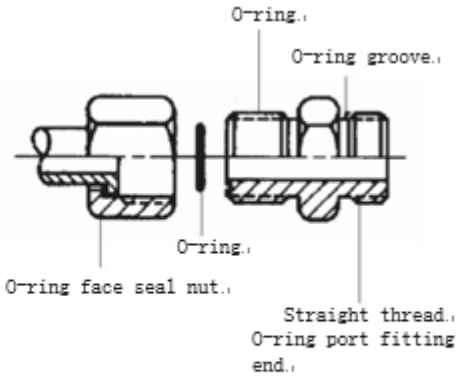


图 1-32

Hose clamp- belt type

Clamp width	New hose torque	Torque for re-tightening
7.9 mm (0.312 in)	0.9±0.2 N·m (8±2 lb·in)	0.7±0.2 N·m (6±2 lb·in)
13.5 mm (0.531 in)	4.5±0.5 N·m (40±5 lb·in)	3.0±0.5 N·m (25±5 lb·in)
16.9 mm (0.625 in)	7.5±0.5 N·m (65±5 lb·in)	4.5±0.5 N·m (40±5 lb·in)

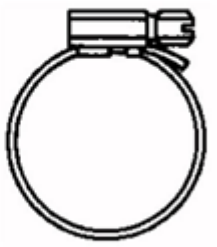


图 1-33

37° bell and straight threaded O - ring accessories

Pic 1-34

图 1-34

37℃ bell and straight threaded O - ring accessories（Sealing accessories for O - ring surface are excluded）

Nominal pipe external diameter		Thread diameter（in）	Standard torque	
Metric	Inch	Inch	(N·M)	Ponds/Feet
3/18	0.125	5/16	5.0±1.5	4±1
4/76	0.188	3/8	11.0±1.5	8±1
6/35	0.250	7/16	16±2	12±1
7/94	0.312	1/2	20±5	15±4
9/52	0.375	9/16	25±5	18±4
9/52	0.375	5/8	35±5	26±4
12.70	0.500	3/4	50±7	37±5
15.88	0.625	7/8	65±7	48±5
19.05	0.750	1-1 / 16	100±10	75±7
22.22	0.875	1-3 / 16	120±10	90±7
25.40	1.000	1-5 / 16	135±15	100±11
31.75	1.250	1-5 / 8	180±15	135±11
38.10	1.500	1-7 / 8	225±15	165±11
50.80	2.000	2-1 / 2	320±30	240±22

45° bell shape and 45° inverted bell fittings

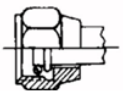
45° inverted bell

45° bell

1-35

45° bell shape and 45° inverted bell fittings				
Nominal pipe external diameter		Thread diameter (in)	Standard torque	
Metric	Inch	Inch	(N·M)	Ponds/Feet
3	0.125	5/16	5.0±1.5	4±1
4	0.188	3/8	8.0±1.5	6±1
6	0.250	7/16	11±2	8±1
7	0.312	1/2	17±3	13±2
9	0.375	5/8	30±3	22±4
11.11	0.438	11/16	30±3	22±2
12.70	0.500	3/4	38±4	28±3
15.88	0.625	7/8	50±5	37±4
19.05	0.750	1-1 / 16	90±8	65±6
22.22	0.875	1-1 / 4	100±10	75±7

Thread fittings for air conditioning and conical pipes



o-rings

45 ° flare

1-36

AC Accessories						
Thread diameter (in.)	Mounting end of O-rings		45° flaring end			
			steel tube		aluminum pipe	
	(N·M)	Ponds/Feet	(N·M)	Ponds/Feet	(N·M)	Ponds/Feet
5/8-18	18±4	13±3	30±3	22±2	23±3	17±2
3/4-16	37±4	27±3	52±5	38±4	33±4	24±3
7/8-14	40±4	30±3	60±7	44±5	38±4	28±3
1-1 / 16-14	45±5	33±4	75±8	55±6	50±5	37±4

Thread fittings for conical pipes				
Thread diameter (in.)	Threads with le2200e sealant		Threads without sealant	
	(N·M)	Ponds/Feet	(N·M)	Ponds/Feet
1/16-27	15	11	20	15
1/8-27	20	15	25	18
1/8-14	25	18	35	26
3/8-18	35	26	45	33
1/2-14	45	33	60	45
3/4-14	60	45	75	55
1-11 1/2	75	55	90	65
1-1 / 4-11 1/2	95	70	110	80
1-1 / 2-11 1/2	110	80	130	95
2-11 1/2	130	95	160	120

2 Electronic System

2-1 General

This model is equipped with an electrical system with the following components:

1． The battery supplies the power to the electrical system [Section 2-2]

2． The emergency switches may be pressed in emergency to turn off all DC and AC circuits [Section 2-3]

3．Motors, controllers, and associated equipment are providing the necessary drive to the vehicle based on their interactions with sensors,
switches, relays, actuators, as well as various parameter settings. [Section 2-4]

4． When the load is supplied at a current above the limit, the fuse will protect all DC loads from overcurrent by cutting off the load's power supply. [Section 2-5-1]

5． Other DC loads that activated by the operator's direct requirements will work independently of the controller. First, such DC loads not regulated by controllers and are not the purpose of controllers' signals. However, they may interact with controllers in some configuration. Such loads include light sets and horns.[Section 2-5-3 to 2-5-5]

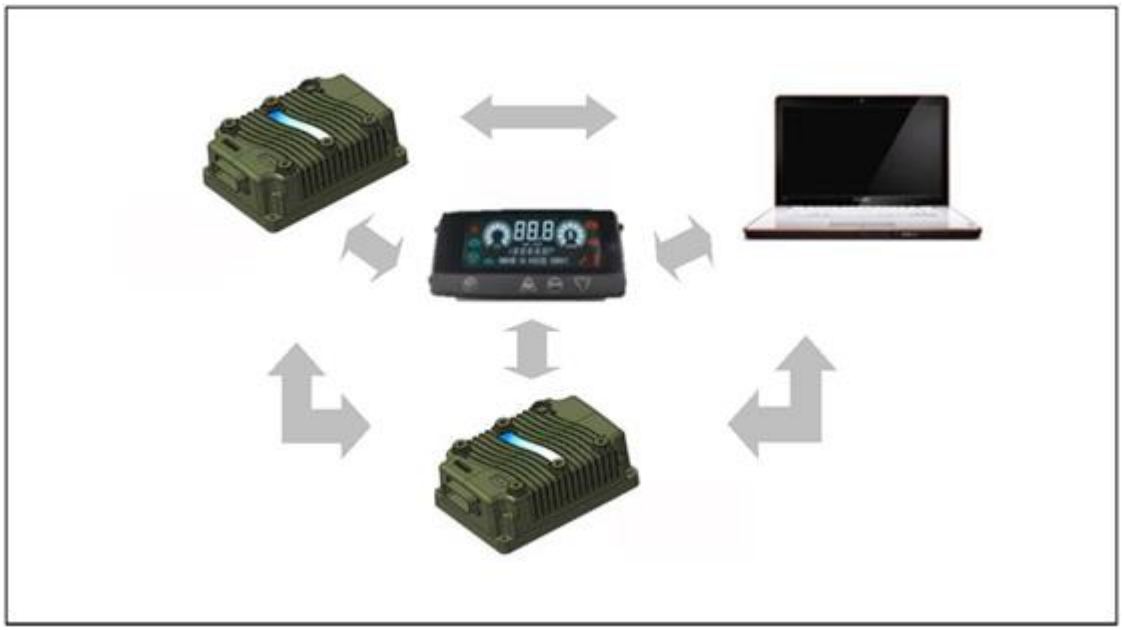
7． The instrument board monitors the vehicle, informs the user of its condition and provides basic functions for mode setting, diagnosis and calibration [Sections 2-6]

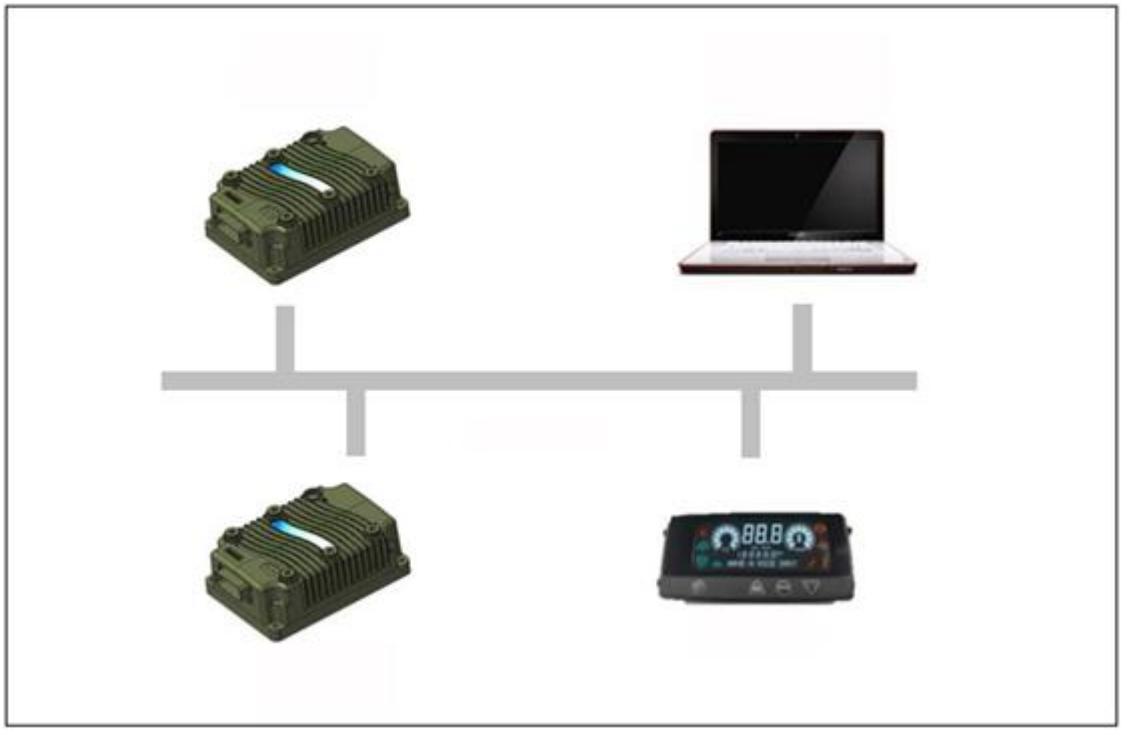
8． The handheld programmer provides the same functions as the instrument board, but are detailed [sections 2-7]

2-1-2 Communication Protocol

To enable all electrical equipment in the vehicle and provide diagnostic and parameter calibration functions to the user, data shall be shared between these controllers and instrument equipment. For this purpose,the CAN (Controller Area Network) is used as the standard protocol.

Note: information on how to install an application to check vehicle conditions and perform parameter calibration through CAN communications shall be referred to sections 2-7.

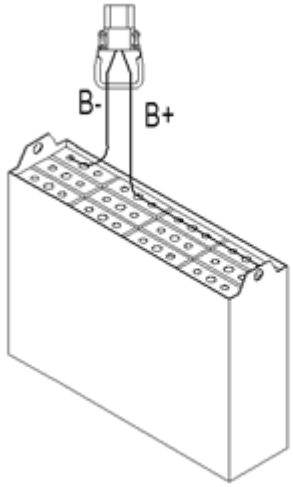




Such CAN communication effectively overcomes the shortcomings of the widely used point-to-point communication based UART
(universal asynchronous receiver/sender) system. The UART systems are limited by the one-to-one communication between individual devices in the number of communication devices, wiring availability and vehicle performance improvement. CAN and UART communication are compared in the figure above.

2-2 Battery (Lead Battery)

2-2-1 Appearance and Specifications



Item	Specification
Dimension of battery compartment	800x212x784 (LXWXH)
Total battery Voltage	24V
Battery connector	Socket connector REMA95044-01
Battery cable capacity	465Ah/375AH
Battery cable size	More then 2/0 GA（60 mm 2 ）

Specific gravity depends on temperature

Temperat								Charging
-15° C (5 ° F)	-5° C (23 ° F)	0° C (32 ° F)	5° C (41 ° F)	15° C (59 ° F)	25° C (77 ° F)	35° C (95 ° F)	45° C (113 ° F)	
1.108	1.101	1.098	1.094	1.087	1.08	1.073	1.066	0%
1.118	1.111	1.108	1.104	1.097	1.09	1.083	1.076	5%
1.128	1.121	1.118	1.114	1.107	1.1	1.093	1.086	10%
1.138	1.131	1.128	1.124	1.117	1.11	1.103	1.096	15%
1.148	1.141	1.138	1.134	1.127	1.12	1.113	1.106	20%
1.158	1.151	1.148	1.144	1.137	1.13	1.123	1.116	25%
1.168	1.161	1.158	1.154	1.147	1.14	1.133	1.126	30%
1.178	1.171	1.168	1.164	1.157	1.15	1.143	1.136	35%
1.188	1.181	1.178	1.174	1.167	1.16	1.153	1.146	40%
120%	1.191	1.188	1.184	1.177	1.17	1.163	1.156	45%
121%	1.201	1.198	1.194	1.187	1.18	1.173	1.166	50%
1.218	1.211	1.208	1.204	1.197	1.19	1.183	1.176	55%
1.228	1.221	1.218	1.214	1.207	1.2	1.193	1.186	60%
1.238	1.231	1.228	1.224	1.217	1.21	1.203	1.196	65%
1.248	1.241	1.238	1.234	1.227	1.22	1.213	1.206	70%
1.258	1.251	1.248	1.244	1.237	1.23	1.223	1.216	75%
1.268	1.261	1.258	1.254	1.247	1.24	1.233	1.226	80%
1.278	1.271	1.268	1.264	1.257	1.25	1.243	1.236	85%
1.288	1.281	1.278	1.274	1.267	1.26	1.253	1.246	90%
1.298	1.291	1.288	1.284	1.277	1.27	1.263	1.256	95%
1.308	1.301	1.298	1.294	1.287	1.28	1.273	1.266	100%

2-2-2 Function

Characteristics of lead batteries
This model uses a lead battery as a power source for its electrical system.
The lead battery is mainly composed of positive plate, negative plate, electrolyte, separator, battery tank, battery cover, electrode, liquid injection cover, etc. The electrode of the exhaust battery is composed of lead and lead oxide, of which the electrolyte is an aqueous solution of sulfuric acid. Main advantages: stable voltage, cheap price; Disadvantages: low energy density (i.e, energy stored per kilogram of battery), short service life and high frequency of daily maintenance. The service life of the old ordinary battery life is generally about 2 years, of which the height of electrolyte shall be checked and the distilled water shall be added. However, With the development of technology, lead-acid batteries have become more durable and easier to maintain.

The plastic covers that can be unscrewed at the top with a vent hole is the most apparent feature of the lead-acid batteries. These caps are designed for distilled water refilling, and electrolytes and gases checking. Theoretically, lead-acid batteries shall be checked for the density of electrolyte and liquid level height during each maintenance, and distilled water should be added if reduced

2-2-3 Test

Battery condition check
Weak batteries can cause problems in the controller and power circuit.
The battery shall be ensured with a good condition before troubleshooting other areas.

Preliminary steps
Verify the polarity on the battery connector and control panel for correctness.
The positive terminal cable shall be located at the line fuse while the negative terminal shall be located at
the negative terminal of the control panel.

When the vehicle is in operation
Battery load test >
1. Turn the range switch on the multimeter to read the battery voltage.
2. Connect the battery
3. Connect the multimeter leads with B+ (1) and B- (2) of the controller.
4. Please operate the hydraulic system (temporarily keeping the tilting lever at its maximum position) in the safe area while reading the voltage indicated on the multimeter.
5. If the indication is below the limit (19.0v), the battery shall be charged or repaired before the troubleshooting.

When the vehicle does not work and the battery is suspicious. Battery pressure drop test

1.The voltage of each battery shall be measured when the vehicle is powered on and the drive motor is running.
2. The normal voltage of each battery should be between 1.95V and 2.12V. If the voltage on each battery is below 1.95V, the battery shall be charged or repaired before troubleshooting resumption.
3. The readings between batteries should not exceed 0.05 volts. If so, the battery shall be properly charged or repaired

Hydrometer test >
1. Test each individual cell of the battery with a hydrometer
2. If any specific gravity indicator is below 1.140, the battery shall be charged.
3. If any reading is 1.265 to 1.285, then the battery is fully charged (please refer to section 2-2-1).
4. The readings between monomers should not exceed 1.020. If so, the battery shall be properly charged or repaired

Insulation check of battery case
Any resistance between any point of the wiring in forklift truck and car body should be at least 10000 Ω or higher.
A short circuit in the battery case may cause many faults. Because the battery may have chassis leakage,
A chassis short circuit in the forklift wiring may cause problems. To avoid any problem as caused by the short circuit, the followings shall be attended:
1. Disconnect the battery and discharge the controller.
2. Measure any component connection or wiring that associated with the forklift chassis or wiring connection randomly, and the minimum resistance shall be 10000 Ω.
Any test point with low resistance shall removed from the chassis against any short circuit.
3. The battery shall be always kept clean to minimize the leakage of current into the case.
4. Make sure that all accessories (e.g. horn and lights) are designed to be chassis free (dual wire system)

2-2-4 Maintenance

Battery maintenance and service is essential to maximize the service life of battery and efficient vehicle operation. Regular inspection and maintenance will extend the service life of the battery.

Special attention should be paid to the following rules:

1. The battery shall be always kept clean Being cleaning can prevent corrosion, current leakage and case short circuit. Please tighten all ventilation plugs, clean batteries with water and brush, and then dry with air hose.
2. Distilled water shall be fully refilled to cover the plate before charging, which will ensure a chemical reaction on the entire surface of the plate. After charging, the water shall be added to 12.7mm (0.50in) above the top of the plate. Distilled or mineralfree water is required.
3. Charge properly. The battery should be discharged to 80% of its capacity and then fully charged. Batteries should be charged evenly once a month to ensure that all batteries are fully charged. Correctly battery charging should be identified to prevent low power in the vehicle installation.
4. Low power operation shall be avoided. Low battery power may damage batteries and cause higher-than-normal currents in electrical systems. High current consumption due to low battery power may damage the contactor tip and shorten the service life of the motor brush.
5. The highest temperature of the battery is essential. The electrolyte temperature shall not exceed
55°C (131°F) during operation or charging. Overcharging of the battery will lead to an overheating of the battery, causing the battery bulge and other adverse phenomena. The battery has the longest service life when the electrolyte temperature is maintained at 25 ° C (77°F). Most charging devices are fully automatic, but should be checked regularly to ensure a normal operation.
6. Maintain accurate battery records. Battery tester or voltmeter should be used to read and record the battery index regularly. The specific gravity and voltage of each cell should be checked at least once a month. This inspection should be carried out after a balanced charge. After adding water, the reading should not be taken directly. Maintenance of all batteries should be recorded to identify batteries that are in deficit or wear.

2-2-5 Disassembly and Installation

Warning

Careless use of the battery may result in an electric shock
The safety precautions given in sections 1-4 shall be followed

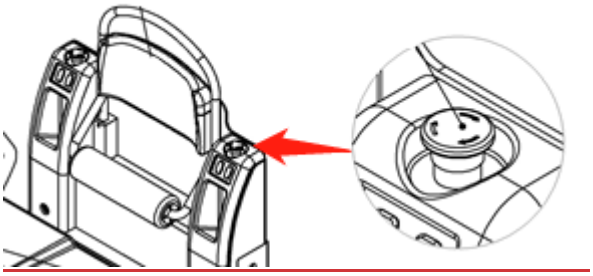
Warning

A short circuit may occur during the removal, transportation, and installation of the battery
Make sure that the battery is covered with insulation material (poly) and that no metal material touches the top of the battery before disassembling, transporting, and installing the battery

1. Vehicles Parking
2. Close key switch
3. Open the key of battery cover
4. Lift the battery cover
5. close battery connector
6. Keep the key switch open to discharge the power module. Twice for 30 seconds.
7. Remove the battery using battery rack truck
8. To install the battery, perform the above steps in reverse order.

2-3 Emergency Switch

2-3-1 Appearance and Specifications



2-3-2 Function

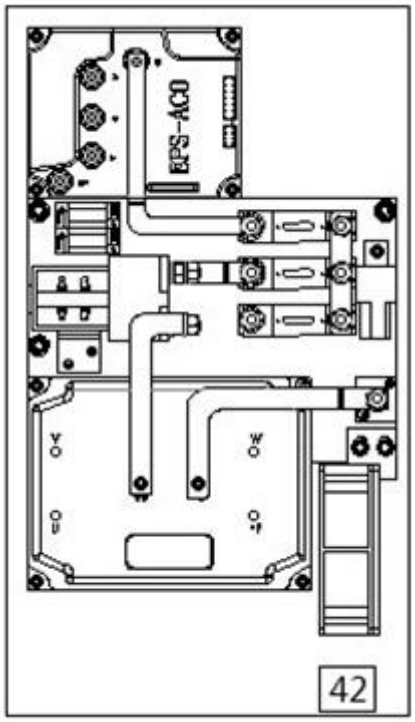
The emergency switch is used to shut off the current in the electrical system in case of emergency,
and thereby stopping the operation of the vehicle. When pressed the key, all DC and AC circuits are open except the speaker circuit.

When the emergency switch is opened, the positive terminal of the battery is disconnected from the key switch, thus cutting off all the load power supplied through the key switch. As a result, all DC loads except the horn will be cut off

The tractor has a combined emergency stop switch and two series emergency stop switches, which turn off any one and can stop all hoisting, dropping and driving functions.

2-4 Controller and Related Equipment

2-4-1 Appearance and Specification



Technical specifications

No.	Description	Specification	Serial Number	Description	Specification
1	PWM Working frequency	10KHZ	8	Accelerator control signal	2 lines of 0-5KΩ/5KΩ-0, 3 lines of potentiometer, 0-5V, current source, electron accelerator
2	Insulation strength with radiator	>500Vac	9	Speed control type	Single end/swing /VCL input
3	Logical port input voltage	If the falling edge > 1.5v, then the voltage is high; if the	10	Operating ambient temperature	-40℃ to 50℃

		rising edge >4.4V, then the voltage is high			
4	KSI input current	<1.0A	11	Storage ambient temperature	-40℃ to 50℃
5	Input current of logical end	<10mA	12	Current limit of overtemperature	The current is limited at 85℃ and will cut off at 95℃
6	Maximum output frequency	300Hz	13	Current limit of low temperature	The current will cut off at 40℃
7	Total drive current	<10A	14	Sealing	IP65perIEC529
15	Relevant standards	EMC Interference: EN50081-2/08.93; Anti-interference: EN50082-2:1995 Safety and Anti-flying: EN1175 UL Component Authentication Satisfy the UL583 insulation test			

2-4-2 Circuits and Functions

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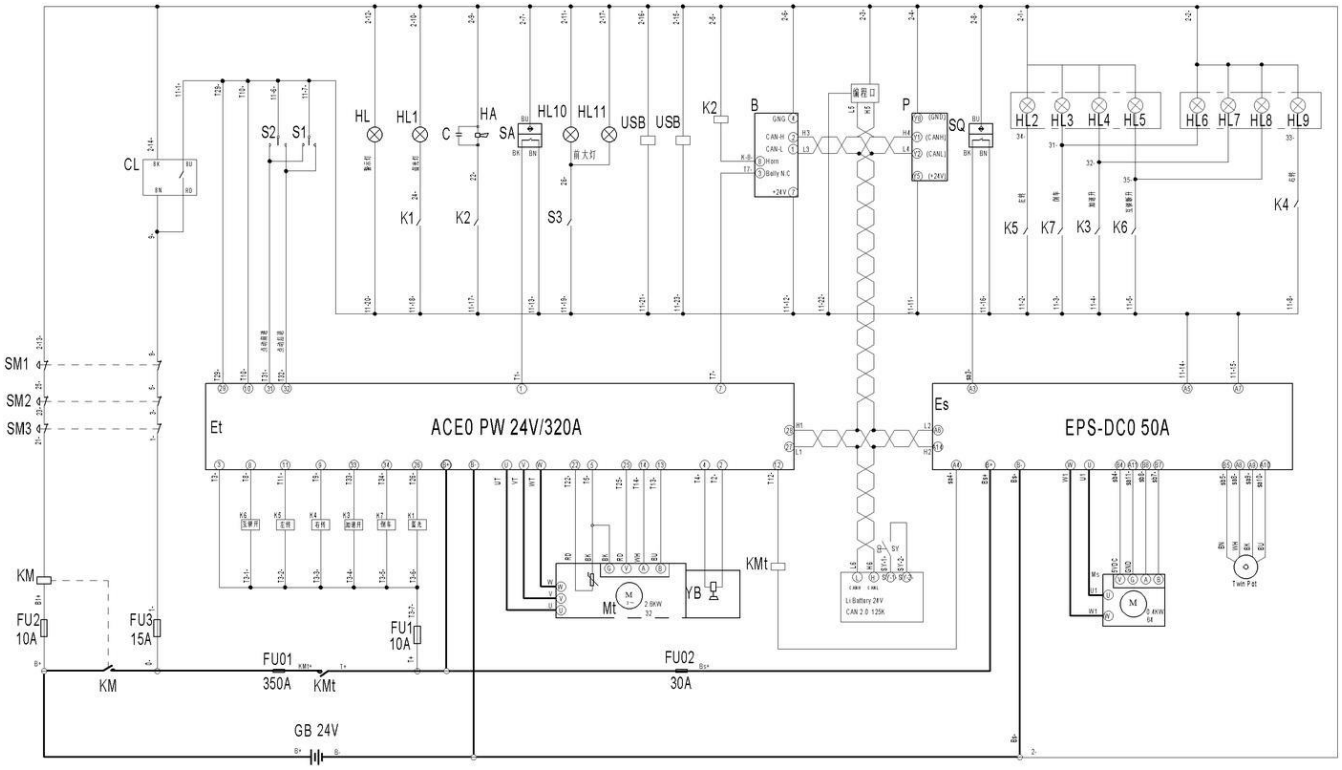

Code Description of Electrical Components:

No.	Code	Name	No.	Code	Name	No.	Code	Name	No.	Code	Name	No.	Code	Name
1	GB	Battery	6	ES	Steering controller	13	C	Capacitance	18	SQ	Switch	24	HL2、HL3、HL4、HL5、HL6、HL7、HL8、HL9	Tri-color Taillight
2	SM1、SM2、SM3	Stop switch	7	Mt	Traction motor	14	S1、S2、S3	Switch	29	USB	USB			
3	FU01、FU02 FU1、FU2、FU3	Fuse	8	YB	Elec. brake	15	HA	Horn	20	Ms	Steering motor			
			9	HL	Warning lamp	16	POT	Potentiometer	21	SA	Switch			
			10	HL1	Blue lamp	17	K1、K2、K3、K4、K5、K6、K7	Relay	22	HL10、HL11	Headlamp			
4	KM、KMt	Main contactor	11	P	Instrument				23	CL	Password lock			
5	Et	Traction controller	12	B	Tiller									

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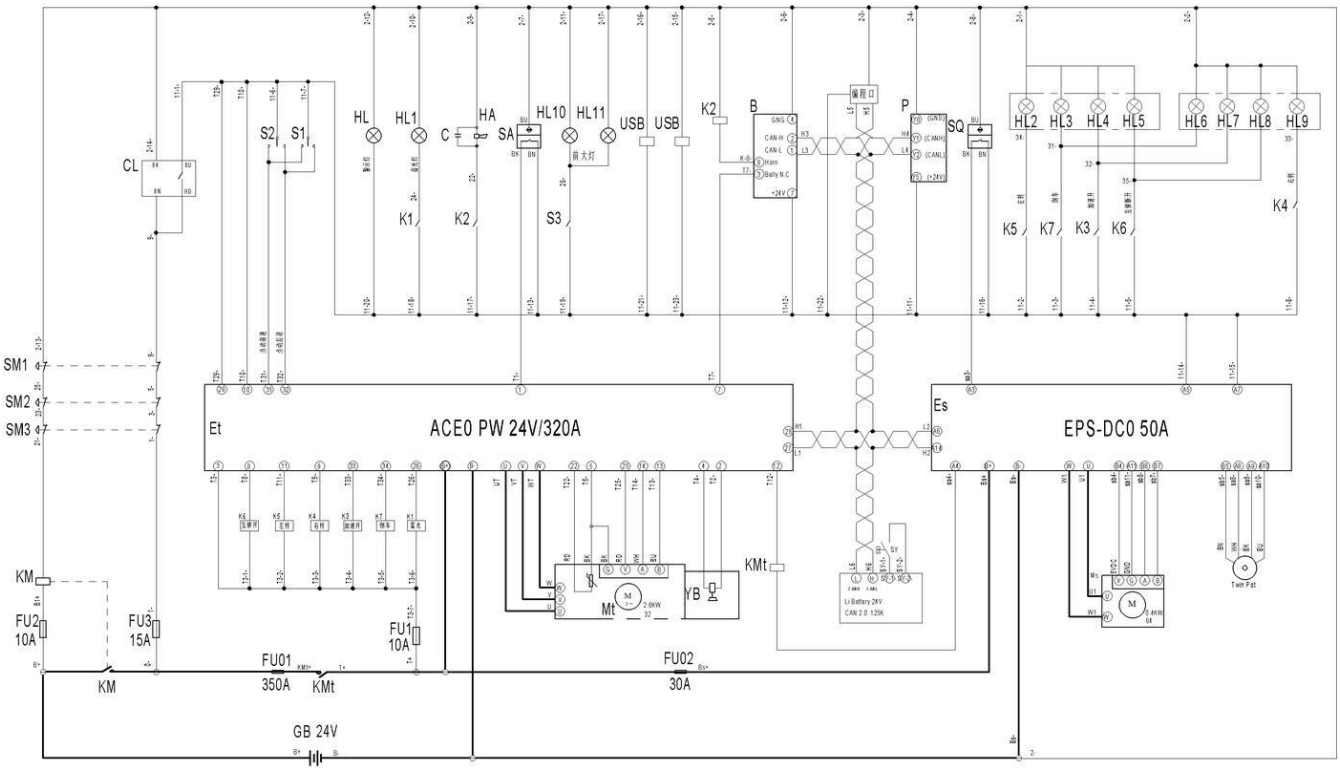

Code Description of Electrical Components:

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2	SM1、SM2、SM3	Stop switch	7	Mt	Traction motor	14	S1、S2、S3	Switch	29	USB	USB			
3	FU01、FU02 FU1、FU2、FU3	Fuse	8	YB	Elec. brake	15	HA	Horn	20	Ms	Steering motor			
			9	HL	Warning lamp	16	POT	Potentiometer	21	SA	Switch			
			10	HL1	Blue lamp	17	K1、K2、K3、K4、K5、K6、K7	Relay	22	HL10、HL11	Headlamp			
4	KM、KMt	Main contactor	11	P	Instrument				23	CL	Password lock			
5	Et	Traction controller	12	B	Tiller									

Contactor

This model is equipped with a drive motor,the contatcor control the power to to controller Once the controller is energized, a magnetic coil built into the line contactor will receive power from the driven motor controller. The two contact points, which act like switches, will then touch each other and connect the lines between the battery and the two controllers. Therefore, the controller becomes a three-phase and three-wire AC power supply and is transmitted to the motor through each UVW connections. The line contactor is equipped with 350A fuse to prevent

Overcurrent.
The controllers are connected through the following sensors, switches, relays and actuators.
Key switch
Emergency Switch
Forward/revise units
Accelerator
Brake pedal switch
~~Parking brake switch~~
Horn relay
These devices provide DC power and interact with controllers that activate or receive data based on a number of parameter settings to control the motor.
Each controller is programmed with different types of firmware to achieve different functions.

The safety & high efficiency performance and complete operation function of electric forklift can be realized by properly setting the motor technical parameters and control technical parameters and function values of the controllers.
1.The crawling speed of electric forklift is adjustable The crawl speed setting function of the controller enables the a long-time operation of electric forklift at a low speed.
2. The acceleration rate is adjustable. The acceleration rate refers to the "soft and hard" feeling of accelerator pedal when operating electric forklift. By setting the acceleration rate, the forklift can meet the requirements of acceleration operation in different working conditions.
3.Plug braking and regenerative braking. The reverse braking signal will be generated when the direction bar is in opposite position, which controls the traction motor to give a braking torque through the motor driver for the purpose of vehicle deceleration. The power level is controlled by the accelerator pedal. Regenerative braking is generated by the controller under the condition that the speed of the vehicle is relatively higher than the speed of the traction

motor, of which the braking energy of the vehicle will be converted into electric energy and fed back to the battery. Especially when the electric forklift is on the downhill slope, the regenerative braking to properly reduce the speed of the vehicle on the downhill slope can be achieved through a proper lifting and releasing accelerator foot plate, which thus extends the driving distance of the battery for any single charge.
4.Slope anti-backward slip function. The electric forklift with AC traction motor has the excellent function of staying non-slip on the slope.
5. The maximum driving speed is adjustable. Reasonable setting on maximum driving speed of electric forklift can prevent any overloading of traction motor due to high speed.
6.Static reply switch off. In the event that the seat switch or key switch is disconnected, the control will be turned off and the directional control lever shall be pushed back into the neutral position to restart. If the driver leaves the vehicle and returns at any time, the direction control lever shall be pulled back into the neutral position before restarting. This function may help to avoid any unexpected unsafe operation A time delay of several seconds is provided at the input end of the seat switch to allow instantaneous disconnection of the seat switch against turbulence.
7.Safety protection function If the power component of the controller is damaged during operation, the controller will disconnect the main contactor in the shortest time, and the controller will automatically limit the armature current of the motor upon the temperature over rise of the controller . When the battery voltage is too low, the controller will also stop working to ensure safety.
8.Traction motor controller is functioned with self-diagnosis When the lead controller come across a fault during operation, the fault code will be displayed on the display instrument and the controller will stop working automatically for the safety of the operating system.
Meter will show error code when controller does self-diagnose and find there is error after start the machine.

9.The amount of battery power and accumulated working hours will be indicated in display instrument.

2-4-3 Diagnosis and Troubleshooting

Controller

The diode voltage of AC MOSFET circuit inside the controller shall be tested and checked for any burn out damage.

According to the table below, each test item shall be tested repeatedly for more than 3 times.

Item	Multimeter terminals		Range of normal value	
	Red indicating pen	Black indicating pen	Polarity measurement	Resistance measurement
1	B+	U/V/W/B-		1MΩand above
2	B-	U/V/W		1MΩand above
3	U/V/W	B+	0.3-0.6V	
4	B-	U/V/W	0.3-0.6V	

Pull multimeter to Ω mode (resistance)　Pull the multimeter to the diode mode (polarity measurement)

Remove the cables and wires that connected to the controller, and release all the internal power of capacitor (discharge the B + and B - terminals with 30 Ω resistance).

Test the diode voltage (0.3-0.6v) with a multimeter and check if it is normal.

Test1：Read the diode voltage, through which the red wire is B-, the black wires are U, V and W.

Test 2：Read the voltage of the diode to U, V and W, and the black lead to B + with red wires.

Notes:　The multimeter pointers shall not be inverted in use

Line contactor and fuse

Line

Figure

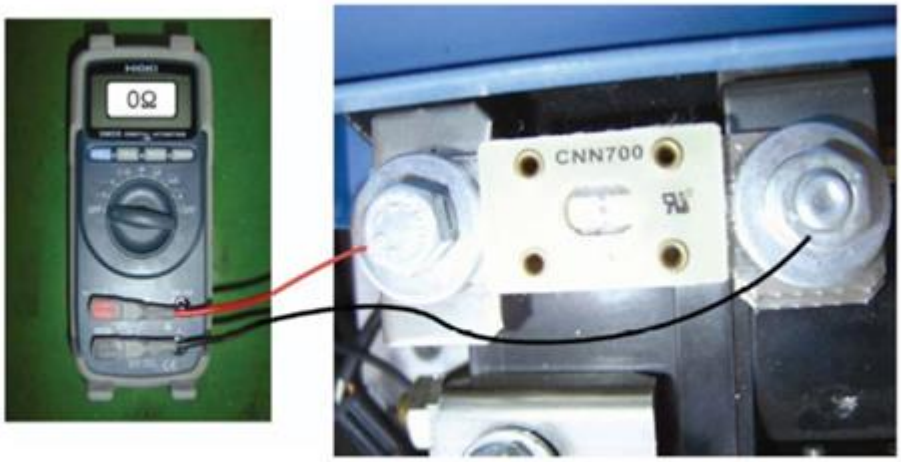


Figure 2-23

For line contactors and line fuses, an ohmmeter shall be connected at the point shown in the figure and shall be tested for the specified value.

2-4-4 Disassembly and Installation

Access to control panel
1. Disconnect the battery connector.
2. Keep the key switch open to discharge the power module. Twice for 30 seconds.
3. Close the key switch
4. Remove the top cover（1）to enter the controller.

Note：Please remember that the controller contains ESD (electrostatic discharge) sensitive components.
Appropriate precautions should be taken when connecting, disconnecting and handling.

Disassemble/install drive motor controllers

Note：Please remember that the controller contains ESD (electrostatic discharge) sensitive components.
Appropriate precautions should be taken when connecting, disconnecting and handling.

1． Disconnect the control harness from the controller connectors

2． Disconnect U, V and W cables. Tightening torque：9.5±1 N·m（7.0±0.7 lb·ft）

3． Remove B+ and B- wires from the drive motor controller

4． Loosen and remove the drive motor controller

5． Perform the above steps in reverse order to install the drive motor controller

Disassembly/installation of line contactor

1． Disconnect the cable from both terminals.

2． Remove the line B+ from the line contactor.

3． Loosen the bracket screw.

4． Remove the line contactor

5． Perform the above steps in reverse order to install the line contactor

Disassembly/installation of line fuse

1 . Remove B+x line from line fuse.

2 . Remove the line fuse.

3 . Perform the above steps in reverse order to install the line fuse

2-5 Display

2-5-1 Appearance

The left side is the main interface of the instrument. The main boardd contains battery power display, cumulative working hours and driving speed.
The right side is the fault interface, which contains fault code.

When the battery's remaining power is 20%, the power starts to flash.
When the battery remains 10 and the speed is reduced.
The light of meter will be red instead of green, also error code:02A66

When the battery surplus is higher than 70, if the battery is charged, the meter shows the power before charging.
Only when the battery surplus is less than 70, the battery charge, the instrument will normally display the battery power.

Electricity meter removal/installation
1 Disconnect the battery connector.
2.Keep the key switch on and discharge the power module. Twice for 30 seconds.
Turn off the key switch.
3.Remove the key
4 Remove casing
5.Disconnect the connection of the meter port.
6.Screw off the two fixed nuts of the meter by hand.

7.Remove the fixed metal ring of the meter and remove the meter
Do the above steps in reverse order to install the power meter.

Code lock

a. Product Description

The password ignition switch (hereinafter referred to as the "code lock ") is an electronic system like an electronic burglar alarm.Before authorizing the password, the machine will not be allowed to start, the main function is to prevent unauthorized people from operating the machine. In addition to the convenience of use, it is also of great help to the theft and safety of the machine.

b. main specification parameters

Operating voltage range :12 V-60V
Working environment :-40℃ to 90℃
Class of protection: IP65

c. Main Control Code and Functions

At present, the password lock supports up to 5 ID cards and 1 group of manual password operation. Each set of passwords consists mainly of four digits,the number range is between 0-9.
Administrator password please check the separate instructions. The default password for this product is "1234, password change steps please
Refer to separate instructions.

d. operation steps

1.ID card operation
Keep the ID card close to the lock button panel and if the ID card is valid, the lock will emit a brief beep sound, then the blue indicator lights, indicating that the code lock normal operation, that is, the normal output of the switch signal. (Credit Card Error:the red indicator will flicker).
2. Password Operation
Enter the password, then press the √ button and loosen it. If the password is correct, the vehicle can start operation.
Press the panel "×" button to loosen and the vehicle closes.
Enter the password again if you want to re-operate the vehicle.

e. Code Lock Indicator

Red light -- fault indication
Blue Light - Status Indicator
Yellow Light - Waiting for Instruction
Green light - Power indication

Error code List

MDI CODE	ALARM	Description	Solution
98	NONE	Meter hour meter inconsistent with controller	In the system in use, if the instrument or traction controller is replaced, this fault will be reported. After boot, wait 5 minutes, the instrument and traction controller hour meter consistent, this fault automatically eliminated.
8	WATCHDOG	Watchdog malfunction	The controller can not communicate normally and the other controller is always waiting state until all CAN communication networks are normal. Check can't communicate Why are those modules not wired properly, check the software version or parameters whether the setting is correct.
13	EEPROM KO	Memory damage	the vehicle does not walk, there is a problem in the storage area of the parameters, and the failure causes the vehicle to stop working. If the fault still exists after repeatedly closing the electric lock, replace the logic card. If the failure disappears, the previously stored parameter is replaced by the wrong parameter and needs to be reset.
15	LOGIC FAILURE #5		
17	LOGIC FAILURE #3	Logic card failure 3	logic card current protection function failure. The controller should be replaced
18	LOGIC FAILURE #2	Logic card failure 2	The phase voltage feedback on the logic card hardware circuit part failure, replace the controller.

19	LOGIC FAILURE #1	Logic card failure 1	failure when low voltage or overvoltage protection function occurs. in 24 V systems,the controller detects a voltage of more than 45 V or less than 9 V; In 48 systems, the controller detects a voltage of more than 65 V or less than 11 V. Possible reasons: 1. whether there is a short circuit phenomenon in the circuit system, such as DC-DC, brake coil, or whether the controller input power contact is good. 2. battery voltage is too low or too high. 3. detect whether the power cable above the connecting post such as B ,B, main contactor is fastened. 4. whether the controller voltage calibration parameters are consistent with the actual voltage. 5. the hardware circuit fault of overvoltage protection on the logic card, replace the controller.
30	VMN LOW	vmn low	Cause: MOS lower end voltage is higher than normal battery voltage when starting up 10%, or phase voltage higher than 1/2 battery voltage. Possible reasons: 1. the motor wiring is wrong, or there is a problem with the motor circuit; check whether the three-phase connection of the motor is correct; whether the motor has leakage to the ground, whether there is a motor coil broken. 2. replacement controller

31	VMN HIGH	vmn high	Cause: MOS lower end voltage is higher than normal battery voltage when starting up 10%, or phase voltage higher than 1/2 battery voltage. Possible reasons: 1. the motor wiring is wrong, or there is a problem with the motor circuit; check whether the three-phase connection of the motor is correct; whether the motor has leakage to the ground, whether there is a motor coil broken. 2. replacement controller
37	CONTACTOR CLOSED	Contactor adhesion	Before closing the main contact coil, the controller must first detect whether the main contactor contact is adhesive. try to discharge the capacitor, if the capacitor voltage reduces the battery voltage by 20%, the failure may occur. 1. suggest to check whether the contactor contact is adhesive or replace the contactor.
38	CONTACTOR OPEN	Contactors not sucked	The logic card has driven the main contactor coil but the contactor is not closed for possible reasons: 1. contactor mechanical malfunction, jam, etc. Contact 2. contactor contacts not well 3. replace the controller if the contactor works properly.
53	STBY I HIGH	High standby current	The signal of the current sensor output detected by the microcontroller system has not run the range allowed by the current. This failure does not involve peripheral components and the controller needs to be replaced.

60	CAPACITOR CHARGE	Capacitor charging error	when the electric lock is turned on, the controller will charge the capacitor through the power resistance, and detect whether the capacitor is sufficient for the specified time. if there is not enough electricity, the capacitor voltage is still less than 20% battery voltage, the controller will alarm and the main contactor will not close. Possible reasons: 1. peripheral equipment, such as DC-DC, motor or other equipment, interferes with the charging process of the controller and the interference caused by these devices should be eliminated. 2. the charging resistance is disconnected, the charging circuit is broken, and the power module is in trouble, the controller needs to be replaced
61	HIGH TEMPERATURE	Controller over-temperature protection	if the temperature of the controller itself drops below 85°, if this fault still exists, it may be a temperature sensor fault or a logic board fault of the controller itself. at this time, the controller needs to be replaced.
65	MOTOR TEMPERAT.	Motor temperature high	1. this fault arises if the motor temperature digital switch is turned on or the analog signal exceeds the cut-off value. 2. the motor temperature reaches 120℃, the controller alarm, at this time the vehicle can still walk, but the maximum current is reduced, the vehicle performance is reduced. when the motor temperature reaches 125℃, the motor stops working. should try to cool the motor at this time. 3. the fault still

			exists when the motor is cooled, check the line. If all are good, replace the controller.
66	BATTERY LOW	Low battery power	If the battery detection function "BATTERY CHECK" parameter is not set to 0, when the battery power is less than 15%, when there is no grid number on the meter, the fault alarm, the lifting function is locked. It should be charged in time. If the battery is found to have electricity, the controller's "ADJUST BATTERY" value of this parameter is consistent with the battery voltage.
74	DRIVER SHORTED	Drive short circuit	when the electric lock is closed, the controller will detect whether the driver of the main contactor is short-circuited or alarm if short-circuited; detect whether the positive pole of the main contactor coil is short to the A1 or the negative power supply, and replace the controller if the periphery is all right.
75	CONTACTOR DRIVER	Drive short circuit	when the electric lock is closed, the controller will detect whether the driver of the main contactor is short-circuited or alarm if short-circuited; detect whether the positive pole of the main contactor coil is short to the A1 or the negative power supply, and replace the controller if the periphery is all right.

78	VACC NOT OK	Accelerator malfunction	Detection Time: Standby Status This alarm shows that the accelerator voltage is more than 1 V larger than the minimum set in the accelerator signal range (PROGRAM VACC). Possible reasons: 1. the voltage upper and lower limits of the accelerator are not collected, enter the PROGRAM VACC menu to collect again. 2. accelerator error, it is possible that the accelerator pedal does not return to position, or the accelerator internal error. 3. controller failure.
79	INCORRECT START	Start sequence failure	Incorrect start order, possible reason: 1. the direction switch is closed before boot. 2. operation sequence error. 3. wire connection is wrong. 4. if the failure can not be eliminated, the controller needs to be replaced.
80	FORW + BACK	Simultaneous presence of forward and backward signals (directional switch adhesion)	The controller will always detect and alarm when there is a request running signal in two directions at the same time. Possible reasons: 1. wire broken 2. Direction Switch Failure 3. improper operation 4. if the failure can not be eliminated, the controller needs to be replaced
86	PEDAL WIRE KO	Accelerator Positive and Negative Connection	See if the positive and negative electrodes of the accelerator are attached to the controller;
99	PROG. TOOTHS	Motor type error	Check the actual use of the motor, is consistent with the parameters.
90	BMS LOW CAP.	Li-battery low capacity	

91	BMS VOLT.DIFF	Li-battery voltage error	
92	BMS MONOMER OV	Li-battery voltage error	
93	BMS MONOMER UV		
21	BMS HIGH TEMP.	Li battery high temperature	
46	LIFT+TRAC	Lifting and walking closing at the same time	only in the case of lithium batteries.
59	NO CAN MSG. BMS	Lithium batteries have no can information	
64	TILLER ERROR	Interlocking ,H&S input not match	Replace the controller;
22	RESET A15 SENSOR	Reset 1800 mm height detection switch A15	Press the drop switch, close the A15 switch again, or pass the A15 switch from top to bottom with a magnet
0	TILLER OPEN	Handle disconnected	When the handle input switch is switched off, after some time, about 30 s, the main contactor is disconnected and the warning occurs. Next time you run the warning, it disappears.
92	TILLER ERROR	Interlocking ,H&S input not match	Replace the controller;
22	RESET A14 SENSOR	Reset 300 mm height detection switch A14	Press the drop switch, close the A14 switch again, or pass the A14 switch from top to bottom with a magnet
85	EPS RELE OPEN	EPS internal contactor disconnected	Check traction and EPS internal failure, troubleshooting restart, this fault is eliminated.
68	CAN BUS KO EPS	eps without can signal	communication failure between CAN steering and traction. Detection CAN wiring and software of settings and version information.

93	WRONG SET BAT.	Battery failure	When starting, the controller detects the battery voltage and checks whether it is within the nominal voltage range. 1. check that the values of the BATTERY VOLTAGE parameters in the TESTER menu are consistent with the values displayed by the voltmeter. If not, use the ADJUST BATTERY function to change the battery voltage to the measured value. 2. replace battery.
23	TR. SPEED OPEN		Switch 300 mm and 1800 mm, after reset, this fault is eliminated。
90	LIFT + LOWER	Rising and falling signals exist simultaneously	The controller will always detect and alarm when there is a request running signal in two directions at the same time. Possible reasons: 1. wire broken 2. Direction Switch Failure 3. improper operation 4. if the failure can not be eliminated, the controller needs to be replaced
1	WRONG CONFIG	Configuration error	Check the internal parameters of the controller, whether the software matches the model.
11	STALL ROTOR	Motor blocking	1. motor stops. 2. motor encoder failure. 3. wire harness damage or wiring error. 4. encoder power supply problems.
89	PEV NOT OK	pev malfunction	See if the CNB#2 is connected to the B behind the contactor
67	CAN BUS KO	Communication malfunction	
99	CHECK UP NEEDED	servicing time	Maintenance time is up, need overhaul
73	THERMIC SENS. KO	Temperature sensor failure	the output signal of the controller temperature sensor is out of range.

			The fault is independent of external components and the controller is replaced.
71	HANDBRAKE	Handbrake closure	The handbrake switch is closed
0	WAITING FOR NODE	Waiting for node signal	The controller can not communicate normally and the other controller is always waiting state until all CAN communication networks are normal. Check can't communicate Why are those modules not wired properly, check the software version or parameters whether the setting is correct.
70	ENCODER ERROR	Encoder fault	the controller detects a large difference between the two consecutive speed readings of the encoder: since the internal encoder of the system can not change a large speed in a very short time, it is possible that the encoder fails (the line of one or two encoders is worn or broken), checks the encoder mechanical and circuit function parts; and may alarm caused by electromagnetic interference on the sensor bearings. If none of the above, replace the controller. Please note that man-made operation may also cause the controller to show this failure, at this time the need to power off to restart the vehicle. For example: 1. vehicles suddenly hit obstacles, resulting in vehicles unable to walk; 2. the vehicle was driving at high speed, it suddenly slammed on the brakes.
16	AUX OUTPUT KO	Auxiliary Drive Output Fault	

Instrument internal parameters adjustment, the company has completed commissioning before leaving the factory, if need to change, contact the company after-sales department to modify.

2.6 ZAPI Use of handheld programmers

Battery
The battery voltage can be used in programmer for pallet. The acid-lead battery voltage is 12V-80V

⚠	For batteries with a nominal voltage of more than 80V, the intelligent controller can be powered by an internal battery. Do not connect the source voltage that exceeds the maximum rating, or the controller will be damaged!

Programmer connects
Wire connects with Zapi , the pic 1 is nuoli-made wire

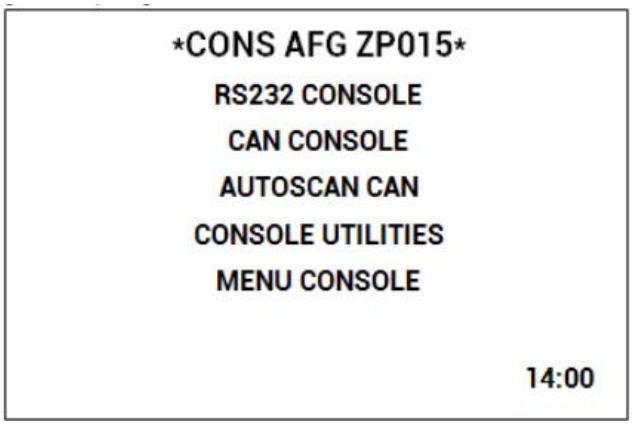
2） Emergency lateral screws to avoid accidental disconnection

3） Zapi connects with Can wire before or when pallet works

4）Red wire connects with positive pole of battery, black wire connects with negative pole of battery

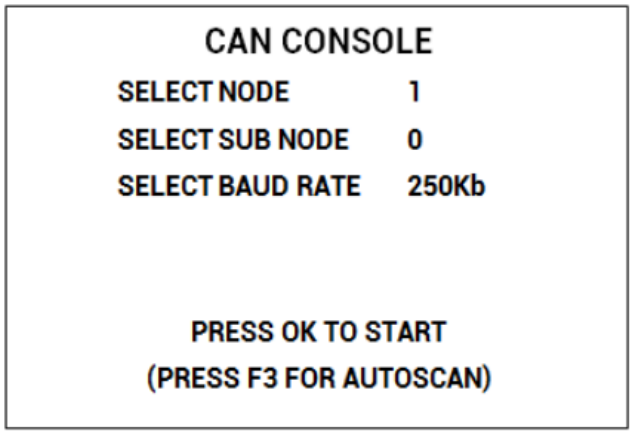
5） Once CN8 get voltage, screen of programmer will show

Programmer can access to controller by wire
Screen
Scree will show as following, LED green will light



Connecting way ： CAN CONSOLE

Choose CAN CONSOLE, Enter ”OK”

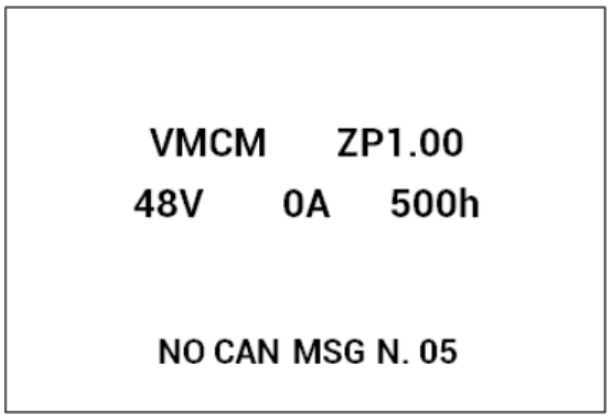


New menu request CAN node and point node connection: current value appears on the right.
The third line requests connection speed
Use the up / down key to move between rows and change the value of each item to the left / right.
Once the correct value is set, press ok to try to communicate with the node / Point

SELECT NODE 2 Drive module ， SELECT NODE 3 Pump module

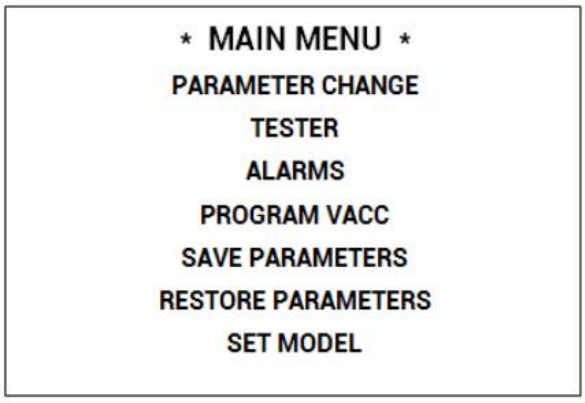
Press“ESC” cancel connecting

If the connection fails, "no communication" warning appears: press the ESC key to find out why the connection is blocked
Connected
If connecting well, screen will show

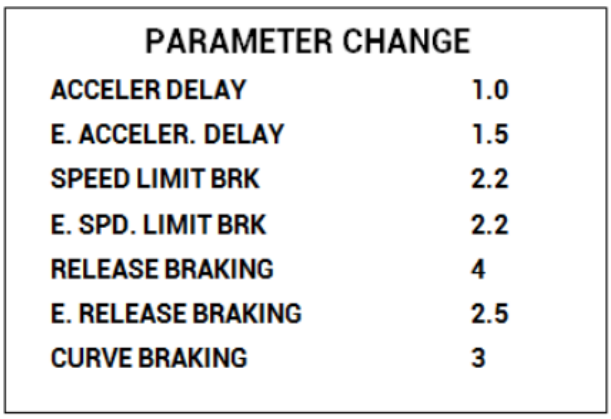


This menu presents basic information about the controller, similar to the super controller.
The first line describes the controller firmware
The second line presents the controller voltage, the current and the hourly meter
The last line presents the current alarm code

Press “OK”,Enter into main menu



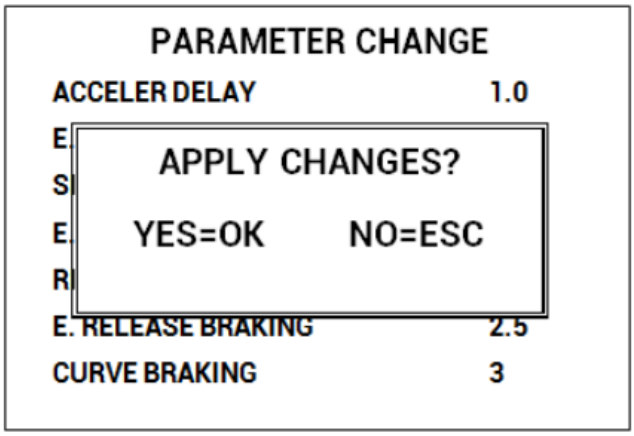
The main menu includes a complete list of menus available. Contrary to the supercontroller, only the controller does not have a hidden menu. The hidden menu needs to be accessed by pressing multiple buttons immediately: now all menus are visible.
Browse the list using the up and down keys: press “OK” to enter when you find the desired menu.
Change parameters
Enter the parameter change menu from the main menu.



Use up and down keys to scroll through the list: Once you have selected the parameter you want to change, use left or right-click to reduce or increase the parameter value.

Press left/right button to change the value repeatedly.
(" Auto-Repeat "function): If you have to change many parameter values, this function will accelerate the program.

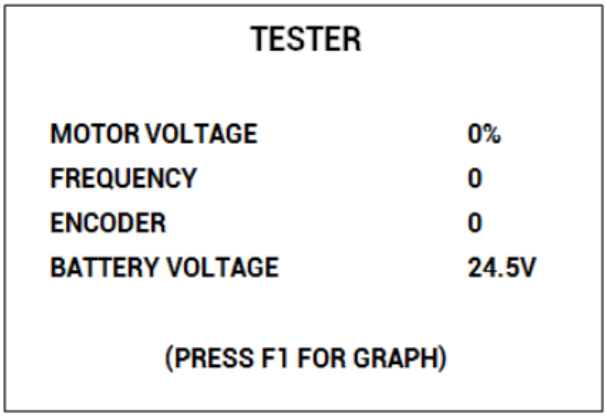
You can press the ESC key at any time to exit the menu. If certain parameters have been changed, the controller prompts for confirmation/delete of the change.



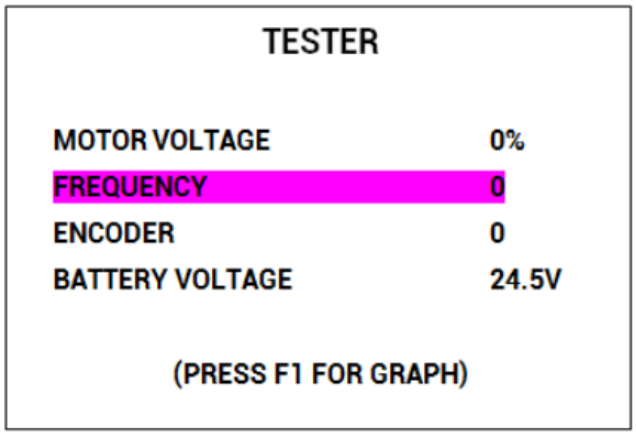
The above instructions are valid for each menu that contains parameters and options such as setting options, adjustments, hardware settings

Tester

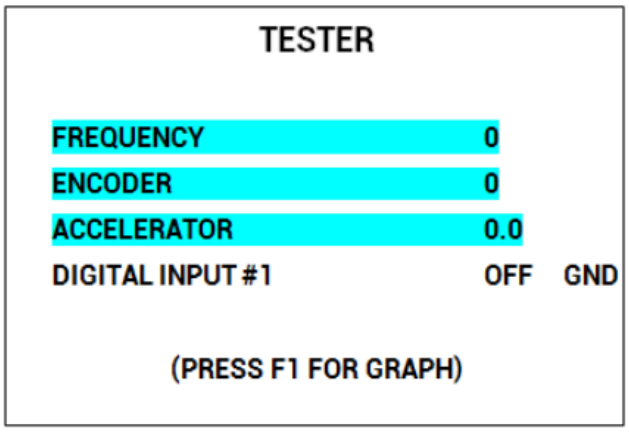
Compared with standard handheld, the monitoring menu has changed significantly. Four variables are displayed immediately: scrolling the menu with the up / down keys as usual



The variable may be “stuck” and then the variable will always appear in the scroll. Once the desired variable is selected, right-click: it will be shown in a different color.



Once you start scrolling up or down again, the "stuck" variable appears on the top first line: from now on, it will no longer move, but will be the current value as usual. "stuck: the variable will be highlighted in light blue.
It is possible to repeat the blocking program up to three times, so that when the fourth variable scrolls, three variables are fixed on the screen. See the following example.



Thus, it is possible to record four variables, and in a single view, the four variables in the complete list are far apart.

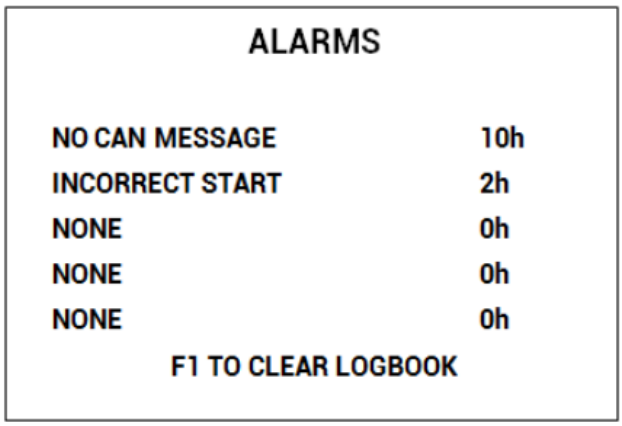
Press the left button to "unlock" the last locked variable. Pressing the left button up to three times will unlock all variables.
Press ESC to return to the main menu.

Note that pressing F1 activates the graphical representation of the selected variable in excess of time.

The function of the graphics tester is not yet fully operational: it will be activated in the future firmware.

Alarm

The alarm menu is different from the old handheld programmer. The display immediately presents all alarms of the controller.



The maximum number of alarm codes stored in the controller is 5

Use different colors to distinguish between recurrent alarm code and rare events. In order of increasing frequency alarm name:

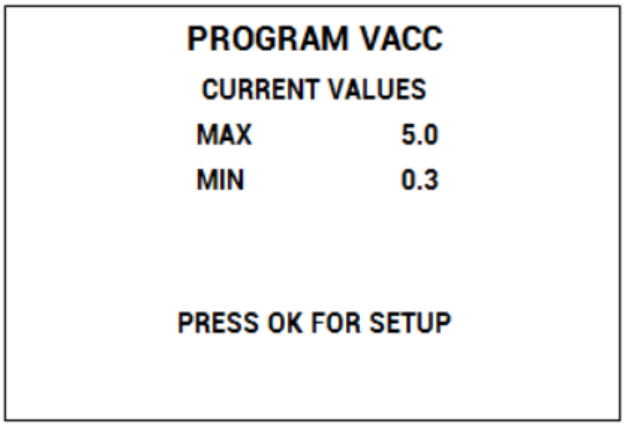
- White: maximum 5 events
- Yellow: maximum 20,
- Orange: maximum 40,
- Red: greater than 40.

Use the up / down key to select an alarm in the list: if you press OK, additional information about the alarm will be showing.
Press F1 to delete the controller alarm log: when you press button, the controller will request confirmation.

Program VACC

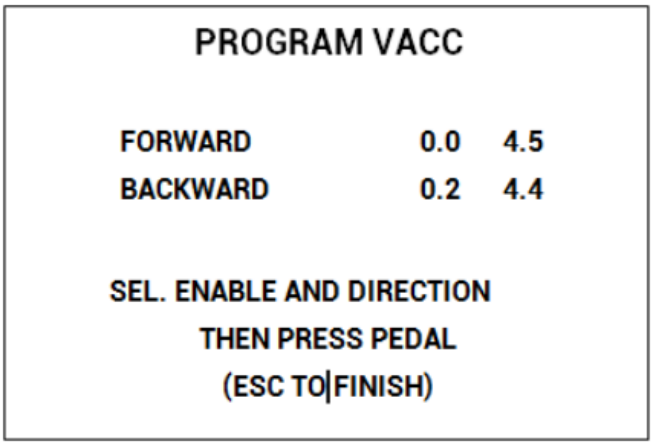
Compare with old controller , the menu of Program VACC changes little

As soon as you enter this menu, the controller presents the current set value.



When the ok key is pressed, the program vacc program will start: the controller will invite you to select the boot switch,
Choose start switch
Choose direction switch (forward or backward)
Hold down the pedal until its farthest journey.
The display value varies with the operator's input.

The above order can be slightly changed according to the controller firmware. In any case, the logic is consistent: perform any necessary startup order before setting the minimum / maximum value, and then press the pedal / push lever



When the ESC is pressed, the controller asks to store or delete the set value.
End of connection
Return to the home screen to end the connection: at this point, the cable may be removed from controller.
If the cable is removed from another menu, the controller returns no communication alarm status.

Controller shutdown
Once the cable is removed, the controller will automatically shut down.

3 Drive / Brake System

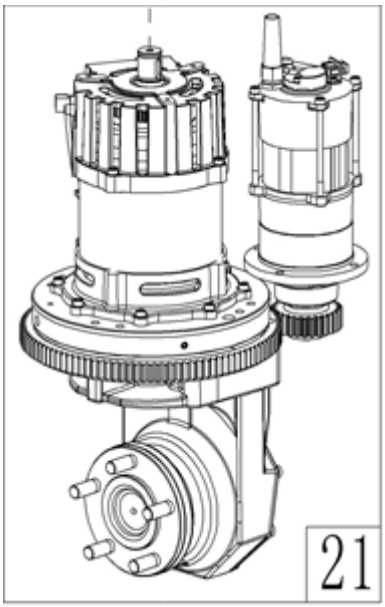
3-1 Overview

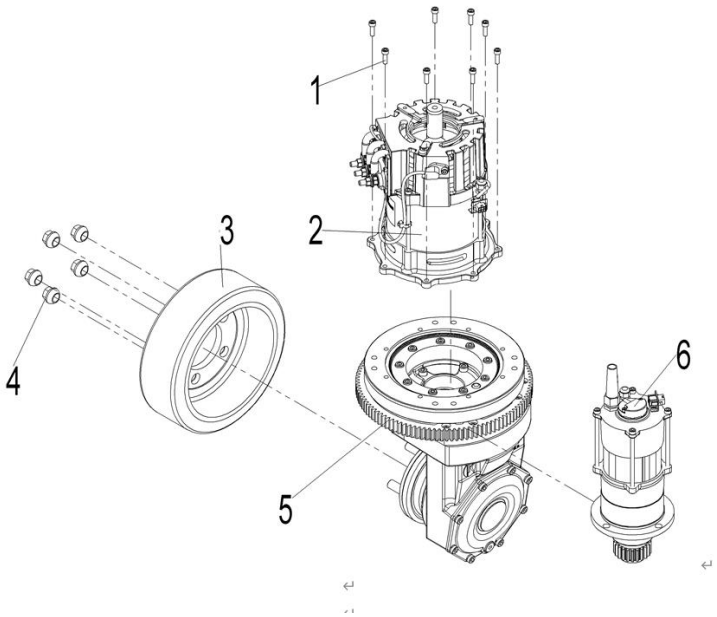
3-1-1 Assembly

The drive/brake system consists of the followings:
1.The drive motor regulated by the respective controller transmits the rotating force to the left and right drive shafts (electric power/ mechanical power).[Section 3-2]
2.The drive shaft converts the rotating force transmitted from the drive motor into the torque and speed suitable for driving through its gear set, and sends them to the corresponding wheel (mechanical power). They also contain the service brakes, which are actuated by magnetic brake pedal to produce braking force (/friction). [Section 3-3]
3.The accelerator sends an electrical signal to the drive motor controller to accelerate the motor.[Section 3-4]
4.The F/R unit sends an electrical signal to the drive motor controller to determine the drive direction of the motor.[Section 3-5]

3-2 Drive motor

3-2-1 Appearance and specification





3-2-2 How to run it

On the electric side, the drive motors turn their respective drive wheels so that the vehicle can move forward / backward.

Control by a controller
Each drive motor is connected to the controller via U, V and W wires. The controller operates the drive motor based on inputs from multiple switches and sensors and internal parameter settings.

The drive motor operates when the following conditions are met:
1. The key switch is turn to on-position to power the controller,
2. Stand on the platform
3. Determine the direction of travel (in F / R units),
4. Accelerator pedal pressed (accelerator)

Motor speed detection (encoder operation)
Each drive motor is equipped with an encoder, which is used as the speed sensor of the motor.It contains two hole sensors, and gears are installed on the drive shaft of the motor to interact with the two hole sensors.The gear rotates with the drive shaft at the same time, so that the gear teeth periodically pass through the magnetic field of each hole sensor. When the top platform of the gear passes through the magnetic field, it is close to the hole sensor, so the magnetic flux increases. On the other hand, the distance increases and the magnetic flux decreases accordingly, when the bottom platform passes through the magnetic field.

The cycle occurs again and the flux has a waveform that produces a voltage pulse. The controller analyzes the amplitude of the pulse to calculate the speed of the motor. The smaller the amplitude, the higher the speed of the motor.

Like other sensors, the encoder generates the main signal (Signal A) and the reference signal (Signal B) through the two hole sensors.The order of the generated signals varies according to the direction of rotation.

Overheat protection (thermal sensor operation)
Each drive motor is equipped with a thermal sensor to prevent overheating.Once the motor is heated to 145 ° C (293°F), an overheat alarm is activated and the operating performance of the motor is limited. Resistence is 603Ω±3％ when temperature is 25°C（77°F）

3-2-3 Disassembly/assembly and test of drive motor

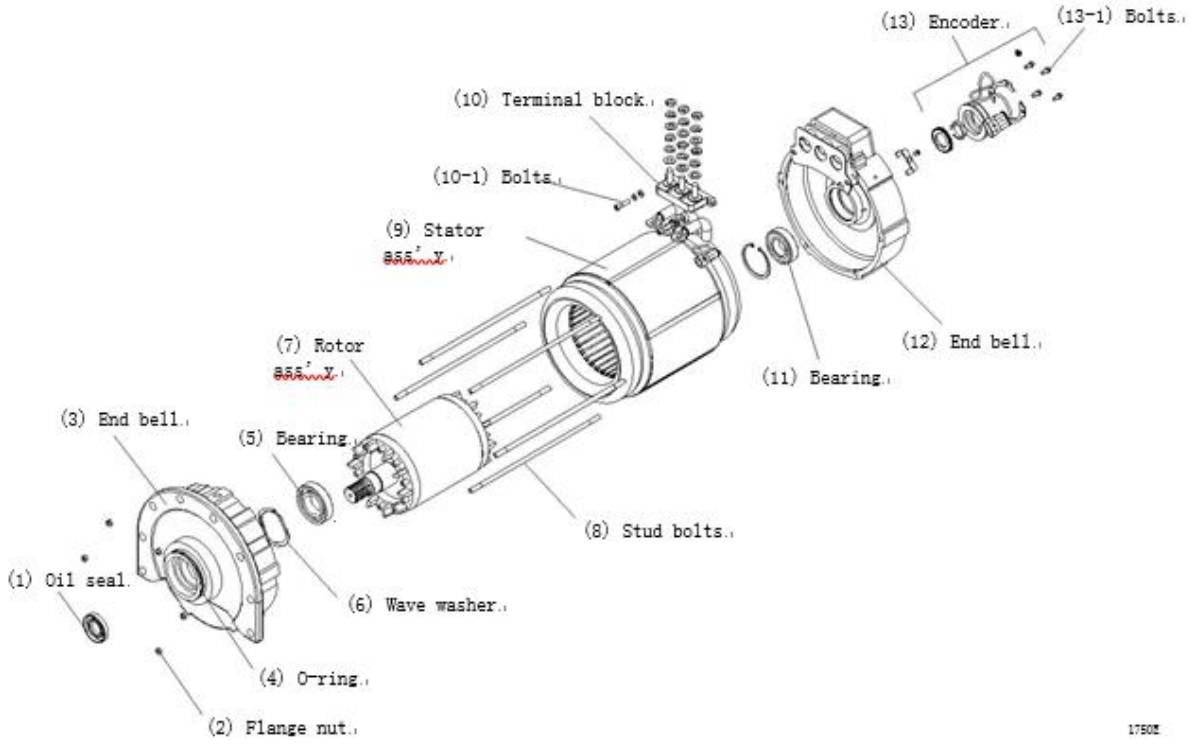


图 3-9

Disassembly/assembly

1.After removing the terminal protector, loosen the screws (10-1) and remove the terminal block (10).

2.Loosen the bolts (13-1) and remove the encoder (13).

3.Remove the O-ring (4) and the oil seal (1).

4.Loosen the back nut (2) and remove the lower cover (3).

5.Remove the stator assembly (9) by hand or using a tool.

6.Remove the wave washer (6) and the bearing (5) from the rotor assembly (5).

7.Remove bearing (11) and rotor assembly (7) from end cap (12).

The bearing puller recommended is as shown in the figure.

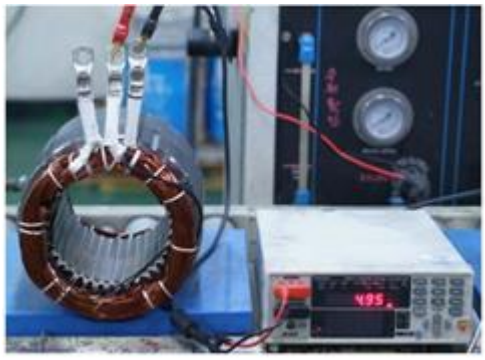
8.Perform the above steps in reverse order to assemble the drive motor.

Note: before reassembling the motor, you can test its components as follows.

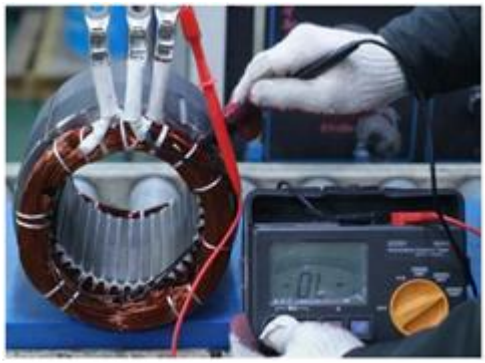
Stator test

1.Carefully wipe the contamination on the stator surface with a clean cloth dipped in alcohol.
Note: contamination in the stator can cause coil damage and therefore damage to the stator itself.

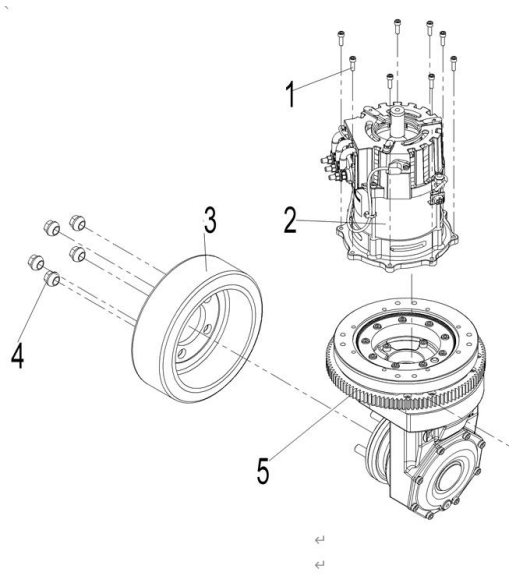
2.Use a milliohmmeter to measure the resistance of each phase (UV, VW, Wu).
Rated resistance: 0.4 Ω



3. Test insulation at 1000 VAC and minUse insulation tester for 10m Ω.
If there is a problem with the insulation, replace the stator with a new one.



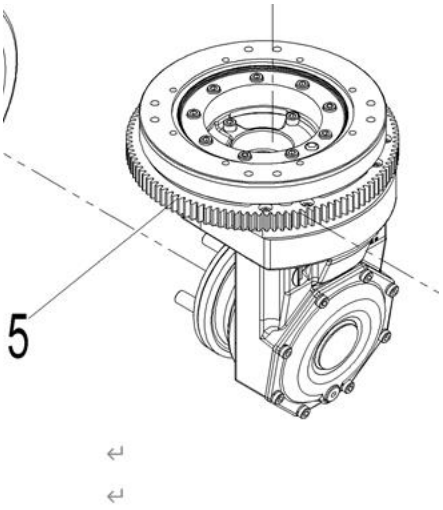
3-2-4 Removal / installation of drive wheel



1.Place a jack or block of wood under the forklift to empty the wheel and loosen the nut (1).
Installation torque: 450 ± 70 n · m (331.9 ± 51.6 LB · ft)
2.Remove the nut (1) and drive the tire (2).
3.Perform the above steps in reverse order to install the drive wheels.

3-3 Drive axle

3-3-1 Appearance and specifications



3-3-2 How does it work

Driving function

The drive shaft is responsible for transmitting the output of the drive motor to the wheel, reducing the speed and multiplying the torque according to the specific gear ratio generated by its internal gear train.This is to make the motor adapt to driving at high speed and obtain enough force to bear the load of the vehicle and other external conditions.
When the motor shaft rotates, the connected pinion also rotates, and then the helical gear is rotated, and the spline is connected to the pinion.Since the helical gear has several times more teeth than the pinion, the first reduction occurs between the two gears and the torque multiplies accordingly

The solar gear engaged with spiral hearing rotates at the same time as the rotation of spiral .The rotation of the solar gear causes the three planetary gears to move around the solar gear. As the ring gear contains, the planetary gear keeps its circular motion without becoming unmeshed. These gears are so named because they work together in a way comparable to the planetary orbit around the sun.

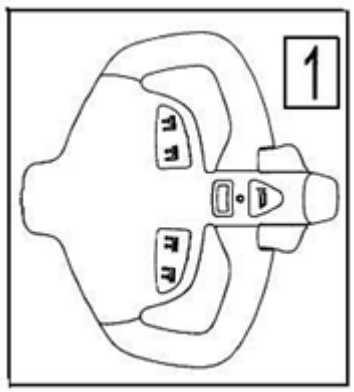
3-3-3 Replacement of drive gear oil

Initial steps
1.Park the vehicle on level ground.~~Check that the parking brake indicator is on, then place the F / R switch in neutral.~~

Process
1. Turn off the key switch.
2. Unscrew the oil level check plug and remove the drain plug to drain the oil.
3. Clean drain plug and install.
4. Unscrew and fill the oil filler plug.
~~5. Maintain the proper oil level by checking the dipstick.~~

3-4 Knob

3-4-1 Appearance and specifications



3-4-2 How does it work

Electric vehicle is powered by a drive motor. As a result, the accelerator that determines the vehicle's travel speed is connected to the drive motor controller.

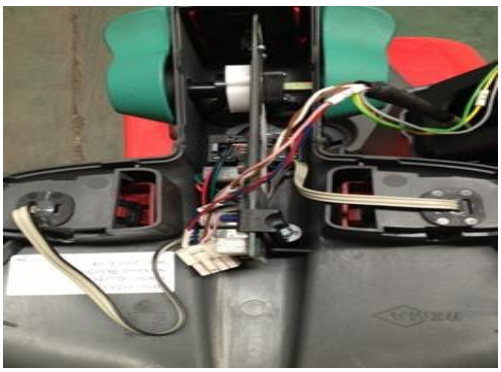
The accelerator is powered by 24 V from the drive motor controller, and generates Signal A in gear F and Signal B in gear R. This output determines that the speed of the vehicle is proportional to the angle at which the accelerator button is pressed.

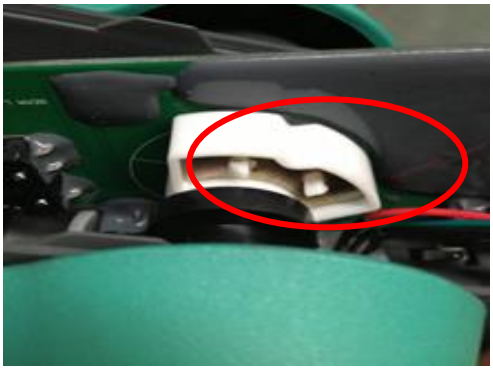
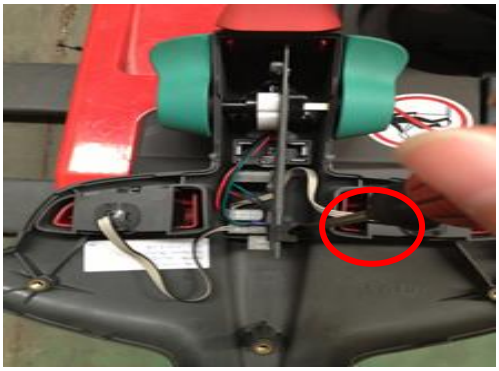
As shown above, Signal A or B sent by the accelerator are communicated to the controller by CAN. In principle, the values of the two signals shall be the same. If they differ by more than the tolerance, it will be identified as a problem in the electrical system or accelerator and a fault code will appear on the display.

3-4-3 Disassembly and installation

Initial steps
1.Turn off the key switch.

Process

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">1: loose bolt and remove back cover</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>2: loose connector</td><td>3: loose bolt and remove accelerator</td></tr>
</table>

	cover
	
4: Remove the switch shaft	
	
5.remove the bolts ,take out connector and replace the board.	

3-5 Brake

3-5-1 Overview

The electromagnetic brake system consists of electromagnetic coil, brake disc and gear.
1. Action of automatic clearance adjusting mechanism
When the forklift truck recedes, the brake shoe is in contact with the main brake shoe and rotates together to make the pull rod turn right around the A point. As shown in the figure, the B point is raised. After the brake is released, the pull rod turns left under the spring force. B point drops. As the gap between the friction plate and the brake hub becomes larger, the vertical distance of the B point rotation increases, the regulator is moved to a tooth, the adjusting rod becomes longer, and the gap shrinks. The clearance adjustment range is 0.40 mm~0.45 mm.

3-5-2. Inspection of the brake

Inspection of parts, maintenance or replacement of damaged parts.
(1) Check the surface of the pump body and the periphery of the piston for rust; then determine the gap between the piston and the pump body.

Standard Size :0.03 mm—0.10mm; Limit Size :0.15 mm
(2) Visually inspect the piston leather bowl for damage and deformation and replace it if abnormal.
(3) The length of the brake pump spring shall be measured and replaced when the reference is exceeded.
(4) Measurement of the thickness of the friction sheet and replacement when the wear limit is exceeded. Standard value :8.0 mm; limit value :2.0 mm
(5) Visual inspection of the inner surface of the brake drum, if there is damage or partial wear, grinding correction, beyond the correction limit to replace.
Standard value :314 mm; limit value :316 mm.

3-5-3 Brake assembly

(1) Apply brake fluid to the leather bowl and piston of the brake sub-pump spring, piston leather bowl, piston and anti-ring in sequence.
(2) Install the brake sub-pump on the brake floor.
(3) Install the brake floor on the drive bridge.
(4) Apply heat-resistant grease everywhere as shown,
Be careful not to apply to the friction sheet.
(a) The contact surface between the bottom plate and the brake shoe;
(b) Fixed pins;
(c) The contact surface between the hoof and the spring holder;
(d) Hand brake lever support pin;
(e) adjusting mechanism threads and other rotary parts.
(5) The parking brake cable is jammed with a E retaining ring.
(6) Install the brake shoe with a fixed spring.
(7) Put the compressed spring on the brake push rod and then put the push rod on the brake shoe.
(8) Install the brake shoe guide plate on the support pin and then install the brake shoe return spring. Install the main hoof first, then install the auxiliary hoof. Figure 2-28
(9) Install regulator, regulator spring, top rod, top rod return spring. Note the following:
(a) The thread direction of the regulator and its installation direction;
(b) The direction of the regulator spring (no contact between the regulator tooth and the spring is allowed);
(c) Back spring direction of the top rod (spring hook at the end of the support pin should be fixed on the opposite side of the top rod);
(d) The lower end of the adjusting lever must be in contact with the adjusting gear.
(10) Connect the brake tubing to the sub-pump.
(11) Measuring the inner diameter of the brake drum, the outer diameter of the brake shoe, and adjusting the regulator make the difference between the inner diameter of the brake drum and the outer diameter of the brake shoe friction0.3 mm- 0.5mm.

3-5-4 Operating test of automatic clearance regulator

(1) First, the diameter of the brake shoe is brought close to the specified installation size, and the adjusting lever is rotated by hand, and when the hand is loosened, the adjusting lever returns to its original position, while the adjusting gear does not rotate.
Note: even when the hand is released, the regulator gear returns with the adjustment lever, and the regulator still works properly.
(2) If the regulator is unable to do the above action while pulling the adjusting lever, the following checks shall be carried out:
(a) Fasten adjustment lever, top rod, top rod spring and press spring seat;
(b) Check that the top rod return spring and the regulator spring are damaged, and then check the rotation of the regulator gear and whether the meshing part is excessively worn or damaged. Check that the lever is in contact with the gear. Replace damaged parts.

Problem	Reason
Drive motor doesn’t work	Switch is not off (battery connector, key switch, proximity switch): Turn off switch. If still not running, use a voltmeter to test the power of the control panel and the current of each switch.
	Bad signal. fuse burned: check battery connection. Check the connection of the battery Check fuse, driver and logic. Replace fuse if burned. Check the drive motor and control panel which possible cause fuse breakage. Some of the reasons are: operating under excessive load, the current limit is too high.
	Battery voltage low: Check the battery terminal voltage. Charge the battery if too low. Check if there is one or more defective cell cells.
	Incorrect operate
Drive motor doesn’t work	Speed sensor fault
Traction does not work during normal operation	The brake is defective, resulting in excessive resistance. The heat increases, causing the motor to stop. Check braking adjustment
	Too much heat in the control panel for the following reasons: Overweight traction load: Reduced duty cycle load. Heat sensor failure:

	These may cause malfunction of the drive motor, failure of the control handle or opening of the drive fuse
Traction does not last throughout the normal working period.	The pallet is equipped with too small batteries
	Battery not charged fully during battery charging: Check if battery charges Check if battery charger is malfunction.
	Battery replacement interval is too long or battery replacement cooling time is too short.
	The battery has one or more defective single batteries, causing the rated capacity and capacity of the battery to be below normal:
	Due to the failure of the drive system, the drive system consumes too much battery power. Check the brake adjustment. Check the wheel bearings, axles and other mechanical parts for correction to eliminate the failure. Replace the smaller friction tire.
	After a work shift, the pallet capacity exceeds its designed capacity without the power available:
Battery positive (+) or negative (-) is in direct contact with the vehicle frame (body) or drive motor	The battery is dirty, the electrolyte is on top of the battery. The current flows through the battery box, which applies voltage on the forklift frame: clean the battery with baking soda
	Battery or control panel wire connection in contact with frame: Conduct continuity test and move wire. Remove wire in sequence until troubleshooting. Fault will be disconnected at the end of the wire.
	Wet motor
The vehicle did not reach its maximum speed	The battery is not fully charged or the battery is poor charge the battery. Check the cell of battery. If necessary, please replace the cell of battery
	Failure in driving motor, control handle or transmission system Check speed in both directions. If you need to adjust the controller, follow the corresponding

	part of the manual programmer. If the drive motor fails, test the motor assembly.
Slow acceleration of vehicles	Drive control overheat, temperature induction switch on. Note: If temperature is 145°c (293°f), heat – sensoe will issue warning.

3-6-2 Gear box

Problem	Possible causes
Noise or vibration in the transmission	Incorrect oil level: Meet the correct oil level
	Use non-standard oil: Replace the oil with standard oil.
	Gear damaged or dented: Replace the gear.
	Bearing damage: Replace the bearing.
	Loose mounting bolts: Apply thread compound to the threads of the bolts and retighten to the specified torque.
Noise or vibration in the brake disc pack	Use non-standard oil or friction materials: Replace oil or friction materials with standard materials.
	Incorrect oil level: Meet the correct oil level
	Foreign matter (water) introduced into oil: Replace the oil.
	Friction plate wear: Replace the friction plate.
Leakage of installation part	Loose mounting bolts: Apply thread compound to the threads of the bolts and retighten to the specified torque.
	Damaged mounting surface: After removal, readjust or replace the components.
	O-ring damage:

	Replace the O-ring.
Hub leakage	Damaged oil seal: Oil seal replacement
	O-ring damage: Replace the O-ring.
Input shaft leakage	Damaged oil seal: Replace the oil seal.
	Motor O-ring damaged: Replace the motor O-ring.
	Damaged motor mounting part or housing: Replace the components.
Air respirator leakage	Too much oil: Meet the correct oil level
	Air respirator damaged: Clean or replace vent
	Use non-standard oil: Replace the oil with standard oil.
Brake disc pack leakage	Brake seal damaged: Replace sealing ring
	Brake seal not installed correctly: Reinstall or replace the seal.
	The sliding parts of the brake seal (damaged shaft, bearing seat or piston: Replace damaged components.
	The outer particles are placed on the sliding parts of the seal: Clean sliding parts and master cylinder and replace them if damaged parts are found
	Material or oil passage damage: Replace damaged parts
	Gear damaged or dented: Replace the gear.
	Bearing damage: Replace the bearing.
	Loose mounting bolts: Apply thread compound to the threads of the bolts and retighten to the specified torque.

4 Steering system

4-1 Overview

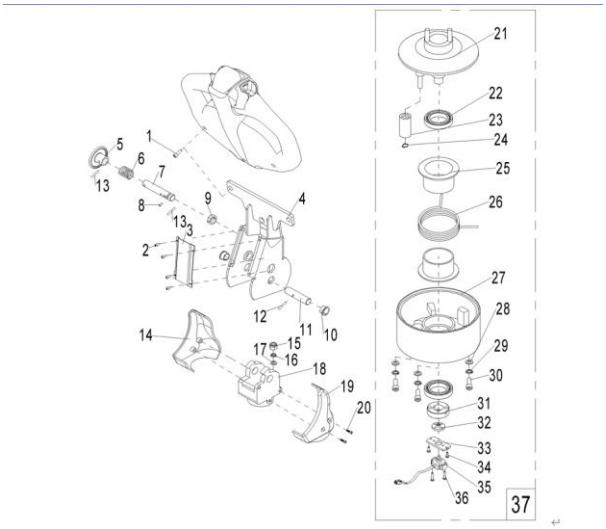
The steering system is a set of devices that turn the vehicle left or right.In this model, the steering system is mechanically operated and consists of a control group and an actuator group:

1. The control group determines the speed and direction of steering This group includes knob and potentiometer.

2. The actuator sends the signal from the potentiometer to the steering controller, which drives the steering motor to realize the steering.

4-2 Steering control group

4-2-1 Appearance and specifications



4-2-2 How does this work

Steering control mechanism
Once the handle rotates, the steering unit also rotates through a potentiometer connected with a spline between them. The potentiometer sends the corresponding signal to the steering controller, which drives the steering motor to realize the steering.

A. turn left
When the handle turns

When the potentiometer is connected to the steering wheel, turning the steering wheel makes the potentiometer rotate to produce the corresponding signal to the steering driver, and the steering controller drives the steering motor to turn left.

When the steering wheel is still

Once the operator stops turning the handle, the steering system devices stop working and the steering angle of the wheel remains the same.

B.turn right

When the handle turns
When the potentiometer is connected to the steering wheel, turning the steering wheel makes the potentiometer rotate to produce the corresponding signal to the steering driver, and the steering controller drives the steering motor to turn right.

5 Battery charger

5-1 Introduction of Battery Charger

This model adopts the intelligent charger of energy application
Normal working conditions:
1) Altitude not more than one kilometer
2) The surrounding medium temperature is not higher than 40 ℃ and not lower than - 10 ℃
3) The relative humidity of air shall not be greater than 85% (when the medium temperature is 20 ± 5 ℃)
4) Place without conductive dust and environment without explosion risk
5) Environment free of gas and steam that can corrode metal and insulation
6) Where there is no rain or snow
7) Where the vertical plane is not inclined more than 5 degrees and there is no violent vibration and impact

5-2 Introduction of Control Panel

1) Power switch - used to turn on or off the power grid
2) Information window (LED screen) - display various charging parameters, fault code information, etc
3) Information content indicator light - each light is on, and the corresponding information window will display the information of the corresponding content
4) Charging status indicator——
A) "Working" indicator light: the light is on, indicating that the charger is charging
B) "80%" indicator light: the light is on, indicating that the capacity of charger charging battery is more than 80%
C) "100%" indicator light: the light is on, indicating that the charger is charged and the battery is sufficient
D) "Equalizing charge" indicator: the light is on, indicating that equalizing charge will be carried out in this charge; the light flashes, indicating that equalizing charge is in progress
E) "Initial charge" indicator light: it lights up together with the working indicator light, indicating that the charger is in initial charge

5-3 Common faults of charger

Serial No.	Trouble code	Cause of failure	Processing method
1	----	The battery has not been connected or the connection is poor	Connect the battery and make sure the connection is reliable
2	E-03	The positive and negative polarity of the battery are reversed	Connect battery polarity correctly
3	E-04	Charging current over-current, sudden change of power grid or short circuit damage of rectifier module of charger	Check whether the power supply of power grid is normal; Replace the rectifier module
4	E-05	Battery Specification mismatch (average cell voltage is less than 1.5V or battery capacity is too large) or battery fault	Check whether the capacity and voltage of the charged battery match the specifications of the charger; Replace the matched battery; Replace faulty battery
5	E-06	During the charging process, the charging connecting line falls off, and the battery is disconnected from the charger	Check the connection points in the charging circuit and clear the oxide layer to ensure good contact
6	E-07	Power supply failure: low power supply voltage, power supply failure or input fuse damage Charger fault: charger has no current output, rectifier module or control board is damaged	Check the input power supply voltage and restore the normal power supply Replace the failed fuse Replace the faulty rectifier module Replace damaged control panel
7	E-08	The fan is damaged or the ambient temperature is too high, which causes the module temperature in the fan to be too high	Replace the damaged fan Check whether the vent of charger is blocked Improve working environment of charger
Note: when the "" indicator light on the panel is on, the fault code will be displayed in the information window			