

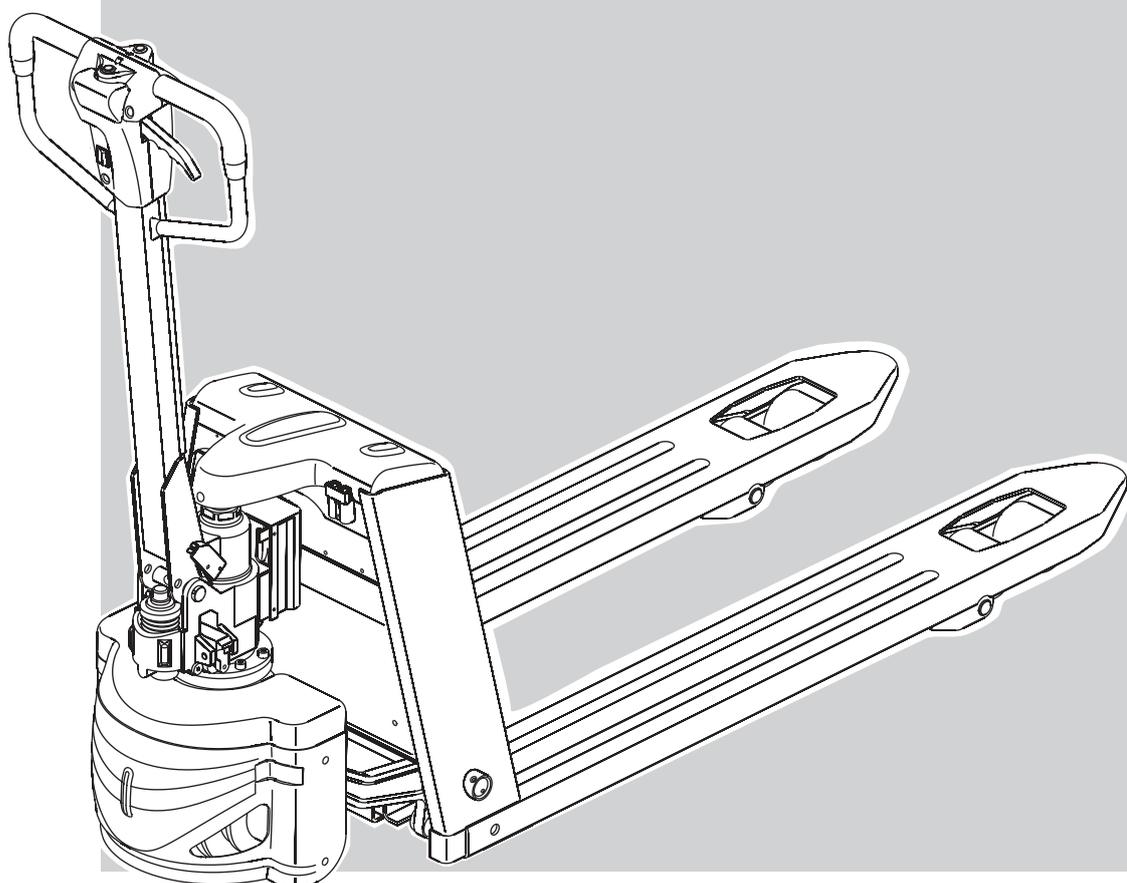
EP中力

EPT20-15EHJ

Semi-electric Pallet Truck

Service Manual

MANUAL NO. SM1121 01.16



CE
CE CERTIFICATE

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1.LOAD WHEELS

1.1 Disassembly and Assembly

Place hardwood block under the Frame as shown in Figure 01101. Remove the riser pivot shaft (index 2) after extracting roll pin (index 1).



CAUTION

In order to avoid scratching the surface of vehicle, put a piece of rubber mat on the hardwood block.

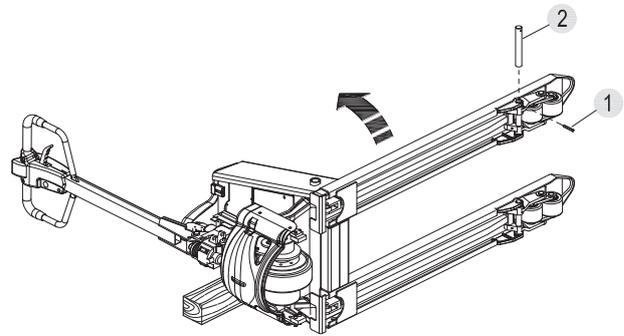


Figure 01101

Remove the riser pivot shaft (index 4) after extracting roll pin (index 3) as shown in Figure 01102. Then the wheel bracket assembly (index 5) can be replaced.

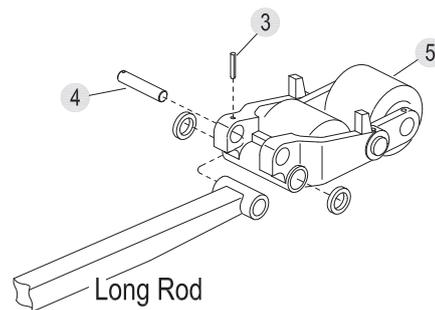


Figure 01102

If the load wheel (index 9) is only replaced, the riser pivot shaft (index 7) will have to be removed after extracting roll pin (index 6) as shown in Figure 01103. Remove the bearings (index 8) and change the load wheel (index 9).

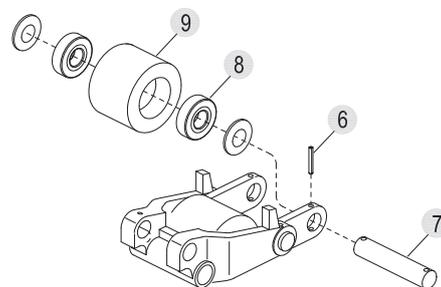


Figure 01103

2.DRIVE UNIT

2.1 Disassembly and Assembly

Place hardwood blocks under the Frame as shown in Figure 01201. Make the drive wheel hang in the air



CAUTION

Put the hardwood block as near the drive wheel as possible.

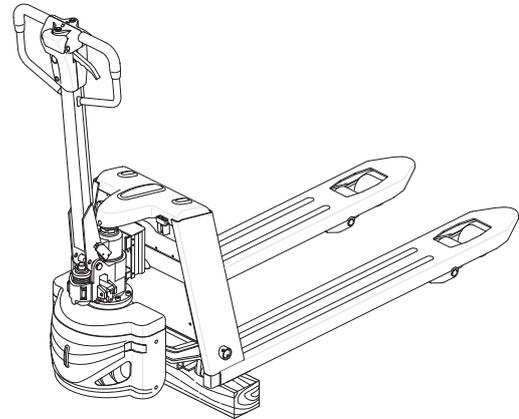


Figure 01201

Unfasten the four screws (index 1, Figure 01202) by using a wrench and remove the upper cover (index 3) and the lower cover (index 2) .

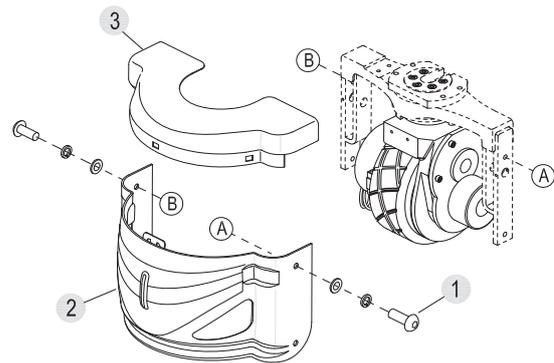


Figure 01202

Dismantle the motor cable box (index 4) and remove the two cables (index 5). Unscrew the three screws (index 6) and take down the brake (index 7). Unfasten the eight screws (index 8) and remove the gear box cover (index 9) and the gears (index 10) . Note the number and position for reference at assembly. Then knock out the assembly (index 12) after unscrewing the five screws (index 11). Refer to Figure 01203.

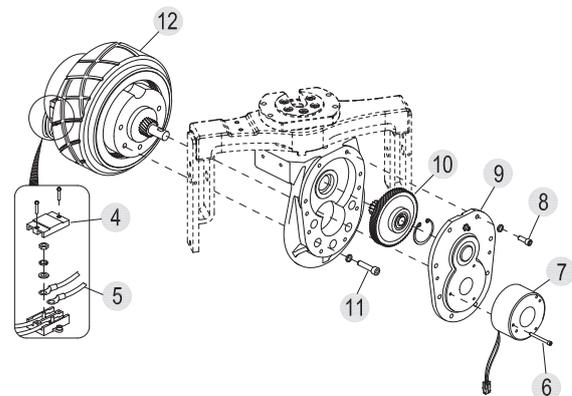


Figure 01203

Refer to Figure 01204. Knock out the motor (index 13) and pick out the oil seal (index 14). After the six screws (index 15) have been removed, knock out the gear ring (index 16) and the bearings (index 17). Then the drive wheel can be changed.

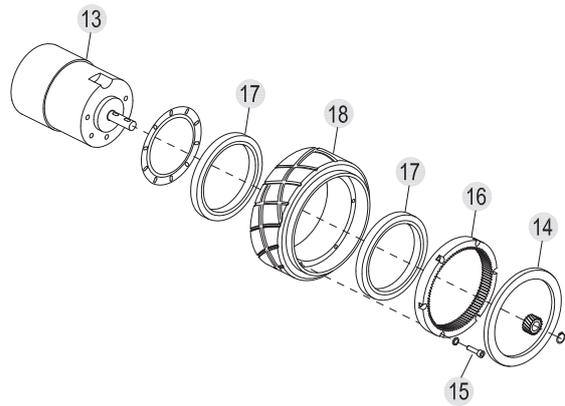


Figure 01204

Change the brushes

If the brushes (index 7) must be replaced, the motor will have to be dismantled.

Unfasten the three screws (index 1), Open the motor. Remove the four screws (index 5) and pick out the brush holder (index 6). Then the brushes (index 7) can be replaced. Refer to Figure 01205.

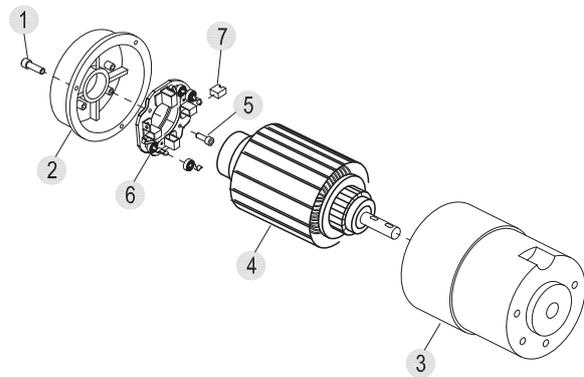


Figure 01205

3. TILLERHEAD

3.1 Disassembly and Assembly

1.

IMPORTANT-SAFETY

Verify that spring safety pin is in place. The pin should be well rested in the holes situated on each side of the pump housing. If the safety pin is not rested properly in one of the holes, put pressure on the spring using a "C" clamp pushing down on the pump stem. Once pressure is relieved on the pin, reinsert properly and remove clamp slowly.



Figure 01301

2.

Insert handle pin into corresponding holes and , drive in one cotter pin on one side only(see arrow 2).

Note: Insert handle pin without the handle and verify that the center hole is facing you (see arrow 1).

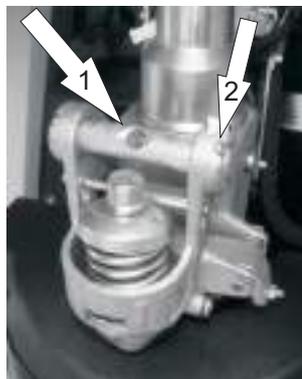


Figure 01302

3.

IMPORTANT-CHAIN

Before this step, make sure to feed the chain on the outside of the piston stem roller (see arrow 1).If left in its proper position, it will not be possible to insert the handle pin and chain, breakage may occur. Align handle holes with pump housing holes and push through handle pin(see arrow 2).

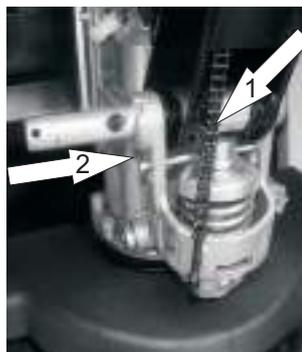


Figure 01303

4.

Make sure that handle pin is completely through the handle and resting on the other side.



Figure 01304

5.

Feed the chain and nut first back inside the handle through the handle pin's center hole.

IMPORTANT-TIP

Release the up/down lever to its lowest position to make the process easier.
Once the chain is in the proper position, check to see that it moves freely and that it is not obstructed.



Figure 01305

6.

Use both hands, push on the valve cam to raise the hook inside the housing and feed the end of the chain in the cam.



Figure 01306

7.

Pull down on the handle to release the tension on the safety pin. CAREFULLY remove the safety pin.



Figure 01307

8.

Connect the both electrical plugs.



Figure 01308

9.

IMPORTANT-FINAL CHECK

Test all the features of the semi-electric pallet truck before this step. The handle should be pumped with full strokes to prime and eliminate air in the system.

The up/down lever should be checked at the handle's lowest position for this puts the most tension on the chain. Once the pallet truck is adjusted properly and is performing well, drive in the second cotter pin.



Figure 01309

10.

Tie the wire harness with a tie wrap(see arrow 1) together .

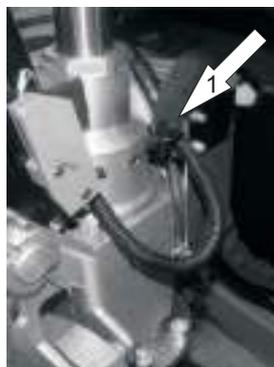


Figure 01310

4. HYDRAULIC SYSTEM

4.1 Disassembly and Assembly

Remove the handle (index 1) and the controller (index 2). Remove the hydraulic assembly by unscrewing the screw (index 3) and the four screws (index 4). Place hardwood blocks under the Frame as shown in Figure 01401.



CAUTION

Put the hardwood block as near the drive wheel as possible.

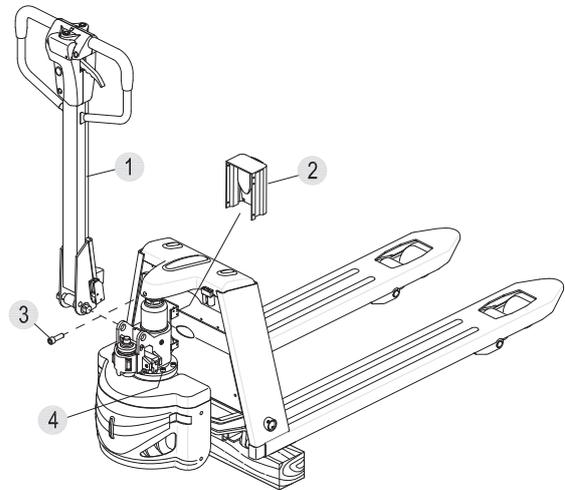


Figure 01401

The filler of hydraulic assembly is as shown in Figure 01402.



CAUTION

It is filled with the 32# hydraulic oil.

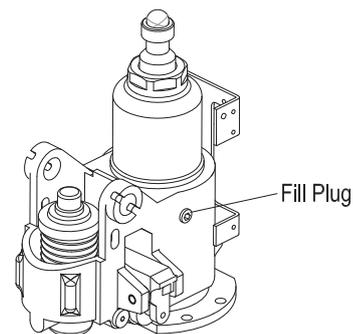


Figure 01402

Refer to Figure 01403. Change the lift capacity by adjusting the position of the screw (index 2) which is in the relief valve (index 1).

- Screwing Inward = bigger
- Screwing outward = smaller

The seal kit of hydraulic assembly includes index 5,6,7,8&9. Pick out the piston rod (index 3) and the pressure bar (index 4). Then the seals are removed by using a hooked tool (index 10).

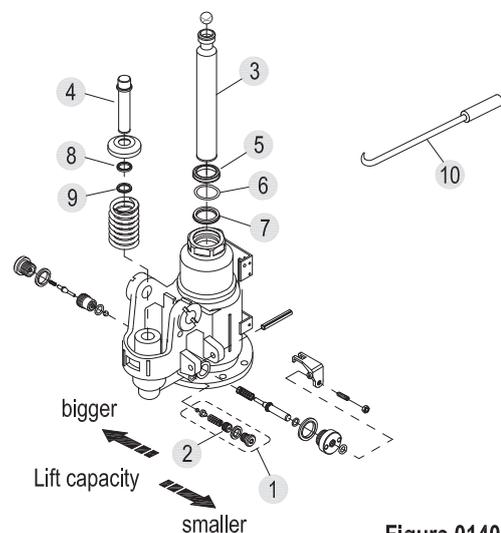


Figure 01403

4.2 Commissioning

After the handle is installed to the new vehicle, or the vehicle has been used for more than 6 months, further commissioning should be conducted to the hydraulic pump, make sure that the hydraulic pump is always working in the best condition. Gear lever on the handle is associated with the screws on the lever plate.

1. When the gear lever is at Gear 1, the vehicle is in the state of lifting, turn the handle at this time, the vehicle will be lifting.
2. When the gear lever is in the middle, Gear 2, the vehicle is in the state of traveling, turn the handle at this time, the vehicle won't be lifting or lowering, this working condition is forward or reverse state.
3. When the gear lever is flipped to higher position, Gear 3, the vehicle will be in the lowering state.

 Operate the vehicle slowly when lifting heavy load, do not rapidly flip the gear lever, otherwise may damage the vehicle or the loads!

4. After the handle is installed properly, follow the steps described below for commissioning, the methods are as follows:

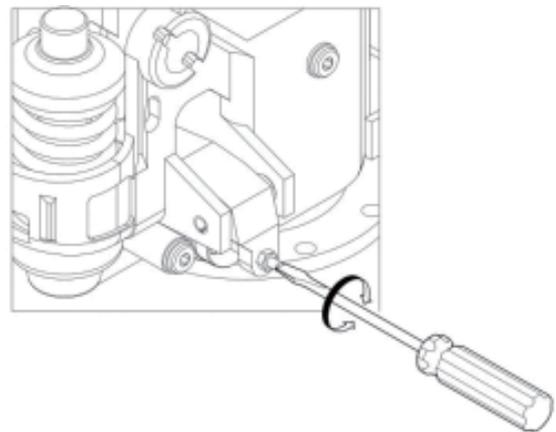
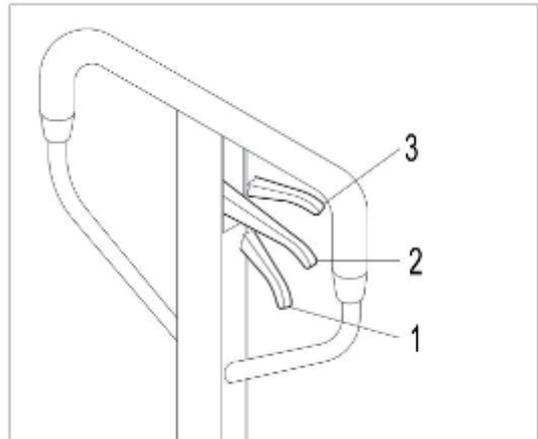
The position of the screws underneath the lever plate will decide if the working condition of gear lever is normal:

Turn the handle, but the vehicle cannot lift, slightly turn the screw counterclockwise and try turning the handle until the vehicle can lift properly;

If there is no middle gear or the vehicle is lowering too slowly, slightly turn the screw clockwise and try turning the handle again until it can shift properly among the three gears, namely: middle, lifting, lowering;

Hexagon nut at the screw is for the purpose of locking, loosen it prior to adjustment and tighten it after the adjustment is completed.

 This step may be repeated several times so as to complete this work, if necessary, until each gear is functioning properly.



5. Relieve Valve Commissioning

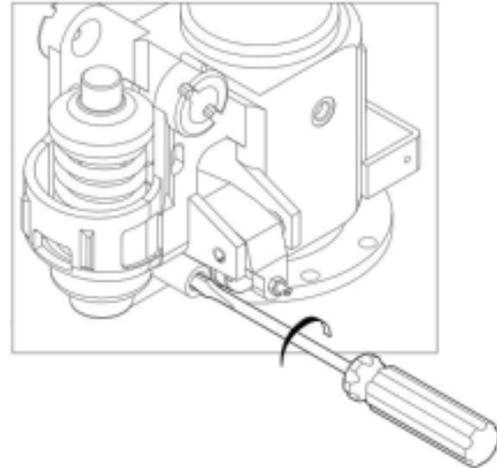
If the vehicle can lift light load, but cannot lift rated load, such case may be caused by the relief valve being opened in advance, follow the steps below for commissioning:

Firstly, remove the external screw plug of the relief valve, and then adjust it with screwdriver;

Turn it clockwise to increase opening load of relief valve;

Turn it counterclockwise to decrease the opening load of relief valve.

Install the screw plug back in place after the commissioning is completed.



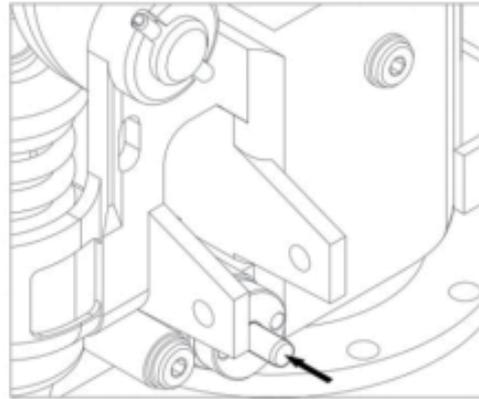
DO NOT turn too much during adjustment, the angle is recommended to be less than 15° at one time.

Relief valve must not be closed completely, otherwise, once the valve is overloaded, the vehicle will be damaged!

4.3 General Failures and Troubleshooting

1. The vehicle cannot lift?	
Cause 1	Due to transportation, long time storage or inversion, it is likely to be air entering into the hydraulic system of the pump.
	Troubleshooting:
	Flip the gear lever on the handle to lowering position and fully turn the handle for several times to discharge the air within the hydraulic system of the pump, repeat for several times, if necessary.
Cause 2	Unloading valve abnormalities, unloading valve stem not at normal operating position.
	Troubleshooting:
	Check if the commissioning is in place.

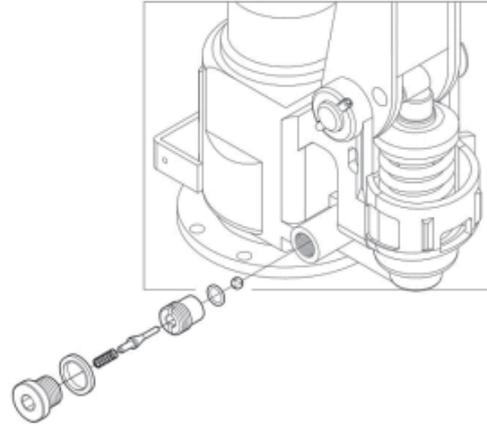
Cause 3	Check if the unloading valve stem is blocked.
	Troubleshooting:
	Push the unloading valve stem in the direction of the arrow as shown in the figure, if the stem can automatically reset, then it indicates that the fault is due to insufficient commissioning, the fault can be fixed through re-commissioning.
	If the valve stem can only be pushed forward, but cannot be pulled backward, and cannot automatically reset, the stem seems to be blocked, then the valve stem and related parts need to be replaced.
i	Sometimes, by applying lubricants on the surface of valve stem can also make it reset.
Cause 4	The hydraulic oil viscosity changes due to different ambient temperature or long time storage, as well as alpine region, the hydraulic oil may freeze or may become diluted at tropical region, long time use of hydraulic oil with no replacement can also lead to qualitative change, thickening or drying of the oil, and so on.
	Troubleshooting:
	Needs to replace with new hydraulic oil.



2. The vehicle cannot lift to maximum height?	
Cause	It is likely to be insufficient hydraulic oil.
	Troubleshooting:
	Refill hydraulic oil.
⚠	Different brands of hydraulic oils, and oils from different vendors cannot be mixed together! Otherwise may accelerate the premature deterioration and failure of hydraulic oil!

3. The vehicle can lift but cannot retain, by turning the handle, the vehicle can lift, or although the vehicle can lift, but then automatically lower?

Cause 1	Valve blocked by debris.
	Troubleshooting:
	Remove all the parts within the valve, clean them up and re-install, the fault can then be fixed. Seals need to be replaced when necessary.
	1. Valves are precision parts, apart from the seals, no parts shall be replaced or swapped between two vehicles, otherwise may need a technician with certain skills to fix!
	2. An appropriate amount of hydraulic oil needs to be refilled depending on the loss of hydraulic oil! Warning! DO NOT attempt this repair operation without proper training!



4. The vehicle can lift but cannot lower?

Cause 1	Piston rod bent or bonded with cylinder block.
Cause 2	May be caused by other parts on the vehicle.
Cause 3	May be caused by the vehicle getting rusty or blocked by foreign bodies.
	Troubleshooting:
	Check all the related parts of the entire vehicle for abnormalities, remove the foreign objects on other parts, rectify and replace the damaged or deformed parts.

5. The vehicle cannot lower to bottom?

Cause 1	Excessive hydraulic oil.
	Troubleshooting:
	Drain the excessive hydraulic oil.

5. The vehicle cannot lower to bottom?	
Cause 2	Parts deformation of parts.
	Troubleshooting:
	Check other parts of the vehicle, remove foreign objects and replace the parts with deformation.

6. Oil leakage?	
Cause 1	Damaged seals.
	Troubleshooting:
	Replace the damaged seals.
Cause 2	Loose parts.
	Troubleshooting:
	Carry out the troubleshooting again and tighten the loose parts.
Cause 3	Sealing surface of parts scratched.
	Troubleshooting:
	Replace the damaged parts and related seals.

4.4 Oil Seal Replacement

1. Replace the main oil seal of piston pump.

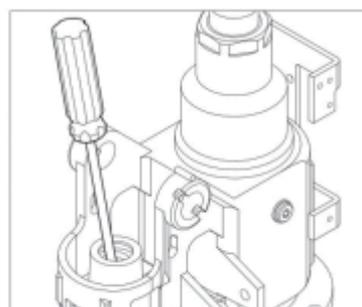
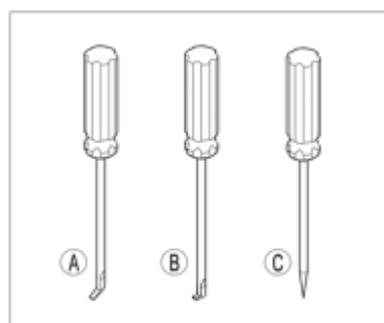
Failure symptom: oil leakage at piston pump.

Cause: Damaged pump oil seals.

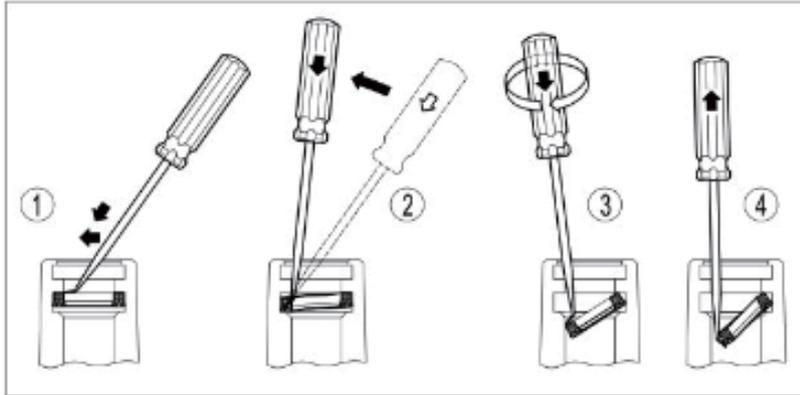
Troubleshooting: Replace the pump seals.

Replacement procedure: Remove the piston pump element, big spring and other parts, then get the oil seal removal tools A, B and C ready, and replace the oil seals with these tools.

i The pump oil seal groove is of closed structure, extra care shall be taken upon replacement.

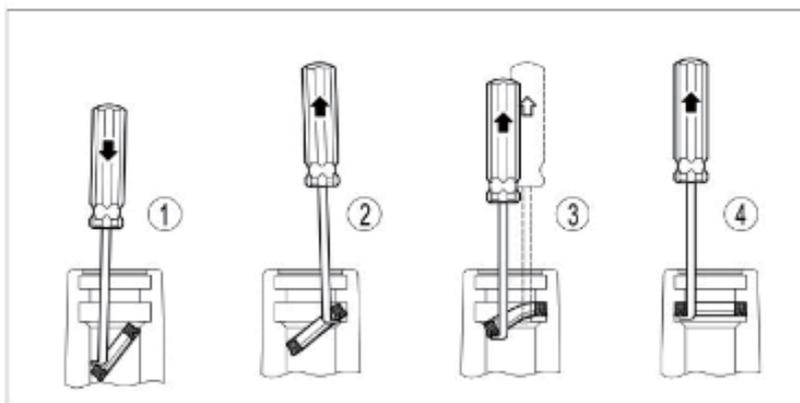


Removal of pump seals can roughly be divided into four steps, as shown below:



1. Use tool A, apply a force in the direction of the arrow, squeeze the tool between the oil seal and the engaging surface of the groove;
2. Apply a force in the direction as shown in the figure, initially thrust the oil seal out of the groove with tool, if necessary, stab the oil seal with tool C and then thrust it;
3. Apply a force in the direction of the arrow as shown in the figure, thrust the oil seal completely out of the groove;
4. Go on thrusting tool A and turn it for 180°, draw and prick to remove the oil seal finally.

Installation of pump seals can roughly be divided into four steps, as shown below:



1. Press the oil seal into the pump hole with tool B;
2. Partly draw the oil seal into the groove as shown in the figure;
3. Progressively draw the oil seal into the groove as shown in the figure;

4. Adjust the oil seal in the groove to rectify it in place.

The tools shall be with no sharp edges and corners, otherwise may easily damage the oil seal!

DO NOT attempt this repair operation without proper training!

2. Replace oil seals of big cylinder.

Failure symptom 1 : After the big piston rod is lifted, it is lowered rapidly.

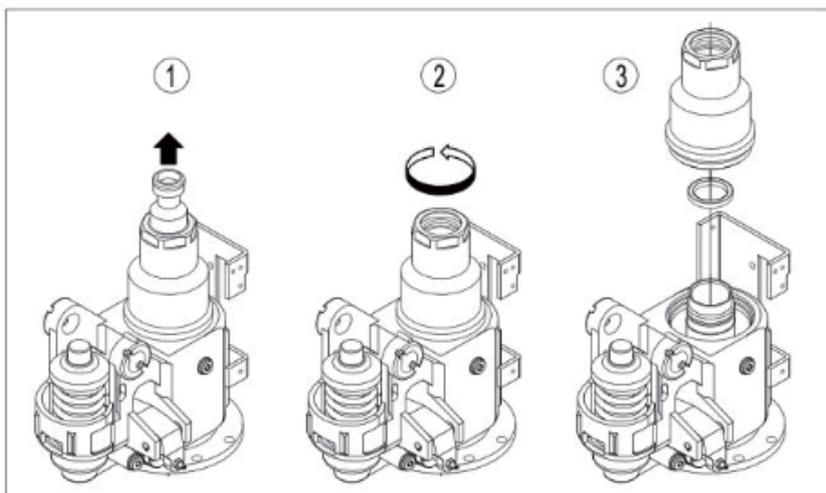
Failure symptom 2 : After the big piston rod is lifted under no load of light load, there is no obvious sign of lowering, but it is lowered rapidly under heavy load.

Cause: Damaged big piston seal.

Troubleshooting: Replace the big piston seal.

The big piston seal is of open structure.

Removal of big piston seal can roughly be divided into three steps, as shown below:



Replacement procedure:

1. Remove the big piston rod first, as shown in Figure ①, it can be directly pulled out;
2. Loosen the guide bushing with a wrench, as shown in Figure ② until it is thoroughly removed;
3. Remove the big piston seal from the guide bushing, as shown in Figure ③.

4. Install the big piston seal and other parts in reverse order of the removal procedure.

i The removal of big piston seal can be carried out with tool A, B and C, and the method is the same as that for pump seal, if so, the guide bushing does not need to be loosened.

4.5 Other Issues

1. Hydraulic oil: anti-wear hydraulic oil ISO-32 is used for general regions, it is recommended to use ISO VG 15 hydraulic oil at extremely cold areas or cold storage, the allowed oil volume within the pump is: 250~280mL.

 Neither too much nor too little oil can make the pump work properly, you can also visually observe until the oil overflows from the filling hole.

2. Daily inspection and maintenance are essential, the appearance of the pump should always be cleaned up to prevent big and small piston rods from being scratched by foreign objects; lower the vehicle to the bottom when idling, unload the loads from the vehicle, the loads must not be placed on the vehicle for a long time.
3. The commissioning shall be made every 6 months, so that the control stem is always in the correct position.
4. Prior to the pump inspection, make sure the vehicle is lowered to bottom, otherwise, once the parts on the pump are loosened, the high pressure liquid inside can be ejected, and may lead to hazards.
5. Upon inspection, including prior to the inspection, clean up the stains on the appearance first, and clean up each part from time to time during the inspection and cover all the exposed holes properly to prevent dirt from entering the system; welding or grinding may generate dust, such operations shall be prohibited at the site of pump repair.
6. After the repair or replacement of parts, the parts shall be cleaned up first, make sure the parts are thoroughly clean and then install again.

7. If the seals within the pump need to be replaced, smooth tools must be used, any sharp tool can cause damages to the seals, resulting in failure of hydraulic functions.
8. Upon removal or demolition, pay attention to the order and direction of the removal, the parts removed must be kept properly to avoid the occurrence of loss, scratches and deformation, all parts must be kept clean after the repair and before the installation.
9. The operator is required to apply even force when tightening the parts during installation, otherwise may lead to damage to parts or deformation of valve, blocked spool or oil leakage at joining parts, and other problems.
10. The oil in the tank shall be refilled or replaced upon inspection, and the viscosity of the oil must comply with the relevant requirements, the new oil must be filtered before use to ensure it is clean and free of impurities.
11. After the inspection, double check the parts that has been repaired, make sure there is no problem, then adjust the system in accordance with relevant requirements, observe the parts for abnormalities, only after having confirmed that everything is normal, can the part be put into operation again.
12. DO NOT attempt to the repair operations without proper training!
13. Discard:
 - Demolish the product first, drain the hydraulic oil, and classify the parts by metal parts and rubber parts;
 - The waste hydraulic oils shall be collected and transported to used oil recycling sites or burned in accordance with national safety standards;
 - More than 99% of the parts in this product are made of metal, which can be handed to scrap metal recycling agent for disposal;
 - Very little rubber parts can also be used as renewable raw materials and sent to the local recycling agent for disposal.

5. ELECTRICAL

5.1 Disassembly and Assembly

Change the batteries

Lift the forks by moving the handle (index 1) up and down to the highest. Rotate the handle a few degrees to the left or right as shown in Figure 01501.

Remove the two screws (index 2) and take out the battery cover (index 4).

After the wire harness and cables have been removed from the batteries carefully, the batteries can be taken out.

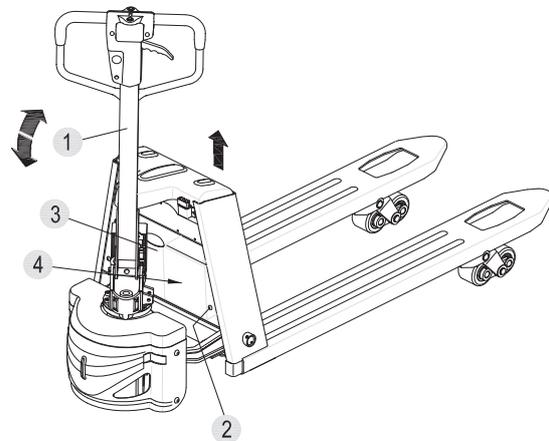


Figure 01501

Change the charger

Lift the forks by moving the handle (index 1) up and down to the highest. Rotate the handle a few degrees to the left as shown in Figure 01502.

Remove the two screws (index 2) and take out the battery cover (index 4). Then remove the wire harness from the battery.

Remove the battery connector (index 5) in order to replace the charger easily.

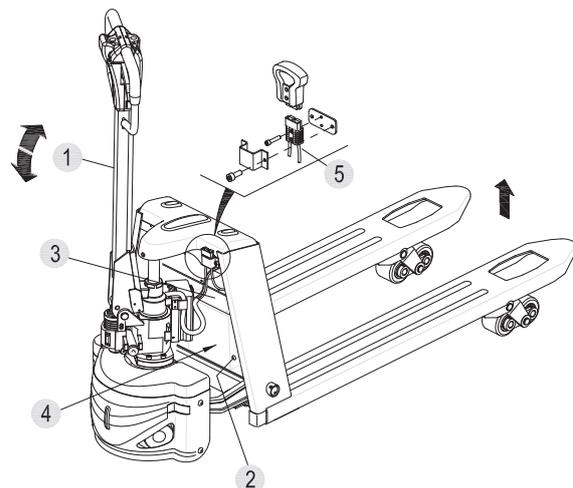


Figure 01502

Refer to Figure 01503. Unscrew the three lock nuts (index 6) and remove the bracket (index 7) from the front frame.

Disconnect the LED lamp and charger cable from the charger. Unfasten the screws (index 10) and lock nuts (index 11). Then the charger can be replaced.

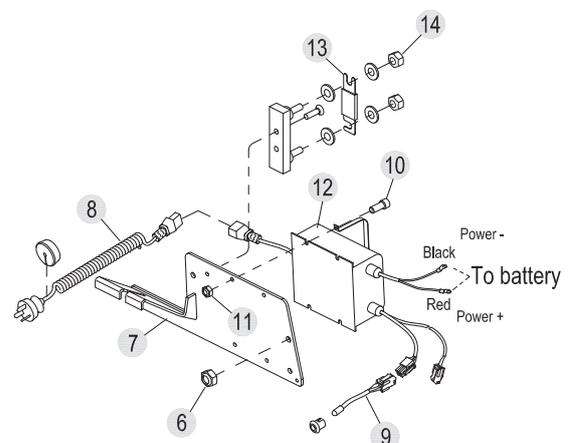


Figure 01503

Change the controller

Unscrew the five screws (index 1) and remove the controller cover (index 2). Unfasten the screws (index 3) and nuts (index 4). Then disconnect the wire harness and cable from the controller. And the controller (index 5) can be replaced.

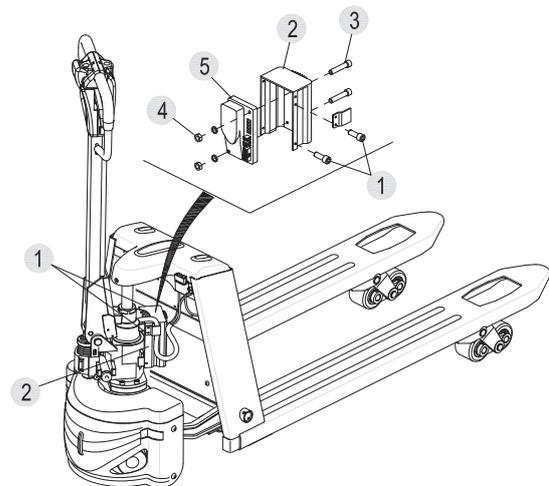


Figure 01504

Change the controller settings

Disconnect the charger wire harness (index 1) from the controller wire harness (index 2). Then connect the handheld programmer to the connector which is connected with charger wire harness (index 1).

How to use the handheld programmer? Please see the manual of handheld programmer.

The parameters of EPT20-15EHJ are in the document which is the "Parametric sheet for EPT20-15EHJ".

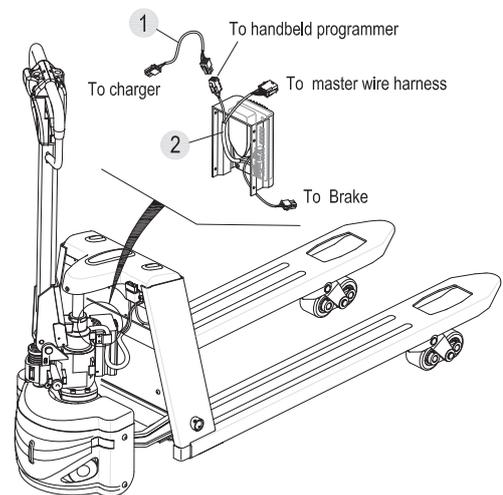


Figure 01507

5.2 Electrical Schematic Diagram

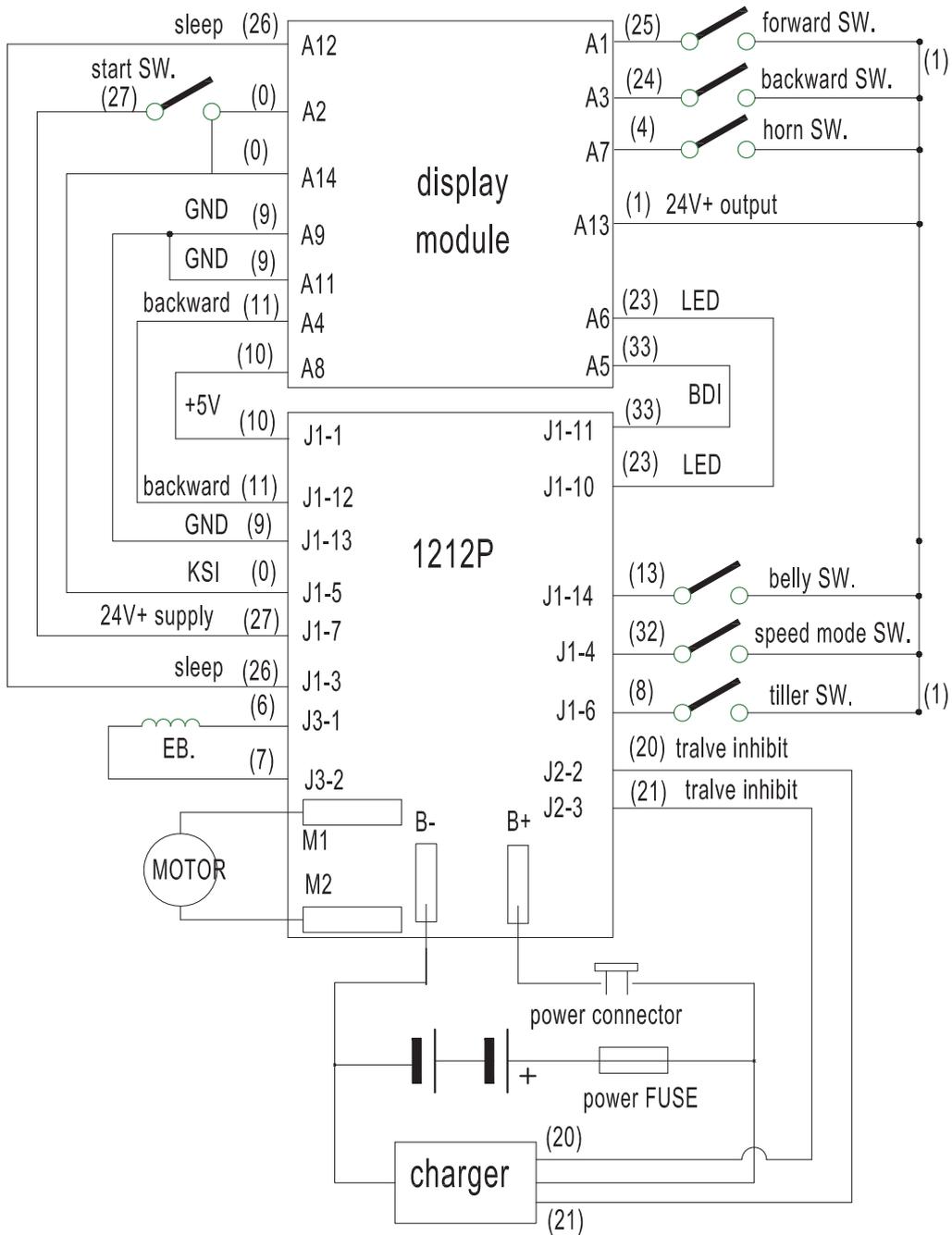


Figure 01505

5.3 Power Cables

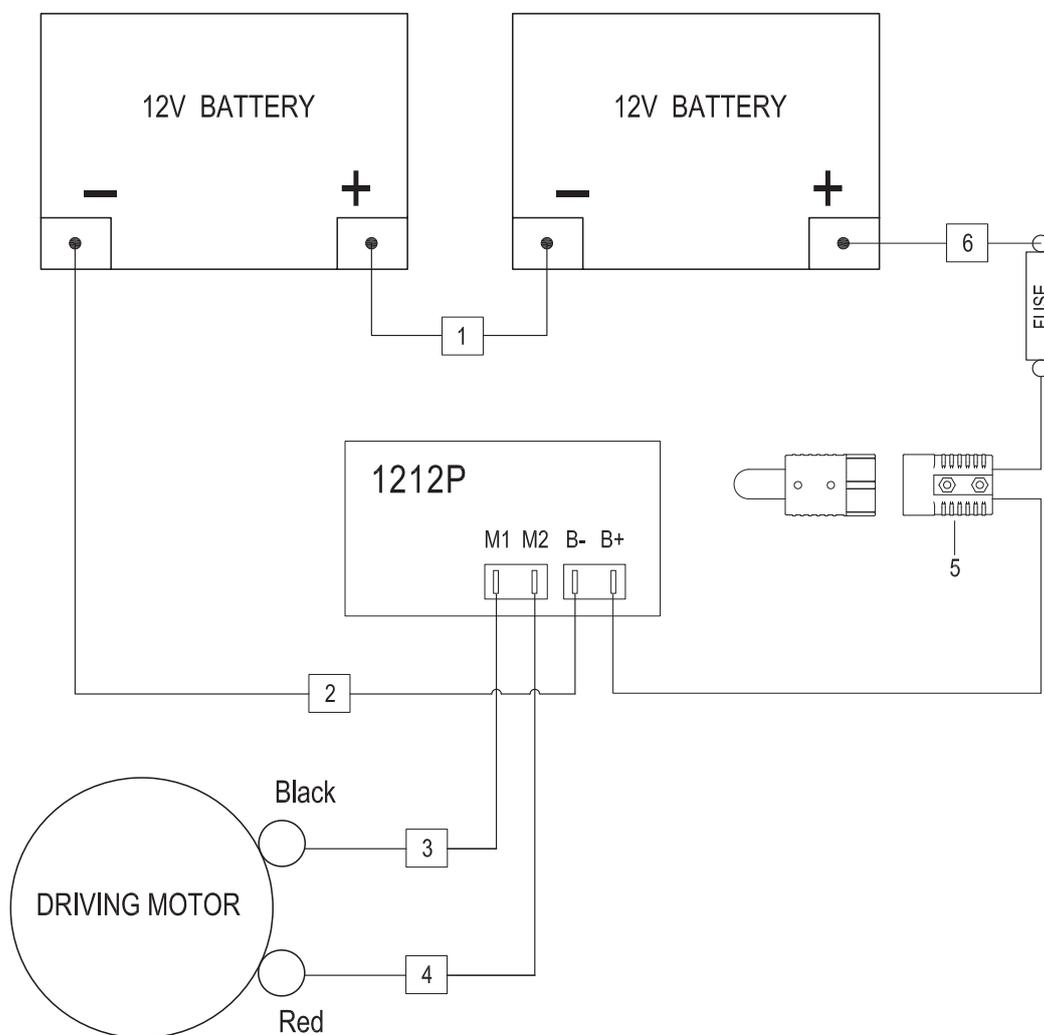


Figure 01506

ITEM	PART NAME
1	Battery connector cable
2	B- cable
3	M1 cable
4	M2 cable
5	Connector assembly
6	Fuse-Battery cable

5.4. Controller Troubleshooting

5.4.1. Fault Detection

The controller provides diagnostics information to assist technicians in troubleshooting drive system problems. When a fault is detected, the appropriate fault code is signaled via the panel mounted LED.

5.4.2. Hand Held Programmer (Optional)

The hand held programmer is available that is designed specifically for use with the controller. The programmer is available through your EP dealer.

5.4.3. Fault Recording

Fault events are recorded in the controller's memory. However, multiple occurrences of the same fault are recorded as one occurrence.

The fault event list can be loaded into the programmer for readout. The Special Diagnostics mode provides access to the controller's diagnostic history file. The history file contains the entire fault event list created since the diagnostic history file was last cleared. The standard Diagnostics mode provides information about only the currently active faults.

5.4.4. General Checkout

Carefully complete the following checkout procedure. If you find a problem during the checkout, refer to paragraph A-1.8. for further information.

The checkout can be conducted with or without the handheld programmer (See Paragraph A-1.2.). However, the checkout procedure is easier with a programmer. To evaluate the system without a programmer, observe the LED and note the flashing pattern and refer to Table 1 for the code description.

CAUTION: Put the vehicle up on blocks to get the drive wheel off the ground before beginning these tests.



Turn the keyswitch off and make sure the brake is applied, the throttle is in neutral, and the forward/reverse switches are open.

Do not stand, or allow anyone else to stand directly in front of or behind the vehicle during the tests.

1. Disconnect the battery charger and connect the programmer to the 4-pin connector (Figure01508) on the controller.

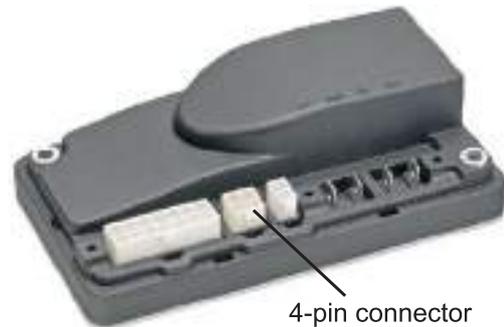


Figure01508 Controller Terminals

2. Turn the lift truck key switch to the ON position. The programmer should "power up" with an initial display (Figure01509), and the controller's Status LED should begin steadily blinking a single flash. If neither happens, check for continuity in the key switch circuit and controller ground.

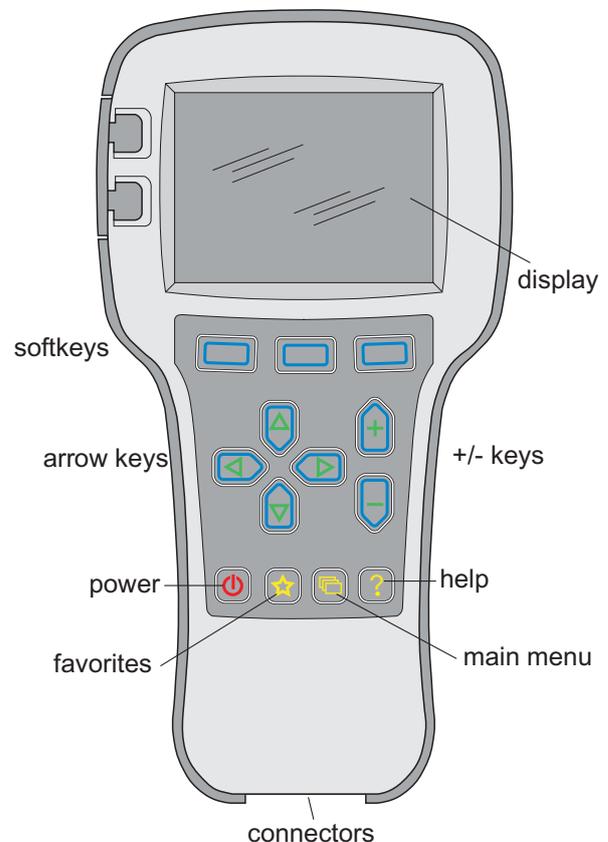


Figure01509 Hand Held Programmer

- Put the controller into the diagnostic mode by pressing the "Arrow Keys" (Figure 01508). Using the Navigation key, select the Faults menu. Display the Faults menu by pressing the Right side of the Arrow Keys. Press the Right side of the Arrow Keys again to display the list of System Faults. The display should indicate "No Known Faults."

Release the brake by pulling down the steering arm into the operating position. The controllers LED should continue blinking a single flash and the programmer should continue to indicate no faults. If there is a problem, the LED will flash a diagnostic code and the programmer will display a diagnostic message. If you are conducting the checkout without a programmer, look up the LED diagnostic code in Table 1 .

When the problem has been corrected, it may be necessary to cycle the brake in order to clear the fault code.

- With the brake released, select a direction and operate the throttle. The motor should begin to turn in the selected direction. If it does not, verify the wiring to the forward/reverse switches and motor. The motor should run proportionally faster with increasing throttle. If not, refer to Paragraph A-1.8.
- Put the controller into the test mode by using the Arrow Keys to select the "Monitor" menu. Select the Monitor mode by pressing the "Right" arrow on the Arrow Keys. Press the Arrow key "Down" arrow to scroll down to observe the status of the forward, reverse, brake, emergency reverse, and mode switches. Cycle each switch in turn, observing the programmer. Each input should show the correct state on the programmer.
- Check the controller's fault detection circuitry as described in Paragraph A-1.5.
- Take the vehicle off the blocks and drive it in a clear area. It should have smooth acceleration and good top speed.
- Test the plug braking of the vehicle. The vehicle should smoothly slow to a stop and reverse direction, with the audible plugging tone.
- Verify that all options, such as high pedal disable (HPD), static return to off (SRO), and anti-tiedown, are as desired.
- Check to see whether the emergency reverse (belly button) feature is working correctly. Verify that the circuit is operational by momentarily disconnecting one of the emergency reverse wires. The vehicle should be disabled and a fault indicated.

5.4.5. Diagnostic History

The handheld programmer can be used to access the controller's diagnostic history file. When the programmer is connected to the unit, the error log file is automatically uploaded into the handheld programmer.

To see the present status of the unit, use the Arrow Keys (Figure 01509) to select:

Faults->System Faults.

To access this log, use the Arrow Keys to select:

Faults->Fault History.

The faults are shown as a code and descriptive text. If there are multiple faults, you have to scroll through the list using the Up and Down Buttons on the Arrow Keys.

The faults may be intermittent faults, faults caused by loose wires, or faults caused by operator errors. Faults such as HPD or over-temperature may be caused by operator habits or by overloading.

After a problem has been diagnosed and corrected, clearing the diagnostic history file is recommended. This allows the controller to accumulate a new file of faults. By checking the new diagnostic history file at a later date, you can quickly determine whether the problem has been completely fixed.

To clear the diagnostic history file, select:

Faults->Clear Fault History.

You will be asked to confirm your actions. Use the "plus" arrow (+) for yes to clear the menu and the "minus" arrow (-) to cancel your selection and not clear the Fault History.

5.4.6. Test the Fault Detection Circuitry

1. Put the vehicle up on blocks to get the drive wheel off the ground.
2. Turn off the key switch and disconnect the batteries.
3. Using an inline fuse holder fitted with a 10 amp fuse and alligator clips, connect the controller's M and B- terminals.

4. Reconnect the batteries and turn on the key switch .
5. Leave the key switch on and remove the in-line fuse wire. The vehicle status should continue to remain off.
6. Cycle the key switch off and on. Release the brake and apply the throttle. The vehicle should now operate normally.

5.4.7. Programmable Parameters

The controller has a number of parameters that can be programmed using the handheld programmer. These programmable parameters allow the vehicle's performance characteristics to be customized to fit the needs of individual vehicles or vehicle applications.

The OEM can specify the default value for each parameter and can also designate whether a parameter will have User or OEM access rights. Accordingly, programmers are available in User and OEM versions. The User programmer can adjust only those parameter with User access rights, whereas the OEM programmer can adjust all the parameters.

The MultiMode™ feature of the controller allows operation in two distinct modes: Mode 1 and M2. These modes can be programmed to provide four different sets of operating characteristics, which can be useful for operating in different conditions. Mode 1 could be programmed such that the vehicle moves slowly for precise, indoor maneuvering, and Mode 2 programmed for higher speed, long distance travel outdoors.

The controller is in Mode 2 when the mode switch is in the On position (input connected to B+). Leaving the mode input floating or actively switching it Off (pulling it to B-) puts the controller in Mode 1.

The Speed menu allows the maximum speed in forward and reverse to be set independently in Mode 1 and Mode 2. The position of the speed limit pot determines whether the programmed Max Speed or Min Speed - or a speed between thee two programmed speeds - is in effect. Speed is varied linearly over the range between the two speeds in each mode, in forward and reverse

5.4.8. Diagnostics and Troubleshooting

The motor controller provides diagnostics information to assist in troubleshooting drive system problems. The diagnostics information can be obtained in two ways:

- Reading the appropriate display on the programmer.
- Observing the fault codes issued by the panel mounted Status LED.

5.4.8.1. LED Diagnostics

During normal operation with no faults present, the Status LED is steady on. If the controller detects a fault the Status LED flashes a fault identification code continuously until the fault is corrected.

NOTE: The Status LED can only indicate one fault at a time. If multiple faults are detected, the highest priority fault code flashes until it is cleared.

With Fault Code Type parameter is set to 0, the status LED uses the fault codes listed in Table 1. Six single-digit codes are used: 2, 3, 5, 6, 7, and 9.

For suggestions about possible causes of the various faults, refer to Table 2 Troubleshooting Chart.

5.4.9. Programmer Diagnostics

With a programmer, diagnostics and troubleshooting is more direct than with the LED alone. The programmer presents complete diagnostic information in plain language - no code to decipher. Faults are displayed in the Diagnostic Menu, and the status of the controller inputs/outputs is displayed in the Test Menu.

The following 4-step process is generally used for diagnosing and troubleshooting an inoperative vehicle using the programmer:

1. Visually inspect the vehicle for obvious problems:
2. Diagnose the problem:
3. Test the circuitry with the programmer:
4. Correct the problem.

Repeat the last three steps as necessary until the vehicle is operational.

Refer to the Table 2 for suggestions covering a wide range of possible faults.

Table 1 LED Codes

LED Code		Explanation
LED Off	Not illuminated	No power or defective controller
Solid On	Always on	Controller operational, no faults
2	00	Undervoltage Fault
3	000	Overvoltage Fault
5	00000	Brake ON Fault
6	000000	HPD Fault Wiring Fault *
7	0000000	Speed Pot Fault Throttle Fault
9	000000000	Battery Disconnect Fault* Brake OFF Fault Current Sense Fault* EE Checker Fault† Hardware Failsafe* Main Fault* Main OFF Fault Main ON Fault Precharge Fault*
* = Must cycle keyswitch to clear		
† = Must use programmer to clear, as follows: select Program menu, alter data value of any parameter, cycle keyswitch.		

Table 2 Troubleshooting Chart

LED CODE	PROGRAMMER LCD DISPLAY	POSSIBLE CAUSE	FAULT CLEARANCE
9	Battery Disconnect Fault	Battery disconnected	1. Battery not connected. 2. Poor connection to battery terminals.
9	Battery OFF Fault	Brake OFF Fault	1. Electromagnetic brake driver open. 2. Electromagnetic brake coil shorted.
5	Brake ON Fault	Brake ON fault	1. Electromagnetic brake driver shorted. 2. Electromagnetic brake coil open.
9	Current Sense Fault	Current sense out of range	1. Short in motor on in motor willing. 2. Controller failure. *
9	EEPROM Checksum Fault	EEPROM fault	EEPROM failure or fault
9	Hardware Failsafe	Motor voltage out of range	1. Motor voltage does not correspond to throttle request. 2. Short in motor or in motor wiring. 3. Controller failure.*
6	HPD Fault	HPD (High Pedal Disable)	1. Improper sequence of throttle and KSI, push or inhibit pot. 2. Misadjusted throttle pot.
9	Main Fault	Main contactor fault	1. Main contractor welded or stuck open. 2. Main contactor driver fault.
9	Main OFF Fault	Main contactor driver Off fault	Main contactor driver failed open.
9	Main ON Fault	Main contactor driver On fault	Main contactor driver failed closed.
3	Overvoltage Fault	Battery voltage too high	1. Battery voltage >31 volts. 2. Vehicle operating with charger attached. 3. Intermittent battery connection.
9	Precharge Fault	Precharge fault	1. Brake driver shorted. 2. Precharge circuit damaged. 3. MOSFET failure.
7	Speed POT Fault	Speed limit pot wiper out of range	1. Speed limit pot wire(s) broken or shoted. 2. Broken speed limit pot.

Table 2 Troubleshooting Chart- Continued

LED CODE	PROGRAMMER LCD DISPLAY	POSSIBLE CAUSE	FAULT CLEARANCE
7	Throttle Fault	PotLow and /or PotWiper out of range	<ol style="list-style-type: none">1. Throttle input wire open or shorted.2. Throttle pot defective.3. Wrong throttle type selected.
2	Undervoltage Fault	Battery voltage too low	<ol style="list-style-type: none">1. Battery voltage <17 volts.2. Bad connection at battery or controller.
6	Wiring Fault	HPD fault present >10 sec.	<ol style="list-style-type: none">1. Misadjusted throttle.2. Broken throttle pot or throttle mechanism.