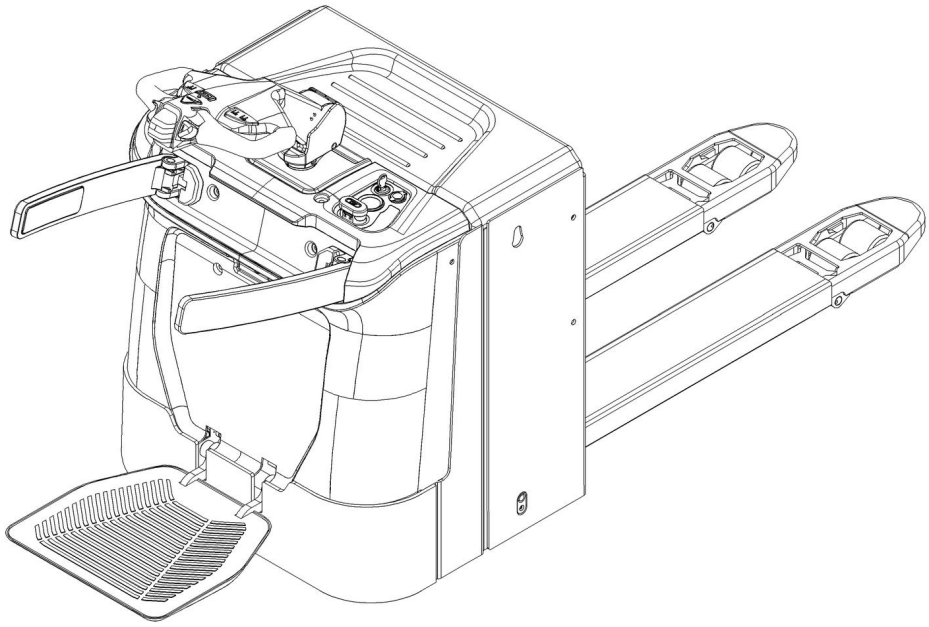
20EPR-X, 25EPR-X

Electric Pallet Truck

Service Manual



WARNING

Do not use the pallet truck before reading and understanding this manual.

NOTE:

- **Please check the designation of your present type at the last page of this document as well as on the ID-plate.**
- **Keep for future reference.**

FOREWORD

Before operating the truck, read this ORIGINAL INSTRUCTION HANDBOOK carefully and understand the usage of the truck completely. Improper operation could create danger.
This handbook describes the usage of different electric pallet trucks. When operating and servicing the truck, make sure, that it applies to your type.

Please take care of it for future use. If this manual or warning/warning label is damaged or lost, please contact your local dealer for replacement.

This truck complies with the requirements according to EN 3691-1; -5 (Industrial trucks- safety requirements and verification, part 1; part 5), EN 12895 (Industrial trucks- electromagnetic compatibility), EN 12053 (Safety of industrial trucks- test methods for measuring noise emissions), EN 1175-1 (Industrial truck safety – electrical requirements), assumed the truck is used according to the described purpose.
The noise level for this machine is 69 dB(A) according to EN 12053.
The vibration is 0,85 m/s2 (if equipped with a platform) according to EN 13059.

ATTENTION:

- Environmentally hazardous waste, such as batteries, oil and electronics, will have a negative effect on the environment, or health, if handled incorrectly.

- The waste packages should be sorted and put into solid dustbins according to the materials and be collected disposal by local special environment protection bureau. To avoid pollution, it's forbidden to throw away the wastes randomly.

- To avoid leaking during the use of the products, the user should prepare some absorbable materials (scraps of wooden or dry duster cloth) to absorb the leaking oil in time. To avoid second pollution to the environment, the used absorbable materials should be handed in to special departments in terms of local authorities.

- Our products are subject to ongoing developments. Because this handbook is only for the purpose of operating /servicing the pallet truck, therefore please have understanding, that there is no guarantee out of particular features out of this handbook.

NOTE: On this manual, the left sign means warning and danger, which can lead to death or serious injury if not followed.

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1. CORRECT APPLICATION

It is only allowed to use this electric pallet truck according to this service manual.

The trucks described in this manual are self-propelled electric power pallet trucks, with electrically powered low height lifting function as well for trucks with mast-lift and initial lift. The trucks are designed to lift, lower and transport palletized loads.

A wrong usage can cause human injuries or can damage equipment.
The operator/ the operating company has to ensure the correct usage and has to ensure, that this pallet truck is used only by staff, which is trained and authorized to use this truck.

The pallet truck has to be used on substantially firm, smooth, prepared, level and adequate surfaces. The truck is intended to be used for indoor applications with ambient temperatures between +5°C and + 40°C and for various transportation applications without crossing permanent obstacles or potholes. Operating on ramps is not allowed. While operating, the load must be placed approximately on the longitudinal center plane of the truck.
Lifting or transporting people is forbidden.

If used on tail lifts or loading ramps, please ensure that these are used correctly according to the operating instructions.

The capacity is marked on capacity sticker as well on the Identification plate. The operator has to consider the warnings and safety instructions.
Operating lighting must be minimum 50 Lux.

Modification
No modifications or alterations to this pallet truck which may affect, for example, capacity, stability or safety requirements of the truck, shall be made without the prior written approval of the original truck manufacturer, its authorized representative, or a successor thereof. This includes changes affecting, for example braking, steering, visibility and the addition of removable attachments. When the manufacturer or its successor approve a modification or alteration, they shall also make and approve appropriate changes to capacity plate, decals, tags and operation and maintenance handbooks.

By not observing these instructions, the warranty becomes void.

2. DESCRIPTION OF THE PALLENT TRUCK

a. Overview of the main components

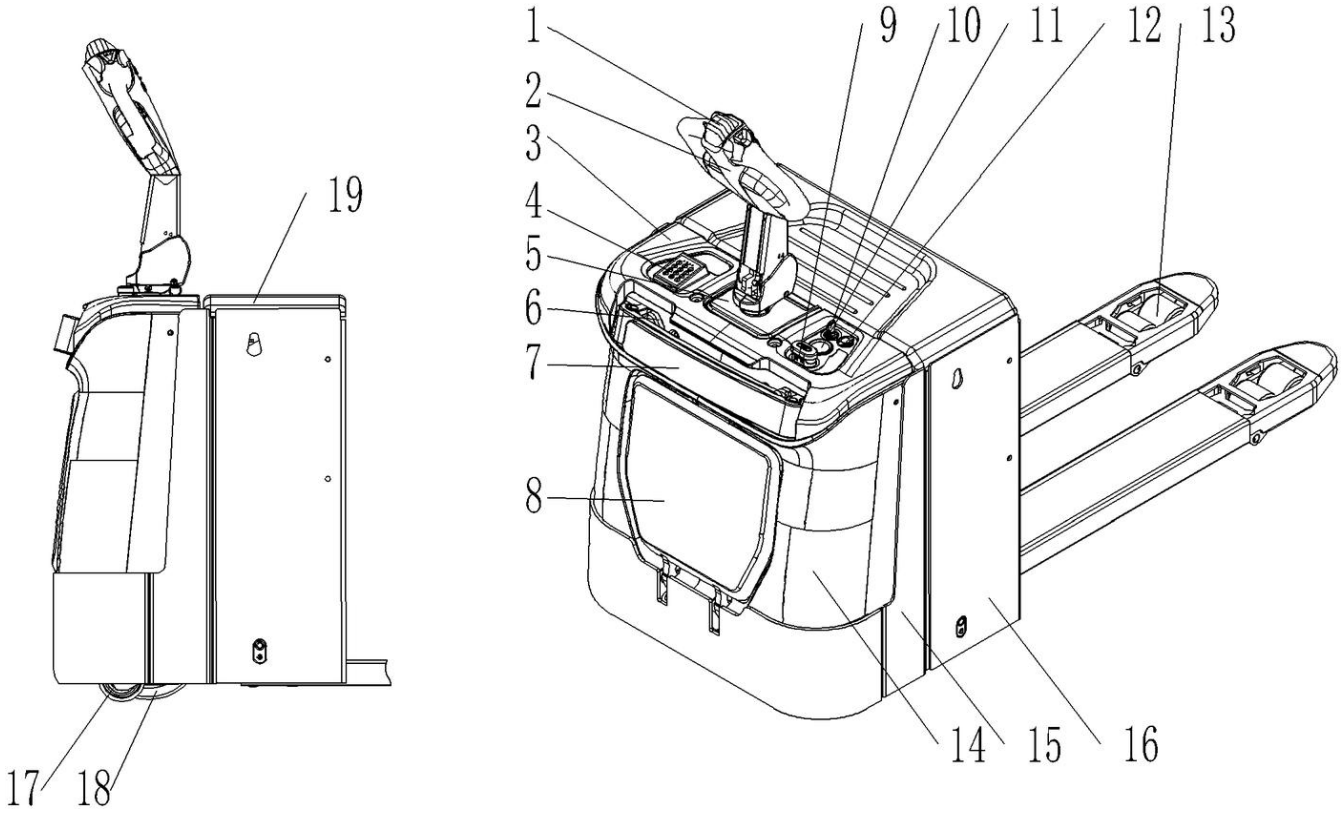


Fig.1: Overview main components

1. Safety (belly) button
2. Tiller
3. Top cover
4. Pin-code panel
5. Middle cover
6. Protective arm cover
7. Protective arm
8. Platform
9. Emergency button
10. Key switch
11. Battery level indicator
12. USB port
13. Load roller
14. Main cover
15. Frame
16. Chassis
17. Side roller
18. Driving wheel
19. Battery cover

b. Main technical data

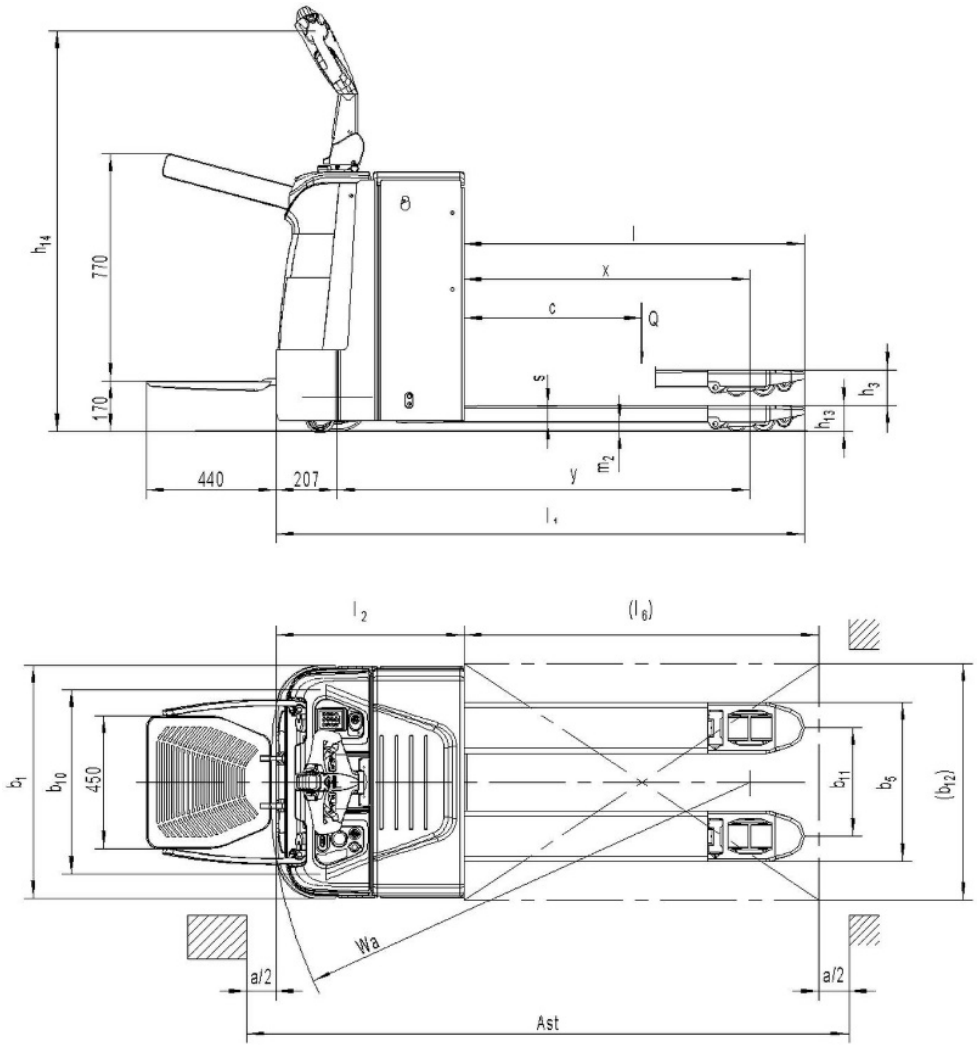


Fig. 2: Technical data

Table1: Main technical data for standard version

Type sheet for industrial truck acc. to VDI 2198					
Distinguishing mark	1.2	Manufacturer`s type designation		20EPR-X	25EPR-X
	1.3	Power(battery,diesel,petrol gas,manual)		Electric	
	1.4	Operator type		Pedestrian/ Stand	
	1.5	Load Capacity / rated load	Q (t)	2.0	2.5
	1.6	Load center distance	c (mm)	600	600
	1.8	Load distance, center of drive axle to fork	x (mm)	892 1)	892 1)
	1.9	Wheelbase	y (mm)	1330 1) 2)	1435 1)
Weight	2.1	Service weight	kg	650	820
	2.2	Axle loading, laden front/rear	kg	1110/1540	1370/1950
	2.3	Axle loading, unladen front/ rear	kg	510/140	600/200
Tire, chassis	3.1	Tires		Polyurethane (PU)	
	3.2	Tire size, front	∅ x w (mm)	∅210X70	
	3.3	Tire size, rear	∅ x w (mm)	∅84×84	
	3.4	Additional wheels (dimensions)	∅ x w (mm)	∅100x40	
	3.5	Wheels, number front/ rear(x=driven wheels)		1x + 2/4	
	3.6	Tread, front	b_{10} (mm)	560	
	3.7	Tread, rear	b_{11} (mm)	367/512	
Dimensions	4.4	Lift height	h_3 (mm)	120	
	4.9	Height of tiller in drive position min. / max.	h_{14} (mm)	950/1350	
	4.15	Height, lowered	h_{13} (mm)	85	
	4.19	Overall length	l_1 (mm)	1790 2) 3)	1895
	4.20	Length to face of forks	l_2 (mm)	640 2) 3)	745 3)
	4.21	Overall width	b_1 (mm)	790	
	4.22	Fork dimensions	s/e/l (mm)	55/173/1150	
	4.25	Distance between fork-arms	b_5 (mm)	540/685	
	4.32	Ground clearance, center of wheelbase	m_2 (mm)	30	
	4.33	Aisle width for pallets 1000 x 1200 crossways	Ast (mm)	2400 2) 3)	2505 3)
	4.34	Aisle width for pallets 1000X1200 lengthways	Ast (mm)	2290 2) 3)	2395 3)
	4.35	Turning radius	Wa (mm)	1585 2)3)	1690 3)
Performance	5.1	Travel speed, laden/ unladen	km/h	7.0/8.0	6.0/7.0
	5.2	Lift speed, laden/ unladen	m/s	0.025/0.030	0.035/0.045
	5.3	Lowering speed, laden / unladen	m/s	0.030/0.025	0.045/0.050
	5.8	Gradeability, laden/ unladen	%	8/15	
	5.10	Service brake		Electromagnetic	
Motors	6.1	Drive motor rating S2 60min	kW	1.4	
	6.2	Lift motor rating at S3 10%	kW	0.8	2.2
	6.3	Battery acc. to DIN 43531 /35 / 36 A, B, C, no		/	/
	6.4	Battery voltage, nominal capacity K5	V/ Ah	24/210	24/350
	6.5	Battery weight (minimum)	kg	185	285
	6.6	Energy consumption acc. to VDI cycle	KWh/h	0.36	0.9
Others	8.1	Type of drive control		AC -Speed Control	
	8.4	Sound level at driver`s ear acc. to EN 12053	dB(A)	69	
	1）Load section lowered:+65mm；2）With side battery removal: + 30 mm；3）With unfolded platform: + 440 mm				

c. Description of the safety devices and warning labels

A Instruction label
B Warning label
C Load label
D Hock
E Identification plate
F Oil point injection label
G Indication label
H Warning information

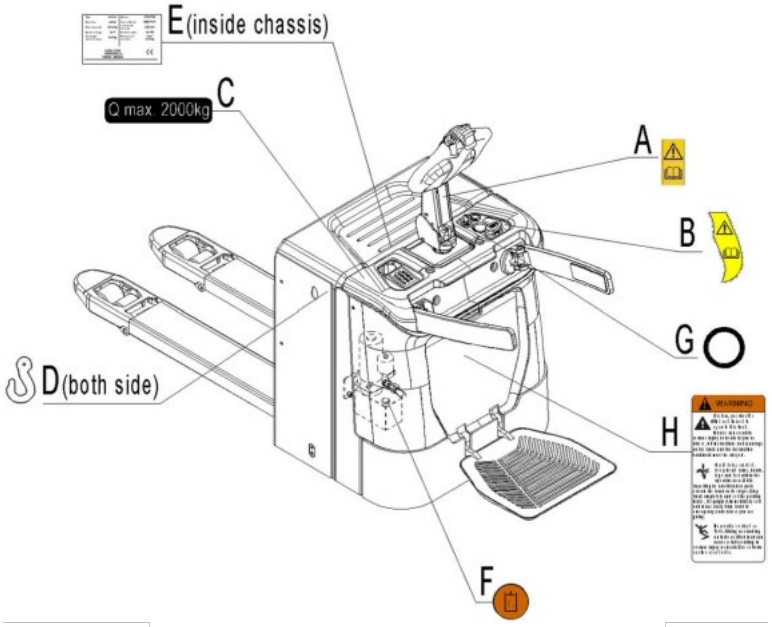


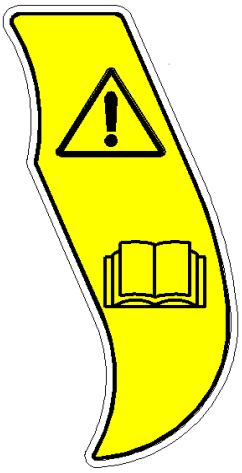
Fig. 3: Safety and warning labels

The truck is equipped with an emergency switch (9) which stops all lifting-, lowering-, driving- functions and engages the failsafe electromagnetic brake when it is pushed.

By pulling this button, the truck can be operated after the controller checked the functions. Before operating, insert the key and turn the switch (10) clockwise or, in case the truck is equipped with Pin-code panel, press the start-button and enter the Pin-code or use RFID access card. To prevent against unauthorized access, turn the key anti-clockwise and remove it if you do not operate this truck or, in case the truck is equipped with Pin-code panel, press the start-button or press the X button of pin-code panel. The truck is equipped with a safety (belly) button (1) which switches the driving function away from the operator, if the truck travels towards the operator and the tiller is activated in the tillers operating zone. Follow also the instructions given on the decals. Replace the decals if they are damaged or missing.

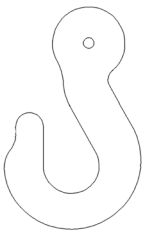
Sign read and follow this instruction (A)

Warning sticker (B)



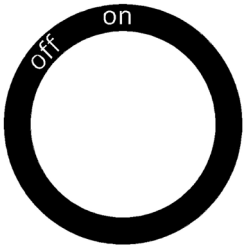
Capacity sticker (C)

Crane hook label (D)



Sign oil filling point (F)

Indicating sticker (G)



Sign warning stay clear stop truck (H)

d. Identification plate

1 Designation, type
2 Serial number
3 Rated capacities in kg
4 Supply voltage in V
5 Own mass (self weight) in kg without battery
6 Name and address of manufacturer)
7 Battery weight minimum/ maximum
8 Nominal power in kW
9 Load center distance
10 Manufacturing date
11 Option

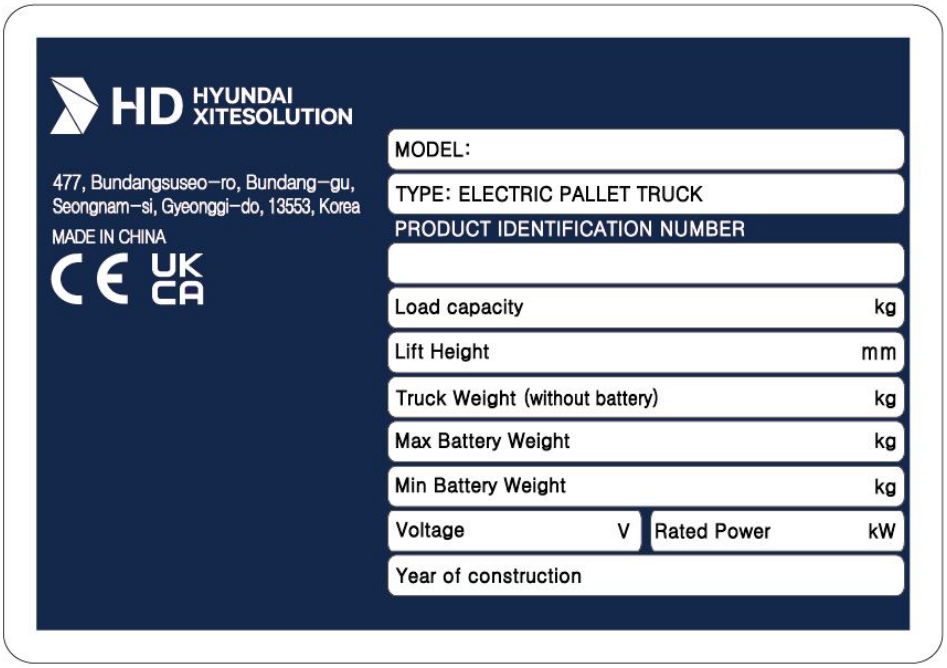


Fig. 4：Identification plate

3. WARNINGS, RESIDUAL RISK AND SAFETY INSTRUCTIONS

DO NOT

- Put foot or hand under or into the lifting mechanism.
- Allow other person than the operator to stand in front of or behind the truck when it is moving or lifting/lowering.
- Overload the truck.
- Put foot in front of the wheels, injury could result.
- Lift people. People could fall down and suffer severe injury.
- Push or pull loads
- Use this truck on ramps
- Side or end load. Load must be distributed evenly on the forks.
- Use the truck with unstable, unbalanced not stable load.
- Use truck without manufacturer's written consent.
- Lifted loads could become unstable at wind forces. In the case of wind forces do not lift the load if there is any influence to the stability

Watch difference in floor levels when driving. Load could fall down or the truck could get uncontrollable.

Keep watching the condition of load. Stop operating the truck if load becomes unstable.

Brake the truck and activate the emergency button (9) by pushing when sliding load on or off the truck. If the truck has any malfunctions, follow chapter 10.

Practice maintenance work according to regular inspection. This truck is not designed to be water resistant. Use the truck under dry condition. Prolonged continuous operation might cause damage of the power pack. Stop operation if temperature of hydraulic oil is too high.

- When operating the electric pallet truck, the operator has to wear safety shoes.
- The truck is intended to be used for indoor applications with ambient temperatures
- between +5□ C and + 40□ C.
- The operating lighting must be minimum 50 Lux.
- It is not allowed to use the truck on ramps.
- To prevent unintended sudden movements when not operating the truck (i.e. from another person, etc.), switch off the truck and remove the key.
- In case of moving the load which overlap the field of view on forward/backward direction use visual assistance from trained personnel

4. COMMISSIONING, TRANSPORTING, DECOMMISSIONING

a. Commissioning

b. Commissioning data

Table2:

Type	20EPR-X	25EPR-X
Hauled weight [kg]	670 kg	800 kg
Dimensions [mm]	1865x730x1390	1950x730x1390

After receiving our new pallet truck or for re-commissioning you have to do the following before (firstly) operating the truck:

- Check if are all parts included without damage.
- Installation of the multifunction tiller.
- Installation and charging of the batteries (follow chapter 7)
- Daily inspections, and functional check of machine.

c. Lifting/ transportation

For transporting, remove the load, lower the forks to the lowest position and fix the truck safely with dedicated lifting gear according to the following figures.

Lifting

USE DEDICATED CRANE AND LIFTING EQUIPMENT
DO NOT STAND UNDER THE SWAYING LOAD
DO NOT WALK INTO THE HAZARDOUS AREA DURING LIFTING

Transportation

THE PALLET TRUCK MUST BE FASTEN TO THE TRUCK FIRMLY DURING TRANSPORTATION.

Lower the forks and park the truck securely.

Fasten the truck according to fig. 6 by fixing dedicated lashing belts to each side of the trucks crane hook holes and fasten the other side to the transporting truck.

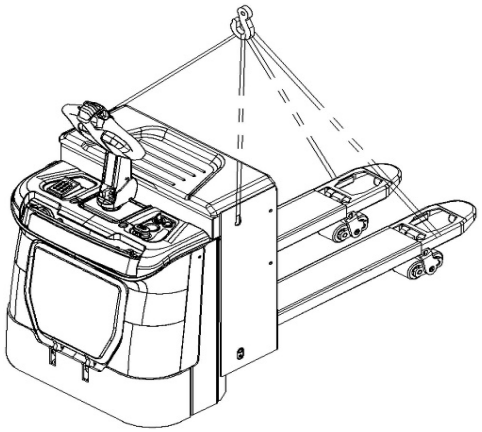


Fig. 5: Lifting with a crane

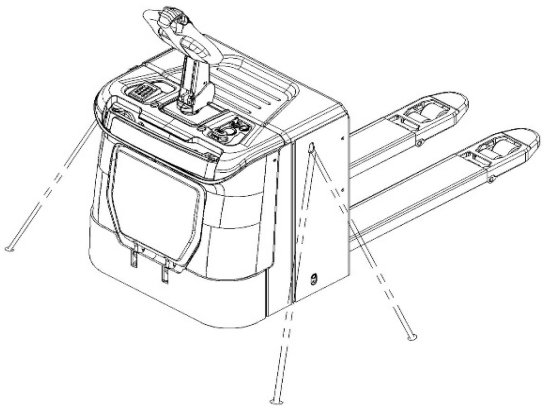


Fig. 6: fixing point

d. Decommissioning

For storage, remove the load, lower the truck to the lowest position, grease all greasing points mentioned in this handbook (regular inspection), eventually protect the truck against corrosion and dust. Remove the batteries and jack the truck safely to make sure no flattening after storage.

For final decommissioning hand the truck to a designated recycling company. Oil, batteries and electric components must be recycled due to legal regulations.

5.DAILY INSPECTION

This chapter describes pre-shift checks before putting the truck into operation.

Daily inspection is effective to find the malfunction or fault on this truck. Check the truck on the following points before operation.

Remove load from truck and lower the forks.

DO NOT USE THE TRUCK IF ANY MALFUNCTION.

Check for scratches, deformation or cracks.

Check if any oil leakage from the cylinder.

Check the vertical creep of the truck.

Check if the movement of the wheel agility

Check the function of the emergency brake by activating the emergency button

Check the tiller arm- switch braking function

Check the lifting and lowering functions by operating the buttons.

Check if all the bolts and nuts are tightened firmly.

Visual check if any broken hoses or electric wires.

6.OPERATING INSTRUCTIONS

BEFORE OPERATION, PLEASE FOLLOW THE WARNINGS AND SAFETY INSTRUCTIONS (CHAPTER 3).

Make sure the load is palletized and stable, and the daily inspection is necessary.

Insert the key switch (10), and start

Press the horn button (21) to activate the audible warning signal.

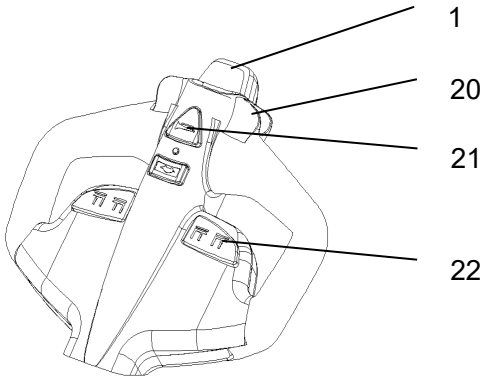


Fig7. **Tiller operating controls**

a. Parking

DO NOT PARK THE TRUCK ON INCLINED SURFACES

The truck is equipped with an electromagnetic failure stopping and parking brake.

Lower the forks completely, press the emergency switch (9), rotate the key anti-clockwise 90°and then remove the key

b. Lifting

DO NOT OVERLOAD! THE MAXIMUM CAPACITY IS 2000/2500 kg.

Lower the forks completely underneath the pallet when driving, and press the lifting button (Fig. 7, 22) to reach the desired lifting height.

c. Lowering

Press the lowering button (22) carefully.

Lower the load to the bottom, then drive the truck away from the load area carefully.

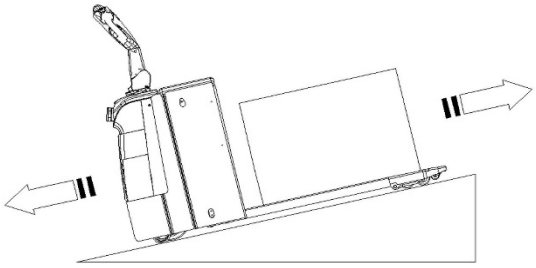


Fig.8: Load facing upward

d. Travelling

TRAVEL ON INCLINES AVAILABLE ONLY IF THE LOAD FACING UPWARD.

DO NOT TRAVEL ON INCLINES IF THE TECHNICAL DATA EXCEEDED

Start the truck by turning on the key switch (10), or activate by Pin-code panel, move the tiller to the operating area ('F', fig.9). Turn the acceleration button to the desired direction forward 'Fw.' or backwards Bw.' (fig. 9).

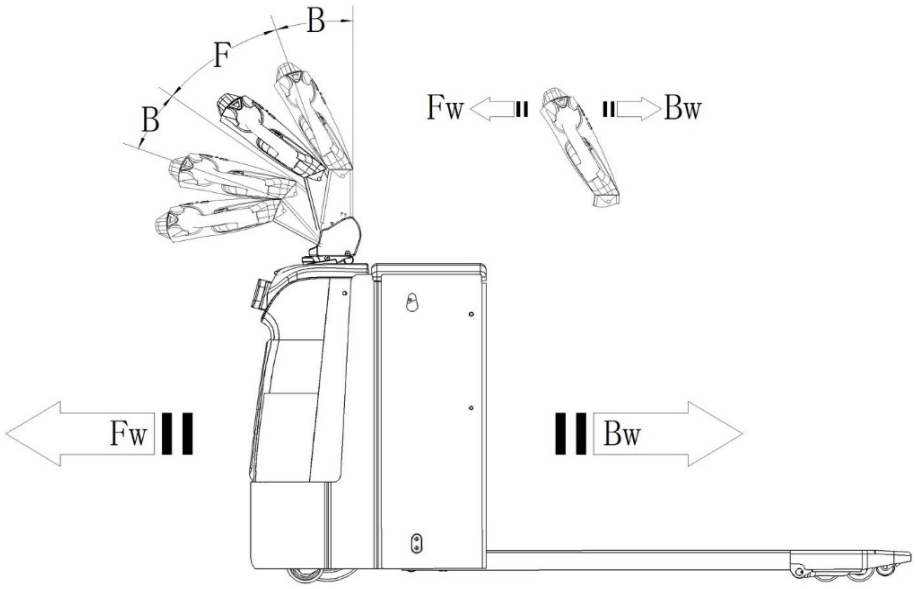


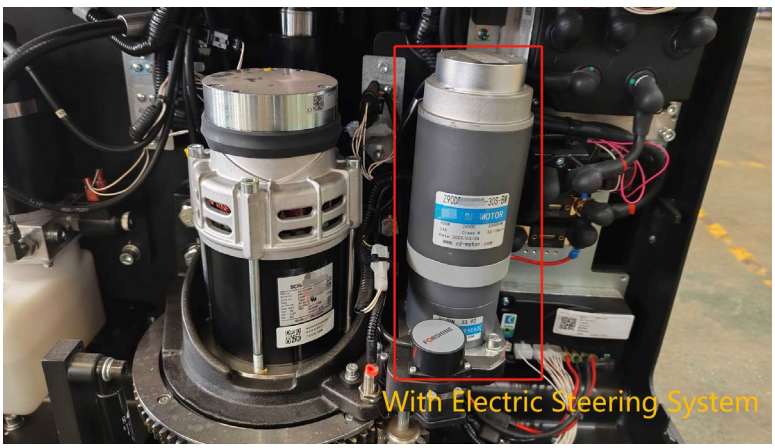
Fig 9: Operating direction

Control the travelling speed by moving the acceleration button (20) carefully to reach the desired speed.
If you move the acceleration button back to the center position, the controller decelerates the truck until stopped. the parking brake starts up.
Drive the truck carefully to the destination. Watch the route conditions and adjust the travelling speed with the accelerator-button.

e. Steering

THE TRUCK CAN BE OPTIONAL EQUIPPED WITH AN ELECTRIC STEERING SYSTEM. BE CAREFUL WHEN OPERATING A TRUCK WITH THIS KIND OF SYSTEM; THE OPERATION OF THE TRUCK WILL BE DIFFERENT IF WITH THE ELECTRIC STEERING SYSTEM OR NOT.

Move the tiller to left or right side for steering



f. Braking

THE BRAKING PERFORMANCE DEPENDS ON THE ROAD CONDITONS AND THE LOAD CONDITONS OF THE TRUCK

The braking function can be activated by several ways below:

- By moving the acceleration button (20) to the initial position ‘0’ or by releasing the button, the regenerative braking is activated. The truck brakes until it stops.
- By moving the acceleration button (20) from one driving direction directly to the opposite direction, the truck brakes regenerative to start travelling to the opposite direction.
- The truck brakes, if the tiller is moved up or down to the braking area (‘B’). when releasing the tiller, it moves automatically up to the upper baking area (‘B’).
- The truck brakes until it stops.
- The safety (belly) button (1) prevents the operator from being crushed. If this button is activated, the truck decelerates and/ or starts travelling to the backwards direction (‘Bw.’) for a short distance and then stops.
- This button is also available if the truck not travels when tiller was in the operating area.

g. Malfunctions

If there are any malfunctions or the truck cannot be operated, please stop using the truck and press the emergency button (9). If possible, park the truck in a safe area, turn the key counterclockwise, and remove the key switch. If the truck is equipped with Pin-code panel, press the start-button or press the X button of pin-code panel. Inform the manager or after-sales customer service immediately. If necessary, tow the truck out of the operating area by using dedicated towing/ lifting equipment.

h. Emergency

In emergencies or the truck overturned (or off dock), please keep the safe distance immediately. If possible press the emergency button (9). All electrical functions will be stopped.

7.PIN-CODE PANEL

The truck can be equipped optional with a pin-code panel (4), start button (26) will replace the key switch (10) if equipped with pin-code panel.

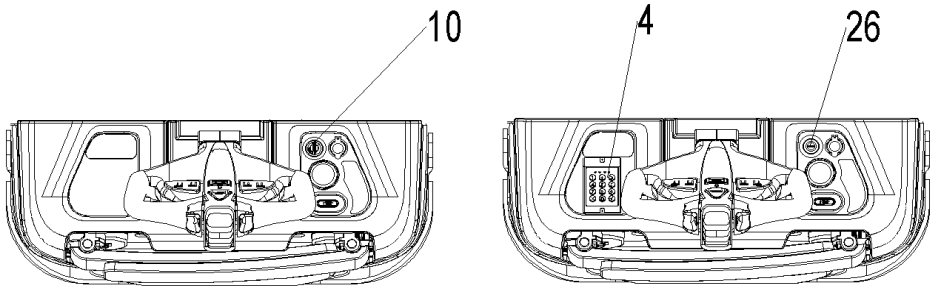


Fig.10: Pin-code panel

a. Introduction

Pin-code panel is an electronic system which is similar to an electronic alarm system. Truck will not available before entering a correct password, the main function is to prevent unauthorized operation. It is not only more convenient, but also helpful for the security.

b. Main parameters

Working voltage：12V-60V
Ambient temperature：-40℃ to +90℃
IP grade：IP65

c.Main functions

Truck can be operated only when typing the correct password or swiping the card properly.

Administrator password can be checked on the separate instruction. Default user password is 1234, which can be used directly. If changing the password, please refer to the separate instruction.

d.Operation

1.ID card

Putting the ID card close to the code panel, there will be a short buzzer if the ID card is available, then the blue light brights, truck can be operated. (If the red light brights, that means there are mistakes during card starting or card is not valid. The truck can't be used)

2.Password

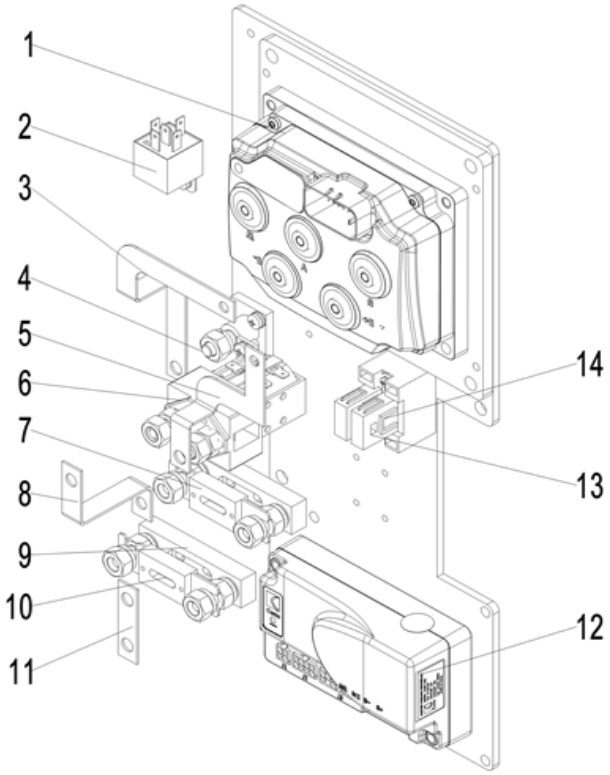
- Enter the password, press" √" button. If correct, the truck can be operated.
- Press "×" to turn off the truck, the truck will exit the operation mode.
  Restart operation needs to re-enter the password.

e. Pin-code panel indicator

Red-----fault code Yellow-----hold for further instruction
Blue-----active Green-----Power on

8.CONTROLLER AND ASSOCIATED EQUIPMENT

a. Controller appearance

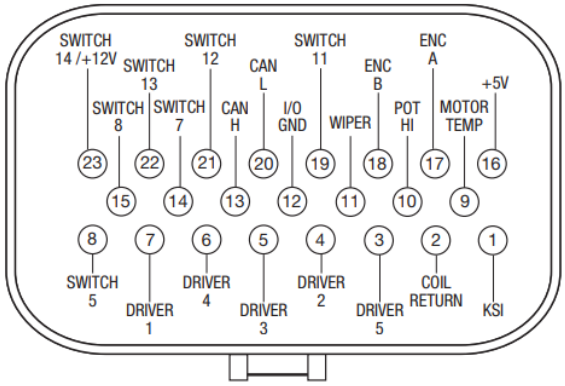


No	Materials
1	main controller
2	relay
3	copper bar
4	fuse block M8
5	copper bar
6	contactor
7	fuse 150A
8	copper bar
9	fuse SYY
10	fuse 80A
11	copper bar
12	steering controller
13	fuse block
14	fuse 10A

b. Controller pin definition

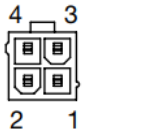
Curtis F2-A

Connector pin diagram



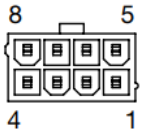
Curtis 1220E

Connector pin diagram



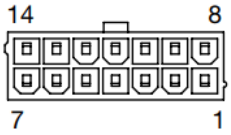
J1

Pin	Definition
1	Rx
2	I/O GND
3	Tx
4	+12V



J2

Pin	Definition
1	Home Switch 2
2	Interlock Input 2
3	Command Encoder 2A
4	Command Encoder 2B
5	Steer Motor Encoder 2A
6	Steer Motor Encoder 2B
7	CAN Term H
8	Aux Analog Input



J3

Pin	Definition	Pin	Definition
1	Fault Output	8	CAN H
2	Steer Motor Encoder 1A / Position Analog 1	9	Steer Motor Encoder 1B / Position Analog 2
3	Home Switch 1	10	I/O GND
4	Interlock Input 1	11	+5V Supply 2
5	KSI	12	CAN L
6	Comm and Analog 1 / Comm and Encoder 1A	13	Comm and Analog 2 / Comm and Encoder 1B
7	+5V Supply 1	14	I/O GND

c. Wiring/Circuit diagrams

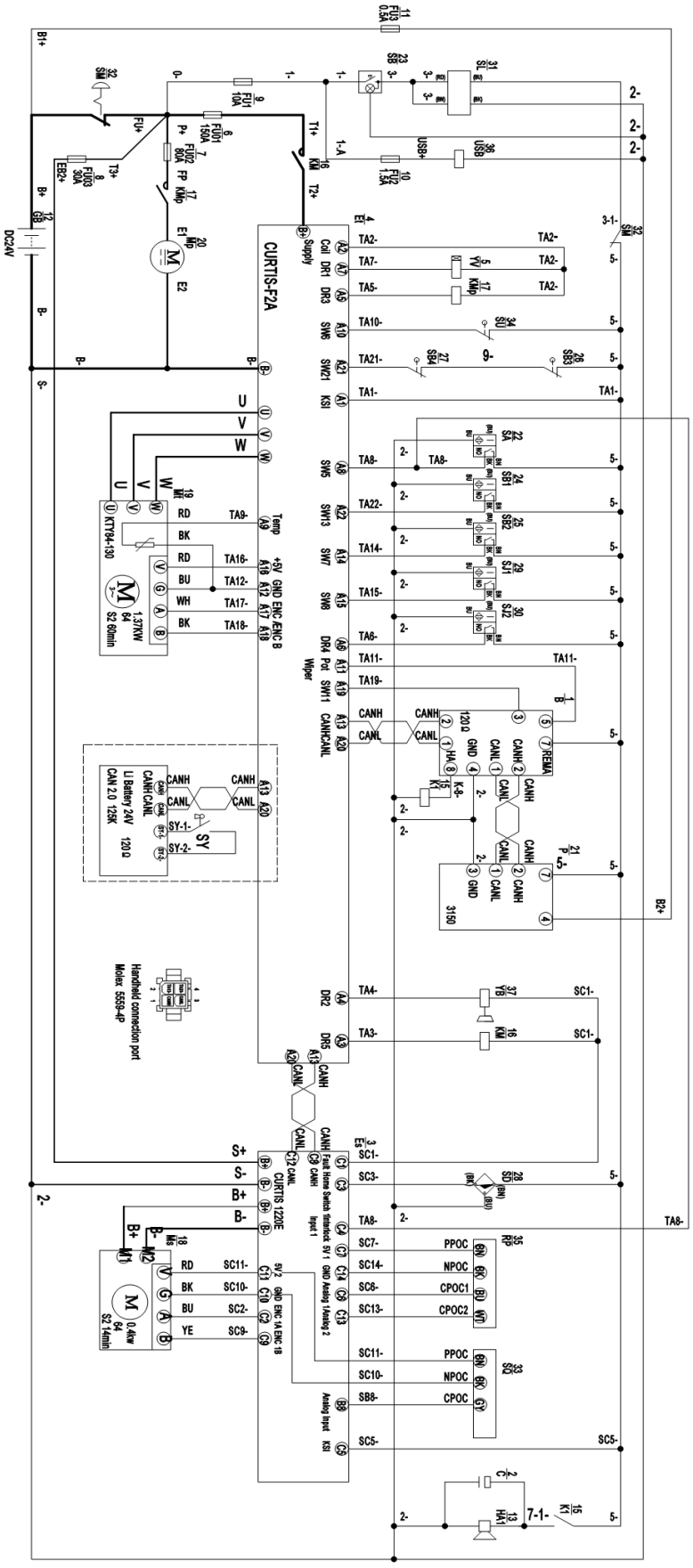


Fig. 11: circuit diagram **Curtis F2-A+EPS1220E**（Electric steering）EN1175 standard

Fig 3: symbol description

Code	Name	Code	Name
B	tiller	Ms	steering motor
C	capacity	Mt	pulling motor
Es	steering controller	SA	proximity switch
Et	traction controller	SB	button switch
FU01	fuse150A	SB1	interlock switch1
FU02	fuse 80A	SB2	interlock switch2
FU03	fuse 30A	SB3	interlock switch3
FU1	fuse 10A	SB4	interlock switch4
FU2	fuse tube1.5A	SD	proximity switch
FU3	fuse 0.5A	SJ1	micro switch1
GB	storage battery	SJ2	micro switch2
HA	trumpet	SL	coded lock
K	relay	SM	DC power switch
KM	master contactor	SQ	position sensor
KMp	pump station contactor	SU	micro switch
Mp	pump station motor	SY	key switch
P	power display table	RP	Two-phase potentiometer
USB	USB port	YB	electromagnetic brake

d.Testing and trouble clearing

Current fault codes can be viewed in the dashboard and handheld programmer

Testing

A. controller

Measure the diode voltage of the AC MOSFET circuit inside the controller (e.g. ZAPI), check for burn damage.

Testing according to the table as below, each test item must be tested repeatedly more than 3 times.

Item	Multimeter terminal		Range of normal value	
	red pen	black pen	polarity value determination	resistance determination
1	B+	U/V/W/B-		above 1MΩ
2	B-	U/V/W		above 1MΩ
3	U/V/W	B+	0.3-0.6V	
4	B-	U/V/W	0.3-0.6V	

Pull the multimeter to Ω position (resistance determination), pull the multimeter to diode position (polarity value determination).

1) Remove the cable and wiring harness that connected to the controller, and release the internal capacitor power completely. (Discharge the B+ and B- terminals with a resistance of 30Ω/5W)

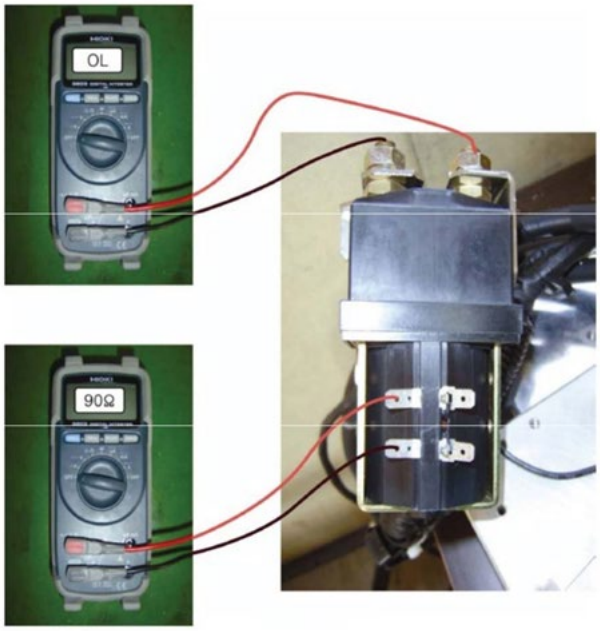
2) Measure the diode voltage with multimeter (0.3-0.6 V), and check if it is normal.

Test 1: Measure diode voltage, red wire B-, black wire U, V and W

Test 2: Measure diode voltage to U, V and W with red wire, and to B+ with black wire.

Note: The multimeter pointer cannot be reversely connected

B. Line contactor and fuses



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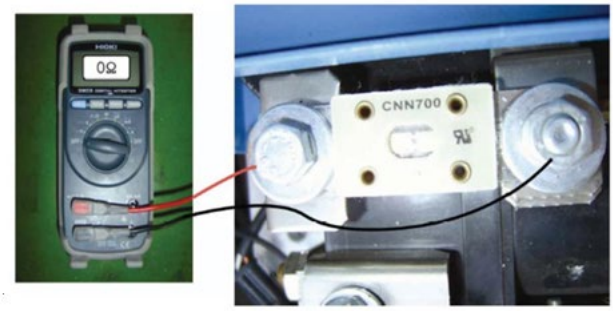


2-23

For the line contactor fuses, connect an Ohm meter at the point shown in the figure, and check if the specified value measured.

9. USAGE、CHARGING AND REPLACEMENT OF BATTERY

a. USAGE

- Only qualified personnel are allowed to service or charge the batteries. Be sure to follow this manual and the instructions of battery manufacture.
- Lead-acid batteries and Lithium batteries are allowed. Maintenance-free battery is optional, do not allow to refill these batteries.
- Battery recycling shall comply with national regulations. Please follow the regulations.
- When handling batteries, prohibit using open flame, which may cause gas explosion
- Burning materials or liquids are prohibited in the battery charging area. Smoking is prohibited. Good ventilation must be ensured in the area
- Park the truck safely before starting charging or installing/replacing the battery.
- Before completing the maintenance work, ensure that all cables are connected correctly and no interference to other parts of the truck.

For standard battery, the truck is equipped with the following lead-acid battery models:

20EPR-X 1 pc 2 PzS 24V/ 210 Ah (C5) [624 x 212 x 627 (LxWxH)] weight 185kg
25EPR-X 1 pc 3 PzS 24V/ 350 Ah (C5) [624 x 284 x 627 (LxWxH)] weight 288kg

LEAD-ACID BATTERIES AND LITHIUM BATTERIES ARE ALLOWED.
THE WEIGHT OF THE BATTERIES HAS SOME INFLUENCE ON THE TRUCKS OPERATING BEHAVIOR.
PLEASE CONSIDER THE MAXIMUM OPERATING TEMPERATURE OF THE BATTERIES.

b. REPLACEMENT

Regular truck models

Park the truck safely, switch off the key (10) or start button., and press the emergency button (9) to turn off the truck. Open the battery cover (19) and pull out its hinge. Then, remove the battery cover, pull out the battery plug (23), and take the battery out with a crane.
The installation is in the reverse order.

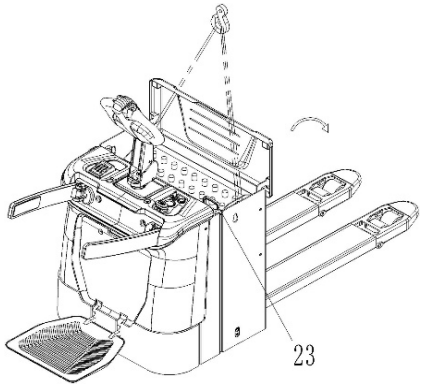


Fig. 12: battery replacement （ regular

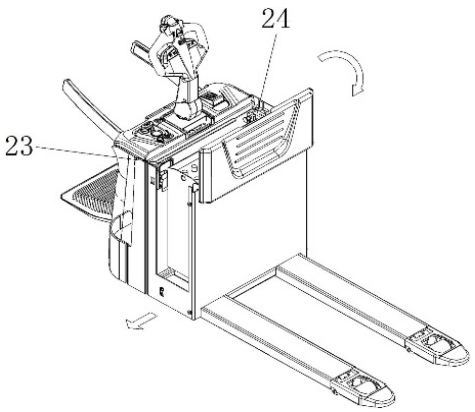
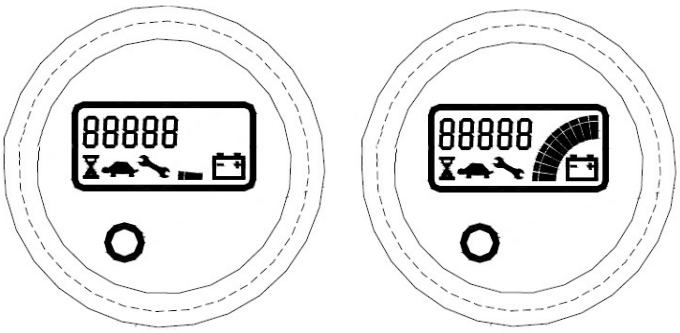


Fig. 13: battery replacement（regular models）

With sideways battery (optional)

Park the truck safely and turn off the truck with the key switch (or start-button) and press the emergency button (9). Disconnect battery plug (23) and lock pin (24). Open the battery locker, then pull out the battery from the side. The installation is the reverse order of the removal.

c. Battery indicator



Battery discharged Battery charged

Fig. 14: Battery discharge indicator

Hour meter

An alpha-numeric liquid crystal display is fitted in the center of the unit that shows the hours worked. The display is backlight (the backlight is normally lighted).

Alarms

The corresponding fault code will appear on the display if there is a truck malfunction. To attract attention, the red indicator light will start blinking.

Software version

When the key switch is initially closed, in case truck is equipped with pin-code panel, please press the start-button and start the truck by entering the Pin-code or swiping the card. The display shows the EP-ROM version for a few seconds (EPXXX, XXX represents the version) and then the controller EP-ROM version appears, each lasts for 2 seconds. Simultaneously the symbol of the wrench appears.

Battery State of charge 

The battery's state of charge indication is integrated in the LCD display; it is shown by ten LED display segments. Each segment represents 10% of the battery charge. As the battery gradually discharges, the LED lights go off, and only one at at a time. When the power is low, the battery symbol flashes, and the red indicator light also flashes.

Turtle Symbol: 

Generally, the turtle symbol is extinguished. The turtle symbol flashing means that the truck is in low speed mode.

Monkey Wrench Symbol 

Generally, the wrench symbol is extinguished. The wrench symbol flashing means that the fault needs to be fixed

Hourglass Symbol: 

Generally, the hourglass symbol is extinguished, the hourglass symbol flashing means that the hour meter is working.

Battery indicator（20CE:EN1175）

Fig.15: Battery discharge indicator

An alphanumeric liquid crystal display is mounted in the center of the unit to indicate the speed of the truck.

Alarms

The same display can also indicate the alarm status, show the fault code corresponding to the alarm type.

Battery State of Charge

The battery's state of charge indication is integrated in the LCD display; it is shown by ten notches. Each rectangle represents 10% of the battery charge. As the battery is discharged, the rectangles turn off progressively, one after the other, in proportion to the value of the residual battery charge. The power level of the battery is calculated and indicated by the display. When the power is low, the corresponding rectangle is yellow or red with a error code.

Hourglass Symbol:

The displayed information indicates the working time of the truck.

Working Status

The displayed information indicates the working status of the truck, that is, the driving or lifting status.

d. Charging

- Charge only with the attached charger.
- Before using the charger, please fully understand the charger instruction manual.
- Comply with these instructions!
- The charging room must be ventilated.
- Full charging status can be only checked from the discharge display, interrupt the charging process and start the truck to control this situation.
- Optional build-in charger can only be used with 110V or 220V.

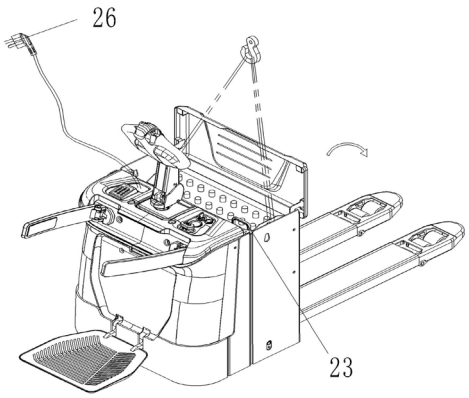


Fig. 16: Battery charging

External charger

Park the truck in a dedicated safety area with a dedicated power supply.
Lower the forks and remove the load.
Switch the truck off and connect the battery connector (23) to the power supply.
The charger starts to charge.
Connect the battery connector after fully charged.
If supplied, assemble the battery cover. Connect the battery plug with the plug at the truck.
When charging is finished, disconnect the connector from the socket and place it in the designated pocket.

Build-in charger

Parking the truck in a safety area which is dedicated for charging with a specific power resource.
Lower the forks and remove the load.
Turn off the power, pull out the power code (26), and connect directly to a rechargeable socket.
The charger starts to charge.
Disconnect the charging plug after charging and install the battery cover. After charging, disconnect the connector from the socket and place it in the designated position.
The charging LED lights (17,27) displayed green continuously, that means the charging is complete. The charge will enter a floating mode to prevent the battery damaged. Plug the power cord (26) back to the car body after the charging.

Table 4: LED light situation

LED light signal	function
red	discharge
orange	in charging
green	fully charged

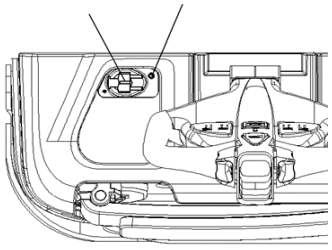


Table 5: Charger specifications (lead-acid battery)

model	specification	
20EPR-X	30A24V	
25EPR-X	45A24V	

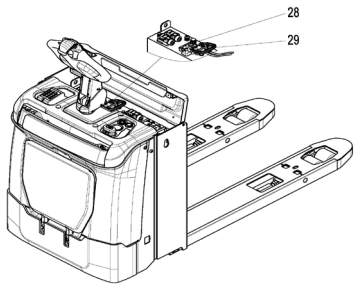


Fig 18: Lithium-ion charging

The external charger of lithium-ion battery

Parking the truck in a safety area which is dedicated for charging with a specific power resource.
Lower the forks and remove the load
Turn off the power, Open the battery cover and let it stay upright, connect the charging connector (28) and power connector (29). Start charging.
Disconnect the charging plug after charging and install the battery cover. After charging, disconnect the connector from the socket and place it in the designated position.

Charger specification

Manufacturer`s type designation	Battery type	Capacity	Charger specification
20EPR-X	24 V battery	2PzS-160Ah	24V /SN25A
	24 V battery	2PzS-210Ah	24V /SN30A
	24 V battery Li-Ion	100Ah	24V60A
	24 V battery Li-Ion	150Ah	24V60A
	24 V battery Li-Ion	200Ah	24V80A
25EPR-X	24 V battery	3PzS-270Ah	24V /SN35A
	24 V battery	3PzS-350Ah	24V /SN45A
	24 V battery Li-Ion	150Ah	24V60A
	24 V battery Li-Ion	200Ah	24V80A

e. Usage and maintenance of battery

a. AQUAMATIC SYSTEM

Please note the following if the truck equipped with aquamatic system.

Water After Charge

Electrolyte levels drop during discharge and rise during charge
Before charge (or with a low charge level) will lead to boil over resulting in potential damage of the watering system, battery and vehicle.

Water, when needed, must be added to a fully charged battery. Prior to charging, there must be sufficient water to cover the plates. If the battery has been discharged (partially or fully), the water level should still be above the plates

b. Watering Intervals

Watering intervals are dependent on the local climate, charging methods, application, and age of batteries. Flow-Rite recommends that new batteries be checked once a month and older batteries be checked weekly until you get a feel for your water consumption rate.

Typically for a heavy use application, watering a maximum of once per week is recommended, and for light use applications once per month. Do not water a battery that has been sitting for an extended period of time with no activity (non-use or not on charge) such as a battery that has sat idle over the weekend. It is best to water a warm battery that has just been fully charged.

Water quality is important to maintain the life of your battery and watering system. Always use water that meets the quality requirements of your battery's manufacturer.

c. Operation

1.Remove dust cover

Fig19：Remove dust cover

Fig20：Mate couplers

2. Mate couplers

Insert the male coupler on the single point watering system into the female coupler on the end of the water supply.

3.Observe flow indicator

As the cells fill, the red balls inside the flow indicator will spin. As the valves close, the balls will begin to spin slower until they come to a stop. This indicates that all valves have closed and filling is complete.

Fig.18: Observe flow indicator

Fig.19: Disconnect couplers

4.Disconnect couplers

When the balls stop spinning, and not before, immediately disconnect the couplers by depressing the push button on the female coupler

If the water supply is left connected after the filling process is finished,
it could lead to an overfill.
Disconnecting before the balls come to a complete stop will lead to underfilled cells.

5.Replace dust cover

Place dust cover back over the male coupler and place feed tube on top of battery.

Fig20：Replace dust cover

f. Description of the lithium-ion battery

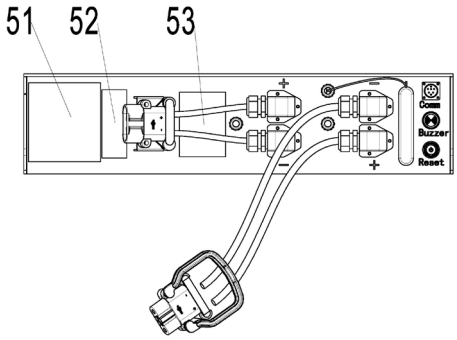
The lithium-ion battery is a battery with rechargeable cells, the battery is designed for industrial trucks and can withstand related vibrations during operation. The battery is equipped with special connections for charging and discharging operations. Do not try to install or connected improper connectors to the battery.

The battery is equipped with BMS – battery management system, which performs the control of battery condition and implements related safety protocols to protect the battery and cells from damages caused by operation or environmental conditions. The BMS controls the following safety functions and conditions: voltage, temperature, undervoltage, overvoltage, overtemperature and overcurrent.

Parameter of lithium-ion battery

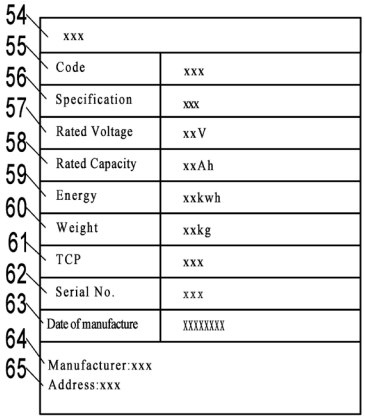
NO.	Item	Specifications	
1	Model	25.6V150Ah	
2	battery Cell	LPSNT-IFP09133202-25Ah	
3	Nominal capacity(0.5C1A)	150Ah @ 2.5V-3.65V	
4	rated voltage (working voltage)	25.6V	
5	Maximum charging voltage	29.2V	
6	End-off voltage	20V	
7	Maximum charging current	100A	
8	Maximum continuous discharge current	150A	
9	Heating function	Heating film	
10	Communication function	CAN	
11	Heat management	Natural heat dissipation	
12	Protection grade	IP54	
13	weight	210kg	
14	working temperature	charge	0℃~55℃
		discharge	-20℃~60℃
		storage	-10℃~45℃

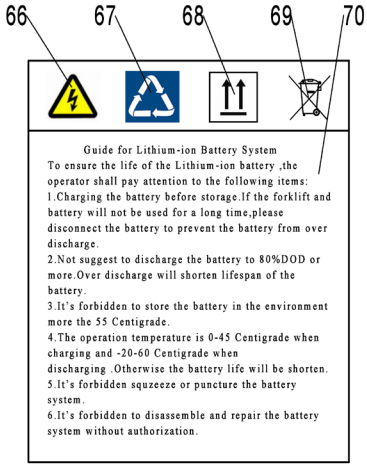
lithium-ion battery Tag



Item	Illustration
51	nameplate
52	bar code and QRcode
53	warning label

Nameplate and warning label





Item	illustration	item	illustration
54	Manufacturer's mark	65	Manufacturer's address
55	Code	66	electrical hazard marker
56	Battery specifications	67	Rechargeable logo
57	Rated voltage	68	Vertical upward packing, transportation
58	Rated Capacity	69	No labeling
59	Energy	70	Guide to use
60	Weight	71	Production date
61	TCP	72	Battery information bar code
62	Serial No.	73	Bar code interpretation
63	Production date	74	Battery information 2D code
64	Name of manufacturer		

Storage, maintenance and transportation

1.Storage

For long time storing, please Charge the battery pack to 50% (charge for 1-2 hours after discharging),place in a dry、ventilated area, and charge for 1-2hours every 3 months.

The battery pack and the charger should be stored in a clean、dry and ventilated places, avoid contacting with the corrosive substances, be away from fire and heat sources.

2.Transport

The battery pack and charger should be packed for transportation, prevent violent vibration, shock or extrusion, protect against the sun and rain. Cars, trains, ship, aircraft and other transportation are available for transportation.

3.Maintenance

a) Battery pack should be stored on a 40%~60% charge state when storing.
b) If not using for long time, it is suggested to charge for 1-2 h every 3 months.
c) During the maintenance, do not re-load the battery privately, or it will cause a decline in the battery performance
d) Do not replace any battery without authorization. Do not dissect the battery.

Typical faults and troubleshooting

Fault appearance	Fault cause	Troubleshooting
No output	Output line is not connected	Connect the output line correctly according to the specification
	Out of the power	Charge the battery pack
Unable to charge	Output plug of the charger is loose	Check if the output plug of the charger is connected to the battery pack firmly.
	The battery pack is fully charged	The battery pack can F be used as normal

Notes for battery using:

Read the manual carefully before using the battery.

* Do not put the battery pack into the water or wet it.
* Do not charge the battery pack under ignition source or extremely hot conditions.
* DO not use or store the battery pack near the heat source (such as fire or heater). If the battery leaks or smells, remove it away from the fire immediately. For the first time usage, Charge fully before using the battery pack.
* Connect the positive and negative poles correctly
* Do not put the battery pack into the fire or heat the battery pack.
* Do not short-circuit the positive or negative electrodes of the battery pack with wires or other metal objects.
* Do not puncture the battery pack shell with nails or other sharp objects. Do not hammer or pedal the battery pack.
* Do not break down the battery and battery pack.
* Do not place the battery pack in a microwave oven or in a pressure vessel.
* Do not charge indoors or on rainy days.
* Do not use the battery in series and parallel
* Do not use the battery pack if it emits odor, heating, deformation, discoloration or any other abnormal phenomenon, remove the battery pack from the appliance or charger and stop using if it is in charging or using.
* Do not use the battery packs that is in extremely hot environments, such as the direct sunlight or in the cars on hot days, otherwise the super-heating battery pack will affect the performance and shorten the service life
* Do not wipe the eyes if the electrolyte leaked from battery enters the eyes, rinse with the water immediately and seek medical assistance at once. The eye will be hurt if not handle in time.
* The ambient temperature will affect the discharge capacity. When the ambient temperature exceeds the standard environment (25 ± 5℃), the discharge capacity will be reduced.
* Discharge (using the vehicle) after 30min when finished charging.
* Stop charging immediately if there is an odor or abnormal sound in charging
* Please contact the manufacturer if there occurs the above phenomenon.

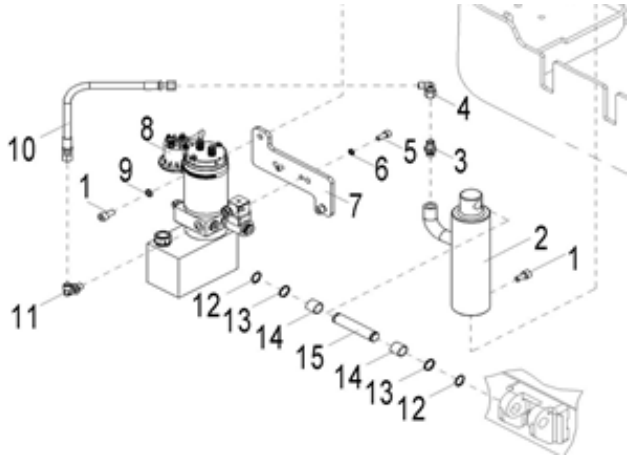
Do not disassemble without permission.

10.HYDRAULIC SYSTEM

a. General survey

The hydraulic system is composed of working oil pump, lifting cylinder and pipeline components. The hydraulic oil is supplied by the oil pump that connected to the motor directly. The oil pumps the hydraulic oil to the oil cylinder.

1). Subassembly



The hydraulic system lifts the cylinders by operating with the pressurized hydraulic oil of the autonomous hydraulic pump and draws out the oil discharged from these cylinders.

1 The main hydraulic pump is driven by the pump motor controlled by the controller

2 The main hydraulic pump uses the rotating force output from the motor to pressure the oil in the hydraulic tank and conveys the oil to the lifting cylinder.

3 The hydraulic tank stores the hydraulic oil returned from the cylinder. The stored oil is sucked in by the main hydraulic pump for reuse.

Hydraulic oil cycle

The hydraulic oil tank stores the hydraulic oil, which is supplied to the main hydraulic pump through the filter. The main hydraulic pump pressurizes the supplied oil and delivers it to the lifting cylinder. when receiving the hydraulic oil, the systems perform the functions and discharge the waste oil back to the tank through a return filter.

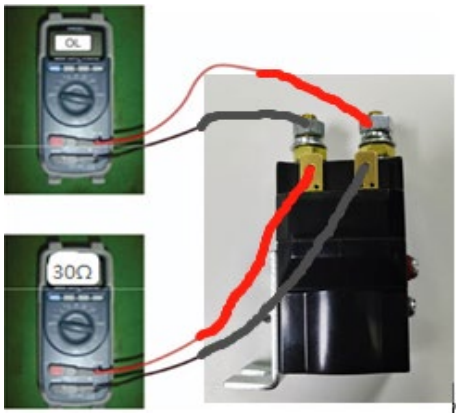
2). Test

The pump motor transmits the power to the main hydraulic pump by electric mode in order to pump the hydraulic oil to operate the hydraulic system.

The pump motor is connected to the pump motor controller through the pump contactor, the controller runs the pump motor according to the input from a plurality of switches and sensors, and on internal parameter settings.

When the following conditions are met, the pump motor runs:
The key emergency stop switch is turned off
Upper limit switch closing
Handle rising-switch closed
Pump contactor suction

Pump-motor contactor test：
For the pump motor contactor, as shown in Fig, check if measuring the specified value.



Danger

Pressurized hydraulic oil can cause severe burns and even amputation.
Make sure that the pressure has been released from the system before performing the following steps.

The pressure of the safety valve adjusted before leaving the factory, adjust and dismantle it privately is not allowed.

b. Hydraulic schematic diagram

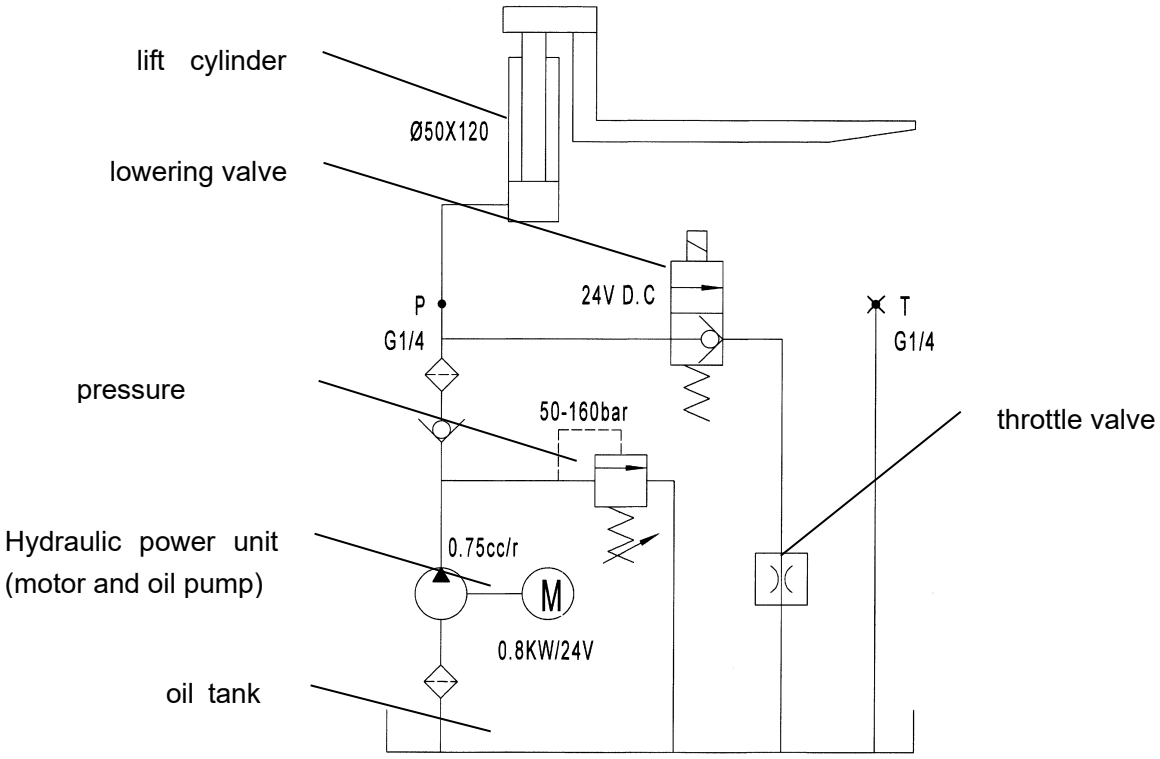


Fig.24: 20EPR-X hydraulic circuit

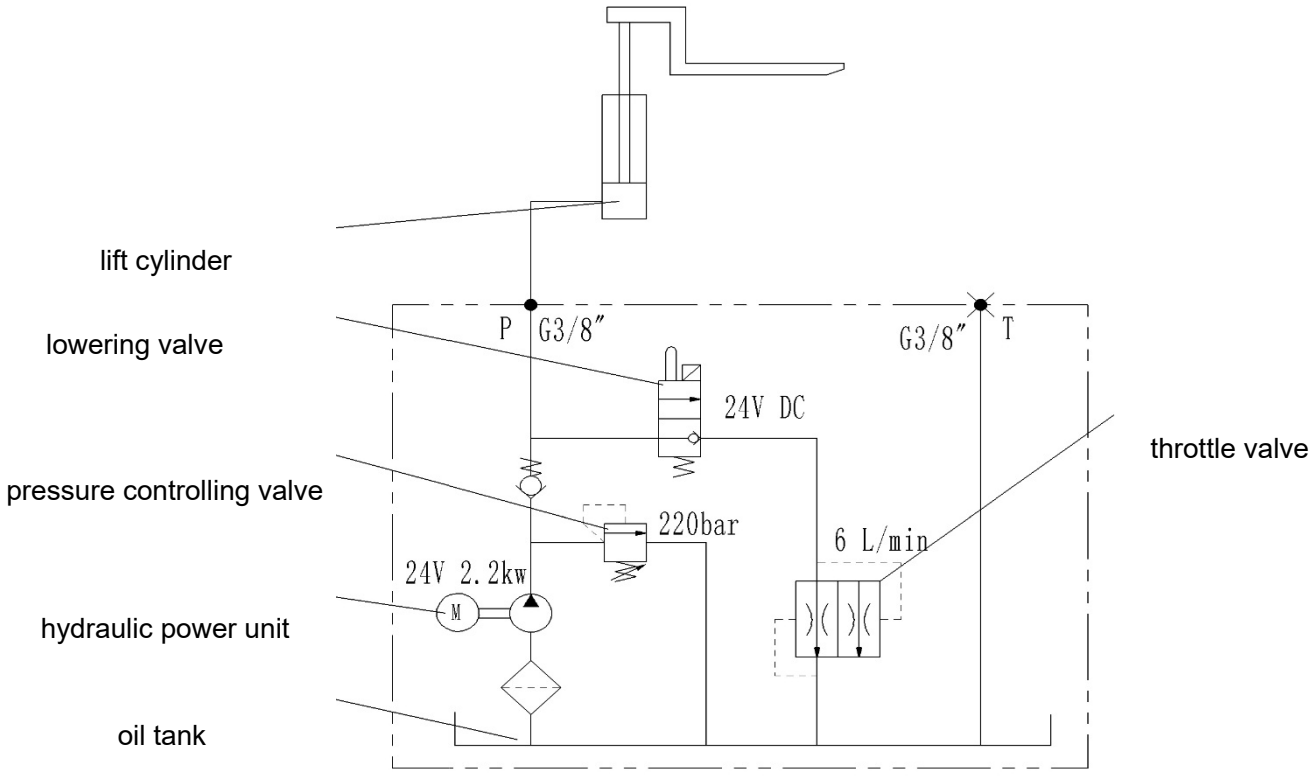


Fig.25: 25EPR-X hydraulic circuit

c. Troubleshooting

Pump motor

fault	Reason
Hydraulic motor doesn't work	Bad connection or fuse burning. Check the battery connection. Check the key fuse. Check if hydraulic pump motor is likely to cause fuse burning.
	The key switch, upper limit location switch or pump station contactor is not turned off. Turn off the key switch. Check the power of pump station contact coil and pump station contactor with multimeter.
	Insufficient voltage. Charge or replace batteries. Check cable terminals are tightly aligned with battery terminals and control panel connectors. Check cable internal wires for breakage..
	The lift and drive system is not operating correctly.
	The battery is not fully charged during the battery
	The hydraulic system consumes excessive battery power due to incorrect lifting or hydraulic control for the working cycle.
	The hydraulic pump motor is overheated,If the motor temperature reaches155°C（311°F）

Hydraulic pump

Fault	Reason
Pump noise	Low oil level
	thick oil (high viscosity)
	The pump inlet line is limited
	Wear parts in the pump
	dirty oil
	Air leaks into the inlet line
High oil temperature	Low oil level
	Oil channel limited
	too thin oil
	Air leakage in the system
	Pump wear is too high。
	The system operates at too high a pressure.
Pump seal oil leakage	Seal is worn
	Pump inside worn
	Too low oil level in the tank causes the seal be sucked
	During installation, seal is cutted on the shoulder of the pump or keyway.
	Sealing lips dry and hardened by heat.
Pump can’t convey hydraulic	Low oil in tank
	Restrictions on the pump inlet pipeline
	Air leakage in the inlet pipe. Loose bolts. Defects in the inlet pipe.
	wrong viscosity of the oil
	Pump wears too much
	Pump shaft fault
	The bolts of the pump do not have the correct torque

11.REGULAR MAINTENANCE

- Only qualified and trained personnel are allowed to maintain the truck.
- Before maintaining, remove the load from the forks and lower the forks to the lowest position.
- If you need to lift the truck, using designated lashing or jacking equipment according to the chapter 4b, before working, put safety devices (as designated lift jacks, wedges or wooden blocks) under the truck to protect against accidental lowering, movement or slipping.
- Be care to maintain the tiller arm. The gas pressure spring is preinstalled by compression, carelessness can cause injury
- Use the approved and dealer-issued original spare parts.
- Consider machine failures and accidents possibly due to the leakage of the hydraulic oil
- Only trained maintenance technicians are allowed to regulate the pressure valves

If you need to replace the wheels, follow the instructions above. The castors must be round and free of abnormal abrasion.
Check the key items on the maintenance list

a. Maintenance checklist

Table 6: Maintenance checklist

		Interval（month）			
		1	3	6	12
Hydraulic					
1	Check the hydraulic cylinder and piston for damaged noise and leakage		•		
2	Check the hydraulic connector and tubing for damage and leakage		•		
3	Check the hydraulic oil level, refill if needed		•		
4	Fill with hydraulic oil after 12 months or 1500 hours				•
5	Check and adjust the function of the hydraulic valve (2000kg +0/+10%)				•
mechanical system					
6	Check the fork for deformation and rupture		•		
7	Check the chassis for deformation and rupture		•		
8	Check all screws are secured		•		
9	Check the push rod for deformation and damage		•		
10	Check the gearbox for noise and leakage		•		
11	Check the wheels for deformation and damage		•		
12	check the Lubrication steering bearings				•
13	Check and lubricate the pivot points		•		
14	Lubricate oil fat mouth	•			
Electrical system					
15	Check the electrical wiring for damage		•		
16	Check the electrical connection		•		
17	Check the emergency switch function		•		
18	Check the electric drive system for noise and damage		•		
19	Test the display		•		
20	Check for the correct fuse		•		
21	Test the warning signal		•		

22	Check the current contactor		•		
23	Check the frame for leakage (insulation test)		•		
24	Check the drive controller for its function and wear		•		
25	Check the electrical system of the drive motor		•		
brake system					
26	Check the brake performance, replace the brake disc or adjust the air gap if necessary		•		
battery					
27	Check the battery voltage		•		
28	Clean and grease the terminals and check for corrosion and damage		•		
29	Check the battery outer cover for damage		•		
30	Check the battery and fill distilled water if necessary	•			
charger					
31	Check the main cable for damage			•	
32	Check the start-up protection during charging			•	
function					
33	Check the horn function	•			
34	Check the air gap of the solenoid valve	•			
35	Test the emergency braking	•			
36	Test the reverse and regenerative braking	•			
37	Test the safety (belly) switch function	•			
38	Check the steering function	•			
39	Check the lifting and lowering function	•			
40	Check the tiller arm switch function	•			
General					
41	Check if all the labels are clear and complete	•			
42	Check the castors, adjust the height or replace these if worn out.		•		
43	Carry out a test run	•			

b. Lubricating points

Lubricate the marked points according to the maintenance checklist. The required grease specification is: DIN 51825, standard grease.

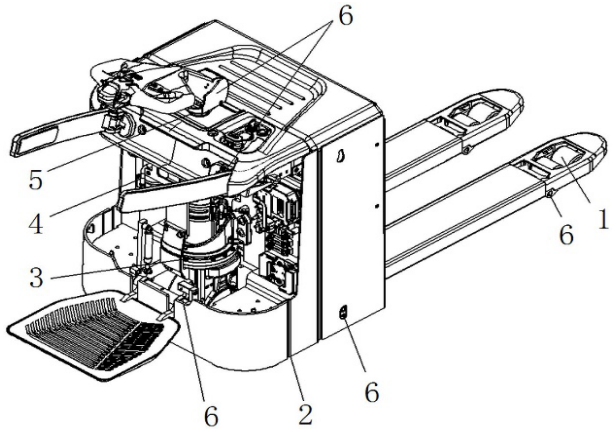


Fig. 26: Lubricating points

1. Load roller
2. Bearing
3. Gear box
4. Hydraulic system
5. Electric steering system
6. Connection point

c. Check and refill hydraulic oil

It is recommended to use hydraulic oil in connection with average temperature

Environment temperature	–5℃~25℃	>25℃
Type	HVLP 32， DIN 51524	HLP 46， DIN 51524
Viscosity	28.8-35.2	41.4 - 47
Amount	0.7L	

Waste material, such as waste oil, used batteries or other materials must be disposed and recycled probably according to the national regulations and submitted to a recycling company if necessary.

The oil level height shall not be lower than the minimum amount of the oil required to start the vehicle.

If necessary, add oil to the refueling point.

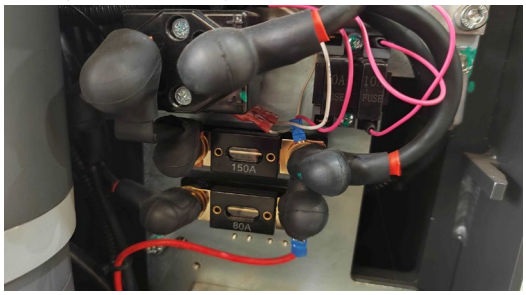


Fig7: Fuse specifications

d. Checking electrical fuse

Remove the main cover，The fuse is located at the position shown in Figure 27

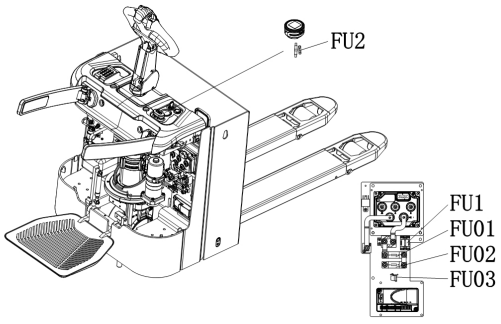


Fig 27: Location of fuses

	Specifications
Fuse1	10A
Fuse2	0.5A
Fuse01	150A
Fuse02	80A
Fuse03	30A

e. Remove, and reinstall the protective panel.

Do not use the vehicle if the protection is damaged or not installed properly.

Take down he clip that protected the guard plate, and then remove the guard plate. Setup procedure is opposite. Ensure that the guard plate is fixed correctly and not damaged. Please contact our after-sales service center if you need replacement parts.

f. Disassembly/assembly instructions

The disassembly/assembly section includes the following: preparation before disassembly, inspection and testing before disassembly, precautions during disassembly, precautions after disassembly, precautions during assembly, handling of general parts and hydraulic pipeline fittings. Measures for proper disassembly / assembly work are listed under each heading.

Preparation before disassembly

Remove dust and pollutants from the vehicle before sending to the maintenance center. Dust or pollutants entering the repair center may stain the parts and cause damage.

Electric vehicles operate based on the electrical system. Do not let any water get into the system.

To avoid unnecessary disassembly work, prepare the necessary tools, place boxes for parts, and ensuring site cleaning primarily.

Check and test before disassembly

Be sure to record any issues before starting disassembly. This prevents unnecessary disassembly, loss of replacement parts, and repeated failures caused by the same problem.

To prevent faults, record and replace the required components

Make sure to check and record the following information:

Vehicle model number, serial number, and working hours

Reason for disassembling

Check for the symptoms, location, and cause of the fault.

(Reappear the same fault if necessary)

Check if any parts are not suitable

Check the parts for damage or loosening.

Check the vehicle for maintenance, if possible.

Attentions during the disassembly

Disassembly

Determine the assembly method of the parts (front / rear, left / right and top / bottom connections) to determine the disassembly sequence.

Before disassembly, note the connection points of the parts and mark them with arrows to avoid misplacing the parts during assembly

Remove the specific parts by the correct tool

If no parts are removed, do not remove the mounting bolts and nuts by over forcing. Check and find the cause.

Place the removed parts on one side, labels and marks on the parts of the similar appearance.

Store bolts, nuts and other common parts orderly.

Check and test during the disassembly

The cause of the failure may be found during the disassembly process. Therefore, it is very important to check the contact parts and the status of the friction surface carefully.

During the disassembly, measure and record the gaps, deformation, projection, and other factors that may cause the failure.

Keep the clearance.

Ensure that the installed spacers and washer generate the required specified clearance values

Disassemble the press-fitting parts

Remove any dents or marks caused by hammering and polishing of this area

If any press-fitting parts are released, determine and exclude the cause to avoid problems during assembly.

Removing the bearing

Do not remove the bearing vigorously, but use the bearing puller.

Notes after disassembly:

Cleaning

Clean the removed parts and keep them away from the contaminants.

Pay attention to removing contaminants from upper oil lines or component pipes.

When cleaning special parts, increase the number of detergent containers and clean them for several times.

Koil or neutral anhydride diesel is suitable for cleaning the viscous oil in bearings.

Be careful not to contact the skin or eyes when using hazardous chemical cleaners. The used oil shall be handled at the designated place with the designated container.

Dust proof

Place the clean parts without dust and contamination by using duct covers, and block the ends of all the pipes

Any part stored is rust-proof before you install again.

Notes for the assembly:

Parts assembly

Keep all parts clean before assembly. Check the surface for defects and repair as needed. Be sure not to apply or rub surfaces on any part, which may shorten the service life.

Clean the rust preventer from the parts with cleanser before starting assembly

Before starting assembly, mark the assemble the parts together

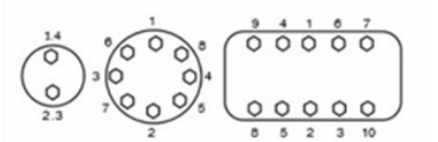
Assemble bearings, bushings and oil seals with press tools and process specific parts with the specified tools.

Lubricate the surface with lubricating oil before pressing the parts

Tighten the bolts and nuts

To ensure the uniform torque of bolts and nuts, tighten in the order as showed in Figure 1-19 and tighten the other side on the other side. This method is called "template method," which gradually repeats loosening and tightening to ensure uniform contact.

Fix the bolts, nuts or other non-visual fasteners with the wires, open pins, locking washers or other important fasteners shown in Figure 1-20.



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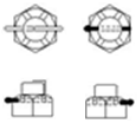


1-20

Check during assembly

Check and record the individual part number in each step of the assembly process.

Reassemble the gasket

Install the gasket and washer in the same position as before, and check if the clearance is correct

Assemble and adjust linking

If no adjustments is required, assemble them into the same length as before.

Assemble press-fitting parts

Repair the scratches and dents as needed and keep the parts clean before insertion.

Note that the press-fitting parts that not tightened completely may become loose

Assemble the keys and keyway.

Check that the keyways and keys are loose and contacted with the key head. If the key head contacts the keyway, remove the remainder of the key head.

Handle general parts

Processing packaging

Packaging, washers and copper packaging shall be replaced as indicated. After using the adhesive, assemble the washers specified in this service manual. When applying the adhesive on the washer, please note the following:

Completely clean the old adhesive, scratches, dust, paint and grease from the washer surface

Apply evenly on both sides of the washer with appropriate sealant and wait a few minutes until dry.

Once the sealant is dried to touchable, it will not stick to your hand, then assemble the parts.

Soak the leather package in the oil before usage.

Handle O-ring

Remember to check the condition of the O-ring. Do not use the O-rings that have already hardened.

Use the O-rings only specified in the part list. For example, O-rings for engine oil are made of special materials, such as silicone rubber that are heat-resisting and aging resistance. Installing different types of O-rings may cause serious damage to the system and its components in this case.

Lubricate the O-ring to avoid scratching its surface during installation. Do not overstretch the Silicone which is damaged easily.

Handle oil seal

Prevent oil seals from gathering dust, especially on lips and ensure no hardening or scratches

Lubricate evenly the lip that is opposite to the oil seal.

Check the surface of the shaft installed with the oil seal for contamination, rust or scratches, and then apply grease or grease so that the oil seal can be easily installed

Check the surface of the oil lip for scratches. If scratched, please replace the oil seal.

When inserting the oil seal, use the guide and fixture to avoid damaging the oil seal.

After inserting the oil seal, check the inclination (tilt tolerance: 0.2 mm / 00 mm, diameter 0.008 inch / 3.937 inch).

When applying the adhesive to the oil seal, ensure that no adhesive touches the lip surface. Remove residual adhesive on the rail and fixture before inserting to another seal.

Handle bearing

To properly assemble the bearings and avoid any damage, note the following:

Thorough clean the dust and other contaminants that may shorten the service life of the bearings. Keep the bearings packed until they are installed.

Do not rotate the bearing to remove the purifier by blowing in compressed air. Make sure that the oil seal ring is installed in the correct direction

Note the following when installing the bearing:

Neither striking the outer ring with a hammer to mount it nor the inner ring to insert the outer ring. Hammering like this can cause damage to the track of the bearing.

When you insert the inner ring of the bearing with a reasonable tolerance, use the fixture and apply pressure on the inner ring. For thermal insertion to the press-in tolerance, heat the bearing to 120℃（248 ℉）. However, note that excessive heating reduces the hardness of the bearing surface.

When you insert a non-split bearing with the inner and outer ring at a reasonable tolerance, use the fixture and press both the inner and outer ring

Handle the retaining ring

When removing or installing the fixed ring, use a pair of right ring pliers, not apply too much pressure on the fixing ring.

After installing the fixed ring, check if the fixed ring is inserted correctly.

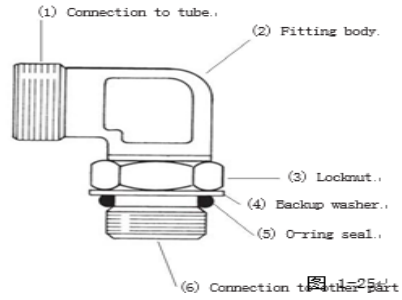


图 1-25

Assembly with straight thread and O-ring seals

(for different applications)

1 Seal the lock nut (3), backup washer (4) and O-ring seal

(5) back on the fitting body (2) as far as possible.

2 Turn the connector to the part until the backup washer (4)

touches the surface of the part.

3 To place the connector assembly in the correct position,

place the fitting body (2) rotate outward (counterclockwise)for maximum 359°.

4 Tighten the lock nut (3) to the torque of accessories used correctly as shown in figure.

5 If the tube end of the fitting body is as shown in Figure 1-25 (elbow or straight), place the sleeve on the tube before connecting it to the end

Note: If the joint is a connector (direct connector), the hexagonal on the body replaces the lock nut. To install this type of connector, tighten the hexagonal joint to the surface of the component it enters.

Tighten the other accessory types

High load (shear sleeve) fittings: After the tube passes through the nut and contacts the shoulder in the fitting body, turn the nut with a wrench until a slightly reduced torque is felt.

High seal fittings: Place the nuts and casing on the pipe, with the short heavy end of the casing facing toward the end of the pipe. Position the tube end against the sink hole in the fitting body and tighten until the nut is above the last thread on the body. By simply removing the accessories and installing them again, the remaining space is used.

Flexible fittings: place the nut and casing on the pipe and push the pipe into the sink hole of the main body of the accessory as much as possible. Tighten the nut until it touches the hexagonal portion of the joint body.

g. Standard torque

Standard torque for the bolts and nuts

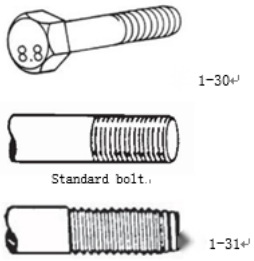
Take care to avoid mixed metric and British size fasteners. Mismatch or incorrect Fasters may cause damage or fault of the vehicle, or may cause personal injury. Exceptions to these torques are available Service Manual if required.

Before installing any hardware, make sure that the component is in a near to new state. spiral shell Bolt and nut threads shall not be worn or damaged. Hardware must be free from rust and corrosion. Clean hardware with non-corrosive detergent and apply oil on threads and bearings On the surface. If using thread glue or other compounds, do not use the engine oil. After loosening the fastener, remain in good condition and reuse only under fine conditions. When replacing new ones, be sure to select fasteners of the same size and grade.

Usually, you can identify the strength of the bolts based on the number of the head tag (such as 8.8 or 10.9), as shown in Figure 1-30. The table below lists the standard torque of the standard bolts and nuts, and the conical bolts as shown in Figure 1-31.

For the metric fasteners

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



Taper lock stud

For British fasteners

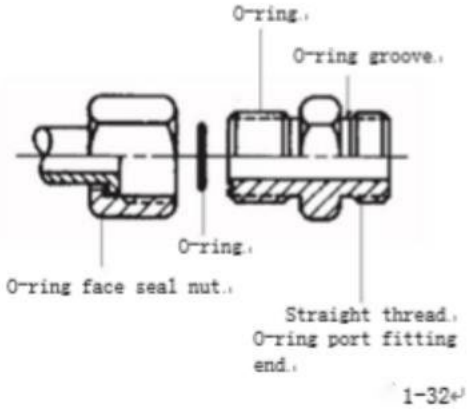
Thread size(inch)	British nuts and bolts		British taperlock stud	
	(N · M)	Pounds/feet	(N · M)	
1/4	12 ± 3	9 ± 2	8 ± 3	6 ± 2
5/16	25 ± 6	18.0 ± 4.5	17 ± 5	13 ± 4
3/8	47 ± 9	35 ± 7	35 ± 5	26 ± 4
7/16	70 ± 15	50 ± 11	45 ± 10	33 ± 7
1/2	105 ± 20	75 ± 15	65 ± 10	48 ± 7
9/16	160 ± 30	120 ± 20	–	–
5/8	215 ± 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

Standard torque of the fittings

Standard torque for the sealing fittings of O-ring surface

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



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)
12.5 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)

37° bell and straight threaded O - ring accessories

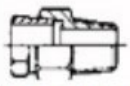
Pic 1-34

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*18	0.125	5/16	5.0±1.5	4±1
4*76	0.188	3/8	8.0±1.5	6±1
6*35	0.250	7/16	11±2	8±1
7*94	0.312	1/2	17±3	13±2
9*62	0.378	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

Taper pipe threaded fittings

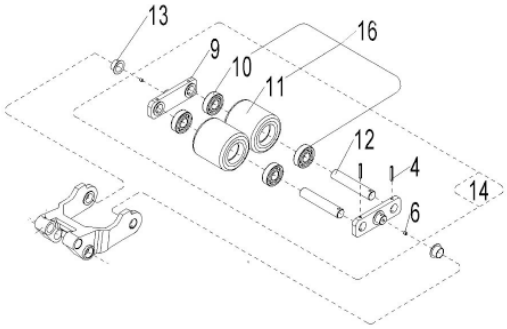
Thread fittings for conical pipes				
Thread diameter (in.)	Threads with le2200e sealant		Threads without sealant	
	(N · M)	Ponds/Feet	(N · M)	Ponds/Feet
1/ 16-27	15	11	20	15
1/ 8-27	20	15	25	18
1/8-14	25	18	35	26
3/ 8-18	35	26	45	33
1/ 2-14	45	33	60	45
3/ 4-14	60	45	75	55
1-11 1/2	75	55	90	65
1-1 /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

h. Wheel replacement procedure

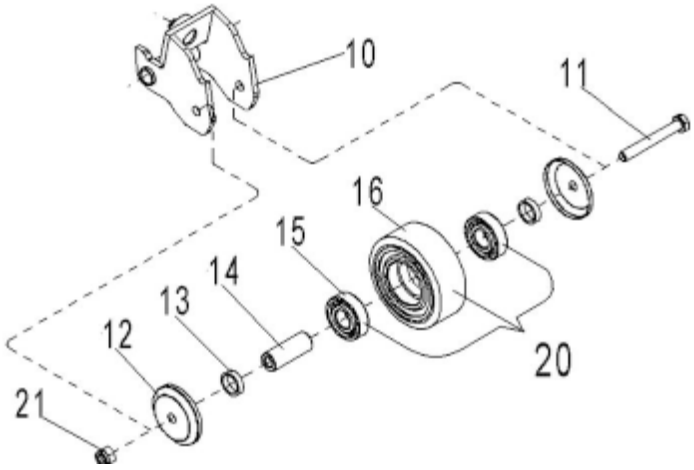
1). Drive wheel

Lift the truck with help of hydraulic jack	
Unscrew five nuts holding the tire	
Remove the tire	
Assemble back with reversed order	Torque for nuts 90Nm

2). **Rollers**

Remove pins pos. 4 Remove axles pos. 12 Remove rollers pos. 11 Assemble in the reversed order	

3). Support wheel

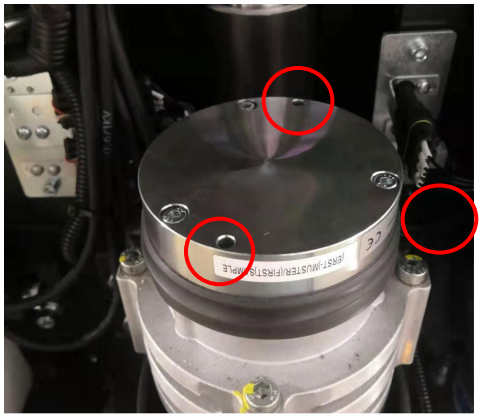
Remove nut pos. 21 Remove bolt pos. 11 Replace wheel pos. 16 and bearings pos. 15 Assemble in the reversed order Sleeve pos. 14 must be inserted in bearings pos. 15	

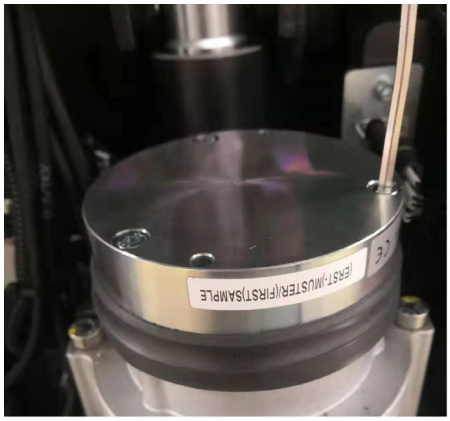
Note: During maintenance of energy stored components, the energy need to be released before any maintenance procedures to avoid injuries.

Gas spring: the gas spring of the tiller can be removed only when tiller is put to its upright position.

Electromagnetic brake: before disassembling of electromagnetic brake the braking disk needs to be fixed with two M6x40 screws through the special holes in the coil of brake. Slightly tighten the screws to fix the braking disk together with the coil. The brake can be removed afterwards.

After the brake is assembled back to the motor, the screws must be removed.





12.TROUBLE SHOOTING

If the truck has malfunctions follow the instructions, mentioned in chapter 6.

Fig8: Trouble shooting

TROUBLE	CAUSE	REPAIR
Load can’t be lifted	Load weight too high	Lift only the max. capacity, mentioned on the ID-plate
	Battery discharged	Charge the battery
	Lifting fuse faulty	Check and eventually replace the fuse
	Hydraulic oil level too low	Check and eventually refill hydraulic oil
	Oil leakage	Repair the hoses and/or the sealing of the cylinder
Oil leakage from air breathing	Excessive quantity of oil.	Reduce oil quantity.
Truck not starts operating	Battery is charging	Charge the battery completely and then remove the main power plug form the electrical socket.
	Battery not connected	Connect the battery correctly
	Fuse faulty	Check and eventually replace fuses
	Low battery	Charge the battery
	Combined emergency switch is activated	De-activate the combined emergency switch by insert and pull the knob.
	Tiller in the operating	Move the tiller to the braking area firstly

If the truck has malfunctions and can’t be operated out of the working area, jack the truck up and go with a load handler under the truck and safe the truck securely. Then move truck out of the aisle.

13.CURTIS HANDHELD PROGRAMMER

a. The 1313 HANDHELD PROGRAMMER

INTRODUCTION

The Curtis 1313 Handheld Programmer (1313 HHP) performs programming and troubleshooting tasks for Curtis programmable motor controllers, gauges, and control systems. The 1313 HHP connects to Curtis devices in one of two ways—specific to the device: Either directly via the device's RS232 serial port, or through a Controller Area Network (CAN) connection which can have multiple devices on the CANbus. Cables specific to the connection type are supplied with the 1313 HHP.

This manual covers the operation for the CAN open network connected devices.

For an additional overview of the 1313 HHP, consult the datasheet, Curtis document number 50194, available on the Curtis website: www.curtisinstruments.com

See: *Home/Products/Motor Controllers/Programming/1313 Handheld Programmer/Datasheet*

Direct Link: 1313 Handheld Programmer: datasheet

Available on the Curtis website is the 1313 Handheld Programmer Operation video tutorial.

See: *Home/Videos/1313 Handheld Programmer Tutorial*

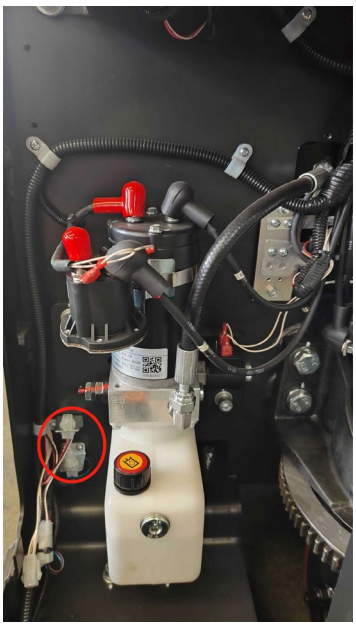
Direct link: Tutorial:1313 Handheld Programmer Operation

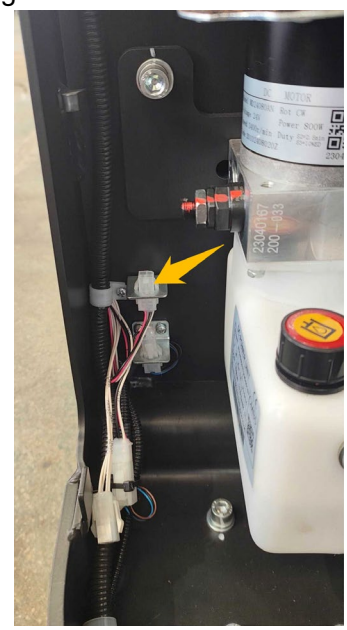
The prompt function of the console is designed for the convenience of vehicle inspection and maintenance, Adjustments to the controller parameters are not allowed without the approval of the vehicle manufacturer，so as to avoid vehicle and personal safety accidents.

After modifying the parameters, the handheld unit will automatically save the parameter settings, and the only thing you need to do is just close the key switch and restart.

CURTIS handheld console can be connected when the controller is powered on or off.

The connection port of the handheld unit is shown in the figures as below.





NOTICE

This document refers to generic Curtis products. The images used are principally of the F2-A motor controller which may not match other devices or applications compatible with this 1313 HHP. This manual does, however, describe the usage of the applications (app) that can be used for all compatible devices. Custom OEM products and applications may not have some features described in this manual.
For technical support or applications not covered in this manual, contact the vehicle manufacturer. OEMs should contact the Curtis distributor where the 1313 HHP and devices were obtained, or the regional Curtis sales-support office.

WARNING

> WARNING! The control system can affect speed, acceleration, deceleration, dynamic stability, and braking. If the control system is programmed incorrectly or outside the safe limits as determined by the vehicle manufacturer, a dangerous situation can result. Only the vehicle manufacturer or an authorized service agent or dealer should program the devices that form a control system.

This manual, RevC July 2022, is updated for the following 1313 HHP software.

Consult the Application Note: 1313 HHP Software Update, RevG (pdf) for the software matching the revisions shown. Update to both the Serial and CAN (this manual) software versions as illustrated below.

HW3 = **Blue-band** handsets
Serial (G1) communication protocol

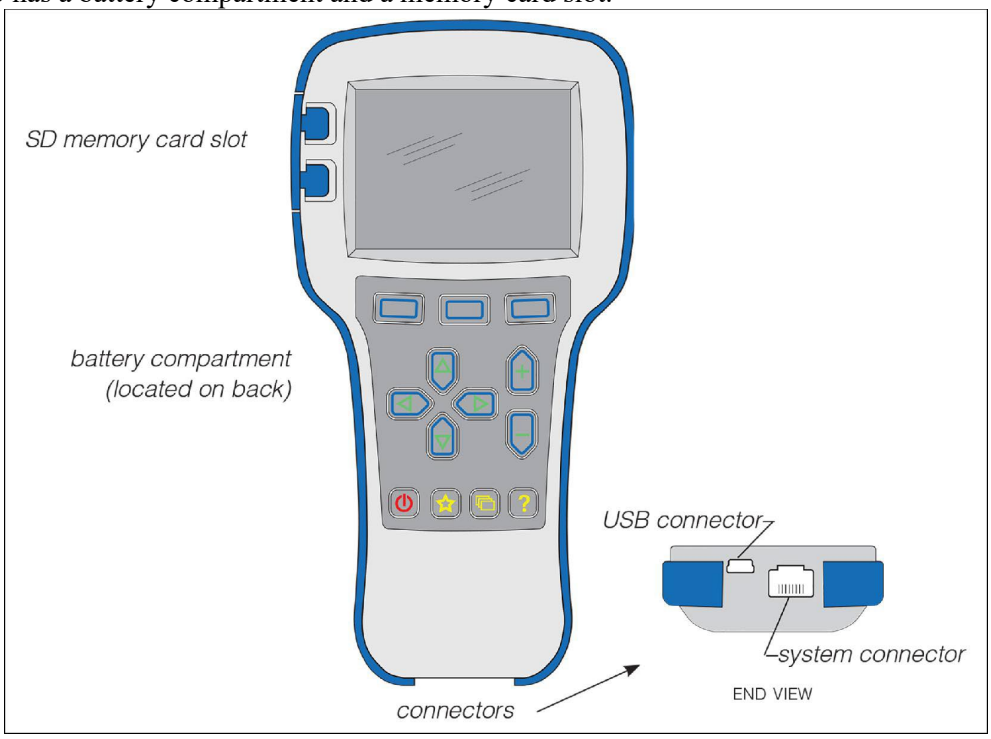
HW3 = **Blue-band** handsets
CANopen (G2) communication protocol

b.1313 HHP OPERATION

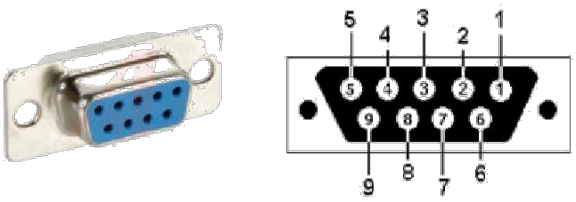
This Chapter describes how to use the 1313 HHP for CAN-based communication devices. Although there are similarities between the CAN-based devices and the serial devices, there are differences in the connection and the apps.

CONNECTIONS

The 1313 HHP has two connectors, one for communicating with the devices and one for interfacing with a PC. The 1313 HHP also has a battery compartment and a memory card slot.



Controller (Vehicle System) Connector



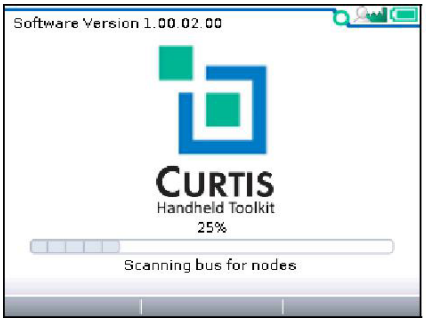
1313-xx31 Wiring	
D-Sub Pin	Function
7	CAN_H
2	CAN_L
9	B+ (8–36 V)
6	B–

Vehicle Harness Wiring for CAN Connected 1313 HHP

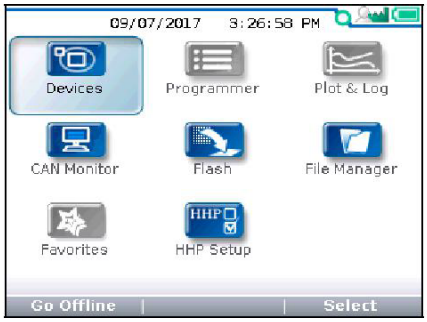
POWER-ON THE 1313 HHP

Connect the 1313 HHP to the system by plugging it into the system's CANbus using the supplied DB9 CAN-port cable. If the CAN connection point provides power, the 1313 HHP will automatically power up. If not, press the power key ( ) and it will power up and run off its internal batteries (if batteries are installed). Once running, the 1313 HHP will then listen to the CAN bus and automatically create a list of detected devices.

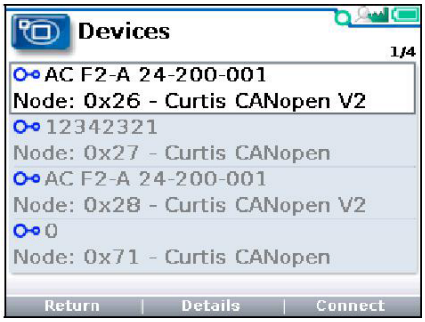
The first screen (see left image) indicates the scanning progress. Systems can have multiple devices on the CANbus, so once the scanning process is complete, press the "Select" softkey on the main screen (middle image) to open the Devices app, then scroll to the desired device and press the "connect" softkey (right image). The device-specific apps are disabled (grayed out) until a device is connected.



Scanning for Nodes

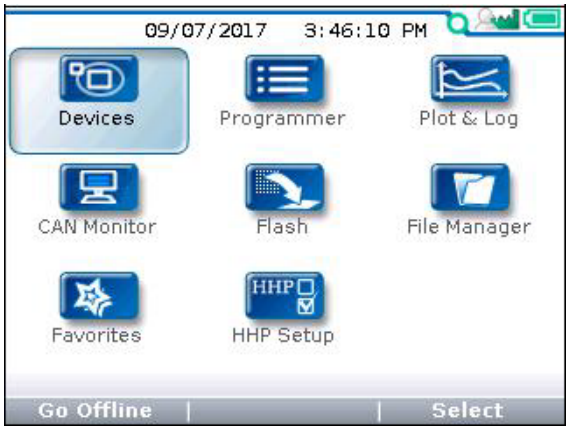


Devices option



Select the device to connect

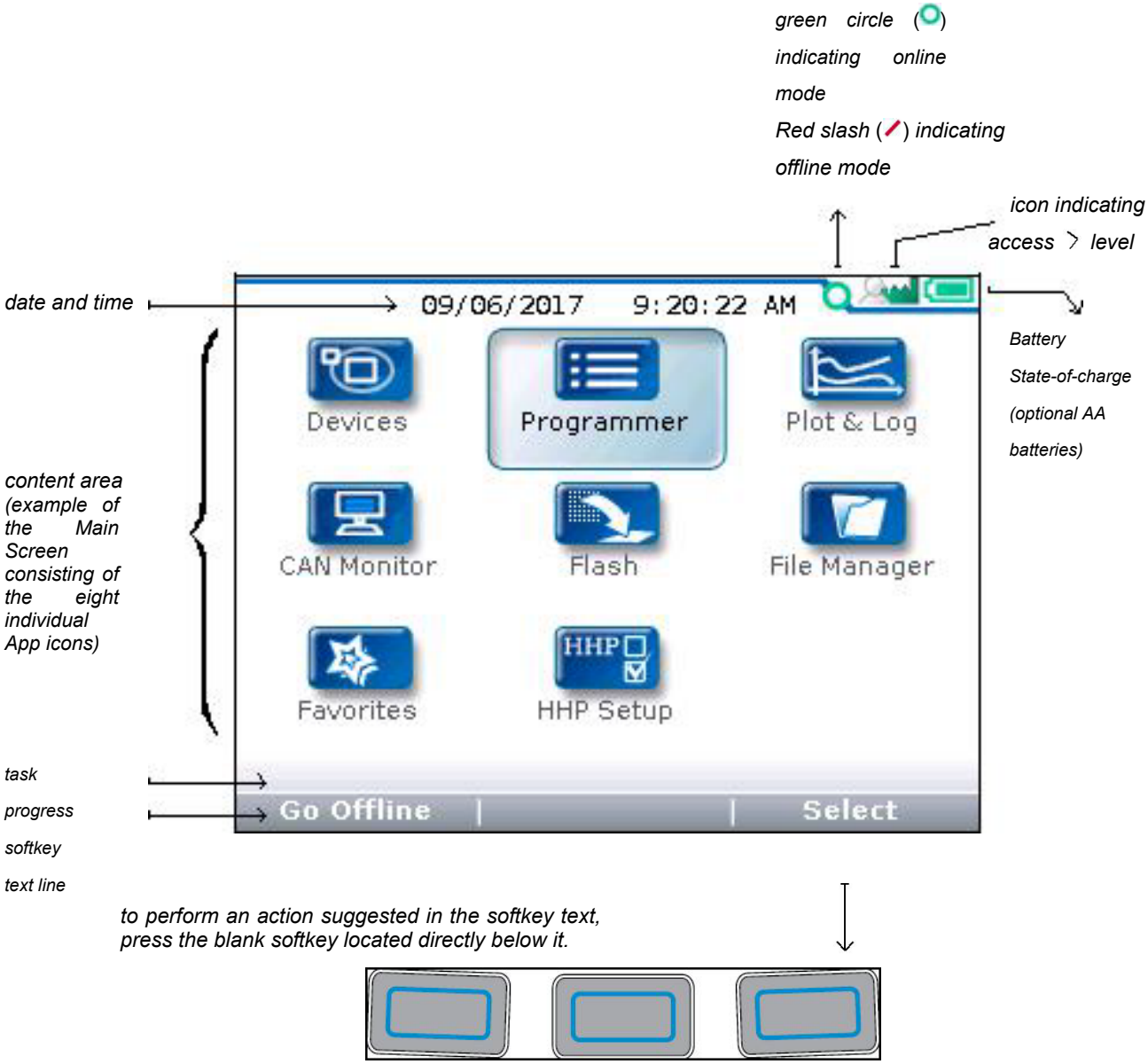
If the 1313 HHP hasn't previously connected to a selected device, it will sequence through four steps uploading information. The 1313 HHP will automatically remember this device. All subsequent connections to this device, even on a different system, will be much faster, only requiring the final current-data upload step. After the 1313 HHP has uploaded this data from the device, the Main Screen is displayed.



Main Screen: when connected to a device.

DISPLAY FORMAT

The high-resolution clarity of the LCD screen allows a wealth of information to be displayed at once. The example below shows the information available in the Main Screen.



In this above example, pressing the “Select” softkey will open the highlighted Programmer app. The “Select” softkey opens whichever app is highlighted. Pressing the "Offline" softkey switches the 1313 HHP to Offline mode. In Offline Mode, the 1313 HHP cannot communicate with the device. The 1313 HHP can perform operations that do not require communication with the device.

ACCESS LEVEL

The 1313 HHP is available in five access levels: OEM Factory, OEM Dealer, Field Advanced, Field Intermediate, and Field Basic, based upon the model number. Each 1313 HHP model has access to levels below it, but not above it. Using the HHP Setup app, the access levels can be lowered, which is useful to view apps and menus as they would appear to the lower-access 1313 HHP models.

For technical support regarding access levels, contact the vehicle manufacturer. OEMs should contact the Curtis distributor from which the 1313 HHP and device were obtained, or contact the regional Curtis sales-support office.

Access levels:

OEM Factory:

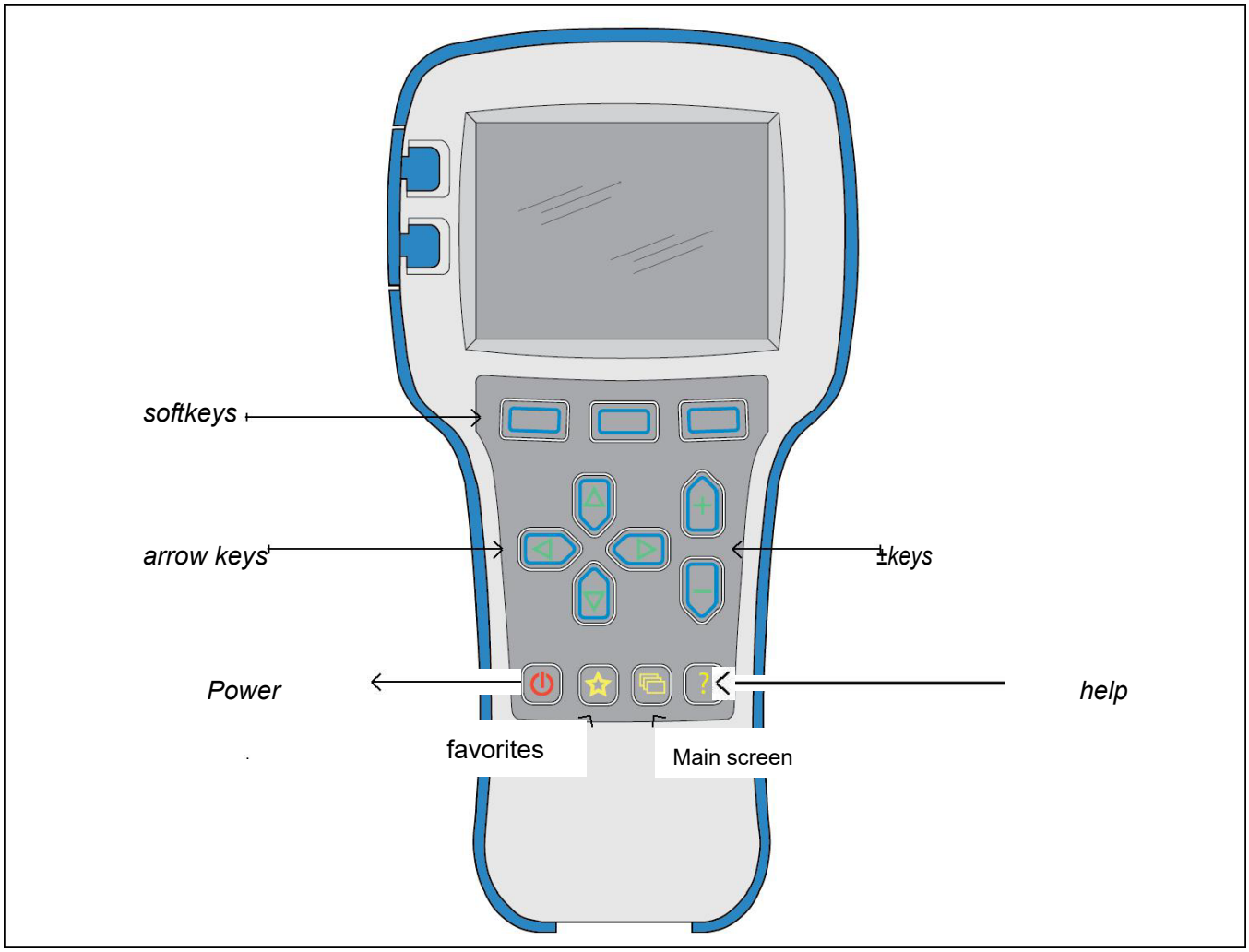
OEM Dealer:

Field Advanced:

Field Intermediate: **Field Basic:**

KEY FUNCTIONS

The pushbutton keys on the 1313 HHP's keypad allow rapid navigation through the apps.



Softkeys

These three keys are blank because their function is context-specific. At any given time, their function is shown directly above them on the LCD screen. The symbol "»" indicates more options. Pressing the softkey under the "»" will scroll to another set of softkey options.

Arrow Keys

Use these four keys to scroll up-and-down and right-and-left within the display screen. In the main screen, use the arrow keys to highlight one of the apps; then open the highlighted app using the "Select" softkey.

Within apps, the left-arrow key (◄) is used to navigate back to the previous screen, up to the apps opening screen. If the "Exit menus with left arrow" is set to "Yes" in the HHP Setup options, press this key will exit the app, displaying the main screen.

Within apps, the right-arrow key (►) is used to navigate forwards—that is, to go to the next screen, the next function, or to open a parameter's detail screen.

± Keys

Use these keys to increase or decrease the value of parameters. These keys are also used as "+ = Yes" and "– = No" keys. The keys are also used to scroll through optional settings such as access levels or languages.

Power

The Power key turns the 1313 HHP on or off.

If the CANbus is powered, the 1313 HHP will turn on automatically when connected.

Turn off the 1313 HHP by pressing and holding the Power key for 2 seconds. A pop-up message will ask you to confirm. The softkey text will offer the choices "Yes" and "No."
Unplugging the 1313 HHP will turn it off even if the batteries are installed.

If the 1313 HHP has been turned off, or if it has timed out and shut off, pressing the Power key will turn it on again.

Note: when the 1313 HHP is connected to a PC using the USB cable, the 1313 is powered by the PC. Pressing the power key will have no effect. The 1313 HHP displays "USB Mode Active" and appears as a removable drive to the PC.

Favorites

This key is an alternate way to bring up the Favorites app. Access Favorites by either selecting the Favorites icon on the Main Screen, or by using this Favorites key, Favorites, for more information about using the Favorites app.

Screenshots

Momentarily press the Power Key and then momentarily press the Favorites key to save the present image of the LCD display. These are called screenshots.

Main Screen

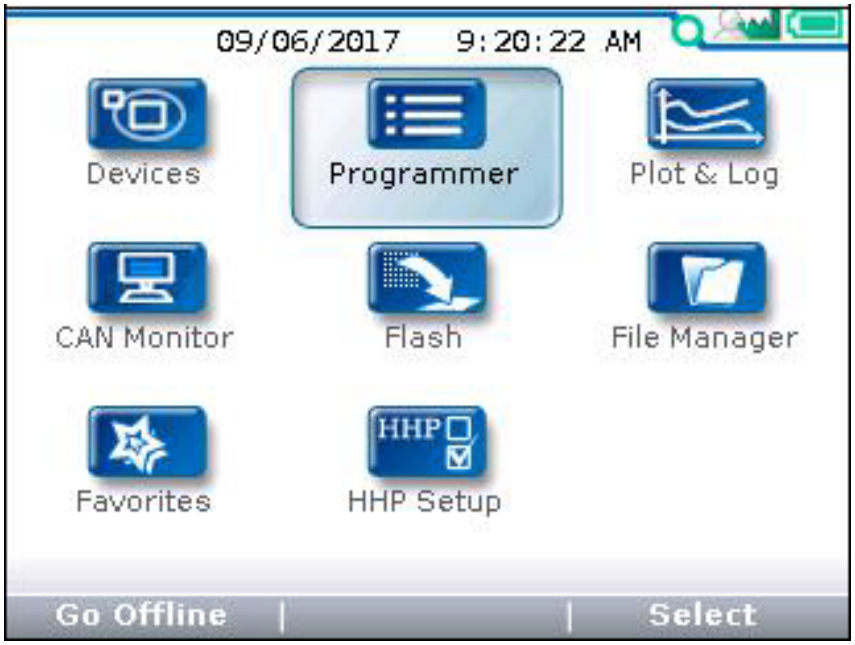
Pressing this key will return the 1313 HHP to the Main Screen from any location. When the main screen is displayed, use this key to cycle through the individual apps. Use either this key or the arrow keys to navigate within the main screen.

Help

This key is used to display context-specific Help texts.

MAIN SCREEN AND APPS ORGANIZATION

The Main Screen contains 8 apps that are each identified by a specific icon.



To select an app, scroll using the arrow keys () until the app is highlighted. Apps can also be selected by successive presses of the main screen key (). Each press will highlight the next app.

When navigating within an app, the left-arrow key () can be used to navigate back to the previous screen. (It is possible to limit this left-arrow key function using the "`Exit menus with left arrow`" item in the HHP Settings menu.

c. DEVICE

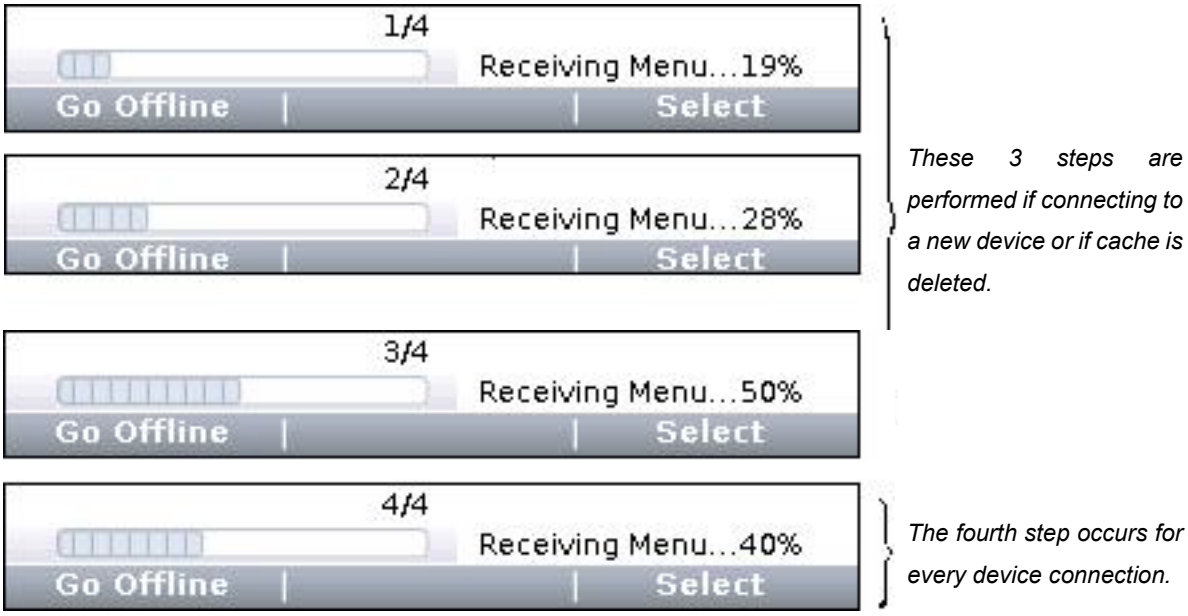
Device Details and Connection

To use the 1313 HHP, a device must be compatible and then a CAN connection established. The Device app is where devices (CAN nodes) discovered during the startup CANbus-scan are listed*.

After the 1313 powers up and completes the start -up scan, the Main Screen is displayed with the Devices app highlighted. Press the "Select" softkey to open the Devices app. The app lists the active devices found on the CANbus. When a compatible device (e.g., `Curtis CANopen V2`) is highlighted, the "Connect" softkey will be enabled (selectable). If not, the softkey will be disabled (grayed out).

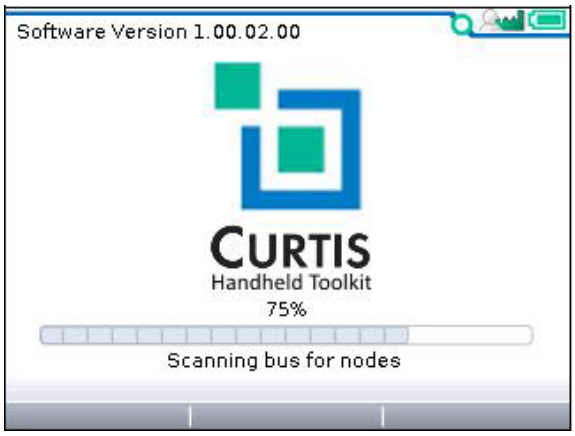
The Device app is also where device-specific information can be viewed before connecting—useful when many devices are listed. Press the "Details" softkey to view information such as the device Family, Model number, Serial number, Manufacture date, and its software/firmware/hardware versions. The "Details" softkey remains available once connected.

If a selected device hasn't connected to the 1313 HHP before, the connection-screen displays a series of 4 successive progress bars (`Receiving Menu...x%`) that are identified as ¼, 2/4, ¾, 4/4. The 1313 HHP saves the information from the first 3 progress bars in a cache file. If this cache file is deleted (see "*`Delete Cache File`*" in the HHP Setup app), the 4 steps will repeat the next time a connection is made to the same device. If the device's cache file is available, the next connection to the device will skip the first 3 progress bars and will display progress bar 4/4 as the latest parameter settings are acquired from the device. Connection times are greatly improved when a cache file is available.

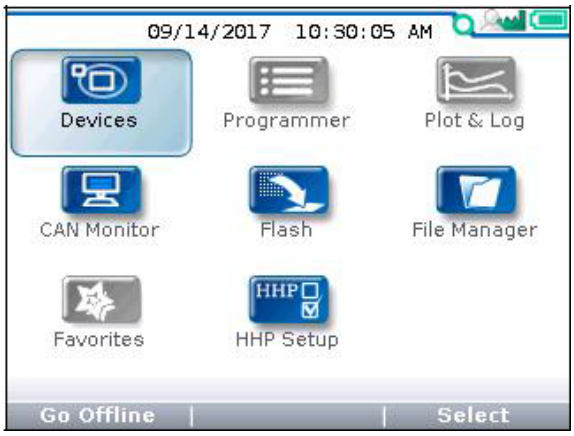


The following screenshots illustrate the Devices app usage. Notice that in the second and fifth images, the Devices app and 4 other apps are available before connecting to a device. (See the CAN Monitor, Flash, File Manager, HHP Setup, and Offline Mode chapters.) Once a device is connected, the remaining 3 device-specific apps (Programmer, Plot & Log, and Favorites) become available.

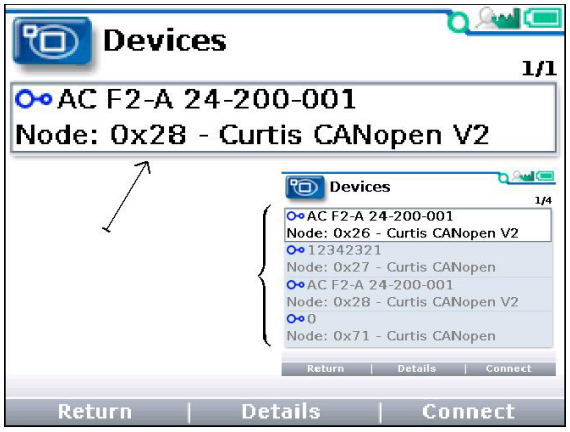
** Note: If known devices on the CANbus do not appear on the app's listed devices, check their node ID. Devices on the CANbus cannot have the same node ID and be discovered/shown on the 1313 HHP.*



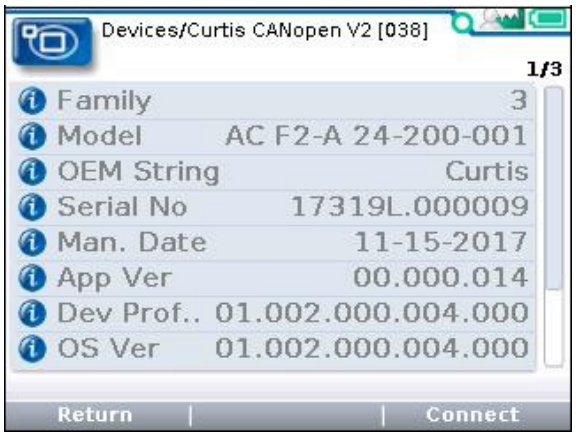
(1) 1313 HHP startup-scan of CANbus for devices



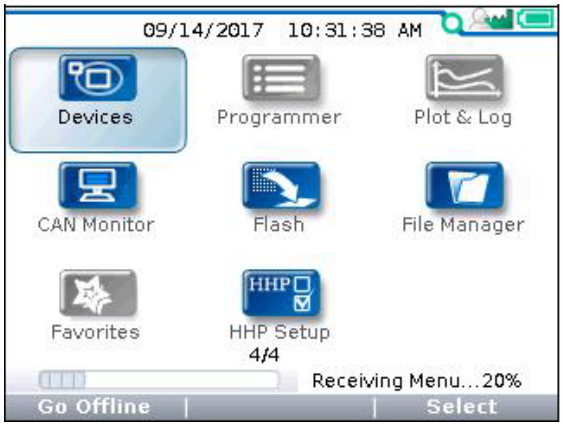
(2) Main Screen following the CANbus scan Just the "Offline" capable apps are available.



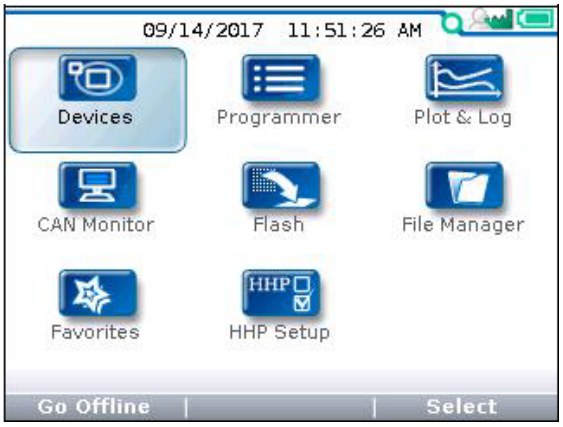
(3) "Select" softkey—opens app and lists devices



(4) "Details" softkey—returns device information

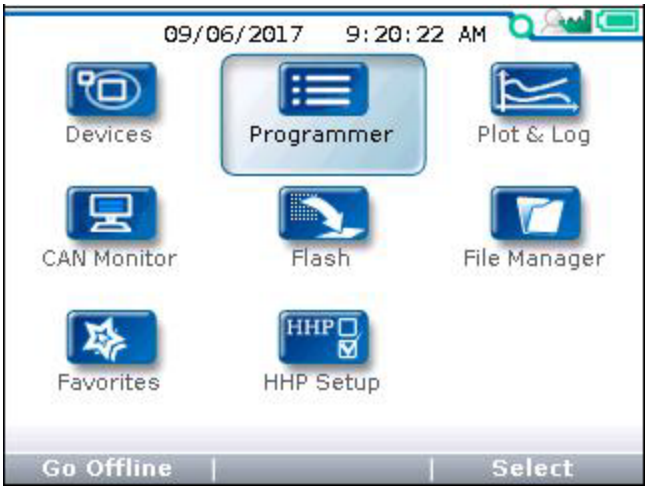


(5) "Connect" softkey—receiving data progress



(6) Device connected—all apps are available

d.PROGRAMMER



The Programmer* app is where parameters, monitor variables, active-faults, and the fault -history are accessed. There are no separate monitor and diagnostics apps on the main screen. This chapter covers all of the items that can be accessed with the Programmer. It is recommended that the Device manual be consulted for explanations of the read/write and read only variables viewable within Programmer.

Not all devices will have the same Programmer menus pictured here, and some devices may not operate as describe in this chapter. Available faults and diagnostic procedures can vary with the deviceThe the 1313 HP does not support the umlaut characters ÄÖÜ and äöü. Their usage (i.e., custom parameters or menus) will result in a corrupted/shifted text display.

In the main screen, highlight the Programmer icon and press the “Select” softkey to open the app. Use the arrow keys and the softkeys to navigate within Programmer. Use the +/- keys to adjust parameter values.
Each item in Programmer is assigned an icon indicating its type. These are:

( ) The *pencil* read/write icon indicates an adjustable parameter.
( ) The *open-book* read-only icon corresponds to monitor variables.
( ) The menu icon, indicating there are additional items, or sub-menus, within.
( ) An active fault, or a fault within the Fault History menu.
( ) The parameter is out of range (warning)

Note that related monitor variables often reside within particular parameter menus—offering immediate feedback for a parameter change**.

PROGRAMMER STRUCTURE

When any of the app's top-level menus are selected (Select) the name of the app is displayed adjacent to the Programmer icon. When navigating through a hierarchical menu, the text at the top of the screen expands to show the path taken. Likewise, the item's relative position on the screen or in a menu is shown in the window. The top, or first item will indicate "`1 of X`" while the bottom, or last item will indicate "`X of X`" on the screen. This is helpful when the quantity of items in the menu/sub-menu exceeds the display's 8 lines. Illustrated below are two examples showing the path and position of highlighted items in the Speed Mode menu of an F2-A motor controller.

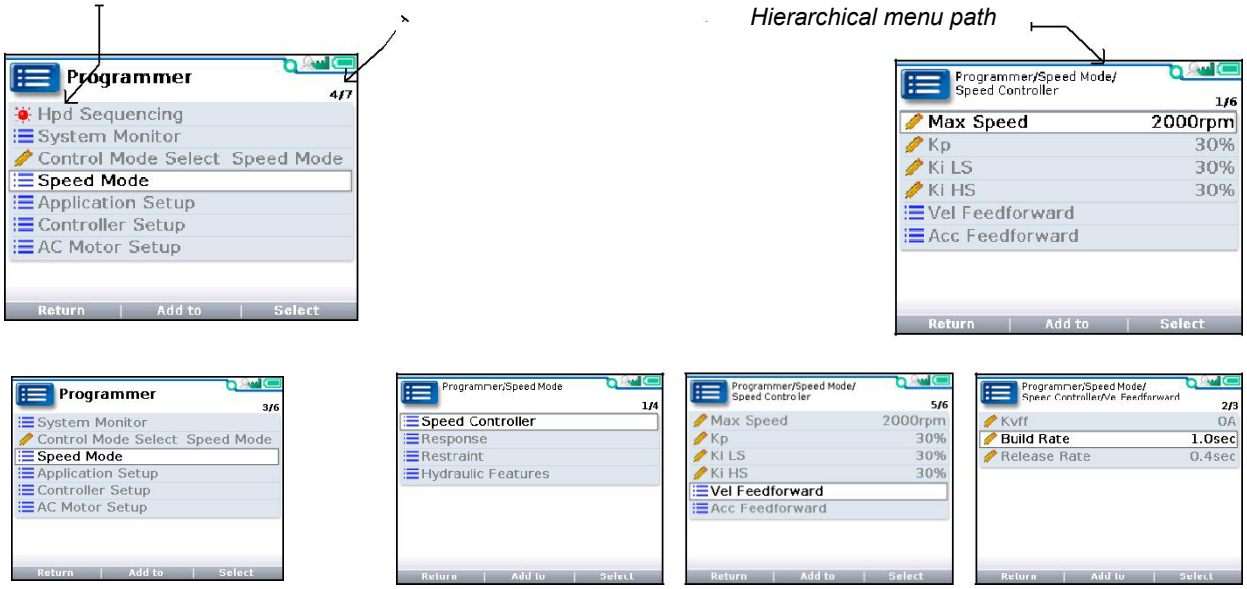
(1) parameter *Max Speed*

(2) parameter *Build Rate*

Displayed faults are device specific

Highlighted parameter is the 4th of 7 items(4/7)

Hierarchical menu path

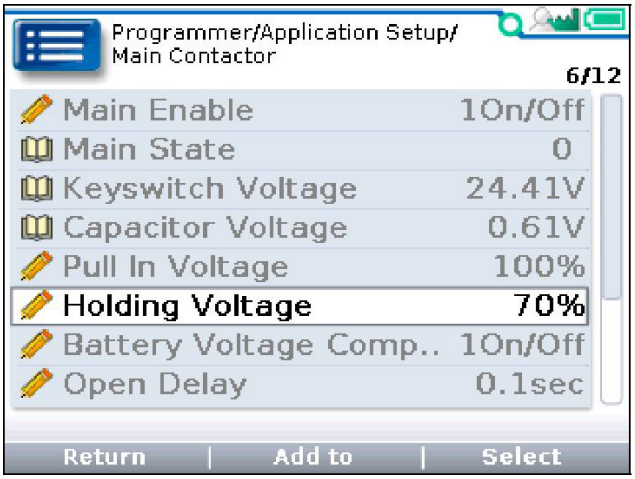


If exiting an app using the main screen key ( ) and later returning to the same app, the app will open to a location that depends on the "`Remember Last View`" setting in the HHP Setup app. If the setting is "Off", the app opens at the top-level. If the setting is "On", the app opens to the most recently used location.

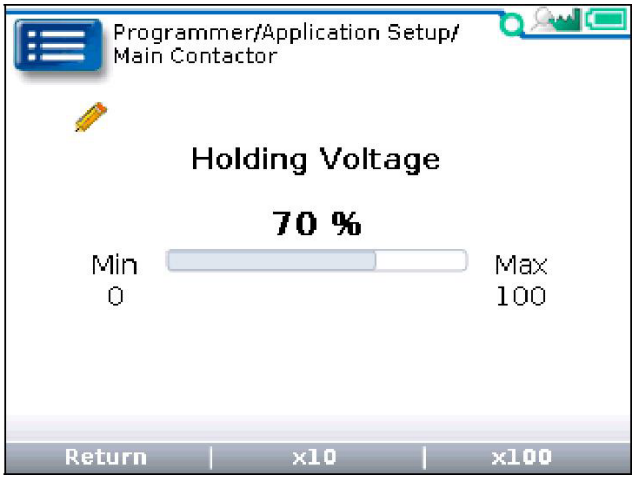
Note: If the 1313 HHP is turned off (e.g., the device or CANbus is key-cycled) the "`last-place-memory`" is lost. Each power-on session begins the Remember Last View anew, even if the setting is "On".

ADJUSTING/EDITING PARAMETERS

Within Programmer, use the down (▽) or up (△) arrows to navigate between parameters, monitor-items, or sub-menus. If the menu contains more than the 8 items shown on the screen, a scrollbar appears at the right edge of the screen. When a scrollbar is present, the lines wrap around so that navigating up from the top line/item navigates the screen to the last line/item on the list and vice versa.



Holding Voltage highlighted



Holding Voltage _ expanded (detail screen example)

When a parameter is highlighted, pressing the "Select" softkey or right-arrow key (▷) will open to a detail screen, where the present setting is shown in relation to the available range. The preceding comments regarding parameter adjustments also apply to the detail screen.

14. Controller Fault Code Table

Countermeasures of fault codes for Curtis AC-F2-A controller

NO.	Fault code	Fault Name	Solution
1	1.2	Controller Overcurrent	1.The external U, V or W connection of the motor is short-circuited; 2. Motor parameters do not match; 3. Controller failure; 4. If the phase current exceeds the limit current, the key switch shall be turned on and off when the power is turned on;
2	1.3	Current Sensor Fault	1.Motor U, V and W short circuit to the vehicle body through the the determiner, resulting in leakage 2.Controller fault 1. Reading deviation of Controller current sensor Solution: replace the controller by restart the key switch;
3	1.4	Precharge Failed	1. The key switch input voltage failed to charge the capacitor. Solve the reset of VCL function precharge() or the re-input of interlock switch; 2.Replace Controller；
4	1.5	Controller Severe Undertemp	If the radiator temperature is lower than - 40 ℃, solve the fault by raising the temperature to above - 40 ℃, restart the key switch or interlock switch, otherwise replace the controller;
5	1.6	Controller Severe Overtemp	The radiator temperature is higher than 95 degrees Celsius by reducing the temperature to below 95 degrees Celsius. Restart the key switch or interlock switch. If not, replace the controller;
6	1.7	Severe Undervoltage	1. Battery parameter setting error; 2. Power consumption of non-controller system; 3. The battery impedance is too large; 4. The battery is disconnected; 5. The fuse is disconnected or the main contactor is not connected;
7	1.8	Severe Overvoltage	1. Battery parameter setting error; 2. The battery impedance is too high; 3. The battery is disconnected during regenerative braking; 4. The capacitance voltage exceeds the maximum voltage limit when the MOSFEET bridge works Solution: reduce the voltage and restart the key switch;
8	2.1	Controller Undertemp Cutback	1. Controller works under restricted conditions; 2. The working environment of the controller is harsh; Set: radiator temperature is lower than -25℃ Clear: make the radiator temperature higher than -25℃

9	2.2	Controller Overtemp Cutback	1. The working environment of Controller is harsh; 2. Vehicle overload; 3. The controller is not installed correctly; Set: radiator temperature exceeds 85℃ Clear: reduce the temperature
10	2.3	Undervoltage Cutback	1. The battery is low 2. Battery parameter setting error 3. Non-controller system runs out of power 4. The battery impedance is too large 5. The battery is disconnected 6. The fuse is disconnected or the main contactor is disconnected
11	2.4	Overvoltage Cutback	1. The regenerative braking current causes the battery voltage to rise during the regenerative braking process 2. Battery parameter setting error 3. The battery impedance is too large 4. The battery is disconnected during regenerative braking
12	2.5	+5V Supply Failure	External load impedance is too low
13	2.6	Digital Out 6 Failure	External load impedance is too low
14	2.7	Digital Out 7 Overcurrent	External load impedance is too low
15	2.8	Motor Temp Hot Cutback	1. The motor temperature reaches or is higher than the warning temperature set by the program, resulting in reduced current output 2. The motor temperature parameter is set incorrectly 3. If the motor does not use a temperature sensor, the programming parameters "Temp compensation" and "Temp cutback" must be set to "OFF"
16	2.9	Motor Temp Sensor Fault	1. The motor temperature sensor is connected incorrectly 2. If the motor does not use a temperature sensor, the programming parameter "Temp Compensation and Temp Cutback" must be set to "OFF"
17	3.1	Coil 1 Driver Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
18	3.1	Main Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
19	3.2	Coil2 Driver Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
20	3.2	EM Brake Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring

21	3.3	Coil3 Driver Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
22	3.4	Coil4 Driver Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
23	3.5	PD Open/Short	1. Open circuit or short circuit of connected load 2. The connecting pin is dirty 3. Wrong wiring
24	3.6	Encoder Fault	1. Motor encoder fault 2. Wrong wiring
25	3.7	Motor Open	1. Motor phase loss 2. Wrong wiring
26	3.8	Main Contactor Welded	1. Main contactor contact fusion 2. Motor U or V is disconnected or out of phase 3. There is electricity connected to B+ terminal Charging condition of directional capacitor
27	3.9	Main Contactor Did Not Close	1. Main contactor is not closed 2. The contact of the main contactor is oxidized, melted, or the connection state is unstable 3. The capacitor is charged by external devices 4. The fuse is disconnected
28	4.1	Throttle Wiper High	Throttle potentiometer output voltage too high
29	4.2	Throttle Wiper Low	Throttle potentiometer output voltage is too low
30	4.3	Pot2 Wiper High	Potentiometer 2 output voltage is too high
31	4.4	Pot2 Wiper Low	Potentiometer 2 output voltage is too low
32	4.5	Pot Low Overcurrent	Potentiometer impedance is too low
33	4.6	EEPROM Failure	Writing to EEPROM memory failed. This may be caused by the VCL writing to the EEPROM, or the CAN BUS, or the wrong parameters programmed into the Controller after the programmer parameters are adjusted.
34	4.7	HPD/Sequencing Fault	1. Key start, interlock, direction, and Throttle input sequence settings are wrong 2. Faulty wiring, key switch, interlock, direction, or Throttle input
35	4.7	Emer Rev HPD	The emergency reverse operation has ended, but the Throttle, forward and reverse inputs and interlocks have not been reset
36	4.9	Parameter Change Fault	In order to ensure the safety of the vehicle, the change of some specific parameters will take effect only after the key switch is restarted

37	5.1	constant USER 1 FAULT	PDO Fault Rema
38	5.2	constant USER 2 FAULT	PDO Timeout BMS
39	5.3	constant USER 3 FAULT	User HPD Fault
40	5.4	constant USER 4 FAULT	Throttle Open Fault
41	5.5	constant USER 5 FAULT	Interlock SRO
42	5.6	constant USER 6 FAULT	GPS Flag Lock 1
43	5.9	constant USER 9 FAULT	GPS No Communication Fault
44	6.1	constant USER 10 FAULT	Throttle Supervisor Fault
45	6.3	constant USER 12 FAULT	GPS Flag Lock2
46	6.4	constant USER 13 FAULT	BDI Low Liftlock
47	6.5	constant USER 14 FAULT	PDO Fault 1220
48	6.6	constant USER 15 FAULT	1220 Shutdown Fault
49	6.7	constant USER 16 FAULT	1220 Limit Fault
50	5-10	constant USER 17 FAULT	Handshake Fault
51	5-11	constant USER 18 FAULT	BMS Fault Grade Non Zero
52	5-12	constant USER 19 FAULT	PDO Fault ECS
53	5-13	constant USER 20 FAULT	Rema EMR SRO
54	5-14	constant USER 21 FAULT	HYD SRO Fault

55	5-15	constant USER 22 FAULT	Throttle ON Without Interlock Fault
56	6-10	constant USER 23 FAULT	BMS Cell Undervolt Fault
57	6-11	constant USER 24 FAULT	BMS Temp Fault
58	6-12	constant USER 25 FAULT	BMS Cell voltage Fault
59	6-13	constant USER 26 FAULT	BMS LOW AH
60	6-14	constant USER 27 FAULT	BMS voltage difference
61	6-15	constant USER 28 FAULT	Display PDO Timeout Fault
62	7-10	constant USER 29 FAULT	Battery type mismatch
63	7-11	constant USER 30 FAULT	Unmatched Display Fault
64	6.8	VCL Run Time Error	VCL code timeout for running time
65	6.9	External Supply Out of Range	1.The current of external load at 5V and 12V power supply is too large or too small 2.Parameter error in "Checking Menu", such as "Ext Supply Max", "Ext Supply Min"
66	7.1	OS General	Internal controller failure
67	7.2	PDO Timeout	CAN PDO message acceptance time exceeds PDO time limit
68	7.3	Stall Detected	1. Motor locked 2. Motor encoder failure 3. Wrong wiring 4. Input motor encoder power failure
69	8.7	Motor Characterization Fault	Code comparison occurs during motor matching: 0=normal 1=The controller receives the encoder number, but the pulse quantity is not defined. Please set the pulse value manually 2=motor temperature sensor failure 3=motor high temperature reaction failure 4=motor overheat reaction failure 5=motor low temperature reaction failure 6=low voltage response failure 7=high pressure reaction failure 8=Controller cannot detect encoder signal and channel signal disappears 9=motor parameter setting exceeds the range

70	8.9	Motor Type Fault	Motor type parameter value is out of range
71	9.1	VCL/OS Mismatch	VCL program in Controller does not match OS program
72	9.2	EM Brake Failed to Set	1. The vehicle still moves after the electromagnetic brake command is set. 2. The braking force of electromagnetic brake is too small
73	9.3	Encoder LOS(Limited Operating Strategy)	1. The restricted operation state is activated due to motor locked-rotor or encoder fault 2. Wrong wiring 3. Vehicle locked
74	9.4	Emer Rev Timeout	1. The emergency reverse timeout is activated due to the expiration of the EMR Timer 2. The emergency reverse switch is always in the On position
75	9.8	Illegal Model Number	1. The controller model is not recognized 2. Software and hardware do not match each other 3. Controller is damaged
76	9.9	Dual motor Parameter Mismatch	The Enable parameter of the dual motor is set to ON, and the control mode selection parameter is not set to 0 (Speed Mode Express) or 1 (Speed Mode)

EPS 1220E Fault Code

FLASH CODE	NAME	POSSIBLE CAUSE	CLEAR CONDITION	STEER FAULT ACTION	TRACTION FAULT ACTION
12	Controller Overcurrent	1. The steer motor wires shorted. 2. Controller defective.	Cycle KSI	Shutdown	1 = Stop
13	Current Sense Fault	1. Controller defective.	Cycle KSI	Shutdown	1 = Stop
14	Precharge Fault	1. Controller defective.	Cycle KSI	Shutdown	1 = Stop
15	Controller Severe Undertemp	1. Controller is operating in extreme low temperature. 2. the temperature sensor is broken.	Heatsink temperature above -35°C.	Warning Only	3 = No Action
16	Controller Severe Overtemp	1. Excessive load on vehicle. 2. Controller is operating in extreme high temperature. 3. Improper mounting of controller.	Cycle KSI	Warning then Shutdown	1 = Stop
17	Severe Undervoltage	1. Battery or battery cables or battery connections defective. 2. Excessive non-controller hydraulic system drain on battery. 3. Battery discharged or improper battery.	Cycle KSI	Shutdown	1 = Stop
18	Severe Overvoltage	1. Battery or battery cable resistance too high for a given regen current. 2. Battery disconnected while regen braking.	Cycle KSI	Shutdown	1 = Stop
23	Motor Polarity Fault	1. The motor polarity is reversed. 2. The position feedback device polarity is reversed.	Cycle KSI	Shutdown	1 = Stop
24	5V Supply Failure	1. Overload for the 5V supply 2. Controller defective 3. Load wiring open for the 5V supply	Cycle KSI	Hold then Shutdown	1= Stop
25	12V Supply Failure	1. Overload for the 12V supply 2. Controller defective	Cycle KSI	Warning then Shutdown	1= Stop
26	Motor Temp Hot Cutback	1. Excessive load on vehicle. 2. Controller is operating in extreme high temperature.	Bring Steering Motor temperature backs to range.	Warning and Reduce Current Limit	2 = Reduce Speed
31	Main Driver Fault	1. Internal relay coil is broken. 2. Internal relay driver is open or shorted.	Cycle KSI	Warning then Shutdown	1 = Stop

33	Motor Short	1. The steer motor wires shorted.	Cycle KSI	Shutdown	1 = Stop
34	Encoder Fault	1. Encoder is broken. 2. Encoder wiring is open. 3. Controller defective.	Cycle KSI	Hold then Shutdown	1 = Stop
35	Fault Output Failure	1. Incorrect Fault Output wiring. 2. Controller defective.	Cycle KSI	Shutdown	1 = Stop
36	Motor Stalled	1. Stalled steer motor. 2. Steer motor encoder failure or wires open. 3. Steer motor wires open. 4. Related parameters do not match with steer motor.	Cycle KSI	Shutdown	1 = Stop
37	The main contactor coil is open	1. Steer motor wires open. 2. Faulty motor cable wiring. 3. Controller defective.	Cycle KSI	Warning then Shutdown	1 = Stop
38	Relay Welded	1. Internal relay welded. 2. Controller defective.	Cycle KSI	Shutdown	1 = Stop
39	Relay Did Not Close	1. Internal relay was commanded to be close but it did not. 2. Controller defective.	Cycle KSI	Shutdown	1 = Stop
41	Command Analog1 Out of Range	1. Command Analog Input 1 (J3-6) is out of range. 2. Incorrect parameter settings.	Cycle KSI	Hold then Shutdown	1 = Stop
42	Command Analog2 Out of Range	1. Command Analog Input 2 (J3-13) is out of range. 2. The crosscheck on Command Analog Input 1 (J3-6) and Command Analog Input 2 (J3-13) failed. 3. Incorrect parameter settings.	Cycle KSI	Hold then Shutdown	1 = Stop
43	Feedback Analog1 Out of Range	1. Analog Input (J3-2) is out of range. 2. Incorrect parameter settings.	Cycle KSI	Hold then Shutdown	1 = Stop
44	Feedback Analog2 Out of Range	1. Position Analog Input 2 (J3-9) is out of range. 2. The crosscheck on Position Analog Input 1 (J3-2) and Position Analog Input 2 (J3-9) failed. 3. Incorrect parameter settings.	Cycle KSI	Hold then Shutdown	1 = Stop
45	CAN Not Operational	1. 1220E CAN NMT State did not go operational within 80 ms of interlock being applied.	Cycle KSI	Warning then Shutdown	1 = Stop
46	NV Failure	1. Internal Non-Volatile Memory defective.	Cycle KSI	Shutdown	1 = Stop
47	Parameter Change	1. A parameter value was changed that requires a power cycle.	Cycle KSI	Shutdown	1 = Stop

		2. Parameters are restored to the default settings.			
51	Interlock Switch Supervision	1. A fault is set if the 2 switch inputs are not matched. 2. Interlock switch defective.	Cycle KSI	Interlock = OFF	1 = Stop
52	Home Switch Supervision	1. When the wheel position is not close to home, the redundant home switch inputs are checked and a fault is set if they disagree. 2. Home switch defective.	Cycle KSI	Warning then Shutdowm	1 = Stop
53	Home Position Not Found	1. Home switch defective. 2. Mounting or wiring defective.	Cycle KSI	Shutdown	1 = Stop
54	Home Reference Tolerance Fault	1. Home switch defective.	Cycle KSI	Shutdown	1 = Stop
55	Steer Command Supervision	1. Command input device defective.	Cycle KSI	Hold then Shutdown	1 = Stop
56	Wheel Position Supervision	1. Position feedback device defective.	Cycle KSI	Hold then Shutdown	1 = Stop
71	Software Fault	1. Software defective. 2. Controller defective.	Cycle KSI	Shutdown	1 = Stop
72	PDO1 Timeout	1. Communication between the traction and the steering controller has halted.	Cycle KSI	Warning then shutdown	1 = Stop
73	Following Error	1. Incorrect parameter settings. 2. Position feedback device defective. 3. Steer motor defective.	Cycle KSI	Shutdown	1 = Stop
74	Hardware Fault	A hardware error has been detected. 1. Power MOSFET is shorted. 2. MODFET driver is defective. 3. Watchdog cross checking defective. 4. Internal +15V defective. 5. Poor connection to battery terminals	Cycle KSI	Shutdown	1 = Stop
75	Parameter Conflict	1. Parameter settings are selected that are in conflict with each other. 2. Parameter setting out of range.	Cycle KSI	Shutdown	1 = Stop
78	CAN Bus Loading	1. CAN bus defective. 2. The message sending is too fast.	Cycle KSI	Warning then Shutdown	1 = Stop
79	PDO Mapping Error	1. Incorrect CAN mapping data.	Cycle KSI	Shutdown	1 = Stop

81	Bad Calibrations	1. Calibration data is out of range	Cycle KSI	Shutdown	1 = Stop
82	Parameter Out of Range	1. Parameter data out of range	Cycle KSI	Shutdown	1 = Stop
84	Supervision	1. Supervisor defective	Cycle KSI	Shutdown	1 = Stop