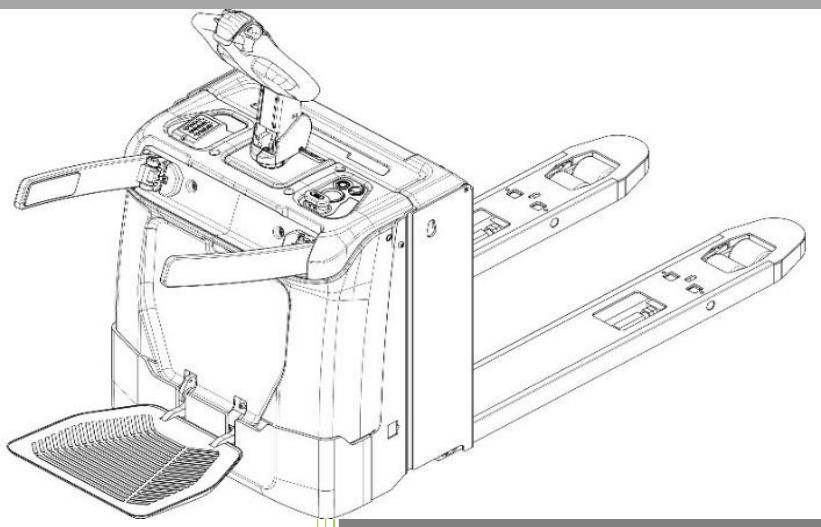
NOBLELIFT

Service Manual

Pallet Truck

PT20 Li



WARNING

Do not use the pallet truck before reading and understanding these operating instructions.

NOTE:

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

Version 07/2023

PT20Li-SM-003-EN

FOREWORD

Before operating the truck, read this ORIGINAL INSTRUCTION MANUAL carefully and understand the usage of the truck completely. Improper operation could create danger.

This manual describes the usage of different electric pallet trucks. When operating and servicing the truck, make sure, that it applies to your type.

Keep this manual for future reference. If this or the warning/ caution labels are damaged or get lost, please contact your local dealer for replacement.

This truck complies with the requirements according to EN ISO 3691-1 (Industrial trucks - Safety requirements and verification - Part 1), EN 12895 (Industrial trucks - electromagnetic compatibility), EN 12053 (Safety of industrial trucks - test methods for measuring noise emissions), EN 1175-1 (Safety of industrial trucks - Electrical requirements), assumed the truck is used according to the described purpose.

According to EN 12053, the level of noise around the operator shall be less than 69 dB(A).

According to EN 13059, the vibration acceleration shall be less than 0.85m/s².

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 manual 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 manual.

NOTE: In this manual, the left symbol indicates warning and danger, which may lead to death or serious injury if not followed.

Copyright

Catalog

1. CORRECT APPLICATION

It is only allowed to use this electric pallet truck according to this instruction handbook.

The trucks described in this handbook are self-propelled electric power pallet trucks. 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. The work 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 PALLET TRUCK

a. Overview of the main components

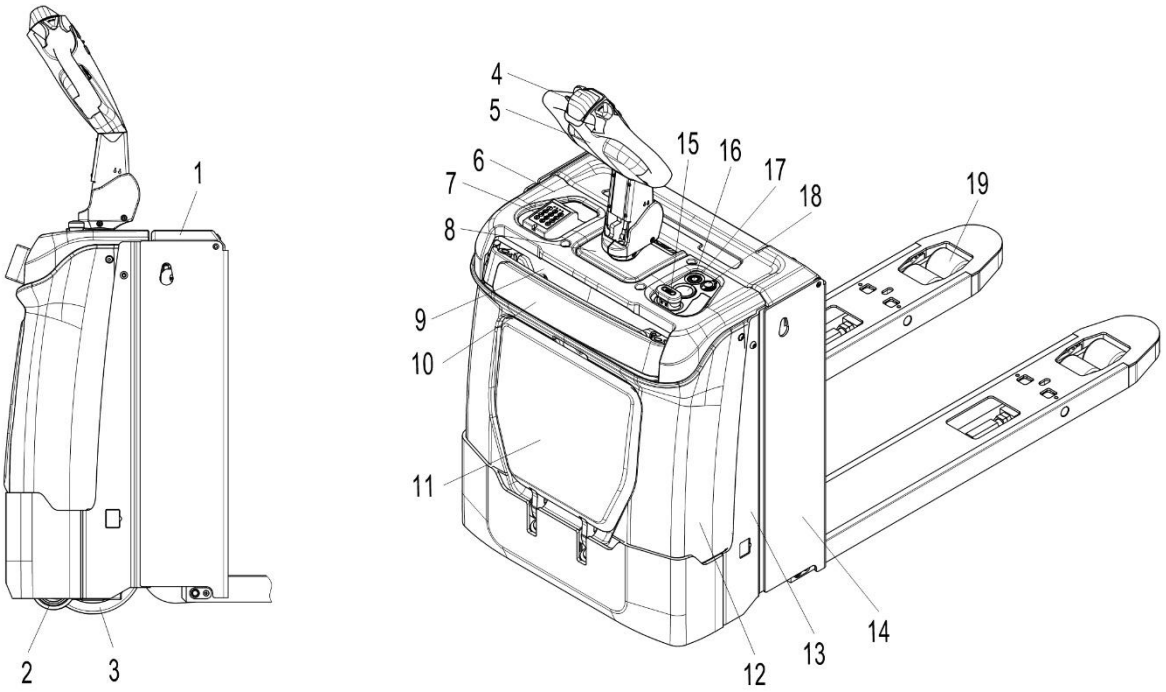


Fig. 1: Overview of the main components

1. Battery cover
2. Side wheels
3. Drive wheels
4. Safety (belly) button
5. Tiller
6. Protective cover
7. combination lock
8. Middle cover
9. Cover of protective arm
10. Protective arm subassembly
11. Pedal pad subassembly
12. Outer cover
13. Truck body
14. Fork chassis
15. Emergency button
16. Power switch
17. Instrument
18. USB Port
19. Load roller

b. Technical data

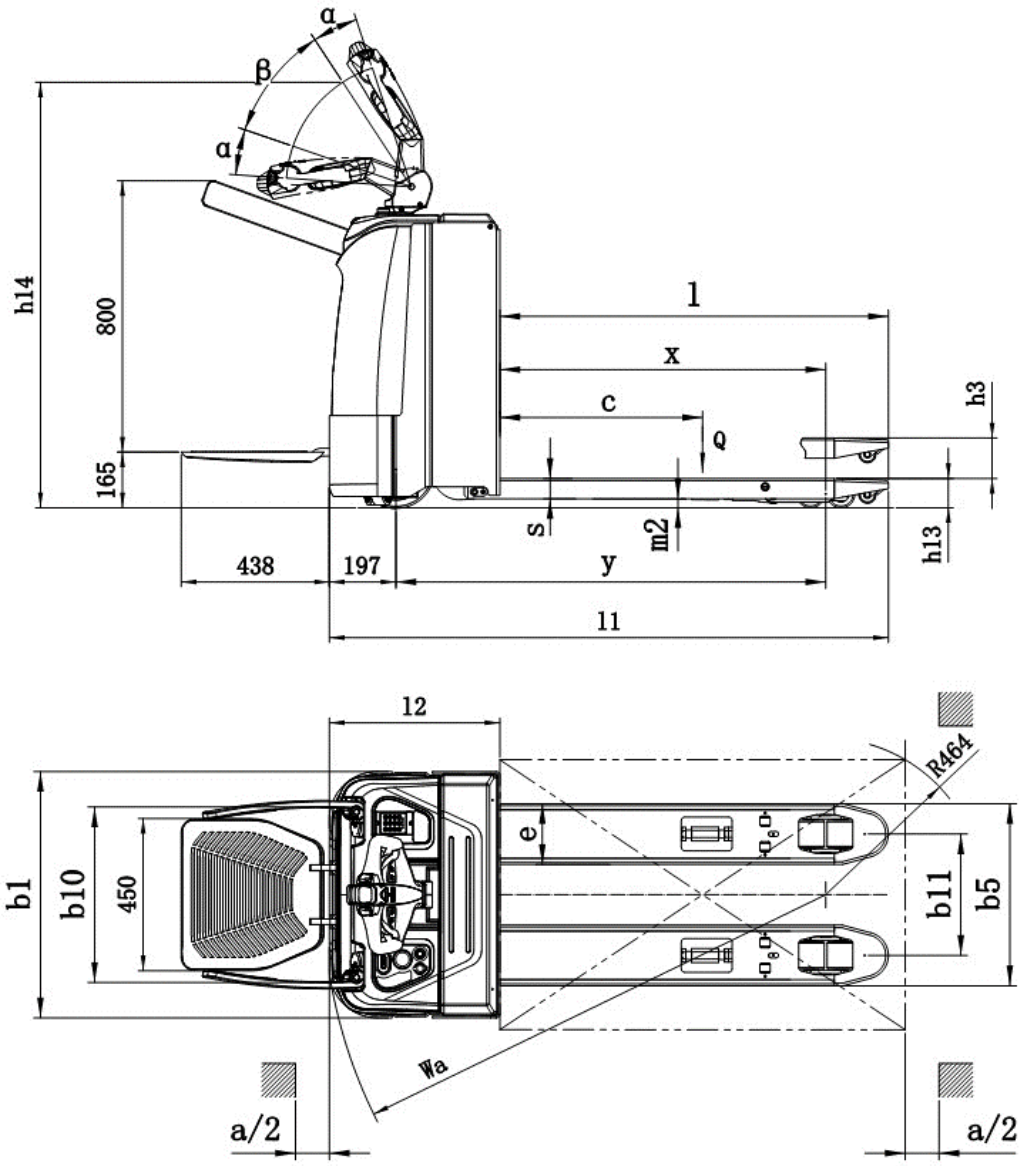


Fig. 2: Technical data

Table 1: Main technical data for standard version

Technical data in line with VDI 2198				
Identification	1.2	Model		PT20Li
	1.3	Drive		Electric
	1.4	Operation		Pedestrian/Stand
	1.5	Load capacity/rated load	Q(kg)	2000
	1.6	Load centre distance	c(mm)	600
	1.8	Load distance	x(mm)	899[1)]
	1.9	Wheelbase	y(mm)	1206[1)]
Wei-ghts	2.1	Net weight with battery	kg	*505*
	2.2	Axle loading, laden front/rear	kg	*695/1810*
	2.3	Axle loading, unladen front/rear	kg	*385/120*
Wheels/ frame	3.1	Tires		PU
	3.2	Tire size, front	∅ x w (mm)	∅230×70
	3.3	Tire size, rear	∅ x w (mm)	∅82×82
	3.4	Additional wheels(dimensions)	∅ x w (mm)	∅100×40
	3.5	Wheels, number front/rear(x=driven wheels)		1x+2/2 or 4
	3.6	Tread width, front	b_{10} (mm)	520
	3.7	Tread, width, rear	b_{11} (mm)	360
Basic dimensions	4.4	Lift	h_3 (mm)	120
	4.9	Height of tiller	h_{14} (mm)	1070/1260
	4.15	Height, lowered	h_{13} (mm)	85
	4.19	Overall length	l_1 (mm)	1655
	4.20	Length to face of forks	l_2 (mm)	505
	4.21	Overall width	b_1 (mm)	730
	4.22	Fork dimensions	s/e/l	60/180/1150
	4.25	Width across forks	b_5 (mm)	540/685
	4.32	Ground clearance(centre of wheelbase)	m_2 (mm)	25
	4.34	Aisle width for pallets 800×1200 lengthways	Ast (mm)	2086[1)]
	4.35	Turning radius	Wa (mm)	1422[1)]
Performance data	5.1	Travel speed laden/unladen	km/h	*7/8*
	5.2	Lift speed, laden/unladen	mm/s	47/64
	5.3	Lowering speed, laden/unladen	mm/s	60/59
	5.8	Max. grade ability, laden/unladen	%	*8/15*
	5.10	Service brake		regenerative
Electrics	6.1	Drive motor, output at S2 60min	kW	1.4
	6.2	Lift motor, output at S3 10%	kW	2.2
	6.3	Battery as per DIN 43531/35/36 A，B，C，no		no
	6.4	Battery voltage/nominal capacity	V/Ah	24/150
	6.5	Battery weight	kg	*80*
	6.6	Energy consumption as per EN 16796	kWh/h	*0.188*
Misc.	8.1	Type of drive control		AC-speed control
	8.4	Sound pressure level at operator’s ear as per EN12053	dB(A)	*<70*
	8.6	Steering		Electric steering

c. Description of the safety devices and warning labels (Europe and other, excepting USA)

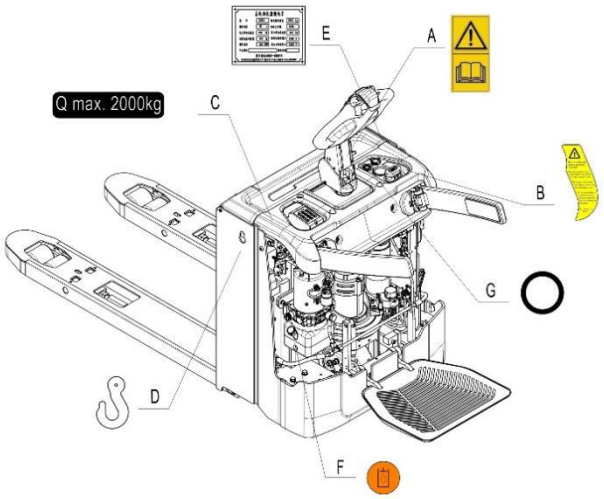


Fig. 3: Safety and warning labels

A Sticker to observe and follow this instruction
B Warning sticker
C Capacity label
D Crane hook label
E Identification plate (ID plate)
F Oil filling decal
G Indication decal

The truck is equipped with an emergency button (15), which stops all lifting-, lowering-, driving- functions and engages the electromagnetic brake when it is activated by pressing。Pull out the emergency button to restart the truck after checking functions of the controller。Press the power button (16) and start the truck via RFID or manually enter the password. To prevent unauthorized access, press the power button or the “X” button on the combination lock panel if the truck is inoperative. The truck is equipped with a safety (belly) button (4) 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 the instructions given on the labels and decals. Replace the label and decals in time if they are damaged or missing.

d. Identification plate

Table 2：Identification plate

Model	**PT20Li**	**Size of forks**	**XXX**
Serial No.		**Year of manuf.**	**XXX**
Rated capacity	**XXX**	**Load center distance**	**XXX**
System voltage	**XXX**	**Nominal power**	**XXX**
Net weight without the battery	**XXX**	**Battery mass min/max**	**XXX**
Noblelift Intelligent Equipment Co., Ltd. 528 Changzhou Road, Taihu Sub-district, Changxing, Zhejiang 313100 China			CE

Check the ID plate taped on the truck for contents and type.

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.
- Side or end load. Load must be distributed evenly on the forks.
- Use the truck with unstable or unbalanced load.
- Use truck without manufacturer's instructions manual.
- 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 (12) by pulling when the load is sliding on or off the truck. If the truck has any malfunctions, follow instructions in 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 the temperature of the 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 temperature between +5°C and +40°C (41℉～104℉).
- The operating lighting must be minimum 50 Lux.
- Operating the truck on the ramp is not allowed.
- To prevent unintended sudden movements when not operating the truck (i.e. from another person, etc.), cut off the power first.
- To avoid unintended impact between the foldable pedal and other objects, especially the risk of crash or shear on the way forward, please always be in the safe speed when driving.

4. COMMISSIONING, TRANSPORTING, DECOMMISSIONING

a. Commissioning

Table 3: Commissioning data

Model	PT 20Li
Commissioning weight [kg]	505 kg
Dimensions [mm]	1565x730x1365

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

- Check if are all parts included and not damaged.
- Make sure the multifunctional tiller is assembled correctly.
- Check that battery is charged (follow chapter 8).
- Do the daily inspections as well as the functional check.

b. Hoisting/ transportation

For transporting, remove the load, lower the forks to the lowest position and fix the truck safely with dedicated hoisting equipment according to the figure 4.

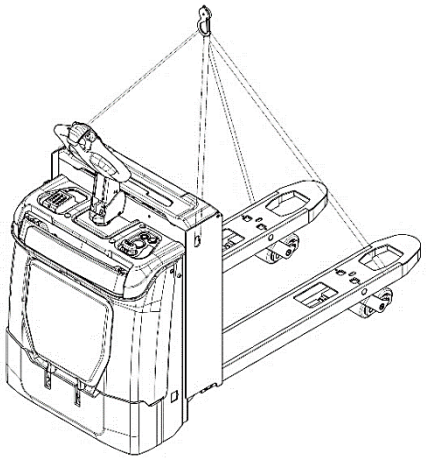


Fig. 4：Fixing points when hoisting

Hoisting

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

Transport

⚠ Fix the truck firmly on trucks or vans when transporting.

Lower forks and parking the truck safely.
As shown in the Fig. 5, fix one end of the hoisting-used strapping tape on both sides of the truck, and fix another end on the transporting truck.

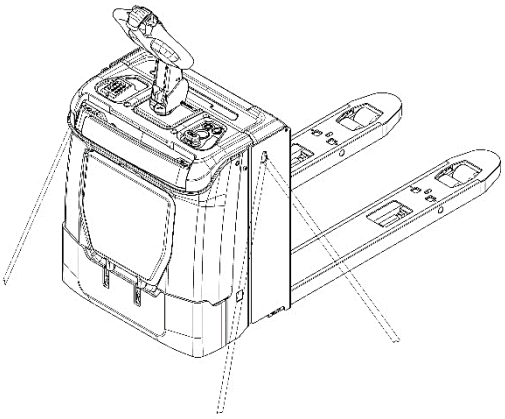


Fig. 5：Fixing points when transporting

c. Decommissioning

For storage, remove the load, lower the truck to the lowest position, grease all greasing points mentioned in this instruction manual (regular inspection), and eventually protect the truck against corrosion and dust. Remove the batteries and jack the truck safely, so that there will be 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 IS FOUND.

- Check for scratches, deformation or cracks.
- Check if there is any oil leakage from the cylinder.
- Check the function of driving with tiller in its vertical position.
- Check the smooth movement of the wheels.
- Check the function of the emergency brake by activating the emergency switch.
- Check the braking function of the proximity switch of the tiller.
- Check the lifting and lowering functions by operating the buttons.
- Check if all bolts and nuts are tightened firmly.
- Visual check if there are any broken electric wires.
- Check if the load backrest damaged or installed correctly (if it is equipped).

6. OPERATING INSTRUCTIONS

BEFORE OPERATING THIS TRUCK, PLEASE FOLLOW THE WARNINGS AND SAFETY INSTRUCTIONS (SEE CHAPTER 3).

Please ensure that cargos are settled on the pallet stably, and implement regular inspection.

Pull out the emergency button (9), long press the power button (10), activate the truck via RFID or enter password manually. Press the horn button (21) to activate the audible warning signal.

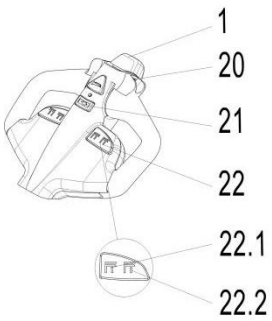


Fig. 6：Distribution of buttons on tiller

a. Parking

DO NOT PARK THE TRUCK ON INCLINED SURFACES.

The truck is equipped with an electromagnetic fail-safe stopping and parking brake.
Always lower the forks fully and press down the emergency button (9).

b. Lifting

DO NOT OVERLOAD THE TRUCK! MAXIMUM CAPACITY OF THIS TRUCK IS 2000KG

Travel with the lowered forks fully underneath the pallet and press the lifting button (22.1) until the pallet is lifted at your desired lifting height.

c. Lowering

Press the lowering button (22.2) carefully.
Lower the load until the forks are clear of the pallet, then drive the truck carefully out of the load unit.

d. Travelling

TRAVEL ON INCLINED SURFACE ONLY WITH THE LOAD FACING UPHILL (see fig. 7).
DO NOT TRAVEL ON INCLINED SURFACE MORE THAN THE SPECIFIED TECHNICAL DATA。

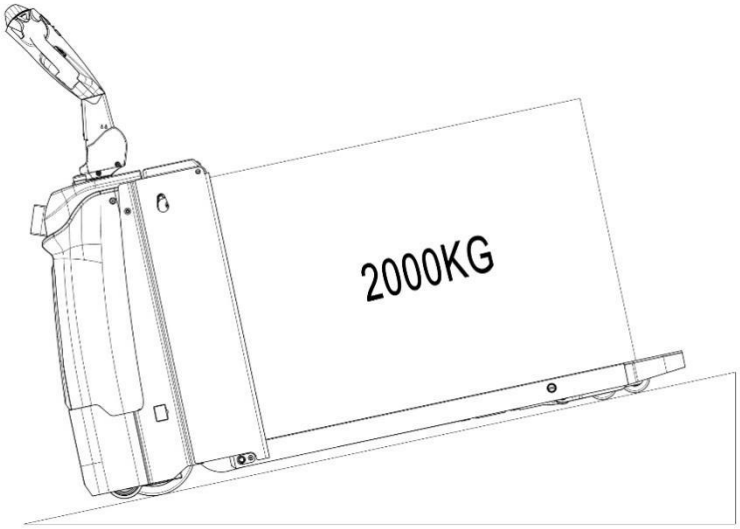


Fig. 7：Traveling on the ramp

Long press power button (10), activate the truck by combination lock, move the tiller to the operation position (‘F’, see Fig. 8). Turn the accelerator knob to the desired direction forward ‘FW.’ or backward ‘BW.’ (Fig. 8)

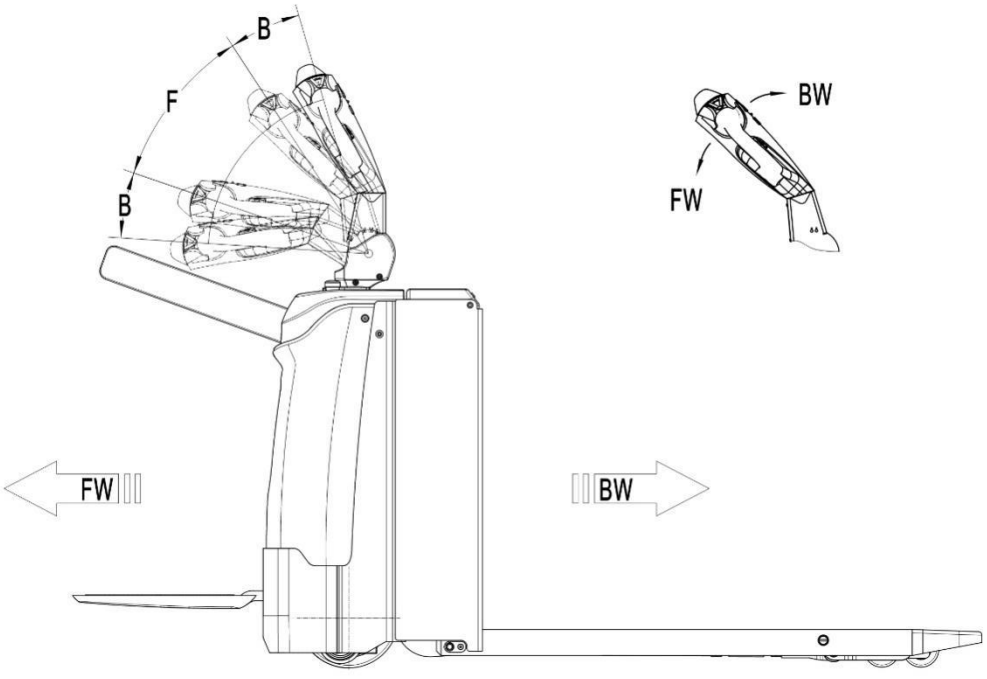
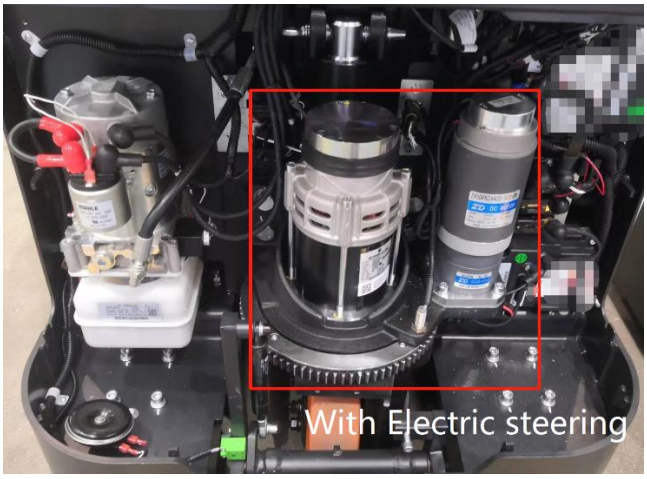


Fig. 8：Operating direction

Control travelling speed by operating the accelerator (20) carefully until it reaches your desired speed. If you move the accelerator back to the neutral position, the controller will decelerate the truck until the truck stops. If the truck stops, the parking brake will be engaged.
Drive the truck to the destination carefully. Watch the route conditions and adjust the travelling speed by operating the accelerator.

e. Steering

⚠ Electrical power steering (EPS) utilized, be careful when operating.
Steer the truck by moving the tiller to the left or right side



f. Braking

⚠ THE BRAKING PERFORMANCE DEPENDS ON THE TRACKCONDITIONS AND THE LOAD CONDITIONS OF THE TRUCK.

The braking function can be activated in several ways:

- By moving the accelerator (20) to the initial ‘0’ position or by releasing the accelerator, the regenerative braking is activated. The truck brakes until it stops.
- By moving the accelerator (20) from one driving direction directly to the opposite direction, the regenerative braking is activated until the truck starts traveling into the opposite direction.
- The brake activated and the truck stopped when the tiller is located in the braking zones (‘B’) or the tiller is released and moves automatically to the upper braking zone (‘B’).
- The safety (belly) button (1) prevents the operator from crush. If this button is activated, the truck decelerates and/or starts traveling into backwards direction (‘Bw.’) for a short distance and stops then. Please consider that this button still works if the truck is not traveling with tiller in operating zone.

g. Malfunctions

If there are any malfunctions or the truck is inoperative, please stop using the truck and press down the emergency button (9). If possible, park the truck in a safe area and press the power button or the “X” button on the combination lock panel. Inform the manager or call your service immediately. If necessary, move the truck out of the operating area by using dedicated towing/ hoisting equipment.

h. Emergency

In emergencies or in the event of tipping over, keep a safe distance immediately. If possible, push the emergency button (9) and all electrical functions will be stopped.

7. Combination lock

This serial is equipped with the combination lock. Pressing the power button (10) and it will be activated.

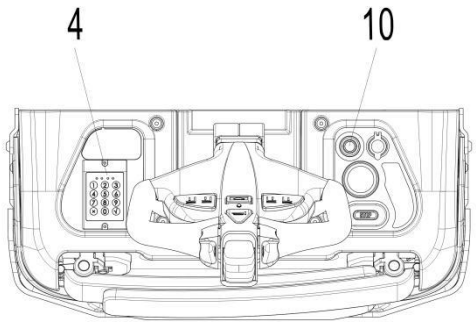


Fig. 9：Combination lock and power button

a. Introduction

Under the control of the combination ignition switch (refer as “combination lock” below), the truck will not be allowed to be activated before entering an authorized password. The main purpose of this device is to prevent the unauthorized person from operating the truck. Also, it serves as an anti-theft and security enhancement.

b. Main parameters

Operating voltage：12V-60V
Operating ambient temperature：-40℃ to +90℃
Ingress Protection：IP65

c. Main control code and functions

The current combination lock supports max 5 RFID cards and 1 set of password. Each set of password is constituted of 4 digits, from 0-9.

⚠ Please check the administrator password in the separate instruction manual. The factory default password is “1234”, and please refer to the separate instruction manual for password change procedures.

d. Unlocking procedures

1. ID Card

1.1 Place the ID card close to the combination lock panel, and if the ID card is available, then there will be a short buzz come from the combination lock. Subsequently, the blue indicator always on, which means the electric lock switch can output data correctly, and the combination lock is in working order.

2. Password

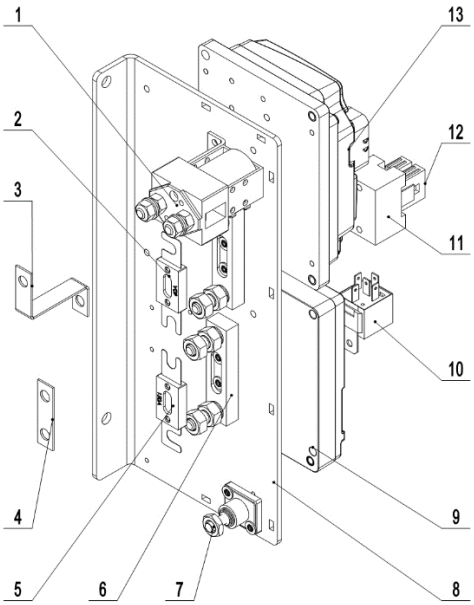
2.1 Enter the password, press the “ √ ” button then release it. The truck can be operated if the password is correct.
2.2 Press the “×” button then release it, and the truck will be turned off.
2.3 Re-enter the password to re-operate the truck.

e. Definitions of the indicator

Red	fault code
Yellow	waiting for further instruction
Blue	active
Green	power on

8. CONTROLLER AND RELATED DEVICES

a. Controller appearance

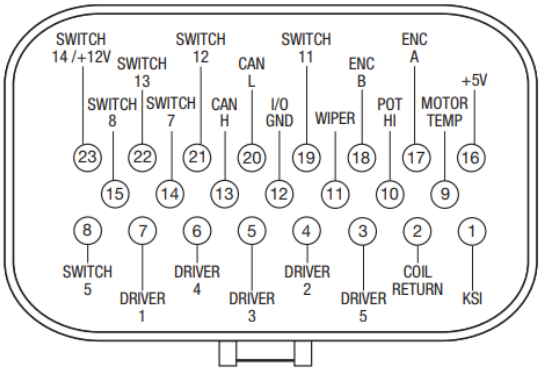


NO	Item Description	Qty.	Note
1	Relay	1	
2	Fuse	1	
3	Copper Busbar	1	
4	Copper Busbar	1	
5	Fuse	1	
6	Fuse Holder	2	
7	Fuse Holder	1	
8	Mounting Plate	1	
9	Controller	1	Steering controller
10	Relay	1	
11	Fuse Holder	1	
12	Fuse	1	
13	Controller	1	Traction controller

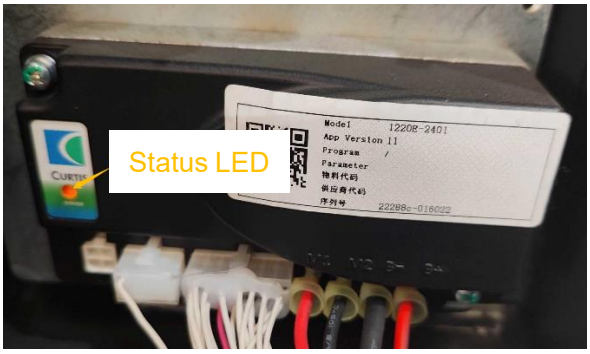
b. Controller pin definition

Curtis F2-A

PINOUT CHART



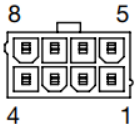
Curtis 1220E



PINOUT CHART

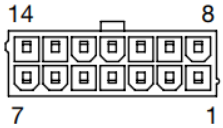
J1

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



J2

Pin	Description
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	Description	Pin	Description
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. Electrical circuit diagram

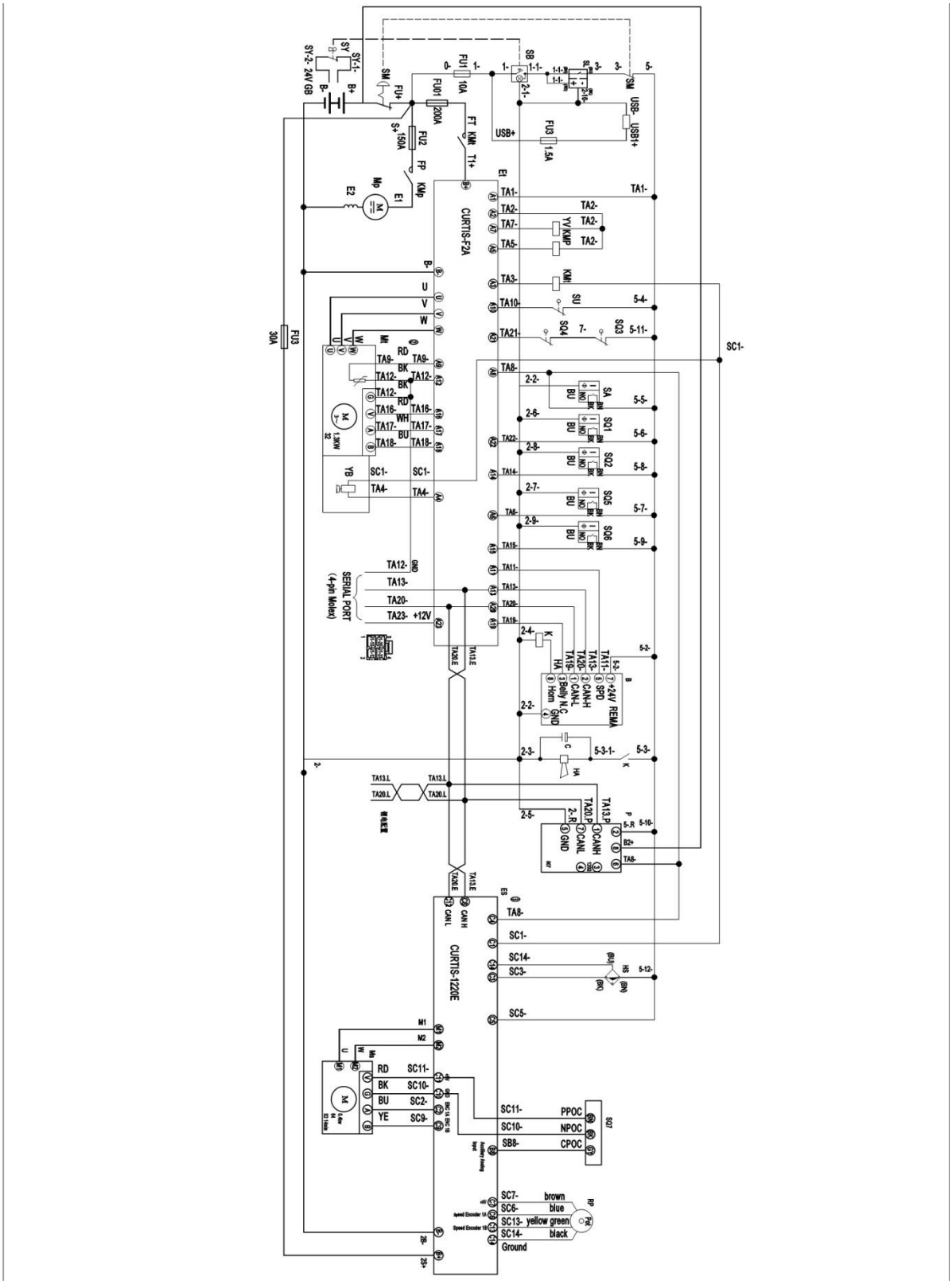
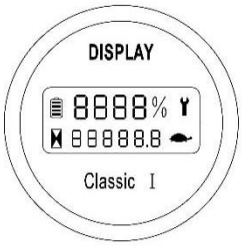


Fig. 10：Circuit diagram(EPS)

Table 4：Description of electrical diagram

Code	Item	Code	Item
GB	Battery	C	Capacitor
SM	AC switch	HA	Horn
FU01	Fuse 150A	SU	Micro switch
FU02	Fuse 80A	YV	Electromagnetic valve
FU03	Fuse 30A	SA	interlock switch
FU1	Fuse 10A	SB1、SB2	interlock switch
SY	Key switch	SJ	interlock switch
KMt	Main contactor	SL	Combination lock
Et	Controller	U	Charger
Mp	The motor of pump	HL	The indicator of charging
Mt	The motor of drive	XW	Power input wire
YB	Electromagnetic braking	USB	USB Plug-in
K	Relay	Ms	The motor of steering
P	Indicator	Es	The controller of steering
B	CAN tiller	Twin Pot	Twin potentiometer
SQ7	Sensors of the gear	HS	Proximity switch

d. Test and troubleshoot



Fault codes can be viewed directly in the dashboard or with the handheld programmer to view current fault information.

A. Controller test

Measure the diode voltage of the AC MOSFET circuit in the controller (as ZAPI for an example), and check whether it is burnt or damaged.

Each test item must be tested repeatedly for more than 3 times.

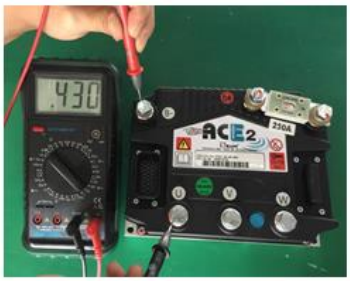
Item	Multimeter terminals		Normal range	
	Red pen	Black pen	Determination of polarity value	Resistance measurement
1	B+	U/V/W/B-		Over 1MΩ
2	B-	U/V/W		Over 1MΩ
3	U/V/W	B+	0.3-0.6V	
4	B-	U/V/W	0.3-0.6V	

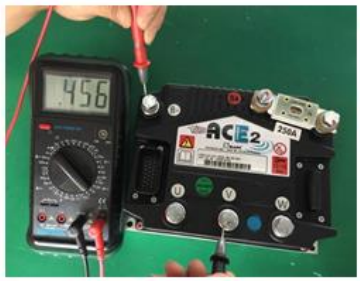
1） Pull the multimeter to Ω Turn the multimeter to diode (polarity measurement)

2） Remove the cables and wiring harness connected to the controller, and fully discharge the internal capacitor (with resistance 30) Ω/ 5W to discharge B + and b-terminals).

3）Use a multimeter to measure the voltage of the diode (0.3-0.6 V) and check whether it is normal.

Test 1: measure the diode voltage, red wire is B -, black wire is u, V and W.

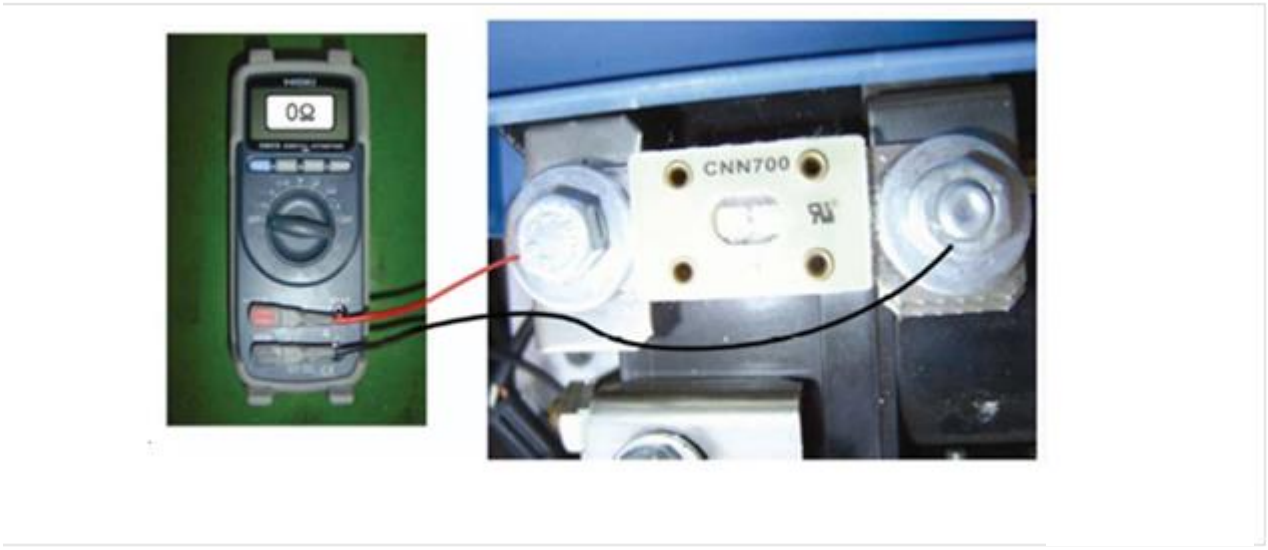




Test 2: measure the diode voltage to u, V and W with red lead, and B + with black lead.

Note: The multimeter pointer cannot be reversed

B. Line contactor and fuse measurement



For line contactors and fuses, connect an ohmmeter (multimeter set to Ohm) at the point shown in the figure and check that it measures the specified value.

9. BATTERY SAFETY, CHARGING AND REPLACEMENT

a. Instruction

- Only qualified personnel are allowed to service or charge the batteries. The instructions of this manual must be observed.
- The batteries are Li-ion Batteries.
- Recycling of batteries undergoes national regulations. Please follow the regulations.
- By handling batteries, open fire is prohibited, and it may cause gas explosion.
- In the area of battery charging neither burning materials nor burning liquids are allowed. Smoking is prohibited and the area must be ventilated.
- Park the truck securely before starting charging or installing/changing the batteries.
- Before finishing the maintenance work, make sure, that all cables are connected correctly and that they are no disturbing towards other components of the truck.

IT IS ONLY ALLOWED TO USE LITHIUM BATTERIES.
THE WEIGHT OF THE BATTERY HAS AN INFLUENCE ON THE OPERATING BEHAVIOUR OF THE TRUCK.
PLEASE CONSIDER THE MAXIMUM OPERATING TEMPERATURE OF THE BATTERIES

b. Replacement

Parking the truck safely, press down the power button (10) and the emergency button (9) to turn off the truck. Open the battery compartment, disconnect the power cord, then hoisting the battery out to charge. The installation is opposite.

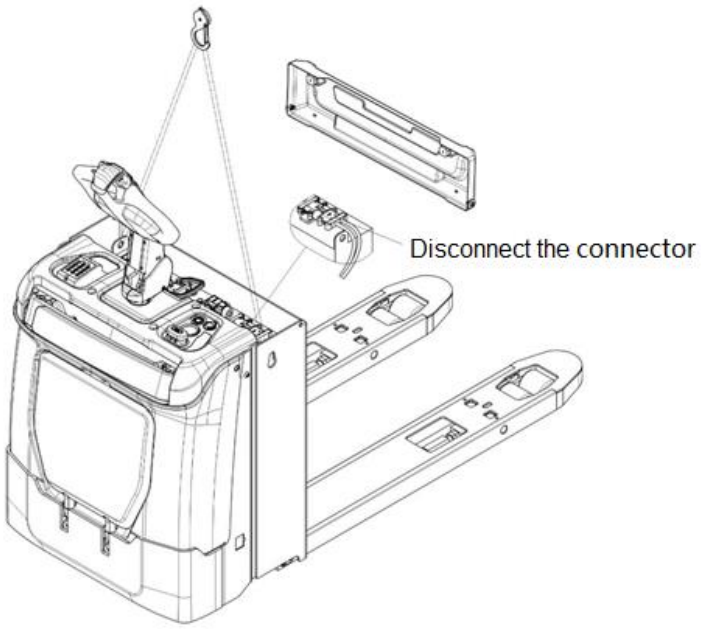


Fig. 11：Battery replacement

c. Power status display

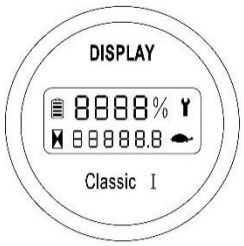


Fig. 12：The discharging instrument

Timer
The second row of numbers in the middle of the instrument shows the operating hours of the truck.

Malfunction code
If there is a truck malfunction, the corresponding malfunction code will appear on the instrument and the red light will flash

Version of the software
The instrument displays the eprom version (EPXXX, XXX for version number) and then the controller version, each lasting two seconds, while the spanner symbol appears.

Power display 

The power is indicated by a 4 segment battery symbol, each cell representing 25% of the charge, and a percentage of the power is displayed after the battery symbol. As the battery is discharged, the LEDs disappear in sequence, but only one at a time. When the battery is low, the battery symbol flashes and the red indicator light flashes.

Turtle speed 

Normally, the turtle speed symbol is off. The turtle speed symbol is flashing to indicate that the vehicle is in low speed mode.

Spanner symbol 

Normally, the spanner symbol is off. The spanner symbol is flashing to indicate that the fault needs to be repaired.

Hourglass symbol 

Normally, the hourglass symbol is off and the hourglass symbol flashes to indicate the start of the timer.

d. Charging

- Please use the supplied charger for charging
- Before using the charger, please fully understand the instructions of the charger instructions
- Always follow these instructions.
- The room, where you are charging must be ventilated.
- The exactly charge status can be only checked from the discharge indicator. To control the status, the charging must be interrupted and the truck must be started.
- The optional automatic charger is only available for 110V or 220V.

The external charger

Parking the truck at a safe field which is dedicated for charging with a specific power resource.

Lower the forks and remove the load.

Turn off the power, connect the charging connector (23) and power connector (24).

Start charging.

After fully charged, cover the battery compartment and reconnect the battery connector.

Charging finished, disconnect the connector from the socket, and place it into the designated bag.

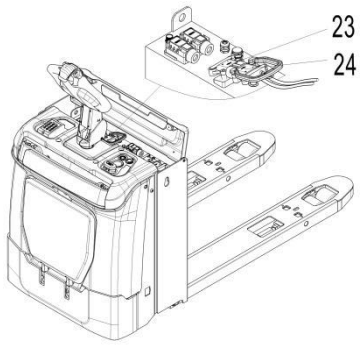


Fig. 13：Charging

Table 5: Charger specification

Model	Specification
PT 20Li	24V80A

e. Lithium battery

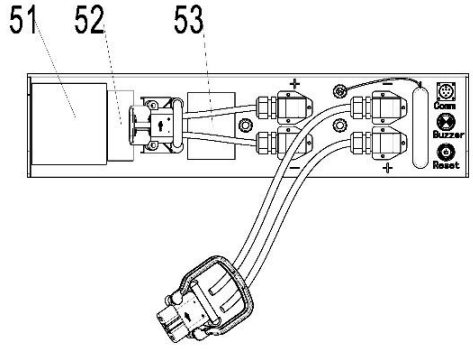
A lithium battery is a rechargeable battery that is designed for industrial trucks and can withstand the associated vibrations during operation. The battery is equipped with dedicated charging and discharging connections. Do not attempt to install or connect an inappropriate connector to the battery.

The battery is equipped with a BMS-Battery Management System, which controls the battery status and implements relevant safety protocols to protect the battery and cells from damage from operating or environmental conditions. The BMS controls the following safety functions and conditions: voltage, temperature, undervoltage, overvoltage, overtemperature and overcurrent.

Lithium battery parameters

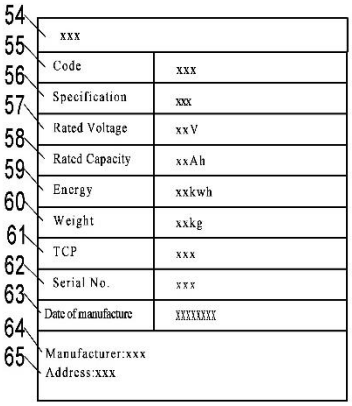
NO	project	Specifications	
1	Model number	25.6V150Ah	
2	Batteries	LPSNT-IFP09133202-25Ah	
3	Nominal Capacity (0.5C1A)	150Ah @ 2.5V-3.65V	
4	Rated voltage (operating voltage)	25.6V	
5	Maximum charging voltage	29.2V	
6	Discharge to voltage	20V	
7	Maximum charging current	100A	
8	Maximum continuous discharge current	150A	
9	Heating function	Heating film heating	
10	Communication functions	CAN	
11	Thermal management	Heat dissipation naturally	
12	Degree of protection	IP54	
13	weight	210kg	
14	Operating temperature	Charge	0 ℃ ~55℃
		Discharge	-20 ℃ ~60℃
		Storage	-10 ℃ ~45℃

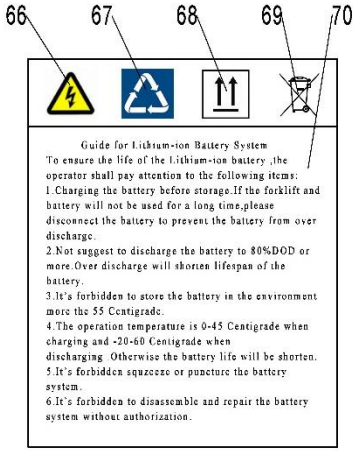
Lithium battery labels



Project	Note
51	Nameplate
52	Barcodes and QR codes
53	Warning labels

Nameplate and warning label





Project	illustrate	Project	illustrate
54	Manufacturer	65	Manufacturer address
55	encode	66	Electrical hazard signs
56	Battery specifications	67	Charging sign
57	Rated voltage	68	Vertical upward packing, shipping
58	Rated capacity	69	No labels
59	energy	70	User Guide
60	weight	71	Date of manufacture
61	TCP	72	Battery information barcode
62	Serial number	73	Barcode interpretation
63	Date of manufacture	74	Battery information QR code
64	Manufacturer name		

Storage, maintenance and transportation

1. Storage

When the battery pack needs to be stored for a long time, please charge the battery pack to about 50% of the power (after discharging, charge with the charger for 1~2 hours), place it in a dry, ventilated place, and charge it with the charger for 1~2 hours every 3 months.
The battery pack and charger should be stored in a clean, dry and ventilated place, and should avoid contact with corrosive substances, away from fire and heat sources.

2. Transportation

The battery pack and charger should be packaged and transported, and severe vibration, shock or extrusion should be prevented during transportation to prevent sun and rain. Transportation can be carried out by car, train, ship, airplane, etc.

3. Maintenance

a) When the battery pack is stored, it should be stored in a state of charge of 40%~60%.
b) When the battery pack is not used for a long time, it is recommended to replenish the power every three months or so, and supplement it with the charger for 1~2h.
c) During the maintenance process, do not reload the batteries in the battery pack by yourself, otherwise it will cause the battery performance to deteriorate.
d) Do not disassemble and replace any battery in the battery pack without authorization, and it is strictly forbidden to dissect the battery.

Typical faults and troubleshooting

Symptom	The cause of the failure	Troubleshooting
The battery pack has no output	The battery pack output cable is not connected	Connect the battery pack output line correctly according to the requirements of the specification
	The battery pack is dead	Charge the battery pack
The battery pack does not charge	The charger output plug is loose	Check that the charger output plug is firmly plugged in with the battery pack
	The battery pack is fully charged	The battery pack can be used normally

Precautions for using batteries

* Please read this manual carefully before using the battery;
* Do not throw the battery pack into water or get it wet!
* Do not charge the battery pack under fire or extreme heat conditions! Do not use or store battery packs near heat sources such as fire or heaters! If the battery leaks or emits an odor, it should be removed immediately from close to an open flame. The first time you use the battery, you need to fully charge the battery before using it!
* Do not connect the positive and negative poles backwards!
* Do not throw the battery pack into a fire or heat the battery pack!
* It is forbidden to short-circuit the positive and negative poles of the battery pack with wires or other metal objects!
* It is forbidden to pierce the battery pack housing with nails or other sharp objects, and it is forbidden to hammer or step on the battery pack!
* It is forbidden to disassemble the battery pack and battery in any way!
* Do not place the battery pack in the microwave or pressure vessel!
* No charging indoors or rain!
*It is forbidden to connect batteries in series and parallel!
* Do not use if the battery pack emits peculiar smell, heat, deformation, discoloration or any other abnormal phenomenon; If the battery pack is in use or charging, it should be removed from the appliance or charger immediately and discontinued!
* Do not use battery packs in extremely hot environments, such as cars in direct sunlight or hot days. Otherwise, the battery pack will overheat, which will affect performance and shorten the service life of the battery pack!
* If the electrolyte enters the eyes after the battery leaks, do not wipe it, rinse immediately with water and seek medical attention immediately. If not treated in time, the eyes will be damaged!
* The ambient temperature will affect the discharge capacity, and when the ambient temperature exceeds the standard environment (25±5℃), the discharge capacity will be reduced!
* After charging, it needs to be left for 30min and then discharged (using the vehicle)
* If there is an odor or abnormal sound during the charging process of the battery pack, please stop charging immediately.

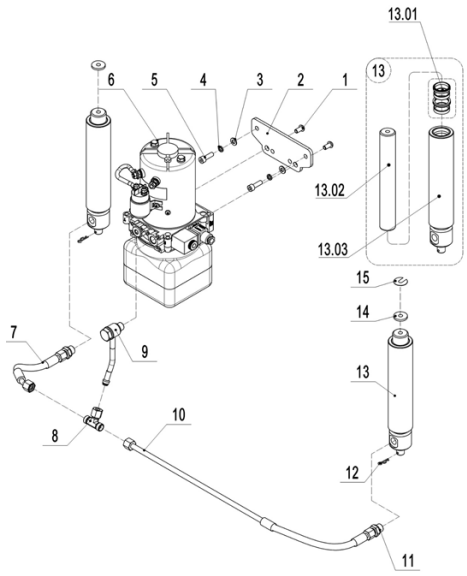
If the above phenomenon occurs, please contact the manufacturer, please do not disassemble it privately.

10. HYDRAULIC SYSTEM

a. Overview

The hydraulic system is composed of working oil pump, lifting oil cylinder, pipeline and other parts. The hydraulic oil is supplied by the oil pump directly connected with the motor. The oil pump sends the hydraulic oil to the cylinder.

1) Component



The hydraulic system operates the lifting cylinders with pressurized hydraulic oil from the main hydraulic pump and extracts the oil discharged from these cylinders.

1. The pump motor controlled by the controller drives the main hydraulic pump.
2. The main hydraulic pump pressurizes the oil in the hydraulic oil tank with the rotating force output from the motor, and sends the oil to the lifting cylinder.
3. The hydraulic oil tank stores the hydraulic oil returned from the lifting cylinder. The stored oil is sucked in by the main hydraulic pump for reuse.

Hydraulic oil circulation

The hydraulic oil tank stores hydraulic oil, which is supplied to the main hydraulic pump through a filter. The main hydraulic pump pressurizes the supplied oil and sends it to the lifting cylinder. When hydraulic oil is received, these systems perform their functions and then drain the waste oil to the tank through the return filter.

2) Detection

The pump motor electrically transfers power to the main hydraulic pump to pump hydraulic oil to operate the hydraulic system.

The pump motor is connected to the controller through the motor contactor. The controller operates the pump motor contactor based on inputs from multiple switches and sensors and internal parameter settings.

The pump motor operates when the following conditions are met:
The key emergency stop switch is turned off.
The limit switch and the raise button are closed.
Pump motor contactor closed.

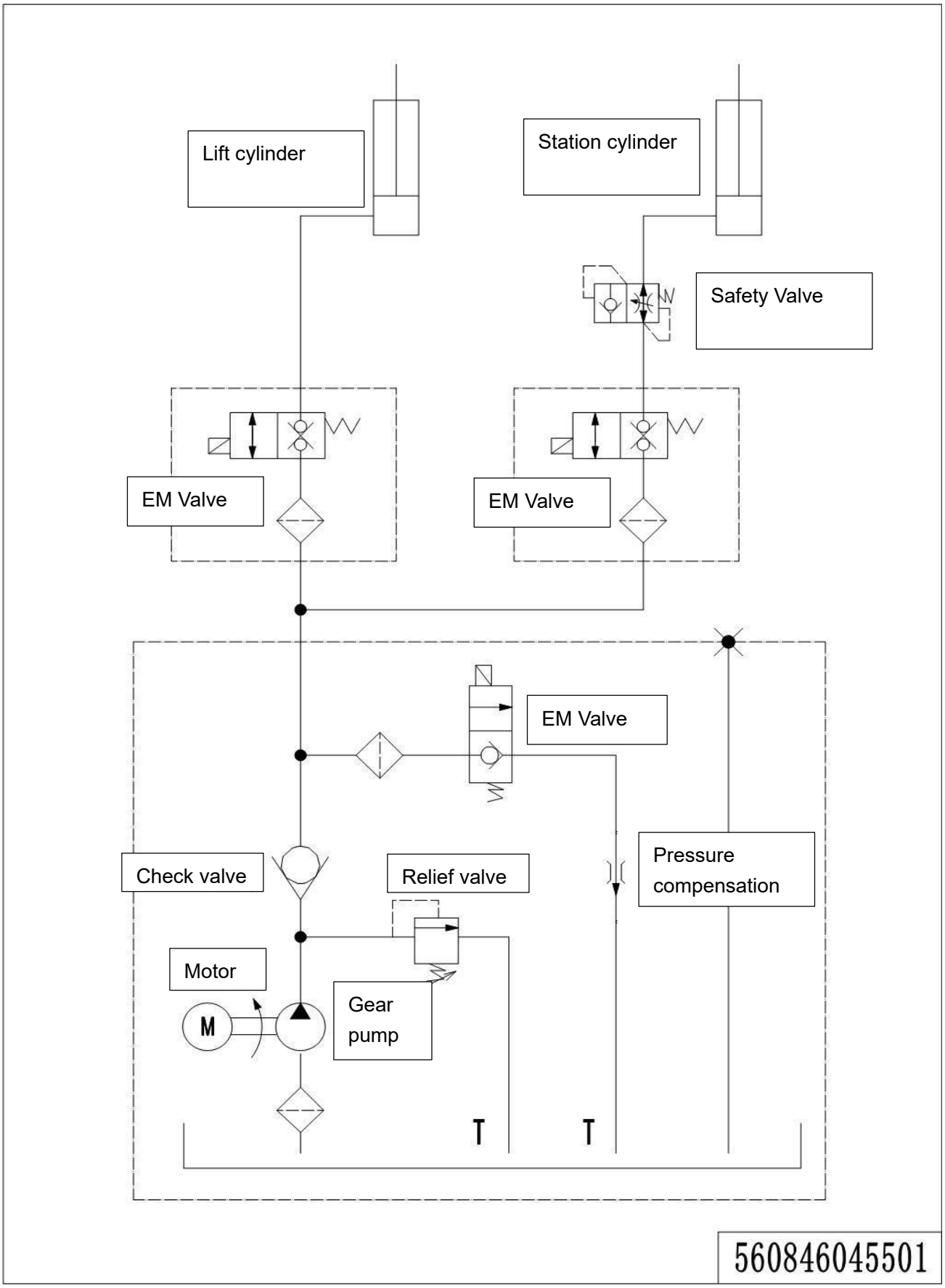
Detection of pump motor contactor:

For the pump motor contactor, as shown in the figure,
And check whether it measures the specified value.

! DANGER:
Pressurizing the hydraulic oil can cause severe burns and even amputation infection. Before performing the following steps, make sure that the pressure has been released from the system

The pressure of the safety valve has been adjusted before delivery, and the user is not allowed to adjust and disassemble.

b. Hydraulic circuit diagram



c. Troubleshooting

Pump motor

Fault phenomenon	Possible reason
The hydraulic pump motor does not work	Poor connection or blown fuse. Check the battery connection. Check the key fuse. Check whether the hydraulic pump motor cause the fusing
	The key switch, upper limit switch, and line contactor are not closed. Turn off the key switch. Use a multimeter to check the power flow through the key switch, line contactor coil and line contactor. The key switch must be turned off.
	The voltage is not enough. Charge the battery or replace the battery. Check whether the cable terminals are tightly matched with the battery terminals and the control panel connector. Check whether the wires inside the cable are broken.
	Incorrect operation of lifting and drive systems.
	During the battery charging operation, the battery is not fully charged.
	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 reaches 155°C (311°F)

Hydraulic pump

Fault phenomenon	Possible reason
Noise in the pump	Oil level is low
	The oil is very thick (too viscous)
	Pump inlet line is limited
	Worn parts in the pump.
	Oil is very dirty
	Air leaked into the inlet pipeline
The oil temperature is too high	Oil level is low
	The oil duct is restricted
	The oil is too thin
	There is a leak in the system
	There is too much wear and tear on the pump
	The system operates under too much pressure
The pump shaft seal is leaking	The shaft seal has worn away
	Internal wear of pump body
	Operating at too low an oil level in the tank can cause suction on the seals
	During installation, the seal is cut at the shoulder of the pump or keyway.
	Seal lips are dry and hardened by heat.
The pump is unable to move fluid	The oil content in the tank is low
	Pump inlet line is limited
	There is a leak in the pump inlet line. Loose bolts. Defects in inlet line of bay
	The viscosity of the oil is wrong
	There is too much wear and tear on the pump
	Pump shaft failure
	The pump bolt does not have the correct torque

11. REGULAR MAINTENANCE

- Only the authorized and trained personnel is allowed to maintain the truck.
- Before maintenance, please remove the load and lower the forks to the bottom.
- If you need to lift the truck, follow chapter 4b by using designated lashing or jacking equipment. Before working, put safety devices (for instance designated lift jacks, wedges or wooden blocks) under the truck to protect against accidental lowering, movement or slipping
- Please pay attention by maintain the tiller arm. The gas pressure spring is pre-loaded, and carelessness can cause injury.
- Use approved and from your dealer released original spare parts.
- Please consider that oil leakage of hydraulic fluid can cause failures and accidents.
- It is allowed to adjust the pressure valve only from trained service technicians.

If you need to replace the wheels, please follow the instructions above. The casters must be round and free of abnormal wear.

Please check the emphasized items in the maintenance list out.

a. Maintenance checklist

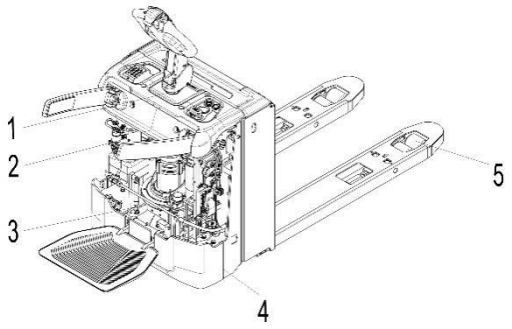
Table 5： Maintenance checklist

		Interval(month)			
		1	3	6	12
Hydraulic					
1	Check the hydraulic cylinder for damage noise and leakage		●		
2	Check the hydraulic joints for damage and leakage		●		
3	Inspect the hydraulic oil level, refill if necessary		●		
4	Replace the hydraulic oil (12 month or 1500 working hours)				●
5	Check and adjust the pressure valve (1500kg+0/+10%)				●
Mechanical system					
6	Inspect the forks for deformation and cracks		●		
7	Check the chassis for deformation and cracks		●		
8	Check if all screws are fixed		●		
9	Check the push rods for deformation and damages		●		
10	Check the gearbox for abnormal sound and noise		●		
11	Inspect the wheels for deformation and damages		●		
12	Inspect and lubricate the steering bearing				●
13	Inspect and lubricate the pivot points		●		
14	Lubricate the grease nipples	●			
Electrical system					
15	Inspect the electric wiring for damage		●		
16	Check the electric connections and terminals		●		
17	Test the Emergency switch function		●		
18	Check the electric drive motor for noise and damages		●		
19	Test the display		●		
20	Check, if correct fuses are used		●		
21	Test the warning signal		●		

22	Check the contactor(s)		●		
23	Check the frame leakage (insulation test)		●		
24	Check function and mechanical wear of the accelerator		●		
25	Check the electrical system of the drive motor		●		
Braking system					
26	Check brake performance, if necessary, replace the brake disc		●		
Battery					
27	Check the battery voltage		●		
28	Clean the terminals for corrosion and damages		●		
29	Check the battery housing for damages		●		
30	Check the battery, fill in the distilled water if necessary	●			
Charger					
31	Check the main power cable for damages			●	
32	Check the start-up protection during charging			●	
Function					
33	Check the horn function	●			
34	Check the air gap of the electromagnetic brake	●			
35	Test the emergency braking	●			
36	Test the reverse and regenerative braking	●			
37	Test the safety (belly) button 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 decals are legible and complete	●			
42	Inspect the castors, adjust the height or replace if worn out.		●		
43	Carry out a test run	●			

b. Lubricating point

According to the marked point in the maintenance checklist. The specification of the demand grease is: DIN 51825 standard grease.



1. EPS
2. Hydraulic system
3. Gear box
4. Bearings of side wheels
5. Bearings of load wheels

Fig. 15：Lubricating point

c. Inspect and re-fill hydraulic oil

Table 6： Recommended hydraulic oil type according to the temperature

Ambient temperature	–5℃~25℃	>25℃
Type	HVLP 32， DIN 51524	HLP 46， DIN 51524
Viscosity	28.8-35.2	41.4 - 47
Volume	1.2L	

Recycling and disposing of scrap materials, for example, scrap batteries, oil or other materials, undergoes national regulations. Let the dedicated recycling company to recycle and dispose scrap materials if necessary.
The oil level shall not be lower than the minimum demanded volume of the oil to start the truck.
Fill the oil to the recommended level if necessary.

d. Check the fuse

Remove the outer cover, fuses are in the position shown in the Fig. 14

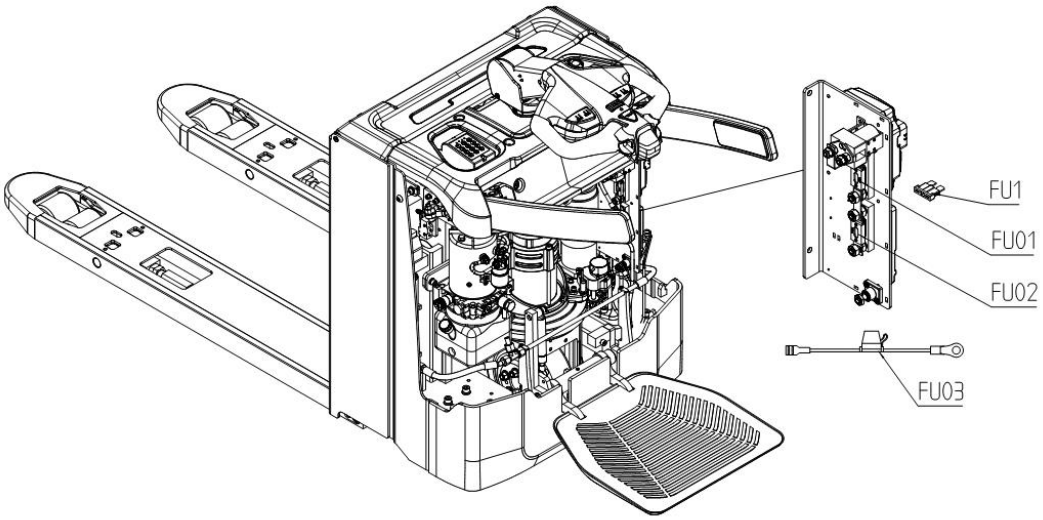


Fig. 16：Fuses

Table. 7：Specifications of fuses

	Specifications
Fuse FU01	200A
Fuse FU02	150A
Fuse FU03	30A
Fuse FU1	10A

e. Remove and reinstall the protective plate

Do not use the vehicle if the guards are damaged or not installed correctly

Remove the clip that protects the shield and remove the shield. The installation procedure is reverse. Please confirm that the protective plate is properly fixed and not damaged. If you need to replace parts, please contact our after-sales service center.

f. Disassembly/assembly instructions

The disassembly/assembly part includes the following subsections: preparations before disassembly, inspection and testing before disassembly, precautions during disassembly, precautions after disassembly, precautions during assembly, handling of general parts, and hydraulic pipeline accessories. Precautions to be taken to perform disassembly/assembly work correctly are listed under each heading

Preparation before disassembly

Remove dust and pollutants from the vehicle before sending it to a repair center. Dust or contaminants entering the repair center may stain the components and enter them to cause damage.

Electric vehicles operate based on electrical systems. Do not let any water enter the system.

To avoid unnecessary disassembly work, prepare the necessary tools, place the boxes for the parts, and give priority to ensuring the cleanliness of the site

Check and test before disassembly

Before starting disassembly, be sure to record any problems. This prevents unnecessary disassembly, loss of replacement parts, and repeated failures caused by the same problem.

To prevent malfunction, please record the malfunction and the parts required for replacement.

Also make sure to check and record the following information

Vehicle model, serial number and business hours

The reason why the vehicle needs to be disassembled

Check the symptom, location and cause of the malfunction.

(If necessary, reproduce the same failure).

Check if any parts are inappropriate.

Check for damage or loose parts.

If possible, check the maintenance of the vehicle

Precautions when disassembling

Disassemble

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

Before starting to disassemble the parts, pay attention to the connection points of the parts and mark them with arrows to avoid incorrect placement of the parts during assembly.

Use the right tools to delete specific parts.

If you have not removed any parts, even the mounting bolts and nuts, do not use excessive force. Check and find the reason.

Put the disassembled parts on one side in the order of disassembly, and put labels or marks on the parts with similar appearance.

Store bolts, nuts and other common parts in an orderly manner.

Check and test during disassembly

Sometimes the cause of the failure will be discovered during the disassembly process. Therefore, it is very important to carefully check the condition of the friction surface and the contact parts.

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

Keep the gap

Ensure that the installed gaskets and washers produce the required specified clearance value.

Remove press parts

Remove any dents or marks caused by hammering and polishing the area.

If you loose any press-fitted parts, please determine and eliminate the cause to avoid problems during the assembly process.

Disassemble the bearing

Do not use force to disassemble the bearing, but use a bearing puller.

Precautions after disassembly

Clean

Clean the disassembled parts and keep them away from contaminants.

Pay special attention to removing contaminants from the oil pipeline or component pipeline.

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

Kerosene or neutral anhydride diesel oil is suitable for cleaning the viscous oil in the bearing.

When using hazardous chemical cleaners, please be careful not to contact your skin or eyes.

Use designated containers to dispose of used oil at designated locations.

Dust-proof

Use a dust cover to place the cleaned parts in a place free of dust and contaminants, and block the ends of all pipes.

Before installing again, any parts you may store must be rust-proof.

Precautions during assembly

Parts installation

Keep all parts clean before assembly. Check the surface for defects and repair as needed. Make sure not to smear or rub the surface on any part, otherwise the service life of the part may be shortened.

Before starting the assembly, use a cleaning agent to remove the rust inhibitor from the components.

Before starting the assembly, determine the mark that will assemble the parts together.

Use press-fit tools to assemble bearings, bushings and oil seals, and use designated tools to process specific parts.

Before press-fitting parts, lubricate their surfaces with lubricating oil.

Tighten the bolts and nuts

To ensure the even torque of the bolts and nuts, tighten them in the order shown in Figure 1-19, and then tighten the other side on the other side. This method is called the ‘template method” and it gradually repeats loosening and tightening to ensure uniform contact.

Use the wires, split pins, lock washers or other parts shown in Figure 1-20 to fix bolts, nuts or other important fasteners that cannot be visually inspected.

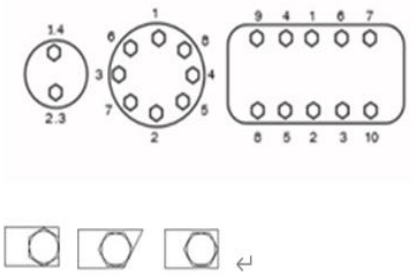


图 1-19

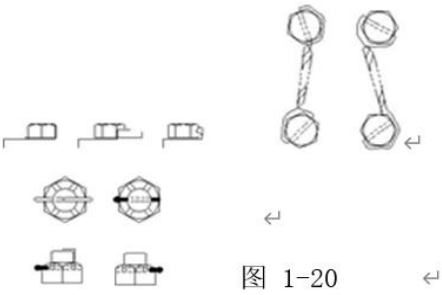


图 1-20

Check during assembly

In each step of the assembly process, check and record each part number.

Reassemble the gasket

Install gaskets and washers in the same positions as before, and then check if the gap is correct

Assembly adjustment link

If there is no need to adjust, please assemble them to the same length as before.

Assemble press parts

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

Note that press-fit parts that are not sufficiently tightened may loosen.

Assemble the key and keyway

Check whether the keyway and key are loose and whether they are in contact with the key head. If the key head touches the keyway, remove the remaining part of the key head.

Handling general parts

Handling packaging

Packaging, gaskets and copper packaging should be replaced as directed. After using the adhesive, please assemble the gasket specified in this service manual. When applying adhesive to the gasket, please pay attention to the following:

Thoroughly remove the old adhesive, scratches, dust, paint and grease on the surface of the gasket.

Apply a suitable sealant evenly on both sides of the gasket and wait a few minutes until it is dry.

Once the sealant is dry to the touch, it won't stick to your hands, assemble the parts.

Soak the leather packaging in oil before use.

Handle O-ring

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

Only use the O-ring specified in the parts list. For example, O-rings used for engine oil are made of special materials, such as silicone rubber, and are resistant to heat and aging. In this case, installing different types of O-rings may cause serious damage to the system and its components.

Lubricate the O-ring to avoid scratching its surface during installation. Silicone rubber O-rings are easily damaged, so be careful not to stretch them excessively.

Deal with the oil seal

Prevent the oil seal from collecting dust, especially dust on the lips, and make sure that there is no hardening or scratching.

Evenly lubricate the lip surface opposite to the oil seal.

Check whether the surface of the shaft where the oil seal is installed is contaminated, rusted or scratched, and then apply grease or lubricant so that the oil seal can be installed easily.

Check the surface of the oil seal lip for scratches. If there are scratches, replace the oil seal.

When inserting the oil seal, use guides and clamps to avoid damage to the oil seal.

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

When applying adhesive to the oil seal, make sure that no adhesive is in contact with the lip surface. Before inserting another seal, completely remove residual adhesive on the rails and clamp.

Handling the bearings

To assemble the bearing correctly and avoid damage to the bearing, please pay attention to the following：

Thoroughly remove dust and other contaminants that may shorten the life of the bearing. Keep the bearing package until it is installed.

Do not rotate the bearing excessively in order to clean the purifier by blowing in compressed air. Ensure that the oil seal ring is installed in the correct direction.

Please pay attention to the following when installing the bearing：

Neither the outer ring was hit with a hammer to install it, nor the inner ring was hit to insert the outer ring. Hammering like this can cause damage to the bearing track.

When you insert the inner ring of the bearing with a reasonable tolerance, use a clamp and apply pressure to the inner ring. When performing hot insertion with a press-in tolerance, heat the bearing to 120°C (248°F). However, please note that excessive heating will reduce the hardness of the bearing surface.

When you insert a non-split bearing with an inner ring and an outer ring with a reasonable tolerance, use a clamp while pressing the inner ring and the outer ring at the same time.

Handling the retaining ring

When removing or installing the fixing ring, please use a pair of right ring pliers, being careful not to put too much pressure on the fixing ring.

After installing the fixing ring, check whether the fixing ring is inserted correctly.

Assembly of accessories with straight thread and O-ring seal (suitable for different applications)

1. Seal the lock nut (3), support washer (4) and O-ring Place the piece (5) as far as possible on the main body (2) of the accessory.

2. Turn the joint to the part it uses until the support washer (4) Just touched the surface of the part.

3. To place the joint assembly in the correct position place the joint body (2) Rotate outward (counterclockwise) up to 359°.

4. Tighten the lock nut (3) to the correct diagram of the accessory used The torque shown.

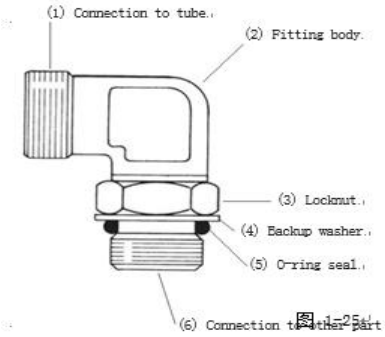


图 1-25

5. If the shape of the pipe end of the fitting body is shown in Figure 1-25 (elbow or Straight body), put the sleeve on the tube before connecting the tube to the end.

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

Tighten other accessory types

High-load (shear casing) pipe fittings: After the pipe passes through the nut and contacts the pipe shoulder in the fitting body, turn the nut with a wrench until you feel a slight decrease in torque.

High-sealing fittings: Place the nut and sleeve on the pipe with the short and heavy end of the sleeve facing the end of the pipe. Place the end of the pipe against the counterbore in the main body of the fitting and tighten it until the nut is above the last thread on the main body. Just remove the accessory and install it again, and the remaining space will be used.

Flexible fittings: Put the nut and sleeve on the pipe, and push the pipe into the counterbore of the fitting body as much as possible. Tighten the nut until it touches the hexagonal part of the connector body.

g. Standard torque

Standard torque of bolts and nuts

Be careful to avoid mixing metric and imperial size fasteners. Mismatch or incorrect The fasteners may cause vehicle damage or malfunction, or may cause personal injury. If necessary, exceptions to these torques can be given in the service manual.

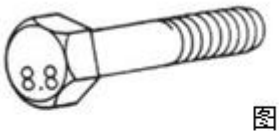
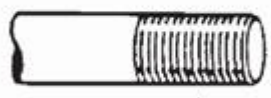


图 1-30

Before installing any hardware, make sure that the components are in a near new state. Screw. The bolt and nut threads must not be worn or damaged. The hardware must be free of rust and corrosion. Use non-corrosive cleaners to clean the hardware and apply engine oil to the threads and bearings Surface. If you want to use thread glue or other compounds, do not use engine oil. After loosening the fasteners, keep them in good condition and only reuse them under delicate conditions. When replacing a new one, be sure to select fasteners of the same size and grade.



Standard bolt

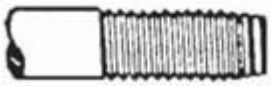


图 1-31

Taperlock stud

Generally, you can identify it based on the number marked on the head (such as 8.8 or 10.9) The strength of the bolt is shown in Figure 1-30. The following table lists standard bolts and nuts. The standard torque, and the tapered bolt shown in Figure 1-31.

For metric fastener

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

For British fasteners

Thread size(inch)	British nuts and bolts		British taperlock stud	
	（N・M）	Pounds/feet	（N・M）	
1/4	12±3	9±2	8±3	6±2
5/16	25±6	18.0±4.5	17±5	13±4
3/8	47±9	35±7	35±5	26±4
7/16	70±15	50±11	45±10	33±7
1/2	105±20	75±15	65±10	48±7
9/16	160±30	120±20	–	–
5/8	215±40	160±30	110±20	80±15
3/4	370±50	275±35	170±30	125±22
7/8	620±80	460±60	260±40	190±30
1	900±100	660±75	400±60	300±45
1 1 / 8	1300±150	950±100	500±70	370±50
1 1 / 4	1800±200	1325±150	650±80	480±60
1 3 / 8	2400±300	1800±225	750±90	550±65
1 1 / 2	3100±350	2300±250	870±100	640±75

Standard torque for fastening accessories

Standard torque for O - ring sealing fittings

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
9/8-16-18	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 / 8-12	300 ± 40	225 ± 30
1-7 / 8-12	300 ± 40	225 ± 30
2-1 / 2-12	300 ± 40	225 ± 30

Thread size(inch)	Sealing joint nuts for O-ring face	
	（N · M）	Pounds/feet
9/8-16-18	16 ± 3	12 ± 2
1/4 / 16-16	30 ± 4	22 ± 3
1/2 / 16-16	50 ± 7	37 ± 5
1-14	90 ± 10	65 ± 7
1-3 / 16-12	120 ± 15	90 ± 10
1-7 / 16-12	160 ± 20	120 ± 15
1-11 / 16-12	190 ± 20	140 ± 15
2-12	215 ± 25	160 ± 20

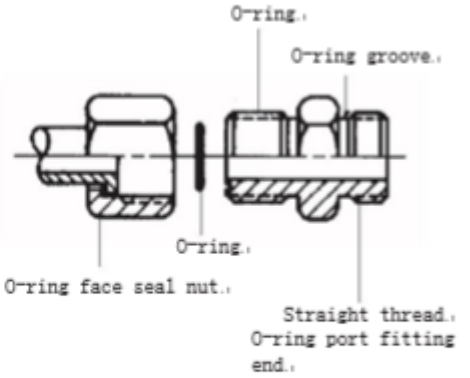


图 1-32

Thread size(in.)　Straight thread O-ring accessories (Pound in.)

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)
10.5 mm (0.531 in)	4.5±0.5 N·m (40±5 lb·in)	3.0±0.5 N·m (25±5 lb·in)
16.9 mm (0.625 in)	7.5±0.5 N·m (65±5 lb·in)	4.5±0.5 N·m (40±5 lb·in)

图 1-33

37° bell and straight threaded O - ring accessories

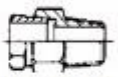
Pic 1-34

图 1-34

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

Nominal pipe external diameter		Thread diameter（in）	Standard torque	
Metric	Inch	Inch	(N·M)	Ponds/Feet
3.18	0.125	5/16	5.0±1.5	4±1
4.76	0.188	3/8	11.0±1.5	8±1
6.35	0.250	7/16	16±2	12±1
7.94	0.312	1/2	20±5	15±4
9.52	0.375	9/16	25±5	18±4
9.52	0.375	5/8	35±5	26±4
12.70	0.500	3/4	50±7	37±5
15.88	0.625	7/8	65±7	48±5
19.05	0.750	1-1 / 16	100±10	75±7
22.22	0.875	1-3 / 16	120±10	90±7
25.40	1.000	1-5 / 16	135±15	100±11
31.75	1.250	1-5 / 8	180±15	135±11
38.10	1.500	1-7 / 8	225±15	165±11
50.80	2.000	2-1 / 2	320±30	240±22

45° bell shape and 45° inverted bell fittings



45° inverted bell

45° bell

| 1-35

45° bell shape and 45° inverted bell fittings				
Nominal pipe external diameter		Thread diameter (in)	Standard torque	
Metric	Inch	Inch	(N · M)	Ponds/Feet
3-18	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	0.375	5/8	30±3	22±4
11.11	0.438	11/16	30±3	22±2
12.70	0.500	3/4	38±4	28±3
15.88	0.625	7/8	50±5	37±4
19.05	0.750	1-1 / 16	90±8	65±6
22.22	0.875	1-1 / 4	100±10	75±7

Taper pipe threaded fittings

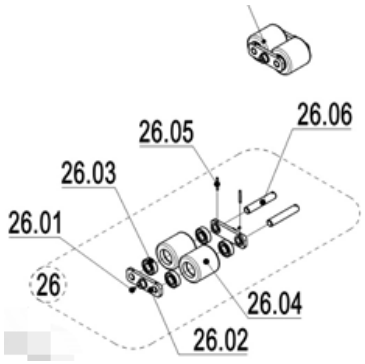
Thread fittings for conical pipes				
Thread diameter (in.)	Threads with le2200e sealant		Threads without sealant	
	(N · M)	Ponds/Feet	(N · M)	Ponds/Feet
1-/ 16-27	15	11	20	15
1-/ 8-27	20	15	25	18
1/8-14	25	18	35	26
3-/ 8-18	35	26	45	33
1-/ 2-14	45	33	60	45
3-/ 4-14	60	45	75	55
1-11 1/2	75	55	90	65
1-1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

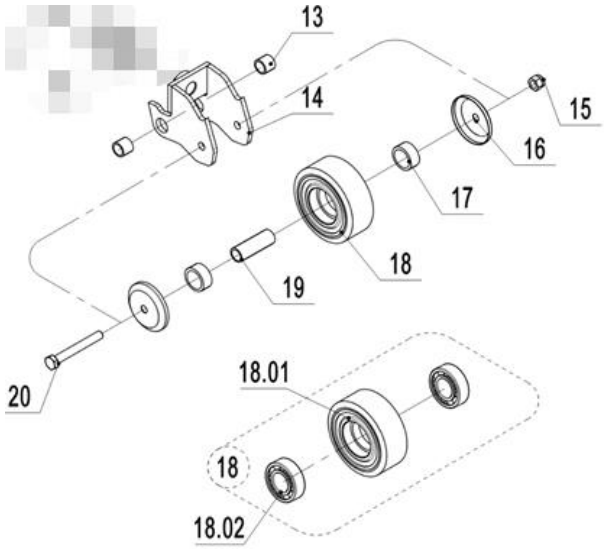
1). Drive wheels

Lift the position of the vehicle's drive wheels with a hydraulic jack	
Unscrew the five nuts that hold the wheels in place	
Remove the wheels	
Install the wheels in reverse order	**The torque to tighten the nut is 90Nm**

2). **Roller**

Remove the pin 26.05 **Remove the roller shaft 26.06** **The roller 26.04 can be removed** **Installation is the reverse order of removal**	

3)**. Balance wheel**

Remove the nut 15 **Remove bolt 20** **Replace the balance wheel 18.01 and bearing 18.02** **Installation is the reverse order of removal** **Sleeve 19 must be inserted into bearing 18.02**	

Note: When performing maintenance on energy storage components, energy needs to be released before any maintenance operations are performed to avoid injury.
Gas spring: The gas spring of the handle can only be removed when the handle is placed in an upright position.

Electromagnetic brake: Before removing the electromagnetic brake, the brake disc needs to be fixed with two M6 × 40 screws through a special hole in the brake coil. Gently tighten the screws to secure the brake disc with the coil. The brakes can then be removed.
After the brakes are assembled back into the motor, the screws must be removed.

12. TROUBLE SHOOTING

IF TRUCK HAS MALFUNCTIONS, FOLLOW THE INSTRUCTIONS IN CHAPTER 6.

Table 8：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 low power	Charge the battery
	Lifting contactor failure	Check and contact with service support for replacement if necessary
	Hydraulic oil level too low	Check and eventually refill hydraulic oil
	Oil leakage	Repair 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 from the electrical socket.
	Battery not connected	Connect the battery correctly
	Fuse faulty	Check and eventually replace fuses
	Low battery	Charge the battery
	Emergency switch is activated	Turn the emergency switch clockwise
	Tiller in the operating zone	Move the tiller firstly to the braking zone.

If the truck has malfunctions and can’t be operated out of the working zone, 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 CANopen 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

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.

Software Version	1.24.03.00
HHP Resource Version	0.91
DME Resource Version	0.98
MH Resource Version	0.59
FWM Version	2.09.00.00

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

Software Version	1.09.08.00
HHP Resource Version	0.19
FWM Version	2.09.00.00

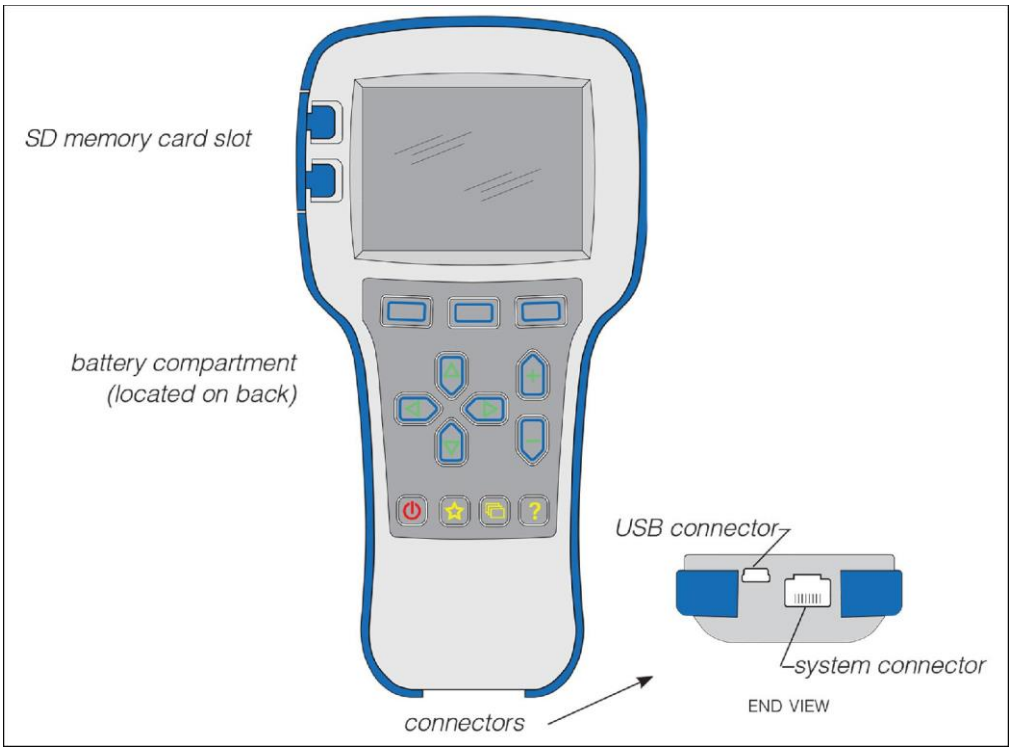
HW3 = **Blue-band** handsets
CANopen (G2) communication protocol

b.1313 HHP OPERATION

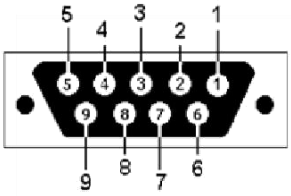
This Chapter describes how to use the 1313 HHP for CAN-based communication devices. Although there are similarities between the CAN-based devices and the serial devices, there are differences in the connection and the apps.

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



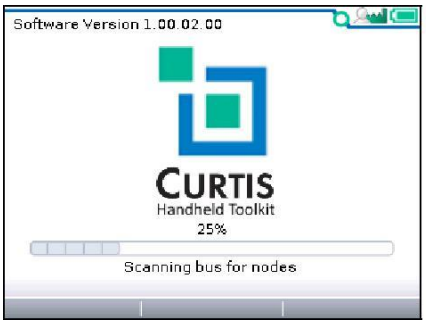
1313-xx31 Wiring	
D-Sub Pin	Function
7	CAN_H
2	CAN_L
9	B+ (8–36 V)
6	B–

Vehicle Harness Wiring for CAN Connected 1313 HHP

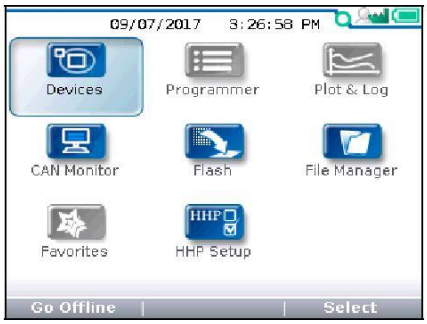
POWER-ON THE 1313 HHP

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.

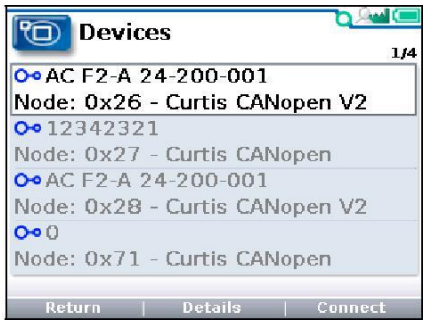
The first screen (see left image) indicates the scanning progress. Systems can have multiple devices on the CANbus, so once the scanning process is complete, press the "Select" softkey on the main screen (middle image) to open the Devices app, then scroll to the desired device and press the "connect"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



Scanning for Nodes



Devices option



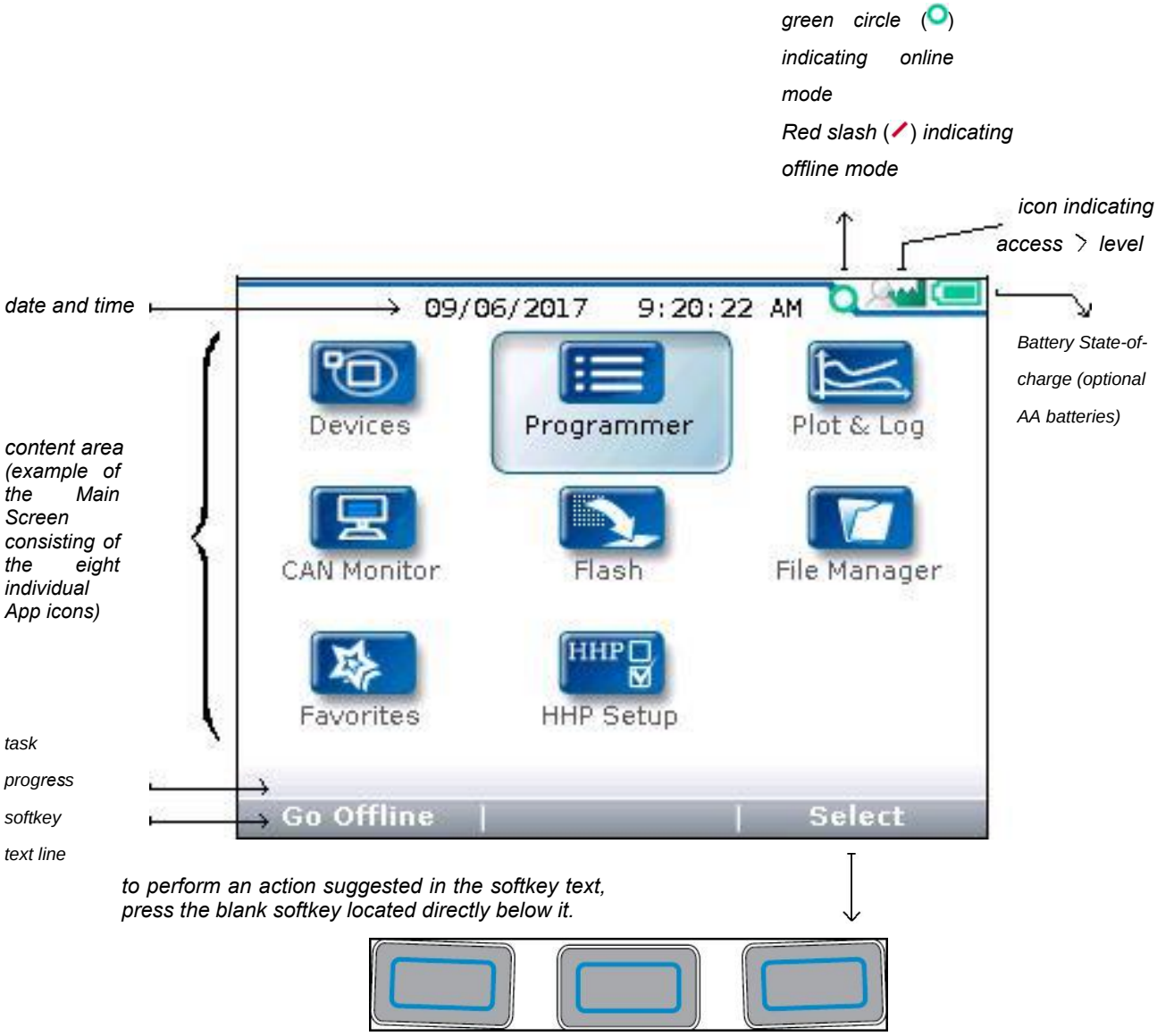
Select the device to connect

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:

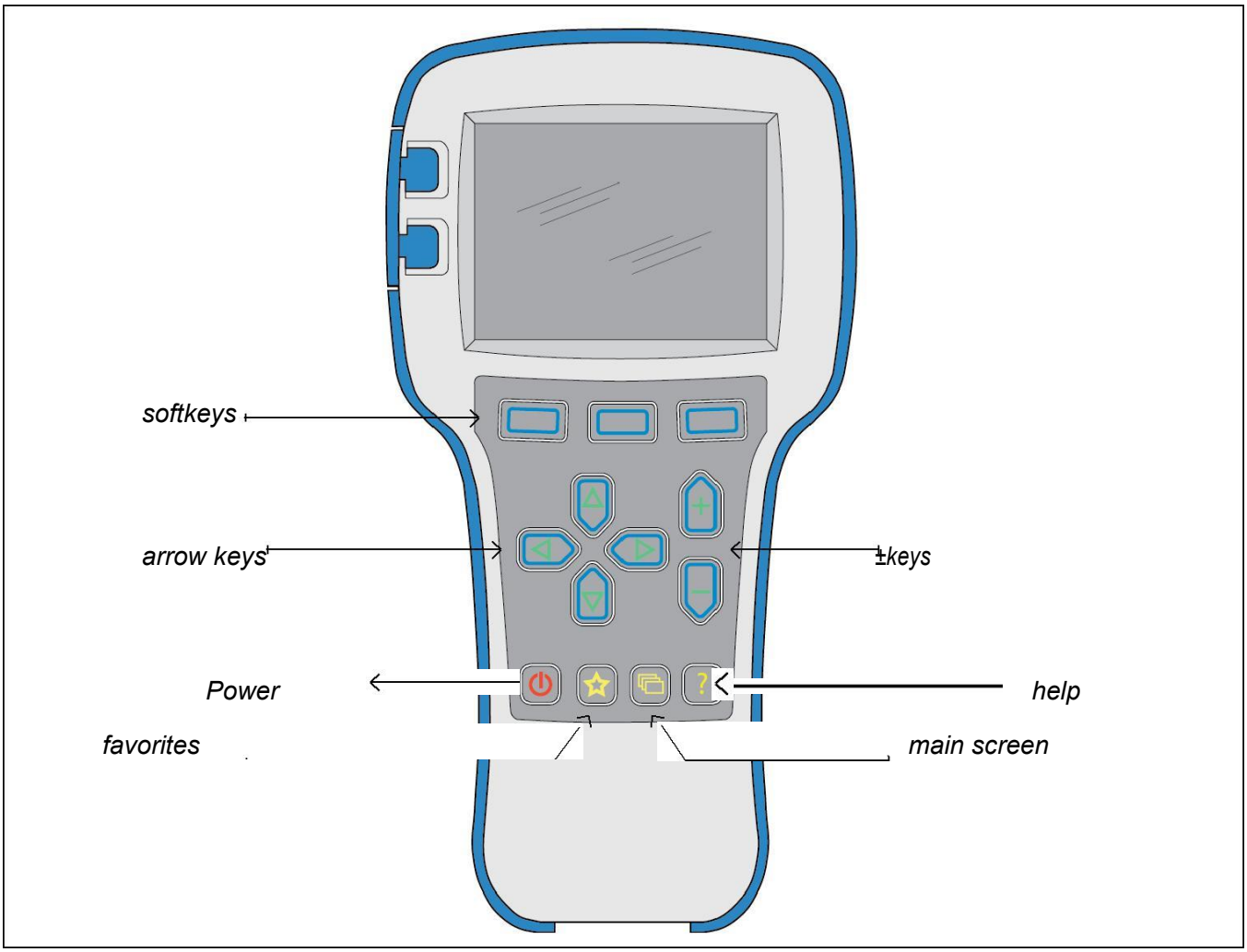
OEM Dealer:

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. See Chapter 13 for further details about 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. DEVICES

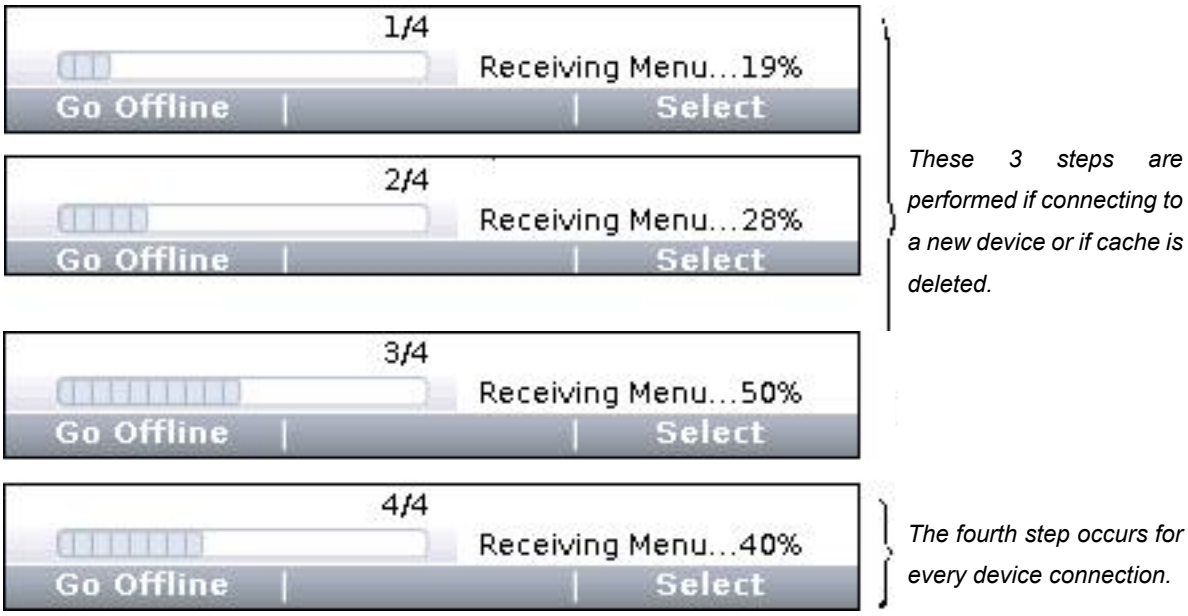
Device Details and Connection

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).

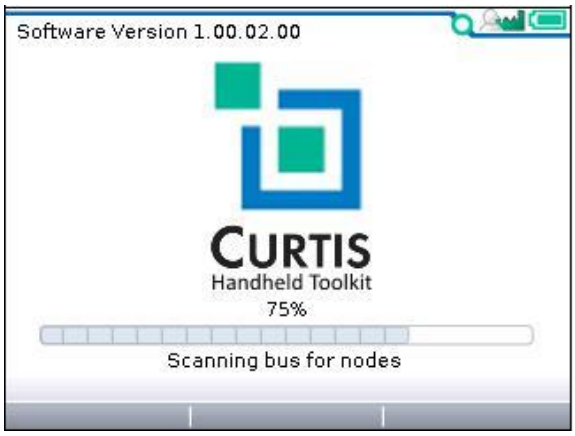
The Device app is also where device-specific information can be viewed before connecting—useful when many devices are listed. Press the “Details” softkey to view information such as the device Family, Model number, Serial number, Manufacture date, and its software/firmware/hardware versions. The “Details”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



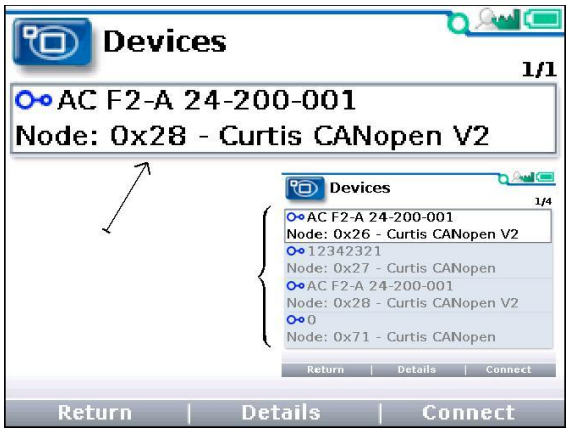
The following screenshots illustrate the Devices app usage. Notice that in the second and fifth images, the Devices app and 4 other apps are available before connecting to a device. (See the CAN Monitor, Flash, File Manager, HHP Setup, and Offline Mode chapters.) Once a device is connected, the remaining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

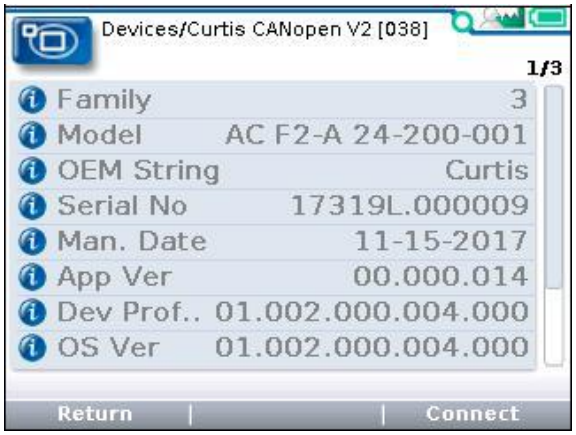


(1) 1313 HHP startup-scan of CANbus for devices

(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.

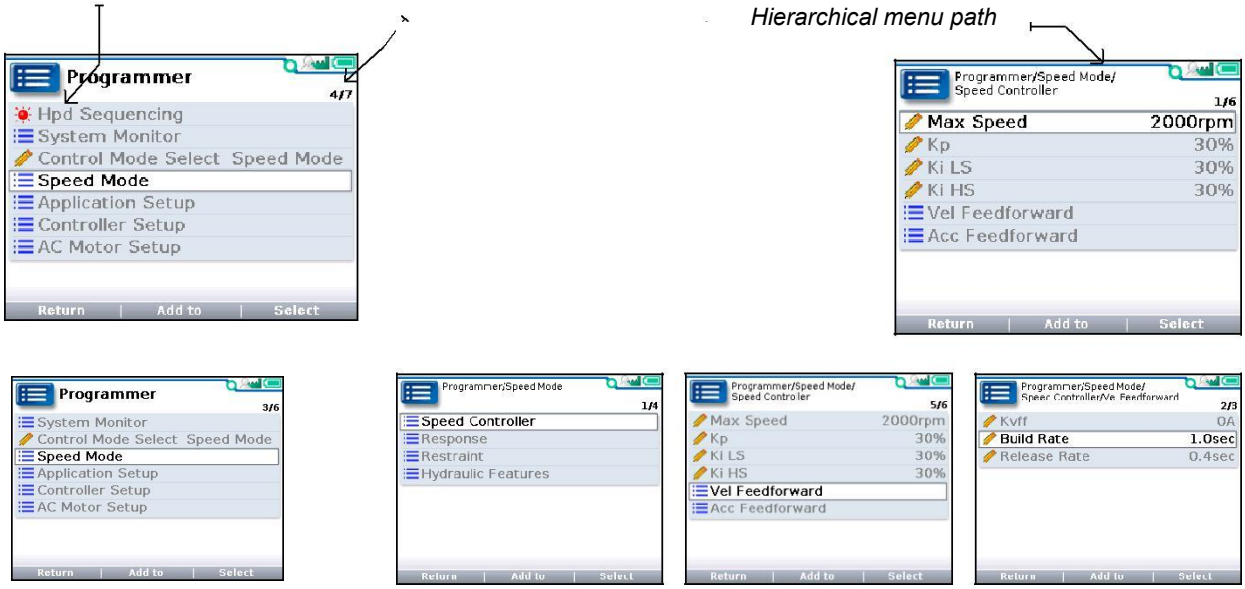
(1) parameter *Max Speed*

(2) parameter *Build Rate*

Displayed faults are device specific

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

Hierarchical menu path

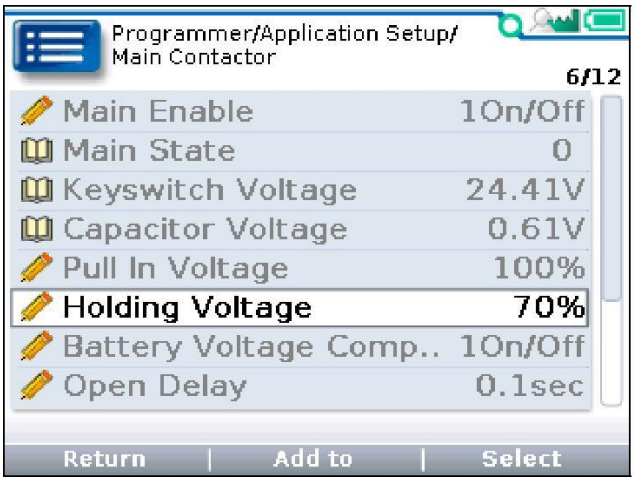


If exiting an app using the main screen key ( ) and later returning to the same app, the app will open to a location that depends on the "`Remember Last View`" setting in the HHP Setup app. If the setting is "Off", the app opens at the top-level. If the setting is "On", the app opens to the most recently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

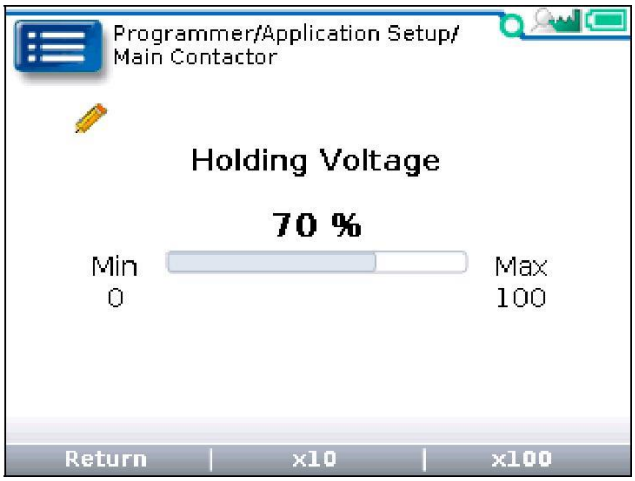
Note: If the 1313 HHP is turned off (e.g., the device or CANbus is key-cycled) the "`last-place-memory`" is lost. Each power-on session begins the Remember Last View anew, even if the setting is "On".

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.Troubleshooting for each controller fault code

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

NO.	Fault code	Foult 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. 2. Parameters are restored to the default settings.	Cycle KSI	Shutdown	1 = Stop
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