16/20/25EP-X

Pallet Truck Service Manual





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 for future reference.

FOREWORD

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

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

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

ATTENTION:

- Environmentally hazardous waste, such as batteries, oil and electronics, will have a negative effect on the environment, or health, if handled incorrectly.
- The waste packages should be sorted and put into solid dustbins according to the materials and be collected disposal by local special environment protection bureau. To avoid pollution, it's forbidden to throw away the wastes randomly.
- To avoid leaking during the use of the products, the user should prepare some absorbable materials (scraps of wooden or dry duster cloth) to absorb the leaking oil in time. To avoid second pollution to the environment, the used absorbable materials should be handed in to special departments in terms of local authorities.
- Our products are subject to ongoing developments. Because this handbook is only for the purpose of
 operating /servicing the pallet truck, therefore please have understanding, that there is no guarantee out of
 particular features out of this handbook.

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

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1. CORRECT APPLICATION

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

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

A wrong usage can cause human injuries or can damage equipment.

The operator/ the operating company has to ensure the correct usage and has to ensure, that this pallet truck is used only by staff, which is trained and authorized to use this truck.

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

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

The capacity is marked on capacity sticker as well on the Identification plate. The operator has to consider the warnings and safety instructions.

Operating lighting must be minimum 50 Lux.

Modification

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

By not observing these instructions, the warranty becomes void.

2. DESCRIPTION OF THE PALLET TRUCK

a. Overview of the main components



Fig. 1: Overview main components

- 1. Electrical box cover
- 2. Battery discharge Indicator
- 3. Tiller
- 4. Accelerator
- 5. Safety (belly) button
- 6. Instrument board cover
- 7. Emergency button

- 8. Key switch
- 9. Fork chassis
- 10. Load wheels
- 11. Drive wheel
- 12. Castors
- 13. Hydraulic cylinder

b. Main technical data



Fig. 2: Technical data 16/2EP-X



Fig. 3: Technical data 25EP-X

| | Type sheet for industrial truck acc. to VDI 2198 | | | | | | | |
|--------|--|--|----------------------|-------------------------|------------------|-------------|--|--|
| ķ | 1.2 | Manufacturer`s type designation | | 16EP-X | 20EP-X | 25EP-X | | |
| mar | 1.3 | Power(battery,diesel,petrol gas,manual) | | | Battery | | | |
| bu | 1.4 | Operator type | | | | | | |
| ishi | 1.5 | Load Capacity (upper and lower pallets) | Q (t) | 1.6 2.0 | | 2.5 | | |
| nɓu | 1.6 | Load center distance | c (mm) | | 600 | | | |
| istiı | 1.8 | Load distance, center of drive axle to fork | x(mm) | | 892 | | | |
| Δ | 1.9 | Wheelbase | y (mm) | 1261 | 1550 | 1541 | | |
| Ħ | 2.1 | Service weight | kg | 445 | 535 | 720 | | |
| /eig | 2.2 | Axle loading, laden front/rear | kg | 715/1330 | 855/1680 | 1020/2200 | | |
| 3 | 2.3 | Axle loading, unladen front/ rear | kg | 345/100 415/120 530/190 | | | | |
| | 3.1 | Tires | | | Polyurethane (PU |) | | |
| | 3.2 | Tire size, front | Ø x w (mm) | | Ø230X70 | | | |
| | 3.3 | Tire size, rear | Ø x w (mm) | | Ø84X84 | | | |
| | 3.4 | Additional wheels (dimensions) | Ø x w (mm) | | Ø100X40 | | | |
| | 3.5 | Wheels, number front/ rear(x=driven wheels) | | | 1×+2/4 | | | |
| | 3.6 | Tread, front | b ₁₀ (mm) | | 510 | | | |
| | 3.7 | Tread, rear | b ₁₁ (mm) | | 367/512 | | | |
| is | 4.4 | Lift height | h₃ (mm) | | 120 | | | |
| ass | 4.9 | Height of tiller in drive position min. / max. | h14 (mm) | 820/1335 | | | | |
| , ch | 4.15 | Height, lowered | h ₁₃ (mm) | 85 | | | | |
| ires | 4.19 | Overall length | l₁ (mm) | 1670 | 1735 | 1950 | | |
| F | 4.20 | Length to face of forks | l ₂ (mm) | 520 | 595 | 810 | | |
| | 4.21 | Overall width | b₁ (mm) | 729 | | | | |
| | 4.22 | Fork dimensions | s/e/l (mm) | 60/173/1150 | | | | |
| | 4.25 | Distance between fork-arms | b₅ (mm) | 540/685 | | | | |
| | 4.32 | Ground clearance, center of wheelbase | m ₂ (mm) | | 25 | | | |
| | 4.33 | Aisle width for pallets 1000 x 1200 crossways | Ast(mm) | 2250 | 2315 | 2535 | | |
| | 4.34 | Aisle width for pallets 800X1200 lengthways | Ast (mm) | 2140 | 2205 | 2425 | | |
| | 4.35 | Turning radius | Wa (mm) | 1440 | 1490 | 1750 | | |
| e | 5.1 | Travel speed, laden/ unladen | km/h | 6.0/ | 6.0 | 5.7/6.0 | | |
| anc | 5.2 | Lift speed, laden/ unladen | m/s | 0.025/0.035 | 0.020/0.035 | 0.035/0.045 | | |
| orm | 5.3 | Lowering speed, laden / unladen | m/s | 0.035/0.030 | 0.035/0.030 | 0.040/0.040 | | |
| Perf | 5.8 | Gradeability, laden/ unladen | % | | 8/15 | | | |
| - | 5.10 | Service brake | | | Electromagneti | с | | |
| | 6.1 | Drive motor rating S2 60min | kW | 1. | 3 | 1.7 | | |
| s | 6.2 | Lift motor rating at S3 10% | kW | 0. | 8 | 2.2 | | |
| tor | 6.3 | Battery acc. to DIN 43531 /35 / 36 A, B, C, no | | 2VBS | 2PzS | 3PzS | | |
| ٥ ۳ | 6.4 | Battery voltage, nominal capacity K5 | V/Ah | 160 | 210 | 350 | | |
| | 6.5 | Battery weight (minimum) | kg | 155 | 195 | 285 | | |
| | 6.6 | Energy consumption acc. to VDI cycle | KWh/h | 0.44 | 0.39 | 0.82 | | |
| | 8.1 | Type of drive control | | | AC -Speed Contro | bl | | |
| | 8.4 | Sound level at driver`s ear acc. to EN 12053 | dB(A) | 67 | 69 | 64 | | |
| | | | | | | | | |

Table 1: Main technical data for standard version

C. Description of the safety devices and warning labels



d.Identification plate

| | MODEL: | |
|---|--------------------------------|----|
| 477, Bundangsuseo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, 13553, Korea | TYPE: ELECTRIC PALLET TRUCK | |
| MADE IN CHINA | PRODUCT IDENTIFICATION NUMBER | |
| | | |
| | Load capacity | k |
| | Lift Height | mn |
| | Truck Weight (without battery) | k |
| | Max Battery Weight | k |
| | Min Battery Weight | k |
| | Voltage V Bated Power | L/ |

Fig. 6: Identification plate

The content of the nameplate layout is subject to the equipment posting.

3. WARNINGS, RESIDUAL RISK AND SAFETY INSTRUCTIONS

DO NOT

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

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

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

Brake the truck and activate the emergency button (7) by pushing when sliding load on or off the truck. If the truck has any malfunctions, follow chapter 6.

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

- When operating the electric pallet truck, the operator has to wear safety shoes.
- The truck is intended to be used for indoor applications with ambient temperatures between +5°C and + 40°C.
- The operating lighting must be minimum 50 Lux.
- It is not allowed to use the truck on ramps.
- To prevent unintended sudden movements when not operating the tuck (i.e. from another person, etc.) switch of the truck when not operating it.

4. COMMISSIONING, TRANSPORTING, DECOMMISSIONING

a. Commissioning

| Table 2: Commissioning data | | | | | | | |
|---|---------------|---------------|---------------|--|--|--|--|
| Type 16EP-X 20EP-X 25EP-X | | | | | | | |
| Commissioning weight [kg] | 445 | 535 | 720 | | | | |
| Dimensions [mm] | 1385x729x1670 | 1385x729x1735 | 1950X729X1385 | | | | |

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

- Check if are all parts included and not damaged
- Eventually installation of the multifunction tiller
- Eventually installation and charging the batteries (follow chapter 7)
- Do the work according to the daily inspections as well as functional checks.

b. Lifting/ transportation

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

Lifting

 \triangle

USE DEDICATED CRANE AND LIFTING EQUIPMENT DO NOT STAND UNDER THE SWAYING LOAD

DO NOT WALK INTO THE HAZARDOUS AREA DURING LIFTING

Park the truck securely and lash the truck according to the points identified in fig. 7. Lift the truck to its destination and place the truck securely before removing the lifting gear. The lashing points are according to the fig. 7.

Transportation



DURING TRANSPORTATION ON A LORRY OR TRUCK ALWAYS FASTEN THE TRUCK SECURELY

Lower the forks and park the truck securely.

Fasten the truck according to fig. 8 by fixing dedicated lashing belts to each side of the trucks crane hook holes and fasten the other side at the transporting truck.





Fig. 8: fixing points

C. Decommissioning

For storage, remove the load, lower the truck to the lowest position, grease all in this handbook mentioned greasing points (regular inspection), 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 vertical creep of the truck.
- Check the smooth movement of the wheels.
- Check the function of the emergency brake by activating the emergency button.
- Check, the tiller arm- switch braking function
- Check the lifting and lowering functions by operating the buttons.
- Check if all bolts and nuts are tightened firmly.
- Visual check if there are any broken hoses or broken electric wires.

6. OPERATING INSTRUCTIONS

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

Make sure, that the load is palletized and stable and that the daily inspection is carried out. Insert the key switch(8), turn on it. Press the horn button (14) to activate the audible warping

Press the horn button (14) to activate the audible warning signal.





Fig.9: Tiller operating controls

a. Parking

DO NOT PARK THE TRUCK ON INCLINED SURFACES

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

Always lower the forks fully. Press the emergency switch (7), turn the key 90° counterclockwise and unplug the key.

b. Lifting

DO NOT OVERLOAD THE TRUCK! THE MAXIMUM CAPACITY IS 1600kg(16EP-X), 2000kg (20EP-X), 2500kg (25EP-X)

Travel with the lowered forks fully underneath the pallet until the load and press the lifting button (15) until you reached the desired lifting height.

C. Lowering

Press the lowering button (15) carefully.

Lower the load until the forks are clear of the pallet, then drive the truck carefully out of the load unit.



Fig. 10: Load facing

d. Travelling

TRAVEL ON INCLINES ONLY WITH THE LOAD FACING UPHILL. DO NOT TRAVEL ON INCLINES MORE THAN SPECIFIED WITH THE TECHNICAL DATA.



Fig. 11: Operating direction

Turn on the key switch (8) to start the vehicle and move the handle to the operation area 'F'.

Turn the acceleration button in the desired direction forward 'Fw.' or backward 'Bw.'

Carefully move the acceleration button (4) to control the driving speed until the desired speed is reached.

If the acceleration button is moved back to the middle position, the controller slows the vehicle until it stops. If the vehicle stops, the parking brake starts working.

Please drive the vehicle carefully to the destination, observe the road conditions and adjust the driving speed through the acceleration knob.

e. Steering

Steering the truck by moving the tiller to the left or right side.



f. Braking

THE BRAKING PERFORMANCE DEPENDS ON THE TRACK CONDITONS AND TRHE LOAD CONDITONS OF THE TRUCK

The braking function can be activated on several ways:

- By moving the accelerator button (4) back to the initial '0' position or by releasing the button, the regenerative braking is activated. The truck brakes until it stops.
- By moving the accelerator button (4) from one driving direction directly to the opposite direction, the truck brakes regenerative until it starts travelling into the opposite direction.
- The truck brakes, if the tiller is moved up or down to the braking zones ('B'). If the tiller is released, the tiller moves automatically up to the upper baking zone ('B'). The truck brakes until it stops.

The safety (belly) button (5) prevents the operator from being crushed. If this button is activated, the truck decelerates and or starts travelling into the backwards direction ('Bw.') for a short distance and stops. Please consider, that this button also operates, if the truck is not travelling and the tiller is in the operating zone.

g. Malfunctions

If there are any malfunctions or the truck is inoperative, please stop using the truck and activate the emergency button (7) by pushing it. If possible, park the truck on a safe area and remove the key switch (8). Inform immediately the manager and, or call your service. If necessary, tow the truck out of the operating area by using dedicated towing/ lifting equipment.

h. Emergency

In emergencies or in the event of tip over (or off dock), keep safe distance immediately. If possible push the emergency button (7). All electrical functions will be stopped.



7. Controllers and related devices

a. Controller appearance

The AC-0 controller is used as an example. For other models, see the parts manual



| No. | Item Description | | | |
|-----|------------------|--|--|--|
| 1 | Plate | | | |
| 2 | Controller | | | |
| 3 | Copper Busbar | | | |
| 4 | Contactor | | | |
| 5 | Holder | | | |
| 6 | Copper Busbar | | | |
| 7 | Relay | | | |
| 8 | Copper Busbar | | | |
| 9 | Fuse 150A | | | |
| 10 | Copper Busbar | | | |
| 11 | Fuse Holder | | | |
| 12 | Fuse 80A | | | |
| 13 | Holder | | | |
| 14 | Fuse Holder | | | |
| 15 | Fuse 10A | | | |
| 16 | Fuse Holder | | | |
| 17 | Cable fastener | | | |
| 18 | Mounting Plate | | | |

b. WIRING/ CIRCUIT DIAGRAM

b-1 16/ 20/ 25EP-X (CURTIS System)



Fig. 12: Electrical diagram

10A

| Code | Item | Code | Item |
|------|---------------------|------|-----------------------|
| GB | Battery | К | Relay |
| SM | Emergency button | SA | Proximity switch |
| Et | Controller | Р | Indicator |
| KMt | Main contactor | В | Tiller |
| FU01 | Fuse 80A | С | Capacitor |
| FU02 | Fuse 150A | HA | Horn |
| FU1 | Fuse 10A | SU | Micro switch |
| SY | Key switch | YV | Electromagnetic valve |
| KMp | Lifting contactor | Mt | Traction motor |
| Es | Steering Controller | Ϋ́В | Electromagnetic brake |
| Мр | Pump motor | VD | Diode |

Table 3: Description of electrical diagram



Fig. 13: Electrical diagram (16/20/25EP-X Li)

| Code | Item | Code | ltem |
|------|---------------------|------|-----------------------|
| GB | Li battery | K | Relay |
| SM | Emergency button | SA | Proximity switch |
| Et | Controller | Р | Indicator |
| KMt | Main contactor | В | Tiller |
| FU01 | Fuse 80A | С | Capacitor |
| FU02 | Fuse 150A | HA | Horn |
| FU1 | Fuse 10A | SU | Micro switch |
| SY | Key switch | YV | Electromagnetic valve |
| КМр | Lifting contactor | Mt | Traction motor |
| Es | Steering Controller | YB | Electromagnetic brake |
| Мр | Pump motor | VD | Diode |

C. Test and troubleshoot

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



Test

A. Controller

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

| | | | | | - | |
|------|-----------|---------|--------|------------|----------|--------------|
| Fach | test item | must he | tested | reneatedlv | for more | than 3 times |
| Laon | lost nom | must be | losicu | cpcatoury | | |

| | Multi-meter | | Normal range | | |
|------|-------------|-----------|--------------|----------|-------------|
| item | terminals | | | | |
| | Red pen | Black pen | Deter | mination | Resistance |
| | | | of | polarity | measurement |
| | | | value | | |
| 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 multi-meter to Ω Turn the multi-meter 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 multi-meter 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 multi-meter pointer cannot be reversed

B. Wiring contactor and fuse measurement



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

8. BATTERY CHARGING AND REPLACEMENT



• Only qualified personnel are allowed to service or charge the batteries. The instructions of this handbook and from the battery- manufacturer must be observed.

- Recycling of batteries undergoes national regulations. Please follow these regulations.
- By handling batteries, open fire is prohibited, gases could cause 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 there are no disturbing towards other components of the truck.

Battery types

Depending on the version, the truck is equipped with different battery types. The following tables show which combinations are intended as standard, indicating the capacity. The battery weights can be taken from the battery data plate.

| Manufacturer`s type designation | Battery type | Capacity | Weight | Max. dimensions |
|---------------------------------|---------------------|------------|--------|-----------------|
| | 24 V battery | 2PzB-160Ah | 155kg | 624x146x590mm |
| 16EP-X | 24 V battery Li-Ion | 100Ah | 55kg | 624x146x590mm |
| | 24 V battery Li-Ion | 150Ah | 60kg | 624x146x590mm |
| | 24 V battery | 2PzS-210Ah | 195kg | 624x212x627mm |
| | 24 V battery Li-Ion | 100Ah | 62kg | 624x212x627mm |
| 2027-7 | 24 V battery Li-Ion | 150Ah | 67kg | 624x212x627mm |
| | 24 V battery Li-Ion | 200Ah | 80kg | 624x212x627mm |
| | 24 V battery | 3PzS-350Ah | 285kg | 624x284x627mm |
| 25EP-X | 24 V battery Li-Ion | 150Ah | 83kg | 624x284x627mm |
| | 24 V battery Li-Ion | 200Ah | 90kg | 624x284x627mm |



LEAD-ACID BATTERIES AND LITHIUM BATTERIES ARE ALLOWED FOR APPLICATION. THE WEIGHT OF THE BATTERIES HAS AN INFLUENCE TO THE TRUCKS OPERATING BEHAVIOR.

PLEASE CONSIDER THE MAXIMUM OPERATING TEMPERATURE OF THE BATTERIES.



Lead-acid battery



Lithium Battery

a. Replacement

16/20EP-X

Park the truck securely and switch off the truck with the key switch (8), push the emergency button (7). Open the battery cover and let it stay upright, disconnect the battery plug (16), then move the battery out with a crane.

25EP-X

Park the truck securely and switch off the truck with the key switch (8), push the emergency button (7). Open the battery cover and let it stay upright, disconnect the battery plug (16) and mechanical lock (17), and then pull out the battery.

The installation is in the reverse order of the removal. Please connect the positive terminals firstly. Otherwise the tuck could be damaged.

Note: for 20EP-X, if you would like to exchange to the side, please refer to 25EP-X.



Fig. 16: Battery replacement



Fig. 17: Battery



a-1 LIFTING TYPE

a-2 Side pull



R

b. Maintenance of lead-acid batteries

1. Cause of water supply of battery

The battery recharge is due to the electrolytic effect of the battery at the later charging stage, which makes the moisture part of the electrolyte electrolyze. After a long period of charge and discharge, the water content of the battery will be more electrolytic, which will increase the electrolyte potency and decrease the liquid level. At this time, it is necessary to supplement distilled water to restore the liquid level to the original height and maintain the normal potency of electrolyte to ensure the service life of lead-acid battery.

2. Note:

(1) Remember not to drop the liquid level below plate before starting to replenish water. Once the plate is exposed to air, the battery performance can be seriously affected.

(2) In order to reduce the number of water recharging, battery charging should be strictly required by the instructions, do not overcharge. Overcharge will aggravate the battery water loss.

3. Distill-Water-adding materials and tools

(1) Water requirements: it is recommended to use battery special supplementary liquid or distilled water. In case of emergency, pure water for drinking water on the market can also be used, but remember not to use tap water, mineral water and other water containing impurities.

(2) Water filling tool: water funnel, water ladle. If the tool used can be made of plastic or glass, it shall not be made of metal.

(3) For users with large amount of water, the self-made water filling device in large bucket is adopted.

4. When the water supply does not lead to the water shortage of the battery in time, it can cause:

1) As the electrolyte surface decreases, the temperature rise is high when the battery is charged;

2) The capacity of the battery is reduced;

3) If the plate is exposed to the air, it can be oxidized;

4) The specific gravity of the electrolyte is increased, and the corrosion of the polar plate can be easily degraded.



C. Battery indicator

The discharge situation is represented by 10 red LED display segments. Battery indicator (CURTIS)



Fig. 19: Battery indicator

The main interface displays as shown in the figure above.

Hour meter

The digital counter after Hourglass Symbol indicates the working hour of the truck. Unit: H

Battery state of charge

| | _ | _ |
|---|------------|---|
| - | — — | |
| - | _ | |
| | | |
| - | | |
| | | |
| _ | _ | _ |
| | | |
| | | |
| | | |
| | | |
| | | |

It displays the battery symbol and the current battery level. The charge status of the battery is displayed in ten increments. Each is represented by a rectangle that corresponds to 10% of the battery charge.

Fault Code



It displays the current fault code (TRA is for drive controller failure, STR is for steering controller failure).

Operating mode and truck speed

The number in the center of the battery indicator indicates the traveling speed (km/h).

Working state

The upper left corner is the vehicle status display bar, and the speed status display (normal speed and turtle speed status switch);

The forward and backward state of the vehicle is switched, the brake brake state is displayed, the lifting and descending state is switched, and the handle interlock state is displayed.

d. Charging

- Before charging ensure that you are using an appropriate charger for charging the installed battery!
 - Before using the charger, please fully understand the instructions of the charger 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 external charger of Lead-acid battery

Park the truck at a dedicated secured area with a dedicated power supply. Lower the forks and remove the load; if supplied remove the battery cover.

Switch the truck off and connect the battery plug to the charging plug of the charger.

When charging is finished, disconnect the connector from the socket and place it in the designated pocket.

The external charger of lithium-ion battery

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, Open the battery cover and let it stay upright, connect the charging connector (18) and power connector (19). Start charging.

Disconnect the charging plug after charging and install the battery cover. After charging, disconnect the connector from the socket and place it in the designated position.

arman an a alflaatian





| Charger specification | | | | |
|------------------------------------|---------------------|------------|-----------------------|--|
| Manufacturer`s type designation | Battery type | Capacity | Charger specification | |
| | 24 V battery | 2PzB-160Ah | 24V /SN25A | |
| 16EP-X | 24 V battery Li-Ion | 100Ah | 24V60A | |
| | 24 V battery Li-Ion | 150Ah | 24V60A | |
| | 24 V battery | 2PzS-210Ah | 24V /SN30A | |
| | 24 V battery Li-Ion | 100Ah | 24V60A | |
| 2022-7 | 24 V battery Li-Ion | 150Ah | 24V60A | |
| | 24 V battery Li-Ion | 200Ah | 24V80A | |
| | 24 V battery | 3PzS-350Ah | 24V /SN45A | |
| 25EP-X | 24 V battery Li-Ion | 150Ah | 24V60A | |
| | 24 V battery Li-Ion | 200Ah | 24V80A | |





e. Description of the lithium-ion battery

- The lithium-ion battery is a battery with rechargeable cells
- The battery is designed for industrial trucks and can withstand related vibrations during operation.
- The battery is equipped with special connections for charging and discharging operations.
- The BMS controls the following safety functions and conditions: voltage, temperature, under voltage, overvoltage, over temperature and overcurrent.
- The internal resistance of the battery is very low, which minimizes heat generation and maximizes the available power of the car.

Battery temperature range

- Temperature range for using the battery is from +5°C to +40°C.
- Low temperatures reduce the effective battery capacity, high temperatures reduce the battery's life time.
- The temperature difference between the two sides of the battery shall not exceed 5°C.

Battery Charger

• Only approved battery chargers must be used to charge the lithium battery.

f. Battery Label



| ltem | Description | |
|------|-----------------------------------|--|
| 51 | Identification plate | |
| 52 | Bar code and two-dimensional code | |
| 53 | Warning Label | |

Identification plate and Warning label

| 54 | | | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 |
|----------------|----------------------------------|--------------------------|----|--|--|--|--|---|---|----|-----|----------|------|----|----|
| 55 56 57 | LOGO Model Naminal Voltage | LFPman | | | | | | * (| D | / | | Date M.Y | Verx | | Q |
| 58 | Rated Capacity Energy | xx Ab | | To ensure the the following 1.Use the orig | User Gui life of the lit items: ginal charger. | de for Lithiun thium-ion batt | a-ion Batter ery ,the ope | y System rator shall | l pay attention to | | , x | | | | õ? |
| 59 60 | Weight | xx kg±xx kg G-CH-FK-R | | 2.Before storns three months. I disconnect th 3.Not suggest | so, the battery sl f the forklift e battery to put t to discharge | hould be charge and battery w revent the bat the battery to | d to about 50 ill not be us tery from o less than 5 | % SOC and ed for a lo ver dischar % SOC.Ov | recharged every ong time please rge. ver discharge | | _ | | | | |
| 61 | TCP Serial No. | XXX | | will shorten 1 4.It's forbidd 5.Battery's or | ifespan of the en to store the eration tempe | battery. e battery in th ersture is 0-55 | e environm Cwhen ch | ent more ti arging and | he 35°C. -20-60°C when | | | | | | |
| 63 | Date of manufacture | 20xx.* | | discharging .] life will be sh 6. It's forbidd | But the best an norten. | mbient tempe | rature is 5~ | 40°C.Othe | rwise the battery | | | | | | |
| 64 | Manufacturer: Address: | | l | 7.It's forbidd | en to disassen | nble and repa | ir the batter | y without | authorization. | | | | | | |

| ltem | Description | ltem | Description |
|------|-------------------|------|--------------------------|
| 54 | Manufacturer logo | 67 | Rechargeable logo |
| 55 | Battery model | 68 | Vertical upward packing, |

| 56 | Nominal voltage of | 69 | No putting into ordinary garbage bins |
|----|---------------------------|----|---------------------------------------|
| 57 | Rated capacity of battery | 70 | No long-term exposure to sunshine |
| 58 | Battery energy of battery | 71 | Stay away from fire |
| 59 | Weight of battery | 72 | Keep out of the rain |
| 60 | Configuration of battery | 73 | Guide to use |
| 61 | Protocol version of | 74 | Production date |
| 62 | Production serial No. | 75 | Battery information bar code |
| 63 | Production date | 76 | Bar code interpretation |
| 64 | Name of manufacturer | 77 | Software version of battery |
| 65 | Manufacturer's address | 78 | Battery information 2D code |
| 66 | Electrical hazard marker | | |



Outline diagram (24V 100Ah)

g. Safety Instructions, Warning Indications and other Notes

Safety regulations for handling lithium-ion batteries

Do not try to make any repairs or servicing of lithium batteries



Risk of electric shock and burning

The battery's charging and discharging connectors have open terminals, avoid any body contacts, contamination or direct contacts with objects which can cause short circuit connection of terminals. Use necessary pre-cautions and protective caps to secure the open terminals. The connectors should be maintained in clean and dry conditions.



Use only batteries designed and approved by the manufacturer for the truck. Do not try to modify or alter the battery.



Any damage or defects to the charger can result in accidents. Use only charger approved by the manufacturer of the truck, which is suitable for used battery

In case charger has any damages or defects, exclude the charger from operation and contact your service provider. Do not modify or try to repair the charger.

mproper use of charger or use of wrong charger can cause damages to a battery or charger. Follow the required charger specifications; If the operation voltage of the charger is out of the applicable voltage range, the charger or battery may be damaged causing serious safety risks. The charger in use must be approved by the battery (truck) manufacturer.

Reversed connection of charging plug is prohibited. Follow the instruction for correct connection. For disconnection of charging plug use dedicated grip and never pull out the plug by means of cable.

Stop charging immediately if any abnormalities are detected, e.g. severe temperature increase, deformation of battery case, smoke, noise etc.

Intermediate charging

Lithium batteries support so called opportunity charging. The lithium battery, which is not fully discharged can be charged in any time. However, frequent opportunity charging not to the full charging state and stop of charging process before the appearance of corresponding indication of charger may result in dis-balance voltage of cells which increases the battery BMS calculation error. In order to effectively deal with this phenomenon, charge the battery in full allowing the automotive balancing process to be completed at least once a week.

Do not charge a fully charged battery



Note that in order to prevent the battery from continuing restart of charging under fully charged condition causing reduction of battery lifetime, the BMS has a protection function that prohibits recharging of fully charged battery. The charger will not work while battery is fully charged.

Potential hazards

If equipment is used according to its design purpose, following the correct operations procedures, there are no hazards anticipated.

The following hazards can arise in the event of improper use:

- Physical damage to the battery in case a battery falls or is deformed through impacts. Mechanical damages can cause leakages of harmful materials, fire or battery explosion.
- Short circuits may be caused by connecting the two battery terminals, for instance caused by water or intentional/unintentional connections.
- Temperature damages caused by location of batteries in overheated locations or being exposed to impact of fire, open sunlight etc. can cause leakages of harmful materials, fire or battery explosion.

In order to avoid fire, explosion and leakage of harmful materials, a safe place for storing batteries until the service arrives on site must satisfy the following criteria:

- Do not store in places where personnel is located.
- Do not store in places with valuable objects and close to valuable objects.
- A Class D fire extinguisher must be available on demand.
- There should not be any fire or smoke detectors in the storage area in order to ensure that an automatic fire detection system is only activated in the event of actual danger (e.g. naked flames).
- No ventilation intake pipes should be in the facility to exclude spreading of discharged content within a building.

Examples of where to store a non-functional battery:

- Roofed outdoor position.
- Ventilated container.
- Covered fire resistant box with pressure and smoke discharge option.

Symbols - Safety and Warnings

| <u>/</u> | Caution! Battery short-circuit is prohibited. |
|--|--|
| | The battery can be recharged cyclically |
| <u><u><u></u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u> | Vertical upward packing, transportation and use |
| | Used lithium-ion batteries must be treated as hazardous waste. |
| X | Lithium-ion batteries marked with the recycling symbol and the sign showing a |
| | crossed-out waste bin must not be disposed of with ordinary household waste. |
| ~!! | Avoid fire and short circuits causing overheating. |
| 1 | Do not ignite or locate batteries close to open flame, heat sources or sparks. |
| | Keep lithium-ion batteries away from heat sources. |



Protect the lithium-ion battery from solar radiation or other forms of heat radiation. Do not expose the lithium-ion battery to heat sources.

Keep out of the rain.

Explosion and fire hazard



Physical damage, thermal effects or incorrect storage in the event of a defect can result in explosions or fire. The battery materials can be flammable.

Particular hazard from combustion products

The lithium batteries may be damaged by a fire. When extinguishing a lithium battery fire, the following information must be taken into consideration.



Contact with combustion products can be hazardous

Fire produces combustion products, which can occur in the form of smoke, through leaking fluids, escaping gases, debris as well decomposition products of certain chemicals. These combustion products are substances that enter the body through the respiratory tract and/or the skin can produce and adverse effects such as choking.



Avoid contact with combustion products. Use protective equipment.

Special firefighting protective equipment

Use self-contained breathing apparatus. Wear protective equipment.

Additional firefighting instructions

To prevent secondary fires, the lithium-ion battery must be cooled from the outside. Fluids or solids must never be directed into the lithium battery.

Suitable extinguishing agents

- Carbon dioxide extinguisher (CO2)
- Water (not on mechanically opened or damaged batteries)

Unsuitable extinguishing agents

- Foam
- Grease fire extinguishing agents
- Powder extinguishers
- Metal fire extinguishers (PM 12i extinguishers)
- Metal fire powder PL-9/78 (DIN EN 3SP-44/95)
- Dry sand

Instructions for cooling an overheated, non-physically damaged battery

This type of damage may be caused by a short circuit inside the battery, which may result in leakage of harmful materials, fire or battery explosion.

Material discharge

Battery electrolyte fluid can be hazardous



- Rinse the affected parts with big amount of water and request for medical assistance immediately.
- In case of skin irritation or if any substances are breathed in request the medical assistance immediately.

Precautionary measures for personnel

- Keep personnel away, avoid any contact with smoke or discharged materials.
- Block off the affected area and ensure its reasonable ventilation.
- Wear personal protective equipment. If vapors, dust or aerosols are presented use self-contained breathing apparatus.

Precautionary measures for the environment

Do not allow spilled fluids to enter the water system, drainage system or the underground water.

Cleaning measures

The leaked fluid must be removed professionally following the related protocols.

Battery lifetime and maintenance

The lithium-ion batteries are maintenance-free.

Full discharge can damage the battery

Self-discharge can cause the battery to fully discharged state. Full discharge shortens the service life of the battery and can cause deep discharge and activation of related safety protocols when battery will not be able to be charged anymore.

Before a long period of inactivity, the battery must be charged to at least 70%. Re-charge the battery at least every 12 weeks.

If the battery is deeply discharged or if the battery temperature is below the permissible level, the battery will not charge. Deep discharged batteries can never be charged. Due to the risk of condensate formation, batteries that have been stored at 0°C or below must only be charged after natural warming up to at least +5°C, forced heating is forbidden.

Storage and safe handling

Storage of batteries

Deep Discharge can damage the battery

If the battery is not used for a long period of time, it can become damaged through discharge.

- Before a long period of inactivity, the battery must be charged to the level of at least 70%.
- Recommended to check and charge, if necessary, the battery every 4 weeks when not in use.
- The storage of fully charged battery reduces its lifetime. Recommended level of charge is in the range of 30% to 70%.
- The temperature range for storing the battery is 0°C to 30°C.

Instructions for safe handling

New lithium-ion batteries are transported and stored with a charge status of at least <70 %.

- Do not modify the battery.
- Do not open, damage, drop, penetrate or deform the battery.
- Do not throw the battery into a fire.
- Protect the battery from overheating.
- Protect the battery from direct sun light.
- Follow storage and charging procedures

Failure to comply with these safety instructions can result in fire and explosion or the leakage of harmful materials.

Faults

If any damage is found to the battery or battery charger contact the service provider immediately. Do not open the battery.

Disposal and transport of a lithium-ion battery

Instructions for disposal

Lithium-ion batteries must be disposed of in accordance with the relevant national environmental protection regulations. Batteries must be treated as hazardous waste. Batteries must not be disposed with ordinary waste.

Shipping information

The lithium-ion battery is a hazardous material. The applicable regulations must be fulfilled during transportation.

Shipping functional batteries

Functioning batteries can be shipped in accordance with the related regulations

Shipping faulty batteries

To transport faulty lithium-ion batteries, contact the service provider. Faulty lithium batteries require following of special transporting procedures.

9. Drive/brake system

a. Overview

The drive/brake system includes the following:

1) The drive motor controlled by the controller transmits the rotating power to the drive shaft (electric-mechanical power)

2) The drive shaft converts the rotational power transmitted from the drive motor through its gear set into the torque and speed suitable for the drive, and sends it to the corresponding wheels (mechanical power). They also contain service brakes, which are electromagnetic brakes controlled by a controller to generate braking power (friction).

3) The accelerator sends the CAN number to the drive motor controller to accelerate the motor (CAN signal)

a-1 Drive Unit



| No. | Item Description | Qty. |
|-----|------------------|------|
| 1 | Brake | 1 |
| 2 | Screw | 8 |
| 3 | Spring Washer | 9 |
| 4 | Flat Washer | 4 |
| 5 | Spring Washer | 4 |
| 6 | Bolt | 4 |
| 7 | Wheel Mount | 1 |
| 8 | Flat Washer | 1 |
| 9 | Screw | 1 |
| 10 | Bracket | 1 |
| 11 | Screw | 4 |
| 12 | Spring Washer | 4 |
| 13 | Cylindrical Pin | 2 |
| 14 | Drive Unit | 1 |

Operation

The drive motor runs when the following conditions are met:

1 Turn on the button and the emergency stop switch to power the controller.

- 2 Move the handle to the operation area,
- 3 Determine the direction of travel,
- 4 Twist the throttle on the handle

Remove and install the drive assembly

Preliminary steps

- 1 Park the vehicle safely and remove the drive wheel cover
- 2 Turn off the emergency stop switch and key switch
- 3 Disconnect the battery connector

Disassembly procedure

1) Remove the drive motor cover and handle seat, and then remove 8 screws,



2) Unplug the harness connector of the motor



3) Remove the screw and take off the motor power cord connector





4) Remove and replace the 5 screws fixing the PU ring with a 17mm wrench



5) The reverse process of installation and disassembly



b. Brakes

Appearance

Brake removal and installation

Remove the brake by removing the three screws that are fixed to the drive wheel with a 5mm hex wrench.



The reverse process of installation and disassembly

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 other hydraulic parts through hydraulic force from pump.

- 1. The main hydraulic pump is driven by the pump motor controlled by the controller.
- 2. The main hydraulic pump uses the rotating force output from the motor to pressure the oil in the hydraulic tank and conveys the oil to the lifting cylinder.
- 3. The hydraulic tank stores the hydraulic oil returned from the cylinder. The stored oil is sucked 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 transmits the power to the main hydraulic pump electrically 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 according to the input from multiple switches and sensors and the internal parameter settings

The pump motor operates when the following conditions are met:

The key emergency stop switch is closed

The limit switch and the up button are closed

Pump motor contactor is 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



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

b. Hydraulic circuit



Fig. 26: 25E-X Hydraulic circuit

c. TROUBLESHOOTING

Pump Motor

| Trouble | Possible cause |
|-----------------------------------|--|
| | Poor connection or blown fuse. |
| | Check the battery connection. |
| | Check the key fuse. |
| | Check whether the fuse of the hydraulic pump motor |
| | may be blown. |
| | Key switch, upper limit switch and line contactor are |
| | not closed. |
| The hydraulic pump motor does not | Turn off the key switch. Use a multi-meter to check |
| | the power flow through the key switch, line contactor |
| | coil and line contactor. The key switch must be turned |
| | off. |
| | Insufficient voltage. |
| work | Charge or replace the battery. |
| | Check whether the cable terminal fits closely with the |
| | battery terminal and the control panel connector. |
| | Check whether the wires inside the cable are broken. |
| | The lifting and drive system is not operating correctly. |
| | During the battery charging operation, the battery is |
| | not fully charged. |
| | The hydraulic system uses too much battery power |
| | because the lift or hydraulic control is not correct for |
| | the duty cycle. |
| | The hydraulic pump motor is overheating. |
| | If the motor temperature reaches 155 $^{\circ}$ C (311 $^{\circ}$ F) |

Hydraulic Pump

| Trouble | Possible cause |
|----------------------------------|---|
| | The oil level is low. |
| | Oil is very thick (viscosity is too high) |
| Noise in the pump. | The pump inlet pipeline is restricted. |
| | Worn parts in the pump. |
| | The oil is dirty. |
| | Air leaks into the inlet line. |
| | The oil level is low. |
| | The oil passage is restricted. |
| | The oil is too thin. |
| The oil temperature is too high. | Air leakage exists in the system. |

| | The pump is too worn. |
|--------------------------------|--|
| | The system operates under too high pressure. |
| | The shaft seal is worn out. |
| Leakage at pump shaft seal. | The pump body is worn internally. |
| | Operation with low oil level in the tank will cause the seal |
| | to be sucked. |
| | During installation, the seal is cut at the shoulder of the |
| | pump or keyway. |
| | The sealing lip is dry and hardened by heat. |
| | The oil content in the tank is low. |
| | The pump inlet pipeline is restricted. |
| The pump cannot deliver fluid. | There is air leakage in the pump inlet pipeline. Loose |
| | bolts. |
| | Defects in the suction line of the bay. |
| | The viscosity of the oil is wrong. |
| | The pump is too worn. |
| | Pump shaft failure |
| | The bolts for the pump do not have the correct torque. |

11. REGULAR MAINTENANCE

- Only qualified and trained personnel are allowed to do maintenance on this truck.
- Before maintaining, remove the load from the forks and lower the forks to the lowest position.
 - 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 by compression, 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 change the wheels, please follow the instructions above. The castors must be round and they should have no abnormal abrasion. Check the items emphasized maintenance checklist.

a. Maintenance checklist

| Table 3: | Maintenance checklist |
|----------|-----------------------|
|----------|-----------------------|

| | | Inte | erval | l(Mc | nth) |
|-----|---|------|-------|------|------|
| | | 1 | 3 | 6 | 12 |
| Нус | Iraulic | | | | |
| 1 | Check the hydraulic cylinder(s), piston for damage noise and leakage | | • | | |
| 2 | Check the hydraulic joints and hose for damage and leakage | | • | | |
| 3 | Inspect the hydraulic oil level, refill if necessary | | • | | |
| 4 | Refill the hydraulic oil (12 month or 1500 working hours) | | | | • |
| 5 | Check and adjust function of the pressure valve (1600kg /2000kg /2500kg +0/+10% | | | | • |
| | OR 3500lb /4500 lb /5500 lb +0/+10%) | | | | |
| Mee | chanical system | | | | |
| 6 | Inspect the forks for deformation and cracks | | ٠ | | |
| 7 | Check the chassis for deformation and cracks | | ٠ | | |
| 8 | Check if all screws are fixed | | ٠ | | |
| 9 | Check the push rods for deformation and damages | | ٠ | | |
| 10 | Check the gearbox for noise and leakage | | ٠ | | |
| 11 | Inspect the wheels for deformation and damages | | • | | |
| 12 | Inspect and lubricate the steering bearing | | | | • |
| 13 | Inspect and lubricate the pivot points | | ٠ | | |
| 14 | Lubricate the grease nipples | ٠ | | | |
| Ele | ctrical 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 | | ٠ | | |
| 25 | Check the electrical system of the drive motor | | ٠ | | |
| Bra | king system | | | | |
| 26 | Check brake performance, if necessary replace the brake disc or adjust the air gap | | ٠ | | |
| Bat | tery | | | | |
| 27 | Check the battery voltage | | • | | |
| 28 | Clean and grease the terminals and check for corrosion and damage | | • | | |
| 29 | Check the battery housing for damages | | • | | |
| 30 | Check and if necessary refill the battery with distillated water | • | | | |
| | | | | | |
| Cha | arger | • | | | |
| Cha 31 | arger Check the main power cable for damages | | | • | |
| Cha 31 32 | arger Check the main power cable for damages Check the start-up protection during charging | | | • | |
| Cha 31 32 Fur | arger Check the main power cable for damages Check the start-up protection during charging nction | | | • | |
| Cha 31 32 Fur 33 | Arger Check the main power cable for damages Check the start-up protection during charging Inction Check the horn function | • | | • | |
| Cha 31 32 Fur 33 34 | arger Check the main power cable for damages Check the start-up protection during charging Inction Check the horn function Check the air gap of the electromagnetic brake | • | | • | |
| Cha 31 32 Fur 33 34 35 | Arger Check the main power cable for damages Check the start-up protection during charging Inction Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking | • | | • | |
| Cha 31 32 Fur 33 34 35 36 | arger Check the main power cable for damages Check the start-up protection during charging action Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking | • | | • | |
| Cha 31 32 Fur 33 34 35 36 37 | arger Check the main power cable for damages Check the start-up protection during charging Inction Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function | • • • • | | • | |
| Cha 31 32 Fur 33 34 35 36 37 38 | arger Check the main power cable for damages Check the start-up protection during charging nction Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the steering function | • • • • • | | | |
| Cha 31 32 Fur 33 34 35 36 37 38 39 | arger Check the main power cable for damages Check the start-up protection during charging Inction Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the steering function Check the lifting and lowering function | • • • • • • | | | |
| Cha 31 32 Fur 33 34 35 36 37 38 39 40 | arger Check the main power cable for damages Check the start-up protection during charging action Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the steering function Check the lifting and lowering function Check the tiller arm switch function | • • • • • • • • • • • • | | | |
| Cha 31 32 Fur 33 34 35 36 37 38 39 40 Ger | arger Check the main power cable for damages Check the start-up protection during charging action Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the lifting and lowering function Check the tiller arm switch function | • • • • • • • • • • • | | | |
| Cha 31 32 Fur 33 34 35 36 37 38 39 40 Ger 41 | arger Check the main power cable for damages Check the start-up protection during charging action Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the lifting and lowering function Check the tiller arm switch function Check the tiller arm switch function Check the tiller arm switch function | • • • • • • • • | | | |
| Cha 31 32 Fur 33 34 35 36 37 38 39 40 Ger 41 42 | arger Check the main power cable for damages Check the start-up protection during charging nction Check the horn function Check the air gap of the electromagnetic brake Test the emergency braking Test the reverse and regenerative braking Test the safety (belly) button function Check the lifting and lowering function Check the tiller arm switch function neral Check if all decals are legible and complete Inspect the castors, adjust the height or replace these if worn out. | • • • • • • • • | | | |

b. Lubricating points

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



Fig. 24: Lubricating points

- 1. Steering castor bearing
- 2. Support castor bearing
- 3. Pump
- 4. Axle
- 5. Joint
- 6. Load roller bearing

c. Check and refill hydraulic oil

The required hydraulic fluid- type is

- H-LP 46, DIN 51524
- Viscosity is 41.4 47
- Depending on the type the amount is 0,7L(16/2EP-X) and 0.8L (25EP-X)

Waste material like oil, used batteries or other must be probably disposed and recycled according to the national regulations and if necessary brought to a recycling company. The oil level height shall be in the not lifted position min.0.6L to 0.8L. If necessary add oil at the filling point.

d. Checking electrical fuses

Remove the main cover. The fuses are located according to fig. 19/20.



Fig. 25: Location fuses (16/ 20/ 25EP-X)



The location of the fuses

| Table 8 | : Size fuses | (16/20/ | 25EP-X) |
|---------|--------------|---------|---------|
| 1010100 | | | |

| | Rate |
|------|------|
| FU01 | 150A |
| FU02 | 80A |
| FU1 | 10A |



 $\underline{\mbox{Fig. 26:}}$ Location fuses $(\,16/\,20/\,25\mbox{EP-X})$ (\mbox{CURTIS})

 $\underline{\text{Table 9:}} \text{ Size fuses } (16/20/25\text{EP-X})$

| | Rate |
|------|-------|
| FU1 | 0.5 A |
| FU2 | 10 A |
| FU01 | 80A |
| FU02 | 150A |

12. TROUBLESHOOTING

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

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

Table 10: Trouble shooting

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. The CURTIS control system

a. The Curtis 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.

| O Software Version | 1.24.03. | 00 |
|-----------------------------------|---------------------|----------|
| HHP Resource Vers | sion 0. | 91 |
| 1 DME Resource Ver | sion 0. | 98 |
| MH Resource Versi | on 0. | 59 |
| FWM Version | 2,09,00, | 00 |
| Software Version | 1.09.08. | 00 |
| | | UU. |
| 1 HHP Resource Vers | sion 0. | 19 |
| HHP Resource Vers FWM Version | sion 0. 2.09.00. | 19 00 |

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







Vehicle Harness Wiring for CAN Connected 1313 HHP

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

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 (1990) 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 (\mathbf{D}) 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.



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

Main Screen



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

Help



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

MAIN SCREEN AND APPS ORGANIZATION

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



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

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

c. DEVICE

Device Details and Connection

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

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

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

If a selected device hasn't connected to the 1313 HHP before, the connection-screen displays a series of 4 successive progress bars (Receiving Menu...x%) that are identified as $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$. 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 $\frac{4}{4}$ 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



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



(5) "Connect" softkey—receiving data progress



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

| | | 1, | 13 |
|---|------------|--------------------|----|
| 1 | Family | 3 | |
| 1 | Model | AC F2-A 24-200-001 | |
| 0 | OEM String | g Curtis | |
| 0 | Serial No | 17319L.000009 | |
| 0 | Man. Date | 11-15-2017 | |
| 0 | App Ver | 00.000.014 | |
| 0 | Dev Prof | 01.002.000.004.000 | |
| 1 | OS Ver | 01.002.000.004.000 | |

(4) "Details" softkey—returns device information



(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:

- (*I*) The *pencil* read/write icon indicates an adjustable parameter.
- (III) 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.
- (IIII) 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 (<u>Select</u>) 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



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 $(\mathbf{\nabla})$ or up $(\boldsymbol{\Delta})$ 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 <u>wrap around</u> so that navigating <u>up</u> 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" soft-key or right-arrow key (\bigcirc) 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.

e. Trouble shooting for Curtis system (Curtis-F2-A)

| No. | Fault | Fault Name | Solution | Fault | Note |
|-----|-------|------------------------|---|-----------------------|------|
| | Code | | | Source | |
| 1 | 1.2 | | 1. The external U, V or W connection of the motor is short-circuited; | AC-F2-A Controller | |
| | | | 2. Motor parameters do not match; | | |
| | | Controller Overcurrent | 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 | | 1. The motor U, V and W were short-circuited to | AC-F2-A | |
| | | | the vehicle body through the stator, resulting in | Controller | |
| | | | electric leakage; | | |
| | | | 2. Controller fault 1. Controller current sensor | | |
| | | Current Sensor Fault | reading deviation is resolved by restarting the key | | |
| | | | switch; | | |
| | | | 2 Doplage Controller | | |
| | | | | | |
| 3 | 1.4 | | 1. The key switch input voltage failed to charge the | AC-F2-A | |
| | | | capacitor. Solve the reset of VCL function | Controller | |
| | | Precharge Failed | precharge () or the re-input of interlock switch; | | |
| | | | 2 Replace the controller: | | |
| | | | | | |
| 4 | 1.5 | | If the radiator temperature is lower than - 40 $^\circ$ C, | AC-F2-A | |
| | | Controller Severe | solve the fault by raising the temperature to above | Controller | |
| | | Undertemp | - 40 $^{\circ}$ C, restart the key switch or interlock switch, | | |
| | | | otherwise replace the controller; | | |
| 5 | 1.6 | | The radiator temperature is higher than 95 | AC-F2-A | |
| | | Controller Severe | degrees Celsius by reducing the temperature to | Controller | |
| | | Overtemp | below 95 degrees Celsius. Restart the key switch | | |
| | | | or interlock switch. If not, replace the controller; | | |
| 6 | 1.7 | | 1. Battery parameter setting error; 2. Power | AC-F2-A | |
| | | | consumption of non-controller system; 3. The | Controller | |
| | | Severe Undervoltage | 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 | | 1. Battery parameter setting error; 2. The battery | AC-F2-A | |
| | | | impedance is too high; 3. The battery is | Controller | |
| | | | disconnected during regenerative braking; 4. The | | |
| | | Severe Overvoltage | capacitance voltage exceeds the maximum | | |
| | | | voltage limit when the MOSFEET bridge works | | |
| | | | Solution: reduce the voltage and restart the key | | |
| | | | switch; | | |

| 0 | 0.1 | | | | |
|--------------------------|-------------------|--|---|---|--|
| 8 | 2.1 | | 1. Controller works under restricted conditions; | AC-FZ-A Controller | |
| | | | 2. The working environment of the controller is | Controllor | |
| | | Controller Undertemp | harsh; | | |
| | | Cutback | Set: radiator temperature is lower than - 25 °C | | |
| | | | Clear: make the radiator temperature higher than - | | |
| | | | 25 °C | | |
| 9 | 2.2 | | 1. The working environment of Controller is harsh; | AC-F2-A | |
| | | | 2. Vehicle overload; | Controller | |
| | | Controller Overtemp | 3. The controller is not installed correctly; | | |
| | | Cutback | Set: radiator temperature exceeds 85 °C | | |
| | | | Clear: reduce the temperature | | |
| 10 | 2.3 | | 1. The battery is low | AC-F2-A | |
| | | | 2. Battery parameter setting error | Controller | |
| | | | 3. Non-controller system runs out of power | | |
| | | Undervoltage Cutback | 4 The battery impedance is too large | | |
| | | | 5. The battery is disconnected | | |
| | | | 6. The fuse is disconnected or the main contactor | | |
| | | | is disconnected | | |
| 11 | 24 | | 1. The regenerative braking current causes the | AC-F2-A | |
| | 2.1 | | 1. The regenerative braking current causes the | Controller | |
| | | | ballery voltage to fise during the regenerative | | |
| | | | braking process | | |
| | | Overvoltage Cutback | 2. Battery parameter setting error | | |
| | | | 3. The battery impedance is too large | | |
| | | | 4. The battery is disconnected during regenerative | | |
| - 10 | | | braking | | |
| 12 | 2.5 | +5V Supply Failure | External load impedance is too low | AC-F2-A Controller | |
| | | | | | |
| 13 | 2.6 | Digital Out 6 Failure | External load impedance is too low | AC-F2-A | |
| 14 | 2.7 | Digital Out 7 | | AC-F2-A | |
| | | | External load impedance is too low | Controller | |
| 15 | 2.8 | | 1. The motor temperature reaches or is higher | AC-F2-A | |
| | | | then the warning temperature act by the measure | Controller | |
| | | | than the warning temperature set by the program, | | |
| | | | | | |
| | | Motor Temp Hot | 2. The motor temperature parameter is set | | |
| | | Cutback | 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 | | 1. The motor temperature sensor is connected | AC-F2-A | |
| | | Motor Tomp Songer | incorrectly | Controller | |
| | | | 2. If the motor does not use a temperature sensor, | | |
| | | Fault | the programming parameter "Temp Compensation | | |
| | | | and Temp Cutback" must be set to "OFF" | | |
| 14 15 16 | 2.7 2.8 2.9 | Digital Out 7 Overcurrent Motor Temp Hot Cutback Motor Temp Sensor Fault | External load impedance is too low 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" 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 Compensation" and "Temp Compensation" and Temp Cutback" must be set to "OFF" | AC-F2-A Controller AC-F2-A Controller AC-F2-A Controller | |

| 17 | 3.1 | Coil 1 Driver | 1. Open circuit or short circuit of connected load | AC-F2-A Controller | |
|----|-----|---------------------|--|-----------------------|--|
| | | Open/Short | 2. The connecting pin is dirty | Controllor | |
| 40 | 0.4 | • | 3. Wrong wiring | | |
| 18 | 3.1 | | 1. Open circuit or short circuit of connected load | AC-F2-A Controller | |
| | | Main Open/Short | 2. The connecting pin is dirty | Controller | |
| | | | 3. Wrong wiring | | |
| 19 | 3.2 | Coil2 Driver | 1. Open circuit or short circuit of connected load | AC-F2-A | |
| | | Open/Short | 2. The connecting pin is dirty | Controller | |
| | | openionen | 3. Wrong wiring | | |
| 20 | 3.2 | | 1. Open circuit or short circuit of connected load | AC-F2-A | |
| | | EM Brake Open/Short | 2. The connecting pin is dirty | Controller | |
| | | 3. Wrong wiring | | | |
| 21 | 3.3 | Osilo Driver | 1. Open circuit or short circuit of connected load | AC-F2-A | |
| | | | 2. The connecting pin is dirty | Controller | |
| | | Open/Short | 3. Wrong wiring | | |
| 22 | 3,4 | | 1. Open circuit or short circuit of connected load | AC-F2-A | |
| | | Coil4 Driver | 2. The connecting pin is dirty | Controller | |
| | | Open/Short | 3. Wrong wiring | | |
| 23 | 3.5 | | 1. Open circuit or short circuit of connected load | AC-F2-A | |
| | | PD Open/Short | 2. The connecting pin is dirty | Controller | |
| | | | 3 Wrong wiring | | |
| 24 | 3.6 | | 1 Motor encoder fault | AC-F2-A | |
| | | Encoder Fault | 2 Wrong wiring | Controller | |
| 25 | 3.7 | | 1 Motor phase loss | AC-F2-A | |
| | - | Motor Open | 2 Wrong wiring | Controller | |
| 26 | 3.8 | | 1. Main contactor contact fusion | AC-F2-A | |
| | | Main Contactor | 2. Mater II or V is disconnected or out of phase | Controller | |
| | | Waldad | 2. There is electricity expressed to P+ terminal | | |
| | | Welded | Charging condition of directional consoltar | | |
| 27 | 39 | | 1. Main contactor is not closed | AC-F2-A | |
| 21 | 0.0 | | 2. The contactor is not closed | Controller | |
| | | Main Contactor Did | 2. The contact of the main contactor is oxidized, | | |
| | | Not Close | | | |
| | | | 3. The capacitor is charged by external devices | | |
| 20 | 1 1 | | 4. The fuse is disconnected | | |
| 20 | 4.1 | Throttle Wiper High | Throttle potentiometer output voltage too high | Controller | |
| | 1.0 | | | | |
| 29 | 4.2 | Throttle Wiper Low | Throttle potentiometer output voltage is too low | Controller | |
| | | | | | |
| 30 | 4.3 | Det2 Winer Link | Detentiometer 2 output veltage is too high | AC-F2-A | |
| | | Polz wiper High | | Controller | |
| 31 | 4.4 | D. (0.) M/i | | AC-F2-A | |
| | | Pot2 Wiper Low | Potentiometer 2 output voltage is too low | Controller | |
| 32 | 4.5 | | | AC-F2-A | |
| | | Pot Low Overcurrent | Potentiometer impedance is too low | Controller | |
| | | | | | |

| 33 | 4.6 | | Writing to EEPROM memory failed. This may be | AC-F2-A | |
|----|-------|----------------------|--|------------|------------|
| | | | caused by the VCL writing to the EEPROM, or the | Controller | |
| | | EEPROM Failure | CAN BUS, or the wrong parameters programmed | | |
| | | | into the Controller after the programmer | | |
| | | | parameters are adjusted. | | |
| 34 | 4.7 | | 1. Key start, interlock, direction, and Throttle input | AC-F2-A | |
| | | | sequence settings are wrong | Controller | |
| | | HPD/Sequencing Fault | 2. Faulty wiring, key switch, interlock, direction, or | | |
| | | | Throttle input | | |
| 35 | 4.7 | | The emergency reverse operation has ended, but | AC-F2-A | |
| | | EMR Rev HPD | the Throttle, forward and reverse inputs and | Controller | |
| | | | interlocks have not been reset | | |
| 36 | 6 4.9 | | In order to ensure the safety of the vehicle, the | AC-F2-A | |
| | | Parameter Change | change of some specific parameters will take | Controller | |
| | | Fault | effect only after the key switch is restarted | | |
| 37 | 5.1 | constant USER 1 | PDO Fault Rema | AC-F2-A | OEM Faults |
| | | FAULT | | Controller | |
| | | | | | |
| 38 | 5.2 | constant USER 2 | PDO Timeout BMS | AC-F2-A | OEM Faults |
| | | | | Controller | |
| 39 | 5.3 | constant USER 3 | User HPD Fault | AC-F2-A | OEM Faults |
| | 0.0 | FAULT | | Controller | • |
| | | | | | |
| 40 | 5.4 | constant USER 4 | Throttle Open Fault | AC-F2-A | OEM Faults |
| | | FAULI | | Controller | |
| 11 | 5.5 | constant LISER 5 | Interlock SPO | | |
| | 0.0 | FAULT | | Controller | |
| | | | | | |
| 42 | 5.6 | constant USER 6 | GPS Flag Lock 1 | AC-F2-A | OEM Faults |
| | | FAULT | | Controller | |
| | | | | | |
| 43 | 5.9 | constant USER 9 | GPS No Communication Fault | AC-F2-A | OEM Faults |
| 44 | 6.1 | constant USER 10 | Throttle Supervisor Fault | AC-F2-A | OEM Faults |
| | | FAULT | · · | Controller | |
| | | | | | |
| 45 | 6.3 | constant USER 12 | GPs Flag Lock2 | AC-F2-A | OEM Faults |
| | | FAULI | | Controller | |
| 16 | 64 | constant LISED 12 | RDLL ow Lifflock | | |
| 40 | 0.4 | FAULT | | Controller | |
| | | | | | |
| 47 | 6.5 | constant USER 14 | PDO Fault 1220 | AC-F2-A | OEM Faults |
| | | FAULT | | Controller | |
| | | | | | |
| 48 | 6.6 | constant USER 15 | 1220 Shutdown Fault | AC-F2-A | OEM Faults |
| | | FAULI | | Controller | |
| | | | | | |

| 49 | 6.7 | constant | USER | 16 | 1220 Limit Fault | AC-F2-A | OEM Faults |
|----|------|--------------------|-----------|-------|--|-----------------------|------------|
| | | FAULT | | | | Controller | |
| 50 | 5-10 | constant | USER | 17 | Handshake Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 51 | 5-11 | constant | USER | 18 | BMS Fault Grade Non Zero | AC-F2-A | OEM Faults |
| | | FAULI | | | | Controller | |
| 52 | 5-12 | constant | USER | 19 | PDO Fault ECS | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 53 | 5-13 | constant | USER | 20 | Rema EMR SRO | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 54 | 5-14 | constant | USER | 21 | HYD SRO Fault | AC-F2-A | OEM Faults |
| 55 | 5-15 | constant | USER | 22 | Throttle ON Without Interlock Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 56 | 6-10 | constant | USER | 23 | BMS Cell Undervolt Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 57 | 6-11 | constant | USER | 24 | BMS Temp Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 58 | 6-12 | constant | USER | 25 | BMS Cell voltage Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 59 | 6-13 | constant | USER | 26 | BMS LOW AH | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 60 | 6-14 | constant | USER | 27 | BMS voltage difference | AC-F2-A | OEM Faults |
| | | FAULI | | | | Controller | |
| 61 | 6-15 | constant | USER | 28 | Display PDO Timeout Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 62 | 7-10 | constant | USER | 29 | Battery type mismatch | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 63 | 7-11 | constant | USER | 30 | Unmatched Display Fault | AC-F2-A | OEM Faults |
| | | FAULT | | | | Controller | |
| 64 | 6.8 | VCL Run | Time Errc |)r | VCL code timeout for running time | AC-F2-A | |
| 05 | | VOL RUN TIME Error | | | 4. The summation of external load at 51(and 40)(| | |
| 65 | 0.9 | External S | Supply Ou | ut of | power supply is too large or too small | Controller | |
| | | Range | | | 2. Parameter error in "Checking Menu", such as "Ext Supply Max", "Ext Supply Min" | | |
| 66 | 7.1 | OS Gener | al | | Internal controller failure | AC-F2-A Controller | |
| 67 | 72 | | | | | | |
| | | PDO Time | out | | CAN PDO message acceptance time exceeds PDO time limit | Controller | |

| 68 | 7.3 | Stall Detected | Motor locked Motor encoder failure Wrong wiring Input motor encoder power failure | AC-F2-A Controller |
|----|-----|---|--|-----------------------|
| 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 | AC-F2-A Controller |
| 70 | 8.9 | Motor Type Fault | Motor type parameter value is out of range | AC-F2-A Controller |
| 71 | 9.1 | VCL/OS Mismatch | VCL program in Controller does not match OS program | AC-F2-A Controller |
| 72 | 9.2 | EM Brake Failed to Set | The vehicle still moves after the electromagnetic brake command is set. The braking force of electromagnetic brake is too small | AC-F2-A Controller |
| 73 | 9.3 | Encoder LOS (Limited Operating Strategy) | The restricted operation state is activated due to motor locked-rotor or encoder fault Wrong wiring Vehicle locked | AC-F2-A Controller |
| 74 | 9.4 | EMR Rev Timeout | The emergency reverse timeout is activated due to the expiration of the EMR Timer The emergency reverse switch is always in the On position | AC-F2-A Controller |
| 75 | 9.8 | Illegal Model Number | The controller model is not recognized Software and hardware do not match each other Controller is damaged | AC-F2-A Controller |
| 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) | AC-F2-A Controller |