GROUP 1 GENERAL LOCATIONS OF PARTS
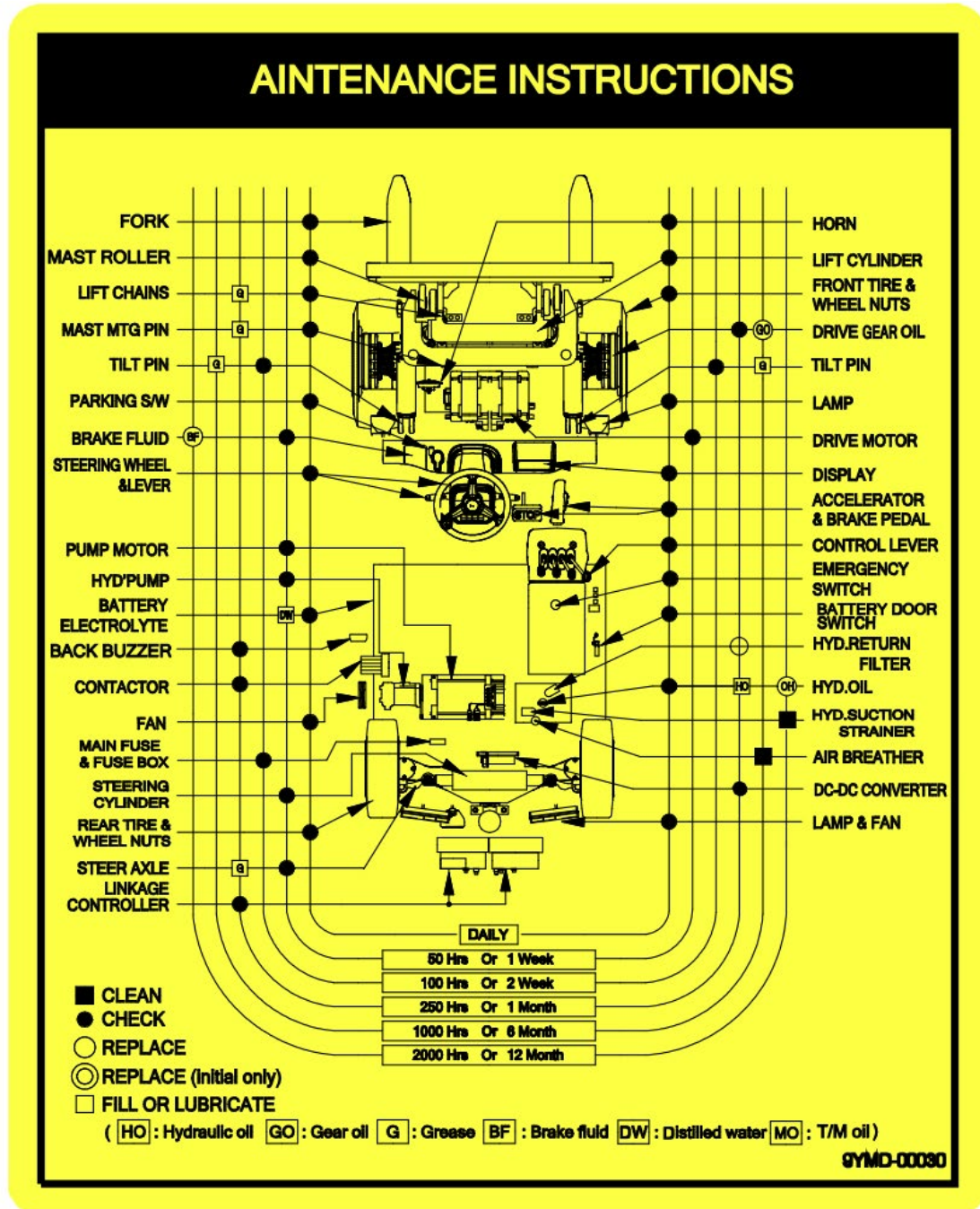
GROUP 2 ELECTRIC CIRCUIT DIAGRAMS

1. CODES IN ELECTRIC CIRCUIT DIAGRAMS

| Code	Name
00	Battery negative electrode
99	Negative electrode of DC-DC converter
T	Traction controller control signal
P	Pump controller control signal
JT	Emergency power-off switch
F	Fuse
D	Weighing sensor signal
N+	Heater positive wire harness
N-	Heater negative wire harness
K+	Air conditioner positive wire harness
K-	Air conditioner negative wire harness

2. ELECTRICAL SCHEMATIC DIAGRAM OF LEAD-ACID BATTERY 25BE-X
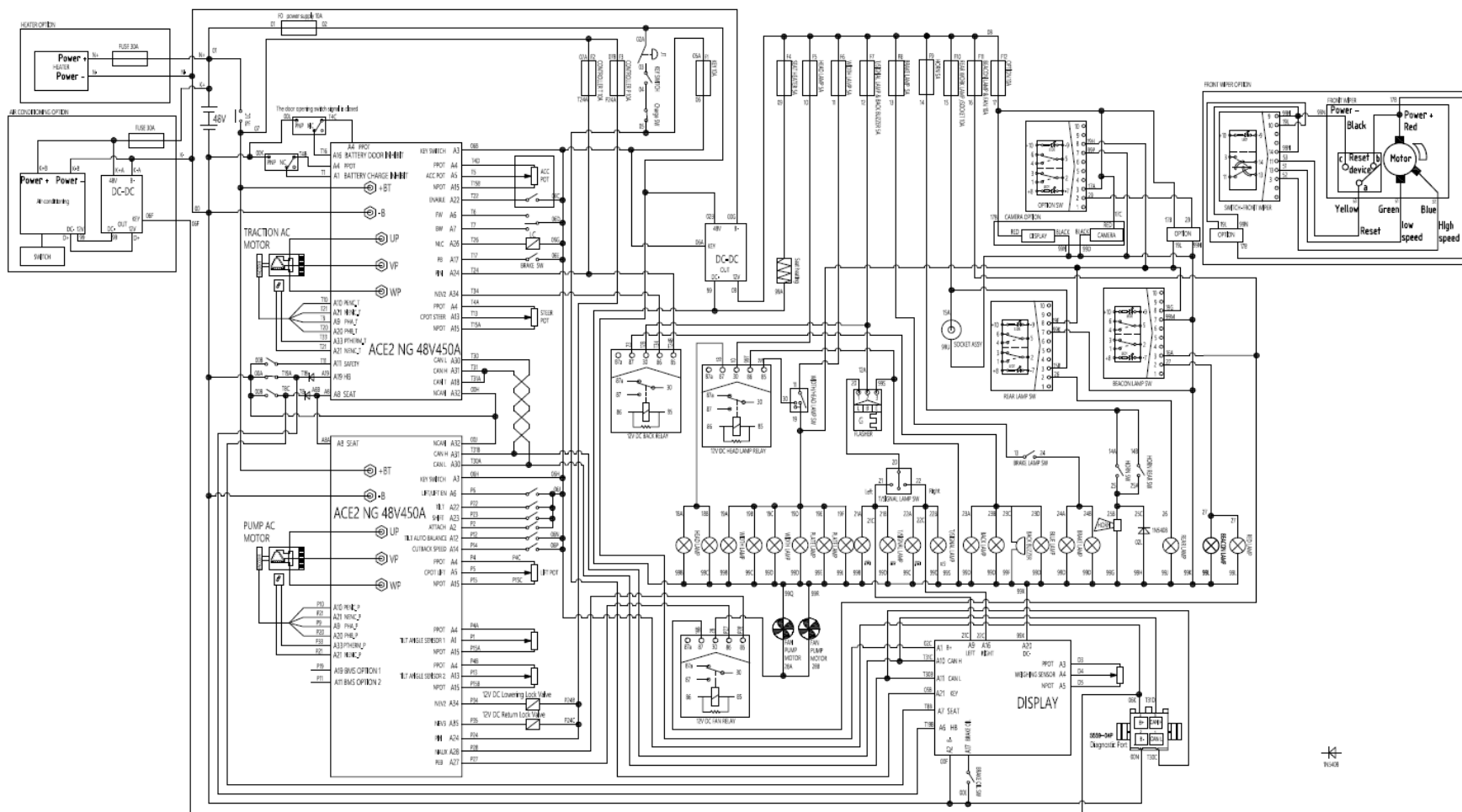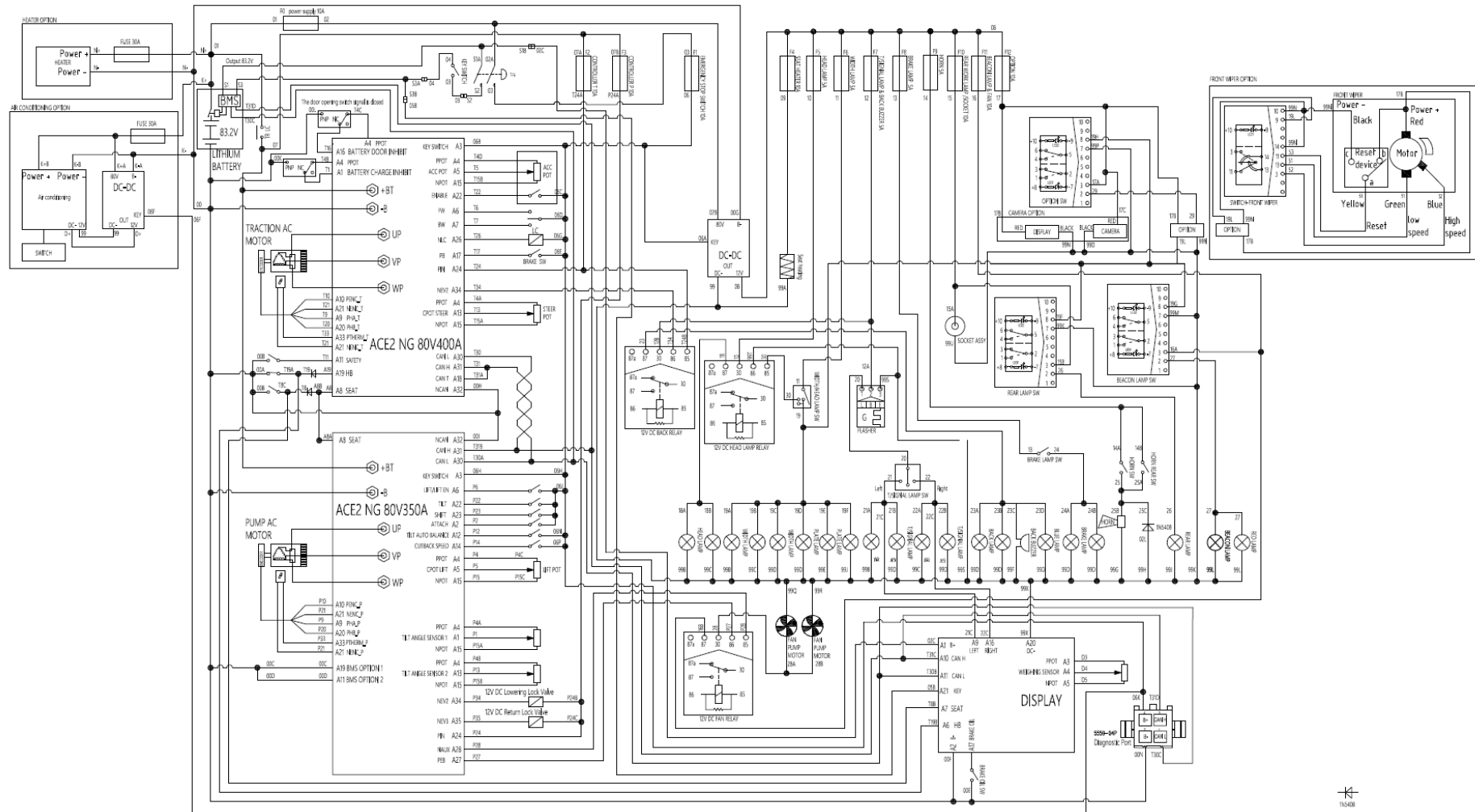
3. ELECTRICAL SCHEMATIC DIAGRAM OF LITHIUM BATTERY 25BE-X (OPT)

102
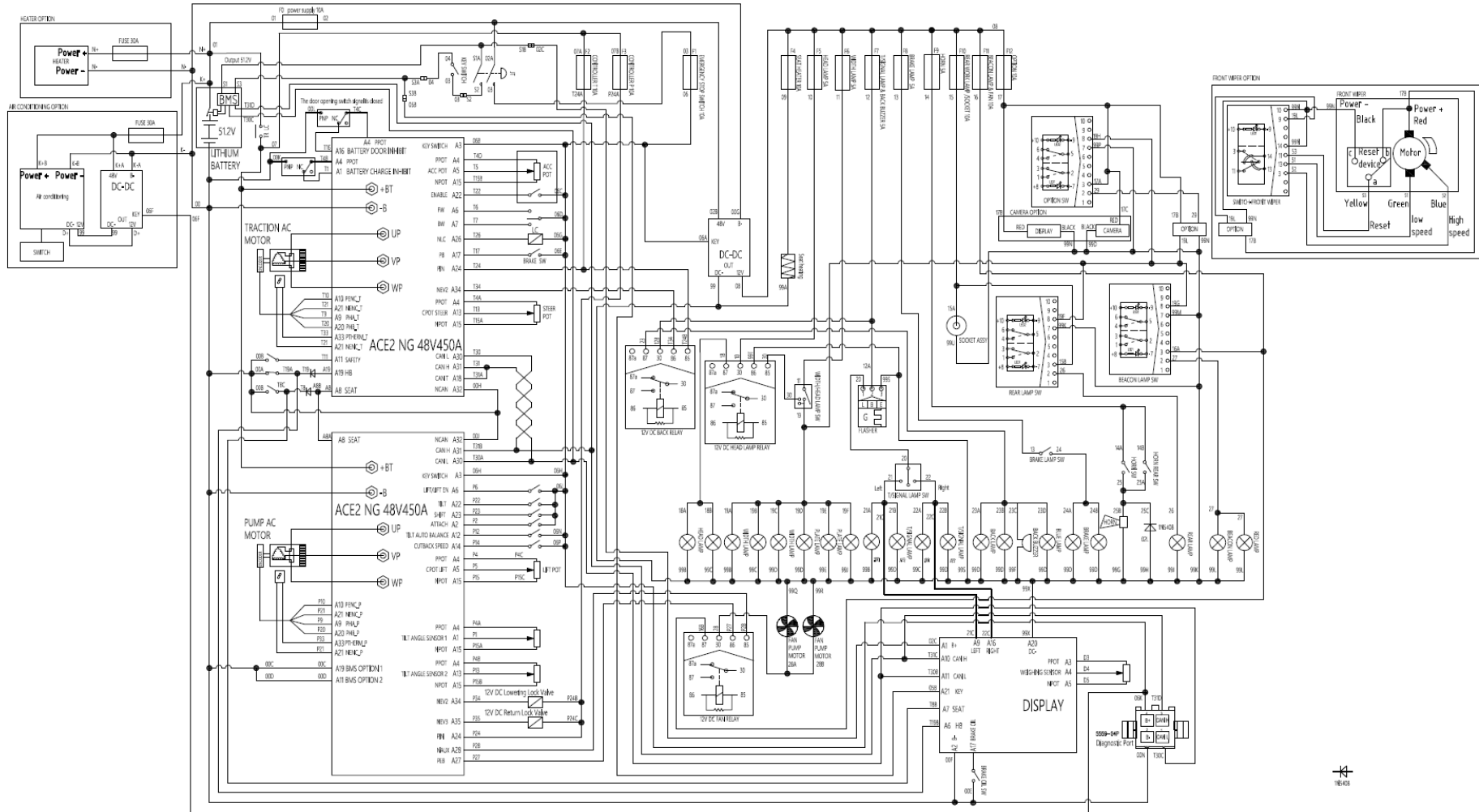
4. ELECTRICAL SCHEMATIC DIAGRAM OF LEAD-ACID BATTERY 30/35BE-X
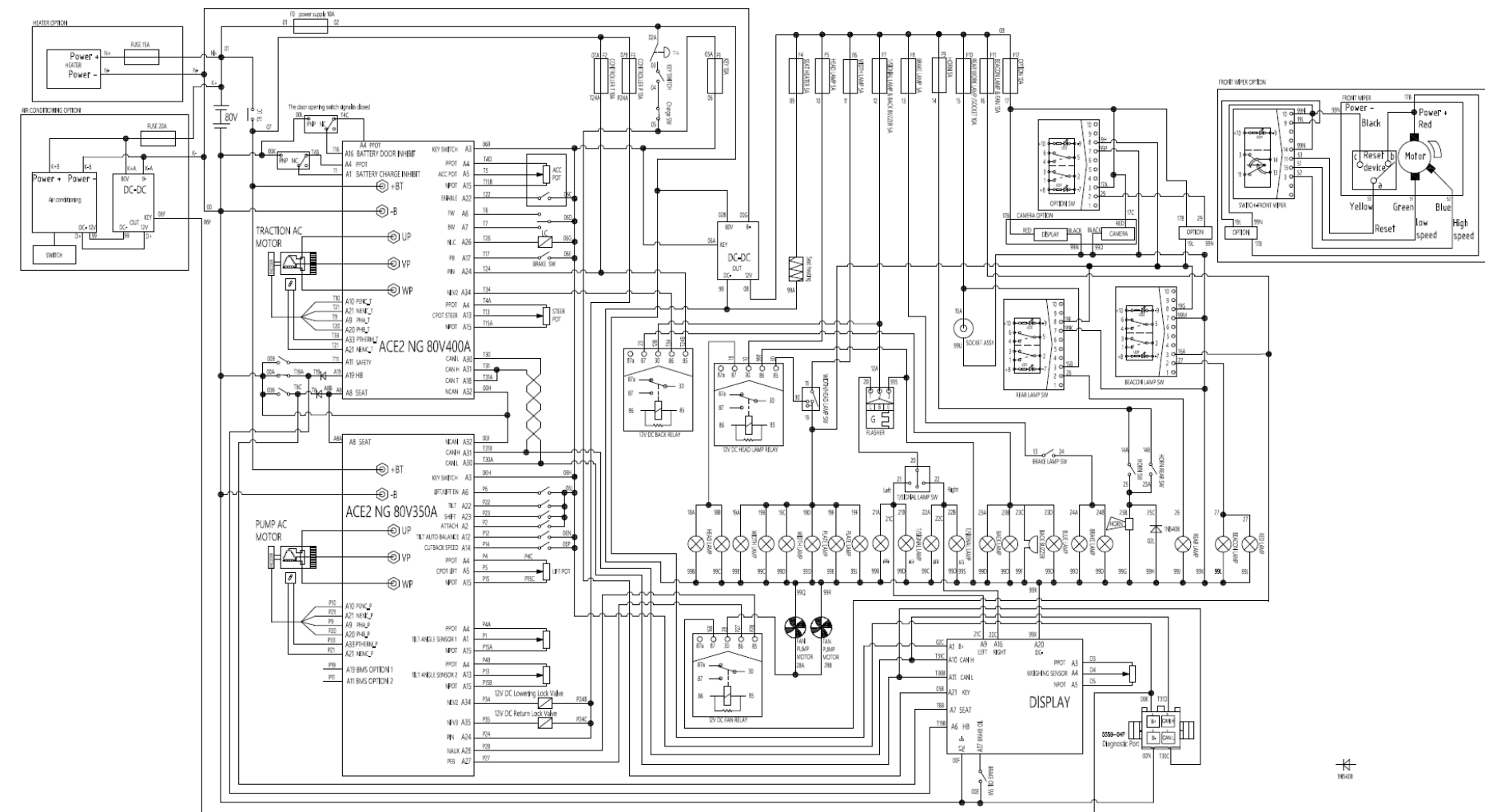
5. ELECTRICAL SCHEMATIC DIAGRAM OF LITHIUM BATTERY 30/35BE-X (OPT)

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GROUP 3 ELECTRIC FUNCTIONAL PARTS

1. FUNCTIONS OF POWER FORKLIFT TRUCK AND PARTS

The major functions of forklift truck are classified into two categories: Driving and loading/unloading. These functions operated by AC motor, which uses battery as power source, and requires battery charger, accordingly.

It is required to select driving direction by making use of electric components such as drive control system and direction switching lever (front/rear section switch), and to adjust speed drive motor to operate forklift truck.

Protection circuits are embedded in control system for protecting truck and components from failure. Monitoring system embedded in monitor panel monitors and shows conditions of truck and working to let operator take adequate acti9ons, if required. Monitoring system is mounted with sensors such as current sensor, hydraulic pressure sensor and temperature sensor.

Forklift truck of HD HYUNDAI has operator-friendly features for adjusting conditions of truck dependent upon working environments at driver's seat by making use of the advanced drive control system. Self-diagnosis function displays current conditions of working truck, and provides environment for operation of truck in more efficient manner.

2. BATTERY

### 1) STRUCTURE
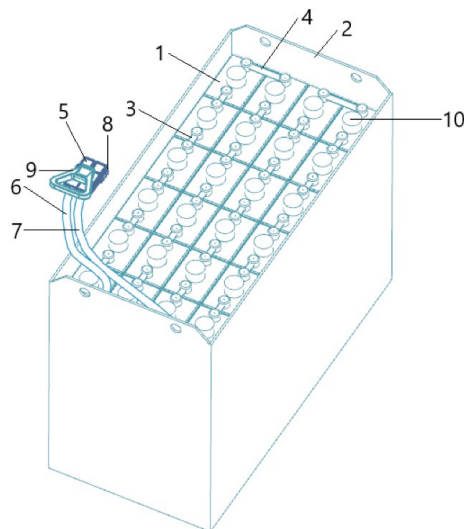
1	Cell	5	Terminal connector	8	Plug
2	Battery box	6	(+) Cable	9	Steering wheel
3	Connector	7	(−) Cable	10	Cap
4	Connector				

2) GENERAL

Battery is power source for battery-powered forklift truck, and careful handling of battery is very important.

Service life and capabilities of lift truck largely vary dependent upon routine handling and maintenance.

It is, therefore, must to ensure correct inspection and maintenance to keep battery at the best conditions.
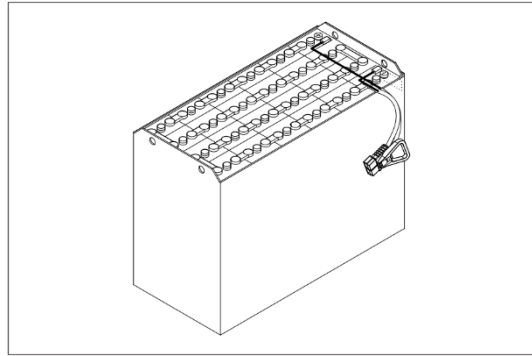
3) SPECIFICATIONS AND SERVICING

Item	Unit	25BE-X	30/35BE-X
Type	-	Plumbic acid	←
Rated voltage	V	48	80
Capacity	AH/hr	600/5	500/5
Electrolyte	-	Wet	←
Dimensions (W×L×H)	mm	984×466×744	984×660×744
Connector (CE standard)	-	SB 350 or SR 350	
Weight	kg	950	1295

Specific gravity of fully charged battery	1.280 (25 ˚C)
Specific gravity of fully discharged battery	1.120 (25 ˚C)
Voltage at end of discharging	48V
Electrolyte	Refined thin sulfuric acid
Makeup solution	Purified water (distilled water)
Insulation resistance	1 MΩ

4) SAFETY PRECAUTIONS

① When skin contact with sulfuric acid

When skin, eyeball or clothes contacts with sulfuric acid, immediately flush with flowing water. If ingested, drink large volume of water or milk, and immediately see physician. Always wear safety goggles, face mask and rubber gloves when handling acid materials.

② Prevention of heat source, and ventilation

Battery produces explosive hydrogen. There should be heat source in the vicinity of battery. Open battery cover to ventilate before battery charging. Charging battery in confined space, explosion may take place.

③ Never put metal articles on the top of battery.

Metal article on battery may cause short circuit, especially during charging. Flame is equally dangerous open fires.

④ Handling of charger

When connecting or disconnecting a battery from a charger or attempting maintenance, make sure switches are all off. Ensure that the charger and the battery are matched. If a 300-Ah battery is used with a charger designed to charge a 500-Ah battery, it will severely overcharge the battery.

5) OPERATION PRECAUTIONS

① Avoid over-discharging

If over-discharged, it will be difficult to restore the batteries to the original state by recharge. In order to maintain the batteries in use for long period of time, it is recommended to use the batteries with discharge amount not exceeding 80% of the rated capacity. Further care should be taken for preventing the unit cell voltage from falling below 1.5V.

② Avoid over-charging

If overcharged, the rise in battery temperature will become excessive, resulting in deterioration of plates and other parts and markedly shortening of battery life.

③ Avoid excessive elevation of temperature

Be sure to open the cover of battery housing tray before charging. If there is a possibility of temperature to exceed 55° C, discontinue the charge operation temporarily, or reduce the charge current.

6) CHECKING

① Unpacking

Batteries are delivered to customers in dry-charged condition. At unpacking, check whether the batteries and accessories have been damaged. If there are observed defects, you should notify the condition to our branch office or agent. Never remove the sealing plug until the battery is put into service.

② Performance and maintenance of batteries

Initial charging

Battery gradually decreases its capacity during storage. In order to provide sufficient discharge capacity in the first discharge, the good initial charge is required. The conditions of initial charging are seen as below (at room temperature).

➢ By modified constant voltage charger

Connect the battery to the charger and turn on the equalizing charge "ON." The battery will be fully charged and terminated automatically.

➢ By constant voltage constant current charger (standard)

Connect the battery to the charger and turn on the equalizing charge "ON." The battery will be fully charged and terminated automatically.

Discharge and capacity

The capacity of batteries is indicated at 5 hours rate capacity which means the battery can be discharged for 5 hours with the discharge current calculated by dividing the capacity value by 5 until the unit cell mean voltage reaches down to 1.7V at the electrolyte temperature of 30℃. That is, the capacity is indicated by AH (ampere hour) being calculated as the product of ampere and time (H). However, even if it is the same type of batteries, the capacity varies with the discharge conditions (discharge current, battery temperature and specific gravity of electrolyte). Even if the batteries discharged its full capacity, if immediately charged to full, there will be no harmful effects remained. Ideal charging amount (AH) is 110-125% of the amount of previous discharge.

Specific gravity of electrolyte

Specific gravity of electrolyte drops at discharge and rises at charge. When the batteries are fully charged, it becomes almost constant and shows no further rise. The specific gravity value varies with the change in temperature. Therefore, specific gravity measurement should be made with temperature of electrolyte at the same so the measured specific gravity value could be corrected to that at the standard temperature of 25℃ by the following formula.

$$S25 = St + 0.0007 (t-25)$$

S25: Specific gravity at 25℃

St: Actual measured specific gravity at t℃

t: Electrolyte temperature (℃)

The standard specific gravity for this type of battery is 1.280±0.01 (25℃) at full charge condition. If the electrolyte decreases naturally while using, distilled water shall be replenished up to the specified level. (Never refill sulfuric acid).

Only when large quantity of electrolyte is lost due to spillage, etc., dilute sulfuric acid specified in gravity shall be added.

Normal charging

Charge the discharged batteries as quickly as possible. The temperature of electrolyte before starting the charging operation shall preferably be below 45℃, and the temperature during the charge should be maintained at no higher than 55℃. (Under any unavoidable situations, it should never be above 55℃). Methods of charging vary in precise meaning with the types of chargers used. A standard charging method is described hereunder. (If a special method is mentioned to be adopted, follow that instruction).

➢ Charging by modified constant voltage automatic charger

There is almost automatic charger today which completes the charging just only connecting the plug between battery and charger without outer operating timer. But if your charger has it, after setting the timer for 3-4 hours and turn on the charger and the charger is left as it is, then the charge will be made automatically. In principle, regardless of the amount of previous discharge, it is not required to alter the setting of timer time. The recommendable current value of this type of charger is "5 hours rate current $\times$ 1.0-1.5" at the start of charging, and at the final stage it is "5 hours rate current $\times$ 0.15-0.25". Normally the charge is terminated within 8~12 hours automatically.

Charging by constant current constant voltage automatic charger.

After a lapse of specified charging time after the switch is turned on, the charge will be completed by turning off the switch. The charging time can be calculated by the following formula:

Charging time = 2~3 (H) + Amount of previous discharge (AH) / Capacity of charger (A)

➢ When the amount of previous discharge is not known, use the 5 hours rate rated capacity of the batteries. At immediately after charging, the charge current is allowed up to 3 times 5 hours rate current. For charger provided with a timer, the charge will terminate automatically if the timer is set at the specified time according to the operation manual.

Charging by constant current charger

Connect the charger to the battery and charge the battery by 0.1C $\times$ 5 hours rate nominal capacity current for 24 hours or more.

Equalizing charging

When large number of cells are used in a set of battery, the voltage and specific gravity of respective cells tend to become unequal, resulting in necessity of charging all the cells at an appropriate time in order to equalize them. This is called equalizing charge. Normally the equalizing charge should be carried out once every month. The methods are in normal type charger, extend the charge for 5 more hours after full charge at the final stage current, and in automatic charger which is in most cases provided with timer, extend the time setting for 3-6 more hours.

Replenishment of distilled water

Only the water content of electrolyte is decreased due to electrolysis of distilled water during charge and natural evaporation. If a battery used with the electrolyte decreased excessively, plates will deteriorate resulting in markedly shortening of battery life. Be sure to check the electrolyte level once every week. If the electrolyte level is lowered, replenish distilled water up to the specified level. In this case, never attempt to replenish sulfuric acid or tap water. Use only dis- tilled water for battery replenishment. If the amount of water required for weekly addition to a unit cell for 100 AH of battery capacity is in excess of 45 cc, it is assumed that the cell is receiving overcharge. Accordingly, be sure to reduce slightly the daily charge amount. Under the nor- mal conditions, the addition of water per week is 45 cc or less. Incidentally, distilled water replenishment should be made before charging to the content of minimum level. (For the purpose of uniform stirring of electrolyte by charging).

If the electrolyte level is improper after completion of charging, you may top up the electrolyte level to the maximum level.

Determination of replenishment time and methods (cell with ONE TOUCH CAP)

Confirm the electrolyte level by looking at the float in the ONE TOUCH CAP. If too low as shown in figure, replenish distilled water. Replenishment shall be performed after opening the cover of the plug using syringe and jug. When refilling is completed, close each cover completely until "click" sound is heard
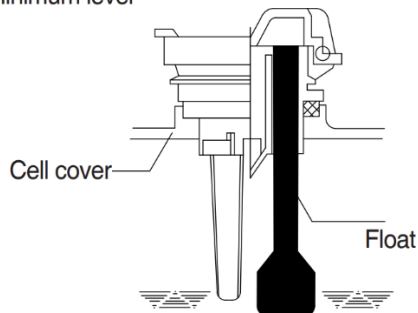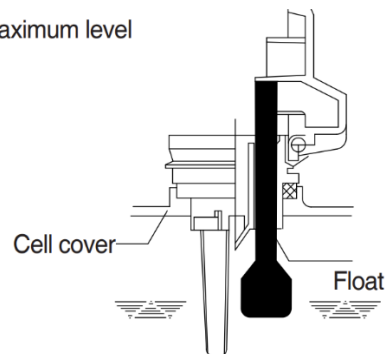
Cleaning

If electrolyte spills or the cells are polluted with dust or stains, it will cause generation of leak current. Wipe off dust and stains with moist cloth and clean in such a manner that the cells are kept in dry condition. In the case of plastic containers or covers, never use such organic solvents as paint thinner and gasoline. If used, the plastic containers or covers may suffer cracking. If you are forced to use them, be sure to use white kerosene.

Notice on charging

The charging area must be well ventilated to facilitate exhaust of gas generated from the battery during charging. Charge the battery in an area free from iron working, welding, etc. Further the battery generates hydrogen, oxygen, acid mist and on rare occasions, hydrogen sulfide during charging depending on the case. Special care may be required in the case of equipment and objects near the battery that may contaminated or damaged. Do not pull out the charging plug during charging, as it will cause sparks. Since hydrogen gas generated during charging may remain in the area surrounding the battery after charging, never bring fire or flame close to this area. In case of counter-balance type vehicles, open the battery cover before charging.

Repair of failure cell

To remove a cell from the circuit or battery from steel tray, it is first necessary that the intercell connector be removed.

Before performing any repairs, you must open one-touch caps for gas purging of all cells. After you have finished that, must remove connector covers and on-touch caps from failure cell including surrounding cells. All vent holes of cells removed of one-touch caps must cover by four layers of water dampened cloth and then proceed with repairs. Using an acid syringe withdraw sufficient electrolyte from failure cell to reduce the liquid levels until minimum level indicating of one touch caps.

The safe and most effective way to remove the connector from the faulty unit and all surrounding units is the socket wrench.

⚠ **You must make sure to clear of explosive hydrogen gas in the cells before repairs.**

Remove the connector between batteries after removing the fixing bolts.

Lifted off the failure cell from circuit after removing of intercell connector.

Installing new cell and connector.

With surfaces properly cleaned and neutralized, position the connectors.

Fix and tighten the connecting cable between battery cells with M10 bolts with socket wrench, requiring torque of 25Nm.

When replacing electrolyte in a repaired cell, use sulfuric acid of the same specific gravity that is found in the balance of the battery.

Finally, rejoin connector covers and one-touch caps to the cells.

Summary of daily maintenance

Avoid overcharge. After discharge, charge the batteries immediately. The standard frequency of equalizing charge is more than once every month.

Be sure to check the electrolyte level once every week. If the electrolyte level is lowered, replenish distilled water up to the specified level.

The top surface of battery cells should be kept clean and dry.

Be sure to keep open the cover of battery housing tray during charge.

Never draw near open fires such as lighted cigarettes or burning matches during charge.

③ Others

Storage of batteries

When batteries are stored, keep them away from room heaters or other heat generating sources. Clean, cool and dry place where no direct sunlight is suited for battery storage. Before putting into storage, it is important to charge the batteries and keep the electrolyte level at the specified level.

When the temperature in storage location is higher than 20℃, check the specific gravity once a month, and when lower than 0℃, check it once every two months. If the measurements show values lower than 1.230 (20℃), it is required to charge the battery in accordance with the method described in NORMAL CHARGE.

Maintenance record

It is recommended to keep maintenance record in order to know the operational conditions of batteries. Daily charge and discharge, equalizing charge requirements, and distilled water replenishment requirements can be clarified at a glance. Measurements of specific gravity and temperatures once every two to four months after equalizing charge and maintenance thereof will serve for battery health diagnosis.

Electrolyte temperature (℃)

The operating temperature range of batteries is -10~45℃ (temperature of electrolyte). If the batteries are exposed to cold atmosphere in discharged condition, the electrolyte may freeze, and in extreme cases, the capacity will be decreased, but, if not frozen, no adverse effects will be exerted.

Contrarily if the temperature is high, especially if used at above 55℃, the battery life will be considerably shortened. Care must be taken so that the temperature during charge will be maintained at 55℃ or lower. Even under unavoidable circumstances it should not exceed 55℃.

7) FAILURE DIAGNOSIS AND TROUBLESHOOTING

Nature of trouble	Symptoms	Causes	Corrective actions
Deformation	· Deformation of container Lid or one-touch cap	· Excessive temperature rising or external impact	· Replace.
Breakage	· Electrolyte leakage according to breakage of container, lid or one touch cap.	· External impact, improper handling, excessive vibration	· Replace or install a new one.
	· Termination of connector or pole post etc.	· Excessive temperature rising or external impact	· Replace.
Sulfate	· Specific gravity drops and capacity is decreased.	· When left in state of discharge or left long without equalizing charge.	· Need equalizing charge.
	· Charge voltage rises rapidly with immature gassing in earlier stage but specific gravity does not rise and charge can't be carried out.	· Insufficient charge. · When electrolyte is so decreased that plate is deposed. · When concentration of electrolyte rises. · When impurities are mixed in electrolyte.	· Need equalizing charge. · Need equalizing charge. · Adjust specific gravity. · Replace electrolyte.
Decrease and falling of specific gravity	· May be easily detected by measurement of the specific gravity.	· Rise of temperature due to such trouble. · When left long period without refilling of water. Short circuit.	· Replace. · Refill water in regular period. · Replace.
Rise of specific gravity	· May be easily detected by measurement of the specific gravity.	· Diluted sulfuric acid is used in refilling. · When the electrolyte level excessively drops.	· Adjust specific gravity after full charge. · Refill distilled water.
Mixing of impurities	· Decrease of capacity. · Drop of charge and discharge voltage. · Odor of generated gas and coloring of the electrolyte.	· Metals such as iron, copper nickel and manganese. · Impurities such as sea water, chloric acid, nitric acid etc. · Filling of impure water.	· Under a fully discharged condition, pour out the electrolyte. Then pour in an acid of the specific gravity higher by 0.03-0.05 than that of the drained acid. Charge fully and adjust the specific gravity to the specified value.

3. DRIVE MOTOR

1) STRUCTURE
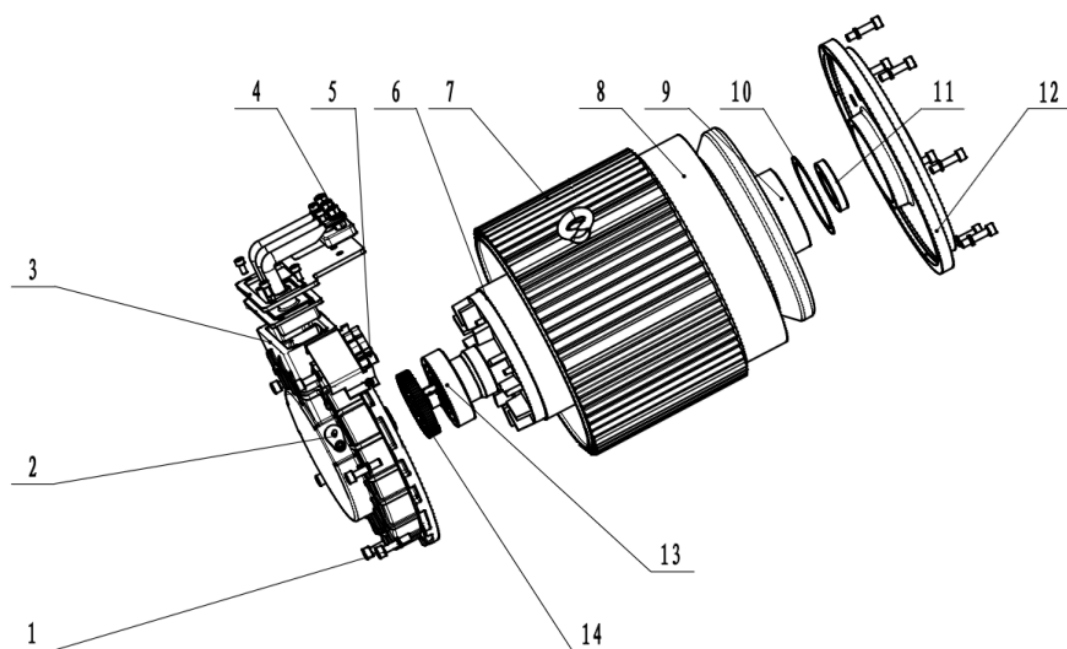
1	Stud bolt	6	Rotor	11	Oil seal
2	Speed sensor kit	7	Shell	12	End cap
3	End cap	8	Stator	13	Bearing
4	Terminal block	9	Bearing	14	Encoder gear
5	Temperature sensor	10	Gasket		

2) SPECIFICATIONS

Item	Unit	25BE- X	30/35BE-X
Type	-	JXQ-10-XD	JXQ-14-XD
Rated voltage	Vac	32	52
Rated output	kW	10	14
Insulation	-	Grade F	←

3) CHECKING

① Rotor

Always clean the rotor with compressed air. If dust is not removed, wipe the rotor with soft cloth or cotton dampened with gasoline.

➢ Tools: Vernier calipers and standard tools

② Stator

Always clean the rotor with compressed air. If dust is not removed, wipe the stator with soft cloth or cotton dampened with gasoline while exercising care for protecting coil insulator from damage.

Repeat inspection of power source line 2 of the stator with meter-ohm gauge. (U-V, V-W, W-U)

➢ Proper resistance:

JXQ-10-XD, Ambient temperature 9℃, resistance 5.2 MΩ.

JXQ-14-XD, Ambient temperature 9℃, resistance 7.7 MΩ.
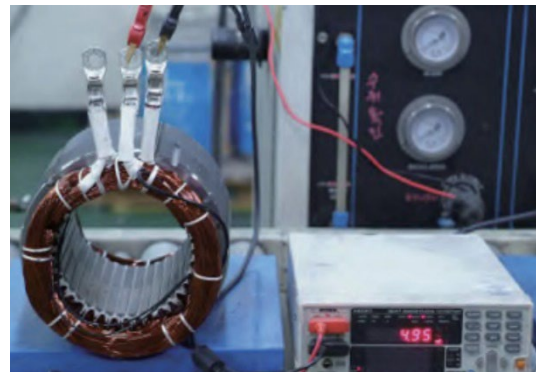
Measuring insulator

Make use of insulator gauge (1000V, min. 10 MΩ) to perform measurement as shown on the photo. Replace insulator with new part, if damaged.
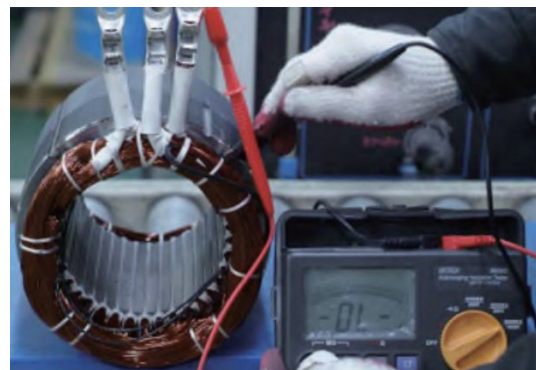
4. PUMP MOTOR

1) STRUCTURE
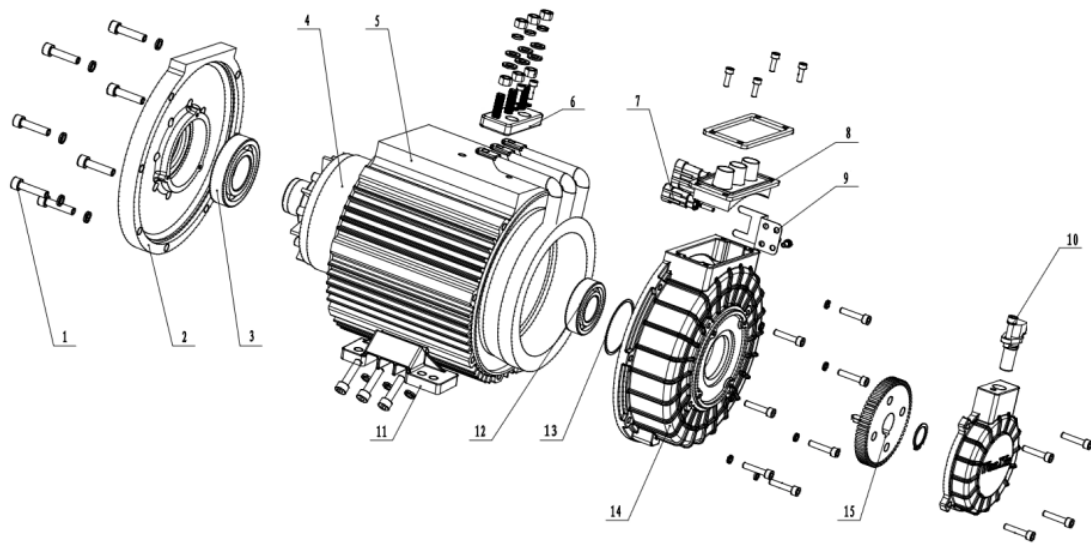
1	Stud bolt	6	Terminal block	11	Mounting support
2	End cap	7	Temperature sensor	12	Bearing
3	Bearing	8	Terminal block	13	Gasket
4	Rotor	9	Plug-in support	14	End cap
5	Stator	10	Speed sensor kit	15	Encoder gear

2) SPECIFICATIONS

Item	Unit	25BE-X	30/35BE-X
Type	-	JXQD-14-XD	JXQD-16.5-XD
Rated voltage	Vac	32	53
Rated output	kW	14	16.5
Insulation	-	Grade F	←

3) INTERNAL INVOLUTE SPLINE DATA

Item		Unit	Specifications
Flat root side fit	No. of teeth	EA	10
	Pressure angle	Degree	30
	Spline pitch	-	16/32
	Major diameter	mm	17.463
	Form diameter	mm	13.749
	Minor diameter	mm	14.465
	Pin diameter	mm	2.743

4) CHECKING

① Rotor

Always clean the rotor with compressed air. If dust is not removed, wipe the rotor with soft cloth or cotton dampened with gasoline.

Tools: Vernier calipers and standard tools

② Stator

Always clean the rotor with compressed air. If dust is not removed, wipe the stator with soft cloth or cotton dampened with gasoline while exercising care for protecting coil insulator from damage.

Repeat inspection of power source line 2 of the stator with meter-ohm gauge. (U-V, V-W, W-U)

Proper resistance:

JXQD-14-XD，Ambient temperature 9℃, resistance 3.98 MΩ.

JXQD-16.5-XD，Ambient temperature 9℃, resistance 8.6 MΩ.

Measuring insulator: refer to Page 115 Measuring Stator of Drive Motor.

5. CONTROLLER SYSTEM

1) STRUCTURE
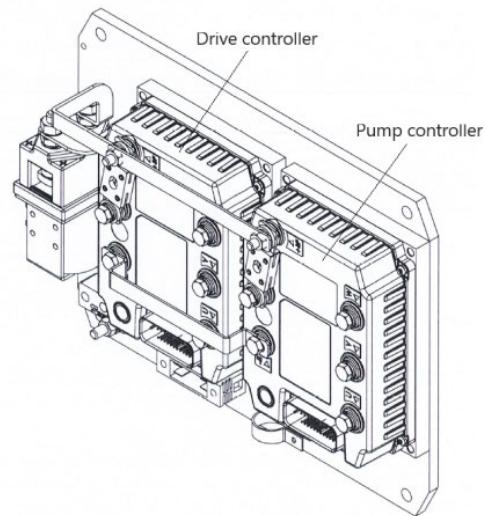
Model	Application	Type	Power	Current limit
ACE2 NEWGEN	25BE-X Traction	MOSFET	36-48V, 450A	450A/2 min
ACE2 NEWGEN	25BE-X Pump	MOSFET	36-48V, 450A	450A/2 min
ACE2 NEWGEN	30/35BE-X Traction	MOSFET	72-80V, 400A	400A/2 min
ACE2 NEWGEN	30/35BE-X Pump	MOSFET	72-80V, 350A	350A/2 min

2) OPERATIONAL FEATURES (TRACTION AND PUMP CONTROLLER)

The controller controls closed circuit speed and torque for induction (ACIM) and surface permanent magnet (SPM) motor.

Field-oriented motor control algorithm of high efficiency capable of exerting max. motor torque in any working environments.

Hi-end pulse-width modification technology ensuring efficient consumption of battery voltage, low motor harmonics, low torque ripple, and min. conversion loss.

Very large-scope torques and speeds including full playing function.

Smooth low-speed control including zero speed.

ACIM motor mitigating field, and SPM motor capable of controlling speeds including non-load basic speed.

Control algorithm is applied to motor temperature variation for keeping optimal capabilities in conditions of wide range and high diversity.

Power limit map reduces heat generated from motor, and is capable of satisfying capability requirements for keeping capability constant under various battery charging conditions.

The functions of overheat prevention, warning and auto stop protect motor and controller.

Power base of metal insulation substrate of excellent heat transfer enhances reliability.

Embedded auto characterization routine for optimizing trucks for motor capabilities and efficiency.

Powerful operating system is capable of performing control of truck and motor, and parallel processing of user-defined programmable logic (VCL).

Wide-range input/out are applied whenever required for controlling distributed systems to the largest extent.

Embedded dual drive software easily sets and controls of common dual drive trucks without VCL.

Battery charging indicator, hour meter and service timer.

CAN open compatible with CAN bus (CAN bus protocol configured through VCL).

Increased CAN master capabilities (VCL execution speed and code space).

Field programming mode allowing flash download of main operation codes.

Programming facilitated by Zapi PC CAN Console and Zapi Smart Console.

Stubbornly sealed housing and connector satisfy IP65 environmental sealing standards in severe environments.

Compliant with EN1175:2020

3) DESCRIPTION OF THE CONNECTORS

① Traction and pump controller

Every low-power connection is connected through single 35-in AMPSEAL connector. Plug housing for coupling is AMP P/N 776164-1, and contact pin is AMP P/N 770520-3.

Connector accommodates 0.5-1.25 mm (20-16 AWG) wire having thin wall insulator of 1.7-2.7 mm diameter. The wire is sealed in unused connector of silo-diagram together with seal plug 77068-1.
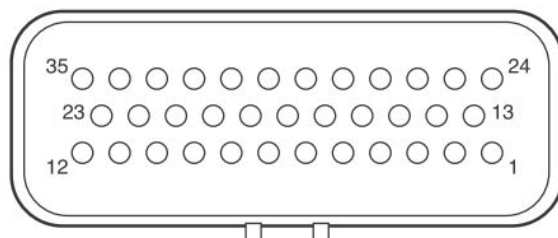
PIN	NAME	DESCRIPTION
1	EVP POT	Analog input 3. The default function is as lowering reference (wiper contact of the lowering potentiometer)
2	AUX1	Digital input, active when connected to +B. By default, closing the switch output NEV1 (Pin24) is activated.
3	KEY	Input of the key switch signal.
4	PPOT	Positive supply for potentiometers (+5 V or +12 V, 200 mA maximum).
5	ACC POT	Analog input 1. The default function is as accelerator reference (wiper contact of the accelerator potentiometer).
6	FW	Digital input active when connected to +B. The default function is as forward request; closing this input the truck moves forward.
7	BW	Digital input active when connected to +B. The default function is as backward request; closing this input the truck moves backward.
8	SEAT	Digital input active when connected to -B. The default function is as seat (or tiller) input.
9	CHA	Channel A of the incremental encoder.
10	PENC	Positive supply for the encoder or for another speed transducer (+5 V or +12 V, 200 mA maximum).
11	LOWER	Digital input, active when connected to -B. The default function is as lowering request. Closing the switch, NEVP output (Pin29) is activated according to the setpoint defined by EVP POT (Pin1).
12	AUX2	Digital input, active when connected to +B. By default, closing the switch output NEV2 (Pin25) is activated.
13	STEER POT	Analog input 4. The default function is as steering reference (wiper contact of the steering potentiometer).

PIN	NAME	DESCRIPTION
14	AUX3	Digital input, active when connected to +B. By default, closing the switch output NEV3 (Pin34) is activated.
15	NPOT	Negative supply for the potentiometers.
16	BRK POT	Analog input 2. The default function is as breaking reference (wiper contact of the brake potentiometer).
17	QI/PB	Digital input active when connected to +B. The default function is as quick-inversion or brake-pedal input.
18	CANT	If connected to Pin31 (CANH), it introduces the 120 Ohm termination resistance between CANL and CANH.
19	SR/HB	Digital input inactive when connected to -B, active when the switch is open. The default function is as speed-reduction or handbrake request.
20	CHB	Channel B of the incremental encoder.
21	NENC	Negative supply for the encoder. By default, it is to be used as negative terminal for the thermal sensor too.
22	BACK. FW	Digital input, active when connected to +B. The default function is as forward backing (inching) request.
23	BACK. BW	Digital input, active when connected to +B. The default function is as backward backing (inching) request.
24	PIN	Positive supply for the high-side driver of pin PEB (Pin27). By default, it is to be connected after the main contactor connecting.
25	NEV1	Driving output for the on/off electric valve EV1 (driving to -B); PWM voltage controlled; 1.5 A maximum continuous current.
26	NLC	Driving output for the line – or main – contactor (driving to -B); PWM controlled; 2 A maximum continuous current.
27	PEB	Positive supply for the electromechanical brake and the electric valve. It is supplied by PIN (24) through a high-side driver.
28	NEB	Driving output for the electromechanical brake (driving to -B); PWM controlled; 3 A maximum continuous current.
29	NEVP	Driving output for the proportional electric valve (driving to -B); PWM current-controlled; 1.7 A maximum continuous current. Default function is as LOWERING valve.
30	CANL	Low-level CAN bus line.
31	CANH	High-level CAN bus line.
32	NCAN	CAN bus negative reference. To be used only in case of isolated CAN bus.
33	PTHERM	Analog input for the thermal sensor of the traction motor. Internal pull-up is 2 mA current source (max 5 V).
34	NEV2	Driving output for the on/off electric valve EV2 (driving to -B); 1.5 A maximum continuous current.
35	NEV3	Driving output for the on/off electric valve EV3 (driving to -B); 1.5 A maximum continuous current.

② Encoder connection (drive and pump)

Two control lines are configured inside for reading quadrature type position encoder.

Power supply of encoder is commonly 5V or 12V (Pin 10), and power can be supplied by 5V –
B+ by external source only when logic critical value is satisfied.

PIN	NAME	DESCRIPTION
10	+ 5 V	Power supplying to positive electrode of encoder
21	GND	Power supplying to negative electrode of encoder
9	ENC A	Encoder A phase
20	ENC B	Encoder B phase

These signal tolerances should be within operating conditions of application including scope of
voltage, temperature, speed and torque.
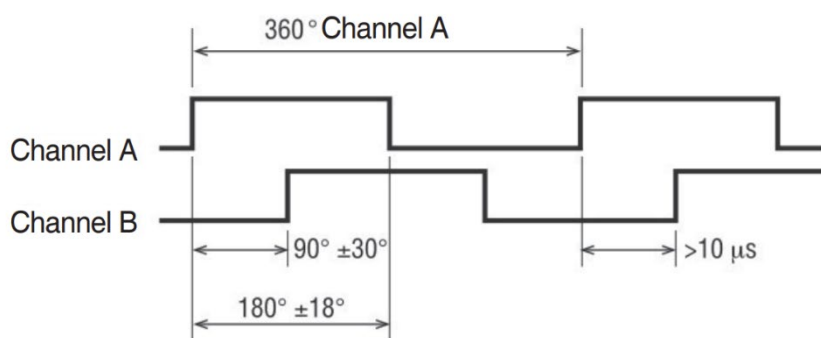
4) PROGRAMING AND ADJUSTMENT

It is allowed to adjustment parameters through Zapi Smart Console programmer.

Adjusting with portable programmer (opt)

Connect to the main harness of the lift truck.

※ **Turn Start key to OFF position, and then make connection and release.**

① Operational Modes

Smart Console has been designed to have multiple ways of operation. Three modes can be identified:

➢ Serial connection powered by four standard AA size batteries placed in the battery holder of the console.

➢ CAN bus connection powered by four standard AA size batteries placed in the battery holder of the console.

➢ CAN bus connection with Smart Console supplied by an external dc source. This source may be a standard battery (lead-acid or other type) or a DC/DC converter

Current-loop serial connection

Smart Console offers the same serial connection as the well-known Console Ultra.

Main features of this operational mode are:

➢ Current-loop serial communication.

➢ Console is connected to a single controller only (even if Remote Console option is available).

➢ Selectable baud-rate.

➢ Zapi can provide the serial cable compatible with Molex SPOX connector used in Console Ultra.

CAN bus connection

The Smart Console can connect to an existing CAN line and connect with any Zapi controller inside this line.

Main features of this operational mode:

➢ It can be connected to a CAN line composed of any combination of modules, both Zapi ones and non-Zapi ones;

➢ Supported speeds: 125, 250, 500 kbps;

➢ It sees the entire CAN line and all CAN modules.

② The keyboard

The keyboard is used to navigate through the menus. It features some keys with special functions and a green LED. Different button functions are shown below.

UP and DOWN keys

In most cases a menu is a list of items: these items are ordered in rows. The selected item is highlighted in light blue. Up and down keys are used to move the selection up and down: others are used to roll or scroll the menu.

LEFT and RIGHT keys

Normally used to increase and decrease the value associated with the selected item.

OK and ESC keys

OK key is used either to confirm actions or to enter a submenu. ESC is used either to cancel an action or to exit a menu.

F1, F2, F3 keys

These buttons have a contextual use. The display will show which F button can be used and its function.

ON key

Used while operating with internal batteries.

Green LED

When the console is powered running the green LED is on. Green LED can blink in certain cases which will be described better in the following sections.

③ Home Screen

After showing the Zapi logo, the HOME SCREEN will appear on the display:

From top:

```
*CONS AFG ZP015*
RS232 CONSOLE
CAN CONSOLE
AUTOSCAN CAN
CONSOLE UTILITIES
MENU CONSOLE

                    14:00
```

➢ First line tells which firmware version is running inside the console, in this case ZP 0.15.

➢ RS232 Console: enter this menu to start a serial connection as in the Console Ultra.

➢ CAN Console: enter this menu to establish a CAN connection. ● AUTOSCAN CAN: another way to establish a CAN connection.

➢ Console Utilities and Menu Console: ignore them at the moment.

➢ The current hour is shown at the bottom right.

Moreover, the green LED is on and still.

The "RS232" line is already highlighted at the start-up. Press OK key to start a serial connection.

Display prompts a message to inform you that a connection attempt is ongoing. If serial connection fails a "NO COMMUNICATION" warning will be shown after some seconds: press ESC key and look for what is preventing the connection.

Please notice the red dot appearing on the top right of the display every time you press a button. It indicates that the console has received the command and it is elaborating the request. If the red dot does not appear when a button is pressed, there is probably a failure inside the keyboard or the console has stalled.

④ Connected

If connection is successful, the display will show a page similar to the next one.

This menu shows basic information about the controller, in a similar way to the console Ultra.

```
VMCM     ZP1.00
48V     0A     500h


NO CAN MSG N. 05
```

➢ First line displays the controller firmware.

➢ Second line shows controller voltage, controller current and hour meter.

➢ Last line shows the current alarm code, if present.
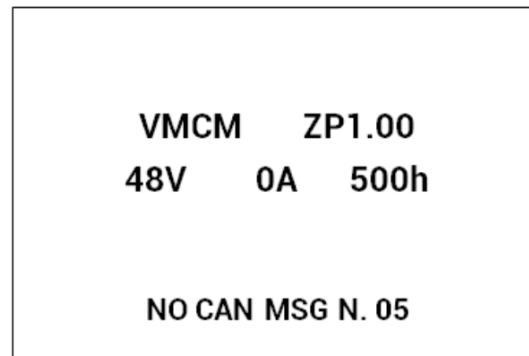
Press OK to access the MAIN MENU.

MAIN MENU contains the complete list of menus available in the controller. Contrary to Console Ultra there are no "hidden" menus which must be reached by some combinations of buttons: here all menus are visible. Use UP and DOWN keys to navigate the list: once you find the desired menu press OK to enter it.

```
* MAIN MENU *
PARAMETER CHANGE
     TESTER
     ALARMS
 PROGRAM VACC
 SAVE PARAMETERS
RESTORE PARAMETERS
   SET MODEL
```
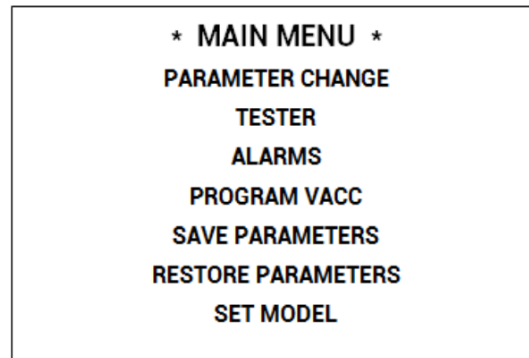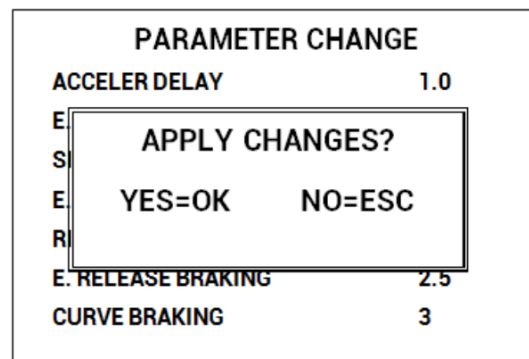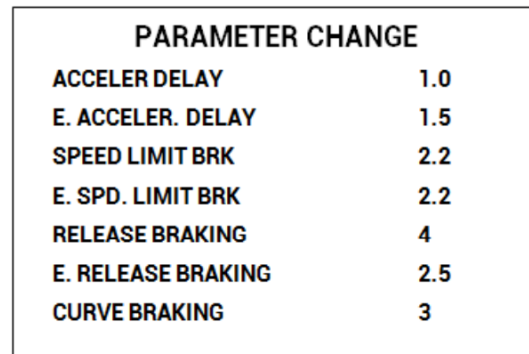
⑤ How to modify parameters

From MAIN MENU enter the desired menu (for example the PARAMETER CHANGE menu).

With UP and DOWN keys you can scroll the list: once you have highlighted the parameter you want to modify, press either LEFT or RIGHT keys to decrease or increase the parameter value.

```
PARAMETER CHANGE
ACCELER DELAY          1.0
E. ACCELER. DELAY      1.5
SPEED LIMIT BRK        2.2
E. SPD. LIMIT BRK      2.2
RELEASE BRAKING        4
E. RELEASE BRAKING     2.5
CURVE BRAKING          3
```

Keep LEFT/RIGHT button pressed to continuously repeat the value modification ("auto-repeat" function): this function will speed up the procedure in case many parameter values must be changed.

You can press ESC to exit the menu at any time. In case parameters have been modified, the console will prompt the request to confirm/discard changes.

```
PARAMETER CHANGE
ACCELER DELAY          1.0
E.
S|    APPLY CHANGES?
E|
R|  YES=OK     NO=ESC
E. RELEASE BRAKING     2.5
CURVE BRAKING          3
```

Description above is valid for every menu which contains parameters and options like SET OPTIONS, ADJUSTMENT, HARDWARE SETTINGS, etc.

⑥ PROGRAM VACC

PROGRAM VACC menu has been slightly modified from old consoles. Upon entering this menu, the console shows the current programmed values.

```
PROGRAM VACC
 CURRENT VALUES
MAX       5.0
MIN       0.3



PRESS OK FOR SETUP
```

When OK is pressed, PROGRAM VACC procedure starts. Console invites you:

➢ to select the enable switch, if any;

➢ to select the direction switch (either forward or backward);

➢ to depress the pedal to its maximum excursion.
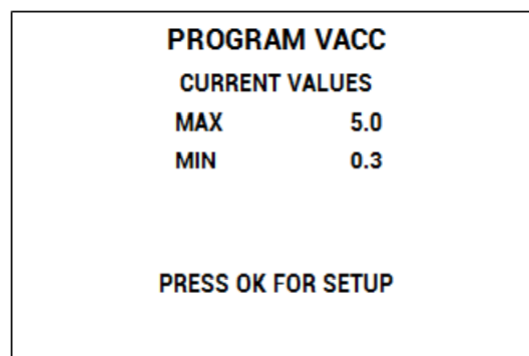
Displayed values vary accordingly to operator inputs.

Sequence above can slightly vary depending on controller firmware. The logic remains the same: before programming the min/max values, execute any starting sequence which is necessary, then press the pedal or push the joystick.

```
┌──────────────────────────────────────┐
│            PROGRAM VACC               │
│                                       │
│   FORWARD           0.0    4.5        │
│   BACKWARD          0.2    4.4        │
│                                       │
│     SEL. ENABLE AND DIRECTION         │
│         THEN PRESS PEDAL              │
│         (ESC TO|FINISH)               │
└──────────────────────────────────────┘
```

When ESC is pressed, console asks if programmed values must be saved or discarded.

⑦ Lift and Lower acquisition

From MAIN MENU go into the Adjustment menu. With UP and DOWN keys you can scroll the list: once you have highlighted a value you want acquire, press OK. When OK is pressed, the procedure starts:

➤ select the Enable switch, if any;

➤ select the control switch if any (either lift or lower);

➤ move the control sensor (lift/lower potentiometer) to the correct position according to what you are acquiring.

Displayed values vary accordingly to operator inputs.

Sequence above can slightly vary depending on controller firmware. The logic remains the same: before programming the min/max values, execute any starting sequence which is necessary, then press the pedal or push the joystick.

PARAMETER CHANGE

ACCELER DELAY	1.0
E.	
S.	**APPLY CHANGES?**
E.	YES=OK NO=ESC
R.	
E. RELEASE BRAKING	2.5
CURVE BRAKING	3

It is possible to acquire all the values in only one session. At the end you can press ESC and the console will prompt a request to confirm/discard changes.
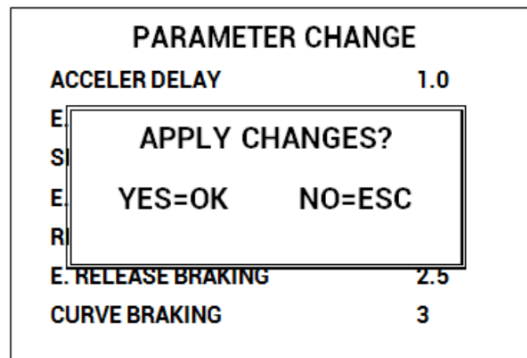
⑧ Steer acquisition

From MAIN MENU go into the Adjustment menu. The procedure to follow is the same described in previous paragraph.

⑨ Tester

Compared to standard console Ultra, the TESTER menu has been deeply modified. Now it shows four variables at once: use UP/DOWN keys to scroll the list.

TESTER

MOTOR VOLTAGE	0%
FREQUENCY	0
ENCODER	0
BATTERY VOLTAGE	24.5V
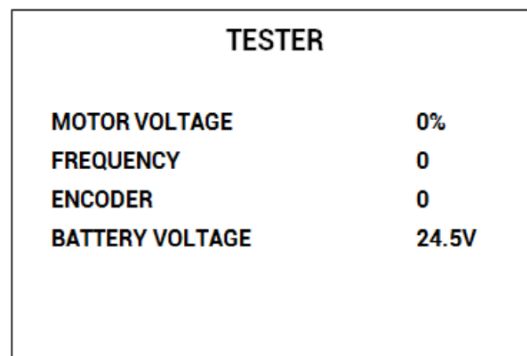
⑩ Alarms

ALARMS menu has changed from Console Ultra. Display shows all controller alarms at once.

Five is the maximum number of alarm codes which is stored inside the controller. Colors are used to separate recurrent alarm codes from rare events. In order of increasing frequency, alarm names can be:

➤ White: up to 5 occurrences

➤ Yellow: up to 20,

ALARMS

NO CAN MESSAGE	10h
INCORRECT START	2h
NONE	0h
NONE	0h
NONE	0h
F1 TO CLEAR LOGBOOK	
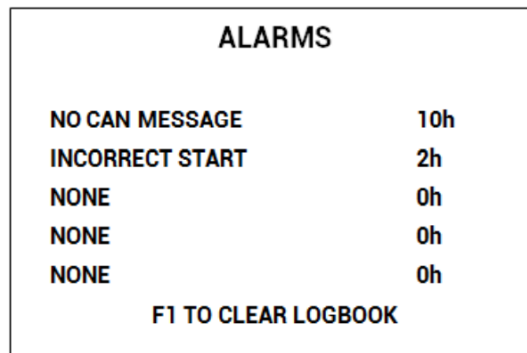
- ➢ Orange: up to 40,
- ➢ Red: more than 40.

Use UP/DOWN to select a certain alarm in the list: if OK is pressed, additional pieces of information about that alarm are displayed.

Press F1 to clear the alarm logbook of the controller: once F1 is pressed, the console asks for confirmation.

⑪ Download parameter list into a USB stick

When Smart Console is connected to a controller, it has the possibility to download all parameters into a USB stick. To use this function, go into the menu SAVE PARAMETER USB in the MAIN MENU.

File format

The complete list of parameters is saved as a csv file in order to be opened with Microsoft Excel® or any other spreadsheet tool.

The file is formatted in the same way as if it has been created with the PC CAN Console. Thus, it contains the whole list of parameters and, for each one, various data are available, in particular:

- ➢ Parameter value as it is saved within controller ("Value" column).
- ➢ Parameter value as it is shown by console or similar tools ("Scaled Value" column).
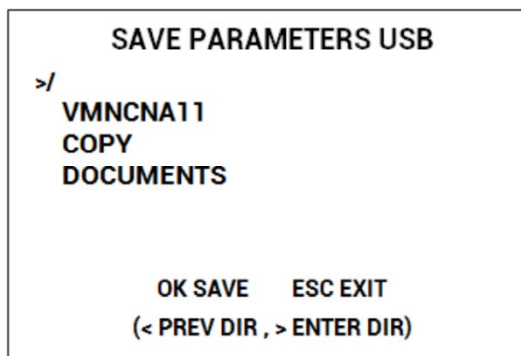- ➢ Name of the menu where parameter is placed tools ("Name menu" column).

File name is generated as a hexadecimal code of the time and date of save. This codification prevents any overwrite of previously saved files.

Download procedure

After entering SAVE PARAMETER TO USB, the Smart Console checks the presence of a USB stick. If the stick is not connected, it asks the operator to connect one.

When the stick is present, the display shows the content, starting from the root directory (/) of the filesystem. Display looks like the following picture.

Notice that only directories are shown, not single files.

```
SAVE PARAMETERS USB
>/
   VMNCNA11
   COPY
   DOCUMENTS


        OK SAVE     ESC EXIT
      (< PREV DIR , > ENTER DIR)
```

While exploring the content, the navigation buttons work in the following way:

- ➢ Up/down keys scroll the list.
- ➢ Right key explores the highlighted directory: its content (directories only) will be shown immediately.
- ➢ Left key returns one level back in the directory tree: it does not work in the root directory.
- ➢ Esc returns to HOME SCREEN.
- ➢ OK starts download.

When saving files, the console creates a subdirectory whose name has eight digits:

- ➢ First four digits are controller type.
- ➢ Fifth and sixth digits are the customer identification code.
- ➢ Seventh and eight digits are the code of the software installed inside the controller.

An example of this code is the first directory name (VMNCNA11) shown in the previous figure.

If parameters are downloaded multiple times from the same controller, or from another controller whose eight codes are the same, all parameter files are saved in the same location.

If the directory does not exist, it is created when download is carried out for the first time.

To download parameters, proceed as follows:

➢ Navigate the directory list and go into the directory where you want to save the parameters.

➢ If this directory already contains the subdirectory with the correct 8 digits go to step3. If it is not present, a new subdirectory will be created automatically. Do not enter the subdirectory manually.

➢ Press OK to start parameter download. A progression bar shows the ongoing process.

➢ When finished, press ESC so to return to MAIN MENU. USB stick can be removed safely.

Connect the USB stick to a PC and enter the directory of point 1). A subdirectory with the correct name and, inside this one, a csv file is present.

During download the led blinks slowly to indicate the console is running. When download has finished USB stick can be unplugged safely.

⚠ **Do not remove USB stick during download or the file will result empty or corrupted.**

5) SAFETY INSTRUCTIONS

➢ Make sure that battery is disconnected before use.

➢ Driving wheel should be prompted or deactivated during driving to prevent unexpected operation or moving in wrong direction during initial startup of the truck. Open the value during hydraulic operation to prevent excessive rise of pressure if the relief valve pressure malfunctions.

➢ Prerequisite actions should be taken for safety for ensuring prevention of damage to workers or equipment.

➢ The inside battery is kept charged for a certain period even when the key switch is kept open after starting operation. Separate the battery for safety drive, and use resistance of 10-100 Ω to make short circuit between power terminals of positive and negative electrodes of the inverter battery.

6) ALARM CODE

Drive and pump controller

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
209	PARAM RESTORE	O	O	Cause: The controller has restored the default settings. If a CLEAR EEPROM has been made before the last key recycle, this warning informs you that EEPROM was correctly cleared.	Symptom：No effect. Troubleshooting：A travel demand or a pump request cancels the alarm. If the alarm appears at key-on without any CLEAR EEPROM performed, replace the controller.
244	WARNING SLAVE	O	O	Cause: Warning on supervisor uC.	Symptom：It depends on the supervisor uC. Troubleshooting：Connect the Console to the supervisor uC and check which alarm is present.
17	LOGIC FAILURE #3	O	O	Cause: A hardware problem in the logic board due to high currents (overload). An overcurrent condition is triggered even if the power bridge is not driven.	Symptom：MC is opened, EB is applied, traction/pump stopped. Troubleshooting：The failure lies in the controller hardware. Replace the controller.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
60	CAPACITOR CHARGE	O	O	Cause: When the key is switched on, the inverter tries to charge the power capacitors through the series of a PTC and a power resistance, checking if the capacitors are charged within a certain timeout. If the capacitor voltage results less than a certain percentage of the nominal battery voltage, the alarm is raised and the main contactor is not closed.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check if an external load in parallel to the capacitor bank, which sinks current from the capacitors-charging circuit, thus preventing the caps from charging well. Check if a lamp or a DC/DC converter or an auxiliary load is placed in parallel to the capacitor bank. The charging resistance or PTC may be broken. Insert a power resistance across line-contactor power terminals; if the alarm disappears, it means that the charging resistance is damaged. The charging circuit has a failure or there is a problem in the power section. Replace the controller.
30	VMN LOW	O	O	Cause1: Start-up test. Before switching the LC on, the software checks the power bridge: it turns on alternatively the high-side power MOSFETs and expects the phase voltages increase toward the positive rail value. If one phase voltage is lower than a certain percentage of the rail voltage, this alarm occurs. Cause2: Motor running test. When the motor is running, the power bridge is on and the motor voltage feedback tested; if it is lower than expected value (a range of values is considered), the controller enters in fault state	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：If the problem occurs at start up (the LC does not close at all), check: motor internal connections (ohmic continuity); motor power-cables connections; if the motor connections are OK, the problem is inside the controller; replace it. If the alarm occurs while the motor is running, check: motor connections; that the LC power contact closes properly, with a good contact; if no problem is found, the problem is inside the controller. Replace it.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
74	DRIVER SHORTED	O	O	Cause: The driver of the LC coil is shorted.	Symptom：MC is opened (the command is released), EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check if there is a short or a low impedance pull-down between NLC (pin A12) and -B. The driver circuit is damaged; replace the logic board.
235	CTRAP THRESHOLD	O	O	Cause: This alarm occurs when a mismatch is detected between the setpoint for the overcurrent detection circuit (dependent on parameter DUTY PWM CTRAP, see paragraph 8.2.4) and the feedback of the actual threshold value.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：The failure lies in the controller hardware. Replace the logic board.
31	VMN HIGH	O	O	Cause: Before closing the LC, the software checks the power bridge voltage without driving it. The software expects the voltage to be in a "steady state" value. If it is too high, this alarm occurs. The hexadecimal value "XX" identifies the faulty phase: 81: phase U 82: phase V 83: phase W.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check the motor power cables. Check the impedance between U, V and W terminals and -B terminal of the controller. Check the motor leakage to truck frame. If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
226	VACC OUT RANGE	O	O	Cause: The CPOT input read by the microcontroller is not within the MIN VACC ÷ MAX VACC range, programmed through the PROGRAMM VACC function (see paragraph 9.1). The acquired values MIN VACC and MAX VACC are inconsistent.	Symptom：Traction/Pump motor is stopped. Troubleshooting：Acquire the maximum and minimum potentiometer values through the PROGRAM VACC function. If the alarm is still present, check the mechanical calibration and the functionality of the accelerator potentiometer. If the problem is not solved, replace the logic board.
53	STBY I HIGH	O		Cause: In standby, the sensor detects a current value different from zero.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：The current sensor or the current feedback circuit is damaged. Replace the controller.
38	CONTACTOR OPEN	O		Cause: The LC coil is driven by the controller, but it seems that the power contacts do not close. In order to detect this condition the controller injects a DC current into the motor and checks the voltage on power capacitor. If the power capacitors get discharged it means that the main contactor is open.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：LC contacts are not working. Replace the LC. If LC contacts are working correctly, contact a Zapi technician.
86	PEDAL WIRE KO	O	O	Cause: This alarm is signaled if a fault is detected in the accelerator unit wiring (NPOT or PPOT cable is interrupted).	Symptom：T86 Fault performance Traction is stopped；P86 Fault performance Lift stop. Troubleshooting：Replace the accelerator or increase the potentiometer.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
254	EB. DRIV.SHRT.	O	O	Cause: The EB driver is shorted. The microcontroller detects a mismatch between the setpoint and the feedback at the EB output.	Symptom：MC remains closed, EB is applied (the command is released), Traction/Pump, valves stopped. Troubleshooting：Check if there is a short or a low impedance path between the negative coil terminal and -B. Check if the voltage applied is in accordance with the settings of the EB-related parameters (see paragraph 8.2.5). If the problem is not solved, replace the controller.
19	LOGIC FAILURE #1	O	O	Cause: This fault is displayed when the controller detects an undervoltage condition at the KEY input (pin A3). Undervoltage threshold is 11V for 24V and 36/48V controllers.	Symptom：MC is opened, EB is applied, traction/pump stopped. Troubleshooting（fault at startup or in standby）：Fault can be caused by a key input signal characterized by pulses below the undervoltage threshold, possibly due to external loads like DC/DC converters starting-up, relays or contactors during switching periods, solenoids energizing or de-energizing. Consider to remove such loads. If no voltage transient is detected on the supply line and the alarm is present every time the key switches on, the failure probably lies in the controller hardware. Replace the logic board. Troubleshooting（fault displayed during motor driving）：If the alarm occurs during motor acceleration or when there is a hydraulic-related request, check the battery charge, the battery health and power-cable connections.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
18	LOGIC FAILURE #2	O	O	Cause: Fault in the hardware section of the logic board which deals with voltage feedbacks of motor phases.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：The failure lies in the controller hardware. Replace the controller.
243	THROTTLE PROG.	O	O	Cause: A wrong profile has been set in the throttle profile.	Symptom：MC remains closed, EB is applied (the command is released), Traction stopped. Troubleshooting：Set properly the throttle-related parameters.
80	FORW + BACK	O		Cause: This alarm occurs when both the travel requests (FW and BW) are active at the same time.	Symptom：Traction is stopped. Troubleshooting：Check that travel requests are not active at the same time. Check the FW and BW input states through the TESTER function. Check the wirings relative to the FW and BW inputs. Check if there are failures in the microswitches. If the problem is not solved, replace the logic board.
79	INCORRECT START	O	O	Cause: Incorrect starting sequence. Possible reasons for this alarm are: - A travel demand active at key-on. - Man-presence sensor active at key on.	Symptom：Traction/Pump motor is stopped. Troubleshooting：Check the states of the input at key-on. Check wirings and the microswitches for failures. Through the TESTER function, check the states of the inputs are coherent with microswitches states. If the problem is not solved, replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
78	VACC NOT OK	O	O	Cause: At key-on and immediately after that, the travel demands have been turned off. This alarm occurs if the ACCELERATOR reading (in TESTER function) is above the minimum value acquired during the PROGRAM VACC procedure.	Symptom：Traction/Pump motor is stopped. Troubleshooting：Check the wirings. Check the mechanical calibration and the functionality of the accelerator potentiometer. Acquire the maximum and minimum potentiometer value through the PROGRAM VACC function. If the problem is not solved, replace the logic board.
75	CONTACTOR DRIVER	O	O	Cause: The LC coil driver is not able to drive the load. The device itself or its driver circuit is damaged.	Symptom：MC is opened (the command is released), EB is applied, Traction/Pump, valves stopped. Troubleshooting：This type of fault is not related to external components; replace the logic board.
62	TH. PROTECTION	O	O	Cause: The temperature of the controller base plate is above 85 °C. The maximum current is proportionally decreased with the temperature excess from 85 °C up to 105 °C. At 105 °C the current is limited to 0 A.	Symptom：Traction controller reduces the max current linearly from Imax (85°C) down to 0 A (105°C). Troubleshooting：It is necessary to improve the controller cooling. To realize an adequate cooling in case of finned heat sink important factors are the air flux and the cooling-air temperature. If the thermal dissipation is realized by applying the controller base plate onto the truck frame, the important factors are the thickness of the frame and the planarity and roughness of its surface. If the alarm occurs when the controller is cold, the possible reasons are a thermal-sensor failure or a failure in the logic board. In the last case, it is necessary to replace the controller.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
66	BATTERY LOW	O	O	Cause: Parameter BATTERY CHECK is other than 0 (SET OPTION list, paragraph 8.2.2) and battery charge is evaluated to be lower than BATT.LOW TRESHLD.	Symptom：According to parameter BATTERY CHECK. Troubleshooting：Check the battery charge and charge it if necessary. If the battery is actually charged, measure the battery voltage through a voltmeter and compare it with the BATTERY VOLTAGE reading in the TESTER function. If they are different, adjust the ADJUST BATTERY parameter with the value measured through the voltmeter. If the problem is not solved, replace the logic board.
221	HANDBRAKE	O		Cause: Handbrake input is active.	Symptom：Traction/Pump motor is stopped. Troubleshooting：Check that handbrake is not active by mistake. Check the SR/HB input state through the TESTER function. Check the wirings. Check if there are failures in the microswitches. If the problem is not solved, replace the logic board.
65	MOTOR TEMPERAT.	O	O	Cause: This warning occurs when the temperature sensor is open (if digital) or if it has overtaken the MAX. MOTOR TEMP. threshold (if analog).	Symptom：Maximum current is linearly reduced and speed is reduced to a fixed value. Troubleshooting：Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. Check the sensor ohmic value and the sensor wiring. If the sensor is OK, improve the cooling of the motor. If the warning is present when the motor is cool, replace the controller.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
251	WRONG SET BAT	O	O	Cause: At start-up, the controller checks the battery voltage (measured at key input) and it verifies that it is within a range of ±20% around the nominal value.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check that the SET BATTERY parameter inside the ADJUSTMENTS list matches with the battery nominal voltage. If the battery nominal voltage is not available for the SET BATTERY parameter inside the ADJUSTMENTS list, record the value stored as HARDWARE BATTERY RANGE parameter in the SPECIAL ADJUST. list and contact a Zapi technician. Through the TESTER function, check that the KEY VOLTAGE reading shows the same value as the key voltage measured with a voltmeter on pin A3. If it does not match, then modify the ADJUST BATTERY parameter according to the value read by the voltmeter. Replace the battery.
250	THERMIC SENS. KO	O	O	Cause: The output of the controller thermal sensor is out of range.	Symptom：Maximum current is reduced according to parameter MOT.T. T.CUTBACK and speed is reduced to a fixed value. Troubleshooting：This kind of fault is not related to external components. Replace the controller.
218	SENS MOT TEMP KO	O	O	Cause: The output of the motor thermal sensor is out of range.	Symptom：Maximum current is reduced according to parameter MOT.T. T.CUTBACK and speed is reduced to a fixed value. Troubleshooting：Check if the resistance of the sensor is what expected measuring its resistance. Check the wiring. If the problem is not solved, replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
249	CHECK UP NEEDED	O	O	Cause: This is a warning to point out that it is time for the programmed maintenance.	Symptom：Alarm CHECK UP NEEDED. Troubleshooting：Turn on the CHECK UP DONE option after that the maintenance service.
248	NO CAN MSG	O	O	Cause: CAN-bus communication does not work properly. The hexadecimal value "XX" identifies the faulty node.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify the CAN-bus network (external issue). Replace the logic board (internal issue).
247	DATA ACQUISITION	O	O	Cause: Controller in calibration state.	Symptom：Traction is stopped. Troubleshooting：The alarm ends when the acquisition is done.
246	EB. DRIV.OPEN	O	O	Cause: The EB driver is not able to drive the load. The device itself or its driving circuit is damaged.	Symptom：MC remains closed, EB is applied (the command is released), Traction/Pump, valves stopped. Troubleshooting：This type of fault is not related to external components. Replace the logic board.
237	ANALOG INPUT	O	O	Cause: This alarm occurs when the A/D conversion of the analog inputs returns frozen values, on all the converted signals, for more than 400 ms. The goal of this diagnosis is to detect a failure in the A/D converter or a problem in the code flow that skips the refresh of the analog signal conversion.	Symptom：MC is opened, EB is applied, traction/pump stopped. Troubleshooting：If the problem occurs permanently it is necessary to replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
8	WATCHDOG	O	O	Cause: This is a safety related test. It is a self-diagnosis test that involves the logic between master and supervisor microcontrollers.	Symptom： MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting： This alarm could be caused by a CAN bus malfunctioning, which blinds master-supervisor communication.
204	BRAKE RUN OUT	O	O	Cause: The CPOT BRAKE input read by the microcontroller is out of the range defined by parameters SET PBRK. MIN and SET PBRK. MAX (ADJUSTMENTS list, paragraph 8.2.3).	Symptom：Traction is stopped. Troubleshooting： Check the mechanical calibration and the functionality of the brake potentiometer. Acquire the minimum and maximum potentiometer values. If the alarm is still present, replace the logic board.
233	POWERMOS SHORTED	O	O	Cause: The DC-link voltage drops to zero when a high-side or low-side MOSFET is turned on.	Symptom：MC is opened, EB is applied, traction/pump stopped. Troubleshooting：Check that motor phases are correctly connected. Check that there is no dispersion to ground for every motor phase. In case the problem is not solved, replace the controller.
37	CONTACTOR CLOSED	O		Cause: Before driving the LC coil, the controller checks if the contactor is stuck. The controller drives the power bridge for several dozens of milliseconds, trying to discharge the capacitors bank. If the capacitor voltage does not decrease by more than a certain percentage of the key voltage, the alarm is raised.	Symptom：MC is not closed (command is not activated), EB is applied, Traction/Pump stopped. Troubleshooting：It is suggested to verify the power contacts of LC; if they are stuck, is necessary to replace the LC.
123	AUTOBALANCE FUNC	O		Cause: AUTO_BALANCE FUNCTION can be activated only when no direction switch is closed. The controller should alarm if the AUTO_BALANCE FUNCTION is activated when the direction switch is closed.	Symptom：The controller does not perform this function. Troubleshooting：Reset the AUTOBALANCE switch.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
228	TILLER OPEN	O		Cause: Tiller/seat input has been inactive for more than 120 seconds.	Symptom：LC opens. Troubleshooting：Activate the tiller/seat input. Check the tiller/seat input state through the TESTER function. Check the wirings. Check if there are failures in the microswitches. If the problem is not solved, replace the logic board.
232	CONT. DRV. EV	O	O	Cause: One or more on/off valve drivers are not able to drive the load. For the meaning of code "XX", refer to paragraph 0.	Symptom：Valves stopped. Troubleshooting：The device or its driving circuit is damaged. Replace the controller.
234	DRV. SHOR. EV	O	O	Cause: One or more on/off valve drivers are shorted. For the meaning of code "XX", refer to paragraph 0.	Symptom：Valves stopped. Troubleshooting：Check if there is a short circuit or a low impedance path between the negative terminals of the involved coils and -B. If the problem is not solved, replace the logic board.
217	PEV NOT OK	O	O	Cause: Terminal PEV (pin A3) is not connected to the battery or the voltage is different from that defined by parameter SET POSITIVE PEB. This alarm can occur if one output among EVP, EV1, EV2, EV3, HORN is present or AUX OUT FUNCTION is active.	Symptom：Pump motor stopped, valves stopped. Troubleshooting：Check PEV terminal (pin A3): it must be connected to the battery voltage (after the main contactor). Set the nominal PEV voltage in parameter SET POSITIVE PEB in the ADJUSTMENTS list.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
220	VKEY OFF SHORTED	O	O	Cause: At key-on, the logic board measures a voltage value of the KEY input that is constantly out of range, below the minimum allowed value.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：Check that the battery has the same nominal voltage of the inverter. Check the battery voltage, if it is out of range replace the battery. If the battery voltage is ok, replace the logic board.
211	STALL ROTOR	O	O	Cause: The traction rotor is stuck or the encoder signal is not correctly received by the controller.	Symptom：Traction/Pump stopped. Troubleshooting：Check the encoder condition. Check the wiring. Through the TESTER function, check if the sign of FREQUENCY and ENCODER are the same and if they are different from zero during a traction request. If the problem is not solved, replace the logic board.
240	EVP DRIVER OPEN	O	O	Cause: The EVP driver (output NEVP, pin A23) is not able to drive the EVP coil. The device itself or its driving circuit is damaged.	Symptom：MC is opened (the command is released), EB is applied, Traction/Pump, valves stopped. Troubleshooting：This fault is not related to external components. Replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
202	VDC LINK OVERV.	O	O	Cause: This fault is displayed when the controller detects an overvoltage condition. Overvoltage threshold depends on the nominal voltage of the controller. | Nominal voltage	24 V	36 V, 48 V	80 V	96 V
Overvoltage threshold	35 V	72.5 V	115 V	125 V | As soon as the fault occurs, power bridge and MC are opened. The condition is triggered using the same HW interrupt used for under-voltage detection, microcontroller discerns between the two evaluating the voltage present across DC-link capacitors: High voltage → Overvoltage condition Low/normal voltage → Under-voltage condition	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：If the alarm happens during the brake release, check the line contactor contact and the battery power-cable connection.
236	CURRENT GAIN	O	O	Cause: The current gain parameters are at the default values, which means that the maximum current adjustment procedure has not been carried out yet.	Symptom：Controller works, but with low maximum current. Troubleshooting：Ask for assistance to a Zapi technician in order to do the adjustment procedure of the current gain parameters.
241	COIL SHOR. EVAUX	O	O	Cause: This alarm occurs when there is an overload on any of the auxiliary voltage controlled outputs: NEV1 A25, NEV2 A34 and NEV3 A35.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：The typical root cause is in the wiring harness or in the load coil. Check the connections between the controller output and the load.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
242	OPEN COIL EV.	O	O	Cause: This fault appears when no load is connected between one or more EV outputs and the positive terminal PEV (pin A3). For the meaning of code "XX", refer to paragraph 0.	Symptom：MC remains closed, EB is applied, Traction/Pump, valves stopped (the command is released). Troubleshooting：Check the coils. Check the wiring. If the problem is not solved, replace the logic board.
216	EB. COIL OPEN	O	O	Cause: No load is connected between the NEB output (pin A28) and the EB positive terminal PEB (pin A27).	Symptom：MC remains closed, EB is applied (the command is released), Traction/Pump, valves stopped. Troubleshooting：Check the EB coil. Check the wiring. If the problem is not solved, replace the logic board.
230	LC COIL OPEN	O		Cause: No load is connected between the NLC output (pin A12) and the positive voltage (for example +KEY).	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check the wiring, in order to verify if LC coil is connected to the right connector pin and if it is not interrupted. If the alarm is still present, rather than the problem is inside the logic board; replace it.
224	WAITING FOR NODE	O	O	Cause: The controller receives from the CAN bus the message that another controller in the net is in fault condition; as a consequence, the controller itself cannot enter into an operative status, but it has to wait until the other node comes out from the fault status.	Symptom：MC is opened, EB is applied, Traction/Pump stopped. Troubleshooting：Check if any other device on the CAN bus is in fault condition.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
253	FIELD ORIENT. KO	O	O	Cause: The error between the estimated Id (d-axis current) and the relative setpoint is out of range.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
245	IQ MISMATCHED	O	O	Cause: The error between the estimated Iq (q-axis current) and the related set point is out of range.	Symptom：Traction is stopped. Troubleshooting：Ask for assistance to a Zapi technician in order to do the correct adjustment of the motor parameters.
180	OVERLOAD	O	O	Cause: The motor current has overcome the limit fixed by hardware.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：If the alarm condition occurs again, ask for assistance to a Zapi technician. The fault condition could be affected by wrong adjustments of motor parameters.
200	VDC OFF SHORTED	O	O	Cause: The logic board measures a voltage value across the DC-link that is constantly out of range, above the maximum allowed value.	Symptom：VDC OFF SHORTED. Troubleshooting：Check that the battery has the same nominal voltage of the inverter. Check the battery voltage, if it is out of range replace the battery. If the battery voltage is ok, replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
179	STEER SENSOR KO	O	O	Cause: The voltage read by the microcontroller at the steering-sensor input is not within the STEER RIGHT VOLT ÷ STEER LEFT VOLT range, programmed through the STEER ACQUIRING function.	Symptom：Speed is reduced according to parameter CTB. STEER ALARM. Troubleshooting：Acquire the maximum and minimum values coming from the steering potentiometer through the STEER ACQUIRING function. If the alarm is still present, check the mechanical calibration and the functionality of the potentiometer. If the problem is not solved, replace the logic board.
196	MOT.PHASE SH.	O	O	Cause: Short circuit between two motor phases. The hexadecimal value "XX" identifies the shorted phases: 36: U – V short circuit 37: U – W short circuit 38: V – W short circuit.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify the motor phases connection on the motor side. Verify the motor phases connection on the inverter side. Check the motor power cables. Replace the controller. If the alarm does not disappear, the problem is in the motor. Replace it.
205	EPS RELAY OPEN	O	O	Cause: The controller receives from EPS information about the safety contacts being open.	Symptom：Traction/Pump motor is stopped. Troubleshooting：Verify the EPS functionality.
239	CONTROLLER MISM.	O	O	Cause: The software is not compatible with the hardware. Each controller produced is "signed" at the end of line test with a specific code mark saved in EEPROM according to the customized part number. According with this "sign", only the customized firmware can be uploaded.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Upload the correct firmware. Ask for assistance to a Zapi technician in order to verify that the firmware is correct.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
214	EVP COIL OPEN	O	O	Cause: No load is connected between the NEVP output (pin A23) and the electrovalve positive terminal.	Symptom：Valves stopped. Troubleshooting：Check the EVP condition. Check the EVP wiring. If the problem is not solved, replace the logic board.
215	EVP DRIV. SHORT.	O	O	Cause: The EVP driver (output NEVP, pin A23) is shorted. The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP output.	Symptom：MC is opened, EB is applied, EVP stopped. Troubleshooting：Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -B. Collect information about: the voltage applied across the EVP coil, the current in the coil, features of the coil. Ask for assistance to Zapi in order to verify that the software diagnoses are in accordance with the type of coil employed. If the problem is not solved, it could be necessary to replace the controller.
229	HW FAULT EB.	O	O	Cause: At start-up, the hardware circuit dedicated to enable and disable the EB driver (output NEB, pin A28) is found to be faulty. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：MC is opened, EB is applied, Traction/Pump stopped. Troubleshooting：This type of fault is not related to external components. Replace the logic board.
227	HW FAULT	O	O	Cause: At start-up, some hardware circuit intended to enable and disable the power bridge or the LC driver (output NLC, pin A12) is found to be faulty. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：This type of fault is related to internal components. Replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
176	EVP COIL SHORT.	O	O	Cause: On output NEVP A29, is shorted to ground. The microcontroller detects a mismatch between the valve set-point and the feedback of the EVP output.	Symptom：Valves stopped. Troubleshooting：Check if there is a short circuit or a low-impedance conduction path between the negative of the coil and -B.
210	WRONG RAM MEM.	O	O	Cause: The algorithm implemented to check the main RAM registers finds wrong contents: the register is "dirty". This alarm inhibits the machine operations.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Try to switch the key off and then on again, if the alarm is still present replace the logic board.
208	EEPROM KO	O	O	Cause: A HW or SW defect of the non-volatile embedded memory storing the controller parameters. This alarm does not inhibit the machine operations, but it makes the truck to work with the default values.	Symptom：Controller works using default parameters. Troubleshooting：Execute a CLEAR EEPROM procedure (refer to the Console manual). Switch the key off and on to check the result. If the alarm occurs permanently, it is necessary to replace the controller. If the alarm disappears, the previously stored parameters will be replaced by the default parameters.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
223	COIL SHOR. MC	O		Cause: This alarm occurs when there is an overload of the MC driver (pin A26) or EB driver (pin A28). As soon as the overload condition disappears, the alarm will be removed automatically by releasing and then enabling a travel demand.	Symptom： MC is opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting： The typical root cause is in the wiring harness or in the load coil. So, the very first check to carry out concerns the connections between the controller outputs and the loads. Collect information about characteristics of the coils connected to the two drivers and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded.
207	INIT VMN LOW	O	O	Cause: Before closing the LC, the software checks the power bridge voltage without driving it. The software expects the voltage to be in a "steady state" value. If it is too low, this alarm occurs. The hexadecimal value "XX" identifies the faulty phase: 01: phase U 02: phase V 03: phase W.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting： Check the motor power cables. Check the impedance between U, V and W terminals and -B terminal of the controller. Check the motor leakage to truck frame. If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
206	INIT VMN HIGH	O	O	Cause: Before closing the LC, the software checks the power bridge voltage without driving it. The software expects the voltage to be in a "steady state" value. If it is too high, this alarm occurs. The hexadecimal value "XX" identifies the faulty phase: 81: phase U 82: phase V 83: phase W.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check the motor power cables. Check the impedance between U, V and W terminals and -B terminal of the controller. Check the motor leakage to truck frame. If the motor connections are OK and there are no external low impedance paths, the problem is inside the controller. Replace it.
213	POSITIVE LC OPEN	O		Cause: The voltage feedback of the LC driver (output NLC, pin A12) is different than expected.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify LC coil is properly connected. Verify CONF. POSITIVE LC parameter is set in accordance with the actual coil positive supply (see paragraph 8.2.5). Software makes a proper diagnosis depending on the parameter; a wrong setting could generate a false fault. In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
222	SEAT MISMATCH	O	O	Cause: This alarm can appear only in a traction + pump configuration or in a multi-motor one. There is an input mismatch between the traction controller and the pump controller relatively to the TILLER/SEAT input (A1): the two values recorded by the two controllers are different.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：Check if there are wrong connections in the external wiring. Using the TESTER function, verify that the seat inputs are in accordance with the actual state of the external switch. In case no failures/problems have been found, the problem is in the controller, which has to be replaced.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
201	CURRENT PROFILE	O	O	Cause: There is an error in the choice of the current profile parameters. Points P0 through P3 are expected to describe a descending profile.	Symptom：EB is applied, Traction/Pump motor is stopped. Troubleshooting：Check the values under the CURRENT PROFILE list.
197	WRONG SLAVE VER.	O	O	Cause: There is a mismatch in the software versions of master and supervisor microcontrollers.	Symptom：MC opened, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Upload the software to the correct version or ask for assistance to a Zapi technician.
198	M/S PAR CHK MISM	O	O	Cause: At start-up there is a mismatch in the parameter checksum between the master and the supervisor microcontrollers.	Symptom：MC stays closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Restore and save again the parameters list.
199	PARAM TRANSFER	O	O	Cause: Master uC is transferring parameters to the supervisor.	Symptom：MC stays closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Wait until the end of the procedure. If the alarm remains longer, re-cycle the key.
238	HW FAULT EV.	O	O	Cause: At start-up, the hardware circuit dedicated to enable and disable the EV drivers is found to be faulty. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：This type of fault is not related to external components. Replace the logic board.
212	POWER MISMATCH	O	O	Cause: The error between the power setpoint and the estimated power is out of range.	Symptom：Traction is stopped, EB is applied, MC is opened. Troubleshooting：Ask for assistance to a Zapi technician about the correct adjustment of the motor parameters.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
193	SMARTDRIVER KO	O	O	Cause: Hardware problem in the circuit for the management of smart driver. The driver is turned ON but the output voltage does not increase.	Symptom：MC is not closed, Traction/Pump, valves stopped. Troubleshooting：Verify that the coil is connected correctly between terminals PEB (pin A27) and NEB (pin A28). The output of Smart driver is in fact evaluated checking the voltage feedback of low side driver. Verify that the parameter POSITIVE EB is set in accordance with the actual coil positive supply. The software makes a proper diagnosis depending on the parameter; a wrong setting could generate a false fault. In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
194	AUX BATT. SHORT.	O	O	Cause: The voltage on PEB output (pin A27) is at high value even if it should not. For the versions where the smart driver is not installed (36/48V), it is possible to decide where the positive supply for pin A27 comes from by choosing a dedicated hardware configuration. The parameter POSITIVE E.B. has to be set in accordance with the hardware configuration (see paragraph 8.2.5), because the software makes a proper diagnosis depending on the parameter; a wrong setting could generate a false fault. The available choices are: 0 = PEB is managed by the smart driver (available for 24V version only). 1 = PEB comes from the TILLER input (A1). 2 = PEB comes from PAUX (A3). PAUX must be connected to terminal +B of the controller. This is the default configuration for 36/48V and 80V version. This alarm can only appear if POSITIVE E.B. is set as 1 TILLER/SEAT.	Symptom：None Troubleshooting：Verify that the parameter POSITIVE E.B. is set in accordance with the actual coil positive supply (see paragraph 8.2.5). In case no failures/problems have been found, the problem is in the controller, which has to be replaced.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
195	POS. EB. SHORTED	O	O	Cause: The voltage on terminal PEB (pin A27) is at the high value even if the smart driver is turned OFF.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify that the parameter POSITIVE EB is set in accordance with the actual coil positive supply (see paragraph 8.2.5). Since the software makes a proper diagnosis depending on the parameter, a wrong setting could generate a false fault. Check if there is a short or a low impedance path between PEB (pin A27) and the positive battery terminal +B. In case no failures/problems can be found, the problem is in the controller, which has to be replaced.
178	MOTOR TEMP. STOP	O	O	Cause: The temperature sensor has overtaken the threshold defined by STOP MOTOR TEMP.	Symptom：EB is applied, Traction/Pump, valves stopped. Troubleshooting： ﹣Check the temperature read by the thermal sensor inside the motor through the MOTOR TEMPERATURE reading in the TESTER function. ﹣Check the sensor ohmic value and the sensor wiring. ﹣If the sensor is OK, improve the cooling of the motor. ﹣If the warning is present when the motor is cool, replace the controller.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
177	COIL SHOR. EB.	O	O	Cause: This alarm occurs when an overload of the EB driver (output NEB A18) occurs.	Symptom：MC is opened, EB is applied, Traction/Pump, valves stopped Troubleshooting： - Check the connections between the controller outputs and the loads. - Collect information about characteristics of the coil connected to the driver and ask for assistance to a Zapi technician in order to verify that the maximum current that can be supplied by the hardware is not exceeded. - In case no failures/problems have been found, the problem is in the controller, which has to be replaced.
185	TILLER ERROR	O	O	Cause: Input mismatch between H&S input (pin A6) and TILLER/SEAT input (pin A1): the two inputs are activated at the same time.	Symptom：Traction stopped, EB applied. Troubleshooting：Check if there are wrong connections in the external wiring. Using the TESTER function of the controller verify that the input-related readings are in accordance with the actual state of the external input switches. Check if there is a short circuit between pins A6 and A1 in case no failures/problems have been found, the problem is in the controller, which has to be replaced.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
186	WAIT MOT.P STILL	O	O	Cause: The controller is waiting for the motor to stop rotating. This warning can only appear in BLE2 NEW GENERATION for brushless motors.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：The controller receives from the CAN bus the message that another controller in the net is in fault condition; as a consequence, the controller itself cannot enter into an operative status, but it has to wait until the other node comes out from the fault status.
175	SPEED OVERHEAD	O	O	Cause: The motor speed has exceeded the maximum defined by parameter TOP MAX SPEED (under HARDWARE SETTINGS) by more than a 100 Hz excess.	Symptom：MC is opened, EB is applied, Traction/Pump stopped. Troubleshooting：Check the motor parameters. Ask for assistance to a Zapi technician.
171	ACQUIRING A.S.	O	O	Cause: Controller is acquiring data from the absolute feedback sensor.	Symptom：None Troubleshooting：The alarm ends when the acquisition is done.
173	ACQUIRE END	O	O	Cause: Absolute feedback sensor acquired.	Symptom：None Troubleshooting：The alarm ends when the acquisition is done.
181	WRONG FBSENS.SET	O	O	Cause: Mismatch between parameters ENCODER PULSES 1 and ENCODER PULSES 2	Symptom：MC is not closed, EB applied, Traction/Pump, valves stopped. Troubleshooting：Set the two parameters with the same value, according to the adopted encoder.
172	ACQUIRE ABORT	O	O	Cause: The acquiring procedure relative to the absolute feedback sensor aborted.	Symptom：None Troubleshooting：The alarm ends when the acquisition is done.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
168	SPEED FB.ERR. XX	O	O	Cause: Motor speed encoder feedback problem.	Symptom：MC is opened, EB is applied, EVP stopped. Troubleshooting：Test the connection of motor encoder.
159	HVIL FAIL	O	O	Cause: The low voltage circuit detects that the high voltage components, conductors, and connectors are abnormal.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check the status of high voltage components, conductors, and connectors.
162	POS.EB.SHORT PIN	O	O	Cause: The voltage on terminal PEB A27, downstream the internal smart diver and input PIN A24, is sensed higher than expected with the smart driver driven OFF.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify that the parameter POSITIVE E.B. is set in accordance with the actual coil positive supply. Check if there is an external short or a low impedance path between PEB A27 and the positive battery terminal +B.
163	ED SLIP MISMATCH	O	O	Cause: The control detects a mismatch between the expected slip and the evaluated one. This diagnostic occurs only if ED COMPENSATION = TRUE.	Symptom：MC is opened, EB is applied, Traction/Pump stopped. Troubleshooting：Check the status of ED COMPENSATION parameter.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
164	POS.EB.SHORT GND	O	O	Cause: The voltage on terminal PEB A27, downstream the internal smart diver and input PIN A24, is sensed lower than expected after the smart driver is driven ON.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Verify that the parameter POSITIVE E.B. is set in accordance with the actual coil positive supply Check if there is an external short or a low impedance path between PEB A27 and any ground reference (-B or GND).
161	RPM HIGH	O	O	Cause: This alarm occurs in Gen. Set versions when the speed exceeds the threshold speed.	Symptom：MC is opened, Traction/Pump stopped. Troubleshooting：This alarm can appear only in a traction + pump configuration or in a multi-motor one. There is an input mismatch between the traction controller and the pump controller relatively to the TILLER/SEAT input (A1): the two values recorded by the two controllers are different.
160	SENS BAT TEMP KO	O	O	Cause: The output of the motor thermal sensor is out of range.	Symptom：Maximum current is reduced according to parameter MOT.T. T.CUTBACK and speed is reduced to a fixed value. Troubleshooting：Check if the resistance of the sensor is what expected measuring its resistance. Check the wiring.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
170	WRONG KEY VOLT.	O	O	Cause: The measured key voltage is not within the range defined by parameters SET BATTERY, VOLTAGE THR LOW and VOLTAGE THR HIGH under SET OPTIONS.	Symptom：MC is not closed, EB is applied, Traction/Pump, valves stopped. Troubleshooting：Check the settings of parameters SET BATTERY, VOLTAGE THR LOW and VOLTAGE THR HIGH under SET OPTIONS to be in accordance with the battery in use. Adjust the SET KEY VOLTAGE calibration under ADJUSTMENTS: tune it to be in accordance with the actual key voltage. Check if the key voltage is ok using a voltmeter, if not check the wiring. In case the problem is not solved, replace the logic board.
158	NOT RDY DRV.POW.	O	O	Cause: The error between the power setpoint and the estimated power is out of range.	Symptom：Traction is stopped, EB is applied, MC is opened. Troubleshooting：Ask for assistance to a Zapi technician about the correct adjustment of the motor parameters.
157	FAULT DRV.POWER	O	O	Cause: The error between the power setpoint and the estimated power is out of range.	Symptom：Traction is stopped, EB is applied, MC is opened. Troubleshooting：Ask for assistance to a Zapi technician about the correct adjustment of the motor parameters.
155	WAIT MOTOR STILL	O	O	Cause: The controller is waiting for the motor to stop rotating. This warning can only appear in BLE2 NEW GENERATION for brushless motors.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped Troubleshooting：The controller receives from the CAN bus the message that another controller in the net is in fault condition; as a consequence, the controller itself cannot enter into an operative status, but it has to wait until the other node comes out from the fault status.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
169	EMERGENCY	O	O	Cause: This alarm occurs when parameter EMERGENCY INPUT is set to 1 and the emergency input is active.	Symptom：MC is opened, EB is applied, traction/pump and valves are disabled. Troubleshooting：The emergency input has been activated. Wait until the emergency conditions cease and restore the emergency input.
153	OFFSET SPD.SENS.	O	O	Cause: It is necessary to acquire the offset angle between the stator and the speed sensor, i.e. they mutual angular misalignment. An automatic function is dedicated to this procedure.	Symptom：EB is applied, Traction/Pump, valves stopped. Troubleshooting：Perform the teaching procedure.
152	SENSOR SUPPLY XX	O	O	Cause: The current supplied on pin PENC A10 (A8) or PPOT A4 (A2) is outside the range MIN.CURR.SUPPLY 1/2 through 200 mA. The hexadecimal value "XX" defines the following cases: 01: PENC A10 (A8) below MIN.CURR.SUPPLY 1. 02: PENC A10 (A8) above 200 mA. 11: PPOT A4 (A2) below MIN.CURR.SUPPLY 2. 12: PPOT A4 (A2) above 200 mA.	Symptom：MC is opened, EB is applied, traction/pump and valves are disabled. Troubleshooting：If an undercurrent is detected, check that parameters MIN.CURR.SUPPLY 1 and MIN.CURR.SUPPLY 2 are appropriate for the device(s) connected to the faulty pin. Try to decrease them, even down to 0 mA. Check if the resistance of the load connected to the faulty pin is what expected measuring its resistance. Check the wiring. If an overcurrent is detected, try to disconnect the device(s) from the faulty pin. if the alarm persists, replace the logic board; if not, replace the device(s) connected to the faulty pin. If the problem is not solved, replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
203	HW FAULT MC	O	O	Cause: At start-up, some hardware circuit intended to enable and disable the power bridge or the LC driver on output NLC A26 (A16) is found to be faulty. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：MC is not closed, EB is applied, Traction/Pump and valves are disabled. Troubleshooting：This type of fault is related to internal components. Replace the logic board.
151	POT MISMATCH	O	O	Cause: This alarm can occur only if the auxiliary potentiometer is of crossed-twin type, in combination with the main potentiometer. The sum of main and auxiliary potentiometers is not constant.	Symptom：Traction/Pump motor is disabled. Troubleshooting：Verify that the main and auxiliary potentiometers are properly connected. Check the mechanical and electrical functionality of the main and auxiliary potentiometers. Perform the acquisition of the potentiometers; ask for assistance to a Zapi technician if necessary. If the problem is not solved, replace the logic board.
154	AGV	O	O	Cause: The automatic guide is enabled and the periodic automatic-guide-request CAN message is missed.	Symptom：Traction is disabled. Troubleshooting：Check the CAN bus communication. Verify that the controller receives the periodic automatic-guide-request message. If necessary, ask for assistance to a Zapi technician in order to record and verify the CAN traces.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
150	NO CAN MSG DISP	O	O	Cause: CAN bus communication with the display does not work properly. Upon this alarm, economy mode is activated by default.	Symptom：CAN bus communication with the display does not work properly. Troubleshooting：Verify the CAN bus network and the display connected to it. By a multimeter check the impedance between CANH and CANL; it shall be 60 Ω. If the alarm persists, replace the logic board.
149	WRONG PERFORM.	O	O	Cause: This alarm occurs only if the PERFORMANCE parameter under SET OPTIONS is set to ON. The three performance levels (economy, normal, power) are not set in an ascending order of performance.	Symptom：Traction is disabled. Troubleshooting：Check the performance settings under the PERFORM. ECONOMY and PERFORM. POWER lists. The performance related parameters must be set in such a way that the economy mode results in the weakest and the power mode results the highest. Contact a Zapi technician for assistance.
148	BMS NOT READY	O		Cause: This alarm occurs if the BMS FUNCTION is enabled and the controller does not receive any information about the battery state of charge; the battery management system is not operative.	Symptom：MC is opened, EB is applied, traction/pump and valves are disabled. Troubleshooting：Check the battery charge and the battery management system status. Check the CAN bus communication.
147	17A0X	O	O	Cause: The lithium battery is faulty.	Symptom：Limited traction and oil pump function. Traction/Pump stopped. Troubleshooting：Check the lithium battery.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
146	SAFETY DIAG. XX	O	O	Cause: One of the safety related diagnosis has failed.	Symptom：MC is opened, EB is applied, Traction/Pump is disabled. Troubleshooting：The fault condition could be due to wrong adjustments of the safety related parameters.
145	SAFETY SW. XX	O	O	Cause: One of the safety related modules has reported an error.	Symptom：MC is opened, EB is applied, Traction/Pump is disabled. Troubleshooting：The fault condition could be due to wrong adjustments of the safety related parameters.
144	SAFETY WARN. XX	O	O	Cause:One of the safety related modules has reported an error.	Symptom：MC is opened, EB is applied, Traction/Pump is disabled. Troubleshooting：The fault condition could be due to wrong adjustments of the safety related parameters.
143	SAFETY INIT. XX	O	O	Cause: One of the safety related modules has reported an error during its initialization.	Symptom：MC is not closed, EB is applied, Traction/Pump is disabled. Troubleshooting：The fault condition could be due to wrong adjustments of the safety related parameters.
142	STO-SS1 ALARM XX	O	O	Cause: One between the STO and the SS1 procedures has reported an alarm. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：MC is opened, EB is applied, Traction/Pump is disabled. Troubleshooting： The fault condition could be due to a timeout of the STO or SS1 procedure; the braking took too long. Check if the truck follows the imposed braking ramp and ask for assistance to a Zapi technician. In case the problem is not solved, replace the logic board.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
141	STO-SS1 ACTIVEXX	O	O	Cause: One between the STO and the SS1 procedures is in progress. The hexadecimal value "XX" facilitates Zapi technicians debugging the problem.	Symptom：A warning is shown in the display. Troubleshooting：Wait until the STO procedure or SS1 procedure or both are done.
139	THERM.PU.SENS.	O	O	Cause: The output of the controller thermal sensor is out of range.	Symptom：Maximum current is reduced according to parameter MOT.T. T.CUTBACK and speed is reduced to a fixed value. Troubleshooting：This kind of fault is not related to external components. Replace the controller.
138	BACK EMF HIGH	O	O	Cause: The reverse electromotive force generated by the truck when braking is too high.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：Contact ZAPI to adjust the parameters.
137	SLAVE MOT ALARM	O	O	Cause: The master and supervisor microcontrollers detect the motor state differently.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：Connect the Console to the supervisor microcontroller and check which alarm is present.
136	DISPLAY ENABLE	O	O	Cause: the display enable signal has not been received to operate the truck.	Symptom：Traction/Pump stopped. Troubleshooting：To remove warning cause.
124	HW WRONG	O	O	Cause: The controller hardware is faulty.	Symptom：Disable all functions of the controller. Troubleshooting：Request ZAPI help or replace the controller.
134	BMS WARNING 0	O		Cause: The lithium battery is faulty.	Symptom：Traction/Pump stopped Troubleshooting：Check the lithium battery.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
133	BMS WARNING 1	O		Cause: The lithium battery is faulty.	Symptom：Traction/Pump stopped Troubleshooting：Check the lithium battery.
132	BMS WARNING 2	O		Cause: The lithium battery is faulty.	Symptom：Traction/Pump stopped Troubleshooting：Check the lithium battery.
131	OVERLOAD	O	O	Cause: The motor current has exceeded the hardware-fixed limit.	Symptom：MC is not closed, EB is applied, Traction/Pump stopped. Troubleshooting：If the alarm condition occurs again, ask for assistance to a Zapi technician. The fault condition could be affected by wrong adjustments of motor parameters.
130	LOAD SENS. ERROR	O	O	Cause: An error has occurred on the WEIGHING SENSOR.	Symptom：This function is disabled. Troubleshooting：Acquire the maximum and minimum potentiometer values through the ADJ MIN LOAD function.
129	FORK SENSOR LOCK	O	O	Cause: An error has occurred on the TILT ANGLE SENSOR.	Symptom：This function is disabled. Troubleshooting：Acquire the maximum and minimum potentiometer values through the TILT ANGLE 1 function.
128	FORK WRONG DIR.	O	O	Cause: TILT ANGLE SENSOR1 The maximum or minimum Angle is incorrect.	Symptom：This function is disabled. Troubleshooting：Acquire the maximum and minimum potentiometer values through the MAX/MIN ANGLE function.

Code	Alarm	Traveling	Pump	Causes	Symptom and troubleshooting
127	A17 INPUT ERROR	O		Cause: The BATTERY DOOR INHIBIT switch is turned on.	Symptom：Inhibit both traction and lift function. Troubleshooting：Close the BATTERY DOOR INHIBIT switch.
187	LIFT+LOWER		O	Cause: Both the pump requests (LIFT and LOWER) are active at the same time.	Symptom：Pump is stopped. Troubleshooting： Check that LIFT and LOWER requests are not active at the same time. Check the LIFT and LOWER states through the TESTER function. Check the wirings and the micro-switches. If the problem is not solved, replace the logic board.
135	A7 INPUT ERROR	O		Cause: The BATTERY CHARGE INHIBIT switch is turned on.	Symptom：Inhibit both traction and lift function. Troubleshooting：Close the BATTERY CHARGE INHIBIT switch.
126	SEAT BELT	O	O	Cause: The SEAT BELT switch is turned on.	Symptom：Traction speed is limited. Troubleshooting：Close the SEAT BELT switch.
125	ERR CONFIG BMS	O		Cause: A19 and A11 on PUMP only have one closed to -B.	Symptom：The controller cannot communicate with lithium. Troubleshooting：Check the A19 and A11 switches.
122	BATT SERIOUS LOW	O	O	Cause: The BATT SERIOUS LOW alarm occurs when the battery level is evaluated to be lower or equal to BATT LOW SER THRES of the full charge.	Symptom：Inhibit both track and lift functions. Troubleshooting：The battery is charged.

6. Cluster

1) Instrument interface definition

The combination instrument of DZB916-XDZG forklift adopts 23-core AMP776228 connector, and the docking end is compatible with Tyco Electronics AMP 770680-1. The definition of instrument interface is shown in below table.
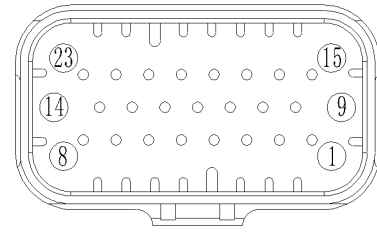
Pin	Signal name	State	Remark
1	B+(normal fire)	DC18~100V	Connected to positive pole of battery pack
2	Negative pole of instrument power supply	/	Connected to negative pole of battery pack
3	DC+5V output	Power the load cell	Load less than 200mA
4	Load cell signal input	Voltage signal	0.5V~4.5V
5	Load cell ground wire	Instrument output	Common ground inside the instrument
6	Hand brake signal input	Switching value	Negative control
7	Seat switch	Switching value	Negative control
8	Switching value 2	Standby switching value 2	Control polarity can be set
9	Left turn signal input+	Switching value (isolated)	Positive control
10	CAN1_ H	CAN1 port (CAN Open, non isolated)	Matching resistor built-in
11	CAN1_ L		
12	CAN2_ H	CAN2 port (SAE J1939 (isolated)	Matching resistor built-in
13	CAN2_ L		
14	Switching value 4	Standby switching value 4	Control polarity can be set
15	PWM_ In	Connected to speed sensor	Standby speed signal
16	Right turn signal input+	Switching value (isolated)	Positive control
17	Brake fault signal input	Switching value	Negative control
18	Analog signal input 2	Standby analog quantity	Resistance signal
19	Analog signal input 3	Standby analog quantity	Voltage signal
20	DC-DC power supply negative terminal	/	Isolating ground
21	IGN+	Connected to ignition switch	Instrument power-on trigger signal
22	Switching value 3(isolated)	Standby switch(isolated)	Positive control
23	Switching value 13(isolated)	Standby switch(isolated)	Positive control

2) Basic technical indicators and requirements of instruments

① Working voltage

Instrument working voltage range: DC18V～100V;

② Working and storage temperature

Operating temperature range of the instrument: -30℃～75 ℃;

Instrument storage temperature range: -40℃～85℃;

③ Communication interface

The instrument has two communication interfaces in accordance with CAN2.0B.

CAN1 port is standard frame CAN Open, baud rate is 125K bps, MOTOROLA data format. CAN2 port is an extended frame, the protocol is compatible with SAE J1939, the baud rate is 250K bps, Intel data format, with isolation.

④ ESD performance

Meet GB/T 19951-2005 (ISO10605:2001) standard contact discharge ±8KV, air discharge ±15KV, grade B or above.

⑤ Switching value

The input and output of instrument switch signal are shown in below table.

NO.	Function description	Icon	Colour	Normal working state	Alarm input status	remarks
1	Brake failure	(O)	red	CAN	CAN	
				Suspended	Low level	
2	Maintenance reminder	🔧	yellow	CAN	CAN	
3	High motor temperature	(M)	red	CAN	CAN	
4	Seat indication	💺	yellow	CAN	CAN	
				Low level	Suspended	
5	Seat belt indication	👤	red	CAN	CAN	
6	Parking indication	(P)	red	CAN	CAN	
				Low level	Suspended	
7	Low battery power	🔋	red	CAN, low battery alarm value can be set, 20% by default;		
8	slow mode	🐢	green	Press ▼ to switch the tortoise speed mode and light up the symbol indication		
9	Gear R	R	red	CAN	CAN	Gear interlock
	Gear N	N	green	software control	software control	
	Gear F	F	blue	CAN	CAN	
10	High temperature of electric control system	(C)	red	CAN	CAN	
11	Operating mode H	H	white	Switch the working mode through ▲ and light up the mode icon at the same time		Mode interlock
	Working mode N	N	white			
	Operating mode E	E	white			
12	Overload alarm indication	⚠	red	Software control, overload alarm value can be set, default is 110%.		
13	Lithium battery heating indication	🔋	green	CAN	CAN	

NO.	Function description	Icon	Colour	Normal working state	Alarm input status	remarks
14	Left turn indicator light	←	green	High potential	Suspended	
15	Right turn indicator light	→	green	High potential	Suspended	

3) Input and display requirements of function indicator

① Vehicle speed

Vehicle speed comes from CAN message. The vehicle speed of the instrument is displayed by analog pointer + digital display, unit: km/h; Range: 0～30km/h; Display accuracy: 0.1km/h.

② Working hours

The working hours are displayed digitally. Unit: h; Range: 0～99999.9h; Display accuracy: 0.1h. Input signal: accumulated working hours will start when the instrument is powered on;

③ Battery power SOC

Battery power comes from CAN message. The battery power meter is displayed by the segment meter + digital meter.

Unit: percentage of rated capacity, range: 0～100%, display accuracy: 1%.

④ Load weight

The output signal of the load sensor (pressure transmitter) is a voltage signal with a voltage range of DC0.5～4.5V. The load weight is collected and displayed by the instrument. The display form is digital display; Unit: kg; Range: 0～150% of rated load; Display accuracy: 1% of full scale.

The system error of the load signal sampled by the instrument is ±5% of the rated load.

The instrument has overload alarm function, and the overload limit can be set through the instrument. The default overload limit is 110% of the rated load.

⑤ Wheel steering angle

Wheel steering angle is from CAN message.

The steering angle display mode is analog pointer display. Unit: °; Range: ±90°; Display accuracy: 1°.

⑥ Gantry tilt angle

Gantry tilt angle is from CAN message.

The gantry tilt angle is displayed digitally. Unit: °; Range: ±20°; Display accuracy: 1°

⑦ DC+5V output

The instrument outputs 1 circuit of 5V power supply to supply power to the load cell (pressure transmitter). The+5V power output has automatic protection functions for ground, positive pole of input power, overload, etc.

※ **Note: the load capacity of the+5V power supply is not more than 200mA;**

⑧ Protection grade of instrument enclosure

The protection grade of instrument enclosure is IP65.

⑨ Symbols

Alarm symbols

The instrument alarm symbols are shown in below table.

NO.	Function description	Icon	Colour	remarks
1	Brake failure		red	Sound when alarming
2	Maintenance reminder		yellow	Sound and text prompt when alarming
3	High motor temperature		red	Sound and text prompt when alarming
4	Seat indication		yellow	
5	Seat belt indication		red	
6	Parking indication		red	
7	Low battery power		red	Light on when≤ 20% Sound and text prompt when≤10%
8	High temperature of electric control system		red	Sound and text prompt when alarming
9	Overload alarm indication		red	Sound when alarming

Speedometer

The speedometer shows the current speed of the forklift in km/h.

The vehicle speed signal is sampled by the controller.

The controller sends it to the instrument for display via CAN bus.

Percentage of electricity (SOC)

The electricity meter (SOC) displays the current percentage of remaining battery power.

The power is sampled by BMS controller.

The controller sends it to the instrument for display via CAN bus.
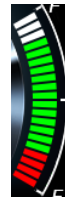
Wheel steering angle

The rear wheel steering angle signal comes from the controller.

The display range is ‑90 degrees to 0 degrees to 90 degrees.

The rear wheel angle function can be turned on or off by entering the [Rear wheel angle function] interface in the [Function setting] menu

4) Instrument menu

There are four buttons below the cluster to operate and set the cluster.

Menu/back:

① Press this button to enter menu interface from main working interface.

② Back to last level (While the cluster is not in main working interface).

Up: Move the select cursor up.

Down: Move the select cursor down.

Enter: Enter to next level.

① System status interface

After enter menu interface, select "system status" and press enter button.

② Running parameters interface

After enter menu interface, select "Running parameters" and press enter button.

When using lithium battery, 6, 7, 8, 9 will show data.

③ Display settings interface

After enter menu interface, select "display settings" and press enter button.

In the display setting interface, the brightness of the LCD screen, time and language can be set. There are three languages, Chinese, English and Korean.

④ Weight calibration interface

The load weight signal comes from the sensor, and directly connected to cluster. In order to improve the weighing accuracy, the weighing sensor will be calibrated in the process of truck debugging.

Calibration of weight sensor

➢ Enter fork weight
➢ Enter load weight
➢ Confirm parameter

After enter menu interface, select "Weight calibration" and press enter button to start calibrating of weight sensor.

⑤ Function settings

After enter menu interface, select "function setting" and press enter button.

OPS setting

After enter function setting interface, select "OPS setting" and press enter button.

This number means duration of alarm.

※ **Alarm when: Parking system is not working and operator is not on the seat whatever power on or off.**
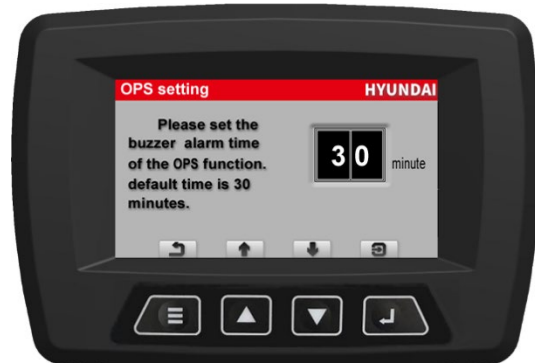
Gantry Tilt Angle

This function is not currently implemented.

Weighing display (OPT)

After enter function setting interface, select "Weighing display" and press enter button.

Wheels Steering Angle

This function is not currently implemented.

Hourly meter management

After enter function setting interface, select "Hourly meter management" and press enter button. It will be used after truck debugging in factory only. Then hourly meter works normally.

7. BATTERY CHARGER

This chapter explains basic information related to charger to help you easily understand and use it. This includes the contents from the way to install a charger to tips for emergency situations. This is focused on practices aiming to be usefully utilized in the field

1) Installation

The diameter of the AC input cable installed in single HWBC26 charger must be more than $6mm^2$, and the power distribution circuit breaker capacity must be more than 63A. $6mm^2*3C(A/B/C)$ $+4mm^2*1C(PE)$ 4-core copper cable is recommended.

⚠ **Only electricians who have received professional training and obtained working certificate can install this power system. Never violate the relevant safety regulations.**

⚠ **The system voltage is 380VAC, which is a dangerous voltage. Insulation protection should be made during installation.**

⚠ **Make sure the power system is not powered on if need to operate the power system inside the cabinet. The input of the power system and the battery must be disconnected.**
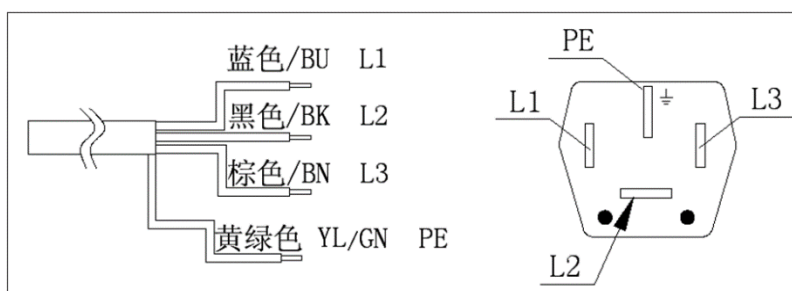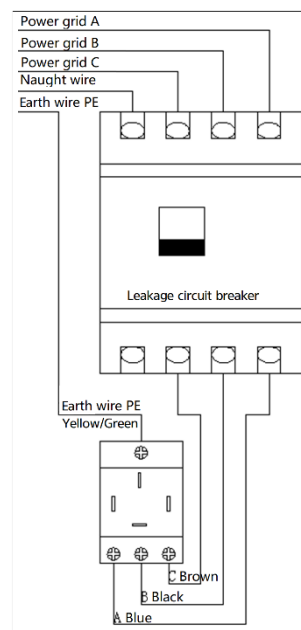
2) Charge

Before using the charger, professionals must check:

① Whether the battery and the charger match.

② Confirm that the battery is correctly connected to the charging machine.

③ The ground cable must be grounded reliably.

④ Open the liquid cover or seal cover.

⑤ Do not smoke near the battery while charging.

⑥ No fireworks in the vicinity while charging.

※ **Do not charge different types of batteries in series or parallel.**

Charge step：

① Connect to battery.

② Connect to power.

⚠ **Do not pull down the charging plug before closing the charger. Otherwise, an electric spank may cause a fire or even an explosion!**

Charge state adjustment switch

① When the battery charging effect is poor, this switch could adjust the charging conditions.

② If battery runs low, adjust the switch to "0" or "Ⅱ", then battery capacity charged could be 5% or 10% more than in "Ⅰ" charging state.

③ If the electrolyte is consumed too fast or battery temperature too high during charging, switch to "0" or "Ⅰ" which means battery capacity charged could be 5% or 10% less than before.

Switch	Ⅰ	0	Ⅱ
coefficient	1.1	1.15	1.2

Charging mode

Off/On button:

Pause the charging, then it can be disconnected. Restart the charging after connecting.

Information button:

➤ Press for 5 seconds to switch to BALANCE CHARGING, balance light will be on.

➤ Press for 10 seconds to switch to DESULFURIZATION CHARGING, desulf light will be on.

➤ Press for 15 seconds to switch to FIRST CHARGING, desulf light and balance light will be on.

➤ Press for 3 seconds to cancel last three charging mode.

➤ Press for 2 seconds to enter inquiring interface.

Pilot light and backlight

➤ Backlight is white when charging normally.

➤ Off/On: Green light will be on when charging normally. Red light will be on when charging paused and backlight will be yellow,

➤ Full: Full light will be on when charging has been finished and backlight will be green.

➤ Error: Backlight will be red and there will be a code in screen when there is an error.

BALANCE CHARGING

It means must to balance charging when in the flowing condition:

➢ Once a month in normal using.

➢ Battery is totally empty or discharge current is too big.

➢ The voltage of a single battery is less than 1.75V or less than 1.8V for more than three times after using.

In balance charging, test the electrolyte density of the battery every 1-2 hours until the electrolyte reached 1.280±0.005g/cm3(25℃). If the density is higher than the specified value, add distilled water and continue to charge 0.5-1 hours, in order to make the electrolyte density uniform, Balance charging is end when density difference of each cell electrolyte is no more than 0.01g/cm3.

DESULFURIZATION CHARGING

Plate of the battery is vulcanized

➢ Capacity of battery decline obviously than normal

➢ Electrolyte gravity is lower than that of other batteries working at the same time, or much lower than normal

➢ The voltage rises quickly when charging, and drops quickly when discharging,

Causes of battery plate vulcanization

➢ Excessive discharge

➢ Lack of charging for a long time, or prolonged half discharge

➢ The level of electrolyte is too low

➢ The proportion of electrolyte is too large

➢ Battery has not been charged in time when it has been storage.

FIRST CHARGING

The accumulated amount of power charged into the battery, which should be 5~6 times the rated capacity of the battery, the voltage of each battery is above 2.7-2.75V, at this time, the electrolyte bubble. After the proportion of electrolyte is adjusted, the voltage does not rise for three hours, indicating that the battery is fully charged.

Batteries have been first charged before leaving the factory, and users no longer need to perform additional first charging.

3) Inner part
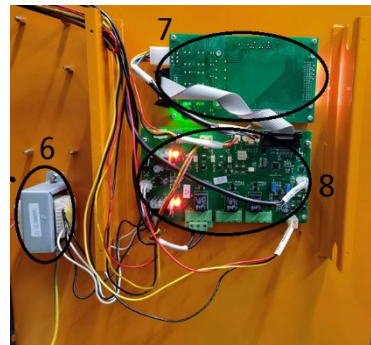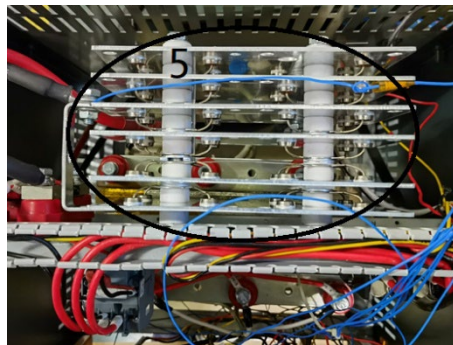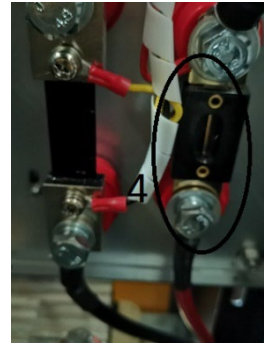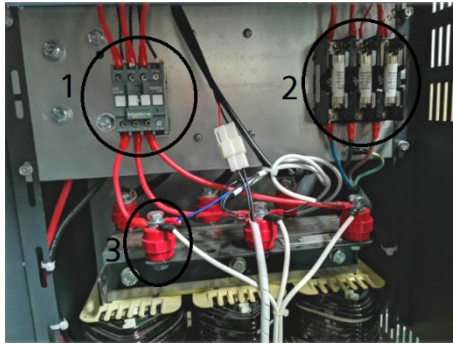
| 1 | Three-phase contactor | 4 | Output fuse | 7 | Display |
| 2 | Input fuse | 5 | Plate rectifier bridge | 8 | Controller |
| 3 | Transformer | 6 | Slave transformer | | |

4) Troubleshooting

| No.	Code	Reason	Troubleshooting
1	E-1	Battery is disconnecting	Connect to battery
2	E-2	Voltage of battery is too low or the battery does not match	Check
3	E-3	Charge error	Check controller of charge
4	E-4	Voltage of battery is too high or the battery does not match	Check
5	E-5	Voltage of battery is too high	Check controller of charge and battery
6	E-6	Input phase loss protection	Check input fuse
7	E-9	The charger output overcurrent	Check controller of charge and battery
8	E-10	The rectifier bridge of the charger is overheating	Check the radiator of the charger and rectifier bridge
9	E-11	The charger transformer is overheating	Check the radiator of the charger and transformer
10	E-15	The charger input undervoltage	Check input voltage
11	E-16	The charger input overvoltage	Check input voltage
12	F-21	Battery is shedding while charging	Check output fuse

8. Lithium Battery (OPT)

1) STRUCTURE

① Battery pack
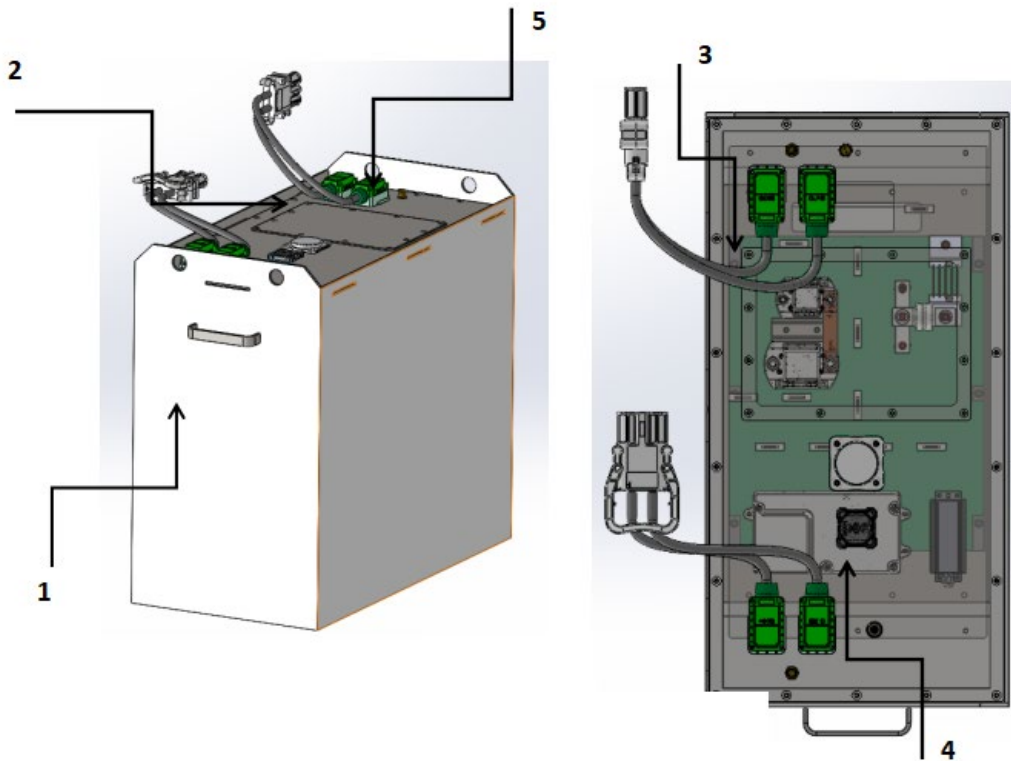
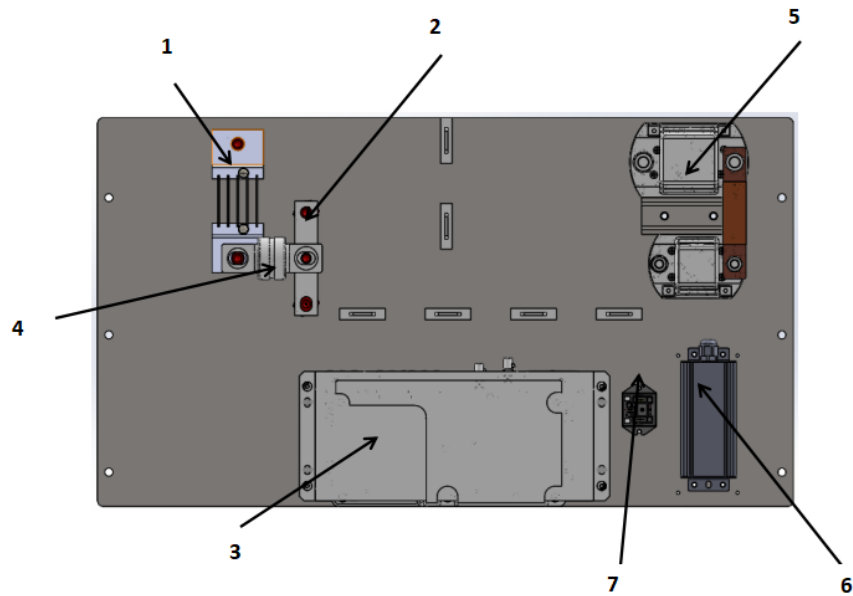|					
1	Housing	3	Module	5	Cable
2	Top case	4	BMS		

② Battery module
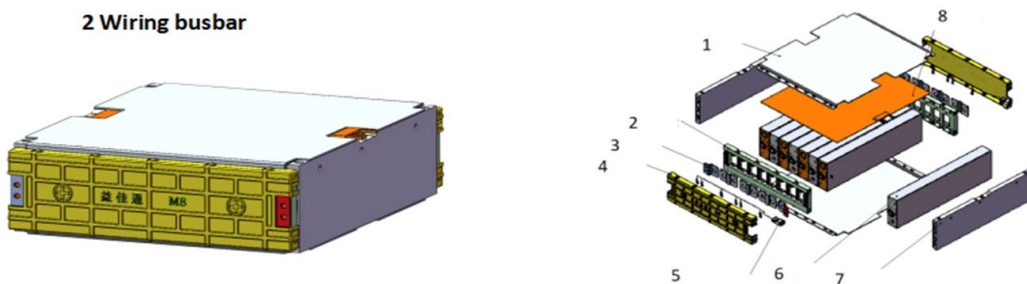
1	Aluminum cover plate	4	Plastic cover	7	End plate
2	Wire harness bracket	5	Acquisition harness	8	Heating plate
3	Tandem array	6	Electric core		

③ Electrical board

1	Diverter	4	Fuse	6	DC-DC
2	Wiring busbar	5	Relay	7	Relay
3	BMS				

2) INSPECTION PROCEDURES

① Daily inspection before starting

➢ Make sure that the battery pack charging terminal (DIN320 connector) is disconnected on the

➢ charge.

➢ Check the battery pack charging terminal for fixed state.

➢ Check the battery pack charging terminal for damage.

➢ Check the battery pack charging terminal and system load for fixed state.

② Measures for abnormality before starting

Voltage on charging and discharging terminals of battery pack.

➢ Servicing is required for troubleshooting of failure by molten relay, short on both ends of relay.

➢ Servicing is required in cases of function failure of BMS, or power supply to BMS.

Measures for poor stationary conditions of charging and discharging terminals of battery pack.

➢ Check tightening status of bolts of charging/discharging terminals.

➢ Fasten the bolt at specified torque.

③ Damage of battery pack charging terminal Damage of battery pack charging terminal

➢ Replace with specified connector (DIN320).

➢ Checking for defects after start stopping Checking for defects after start stopping

➢ Check if starting is stopped before connecting charging terminal on battery pack charging terminal.

➢ Check if voltage is detected before connecting charging terminal on battery pack charging

terminal.

> ➤ Check the battery pack charging terminal for damage.

④ Measure for defects after start stopping Measure for defects after start stopping

When starting is not stopped When starting is not stopped

> ➤ Starting should be stopped.

Voltage detected on charger terminal Voltage detected on charger terminal

> ➤ Make sure that starting is stopped. If so, take servicing action.
> ➤ Failure by molten relay is suspected. Take servicing action.

Charging terminal of charger or battery pack damaged Charging terminal of charger or battery pack damaged

> ➤ Replace with specified connector (DIN320)

3) Precautions

① It is strictly prohibited to work outdoors in rain and snow weather, to prevent the battery from entering water. In transportation and installation, waterproof measures should also be taken.

② Battery overload work is strictly prohibited.

③ When the battery is used in summer, pay attention to the ambient temperature (not higher than 50 degrees), and the charging area should not be exposed to the sun.

④ When the battery is used in winter, the vehicle needs to heat before working:
First turn on the power and let the vehicle run slowly for 5-10 minutes, then stop and slowly stretch the crane boom, avoid battery not active at low temperature, causing large current battery discharge and even over-current protection.

⑤ It is recommended to charge the battery before SOC lower than 20%. If over-discharge, the battery life will be affected (do not overcharge).

⑥ Keep high SOC of lithium battery to protect the cell, fully charge when not in use.

⑦ When charging wait till the charger stop and calibrated automatically. (Not fully charged for a long time will lead to a deviation from the actual SOC.)

⑧ Long-term storage requires charging and maintenance every three months.
Before using it again, please confirm that the power battery system has no fault alarm. Please contact our after-sales service for maintenance when needed.

4) Fault codes and phenomena of lithium battery

Code	Fault information	Fault grade
1	BMS CUTBACK	Secondary fault，Traction speed reduced to 50%
2	BMS INHIBIT	Limit traction and oil pump functions
3	BMS ALARM	First-class fault, Show only fault codes. Vehicles are unlimited
4	BMS INHIBIT	Limit traction and oil pump functions
5	BMS INHIBIT	Tertiary fault，Limit traction and oil pump functions，After 30S, the battery will automatically cut off power
6	discharge cell temp.low_1	First-class fault

Code	Fault information	Fault grade
7	discharge cell temp.low_2	Secondary fault
8	discharge cell temp.low_3	Tertiary fault
9	discharge cell temp.hig_1	First-class fault
10	discharge cell temp.hig_2	Secondary fault
11	discharge cell temp.hig_3	Tertiary fault
12	cell voltage low_1	First-class fault
13	cell voltage low_2	Secondary fault
14	cell voltage low_3	Tertiary fault
15	cell voltage high_1	First-class fault
16	cell voltage high_2	Secondary fault
17	cell voltage high_3	Tertiary fault
18	cell voltage differ_1	First-class fault
19	cell voltage differ_2	Secondary fault
20	cell voltage differ_3	Tertiary fault
21	cell temp. differ_1	First-class fault
22	cell temp. differ_2	Secondary fault
23	cell temp. differ_3	Tertiary fault
24	SOC LOW_1	First-class fault
25	SOC LOW_2	Secondary fault
26	SOC LOW_3	Tertiary fault
27	discharge current high_1	First-class fault
28	discharge current high_2	Secondary fault
29	discharge current high_3	Tertiary fault
30	Module lost connection_1	First-class fault
31	Module lost connection_2	Secondary fault
32	Module lost connection_3	Tertiary fault
33	cell temp.sensor fault_1	First-class fault
34	cell temp.sensor fault_2	Secondary fault
35	cell temp.sensor fault_3	Tertiary fault
36	total voltage low_1	First-class fault
37	total voltage low_2	Secondary fault
38	total voltage low_3	Tertiary fault
39	total voltage high_1	First-class fault
40	total voltage high_2	Secondary fault
41	total voltage high_3	Tertiary fault
42	discharging relay fault_1	First-class fault
43	discharging relay fault_2	Secondary fault
44	discharging relay fault_3	Tertiary fault
45	battery leakage_1	First-class fault
46	battery leakage_2	Secondary fault
47	battery leakage_3	Tertiary fault
49	Battery heating .Vehicle stops	First-class fault

5) Troubleshooting

Faults	Description	Fault causes	Troubleshooting	Remark
Battery cannot charge, can discharge	The vehicle can work normally, no alarm from buzzer, charger display: please connect the battery.	· Charging plug loose. · Poor wire contact of charging relay. · The charging relay stuck.	· Reconnect the charging plug. · Check the connection of charging relay power line. · Replace relay.	The stuck relay may close temporally if being beaten, replace it once new parts is available.
	The vehicle can work normally, no alarm from buzzer, charger display: communication error.	· The CAN pin-out of charging plug not match. · The charging plug CAN pin break.	· Replace the CAN pin-out of battery or charger plug. · Reinstall the CAN line of charging plug.	
	Output voltage still there after turning off the vehicle key switch. Buzzer alarm and charger display: please connect the battery.	Discharge relay contact adhesion	Replace the discharge relay.	
Unable to charge, unable to discharge	Vehicle cannot move, buzzer alarms, the charger has a voltage and no current	Charging relay contact adhesion	Replace the charging relay	
	Vehicle cannot move, fault alarm level 3 (not including SOC low)	Level 3 fault alarm	Check the relevant components and parameter settings according to the fault code	
	Vehicle cannot move, cannot charge	· Switch fault or switch wiring disconnected · Fuse damage · DC damage · BMS fault · Low SOC due to battery over-discharge or long-time storage.	· Replace the switch or wiring repair · Replace the fuse and check other components · Replace DC · Replace BMS · Recharge the battery	Do check the vehicle short circuit if the fuse is damaged and the relay is contact adhesion. (Battery without auxiliary power supply.)

Faults	Description	Fault causes	Troubleshooting	Remark
	Vehicle cannot move, cannot be charged, charger display: please connect the battery.	The fuse is damaged.	Replace the fuse	Battery with auxiliary power supply.
Can be charged, unable to discharge	The battery can be charged, unable to discharge	DC damage	Replace DC	Battery with auxiliary power supply.
Short charging time and short discharge time	The battery is fully charged very quickly when charging, and the power supply drops very quickly when discharging.	· Module cell breakdown. · BMS wiring harness damage. · BMS parameter setting error.	· Replace the module · Replace the BMS wiring harness · Reset the BMS parameter or update the program	
Small charging current	Charging current value is much less than the BMS request current, fault indicator of charger is on.	Some module of the charger fails	Replace the charger module or replace the charger directly	Charging current value is much less than the BMS request current, fault indicator of charger is on.
	Charging current of the charger is about 30A @ 0-5℃	Low temperature	Charging current 30A @ 0-5℃is normal, current will returns and fault code disappears with the increase of cell temperature.	Charging current of the charger is about 30A @ 0-5℃
Low SOC	Alarm when SOC > 15%: (for example 22%′60%)	· BMS failure · BMS wiring broken or loose · Battery unused for a long time (actual voltage is inaccurate)	· Replace BMS · Replace or reinforce the wiring harness of connector · Battery full charge then calibrate	Low SOC
Intermittent power failure	The vehicle is powered off repeatedly during operation	· Relay power line poor contact · Relay breakdown	· Check the relay power line and reinforce it. · Replace the relay.	Poor power supply by BMS; excessive battery pressure difference will cause the same fault.

9. Lithium Battery Charger

1) Parameters

Project	Parameter Index	
All-in-one type	CD18-80V100ALI	CD18-80V200ALI
DC Output		
Maximum Output Power	10kW	20kW
Rated Output Current	100A	200A
Output Voltage Range	30VDC ~ 100VDC	40VDC ~ 100VDC
Current Limit Adjustable Range	2A ~ 100A、 2A ~ 200A	
Peak-to-peak Noise	≤1%	
Stabilization Accuracy	≤±0.5%	
Steady Flow Accuracy	≤±1%	
Current Sharing	≤±3%	
Effectiveness	Overall efficiency≥94%	
Protection	Short circuit, over current, over voltage, reverse connection, current backflow protection	
AC Input		
Rated Input Voltage	Three-phase four-wire system 380Vac±15%	
Input Voltage Range	280Vac ~ 480Vac	
Input Current	20A	40A
Frequency	45Hz ~ 65Hz	
Power Factor (PF)	≥0.99	
Current Distortion	≤5%	

Project	Parameter Index
Input Protection	Overvoltage, undervoltage, phase loss, overcurrent protection
Working Environment Conditions	
Working Temperature	-30℃~55℃ normal operation；57℃~75℃ derating output；75℃or more shutdown protection
Storage Temperature	-30℃~75℃
Relative Humidity	0~95%
Altitude	≤2000m full load，2000~3000m in accordance with GB/T3859.2-1993 5.11.2 predetermined , derating
Product Safety and Reliability	
Dielectric Strength	Input‐output：3000VAC/10Ma/1Min Input‐Shell：2500VAC/10Ma/1Min Output‐shell：2500VAC/10Ma/1Min
	Input‐output：DC1000V〉20MΩ Input‐Shell：DC1000V〉20MΩ Output‐shell：DC1000V〉20MΩ
Dimensions and Weight	
Dimensions (Host)	481（length）×430（width）×731（height）
Protection Level	IP21
All-in-one Net Weight	51Kg
Other	
Output plug-in Specifications	Comply with GB/T 20234.1-2011 and GB/T 20234.3-2011
Cooling Method	Forced air cooling

2) Installation

① Installation and wiring of the charger

② Precautions for charger installation:
  ➢ Confirm the model and specifications of the charger.
  ➢ Check if the random materials and attachments are complete.
  ➢ Check whether the charger is damaged due to collision, water ingress, etc.
  ➢ Check whether the relevant electrical parts are loose or damaged.

③ Installation steps of charger:
  ➢ Confirm the working environment of the charger.
  ➢ Determine whether the AC power supply can meet.
  ➢ Unpacking and testing of the charger.
  ➢ Input line access.
  ➢ Power on.
  ➢ Trial run.

3) Charger interface
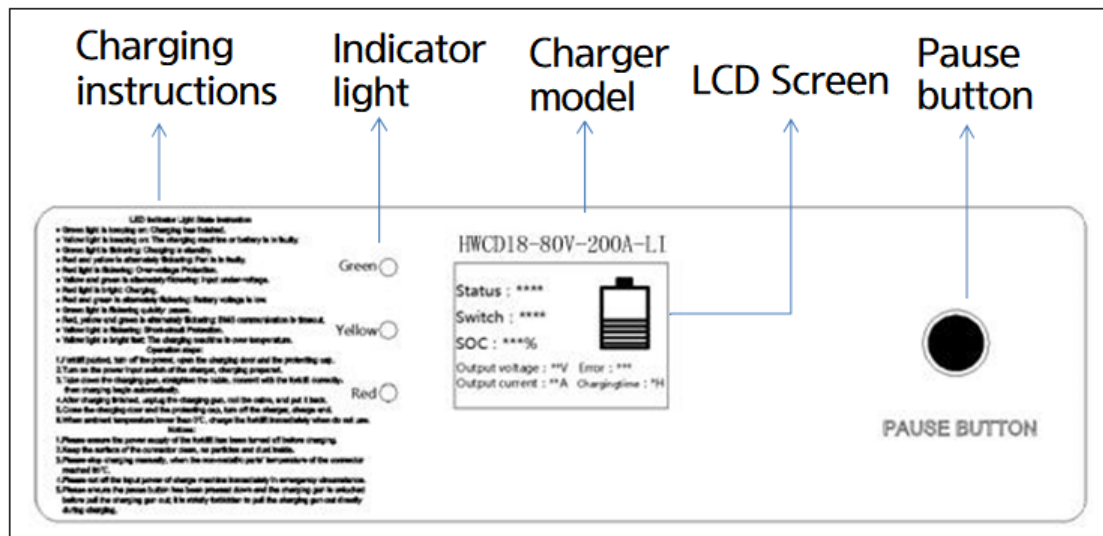
① Display status

Charger Status	Background	Battery Icon	Light Status
Standby	Blue	Blue	Flashing Green
Recharge	Green	Orange	Red lights Always On
Time Out	Blue	Orange	Flashing Red
Malfunction	Red	Orange	Fault Status Indication
Carry Out	Blue	Green	Steady Green
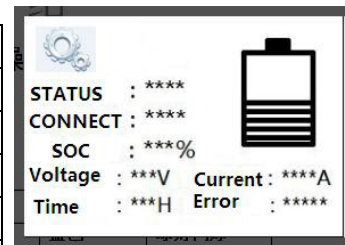
② Working status

There are 5 working statuses of this charger: "standby", "charge", "completed", "suspended" and "faulty".

Standby: When the charger is powered on, and the charging connector head is not connected to the battery or the connection is bad, the power display at this time is 0%, and the battery graphic shows 0 grid; when the charging connector head is unplugged during charging, it also shows standby.

Charging: The connector head is connected normally (CC1 confirms and the message is normal), at this time the battery level shows the battery level value.

Completion: charging is complete, the battery level shows 100%.

Pause: When the manual pause button is pressed, pause is displayed, output is stopped, and the battery power value is displayed on the battery level.

Fault: When the battery or the charger itself fails, the charging status becomes fault, the module stops output, the background color of the display is red, and the fault message indicates the fault phenomenon.

③ Charging connection

displayed as "normal" or "disconnected". Disconnected: "When the charging connector is pulled out" or "Switch S is pressed", it will display "Disconnected"; Normal: When the charging connection is normal, it will display "Normal".

④ LCD display page turning interface

Touch the dot mark ▤ on the display screen by hand to enter the next interface, enter the

charger and battery connection message and information, and then click the "return" mark to return to the previous interface.
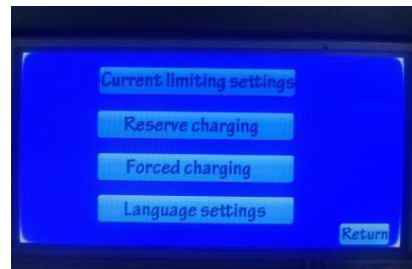
Touch with your hand to enter the next interface. There are three functions: current limit setting, scheduled charging, and forced charging.
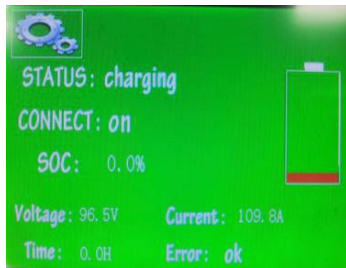
Normal charging   Message and information   Three functions

Password: 6666   Current limit setting   Schedule charging

Forced charging   Language setting

4) Charging operation steps

Step 1: charge preparation

① Park the forklift in the charging area and turn off the key switch of the vehicle.

② Open the vehicle charging compartment door and protective cover, and check the charging interface.

③ Confirm the status of the charger and check the charging connector.

Step 2: Charging starts

① Correctly connect the charging connector to the vehicle charging interface.

② Observe the charging connection and working status in the display of the charger, the display is blue. Wait for the charging confirmation for about 15 seconds, the charging current is normal, the display is green, and charging starts.

Step 3: End of charging

① After confirming that the charging current in the charger is displayed as 0A, pull out the charging connector correctly.

② The charger is not fully charged, and the display current is not 0A, please press the pause button, after the charging current is displayed as 0A, pull out the charging connector correctly.

③ Close the charging protective cover and hatch, and place the charging connector in a standard manner.

※ **Before charging, make sure that the power of the forklift is turned off.**

➤ Keep the surface of the charging interface clean, and there are no particles, dust and other debris in the interface.

➤ When the temperature of the non-metal part of the charging interface is too high, please stop charging immediately.

➤ Before pulling out the charging connector, please make sure that the charging is completed or press the charging pause button, and confirm that the charging current is displayed as 0A;

➤ The charging temperature range is: 0~40℃, low temperature environment below 0℃, please charge the vehicle immediately after use;

➤ When storing the vehicle, please make sure that the battery power is around 50%, and disconnect the battery from the vehicle.

5) Failure analysis

This smart charger intelligently recognizes the fault of the battery BMS, and displays the fault information on the charger interface. At the same time, it can self-check the charger's input and output current, voltage, and the temperature of the charging connector, and judge the charger fault based on this.

Fault query list

Fault Category	No.	Fault Information	ABBR.	Remark
Electric Supply Fault	1	Input under-voltage	Input under-volt	Check the electric supply.
	2	Input overvoltage	Input over-volt	
	3	Input fault	Input fault	
	1	Short circuit protect	Short circuit	Check the charger.
	2	Charger over-temperature protection	Charger overtemperature	
	3	Communication module timeout	CM timeout	
	4	Hardware fault	Hardware fault	
Battery Fault	1	Battery overcharge protect	BAT overcharge	Check the battery.
	2	Over-temperature protect	BAT overtemperature	
	3	Lower-temperature protect	Lower-temp	
	4	Cell voltage lower	Cell-volt lower	
	5	Charging overcurrent	Overcurrent	
	6	BMS Fault	BMS Fault	
	7	cells voltage difference	Cell-volt DIFF	
	8	cells Temp difference	Cell-temp DIFF	
	9	Insulation fault	Insulation fault	
	10	Undefined	Undefined	
Other Faults	1	BMS Timeout	BMS Timeout	Check the charger's connection.

Troubleshooting

NO.	Phenomenon	Information in LCD screen	Fault Investigations
1	LCD screen and LED lights on the panel don't brighten after starting machine.	LCD screen shows nothing.	1. Whether the three-phase switch on the side of the charger is in the ON position. 2. Check whether the input three-phase power is connected or not and whether lack of phase. 3. Whether the three-phase fuse in the charger fused. 4. Whether the 12V+ auxiliary power module in the charger is damaged. 5. Whether the 5V power on the LCD is normal. 6. Whether the LCD screen is broken.
2	It can't charge after starting machine. LCD screen brightens and green LED light flickers.	Status: standby Error: ok Voltage: 0V SOC: 0.0％	1. Whether connect the charging connector and the forklift well. 2. Click the battery icon to enter the next interface on LCD screen. If screen shows that 'Whether receive the message of the charger: 'NO'', the control panel of the charger was broken. 3. Whether receive the message of the charger: 'YES'. Whether receive the message of BMS: 'NO'. Check whether the +12V power of the charge connector A+ and A- is normal or not. If normal, it is the battery problem, please contact the battery manufacturer.
3	It can't charge after starting machine. LCD screen brightens and green LED light flickers.	Status: standby Error: ok Voltage: 0V SOC: 0.0％	1. Whether connect the charging connector and the forklift well. 2. Click the battery icon to enter the next interface on LCD screen. If it shows: Whether receive the message of the charger: 'NO'. Whether receive the message of BMS: 'NO'. ' The +12V power is broken. Please replace the +12V auxiliary power.

NO.	Phenomenon	Information in LCD screen	Fault Investigations
4	It can't charge after starting machine. LCD screen brightens and green LED light flickers.	Status: standby Error: ok Voltage: 0V SOC: **.*％	1. Confirm whether the charging connectors and sockets connect well. 2. Open the back door of charger, measure the voltage between positive and negative terminals with multi-meter, which connect the charging connector and the charger. 2.1 If voltage can't be measured, the battery has problem. 2.2 If voltage can be measured, then measure the voltage between OUT+ and OUT- terminals. If voltage still can be measured, then the control panel is broken. Otherwise, check further whether 300A fuse, pre-charge resistors and diodes between the two ends of the output contactor are broken or not.
5	It can't charge after starting machine. LCD screen and red LED light both brighten.	Status: standby Error: ok SOC: **.*％Battery Voltage: **.*％ Current: 0A	The output contactor is damaged (charging voltage reaches BMS demand voltage).
6	It charges after starting machine. LCD screen and red LED light both brighten. Charging current is less than BMS required current.	Status: standby Error: one module work SOC: **.*％ Voltage: **.*V Current: 100A	1. Check whether the input power of the charging module is normal and whether the connector is loose. 2. Check whether the output connector of the charging module is loose. 3. Check whether CAN communication connecting line is loose. If the above checks are normal, the charging module is broken.
7	It can't charge after starting machine. LCD screen and yellow LED light both brighten.	Status: fault Error: input fault Voltage: **.*V SOC: **.*％	Input is lack of phase. Check the fuse in L3 phase and three-phase circuit breaker of the charger. Electricity connected to the charger is lack of L3 phase.
8	It can't charge after starting machine. LCD screen and yellow LED light both brighten. Meanwhile, charger starts repetitively.	Status: fault Error: input fault Voltage: **.*V SOC: **.*％	Input is lack of phase. Check the fuse in L1 or L2 phase and three-phase circuit breaker of the charger. Electricity connected to the charger is lack of L1or L2 phase.