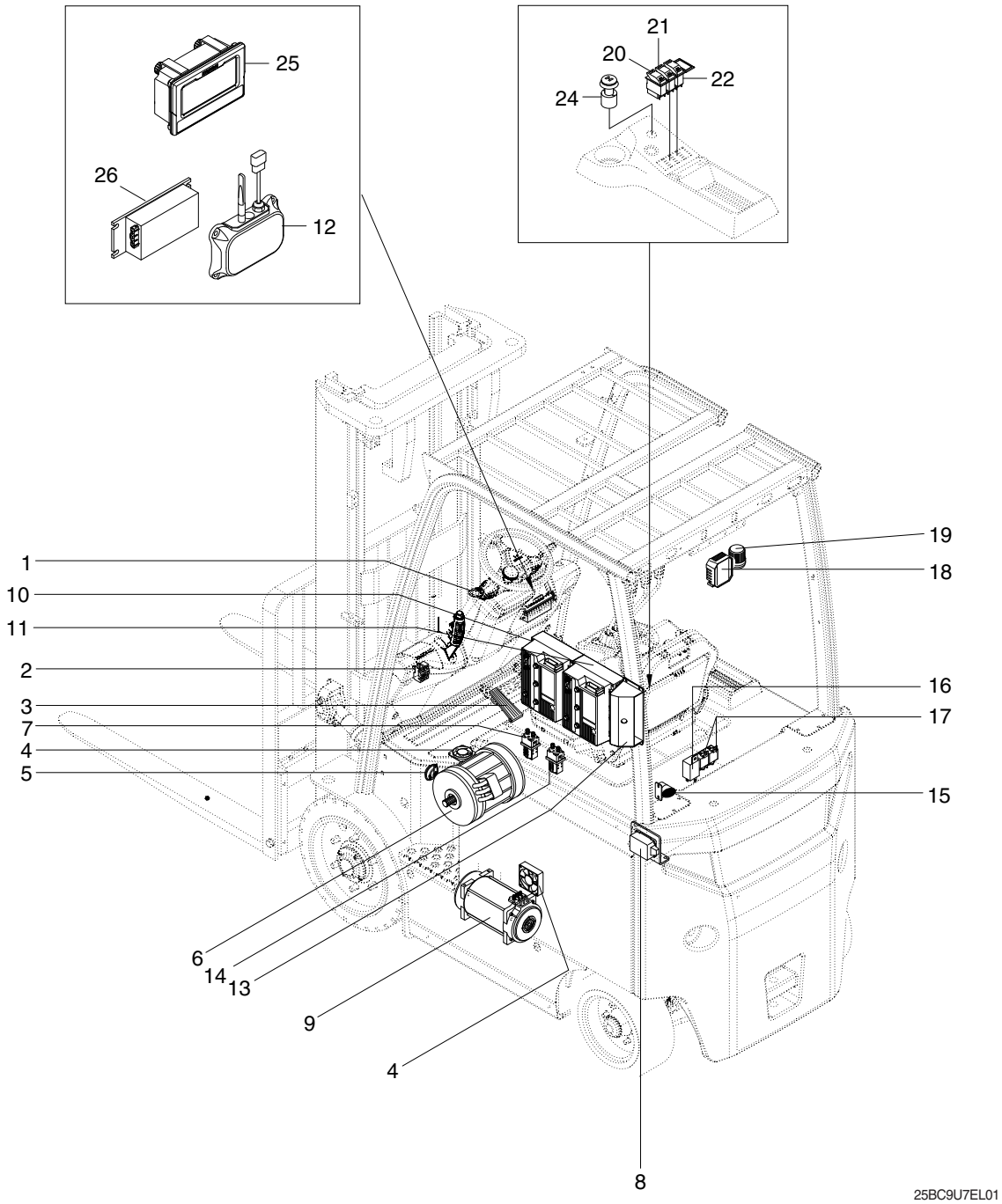
SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION



1	Combination switch	10	Pump controller	19	Beacon lamp (opt)
2	Parking micro switch	11	Traction controller	20	Head lamp switch (opt)
3	Accelerator assy	12	RMCU assy	21	Working lamp switch (opt)
4	Fan assy	13	Fan assy	22	Beacon switch (opt)
5	High horn	14	Contactor	24	Emergency switch assy
6	Drive motor	15	Back up alarm	25	Display
7	Contactor	16	Flasher unit assy	26	DC-DC converter
8	Fuse box assy	17	Relay		
9	Pump motor	18	Working lamp (opt)		

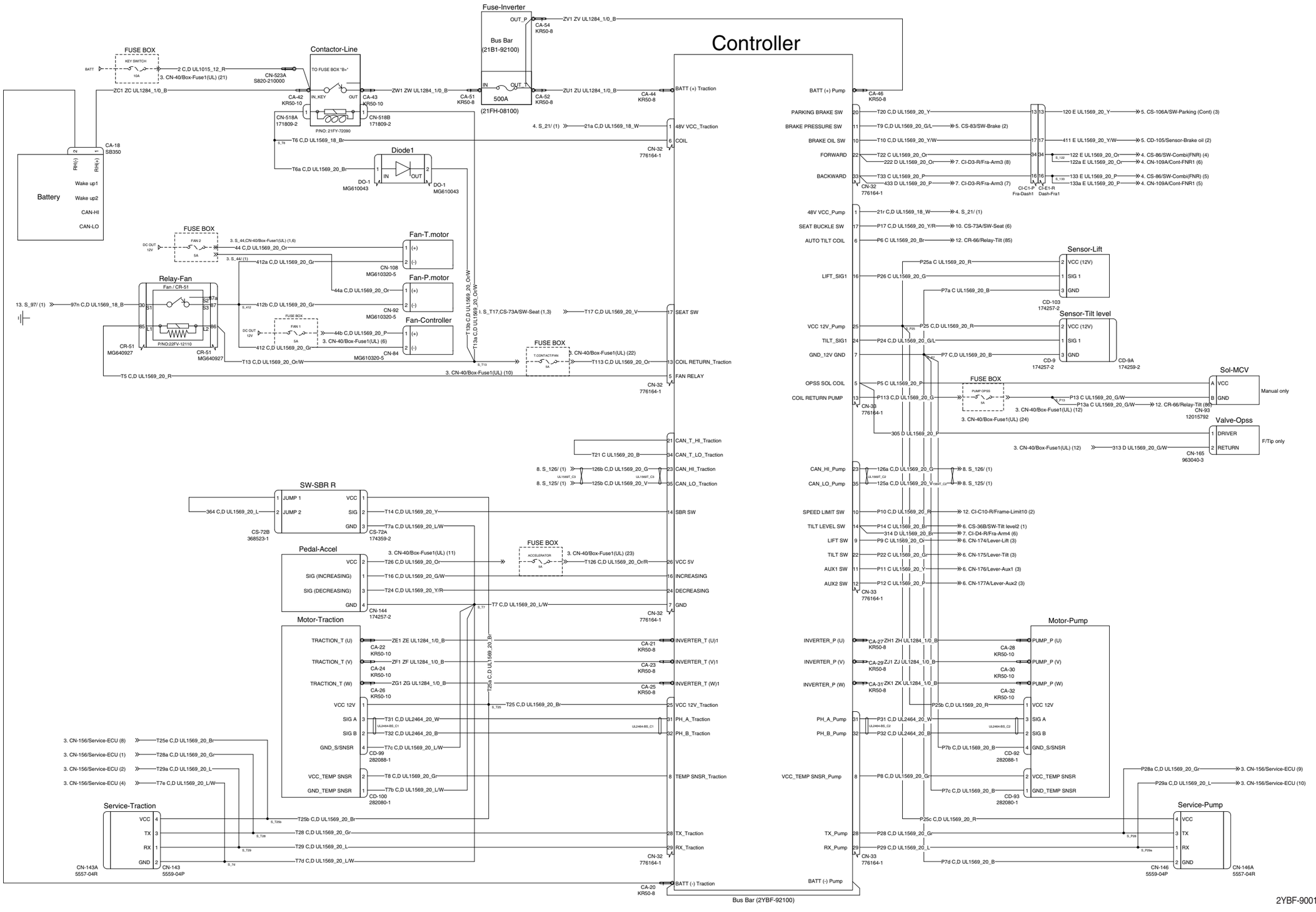
GROUP 2 ELECTRIC CIRCUIT DIAGRAMS

1. CODES IN ELECTRIC CIRCUIT DIAGRAMS

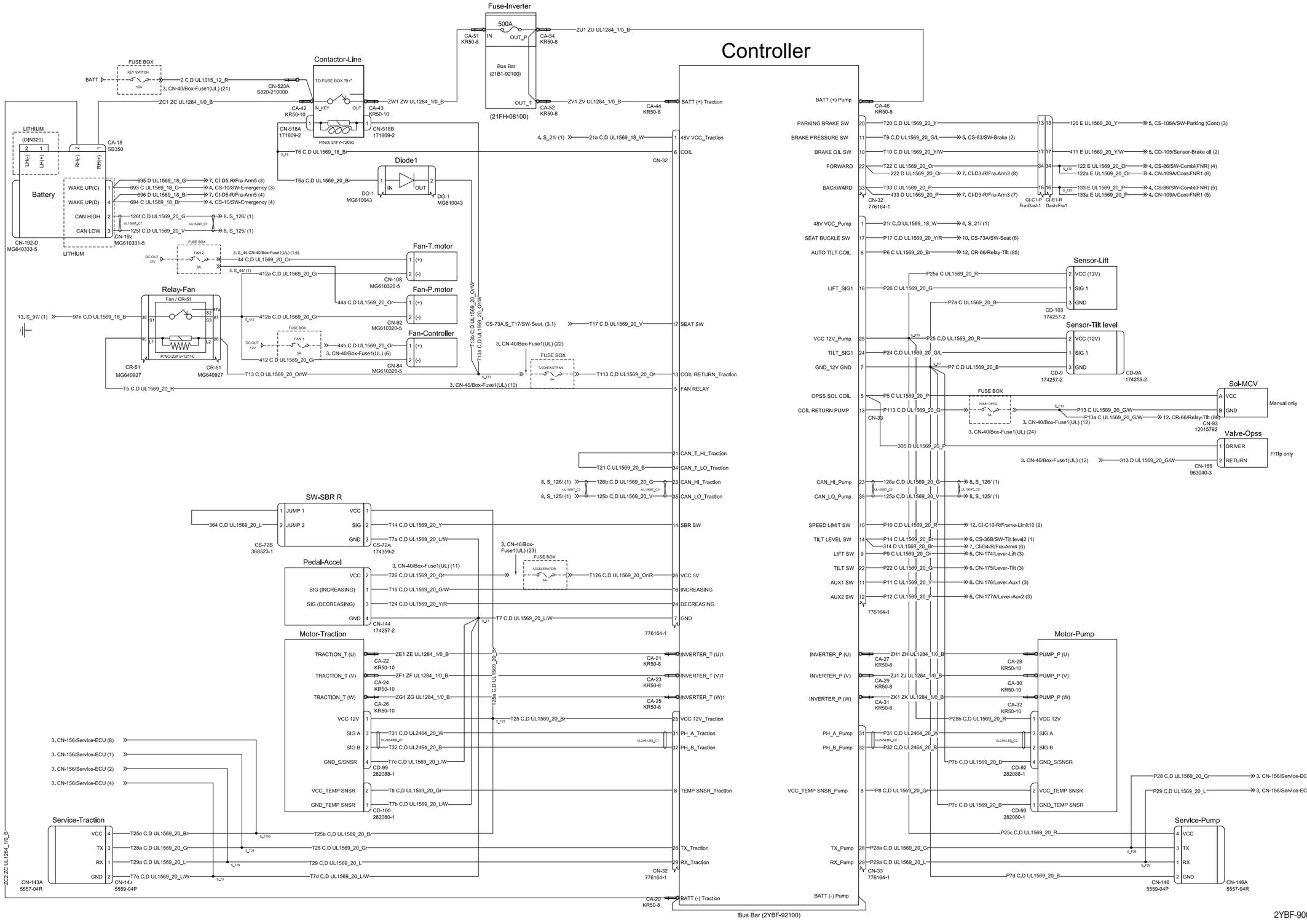
Code	Name
C	Frame harness (manual)
D	Frame harness (fingertip)
E	Dashboard harness
F	Cabin harness
GB	Overhead guard LH harness (LED)
GD	Overhead guard RH harness (LED)
JK	Red zone harness
K	Fingertip harness
L	Armrest harness
ME	RMCU harness
VA	Interlock clamp harness
Y	Lithium harness
ZC	Charging cable RH (Pb)
ZE	Drive motor cable (U)
ZF	Drive motor cable (V)
ZG	Drive motor cable (W)
ZH	Pump motor cable (U)
ZJ	Pump motor cable (V)
ZK	Pump motor cable (W)
ZU	Traction B+ cable
ZV	Pump B+ cable
ZW	L. contactor cable

2. ELECTRIC CIRCUIT DIAGRAMS

1) CONTROLLER AND MOTOR (25BC-9U : -#0002)

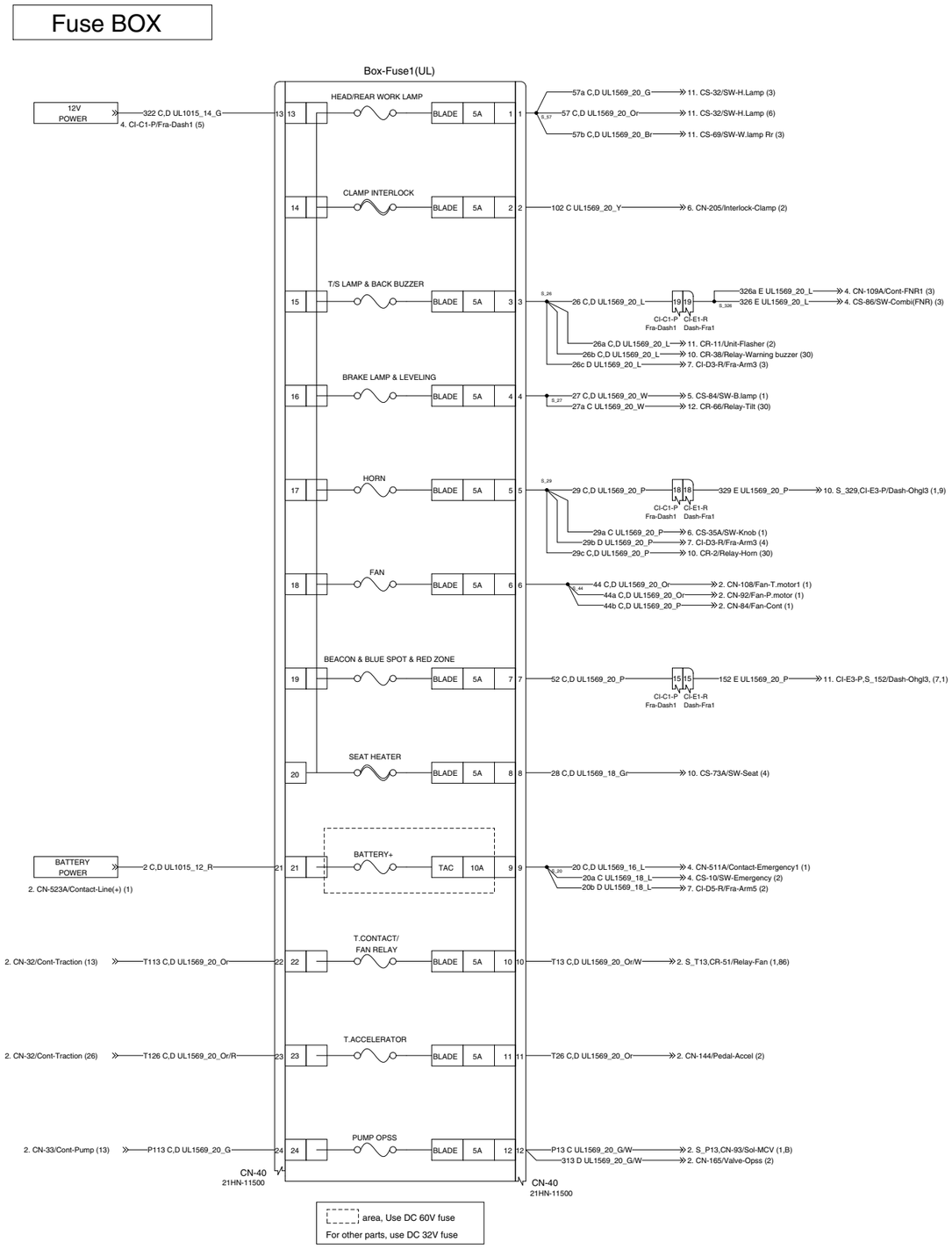


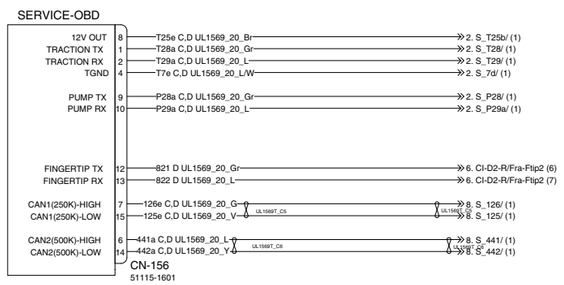
CONTROLLER AND MOTOR (25BC-9U : #0003-, 30/32BC-9U : #0001-)



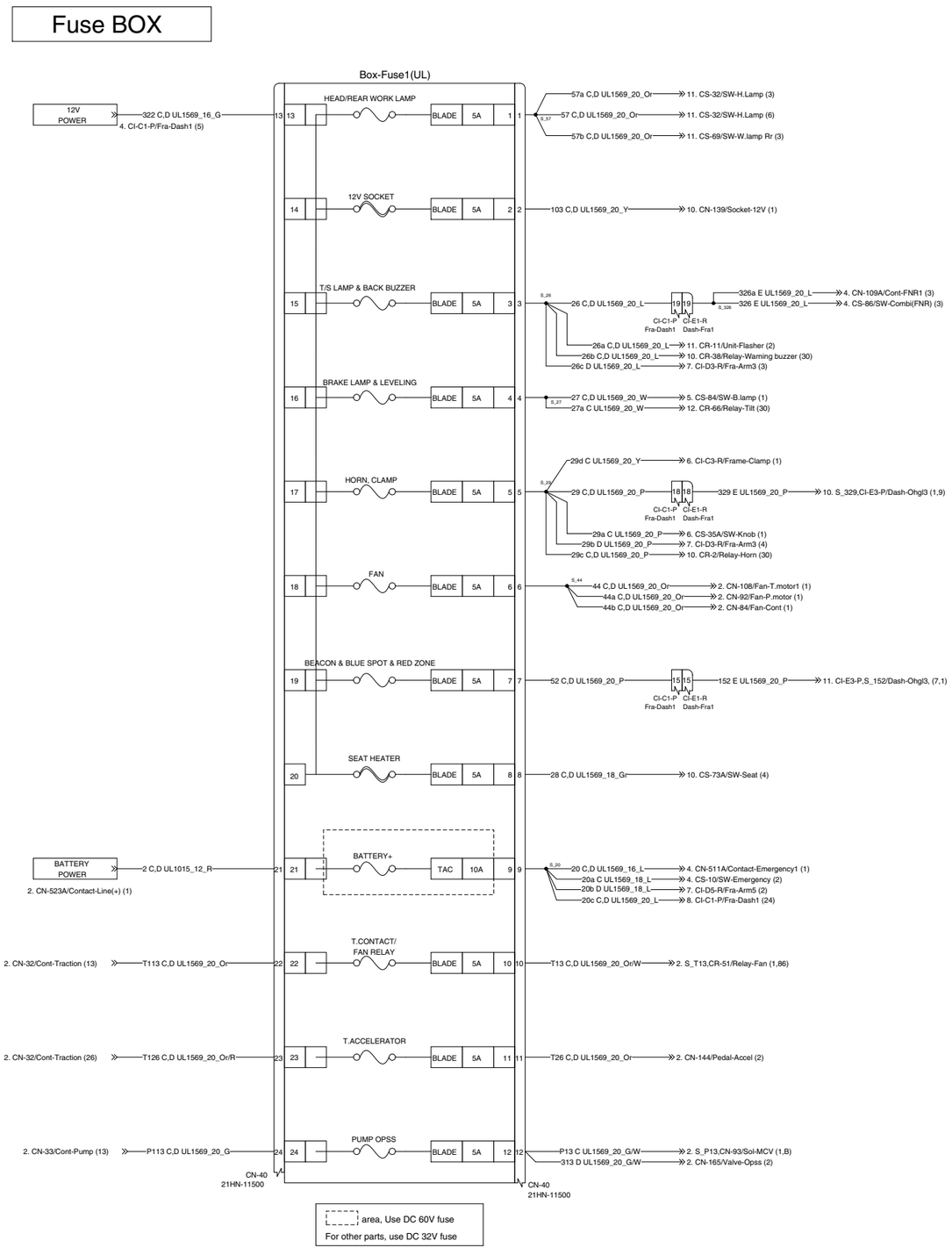
2YBF-90013-01 1OF12

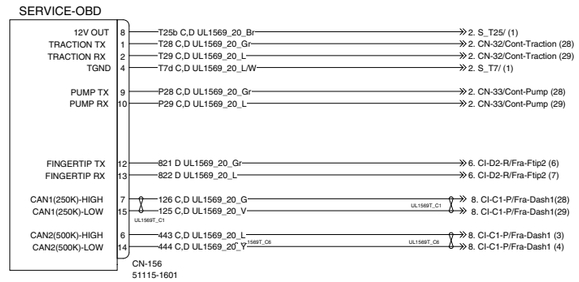
2) **FUSE BOX** (25BC-9U : -#0002)





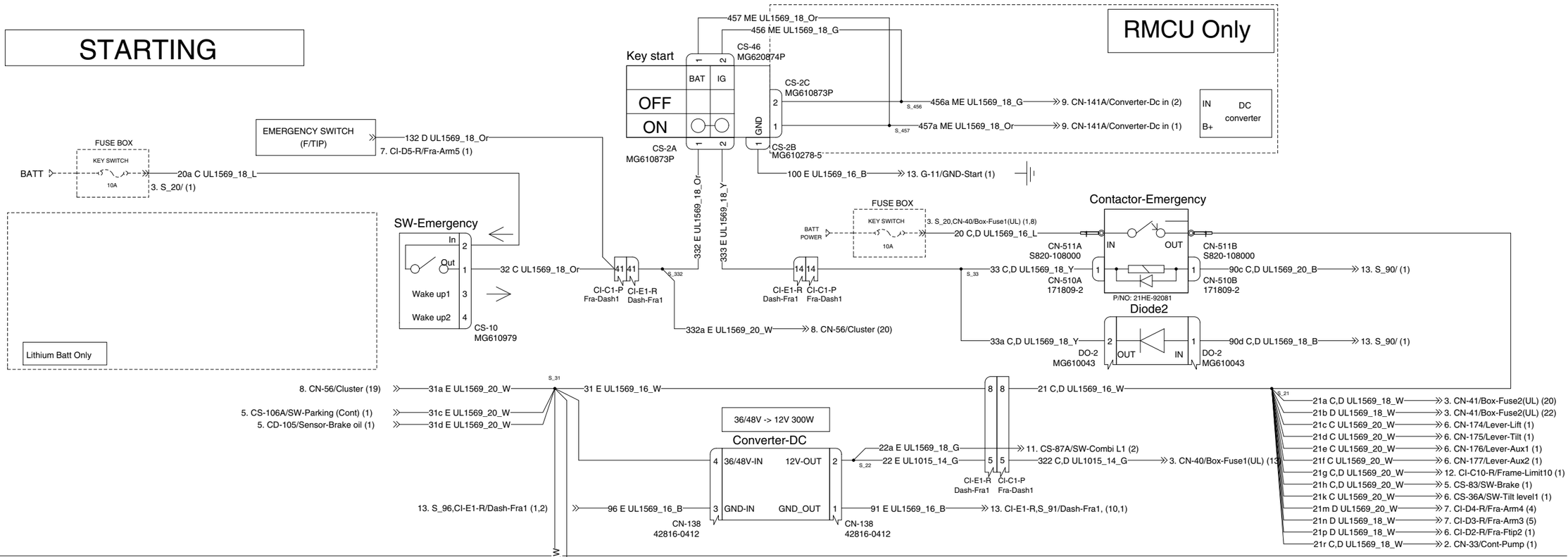
FUSE BOX (25BC-9U : #0003-, 30/32BC-9U : #0001-)



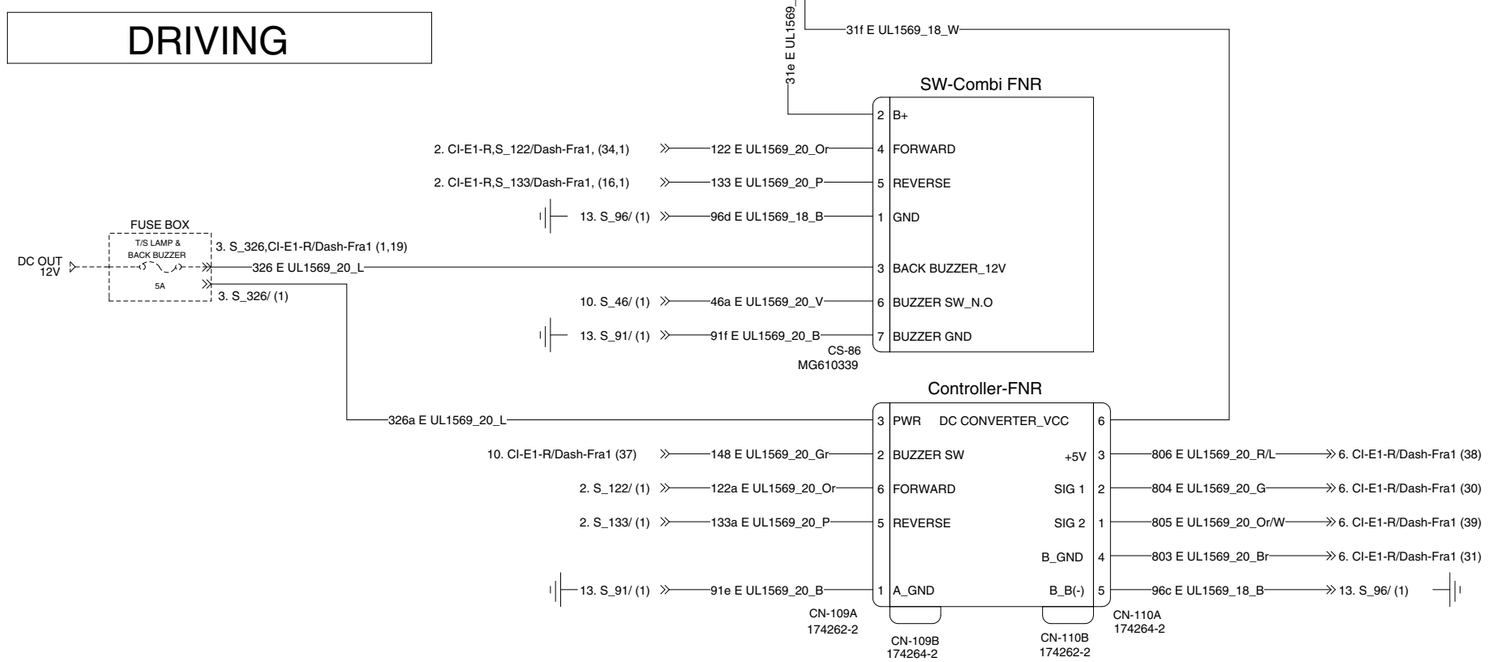


3) START AND DRIVE (25BC-9U : -#0002)

STARTING



DRIVING



2YBF-90011-00 3OF12

STARTING

RMCU Only

Key start

CS-46
MG620874P

	BAT	IG
OFF		
ON	○	○

CS-2A
MG610873P

CS-2C
MG610873P

CS-2B
MG610278-5

457 ME UL1569_18_Or
456 ME UL1569_18_G
S_456
456a ME UL1569_18_G » 9. CN-141A/Converter-Dc in (2)
S_457
457a ME UL1569_18_Or » 9. CN-141A/Converter-Dc in (1)
100 E UL1569_16_B » 13. G-11/GND-Start (1)

IN DC converter B+

EMERGENCY SWITCH (F/TIP)
132 D UL1569_18_Or
7. CI-D5-R/Fra-Arm5 (1)

FUSE BOX
KEY SWITCH
10A
BATT
20a C UL1569_18_L
3. S_20/ (1)

SW-Emergency
In(B) 2
Out(A) 1
Wake up(C) 3
Wake up(D) 4
32 C UL1569_18_Or
693 C UL1569_18_G » 2. CN-192/Batt-Li ion (1)
694 C UL1569_18_Br » 2. CN-192/Batt-Li ion (4)
CS-10
MG610979

332 E UL1569_18_Or
333 E UL1569_18_Y
41 41 CI-C1-P Fra-Dash1 CI-E1-R Dash-Fra1
14 14 CI-E1-R Dash-Fra1 CI-C1-P Fra-Dash1

FUSE BOX
KEY SWITCH
10A
BATT POWER
3. S_20,CN-40/Box-Fuse1(UL) (1,8)
20 C,D UL1569_16_L

Contactor-Emergency
CN-511A S820-108000
IN OUT
CN-511B S820-108000
CN-510A 171809-2
CN-510B 171809-2
P/NO: 21HE-92081
S_33
33 C,D UL1569_18_Y
90c C,D UL1569_20_B » 13. S_90/ (1)

Diode2
DO-2 MG610043
2 OUT IN 1
33a C,D UL1569_18_Y
90d C,D UL1569_18_B » 13. S_90/ (1)

S_31
8. CN-56/Cluster (19) » 31a E UL1569_20_W
31 E UL1569_16_W
5. CS-106A/SW-Parking (Cont) (1) » 31c E UL1569_20_W
5. CD-105/Sensor-Brake oil (1) » 31d E UL1569_20_W
8 8 21 C,D UL1569_16_W
S_21

36/48V -> 12V 300W
Converter-DC
4 36/48V-IN 12V-OUT 2
3 GND-IN GND_OUT 1
S_22
22b E UL1569_18_G » 10. P4401/ (1)
22a E UL1569_18_G » 11. CS-87A/SW-Combi L1 (2)
22 E UL1569_16_G
5 5 322 C,D UL1569_16_G » 3. CN-40/Box-Fuse1(UL) (13)
CI-E1-R Dash-Fra1 CI-C1-P Fra-Dash1
13. S_96,CI-E1-R/Dash-Fra1 (1,2) » 96 E UL1569_16_B
CN-138 42816-0412
91 E UL1569_16_B » 13. CI-E1-R,S_91/Dash-Fra1, (10,1)
CN-138 42816-0412

21a C,D UL1569_18_W » 3. CN-41/Box-Fuse2(UL) (20)
21b D UL1569_18_W » 3. CN-41/Box-Fuse2(UL) (22)
21c C UL1569_20_W » 6. CN-174/Lever-Lift (1)
21d C UL1569_20_W » 6. CN-175/Lever-Tilt (1)
21e C UL1569_20_W » 6. CN-176/Lever-Aux1 (1)
21f C UL1569_20_W » 6. CN-177/Lever-Aux2 (1)
21g C,D UL1569_20_W » 12. CI-C10-R/Frame-Limit10 (1)
21h C,D UL1569_20_W » 5. CS-83/SW-Brake (1)
21k C UL1569_20_W » 6. CS-36A/SW-Tilt level1 (1)
21m D UL1569_20_W » 7. CI-D4-R/Fra-Arm4 (4)
21n D UL1569_18_W » 7. CI-D3-R/Fra-Arm3 (5)
21p D UL1569_18_W » 6. CI-D2-R/Fra-Ftip2 (1)
21r C,D UL1569_18_W » 2. CN-33/Cont-Pump (1)

31e E UL1569_18_W

DRIVING

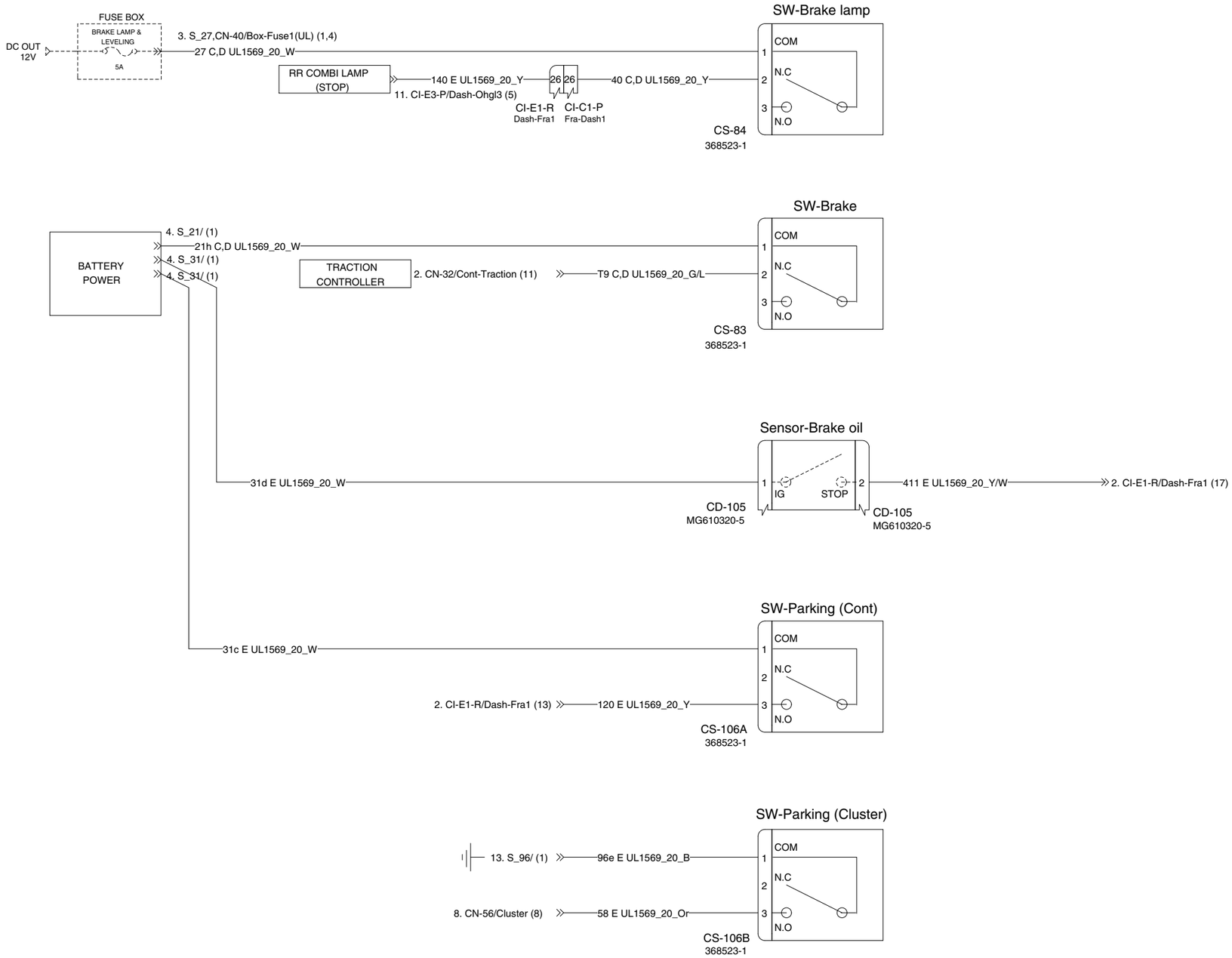
31f E UL1569_18_W

SW-Combi FNR
2 B+
2. CI-E1-R,S_122/Dash-Fra1, (34,1) » 122 E UL1569_20_Or — 4 FORWARD
2. CI-E1-R,S_133/Dash-Fra1, (16,1) » 133 E UL1569_20_P — 5 REVERSE
13. S_96/ (1) » 96d E UL1569_18_B — 1 GND
3 BACK BUZZER_12V
10. S_46/ (1) » 46a E UL1569_20_V — 6 BUZZER SW_N.O
13. S_91/ (1) » 91f E UL1569_20_B — 7 BUZZER GND
CS-86
MG610339

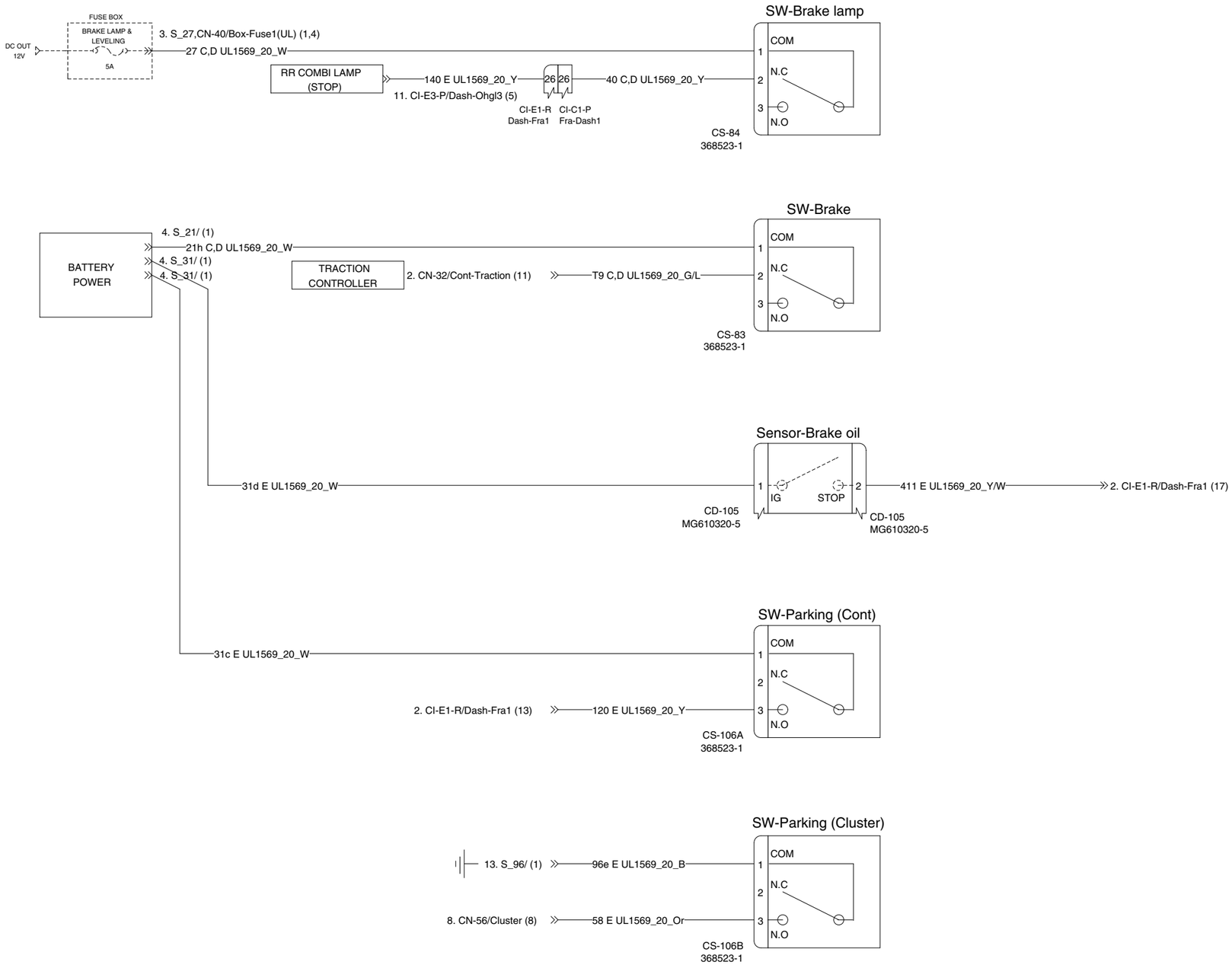
FUSE BOX
T/S LAMP & BACK BUZZER
5A
DC OUT 12V
3. S_326,CI-E1-R/Dash-Fra1 (1,19)
326 E UL1569_20_L
3. S_326/ (1)

Controller-FNR
326a E UL1569_20_L — 3 PWR DC CONVERTER_VCC 6
10. CI-E1-R/Dash-Fra1 (37) » 148 E UL1569_20_Gr — 2 BUZZER SW
2. S_122/ (1) » 122a E UL1569_20_Or — 6 FORWARD
2. S_133/ (1) » 133a E UL1569_20_P — 5 REVERSE
13. S_91/ (1) » 91e E UL1569_20_B — 1 A_GND
+5V 3 806 E UL1569_20_R/L » 6. CI-E1-R/Dash-Fra1 (38)
SIG 1 2 804 E UL1569_20_G » 6. CI-E1-R/Dash-Fra1 (30)
SIG 2 1 805 E UL1569_20_Or/W » 6. CI-E1-R/Dash-Fra1 (39)
B_GND 4 803 E UL1569_20_Br » 6. CI-E1-R/Dash-Fra1 (31)
B_B(-) 5 96c E UL1569_18_B » 13. S_96/ (1)
CN-109A 174262-2
CN-109B 174264-2
CN-110B 174262-2
CN-110A 174264-2

4) START AND STOP (25BC-9U : -#0002)

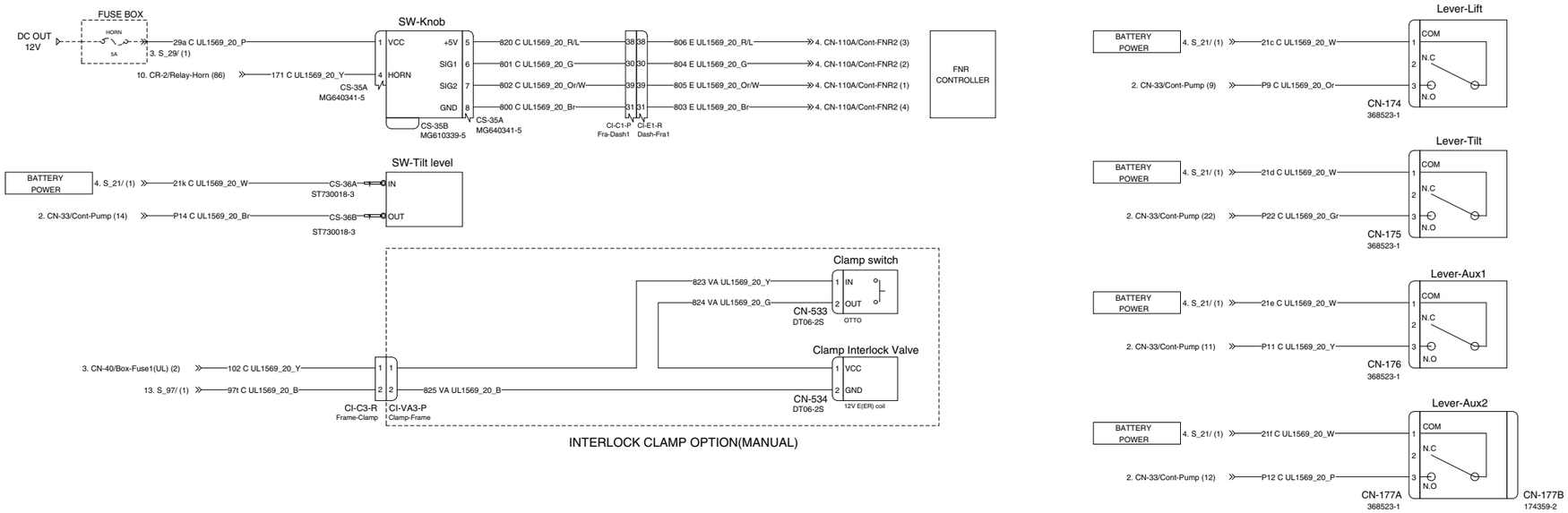


START AND STOP (25BC-9U : #0003-, 30/32BC-9U : #0001-)

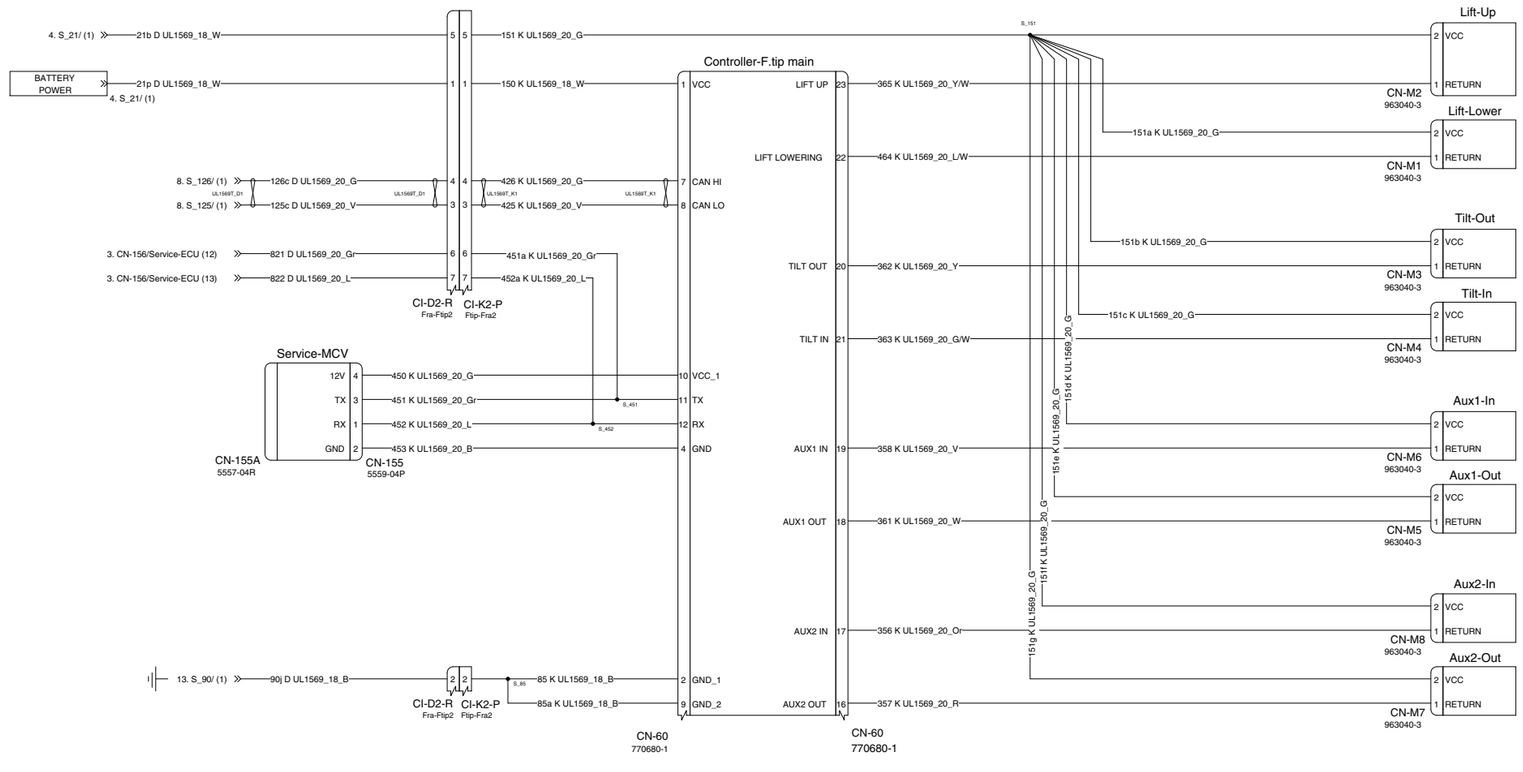


5) FINGERTIP, MCV (25BC-9U : -#0002)

MANUAL

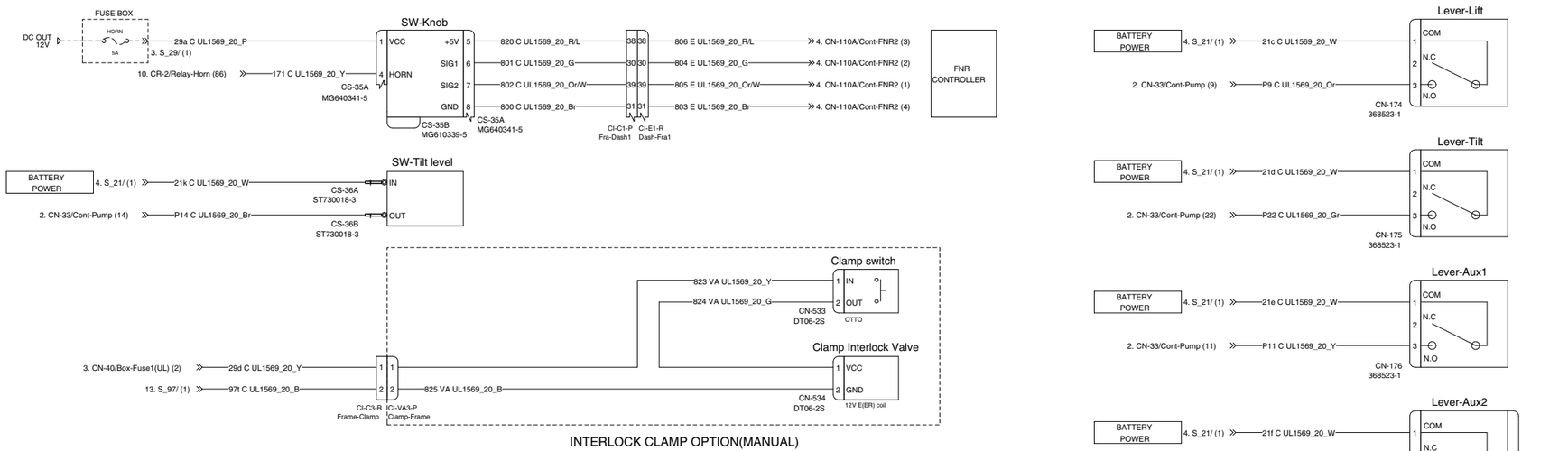


F/TIP

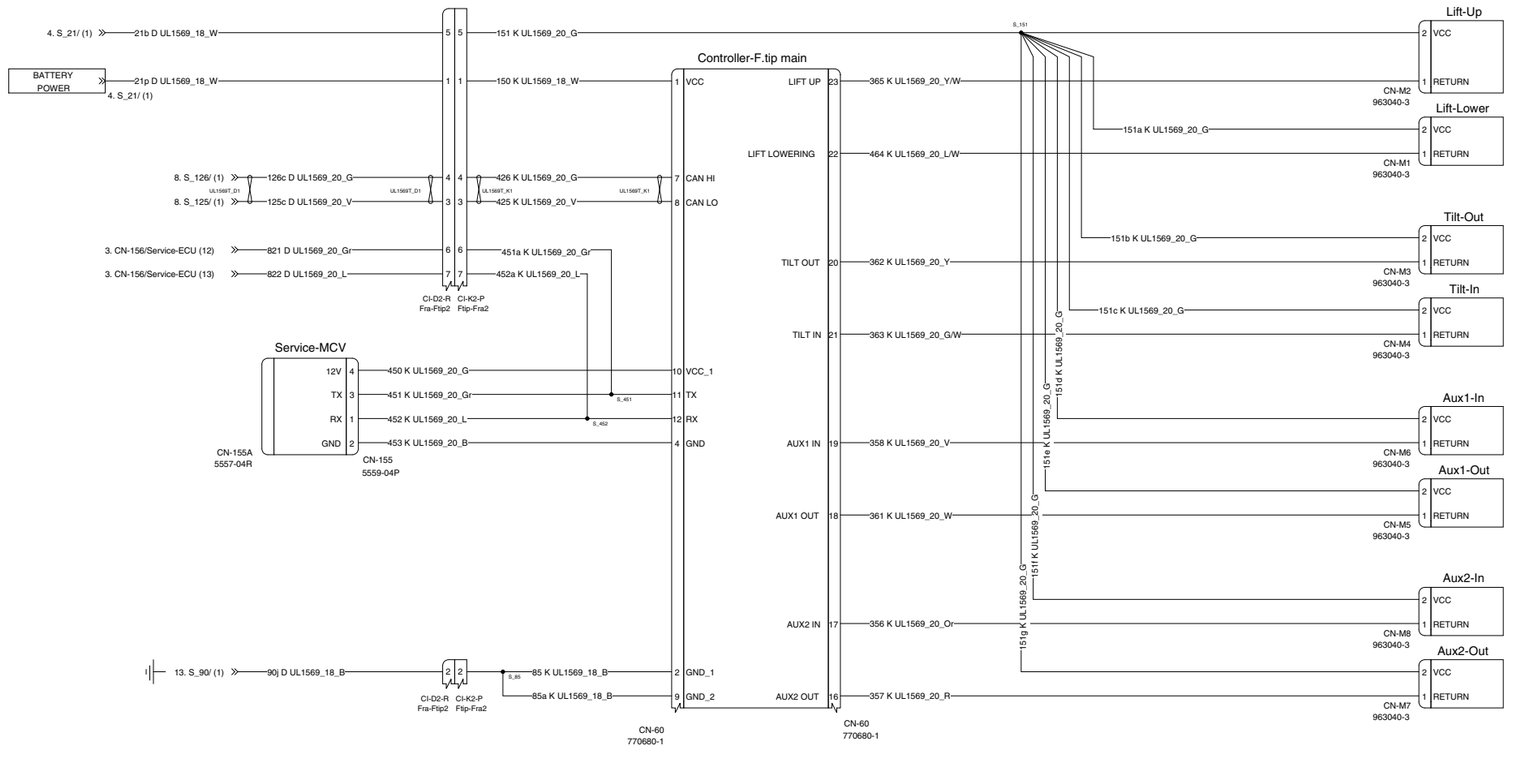


FINGERTIP, MCV (25BC-9U : #0003-, 30/32BC-9U : #0001-)

MANUAL

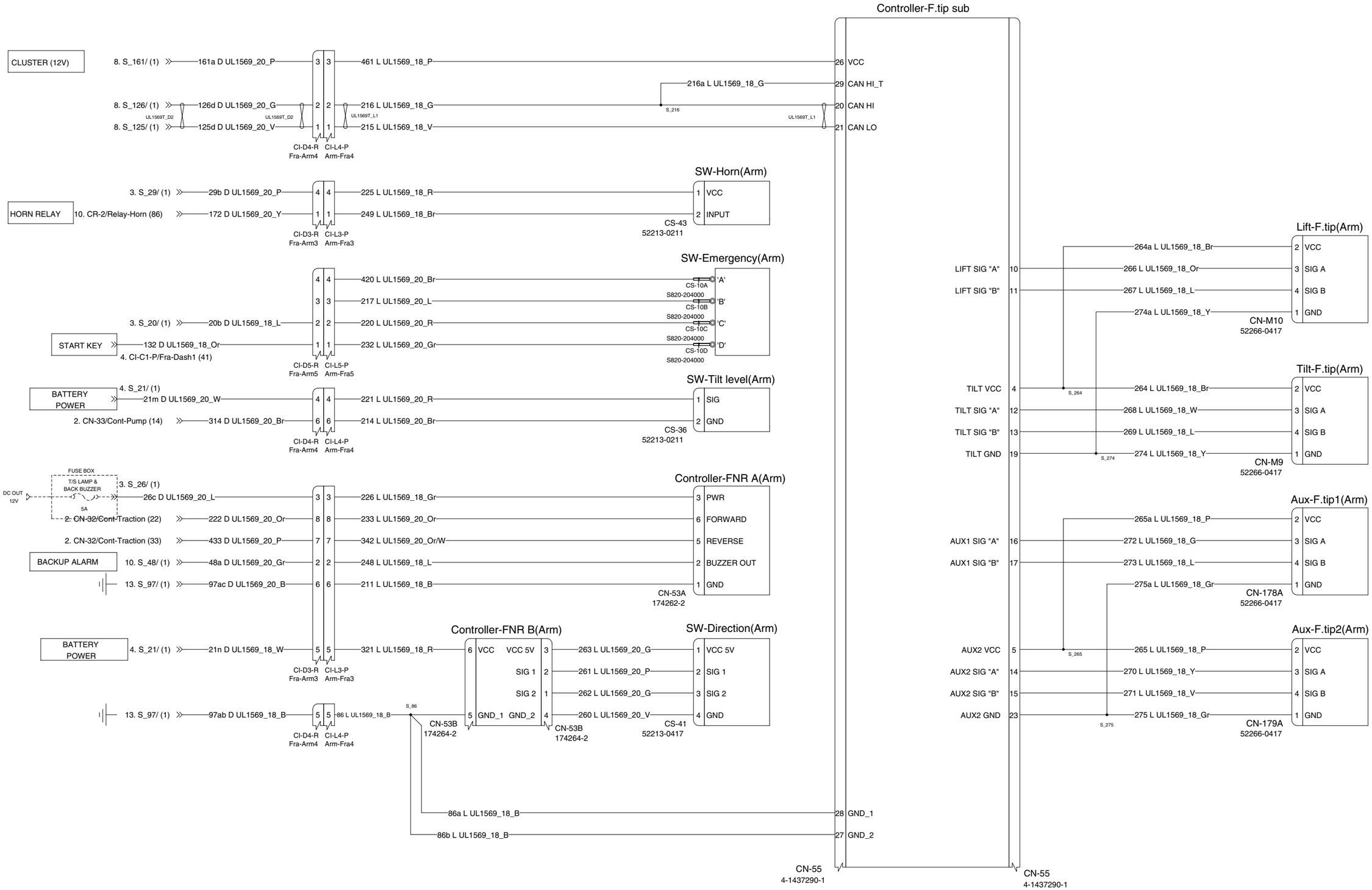


F/TIP



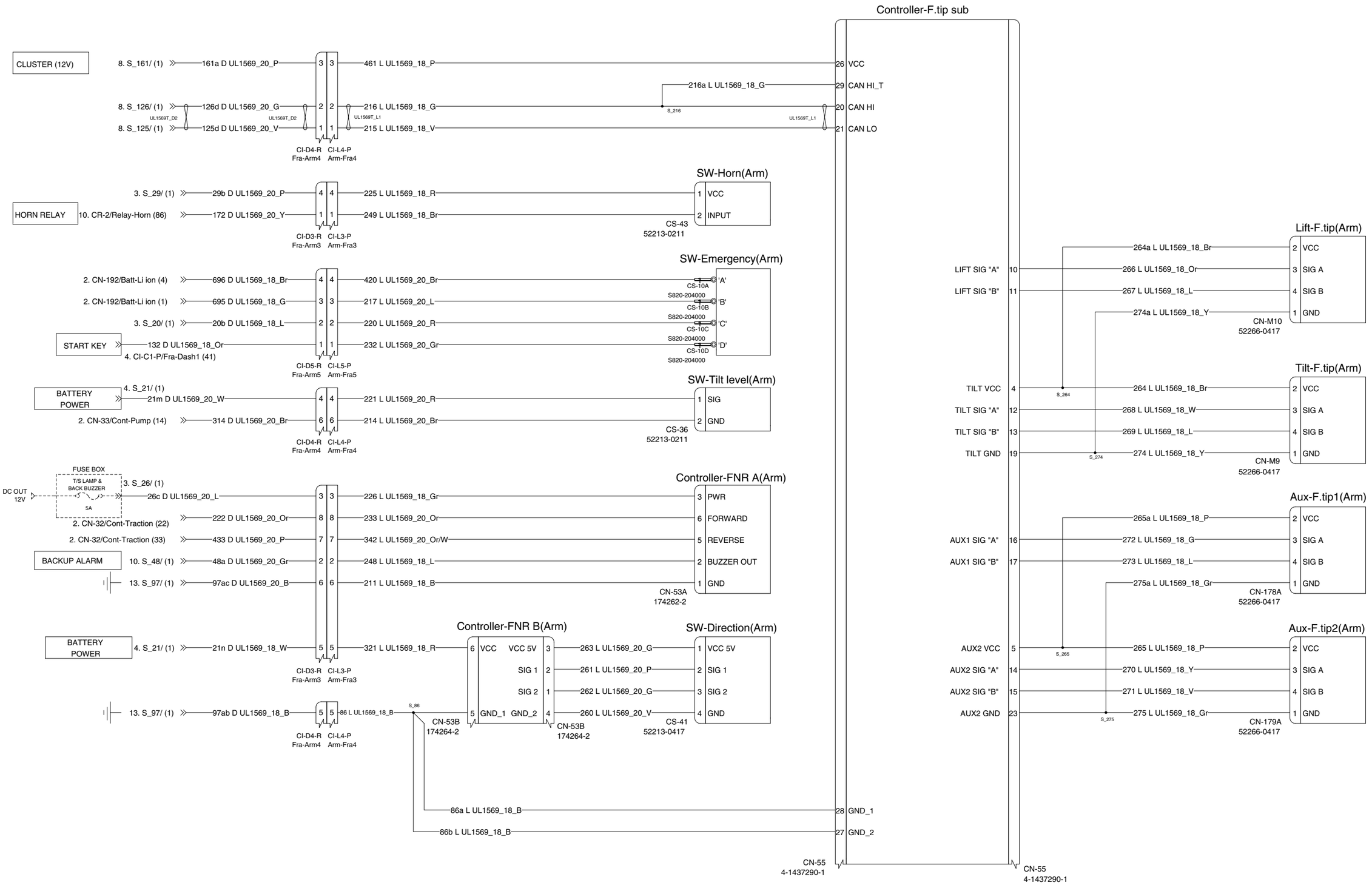
2YBF-90013-01 5OF12

6) FINGERTIP, ARMREST (25BC-9U : -#0002)



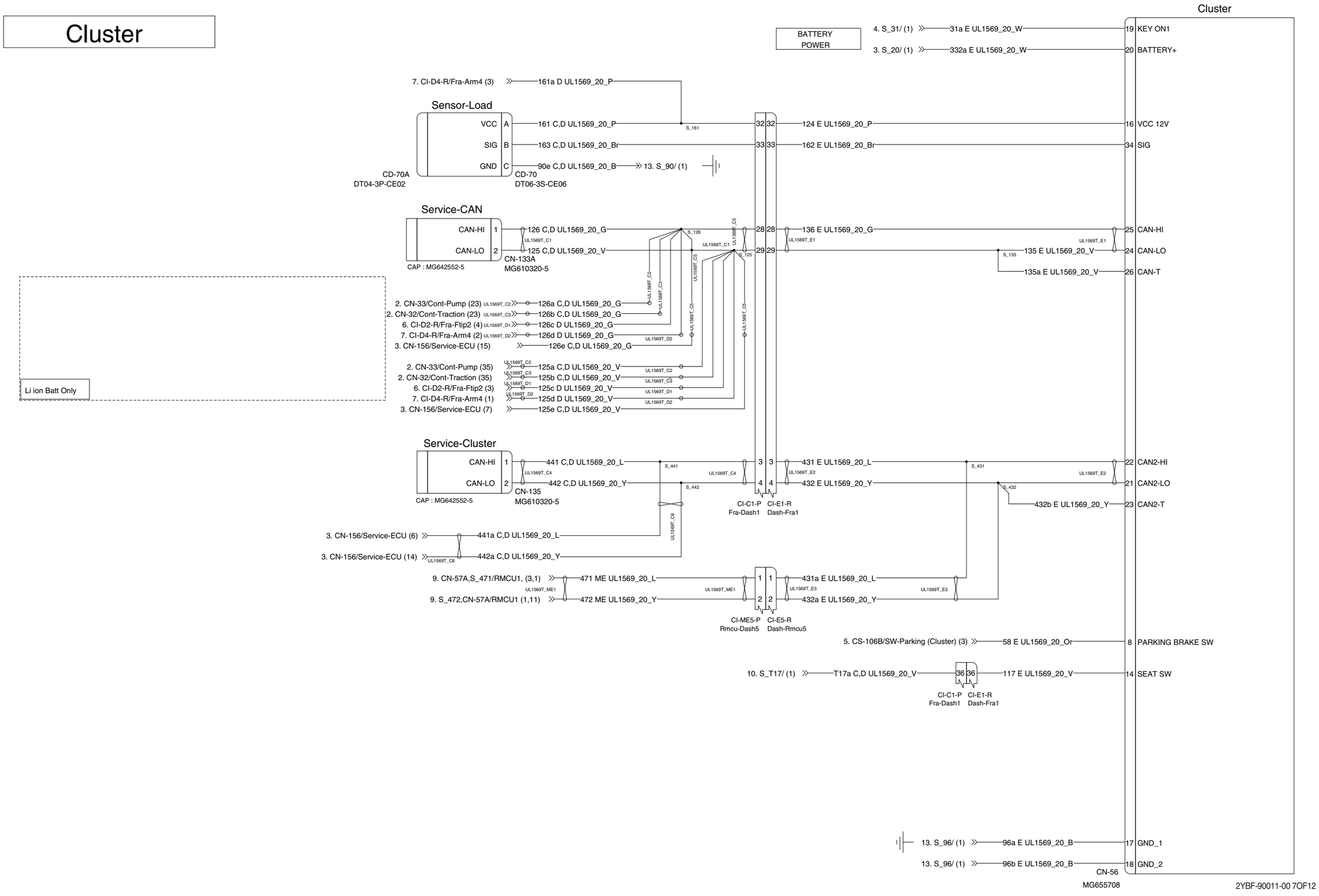
2YBF-90011-00 6OF12

FINGERTIP, ARMREST (25BC-9U : #0003-, 30/32BC-9U : #0001-)



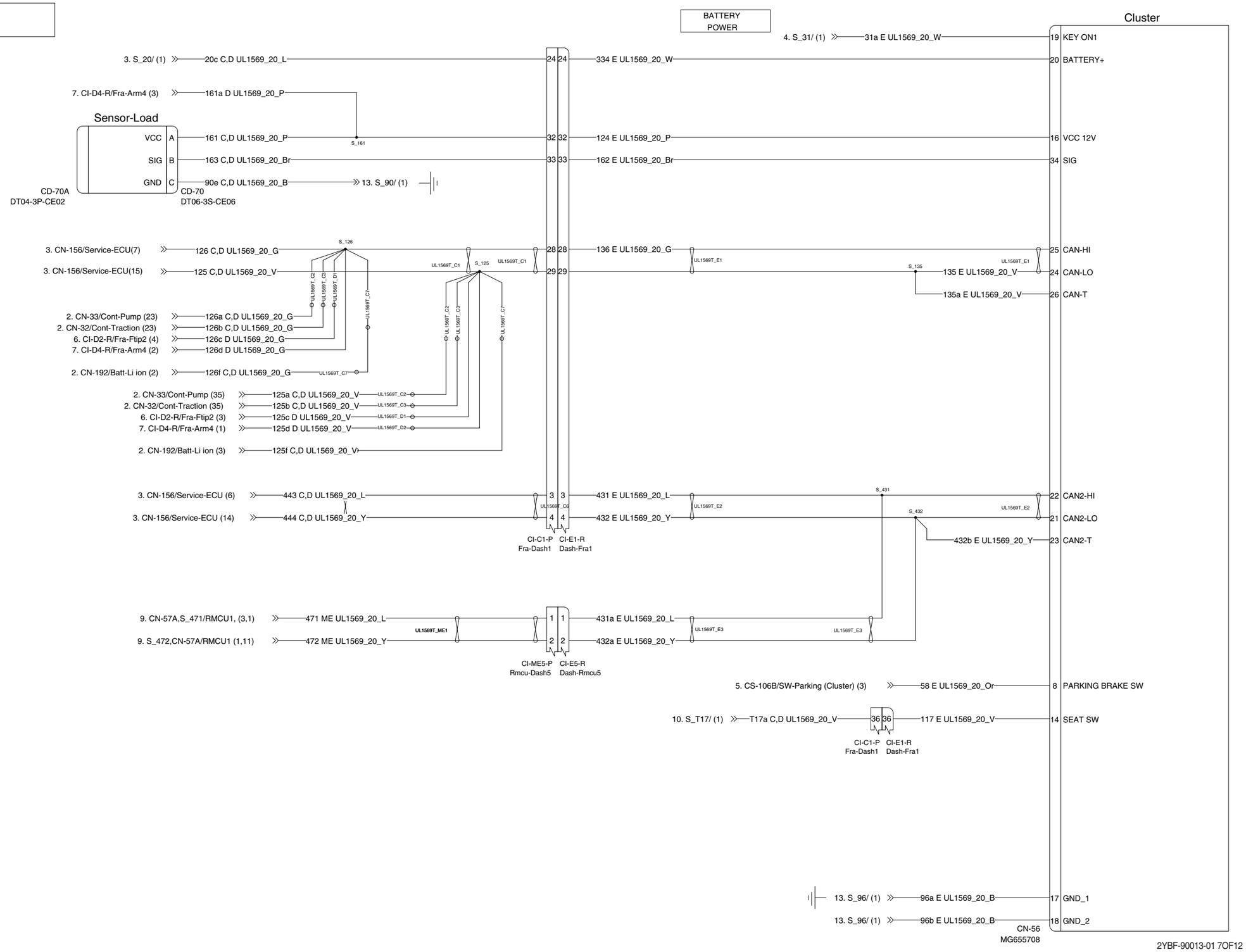
2YBF-90013-01 6OF12

7) CLUSTER AND SENSOR (25BC-9U : -#0002)



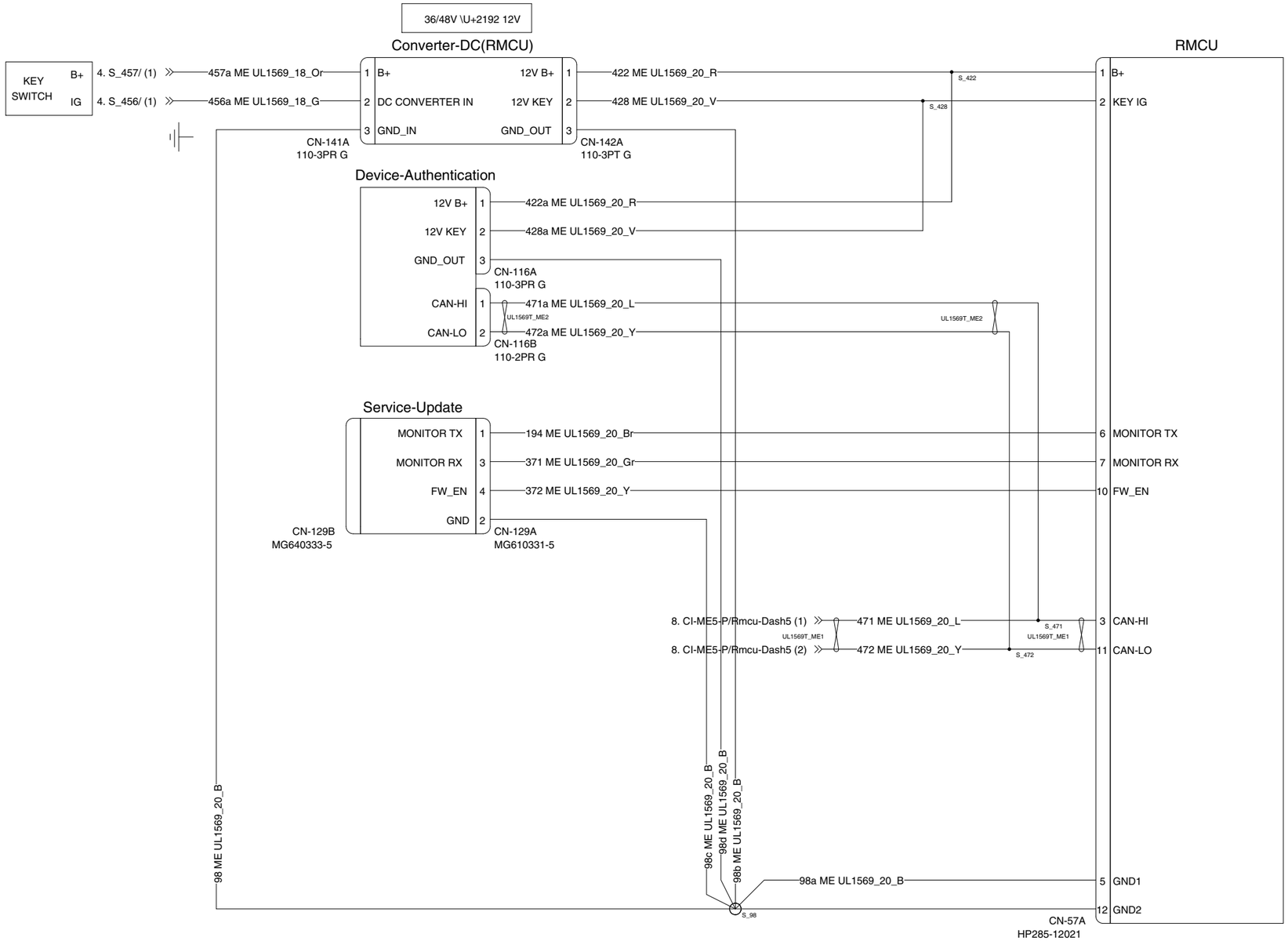
CLUSTER AND SENSOR (25BC-9U : #0003-, 30/32BC-9U : #0001-)

Cluster



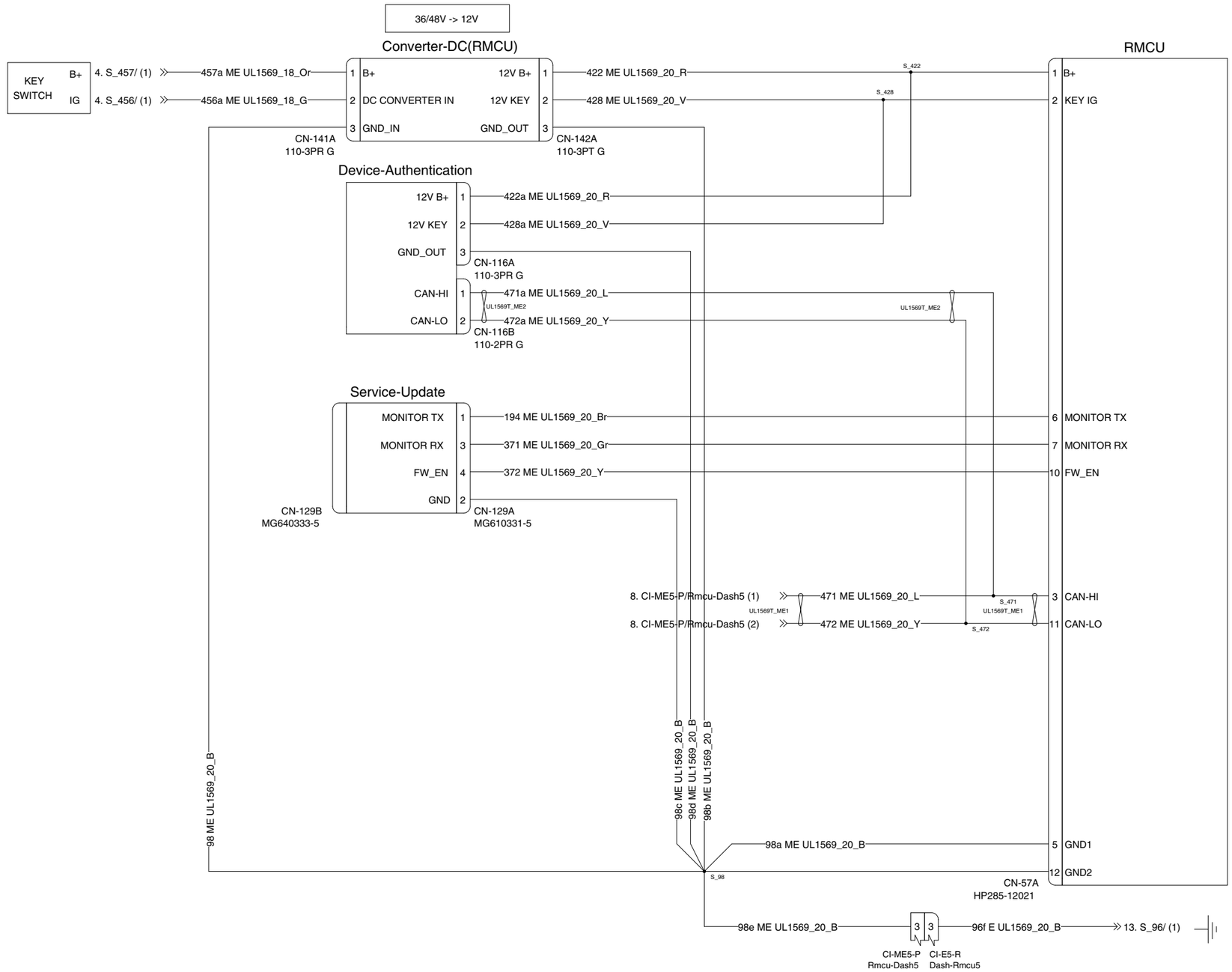
2YBF-90013-01 7OF12

8) RMCU (25BC-9U : -#0002)



2YBF-90011-00 8OF12

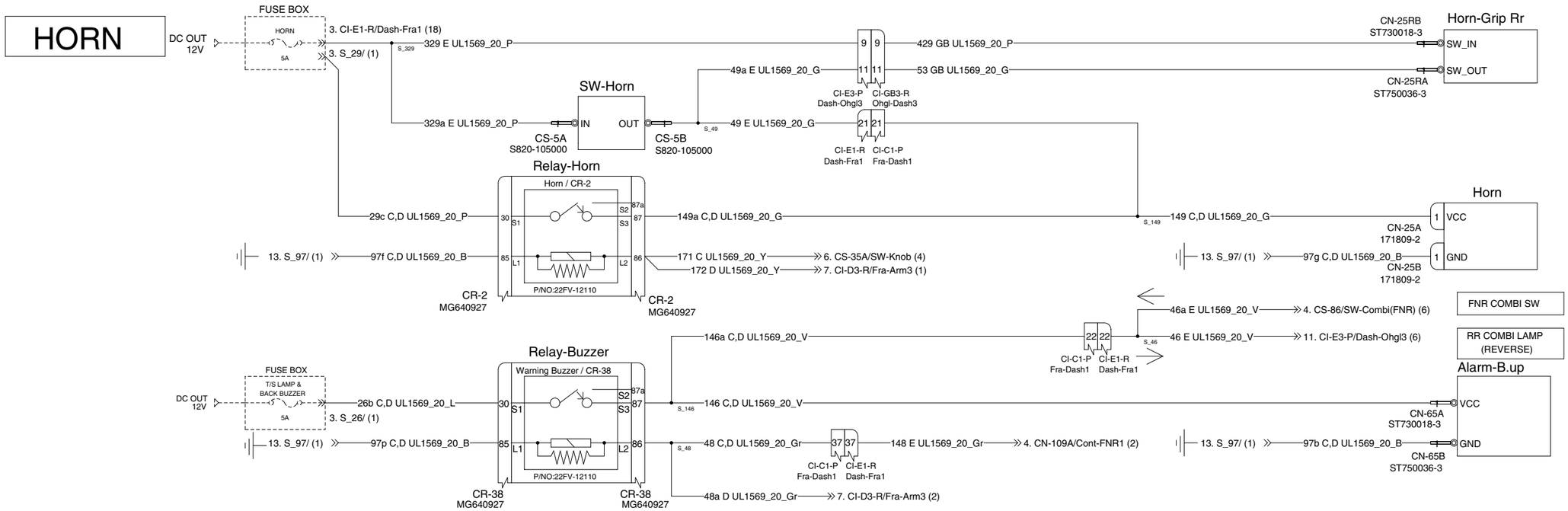
RMCU (25BC-9U : #0003-, 30/32BC-9U : #0001-)



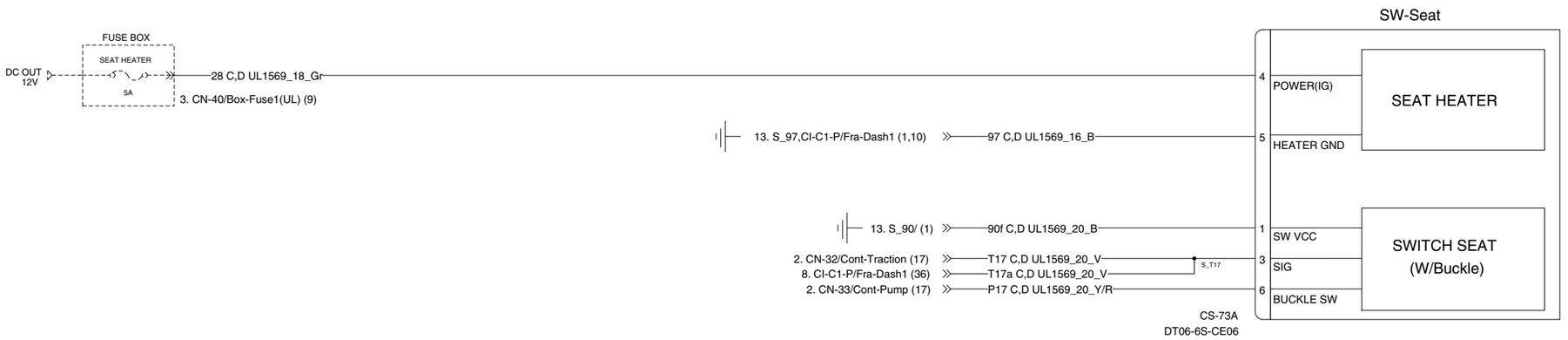
2YBF-90013-01 8OF12

9) HORN AND SEAT (25BC-9U : -#0002)

HORN

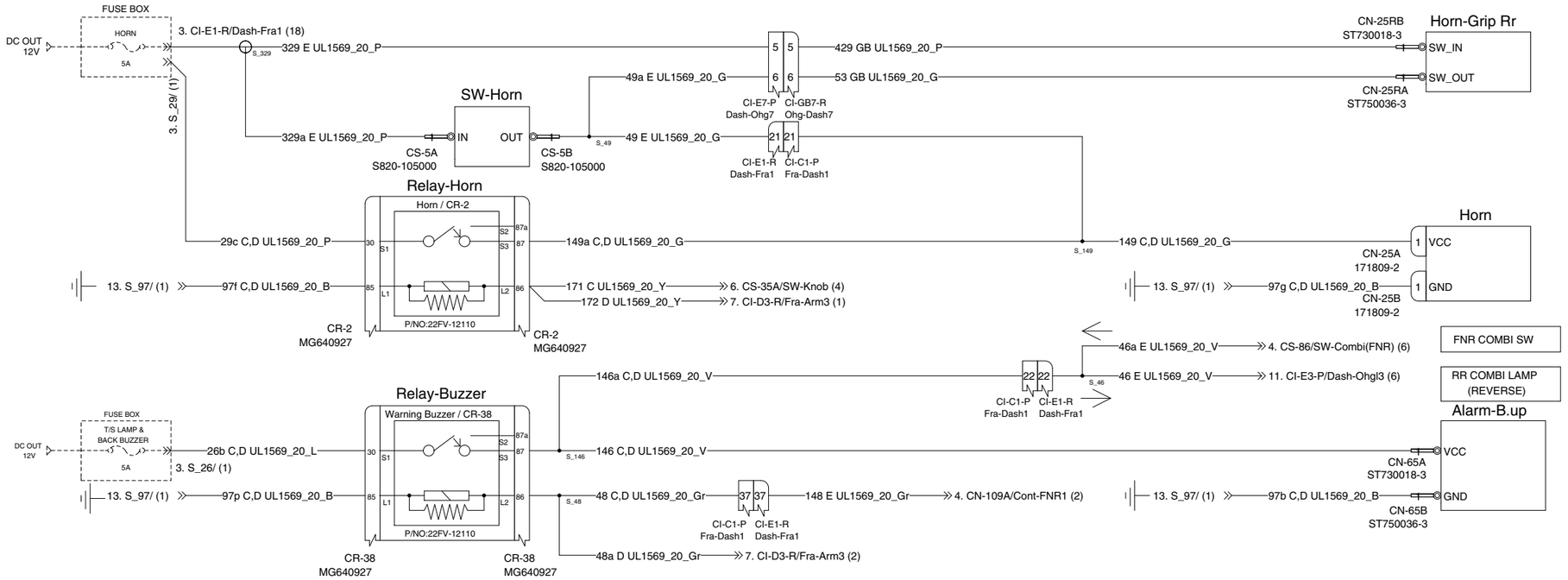


SEAT

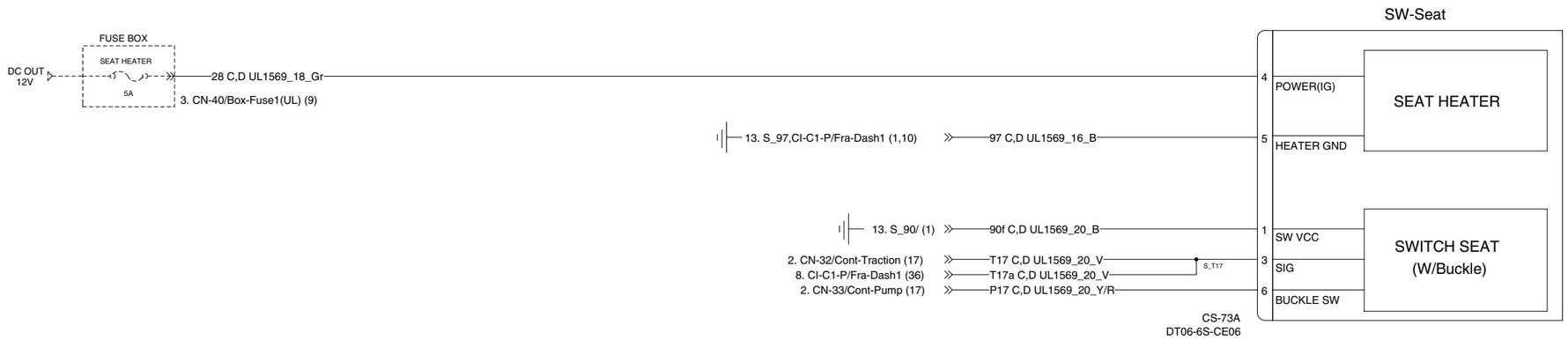


HORN AND SEAT (25BC-9U : #0003-, 30/32BC-9U : #0001-)

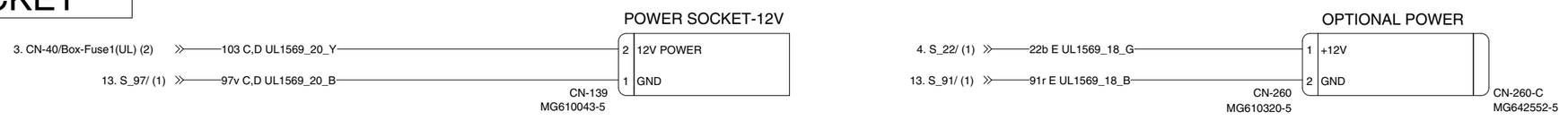
HORN



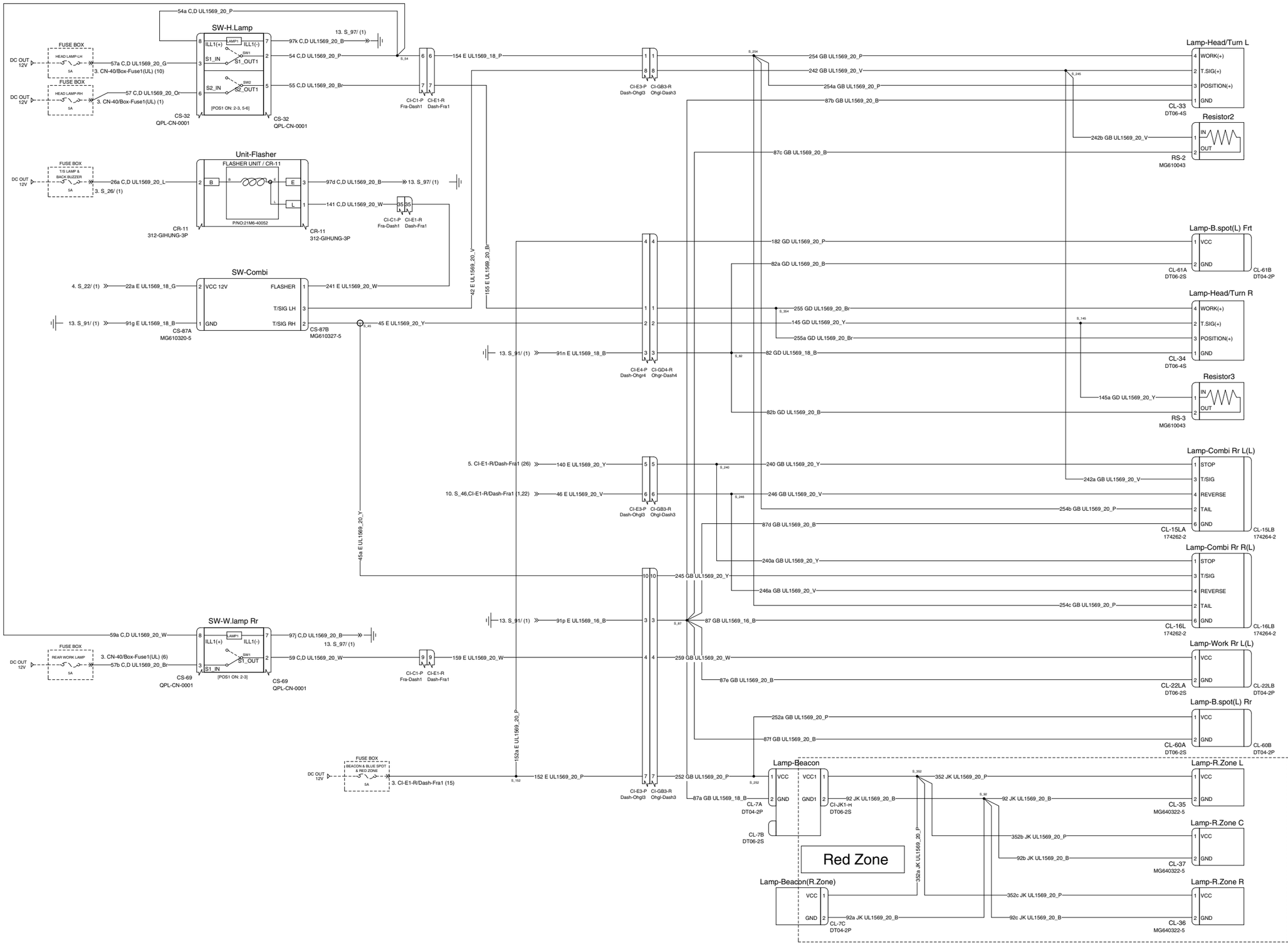
SEAT



12V SOCKET

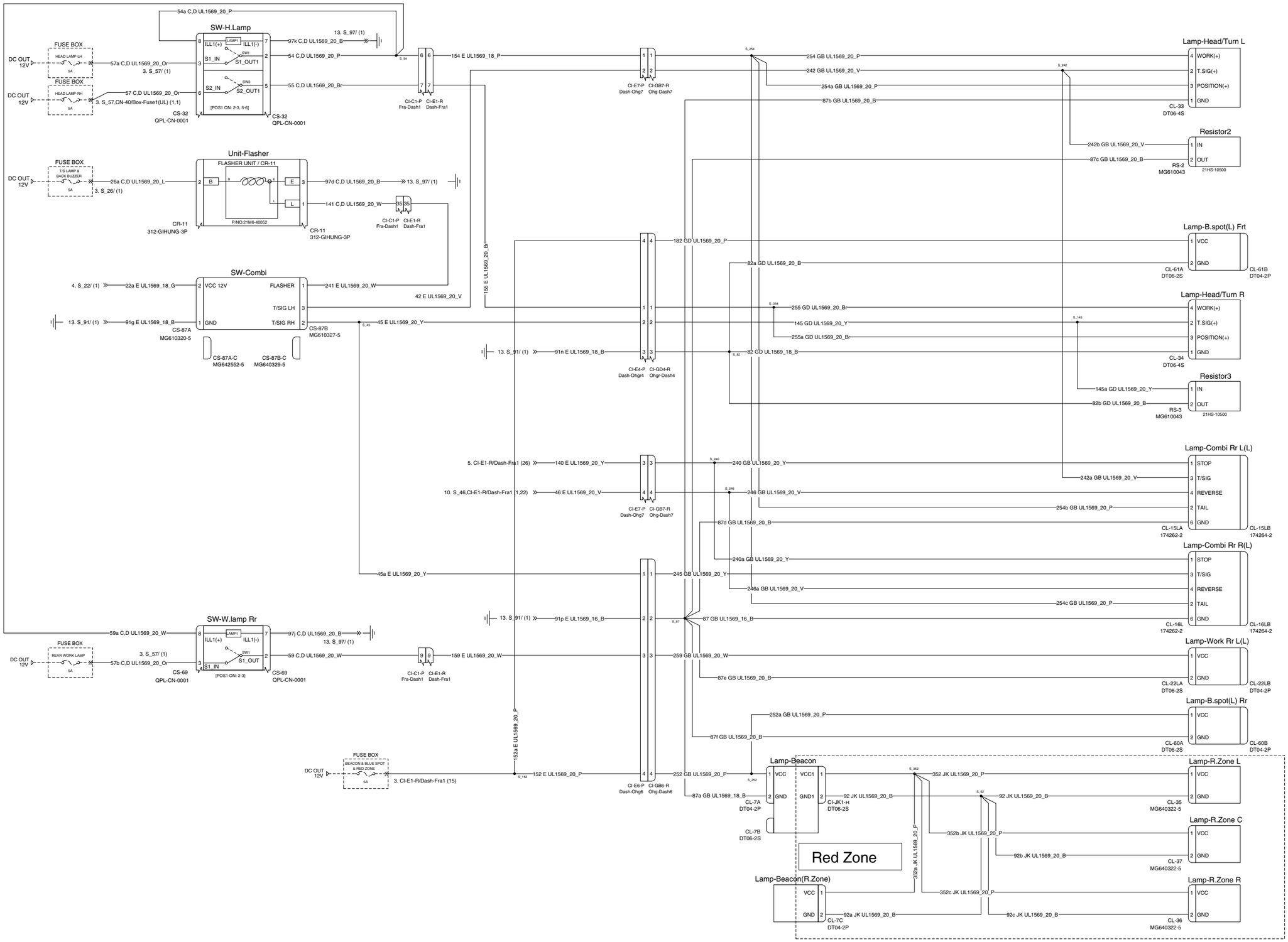


10) LAMP (25BC-9U : -#0002)



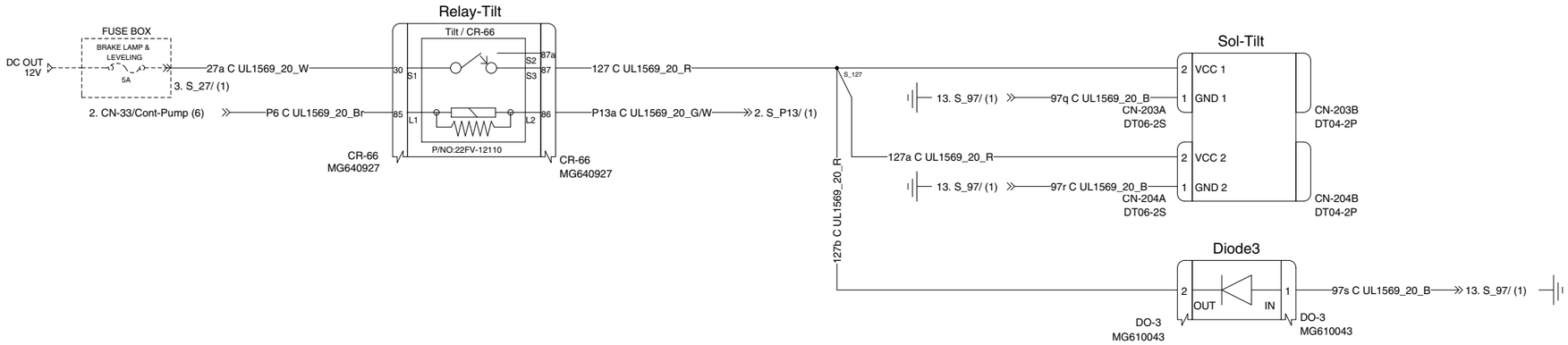
2YBF-90011-00 10OF12

LAMP (25BC-9U : #0003-, 30/32BC-9U : #0001-)

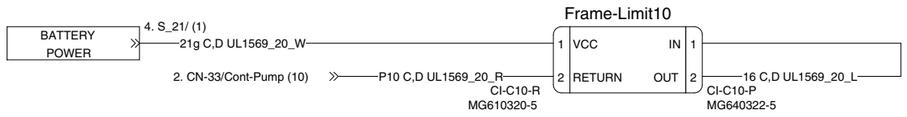


2YBF-90013-01 10OF12

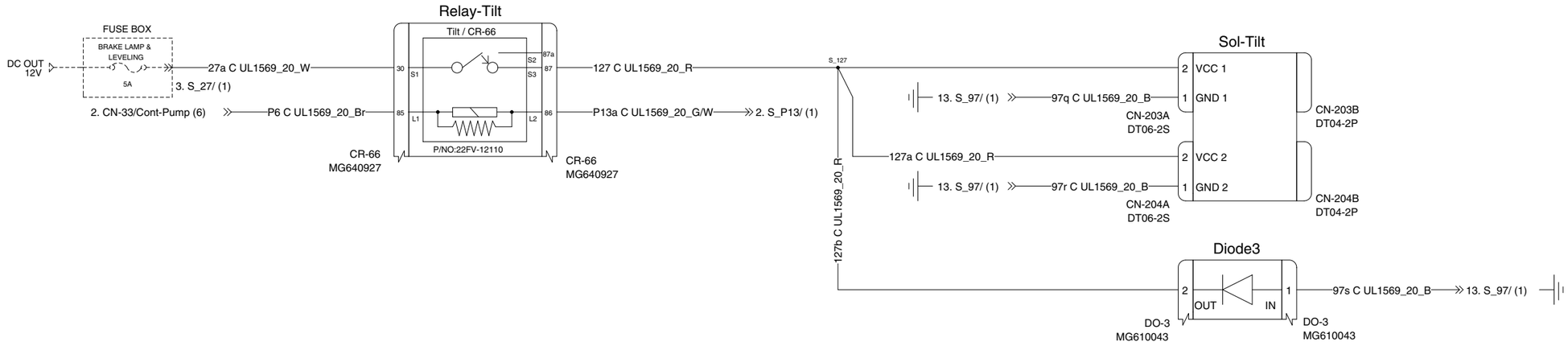
AUTO TILT



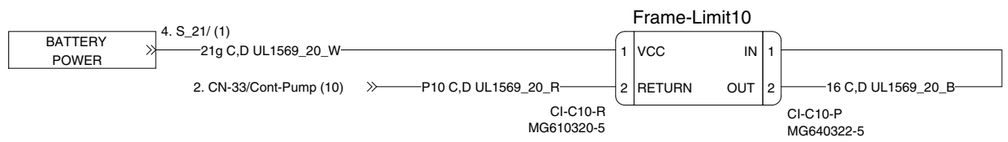
SPEED LIMIT



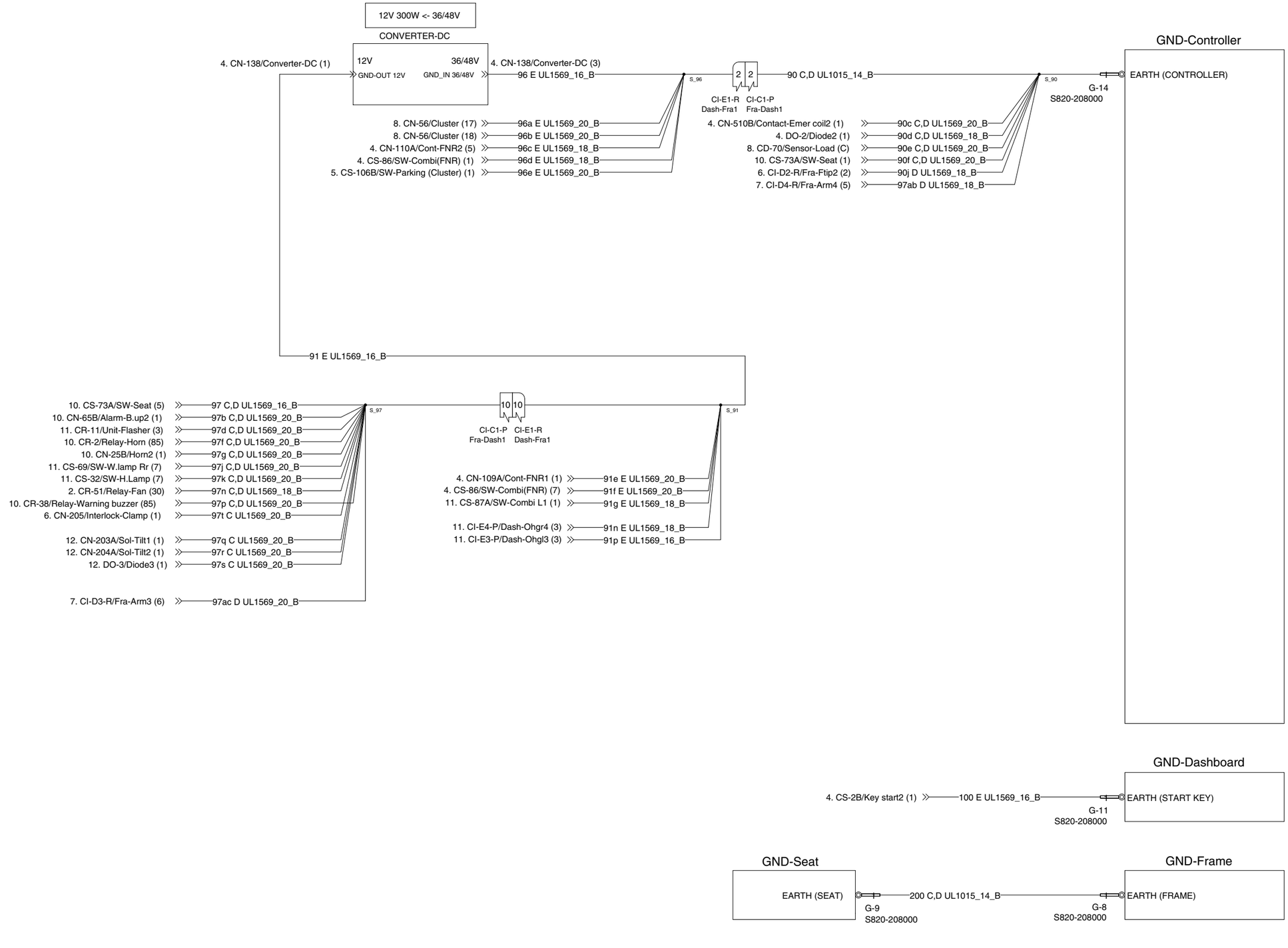
AUTO TILT



SPEED LIMIT

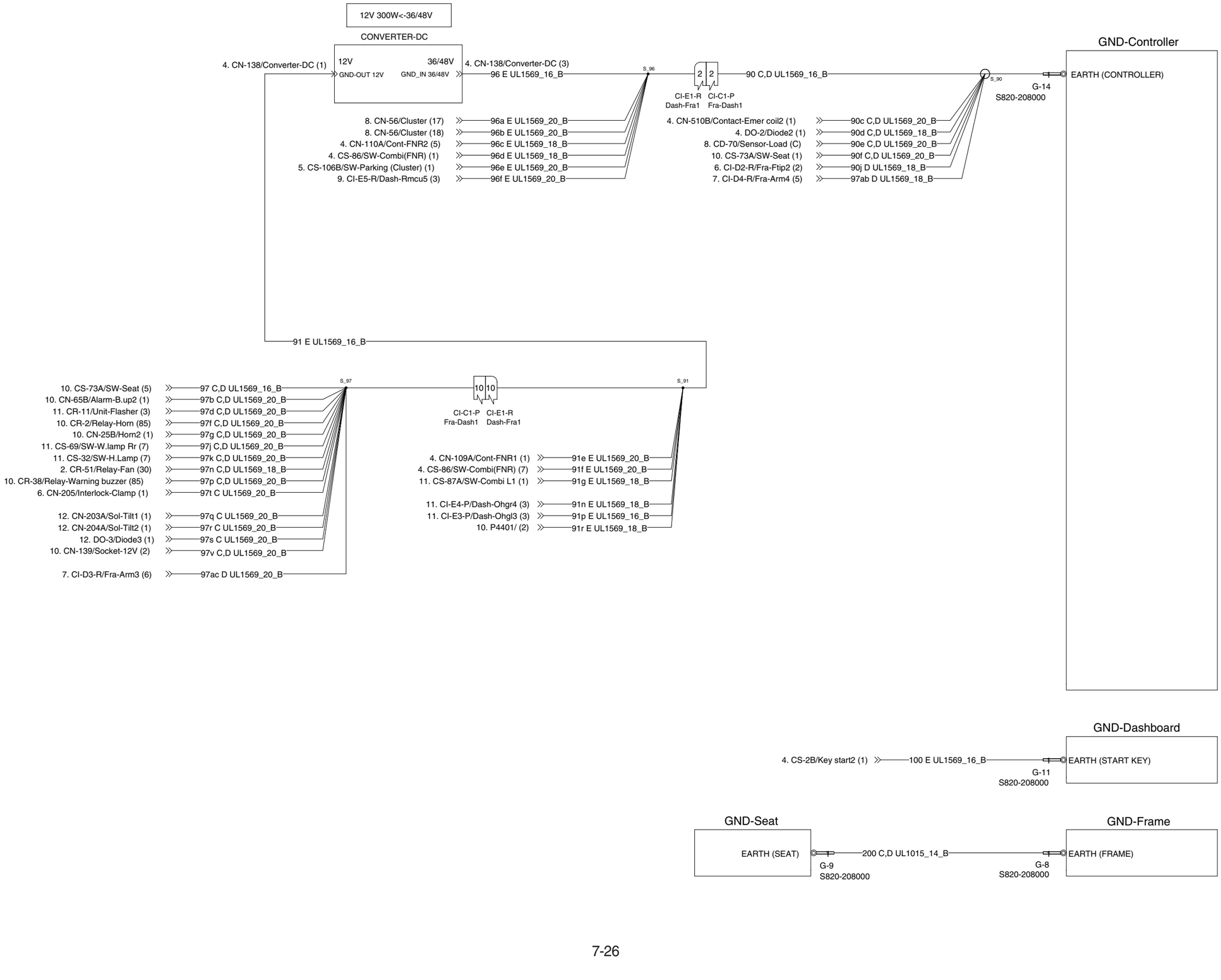


12) GROUND (25BC-9U : -#0002)



2YBF-90011-00 12OF12

GROUND (25BC-9U : #0003-, 30/32BC-9U : #0001-)



2YBF-90013-01 12OF12

GROUP 3 ELECTRIC COMPONENTS

1. FUNCTIONS OF BATTERY FORKLIFT TRUCK AND ELECTRIC COMPONENTS

The major functions of forklift truck can be divided into DRIVING FUNCTION and LOADING and UNLOADING FUNCTION.

All the components that work DRIVING and LOADING & UNLOADING functions are driven by AC motors. And as the BATTERY works as power source of these motors, a charging device is needed.

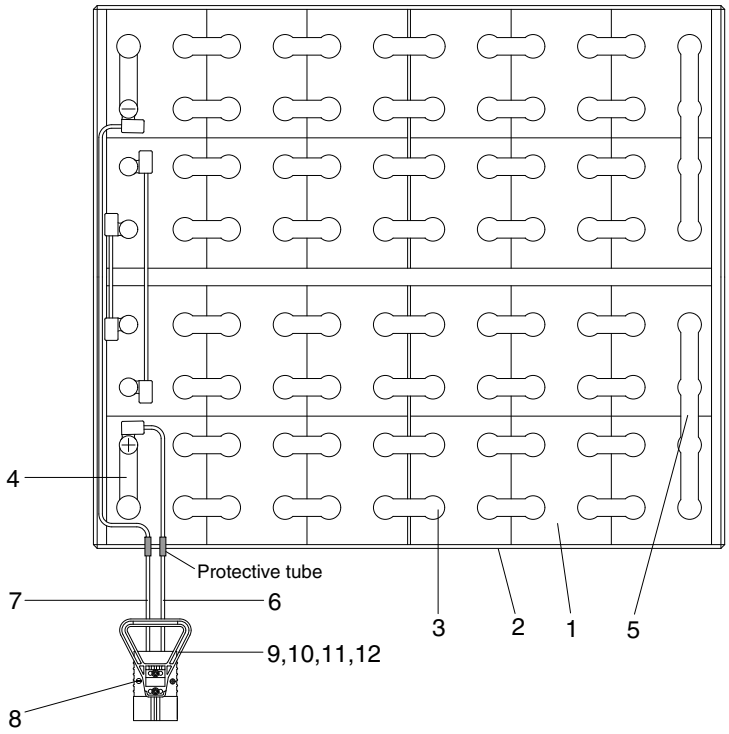
To drive the fork lift truck, a DRIVING CONTROL SYSTEM and some electric components such as direction change lever (forward/reverse section switch) and accelerator are required to select the driving direction and to control the speed of driving motor.

The CONTROL SYSTEM includes some protective circuits that protect the equipment and components from malfunctioning.

A MONITORING SYSTEM is installed in the monitor panel, which monitors the equipment and working condition, and let the operator take proper action. For the monitoring system, there are many sensors such as current sensors, potentiometer sensors, and temperature sensors. The HYUNDAI Battery forklift trucks are equipped with the most advanced DRIVING CONTROL SYSTEM currently available world-widely. The operator friendliness features enable him to set the truck conditions properly according to each working circumstance easily on his seat, and the SELF-DIAGNOSTIC function displays current status of truck in working.

2. BATTERY

1) STRUCTURE



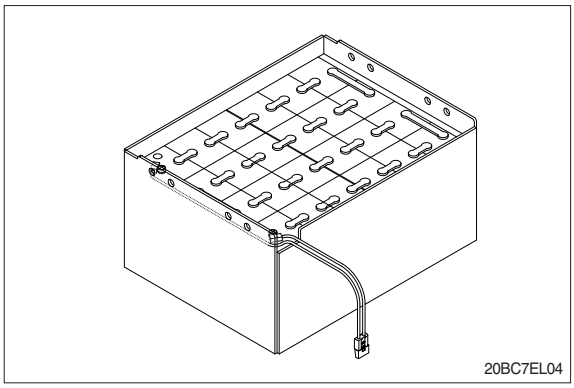
20BC7EL03

1	Cells	7	Negative leading cable
2	Steel box	8	Plug
3	Cell connector	9	Handle (Red)
4	Common connector	10	Screw
5	Row connector	11	Spring washer
6	Positive leading cable	12	Nut

2) GENERAL

As in the battery forklift, the battery is an energy source, the handling of the battery is very important.

The life and performance of the battery greatly depend on the ordinary handling and maintenance. Therefore, be sure to check and maintain the battery so that it may be kept best.



3) SPECIFICATION AND SERVICE DATA

Item	Unit	25BC-9U	30/32BC-9U
Type	–	Lead Acid	
Rated voltage	V	48	
Capacity	AH/hr	740	845
Electrolyte	–	WET	
Dimension (W×D×H)	mm	996×782×605	996×884×605
Connector	–	SB 350 or SR 350 (SBE 320 BLUE)	
Weight	kg	1180	1410

Fully charged specific gravity	1.280 (25°C)
End of discharge specific gravity	1.120 (25°C)
Discharge end voltage	48V
Electrolyte	Refined dilute sulfuric
Replenishment fluid	Refined (pure) water
Insulation resistance	1MΩ

4) SAFETY PRECAUTIONS

(1) When sulfuric acid contact with skin

For acid contact with skin, eye or clothing, flush with water immediately. If swallowed, drink a large amount of water or milk. Seek medical attention immediately. When handling acid, always wear eye goggles or a face shield and rubber gloves.

(2) Strict prohibition of fire and ventilation

Since batteries generate explosive hydrogen gas, no fire should be drawn near. Before the battery charging, keep the battery cover open and check the ventilation status. Charging in an enclosed space can cause an explosion.

(3) Never place metallic articles on the batteries

If done so, it may cause "short circuit" accidents (dangerous especially while charging) (Especially dangerous while charging).
Sparks will be generated which is equally dangerous as 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 300Ah battery is used with a charger designed to charge a 500Ah battery, it will severely overcharge the battery.

5) OPERATION PRECAUTIONS

(1) Avoid over-discharge

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-charge

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

Electric traction storage batteries (herein after refer to as "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

① Initial charge

Wet-charged 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.

a. 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.

b. 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.

c. By constant current charger

Connect the charger to the battery and charge the battery by 0.1C×5 hour rate nominal capacity current for 24 hours or more. The charge shall be terminated when one of the following conditions is identified.

- When a constant value is indicated for more than 1 hour after the battery voltage has reached the maximum value.
- When more than 1 hour of charge is continued after the electrolyte specific gravity has risen fully and becomes constant.

② Discharge and capacity

The capacity of batteries is indicated at 5 hour 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°C.

That is, the capacity is indicated by AH (ampere hour) being calculated as the product of ampere (A) 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.

③ 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°C by the following formula.

$$S_{25} = S_t + 0.0007\ (t-25)$$

Where, S_{25} : Specific gravity at 25°C

S_t : Actually measured specific gravity at t°C

t : Electrolyte temperature (°C)

The standard specific gravity for this type of battery is 1.280±0.01(25°C) at full charge condition. If the electrolyte is decreased 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.

④ **Normal charge**

Charge the discharged batteries as quickly as possible. The temperature of electrolyte before starting the charging operation shall preferably be below 45°C, and the temperature during the charge should be maintained at no higher than 55°C. (Under any unavoidable situations, it should never be above 55°C). 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).

a. 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 hour rate current ×1.0~1.5" at the start of charging, and at the final stage it is "5 hour rate current ×0.15~0.25". Normally the charge is terminated within 8~12 hours automatically.

b. 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.

$$\text{Charging time} = \frac{\text{Amount of previous discharge(AH)}}{\text{Capacity of charger(A)}} + 2\sim3\text{(H)}$$

When the amount of previous discharge is not known, use the 5 hour rate rated capacity of the batteries. At immediately after charging, the charge current is allowed up to 3 times 5 hour 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.

c. Charging by constant current charger

Connect the charger to the battery and charge the battery by 0.1C×5 hour rate nominal capacity current for 24 hours or more. The charge shall be terminated when one of the following condition is identified.

⑤ **Equalizing charge**

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.

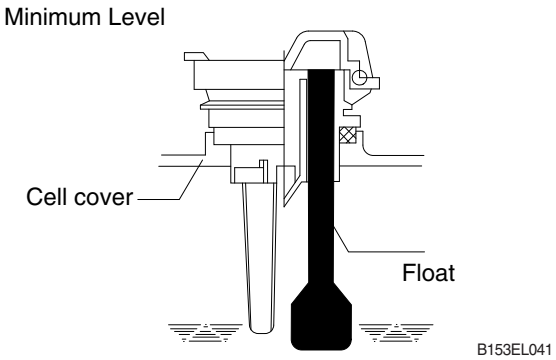
⑥ **Replenishment of distilled water**

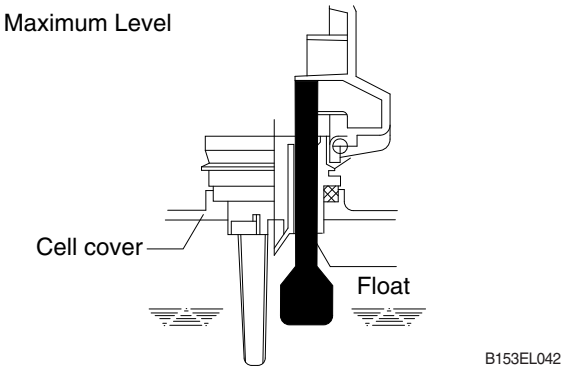
Only the water content of electrolyte is decreased due to electrolysis of distilled water during charge and natural evaporation. If a battery used with the electrolyte decreased excessively, plates will deteriorate resulting in markedly shortening of battery life. Be sure to check the electrolyte level 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 distilled water for battery replenishment. If the amount of water required for weekly addition to a unit cell for 100AH 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 normal 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 topping up the electrolyte level to the maximum level.

a. 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.





⑦ **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.

⑧ **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.

⑨ **Repair of failure cell**

a. To remove a cell from the circuit or battery from steel tray, it is first necessary that the intercell connector be removed.
b. 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.
c. The safe and most efficient method of removing a connector from failure cell as well as all surrounding cells is with hand or electric drill (25 ㎜).

⚠ You must make sure to clear of explosive hydrogen gas in the cells before repairs. Be careful not to drill to far into the cell and damage the unit. During drilling operation make sure lead curls produced do not contact opposite cell poles and cause a spark.

d. Upon completion of drilling the intercell connectors, can be lifted off.
e. Lifted off the failure cell from circuit after removing of intercell connector.
f. Installing new cell and connector.
g. With surfaces properly cleaned and neutralized, position the connectors.
h. Place damp rags around each lead head. Hold tip of the welder in center of post move welder completely around top of post and out to the area where the post meets the connector. Move welder back to center of post and add molten lead until area is filled to top of connector. Again, move welder completely around area, with tip on molten lead. If you have jig for welding connector, have easier and better welding work.
i. When replacing electrolyte in a repaired cell, use sulphuric acid of the same specific gravity that is found in the balance of the battery.
j. Finally, rejoin connector covers and one-touch caps to the cells.

⑩ **Summary of daily maintenance**

a. Avoid overcharge. After discharge, charge the batteries immediately. The standard frequency of equalizing charge is more than once every month.
b. Be sure to check the electrolyte level once every week. If found decreased, replenish distilled water up to the specified level.
c. The top surface of battery cells should be kept clean and dry.
d. Be sure to keep open the cover of battery housing tray during charge.
e. Never draw near open fires such as lighted cigarettes or burning matches during charge.

(3) Others

① **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°C, check the specific gravity once a month, and when lower than 0°C, check it once every two months. If the measurements show values lower than 1.230 (20°C), it is required to charge the battery in accordance with the method described in NORMAL CHARGE.

② **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.

③ **Electrolyte temperature**

The operating temperature range of batteries is -10~45°C (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.

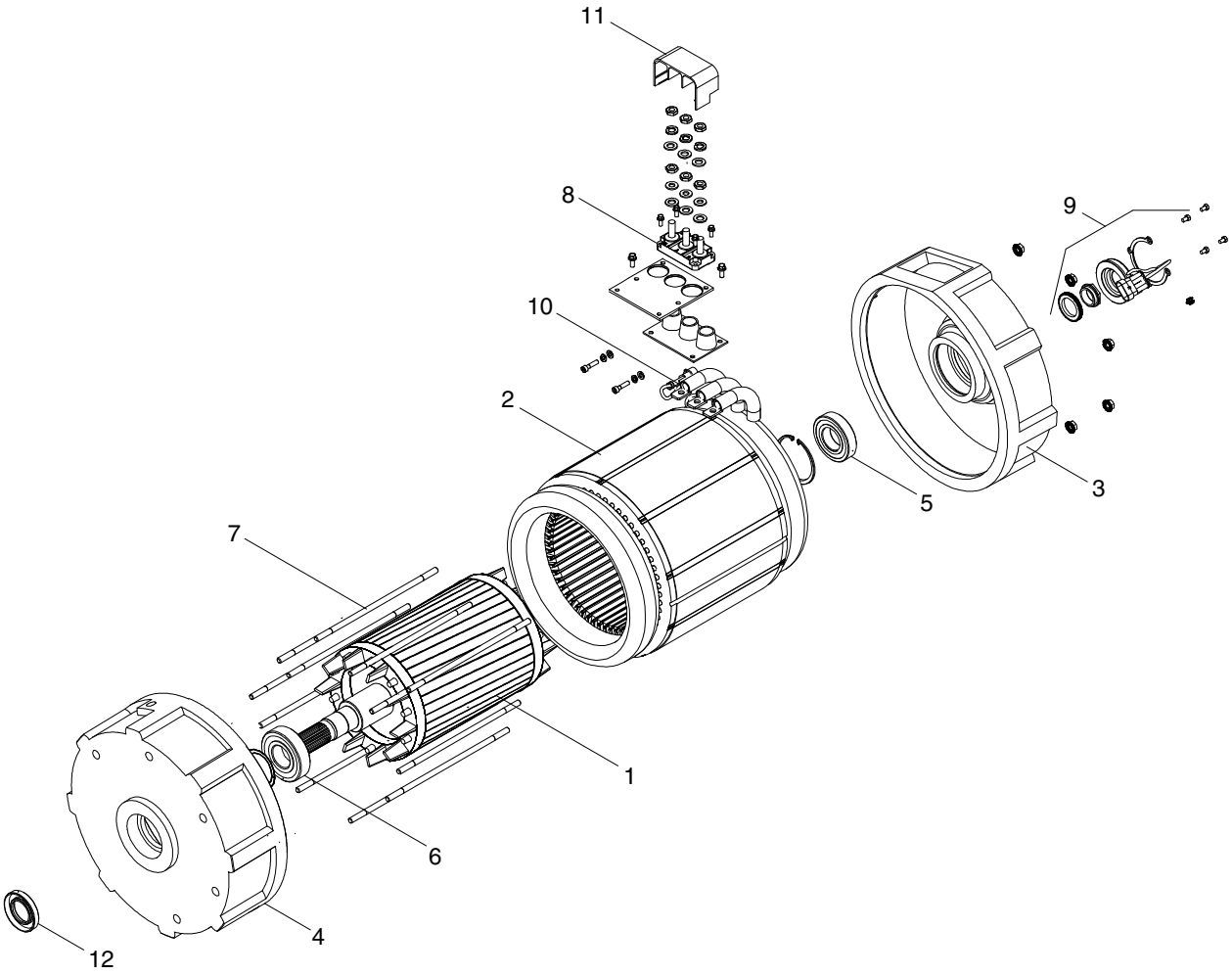
Contrarily if the temperature is high, especially if used at above 55°C, the battery life will be considerably shortened. Care must be taken so that the temperature during charge will be maintained at 55°C or lower. Even under unavoidable circumstances it should not exceed 55°C.

7) TROUBLESHOOTING

Nature of trouble	Symptoms	Causes	Corrective Action
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 · Termination of connector or pole post etc.	· External impact, improper handling, excessive vibration · Excessive temperature rising or external impact	· Replace or install a new one · Replace
Sulfate	· Specific gravity drops and capacity is decreased. · Charge voltage rises rapidly with immature gassing in earlier stage but specific gravity does not rise and charge can't be carried out.	· When left in state of discharge or left long without equalizing charge. · 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 · 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



2YBD-92080

1	Rotor assy	5	Bearing	9	Speed sensor kit
2	Stator assy	6	Bearing	10	Temperature sensor
3	Endbell	7	Stud bolt	11	Terminal protector
4	End cap	8	Terminal block	12	Oil seal

2) SPECIFICATION

Item	Unit	Specification
Type	-	ASRH4002
Rated voltage	Vac	30
Rated output	kW	14
Insulation	-	Class F

3) MAINTENANCE INSTRUCTION

※ Before starting the maintenance please disconnect the power supply.

(1) Ball bearing

Both ball bearing are maintenance free. Should it be necessary to remove the bearings in case of repair, they should be replaced. In any case the sealing parts (shaft sealing ring etc.) have to be replaced.

If a bearing which is to be replaced has only one sealing lip, this should be greased with quality bearing grease.

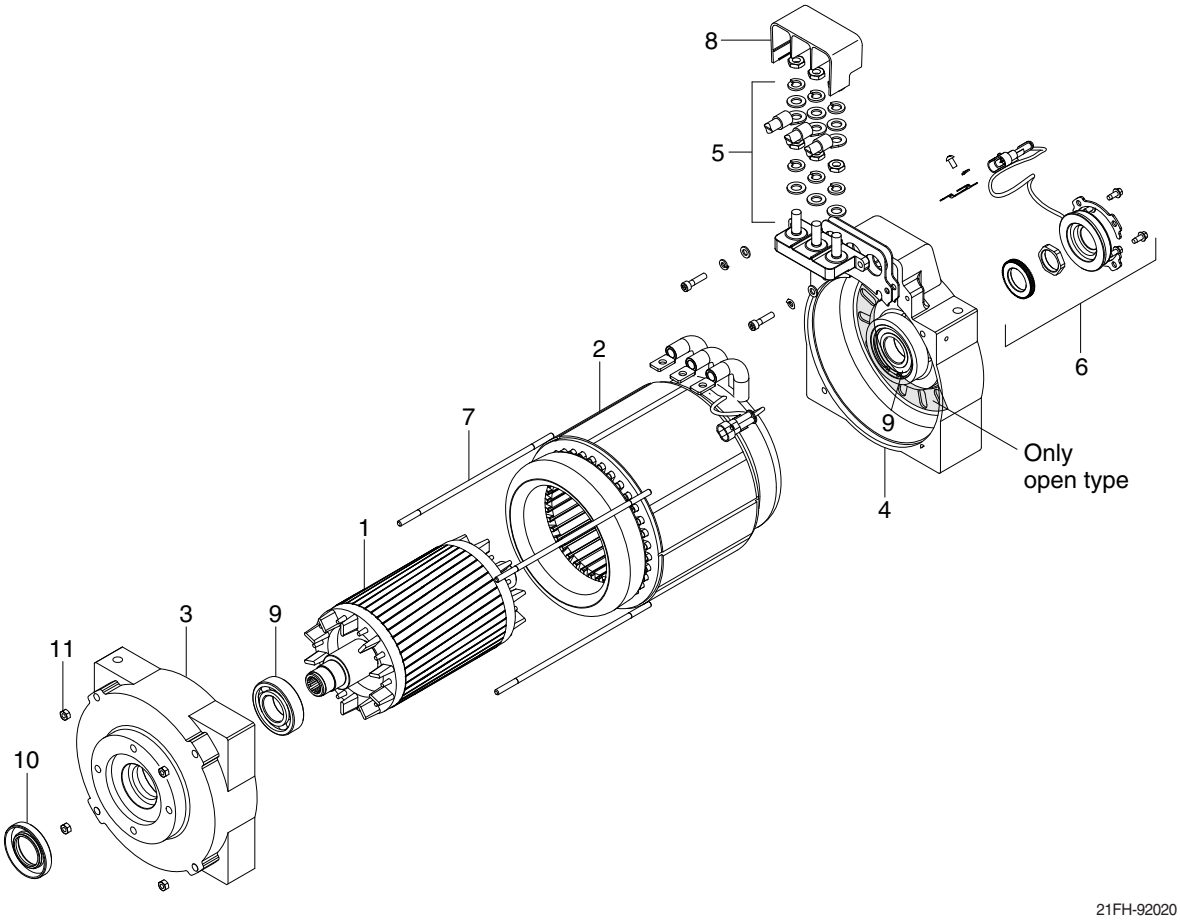
After approximately 10,000 operating hours the bearings have to be replaced.

(2) Disassembly and assembly

The motor is assembled and disassembled according to the relevant drawing and part list. (See page 7-13)

4. PUMP MOTOR

1) STRUCTURE



1	Rotor assy	5	Terminal block	9	Bearing
2	Stator assy	6	Speed sensor kit	10	Oil seal
3	Endbell	7	Stud bolt	11	Flange nut
4	Endbell	8	Terminal protector		

2) SPECIFICATION

Item	Unit	Specification
Type	-	AMDL4001
Rated voltage	Vac	30
Rated output	kW	17
Insulation	-	Class F

3) INTERNAL INVOLUTE SPLINE DATA

Item	Unit	Specification
Flat root side fit	-	Class 7
No of teeth	EA	11
Spline pitch	mm	16/32
Pressure angle	Degree	30
Major diameter	mm	19.7104
Form diameter	mm	19.1516
Minor diameter	mm	16.0274
Pin diameter	mm	2.7432

4) MAINTENANCE INSTRUCTION

※ Before starting the maintenance please disconnect the power supply.

(1) Ball bearing

Both ball bearing are maintenance free. Should it be necessary to remove the bearings in case of repair, they should be replaced. In any case the sealing parts (shaft sealing ring etc.) have to be replaced.

If a bearing which is to be replaced has only one sealing lip, this should be greased with quality bearing grease.

After approximately 10,000 operating hours the bearings have to be replaced.

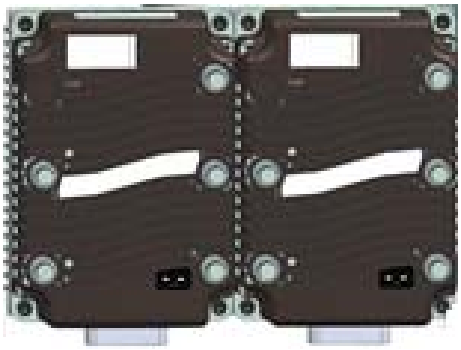
(2) Disassembly and assembly

The motor is assembled and disassembled according to the relevant drawing and part list. (See page 7-15)

5. CONTROLLER SYSTEM

1) STRUCTURE

Traction controller Pump controller



Fingertip controller

25BC9U7EL10

Model	Model	Application	Type	Power	Current limit
25/30/32BC-9U	CURTIS 1236SE-5621	Traction	MOSFET	36-48V, 600A	600A/3 min
	CURTIS 1236SE-5621	Pump	MOSFET	36-48V, 600A	600A/3 min
	CURTIS 1353-6101	Fingertip	Valve controller	36-80V, 70A	-

2) OPERATIONAL FEATURES (TRACTION AND PUMP CONTROLLER)

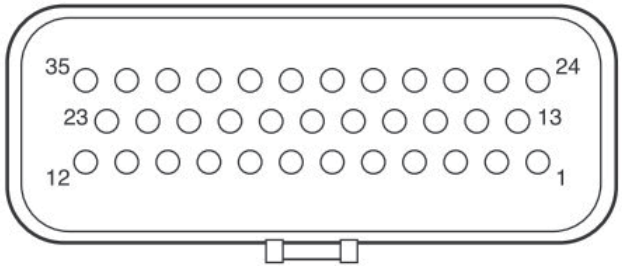
(1) Features

- 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, an d 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
- CANopen 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 portable Curtis 1311 programmer, and 1314 PC programming.
- Stubbornly sealed housing and connector satisfy IP65 environmental sealing standards in severe environments.
- Compliant with 2006/42/EC and EN13849

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 ㎜ (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.



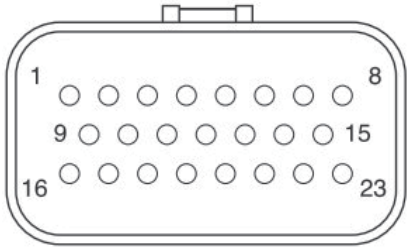
25BX7ES11

PIN	NAME	DESCRIPTION
1	KSI	Input of key switch signal, supplying controller logic and coil driver power
2	Prop. Driver	Proportional driver. Coil driver having current control function commonly used on hydraulic proportional valve
3	Driver 4	Common driver No. 4: Usable as digital input also; low-frequency PWM function
4	Driver 3	Common driver No. 3: Usable as digital input also; low-frequency PWM function; typically used for pump connector
5	Driver 2	Common driver No. 2: Usable as digital input also; low-frequency PWM function; slightly higher rated current, typically used for electromagnetic brake
6	Driver 1	Common driver No. 1: Usable as digital input also; low-frequency PWM function; typically used for main connector
7	I/O Ground	Input & output ground criteria
8	Switch 2 Analog 2	Usable as common switch input No. 2 or common analog input No. 2
9	Switch 3	Common switch input No. 3
10	Switch 4	Common switch input No. 4
11	Switch 5	Common switch input No. 5
12	Switch 6	Common switch input No. 6
13	Coil Return	Coil return pin of every connector coil
14	Switch 16	Common switch input No. 16
15	Throttle Pot High	Pot high power connection of 3-wire throttle pot 1
16	Throttle Pot Wiper	Pot wire connection of throttle pot 1
17	Pot2 Wiper	Port wire connection of throttle pot 2

PIN	NAME	DESCRIPTION
18	Pot Low	Common pot low-connections of throttle and brake pots
19	Digital Out 6	Usable for On/Off function or output driver, and digital input
20	Digital Out 7	Usable for On/Off function or output driver, and digital input
21	CAN Term H	High-power connection of CAN terminal jumper
22	Switch 7	Common switch input No. 7
23	CAN H	CAN Bus High
24	Switch 1	Usable as common switch input No. 1 or common analog input No. 1
25	+12V Out	Non-regulatory low-power +12V output
28	Serial TX	Serial transmission line for display or flash update
29	Serial RX	Serial receiving line for flash update
30	Analog Output	Low-power, low-frequency 0V - 10V analog output
31	Position Feedback A	Quadrature encoder input phase A (ACIM motor), Sin/Cos sensor input sine (SPM motor)
32	Position Feedback B	Quadrature encoder input B (ACIM motor), Sin/Cos sensor input sine (SPM motor)
33	Switch 8	Common switch input No. 8
34	CAN Term L	Low-power connection of CAN terminal jumper
35	CAN L	CAN Bus Low

(2) Fingertip controller

Every low-power connection is connected through single 23-in AMPSEAL connector.
Plug housing for coupling is AMP P/N 770680-1, and contact pin is AMP P/N 770520-3.
Connector accommodates 1.7-2.7 mm (20-16 AWG) wire having thin wall insulator of 1.7-2.7 mm diameter.
Pins of 1353 are not sealed until connector is fully latched and locked. Cable harness connector include silicone rubber, an essential part for module sealing.



25BX7ES11

PIN	NAME	DESCRIPTION
1	B+	Positive electrode of battery
2	B-	Negative electrode of battery
3	+5 V	Non-regulatory low-power +5 V output
4	I/O GND	Input & output ground criteria
5	Analog Input 4 / Encoder 2B	Voltage or resistance input 4, quadrature encoder input phase 2B
6	Analog Input 4 / Encoder 2B	Voltage or resistance input 3, quadrature encoder input phase 2A
7	CAN H	CAN Bus High communication line
8	CAN L	CAN Bus Low communication line
9	B-	Marginal battery negative electrode (for high-current drive)
10	+12 V	Non-regulatory low-power +12 V output
11	Analog Input 5 / Serial TX	Voltage or resistance input 5, serial transmission
12	Analog Input 6 / Serial RX	Voltage or resistance input 6, serial receiving
13	Analog Input 2 / Serial 1B	Voltage or resistance input 2, quadrature encoder input phase 1B
14	Analog Input 1 / Serial 1A	Voltage or resistance input 1, quadrature encoder input phase 1A
15	Input/Output 9	Active high input 9, high-power PWM active low output 9
16	Input/Output 8	Active high input 8, high-power PWM active low output 8
17	Input/Output 7	Active high input 7, high-power PWM active low output 7
18	Input/Output 6	Active high input 6, high-power PWM active low output 6
19	Input/Output 5	Active high input 5, high-power PWM active low output 5

PIN	NAME	DESCRIPTION
20	Input/Output 4	Active high input 4, high-power PWM active low output 4
21	Input/Output 3	Active high input 3, high-power PWM active low output 3
22	Input/Output 2	Active high input 2, high-power PWM active low output 2
23	Input/Output 1	Active high input 1, high-power PWM active low output 1

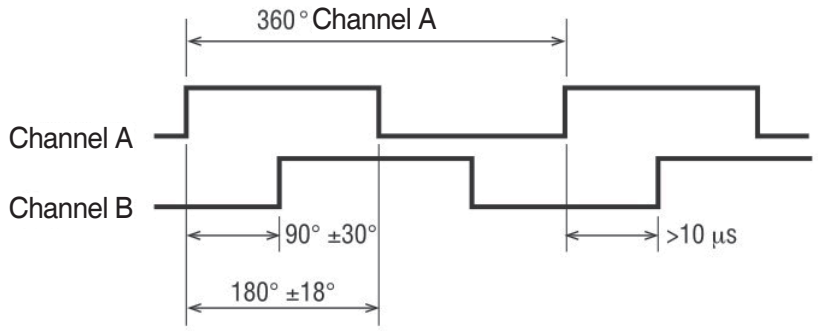
(3) Encoder connection (drive and pump)

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

Power supply of encoder is commonly 5V (Pin 26) or 12V (Pin 25), and power can be supplied by 5V - B+ by external source only when logic critical value is satisfied.

PIN	NAME	DESCRIPTION
25	+ 12 V	Power supplying to positive electrode of encoder
7	GND	Power supplying to negative electrode of encoder
31	ENC A	Encoder A phase
32	ENC B	Encoder B phase

These signal tolerances should be within operating conditions of application including scope of voltage, temperature, speed and torque.



25BX7ES12

4) PROGRAMING AND ADJUSTMENT

It is allowed to adjustment parameters through portable 1313 programmer or cluster.

※ Refer to Display Section for adjustment of variables on cluster. (page 7-75)

Adjusting with portable programmer (opt)

Adjustment and change of variables for inverter configuration are made through portable 1313 programmer.

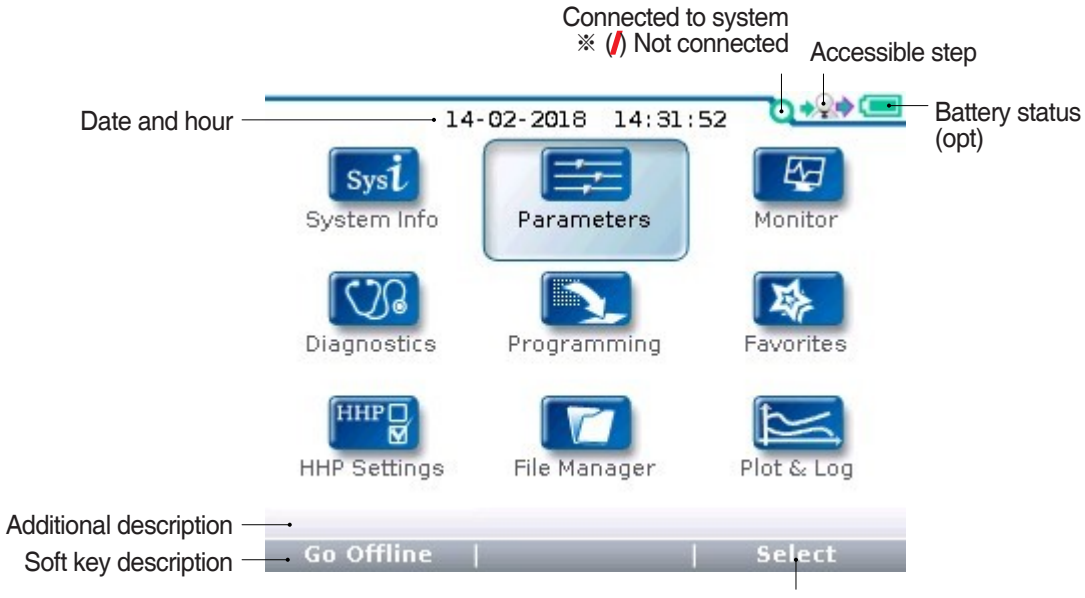
Connect to the main harness of the lift truck.

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

25BX7ES14

(1) Connected

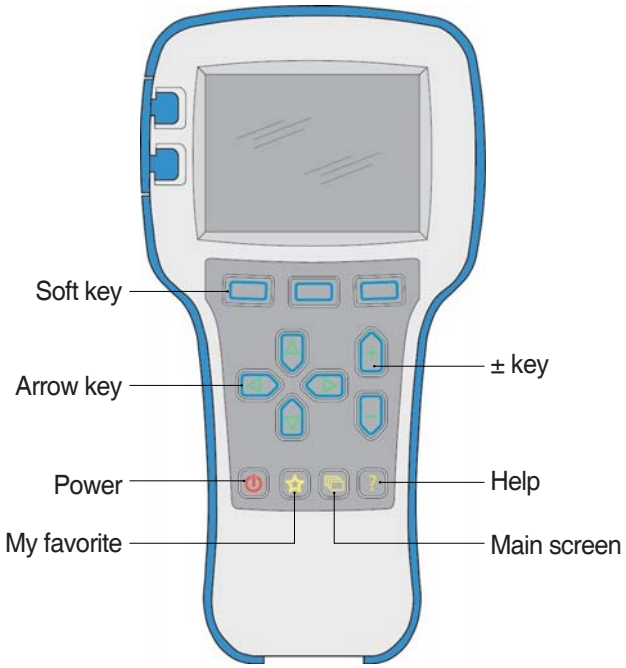
Once connection is made, the screen is displayed as shown below.



25BX7ES15

Pressing Select soft key on the screen prompts the variable screen. Pressing Offline soft key switches 1313 HHP to offline mode. 1313 HHP can be connected to the controller. 1313 HHP is cable of performing functions not required of connection.

(2) Key description



25BX7ES16

(3) How to adjust variables

On Variable screen of the main screen, press +/- keys to adjust parameters. If the menu contains 8 items or more, a scroll bar appears on the right corner of the screen. (see above figure.)

(4) Monitor

This menu displays real-time values. Refer to the user's manual of the controller for description of the values. This menu is useful for setup, testing, diagnosis and troubleshooting. (see page 7-80.)

Diagnosis

(5) This menu displays current errors and defects records. (see page 7-52.)

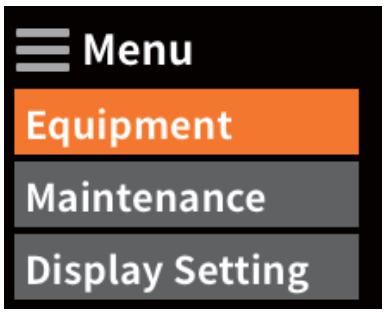
5) SAFETY INSTRUCTIONS

- 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 equipments.
- 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. CLUSTER

1) TRUCK MENU

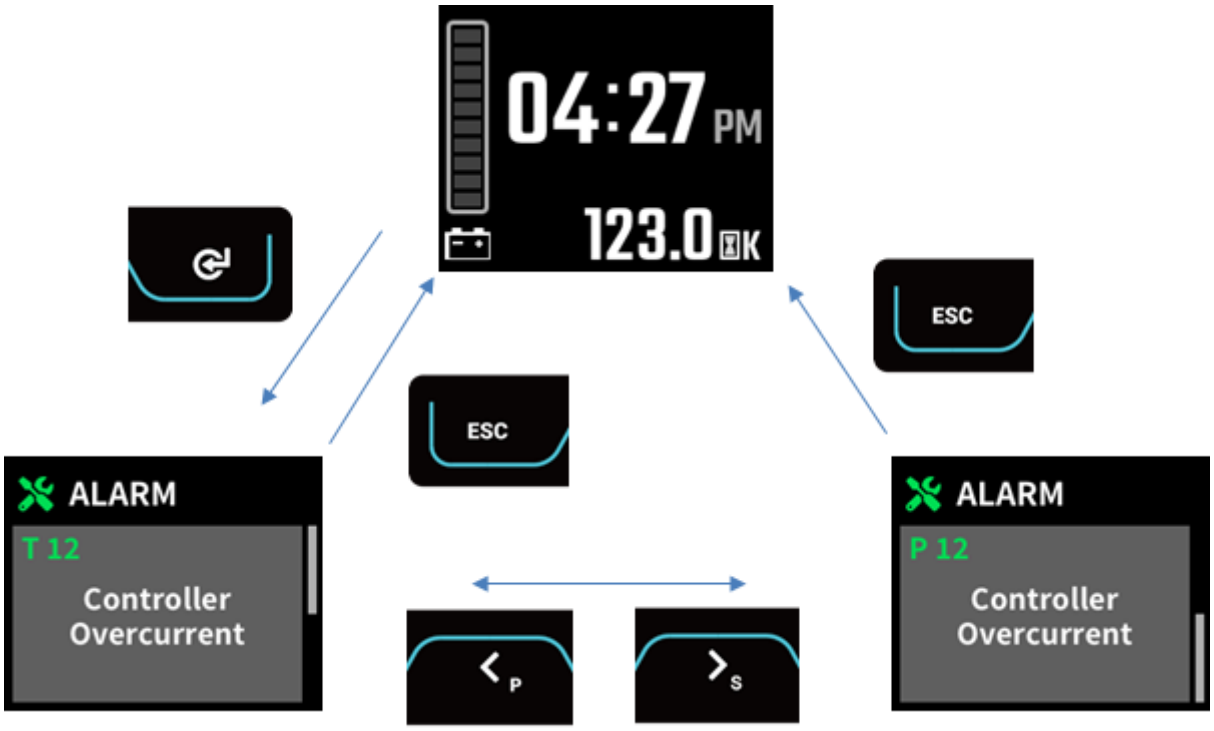
(1) Access to truck menu

Step	Display	DESCRIPTION
1	 E25BX7ES19	1. Press "HOME" button in the initial screen. 2. Press “LEFT/RIGHT” and “ENTER” buttons to enter the menu.
2	 E25BX7ES18	1. The password input screen appears as shown on the left. 2. Enter the password using the “LEFT “, "RIGHT" and “ENTER” buttons. 3. To move to the upper menu, press “ESC” button.

2) ALARMS AND ALARM HISTORY

(1) How to check alarms

Normally, ALARM SCREEN pops up if any kind of a alarm happens, but service man can switch between a MAIN SCREEN and ALARM SCREEN with “ENTER”, “ESC” buttons as follows :



15BRXEL24

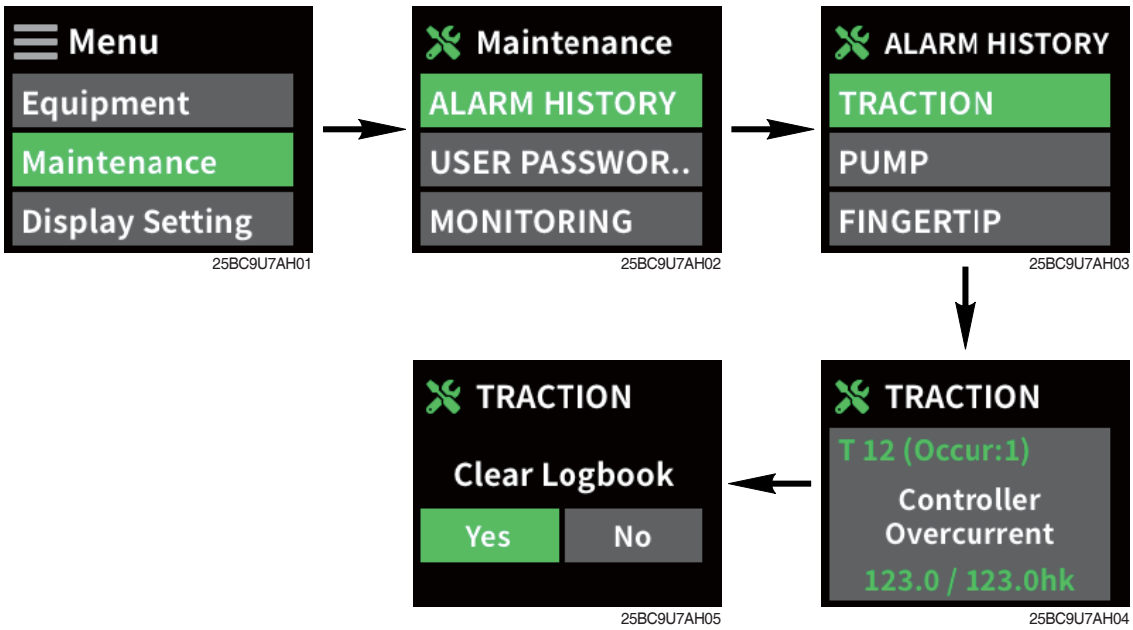
(2) Detail description of ALARM SCREEN

15BRXEL25

①First green capital letter shows in which controller the alarm happens as below;
T : Traction, P : Pump
②Following two digits show alarm code.
③This shows a name of ALARM.

(3) Alarm history

Alarm History can be looked up as follows ;



① Step 1 : Service man can check the alarm history on ALARM HISTORY menu in Maintenance menu.

② Step 2 : Service man can choose each controller to read the alarm history.

③ Step 3 : service man can check simply up to 20 alarms and see detail alarm information.

④ Step 4 : When service man press “Enter” button at Step 3, service man can see a alarm clear menu. If service man press “Enter” button, Recorded alarms of selected controller will be erased.

If operator press “ESC” button, just escape to step 3 without clearing

(4) Alarm code

① **Drive and pump controller** (manual)

* SET conditions : It is the conditions that the fault occurs.
* CLEAR conditions : It is the conditions to clear the fault.
* Cycle KSI : Truck key off and on
* Cycle interlock : Seat switch on (In case of truck equipped with optional seat belt switch, seat switch ON and belt switch ON))

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
18	Controller Overcurrent	O	O	1. External short of phase U,V, or W motor connections. 2. Motor parameters are mis-tuned. 3. Controller defective. 4. Speed encoder noise problems.	Set : Phase current exceeded the current measurement limit. Clear : Cycle KSI.
19	Current Sensor Fault	O	O	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	Set : Controller current sensors have invalid offset reading. Clear : Cycle KSI.
20	Precharge Failed	O	O	1. See Monitor menu » Battery: Capacitor Voltage. 2. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging.	Set : The precharge failed to charge the capacitor bank. Clear : Cycle Cycle Interlock input.
21	Controller Severe Undertemp	O	O	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	Set : Heatsink temperature below -40°C. Clear : Bring heatsink temperature above -40°C, and cycle interlock or KSI.
22	Controller Severe Overtemp	O	O	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	Set : Heatsink temperature above +95°C. Clear : Bring heatsink temperature below +95°C, and cycle interlock or KSI.

* Please see the diagnostics menu with CURTIS 1313 hand programer to know which error (B+ or KSI) occurred when the code 18 is occurred.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
23	Severe B+ Undervoltage	O	O	1. Battery parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See Monitor menu » Battery: Capacitor Voltage. 6. Blown B+ fuse or main contactor did not close.	Set : Capacitor bank voltage dropped below the Severe Undervoltage limit with FET bridge enabled. Clear : Bring capacitor voltage above Severe Undervoltage limit *Severe Undervoltage = Either drive current cut back to 0% for 64 ms or Brownout Voltage is reached, whichever comes first.
	Severe KSI Undervoltage	O	O	1. See Monitor menu » Battery: Keyswitch Voltage. 2. Non-controller system drain on battery/KSI circuit wiring. 3. KSI disconnected while driving. 4. Blown KSI fuse.	Set : When below Brownout Voltage for 2 seconds. Clear : Bring KSI voltage above Brownout Voltage.
24	Severe B+ Overvoltage	O	O	1. See Monitor menu » Battery: Capacitor Voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.	Set : Capacitor bank voltage exceeded the Severe Overvoltage limit with FET bridge enabled. Clear : Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.
	Severe KSI Overvoltage	O	O	1. Incorrect (to high) battery-voltage applied to KSI (pin 1) 2. See Monitor menu » Battery: Keyswitch Voltage. Note: Prevents the Main Contactor closure if KSI is greater than the Severe Overvoltage limit.	Set : KSI voltage exceeded Severe Overvoltage limiit Clear : Bring KSI voltage below the Severe Overvoltage limit.
34	Controller Overtemp Cutback	O	O	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	Set : Heatsink temperature exceeded 85°C. Clear : Bring heatsink temperature below 85°C.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
35	B+ Undervoltage Cutback	O	O	1. Normal operation. Fault indicates the batteries need recharging. 2. Controller is performance limited at this voltage. 3. Battery parameters are misadjusted. 4. Non-controller system drain on battery. 5. Battery resistance too high. 6. Battery disconnected while driving. 7. See Monitor menu » Battery: CapacitorVoltage. 8. Blown B+ fuse or main contactor did not close.	Set : Capacitor bank voltage dropped below the Undervoltage limit with the FET bridge enabled. Clear : Bring capacitor voltage above the Undervoltage limit.
36	B+ Overvoltage Cutback	O	O	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. 2. Controller is performance limited at this voltage. 3. Battery parameters are misadjusted. 4. Battery resistance too high for given regen current. 5. Battery disconnected while regen braking. 6. See Monitor menu » Battery: Capacitor Voltage.	Set : Capacitor bank voltage exceeded the Overvoltage limit with the FET bridge enabled. Clear : Bring capacitor voltage below the Overvoltage limit.

※ Overvoltage = Either Max Voltage (see Table D-1) or User Overvoltage × Nominal Voltage, whichever is lower.

※ Severe Overvoltage = Overvoltage (see previous item) + 10V.

※ Undervoltage = Either Min Voltage (see Table D-1) or User Undervoltage × Nominal Voltage, whichever is higher.

※ Severe Undervoltage = Either drive current cut back to 0% for 64 ms or Brownout Voltage * (see Table D-1) is reached, whichever comes first.

Nominal voltage	Min. voltage	Max. voltage	Brownout voltage
24 V	14 V	30 V	12 V
24 - 36 V	16.8 V	45 V	15 V
36 - 48 V	25.2 V	60 V	20 V
48 - 80 V	33.6 V	105 V	20 V
72 - 96 V	50.4 V	120 V	30 V

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
37	+5V Supply Failure	O	O	1. External load impedance on the +5V supply (pin 26) is too low. See Monitor menu » outputs: 5 2. Volts and Ext Supply Current.	Set : +5V supply (pin 26) outside the 5 V±10% range. Clear : Bring voltage within range.
38	Digital Out 6 Open/Short	O	O	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	Set : Digital Output 6 (pin 19) current exceeded 1 Amp. Clear : Remedy the overcurrent cause.
39	Digital Out 7 Open/Short	O	O	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	Set : Digital Output 7 (pin 20) current exceeded 1 Amp. Clear : Remedy the overcurrent cause.
40	Motor Temp Hot Cutback	O	O	1. Motor temperature is at or above the programmed Temperature Hot setting, and the current is being cut back. 2. Motor Temperature Control Menu parameters are mis-tuned. See Monitor menu » Motor: 3. Temperature and » Inputs: Analog2. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off."	Set : Motor temperature is at or above the Temperature Hot parameter setting. Clear : Bring the motor temperature within range.
41	Motor Temp Sensor Fault	O	O	1. Motor thermistor is not connected properly. 2. If the application doesn't use a motor thermistor, Motor Temp Sensor Enable should be programmed Off. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2."	Set : Motor thermistor input (pin 8) is at the voltage rail (0 V or 10 V). Clear : Bring the motor thermistor input voltage within range.
49	Coil1 Driver Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off. Clear : Correct open or short, and cycle driver.
	Main Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = On. Clear : Correct open or short, and cycle driver

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
50	Coil2 Driver Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0. Clear : Correct open or short, and cycle driver.
	EMBrake Open/ Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type >0. Clear : Correct open or short, and cycle driver.
51	Coil3 Driver Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Driver 3 (pin 4) is either open or shorted. Clear : Correct open or short, and cycle driver.
52	Coil4 Driver Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Driver 4 (pin 3) is either open or shorted. Clear : Correct open or short, and cycle driver.
53	PD Open/Short	O	O	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	Set : Proportional driver (pin 2) is either open or shorted. Clear : Correct open or short, and cycle driver.
54	Encoder Fault	O	O	1. Motor encoder failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	Set : Motor encoder phase failure detected. This fault can be set only when Feedback Options = 1(Encoder). Clear : Either cycle KSI, or if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Encoder Fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.
	Sin/Cos Sensor Fault	O	O	1. Sin/Cos sensor failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	Set : Greater than Sin_Cos_ Fault_Threshold % difference from expected value between two phases seen 5 times within one second. This fault can be set only when Feedback Options = 2(Sin/Cos). Clear : Cycle KSI or Entry into LOS mode if enabled. *Feedback Options is 1(Encoder) in BC-9U

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
55	Motor Open	O	O	1. Motor phase is open. 2. Bad crimps or faulty wiring.	Set : Motor phase U, V, or W detected open. Clear : Cycle KSI.
56	Main Contactor Welded	O	O	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	Set : Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. Clear : Cycle KSI.
57	Main Contactor Did Not Close	O	O	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact.* External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 3. Blown B+ fuse.	Set : With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. Clear : Cycle KSI.
65	Throttle Wiper High	O	O	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	Set : Throttle pot wiper (pin 16) voltage is higher than the high fault threshold. Clear : Bring throttle pot wiper voltage below the fault threshold.
66	Throttle Wiper Low	O	O	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too low.	Set : Throttle pot wiper (pin 16) voltage is lower than the low fault threshold. Clear : Bring throttle pot wiper voltage above the fault threshold.
67	Pot2 Wiper High	O	O	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too high.	Set : Pot2 wiper (pin 17) voltage is higher than the high fault threshold. Clear : Bring Pot2 wiper voltage below the fault threshold.
68	Pot2 Wiper Low	O	O	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too low.	Set : Pot2 wiper (pin 17) voltage is lower than the low fault threshold. Clear : Bring Pot2 wiper voltage above the fault threshold.
69	Pot Low OverCurrent	O	O	1. See Monitor menu » Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	Set : Pot low (pin 18) current exceeds 10 mA. Clear : Clear pot low overcurrent condition and cycle KSI. *Pin18 is not used in BC-9U. Pin18 is for the resistance accelerator type only.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
70	EEPROM Failure	O	O	1. Failure to write to EEPROM memory. 2. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	Set : Controller operating system tried to write to EEPROM memory and failed. Clear : Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.
71	HPD/ Sequencing Fault	O	O	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. (eg. KEY ON with forward or backward switch on) 2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. 3. See Monitor menu » Inputs.	Set : HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. Clear : Re-apply inputs in correct sequence.
	Emer Rev HPD	O	O	1. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.	Set : At the conclusion of Emer gency Reverse, the fault was set because various inputs were not returned to neutral. This fault can be set only when EMR_Interlock = On. Clear : If EMR_Interlock = On, clear the interlock, throttle, and direction inputs. If EMR_ Interlock = Off, clear the throttle and direction inputs. *EMR_Interlock is OFF in BC-9U.
73	Parameter Change Fault	O	O	1. This is a safety fault caused by a change in certain parameter set-tings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	Set : Adjustment of a param eter setting that requires cycling of KSI. Clear : Cycle KSI.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
81	CAN Communications Fault	O		1. Bad crimps or faulty wiring between traction and pump controller. 2. Dirty connector pins. 3. Pump controller failure.	Set : CAN communication Fault between traction and pump when cycling KSI. Traction controller checks the pump CAN message when cycling KSI and If there is a fault with the check, the alarm will occur. Clear : Cycle KSI.
	Level HPD Fault		O	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. (eg. KEY ON while pulling the lift lever)	Set : HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs The manual Lever or finger tip is operated before power-on. Clear : Re-apply inputs in correct sequence. Release the finger tip and manual lever to neutral state
82	Pump CAN PDO Timeout	O		1. Bad crimps or faulty wiring between traction and pump controller. 2. Dirty connector pins. 3. Pump controller failure.	Set : Time between CAN PDO messages from pump controller received exceeded the PDO Timeout Period. Clear : Cycle KSI or receive CAN NMT message.
	Pump Level PDO Timeout		O	1. Bad crimps or faulty wiring between pump and fingertip controller. 2. Fingertip Subcontroller failure 3. Dirty connector pins. 4. Pump controller failure.	Set : Time between CAN PDO mes sages from fingertip controller received exceeded the PDO Timeout Period. The checked time that CAN data from finger tip Subcontroller is over 500ms Clear : Cycle KSI or receive CAN NMT message. Check the CAN bus and make the finger Subcontroller PDO cycle time normal
83	Accel Pedal A&B Fault	O		1. Accelerator pedal failure. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Inputs: Throttle Pot. 4. See Monitor menu » Inputs: Pot2 Raw.	Set : It occurs when the sum of Throttle Pot and Pot2 Raw input voltages do not match the supply voltage of the sensor. Clear : Cycle KSI.
	Pump SRO Fault		O	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. (eg. Pulling the lift lever without seat switch on) 2. The manual Lever or finger tip is operated before the seat switch is on"	Set : HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. Clear : Re-apply inputs in cor rect sequence. Release the finger tip and manual lever to neutral state

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
84	BMS PDO TimeOut	O		1. Bad crimps or faulty wiring between traction controller and BMS(Battery Management System)	Set : Time between CAN PDO messages from BMS(Battery Management System) received exceeded the PDO Timeout Period. Clear : Cycle KSI or receive CAN NMT message.
	SASA PDO Timeout			1. Bad crimps or faulty wiring between pump controller and SASA steering sensor.	Set : Time between CAN PDO messages from SASA steering sensor received exceeded the PDO Timeout Period. Clear : Cycle KSI or receive CAN NMT message.
85	Break oil	O		1. Lack of brake oil. 2. Brake oil sensor failure. 3. Bad crimps or faulty wiring. 4. See Monitor menu » Inputs: Switch (Traction controller)"	Set : It occurs when switch (Pin10) in the traction controller is On. Clear : Check the brake oil tank & sensor.
	Tilt Sensor Fualt		O	1. Tilt Lever or Tilt Sensor Fault	Set : The tilt sensor voltage is out of range Clear : Check the sensor(Pump controller Pin 24) wiring or adjust the related parameters
86	Battery Out	O		1. SBR(Side Battery Removal) switch is opened. 2. SBR switch failure. 3. Bad crimps or faulty wiring. 4. See Monitor menu » Inputs: Switch 16 (Traction controller)	Set : It occurs when switch 16 (pin14) in the traction controller is Off. Clear : Check the SBR switch.
	Lift Pot Fault		O	1. Lift Lever or Lift Sensor Fault	Set : The lift pot voltage is out of range Clear : Check the lift pot wiring(Pump Controller Pin 16) or adjust the related parameters
87	BMS Not Ready	O		1. The battery monitoring system is in BMS NOT READY status.	Set : The battery monitoring system is in BMS NOT READY status. It is received through CAN mgs. Clear : Check the BMS(Battery Management System).
	Fingertip CAN PDO Timeout		O	1. Fintertip Controller Fault 2. CAN Line Fault	Set : The checked time that CAN data from Fingertip Controller is over 500ms Clear : Check the CAN bus line and make the Fingertip CAN PDO cycle time normal

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
88	BMS Warning 0	O		1. The battery monitoring system is in WARNING 0 status.	Set : The battery monitoring system is in WARNING 0 status. It is received through CAN mgs. Clear : Check the BMS (Battery Man agement System).
	Traction CAN PDO Timeout	O		1. Traction Controller Fault 2. CAN Line Fault	Set : The checked time that CAN data from Traction controller is over 500ms Clear : Check the CAN bus and make the Traction controller CAN PDO cycle time normal
89	Wrong Model Display	O		Not used.	Not used.
	Incorrect Start (Lever, Seat, Belt)		O	1. incorrect seat belt sequence state	Set : The manual Lever or finger tip is operated in incorrect seat belt sequence state Clear : Release the finger tip and manual lever to neutral state and loosen the seat belt or operate it in correct sequence
97	Unmatched Dis-play	O		Not used.	Not used.
98	BMS Warning 1	O		1. The battery monitoring system is in WARNING 1 status.	Set : The battery monitoring system is in WARNING 1 status. It is received through CAN mgs. Clear : Check the BMS (Battery Man agement System).
99	BMS Fault	O		1. The battery monitoring system is in FAULT status.	Set : The battery monitoring system is in FAULT status. It is re-ceived through CAN mgs. Clear : Check the BMS (Battery Man agement System).
100	Release Parking Brake	O		1. Incorrect Start Sequence state (when occur throttle On Parking)	Set : The parking switch is off but the throttle is in operated volt-age range Clear : Check the SBR switch.
101	Incorrect Start (Fwd/Rev, Accel)	O		1. Incorrect Start Sequence state (Fwd/Rev/Throttle SRO Fault)	Set : 1. The fwd, rev switch or throttle is operated before power-on 2. The fwd, rev or throttle is operated before the seat switch is on Clear : Release the throttle to deadband state and reset the fwd & rev to neutral state

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
102	Incorrect Start (Fwd/Rev, Accel)	O		1. Incorrect Start Sequence state (Fwd/Rev Exchange Timeout)	Set : When the throttle is operated but the direction switch exchange time is over Direction Exchange Delay Clear : Release the throttle to deadband state or Exchange slowly.
103	Incorrect Start (Seat, Belt)	O		1. Incorrect Start Sequence state (Safety Belt SRO Fault)	Set : Incorrect seat belt operation sequence Clear : Reset the fwd & rev to neutral state
104	VCL Run Time Error	O	O	1. VCL code encountered a runtime VCL error. 2. See Monitor menu » Controller: VCL Error Module and VCL Error. 3. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	Set : Runtime VCL code error condition. Clear : Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
105	External Supply Out of Range	O	O	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned. See Monitor menu » Outputs: Ext 3. Supply Current.	Set : The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. Clear : Bring the external supply current within range. *External Supply Max is 200mA in BC-9U.
113	OS General	O	O	1. Internal controller fault.	Set : Internal controller fault detected. Clear: Cycle KSI.
114	PDO Timeout	O	O	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	Set : Time between CAN PDO messages received exceeded the PDO Timeout Period. Clear : Cycle KSI or receive CAN NMT message.
115	Stall Detected	O	O	1. Stalled motor. 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See Monitor menu » Motor: Motor RPM.	Set : No motor encoder movement detected. Clear : Either cycle KSI, or if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Stall Detected fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
116	Fault On Other Traction Controller	O	O	1. Dual Drive fault : see Dual Drive manual.	*BC-9U has a single drive.
117	Dual Severe Fault	O	O	1. Dual Drive fault : see Dual Drive manual.	*BC-9U has a single drive.
119	Supervisor Fault	O	O	1. The Supervisor has detected a mismatch in redundant readings. Internal damage to Supervisor 2. microprocessor. Switch inputs allowed to be within 3. upper and lower thresholds for over 100 milliseconds. (for recurring errors, check the switches for moisture).	Set : Mismatched redundant readings; damaged Supervisor; illegal switch inputs. Clear : Check for noise or voltage drift in all switch inputs; check connections; cycle KSI.
120	Supervisor Incompatible	O	O	1. The main OS is not compatible with the Supervisor OS.	Set : Incompatible software. Clear : Load properly matched OS code or update the Supervisor code; cycle KSI.
130	Bad Calibrations	O	O	1. Internal controller fault.	Set : Internal controller fault detection. Clear : Cycle KSI.
131	Driver Supply	O	O	1. Internal controller fault in the voltage supply for the driver circuits.	Set : Internal controller fault detection. Clear : Cycle KSI.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
135	Motor characterization error	O	O	1. Motor characterization failed during characterization process. See Monitor menu » Controller: 2. Motor Characterization Error for cause : 0 = sequencing error. Normally caused by turning off Motor Characterization Test Enable before running the test. 1 = encoder signal seen but step size not auto-detected; set up Encoder Steps manually 2 = motor temp sensor fault 3 = motor temp hot cutback fault 4 = controller overtemp cutback fault 5 = controller undertemp cutback fault 6 = undervoltage cutback fault 7 = severe overvoltage fault 8 = encoder signal not seen, or one or both channels missing 9 = motor parameters out of characterization range 20 = Sin/Cos sensor not found 21 = phasing not detected 22 = Sin/Cos sensor characterization failure 23 = started characterization procedure while motor rotating.	Set : Motor characterization failed during the motor characterization process. Normally caused by turning off Motor_Characterization_Test_Enable before running test. Needs controller reset. Clear : Correct fault; cycle KSI, or VCL reset.
136	Encoder Pulse Count Fault	O	O	1. Encoder Steps parameter does not match the actual motor encoder.	Set : Detected wrong setting of the Encoder Steps parameter. Clear : Ensure the Encoder Steps parameter matches the actual encoder; cycle KSI.
137	Motor Type Fault	O	O	1. The Motor_Type parameter value is out of range.	Set : Motor_Type parameter is set to an illegal value. Clear : Set Motor_Type to correct value and cycle KSI.
145	VCL/OS Mismatch	O	O	1. The VCL software in the controller does not match the OS software in the controller.	Set : VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. Clear : Download the correct VCL and OS software into the controller.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
146	EM Brake Failed to Set	O	O	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	Set : After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. Clear : Activate the Throttle (EM Brake type 2). 2. Activate the Interlock (EM Brake type 1). *BC-9U doesn't have EM Brake.
147	Encoder LOS (Limited Operating Strategy)	O	O	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detected fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	Set : Encoder Fault (code 36) or Stall Detected (code 73) was activated, if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Encoder LOS (code 93) control mode is activated, allowing limited motor control. Clear : Cycle KSI or, if LOS mode was activated by the Stall Detected fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.
148	Emer Rev Timeout	O	O	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	Set : Emergency Reverse was activated and ran until the EMR Timeout timer expired. Clear : Turn the emergency reverse input Off. *EMR_Interlock is OFF in BC-9U.
152	Illegal Model Number	O	O	1. Model_Number variable contains illegal value. Software and hardware do not match. Controller defective.	Set : Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_ Number, and a fault is issued if one is not found. Clear : Download appropriate software for your controller model.

Code	Alarm	Traction	Pump	Possible cause	Set/clear conditions
153	Parameter Mismatch	O	O	1. Dual drive enabled on only one controller. 2. Incorrect position feedback type chosen for motor technology in use. 3. Dual drive is enabled in torque mode.	Set : When the Dual Drive software is enabled, the controller must be set to either Speed Mode Express or Speed Mode; otherwise this fault is set. Motor Techology=0 must be paired with Feedback Type=1, and Motor Technology=1 must be paired with Feedback Type=2; otherwise this fault is set. Clear : Adjust parameters to appropriate values and cycle KSI. *BC-9U has a single drive.

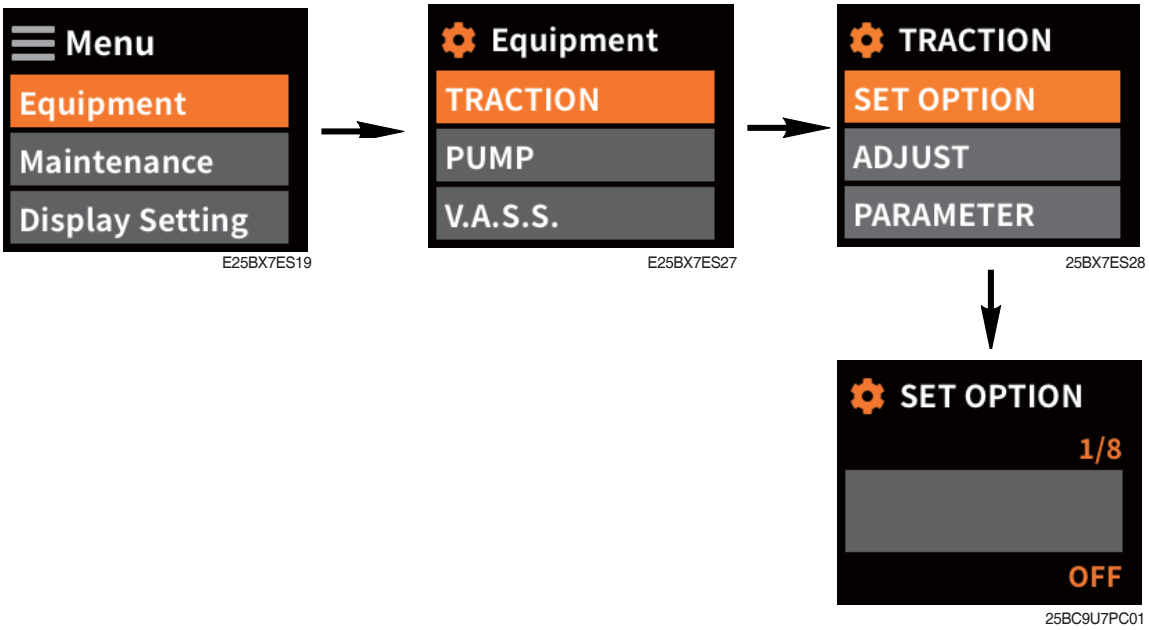
② **Drive and pump controller** (fingertip)

Code	Alarm	Description	Results	Troubleshooting
23	Internal Fault	Encryption failure.	1353 in Stopped state.	Requires repair and ATS test.
24	EEPROM Fault	EEPROM did not properly write, or Checksum did not match.	All outputs stopped.	Write to failed location.
25	5V Supply Fail	External load impedance on +5V Supply is too low.	None.	Bring voltage within range.
32	12V Supply Fail	External load impedance on +12V Supply is too low.	None.	Bring voltage within range.
33	External Supply Out of Range	External load on +5V or +12V exceeds 200 mA.	None.	Bring external supply currentwithin range.
34	Flash Fault	The flash did not properly write.	1353 in Stopped state.	Write to failed location.
35	Analog Input Fault	Analog input exceeds 15.5V (voltage input) or 7.5kΩ (resistance input).	None.	Bring analog input within range.
36	Encoder Fault	Encoder wire open.	Encoder count stopped.	Cycle KSI.
51	Overvoltage	Battery over limit. Limit = (Nominal Voltage * 1.25) + 5V.	All outputs stopped.	Battery returns to normal range for >1 second.
52	Undervoltage	Battery under limit. Limit = (Nominal Voltage * 0.7) - 5V when Nominal Voltage ≥24V. Limit = (Nominal Voltage * 0.7) - 0.6V when Nominal Voltage =12V.	All outputs stopped.	Battery returns to normal range for >1 second.
53	Overtemp	Heatsink over allowed temperature.	All outputs stopped.	Temperature returns to normal range (<95°C).
54	Undertemp	Heatsink below allowed temperature.	All outputs stopped.	Temperature returns to normal range (>-50°C).
55	Overcurrent	Total current exceeds 18A.	All outputs stopped.	Temperature returns to normal range (<95°C).
73	Driver 1 Fault	Driver is in overcurrent (>3.5 amps).	Output on the faulted driver stopped.	Send a 0% PDO command to the faulted driver.
80	Driver 2 Fault			
81	Driver 3 Fault			
82	Driver 4 Fault			
83	Driver 5 Fault			
84	Driver 6 Fault			
85	Driver 7 Fault			
86	Driver 8 Fault			
87	Driver 9 Fault			

Code	Alarm	Description	Results	Troubleshooting
101	Coil 1 Fault	Driver output pin is low when driver is Off. This implies the pin has been left open.	Output on the faulted driver not functional.	Driver pin is reconnected
102	Coil 2 Fault			
103	Coil 3 Fault			
104	Coil 4 Fault			
105	Coil 5 Fault			
112	Coil 6 Fault			
113	Coil 7 Fault			
114	Coil 8 Fault			
115	Coil 9 Fault			
129	PDO Timeout	PDO from master has not been received within the time-out period.	All drivers disabled and commands cleared.	New PDO received within proper timing.
130	CAN Bus Fault	Too many CAN bus errors detected.	1353 in Stopped state.	NMT received, or bus reception & transmission restored.

3) PARAMETER CHANGE

Service man can change and check the traction and pump controller parameters.



(1) Traction inverter

Set options	Description
Lithium Battery Enable	This option set the communication check between traction and Li-ion Battery Management System. - ON : using BMS with Lithium Battery - OFF : not using BMS with Lithium Battery
Safety Belt Sequence Option	- None : need to only 'Taking a seat' for Driving and Lifting. - Option #1 : need to 'Taking a seat' and 'Fastening a seat belt' for driving and lifting. The order is not matter. - Option #2 : need to 'Taking a seat' and 'Fastening a seat belt' for Driving and Lifting. It must meet the order.
BDI Lockout Enable	- ON : BDI lockout is enabled. - OFF : BDI lockout is not enabled. (default) *BDI lockout : controller locks out lift if battery charge < [BDI LockOut Level].
Motor Fan Working Type	Cooling fans installed on nearby motors will work as follows; - Option #1 : fans work always. - Option #2 : fans work in case a temperature of controller or motor exceeds a temperature set in [Traction Motor Fan Starting Temp] and [Pump Motor Fan Starting Temp]. - Option #3 : fans work when motors work.
Position Hold Enable	- ON : The stop on ramp feature (truck electrically hold on a ramp) is is managed for [Position Hold Timeout Time]. - OFF : The stop on ramp feature is not performed.
Traction Cutback Enable	If the mast is lifted the height over free lift, traction speed reduction is working depends on the setting status of this function. - ON : Traction speed control [Traction Cutback Speed] is performed. - OFF : Traction speed control [Traction Cutback Speed] is not performed.

Parameter	Description
Cluster Enable	- ON : The forklift works normally only when The cluster is activated. - OFF : You can use The forklift regardless of The cluster.
BDI LockOut Level	(This parameter is used for that [BDI Lockout Enable] is ON) This parameter defines BDI LockOut Level. Controller locks out lift if battery charge < [BDI LockOut Level].
Seat Switch Delay	This parameter defines the delay time after the seat switch is off.
Traction Cutback Speed	It sets the traction motor speed when lift cutback switch is on.
BMS Warning Speed	This parameter defines the maximum speed performed when the BMS warning 1 is active.
BMS Warning Current	This parameter defines the maximum current performed when the BMS warning 0 is active.
Brake Rate Foot Pedal	Sets the rate (in seconds) at which the vehicle slows down from high speeds when brake is applied or when full throttle is applied in the opposite direction.
Brake Rate Else	Sets the rate (in seconds) at which the vehicle slows down from high speeds when brake is not applied or a small amount of throttle is applied in the opposite direction.
T mode Speed	(Turtle mode) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
T mode Drive Current	(Turtle mode) Sets the maximum RMS current the controller will supply to the motor during drive operation, as a percentage of the controller's full rated current. *Reducing this value will reduce the maximum drive torque.
H mode Fwd Max Speed	(H mode, Forward direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
H mode Rev Max Speed	(H mode, Reverse direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
H mode Drive Current	(H mode) Sets the maximum RMS current the controller will supply to the motor during drive operation, as a percentage of the controller's full rated current. *Reducing this value will reduce the maximum drive torque.
N mode Fwd Max Speed	(H mode, Forward direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.

Parameter	Description
N mode Rev Max Speed	(H mode, Reverse direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
N mode Drive Current	(H mode) Sets the maximum RMS current the controller will supply to the motor during drive operation, as a percentage of the controller's full rated current. *Reducing this value will reduce the maximum drive torque.
E mode Fwd Max Speed	(H mode, Forward direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
E mode Rev Max Speed	(H mode, Reverse direction) Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value.
E mode Drive Current	(H mode) Sets the maximum RMS current the controller will supply to the motor during drive operation, as a percentage of the controller's full rated current. *Reducing this value will reduce the maximum drive torque.
T mode Full Accel Rate HS	(Turtle mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response.
T mode Full Accel Rate LS	(Turtle mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low vehicle speeds.
H mode Full Accel Rate HS	(H mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response.
H mode Full Accel Rate LS	(H mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low vehicle speeds.
N mode Full Accel Rate HS	(N mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response.
N mode Full Accel Rate LS	(N mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low vehicle speeds.
E mode Full Accel Rate HS	(E mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response.
E mode Full Accel Rate LS	(E mode) Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low vehicle speeds.

Parameter	Description
Low Accel Rate	Sets the rate (in seconds) at which the speed command increases when a small amount of throttle is applied. This rate is typically adjusted to affect low speed maneuverability.
Neutral Decel Rate HS	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is released to neutral at high vehicle speeds.
Neutral Decel Rate LS	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is released to neutral at slow vehicle speeds.
Position Hold Timeout Time	This parameter plus the Position Hold Settling Time parameter sets the maximum time the vehicle will stay in Position Hold before releasing the hold and going into Restraint mode. Setting the parameter to zero disables this timeout function, which means the Position Hold will be held. Activating the interlock resets the timer.
Partial Decel Rate	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is reduced without being released to neutral. Larger values represent slower response.
Forward Map	Modifies the vehicle's response to the throttle input. Setting the throttle map at 50% provides a linear output response to throttle position. Values below 50% reduce the controller output at low throttle settings, providing enhanced slow speed maneuverability. Values above 50% give the vehicle a faster, more responsive feel at low throttle settings. The map value is the percentage of controller output at half throttle [(deadband + max)/2].
Reverse Map	Same as throttle forward counterpart and applies when throttle direction is reversed.
Speed to RPM	The value entered for Speed to RPM is a conversion factor that scales motor speed to vehicle speed. It does not affect actual vehicle performance. KPH to RPM: (G/d)*5305, where G = gear ratio, d = tire diameter [mm]. MPH to RPM: (G/d)*336.1, where G = gear ratio, d = tire diameter [in].

Adjustment	Description
Battery Nominal Voltage	Must be set to the vehicle's nominal battery pack voltage. This parameter is used in determining the overvoltage and undervoltage protection thresholds for the electronic system. NOTE: In all cases the OS default Nominal Voltage is the highest value in the controller's range Always check and adjust this parameter whenever using a lower nominal voltage. Scaling is 64 counts per volt. For example, controller 1238E-65XX has a 48–80 voltage range. Therefore, when using a 48 volt battery, the Nominal_Voltage parameter will be 3072 (64 × 48 = 3072) in your VCL program, or as the raw (decimal) value in TACT. Must be changed according to 36V, 48V.
Contactor Pull In Voltage	The main contactor pull-in voltage parameter allows a high initial voltage when the main contactor driver first turns on, to ensure contactor closure. After 1 second, this peak voltage drops to the contactor holding voltage. NOTE: The Battery Voltage Compensated parameter (below) controls whether the pull-in and holding voltages are battery voltage compensated. Must be changed according to 36V, 48V.
Contactor Holding Voltage	The main contactor holding voltage parameter allows a reduced average voltage to be applied to the contactor coil once it has closed. This parameter must be set high enough to hold the contactor closed under all shock and vibration conditions the vehicle will be subjected to. NOTE: The Battery Voltage Compensated parameter (below) controls whether the pull-in and holding voltages are battery voltage compensated. Must be changed according to 36V, 48V.
Fan Relay Driving Voltage	This function controls the fan relay voltage. Must be changed according to 36V, 48V.
Traction Motor Fan Starting Temp	(This parameter is used for that [Motor Fan Working Type] is option #2) If the temperature of traction motor exceeds the temperature indicated in this paramter.
Pump Motor Fan Starting Temp	(This parameter is used for that [Motor Fan Working Type] is option #2) If the temperature of pump motor exceeds the temperature indicated in this paramter.

Adjustment	Description
OCV 10 Percent Voltage OCV 100 Percent Voltage BDI Reset 1 BDI Reset 2 Standby Time Reset Volts Per Cell Full Volts Per Cell Empty Volts Per Cell Discharge Time BDI Reset Percent	1. At the start 1) Controller get the battery voltage from key input. 2) BDI is changed to the new BDI matching with [OCV 10 Percent Voltage] and [OVC 100 Percent Voltage]. But, If the new BDI is within the range 'Last BDI ±[BDI RESET 1]', it is discarded. 2. Stand-by (during no running motor) 1) Controller get the battery voltage from B+ input when the all motors do not run for [Standby Time]. 2) BDI is changed to the new BDI matching with [OCV 10 Percent Voltage] and [OVC 100 Percent Voltage]. But, If the new BDI is within the range 'Last BDI ±[BDI RESET 2]', it is discarded. 3. Discharging (during running motor) - Full Volts Per Cell : The full voltage level sets the B+ (capacitor voltage) that is considered to be 100% state-of-charge; when a loaded battery drops below this voltage, it begins to lose charge. *Full Voltage Level = Full Volts Per Cell × number of cells in the battery pack(24). - Empty Volts Per Cell : The empty voltage level sets the Capacitor Voltage that is considered to be 0% state-of-charge. *Empty Voltage Level = Empty Volts Per Cell × number of cells in the battery pack(24). - Discharge Time : Sets the minimum time for the BDI algorithm to count down the BDI Percentage from 100% to 0%. The BDI algorithm integrates the time the filtered capacitor voltage is below the state of charge voltage level. When that cumulative time exceeds the Discharge Time / 100, the BDI Percentage is decremented by one percentage point and a new state of charge voltage level is calculated. *State of Charge Level = [(Full Voltage Level - Empty Voltage Level) x BDI Percentage / 100] + Empty Voltage Level. - Reset Volts Per Cell : not used. - BDI Reset Percent : not used. OCV 10 Percent Voltage, OCV 100 Percent Volatge Must be changed according to 36V, 48V.
Direction Exchange Delay	Define the permitted neutral time when exchange fwd / rev with pressing the throttle. If the nuetral time is more than this parameter value, T102 error will appear
Throttle HPD Deadband Voltage	Define the max throttle voltage threshold if the Throttle Pot is more than this parameter value at power-on, T101 error will appear

(2) Pump inverter

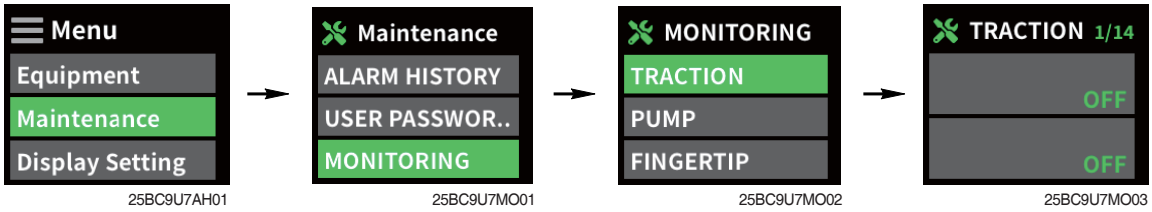
Set options	Description
Fingertip Enable	- ON : The truck model includes electro-hydraulic distributor and finger tips. Can communication with 1353-6101 (fingertip controller) and 1236SE-5621(pump controller) is enabled. - OFF : The truck model includes mechanical lever distributor.
Fingertip Clamp Interlock Enable	- ON : Clamp interlock function via finger tip is activated. (Clamp is only available when the clamp enable button is pressed) - OFF : Clamp interlock function via finger tip is disabled (available regardless of clamp enable button)
Fingertip Aux 2 Lever Enable	- ON : When Fingertip is 4spool (4lever), you have to turn it on. - OFF : When Fingertip is 3spool (3lever) you have to turn it off.
Lift Cutback Enable	If the mast is lifted the height over free lift, pump speed reduction is working depends on the setting status of this function. - ON : Pump speed control [Pump Cutback Speed) is performed. - OFF : Pump speed control [Pump Cutback Speed) is not performed.
Driver 1 Checks Enable	The two Checks Enable parameters are used to enable driver and coil fault detection at the five individual drivers (at Pins J1-6, J1-5). When a Driver Checks parameter is enabled, the associated driver, driver wiring, and driver load are checked to verify that the driver correctly drives the load both high and low. The checks will occur regardless of the PWM output of the driver. The checks will detect both open and shorted conditions. When a fault is detected, the controller opens the driver and issues a fault code. If nothing is connected to a driver, its Checks Enable parameter should be set Off.
Driver 2 Checks Enable	NOTE : Short circuit protection is always active at these five drivers, regardless of how Checks Enable is set. when fingertip, manual & Auto tilt option : X Driver 1 Checks Enable: OFF, Driver 2 Checks Enable: ON when manual & Auto tilt option : O

Parameter	Description
Max Total Speed	This parameter defines the motor speed limit. Motor speed is sum of lift, tilt, aux and steering request. If the request is higher than this value, it will be limited to this value.
BMS Warning Current	This parameter defines the maximum current performed when the BMS warning 0 is active.
Lift Speed BMS Warning Mode	This parameter defines the maximum speed performed when the BMS warning 1 is active.
Lift Speed High Mode	(H mode) This parameter defines the maximum speed of the pump motor during lift.
Lift Speed Normal Mode	(N mode) This parameter defines the maximum speed of the pump motor during lift.
Lift Speed Low Mode	(E mode) This parameter defines the maximum speed of the pump motor during lift.
Lift Cutback Speed	It sets the pump motor speed when lift cutback switch is on.
Tilt UP Speed (Manual)	This parameter defines the maximum speed of the pump motor during tilt in/out
AUX1 Speed (Manual)	This parameter defines the maximum speed of the pump motor during AUX1.
AUX2 Speed (Manual)	This parameter defines the maximum speed of the pump motor during AUX2.
Tilt UP Speed (Fingertip)	This parameter defines the maximum speed of the pump motor during tilt (in) with fingertip lever
Tilt Down Speed (Fingertip)	This parameter defines the maximum speed of the pump motor during tilt (out) with fingertip lever
AUX1 Speed (Fingertip)	This parameter defines the maximum speed of the pump motor during AUX1 with fingertip lever
AUX2 Speed (Fingertip)	This parameter defines the maximum speed of the pump motor during AUX2 with fingertip lever
Decel Rate Lift	Sets the rate (in seconds) that is used to slow down the motor speed when the lift throttle is released to neutral.
Decel Rate Else	Sets the rate (in seconds) that is used to slow down the motor speed when the throttle other than the lift is released to neutral.
Accel Rate When Speed Below 500	Sets the rate (in seconds) at which the speed command increases when the motor speed is lower than 500rpm. Larger values represent slower response.
Full Accel Rate HS	Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high motor speeds. Larger values represent slower response.
Full Accel Rate LS	Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low motor speeds. Larger values represent slower response.
Low Accel Rate	Sets the rate (in seconds) at which the speed command increases when a small amount of throttle is applied.
Lift Pot Fault Min Voltage	Define the min lift potentiometer voltage, if the lift potentiometer is less than it, P85 error will appear

Parameter	Description
Lift Pot Fault Max Voltage	Define the max lift potentiometer voltage, if the lift potentiometer is more than it, P85 error will appear
Fingertip Clamp Interlock Switch Hold Time	If the time that Aux 2 lever keep in neutral zone is more than this parameter, means Aux 2 lever is neutral
Battery Nominal Voltage	Must be set to the vehicle's nominal battery pack voltage. This parameter is used in determining the overvoltage and undervoltage protection thresholds for the electronic system. NOTE: In all cases the OS default Nominal Voltage is the highest value in the controller's range Must be changed according to 36V, 48V. Always check and adjust this parameter whenever using a lower nominal voltage. Scaling is 64 counts per volt. For example, controller 1238E-65XX has a 48–80 voltage range. Therefore, when using a 48 volt battery, the Nominal_Voltage parameter will be 3072 (64 × 48 = 3072) in your VCL program, or as the raw (decimal) value in TACT. Must be changed according to 36V, 48V.
Auto Tilt Coil Driving Voltage	This function controls the fan relay voltage. Must be changed according to 36V, 48V.
OPSS Coil Driving Voltage	This function controls the fan relay voltage. Must be changed according to 36V, 48V.

4) MONITORING

Service man can check the traction, pump, fingertip controller monitoring status.



25BC9U7AH01 25BC9U7MO01 25BC9U7MO02 25BC9U7MO03

(1) Traction inverter

Monitoring	Description
Seat Belt Input	Status of the Seatbelt switch Input on Pump Controller Pin 17.
Seat Input	Status of the Seat switch Input on PIN 7.
Brake Switch Input	Status of the Brake pressure switch input on PIN 10.
Forward Switch Input	Status of the Forward switch input on PIN 22.
Reverse Switch Input	Status of the Backward switch input on PIN 33.
Throttle Command	Throttle request % of accelerate pedal.
Throttle Pot_Accel 1	Input voltage from the accelerator pedal(Increasing analog signal) on PIN 16.
Pot2 Raw_Accel 2	Input voltage from the accelerator pedal(decreasing analog signal) on PIN 24.
SW4_Brake oil SW	Status of the Brake oil switch Input on PIN10.
SW5_Pedal brake SW	Status of the Brake pressure switch input on PIN 11.
Dig7 Input_Parking brake SW	Status of the Parking brake switch input on PIN 20.
SW16_SBR SW	Status of the SBR switch input on PIN 14.
Driver 1 PWM_M.C.	Voltage applied over the main contactor coil on PIN 6(driver 1 PWM). It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 2 PWM Fan.R.	Voltage applied over the Motor fan relay on PIN 5(driver 2 PWM). It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
5 Volts	Voltage at +5V output (pin 26).
12 Volts	Voltage at +12V output (pin 25).
Ext Supply Current	Combined current of the external +12V and +5V voltage supplies (PIN 25 and 26).
BDI	Estimation of the battery charge based on the battery voltage.
Capacitor Voltage	Voltage of controller's internal capacitor bank at B+ terminal.
Keyswitch Voltage	Voltage at KSI (PIN 1).
Motor RPM	Motor speed in revolutions per minute.
Motor Temperature	Traction motor temperature sensor readout.
MotorSpeed A	Motor encoder phase A speed in revolutions per minute.

Monitoring	Description
MotorSpeed B	Motor encoder phase B speed in revolutions per minute.
Battery Current	The current on controller DC side
Current (RMS)	RMS current of the controller, taking all three phases into account.
Frequency	Controller electrical frequency.
Controller Temp.	Controller internal temperature.
Controller SW ver	Controller software version.

(2) Pump inverter

Monitoring	Description
Pressure Sensor	Status of the Load sensor potentiometer (analog signal) input on cluster pin34.
Weight	This shows the measured load weight.
Mast Angle	The calculated angle with (Mast Angle From Sensor) and (Mast Angle Offset).
Manual_Lift Pot	The lift lever throttle pot of MCV sensor box.
SW3_LIFT Switch	Status of the lift switch input on PIN 9
SW7_Tilt Switch	Status of the Tilt switch input on PIN 22
SW5_AUX1 Switch	Status of the Aux1 switch input on PIN 11
SW6_AUX2 Switch	Status of the Aux2 switch input on PIN 12
F.tip_Lift Lower Pot	The lift lever throttle pot from the CAN data of finger-tip sub controller.
F.tip_Tilit Pot	The Tilt lever throttle pot from the CAN data of finger-tip sub controller.
F.tip_Aux1 Pot	The Aux1 lever throttle pot from the CAN data of finger-tip sub controller.
F.tip_Aux2 Pot	The Aux2 lever throttle pot from the CAN data of finger-tip sub controller.
SW16_Tilt Leveling SW	Status of the auto tilt leveling switch input on PIN 14
Fingertip Clamp Interlock Switch	Fingertip clamp Interlock switch input is available with data from the finger-tip sub controller.
Driver 1 PWM_Auto tilt	The value is output when the autotilt is operated through the finger-tip. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.PIN 6(driver 1 PWM).
Driver 2 PWM_OPSS	Voltage applied over the traction motor fan relay on PIN 5(driver 2 PWM). It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
5 Volts	Voltage at +5V output (pin 26).
12 Volts	Voltage at +12V output (pin 25).
Ext Supply Current	Combined current of the external +12V and +5V voltage supplies (PIN 25 and 26).
Capacitor Voltage	Voltage of controller's internal capacitor bank at B+ terminal.
Keyswitch Voltage	Voltage at KSI (PIN 1).
Motor RPM	Motor speed in revolutions per minute.
Motor Temperature	Traction motor temperature sensor readout.
MotorSpeed A	Motor encoder phase A speed in revolutions per minute.
MotorSpeed B	Motor encoder phase B speed in revolutions per minute.
Battery Current	The current on controller DC side
Current (RMS)	RMS current of the controller, taking all three phases into account.
Frequency	Controller electrical frequency.
Controller Temp.	Controller internal temperature.
Controller SW ver	Controller software version.

(3) Fingertip inverter

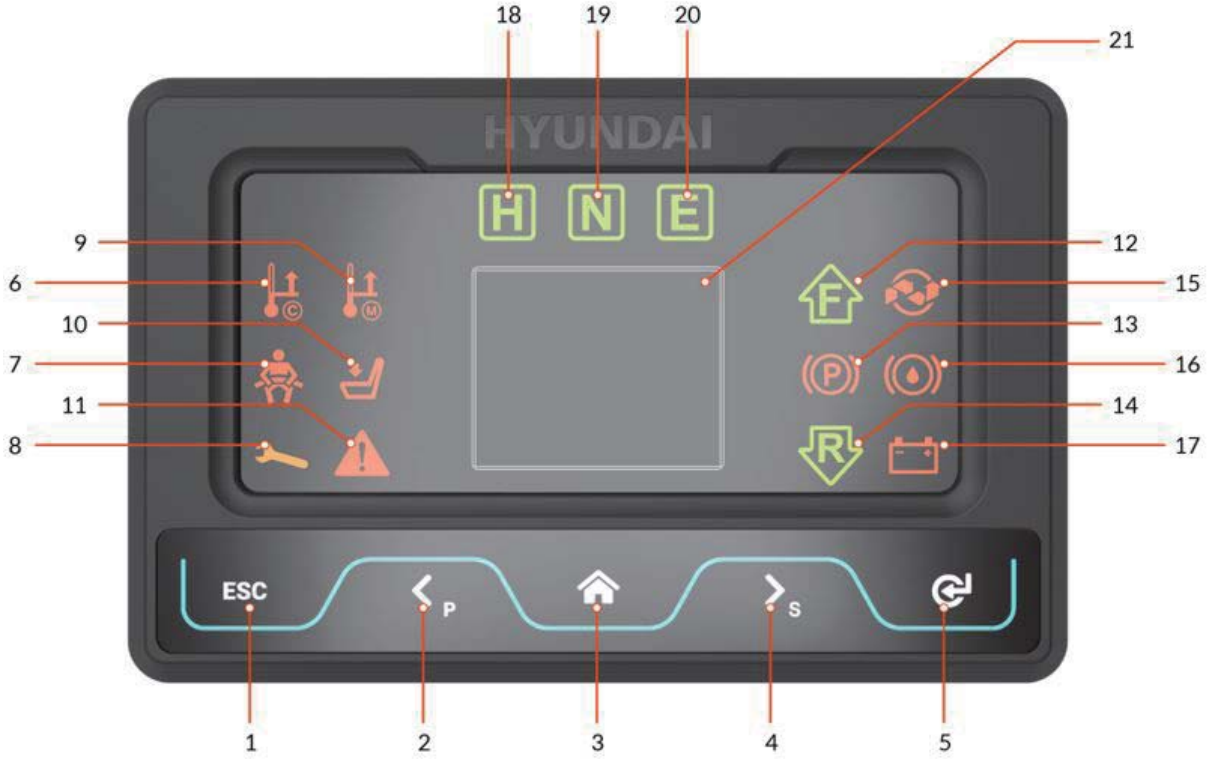
Monitoring	Description
Battery Voltage	Voltage at KSI (PIN 1).
Driver 1 Current_Lift Up	Driver 1 Current output. (PIN 23)
Driver 1 PWM_Lift Up	Driver 1 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 2 Current_Lift Lowering	Driver 2 Current output. (PIN 22)
Driver 2 PWM_Lift Lowering	Driver 2 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 3 Current_Tilt In	Driver 3 Current output. (PIN 21)
Driver 3 PWM_Tilt In	Driver 3 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 4 Current_Tilt Out	Driver 4 Current output. (PIN 20)
Driver 4 PWM_Tilt Out	Driver 4 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 5 Current_Aux1 In	Driver 5 Current output. (PIN 19)
Driver 5 PWM_Aux1 In	Driver 5 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 6 Current_Aux1 Out	Driver 6 Current output. (PIN 18)
Driver 6 PWM_Aux1 Out	Driver 6 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 7 Current_Aux2 In	Driver 7 Current output. (PIN 17)
Driver 7 PWM_Aux2 In	Driver 7 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 8 Current_Aux2 Out	Driver 8 Current output. (PIN 16)
Driver 8 PWM_Aux2 Out	Driver 8 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Driver 9 Current	Driver 9 Current output. (PIN 15)
Driver 9 PWM	Driver 9 PWM output. It corresponds to the duty cycle value of PWM applied and it is expressed in percentage.
Controller SW ver	Controller software version.

5) SETTING

(1) Access the display menu

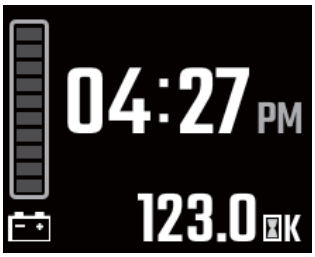
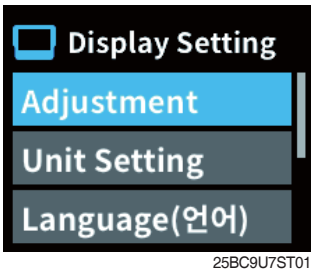
The instrument panel (cluster) has fifteen built-in LED (red, green, amber), which provide the operator with an easy information about the status of some truck devices.

① Buttons and lamps

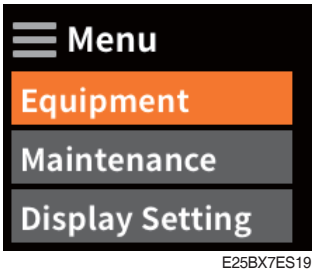


1	ESC button	8	Wrench Lamp	15	Consumable Exchange Lamp
2	LEFT/PERFORMANCE button	9	High Temp Motor Lamp	16	Brake Oil Lamp
3	HOME button	10	Seat Lamp	17	Battery Level Lamp
4	RIGHT/SPEED button	11	Warning Lamp	18	High Mode Lamp
5	ENTER button	12	Forward Lamp	19	Normal Mode Lamp
6	High Temp Controller Lamp	13	Parking brake Lamp	20	ECO Mode Lamp
7	Seat belt Lamp	14	Reverse Lamp	21	LCD Function

② Access the screen setting menu

Step	Cluster	Description
1	 25BX7ES17	1. When starting the truck, a screen is prompted as shown on the left. 2. On the first screen, press "HOME" button.
2	 25BC9U7ST01	1. Display Setting menu screen is displayed as shown on the left.

③ Access the truck menu

Step	Cluster	Description
1	 25BX7ES17	1. When starting the truck, a screen is prompted as shown on the left. 2. On the first screen, press "ESC" button for one second or longer.
2	 E25BX7ES18	1. Password input screen is displayed as shown on the left. 2. Input the password by using "LEFT/RIGHT/ENTER" buttons and press "ENTER"button. 3. The first screen of 1st step is displayed, press "HOME" button.
3	 E25BX7ES19	1. Truck Menu screen is displayed as shown on the left. 2. Select desired menu by using "LEFT/RIGHT" button and press "ENTER" button to access the menu. 3. Press "ESC" to move to the previous menu.

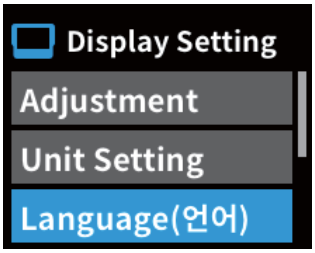
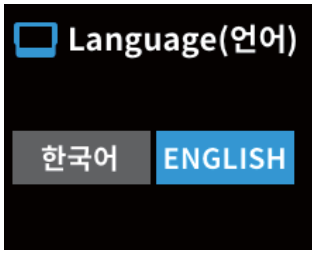
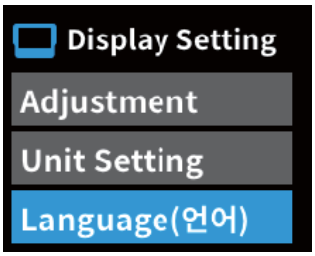
(2) Setting current time and language

- The 2 inch display of X-series battery truck has can be set the screen by 2 languages.

① Setting the language for each country

You can set the language of the display as below.

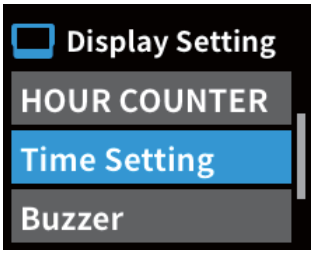
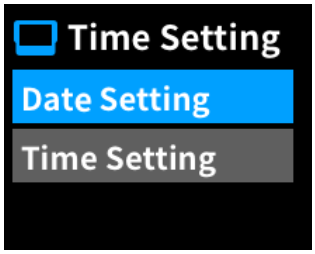
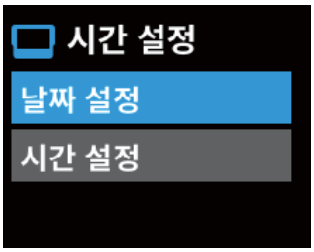
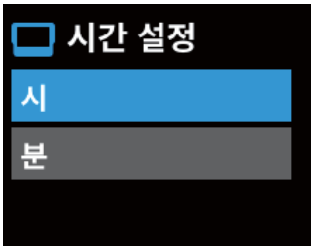
※ Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.

Step	Cluster	Description
1	 25BC9U7ST02	1. In Display Setting menu screen, select language setting menu by using "LEFT/RIGHT" buttons. 2. Go into the language setting by pressing the "Enter" button.
2	 25BC9U7ST08	1. Select language by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST09	1. The screen of changed language will display as shown on the left.

② **Current time setting**

You can set the current time of the display as below

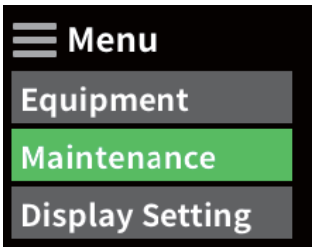
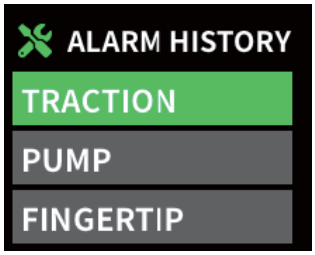
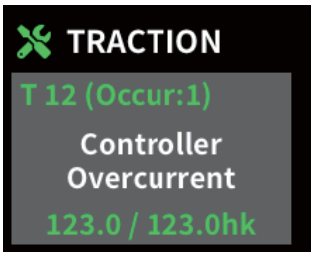
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

Step	Cluster	Description
1	 25BC9U7ST06	1. In Display Setting menu screen, select Time Setting menu by using "LEFT/RIGHT" buttons. 2. Go into the Time Setting setting by pressing the "Enter" button.
2	 25BC9U7ST07	1. Select Date Setting by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST03	1. Set Current Date by using "LEFT/RIGHT" buttons and press the "Enter" button.
4	 25BC9U7ST04	1. Select Time Setting by using "LEFT/RIGHT" buttons and press the "Enter" button.
5	 25BC9U7ST05	1. Set Current Time by using "LEFT/RIGHT" buttons and press the "Enter" button.

(3) Alarm history deleting

You can delete the alarm history of the controllers as below.

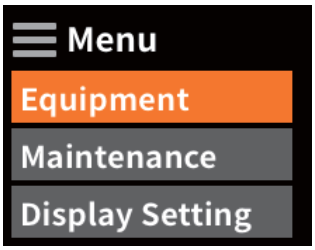
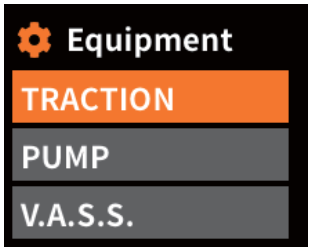
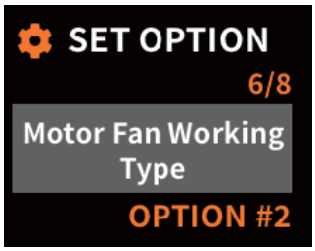
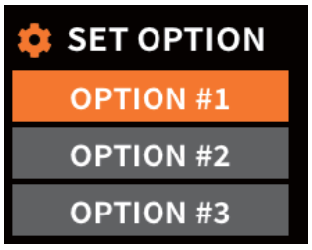
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

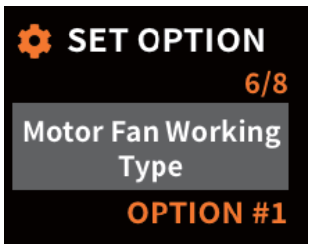
Step	Cluster	Description
1	 25BC9U7AH01	1. In Truck menu screen, select Maintenance menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7AH02	1. In Maintenance menu screen, select Alarm History menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7AH03	1. Select controller by use "LEFT/RIGHT" buttons and check the alarm history of the controller.
4	 25BC9U7AH04	1. The stored alarm lists in the controller are displayed as shown on the left. 2. To delete the alarms, press "ECS" button.
5	 25BC9U7AH05	1. The display will ask " Clear Logbook" as shown on the left. 2. To delete the alarms, press "ENTER" button.

(4) Fan working type setting

You can check and set the fan working type as below.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 E25BX7ES27	1. The Controller selecting menu screen is displayed as shown on the left. 2. Select items as below by using "LEFT/RIGHT" buttons and press the "Enter" button. 1) TRACTION - SET OPTION
3	 25BC9U7ST10	1. Find the "Motor fan working type" by using "LEFT/RIGHT" buttons. 2. You can set 3 kinds of the motor fan working type as below. 1) OPTION #1 : Operated always 2) OPTION #2 : Operated when the temperature of the controller or motor exceeds set values (default) 3) OPTION #3 : Operated when the motor running. 3. Press the "Enter" button to change the "Motor Fan Working Type".
4	 25BC9U7ST11	1. The Setting Option menu of the cooling fan will display as shown on the left. 2. Select "Option type" by using "LEFT/RIGHT" buttons and press the "Enter" button.

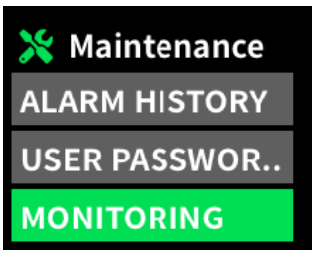
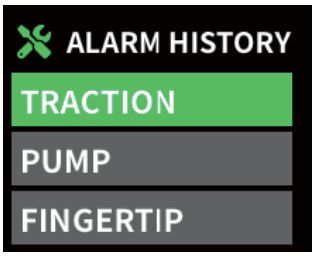
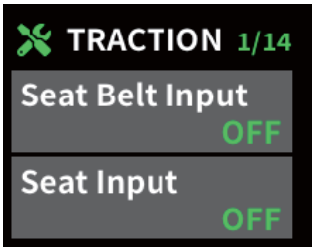
Step	Cluster	Description
5	 25BC9U7ST12	1. The display will ask "Set option" as shown on the left. 2. Press the "Enter" button to save the "Motor fan working type".
6	 25BC9U7ST13	1. The parameter of the motor fan working type will change "OPTION #1".

(5) Controller and display version confirming

You can confirm the version of the controllers and display as below.

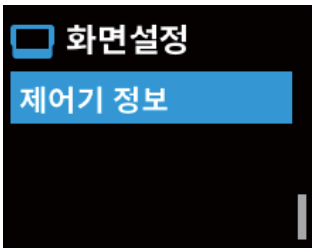
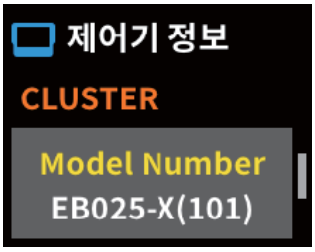
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

① **Controller version**

Step	Cluster	Description
1	 25BC9U7ST20	1. Truck menu -> In Maintenance menu screen, select Monitoring menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7AH03	1. The Monitoring menu screen is displayed as shown on the left and select the Traction and press the "Enter" button.
3	 25BC9U7ST21	1. The first screen of the Traction monitoring menu is displayed as shown on the left. 2. Find the "Controller SW ver" by using "LEFT/RIGHT" buttons. (The monitoring menu is located last position in generally)
4	 25BC9U7ST22	1. Check the software version item of the traction controller. 2. Press "ESC" to move to the previous menu. 3. To check the software version of other controllers, repeat above 2~4 steps.

② Display version

※ Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.

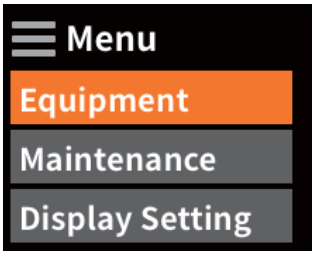
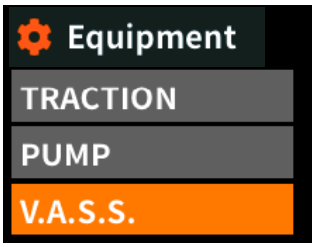
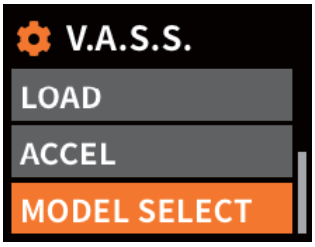
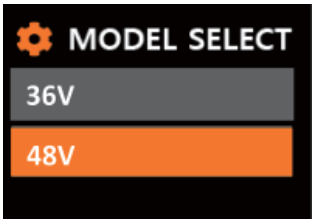
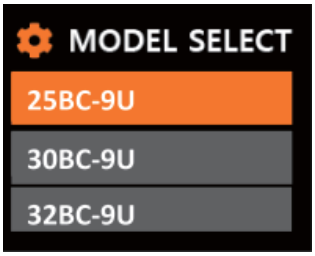
Step	Cluster	Description
1	 25BC9U7ST23	1. Truck menu -> In Display Setting menu screen, select controller information menu by using "LEFT/RIGHT" buttons. 2. Press the "Enter" button to confirm the controller information.
2	 25BC9U7ST24  25BC9U7ST25  25BC9U7ST26  25BC9U7ST27	1. You can check the display part number, serial number and software version of the cluster.

(6) Battery voltage and model setting (1/2)

You can change the parameter value of the controllers by setting the voltage and model of the battery as below.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

① **Controller version**

Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7ST30	1. In Equipment menu screen, select V.A.S.S. menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST31	1. In V.A.S.S. menu screen, select model select menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
4	 25BC9U7ST32	1. Select the model and set the battery voltage and then press the "Enter" button.
5	 25BC9U7ST33	1. Select the model and press the "Enter" button to save the model.

※ **For 25/30/32BC-9U model, the parameter value in need of change is set on the display automatically.**

After 5 step, the items in need change as voltage are set done automatically, the "Download Success" will display on the screen.

Battery voltage and model setting (2/2)

※ **31 items are changed through the cluster automatically and it completed, Setting Done" will display on the screen.**

※ See below table and progress work if you want to change the parameter value by manually.

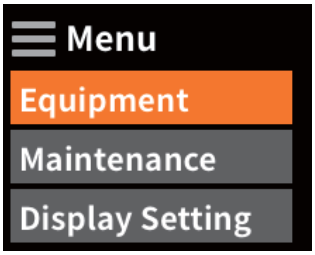
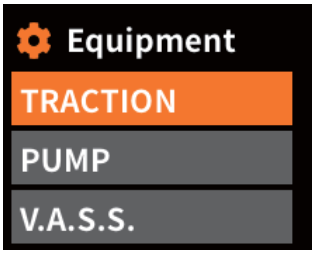
25BC9U7ST34 25BC9U7ST35 25BC9U7ST36

Menu				Change of parameter value		Remark
Menu	1st Depth	2nd Depth	Description	48V	36V	
Equipment	TRAC	ADJUSTMENT	Battery Nominal Voltage	48	36	(Volt)
			Contactor Pull In Voltage	75	100	(%)
			Contactor Holding Voltage	60	80	(%)
			Fan Relay Driving Voltage	25	33	(%)
			OCV 10 Percent Voltage	46.8	35.1	(Volt)
			OCV 100 Percent Voltage	51.1	38.3	(Volt)
		PARAMETER	T mode Speed	1760	1320	(rpm)
			H mode Fwd Max Speed	3520	2640	(rpm)
			H mode Rev Max Speed	3520	2640	(rpm)
			N mode Fwd Max Speed	3000	2244	(rpm)
			N mode Rev Max Speed	3000	2244	(rpm)
			E mode Fwd Max Speed	2465	1848	(rpm)
			E mode Rev Max Speed	2465	1848	(rpm)
Equipment	PUMP	ADJUSTMENT	Battery Nominal Voltage	48	36	(Volt)
			Auto Tilt Coil Driving Voltage	25	33	(%)
			OPSS Coil Driving Voltage	25	33	(%)
		PARAMETER	Lift Speed High Mode	2900	2175	(rpm)
			Lift Speed Normal Mode	2465	1850	(rpm)
			Lift Speed Low Mode	2030	1525	(rpm)

(7) Lithium-Ion Battery Option Setting

The lift truck applied with the Lithium-Ion Battery option must be enabled with the setting as shown below.

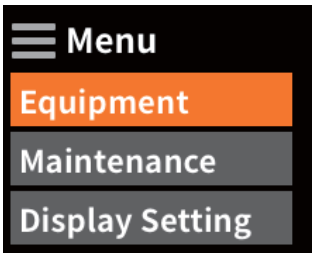
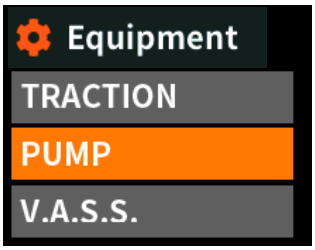
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 E25BX7ES27	1. The Controller selecting menu screen is displayed as shown on the left. 2. Select items as below by using "LEFT/RIGHT" buttons and press the "Enter" button. 1) TRACTION - SET OPTION
3	 25BX7ES61	1. Find "Lithium Battery Enable" parameter by using "LEFT/RIGHT" buttons. 2. You see the "Lithium Battery Enable" parameter is OFF status (default). 3. Select ON by using "LEFT/RIGHT" buttons and press the "Enter" button to change parameter.
4	 25BX7ES62	1. You see the "Lithium Battery Enable" parameter is changed ON. 2. Turn the key off and on one time.

(8) Fingertip lever option setting

If the truck is applied fingertip lever option, the fingertip enable parameter setting is needed as below.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

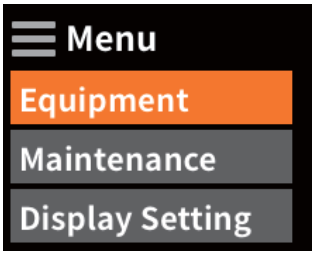
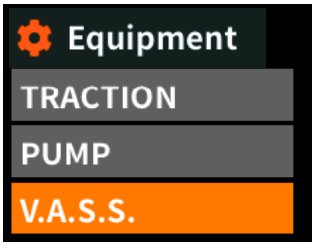
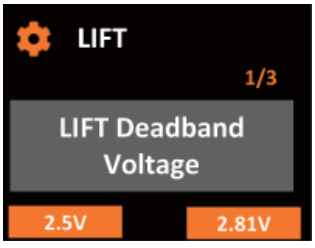
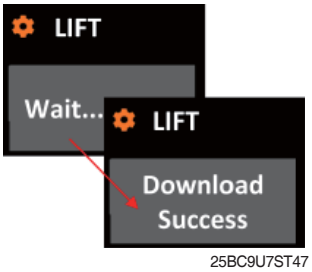
Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7ST40	1. The Controller selecting menu screen is displayed as shown on the left. 2. Select items as below by using "LEFT/RIGHT" buttons and press the "Enter" button. 1) PUMP - SET OPTION
3	 25BC9U7ST41	1. Find "Fingertip Enable" parameter by using "LEFT/RIGHT" buttons. 2. Press the "Enter" button to change the parameter and select the ON by using "LEFT/RIGHT" buttons and press the "Enter" button once more.
4	 25BC9U7ST42	1. You will see the "Fingertip Enable" parameter is changed ON. 2. Turn the key off and on one time.
5	 25BC9U7ST43	1. Fingertip Enable parameter option is as below. 1) Fingertip AUX 2 Lever Enable (FFV) - 3SP & 3LEVER (FFV05) : OFF - 4SP & 4LEVER (FFV06) : ON 2) Fingertip Clamp Interlock Enable (FOE) - Clamp Interlock without (FOE00) : OFF - Clamp Interlock 4SP (FOE02) : ON 2. Turn the key off and on one time.

(9) Lift lever setting

If the truck is applied manual lever, the manual lever parameter setting is needed as below.

※ **This setting have to carry out after checking the the "Fingertip Enable" is OFF status.**

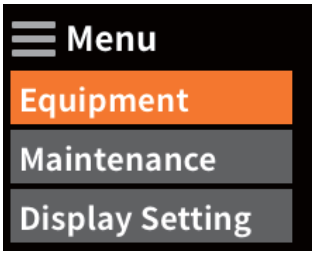
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

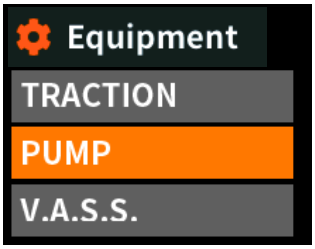
Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7ST44	1. In the Equipment menu screen, select V.A.S.S. menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST45	1. In V.A.S.S. menu screen, select LIFT menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
4	 25BC9U7ST46	1. The screen will display in order to set as shown on the left. 2. The calibration will start by pressing the "Enter" button. 3. In progressing the calibration, the current voltage value is displayed left lower side. 4. Locate lift lever in the middle position and pull the lever toward body side and maintenance for more than one second and then release the lever. 5. Keep the lever in the middle position for more than one second and press the "Enter" button.
5	 25BC9U7ST47	1. In above 4 clause, "Wait ..->Download success" will displayed on the screen when the "Enter" button is pressed. ※ **It is normal if the voltage is similar as below figure.**  25BC9U7ST48

(10) Fork leveling option setting (1/2)

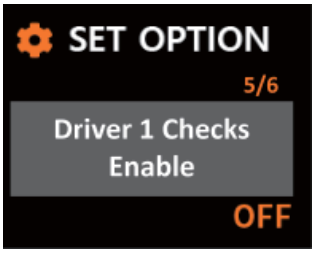
The fork leveling option setting is base on the Auto tilt (FAL00, FAL01) option.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

<table>
<tr><th>Step</th><th>Cluster</th><th>Description</th></tr>
<tr><td>1</td><td> 

E25BX7ES19</td><td>1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.</td></tr>
<tr><td>2</td><td> 

25BC9U7ST40</td><td>1. In Equipment menu screen, select V.A.S.S. menu by using "LEFT/RIGHT" buttons and press the "Enter" button.</td></tr>
<tr><td>3</td><td> 

25BC9U7ST50</td><td>1. Change the items according to the Auto Tilt (FAL).
<table>
<tr><th>Items</th><th>Auto Tilt Enable</th></tr>
<tr><td>Auto Tilt X (FAL00)</td><td>OFF</td></tr>
<tr><td>Auto Tilt O (FAL01)</td><td>ON</td></tr>
</table></td></tr>
<tr><td>4</td><td rowspan="2"> 

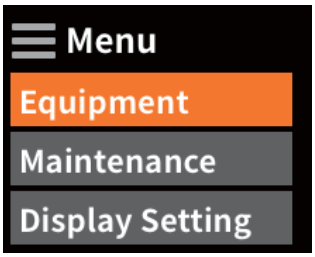
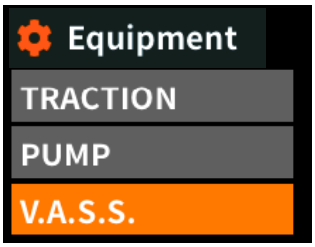
25BC9U7ST51</td><td rowspan="2">1. STD parameter of the Driver 1 Check enable : OFF
In case of the manual and FAL01 conditions, change to ON. (Driver 2 checks enable changing is not necessary)
<table>
<tr><th>Items</th><th>Driver 1 checks enable</th><th>Driver 2 checks enable</th></tr>
<tr><td>Fingertip option</td><td>OFF</td><td>ON</td></tr>
<tr><td>Manual & Auto tilt (X) (FAL00)</td><td>OFF</td><td>ON</td></tr>
<tr><td>Manual & Auto tilt (O) (FAL01)</td><td>ON</td><td>ON</td></tr>
</table></td></tr>
<tr><td>5</td><td> 

25BC9U7ST52</td></tr>
</table>

Fork leveling option setting (2/2)

Fork leveling (Auto tilt leveling) option setting makes the fork arrange horizontal conditions. This setting must be performed before the truck shipment, and on replacing the controllers and the tilt sensor.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

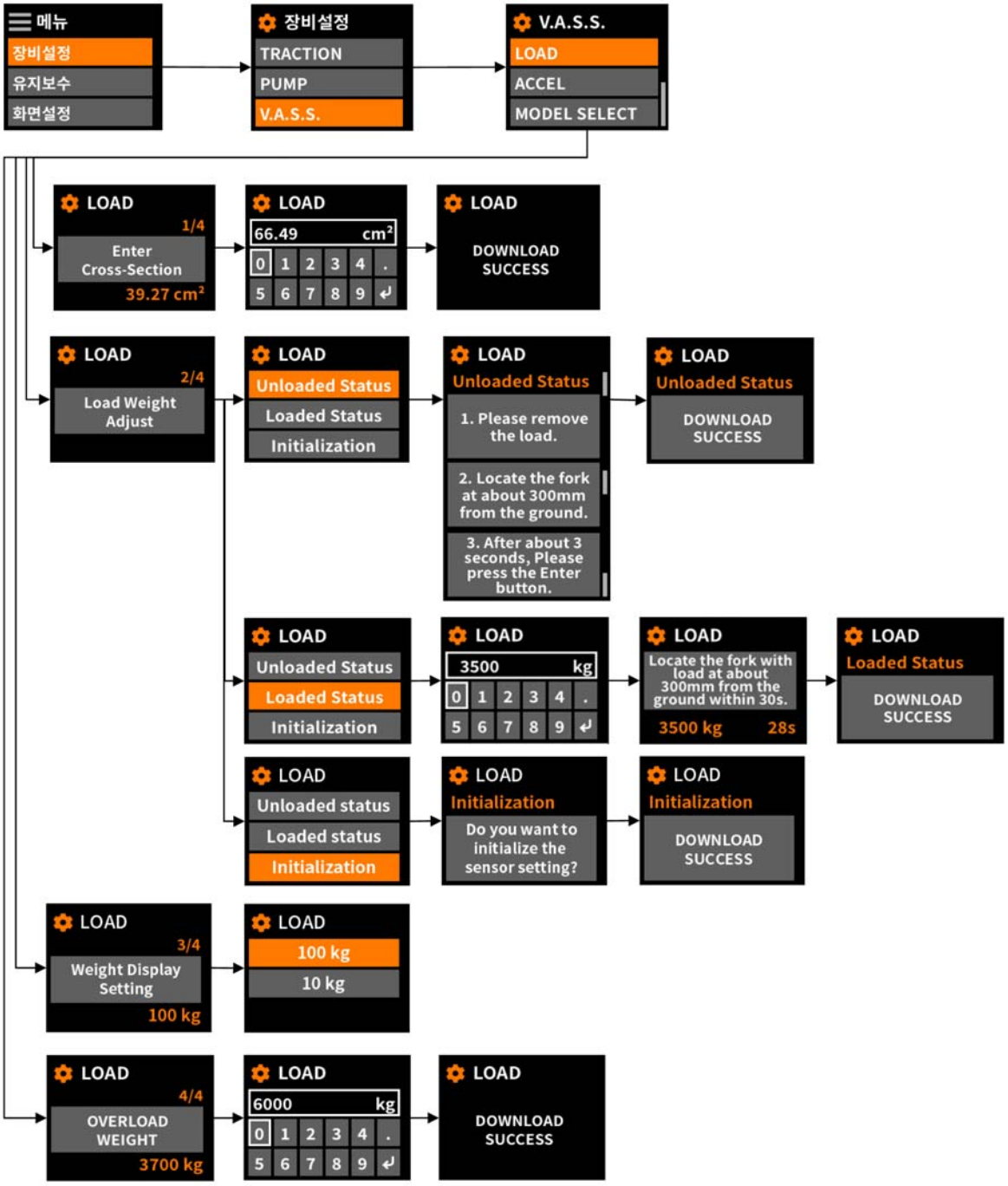
Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7ST44	1. In Equipment menu screen, select V.A.S.S. menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST53	1. In V.A.S.S. menu screen, select fork leveling menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
4	 25BC9U7ST54	1. The screen will display in order to set as shown on the left. 2. The calibration will start by pressing the "Enter" button. 3. In progressing the calibration, the current voltage value is displayed left lower side. 4. Check the voltage value is changed as moving the lever positions. 5. Locate the fork to horizontal condition with the truck and press the "Enter" button then the setting is completed.
5	 25BC9U7ST55	1. In above 4 clause, "Wait ..->Download success" will displayed on the screen when the "Enter" button is pressed. **※ It is normal if the set value, negative and positive are not differ within ±1 V.**  25BC9U7ST56

(11) Load sensor option setting

If the truck is applied load weight option, the load weight setting is needed as below.

※ Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.

※ Menu tree for reference on load sensor option setting

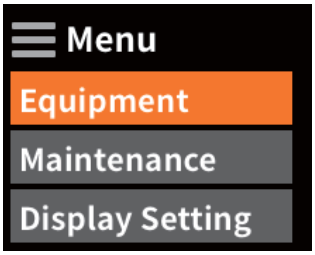
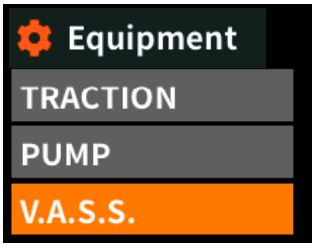
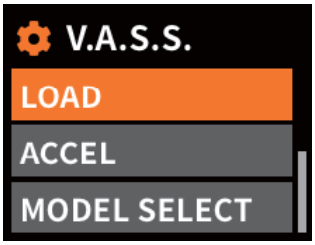
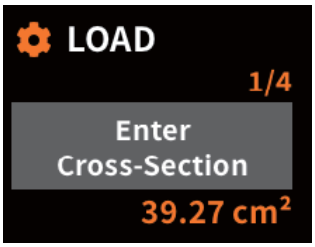
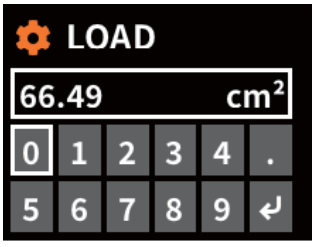


25BC9U7ST60

Load sensor option setting

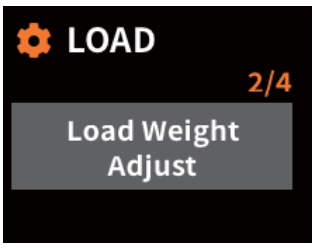
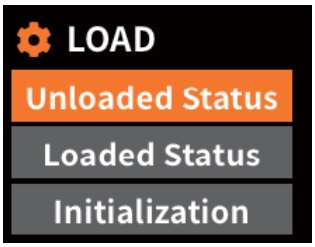
If the truck is applied load weight option, the load weight setting is needed as below.

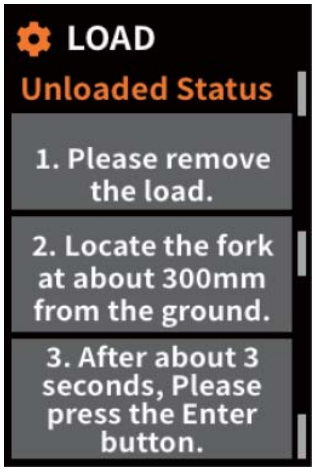
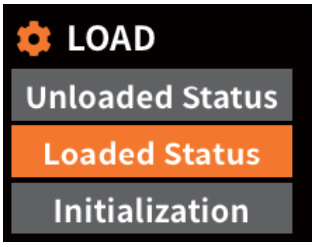
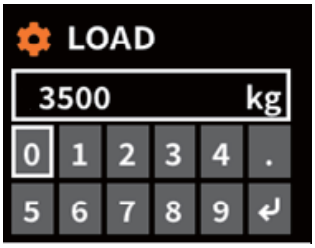
※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

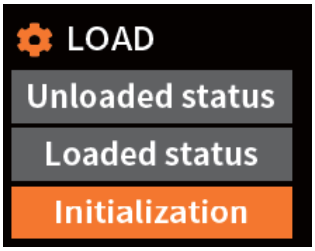
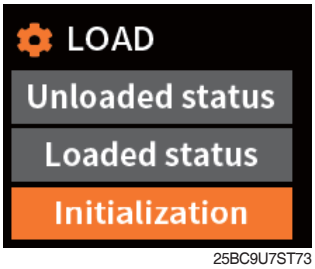
Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 25BC9U7ST44	1. In Equipment menu screen, select V.A.S.S. menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
3	 25BC9U7ST61	1. In V.A.S.S. menu screen, select load menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
4	 25BC9U7ST62	1. In Load menu screen, select Enter Cross-section (Cylinder cross-section input menu) by using "LEFT/ RIGHT" buttons and press the "Enter" button.
5	 25BC9U7ST63	1. A screen for entering cylinder cross-section is displayed as shown on the left. 2. Refer to the table of cylinder cross-sections to input cross section, and press "Enter" image button to save the input.

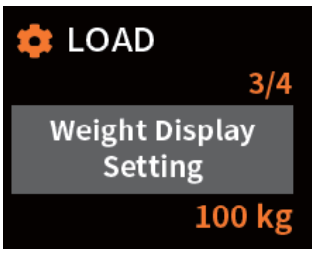
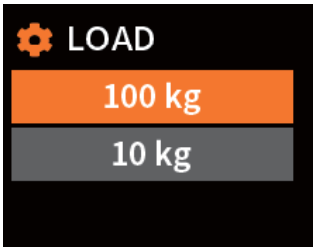
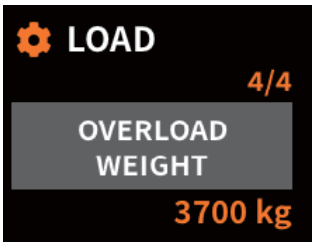
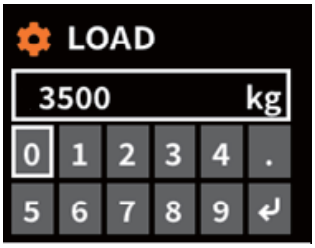
※ Cylinder cross-section table

Model	Mast	Cross-section (cm^2)	Remark
25BC-9U	MBS(V)	39.27	Lift cylinder
	MBT(TF)	44.18	Free lift cylinder
	MBQ(QF)	44.18	
30/32BC-9U	MBS(V)	47.52	Lift cylinder
	MBT(TF)	56.75	Free lift cylinder
	MBQ(QF)	44.18	

Step	Cluster	Description
6	 25BC9U7ST64	1. Make sure that setting has been complete as shown on the left.
7	 25BC9U7ST65	1. In Load menu screen, select the Load weight adjust menu by using "Left/Right" button and press the "Enter" button.
8	 25BC9U7ST66	1. In Load menu screen, select the Unload status menu by using "Left/Right" button and press the "Enter" button.

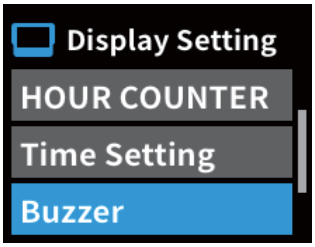
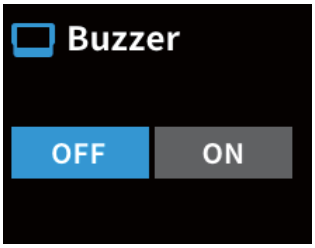
Step	Cluster	Description
9	 25BC9U7ST67	1. A screen for setting is displayed as shown on the left. 2. Press the "Right" button to move to page as shown on the left. 3. Do lift the unloaded fork to 300 mm position from the ground, and press the "Enter" button after waiting for 3 seconds.
10	 25BC9U7ST68	1. Make sure that setting has been complete as shown on the left.
11	 25BC9U7ST69	1. In Load menu screen, select Loaded status menu by using "Left/Right" button and press the "Enter" button.
12	 25BC9U7ST70	1. A screen for entering load weight is displayed as shown on the left. 2. Input the load weight to be used for setting, and select the "Enter" button image.
13	 25BC9U7ST71	1. A screen for setting is displayed as shown on the left. 2. Do lift the loaded fork to 300 mm position from the ground, and press the "Enter" button after waiting for 3 seconds.

Step	Cluster	Description
14	 25BC9U7ST72	1. Make sure that setting has been complete as shown on the left.
15	 25BC9U7ST73   25BC9U7ST74   25BC9U7ST73	1. It is allowed to initialize Non-load/Load set value by pressing "Left/ Right" button on Load menu screen, and then pressing "Enter" button in the Initialization menu. ※ **The screen is used if setting is erroneous due to sensor failure.**

Step	Cluster	Description
16	 25BC9U7ST76  25BC9U7ST77	1. It is possible to change unit of weight in the third menu of Weight display setting. 1) 100 kg : Weight rounded off from the second digit is indicated 2) 10 kg : Weight rounded off from the first digit is indicated 2. Press "Enter" button to check weight indication functions of respective settings, and change the value to default 100 kg (round off from the second digit).
17	 25BC9U7ST78	1. In Load menu screen, select Overload input menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
18	 25BC9U7ST70	1. A screen for inputting load weight is displayed as shown on the left. 1) Input the over load for each model and select the "Enter" button image (e.g. 25BC-9U=2500 kg, 32BC-9U=3200 kg).
19	 25BC9U7ST79	1. Make sure that setting has been complete as shown on the left.

■ Verification method of overload buzzer function

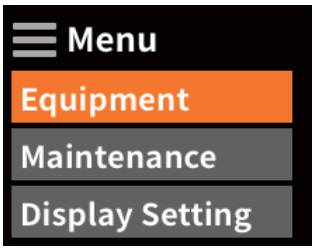
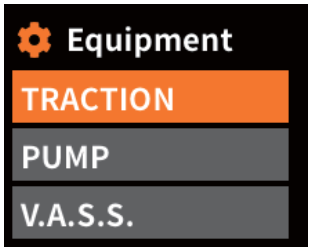
※ Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.

Step	Cluster	Description
20	 25BC9U7ES59	1. In Display Setting menu screen, select Buzzer menu by using "LEFT/RIGHT" buttons. 2. Press the "Enter" button to access to Buzzer setting.
21	 25BC9U7ES60	1. Check operation upon Buzzer OFF/ON respectively. 1) OFF : Buzzer does not sound even if sensing weight higher than standard overload weight. 2) ON : Buzzer sounds if sensing weight higher than standard overload weight. 2. Press ON button after checking is completed.

(12) Seat and seat belt interlock option setting

If the truck is seat and seat belt interlock option, the seat and seat belt interlock option setting is needed as below.

※ **Refer to (1) Access the display menu at page 7-84 for the method of accessing into the menu.**

Step	Cluster	Description
1	 E25BX7ES19	1. In Truck menu screen, select Equipment menu by using "LEFT/RIGHT" buttons and press the "Enter" button.
2	 E25BX7ES27	1. The Controller selecting screen of the Equipment menu is displayed as shown on the left. 2. Select items as below by using "LEFT/RIGHT" buttons and press the "Enter" button. 1) TRACTION - SET OPTION
3	 25BC9U7ST80	1. Find the Safety belt sequence option parameter by using "LEFT/RIGHT" buttons. 2. The screen of the Safety belt sequence option parameter will displayed NONE (default). 3. You can set 3 kinds of the Safety belt sequence option as below. 1) NONE : Truck is operated when the seat switch is ON. *FG17/36/38/40/43, BI00 2) OPTION #1 : Truck is operated when the seat and belt switch is ON. *FG37/39, BI00 3) OPTION #2 : Seat switch ON -> Truck is operated when the belt switch is ON. *FG37/39. BI01 *Option #2 must be satisfied with the operating order of seat switch and belt switch. 4. Press "Enter" button to change the value and select the suitable option by using "LEFT/RIGHT" buttons and press the "Enter" button. 5. Turn the key off and on one time.

7. BATTERY CHARGER

This 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) BASIC INFORMATION

(1) What is charger

Charger is a device which makes a battery accept D.C electricity under optimal condition as it transforms A.C provided from external source of electricity.

The charger is a constant-current and constant-voltage way, SCR type charger that it has advantages as follows

① Even though A.C input voltage fluctuates within 10% of rated voltage (220/380/410/440V), the current and voltage provided to the battery are stable.

② As minimizing the increase of temperature while charging a battery, it minimizes the stress on the battery.

③ The noisy of charger is minimal but the charging efficiency is very high.

④ It prevents from under charging and overcharging.

Therefore, it helps the battery to maintain its performance for longer time and to prolong the life of the battery.

(2) Notice on caring chargers

① If any abnormal status is found while using a charger, immediately stop using and check the charger. If it is impossible to take an appropriate measure for yourself, please apply for A/S.

② While charging, hydrogen and oxygen gas is produced. Use or approach of fire should be strictly prohibited.

③ Keep clean to prevent from sneak current and attack on the interface and surroundings of the battery.

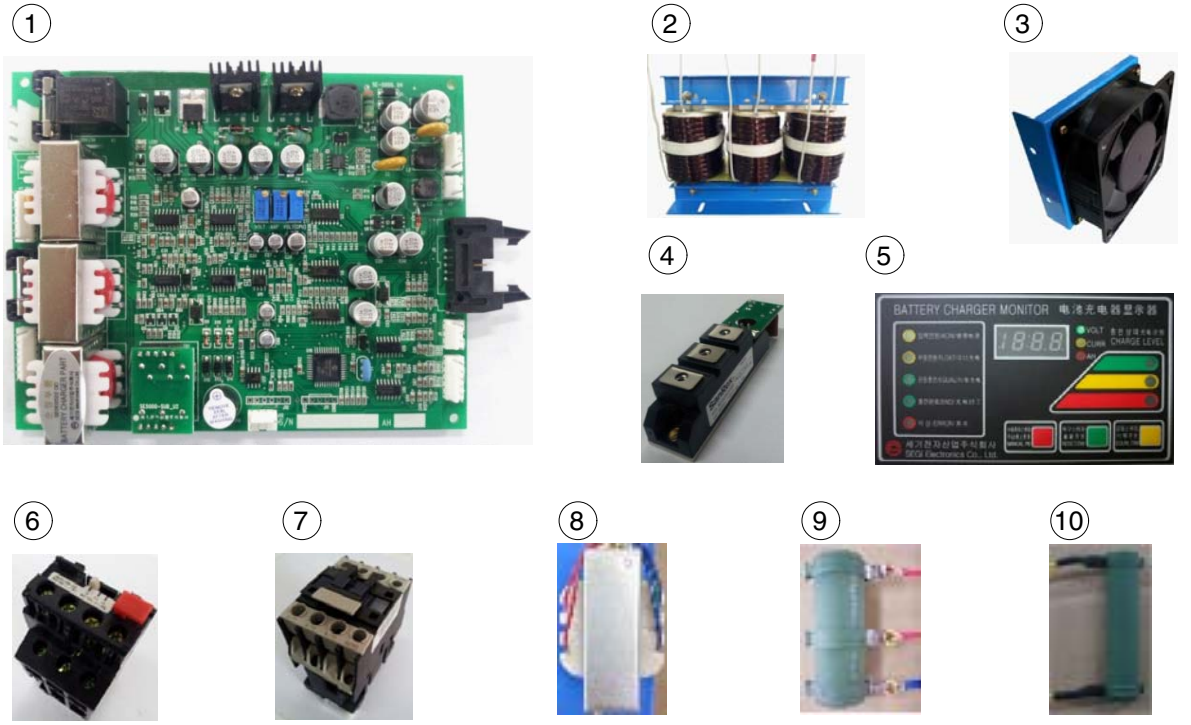
④ Check the electrolyte of the battery every week and provide distilled water immediately if it is required. (Electrolyte has to be provided between 10~12 ㎜ level on the positive plate inside storage battery)

⑤ If battery liquid temperature becomes over 55°C, charging should be stopped.
If it is continued,
- the appearance is transformed
- and metal area can be attacked as electrolyte overflows

⑥ Electric forklift truck using battery should be charged as soon as the charging lamp is on while driving. As batteries are internally discharged naturally if they are deposed for a long time, charge them once or twice a month to prevent from reducing the lives of batteries.

⑦ When a green sign is on among charging status indication lamps, please notify that it is not converted as equalized charge for stabilization of charging status.

(3) Names of each part (independent items)



22B9BAT30

1	Main PCB board	5	Monitor PCB	9	Resistance (RD)
2	Main trans (Class H)	6	Overload	10	Resistance (DR)
3	Cooling fan	7	MG S/W		
4	SCR module	8	Assistant trans		

2) CHARGER INSTALLATION METHOD

(1) Location for charger installation

① Dry and well ventilated place.
② No inflammable and B7 fire are near by.
③ Safe place where no collision possibility with people or equipment is.

(2) Check points before installing charger

① Enough capacity of AC input power source to operate charger.
② Standard electric wire for power source by capacity.

(3) Table for capacity of charger input cable

48 V battery	Capacity of cable	Input voltage	Remarks
200-365 AH	4P - 2.5 mm^2	Based on 3Ø380 V 3Ø440 V	For 3Ø220V, one step higher capacity cable should be used. (2.5 mm^2 → 4mm^2)
400-580 AH	4P - 4 mm^2		
600-800 AH	4P - 6 mm^2		
850-1000 AH	4P - 10 mm^2		
24 V battery	-		
200-600 AH	4P - 2.5 mm^2		
700-1000 AH	4P - 4 mm^2		
80V battery	-		
500-600 AH	4P - 6 mm^2		
700-800 AH	4P - 10 mm^2		

3) HOW TO USE A CHARGER

(1) General charging method (Floating charging)

① Charging by this method supplies electric power to the charger as operating external AC power switch of the charger.

② Connect battery connecter and charger connecter.

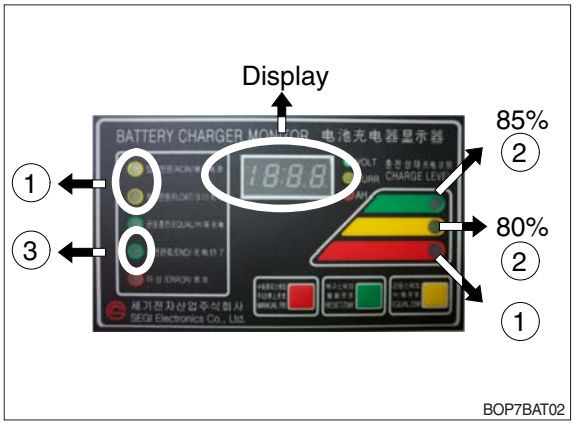
· **According to charging condition**

① If there is no abnormality found when the charger checks itself for 3-4 seconds after inputting AC input power source, the charger slowly increases the electric flow for charging and the charging condition lamp in the lower part of the front panel for floating charging of "input" is on.

② A charging voltage, current, amount and time are displayed in order on a monitor display window.

③ When charging is processed about 80%, yellow lamp in the middle of the front panel, which shows that the charging condition is in the middle, is on and then green lamp is on when charging is processed over 85% until charging is completed.

④ When charging is completed, "charging is completed" lamp is on in the monitor and other lamps of all monitors become off.



(2) Equalized charging

① **Equalized charging is**

Equalized charging is to correct the battery when it does not normally perform its functions as the voltage differences are too big between cells of a battery.

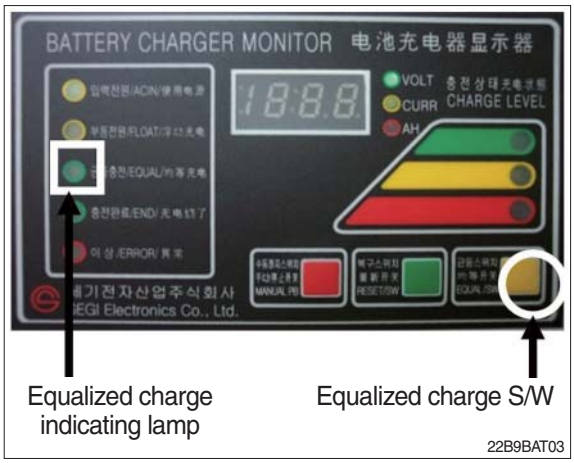
When equalized charging is required?

- When re-operates the battery after having left the battery for a long time.
- When a battery is over-discharged.
- When there is large deviation of voltage and specific gravity between battery cells.
- When change or supply electrolyte of battery.

② **Tips for equalized charging**

If once push the equalized charging button on the monitor in the beginning of charging, the equalized charging lamp becomes on and starts charging.

※ **When the green charging condition lamp is on (over 85% charged), the equalized charging switch is locked that it does not operate even pushing the button.**



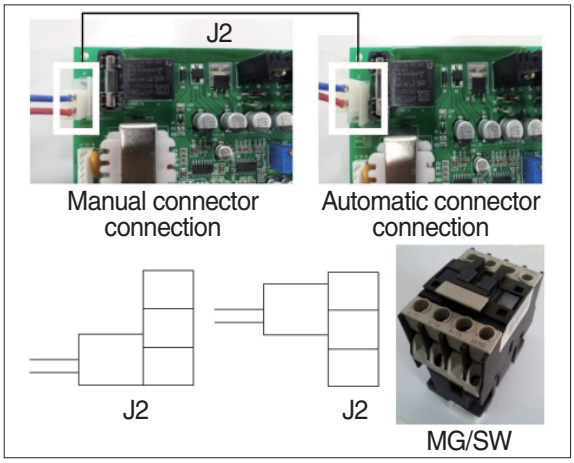
22B9BAT03

(3) Automatic/Manual switching method

Automatic connector. Manual switching connector (J2) is located on a left top corner of PCB.

※ **In case of manual switching for charger checking, make sure that the battery connector is separated beforehand.**

⊙ MG/SW operation
(Refer to the charger trouble SHEET components manual)



22B9BAT04

(4) Checking charging voltage soft start function (Refer to the monitor)

① Plug it into a manual connector and input after 5 sec., a floating charge, charging status red LED lights up.
② After 15 sec., charging status yellow LED lights up.
③ After a green LED lights up, if measured voltage comes out as lula64V by measuring output voltage of battery connector side with multi-meter, then it is normal.
④ After 30 sec. of switching to a manual connector, if a buzzer sound rings continuously for 10 sec. and completion LED lights up, then it is normal.
⑤ If you confirm that the charger operates in normal after checking manual switching of the charger, make sure that the charger is switched to automatic.

BOP7BAT10

⑥ If charger's out voltage is under 60 V, it is abnormal.
Please refer to the error sheet.

⑦ When the charging voltage is indicated as normal condition (64 V), convert automatic / manual switch to automatic and start charging.

※ **Display error code on the front cover as following table.**

22B9BAT11

No	Code	Description of error
1	E.F	EPROM fail
2	O.V	Over voltage - Refer to page 7-116
3	O.C	Over current - Refer to page 7-115, 7-117
4	F.B	Battery error (After starting charging, the voltage doesn't go over 52V for 2 hours.) Check the battery.
5	O.T	Transformer over heat (Stop charging when it is over 160°C). - If input voltage is high, output current is over normal value and there is heat in the trans because of SCR control part fault. - Check the output current and PCB control board
6	O.H	Heatsink over heat (Stop charging when it is over 100°C). - Check the cooling fan, SCR connection cable contact point and control part.
7	A.O	Power supply error (input power 220/380V wrong wiring). - Refer to page 7-114.
8	A.F	Power supply error (absent phase) - Check if input cable is open.
9	A.C	AC fail (black out) - Check if input voltage is right.
10	L.C	Low current (If this sign is on for setting value (60 sec), charging is over).
11	F	Manual stop.

4) CHECK POINTS BEFORE APPLYING A/S

(1) AC input power source switch is input.

(2) Check if the battery connector of the order picker truck and charger's connector are connected.

(3) Check points when "Error" lamp is on in the front monitor of the charger.

(4) Check the front cover indicator.

① A.F : Input three phase power source continuity check = Check if input three phase power source is normal with AC voltage meter.

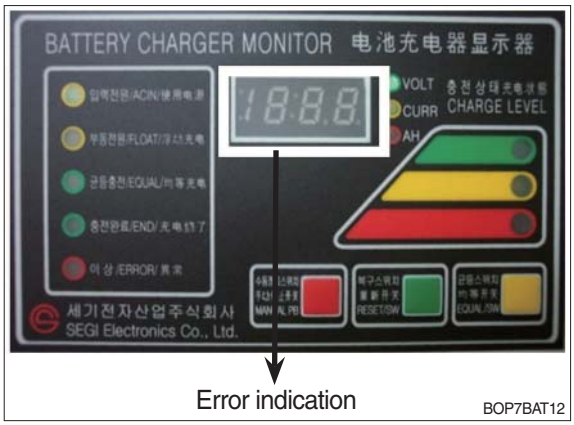
② A.O : Error on selection of input power source of 220V or 380V - Check it appropriately with full three phases.

③ A.C : Check if the input power source (220V or 380V) is normal.

④ O.C : Check the electric current, as charging current of the battery is over-standards condition.

⑤ O.V : Check the voltage, as charging voltage of the battery is over-voltage condition (66V).
Normally it is 64V±1.0V.

(5) Check other abnormalities as well. Then apply for A/S when on-site measurements are not applicable.



5) ERROR DETECTION

(1) Error list

① Only floating charge lamp is on in the monitor but it is not charged.

② ON and OFF is repeated with a few minutes intervals even after starting charging.

③ Charger TRIP is occurred after abnormality lamp is on.
In case error code is "O.V"

④ Charger TRIP is occurred after abnormality lamp is on.
In case error code is "O.C"

⑤ Charger TRIP is occurred after it started charging and charging completion lamp is on.

⑥ Charger has no response even the battery connector is connected.

⑦ SCR module checking method

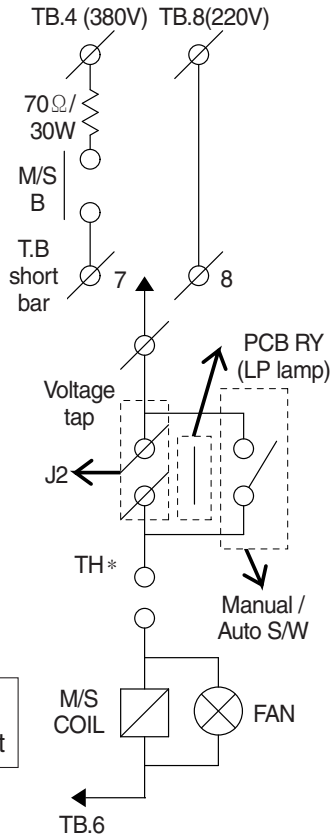
(2) Troubleshooting

① Only floating charge lamp is on after indicating "A.O", It's not charged.

· 220/380V Model : Measure the voltage between input voltage change over tabs 2-4 2-6 4-6
· 220,380,410,440V Model : Measure the voltage in front of AC INPUT MS S/W

MS electric socket

Manual/Auto TAP (J2)



M/S electrical circuit

Check the rated voltage → YES → Insert automatic/ manual connector (J2) at the upper part of PCB to manual, after separating battery connector.

Insert automatic/ manual connector (J2) at the upper part of PCB to manual, after separating battery connector. → AC INPUT MS switch ON → YES → PCB LP lamp lights up → YES → CN4 contact fault / PCB RY contact fault

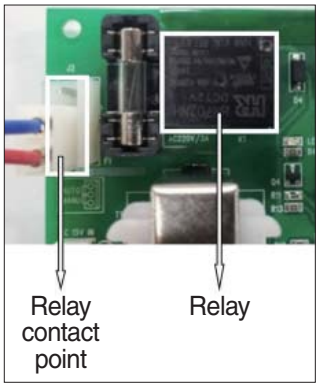
AC INPUT MS switch ON → NO → Put a black lead of multi-tester to input voltage switch No. 6 and measure voltage between tab No.8,PCB CN4,TH contact points with a red lead.

PCB LP lamp lights up → NO → Change PCB

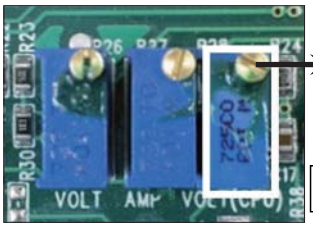
Check the rated voltage → NO → Input power supply is not supplied.
· Check external lead cable.
· Check the connection of external input connecter
· Check external NFB TRIP

Put a black lead of multi-tester to input voltage switch No. 6 and measure voltage between tab No.8,PCB CN4,TH contact points with a red lead. → Voltage 220V → NO → TH contact fault / CN4 contact fault / PCB RELAY fault / TH manual restoration release

Voltage 220V → YES → MS COIL fault



② ON and OFF is repeated with a few minutes intervals after starting charging.
Indicate "O.C" on the monitor.
- TH is operated (AC input over-current TRIP).



OUTPUT CURRENT

DE-CREASE

IN-CREASE

Trans noise is severe at MS ON status

NO

Measure output current using DC current measure

Current value : 10~16A /100AH

NO

Exceed Standard current

Adjust output current AMP, VR within PCB Re-adjust to VR

YES

· TH Setting fault
· Re-adjust TH setting value

TH. TRIP

YES

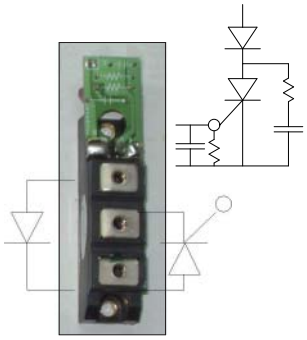
Change TH

NO

Complete

YES

* Refer to SCR Module checking method



Rated Current SETTING

YES

NO

Complete

Change PCB

Separate the battery connector and tune the charger off

Check SCR Module

NO

Change SCR MODULE

YES

Check MAIN TRANS VOLT

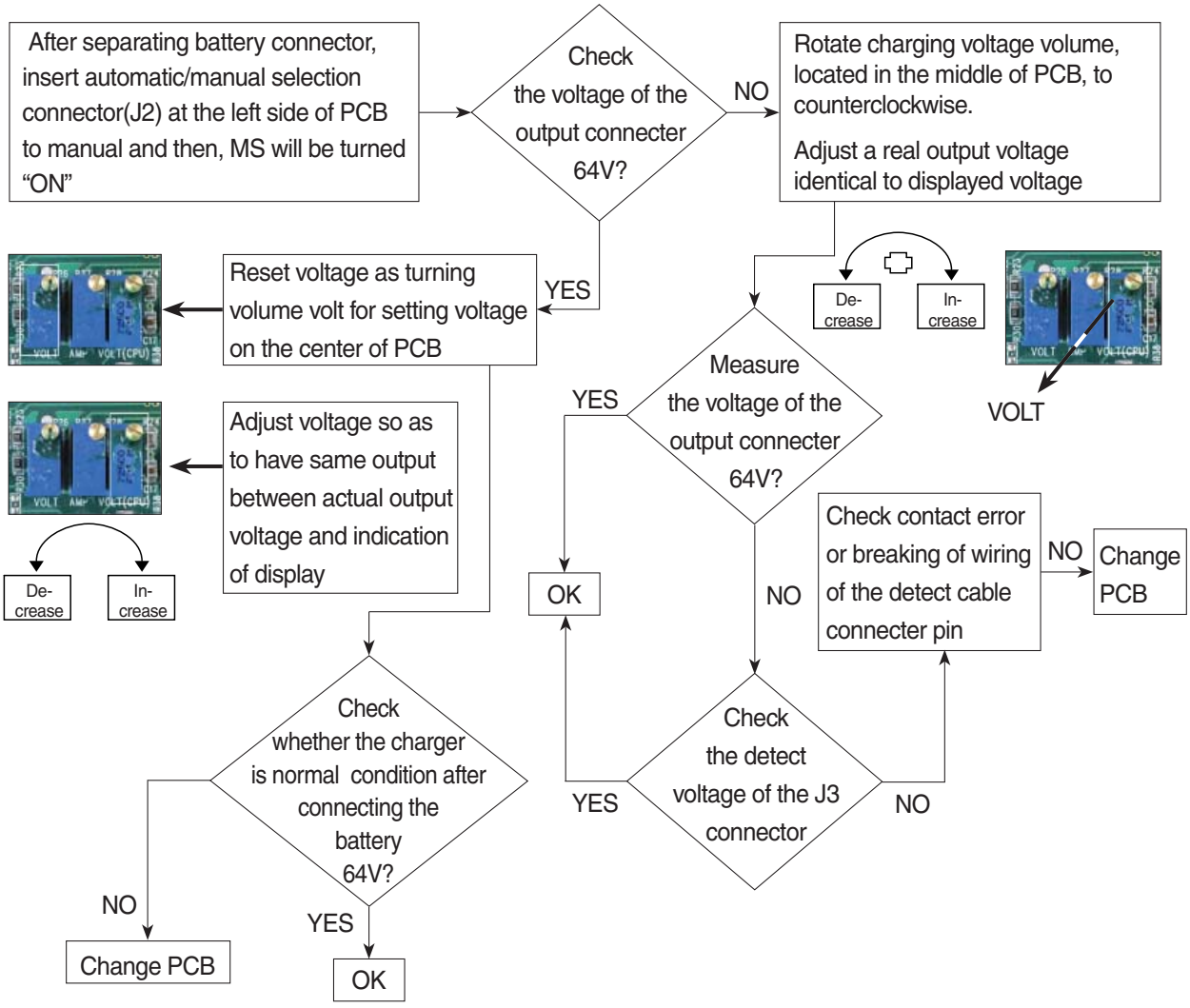
NO

Change PCB

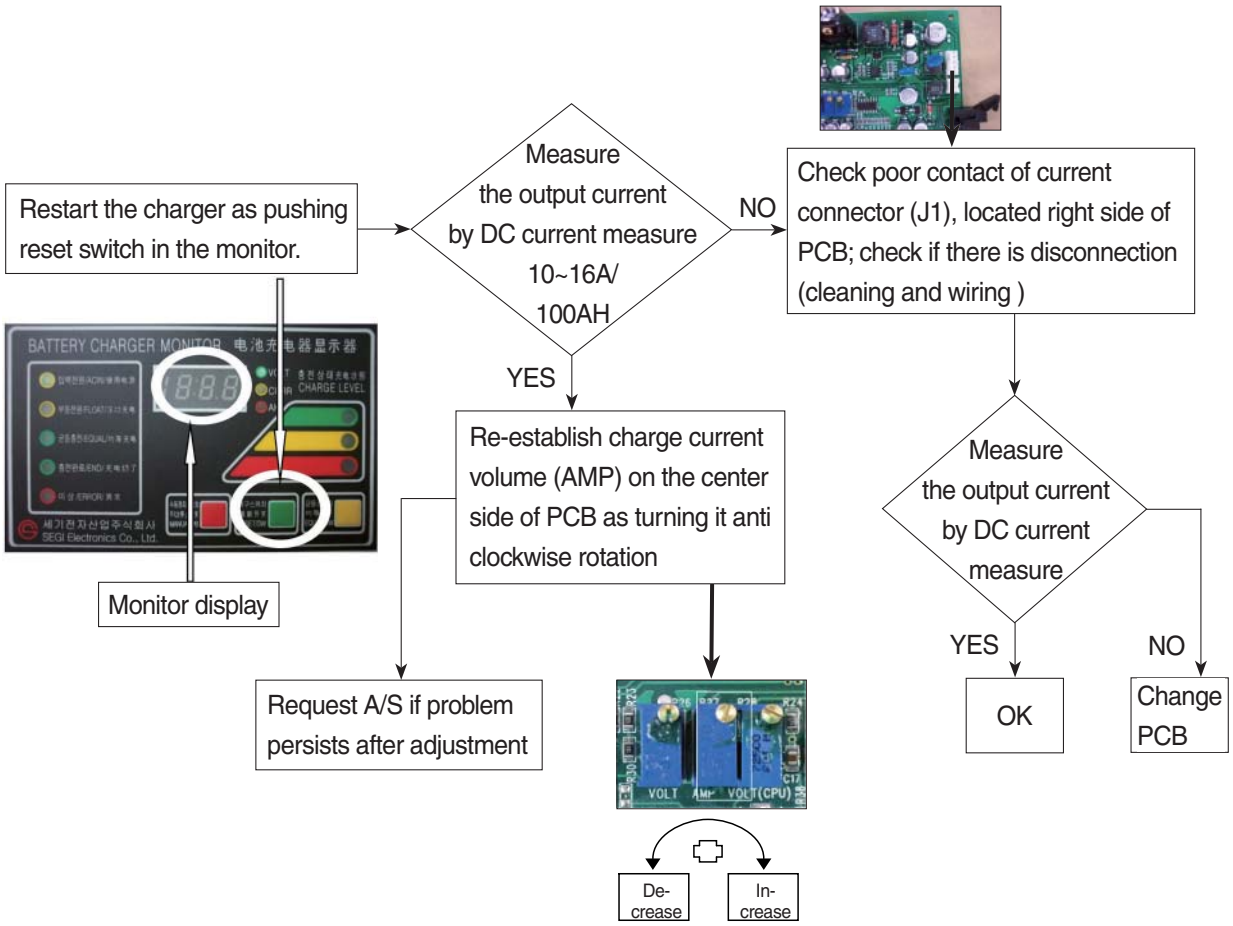
YES

Check the normal operating condition of the charger

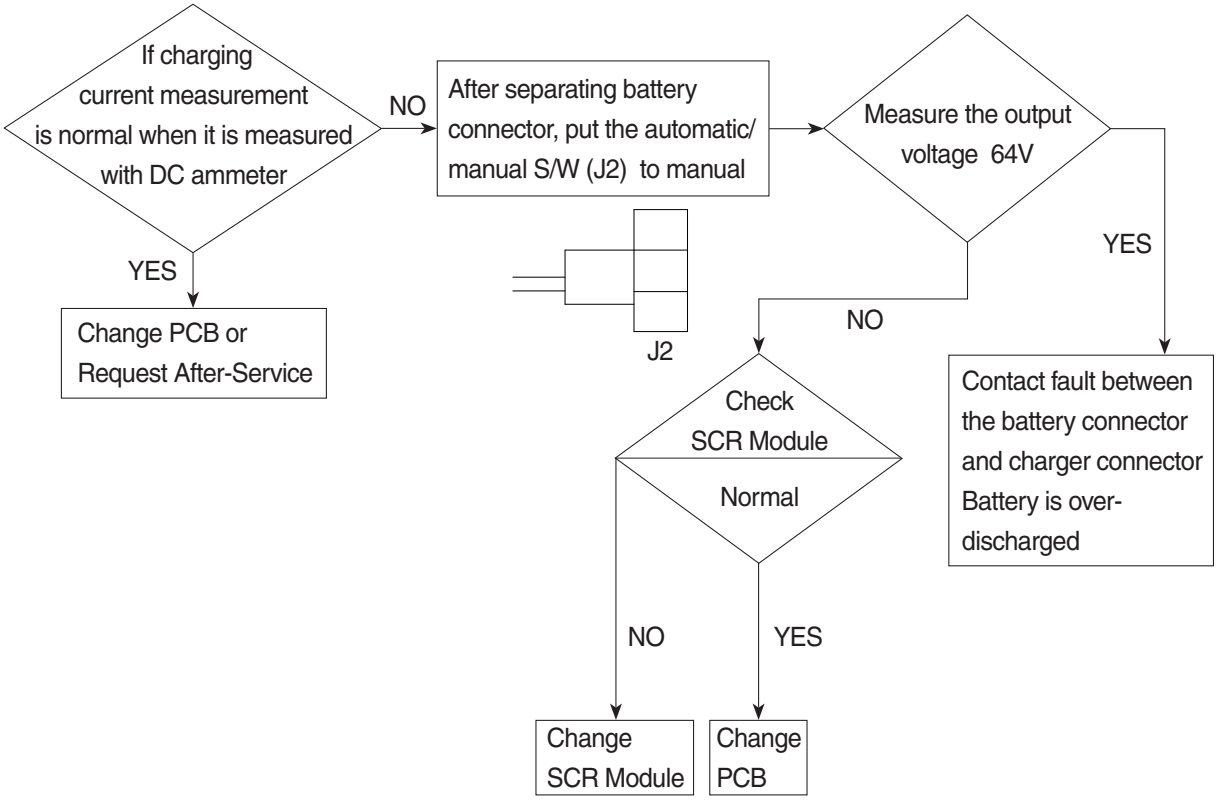
③ **Charger TRIP is occurred after abnormality lamp is on.**
In case error code is "O.V" → Over-voltage output / Set at 66V (In case of BATT 48V)
34V (In case of BATT 24V)
108V (In case of BATT 80V)



④ **Charger TRIP is occurred after abnormality lamp is on.**
After opening the cover which is located on the front bottom side of the charger.
In case error code is "O.C" → Output over current, established as 110~120% of the rated current.

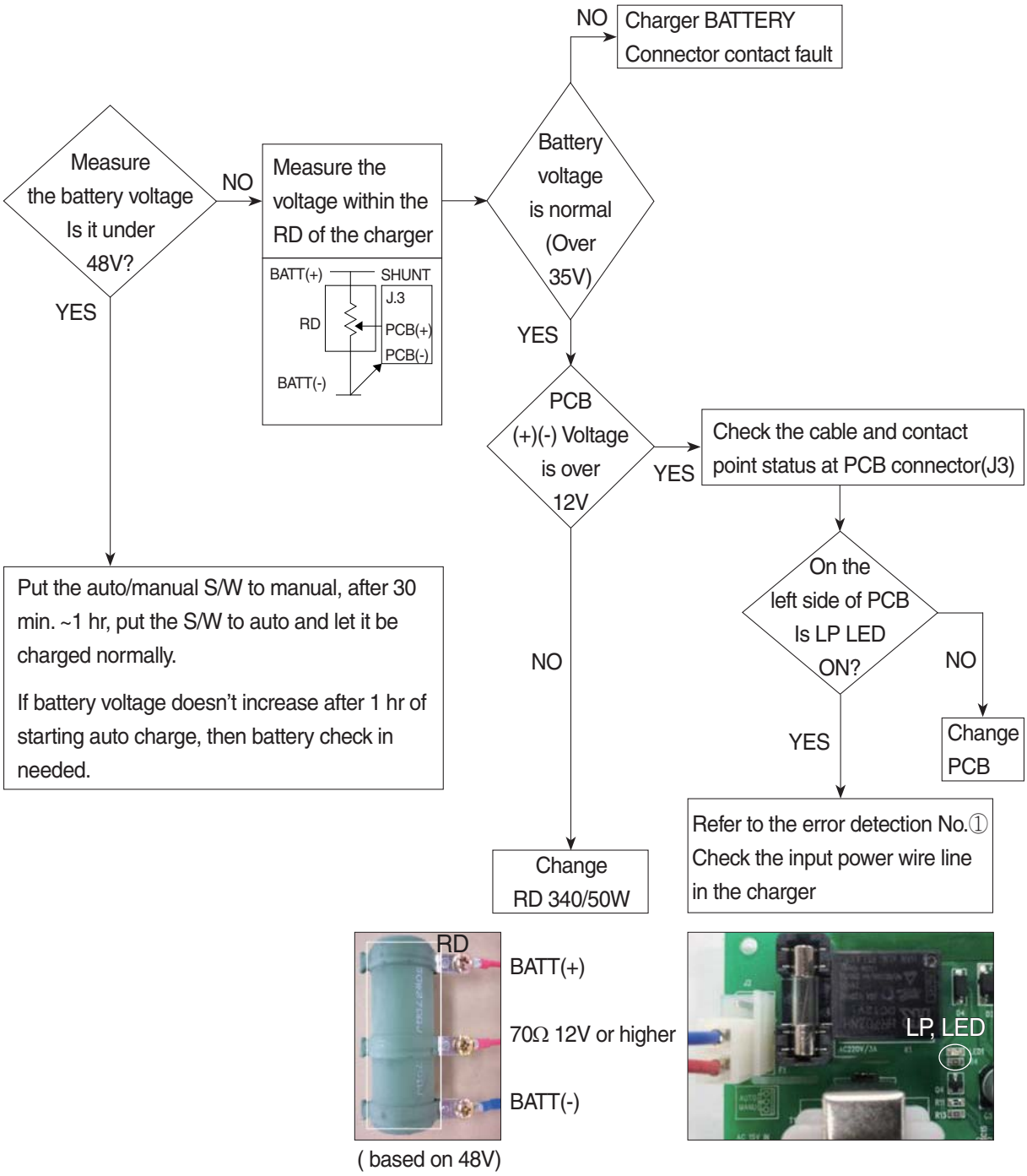


⑤ **Charger TRIP is occurred after it started charging and charging completion lamp is on.**
(In case input voltage is normal - Refer to the error detection No. 1)
Restore the charger as pushing reset switch.



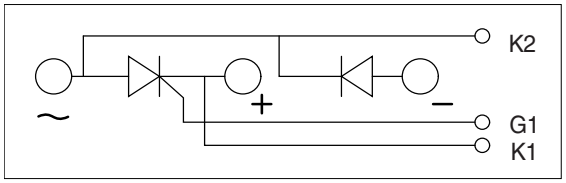
⑥ **Charger has no response even if the battery connector is connected.**

- In case only floating LED is on, charger input power is cut off or doesn't connect. (In case the input voltage is normal - Refer to the error detection No. ①)

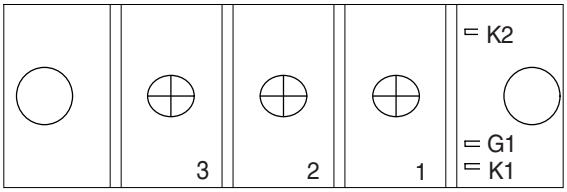


7) HOW TO CHECK THE SCR MODULE

Circuit

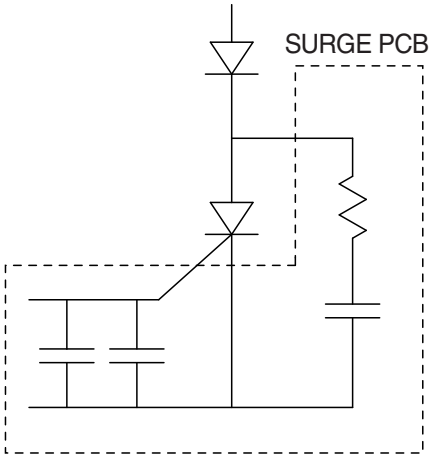


Real diagram

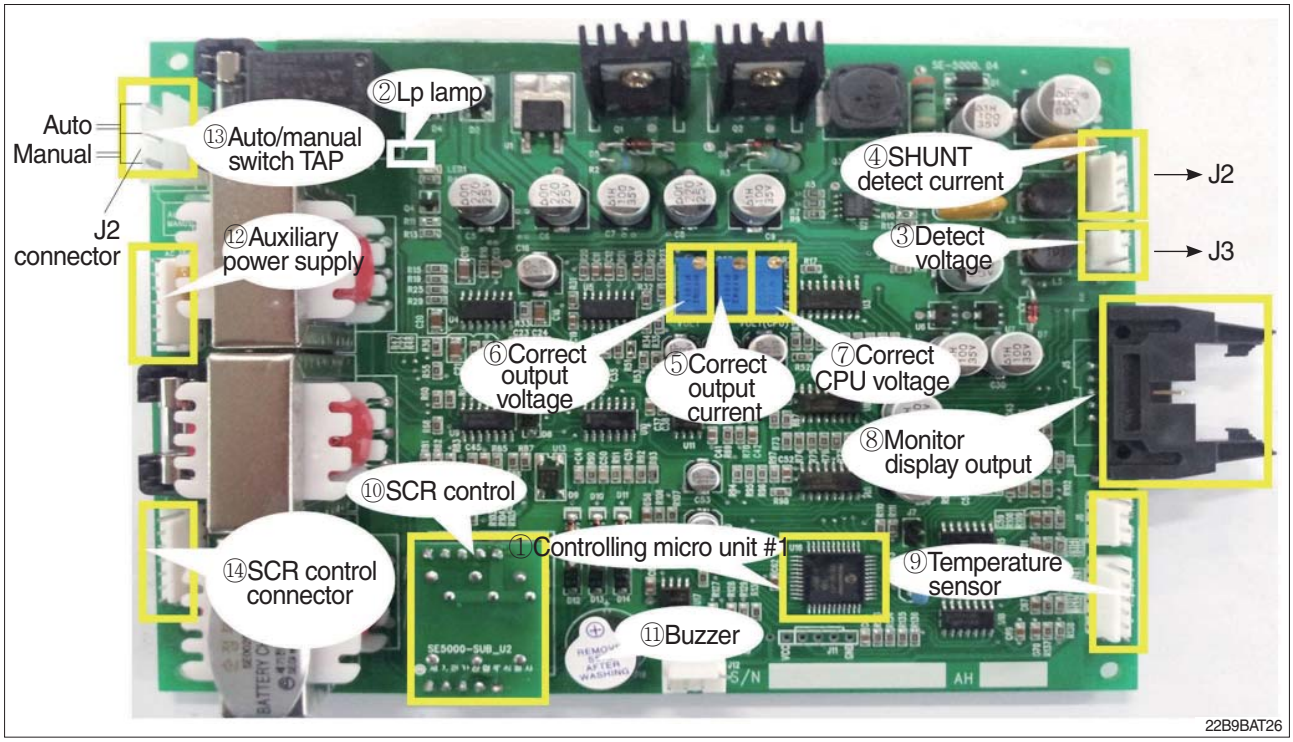


* Before checking SCR MODULE, be sure to disconnect bus bar and wire on the terminal.

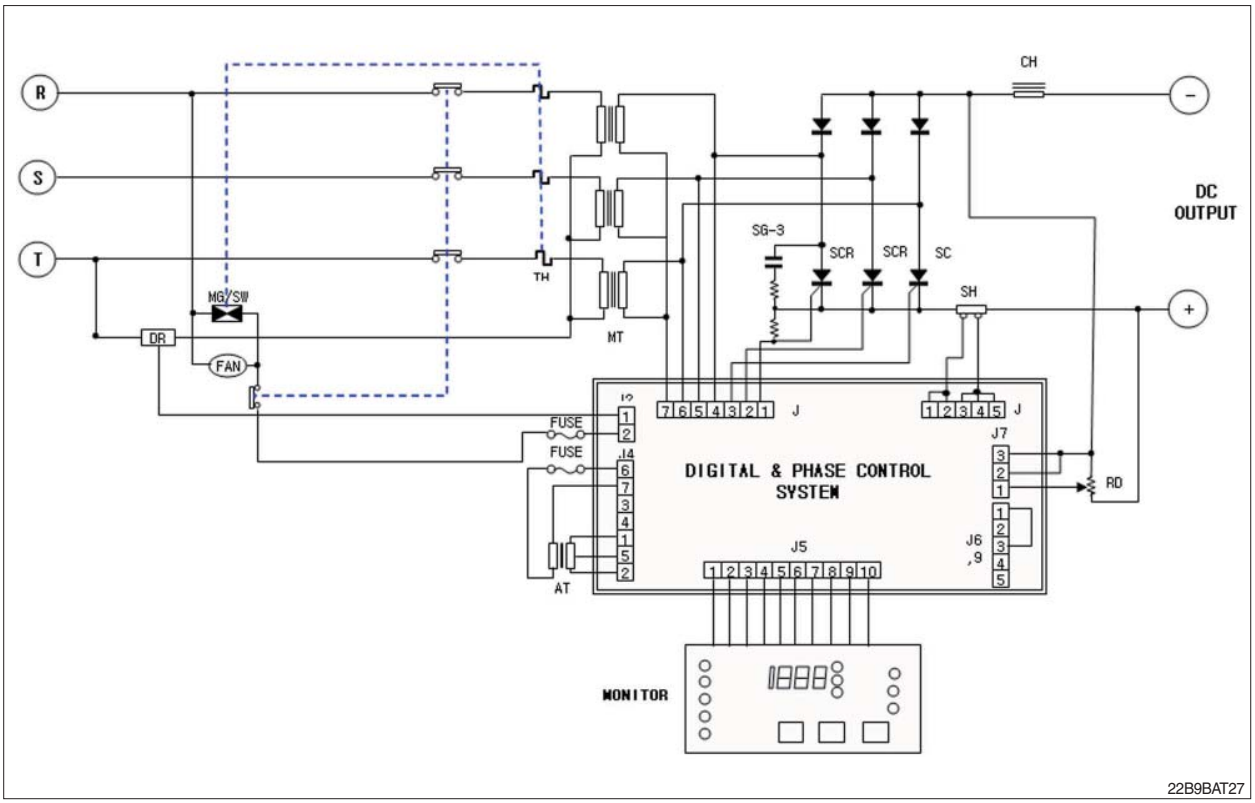
No.	Measuring point (Real diagram)	Measure value (Measurement of digital tester)
1	No.1 ~ No.3	Forward : Under 100 k ohm Reverse : Infinity (∞)
2	No.2 ~ No.3	Forward : Infinity (∞) Reverse : Infinity (∞)
3	G1 ~ K1	Forward : Under 100 ohm Reverse : Under 100 ohm But It depends on the module. If it is not 0 ohm, It is Ok.
4	G1 ~ K2	Forward : Infinity (∞) Reverse : Infinity (∞)



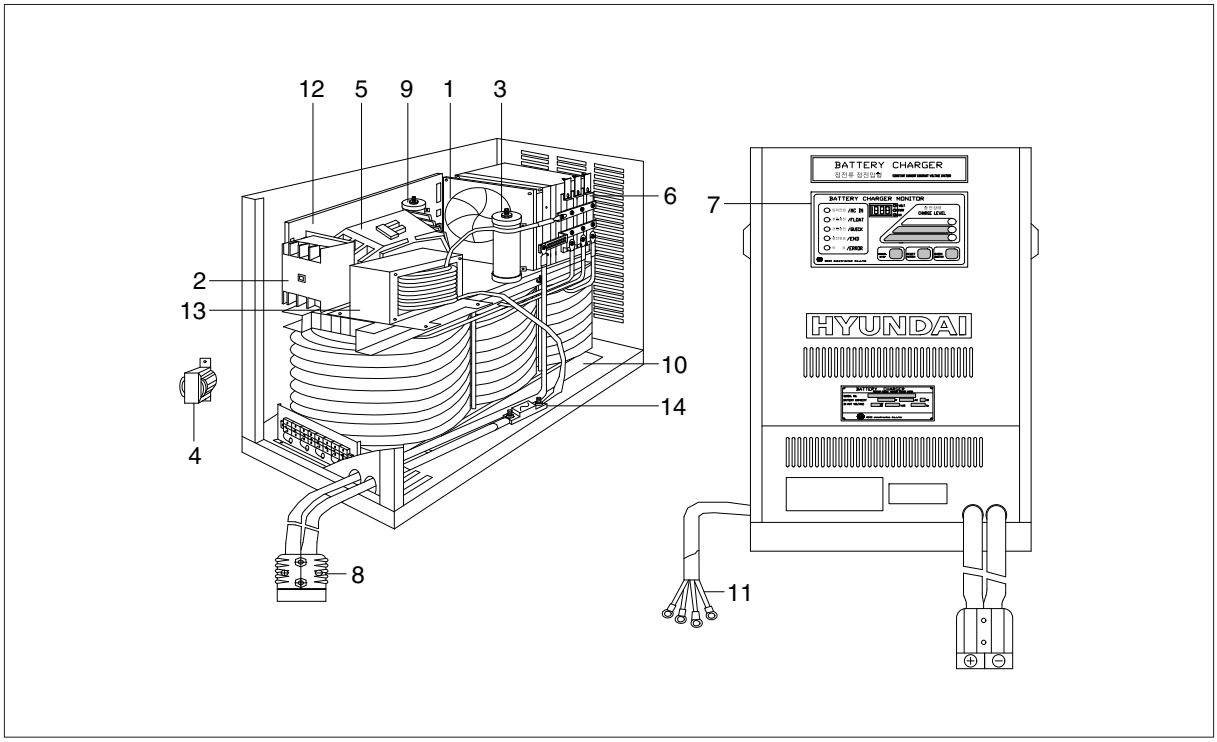
8) PCB MAJOR PARTS (NAME AND LOCATION)



1	Controlling MICOM #1	6	Correct output voltage	11	Buzzer
2	Lp lamp	7	Correct CPU voltage	12	Auxiliary power supply
3	Detect voltage	8	Monitor display output	13	Auto/manual switch TAP
4	SHUNT detect current	9	Temperature sensor	14	SCR control connector
5	Correct output current	10	SCR control		


R
S
T
MG/SW
DR
FAN
TH
MT
CH
DC
OUTPUT
SG-3
SCR
SCR
SC
SH
FUSE
FUSE
AT
DIGITAL & PHASE CONTROL
SYSTEM
J
J7
RD
J5
J6
MONITOR
22B9BAT27

CHARGER INTERIOR PARTS



22B9BAT28

No	Part name	Remarks
1	AC fan	
2	Over load	
3	Resister RD	
4	Trans-aux	
5	Magnet switch	
6	SCR module	
7	Monitor	
8	DC out cable	
9	Resister DR	
10	Main transformer	
11	AC input cable	
12	Main control board	
13	Filter	
14	Fuse	