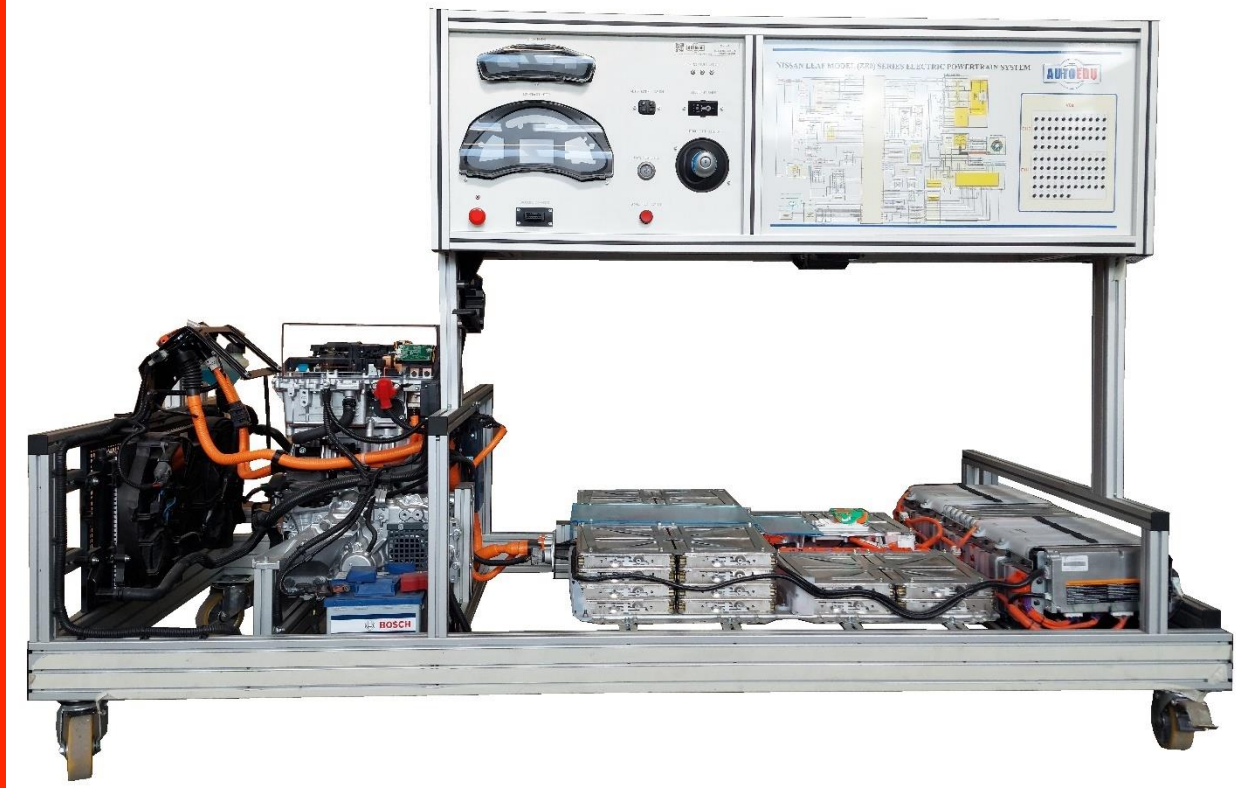
AutoEDU
MAKING PRACTICE PERFECT



ELECTRIC VEHICLE TRAINING STAND

MSEV02

www.autoedu.lt

www.bads.lt

www.automotivetrainingequipment.com

2024 Kaunas Lithuania

CONTENT

1. SAFETY REQUIREMENTS

1.1. General safety requirements

Attention:

Before using the training board, take a look at the user manual.

Before turning on the educational training board, check if there are no mechanical damage, breaches or if the power supply cable and the plug are not damaged.

It is forbidden to modify, repair, and improve the educational training board.

Educational training board can only be used for the purposes indicated in the user manual.

Do not let children, unqualified personnel, or people affected by alcohol or other psychotropic substances work with the training board.

After you put up the stand, take measures that it would not roll away.

Do not take off protective shields that cover the turning parts.

Do not put your fingers, hands or any other stuff near to the turning parts.

Follow the rules of safe working with cars.

Before working with training equipment, check that:

- Equipment is not mechanically damaged, broken;
- All protective shields are assembled;
- All heated, rotating parts (e.g., heating plugs, pulleys, gears, etc.) are covered;
- All components (e.g., wires, jumpers, fuses, handles, etc.) are available;
- Sufficient technical fluids (e.g., brake fluid, oil, coolant, etc.);
- Liquids do not leak through the joints;
- The equipment components are free of foreign bodies;
- Undamaged power cords;
- Neat power supplies (battery or stand power supply);
- Power supplies are properly connected (e.g., battery terminals are screwed on, polarity is not mixed, proper power supply is used according to local electrical installation standards);
- The use of training equipment with internal combustion engines ensures the removal of burns from the auditorium;
- The training equipment is properly constructed and locked (e.g., the equipment is placed on a sufficiently solid base, the transport wheels are locked);
- During operation, the equipment will not pose any danger to those working with it and the surrounding staff;
- There are other factors not specified in the instructions that may endanger the health of personnel working with the equipment and others.

Observe during work with the equipment:

- The noise emitted by the equipment is characteristic of such a work process (no extraneous sounds);
- No leakage of liquids from the equipment;
- Odor of glowing, burning objects;
- Power supplies are working properly;
- There are no factors or processes other than those specified in the instructions that could endanger the health of personnel working with the equipment or other persons.

1.2. Safety requirements for working with high voltage electrical components

Employees, lecturers, students, support and service personnel must be familiar with the requirements of the work instructions for work with electrical devices after listening to the instructions and must sign the work safety logs. Instruction of employees and other personnel is carried out in accordance with the normative legal acts, laws and by-laws in force in that state (country). The "Safety Regulations for the Operation of Electrical Equipment" are followed.

Only suitably qualified persons may work with high voltage components and circuits.

Elements marked in orange (wires, connectors, control units, voltage converters, etc.) are constantly or periodically high in the fuel.

Warning:

- Before inspecting or servicing the circuits and components of the high voltage system, be sure to remove the maintenance connector (fuse) from the socket in the battery box of the high voltage battery. This will turn off the high voltage circuit.
- Place the maintenance connection (fuse) safely out of the reach of other persons to prevent it from being accidentally connected by another person during maintenance and service work.
- Before working on high voltage components, take care of personal protective equipment and equipment: gloves, shoes, face shield, rubber mat, earthing circuit, etc.
- Take care of the safety of the work area around the high-voltage battery: the work area must be marked, a responsible employee must be appointed, and the work area must be fenced. When work is not in progress, high-voltage parts and components must be covered with insulating covers or shields to prevent them from touching them.

CAUTION: HIGH VOLTAGE. DO NOT TOUCH DURING OPERATION.

To draw the attention of other employees, set up an information warning sign.

CAUTION:

HIGH VOLTAGE. DO NOT TOUCH DURING OPERATION

CAUTION:

HIGH VOLTAGE. DO NOT TOUCH DURING OPERATION

The table must be printed, folded into a triangle (the bends are marked with a dotted line) and placed on the car.

High voltage wires, regardless of their polarity, are marked with orange insulation.

Attention!

Before inspecting or servicing the high-voltage system, be sure to follow safety measure, such as wearing insulated gloves and removing the service plug to prevent electrocution. Carry the removed service plug in your pocket to prevent other technicians from reinstalling it while you are servicing vehicle.

After removing the service plug, wait 10 minutes before touching any of the high – voltage connectors and terminals.

When working with high voltage components, the battery must use protective equipment:

- glasses
- face shield
- rubber, latex gloves;
- protective clothing and apron;
- rubber boots:
- rubber mats.

All protective and working equipment must meet the requirements of electrical safety standards, be metrologically inspected and have valid metrological inspection documents.

When disconnecting high-voltage wires or other electrical connections, it is mandatory to insulate the open contacts with insulating materials.

After disconnecting the electrical components, make sure that there is no residual voltage.

Protective equipment must be used when working with high voltage circuits. Measure the voltage inside the electrical components before working on them. The devices must display 0 V. It is only possible to work with high-voltage circuit elements at least 10 minutes after the circuit has been switched off. There are capacitors in the system that need to be discharged (discharged).

Attention!

Work safety instructions must be observed when working with high voltage circuits. Workers working on high-voltage circuits can be shocked by high-voltage electricity and injured by improper handling of measuring and repair equipment due to sparks. At the beginning of the work, it must be ensured that all repair and maintenance work is carried out only with the high-voltage lines disconnected.

When disconnecting high voltage cables, they must be insulated. This avoids short circuits, self-coupling and human protection. Use only fully insulated tools for this purpose.

It is forbidden to remove the clear plastic covers from the frame holding the high-voltage battery.

PRECAUTIONS

Description

Observe the following precautions to ensure safe and proper servicing. These precautions are not described in each individual section.

Precaution for Technicians Using Medical Electric

OPERATION PROHIBITION

WARNING:

• Parts with strong magnet is used in this vehicle.
• Technicians using a medical electric device such as pacemaker must never perform operation on the vehicle, as magnetic field can affect the device function by approaching to such parts.

NORMAL CHARGE PRECAUTION

WARNING:

• If a technician uses a medical electric device such as an implantable cardiac pacemaker or an implantable cardioverter defibrillator, the possible effects on the devices must be checked with the device manufacturer before starting the charge operation.
• As radiated electromagnetic wave generated by on board charger at normal charge operation may affect medical electric devices, a technician using a medical electric device such as implantable cardiac pacemaker or an implantable cardioverter defibrillator must not enter the vehicle compartment (including luggage room) during normal charge operation.

Precaution at telematics system operation

WARNING:

• If a technician uses implantable cardiac pacemaker or implantable cardioverter defibrillator (ICD), avoid the device implanted part from approaching within approximately 220 mm (8.66 in) from interior/ exterior antenna.
• The electromagnetic wave of TCU might affect the function of the implantable cardiac pacemaker or the implantable cardioverter defibrillator (ICD), when using the service, etc.
• If a technician uses other medical electric devices than implantable cardiac pacemaker or implantable cardioverter defibrillator (ICD), the electromagnetic wave of TCU might affect the function of the device. The possible effects on the devices must be checked with the device manufacturer before TCU use.

Precaution at intelligent key system operation

WARNING:

• If a technician uses implantable cardiac pacemaker or implantable cardioverter defibrillator (ICD), avoid the device implanted part from approaching within approximately 220 mm (8.66 in) from interior/exterior antenna.

• The electromagnetic wave of intelligent key might affect the function of the implantable cardiac pacemaker or the implantable cardioverter defibrillator (ICD), at door operation, at each request switch operation, or at engine starting.
• If a technician uses other medical electric devices than implantable cardiac pacemaker or implantable cardioverter defibrillator (ICD), the electromagnetic wave of intelligent key might affect the function of the device. The possible effects on the devices must be checked with the device manufacturer before intelligent key use.

Point to Be Checked Before Starting Maintenance Work

The high voltage system may start automatically. It is required to check that the timer air conditioner and timer charge (during EVSE connection) are not set before starting maintenance work.

NOTE:

If the timer air conditioner or timer charge (during EVSE connection) is set, the high voltage system starts automatically even when the power switch is in OFF state.

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

Always observe the following items for preventing accidental activation.
• When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the power switch ON, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
• When using air or electric power tools or hammers, always switch the power switch OFF, disconnect the 12V battery, and wait at least 3 minutes before performing any service.

Precautions Necessary for Steering Wheel Rotation After Battery Disconnection

CAUTION:

Comply with the following cautions to prevent any error and malfunction.
• Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
• After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
• Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

Precaution for Removing 12V Battery

When removing the 12V battery, turn ON/OFF the power switch and check that the charging status indicator does not blink. The 12V battery must be removed within one hour after checking the indicator lamp.

NOTE:

• The automatic 12V battery charge control may start even when the power switch is in OFF state.
• The automatic 12V battery charge control does not start within approximately one hour when the power switch is turned ON/OFF.

CAUTIONS AS TO HIGH VOLTAGE

How to Cut Off High Voltage

HIGH VOLTAGE SHUT-OFF PROCEDURE

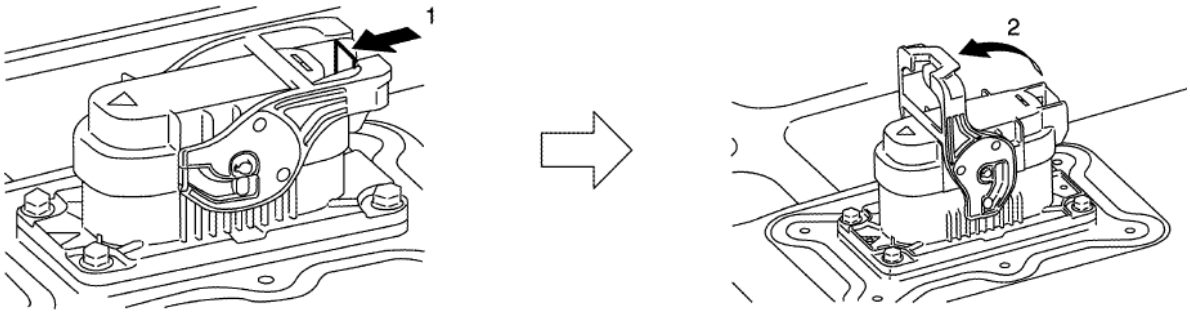
Be sure to follow the procedure below and shut off the high voltage before performing inspection or servicing of the high voltage system.

1. Turn power switch OFF.

CAUTION:

The worker must keep the intelligent key on his/her person.

2. Disconnect 12V battery negative terminal.
3. Remove service plug, following below procedure.



DANGER:

Touching high voltage components without using the appropriate protective equipment will cause electrocution.

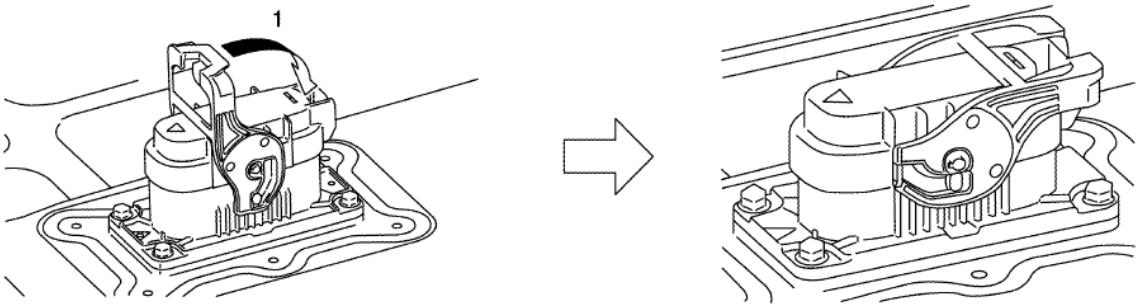
WARNING:

• Immediately insulate removed high voltage connectors and terminals with insulating tape.
• Be sure to put the removed service plug in your pocket and carry it with you so that another person does not accidentally connect it while work is in progress.

4. Wait for a minimum of approximately 10 minutes after the service plug is removed.

CONNECTING PROCEDURE

1. Check that 12V battery negative terminal is disconnected.
2. Install service plug as per the following steps.



DANGER:

Touching high voltage components without using the appropriate protective equipment will cause electrocution.

WARNING:

• Immediately insulate removed high voltage connectors and terminals with insulating tape.
• Be sure to put the removed service plug in your pocket and carry it with you so that another person does not accidentally connect it while work is in progress.

High Voltage Precautions

WARNING:

• Because hybrid vehicles and electric vehicles contain a high voltage battery, there is the risk of electric shock, electric leakage, or similar accidents if the high voltage component and vehicle are handled incorrectly. Be sure to follow the correct work procedures when performing inspection and maintenance.
• Be sure to remove the service plug in order to shut off the high voltage circuits before performing inspection or maintenance of high voltage system harnesses and parts.
• Be sure to put the removed service plug in your pocket and carry it with you so that another person does not accidentally connect it while work is in progress.
• Be sure to wear insulating protective equipment consisting of glove, shoes and face shield before beginning work on the high voltage system.
• Clearly identify the persons responsible for high voltage work and ensure that other persons do not touch the vehicle. When not working, cover high voltage parts with an insulating cover sheet or similar item to prevent other persons from contacting them.

CAUTION:

There is the possibility of a malfunction occurring if the vehicle is changed to READY status while the service plug is removed. Therefore, do not change the vehicle to READY status unless instructed to do so in the Service Manual.

HIGH VOLTAGE HARNESS AND EQUIPMENT IDENTIFICATION

The color of the high voltage harnesses and connectors are all orange. Orange "High Voltage" labels are applied to the Li-ion battery and other high voltage devices. Do not carelessly touch these harnesses and parts.

HANDLING OF HIGH VOLTAGE HARNESS AND TERMINALS

Immediately insulate disconnected high voltage connectors and terminals with insulating tape.

REGULATIONS ON WORKERS WITH MEDICAL ELECTRONICS

WARNING:

The vehicle contains parts that contain powerful magnets. If a person who is wearing a pacemaker or other medical device is close to these parts, the medical device may be affected by the magnets. Such persons must not perform work on the vehicle.

PROHIBITED ITEMS TO CARRY DURING THE WORK

Because this vehicle uses components that contain high voltage and powerful magnetism, due not carry any metal products which may cause short circuits, or any magnetic media (cash cards, prepaid cards, etc.) which may be damaged on your person when working.

High voltage components

Traction motor; Traction motor inverter; DC/DC-J/B; Li-ion battery controller; Li-ion battery; Service plug; PTC elements heater; Electric compressor.

CAUTION:

At times such as when a part was replaced, or when a label had become peeled, be sure to apply the new product label in the same position and facing in the same direction.

Insulated Protective Wear and Insulating Tools

PROTECTIVE WEAR CONTROL

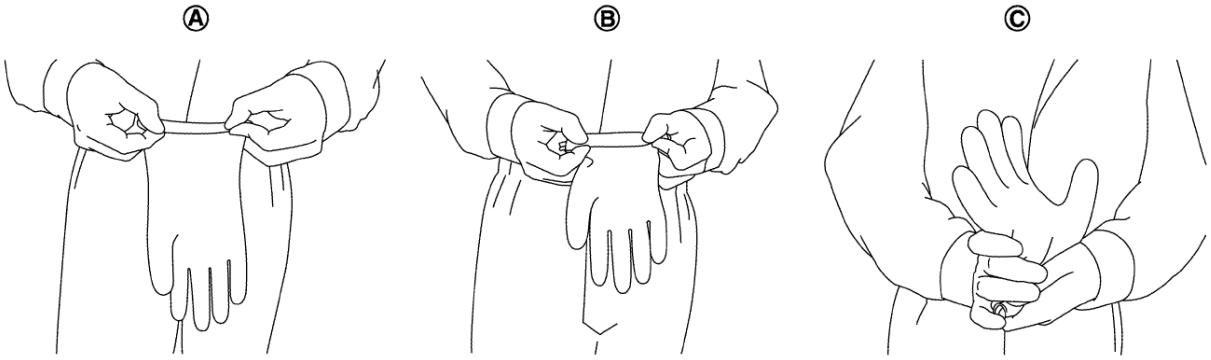
• Perform an inspection before beginning work, and do not use any items where abnormalities are found.

DAILY INSPECTION

This inspection is performed before and after use, the worker in responsible who will directly use the items inspects them and checks for deterioration and damage.

• Insulated gloves

Inspect the insulated gloves for scratches, holes, and tears. (Visual check and air leakage test)



A : Hold glove and fold as shown in the figure.
B : Fold three or four more times, preventing air from escaping from the glove.
C : Squeeze glove to check that the glove has no holes.

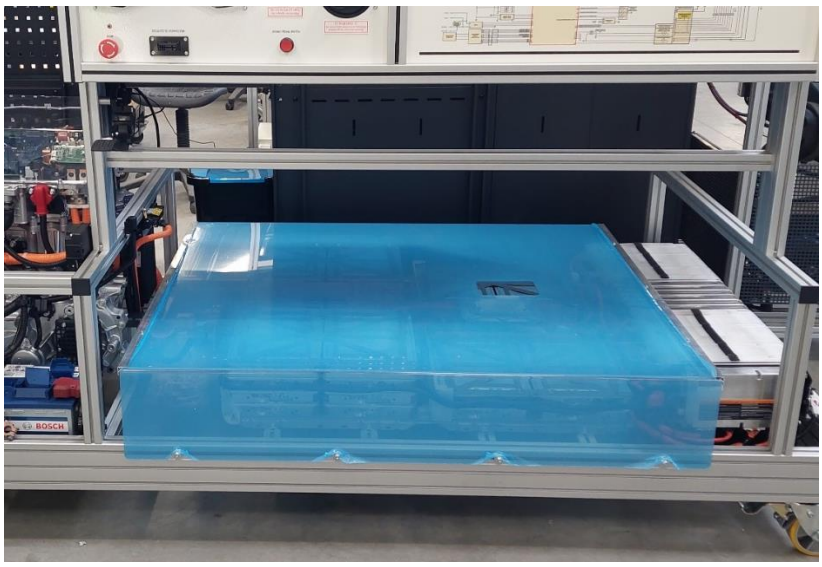
• Insulated safety shoes
Inspect the insulated safety boots for holes, damage, nails, metal pieces, wear or other problems on the soles. (Visual check)
• Insulated rubber sheet Inspect the insulated rubber sheet for tears. (Visual inspection)

INSULATING TOOLS
When performing work at locations where high voltage is applied (such as terminals), use insulated tools.

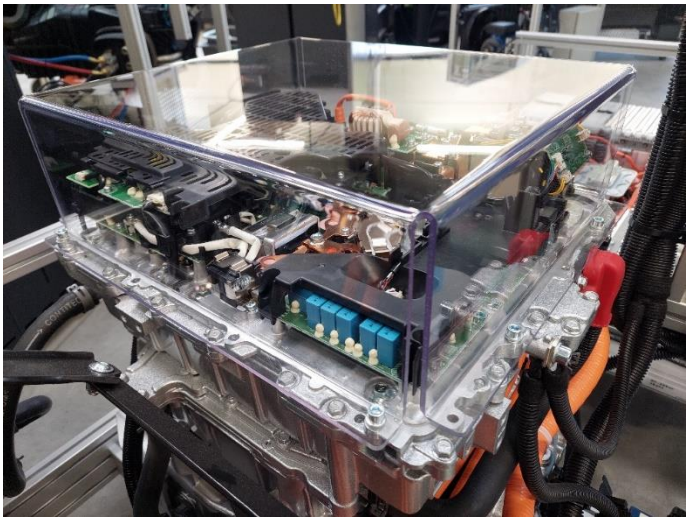
HANDLING OF INSULATION RESISTANCE TESTER

CAUTION:

Unlike the ordinary tester, the insulation resistance tester applies 500 V when measuring. If used incorrectly, there is the danger of electric shock. If used in the vehicle 12 V system, there is the danger of damage to electronic devices. Read the insulation resistance tester instruction manual carefully and be sure to work safely.



The protective battery cover of the high-voltage batteries



The protective inverter covers

2. GENERAL INFORMATION

2.1. Purpose of training equipment

Teaching equipment for educational activities. It is a visual tool for explaining and demonstrating the structure and operation of various automotive parts, assemblies, structures, systems. The equipment is used as a teaching and learning tool for monitoring and analysis of various car systems work processes. It is possible to perform various measurements of the system installed in the training equipment, parameters of ongoing processes, to perform fault simulations, to diagnose. A variety of laboratory tasks can be performed using the training equipment. The equipment is designed and manufactured in order to provide learners with the clearest and most convenient information about the structure of the unit, the composition of the system and the principle of operation.

The training equipment is intended for demonstration, training and learning of the construction, structure, principle of operation, settings and adjustments of the NISSAN LEAF electric car.

2.2. Training equipment parameters

Length	2505 mm;
Width	1055 mm;
Height	1605 mm;
Weight	~ 700 kg;
Power supply	12 V battery

High voltage battery (~ 400 V) 24 kWh
230 V 50 Hz household electricity network

Car code	ZE0
Year of production	2013 – 2017
Power	80 kW (109 HP), 280 Nm

In the diagnostic tool, you select manually: Nissan -> North America -> North America Common -> Leaf -> ZE0 -> 2013

2.3. Transport and storage conditions

Training equipment is installed in a dedicated box. Do not overturn or lay the equipment during transport. During transport, the equipment must be protected from falling, tipping, shocks, humidity, temperature, vibration.

Put the training equipment only on a suitable, solid base (table, cupboard).

Export or import procedures must take into account the legislation in force between the countries. Import export procedures and various taxes apply to various technical fluids, oils, batteries, tires and more.

Training equipment must be stored in a room with a minimum ambient temperature of at least +10 ° C. Relative humidity not more than 60 %.

Training equipment must not be exposed to direct sunlight. Equipment must be covered by protective equipment if it is stored in a place exposed to direct sunlight.

2.4. Preparation and use of equipment

The training equipment is maintained as conventional mechanical, hydraulic, pneumatic, electrical machines and systems. Training equipment requires minimal maintenance and service.

Training equipment - a car, maintained and serviced according to the car manufacturer's recommendations.

It is necessary to constantly monitor the leakage of fluids from the training equipment units.

All components of the training equipment must be controlled and ensured.

Damaged, broken parts, blown fuses, damaged connecting cables and other parts are replaced with new ones.

In the case of training equipment with internal combustion engines, gearboxes and air-conditioning systems, maintenance and service shall be carried out in accordance with the vehicle used in the training equipment.

The charge of the 12 V battery must be checked and monitored regularly. Strong battery discharge (voltage less than 10.5 V) is not permitted. Do not store a discharged battery for more than 10 days (lead acid batteries can cause irreversible sulphation processes that can damage the battery).

The charge level of high-voltage (hybrid and electric) batteries must be checked regularly. The charge level must not be less than the minimum permissible battery voltage specified by the battery manufacturer. If necessary, the battery must be charged with the appropriate means and equipment.

Only technical fluids of the appropriate quality and technical specification (engine, transmission oil, coolant, brake fluid, etc.), quality filters and other spare and component parts must be used for maintenance and service work on the training equipment.

The training equipment uses electricity stored in a 12 V and high voltage battery.

The 12 V battery must meet the technical conditions of the training equipment: battery terminal arrangement, capacity (Ah), starting current (A), size (length (mm), width (mm), height (mm)).

Disconnect the battery charger when working with training equipment that is powered by a 12 V battery. The charger can emit electromagnetic noise that affects the operation of the training equipment and can be recorded by sensitive measuring devices (oscilloscope).

The technical condition of the equipment, attachment of protective shields, complete set and other things are checked. For more information on safe work

requirements, see the section "Safety requirements → Before working with the training equipment, check that: and Observe during work with the equipment:".

The position of the emergency stop switch is checked. If the training equipment has been stopped in an emergency, the emergency stop switch will remain depressed and the equipment will not start. When the emergency stop switch is unlocked, it pops out when its upper part is turned clockwise (the upper part moves to the right).

Emergency stop switch

If the emergency stop switch needs to be used, it is pressed with your finger or palm. There is no need to turn anything.

The training equipment is activated by a switch, ignition key (depending on the type and equipment of the training equipment).

In training equipment with an in-car dashboard, all indications of equipment operation are reflected on the dashboard.

By learning diagnostics, car control computer system scanners (computer diagnostics), it is possible to activate the execution components. This item can be activated depends on the available diagnostic and training equipment.

With the help of system scanners, written fault codes / messages can be found in the car's control computer memory. These codes / messages are stored in the memory when the sensor, the actuator, the wire is broken, the contacts are lost, the jumper is removed from the circuit. All fault codes can be deleted from the car's control computer memory using system scanners. Fault codes are stored in the memory, for example: when the jumper is disconnected when the training equipment is switched on, the signals of the speed sensors do not match, due to voltage fluctuations and other real or simulated malfunctions. As in cars, errors can only be cleared from the control computer's memory when the fault has been physically rectified (e.g., jumper inserted, cable connected, faulty sensor replaced, etc.).

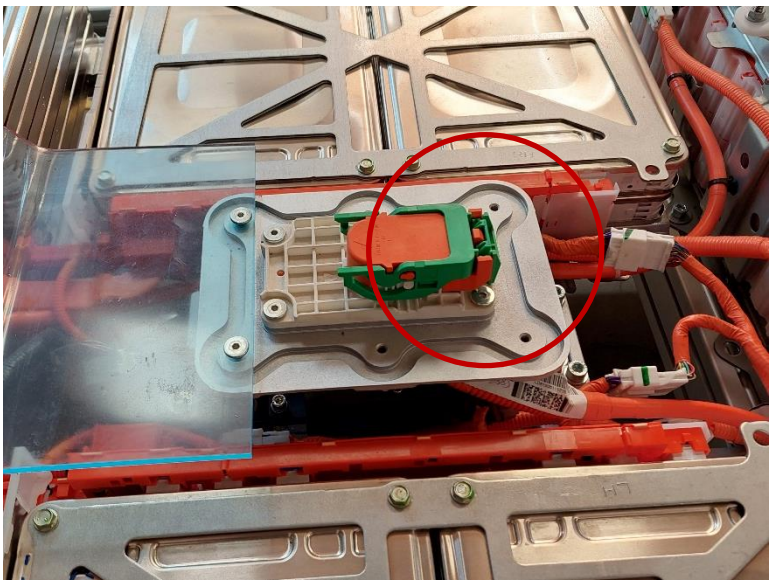
After carrying out computer diagnostics and disconnecting the diagnostic device, it is necessary to turn off the stand for at least 1 minute so that all control units turn off. Only after this action, the trouble codes that were in the control units will be deleted.

Note:

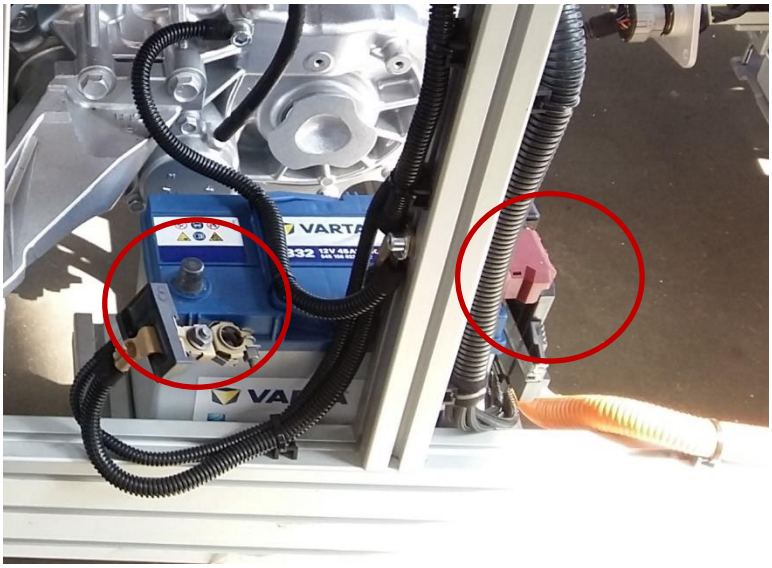
Because not all control units from the electric car are placed in the training stand, so the systems will have fault codes that cannot be deleted. These fault codes are related to communications, ABS unit and others.

2.5. How to run the equipment

1. Insert the service plug into the slot and lock it.



2. Connect the 12 V battery (first “+” and then “-“ contacts)



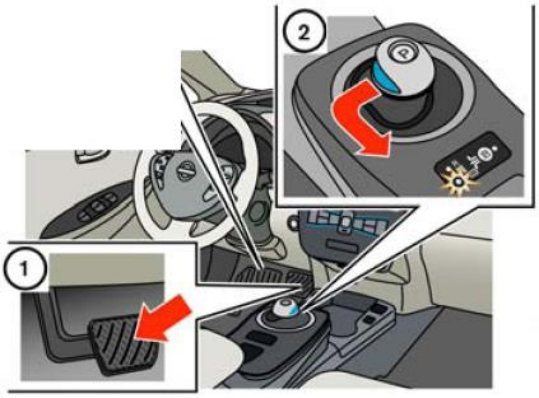
3. Turn off the Emergency stop switch. By unlocking the emergency stop switch it pops out when its upper part is turned clockwise.

4. Press and hold the Brake pedal switch. Press the POWER switch.

5. Check that the READY to drive indicator light illuminates and the start-up sound is audible. See Ready to drive indicator light in the Instruments and controls section.

If the READY to drive indicator light illuminates, the training equipment is ready for operation.

6. Select the direction of travel while holding down the brake pedal switch.



Move the selector lever into the D (Drive) position. When released, the selector lever returns to its original center position.

Confirm that the vehicle is in the D (Drive) position. The indicator next to the “D” by the selector lever illuminates and “D” is displayed on the meter. Release the brake pedal. Depress the accelerator pedal and start driving.

7. To change the driving direction, release the accelerator pedal. When the traction motor stops, press the brake pedal switch and select the desired driving direction with the selector.

WARNING

Do not change the drive direction while the wheels are turning.

Do not put Shift selector in to P (Parking) position while the wheels are turning.

Do not switch OFF the stand while the wheels are turning.

8. To turn off the learning equipment, press the Power switch.
After turning off the training equipment, the Emergency Stop bottom can also be pressed when the instrument panel turns off completely. It is recommended to do this by leaving the stand unused for a longer period of time (1 week or more).

2.6. High voltage and 12 V battery

How to charge and maintain high-voltage and 12V batteries is explained in the car's owner's manual. No exclusions apply to this training stand.

However, we provide some explanations and recommendations on how to properly handle battery batteries.

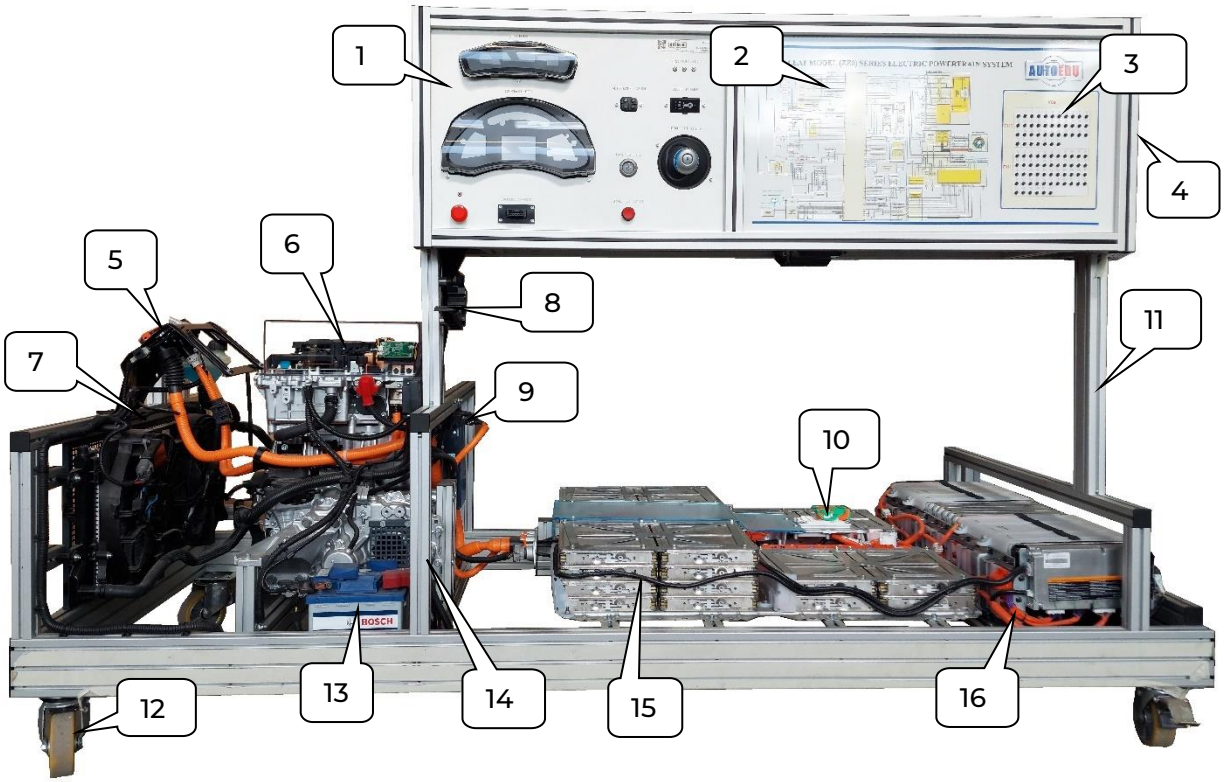
1. It is recommended that the battery charge of high-voltage batteries be between 20 and 80 % at all times.
2. The battery of high-voltage batteries can only be charged with a dedicated charger.

3. The service plug must be connected when charging the high-voltage battery.
4. When charging a high-voltage battery pack, the 12 V battery is charged at the same time.
5. When not using the equipment for more than two weeks, it is recommended to push the Emergency stop bottom, disconnect the 12 V battery and remove the service plug.
6. Time to time check the voltage of 12 V battery with a multimeter and if necessary, charge this battery with a conventional battery charger.

3. TRAINING EQUIPMENT

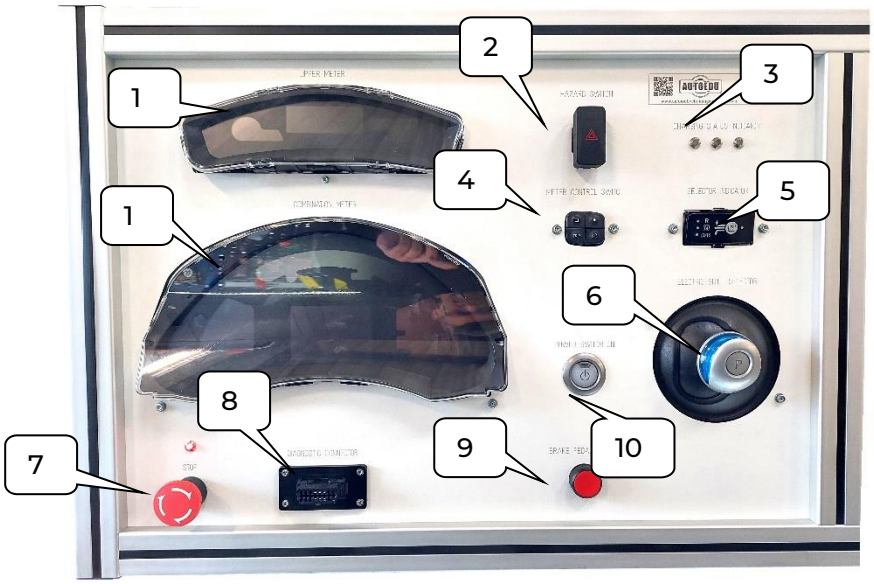
3.1. General overview of training equipment

A general view and structure of the training equipment is given in the illustrations below.



Electric vehicle training stand

1. Control panel
2. Principal electrical diagram
3. Measuring box
4. Information board (back side)
5. Charging connector
6. Traction motor inverter
7. Cooling radiator
8. Accelerator
9. Electric interior heater
10. Service plug
11. Frame
12. Transport wheels
13. 12 V battery
14. Traction motor
15. High voltage battery
16. High voltage cables (orange colour)

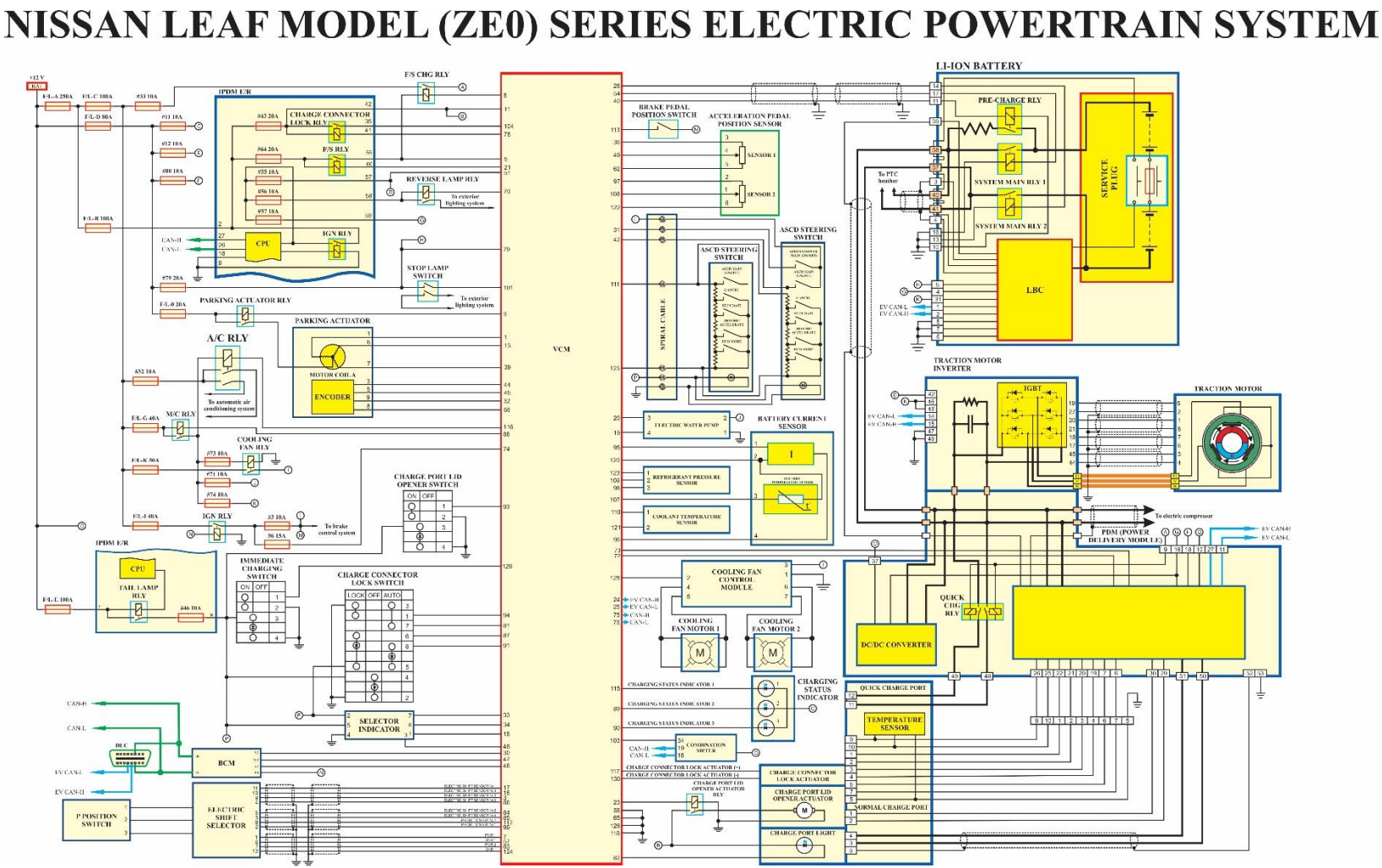


Control panel

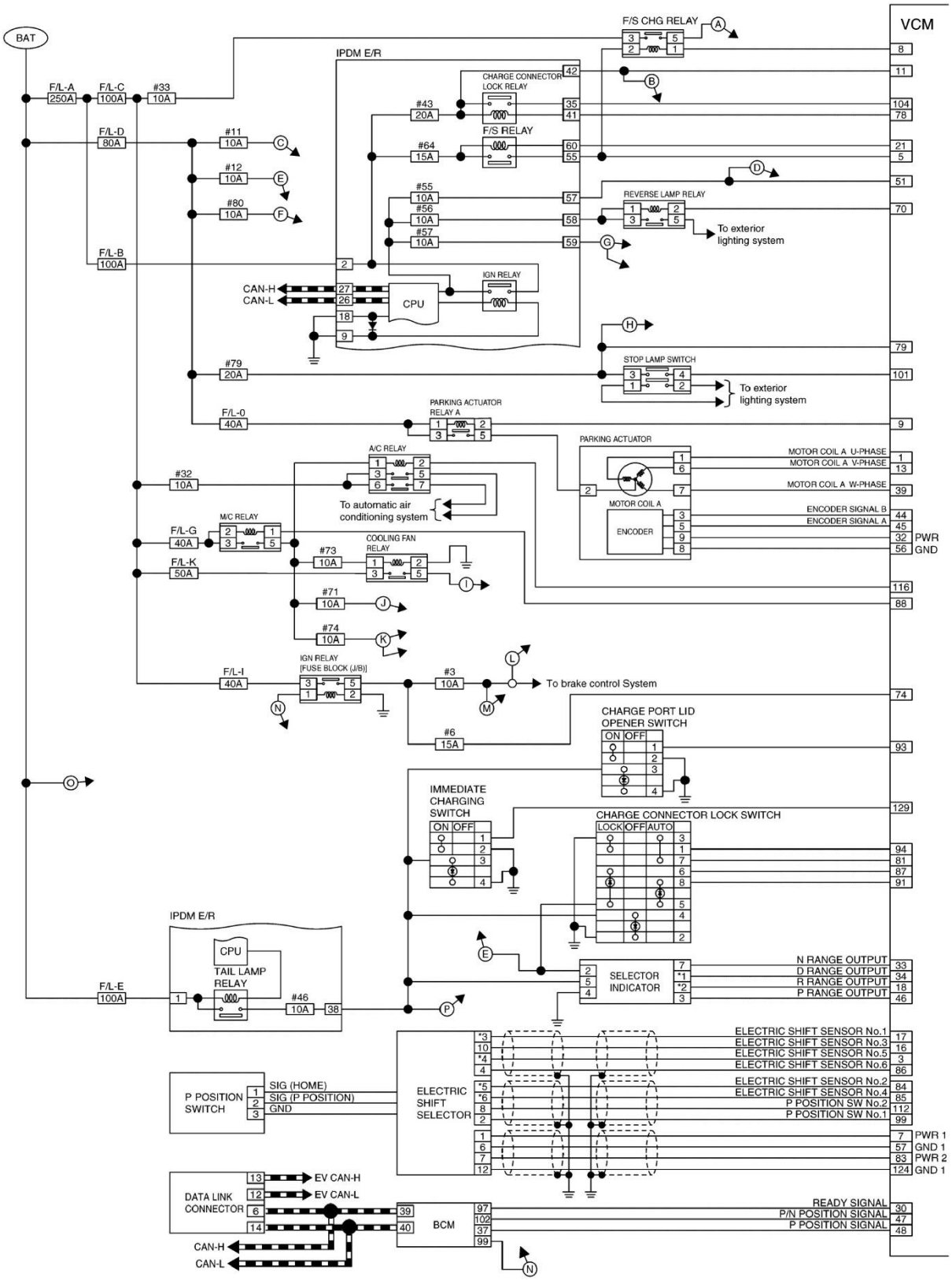
1. Combination meter
2. Hazard switch
3. Charging status indicator
4. Setting switches
5. Driving direction display
6. Selector
7. Emergency stop bottom
8. Data link connector
9. Brake pedal switch
10. POWER switch

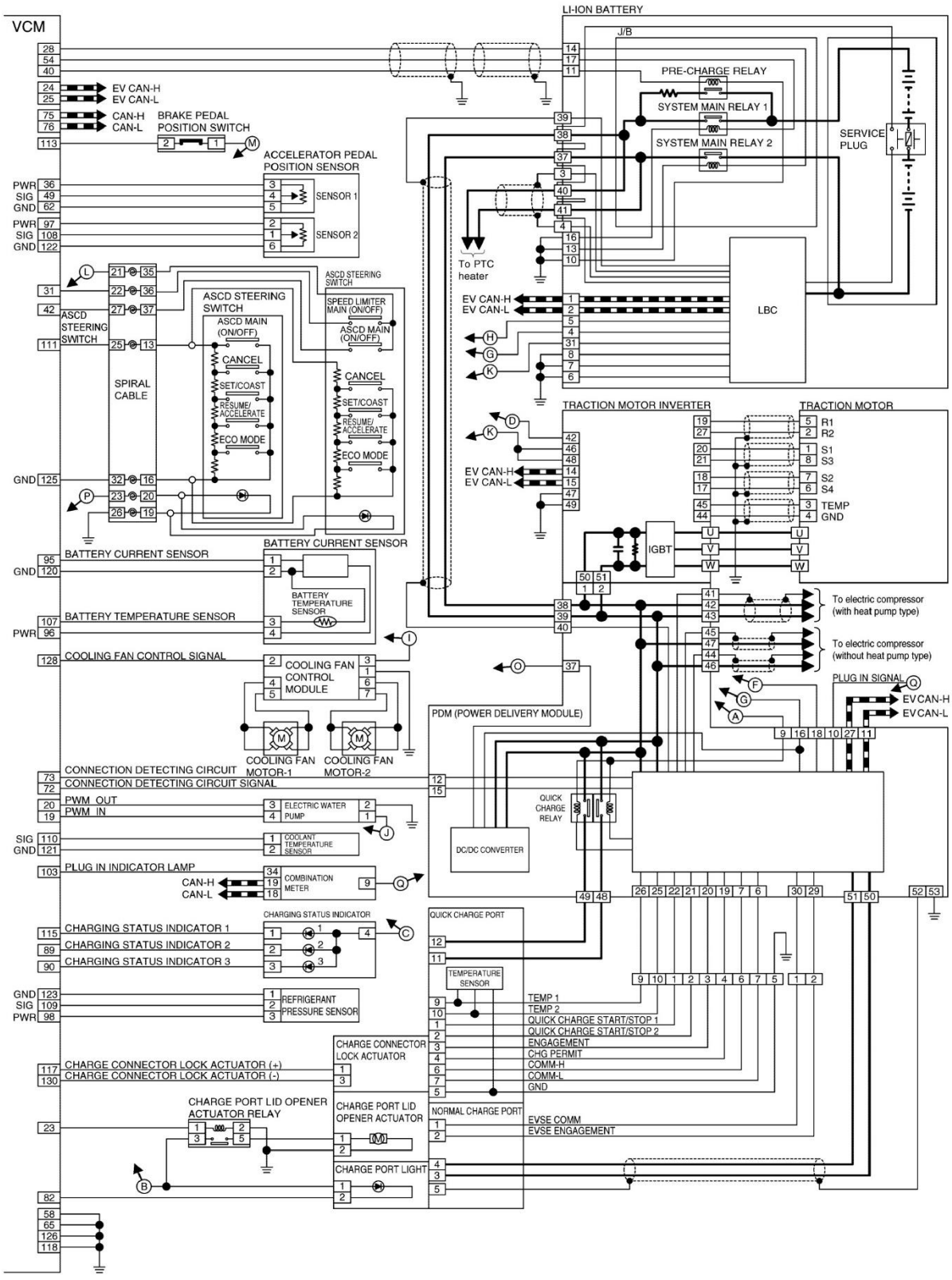
3.2. Wiring diagram

The wiring diagram contains all the elements: sensors, actuator components, data transmission lines, diagnostic connection. This diagram shows the connection circuits of the elements, the connection contact numbers, the component numbers.



Nissan Leaf electric vehicle principal structure


BAT
F/L-A 250A
F/L-C 100A
#33 10A
F/L-D 80A
F/L-B 100A
IPDM E/R
#11 10A
#12 10A
#80 10A
#43 20A
#64 15A
#55 10A
#56 10A
#57 10A
#79 20A
F/L-0 40A
#32 10A
F/L-G 40A
F/L-K 50A
#73 10A
#71 10A
#74 10A
F/L-I 40A
#3 10A
#6 15A
F/L-E 100A
#46 10A
CHARGE CONNECTOR LOCK RELAY
F/S RELAY
IGN RELAY
CPU
CAN-H
CAN-L
F/S CHG RELAY
REVERSE LAMP RELAY
To exterior lighting system
STOP LAMP SWITCH
To exterior lighting system
PARKING ACTUATOR RELAY A
PARKING ACTUATOR
MOTOR COIL A U-PHASE
MOTOR COIL A V-PHASE
MOTOR COIL A W-PHASE
MOTOR COIL A
ENCODER
ENCODER SIGNAL B
ENCODER SIGNAL A
A/C RELAY
To automatic air conditioning system
M/C RELAY
COOLING FAN RELAY
IGN RELAY [FUSE BLOCK (J/B)]
To brake control System
CHARGE PORT LID OPENER SWITCH
IMMEDIATE CHARGING SWITCH
CHARGE CONNECTOR LOCK SWITCH
IPDM E/R
CPU
TAIL LAMP RELAY
SELECTOR INDICATOR
N RANGE OUTPUT
D RANGE OUTPUT
R RANGE OUTPUT
P RANGE OUTPUT
P POSITION SWITCH
SIG (HOME)
SIG (P POSITION)
GND
ELECTRIC SHIFT SELECTOR
ELECTRIC SHIFT SENSOR No.1
ELECTRIC SHIFT SENSOR No.3
ELECTRIC SHIFT SENSOR No.5
ELECTRIC SHIFT SENSOR No.6
ELECTRIC SHIFT SENSOR No.2
ELECTRIC SHIFT SENSOR No.4
P POSITION SW No.2
P POSITION SW No.1
PWR 1
GND 1
PWR 2
GND 1
DATA LINK CONNECTOR
EV CAN-H
EV CAN-L
CAN-H
CAN-L
BCM
READY SIGNAL
P/N POSITION SIGNAL
P POSITION SIGNAL
VCM
PWR
GND



Nissan Leaf wiring diagram

4. FAULT SIMULATOR

The electric car is equipped with equipment controlled by Wi-Fi technology, which allows 10 faults to be introduced powertrain management. Faults are switched on and off remotely using a computer, tablet or smartphone.

After connecting to the equipment with smart devices, browser windows provide information about the electrical diagrams of the electric car.

The fault simulation equipment is activated automatically as soon as the car is activated. The fault simulation equipment is active for several minutes after the car is turned off. All systems of an unused car are turned off, and the failure simulation equipment is also turned off.

When the fault simulation equipment is turned off, all enabled faults are also turned off. After switching on the equipment, the faults to be simulated must be switched on again.

Connecting to Wi-Fi controlled equipment:

1. The electric car must be activated.

2. In the device (computer, tablet, mobile phone), a router is found in the Wi-Fi network **MSEV02**.

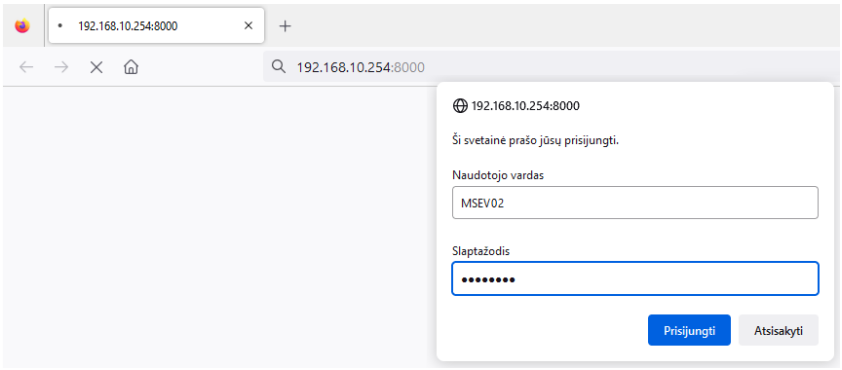
3. Connecting to the router leads to:
   Username: **MSEV02,**
   Password: **12345678**

4. After connecting to the router, on Internet browser is opened and the address is entered: **192.168.10.254:8000**

5. The web browser window that opens will ask you to enter your login details:

Username: **MSEV02**

Password: **12345678**



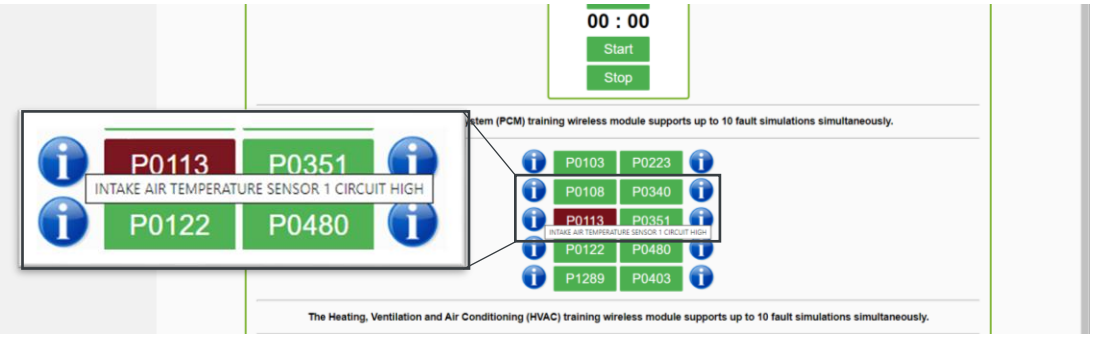
6. After successfully connecting to the page, the browser will take you to the initial window.

On the upper left side of the initial window, you can choose the contents: HOME, WIRING DIAGRAM VCM, FAULT SIMULATION, ABOUT.

The wiring diagrams contain schematics of the electric car's powertrain management.

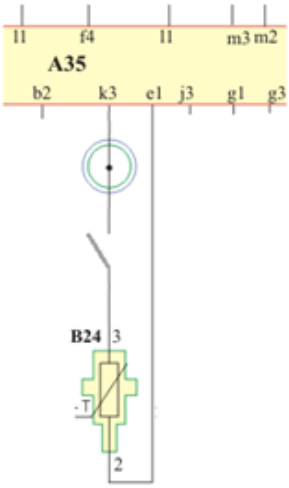
The fault simulation provides 10 simulated faults for VCM systems. A rectangular box with the fault code written in it that would be read by the diagnostic tool if the fault simulation was enabled. The activation of the fault simulation is reflected by the color of the rectangular box: the field is green - the fault is not enabled; the field is cherry - the fault is enabled.

After placing the cursor on the letter, I and waiting, a description of the simulated fault is given in English (if the diagnostic tool is set to English, this avoids confusion).



Fault simulation is performed with the help of a relay by breaking the circuit between the control unit and the sensor or actuator.

Switching off the switch interrupts the electrical circuit. This causes an error in the system. Switches are installed between the component and the electrical measurement point. Look on the picture below. Electronic control unit A35 contact k3, measurement point, hidden fault switch, component B24.



Location of the hidden fault switch

Depending on the capabilities of the diagnostic equipment used, there may be various options for scanning and removing (erasing) fault codes.

- Fault codes with diagnostic equipment can be erased immediately after the corresponding switch of the error simulation has been activated.
- Fault codes with diagnostic equipment can be deleted immediately after the fault simulation has been switched off. Rechecking the memory of the control unit with diagnostic equipment shows the fault codes again. These codes disappear from the memory of the control unit only after the car is completely turned off and on.
- Fault codes with diagnostic equipment can be deleted immediately after the fault simulation has been switched off. When repeatedly checking the control unit memory with diagnostic equipment, no fault codes are displayed, but the display of the actual parameter value is restored only after restarting the electric car.

Vehicle identification in the diagnostic equipment is carried out according to the WIN number or by specifying the following data: Nissan Leaf ZE0.

Simulated fault codes:

FAULT 1
DTC P1551
ACTUAL FAULT
Open circuit between VCM pin 95 and Battery current sensor pin 1
DTC DESCRIPTION
P1551 – Battery current sensor
FAULT SET CONDITION
An excessively low voltage from the sensor is sent to VCM
POSSIBLE CAUSES
Harness or connectors (Battery current sensor circuit is open or shorted)
Battery current sensor
EFFECT FAULT HAS ON SYSTEM
DTC stored in EV system memory
TEST PROCEDURE
Turn power switch ON. Check voltage between VCM pin 95 and pin 120 (GND). Actual value 0,5 – 4,5 V.

FAULT 2
DTC P2127
ACTUAL FAULT
Open circuit between VCM pin 108 and Acceleration pedal position sensor pin 1
DTC DESCRIPTION
P2127 – APP Sensor E (Throttle / Pedal position sensor / switch “E” circuit low)
FAULT SET CONDITION
An excessively low voltage from the APP sensor 2 is sent to VCM
POSSIBLE CAUSES
Harness or connectors (Accelerator pedal position sensor 2 circuit is open or shorted to ground)
Accelerator pedal position sensor 2
EFFECT FAULT HAS ON SYSTEM
System works in “TURTLE” mode
TEST PROCEDURE
Turn power switch ON. Check the APP sensor power voltage between VCM pin 97 (PWR) and pin 122 (GND). Actual value 4,5 – 5,5 V.
Check the sensor signal between VCM pin 122 (GND) and pin 108 (SIG). Actual value fully released 0,3 – 0,45 V. Actual value fully depressed 1,95 – 2,4 V.

FAULT 3
DTC P0A00
ACTUAL FAULT
Open circuit between VCM pin 110 (SIG) and Coolant temperature sensor pin 1
DTC DESCRIPTION
P0A00 – Coolant Temperature sensor (Motor electronics coolant temperature sensor circuit)

FAULT SET CONDITION

VCM detects that coolant temperature sensor voltage remains out of range 0,1 – 4,9 V for 2,5 seconds

POSSIBLE CAUSES

Harness or connectors (The sensor circuit is open or shorted)

Coolant temperature sensor

EFFECT FAULT HAS ON SYSTEM

Cooling fan constantly ON

TEST PROCEDURE

Turn power switch ON. Check voltage between VCM pin 110 (SIG) and pin 121 (GND). Actual value 0,5 – 4,5 V temperature dependent.

FAULT 4

DTC P2122

ACTUAL FAULT

Open circuit between VCM pin 36 (PWR) and Acceleration pedal position sensor pin 3

DTC DESCRIPTION

P2122 – APP Sensor D (Throttle / Pedal position sensor / switch “D” circuit low)

FAULT SET CONDITION

An excessively low voltage from the APP sensor 1 is sent to VCM

POSSIBLE CAUSES

Harness or connectors (Accelerator pedal position sensor 1 circuit is open or shorted to ground)

Accelerator pedal position sensor 1

EFFECT FAULT HAS ON SYSTEM

System works in “TURTLE” mode

TEST PROCEDURE

Turn power switch ON. Check the APP sensor power voltage between VCM pin 36 (PWR) and pin 62 (GND). Actual value 4,5 – 5,5 V.

Check the sensor signal between VCM pin 62 (GND) and pin 49 (SIG). Actual value fully released 0,6 – 0,9 V. Actual value fully depressed 3,9 – 4,8 V.

FAULT 5

DTC P31E8

ACTUAL FAULT

Open circuit between VCM pin 20 (PWM OUT) and Electric Water pump pin 3

DTC DESCRIPTION

P31E8 – Water pump 1

FAULT SET CONDITION

Electric water pump feedback duty keeps either of the following conditions for 30 seconds

POSSIBLE CAUSES

Harness or connectors

Electric water pump

VCM

EFFECT FAULT HAS ON SYSTEM

DTC stored in WV system memory

TEST PROCEDURE

Set the vehicle to READY.

Connect diagnostic tool and select “EV / HEV” system > Data Monitor W/P 1 CRNT SPD DUDY

Check W/P 1 CRNT SPD DUTY value: Actual value – 17 – 82 %

FAULT 6

DTC P2127

ACTUAL FAULT

Open circuit between VCM pin 97 (PWR) and Acceleration pedal position sensor pin 2

DTC DESCRIPTION

P2127 – APP Sensor E (Throttle / Pedal position sensor / switch “E” circuit low)

FAULT SET CONDITION

An excessively low voltage from the APP sensor 2 is sent to VCM

POSSIBLE CAUSES

Harness or connectors (Accelerator pedal position sensor 2 circuit is open or shorted to ground)

Accelerator pedal position sensor 2

EFFECT FAULT HAS ON SYSTEM

System works in “TURTLE” mode

TEST PROCEDURE

Turn power switch ON. Check the APP sensor power voltage between VCM pin 97 (PWR) and pin 122 (GND). Actual value 4,5 – 5,5 V.

Check the sensor signal between VCM pin 122 (GND) and pin 108 (SIG). Actual value fully released 0,3 – 0,45 V. Actual value fully depressed 1,95 – 2,4 V.

FAULT 7

DTC P1557

ACTUAL FAULT

Open circuit between VCM pin 107 and Battery temperature sensor pin 3

DTC DESCRIPTION

P1557 – Battery temperature sensor

FAULT SET CONDITION

Signal voltage from Battery temperature sensor remains 4,84 V or more for 5 seconds

POSSIBLE CAUSES

Harness or connectors (Battery current sensor circuit is open or shorted)

Battery current sensor

EFFECT FAULT HAS ON SYSTEM

DTC stored in EV system memory

TEST PROCEDURE

Turn power switch ON. Check the voltage between VCM pin 107 and pin 96 (PWR). Actual value 0,5 – 4,5 V temperature dependent.

FAULT 8

DTC P31E0

ACTUAL FAULT

Open circuit between VCM pin 73 and PDM pin 12

DTC DESCRIPTION

P31E0 – High voltage circuit interlock error

FAULT SET CONDITION

The connection detecting circuit is used to detect the connection status of the PDM (Power Delivery Module) cover and the bus bar cover of PDM.

VCM detects an excessively low voltage of the connection detecting circuit for 2,5 seconds during READY.

VCM detects an excessively low voltage of the connection detecting circuit for 0,5 seconds during power switch ON.

POSSIBLE CAUSES

Harness or connectors (Connection detection circuit is open or shorted)

PDM (Power Delivery Module)

EFFECT FAULT HAS ON SYSTEM

DTC stored in EV system memory

After re-turn power switch to ON, the system works in “TURTLE” mode.

TEST PROCEDURE

Turn power switch ON. Check the voltage between VCM pin 73 and pin 72. Actual value 3 – 7 V.

FAULT 9

DTC P0A3F

ACTUAL FAULT

Open circuit between Traction motor inverter pin 19 and traction motor pin 5

DTC DESCRIPTION

P0A3F – Drive motor A position sensor

P1895 – Motor speed

P317A – Motor system

P316A – Motor speed

P3178 – ECU activation error

FAULT SET CONDITION

If there is an abnormality in the traction motor resolver detection circuit

POSSIBLE CAUSES

Harness or connectors (Each circuit is open or shorted)

Traction motor

Traction motor inverter

EFFECT FAULT HAS ON SYSTEM

Stops drive control of traction motor

Display shows “T/M system malfunction. Visit dealer”.

TEST PROCEDURE

Check resistance between Traction motor inverter pin 19 and Traction motor pin 5. Actual value 1 Ω or less.

Check resistance between Traction motor inverter pin 27 and Traction motor pin 2. Actual value 1 Ω or less.

Check resistance between Traction motor inverter pin 20 and Traction motor pin 1. Actual value 1 Ω or less.

Check resistance between Traction motor inverter pin 21 and Traction motor pin 8. Actual value 1 Ω or less.

Check resistance between Traction motor inverter pin 18 and Traction motor pin 7. Actual value 1 Ω or less.

Check resistance between Traction motor inverter pin 17 and Traction motor pin 6. Actual value 1 Ω or less.

NOTE

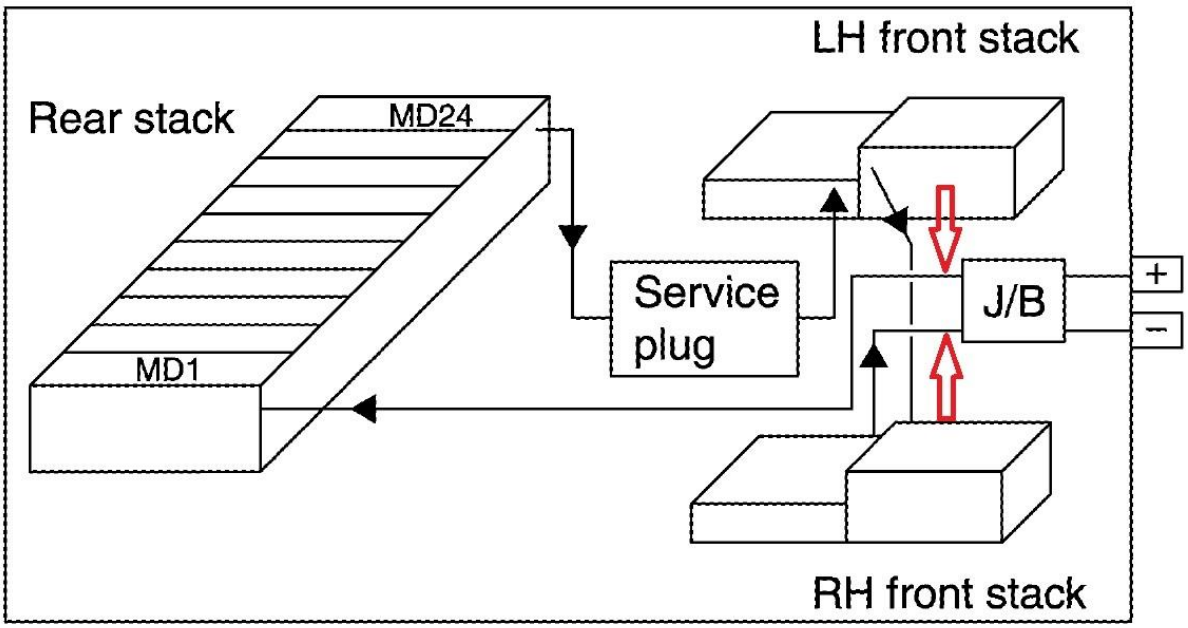
When EV system starts up, Li-ion battery or traction motor inverter does not permit EV system activation

FAULT 10
DTC P3171
ACTUAL FAULT
Open circuit between PDM pin 29 and Normal charge port pin 2
DTC DESCRIPTION
P3170 – Power delivery module system
P3171 – Power delivery module system
P316C – Power delivery module system
P316E – Power delivery module system
B29A0 – N/CHG port engagement error
FAULT SET CONDITION
VCM receives a DTC detection signal from PDM (Power Delivery Module)
POSSIBLE CAUSES
Harness or connectors (Normal charge port circuit is open or shorted)
Normal charge port
EVSE
PDM (Power Delivery Module)
EFFECT FAULT HAS ON SYSTEM
System works in “TURTLE” module
Charging HV battery not possible
TEST PROCEDURE
Check the resistance between PDM pin 29 and normal charge port pin 2.
Actual value 1 Ω or less.

5. HIGH VOLTAGE MEASUREMENT

1. Measurement of the total voltage of a high-voltage battery.

1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Disconnect the negative terminal of the 12V batteries.
4. Wait 10 minutes or more.
5. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
6. Remove the protective battery cover of the high-voltage batteries.
7. Set the measuring instruments for the continuous 1000 V voltage measurement mode.
8. Take the measurement.
9. Cover the battery of high-voltage batteries with a protective cover.
10. Connect the negative terminal of the 12V battery.

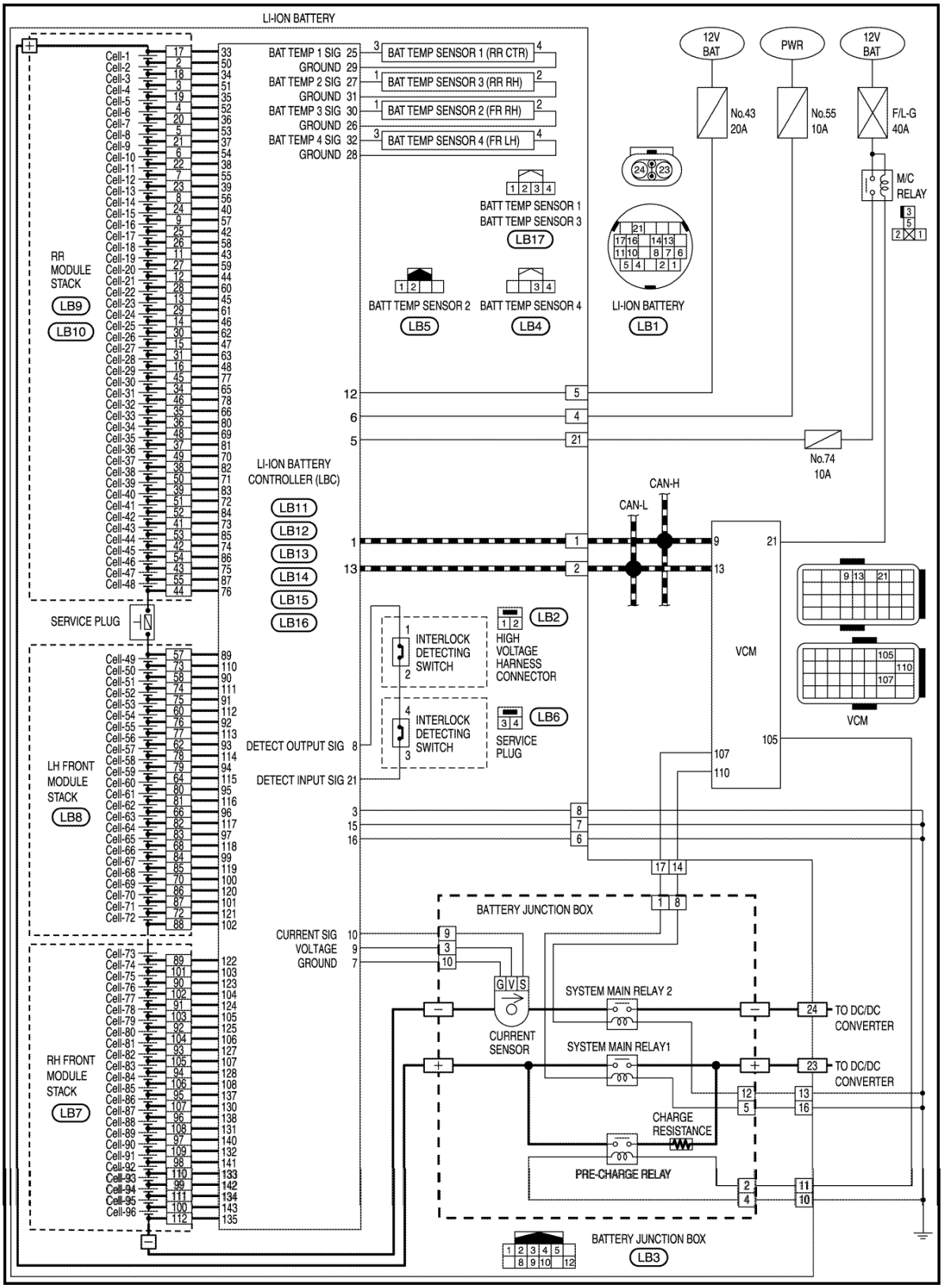


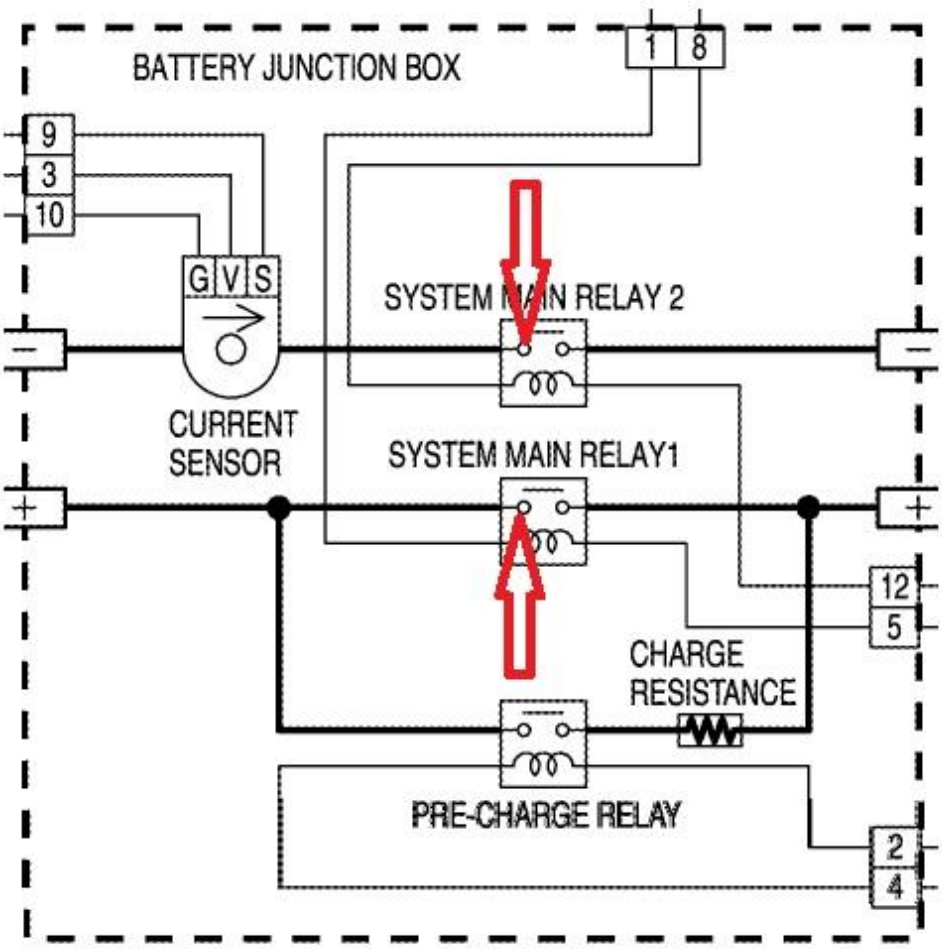
The measurement points are marked with red arrows.

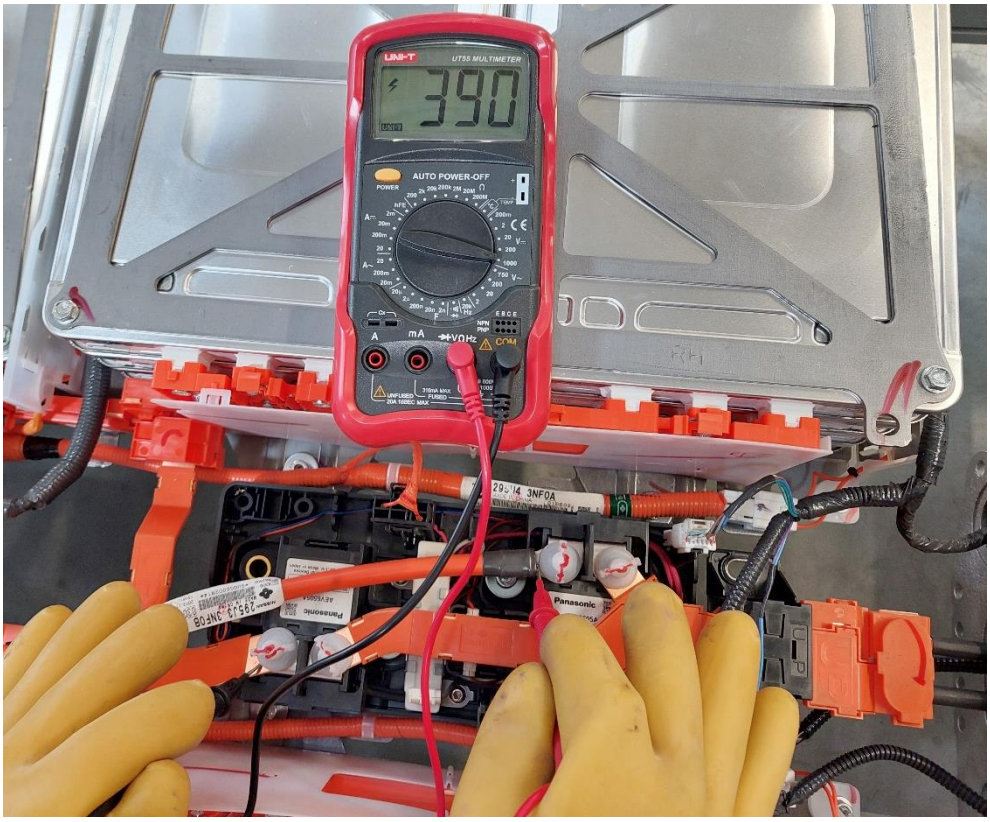
Note:

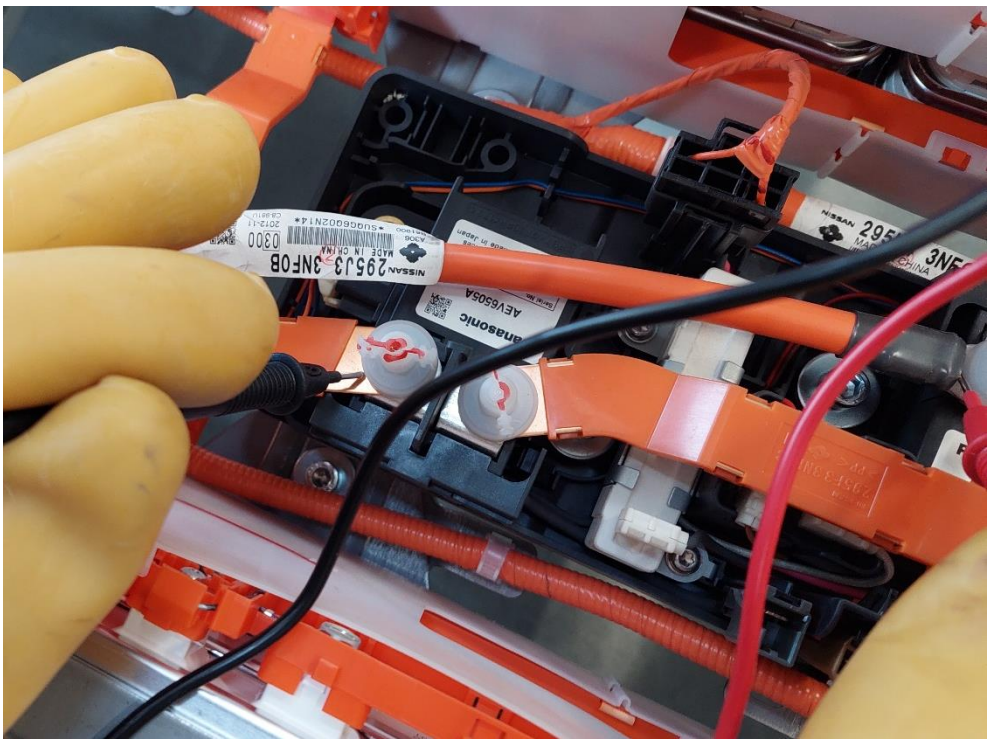
As the high voltage cables are insulated, measurements can be made by opening the battery junction box.

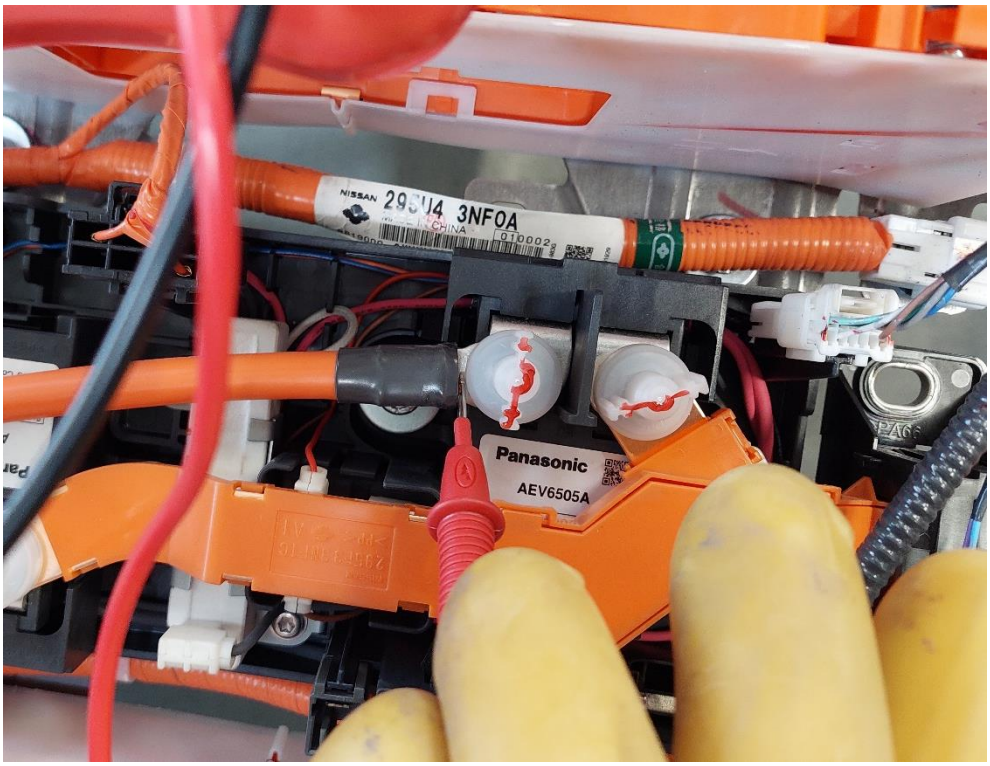
The measurement is made in the battery connection box on the relay contacts on the battery side.


LI-ION BATTERY
RR MODULE STACK
LB9
LB10
LH FRONT MODULE STACK
LB8
RH FRONT MODULE STACK
LB7
SERVICE PLUG
BAT TEMP 1 SIG
GROUND
BAT TEMP 2 SIG
GROUND
BAT TEMP 3 SIG
GROUND
BAT TEMP 4 SIG
GROUND
BAT TEMP SENSOR 1 (RR CTR)
BAT TEMP SENSOR 3 (RR RH)
BAT TEMP SENSOR 2 (FR RH)
BAT TEMP SENSOR 4 (FR LH)
BATT TEMP SENSOR 1
BATT TEMP SENSOR 3
LB17
BATT TEMP SENSOR 2
LB5
BATT TEMP SENSOR 4
LB4
LI-ION BATTERY
LB1
12V BAT
PWR
12V BAT
No.43 20A
No.55 10A
F/L-G 40A
M/C RELAY
No.74 10A
LI-ION BATTERY CONTROLLER (LBC)
LB11
LB12
LB13
LB14
LB15
LB16
CAN-H
CAN-L
VCM
INTERLOCK DETECTING SWITCH
INTERLOCK DETECTING SWITCH
HIGH VOLTAGE HARNESS CONNECTOR
LB2
SERVICE PLUG
LB6
DETECT OUTPUT SIG
DETECT INPUT SIG
CURRENT SIG
VOLTAGE
GROUND
BATTERY JUNCTION BOX
SYSTEM MAIN RELAY 2
SYSTEM MAIN RELAY1
CURRENT SENSOR
TO DC/DC CONVERTER
TO DC/DC CONVERTER
CHARGE RESISTANCE
PRE-CHARGE RELAY
BATTERY JUNCTION BOX
LB3


BATTERY JUNCTION BOX
1
8
9
3
10
G
V
S
SYSTEM MAIN RELAY 2
CURRENT SENSOR
SYSTEM MAIN RELAY1
12
5
CHARGE RESISTANCE
PRE-CHARGE RELAY
2
4

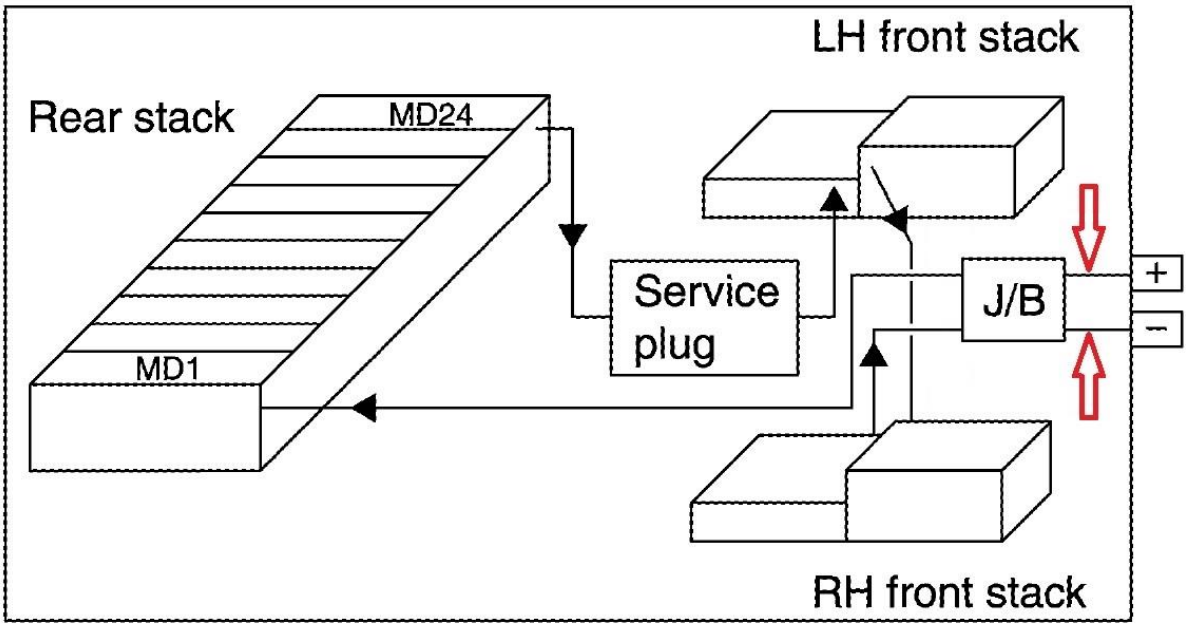

UNI-T
UT55 MULTIMETER
390
AUTO POWER-OFF
Panasonic


NISSAN 295J3 3NF0B
MADE IN CHINA
AEV6505A


NISSAN 295U4 3NF0A
CHINA
Panasonic
AEV6505A

2. High voltage measurement behind the Battery Junction Box

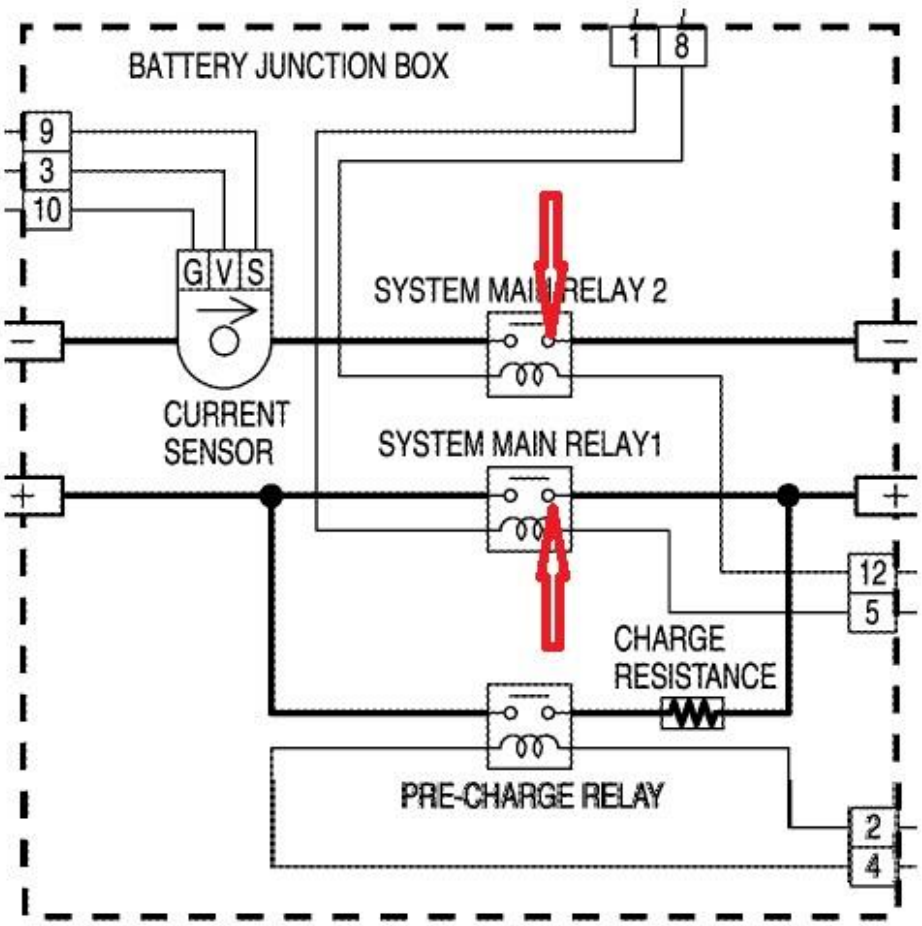
1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Wait 10 minutes or more.
4. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
5. Remove the protective battery cover of the high-voltage batteries.
6. Set the measuring instruments for the continuous 1000 V voltage measurement mode.
7. Take the measurement (1).
8. Unlock the STOP switch.
9. Turn ON the POWER switch. READY mode must be activated.
10. Take the measurement (2).
11. Turn OFF the POWER switch.
12. Press the STOP switch.
13. Cover the battery of high-voltage batteries with a protective cover.

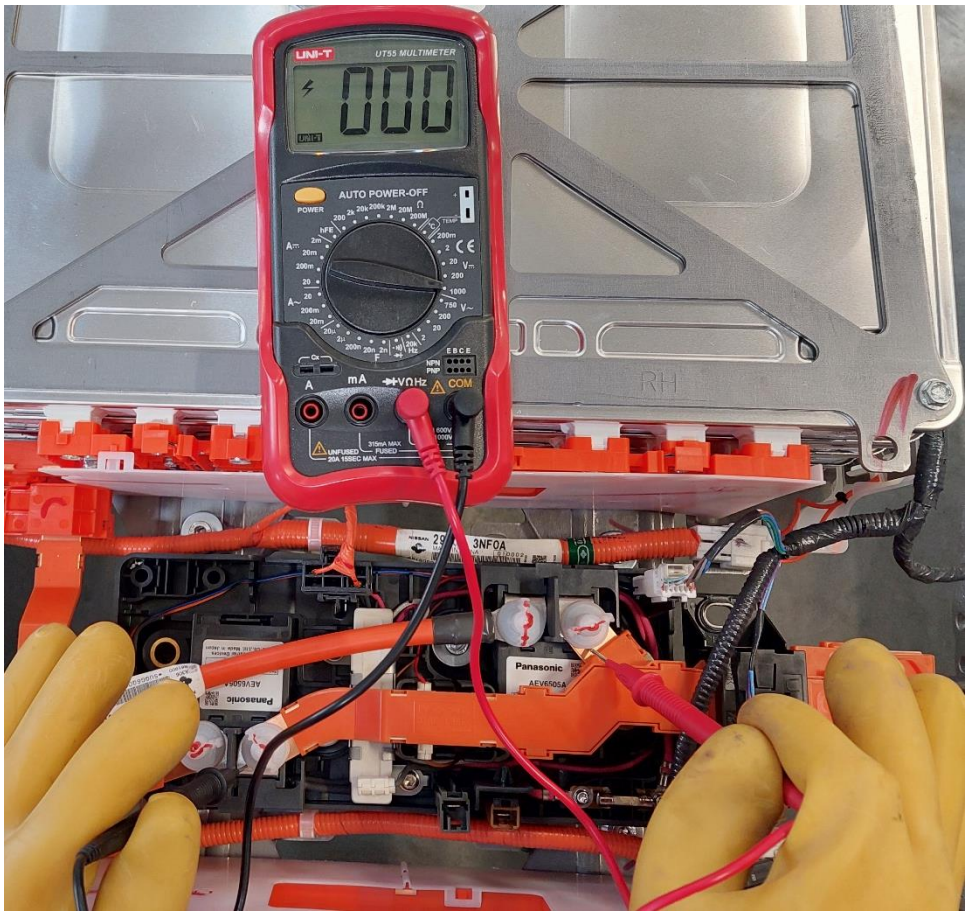


Note:

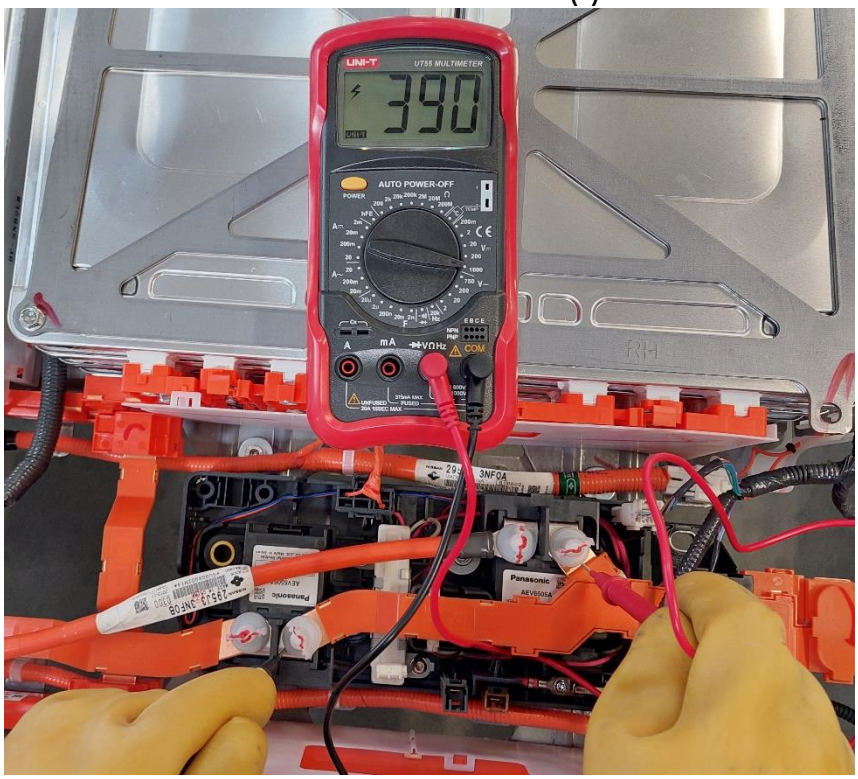
As the high voltage cables are insulated, measurements can be made by opening the battery junction box.

The measurement is made in the battery connection box on the relay contacts on the opposite side of the battery.


BATTERY JUNCTION BOX
1
8
9
3
10
G
V
S
SYSTEM MAIN RELAY 2
CURRENT SENSOR
SYSTEM MAIN RELAY1
12
5
CHARGE RESISTANCE
PRE-CHARGE RELAY
2
4


UNI-T
UT55 MULTIMETER
000
AUTO POWER-OFF
POWER
COM
Panasonic

The measurement (1)



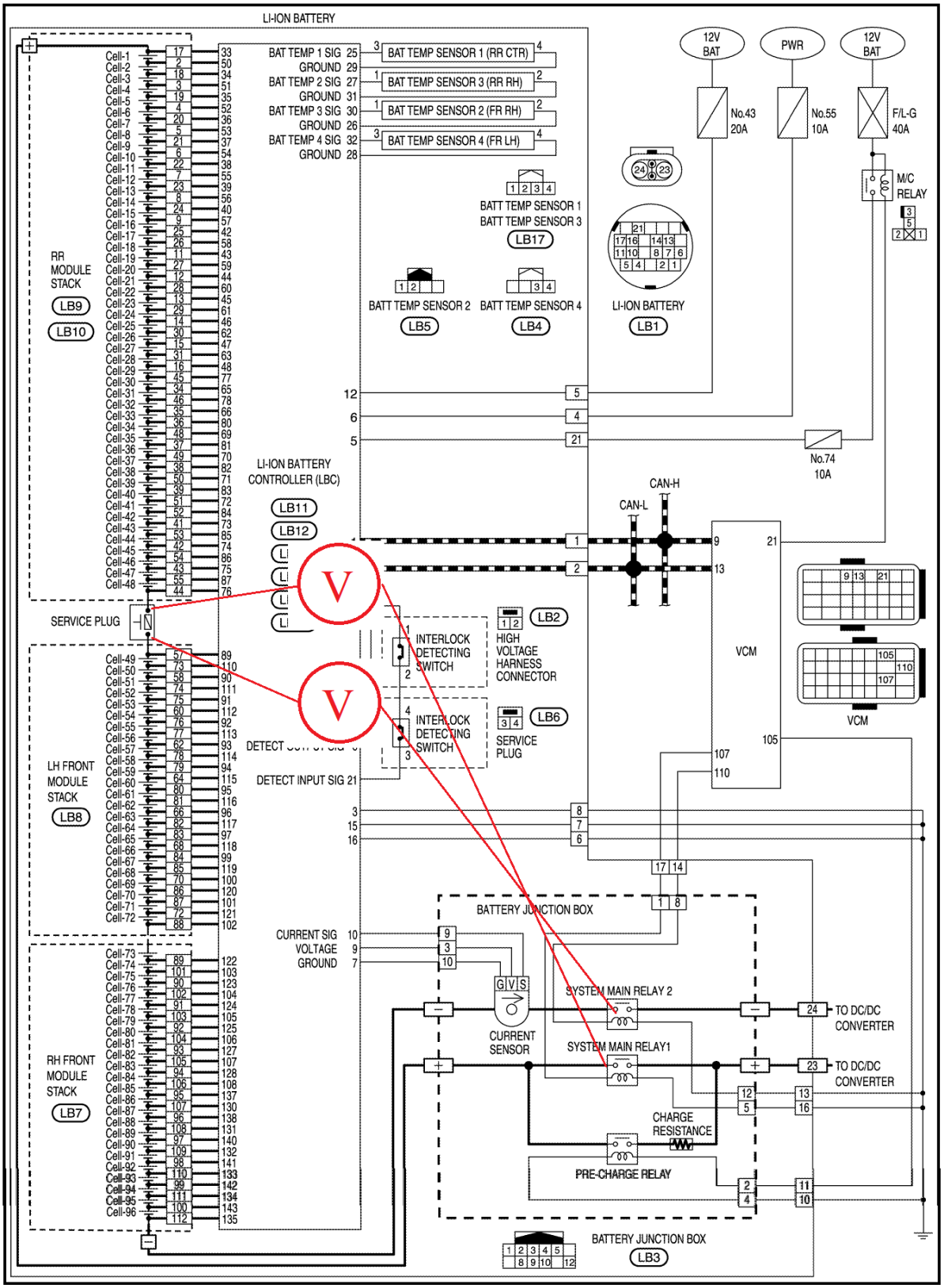
The measurement (2)

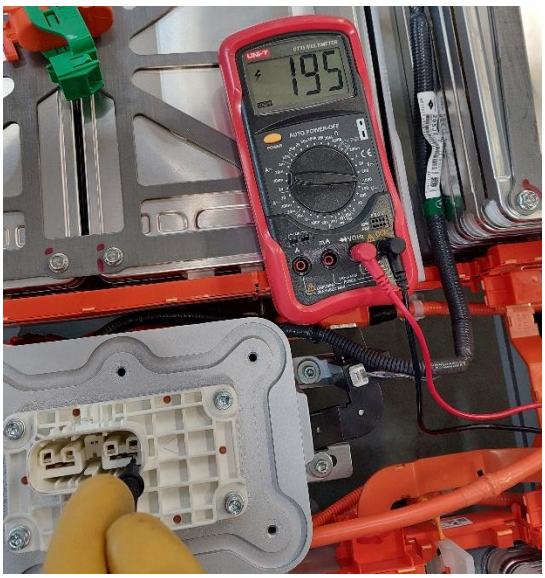
0 V behind the relay when READY is NOT ON.

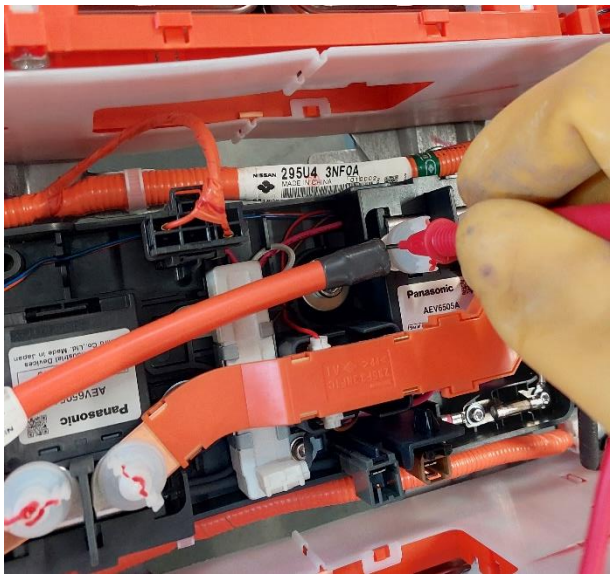
When READY is ON, the voltage across the relays is ~ 400V.

3. Voltage measurement of half of the battery of high voltage batteries

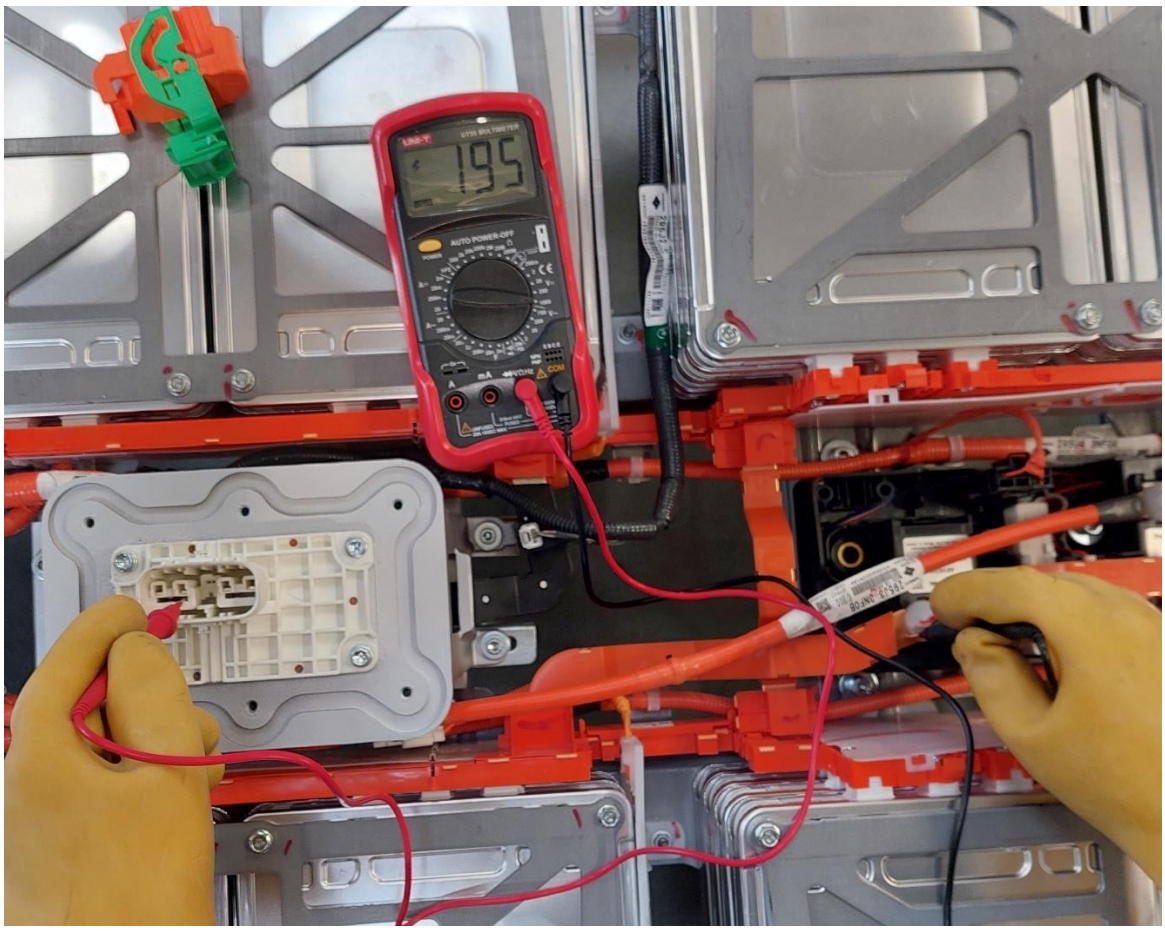
1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Disconnect the negative terminal of the 12V batteries.
4. Wait 10 minutes or more.
5. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
6. Remove the service plug.
7. Remove the protective battery cover of the high-voltage batteries.
8. Set the measuring instruments for the continuous 1000 V voltage measurement mode.
9. Take the measurement (1).
10. Take the measurement (2).
11. Cover the battery of high-voltage batteries with a protective cover.
12. Put in the service plug.
13. Connect the negative terminal of the 12V battery.


LI-ION BATTERY
RR MODULE STACK
LB9
LB10
LH FRONT MODULE STACK
LB8
RH FRONT MODULE STACK
LB7
SERVICE PLUG
LI-ION BATTERY CONTROLLER (LBC)
LB11
LB12
BAT TEMP 1 SIG
GROUND
BAT TEMP 2 SIG
GROUND
BAT TEMP 3 SIG
GROUND
BAT TEMP 4 SIG
GROUND
BAT TEMP SENSOR 1 (RR CTR)
BAT TEMP SENSOR 3 (RR RH)
BAT TEMP SENSOR 2 (FR RH)
BAT TEMP SENSOR 4 (FR LH)
BATT TEMP SENSOR 1
BATT TEMP SENSOR 3
LB17
BATT TEMP SENSOR 2
LB5
BATT TEMP SENSOR 4
LB4
LI-ION BATTERY
LB1
12V BAT
PWR
12V BAT
No.43 20A
No.55 10A
F/L-G 40A
M/C RELAY
No.74 10A
CAN-H
CAN-L
VCM
INTERLOCK DETECTING SWITCH
INTERLOCK DETECTING SWITCH
HIGH VOLTAGE HARNESS CONNECTOR
LB2
SERVICE PLUG
LB6
DETECT INPUT SIG 21
CURRENT SIG
VOLTAGE
GROUND
BATTERY JUNCTION BOX
CURRENT SENSOR
SYSTEM MAIN RELAY 2
SYSTEM MAIN RELAY1
TO DC/DC CONVERTER
TO DC/DC CONVERTER
CHARGE RESISTANCE
PRE-CHARGE RELAY
BATTERY JUNCTION BOX
LB3





The measurement (1)

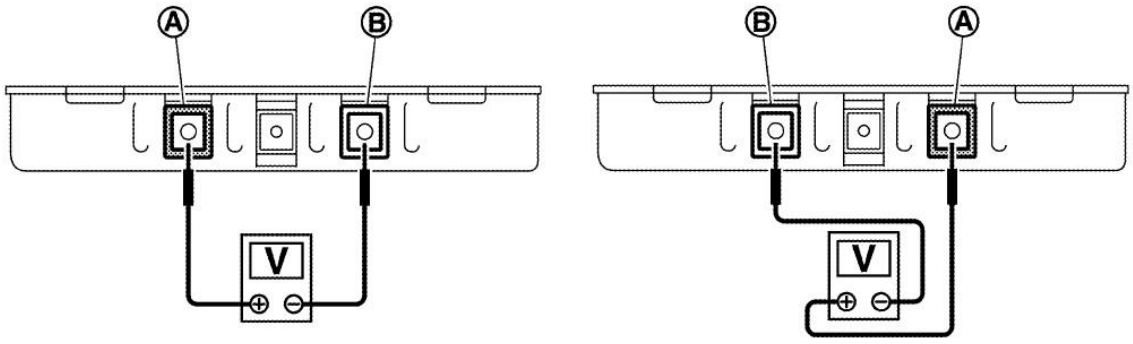


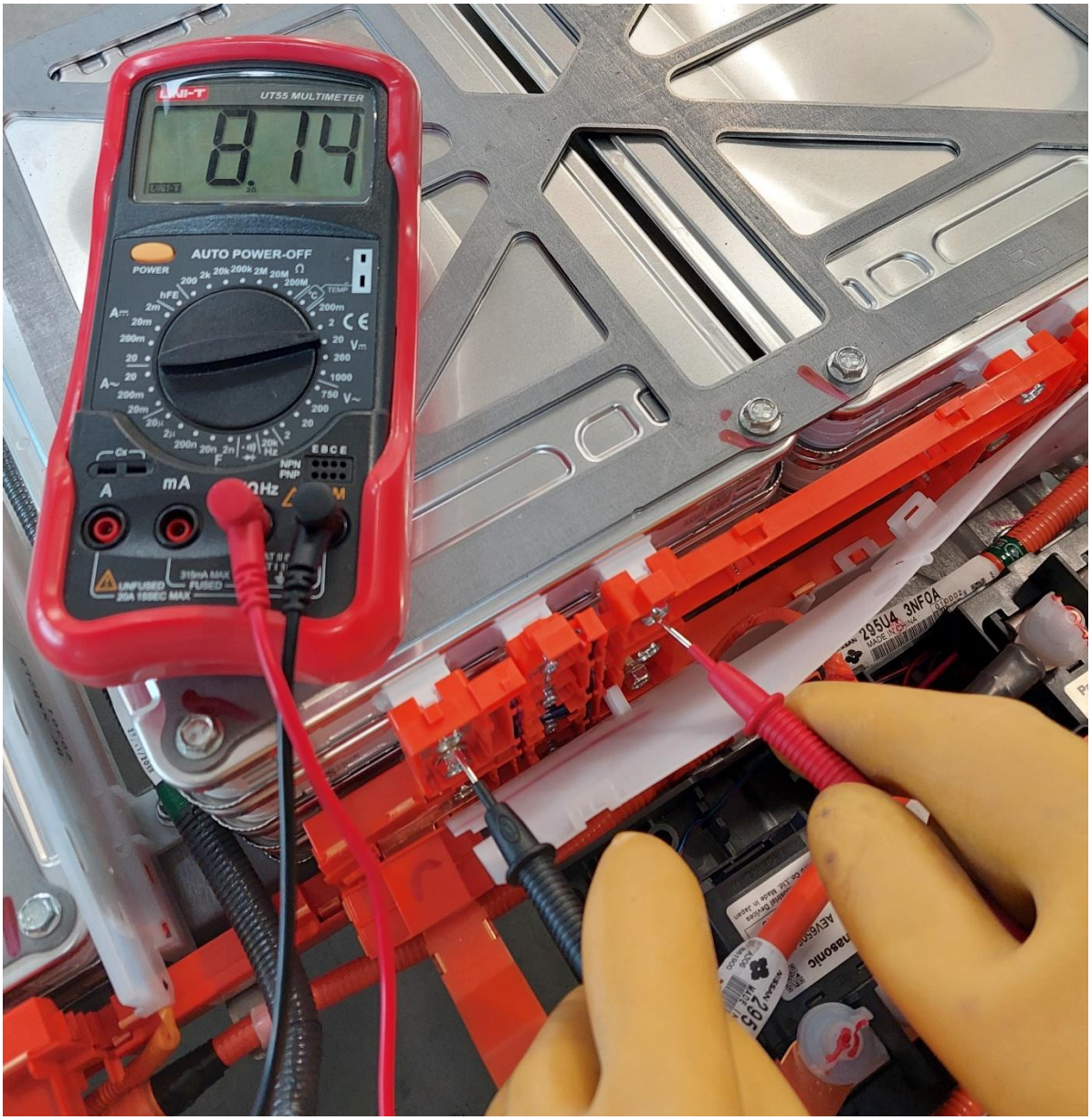
The measurement (2)

4. Measurement of cell voltage

1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Disconnect the negative terminal of the 12V batteries.
4. Wait 10 minutes or more.
5. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
6. Remove the service plug.
7. Remove the protective battery cover of the high-voltage batteries.
8. Set the measuring instruments for the continuous 20 V voltage measurement mode.
9. Pull back the white cell cover a little
10. Take the measurement.
11. Put back the white cell cover.
12. Cover the battery of high-voltage batteries with a protective cover.
13. Put in the service plug.
14. Connect the negative terminal of the 12V battery.

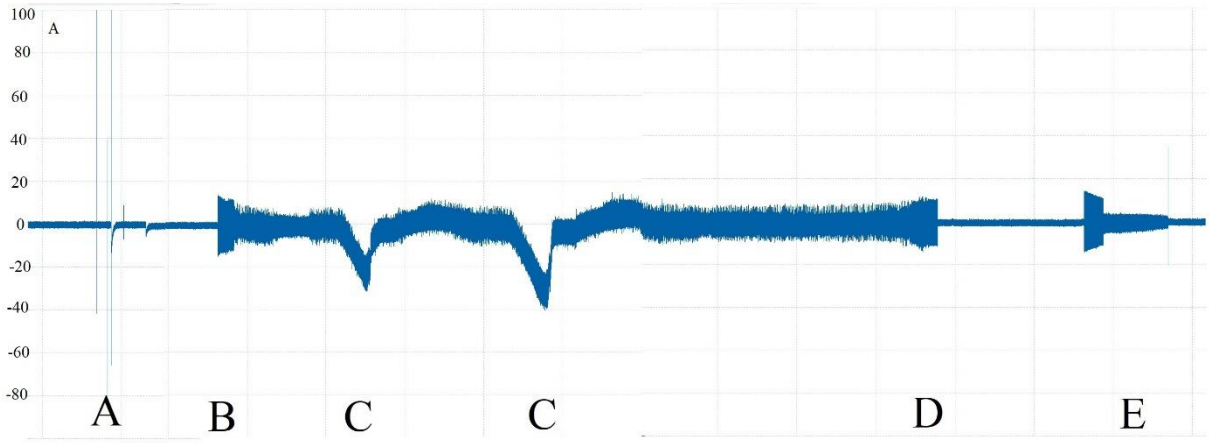
Terminals		Voltage (Approx.)
(+)	(-)	
Module		
+ terminal (Red)	- terminal (Black)	5.0 - 8.5 V




UT55 MULTIMETER
814
AUTO POWER-OFF
POWER
mA
A
29504 3NF0A

5. Current measurement

1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
4. Remove the protective battery cover of the high-voltage batteries.
5. Place the clamp meter on one of the high voltage wires.
6. Take the measurement (Note: If the READY mode is not enabled, the current must be O A).
7. Turn On the POWER switch. READY mode can be activated.
8. Perform a measurement during which you switch on the driving mode. press the accelerator and so on.
9. Turn OFF the POWER switch.
10. Press the STOP switch.
11. Remove the clamp meter.
12. Cover the battery of high-voltage batteries with a protective cover.

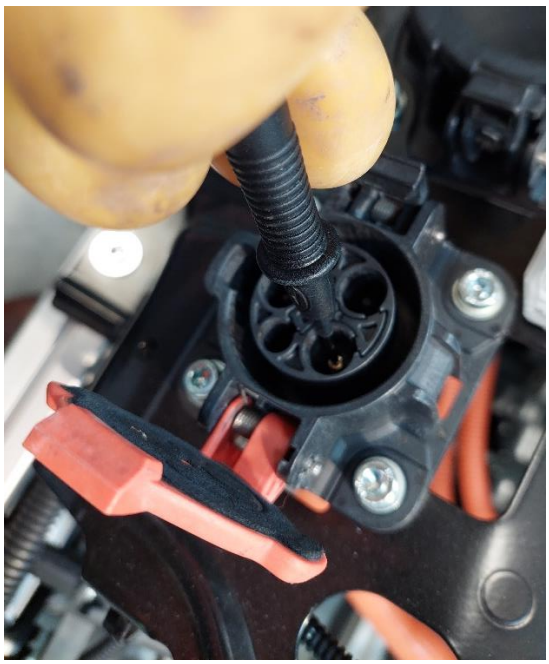


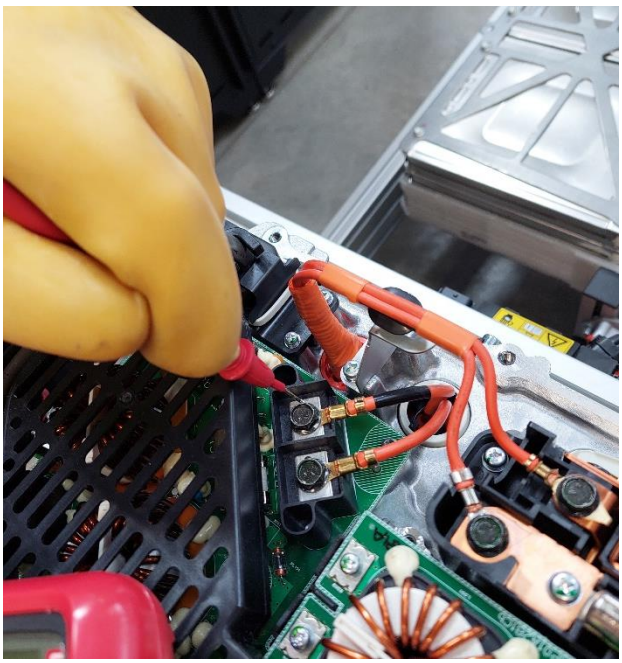
A – Ignition ON
B – Turning on the direction of travel
C – Pressing the accelerator
D – P position activation
E – Ignition OFF

Note:
In the example image above, the measurements were made using a 600 A clamp meter. Pliers of smaller denomination (> 100 A) of clamp meter can also be used.

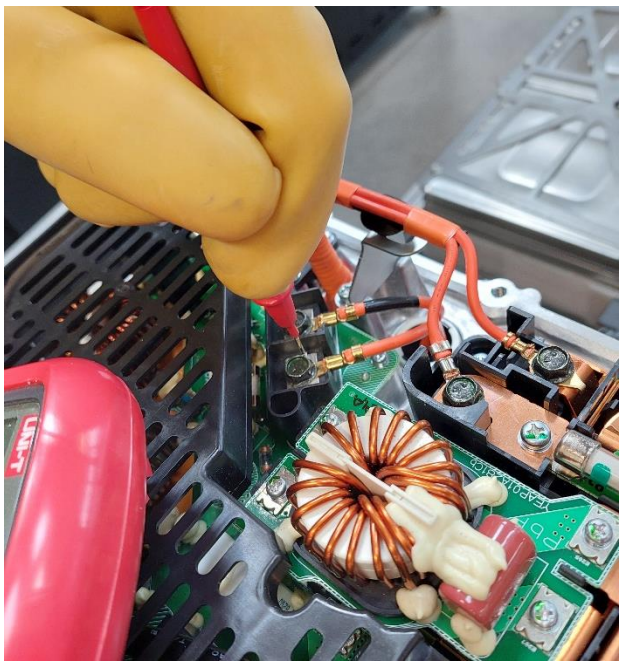
6. Checking for a normal charging cable

1. Turn OFF the POWER switch.
2. Press the STOP switch.
3. Disconnect the negative terminal of the 12V batteries.
4. Wait 10 minutes or more.
5. Take care and prepare personal protective equipment (Yes, as described in the safety instructions).
6. Remove the service plug.
7. Remove the protective inverter cover.
8. Open the normal charging port cover.
9. Set the measuring instruments for the Continuity Beeper measurement mode.
10. Measure the first wire circuit.
11. Measure the second wire circuit.
12. Close the normal charging port cover.
13. Close the protective inverter cover.
14. Put in the service plug.
15. Connect the negative terminal of the 12V battery.





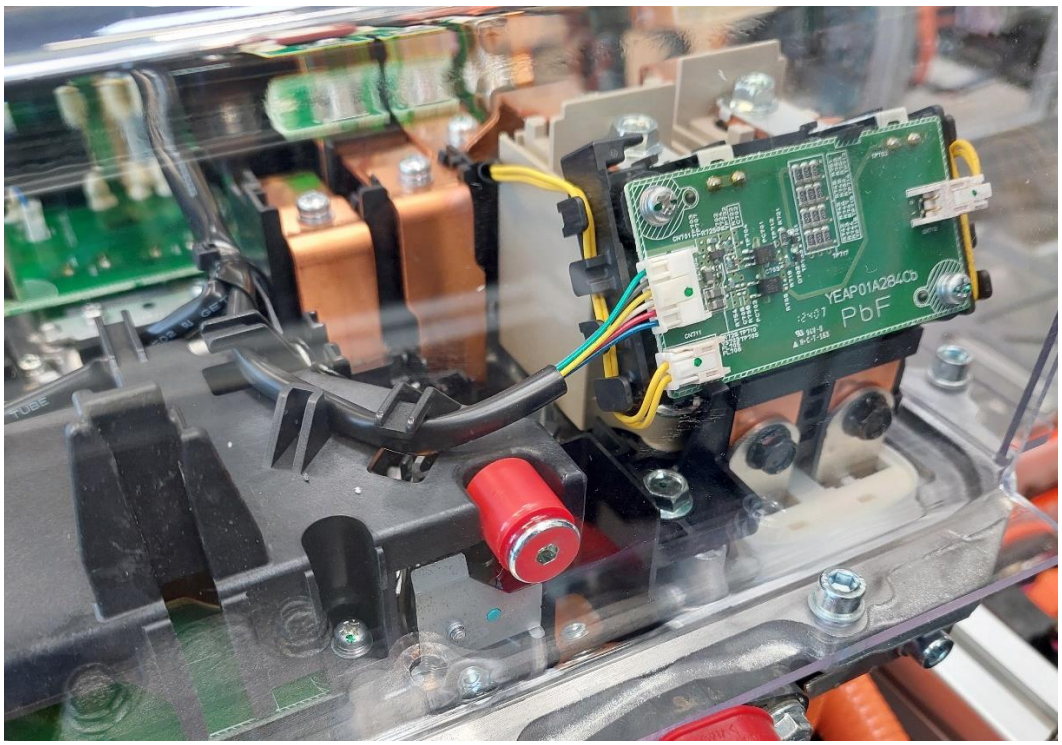
Measure the first wire circuit.



Measure the second wire circuit.

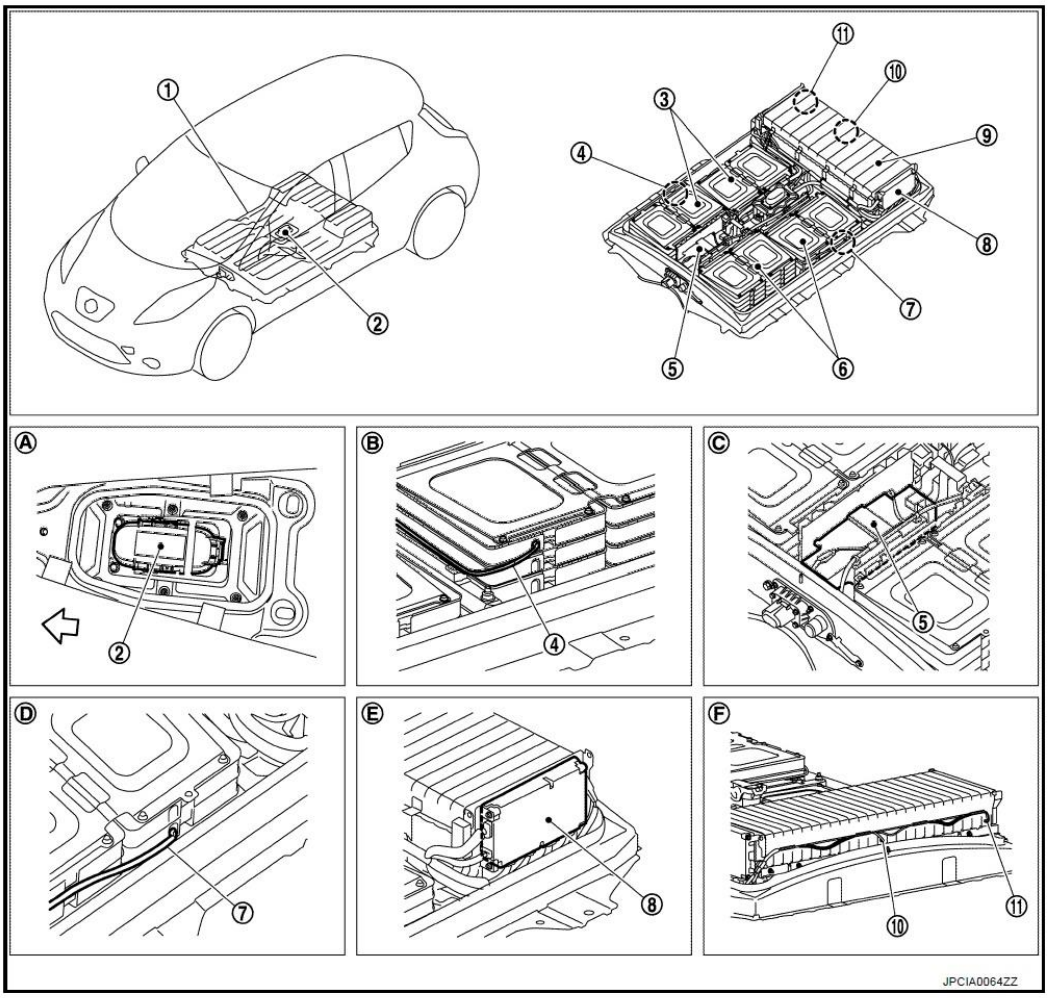
Note:

When you removing the protective inverter cover, pay attention to where this red detail is located. After removing the protective inverter cover, the interlock is turned off. When placing the protective inverter cover, it must press down the micro-connect. Without the protective inverter cover stand does not work.



6. COMPONENTS

High voltage battery



High voltage battery structure

A. Center of rear seat legroom. B. Center of battery pack right side. C. Center of battery pack front side. D. Center of battery pack left side. E. Back of battery pack left side. F. Back of battery pack.

⇦ : Vehicle front

Component

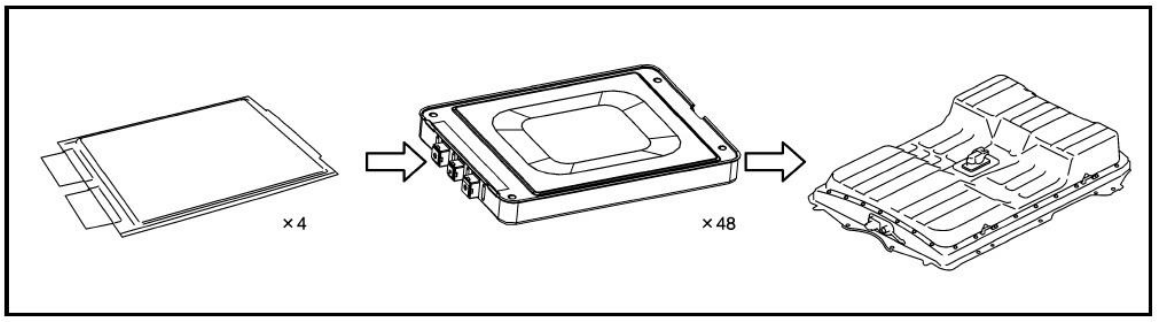
1. Li-ion battery
2. Service plug
3. Front module stack RH
4. Battery temperature sensor (Front RH)
5. Battery junction box
6. Front module stack LH
7. Battery temperature sensor (Front LH)
8. Li-ion battery controller
9. Rear module stack
10. Battery temperature sensor (Rear center)
11. Battery temperature sensor (Rear RH)

Li-ion battery

A Li-ion battery with flat construction is placed under floor.

The battery pack is equipped with necessary devices, such as Li-ion battery controller, battery junction box, and service plug in addition to a battery storing electricity.

Four cells are integrated into a single module. The Li-ion battery consists of forty-eight modules placed in series.

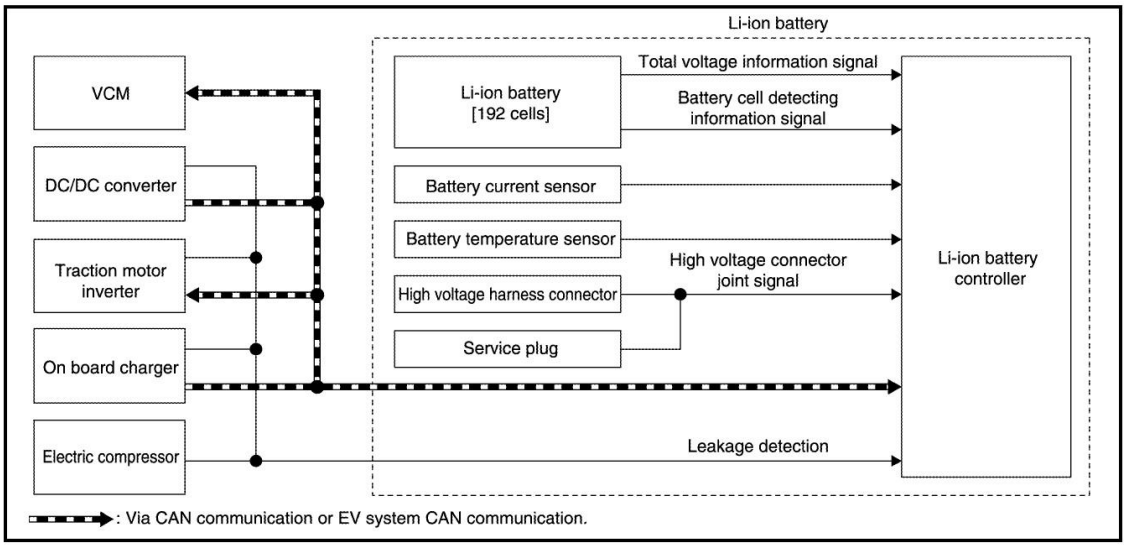


Battery components

Li-ion battery controller

Li-ion battery controller (LBC) is included in the battery pack and installed on the left surface of the rear module stack.

The Li-ion battery controller is the core of battery control. This Li-ion battery controller detects the voltage and current of the assembled battery, the temperature of each module, and the voltage of each cell to judge SOC (state of charge) and calculates possible input/output values, meter indication value, and chargeable value to send these data to VCM (vehicle control module). VCM controls the vehicle, according to the battery state.



System diagram

Main Role of Li-ion Battery Controller

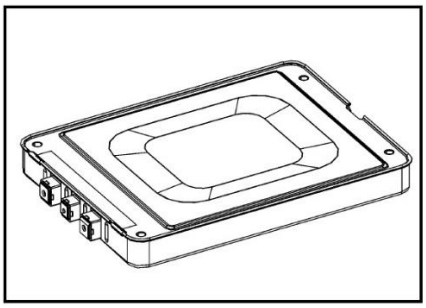
1. Li-ion battery state check
   - SOC (state of charge)
   - Possible output value
   - Possible input value
   - Temperature

2. Optimization of Li-ion battery voltage
3. Prevention of overvoltage and overcurrent
4. Prevention of overheat
5. Detection of decrease in insulation resistance of high-voltage circuit
6. Detection of a fit of high voltage harness connector and service plug

Module

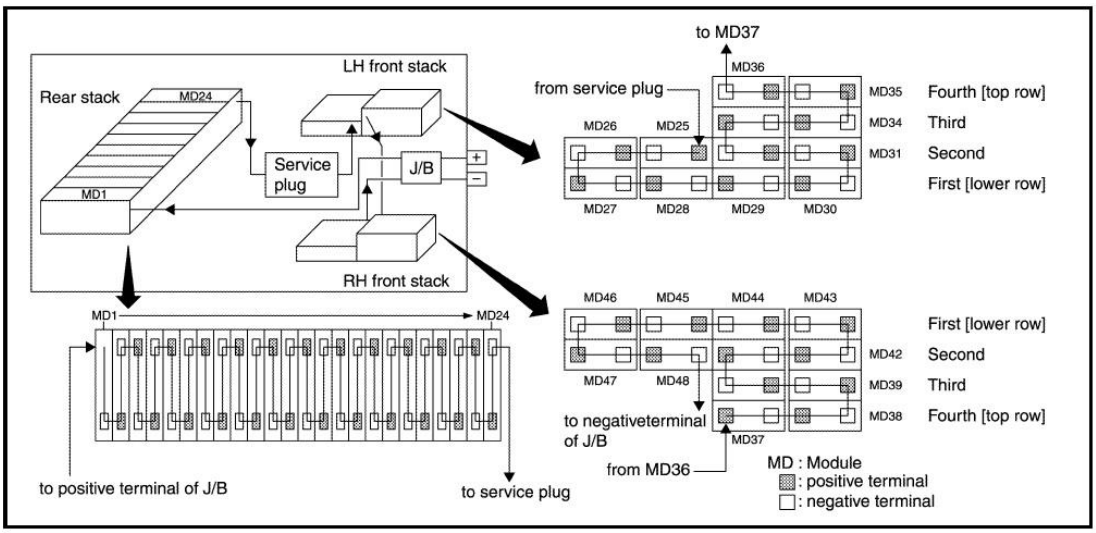
- Four laminated cells are integrated into one module.
- The Li-ion battery is equipped with forty-eight modules.
- There are two kinds of modules, according to the location of positive and negative terminals.

  Positive terminal: Red
  Negative terminal: Black



Battery module

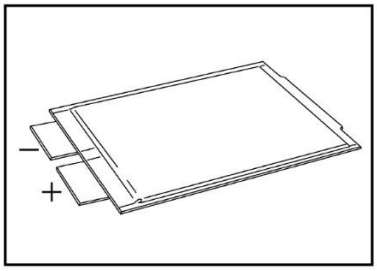
Module layout



Wiring diagram of battery modules

NOTE:
The highest potential is module (MD) 1 and the lowest is module (MD) 48

Cell
These are thin laminated cells with excellent cooling performance.



Cell

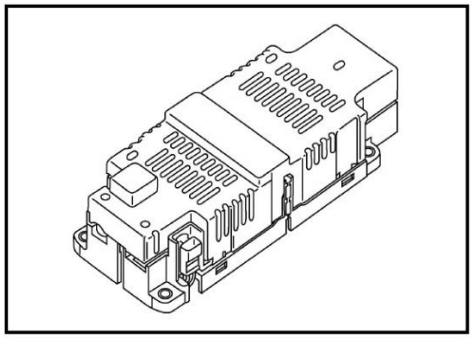
The Features of laminated cell

• Large surface area with excellent cooling performance reduces heat load to the battery and improves battery life.

• The light and thin structure increases the flexibility in layout.

Battery Junction Box

The battery junction box is installed to the front side in the battery pack



Battery Junction Box

The battery junction box includes:

System main relay to provide/cut off DC current sent from Li-ion battery.

Pre-charge relay to protect the high voltage circuit from a high current immediately after power switch ON.

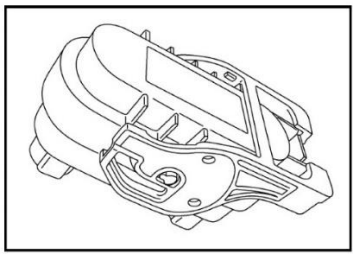
Current sensor to calculate battery capacity.

- Installed to both positive side and negative side, the system main relay provides DC current to each high voltage part. In addition, the system main relay provides DC current to the Li-ion battery during motor regeneration or charge.
- When an error occurs in the system, the system main relay is tuned OFF and the Li-ion battery is shut off to ensure the safety, based on a command from VCM (Vehicle control module).

Service plug

The service plug is included in the Li-ion battery to securely shut off the high voltage during high voltage part inspection and maintenance.

The service plug is installed on the upper surface of the battery pack. The plug can be removed when the legroom-mounted service plug cover is removed.



Service plug

WARNING:

Always use insulating protective equipment when removing and installing service plug

BATTERY PROTECTION

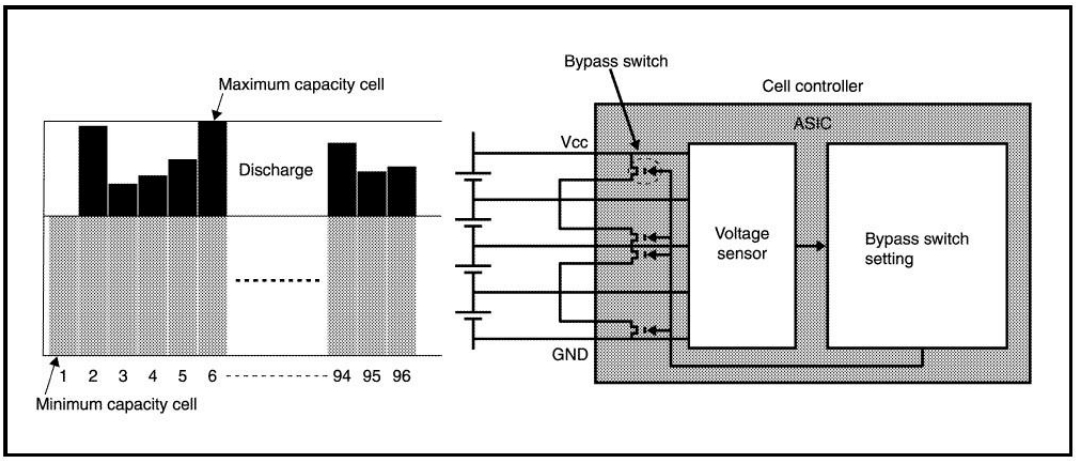
The Li-ion battery has a voltage range capable of charge/discharge. If charged/discharged exceeding the range, excessive low capacity or malfunction may be caused. To prevent this, the Li-ion battery controller detects voltage of each cell and requests the control of charging/discharging energy to VCM so that the cell voltage stays within the voltage range.

Control item	Control	Operating condition
Overvoltage/overcurrent protection	Charging energy control	Gradual control of charging energy as the cell voltage approaches the upper limit of the voltage capable of charging.
	System main relay cut	Cell voltage exceeds the voltage judged as overvoltage and maintains the voltage for more than the specified time.
Over discharge protection	Discharging energy control	Gradual control of discharging energy as the cell voltage approaches the lower limit of the voltage capable of discharging.
	System main relay cut	Cell voltage exceeds the voltage judged as over discharge and maintains the voltage for more than the specified time.
Excessive temperature rise protection	Charging/discharging energy control	Gradual control of charging/discharging energy as a Li-ion battery temperature approaches the upper limit of the temperature capable of use.
	System main relay cut	Li-ion battery temperature exceeds the temperature judged as excessive temperature rise and maintains the temperature for more than the specified time.

HOW TO ADJUST CELL CAPACITY

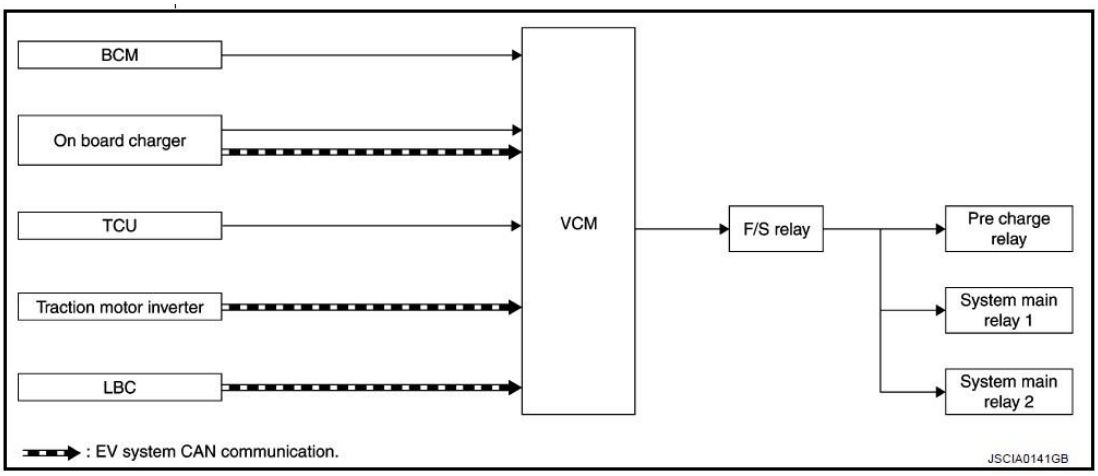
Cell capacity adjustment means the adjustment of cell capacity to a target capacity by estimating the capacity of each cell from the no-load voltage at system

start-up. The voltage of each cell is detected by the Li-ion battery controller and the bypass switch is turned ON to perform the discharge of a cell with the high capacity. Accordingly, the utilization of the capacity of each cell is maximized by adjusting the capacity with the Li-ion battery controller.



Cell capacity adjustment

HIGH VOLTAGE ACTIVATION



High voltage control

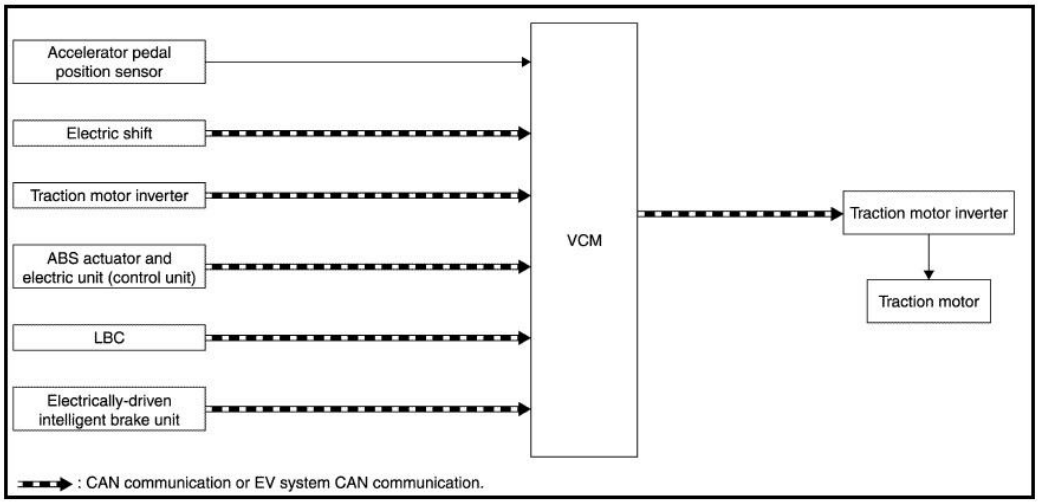
VCM activates system main relay 1, system main relay 2, and the pre-charge relay inside the Li-ion battery to connect the high voltage circuit to the Li-ion battery in response to the READY operation, a driver operation, like connecting the charge connector to the charging port, or VCM timer function.

Moreover, the high voltage circuit of the EV system has a pre-charge circuit to protect the high voltage circuit from sudden application of high voltage current.

To connect the high voltage circuit, VCM first activates the system main relay 2 and precharge relay. As a result, the high voltage power is supplied to the respective systems via the pre-charge resistor in the precharge circuit. When the condenser inside the drive motor inverter is fully charged by the applied power, the drive motor inverter transmits a high voltage power supply preparation completion signal to VCM. Receiving the signal, VCM activates the system main relay 1 and

deactivates the pre-charge relay. Then, normal power is supplied to the respective systems.

MOTOR POWER CONTROL



Traction motor control

The EV system generates traction force by converting the direct current from the Li-ion battery to an alternating current by the traction motor inverter and operating the traction motor with the alternating current.

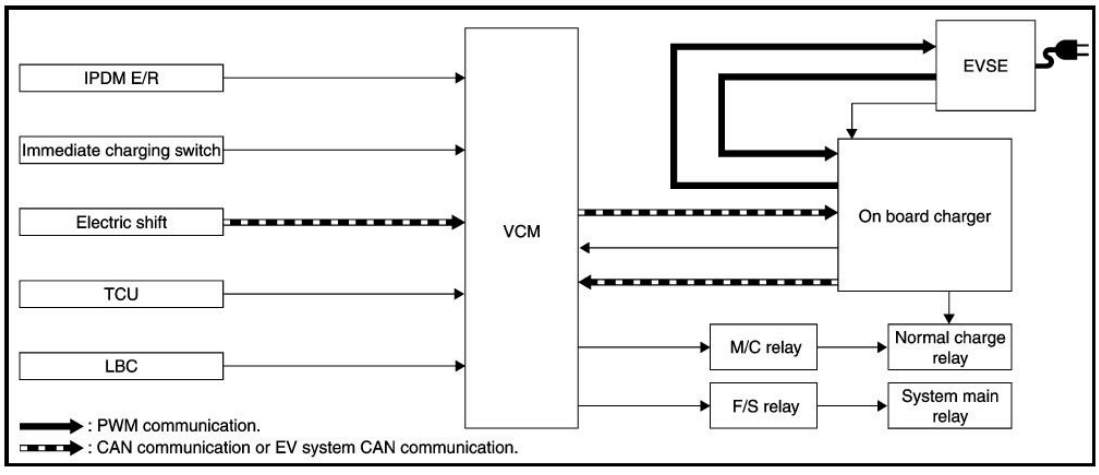
VCM calculates target traction force, based on an accelerator pedal position, vehicle speed, and shift position. After this, VCM adds creep force to the calculated target traction force.

Subsequently, VCM adds torque limitations to the calculated driving force, based on torque down signals received from each system, to decide a motor torque request signal.

This motor torque request signal is transmitted to the traction motor inverter via EV system CAN communication.

LI-ION BATTERY CHARGE CONTROL

When VCM judges that the system is in a charge mode, VCM activates the F/S relay and M/C relay to allow charging operation.



Battery charge control

Then, VCM determine the charge power based on the Li-ion battery chargeable power signal received from the Li-ion battery controller and the on-board charger chargeable power signal received from the on-board charger, and then VCM sends the maximum charge power signal to the on-board charger.

The on-board charger determines a charge power based on the maximum charge power signal and the maximum input current signal sent by the EVSE control box.

Concurrently, the on-board charger activates the normal charge relay and VCM activates the system main relay 1 and system main relay 2. Consequently Li-ion battery charge starts.

IMMEDIATE CHARGE MODE

When EVSE is connected to the normal charge port, the on-board charger transmits an EV system activation signal to VCM. Li-ion battery charge then starts immediately.

When the timer charge is set, Li-ion battery charge does not start just after the on-board charger transmits an EV system activation signal to VCM. When VCM detects an ON signal from the immediate charging switch in that state, VCM judges that the immediate charge mode is selected and starts charging.

When the charge is finished and VCM receives a Li-ion battery charge completion signal from Li-ion battery controller, VCM stops the charge control.

TIMER CHARGE MODE

When the set time comes, VCM starts up automatically and starts charging.

When VCM receives a Li-ion battery charge completion signal from Li-ion battery controller or at a set timer charge finish time, VCM stops the charge control.

NOTE:

When timer charge and the timer air conditioner operate simultaneously, VCM distributes power to the air conditioner system and the charge system according to the priority set on the navigation screen.

REMOTE CHARGE MODE

When TCU transmits an EV system activation signal to VCM, VCM judges that the remote charge mode is selected and starts charge control.

When VCM receives a Li-ion battery charge completion signal from Li-ion battery controller, VCM stops the charge control.

CANCEL CONDITIONS

VCM stops the normal charging when VCM detects the EVSE is disconnected.

In addition, when the following conditions, VCM temporarily stops the normal charging and enters the wait status.

- When the AC voltage and PWM communication from the EVSE are interrupted.
- When the EVSE connector release switch is pressed.
- When the Li-ion battery temperature reaches 60°C (140°F) or higher.

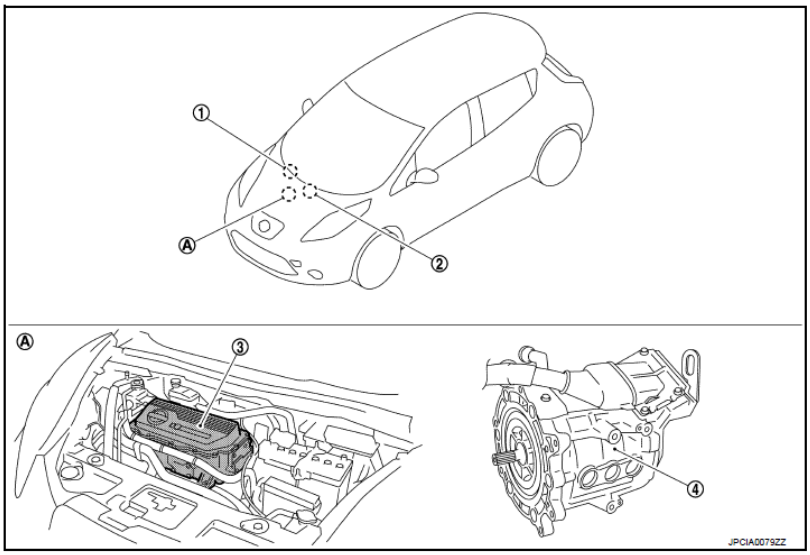
TRACTION MOTOR

The traction motor contains a compact, lightweight, high output, high efficiency “Interior Permanent Magnet Synchronous Motor (IPMSM)”.

The traction motor inverter is a device which converts DC power from the Li-ion battery to AC power, and drives the traction motor. Because the AC power frequency and voltage can be varied when the DC power is converted to AC power, it provides control performance with a high degree of freedom.

Specification

Max torque: 280 Nm
Max output: 80 kW
Max speed: 10390 min^{-1}
Water cooling type



Component description

Nr.	Item	Function
1	VCM	Transmits mainly the following signals to VCM via EV system CAN. - Motor speed signal - Motor torque limit signal - Motor discharge status signal - High voltage power supply preparation completion signal - Input high voltage signal Receives mainly the following signal from VCM via EV system CAN. - Target motor torque signal - Pulse signal OFF signal - High voltage power supply status signal - System cut off signal - Vibration control switching signal - Motor charge preparation request signal - Motor discharge request signal - Regenerative torque command signal - Shift position signal
2	Electric shift control module	Receives mainly the following signal from electric shift control module via EV system CAN. - Shift position signal
3	Traction motor inverter	
4	Traction motor	

Traction motor inverter

NOTE:

Control of the traction motor and control of EV system CAN communications with other control modules is actually performed by the motor controller. However, because the motor controller is installed inside the traction motor inverter, the motor controller is here referred to as the traction motor inverter.

• The traction motor inverter is composed of the motor controller, driver, smoothing condenser, 3 current sensors, and power module.

• The traction motor inverter controls the traction motor based on the target motor torque signal transmitted by EV system CAN from the VCM.

• Traction motor inverter drives traction motor accurately based on resolver detection signal and current sensor detection signal.

• The traction motor inverter performs charging judgment for the high voltage circuit and also discharges the voltage inside the circuit.

• The traction motor inverter performs vibration control in order to improve accelerator response and provide good acceleration while driving.

MOTOR CONTROLLER

• The motor controller receives the rotor rotation angle from the traction motor resolver and the traction motor current value from the current sensor, and creates the pulse signal for driving the IGBT.

• The motor controller detects the traction motor temperature by means of the traction motor temperature sensor, and limits the output torque (protection control) according to the level of heat in the traction motor.

DRIVER

The driver converts the pulse signal (12V) from the motor controller to a high voltage signal (300V) and drives the IGBT.

POWER MODULE

• The power module is composed of 6 power semiconductor IGBT (Insulated Gate Bipolar Transistor).

• An IGBT is a semiconductor switch that is capable of switching ON/OFF at high speed.

• An IGBT uses the IGBT drive signal from the driver to perform switching, converting the Li-ion battery DC power to AC power and supplying AC power to the traction motor.

SMOOTHING CONDENSER

The smoothing condenser controls the voltage ripple which occurs as a result of IGBT switching.

CURRENT SENSORS

One sensor each is installed at the U-phase, V-phase, and W-phase. They detect the current supplied to the traction motor and send the current values as feedback to the motor controller.

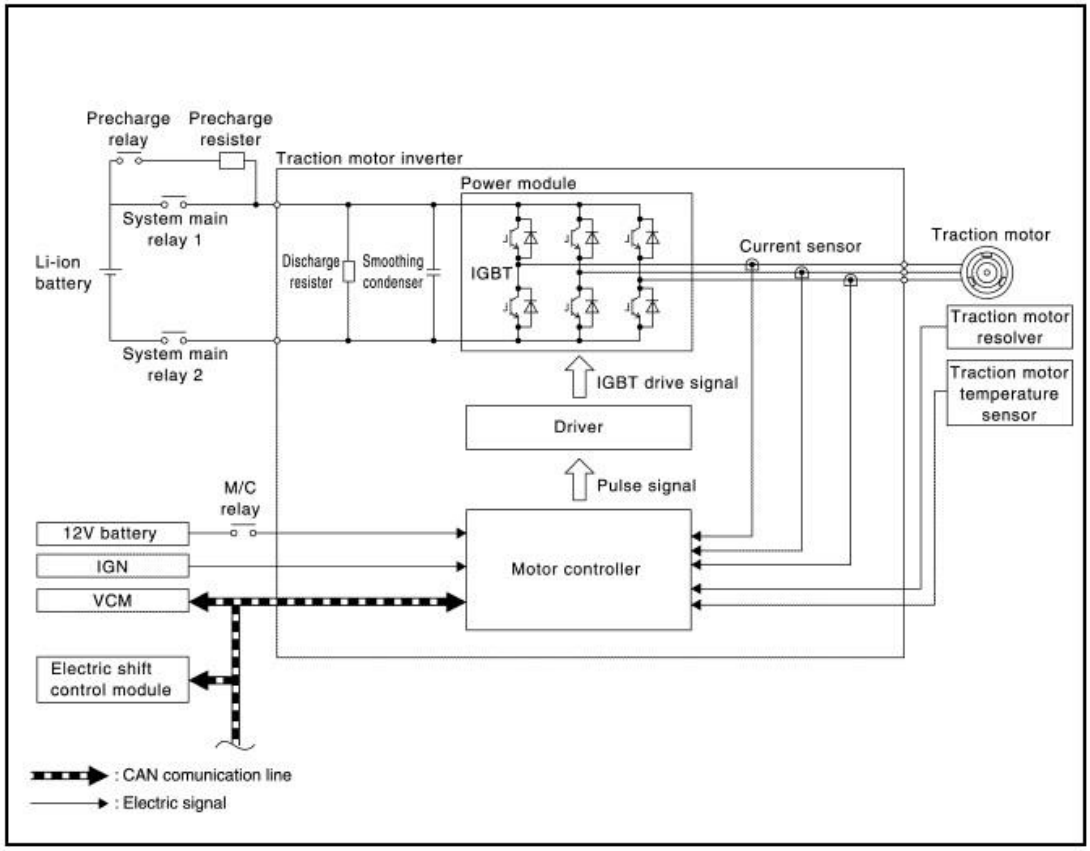
DISCHARGE RESISTER

The discharge resistor discharges the high voltage in case the traction motor inverter is unable to discharge the remaining high voltage in the high voltage circuit due to a malfunction.

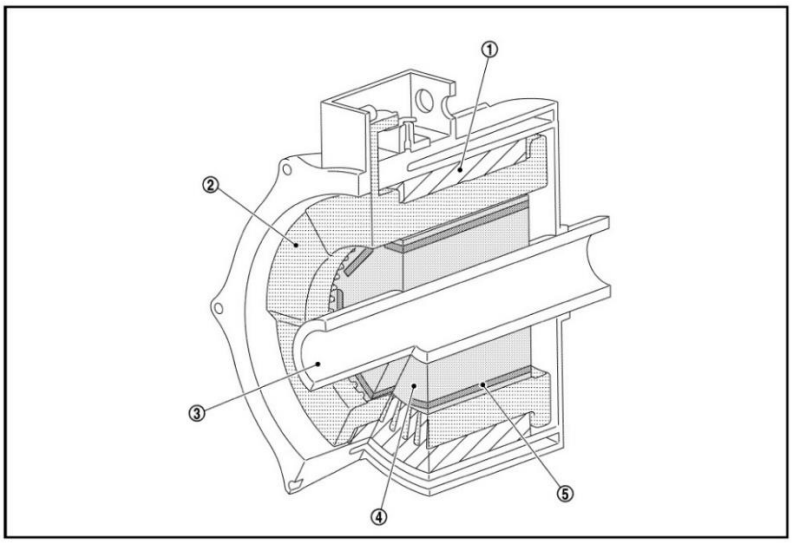
TRACTION MOTOR

• The traction motor contains an “Interior Permanent Magnet Synchronous Motor (IPMSM)”. A permanent magnet is embedded inside the rotor core, and the rotating magnetic field generated by the stator coil is used to generate rotational torque.

• The traction motor is able to generate torque even when the vehicle is stopped, and outputs maximum drive torque when the vehicle starts moving in order to provide good initial acceleration.

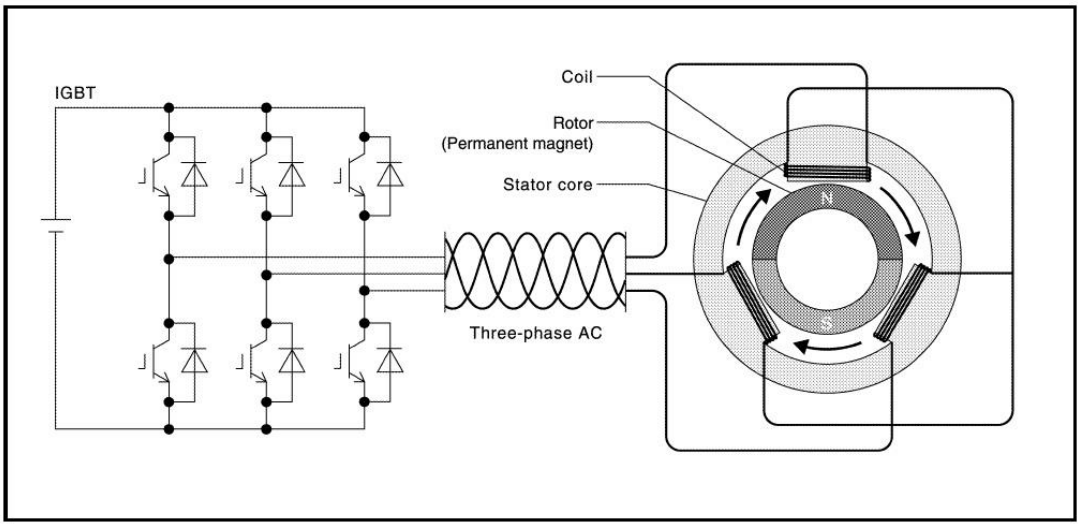


Traction motor control system



Traction motor

1. Stator core 2. Coil 3. Shaft 4. Rotor core 5. Permanent magnet



Operation principle

When 3-phase AC current is applied to the stator coil, a rotating magnetic field is generated. This rotating magnetic field pulls on the permanent magnet inside the rotor core, generating rotational torque that is synchronized with the rotating magnetic field. The generated torque is approximately proportional to the current, and the rotating speed depends on the frequency of the 3-phase current.

• In order to generate optimal rotor rotation, judgments regarding the position (angle) of the permanent magnet within the rotor core and the timing of current application to the coil are necessary. For this purpose, the traction motor resolver and current sensor are used in order to continually detect the rotating position of the rotor and control the timing of current application to the coil.

7. WARRANTY CONDITIONS

Our products meet modern technical standards. We guarantee that our product is perfectly constructed and manufactured. They operate reliably if used correctly and in accordance with the provided maintenance rules.

Educational training board is used for educational purposes and can be used only with the components and operating fluids that are fitted on the board.

The guarantee of ____ months is provided for the educational training board. The guarantee begins to run from the sale date of the stand.

In order to warrant the setting of the appropriate date of sale, we ask the buyer to save the relevant contract documents: purchase check, invoice, transfer-acceptance act, warranty card with a product name filled correctly and clearly, number, date of sale, store stamp, signature and the signature of the seller.

The warranty is not applied:

- if the user did not comply with the usage, transportation and storage conditions, used not appropriate operating fluids and aggressive cleaning agents;
- if the stand was damaged by the third parties, force majeure (fire, catastrophe etc.) or another side effect;
- for mechanical breakings and other breaches;
- for warn out parts of the stand, fuses and if non-original spare parts are used;
- when the stand is regulated, improved or remade by unauthorized persons who cannot carry out this work;
- for naturally worn parts such as collars, straps and filters;
- in case of the fluid spill;
- when using the incomplete kit;
- if extraneous objects or some water gets into the product;
- when operating incorrectly or plugging into a messy electric network.

Warranty conditions do not cover the costs related with dismantlement of the product and transportation to the authorized warranty service enterprise. Also, it does not cover consultation, actuation and adjustment work costs. If the elements necessary for repairing the board have to be ordered from the supplier, the repair work may be prolonged.

Warranty repair is done at technical service stations authorized by the manufacturer. During the warranty period defective product components are repaired or replaced free of charge. Technical service station has the right to make a decision about the repair or replacement of the components. The elements that are being changed become the property of the service station.

After completion of the warranty repairs, the guarantee is not extended but remains valid until the time limit provided. The manufacturer reserves the right to change the appearance, design and structure of the product. Service center has the right to suspend the guarantee if the stand was used for other purposes.

Warranty maintenance coupon

Name	_____
Product number	
Date of sale	
Training equipment owner	_____
Trading partner / representative	_____

Description of work performed

Data	Description of the fault and its elimination process	Technician / Signature
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	

NOTES

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