64-1 Electric safety requirements for battery electric vehicles: Effective date from 2019/1/1

Refer to: R100 02-S3

64-1.1 Effective Date and Scope:

64-1.1.1 Effective date from 2019/1/1, the new vehicle variants of category symbols M and N electric vehicles and from 2021/1/1, all vehicle variants of categories M and N electric vehicles shall comply with this regulation. The existing vehicle variants of category symbols M and N electric vehicles which were confirmed to “64. Electric safety requirements for battery electric vehicles”, regard as conform to this regulation.

64-1.1.2 This Regulation does not apply to the vehicle with a maximum design speed not exceeding 25 km/h, and the REESS(s) whose primary use is to supply power for starting the engine and/or lighting and/or other vehicle auxiliaries systems.

64-1.1.3 The same applicant applying for low volume or vehicle-by-vehicle low volume safety approval and the amounts of vehicle not exceed 3 at same year and vehicle of same variant and specification, could exempt from paragraph 64-1.4.1.3 Isolation resistance and / or paragraph 64-1.7. Confirmation method for functions of on-board isolation resistance monitoring system.

64-1.1.4 The applicant applying for low volume or vehicle-by-vehicle low volume safety approval could exempt from the table 2 and table 3.

64-1.2 Definitions

64-1.2.1 "Active driving possible mode" means the vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) or release of the brake system will cause the electric power train to move the vehicle.

64-1.2.2 “Barrier" means the part providing protection against direct contact to the live parts from any direction of access.

64-1.2.3 "Cell" means a single encased electrochemical unit containing one positive and one negative electrode which exhibits a voltage differential across its two terminals.

64-1.2.4 "Conductive connection" means the connection using connectors to an external power supply when the REESS is charged.

64-1.2.5 "Coupling system for charging the rechargeable energy storage system (REESS)" means the electrical circuit used for charging the

REESS from an external electric power supply including the vehicle inlet.

64-1.2.6 "C Rate" of "n C" is defined as the constant current of the tested-device, which takes 1/ n hours to charge or discharge the tested-device between 0 per cent of the state of charge and 100 per cent of the state of charge.

64-1.2.7 "Direct contact" means the contact of persons with live parts.

64-1.2.8 "Electrical chassis" means a set made of conductive parts electrically linked together, whose potential is taken as reference.

64-1.2.9 "Electrical circuit" means an assembly of connected live parts which is designed be electrically energized in normal operation.

64-1.2.10 "Electric energy conversion system" means a system that generates and provides electric energy for electric propulsion.

64-1.2.11 "Electric power train" means the electrical circuit which includes the traction motor(s), and may include the REESS, the electric energy conversion system, the electronic converters, the associated wiring harness and connectors, and the coupling system for charging the REESS.

64-1.2.12 "Electronic converter" means a device capable of controlling and/or converting electric power for electric propulsion.

64-1.2.13 "Enclosure" means the part enclosing the internal units and providing protection against direct contact from any direction of access.

64-1.2.14 "Exposed conductive part" means the conductive part which can be touched under the provisions of the protection degree IPXXB, and which becomes electrically energized under isolation failure conditions. This includes parts under a cover that can be removed without using tools.

64-1.2.15 "Explosion" means the sudden release of energy sufficient to cause pressure waves and/or projectiles that may cause structural and/or physical damage to the surrounding of the tested-device.

64-1.2.16 "External electric power supply" means an alternating current (AC) or direct current (DC) electric power supply outside of the vehicle.

64-1.2.17 "High Voltage" means the classification of an electric component or circuit, if its working voltage is > 60 V and ≦ 1500 V DC or > 30 V and ≦ 1000 V AC root mean square (rms).

64-1.2.18 "Fire" means the emission of flames from a tested-device. Sparks and arcing shall not be considered as flames.

64-1.2.19 "Flammable electrolyte" means an electrolyte that contains flammable substances.

64-1.2.20 "High voltage bus" means the electrical circuit, including the coupling system for charging the REESS that operates on high voltage. Where electrical circuits, that are galvanically connected to each other, are galvanically connected to the electrical chassis and the maximum voltage between any live part and the electrical chassis or any exposed conductive part is ≦ 30 V AC and ≦ 60 V DC, only the components or parts of the electric circuit that operate on high voltage are classified as a high voltage bus.

64-1.2.21 "Indirect contact" means the contact of persons or livestock with exposed conductive parts.

64-1.2.22 "Live parts" means the conductive part(s) intended to be electrically energized in normal use.

64-1.2.23 "Luggage compartment" means the space in the vehicle for luggage accommodation, bounded by the roof, hood, floor, side walls, as well as by the barrier and enclosure provided for protecting the occupants from direct contact with live parts, being separated from the passenger compartment by the front bulkhead or the rear bulk head.

64-1.2.24 "On-board isolation resistance monitoring system" means the device which monitors the isolation resistance between the high voltage buses and the electrical chassis.

64-1.2.25 "Open type traction battery" means a liquid type battery requiring refilling with water and generating hydrogen gas released to the atmosphere.

64-1.2.26 "Passenger compartment" means the space for occupant accommodation, bounded by the roof, floor, side walls, doors, window glass, front bulkhead and rear bulkhead, or rear gate, as well as by the barriers and enclosures provided for protecting the occupants from direct contact with live parts.

64-1.2.27 "Protection degree" means the protection provided by a barrier/enclosure related to the contact with live parts by a test probe, such as a test finger (IPXXB) or a test wire (IPXXD), as defined in paragraph 64-1.5.

64-1.2.28 "Rechargeable energy storage system (REESS)" means the rechargeable energy storage system that provides electric energy for electrical propulsion. The REESS may include subsystem(s) together with the necessary ancillary systems for physical support, thermal management, electronic control and enclosures.

64-1.2.29 "Rupture" means opening(s) through the casing of any functional cell assembly created or enlarged by an event, large enough for a 12 mm diameter test finger (IPXXB) to penetrate and make contact with live parts (see table 1 and figure 2).

64-1.2.30 "Service disconnect" means the device for deactivation of the electrical circuit when conducting checks and services of the REESS, fuel cell stack, etc.

64-1.2.31 "State of Charge (SOC)" means the available electrical charge in a tested-device expressed as a percentage of its rated capacity.

64-1.2.32 "Solid insulator" means the insulating coating of wiring harnesses provided in order to cover and protect the live parts against direct contact from any direction of access; covers for insulating the live parts of connectors, and varnish or paint for the purpose of insulation.

64-1.2.33 "Subsystem" means any functional assembly of REESS components.

64-1.2.34 "Tested-device" means either the complete REESS or the subsystem of a REESS that is subjected to the tests prescribed by this Regulation.

64-1.2.35 "Working voltage" means the highest value of an electrical circuit voltage root mean- square (rms), specified by the manufacturer, which may occur between any conductive parts in open circuit conditions or under normal operating conditions. If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively.

64-1.2.36 "Type of REESS" means systems which do not differ significantly in such essential aspects as:

64-1.2.36.1The manufacturer's trade name or mark,

64-1.2.36.2The chemistry, capacity and physical dimensions of its cells,

64-1.2.36.3The number of cells, the mode of connection of the cells and the physical support of the cells,

64-1.2.36.4The construction, materials and physical dimensions of the casing, 64-1.2.36.5The necessary ancillary devices for physical support, thermal management and electronic control and

64-1.2.36.6The category of vehicles on which the REESS can be installed.

64-1.2.37 "Chassis connected to the electric circuit" means AC and DC electric circuits galvanically connected to the electrical chassis.

64-1.3 The applicable type and scope principles for battery electric vehicles are as below：

64-1.3.1 If use completed vehicle for testing, which shall according to suitable variants and range of principle are as below：:

64-1.3.1.1 The same vehicle category.

64-1.3.1.2 The same type of large passenger vehicle body.

64-1.3.1.3 The same brand and vehicle type.

64-1.3.1.4 The same type of vehicle propulsion source (internal combustion engine or pure electric motor or hybrid).

64-1.3.1.5 The same installation of the electric power train and the galvanically connected high voltage bus.

64-1.3.1.6 The same nature and type of electric power train and the galvanically connected high voltage components.

64-1.3.1.7 The same characteristic of REESS.

64-1.3.2 If use chassis vehicle instead of completed vehicle for testing, which shall according to suitable variants and range of principle are as below：

64-1.3.2.1 The same vehicle category.

64-1.3.2.2 The same chassis brand.

64-1.3.2.3 Chassis manufacturers announced that the same chassis vehicle type .

64-1.3.2.4 The same type of vehicle propulsion source (internal combustion engine or pure electric motor or hybrid).

64-1.3.2.5 The same installation of the electric power train and the galvanically connected high voltage bus.

64-1.3.2.6 The same nature and type of electric power train and the galvanically connected high voltage components.

64-1.3.2.7 The same characteristic of REESS.

64-1.4 Tests and requirements:

The applicant required to apply for certification testing shall provide at least one representative vehicle and submit the documents of the essential characteristics of road vehicles (at least contain table 2), and incorporate into the documents for installation of the vehicle.

Table 2 - Essential characteristics of road vehicles

1.	General
1.1	Make (trade name of manufacturer)
1.2	Type
1.3	Vehicle category
1.4	Commercial name(s) if available
1.5	Manufacturer's name and address
1.6	(---)
1.7	Drawing and/or photograph of the vehicle
1.8	Approval report of the REESS (if any)
2.	Electric motor (traction motor)
2.1	Type (winding, excitation)
2.2	Maximum net power and / or maximum 30 minutes power (kW)
3.	REESS
3.1	Trade name and mark of the REESS
3.2	Indication of all types of cells
3.2.1	The cell chemistry

3.2.2	Physical dimensions
3.2.3	Capacity of the cell (Ah)
3.3	Description and / or drawing(s) and / or picture(s) of the REESS explaining
3.3.1	Structure
3.3.2	Configuration (number of cells, mode of connection, etc.)
3.3.3	Dimensions
3.3.4	Casing (construction, materials and physical dimensions)
3.4	Electrical specification
3.4.1	Nominal voltage (V)
3.4.2	Working voltage (V)
3.4.3	Capacity (Ah)
3.4.4	Maximum current (A)
3.5	Gas combination rate (in per cent)
3.6	Description and / or drawing(s) and / or picture(s) of the installation of the REESS in the vehicle
3.6.1	Physical support
3.7	Type of thermal management
3.8	Electronic control
4.	Fuel Cell (if any)
4.1	Trade name and mark of the fuel cell
4.2	Types of fuel cell

4.3	Nominal voltage (V)
4.4	Number of cells
4.5	Type of cooling system (if any)
5.	Fuse and/or circuit breaker
5.1	Type
5.2	Diagram showing the functional range
6.	Power wiring harness
6.1	Type
7.	Protection against Electric Shock
7.1	Description of the protection concept
8.	Additional data
8.1	Brief description of the power circuit components installation or drawings/pictures showing the location of the power circuit components installation
8.2	Schematic diagram of all electrical functions included in power circuit
8.3	Working voltage (V)

Table 3 - Essential characteristics of REESS

1.1	Trade name and mark of the REESS
1.2	Indication of all types of cells
1.2.1	The cell chemistry

1.2.2	Physical dimensions
1.2.3	Capacity of the cell (Ah)
1.3	Description or drawing(s) or picture(s) of the REESS explaining
1.3.1	Structure
1.3.2	Configuration (number of cells, mode of connection, etc.)
1.3.3	Dimensions
1.3.4	Casing (construction, materials and physical dimensions)
1.4	Electrical specification
1.4.1	Nominal voltage (V)
1.4.2	Working voltage (V)
1.4.3	Capacity (Ah)
1.4.4	Maximum current (A)
1.5	Gas combination rate (in percentage)
1.6	Description and / or drawing(s) and / or picture(s) of the installation of the REESS in the vehicle
1.6.1	Physical support
1.7	Type of thermal management
1.8	Electronic control
1.9	Category of vehicles on which the REESS can be installed

64-1.4.1 Protection against Electrical Shock

These electrical safety requirements apply to high voltage buses under conditions where they are not connected to external high voltage power supplies.

64-1.4.1.1 Protection against direct contact

Protection against direct contact with live parts is also required for vehicles equipped with any REESS.

Live parts shall be protected against direct contact and shall comply with paragraphs 64-1.4.1.1.1. and 64-1.4.1.1.2. Barriers, enclosures, solid insulators and connectors shall not be able to be opened, separated, disassembled or removed without the use of tools.

However, connectors (including the vehicle inlet) are allowed to be separated without the use of tools, if they meet one or more of the following requirements:

(a) They comply with paragraphs 64-1.4.1.1.1. and 64-1.4.1.1.2. when separated, or

(b) They are located underneath the floor and are provided with a locking mechanism, or

(c) They are provided with a locking mechanism. Other components, not being part of the connector, shall be removable only with the use of tools in order to be able to separate the connector, or

(d) The voltage of the live parts becomes equal or below 60 V DC or equal or below 30 V AC (rms) within 1 s after the connector is separated.

64-1.4.1.1.1 For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provided.

64-1.4.1.1.2 For protection of live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB shall be satisfied.

64-1.4.1.1.3 Service disconnect

For a service disconnect which can be opened, disassembled or removed without tools, it is acceptable if protection degree IPXXB is satisfied under a condition where it is opened, disassembled or removed without tools.

64-1.4.1.1.4 Vehicle Markings

64-1.4.1.1.4.1 In the case of a REESS having high voltage capability the symbol shown in Figure 1 shall appear on or near the REESS.

The symbol background shall be yellow, the bordering and the arrow shall be black.

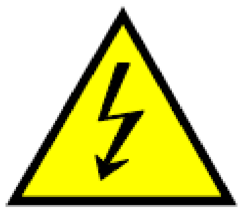


Figure 1 — Marking of high voltage equipment

64-1.4.1.1.4.2 he symbol shall also be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits. This provision is optional to any connector for high voltage buses. This provision shall not apply to any of the following cases：

(a) where barriers or enclosures cannot be physically accessed disassembled, opened or removed, unless other vehicle components are removed with the use of tools.

(b) where barriers or enclosures are located underneath the vehicle floor.

64-1.4.1.1.4.3 Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the colour orange.

64-1.4.1.2 Protection against indirect contact

Protection against indirect contact is also required for vehicles equipped with any REESS.

64-1.4.1.2.1 For protection against electrical shock which could arise from indirect contact, the exposed conductive parts, such as the conductive barrier and enclosure, shall be galvanically connected securely to the electrical chassis by connection with electrical wire or ground cable, or by welding, or by connection using bolts, etc. so that no dangerous potentials are produced.

64-1.4.1.2.2 The resistance between all exposed conductive parts and the electrical chassis shall be lower than 0.1 ohm when there is current flow of at least 0.2 amperes. This requirement is satisfied if the galvanic connection has been established by welding.

64-1.4.1.2.3 In the case of motor vehicles which are intended to be connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanical connection of the electrical chassis to the earth ground shall be provided.

The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle.

Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis.

64-1.4.1.3 Isolation resistance

64-1.4.1.3.1 Electric power train consisting of separate direct current- or alternating current buses

If AC high voltage buses and DC high voltage buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 ohms/volt of the working voltage for DC buses, and a minimum value of 500 ohms/volt of the working voltage for AC buses.

The measurement shall be conducted according to paragraph 64-1.6 "isolation resistance measurement method for vehicle based tests".

64-1.4.1.3.2 Electric power train consisting of combined DC- and AC-buses

If AC high voltage buses and DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 ohms/volt of the working voltage.

However, if all AC high voltage buses are protected by one of the 2 following measures, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 ohms/volt of the working voltage.

(a) Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 64-1.4.1.1. independently, for example wiring harness

(b) Mechanically robust protections that have sufficient durability over vehicle service life such as motor housings, electronic converter cases or connectors.

The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated by calculation, measurement or a combination of both.

The measurement shall be conducted according to paragraph 64-1.6 "Isolation Resistance Measurement Method for vehicle based tests ".

64-1.4.1.3.3 Fuel cell vehicles

If the minimum isolation resistance requirement cannot be maintained, then protection shall be achieved by any of the following:

(a) Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 64-1.4.1.1 independently.

(b) On-board isolation resistance monitoring system together with a warning to the driver if the isolation resistance drops below the minimum required value. The isolation resistance between the high voltage bus of the coupling system for charging the REESS, which is not energized besides during charging the REESS, and the electrical chassis need not to be monitored. The function of the on-board isolation resistance monitoring system shall be confirmed as described in paragraph 64-1.7.

64-1.4.1.3.4 Isolation resistance requirement for the coupling system for charging the REESS

For the vehicle inlet intended to be conductively connected to the grounded external AC power supply and the electrical circuit that is galvanically connected to the vehicle inlet during charging of the REESS, the isolation resistance between the high voltage bus and the electrical chassis shall be at least 1M ohms when the charger coupler is disconnected. During the measurement, the traction battery may be disconnected.

64-1.4.1.3.5 This paragraph shall not apply to chassis connected electrical circuits where the maximum voltage between any live part and the electrical chassis or any exposed conductive part does not exceed 30V AC (rms) or 60 V DC.

64-1.4.2 Rechargeable Electrical Energy Storage System (REESS)

64-1.4.2.1 For a vehicle with a REESS, the requirement below shall be satisfied.

64-1.4.2.1.1 The REESS shall be installed in accordance with the instructions provided by the manufacturer of the REESS (at least contain the documents of table 3) which specified manner and the vehicle type which REESS can be installed.

64-1.4.2.2 Accumulation of gas

Places for containing open type traction battery that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct to prevent the accumulation of hydrogen gas.

64-1.4.3 Functional safety requirements

At least a momentary indication shall be given to the driver when the vehicle is in "active driving possible mode".

However, this provision does not apply under conditions where an internal combustion engine provides directly or indirectly the vehicle´s propulsion power.

When leaving the vehicle, the driver shall be informed by a signal (e.g. optical or audible signal) if the vehicle is still in the active driving possible mode.

If the on-board REESS can be externally charged by the user, vehicle movement by its own propulsion system shall be impossible as long as the connector of the external electric power supply is physically connected to the vehicle inlet.

This requirement shall be demonstrated by using the connector specified by the car manufacturer.

The state of the drive direction control unit shall be identified to the driver.

64-1.5 Protection against direct contacts of parts under voltage

64-1.5.1 Access probes

Access probes to verify the protection of persons against access to live parts are given in table 1.

64-1.5.2 Test conditions

The access probe is pushed against any openings of the enclosure with the force specified in table 1. If it partly or fully penetrates, it is placed in every possible position, but in no case shall the stop face fully penetrate through the opening.

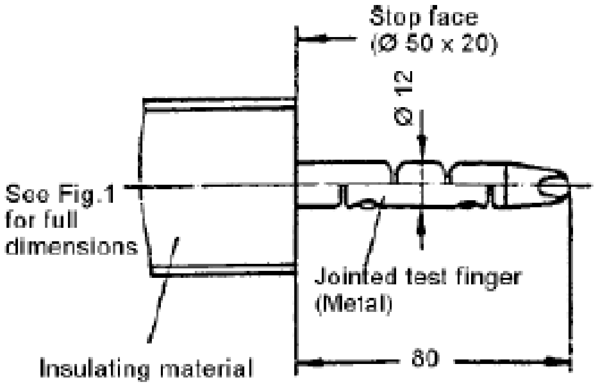
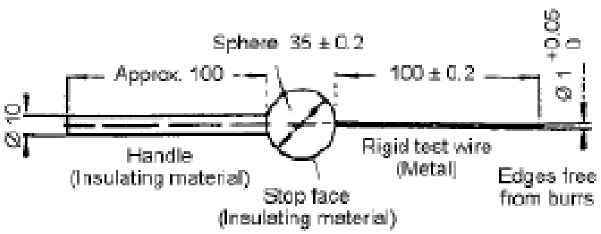
Internal barriers are considered part of the enclosure.

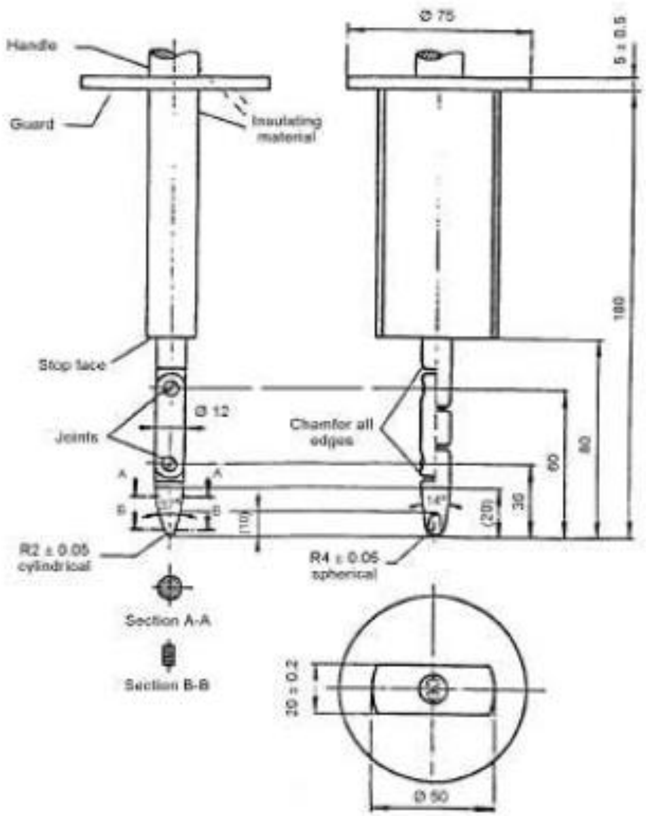
A low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected, if necessary, between the probe and live parts inside the barrier or enclosure.

The signal-circuit method should also be applied to the moving live parts of high voltage equipment.

Internal moving parts may be operated slowly, where this is possible.

Table 1 - Access probes for the tests for protection of persons against access to hazardous parts

First numeral	Addit. letter	Access probe (Dimensions in mm)	Test force
2	B	**Jointed test finger** 	10 N ± 10 %
4, 5, 6	D	**Test wire 1.0 mm diameter, 100 mm long** 	1 N ± 10 %



Material: metal, except where otherwise specified
Linear dimensions in millimeters
Tolerances on dimensions without specific tolerance:

(a) on angles: 0/-10°
(b) on linear dimensions: up to 25 mm: 0/-0.05 mm over 25 mm: ±0.2 mm

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to +10° tolerance.

Figure 2 - Jointed test finger

64-1.5.3 Acceptance conditions

The access probe shall not touch live parts.

If this requirement is verified by a signal circuit between the probe and live parts, the lamp shall not light.

In the case of the test for IPXXB, the jointed test finger may penetrate to its 80 mm length, but the stop face (diameter 50 mm x 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90 degree with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.

In case of the tests for IPXXD, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening.

64-1.6 Isolation resistance measurement method for vehicle based tests

64-1.6.1 General

The isolation resistance for each high voltage bus of the vehicle shall be measured or shall be determined by calculation using measurement values from each part or component unit of a high voltage bus (hereinafter referred to as the "divided measurement").

64-1.6.2 Measurement Method

The isolation resistance measurement shall be conducted by selecting an appropriate measurement method from among those listed in Paragraphs 64-1.6.2.1 through 64-1.6.2.2., depending on the electrical charge of the live parts or the isolation resistance, etc.

The range of the electrical circuit to be measured shall be clarified in advance, using electrical circuit diagrams, etc.

Moreover, modification necessary for measuring the isolation resistance may be carried out, such as removal of the cover in order to reach the live parts, drawing of measurement lines, change in software, etc.

In cases where the measured values are not stable due to the operation of the on-board isolation resistance monitoring system, etc., necessary modification for conducting the measurement may be carried out, such as stopping of the operation of the device concerned or removing it. Furthermore, when the device is removed, it shall be proven, using drawings, etc., that it will not change the isolation resistance between the live parts and the electrical chassis. Utmost care shall be exercised as to short circuit, electric shock, etc., for this confirmation might require direct operations of the high-voltage circuit.

64-1.6.2.1 Measurement method using DC voltage from off-vehicle sources

64-1.6.2.1.1 Measurement instrument

An isolation resistance test instrument capable of applying a DC voltage higher than the working voltage of the high voltage bus shall be used.

64-1.6.2.1.2 Measurement method

An insulator resistance test instrument shall be connected between the live parts and the electrical chassis. Then, the isolation resistance shall be measured by applying a DC voltage at least half of the working voltage of the high voltage bus.

If the system has several voltage ranges (e.g. because of boost converter) in galvanically connected circuit and some of the components cannot withstand the working voltage of the entire circuit, the isolation resistance between those components and the electrical chassis can be measured separately by applying at least half of their own working voltage with those component disconnected.

64-1.6.2.2 Measurement method using the vehicle's own REESS as DC voltage source

64-1.6.2.2.1 Test vehicle conditions

The high voltage-bus shall be energized by the vehicle's own REESS and/or energy conversion system and the voltage level of the REESS and/or energy conversion system throughout the test shall be at least the nominal operating voltage as specified by the vehicle manufacturer.

64-1.6.2.2.2 Measurement instrument

The voltmeter used in this test shall measure DC values and shall have an internal resistance of at least 10 MΩ.

64-1.6.2.2.3 Measurement method

64-1.6.2.2.3.1 First step

The voltage is measured as shown in Figure 1 and the high voltage Bus voltage (Vb) is recorded. Vb shall be equal to or greater than the nominal operating voltage of the REESS and/or energy conversion system as specified by the vehicle manufacturer.

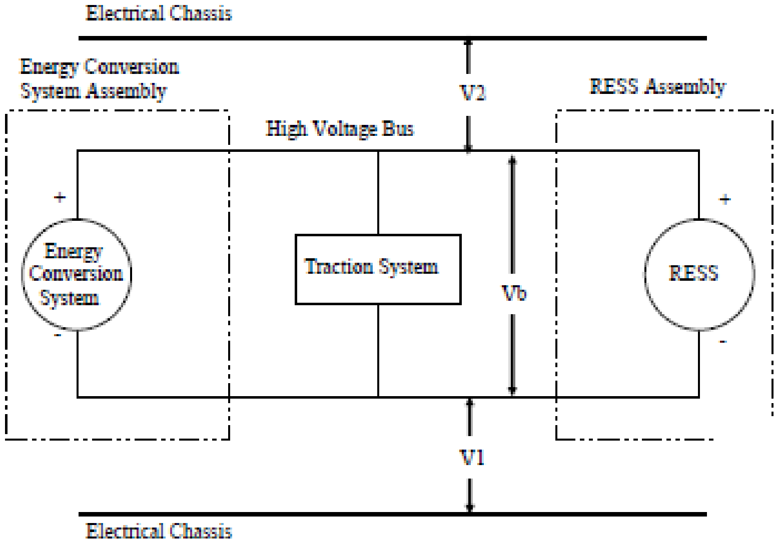


Figure 3: Measurement of Vb, V1, V2

64-1.6.2.2.3.2 Second step

Measure and record the voltage (V1) between the negative side of the high voltage bus and the electrical chassis (see Figure 3):

64-1.6.2.2.3.3 Third step

Measure and record the voltage (V2) between the positive side of the high voltage bus and the electrical chassis (see Figure 3):

64-1.6.2.2.3.4 Fourth step

If V1 is greater than or equal to V2, insert a standard known resistance (Ro) between the negative side of the high voltage bus and the electrical chassis. With Ro installed, measure the voltage (V1') between the negative side of the high voltage bus and the electrical chassis (see Figure 4).

Calculate the electrical isolation (Ri) according to the following formula:

Ri = Ro*(Vb/V1'– Vb/V1) or Ri = Ro*Vb*(1/V1' – 1/V1)

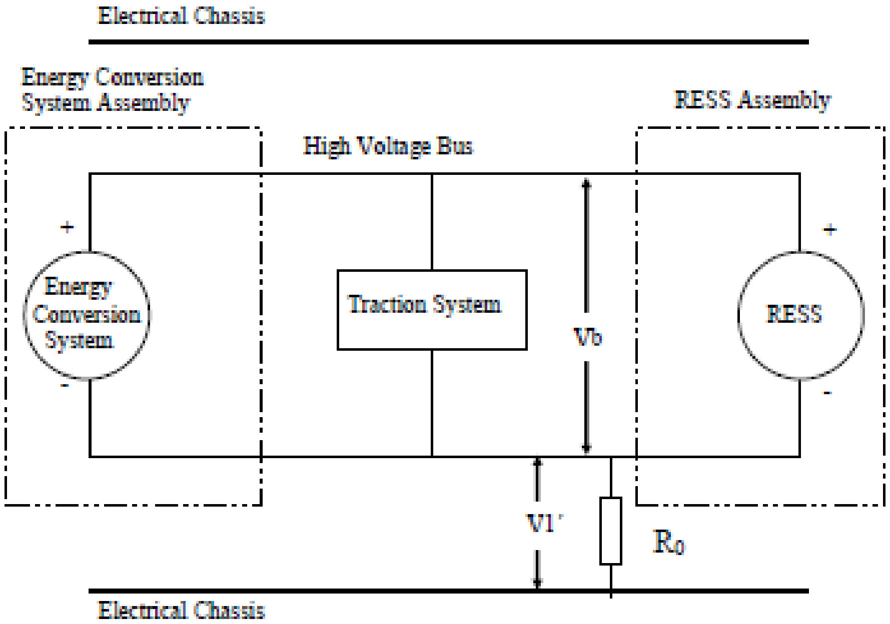


Figure 4: Measurement of V1´

If V2 is greater than V1, insert a standard known resistance (Ro) between the positive side of the high voltage bus and the electrical chassis. With Ro installed, measure the voltage (V2') between the positive side of the high voltage bus and the electrical chassis. (See Figure 3). Calculate the electrical isolation (Ri) according to the formula shown. Divide this electrical isolation value (in ohms) by the nominal operating voltage of the high voltage bus (in volts).

Calculate the electrical isolation (Ri) according to the following formula:

Ri = Ro*(Vb/V2' – Vb/V2) or Ri = Ro*Vb*(1/V2'– 1/V2)

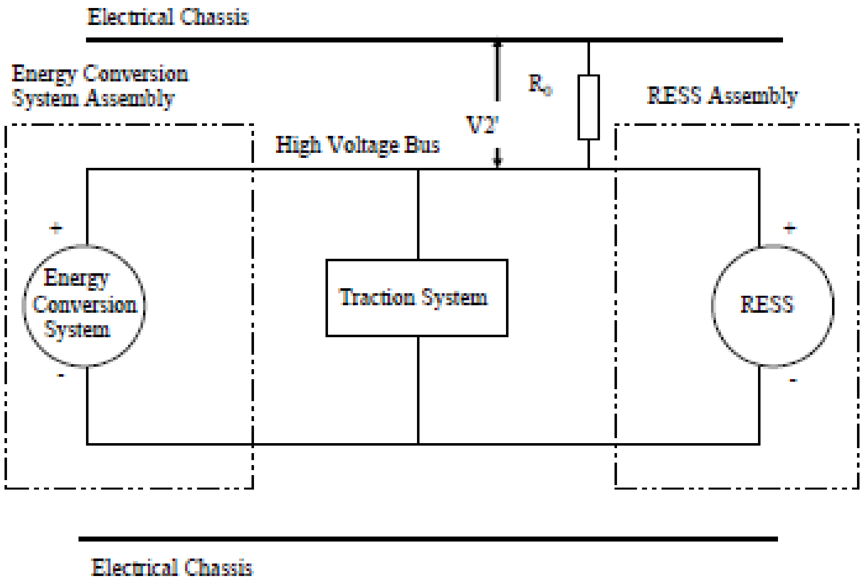


Figure 5: Measurement of V2'

64-1.6.2.2.3.5 Fifth step

The electrical isolation value Ri (in ohms) divided by the working voltage of the high voltage bus (in volts) results in the isolation resistance (in ohms/volt).

NOTE 1: The standard known resistance Ro (in ohms) should be the value of the minimum required isolation resistance (in ohms/V) multiplied by the working voltage of the vehicle plus/minus 20 per cent (in volts). Ro is not required to be precisely this value since the equations are valid for any Ro; however, a Ro value in this range should provide good resolution for the voltage measurements.

64-1.7 Confirmation method for functions of on-board isolation resistance monitoring system

The function of the on-board isolation resistance monitoring system shall be confirmed by the following method.

Insert a resistor that does not cause the isolation resistance between the terminal being monitored and the electrical chassis to drop below the minimum required isolation resistance value. The warning shall be activated.

64-1.8 Declaration of design compliance of related basic safety protection design for the installation of REESS.

64-1.8.1 A protection design should be built in the vehicle to safeguard its REESS against external damage, such as vibration, thermal shock, crush, and mechanical shock. The purpose of its design is to provide the protective function against explosion, fire, electrolyte leakage, venting, and rupture.

64-1.8.2 Its REESS should be safeguard against fire resistance, external short circuit protection, overcharge protection, over-discharge protection, over-temperature protection, and the isolation resistance should be maintained or the protection degree IPXXB should be fulfilled, etc., which provide the protective function against explosion fire, electrolyte leakage, venting, and rupture.