High voltage safety

Sweden, 2018/09

Key Points：

1. **The safety requirements of HV connectors;**
2. **The necessary of low energy requirements in-use;**
3. **Introduction of the isolation resistance measurement method into GTR as an optional test method;**

HV Connector Requirements

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 5.1.1.1.1. and 5.1.1.1.2. when separated, or

(b) They are provided with a locking mechanism (at least two distinct actions are needed to separate the connector from its mating component). Additionally, 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

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

5.1.1.1.1. For high voltage live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD shall be provided.

5.1.1.1.2. For high voltage live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB shall be provided.

Suggestions:

- **connected: IPXXD(outside the passenger compartment and luggage compartment);**
  IPXXB(inside the passenger compartment and luggage compartment);
- **& separated: IPXXB /(b)/(c)**

Reasons:

- **IPXXD/IPXXB requirement when connectors are connected is necessary protection from direct contact on live part;**
- **When the connectors are separated, IPXXB can protect person from unconsciously touching the live part;**
- **There`s no connectors could reach IPXXD when they are separated;**

Low Energy Necessity in Use

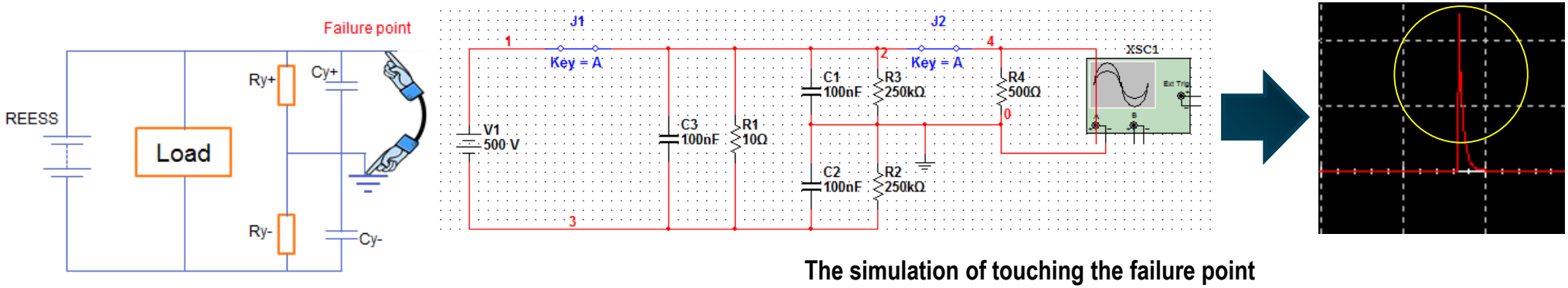
Now low energy requirement is optional choice of post crash in 5.2.2.2.

Suggestion:

- **Low energy should be necessary requirement in-use for indirect contact protection as isolation resistance requirement.**

Reasons:

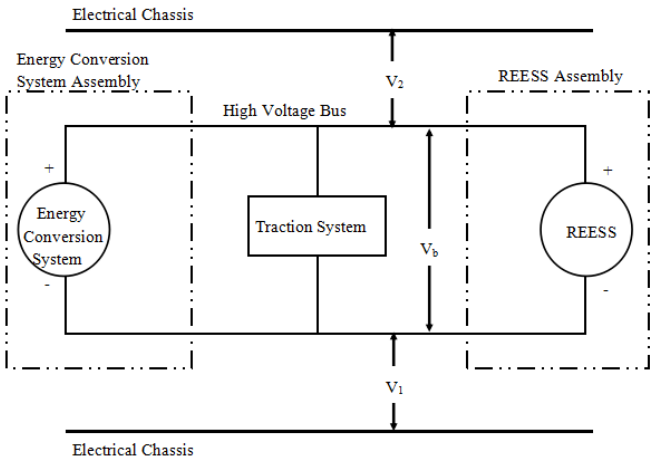
- **IPXXD/IPXXB requirement when connectors are connected is necessary protection from direct contact on live part;**

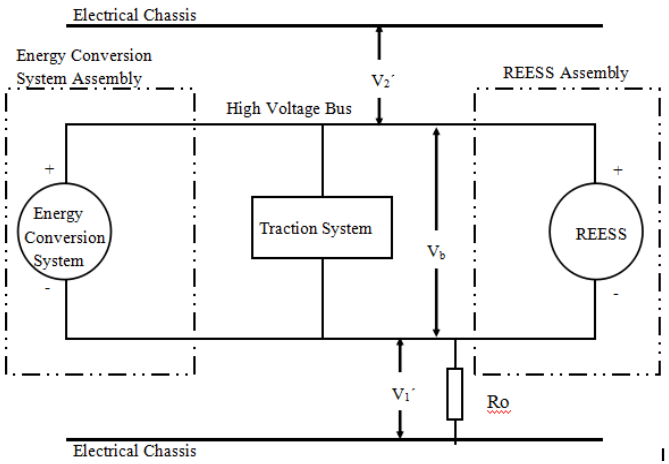


The simulation of touching the failure point

- **If the energy is higher than 0.2J above 60VDC /30VAC, it`s a danger to the person when there`s an one point failure.**

Isolation resistance measurement





1st: Run the circuit , V_b is higher than nominal voltage;

2nd: measure V_1;

3rd: measure V_2;

measure V_1 and V_2 using two same voltmeter

4th: if V_1 is higher than V_2, add R_0 as picture shows; (suggest V_0=1MΩ)

5th: measure V_1'

6th: measure V_2'

measure V_1' and V_2 'using two same voltmeter

- **Voltage measured is more stable;**
- **This method minimized the effection of the internal resistance of the voltmeter on the result;**

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

6.1.2. Confirmation method for functions of on-board isolation resistance monitoring system.

The on-board isolation resistance monitoring system specified in paragraph 5.1.1.2.4.3. for fuel cell vehicles and that specified in paragraph 5.1.1.3.4 for protection against water effects shall be tested using the following procedure.

(a) Determine the isolation resistance, Ri, of the electric power train with the electrical isolation monitoring system using the procedure outlined paragraph 6.1.1.

(b) If the minimum isolation resistance value required in accordance with paragraphs 5.1.1.2.4.1. or 5.1.1.2.4.2. is 100 Ω/V, insert a resistor with resistance Ro between the positive terminal of the electric power train and the electrical chassis. The magnitude of the resistor, Ro, shall be such that:

$1/(1/(95xV) - 1/Ri) \leq Ro < 1/(1/(100xV) - 1/Ri)$

where V is the working voltage of the electric power train.

(c) If the minimum isolation resistance value required in accordance with paragraphs 5.1.1.2.4.1. or 5.1.1.2.4.2. is 500 Ω/V, insert a resistor with resistance Ro between the positive terminal of the electric power train and the electrical chassis. The magnitude of the resistor, Ro, shall be such that:

$1/(1/(475xV) - 1/Ri) \leq Ro < 1/(1/(500xV) - 1/Ri)$

where V is the working voltage of the electric power train.

Suggestion:

1. compare the voltages between both terminals and electrical chasis;
2. insert a resistor with resistance R_0 between the lower voltage terminal of the electric power train and the electrical chasis;

- The definition of isolation resistance is the lower isolation resistance between both positive and negetive sides;

Thank you!