

WORKSHOP A

SESSION ONE

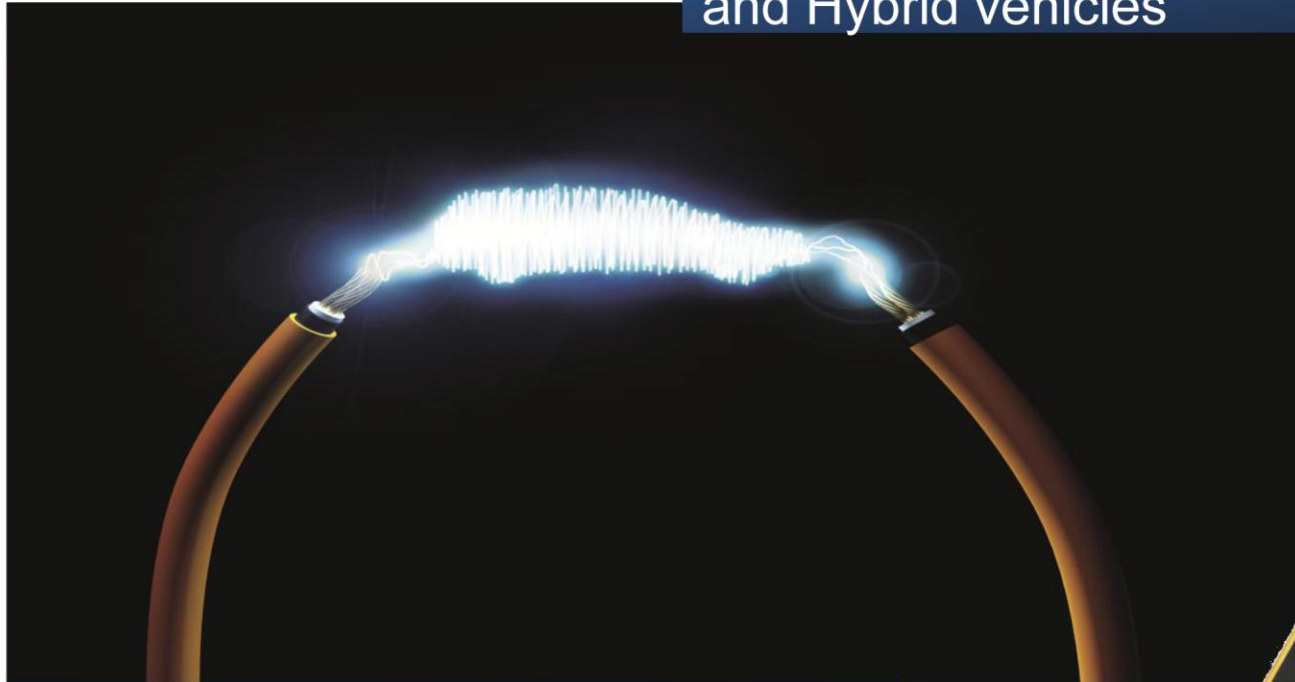
Presentation 4

Confirming safety of electric and hybrid vehicles

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Confirm the safety of Electric and Hybrid vehicles



Bernd Tetyczka



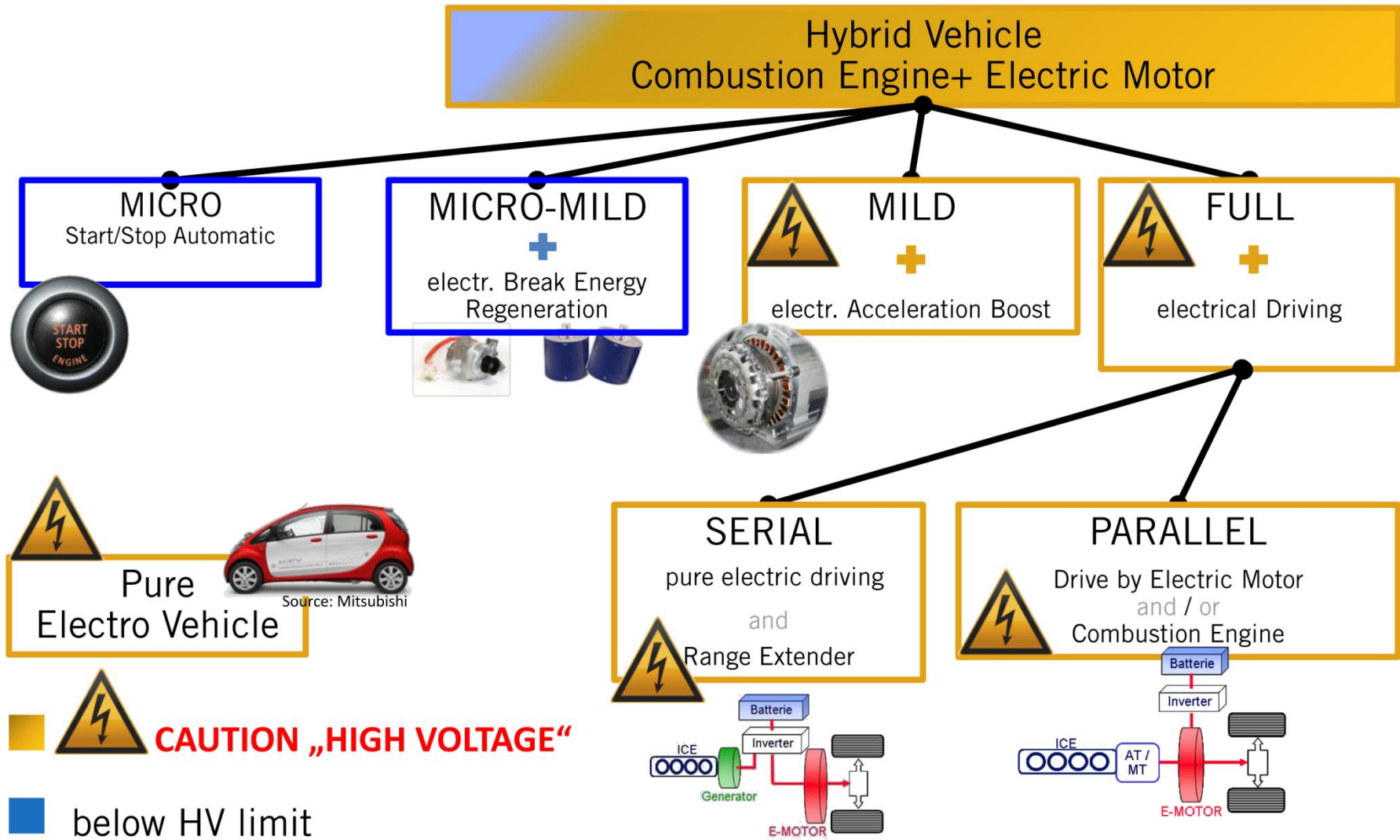
- **HV vehicle in PTI:**
 - What does HV mean?
 - Where are you faced with HV?
 - When to check in PTI
- **Possible Measurement :**
 - All pole voltage measurement
 - HV insulation measurement
 - SAE J1766 measurement
 - Insolation monitor check
 - Equipotential bonding check
- **Conclusion**



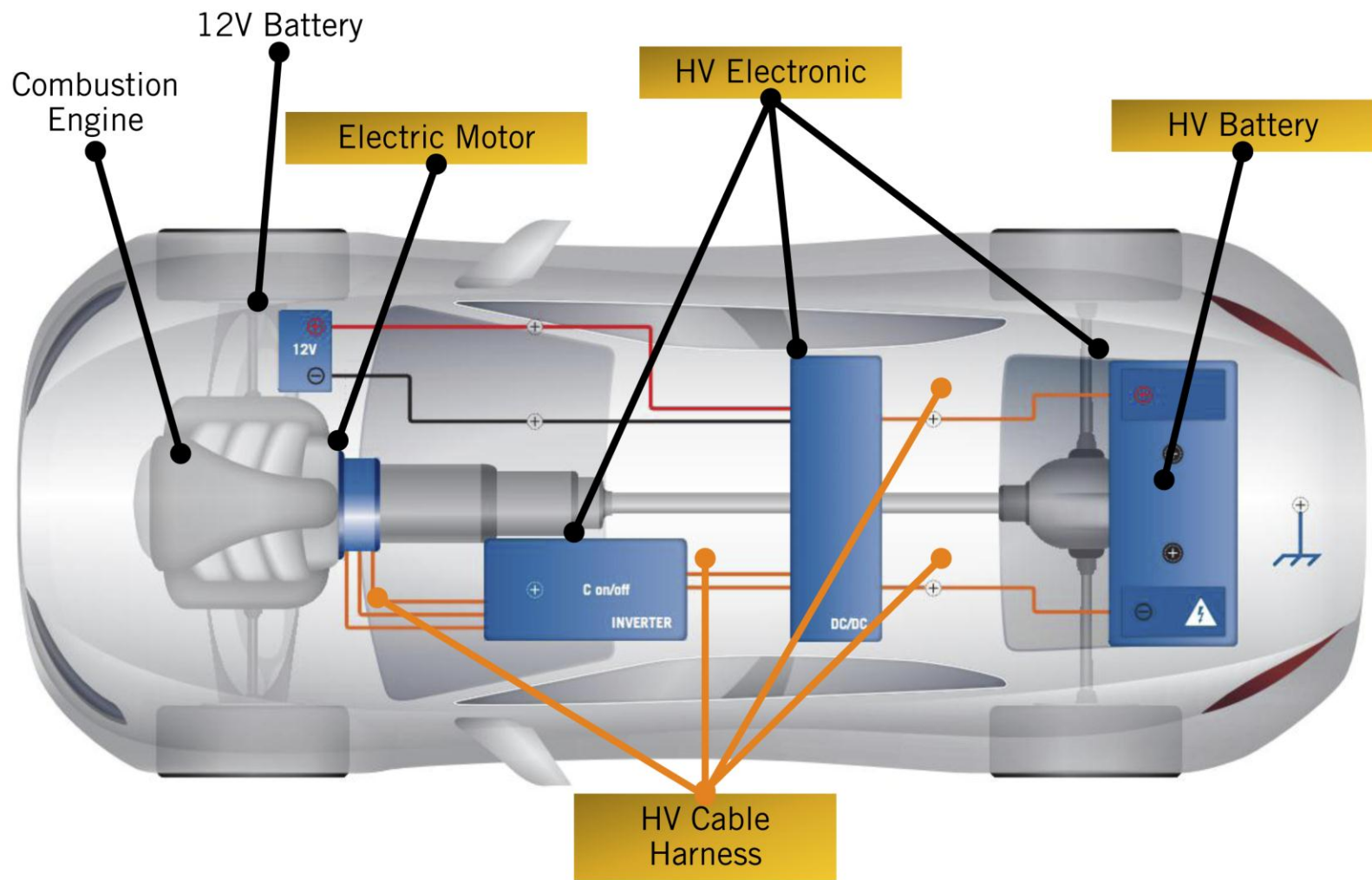
- **ALL voltage > 60V DC and >25V AC are defined as „HIGH VOLTAGE“ (HV)**
- hazardous HV components
 - electric motor
 - HV battery
 - HV electronics
 - A/C compressor / heating...
- specific marking
 - HV symbol
 - orange cables

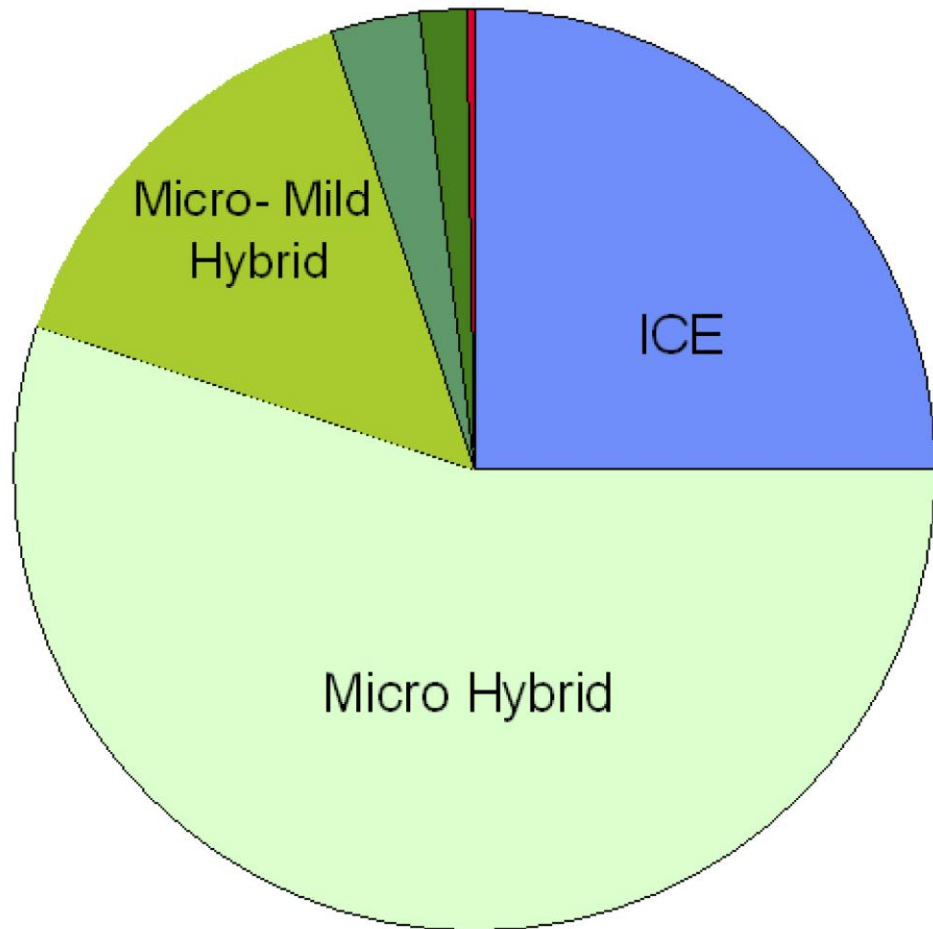








HV: >60V DC >25V AC



OVERVIEW OF HV COMPONENTS





	Market shares (Western Europe 2015)	
	ICE	25 %
	Micro-Hybrid	55 %
	Micro- Mild-Hybrid	15 %
	Mild- Hybrid	3 %
	Full- Hybrid	1,7 %
	Electro vehicles	0,3 %

Increase in electric energy on board

- In every days use the correct function of the safety system is checked via on board diagnosis system
 - Correct function of system is checked via on board diagnosis system
 - Complete control of the HV system is complex as it only can be performed by specially trained personal as system need to be voltage free
 - Therefore complete check @ each PTI might be to high effort
-
- Additional measurement necessary in case of
 - Visible wear
 - crashed cars
 - modified cars
 - after a certain age/km run



All pole voltage measurement

Voltage measurement

HV insulation measurement

SAE J1766 measurement


Insulation monitor check


Equipotential bonding check





All pole voltage measurement



Sicherheitshinweise


 Am HV-Energiespeicher (HV-Batterie) und an den daran angeschlossenen Teilen, liegt eine gefährliche Hochspannung an. Stellen Sie sicher, dass niemand mit den Anschlüssen der Hybridbatterie, den Anschlüssen der HV-Batterie und sonstigen unter Hochspannung stehenden Teilen in Berührung kommt.

 Für Arbeiten unter Spannung gelten besondere Sicherheitsbedingungen! Achten Sie in jeder Situation darauf, dass diese eingehalten werden!

 Die Bedienungsanleitung enthält wichtige Informationen zur Sicherheit! Lesen Sie beachten der Sicherheitsinformationen kann zu gefährlichen Situationen führen.


 Bitte beachten Sie vor jeder Messung, dass die entsprechenden Sicherheitshinweise aus dem Bedienerhandbuch gelesen und verstanden wurden, sowie auf dessen Einhaltung!

 Achten Sie darauf, dass alle geltenden Sicherheitsvorkehrungen getroffen wurden, bevor Sie mit den Messungen fortfahren! 





1. Messung der Batteriespannung HV+ gegen HV-

HV+ == HV-




2. Isolationsmessung HV+ gegen Chassis



HV+ == 







3. Isolationsmessung HV- gegen Chassis

HV- == 

Alle Hinweise genau lesen und mit F8 bestätigen

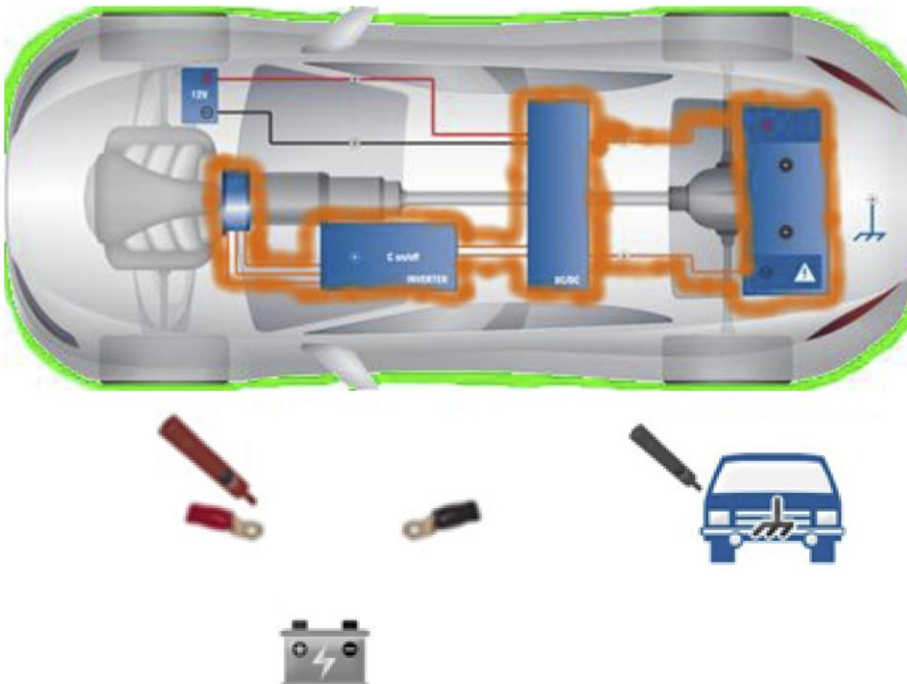


- Reliable confirm that vehicle under test is voltage free
- Clear documentation that process was performed

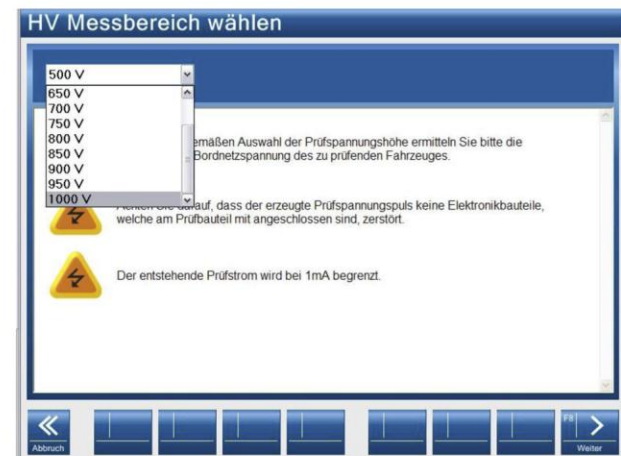
AVL DiTEST HV SAFETY 2000

HV insulation measurement

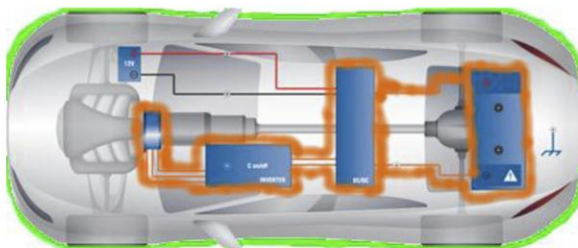
Check the status of the insulation of the HV system



The tool is generating the appropriate test voltage
According the possible current flow
through the measurement
the insulation resistance strength is determined



HV insulation measurement

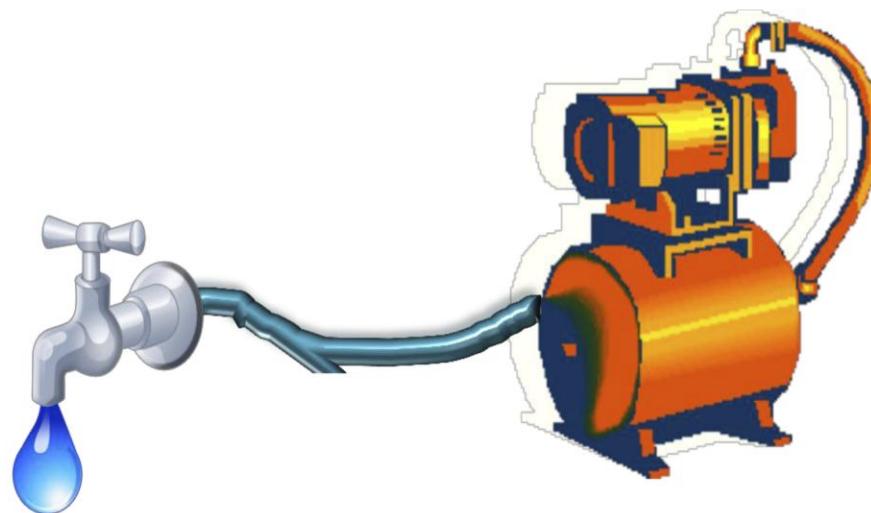


The measurement result shows the resistance
in Ohm per 1V (applied test voltage)

--- > min. 1000 Ω / Volt

Isolationsmessung			
R		10.02	
M Ω	0		10
R _{ISO}		10016	
Ω /V	0		1000
► Isolationswiderstand ok			

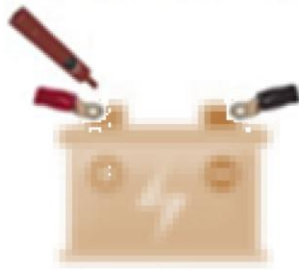

HVISO
Isolation ☒



SAEJ1766 measurement

Insulation strength test according SAE J1766 standard

Measurement on an ENERGIZED system!



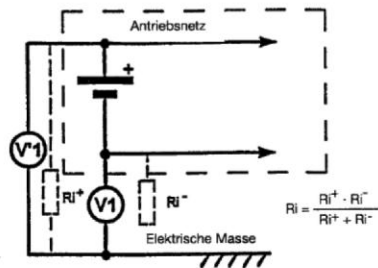
Basically it is a voltage drop measurement

First step with a high internal resistance of the tool $\geq 1\text{ M}\Omega$,

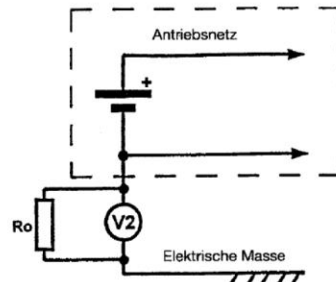
Second step with an internal load resistor

500 x of the nominal HV battery voltage (400V - > 200k Ω)

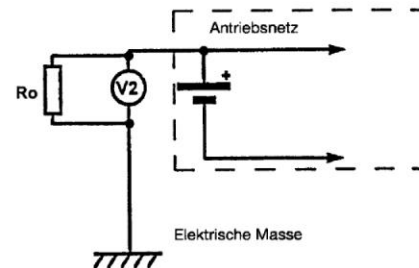
Result: min. 500 Ω / Volt



1. Measurement of HV battery voltage



2. Measurement of HV - to chassis with and without load resistor



3. Measurement of HV + to chassis with and without load resistor

$$R_i = \frac{V_1 - V_2}{V_2} \cdot R_o$$

or

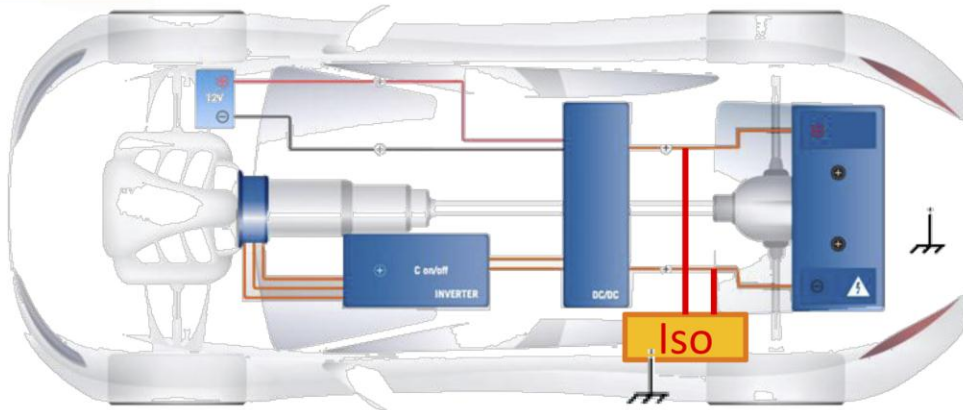
$$R_i = \frac{V'_1 - V_2}{V_2} \cdot R_o$$

Insulation monitor check

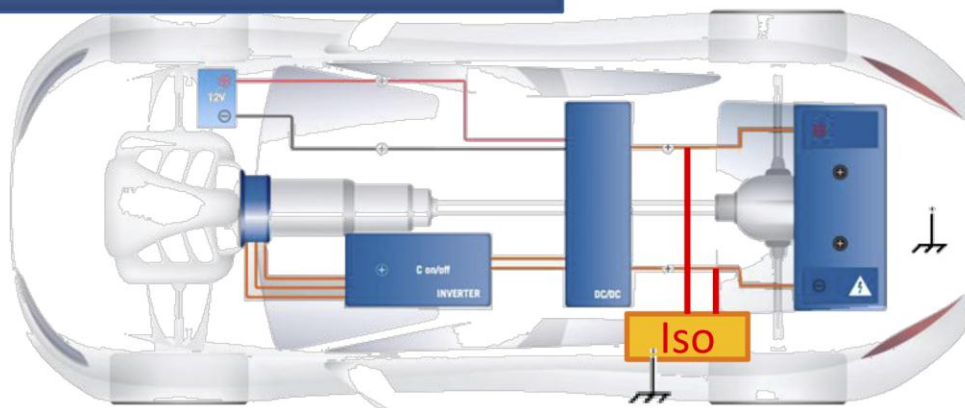
The insulation monitor check is a
Measurement on an energized system!



Via the variable adjustable load resistor in the tool (500k Ω - ∞) the Insulation value is detected at which the on- board insulation monitor show alerts @ min. 500 Ω / Volt



Insulation monitor



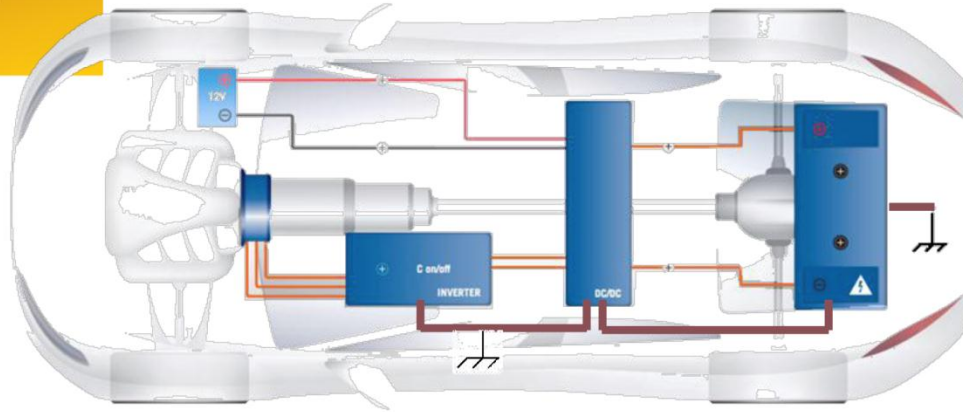
The on- board insulation monitor permanently checks (cyclic) the condition of the insulation between the HV terminals and chassis ground

- Supported and controlled by the 14V on-board power supply
- Fault code set if insulation is faulty - Warning lamp alerts the driver
- HV solenoids get open if insulation problems occur → vehicle is stopped



CAUTION „HIGH VOLTAGE“

Equipotential bonding

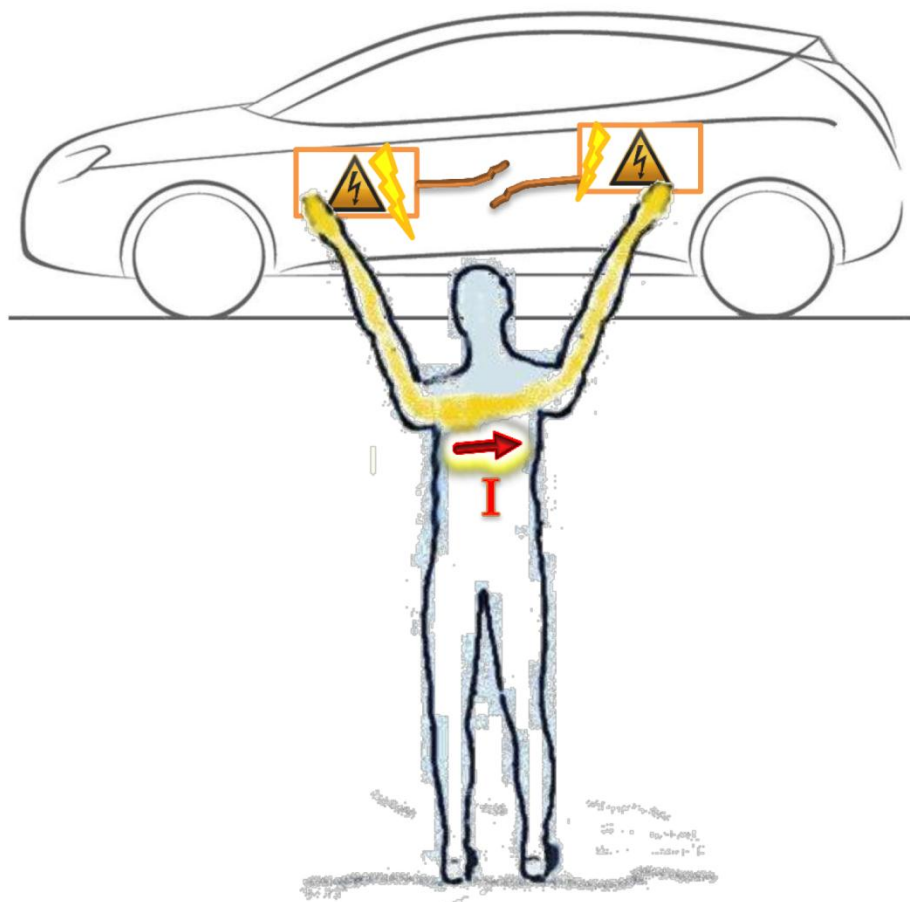


Every HV- component housing is connected via a massive conductive cable with each other and to chassis

- Conduct compensating current in the case of an error
 - Equalize potential differences amongst HV- components in the case of an insulation error
- Prevent an electro shock by touching the chassis and/or the defective HV - component



CAUTION „HIGH VOLTAGE“



- When insulation failures at HV- modules occur
- Equipotential bonding conducts compensating current
- Potentially lethal when equipotential line is missing or defective in case of HV insulation problems
- Equipotential bonding test with a test current of min. 200mA resp. 1A (ECE R100)

Continuity check with high current

Equipotential bonding check

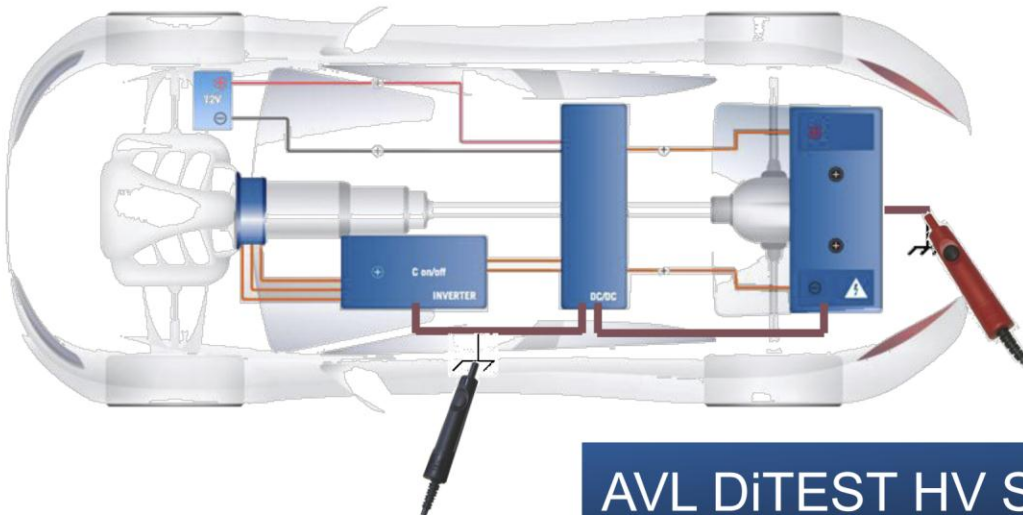
The equipotential bonding check is comparable to a continuity test using a very high test current

The equipotential bonding is stressed by the test current to reveal faults with the bonding

max. $\leq 100 \text{ m}\Omega$ @ 200mA resp.. 1A
test current
(ECE R100)

Manufacturer specific limits $\leq 10 \text{ m}\Omega$

→ four-wire technology required



USB connection suitable for every PC
Power supplied solely via USB

Funktion & Status LEDs

3m measuring leads
using **four-wire technology**



Probes with control button useable with **safety gloves**

Probes using **four-wire technology**