AVL DiTEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT

10th April 2023

About Us

At AVL, we are one of the world’s leading mobility technology companies for development, simulation and testing in the automotive industry, and in other sectors. Drawing on our pioneering spirit, we provide concepts, solutions and methodologies for a greener, safer and better world of mobility.

AVL at a Glance

1948
Founded

75
Years of Experience

26
Countries Represented

45
Global Tech and Engineering Centers

11,200
Employees Worldwide

68 %
Engineers and Scientists

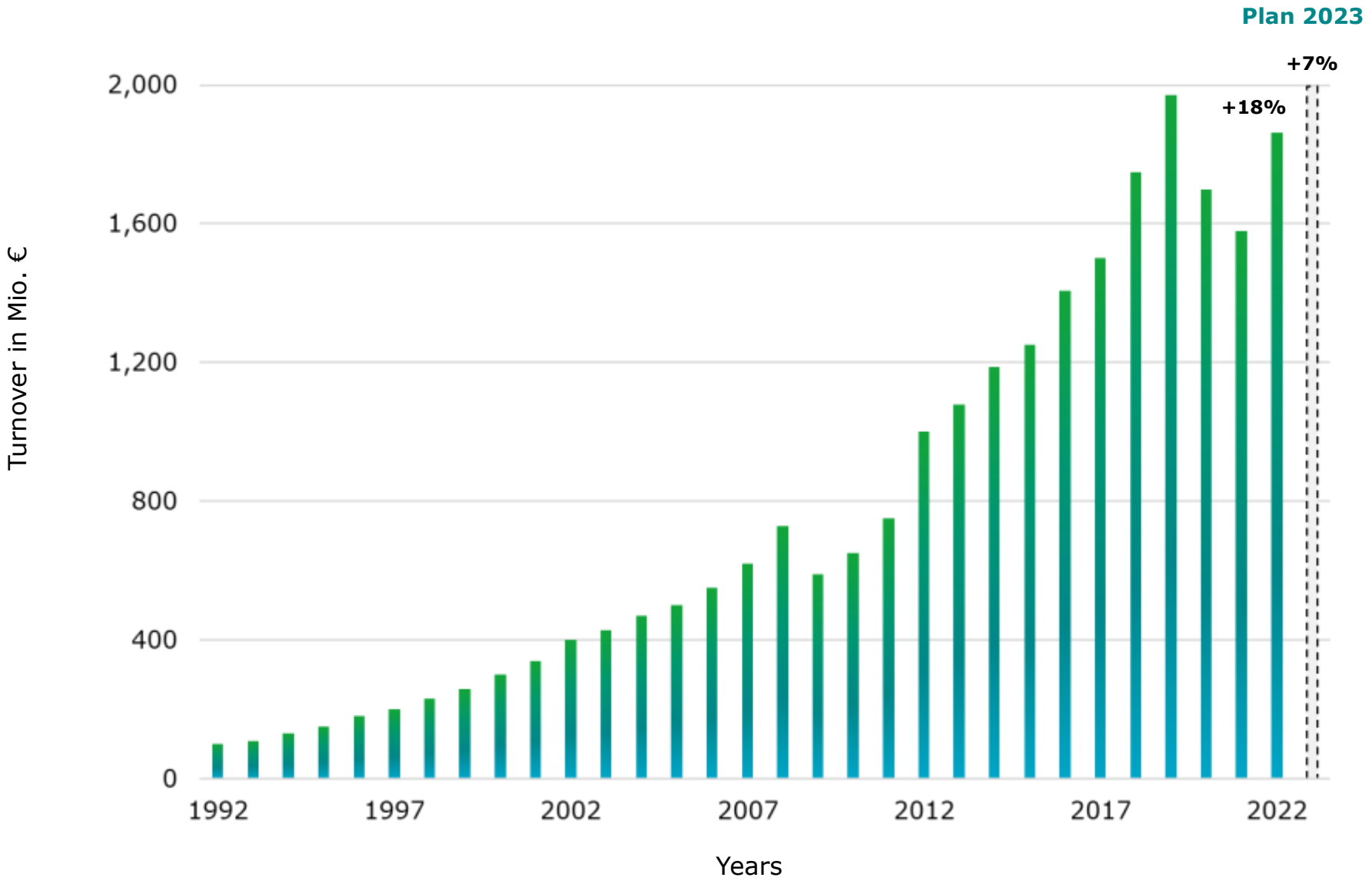
11 %
Of Turnover Invested in Inhouse R&D

2,200
Granted Patents in Force

Our Turnover

1.86 Bn €
Turnover in 2022

97 %
Export Quota



Turning Visions Into Reality

We constantly transform our portfolio of high-end methodologies and technologies to support our customers in achieving their ambitions.

From future fuels to the connected vehicle ecosystem, we are driving innovation today, to build the mobility concepts of tomorrow.

AVL

AVL

Reimagining Motion

Engineering | Testing Solutions | Simulation Solutions

Next Generation Vehicles | E-Mobility | Automated and Connected Mobility | Software | Future ICE Solutions

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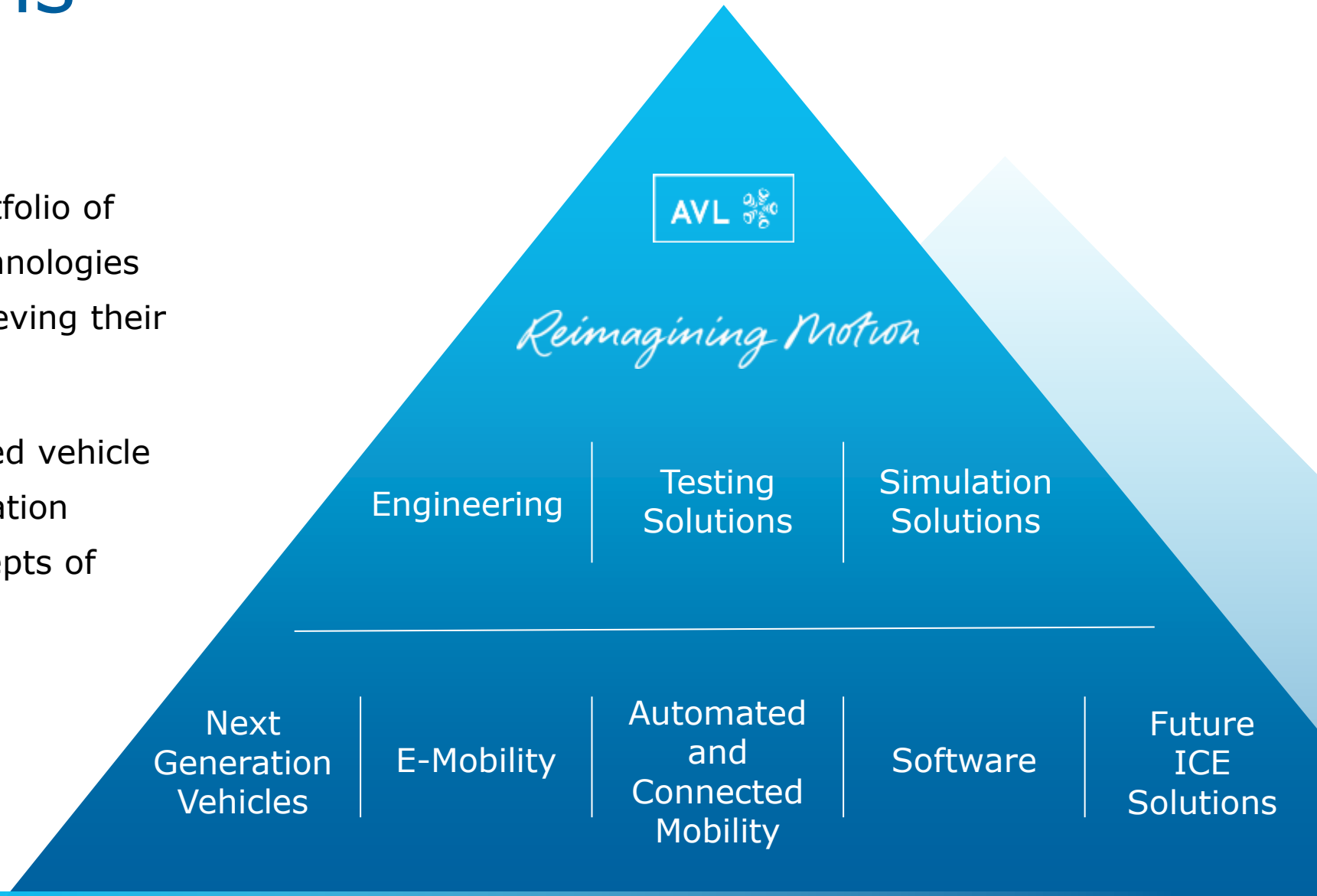


Redrawing the Lines of Electrification

E-Mobility

We are relentlessly striving towards climate-neutral mobility. Not just by increasing the efficiency of multiple propulsion systems, but also by pioneering energy from green resources.

20+
Years of Experience

5,700+
E-Mobility Experts

900+
Executed Battery Projects

5
Fuel Cell Tech Centers

450+
Fuel Cell Engineers

Technology Designed for the Human Journey

Automated and Connected Mobility

Mobility is changing. As technologies such as assisted and automated concepts gain focus, we face a paradigm shift in the way vehicles are designed, built and used. We are your professional and reliable partner for high demanding technology solutions within ADAS/AD system development.

15+
Years of Experience

200+
Customer Projects

70+
Automotive Customers

19
Competence Centers

450+
ADAS/AD Experts Worldwide

Comprehensive and constantly evolving partner ecosystem

Driving the Now, Defining the Next

Software

At AVL we place innovation at the heart of development. Our software is both ready for today and designed for tomorrow’s challenges. Our solutions range from simulation, virtualization, and test automation (for vehicle development) to ADAS/AD and car software.

3,000+
Software Experts and Engineers

100+
Data Engineers and Scientists

20+
Software Development and Support Centers

6,500+
Test Automation Systems

40+
Software Products and Solution Suites

20+
Mio. Vehicles Using AVL Technologies

Innovate. Accelerate. Lead

AVL RACETECH

Our global motorsport division provides state-of-the-art technology and services in the fields of engineering, testing, simulation, and manufacturing. We are a key supplier for teams, series and drivers. From Formula 1, as well as NASCAR or MotoGP. We believe in and utilize motorsport as the platform for innovation.

20+
Years of Experience

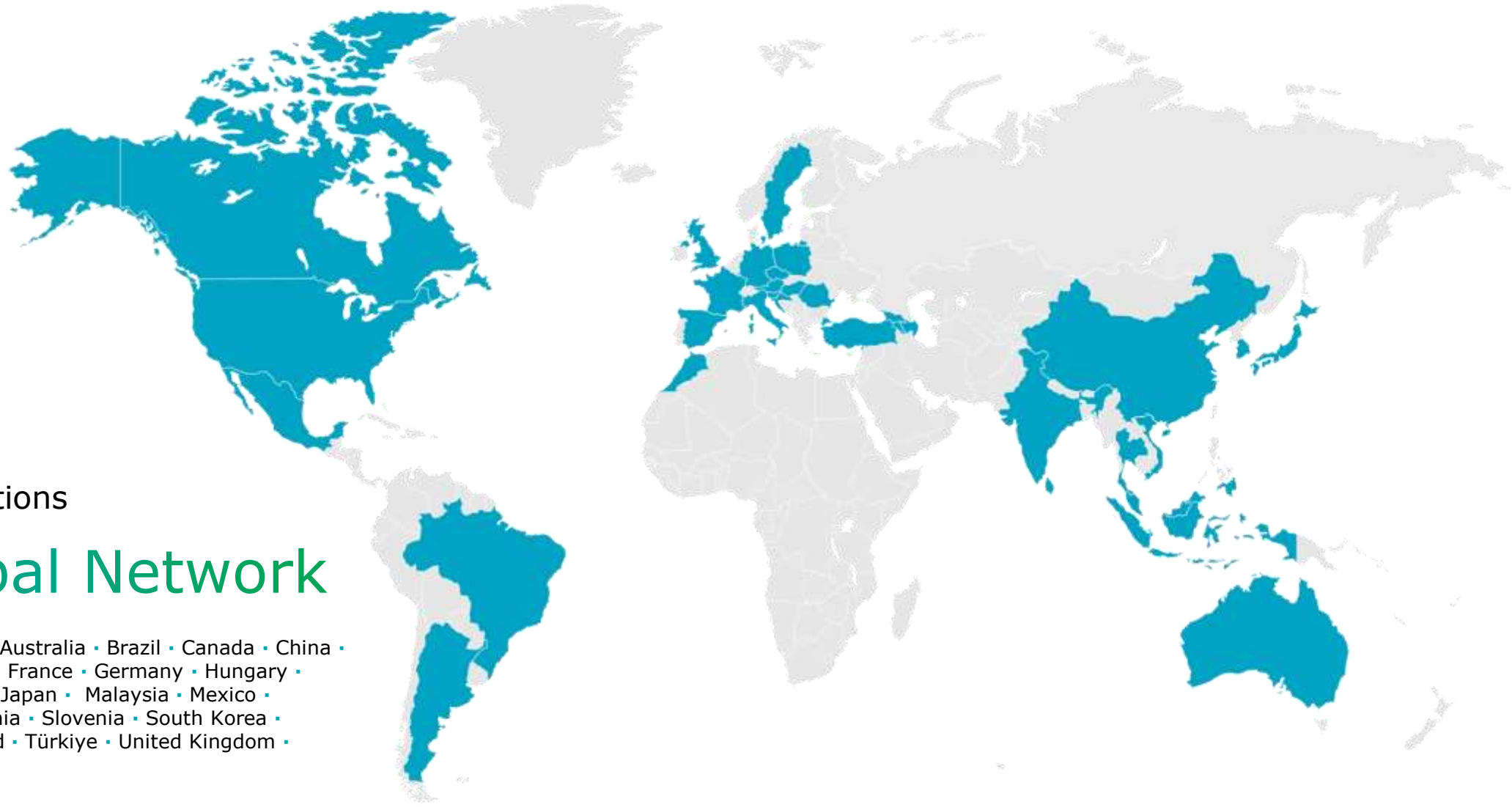
110
Employees Across Business Units

17
Race Series Worldwide with AVL RACETECH Involvement

Our Global Footprint

Strong global presence through a worldwide network of affiliates that allows us to work with our customers locally, from project start to a long-term partnership.

- Global structure and organization
- Global project execution
- Local engineers as part of a global team
- Global pool of expertise
- Global supply chain management



Worldwide Locations

Our Global Network

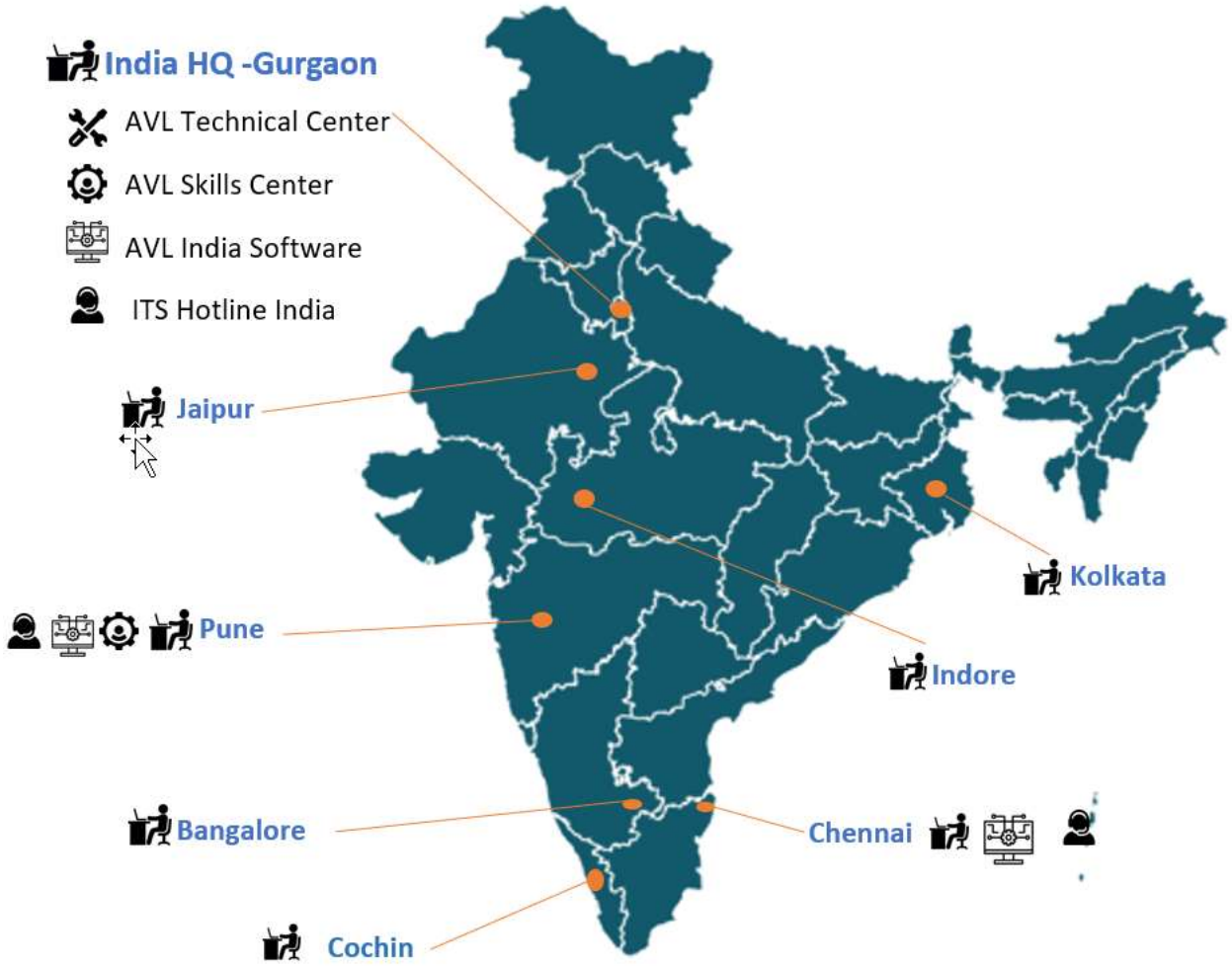
Austria, HQ | Argentina · Australia · Brazil · Canada · China · Croatia · Czech Republic · France · Germany · Hungary · India · Indonesia · Italy · Japan · Malaysia · Mexico · Morocco · Poland · Romania · Slovenia · South Korea · Spain · Sweden · Thailand · Türkiye · United Kingdom · United States · Vietnam

AVL India -Our Presence

900+
Employees

40 years of operations in India

Closer to customers with Pan India presance



AVL DiTEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT

CONTENT

- AVL DiTEST ACOUSTIC CAMERA - ACAM
- AVL DiTEST SCOPE – 1200/1400
- AVL DiTEST XMS
- AVL DiTEST HV SAFETY 2000

AVL DiTEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT

- **AVL DiTEST ACOUSTIC CAMERA - ACAM**
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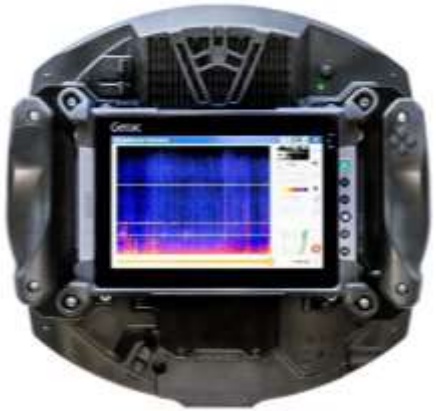
AVL DiTEST ACOUSTIC CAMERA - ACAM

Feature of ACAM:

1. The tool for locating sources of airborne noise.
2. Makes Sound visible.
3. See what you can hear.



Firmly attached 8.1’’ tablet

Unmountable 11.6’’ tablet (Optional)

AVL DiTEST ACOUSTIC CAMERA - ACAM

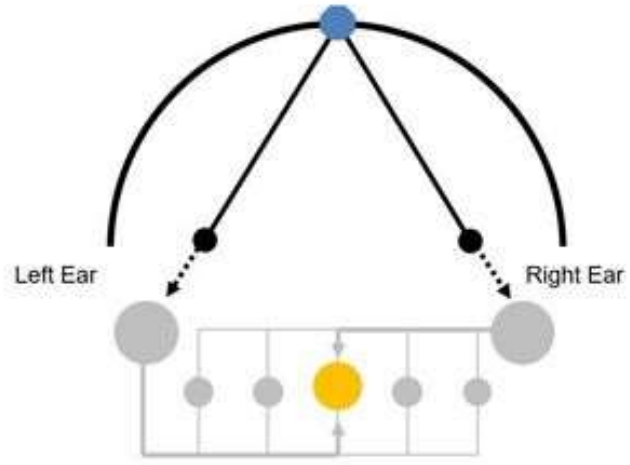
Details on ACAM:

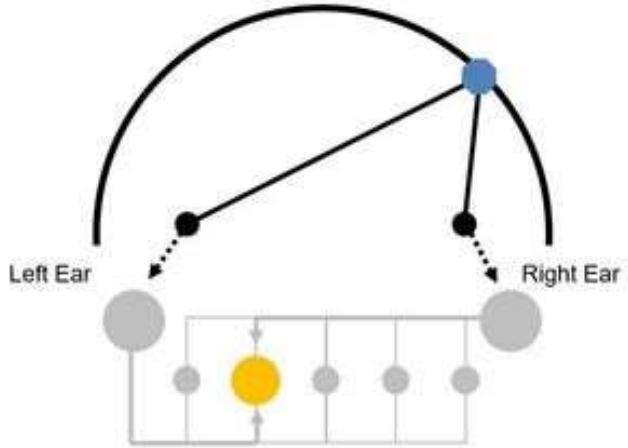
Tripod & Headphone

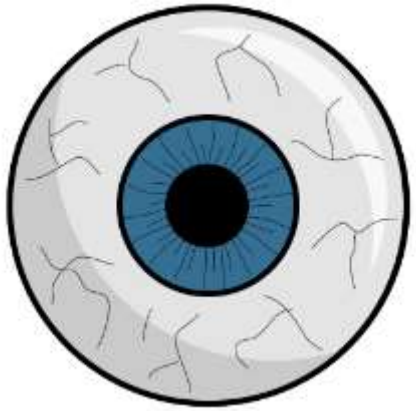
AVL DiTEST ACOUSTIC CAMERA - ACAM

Principle of ACAM Operation:

The sources of noise are located by analyzing the differences in propagation time ($Ø_1$, $Ø_2$, $Ø_3$...) of the sound waves relative to the different microphones ($Θ_1$, $Θ_2$, $Θ_2$...). At the same time, both the intensity (dB_1, dB_2, dB_3…) and the position (X_1,X_2,X_3…). are shown on the display by adjusting the measurement parameters, background noise interference can be blocked out.



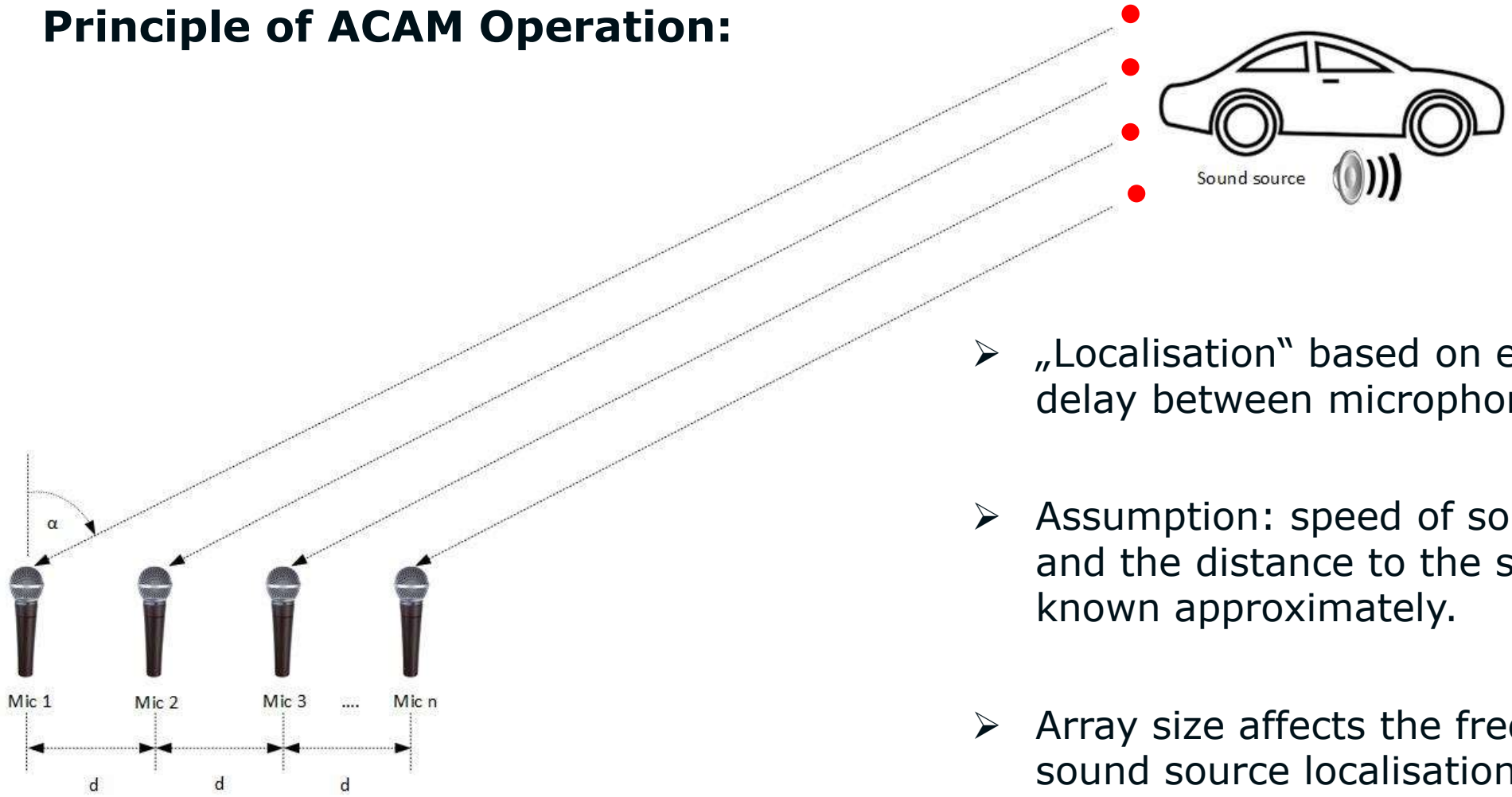




Grey Scale

AVL DiTEST ACOUSTIC CAMERA - ACAM

Principle of ACAM Operation:



- „Localisation" based on estimation of time delay between microphones.
- Assumption: speed of sound is well known and the distance to the sound source is known approximately.
- Array size affects the frequency range of sound source localisation.

Far field source ... distance to source is much greater than distance between mics

AVL DiTEST ACOUSTIC CAMERA - ACAM

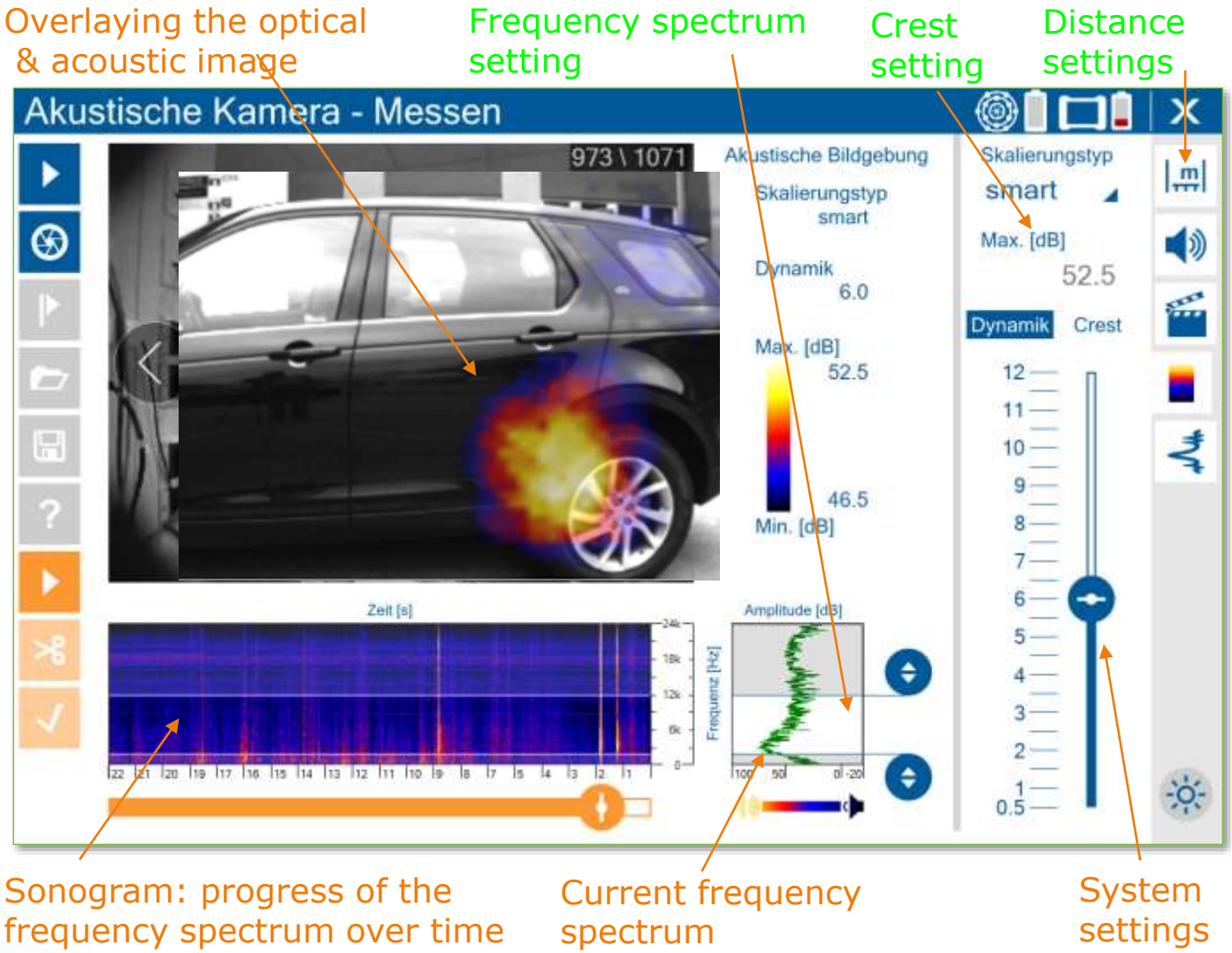
Specification of ACAM:

1. Acoustics: 64 digital MEMS microphones having frequency range 10Hz – 24KHz with sound pressure Max.120dB at sampling rate 48KHz and 24 bit resolution.
2. Optics: Digital camera (grey scales) having aperture angle ± 38° integrated with 4 LED light providing resolution 320x240 **(50fps)** or 640x480 (16fps) or **1280x960** (5fps).
3. Display: Integrated tablet with touch screen 8.1” HD or 11.6 ” (optional).
4. Accessories: Tripod, external USB trigger, 12V Charger, Case, headphones.
5. Casing: Very robust (1 m drop height), dust-proof and splash-proof (IP54).
6. Interfaces: USB for keyboard-mouse, LAN, USB (Audio wav or FLAC sound).
7. Online Performance: Up to 100 acoustic fps, up to 50 optical fps
   (Acoustic pictures, optical pictures, sonogram and spectrum)
8. Battery life: >5 hours (Li-ion).
9. OS: Linux (Windows 10 optional).

AVL DiTEST ACOUSTIC CAMERA - ACAM

ACAM at Glance:

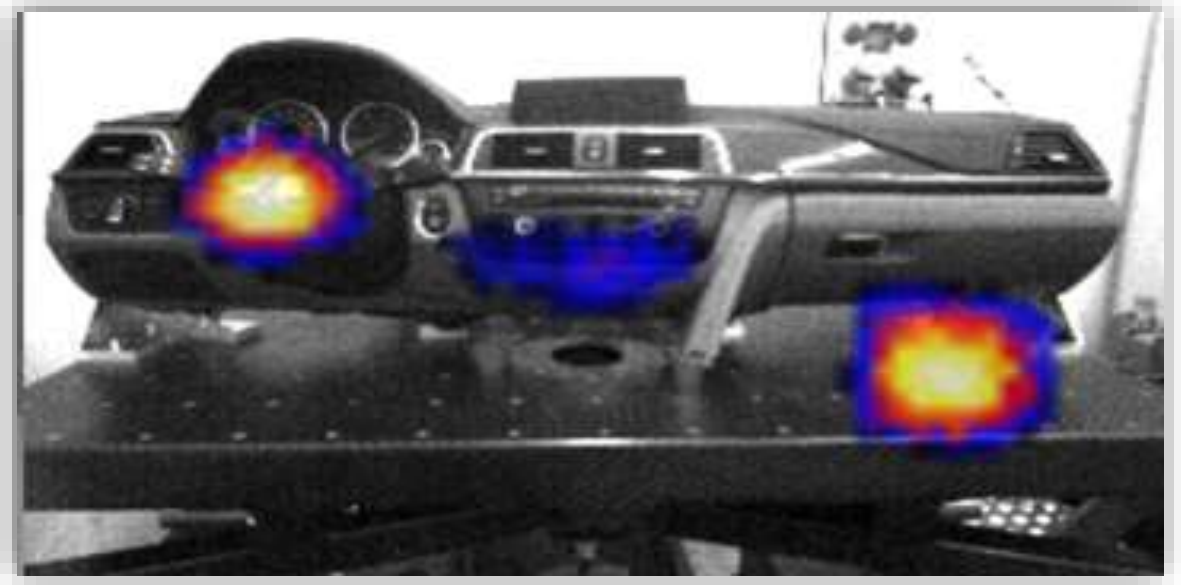
1. Large data buffer keeps measurements up to 120s in the storage
2. Both, optical and Sonogram, can be displayed in full screen mode
3. Stopping a measurement allows scrolling through the pictures (for impulsive noise)
4. Background noise interference can be blocked out by intelligent data algorithms
5. Extensive post-processing data manipulation algorithms
6. Dedicated button for activating directional microphone mode



AVL DiTEST ACOUSTIC CAMERA - ACAM

Product Application:

1. Locating Noises in the Interior (rattling, squeaking).
2. Seal Testing (door & bonnet seals, Trunk lids)
3. Engine compartment: increased noise levels from bearings, drive belt and drive chain.
4. Sound mapping in the Radiator Fan.
5. It is the ideal tool for applications such as noise reduction, quantification of noise radiation, health monitoring, and quality control.



AVL DiTEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT

- AVL DiTEST ACOUSTIC CAMERA - ACAM
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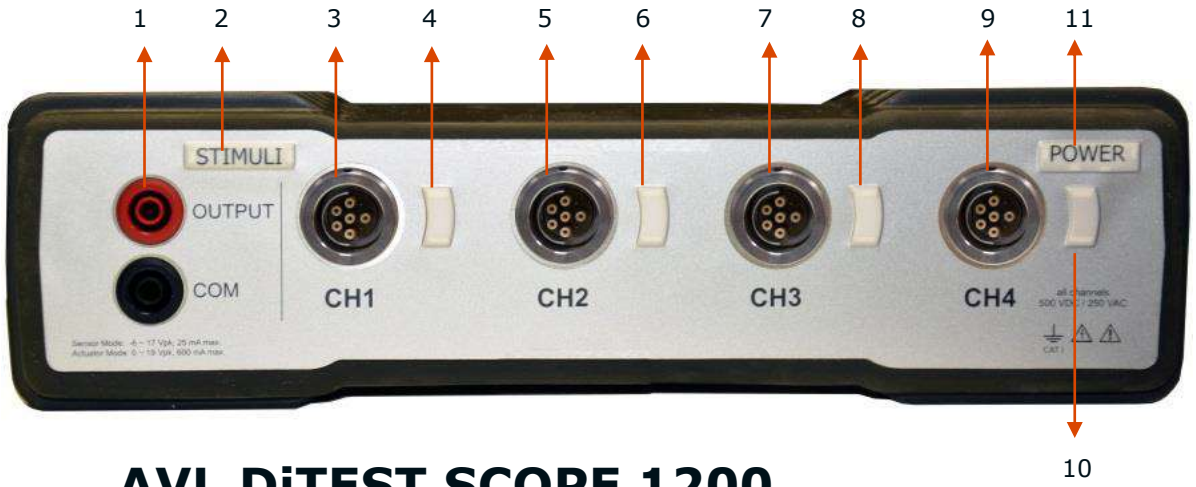
- AVL DiTEST XMS
- AVL DiTEST HV SAFETY 2000

AVL DiTEST SCOPE 1200/1400

AVL DiTEST SCOPE 1400



AVL DiTEST SCOPE 1200

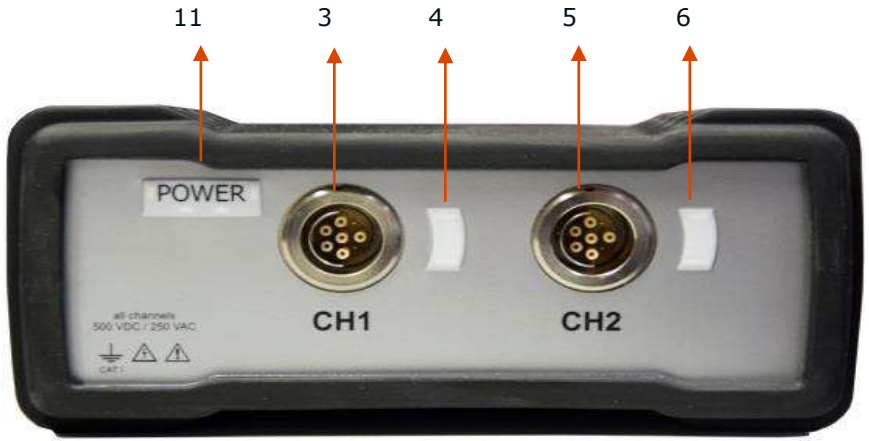


Fig Reference;

1. Stimuli Outlet
2. LED for Stimuli Status
3. Measuring inlet 1
4. LED for inlet 1 status
5. Measuring inlet 2
6. LED for inlet 2 status
7. Measuring inlet 3
8. LED for inlet 3 status
9. Measuring inlet 4
10. LED for inlet 4 status
11. Power
12. SPI Connector
13. USB Port
14. Power supply outlet

AVL DiTEST SCOPE 1200/1400

Features:

- Work as DMM and DSO.
- All channels are galvanically separated.
- Automatic sensors detection and setup.
- 1 Gb on-board memory.
- Measurement voltage 500 V DC & 350 V AC (HV-compliance).
- 2 & 4 Independent 40 MS/s input channels with 10 MHz Bandwidth.
- **Resistor measurement** : 0 to 15 Mohms.
- **Voltage measurement** : +/- 2mV-600V DC (5mV-420V AC).
- **Temperature measurement** : -20°C to 200°C.
- **Pressure measurement** : -1bar to 100bar rel.
- **Current measurement** : Over current probe 150A : +/- 1mA to 150A.
  Over current probe 1800A : +/- 0,1A to 1800A.
- Color illuminated probe connection guidance.
- IP 54 housing, full garage proof (oil, petrol resistant).

AVL DiTEST SCOPE 1200/1400

Sensor Communication:

Sensor	Image	Range	Accuracy
Universal Voltage probe		Upto 600 VDC	-
Temperature Probe (Thermocouple)		-20°C…+200°C	± 1 K for < 0 °C ± 0,5 K for 0 °C to +40 °C ± 1 K for +40 °C to +100 °C ± 2 K for > +100 °C
Ignition kV clip		Up to 50 KV AC	50kV: ±15 % ± 1000V 20kV: ±15 % ± 400V 10kV: ±15 % ± 200V
Pressure probe		-1 bar to 100 bar	Up to 24bar = 0.25% Between 30bar and 100bar = 1% Max
Resistance probe		0–15 MΩ	0,4%–2.0% of measuring range
AC/DC 100A Current probe		100A DC or AC 500A DC (1 min)	±1% of reading ± 2mA
AC/DC 1800A Current probe		1800A DC or AC 3000A < 10 ms	0-1000A : ± 0.8% of reading ± 0.5A 1000-1500A: ± 1.8% of reading ± 0.5A 1500-1800A: ± 5.0% of reading

AVL DiTEST SCOPE 1200/1400

Sensor Communication:

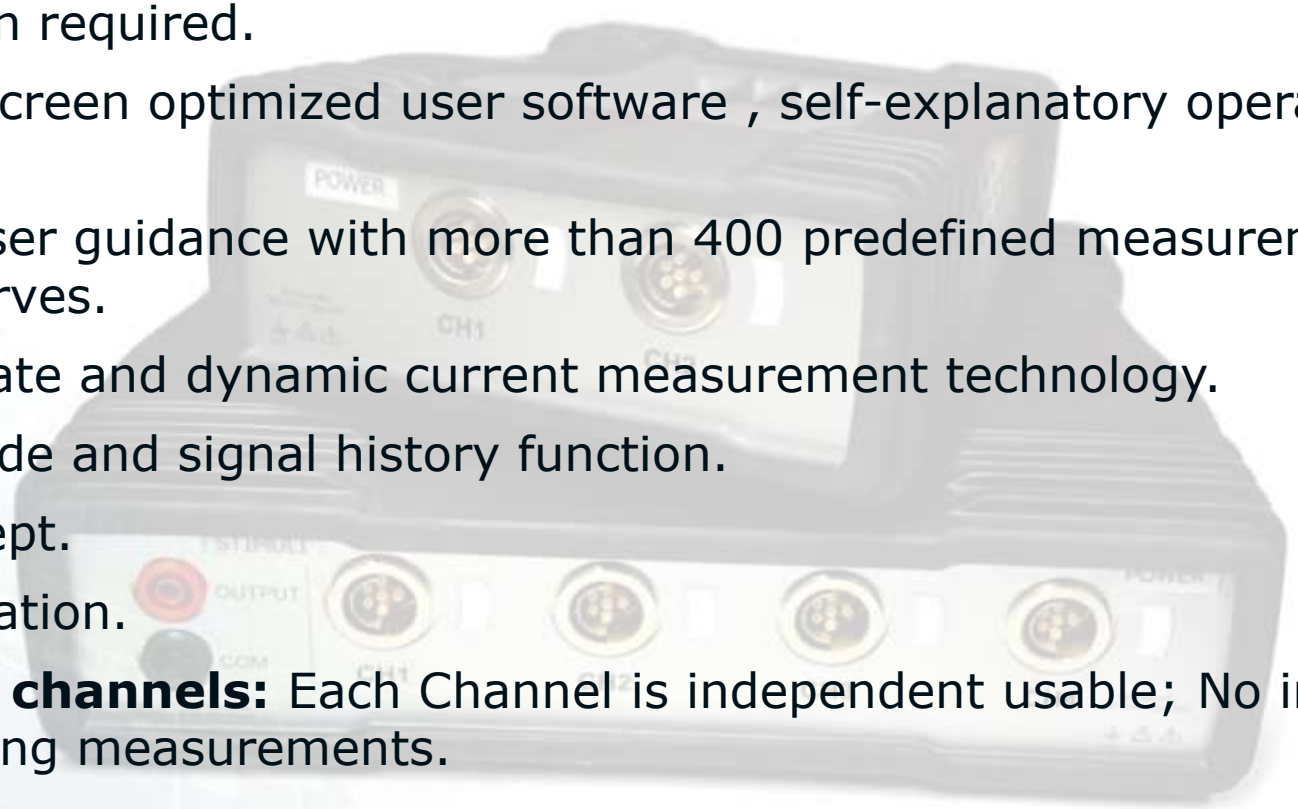
AVL DiTEST Multisense 1000

- **Stroboscope** for timing adjustments.
- **Torch** dimmable light source.
- **Microphone** record and view acoustic signals(air-borne noise).
- **Stethoscope** record and view vibrations as signals (structure-borne noise).
- **LUX meter** to measure light intensity and record and view dynamic light signals.
- **Magnetic sensor** record and view magnetic field signals.
- **Optical sensor** reflected beam sent by the Multisense 1000 gives a countable or trigger able waveform signal (e.g.: RPM or timing measurement).

AVL DiTEST SCOPE 1200/1400

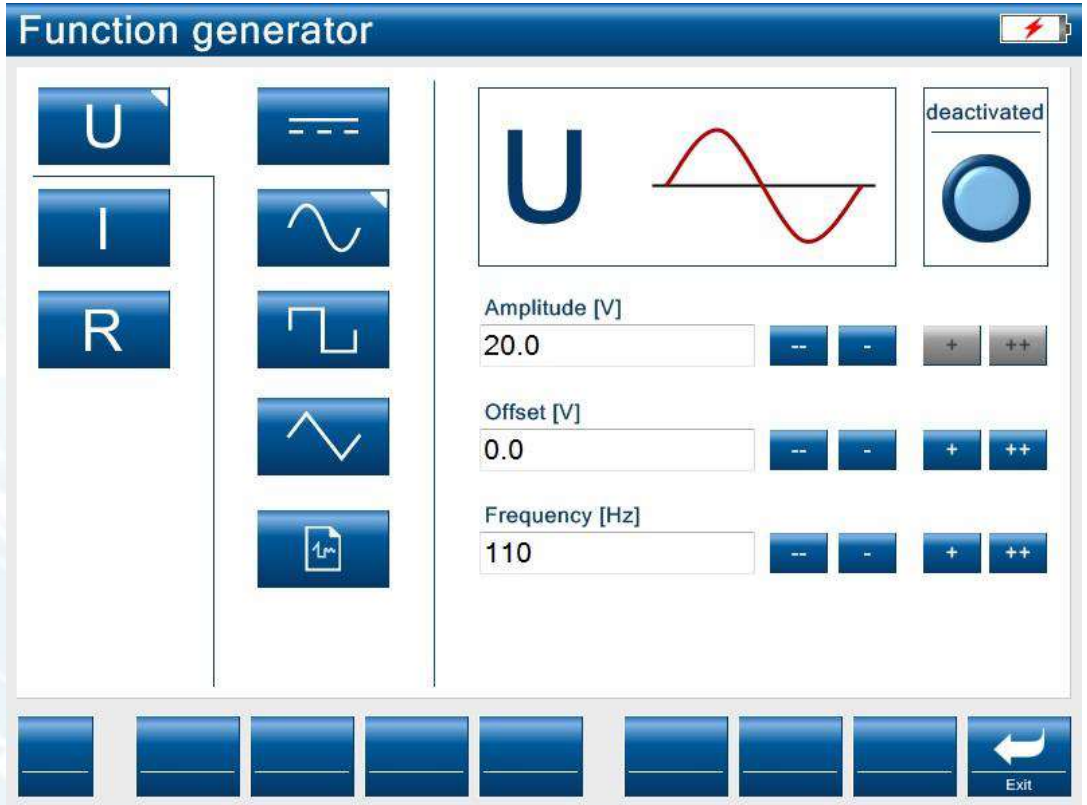
Benefits:

- ✓ Stable, lightweight device design in a very robust housing made of ultra-light magnesium.
- ✓ No calibration required.
- ✓ Multi touch screen optimized user software , self-explanatory operation thus less training effort.
- ✓ Intelligent user guidance with more than 400 predefined measurement setups with reference curves.
- ✓ Highly accurate and dynamic current measurement technology.
- ✓ Recorder mode and signal history function.
- ✓ Plug in concept.
- ✓ Galvanic isolation.
- ✓ **Differential channels:** Each Channel is independent usable; No influence from ground-currents during measurements.



AVL DiTEST SCOPE 1200/1400

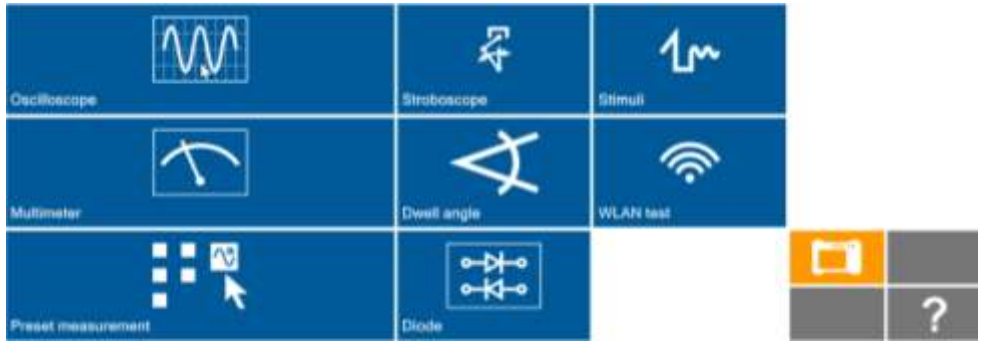
STIMULI GENERATOR

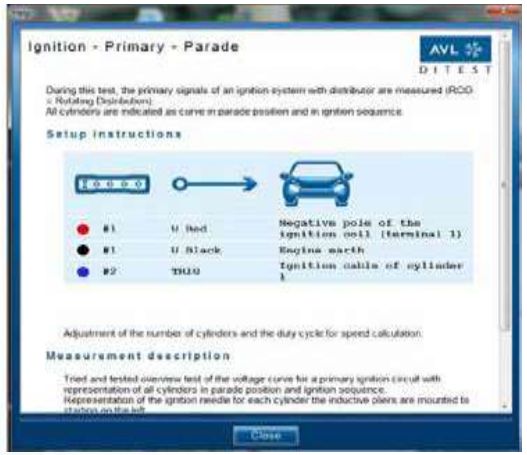


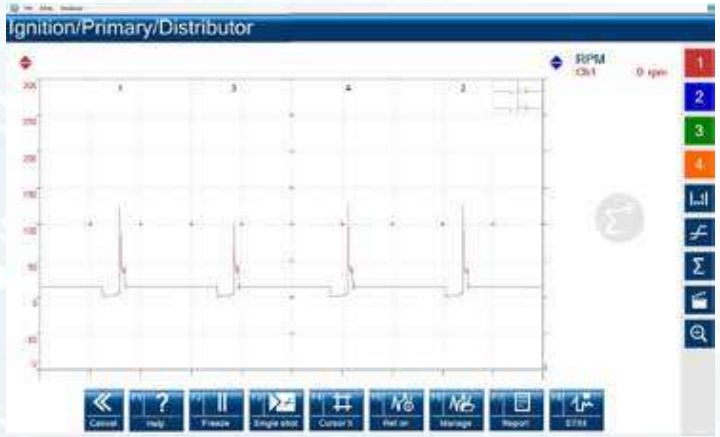
- For active signaling of AC/DC signals +/- 17 volts and up to 11.5 watts.
- Signal frequency up to 100Hz or for the simulation of faster sensor signals.
- -6V to + 17V and up to 24mA, with a 1M Sample signal rate
- Standard Signal Pattern: Sine Rectangle Triangle with Offset and Duty Cycle or Abitrary generatable via file recording.
- For signal simulation of sensor signals to see the result in the ECU data list.
- Measurement sensor circuit control.
- For active actuation of actuators, e.g. Relay u. actuator circle control.

AVL DiTEST SCOPE 1200/1400

Software:







AVL DiTEST SCOPE 1200/1400

Connection Example:

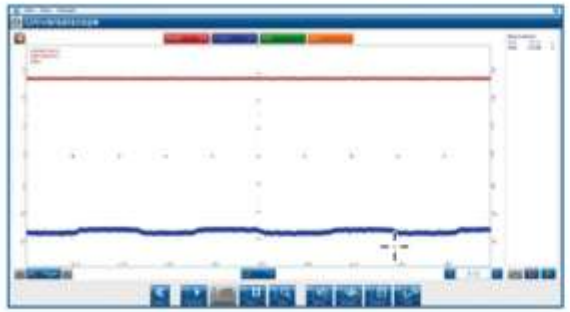
MEASUREMENT OF MODERN IGNITION SYSTEMS.

Measurement of modern ignition systems, no additional adapter needed. Immediate evaluation of all relevant nominal values (includes reference curve comparison).

MEASUREMENT OF RESISTANCE, VOLTAGE AND POWER CURVES FOR INJECTION VALVES.

Simultaneously measure resistance (curve and nominal value), voltage curve and current curve for injection valves.

SIMULTANEOUSLY MEASURE BATTERY VOLTAGE AND VOLTAGE SUPPLY TO LAMBDA SENSOR.



Oscilloscope display: battery voltage andlambda heater supply.

Multimeter display: battery voltage and lambda heater supply.

AVL DiTEST MEASUREMENT AND DIAGNOSTIC EQUIPMENT

- AVL DiTEST ACOUSTIC CAMERA - ACAM
- AVL DiTEST SCOPE – 1200/1400
- **AVL DiTEST XMS**
- AVL DiTEST HV SAFETY 2000

AVL DiTEST XMS

Interfaces:

XTENDED MEASUREMENT SYSTEM

- **4 analog high-precision input channels**
  - ✓Analog input 1 : Measurement of voltage (500 V), current (2 A) and resistance (10 MΩ).
  - ✓Analog input 2 : Measurement of voltage (500 V with adapter) or current clamp.
  - ✓Analog input 3 : Measurement of voltage, current probe or trigger clamp.
  - ✓Analog input 4 :Measurement of voltage, current probe or kV clamp.
- **1 digital input channel**
  - ✓Can support inputs via SPI interface and CAN.
- **1 stimulus output**
  - ✓Sensor simulation up to 40 V and 120 mA.
- **2 Wifi modules**
  - ✓2x WiFi 2.4 and 5 GHz 802.11 a/b/g/n.
- **1 Bluetooth module**
  - ✓1x Bluetooth 4.0

AVL DiTEST XMS

Interfaces:

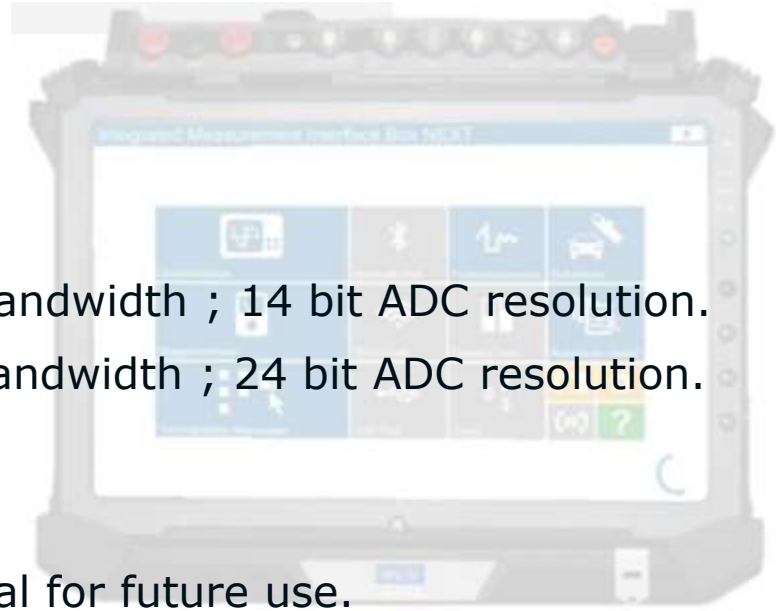
XTENDED MEASUREMENT SYSTEM

- **USB port**
  - ✓The USB test will check the voltage and current supply of the USB port (of the vehicle) and the ability to connect data storage devices.
- **Low-pressure hoses connectors**
  - ✓ Max. 2,5 bar – e.g.: quick assessment of exhaust pressure and inlet pressure.
- **Ethernet port**
  - ✓Allows integration into a LAN.
- **Rechargeable battery**
  - ✓ Approx. 4 hrs / 2 hrs runtime of combination base unit with tablet (1 / 3 channel mode).
- **Getac F110 G4 tablet**
  - ✓ Premium fully rugged with 11.6” display, 16 GB RAM, 1TB SSD embedded with Intel Core i5 CPU processor.

AVL DiTEST XMS

Key Features:

- **Modularity**
  - ✓ Complete in-house development.
  - ✓ Extension board allows hardware changes.
  - ✓ New wired and wireless sensors can be mounted.
- **Performance**
  - ✓ 2 High-performance analog channels : 40 MS/s with 10 MHz bandwidth ; 14 bit ADC resolution.
  - ✓ 2 Mid-performance analog channels : 200 kS/s with 100kHz bandwidth ; 24 bit ADC resolution.
  - ✓ CAN/SPI digital interface.
  - ✓ Radio / wireless communication.
  - ✓ Internal FPGA and high-performance CPU provide high potential for future use.
- **Cost Effectiveness**
  - ✓ "2 in 1" this can used both as an oscilloscope and as a data logger; **One tool for multiple applications.**
- **Maintenance**
  - ✓ All components are selected such that a **long life availability** is provided.



AVL DiTEST XMS

Sensor Communication:

Sensor	Image	Range	Accuracy
Universal Voltage probe		Upto 600 VDC	-
Temperature Probe (Thermocouple)		-20°C…+200°C	± 1 K for < 0 °C ± 0,5 K for 0 °C to +40 °C ± 1 K for +40 °C to +100 °C ± 2 K for > +100 °C
Ignition kV clip		Up to 50 KV AC	50kV: ±15 % ± 1000V 20kV: ±15 % ± 400V 10kV: ±15 % ± 200V
Pressure probe		-1 bar to 100 bar	Up to 24bar = 0.25% Between 30bar and 100bar = 1% Max
Resistance probe		0–15 MΩ	0,4%–2.0% of measuring range
AC/DC 100A Current probe		100A DC or AC 500A DC (1 min)	±1% of reading ± 2mA
AC/DC 1800A Current probe		1800A DC or AC 3000A < 10 ms	0-1000A : ± 0.8% of reading ± 0.5A 1000-1500A: ± 1.8% of reading ± 0.5A 1500-1800A: ± 5.0% of reading

AVL DiTEST XMS

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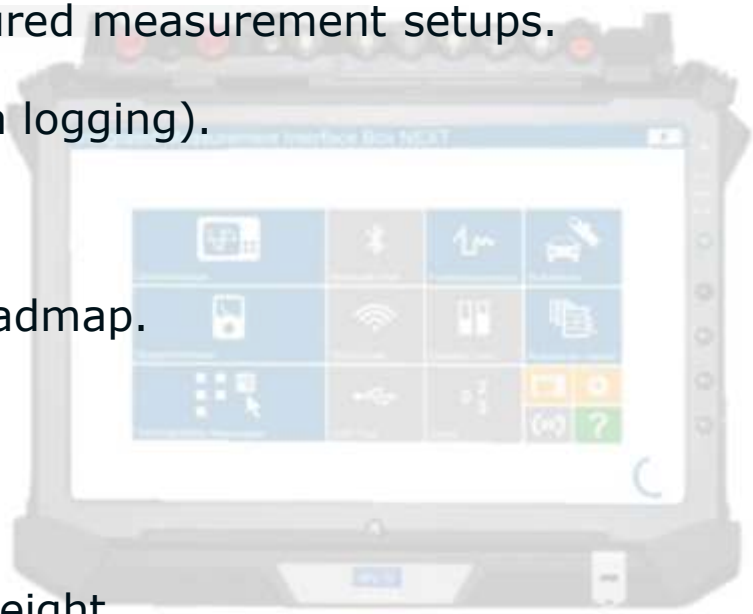
- **LUX meter** to measure light intensity and record and view dynamic light signals.
- **Magnetic sensor** record and view magnetic field signals.
- **Optical sensor** reflected beam sent by the Multisense 1000 gives a countable or trigger able waveform signal (e.g.: RPM or timing measurement).

AVL DiTEST XMS

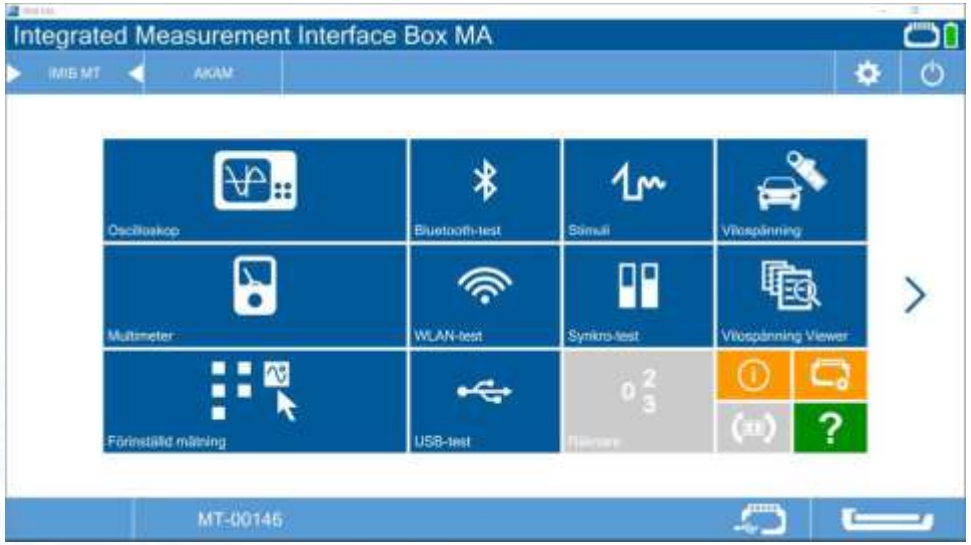
Benefits:

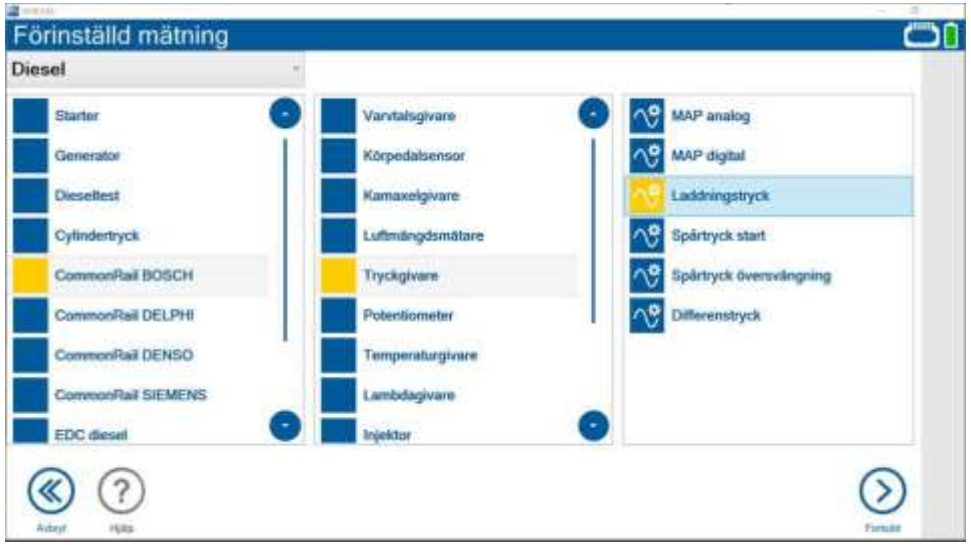
- Measures analog and digital signals with large number of pre-configured measurement setups.
- High application-specific versatility (high-performance scope vs. data logging).
- Large variety of long-term validated automotive sensors.
- Integration of wireless sensors possible and on R&D development roadmap.
- Multimedia test functions (USB, WLAN, Bluetooth) integrated.
- Protection class: IP 54 (Guaranteed drop height 90 cm).
- Dimensions: 316 mm x 237 mm x 73 mm (W x D x H) with 1kg of weight.
- Operating temperature range : 0 °C to 40 °C.

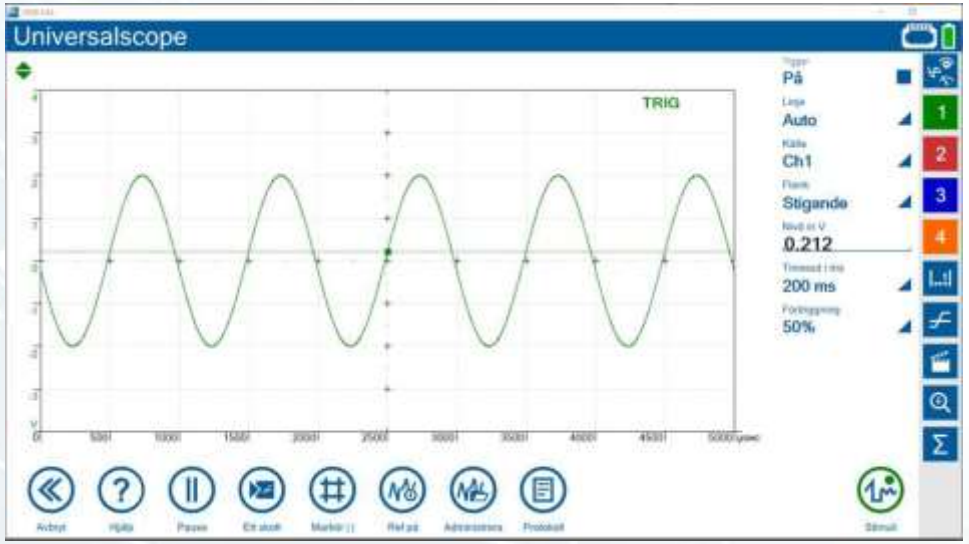


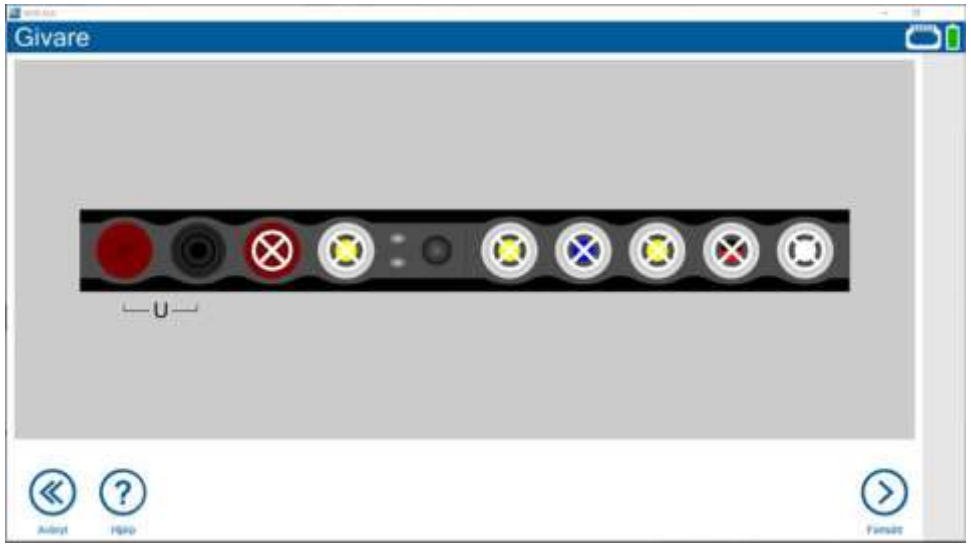
AVL DiTEST XMS

Software









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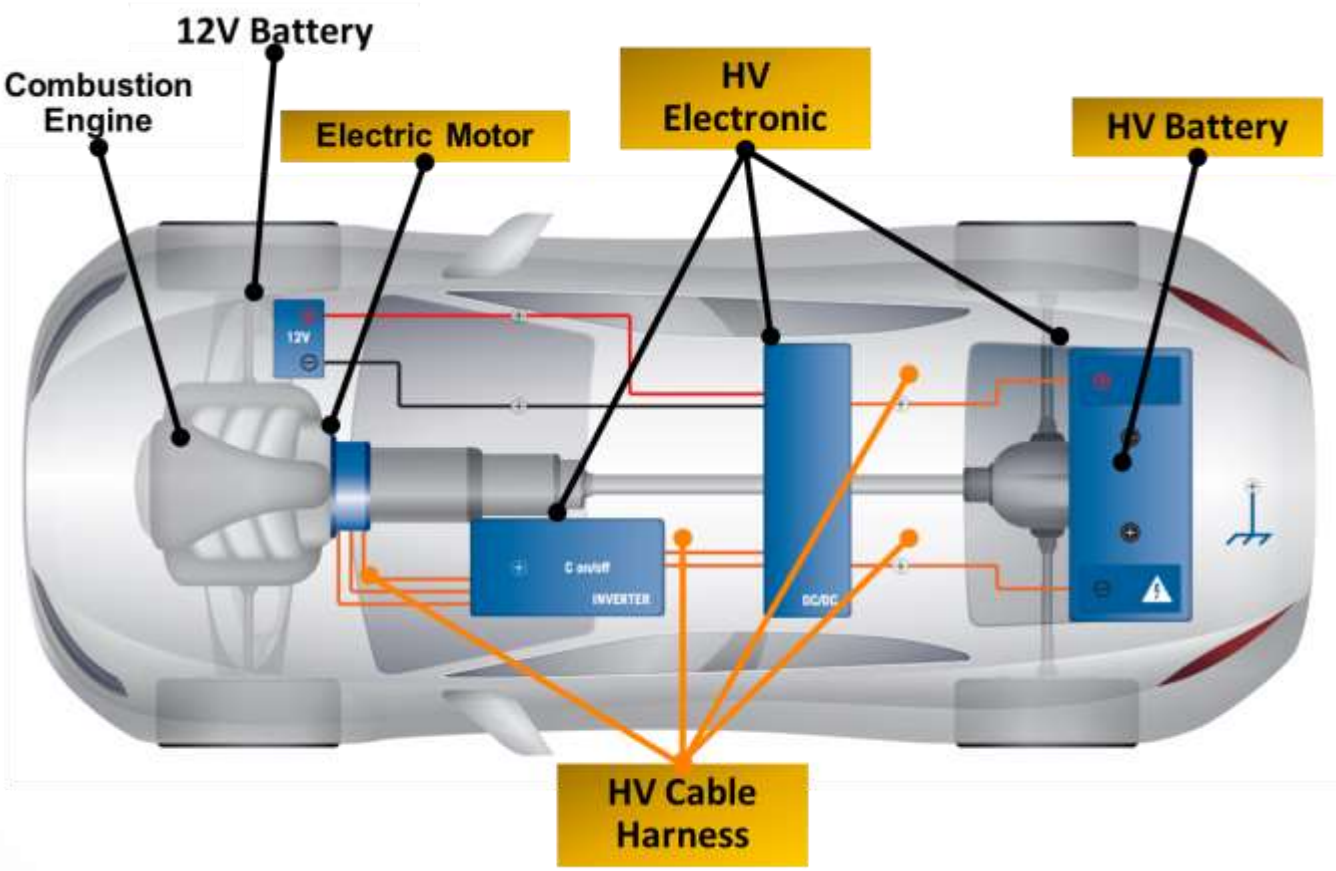
AVL DiTEST HV SAFETY 2000

ALL voltage > 60V DC and > 30V AC are defined as „HIGH VOLTAGE" (HV)

HV symbol

Orange cable (HV)

Documentation ✓
& Guidance ✗



AVL DiTEST HV SAFETY 2000

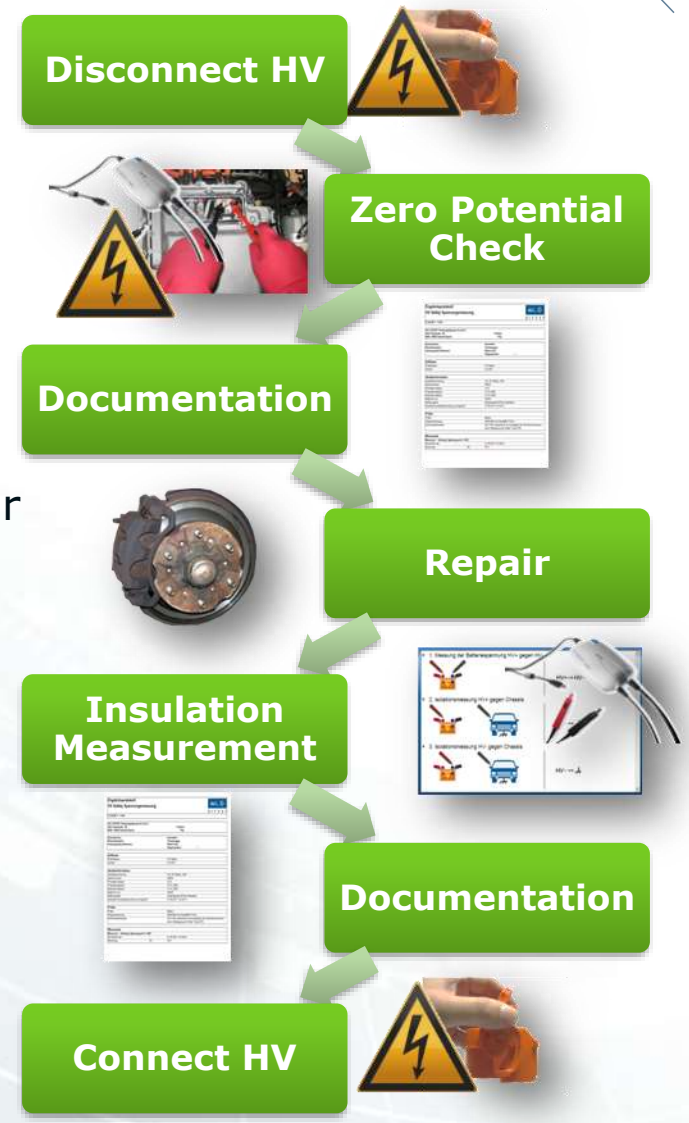
LEGAL BASIS: AIS-038 (ECR R 100), AIS- 048 (USABC, ISO/IEC) and SAE J 1766

Test for Electric Vehicles:

1. All pole voltage measurement
2. HV insulation measurement
3. Equipotential bonding check
4. SAE J1766 measurement
5. Insulation monitor check
6. *Resistance measurement*
7. *Capacity measurement*

AVL DiTEST HV SAFETY 2000

1. Calibration possible
2. Comprehensive automatic documentation
3. Password for user authorization
4. User guidance and evaluation of results
5. Self test
6. Legal security



Test and Documentation!

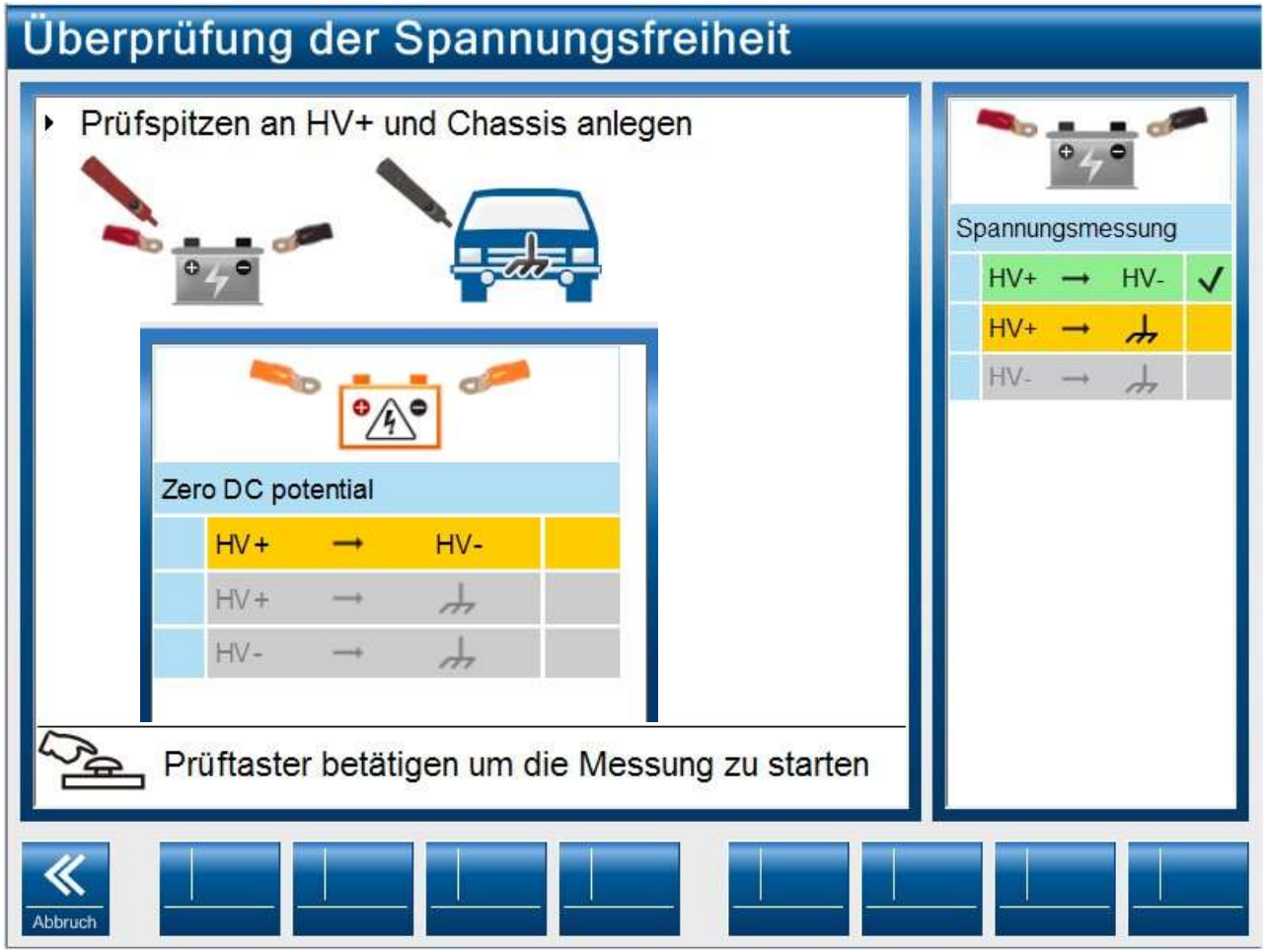
Take care that the vehicle's HV- system is deenergized before you start working on it!

Multimeter must not be used on high voltage systems
Multimeter tools are not suitable for HV- systems!

The HV- system has to be taken as active (energized) till the evidence of deactivation is given and documented

AVL DiTEST HV SAFETY 2000

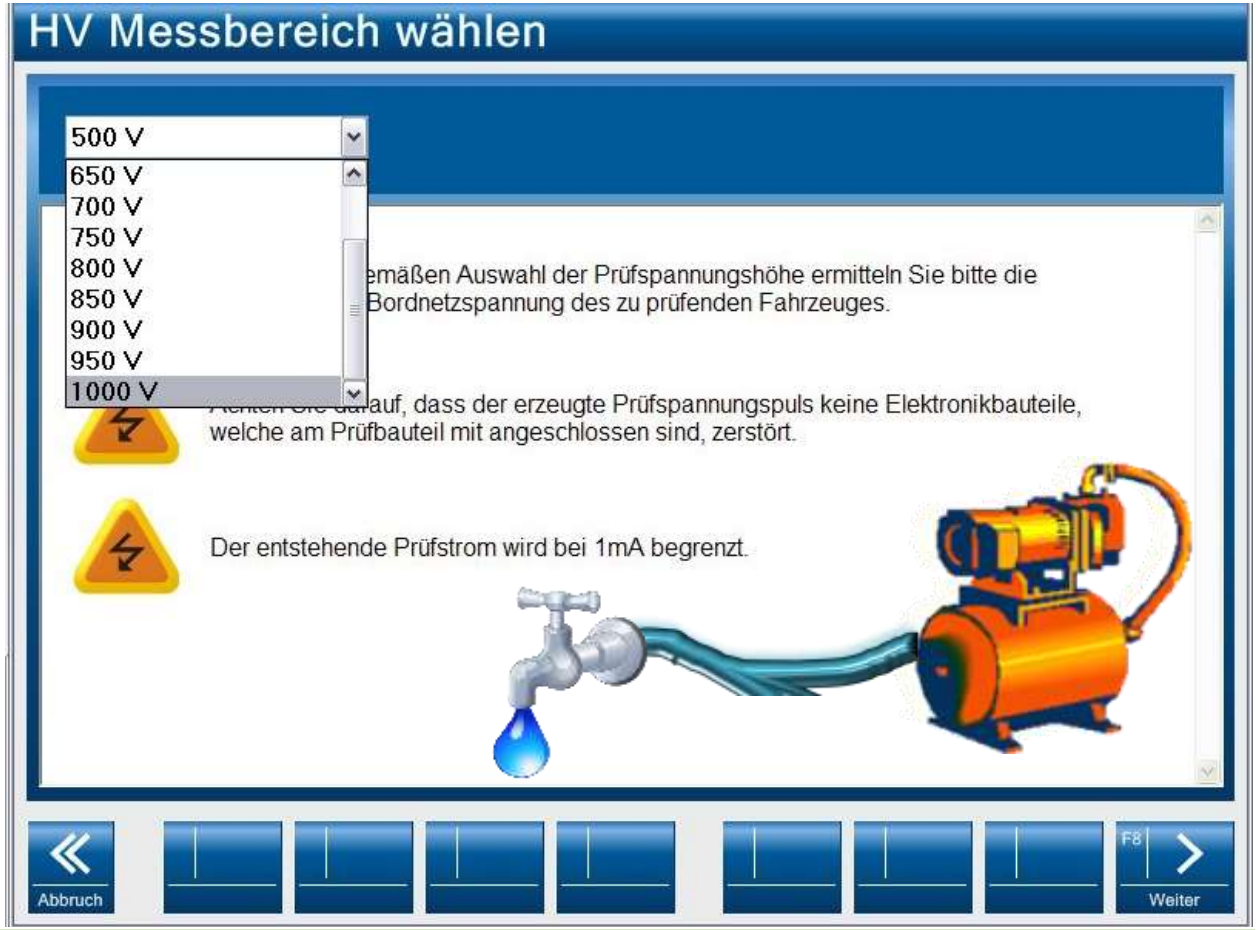
All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement



Rule: Zero Potential Check Before Repair Work

AVL DiTEST HV SAFETY 2000

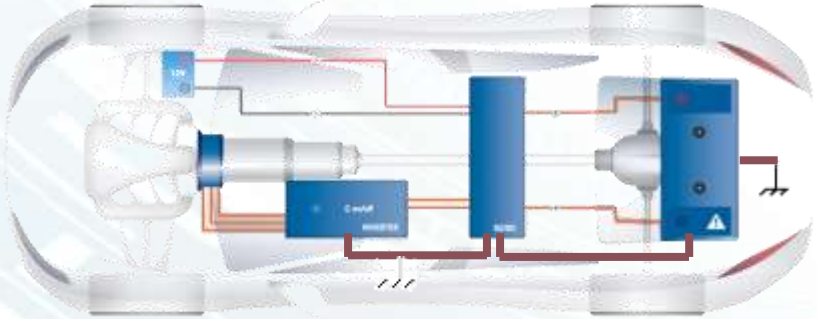
All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement

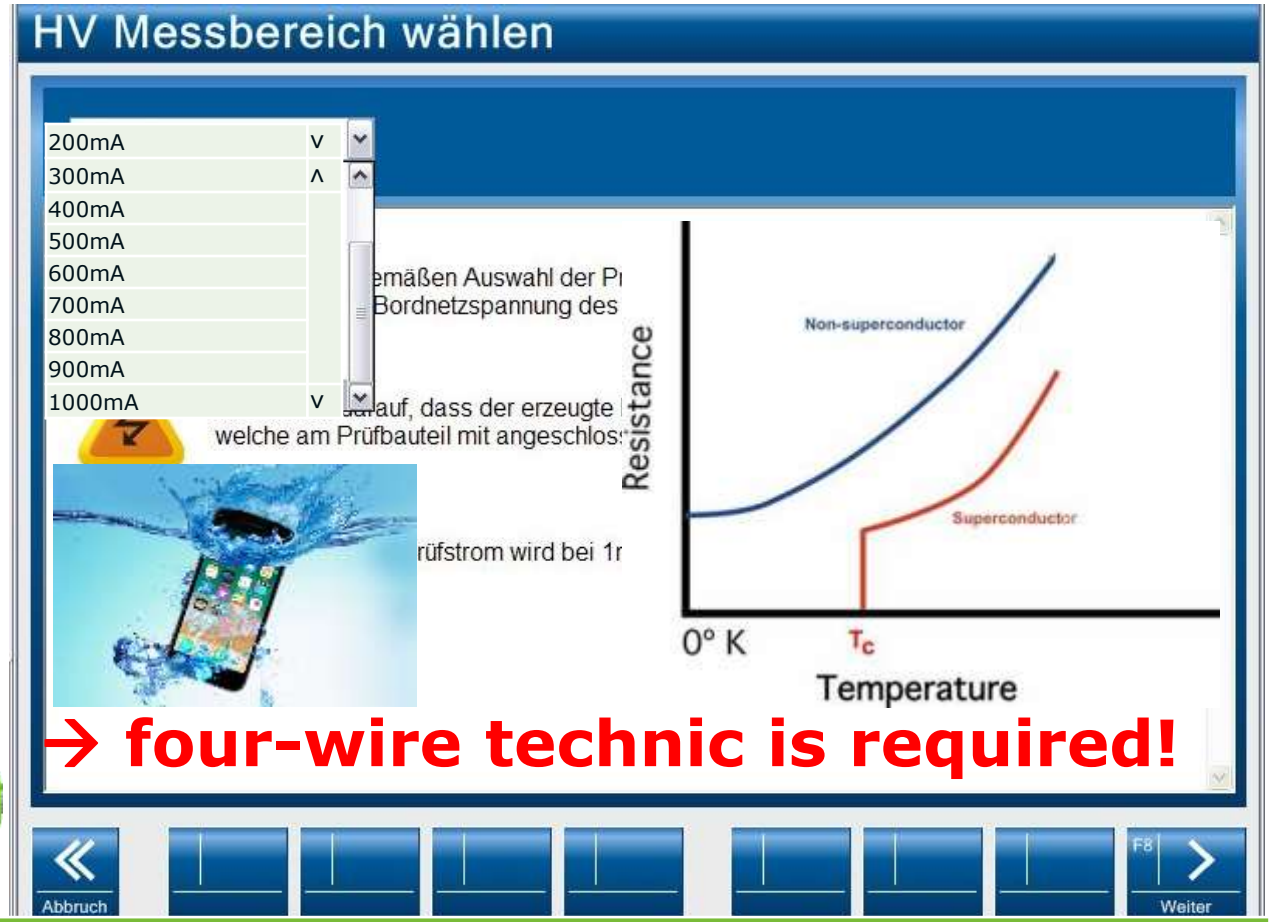


Rule: Resistance in Ω per 1V applied test voltage should be >1000 Ω / Volt

AVL DiTEST HV SAFETY 2000

All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement





Rule: Resistance measured by applying Test current of 200mA to 1000mA in 100 mA steps ≤100 mΩ

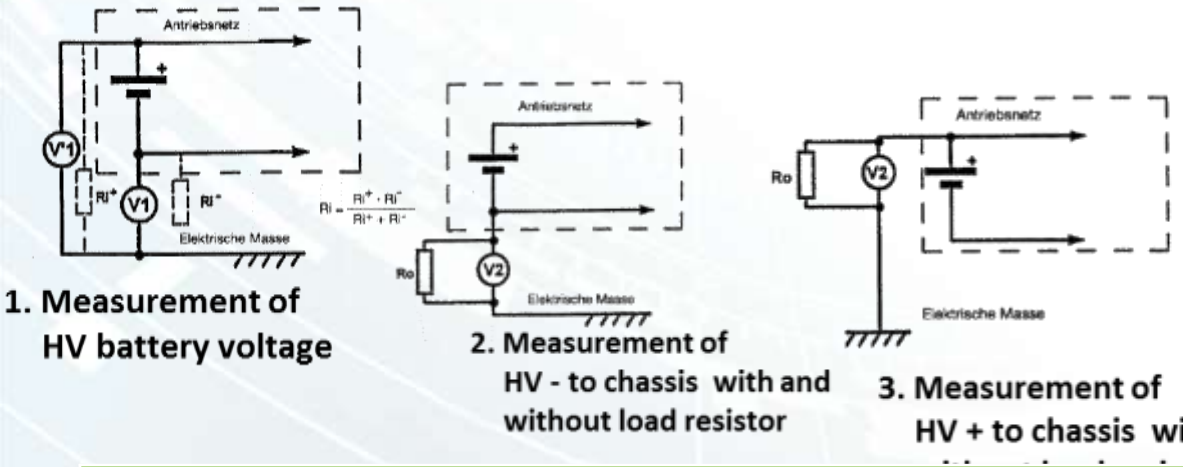
AVL DiTEST HV SAFETY 2000

All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement

Rule: Voltage drop measurement:

First step with a high internal Resistance of the tool ≥ 1MΩ

Second step with an internal load resistor 500 x of the nominal HV battery voltage (400V - > 200k Ω



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

$$Ri = \frac{V_1 - V_2}{V_2} \cdot Ro$$

or

$$Ri = \frac{V'_1 - V_2}{V_2} \cdot Ro$$

Rule: Insulation Measurement on an energized system >500 Ω/V

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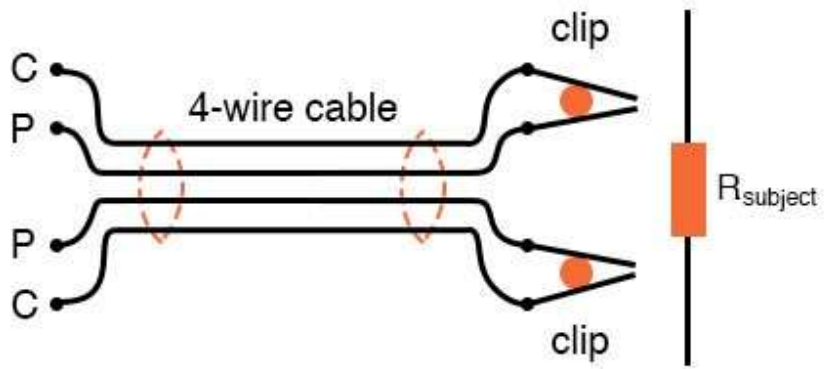
All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement

Rule: Insulation value is measured at which the MIL show alerts by using POT (500k Ω) in the tool @ min. 500 Ω /V

AVL DiTEST HV SAFETY 2000

All pole voltage measurement
HV insulation measurement
Equipotential bonding check
SAE J1766 measurement
Insulation monitor check
R and C measurement

Kelvin clips



Resistance measurement

Standard resistance measurement

10 mΩ - 10 MΩ @ test current of max. 5mA

- **tool safety check**
- **Zero balancing**
- **Documentation**

Capacity measurement

Standard Capacity Measurement

1 nF - 300 µF

- **tool safety check**
- **Zero balancing**
- **Documentation**

Thank you

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