



# **Ciclo de vida de la medida en el desarrollo de componentes electrónicos para la automoción**

Tres Cantos – Madrid  
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# This is Lear



# Seating and Electrical Capabilities

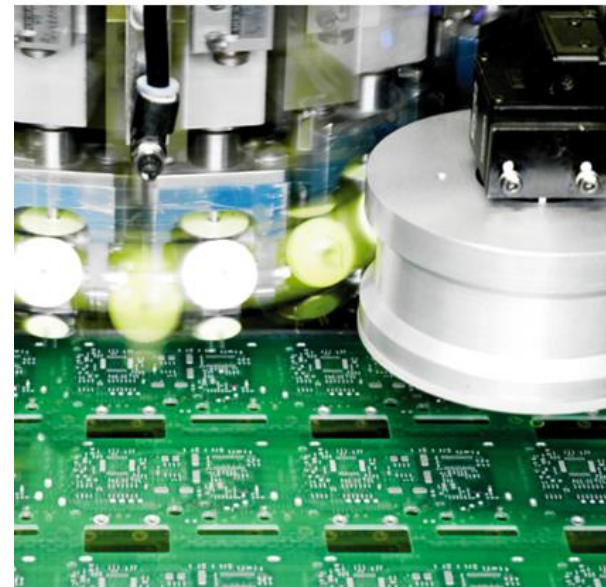
## Seating

- **Strong Market Position** -- One of two independent seat suppliers with global scale and complete component capabilities; 2014 sales of \$13.3 billion
- **Key Capabilities** -- Complete automotive seat systems, seat covers (including cut & sew, fabric and leather), mechanisms & structures and foam



## Electrical

- **Strong Market Position** -- One of four suppliers with global capability in both traditional and high-power electrical distribution systems; 2014 sales of \$4.4 billion
- **Key Capabilities** -- Traditional electrical distribution systems, emerging high-power systems and related components, including connectors, smart junction boxes and battery chargers



# Global Capabilities with Low-Cost Footprint

**235** IN **34**  
 FACILITIES COUNTRIES



- ARGENTINA
- AUSTRALIA
- CANADA
- FRANCE
- GERMANY
- ITALY
- JAPAN
- NETHERLANDS
- SINGAPORE
- SOUTH KOREA
- SPAIN
- SWEDEN
- UNITED KINGDOM
- UNITED STATES
- BRAZIL
- CHINA
- CZECH REPUBLIC
- HONDURAS
- HUNGARY
- INDIA
- INDONESIA
- MALAYSIA
- MEXICO
- MOLDOVA
- MOROCCO
- PHILIPPINES
- POLAND
- ROMANIA
- RUSSIA
- SLOVAK REPUBLIC
- SOUTH AFRICA
- THAILAND
- TUNISIA
- VIETNAM

**136.000**  
 EMPLOYEES

LOW-COST  
 FOOTPRINT  
**20**  
 COUNTRIES

# We Serve All of the World's Major Automakers



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**POWERING IDEAS THAT DELIVER™**

By providing our customers the best ideas, industry-leading innovation and breakthrough technology from the best go-to team in the industry, Lear's Electrical Power Management Systems is able to combine performance, global resources and systems-level knowledge to meet our customers' high standards with uncompromising value. Lear's Electrical + Electronics product portfolio includes:

**ELECTRICAL DISTRIBUTION SYSTEMS**

- Wire Harnesses
- Smart Execution Process™
- Alternative Wire Solutions
- Global, low-cost footprint



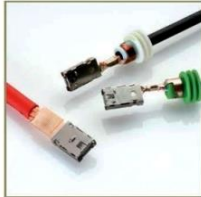
**BODY ELECTRONICS**

- Advanced, highly integrated core body controllers
  - Gateway Modules
  - Door Zone Modules
  - Seat Controls
- Battery Monitoring Systems



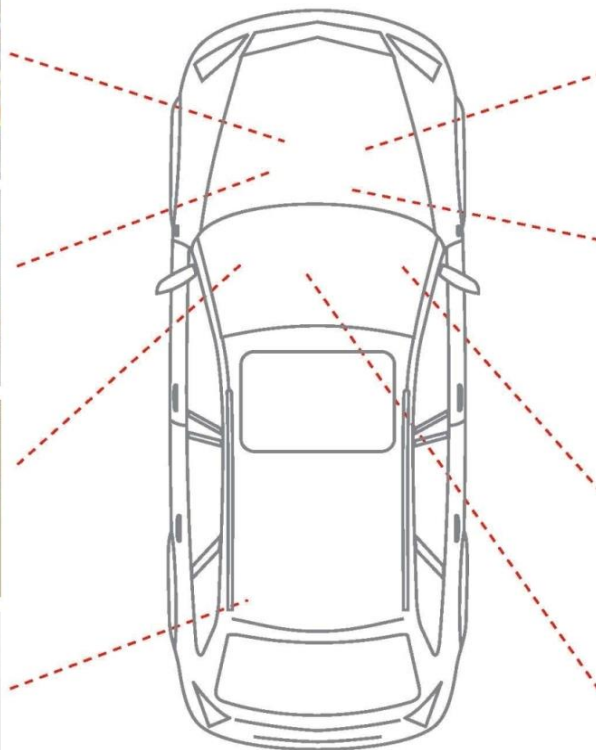
**TERMINALS & CONNECTORS**

- Full T&C Systems
- High Power T&C Systems
- High Voltage T&C Systems
  - Pin Headers
- Fuse & Pre-Fuse Boxes
- Bus Bars



**WIRELESS TECHNOLOGY**

- Passive Entry Systems
- Remote Keyless Entry



**HIGH POWER**

- Charging Systems (included wireless)
- High Power Distribution Systems
- High Power Energy Management



**JUNCTION BOX**

- Passive Junction Boxes
- Smart Junction Boxes
- Solid State Junction Boxes



**AUDIO**

- 2 – 22 Channel Audio Amplifiers
- Sound system integration and tuning expertise



**LIGHTING**

- Interior LED Lighting Control
- Exterior Lighting Control
- Adaptive FrontLight Systems
- LED Signal
- LED Matrix



# Lear Electrical Innovation

## Efficiency

- **Copper-Clad Steel Wire**
- Traditional and High-Power
- Aluminum Terminals
- Aluminum Wire
- **Solid State Smart Junction Box™**
- **Most Highly Integrated Body Control Module**
- Custom Terminals & Connectors
- Highest Power to Size Ratio Terminals
- **Aluminum Printed Circuit Board**
- **Conductive Plastics**
- 96% Efficient EV Charging
- Industry-Leading Size and Weight Power Electronics



## Connectivity

- **2-way Remote Keyless Entry**
- Advanced Passive Entry / Start
- In-Vehicle Wireless Connectivity
- EV Charging and Grid Communication

## Advanced Features

- **LED Matrix Beam Control**
- Seat Massage Contour Module
- Wireless EV Charging
- Ambient Lighting
- Audio Amplifiers and Controls

## Process

- High Output T&C Tooling
- Miniaturized Terminal Crimping
- Modular Frameless Power Distribution Box

### First-to-Market Innovations

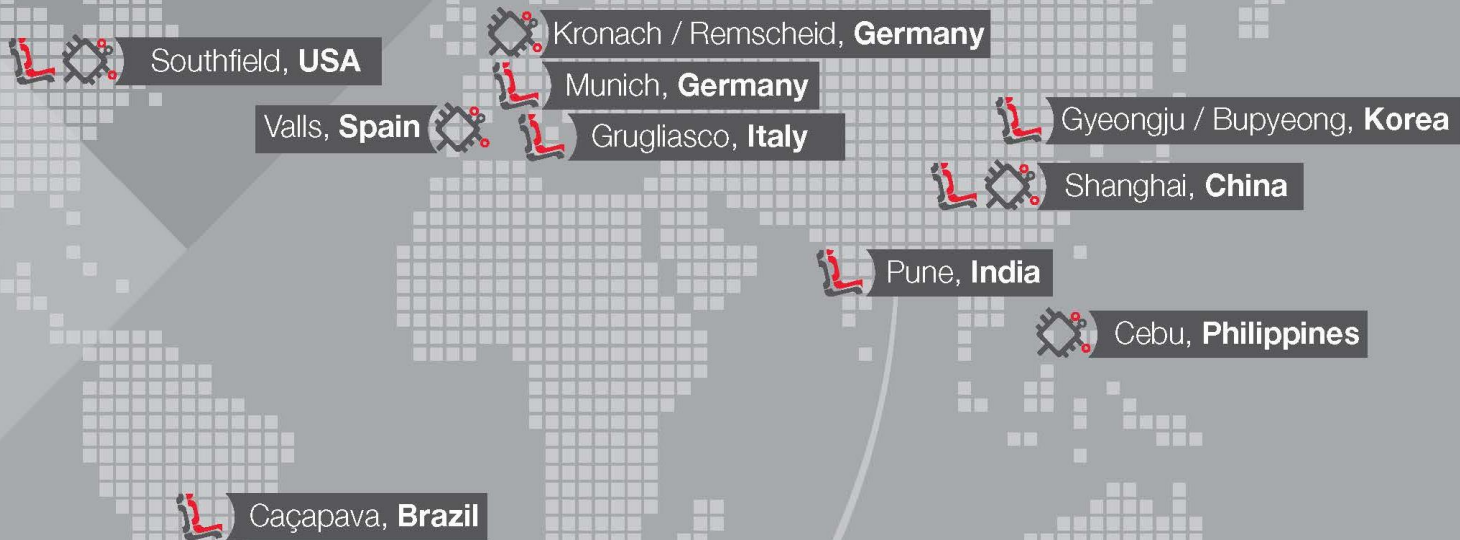


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# Laboratory Capabilities Overview





 **Electrical**  
 Southfield, **USA** / Kronach - Remscheid, **Germany** / Valls, **Spain** / Cebu, **Philippines** / Shanghai, **China**

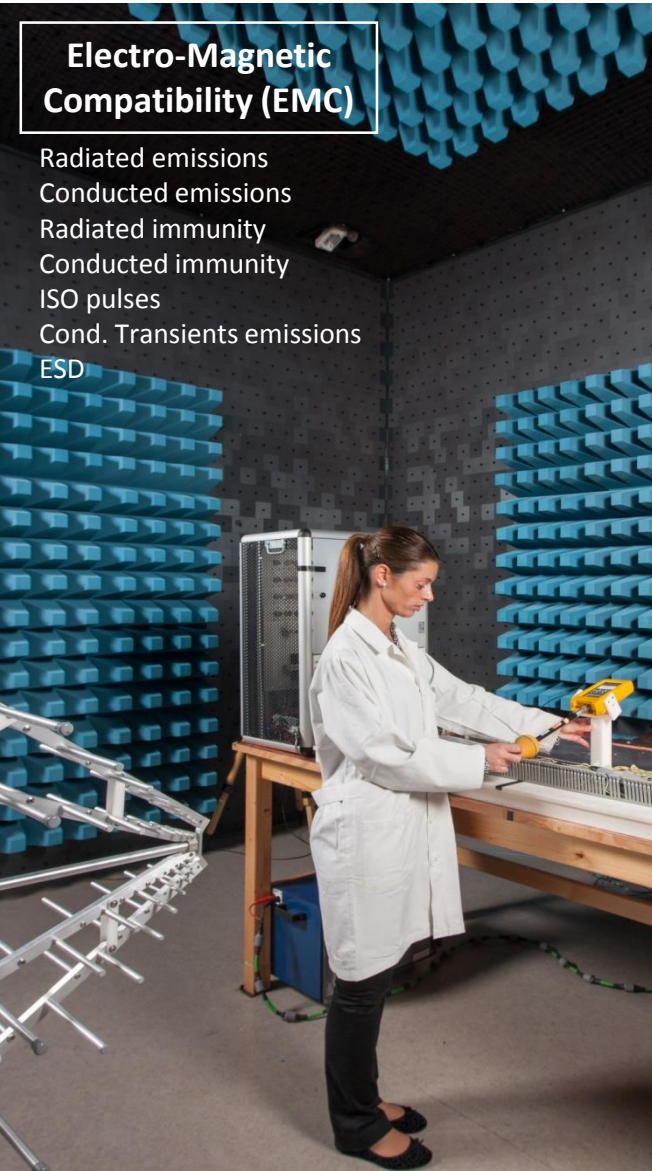
 **Seating**  
 Southfield, **USA** / Munich, **Germany** / Grugliasco, **Italy** / Pune, **India** / Shanghai, **China** / Gyeongju - Bupyeong, **Korea** / Caçapava, **Brazil**

**testlab**

# Validation Laboratory Capabilities

## Electro-Magnetic Compatibility (EMC)

- Radiated emissions
- Conducted emissions
- Radiated immunity
- Conducted immunity
- ISO pulses
- Cond. Transients emissions
- ESD



## Environmental & Mechanical

- Dewing
- High / Low temperature
- Thermal shock
- Temperature Cycle
- Temperature/Humidity cyclic
- Damp heat steady state
- Power Temperature Cycling
- Dust ingress protection
- Water ingress protection
- Salt fog spray
- Mechanical shock
- Random wide band vibration
- Sinus Vibration
- Resonances investigation



## Reliability & Failure Analysis

- Photo documentation
- Optical Microscope inspection
- Cross sectioning analysis
- Components de-capsulation
- Thermal imaging



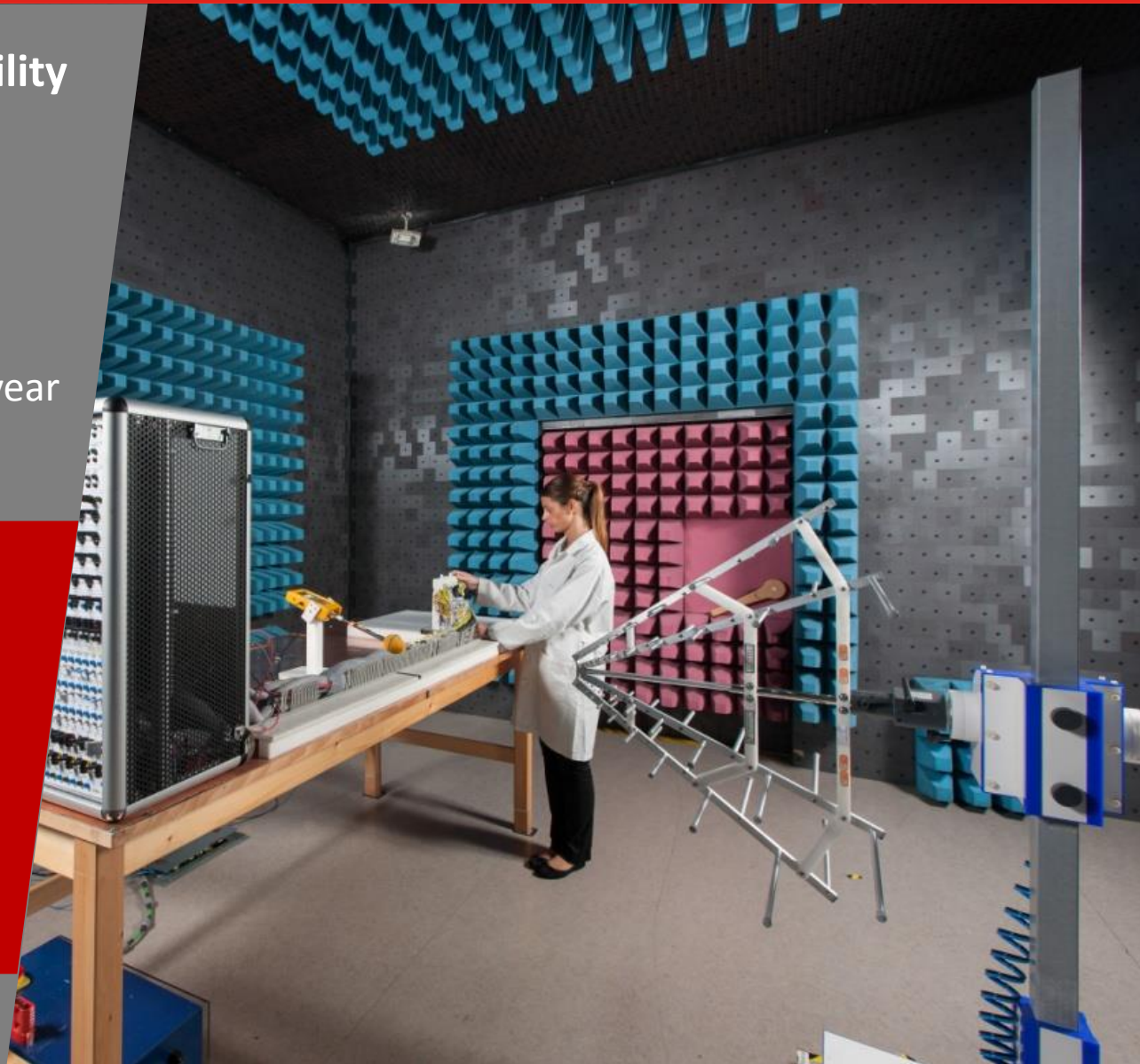
# Validation Laboratory - Capabilities

## Electro-Magnetic Compatibility

ISO 17025 Accredited Lab  
ENAC 1082/LE2133

**8.800** hours test / year

Radiated emissions  
Conducted emissions  
Radiated immunity  
Conducted immunity  
ISO pulses  
ESD



# Validation Laboratory - Capabilities

## Environmental and Mechanical

ISO 17025 Accredited Lab  
ENAC 1082/LE2133

**202.000** hours test / year

Dewing  
High / Low temperature  
Thermal shock  
Temperature Cycle  
Temperature/Humidity cyclic  
Damp heat steady state  
Power Temperature Cycling  
Dust ingress protection  
Water ingress protection  
Salt fog spray  
Mechanical shock  
Random wide band vibration  
Sinus Vibration  
Resonances investigation



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# Engineering, Test and Validation

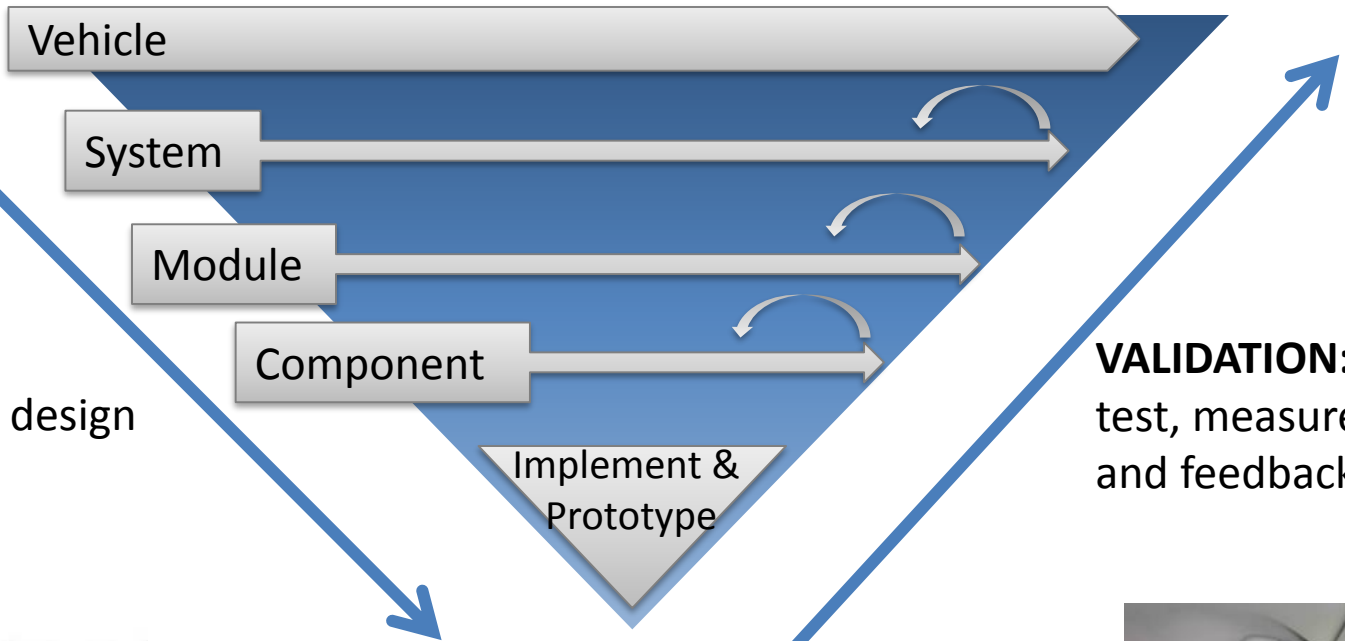
# “V” Model in Automotive Industry



The same engineering workspace environment from design to physical testing



**VERIFICATION:**  
requirements, design  
and simulation



**VALIDATION:**  
test, measure, analyze  
and feedback





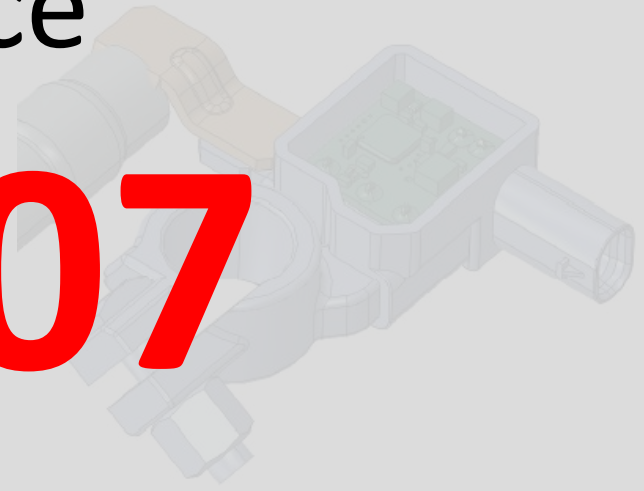
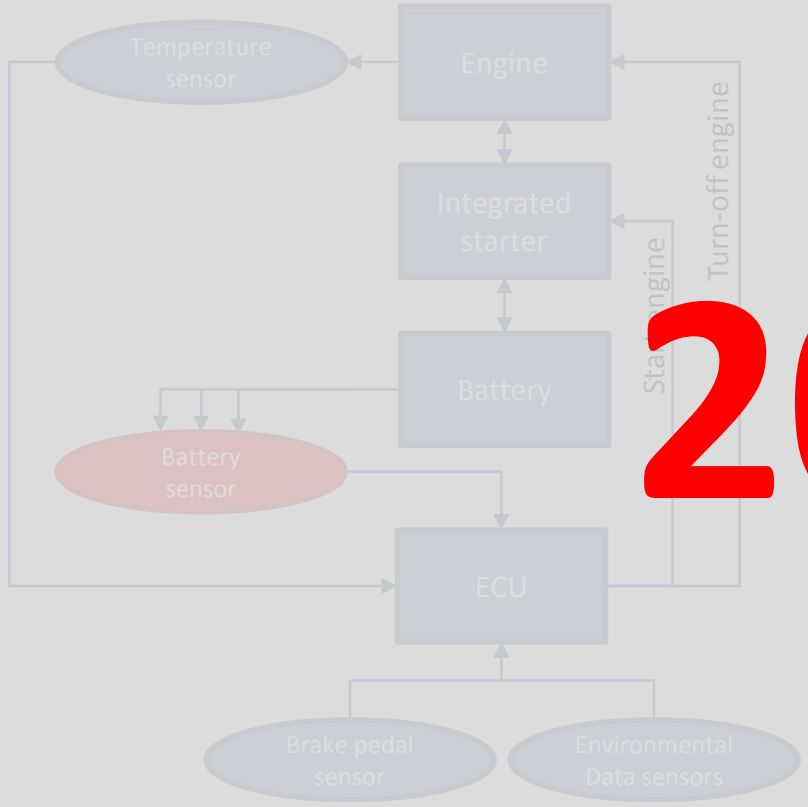
# Battery Monitoring System (BMS)

LEAR Battery Monitoring System measures current, voltage and temperature to help maintain overall performance and life of the battery while helping with fuel economy

**7** million parts

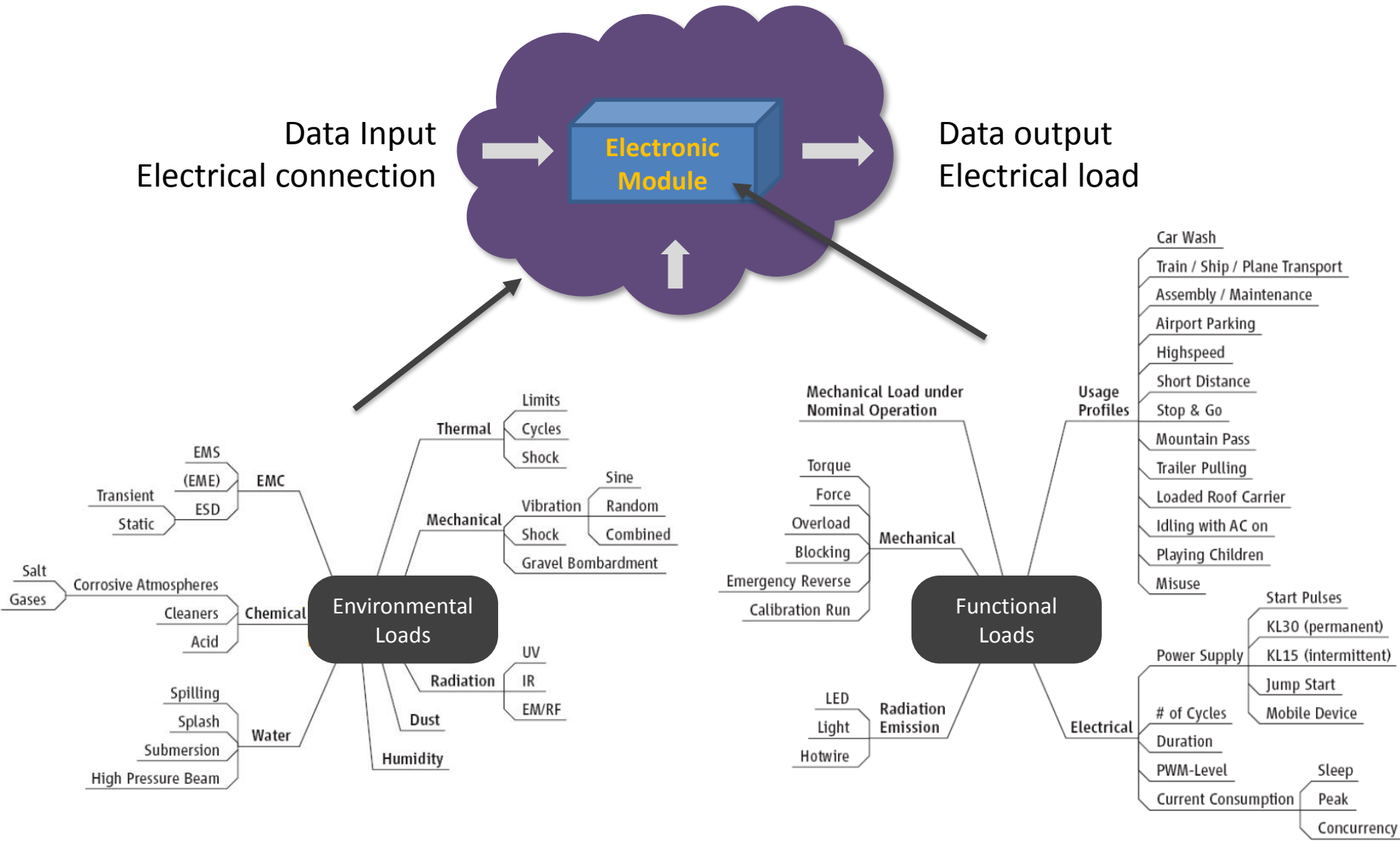
Since

**2007**





# Stress factors and loads during service life



# Pain and gain

Development of Ford's latest F-Series Super Duty pickup truck included grueling durability tests that pushed the vehicle to its absolute limits

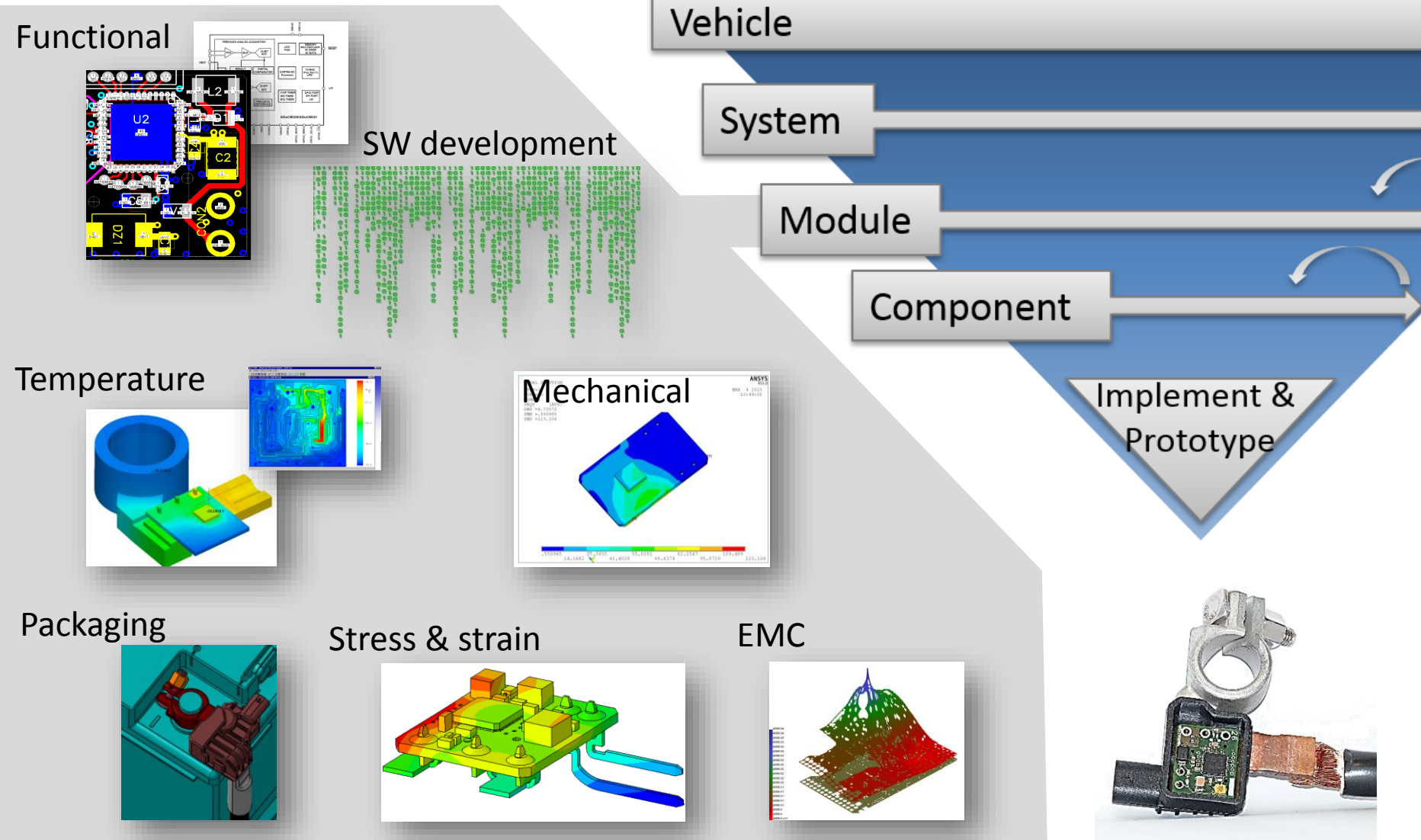
WORDS BY MIKE MAGDA  
ILLUSTRATION BY PHIL HACKETT

service life **15** years

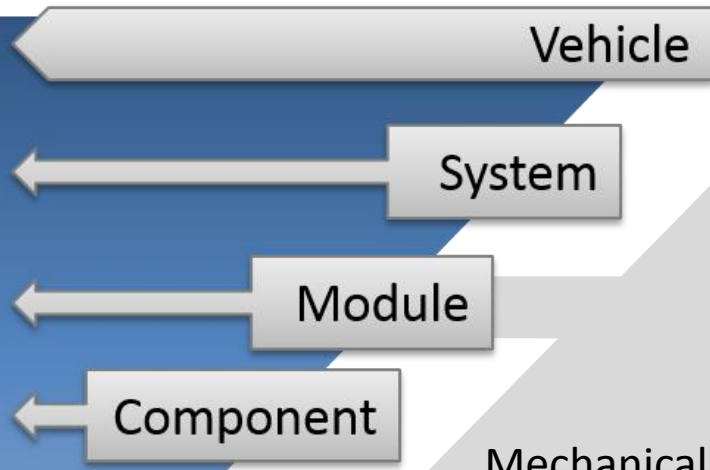
operating hours **80000** h

mileage **3000000** km

# Requirements VERIFICATION



# Measure and VALIDATION Test



EMC

Humidity and Salt fog

Mechanical traction

Vibration combined with temperature

Inspection

X-Ray Computerized tomography

Thermal Cycle

Hardware in the loop - HiL



# Example of VALIDATION Life Test

Service life test: Power Thermal Cycle Endurance (PTCE) – LV124 : ISO 60068-2-14

### 11.3 L-03 Life test - temperature cycle test

#### 11.3.1 Air

This test simulates in contact form the thermal load of the component during temperature changes that occur during vehicle service life. The test serves to verify the quality and reliability of the component with respect to faults that occur due to thermal mechanical load, cracking and delamination in soldered joints, adhesive joints and welded joints, in bond connections as well as in screw or rivet joints.

#### 11.3.2 Test

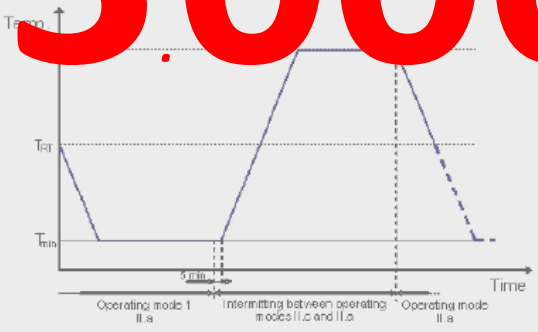
The test is carried out acc. to DIN EN 60068-2-14 with the following parameters:

1.2000

30000

Table 85: Test parameters L-03 Life test - temperature cycle test

DUT operating mode	Intermittent operating mode II.c and operating mode II.a acc. to Figure 38.
Temperature profile	Acc. to Figure 38
Minimum test temperature	$T_{min}$
Maximum test temperature	$T_{max}$
Temperature gradient	4 °C/min If the temperature gradient cannot be produced by the testing device, it can be reduced to values up to a minimum of 2 °C/min in coordination with the purchaser.
Holding time at $T_{min}$ and $T_{max}$	15 min after the component has achieved the condition at which it reaches the temperature. See Section 12.2.2.2 for details.
Number of cycles	To be calculated acc. to Section 12.2.2.2 and to be specified in the Component Performance Specification.
Number of DUT	



### 12.4 Calculation models for the life test 'temperature cycle test'

#### 12.4.1 Coffin-Manson model

The calculation of the test duration for the temperature cycle test life test is based on the average temperature changes of the component in the field  $\Delta T_{Field}$  and the number of temperature cycles during service life in the field  $N_{TempZyklusField}$ .

The acceleration factor of the Coffin-Manson model is calculated as follows:

$$A_{CM} = \left( \frac{\Delta T_{Test}}{\Delta T_{Field}} \right)^c \quad (3)$$

Where:

- $A_{CM}$  Acceleration factor of the Coffin-Manson model
- $\Delta T_{Test}$  temperature difference during a test cycle ( $\Delta T_{Test} = T_{max} - T_{min}$ )
- $\Delta T_{Field}$  average temperature difference during service life in the field
- $c$  parameter of the Coffin-Manson model in the standard a value of 2, please refer to the standard.

thermal cycle  
with function load

The total number of test cycles is calculated acc. to

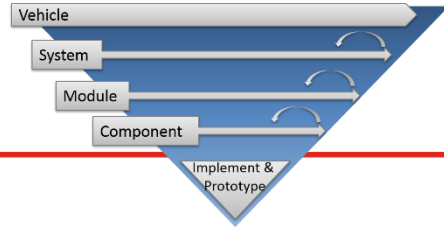
$$N_{Prüf} = \frac{N_{TempZyklusField}}{A_{CM}} \quad (4)$$

Where:

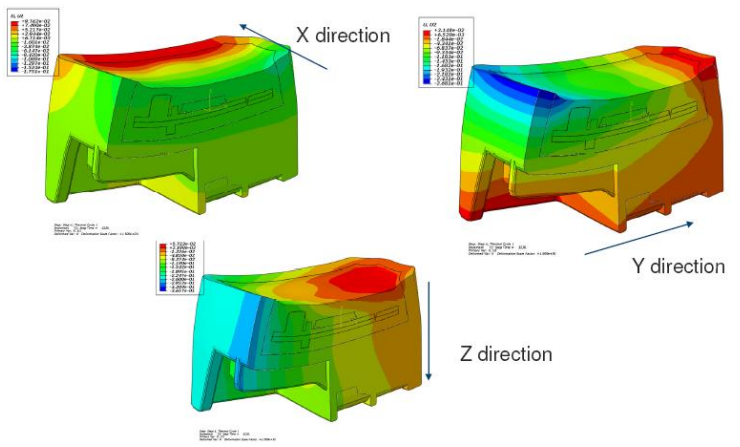
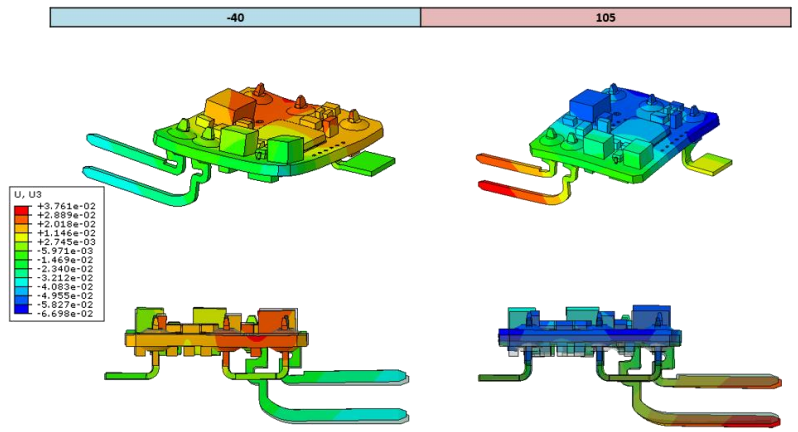
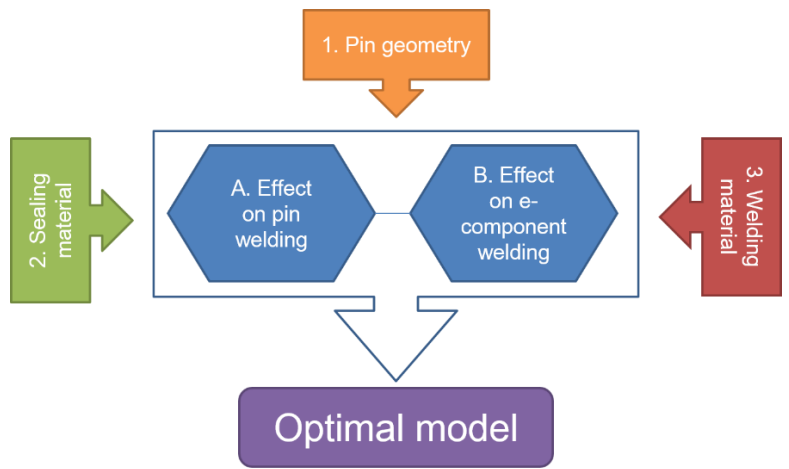
- $N_{Prüf}$  Required number of test cycles
- $N_{TempZyklusField}$  Number of temperature cycles during service life in the field
- $A_{CM}$  Acceleration factor of the Coffin-Manson model acc. to equation (3)

test hours

# Power Thermal Cycle Endurance Test



## Simulation: FEA analysis. Study of variables and effects



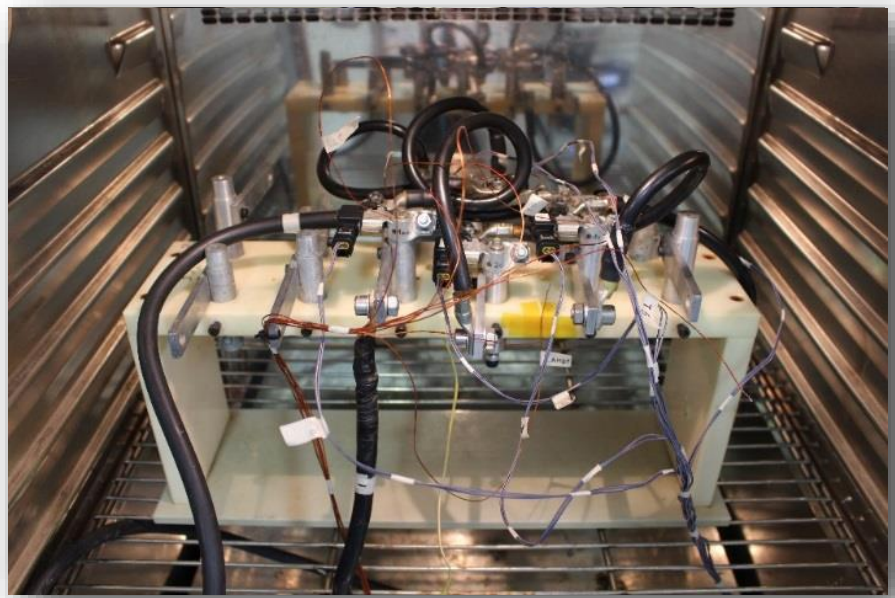
DOUBLE-S-PIN	e-component welding			
		SnPb37		SnAg
Epoxy	Limit	5.7%	Limit	4.2%
Silicone	OK	1.5%	OK	1.2%

Criteria according to experience correlation FEA results/lab. Tests on pin weld:

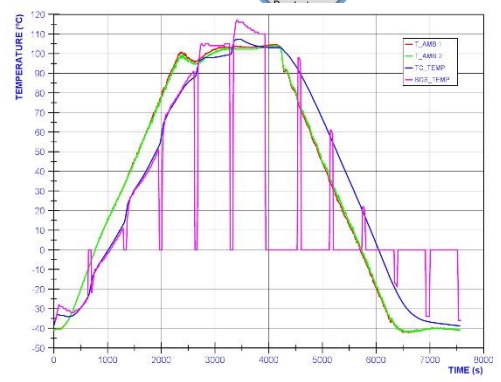
- >7% NOK
- 2-7% Limit
- <2% OK

# Power Thermal Cycle Endurance Test

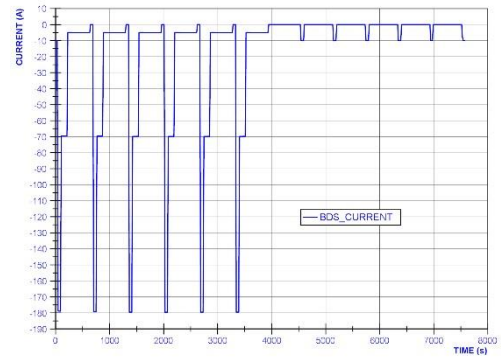
## Test set-up



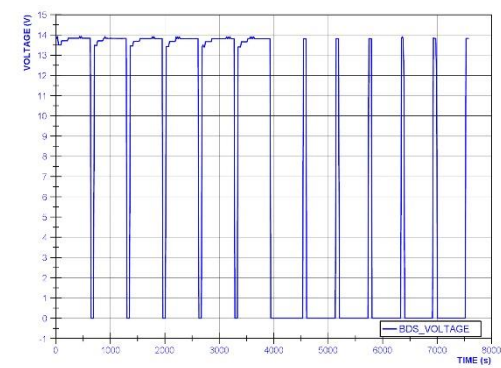
Temperature (°C)



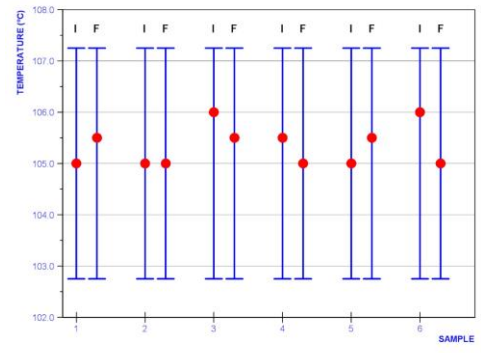
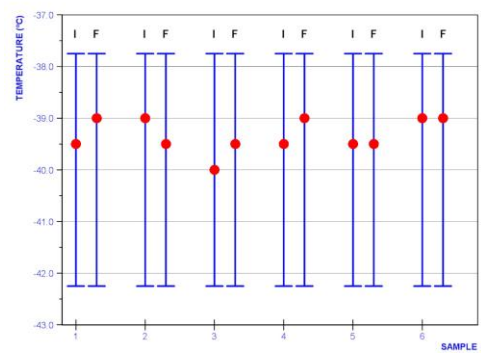
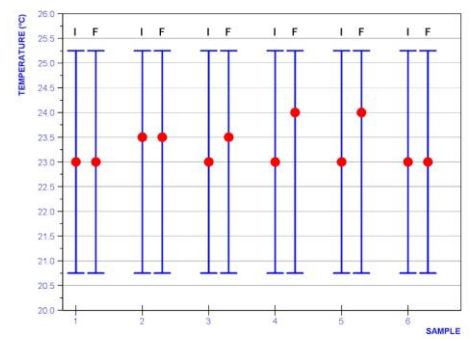
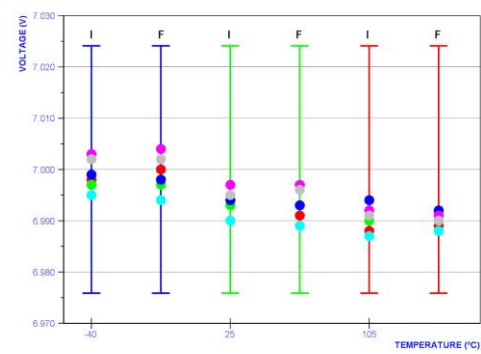
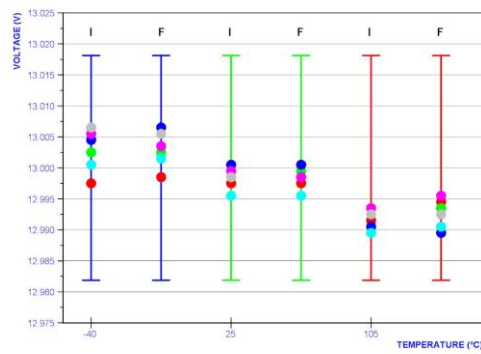
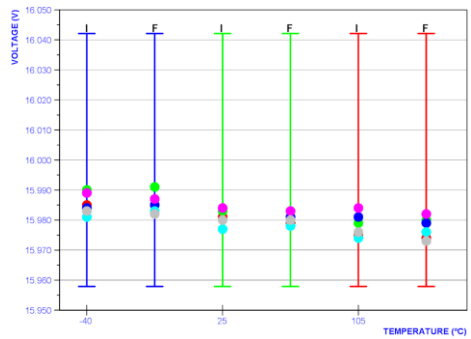
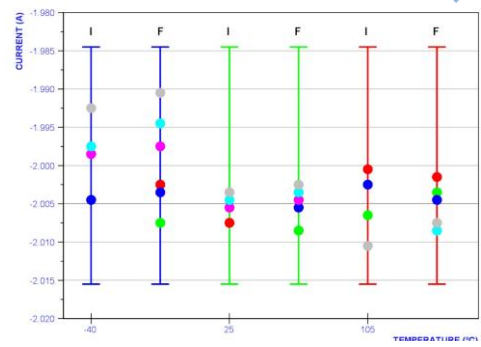
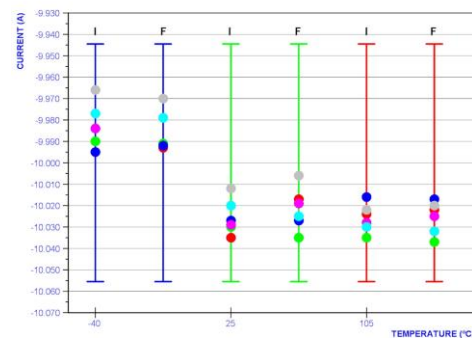
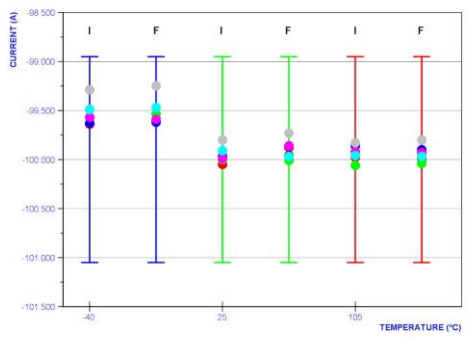
Current (A)



Voltage (V)



# Power Thermal Cycle Endurance Test





**Requirements**

**Car  
integration**

**Design &  
Simulation**

**Test & Measure**

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# Gracias por su atención