
FASTWAY
ENGINEERING
Ansys
Electronics Reliability
Reducing Failures through
Engineering Simulation
WEBINAR
May 31, 2023
11:30a cst/12:30p est

Fastway Engineering

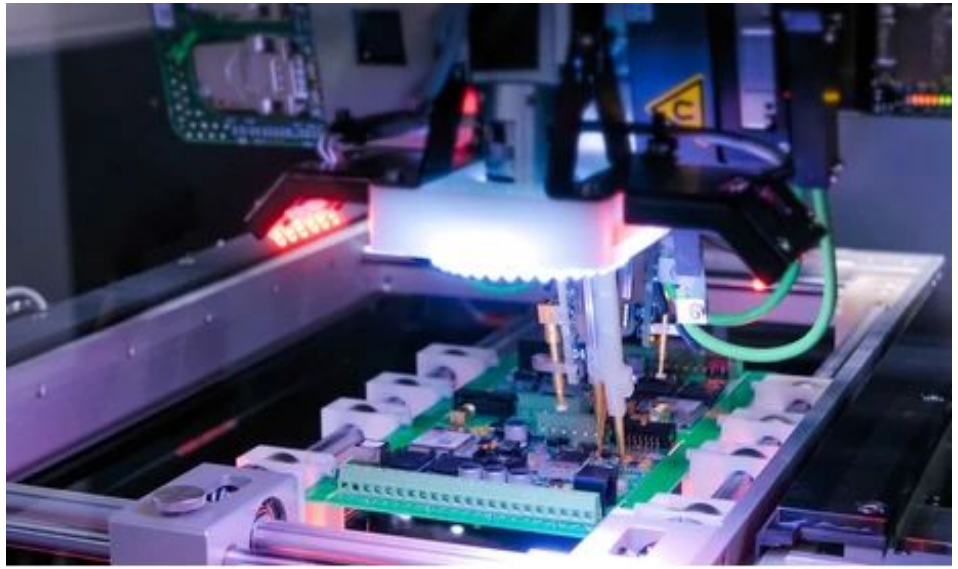
Luke Gelman - *luke@fastwayengineering.com*

Luke is the dynamic Director of Sales and Marketing at Fastway, bringing 27 years of experience in sales, management, and customer service. He prioritizes the needs of customers and delivers tailored solutions that exceed expectations. With a passion for creating and digital design, Luke stays at the forefront of industry trends while infusing each interaction with humor and fun, making work enjoyable and productive.

James Shaw - *jshaw@fastwayengineering.com*

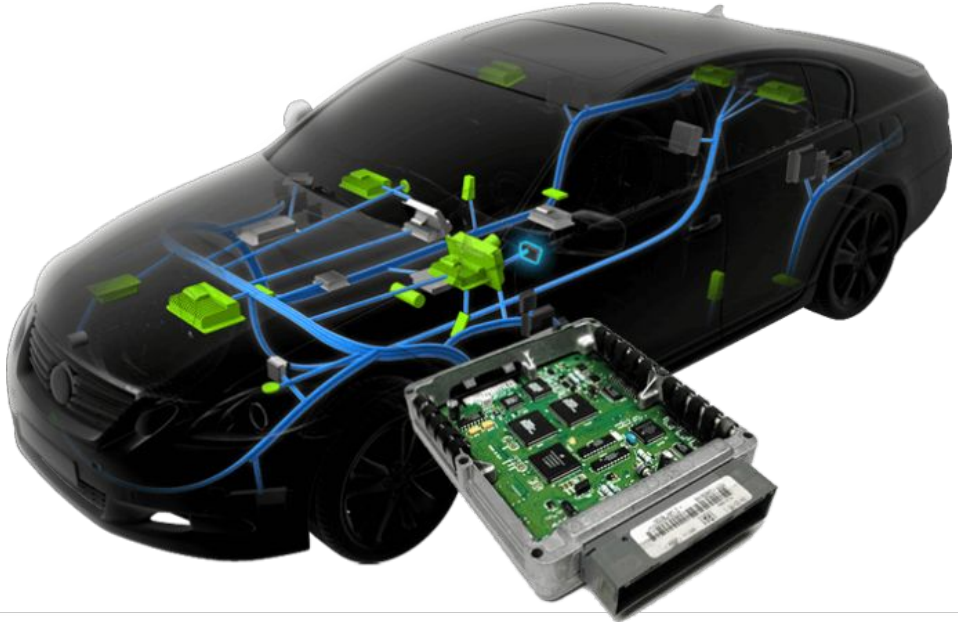
Jim Shaw, the Founder and Managing Director of Fastway Engineering, has over 20 years of high-level engineering experience and is a renowned expert in CAD, FEA, and CFD, with a particular emphasis on ANSYS Simulation. He has successfully improved companies' performance and empowered students through his extensive experience in training simulation software.

Electronics Reliability

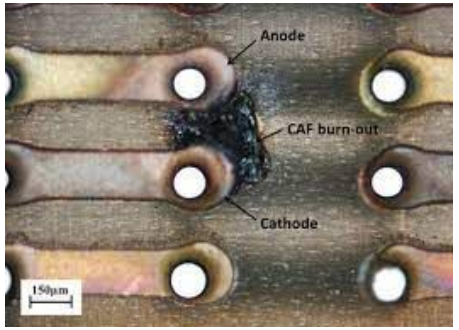


What you will learn today

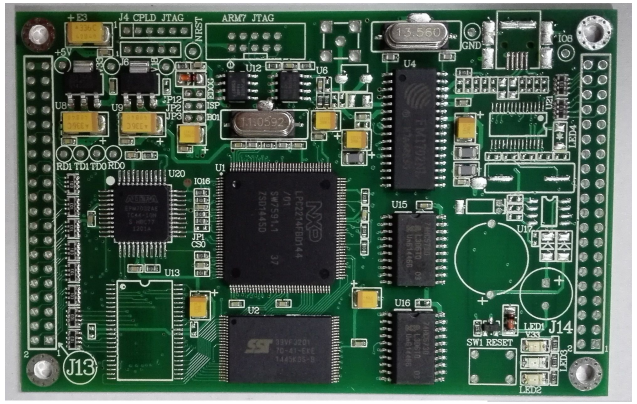
- Brief Overview of PCB Failure Types
- How Simulation can Predict PCB Failures
  - Reduce Development Costs
  - Improve First-Pass Yield
  - Decreasing Warranties/Customer Returns
  - Increasing Number of New Features
  - Lowering Bill Of Materials (BOM) Cost
- Live Demo of PCB Reliability Analysis
- Open Q&A

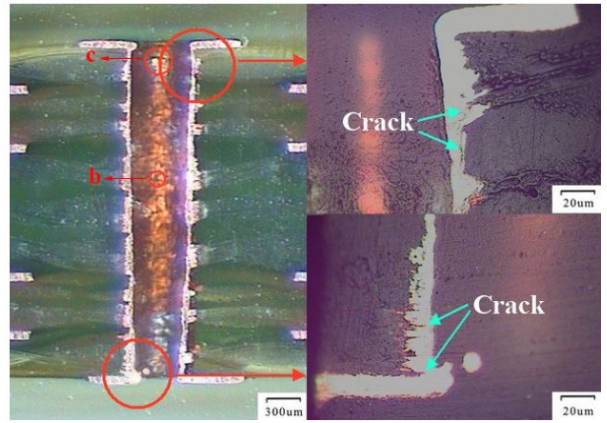


Types of Printed Circuit Board Failures

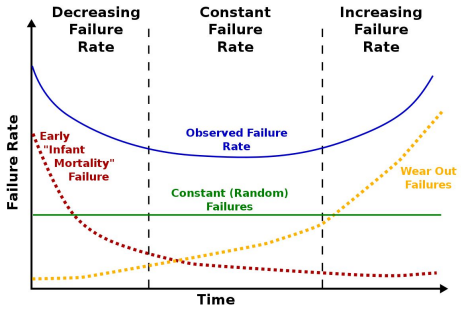


Conductive Anodic Failure

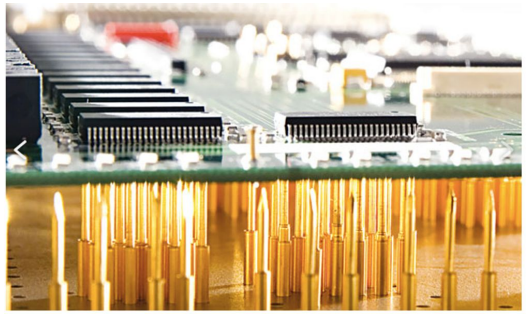




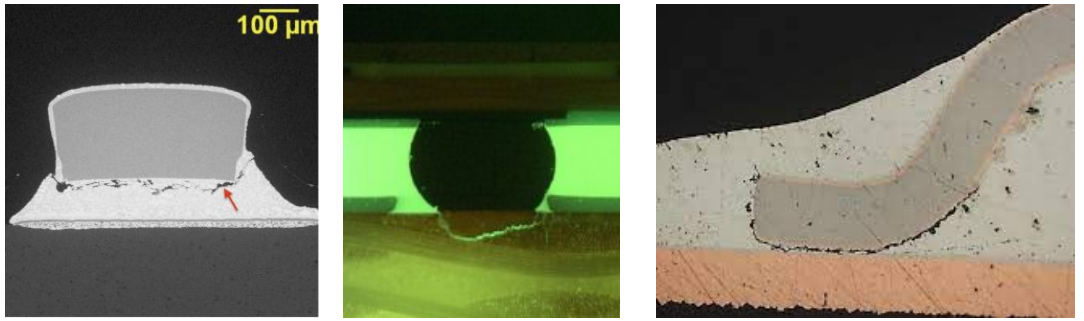
Plated Through Hole Fatigue



Wearout (Bathtub Curve)

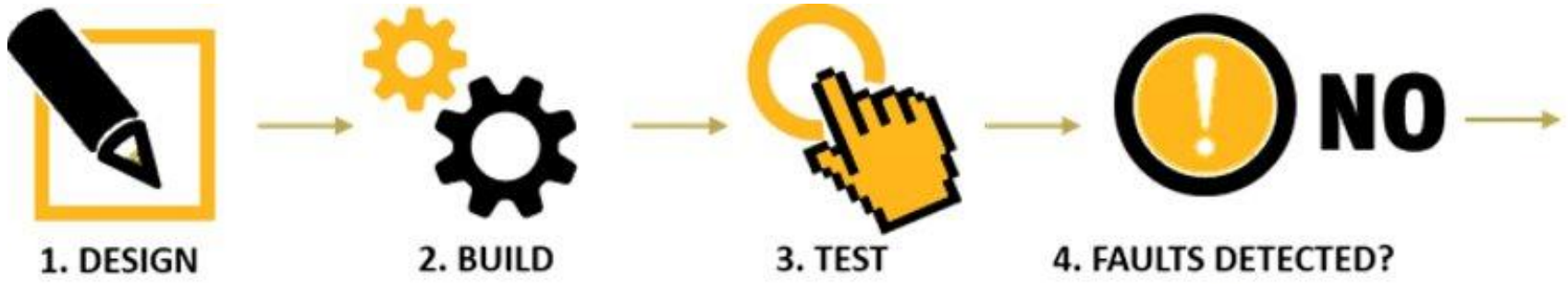


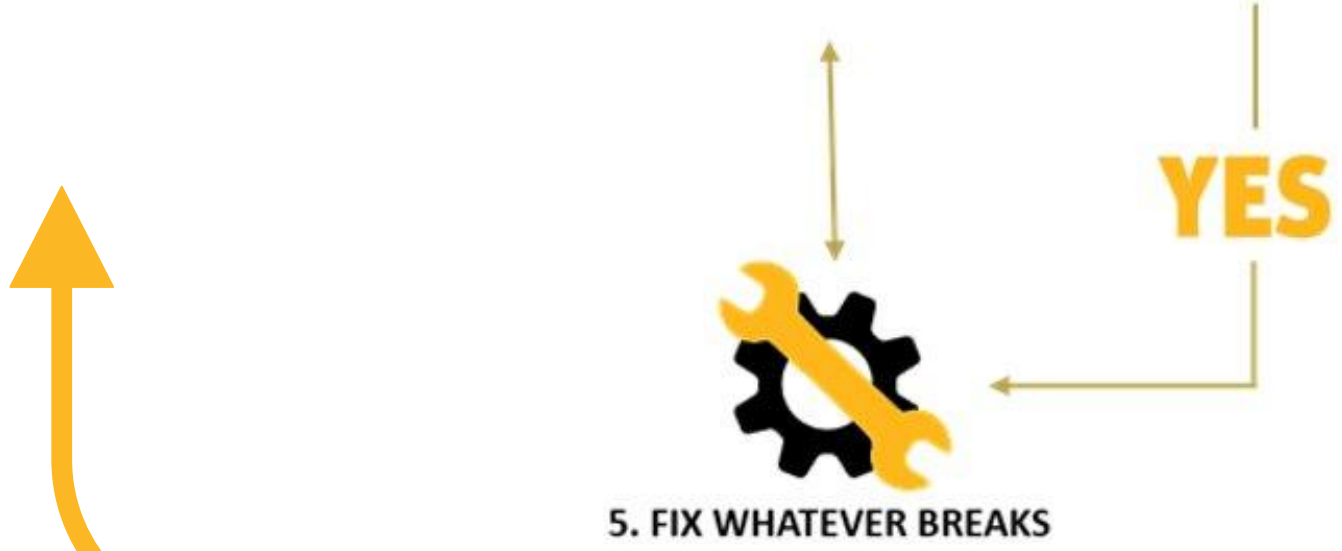
ICT (Bed of Nails)



Solder Pad Structural Failure in various package types

Typical Design Process when Failures are Found in Test





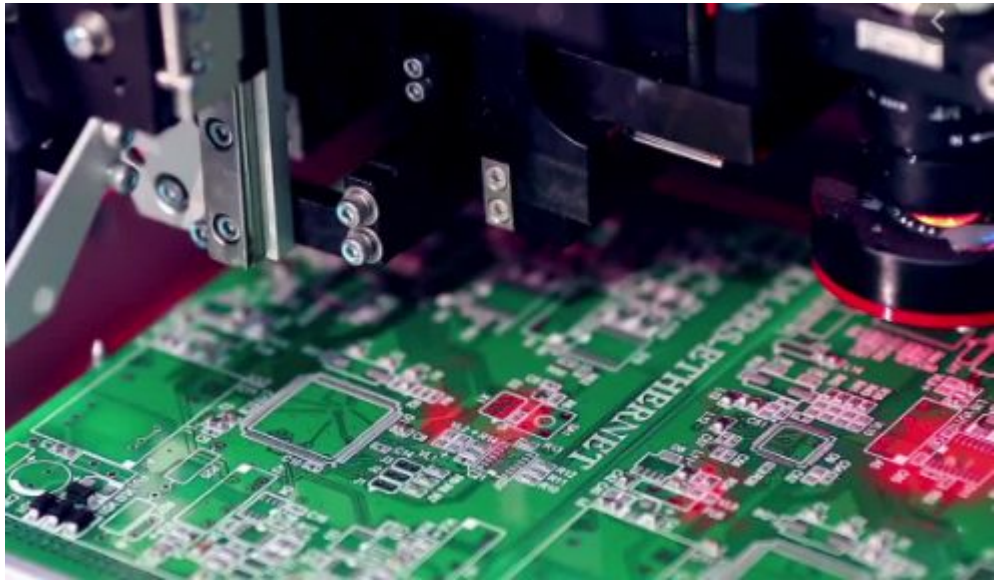
Simulation Reduces Development Costs

Electronics Designers are more Successful with Simulation

The Design Requirements

- **Meet/exceed** power and signal integrity goals
- **Minimize** EMI/EMC risk
- **Optimize** cooling strategies for improved thermal performance
- **Withstand** severe Shock, Vibration, and Drop events
- **Robustness** in the presence of design, material, and manufacturing variations
- **Minimize** system integration, assembly, and product transportation risks

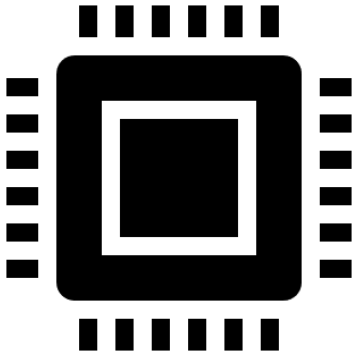
The Designer's Goal

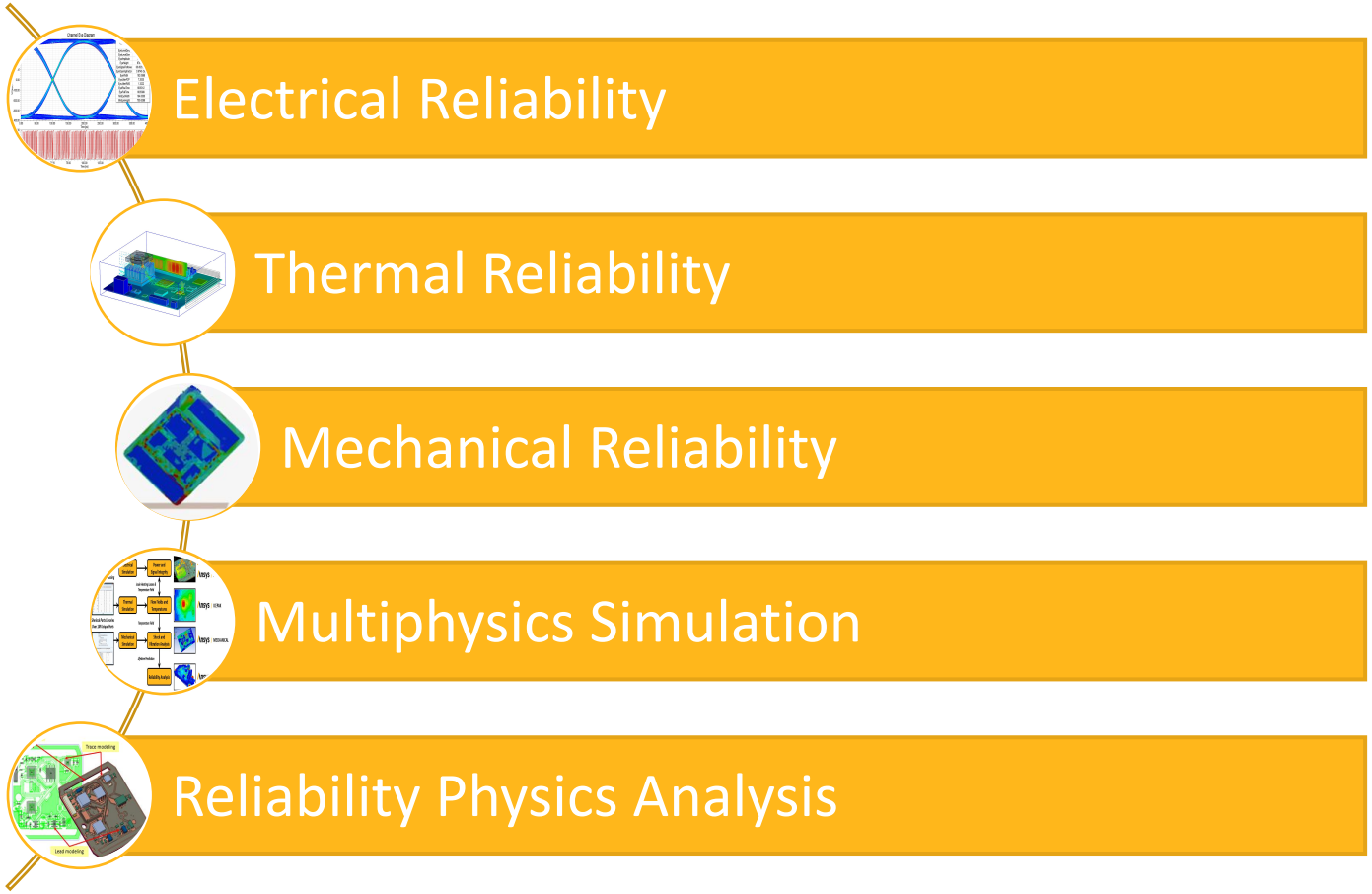


Improve product Reliability and operational Performance while meeting the Design Requirements

“Full Stack” of Electronics Simulation

Comprehensive multi-physics solutions from chip, package and PCB to systems and environment



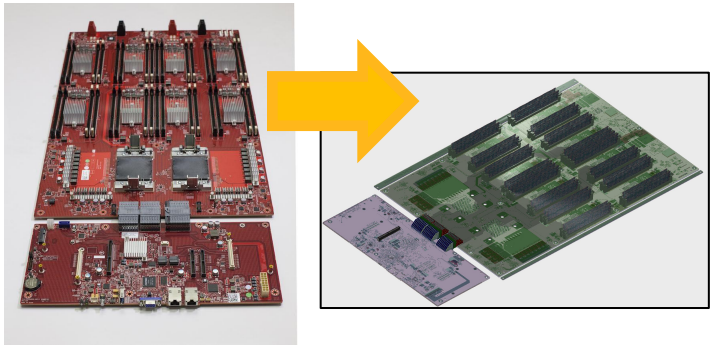


Electrical Simulation

Designers Goal

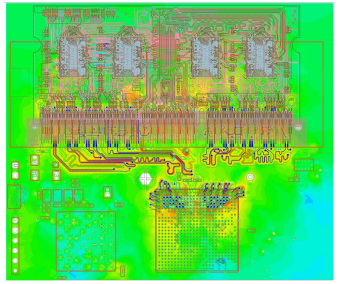
- **Improve** signal and power integrity
- **Minimize** EMI **risk**
- **Improve** antenna **performance**
- **Optimize overall system performance**

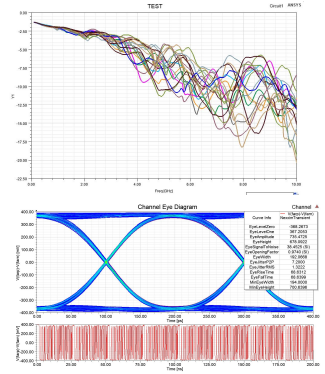
Simulate Real World Designs



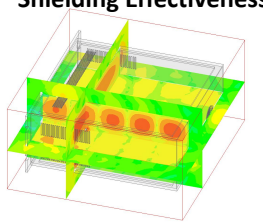
Simulate SI/PI/EMI

Field Plots, S-Parameters, Eye Diagrams

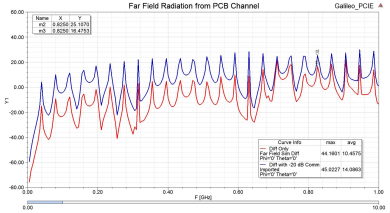




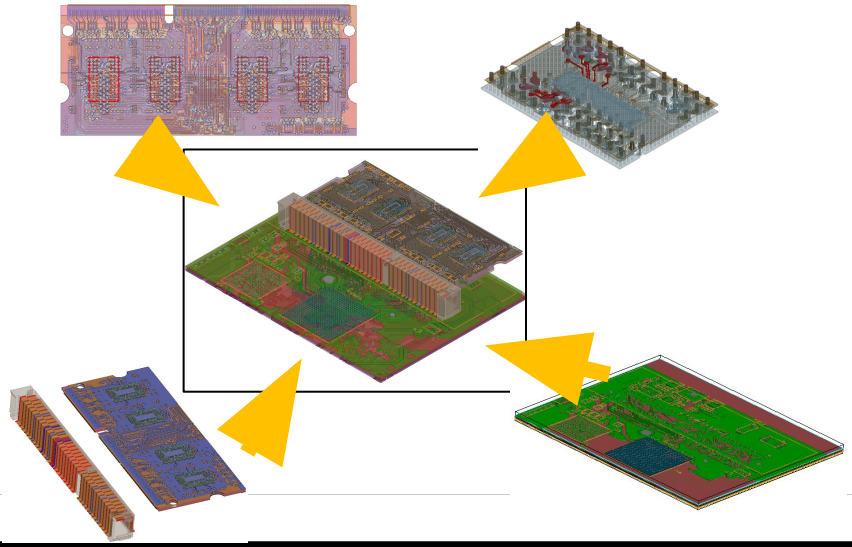
Shielding Effectiveness



Far Field Radiation



Easily Assemble a Full System



Thermal Simulation

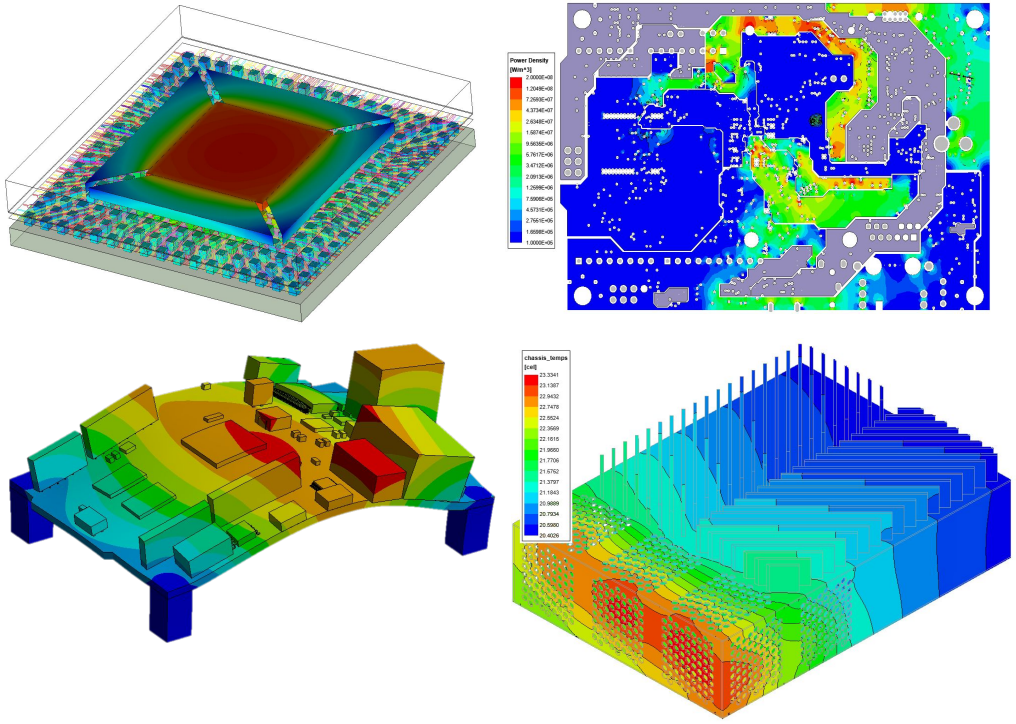
Customer Goal

- **Improve** thermal integrity
- **Optimize** cooling strategies
- Understand **thermal impact** on electrical and mechanical **reliability**

Benefits

- **Enhanced cooling strategies**
- Improved product **reliability** and decreased product **development time**
- **Connections** to electrical, structural, reliability and ROM solutions

Solution Accuracy at All Scales



Mechanical Simulation

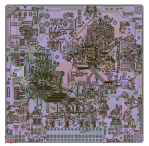
Customer Goal

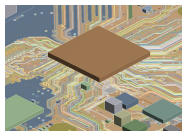
- Electronics **reliability , fatigue and life**
- **Standards compliance :** IPXX , MIL-STD 810
- **Variability:** Material, Manufacturing and assembling

Benefits

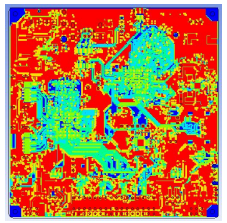
- **Trace effects, solder fatigue and assembly stress effects**
- Performance evaluation under **environmental conditions and duty cycle**
- **Product durability:** Shock and drop events
- **Failure** due to Moisture ingression
- **Trade off**: Cost v/s Reliability

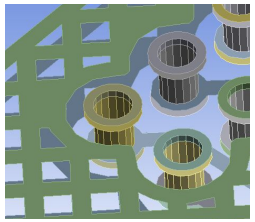
Accurate Trace modeling



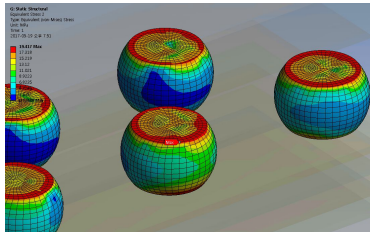


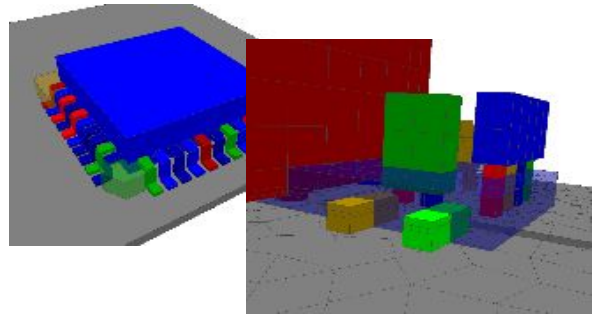
Trace Mapping **Reinforcements**





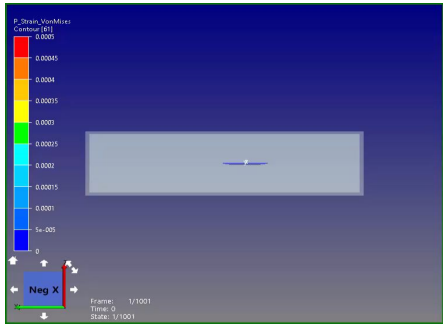
Detailed assembly modeling



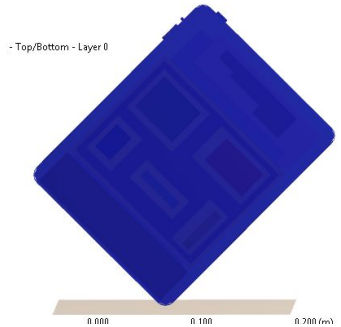


Solder **Coatings, Potting, Underfill**

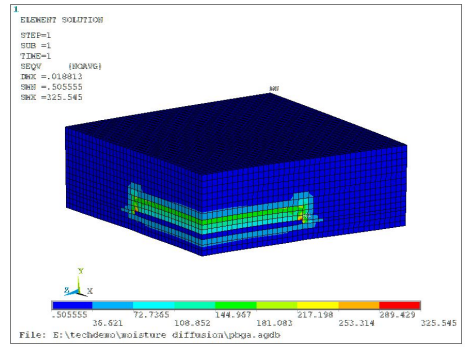
https://www.ansys.com/-/media/ansys/corporate/resourcelibrary/casestudy/robert-bosch-act-case-study.pdf



Tumble Test



Drop Test



Moisture Ingress

Multiphysics Simulation

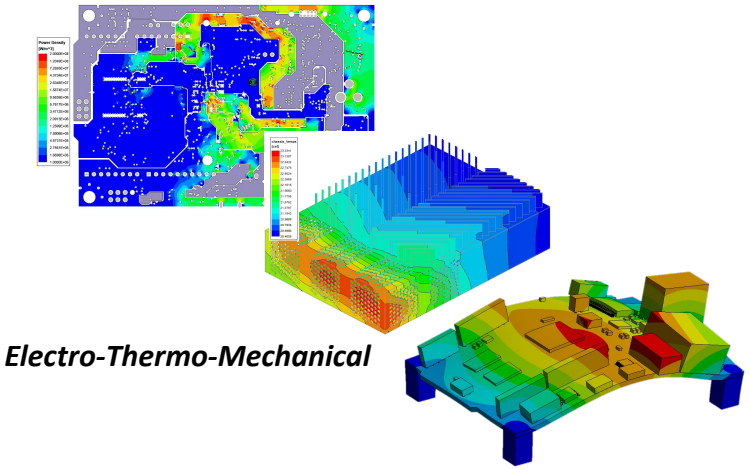
Customer Goal

- **Addressing thermal demands** with miniaturization of electronics
- Reduce cost of **cooling hardware selection**
- **Mitigate** the risks for system integration

Benefits

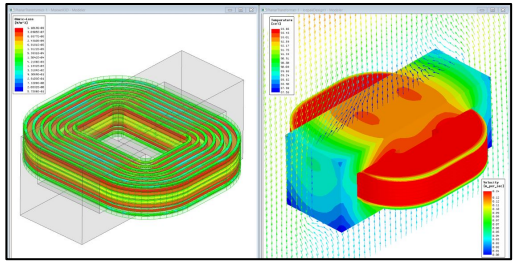
- **Understand** product performance when subjected to multiple physical conditions
- **Optimized** product designs by evaluating Electro-thermo-Mechanical effects
- **Multidomain – Multiscale system level evaluation**

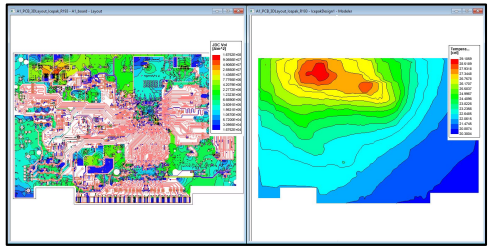
Multiphysics



Electro-Thermo-Mechanical

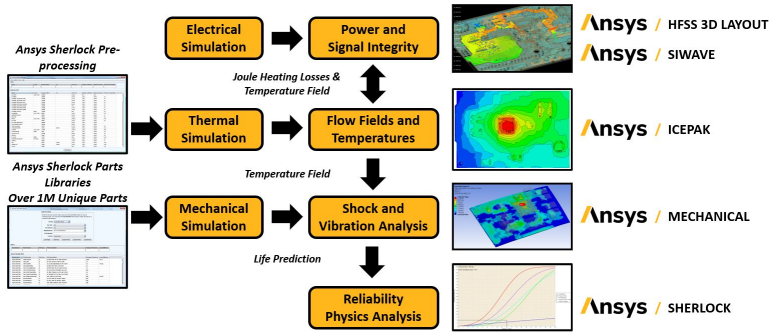
Electro-Thermal

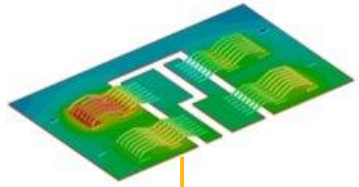




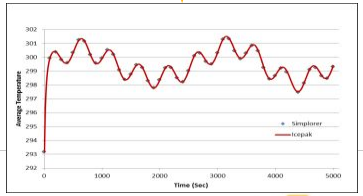
Multi-Domain System-Level Modelling with Reduced Order Modelling (ROM)

Multiphysics Ecosystem





Ansys Icepak Model



Reduced Order Model Performance compared to full 3D model

Reliability Simulation

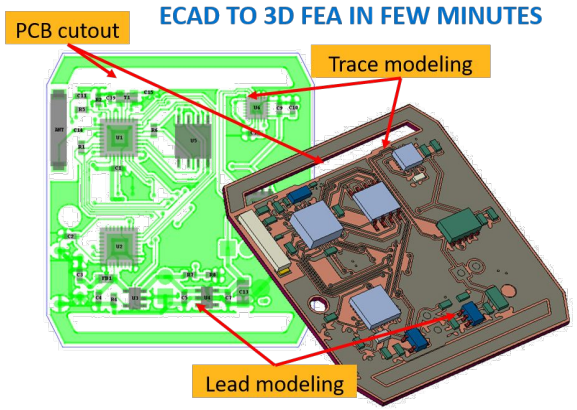
Customer Goal

- PCB reliability
- **Reduce** design cycle.
- **Standards compliance:** IPC-TR-579, IPC 9704, SAE J3168, MIL, JESD-22 etc.

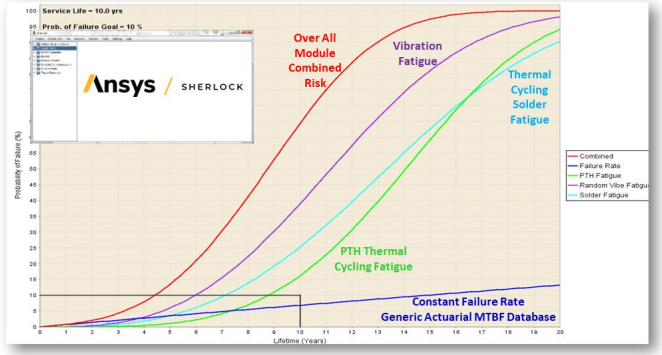
Benefits

- **20-50%** time reduction in PCB reliability prediction at Component, Board and System level
- **Optimized** component selection and placement for target PCB reliability.
- **Meet regulations** at reduced cost for various industry standards by reducing physical prototypes by **~50%**

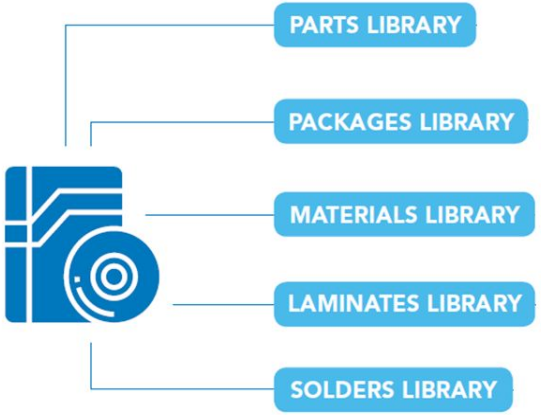
Faster Pre-Processing



Reliability prediction via Life Curve



Sherlock Library



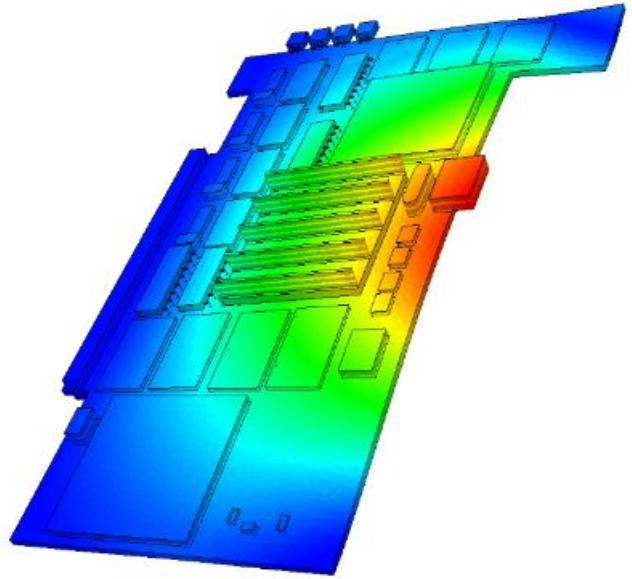
Standards Compliance

FASTWAY ENGINEERING

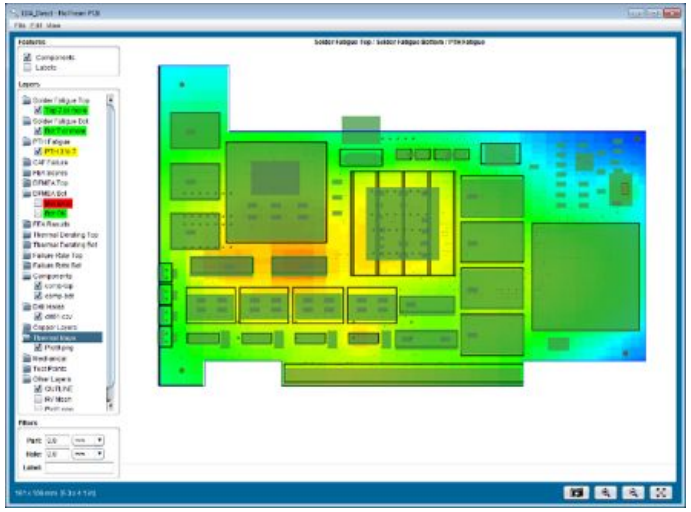
Ansys

What Is Ansys Sherlock?

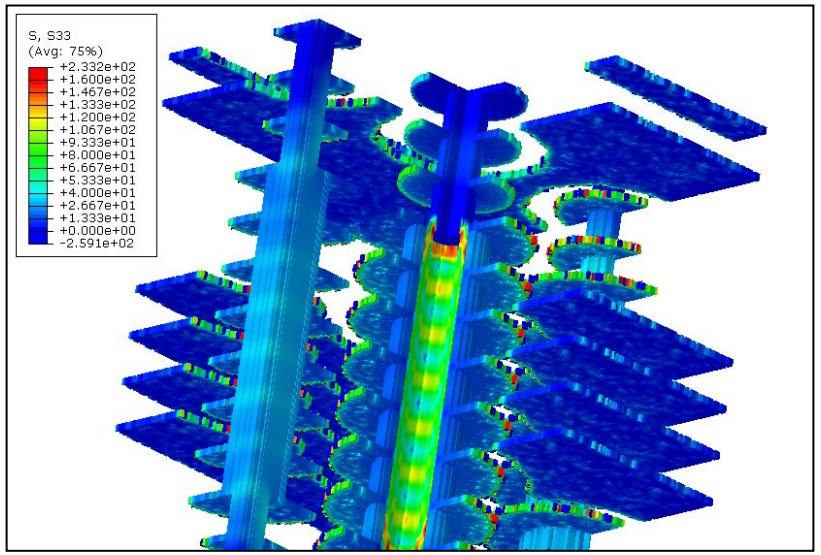
- Reliability Physics Analysis (RPA) tool for electronics
- Helps users mitigate thermal, shock and vibration, and other risks
- Ansys Sherlock can be used in combination with several other Ansys products, such as Ansys SpaceClaim, Ansys Icepak, and Ansys Mechanical as a part of advanced workflows
- Sherlock Library comes with over 600,000 parts!!



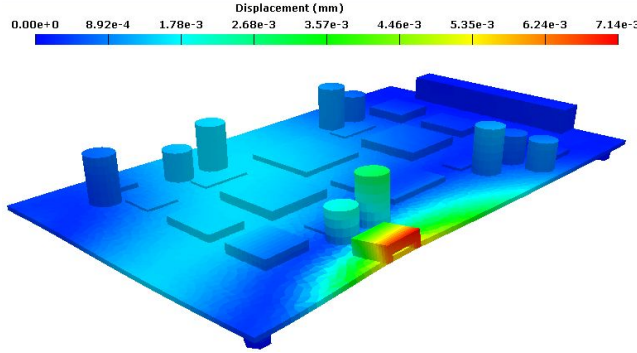
Shock and Vibration



Thermal-Cycle Fatigue



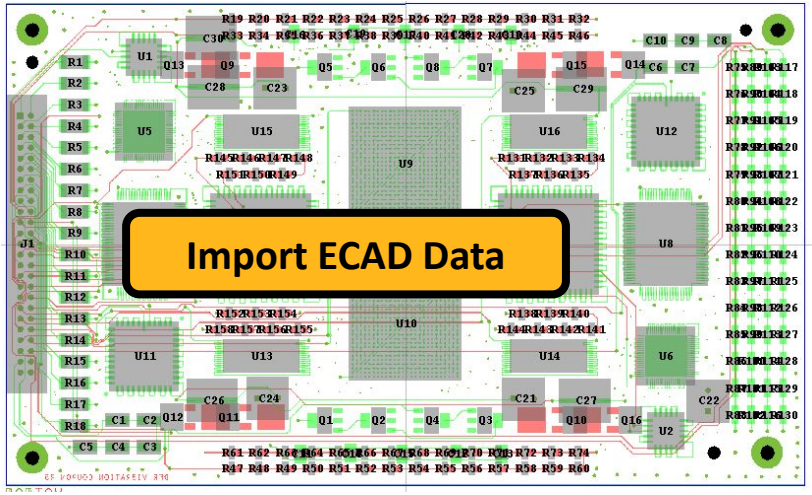
Predict Solder Reflow Failures

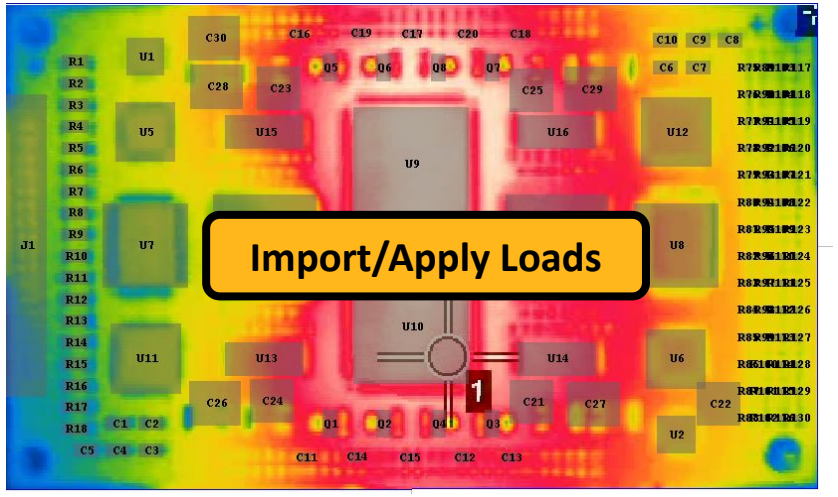


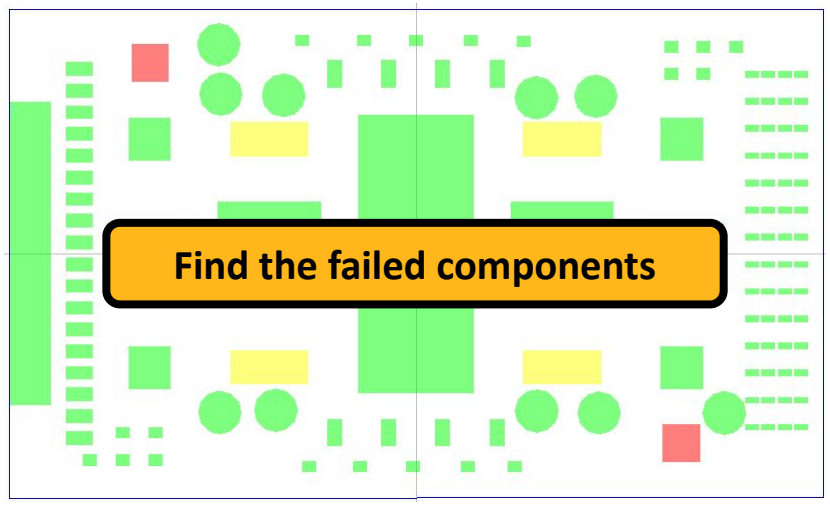
Design for Manufacturability

Reliability Physics Analysis with Sherlock

Ansys Sherlock's intuitive GUI allows users to quickly interpret and modify inputs and review critical output, such as component Time-to-Failure.







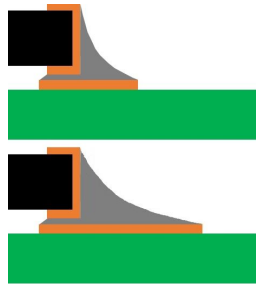
LIVE DEMO

Well-Informed Design Choices Based on Reliability Physics Analysis

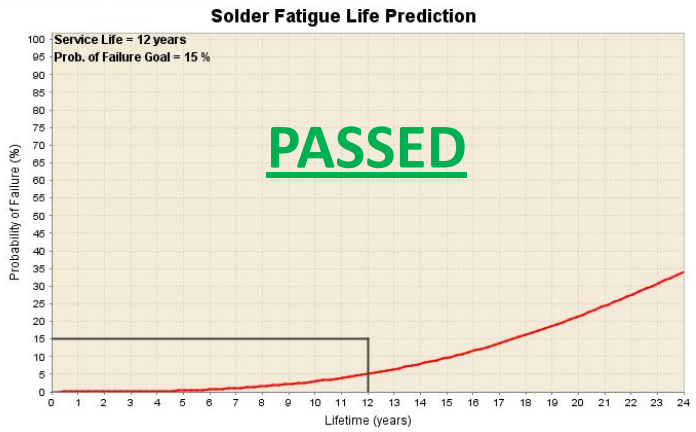
Challenge: Often, design trade-offs have different associated costs and benefits

Solution: Quickly make design decisions to assess their relative impacts on reliability. Such techniques can guide users toward approaches that may be more cost-effective

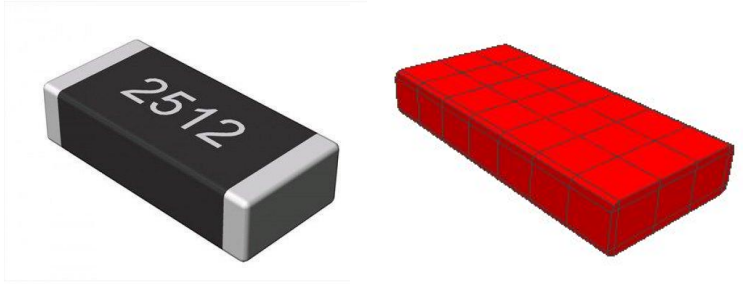
Change Pad Size?



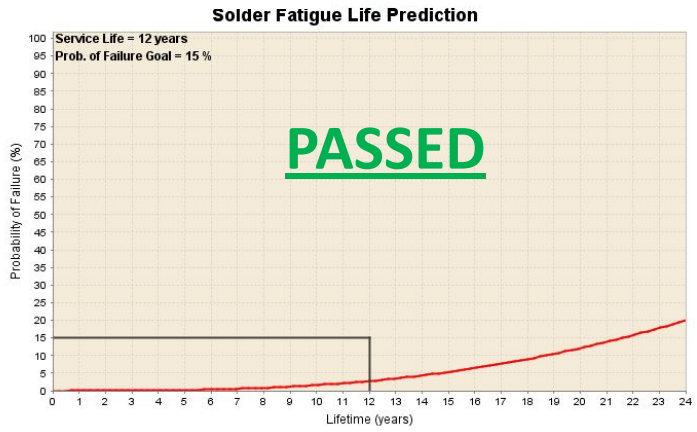
The following chart shows the Solder Fatigue Life Prediction curve for R500.



Switch Package?



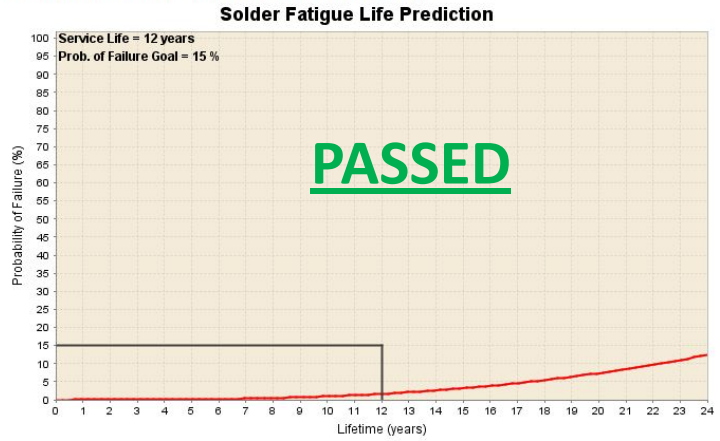
n curve for R500.



Change Laminate?

CTExy:	17.440 ppm/C	CTExy:	13.471 ppm/C
CTEz:	67.308 ppm/C	CTEz:	43.975 ppm/C
Exy:	27,973 MPa	Exy:	29,260 MPa
Ez:	3,681 MPa	Ez:	3,681 MPa

The following chart shows the Solder Fatigue Life Prediction curve for R500.



Electronics Reliability Recap

- There are dozens of potential failure modes in PCB's.
  - Sometimes we don't have enough resources to test for all of them!
  - Simulation can provide those resources and more!
- Using Simulation, a PCB Designer can predict & prevent these failure modes.
  - Reduce Development Costs
  - Improve First-Pass Yield
  - Decreasing Warranties/Customer Returns
  - Increasing Number of New Features
  - Lowering Bill Of Materials (BOM) Cost

Book a meeting to discuss Electronics Simulation with us today!

Learn more at www.fastwayengineering.com