HOBBS ENGINEERING
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Preventing Thermal Cycling and Vibration Failures in Electronic Equipment
by Steven Carlson

Join us for an extensive four day webinar March 5-6 & 12-13, 2019 8:30-11:30 am Pacific time (California)
Cost $850 per person, group discounts available! Attendees must participate in all four days.

Register here and pass this on to your colleagues!

This 4-day webinar which costs $850 will focus on:

1. To understand how variations in coefficients of thermal expansion (CTE) can affect the magnitude of the displacements, forces, and stresses that are developed in electronic assemblies during thermal cycling environments, and how these factors affect fatigue life.

2. To understand how resonant conditions can affect dynamic displacements, forces and stresses in electronic assemblies during different sine and random vibration environments.

3. To understand the concept of "damage accumulation" and how it can be used to determine the approximate fatigue life of various electronic assemblies due to different combinations of fatigue accumulated in thermal cycling and vibration environments.

This course is based upon the popular book *Preventing Thermal and Vibration Failures in Electronic Equipment* by Mr. Dave Steinberg.

Questions are encouraged during the webinar, to make sure each participant understands the design techniques and applications presented.

PHYSICS OF FAILURE IN ELECTRONIC SYSTEMS
- Areas That Require Analysis And Evaluation
- How Thermal Cycling Environments Affect Fatigue Life
- How Vibration Environments Affect Fatigue Life
- Creep and Stress Relaxation in Solder
- Combining Fatigue Damage From Many Different Environments

MOUNTING METHODS FOR VARIOUS TYPES OF ELECTRONIC COMPONENTS
- Different Types Of Electronic Components And PCB Mountings
- Fatigue Life Due To Various Component Geometry and Materials
- Package Types that Yield Rapid Fatigue Failure
- Areas Where Minor Structural Changes Can Produce Large Increases In Fatigue Life
- Tips To Improve Heat Dissipation.

ESTIMATING FATIGUE LIFE – THERMAL AND VIBRATION ENVIRONMENTS
- Solder Thermal Cycle And Vibration S-N Fatigue Curves
- Solder Creep With Constant Stress And With Constant Displacement
- Solder Creep And Stress Relaxation
- Solder Creep Stress Relaxation As A Function Of Time
- Fatigue Damage In Structures Using Miner's Cumulative Damage Criteria
- Relating Fatigue Properties To The Slope Of The Fatigue Curve

THERMAL EXPANSION DISPLACEMENTS, FORCES, AND STRESSES
- Reducing Forces And Stresses In Lead Wires And Solder Joints
- Coefficient Of Thermal Expansion Differences Leads To Relative Displacement
- Evaluate Axial And Bending Forces On Lead Wires and Solder Joints

- Sample Problem: Solder Joint Shear Tear-out Stress and Lead Wire Bending Stress of Through-Hole Mounted Component during Thermal Cycling

THERMAL CYCLING STRESS FAILURES IN SURFACE MOUNTED COMPONENTS

- Solder Shear Strain In Surface Mounted Components
- Equilibrium Equation For Evaluating Thermal Expansion Forces and Stresses In The Solder Joints Of A Small LCCC

VIBRATIONS OF SIMPLE STRUCTURES AND PRINTED CIRCUIT BOARDS

- Determining The Natural Frequency of Beams and Flat Plates
- Effective Spring Rate For Springs In Series and Parallel
- Displacement, Forces, And Stress Due To Input Acceleration
- Damping And Transmissibility of PCBs And Other Electronic Structures
- PCB and Support Structure Dynamic Coupling

DESIGNING ELECTRONIC EQUIPMENT FOR SINUSOIDAL VIBRATION

- How PCB Component Size, Location, And Orientation Effect The Fatigue Life
- Sample Problem: TO-5 Transistor Lead Wire And Solder Joint Fatigue Life During Sine Vibration
- Maximum allowable PCB Dynamic Displacement For Component Fatigue Life Of 10 Million Stress Cycles
- Desired PCB Resonant Frequency For 10 Million Stress Cycles In Sine Vibration

ASSESSMENT OF RANDOM VIBRATION ON ELECTRONIC DESIGN

- How Random Vibration Differs From Sinusoidal Vibration
- Random Vibration Analysis Using The Three-Band Technique
- Sample Problem: Estimating the Fatigue Life Using The Three-Band Technique With Miner’s Cumulative Fatigue Damage Ratio
- Maximum allowable 3σ PCB Dynamic Displacement For Component Fatigue Life of 20 Million Cycles
- Desired PCB Resonant Frequency For 20 Million Stress Cycles in Random Vibration

COMBINING THERMAL CYCLING AND VIBRATION FATIGUE DAMAGE

- Alternating Stress Superimposed Upon A Steady Stress
- Vibration Test Data Failures In Pin Grid Array Wires At Low Temperatures
- Combining Thermal Cycling And Vibration Damage
- Miner's Combined Cumulative Fatigue Damage Criteria

FINITE ELEMENT ANALYSIS METHODS AND TECHNIQUES

- Finite Element Analysis (FEA) Methods To Determine Resonant Frequency, Forces, and Stresses
- Utilize Displacement, Forces, Stresses, And Temperatures From FEA To Determine Total Damage Due To Various Environments

CASE HISTORIES OF FAILURES AND FAILURE ANALYSIS

- Small Ceramic Chip Resistors And Capacitors
- Failures In Small Axial Leaded Through-Hole Components
- Surface Mounted Transformer Lead Wire Failures
- Microprocessor Lead Wire Solder Joint Failures
- Relay Vibration Failures And Possible Screening Methods
- Hybrid Shock Failure Of Internal Die Bond Wires
- Cracked Casting Failure Analysis

WHO SHOULD ATTEND?

R&D Electronic Engineers and Managers
Packaging Engineers
Quality & Reliability Engineers
Test Engineers
Manufacturing Engineers
Mechanical Engineers
Application and Sale Engineers

INSTRUCTOR: Steven Carlson has 19 years of extensive experience in defense/aerospace industry dealing with design and analysis of electronic hardware with a strong understanding of thermal and structural analysis. He is the

principal engineer at Carlson Mechanical Engineering and has provided mechanical analysis services to Northrop Grumman, Physical Optics Corporation, and multiple other electronic manufacturers for military and commercial applications. Steve holds a Masters in Mechanical Engineering and currently works at Jet Propulsion Laboratory (JPL) performing thermal and structural analyses on space based electronic hardware.

Steve learned the classical techniques for analyzing electronic hardware from Joel Sloan (author Design and Packaging of Electronic Equipment) who was a colleague of Dave Steinberg (author of multiple thermal and vibration analysis books) at Litton Guidance and Control Systems. Steve has expanded the classical techniques to include modern solid modeling and Finite Element Analysis to reduce analysis time, improve accuracy, and decrease product development time.

He worked under the mentorship of Joel Sloan at Litton Guidance and Control Systems on navigation grade systems (LN-100, LN-200, and LN25x) and development programs (Fiber Optic Gyro and Silicon Accelerometer). Steve has worked on multiple flight programs at JPL including the Mars Science Laboratory and Juno performing heat transfer and vibration analyses on electronic hardware at component and system level.

Cost $850 per person for all four days. If you have five or more from the same company the price is $765 per person
Date: March 5-6 & 12-13, 2019
Time 8:30-11:30 am Pacific (California) each day 12 hours total

After registering, you will receive a confirmation email containing information about joining the webinar.
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