COMPARISON OF VIBRATIONAL ANALYSIS OF SPRING MOUNTED AND SLOT MOUNTED PRINTED CIRCUIT BOARD

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Abstract — *In this paper, the comparison of vibration analysis of electronic control unit box assembly using spring mounted and slot mounted printed circuit board and an electronic components is discussed. A detailed longitudinal vibration analysis of a real electronic control unit box assembly is performed in simply supported condition with respect to structural type and modal analysis. Effects of component addition, board mounting , component modelling are investigated in detail. In order to identify the most efficient, reliable and suitable method depending on the type of problem,the natural frequency with which the system is vibrating, maximum deflection of this model is solved by finite element solution using solver target as mechanical APDL in ANSYS software.*

Keywords—slot mounted ,spring mounted,simply supported,board mounting,finite element solution.

1. INTRODUCTION

The main consideration of vibration analysis is to find the natural frequency of vibration, which is one of the characteristic frequencies of vibration of body when it is under free vibration. This project deals with the detailed vibration analysis of electronic control unit boxassembly with spring mounted and slot mounted as shown in figure 1.0 and 2.0 with the effect of component addition, boardmounting, component modelling.

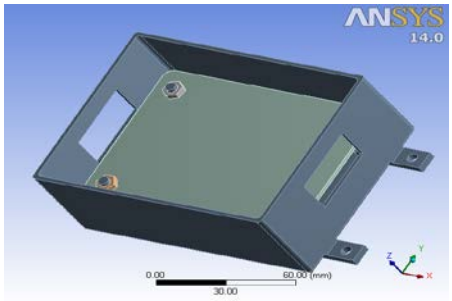


Fig.1.0: Spring Mounted ECU Box Assembly

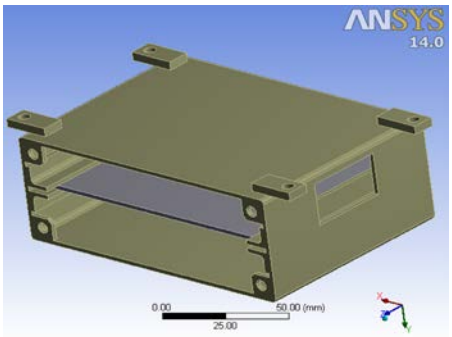


Fig.2.0: Slot Mounted ECU Box Assembly

A. WHY VIBRATION ANALYSIS REQUIRED FOR ELECTRONIC PACKAGING?

Vibration analysis has a vital role to play in society for improving living conditions.It ensures smooth functioning of industrial equipments , minimising the losses due to unwanted vibrations.

We need to see that the structure is excited by frequencies far away from the natural frequency, if necessary, to limit the amplitude of vibration. If the existing frequency is very near the natural frequency, the amplitude of vibration will be excessively large which readily leads to failure due to resonance.

B. Types of Vibrations.

The vibration of the system can be classified as follows:-

- Free Vibration
- Forced Vibration.
- Damped Vibration.

This paper deals the analysis of electronic control unit box with free vibration to find the natural frequency and maximum deflection of the slot munted and spring mounted printed ci

2. DESIGNING OF ECU BOX ASSEMBLY

The dimension of the electronic control unit box assemble are given below.

TABLE.1.0: DIMENSIONS OF ECU BOX ASSEMBLY

Bounding Box	
Length X	160. mm
Length Y	95. mm
Length Z	55. mm
Properties	
Volume	1.0115e+005 mm³
Mass	0.26076 kg
Material	
Assignment	Aluminum Alloy

A. MESHING

The art of subdividing a structure into a convenient number of smaller components is known as Discritization

or Meshing. After Designing of Electronic Control Unit Box assembly then is to be meshed for further analysis as data given in the table 2.0

TABLE.2.0: MESHING DATA OF ECU BOX ASSEMBLY

Physics Preference	Mechanical
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

The figure 3.0 shows the result ofmeshed spring mounted Electronic control unit box assembly and fig 4.0 shows the result of meshed slot mounted Electronic control unit box assembly.

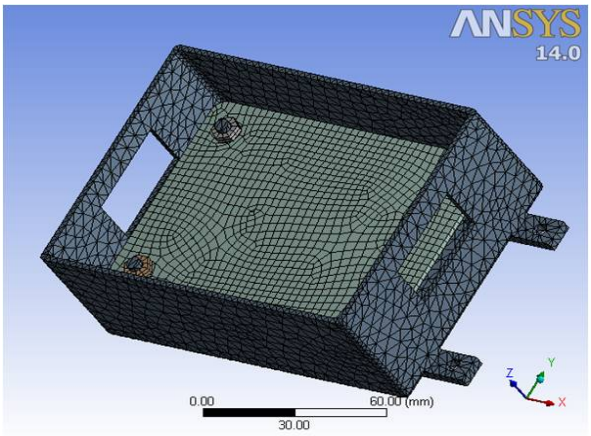


Fig.3.0:Spring mounted Meshed ECU Box Assembly

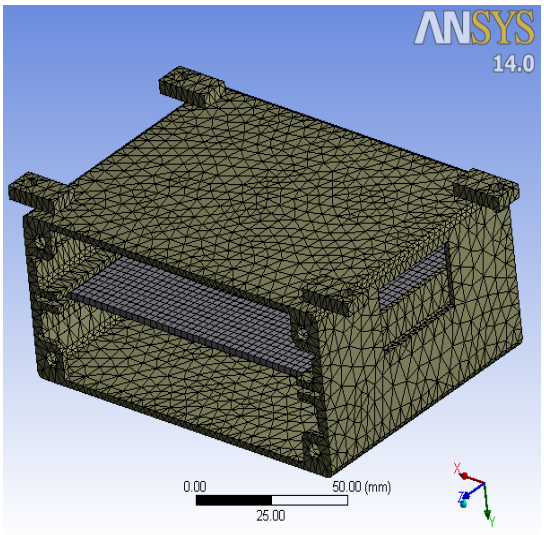


Fig.4.0:Slot mounted Meshed ECU Box Assembly

B. MODAL ANALYSIS SETTINGS

The Meshed assembly is proceed for further analysis using the following data as shown in the Table3.0

TABLE.3.0: ANALYSIS SETTINGS OF ECU BOX ASSEMBLY

Physics Type	Structural
Analysis Type	Modal
Solver Target	Mechanical APDL
Environment Temperature	22. °C
State	Fully Defined
Max Modes to Find	3
Solver Unit System	Mm
Scoping Method	Geometry Selection
Geometry	4 Faces
Type	Fixed Support

C. SOLUTION.

The Electronic Circuit Board Assembly is next proceed for solution to find out the results as defined in the following table 4.0

TABLE.4.0: SOLUTION OF ECU BOX ASSEMBLY

Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Line Thickness	Single
Display Type	Lines

As the results of specified above data the deflection of the electronic box assembly with respect to natural frequency as obtained by ANSYS Software as shown below. The figures 5.0, 6.0, 7.0 show three different modes of spring mounted ECU box assembly as the result of maximum deflection of the assembly with respect to Natural Frequency.

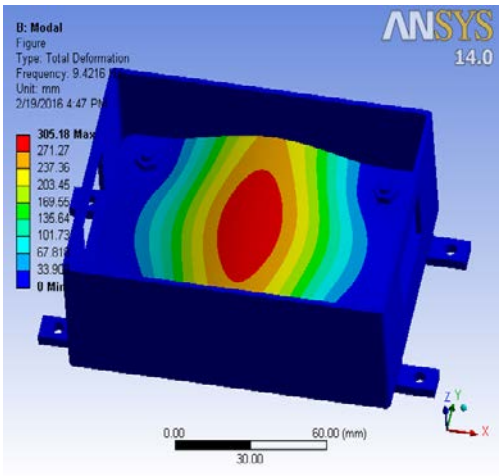


Fig.5.0: MODE 1 of spring mounted PCB

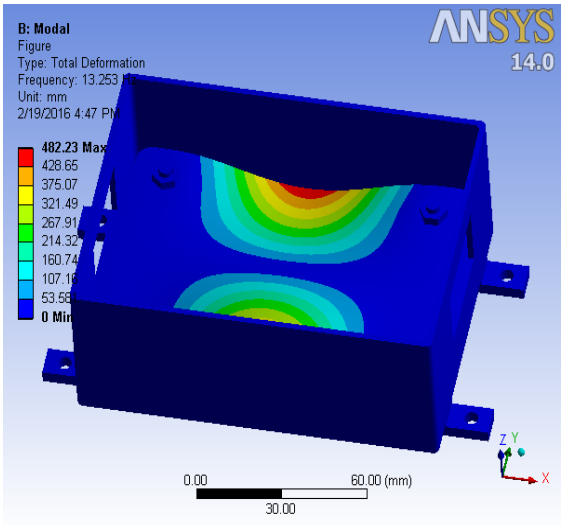


Fig.6.0: MODE 2of spring mounted PCB

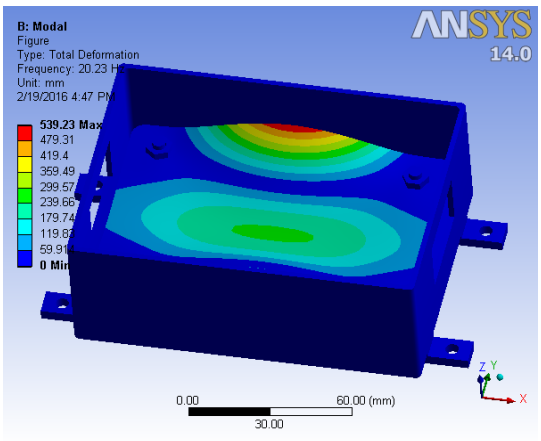


Fig.7.0: MODE 3of spring mounted PCB

As the results of specified data listed in the Table 4.0 the deflection of the electronic box assembly with respect to natural frequency as obtained by ANSYS Software are obtained . The figures 8.0 , 9.0, 10.0 show three different modes of slot mounted ECU box assembly as the result of maximum deflection of the assembly with respect to Natural Frequency.

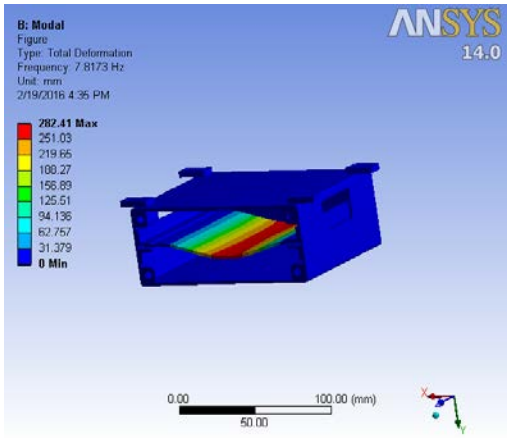


Fig.8.0: MODE 1 of slot mounted PCB

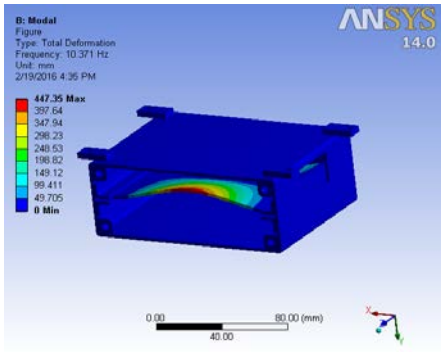


Fig.9.0: MODE 2 of slot mounted PCB

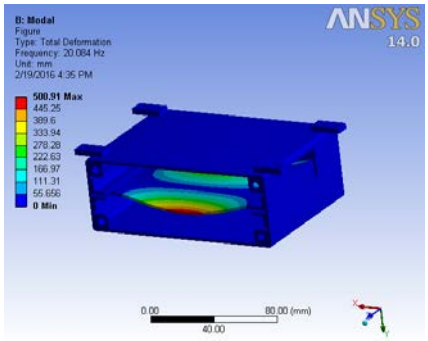


Fig.10.0: MODE 3 of slot mounted PCB

The Above figure shows the result of three different modes of vibration and the respective natural frequency and maximum deflection of the spring mounted and slot mounted PCB assembly is tabulated in Table 5.0

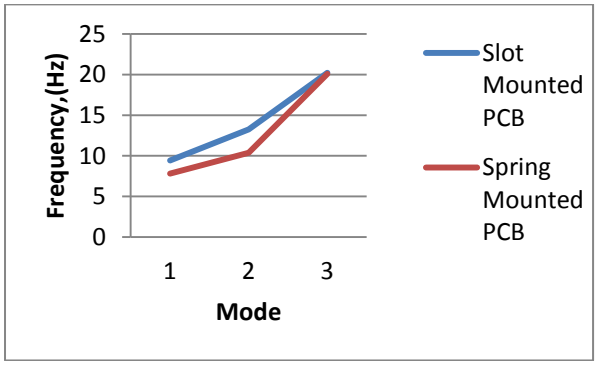
TABLE.5.0: RESULTS OF VIBRATIONAL ANALYSIS

	SPRING MOUNTED PCB		SLOT MOUNTED PCB	
	FREQUENCY (Hz)	MAXIMUM DEFLECTION (mm)	FREQUENCY (Hz)	MAXIMUM DEFLECTION (mm)
MODE 1	9.4216	305.18	7.8173	282.41
MODE 2	13.253	482.23	10.371	447.35
MODE 3	20.231	539.23	20.084	500.91

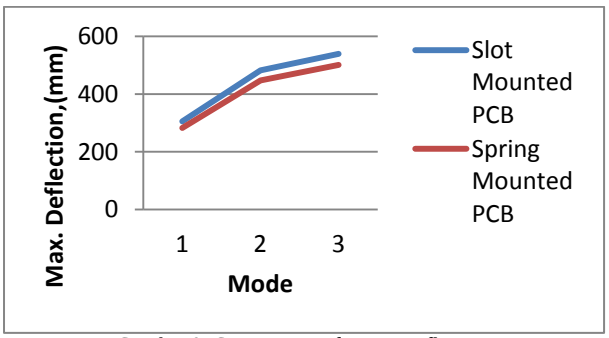
Thus the result obtained from various modal analysis of spring mounted and slot mounted printed circuit board with the electronic control unit box assembly to obtained the natural frequency and maximum deflection.

3.CONCLUSION

From the Graph 1.0 shows the Natural Frequency of the spring mounted and slot mounted Assembly with respect to three different modesare compared and the Graph 2.0 shows the Maximum Deflection of thespring mounted and slot mounted assembly for three different modes are compared..



Graph.1.0: Comparison of Natural Frequency



Graph.2.0: Comparison of Max. Deflection

From the above graphs we studied the natural frequency and maximum Deflection of the spring mounted and slot mounted Electronic Circuit Box assembly and we concluded that the spring mounted printed circuit board with electronic box assembly minimised the natural vibration and maximum deflection compared to the slot mounted printed circuit board assembly.

SUGGESTIONS FOR FUTURE RESEARCH

Experimental verification of the finite element model proposed in this thesis can be investigated further. Also, the suitability of the proposed model fordifferent analysing relative vibration between PCB and component can be investigated. In addition to that, the proposed analytical model can be used in fatigue life prediction of PCBs and electronic components.

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