Experimental Investigation of Particle Damper Based System Implemented on Vibration Reduction of Extension Housing for Printed Circuit Board

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ABSTRACT
When a high-speed moving object is subjected to high-intensity vibration shocks and a pointy rise in temperature, the interior electronic elements (Printed Circuit Board) can manufacture a significant dynamic response. So as to fulfill the requirements of future development, a brand new structure style of vibration reduction of extension housing for PCB is planned. Firstly, harmonic analysis of the extension system is performed to see the modal sensitive space. The installation position of the damper is decided by combining the sensitive space of vibration transfer path of the extension system. This project discusses the novel application of particle damper capsules to suppress the vibration of a printed circuit Board (PCB) and study the relationships between the vibration responses and therefore the input force amplitude for varied particle damper parameters like Particle Size (PS), Particle Density (PD). Many experiments were meted out with totally different mixtures of particle damper parameters for the estimation of vibration responses within the PCB for the first modes of vibration. modal analysis of PCB and printed circuit Board with particle perform using ANSYS workbench nineteen. Three-dimensional CAD model is intended for using CATIA V5R20. Finite component Analysis (FEA) software ANSYS Version 19.0 is employed to see the Natural frequencies of printed circuit Board. Experimental validation of the natural frequency of PCB and computer circuit Board with particles is going to be done using FFT analyzer and impact hammer.

Keywords— PCB, ANSYS, Particle Size, FFT analyzer and impact hammer.

1.0 INTRODUCTION

In order to fulfill the innovation of the idea of air and space operations, several of the objects are being developed within the direction of cross-domain, high-speed and multi-use. Electronic systems will notice positioning navigation, communication, target recognition and alternative technology. Once the inbuilt equipment fails, its mistake can have harmful consequences. PCB (Printed Circuit Board) is a crucial a part of equipment. Beneath the high-intensity vibration, the electronic parts can have a heavy dynamic response. In step with statistics, twenty seventh of the factors inflicting equipment failure are the vibration factors. There are several ancient damping measures, and therefore the wide used damping parts typically with rubber isolators. However, the rubber isolator has following problems: the operating temperature varies and therefore the heat conductivity path is blocked, that brings thermal style difficulties. The rubber material is vulnerable to aging and it has to get replaced sporadically. Particularly within the harsh surroundings, with the speedy movement of the thing, the temperature will increase sharply, that aggravates the failure and aging of rubber. So as to resolve drawbacks of rubber dampers and adapt to future development desires, it's necessary to develop and style a replacement style of vibration reduction technology. The warmth transfer path isn't blocked by this method, and linear and angular displacements can't be introduced. as a result of it's a good temperature vary, this method is applicable to a good band. Particle damping technology may be a new technology for passive vibration management. This technology provides effective broadband damping in harsh environments like high and low temperatures and radiation. it's several blessings like outstanding damping impact, isotropy, no increase in linear displacement, high responsibility and no modification of the first structure, etc.

Particle damping technology may be a kind of kind of kind vibration damper, wherever several metal, metal inorganic compound, ceramic or alternative varieties of tiny particles are placed inside the cavities of the vibratory structure, or the enclosures connected to the vibratory structure so as to mitigate the response of the first structure. The first structure vibrates; K.E. is considerably absorbed through the combined effects of particle-to-particle and particle-to-wall dead collisions and resistance losses, manufacturing goodly damping to the first structure. Particle damping technology has been wide used because of its simplicity, moderate value, smart sturdiness, and temperature insensitiveness. Particle dampers are appropriate for employment in long-term harsh environments, like extreme temperature, severe cold, and oil contamination, wherever alternative varieties of damping devices are not any longer appropriate or economical, therefore creating the utilization of particle dampers a coffee maintenance damping methodology. The vibration attenuation technology has been wide employed in the part and machinery fields, manufacturing several sorts of industrial applications, as an example, the vibration suppression of cutting tools, engine rotary engine system within the space vehicle, and antenna structures. What is more, particle damping technology additionally shows its superiority within the vibration and noise management in lifeline engineering, like wind turbines, power transmission towers, and subsea jumpers.

What are the various varieties of PCBs?

PCB's are typically classified on the premise of frequency, variety of layers and substrate used. Some standard are mentioned below.

•Single Sided PCBs

Single sided PCBs are the fundamental style of circuit boards, that contain just one layer of substrate or base material. The layer is roofed with a skinny layer of metal, i.e. copper- that may be a smart conductor of electricity. These PCBs additionally contain a protecting solder mask, that is applied on the highest of the copper layer together with a silk screen coat. Some blessings offered by single sided PCB's are:

Single sided PCB's are used for volume production and ar low in value.

These PCBs are used for straightforward circuits like power sensors, relays, sensors and electronic toys.

•Double Sided PCBs

Double sided PCBs have each the edges of the substrate that includes metal semiconducting layer. Holes within the card enable the metal components to be connected from one aspect to the opposite. These PCBs connect the circuits on the either aspect by either of the 2 mounting schemes, specifically through-hole technology and surface mount technology. The through-hole technology involves inserting of lead parts through the pre-drilled holes on the card, that ar soldered to the pads on the alternative sides. The surface mount technology involves electrical parts to be directly placed on the surface of the circuit boards. blessings offered by double sided PCBs are:

Surface mounting permits additional circuits to be connected to the board as compared to the through-hole mounting.

These PCB's ar used during a wide selection of applications, as well as itinerant system, power observation, equipment, amplifiers, and plenty of others.

Multi-layer PCBs

Multi-layer PCBs are printed circuit boards, that comprise over 2 copper layers like 4L, 6L, 8L, etc. These PCBs expand the technology utilized in double sided PCB's. Numerous layers of a substrate board and insulating materials separate the layers in multi-layer PCBs. The PCBs square measure compact sized, and supply advantages of weight and area. Some blessings offered by multi-layer PCBs are:

Multi-layer PCBs supply a high level of style flexibility.

These PCBs play a very important role in high speed circuits. They supply extra space for conductor pattern and power.

•Rigid PCBs

Rigid PCBs confer with those kinds of PCBs whose base material is fictitious from a solid material and that can't be bent. Some salient advantage offered by them:

These PCBs are compact, that ensures the creation of kind of advanced electronic equipment around it.

Rigid PCBs supply simple repair and maintenance, as all the parts square measure clearly marked. Also, the signal methods square measure well organized.

•Flexible PCBs

Flexible PCBs square measure made on a versatile base material. These PCBs are available single sided, double-sided and multilayer formats. This helps in reducing the complexness among the device assembly. Some blessings offered by these PCBs are:

These PCBs facilitate save heaps of area, beside reducing the board weight.

Flexible PCBs helps in decreasing the board size, that makes it ideal for numerous applications wherever high signal trace density is required.

These PCBs square measure designed for operating conditions, wherever temperature and density may be a main concern.

•Rigid-Flex-PCBs

Rigid flex PCBs square measure the mixture of rigid and versatile circuit boards. They comprise of multiple layers of versatile circuits hooked up to over one rigid board.

These PCBs square measure exactitude designed. Hence, it's utilized in numerous medical and military applications.

Being light-weight, these PCB supply hr of weight and area savings.

•High-Frequency PCBs

High-frequency PCBs square measure utilized in the frequency vary of 500MHz – 2GHz. These PCBs square measure utilized in numerous frequency vital applications like communication systems, microwave PCBs, micro-strip PCBs, etc.

•Aluminum backed PCBs

These PCBs are utilized in high power applications, because the aluminium construction helps in temperature reduction. aluminium backed PCBs square measure noted to supply high level of rigidity and low level of thermal enlargement, that makes them ideal for applications having high mechanical tolerance. The PCBs square measure used for LEDs and power provides.

What is particle damping?

As an easy and passive suggests that, particle damping provides vibration suppression with granular particles embedded among their containing holes during a vibratory structure. in contrast to in ancient damping materials, mechanisms of energy dissipation of particle damping are primarily associated with friction and impact phenomena that square measure extremely non-linear.

1.1 LITERATURE REVIEW

P Veeramuthuvel, K Shankarand K Sairajan et.al[1], This paper examines the novel use of molecule damper container to smother the vibration of a Printed Circuit Board (PCB) and study the connections between the vibration reactions and the info power abundancy for different molecule damper boundaries like Particle Size (PS), Particle Density (PD) and Packing Ratio (PR). A few examinations were done with various mixes of molecule damper boundaries for the assessment of vibration reactions in the PCB for the essential methods of vibration. In light of these, the variables which influence the vibration reactions are read exhaustively for the picked blend of framework boundaries. Additionally, the connections between the reaction and the applied power for different PS, PR, PD and reaction areas are gotten and they are utilized to show up at the plan rules for the molecule damper appropriate for rocket electronic bundles. The vibration concealment of PCB under irregular vibration climate is performed to exhibit the adequacy of the planned molecule damper.

Ying-Chih Lee , Bor-Tsuen Wang, Yi-Shao Lai , Chang-Lin Yeh , Rong-Sheng Chen et.al[2], In this exploration paper, the exploratory modular investigation (EMA) was performed to build up an identical limited component (FE) model for a standard Joint Electron Device Engineering Council (JEDEC) drop test printed circuit board (PCB) mounted with bundles in a full exhibit. Material properties of the same FE model of the bundled PCB were adjusted through an advancement interaction as for normal frequencies dependent on EMA results acquired with a free limit condition. The model was then applied to decide screwing snugness of the bundled PCB relating to a fixed limit condition with the four corners of the PCB compelled, as characterized by JEDEC for a board-level drop test. Modular damping proportions of the bundled PCB were likewise given.

Influencing Matthias Schmitt, Tobias Kamps, Christian Seidel, Gunther Reinhart et.al[3], In this examination paper they say to accomplish vibration concealment in gears molecule dampers are an appropriate technique and simple to incorporate in the creation when utilizing powder bed-based advances. Assembling dampers with great properties for gears is required to be testing on the grounds that the inquiries of powder evacuation and backing structure must be tended to. For a subsequent stage, reasonable help constructions and powder expulsion systems must be created. Simultaneously, testing ought to be completed to decide the damping execution of molecule dampers with unsolidified powder in diffusive fields, since there is no information accessible yet. On the off chance that reasonable damping exhibitions are acquired, manufacturability is given.

Xiaowei Li , Yue Yang, and Weixing Shi et.al[4], This examination paper says that Particle dampers can expand the damping impact and successfully devour the vibration energy of the fundamental design. While metal particles enjoy benefits in energy scattering moderately, normal structure materials, for example, stone and cement can likewise be applied as particles in the damper, concluded structure molecule damping file However, their pragmatic consequences for damping should be confirmed by additional speculations and investigations. /e instrument of the molecule damper is exceptionally muddled, in view of different vulnerabilities and nonlinearities during the impact, just as various shared coupling factors which will influence the outcomes. Impacts of certain components can be gotten from the hypothetical model, while others require a great deal of trial investigates.

"Tooth Liuand Rongping Fan et.al[5], In this Research paper, the effect hammer testing technique and non-contact TV Laser holography innovation were used to lead trial modular examination and explore the powerful attributes of Printed Circuit Board (PCB) gathering, individually. The test results show that the weight and area of the accelerometer have extraordinary impact on test brings about the previous, and test consequences of the last would be more exact if the excitation focuses were chosen well. In light of the modular test outcomes, a successful Finite Element (FE) model was set up and was utilized to do arbitrary vibration investigation. The recreation aftereffects of arbitrary vibration investigation are in acceptable concurrence with the exploratory information. The advantage of exploratory modular examination and FE reenactment is approved and the current methodology saves demonstrating approval time while expanding exactness. The FE recreation dependent on test modular examination will give a manual for researching the unique qualities and streamlining plan of the PCB get together.

Louis Gagnon , Marco Morandini. et.al[6], Particle dampers are gadgets that work by a blend of effect and rubbing damping. They scatter the energy of a framework by moving it to a bed of particles. This bed is mathematically compelled to stay inside a compartment fixed to the vibrating framework. In that capacity, the movement caused cooperation happening inside the compartment damps the ingested energy. The primary dissipative instruments included are: crashes between the compartment dividers and the particles and between the actual particles; sliding grating between something similar; and, moving rubbing between something similar. For crashes between the particles and the pit dividers to happen, both ought to be out-of-stage with one another. Plan models, scientific definitions, mathematical models, and trial arrangements for such dampers are assembled. Displaying approaches are introduced both for molecule cooperation and for frameworks furnished with molecule dampers. The results of the nonlinear conduct of molecule dampers are brought to consideration. In that capacity, the obvious logical inconsistencies of the ends and approaches introduced in the writing are featured. A rundown of molecule reenactment programming and their utilization in the writing is given. Above all, a proposed way to deal with make a sound mathematical reproduction of a molecule damper and the going with trial tests is given.

Wangqiang Xiaoa , Yuxiang Huanga. et.al[7], As a uninvolved method for vibration decrease, molecule damping is fundamentally applied to the level or vertical consistent field. In any case, it is only from time to time applied to radiating fields. Under high velocity and substantial stacking, the vibration of tooth surfaces of stuff transmissions turns out to be more extreme shortening gear administration life and expanding commotion. Under radial stacking, the molecule framework shows various attributes, for instance, particles are expelled toward the end farthest from the middle. We examined gears with bored through openings loaded up with damping particles. Utilizing the discrete-component technique, we fostered an energy dissemination model for the molecule framework representing grating and inelastic impacts. Energy dissemination and damping attributes of this framework were dissected. Analyses were additionally led with the stuff framework having distinctive molecule filling rates. The outcomes show that this filling rate is a significant boundary related with molecule damping in a radiating field. An unsatisfactory filling rate would fundamentally lessen damping viability. With changes in revolution speed and burden, the stuff transmission framework has distinctive ideal filling rates. The outcomes give rules to the use of molecule damping in divergent fields of stuff transmissions. Trials showed that molecule damping under diffusive field could successfully lessen the vibration in gear transmission. Molecule filling rate is a significant boundary in molecule damping in radiating fields. Unseemly filling rates would diminish the absolute energy misfortune and in this way damping viability in gear transmission. For various turn paces and loadings, we need to pick an ideal molecule filling rate to viably decrease the vibration of the essential stuff framework. The outcomes may gives hypothetical premise to the utilization of molecule damping under an outward field in gear transmission.

1.2 PROBLEM STATEMENT

For previous studies, they installed small dampers on PCB, occupied valuable space, and changed the structure and wiring for the original PCB. It made the problem more troublesome and complicated. In order to improve the convenience of problems, a particle damper on the extension housing was designed, so that the PCB mounted on the extension housing had an obvious anti-vibration capability. Especially for high-speed moving objects, with the rapid increase of temperature, this method is completely suitable for this kind of environment. It fills in the shortcomings of previous studies on the vibration for PCB. The design method could achieve very effective vibration damping effect, which had very important significance and engineering value in harsh vibration environment.

1.3 OBJECTIVES

- Design of vibration reduction of extension housing for PCB and perform harmonic analysis of the extension system is performed to determine the modal sensitive area.
- Main objective of particle damper capsule to suppress the vibration of a Printed Circuit Board (PCB) and study the relationships between the vibration responses and the input force amplitude for various particle damper parameters such as Particle Size (PS), Particle Density (PD) .
- Modal analysis of PCB and Printed Circuit Board with particle carries out using ANSYS workbench 19.
- Three-dimensional CAD model is designed using CATIA V5R20. Finite Element Analysis (FEA) software ANSYS Version 19.0 is used to determine the Natural frequencies of Printed Circuit Board.
- Experimental validation of natural frequency of PCB and Printed Circuit Board with particle will be done using FFT analyzer and impact hammer.

1.4 METHODOLOGY

- Initially research paper relevant to the topic is gathered and after going through research papers, conventional design of extension housing for PCB.

- A 3-D CAD model will be prepared by studying the Extension housing design for PCB.
- Prepared 3-D model will be transferred to ANSYS software and proper meshing will be created on the model for further analysis.
- For determining the natural frequency, modal analysis will be performed on ANSYS.
- For studying vibration analysis will be performed on the Extension housing.
- Redesigning of model will be done to reduce the stresses and to increase the natural frequency of Extension housing.
- A prototype of the model will be manufactured.
- FFT analysis will be performed on the prototype.
- Vibrations and natural frequency will be calculated by using FFT results.
- Comparison of ANSYS and FFT results will be carried out.

1.5 3D model of PCB:

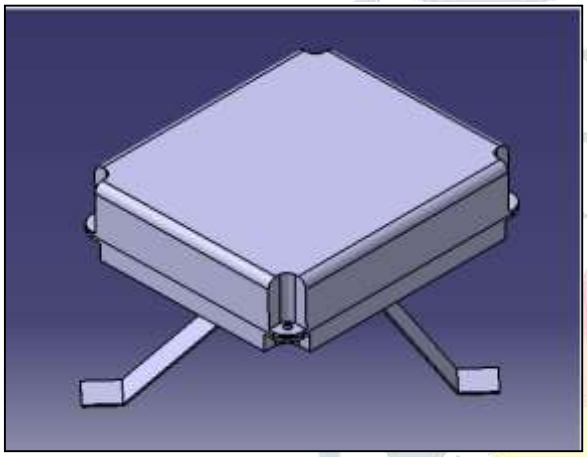


Fig1. 3D Cad model of Extension housing for PCB.

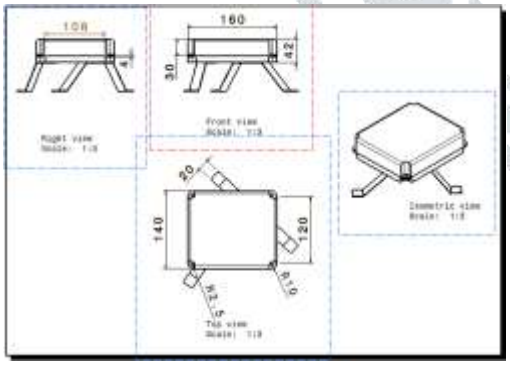


Fig2. Drafting of Extension housing for PCB

1.6 MODAL ANALYSIS:

Modal analysis is a process of extracting modal parameters (natural frequencies, damping loss factors and modal constants) from measured vibration data. Since the measured data can be in the form of either frequency response functions or of impulse responses, there are frequency domain modal analysis and time domain modal analysis. The fundamental of modal analysis using measured frequency response function data is about curving fitting the data using a predefined mathematical model of the measured structure. This model assumes the number of DOF's of the structure, its damping type and possibly the number of vibration modes within the measured frequency range. These assumptions should dictate the mathematical expression of each FRF curve from measurement. As a result, the subsequent work will be a curve fitting process trying to derive all modal parameters in a mathematical formula of an FRF using measurement data. The accuracy of modal analysis is not a simple question of how a measured FRF curve is best fitted in a pure mathematical sense. Obviously, the more accurate the measured FRF data are, the better chance we have to get more accurate curve fitting. In mathematics, the accuracy or successfulness of a curve-fitting endeavor can usually be appraised by defining an error function and aiming to minimize it. This approach is only valid if the correct mathematical formula is used in the curve fitting. If, however, an incorrect mathematical model is used, the curve-fitting outcome is doomed to be a bad one if not a failure, even if the error function is actually minimized numerically. Every object has an internal frequency (or resonant frequency) at which the object can naturally vibrate. It is also the frequency where the object will allow a transfer of energy from one form to another with minimal loss. As the frequency increases towards the "resonant frequency," the amplitude of response asymptotically increases to infinity. In other words, the results of the modal analysis are these frequencies at which the amplitude increases to infinity. Every system can be described in terms of a stiffness matrix that connects the displacements and forces. These frequencies are known as natural frequencies of the system and are provided by the eigenvectors of the stiffness matrix. These frequencies are also known as the resonant frequencies.

2.0 MODAL ANALYSIS OF EXTENSION HOUSING FOR PCB

GEOMETRY:

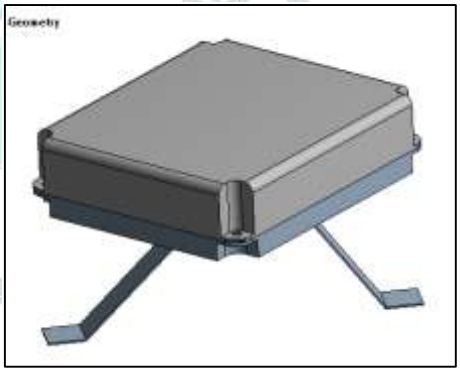


Fig3. Geometry

Material used:

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	2770	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
6	Isotropic Elasticity		
7	Derive from	Young's Modulus and P...	
8	Young's Modulus	7.1E+10	Pa
9	Poisson's Ratio	0.33	
10	Bulk Modulus	6.9608E+10	Pa
11	Shear Modulus	2.6692E+10	Pa

The material was aluminum alloy. The density was 2.7 X103kg/m3. The elastic modulus was 7.5X1010 Pa, and the Poisson's ratio was 0.33.

The modal parameters provided the basis for the optimal design of structural dynamic characteristics, which laid the foundation for design of damper. Because damping has little effect on the natural frequency and main mode of the system, it can be considered as an un-damped system. The free vibration equation is:

$$[M]\{\ddot{X}\} + [K]\{X\} = 0$$

Its characteristic equation is:

$$(K - \omega_n^2 M)X = 0$$

where M is mass and K is stiffness xn is natural frequency and X is displacement.

MESHING:

Fig4. Mesh Model

Details of "Body Sizing" - Sizing	
Scope	
Scoping Method	Geometry Selection
Geometry	2 Bodies
Definition	
Suppressed	No
Type	Element Size
Element Size	5.0 mm

Statistics	
Nodes	40194
Elements	19645

2.1 BOUNDARY CONDITION:

A boundary condition for the model is the setting of a known value for a displacement or an associated load. For a particular node you can set either the load or the displacement but not both.

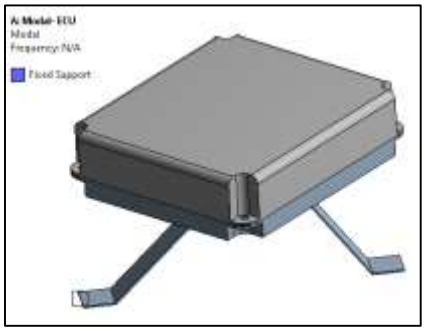


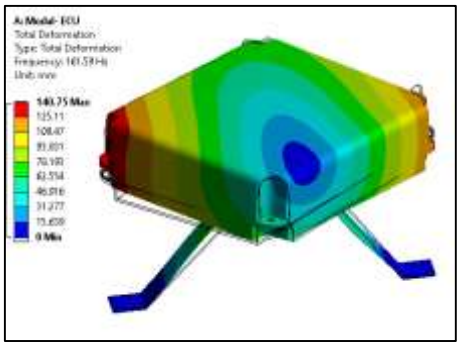
Fig5. Boundary Condition

Fixed support is applied at base of legs as per existing boundary condition

2.2 BOUNDARY CONDITIONS FOR PCB HOUSING

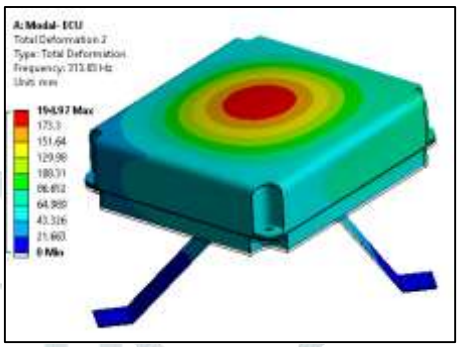
RESULTS AND PLOTS:

MODE SHAPE 01



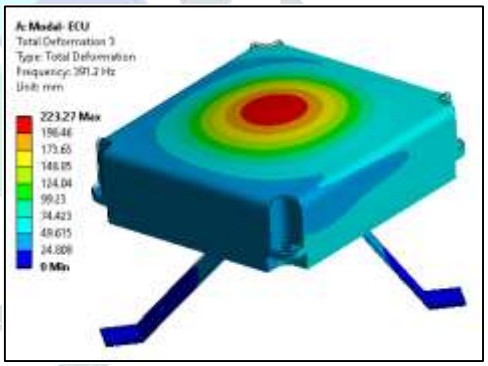
The frequency value for first mode is 161.59 Hz.

MODE SHAPE 02



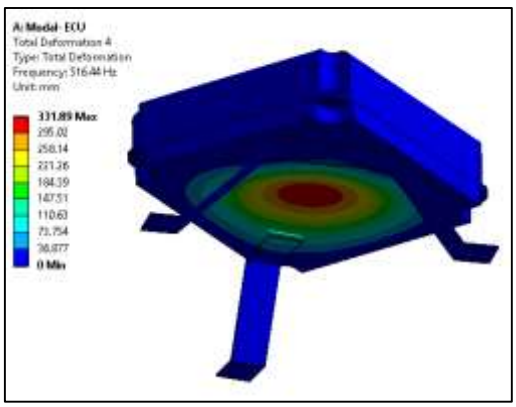
The frequency value for second mode is 313.83 Hz.

MODE SHAPE 03:



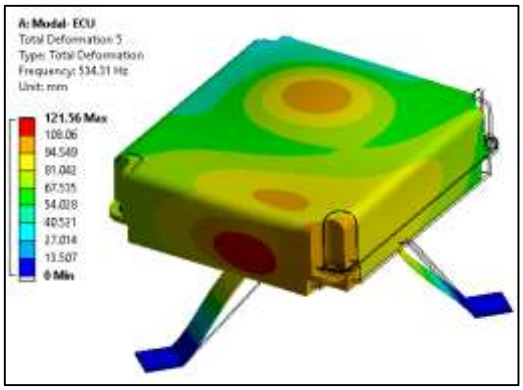
The frequency value for Third mode is 391.2 Hz.

MODE SHAPE 04:



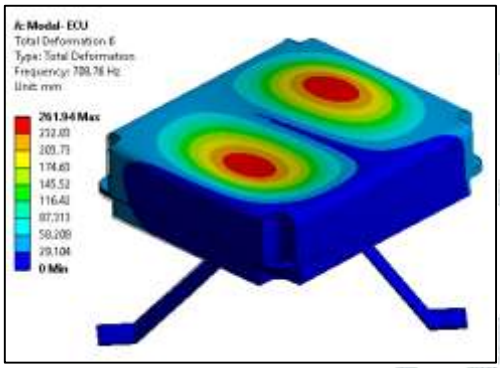
The frequency value for Fourth mode is 516.44 Hz.

MODE SHAPE 05:



The frequency value for Fifth mode is 534.31 Hz.

MODE SHAPE 06:



The frequency value for Sixth mode is 708.76 Hz.

DETAILS OF MODE SHAPE WITH RESPECTIVE NATURAL FREQUENCY

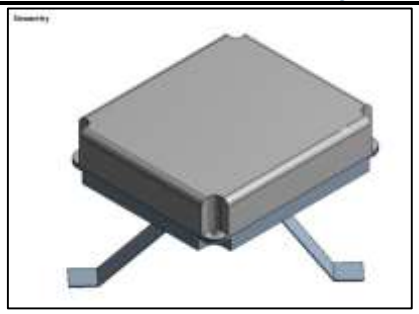
Tabular Data

	Mode	Frequency [Hz]
1	1.	161.59
2	2.	313.83
3	3.	391.2
4	4.	516.44
5	5.	534.31
6	6.	708.76

The particle damping technology is a kind of passive vibration suppression technology. Based on damping mechanism, the technology uses particles as the damping media. By friction and inelastic collision of damping particles being put into the cavities of the machinery, the vibration and noise can be reduced. This technology has the advantage of owning a remarkable damping effect, resisting high temperature, having little modification of the original structure, and adding less mass to the machinery. At present, the technology has become one of the frontiers of the vibration suppression field, and has been widely used in many fields. However, the particle damping technology in the field of Electronic casing or housing has not been studied thoroughly. Thus, applying the particle damping technology into Extension housing of PCB (Printed circuit board) will fill this gap.

3.0 MODIFIED PRINTED CIRCUIT BOARD HOUSING:

GEOMETRY:



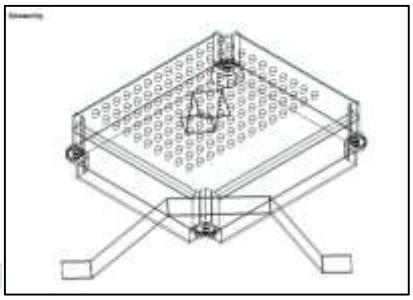


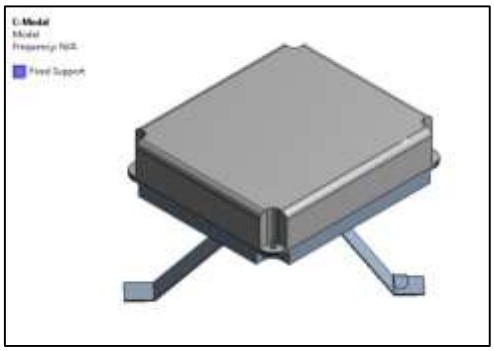
Fig6. Geometry of casing with damping particles

MATERIAL USED:

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	2770	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
6	Isotropic Elasticity		
7	Derive from	Young's Modulus and P...	
8	Young's Modulus	7.1E+10	Pa
9	Poisson's Ratio	0.33	
10	Bulk Modulus	6.9608E+10	Pa
11	Shear Modulus	2.6692E+10	Pa

The balls are made of Steel material.

3.1 BOUNDARY CONDITION:



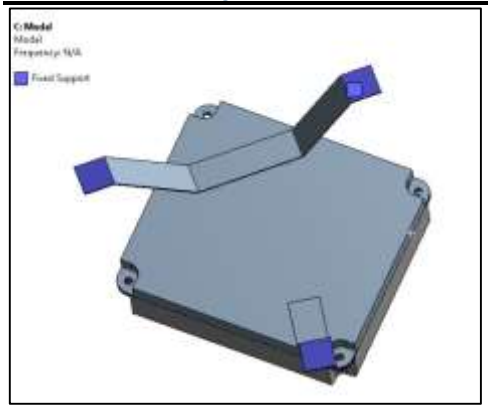
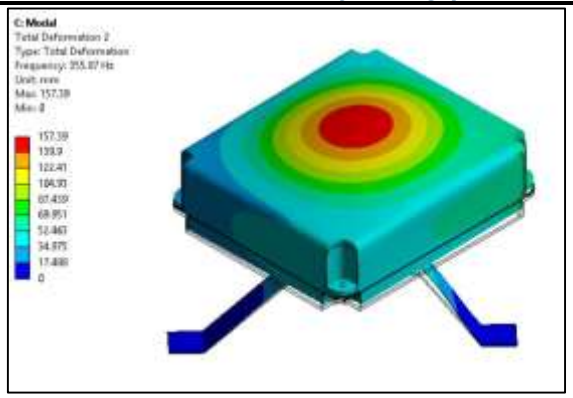


Fig7. The bottom surface is fixed.

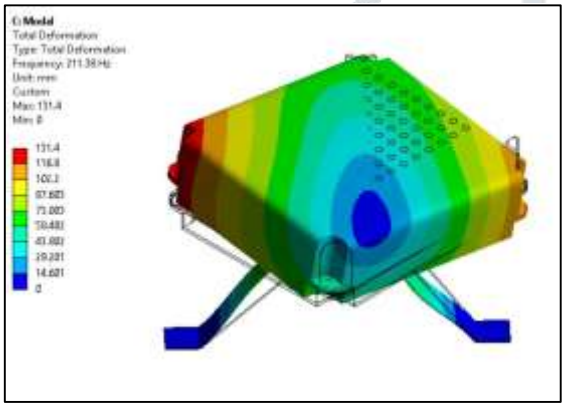


The frequency value for second mode shape is 355.87 Hz.

3.2 RESULTS AND PLOTS:

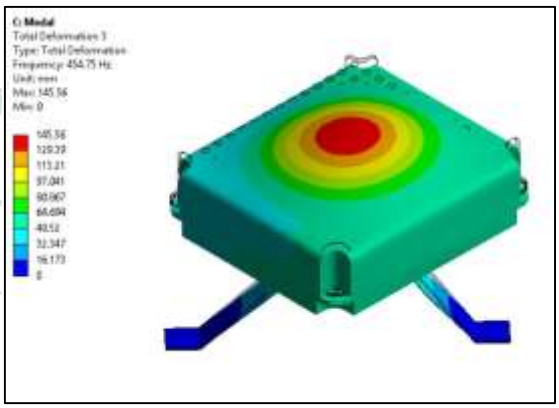
MODE SHAPE RESULTS FOR MODIFIED CASING WITH DAMPING PARTICLE.

MODE SHAPE 01:



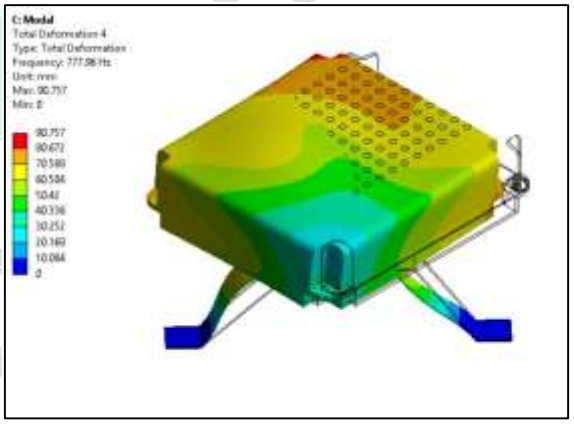
The frequency value for first mode is 211.38 Hz.

MODE SHAPE 03:



The frequency value for Third mode shape is 454.75 Hz.

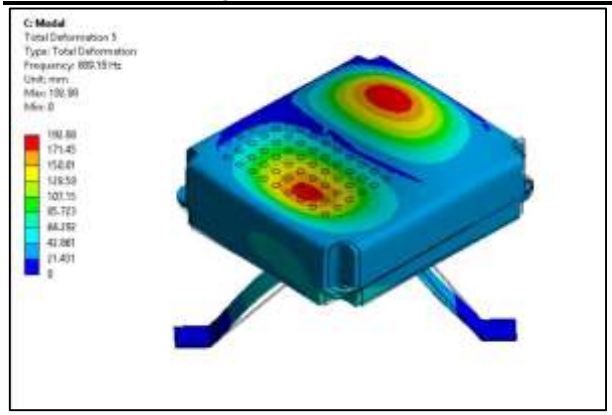
MODE SHAPE 04:



The frequency value for Fourth mode shape is 777.96 Hz.

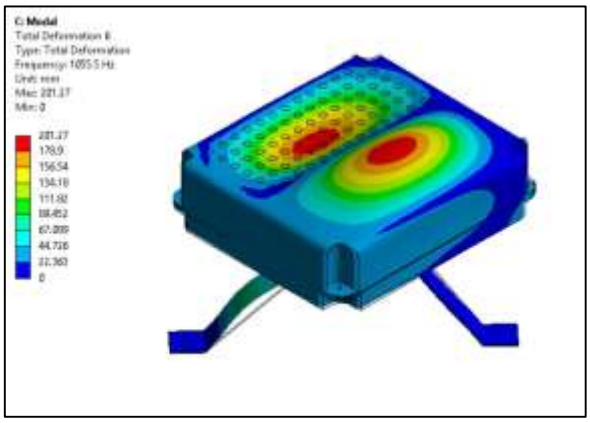
MODE SHAPE 02

MODE SHAPE 05:



The frequency value for Fifth mode shape is 889.18 Hz.

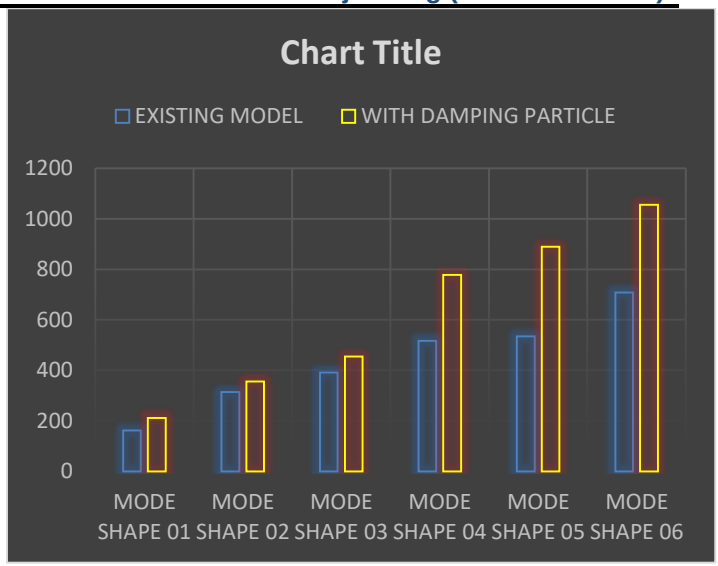
MODE SHAPE 06:



The frequency value for Sixth mode shape is 1055.5 Hz.

3.3 DEFFERENTIATE BETWEEN EXISTING MODEL AND WITH DAMPING PARTICLE

MODE SHAPE RESULT	EXISTING MODEL	WITH DAMPING PARTICLE
MODE SHAPE 01	161.59	211.38
MODE SHAPE 02	313.83	355.87
MODE SHAPE 03	391.2	454.75
MODE SHAPE 04	516.44	777.96
MODE SHAPE 05	534.31	889.18
MODE SHAPE 06	708.76	1055.5



4.0 PARTICLE DAMPER BASED PCB HOUSING EXPERIMENTAL TESTING:

- The damping particles are poured inside the cavity which is manufactured by aluminum plates.
- TIG welding is done on the housing in which these damping particles are being poured.
- The damping particles are poured inside the housing and the case is welded to top cover.

Fig8. Housing with Partical Damper

Fig9. Housing with Partical Damper

5.0 EXPERIMENTAL TESTING USING FFT

5.1 FFT analysis

FFT is one principle property in any succession being utilized as a rule. To discover this property of FFT for some random succession, many changes are being utilized. The significant issues to be seen in discovering this property are the time and memory the board. Two unique calculations are composed for figuring FFT and Autocorrelation of some random succession. Correlation is done between the two calculations concerning the memory and time administrations and the better one is pointed. Examination is between the two calculations composed, thinking about the time and memory as the main fundamental limitations. Time taken by the two changes in finding the basic recurrence is taken. Simultaneously the memory expended while utilizing the two calculations is additionally checked.

5.2 DEWE-43 Universal Data Acquisition Instrument

At the point when associated with the rapid USB 2.0 interface of any PC the DEWE-43 turns into an amazing estimation instrument for simple, computerized, counter and CAN-transport information catch. Eight concurrent simple sources of info test information at up to 204.8 kS/s and in blend with DEWETRON Modal Smart Interface modules (MSI) a wide scope of sensors are upheld Voltage Acceleration Pressure Force Temperature Sound Position RPM Torque Frequency Velocity And more The included DEWESoft application programming includes incredible estimation and examination capacity, transforming the DEWE-43 into a committed recorder, extension or FFT analyzer.

Fig10. Experimental testing photo

The frequency plots for particle damper bases housing are plotted with the help of FFT analyzer

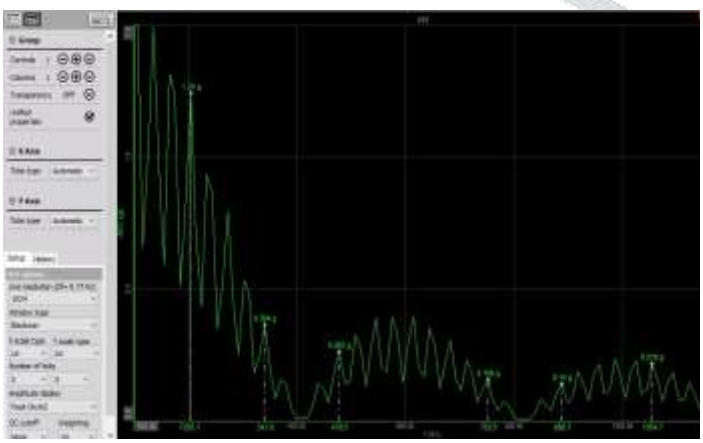
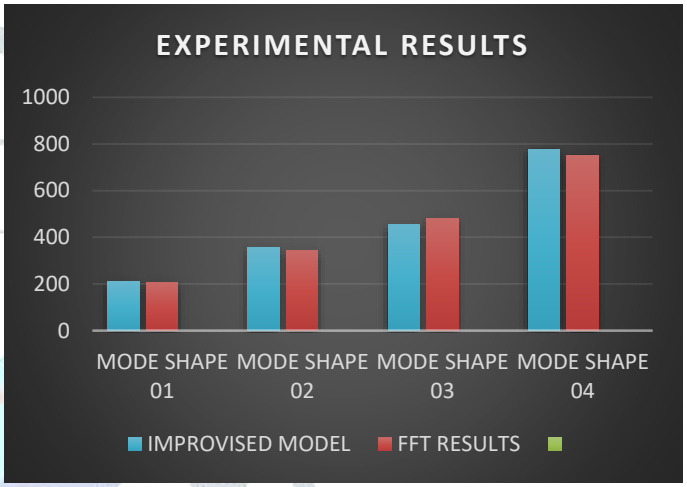


Fig11. Experimental testing photo

6.0 The comparison of Improvised model analytical results and Experimental results

Mode shape results	Improvised model (Hz)	FFT results (Hz)
Mode shape 01	211.38	205.1
Mode shape 02	355.87	341.8
Mode shape 03	454.75	478.5
Mode shape 04	777.96	752
Mode shape 05	889.18	888.7
Mode shape 06	1055.5	1054.7



7.0 CONCLUSION

- With the analytical results the natural frequency of printed circuit board casing without damping particles and with damping particles are observed.
- The analytical results for natural frequency of casing with damping particle are improvised. Due to an application of damping particle method the natural frequency improves and gives better reaction to the vibration caused.

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