# Reserch of Unknown Noise Source in Package Power Distribution System

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**Abstract — In package use, the feed-in and lead-out points of the power supply are not fixed positions, and some components that require large operating currents require an independent power supply to ensure normal operation, so there may be multiple power supply pins on the circuit board, which means The position of the noise source is also not fixed, so this paper designs a sample with multiple power feed-in points, and reserves a chip placement area in the center of the sample to simulate the chip position of the actual product. This paper will use the commonly used system circuit As a research when the system line changes layers, the upper signal line will refer to the ground layer of the second layer and the lower layer signal line will refer to the power layer of the third layer. At this time, the return path will also be due to the gap between the ground layer and the power layer. They are degraded by being non-conductive to each other, which in turn introduces more power supply noise.**

**Keywords： near field measurement, Unknow Noise Source in Package, Return Current Path**

## I. Introduction

The feed-in and lead-out points of the power supply are not fixed positions in actual packaging use. Some components that require a large current will need independent power supply to make sure it works, so there may be multiple power pins on the circuit board, which means that the position of the noise source is also not fixed. Therefore, this paper designs a sample Fig 1 with multiple power feed points, and reserves a wafer placement area in the center of the sample to simulate the actual packaged wafer position. When changing layers, the upper signal line will refer to the ground layer of the second layer and the lower signal line will refer to the power layer of the third layer. In this case, the return path will also be deteriorated due to the non-conductivity between the ground layer and the power layer, which will introduce more power noise. Therefore, we can use this sample to detect unknown noise on the power distribution network.

## II. Method

In the first stage, by measuring the power noise interference characteristics of the power supply noise on the circuit layer structure of the sample system of the unknown package type noise source, compare the power noise interference results at different feed-in positions, and observe whether the power noise at different positions has different interference frequency bands to the system. Based on the results the measured, to verify how the power supply noise feed-in in different positions will affect the noise characteristics received by the sample. And compare the simulation results and measurement results of the unknown noise source in package type sample to different power supply noise feed-in positions to prove the accuracy of the simulation. In the second stage, the package type of the unknown noise source is replaced with a layer structure sample for near-field measurement. The noise source is set at different positions of the sample for measurement, and the near-field measurement is used to measure its broadband radiation pattern.

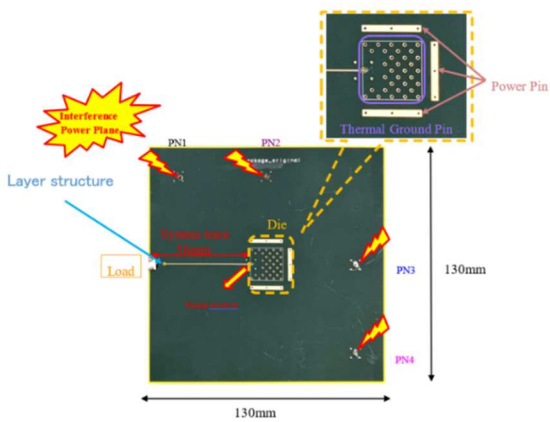


Fig. 1. Unknown Noise Source in Package Type Sample

## III. Results and Discussions

Fig 2. shows the measurement results of the power noise interference characteristic of the circuit layer structure of the sample system of the unknown package type noise source. The frequency band with high power noise interference is the sample resonance mode frequency band. The high noise interference also proves that The layer-change structure with poor return current path will make the system more seriously interfered with by power noise. The interference frequency bands of power noise at different positions in the system are all sample resonance frequencies, but the interference frequency bands at different positions are slightly different, indicating that the power noise at different positions Feed-in affects noise characteristics of sample reception. From Fig 3. can see that the sample will have a higher radiation value at the resonant frequency point, and will have different radiation patterns at the edge of the plate due to the resonance mode. The backflow of the system circuit is poor due to the layer-change structure, resulting in more serious power supply interference. Through the analysis of the results, it can be known that the sample with the layer-change structure will also cause more serious power supply noise interference due to the poor return path. If the noise feed point is placed at the corner of the sample, the mode $TM_{11}$ will generate a resonator effect to conduct power noise. Therefore, if the noise interference of the sample is improved, adjusting the power feed position may avoid the power supply of certain frequency bands. noise interference..

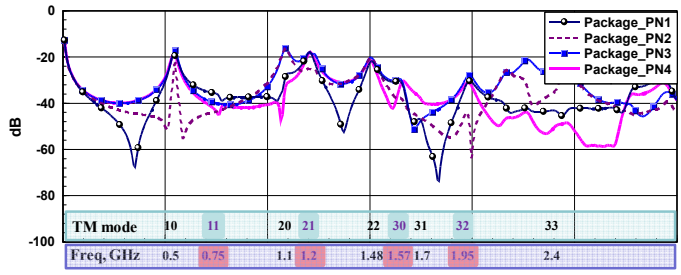


Fig. 2. Unknown Noise Source in Package Type Sample Power Noise Interference Characteristics

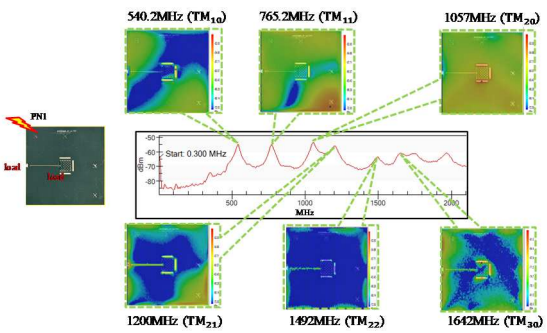


Fig. 3. The near-field measurement results of the noise on frequency domain of the unknown noise source in packaged type samples (PN1)

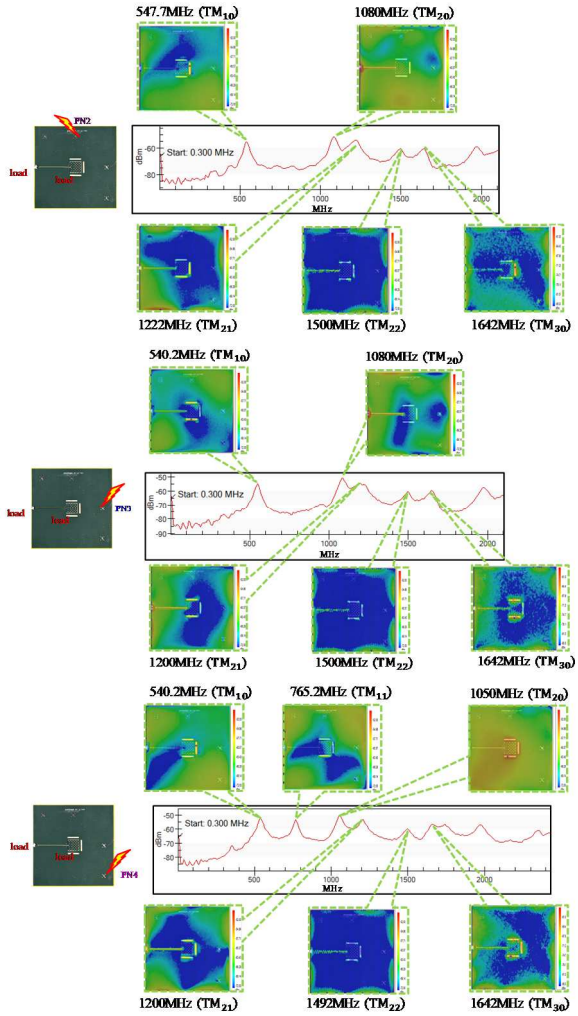


Fig. 3. The near-field measurement results of the noise on frequency domain of the unknown noise source in packaged type samples (PN2-4)

## IV. Conclusions

In this paper, two different measurement methods are used to study the position of the unfixed noise source caused by the position of the complex pins and the influence of the layer structure on the power noise. The establishment of this method will help to find unfixes noise sources more quickly and efficiently in the future.

## References

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