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Frequency Non-selective Structures for Copper Balance in PCBs

N/A

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ABSTRACT

For better manufacturability, printed circuit boards (PCB) typically have periodic planar metallic structures, known as copper balance structures. Copper balance structures are non-functional such that they play no signal processing or computational role. However, with advancing operating frequencies, copper balance structures can start behaving as frequency-selective surfaces (FSS) in bands that overlap with operating frequencies, causing parasitic effects, e.g., attenuation of desired signals, pickup of undesired signals, undesired radiation, etc. Per techniques of this disclosure, copper added to PCBs for the purpose of copper balance is made of aperiodic structures. The aperiodicity of copper balance structures militates against the formation of resonant frequencies, reducing or eliminating parasitic effects.

KEYWORDS

- Printed circuit board (PCB)
- Frequency-selective surface (FSS)
- Electromagnetic bandgap structures (EBG)
- Parasitic effect
- Resonant structure
- Resonant frequency
- Copper balance
- Cross-talk

BACKGROUND

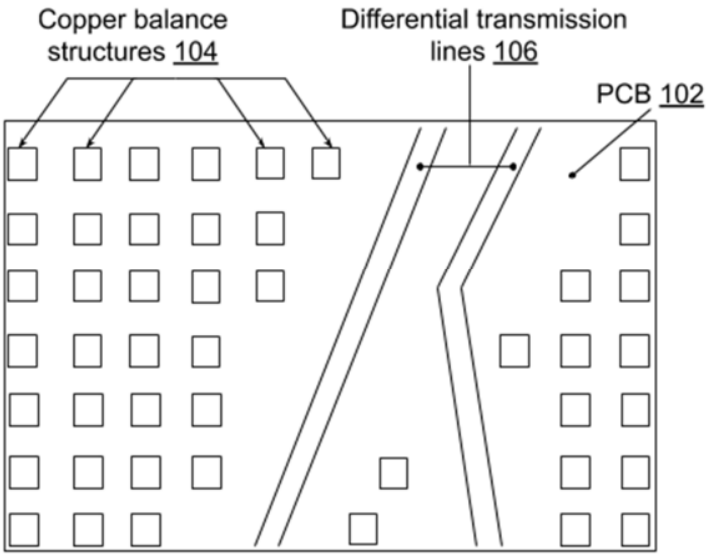

Fig. 1: Copper balance structures in printed circuit boards

Fig. 1 illustrates an example printed circuit board (102), shown with typical features such as differential transmission lines (106) or differential-pair traces, etc. For better manufacturability, PCBs typically have periodic planar metallic structures, known as copper balance structures (104) that improve copper distribution.

Copper balance structures are typically square in shape, e.g., 50 mil^2 in area, and are placed uniformly along a square grid, e.g., at a 100-mil pitch. Copper balance structures are non-functional such that they play no signal processing or computational role. However, with advancing operating frequencies, e.g., in the millimeter-wave range, copper balance structures can start behaving as resonant or frequency-selective surfaces (FSS) in bands that overlap with operating frequencies. They can cause parasitic signaling issues, e.g., at their resonant frequencies, they can attenuate desired signals; pick up and amplify undesired signals (crosstalk or coupling); radiate undesirably; cause insertion loss, etc.

DESCRIPTION

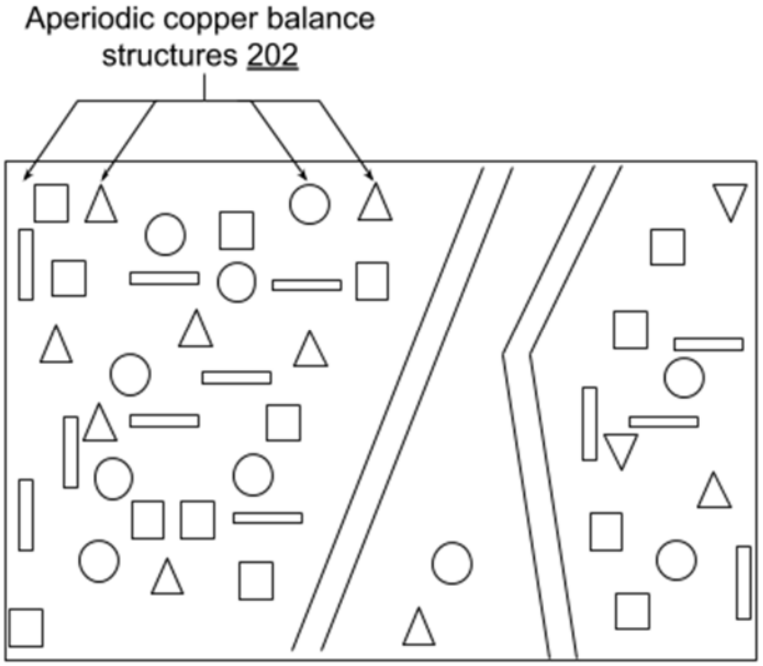

Fig. 2: Aperiodic structures used for copper balance in PCBs

Per techniques of this disclosure, illustrated in Fig. 2, copper added to PCBs for the purpose of copper balance is deliberately made of aperiodic structures (202). The aperiodicity of copper balance structures militates against the formation of resonant frequencies. Undesired resonant effects such as cross-talk, unintended radiation, attenuation of desired signals, insertion loss, etc., are greatly reduced or eliminated.

The aperiodic copper balance structures disclosed herein can be added at the design or the manufacturing stages. An advantage of adding the aperiodic copper balance structures at the design stage is that the (lack of) interaction of the copper balance structures with the functional parts of the PCB can be verified via simulation prior to manufacture.

CONCLUSION

Per techniques of this disclosure, copper added to PCBs for the purpose of copper balance is made of aperiodic structures. The aperiodicity of copper balance structures militates against the formation of resonant frequencies, reducing or eliminating parasitic effects such as cross-talk, desired-signal attenuation, undesired-signal pick-up, insertion loss, etc.