

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VICOR CORPORATION

Petitioner

v.

DELTA ELECTRONICS, INC.

Patent Owner.

Case Nos. IPR2024-00706 and IPR2024-00715

Patent No. 10,877,534

**DECLARATION OF JOSHUA PHINNEY IN SUPPORT OF
PATENT OWNER'S PRELIMINARY RESPONSE**

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I, Joshua Phinney, do declare as follows:

I. INTRODUCTION

1. I have been retained by Delta Electronics to address issues brought forth in Vicor Corporation's IPR Petitions IPR2024-00706 (the "706 IPR") and IPR2024-00715 (the "715 IPR") against U.S. Pat. No. 10,877,534 (the "'534 Patent").

2. I am being compensated for my time. My compensation is not contingent on any result.

3. I understand that Delta Electronics is submitting my declaration to the PTAB with its preliminary response, and that the response is preliminary in nature. Because of this, I have not provided my full opinion and have not addressed the entirety of the record. In no way should be construed that my not addressing an item is a concession, or that I otherwise bear an opinion on it one way or another. If the PTAB decides to institute, I will more fully provide an opinion.

II. BACKGROUND AND QUALIFICATIONS

4. I am a Principal Engineer in the Electrical and Semiconductors practice at Exponent, a multidisciplinary science and engineering consulting firm with headquarters at 149 Commonwealth Drive, Menlo Park, California 94025.

5. I received a Ph.D. in Electrical Engineering from the Massachusetts Institute of Technology ("MIT") in 2005. I also earned S.M. and B.S. degrees in

Electrical Engineering from MIT and the University of Illinois, Chicago, respectively.

6. My doctoral work at MIT centered on miniaturization of power converters and magnetics. As part of my doctoral work, I constructed and modeled planar magnetic systems, including magnetically coupled, printed magnetic coils that were part of LC (inductor-capacitor) resonators. By incorporating such compact LC resonators into the structure of printed-circuit boards (PCBs), the resulting converter enjoyed multiple benefits, including compact size and a printable, laminated form factor. *See* figure below from my doctoral thesis, showing an “air-core” multi-layer laminate structure that I designed. Other designs that I designed and tested included magnetic materials integrated around printed windings. Through the modeling associated with this dissertation, I become proficient in methods for calculating the electrical impedance of packages and interconnects, as well for improving their heat dissipation and electromagnetic emissions.

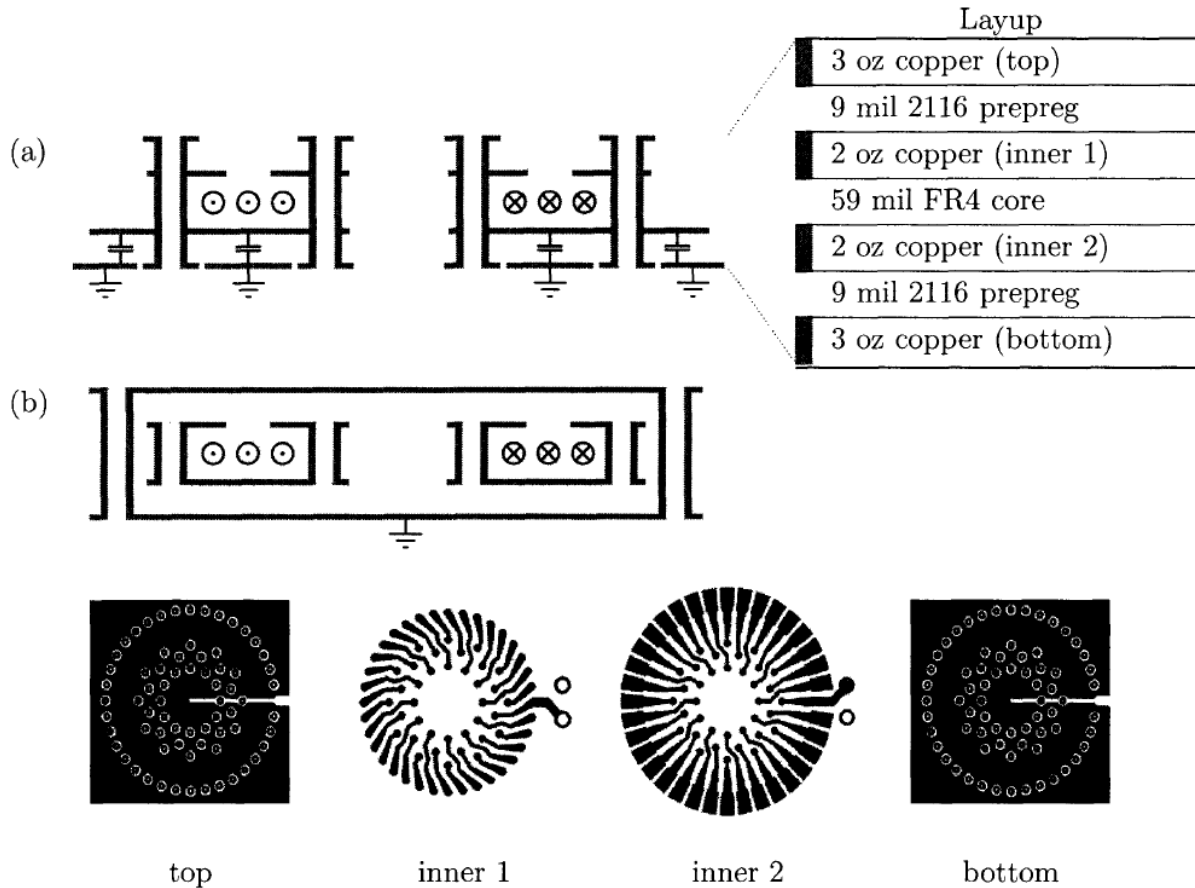


Figure 5.2: (a) Cross-sectional view and layup for a 4-layer PCB used to manufacture low-power multi-resonant structures. The board in (b) incorporates blind vias for more complete shielding of the embedded air-core magnetics.

Figure 5.2 of Phinney Thesis

7. For my publications related to both my Master's and Ph.D. thesis, I received the William M. Portnoy Prize Paper Award (2005) and the IEEE Power Electronics Society Transactions Prize Paper Award (2004). I am the co-inventor on patents for improving the performance of capacitors, EMI filters, and common-mode chokes.

8. After earning my Ph.D., I joined Exponent and have led technical investigations pertaining to power systems, industrial electronics, portable electronic

devices, microcomputers, and electromechanical devices. My job functions include analyzing hardware and software of these devices to understand their modes of failure, and testifying regarding these devices in legal matters involving patents and trade secrets.

9. At Exponent, I have led numerous failure investigations focused on electronic packages and PCBs. Much of this work involves troubleshooting electronics using a variety of techniques, e.g.:

- X-ray and sectioning of packages and interconnects to isolate out-of-tolerance dimensions and short circuits;
- non-destructive (CT) imaging, to reverse engineer structures and perform competitive analyses (e.g., from the standpoint of electrical parasitics and heat transfer);
- electrical measurements of packages and assemblies using automatic test equipment (ATE) to verify electrical tolerances and isolate conductive defects;
- fault-tree analysis and recreation of a propagating faults in PCBs; and
- ionic contamination tests of electronic assemblies, to troubleshoot deposition, cleaning, soldering, and conformal-coating processes.

10. I have testified regarding internal circuitry, physical embodiments, and software-defined features, of electronic equipment. Regarding circuitry, I have

testified regarding the power electronics and communication circuitry in microcomputers, portable electronic devices, peripherals, and machine controllers. In addition, I have testified regarding control and compensation in industrial controllers, voltage regulators, and switched-mode power converters. My experience with wireless RF circuitry includes failure analysis of amplifiers, power supplies, matching networks, and multiplexers in satellites, semiconductor-processing equipment, and medical devices.

11. Regarding the mechanical elements of electronic equipment, I have testified regarding buttons and touch interfaces, connectors, linear and rotary actuators, position-measuring devices, and the design and construction of modular housings for computerized equipment and peripherals. In particular, I have testified regarding user interfaces (including buttons, indicators, touch interfaces and card readers) as they are constructed in relation the housing and underlying electronic assemblies, including PCBs, flex printed circuits, and other connector assemblies within the housing of electronic equipment. In addition, while at Exponent, I have conducted design reviews and comparisons of PCBs and integrated circuits in the context of patent, trade-secret, and employment disputes.

12. Additional details about my employment history, fields of expertise, publications, and testimony are further described in my curriculum vitae, which is filed as Exhibit 2002.

III. MATERIALS REVIEWED

13. My opinions expressed in this declaration are based on my education, knowledge and experience with power electronics and communication circuitry, as well as review of documents and materials identified in this declaration, including the '534 Patent, the prior art references and background materials discussed in this declaration, and the other references specifically identified in this declaration. I have considered these materials in their entirety, even if only portions are discussed here. The following is an exemplary list of the materials on which I based on opinion:

- the U.S. 10,877,534 (“’534 patent”) (VICOR-1001);
- the file history of the ’534 patent (VICOR-1002);
- the declaration and curriculum vitae of Dr. R. Jacob Baker, Ph.D., P.E. (VICOR-1003);
- U.S. Patent Application Publication No. 2014/0355218 to Vinciarelli et al. (“Vinciarelli-218”) (VICOR-1006);
- U.S. Patent Application Publication No. 2009/0175014 to Zeng et al. (“Zeng-014”) (VICOR-1007);
- U.S. Patent No. 10,285,270 to Joseph Fjelstad (“Fjelstad”) (VICOR-1008);
- United States Patent Application Publication No. 2015/0116891 to Park et al. (“Park”) (VICOR-1009);

- United States Patent No. 10,264,664 to Vinciarelli et al. (“Vinciarelli-664”) (VICOR-1010);
- Excerpts from the Prosecution History of U.S. Patent Application No. 14/840,063 (“063 Application and PH”) (VICOR-1011);
- United States Patent Application Publication No. US2005/0098874 to Jun et al. (“Jun”) (VICOR-1012);
- U.S. Patent No. 6,621,011 to Daidai et al. (“Daidai”) (VICOR-1013);
- U.S. Patent. No. 7,361,844 to Vinciarelli et al. (“Vinciarelli-844”) (VICOR-1014);
- U.S. Patent No. 6,934,166 to Vinciarelli et al. (“Vinciarelli-166”) (VICOR-1015);
- “Design Guide & Applications Manual for VI-200 and VI-J00 Family DC-DC Converters and Configurable Power Supplies,” Rev. 3.5, Vicor Corporation (2013) (“Design Guide”) (VICOR-1016);
- U.S. Pat. App. Pub. No. 2012/0014069 to Zeng et al. (“EX2003”)
- U.S. Pat. App. Pub. No. 2012/0327604 to Yang et al. (“EX2004”)
- Excerpts from the prosecution history of U.S. Pat. App. No. 14/840,063 to Zeng (“063 Application”) (EX2005 of 715 IPR)
- English translation of Chinese Pat. App. No. CN201410442972 (“CN972”) (EX2006 of 715 IPR)

- J. Phinney, *Multi-resonant Passive Components for Power Conversion* (Doctoral Thesis, Massachusetts Institute of Technology, Oct. 2005) (“Phinney Thesis”) (EX2005 of 706 IPR and EX2007 of 715 IPR)
- U.S. Pat. App. Pub. No. 2014/0167897 to Choi (“Choi”) (EX2006 of 706 IPR)

and any other material I refer to in this declaration in support of my opinions.

14. I may also consider additional documents and information in forming any necessary opinions — including documents that may not yet have been provided to me. My analysis of the materials produced in this matter is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date.

IV. LEVEL OF ORDINARY SKILL IN THE ART

15. The ’534 Patent identifies the relevant field of art as follows: “[t]he present invention relates to a power supply apparatus. More particularly, the present invention relates to the internal structure of a power supply apparatus.” *’534 Patent*, 1:15-17. Based on that description of the field of art, my experience, and the information I have reviewed for purposes of this proceeding, I believe a person of ordinary skill in the art (“POSITA”) in September 2014 would have had Bachelor’s degree in electrical engineering or a related field, and two or more years of work experience or research related to power engineering, or equivalent training and work

experience in the field. Formal education can substitute for work experience and relevant work experience could substitute for formal education.

16. My level of skill in the art as of September 2014 was at least that of a POSITA. I am qualified to provide opinions concerning what a POSITA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSITA as of that date.

V. RELEVANT LEGAL STANDARDS

17. I am informed by attorneys from Perkins Coie of the relevant legal principles related to patent validity, and hereby describe my understanding of the legal principles and how I apply them in my analysis.

A. Claim Construction

18. I understand that claim terms are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art at the time of the invention when read in the context of the specification and prosecution history unless a patentee sets out a different definition or clearly disavows claim scope.

19. I further understand that extrinsic evidence such as expert or inventor testimony, dictionaries, and learned treatises can help determine the meaning of claim terms, although that evidence is less significant than the claims, specification, and prosecution history.

B. Anticipation

20. I understand that anticipation under 35 U.S.C. §102, a single asserted prior art reference must disclose all of the claim limitations as arranged or combined in the claim, either explicitly or inherently to a person of ordinary skill in the art. I also understand that in order for a reference to inherently disclose a claim limitation, that claim limitation must necessarily be present in the reference and may not be established by probabilities or possibilities.

21. I understand that different embodiments and references cannot be combined to anticipate. Additionally, I understand that for a reference to be an anticipating reference, it must describe the claimed subject matter with sufficient clarity to establish that the subject matter existed and that its existence was recognized by persons of ordinary skills in the field of the invention.

C. Obviousness

22. I understand that even if a patent claim is not anticipated, the claim is invalid if it claims an aspect of an invention that would be obvious to a POSITA at the time of the alleged invention. Specifically, I understand that if the differences between the asserted claim and a single prior art reference or a combination of prior art references are such that the subject matter as a whole would have been obvious to a POSITA at the time the invention was made, a patent may be invalid for “obviousness.”

23. I understand that an obviousness evaluation can be made by using a single reference or by combining several prior art references. For example, a single reference, when considered in view of the knowledge of a POSITA, could render a claim obvious.

24. I also understand and have been informed by counsel that a determination of obviousness is made after weighing the following factors: (1) level of ordinary skill in the pertinent art; (2) the scope and content of the prior art; (3) the differences between the prior art as a whole and the claim at issue; and (4) as appropriate, secondary considerations of non-obviousness.

25. In evaluating obviousness, both the prior art and the claimed invention should be viewed through the knowledge and understanding of a POSITA at the time of the invention—*hindsight* should not be used to decide whether a claim is obvious. In particular, it is my understanding that to render a patent claim invalid as being obvious from a combination of references, *indication* should be given as a whole to suggest the motivation, desirability and thus the obviousness, of making the proposed combination in a way that would produce the patented invention.

26. I understand that an explicit teaching, suggestion, or motivation to combine prior art references is not required. I also understand that an obviousness analysis involving two or more references generally must account for a *reason* why a POSITA would have made a particular combination and that there would have

been a reasonable expectation of success. I understand that the POSITA's common sense or ordinary creativity can be used by itself as a motivation for combining references. I understand that a particular combination of prior art references can be made by merely showing that it was obvious to try the combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, common sense may be a good reason for a POSITA to pursue known options.

27. I am informed and understand that a patent claim composed of several elements is not proven obvious merely by demonstrating that each of its elements was, *independently*, known in the prior art. When combining multiple prior art reference or elements to argue the combination is obvious, I understand that I should consider whether there is an "apparent reason" or *motivation* to combine the prior art references or elements in the way the patent claims.

28. I am informed and understand that when the prior art "*teaches away*" from combining prior art references or certain elements, discovery of a successful means of combining them is more likely to be nonobvious. A prior art reference may be said to "teach away" from a patent when a person of ordinary skill in the art, upon reading the reference, would be *discouraged* from the path set out in the patent or would be led in a direction divergent from the path that was taken by the patent. Additionally, a prior art reference may "teach away" from a claimed invention when

substituting an element within that prior art reference for a claim element would render the claimed invention *inoperable*.

29. I am informed and further understand that to ascertain the scope and content of the prior art, it is necessary to first examine the field of the inventor's endeavor and the particular *problem* for which the invention was made. The relevant prior art includes prior art in the field of the invention, and also prior art from other fields that a person of ordinary skill in the art would look to when attempting to solve the problem.

30. In evaluating obviousness, I understand that one must look at the claimed subject matter as a whole and through the eyes of a POSITA at the time the invention was made. In other words, when determining obviousness, one considers the perspective of a hypothetical POSITA. I further understand that the asserted claims of the patent should be read from the point of view of a POSITA at the time the claimed invention was made. To evaluate whether a patent claim would have been obvious, I understand that one may analyze the interrelated teachings of multiple prior art references.

31. I further understand that it is assumed a hypothetical POSITA knows and has all relevant prior art in the field of endeavor covered by the asserted patent and all analogous prior art. I understand that the POSITA must interpret the references for what they teach based on the skill level of that person. A POSITA is

not necessarily an expert, and the question is what the POSITA would think, not what someone who's an expert in the field would think.

32. I understand that at least the following rationales may support a finding of obviousness: (1) combining prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain predictable results; (3) use of a known technique to improve similar devices (methods, or products) in the same way; (4) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (5) “obvious to try”—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (6) a predictable variation of work in the same or a different field of endeavor if a POSITA would be able to implement the variation; (7) there existed a known problem for which there was an obvious solution encompassed by the patent's claims at the time of the claimed invention; (8) known work in one field may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA; and (9) some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

33. I also understand that evidence of so-called “objective indicia” or “secondary considerations” should be considered when determining whether an asserted claim would have been obvious. “Objective indicia” include: (1) commercial success attributable to the invention; (2) long-felt but unsolved need for the invention; (3) failure of others; (4) skepticism by experts; (5) praise by others; (6) teaching away by others; (7) recognition of a problem which the claimed invention addresses; (8) copying by others; and (9) unexpected results. But these secondary considerations only apply if there is a “nexus” between the asserted secondary consideration and claimed invention, and the secondary considerations cannot be due to extraneous factors, such as marketing or unclaimed features of an embodiment of the invention.

34. I also understand that if others having ordinary skill in the field independently made the claimed invention at about the same time the inventor made the invention, often referred to as “simultaneous invention,” this can be an indication of obviousness. I understand that simultaneous invention can be persuasive evidence that the claimed apparatus or method was merely the product of ordinary engineering skill. I understand that invention even within a year can be considered a comparatively short time.

VI. BRIEF DESCRIPTION OF THE TECHNOLOGY

35. The '534 Patent is related to internal structures of power supply apparatuses. *'534 Patent*, FIG. 1, 1:15-17, 2:51-3:27.

36. To provide context for the '534 Patent and the state of the relevant technology at the time it was filed, I provide the following overview of the essentials of power supply apparatus designs and applications preceding September 2, 2014—the priority date of the '534 Patent. *'534 Patent*, Cover.

37. Many types of power converters are developed for different circuitry applications. Based on input/output voltage types (e.g., alternative current (“AC”) voltage or direct current (“DC”) voltage) power converters can be classified into AC/DC, DC/DC, or DC/AC power converters. EX2003, ¶5. A DC/DC power converter, for example, receives a DC input voltage V_{in} and converts it into a DC output voltage V_{out} . EX2004, ¶4. Converters with output voltage higher than the input voltage are referred to as “boost converters” while converters with output voltage lower than the input are referred to as “buck converters.” *Id.* The diagram reproduced below is a simplified block circuit diagram of a power converter.

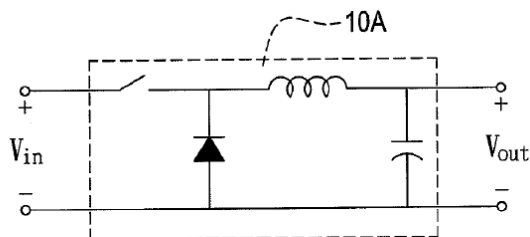


FIG.1
PRIOR ART

Figure 1 of EX2003

EX2004, ¶4, Figure 1. As shown in Figure 1, DC power converter 10A receives a DC input voltage and converts it into a DC output voltage. The power converter is “usually arranged on a printed circuit board (PCB).” *Id.*, ¶4. To meet the demand of increasing output power, multiple DC power converters can be electrically connected in parallel to each other. As shown in the figure below, power converters 20A_1 through 20A_N are connected in parallel and arranged on a PCB board to produce enough power for the system loads. *Id.*, ¶5, Figure 2.

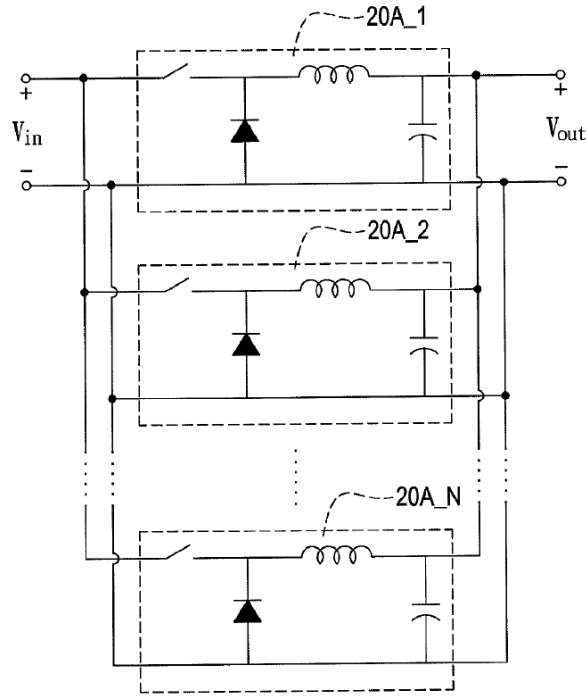


FIG.2
PRIOR ART

Figure 2 of EX2003

38. Boosting energy density is a crucial goal in power converter design. One key factor of achieving this goal to increase the available space inside the power converter to accommodate larger-sized magnetic element. EX2004, ¶¶7-8. In addition, semiconductor devices also play an important role in improving power converters efficiencies, and the usage of these devices require additional components, such as package material for protecting the semiconductor, heat sinks for dissipating heat, and fixtures for attaching the semiconductor device. EX2004, ¶9. A conventional power converter module existing before the September 2, 2014 priority date of the '534 Patent is illustrated in the annotated figure below. Exemplary power

module 30 includes element devices 32 and 34 (e.g., power chips) (shaded in green) attached to a DBC substrate 31a (shaded in blue). A controller 38 (shaded in purple) for driving the power chips is placed side-by-side on a PCB (shaded in yellow) and next to DBC substrate 31a. Both the PCB and the DBC substrate 31a are attached to heat sink 31b to enhance the average temperature performance of the module. *Id.*, ¶¶13-21. Molding compound 36 encapsulates the internal components of power module 30. A lead frame 35 extends out from molding compound 36 to provide electrical connection between internal components of power module 30 and external circuitry. *Id.*

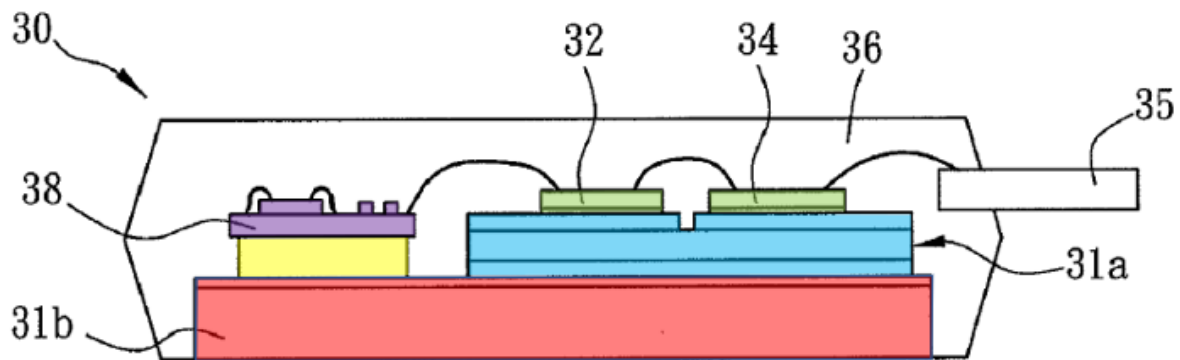


FIG. 5(Prior Art)

Annotated Figure 5 of EX2004

39. However, conventional power modules produced before September 2, 2014, such as power module 30 described above, suffer from several shortcomings. For example, when screws or fixtures are required for attaching the heat sink into

the power module, a thicker molding compound is needed to withstand greater mechanical stress. EX2004, ¶¶22-24. This leads to higher material cost and results in a bulky device. Importantly, there is less available space for internal components. *Id.* Therefore, “the performance of conventional power module still cannot satisfy” the required power density and efficiency. *Id.*, ¶25. Recognizing the shortcomings of conventional power converters, the Inventor of the ’534 Patent developed improvements to the designing and manufacturing of power supply apparatuses and met the long-felt need of higher power density and efficiency, as I further explain in §VII below.

VII. OVERVIEW OF THE ’534 PATENT

40. The ’534 Patent is directed to improvements to the design and manufacture of internal structures of a power supply apparatus. *See generally* ’534 *Patent*. As I explained in §VI, long-felt need for power supplies with higher power pressure¹ and efficiency existed before the September 2, 2014 priority date of the ’534 Patent. ’534 *Patent*, 3:15-23. In light of this need, the Inventor developed a cost-effective solution - by increasing the number of power units that can fit in the power supply apparatus. For example, the claimed invention includes “*a stack*

¹ Power pressure (Pp) equals to Po/S where Po is the power supplies power and S is the horizontal area. ’534 Patent, 1:63-2:2.

structure so that the height of the power supply can be properly utilize[d].” *Id.* at 3:15-23. This inventive stack structure ensures high power pressure and efficiency, thereby enhancing data processing performance. *Id.*

41. The Inventor of the ’534 Patent recognized the growing need of data processing that relies on the support of large-scale data centers. ’534 Patent, 1:21-28. According to the ’534 Patent, a “key component of the data center is the server,” which includes data processing chips and power supply mounted on the same main board. *Id.*, 1:29-43. Along with the ever-improving processing capability of the data processing chips, their power consumption and footprint within the server also increase. *Id.* As a result, the main board power supplies are “expected to exhibit greater efficiency, higher power density and more compact volume, so as to realize the energy-saving of the whole server.” *Id.* Power density is quantified as “power pressure,” which is the power provided by power supply over unit horizontal area. *Id.*, 1:60-62. In other words, power density is directly proportional to the amount of power provided and inversely proportional to the area occupied by the power supply.

42. The ’534 Patent also describes a relationship between power pressure and the height of the power supply devices. As the ’534 Patent clearly articulates, “[t]he following relationship between the power pressure (Pp) and the height (H) could be derived: the greater the H, the greater the Pp.” *Id.*, 2:4-7. It was noted that

“the space above the main board power supply” for certain servers “is not adequately utilized.” *Id.*, 19-22.

43. Conventionally there were two general ways of manufacturing main board power supplies. However, as the '534 Patent explained, both present difficulties of utilizing the full height.

44. The first method of forming main board power supply includes using PCB board “as the bearer on which individual components are installed.” '534 *Patent*, 2:24-25. However, the components are individually installed with safety distances maintained in between, further limiting size reduction. *Id.*, 2:25-31. In addition, “the uneven height would affect the subsequent handling of the heat.” *Id.*, 31-32.

45. The second method of forming main board power supply includes using certain packaging techniques to “integrate each components of the power supply into a quite regular element.” *Id.*, 33-36. However, this technique improves power density but requires lowering the height of the main board. *Id.*, 36-47.

46. The '534 Patent inventor addresses the above deficiencies of existing conventional power supplies, and presents a solution that “deals with both the power pressure and the efficiency” by developing “a stacked structure so that the height of the power supply can be properly utilize[d].” '534 *Patent*, 3:10-22. As shown in Figure 1 of the '534 Patent, the stacked power supply includes multiple power supply

and control units stacked on a main board. *See '534 Patent*, 4:8-36. Each power unit includes *pins* for electrically coupling to the main board. I have annotated and reproduced FIG. 1 of the '534 Patent to show that a control unit 130 is mounted on mainboard 110, and two power units 120 are stacked and mounted on the top surface of control unit 130. Therefore, the height of the package is fully utilized, as indicated by the respective heights H and h of the stacked power supply and the power supply package. *See '534 Patent*, FIGs. 1, 4, 7-10, 17-20, 23-24, 26-27.

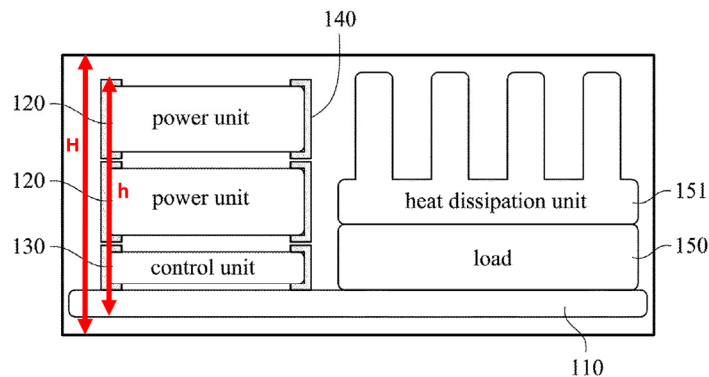


Fig. 1

Annotated Figure 1 of the '534 Patent

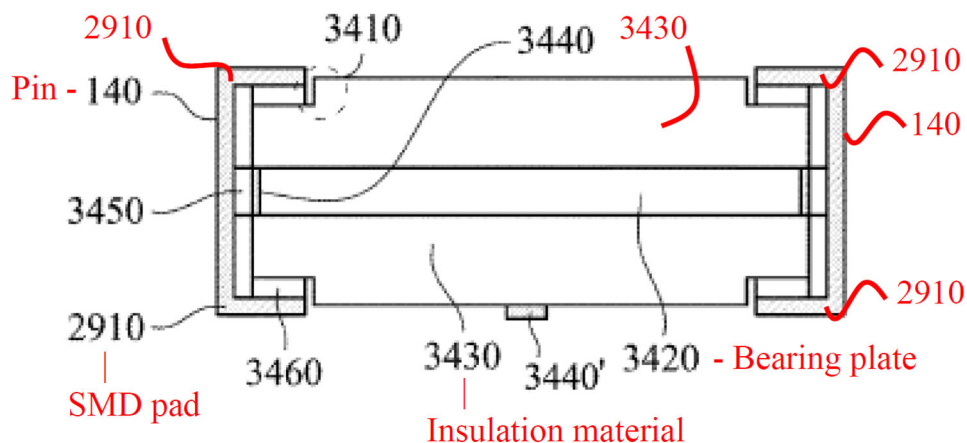
47. The novel stacked structure in the '534 Patent “accomplishes both the high power pressure and high efficiency” and advances the field of power supply design and manufacture because the '534 invention demonstrated that “the height of the power supply can be properly utilized so that a smaller floor space can be realized when the volume is fixed.” *'534 Patent*, 4:1-7.

48. As I explain below in §§IX-X, the Petition’s proposed invalidity grounds failed to appreciate these aspects of the claimed solutions in the '534 Patent.

The combinations described by the Petition and Dr. Baker either plainly failed to disclose claim limitations or a POSITA would not have been motivated to form the combined structures as purported. At a high level, a POSITA would have no reason to modify the *assembly-based, post-singulation* solution (e.g., Vinciarelli-218) with *component level* techniques (e.g., Zeng-014 and Jun), nor does the Petition or Dr. Baker proffered any reason to do so. The Petition also fails to consider many differences in interconnection formations disclosed by the references, which in my opinion, would dissuade a POSITA from combining the references.

49. Grounds relying upon the Vinciarelli-664 reference in the 715 IPR also fail because the '534 Patent is entitled to the September 2, 2014 priority date, which predates the Vinciarelli-664 reference.

50. I have annotated and reproduced FIG. 25 of the '534 Patent to show that the structural features of the above designs are recited in the exemplary claims.



Annotated Figure 25 of the '534 Patent

51. I have provided an excerpt of representative Claim 1 below.

[1pre] A power supply apparatus, comprising:

[1a] a bearing plate;

[1b] insulation material formed on two opposite surfaces of the bearing plate; and

[1c] a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material, wherein two terminals of each of the pins have two SMD pads, wherein the two SMD pads of each of the pins are extending to an upper surface and a lower surface of the insulation material, respectively.

52. I also provide representative claim 10 below:

[10pre] A power supply apparatus, comprising:

[10a] a bearing plate;

[10b] insulation material formed on two opposite surfaces of the bearing plate; and

[10c] a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material, wherein the bearing plate is embedded in the insulation material to form a cuboid body, edges of an upper surface and a lower surface of the cuboid body have recesses, and two terminals of each of the pins have SMD pads extending to the recesses at the upper surface and the lower surface of the cuboid body.

VIII. CLAIM CONSTRUCTION

53. I understand that claim terms are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art at the time

of the invention when read in the context of the specification and prosecution history unless a patentee sets out a different definition or clearly disavows claim scope.

54. I further understand that extrinsic evidence such as expert or inventor testimony, dictionaries, and learned treatises can help determine the meaning of claim terms, although that evidence is less significant than the claims, specification, and prosecution history. I reserve the right to supplement my opinions if the PTAB institutes.

IX. THE CHALLENGED CLAIMS IN THE 706 IPR ARE PATENTABLE

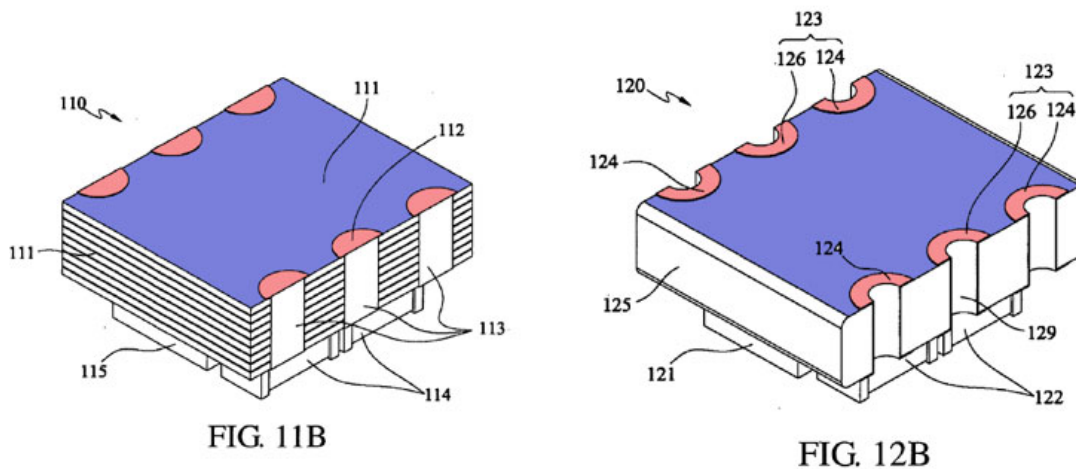
A. Ground 1 of the 706 IPR: Vinciarelli-218 and Zeng-014 fail

55. In my opinion, the Petition's combination for Ground 1 fails for at least the following reasons. First, the Petition presents no motivation to combine Vinciarelli-218 and Zeng-014 to arrive at the challenged claims at least because a POSITA would not have stacked the modules in Vinciarelli-218 as that defeats the purpose of the art. Second, the Petition's combination nonetheless fails because the purported combination is so error prone such that a POSITA would not have made the combination. Third, the Petition's purported motivation fails because it completely ignores the *incompatibilities* between interconnect formations of Vinciarelli-218 and Zeng-014. Fourth, the Petition's combination fails to teach at least limitation [1b] which recites "insulation material formed on two opposite

surfaces of the bearing plate” and limitation [1c] which recites “pins ... allocated along lateral sides of the insulation material.”

1. The Petition’s combination of Vinciarelli-218 and Zeng-014 does not result in limitations [1c] and [10c] being met

56. In my opinion, the Petition’s combination of Vinciarelli-218 and Zeng-014 fails to meet at least the limitations of [1c] (and substantively similar [10c]) for the following reasons. Limitation [1c] (and substantively similar [10c]) requires that SMD pads extend “to an upper surface and a lower surface of the insulation material, respectively.” Vinciarelli-218 does not teach or suggest that its interconnect portions 808A are “SMD pads”, and instead uses terminals that extend in a single, downwardly direction. Zeng-014 is similarly silent regarding this issue and does not cure the deficiency of Vinciarelli-218. I have annotated and reproduced FIG. 11B and FIG. 12B of Zeng-014. As shown below, conductive layers 112 and 123 (shaded in red) do not extend over or onto a lower surface (shaded in purple) of the magnetic material substrate 111 and 125, respectively. Therefore, the combination of Vinciarelli-218 and Zeng-014 cannot teach or suggest any SMD pads extending “to a lower surface” at the least, let alone to “a lower surface of the insulation material” (even if present). Similarly, these conductive layers do not extend over or onto a top surface of the substrates. As such, both limitations [1c] and [10c] are not taught by the Petition’s combinations. Therefore, it is my opinion that Ground 1 fails to present a reasonable likelihood of success.



Annotated Figures 11B and 12B of Zeng-014

2. A POSITA would not have been motivated to stack modules in Vinciarelli-218

57. It is my opinion that a POSITA would not have been motivated to make Vinciarelli-218 a stacked module with connectors on the upper and lower surfaces, as suggested in the claimed invention, as opposed to a device having downward pin connectors. The Petition completely ignores the drawbacks of stacking Vinciarelli-218's modules and presents no valid rationale to change the entire nature of Vinciarelli-218's device. I discuss my view below.

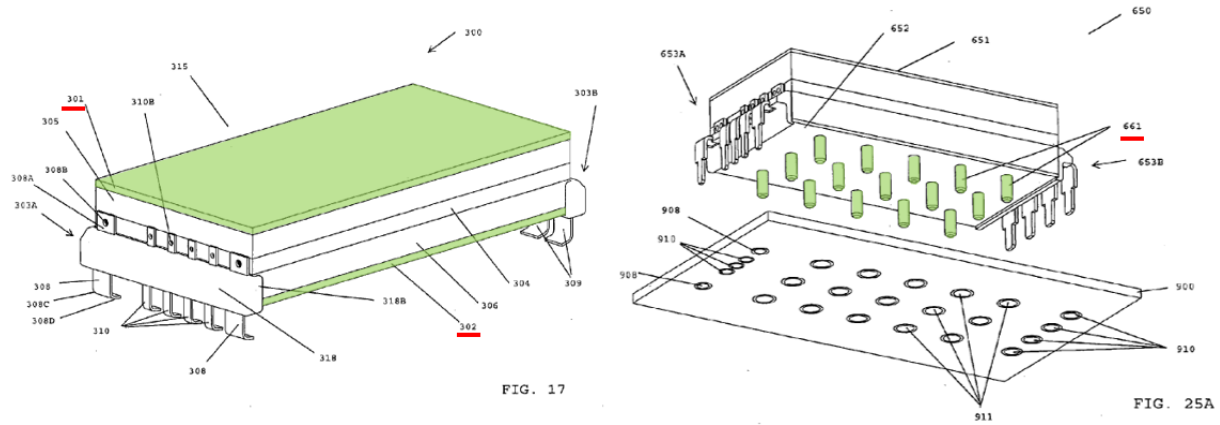
58. The Petition contends that a POSITA would have been motivated to modify Vinciarelli-218 to use Zeng-014's pin scheme for "enabling additional electronic components to be stacked on." Petition at 16. However, not all electronic components are suitable for being stacked for reasons such as package height constraints and poor heat dissipation. For example, placing a module on top of

another module restricts air circulation and thermal conduction between opposing surfaces of the two modules, which in turn impacts the modules' heat dissipation capability.

59. Indeed, Vinciarelli-218's modules are restricted by these factors as directed to singulated module having heatsinks on its top and bottom, and a POSITA would not have been motivated to stack Vinciarelli-218's modules. Neither did the Petition nor Dr. Baker provide any reason to.

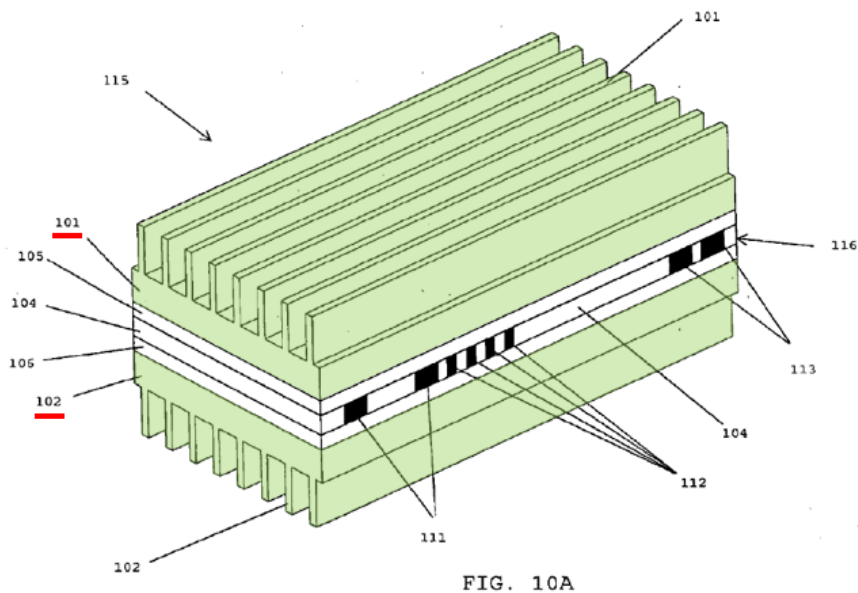
60. Vinciarelli-218 dissuades a POSITA to look at the Petition's purported combination as requiring heat sink panels, such as flat heat sink surfaces, finned heat sinks, or pinned heat sink. *Vinciarelli-218*, ¶¶82-83, 87-105, 119-123, 128, 131-139, 153-157, FIGs. 1, 10, 12, 15-16, 17-26. The purpose of having heat-sinks on the module's surfaces is to increase surface area for increased heat dissipation, and obstructing the heat-sinks reduces thermal conduction. Heat dissipation would be hindered when another module is stacked on Vinciarelli-218's module. Therefore, the Petition's combination of stacked devices for Vinciarelli-218 defeats the heat dissipation aspect of Vinciarelli-218. Vinciarelli-218 further states that "[i]n some applications it may be desirable to use the panel-molding process to produce components, such as power converters, without the flat heat sink surfaces." Vinciarelli-218, ¶159. I have annotated and reproduced FIG. 17 and FIG. 25A below

to show flat heat sinks 301, 302 (shaded green) and pinned heat sinks 661 (shaded green).



Annotated Figures 17 and 25A of Vinciarelli-218

61. Vinciarelli-218 also teaches finned heat sinks, which further add heights to the overall height of the device. For example, finned heat sinks 101 and 102 (shaded green) are illustrated in annotated Figure 10A reproduced below.



Annotated Figure 10A of Vinciarelli-218

62. Because heat sinks add considerable thickness to the power converter (e.g., finned heat sink illustrated in FIG. 10A reproduced above) one of those applications would be reducing the height of the internal components to accommodate encapsulating the power converter in a package having a height restriction. Vinciarelli-218 states that “[i]n some applications it may be desirable to use the panel-molding process to produce components, such as power converters, without the flat heat sink surfaces.” *Vinciarelli-218*, ¶159.

63. The Petition’s suggestion to stack the heatsink-less modules actually defeats its purpose for the proposed combination. Indeed, Vinciarelli-218 discloses that “[a]s internal components are reduced in height, e.g. reducing the thickness of the magnetic core, the depth of the interior cavity may be decreased bringing the heat sink panels closer together, reducing the encapsulant thickness and the resulting module thickness.” *Vinciarelli-218*, ¶135. Neither the specification nor the figures of Vinciarelli-218 teach or suggest that its power converters can, in fact, be stacked. The Petition has provided no reason why a POSITA would have been motivated to stack two or more heat-sinkless modules 815 and increase the device height. Doing so would be in direct contradiction to the original purpose of reducing device height by removing the heat sink, e.g., “without the flat heat sink surfaces.” *Vinciarelli-218*, ¶159.

64. On the other hand, stacking singulated modules 815 would also have exacerbated heat dissipation, and it is my opinion that a POSITA would not have been motivated to stack Vinciarelli-218's modules. Vinciarelli-218 does not state that its heat-sinkless singulated module 815 produces any less heat than its other heat-sink modules.

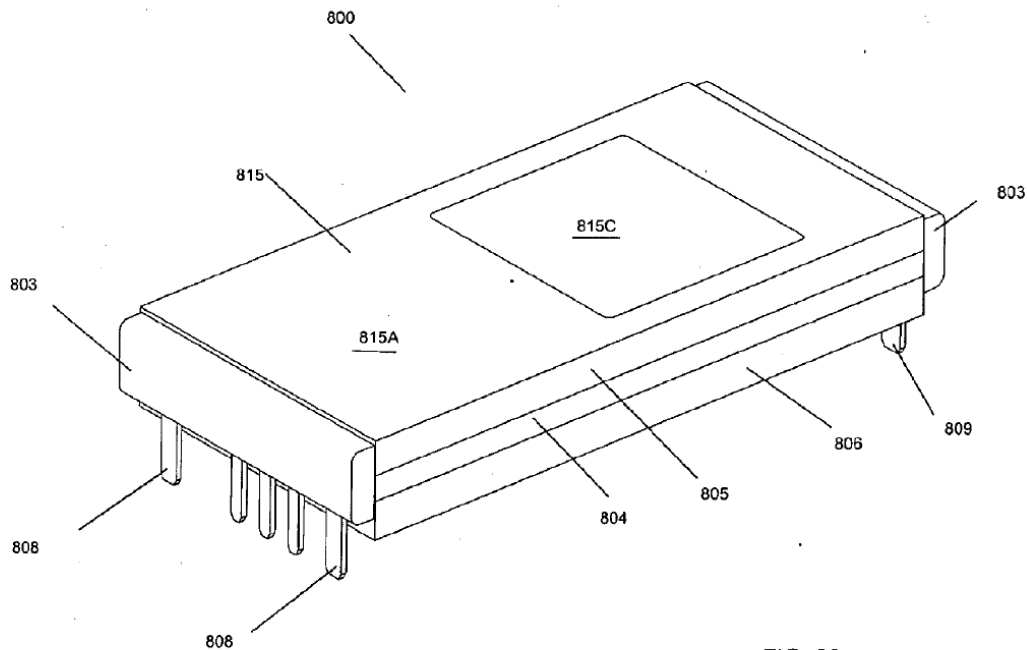


FIG. 33

Figure 33 of Vinciarelli-218

65. In fact, removing the heat-sink from singulated module 815 makes it more susceptible to problems caused by poor heat dissipation. The purpose of removing heat sinks is for packing the module into more tight spaces and usually with higher device density. However, under these circumstances, heat dissipation can be more difficult. The Petitioner's proposal of stacking additional singulated

modules 815 on the existing singulated module 815 would further block air flow (e.g., hot air will be trapped between opposing surfaces of two stacked modules), reduce thermal conduction, and exacerbate the heat dissipation problem. That in turn will lead to poor device performance and even hazardous conditions such as device overheating. Therefore, for at least the above reasons, it is my opinion that a POSITA would not have been motivated to stack Vinciarelli-218's singulated module 815.

66. Moreover, in my opinion, the Petition's rationale for having stacked modules also fail. The Petition alleges that "[s]ince Vinciarelli-218 discloses a component that is a DC-DC power converter module," "a skilled artisan would have been motivated to stack input or output capacitors onto the power converter module to save space." Petition at 21-22. I disagree. As opposed to a stacked package, simply having more electronic components instead of a singular package does not increase power density when more elements could be fit into a singular package. In my opinion, the purpose of putting electronic elements into one power module package is to **improve integration**, increase power density, and reduce device footprint both horizontally and vertically. Indeed, Vinciarelli-218 discloses that its singular modules already contain "power transistors, control ICs, and discrete resistors and **capacitors**" within its body. *Vinciarelli-218*, ¶¶82, emphasis added. Examples of these capacitors include input capacitors 132-2F, 132-2G, 132-1F, 132-1G and output capacitors 132-2A and 132-1A—the exact same "input or output capacitors"

that the Petition suggested to stack on top of Vinciarelli-218's modules. Vinciarelli-218, ¶¶143, 145, 148, 150, 153. A POSITA would not have placed some elements in the package but leave some outside when Vinciarelli-218 teaches that they could have been all been placed in the package, nor has the Petition identified any benefits for such modification. Simply put, a POSITA would not have placed elements (e.g., discrete capacitors) outside of the package because doing so would decrease power density and lead to increased overall device dimensions and footprint.

67. On the other hand, however, making a stacking device is required by the claims because they recite that there be SMD pads on both the bottom and top surfaces. Specifically, claim 1 recites, “the two SMD pads of each of the pins are extending to an upper surface and a lower surface of the insulation material.” Claim 10 recites that “each of the pins have SMD pads extending to the recesses at the upper surface and the lower surface of the cuboid body.” *'534 Patent*, 21:28-29, 22:12-14. As I explained above, a POSITA would not have been motivated to make a stacked device in Vinciarelli-218. In my opinion, the Petition's purported combination further misses limitation [1c] because a POSITA would also not have been motivated to add SMD pads on both the top and bottom surfaces of Vinciarelli-218.

68. In short, the Petition fails to demonstrate that a POSITA would have been prompted to combine the teachings of Vinciarelli-218 and Zeng-014 to realize

a device that achieved all of the features of independent claims 1 and 10. I believe that the Petition's disregard of fundamental differences between Vinciarelli-218 and Zeng-014's devices render Ground 1 fatally deficient.

69. In my opinion, institution of Ground 1 should be denied because the Petition has failed to demonstrate a reasonable likelihood of prevailing on at least one claim in Ground 1.

3. The Petition's combination creates a device that no POSITA would have been motivated to create

a. Petitioner proposes combination through hindsight

70. As detailed below, the Petition's combination results in a device of pure *hindsight* bias that no POSITA would have been motivated to create. Beyond having no motivation to provide a stacked module, the eventual module combining the teachings of Vinciarelli-218 and Zeng-014 results in a device that no POSITA would have ever made. Dr. Baker opines that it would have been obvious to modify Vinciarelli-218 to use Zeng-014's connector/conductors. EX1003, ¶70. However, Dr. Baker's proposed combination results in a manufacturing process where the encapsulant is drilled, or where interconnects are formed and machined without protection; both of which are error-prone manufacturing processes. However, in my opinion, a POSITA would not have modified Vinciarelli-218's to form connectors integrally with the device, whether layer-by-layer or by drilling.

71. Vinciarelli-218 provides a device containing several components (*e.g.*, several inductors that are encapsulated) that are encapsulated but provides no terminals that reach to the top and bottom of the encapsulant. Zeng-014, on the other hand, teaches multi-layer substrate of an inductor where its conductor is pre-formed or pre-fabricated on each layer of the substrate or by drilling holes directly into the component itself and filling the holes with conductive material. Petitioner contends that Vinciarelli-218's device could be modified with Zeng-014's conductors. A POSITA, however, would not have pre-formed or pre-fabricated an encapsulant with conductors because it would not be technically feasible to pre-form conductors layer-by-layer onto an unknown material layer then encapsulate the structure; nor would it be feasible to drill holes into the encapsulant to reach the unknown material layer. The differences in the devices (and the inapplicability of the manufacturing processes) are apparent when each is viewed in turn. First, Vinciarelli-218 teaches a device having several components that are encapsulated into a larger unit. The relied-upon embodiment of Vinciarelli-218 (Vinciarelli-218, ¶¶159-160) is a device having encapsulant (yellow) surrounding an unknown/undefined layer labeled as 804 (green) which is disposed within module 815. Vinciarelli-218, ¶¶159-160. Vinciarelli-218 provides exposed interconnects 811/812 that the interconnect portions 808A are connected to. Another view of FIG. 35 is shown in FIG. 34 below,

illustrating interconnect portions 808A being attached to the side of the layer 804 (green) and extending downwards through terminal portions 808 for connection.

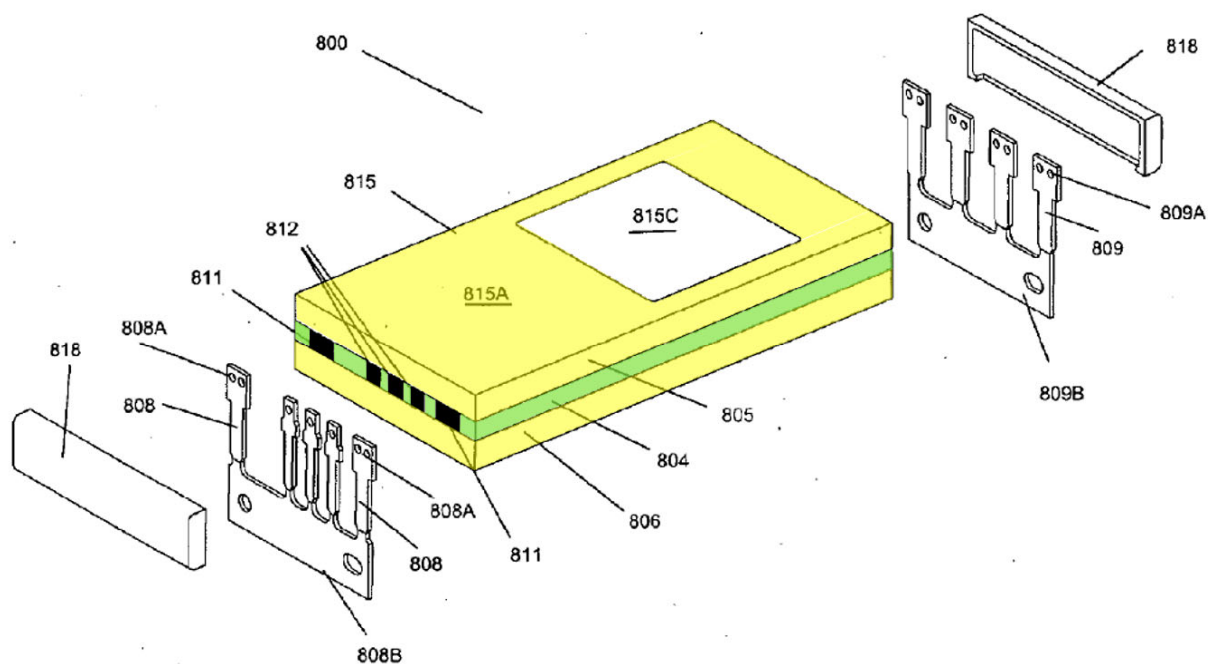


FIG. 35

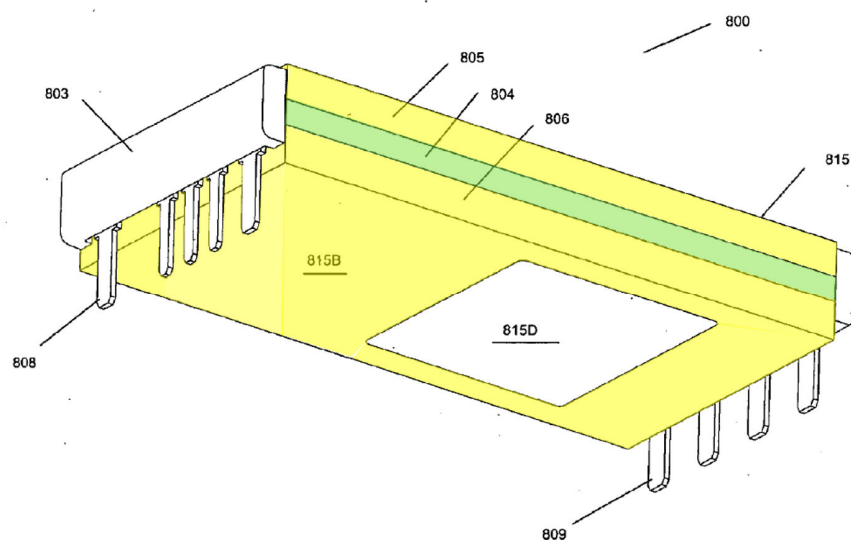
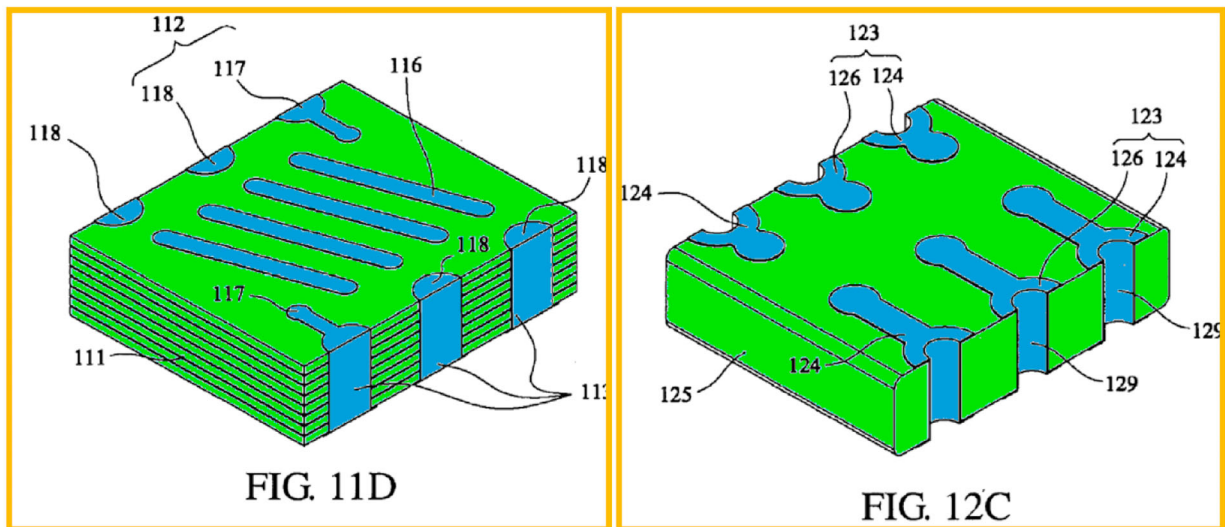


FIG. 34

Annotated Figures 35 and 34 of Vinciarelli-218

72. The Petition then attempts to rely on Zeng-014 for the structure missing from Vinciarelli-218's device, such as [1c] - "a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material..." Zeng-014 teaches multi-layer substrate where the conductor is pre-formed or pre-fabricated on each layer of the substrate or by drilling holes directly into the component itself and filling the holes with conductive material, exemplary illustrations of which is provided below. Specifically, conductors 113, 117, and 118 depicted in FIG. 11D of Zeng-014 are pre-formed with each layer of substrate 111, while contacts 129 depicted in FIG. 12C are formed by drilling through-holes in substrate 125 and filling the through-holes with conductive material. *See Zeng-014*, ¶¶73-83.



Annotated Figure 11D and 12C of Zeng-014

73. Dr. Baker opines that it would have been obvious to modify Vinciarelli-218's device to use Zeng-014's pin/connector conductors. EX1003, ¶70. I disagree – in my opinion, a POSITA would not have pre-formed or pre-fabricated an encapsulant with conductors or drilled into an encapsulant *after* encapsulating the manufactured devices (along with their components) such as done in Zeng-014 and *then* singulating the devices. Specifically, it would not be technically feasible to pre-form a conductor on the encapsulating material in Vinciarelli-218 as done in Zeng-014, and then combine it with or encapsulating the components.

74. As shown in FIG. 11E of Zeng-014 below, its pre-formed conductors (e.g., 113 and 117) and conductive elements (e.g., 119) are pieced together to form a single, discrete component of an inductance coil 116. *See Zeng-014*, ¶¶74-75, FIG. 11E. In contrast, Vinciarelli-218's module is at a much larger scale and contains in itself, “power transistors, control ICs, and discrete resistors and capacitors” mounted on a circuit board within its module. *See Vinciarelli-218*, ¶¶82, 153, FIG. 28. In fact, the discrete circuit component mounted on Vinciarelli-218's “printed circuit assembly may include **one or more inductive components**, such as inductors and transformers.” *Vinciarelli-218*, ¶4. It is not feasible to form all the internal components of Vinciarelli-218 (e.g., power ICs and inductors) using the layer-by-layer technique disclosed by Zeng-014 simply because these components mounted on Vinciarelli-218's circuit board are *vastly different in scale and*

complexity. Moreover, such technique is neither taught nor provided by Vinciarelli-218 and/or Zeng-214; nor has the Petitioner or Dr. Baker so indicated. I have embedded FIG. 11E of Zeng-014 in FIG. 28 of Vinciarelli-218 to show, as an example, an inductor element mounted on the populated circuit board of Vinciarelli-218.

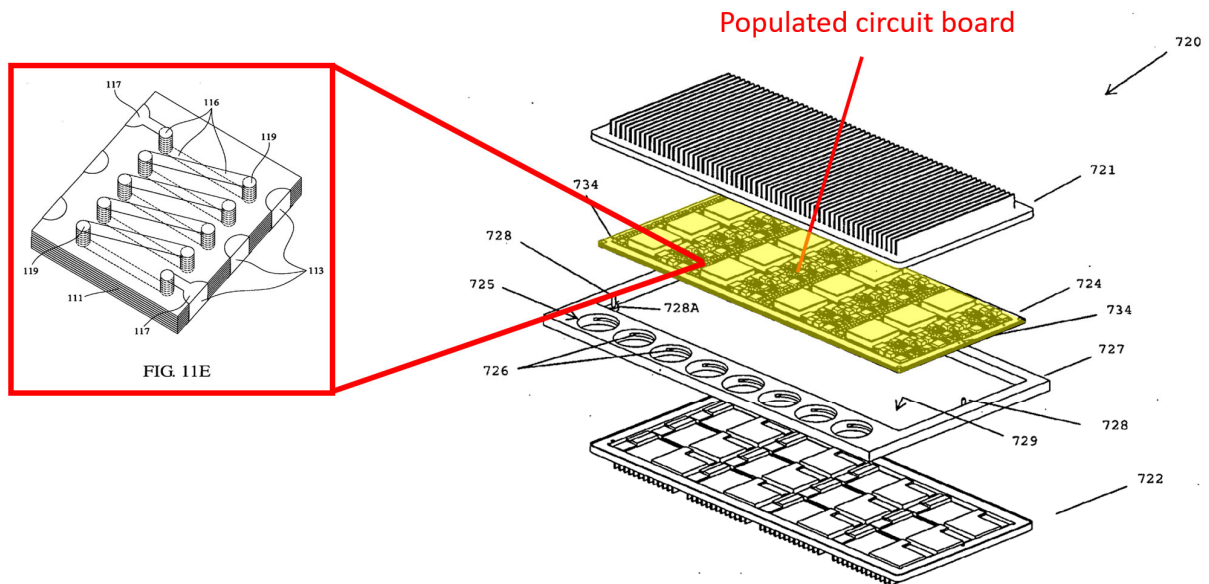


FIG. 28

Figure 11E of Zeng-014 (embedded) in annotated Figure 28 of Vinciarelli-218

75. As illustrated in FIG. 35 (shown below), Vinciarelli-218 teaches a device having several components that are encapsulated. In particular, the relied-upon embodiment of Vinciarelli-218 for this combination is a device having encapsulant 806 that surrounds an unknown/undefined layer 804 which is disposed within module 815 (e.g., an inductor). *Vinciarelli-218*, ¶¶0159-0160. I have annotated and reproduced Vinciarelli-218's FIG. 35 to show the encapsulant shaded

in yellow and the unknown/undefined layer 804 shaded in green. I note that layer 804 is an unknown/undefined layer because it is only shown in the figures of Vinciarelli-218 and the specification of Vinciarelli-218 is silent regarding this element. Vinciarelli-218 provides exposed interconnects 811/812 that interconnect portions 808 (shaded in blue) are connected to. *Id.*

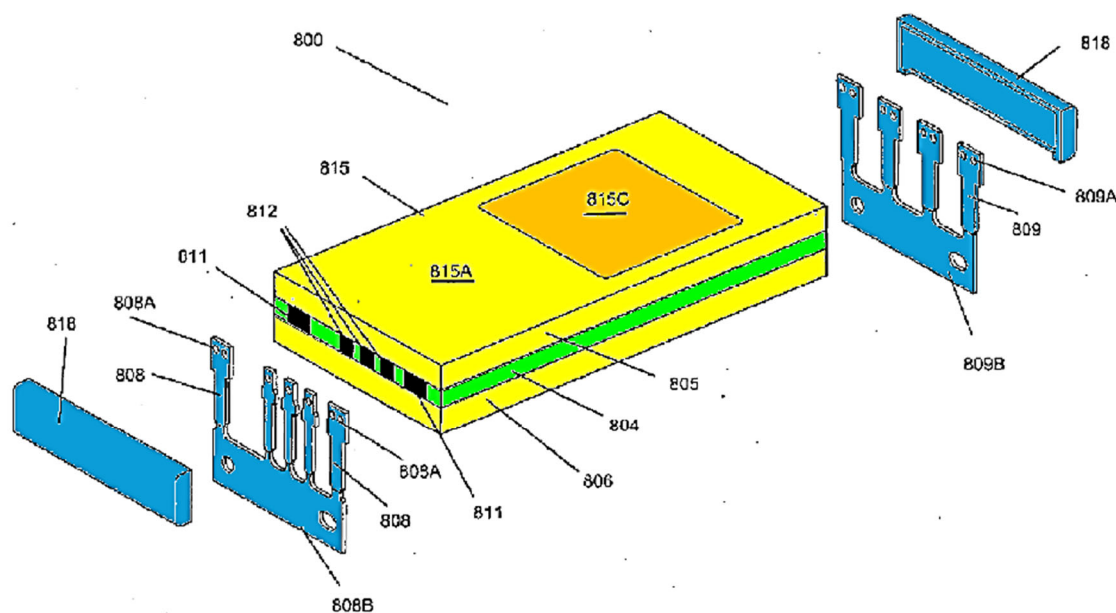


FIG. 35

Annotated Figure 35 of Vinciarelli-218

76. Further for illustration, I have annotated and reproduced FIG. 34 of Vinciarelli-218 below, which is another view of FIG. 35 after terminal portions 808 are attached. As can be seen in my annotated figure below, interconnect portions

808A are attached to the side of the layer 804 (shaded green) and extend downwards for connection.

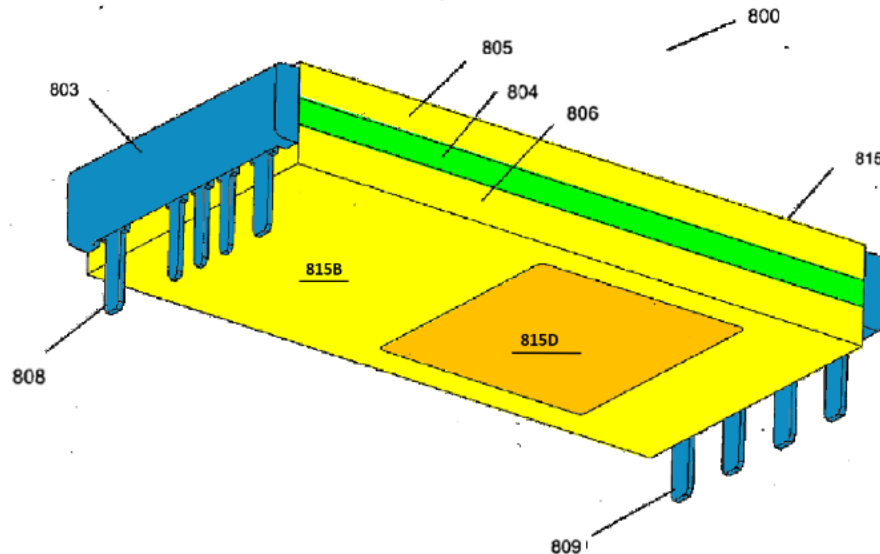


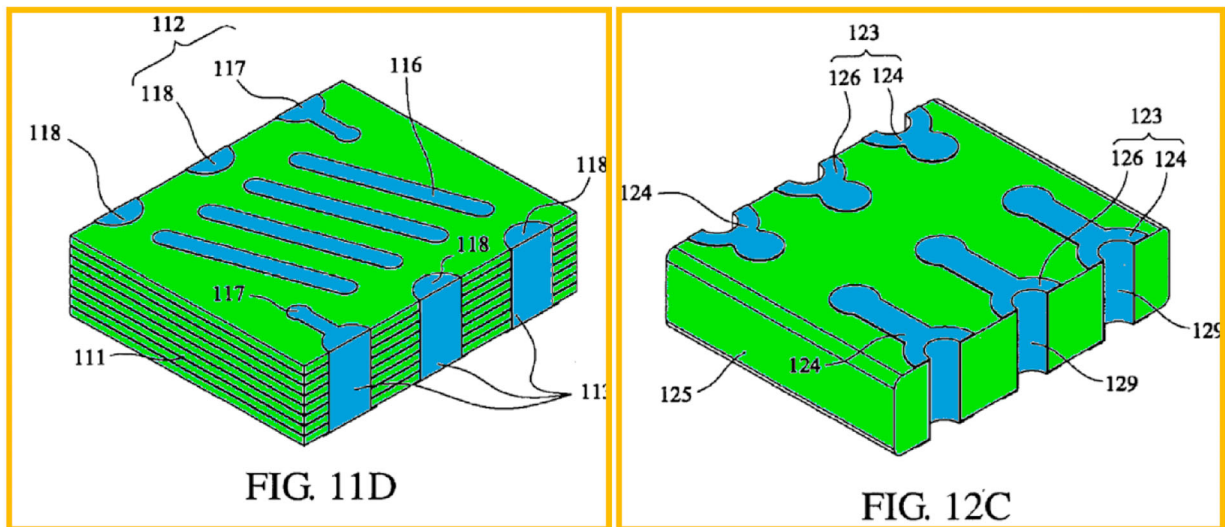
FIG. 34

Annotated Figure 34 of Vinciarelli-218

77. As can be seen from the above, the terminal portions 808 (including interconnect portions 808A, shown in FIG. 35 but not visible in FIG. 34) do **not** extend to the top and bottom surfaces of the encapsulant. Moreover, the portions 808A are not SMD pads; neither has the Petition so argued or indicated. The Petition also acknowledges that Vinciarelli-218 lacks at least the claimed structure of limitation [1c] which recites “pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material ... [the] pins have two SMD pads ... extending to an upper surface and a lower surface of the insulation material”). However, the Petition then argues that a POSITA would have arrived at the claimed

structure by “modify[ing] Vinciarelli-218 to use Zeng-014 pin’s scheme” where “pins are similar to Zeng-014’s pin conductors.” Petition at 16; EX1003, ¶70.

78. I note that *no* such motivation is provided by Vinciarelli-218 and/or Zeng-014 for the reasons further explained below. Specifically, Zeng-014 teaches fabricating an inductor utilizing multilayer magnetic material substrates 111 or magnetic material substrate 125. I have annotated FIGs. 11D and 12C of Zeng-014 to show an inductor within the orange boxes and magnetic material substrates 111 and magnetic material substrate 125 in green. In both magnetic material substrates 111 or 125 are pins 117/118/123/129 that are formed integrally with the device. As such, Zeng-014 teaches forming pins *integrally* with the device.



Annotated Figures 11D and 12C of Zeng-014

79. In both embodiments described above, Zeng-014 teaches forming pins *integrally* with the magnetic substrate. I have annotated and reproduced FIGs. 11D

and 12D of Zeng-014 below to show pins (shaded red) being formed as part of the magnetic substrate (shaded green) (e.g., FIG. 11D, and other FIG. 11 embodiments).

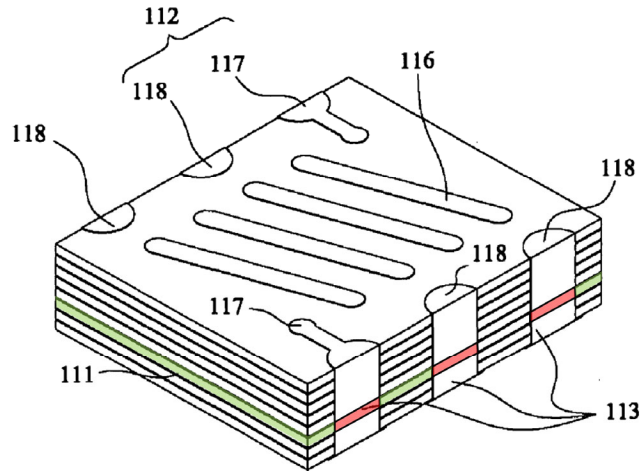


FIG. 11D

Annotated Figure 11D of Zeng-014

Pins can also be formed by *drilling through* the substrate, such as in the embodiment shown in FIG. 12D.

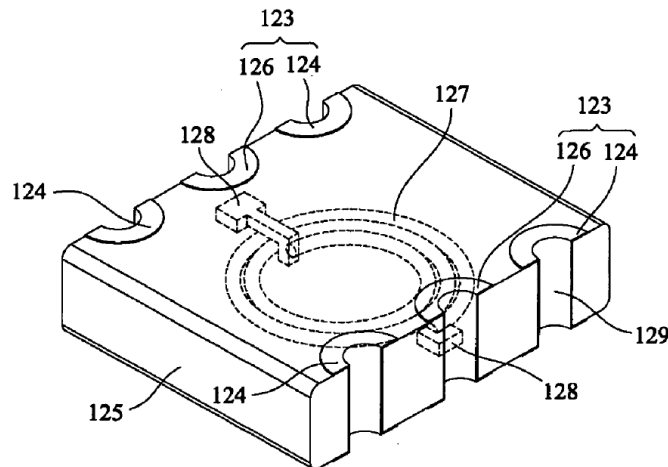
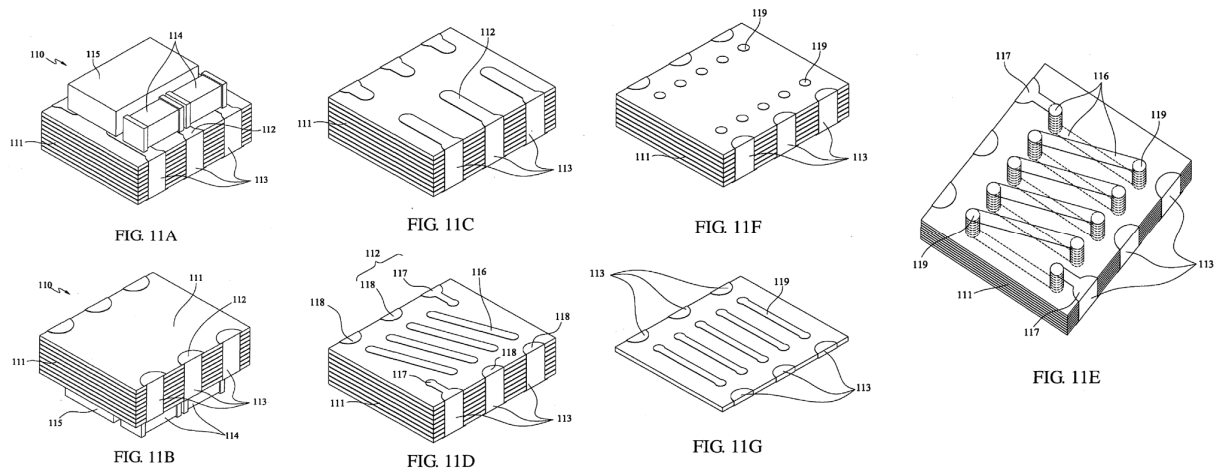


FIG. 12D

Figure 12D of Zeng-014

80. More specifically, and as I noted above, Zeng-014 describes “a POL DC to DC converter” and discloses forming *pins integrally* with the substrate. *Zeng-014*, ¶73. I have reproduced FIGs. 11A-11G of Zeng-014 below that illustrate different views of the DC-to-DC converter, where the first fabrication step of the converter includes forming “a number of semi-circular through-holes” “at two opposite sides of each magnetic material layer [111]” and filling the semi-circular through-holes “with a metal material” to form the pins 117 and 118. *Zeng-014*, ¶74.



Figures 11A-11G of Zeng-014

81. Multiple layers of substrates 111 are then stacked by “sintering multiple layers of magnetic material together, which is a process similar to the low temperature co-fired ceramic (LTCC) process.” *Zeng-014*, ¶74. The layers of each conductor (e.g., pins 117 and 118) are aligned and stacked at the same time when substrates 111 are stacked, and the stacked layers of pins 117 and 118 form conductor 113. *Id.* Although FIGs. 11A-11F seem to illustrate conductor 113 as one

single piece, a POSITA would have understood that each conductor 113 is formed with several stacked conductive layers, with each conductive layer formed integrally during the formation of each individual magnetic material substrate 111 (e.g., shown in FIG. 11G). *See also Zeng-014*, ¶74, which states “Finally, the multiple magnetic material layers are laminated together to form the inductance coil 116 and a portion of the first conductive layer 113.” FIGs. 11D and 11G of *Zeng-014* reproduced below show the substrate stack which includes multiple single substrate 111 (green) and embedded pins 117 and 118 (red) stacked on top of each other. *Zeng-014*, ¶¶73-75. Only one layer of substrate 111 and embedded pins 117 and 118 are annotated for clarity; as can be seen below, the pins are made integral with the substrate.

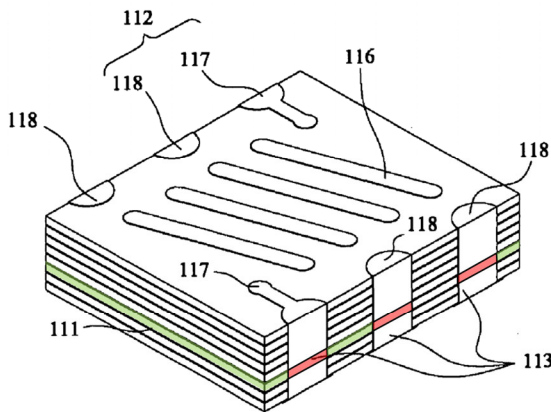


FIG. 11D

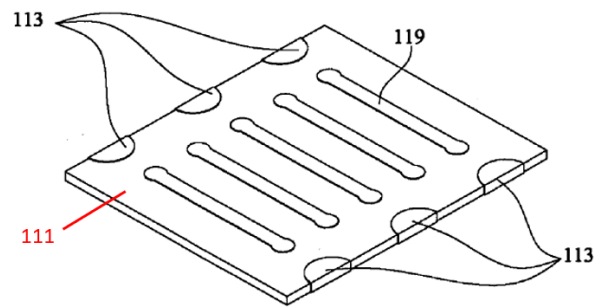


FIG. 11G

Annotated Figures 11D and 11G of Zeng-014

82. On the other hand, *Zeng-014*’s embodiments illustrated in FIGs. 12A-12D also demonstrate that the pins are *integrally formed* with the substrate, but this time by drilling it to form the pins. For example, *Zeng-014*’s DC to DC converter

120 includes a “first conductive layer 123 [that] comprises a connecting conductor having four pins 124 and a pin conductor having two pins 126.” *Id.* Each of the pins 124 and 126 contains a conductor 129 which is “formed in a through-hole form through the top and the bottom surfaces of the magnetic material substrate 125.” *Zeng-014*, ¶77. The through-holes are drilled in sides of the magnetic material substrate and electro-plated to form conductors 129. *See Zeng-014*, ¶77. Conductor 129 is “electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 inside the magnetic material substrate 125.” *Zeng-014*, ¶77. I have annotated and reproduced *Zeng-014*’s FIG. 12D below to show conductors 129 in red.

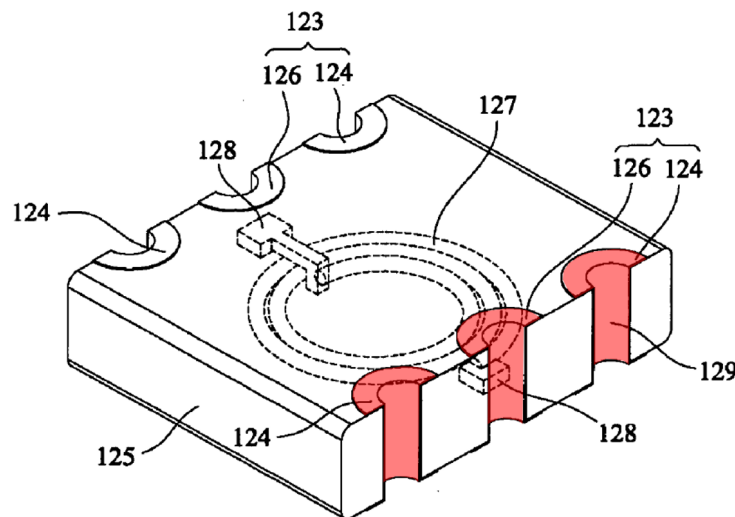


FIG. 12D

Annotated Figure 12D of Zeng-014

83. The side surface of 125 are drilled to form semi-circular through-holes and electro-plated to form conductors 129 in a shape of semi-circular collar. *Zeng-*

014, ¶¶77. Conductors 129 are “electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 *inside* the magnetic material substrate 125.” Zeng-014, ¶77. As shown in annotated FIG. 12D above, the sidewall surfaces of substrate 125 contains multiple semi-circular collars extending into magnetic material substrate 125 in which flat coil pins 128 are embedded. Zeng-014, FIG. 12D.

84. Therefore, embodiments in Zeng-014’s Figs. 11D and 12D disclose *pre-forming pins integrally* with the substrates. Following Petitioner’s proposed rationale, Petition’s combination would result with pins being formed *integrally with the encapsulant*.

85. It is noteworthy that the Petition fails to identify any incentive for a POSITA to make such combination, or describe how this could possibly be accomplished on Vinciarelli-218’s device (excerpted again below). For example, the Petition does not explain *how* pins can be integrally formed in the encapsulant (shaded yellow), and just suggests so without providing any specifics. As explained below, a POSITA would have no reason to modify the *assembly-based, post-singulation* solution of Vinciarelli-218, and would not have integrally formed pins in an encapsulant. Since Vinciarelli-218 does not feature stacked laminations (akin to Zeng’s substrates 111) that extend the full height of device, Petitioner’s proposed combination would require forming pins on the PCB upwards and then pouring and curing an encapsulant.

86. A POSITA would have understood that this operation is *error prone* and potentially *inoperable* in the context of semiconductor manufacturing, since the interconnects are already formed during the formation of layer 804. These conductors (such as interconnects 811 “bar codes” in FIG. 35 of Vinciarelli-218) would be formed in layer 804 *before* forming encapsulants are attached, and would be prone to damage without the protection of the encapsulant. For example, machining or milling into the bar code region is liable for causing harm to the bar codes. In my opinion, a POSITA would not have been motivated to make the purported modifications to Vinciarelli-218’s device, using a method which Dr. Baker fails to elucidate and is not disclosed in Vinciarelli-218 or Zeng-014. A POSITA would have no reason to deviate from Vinciarelli-218 *post-singulation* assembly of an unbent lead frame with Vinciarelli-218’s exposed “bar codes” 811. A POSITA would have no expectation of success in doing so because forming contacts using methods taught by Zeng-014, such as drilling through holes into components without the protection of encapsulants, would introduce stress and vibration during the process and cause the unprotected interconnects to be damaged.

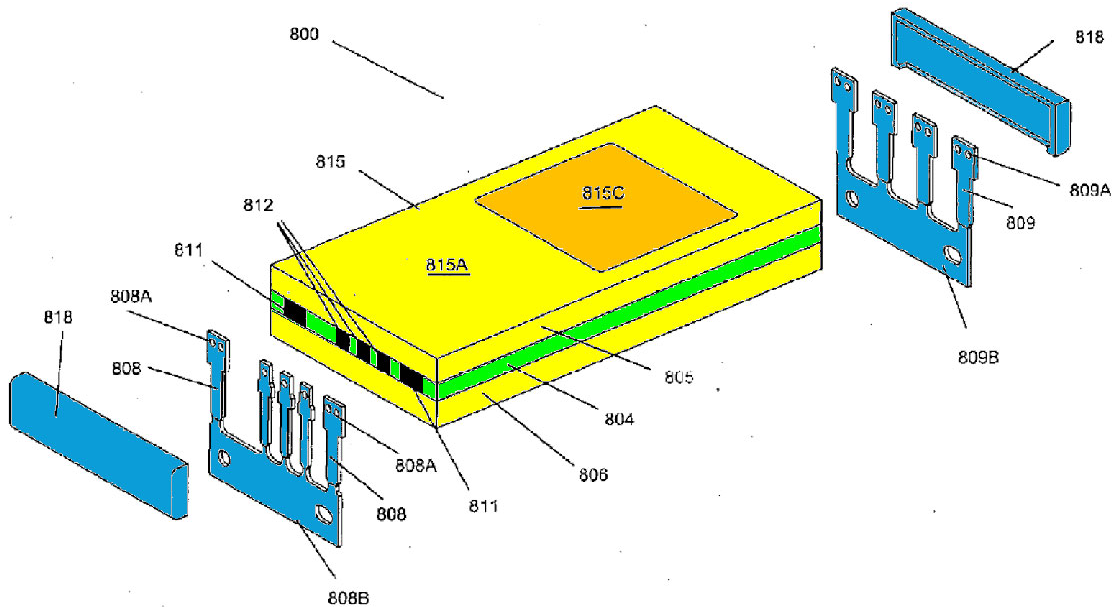


FIG. 35

Annotated Figure 35 of Vinciarelli-218

87. Moreover, a POSITA would also not have drilled holes into the encapsulant to provide conductive pins, which is the embodiment in FIGs. 12A-12D of Zeng-014 that was relied upon in the Petition. This process requires *extra manufacturing steps* that would result in possible breakage or weaken or destroy the protection of the encapsulant. For example, drilling into encapsulants introduces stresses which could lead to device mechanical failure and delamination. Again, this operation would be *error prone*. Particularly in the semiconductor manufacturing industry, where profit margin was very thin, a POSITA would not have made such a combination that resulted in lower yields and additional costs. This not only

required introducing an additional step in the manufacturing process but also likely would cause damages to the device.

88. As such, a POSITA would not have made this combination. In my opinion, the Petition's combination simply ignores the technical details of Vinciarelli-218 and Zeng-014, and the Petition arrives at its combination through impermissible hindsight. The Petition provides no source to arrive at the '534 Patent's claims, and points to nowhere in Vinciarelli-218 or Zeng-014 to suggest the purported combination. Therefore, a POSITA would not have been motivated to make this combination.

b. The combination still fails to meet limitations [1c] and [10c]

89. The Petition's combination also fails to meet at least the limitations [1c] and [10c] for the following reasons. Zeng-014 fails to teach [1c] which requires that SMD pads extend "to an upper surface and a lower surface of the insulation material, respectively." Zeng-014's pins 117 and 118 are formed "at two opposite sides of each magnetic material layer, and are filled with a metal material...to form the connecting conductive elements 119 and pins 117, 118 of the inductance coil 116." *Zeng-014*, ¶74. Magnetic material substrates 111 with pre-formed conductors 113 and pins 117 and 118 are "laminated together to form the inductance coil 116." *Id.* A POSITA would have understood that the top and bottom surfaces of pins 117, 118, and each layer of conductors 113 are *coplanar* with top and bottom surfaces of their

respective magnetic material substrate 111, because pins 117, 118, or conductors 113 protruding from top and bottom surfaces of magnetic material substrate 111 would cause gaps between the substrates during lamination which in turn leads to mechanical failure. Therefore, after lamination, bottom surfaces of pins 117, 118, and stack of conductors 113 are *coplanar* with bottom surfaces of substrate 111. In other words, bottom surfaces of the conductors and substrate 111 are on the same plane. As such, there is no disclosure or motivation in Zeng-014 that teaches [1c]. Moreover, limitation [10c] requires that the “SMD pads extending to the recesses at the upper surface and the lower surface of the cuboid.” As an initial matter, Vinciarelli-218 does not teach or suggest that its interconnect portions 808A are “SMD pads.” Zeng-014 is similarly silent regarding this issue and does not cure the deficiency of Vinciarelli-218. Additionally, the Petition and Dr. Baker fail to provide any explanation that Vinciarelli-218 or Zeng-014 disclose SMD pads. The Petition’s combination does not demonstrate recesses at the upper/lower surfaces, as Zeng-014 teaches integrally forming (or drilling) conductive pins. The limitations [10c] and 10b are respectively similar to limitations [1c] and [1b]. As such, it is my opinion that both limitations [1b]/[1c] and [10b]/[10c] are not taught by the combination as purported by the Petition.

4. The Petition ignores the differences in interconnection formation between Vinciarelli-218 and Zeng-014

90. In addition to the above, in my opinion, the Petition's motivation fails because it ignores the differences between Vinciarelli-218 and Zeng-014.

91. The Petition's purported combination takes Vinciarelli-218's *singulated* module 815 and adds Zeng-014's pins and conductors formed in a *non-singulated* structure (described in FIGs. 11D and 12C). Petition at 16-18. While acknowledging that Vinciarelli-218 needs to be modified by Zeng-014 to make its proposed combination work (Petition at 16), the Petitioner fails to explain why nor a roadmap as to how a POSITA would use Zeng-014's pin scheme on Vinciarelli-218's singulated module 815. Petition at 16-18.

92. Fundamentally, Petition's purported combination ignored the differences between the *fabrication processes* of Vinciarelli-218 and Zeng-014 and provided no benefits prompting a POSITA to make the change. For example, the conductors in Vinciarelli-218 are standalone components that are attached to a singulated module, whereas each layer of the conductors in Zeng-014 are formed separately by each integrally formed with a magnetic substrate. Faced with feasibility challenges in incorporating conductors in Zeng-014 into Vinciarelli-218' structure, a POSITA would not have been motivated to do so, as further explained below.

93. As noted above, Vinciarelli-218 describes a singulated module 815 and two adaptors 803 that are “suitable for through-hole mounting to a motherboard.” *Vinciarelli-218*, ¶159. I note that adaptors 803A and 803B are only mentioned once in Vinciarelli-218’s specification at ¶159 and are not shown in FIGs. 33-36 of Vinciarelli-218. But for my analysis, I presume that this is a typographical error and that adaptors 803A and 803B refer to the pair of adaptors 803 depicted in FIGs. 33 and 34 of Vinciarelli-218. Vinciarelli-218’s FIG. 33 shows that singulated module 815 includes cured encapsulant 805 and 806 with a layer 804 in between. *Id.*, ¶159, FIG. 33. I note that layer 804 of Vinciarelli-218 is only marked in FIGs. 33-36 but not described anywhere in the specification. Adaptors 803 are attached to side surfaces of singulated module 815. *Id.*

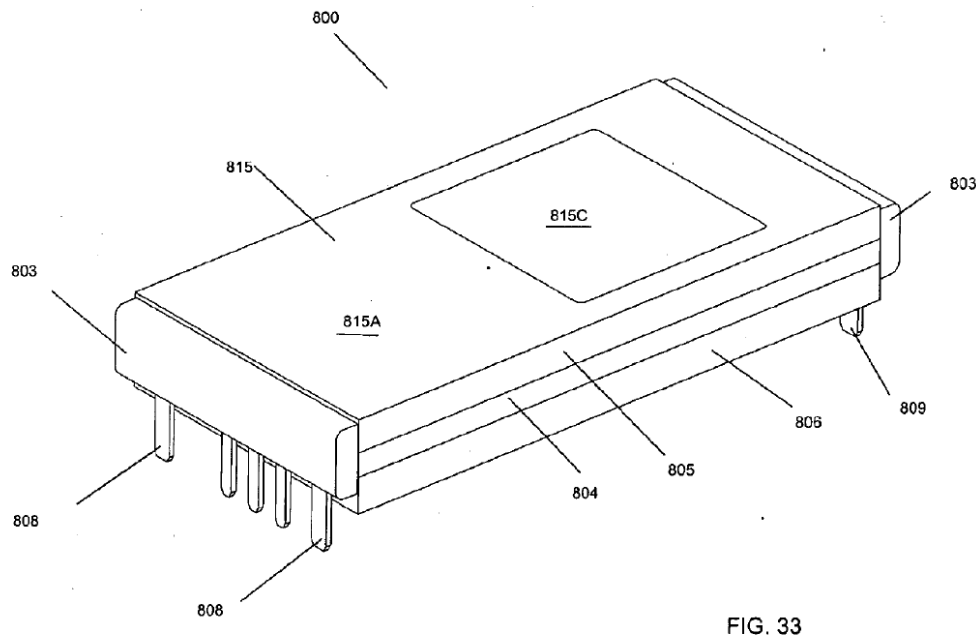


Figure 33 of Vinciarelli-218

94. Adapters 803 consists of “terminal portions 808 and interconnect portions 808A [that] may be formed for example by a precision metal stamping process.” *Vinciarelli-218*, ¶160. FIG. 35 of *Vinciarelli-218* reproduced below is an exploded view showing interconnect portions 808A (shaded in blue). *Vinciarelli-218* further discloses that interconnect portions 808A “may be soldered to the exposed interconnects 811, 812.” *Id.* After interconnect portions 808A “are attached to the exposed contacts” of singulated module 815, the “lead frame 808B may be separated from the terminals 808.” *Id.* I have shaded interconnect portions 808A in blue. Therefore, singulated module 815 and terminals 808 are *fabricated separately* and then joined together to form a connection in between. In addition, *Vinciarelli-218* discloses attaching protective caps 818 to interconnect portions 808A after they are attached to singulated module 815 “to provide structural integrity.” *Vinciarelli-218*, ¶160. Indeed, protective caps are depicted in drawings of *Vinciarelli-218* where adaptors are used. *See Vinciarelli-218*, FIGs. 15-18, 25, 26, 33-36. However, neither the Petition nor Dr. Baker explained how Zeng-014’s terminal can be incorporated with protective caps 818 as required by 218 patent to provide the necessary “structure integrity.” They intentionally omitted certain necessary feature as required by *Vinciarelli-218* and their combination is purely based on impermissible hindsight.

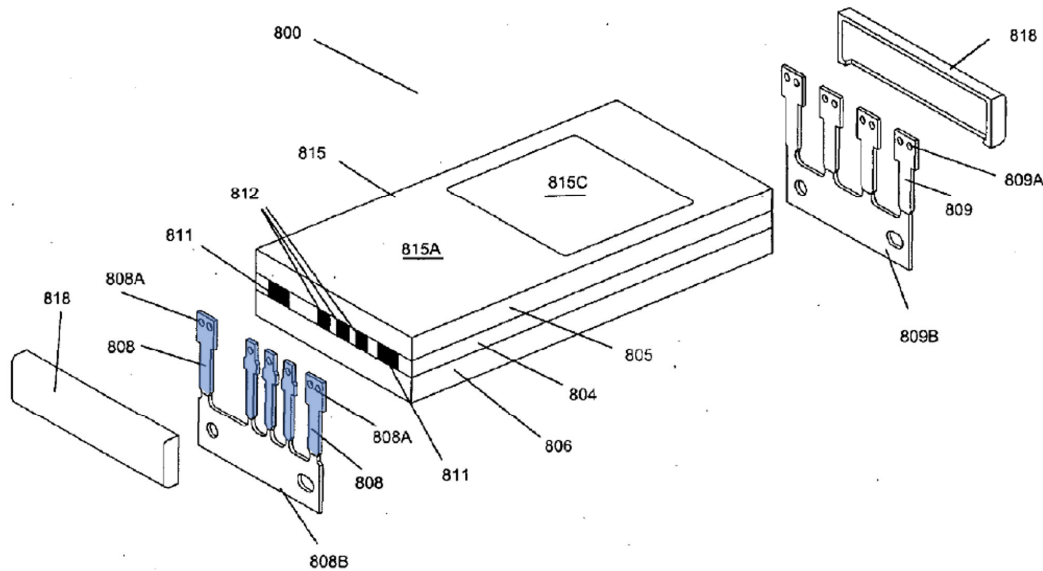


FIG. 35

Annotated Figure 35 of Vinciarelli-218

95. As I explained above in §IX.A.3, Vinciarelli-218 and Zeng-014 use completely different fabrication methods and sequences to form their vertical connectors. Specifically, different from Vinciarelli-218, in which singulated module 815 is fabricated *separately from* interconnect portions 808A, the conductors of Zeng-014 are pre-formed *with each substrate 111*. In other words, Zeng-014's conductors 113 are formed *in-situ during* the formation of each individual substrate 111, rather than after substrates 111 are completely formed and stacked or after the components of a power supply module has been encapsulated.

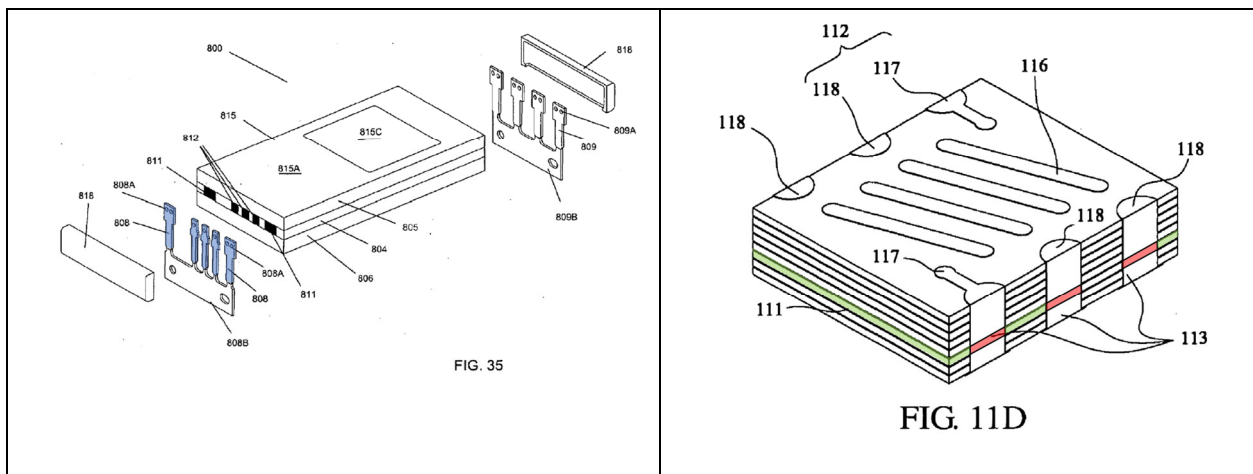
96. The Petition ignores this critical technical difference between forming the interconnects, and failed to provide any rational how the different interconnect schemes are interchangeable between Vinciarelli-218 and Zeng-014. While

purporting the combination, the Petition does not indicate how Vinciarelli-218 could be modified using Zeng-014's pin scheme to arrive at the claim limitations.

97. As I further explain below, a POSITA would not have been motivated to incorporate Zeng-014's conductors 113 into Vinciarelli-218 because Vinciarelli-218 requires a separately fabricated interconnect (e.g., interconnect 808A) to be connected to Vinciarelli-218's exposed contacts 811 and 812 *after* singulated module 815 is assembled. Moreover, Vinciarelli-218 requires that the terminals (e.g., 808) be connected to a lead frame, which is then broken off from the terminals after the terminals are joined to the singulated module. In my opinion, the fabrication processes of Vinciarelli-218 and Zeng-014 are entirely *incompatible* such that the modification proposed by Petition could only be derived from hindsight, utilizing Patent Owner's claimed invention and patent specification as a roadmap.

98. As noted above and further detailed below, Zeng's third embodiment (FIGs. 11A-11G) describes "a POL DC to DC converter." *Zeng-014*, ¶73. The first fabrication step includes forming "a number of semi-circular through-holes" "at two opposite sides of each magnetic material layer [111]" and filling the semi-circular through-holes "with a metal material" to form pins 117 and 118. *Zeng-014*, ¶74. Multiple layers of substrates 111 are then stacked by "sintering multiple layers of magnetic material together, which is a process similar to the low temperature co-fired ceramic (LTCC) process." *Zeng-014*, ¶74. The layers of each conductor (e.g.,

100. Given the apparent difference in interconnect formation, as I explained above, it is my opinion that a POSITA would have recognized that the modification required Vinciarelli-218 to *fabricate the external interconnect (e.g., interconnect 808A) within singulated module 815*. This challenge in the modification is evidenced by the Petition’s failure to explain how a POSITA would have modified Vinciarelli-218. Indeed, Vinciarelli-218 requires a separately formed interconnect for connecting to exposed interconnects 811 and 812, while Zeng-014’s conductor 113 is *pre-formed* with substrate 111.



Annotated Figure 35 of Vinciarelli-218 (left) and Figure 11D of Zeng-014 (right)

101. The Petition considers none of this while asserting that a POSITA would have been motivated to combine the references. Rather, the Petition simply stated that “Zeng-014’s pin scheme would be used in place of Vinciarelli-218’s connectors” and came to the conclusion that the “pins in the combination” would have the same structure as taught by Zeng-014. Petition, 19-20. Dr. Baker merely

repeats the attorney’s argument—and ignores the same details—without adding anything substantial beyond conclusory statements from the petition. The Petition’s purported combination appears to be an incomplete solution, and does not satisfy the limitations of the challenged claims.

102. Like Zeng-014’s third embodiment, its fourth embodiment illustrated in FIGS. 12A-12D is also directed to a “POL DC to DC converter.” *Zeng-014*, ¶76. It is my opinion that the Petition also fails in this combination because the modification would have impermissibly changed the principle of operation of Vinciarelli-218. Specifically, doing so would have required the **removal** of Vinciarelli-218’s interconnect (barcodes) 811 and 812, and as a result, a POSITA would not have been motivated to pursue the Vinciarelli-218 and Zeng-014 combination.

103. As noted above, Zeng-014’s DC to DC converter 120 includes a “first conductive layer 123 [that] comprises a connecting conductor having four pins 124 and a pin conductor having two pins 126.” *Id.* Each of the pins 124 and 126 contains a conductor 129 which is “formed in a through-hole form through the top and the bottom surfaces of the magnetic material substrate 125.” *Zeng-014*, ¶77. The through-holes are drilled in sides of the magnetic material substrate and electroplated to form conductors 129. *See Zeng-014*, ¶¶77. Conductor 129 is “electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 inside

the magnetic material substrate 125.” *Zeng-014*, ¶77. I have annotated and reproduced *Zeng-014*’s Figure 12D below to show conductors 129 (shaded red).

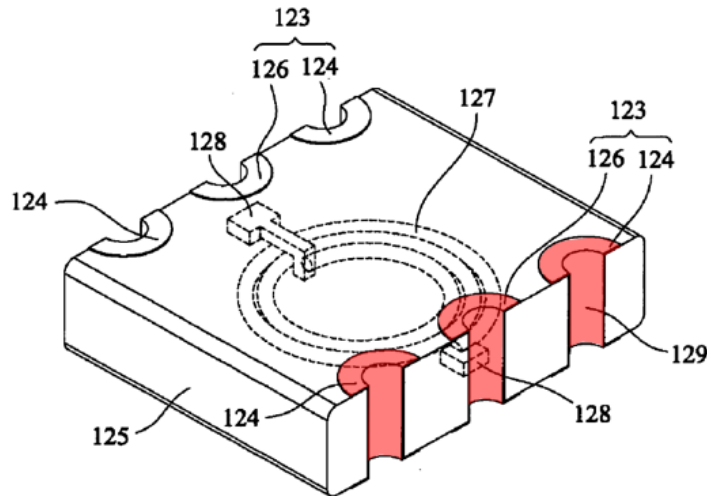


FIG. 12D

Annotated Figure 12D of *Zeng-014*

104. The side surfaces of 125 are drilled to form semi-circular through-holes and electro-plated to form conductors 129 in a shape of semi-circular collar. *Zeng-014*, ¶77. Conductors 129 are “electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 *inside* the magnetic material substrate 125.” *Zeng-014*, ¶77. As shown in annotated Figure 12D above, the sidewall surfaces of substrate 125 contains multiple semi-circular collars extending into magnetic material substrate 125 in which flat coil pins 128 are embedded. *Zeng-014*, FIG. 12D.

105. In contrast, Vinciarelli-218’s interconnects 811 and 812 (shaded red) are exposed and formed in flush with the sidewall surface of singulated module 815, as shown in annotated Figure 35 of Vinciarelli-218 below.

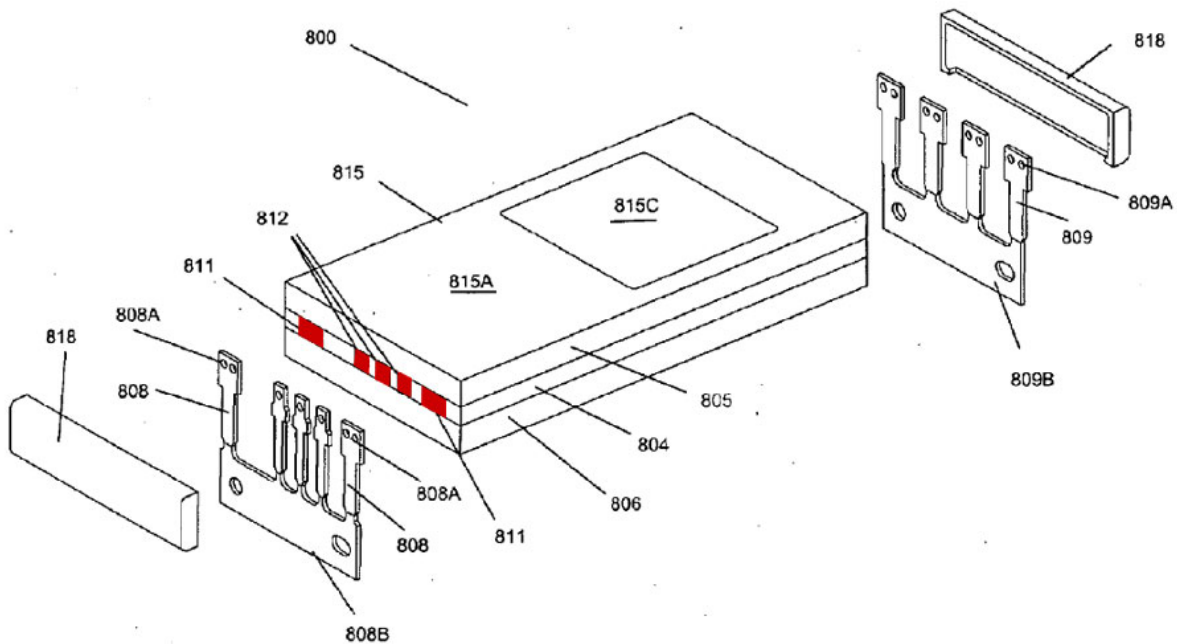


FIG. 35

Annotated Figure 35 of Vinciarelli-218

106. In my opinion, a POSITA would not have been motivated to modify Vinciarelli-218 and incorporate Zeng-014's conductors 129. Based on the teachings of Zeng-014, doing so would have required forming semi-circular collars (like those illustrated in Zeng-014's FIGS. 11A-12D) at the side surface of Vinciarelli-218. Beyond there being no motivation to adjust the shape of Vinciarelli-218's bar codes or Vinciarelli-218's assembly-based interconnect strategy, creating semi-circular holes at sidewall locations would require additional processing steps. Each additional step introduces additional manufacturing costs and possibility of yield issues. Besides the drilling step itself, when a plating process is used to form "[a] plated layer" "on the input terminal 151, the output terminal 152, and the ground

terminal 153” as Park suggested (Park, ¶131), masking or stop-off would be required to form Zeng-014’s conductors 129 only where needed and not on any other exposed metal.

107. In addition, Vinciarelli-218’s terminal portions 808 and interconnect portions 808A are designed to mount singulated module 815 onto a motherboard using a “through-hole mounting” method. *Vinciarelli-218*, ¶¶159-160. This method, also referred to as insertion mounting method, requires the ends of the interconnect portions to be “constructed and arranged to be inserted into conductive holes in the circuit board” by having interconnect portions protruding vertically down into the circuit board. *Vinciarelli-218*, ¶18. In contrast, Zeng-014’s conductors 113 and 129 extend horizontally and do not have the capability of being inserted into conductive holes in the circuit board.

108. Moreover, Vinciarelli-218 requires that the terminals (e.g., 808) be connected to a lead frame, which is then broken off from the terminals after the terminals are joined to the singular module. In my opinion, the fabrication processes of Vinciarelli-218 and Zeng-014 are entirely incompatible such that the modification proposed by Petition could only be derived from hindsight, utilizing Patent Owner’s claimed invention and patent specification as a roadmap.

109. Therefore, faced with feasibility challenges and differences between the interconnect designs, it is my opinion that a POSITA would not have been motivated to incorporate Zeng-014's conductors into Vinciarelli-218's structure.

5. The Petition's combination does not result in other limitations of [1b], [1c], [10b], and [10c]

110. In addition to the above, it is my opinion that the Petition's combination would not result in a device that satisfies the limitations of [1b] and [1c]. Limitations [10b] and [10c] recite substantively similar features as limitations [1b] and [1c].

111. Claims of the '534 Patent require [1b] - "insulation material formed on two opposite surfaces of the bearing plate" and [1c] - "a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material [with] each of the pins [] extending to an upper surface and a lower surface of the insulation material." '534 Patent, 21:26-33. I have annotated and reproduced FIG. 25 of the '534 Patent to highlight pins 140 (shaded blue) that are located on lateral sides of the insulation material 3430, which is formed on the bearing plate 3420. *Id.*, 19:34-40. As depicted below, the pins 140 wrap around insulator 3430 and are allocated along its lateral side.

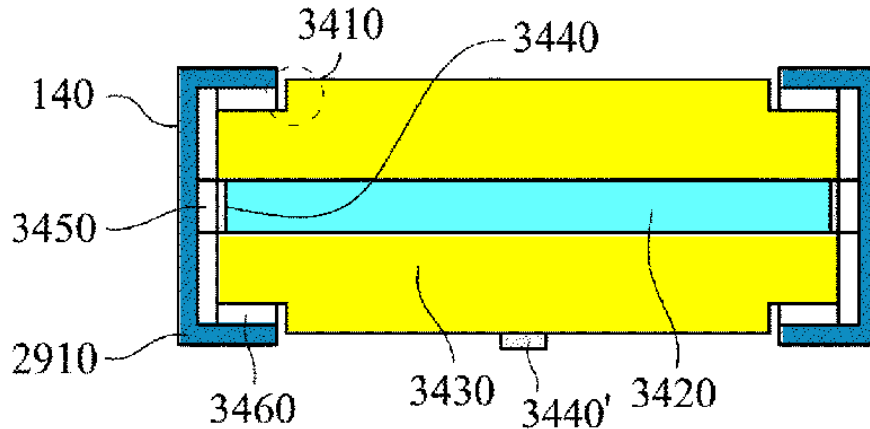


Fig. 25

Annotated Figure 25 of the '534 Patent

112. As I explained above in §§IX.A.3-IX.A.4, the Petition's combination results in pins being made *into* the encapsulant and not on its lateral sides. As a consequence, the Petition's combination cannot and does not result in a device with "insulation material formed on two opposite surfaces of the bearing plate," as required by limitation [1b] and [1c] that recites "a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material." Therefore, it is my opinion that the Petition's combination (even if a motivation were found) fails to teach these limitations.

113. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on at least one claim in Ground 1 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

B. Ground 2 of the 706 IPR: Zeng-014 does not anticipate claims 1-8 and 10-12 because it fails to teach limitations [1a], [1b], and [1c]

1. Zeng-014 does not teach limitations [1a] and [10a]

114. In my opinion, the Petition has failed to show that Zeng-014 anticipates limitation [1a], which recites “a bearing plate.” Claim limitation [10a] recites substantively similar features as limitation [1a].

115. The Petition identifies Zeng-014’s magnetic substrates 111 or magnetic material substrate 125 as being the “bearing plate.” Petition at 36-37. However, these structures are *not* bearing plates because they are magnetic substrates in which an inductor is encapsulated. Specifically, as shown in FIGs. 11D and 12D reproduced below, inductors 116 and 127 are respectively encapsulated within magnetic substrates 111 or magnetic material substrate 125, rather than being mounted thereon. According to the ’534 Patent, a “bearing plate” bears mountable components for the unit. Examples of a bearing plate include a PCB. *See ’534 Patent*, 8:25-29.

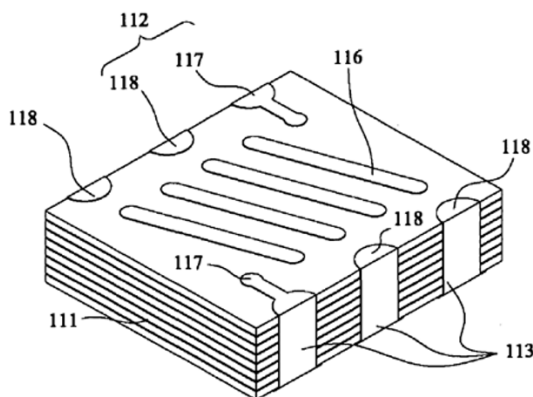


FIG. 11D

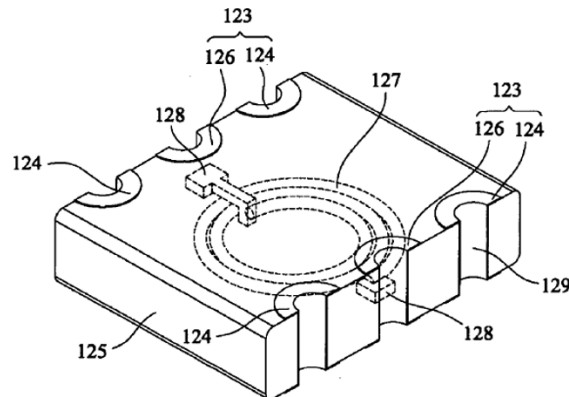


FIG. 12D

Figures 11D and 12D of Zeng-014

116. Specifically, the Petition alleges that magnetic substrates 111 and magnetic material substrate 125 are bearing plates because it is used for “mounting other elements, such as integrated circuit 115 and capacitors 114” as well as “integrated circuit 121 and capacitors 122.” Petition at 36. However, FIGs. 11A and 12A reproduced below show that integrated circuit 115 and capacitors 114 are in fact mounted on conductive layers 112 and 123, respectively. They are not even in direct contact with magnetic substrates 111 or magnetic material substrate 125. Therefore, magnetic substrates 111 and magnetic material substrate 125 are not a “bearing plate” as recited by limitations [1a] and [10a].

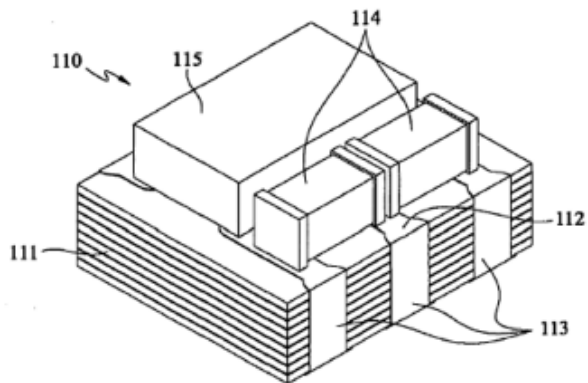


FIG. 11A

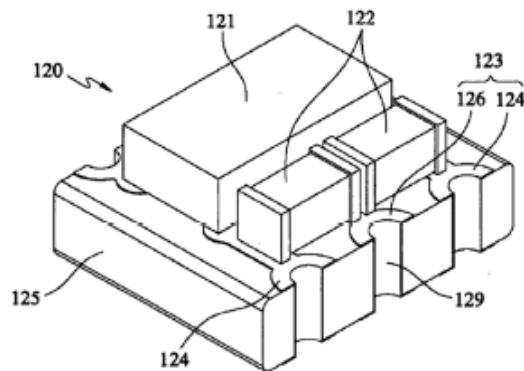


FIG. 12A

Figures 11A and 12A of Zeng-014

117. In my view, magnetic substrates 111 and magnetic material substrate 125 are not a “bearing plate” as recited by limitations [1a] and [10a].

2. Zeng-014 does not teach limitations [1b] and [10b]

118. It is my opinion that the Petition has failed to show that Zeng-014 anticipates limitation [1b], which recites “insulation material formed on two opposite surfaces of the bearing plate.” Limitation [10b] recites substantively similar features as limitation [1b].

119. The Petition identifies Zeng-014’s magnetic material substrate 125 as being both the “bearing plate” and the “insulation material.” The Petition also argues that its identification is appropriate because the magnetic substrate has insulative properties. *See* Petition at 37-39.

120. I disagree with the Petition’s analysis because its argument is inconsistent with the claims and specification of the ’534 Patent, which proffer a clear meaning to the term “bearing plate.” The specification of the ’534 Patent describes the bearing plate as a “printed circuit board (PCB) or the direct bonding circuit (DBC), etc., for bearing the components of the unit.” *’534 Patent*, 8:25-29. It is my opinion that a POSITA would have understood that a PCB has non-conductive properties because it is formed using a flat sheet of non-conductive materials, such as fiberglass—a term encompassing many types of non-conductive plastic. The claims do not define the property, rather, they describe an entirely separate component, the “insulation material” in addition to the “bearing plate.” In my opinion, to state that the “insulation material” can be the “bearing plate” itself is

nonsensical, because it is non-conductive, and that also renders the “insulation material” wholly superfluous. I am informed that each structural limitation must be given its meaning, and the Petition reliance on a single component to satisfy multiple different structural limitations makes little sense.

121. There are further problems with Petitioner’s identification. The magnetic material substrates alone cannot be a bearing plate because they cannot bear or house components. To do so, the magnetic material substrate needs to be able to have conductors (*e.g.*, pins). Petitioner, however, has not identified those pins as being part of the identified bearing plate (due to requirements of [1c] and [10c] which require that the pins be separate from the bearing plate). As such, the magnetic material substrates 111 / 125 alone (absent the conductive pins) cannot be a bearing plate.

122. Therefore, in my view, the Petition failed to demonstrate that limitation [1b] (reciting both a bearing plate and an insulating material) is taught by Zeng-014.

3. Zeng-014 does not teach limitations [1c] and [10c]

123. In my opinion, the Petition has failed to show that Zeng-014 anticipates limitation [1c], which recites “a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material.” Limitation [10c] recites substantively similar limitations but provides additional limitation.

124. In Ground 2, the Petition again relies on the embodiments of Zeng-014 described above (FIGs. 11A-11G and 12A-12D). However, the Petition fails for at least the same reasons. As I explained in §§IX.A.1-IX.A.2, Zeng-014's conductors are formed integrally with or pre-formed in each of its substrates. Zeng-014 fails to anticipate because it does not teach limitation [1c] for the same reasons I explained in §§IX.A.1-IX.A.2.

125. As I explained, pins 117 of Zeng-014's FIGs. 11A-11G are formed integrally as part of the device because they are embedded within the device, and *not* on the lateral side of the insulating material. FIGs. 11B and 11D of Zeng-014 reproduced below are annotated to highlight the top and bottom magnetic material substrates 111 (shaded green) and embedded pins 117 and 118 (shaded red). *Zeng-014*, ¶¶73-75.

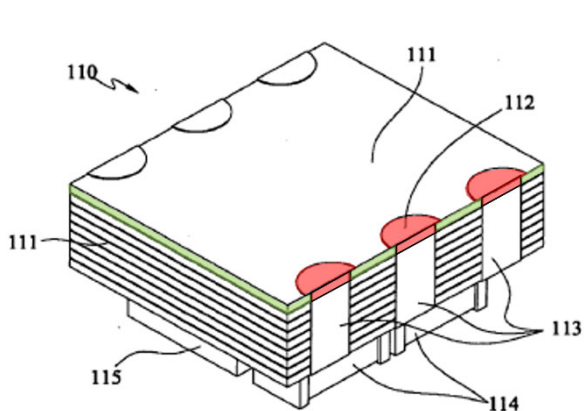


FIG. 11B

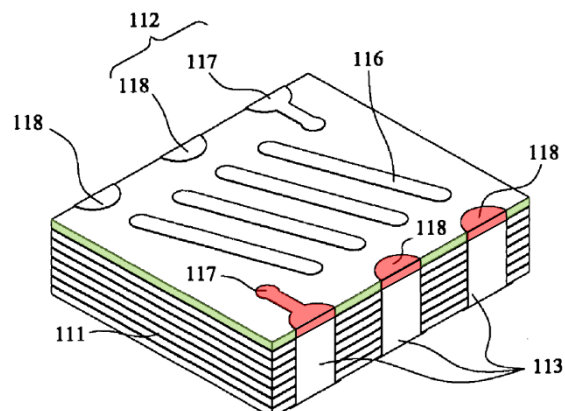


FIG. 11D

Annotated Figures 11B and 11D of Zeng-014

126. Zeng-014 fails to teach [1c] which requires that SMD pads extend “to an upper surface and a lower surface of the insulation material, respectively.” Zeng-014’s pins 117 and 118 are formed “at two opposite sides of each magnetic material layer, and are filled with a metal material...to form the connecting conductive elements 119 and pins 117, 118 of the inductance coil 116.” *Zeng-014*, ¶74. Magnetic material substrates 111 with pre-formed conductors 113 and pins 117 and 118 are “laminated together to form the inductance coil 116.” *Id.* A POSITA would have understood that the top and bottom surfaces of pins 117, 118, and each layer of conductors 113 are *coplanar* with top and bottom surfaces of their respective magnetic material substrate 111, because pins 117, 118, or conductors 113 protruding from top and bottom surfaces of magnetic material substrate 111 would cause gaps between the substrates during lamination which in turn leads to mechanical failure. Therefore, after lamination, top and bottom surfaces of pins 117, 118, and stack of conductors 113 are *coplanar* with bottom surfaces of substrate 111. In other words, both top and bottom surfaces of the conductors and top and bottom surfaces of substrate 111 are on the same plane, respectively. As such, there is no disclosure or motivation in Zeng-014 that teaches [1c].

127. The contrast can be seen in the figures of the ’534 Patent whose claims require “insulation material formed on two opposite surfaces of the bearing plate” and “a plurality of pins electrically connected to the bearing plate and allocated along

lateral sides of the insulation material [with] each of the pins [] extending to an upper surface and a lower surface of the insulation material.” ’534 Patent, 21:26-33. This claimed novel configuration is shown in annotated FIG. 25 below, which depicts insulation material 3430 being formed on bearing plate 3420 (shaded aqua), and pin 140 (shaded blue) being allocated on lateral sides of the insulation material 3430. *Id.*, 19:34-46. Specifically, the ’534 Patent discloses that “insulating material 3430 is formed on the two opposite surfaces of the bearing plate” and “each pin 140 has the SMD pad 2910 extending to the recess 3410 at the upper and lower surfaces.” *Id.* As the annotated figure below shows, pins 140 wrap around insulating material 3430 and are allocated along the lateral sidewalls of insulating material 3430.

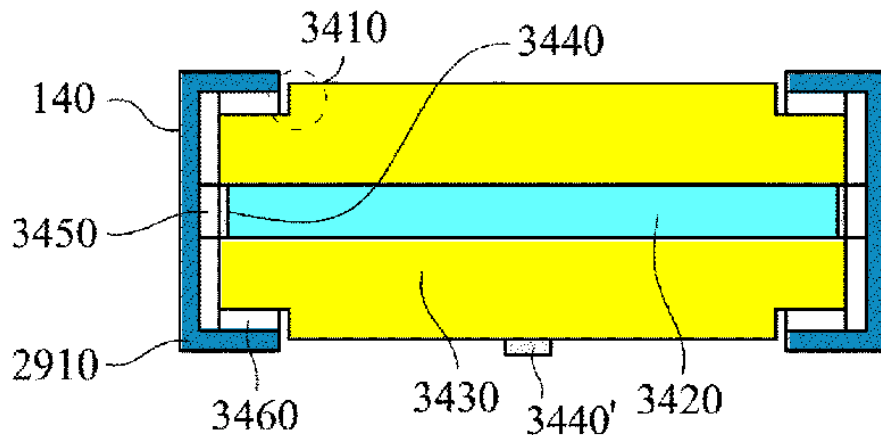


Fig. 25

Annotated Figure 25 of the ’534 Patent

128. As I explained in §§IX.A.3-IX.A.5, the Petition’s argument on Zeng-014’s embodiments depicted in FIGs. 12A-12D likewise fail. Because these

embodiments are formed *via drilling*, they similarly do not provide “plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material” as required by limitation [1c]. As shown in FIGs. 12A-12D (reproduced below), each of pins 124 and 126 contains a conductor 129 which is “formed in a through-hole form through the top and the bottom surfaces of the magnetic material substrate 125.” *Zeng-014*, ¶77.

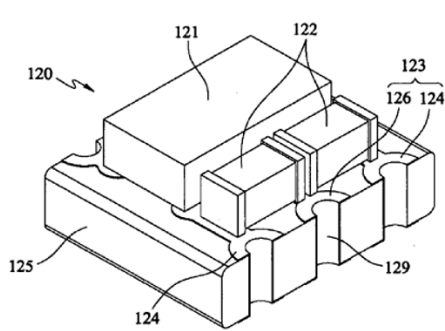


FIG. 12A

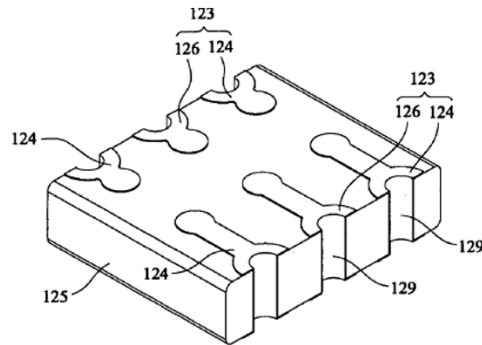


FIG. 12C

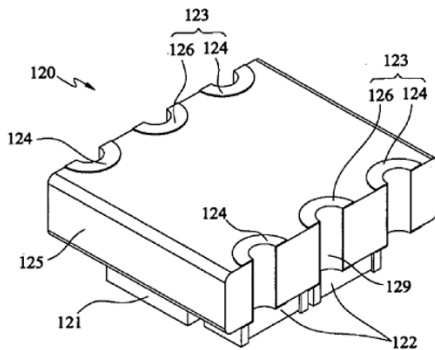


FIG. 12B

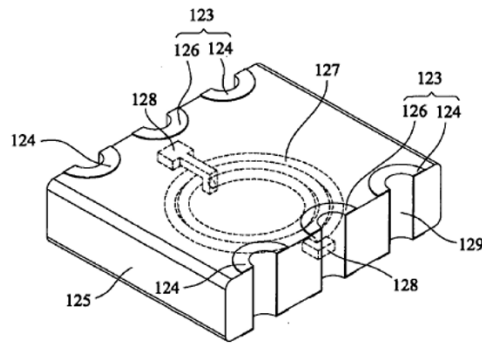


FIG. 12D

Figures 12A-12D of Zeng-014

129. The through-holes are drilled in sides of the magnetic material substrate and electro-plated to form conductors 129. See *Zeng-014*, ¶¶77. Conductor 129 is

“electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 inside the magnetic material substrate 125.” *Zeng-014*, ¶77. Therefore, *Zeng-014*’s FIG. 12 embodiment fails to disclose limitation [1c] because *Zeng-014* only discloses conductors 129 being electrically coupled to flat coil pins 128. *Zeng-014*’s FIG. 12D is reproduced below.

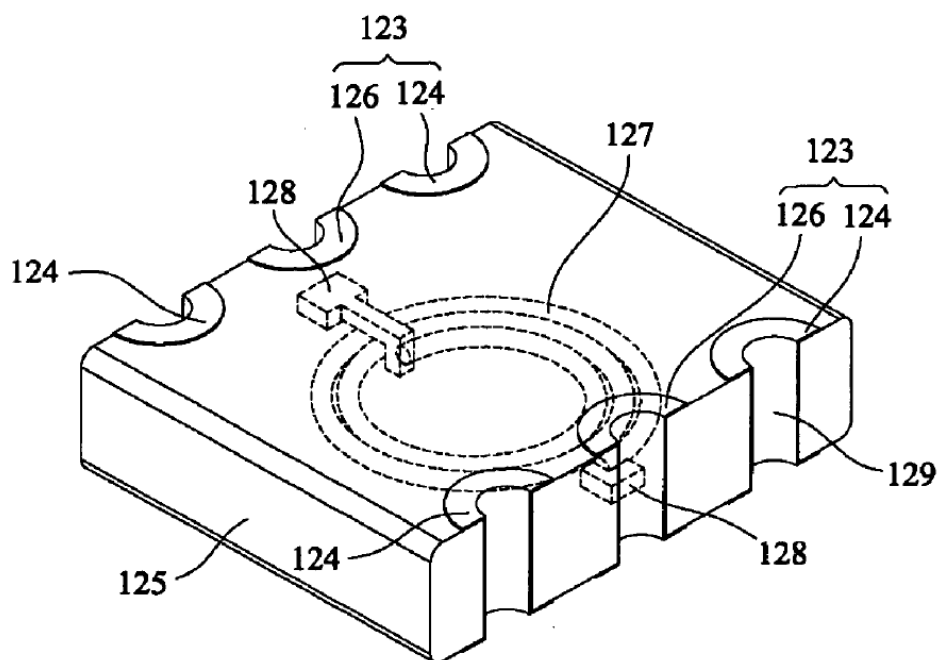


FIG. 12D

Figure 12D of Zeng-014

130. As I explain below, the Petition's analysis here fails at least for another reason because Zeng-014's magnetic material substrate 125 is already non-conductive and Zeng-014 does not disclose or suggest disposing another insulating layer on the *already insulating* magnetic material substrate 125.

131. The Petition first contends that Zeng-014's magnetic material substrate discloses the claimed "bearing plate" and concedes that "Zeng-014 does not expressly describe insulation material formed on opposite surfaces of the bearing plate in DC to DC converter 120." Petition at 36. The Petition continues to argue that because conductor pins 124 and 126 need to be insulated, "a skilled artisan would have at once envisaged the use of an insulation material layer in DC to DC converter 120." Petition at 39.

132. I disagree with the Petition's arguments. Zeng-014's magnetic material substrate 125 is non-conductive. Regardless of whether additional insulating material would be formed, magnetic material substrate 125 must be electrically insulating because "inductance coil 127 has been compressed into the magnetic material substrate 125 when the substrate 125 is produced." *Zeng-014*, ¶78. If magnetic material substrate 125 is conductive, inductance coil 127, pins 124 and 126, flat coil pins 128, as well as any conductive structures formed within magnetic material substrate 125 would all be electrically connected, forming a wholly conductive brick and render the device *inoperable*. Therefore, it is my opinion that Zeng-014's third embodiment does not disclose or teach an insulating material between magnetic substrate 125 and pins 124 or 126.

133. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on claims 1-8 and 10-12 in

Ground 2 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

C. Ground 3 of the 706 IPR: Zeng-014 and Jun does not render obvious Claims 1-8 and 10-12

1. The Zeng-014-Jun combination does not teach limitations [1a], [1b], [1c], [10a], [10b], and [10c]

134. The Petition relies on Zeng-014 to teach the features of limitations [1a], [1b], and [1c]. Petition, 49-50. The Petition's arguments are deficient as I explained above in §IX.B regarding Ground 2. Limitations [10a], [10b], and [10c] recite substantively similar features as limitations [1a], [1b], and [1c]. Therefore, it is my opinion that Ground 3 fails for at least the same reasons.

2. A POSITA would not have been motivated to add additional insulation material to Zeng-014

135. The Petition relies on Jun only for dependent claim (claim 2) limitations - "a plurality of first pads disposed on lateral sides of the bearing plate" - and not independent claim limitations. As such, Petitioner's Jun combination does not help address deficiencies for the base independent claims. Further, the Petition fails to present a viable motivation to combine Zeng-014 and Jun.

136. The Petition concedes that Zeng-014 does not teach a separate insulation layer for substrate 125 of Zeng-014's fourth embodiment. Petition at 50. The Petition further contends that "it would have been obvious to insulate the upper and lower surfaces of Zeng-014's substrate 125 to prevent short circuits between

pins 124 and 126 disposed on the surface of the substrate.” *Id.* Zeng-014’s FIG. 12D (annotated and reproduced below) shows that the only structure between pins 124 and 126 is substrate 125. If substrate 125 is conductive, an electrical path would have existed between not only adjacent pins 124 and 126, but also between all other conductive elements such as pins 124 and 126 formed on the opposite side surface of substrate 125, and even between pins 124 and 126 and inductive coil 127. This renders the entire structure depicted in Figure 12D a conductive brick and defeats its purpose as a DC-to-DC converter because the elements within substrate 125 are shorted and can no longer exercise their intended functions.

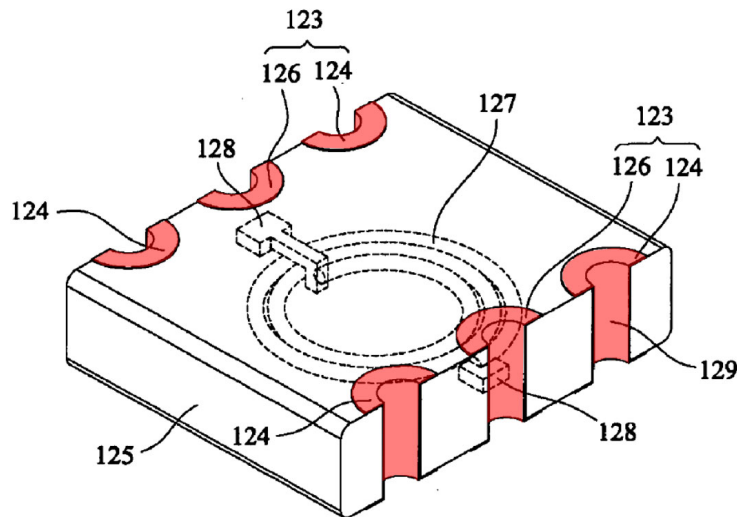


FIG. 12D

Annotated Figure 12D of Zeng-014

3. A POSITA would not have been motivated to modify Zeng-014 with the teachings of Jun

137. As I explain below, the Petition relied on *impermissible hindsight* to argue that it would have been obvious to modify Zeng-014 with the connection pad of Jun. However, in my opinion, the Petition's argument fails because Zeng-014 does not disclose any pins that are formed on lateral sides of the substrate, therefore, this is no need or motivation to form electrical contact to its lateral side of the substrate, which is a non-conductive material. For at least these reasons, Ground 3 should be rejected.

138. The Petition contends that pins 128 of Zeng-014 “are disposed on lateral sides of the bearing plate and are exposed from the insulation material and whose ends are contacting and electrically connecting the adjacent pins.” Petition at 50. This feature is not found in the specification or figures of Zeng-014. Zeng-014 merely discloses that “*conductor 129 in the two pins 126 of the pin conductor are electrically connected with the flat coil pins 128 at both ends of the inductance coil 127 inside the magnetic material substrate 125.*” Zeng-014, ¶77. The Petition failed to provide any argument that pins 128 are formed on the lateral sides of substrate 125. However, nowhere does Zeng-014 teaches or suggests that conductor 129 and flat coil pins 128 are also physically connected. Indeed, flat coil pins 128 within substrate 125 could have been electrically connected to conductor 129 through other conductive structures, such as pins 124 and 126. Zeng-014 does not disclose or

suggest any internal component protruding out from sidewall surfaces of substrate 125. Therefore, the Petition's arguments fail because that a POSITA would not have been motivated to use connection pads on the lateral sides of substrate 125.

139. In my opinion, the Petition's arguments on Jun regarding the claim limitation of "a plurality of pins...allocated along lateral sides of the insulation material" fail and do not address the deficiencies of Zeng-014 described above. Therefore, it is my opinion that Zeng-014 alone or Zeng-014 and Jun do not render claims 1-8 and 10-12 unpatentable.

140. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on claims 1-8 and 10-12 in Ground 3 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

D. Ground 4 of the 706 IPR: The Petition fails to establish a reasonable likelihood that Park anticipates claims 1-3 and 5-8

141. In my opinion, Park fails to teach several elements of claims 1-3 and 5-8, and Ground 4 should be denied.

1. Park fails to teach limitations [1pre] and [10pre], "a power supply apparatus"

142. As an initial matter, it is my opinion that the Petition fails to show that Park teaches a power supply apparatus. The petition cites Park which discloses "a composite electronic component 100" that includes "a composite body 130" that

further includes “a capacitor 110” and “an inductor 120.” *Park*, ¶68. I have reproduced FIG. 1 of *Park* below which illustrates these components. Specifically, the Petition points to the combined inductor 120 (red) and capacitor 110 (blue) to satisfy limitation [1pre]. Petition at 57. As acknowledged by *Park*, it was well known before the September 2, 2014 priority date of the ’534 Patent that inductors and capacitors are passive elements of electronic circuits because “[t]he present disclosure relates to a composite electronic component including a plurality of *passive elements* and a board for mounting the same.” *Park*, ¶2; *see id.*, ¶¶34, 55, 61, 68.

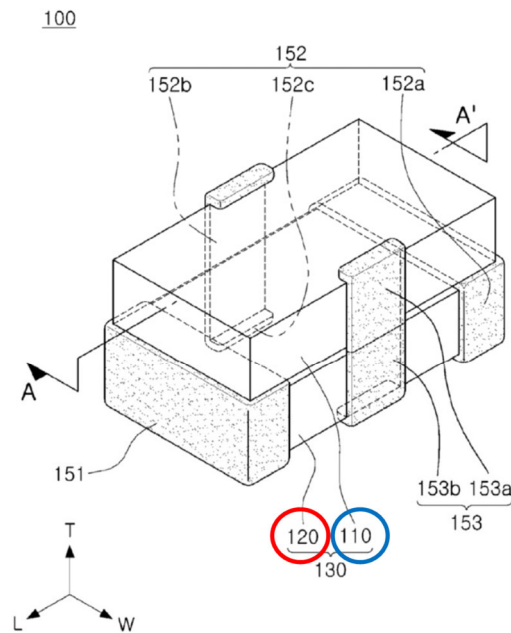


FIG. 1

Annotated Figure 1 of Park

143. As I explain below, inductors and capacitors alone are not a power supply apparatus. As exemplified in the figure from my PhD thesis, below, a buck converter (which is a power supply apparatus for converting one DC voltage to another DC voltage, includes inductors and capacitors as component parts. Inductors (one is labeled “59 μH ” in the figure below) and capacitors (one is labeled “9.4 μH ” in the figure below) are passive components within the power supply. Whether these passive components are stacked together or not, the power supply includes other elements (e.g., semiconductor switches, gate drive, and controller) that are necessary to convert electric power. *See Phinney Thesis*, 38-40, FIG. 2.3.

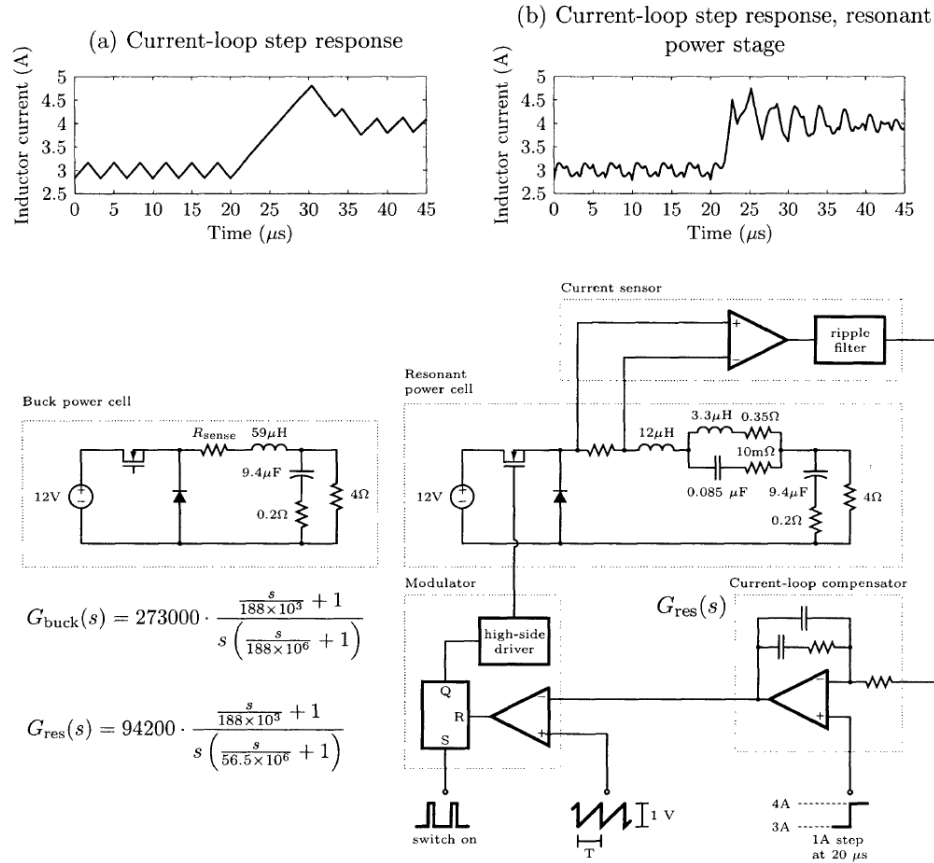


Figure 2.3: Simulated step responses of current-control loops for a (a) buck converter and (b) a buck converter with a power-stage resonance, demonstrating an increase in control bandwidth accompanying a reduction in power-stage inductance. Both converters are 300-kHz, 36 W buck converters under average current-mode control, and the magnetics are designed for ferrite cores using manufacturer's loss models. That the resonant filter behaves like a smaller inductor across the regulation bandwidth is plausible: the resonator Q is high enough that impedance variations are appreciable only above half the switching frequency, yet not so high that earlier crossover is necessary to maintain acceptable gain margin in the current-command loop.

Figure 2.3 of Phinney Thesis

144. The Petition's other citations to a PMIC (power management integrated circuit) are to general background. Petition at 57. For example, the paragraph cited by the Petition merely states broadly that there is "an increase in the number of DC/DC converters provided in a PMIC" and in "the number of passive elements." *Park*, ¶5, FIG. 1. The Petition failed to identify any components of a PMIC as

satisfying the claims, and only identified the inductor/capacitor pair. Park only discloses that its “composite electronic component” can be “used in a power management integrated circuit (PMIC).” *Park*, ¶93. However, as I explained above, an inductor alone is not a power supply apparatus. Therefore, in my opinion, this fails to teach limitation [1pre] and substantively similar [10pre].

2. Park fails to teach limitations [1a] and [10a], “a bearing plate”

145. In my opinion, Park does not teach a bearing plate.

146. The Petition presents several alternatives for satisfying this element: (1) inductor 120; (2) the combination of substrate 123 and coil 140; and (3) substrate 123. Petition at 58-59. As I explain below, each of these alternatives fail.

147. First, the Petition contends that an inductor is a bearing plate. Petition at 58. This is incorrect. A POSITA would have understood that a bearing plate is a platform for bearing multiple circuitry components of the unit. An inductor itself is an example of the circuitry component. To over broadly state that any component can be a bearing plate simply because it can connect to another component, effectively erases any meaning from “bearing plate” because following this faulty logic, any two contacting items can be a “bearing plate” for each other. I have been informed by counsel that a claim term cannot be rendered wholly superfluous.

148. Second, the Petition’s argument that substrate 123 and coil 140 combined is a bearing plate also fails. As I explained immediately above, a bearing

plate is for bearing and to be mountable by components. Examples of a bearing plate can be a PCB or a DBC. See '534 Patent, 2:24-25. A substrate surrounded by an insulated coil, which is what Park teaches, cannot have any additional components mounted on it. Therefore, in my opinion, this alternative as purported by the Petition also fails to satisfy limitation [1a].

149. Third, the Petition argues that substrate 123 is a bearing plate. Petition, at 58. I disagree because Petitioner's argument breaks down when substrate 123 is analyzed in combination with limitations [1b] and [10b] as explained in §IX.D.3 below. Again, an inductor is not a "bearing plate" and to argue it is would render the term "bearing plate" effectively meaningless.

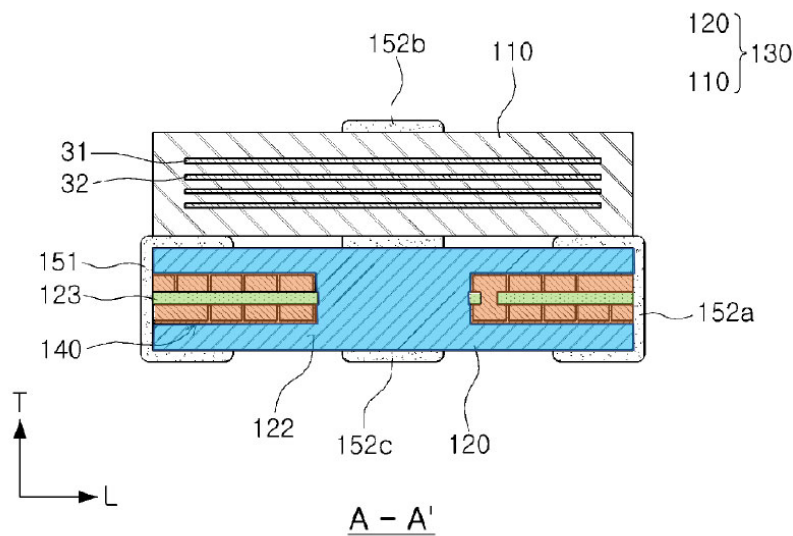


FIG. 3

Annotated Figure 3 of Park

150. As such, it is my opinion that Park fails to teach limitations [1a] and [10a] and that Ground 4 shall fail.

3. Park fails to teach limitations [1b] and [10b], “insulation material formed on two opposite surfaces of the bearing plate”

151. In my opinion, the Petition’s analysis regarding limitation [1b] fails for at least three reasons. I discuss my views below.

152. First, the claims require that the “insulation material” be “formed” on opposite surfaces of the bearing plate. The Petition identified magnet 122 as an insulator and substrate 123 (or substrate with coil) as the bearing plate (in its alternative read). However, in my view, this is simply inconsistent with the claim language which recites “insulation material formed on two opposite surfaces of the bearing plate.” Substrate 123 with coil unit 140 are *wrapped around* magnet 122. Therefore, magnet 122 is consequently not formed onto the substrate 123 (or onto substrate 123 with the coil). As such, it is my opinion that the Petition’s alternative read of substrate 123 (or substrate 123 and coil 140) as the bearing plate in limitation [1b] fails.

153. Second, the Petition’s mapping between [1a] (“a bearing plate”) and [1b] cannot be reconciled with the claim language “formed on two opposite surfaces of the bearing plate” and the specification. In limitation [1a], the Petition argues that “[i]nductor 120 is a bearing plate because it supports capacitor 110 on top of it.” *See*

Petition at 58. And, for limitation [1b], the Petition argues that the magnet is the insulating material. Following the Petition's faulty logic, the Petition's mapping leads to the nonsensical result that the magnet, which is an internal component of the inductor, is the insulating material for that inductor. This is inconsistent with Park's teachings, as I explain below.

154. Park teaches that magnet 122 is an internal component of inductor 120 and even points to the same structure in FIG. 3 below. Park states that an inductor is formed by wrapping a coil around a magnetic core. *See Park*, ¶¶18, 81. I have annotated and reproduced FIG. 3 of Park below to highlight that coil 140 (shaded orange) is wrapped around a magnet 122 (shaded blue). *See Park*, ¶¶85, 90. The coil is on substrate 123 (shaded green). By wrapping a coil around a magnet, an inductor is formed, which is one of the fundamental configurations of an inductor. Therefore, magnet 122 is a device that has the coil wrapped around it (i.e., the substrate 123 with coil); magnet 122 is consequently not formed onto the substrate 123 (or onto the substrate 123 with the coil).

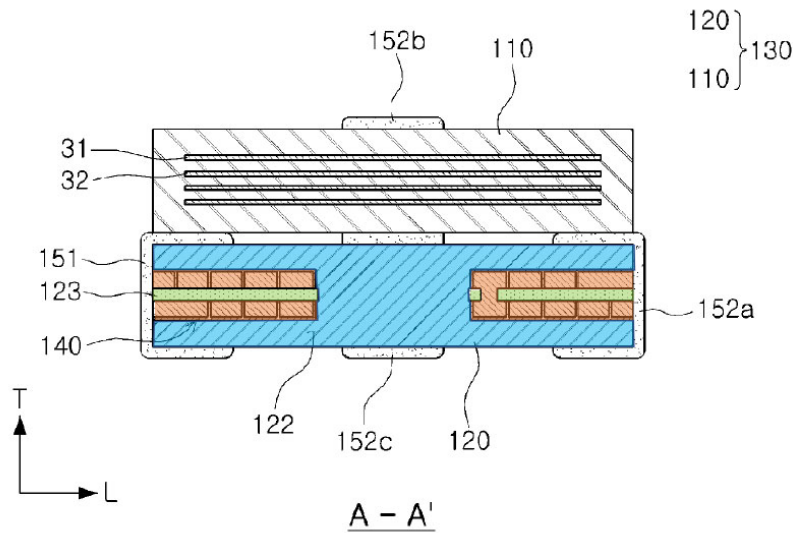


FIG. 3

Annotated Figure 3 of Park

155. Third, in my opinion, the Petition’s analysis also fails to consider that Park’s inductor is intertwined with an insulator. This can be seen below in the annotated and enlarged Figure 3 of Park, where the insulator around coil 140 is in shaded in purple. In my opinion, a POSITA would have understood that the insulator is provided so that conduction or magnetic interference does not occur in other parts (i.e., the magnet) or between adjacent coils. Indeed, in U.S. Pat. App. Pub. No. 2014/0167897 to Choi (“Choi”) that was submitted by the same applicant as Park (Samsung Electro Mechanics Co. Ltd.), disclosed an insulator and coil structure in FIG. 2 (annotated and reproduced below). After comparing Figure 2 of Choi and FIG. 3 of Park and the associated specifications, I conclude that at least the insulator and coil combination have identical properties. Choi explicitly states that “first and

second coil layers 41 and 42 may have an *insulating* film 50 formed along circumferences thereof so as to enclose surfaces thereof.” Choi, ¶64. In addition, insulating film 50 (purple) is formed of a material having *insulating* properties, for example, a polymer, or the like.” Choi, ¶65. Therefore, the Petition relies on the magnet being non-conductive, but fails to consider Park’s that has an insulator between the coil and magnet.

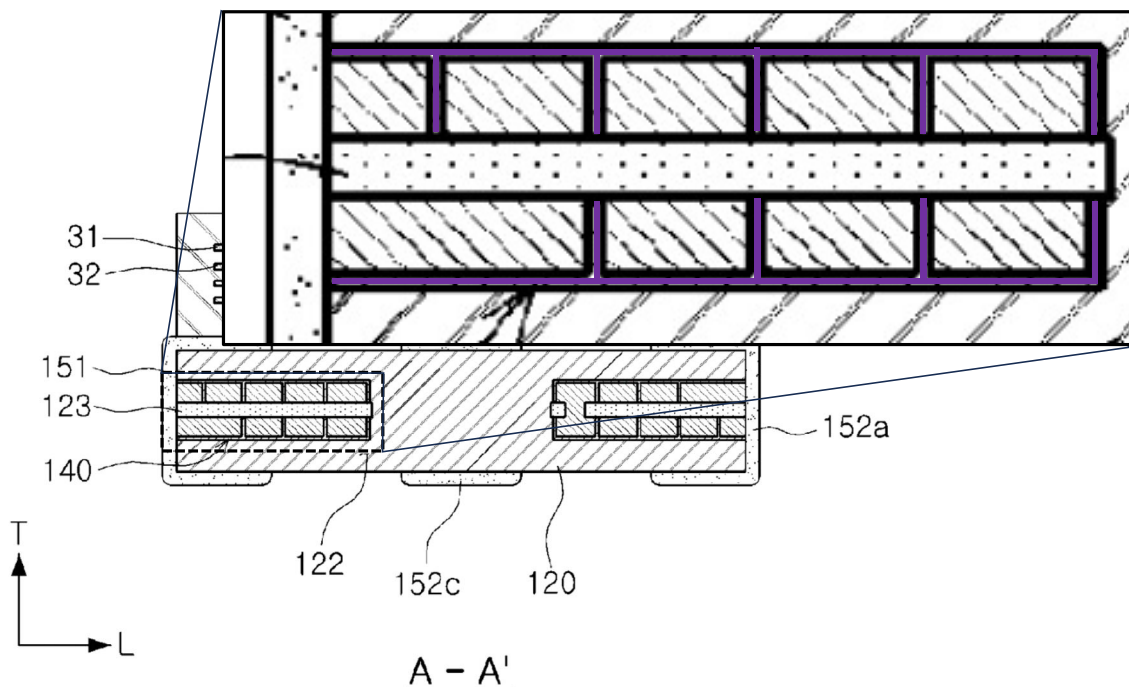


FIG. 3

Annotated and enlarged Figure 3 of Park

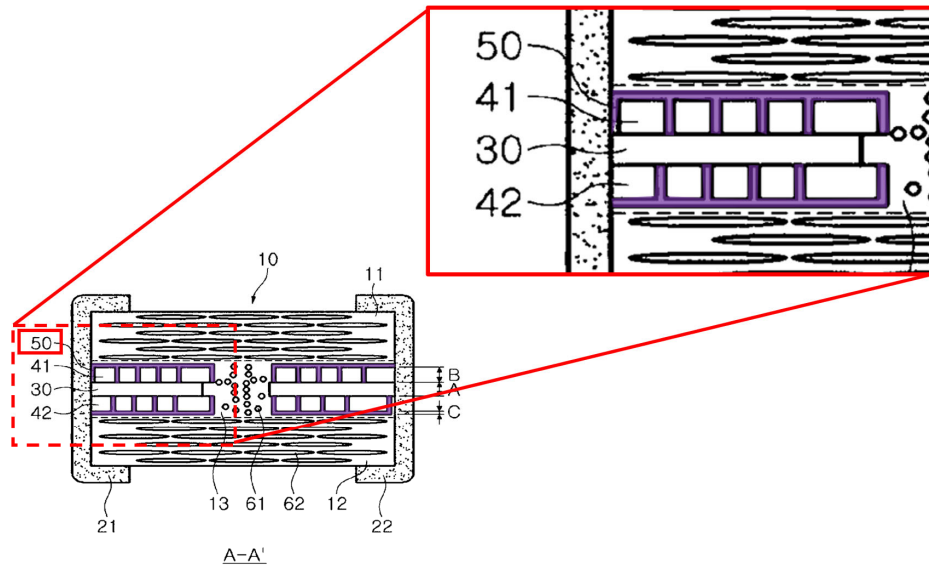


FIG. 2

Annotated and enlarged Figure 2 of Choi

156. Therefore, it is my opinion that Ground 4 fails because Park further fails to teach limitation [1b] and substantively similar limitation [10b].

4. Petitioner fails to present the requisite particularity of a challenge for limitations [1c] and [10c]

157. As I explained with respect to limitation [1a], the Petition presents “[t]he insulating substrate 123 may be considered the bearing plate.” Petition at 58. This reading does not comport with the requirements of limitation [1c]. Specifically, limitation [1c] requires that “a plurality of pins electrically connected to the bearing plate.” The substrate is an insulating (i.e., not conductive) material. *Park*, ¶86. In my opinion, a POSITA would have understood that connecting pins to an insulator does not establish any electrical connection because an insulator, as indicated by its own

name, does not conduct electricity. Therefore, it is my opinion that the Petition's read involving the substrate 123 also fails.

158. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Ground 4 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

E. Ground 5 of the 706 IPR fails to present a reasonable likelihood of success

159. The Petition relies on Park and Jun to remedy perceived deficiencies of Ground 4. However, the Petition failed to do so and turned its efforts to relying on Jun to cure a non-existent deficiency of Park.

160. The Petition argues that a POSITA would have found magnet 122 to be an insulating material, and without any evidential support, alleges that somehow its insulating property is insufficient and “additional insulating layers” are needed “above and below the module.” Petition at 66. Because of this so-called added insulation material, the Petition alleges that a POSITA would have combined Park with Jun, which discloses a connection pad “disposed on a lateral side” “to connect an external electrode” to “internal circuitry of the substrate” through the insulating layers.

161. Therefore, the Petition focused on a non-existent shortcoming of Park but failed to address any of the deficiencies addressed above with respect to each of

limitations [1pre], [1a], and [1b]. I note that the Petition does appear to discuss the deficiency of limitation [1c], but its rationale on how limitations [1a] and [1b] are met at a level to understand limitation [1c] is too ambiguous and uncertain for me to address, especially when other limitations are plainly absent from the Petition's argument. It is my opinion that Ground 5 also shall fail for at least the same reasons as I explained with respect to Park.

162. In addition, it is my opinion that Ground 5 does not cure any deficiencies in claim 1 with regard to Jun. It only addresses dependent claims. Therefore, it bears no relevance as to whether there is a reasonable likelihood for claim 1. This ground's failure however leads towards non-institution because of the numerosity of failed grounds.

163. Petitioner argues that a POSITA would have found it obvious to make ferrite magnet 122 an insulating material. In my opinion, this fails to cure the deficiencies of Park. Park fails because magnet 122, even assuming it is insulation material, is not "formed on two opposite surfaces of the bearing plate." Specifically, magnet 122 has the coil 140 and substrate 123 wrapped around it instead of being formed on the combination of substrate 123 and coil 140 as described in Ground 4 with respect to limitation [1b]. Park fails for at least that reason. It moreover fails considering the inductor itself as the bearing plate (which the Petition does in

element [1a]) because magnet 122 is a component of the inductor (and not its insulator).

164. Finally, it is my opinion that Ground 5 fails to present the requisite clarity required. The Petition simply cherry-picked random elements while making only high-level ties to specific claim language. For example, the Petition alleges that “additional insulating layers” are needed “to better insulate components *above and below* the module.” Petition at 66. However, the Petition does not even address whether Park discloses or suggests whether additional insulating material is needed on its *lateral* surfaces. Jun’s interconnection improvements in the form of connection bar 110 and 210 occurs *only on lateral sides*. Jun, ¶¶44-47, 52-55, FIGs. 10, 12g. I have annotated and reproduced FIGs. 10 and 12g below.

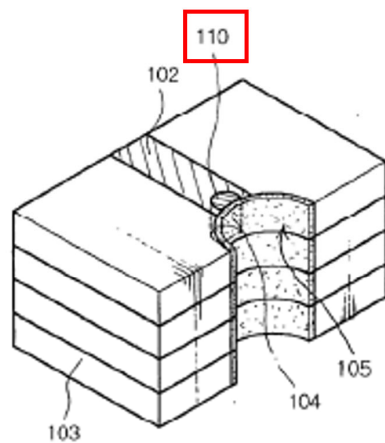


FIG. 10

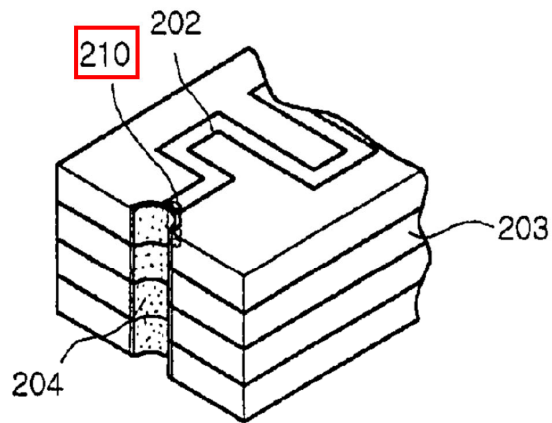


FIG. 12g

Annotated Figures 10 and 12g of Jun

165. The lack of clarity in Ground 5 is compounded by the lack of clarity in Ground 4, which Ground 5 inherits most of its arguments from. In my opinion, the Petition lacks a minimum clarity and does not meet a threshold of demonstrating that Ground 5 would be obvious from a POSITA's viewpoint.

166. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing in Ground 5. Should the Board institute, I reserve the right to supplement my opinion with more detail.

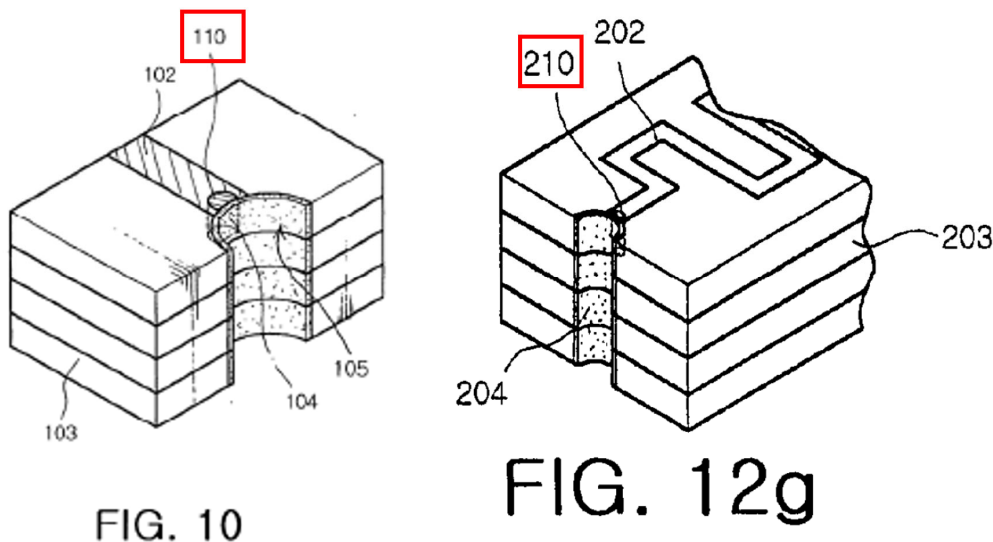
F. Ground 6 of the 706 IPR fails to present a reasonable likelihood of success

167. Ground 6 address independent claim 10, which recites substantively similar features as independent claim 1. The Petition relies on the same analysis of Park for Ground 4 (*see* Petition at 71), and in my opinion, its analysis fails for the same reasons described above with respect to each of limitations [1pre], [1a], [1b], [1c].

168. I note that like in Ground 5, the discussion in Ground 6 does appear to discuss the deficiency of limitation [1c], but its rationale on how limitations [1a] and [1b] are met at a level to understand limitation [1c] is too ambiguous and uncertain for me to address in this preliminary response. This is especially so when other limitations, such as bearing plate and insulation material, are plainly absent from or not disclosed by the applied references. Limitations [10pre], [10a], [10b], [10c] have

substantively similar limitations. Therefore, at least for the same reasons I explained with respect to Park, Ground 6 shall also fail.

169. Finally, similar to Ground 5, Ground 6 fails to present the requisite clarity required. The Petition is simply cherry-picking random elements, while making only high-level ties to specific claim language and providing back-referencing language. As I explained in §IX.E in Ground 5, the Petition alleges that “additional insulating layers” are needed in Park “to better insulate components *above and below* the module” but Jun’s interconnection improvements in the form of connection bar 110 and 210 occurs *only on lateral sides*. Jun, ¶¶44-47, 52-55, FIGs. 10, 12g. The lack of clarity here is compounded by the lack of clarity in Ground 4, which this ground inherits most of its arguments from. This is a threshold issue warranting denial of ground 6.



Annotated Figure 10 and 12g of Jun

170. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing in Ground 6 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

G. Ground 7 of the 706 IPR fails to present a reasonable likelihood of success

171. In Ground 7, the Petition relies on Park and Vinciarelli-218, and relies on Vinciarelli-218's discussion in Ground 1. For example, the Petition relies on at least the same arguments for limitations [1pre], [1a], and [1b] from Ground 1. Like Ground 1 where the Petition attempted to incorporate Zeng-014's pin scheme into Vinciarelli-218, Ground 7 relies on electrodes from Park in an attempt to cure the deficiency of Vinciarelli-218. In my opinion, the combination of Park and Vinciarelli-218 also fails for similar reasons.

172. Here, there is further no motivation to make the suggested combination. The Petition presumes that a POSITA would have been motivated, looking at Park, to apply entirely different connection structures than those discussed in Vinciarelli-218. The Petition's combination, however, does not lead to the result it seeks, and is motivated by hindsight. Park plainly teaches a component, (e.g., a capacitor 110/inductor 120) with separate electrodes. Vinciarelli-218, on the other hand, encapsulates all its components within the encapsulant materials. In a power converter example, the "electronic components may include power transistors,

control ICs, and discrete resistors and capacitors.” Vinciarelli-218, ¶¶82, 143, FIG. 27. These components are mounted on a board and encapsulated. *Id.* The Petition presents no reasonable motivation to take a **component** teaching to modify the device as disclosed in Vinciarelli-218.

173. A POSITA would not have been motivated to take a component-level teaching (of the inductor) and applied it to an entire device, and arrive at, for example, the claimed structure of stacked device. A POSITA would have known that component-level interconnection and device level interconnection differ greatly in scale and manufacturing challenges, as explained further below. Therefore, without any explanation, the Petition is applying impermissible hindsight bias.

174. Moreover, the formation of interconnects in Vinciarelli-218 and Park rely on entirely ***different manufacturing processes that are incompatible*** with each other given that one is a panel-molded power-converter assembly and another is a single component. A POSITA would not apply Park’s conductive pins to Vinciarelli-218, as I explain below.

175. Park teaches that its terminals are formed of printing a conductive paste material, including conductive metal. *Park*, ¶¶111-113. In Park, the paste must undergo a sintering or curing process to evaporate the solvent and harden the binder. As Park discloses, “inductor 120 is a laminated-type inductor” with its magnetic body manufactured by printing conductive patterns on magnetic green sheets,

laminating the magnetic green sheets, and “subsequently sintering the resultant structure.” *Park*, ¶¶94-95. Both these processes are *incompatible* with Vinciarelli-218, as I explain below.

176. Sintering is a high heat process (e.g., above 1000°C), and it would cause Vinciarelli-218’s device to fail. For example, Vinciarelli-218’ encapsulant could potentially melt. Its internal electronic devices such as “power transistors” and “control ICs” would not have survived those temperatures. Most certainly any solder connections within the Vinciarelli-218 device would melt because most solder melt above about 500°C. Therefore, a POSITA would not have exposed the Vinciarelli-218 device to high heat to attach pins because it would cause significant damage. Curing, on the other hand, is a lower temperature process. However, curing causes a significant amount of insulating material to remain in the joint between the device and connectors/conductors. A POSITA would have also known that non-conductive materials are added during the lamination process to enhance adhesion and to aide in curing, which could include rheology modifiers, surfactants, catalysts, or crosslinkers. A POSITA would not have added this process to Vinciarelli-218 because it would lessen conductivity as the non-conductive materials added to the electrical contacts would cause an increase in contact resistance (e.g., low conductivity). Vinciarelli-218 provides soldering metal to metal, which is a high conductive device or connection. As a result, a POSITA would not have modified or

substituted the device of Vinciarelli-218 with low conductive material when high conductivity is required because doing so would result in undesirable higher resistance.

177. Park also discloses that the pins can be formed via electroplating. As Park explained, “the input terminal 151, the output terminal 152, and the ground terminal 153 may be formed by dipping the ceramic body or by using any other method such as plating, or the like.” *Park*, ¶138. The plating technique in Park refers to electroplating, which requires dipping (i.e., submerging) the entire component into a plating bath to uniformly coat a layer of metal on exposed metal surfaces. The plating bath contains positive ions of the metal to be deposited, and metal will be deposited on all exposed surfaces. Plating is suitable for *smaller scale* components with a few surfaces that require metal deposition, such as Park’s inductor, because a larger device such as those described in Vinciarelli-218 contains many exposed metal surfaces where plating is not desired. Electroplating Vinciarelli-218 that have many exposed interconnects (e.g., interconnects 111, 112, 113) would require manually applying “stop-offs” on every metal surface where plating is not desired to prevent the bath from coming into contact with those metal surfaces. As the number of interconnects increase to a level such as those described in Vinciarelli-218 (*see* Vinciarelli-218 FIG. 10B, illustrating more than 20 total exposed interconnects 111, 112, and 113, including 11 visible interconnects and more on

opposing surfaces not depicted), it becomes uneconomical and/or infeasible to apply “stop-offs” to every single metal surface where plating is not desired. Therefore, a POSITA would not have been motivated, and in some cases not feasible, to apply electroplating in Vinciarelli-218.

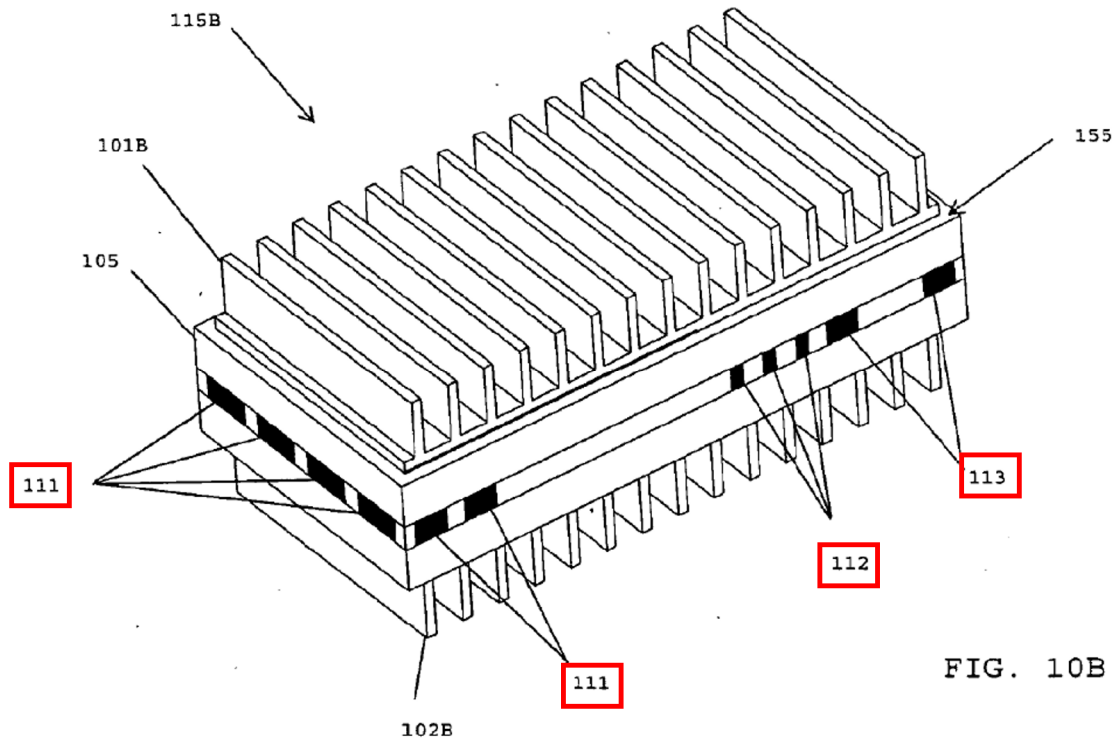


FIG. 10B

Annotated Figure 10B of Vinciarelli-218

178. Moreover, the Petition contends that a POSITA would have been motivated to modify Vinciarelli-218 to use Park’s electrodes with Vinciarelli-218 to form a stacked device. *See* Petition at 73-76. However, not all electronic components are suitable for being stacked for reasons such as package height constraints and poor heat dissipation. Indeed, Vinciarelli-218’s modules are restricted by these factors as directed to singulated module having heatsinks on its top and bottom and

a POSITA would not have been motivated to stack Vinciarelli-218's modules. Neither did the Petition nor Dr. Baker provide any reason to.

179. As I explained in §IX.A.2, Vinciarelli-218's embodiments dissuades a POSITA to make the Petition's proposed combination because Vinciarelli-218's modules require heat sink panels, such as flat heat sink surfaces, finned heat sinks, or pinned heat sink. *Vinciarelli-218*, ¶¶82-83, 87-105, 119-123, 128, 131-139, 153-157, FIGs. 1, 10, 12, 15-16, 17-26. Vinciarelli-218 states that “[i]n some applications it may be desirable to use the panel-molding process to produce components, such as power converters, without the flat heat sink surfaces.” *Vinciarelli-218*, ¶159. Because heat sinks add considerable thickness to the power converter (e.g., finned heat sink illustrated in FIG. 10A, reproduced below), one of those applications would be reducing the height of the internal components to accommodate encapsulating the power converter in a package having a height restriction.

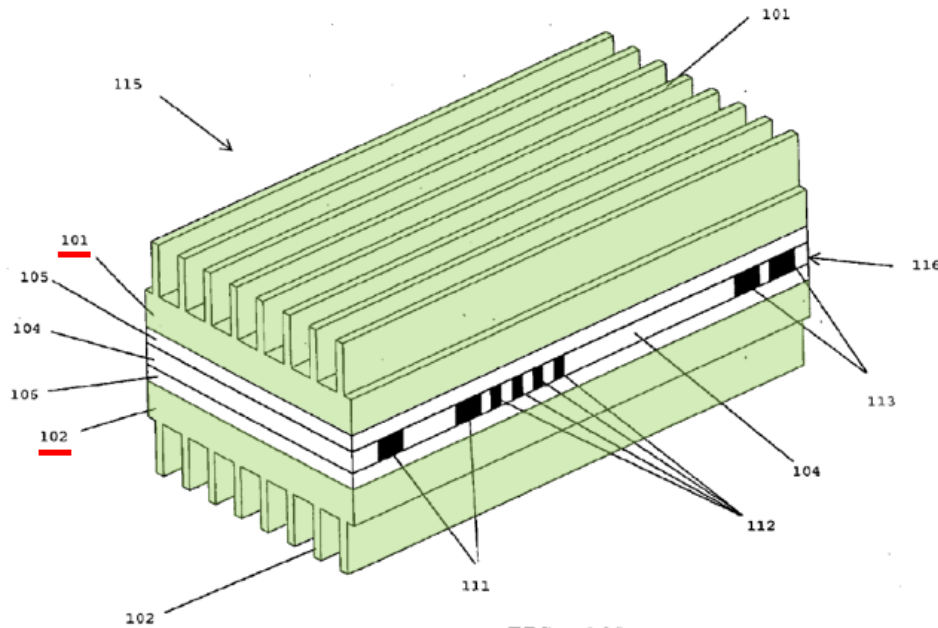


FIG. 10A

Annotated Figure 10A of Vinciarelli-218

180. The Petition's suggestion to stack the heatsink-less modules actually defeats its purpose for the proposed combination. Indeed, Vinciarelli-218 discloses that "[a]s internal components are reduced in height, *e.g.* reducing the thickness of the magnetic core, the depth of the interior cavity may be decreased bringing the heat sink panels closer together, reducing the encapsulant thickness and the resulting module thickness." *Vinciarelli-218*, ¶135. Nowhere does Vinciarelli-218 teach or suggest that its power converters can be stacked. The Petition has provided no reason why a POSITA would have been motivated to stack two or more heat-sinkless modules 815 and multiple the device height. Doing so would be in direct contradiction to the original purpose of reducing device height by removing the heat sink.

181. In addition, stacking singulated modules 815 would have exacerbated heat dissipation and a POSITA would not have been motivated to do so. Vinciarelli-218 does not state that its heat-sinkless singulated module 815 produces any less heat than the other modules in the heat-sink embodiments. Rather, removing the heat-sink from singulated module 815 makes it more susceptible to problems caused by poor heat dissipation. Stacking additional singulated modules 815 on the existing singulated module 815 would further block air flow (e.g., hot air will be trapped between opposing surfaces of two stacked modules), reduce thermal conductance, and exacerbate the heat dissipation problem, which in turn leads to poor device performance and even hazardous conditions. Therefore, for at least the above reasons, a POSITA would not have been motivated to stack Vinciarelli-218's singulated module 815.

182. On the other hand, making a stacking device is critical to the claims because they require that there be an SMD pad on both the bottom and top surfaces. '534 *Patent*, 21:28-29. If a POSITA had no motivation to make a stacked device (which it does not as described above), there would be ***no reason to add an SMD pad*** on both the top and bottom surfaces of Vinciarelli-218. Indeed, Vinciarelli-218's modules already have various types of heat sinks attached to its top and bottom surfaces that do not require any electrical connection. *See Vinciarelli-218*, ¶¶82-83, 87-105, 119-123, 128, 131-139, 153-157, FIGs. 1, 10, 12,

15-16, 17-26. Because connections to Vinciarelli-218's device is through its downward terminals, in my opinion, there is no reason to provide a connection point to the top of Vinciarelli-218's device.

183. In short, the Petition fails to demonstrate that a POSITA would have been prompted to combine the teachings of Vinciarelli-218 and Park to realize a device that achieved all of the features of independent claims 1 and 10. The Petition's disregard of fundamental differences between Vinciarelli-218 and Park's devices render Ground 7 fatally deficient.

184. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing in Ground 7 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

H. Ground 8 of the 706 IPR fails to present a reasonable likelihood of success

185. Ground 8 restates arguments presented in Ground 7, and in my opinion, fails for the same reasons. Therefore, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing in Ground 8 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

X. THE CHALLENGED CLAIMS IN THE 715 IPR ARE PATENTABLE

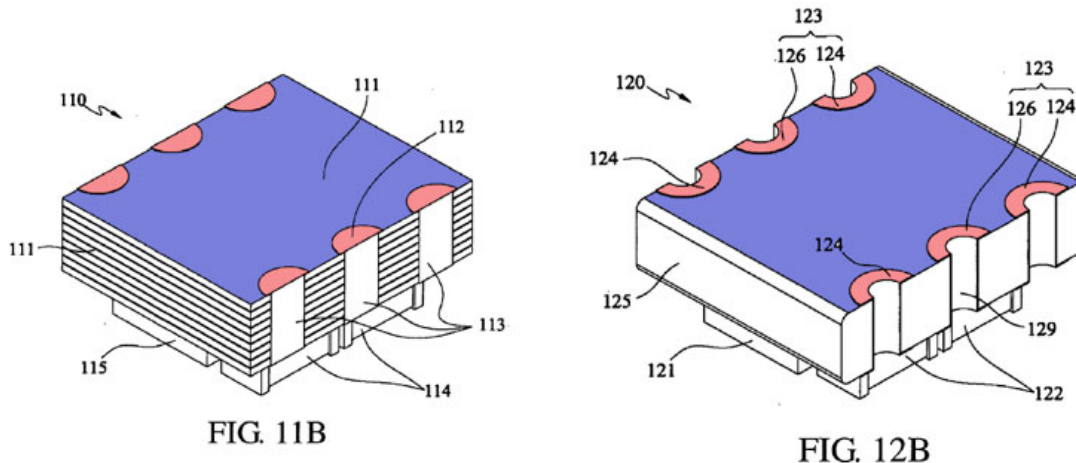
A. Ground 1 of the 715 IPR fails to present a reasonable likelihood of success

186. As described below, Petitioner fails to present a reasonable likelihood of success in its Vinciarelli-218 and Zeng-014 combination. Neither the Petition nor Dr. Baker provides any motivation to combine these references. First, there is no motivation to combine Vinciarelli-218 with any of Zeng-014's embodiments because the connections of Zeng-014's embodiments are *incompatible* with Vinciarelli-218's encapsulated device. Second, a POSITA would not have been motivated to modify Vinciarelli-218's encapsulated modules to become stacked modules. Third, a POSITA would not have been motivated to use Zeng-014's pin connectors instead of Vinciarelli-218's. Rather, a POSITA would have been motivated to use Vinciarelli-218's connectors instead. Finally, in my opinion, all of the Petition's motivations are superficial and ring hollow.

1. Petitioner's combination of Vinciarelli-218 and Zeng-014 does not result in limitations [13c] and [17c] being met

187. In my opinion, the Petition's combination of Vinciarelli-218 and Zeng-014 fails to meet at least the limitations of [13c] (and substantively similar [17c]) for the following reasons. I have annotated and reproduced FIGs. 11B and 12B of Zeng-014. As shown below, conductive layers 112 and 123 (shaded in red) do not extend over or onto a lower surface (shaded in purple) of the magnetic material substrate 111 and 125, respectively. Similarly, conductive layers do not extend over or onto a

top surface of the substrates. Therefore, the combination of Vinciarelli-218 and Zeng-014 cannot teach or suggest “the pin covers at least part of a lower surface, at least part of an upper surface of the insulation material the pin covers at least part of a lower surface, at least part of an upper surface” at the least, let alone to “at least part of a lower surface, at least part of an upper surface of the insulation material” (even if present). As such, both limitations [13c] and [17c] are not taught by the Petition’s combinations. Therefore, it is my opinion that Ground 1 fails to present a reasonable likelihood of success.



Annotated Figures 11B and 12B of Zeng-014

2. A POSITA would not have been motivated to stack modules in Vinciarelli-218

188. In my opinion, a POSITA would not have been motivated to make Vinciarelli-218 a stacked module.

189. The Petition contends that a POSITA would have been motivated to modify Vinciarelli-218 to use Zeng-014's connection scheme for "enabling additional electronic components to be stacked on." Petition at 16. However, as I explained in §IX.A with respect to Ground 1 of the 706 IPR, not all electronic components are suitable for being stacked for reasons such as package height constraints and poor heat dissipation. In short, Vinciarelli-218's modules are restricted by these factors as directed to singular module having heatsinks on its top and bottom and a POSITA would not have been motivated to stack electronic components on Vinciarelli-218's encapsulated power converter or module. My explanation in §IX.A applies here to Ground 1 of the 715 IPR because the Petition proffers the same reasoning in Ground 1 of the 706 IPR, namely, that a POSITA would have made Vinciarelli-218 a stacked module.

190. Therefore, for at least the above reasons and reasons I provided in above, it is my opinion that a POSITA would not have been motivated to stack Vinciarelli-218's singulated encapsulated modules.

3. A POSITA would not have been motivated to combine Vinciarelli-218 and Zeng-014's pins to arrive at limitations [13c] and [17c]

191. In my opinion, the Petition has not presented a viable motivation to combine Vinciarelli-218 and Zeng-014. The Petition relies on three separate

embodiments of Zeng-014 in attempts to arrive at limitation [13c]. Limitation [17c] recites substantively similar features. *See* Petition at 16.

192. It is my opinion that there is no motivation to combine using any of Zeng-014's embodiments because the connection of Zeng-014's embodiments are *incompatible* with Vinciarelli-218's encapsulated device. The Petition unreasonably proposes incorporating Zeng-014's teachings as an inferior alternative to solutions already discussed in Vinciarelli-218. In particular, it is my opinion that a POSITA would consider lead frame wrapping to be infeasible for contacting PCB side edge "bar codes," compared to Vinciarelli-218's adapters specially suited for that purpose. Moreover, several other embodiments of Zeng-014, such as embodiments illustrated in FIGs. 11A-G and 12A-D, bear zero resemblance to the claims. The Petition's attempt to recreate the claims of the '534 Patent uses the claims as a guide which is impermissible hindsight bias. In my opinion, no reasonable motivation for making the Petition's combination is presented in Zeng-014 (or Vinciarelli-218). I provide explanations regarding each of the embodiments the Petition relies upon (FIGs. 11, 12, and 4) in turn below.

a. Zeng-014's lead frame wrapping is not suitable for Vinciarelli-218's modules

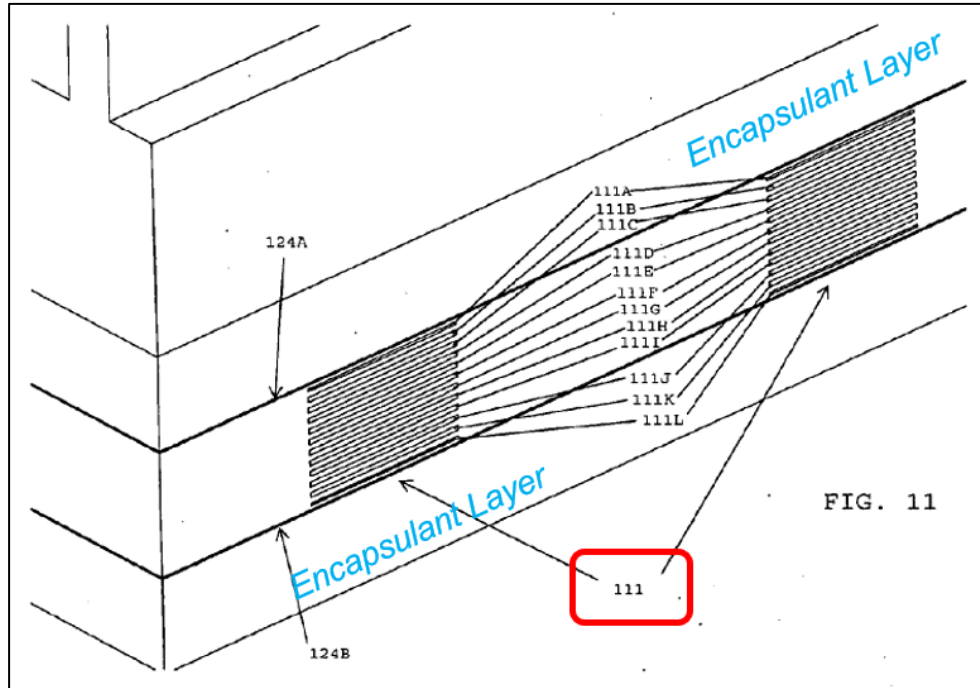
193. In my opinion, a POSITA would not have combined Vinciarelli-218 and Zeng-014 because Zeng-014 techniques are *incompatible* with Vinciarelli-218.

194. Vinciarelli-218 discloses a need to connect to interconnection features that are disposed on the side edges of its encapsulated module's PCB ("bar codes") and exposed through panel singulation. *See Vinciarelli-218*, ¶108. The idea of Vinciarelli-218's disclosure exists in a molding process that starts with a panel of un-singulated power converters, later singulated to produce many individual power converter modules. *See Vinciarelli-218* at Title ("PANEL-MOLDED ELECTRONIC ASSEMBLIES"), Abstract, ¶¶85-87 ("The panel molding process may be used to produce a multiplicity of modules at a time.").

195. Vinciarelli-218's molding process covers the top and bottom surfaces of the panel (and its modules) with encapsulant. For example, Vinciarelli-218 describes a mold cavity that "may be filled at least in part by an encapsulant encapsulating the surfaces of the PCB panel 124 and the electronic components on the PCB panel 124." *Vinciarelli-218*, ¶87. As a result of this molded encapsulant, the interconnection features for each individual module are necessarily located along the side edges of its PCB because these interconnection features "may be embedded in the PCB panel 124, preferably *along the boundaries* of the individual circuits" and are exposed on the *PCB side edges* when a module is singulated from the panel. *Id.*, ¶107.

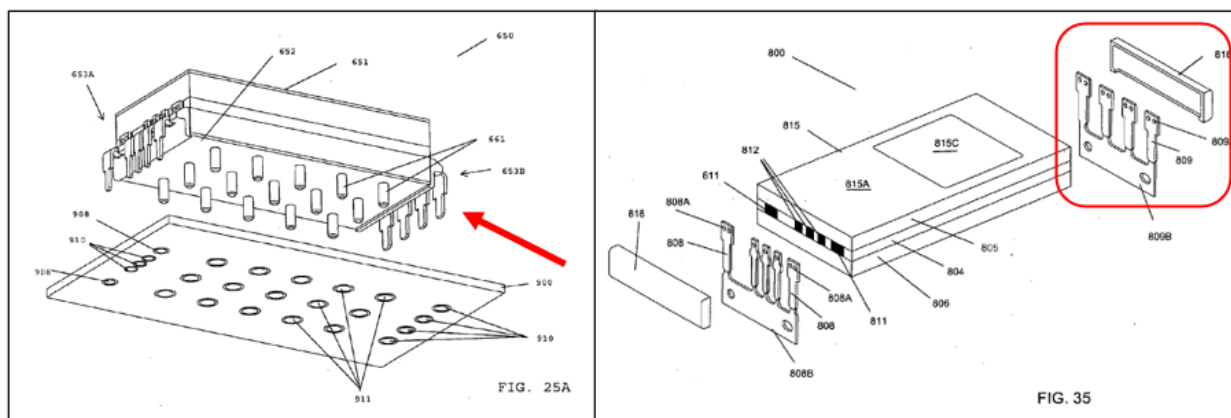
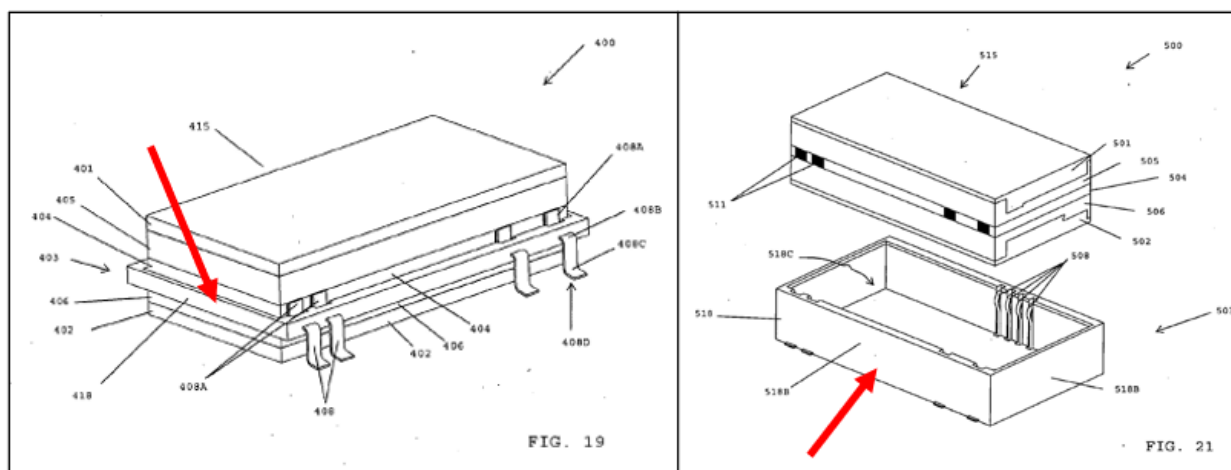
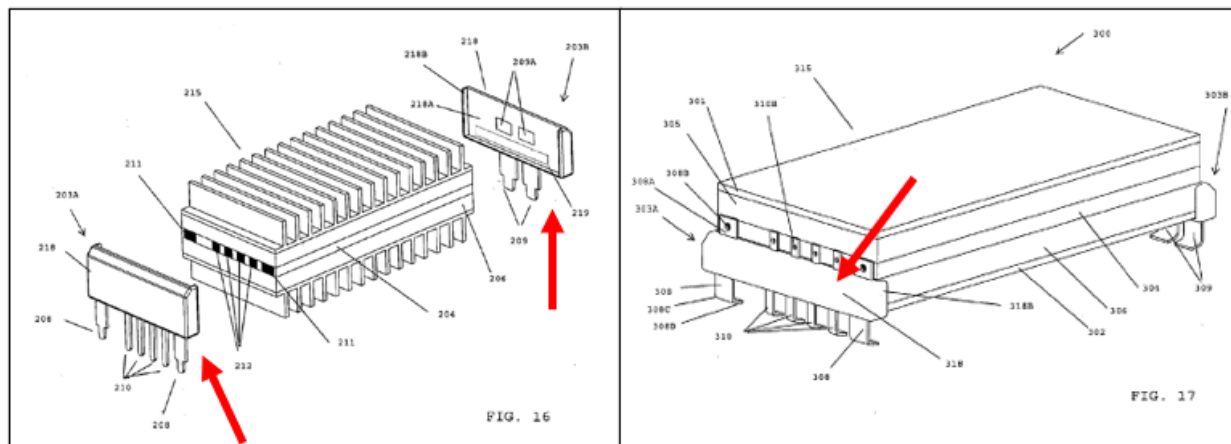
196. Specifically, these interconnection features are described as "bar codes", with multiple conductive strips arranged vertically along the edge of the

PCB. *Id.*, ¶108. This feature is depicted in annotated FIG. 11 of Vinciarelli-218 reproduced below.



Annotated Figure 11 of Vinciarelli-218

197. Vinciarelli-218 provides solutions to the need to connect to the bar codes’ small footprint. For example, Vinciarelli-218 provides “various types of connectors or adapters [that] may be coupled to the exposed interconnects . . . at the edges of the singulated module.” *See* Vinciarelli-218, ¶160; *see also id.* at ¶¶112-133, FIGs. 13-26, 35 (selectively reproduced below).



Annotated Figures of Vinciarelli-218

198. Specifically, the Horizontal Through-Hole Mount adapter shown in FIG. 16 reproduced above includes “exposed areas [of two power terminals that] align with their respective interconnects when the adapters 203A, 203B are assembled onto the module 215.” *Id.*, ¶116. As another example, the Surface-Mount Lead Frame includes a frame body that “leave[s] a portion of the terminals exposed for making connections to their interconnects during assembly and for post assembly inspection.” *Id.*, ¶124. With respect to the heat-sink-less embodiments that are depicted in Figs. 33-35 of Vinciarelli-218, adapters 803A, 803B are attached to the horizontal ends of the module where the bar codes are exposed. *Id.*, ¶¶158-160, FIGs. 33-35 (reproduced below).

199. Vinciarelli-218 discloses that one of these adapter units can be assembled forming an adapter body to terminals provided on a lead frame, which is removed after assembly. Specifically, Vinciarelli-218 discloses that “***the terminal portions 808 may be coupled to a lead frame 808B*** as shown in FIGs. 35 and 36 forming a unitary unit for ease of assembly. The interconnect portions 808A may be soldered to the exposed interconnects 811, 812 in the manner described above, and protective caps 818 may be attached, e.g., with epoxy, covering the interconnect portions 808A, to provide structural integrity, and exposing only the terminals 808. ***The lead frame 808B may be separated*** from the terminals 808 after the terminals are attached to the exposed contacts.” *Id.*

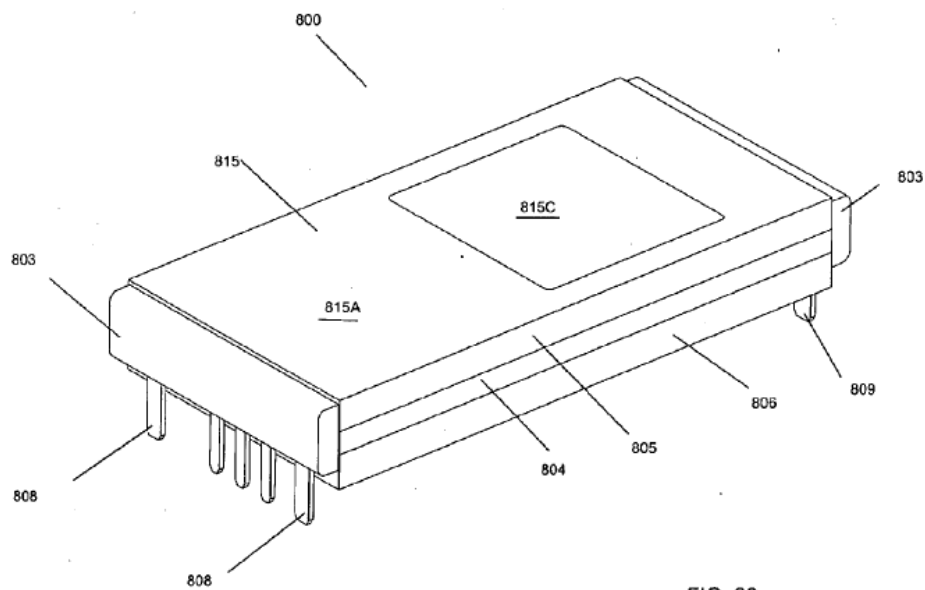


FIG. 33

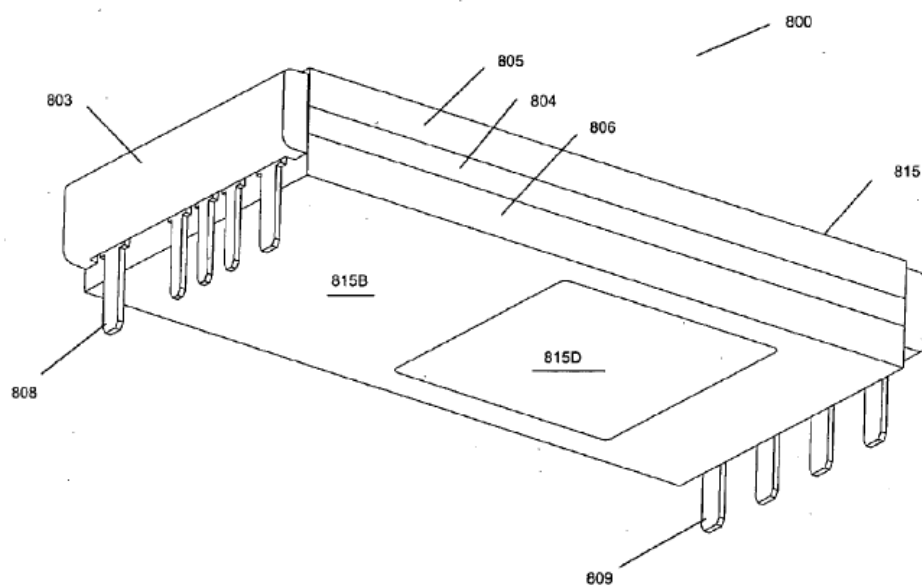


FIG. 34

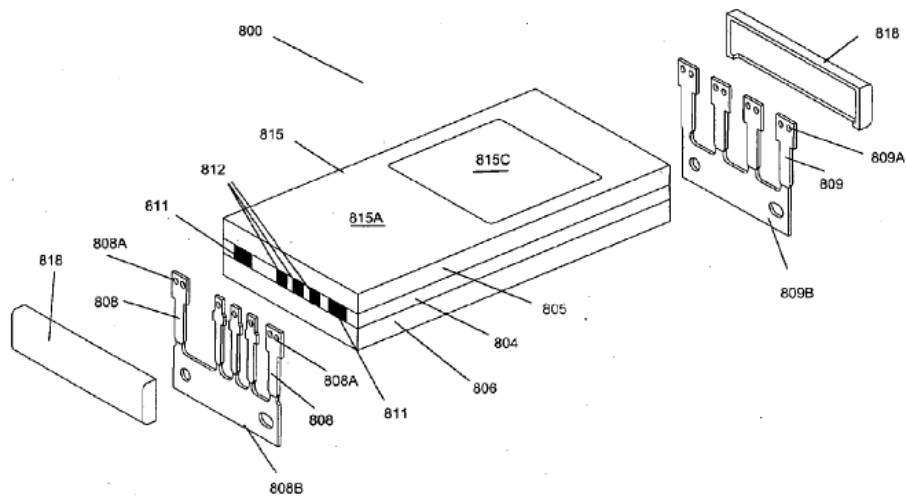


FIG. 35

Figures 33-35 of Vinciarelli-218

200. In my opinion, a POSITA would readily appreciate that the wide variety of these adapters (e.g., “for using the modules in vertical or horizontal mounting positions in connector, through-hole, surface-mount solder variations” are well-suited for providing electrical contact to the small bar codes, while also providing versatility to different customer needs. *See, e.g., id.*, Abstract, ¶¶111, 132.

201. Importantly, the POSITA would also have their concerns regarding the usability of the small bar codes, introduced in the first portion of Vinciarelli-218, assuaged by these adapter solutions, disclosed in the second portion of Vinciarelli-218. For example, as shown in FIG. 35 reproduced above, each interconnect portion 808A are precisely aligned with each of the exposed interconnects 811 and 812,

forming reliable electrical connection once the adaptors are attached to singulated module 815.

202. Given this, Petitioner's argument that Zeng-014's lead frame wrapping should be incorporated into Vinciarelli-218 to electrically connect to the bar codes is unreasonable.

203. Specifically, the Petition's imagined combination is based upon "applying Zeng-014's lead frame to the module of Vinciarelli-218 and ***curving the contacts against the module*** such that the modules form a unitary structure with contact surfaces on the top, bottom, and sides of the module, as taught by Zeng-014." Petition at 73 (emphasis added). The Petition further explains that "the lead frame in Zeng-014 . . . would be ***curved over module 800 from the bottom to the top***" to replace Vinciarelli-218's adapters. Petition at 73-74. The Petition attempts to justify this imagined combination based upon Vinciarelli-218's general disclosure of press-fit and flush-mount adapters. *See id.* at 71-72. Petitioner then concludes that this exercise would be "a simple mechanical modification." *Id.* at 74.

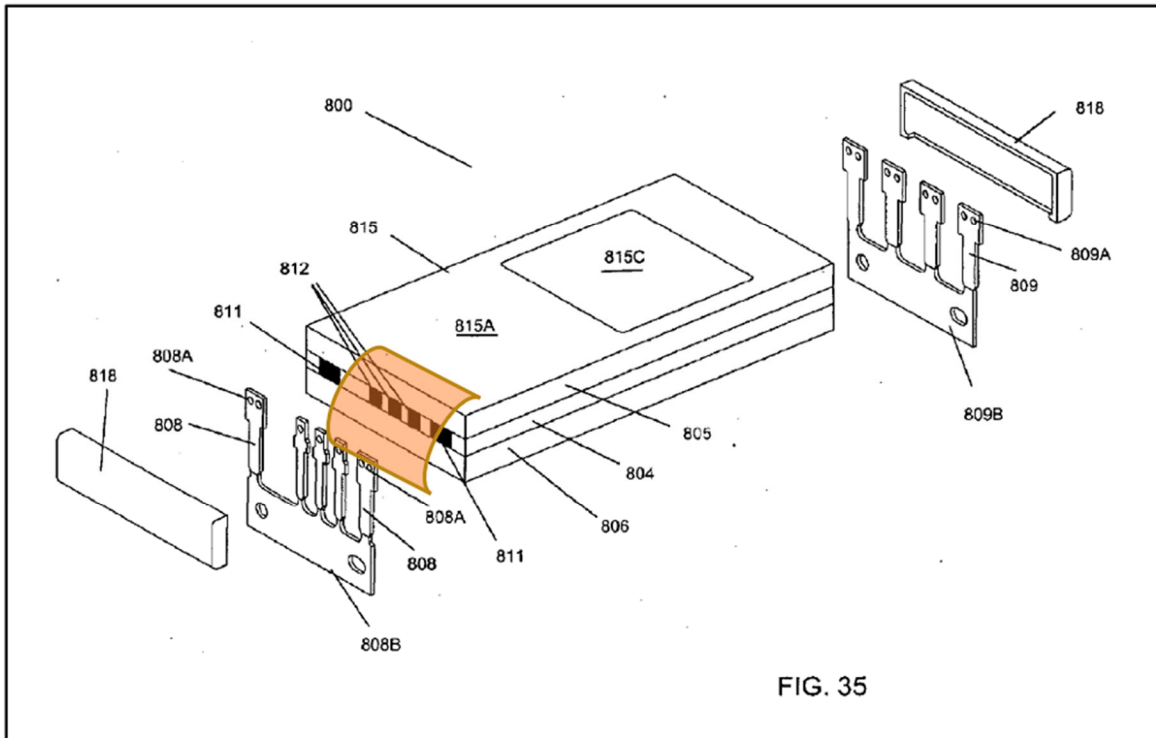
204. I disagree and as I further explain below, Zeng-014's lead frame wrapping is inferior to these adapters, causing additional contact problems that they do not. To the contrary of the Petition's allegations, a reasonable POSITA would immediately recognize that curving and wrapping a lead frame like Zeng-014 would

fail to reliably establish and maintain electrical contact with the PCB side edge bar codes of Vinciarelli-218, as I explain below.

205. A reasonable POSITA would immediately recognize that curving and wrapping a lead frame would fail to reliably establish and maintain electrical contact with the PCB side edge bar codes of Vinciarelli-218, for at least the following two reasons.

206. First, when curving and wrapping a lead frame around Vinciarelli-218's module's side surface, the lead frame would retain a degree of bow and bend, never perfectly flush, due to the natural mechanical resistance when metal is being deformed. According to basic physics principles of forces, a POSITA would immediately have understood that the most bend or bowing in the contact of Vinciarelli-218 would occur at the middle region of the lead frame, which is close to where the exposed interconnects 811 and 812 ("bar codes") are located. From this bowing and bending, there would be a sizable gap between the lead frame contact and the side edge bar codes of Vinciarelli-218. This gap causes faulty electrical connections because electrical connections require direct metal-to-metal contact.

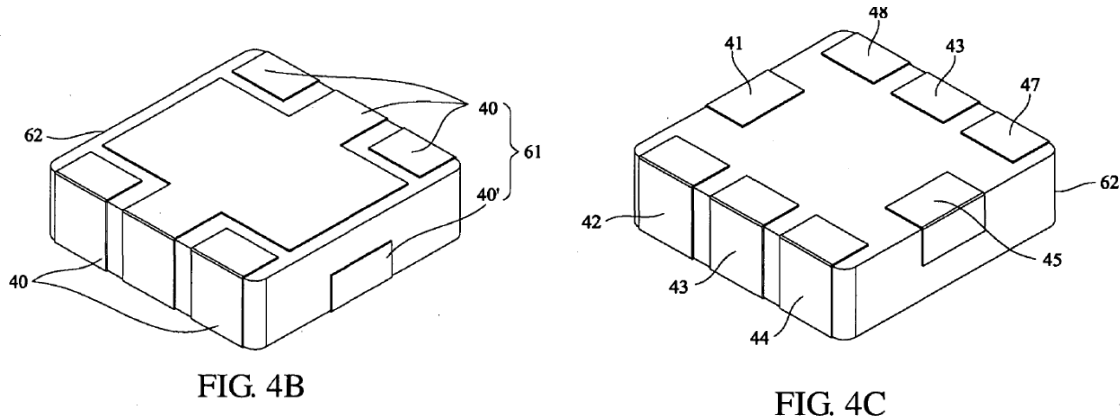
207. Therefore, a POSITA would have recognized that lead frame wrapping is not well-suited for Vinciarelli-218's exposed interconnects that are formed on the sides of the singulated module 815.



Annotated Figure 35 of Vinciarelli-218

208. Second, curving and wrapping a lead frame like Zeng-014 would also lead to yield issues due to the dimension differences between Vinciarelli-218's exposed interconnects. A POSITA would have known that narrower metal sheets are easier to bend than wider metal sheets, simply because less material needs to be deformed for the narrower metal sheets. When bending metal sheets with different widths, the same exerted force could have fully deformed the narrower metal sheets whereas the wider metal sheets are likely not fully deformed. This won't be an issue for Zeng-014, because its contacts 40-48 depicted in the FIGs. 4B and 4C below are

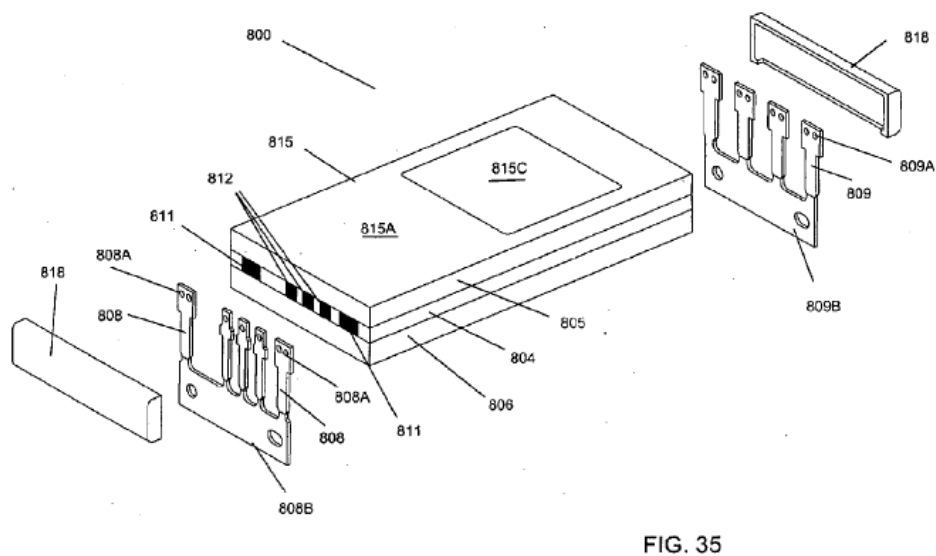
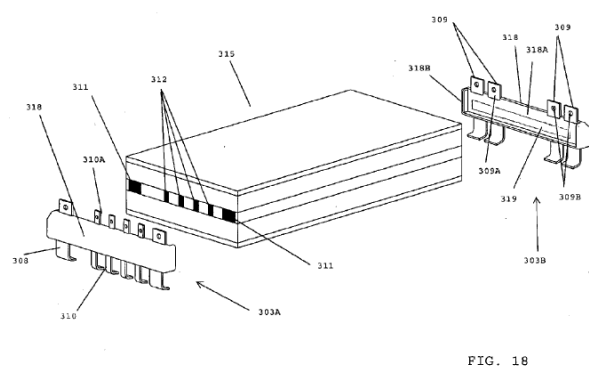
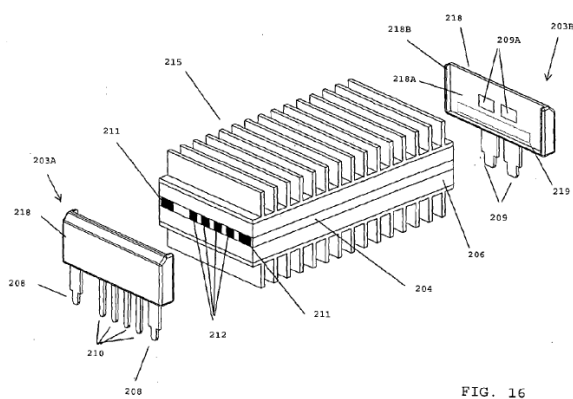
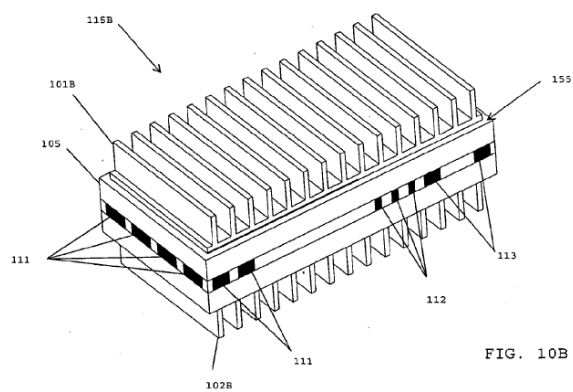
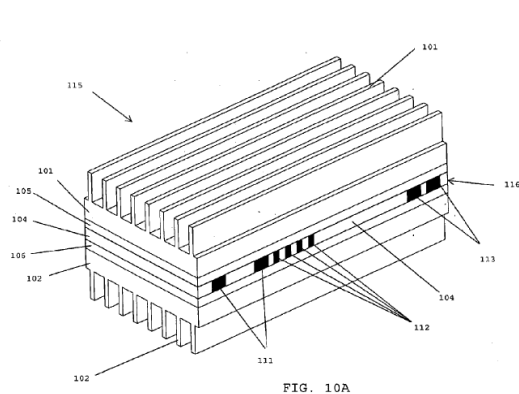
formed using the same lead frame material and share similar widths, and therefore would experience similar deformation progress.



Figures 4B and 4C of Zeng-014

209. However, this would be an issue for Vinciarelli-218, because as shown in FIGs. 10A, 10B, 16, 18, and 35 reproduced below, the exposed interconnects have different widths. Applying the process of curving and wrapping a lead frame like Zeng-014 in Vinciarelli-218 would have caused yield issues in Vinciarelli-218's device because of the different degrees of formation between conductors of different widths, resulting in yield issues.

210. A POSITA also wouldn't have used contacts having uniform widths for Vinciarelli-218's exposed interconnects because a narrow contact for the wider exposed interconnect would result in increased contact resistance while a wide contact for the narrower exposed interconnect would risk shorting between adjacent interconnects.



Figures 10A, 10B, 16, 18, and 35 of Vinciarelli-218

211. In contrast, Vinciarelli-218's own adapters/connectors do not suffer from such bowing and yield issues as Zeng-014's lead frame wrapping would, because Vinciarelli-218's interconnect portions 808A do not rely on wrapping and deforming to establish electrical contact with exposed interconnects 811 and 812.

212. None of Vinciarelli-218's adapter/connectors rely upon wrapping, curving, or bending, and can be directly applied onto the side edge bar codes. Rather, as shown in FIG. 35 above, adapter 803 (803A, 803B) having terminal portions 808 formed from a lead frame are *directly attached or pressed* to a heat-sink-less module's side edge bar codes. Vinciarelli-218, ¶160, FIG. 35.

213. Specifically, Vinciarelli-218 discloses that “adapters 803 having terminal portions 808 and interconnect portions 808A may be formed for example by a precision metal stamping process. Initially, the terminal portions 808 may be coupled to a lead frame 808B as shown in FIGs. 35 and 36 forming a unitary unit for ease of assembly.” *Id.* Therefore, by being attachable directly at the location of side edge bar codes, Vinciarelli-218's own adapters/connectors are superior in establishing and maintaining electrical connection due to their reliable electrical contact, high yield, and precision alignment.

b. Zeng-014's Figs. 11 and 12 embodiments bear no resemblance to the claims and provide no motivation

214. Furthermore, in my opinion, the Petition's reliance on Zeng-014's FIGs. 11 and 12 embodiments fails because they bear no resemblance to the claims,

and even if motivation were assumed to exist (which it does not) they do not arrive at the claims, as I explain below.

215. Claim limitation [13c] require that the pin is “electrically connected to the bearing plate” and also covers “at least part of two lateral sides of the bearing plate.”

216. In attempts to arrive at the claimed configuration, Petitioner takes Vinciarelli-218’s device and applies Zeng-014’s conductors from FIGs. 4A-4D and 11-12. *See* Petition at 16. However, as I explain below, neither embodiments described in these figures of Zeng-014 meet all of limitation [13c].

217. The relied-upon embodiment of Vinciarelli-218 depicted in FIG. 35 is a device having encapsulant (shaded yellow) surrounding a layer 804 (shaded green) along with a singulated module 815. *See* Vinciarelli-218, ¶¶159-160. Vinciarelli-218 provides exposed interconnects 811 and 812 that interconnect portions 808A are connected to. *Id.* As can be seen from the below, the pins do not cover “at least part of two lateral sides of the bearing plate” as required by [13c].

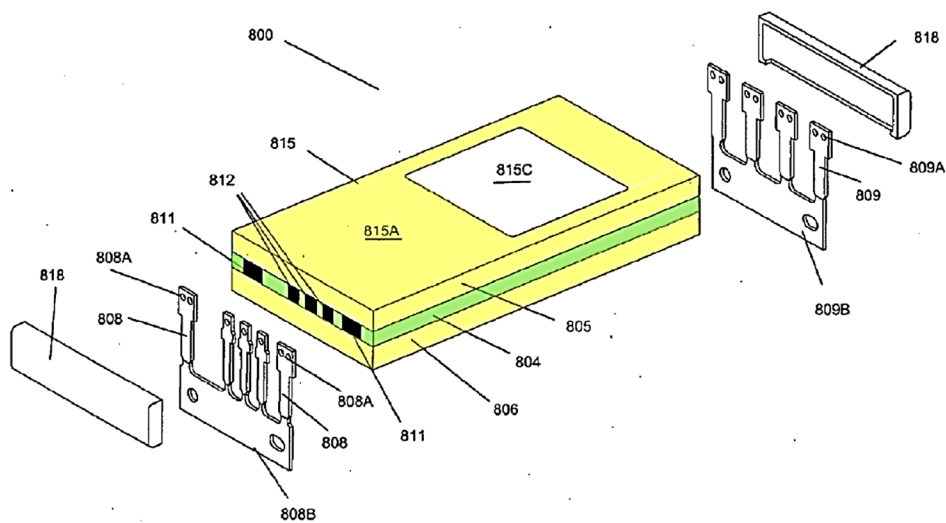


FIG. 35

Annotated Figure 35 of Vinciarelli-218

218. Another view of FIG. 35 is shown in FIG. 34 below. As can be seen in the figure, interconnect portions 808A are attached to the side of the layer 804 (green) and extend downwards for connection, and do not extend to any other sidewalls of singulated module 815.

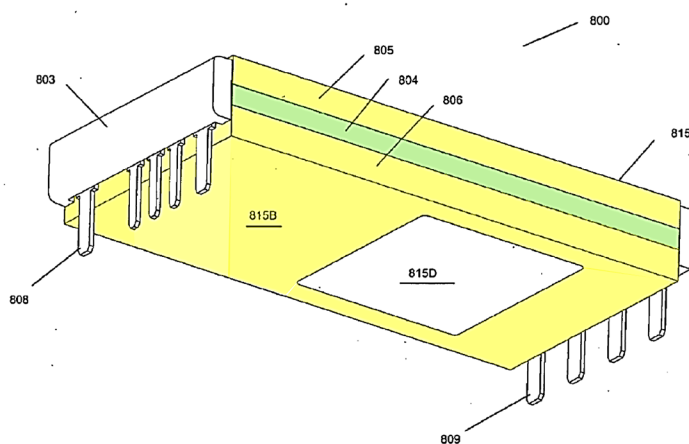


FIG. 34

Annotated Figure 34 of Vinciarelli-218

219. The Petition acknowledges that Vinciarelli-218's pin-structure is different than the claimed configuration, and to cure Vinciarelli-218's deficiency, the Petition takes Zeng-014's pin structure teachings. *See* Petition at 18-19.

220. However, Zeng-014's embodiment of FIGs. 11-12 fails to disclose the pin covering "at least part of two lateral sides of the bearing plate." Based on my review of Zeng-014, there is no disclosure in Zeng-014 that teaches or suggests embodiments in FIGs. 4A-4D and FIGs. 11-12 are interchangeable or combinable. In fact, the embodiments described in FIGs. 4A-4D and 11-12 are formed using totally different fabrication methods, shown below.

221. Pins depicted in FIGs. 4A-4D of Zeng-014 are formed by wrapping and compressing the lead frame, as shown in FIGs. 5A and 5B. *Zeng-014*, ¶¶62-64. Figs. 5A and 5B are reproduced below to illustrate frame 51, conductive layer 61, and inductive component 62. Specifically, Zeng-014 discloses that "the first conductive layer 61 of the frame 51 is adhered to the first surface of the inductive component 62 through a kind of the adhesive e.g. a thermosetting adhesive." *Zeng-014*, ¶63. Zeng-014 also discloses that the wrapped body is covered by an insulating material. *See Zeng-014*, ¶75 ("an insulation material layer is applied to each of the top surface and the bottom surfaces of the completed inductor").

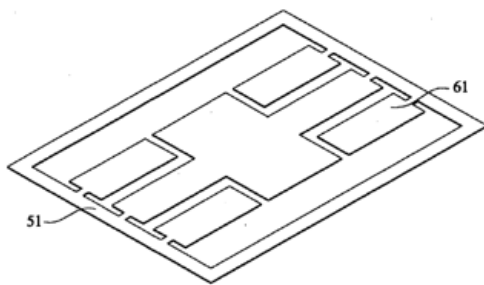


FIG. 5A

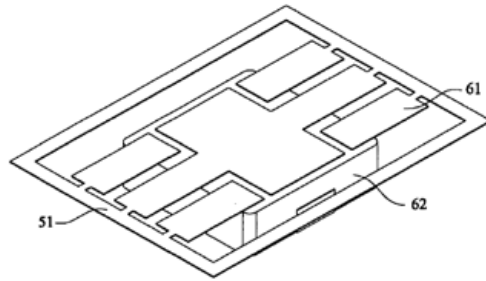
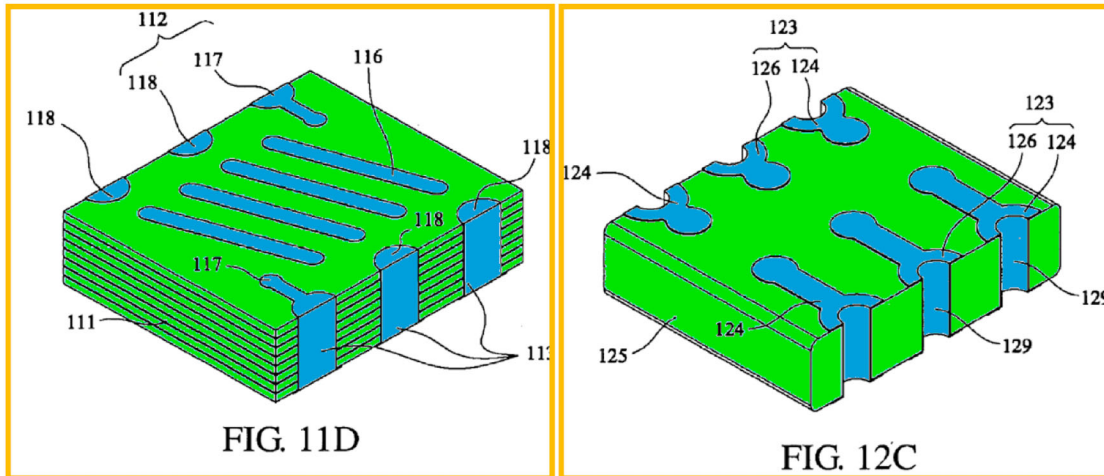


FIG. 5B

Figures 5A and 5B of Zeng-014

222. On the other hand, Zeng-014's embodiments in Figs. 11-12 teach inductors (within orange boxes) that have magnetic substrates 111 forming a magnetic material substrate 125 (both shown in green in FIG. 11D and 12C below). Therefore, conductors 113 and 129 depicted in FIGs. 11-12 of Zeng-014 are formed in a multi-layer substrate where the conductor is pre-formed or pre-fabricated on each layer of the substrate (below, left) or by drilling holes directly into the component itself and filling the holes with conductive material (below, right). *See Zeng-014*, ¶¶73-78, FIGs. 11-12.

223. As can be seen from below, conductors 113 and 129 are formed on only one side of substrates 111 or 125, and cannot teach covering “at least part of two lateral sides of the bearing plate” as required by limitation [13c].



Annotated Figures 11D and 12C of Zeng-014

224. Petitioner takes these teachings and argues that a POSITA would have arrived at the claimed pin structure by “have a plurality of pins as disclosed in Vinciarelli-218 ... and Zeng-014 (VICOR-1007, FIGs. 4A-D, 11A-G, 12A-D).” Petition at 16. Petitioner’s combination would result in pins being connected to only a singular side of the layer, which is not what is claimed by limitation [13c]. As limitation [13c] also recites, “the pin covers at least part of a lower surface, at least part of an upper surface of the insulation material.” Zeng-014 fails to teach or suggest this feature. Zeng-014’s pins 117 and 118 are formed “at two opposite sides of each magnetic material layer, and are filled with a metal material...to form the connecting conductive elements 119 and pins 117, 118 of the inductance coil 116.” *Zeng-014*, ¶74. Magnetic material substrates 111 with pre-formed conductors 113 and pins 117 and 118 are “laminated together to form the inductance coil 116.” *Id.* A POSITA

would have understood that the top and bottom surfaces of pins 117, 118, and each layer of conductors 113 are *coplanar* with top and bottom surfaces of their respective magnetic material substrate 111, because pins 117, 118, or conductors 113 protruding from top and bottom surfaces of magnetic material substrate 111 would cause gaps between the substrates during lamination which in turn leads to mechanical failure. Therefore, after lamination, bottom surfaces of pins 117, 118, and stack of conductors 113 are *coplanar* with bottom surfaces of substrate 111. In other words, bottom surfaces of the conductors and substrate 111 are on the same plane. As such, there is no disclosure or motivation in Zeng-014 that teaches [13c].

225. Therefore, it is my opinion that Zeng-014's FIGs. 4A-4D, 11-12 do not disclose the required limitation or motivation to arrive at [13c]. Limitation [17c] recite substantively similar features and the Petition's argument fail for similar reasons.

4. A POSITA would not have been motivated to combine Zeng-014 and Vinciarelli-218

226. The Petition takes Vinciarelli-218's encapsulated embodiment and states that a POSITA would have placed conductors atop it. *See* Petition at 19-24. In my opinion, the Petition provided no valid motivation, and attempts to hide this through a long-enumerated list of motivations. Each of the motivations purported by the Petition fall short and rely on hindsight bias.

227. The Petition's first reason rings hollow because the purported motivation actually increases overall size of the device. The Petition argues that variants exist, and a POSITA would have been motivated to decrease the mounting area on a motherboard. *See* Petition at 20. In my opinion, references teaching that there-exist variants does not present a motivation to modify certain embodiments with features of others. To state that it does, renders the requirement for a motivation superfluous because all patents are not limited to their disclosed embodiments. Importantly, the Petition does not even appropriately analyze the sizing requirements when arguing the alleged footprint savings. To the contrary, however, the purported combination would lead to devices that are increased in size. For example, placing lead frames atop (and below) Vinciarelli-218's embodiment **increases** size, not decreases it because the frames' thickness would contribute to the overall thickness of the device. Moreover, the only reason to have conductors on at least the top surface of the device is to allow stacked modules because according to Vinciarelli-218, electrical connections to the underlying motherboard are already formed through adapter connection such as adapters 803. *See Vinciarelli-218*, ¶¶84, 111, 115, 119-123, 139, 159. With the purported frames attached on the top and bottom surfaces of each singulated module, the stacked modules (i.e., one Vinciarelli-218 module on top of another) as suggested by the Petition also increases overall vertical

size. Therefore, in my opinion, the Petition's first reason for combination rings hollow.

228. The Petition's **second** reason is self-contradictory. Petitioner states that its combination provides space savings but at the same time argues for stacking. In particular, the Petition argued that "board space can be saved by using Zeng-014's connecting and the pin" to stack "external components on the component using the surface conductors." Petition at 20. However, as I explained in §IX.A.2, the embodiments relied upon by the Petition is "heat-sinkless module 815" where the heatsink is removed precisely due to height restrictions. *See Vinciarelli-218*, ¶¶84, 162. A POSITA would not have been motivated to stack Vinciarelli-218's modules because of the height restrictions. Therefore, in my opinion, stacking components conflicts with the immediately preceding motivation of decreasing height.

229. The Petition's **third** reason that the connection part provides flush mounting lacks evidentiary support. Without pointing to any support in Vinciarelli-218, the Petition argues that "flush surface mount [is] desirable in Vinciarelli-218." *See* Petition at 20. Dr. Baker's declaration parrots the Petition's statement without providing any further explanation. In fact, Vinciarelli-218 protruding connections, such as interconnect portions 808A used with singulated module 815, provide the benefit of being "mechanically and electrically connected to the interconnects on the singulated modules forming an integral modular component." *Vinciarelli-218*, ¶127.

In addition, including a conductor atop (and below) Vinciarelli-218's encapsulated device increases size and makes the device less flush.

230. The Petition's *fourth* reason is simply a broad-stroke statement that a POSITA would have been combined Vinciarelli-218 and Zeng-014 because Zeng-014 generally states its technology can be applied to other electronic components. Petition at 20. However, Zeng-014 and Vinciarelli-218 involve technologies applied at totally different scale levels. Specifically, Zeng-014's connectors are applied at a component level (e.g., a discrete component with only a single inductor) while Vinciarelli-218's modules are at a packaging level (e.g., a device including transistors, ICs, discrete passive components such as inductors, resistors, and capacitors). For example, Zeng-014's inductive component 62 includes only a single inductor, and as a discrete component, is mounted on a circuit board 63 which is in turn mounted on an even larger circuit board 69. *See Zeng-014*, ¶66, FIGs. 6A-6C. Vinciarelli-218's module, on the other hand, is at a much larger scale because it includes "power transistors, control ICs, and discrete resistors and capacitors." *Vinciarelli-218*, ¶82. Therefore, in my opinion, an overly broad statement like this does not mean that Zeng-014's teachings can simply be combined with anything.

231. The Petition's *fifth* reason which refers to increased power density and decreasing area is very generic and hallow. The Petition provides no reason *why* its combination achieves this. Although the Petition appeal to space savings, it fails to

provide any reason why a position would have made a device that **increases** vertical footprint through extra lead-frames atop and on the bottom of the structure, and made the device used in stacking.

232. Petitioner does not answer the question regarding **why** a POSITA would modify Vinciarelli-218 to add conductors atop it. Doing so goes against Vinciarelli-218's other teachings. Vinciarelli-218 describes making its devices compatible with heat dissipation through attaching various types of heat sinks (such as flat heat sink surfaces, finned heat sinks, or pinned heat sink). *Vinciarelli-218*, ¶¶82-83, 87-105, 119-123, 128, 131-139, 153-157, FIGs. 1, 10, 12, 15-16, 17-26. Vinciarelli-218 does have a singular embodiment lacking a heatsink (*Vinciarelli-218*, ¶159-160; FIGs. 33-35) but a POSITA would not have read it outside of the context of the rest of the patent which is directed to heat dissipation because Vinciarelli-218 does not disclose or suggest that its heat-sinkless module generate any less heat than the other embodiments having a heatsink. As such, a POSITA would not view an embodiment of Vinciarelli-218 lacking a heatsink as being one that does not need heat dissipation. In fact, one of the reasons to remove the heatsinks is to accommodate a height restriction. *See Vinciarelli-218*, ¶84, 159. Every other embodiments are directed to heat dissipation and making one of those devices stackable via conductors on top, would lead to poor heat dissipation. As I explained in §IX.A.2, heat would get

trapped on the lower devices because of the lack of airflow. A POSITA would not have made that combination.

233. Therefore, every single one of Petitioner's motivations rings hollow. In my opinion, there is no valid reason for *why* a POSITA would have made the combination has been presented.

234. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Ground 1 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

B. Ground 2 of the 715 IPR: Petitioner failed to establish a reasonable likelihood that Park anticipates claims 13-15, 17, and 19

235. Park fails to anticipate several claim limitations, as described below.

1. Park fails to teach limitations [13pre] and [17pre], “a power supply apparatus”

236. In my opinion, the Petition has failed to show that Park teaches a power supply apparatus.

237. The Petition points to FIG. 1 of Park and contends that composite electronic component 100 that is a combined inductor 120 (red) and capacitor 110 (blue) to satisfy limitation [13pre]. *See* Petition at 32. However, as I explained in §IX.D.1 with respect to Ground 1 of the 706 IPR, inductors and capacitors alone are not a power supply apparatus. The Petition fails to identify any PMIC as satisfying

the claims, and only identified the inductor/capacitor pair. My explanation in §IX.D.1 applies here to Ground 2 of the 715 IPR because limitations [1pre], [10pre], [13pre], and [17pre] are identical and that the Petition proffers the same reasoning in Ground 1 of the 706 IPR, namely, that Park teaches a power supply apparatus.

238. Therefore, for at least the above reasons and reasons I provided in §IX.D.1, it is my opinion that Park fails to disclose a power apparatus.

2. Park fails to teach limitations [13a] and [17a], “a bearing plate”

239. In my opinion, the Petition has failed to show that Park teaches a bearing plate.

240. The Petition presents several alternatives for satisfying this element: (1) inductor 120; (2) the combination of substrate 123 and coil 140; and (3) substrate 123. *See* Petition at 33-35. As I explained in §IX.D.2 of Ground 4 of the 706 IPR, each of these alternatives fail.

241. My explanation in §IX.D.2 of the 706 IPR applies here to Ground 2 of the 715 IPR because limitations [1a], [10a], [13a], and [17a] are identical and that the Petition proffers the same reasoning in Ground 4 of the 706 IPR, namely, that Park teaches a bearing plate.

242. Therefore, for at least the above reasons and reasons I provided in §IX.D.2, it is my opinion that Park fails to disclose a bearing plate.

3. Park fails to teach limitation [13b] and [17b], “insulation material formed on two opposite surfaces of the bearing plate”

243. In my opinion, the Petition has failed to show that Park teaches this limitation.

244. My explanation in §IX.D.3 of the 706 IPR applies here to Ground 2 of the 715 IPR because limitations [1b], [10b], [13b], and [17b] are identical and that the Petition proffers the same reasoning in Ground 4 of the 706 IPR, namely, that Park teaches an insulation material that is formed on two opposite surfaces of the bearing plate.

245. Therefore, for at least the reasons I provided in §IX.D.3, it is my opinion that Park fails to disclose a bearing plate.

4. Park fails to teach [13c] and [17c]

246. As I explained in my analysis regarding limitation [13a], the Petition presents the substrate 123 as the bearing plate. However, in my opinion, this reading does not comport with the requirements of [13c] / [17c]. [13c] / [17c] which requires that “a plurality of pins electrically connected to the bearing plate.” Park discloses that substrate 123 is “insulating.” *Park*, ¶86. A POSITA would have understood that pins cannot electrically connect to an insulator. In other words, it is useless to connect a pin to an insulator because an insulator, by its definition, does not conduct

electricity. Therefore, it is my opinion that the Petition's read involving substrate 123 fails.

247. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Ground 2 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

C. Ground 3 of the 715 IPR fails to present a reasonable likelihood of success

248. In my opinion, the Petition has failed to address any of the deficiencies addressed above with respect to each of [13pre], [13a], [13b]. The Petition does appear to discuss the deficiency of [13c], but in my opinion, its rationale on how [13a] and [13b] are met at a level to understand [13c] is too ambiguous and uncertain to address in this preliminary response, especially when other limitations are plainly absent.

249. My explanation in §IX.E regarding Ground 5 of the 706 IPR similarly applies here to Ground 3 of the 715 IPR because the Petition proffers the same reasoning in Ground 5 of the 706 IPR. Therefore, for at least the reasons I provided in §IX.E, it is my opinion that Jun fails to cure the deficiencies of Park.

250. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Ground 3 and institution

should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

D. Ground 4 of the 715 IPR fails to present a reasonable likelihood of success

251. In Ground 4, the Petition relies on Park and Vinciarelli-218, and relies on Vinciarelli-218's discussion in Ground 1. For example, the Petition relies on at least the same arguments for limitations [13pre], [13a], and [13b] from Ground 1. Like Ground 1 where the Petition attempted to incorporate Zeng-014's pin scheme into Vinciarelli-218, Ground 7 relies on electrodes from Park in an attempt to cure the deficiency of Vinciarelli-218. In my opinion, the combination of Park and Vinciarelli-218 also fails for similar reasons.

252. My explanation in §IX.G regarding Ground 7 of the 706 IPR similarly applies here to Ground 4 of the 715 IPR because the Petition proffers the same reasoning in Ground 7 of the 706 IPR. Therefore, for at least the reasons I provided in §IX.G, it is my opinion that the combination of Vinciarelli-218 and Park fails to disclose the limitations of claims 13-15, 17, and 19.

253. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Ground 4 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

E. Grounds 5 and 6: Vinciarelli-664 is not prior art because the '534 Patent is entitled to its September 2, 2014 priority date

254. In my opinion, claims 13-19 of the '534 Patent is adequately supported by the disclosures of CN972 and the '063 Application.

255. It is my opinion that CN972 reasonably conveys to a POSITA that the inventors had possession of the entirety of claims 13-19 of the '534 Patent as of September 2, 2014, the filing date of CN972. The Petition's sole argument is that the '063 Application does not disclose "a pin that covers both top and bottom and at least portions of *two* lateral sides of either a cuboid body or a bearing plate." Petition at 58, emphasis in original. The Petition further argues that "the only pins that cover portions of exterior surfaces in the disclosed embodiments are described and shown as only covering portions of single lateral side surface, as can be seen in the following Figures." *Id.* The Petition mischaracterizes the '534 Patent family including CN972 because the Petition cited to FIGs. 19, 23, 24, and 25 of the '534 Patent and abruptly ceased its analysis there, as I explain below.

256. The Petition turns a blind eye to the neighboring figure - FIG. 26 - of the '534 Patent, which adequately discloses a pin covering top, bottom, and portions of **two lateral sides** of a cuboid body or a bearing plate. I have reproduced FIG. 26 of the '534 Patent below.

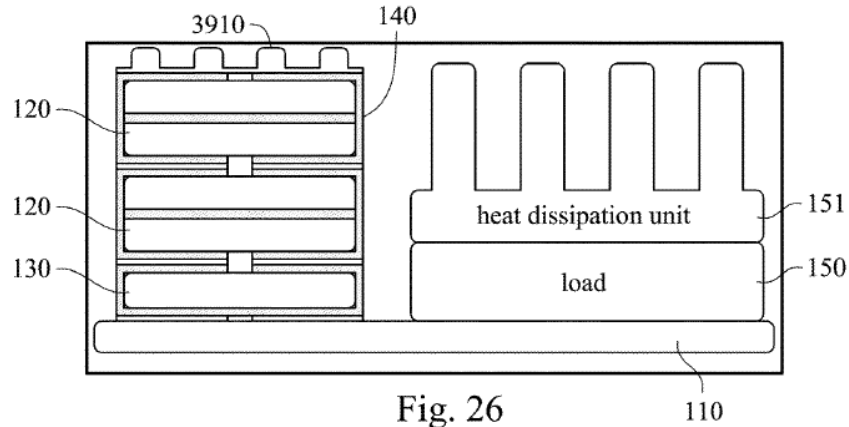


Fig. 26

Figure 26 of the '534 Patent

257. The '063 Application, whose specification and drawings are identical to the '534 Patent, discloses a power unit 120 “disposed on the control unit 130” which is placed on “main board 110.” EX2005, 356. After review, I conclude that FIG. 26 of the '063 Application (also reproduced below) and the '534 Patent are identical and both illustrate this configuration. *Id.*, 375; '534 Patent, FIG. 26.

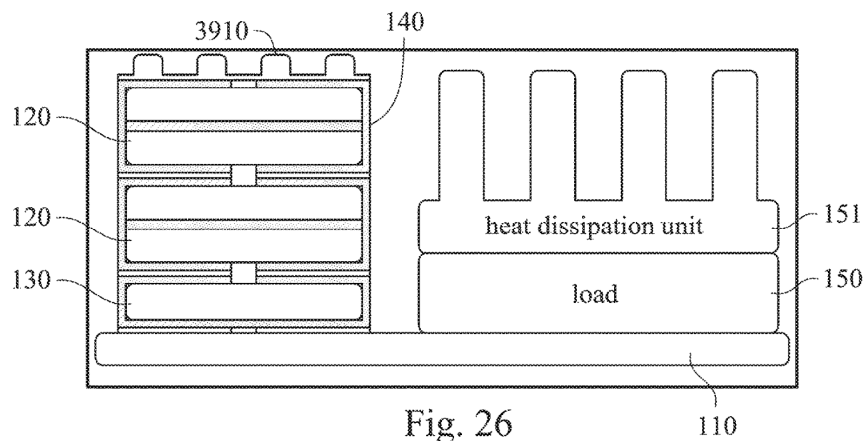
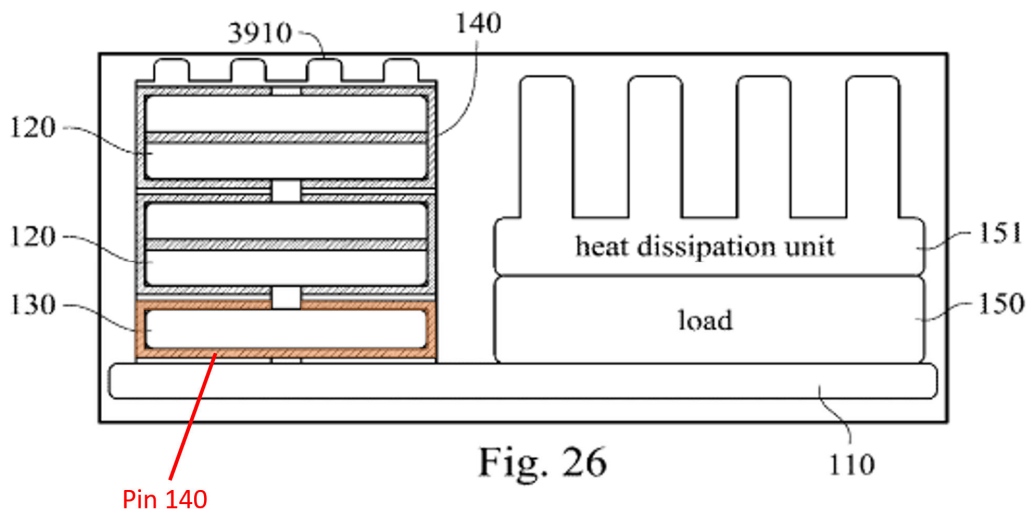


Fig. 26

Figure 26 of the '063 Application

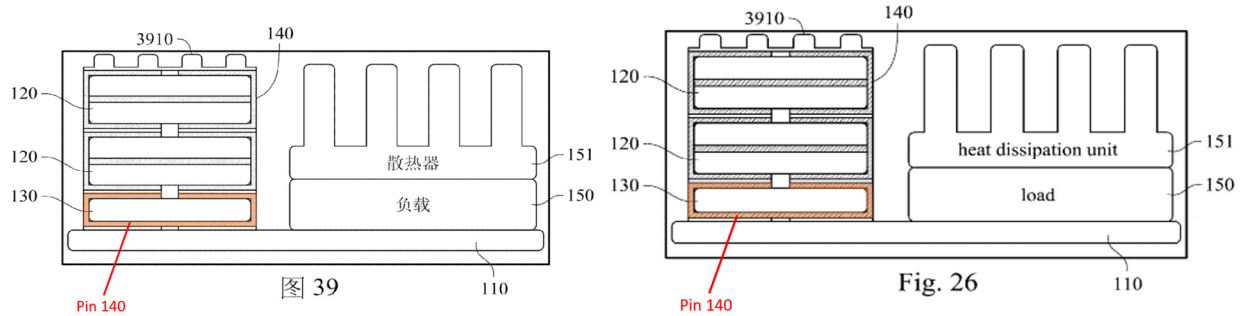
258. As shown in FIG. 26 of both the '534 Patent and the '063 Application, pins 140 are disposed on the top, bottom, and lateral surfaces of each of the power unit 120 and control unit 130. *Id.* Particularly, I note that pins 140 of the bottom control unit 130 ***continuously*** cover the top and bottom surfaces as well as ***two*** opposing lateral surfaces of control unit 130. *Id.* Contradictory to the Petition, this fully supports the limitation recited in claims 13-19 because pin 140 that wraps around control unit 130 fully supports that “the pin covers at least part of a lower surface, at least part of an upper surface of the insulation material and at least part of two lateral sides of the bearing plate,” as recited by claims 13 and 17.



Annotated Figure 26 of the '063 Application

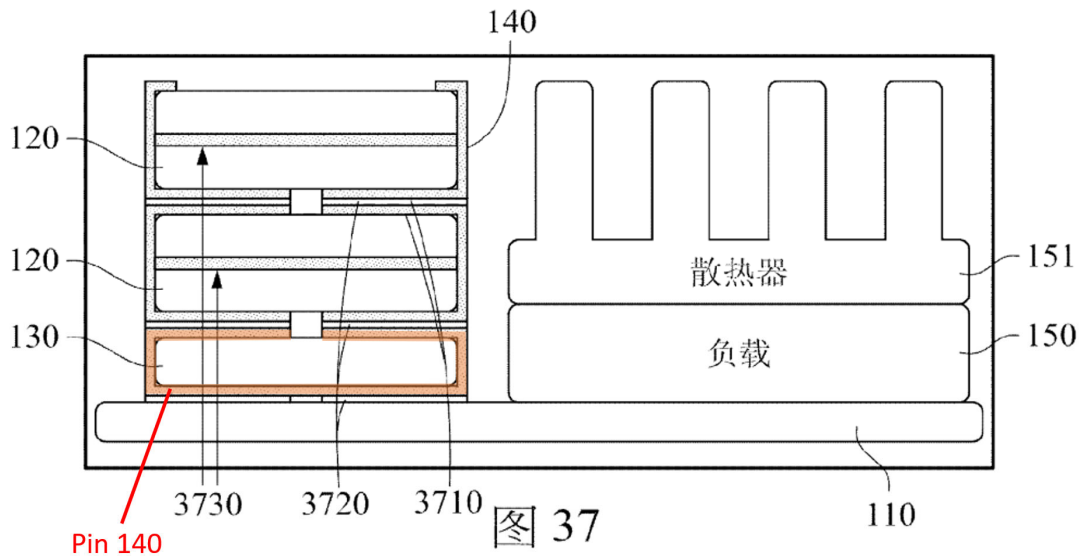
259. The '063 Application and the '534 Patent both claim priority to CN972, which contains a figure identical to FIG. 26, and more. For example, FIG. 39 of CN972 is identical to FIG. 26 of the '063 Application and the '534 Patent. I have

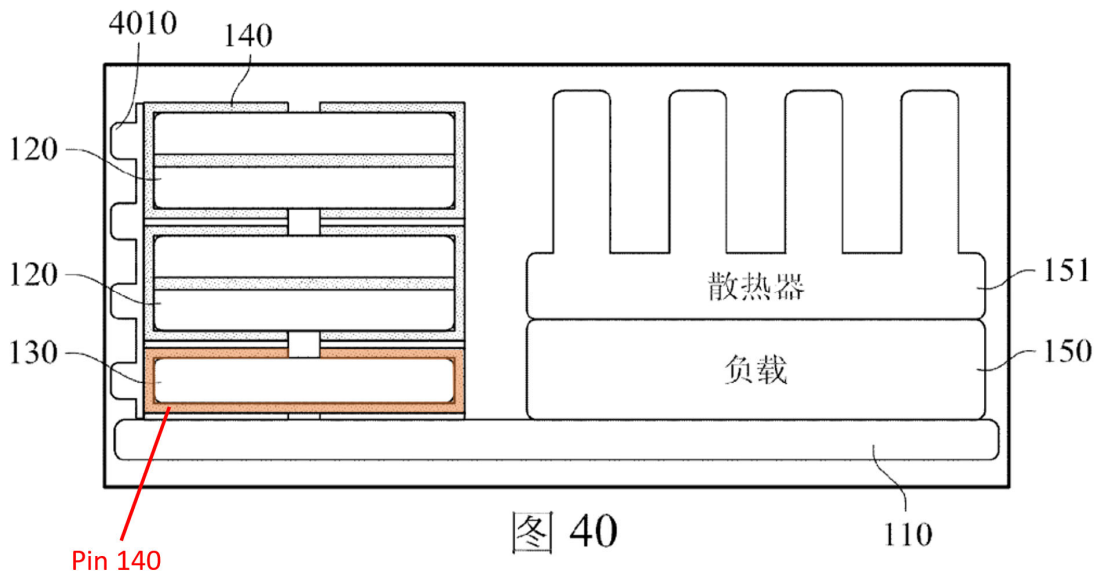
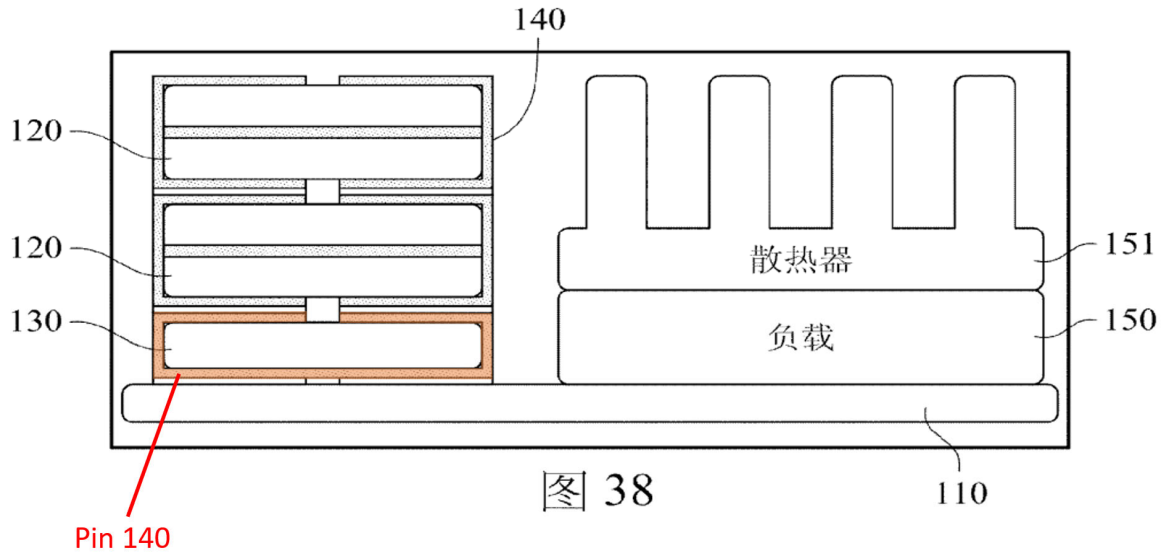
annotated and reproduced FIG. 39 from CN972 and FIG. 26 from the '534 Patent and the '063 Application below. After comparing those two figures, I conclude that they disclose the same pin 140 and control unit 130.



Annotated Figure 39 of CN972 (left) and Figure 26 of the '534 Patent (right)

260. In addition, FIGs. 37-38, and 40 of CN972 all illustrated a control unit 130 having pins 140 that continuously cover top, bottom, and **two** opposing lateral surfaces. EX2003, 242-43. I have annotated and reproduced FIGs. 37-38, and 40 below.





Annotated FIGs. 37, 38, and 40 of CN972

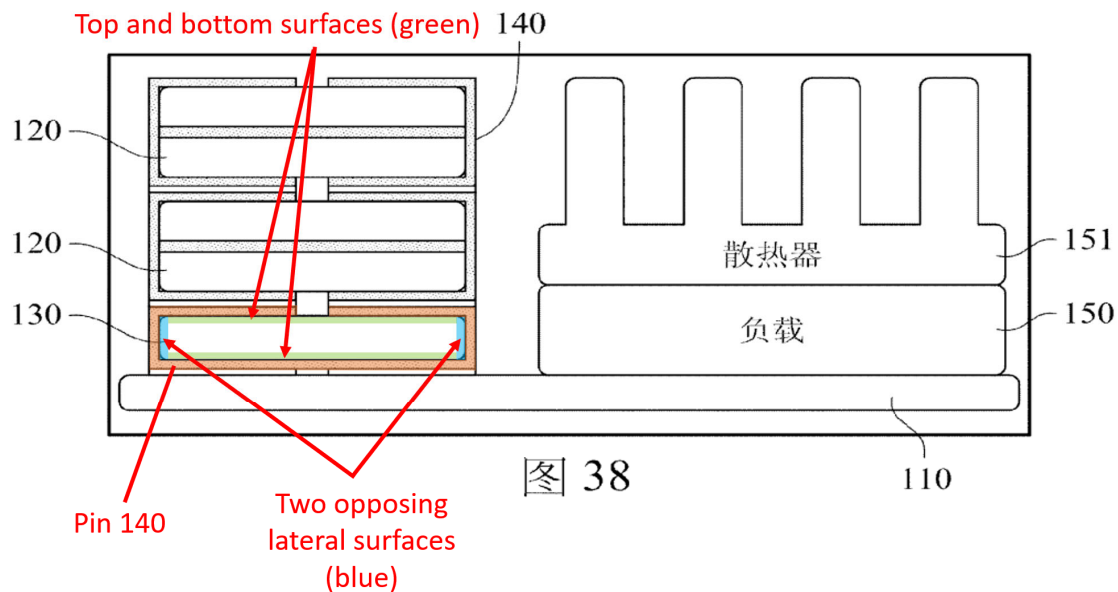
261. Particularly with respect to FIG. 38, CN972 further discloses that “better heat exchange capability can be achieved by placing each pin 140 on the *side* and top surfaces to expand the occupied area.” EX2006, ¶156. Indeed, CN972 discloses that “[t]he coverage of the unit should have *at least one side* that accounts for more than 30% of the surface of the unit, preferably more than 50%.” *Id.* Based

on this teaching, CN972 clearly conveys that the greater surface area of pin 140 (e.g., 50% vs 30%) the “better heat exchange capability” achieved. Indeed, POSITAs would have understood, based on CN972’s teaching, that pin 140 continuously covering the top, bottom, and two lateral surfaces of control unit 130 would be desirable as achieving greater heat exchange capability, efficiency, and uniformity. For example, compared to pins that cover only one lateral surface of the cuboid body or bearing plate, pins that cover two lateral surfaces distribute heat better due to the pins’ greater surface area.

262. Connecting pin portions that cover two lateral surfaces also provides the benefit of distributing heat generated by hot spots at one lateral surface to other portions of the pins. For example, when the pin covers only one lateral surface, heat generated by the lateral surface can only be dissipated locally around the pin that covers this lateral surface. In contrast, when first and second portions of the pin respectively covers first and second lateral surfaces, and that the first and second portions of the pin are connected together like pin 140 that wraps control unit 130 in FIG. 26, heat generated along the first lateral surface could also be dissipated by the second pin portion that covers the second lateral surface because heat could be transferred from the first portion to the second portion.

263. I have annotated and reproduced FIG. 38 of CN972 below to show that pin 140 (orange) that wraps around control unit 130 *continuously* covers top and

bottom surfaces (green) and two opposing lateral surfaces (blue) of control unit 130. In other words, portions of pin 140 that covers the two opposing lateral surfaces are connected by portion of pin 140 that extend across the bottom surface of control unit 130. EX2005, 243. It would be reasonably clear to those skilled in the art that the pin covers “two lateral sides of the bearing plate” recited in claims 13-19.



Annotated Figure 38 of CN972

264. While FIG. 38 does not specifically illustrate a bearing plate within the control unit 130, **all** of CN972, the '063 Application, and the '534 Patent **explicitly disclose** that both units 120, 130 contain a bearing plate 3420 and insulation material 3430 formed on two opposite surfaces of bearing plate 3420. For example, they recite “[s]pecifically, any one of the control unit and the power unit comprises a bearing plate 3420 and insulation material 3430.” EX2005, 354; EX2006, 146;

EX1001, 19:34-40. Indeed, as I explain below, it is my opinion that the teachings from the specification and drawings of these references convey with reasonable clarity to those skilled in the art that the power unit 120 and the control unit 130 can share similar structure comprising bearing plate, encapsulation materials, pins and electrical interconnections as well as structural interrelationships, as recited in claims 13-19. EX2006, 117-120, 123-130, FIG. 34; EX2005, 342-344, FIG. 25; EX1001, 13:29-14:62, FIG. 25.

265. For example, CN972 demonstrates the above as teaching that “[t]he unit shown in Figure 34 may be the above-mentioned power unit and/or *control unit*.” EX2006, ¶147, emphasis added. I have annotated and reproduced FIG. 34 of CN972 below to highlight that pins 140 (shaded orange) of control unit 130 are electrically connected to bearing plate 3420 (shaded blue) through conductive pads 3440 (red) and soldering material 3450 (shaded yellow). *See* EX2006, ¶122.

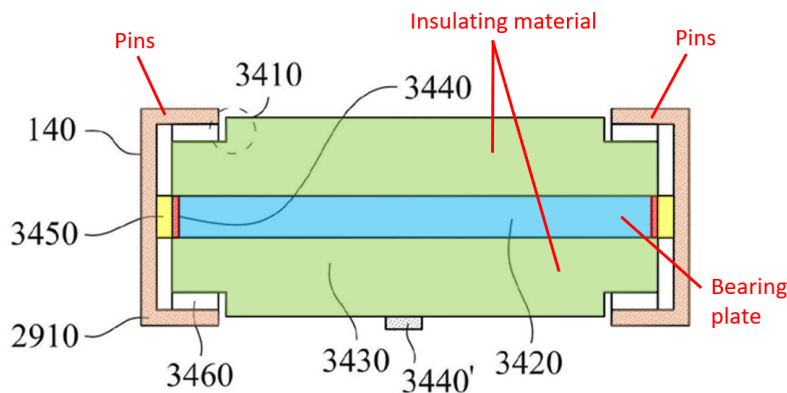


图34

Annotated Figure 34 of CN972

266. Comparing FIG. 25 of the '063 Application and the '534 Patent to FIG. 34 of CN972 reproduced above, I conclude that they are identical. EX2005, 375, 355; EX1001, 19:47-48. As shown in the annotated figures above and below, CN972's FIG. 34 and FIGs. 25 of the '063 Application and the '534 Patent both include bearing plate 3420 (shaded blue), insulating materials 3430 (shaded green) formed on two opposite surfaces of bearing plate 3420, and pins 140 (shaded orange) electrically connected to bearing plate 3420 through conductive pads 3440 (shaded red) and soldering material 3450 (shaded yellow). *See* EX2006, ¶¶146-147, FIG. 34; EX2005, 43, 354-355, 375; EX1001, 19:26-20:10, FIG. 25.

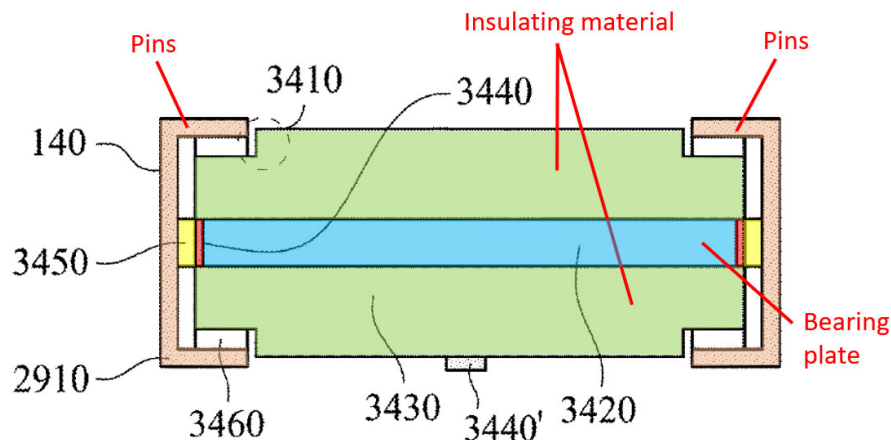


Fig. 25

Annotated Figure 25 of '534 Patent

267. In sum, it is my opinion that the teachings of CN972 and the '063 Application have clearly conveyed to POSITAs that control unit 130 and power unit 120 contain the same components. For example, as I explained above, both control

unit 130 and power unit 120 contain a bearing plate, insulating materials, and pads. *See* EX2006, ¶147.

268. In view of FIG. 26 of the '534 Patent and the '063 Application and FIGs. 37-40 of CN972, the drawings of FIGs. 37-40 of CN972 and the associated texts would have conveyed with reasonable clarity to a POSITA that the inventor was in possession of the invention on September 2, 2014, especially regarding the “two lateral sides of the bearing plate” feature at issue. As I explained above, this is because the figures of CN972 explicitly show pins 140 that continuously cover top, bottom, and *two* opposing lateral surfaces of the control unit 130. which POSITAs would readily comprehend from the relevant texts to have same components and structural/electrical connections as the power unit (120). *See* EX2006, ¶147. Having pins 140 contacting lateral surfaces presents a clear advantage for heat dissipation and efficiency for power units, as recognized in CN972, because larger coverage of pins 140 provides “better heat exchange capability.” EX2006, ¶156.

269. Because CN972 provides adequate written description support for the claimed “power supply apparatus” to both the '063 Application and the '534 Patent, it is my opinion that the '534 Patent is entitled to the CN972's filing date of September 2, 2014. Therefore, Vinciarelli-664 is disqualified as prior art and Grounds 5-6 shall fail.

270. For these additional reasons, the Board should find that the Petition has not demonstrated a reasonable likelihood of prevailing on Grounds 5 and 6 and institution should be denied. Should the Board institute, I reserve the right to supplement my opinion with more detail.

XI. CONCLUSION

I, Joshua Phinney, declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: July 10, 2024

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Joshua Phinney', is written above a horizontal line.

Joshua Phinney, Ph.D.