IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Jian-Hong Zeng	Attorney Docket No.: 25808-0013IP1
U.S. Patent No.:	10,877,534	
Issue Date:	December 29, 2020	
Appl. Serial No.:	15/952,224	
Filing Date:	April 12, 2018	
Title:	POWER SUPPLY APPARATUS	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 10,877,534 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

TABLE OF CONTENTS

I. REQUIREMENTS FOR IPR 1
A. Grounds for Standing 1
B. Challenge and Relief Requested 1
C. Priority Dates 2
D. Claim Construction 3
E. Level of Ordinary Skill in the Art 3

II. THE '534 PATENT 4
A. Brief Description 4
B. Prosecution History 5

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE 5
A. GROUND 1 – Claims 1-8 and 10-12 are Obvious over Vinciarelli-218 in view of Zeng-014 5
1. Summary of Vinciarelli-218 5
2. Summary of Zeng-014 9
3. Analysis 12
B. GROUND 2 – Claims 1-8 and 10-12 are Anticipated by Zeng-014 35
C. GROUND 3 – Claims 1-8 and 10-12 are Obvious Over Zeng-014 alone and, if necessary, in combination with Jun 49
D. GROUND 4 – Claims 1-3 and 5-8 are Anticipated by Park 52
1. Summary of Park 52
2. Analysis 57
E. GROUND 5 – Claims 1-3 and 5-8 are Obvious over Park Alone and, if Necessary, in Combination with Jun 65
F. GROUND 6 – Claims 4 and 10-12 are Obvious over Park in view of Zeng-014 and, if necessary, Jun 68
G. GROUND 7 – Claims 1-8 and 10-12 are Obvious over Vinciarelli-218 in view of Park 73
H. GROUND 8 – Claims 4 and 10-12 are Obvious over Vinciarelli-218 in view of Park and Zeng-014 84

IV. DISCRETIONARY DENIAL IS NOT WARRANTED 86
A. 35 U.S.C. §325(d) – *Advanced Bionics* 86
B. 35 U.S.C. §314(a) – *Fintiv* 86

V. CONCLUSION AND FEES 88

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1) 88
A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1) 88
B. Related Matters Under 37 C.F.R. § 42.8(b)(2) 88

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3).....89
D. Service Information 89

EXHIBITS

VICOR-1001	U.S. Patent No. 10,877,534 to Jian-Hong Zeng ("the '534 patent")
VICOR-1002	Excerpts from the Prosecution History of the '534 patent ("the Prosecution History")
VICOR-1003	Declaration and Curriculum Vitae of Dr. R. Jacob Baker, Ph.D., P.E.
VICOR-1004	Complaint, *Delta Electronics, Inc. v. Vicor Corporation* 1-23-cv-01246, D. Del., filed November 1, 2023
VICOR-1005	Amended Complaint, *Delta Electronics, Inc. v. Vicor Corporation* 1-23-cv-01246, D. Del., filed January 26, 2024, including Exhibit 4 (infringement claim chart)
VICOR-1006	United States Patent Application Publication No. 2014/0355218 to Vinciarelli et al. ("Vinciarelli-218")
VICOR-1007	United States Patent Application Publication No. 2009/0175014 to Zeng et al. ("Zeng-014")
VICOR-1008	U.S. Patent No. 10,285,270 to Joseph Fjelstad ("Fjelstad")
VICOR-1009	United States Patent Application Publication No. 2015/0116891 to Park et al. ("Park")
VICOR-1010	United States Patent No. 10,264,664 to Vinciarelli et al. ("Vinciarelli-664")
VICOR-1011	Excerpts from the Prosecution History of U.S. Patent Application No. 14/840,063 ("063 Application and PH")
VICOR-1012	United States Patent Application Publication No. US2005/0098874 to Jun et al. ("Jun")
VICOR-1013	U.S. Patent No. 6,621,011 to Daidai et al. ("Daidai")

VICOR-1014	U.S. Patent. No. 7,361,844 to Vinciarelli et al. ("Vinciarelli-844")
VICOR-1015	U.S. Patent No. 6,934,166 to Vinciarelli et al. ("Vinciarelli-166")
VICOR-1016	"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 Corporation ("Petitioner" or "Vicor") petitions for *Inter Partes* Review ("IPR") of claims 1-8 and 10-12 ("the Challenged Claims") of U.S. Patent No. 10,877,534 ("the '534 patent"). Compelling evidence presented in this Petition demonstrates at least a reasonable likelihood that Vicor will prevail with respect to at least one of the Challenged Claims.

I. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the '534 patent is available for IPR. This petition is being filed within one year of service of a complaint against Vicor and Vicor is not barred or estopped from requesting review of the Challenged Claims on the below-identified grounds.

B. Challenge and Relief Requested

Vicor requests an IPR of the Challenged Claims on the grounds noted below. Dr. Baker provides supporting testimony in his Declaration. VICOR-1003.

Ground	Claim(s)	Statutory Basis
1	1-8, 10-12	103: U.S. Pat. App. Pub. No. 2014/0355218 (Vinciarelli-218) in view of 2009/0175014 (Zeng-014)
2	1-8, 10-12	102: Zeng-014
3	1-8, 10-12	103: Zeng-014 alone, and, if necessary, in view of U.S. Pat. App. Pub. No.

Ground	Claim(s)	Statutory Basis
		2005/0098874 (Jun)
4	1-3, 5-8	102: U.S. Pat. App. Pub. No. 2015/0116891 (Park)
5	1-3, 5-8	103: Park alone, and, if necessary, in view of Jun
6	4, 10-12	103: Park in view of Zeng-014, and, if necessary, in view of Jun
7	1-8, 10-12	103: Vinciarelli-218 in view of Park
8	4, 10-12	103: Vinciareli-218 in view of Park and Zeng-014

The '534 patent issued from U.S. Patent Application No. 15/952,224, which has a filing date of April 12, 2018. The '534 patent claims priority to a foreign application (CN 2014 1 0442972, "CN 927 Application") filed on September 2, 2014, and to a prior U.S. application (14/840,063) filed on August 31, 2015. Accordingly, the patent should be reviewed pursuant to the AIA.

C. Priority Dates

Without conceding that the patent is entitled to the foreign priority date, this Petition will use September 2, 2014 as the critical date.

Reference	Filing Date	Publication Date	Prior Art At Least Under
Vinciarelli-218	5/11/2012	12/4/2014	102(a)(2)
Zeng-014	1/2/2009	7/9/2009	102(a)(1)
Park	4/22/2014	4/30/2015	102(a)(2)
Jun	11/8/2004	5/12/2005	102(a)(1)

D. Claim Construction

All claim terms should be construed according to the *Phillips* standard. *See* 37 C.F.R. § 42.100. The invalidity issues raised in this Petition may be resolved without any formal claim construction and without determining the precise metes and bounds of the claims.[1]

E. Level of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") relating to the subject matter of the '534 patent as of September 2, 2014 would have had (1) at least a bachelor's degree in electrical engineering or a related field, and (2) at least two years of industry experience in power engineering. VICOR-1003, ¶¶47-48.

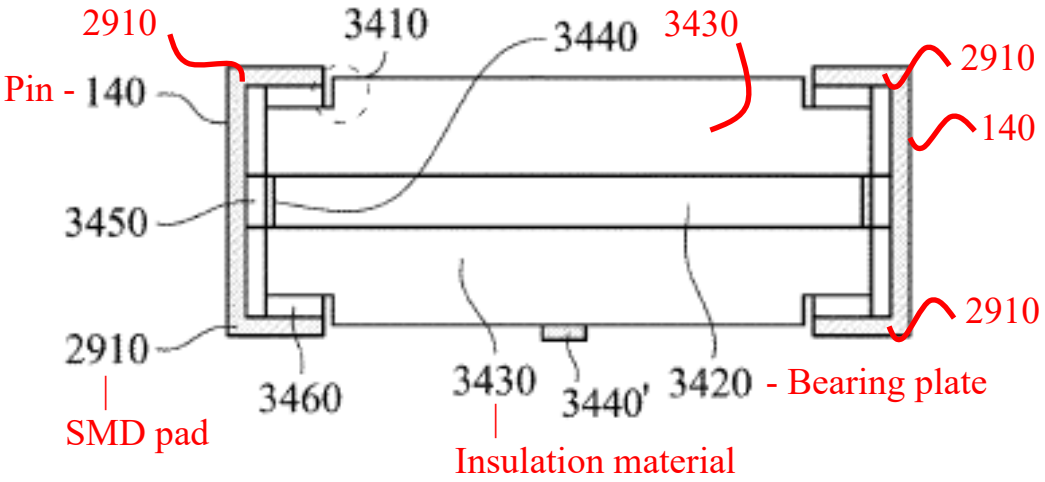
[1] Petitioner is not conceding that each claim satisfies all statutory requirements, nor waiving any arguments concerning indefiniteness or other grounds that may not be raised in an *inter partes* review proceeding.

Additional graduate education could substitute for professional experience, and *vice versa*. *Id.*

II. THE '534 PATENT

A. Brief Description

The '534 patent is directed to "a power supply apparatus that includes a bearing plate, insulation material and a plurality of pins." VICOR-1001, Abstract; *see also id.,* Fig. 25.



Id., Fig. 25 (annotated). The bearing plate (3420 in Fig. 25 above) may be a "printed circuit board ['PCB'] or the lead frame, etc." *Id.*, 15:12-14. And the insulation material (3430 in Fig. 25 above) may be formed on the top and bottom surfaces of the bearing plate. *Id.*, 19:26-46, Fig. 25. "[T]he lateral side of the bearing plate 3420 is disposed with the pads 3440[] [and] the soldering material 3450 on the pads 3440 is soldered to the pins 140." *Id.*, 19:38-40. "At the edge of the upper and lower surface of the insulation material 3430, there is a recess 3410;

the two terminals of each pin 140 ha[ve] [an] SMD pad 2910 extending to the recess 3410 at the upper and lower surfaces, the recesses 3410 ha[ve] the bonding material 3460 disposed thereon for bonding with the SMD pads 2910." *Id*., 19:40-46.

B. Prosecution History

During prosecution, Patent Owner did not cite the prior art at issue here. The examiner rejected many of the original claims as obvious over U.S. Pat. App. Pub. No. 2005/0189566 (Matsumoto) in view of U.S. Pat. No. 6,496,377 (Happ) but indicated that certain dependent claims would be allowable if rewritten in independent form. VICOR-1002, p. 35-38, 41-49. Patent Owner failed to traverse the prior art rejection and ultimately rewrote the dependent claims in independent form to obtain allowance. *Id*., p. 9-14, 22-23, 24-40.

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND 1 – Claims 1-8 and 10-12 are Obvious over Vinciarelli-218 in view of Zeng-014

1. Summary of Vinciarelli-218

Vinciarelli-218 is entitled "Panel-Molded Electronic Assemblies" and concerns a method for making a power converter that has a printed circuit board at the center and insulation layers above and below the circuit board. Connections to the outside world are provided by "interconnection features" at the perimeter of the circuit board. Adapters with through-hole pins, surface mount pins, or other

connecters may be attached to the module and electrically connect with the interconnection features. VICOR-1006, [0111].

The method encapsulates components mounted to two sides of a printed circuit board (PCB) to form a panel of power converter modules. "Interconnection features [are] provided along [the] boundaries of [the] [PCB] … providing electrical connections to the components [on the PCB] without wasting valuable PCB surface area." VICOR-1006, Abstract. Such interconnection features may be used to form a "variety of electrical connections," such as to a motherboard. VICOR-1006, [0111], *see also id.*, [0013]-[0019], [0107]-[0110].

A module with heat sinks attached is shown in FIG. 10A. The black squares 111-113 (original to the figure), said to resemble "bar codes" (VICOR-1006, [0108]), are the interconnects:

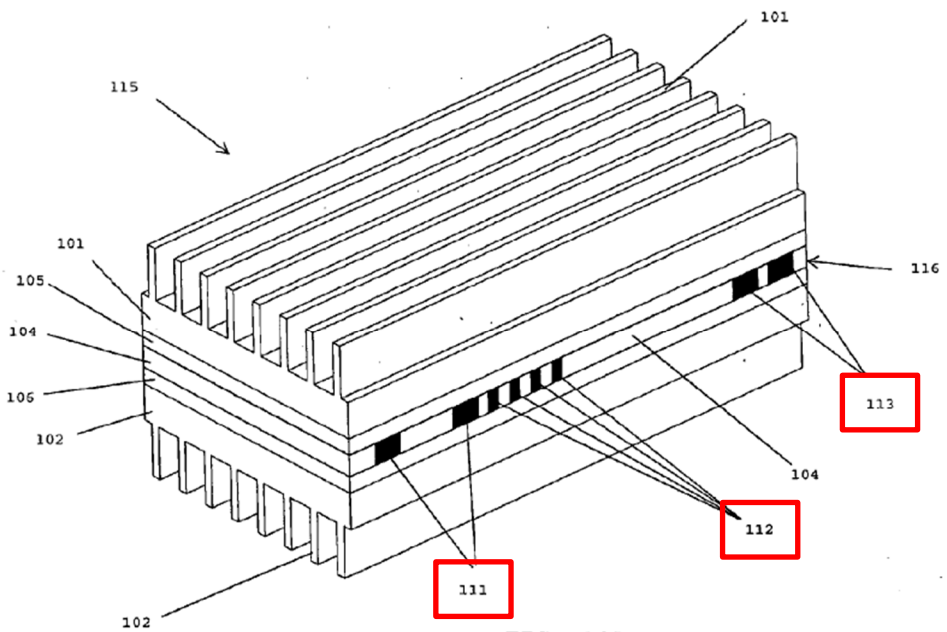


FIG. 10A

To accommodate different types of interconnects, the module may be used with various adapters. VICOR-1006, [0026], [0028]. For example, "through-hole adapters 203A, 203B" are depicted in Figs. 15 and 16. *Id.*, [0115].

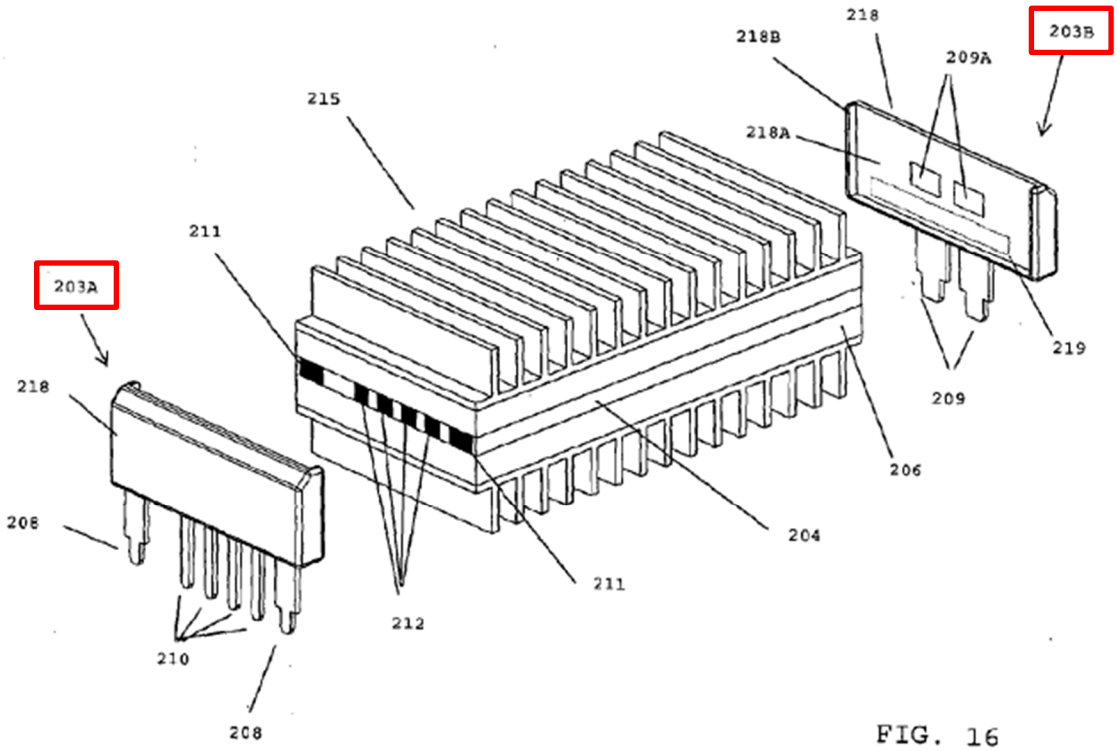


FIG. 16

Vinciarelli-218 also discloses a surface mount adapters 303A and 303B in Figs. 17 and 18. *Id.*, [0120].

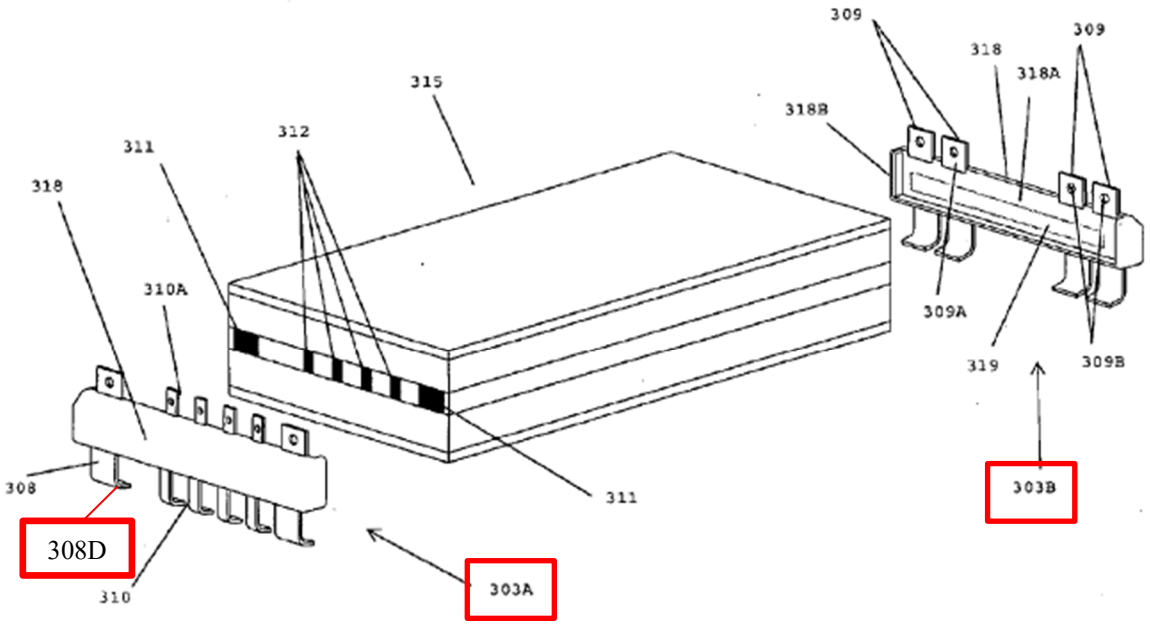


FIG. 18

Additional examples are provided. *Id*., [0127]. Notably, Vinciarelli-218 further describes a "flush-mount technique" for mounting the module directly in contact with the customer's motherboard. *Id*., [0131].

Although the modules shown above include heatsinks, Vinciarelli-218 discloses that the heatsinks can be removed such that "the top 815A and bottom 815B surfaces of the singulated module 815 are defined by the cured encapsulant 805, 806 in which the magnetic core surfaces 815C, 815D are exposed." *Id*., [0159]-[0160].

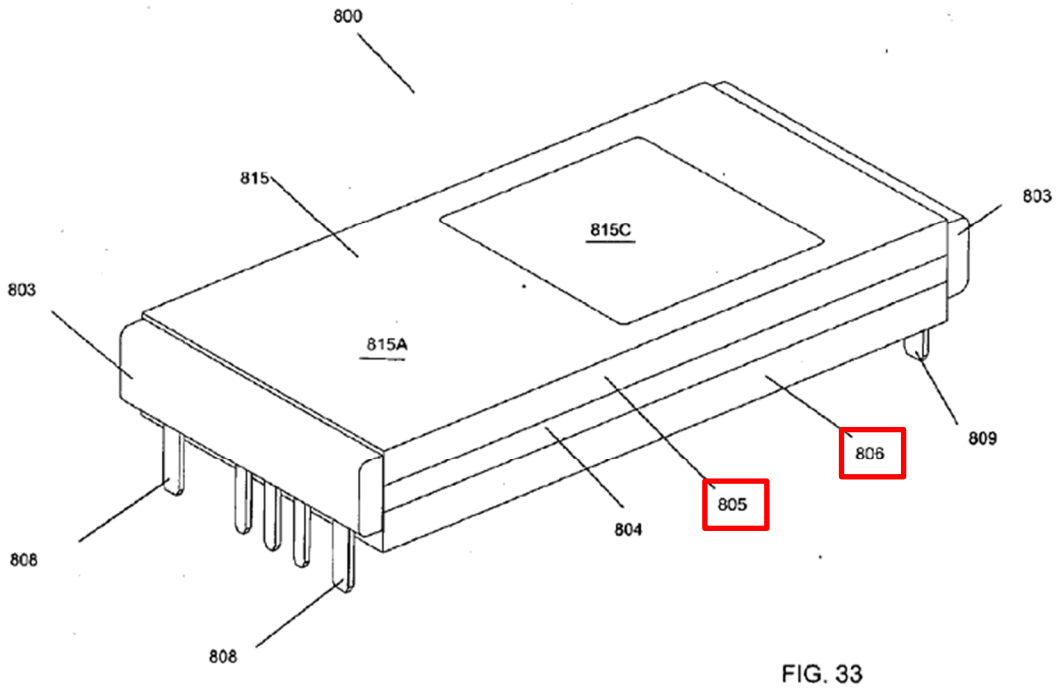


FIG. 33

2. Summary of Zeng-014

Zeng-014 teaches "a novel pin scheme adapted to be widely used with a variety of common electronic apparatuses." VICOR-1007, [0057]. In Ground 1, the Petition explains how the third and fourth embodiments of Zeng-014 are each independently combined with Vinciarelli-218 to render the challenged claims obvious. In Ground 2, the Petition explains how the third and fourth embodiments each anticipate claims 1-2, 4-8, 10, and 12 as well as how the fourth embodiment anticipates claims 3 and 11.

In the third embodiment (DC to DC converter 110), stacked co-fired material substrates 111 houses an inductance coil 116 and has on its surface a "connecting conductor" providing electrical connections for external components and a "pin conductor" that is electrically connected to the inductance coil 116. *Id.*,

[0074]

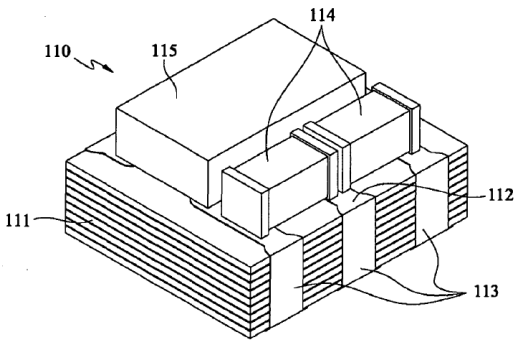


FIG. 11A

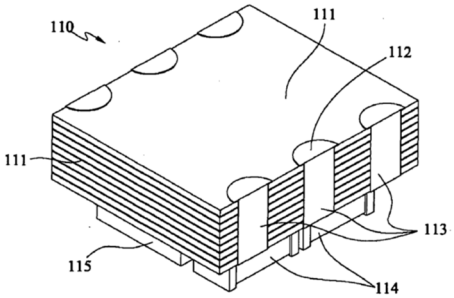


FIG. 11B

"[T]he connecting conductor has four pins 118 and a conductor 113 connected therewith, and the pin conductor has two pins 117 and a conductor 113 connected therewith." *Id.*, [0073], Figs. 11A-G.

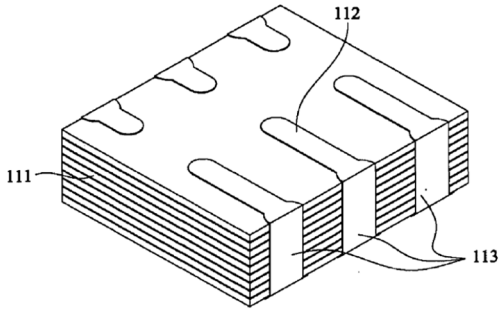


FIG. 11C

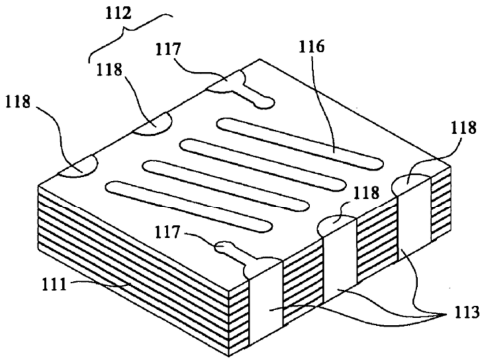


FIG. 11D

Pins 117 together with conductors 113 form a conductive layer 112 on both the top and bottom surfaces of the inductive component. *Id.*, [0073], Figs. 11A, 11B. In addition, the top surface of inductive component 111 may provide a surface for mounting additional components of a DC to DC converter 110, which may be electrically connected to conductive layer 112, including pins 117, and thus

to the inductance coil 116. *Id.*, [0073], [0075], Fig. 11A.

In the fourth embodiment (DC to DC converter 120), a "substrate 125" similarly has a connecting conductor and a "pin conductor" that is electrically connected to an inductance coil 127 within the substrate. *Id.*, [0077]

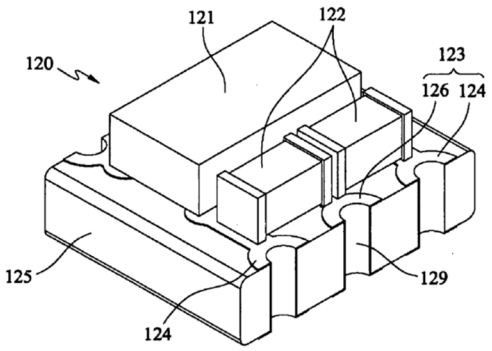


FIG. 12A

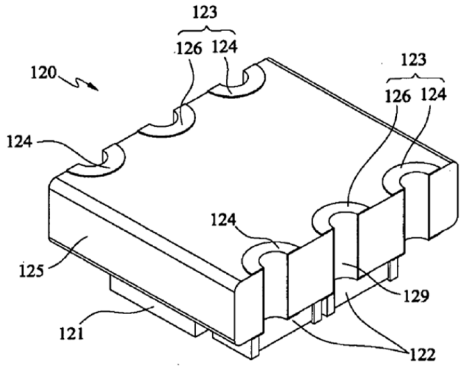


FIG. 12B

VICOR-1007, FIGs. 12A, 12B.

"[C]onnecting conductor [has] four pins 124 and a pin conductor having two pins 126. Each of the pins 124 of the connecting conductor and the pins 126 of the pin conductor has a conductor 129." *Id.*, [0076]-[0077]. "The first conductive layer 123 wraps a first surface of the outer surface of the magnetic material substrate 125. The first surface comprises a top surface, a bottom surface and side surfaces." *Id.*, [0077]-[0078], FIGs. 12A-D. Pins 126 together with conductors 129 form a conductive layer 123 on both the top and bottom surfaces of the inductive component. *Id.*, [0077].

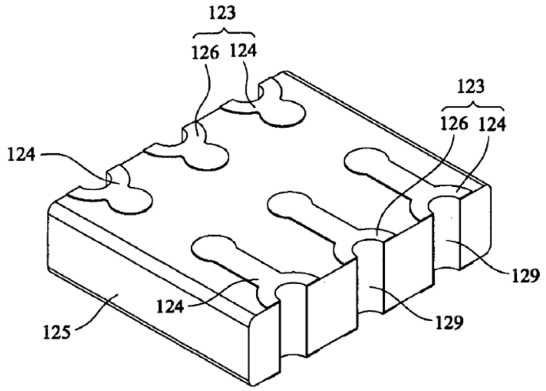


FIG. 12C

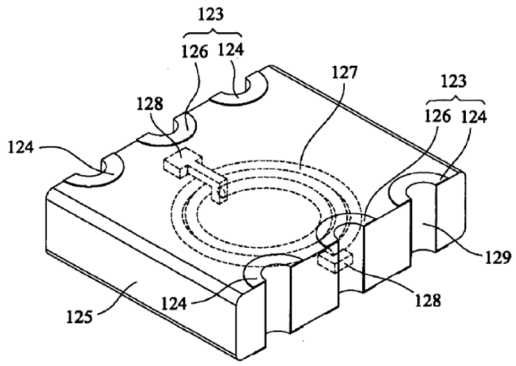


FIG. 12D

VICOR-1007, FIGs. 12C, 12D.

In addition, the top surface of substrate 125 may provide a surface for mounting additional components of a DC to DC converter 120, which maybe electrically connected to conductive layer 112, including pins 117, and thus to the substrate 111. *Id.*, Fig 12A.

3. Analysis

[1pre] A power supply apparatus, comprising:

Vinciarelli-218 discloses this element. VICOR-1003, ¶66. Vinciarelli-218's "invention relates to the field of encapsulating electronic assemblies and more particularly to encapsulated power converters." VICOR-1006, [0002]; *see also* Figs. 10, 16, 18, 33, [0004], [0021]-[0022]. A power converter is a power supply apparatus. VICOR-1003, ¶66.

[1a] a bearing plate;

Vinciarelli-218 discloses a bearing plate ("a printed circuit board 'PCB'" 804). VICOR-1003, ¶67; VICOR-1006, Figs. 33-36, [0158]-[0160].

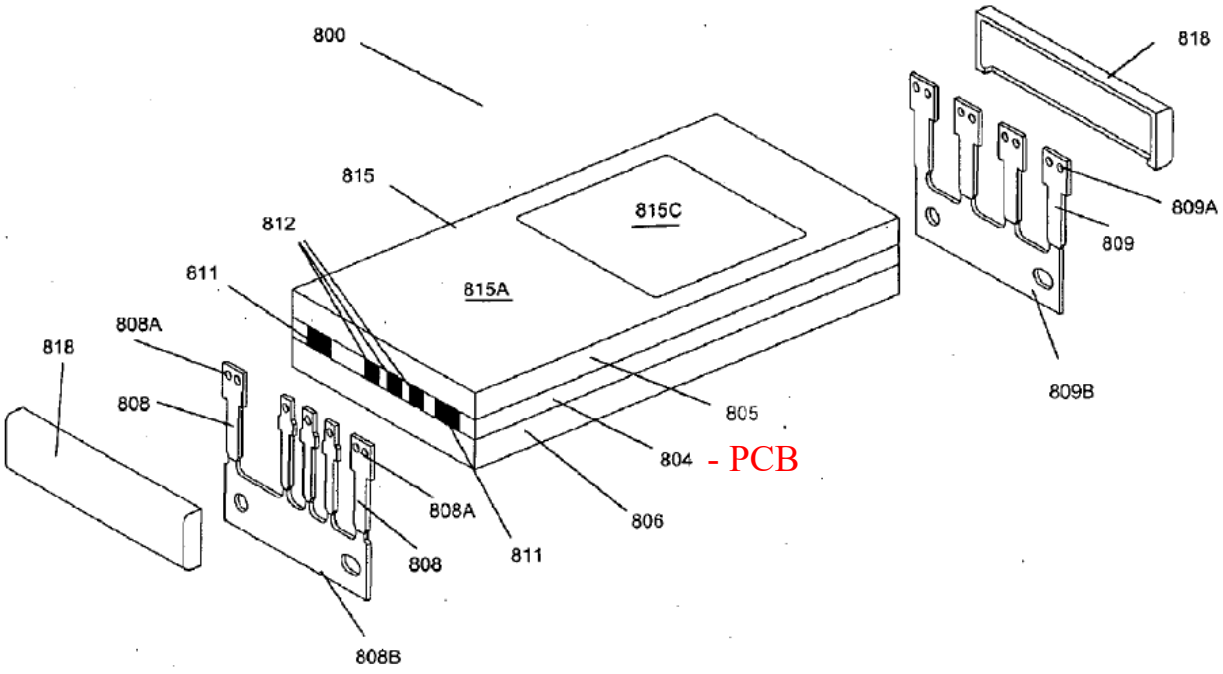


FIG. 35

VICOR-1006, Fig. 35 (annotated); *see also* Figs. 33-36. Although PCB 804 is shown in Figs. 33-36, it does not appear to be mentioned in the specification for this figure. However, the presence of a PCB is clear, because the embodiment of Figs. 33-35 has a layer 804, which is the same as the PCB layer shown in Figs. 16 and 17. VICOR-1003, ¶67; VICOR-1006, Figs. 16, 17, [0115], [0119], [0159] ("[c]omparing the singulated module 815 (FIG. 33) with the singulated modules 215 (FIG. 16) and 315 (FIG. 17)"). At a minimum, it would have been obvious to use a PCB as element 804 for the same reason a PCB is used in Vinciarelli-218's other embodiments. *Id*.

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

Vinciarelli-218 discloses an insulation material (encapsulant layers 805 and

806) formed on two opposite surfaces (the "top surface" and the "bottom surface") of the bearing plate (PCB 804) as shown below in Fig. 35. VICOR-1003, ¶¶68-69; VICOR-1006, Figs. 33-36, [0159] ("the top 815A and bottom 815B surfaces of the singulated module 815 are defined by the cured encapsulant 805, 806 in which the magnetic core surfaces 815C, 815D are exposed.").

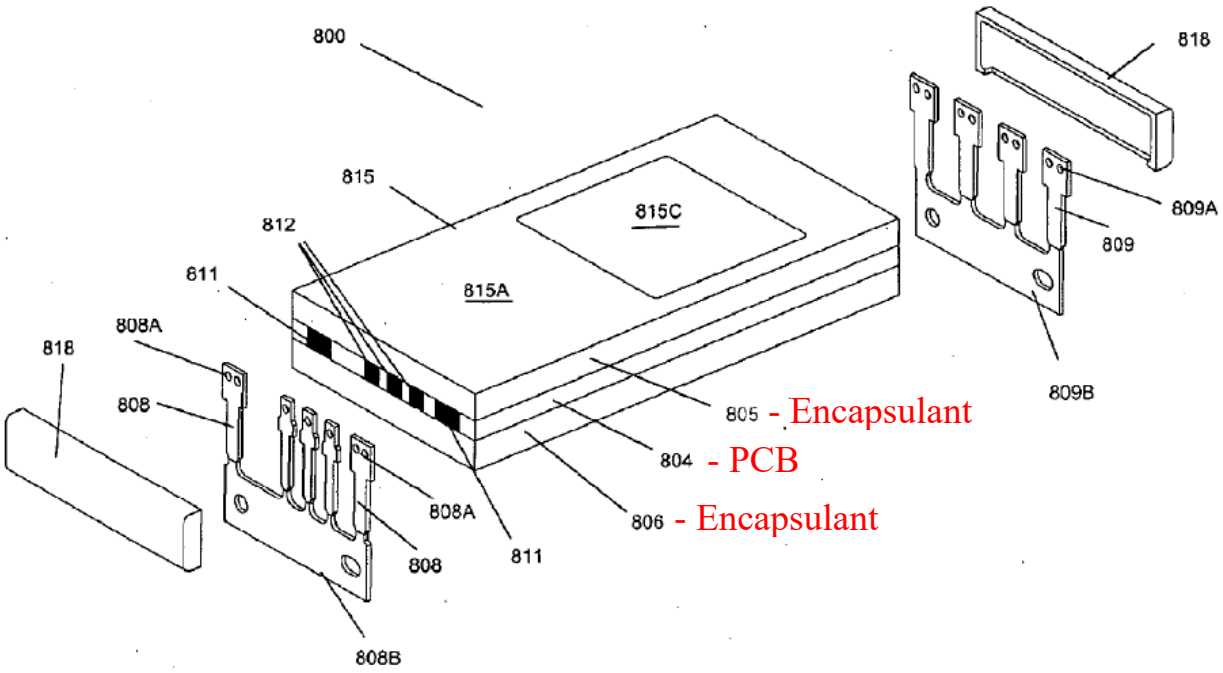


FIG. 35

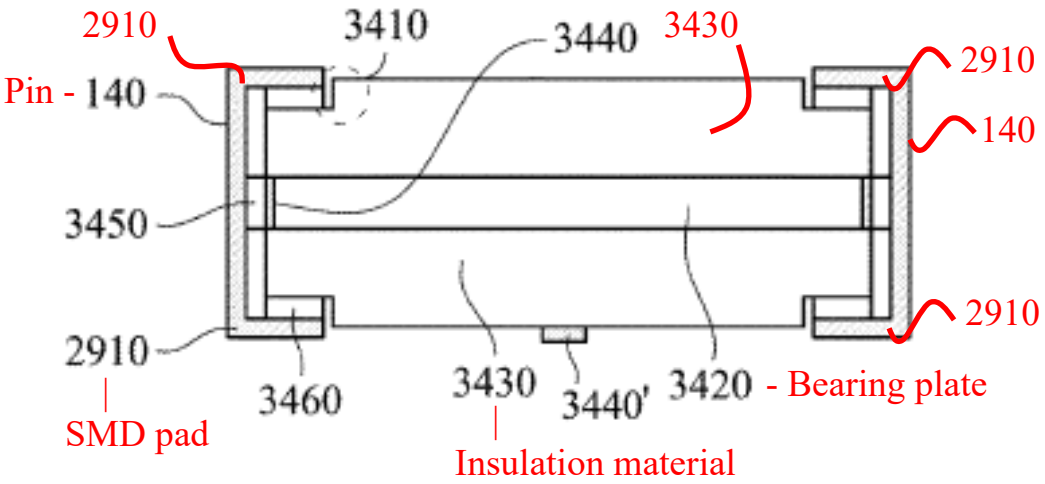
VICOR-1006, Fig. 35.

A skilled artisan would have known that the encapsulants layers 805, 806 are an insulation material that is formed on the two opposite surfaces of PCB 804. *Id.* Indeed, U.S. Pat. No. 7,361,844 (VICOR-1014), which is incorporated by reference into Vinciarelli-218 at VICOR-1006, [0004], states: "The top and bottom surfaces of the circuit board may be encapsulated in thermally conductive epoxy

(e.g., EME-LK4-2, manufactured by Sumitomo Bakelite Co. Ltd.)." VICOR-1014, 11:33-35. Epoxy (without conductive additives) is known to be non-conductive. VICOR-1003, ¶69; *see also, e.g.,* VICOR-1008 (Fjelstad, U.S. Patent No. 10,285,270), 10:7-19 (identifying "epoxy resin" as "an insulating material").

[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.

As shown below, the '534 patent provides an example of element [1c].



VICOR-1001, Fig. 25 (red annotations added). The pins 140 are: (a) electrically connected to the bearing plate 3420; (b) located on the lateral sides of the insulation material 3430 and the lateral side of the bearing plate; where (c) each pin has two terminals (one on the top and one on the bottom); (d) each terminal has a surface mount device (SMD) pad 2910, and (e) the surface mount pads 2910 are located at the upper and lower surface of the insulation material.

It would have been obvious in view of Zeng-014 to modify Vinciarelli-218 to use Zeng-014's pin scheme, which would enable the Vinciarelli-218 power converter module to be surface mounted on a PCB, while also enabling additional electronic components to be stacked on and electrically connected with the module to "improve the power density and shrink the overall dimensions of" an apparatus that included the Vinciarelli-218 power converter. VICOR-1007, [0011]. This would result in the structure claimed. VICOR-1003, ¶¶70-86.

The Vinciarelli-218/Zeng-014 combination would have a plurality of pins as disclosed in Vinciarelli-218 (VICOR-1006, Fig. 35) and Zeng-014 (VICOR-1007, Figs. 11A-G, 12A-D), wherein the pins are similar to Zeng-014's pin conductors and would be electrically connected to Vinciarelli-218's bearing plate (PCB 840) through interconnects 811 and 812. *Id*. VICOR-1003, ¶¶70-71; VICOR-1006, Figs. 33-36, [0160]; *see also* VICOR-1006, [0027], [0030], [0106]-[0111], [0115], [0137].

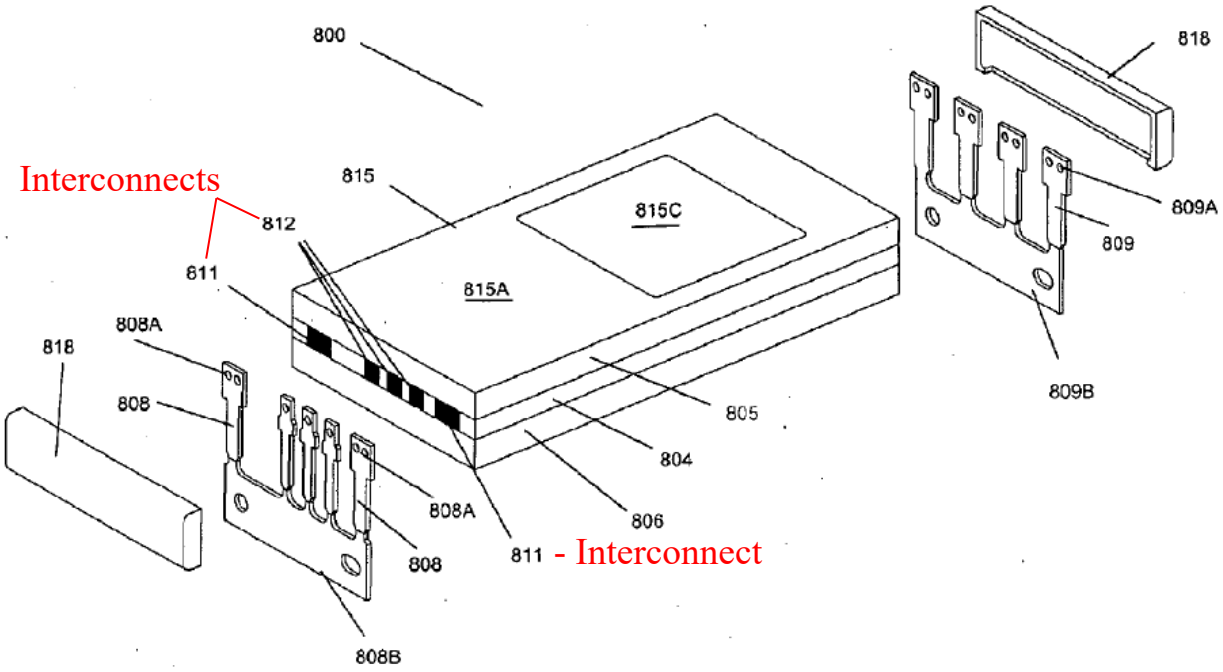


FIG. 35

VICOR-1006, Fig. 35.

Vinciarelli-218 further explains that "various types of connectors [and] adapters may be coupled to the exposed interconnects 811, 812 at the edges of the singulated module 815." *Id*., [0160]. One such type of connector is disclosed by Zeng-014. Zeng-014 discloses "a novel pin scheme" to "improve the power density and shrink the overall dimensions of an electronic apparatus, particularly a power converter." VICOR-1007, [0057]. Zeng-014's scheme uses various "pin conductors," including those shown below, that provide an external connection for an "electronic component" circuitry within a substrate, and to enable mounting of additional electronic components on the top surface of the substrate. Zeng-014's pin scheme would be used in place of Vinciarelli-218's connectors:

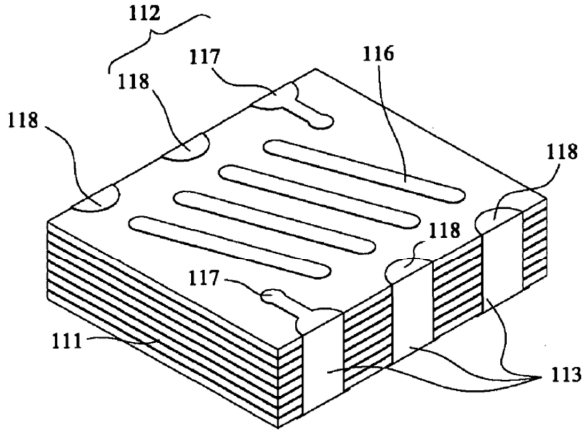


FIG. 11D

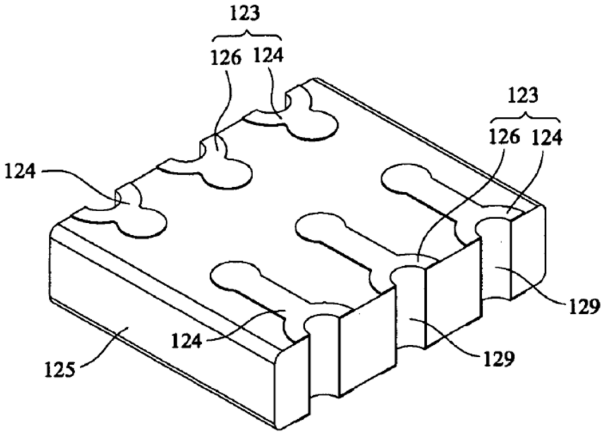


FIG. 12C

VICOR-1007, Figs. 11D, 12C, [0073]-[0078].

The pins in the combination would be (a) electrically connected to the bearing plate (Vinciarelli-218's PCB 804) via the edge interconnects 811, 812 on Vinciarelli-218's PCB 804 just as pins 808/808A in Vinciarelli-218's adapters 803 are electrically connected to PCB 804. VICOR-1003, ¶73; VICOR-1006, Fig. 35, [0160].

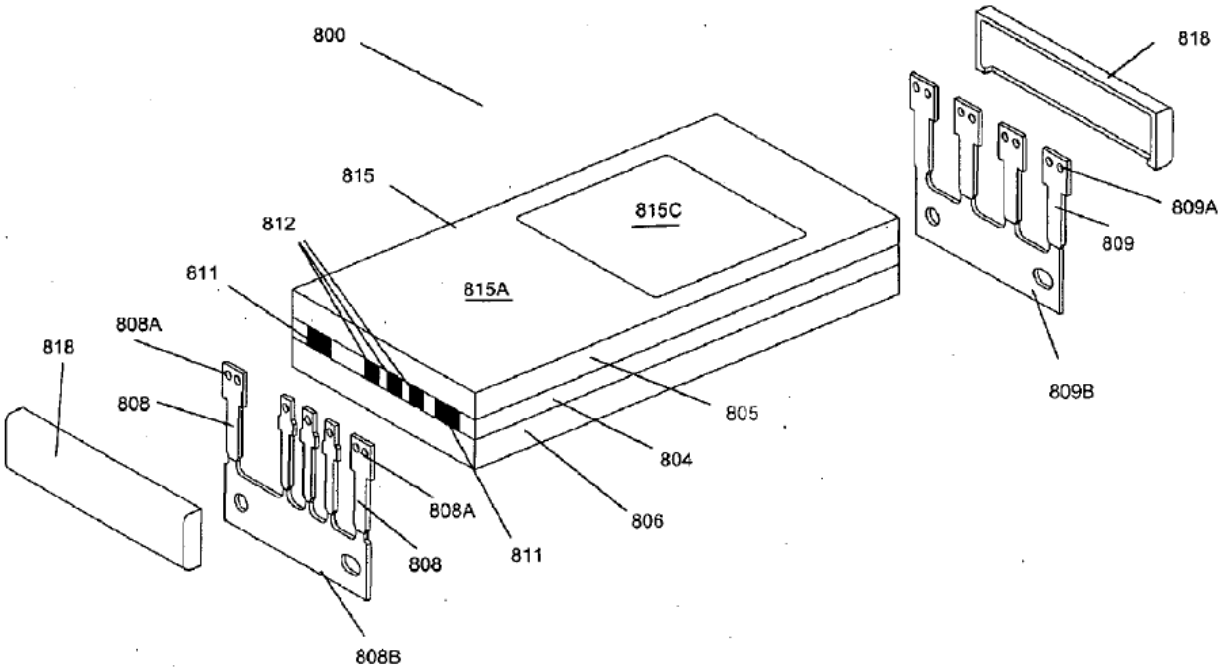


FIG. 35

Like the pins in Vinciarelli-218 and Zeng-014, the pins in the combination would be (b) allocated along lateral sides of Vinciarelli-218's insulation material 805, 806. VICOR-1003, ¶75; VICOR-1006, Fig. 35; VICOR-1007, Figs. 11D, 12C, [0073]-[0078].

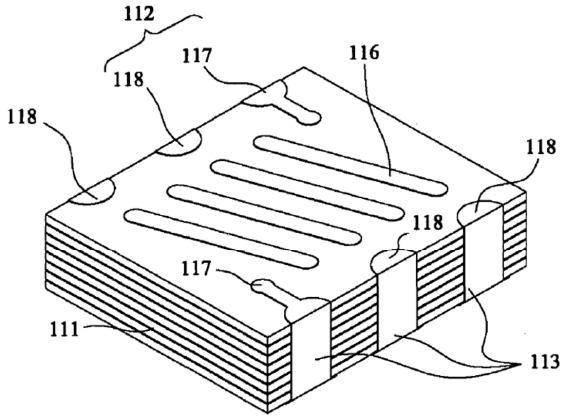


FIG. 11D

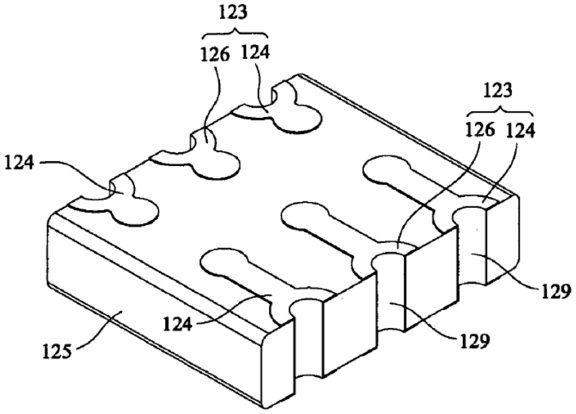


FIG. 12C

Like the pins 117 and 126 in Zeng-014, the pins in the combination would each have (c) two terminals (one on the top and one on the bottom of the module) and each terminal would have a surface mount device (SMD) pad (portions of pins 117 or 126 forming the conductive layers 112 or 123 on the top and bottom surfaces of substrates 111 or 125, respectively), as taught by Zeng-014. VICOR-1003, ¶76.

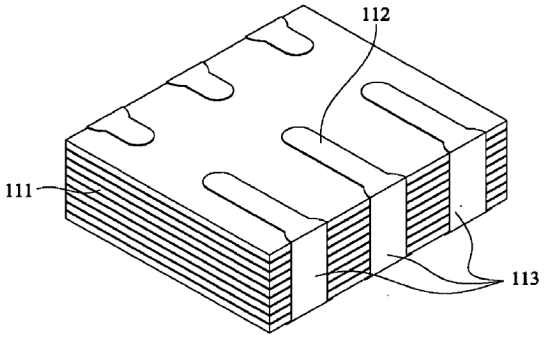


FIG. 11C

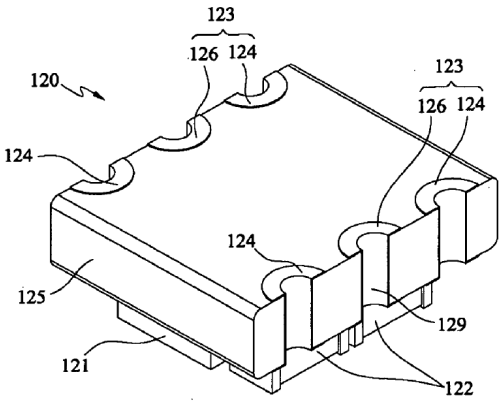


FIG. 12B

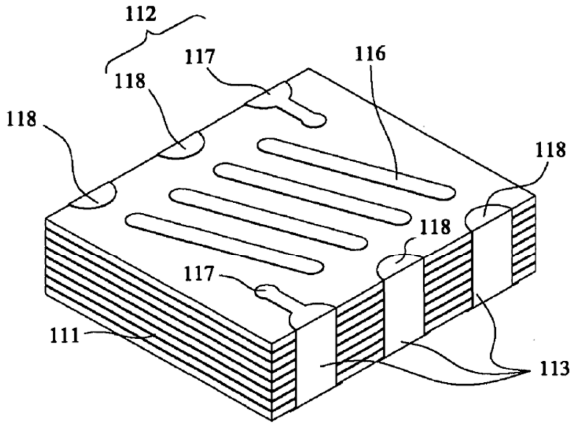


FIG. 11D

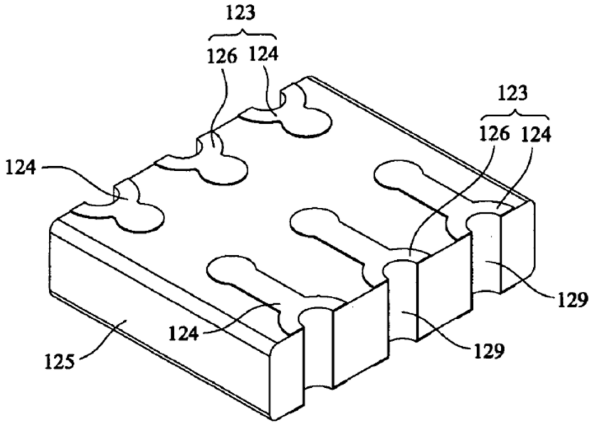


FIG. 12C

Finally, as noted above, the terminals on the top and bottom surfaces in the combination would be or have SMD pads, and thus (d) the two SMD pads of each

of the pins in the combination extend to an upper surface and a lower surface of Vinciarelli-218's insulation material 805, 806, respectively. VICOR-1003, ¶77; VICOR-1006, Fig. 35, [00159]-[0160]; VICOR-1007, Figs. 11C, 11D, 12B, 12C.

A skilled artisan would have been motivated to modify Vinciarelli-218 as described above for several reasons. VICOR-1003, ¶¶78-86.

First, Vinciarelli-218 discloses that many variations for the power converter module, including variations for contacts to external components or circuits, such as through-hole and surface mount options. VICOR-1006, Figs. 15-26, 33-36. Vinciarelli-218 further discloses that it may be beneficial to have a module that is press-fit into a surface mount adapter or flush mounted to a motherboard. *Id*., [0124]-[0125], [0130]-[0133]. Vinciarelli-218 further teaches the desirability of "decreasing [the] mounting area on [a] customer motherboard." *Id*., [0003].

Second, the skilled artisan would turn to Zeng-014 given Zeng-014's teaching that board space can be saved and power density increased by using Zeng-014's pin conductors or pins to "stack" electrically connected external components on the component. VICOR-1007, Abstract, [0012], [0013]. Since Vinciarelli-218 discloses a component that is a DC-DC power converter module, a skilled artisan would understand that enabling electrically connected stacking would permit, for example, multiple DC-DC power converter modules to connected in parallel to increase power throughput without taking up additional board space, thereby

increasing power density. Also, a skilled artisan would have been motivated to stack input or output capacitors onto the power converter module to save space. VICOR-1003, ¶80 (discussing Vinciarelli-166's disclosure of parallel power converters and Design Guide's disclosure of input/output capacitors). VICOR-1003, ¶80 (discussing Vinciarelli-166). Also, a skilled artisan would have been motivated to stack input or output capacitors onto the power converter module to save space. *Id*.

Third, a skilled artisan would have recognized that Zeng-014's surface conductors provide a flush surface mount identified as desirable in Vinciarelli-218 without the need for a surface mount adapter. VICOR-1003, ¶81.

Fourth, Zeng-014 teaches that the inductor in the figures "is only for purpose[s] of illustration, and in practice, the technology disclosed in this invention may be applied to other electronic components." VICOR-1007, [0057]. Thus, a skilled artisan would have recognized Zeng-014's applicability to the power converter modules of Vinciarelli-218, which are electronic components having a cuboid general form factor like the inductor component and substrates of Zeng-014. VICOR-1003, ¶82.

Fifth, Vinciarelli-218 and Zeng-014 both concern improvements to small power converters to provide increased "power density" and decreasing the circuit board "area" used by the power converters. VICOR-1006, [0003]; VICOR-1007,

[0003], [0008], [0010], [0012], [0065]. A skilled artisan would thus turn to both references given their common concerns to apply beneficial features of each reference. VICOR-1003, ¶83.

A skilled artisan applying the teachings of Zeng-014 to Vinciarelli-218 would have been motivated to reduce the space used by the contact adapters of Vinciarelli-218 by applying Zeng-014's connecting/pin conductors to Vinciarelli-218's module to provide contact surfaces on the top, bottom, and sides of the module, as taught by Zeng-014. VICOR-1003. ¶84. One example of how this modification would be performed can be illustrated by the combination of Fig. 35 of Vinciarelli-218 and Figs. 11A-G (third embodiment) or Figs. 12A-12D (fourth embodiment) of Zeng-014. In the combination, the lead frames in Vinciarelli-218 would be replaced by the pins 117 or 126 of Zeng-014's third and fourth embodiments, which would connect to the PCB 804 in Vinciarelli-218 via interconnects 811-813. VICOR-1003, ¶85; VICOR-1007, [0074]-[0075].

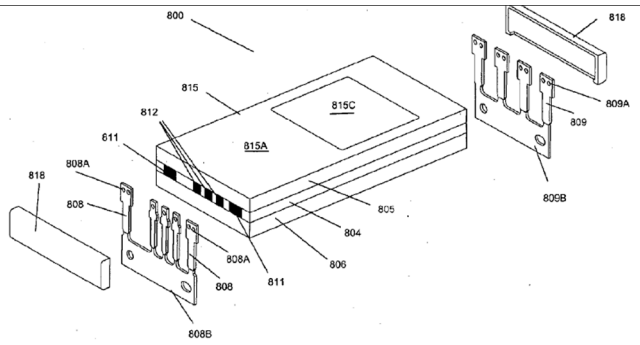


FIG. 35

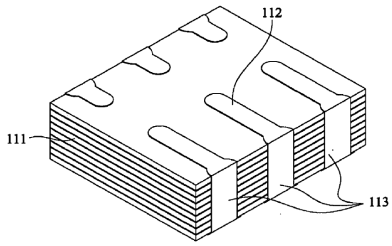


FIG. 11C

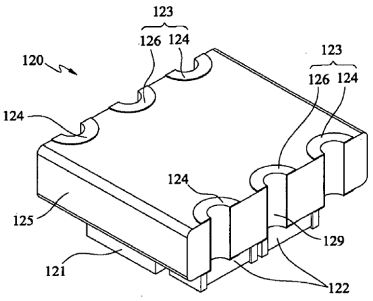


FIG. 12B

Vinciarelli-218	**Zeng-014**

A skilled artisan also would have reasonably expected to succeed because the modifications proposed here would have been well within the skilled artisan's abilities. VICOR-1003, ¶86; *see also* VICOR-1013, Fig. 2 (illustrating an electronic chip component with a structure similar to the proposed combination). Indeed, it would have been merely the application of a known technique (using connecting/pin conductors, as taught by Zeng-014) with a known system (Vinciarelli-218's module) in the same field of endeavor (power converters). VICOR-1003, ¶86; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). And, in the combination, each element merely performs the same predictable function as it does separately, without significantly altering or hindering the functions performed by Vinciarelli-218's module or Zeng-014's surface conductors. VICOR-

1003, ¶86. In fact, the Vinciarelli-218 module would continue to perform all the functions it performed before the proposed modification. *Id*. In addition, the modification is a mechanical modification based on the teachings of Zeng-014 that provides fewer parts for assembly. *Id*.

2. The power supply apparatus of claim 1, further comprising: a plurality of first pads disposed on lateral sides of the bearing plate.

Vinciarelli-218 discloses a plurality of first pads (interconnects 811 and 812, shown below) disposed on the bearing plate as well as similar interconnects (not visible in Figs. 33-36) disposed on the opposite side of the bearing plate. VICOR-1003, ¶87; VICOR-1006, Figs. 33-36, [0159]-[0160]; *see also* VICOR-1006, [0106]-[0111], [0115] (pads on long and short sides of PCB), [0137]. As shown below, the pads are disposed on lateral sides of the bearing plate. *Id*.

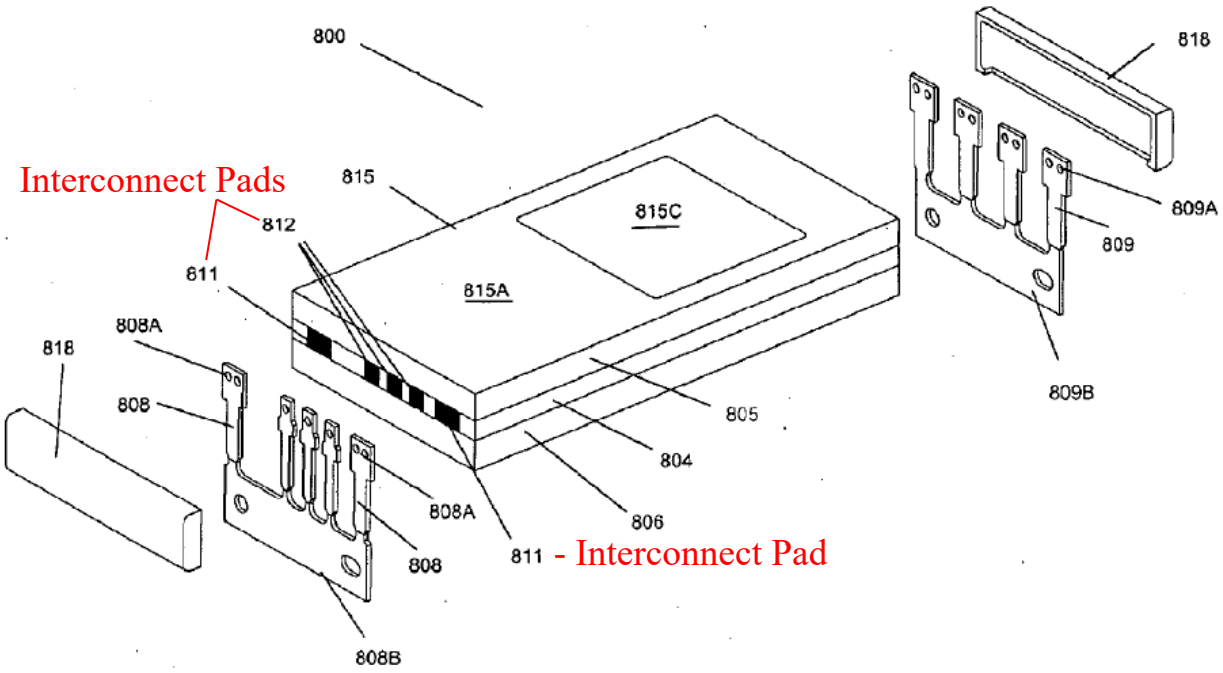


FIG. 35

VICOR-1006, Fig. 35.

3. The power supply apparatus of claim 2, wherein the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate.

See Ground 1, Element [1c]. In the combination, the side contact portions of the pins are electrically coupled to the pads (Vinciarelli-218's interconnects 811, 812), which are electrically connected to the PCB. VICOR, 1003, ¶88; VICOR-1006, Figs. 33-36, [0160]; *see also* VICOR-1006, [0106]-[0111], [0115] (pads on long and short sides of PCB), [0137].

4. The power supply apparatus of claim 1, wherein edges of the upper surface and the lower surface of the insulation material have recesses, and the two SMD pads of each of the pins extend to the recesses at the upper surface and the lower surface of the insulation material.

In the Vinciarelli-218/Zeng-014 combination that uses pin conductors similar to Zeng-014's third and fourth embodiments (Figs. 11A-G, 12A-D), edges of the upper surface (top) and the lower surface (bottom) of Vinciarelli-218's insulation material (encapsulant 805, 806) have recesses (semi-circular through holes). VICOR-1003, ¶¶89-100; VICOR-1007, Figs. 11A-G, 12A-D.

In Zeng-014's third embodiment, "semi-circular through-holes are formed at [] opposite sides of each magnetic [] layer" of inductor 111 and "filled with a metal" to form pins 117. VICOR-1007, [0074]. Those pins occupy the semi-circular through holes, which are recesses, and include recesses at the top and bottom layers. *Id.* Fig. 11D. The pads (*e.g.*, pins 117) extend to those recess. *Id.,*

Fig. 11D, and the pins within each semi-circular through hole reaches the recesses at the top and bottom surface layers. *Id.,* Fig 11D. It would have been obvious to create similar pins with SMD pads in Vinciarelli-218's module to connect to the PCB through the "bar code" interconnects in a similar manner. VICOR-1003, ¶90.

Zeng-014's fourth embodiment is like the third embodiment, except that the conductors (129) forming pins 126 do not completely fill the semi-circular through holes, which nonetheless form recesses in the upper and lower surfaces of the insulation material to which the pins extend. VICOR-1003, ¶91; VICOR-1007, Figs. 12A-D. It would have been obvious for a skilled artisan to create similar pins in Vinciarelli-218's module to connect the PCB "bar code" interconnects to SMD pads in a similar manner. VICOR-1003, ¶91. The pin 126 in this embodiment connects with an internal pin 128 along a lateral edge of the module (Fig. 12D), and it would have been obvious for a skilled artisan to connect Vinciarelli-218's bar code interconnects to external pins in a similar manner. VICOR-1003, ¶91.

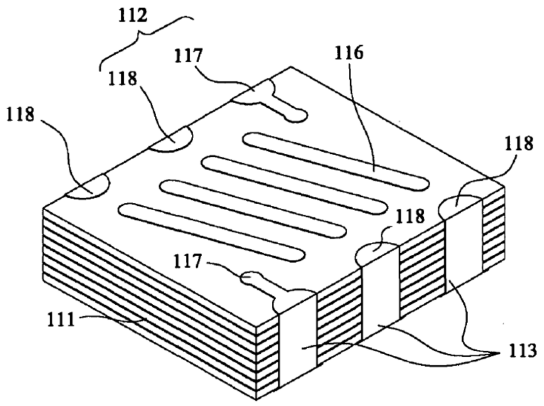


FIG. 11D

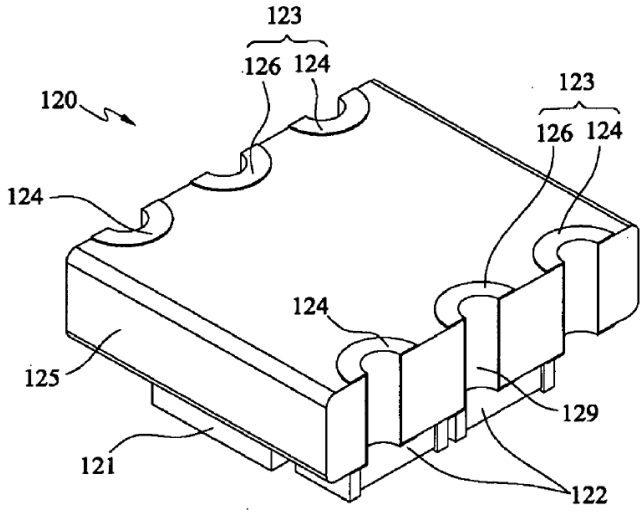


FIG. 12B

VICOR-1007, FIGs. 11D, 12B.

Furthermore, in the Vinciarelli-218/Zeng-014 combination using the fourth embodiment of Zeng-014 would look like FIG. 12B, above, which has a recess at the upper and lower surface in the lateral direction. It would have further been obvious to have a vertical recess at the top and bottom surfaces of the device so that the conductors 126 and 124 are flush with the surface as disclosed in FIG. 14B of Zeng-014. VICOR-1003, ¶92.

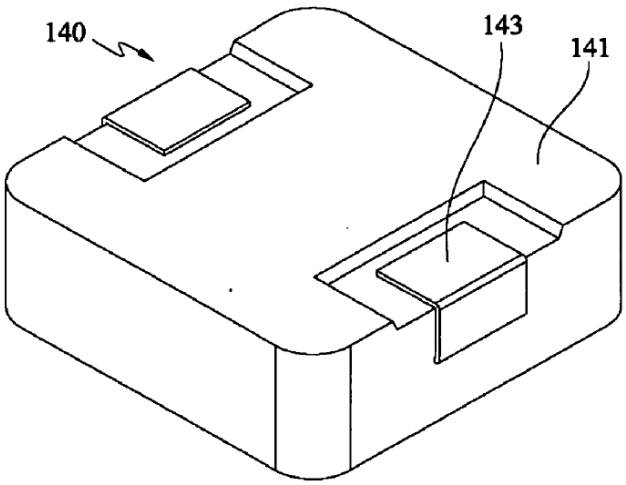


FIG. 14B

VICOR-1007, Fig. 14B; *see also* VICOR-1006, [0128], Fig. 21-24 (showing similar recesses for surface mound pads 508D in Vinciarelli-218's module).

Accordingly, edges of the upper surface (top) and the lower surface (bottom) of Vinciarelli-218's insulation material (encapsulant 805, 806) would have recesses (like those shown above), and the two SMD pads (contacts, in accordance with Zeng-014) of each of the pins would extend to the recesses at the upper surface and the lower surface of the insulation material. VICOR-1003, ¶93; VICOR-1007, Figs. 14A-C.

A skilled artisan would have been motivated to include such vertical recesses for several reasons. VICOR-1003, ¶¶93-100. **First**, Vinciarelli-218 discloses that many variations for the power converter module, including variations for contacts to external components, such as through-hole and surface mount options. VICOR-1006, Figs. 15-26, 33-36. Vinciarelli-218 further discloses that it

may be beneficial to have a module that is flush mounted to a motherboard. *Id*., [0124]-[0125], [0130]-[0133]. Vinciarelli-218 further teaches the desirability of "decreasing [the] mounting area on [a] customer motherboard." *Id*., [0003]. A skilled artisan would have understood that using recesses for surface mount pads in the combination, as described above, would have enabled Vinciarelli-218's modules to be flush mounted. VICOR-1003, ¶95.

Second, the skilled artisan would turn to Zeng-014 given Zeng-014's teaching that board space can be saved by using Zeng-014's surface conductor to "stack" external components on the component using the surface conductor, and providing recesses can lower the level of the stacked component and help with the solderability and mounting of the devices. VICOR-1007, Abstract, [0013]; VICOR-1003, ¶96.

Third, a skilled artisan would have recognized that Zeng-014's surface conductor provides the flush surface mount identified as desirable in Vinciarelli-218 without the need for a surface mount adapter. VICOR-1003, ¶97; VICOR-1006, [0124]-[0125], [0130]-[0133].

Fourth, Zeng-014 teaches that the inductor in the figures "is only for purpose[s] of illustration, and in practice, the technology disclosed … may be applied to other electronic component[s]." VICOR-1007, [0057]. Thus, a skilled artisan would have recognized Zeng-014's applicability to the power converter

modules of Vinciarelli-218, which are electronic components having a general form factor like the inductor components of Zeng-014. VICOR-1003, ¶98.

Fifth, Vinciarelli-218 and Zeng-014 both concern improvements to small power converters to provide increased "power density" and decreasing the circuit board "area" used by the power converters. VICOR-1006, [0003]; VICOR-1007, [0003], [0008], [0010], [0065]. A skilled artisan would thus turn to both references given their common concerns to apply beneficial features of each reference. VICOR-1003, ¶99.

A skilled artisan also would have reasonably expected to succeed because the addition modification proposed here would have been well within the skilled artisan's abilities. VICOR-1003, ¶100. Indeed, it would have been merely the application of a known technique (using recesses as taught by Zeng-014 and Vinciarelli-128) with a known system (Vinciarelli-128's module) in the same field of endeavor (power supply apparatuses). *Id*.; *KSR*, 550 U.S. at 417. And, in the combination, each element merely performs the same predictable function as it does separately, without significantly altering or hindering the functions performed by the Vinciarelli-128/Zeng-014 module. VICOR-1003, ¶100. In fact, the Vinciarelli-128/Zeng-014 module would continue to perform all the functions it performed before the proposed modification and the addition of recesses would simply reduce the space needed to mount the module(s). *Id*.

5. The power supply apparatus of claim 2, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

The Vinciarelli-218/Zeng-014 combination includes at least one second pad (upper or lower portion of any wrap-around contact, in accordance with Zeng-014) that is located at an upper surface or a lower surface of the insulation material (Vinciarelli-218's encapsulant 805 or 806) and is electrically connected (via Vinciarelli-218's interconnects 811, 812 and Zeng-014's conductors 113 or 129 and pins 117 or 126) to the bearing plate. VICOR-1003, ¶101; VICOR-1007, Figs. 11D, 12C.

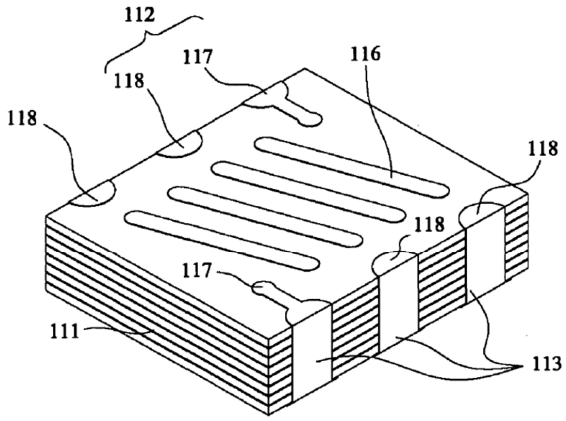


FIG. 11D

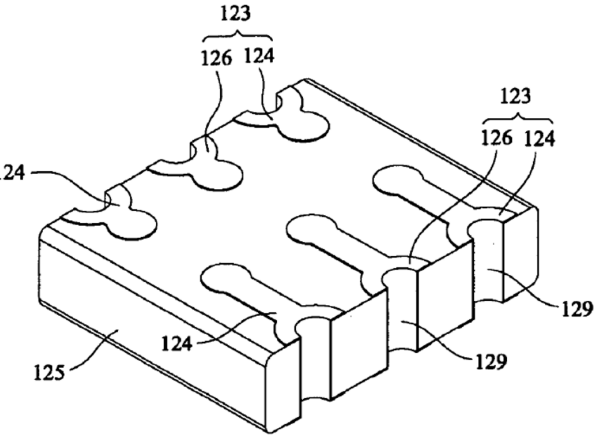


FIG. 12C

VICOR-1007, 11D, 12C.

6. The power supply apparatus of claim 1, wherein the two opposite surfaces of the bearing plate are covered with the insulation material, and at least one lateral side of the bearing plate is exposed from the insulation material.

See Ground 1, Elements [1b] (demonstrating that opposite surfaces of the

bearing plate are covered with insulation material) and [1c] (demonstrating that at least one lateral side of the bearing plate is exposed from the insulation material and thus reveals Vinciarelli-218's interconnects 811, 812); VICOR-1003, ¶102.

7. The power supply apparatus of claim 1, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

See Ground 1, Claim 5.

8. The power supply apparatus of claim 1, wherein the power supply apparatus is a power unit or a control unit.

The Vinciarelli-218/Zeng-014 power supply apparatus is a power unit. VICOR-1003, ¶104; VICOR-1006, Abstract ("power converter").

[10pre] A power supply apparatus, comprising:

See Ground 1 Element [1pre].

[10a] a bearing plate

See Ground 1, Element [1a].

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

See Ground 1, Element [1b].

[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.

See Ground 1, Element [1c] (confirming that the Vinciarelli-218/Zeng-014 combination includes 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); Ground 1, Claim 4 (confirming that, in the Vinciarelli-218/Zeng combination, edges of the upper surface and the lower surface of the insulation material have recesses, and the two SMD pads of each of the pins extend to the recesses at the upper surface and the lower surface of the insulation material); VICOR-1003, ¶109.

In the Vinciarelli-218/Zeng-014 combination, the bearing plate (Vinciarelli-218's PCB 804) is also embedded in the insulation material (encapsulation layers 805, 806) to form a cuboid body as shown below in Figure 35 of Vinciarelli-218. VICOR-1003, ¶109.

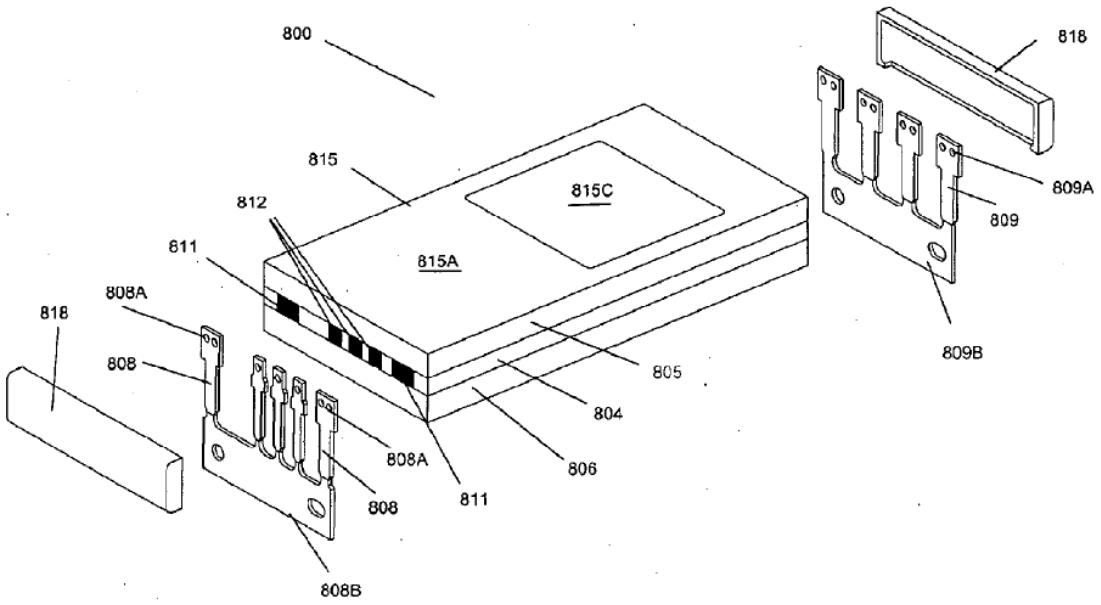


FIG. 35

VICOR-1006, Fig. 35.

11. The power supply apparatus of claim 10, further comprising: a plurality of first pads disposed on lateral sides of the cuboid body, wherein the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate.

See Ground 1, Claim 2 (confirming the combination includes a plurality of first pads disposed on lateral sides of the cuboid body), Claim 3 (confirming that the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate); VICOR-1003, ¶110.

12. The power supply apparatus of claim 10, further comprising: at least one second pad, wherein the second pad is located at the upper surface or the lower surface of the cuboid body and the second pad is electrically connected to the bearing plate.

See Ground 1, Claim 5.

B. GROUND 2 – Claims 1-8 and 10-12 are Anticipated by Zeng-014

For this Ground, Petitioner relies on two embodiments of Zeng-014: (i) DC to DC converter 110; and (ii) DC to DC converter 120. Each DC to DC converter anticipates claims 1-2, 4-8, 10, and 12. DC to DC converter 120 also anticipates claims 3 and 11.

[1pre]. A power supply apparatus, comprising:

Zeng-014 discloses this element. VICOR-1003, ¶124. Zeng-014 discloses DC to DC converters 110 and 120. VICOR-1007, 11A-G, 12A-D, and related

descriptions. Each DC to DC converter 110, 120 is a power supply apparatus. VICOR-1003, ¶124; VICOR-1007, [0073] ("DC to DC converter 110"), [0076] ("DC to DC converter 120").

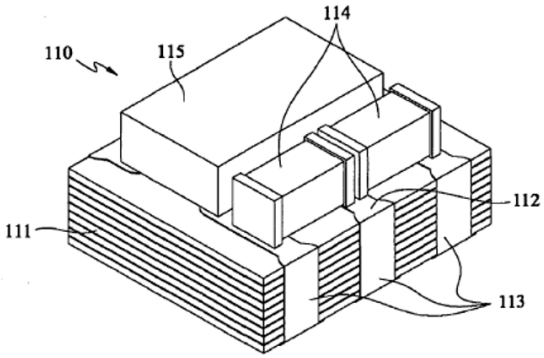


FIG. 11A

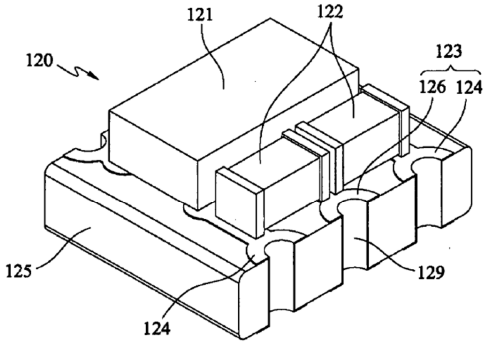


FIG. 12A

[1a] a bearing plate;

Each of Zeng-014's DC to DC converters 110 and 120 includes a bearing plate (stack of co-fired magnetic substrates 111 for converter 110 and magnetic material substrate 125 or the internal inductance coil 127 and laterally surrounding substrate layer for converter 120). VICOR-1003, ¶125; VICOR-1007, Figs. 11A-B, 12A-B, [0073], [0076]. Each magnetic substrate (or stack of magnetic substrates) is a bearing plate because it is used for mounting other elements, such as integrated circuit 115 and capacitors 114 in DC to DC converter 110, and integrated circuit 121 and capacitors 122 in DC to DC converter 120. VICOR-1003, ¶125.

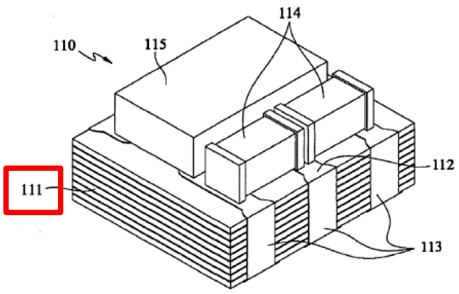


FIG. 11A

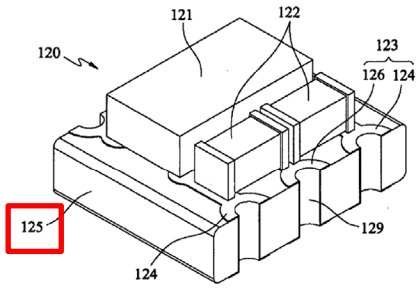


FIG. 12A

VICOR-1007, Figs. 11A, 12A.

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

Each of Zeng-014's DC to DC converters 110 and 120 includes an insulation material formed on two opposite surfaces (the top surface and the bottom surface) of the bearing plate. VICOR-1003, ¶¶126-130.

DC to DC converter 110

Regarding DC to DC converter 110, Zeng-014 teaches that the stack of magnetic substrates 111 in Fig. 11A forms an inductor. VICOR-1007, [0074]. With regard to the inductor (bearing plate), Zeng-014 explains that an "insulation material layer is applied to each of the top surface and the bottom surfaces of the completed" device, after which "semi-circular through-holes are formed in the magnetic material layers or the insulation material layers and filled with a metal material," thereby forming the pins 117/118 with conductors 113 that extend from the top to the bottom (insulating surface). VICOR-1007, [0075].

Furthermore, the top and bottom (and side) surfaces of the magnetic material

substrates 111 are necessarily insulators, because semi-circular through holes are formed in the magnetic material layers or the insulation material layers and filled with a metal to form conductive elements 119 and pins 117 and 118. It is thus inherent (and a skilled artisan would have at-once envisaged) that the outer surfaces of the substrate be insulating to prevent short circuits between the conductors 113 forming the pins 117 and 118. *Id*., [0074]-[0075]; VICOR-1003, ¶128.

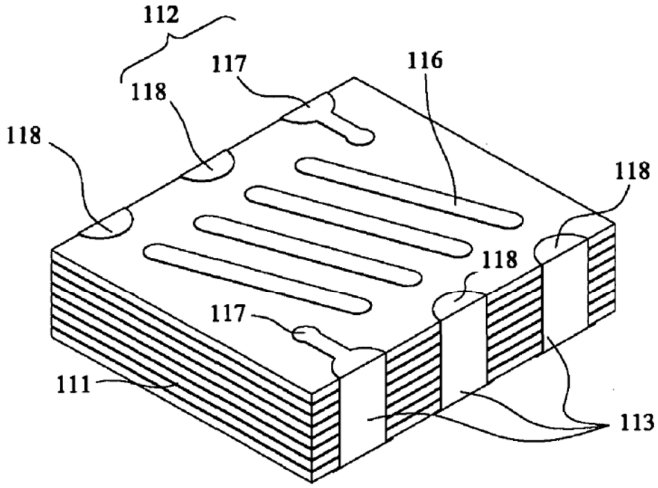


FIG. 11D

DC to DC converter 120

Although Zeng-014 does not expressly describe insulation material formed on opposite surfaces of the bearing plate in DC to DC converter 120, it is evident that the top and bottom surfaces are necessarily insulated. VICOR-1003, ¶129. Both sides of the substrate include conductor pins (124 and 126) that form pads on both the top and bottom surfaces of the substrate 125. Thus, the top and bottom

surfaces of the substrate are inherently insulating so as not to form short circuits between the pins. VICOR-1003, ¶129.

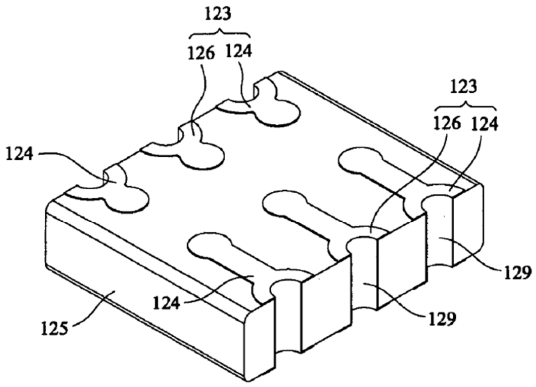


FIG. 12C

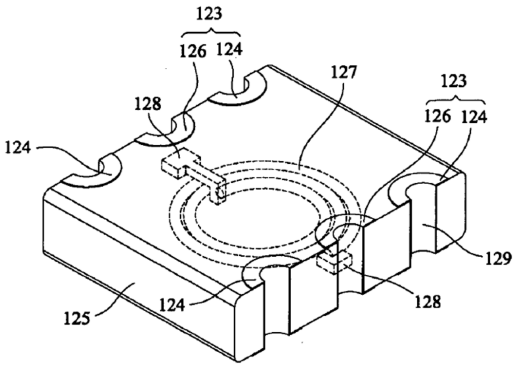


FIG. 12D

VICOR-1006, Figs. 12C-D (and related descriptions).

Furthermore, as explained above, Zeng-014 expressly teaches that DC to DC converter 110, which is similar to DC to DC converter 120, includes an "insulation material layer [that] is applied to each of the top surface and the bottom surfaces of the completed" device. VICOR-1007, [0075]; *see also* [0079] (disclosing "insulating layer 133"). Accordingly, a skilled artisan would have at once envisaged the use of an insulation material layer in DC to DC converter 120. VICOR-1003, ¶130; *see also Blue Calypso, LLC v. Groupon, Inc*., 815 F.3d 1331, 1341 (Fed. Cir. 2016) (quoting *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015)) ("a reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the

claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination").

[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.

Each of Zeng-014's DC to DC converters 110 and 120 includes element [1c]. VICOR-1003, ¶¶131-134.

DC to DC converter 110

DC to DC converter 110 includes a plurality of pins (combination of pins 117 and conductors 113) electrically connected (via inductor coils 116 formed within the magnetic substrate 111) to the bearing plate (111). VICOR-1003, ¶131; VICOR-1007, Figs. 11D-E, [0075]. As shown below, the pins are allocated along the lateral sides of the insulation material forming the top and bottom surfaces of the module.

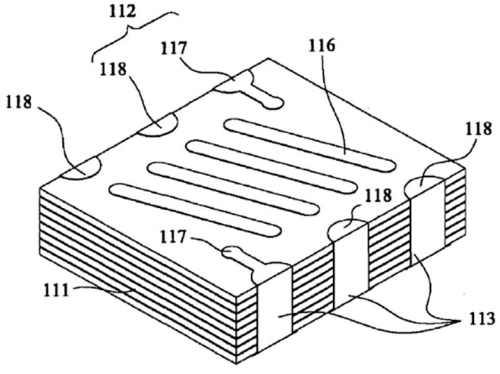


FIG. 11D

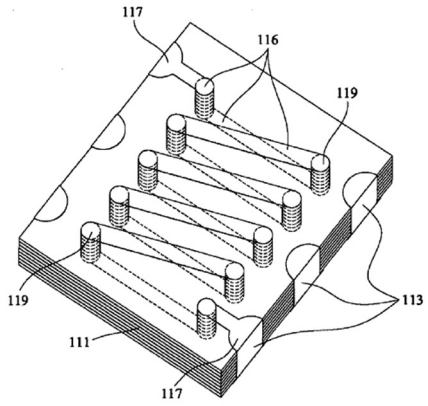


FIG. 11E

VICOR-1007, Figs. 11D-E.

As can be seen in Figures 11A and 11B, the two terminals (top and bottom) of each of the pins have two SMD pads (pins 117), wherein the two SMD pads (117) of each of the pins extend to an upper surface and a lower surface of the insulation material forming the top and bottom surfaces of the module, respectively:

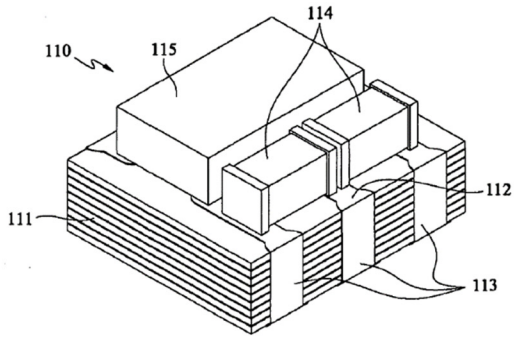


FIG. 11A

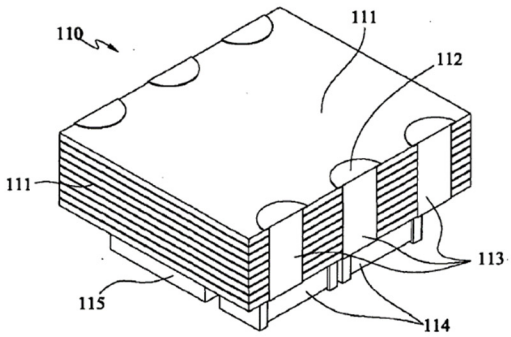


FIG. 11B

VICOR-1007, Figs. 11A-B; VICOR-1003, ¶132.

DC to DC converter 120

DC to DC converter 120 also includes a plurality of pins (combination of pins 126 and conductors 129) electrically connected (via pins 128 of inductor coil 127 formed within the magnetic substrate 125) to the bearing plate (125). VICOR-1003, ¶¶133-134; VICOR-1007, Figs. 12C-D, [0077]. As shown below, the pins are allocated along the lateral sides of the insulation material forming the top and bottom surfaces of the module.

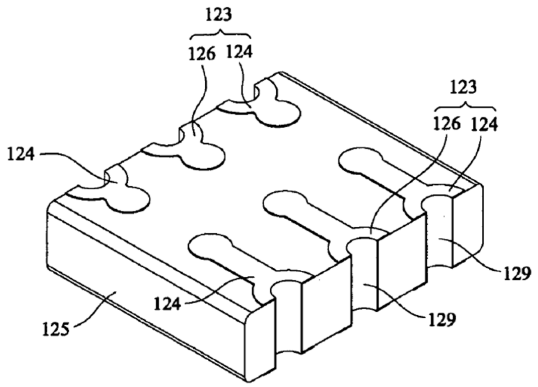


FIG. 12C

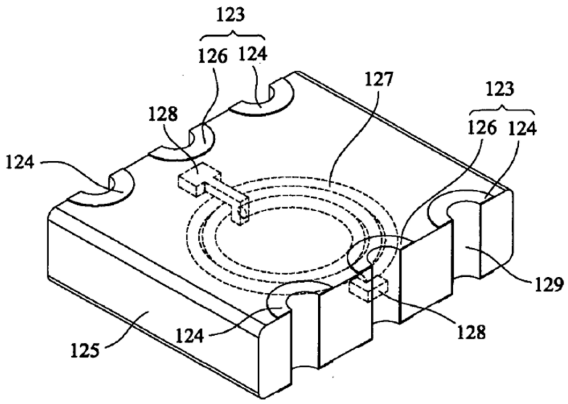


FIG. 12D

As can be seen in Figures 12A and 12B (shown below), the two terminals (top and bottom) of each of the pins have two SMD pads (pins 126), wherein the two SMD pads (126) of each of the pins extend to an upper surface and a lower surface of the insulation material forming the top and bottom surfaces of the module, respectively. VICOR-1003, ¶134; *see also* Ground 2, Element [1b] (explaining why the insulation layers are inherent in DC to DC converter 120).

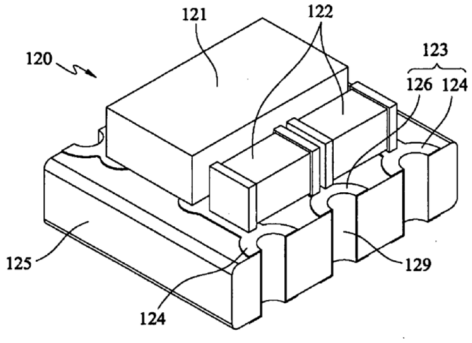


FIG. 12A

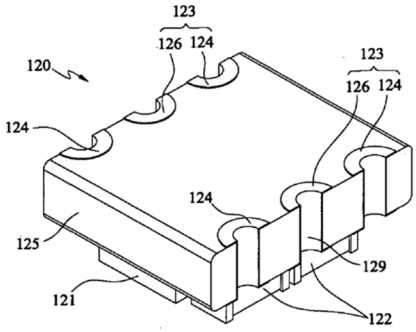


FIG. 12B

2. The power supply apparatus of claim 1, further comprising: a plurality of first pads disposed on lateral sides of the bearing plate.

Each of Zeng-014's DC to DC converters 110 and 120 includes a plurality of first pads (conductors 113 and 129, respectively, and/or the connection point

between those conductors and the internal component, hidden from view by the depicted conductors) disposed on lateral sides of the bearing plate. VICOR-1003, ¶135; VICOR-1007, Figs. 11D, 12C (and corresponding descriptions).

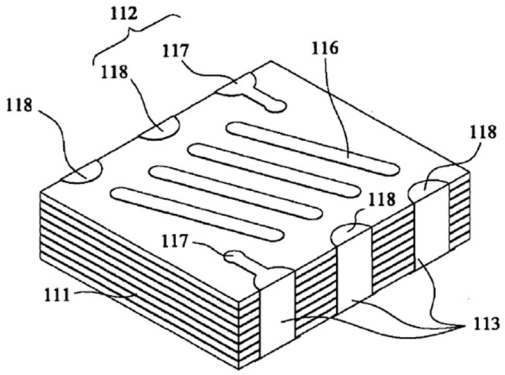


FIG. 11D

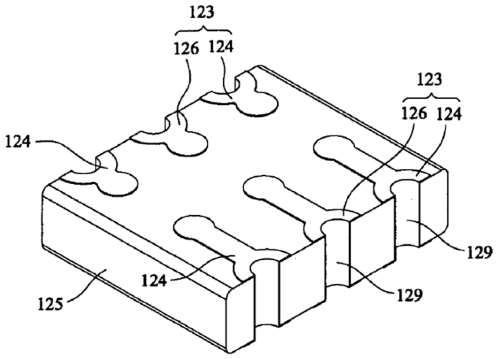


FIG. 12C

Additionally or alternatively, Zeng-014's DC to DC converter 120 includes a plurality of first pads (pins 128) disposed on lateral sides of the bearing plate. VICOR-1003, ¶135; VICOR-1007, Figs. 12C, 12D. As can be seen below, first pads (pins 128) are in electrical and physical contact with conductors 129 of the pins 126 on lateral sides of the bearing plate, requiring that they be disposed on the lateral sides of the bearing plate. VICOR-1007, Figs. 12C-D, [0077]. Alternatively, the pad would be the point at which conductor 129 and pins 128 meet. VICOR-1003, ¶135.

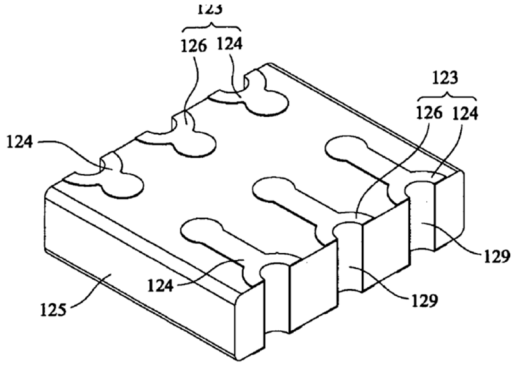


FIG. 12C

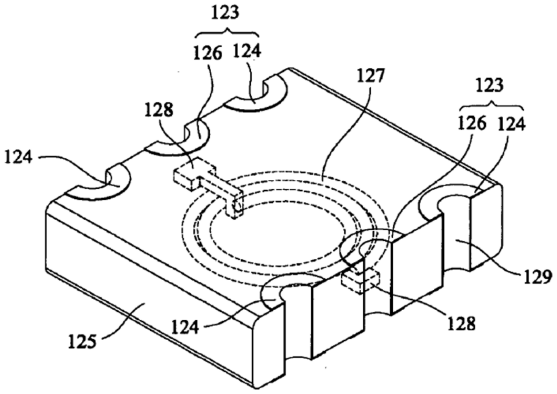


FIG. 12D

VICOR-1007, Figs 12C-D.

3. The power supply apparatus of claim 2, wherein the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate.

See Ground 2, Element [1c] (identifying the claimed pins in Zeng-014). In Zeng-014's DC to DC converter 120, the pins (126/129) are electrically connected to the pads (the tips of pins 128, which connect to pins 126/129), which are electrically connected (via coil 127) to the bearing plate (125). VICOR, 1003, ¶136; VICOR-1006, [0083], Fig. 12D.

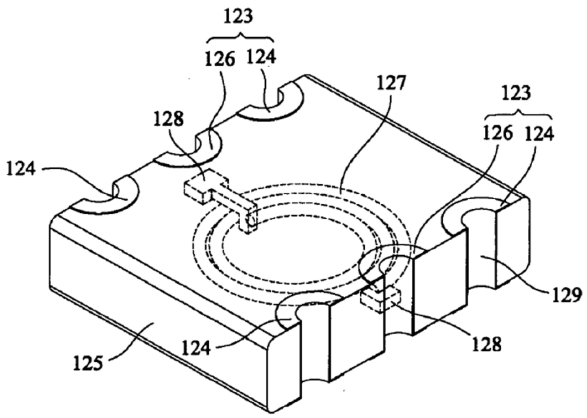


FIG. 12D

VICOR-1007, Figs. 12D.

4. The power supply apparatus of claim 1, wherein edges of the upper surface and the lower surface of the insulation material have recesses, and the two SMD pads of each of the pins extend to the recesses at the upper surface and the lower surface of the insulation material.

In Zeng-014's DC to DC converters 110 and 120, the edges of the upper surface and the lower surface of the insulation material have recesses (semi-circular through holes), and the two SMD pads (pins 117 in Fig. 11D and corresponding surface on opposing side in Fig. 11B as well as pins 126 in Figs. 12C and 12D) of each of the pins extend to the recesses at the upper surface and the lower surface of the insulation material. VICOR-1003, ¶137; VICOR-1007, Figs. 11A-G, 12A-D, [0073], [0076].

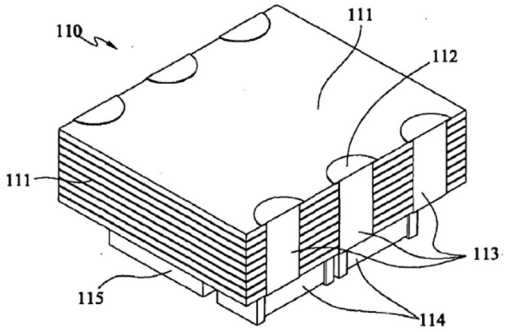


FIG. 11B

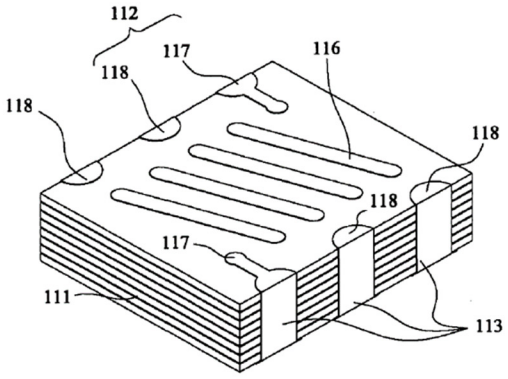


FIG. 11D

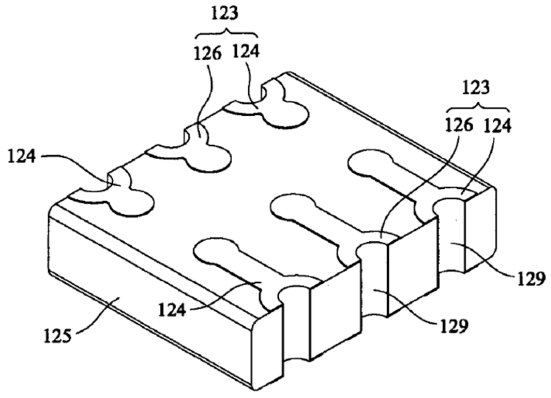


FIG. 12C

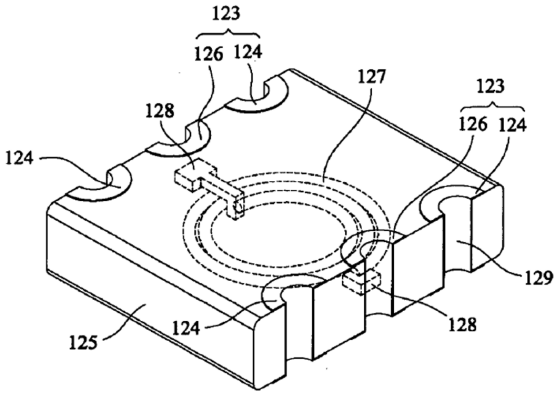


FIG. 12D

VICOR-1007, Figs. 11B, 11D, 12C-D.

5. The power supply apparatus of claim 2, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

Zeng-014's DC to DC converters 110 and 120 each include at least one second pad (at least one of pins 117 and 126, respectively) that is located at an upper surface or a lower surface of the insulation material and is electrically connected (via inductor coil 116 and 127, respectively) to the bearing plate (111 and 125, respectively). VICOR-1003, ¶138; VICOR-1007, Figs. 11A-E, 12A-D (and related descriptions).

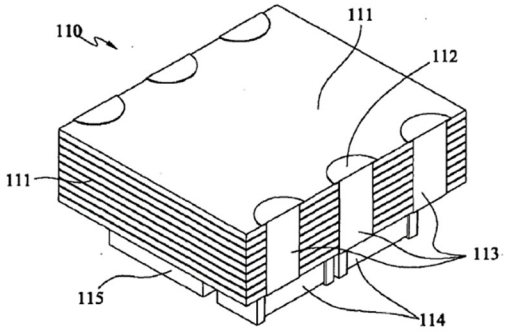


FIG. 11B

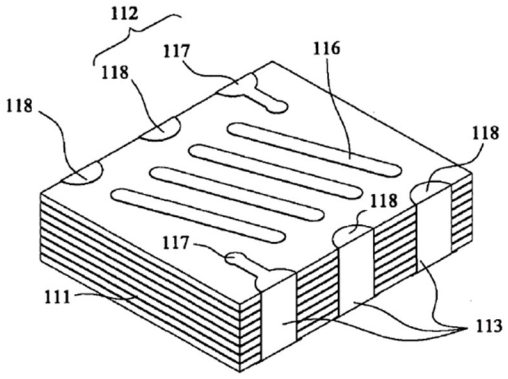


FIG. 11D

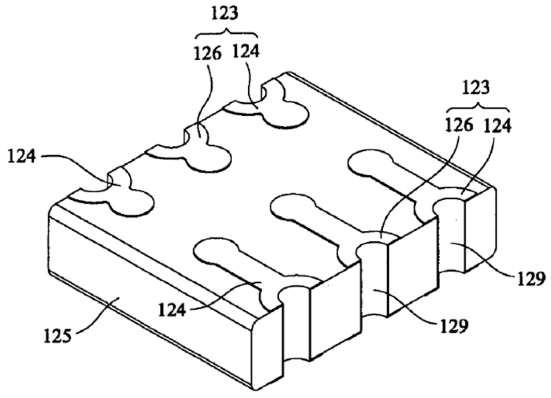


FIG. 12C

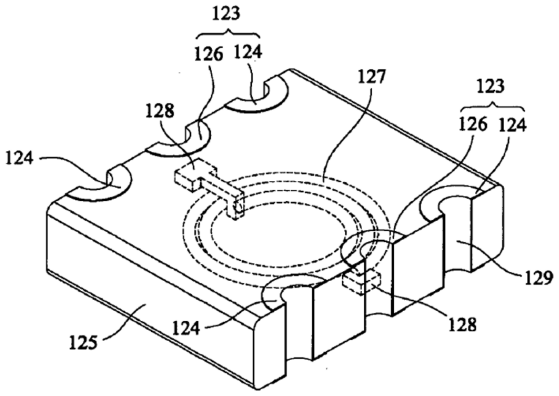


FIG. 12D

VICOR-1007, Figs. 11B, 11D, 12C-D.

6. The power supply apparatus of claim 1, wherein the two opposite surfaces of the bearing plate are covered with the insulation material, and at least one lateral side of the bearing plate is exposed from the insulation material.

In Zeng-014's DC to DC converter 110, two opposite surfaces of the bearing plate are covered with the insulation material, while the sides are not covered with the insulation material that covers to top and bottom sides. *See* Ground 2, Element [1b] (demonstrating that opposite surfaces of the bearing plate in DC-DC converter 110 are covered with insulation material). Further, a skilled artisan would have understood that at least two lateral sides of the bearing plate in Zeng-014's DC-DC converter 120, would necessarily be exposed from the insulation material to permit the required electrical connection between the pins and the first pads. VICOR-1003, ¶139.

7. The power supply apparatus of claim 1, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

See Ground 2, Claim 5.

8. The power supply apparatus of claim 1, wherein the power supply apparatus is a power unit or a control unit.

Each of Zeng-014's DC to DC converters 110 and 120 is a power unit. VICOR-1003, ¶141.

[10pre] A power supply apparatus, comprising:

See Ground 2, Element [1pre].

[10a] a bearing plate

See Ground 2, Element [1a].

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

See Ground 2, Element [1b].

[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.

See Ground 2, Element [1c] (confirming that the Zeng-014's DC to DC converters each include 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) and Claim 4 (confirming that, in Zeng-014's DC to DC converters 110 and 120, edges of the upper surface and the lower surface of the insulation material have recesses, and the two SMD pads of each of the pins extend to the recesses at the upper surface and the lower surface of the insulation material); VICOR-1003, ¶144.

In Zeng-014's DC to DC converters 110 and 120, the bearing plate (111 and 125, respectively) is embedded in the insulation material (i.e., "insulation material layer [that] is applied to each of the top surface and the bottom surfaces of the

completed" device, VICOR-1007, [0075]) (*see* Ground 2, Element [1b]) to form a cuboid body as shown below. VICOR-1003, ¶144.

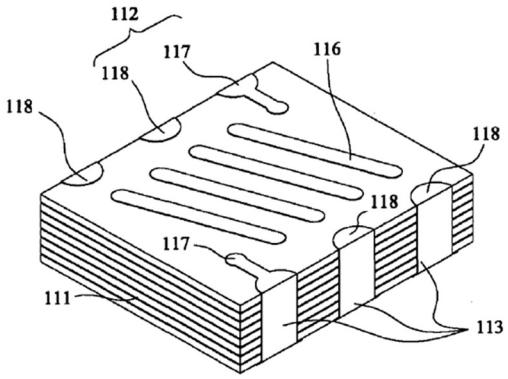


FIG. 11D

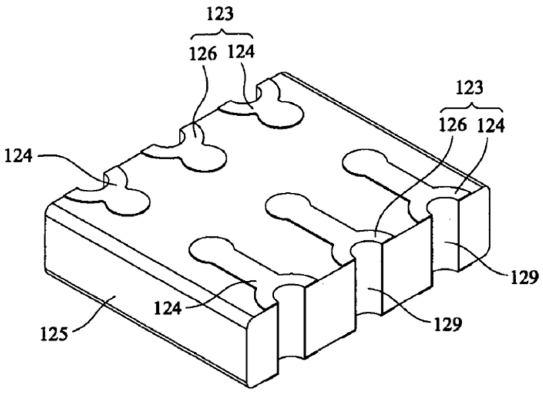


FIG. 12C

VICOR-1007, Figs. 11D, 12C.

11. The power supply apparatus of claim 10, further comprising: a plurality of first pads disposed on lateral sides of the cuboid body, wherein the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate.

See Ground 2, Claims 2-3. The analysis for claims 2 and 3 applies to the cuboid body of claim 10. VICOR-1003, ¶145.

12. The power supply apparatus of claim 10, further comprising: at least one second pad, wherein the second pad is located at the upper surface or the lower surface of the cuboid body and the second pad is electrically connected to the bearing plate.

See Ground 2, Claim 5. The analysis for claim 5 applies to the cuboid body of claim 10. VICOR-1003, ¶146.

C. GROUND 3 – Claims 1-8 and 10-12 are Obvious Over Zeng-014 alone and, if necessary, in combination with Jun

As shown in Ground 2, Zeng-014 discloses each element of claims 1-8 and

10-12. Each of those claims would also have been obvious over Zeng-014 (in a single reference obviousness analysis) based on general knowledge in the art. VICOR-1003, ¶¶147-151. For example, Zeng-014 expressly discloses separate insulation layers on the upper and lower surfaces of the substrate (bearing plate) 111, but not for substrate (bearing plate) 125. *See* Ground 2, Element [1b]. To the extent not implicit or immediately envisaged, 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. In addition, Zeng-014 discusses adding an insulation layer in connection with Fig. 11, and that suggestion would motivate a skilled artisan to do so for the Fig. 12 embodiment as well to increase the insulation between the bearing plate and components above and below the bearing plate. VICOR-1003, ¶147.

Similarly, to the extent not implicit or immediately envisaged, a skilled artisan would have understood that Zeng-014's DC to DC converters 110 and 120 have (or at the very least it would have been obvious to provide) pads attached to the interior side of the lateral pins to electrically connect the pins to the internal components. For example, DC to DC converter 120 includes a plurality of first pads (pins 128) that 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. *See* Ground 2, Claims 2, 6. To the extent

not immediately envisaged or inherent, it would have been obvious in view of Zeng-014 alone and, if necessary, Jun to include such pads on lateral sides of the bearing plate and expose those lateral sides of the bearing plate from the insulation material to provide the required electrical connection between pins 128 and 126/129. VICOR-1003, ¶147; VICOR-1012, Figs. 10, 12a-g, 13a-g, [0043]-[0047] (describing connection bar 110), [0052]-[0055] (describing connection bar 210), [0060]-[0061] (describing connection bar 310). Similarly, DC to DC converter 110 would have pads between the pin on the external surface of substrate 111 and internal components, and an obvious location for such pads would be attached to the internal side of the lateral pins used for internal connections. VICOR-1003, ¶148.

Jun (VICOR-1012) discloses a connection pad (connection bars 110, 210) disposed on a lateral side of a cuboid multilayer substrate (bearing plate) to connect an external electrode 104, 204 formed in the lateral side to internal circuitry of the substrate (pattern layer 102, 202). VICOR-1012, [0043]-[0056], Figs. 10, 12g. Jun teaches that the use of a connection bar, which penetrates multiple sheets of the multilayer substrate, advantageously creates a large connection area between internal circuitry and the external electrode, thereby improving the degree of electrical connection between the circuitry and the external electrode. VICOR-1012, [0080], VICOR-1003, ¶149. It would have been

obvious to a skilled artisan to apply the teaching of Jun to form similar improved connections between the pins on the lateral surface of Zeng-014's DC-DC converter 110 and internal circuitry of bearing plate 111 by deploying connection bars (pads) on lateral sides, as recited in claims 2, 3 and 11. VICOR-1003, ¶149.

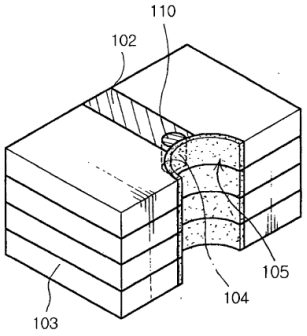


FIG. 10

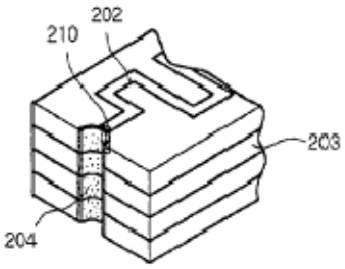


FIG. 12g

VICOR-1012, Figs. 10, 12g.

To the extent necessary, any such modifications would have been well-within the level of ordinary skill in the art. VICOR-1003, ¶¶150-151. Accordingly, a skilled artisan modifying Zeng-014 as described here would have reasonably expected to succeed. *Id*.

D. GROUND 4 – Claims 1-3 and 5-8 are Anticipated by Park

1. Summary of Park

Park discloses a packaging design for power supply apparatus, namely a power management integrated circuit (PMIC). VICOR-1009, [0005]; VICOR-1003, ¶¶152-157. The PMIC may include DC/DC converters. VICOR-1009, [0183].

Specifically, Park discloses an arrangement, like that of Fig. 1, comprising an inductor module 120 combined together with a capacitor module 110 as part of a PMIC circuit. As can be seen in Fig. 1, capacitor module 110 is stacked on top of inductor module 120 to form composite component 100, such that capacitor module 110 does not increase the footprint of composite component 100, relative to inductor module 120 alone. VICOR-1009, [0068], Figs. 1-3, 13.

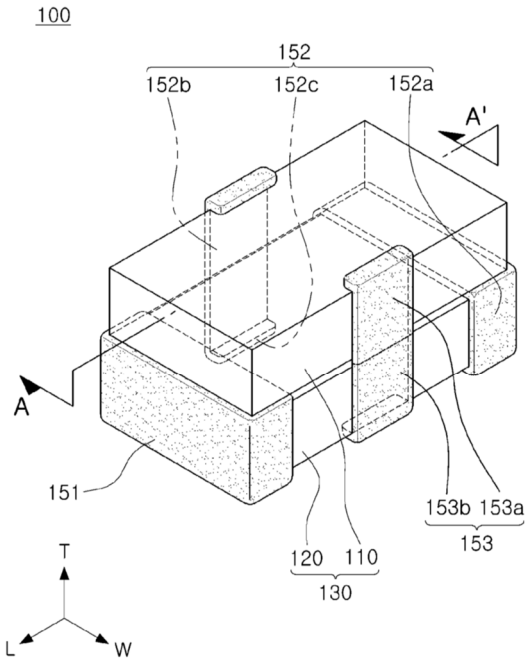


FIG. 1

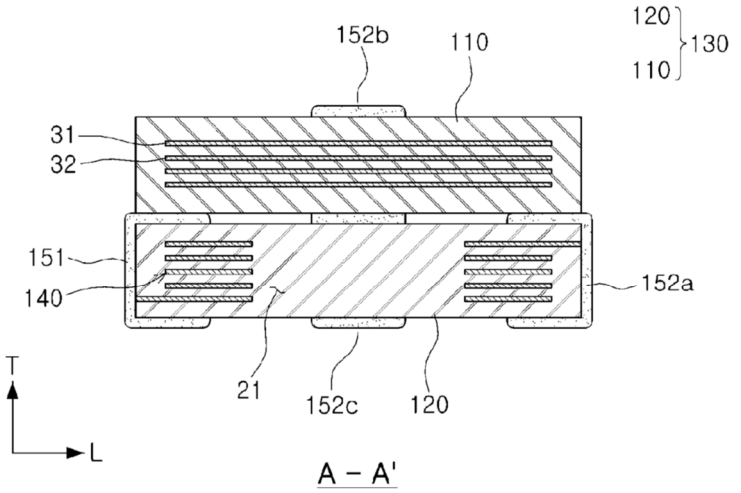


FIG. 2

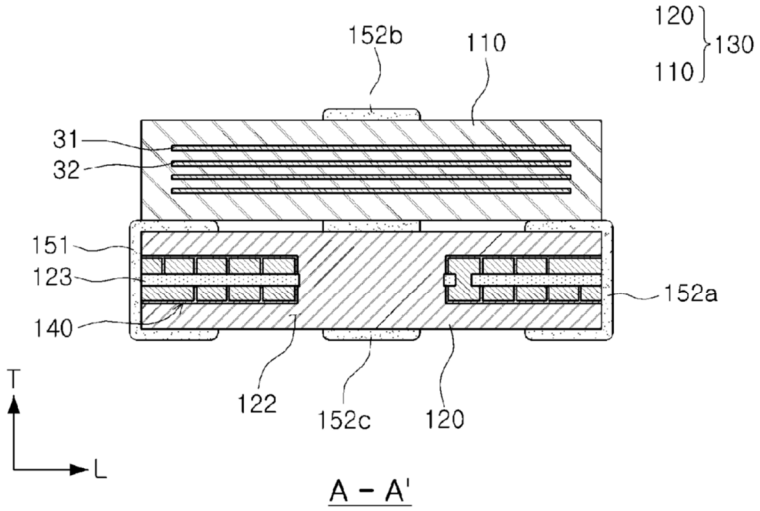


FIG. 3

The inductor module 120 includes an input electrode 151, and an output electrode 152a. VICOR-1009, [0100]. These electrodes are electrically connected to a coil unit (140) that is internal to the inductor component 120. As can be seen, the electrodes 151, 152a cover a portion of a top and bottom surface of the inductive component 120, as well as portions of two lateral sides of the inductive

component. *Id*., [0122].

The inductor module 120 includes a magnet 122, which may be formed of a ferrite material, and which may fill the interior of the inductor module 120 up to its upper and lower surfaces. *Id*., [0080], [0090], Fig. 3. Ferrite is a magnetic material that is typically non-conductive and would need to be non-conductive in the disclosed embodiments to avoid shorting the input and output terminals. VICOR-1003, ¶155.

Park also teaches that a composite component, such as composite component 100 may be surface mounted to a circuit board 200, as shown in Figure 13, with the bottom surfaces of electrodes 151 and 152a forming surface mount electrical contact with conductive pads (221, 222) on mounting board 200 through soldered connections. VICOR-1009, [0212]-[0223], Fig. 13.

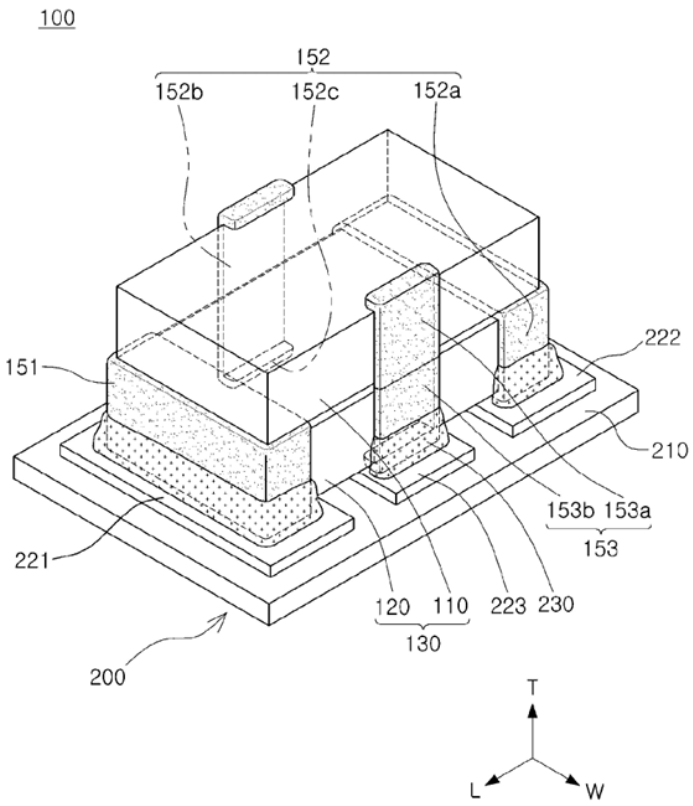


FIG. 13

Park describes a number of advantages to its composite component design (*id*., [0141]-[0144]):

> [0141] In addition, since the inductor 120 and the capacitor 110 are combined, a mounting area in the power management unit may be minimized, advantageously securing a mounting space.
>
> [0142] Also, mounting costs may be reduced.
>
> [0143] Also, in the composite electronic component, since the capacitor 110 is formed on the inductor 120, transmission of vibrations of the capacitor 110 due to inverse-piezoelectricity of the capacitor 110 when the composite electronic component is mounted on a board may be reduced to reduce acoustic noise.
>
> [0144] Also, since a bonding unit of the inductor and the capacitor is a conductive resin layer, damage such as cracks generated in the

capacitor due to mechanical stress such as thermal shock, or the like, may be prevented.

2. Analysis

[1pre]. A power supply apparatus, comprising:

Park discloses this element. VICOR-1003, ¶158. Park discloses a packaging design for power supply apparatus, namely a power management integrated circuit (PMIC). VICOR-1009, [0005], Fig. 1. The PMIC may include DC/DC converters. *Id*., [0183], Fig. 10. Specifically, Park discloses a composite electronic component 100 (shown below in Fig. 1) comprising an inductor module 120 and a capacitor module 110. *Id*., [0068], Figs. 1-2.

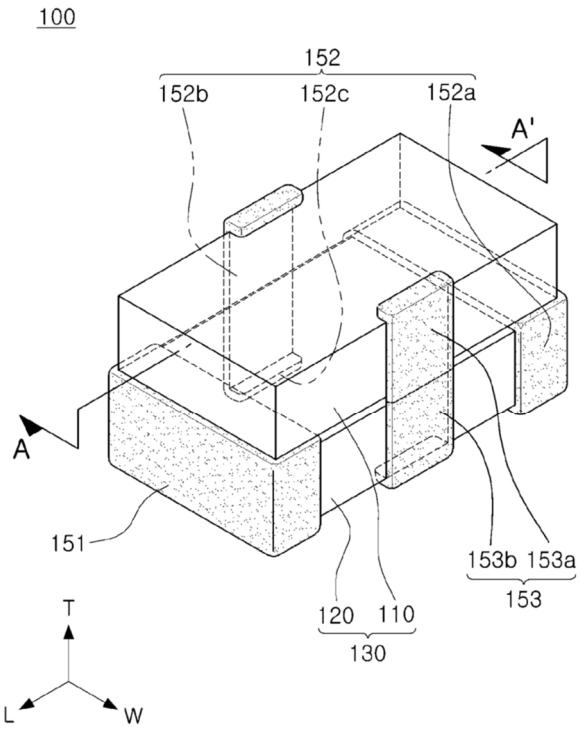


FIG. 1

[1a] a bearing plate;

Park's composite electronic component 100 includes a bearing plate (inductor 120, substrate 123, or the combination of substrate 123 and coil 140). VICOR-1003, ¶159; VICOR-1009, Figs. 1, 3, [0085]-[0086]. Inductor 120 is a bearing plate because it supports capacitor 110 on top of it. VICOR-1003, ¶159.

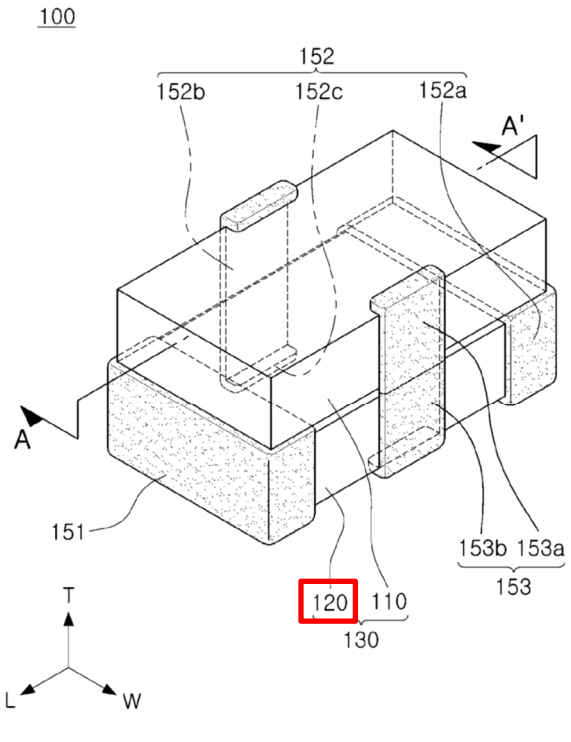


FIG. 1

VICOR-1009, Fig. 1.

Alternatively, Park discloses an insulating substrate 123, on the surface of which is formed an inductor coil unit 140. VICOR-1009, [0077], [0086], Fig. 3. The insulating substrate 123 may be considered the bearing plate. VICOR-1003, ¶160. Substrate 123 is a bearing plate because it supports at least coil 140 (as well

as portions of magnet 122 and conductor 110) on top of it. *Id*. And the combination of substrate 123 and coil 140 is a bearing plate because it supports at least portions of magnet 122 and capacitor 110 on top of it. *Id*.

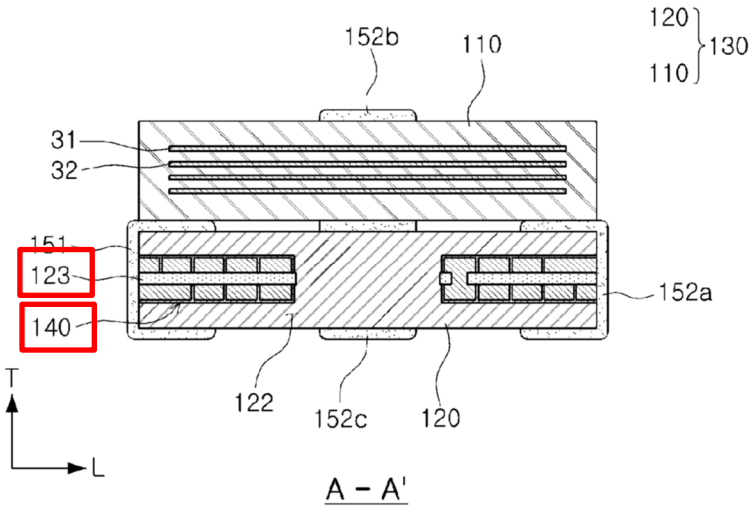


FIG. 3

VICOR-1009, Fig. 3 (annotated) (the figure is in cross section and a skilled artisan would understand that the two sides of the coil and substrate are connected).

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

Park's composite electronic component 100 includes an insulation material (magnet 122 made of non-conductive ferrite) formed on two opposite surfaces (the top surface and the bottom surface) of the bearing plate (inductor 120, substrate 123, or the combination of substrate 123 and coil 140). VICOR-1003, ¶¶162-163. VICOR-1009, [0080], [0087], [0090], Fig. 3. In Park, ferrite magnet 122 is necessarily and would have been immediately envisaged to be non-conductive to

avoid shorting input and output electrodes 151 and 152a and thus constitutes an insulating material. VICOR-1003, ¶162.

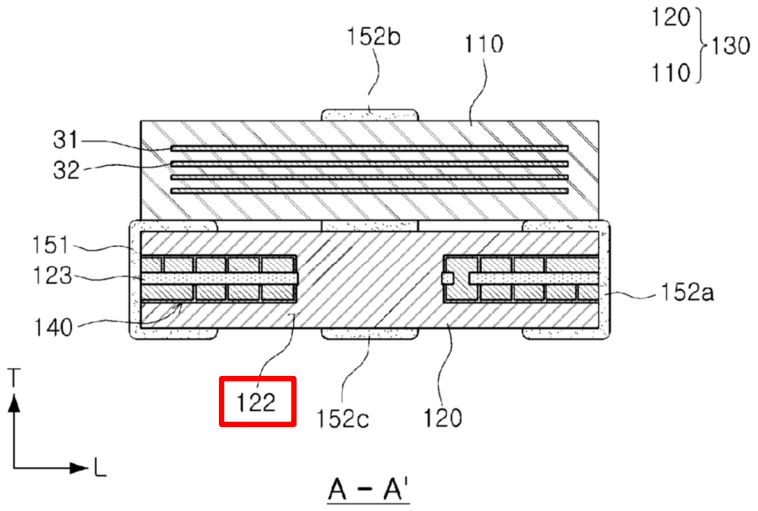


FIG. 3

VICOR-1009, Fig. 3 (annotated).

Indeed, ferrite magnet 122 is necessarily and would have been immediately envisaged to be an insulating material because electrodes 151, 152a, 152b and coil 140 are conductive elements. It is thus inherent that ferrite magnet 122—the only material separating those conductive elements—be an insulating material to prevent short circuits. VICOR-1003, ¶163.

[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.

Park's composite electronic component 100 includes a plurality of pins (electrodes 151 and 152a) electrically connected to coil 140 of the bearing plate

and allocated along lateral sides (shown below) of the insulation material, wherein two terminals of each of the pins (the top and bottom of each electrode 151, 152a) have two SMD pads (for mounting inductor 120 on the PCB and for mounting capacitor 110 on inductor 120), wherein the two SMD pads of each pin extend to an upper surface (the top) and a lower surface (the bottom) of the insulation material. VICOR-1003, ¶164; VICOR-1009, Figs. 1, 3, 13. As shown below, each electrode 151, 152a contacts at least part of ferrite magnet 122 and covers at least part of a lower surface, at least part of an upper surface, and at least part of two lateral sides of inductor 120. *Id*.

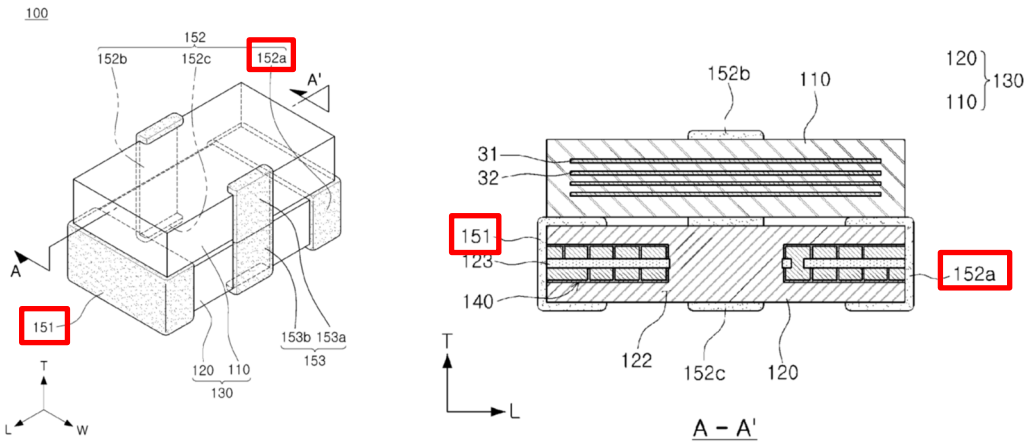


FIG. 1 FIG. 3

VICOR-1009, Figs. 1, 3.

2. The power supply apparatus of claim 1, further comprising: a plurality of first pads disposed on lateral sides of the bearing plate.

Park's composite electronic component 100 includes a plurality of first pads (the points of electrical connection identified below in the red boxes between coil

unit 140 and electrodes 151, 152a). VICOR-1003, ¶165; VICOR-1009, [0117], Fig. 3. As seen in Figure 3, coil unit 140, which is part of the bearing plate (inductor unit 120 or the combination of substrate 123 and coil 140), extends to the lateral sides of the inductor unit 120 allowing the formation of an electrical connection between the coil unit and electrodes 151 and 152b. *Id*. These pads are disposed on lateral sides of the bearing plate. *Id*.

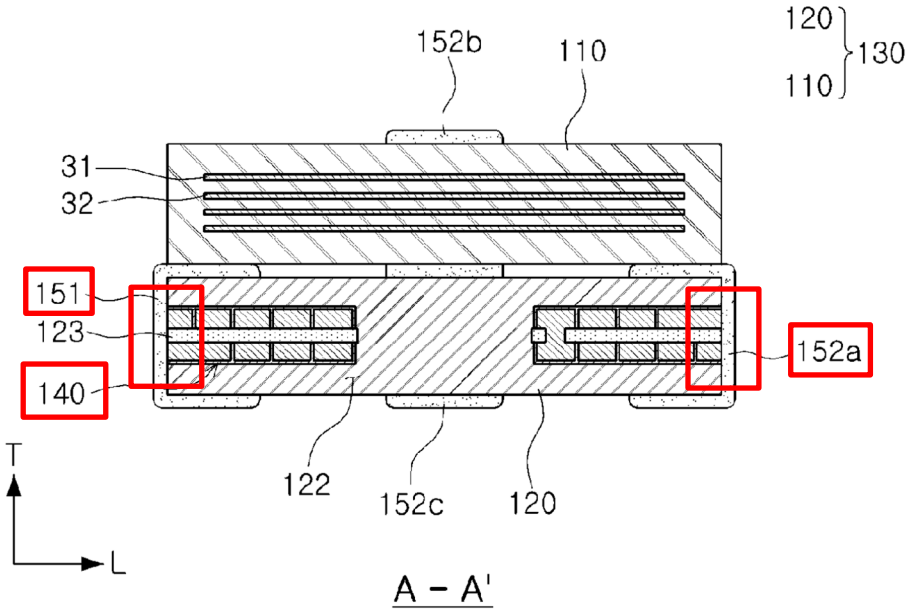


FIG. 3

VICOR-1009, Fig. 3.

3. The power supply apparatus of claim 2, wherein the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate.

See Ground 4, Element [1c] (identifying the claimed pins in Park). In Park's composite electronic component 100, the pins (electrodes 151, 152a) are electrically connected to the pads (the points of electrical connection between coil

unit 140 and electrodes 151, 152a), which are electrically connected to coil 140 of the bearing plate (inductor 120 or substrate 123/coil 140). VICOR, 1003, ¶166.

5. The power supply apparatus of claim 2, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

Park's composite electronic component 100 includes at least one second pad (at least one of the upper or lower portion of electrode 151 or electrode 152a identified below in red boxes in Fig. 3) that is located at an upper surface or a lower surface of the insulation material and is electrically connected (via the point of electrical connection between coil unit 140 and electrode 151 or electrode 152a) to coil unit 140 of the bearing plate (inductor 120 or substrate 123/coil 140). VICOR-1003, ¶167; VICOR-1009, Figs. 1, 3. *See also* Ground 4, claim 3.

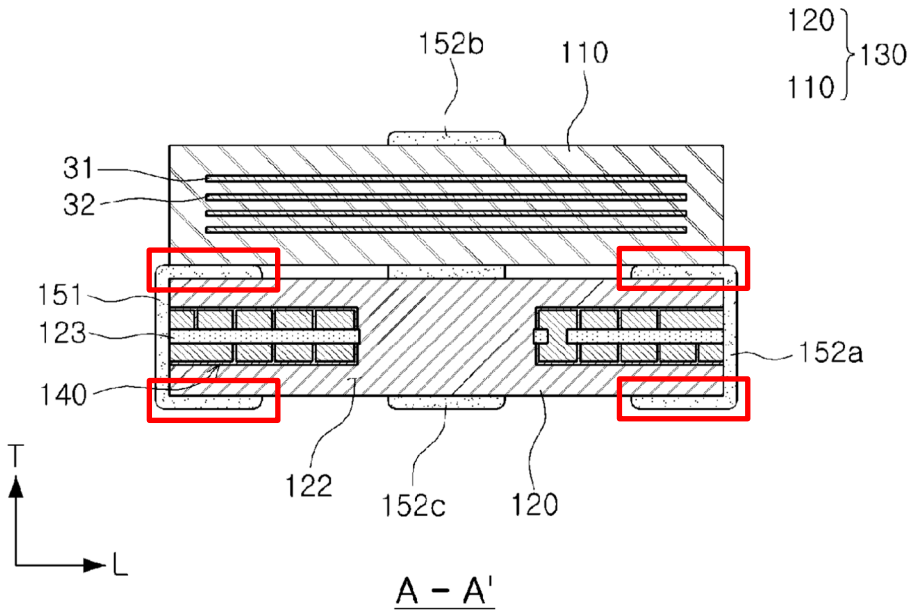


FIG. 3

VICOR-1009, Fig. 3.

6. The power supply apparatus of claim 1, wherein the two opposite surfaces of the bearing plate are covered with the insulation material, and at least one lateral side of the bearing plate is exposed from the insulation material.

See Ground 4, Element [1b] (demonstrating that opposite surfaces of the bearing plate are covered with insulation material) and Claim 3 (demonstrating that the plurality of pins are electrically connected to the plurality of first pads). As shown below in Fig. 3, at least one lateral side (highlighted yellow) of the bearing plate is exposed from the insulation material (ferrite magnet 122) to permit the required electrical connection between the pins (electrodes 151, 152a) and the first pads (the points of electrical connection between coil unit 140 and electrodes 151, 152a) on lateral sides of inductor 120. VICOR-1003, ¶168; VICOR-1009, Fig. 3.

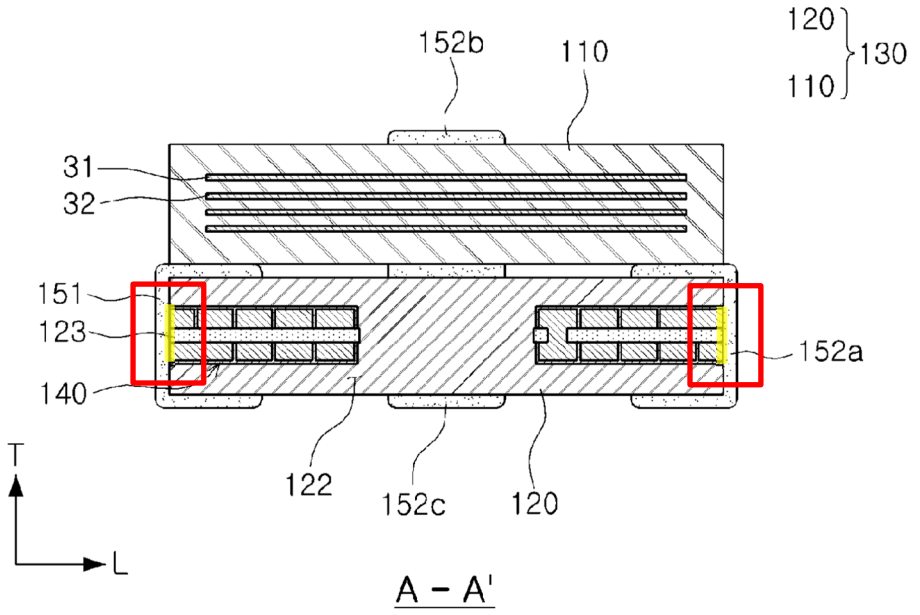


FIG. 3

VICOR-1009, Fig. 3.

7. The power supply apparatus of claim 1, further comprising: at least one second pad, wherein the second pad is located at an upper surface or a lower surface of the insulation material and the second pad is electrically connected to the bearing plate.

See Ground 4, Claim 5.

8. The power supply apparatus of claim 1, wherein the power supply apparatus is a power unit or a control unit.

Park's composite electronic component 100 may be used as part of a "driving power supply system," which is a power unit or a control unit. VICOR-1003, ¶170; VICOR-1009, [0013]-[0014]. Park's composite electronic component 100 may comprise a portion of a power smoothing unit which receives power from a power management unit, which together comprise a power unit or a control unit. VICOR-1003, ¶170; VICOR-1009, [0027]. Park's composite electronic component 100 may be used in a PMIC, which is a power unit or a control unit. VICOR-1003, ¶170; VICOR-1009, [0093], [0171], [0183]-[0184]. Park's composite electronic component 100 may be used to adjust the output voltage of a power management unit, which, when combined with the integrated electronic component 100 is a power unit or a control unit. VICOR-1003, ¶170; VICOR-1009, [0116], [0141].

E. GROUND 5 – Claims 1-3 and 5-8 are Obvious over Park Alone and, if Necessary, in Combination with Jun

As shown in Ground 4, Park discloses each element of claims 1-3 and 5-8. Each of those claims would also have been obvious over Park (in a single reference

obviousness analysis) based on general knowledge in the art. VICOR-1003, ¶¶181-184. For example, Park expressly discloses insulation material (ferrite magnet 122). *See* Ground 4, Element [1b]. To the extent not immediately envisaged or inherent, it would have been obvious for ferrite magnet 122 to be an insulating material to prevent short circuits, and a skilled artisan had reason to add additional insulating layers to better insulate against components above and below the module. VICOR-1003, ¶181. Similarly, a skilled artisan would have understood that Park's composite electronic component 100 includes a plurality of first pads (the points of electrical connection between coil unit 140 and electrodes 151, 152a) that are disposed on lateral sides of the bearing plate and are exposed from the insulation material. *See* Ground 4, Claims 2, 6. To the extent not immediately envisaged or inherent, it would have been obvious in view of Jun to include such pads on lateral sides of the bearing plate and expose those lateral sides of the bearing plate from the insulation material to provide the required electrical connection between coil unit 140 and electrodes 151, 152a. VICOR-1003, ¶181.

Jun (VICOR-1012) discloses a connection pad (connection bars 110, 210) disposed on a lateral side of a cuboid multilayer substrate (bearing plate) to connect an external electrode 104, 204 formed in the lateral side to internal circuitry of the substrate (pattern layer 102, 202). VICOR-1012, [0043]-[0056],

Figs. 10, 12g. Jun teaches that the use of a connection bar, which penetrates multiple sheets of the multilayer substrate, advantageously creates a large connection area between internal circuitry and the external electrode, thereby improving the degree of electrical connection between the circuitry and the external electrode. VICOR-1012, [0080]; VICOR-1003, ¶182. It would have been obvious to a skilled artisan to apply the teaching of Jun to form similar improved connections between the pins 151 and 152a of Park's composite body 130 and the inductor coil on substrate (bearing plate) 123 by deploying connection bars (pads) on lateral sides, as recited in claims 2, 3 and 11. VICOR-1003, ¶182.

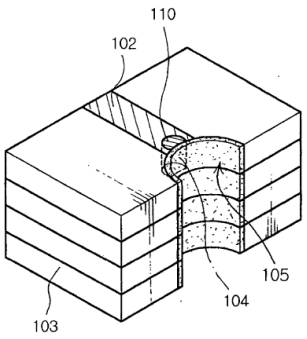


FIG. 10

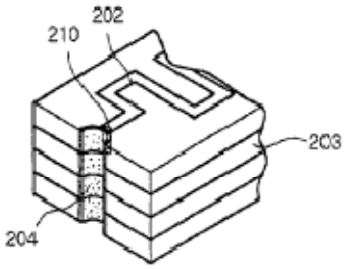


FIG. 12g

VICOR-1012, Figs. 10, 12g.

To the extent necessary, any such modification would have been well-within the level of ordinary skill in the art. VICOR-1003, ¶¶183-84. Accordingly, a skilled artisan modifying Park as described here would have reasonably expected to succeed. *Id*.

F. GROUND 6 – Claims 4 and 10-12 are Obvious over Park in view of Zeng-014 and, if necessary, Jun

Claim 4.

It would have been obvious in view of Zeng-014 to recess the upper and lower surface of Park's insulation material (ferrite magnet 122) at the location of the upper and lower pads. VICOR-1003, ¶¶186-194; VICOR-1007, Figs. 14A-C. The resulting recesses would be like those shown below in Fig. 14B of Zeng-014 (shown below). VICOR-1003, ¶186. However, because Park's pins wrap around each side of inductor 120, the recesses in the Park/Zeng-014 combination would be formed on both the top and the bottom surface of Park's inductor 120 and all the way across each surface to obtain the benefit of the recess. *Id*.

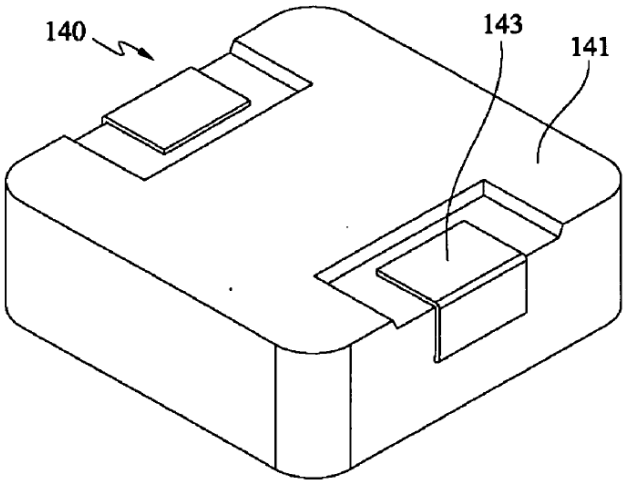


FIG. 14B

VICOR-1007, Fig. 14B; *see also* VICOR-1006, Fig. 25-26 (showing similar recesses 602B in Vinciarelli-218's module).

Accordingly, edges of the upper surface (top) and the lower surface (bottom) of Park's insulation material (ferrite magnet 122) would have recesses (like those shown above), and the two SMD pads (top and bottom) of each of the pins (Park's electrodes 151, 152b) would extend to the recesses (as taught by Zeng-014) at the upper surface and the lower surface of the insulation material. VICOR-1003, ¶187; VICOR-1007, Figs. 14A-C.

A skilled artisan would have been motivated to include such recesses in Park's inductor 120 for several reasons. VICOR-1003, ¶¶188-194.

First, Park teaches the desirability of minimizing the mounting area in a power management unit, reducing mounting costs. VICOR-1009, [0141] ("In addition, since the inductor 120 and the capacitor 110 are combined, a mounting area in the power management unit may be minimized, advantageously securing a mounting space."), [0142] ("mounting costs may be reduced").

Second, the skilled artisan would turn to Zeng-014 given Zeng-014's teaching that board space can be saved by using Zeng-014's surface conductor to "stack[]" external components on the component using the surface conductor. VICOR-1007, Abstract, [0013].

Third, a skilled artisan would have recognized that Zeng-014's surface conductor provides a flush surface mount. VICOR-1003, ¶191. As confirmed in Vinciarelli-218, a skilled artisan would have understood that flush mounts were

desirable. *Id*.; VICOR-1006, [0124]-[0125], [0130]-[0133]. Further, a skilled artisan would have understood that the recesses shown in Zeng-014, FIG. 14A and 14B would provide a lower profile and improve assembly and solderability onto a customer's board. VICOR-1003, ¶190.

Fourth, Zeng-014 teaches that the inductor in the figures "is only for purpose[s] of illustration, and in practice, the technology disclosed … may be applied to other electronic component[s]." VICOR-1007, [0057]. Thus, a skilled artisan would have recognized Zeng-014's applicability to Park's inductor 120, which is an electronic component having a general cuboid form factor like the inductor components of Zeng-014. VICOR-1003, ¶192.

Fifth, Park and Zeng-014 both concern improvements to small power converters to provide increased power density and decreasing the circuit board "area" used by the power converters. VICOR-1009, [0141]-[0142]; VICOR-1007, [0003], [0008], [0010], [0065]. A skilled artisan would thus turn to both references given their common concerns to apply beneficial features of each reference. VICOR-1003, ¶193.

A skilled artisan also would have reasonably expected to succeed because the addition modification proposed here would have been well within the skilled artisan's abilities. VICOR-1003, ¶194. Indeed, it would have been merely the application of a known technique (using recesses for the pins of an inductor as

taught by Zeng-014) with a known system (Park's inductor 120) in the same field of endeavor (power supply apparatuses). *Id*.; *KSR*, 550 U.S. at 417. And, in the combination, each element merely performs the same predictable function as it does separately, without significantly altering or hindering the functions performed by the Park/Zeng-014 module. VICOR-1003, ¶194. In fact, the Park/Zeng-014 module would continue to perform all the functions it performed before the proposed modification and the addition of recesses would simply reduce the space needed to mount the module(s). *Id*.

Claim 10.

[10pre]

See Ground 4, Element [1pre].

[10a]

See Ground 4, Element [1a].

[10b]

See Ground 4, Element [1b].

[10c]

See Ground 4, Element [1c] (confirming that Park discloses a plurality of pins electrically connected to the bearing plate and allocated along lateral sides of the insulation material); Ground 5 (confirming that Element [1c] would have been obvious over Park alone and, if necessary, in combination with Jun); Ground 6, Claim 4 (confirming that it would have been obvious in view of Zeng-014 to recess

edges of the upper surface and the lower surface of Park's insulation material, and extend the two SMD pads of each of Park's pins to the recesses at the upper surface and the lower surface of the insulation material); VICOR-1003, ¶¶179, 197. The analysis for claims 1 and 4 applies to the cuboid body of claim 10. VICOR-1003, ¶¶163, 173, 185-193, 197.

As shown below, Park's bearing plate (substrate 123 of the combination of substrate 123 and coil 140) is embedded in the insulation material (magnet 122) to form a cuboid body. VICOR-1003, ¶179.

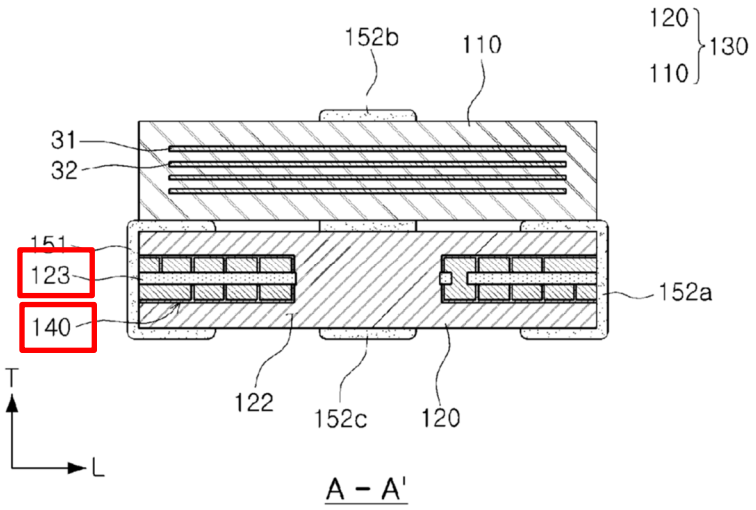


FIG. 3

VICOR-1009, Fig. 3 (annotated).

Claim 11.

See Ground 4, Claims 2-3; Ground 5; Ground 6, Element 10[c]; VICOR-1003, ¶198. The analysis for claims 2 and 3 applies to the cuboid body of claim 10. VICOR-1003, ¶198.

Claim 12.

See Ground 4, Claim 5.

G. GROUND 7 – Claims 1-8 and 10-12 are Obvious over Vinciarelli-218 in view of Park

Claim 1.

[1pre].

See Ground 1, Element [1pre].

[1a]

See Ground 1, Element [1a].

[1b]

See Ground 1, Element [1b].

[1c]

It would have been obvious use Park's electrodes 151, 152a with Vinciarelli-218's power converter. VICOR-1003, ¶¶203-215. Although Vinciarelli-218's power converter is shown with multiple pads (interconnects) disposed on lateral sides of the cuboid body, Vinciarelli-218's interconnects are not limited to a single fixed pattern or location. VICOR-1003, ¶203, VICOR-1006, [0107], Figs. 10A, 10B. Accordingly, a skilled artisan would have found it obvious to design Vinciarelli-218's bearing plate (PCB) to include interconnects where they are needed (e.g., by placing one interconnect on each side to accommodate Park's electrodes 151, 152a, and by positioning Park's electrodes to align with Vinciarelli-218 interconnects). *Id*. To the extent additional electrodes were

needed, Park describes additional electrodes 152b, and 153c that could electrically connect with additional interconnects on Vincarelli-218's power converter. For example, electrode 151 could be used as an input terminal, electrode 152a could be used as an output terminal, and electrodes 152b and 153c could be used as ground terminals. Additional electrodes similar to 152b or 153c could be used for control signals as well. VICOR-1003, ¶203.

In the resulting module, which resembles Park's inductor 120 and electrodes 151, 152a, the plurality of pins (Park's electrodes 151, 152a) are electrically connected (via Vinciarelli-218's interconnects) to the bearing plate (Vinciarelli-218's PCB) and allocated along lateral sides of the insulation material in accordance with Park. VICOR-1003, ¶204.

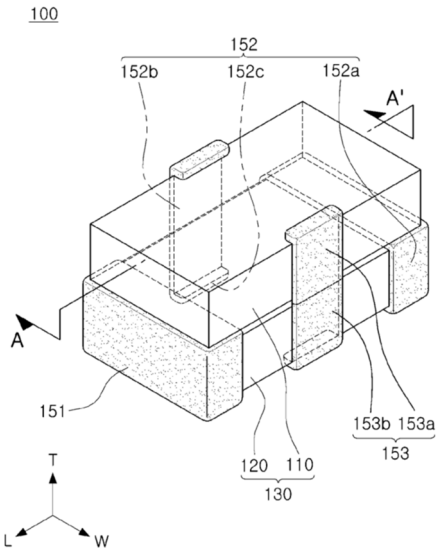


FIG. 1

VICOR-1009, Fig. 1.

Furthermore, two terminals of each of the pins (Park's electrodes 151, 152a) have two SMD pads (upper portion of each electrode), wherein the two SMD pads of each of the pins extend to an upper surface (top surface of Vinciarelli-218's encapsulant 805) and a lower surface (bottom surface of Vinciarelli-218's encapsulant 806) of the insulation material, respectively. VICOR-1003, ¶205; *see also* Ground 4, Element [1c].

A skilled artisan would have been motivated to modify Vinciarelli-218 as described above for several reasons. VICOR-1003, ¶¶206-215.

First, Vinciarelli-218 discloses that many variations for the power converter module, including variations for contacts to external components or circuits, such as through-hole and surface mount options. VICOR-1006, Figs. 15-26, 33-36. Vinciarelli-218 further discloses that it may be beneficial to have a module that is press-fit into a surface mount adapter or flush mounted to a motherboard. *Id*., [0124]-[0125], [0130]-[0133]. Vinciarelli-218 further teaches the desirability of "decreasing [the] mounting area on [a] customer motherboard." *Id*., [0003].

Second, the skilled artisan would turn to Park given Park's teaching that board space can be saved by using Park's surface conductor to "stack[]" external components on the module using the surface conductor. VICOR-1009, [0072], [0100], [0101], [0117]-[0125]. Since Vinciarelli-218 discloses a component that is a DC-DC power converter module, a skilled artisan would understand that

enabling electrically connected stacking would permit, for example, multiple DC-DC power converter modules to connected in parallel to increase power throughput without taking up additional board space, thereby increasing power density. VICOR-1003, ¶208 (discussing Vinciarelli-166's disclosure of parallel power converters and Design Guide's disclosure of input/output capacitors). Also, a skilled artisan would have been motivated to stack input or output capacitors onto the power converter module to save space. *Id*.

Third, a skilled artisan would have recognized that Park's surface conductor provides a surface mount identified as desirable in Vinciarelli-218 without the need for a surface mount adapter. VICOR-1003, ¶209.

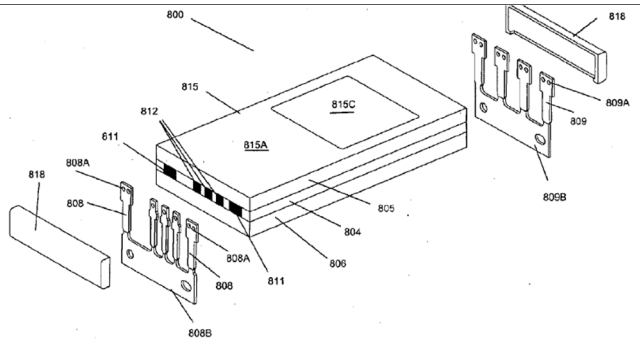
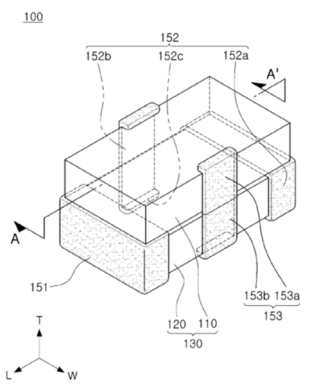
Fourth, A skilled artisan would have recognized Park's applicability to the power converter modules of Vinciarelli-218, which are electronic components having a cuboid general form factor like the inductor component of Park. VICOR-1003, ¶210.

Fifth, Vinciarelli-218 and Park both concern improvements to small power converters and decreasing the circuit board "area" used by the power converters. VICOR-1006, [0003], VICOR-1009, [0141], [0188], [0209], [0228]. A skilled artisan would thus turn to both references given their common concerns to apply beneficial features of each reference. VICOR-1003, ¶211.

A skilled artisan applying the teachings of Park to Vinciarelli-218 would

have been motivated to reduce the space used by the contact adapters of Vinciarelli-218 by applying Park's electrodes to Vinciarelli-218's module to provide contact surfaces on the top, bottom, and sides of the module, as taught by Park. VICOR-1003, ¶212. One example of how this modification would be performed can be illustrated by Fig. 35 of Vinciarelli-218 and Fig. 1 of Park.

Figure 35 of Vinciarelli-218 depicts a module with PCB edge contacts 811, 812 that are mated with contacts on lead frames 808B and 809B. VICOR-1006, Fig. 35 (and related descriptions). In the combination, the lead frames in Vinciarelli-218 would be replaced by the electrodes of Park, and a skilled artisan would have adjusted the width and location of Park's electrodes to accommodate the various interconnects required by the module, and further understand that Park's electrodes wrapping two lateral sides provides a low resistance path for high current signals. VICOR-1003, ¶213. Accordingly, the resulting module would resemble the combination of Park's inductor 120 and electrodes 151, 152a. *Id*.

 FIG. 35	 FIG. 1
Vinciarelli-218	**Park**

Although not required, it also would have been obvious to accommodate the multiple interconnects 811, 812 of Vinciarelli-218 with a combination of Park's side-mounted electrodes 153 and end-mounted electrodes 151, 152a. VICOR-1003, ¶214; VICOR-1006, Fig. 36, [0160]. For example, Park teaches that its electrodes may come in a variety of shapes. VICOR-1009, [0119], Fig. 1. And Vinciarelli-218 teaches that interconnects can be disposed along the long and/or short edges of the module. VICOR-1006, [0018], Figs. 10A-B.

A skilled artisan also would have reasonably expected to succeed because the modifications proposed here would have been well within the skilled artisan's abilities. VICOR-1003, ¶215. Indeed, it would have been merely the application of a known technique (using electrodes, as taught by Park) with a known system (Vinciarelli-218's module) in the same field of endeavor (power supplies). *Id*.; *KSR*, 550 U.S. at 417. And, in the combination, each element merely performs the same predictable function as it does separately, without significantly altering or hindering the functions performed by Vinciarelli-218's module or Park's electrodes. VICOR-1003, ¶215. In fact, the Vinciarelli-218/Park module would continue to perform all the functions it performed before the proposed modification. *Id*. In addition, the modification is a mechanical modification based on the teachings of Park that provides fewer parts for assembly. *Id*.

Claim 2.

See Ground 1, Claim 2.

Claim 3.

See Ground 7, Element [1c]; *see also* Ground 1, Claim 3. In the Vinciarelli-218/Park combination, the side contact portions of the pins (Park's electrodes 151, 152a) are electrically coupled to the pads (Vinciarelli-218's interconnects), which are electrically connected to the bearing plate (Vinciarelli-218's PCB). VICOR, 1003, ¶217.

Claim 4.

It would have been obvious in view of Vinciarelli-218 to recess the upper and lower surfaces of the insulation material (Vinciarelli-218's encapsulant 805, 806) at the location of the upper and lower pads. VICOR-1003, ¶¶218-221; VICOR-1006, Figs. 25-26; VICOR-1007, Figs. 14A-C. The resulting recesses would be like recesses 602B in Figs. 25 and 26 of Vinciarelli-218 (shown below).

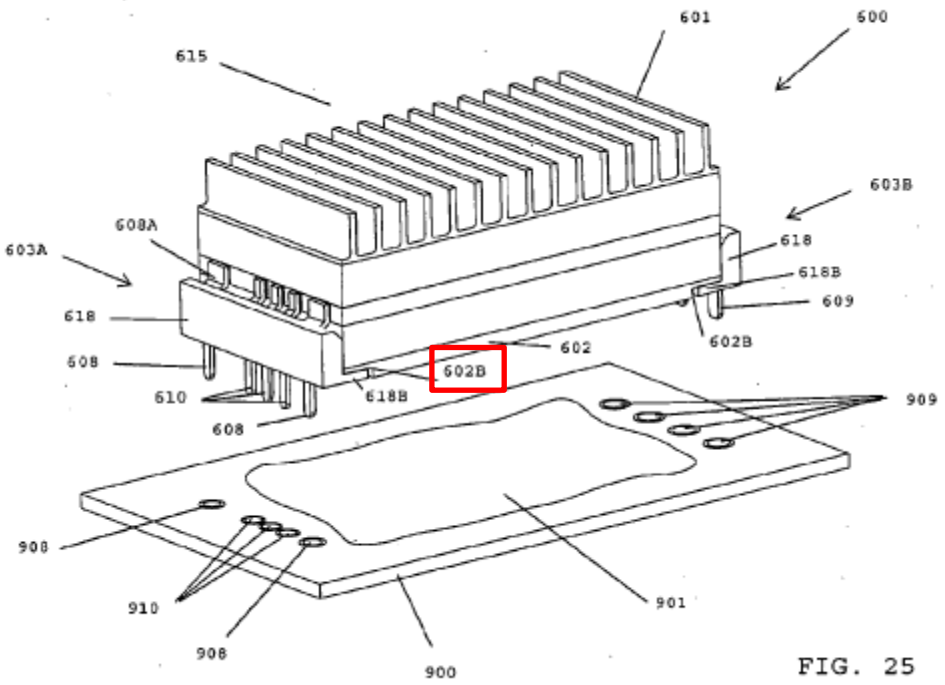


FIG. 25

VICOR-1006, 25-26.

In the combination, edges of the upper surface (top) and the lower surface (bottom) of Vinciarelli-218's encapsulant 805, 806 would have recesses (like those shown above), and the two SMD pads (upper and lower portions) of each of the pins (Park's electrodes 151, 152a) would extend to the recesses at the upper surface and the lower surface of the insulation material. VICOR-1003, ¶219. Although recesses 602B in Fig. 25 of Vinciarelli-218 are shown in a heatsink 602, Vinciarelli-218 confirms that the module can be made without a heatsink. VICOR-1006, [0159]. In such embodiments, a skilled artisan would have understood that the recesses would be in the encapsulant layer. VICOR-1003, ¶219; *see also* VICOR-1006, [0160] (explaining that "[l]ike the singulated modules with heat

sinks, various types of connectors [and] adapters may be coupled to the exposed interconnects 811, 812 at the edges of the singulated module 815").

A skilled artisan would have been motivated to include recesses as described above because Vinciarelli-218 discloses that it may be beneficial to have a module that is press-fit into a surface mount adapter or flush mounted to a motherboard. VICOR-1006, [0124]-[0125], [0130]-[0133]. Vinciarelli-218 further teaches the desirability of "decreasing [the] mounting area on [a] customer motherboard." *Id*., [0003]. And a skilled artisan would have understood that using recesses in the combination, as described above, would have furthered these goals. VICOR-1003, ¶220.

A skilled artisan also would have reasonably expected to succeed because the modification proposed here would have been well within the skilled artisan's abilities. VICOR-1003, ¶221. Indeed, it would have been merely the application of a known technique (using recesses as taught by Vinciarelli-128) with a known system (Vinciarelli-128's module) in the same field of endeavor (power supply apparatuses). *Id*.; *KSR*, 550 U.S. at 417. And, in the combination, each element merely performs the same predictable function as it does separately, without significantly altering or hindering the functions performed by the Vinciarelli-128/Zeng-014 module. VICOR-1003, ¶221. In fact, the Vinciarelli-128/Park module would continue to perform all the functions it performed before the

proposed modification and the addition of recesses would simply reduce the space needed to mount the module. *Id*.

Claim 5.

The Vinciarelli-218/Park combination includes at least one second pad (at least one of the upper or lower portion of Park's electrode 151 or electrode 152a identified below in red boxes in Fig. 3) that is located at an upper surface or a lower surface of the insulation material (Vinciarelli-218's encapsulant layers 805, 806) and is electrically connected (via one of Vinciarelli-218's interconnects and Park's electrode 151 or electrode 152a) to the bearing plate (Vinciarelli-218's PCB). VICOR-1003, ¶222; VICOR-1009, Figs. 1, 3.

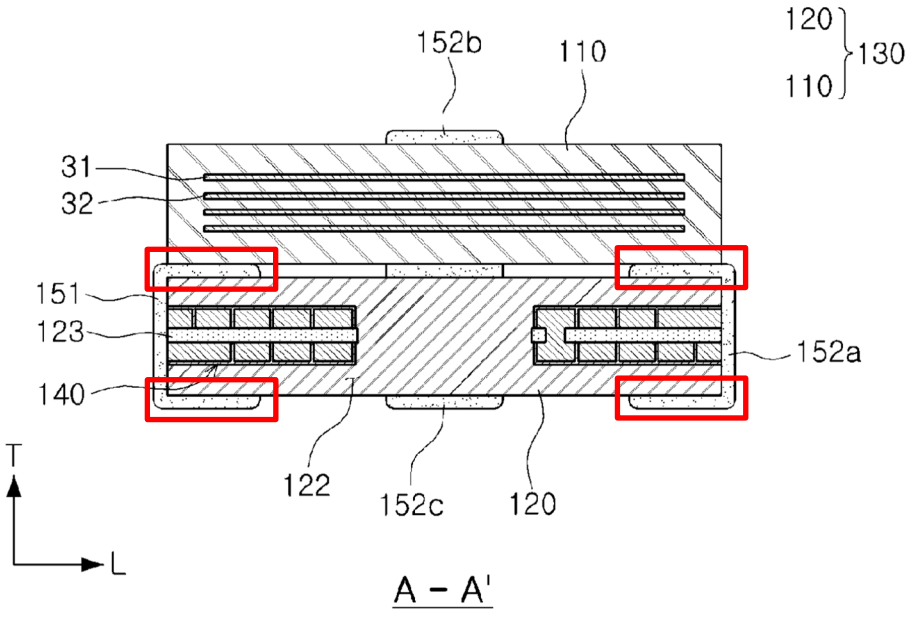


FIG. 3

VICOR-1009, Fig. 3.

Claim 6.

See Ground 7, Elements [1b] (demonstrating that opposite surfaces of the bearing plate are covered with insulation material) and [1c] (demonstrating that at least one lateral side of the bearing plate is exposed from the insulation material and thus reveals Vinciarelli-218's interconnects); VICOR-1003, ¶223.

Claim 7.

See Ground 7, Claim 5.

Claim 8.

The Vinciarelli-218/Park power supply apparatus is a power unit. VICOR-1003, ¶225; VICOR-1006, Abstract ("power converter").

Claim 10.

[10pre]

See Ground 1, Element [1pre].

[10a]

See Ground 1, Element [1a].

[10b]

See Ground 1, Element [1b].

[10c]

See Ground 7, Element [1c] (confirming that it would have been obvious in to use a plurality of Park's pins electrically connected to Vinciarelli-218's bearing plate); Ground 7, Claim 6 (confirming that the Vinciarelli-218/Park combination's bearing plate is embedded in the insulation material because the two opposite

surfaces of the PCB are covered with insulation material); Ground 7, Claim 4 (confirming that it would have been obvious in view of Vinciarelli-218 to recess edges of the upper surface and the lower surface of Vinciarelli-218's insulation material, and extend the two SMD pads of each of Park's pins to the recesses at the upper surface and the lower surface of the insulation material); VICOR-1003, ¶229. The analysis for claims 1, 4, and 6 applies to the cuboid body of claim 10. VICOR-1003, ¶229.

Claim 11.

See Ground 7, Claim 2 (confirming the combination includes a plurality of first pads disposed on lateral sides of the cuboid body), Claim 3 (confirming that the plurality of pins are electrically connected to the plurality of first pads, and the plurality of first pads are electrically connected to the bearing plate); VICOR-1003, ¶230. The analysis for claims 2 and 3 applies to the cuboid body of claim 10. VICOR-1003, ¶230.

Claim 12.

See Ground 7, Claim 5.

H. GROUND 8 – Claims 4 and 10-12 are Obvious over Vinciarelli-218 in view of Park and Zeng-014

Claim 4.

In this ground, Fig. 14 of Zeng-014 suggests the use of a recess for an external conductor of a surface mount module. Such a recess allows flush

mounting, reduces component height, and improves solderability and assembly onto a customer board. *See* Ground 7, Elements [1c], [10c] (explaining why it would have been obvious to combine Vinciarelli-218 and Park); Ground 1, Claim 4 (confirming that it would have been obvious in view of Vinciarelli-218 and Zeng-014 to recess edges of the upper surface and the lower surface of Vinciarelli-218's insulation material, and extend the two SMD pads of each of Zeng-014's pins to the recesses at the upper surface and the lower surface of the insulation material). In the Vinciarelli-218/Zeng-014/Park combination, the two SMD pads of each of Park's pins (electrodes 151 and 152a) extend to those recesses instead of Zeng-014's pins. VICOR-1003, ¶243.

Claim 10.

[10pre]

See Ground 1, Element [1pre].

[10a]

See Ground 1, Element [1a].

[10b]

See Ground 1, Element [1b].

[10c]

See Ground 7, Element [10c] (confirming that the Vinciarelli-218/Park combination discloses Element [10c]); Ground 8, Claim 4 (confirming that it also would have been obvious in view Zeng-014 to provide the claimed recesses).

Claim 11.

See Ground 7, Claim 11.

Claim 12.

See Ground 7, Claim 12.

IV. DISCRETIONARY DENIAL IS NOT WARRANTED

A. 35 U.S.C. §325(d) – *Advanced Bionics*

Advanced Bionics and the *Becton* factors strongly favor institution. *Advanced Bionics LLC v. MED-EL Elektromedizinische Gerate GmbH*, IPR2019-01469, Paper 6, 2020 WL 740292 (P.T.A.B. Feb. 13, 2020) ("*Advanced Bionics*") (precedential); *Becton, Dickinson and Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 2017 WL 6405100 (P.T.A.B. Dec. 15 2017) ("*Becton*") (precedential).

Patent Owner did not cite any of the art presented in this Petition and did not consider any of the grounds presented here. Accordingly, neither condition of the first prong of the *Advanced Bionics* framework is met, and there is no need to reach the second prong to resolve against discretionary denial under Section 325(d). *See*, *e.g.*, *Oticon Medical AB et. al. v. Cochlear Ltd.*, IPR2019-00975, Paper 15 at 20, 2019 WL 5237817, at *8 (P.T.A.B. Oct. 16, 2019) (precedential).

B. 35 U.S.C. §314(a) – *Fintiv*

The grounds presented in this Petition strongly favor institution, even under the *Fintiv* framework, as clarified by the interim guidance to the PTAB from Director Vidal, dated June 21, 2022.

Factor 1 (Stay)—Neither party has requested a stay, but Petitioner intends to seek a stay, and thus this factor tends to weigh against discretionary denial.

Factor 2 (Trial Date)—An Amended Complaint adding the '534 patent to the co-pending litigation (the "Litigation") was filed on January 26, 2024 (VICOR-1004), and no trial date has been set. The median time to trial in the District of Delaware is about 3 years. *See* Table C.5 (Period ending March 31, 2023), https://www.uscourts.gov/file/72522/download. This proceeding is expected to be resolved in 18 months, and thus this factor weighs against discretionary denial.

Factor 3 (Investment)—The bulk of the investment in the Litigation has yet to occur. Petitioner has not yet answered, and no part of claim construction has begun. By the time of institution in this proceeding, the Litigation will be at a posture where "much of the district court's investment relates to ancillary matters untethered to the validity issue itself." *Sand Revolution*, IPR2019-01393, Paper 24 at 10-11, 2020 WL 3273334, at *4 (P.T.A.B. June 16, 2020).

Factor 4 (Overlap)—The factual overlap between this proceeding and the litigation should be minimal. Petitioner stipulates that, should institution be granted, it will not raise in the Litigation the same grounds presented in this proceeding. *See Sand Revolution*, Paper 24 at 11-12, 2020 WL 3273334, at *5. Factor 4 thus weighs against discretionary denial.

Factor 6 (Merits and Other Circumstances)—The compelling merits

presented in this Petition alone justifies institution in the public interest and outweighs any alleged inefficiencies due to the parallel litigation. Petitioner is presenting this petition within 2 months of the filing of the Amended Complaint in the Litigation, and has diligently developed the grounds presented against the Challenged Claims.

V. CONCLUSION AND FEES

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 06-1050.

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Vicor Corporation is the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

The '534 patent is the subject of a civil action, *Delta Electronics, Inc. v. Vicor Corporation* 1-23-cv-01246, D. Del., filed November 1, 2023 (VICOR-1004) and amended on January 26, 2024 (VICOR-1005).

Petitioner is also filing today another IPR petition against the '534 Patent (challenging a different set of claims). *See* IPR2024-00715. Petitioner is not aware of any other disclaimers, reexamination certificates, or IPR petitions addressing the '534 patent.

In addition, Petitioner is filing today two more IPR petitions against Patent Owner's patents. The petition in IPR2024-00704 challenges claims in US Patent

No. 8,711,580. The '580 patent is being asserted in the same Delaware civil action as the '534 patent. The petition in IPR2024-00705 challenges claims in US Patent No. 9,819,263. Patent Owner is asserting the '263 patent in *Delta Electronics, Inc. v. Vicor Corporation* 6-23-cv-00726, W.D. Tex., filed October 23, 2023. The inventor of the '534 patent is also the lead inventor on the '263 patent, and the patents have overlapping subject matter.

Patent Owner is also prosecuting U.S. Pat. App. No. 17/733,364, which claims the benefit of U.S. Pat. App. No. 15/952,224.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
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D. Service Information

Please address all correspondence and service to the address listed above. Petitioner consents to electronic service by email at IPR25808-0013IP1@fr.com (referencing No. 25808-0013IP1 and cc'ing PTABInbound@fr.com, katz@fr.com, kolodney@fr.com and oconnor@fr.com).

Respectfully submitted,

Dated 3/25/2024

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,677 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated 3/25/2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on March 25, 2024, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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