

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

RESONANT SYSTEMS INC.,
d/b/a/ REVELHMI,
Patent Owner.

IPR2024-00697
Patent 8,093,767 B2

Before KARL D. EASTHOM, NORMAN H. BEAMER, and
BRIAN D. RANGE, *Administrative Patent Judges*.

RANGE, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Apple Inc. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–5 of U.S. Patent No. 8,093,767 B2 (Ex. 1001, “the ’767 patent”). Paper 2 (“Pet.”). Resonant Systems, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). On October 21, 2024, we instituted *inter partes* review of the challenged claims on all asserted grounds. Paper 9 (“Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 14, “PO Resp.”), Petitioner filed a Reply (Paper 19, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 25, “PO Sur-Reply”). An oral hearing was held on July 16, 2025, and a transcript of the hearing is in the record (Paper 28, “Tr.”). We have jurisdiction under 35 U.S.C. § 6. This decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–5 of the ’767 patent are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies itself as the real party in interest. Pet. 80. Patent Owner identifies itself as the real party in interest, as assignee of the ’767 patent. Paper 5, 1.

B. *Related Matters*

The parties identify the following pending matters as related to this proceeding: *Resonant Systems, Inc. d/b/a RevelHMI v. Apple, Inc.*, 7-23-cv-00077 (W.D. Tex.) (filed June 1, 2023) (“the District Court case”). Pet. 81; Paper 5 at 1. Patent Owner also identifies the companion Petition, IPR2024-00698, also filed by Petitioner. Paper 5 at 1.

C. The '767 patent

The '767 patent, titled “Linear-Resonant Vibration Module,” issued January 10, 2012, with claims 1–5. Ex. 1001, codes (45), (54), 11:6–12:33. The '767 patent claims priority to a provisional application, No. 61/179,109, filed on May 18, 2009. The '767 patent describes that it is “related to vibration-generating devices and, in particular, to vibration modules that can be incorporated into a wide variety of different types of electromechanical devices and systems to produce vibrations of selected amplitudes and frequencies over a wide range amplitude/frequency space.” *Id.* at 1:11–16.

The '767 patent describes that the most common prior-art method of producing vibrations in consumer appliances, toys, and other devices is an intentionally-unbalanced electric motor. *Id.* at 1:22–28. The patent describes four problems with this method: unbalanced forces (which can damage devices), inefficiency in producing forces (which drains batteries faster), elliptical, rather than linear, vibrations, and that “only a very limited portion of the total vibrational-force/frequency space is accessible to unbalanced electric motors.” *Id.* at 2:9–45.

In the '767 patent, “vibrational forces are produced by linear oscillation of a weight or member, in turn produced by rapidly alternating the polarity of one or more driving electromagnets,” and “[f]eedback control is used to maintain the vibrational frequency.” *Id.* at 3:9–15. Figure 6, reproduced below, is a block diagram of a linear-resonant vibration module (“LRVM”) of the '767 patent:

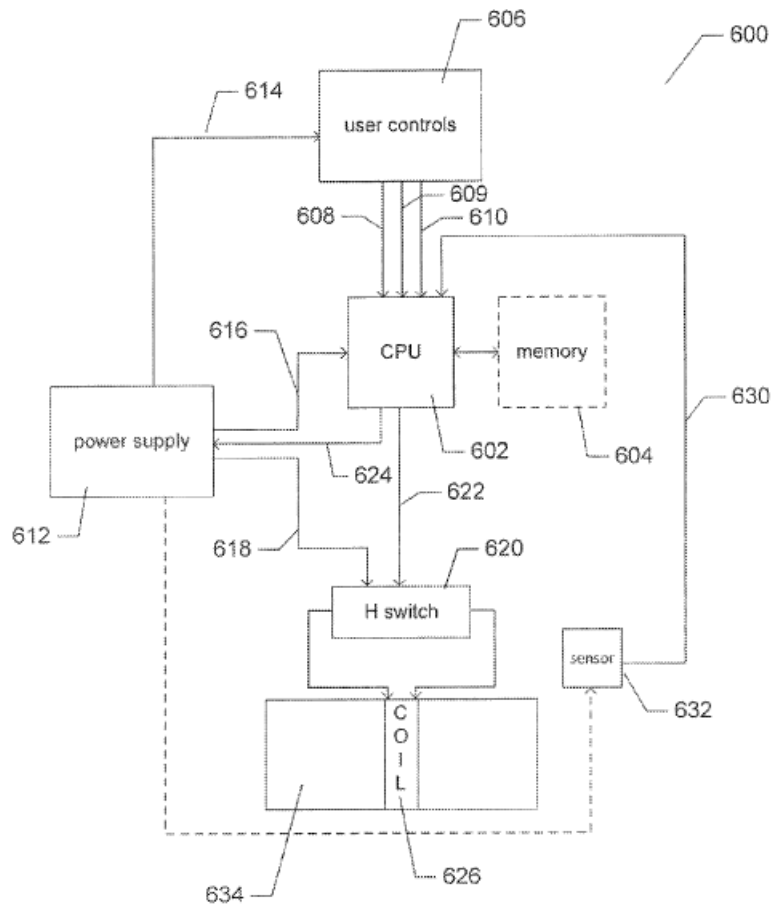


Figure 6 illustrates CPU 602, memory 604, user controls 616, input signals 608–610, power supply 612, H-bridge switch 620, sensors 632, coil 626, and linearly oscillating mass 634.

A side-view of one type of coil and oscillating mass is shown in Figure 10, reproduced below.

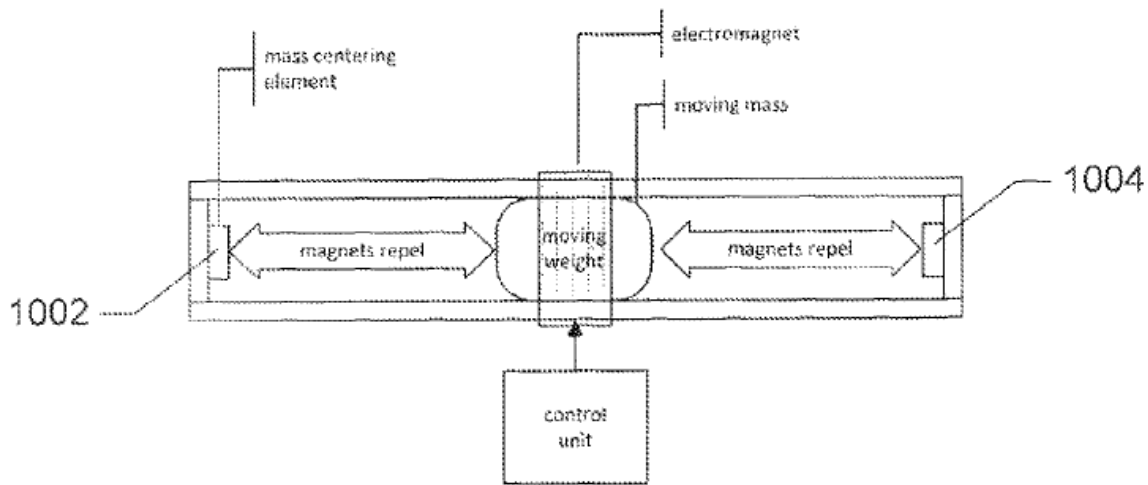


Figure 10 shows a LRVM, which illustrates end magnets 1002 and 1004 (which may instead be springs), a moving weight, an electromagnet, and a control unit. *Id.* at 8:45–51.

D. Illustrative Claims

Claim 1 is independent. The other challenged claims (claims 2–5) depend from claim 1. *See* Ex. 1001, 11:5–12:33.

Claim 1 (with identifiers of claim elements, *see, e.g.*, Pet. vii–viii, 18–31) is illustrative and is reproduced below.

[1.P] A linear resonant vibration module comprising:

[1.1] a housing;

[1.2] a moveable component;

[1.3] a power supply;

[1.4] a driving component that drives the moveable component in each of two opposite directions; and

[1.5.1] a control component that includes a microprocessor and that controls supply of power from the power supply to the driving component to cause the moveable component to linearly oscillate, the control component including, in addition to the microprocessor,

[1.5.2] a control program, stored in one of a separated electronic memory or within the processor, that is executed by the microprocessor to control operation of the linear resonant vibration module, and

[1.5.3] a switch that receives a directional signal d from the processor and that selects a corresponding direction of the two opposite directions in which the driving component drives the moveable component,

[1.6] the control component receiving output signals from sensors within the linear resonant vibration module during operation of the linear resonant vibration module and adjusting one or more operational control outputs of the control component according to the received output signals from the sensors in order that subsequent operation of linear resonant vibration module produces desired outputs from the one or more sensors corresponding to one or more operational control parameters.

Ex. 1001, 11:6–33.

E. Asserted Grounds of Unpatentability

Petitioner, supported by the Declaration of Dr. Blake Hannaford (Ex. 1003), asserts the following grounds of unpatentability (Pet. 1):¹

Ground	Claim(s) Challenged	35 U.S.C. §	References/Basis
1A	1	103(a)	Shahoian ² , Cosper ³
1B	1–4	103(a)	Shahoian, Cosper, Rossi ⁴

¹ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. The ’767 patent was filed before this date. *See* Ex. 1001, codes (22), (60). For the purposes of this Decision, pre-AIA statutes apply.

² US 6,982,969 B1, issued Jan. 3, 2006, Ex. 1004 (“Shahoian”).

³ US 2008/0246532 A1, published Oct. 9, 2008, Ex. 1009 (“Cosper”).

⁴ US 4,879,641, issued Nov. 7, 1989, Ex. 1020 (“Rossi”).

Ground	Claim(s) Challenged	35 U.S.C. §	References/Basis
1C	5	103(a)	Shahoian, Cospers, Rossi, Ramsay ⁵
2A	1	103(a)	Shahoian, Cospers, Ramsay, Aldrich ⁶
2B	1–5	103(a)	Shahoian, Cospers, Ramsay, Aldrich, Rossi

III. ANALYSIS

A. Legal Standard

“In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity ... the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and “the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying

⁵ US 2008/0294984 A1, published Nov. 27, 2008, Ex. 1006 (“Ramsay”).

⁶ “Controller for Driving a Piezoelectric Actuator at Resonance,” NASA Tech Briefs, Apr. 2008, Ex. 1021 (“Aldrich”).

factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the invention was made, we consider the level of ordinary skill in the pertinent art at the critical time. *Graham*, 383 U.S. at 17. The resolution of this question is important because it allows us to “maintain[] objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovation Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Petitioner contends that a person of ordinary skill in the art (POSITA) would have had a degree in mechanical engineering, electrical engineering,

⁷ Objective evidence of nonobviousness is not at issue here.

physics, or a related technical field, and at least 2–3 years of experience related to the design or development of systems incorporating linear actuators; additional years of experience could substitute for the degree. Pet. 4 (citing Ex. 1003 ¶ 30–31). Patent Owner contends a POSITA would have had (1) a bachelor’s degree in electrical engineering, mechanical engineering, or a comparable field of study, and (2) at least two years of professional experience with electro-mechanical control systems, or other similarly relevant industry experience. PO Resp. 2–3. Additional relevant industry experience may compensate for lack of formal education or vice versa. *Id.* Patent Owner further contends this is similar to Petitioner’s POSITA contention and states that “Patent Owner does not believe that any of the arguments herein would change if the Board were to adopt Petitioner’s definition for the level of ordinary skill rather than Patent Owner’s.” *Id.* at 3.

For purposes of this Decision, we adopt Petitioner’s proposal as reasonable and consistent with the ’767 patent specification and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art). Our reasoning herein would be the same under Patent Owner’s similar proposal.

C. Claim Construction

In *inter partes* reviews, the Board interprets claim language using the district-court-type standard, as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b). Under that standard, we generally give claim terms their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the

specification, and the prosecution history. *See Phillips*, 415 F.3d at 1313–14. Although extrinsic evidence, when available, may also be useful when construing claim terms under this standard, extrinsic evidence should be considered in the context of the intrinsic evidence. *See id.* at 1317–19.

In considering claim construction, we take into account the August 23, 2024, Claim Construction Memorandum and Order (“Dist. Ct. Constr.”) issued in the District Court case. *See supra* Section II.B.

Claim 1, Preamble. Both parties agree that the preamble of claim 1 is limiting. Pet. 6; PO Resp. 6. We agree that claim 1’s preamble is limiting. We also note that the parties agreed that this preamble is limiting in the District Court case. Dist. Ct. Const. 10.

Claim 1, “driving component” and “control component.” Petitioner argues that two terms recited in all claims, “driving component” and “control component,” should be construed under their plain and ordinary meaning. Pet. 5. But Petitioner also indicates that in the District Court case, Petitioner is arguing the terms should be construed under 35 U.S.C. § 112 ¶ 6 as “means-plus-function” terms. *Id.* Therefore, Petitioner argues Grounds 1A–1C based on plain and ordinary meaning but argues based on a means-plus-function construction for Grounds 2A and 2B. *Id.*

Patent Owner argues that we do not need to address means-plus-function issues here because those issues “relate to issues not relevant to arguments made in [its] Response.” PO Resp. 7. Patent Owner also notes that the District Court ordered that “control component” has its plain and ordinary meaning.

Because neither party asserts that construction of “driving component” or “control component” is necessary to resolve the issues before

us, we decline to expressly construe these claim terms. *See, e.g., Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). For clarity, because Petitioner argues that plain and ordinary meaning is appropriate and because Patent Owner does not dispute that construction, we adopt the plain and ordinary meaning of these claim terms when comparing the challenged claims to the prior art.

Other claim terms. It is unnecessary for us to expressly construe other claim terms for purposes of this Decision. *See, e.g., Realtime Data, LLC*, 912 F.3d at 1375.

D. Overview of the Asserted Art

1. Shahoian (Exhibit 1004)

Shahoian relates “to the output and control of vibrations and similar force sensations from actuators in a force feedback interface device.”

Ex. 1004, 1:20–22. Shahoian explains that:

Using an interface device, a user can interact with an environment displayed by a computer system to perform functions and tasks on the computer, such as playing a game, experiencing a simulation or virtual reality environment, using a computer aided design system, operating a graphical user interface (GUI), or otherwise influencing events or images depicted on the screen.

Id. at 1:23–29.

Shahoian further describes that many low-cost devices provide forces to a user by vibrating using an eccentric mass on the shaft of a motor, but this tends to “produce low-bandwidth vibrations that tend to all feel the

same, regardless of the different events and signals used to command them.” *Id.* at 1:61–64. Shahoian’s device “provides an actuator for a haptic feedback device that can output high quality vibrotactile sensations. Both the frequency and amplitude of the vibrations can be controlled using bi-directional control, and features such as the elastic material and flexures contribute to a high quality and high bandwidth vibration force output.” *Id.* at 2:59–65.

Shahoian uses moving magnet actuators to product vibration, which can be linear or rotational. *Id.* at 2:3–5, 2:32–33. An embodiment of Shahoian is shown in the diagram of Figure 2, reproduced below.

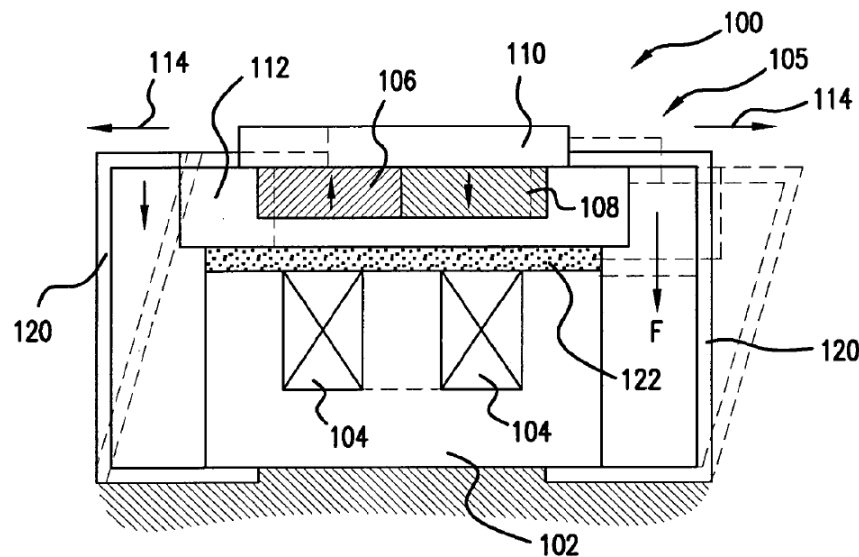


Figure 2 shows actuator 100, grounded metal core 102, wire coil 104, magnet head 105, which includes magnets 106 and 108, metal piece 110 (providing a flux return path), and plastic housing 112. *Id.* at 6:14–25.

“[A]ctuator 100 operates by producing a force on the magnet head 105 in the linear directions indicated by arrows 114 when a current is flowed through the coil 104.” *Id.* at 6:26–25. A controller can adjust the magnitude of vibration to a desired level within the allowed magnitude range, by

adjusting the magnitude of the waveform. *Id.* at 7:38–41. The controller can also adjust the frequency of the drive waveform independently of the amplitude, to adjust the frequency of vibration. *Id.* at 7:41–49. The drive signal can be supplied by an “H-bridge circuit or other amplifier circuit.” *Id.* at 7:48–53.

2. *Cosper (Exhibit 1009)*

Cosper relates to “automatically driving and maintaining oscillation of an assembly system including a mass and a bias member (which may also be referred to as a spring or elastomeric member) at or near a resonant frequency of the assembly system.” Ex. 1009, code[57]. Cosper’s system includes “a controller operable to receive a signal from a sensor associated with a position or motion of the subassembly, and generate a drive signal for driving the subassembly in response to the received signal from the sensor.” *Id.* Cosper’s “controller may monitor the motion of the subassembly and adjust or modulate the driving force over time to maintain the subassembly at or near a resonant frequency.” *Id.*

Figure 1, reproduced below, is a schematic of Cosper’s system.

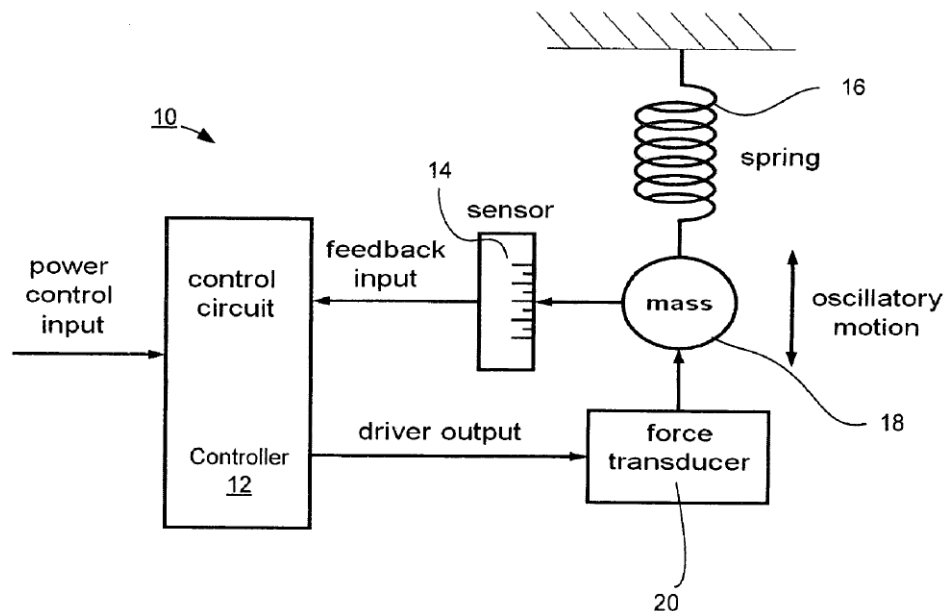


Figure 1 shows control system 10, with

control logic (e.g., hardware, software, firmware, or combinations thereof included with a controller or control circuit 12), a sensor 14 for determining a parameter from the moveable subassembly (e.g., including a bias 16 and mass 18), a sensor input for inputting the parameter into the control logic of control circuit 12, and a control output from the control logic to drive the moveable subassembly at or near resonance via force transducer 20.

Id. ¶ 49.

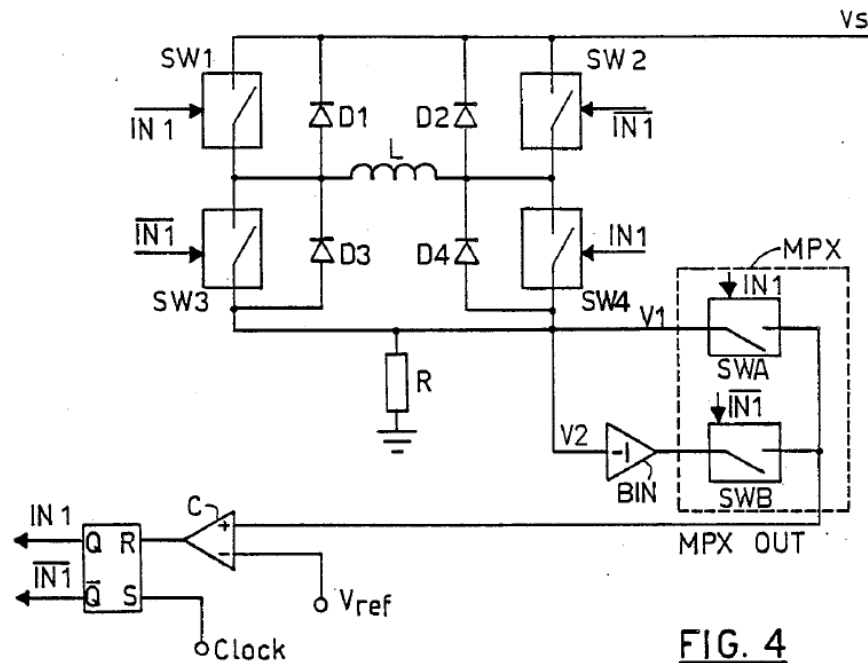
3. Rossi (*Exhibit 1020*)

Rossi “relates to circuits for a switching mode driving of a load and in particular to circuit arrangements for controlling the current being delivered to the load.” Ex. 1020, 1:8–11. Rossi describes that prior art apparatuses for controlling electric motors typically use “sensing resistances,” which “represent[] a remarkable cost factor of the apparatus [] because they must often possess well determined precision and temperature co-efficient characteristics and be exempt of any appreciable inductance.” *Id.* at 1:32–36.

Rossi’s circuit “determines the magnitude and direction of the current

being delivered to a load of an H-bridge stage by utilizing a single sensing resistor connected between a common virtual ground node of the driving bridge circuit and a real ground node.” *Id.* at 1:38–43.

A diagram of Rossi’s circuit is reproduced below:



Rossi’s Figure 4 depicts a circuit that utilizes “a single sensing resistor R connected between a single common virtual ground node (V_t) and a real ground node of the circuit.” *Id.* at 2:57–59.

4. Ramsay (*Exhibit 1006*)

Ramsay “relates to enabling a user to customize the haptic effects on an end user device.” Ex. 1006 ¶ 2. Ramsay explains that “haptic feedback can be used to supplement auditory and visual feedback to enhance how information is provided to the user.” *Id.* ¶ 14. However, unlike the ability to change “ring tones,” “a user typically does not have the option on the device itself to modify characteristics of haptic feedback.” *Id.*

Therefore, Ramsay discloses “allowing a user of an end user device to

modify parameters associated with haptic effects that can be played on the end user device.” *Id.* ¶ 5. Ramsay discloses “enabling a user of an end user device to access software adapted to design or modify haptic effects of the end user device,” or “enabling the user to open a haptic track file and enter or modify parameters associated with the haptic effects of the opened haptic track file.” *Id.* Ramsay discloses altering the speed of a motor with the use of an “eccentric rotating mass (ERM) actuator,” or modifying “amplitude values” with the use of a “linear resonant actuator (LRA).” *Id.* ¶ 26.

5. *Aldrich (Exhibit 1021)*

Aldrich describes a “digital control system based partly on an extremum-seeking control algorithm [which] tracks the changing resonance frequency of a piezoelectric actuator or an electrically similar electromechanical device that is driven by a sinusoidal excitation signal and is required to be maintained at or near resonance in the presence of uncertain, changing external loads and disturbances.” Ex. 1021, 41⁸.

Aldrich describes incrementing or decrementing an excitation frequency, determining if the change “results in an increase in the current/voltage ratio,” and then either making another increment, or reversing and decrementing, until the resonance peaks. *Id.* at 42.

E. *Unpatentability Grounds*

1. *Unpatentability over Shahoian and Cospier (Ground 1A)*

Petitioner asserts that claim 1 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Shahoian and Cospier, citing the Declaration of Dr. Hannaford for support. Pet. 1, 10–31 (citing Ex. 1003).

⁸ We refer to the page numbers in the original.

Patent Owner does not dispute Petitioner's assertions regarding claim 1 except for disputing the motivation to combine. *See generally* PO Resp. We address the parties' assertions below.

a. *Combining Shahoian and Cosper*

Petitioner argues that Shahoian teaches a linear actuator module for a force feedback device that provides haptic feedback to a user as part of a "handheld game device or computer." Pet. 10–11 (citing, e.g., Ex. 1004, code [57], 2:1–3:2, 3:9–10, 3:21–5:39, 6:3–7:63; Ex. 1003 ¶¶ 72–80).

Petitioner argues that Cosper describes a feedback control system for maintaining resonant oscillation of a linear actuator. *Id.* at 12–13 (citing, e.g., Ex. 1009 ¶¶ 49–50; Ex. 1003 ¶¶ 81–82).

Petitioner argues that a person having ordinary skill in the art would have combined Shahoian's module to include multiple sensors in accordance with Cosper's teachings. Pet. 14. Petitioner argues that the sensor would allow adjusting a control signal to drive the actuator, "thereby facilitating vibration according to desired characteristics." *Id.* Patent Owner argues that Petitioner has not adequately established a motivation to combine Shahoian and Cosper. In particular, Patent Owner argues that Shahoian and Cosper have various differences such that there would be no motivation to combine these references' teachings. PO Resp. 11–13.

The preponderance of the evidence supports Petitioner's position that a person having ordinary skill in the art would have had reason to combine the teachings of Shahoian and Cosper with a reasonable expectation of success. We emphasize that Petitioner proposes modification of Shahoian in order to incorporate "sensors that 'detect position, velocity, acceleration, etc.' in accordance with Cosper." Pet. 14 (quoting Ex. 1009 ¶ 50). Cosper's

sensors would allow Shahoian to adjust a control signal to drive its actuator according to desired characteristics. *Id.* (citing Ex. 1003 ¶¶ 109–110).

Petitioner’s expert credibly testifies, with persuasive reasoning and citations to supporting evidence, that a person having ordinary skill in the art would have had three reasons to implement feedback control and user-input features in Shahoian in accordance with Cosper’s suggestions. Ex. 1003 ¶¶ 112–115. First, a person having ordinary skill in the art would have looked to the teachings of Cosper to further Shahoian’s goal of using a drive waveform to cause the actuator to produce a specific vibration output. Pet. 15 (citing Ex. 1003 ¶ 111; Ex. 1004, 6:40–44, 7:29–53, Ex. 1009, Abstract, ¶¶ 50–52); *see also* Pet. Resp. 6–7 (citations omitted). Cosper teaches that its techniques could apply to “any appropriate subassembly.” Ex. 1009 ¶ 12; *see also* Pet. Reply 10; Ex. 1049 ¶ 18. Second, the combined teachings would have achieved the benefit of monitoring real-time movement of the actuator with sensors thereby enhancing the ability to output vibration to particular parameters while making the output less susceptible to external influences. *Id.* at 15–16 (citing Ex. 1003 ¶ 112; Ex. 1009 ¶ 50. Third, the combined teachings would allow user inputs to facilitate device operation. *Id.* at 16–17 (citing Ex. 1003 ¶ 114; Ex. 1004, 4:44, 5:26–39; Ex. 1009 ¶¶ 53, 106.

Patent Owner’s arguments and evidence do little to weigh against the evidence Petitioner presents. Patent Owner argues, for example, that Cosper differs from Shahoian because “Cosper ... has nothing to do with haptic feedback or with high bandwidth variations.” PO Resp. 11. Patent Owner also argues that Cosper focuses on rotational movement rather than linear movement. *Id.* at 11–12. Patent Owner further argues that Cosper is

interested in a narrow bandwidth system rather than a high bandwidth system. *Id.* at 13; *see also* PO Sur-Reply 6. None of these arguments squarely address Petitioner’s position. Petitioner’s combination does not bodily incorporate Cosper into Shahoian or combine the entirety of the references’ teachings. Pet. Reply 9–10 (citing Ex. 1049 ¶ 18). With respect to narrow versus high bandwidth, Shahoian teaches that vibration at the resonance frequency “can” be compensated for “if desired.” Ex. 1004, 7:54–62; *see also* Pet. Reply 8; Ex. 2011, 31:14–19 (Dr. Hannaford explaining that Shahoian teaches changing mode of operation depending on whether or not resonance is desired). Thus, Shahoian recognizes that the ability to control frequency is desired. In sum, the differences between Cosper and Shahoian do not undermine Petitioner’s position: that a person having skill in the art would have had reason to implement sensors as Cosper teaches to improve the functionality of Shahoian.

Patent Owner also argues that Shahoian and Cosper “are not analogous.” Appeal Br. 9, 15.⁹ Petitioner disagrees and argues that both

⁹ During oral argument, Petitioner argued that Patent Owner’s Sur-Reply improperly raises the analogous art argument for the first time because Patent Owner’s Response argued that Shahoian and Cosper are not analogous to each other rather than arguing that Shahoian and Cosper are not analogous to the challenged ’797 patent. Tr. 55:13–60:6. On this record, it is unclear whether or not Patent Owner intended to raise a true “analogous art” argument in Patent Owner’s Reply rather than using these words in the context of arguing motivation to combine. We note, however, that Petitioner addressed “analogous art” in Petitioner’s Reply. Pet. Reply 2–6.

We do not need to address the procedural issue Petitioner raises because, even if Patent Owner’s Sur-Reply and evidence cited therein is considered, the preponderance of the evidence supports Petitioner for the reasons we explain herein.

Shahoian and Cospers “are analogous art to the ’767 Patent.” Pet. Reply 3.

Our reviewing court has stated that “[t]wo separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.” *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (citations and internal quotes omitted). While these two criteria are helpful in many instances, we must not lose sight of the key question at hand: what is “prior art” as that term is used in 35 U.S.C. § 103(a)? References that are “too remote to be treated as ‘prior art’” are excluded from the obviousness analysis. *In re Sovish*, 769 F.2d 738, 741, 226 (Fed. Cir. 1985). The non-analogous art test provides helpful insight on the underlying question of what is “prior art” within the meaning of the statute; we should not, however, be blind to the reality of the circumstances of the case before us. *In re Wood*, 599 F.2d 1032, 1036 (CCPA (1979)). Nor should we adhere to rigid and mandatory formulas that overly limit the inquiry. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007).

Focusing on the first of the two tests above, the test for analogous art “requires the PTO to determine the appropriate field of endeavor by reference to explanations of the invention's subject matter in the patent application, including the embodiments, function, and structure of the claimed invention.” *In re Bigio*, 381 F.3d at 1325. We thus consider all explanations of the inventors’ subject matter while keeping in mind that prior art is analogous when it “is from the same field of endeavor, **regardless of the problem addressed. . . .**” *In re Bigio*, 381 F.3d at 1320

(emphasis added). Thus, “field of endeavor” should not be defined narrowly based only upon the specific problem addressed.

Moreover, when considering field of endeavor, we also remain cognizant of the adage that “the name of the game is the claim.” *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998) (quoting Giles Sutherland Rich, *Extent of Protection and Interpretation of Claims—American Perspectives*, 21 Int'l Rev. Indus. Prop. & Copyright L. 497, 499 (1990)). The Supreme Court articulated this same sentiment when emphasizing that the patentee's motivation and purpose do not control an obviousness determination: “In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. **What matters is the objective reach of the claim.** If the claim extends to what is obvious, it is invalid under § 103.”

KSR Intern. Co., 550 U.S. at 419 (emphasis added).

Turning to the issues at hand while keeping this legal framework in mind, we first turn to the first test enumerated by *In re Bigio* (same field of endeavor). Claim 1 is directed to a “linear resonant vibration module” having, for example, a housing, moveable component, power supply, driving component, and control component. Ex. 1001 11:6–33. Based on the breadth of claim 1 (and the other challenged claims), we agree with Petitioner that the '767 Patent Specification's “Technical Field” section appropriately defines the '767 Patent's field of endeavor as “vibration-generating devices and, in particular, to vibration modules that can be incorporated into a wide variety of different types of electromechanical devices and systems to produce vibrations of selected amplitudes and frequencies over a wide range amplitude/frequency space.” Ex. 1001, 1:11-16.

The preponderance of the evidence supports that Shahoian is in the same field of endeavor as the '767 patent. Shahoian describes electromechanical devices that generate vibration using a linear actuator for use with a user interface device such as a controller or joystick. Pet. Reply 3 (citing Ex. 1004, 1:18–2:34, 2:59–32; Fig. 1; Ex. 1049 ¶ 10); Pet. 10 (citing, *e.g.*, Ex. 1004 6:3–6); Ex. 1003 ¶¶ 72–80. Patent Owner does not appear to dispute that Shahoian is in the same field of endeavor as the '767 patent. PO Sur-Reply 2–3.

The preponderance of the evidence also supports that Cosper is in the same field of endeavor as the '767 patent. Cosper relates to controlling an “oscillating mechanical system” and indicates that “[a]ny appropriate subassembly may be used with the systems and methods” Cosper describes. Pet. Reply 3 (citing Ex. 1009 ¶¶ 3, 12; Ex. 1049 ¶ 10); Pet. 12–13 (citing, *e.g.*, Ex. 1009 ¶¶ 8–10, 49–50, 54, 58, 69, 125, 127, Fig. 1; Ex. 1003 ¶¶ 81–84). Patent Owner does not dispute that Cosper is a vibration-generating device that can produce vibrations of selected amplitude and frequency.

Patent Owner argues that Cosper is not in the field of endeavor as the '767 Patent because it relates to vibrations occurring over a narrow range of frequencies as oppose to the “wide range amplitude/frequency space” the '767 Patent refers to. PO Sur-Reply 2–6. Patent Owner’s argument does not undermine Petitioner’s showing for two reasons. First, the field of endeavor of the alleged '767 Patent invention is not limited to individual devices that must operate over a “wide range amplitude/frequency space.” Claim 1 does not include recitations that limit the scope of the invention in this way. Instead, the '767 Patent indicates that its field includes many embodiments and it is “different implementations” that cover include a “wide range

amplitude/frequency space.” Ex. 1001, 7:4–19 (“FIG. 8 represents the range of frequencies and vibrational forces that can be achieved *by different implementations* of LRVM and LRVM control programs *that represent embodiments of the present invention.*”) (emphases added). Thus, even if Cosper were only one embodiment working within a narrow range, it would still fall within the ’767 Patent’s field of invention which includes different implementations that, collectively, allow the ’767 Patent to encompass a wide range.

Second, Cosper’s field is broader than Patent Owner suggests. When Cosper states that its systems “operate in an oscillatory mode at or near their mechanical resonant frequency” (PO Sur-Reply 3 (quoting Ex. 1009 ¶ 3) (emphasis removed)), it is providing an example of the “systems and method for control of a mass and bias ... subassembly” that Cosper includes. Ex. 1009 ¶ 3. Cosper also teaches, for example, that a drive circuit can vary the resonant frequency of the mechanism. *Id.* ¶ 11. Thus, we find that both Shahoian and Cosper are analogous art to the ’767 Patent because they are in the same field of endeavor.

A preponderance of evidence also supports that both Shahoian and Cosper are analogous art because they are reasonably pertinent to the particular problem with which the inventor is involved. The ’767 Patent describes problems “unbalanced electric motors,” “destructive, unbalanced forces,” “relatively inefficient [past solutions],” “elliptical vibrational modes,” and “only a very limited portion of the total vibrational-force/frequency space [being] accessible.” Ex. 1001, 2:8–3:2; *see also* Pet. Reply 4; Ex. 1049 ¶ 11. In view of these problems, the ’767 Patent seeks “more efficient and capable vibration-generating units for incorporation into

many consumer appliances, devices, and systems.” Ex. 1001, 2:63–3:2.

Shahoian is pertinent to these same problems and identifies the shortcomings of vibrations that “tend to all feel the same” and that “cannot be significantly varied” (i.e., are within a limited portion of the vibrational-force/frequency space). Ex. 1004:1:45–67; *see also* Pet. Reply 4; Ex. 1049 ¶ 12. Patent Owner does not dispute that Shahoian is reasonably pertinent to the particular problem with which the inventor is involved. *See, e.g.*, PO Sur-Reply 2–7.

Cosper is also reasonably pertinent to problems addressed by the ’767 patent. Cosper, like the ’767 Patent, is concerned with “efficient oscillation and is interested in providing vibration modes beyond “elliptical” vibration, including “linear” oscillation. Ex. 1049 ¶ 13 (citing Ex. 1009 ¶¶ 5–13, 48–57, 67). Cosper teaches promoting oscillation at a particular frequency (at a resonant frequency) and making uses of sensors and feedback control to reach this frequency for efficient operation. Ex. 1009, Fig. 1.

Patent Owner argues that Cosper is not directed to problems pertinent to the ’767 Patent by arguing that Cosper is only “intended to produce oscillations at or near a single frequency, the resonant frequency.” PO Sur-Reply 4. But, even if this is true, it does not undermine Petitioner’s position and evidence establishing that Cosper, like the ’767 Patent, is concerned with problems of efficiency and controlling oscillation at a particular frequency. Thus, we find that both Shahoian and Cosper are analogous art to the ’767 Patent because they are reasonably pertinent to the particular problem with which the ’767 Patent’s inventor is involved.

a. *Claim 1*

Petitioner contends that the combined teachings of Shahoian and Cosper teach or suggest each limitation of claim 1. Pet. 19–30. Patent Owner does not address any particular recitations of claim 1. PO Resp. *passim*. We address each limitation below.

[1.P] A linear resonant vibration module comprising:

Petitioner argues that the Shahoian-Cosper combination includes a linear resonant vibration module. Pet. 18–20. Petitioner’s argument is sufficiently supported by a preponderance of the evidence. Shahoian teaches, for example, “a linear moving magnet actuator for providing haptic feedback.” Ex. 1004, code [12], Fig. 2. A preponderance of the evidence supports that the combined system provides an actuator that “can be controlled to produce periodic motion in alternately opposite directions across a single axis at a resonant frequency.” Ex. 1003 ¶¶ 117–118.

[1.1] a housing;

Petitioner argues that the Shahoian-Cosper combination includes a housing. Pet. 20. We find that Petitioner’s argument is supported by a preponderance of the evidence. Shahoian teaches a housing. *See, e.g.*, Ex. 1004, 2:51–52; Ex. 1003 ¶ 119.

[1.2] a moveable component;

Petitioner argues that the Shahoian-Cosper combination includes a moveable component. Pet. 20. In particular, Petitioner identifies Shahoian’s “magnet head” as a moveable component. *Id.* We find that Petitioner’s argument is supported by a preponderance of the evidence. Shahoian teaches a moveable component. *See, e.g.*, Ex. 1004, 2:3–5, 6:14–35, 6:62–7:16; Ex. 1003 ¶ 120.

[1.3] a power supply;

Petitioner argues that the Shahoian-Cosper combination includes a power supply. Pet. 20–21. We find that Petitioner’s argument is supported by a preponderance of the evidence. Shahoian teaches “actuator interface 38” along with “power supply 40.” Ex. 1004, 5:35–37, Fig. 1; Ex. 1003 ¶ 121.

[1.4] a driving component that drives the moveable component in each of two opposite directions;

Petitioner argues that Shahoian teaches a “wire coil” that drives the moveable component (Shahoian’s moveable “magnet head”) in each of two opposite directions. Pet. 21–22. We find that Petitioner’s argument is supported by a preponderance of the evidence. Shahoian teaches, for example, that “[t]he actuator 100 operates by producing a force on the magnet head 105 in linear directions indicated by arrows 114 when a current is flowed through the coil 104.” Ex. 1004, 6:26–28; *see also id.*, Fig. 2, code [57], 2:15–17, 2:34–41, 6:14–25; Ex. 1003 ¶¶ 122–123.

[1.5.1] a control component that includes a microprocessor and that controls supply of power from the power supply to the driving component to cause the moveable component to linearly oscillate, the control component including, in addition to the microprocessor,

Petitioner argues that the Shahoian-Cosper combination includes a control component with a microprocessor programmed to execute a vibration control program (as modified in accordance with Cosper) and an H-bridge switch. Pet. 23–24. Petitioner argues that the control component controls power from the power supply to the driving component to cause the moveable component to linearly oscillate. *Id.* at 23.

We find that Petitioner's argument is supported by a preponderance of the evidence. Shahoian teaches a local microprocessor and software instructions that control power in the recited manner. Ex. 1003 ¶¶ 108–115, 124–135; Ex. 1004, Fig. 1, 4:16–30, 4:56–61, 5:4–6.

[1.5.2] a control program, stored in one of a separated electronic memory or within the processor, that is executed by the microprocessor to control operation of the linear resonant vibration module,

Petitioner argues that the Shahoian-Cosper combination includes a control program stored in Shahoian's local memory 27 that is executed by Shahoian's local microprocessor to control operation of the linear resonant vibration module. Pet. 25–26. We find that Petitioner's argument is supported by a preponderance of the evidence. Shahoian teaches microprocessor 26 having software instructions to handle/control input and output signals. Ex. 1003 ¶ 127–128; Ex. 1004 ¶¶ 4:10–24, 4:49–54. Cosper further describes controlling an output signal to maintain oscillation at a resonant frequency. Ex. 1009, code [57], ¶¶ 9–11, 50, 55, 57–58; Ex. 1003 ¶ 127.

[1.5.3] a switch that receives a directional signal d from the processor and that selects a corresponding direction of the two opposite directions in which the driving component drives the moveable component;

Petitioner argues that the combination's H-bridge circuit is a switch that receives a directional signal from Shahoian's local microprocessor and selects a corresponding direction in which Shahoian's wire coil drives the magnet head. Pet. 27–29. Petitioner argues that Shahoian describes that its microprocessor receives control signals from the microprocessor and also argues that such an arrangement would have been obvious. *Id.*

We find that Petitioner’s argument is supported by a preponderance of the evidence. Shahoian’s H-bridge circuit receives a directional signal *d* at each transistor 52, 54, 56, and 58 from the local microprocessor and selects a corresponding direction in which the wire coil drives the magnet head. Ex. 1004, 4:19–39, 4:46–53 (explaining that an H-bridge circuit is disclosed in a co-pending application incorporated by reference), 5:4–10; Ex. 1037, 13:24–14:18 (co-pending application further explaining the H-bridge circuit), Fig. 5A; Ex. 1003 ¶¶ 129–135.

[1.6] the control component receiving output signals from sensors within the linear resonant vibration module during operation of the linear resonant vibration module and adjusting one or more operational control outputs of the control component according to the received output signals from the sensors in order that subsequent operation of linear resonant vibration module produces desired outputs from the one or more sensors corresponding to one or more operational control parameters.

Petitioner argues that the microprocessor of the combination’s control component receives output from multiple sensors (sensors in accordance with Cosper). Pet. 30. Petitioner argues that the microprocessor adjusts outputs based on the signals corresponding to operational control parameters. *Id.* at 29–31. Petitioner’s argument is supported by a preponderance of the evidence. Cosper teaches multiple sensors that detect “position, velocity, acceleration, etc.” Ex. 1009 ¶ 50. The microprocessor uses the sensor inputs to control parameters such as amplitude or frequency. Ex. 1003 ¶¶ 136–137; Ex. 1009, code [57], ¶¶ 9–11, 50, 55, 57–58.

We determine Petitioner has established by a preponderance of the evidence that that claim 1 would have been obvious over the combined teachings of Shahoian and Cosper.

2. *Unpatentability over Shahoian, Cosper, and Rossi
(Ground 1B)*

Petitioner asserts claims 1–4 are unpatentable under 35 U.S.C. § 103(a) as obvious over Shahoian in view of Cosper and Rossi. Pet. 1, 34–46 (citing Ex. 1003).

a. *Combining Shahoian, Cosper, and Rossi*

Petitioner argues that Rossi describes an embodiment of an H-bridge switching circuit. Pet. 31–32. Shahoian teaches use of a “well-known H-bridge circuit” to supply a drive signal to the actuator. Pet. 32 (citing Ex. 1004, 7:47–50). Petitioner argues that a person having ordinary skill in the art would have looked toward Rossi to implement Shahoian’s H-bridge to further Shahoian’s objectives, to achieve a simple and reliable circuit design, and because doing so would have been application of a known technique to a known device. *Id.* at 33–36. Petitioner argues that implementing Rossi with Shahoian would have had a reasonable expectation of success because it would have been routine. *Id.* at 36.

Patent Owner does not dispute Petitioner’s position. A preponderance of the evidence supports that a person having ordinary skill in the art would have had reason to reach Petitioner’s proposed Shahoian, Cosper, Rossi combination with a reasonable expectation of success. *See, e.g.*, Ex. 1004, 7:47–50; Ex. 1020, Abstract, 1:65–2:49, 2:56–3:54, Figs. 4, 6; Ex. 1037, 4:1–11, 12:29–14:18, Fig. 5a; Ex. 1003 ¶¶ 68, 80, 139–144.

b. *Claim 1*

Petitioner contends that Shahoian, Cosper, and Rossi teach or suggest each recitation of claim 1 and contends that a person having skill in the art would have had reason to combine the references teachings with a

reasonable expectation of success. Pet. 36–38. A preponderance of the evidence supports this position. *Id.* (providing citations to the record); *see also* Section III(E)(1), *supra*. Patent Owner does not dispute Petitioner’s position aside from raising the reason to combine and analogous art arguments we address above. *Id.*

We determine Petitioner has established by a preponderance of the evidence that that claim 1 would have been obvious over the combined teachings of Shahoian, Cosper, and Rossi.

c. *Claim 2*

Petitioner contends that Shahoian, Cosper, and Rossi teach or suggest each recitation of claim 2 and contends that a person having skill in the art would have had reason to combine the references teachings with a reasonable expectation of success. Pet. 38–45. We address each recitation of claim 2 below.

[2.1] The linear resonant vibration module of claim 1 wherein the switch comprises: a directional-signal d input;

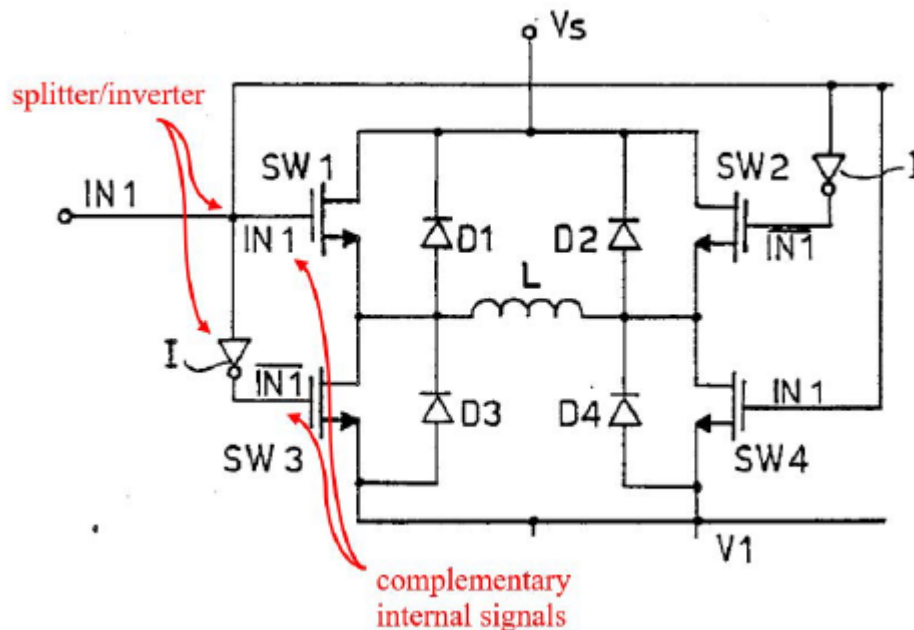
Petitioner argues that the Shahoian-Cosper-Rossi combination includes a directional signal d input (“driving signal IN1” node). Pet. 39–40. Patent Owner does not dispute this point. A preponderance of the evidence supports Petitioner’s position. Ex. 1003 ¶ 149; Ex. 1020, Fig. 6.

[2.2] a voltage input;

Petitioner argues that the Shahoian-Cosper-Rossi combination’s switch includes a voltage input (voltage supply node “Vs” in accordance with Rossi). Patent Owner does not dispute this point. A preponderance of the evidence supports Petitioner’s position. APPLE-1020, Abstract, 1:65–2:12, 3:57–4:52, Figs. 4, 6.

[2.3] a directional-signal splitter/inverter that generates two complementary internal signals, d and $\bar{d}$, corresponding to directional-signal d ; and

Petitioner argues that The Shahoian-Cosper-Rossi combination's switch includes a directional signal splitter/inverter ("I") that generates two complementary internal signals, d ("driving signal IN1" after the splitter) and $\bar{d}$ ("driving signal $\overline{\text{IN1}}$ after the splitter") corresponding to direction-signal d. Pet. 40–41. Petitioner annotates Rossi Figure 6 to illustrate its position. *Id.* We reproduce Petitioner's annotated Rossi Figure 6 below.



Pet. 41. Rossi Figure 6 is “a circuit diagram of an embodiment of the circuit of FIG 4 utilizing analog switches implemented by means of MOS transistors. Ex. 1020, 1:62–64. Petitioner identifies the splitter/inverter on the left side of the figure and identifies IN1 and $\overline{\text{IN1}}$ on the left side of the figure as “complementary internal signals.” Pet. 41.

Patent Owner does not dispute that Rossi teaches this particular recitation. Pet. Resp. 15–17 (arguing recitation [2.4] rather than recitation

[2.3]). A preponderance of the evidence supports Petitioner’s position that Rossi suggests this recitation. *See, e.g.*, Ex. 1003 ¶ 151; Ex. 1020, 1:65–2:2, Fig. 6.

[2.4] two pairs of solid-state switches, a first switch of each pair controlled by internal signal d and a second switch of the pair controlled by internal signal $\bar{d}$, that apply the input voltage in a first direction to the driving component when the d is in a first voltage state and that apply the input voltage in a second direction to the driving component when the d is in a second voltage state.

Petitioner argues that, as depicted in Rossi Figure 6 reproduced above, the first pair of solid-state switches is SW1 and SW3. Pet. 41–42. Petitioner argues the second pair of solid-state switches is SW2 and SW4. *Id.* SW1 and SW4 are the first switch of each pair, and SW2 and SW3 are the second switch of each pair. *Id.* Petitioner argues that the first switch of each pair is controlled by internal signal d and the second switch of each pair is controlled by internal signal $\bar{d}$. *Id.* at 43–45; *see also* Ex. 1003 ¶¶ 152–157. Petitioner argues that the Rossi Figure 6 apparatus applies voltage in two different directions depending on the voltage state of internal signal d . Pet. 43–44.

Patent Owner argues that argues that the alleged second switch of each pair (SW2 and SW3) are not both “controlled by internal signal $\bar{d}$ ” as claim 2 requires. PO Resp. 17. Patent Owner argues that while Figure 6 shows that both SW2 and SW3 receive signal $\overline{IN1}$, only the signal received by SW3 is “internal signal $\bar{d}$,” i.e. the signal generated by the splitter/inverter of limitation [2.3].” *Id.*

As we explain here, the preponderance of the evidence supports Petitioner’s position for two reasons. First, Rossi Figure 6 teaches or suggests that both switch SW2 and SW3 receive an identical signal “ $\overline{IN1}$.”

Ex. 1020, Fig. 6. The language of claim 2 does not require that the signal to these switches come from an identical inverter. Rather, recitation [2.3] requires that an inverter generate a signal d and $\bar{d}$, and recitation [2.4] requires that the second switch of each pair be controlled by $\bar{d}$. The claim uses the word “comprising” so it is open ended and could, optionally, include another inverter that generates an identical $\bar{d}$. Thus, even if Rossi is understood as having two inverters generating a $\bar{d}$ signal, this would not distinguish it from claim 2 properly construed. *See* Pet. Reply 15–16.

Second, even if claim 2 is construed to require that only one inverter generate one signal $\bar{d}$ that then controls both of the second switches of each pair of switches, Rossi reasonably suggests such a configuration. *Id.* at 10–16. For example, Rossi states that Figure 6 is a *circuit diagram* of an embodiment of Figure 4. Ex. 1020, 1:62–64. Because it is a circuit diagram, it is meant to depict the functionality of a circuit and is not limited to a precise layout. Rather, a person of ordinary skill in the art would know that specific components and structural details could be selected in various ways, including use of a single inverter, to satisfy the logical circuit layout of Fig. 6. Ex. 1049 ¶ 23 (Petitioner’s expert, Dr. Hannaford, credibly explaining this). Figure 4 illustrates signal $\overline{IN1}$ as an input to both SW2 and SW3 without limiting what generates signal $\overline{IN1}$. Ex. 1020, Fig. 4. Rossi also teaches that a single inverter may be implemented. *Id.* at Fig. 1; *see also id.* at 2:56–3:5 (referring to a single “clocked driving signal” and its “inverted signal $\overline{IN1}$.”); Ex. 1049 ¶¶ 19–26 (Petitioner’s witness, Dr. Hannaford, credibly explaining with reference to Rossi why Rossi suggests use of single inverter configurations). Moreover, using a single inverter would be a predictable implementation of Rossi within a Shahoian-Cosper

system. Ex. 1049 ¶ 1049. Patent Owner does not present evidence or argument persuasively rebutting this Petitioner’s position in this regard on the merits. *See* PO Sur-Reply 7–11 (addressing the timing of Petitioner’s argument rather than the merits).

Patent Owner argues that the Petition relies only on Rossi Figure 6, and that arguments in Petitioner’s Reply concerning Rossi’s other teachings are improper. PO Sur-Reply 9–11. We determine that Petitioner’s arguments in the Reply regarding Rossi’s broader teachings are proper. In the Patent Owner Response, Patent Owner takes the position, for the first time, that claim 2 requires that the $\bar{d}$ signal that controls the second switch of each pair must come from an identical inverter. PO Resp. 17. Petitioner is permitted to respond to this new claim construction position by citing additional teachings of the asserted reference Rossi. *Axonics, Inc. v. Medtronic, Inc.*, 75 F.4th 1374, 1380 (Fed. Cir. 2023) (explaining that “where a patent owner offers a new claim construction for the first time in its response after the institution decision, a petitioner may introduce new arguments and evidence in reply under the newly proposed claim construction”).

A preponderance of the evidence supports Petitioner’s position for the reasons we explain above. We thus determine Petitioner has established by a preponderance of the evidence that that claim 2 would have been obvious over the combined teachings of Shahoian, Cosper, and Rossi.

d. *Claim 3*

Petitioner contends that Shahoian, Cosper, and Rossi teach or suggest each recitation of claim 3 and contends that a person having skill in the art would have had reason to combine the references teachings with a

reasonable expectation of success. Pet. 45–46. We address each recitation of claim 3 below.

[3.1] The linear resonant vibration module of claim 2 wherein the linear resonant vibration module further includes a vibration sensor; and

Petitioner argues that the Shahoian-Cosper-Rossi combination’s control program “continuously monitors output from the vibration sensor (accelerometer) to adjust the frequency at which the control program changes the voltage state of the directional signal d (IN1) delivered to the H-bridge circuit.” Pet. 45–46 (citing, for example, Ex. 1004, 5:21–53; Ex. 1003 ¶ 159).

Patent Owner argues that the Petition “cites to nothing in Cosper or any other reference that is an accelerometer.” PO Resp. 17–18. Patent Owner is incorrect. Cosper teaches an accelerometer at paragraph 50. Ex. 1009 ¶ 50 (“one or more sensors 14 may detect position, velocity, **acceleration**, etc.” (emphasis added)); *see also* Pet. Reply 17; Ex. 1049 ¶ 28 (Petitioner’s witness explaining that an accelerometer is a sensor that detects acceleration). The Petition quotes Cosper’s reference to a sensor that detects acceleration. Pet. 14 (citing, for example, .Ex. 1009 ¶¶ 49–50).

Patent Owner argues in Sur-Reply that not every sensor that senses acceleration is an accelerometer. PO Sur-Reply 12–14. For example, Patent Owner argues that acceleration could be measured “without using a sensor that itself is experiencing the acceleration” and that this would not be an “accelerometer” under at least one dictionary definition. *Id.* at 14. Patent Owner’s argument does not persuasively undermine Petitioner’s showing for three reasons.

First, Patent Owner’s argument that Cosper lacks an “accelerometer” does not squarely address the issues at hand because claim 3 recites a vibration sensor, not an “accelerometer.” Patent Owner fails to persuasively undermine Petitioner’s position that Cosper’s sensor that measures acceleration, whether qualifying as an “accelerometer” or not, is a vibration sensor within the ambit of claim 3. Pet. 45. Indeed, the ’767 patent confirms that vibration sensors are not limited to “accelerometers” but could also be “other types of sensors that generate signals corresponding to the strength of desired vibrational forces.” Ex. 1001, 6:10–14. Cosper’s sensors that measure acceleration, even if not themselves experience vibration, would generate signals corresponding to acceleration “for the subassembly,” and acceleration signals correspond to strength of vibrational forces.¹⁰

Second, Cosper at paragraph 50 refers to “[s]ensors 14” as being able to detect acceleration. Cosper further explains that “sensor 14 is connected to a driver associated with force transducer 20, and senses the load or driving force applied to the subassembly.” Ex. 1009 ¶ 50. Thus, Cosper reasonably suggests that the sensors may directly measure acceleration, and this would be an accelerometer even under the narrower definition Patent Owner proposes. In contrast, Patent Owner does not persuasively cite any evidence supporting that Cosper teaches *only* a sensor that does not experience acceleration.

Third, Petitioner provides evidence that a person having ordinary skill in the art would have implemented a vibration sensor in view of Shahoian and Cosper. Pet. Reply 18 (citing Pet. 15–16; Ex. 1049 ¶ 30). Patent Owner

¹⁰ Force equals mass multiplied by acceleration.

argues that this position is new to the Reply and, thus, comes too late. PO Sur-Reply 14–15. Petitioner, however, is responding to Patent Owner’s implicit claim construction position, raised for the first time in the Reply, that claim 3’s “vibration sensor” excludes a sensor that measures acceleration if it the sensor is not an “accelerometer.” PO Resp. 17–18; *see also* PO Sur-Reply 12–14. Petitioner may introduce new arguments in reply where patent owner relies on a new claim construction in its Patent Owner Response. *Axonics, Inc.*, 75 F.4th at 1380.

Patent Owner also argues that the Petition “fails to explain why a POSITA would have been motivated to add a separate accelerometer for adjusting frequency in addition to the sensors already being used for the feedback control in the mapping of claim 1.” PO Resp. 18. Petitioner, however, explains that Cosper taught the use of multiple sensors one of which could be a sensor for measuring acceleration. Pet. 30; Pet. Reply. 17–18. A preponderance of the evidence supports Petitioner’s argument. Ex. 1009 ¶¶ 10, (referring to “[f]eedback on the position, velocity, and/or acceleration of the mass”), 50 (referring to “one or more feedback inputs from one or more sensors”), 125 (“one or more sensors (e.g., optical sensors, electrical sensors, motion sensors, etc.) may be used to provide information to the control circuitry”).

Thus, for the reasons explained above, a preponderance of the evidence supports that this recitation would have been obvious in view of Cosper in combination with Shahoian and Rossi.

[3.2] wherein the control program continuously monitors output from the vibration sensor in order to adjust the frequency at which the control program changes the voltage state of the directional signal d.

Petitioner argues that the combined Shahoian-Cosper-Rossi system continuously monitors output from the vibration sensor to adjust frequency by use of a continuous control loop. Pet. 45–46. Patent Owner argues that the Petition fails “to point to anything in the prior art references that teaches ‘continuous’ monitoring or to explain why it would have been obvious to modify the prior art to perform such ‘continuous’ monitoring.” PO Reply 19.

The preponderance of the evidence supports that, as the Petition asserts, the Shahoian-Cosper-Rossi system would have included continuous monitoring. Paragraph 10 of Cosper, for example, suggests a system with continuous monitoring as follows:

A drive circuit typically functions to compensate for changes in mechanical, electrical or magnetic parameters that may otherwise alter the mechanism’s resonant frequency. In general, a mass may be set in motion via an electromagnetic control and drive circuit. Feedback on the position, velocity, and/or acceleration of the mass may be input to the controller. The controller is operable to process the feedback signal and generate drive signals that are processed to maintain mechanical oscillation at the mechanical resonant frequency of the system.

Ex. 1009 ¶ 10; *see also* Pet. 45–46 (citing, for example, this passage of Rossi). A person having ordinary skill in the art would have understood from this passage that many signals provide feedback continuously in order to “maintain” a particular frequency. Ex. 1003 ¶ 159. Given the context of Cosper as a whole, Cosper would have suggested that continuous adjustments are needed to maintain a frequency because “[t]he frequency of the two systems, one mechanical, and one electronic, will typically drift apart over time.” Ex. 1009 ¶ 7; *see also* Pet. Reply 19–22 (citing Ex. 1009 ¶¶ 50–51, 54, 125; Ex. 1005 ¶¶ 44–47; Ex. 1050, 36:12–37:10).

Patent Owner cites no evidence that persuasively weighs against Petitioner's showing. Thus, for the reasons explained above, a preponderance of the evidence supports that this recitation would have been obvious in view of Cosper in combination with Shahoian and Rossi.

3. *Unpatentability over Shahoian, Cosper, Rossi, and Ramsay (Ground 1C)*

Petitioner contends that Shahoian, Cosper, Rossi, and Ramsay teach or suggest each recitation of claim 5 and contends that a person having skill in the art would have had reason to combine the references teachings with a reasonable expectation of success. Pet. 47–40. A preponderance of the evidence supports this position. *Id.* (providing citations to the record). Patent Owner does not dispute Petitioner's position with regard to claim 5 in particular. PO Resp. *passim*.

We determine Petitioner has established by a preponderance of the evidence that that claim 5 would have been obvious over the combined teachings of Shahoian, Cosper, Rossi, and Ramsay.

4. *Unpatentability over Shahoian, Cosper, Ramsay, and Aldrich (Ground 2A)*

Petitioner asserts claim 1 is unpatentable under 35 U.S.C. § 103(a) as obvious over Shahoian, Cosper, Ramsay, and Aldrich. Pet. 1, 54–71 (citing Ex. 1003). Petitioner argues that a person of ordinary skill in the art would have had reason, with reasonable expectation of success, to implement “a hill-climb feedback control algorithm, in accordance with Aldrich, in Shahoian-Cosper-Ramsay's system. Pet. 56. A preponderance of the evidence supports Petitioner's position. *Id.* (citing, for example, Ex. 1003 ¶¶ 180–186; Ex. 1009 ¶¶ 8–11, 56; Ex. 1021, 2).

Petitioner argues that, in addition to the teachings of Shahoian,

Cosper, and Ramsay that we discuss above, such a system would teach or suggest the control component, control program, and control component recitations of claim 1. Pet. 60–71. A preponderance of the evidence supports Petitioner’s position. *Id.* (citations omitted).

Patent Owner argues that Aldrich does not remedy deficiencies of the Shahoian-Cosper ground. PO Resp. 14–15; *see also id.* at 10 (“each of the grounds depends on the combinability of Shahoian with Cosper”). As we explain above, we do not agree that the Shahoian-Cosper ground is deficient.

Patent Owner also argues that Aldrich, similar to Cosper, is not in the same field of endeavor as Shahoian and that a person having ordinary skill in the art would not have had reason to combine Aldrich with Shahoian.¹¹ PO Resp. 14–15. We disagree for the reasons we explain with regard to Cosper. Aldrich is related to the field of oscillating actuators and addresses the problem of controlling an actuator. Pet. 55–56 (citations omitted). Petitioner provides evidence that a person having skill in the art would have sought to improve Shahoian-Cosper-Ramsay with the teachings of Aldrich (*id.* at 56–60), and Patent Owner does not present persuasive evidence to the contrary.

For the reasons above, we determine Petitioner has established by a preponderance of the evidence that that claim 1 would have been obvious over the combined teachings of Shahoian, Cosper, Ramsay, and Aldrich.

5. *Unpatentability over Shahoian, Cosper, Ramsay, Aldrich, and Rossi (Ground 2B)*

Petitioner asserts claims 1–5 are unpatentable under 35 U.S.C.

¹¹ We note that Patent Owner does *not* argue in the Patent Owner response that Aldrich does not qualify as analogous art to the ’767 patent. PO Resp. 14–15.

§ 103(a) as obvious over Shahoian, Cosper, Ramsay, Aldrich, and Rossi. Pet. 1, 73–78 (citing, for example, Ex. 1003). Aside from arguments we address above, Patent Owner does not dispute Petitioner’s assertions for this ground. PO Resp. *passim*.

For the reasons above and based on the evidence cited in the Petition, we determine Petitioner has established by a preponderance of the evidence that that claims 1–5 would have been obvious over the combined teachings of Shahoian, Cosper, Ramsay, Aldrich, and Rossi.

IV. CONCLUSION¹²

For the reasons above, we determine that Petitioner has proven, by a preponderance of the evidence, that claims 1–5 of the ’767 patent are unpatentable as summarized in the following table.

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1	103(a)	Shahoian, Cosper	1	
1–4	103(a)	Shahoian, Cosper, Rossi	1–4	
5	103(a)	Shahoian, Cosper, Rossi, Ramsay	5	

¹² Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*, 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

1	103(a)	Shahoian, Cosper, Ramsay, Aldrich	1	
1–5	103(a)	Shahoian, Cosper, Ramsay, Aldrich, Rossi	1–5	
Overall Outcome			1–5	

V. ORDER

For the foregoing reasons, it is

ORDERED that Petitioner has demonstrated by a preponderance of the evidence that claims 1–5 of the '767 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-00697
Patent 8,093,767 B2

For PETITIONER:

W. Karl Renner
Craig Deutsch
Karina Calliste
FISH & RICHARDSON P.C.
axf-ptab@fr.com
deutsch@fr.com
calliste@fr.com

For PATENT OWNER:

Reza Mirzaie
Qi (Peter) Tong
Kristopher Davis
Neil A. Rubin
RUSS AUGUST & KABAT
rmirzaie@raklaw.com
rak_revelhmi@raklaw.com
ptong@raklaw.com
kdavis@raklaw.com
nrubin@raklaw.com