

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

RESONANT SYSTEMS, INC.,
Patent Owner.

Case No. IPR2024-00697
U.S. Patent No. 8,093,767

PATENT OWNER'S SUR-REPLY

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Statutes and Regulations

35 U.S.C. § 312	10, 15
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PATENT OWNER'S EXHIBIT LIST

<i>Exhibit No</i>	<i>Description</i>
2001	Defendant Apple Inc.'s Proposed Claim Constructions, (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.))
2002	Court's Claim Construction Order (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.), Dkt. 91)
2003	Defendant Apple Inc.'s Opening Claim Construction Brief (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.), Dkt. 75)
2004	Order Modifying Scheduling Order (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.), Dkt. 57)
2005	Federal Court Management Statistics, Western District of Texas, 2018-2023
2006	Excerpt of Plaintiff's Infringement Contentions (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.))
2007	Excerpt of Defendant's Final Invalidity Contentions (<i>Resonant Systems, Inc. v. Apple Inc.</i> , Case No. 23-cv-00077-ADA (W.D. Tex.))
2008	[Reserved]
2009	Declaration of Keith W. Goossen, Ph.D.
2010	Curriculum Vitae of Keith W. Goossen, Ph.D.
2011	Transcript of Deposition of Blake Hannaford, Ph.D., Jan. 27, 2025
2012	Transcript of Deposition of Blake Hannaford, Ph.D., Jan. 28, 2025
2013	Transcript of Deposition of Blake Hannaford, Ph.D., Jan. 29, 2025
2014	Excerpt of CRC Handbook of Chemistry and Physics (52 nd Ed. 1964)
2015	"Why do ferromagnetic materials channel magnetic field lines?," Physics Stack Exchange, <i>available at</i> https://physics.stackexchange.com/questions/129782/why-do-ferromagnetic-materials-channel-magnetic-field-lines

<i>Exhibit No</i>	<i>Description</i>
2016	“Quality Factor (Q)” in Smith, J.O., <i>Introduction to Digital Filters with Audio Applications</i> , available at https://ccrma.stanford.edu/~jos/fp/Quality_Factor_Q.html
2017	Texas Instruments Precision Designs: Verified Design SLAU508, “Analog Pulse Width Modulation,” by John Caldwell
2018	Declaration of Paul A. Kroeger in Support of <i>Pro Hac Vice</i> Recognition on Behalf of Patent Owner Resonant Systems, Inc.
2019	Declaration of Christian W. Conkle in Support of <i>Pro Hac Vice</i> Recognition on Behalf of Patent Owner Resonant Systems, Inc.
2020	Transcript of Deposition of Blake Hannaford, Ph.D., June 23, 2025
2021	Transcript of Deposition of Blake Hannaford, Ph.D., June 24, 2025

I. INTRODUCTION

In its Response, Resonant explained that the Shahoian and Cosper fundamentally differ, including in that Shahoian is directed to high bandwidth vibrations over a wide range of amplitudes and frequencies, while Cosper is directed to low bandwidth oscillations that are specifically at or near a mechanical resonant frequency. Accordingly, for all grounds, the references fail to all be analogous art, and there is a lack of motivation to combine. The Reply fails to overcome these arguments.

The Response also explained that the Aldrich reference relied upon in Grounds 2A and 2B is not analogous art, and that there would be no motivation to combine it with the Shahoian reference in those grounds. The Reply fails to address these arguments at all. As a result, neither the Petition nor the Reply presents any argument that Aldrich is analogous art, and Grounds 2A and 2B should be rejected on that basis.

For Grounds 1B, 1C, and 2B, the Reply presents new arguments for how limitations [2.3] and [2.4] are purportedly obvious, resting on different disclosures in Rossi and different legal contentions than those presented in the Petition. These untimely arguments should be rejected and these grounds likewise rejected.

For Grounds 1B and 2B, the Reply fails to demonstrate that Cosper teaches the “accelerometer” relied upon in the Petition to satisfy the “vibration sensor” limitation.

Accordingly, all grounds of the Petition should be rejected and the validity of the challenged claims affirmed.

II. ARGUMENT

A. No Motivation To Combine (All Grounds)

Each ground of the -00697 IPR requires combining Shahoian with Cosper, in some cases with additional references as well. As the Response explained, Cosper is from a different field of endeavor than Shahoian. Accordingly, they cannot both be in the same field of endeavor as the '767 patent.

The Reply identifies this field of endeavor for the '767 patent as:

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*.

(Reply at 3, quoting '767 patent at 1:11–16 (emphasis added).) Shahoian is likewise directed to producing vibrations over a wide range of amplitudes and frequencies. Shahoian specifically seeks to be able to produce vibrations over

a range of different frequencies “independently” from the magnitude of vibration:

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.

(Ex. 1004 at 4:56–60.)

The controller can also ***adjust the frequency of the drive waveform independently of the amplitude*** to adjust the frequency of vibration. This allows different frequency vibrations to be output independently of the magnitude of those vibrations.

(Ex. 1004 at 7:41–45.)

Cosper, by contrast, is directed to vibrations occurring over a narrow range of frequencies, specifically frequencies that are near resonance. The Reply itself identifies Cosper’s field of endeavor by quoting the statement that it “generally relates to systems and methods for control of a mass and bias (e.g., ‘elastomeric members’) subassembly, including oscillating mechanical systems, that operate in ***an oscillatory mode at or near their mechanical resonant frequency.***” (Reply at 3, quoting Ex. 1009, ¶ [0003] (emphasis added).)

Under Petitioner’s own framing of the ’767 patent’s and the prior art references’ fields of endeavor, Cosper is from a different field of endeavor (control of oscillation at or near mechanical resonance) than the ’767 patent (production of vibration over a wide range of amplitudes and frequencies).

Nor is Cosper “directly pertinent to the problems recited by the ’767 Patent,” as the Reply argues in a single, largely conclusory paragraph. (Reply at 4–5.) This paragraph argues that Figure 1 of Cosper “illustrates linear oscillation,” but this plainly a schematic diagram, not meant to depict the sizes or shapes of the actual structures or the directions of movement. (Ex. 1009, Fig. 1.) Moreover, the quoted portions of Cosper clearly demonstrate that its control system is specifically intended to produce oscillations at or near a single frequency, the resonant frequency. (Ex. 1009, ¶¶ [0009], [0049], [0067].) To the extent the frequency of oscillation is changed, it is only to restore the oscillation back to the resonant frequency, after the mechanical resonant frequency and a reference electronic resonant frequency have “drift[ed] apart over time.” (*Id.*, ¶ [0007].) This control system meant to maintain oscillation at or near resonance is of little pertinence to the ’767 patent’s problem of “high bandwidth vibration” over a range of different frequencies and adjustment of “frequency of the drive waveform independently of the amplitude.” (Ex. 1004 at 4:56–60, 7:41–45.)

Apple's expert testified concerning the relationship between the bandwidth of a resonant system and its Q factor:

Q: And so for a mechanical resonant system – saying that it has a high Q is equivalent to saying that it has a low bandwidth, and vice versa, saying it has a low Q is saying it has a high bandwidth?

A: Yes.

(Ex. 2020 at 30:21–31:1.) As explained in the Response, Shahoian's teachings address the requirements of a high bandwidth (low Q) haptic feedback device and Cosper's teachings address the requirements of a low bandwidth (high Q) scanning light source device. (Response at 13–14; Ex. 2009, ¶¶ 87–88.) There also would be no motivation for applying Cosper's techniques for maintaining the oscillations at the resonant frequency to Shahoian. (Ex. 2009, ¶ 88.) Operation at resonance is not specifically desirable in the Shahoian system, which instead must operate over a range of frequencies. (*Id.*) Even when operating in the vicinity of resonance, there is no particular importance in Shahoian to maintaining the oscillation specifically at resonance, as Cosper teaches, because the gain in Shahoian's low Q, high bandwidth system is not highly sensitive to small variations in frequency. (*Id.*)

The Reply has no response to the lack of motivation to combine a control system that specifically maintains oscillation at or near resonance with a system that produces high bandwidth vibration, except to suggest that a combined system could produce an output that simultaneously has both. (Reply at 9–10.) Specifically, the Reply argues the POSITA would have implemented feedback control “in order to facilitate precise vibration output having desired characteristics, including oscillation at a resonant frequency and over a range of frequencies suggested by Shahoian, based on the express teachings of Shahoian and Cosper.” (*Id.*) But the Reply fails to explain how an output could simultaneously have oscillation at a single resonant frequency (low bandwidth) and over a range of frequencies (high bandwidth), let alone how the POSITA would have considered this situation to be desirable.

With respect to Grounds 2A and 2B, the Response explained that like Cosper, Aldrich addresses the problem of keeping the frequency “at or near the resonance frequency,” through its teaching of “fine resonance tracking.” (Ex. 1021 at 1–2.) Like Cosper, Aldrich is not in the same field of endeavor as Shahoian, or the ’767 patent, is not pertinent to problems Shahoian, or the ’767 patent, is involved with, and a POSITA would not have been motivated to apply its “fine resonance tracking” to the devices taught by Shahoian. (Ex. 2009, ¶ 89.) The reply failed to address these arguments whatsoever. The

Petition likewise failed to address the issue of analogous art, with respect to Aldrich or any of the other references in the Petition. By failing to argue that Aldrich is analogous art in either the Petition or the Reply, Apple has waived any such argument, and Grounds 2A and 2B should be rejected on the basis that Aldrich is not analogous art.

B. Limitations [2.3] and [2.4] (Grounds 1B, 1C, and 2B)

As explained in the Patent Owner’s Response (Response at 15–16), claim 2 of the ’767 Patent includes the limitations:

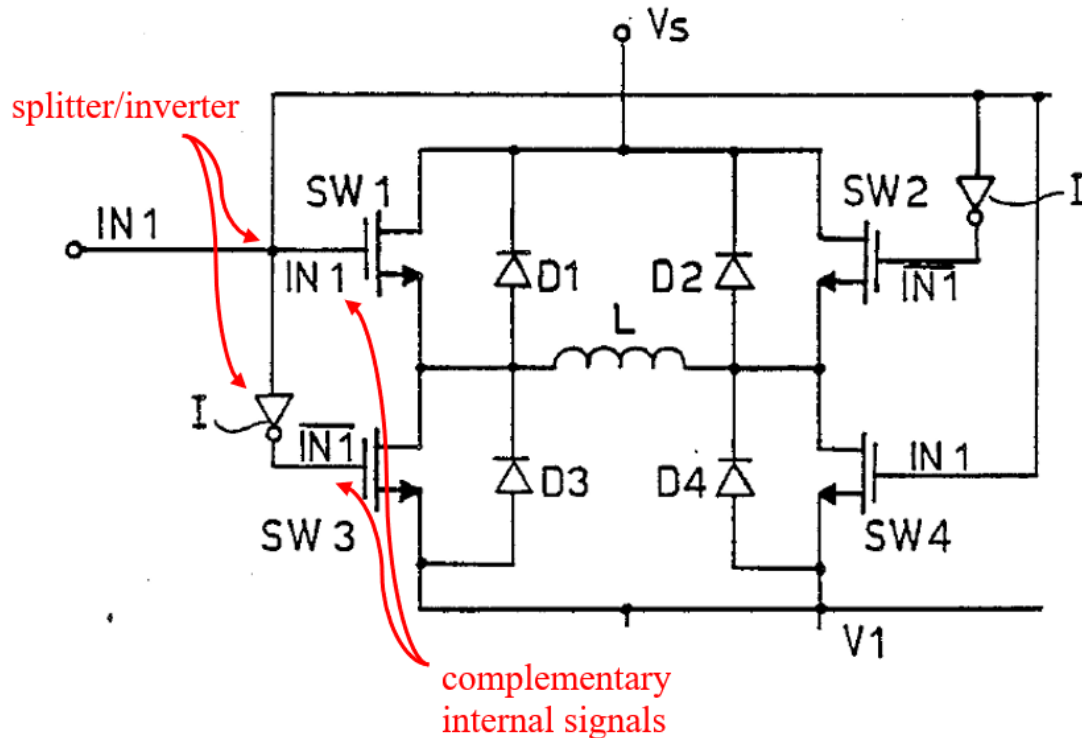
[2.3] a directional-signal splitter/inverter that generates *two complementary internal signals, d and $\bar{d}$* , corresponding to directional-signal d ; and

[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.

(’767 Patent at 12:3–12.) Claims 3–5 depend from claim 2 and thus also include these limitations. (’767 Patent at 12:13–33.)

As limitation [2.3] explicitly states, d and $\bar{d}$ are “*two complementary internal signals*,” meaning that $\bar{d}$ is one “signal.” Both signals are produced by

the same “directional-signal splitter/inverter.” The single signal $\bar{d}$ is the antecedent basis for the “internal signal $\bar{d}$ ” that must control one switch of each of the two pairs of solid-state switches in limitation [2.4]. Petitioner’s reply halfheartedly argues that these limitations do not require that the two second switches of the two pairs both be controlled by the same “internal signal $\bar{d}$,” suggesting that “Patent Owner fails to demonstrate” what the claim language clearly states. (Reply at 16.) In an IPR, “the burden of persuasion is on the petitioner to prove ‘unpatentability by a preponderance of the evidence,’ 35 U.S.C. § 316(e), and that burden never shifts to the patentee.” *Dynamic Drinkware, LLC v. National Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Apple has completely failed to carry its burden of showing obviousness based upon interpreting limitations [2.3] and [2.4] to encompass structures such as those in Rossi’s Figure 6 with two separate inverters after the splitter:



(Ex. 1020, Fig. 6, as annotated in Petition at 41.)

Apple's Reply also argues obviousness based upon a combination with Rossi using a single inverter, pointing to Rossi's Figure 1. (Reply at 13–14.) The Reply seeks to leave the impression that this combination with a single inverter was described in the Petition. (*Id.*) It was not.

Notably, the only figure from Rossi excerpted in the Petition is Rossi's Figure 6, with its two separate inverters. (Petition at 31, 37, 39, 40, 41, 43, 44, 45.) Rossi Figure 4 is also cited (though not excerpted), but Figure 4 does not contain a splitter or inverter that would satisfy limitations [2.3] and [2.4] at all. (Ex. 1020, Fig. 4.) As Rossi itself says, "FIG. 6 is a circuit diagram of an embodiment of the circuit of FIG. 4," suggesting—to the extent that Figure 4

discloses teaches anything of relevance to limitations [2.3] and [2.4]—that it would use the same splitter and inverter configuration as Figure 6. (Ex. 1020 at 1:62–64.) The Petition never cites to Rossi’s Figure 1.

The Petition is explicit that the proposed combination with Rossi uses the splitter and two inverter configuration of Rossi Figure 6, not only using an annotated Figure 6 to illustrate the combination, but stating that in the combination, “[a]s described in Rossi, the ‘inverter I’ *inverts each split* of the driving signal IN1 to generate the complementary internal signals.” (Petition at 40–41.) In other words, in the Petition the inverting two create the two signals controlling switches SW2 and SW3 occurs after the splitting and requires the two inverters I illustrated in Rossi Figure 6.

The Reply presents a new and different theory of obviousness, citing to different portions of Rossi, based upon utilizing “a single inverter component.” (Reply at 16.) This new theory, set forth for the first time in the Reply, cannot form the basis for invalidating claims. Rather, the petitioner has the burden to clearly set forth the basis for its challenges in the petition. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) as “requiring IPR petitions to identify ‘with particularity ... the evidence that supports the grounds for the challenge to each claim’”); *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1367 (Fed. Cir. 2015)

(“We see no error in the Board's rejection of [petitioner’s] reliance, in its Reply submissions, on previously unidentified portions of a prior-art reference to make a meaningfully distinct contention.”); *Wasica Finance GMBH v. Continental Auto. Systems*, 853 F.3d 1272, 1286 (Fed. Cir. 2017) (holding that new arguments in a reply brief are “foreclosed by statute, our precedent, and Board guidelines”).

In particular, the Reply’s new arguments concerning purportedly “conventional techniques,” “conventional use of a single inverter,” “predictable implementation,” or “routine implementation” are each a “meaningfully distinct contention” from those made in the petition raised for the first time in a reply, which the Federal Circuit has repeatedly held the Board has properly refused to consider. *Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1367 (Fed. Cir. 2023) (affirming rejection of argument in reply about “what a relevant artisan would have found obvious to modify,” where the petition only argued about what the reference actually teaches); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1370 (Fed. Cir. 2016) (same).

C. Failure to Satisfy Either “Vibration Sensor” or “Continuously Monitors Output from the Vibration Sensor” in Claim 3 (Grounds 1B and 2B)

As explained in the Response, for the “vibration sensor” of limitation [3.1], the petition points to an “accelerometer” that is distinct from the sensors

that were mapped to the limitations of claim 1. (Petition at 45.) Specifically, petition points to “a vibration sensor (*accelerometer*) in addition to the sensors associated with ‘position’ and ‘velocity’ that are used as part of the feedback control.” (Petition at 45; Ex. 2009, ¶ 107.) The Petition is silent on which reference or references it relies upon for the accelerometer. (Ex. 2009, ¶ 108.) It cites to nothing in Cosper or any other reference that is allegedly an accelerometer. (*Id.*) The Petition does cite to a declaration of Dr. Hannaford’s. (Petition at 45.) Dr. Hannaford is clear in his declaration that he is pointing to an “accelerometer” that is “in accordance with Cosper.” (Ex. 1003, ¶ 158.) But like the petition, his declaration does not point to anything in Cosper that is allegedly an accelerometer. (Ex. 1003, ¶ 158; Ex. 2009, ¶ 108.)

The Reply takes the position that “an accelerometer *is* a sensor that detects acceleration.” (Reply at 17.) But its evidence fails to demonstrate this. First, the Reply cites to a “Dictionary of Civil Engineering,” which provides a definition for accelerometer as “[a] sensor for measuring acceleration used e.g. to measure the response of the ground or a structure to an earthquake.” (Ex. 1051 at 1, 3.) A civil engineering dictionary describing sensors for measuring responses to earthquakes is not persuasive evidence of how a person skilled in the art the ’767 patent pertains to would understand prior art such as Cosper.

The second dictionary that the Reply cites is a dictionary of “Electronics,” and more pertinent to the art of the ’767 patent. (Ex. 1052 at 1.) This dictionary demonstrates that the concept of an accelerometer is more specific than simply any sensor that can detect acceleration. Rather, it is “a device that senses or measures the acceleration *applied to it*, usually with an electrical output.” (Ex. 1052 at 3 (emphasis added).) Indeed, Apple’s expert testified that an accelerometer is commonly used to determine the orientation of a device, because what it measures is specifically its acceleration relative to a hypothetical observer in free fall:

Q: The question was: Is one of the things that accelerometer is used for determining the orientation of the device?

A: Yes.

Q: And imagine that a smartphone with an accelerometer like we've been discussing is sitting on the desk in front of you.

A: And one is actually—yes.

Q: So the accelerometer—even though the phone is sitting on the desk and at rest relative to the desk, the accelerometer inside of it is measuring an acceleration because of the gravitational force that it’s experiencing; correct?

A: That is my understanding, yes.

Q: So at least for the accelerometer in the smartphone on the desk in front of you, it's measuring acceleration not relative to the desk that it's sitting on top of, but relative to an observer that was in free fall?

A: I think that's a correct statement.

(Ex. 2020 at 19:14–20:14.) Apple's expert also agreed that there are ways of measuring acceleration without using a sensor that itself is experiencing the acceleration, i.e., without using an “accelerometer” under the Collins Dictionary of Electronics definition. (Ex. 2020 at 22:11–24:18; Ex. 1052.)

For these reasons, the Reply fails to show that Cosper or the other art relied upon in these grounds teaches an accelerometer, which the Petition relies upon for the “vibration sensor” of limitation [3.1].

The Reply also adds an alternative argument that the “vibration sensor” would be obvious in view of a combination of references, even if not described in Cosper. (Reply at 18.) As explained above in connection with limitations [2.3] and [2.4], this new theory, set forth for the first time in the Reply, cannot form the basis for invalidating claims. Rather, the petitioner has the burden to clearly set forth the basis for its challenges in the petition. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. §

312(a)(3) as “requiring IPR petitions to identify ‘with particularity ... the evidence that supports the grounds for the challenge to each claim’”); *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1367 (Fed. Cir. 2015) (“We see no error in the Board's rejection of [petitioner's] reliance, in its Reply submissions, on previously unidentified portions of a prior-art reference to make a meaningfully distinct contention.”); *Wasica Finance GMBH v. Continental Auto. Systems*, 853 F.3d 1272, 1286 (Fed. Cir. 2017) (holding that new arguments in a reply brief are “foreclosed by statute, our precedent, and Board guidelines”).

These new arguments are a “meaningfully distinct contention” from those made in the petition raised for the first time in a reply, which the Federal Circuit has repeatedly held the Board has properly refused to consider. *Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1367 (Fed. Cir. 2023) (affirming rejection of argument in reply about “what a relevant artisan would have found obvious to modify,” where the petition only argued about what the reference actually teaches); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1370 (Fed. Cir. 2016) (same).

III. CONCLUSION

For the reasons set forth above and in its prior Response, Resonant Systems respectfully requests that the Board affirm the validity of all challenged claims.

Dated: July 8, 2025

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CERTIFICATE OF WORD COUNT

I certify that there are 3,104 words in this paper, excluding the portions exempted under 37 C.F.R. § 42.24(a)(1), according to the word count tool in Microsoft Word.

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Case No. IPR2024-00697
U.S. Patent No. 8,093,767

CERTIFICATE OF SERVICE

I hereby certify that “Patent Owner’s Sur-Reply” was served on July 8, 2025

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