

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC,
Petitioner,

v.

SONOS, INC.,
Patent Owner.

IPR2021-00475
Patent 9,219,460 B2

Before MICHAEL R. ZECHER, TERRENCE W. McMILLIN, and
GARTH D. BAER, *Administrative Patent Judges*.

McMILLIN, *Administrative Patent Judge*.

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

I. INTRODUCTION

Petitioner, Google LLC, filed a Petition to institute an *inter partes* review (“IPR”) of claims 1–3, 5, 6, 10, 15, 18, and 19 (the “challenged claims”) of U.S. Patent No. 9,219,460 B2 (Ex. 1001, the “’460 patent”). Paper 1 (“Petition” or “Pet.”). Patent Owner, Sonos, Inc., filed a Preliminary Response. Paper 17 (“Preliminary Response” or “Prelim. Resp.”). Taking into account the arguments presented in Patent Owner’s Preliminary Response, we determined that the information presented in the Petition established that there was a reasonable likelihood that Petitioner would prevail with respect to challenging at least one of claims 1–3, 5, 6, 10, 15, 18, and 19 of the ’460 patent as unpatentable. Pursuant to 35 U.S.C. § 314, we instituted this IPR on March 11, 2022, as to all challenged claims and all grounds raised in the Petition. Paper 18 (“Institution Decision” or “Dec. on Inst.”).

During trial, Patent Owner filed a Response (Paper 24, “PO Resp.”), Petitioner filed a Reply to the Response (Paper 26, “Pet. Reply”), and Patent Owner filed a Sur-reply to the Reply (Paper 27, “PO Sur-reply”). An oral argument was held on December 14, 2022, and a transcript of the hearing is included in the record. Paper 33 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–3, 5, 6, 10, 15, 18, and 19 of the ’460 patent. For the reasons we identify below, we hold that Petitioner has demonstrated by a preponderance of the evidence that all challenged claims are unpatentable.

A. *Related Matters*

The parties identify the following related proceedings: *Sonos, Inc. v. Google LLC*, No. 6:20-cv-00881 (W.D. Tex.) (filed Sept. 29, 2020); *Google*

LLC v. Sonos, Inc., No. 3:20-cv-06754 (N.D. Cal.) (filed Sept. 28, 2020).
Pet. 73; Paper 8, 1.

B. Real Party in Interest

Petitioner identifies itself (Google LLC) as the only real party in interest. Pet. 73. Patent Owner identifies itself (Sonos, Inc.) as the only real party in interest. Paper 8, 1.

C. The '460 Patent

The '460 patent is titled “Audio Settings Based on Environment.” Ex. 1001, code (54). The '460 patent relates to media playback and involves “dynamically adjusting the equalization of a playback device based on the environment in which the playback device is operating.” *Id.* at 1:6–9, 64–66. The '460 patent asserts that “adjusting the equalization of the playback device based on the current operating environment may improve the listening experience for some listeners.” *Id.* at 2:3–5. One example is that “a playback device may be configured to perform advantageously in a small room, but nonetheless may come to be positioned outdoors. When operating outdoors, boosting the bass levels of the playback may result in an improved listening experience.” *Id.* at 2:6–10.

The '460 patent purportedly provides an improved listening experiencing by using a playback device that includes a speaker, microphone, and processor. *Id.* at 2:37–38. An audio signal, such as a pulse, is emitted, reflected by the surrounding environment, and detected by the microphone. *Id.* at 2:38–52. The device then determines “reflection characteristics,” such as being in a small room, or the presence of sound-absorbing material in the environment. *Id.* at 2:53–3:1. “The playback device may then adjust an equalization setting of the playback device based

on the one or more reflection characteristics,” such as by increasing or decreasing the bass frequencies. *Id.* at 3:6–24.

D. Challenged Claims

Petitioner challenges claims 1–3, 5, 6, 10, 15, 18, and 19 of the ’460 patent. Pet. 1. The ’460 patent has two challenged independent claims: a method claim (claim 1) and a device claim (claim 15). Independent, method claim 1 recites:

1. A method comprising:
emitting, by a playback device, a first audio signal via at least one speaker, wherein the at least one speaker is contained within a housing of the playback device;
detecting, by the playback device via at least one microphone, a second audio signal, wherein at least a portion of the second audio signal is a reflection of the first audio signal, and wherein the at least one microphone is contained within the housing of the playback device;
in response to the detecting, determining, by the playback device, one or more reflection characteristics wherein each of the one or more reflection characteristics are based on at least the second audio signal;
adjusting, by the playback device, an equalization setting of the playback device based on the one or more reflection characteristics; and
causing, by the playback device, an audio track to play according to the adjusted equalization setting.

Ex. 1001, 22:28–40; Ex. 2009.¹ Independent, device claim 15 recites:

15. A playback device, comprising:
at least one speaker that is contained within a housing of the playback device;
a microphone that is contained within the housing of the playback device;
a processor;

¹ On November 30, 2021, a certificate of correction for the ’460 patent was issued. Paper 16, 1; Ex. 2009 (“Certificate of Correction”).

a network interface;
a data storage; and
a program logic stored in the data storage and executable by the processor to:
 emit a first audio signal from the at least one speaker;
 detect, via the microphone, a second audio signal,
 wherein at least a portion of the second audio signal is
 a reflection of the first audio signal;
 in response to the detecting, determine a first reflection
 characteristic based on at least the second audio signal;
 adjust an equalization setting of the playback device
 based on at least the first reflection characteristic; and
 play, via the at least one speaker, an audio track
 according to the equalization setting.

Ex. 1001, 24:1–19; Ex. 2009.

E. The Asserted Grounds

Petitioner challenges claims 1–3, 5, 6, 10, 15, 18, and 19 of the '460 patent based on the grounds set forth in the table below.

Claims Challenged	35 U.S.C.	Reference(s)
1–3, 10, 15	§§ 102(a)(1), (a)(2) ²	Maher ³
1–3, 10, 15	§ 103	Maher
1–3, 5, 6, 10, 15, 18, 19	§ 103	Maher, Hooley ⁴
1, 2, 5, 10, 15, 18, 19	§ 103	Zurek ⁵ , Levy ⁶
3, 6, 18	§ 103	Zurek, Levy, Hooley

² Because the application that issued as the '460 patent was filed after March 16, 2013, we are relying on the AIA versions of §§ 102 and 103.

³ US 2013/0216071 A1, published Aug. 22, 2013 (Ex. 1005).

⁴ US 2006/0153391 A1, published July 13, 2006 (Ex. 1006).

⁵ US 2014/0274212 A1, published Sept. 18, 2014 (Ex. 1007).

⁶ US 6,766,025 B1, issued July 20, 2004 (Ex. 1008).

Petitioner relies on the Declaration of Jeffrey S. Vipperman, Ph.D. (Ex. 1003, “Vipperman Decl.”). Patent Owner relies on the Declaration of Michael T. Johnson, Ph.D. (Ex. 2016, “Johnson Decl.”).

II. ANALYSIS

A. *Legal Standards*

Anticipation under 35 U.S.C. §§ 102(a)(1), (a)(2) requires that each limitation in a claim is found in a single prior art reference, arranged as recited in the claim. *Net MoneyIn, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). The disclosure of the element by the reference can be an express disclosure or an inherent disclosure. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987).

A patent claim is unpatentable as obvious under 35 U.S.C. § 103 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 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 presented, objective evidence of non-obviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“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.*

⁷ Neither party argues or presents evidence of objective evidence of non-obviousness. *See generally* Pet.; PO Resp.

Avid Tech., Inc., 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring IPR petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). Petitioner, however, cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

B. Certificate of Correction

As noted above, a Certificate of Correction (Ex. 2009) has been issued for the ’460 patent. The Certificate of Correction was necessary because amendments to the claims that were agreed to by the Applicant and the Examiner during prosecution were not entered into the ’460 patent prior to its issuance. Ex. 1002 (the ’460 patent file history), 17 (Interview Summary dated Oct. 10, 2015). As shown in the Interview Summary, the Examiner agreed that the Applicant’s proposed amendments overcame the cited art and the Examiner was to enter the changes to the claims in an Examiner’s Amendment. *Id.* However, those amendments were not entered prior to issuance of the ’460 patent.

The claims of the ’460 patent were changed substantially in the Certificate of Correction. *See* Ex. 2009. All the changes are in accordance with the proposed amendments as shown in the file history. *See* Ex. 1002, 32–38. In the Certificate of Correction, the following changes were made to claims 1 and 15:⁸

1. A method comprising:
~~emitting, by a playback device, a first audio signal~~ emitting, by
a playback device, a first audio signal via at least one

⁸ In the Certificate of Correction, changes were also made to challenged dependent claim 2 and to unchallenged claim 11. Ex. 2009, 1–2.

speaker, wherein the at least one speaker is contained within a housing of the playback device;
~~detecting, by the playback device, a second audio signal,~~
wherein at least a portion of the second audio signal is a reflection of the first audio signal detecting, by the playback device via at least one microphone, a second audio signal,
wherein at least a portion of the second audio signal is a reflection of the first audio signal, and wherein the at least one microphone is contained within the housing of the playback device;
~~in response to the detecting, determining one or more reflection characteristics, in response to the detecting, determining, by the playback device, one or more reflection characteristics~~
wherein each of the one or more reflection characteristics are based on at least the second audio signal;
~~adjusting an equalization setting of the playback device~~
adjusting, by the playback device, an equalization setting of the playback device based on the one or more reflection characteristics; and
~~causing an audio track to play~~ causing, by the playback device, an audio track to play according to the adjusted equalization setting.

15. A playback device, comprising:
~~a speaker~~ at least one speaker that is contained within a housing of the playback device;
~~a microphone that is physically coupled to the speaker~~ a microphone that is contained within the housing of the playback device;
a processor;
a network interface;
a data storage; and
a program logic stored in the data storage and executable by the processor to:
~~emit a first audio signal from the speaker~~ emit a first audio signal from the at least one speaker;
detect, via the microphone, a second audio signal, wherein at least a portion of the second audio signal is a reflection of the first audio signal;

in response to the detecting, determine a first reflection characteristic based on at least the second audio signal; adjust an equalization setting of the playback device based on at least the first reflection characteristic; and ~~play, via the speaker~~ play, via the at least one speaker, an audio track according to the equalization setting.

Ex. 1001, 22:28–40, 24:1–19; Ex. 2009.

The parties do not dispute that the Certificate of Correction was properly entered. Pet. 1 (Petitioner stating “the claims issued in error”); Prelim. Resp. 1 (“Patent Owner filed a Request for Certificate of Correction pursuant to 35 U.S.C. § 254 and 37 C.F.R. § 1.322 to correct a mistake made by the Office.”); Paper 10, 1 (Petitioner agreeing that “the correct version of the claims” are “the claims that emerge from the certificate of correction (‘CoC’) process”). However, the Petition addresses both the claims as issued and the claims as corrected in the Certificate of Correction. *See, e.g.*, Pet. 24 n.1. “The Patent Owner Response addresses the claims as corrected by the Certificate of Correction.” PO Resp. 10 n.1. This proceeding presents unusual circumstances—the Office issued claims without entering agreed-to amendments and substantial changes were made to the claims by virtue of a Certificate of Correction. Under the unique facts and circumstances of this case and because the parties agree, we address the claims as corrected in the Certificate of Correction in this IPR.

C. Level of Ordinary Skill in the Art

With regard to the level of ordinary skill in the art, Petitioner contends a “POSITA^[9] would have had a bachelor’s degree in physics, mechanical engineering, electrical engineering, acoustics, or audio engineering (or

⁹ “POSITA” is an acronym commonly used in patent proceedings for a “person of ordinary skill in the art.”

equivalent experience), and three years of experience designing or implementing acoustic systems.” Pet. 5 (citing Ex. 1003 ¶¶ 40–41). Patent Owner does not dispute Petitioner’s contention. PO Resp. 12.

Petitioner’s proposal is consistent with the technology described in the Specification of the ’460 patent and the cited prior art. For purposes of this proceeding, we adopt Petitioner’s undisputed proposed level of ordinary skill in the art and apply it in our anticipation/obviousness analysis below.¹⁰

D. Claim Construction

We construe claims using the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), as articulated by the Federal Circuit in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and subsequent cases. See 37 C.F.R. § 42.100(b) (2022). Under the standard set forth in *Phillips*, claim terms are given their ordinary and customary meaning, as would have been 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 of record. See *Thorner v. Sony Comput. Ent. Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012). There is a “heavy presumption,” however, that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (citation omitted).

Petitioner proposes that no claim construction is necessary. Pet. 6 (“no terms require construction because the claims encompass the prior-art mappings under any construction consistent with *Phillips*.”). Patent Owner does not address claim construction in its Response. See generally PO Resp.

¹⁰ We adopted this same level of ordinary skill in the art as proposed in the Petition at the institution stage of this proceeding. See Dec. on Inst. 8. Patent Owner agreed with this decision. PO Resp. 12.

However, prior to institution, Patent Owner proposed that “an equalization setting” recited in claims 1 and 15 should be construed as “an equalization setting for audio playback.” Prelim. Resp. 15–18. We did not adopt Patent Owner’s proposed construction in our Institution Decision and accorded “an equalization setting” its ordinary and customary meaning, without express construction. Dec. on Inst. 10. As noted above, Patent Owner does not reassert its argument regarding claim construction in its Response. *See generally* PO Resp. For the reasons stated in the Institution Decision, we do not agree with Patent Owner’s proposed construction of “an equalization setting.” *See* Dec. on Inst. 9–11. And, by failing to renew its claim construction argument in the Response, Patent Owner has waived this argument.¹¹ *See* Paper 19, 8 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”).

Based on the fully developed trial record, we determine that claim construction is not disputed and that no claim construction is necessary to make this decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (explaining that construction is needed only for terms that are in dispute, and only as necessary to resolve the controversy).

¹¹ *See, e.g., In re NuVasive, Inc.*, 842 F.3d 1376, 1380 (Fed. Cir. 2016) (determining that an argument raised in a preliminary response, but omitted in the patent owner’s response, despite the Board’s “warn[ing] . . . that this would result in waiver,” is “abandoned” and deemed “waived”); *Finjan, Inc. v. Cisco Sys., Inc.*, 837 F. App’x 799, 809 (Fed. Cir. Dec. 30, 2020) (non-precedential) (determining that where the patent owner “raised [an] argument in its preliminary response” but “abandoned it in its Patent Owner’s Response,” and the patent owner “was on notice that such an omission would result in waiver,” the argument is “waived”).

E. Cited References

1. Maher (Ex. 1005)

Maher is titled “Audio Reproduction Systems and Methods.” Ex. 1005, code (54). Maher relates to “facilitating cost-effective calibration of filters for, e.g., correcting room and/or speaker-based distortion and/or binaural imbalances in audio reproduction, and/or for producing three-dimensional (3D) sound in stereo system environments.” *Id.* ¶¶ 3, 11. Maher states that its calibration methods for filters are especially useful “with music being highly portable with mp3 players, mobile phones, and the like, and with music available through Internet cloud services,” where “consumers bring their music into many different listening environments.” *Id.* However, Maher notes that pre-existing “calibration methods for filters have been cumbersome, inconvenient, and expensive, and are not easily performed by the user of an audio source in different environments.” *Id.* ¶ 12.

Maher plays a test file over speakers, detects the audio content with a microphone, and compares the received audio with the source audio. *Id.* ¶ 20. Maher calculates “equalization parameters . . . by performing spectral analysis on the received signal and comparing [an] ideal test response with the actual test response.” *Id.* ¶ 25. Then, equalization parameters are made available to the digital signal processor, which can implement filters for equalizing the non-ideal responses of the room environment, and the speakers. *Id.* ¶ 27.

Maher was published on August 22, 2013, based on an application filed on February 21, 2013. Ex. 1005, codes (22), (43). The earliest priority date claimed for the ’460 patent is March 17, 2014. Ex. 1001, code (22). Patent Owner does not dispute that Maher is prior art to the ’460 patent

under 35 U.S.C. §§ 102(a)(1), (a)(2). *See generally* PO Resp. We find that Maher is prior art to the '460 patent.

2. *Hooley (Ex. 1006)*

Hooley is titled “Set-up Method for Array-type Sound System.” Ex. 1006, code (54). Hooley relates to methods and systems for setting up an array of “acoustic transducers” referred to as a “Sound Projector.” *Id.* ¶¶ 1–2. Hooley describes that, although “Sound Projector systems that use the reflections of acoustic beams can be installed by trained installers and closely guided users, there remains a desire to facilitate the set-up procedure for less-trained personnel or the average end user.” *Id.* ¶ 6.

One method described in Hooley to accomplish this is to use a Sound Projector and microphone “to measure the room/environment geometry and the relevant locations and surface acoustic properties.” *Id.* ¶ 44. Hooley forms a “steerable beam of sound” with a high frequency and emits pulses of sound in chosen directions, while detecting the reflected, refracted, and diffracted return sounds with the microphone, much like a SONAR system. *Id.* ¶ 45. By choosing a range of emission directions for pulses from the Sound Projector array, and determining the received magnitudes and propagation times of the pulses at the microphone, Hooley is able to determine information about the listening environment, to permit automatic set-up in most environments. *Id.* ¶ 47.

Figure 2, reproduced below, shows a top-view of a Sound Projector and microphone with sound waves and walls.

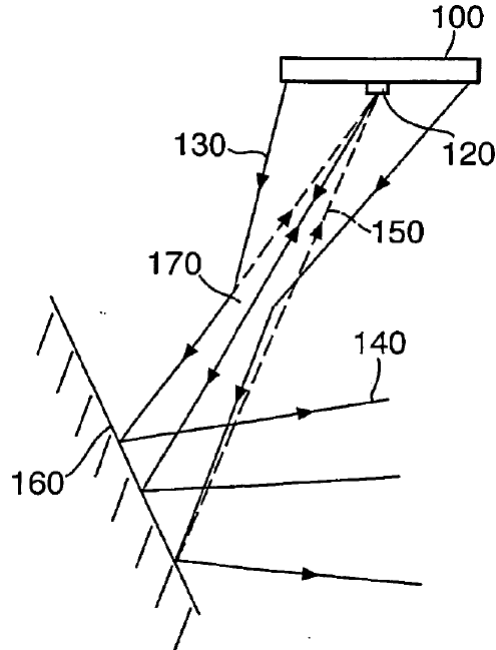


Figure 2 depicts Sound Projector 100, microphone 120, directed sound beam 130, wall 160, focal point 170, reflected wave 140, and “weaker diffuse reflection” 150. *Id.* ¶ 58.

Hooley was published on July 13, 2006. Ex. 1006, code (43). The earliest priority date claimed for the '460 patent is March 17, 2014. Ex. 1001, code (22). Patent Owner does not dispute that Hooley is prior art to the '460 patent under 35 U.S.C. §§ 102(a)(1), (a)(2). *See generally* PO Resp. We find that Hooley is prior art to the '460 patent.

3. *Zurek (Ex. 1007)*

Zurek is titled “Method and Apparatus for Acoustically Characterizing an Environment in which an Electronic Device Resides.” Ex. 1007, code (54). Zurek relates to “mobile devices,” such as cell phones, personal digital assistants, and smartphones, and other devices which perform voice recognition, and “adapting acoustic processing” in these devices. *Id.* ¶¶ 3, 20.

Zurek implements functions within the mobile device to capture an acoustic signal from the environment surrounding the mobile communication device, and then use that signal to “characterize an acoustic environment external to the communication device.” *Id.* ¶ 39. The adaptive processing may include noise suppression, echo cancellation, volume control, reverberation removal, and/or equalization. *Id.* ¶ 40. Zurek’s method may include “outputting an acoustic signal and capturing at least one reflection of the output acoustic signal.” *Id.* ¶ 45.

Zurek was published on September 18, 2014, based on an application filed on July 31, 2013. Ex. 1005, codes (22), (43). The earliest priority date claimed for the ’460 patent is March 17, 2014. Ex. 1001, code (22). Patent Owner does not dispute that Zurek is prior art to the ’460 patent under 35 U.S.C. §§ 102(a)(1), (a)(2). *See generally* PO Resp. We find that Zurek is prior art to the ’460 patent.

4. *Levy (Ex. 1008)*

Levy is titled “Intelligent Speaker Training Using Microphone Feedback and Pre-loaded Templates.” Ex. 1008, code (54). Levy is directed to tuning audio speakers. *Id.* at 1:8–9. Levy describes that current “techniques used to tune a speaker . . . are all mechanical, generally intrusive, and time-intensive since they are often performed by hand.” *Id.* at 1:56–58.

To address this, Levy describes a “programmable speaker and a system and method of tuning the speaker [that] uses digital signal processing and stored characterization data to obtain the desired transfer function for the speaker.” *Id.* at 2:25–28. Levy uses a microphone to receive an audio signal produced by the speaker, where the received signal is fed to a tuning device which transforms input signals, so that they match the characteristics of a

reference signal after being received during playback. *Id.* at 2:48–57. The tuning transformation of the input signal compensates for distortion caused by the environment. *Id.* at 8:11–17.

Levy was issued on July 20, 2004. Ex. 1008, code (45). The earliest priority date claimed for the '460 patent is March 17, 2014. Ex. 1001, code (22). Patent Owner does not dispute that Levy is prior art to the '460 patent under 35 U.S.C. §§ 102(a)(1), (a)(2). *See generally* PO Resp. We find that Levy is prior art to the '460 patent.

F. Discussion of the Unpatentability Challenges

1. Overview

There are two challenged independent claims (claims 1 and 15). Both parties acknowledged during the oral argument that independent claims 1 and 15 are substantively identical (but for being directed to different statutory classes); that the same arguments apply to both claims 1 and 15; and that no separate arguments are made for any of the dependent claims. Tr. 5:25–6:16 (Petitioner's counsel), 25:23–25 (Patent Owner's counsel). Accordingly, although we consider all the arguments and evidence presented by the parties, we focus our discussion herein on the challenges to independent claim 1.

2. Challenges based on Maher

Petitioner contends that Maher anticipates or renders obvious claims 1, 2, 3, 10, and 15 of the '460 patent, and that Maher and Hooley render obvious claims 1, 2, 3, 5, 6, 10, 15, 18, and 19 of the '460 patent.¹² Pet. 3, 14–38. Specifically, Petitioner contends “Maher teaches every

¹² In the Petition, Petitioner present its arguments and evidence relating to these grounds together. *See* Pet. 14–38. In order to follow the presentation in the Petition, we discuss these grounds together.

element of the claims,” and we understand Petitioner to argue that to the extent Maher does not teach every element of each challenged claim, “Hooley discloses detecting a reflection characteristic based on a portion of the detected signal used to measure the environment, and it would have been obvious to incorporate Hooley’s teachings into Maher.” *Id.* at 14–15.

In response, Patent Owner argues:

Maher does not disclose or suggest a playback device with an integrated microphone and speaker that determines equalization settings for playing audio via its integrated speaker. As a result, Maher fails to disclose or suggest (i) “causing, by the playback device, an audio track to play according to the adjusted equalization setting” as recited in independent claim 1, and (ii) “play[ing], via the at least one speaker, an audio track according to the equalization setting” as recited in independent claim 15.

PO Resp. 4. Patent Owner relies on these same arguments for the challenge based on the Maher/Hooley combination. *Id.* (“[C]laims 1–3, 5–6, 10, 15, 18, and 19 are patentable over the combination of Maher and Hooley because Hooley fails to disclose or suggest the above-described limitations lacking in Maher. The Petition does not assert that Hooley teaches or suggests the limitations missing from Maher.”).

Our limitation-by-limitation analysis of the challenge to claim 1 based on Maher and the Maher/Hooley combination is set forth below.

a. Claim 1

A method comprising:

The Petition states, “[t]o the extent it is limiting, Maher discloses the preamble.” Pet. 15 (citing Ex. 1003 ¶ 56). Petitioner cites the Abstract of Maher which states “[s]ystems and method[s] are disclosed for facilitating efficient calibration of filters for correcting room and/or speaker-based

distortion” and additional passages from Maher describing methods. *Id.* (citing Ex. 1005, code 57 (Abstract), ¶¶ 10–18, 23–28, 46–47). In addition, the title and claims of Maher indicate that it is directed to a method. Ex. 1005, code (54), claims 1–10. Patent Owner also does not take a position as to whether the preamble is limiting and does not dispute Petitioner’s showing that the preamble is disclosed in Maher. *See generally* PO Resp.

We find that, regardless of whether the preamble is limiting, Maher discloses a method.

emitting, by a playback device, a first audio signal via at least one speaker, wherein the at least one speaker is contained within a housing of the playback device;

With regard to the first portion of this limitation (“*emitting, by a playback device, a first audio signal via at least one speaker*”), there is no dispute between the parties that Maher discloses the recited elements. The Petition cites multiple passages in Maher in support of its contention that Maher discloses all the elements of this limitation. *See* Pet. 15–16 (citing Ex. 1005, code (57) (Abstract), ¶¶ 19, 20, 24, 42–45, Fig. 2 (ref. no. 203 (“Initiate Audio Playback from Speaker”))), Fig. 3. The Abstract of Maher provides:

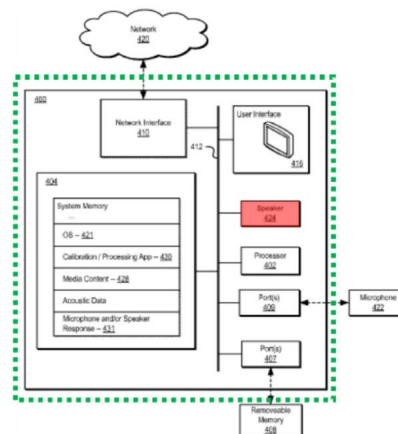
According to some embodiments, using a portable device such as a smartphone or tablet, a user can calibrate speakers by initiating playback of a test signal, detecting playback of the test signal with the portable device's microphone, and repeating this process for a number of speakers and/or device positions (e.g., next to each of the user’s ears).

Ex. 1005, code (57). Patent Owner does not dispute that Maher discloses a playback device that emits an audio signal from a speaker. *See generally* PO Resp.

There is a dispute between the parties as to whether Maher discloses calibrating a speaker “*wherein the at least one speaker is contained within a housing of the playback device.*” The Petition provides:

Maher discloses this feature because portable device 104 of Fig. 1, which can be implemented as integrated devices 302/400 of Figures 3/4, plays a “test file” or “reference signal.” Vipperman [Decl.], ¶¶ 57-60; *see also* Maher, ¶¶ 43-45 (explaining that device 400 in Figure 4 is an embodiment of device 104 in Figure 1 and practices the systems and methods of Maher), ¶ 42 (similar disclosure for device 302).

As explained, Maher’s signal is emitted “via at least one speaker.” *See* Maher, ¶¶ 20, 24, 42, Fig. 2, step 203 (“initiate audio playback from speaker”). The speaker is contained within the playback device housing because Maher describes the speaker as among the “integrated devices” within device 400, *id.*, ¶¶ 43, 45, and Figures 3/4 show **speaker 304/424** included within **device 302/400**:



Id., Figs. 3, 4 (annotated); *see also id.*, ¶ 16 (explaining that the “speakers [are] directly connected to or integrated with the device.”), 42-45 (discussing “connected or integrated devices or subsystems (e.g., microphone 422, speakers 424, and/or the like)”). Moreover, Maher discloses that the device may be a music player, video player, mobile phone, tablet, laptop, or TV, ¶¶ 14-17, 19, 24, 29, 42, 43, which a POSITA would have known include speakers, Vipperman [Decl.], ¶ 60.

Pet. 15–17. In response, Patent Owner argues:

Maher describes a speaker calibration process that uses a separate microphone to calibrate speakers, where the speakers are placed in a room, and the microphone is placed near the listener's ears so that the microphone can detect how audio output from the speakers is perceived by the listener. Johnson, ¶¶ 73-75. Maher describes speaker calibration procedures that use a microphone within a mobile phone (which has its own speakers, too). Johnson, ¶ 76. But Maher does not describe calibrating the mobile phone's speakers. Johnson, ¶ 81-82. All of Maher's disclosed speaker calibration procedures rely on using a microphone separate from the speakers that are being calibrated. Johnson, ¶ 83. As a result, Maher does not disclose or suggest a playback device with an integrated microphone and speaker that determines equalization settings for playing audio via its integrated speaker. Johnson, ¶ 82.

PO Resp. 2. Although Patent Owner acknowledges that Maher discloses a mobile phone with speakers (and a microphone) contained within its housing (PO Resp. 2, 4, 12, 18, 24; PO Sur-reply 9–10) and does not dispute that Maher discloses the other elements of this limitation (*see generally* PO Resp.), Patent Owner argues that Maher does not disclose a method for calibrating the one or more speakers integrated into the mobile phone so that the mobile phone plays back audio using the calibrated and integrated speaker(s) (PO Resp. 4). However, Patent Owner's argument is not specifically related to any of the elements in this limitation and is better addressed in our discussion below in relation to the last limitation of claim 1 (“*causing, by the playback device, an audio track to play according to the adjusted equalization setting*”).

We find that Maher clearly discloses all the elements of this limitation because Figures 3 and 4 illustrate speakers 304 and 424 contained within the housings of devices 302 and 400, respectively.

detecting, by the playback device via at least one microphone, a second audio signal, wherein at least a portion of the second audio signal is a reflection of the first audio signal, and wherein the at least one microphone is contained within the housing of the playback device;

Petitioner contends that Maher either alone or in combination with Hooley discloses all the elements of this limitation. Pet. 17–23 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 61–64, 70; Ex. 1005 (Maher), code (57) (Abstract), ¶¶ 14–17, 19, 20, 24, 27, 29, 42, 43, 45, Figs. 3 & 4, claim 1; Ex. 1006 (Hooley), code (57) (Abstract), ¶¶ 45–47, 53–56, 59). The Petition states, “Maher discloses this element because Maher discloses ‘detecting’ or ‘receiv[ing]’ the test signal after it is reflected by the environment” (*id.* at 17) and “Hooley describes a playback device that emits an audio signal (Hooley’s ‘beam’) via its speaker and detects its reflection via its microphone” (*id.*). The cited art supports Petitioner’s contentions for this limitation. Patent Owner does not dispute that the cited art discloses all the elements of this limitation. *See generally* PO Resp. We find that the cited art discloses all the elements of this limitation. That is, we find that Maher discloses this limitation because Figures 3 and 4 illustrate microphones 306 and 422 contained within the housings of devices 302 and 400, respectively, each of which is capable of detecting a test signal after it is reflected by the environment. We also find that the Maher/Hooley combination teaches this limitation because Hooley discloses a microphone contained with the housing of a playback device that detects the reflection of an audio signal or beam after it is reflected by the environment.

With regard to obviousness and combining the relevant teachings of Maher and Hooley, Petitioner contends:

[A] POSITA would have found it obvious to combine Maher and Hooley to teach that a portion of the second audio signal is a reflection of the first audio signal and to combine Hooley's reflection detection and analysis capabilities with Maher's system to ensure that the signal analyzed by Maher's playback device is the first reflected signal and thus representative of the environment being measured, as specifically taught by Hooley.

Pet. 20. Petitioner provides the following additional reasons for combining the teachings of Maher and Hooley:

“Maher and Hooley both calibrate playback device speakers based on the environment . . . and are thus in the same field of endeavor and solve the same problems in similar devices.” *Id.* (citing Ex. 1003 ¶¶ 65–66).

“[T]he references solve similar problems using similar well-known techniques. . . . Thus, combining Maher and Hooley entails using the known techniques of Hooley to improve Maher's similar device in the same way, and would have been obvious to a POSITA.” *Id.* at 20–21 (citing Ex. 1003 ¶ 67; Ex. 1005, code (57), ¶¶ 20, 24, 25, 27, 29–42; Ex. 1006, code (57), ¶ 44).

“A POSITA would have been motivated and found it obvious to combine or apply Hooley's teachings with Maher's playback device to achieve Maher's stated goals of adjusting the equalization parameters of the system based on the acoustical measurements of the environment.” *Id.* at 21 (citing Ex. 1003 ¶ 68).

“[A] POSITA would have been motivated to combine Hooley's detection and analysis capabilities with Maher's system to ensure that the signal analyzed by Maher's playback device was the first reflected signal

and thus representative of the environment being measured, as specifically taught by Hooley.” *Id.*

“[A] POSITA would have been motivated to make this combination based on Hooley’s teachings that measuring the reflected signal enables a POSITA to calibrate the audio output based on the detected environment of the device, Maher’s expressly stated goal.” *Id.* at 22 (citing Ex. 1003 ¶ 69).

Patent Owner does not present argument against Petitioner’s contention that there existed a motivation to combine the teachings of Maher and Hooley. *See generally* PO Resp. We find that a skilled artisan would have been motivated to combine the relevant teachings of Maher and Hooley as related to this limitation.

in response to the detecting, determining, by the playback device, one or more reflection characteristics wherein each of the one or more reflection characteristics are based on at least the second audio signal;

Petitioner contends that Maher either alone or in combination with Hooley discloses all the elements of this limitation. Pet. 24–26 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 62, 63, 71–73; Ex. 1005 (Maher) ¶¶ 20, 29–42; Ex. 1006 (Hooley) ¶¶ 44–47, 53, 59, 74–76). The Petition states, “Maher discloses this claimed feature by determining the environmental characteristics of the device using the received signal (the second audio signal)” (*id.* at 24) and “Hooley . . . discloses this limitation because Hooley discloses determining reflection characteristics of the environment, e.g., its geometry and location, shape, and acoustic characteristics of objects such as walls based on the received reflected signal” (*id.* at 25). The cited art supports Petitioner’s contentions for this limitation. Patent Owner does not dispute that the cited art discloses all the elements of this limitation. *See*

generally PO Resp. We find that the cited art discloses all the elements of this limitation. That is, we find Maher discloses this limitation because devices 302 and 400 are capable of using the received test signal to determine the reflection characteristics of the environment. We also find that the Maher/Hooley combination teaches this limitation because Hooley discloses that the playback device uses the received audio signal or beam to determine the reflection characteristics of the environment.

With regard to obviousness and combining the relevant teachings of Maher and Hooley, Petitioner relies on its showing with regard to the immediately preceding limitation (Pet. 26) and also provides the following additional reasons for combining the teachings of Maher and Hooley:

“A POSITA would have been further motivated to [combine the teachings of Maher and Hooley] based on Hooley’s teaching that measuring the reflected signal facilitates calibrating the audio output based on the detected environment, Maher’s expressly stated goal.” Pet. 26 (citing Ex. 1003 ¶ 76).

“While Maher and Hooley both disclose using the reflected signal to detect environmental information, Hooley discloses additional detail as to how this is accomplished, and a POSITA would have looked to Hooley’s use of time-of-flight and amplitude calculations to achieve Maher’s stated goals of determining environmental characteristics like room size or geometry.” *Id.* (emphasis omitted).

“This would have been the implementation of a known technique (Hooley’s time-of-flight or amplitude calculations) in a prior art system (Maher’s device) to achieve expected and desired results (Maher’s goals of measuring the device’s environment).” *Id.*

Patent Owner does not present argument against Petitioner's contention that there existed a motivation to combine Maher and Hooley. *See generally* PO Resp. We find that a skilled artisan would have been motivated to combine the relevant teachings of Maher and Hooley as related to this limitation.

adjusting, by the playback device, an equalization setting of the playback device based on the one or more reflection characteristics;

Petitioner contends that Maher discloses all the elements of this limitation. *See* Pet. 26–27 (citing Ex. 1003 (Vipperman Decl.) ¶ 77; Ex. 1005 (Maher), code (57) (Abstract), ¶¶ 20, 25–27, claim 1). The Petition states, “Maher discloses this feature because Maher adjusts equalization parameters of the device based on the ‘reflection characteristics’ (whether determined as described in Maher or Hooley).” *Id.* at 26. Patent Owner does not argue that Maher does not disclose this limitation. *See generally* PO Resp. We find that Maher discloses all the elements of this limitation because devices 302 and 400 are capable of adjusting the equalization settings based on the reflection characteristics of the environment.

causing, by the playback device, an audio track to play according to the adjusted equalization setting.

Petitioner contends that Maher discloses all the elements of this limitation. *See* Pet. 26–27 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 78–80; Ex. 1005 (Maher), code (57) (Abstract), ¶¶ 3, 13–17, 20, 22, 27, 43–45, claim 1). The Petition states, “Maher discloses this feature because Maher explains that after the equalization parameters are adjusted, ‘[w]hen additional audio content is sent to the speakers for playback, **DSP 102**

applies the equalization parameters to the audio content signal before sending the appropriately processed signal *to the speakers for playback.*” *Id.* at 27–28.

As noted above, Patent Owner argues, “Maher does not disclose or suggest a playback device with an integrated microphone and speaker that determines equalization settings for playing audio via its integrated speaker” and, as a result, does not disclose or suggest this limitation. PO Resp. 4.¹³ Patent Owner contends, “Maher only describes calibrating speakers that are separate from the portable device.” *Id.* at 25 (citing Ex. 2016 (Johnson Decl.) ¶¶ 82–84).

We do not agree with this argument because it is contrary to the disclosure of Maher. Maher states that “[s]ystems and methods are described herein for addressing some or all of the following illustrative situations: . . . Audio from a network-connected device (e.g., a mobile phone, tablet, laptop, or connected TV), using *speakers* directly connected to or *integrated with the device.*” Ex. 1005 ¶¶ 13, 16 (emphasis added) (cited at Pet. 17). Thus, Maher explicitly provides that its methods are applicable to devices with integrated speakers, such as devices 302 and 400 illustrated in Figures 3 and 4, respectively. Based on this passage and other passages in Maher that describe or depict devices with integrated speakers (*see id.* ¶¶ 42–43, Figs. 1, 3, 4), a skilled artisan would have understood that the

¹³ Patent Owner relies on the same argument to address the Maher/Hooley combination. Patent Owner’s Response states: “The Petition does not assert that Hooley teaches or suggests the limitations missing from Maher. Petition, pp. 26–28. Therefore, claims 1–3, 5–6, 10, 15, 18, or 19 are patentable over the combination of Maher and Hooley for at least the same reasons that claims 1 and 15 are patentable over Maher individually.” PO Resp. 4–5.

speaker calibration methods of Maher are applicable to devices with integrated speakers.

With specific regard to anticipation by Maher, Patent Owner argues that the “anticipation theory based on Maher fails as a matter of law because [Petitioner] combines elements from multiple embodiments of Maher in an attempt to show that Maher anticipates independent claims 1 and 15.”

PO Sur-reply 2. In support of this argument, Patent Owner contends that Petitioner mixes features from the speaker-calibration methods described in relation to Figures 1 and 2 and the related disclosure (¶¶ 19–28) with the audio detection and processing techniques described in relation to Figure 3 and the related disclosure (¶¶ 29–42). PO Resp. 22. This argument is undermined by Patent Owner’s own statements as to Maher’s teachings with regard to Figure 4 that is depicted in Maher as including an integrated speaker (Fig. 4, ref. no. 424). *See id.* at 15. Patent Owner’s Response states:

After describing speaker calibration techniques with reference to Figures 1 and 2 and describing other audio detection and processing techniques with reference to Figure 3, Maher describes an example computing device 400 in Figure 4 that can be used to practice both (i) the speaker calibration procedures shown and described in Figures 1-2 and ¶¶ 19-28 and (ii) the other “audio detection and processing techniques” shown and described in Figure 3 and ¶¶ 29-42. Johnson, ¶¶ 157-62.

But as explained in detail herein, Maher does not disclose any new speaker calibration or audio detection and processing techniques in the context of Figure 4 that are not already described with reference to Figures 1-3. Maher, ¶¶ 43-45; Johnson, ¶¶ 163-69. Instead, Figure 4 merely shows details of a generic computing device, thereby providing additional written description tying components such as those shown in device 400 to elements and features shown and described with reference to Figures 1-3. Maher, ¶¶ 43-45; Johnson, ¶¶ 163-69.

Id. Thus, Patent Owner appears to acknowledge that, in relation to Figure 4, Maher describes a device (an embodiment) that can be used to practice all the methods and techniques of Figures 1–3. In the Petition, the same paragraphs from Maher (Ex. 1005 ¶¶ 43–45) are cited for “explaining that device 400 in Figure 4 is an embodiment of device 104 in Figure 1 and practices the systems and methods of Maher.”¹⁴ Pet. 15; *see also* Pet. 28 (“explaining that the embodiment of Figure 4 [of Maher] can implement the disclosed systems and methods”). As noted above, Patent Owner also acknowledges that Maher discloses a mobile phone with integrated speakers. PO Resp. 2, 4, 12, 20, 24; PO Sur-reply 9–10. And again, the device depicted in Figure 4 includes integrated speakers.¹⁵ Ex. 1005, Fig. 4, speaker 424; *see also id.* ¶ 44 (“In the example shown in FIG. 4, memory 404 also includes an application 430 for calibrating speakers and/or processing acoustic data as described above.”). Further, as pointed out by Petitioner with respect to Figure 4, “Maher does not refer to any other

¹⁴ Petitioner also points to Maher’s disclosure of other devices that a skilled artisan would have understood have integrated speakers according to uncontradicted testimony from Dr. Vipperman. Pet. 17 (“Moreover, Maher discloses that the device may be a music player, video player, mobile phone, tablet, laptop, or TV, ¶¶ 14-17, 19, 24, 29, 42, 43, which a POSITA would have known include speakers, Vipperman [Decl.], ¶ 60.”).

¹⁵ Maher provides explicit instruction to a skilled artisan not to interpret the disclosure of the device of Figure 4 in a limited way. Ex. 1005 ¶¶ 45 (“One of ordinary skill in the art will appreciate that the systems and methods described herein can be practiced with computing devices similar or identical to that illustrated in FIG. 4, or with virtually any other suitable computing devices.”), 46 (“The systems and methods disclosed herein are not inherently related to any particular computer, electronic control unit, or other apparatus and may be implemented by a suitable combination of hardware, software, or/or firmware.”).

speaker in this example.” Pet. Reply 4. Petitioner contends, “[t]he *only* speaker in [Maher’s] Figure 4—and thus the only speaker requiring calibration—is **speaker 424** residing within device 400.” *Id.* at 11.

Based on our consideration of the contentions of the parties and our weighing of the related evidence, we determine that a preponderance of the evidence supports a conclusion that Maher discloses in Figure 4 and the related description an embodiment that can be used to practice the methods of Figures 1–3. We disagree with Patent Owner’s arguments that Maher does not describe a method where a device determines equalization settings for an integrated speaker and Patent Owner’s attempt to distinguish claim 1 from Maher and the Maher/Hooley combination on this basis.

b. Claims 2, 3, 5, 6, 10, 15, 18, and 19

Petitioner also challenges independent claim 15 and dependent claims 2, 3, and 10 of the ’460 patent as anticipated or obvious based on Maher alone, and independent claim 15 and dependent claims 2, 3, 5, 6, 10, 18, and 19 as obvious based on the Maher/Hooley combination. *See* Pet. 3. The Petition includes a detailed showing that claims 2, 3, 5, 6, 10, 15, 18, and 19 are unpatentable over Maher alone and the Maher/Hooley combination. *See id.* at 28–38. Except for the arguments discussed above in relation to claim 1, Patent Owner does not dispute Petitioner’s showing as to the unpatentability of claims 2, 3, 5, 6, 10, 15, 18, and 19 over Maher alone and the Maher/Hooley combination. The showing in the Petition as to the additional limitations in claims 2, 3, 5, 6, 10, 15, 18, and 19 and the unpatentability of claims 2, 3, 5, 6, 10, 15, 18, and 19 over Maher and the Maher/Hooley combination is well-supported (*see id.*) and, as a result, we agree with and adopt Petitioner’s analysis as our own.

As noted above, both parties acknowledge that independent claims 1 and 15 are substantively identical and that the same arguments apply to both claims. *See, e.g.*, Tr. 5:25–6:16 (Petitioner’s counsel), 25:23–25 (Patent Owner’s counsel). For the reasons discussed above with regard to claim 1, we conclude that claim 15 is unpatentable as anticipated by Maher and as rendered obvious by Maher alone¹⁶ and the Maher/Hooley combination.

Patent Owner has not made any separate argument for any dependent claim. *See generally* PO Resp. For the reasons set forth in the Petition, dependent claims 2, 3, and 10 are unpatentable as anticipated by Maher and as rendered obvious by Maher, and dependent claims 2, 3, 5, 6, 10, 18, and 19 are unpatentable as obvious in view of Maher/Hooley combination.

c. Summary

Based on the fully developed trial record, we conclude that Petitioner has shown by a preponderance of the evidence that: (1) Maher anticipates and renders obvious claims 1, 2, 3, 10, and 15 of the ’460 patent and (2) Maher and Hooley render obvious claims 1, 2, 3, 5, 6, 10, 15, 18, and 19 of the ’460 patent.

3. Challenges based on Zurek

Petitioner contends that claims 1, 2, 5, 10, 15, 18, and 19 of the ’460 patent are unpatentable under § 103 as obvious over a combination of the teachings of Zurek and Levy, and that claims 3, 6, and 18 are unpatentable under § 103 as obvious over a combination of the teachings of Zurek, Levy, and Hooley. Pet. 3, 38–63. Petitioner contends that the cited art teaches every limitation of each challenged claim, and provides reasoning as to why

¹⁶ “It is well settled that anticipation is the epitome of obviousness.” *In re McDaniel*, 293 F.3d 1379, 1385 (Fed. Cir. 2002) (quotation marks omitted).

a person of ordinary skill in the art would have been motivated to combine the teachings of these asserted references. *Id.* Patent Owner contends that the modifications to Zurek proposed by Petitioner “would render Zurek’s mobile device unsatisfactory for its intended purpose, and therefore the Petitioner’s proposed modifications of Zurek are insufficient to show that the limitations recited in claims 1 and 15 would have been obvious.”

PO Resp. 36–44; PO Sur-reply 18–26.

Our limitation-by-limitation analysis of the challenge to claim 1 based on the Zurek/Levy combination is set forth below.

a. Claim 1

A method comprising:

The Petition states, “[t]o the extent it is limiting, Zurek discloses the preamble.” Pet. 38 (citing Ex. 1003 ¶ 112). As set forth in the Petition, Zurek provides that it discloses a method. *Id.* at 38–39 (citing Ex. 1007, ¶¶ 2 (“The present disclosure relates to electronic devices such as mobile devices and, more particularly, to **methods** and systems for performing acoustic processing at or in relation to such electronic devices.”) (emphasis added), 47, Figs. 1–11). In addition, the title, abstract, and claims of Zurek indicate that it is directed to a method. Ex. 1007, codes (54), (57), claims 1–19. Patent Owner also does not take a position as to whether the preamble is limiting and does not dispute Petitioner’s showing that the preamble is disclosed in Zurek. *See generally* PO Resp.

We find that, regardless of whether the preamble is limiting, Zurek discloses a method.

emitting, by a playback device, a first audio signal via at least one speaker, wherein the at least one speaker is contained within a housing of the playback device;

The Petition cites multiple passages in Zurek in support of its contention that Zurek discloses all the elements of this limitation. *See* Pet. 39–40 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 113, 114; Ex. 1007 (Zurek) ¶¶ 21, 26, 32, 47–50, Fig. 5 (step 504 (“Output first acoustic signal from communication device”))). As quoted in the Petition (*id.*), Zurek states, “the communication device includes acoustic hardware configured to emit a first acoustic signal” and “an acoustic signal [is] output from acoustic output hardware in the device, such as one or more speakers.” Ex. 1007 ¶¶ 21, 47; *see also id.* ¶ 32 (“the output device(s) 208 [depicted in Figure 2] include . . . one or more audio output devices 218 such as a speaker”). Zurek supports Petitioner’s contentions with regard to this limitation. Patent Owner does not dispute that Maher discloses that a playback device emits an audio signal from an integrated speaker. *See generally* PO Resp.

We find that Maher clearly discloses all the elements of this limitation because it discloses one or more speakers contained within the housing of communication device 102 that emits a first acoustic signal.

detecting, by the playback device via at least one microphone, a second audio signal, wherein at least a portion of the second audio signal is a reflection of the first audio signal, and wherein the at least one microphone is contained within the housing of the playback device;

Petitioner contends that Zurek disclose all the elements of this limitation. Pet. 40–42 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 115, 116; Ex. 1007 (Zurek) ¶¶ 21, 26, 33, 45, 47, 51, 53–70, Figs. 2, 5–11 (ref. nos. 506, 602, 702, 802, 902, 1002, 1102))). As quoted in the Petition (*id.*), Zurek states, “the communication device includes acoustic hardware . . . to capture at least one acoustic signal comprising . . . at least one reflection of the first acoustic signal,” and “[c]apture, using at least one microphone, at least one

reflection of the first acoustic signal from an external surface.” Ex. 1007 ¶ 21, Fig. 5 (step 506). Zurek also teaches, “the input device(s) 210 include[s] . . . one or more acoustic input devices 224 such as the microphone 108 of FIG. 1” depicted as contained within the housing of the playback device. *Id.* at ¶ 33. Zurek supports Petitioner’s contentions for this limitation. Patent Owner does not dispute that Zurek discloses all the elements of this limitation. *See generally* PO Resp.

We find that Zurek discloses all the elements of this limitation because it discloses microphone 108 contained within the housing of communication device 102 that detects the reflection of the first acoustic signal from an external surface.

in response to the detecting, determining, by the playback device, one or more reflection characteristics wherein each of the one or more reflection characteristics are based on at least the second audio signal;

Petitioner contends that Zurek disclose all the elements of this limitation. Pet. 42–44 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 117, 118; Ex. 1007 (Zurek) ¶¶ 21, 51, 53, 54–70, 74, 75, Figs. 5–11 (ref. nos. 508, 604–608, 704–710, 804–808, 904–908, 1004–1008, 1104–1106). As quoted in the Petition (*id.* at 42), Zurek states, “[t]he communication device also includes a processor configured to characterize an acoustic environment external to the communication device using the at least one captured acoustic signal” and “[c]haracterize the acoustic environment using the at least one reflection.” Ex. 1007 ¶ 21, Fig. 5 (step 508). Zurek supports Petitioner’s contentions for this limitation. Patent Owner does not dispute that Zurek discloses all the elements of this limitation. *See generally* PO Resp.

We find that Zurek discloses all the elements of this limitation because it discloses that communication device 102 uses the reflection of the first acoustic signal to determine the characteristics of the external environment.

adjusting, by the playback device, an equalization setting of the playback device based on the one or more reflection characteristics;

Petitioner relies on Zurek and Levy for this limitation. *See* Pet. 44–51 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 119–131; Ex. 1007 (Zurek) ¶¶ 20, 21, 24, 39, 40, 47, 52, 71, 73–75; Ex. 1008 (Levy), code (57) (Abstract), 1:17–32, 3:4–26, 6:20–52, 7:35–8:45). Petitioner contends that Zurek and Levy individually and in combination disclose all the elements of this limitation. *See id.*

With regard to Zurek, Petitioner contends that this limitation is taught in Figure 5, step 514 (“Adapt acoustic processing based on the characterized acoustic environment”). Pet. 44–45. The Petition states, “[a]s one example, Zurek’s system may detect the proximity of a ‘close surface’ and adapt the acoustic processing of the received signal accordingly.” *Id.* at 46 (citing Ex. 1007 ¶¶ 73–75). Patent Owner does not dispute that Zurek applies acoustic processing to signals received via the mobile phone’s microphone. *See, e.g.*, PO Resp. 40 (citing Ex. 2016 ¶¶ 224–230) (“[B]ased on Zurek’s disclosed embodiments, a POSITA would [have understood] that Zurek’s goal is to perform acoustic processing on *input signals* received by the microphone to facilitate better voice recognition and/or voice audio quality.”).

And, while acknowledging Zurek discusses adjusting signals input at the microphone, Petitioner contends that it would have been obvious to

adjust signals output by the speakers. Pet. 46–47. In this regard, the Petition states:

In addition to applying Zurek’s environment-based acoustic processing to signals received at the microphone, a POSITA would have been motivated to, and would have found it obvious to apply this processing to signals output from Zurek’s device. Vipperman [Decl.], ¶¶ 121-23. Zurek teaches that the device may include audio playback devices such as mobile phones, portable electronic devices, personal media players, or personal computers, Zurek, ¶ 24, all of which output audio signals, Vipperman [Decl.], ¶ 121. A POSITA would have been motivated to use Zurek’s methods of characterizing the environment to facilitate equalizing sound signals emitted from such audio devices to improve the perceived quality of the audio signals being output therefrom. Vipperman [Decl.], ¶ 121.

Id. at 46.

With regard to Levy, Petitioner contends that Levy “discloses this element of claim 1 because it discloses adjusting equalization settings in an audio playback device based on the characteristics of the environment, i.e., based on the same ‘reflection characteristics’ determined by Zurek’s reflection-based analyses described above.” Pet. 47 (citing Ex. 1003 ¶¶ 124–127). The Petition states:

Levy teaches the well-known principle that an audio signal perceived by a listener is a combination of the original audio and the distortion caused by both the speaker and by the listening environment. Levy, 1:17- 32. For example, Levy explains that “when an audio signal leaves the speaker it may hit obstacles or bounce off walls within the listening environment,” and that the “acoustic characteristics of each listening environment might be different,” depending on things like the size of the room. Levy, 7:35-62. Levy therefore discloses programming and adjusting the output of the speaker

“to minimize or eliminate distortion [e]ffects caused by the listening environment.” *Id.*

To do so, Levy discloses tuning the speaker by applying a transfer function to the audio signal emitted by the speaker, to compensate for these environment-based distortions. Levy, 7:49-8:28. The transfer function applied to the speaker is modified using coefficients such that it is the inverse transfer function of the two transfer functions that represent the distortion caused by (a) the speaker, and (b) the environment. Levy, 7:49-61; Vipperman [Decl.], ¶ 125. Levy discloses that the transfer function applied to the audio signal may be changed by modifying “coefficients C2 which compensate for distortion [e]ffects within the current listening environment.” Levy, 7:62-8:28. These coefficients can be stored in a memory located within the speaker system, which may store multiple sets of coefficients, each corresponding to a different environment. Levy, 8:22-45. Levy also discloses that the speaker may be pre-programmed with “sets (or templates) of coefficients—each corresponding to a different type of listening environment,” such as one template for a smaller room like a home theater and another for a larger room like a concert hall. Levy, 8:40-45, Vipperman [Decl.], ¶ 125.

A POSITA would have understood Levy’s disclosure of adjusting the transfer function applied at the speaker to disclose adjusting the equalization settings of the playback device. Indeed, Levy’s use of transfer functions to compensate for signal distortion (audio or otherwise) was a well-known broadband equalization technique. Vipperman [Decl.], ¶ 126. Indeed, Levy discloses that its processes analyze the frequency response of the room and adjust the transform functions to achieve the desired frequency response, Levy, Abstract, 3:4-10, 6:20-52, which a POSITA would have understood entailed adjusting equalization settings. Vipperman [Decl.], ¶ 126.

Id. at 47–49 (footnote omitted).

We find that the Zurek/Levy combination teaches this limitation. That is, Zurek teaches this limitation because it would have been obvious to a POSITA to apply Zurek’s environment-based acoustic processing to

signals output by microphone 108 of communication device 102. Levy teaches this limitation because it discloses adjusting the equalization settings of the playback device by adjusting the transfer function applied at the speaker to account for the acoustical effects of the external environment.

With regard to combining the relevant teachings of Zurek and Levy, Petitioner contends:

[A] POSITA would have found it obvious to combine Zurek and Levy—specifically, to combine Zurek’s system, which determines the acoustical effects of the environment by emitting audio signals and detecting and analyzing their reflections, with Levy’s system, which adjusts equalization settings of the speaker to account for the acoustical effects of the environment, to create a combined system that generates and outputs sound that accounts for the device’s detected environment.

Pet. 49 (citing Ex. 1003 (Vipperman Decl.) ¶¶ 128–131). Petitioner provides the following reasons for combining the teachings of Zurek and Levy:

“Zurek and Levy both configure audio devices based on the environment . . . and are thus in the same field of endeavor and solve the same problems in similar devices.” *Id.* at 50 (citing Ex. 1003 ¶ 129).

“[T]he references solve similar problems using well-known techniques because both references improve audio quality in response to environmental characteristics determined by evaluating an audio signal that has interacted with a listening environment. . . . Thus, combining Zurek and Levy is nothing more than using Levy’s known techniques of adjusting audio output to account for environmental characteristics to improve Zurek’s device that determines those characteristics through reflection-based

analysis, to achieve the predictable result of an audio device that adjusts its output based on the environment it is in to improve audio quality, and thus would have been obvious to a POSITA.” *Id.* (citing Ex. 1003 ¶ 130).

“[D]etermining when to perform the audio signal adjustment (or on which signal to perform the adjustment) would have been within the knowledge of a POSITA, who would have found it obvious to make this modification to achieve the desired and predictable result of a system that adjusts its output to compensate for the environment, thus improving audio quality.” *Id.* at 51 (citing Ex. 1003 ¶ 131).

“[W]hile Zurek discloses adjusting a *received* audio signal to improve voice recognition, Levy (and other systems available at the time, as discussed above) optimizes an *output* audio signal for a listener within a listening environment. Levy’s disclosures of improving the output audio for a listener within a listening environment provide an express motivation for combining Levy with Zurek’s reflection-based analyses of determining the characteristics of the listening environment.” *Id.* (emphasis omitted).

We find that a skilled artisan would have been motivated to combine the relevant teachings of Zurek and Levy as related to this limitation.

*causing, by the playback device, an audio track to play
according to the adjusted equalization setting.*

Petitioner relies on Zurek and Levy for this limitation. *See* Pet. 51–52 (citing Ex. 1003 (Vipperman Decl.) ¶ 132; Ex. 1007 (Zurek) ¶¶ 24, 46; Ex. 1008 (Levy), 6:13–41, 6:48–7:10, 8:13–39). With regard to this limitation, the Petition states:

As discussed [with regard to] the previous [limitation], it would have been obvious to combine Zurek with Levy to create a playback device that adjusts the equalization of its output audio signals based on the reflection characteristics it detected.

Levy discloses the additional limitation of causing, by the playback device, an audio track to play according to the adjusted equalization setting because Levy discloses applying the transfer function with the newly generated coefficients to transform “the input signal to generate a compensated environment specific output signal from the speaker.” Levy, 8:13-39; *see also id.*, 6:13-41. A POSITA would have understood Levy’s output signal to include an “audio track,” in the context of the ’460 patent. Vipperman [Decl.], ¶ 132. For example, Levy discloses that after the speaker is tuned, the transform function is applied to all future audio signals, and that the tuned speaker is used to play different kinds of music. Levy, 6:48-7:10. And Zurek, with which Levy is combined, discloses that the playback device can be a portable music player capable of playing music or other multimedia. Zurek, ¶¶ 24, 46. Similarly, the ’460 patent describes its exemplary audio tracks and audio content as music. ’460 patent, 7:32-8:23, 11:14-57.

Id. The cited art supports Petitioner’s contentions for this limitation. Patent Owner does not dispute that the cited art discloses all the elements of this limitation. *See generally* PO Resp. We find that the cited art teaches all the elements of this limitation because it would have been obvious to a POSITA to modify Zurek’s communication device 102 in a manner that would allow it to play audio tracks according to Levy’s adjustment of equalization settings of the speaker to account for the acoustical effects of the environment.

As noted above, Patent Owner argues, “Petitioner’s proposed modification would render Zurek’s mobile phone unsatisfactory for its intended purpose of processing *input signals* received by the mobile phone’s microphone to facilitate better voice recognition capabilities and/or voice

call audio quality.”¹⁷ PO Resp. 5–6. However, as noted above for this specific challenge, Petitioner relies on Levy for teaching a playback device that adjusts the equalization of its output audio signals based on the reflection characteristics it detected with its microphone. *See* Pet. 47–49. Indeed, Patent Owner acknowledges that Levy does “acoustic analysis to process output signals.” Tr. 43:17–19. Moreover, Patent Owner never explains how Zurek’s mobile phone would be rendered unsatisfactory for applying acoustic processing to input signals when modified as proposed by Petitioner to apply the same or similar acoustic processing to output signals. *See* PO Resp. 36–42; *see also* Tr. 41–45.

In response to this argument, Petitioner argues that “the proposed Zurek[/Levy] combination keeps Zurek operable for its intended purpose.” Pet. Reply 1. Specifically, Petitioner argues that “input and output equalization are not incompatible. Indeed, they use the *same adjustments*” and “[t]he underlying process is the same.” *Id.* at 21–22. And, Petitioner contends that Patent Owner misconstrues the obviousness argument in the Petition as a substitution of output processing for input processing but, in the Petition, the output processing of Levy was applied as an addition to the input processing of Zurek. *Id.* at 22–23. Petitioner states:

[Patent Owner] simply misapprehends the proposed combination. [Petitioner] did not propose wholesale substituting Zurek’s input processing with Levy’s output processing as [Patent Owner] claims. POR 36-39, 41-42. Rather, [Petitioner] combined this output processing “[i]n addition to” Zurek’s input adjustments. Pet. 46, 49; Vipperman

¹⁷ As acknowledged by Patent Owner, “the other cited references . . . focus on processing output signals played by a speaker.” PO Resp. 3. And, Patent Owner acknowledges that “Zurek is not limited just to voice processing,” but could be used to process “other input signals.” Tr. 44:15–21.

[Decl.], ¶¶ 121, 128. The combined system would not trade one for the other—it would do both. *Id.*

Id. at 22.

Petitioner also argues Zurek is not limited to processing voice inputs, but “Zurek repeatedly frames its disclosure as applying to *all* types of ‘acoustic processing’—not just input voice signals.” Pet. Reply 17 (citing Ex. 1007, code (57) (Abstract) (describing “adapting acoustic processing within the communication device based on the characterized acoustic environment” and not mentioning voice processing or signals), ¶¶ 2, 20, 21, 25, 72); *see also id.* at 18 (citing Ex. 1007, claim 1 (reciting “adapting acoustic processing within the communication device based on the characterized acoustic environment.”))).

Based on our consideration of the contentions of the parties and our weighing of the related evidence, we determine that a preponderance of the evidence supports a conclusion that the combination of Zurek and Levy teaches all the limitations of claim 1 and that a skilled artisan would have been motivated to combine the relevant teachings of Zurek and Levy as recited in claim 1. We disagree with Patent Owner’s argument that combining the teachings of Zurek and Levy as proposed in the Petition would render Zurek inoperable for its intended purpose. More specifically, we do not share Patent Owner’s view that adding Levy’s output processing to Zurek’s system would result in rendering Levy’s input processing inoperable for its intended purpose because we agree with Petitioner that (1) Zurek is not limited to processing voice inputs, and (2) input and output equalization are not mutually exclusive, but rather the underlying acoustic processing is the same.

b. Claims 2, 3, 5, 6, 10, 15, 18, and 19

Petitioner also challenges independent claim 15 and dependent claims 2, 5, 10, 18, and 19 of the '460 patent as obvious in view of Zurek and Levy, and dependent claims 3, 6, and 18 as obvious in view of Zurek, Levy, and Hooley. *See* Pet. 3. The Petition includes a detailed showing that claims 2, 3, 5, 6, 10, 15, 18, and 19 are unpatentable over the Zurek/Levy combination and the Zurek/Levy/Hooley combination. *See id.* at 52–63. Except for the arguments discussed above in relation to claim 1, Patent Owner does not dispute Petitioner's showing as to the unpatentability of claims 2, 3, 5, 6, 10, 15, 18, and 19 over the Zurek/Levy combination and the Zurek/Levy/Hooley combination. The showings in the Petition as to the additional limitations in claims 2, 3, 5, 6, 10, 15, 18, and 19 and the unpatentability of claims 2, 3, 5, 6, 10, 15, 18, and 19 over the Zurek/Levy combination and the Zurek/Levy/Hooley combination are well-supported (*see id.*) and, as a result, we agree with and adopt Petitioner's analysis as our own.

As noted above, both parties acknowledge that independent claims 1 and 15 are substantively identical and that the same arguments apply to both claims 1 and 15. *See, e.g.,* Tr. 5:25–6:16 (Petitioner's counsel), 25:23–25 (Patent Owner's counsel). For the reasons discussed above with regard to claim 1, we conclude that claim 15 is unpatentable over the Zurek/Levy combination and the Zurek/Levy/Hooley combination.

Patent Owner has not made any separate argument for any dependent claim. *See generally* PO Resp. For the reasons set forth in the Petition, dependent claims 2, 5, 10, 18, and 19 of the '460 patent are unpatentable as obvious in view of Zurek and Levy, and dependent claims 3, 6, and 18 are unpatentable as obvious in view of Zurek, Levy, and Hooley.

c. Summary

Based on the fully developed trial record, we conclude that Petitioner has shown by a preponderance of the evidence that: (1) claims 1, 2, 5, 10, 15, 18, and 19 of the '460 patent are unpatentable as obvious over a combination of the teachings of Zurek and Levy, and (2) claims 3, 6, and 18 are unpatentable as obvious over a combination of the teachings of Zurek, Levy, and Hooley.

III. CONCLUSION¹⁸

Petitioner has demonstrated by a preponderance of the evidence that claims 1–3, 5, 6, 10, 15, 18, and 19 of the '460 patent are unpatentable. A summary of our conclusions is set forth in the table below.

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–3, 10, 15	102	Maher	1–3, 10, 15	
1–3, 10, 15	103	Maher	1–3, 10, 15	
1–3, 5, 6, 10, 15, 18, 19	103	Maher, Hooley	1–3, 5, 6, 10, 15, 18, 19	
1, 2, 5, 10, 15, 18, 19	103	Zurek, Levy	1, 2, 5, 10, 15, 18, 19	

¹⁸ 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*. See 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).

3, 6, 18	103	Zurek, Levy, Hooley	3, 6, 18	
Overall Outcome			1–3, 5, 6, 10, 15, 18, 19	

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 1–3, 5, 6, 10, 15, 18, and 19 of U.S. Patent No. 9,219,460 B2 are held to be unpatentable; and

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

IPR2021-00475
Patent 9,219,460 B2

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