

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ELECTRONICS INC.,

Petitioner,

v.

JAWBONE INNOVATIONS, LLC,

Patent Owner.

Patent No. 8,467,543

Filing Date: March 27, 2003

Issue Date: June 18, 2013

Inventor: Gregory C. Burnett, Nicolas J. Petit,
Alexander M. Asseily, and Andrew E. Einaudi

Title: MICROPHONE AND VOICE ACTIVITY DETECTION (VAD)
CONFIGURATIONS FOR USE WITH COMMUNICATION SYSTEMS

PATENT OWNER'S PRELIMINARY RESPONSE

Case No. IPR2023-01248

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I. INTRODUCTION

The Board should deny the Petition because Petitioner LG Electronics Inc. (“Petitioner” or “LG”) fails to show that its combination discloses or renders obvious a key limitation of the claims of the ’543 Patent.

The ’543 Patent is directed to a system for performing noise suppression in a multiple microphone system using a voice activity detector and subband processing. The challenged claims of the ’543 Patent require that “the denoising subsystem automatically select[s] at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using . . . control signals,” where the control signals are “automatically generated” by the “voice detection subsystem.”

The Petition contends that Hussain teaches this limitation because it discloses that “the decision of which method is best for each sub-band is determined, at least in part, by the output of a VAD.” Hussain contains no such teaching, and Petitioner and its expert offer no evidence that it does. Rather, Hussain teaches a novel metric for selecting a denoising method which does not use the output of a VAD.

Based on this deficiency as detailed more fully herein, the Board should deny institution of the Petition.

II. THE ’543 PATENT

The ’543 Patent claims systems for performing acoustic noise suppression in a multiple microphone system with the use of a voice activity detector. ’543 Patent,

Abstract (Ex. 1001). Embodiments of the system use two microphones and a voice activity detection (VAD) system, which includes both a VAD device and a VAD algorithm. *Id.*, 5:45-50. The signals from the primary and secondary microphones are filtered into multiple frequency subbands, and each subband is denoised using its own adaptive filter. *Id.*, 16:31-36. The VAD system uses algorithms for processing the voice activity signals from the VAD device and outputs control signals used to adapt the noise suppression system to the received signals. *Id.*, 16:46-54, 19:53-64. The control signals can be used to determine when to adapt the transfer functions used in the denoising process to the presence or absence of speech. *Id.*, 14:51-52, 16:63-67.

The '543 Patent describes the embodiment of Figure 1:

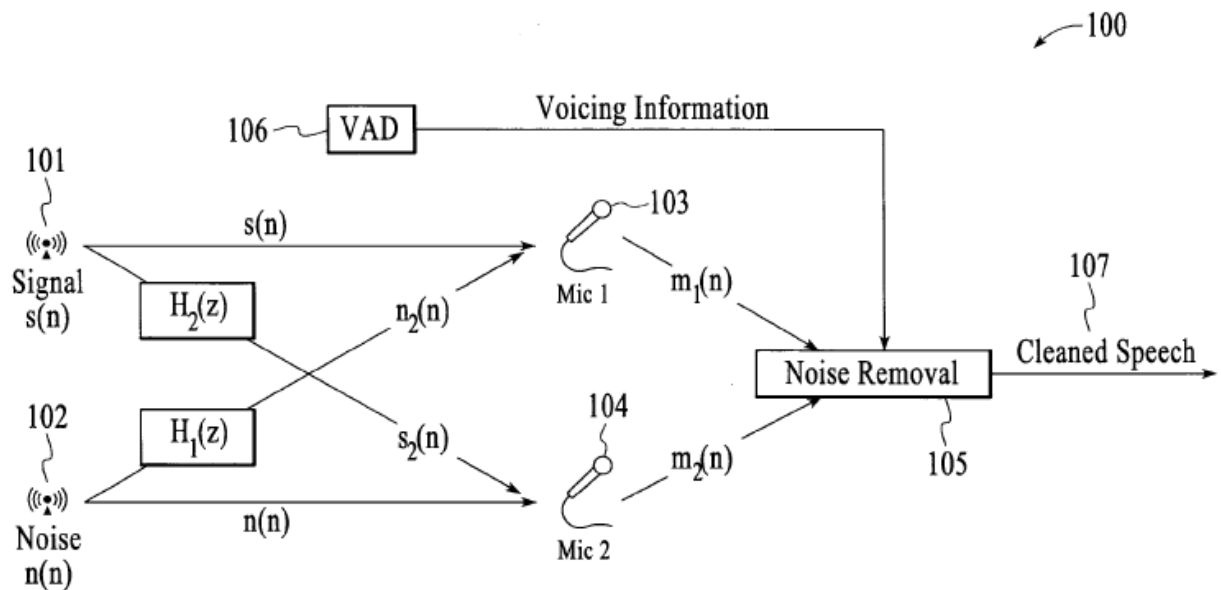


FIG.1

'543 Patent, FIG. 1.

In this embodiment, “[t]he signal processing system 105 includes two microphones MIC 1 103 and MIC 2 104 that receive signals or information from at least one speech source 101 and at least one noise source 102.” *Id.*, 14:43-46. “The path $s(n)$ from the speech source 101 to MIC 1 and the path $n(n)$ from the noise source 102 to MIC 2 are considered to be unity,” which means that MIC 1 is presumed to receive the entire speech signal and MIC 2 is presumed to receive the entire noise signal. *Id.*, 14:46-48. $H_1(z)$ is a transfer function that represents the amount of the noise signal received at MIC 1, and $H_2(z)$ is a transfer function that represents the amount of the speech signal that is received at MIC 2. *Id.*, 14:48-50.

The '543 Patent teaches that “[t]he acoustic information coming into MIC 1 is denoted by $m_1(n)$. The information coming into MIC 2 is similarly labeled $m_2(n)$. In the z (digital frequency) domain, we can represent them as $M_1(z)$ and $M_2(z)$. Thus

$$M_1(z)=S(z)+N(z)H_1(z)$$

$$M_2(z)=N(z)+S(z)H_2(z).”$$

'543 Patent, 14:52-60.

The '543 Patent uses “[a] VAD signal 106, derived in some manner, . . . to control the method of noise removal.” *Id.*, 14:51-52. Using the VAD allows for simplification of these equations such that the equation for the sounds signal $S(z)$ can be derived as:

$$S(z) = \frac{M_1(z) - M_2(z)H_1(z)}{1 - H_2(z)H_1(z)}.$$

Id., 15:60-62.

Assuming the situation where “ $H_2(z)$ is quite small,” *i.e.*, that the amount of the speech signal reaching MIC 2 is very low, and assuming that “ $H_1(z)$ is less than unity,” *i.e.*, that less than the entire noise signal reaches MIC 1, the speech signal can be calculated as:

$$S(z) \approx M_1(z) - M_2(z)H_1(z).$$

Id., 16:2-3.

The '543 Patent teaches that its noise suppression system is an improvement over the prior art because it uses an accurate voice activity detection signal in the denoising process. *Id.*, 2:7-12. The '543 Patent teaches that it is crucial to implement “a sufficiently accurate VAD . . . to adapt the coefficients of H_1 (noise only) and H_2 (if needed, when speech is being produced).” *Id.*, 16:55-67. If the VAD is inaccurate and speech is occurring during the calculation of the coefficients of H_1 (noise only), it “would result in the removal of a large part of the speech energy from the signal of interest,” resulting in “signal distortion and reduction (de-signaling).” *Id.*

Using multiple subbands in processing the acoustic signals results in significant noise suppression. *Id.*, 16:9-11. The signals from MIC 1 and MIC 2 are filtered into multiple subbands and the resulting data from each subband is sent to its own adaptive filter. *Id.*, 16:31-36. The results from each subband are added back together to form the final denoised signal. *Id.*, 16:38-40.

III. THE RELEVANT ALLEGED PRIOR ART

A. Burnett '919 (U.S. Patent No. 6,377,919)

U.S. Patent No. 6,377,919 (Ex. 1003, “Burnett '919”) was filed on November 4, 1999 and issued on April 23, 2002. Burnett '919 is directed using “[l]ow power EM waves . . . to detect motions of vocal tract tissues of the human speech system.” Ex. 1003, Abstract. The motion is used to derive a “voiced excitation function” which can then be used to “enhance speech characterization and to enable noise removal from human speech.” *Id.*

Burnett '919's EM sensor “detects tissue motion in a glottal region of a human speech system before, during, and after voiced speech.” *Id.*, 2:62-65. “From these measurements, a human voiced excitation function can be derived.” *Id.*, 2:66-67. Burnett '919 further cites to U.S. Patent Application Ser. No: 08/597596 and incorporates it by reference to teach the characterization of speech vs. non-speech. *Id.*, 11:65-12:3. U.S. Patent App. No. 08/597596 corresponds to U.S. Patent No. 6,006,175 (Ex. 1009, “Holzrichter”).

Holzrichter teaches that the algorithm for determining when speech begins, *i.e.*, the onset of speech, requires the use of an EM sensor and an acoustic sensor. Ex. 1009, 31:33-32:54. “The algorithm detects the onset of speech by using both an acoustic and one or more EM sensor modules at the same time.” *Id.*, 31:51-53. Although the EM sensors are effective for detecting voiced speech, the acoustic sensor is used to detect unvoiced speech when no vocal fold motion is detected. *Id.*, 32:7-10, FIG. 19, element 79.

B. Hussain (*A New Metric for Selecting Sub-band Processing in Adaptive Speech Enhancement Systems*)

The paper *A New Metric for Selecting Sub-band Processing in Adaptive Speech Enhancement Systems* (“Hussain”) (Ex. 1006) was purportedly published in 1997. Hussain is directed to “A multi-microphone adaptive speech enhancement system employing diverse sub-band processing.” Hussain, 2611.

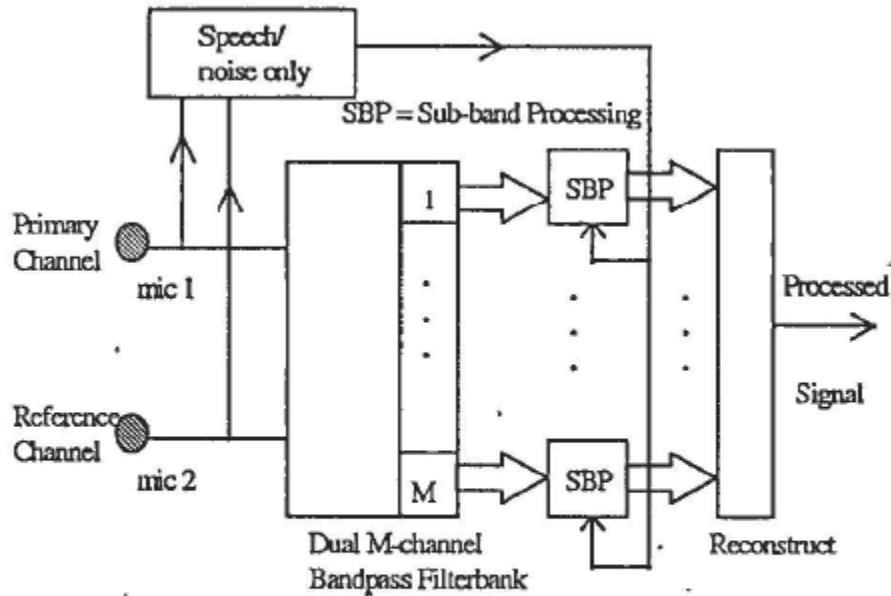


Figure 1: The MMSBA system

Hussain discloses that it has developed a “new robust metric . . . which is capable of real-time implementation, in order *to automatically select* the best form of processing within each sub-band.” *Id.* (emphasis added). “In order to realize this, a robust practical metric has been developed, which is capable of realtime implementation, based on the inter-channel Magnitude Squared Coherence (MSC) relationship *in order to automatically select the best SBP option.*” *Id.* (emphasis added). Based on the MSC, Hussain automatically chooses one of three options for subband processing: “(i) no processing; (ii) intermittent coherent noise canceller; and (iii) continuous incoherent noise canceller.” *Id.*

Hussain “propose[s] the use of a modified MSC as a part of a system for *selecting the best SBP option* in a [multi-microphone sub-band adaptive] speech enhancement system.” Hussain, 2612 (emphasis added). Hussain derives the following equation for the MSC:

$$\overline{\text{MSC}}(f_k) = \frac{1}{I} \sum_{i=1}^I \text{MSC}(f_k, i)$$

Hussain, 2613. According to Hussain:

The above adaptively averaged MSC criterion can thus be used as an effective means for determining the level of correlation between the disturbing noises at various frequencies bands (by averaging the above MSC over each respective sub-band), during the noise alone period in intermittent speech. *The subsequent form of processing in each respective frequency band can therefore be selected on the basis of the inter-channel correlation.*

Id. (emphasis added).

Hussain uses the MSC to choose between using an “intermittent coherent noise canceller” and an “incoherent noise canceller.” Hussain, 2612-13. According to Hussain, “[o]n initial trials, a threshold value of 0.6 for the adaptive MSC has been found to be suitable for distinguishing between highly correlated and weakly correlated sub-band noise signals.” Hussain, 2613. Hussain teaches that when “the

noise power is significant and the noise between two channels is significantly correlated in a sub-band, then perform adaptive intermittent noise cancellation.” Hussain, 2612. But, “[i]f the noise power is significant but not highly correlated between the two channels in a sub-band, then the incoherent noise cancellation approach . . . may be applied during the noisy speech period.” *Id.*

IV. CLAIM CONSTRUCTION

For the purposes of this Preliminary Response only, Patent Owner agrees that no claim terms require construction.

V. LEVEL OF ORDINARY SKILL IN THE ART

For the purposes of this Preliminary Response, Patent Owner utilizes Petitioner’s proposed level of skill in the art: A person of ordinary skill in the art (“POSITA”) would have a bachelor’s degree in computer engineering, computer science, electrical engineering, mechanical engineering, or a similar field, and approximately three years of industry or academic experience in a field related to acoustics, speech recognition, speech detection, or signal processing. Work experience can substitute for formal education and additional formal education can substitute for work experience. *See* Pet. at 13.

VI. ARGUMENT

A. Legal Standard

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 skill in the art, and (4) where in evidence, so called secondary considerations. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). A claim is only unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented 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) (quoting 35 U.S.C. § 103).

“An invention is not obvious simply because all of the claimed limitations were known in the prior art at the time of the invention. Instead, we ask ‘whether there is a reason, suggestion, or motivation in the prior art that would lead one of ordinary skill in the art to combine the references, and that would also suggest a reasonable likelihood of success.’” *Forest Lab ’ys, LLC v. Sigmapharm Lab ’ys, LLC*, 918 F.3d 928, 934 (Fed. Cir. 2019). “Of course, concluding that the references are within the scope and content of the prior art to be considered for obviousness does not end the inquiry. *Graham* makes clear that the obviousness inquiry requires a

determination whether the claimed invention would have been obvious to a skilled artisan.” *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1050 n.14 (Fed. Cir. 2016).

“Although the *KSR* test is flexible, the Board ‘must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to how or why the references would be combined to produce the claimed invention.’” *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1066 (Fed. Cir. 2016) (citation omitted). Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)); accord *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (stating that “conclusory statements” amount to an “insufficient articulation[] of motivation to combine”; “instead, the finding must be supported by a ‘reasoned explanation’” (citation omitted)); *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016) (“To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.”).

B. GROUND 1: The Combination of Burnett '919 and Hussain Does Not Render Obvious Claims 1-2 and 5-7

1. Petitioner's Combination Does Not Disclose or Render Obvious "components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals," as Required by Claims 1-2 and 5-7

Petitioner's combination does not disclose or render obvious "components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals." The Petition relies on Hussain to meet this limitation, but Petitioner presents no evidence that Hussain discloses control signals generated from voice activity signals are used to automatically select a denoising method.

Claim 1 specifies that the "control signals" of this limitation are "automatically generated" by the "voice detection subsystem." '543 Patent, 24:3-7. Petitioner argues that the output of the EM sensor 1240 of Burnett '919 are voice activity signals. Pet., 15. These voice activity signals are input to a processor 1250 that outputs the claimed "control signal." *Id.*, 15-16. Petitioner argues that the processor's output is a control signal because it "controls the operation of amplifier and filter circuit 1224." *Id.* Alternatively, Petitioner argues that "a POSITA would have understood the above disclosure to require that Burnett '919's system

automatically generate control signals identifying the periods of no-speech and/or speech production.” Pet., 16.

Petitioner relies on Hussain to teach “automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals.” Pet., 23-25. Petitioner argues:

Hussain then selects the best processing method for each sub-band. (*Id.* 2612.) For example, for some sub-bands where little noise is present, “the signal in that band need not be modified.” (*Id.*) In other sub-bands, an adaptive noise cancellation method is employed. (*Id.*) ***Hussain discloses that the decision of which method is best for each sub-band is determined, at least in part, by the output of a VAD.*** (*Id.* (Hussain assumes “an effective voice activity detector (VAD) is available”); *id.* (disclosing a VAD algorithm and its use in “selecting the best SBP [sub-band processing] option”); Ex. 1002 ¶ 72.)

Pet., 25 (emphasis added). According to Petitioner, “Hussain therefore discloses using control signals (***from a VAD***) to automatically select at least one denoising method appropriate to data of at least one frequency sub-band of received acoustic signals, and processing the acoustic signals using the selected denoising method to generate denoised acoustic signals.” Pet., 25-26 (emphasis added).

The Petition is deficient because it identifies no evidence that Hussain uses control signals from a VAD to select a denoising method. While the Petitioner is

correct that a denoising method is selected and that a VAD is present in the system, the Petition—and Hussain—contain no evidence that the VAD is used in the selection process.

As discussed above, Hussain teaches “the use *of a modified MSC* as a part of a system for *selecting the best SBP option* in a [multi-microphone sub-band adaptive] speech enhancement system.” Hussain, 2612 (emphasis added). Hussain characterizes this modified MSC as “a robust practical metric,” *id.*, 2611, which is derived using the following equation to “determine[e] the level of correlation between the disturbing noises at various frequencies bands (by averaging the above MSC over each respective sub-band)”:

$$\overline{\text{MSC}}(f_k) = \frac{1}{l} \sum_{i=1}^l \text{MSC}(f_k, i)$$

Hussain, 2612-13.

Although Hussain explains that the point of novelty of his article is the use of an MSC “to automatically select the best SBP option,” Hussain, 2611, the Petition completely ignores—indeed, fails to ever mention—the MSC. Rather, the Petition makes the unsubstantiated assertion that Hussain “disclos[es] a VAD algorithm and its use in ‘selecting the best SBP [sub-band processing] option’); Ex. 1002 ¶ 72.)” Pet. 24. This is false. Hussain does not disclose a VAD algorithm, and the Petition

presents no evidence that it does. Even Petitioner's expert in the cited paragraph (72) of his declaration does not opine that Hussain discloses a VAD algorithm. Ex. 1003, ¶ 72. Moreover, Hussain does not disclose that the VAD is used for "selecting the best SBP option." Except for making the bare assertion and citing page 2612 of Hussain, Petitioner offers no evidence in support that the VAD is used to select an SBP option—because none exists.

Hussain teaches that the "control signal" that determines which denoising method to use is the MSC. Hussain uses the MSC to choose between using an "intermittent coherent noise canceller" and an "incoherent noise canceller." Hussain, 2612-13. Hussain discloses that "[o]n initial trials, a threshold value of 0.6 for the adaptive MSC has been found to be suitable for distinguishing between highly correlated and weakly correlated sub-band noise signals." Hussain, 2613. According to Hussain, an intermittent coherent noise canceller is used when the sub-band noise signals are highly correlated. Hussain, 2612 (stating that the intermittent coherent noise canceller is used "[i]f the noise power is significant and the noise between the two channels is *significantly correlated* in a sub-band.") (emphasis added). On the other hand, an incoherent noise canceller is used when noise power is weakly correlated between two channels in a sub-band. Hussain, 2612 (stating that the incoherent noise canceller is used "[i]f the noise power is significant but *not highly correlated* between the two channels in a sub-band.") (emphasis added). As such,

Hussain expressly teaches that the MSC is used to select between the denoising methods disclosed in Hussain. The Petition's assertion that "that the decision of which method is best for each sub-band is determined, at least in part, by the output of a VAD" is utterly unsupported by the Petition or Hussain and should be rejected.

Accordingly, the Petition is deficient because it presents no evidence that Hussain uses a VAD signal as a control signal to select a denoising method. Therefore, the Petition should not be instituted.

C. GROUND 2: The Combination of Burnett '919, Hussain, and Andrea Does Not Render Obvious Claims 1-2, 5-13, and 26

Petitioner adds Andrea to the combination of Burnett '919 and Hussain but does not contend that Andrea teaches "components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency subband of the acoustic signals using the control signals." Pet., 33-52. As discussed above, the Ground 1 combination does not render obvious this limitation.

Accordingly, no claims are rendered obvious under Ground 2.

D. GROUND 3: The Combination of "Ground 1 or 2 References" and Sasaki Does Not Render Obvious Claims 14-25

Ground 3 is directed to dependent claims 14-25, each of which depends on claim 1. Petitioner relies on its discussion of Grounds 1 and 2 to meet claim 1's

limitations. Pet. at 52. As discussed above, the Ground 1 combination does not render obvious claim 1.

Accordingly, no claims are rendered obvious under Ground 3.

E. GROUND 4: The Combination of “Ground 1 or 2 References” and Puthuff Does Not Render Obvious Claim 3

Ground 4 is directed to dependent claim 3, which depends on claim 1. Petitioner relies on its discussion of Grounds 1 and 2 to meet claim 1’s limitations. Pet. at 62. As discussed above, the Ground 1 combination does not render obvious claim 1.

Accordingly, no claims are rendered obvious under Ground 4.

F. GROUND 5: The Combination of “Ground 1 or 2 References” and Alcivar Does Not Render Obvious Claim 4

Ground 5 is directed to dependent claim 4, which depends on claim 1. Petitioner relies on its discussion of Grounds 1 and 2 to meet claim 1’s limitations. Pet. at 66. As discussed above, the Ground 1 combination does not render obvious claim 1.

Accordingly, no claims are rendered obvious under Ground 5.

VII. CONCLUSION

As discussed above, the Petition is deficient because it presents no evidence that Hussain teaches “components of the denoising subsystem automatically selecting at least one denoising method appropriate to data of at least one frequency

subband of the acoustic signals using the control signals.” The Board should, therefore, deny institution of the Petition.

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S PRELIMINARY RESPONSE specified in 37 C.F.R. § 42.24 has 3,382 words in compliance with the 14,000-word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

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A copy of the foregoing Patent Owner's Preliminary Response has been served on Petitioner's counsel of record as follows:

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