

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

Case IPR2023-00335
U.S. Patent No. 10,894,503 B2

**PETITIONER VOLKSWAGEN GROUP OF AMERICA, INC.’S REPLY TO
PATENT OWNER RESPONSE**

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PETITIONER’S UPDATED EXHIBIT LIST

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1001	U.S. Patent No. 10,894,503 B2 to Spero (“the ’503 patent”)
1002	File History of U.S. Patent No. 10,894,503 B2 (“Prosecution History”)
1003	Declaration of Dr. Jianzhong Jiao (“Jiao Decl.”) in support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,894,503
1004	<i>Curriculum Vitae</i> of Dr. Jianzhong Jiao
1005	U.S. Patent No. 6,144,158 to Beam
1006	U.S. Patent Publication No. 2001/0019486 to Thominet
1007	WIPO Patent Publication No. 2001/070538 to Stam <i>et al.</i>
1008	U.S. Patent No. 6,049,749 to Kobayashi
1009	WIPO Patent Publication No. 2002/004247 to Braun <i>et al.</i>
1010	WIPO Patent Publication No. 1998/054030 to Karlsson
1011	WIPO Patent Publication No. 2001/001038 to Harbers <i>et al.</i>
1012	U.S. Patent No. 5,588,733 to Gotou
1013	WIPO Patent Publication No. 1986/005147 to Flaaten
1014	U.S. Patent No. 5,707,129 to Kobayashi
1015	Westermann, “History and Scientific Back-up,” 48 th Session of GRE, EUREKA Project 1403, Informal Document No. 30, April 30, 2002
1016	“Adaptive Front Lighting Systems (AFS),” 48 th Session of GRE, EUREKA Project 1403, Informal Document No. 28, April 12, 2002
1017	Hogrefe <i>et al.</i> , “Adaptive Light Pattern – A New Way to Improve Light Quality,” SAE Transactions, Vol. 106, No. 6, pp. 1-10, February 27, 1997
1018	Löwenau <i>et al.</i> , “Adaptive Light Control – A New Light Concept Controlled by Vehicle Dynamics and Navigation, SAE Transactions, Vol. 107, No. 6, pp. 31-36, February 26, 1998
1019	Manassero <i>et al.</i> , “Adaptive Headlamp: A contribution for Design and Development of Motorway Light,” SAE Transactions, Vol. 107, No. 6, pp. 1-6, February 26, 1998
1020	Michael Hamm, “System Strategies for Adaptive Lighting Systems,” 2001 Symposium: Progress in Automobile Lighting (PAL), pp. 368-380, September 26, 2001
1021	U.S. Patent Publication No. 2013/0258688 to Kalapodas
1022	<i>Intentionally Left Blank</i>

Exhibit #	Description
1023	Manassero et al., Adaptive Lighting Systems: Technical Solutions and Methodological Approach for Photometric Specifications, Progress in Automotive Lighting Vol. 6, pp. 514-525 (1999).
1024	Hanno Westermann, Lighting Performance Requirements in Vehicle Lighting Exemplified by System Requirements for AFS, Progress in Automotive Lighting Vol. 6, pp. 807-820 (1999).
1025	Diem et al., Analysis of the Eye-Movement Behaviour During Use Moveable Headlamps, Progress in Automotive Lighting Vol. 5, pp. 185-207 (1999).
1026	Kobayashi & Sugimoto, Development of the Phase-I AFS Front Lighting System, Progress in Automotive Lighting Vol. 5, pp. 449-464 (1999).
1027	<i>Intentionally Left Blank</i>
1028	Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999).
1029	<i>Intentionally Left Blank</i>
1030	Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005)
1031	<i>Intentionally Left Blank</i>
1032	First Amended Complaint, Torchlight Techs. LLC v. Daimler AG, et al., Civil Action No. 1:22-cv-00751 (D. Del.), filed August 26, 2022 (ECF No. 24)
1033	File History of Ex Parte Reexamination of U.S. Patent No. 9,955,551, Control No. 90/014,815
1034	<i>Intentionally Left Blank</i>
1035	United States District Courts – National Judicial Caseload Profile, June 2022
1036	U.S. Patent No. 5,523,193 to Nelson
1037	U.S. Patent No. 5,537,433 to Watanabe
1038	U.S. Patent No. 4,662,746 to Hornbeck
1039	U.S. Patent No. 5,061,049 to Hornbeck
1040	U.S. Patent No. 5,933,183 to Enomoto <i>et al.</i>
1041	<i>Intentionally Left Blank</i>
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1050	<i>Intentionally Left Blank</i>
1051	Supplemental Declaration of Dr. Jianzhong Jiao
1052	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2023-00335 regarding U.S. Patent No. 10,894,503
1053	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2023-00315 regarding U.S. Patent No. 9,955,551
1054	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2022-01586 regarding U.S. Patent No. 11,208,029
1055	<i>Intentionally Left Blank</i>
1056	Moddel, G., Spatial Light Modulators: Processing Light in Real Time, <i>Optics and Photonics News</i> , pp. 17-21 (March 1997)
1057	U.S. Patent No. 6,132,072 to Turnbull et al.
1058	U.S. Patent No. 5,754,217 to Allen
1059	U.S. Patent No. 6,195,136 to Handschy et al.
1060	<i>Intentionally Left Blank</i>
1061	<i>Intentionally Left Blank</i>
1062	U.S. Patent No. 4,907,044 to Schellhorn et al.
1063	Leighty, et al., “Developing Technologies for Army Autonomous Land Vehicles (U),” Army Engineer Topographic Labs, Fort Belvoir, October 1985 (accessible online at https://apps.dtic.mil/sti/tr/pdf/ADA187972.pdf , last accessed October 30, 2023)
1064	Lowrie, et al., “The Autonomous Land Vehicle (ALV) Preliminary Road-Following Demonstration,” Proceedings of SPIE, Vol. 579 Intelligent Robot and Computer Vision, 1985 (accessible at https://home.ttic.edu/~mturk/pubs/ALVpreliminary-SPIE1985.pdf , last accessed October 30, 2023)
1065	Surface Vehicle Recommended Practice, SAE International, J1383, May 2018

Exhibit #	Description
1066	Standard No. 108; Lamps, reflective devices, and associated equipment, 49 C.F.R. § 571.108 (November 3, 2023)
1067	Terminology: Motor Vehicle Lighting, SAE J387, November 1987
1068	“The International System of Units (SI),” Bureau International des Poids et Mesures, 7th Edition (1998) (Excerpt)
1069	Surface Vehicle Standard: Color Specification, SAE International, J578, February 2019
1070	Second Declaration of Matthew A. Turk, Ph.D. in IPR2023-00315 regarding U.S. Patent No. 9,955,551

I. INTRODUCTION

Petitioner’s clear, compelling prior art combinations presented in the Petition and confirmed by undisputed expert Dr. Jiao showed all challenged claims are unpatentable. Patent Owner’s (“PO”) Response relies on unsound, uninformed testimony from Dr. Turk—who is not even a person of ordinary skill in the art (“POSA”)—manufacturing shortcomings that do not exist in the art or combinations. It is not difficult to see through PO’s attempt to muddy the waters.

First, alleging “particularity” deficiencies in the Petition that the Board already dismissed, DI, 14-15, PO’s arguments distract from the grounds presented clearly on the record. Second, PO’s scattershot technical arguments mischaracterize the art, misinterpret claim language, and misunderstand what a POSA would have understood. PO’s reliance on their non-expert, non-POSA declarant, Dr. Turk, compounds these errors. PO relies on Dr. Turk’s fundamental misunderstandings of and lack of knowledge of the relevant headlight technology that the parties agree applies here.

All of PO’s arguments fail. Indeed, contrary to PO’s assertions, the Beam-Thominet and Karlsson-Harbers grounds disclose illumination for first and second subsections relative to a predefined threshold, as explained in the Petition. And it would have been obvious to a POSA to make the simple substitution of a curved light/LED substrate for a flat substrate as the Petition explained. Finally, the

combination of Kobayashi and Gotou in the Beam-Thominet and Karlsson-Harbers grounds, respectively, renders the road curvature dependent claims obvious.

II. DR. TURK IS NOT AN EXPERT AND HIS TESTIMONY SHOULD HAVE NO WEIGHT.

Dr. Turk’s declarations (EX2001, EX2006) should be excluded or accorded no weight because he is not a POSA. The parties and Board agree that a POSA would have *two years of industry experience in the area of automotive lighting and lighting-control systems*. DI, 7; Pet., 6; POR, 20; EX1051, ¶¶10-49. Dr. Turk accepted this definition (EX1053, 23:7-19), but does not meet it (and never has).

Only qualified experts can testify about issues of claim construction and validity. *HVLPO2, LLC v. Oxygen Frog, LLC*, 949 F.3d 685, 689 (Fed. Cir. 2020); *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1361 and n.3 (Fed. Cir. 2008). This extends to “ultimate conclusions” on those issues and to “underlying technical” determinations. *HVLOP2*, 949 F.3d at 689; *Sundance*, 550 F.3d at 1363 (“abuse of discretion to permit a witness to testify as an expert on the issues” from the perspective of a POSA “unless that witness is qualified as an expert in the pertinent art.”).

“To offer expert testimony from the perspective of a skilled artisan in a patent case—like for claim construction, validity, or infringement—a witness must at least have ordinary skill in the art. Without that skill, the witness’ opinions are

neither relevant nor reliable.”¹ *Kyocera Senco Indus. Tools v. Int’l Trade Comm’n*, 22 F.4th 1369, 1375-77 (Fed. Cir. 2022); *Sundance* 550 F.3d at 1363-64.

Dr. Turk is not a POSA (EX1051, ¶¶11-49) and cannot testify on issues of claim construction or validity. There is no genuine dispute that Dr. Turk lacks “2 years of industry experience in the area of automotive lighting and lighting-control systems.” Pet., 6. Dr. Turk’s industry experience relates to “computer vision methods for recognizing human faces, gestures, and activity.” EX2006, ¶12. The closest “bit” of relevant experience Dr. Turk identified was at Martin Marietta (EX1054, 53:4–25), working on “computer vision for autonomous vehicle navigation,” not automotive lighting and lighting-control. EX2006, ¶12; EX1051, ¶¶41-49. Dr. Turk did not work on any type of headlight control, much less adaptive headlight control as claimed here. There is no evidence that Dr. Turk has any requisite “industry experience in the area of automotive lighting and lighting-control systems” required of a POSA. Pet., 6; EX1051, ¶¶41-50.

Petitioner’s expert, Dr. Jiao’s, industry experience starkly contrasts Dr. Turk’s. EX1051, ¶¶32-40; EX1003, ¶¶9-20 (discussing Dr. Jiao’s decades of experience in “adaptive front-lighting system (AFS) technologies.”). As an unquestioned expert in the field—confirmed by PO’s Dr. Turk (EX1054, 58:9-19,

¹ Emphasis added unless noted.

59:16-19)— Dr. Jiao opines that Dr. Turk lacks the requisite industry experience required of a POSA. EX1051, ¶¶41-49. For example, Dr. Jiao testified that a POSA would know that “intensity,” in the context of automotive lighting, includes direction and is not synonymous with “brightness,” which Dr. Turk does not understand. EX1051, ¶¶13-16. Dr. Jiao also confirms that Dr. Turk does not understand other concepts known to a POSA: basic terms (e.g., “beam pattern”), glare reduction standards, using zero emission light to reduce glare, and other concepts. EX1051, ¶¶17-28. Dr. Turk does not understand how a POSA would measure, e.g., intensity (in development or under regulations) and is not familiar with leading consortiums or conferences. EX1051, ¶¶13-28.

Notably, Dr. Turk has never worked for a vehicle headlight company, an LED (or other light source) company, or a general lighting company; never designed a vehicle forward lighting system; and has no patents, awards, or papers for vehicle forward lighting. EX1054, 52:18-53:1, 54:24-56:12; EX1051, ¶¶41-49.

Dr. Turk was also unable to answer questions that a POSA would have been able to answer about adjusting headlight patterns for different driving conditions. For example, when asked: “Would a person skilled in the art want to adapt the light intensity of the headlamp on an illuminated urban road differently from an unilluminated country road,” Dr. Turk replied, “[i]n general, *I don’t know what a*

person of ordinary skill in the art wants to do.” EX1052, 126:6-15, *see also* 65:15-25, 66:20-25, 78:18-25, 79:25-80:7, 108:5-11, 114:24-115:7, 141:6-12.

PO may try to rehabilitate Dr. Turk’s qualifications, but the law dictates he cannot meet the POSA requirement. His industry experience “in the area of automotive lighting and lighting-control systems,” Pet., 6, if any, merely amounts to “vague reference[s]” that “fall[] short of establishing two years of ... work experience” and should be “given no weight,” *Avail Medsystems, Inc. v. Teladoc Health, Inc.*, IPR2022-00444, Paper 10, 24, 26 (P.T.A.B. July 21, 2022); *id.*, 24–26 (citing *Kyocera*, 22 F.4th, 1375–78).

III. PO’S “PARTICULARITY” ARGUMENT IS MERITLESS.

Having no credible missing element arguments and facing the reference-supported rationales that a POSA would have to combine conventional prior art elements, PO attempts to re-cast Petitioner’s simple case of unpatentability as unclear.

There are only two sets of grounds here based on: (1) Beam-Thominet, and (2) Karlsson-Harbers. Pet., 3. The Board should confirm its finding of sufficient particularity. DI, 14-15.

Despite the Board’s understanding of the combinations, PO doubles down on its theory that the Petition provided numerous “sub-grounds.” POR, 20-33. Distracting from the merits, PO artificially creates forty-seven “Sub-Grounds.”

POR, 30-31. In doing so, PO conflates independent reasons—*from the prior art*—why the '503 patent claims are unpatentable.

IV. PO'S ARGUMENTS AGAINST THE BEAM-THOMINET AND BEAM-THOMINET-STAM COMBINATIONS FAIL.

The Board should reaffirm its Institution Decision finding and reject PO's arguments against the Beam-Thominet and Beam-Thominet-Stam combinations, which are substantially similar to the POPR. *Compare* POPR, 30-34, *with* POR, 33-35, 50-52; DI, 9-11. The POR does not cure the flaws of the POPR. EX1051, ¶¶60-121.

A. Beam's headlight system includes a processor "determin[ing] an illumination for at least two of the sub-sections" and "adapt[ing] the light emitted from one or more of the light clusters" [1.8-1.10].

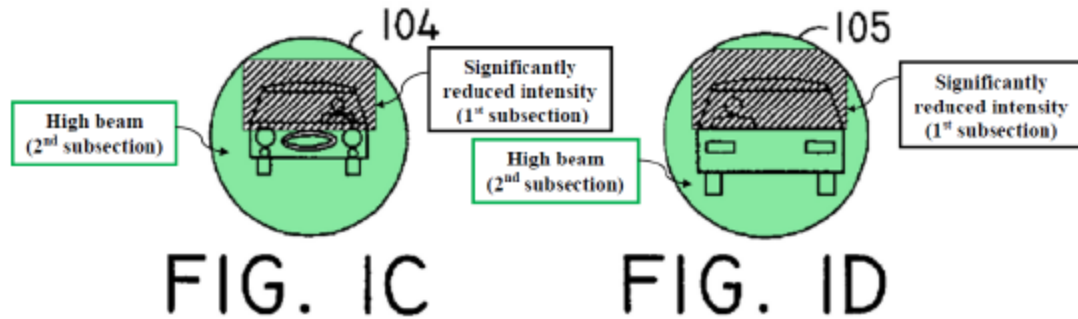
When dimming areas that include detected vehicles (e.g., the two sub-sections), Beam's controller determines illumination for at least those two sub-sections and adapts light emitted from its clusters, contrary to PO/Dr. Turk's assertions. DI, 13; EX1005, 6:30-33; Pet., 28-34; EX1003, ¶¶191-202; POR, 33-35; EX2006, ¶¶130-131. Beam's controller determines illuminating the two subsections at a level significantly less than low-beams. EX1005, 2:66-3:1; Pet., 28-34; EX1003, ¶¶193-202. After determining sub-sections to dim based on sensor data, Beam's controller determines individual microbeams to attenuate to appropriately illuminate sub-sections. EX1005, 4:16-19; Pet., 58-61. A POSA would have understood that Beam's attenuation to reduce glare includes the

preceding processing steps of determining illumination for at least two subsections and adapting light from the one or more light clusters (lamp/LED + SLM).

EX1051, ¶¶62-65; Pet., 28-34.

B. Beam-Thominet-Steam discloses “substantially illuminat[ing] a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value” [37.8].

Dr. Turk fails to understand that Beam’s operation is not “binary” (his term) (POR, 51-52; EX2006, ¶¶183-184). Beam’s attenuated/dimmed areas with detected vehicles are still illuminated, but “reduced significantly” compared to remaining areas of the field-of-view. EX1005, 4:19-25; EX1051, ¶¶66-68; EX1003, ¶¶268-280. Beam describes that “the area of the beam that would dazzle the driver will be darkened,” but it is not completely dark. EX1005, 2:60-61 EX1051, ¶331. Contrary to PO’s assertions (POR, 51-52), a POSA would have understood that dimmed areas of reduced intensity in Beam’s Figures 1C-1D are not devoid of illumination. EX1051, ¶68; EX1003, ¶¶330-332. Regardless, Stam’s “threshold” for preventing glare with Beam-Thominet would have resulted in *illuminating* Beam’s first subsection below a predefined illuminance. Pet., 54-63; EX1003, ¶69.



EX1005, FIGS. 1C-1D (annotated).

EX1005, FIGS. 1C-1D (annotations from Pet., 60).

C. A POSA would have been motivated to combine Thominet’s multi-function beam segments with Beam’s adaptive headlights.

PO incorrectly alleges Thominet would: (1) conflict with Beam’s anti-glare objective, (2) diminish Beam’s forward illumination, and (3) clash with Beam’s system. POR, 38; EX1051, ¶¶74-75.

1. Beam’s and Thominet’s headlight control systems are fully compatible.

Beam does not suggest to a POSA that it *cannot increase light in a direction* by emitting a “beam [that] is at full intensity except in the areas that would dazzle a driver ahead.” EX1005, 4:57-59; EX1051, ¶76. But PO/Dr. Turk misunderstand Beam in reaching their illogical conclusion that Thominet’s multiple directional beam regions conflict with Beam’s anti-glare operation. EX2006, ¶154, 164-168, 217; POR, 45-47, 57-58.

Dr. Jiao confirms that Beam’s system includes at least *both* low and high-beams achieved by its microbeams. EX1051, ¶¶77-80. A POSA would have

understood that Beam’s microbeams *must* be able to change direction to achieve these beam patterns, which by definition are *aimed in different directions*. EX1051, ¶¶77-80; EX2010, 237; EX2012, 8, FIGS. 11A-11B; EX2013, 7. A POSA would thus understand that Beam *controls intensity including angular position* to a maximum desired in a given direction—not “full blast” everywhere at all times. EX1051, ¶¶77-84.

Beam “*control[s] the intensity, and/or the angular position,*” of its LEDs, configured as “an array of individual, independently controllable microbeam sources.” EX1005, Abstract, 8:4-17, 2:53-3:3, 4:9-59, claims 4 and 5; EX1003, ¶¶75-84. This control is “*dynamically varying in position and in size,*” in response to control inputs. EX1005, 6:24-27, 5:46-54. Beam adapts headlight patterns in intensity *and* spatial distribution. Pet., 8-10, 24; EX1003, ¶129; EX1051, ¶¶77-84. Thus, Beam’s headlight patterns include *directionality*.

Accordingly, Beam-Thominet provides a more direct, active, headlight beam “specifically aimed for different functions.” EX1003, ¶126; Pet., 10-15; EX1051, ¶¶83-84.

2. Beam-Thominet’s headlight provides sufficient forward illumination by actively directing beam segments for particular driving functions.

PO’s is wrong that Thominet would “compromise” Beam’s headlight from providing “sufficient forward illumination.” POR, 41-42, 48-50; EX1051, ¶85.

Dr. Jiao explained that employing “multiple beam regions (clusters), as in Thominet,” with Beam’s system would have provided “different spatial distributions for different driving situations beyond reducing glare for drivers.” EX1003, ¶129. This system is “more direct, or active, or specifically aimed for different functions.” EX1003, ¶126. Beam-Thominet’s headlight distributes light to where illumination is desired according to the particular driving function—not somehow made worse as PO/Dr. Turk contend. POR, 41-42; EX1003, ¶126; EX1051, ¶¶86-90. Beam itself describes adjusting the beam’s spatial distribution “for conditions like rain, snow, or fog,” as Dr. Jiao’s First Declaration explained. EX1005, 3:29-36; EX1003, ¶126; EX1051, ¶89.

3. Beam’s lamp/LED/SLM controls the angular position of each microbeam according to achieve different headlight beam patterns.

Beam’s SLM adjusts the angular position of its microbeams, contrary to PO/Dr. Turk’s position. POR, 43-45, 47-50; EX2006, ¶¶65-66. Indeed, Beam’s SLM controls the microbeams’ angular positions/intensities via command signals. EX1051, ¶¶91-93; EX1005, 4:45-57. Dr. Jiao confirmed that a POSA would have understood to “simply modify[] software instructions in memory of Beam’s controller/processor to organize Beam’s array of microbeams into multiple beam regions (clusters)” taught by Thominet. EX1003, ¶131; Pet., 29-30.

D. A POSA would have been motivated to combine Thominet’s curved substrate with Beam’s LED array.

As one reason for combination, Petitioner explained that mounting Beam’s LEDs on a curved surface—as known in Thominet— would “ improv[e] visibility and thereby safety.” Pet., 13-15; EX1003, ¶¶133-139.

In response to Dr. Turk’s unsupported argument (EX2006, ¶¶170-172), a POSA seeking to improve driver visibility by modifying headlights—explained in Dr. Jiao’s First Declaration (EX1003, ¶¶133-139)—would have known curved substrates enhance the headlight’s optical performance, for example, by minimizing distortion. EX1051, ¶¶70-73.

Furthermore, no “additional” rationale is required. *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-1381 (Fed. Cir. 2023) (substituting one known technique for another does not require showing “‘improvement’ in a categorical sense,” so long as the known technique is a “suitable option” for addressing the same problem). Thominet described two known techniques—flat/curved substrate—for generating headlight beams with different spatial distributions. Because Thominet’s curved substrate is a suitable option, the Petition’s explanation is sufficient. Pet., 10-17; EX1003, ¶¶133-139; EX1051, ¶¶70-73; *Ethicon LLC v. Intuitive Surgical, Inc.*, No. 2020-1528, 2021 WL 3716397, at *7 (Fed. Cir. Aug. 23, 2021); *Ethicon LLC v. Intuitive Surgical, Inc.*, Nos. 2021-1995, 2021-1997, 2022 WL 1613188 (Fed. Cir. May 23, 2022).

E. PO's arguments against the dependent claims fail.

1. Beam's headlight system includes a "plurality of light clusters" and a "light modifying element" (claims 2-4 and 42-44).

PO/Dr. Turk do not dispute Beam's SLM is a "light modifying element" including "reflectors" (claims 2-4, 42-44). Rather, PO/Dr. Turk allege Beam fails to disclose "light clusters" combined with a "light modifying element" based on their misunderstanding that Beam's headlight system does not include both an LED array and SLM. POR, 35-36, 54-55; EX2006, ¶¶134-135.

This is demonstrably false, exemplified by Beam's claim 4, which includes both. EX1005, 8:3-12; Pet., 34-42, 71; EX1003, ¶¶203-213. Dr. Turk acknowledges claim 4 specifically provides "both an array of LEDs and a spatial light modulator." EX1054, 90:17-91:8; EX1051, ¶94; Pet., 34-42, 71; DI, 12.

Beam's beam pattern can contain hundreds of thousands of individual, narrow angle microbeams. EX1005, 4:41-45. Of course, Dr. Turk acknowledged Beam would not include 300,000 LEDs (EX1054, 101:4-102:15); rather, an SLM would be included. EX1051, ¶¶94-95. Beam's microbeams are "diverted or attenuated" (EX1005, 5:65-66) which a POSA would understand means, for example, changed direction or dimmed. EX1051, ¶¶94-95. A POSA would not conflate these concepts, as Dr. Turk did. When asked whether "angular position" is the same as "attenuation" in Beam, he responded (wrongly) that "the angular

position of each microbeam is equated to the attenuation of each microbeam.”

EX1054, 94:21-96:12; EX1051, ¶¶95.

The Petition explained a POSA would have understood that Beam’s optical system 106 is a “light modifying element” “provided in the path of light” emitted from Beam’s lamp/LEDs and controls “light-source characteristics.” Pet., 37, 42, 71; EX1003, 212-214, 221-222; EX1005, 5:17-21; EX1051, ¶¶94-95. Beam’s optical system 106, with either lamp 201 or LEDs 401, discloses the “light modifying element.”

2. Beam-Thominet’s headlight system illuminates two sub-sections with a different color (claims 5/45).

PO/Dr. Turk improperly attack the references individually, arguing Beam-Thominet does not include colored LEDs and software to illuminate two sub-sections with a different color. POR, 36-37, 56-57; EX2006, ¶¶142-143.

Thominet’s light sources form beam regions 22/24/26/28 to “emit light of different colors” and/or “a mixture of colors.” EX1006, ¶¶5, 26-29; Pet., 43-44; EX1003, ¶225. Dr. Jiao explained that a POSA would have sought to incorporate “Thominet’s colored semiconductor light sources 10” into Beam’s system “to automatically *provide different colored spatial distributions* for improved visibility in different driving situations.” EX1003, ¶¶229-231; Pet., 43-44. Beam-Thominet’s headlight system includes multi-colored LEDs selectively controlled to *illuminate*

two-subsections with a different color “for improved visibility in different driving situations.” EX1003, ¶229; EX1051, ¶¶96-98; Pet., 43-44.

3. Beam’s headlight system uses a processor “to identify” vehicles (claims 11/50).

PO/Dr. Turk mischaracterize Beam as having “no ability to associate detected light with a particular target,” POR, 38; EX2006, ¶¶151-152, incorrectly concluding Beam’s processor cannot “identify” vehicles.

Dr. Jiao confirms a POSA would have understood Beam’s controller *does distinguish* between light sources, filtering weak signals. EX1005, 5:34-36 (spatial scene data is “thresholded” to eliminate weak signals, becomes processor input); EX1051, ¶¶99-100. Beam’s filtering technique separates lights detected by the sensor into two classes: those that reflect/emit light above the threshold, and those that do not reflect/emit sufficient light. Pet., 47-48; EX1051, ¶100. Beam’s controller thus distinguishes between stronger light sources (e.g., headlights) and ambient light sources (e.g., street sign reflections). Pet., 47-48; EX1051, ¶100. Accordingly, Beam’s controller *identifies* vehicles.

4. Beam’s headlight system’s processor determines “at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle” (claim 38).

PO/Dr. Turk impermissibly add limitations absent from the ’503 patent claims, arguing Beam “cannot determine that those [detected] sources [of light] are or are not associated with a vehicle.” POR, 52; EX2006, ¶¶187-189. Yet Dr. Turk

acknowledged this is not required. EX1051, ¶¶101-104; EX1001, 98:10:-14; EX1052, 40:11-13 (“I don’t think there’s anything in this claim that specifies how that vehicle was detected.”).

Beam’s headlight system processor processes sensor data to determine a first subsection including a detected vehicle. EX1005, 6:14-19, 8:18-28; Pet., 43-45; EX1003, ¶¶184-185; EX1051, ¶¶101-105. Furthermore, as explained in §IV.E.3, Beam’s controller *does* distinguish between light sources by filtering weak signals. EX1005, 5:34-36. Thus, Beam meets even PO’s/Dr. Turk’s re-written claim. Pet., 43; EX1051, ¶105.

5. Beam’s headlight system illuminates two sub-sections with “different illumination characteristics” (claims 39-41).

PO/Dr. Turk again mischaracterize Beam’s anti-glare controls as a “binary system” with an “absence of light” in dimmed areas; they then allege dimmed areas do not include “different illumination characteristics.” POR, 53; EX2006, ¶¶191-193.

Dr. Turk fails to recognize that the attenuated/dimmed area is still illuminated, but “reduced significantly” compared to remaining areas. EX1005, 4:19-25; EX1051, ¶¶106-107. A POSA would have understood “reduced significantly” includes intermediate illumination values, not solely zero illumination. EX1051, ¶¶107.

6. Beam’s headlight system includes “reflectors, refractors, or lens[es] usable to alter the light” (claims 19/58).

Beam discloses “reflectors, refractors, or lenses usable to alter the light emitted from at least one of the light sources” in claim 19 and “patentably indistinct” claim 58. Pet., 53, 74.

Claim 58 merely adds “as part of the instructed operation.” EX1001, 97:54-57 (claim 19), 102:9-14 (claim 58). The Petition demonstrated Beam’s SLM includes “digital mirror devices” controlled to alter light “as part of the instructed operation” by Beam’s controller. Pet., 53, 74; EX1003, ¶¶265-267; EX1051, ¶¶108-109.

V. PO’S ARGUMENTS AGAINST THE BEAM-THOMINET-KOBAYASHI AND BEAM-THOMINET-STAM-KOBAYASHI COMBINATIONS FAIL (CLAIMS 9, 15-17, 49, 54-56).

PO/Dr. Turk base their arguments against Beam-Thominet-Kobayashi/Beam-Thominet-Stam-Kobayashi on the same misunderstanding (*supra* §IV.C.1) that Beam’s “maximum intensity” does not include direction. POR, 57-60; EX2006, ¶¶215-223. As Dr. Jiao explains (EX1051, ¶¶110-117), PO/Dr. Turk incorrectly conclude “there would be no reason to increase light or provide the ability to change the direction of microbeams.” POR, 58; EX2006, ¶217.

Beam states that *angular position* or *attenuation* “of each of these microbeams is independently set by controller 108,” in a dynamic environment of moving vehicles. EX1005, 4:46-52; EX1051, ¶¶111-115; EX1003, ¶¶419-433;

Pet., 18. “Beam’s control is ‘*dynamically varying* in position and in size,’ in response to the control input.” Pet., 18 (citing EX1005, 5:46-54, 6:24-27); EX1003, ¶¶419-433; EX1051, ¶¶111-115. Thus, Beam’s headlights change the direction of microbeams to form beam patterns. EX1051, ¶¶110-117.

A POSA would have been motivated to modify Beam-Thominet/Beam-Thominet-Stam to adjust light clusters to increase illumination of a road curvature/turn (e.g., “increas[ing] illumination in a direction of the road curvature” (claims 15/54); “increasing illumination illuminating the turn” (claims 16/17/55/56)) using map data, as in Kobayashi, to improve driver safety. Pet., 74-86; EX1003, ¶¶310-313; EX1008, 14:53-15:28.

VI. PO’S ARGUMENTS AGAINST THE BEAM-THOMINET-BRAUN AND BEAM-THOMINET-STAM-BRAUN COMBINATIONS FAIL.

Dr. Turk’s assertion that “there were no ‘predictable solutions’” for combining Braun’s “luxels” (light providing regions) with Beam’s modified headlight system further confirms his lack of understanding. EX2006, ¶240; POR, 61-63; EX1051, ¶¶118-121.

Dr. Jiao confirmed that “modifying Beam’s array of light sources 401” with “Braun’s array of colored luxels 26” to “provide colored light sources” would have been “routine and well within a POSA’s skill.” EX1003, ¶515. Braun and Beam both disclose using LEDs. EX1003, ¶515. Braun’s luxels were already

implemented in a glare-preventing “adaptive illumination” headlight system.

EX1003, ¶528; EX1009, 6:4-8.

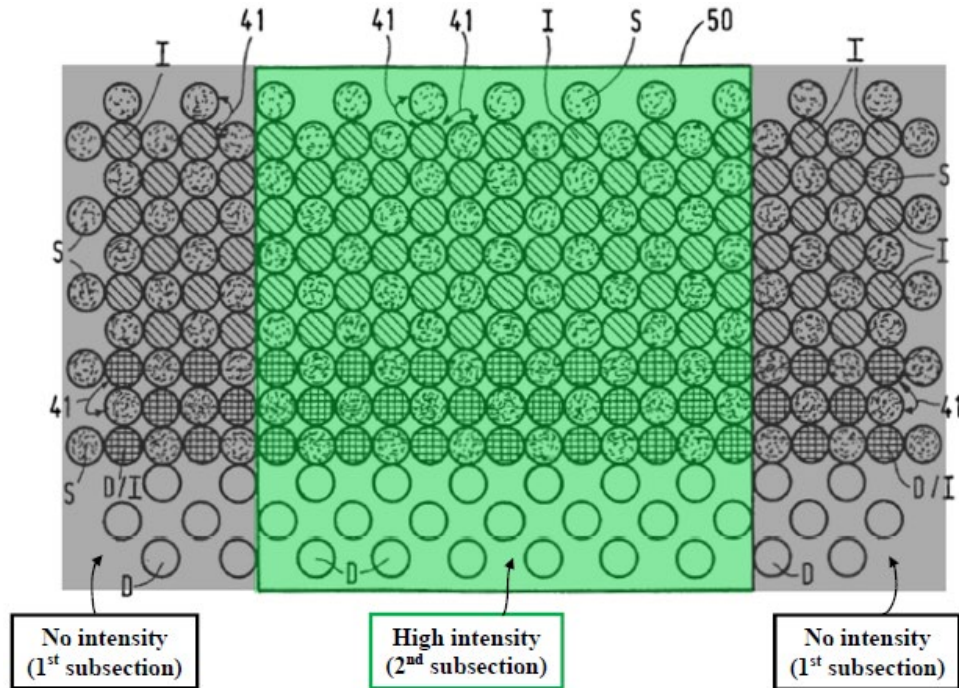
Given these similarities, combining Braun’s teachings with Beam-Thominet-Stam would have predictably yielded “different colored spatial distributions for different situations.” EX1003, ¶514; EX1051, ¶¶118-121.

VII. PO’S ARGUMENTS AGAINST THE KARLSSON-HARBERS COMBINATION FAIL.

The Board should reaffirm its Institution Decision finding and reject PO’s arguments against the Karlsson-Harbers combination, which are substantially similar to the POPR. *Compare* POPR, 37-42, *with* POR, 64-74; DI, 11-12. The POR does not cure the flaws of the POPR.

A. Karlsson’s headlight system includes a processor determining “an illumination” [1.8-1.9] and “a light distribution pattern” [37.7-37.8] for at least two sub-sections.

PO/Dr. Turk fail to understand Karlsson’s Figure 14, incorrectly concluding “Karlsson does not teach determining illumination for either of the alleged shaded areas of no intensity.” EX2006, ¶253, ¶¶248-252; POR, 64-66. PO is wrong. EX1010, 9:6-26, 14:1-15; Pet., 94-95, 115-120; EX1003, ¶¶542-46; 631-643; EX1051, ¶¶122-129.



EX1010, FIG. 14 (annotations from EX1003, ¶481).

Karlsson’s disclosure supports Petitioner’s annotated Figure 14, showing LEDs corresponding to first and second subsections. Pet., 94-95, 115-120; EX1003, ¶¶542-46, 631-643; DI, 12.

Karlsson’s controller receives inputs from light-sensitive sensors for detecting “light from oncoming traffic.” EX1010, 5:17, 14:1-15, 9:9-26; Pet., 108-109; EX1003, ¶¶609-611. It then adjusts “the pattern and the intensity of the light beam” such that “no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor.” EX1010, 9:18-23. Karlsson’s controller “switch[es] one or more of the spotlight beams 34 on and/or off” or “adapt[s] the intensity of the light emitted by [the] spotlight

beam[s].” EX1010, 13:31-36. The switching/dimming of spotlight beams allows headlight beam 50 to “shift” and change “shape” for the “desired pattern and direction.” EX1010, 19:29-34. Using this illumination scheme, Karlsson determines illumination/light distribution pattern for first and second subsections. Pet., 115-120; EX1003, ¶¶622-643; EX1051, ¶¶123-129.

As Dr. Jiao confirmed, Karlsson’s example of dimmed LEDs outside of beam 50 correspond to subsections with detected vehicle headlights. EX1003, ¶¶478-482; EX1051, ¶128. And, for example, Karlsson’s beam 50 corresponds to a subsection where vehicle headlights are *not* detected. EX1003, ¶¶622-643; EX1051, ¶128.

B. Karlsson discloses a headlight system with a processor determining “subsections determined in response to sensor data” [1.4] and sensors indicating “a second vehicle within the field of view” [37.6].

PO/Dr. Turk ignore pertinent sections of the Petition and Karlsson when alleging Karlsson’s light-sensitive sensor 9/23 is not used to determine subsections indicating a second vehicle. POR, 66-68; EX2006, ¶¶262-263.

The Petition cites several sections of Karlsson demonstrating that Karlsson’s light-sensitive sensor indicates “oncoming traffic” to controller 14. Pet., 108 (citing EX1010, 5:16-32, 9:9-17, 15:16-32, 14:1-15), 109, 115-116; EX1003, ¶¶605-611, 618-621. Karlsson’s controller uses the “light from oncoming traffic...*as a parameter*” to adjust the “emitted light beam.” EX1010, 5:13-15, 5:28-32.

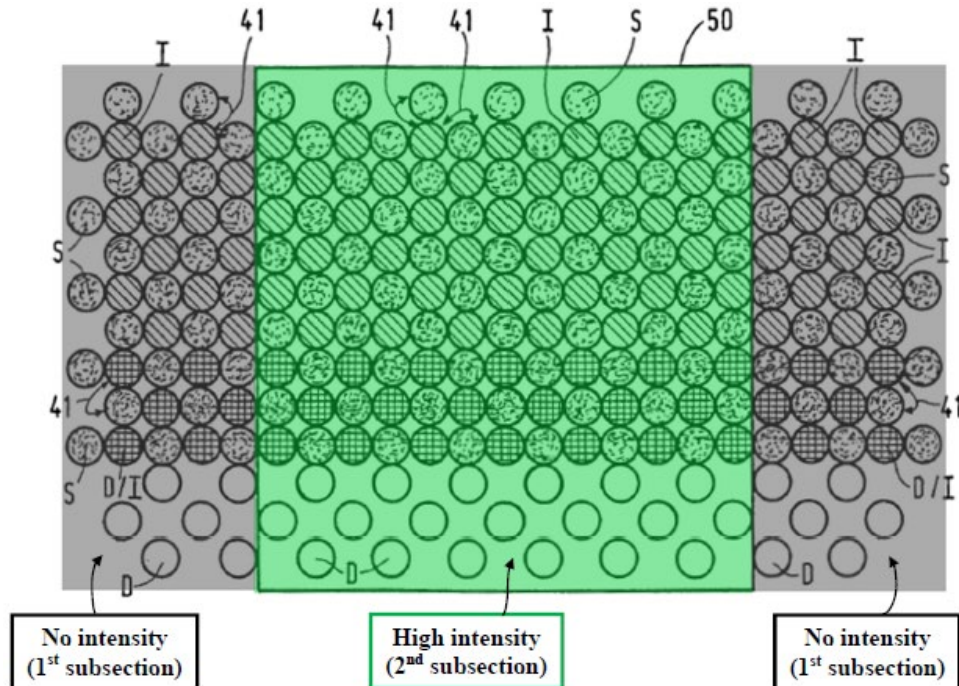
Karlsson’s controller “automatically and dynamically adapt[s]” the “pattern of the light beam” such that “part of the light beam which might cause inconvenience to oncoming traffic is automatically suppressed.” EX1010, 2:4-9. A POSA would have understood that Karlsson’s controller determines a sub-section based on “sensor data,” using detected traffic light “as a parameter” for adjusting the beam. EX1010, 5:13-32; EX1051, ¶¶130-131.

C. Karlsson’s headlight system discloses illuminating “one” of the second sub-sections “above the predefined threshold value” [37.9].

Claim 37 recites “at least the *one or* more second subsections of the field-of-view to *either* side of the first subsection with an illuminance above the predefined threshold value.” EX1001, 100:23-28. Claim 37 does *not* require illuminating *at least two* “second subsections” located on separate sides of the “first subsection.” EX1051, ¶132.

Yet PO contends that Petitioner’s proof of [37.9] fails because Petitioner’s annotated Figure 14 of Karlsson’s shows only one emitted beam 50, not two beams on separate sides of a first subsection. POR, 68. Annotated Figure 14, however, shows emitted beam 50 (green—a second subsection) located to a side of dimmed spotlights (gray—a first subsection). Pet., 125-127; EX1003, ¶¶653-657. Karlsson satisfies the plain claim language. EX1051, ¶133. Furthermore, Petitioner’s annotated Figure 14 shows one example beam. A POSA would have understood

that beam 50 is adaptable to being on both sides of a dimmed subsection using Karlsson's individually and group controllable LEDs. EX1051, ¶133.



EX1010, FIG. 14 (annotations from EX1003, ¶481).

D. A POSA would have been motivated to combine Harbers's multi-function beam segments with Karlsson's adaptive headlights.

1. Karlsson-Harbers's multiple directional beam segments would be actively directed to different driving functions.

PO's assertion that Petitioner fails "to articulate why the inclusion of" Harbers's "multiple directional beam segments" would "improve visibility" is wrong. POR, 77-79; EX1051, ¶139. Karlsson-Harbers's beam is actively directed for functions beyond anti-glare. Pet., 96-100; EX1003, ¶583.

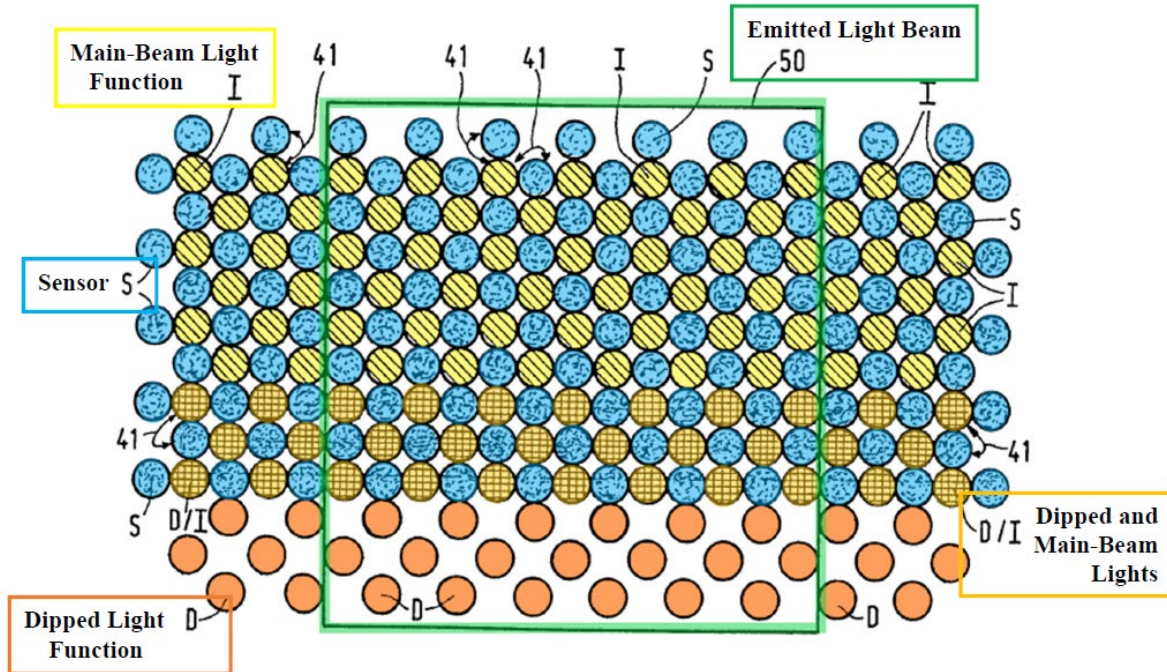
Dr. Jiao explained that implementing Harbers's "multiple directional beam segments (clusters)" would have "provided Karlsson's system with different spatial

distributions for different driving situations beyond reducing glare for drivers.”

EX1003, ¶555; Pet., 96-100; DI, 12. This system is “more direct, or active, or specifically aimed for different functions,” such as “off-axis viewing, bends, narrow roads, motorways, etc.” EX1003, ¶¶583, 587. Accordingly, Karlsson-Harbers’s headlight beam would have been spatially distributed to where illumination is desired for the particular driving function. Pet., 96-100; EX1003, ¶¶583-589; EX1051, ¶¶139-141.

2. PO mischaracterizes Karlsson’s “optimally adapted” lighting.

PO/Dr. Turk wrongly conclude that Karlsson “provid[es] full or maximum intensity light in the remaining areas outside of the anti-glare region...to the greatest extent possible, i.e., everywhere it could be needed.” POR, 85, 77-86; EX2006, ¶¶324, 294-325; EX1051, ¶¶142-149. Karlsson’s actual emitted headlight beam 50 is represented as a window that shifts in the plane from left to right and top to bottom (varying shape, dimension, etc.), based on data inputs to Karlsson’s controller. EX1010, 19:18-20:3; EX1003, ¶¶103-108; EX1051, ¶¶143-144.



EX1010, FIG. 14 (annotated).

Window 50 is a subset of the LEDs available. EX1052, ¶¶143-144. Dr. Jiao explained how shifting this window controls headlight beam directionality.

EX1051, ¶¶143-144; EX1010, 19:29-34; EX1003, ¶¶103-108; Pet., 93-126. Even Dr. Turk agreed that Karlsson's beam 50 can (1) vary its shape and dimension, (2) vary depending on the desired beam pattern and direction, and (3) its dimension can vary depending on the desired beam pattern and direction. EX1010, 19:29-34; EX1054, 132:15-25, 133:6-7, 134:2-7, 134:13-15.

Nothing suggests to a POSA that Karlsson operates with all LEDs active except to implement glare control. EX1051, ¶148. Rather, Karlsson's optimally adapted system, with individually and group controllable LEDs, produces beam patterns based on data inputs to Karlsson's controller. EX1010, 19:18-20:3; Pet.,

93-126; EX1003, ¶¶103-108. Thus, Karlsson's optimum light effect is adapted for the driving condition, consistent with Harbers. Pet., 93-126; EX1003, ¶¶537-657; EX1051, ¶¶143-149.

3. Harbers's colored LEDs are compatible with Karlsson.

Dr. Turk's baseless assertion that Karlsson-Harbers's headlight system "would not have known how to handle colored LEDs" demonstrates his lack of understanding of the claimed headlight technology. EX2006, ¶313; POR, 81-82; EX1051, ¶150.

A POSA would have understood how to implement Harbers's colored-LEDs in Karlsson's headlight system to provide a dynamic headlight with desirable color output. EX1010, 4:10-14, 8:31-34, 10:6-10, 10:26-28; EX1051, ¶151; EX1003, ¶¶690-706. Specifically, a POSA would have understood how to arrange different color-LEDs in Karlsson's headlights to reduce "possible color effects [] for an observer looking into the light emitted by the vehicle headlamp." EX1011, 8:30-33; EX1051, ¶151. A POSA would have also understood how to configure Karlsson-Harbers's optical system to "effectively mix the colors originating from the LEDs" to prevent color-shifts. EX1011, 8:32-34; EX1006, ¶5; EX1051, ¶151.

A POSA also would have understood that forward illumination from Karlsson's/Harbers's headlights would be within a range of white color that would obviate Dr. Turk's lack of predictability concerns. EX2006, ¶313; EX1051, ¶152;

EX1069, 5-6. While Harbers discloses different colored-LEDs, the beams generated from each colored light source have “a more or less ‘white’ appearance.” EX1011, 5:27-29; EX1051, ¶¶152-153.

E. A POSA would have been motivated to combine Harbers’s curved substrate with Karlsson’s LED array.

As one reason for combination, Petitioner explained that mounting Karlsson’s LEDs on a curved surface—as was known in Harbers—would “improve[e] visibility and thereby safety.” Pet., 99-100; EX1003, ¶¶559-563; EX1011, 7:27-32.

In response to Dr. Turk’s unsupported argument (EX2006, ¶303), a POSA seeking to improve driver visibility by modifying headlights—as Dr. Jiao’s First Declaration explained (EX1003, ¶¶559-563)—would have known curved substrates enhance the headlight’s optical performance, for example, minimizing distortion. EX1051, ¶¶134-138.

Because Harbers’s curved substrate is a suitable option, the Petition’s explanation is sufficient. Pet., 10-17; EX1003, ¶¶133-139; EX1051, ¶¶134-138; *Intel Corp.*, 61 F.4th at 1380-1381; §IV.D.

F. PO’s arguments against the dependent claims fail.

1. Karlsson’s headlight system includes a light modifying element (claims 2/42).

Karlsson’s “lighting means in the lighting device according to the invention may be composed of a plurality of light sources *and/or* light modulators.” EX1010,

21:13-17. Karlsson's light modulators adjust "intensity of the light being transmitted." EX1010, 21:25-29. A POSA would have understood that Karlsson's light modulators control/alter "at least one light characteristic" (claims 2/42) of Karlsson's light sources. EX1010, 21:18-31; Pet., 130-132; EX1003, ¶¶668-670; EX1051, ¶¶154-156.

PO/Dr. Turk allege Karlsson fails to disclose the "light modifying element" based on their misunderstanding that Karlsson's spotlight sources do not include a light modulating means. POR, 69; EX2006, ¶¶268-269; EX1051, ¶¶154-156.

2. Karlsson's headlight system includes a controller using sensor data to detect vehicles (claims 7/8/47/48).

PO/Dr. Turk show their lack of understanding of Karlsson by alleging each spotlight sensor (S) functions "as a switch," automatically turning off its respective LED without controller input. POR, 69-71; EX2006, ¶¶277-279.

Nowhere does Karlsson describe the spotlight sensors as an isolated switch. EX1051, ¶¶157-158. Karlsson describes "spotlight sensors S and the spotlight sources are mounted on a printed circuit board (PCB), *together with the associated control electronics 41.*" EX1010, 20:1-4. Karlsson's "processor-controlled control means 14" communicates with control electronics 41 and memory means 51 to control shape/direction of emitted beam 50. EX1010, 9:4-26, 19:29-34, 20:13-15; EX1003, ¶714. A POSA would have understood that control electronics 41 allows Karlsson's controller 14 to receive inputs from the spotlight sensors to determine

location of oncoming vehicles. EX1010, 5:17-24, 20:13-15; EX1003, ¶714; EX1051, ¶158.

3. Karlsson’s headlight system includes a processor “to identify” vehicles (claims 11/50).

PO/Dr. Turk incorrectly allege that Karlsson’s light detection process does not disclose “identification of oncoming traffic” because they fail to understand how Karlsson detects vehicles to perform anti-glare. POR, 70-71; EX2006, ¶¶279-280.

Dr. Jiao confirms Karlsson’s controller distinguishes between “ambient light and light from oncoming traffic.” EX1010, 5:16-33. A POSA would have understood Karlsson filters and distinguishes between received ambient light and vehicle light to reduce glare for oncoming traffic, which satisfies the claims. EX1051, ¶¶159-160.

4. Karlsson’s headlight system includes a camera (claims 14/53).

Dr. Jiao explained that Karlsson’s *sensors 9, 23* can include a “video camera[.]” EX1010, 12:19-24, FIGS. 3, 14; EX1003, ¶735. PO’s arguments (POR, 71-75) that Karlsson fails to disclose a camera are contradicted by its own declarant, Dr. Turk, who admitted in the related ’551 patent proceeding (IPR2023-00315) that Karlsson’s sensor 23 is a camera. EX1070, ¶173 (“Only the light modulator embodiment *includes a camera*. Karlsson illustrates the light-sensitive

sensor 23 adjacent to the light modulator 3 in Figures 3, 5a, 7, [and] 10.”);

EX1051, ¶161.

VIII. PO’S ARGUMENTS AGAINST THE KARLSSON-HARBERS-GOTOU COMBINATION FAIL.

PO/Dr. Turk incorrectly allege that “Karlsson provid[es] full or maximum intensity light in the remaining areas...to the greatest extent possible” POR, 83; EX2006, ¶324; EX1051, ¶¶162-171.

As explained in §VII.D.2, Karlsson’s beam 50 “shift[s] in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa, which may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam.” EX1010, 19:29-34. A POSA would have understood that Karlsson-Harbers-Gotou beam patterns—like known adaptive beam patterns at the time—would vary in direction, length, and width (angular distribution) from a bird’s eye view, or driver’s view with varying intensity points along a projected distance. EX1051, ¶¶162-165; EX1003, ¶777. Because Karlsson’s headlights control beam directionality, the angular position of Karlsson’s emitted beam would be adjusted according to Gotou’s techniques, without any conflicts. EX1051, ¶¶163-171. A POSA would have been motivated to modify Karlsson-Harbers to adjust light clusters for “increas[ing] illumination in a direction of the road curvature” (claims 15/54) and “increasing illumination

illuminating the turn” (claims 16/17/55/56) using map data, as in Gotou, to improve driver safety. Pet., 159-166; EX1003, ¶¶443-460; EX1051, ¶171.

IX. PO’S ARGUMENTS AGAINST THE KARLSSON-HARBERS-BRAUN COMBINATION FAIL.

Dr. Turk’s assertion that “there were no ‘predictable solutions’” for combining Braun’s “luxels” with Beam’s modified headlight system further confirms his lack of understanding. EX2006, ¶330; POR, 86-87.

Dr. Jiao confirmed that “modifying Karlsson’s array of spotlight beams” with “Braun’s array of colored luxels 26” to “provide colored light sources” would have been “routine and well within a POSA’s skill.” EX1003, ¶858. Braun and Karlsson both disclose using LEDs. EX1003, ¶858. Braun’s luxels 26 were already implemented in an “adaptive illumination” headlight system that adjusts illumination to prevent glare. EX1003, ¶863; EX1009, 6:4-8. Combining Braun’s teachings with Karlsson-Harbers’s headlight system would have predictably yielded “different colored spatial distributions for different situations.” EX1003, ¶867; EX1051, ¶¶172-175.

Respectfully submitted,

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CERTIFICATE OF WORD COUNT (37 C.F.R. § 42.24(d))

1. This Petitioner's Reply complies with the type-volume limitation of 5,600 words, comprising 5,567 words, excluding the parts exempted by 37 C.F.R. § 42.24(c).

2. This Petitioner's Reply complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman font.

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CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e))

I certify that the above-captioned **PETITIONER VOLKSWAGEN
GROUP OF AMERICA, INC.'S REPLY TO PATENT OWNER RESPONSE**
and associated Exhibits 1051-1054, 1056-1059, and 1062-1070 were served
electronically via e-mail in their entireties on January 8, 2024, upon the following
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