

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Mercedes-Benz USA, LLC,
Petitioner,

v.

Yechezkal Evan Spero,
Patent Owner.

Case No. IPR2023-01027
Patent 10,894,503

**PETITIONER'S REPLY TO
PATENT OWNER'S RESPONSE**

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TABLE OF CONTENTS

	Page
I. Introduction	1
II. Alden Requires No Modification and Is Operative.....	1
III. Independent Claim 37.....	6
IV. Independent Claim 59.....	8
V. Independent Claim 65.....	10
VI. Dependent Claim 38	11
VII. Dependent Claim 39	12
VIII. Dependent Claim 40	12
IX. Dependent Claim 41	13
X. Dependent Claim 42, 58, and 64	13
XI. Dependent Claim 43	15
XII. Dependent Claim 50	16
XIII. Dependent Claims 54, 60, and 70.....	17
XIV. Dependent Claims 55-56, 61-62.....	20
XV. Dependent Claims 45, 68-69	22
XVI. Dependent Claim 46	23
XVII. Dependent Claim 48	24
XVIII. Dependent Claim 49	25
XIX. Dependent Claims 66-67	26
XX. Conclusion	26

TABLE OF AUTHORITIES

Page(s)

Cases

<i>Fitbit, Inc. v. Aliphcom, Inc.</i> , IPR2016-00714, Paper No. 27 (PTAB Sept. 13, 2017).....	16, 18
<i>Hewlett-Packard Co. v. Mustek Systems, Inc.</i> , 340 F.3d 1314 (Fed. Cir. 2003)	17
<i>Hockerson-Halberstadt, Inc. v. Avia Grp. Int’l, Inc.</i> , 222 F.3d 951 (Fed. Cir. 2000)	5

PETITIONER’S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 10,894,503 (“ ’503 ”)
1002	Original File History for the ’503 Patent
1003	Declaration of Dr. Nikolaos Papanikolopoulos
1004	Curriculum Vitae of Dr. Nikolaos Papanikolopoulos
1005	U.S. Patent Publication No. 2003/0,137,849 (“ Alden ”)
1006	WIPO Patent Publication No. 2001/001038 (“ Harbers ”)
1007	U.S. Patent No. 4,970,628 (“ Bergkvist ”)
1008	U.S. Patent No. 6,144,158 (“ Beam ”)
1009	U.S. Patent No. 6,049,749 (“ Kobayashi ”)
1010	WIPO Patent Publication No. 2001/070538 (“ Stam ”)
1011	WIPO Patent Publication No. 2002/004247A1 (“ Braun ”)
1012	PTAB Trial Statistics April 2023 IPR, PGR
1013	Second Declaration of Dr. Nikolaos Papanikolopoulos
1014	First Deposition Transcript of Dr. Mathew A. Turk
1015	Second Deposition Transcript of Dr. Mathew A. Turk

I. Introduction

Patent Owner's Response ("POR") is a request to ignore the teachings of Alden (EX1005), take the Petition and Petitioner's expert's testimony out of context, and read non-existent limitations into the claims. But, as explained below and in the Petition, when Alden is considered in view of its entirety, it is clear it contains more than sufficient disclosure to invalidate the challenged claims. The POR's arguments are simply attempts to distract from Alden's clear, concise disclosure of the challenged claims and should be dismissed.

II. Alden Requires No Modification and Is Operative

First, Patent Owner ("PO") alleges Alden's Figure 5 is limited to a single row of LEDs that cannot be reconciled with the two-dimensional elements of Figure 3, and Petitioner's proofs allegedly relying on multiple rows of LEDs require "modifying" Alden. (POR, 16-22.)

As an initial matter, even under the erroneous assumption Figure 5 is limited to a single row of LEDs, the challenged claims would still be unpatentable. The claims do not require a two-dimensional array of LEDs, and Alden's disclosure of LEDs, each having a corresponding switch, being controlled to selectively provide dimmed low or high beam illumination in different areas renders the claims unpatentable.

Moreover, as the Board correctly found in its Institution Decision (“DI”), Figure 5 is **not** limited to a single row. (DI, 10-12.) Nowhere does Alden call the LEDs a “row” or indicate they are “one dimensional.” Instead, Alden discloses that Figure 5 illustrates “the segmented headlight” comprised of an “*array*” of lighting elements. (Alden, [0029], Fig. 5.) Figure 5 is simply a sectional view of one row in this array. (Deposition Transcript of Dr. Nikolaos Papanikolopoulos (EX2041), 57:12-58:4, 106:22-107:10, 110:7-19; Second Deposition Transcript of Dr. Nikolaos Papanikolopoulos (EX2066), 32:10-36:22; *see also* DI, 10-12.)

Alden’s disclosures confirm a POSITA would understand Figure 5’s array includes multiple rows. For example, Figures 6-7 show (a) a “sectional” view of one row of lighting elements and (b) a “front-on” view depicting the full two-dimensional array of elements within the headlight. (Alden, Figs. 6-7.) Similarly, Figure 5 shows a sectional view of a row of LEDs to illustrate the segmented lighting, it being understood the full array in front-on view (such as similarly shown in Figures 6-7) would be two-dimensional. (*See e.g.*, Petition, 27-28; Alden, [0029]; EX2041, 57:12-16; EX2066, 32:20-34:15, 36:10-22, 45:14-46:8; Declaration of Dr. Nikolaos Papanikolopoulos (EX1003), ¶55.)

Additionally, Alden explains Figure 5’s LED “array” is controlled by corresponding switches from a switch array using the “CPU and logic *previously described*” in Figures 3 and 4. (Alden, [0025] (emphasis added); First Deposition of

Dr. Matthew Turk (EX1014), 122:12-22.) Thus, Figure 5 must be read with the descriptions of Figures 3-4, not in the abstract. Because Figures 3-4 disclose the CPU and logic providing different light in different sectors across a two-dimensional plane, a POSITA would understand Figure 5 to use multiple rows. (Alden, Figs. 3-4, [0027]-[0028]; EX1013, ¶¶5-15.)

Further, Figure 4 discloses the CPU logic compiling two-dimensional (XY) sensor maps of detected light and determining dimmed and high beam zones *within this XY space*. (Alden, Fig. 4, [0028]; EX1003, ¶¶59-63, 73.) For this logic to apply to Figure 5, as Alden says it does, a POSITA would understand a two-dimensional array would be used. (EX1013, ¶¶5-15; EX2041, 59:14-60:18; EX2066, 20:2-21:13, 34:4-15, 45:18-46:8.) Where Alden discloses the LEDs “are on a curve along the focal point of a headlight lens 121 such that the light from each lighting element goes into a specified portion (or portions) of the headlight distribution area,” it is describing directing light into different sectors of a two-dimensional plane ahead of the vehicle, and as such, Alden discloses rows of LEDs on a curved surface behind the lens to accomplish this. (*Id.*; see also Alden, [0029]; EX2041, 52:18-53:12, 106:22-107:10, 115:7-116:6.)

Finally, Alden discloses additional functionalities its “segmented light distribution elements” can perform, including “directing light to look around corners,” “concentrat[ing] light to look uphill,” and “concentrat[ing] light to look

downhill.” (Alden, Figs. 11-13, [0036]-[0038].) Alden confirms the “segmented light distribution elements described herein” (which includes Figure 5) can perform these functions, not just lighting elements of any particular embodiment. (*Id.*) For Alden’s Figure 5 to direct light uphill and downhill there are multiple rows of LEDs, some positioned on the curved surface to direct light upwards and others positioned to direct light downwards. (EX1013, ¶9.)

Second, PO claims Petitioner is “modifying” Alden because Dr. Papanikolopoulos allegedly “admitted” Alden does not describe certain details of its system and read things into Alden. (POR, 18-22.) But Dr. Papanikolopoulos has consistently testified a POSITA would understand Figure 5 to illustrate one row of a two-dimensional array. (EX1013, ¶¶5-15; Alden, [0029]; EX2041, 57:12-16; EX2066, 32:20-23, 33:5-10, 36:10-22, 45:14-46:8; EX2067, 58:11-59:4.) At deposition Dr. Papanikolopoulos did not read anything into Alden or suggest a POSITA would not understand it. Rather, he explained how Alden’s figures are conceptual (not precise schematics) and gave examples as to what these figures and corresponding descriptions disclose to a POSITA. (*See e.g.*, EX2041, 57:12-21, 107:11-18; EX2066, 32:20-34:3, 44:12-22, 47:1-19, 99:21-100:11.)

Third, PO argues Alden is “inoperative” because (1) Figure 5’s row of LEDs would provide insufficient lumen output and (2) Figures 3 and 5 are incompatible

because “there are 576 switches in the Figure 3 switch array and 9 LEDs in the Figure 5 LED array[.]” (POR 22-24.)

These arguments are, again, predicated on Figure 5 being a single row of LEDs—an argument incorrect as explained above. Moreover, the claims do not require a particular lumen output or compliance with any standard or regulation—for automobiles or otherwise. (EX1013, ¶13.) Indeed, the claims are directed toward a headlight system for a “vehicle,” *generally*, not a headlight system for a specific type of vehicle with a required lumen output. (*See, e.g.*, ’503 Patent, Cl. 1; Second Deposition Transcript of Dr. Mathew Turk (EX1015), 25:7-15.)

Further, Figure 3 does not disclose using 576 switches, and Figure 5 does not limit Alden to 9 LEDs. (EX1013, ¶¶5-15.) These are conceptual figures in a patent application—not technical schematics representing the number of switches and LEDs to be used in a particular real-world system. *See, e.g., Hockerson-Halberstadt, Inc. v. Avia Grp. Int’l, Inc.*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“It is well established that patent drawings do not define the precise proportions of the elements.”). Regardless, Alden teaches how to use a switch array like in Figure 3 with the LEDs of Figure 5—the array has one switch per LED. (Alden, [0029]; EX1014, 121:3-18.)

In sum, when considering Alden in full, a POSITA would understand Alden’s teachings and how to implement them. PO’s arguments that Petitioner is

“modifying” Alden and that Alden would be “inoperative” absent modification therefore fail.¹

III. Independent Claim 37

*Regarding Claim 37[E] (Alden alone),*² PO argues Alden does not disclose illuminance above and below “a predefined threshold value” because Petitioner (1) defines everything between high beam and low beam as the “threshold value” and (2) does not consider light overlapping in Figure 5. (POR, 28-31.)

First, the range of intensities argument is a red herring. PO ignores that Alden discloses a threshold because it teaches the intensity of its low beam must be dim enough to produce “minimum glare.” (Petition, 25.) Thus, a POSITA would have understood Alden contemplated a certain threshold light intensity that the low beam

¹ Patent Owner also suggests a letter from Gentex to Alden proves Alden is “theoretical.” (POR, 13, n. 2.) This letter from Alden’s file history should be given no weight, as it is taken out of context, and there is no indication regarding the circumstances surrounding the submission, the type of review done, what Gentex was looking for, or why it responded as it did. (EX1014, 82:13-85:1.)

² Patent Owner briefly discusses Claim 37[C], but does not contend Alden fails to disclose it. (POR, 27-28.) Alden discloses this element. (Petition, 16-18.)

is lower than to ensure it does not cause glare, with the high beam being above this threshold to provide “maximum” visibility. (*Id*; EX1013, ¶¶16-19.)

PO speculates that even if Alden teaches a predefined threshold, its illumination above and below this threshold may overlap in areas. (POR, 29-33.) This is never discussed in Alden and, in fact, is contradicted by Alden’s teachings. For example, Alden discloses “produc[ing] a high beam in a first sector 65 while concurrently producing a low beam in a second respective sector 63 (or dim beam) where the [oncoming vehicle] is sensed.” (Alden, [0026]-[0027], Fig. 2.) Thus, whether some light possibly overlaps at some theoretical distance from the headlight does not change Alden’s disclosures that certain sectors are set to low beam (below a threshold to avoid glare), while zones adjacent are set to high.

Second, Petitioner does not define *everything* between high and low beam as the threshold value. (POR, 28.) Instead, because Alden’s headlights can operate at a range between high and low, there is some value within this, such as “medium” intensity, that the low beam is set below and the high beam is set above. (Petition, 25; EX1013, ¶19.)

Regarding Claim 37[E] (Alden-Stam), PO concedes Stam discloses dimming headlamps to avoid creating illuminance of 0.1fc incident on another vehicle, but contends Stam does not mention using this as a “threshold.” (POR, 33-34.) PO misses that it would have been obvious to *use this* as a threshold in Alden so as not

to cause glare to other drivers—which again is one of Alden’s stated functionalities. (Petition, 26-27.) That it would have been obvious to include such a threshold is further supported by Stam’s other teachings, including regarding regulations requiring manufacturers to “control the amount of glare experienced by drivers.” (Stam, 1:16-21; Petition, 26.)

PO also argues, relying on a readily apparent typo in the Petition, that Petitioner “fails to motivate any combination of Stam using *Stam’s controller*.” (POR, 34-35) (emphasis added). The Petition is clear that the combination was modifying Alden’s system, including its controllers, to use Stam’s value as a threshold, when applying appropriate power to the LEDs, so as to not cause glare in low beam sectors while having high beam in other sectors. (Petition, 26-27; EX1003, ¶¶71-72.)

IV. Independent Claim 59

PO argues Alden lacks any “determination” of “light output” as Claim 59[D] requires because its processor automatically applies predefined light output after determining which headlight zones to dim. (POR, 35-37.)

First, there is no “automatic step applying predefined light output.” (POR, 36-37.) Instead, Alden says that after its CPU determines sectors where another vehicle is based on a comparison of left and right sensor map data, and determines the distance to such vehicle, it uses the “distance information... to *determine the*

intensity of light that will be produced... in the corresponding headlight sectors [where another vehicle has been detected].” (Alden, [0027], [0028]; EX1013, ¶¶20-23; *see also* Petition, 18-24, 28-34).³ Then, the processor instructs adjustment of the LEDs, as information is “sent to control the power flow from a power source” via the control circuit switch arrays, so the LEDs produce the desired light output.⁴ (Alden, [0027], [0028]; EX1013, ¶¶20-23; *see also* Petition, 18-24, 28-34.) These determinations are continuous, as part of Alden’s real-time process for determining where another vehicle is located and controlling the LEDs to produce dimmed light in sectors currently containing such vehicle(s). (Alden, [0027]-[0028], Petition, 21-22.)

Second, even if Alden only determined whether light output in a first subsection should be a “predefined low value” (it does not) and second subsection high beam, this sufficiently discloses Claim 59[D], which does not require

³ Alden’s system is further “operable within a range of intensities between the high beam and the low beam state.” (Alden, [0027], [0061]; *see also* Petition, 22 n. 6.)

⁴ As such, Alden determines the subsections in Claim 59[C], determines the light output in Claim 59[D], and instructs adjustment of the LEDs based on the determined output in Claim 59[E].

determining a specific numerical intensity or that the determination be done in any particular way. (EX1013, ¶23.)

Finally, PO's argument that Alden does not disclose a "predefined illuminance" (POR, 37) is unavailing as explained above for "predefined threshold value" in Claim 37[E]. *See supra* Section III.

V. Independent Claim 65

PO contends Petitioner's arguments fail for the same reasons as Claim 59[D]; but those are wrong as discussed above. *See supra* Section IV.

PO further argues Petitioner's arguments lack particularity because they refer back to Claims 37[D]-[E], 59[D], urging that nothing in these claims is directed to "determining illumination levels." (POR, 38-39.) But Claims 37[E], 59[D], and 65[B] are materially the same and require: determining an illumination level for the first subsection including a second vehicle that is below a predefined illuminance, and determining an illumination level for illuminating second subsections to either side of the first subsection above the predefined illuminance. The Petition details for Claim 37[E] how Alden "determines illumination levels" for different subsections. (Petition, 22-24, 32-33.)

VI. Dependent Claim 38

First, PO argues Alden does not “determine illumination” because it uses predefined illumination levels. (POR, 38-39.) This is wrong. *See supra* Section III-V (Claims 37[D]-[E], 59[D], 65).

Second, PO argues “Alden is not capable of ‘determining’ whether a section ‘does not’ include a vehicle.” (POR, 40-41.) This too is wrong. Alden provides dimmed intensity where other vehicles are detected and “a second intensity... of illumination *where no vehicle is detected*.” (Alden, [0025].) This is done using a process that detects where sensed light (from another vehicle’s headlights) is above a threshold and accounts for the area around the headlights where the vehicle’s driver may be to determine where the other vehicle is present. (*Id.*, [0027]-[0028].) Alden similarly determines where other vehicles are not present—areas where threshold light is not detected and which do not fall within the area around sensed headlights where a driver may be present. (*Id.*)

PO also argues the Petition is deficient because it refers to Claim 37[D]-37[E], which do not recite “determined not to include a second vehicle.” (POR, 40-41.) But for Claims 37[D]-37[E], the Petition details how Alden determines subsections that include detected vehicles and other subsections that do not. (Petition, 22-24, 36.)

VII. Dependent Claim 39

PO argues the Petition fails to offer any explanation for “determining specific, different illumination characteristics for each of the at least two subsections” because it refers back to Claims 37[B], 37[D]-37[E]. (POR, 41.) Again, this is not true. For Claims 37[B], 37[D]-37[E], the Petition details how Alden provides specific, different illumination characteristics (*e.g.*, dim low beam or high beam) for different subsections. (Petition, 13-16, 18-24.) Further, Alden’s light clusters can illuminate a subsection with a detected vehicle with low beam light and a subsection with no detected vehicle with high beam light. (*Id.*, 38.) Thus, the Petition sufficiently explains how Alden anticipates and renders obvious (alone or in view of Stam) Claim 39.

VIII. Dependent Claim 40

PO argues Petitioner fails to map Alden to the claim language because the “light distribution pattern” cannot be “different illumination levels **output** from the lighting elements.” (POR, 41-42.) This mischaracterizes the Petition, which explains that Alden determines which subsections of the field-of-view should be dimmed and which should be high beam—*i.e.*, a pattern of low and high beams across the headlight distribution area. (Petition, 18-24, 38.) This pattern of low and high beams is then output from the headlights. (*Id.*)

IX. Dependent Claim 41

PO argues Petitioner's referring to Claims 37[D]-37[E] is insufficient for Claim 41 because Claims 37[D]-37[E] do not use the exact language "defining illumination,". (POR, 42-43.) This is wrong. The Petition's sections regarding Claims 37[D]-[E] are replete with discussions of "defining illumination" in the pattern by, for example, setting different intensity levels in different sectors. (Petition, 18-27.)

X. Dependent Claim 42, 58, and 64

Regarding Claim 42[B], PO does not dispute Alden's lens 121 is a "light modifying element." (POR, 43.) Instead, it argues Petitioner fails to explain how and why a POSITA would include a liquid crystal variable refractive element in Alden's Figure 5. (POR, 43-46.)

Alden describes that a liquid crystal element allows light to pass straight through when a circuit is open, and has a second refractive state causing the light to bend when the circuit is closed. (Petition, 42-44; EX1003, ¶¶105-107.) Alden further explains that "[o]ne or more methods employed herein may be used in combination to vary illumination in a segmented system." (Alden, [0061].) A POSITA would have readily understood how to implement variable refractive elements in such a system. (Petition, 44; EX1013, ¶¶27-32.)

Regarding why a POSITA would implement such a variable refractor, as the Petition explains, the variable refractor would provide additional means of modifying the direction or intensity of individual light sectors, allowing greater control of lighting subsections. (*Id.*) For example, Alden is concerned not only with dimming light when other vehicles are detected, but also with illuminating curves. (EX2041, 79:18-80:24.) To achieve this additional control of intensity and direction of light at a curve, Alden's Figure 5 headlight may include a light source with a variable refractive element at either end, so as to be able to bend the light directed towards the sides of the road and, thus, upcoming curves. (EX1013, ¶¶27-32.)

Regarding Claim 42[C], PO argues lens 121 cannot be the "light modifying element" because it is not controllable. (POR, 44-45.) This is a misinterpretation of the claim, which does not require that the light sources and light modifying elements are both controllable.

Claim 42[A] recites that the light sources are controlled (via power), but Claim 42[B] recites only light modifying elements being present, but not controlled. Claim 42[C] simply recites that Claim 42[A] (control of light sources) and 42[B] (inclusion of light modifying elements) "results in a specified light emitted light-source characteristics." Claim 44, depending from Claim 42, supports this understanding, as it recites that the light modifying elements may include optical

coatings, which are simply applied and not controlled in any way, as well as lenses, *like that in Alden*. ('503, Claim 44; EX1013, ¶¶27-32.)

In any event, controlled light modifying elements such as variable refractors can also be included in Alden's headlight. (Petition, 41-45.)

PO's arguments regarding Claims 58 and 64 (POR, 57) fail for the same reasons above.

XI. Dependent Claim 43

PO argues that Petitioner's arguments regarding Alden's variable refractor being the controlled light modifying element in Claim 43 fail for the same reasons as Claim 42[B]. (POR, 45-46.) However, a POSITA would have readily understood how to implement variable refractive elements in Alden's Figure 5 headlight and would have been motivated to do so. *See supra* Section X.

PO further argues that Petitioner does not explain how the control system would work for the combined system. (POR, 45-46.) This is unavailing. Claim 43 simply requires "at least one of the at least one processors" to "instruct control" of the light modifying element. Alden discloses such a processor configured to control a control circuit to change the direction and distribution of light passing through the refractor. (Petition, 45-46, EX1003, ¶109; EX1013, ¶¶33-34.)

XII. Dependent Claim 50

PO argues Alden is incapable of “identifying” a vehicle (POR, 46), but is wrong on the art and the law. A key purpose of Alden is to “sense the locations of *other vehicles*” and control the headlights *in response* to the “sensed vehicle[s].” (Alden, [0006]; *see also* [0008], [0003]-[0005], [0025]-[0027], [0029]; EX1003, ¶113.) Alden’s CPU “checks the status of each respective sector 89 of the light sensors,” assesses whether detected light is “above a *threshold* intensity or distance” such that it indicates “two headlights of [an oncoming vehicle] 41,” and determines “which zones need to be dimmed.”⁵ (Alden, [0027]-[0028]; *see also* Petition, 18-24.) Regardless of whether Alden could at times, theoretically, identify a non-vehicle as a vehicle does not mean that Alden does not “identify” vehicles. “Prior art that sometimes explicitly meets the claim elements is sufficient to show unpatentability.” *Fitbit, Inc. v. Aliphcom, Inc.*, IPR2016-00714, Paper No. 27 at 22 (PTAB Sept. 13,

⁵ That Alden dims the area *above* “the headlight dots” of the oncoming vehicle because it may be “occupied by the driver” reinforces that Alden is “identifying” vehicles. (Alden, [0027], Fig. 3.).

2017); *see also Hewlett-Packard Co. v. Mustek Systems, Inc.*, 340 F.3d 1314, 1326 (Fed. Cir. 2003).⁶

XIII. Dependent Claims 54, 60, and 70

Claims 54 and 60 recite “the at least one of the at least one processors is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the first vehicle[.]” PO argues Alden does not “know[]the difference between vehicles and reflectors” and, therefore, cannot determine whether it should dim in response to a vehicle or concentrate light in response to road curvature. (POR, 47-51, 53-54.)

Alden detects different objects by checking for light above a “threshold” intensity or distance at each location of the sensor array. (Alden, Fig. 4, [0028]; EX1003, ¶¶60-61, 142.) To distinguish different objects, such as roadside reflectors or oncoming vehicles, a POSITA would have understood the threshold intensity or distance of the process in Figures 3-4 may, for example, be adjusted based on the

⁶ Patent Owner proposes construing “identify” based on a portion of a dictionary definition. (POR, 46.) There is no basis to limit the claims, but even under this definition, Alden still discloses “identifying” vehicles, as it shows something (*e.g.*, a light source) is a certain thing (*e.g.*, an oncoming vehicle) based on intensity of detected light.

object type. (EX1013, ¶¶35-41.) As Dr. Papanikolopoulos explained, Figure 4’s logic would apply to detecting roadside reflectors, with Alden’s Paragraph [0036] indicating that instead of dimming where objects (*e.g.*, reflectors) indicating the curve are detected, the system will now “direct light into the corner” by switching LEDs directed towards the reflectors to high beam and switching LEDs not directed at the curve to low beam or even off. (EX1003, ¶117; EX1013, ¶¶35-41; EX2066, 114:20-115:14.) Thus, Alden would not simply “dim” all lights directed to the road curve in Figure 11, but rather would control the LEDs using the process in Figure 4 to “switch [] segments to high beam” that direct light into the curve. (Petition 50-51; Alden, Fig. 4, [0028], [0036]; EX1003, ¶117; EX1013, ¶¶35-41.)

For Claim 54, PO additionally argues Alden does not “increase[e] illumination in a direction of a road curvature” because it “emits high beams everywhere there is not glare reduction and [] lacks optical steering.” (POR, 51-53.) Similarly, for Claim 60, PO argues it is unclear how Alden can “aim[] illumination in a direction of the road curvature” as the LEDs are emitting at high/maximum illumination. (*Id.*, 53-54.)

Alden does not default to high beams everywhere there is not glare reduction. Rather, Alden explains its system can be used for “many applications,” and regarding Figure 11 details an additional functionality of its segmented headlight being “used to concentrate light to look around corners” when the vehicle senses

road turns, by directing “light into the corner to maximize the driver’s ability to see there.” (Alden, [0036], [0061], Fig. 11; EX1003, ¶117.) Further, as shown in Figure 4 at element 109, Alden can “switch requisite headlight segments to dim” and “switch other segments to high beam.” (Alden, Fig. 4, [0027]-[0029], [0036], [0061].)

Thus, as a POSITA would have understood, in the context of Figure 11 where the system will “concentrate” and “direct” light into a corner, Alden does not default all sectors to high and then dim certain ones. (Alden, [0036], [0061]; EX1003, ¶117.) Instead, it can selectively switch to high beam those LEDs that are positioned on the curve—for example those the extreme ends of the headlight curve in Figure 5—such that they would direct high beam light into the area of the road curvature to “concentrate” light there. (Alden, [0036], [0061], [0027]-[0029]; EX1003, ¶117.)

This switching on of LEDs directed at the curve to high beam is increasing illumination in a direction of the road curvature. (EX1003, ¶117; *see also* Petition, 51.) PO’s attempts to confuse the issue by assuming all lights must be on high beam at all times under all circumstances, *other than* for a detected other vehicle, but this is contrary to Alden’s disclosure of its headlights performing multiple functions. (POR, 51-53.) When the system recognizes a curve, it can perform additional

functionality of illuminating the curve while also dimming where needed if other vehicles are present. (EX2041, 50:9-51:3, 76:8-80:24.)⁷

Regarding Claim 70, PO argues that Petitioner's arguments fail because it relies on the arguments for Claims 54-56, 60-62. (POR, 56-57.) Thus, the arguments above apply equally to Claim 70.

XIV. Dependent Claims 55-56, 61-62

PO argues that because the claims recite "turn" instead of "curve," Petitioner cannot use the same arguments as for curve illumination. (POR, 54-56.) This is baseless. The claims do not specify any particular type of turn or illumination pattern, and Alden discloses creating a third illumination pattern to increase illumination when sensing the vehicle must turn at an upcoming curve. (Petition, 52.)

⁷ For Claim 54, Patent Owner argues Petitioner's argument is near-verbatim to the argument for Claim 15 in IPR2023-01026, which does not address "pattern" in Claim 54. (POR, 51.) Patent Owner does not explain what additional requirements "pattern" entails, but Alden discloses determining an illumination pattern with high beam segments directed into the corner to "maximize the driver's ability to see there." (Alden, [0036], Fig. 11; EX1013, ¶¶42-44.)

PO argues curves and turns are different, citing to Dr. Turk, but he simply points to two arbitrarily-selected dictionary definitions of these terms. (POR, 55; EX2040, ¶236.) PO offers no explanation as to how this relates to Alden or invalidity. Moreover, there is no basis to limit the terms “curves” and “turns” to the two dictionary definitions. Nor do these definitions even make sense. For example, PO defines turn as a “change of direction when moving,” but its expert admitted a curve also results in a change of direction when moving. (EX1015, 100:4-8.) Similarly, while PO asserts a curve does have a change in angle required for a turn, its expert admitted the definition of “turn” makes no mention of any angle. (*Id.*, 102:4-7.) In any event, even under these definitions, Alden still discloses the challenged claims—it senses an upcoming curve or turn in the road and controls its headlights accordingly. (Petition, 52-53.)

PO additionally argues Alden cannot determine a “planned” turn, but this is likewise baseless. (POR, 54-56.) Alden’s detection of reflectors along a curve ahead of the vehicle determines a “planned” turn, as the vehicle must turn when it reaches the curve. (Petition, 52, Alden, [0036].) Alden also discloses a rotation sensor in the steering wheel that can detect a planned turn, and the system can change the headlight output accordingly. (Petition, 52; Alden, [0040].) PO does not dispute that Alden can calculate the vehicle’s new direction based on data from the rotation sensor, but argues this is where the vehicle is now heading, not where it is planning

to head. (POR, 55.) However, when a steering wheel is turned in anticipation of a turn, it indicates the planned turn. (Petition, 52.) And, a POSITA would have understood any new direction of the vehicle based on the rotation sensor data is where the vehicle is planning to go. (*Id.*; EX1003, ¶120.)

Finally, PO's argument that "there is no mention of how the array of Figure 5 could be adapted in any manner to accommodate this information" (POR, 55) fails for the reasons discussed above. *See supra* Section XIII.

XV. Dependent Claims 45, 68-69

PO does not dispute Harbers discloses the additional elements of Claims 45 and 68-69, *e.g.*, LEDs that can be controlled such that beam segments have different colors. (POR, 57-61.) Instead, it argues a POSITA would not combine Alden and Harbers because this would result in colored light being output from Alden's headlights, which could result in, for example, the driver of an oncoming vehicle seeing colored beams. (*Id.*)⁸

⁸ Patent Owner makes a passing argument that the Petition includes only proofs about "light clusters" being LEDs, not "light sources." (POR, 58.) This makes no sense. The Petition explains how light clusters can be comprised of different sources, or groups of LEDs (such as groupings that project light into different general areas,

First, this ignores the claims, which contemplate projecting different colors of light forward. Claim 68, for example, recites projecting bluish illumination on the side of the road and yellowish illumination along the road. Second, PO misreads the art and combination. PO claims Alden's array is limited to one row of nine LEDs and Harbers requires the LEDs to be in a "strict ordering." (*Id.*, 58, 60.) PO does not explain the relevance of these assumptions, but they are incorrect, and there is nothing incompatible about Harbers and Alden.

Harbers teaches using colored LEDs to project colors of light in certain areas, like bluish light along the side of the road and yellowish light along the road—*near-identical to Claim 68*. (Petition, 55-57.) Alden says alternate lighting mechanisms may be used in its system. (*Id.*, 54-55.) Dr. Papanikolopoulos provides more than sufficient explanation for how and why a POSITA would apply Harbers to Alden. (*Id.*, 57-61.)

XVI. Dependent Claim 46

PO does not dispute Bergkvist discloses the additional elements of Claim 46 (*e.g.*, headlight beam further comprising UV light), but rather argues a POSITA would not apply this to Alden. (POR, 61-62.) First, whether Bergkvist discloses

e.g., left, center, right, in front of the vehicle), with each group having multiple LEDs. (Petition, 54, 13-14.)

LEDs is irrelevant. What matters is whether it discloses emitting UV light from a headlight, which it does. (Petition, 62.) Second, PO alleges the Petition provides no explanation of how Bergkvist’s UV light alone (without the filter) could be applied to Alden without introducing unwanted visible light. (POR, 61-62.) PO misconstrues the combination—Alden is modified to include UV light output “outside the visible range, such that it is not distracting to other drivers or pedestrians but can still illuminate reflective materials such as road signs or markings.” As taught by Bergkvist, such light source would include a filter to remove all the visible light and emit only UV light outside the visible range. (Petition 61-62; EX1003, ¶¶45-46.)

XVII. Dependent Claim 48

PO does not dispute Beam discloses detecting the taillights of a preceding vehicle, but rather argues applying Beam to Alden would not work because (1) the threshold(s) in Alden for detecting vehicles would need to be reduced, which would result in Alden being unable to adjust light to oncoming vehicles, and (2) Alden would be unable to “match” taillights across its sensors. (POR, 62-63)

First, PO ignores that Beam’s teachings are being applied to Alden, and Beam discloses being able to detect both headlights and taillights. (Petition, 70-72; Beam, 2:54-65.) PO has not argued or shown that Beam is not enabled. (POR, 62-63.)

Second, there is no record evidence that the difference in intensities between headlights and taillights is markedly different. PO cites none. (POR, 62-63.) Thus,

there is no reason to assume significant adjustments would need to be made to Alden when applying Beam.

Third, a POSITA would be able to account for any difference in intensities between headlights and taillights. (Petition, 65-66; EX1003, ¶143.) PO urges that Alden, as modified, would detect and dim light to an overly large area for oncoming vehicles, without saying why the threshold for both headlights and taillights would need to be the same. (POR, 63.) Instead, Alden as modified by Beam can detect, and separately account for, oncoming and preceding vehicles. A POSITA would have readily understood how to account for intensity differences and use two different intensity thresholds, with a lower one being indicative of preceding vehicle taillights and a higher one being indicative of oncoming vehicle headlights. (EX1003, ¶143.)

Finally, PO's argument Alden does not explain how it would "match" light detected between sensors fails to understand the art. (POR, 63.) Alden explains that for a given light source, the right and left sensors "will receive spots of nearly identical intensity and size[.]" (Alden, [0027].) Accordingly, Alden could readily match data across the sensors without the need for modification. (EX1013, ¶¶47-50)

XVIII. Dependent Claim 49

PO does not dispute Kobayashi discloses a GPS sensor, but instead argues that if a GPS sensor were added, there would be no need for Alden's other sensors. (POR, 64.) This is irrelevant, and misses that the Petition explains a POSITA would have

added Kobayashi’s GPS sensor to Alden and using *multiple sensors* would help “maximize successful detection of road curvature in different environments.” (Petition, 69-71.)⁹

XIX. Dependent Claims 66-67

PO does not dispute Braun discloses data indicating a pedestrian/road-sign and determining an illumination level for a third subsection, but argues a POSITA would not apply this to Alden. (POR, 64-66.) PO purports to present three separate arguments for this, but the first and third are premised on the assumption Alden’s sensor array is to be used with Braun’s processor. However, the Petition explains a POSITA would have used teachings of Braun’s camera and pattern recognition system in Alden. (Petition, 73.)

PO additionally argues by using Braun’s processor, Alden will lose the ability to accommodate the oncoming driver. (POR, 65.) This is wrong; Alden would continue to perform this functionality but would now also be able to detect and illuminate roadway signs and pedestrians, all by using Braun’s detection system. (Petition, 73; EX1013, ¶51.)

XX. Conclusion

For the reasons above and in the Petition, the Board should cancel the challenged claims as unpatentable.

⁹ Nor does Alden emit high beam all the time into corners. *See supra* Section XIII.

Dated: July 3, 2024

Respectfully submitted,

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Certificate of Word Count

The undersigned certifies, in accordance with 37 C.F.R. § 42.24(d), that the foregoing **PETITIONER’S REPLY TO PATENT OWNER’S RESPONSE** complies with the type-volume limitation of 5,600 words, comprising 5,586 words, excluding the parts exempted by § 42.24(c).

Dated: July 3, 2024

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Certificate of Service

The undersigned certifies that, in accordance with 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, the foregoing **PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE** was served on July 3, 2024, electronically via e-mail upon the following parties:

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