

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.

Brightplus Ventures LLC
Patent Owner

Patent No. 8,294,075
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Title: SOLID-STATE LUMINAIRES FOR GENERAL ILLUMINATION

Inter Partes Review No. IPR2023-01410

**PETITIONER'S OPPOSITION TO PATENT OWNER'S REVISED
CONTINGENT MOTION TO AMEND UNDER 37 C.F.R. § 42.121**

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CLAIMS APPENDIX

34[a]	<u>A lighting panel, comprising: at least one first substrate on a surface of a first tile, the first substrate and the first tile together comprising a first metal core printed circuit board (MCPCB), the first substrate having a first side parallel to a principal plane of the lighting panel;</u>
34[b]	<u>a first plurality of solid state lighting devices arranged on the first side of the first at least one substrate and configured to emit light; wherein the first plurality of solid state lighting devices are arranged on the first side of the first substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the first plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the first substrate;</u>
34[c]	<u>a second substrate on a surface of a second tile, the second substrate and the second tile together comprising a second MCPCB, the second substrate having a first side parallel to the principal plane of the lighting panel;</u>
34[d]	<u>a second plurality of solid state lighting devices arranged on the first side of the second substrate and configured to emit light; wherein the second plurality of solid state lighting devices are arranged on the first side of the second substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the second plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the second substrate;</u>
34[e]	<u>wherein the first tile and the second tile are arranged horizontally across the lighting panel;</u>
34[f]	<u>a first reflector sheet mounted on the first side of the at least one first substrate and not in contact with the first plurality of solid state lighting devices;</u>
34[g]	<u>a second reflector sheet mounted on the first side of the second substrate and not in contact with the second plurality of solid state lighting devices;</u>
34[h]	<u>a brightness enhancement film on the reflector sheets, wherein the first and second reflector sheets is are arranged between the first and second at least one substrates, respectively, and the brightness enhancement film and the brightness enhancement film is configured to preferentially emit light having a first orientation from the lighting</u>

	panel and to preferentially reflect light having a second orientation, different from the first orientation, back into the lighting panel; and
34[i]	a diffuser sheet between the <u>first and second reflector sheets</u> and the brightness enhancement film, wherein the <u>first and second reflector sheets</u> , the diffuser sheet and brightness enhancement film extend and are arranged parallel to the principal plane of the lighting panel.
35	~~The lighting panel of claim 1 34, wherein the reflector sheet is configured to reflect and disperse light incident thereon.~~ <u>further comprising an optical reflective cavity in contact with the substrate and formed around the solid state lighting elements, the optical reflective cavity having planar angled sidewalls; wherein the optical reflective cavity is not in contact with solid state lighting elements.</u>
36	~~The lighting panel of claim 1 35, wherein the reflector sheet includes a plurality of apertures therethrough, wherein respective ones of the plurality of apertures aligned with corresponding ones of the plurality of solid state lighting devices wherein the diffuser sheet is in direct contact with the uppermost surface of the optical reflective cavity.~~
37	~~The lighting panel of claim 1 34, wherein the reflector sheet comprises a plastic foam~~ <u>further comprising a plurality of current supply circuits that are operable to control a pulse width of a current supplied to each one of the plurality of strings of solid state lighting devices.</u>
38	~~The lighting panel of claim 1 34 wherein the brightness enhancement film comprises a plurality of three dimensional light extraction features configured to bend at least some light rays passing through the brightness enhancement film toward the direction normal to the principal plane of the lighting panel wherein the first and second plurality of strings arranged on each of the first and second substrate, respectively, are controlled by at least two current supply circuits.~~

LIST OF EXHIBITS

EXHIBIT	DESCRIPTION
1001	U.S. Patent No. 8,294,075 (“the ’075 Patent”)
1002	Prosecution History of U.S. Patent No. 8,294,075
1003	Declaration of Morgan Pattison, Ph.D.
1004	Curriculum Vitae of Morgan Pattison, Ph.D.
1005	US 2006/0227545 to Mok <i>et al.</i> (“Mok”)
1006	WO 03/056876 to Holman <i>et al.</i> (“Holman”)
1007	US 2005/0135115 to Lamb <i>et al.</i> (“Lamb”)
1008	US 2005/0265029 to Epstein <i>et al.</i> (“Epstein”)
1009	Counterclaim filed by PO in <i>Hisense USA Corp. v. Brightplus Ventures LLC</i> , No. 1:22-cv-02774, Dkt. 9 (N.D. Ga. Sep. 16, 2022)
1010	Scheduling Order in <i>Hisense USA Corp. v. Brightplus Ventures LLC</i> , No. 1:22-cv-02774, Dkt. 35 (N.D. Ga.)
1011	Judicial Caseload Profile for the Northern District of Georgia
1012	Cover Pleading to Patent Owners’ Infringement Contentions in <i>Hisense USA Corp. v. Brightplus Ventures LLC</i> , No. 1:22-cv-02774 (N.D. Ga.)
1013	Cover Pleading to Patent Owner’s Supplemental Infringement Contentions in <i>Hisense USA Corp. v. Brightplus Ventures LLC</i> , No. 1:22-cv-02774 (N.D. Ga.) served June 21, 2023
1014	US 2006/0082698 to Ko <i>et al.</i> (“Ko”)
1015	Han-Ping D. Shieh, et al., <i>Micro-Optics for Liquid Cristal Displays Applications</i> , IEEE/OSA Journal of Display Tech., Vol. 1, No. 10, Sep. 2005.
1016	Declaration of P. Morgan Pattison, Ph.D. in Response to Patent Owner’s Contingent Motion to Amend
1017	US 2006/0083023 to Ayabe <i>et al.</i> (“Ayabe”)
1018	US 2005/0274972 to Roth <i>et al.</i> (“Roth”)
1019	US 2007/0188425 to Saccomanno (“Saccomanno”)
1020	Taiwanese Patent Application No. 93218806, entitled DIRECT TYPE BACKLIGHT MODULE/ DIRECT TYPE BACKLIGHT MODULE to Chang

1021	Certified Translation of Exhibit 1020, Taiwanese Patent Application No. 93218806, entitled DIRECT TYPE BACKLIGHT MODULE/ DIRECT TYPE BACKLIGHT MODULE to Chang (“Chang”)
1022	US 2006/0186425A1 to Yano <i>et al.</i> (“Yano”)
1023	Transcript of July 12, 2024 Deposition of William Bohannon in Related Case No. IPR2023-01168
1024	Transcript of September 23, 2024 Deposition of William Bohannon
1025	US 6495861 to Hiroki (“Hiroki”)
1026	Korean Patent Application No. 2002/009578, entitled Electronic Display Board for indication equipment to Lee <i>et al.</i> (“Lee”)
1027	Certified Translation of Exhibit 1026, Korean Patent Application No. 2002/009578, entitled Electronic Display Board for indication equipment to Lee <i>et al.</i> (“Lee”)
1028	Japanese Patent Application No. 07199829, entitled Light emitting unit, display device, and illumination device to Hiratsuka (“Hiratsuka”)
1029	Certified Translation of Exhibit 1028, Japanese Patent Application No. 07199829, entitled Light emitting unit, display device, and illumination device to Hiratsuka (“Hiratsuka”)
1030	Certificate of Translation for Ex. 1028, Japanese Patent Application No. 07199829, entitled Light emitting unit, display device, and illumination device to Hiratsuka (“Hiratsuka”)
1031	Exhibit 8 to Deposition of William Bohannon in Related Case No. IPR2023-01168, 3M United States, Prism Films
1032	Exhibit 9 to Deposition of William Bohannon in Related Case No. IPR2023-01168, Vikuiti™ Brightness Enhancement Film (BEF) II
1033	Vikuiti™ Brightness Enhancement Film II (BEF II)
1034	Vikuiti™ Brightness Enhancement Film (BEF) III
1035	LUXEON® Power Light Sources
1036	Declaration of P. Morgan Pattison, Ph.D. in Response to Patent Owner’s Revised Contingent Motion to Amend

1037	US 2005/0231943 to Sloan <i>et al.</i> (“Sloan”)
1038	WO 2005/089293 to Lys <i>et al.</i> (“Lys”)
1039	US 2003/0189829 to Shimizu <i>et al.</i> (“Shimizu”)
1040	US 2007/0046485 to Grootes <i>et al.</i> (“Grootes”)
1041	US 2005/0047134 to Mueller <i>et al.</i> (“Mueller”)
1042	Japanese Patent Pub. No. 2004-139871 A to Shimizu et al. (“Shimizu ’871”)
1043	Certified Translation of Ex. 1042, Japanese Patent Pub. No. 2004-139871 A to Shimizu et al. (“Shimizu ’871”)

I. Introduction

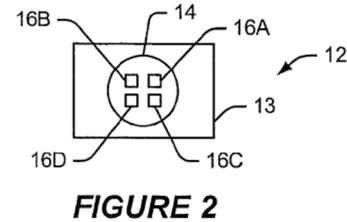
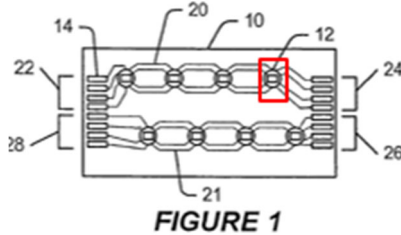
Patent Owner (PO) proposes substitute claims that lack written description. These claims cover well-known panel designs that employ strings of solid state lighting devices, a power supply, a substrate and tile together comprising a metal core printed circuit board (MCPCB) arranged horizontally, and a reflector sheet not in contact with LEDs and current supply circuits for the strings. This exact design is described in many prior art references. The revised claims are not patentable.

II. The Substitute Claims Lack Written Description Support.

There is no written description support for claim 34's "first [or second] substrate on a surface of a first [or second] tile, the first substrate and the first tile together comprising a first [or second] metal core printed circuit board (MCPCB)".

There is no description in the '075 Patent of a substrate on a surface of a tile. Rather, the '075 Patent references only a tile by itself. The only reference to any substrate in the '075 Patent is the "carrier substrate 13" on which LED chips may be mounted. Ex. 1002, at 14, [0063]. And there is no disclosure how the "carrier substrate" relates to a tile. Instead, the "carrier substrate" is described as inside "a packaged solid state lighting device" as distinguished to "a chip-on-board arrangement." *Id.* [0063], [0064]. The '075 Patent does not describe any such "carrier substrate" extending outside the packaged solid state lighting device 12, let

alone its relationship with the “tile 10.” Nor does the ’075 Patent describe the claim limitation of the substrate and tile “*together* comprising” a MCPCB.



Id., FIGS. 1 (annotated), 2. Despite this, the ’075 Patent simply recites that the tile “may include” a MCPCB. *Id.*, at 13, [0061]. There is no description of the specific arrangement of a tile and separate substrate together comprising a MCPCB.

PO’s evidence does not save this claim either. For example, PO relies on the same paragraph [0061] for support, which as discussed above, offers no such support. And there is no description of a substrate anywhere in this section of the specification. PO’s reliance on paragraph [0072] fares no better as that simply discloses multiple tiles and says nothing about a substrate or MCPCB.¹ Substitute claims 34-38 thus lack support.

¹ PO’s additional citations to Ex. 2001, which is the application from Ex. 1002, are simply parallel citations to Ex. 1002 and add nothing to help PO.

III. Mok-Holman-Lamb in Combination with Lys and Chang Render Claims 34-38 Obvious.

A. Motivation to Add Lys and Chang to the Combination.

The majority of the elements of Substitute Claims 34-38 are obvious in view of the Mok, Holman, and Lamb combination. *See also* Petition, 11-34. As detailed below, the new elements added in PO's rMTA are similarly obvious in view of that combination as modified based on the disclosure of Lys and Chang.

The Mok-Holman-Lamb combination and Lys and Chang all utilize similar components and are all aimed at creating brighter, more efficient lighting systems as well as improving heat dissipation. Ex. 1036, ¶75. Lys describes boards 204, or tiles, that hold arrays 2208 of light sources 300 and the board 204 "may positioned on top of a heat-conducting plate 7004, such as a metal plate, that acts as thermal facility 2500 for conducting heat away from the light sources 300." *See, e.g.*, Ex. 1038, 144, FIG. 70; *see also* 31, 146-146. POSA's would be motivated to modify Mok to include Lys's metal plate and metal core board to provide better heat transfer and cooling of the lighting devices. Ex. 1036, ¶77. This would lead to longer life and increased light output for the LEDs. *Id.* Chang also discloses a reflector design that helps manage heat while also allowing for a thin display. Increasing display panel size, maximizing brightness, and maintaining good heat management all would motivate one to employ Chang's teachings of reflective cavities in Mok's panel. *Id.*, ¶79-80.

Similarly, a POSA would have been motivated to use multiple circuit boards/tiles arranged horizontally, as taught by Lys, to manufacture larger size panels. *Id.*, ¶26, 29. For similar reasons, a POSA would recognize that Mok discloses electrically connected light emitting elements on a PCB. As explained by Dr. Pattison, one of skill in the art would know that PCBs use metal traces to create electrical connections. *Id.*, ¶20, 23, 24, 76. A POSA would also recognize that both Mok and Lys disclose electrically connecting strings of LEDs in series. *Id.* And a POSA would be motivated to combine the LED strings controlled by a PWM modulation technique (i.e., modulating the “pulse width of a current supplied to each one of the plurality of strings of solid state lighting devices”) and boards/tiles in Lys with the lighting systems described in the Mok to maximize brightness and efficiency, a common goal of Lys and Mok. *See, e.g.*, Ex. 1005, [0006], [0028]; Ex. 1038, 76; Ex. 1036, ¶75-78. For example, Lys states that through its lighting system “optimal efficacy may be obtained at a lower current than the level where maximum brightness occurs.” Ex. 1038, 76. A POSA would seek to create a lighting system with these desirable characteristics. Ex. 1036, ¶78.

Further, a POSA would be motivated to modify Mok to separate solid state lighting devices from the reflector while keeping the reflector sheet in contact with its base, as is described by Chang. *See* Ex. 1021, 9 (teaching “increasing the heat dissipation area of the base plate via the contact between the base plate and the

reflector.”); *see* FIG. 3 (showing light-emitting component 33, which may comprise an LED); Ex. 1036, ¶79. A POSA would be motivated to use Chang’s aforementioned design in Mok to improve heat dissipation from Mok’s light emitting elements, e.g., LEDs 14. Ex. 1005, [0033]; Ex. 1036, ¶75, 79. Similarly, a POSA would be motivated to apply Chang’s concave regions around light sources to enhance the reflecting effect as Chang describes. *See* Ex. 1021, 7 (explaining purpose of concave region is to “enhance the reflection effect.”); Ex. 1036, ¶80. A POSA would realize that this design would enhance reflection, uniformity, and heat management, which are all goals of Mok. Ex. 1005, [0032]; Ex. 1036, ¶75, 80.

For at least the above reasons, a POSA would be motivated to modify the Mok-Holman-Lamb combination based on Lys and Chang to include: (1) multiple substrates, tiles and PCBs, including a Metal Core PCB (MCPCB) and other related optical sheets, (2) a plurality of strings of solid state lighting devices connected using metal traces and in series, and (3) using Pulse Width Modulation (“PWM”) as a modulation technique to control strings of solid state lighting devices, as described in Lys, (4) to separate the solid state lighting device from the reflector while keeping the reflector sheet in contact with its base to increase the “heat dissipation area,” and (5) to form convex structures that form concave regions around light sources, as described by Chang. A POSA would also have a reasonable expectation of success in combining the disclosures of Lys and Chang with the Mok-Holman-Lamb

combination because these modifications would have been well-known, routine configurations/design choices well within a POSA's capabilities. Ex. 1036, ¶74-80.

B. Claims 34-38 are Obvious

Claim 34[a]: To the extent this claim element has support and/or is capable of interpretation (*see* Section II), the prior art discloses it. Mok discloses a base panel 12, which may comprise a “plate-like member” upon which pads are provided for mounting the LEDs. Ex. 1005, [0019]. Mok also discloses that the base panel 12 may comprise a printed circuit board (PCB)² and have a first parallel to a principal plane of the lighting panel. *See, e.g.*, Ex. 1005, [0019], FIG. 1; Ex. 1036, ¶11.

It would have been obvious to position Mok's base panel (substrate) “on top of a heat-conducting plate 7004, such as a metal plate,” (a tile) as taught by Lys for better heat dissipation. For example, similar to Mok's base panel, Lys's boards 204 hold arrays 2208 of light sources 300. *See, e.g.*, Ex. 1038, 31, 146-146. The board 204 “may be positioned on top of a heat-conducting plate 7004, such as a metal plate,

² To the extent PO argues that Mok's PCB does not have a metal core, this would have been obvious to a POSA. The term PCB is commonly known to refer to a class of PCB's that would include metal core, FR4, Teflon, and other types of materials. Ex. 1036, ¶12-14. Similarly, MCPCBs were well known in the art and commonly used in the LED applications to provide better heat dissipation. *Id.*

that acts as thermal facility 2500 for conducting heat away from the light sources 300.” *Id.*, 144, FIG. 70; Ex. 1036, ¶18. A POSA would understand or find it obvious that Mok’s base panel / Lys’s board (the claimed substrate) together with Lys’s heat-conducting plate 7004 (tile) together comprise and function as a MCPCB because of the heat-conducting function of the plate 7004 and Lys’s disclosure of “thermal facility may include” “a potting facility for receiving heat from a circuit board associated with one or more of the plurality of LEDs, and/or a metal plate” and “a metal core board for accepting heat from one or more of the plurality of LEDs.... The **metal core board may be a printed circuit board.**” Ex. 1038, 5, 31, 56; Ex. 1036, ¶17, 18, 75-77. It would have been obvious to use Lys’s tile structure with Mok’s base panel to enhance heat dissipation and create an enhanced tile comprised of Lys’s metal board/plate with Mok’s base panel. Such a combination would be particularly useful in dissipating heat. *Id.* Moreover, similar to Mok’s base panel, Lys’s board 204 is also shown as having a first side parallel to the principal plane of the lighting panel. *See, e.g., id.*, FIGS. 22b, 70, 74, 75; Ex. 1036, ¶17-18.

Claim 34[b]: Mok discloses its LEDs may be arranged in 2D arrays on the first side of the substrate. Ex. 1005, [0019]. As a POSA would recognize Mok’s disclosure of a 2D array “over both the length 38 and width 40 of the base panel 12” as also disclosing a plurality of strings. Ex. 1036, ¶20. In fact, arranging the LEDs in series on the PCB is a common practice in the art. *Id.* Finally, Mok discloses LEDs

connected through pads using drive circuitry to provide electric current to the LEDs. Ex. 1005, [0019]. A POSA would recognize that Mok's description, in conjunction with the use of a MCPCB, would disclose the use of metal traces formed in the substrate to connect the LEDs in series. Ex. 1036, ¶20, 76.

To the extent not explicitly disclosed in Mok, Lys describes boards 204 that hold arrays 2208 of light sources (e.g., 102 and 300). *See, e.g.*, Ex. 1038, FIGS. 28, 30, pp. 31, 92-94, 146-146. Lys's boards may be PCBs. Ex. 1038 at 56. Lys also teaches a plurality of strings of solid state lighting devices connected in series. *See, e.g., id.* at 96 ("a plurality of lighting units 102 in a serial configuration"); FIGS. 28, 30, 31a-c. Lys also discloses the serial lighting units connected by "circuitry." *Id.* 56-57. A POSA would understand that the use of a PCB in conjunction with the disclosed "circuitry" discloses metal traces on a substrate. Ex. 1036; *see, also, id.* at FIGS. 8, 14a-b, 30; Ex. 1036, ¶20, 24, 76.

Claim 34[c]: As discussed with respect to 34[a], Mok discloses this element. And although Mok arguably only discloses a single base panel, it would have been obvious to modify Mok to assemble multiple base panels, and hence, multiple substrates, tiles, and PCBs (e.g., the claimed second tile, substrate, MCPCB), as taught by Lys to make "large area displays," as envisioned by Mok. Ex. 1005, [0017]; Ex. 1036, ¶ 26, 29. Mok explains that the base panel size should be commensurate with its intended use. Ex. 1005, [0019]. Mok also contemplates the

use of larger sized panels to provide “high illuminations over large areas.” *Id.* at [0017]. Lys explicitly teaches using its tiles as components in multiple form to form large structures. *see also*, Ex. 1038, 31, 146-146, FIG. 8, 74-76; Ex. 1036, ¶29.

Claim 34[d]: Substitute claim 34[d] simply recites well known components, just now multiple of them (i.e. “second” set of solid state lighting devices on a substrate connected in a string in series with metal traces). *See* Section III.B, 34[b]. For the same reasons discussed with respect to claim 34[b] and [c], Mok-Lys renders obvious multiple substrates and tiles, which renders this element obvious. *Id.*, 34[b], [c]. Lys also explicitly teaches multiple boards 204 in an array. Ex. 1038, 31, 146-148, FIGS. 8, 74-78; *see also* Ex. 1036, ¶26, 29, 30.

Claim 34[e]: Mok discloses a base panel used to create a display device. Ex. 1005, [0015], FIGS. 1 and 2. Thus, it would have been obvious to modify Mok to use multiple substrates and tiles (*see* discussion on claim elements 34[a]-[d]) in a 2D array. Any such 2D array would have horizontal tiles as part of the lighting panel.

To the extent not disclosed by Mok, Lys discloses that boards 204 with metal plates may be constructed in an array that would include both vertical and horizontal arrangements. *See, e.g.*, Ex. 1038, FIGS. 8, 74-76, p. 145; Ex. 1036, ¶31, 32, 34.

Claim 34[f]: Mok discloses a reflector sheet 50 that is mounted on the first side of a substrate with solid state lighting devices. Mok, [0016]; FIGS. 1, 3. A POSA would know that Mok’s reflector sheet should not contact the solid state

lighting devices because doing so could lead to adverse effects when such reflector sheets expand due to thermal exposure. Ex. 1036, ¶35-37.

To the extent that Mok does not explicitly disclose LEDs not in contact with a reflector sheet, a POSA would have been motivated to modify Mok's lighting system to include such a desirable feature. Ex. 1036, ¶35-38, 40. For example, since Mok teaches that one way to construct reflector sheet 50 is by creating a separate "sheet-like material," including one made out of aluminum, a POSA would understand that placing the reflector too close to the LED would lead to excessive heat build-up within the reflector, shortening the service life of the reflector. *Id.* A POSA would also understand that registration and fit issues would lead one to design a sheet that had sufficient space between the sheet and the LED to avoid friction, electrical interference, and for ease of manufacturing. *Id.*

To the extent Mok does not disclose this element, it would have been obvious to modify Mok in view of Chang. Chang teaches that display panels, including its reflectors, may be subject to significant heat that may lead to undesirable effects in the panel. Ex. 1021 at 7, 9; see also, Ex. 1036. Thus, Chang teaches both separating the solid state lighting device from the reflector sheet and further teaches keeping the reflector sheet in contact with its base to increase the "heat dissipation area". *Id.* 9, FIG. 6. In light of Chang's teachings, a POSA would have been motivated to

modify Mok's reflector to not be in contact with the solid state lighting devices to better manage heat generated by LEDs. Ex. 1036, ¶40, 75, 79.

Claim 34[g]: As discussed above relative to claim element 34[f], Mok discloses this element. To the extent Mok does not teach a *second* reflector sheet, because it is obvious to include multiple tiles, it would also be obvious to include multiple reflectors. *See* discussion of element 34[c]; Ex. 1036, ¶41.

Finally, as discussed above, Chang discloses reflector sheets on a substrate and not in contact with the solid state lighting element. *See supra* Section III, 34[f]. For the same reasons discussed above, it would have been obvious to modify Mok in light of Chang's teachings to include multiple reflector sheets on substrates and reflector sheets that are not in contact with the solid state lighting devices.

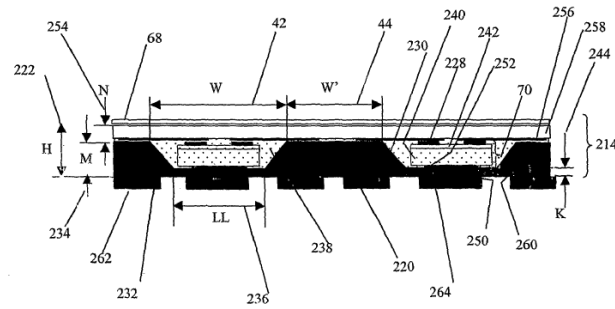
Claim 34[h]: Mok discloses reflectors (reflective surfaces 50) as between substrates (the base panels 12) and the BEF 18. *See* Ex. 1005, [0015], [0022]-[0024], FIG. 1; Ex. 1036, ¶44; Paper 1, 16-24. Moreover, as the revised claim now recites multiple reflector sheets, for the reasons discussed above relative to claim elements 34[f],[h], Mok-Holman-Lamb alone, or Mok-Holman-Lamb in combination with Lys, discloses this element. Further as a POSA would understand, Lys's panel would be constructed of similar components present in LED lighting panel systems, including tiles, substrates, reflectors, lens, diffusers, and other optical components. *See, e.g.*, Ex. 1038 at 70. Such components are universally used in lighting panel

designs, including Mok, Holman and Lamb, and using Lys's tiles in a 2D array would have been obvious to a POSA. Ex. 1038, FIG. 8; Ex. 1036, ¶43, 44, 75.

Claim 34[i]: Mok describes and shows a diffuser sheet 16 that is between the reflector sheets and the BEF. *See* Ex. 1005, [0015], FIG. 1; Ex. 1036, ¶47; Paper 1, 16-24. Similarly, now that the claim recites multiple reflector sheets, such is disclosed by the prior art as discussed above. *See supra* Section III, 34[f], [g] [h].

Claim 35: Mok discloses reflective optical cavities formed in Mok's base panel. *See, e.g.*, Ex. 1005 at [0021], [0027]-[0028]; FIGS. 1, 3; Ex. 1016, ¶23; Ex. 1036, ¶50, 51. It would have been obvious to modify Mok's optical reflective cavity in light of Chang's teachings. Ex. 1036, ¶56, 57. Chang discloses forming convex structures and then placing "light-emitting components...in a relative concave region at the side of the convex region...." Ex. 1021 at 9; *see also*, FIGS. 5A, 6. These concave regions are the claimed "optical reflective cavities" around its light sources. Ex. 1021 at 9, FIGS. 1-6. Chang also discloses that these cavities have planar angled sidewalls and are in contact with Chang's substrate, i.e. base plate 31. Ex. 1021 at 9. As shown and described in Chang, the solid state lighting elements are not in contact with the reflective cavity. *Id.* Similarly, Holman discloses reflective sloped sidewalls 230 in contact with a base layer 220, which is a substrate. These reflective sidewalls form an optical reflective cavity around the LED chips 70. Ex. 1006, 37-38, FIGS. 13-15, *see* inset, FIG. 14. And contrary to PO's

contention, Holman's teachings include embodiments that do not have a confining structure (*see above*) and where both the LED and reflectors are mounted on a substrate. Moreover, it would have been obvious to employ Holman's LED design in a panel design utilizing multiple tiles to allow for large arrays. Ex. 1036, ¶53, 54.



Claim 36: Mok, for example, discloses a generally planar diffuser 16 that may be a distance 48 from base panel 12 and reflective surface 50 that may be 50 mm “or less.” Ex. 1005 at [0023]. Thus, as zero is less than 50 mm, the distance may be zero. A POSA would have been encouraged to use low-profile LEDs, in which case the diffuser would come into contact with the reflector. Ex. 1036, ¶58-60. Mok therefore discloses a diffuser in contact with the reflector. *Id.*

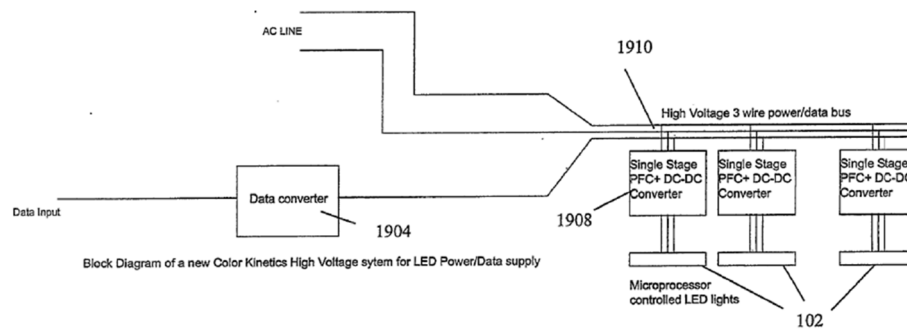
To the extent that Mok does not disclose this element, Chang does. As described above, Chang discloses using concave regions that create “optical cavities” around its light sources and that such are comprised of reflector surfaces. Ex. 1021 at 9, FIG. 6. Moreover, Chang discloses that the upper most surface of the reflective cavity, shown in FIG. 6 for example, is in contact with Chang’s diffuser 34. *See, e.g.*, Ex. 1021 at FIGS. 3, 6, p. 9. One would have been motivated to modify Mok to use Chang’s reflector as Mok teaches that light uniformity is a desirable

property. Ex. 1036, ¶¶64, 79, 80. Chang's reflector design provides a mixing cavity for light, but also allows for the display to be compact. Thus, Chang's reflective optical cavity wherein the reflector is in contact with the diffuser follows Mok's teachings to make the distance between the reflector and diffuser 50 mm or less, and provide a thin, compact design with good light uniformity. *Id.*

Claim 37: Lys describes power supply circuits that provide current to the strings of solid state lighting devices. Ex. 1038, 58:14-19 (describing power facilities 1800 that “may include or be associated with one or more power conversion devices that *convert power* received by an external power source *to a form suitable for* operation of the lighting unit 102.”). Lys also discloses that the lighting unit 102 can include a light source 300, such as LEDs. Ex. 1038, 30:10-12. Moreover, the light sources 300 can be arranged in various geometric configuration, “including two-dimensional and three-dimensional configurations.” Ex. 1038, 34:30-35:3; FIG. 3. Lys further discloses “controlling one or more LEDs in a *string*.” Ex. 1038, 83:20-22. Thus, a POSA would understand that Lys discloses a “plurality of strings of solid state lighting devices” in a two-dimensional configuration. Ex. 1036, ¶24.

Lys further describes that the power factor correction facility 1804 and the DC-to-DC converter 1812 are integrated into a single stage power factor correction/DC-to-DC converter facility 1908 that is integrated with the lighting unit 102. Ex. 1038, 60:18-21. Thus, Lys discloses that “a plurality of current supply

circuits” (e.g., the single stage power factor correction/DC-to-DC converter facilities 1908) that are operable to control a current supplied to “each one of the plurality of strings of solid state lighting devices” (e.g., each lighting unit 102). A POSA would understand that the single stage power factor correction/DC-to-DC converter facilities 1908 are current supply circuits. Ex. 1036, ¶¶68-70.



Ex. 1038, FIG. 17.

Lys also discloses that its “[c]ontrol facilities may include more complex drive facilities 3800, including various forms of drive hardware 3802” and that these control facilities may include “various methods of driving 4300, including modulation techniques such as *pulse-width-modulation*” Ex. 1038, 32:23-29. Moreover, Lys expressly states that the PWM technique is “considered one of the preferred techniques for driving LEDs.” Ex. 1038, 77:14-16. Thus, a POSA would appreciate that Lys discloses “control a *pulse width* of a current supplied to” each one of the plurality of strings because (1) PWM is widely used in the space of LED string control and (2) Lys recognizes PWM as “one of the preferred techniques for driving LEDs.” Ex. 1036, ¶¶68-70.

Claim 38: As articulated *supra*, Lys discloses that “a plurality of current supply circuits” (e.g., the single stage power factor correction/DC-to-DC converter facilities 1908) that are operable to control a current supplied to “each one of the plurality of strings of solid state lighting devices” (e.g., each lighting unit 102). Therefore, a POSA would appreciate that “the first and second plurality of strings arranged on each of the first and second substrate” are respectively “controlled by at least two current supply circuits” (e.g., a plurality of single stage power factor correction/DC-to-DC converter facilities 1908) because multiple current supply circuits are “at least two” current supply circuits. Ex. 1036, ¶¶68-70, 72.

IV. Mok-Holman-Lamb-Lys-Chang in Combination with Grootes Render Claims 37-38 Obvious.

A. Motivation to Add Grootes to the Combination.

A POSA would be motivated to modify the Mok-Holman-Lamb-Lys-Chang combination to further include a plurality of current supply circuits controlled by a PWM controller, as is described in Grootes. Ex. 1040, [0035]-[0037], [0048]-[0049], FIG. 4. A POSA would recognize that including PWM control of multiple current supply circuits would provide a more efficient, uniform lighting system, which are common goals of Grootes, Lys, and Mok. *See, e.g.*, Ex. 1005, [0006], [0028]; Ex. 1040, [0010]; Ex. 1038, 76:26-77:2; Ex. 1036, ¶¶85-87. Grootes explains that its LED strings and control system helps “minimize energy dissipation by the current source” and create “uniform light output characteristics,” which would be highly desirable

to a POSA. Ex. 1040, Abstract, [0010]; Ex. 1036, ¶85-87. Notably, Lys’s teachings that the PWM technique is “considered one of the *preferred techniques* for driving LEDs” would further incentivize a POSA to incorporate Grootes’s PWM control mechanism with a reasonable expectation of success. Ex. 1036, ¶70, 85-87.

B. Claims 37-38 are Obvious

Claim 37: To the extent one would argue that Lys fails to disclose limitations recited in substitute claim 37, Grootes describes a “PWM controller” which is connected to “PWM control line in FIG. 4, that receives a control signal.” Ex. 1040, [0035]-[0037], [0041]-[0044]. The PWM controller delivers control signals based on information that is sent to it from a “programmed microprocessor, a memory, or other controller,” via a communication link. *Id.* As shown in Figure 4, Grootes discloses there are a plurality of PWM control lines delivering control signals to a plurality of current supply circuits (e.g., current sources 40, 41, 42) that are operable to control respectively the pulse width of the current supplied to each LED string. *Id.*, FIG. 4, [0035]-[0037], [0048]-[0049]. As such, the Mok-Holman-Lamb-Lys-Chang-Grootes combination renders claim 37 obvious. Ex. 1036, ¶71.

Claim 38: To the extent Lys does not disclose this element, Grootes discloses that “a plurality of current supply circuits” (e.g., current sources 40, 41, 42) that are operable to control a current supplied to “each one of the plurality of strings of solid state lighting devices” (e.g., LED strings 32, 33, 34). Therefore, a POSA would

appreciate that “the first and second plurality of strings arranged on each of the first and second substrate” are respectively “controlled by at least two current supply circuits” (e.g., multiple current sources 40, 41, 42) because multiple current supply circuits are “at least two” current supply circuits. Ex. 1036, ¶¶71, 73. As such, the Mok-Holman-Lamb-Lys-Chang-Grootes combination renders claim 38 obvious.

V. Epstein-Holman-Lamb in Combination with Lys Render Claims 34-38 Obvious.

A. Motivation to Add Lys to the Combination

As described in further detail below, the majority of the elements of Substitute Claims 34-38 are rendered obvious by the combination addressed in the Epstein-Holman-Lamb combination. *See* Petition, 34-51. PO’s new elements are similarly obvious in view of that combination as modified by Lys.

First, both the Epstein-Holman-Lamb combination and Lys all utilize similar components and are all aimed at creating brighter, more efficient lighting systems and managing heat. Ex. 1036, Ex. 1036, ¶82. Like Epstein, Lys describes a metal layer for, *inter alia*, managing heat. *See, e.g.*, Ex. 1038 (disclosing board 204 on top of “heat-conducting plate 7004” “that acts as thermal facility 2500 for conducting heat away from the light sources 300.”); *see also id.* at pp. 31, 144-146, FIGS. 8, 70. Lys also discloses a metal core PCB, which can be used to enhance heat dissipation. Thus, a POSA would be motivated to modify Epstein to include a metal core board to increase heat transfer and thus cooling of LEDs. Ex. 1036, ¶83. This would lead

to longer life and increased light output for LEDs. Ex. 1036, ¶77, 83. A POSA would recognize that both Epstein and Lys describe tiles in a 2D array that include horizontal tiles, plurality of strings of solid state lighting devices connected in series, and metal traces on the substrate for electrical connections. Ex. 1036, ¶82, 83.

Finally, a POSA would be motivated to combine the LED strings controlled by the PWM technique and boards in Lys with the lighting systems described in Epstein to maximize brightness and efficiency, a common goal of Lys and Epstein. *See, e.g.*, Ex. 1008, [0121]; Ex. 1038, 76; Ex. 1036, ¶82, 83. For example, Lys states that through its lighting system “optimal efficacy may be obtained at a lower current than the level where maximum brightness occurs.” Ex. 1038, 76.

For at least the above reasons, a POSA would be motivated to modify the Epstein-Holman-Lamb combination based on Lys to include: (1) PCBs, including a MCPCB, (2) a plurality of strings of solid state lighting devices connected using metal traces and in series, and (3) using PWM techniques to control strings of solid state lighting devices, as described in Lys. A POSA would also have a reasonable expectation of success in this combination because these modifications were well-known and routine configurations/design choices. Ex. 1036, ¶82, 83.

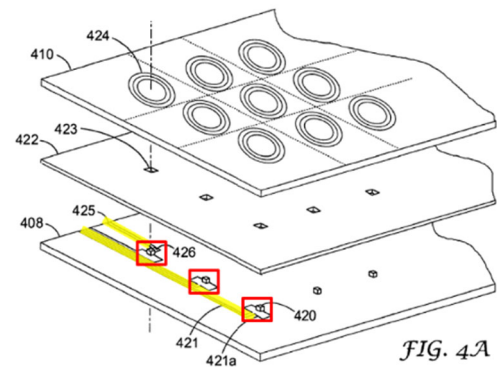
B. Claims 34-38 are Obvious

Claim 34[a]: Although PO’s claims are not supported, to the extent this element can be understood, Epstein discloses it under multiple, different

understandings. Epstein describes a display panel comprised of multiple tiles 304 with each tile comprised of a number of layers (including, for example, substrate 308/408 and guiding layer 310/410). Ex. 1008, [0039], [0055]. Epstein also discloses that its substrate may have a metallic layer on its lower surface “for extracting heat generated by the LEDs”. *Id.* at [0054]. A POSA would understand that Epstein’s metallic layer is the claimed “tile” and Epstein’s substrate is the claimed “substrate” on a surface of a tile (i.e. metallic layer). Alternatively, a POSA would understand that Epstein’s multi-component tile has a metallic layer and substrate layer that is the claimed “tile,” while Epstein’s substrate, as a component of its tile, is on a surface of the claimed “tile.” Ex. 1036, ¶16. Under both of the above understandings, Epstein describes that the LEDs of each tile may be connected by conductors, which may be “metallic traces”. Ex. 1008, [0051]. Such metallic traces are positioned on the substrate to carry current to the LED. *Id.*, [0046], [0051], [0055]. A POSA would understand Epstein’s substrate that may be formed of metal and include metallic traces as a MCPCB. Ex. 1036, ¶16. As Dr. Pattison explains, MCPCBs make excellent substrates and were commonly used because they create electrical connections between arrays of LEDs and also serve as heat sinks for the LEDs. Ex. 1036, ¶12-14; *see also*, Ex. 1037, [0039]. Finally, Epstein’s substrate 308/408 also has a first side parallel to a principal plane of the lighting panel. Ex. 1008, [0039], [0046], [0051], FIG. 4A; Ex. 1036, ¶16.

To the extent Epstein does not explicitly disclose a MCPCB, Lys, for the reasons explained above, Lys does. Ex. 1038, 5, 31, 56; Ex. 1036, ¶18; *see also*, Section IV.B, 34[a]. Further, it would have been obvious to modify Epstein’s system with the teachings of Lys for the reasons explained above.

Claim 34[b]: Epstein discloses light emitting elements mounted on the first side of the metal substrate 308/408. Ex. 1008, FIGS. 3A, 4A, [0039], [0046]. Epstein goes on to state LEDs 420 may be bonded to conductors 421/425 on the substrate 408, where the conductors “may take the form of metallic traces.” *Id.*, [0051]; FIG. 4A. Thus, as shown in Figure 4A, the LEDs 420 are connected in series with one another by a plurality of metal traces 421/425 formed on the first side of the first substrate 408. *Id.*, FIG. 4A (annotated); Ex. 1036, ¶21-23.



Further, a POSA would understand that LEDs connected as shown in FIG. 4A are connected as a string in series. Ex. 1036, ¶22. To the extent that PO argues Epstein does not explicitly disclose LEDs in strings, such an arrangement of LEDs was well-known in the art, and well within a POSA’s toolkit. *Id.*, ¶20, 23. Finally, to the extent this is not explicitly disclosed by Epstein, it would have been obvious to modify Epstein’s design with Lys’s teachings. *See*, Section IV.B, 34[b]; Ex. 1036, ¶24. More specifically, Lys discloses the use of strings in series on a substrate and

such an arrangement is visually shown in Epstein's FIG. 4A. *Id.* Thus, it would have been obvious to use Lys's teachings to serially connected Epstein's LEDs.

Claim 34[c]: Epstein discloses "a number of tiles 304" with the same features described with respect to substitute claim 34[a]. Ex. 1008, [0039]; *See*, Section V.B, 34[a]. Epstein also describes tile 304 as comprising a substrate, upon which LEDs may be mounted. Ex. 1008, [0039]. Finally, Epstein specifically contemplate tiles that are comprised of separate tiles, *each* with its own metallic layer, substrate, MCPCB, upon which LEDs may be mounted. *Id.*, [0039], [0045]; Ex. 1036, ¶27, 28.

Claim 34[d]: For the same reasons set for with respect to element 34[b] in this Section, Epstein discloses this element. Similarly, to the extent not taught by Epstein, Lys teaches a plurality of strings of solid state lighting devices connected in series by a plurality of metal traces arranged on the first side of a substrate. *See*, Section V.B, 34[b]; Section IV.B, 34[b] and [d].

Claim 34[e]: Epstein discloses first and second tiles arranged horizontally across the lighting panel. *See, e.g.*, Ex. 1008, FIG. 3A and [0039]. To the extent not taught by Epstein, Lys discloses this element. *See*, Section IV.B, 34[e].

Claim 34[f]: Epstein discloses an intermediate layer 422/522/622 that is a reflector sheet mounted on the substrate 408/508/608. *See, e.g.*, Ex. 1008, [0054], [0059]-[0062], FIGS. 4, 5D, 6. Epstein further states that "the aperture in the

intermediate layer 522 may be larger than the LED 520” such that the intermediate layer 522 and the LEDs 520 are not in contact. *Id.* FIG. 5D; Ex. 1036, ¶39.

Claim 34[g]: Epstein further discloses “a number of tiles 304” and substrates therein with these same features. *See* Ex. 1008, [0039]; Sections V.B, 34[f], IV.B, 34[e], [f]; Ex. 1036, ¶42, 43.

Claim 34[h]: Epstein describes and shows a reflector (intermediate later 422/622) on the substrate (408/608) and between the substrate and BEF 662 and 664. *See* Ex. 1008, [0074-0075], FIGS. 4A, 11; Paper 1, 38-44. Further, Epstein discloses multiple tiles with the same structure and positional placement. *See*, Section IV.B, element 34[i]; Ex. 1036, ¶45, 46.

Claim 34[i]: Epstein discloses a guiding layer 510/610 that functions as a diffuser, explaining that the guiding layer “spreads” light. *See, e.g.*, Ex. 1008, [0066], [0084] (“Another approach to *spreading the light from the LED* 620 within the guiding layer 610 is now discussed with reference to FIG. 19A.” (emphasis added)); Ex. 1003, ¶100, Paper 1, 38-44. Epstein teaches that guiding layer 610 may include a diffuser. *Id.*, [0084]. As shown in Figure 11, the guiding layer 610 (i.e., the diffuser) is positioned between the reflector sheet 622 and the BEFs 662 and 664. Ex. 1008, [0067], [0074], FIG. 11. Epstein also discloses multiple tiles with the same structure, and thus discloses a diffuser sheet between the first and second reflector sheets and the brightness enhancement film. Epstein’s first and second reflector

sheets, diffuser sheet, and BEF also extend and are arranged parallel to the principal plane of the lighting panel. Ex. 1008, FIG. 11; Ex. 1036, ¶48, 49.

Claim 35: Epstein discloses a reflective sheet 522 that creates an optical reflective cavity around each LED 520 disposed on and in contact with substrate 508. Ex. 1008, [0058]-[0061]; Ex 1036, ¶52. As shown in Figure 5D, the reflector sheet 522 is in contact with the substrate 508, has planar angled sidewalls (i.e. 90° angle), and does not contact the LEDs 520. Moreover, Holman, for the same reasons explained above, discloses this element. *See supra* Section IV.B, claim 35.

Claim 36: Epstein discloses a diffuser (guiding layer 510) in direct contact with the uppermost surface of the reflective cavity, as defined by the reflector sheet 522. Ex. 1008, [0058-0061], [0066], [0084], FIG. 5D. Holman also discloses substitute claim 36, describing and showing a diffuser 68 in direct contact with the uppermost surface of the optical reflective cavity created by reflective sidewalls 230. Ex. 1006, 37-39, FIGS. 13, 14, 15; Ex. 1036, ¶61-63.

Claim 37: Epstein discloses control circuits which “selectively provide[] current to individual light emitting elements so as to illuminate a desired pattern on the display panel 104.” Ex. 1008, [0035]. Moreover, to the extent Epstein does not disclose this element, Lys does as set forth in Section III.B, claim 37 above.

Claim 38: Lys discloses this element as described above in Section III.B, claim 38. Thus, Epstein in combination with Lys discloses this claim.

VI. Epstein-Holman-Lamb-Lys in Combination with Grootes Render Claims 37-38 Obvious.

A. Motivation to Add Grootes to the Combination.

A POSA would be motivated to modify the Epstein-Holman-Lamb-Lys combination to further include a plurality of current supply circuits controlled by a PWM controller, as is described in Grootes. Ex. 1040, [0035]-[0037], [0048]-[0049], FIG. 4; Ex. 1036, ¶88-90. A POSA would recognize that including PWM control of multiple current supply circuits would provide a more efficient, uniform lighting system, which is a common goal of Grootes as well as Lys and Epstein. *See, e.g.*, Ex. 1008, [0121]; Ex. 1040, [0010]; Ex. 1038, 76:26-77:2; Ex. 1036, ¶88-90. Grootes explicitly states that its LED strings and control system helps “minimize energy dissipation by the current source” and create “uniform light output characteristics,” which would be highly desirable to a POSA. Ex. 1040, Abstract, [0010]; Ex. 1036, ¶88-90. Notably, Lys’s teachings that the PWM technique is “considered one of the *preferred techniques* for driving LEDs” would further incentivize a POSA to incorporate Grootes’s PWM control mechanism with a reasonable expectation of success. Ex. 1036, ¶70, 88-90.

B. Claims 37-38 are Obvious

Grootes discloses the elements in claims 37 and 38. *See* Section III.B.

VII. Conclusion

PO’s substitute claims are invalid.

Respectfully submitted,

By: /s/ Matias Ferrario

Matias Ferrario

Registration No. 51,082

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on the date below a copy of this
PETITIONER'S OPPOSITION TO PATENT OWNER'S REVISED
CONTINGENT MOTION TO AMEND has been served via email on the
following:

hni@nilawfirm.com
twang@nilawfirm.com
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Dated: December 17, 2024

By: /s/ Matias Ferrario
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