

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. 8,941,331
Filing Date: May 17, 2013
Issue Date: January 27, 2015
Title: SOLID-STATE LIGHTING PANELS WITH VARIABLE VOLTAGE
BOOST CURRENT SOURCES

Ex. 1027 – Third Declaration of Rafael Betancourt

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I, Rafael J. Betancourt, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Reviews of U.S. Patent No. 8,941,331 (“the ’331 Patent”) and the Revised Contingent Motion to Amend (the “Revised Motion”) Filed by Patent Owner in the *Inter Partes* Review Proceeding.

3. I provide this Declaration at the request of and have been retained by Kilpatrick Townsend & Stockton, LLP, which represents Hisense USA Corporation (“Hisense”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Hisense contends that substitute claims 26-34 submitted by the Patent Owner in the Motion are invalid.

4. I am being compensated at an hourly rate of \$750 per hour. My compensation is not dependent on the outcome of or any issue in relation to the above-captioned *Inter Partes* Review, and I have no interest in either party.

5. In forming my opinions, I relied on my knowledge, education, experience, and training in the field and on documents and information referenced in this Declaration.

6. My qualifications are summarized in Ex. 1003, which is my prior declaration in this proceeding and my CV, which was submitted as Ex. 1004. *See* Ex. 1003, ¶¶6-13. I am not a lawyer, however, my understanding of the legal issues with respect to obviousness are summarized in my prior declaration. *See* Ex. 1003, ¶¶14-21. My prior declaration also provides my opinion on the appropriate level of experience for a person to be a person of ordinary skill in the art. *See* Ex. 1003, ¶¶23-25.

II. Materials Considered

7. In addition to the materials identified in my first declaration (*see* Ex. 1003, ¶27) and my second declaration (*see* Ex. 1022, ¶7) in forming my opinions, I have considered the following documents and things that I have obtained, or that have been provided to me:

Exhibit	Description
1023	TW 502928U to Yu (“Yu”)
1024	Certified Translation of Yu
1025	CN 2726277Y to Zhong (“Zhong”)
1026	Certified Translation of Zhong
1028	Narendran, PIER Lighting Research Program – Project 2.3 Low-profile LED Luminaires Final Report (“Narendran”)

8. In addition to the documents above, in forming the opinions expressed below, I have also considered my own knowledge and experience based upon my education and work in the fields of LEDs, circuitry, and display technology, as described above and in my *curriculum vitae* (Ex. 1004).

III. Patent Owner's Substitute Claims.

9. I am informed and understand that Patent Owner has proposed to substitute original claims 17-25 of the '331 Patent with the following substitute claims (the "Substitute Claims"):

26. (proposed substitute for Claim 17) A lighting system, comprising:
a lighting panel including at least a first lighting tile and a second lighting tile, each lighting tile comprising at least a first string of solid state lighting devices, and a second strings of solid state lighting devices;
wherein each of said strings that are respectively configured to emit at least a first light and a second light, respectively;
wherein the brightness of the at least first light and second light is a function of the duty cycle of the string;
wherein each of the first lighting tile and second lighting tile are arranged horizontally in the lighting panel;
wherein each of the at least first, and second lighting tiles comprise a metal core printed circuit board (MCPCB) on which a plurality of patterned metal traces are formed and having thereon a polymer coating;
at least first and second current supply circuits coupled to the at least first and second strings of solid state lighting devices, respectively, and configured to supply an on-state drive current to a respective one of the first and second strings of solid state lighting devices; ~~and~~
wherein the at least first and second current supply circuits are coupled to the at least first and second strings of solid state lighting devices at least in part by one of the plurality of patterned metal traces formed on MCPCB;
a pulse width modulation (PWM) controller that is coupled to the at least first current supply circuit and the second current supply circuit and that is configured to generate, for each of the at least first current supply circuit and the second current supply circuit, a first PWM control signal and a second PWM control signal that are supplied to the each of the at least first and second strings of solid state lighting devices.

27. (proposed substitute for claim 18) The lighting system according to claim ~~17~~ 26, wherein the PWM control signals both have a period of approximately 5ms or a frequency of approximately 200Hz. each of the first

~~and second current supply circuits comprises a variable voltage boost, constant current power supply circuit configured to operate in continuous current mode.~~

28. (proposed substitute for claim 19) The lighting system according to claim ~~48~~ 26, wherein the PWM control signals both have a period greater than 0.5ms or a frequency of less than 2000Hz. ~~each of the first and second current supply circuits comprises: a temperature sensor that is configured to generate a sensor output signal that the PWM controller uses to generate the first PWM signal or the second PWM signal, and a sense resistor that is coupled to an output terminal of the current supply circuit and that is configured to provide a feedback signal to the PWM controller.~~

29. (proposed substitute for claim 23) The lighting system according to claim ~~22~~ 26, wherein each of the solid state lighting devices comprises at least two or more light emitting diodes each covered by the same encapsulant. ~~wherein the first current supply circuit provides current control of the first string of solid state lighting devices that is independent of current control of the second string of solid state lighting devices provided by the second current supply circuit.~~

30. (proposed substitute for claim 24) The lighting system according to claim ~~22~~ 26, wherein an interconnect is mounted on each tile. further comprising a third string of solid state lighting devices that are configured to emit a third light that includes a dominant wavelength corresponding to a red color.

31. (proposed substitute for claim 20) The interconnect according to claim ~~47~~ 30, comprising a low-profile configured so as to not interfere with the optical performance of the LEDs. ~~each of the first and second current supply circuits comprises a sense resistor that is coupled to an output terminal of the respective one of the first and second current supply circuits and that is coupled to a feedback input to provide the feedback signal to provide closed loop control.~~

32. (proposed substitute for claim 25) The lighting system according to claim ~~24~~ 30 wherein each tile is coupled to a flexible connector. further comprising a third current supply circuit that is configured to supply an on-state drive current to the third string of solid state lighting devices, and wherein the first current supply circuit provides current control of the first string of solid state lighting devices that is independent of current control of

~~the second string of solid state lighting devices provided by the second current supply circuit and that is independent of current control of the third string of solid state lighting devices provided by the third current supply circuit~~

33. (proposed substitute for claim 21) The lighting system according to claim ~~20~~ 32, wherein the tiles are mounted to a metal backplate that contains a through hole. ~~further comprising a filter coupled to the sense resistor, the filter configured to filter the feedback input. wherein~~

34. (proposed substitute for claim 22) The metal backplate lighting system according to claim ~~17~~ 33, wherein the flexible connector travels via the through hole to the interconnect mounted on the tile substrate. ~~the first string of solid state lighting devices are coated with a wavelength conversion phosphor and are configured to emit the first light that includes a combined light including a dominant wavelength corresponding to a blue color and a dominant wavelength corresponding to a yellow color, and wherein the second string of solid state lighting devices are configured to emit the second light that includes a dominant wavelength corresponding to a red color.~~

IV. The Prior Art Renders Every Element of Substitute Claims 26-34 Obvious.

10. In my first declaration, I broke down the elements of claims 17-25 and demonstrated that each of the elements of those claims were known in the art before November 18, 2005, the priority date of the '331 Patent. *See* Ex. 1003, ¶¶49-122. In my second declaration, I broke down the elements of Substitute Claims 26-27 proposed by Patent Owner in the Contingent Motion to Amend and demonstrated that each of the elements of those claims were known in the art before the priority date of the '331 Patent. *See* Ex. 1022, ¶¶10-46.

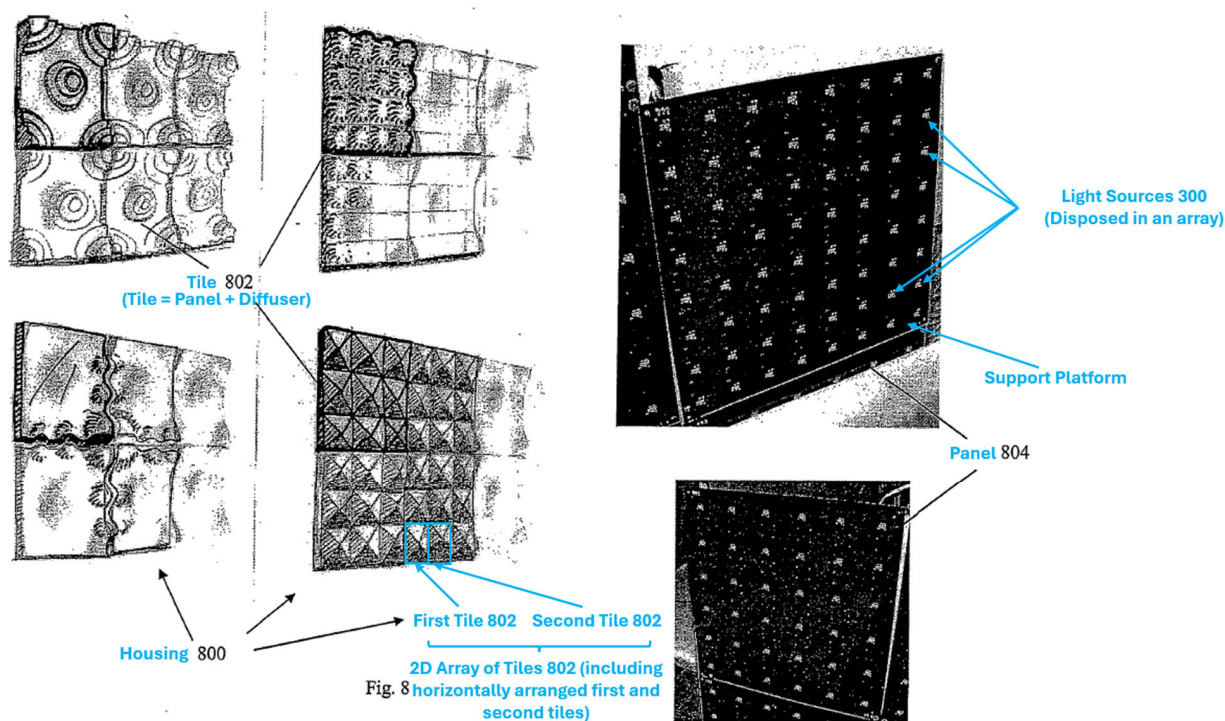
11. In the analysis below I address the new elements of Substitute Claims 26-34 proposed by Patent Owner in the Revised Contingent Motion to Amend and demonstrate that each of these elements was also known in the art before the priority date of the '331 Patent. I group these new elements into the following eight groupings (corresponding to Sections A-H below) based on the substances thereof.

- A. A lighting panel including at least a first lighting tile and a second lighting tile, each lighting tile comprising at least a first string of solid state lighting devices, and a second strings of solid state lighting devices; wherein each of said strings are respectively configured to emit at least a first light and a second light, respectively; ... wherein each of the first lighting tile and second lighting tile are arranged horizontally in the lighting panel. (Substitute Claim 26).**

12. As discussed in my first declaration, lighting panels using multiple strings of LEDs were known in the prior art, such as Lys (Ex. 1005). Ex. 1003, ¶¶51-53. Moreover, as discussed in my second declaration, configuring multiple tiles, each containing multiple LED strings, into a 2D array is well-known in the field of display technology. Ex. 1022, ¶¶12-21. Specifically, Lys describes an example where the housing 800, which is equivalent to the claimed “lighting panel,” includes tiles 802 configured into a 2D array, and each tile 802 includes a support platform and an array of light sources 300 disposed on the support platform. Ex. 1005, 49:15-17.

13. I understand that Patent Owner, in Substitute Claim 26, now proposes to recite “a first lighting tile and a second lighting tile” and “wherein each of the first lighting tile and the second lighting tile are arranged horizontally in the lighting panel.”

14. As shown in the annotated Figure 8 of Lys, the 2D array of tiles 802 includes the first tile and the second tile, which are horizontally arranged. The horizontally arranged tiles 802 can be used on or as a part of a wall, door, window, ceiling, floor, or other architectural features. Ex. 1005, 49:19-21. The 2D array design of tiles 802, which includes horizontally arranged individual tiles, provides design flexibility and can cover a larger area as needed. A POSITA would readily understand that the teaching of the 2D array of tiles 802 inherently suggests “a first lighting tile and a second lighting tile” that are “arranged horizontally in the lighting panel.”



Ex. 1005, Fig. 8 (annotated).

B. Wherein the brightness of the at least first light and second light is a function of the duty cycle of the string. (Substitute Claim 26).

15. I understand that Patent Owner, in Substitute Claim 26, now proposes to recite “wherein the brightness of the at least first light and second light is a function of the duty cycle of the string.”

16. Adjusting the brightness (i.e., intensity) of the light emitted by a string of solid state lighting devices by changing the duty cycle is well known in the field of display technology. For example, Lys describes “varying the respective intensities of the light sources ... using a duty cycle in a pulse width modulation technique.” Ex. 1005, 35:16-24. As the duty cycle increases, the percentage of time

during which the solid state lighting devices are turned on increases as well. As a result, the brightness of the light emitted by these solid state lighting devices increases.

17. Lys also describes, in one example, that a switch 3900 used for turning on the current to a light source 300 can turn on or off in rapid pulses, such as in PWM of the current to the LEDs, which results in changes in the apparent intensity of the LED, “based on the percentage of the duty cycle of the pulse width modulation technique.” Ex. 1005, 74:7-15. Lys further explains that the apparent intensity of the LEDs reflects the portion of the duty cycle of a PWM signal during which the LED is on as compared to the portion during which it is off. Ex. 1005, 81:21-24.

18. Thus, based on at least these teachings in Lys, a POSITA would understand that the brightness of the at least first light and second light is a function of the duty cycle of the string.

C. Wherein each of the at least first, and second lighting tiles comprise a metal core printed circuit board (MCPCB) on which a plurality of patterned metal traces are formed and having thereon a polymer coating; ... wherein the at least first and second current supply circuits are coupled to the at least first and second strings of solid state lighting devices at least in part by one of the plurality of patterned metal traces formed on MCPCB. (Substitute Claim 26).

19. I understand that Patent Owner, in Substitute Claim 26, now proposes to recite “wherein each of the at least first, and second lighting tiles comprise a

metal core printed circuit board (MCPCB) on which a plurality of patterned metal traces are formed and having thereon a polymer coating.” I also understand that Patent Owner, in Substitute Claim 26, now proposes to recite “wherein the at least first and second current supply circuits are coupled to the at least first and second strings of solid state lighting devices at least in part by one of the plurality of patterned metal traces formed on MCPCB.”

20. Using metal core printed circuit board (MCPCB) for electrical connection and thermal management is well known in the space of backlighting technology. A PCB is a substrate or platform used to connect or “wire” electronic components such as the claimed “first and second strings of solid state lighting devices.” It usually takes the form of a laminated sandwich structure of conductive and insulating layers. Each of the conductive layers is designed with a pattern of metal (e.g., copper) traces. Electronic components are usually attached to conductive pads on the outer layers by means of, for example, soldering. Vias or drill holes may also be utilized to allow for electrical interconnections between multiple conductive layers. A PCB also typically includes a conformal coating, which is applied on the patterned metal traces and prevents corrosion and leakage currents or shorting due to condensation. Common materials employed as the coating include various types of polymers (e.g., silicone rubber, polyurethane, acrylic, epoxy, etc.). A POSITA would know a dielectric material is not

necessarily a polymer, although a polymer is one of many types of dielectric materials.

21. MCPCB is a special type of PCBs. A MCPCB utilizes a utilizes a metal core for heat dissipation. Unlike traditional PCBs (e.g., FR4 PCBs), which use non-conductive material as the base, MCPCBs incorporate a metal “core” layer to efficiently conduct and distribute heat generated by electronic components placed thereon. The metal core acts as a heat sink, drawing heat away from critical components and preventing overheating. This is crucial for high-power devices like LEDs, power amplifiers, and other heat-sensitive components. Specifically, MCPCBs are widely used in LED lighting fixtures to efficiently dissipate heat from high-power LEDs, ensuring optimal performance and longevity. The metal core can enhance signal integrity and reduce electromagnetic interference (EMI) due to its conductive properties. MCPCBs are generally more robust and durable than traditional PCBs, making them suitable for demanding applications. The metal core is usually made of aluminum, copper, or steel.

22. I am informed that Narendran (Ex. 1028), entitled “PIER Lighting Research Program – Project 2.3 Low-profile LED Luminaires Final Report,” was published before November 18, 2005, the priority date of the ’331 Patent and therefore serves as evidence of what knowledge a person of ordinary skill in the art would possess at the relevant time, which is consistent with my opinion as to what

one of ordinary skill in the art would know prior to the earliest priority date of the '331 Patent. Narendran states that a traditional PCB becomes an obstacle between the LED and the heat sink and increases the thermal resistance. Ex. 1028, p. 29. A standard PCB made of FR4 or similar materials was not an acceptable solution with respect to thermal management. Ex. 1028, p. 29. Thus, the PCB “needed to have a metal core (i.e., metal-core printed circuit board (MCPCB))” in order to transfer heat from the LED into the heat sink efficiently. Narendran further describes that MCPCBs have an electrically insulating but heat conductive layer on the metal core in order to prevent short circuits. Ex. 1028, p. 29. LEDs are then “attached” to the MCPCB. Ex. 1028, p. 30.

23. In addition, the prior art of record discloses these new elements. Lys discloses that the board 204 may be a metal core board for accepting heat from the light sources 300 and trapping the heat away from the light sources 300. Ex. 1005, 56:18-19. Lys further teaches that the metal core board may be a printed circuit board (PCB) and the board 204 may be a PCB. Ex. 1005, 5:19-20; 56:21; 144:11. Therefore, Lys teaches the lighting tiles that each comprises an MCPCB. As explained above, a POSITA would appreciate that the MCPCB is characterized by patterned metal traces on the MCPCB and a polymer coating on the patterned metal traces. A POSITA would also appreciate that current supply circuits can be coupled to the first and second strings of solid state lighting devices “at least in

part by one of the plurality of patterned metal traces formed on MCPCB” because the patterned metal traces are intended for electrical connections.

24. Henson (Ex. 1020) discloses an interconnect circuit layer “utilized to provide thermal management for and electric connection.” Ex. 1020 at ¶46. The interconnect circuit layer comprises a multilayer structure, which can comprise a metal mounting substrate 112 (made of copper or other thermally conductive material), an electrically insulative dielectric layer 114, and a patterned conductive layer 113, where the LED dies are operatively connected to bond pads of the conductive layer 113. Ex. 1020 at ¶46. Henson further describes that the electrically insulative dielectric layer 114 may comprise of a variety of suitable materials, including polyimide, polyester, polyethylene terephthalate (PET), polycarbonate, polysulfone, or FR4 epoxy composite. Ex. 1020 at ¶46.

25. A POSITA would understand that the interconnect circuit layer discussed in Henson is a type of MCPCB, on which the patterned conductive layer 113 (including “a plurality of patterned metal traces”) are formed and that the dielectric (e.g., polymer) layer 114 should be applied over the patterned metal traces to provide insulation, protect the copper from corrosion, and prevent shorting between the traces, as explained above.

26. A POSITA would also appreciate that for the first and second current supply circuits to supply driving current to the LEDs (“the at least first and second

strings of solid state lighting devices”), the first and second current supply circuits are coupled to the LEDs at least in part by the patterned conductive layer 113 (“a plurality of patterned metal traces” formed on the MCPCB) because the patterned metal traces are intended for electrical connections.

D. Wherein the PWM control signals both have a period of approximately 5 ms or a frequency of approximately 200 Hz. (Substitute Claim 27) Wherein the PWM control signals both have a period greater than 0.5 ms or a frequency of less than 2000 Hz. (Substitute Claim 28)

27. I understand that Patent Owner, in Substitute Claim 27, now proposes to recite “wherein the PWM control signals both have a period of approximately 5 ms or a frequency of approximately 200 Hz.” I also understand that Patent Owner, in Substitute Claim 28, now proposes to recite “wherein the PWM control signals both have a period greater than 0.5 ms or a frequency of less than 2000 Hz.”

28. I am informed that Yu (TW 502928U) is prior art to the ’331 Patent. Yu (Ex. 1024) is entitled “control device with high-efficiency cold cathode fluorescent lamp.” Yu generally relates to a control device with a high-efficiency cold cathode fluorescent lamp, and especially to a cold cathode fluorescent lamp control device for starting and adjusting brightness. Ex. 1024, p. 4. As shown in Figure 2, the control device includes a Royer oscillation circuit 1, a cold cathode fluorescent lamp 2, and a PWM controller 4. Ex. 1024, p. 7; Figure 2. A feedback signal is utilized to control the Royer oscillation circuit 1 to turn on and off, and

the cold cathode fluorescent lamp 2 is started by adjusting a beam density so that the liquid crystal display has higher brightness, more power saving, and less expensive requirements. Ex. 1024, p. 7. The clock in which the bright (i.e., turned on) and dark (i.e., turned off) states of the Royer oscillation circuit 1 appear alternately is provided by an output 15 of the PWM controller 4. Ex. 1024, p. 9. The PWM controller 4 determines a duty cycle of the output clock according to a magnitude of detected average current output 16 through current feedback 3, and thus controls the average current flowing through the cold cathode fluorescent lamp 2 by a proportion in one clock time. Ex. 1024, p. 9. In one example, a traditional general-purpose PWM controller 4 at a low speed of 90-200 Hz is used to control the beam density. Ex. 1024, p. 9.

29. Thus, Yu discloses a PWM control signal having “a frequency of approximately 200 Hz.” As the period of the PWM control signal is the inverse of the frequency of the PWM control signal, a POSITA would understand that Yu inherently discloses a PWM control signal having “a period of approximately 5 ms (i.e., 1/200 s).”

30. A POSITA would also understand that the “traditional general-purpose PWM controller 4 at a low speed of 90-200 Hz” disclosed in Yu can be used for the PWM controller discussed in Lys, which generates “a first PWM control signal and a second PWM control signal” because it is traditional and

general-purpose. Thus, Yu discloses “the PWM control signals both have a period of approximately 5 ms or a frequency of approximately 200 Hz.”

31. In addition, since Yu discloses the frequency range between 90 Hz and 200 Hz, a POSITA would understand that Yu inherently discloses the period range between 5 ms and 11.11 ms. As a matter of fact, the frequency range between 90 Hz and 200 Hz is less than 2000 Hz, whereas the period range between 5 ms and 11.11 ms is greater than 0.5 ms.

32. Moreover, it is common practice to implement a broad PWM frequency/period range when designing an LED lighting control circuit. A POSITA would be incentivized to modify, for example, the disclosed frequency range (i.e., 90-200 Hz) to encompass a wider frequency range (e.g., 90-2000 Hz) for various technical reasons related to both electrical and optical interference mitigation. First, the PWM switching “noise” may couple into sensitive electronic circuits within the system that contains the lighting system via either power supply connections or parasitic wiring coupling. Second, the light “flicker” due to the PWM frequency, although not directly detectable to the human eye in most cases, can cause visual artifacts due to beat frequencies related to the difference between the PWM frequency and either the room lighting frequency (e.g., 50/60 Hz and harmonics) or the refresh frequency (and harmonics) of the display being illuminated. For these reasons, a POSITA will know the need to “tune” the PWM

frequency to avoid causing interference, and thus require a relatively broad range of PWM frequencies to choose from (e.g., 90-2000 Hz). As the period of the PWM control signal is the inverse of the frequency of the PWM control signal, the same rationale applies to the corresponding period range (i.e., 0.5 ms to 5 ms).

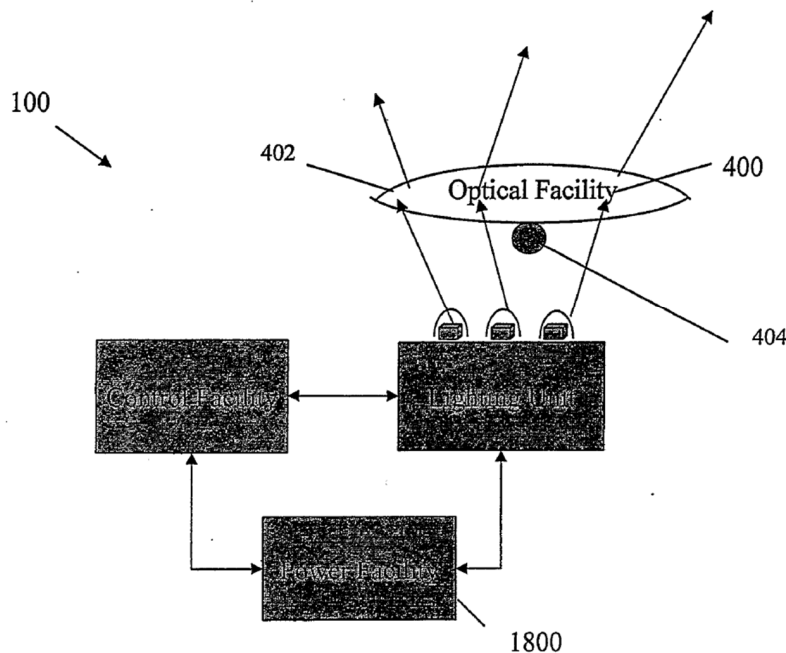
E. Wherein each of the solid state lighting devices comprises at least two or more light emitting diodes each covered by the same encapsulant. (Substitute Claim 29)

33. I understand that Patent Owner, in Substitute Claim 29, now proposes to recite “wherein each of the solid state lighting devices comprises at least two or more light emitting diodes each covered by the same encapsulant.”

34. Lys discloses that the “lighting unit 102 can include a light source 300, ..., such as light emitting diode, or LED.” Ex. 1005, 30:11-12. Lys’s Figures 1, 2, and 4 explicitly shows that the lighting unit 102 includes three light sources (e.g., LEDs) 300. Ex. 1005, Figs 1, 2, and 4. Figure 2 shows that the lighting unit 102 including three light sources (e.g., LEDs) 300 covered by the same secondary optical facility 400, which may diffuse, spread, focus, filter, diffract, reflect, guide or otherwise affect light coming from a light source 300. Ex. 1005, Fig 2; 30:30-31:2. The lighting unit 102 may have a primary optical facility 1700, such as a lens, mirror, or other optical facility for shaping beams of light that exit the light source, such as photons exiting the semiconductor in an LED package. Ex. 1005, 30:26-28.

35. As an example, the lighting unit 102 may have a primary optical facility 1700, such as a lens, mirror, or other optical facility for shaping beams of light that exit the light source, such as photons exiting the semiconductor in an LED package. Ex. 1005, 30:26-28.

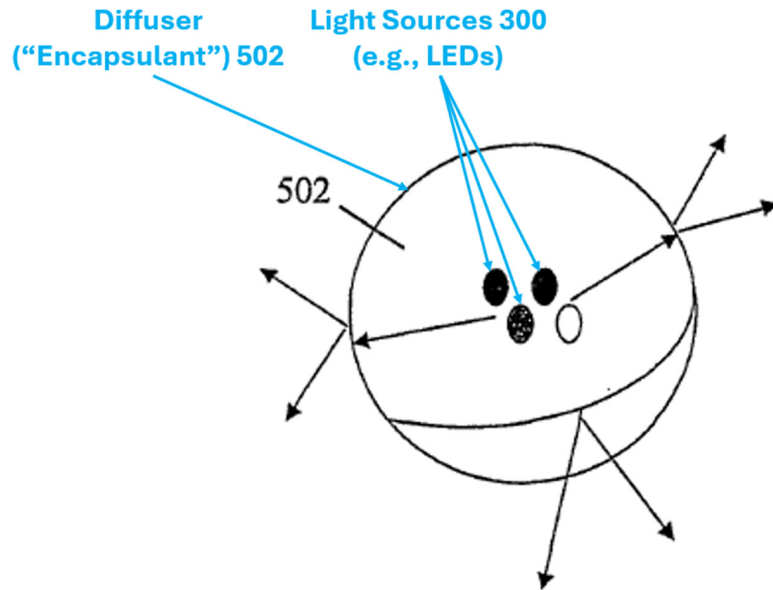
36. As shown in Figure 4, an optical facility 400 is configured to optically process the radiation generated by the light sources 300, such as to change the spatial distribution and/or the propagation direction. Ex. 1005, 40:29-31.



Ex. 1005, FIG. 4.

37. Lys further explains that the optical facility 400 may be a diffuser 502, which may absorb and scatter light from the source. Ex. 1005 at 41:8-10. The diffuser 502 can take many different shapes, including *spheres*, shown in Figure 5

and may be made of materials such as plastics, *polymers*, hydrocarbons, coated materials, etc. *Id.* at 41:10-21.

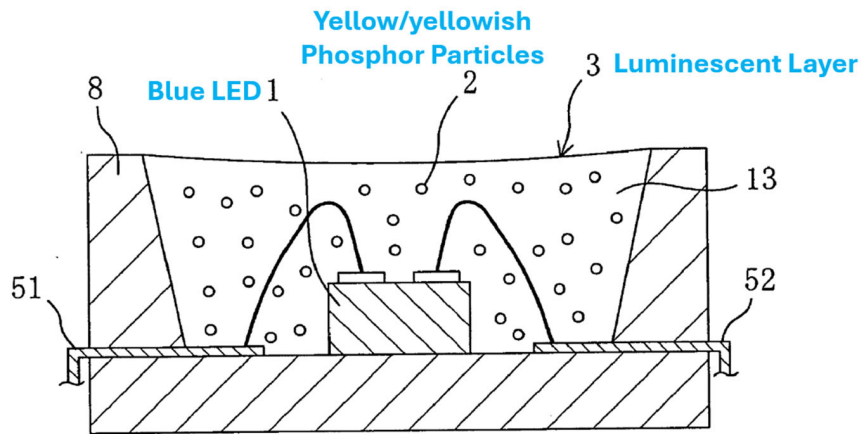


Ex 1005, FIG. 5 (excerpt and annotated).

38. Therefore, a POSITA would appreciate that Lys teaches “two or more light emitting diodes (LEDs 300) each covered by the same encapsulant (diffuser 502)” as the sphere diffuser 502 covers the light sources 300.

39. To the extent Patent Owner argues that the diffuser 502 in Lys is not an encapsulant, Maeda discloses the recited “encapsulant” that covers a blue LED. As shown in the embodiment illustrated in Figure 3, a chip-type LED includes a blue LED 1 placed in the recess of the casing 8 and a luminescent layer 3 formed in the casing 8, and the luminescent layer 3 is made of a mixture of

yellow/yellowish phosphor particles 2 and a base material (e.g., resin) 13. Ex. 1018, ¶178, 180, 181.



Ex. 1018, Fig. 3 (annotated).

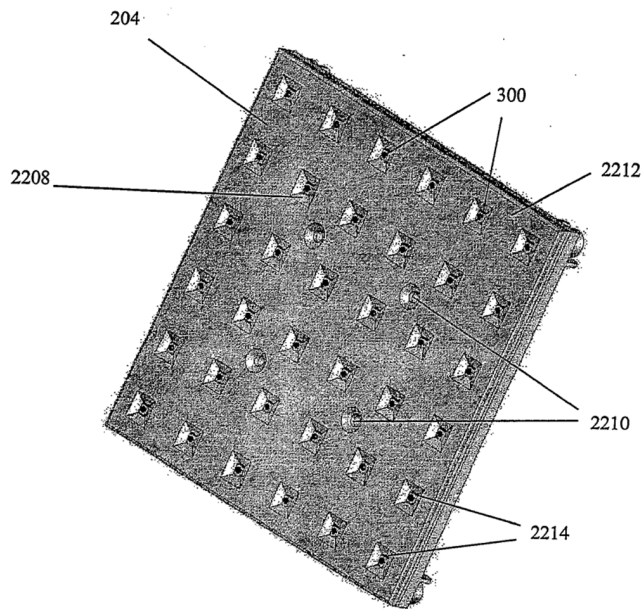
40. A POSITA would be motivated to modify the sphere diffuser 502 disclosed in Lys to be the luminescent layer 3 disclosed in Maeda because Lys suggests LEDs including “some type of encasement and/or optical element.” Ex. 1005, 38:9-12. The luminescent layer 3 discussed in Maeda serves the same purpose (i.e., encasement and/or optical element) and utilizes the same material (i.e., polymer).

F. Wherein an interconnect is mounted on each tile. (Substitute Claim 30) Comprising a low-profile configured so as to not interfere with the optical performance of the LEDs. (Substitute Claim 31)

41. I understand that Patent Owner, in Substitute Claim 30, now proposes to recite “wherein an interconnect is mounted on each tile.” I also understand that

Patent Owner, in Substitute Claim 31, now proposes to recite “comprising a low-profile configured so as to not interfere with the optical performance of the LEDs.”

42. Lys describes that the board 204 has multiple pre-fabricated screw holes 2210 that make it very convenient to attach the board 204 to a wall or other mounting area to “facilitate rapid installation.” Ex. 1005, 68:28-30; Figure 22b.

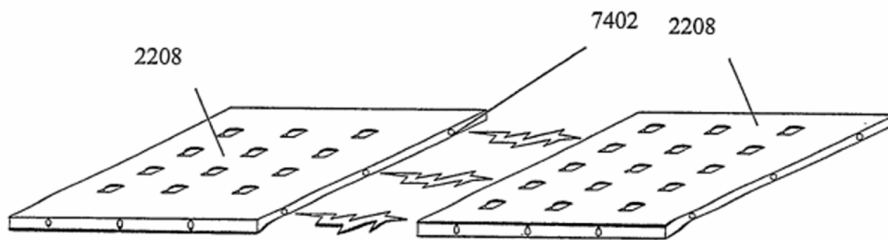


Ex. 1005, FIG. 22b.

43. Figure 74 shows that two boards 204, each of which holds the array 2208 of light sources 300, are fitted with magnetic facilities 7402 along their sides for fastening one to another. Ex. 1005, 145:18-20. The magnetic facilities 7402 provide a magnetic connection as well as a power and/or data interface between these two boards 204. Ex. 1005, 145:20-21. The boards 204 may be fitted with other fastening facilities for connecting one board 204 to another, such as

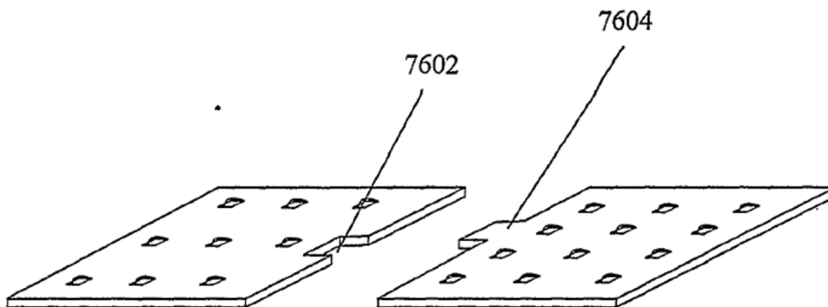
ball/socket combinations, adhesives, tapes, interlocking shapes, tabs, or the like.

Ex. 1005, 145:21-24.



Ex. 1005, Fig. 74.

44. Similarly, Figure 76 shows another embodiment of interlocking boards 204 using the tab 7604 designed to fit into the space 7602 to form a physical connection, thereby allowing for a data and/or power connection. Ex. 1005, 146:12-14.



Ex. 1005, Fig. 76.

45. A POSITA would appreciate that the pre-fabricated screw holes 2210 (shown in Figure 22b), the magnetic facilities 7402 (shown in Figure 74), and the tab 7604 (shown in Figure 76) can be interpreted as the claimed “interconnect”

mounted on each tile (i.e., board 204) because they are used for interconnection between, for example, two boards 204. Moreover, these “interconnect” examples disclosed in Lys are low-profile as each of them does not include any protruding feature that extends beyond the dimension of tiles or boards 204 that would interfere with the optical performance of the LEDs.

46. Moreover, Lys describes that variable optics can provide discrete or continuous adjustment of optical performance (e.g., beam spread or angle) of the light emitted from a fixture, and properties can include adjusting the profile for surfaces that vary in distance from the fixture. Ex. 1005, 42:2-7. Thus, Lys expressly discloses and emphasizes the need to maximize optical performance, including brightness.

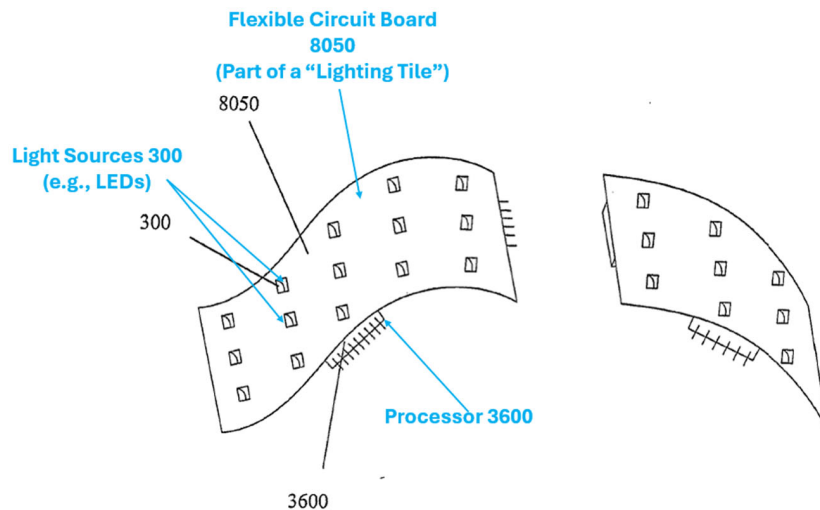
47. A POSITA therefore is motivated to adopt the design choice that employs a low-profile interconnect “configured so as to not interfere with the optical performance of the LEDs.” Mitigating optical interference is one of the requirements for designing LEDs. If an interconnect had a large profile so that optical interference with the LEDs increases, a POSITA would be motivated to adopt a low-profile interconnect to mitigate the optical interference considering the express teachings in Lys explained above.

G. Wherein each tile is coupled to a flexible connector. (Substitute Claim 32)

48. I understand that Patent Owner, in Substitute Claim 32, now proposes to recite “wherein each tile is coupled to a flexible connector.”

49. Lys describes a lighting system that includes “a flexible connection between the circuit boards,” which may include interlocking tab, a power/data connection, a data cable, a wire, or other connection type. Ex. 1005, 15:17-21. Lys also discloses embodiments that are flexible and a POSITA would understand that in such embodiments flexible connectors would be used. For example, Lys discloses embodiments wherein a housings 800 may “take the form of a flexible band 1102, tape or ribbon to allow the user to conform the housing to particular shapes or cavities.” Ex. 1005, 54:12-14. Such embodiments would employ a flexible connector to accommodate the flexible housing.

50. In addition, Figure 80 shows a lighting unit 100 with light sources 300 constructed using a flexible circuit board 8050 on which a processor 3600 is also disposed to provide control for the light sources 300. Ex. 1005, 147:1-3.



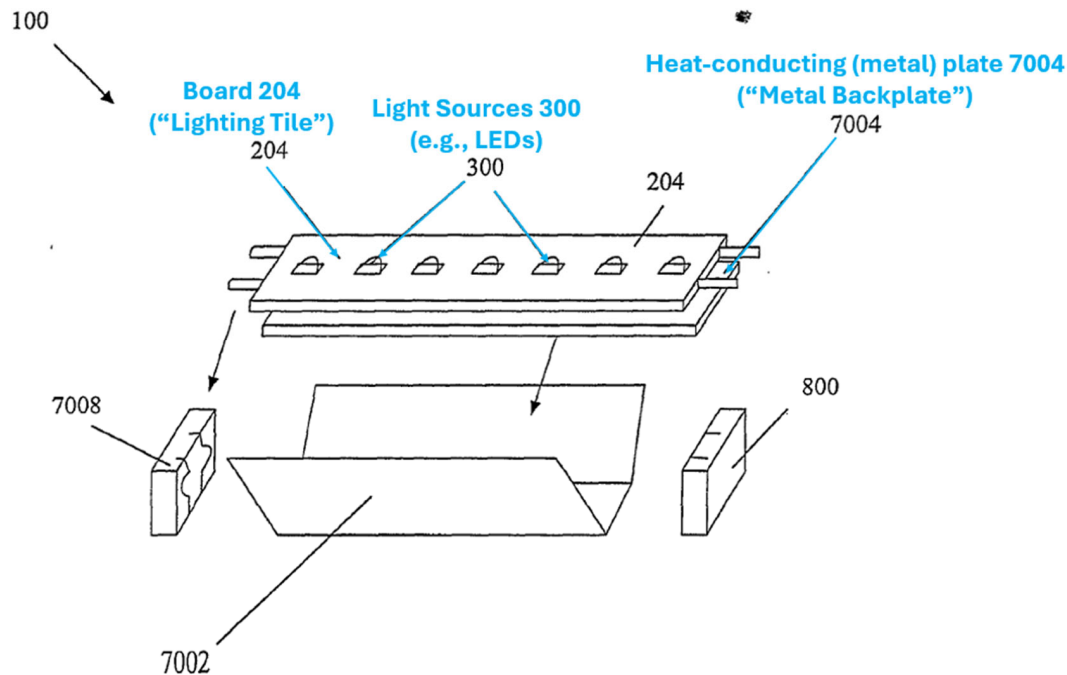
Ex. 1005, Fig. 80 (annotated).

51. Thus, Lys discloses a flexible “lighting tile” (the flexible circuit board 8050). Since the lighting tile is flexible, a POSITA would appreciate that a flexible connector is inherently disclosed for coupling other components (e.g., the processor 3600) to the flexible circuit board 8050, especially in light of the express teachings in Lys that “a flexible connection” that may include interlocking tab, a power/data connection, a data cable, a wire, or other connection type. The teachings that a flexible band or string for shaping to fit body parts or cavities, objects, unusual spaces, or the like would also incentivize a POSITA to adopt a flexible connector. Accordingly, Lys discloses or renders obvious “wherein each tile is coupled to a flexible connector.”

H. Wherein the tiles are mounted to a metal backplate that contains a through hole. (Substitute Claim 33) Wherein the flexible connector travels via the through hole to the interconnect mounted on the tile substrate. (Substitute Claim 34)

52. I understand that Patent Owner, in Substitute Claim 33, now proposes to recite “wherein the tiles are mounted to a metal backplate that contains a through hole.” I also understand that Patent Owner, in Substitute Claim 34, now proposes to recite “the flexible connector travels via the through hole to the interconnect mounted on the tile substrate.”

53. Lys discloses a metal plate 1428 conducts heat away from the board 204. Ex. 1005, 57:21-21; Figure 14c. Lys also discloses the board 204 is “positioned on top of a heat-conducting plate 7004, such as a metal plate, that acts as a thermal facility for conducting heat away from the light sources 300.” Ex. 1005, 144:10-18; Figure 70.



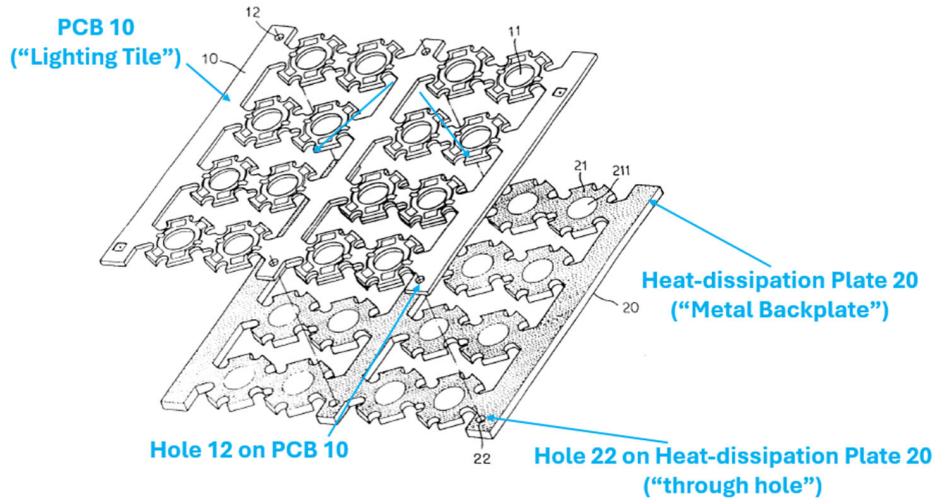
Ex. 1005, Fig. 70.

54. Thus, Lys discloses that “wherein the tiles (boards 204) are mounted to a metal backplate (the heat-conducting (metal) plate 7004).”

55. To the extent one would argue that Lys fails to disclose a “through hole” contained by the metal backplate, Zhong discloses this element.

56. I am informed that Zhong (CN 2726277Y) is prior art to the ’331 Patent. Zhong (Ex. 1026) is entitled “heat dissipation circuit board structure.” Zhong generally relates to a heat dissipation circuit board structure capable of solving the heat dissipation problem of electronic components plugged on a general PCB. Ex. 1026, p. 1. As shown in Figure 2, the heat dissipation circuit board includes one PCB 10 and one heat dissipation plate 20 bonded in an

overlapping manner. Ex. 1026, p. 5. Mutually corresponding holes 12 and 22 are punched on the PCB 10 and the heat dissipation plate 20, respectively. Ex. 1026, p. 4.



Ex. 1026, Fig. 2 (annotated).

57. A POSITA would understand that the heat-dissipation plate 20 is equivalent to the claimed "metal backplate," whereas the hole 22 is equivalent to the claimed "through hole." A POSITA would be further motivated to modify the heat-conducting metal plate 7004 in Lys to incorporate the through hole 22 discussed in Zhong. Such a modification would provide precise alignment between the lighting tile and the metal backplate and facilitate the attachment therebetween (by using the corresponding through holes for attachment or coupling). Such a dual-use (e.g., both alignment and attachment) through hole system is a common

design choice that a POSITA could appreciate. In fact, alignment is secured by attachment, whereas attachment is enabled by alignment.

58. Further, since Lys discloses or renders obvious “wherein each tile is coupled to a flexible connector” and “an interconnect ... mounted on each tile” and Zhong discloses “a metal backplate that contains a through hole,” a POSITA would be motivated to make the flexible connector of Lys travel via the through hole of Zhong to the interconnect of Lys mounted on the tile. Since the through hole exists on the metal backplate after combining Lys and Zhong, a natural design choice would be utilizing the through hole on the metal backplate for attachment, one of the two functions (i.e., attachment and alignment). Furthermore, flexible connectors such as “power/data connection, a data cable, a wire, ...” would be part of the flexible connector that travels via the through hole to the interconnect. Ex. 1005, 15:17-21. Moreover, the fact that the connector is flexible further enables traveling it “via the through hole.” In contrast, a rigid connector may not smoothly travel via the through hole.

V. Motivations to Combine

A. It Would Have Been Obvious to Combine Lys, Grootes, and Henson

59. As discussed in my first declaration, a POSITA would be motivated to combine Lys and Grootes. Ex. 1003, § VIII.

60. As mentioned above, Henson discloses an interconnect circuit layer “utilized to provide thermal management for and electric connection to the LED dies.” Ex. 1020 at ¶46. Lys, in the same endeavor of lighting systems, discloses that the board 204 may be a metal core board for accepting heat from the light sources 300 and trapping the heat away from the light sources 300. Ex. 1005, 56:18-19.

61. Thus, a POSITA would be motivated to combine the Lys-Grootes combination with Henson by introducing the detailed structures of the interconnect circuit layer that comprises a metal mounting substrate, a patterned conductive layer, and an electrically insulative dielectric layer because the modification could further improve the thermal management capabilities of the MCPCB disclosed in Lys, considering the express desire in Lys.

B. It Would Have Been Obvious to Combine Lys, Grootes, Henson, and Yu.

62. In my opinion, a person of ordinary skill in the art would have been motivated to combine Lys, Grootes, Henson, and Yu, would have understood how to do so, and would have had the skillset to do so.

63. As explained above, Yu teaches a control device with a high-efficiency cold cathode fluorescent lamp. Ex. 1024, p. 4. Yu describes that a traditional general-purpose PWM controller 4 at a low speed of 90-200 Hz is used to control the beam density. Ex. 1024, p. 9.

64. A POSITA would be motivated to combine the Lys-Grootes-Henson combination with Yu by introducing the “traditional general-purpose PWM controller 4 at a low speed of 90-200 Hz” disclosed in Yu because such a traditional and general-purpose PWM controller 4 should be in the toolbox of a POSITA.

65. Moreover, it is common practice to implement a broad PWM frequency/period range when designing an LED lighting control circuit. A POSITA would be further incentivized to modify, for example, the disclosed frequency range (i.e., 90-200 Hz) in Yu to encompass a wider frequency range (e.g., 90-2000 Hz) for various technical reasons related to both electrical and optical interference mitigation with a reasonable expectation of success. In summary, a POSITA would be motivated to combine the Lys-Grootes-Henson combination with Yu to incorporate the traditional general-purpose PWM controller 4 at a low speed of 90-200 Hz and go beyond that frequency range as well.

C. It Would Have Been Obvious to Combine Lys, Grootes, Henson, and Zhong.

66. In my opinion, a person of ordinary skill in the art would have been motivated to combine Lys, Grootes, Henson, and Zhong, would have understood how to do so, and would have had the skillset to do so.

67. As explained above, Zhong generally relates to a heat dissipation circuit board structure capable of solving the heat dissipation problem of electronic components plugged on a general PCB. Ex. 1026, p. 1. Lys, in the same endeavor of lighting systems, discloses that the board 204 may be a metal core board for accepting heat from the light sources 300 and trapping the heat away from the light sources 300. Ex. 1005, 56:18-19.

68. Thus, a POSITA would be motivated to combine the Lys-Grootes-Henson combination with Zhong by modifying the heat-conducting metal plate 7004 in Lys to incorporate the through hole 22 discussed in Zhong. Such a modification would further provide precise alignment between the lighting tile and the metal backplate and facilitate the attachment therebetween (by using the corresponding through holes for attachment or coupling). Such a dual-use (e.g., both alignment and attachment) through hole system is a common design choice that a POSITA could appreciate. In fact, alignment is secured by attachment, whereas attachment is enabled by alignment.

69. A POSITA would also be motivated to make the flexible connector of Lys travel via the through hole of Zhong to the interconnect of Lys mounted on the tile because a natural design choice would be utilizing the through hole on the metal backplate for attachment, one of the two functions (i.e., attachment and alignment).

70. In summary, a POSITA would be motivated to combine the Lys-Grootes-Henson combination with Zhong for improved thermal management and better alignment and attachment.

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may revise my opinions accordingly as necessary. I declare under penalty of perjury that the foregoing Declaration is true and correct.



12/09/2024
Date

Rafael J. Betancourt