

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Xu Peicheng (Hong Kong) Optoelectronic Technology Co., Limited,
Petitioner

v.

Semisilicon Technology Corp.,
Patent Owner

U.S. Patent No. 8,884,546

Filing Date: Sept. 14, 2011

Issue Date: Nov. 11, 2014

Title: Driving Apparatus for Light-Emitting Diode Curtain Lamp

Inter Partes Review No.: IPR2024-00156

EXHIBIT 1010

REPLY DECLARATION OF E. FRED SCHUBERT, PH.D.

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LIST OF PETITIONER’S EXHIBITS

No.	Description
1001	U.S. Patent No. 8,884,546
1002	Prosecution File History of U.S. Patent No. 8,884,546
1003	Declaration of E. Fred Schubert, Ph.D.
1004	U.S. Publication No. 2009/0021955 to Kuang et al. (“Kuang”)
1005	U.S. Publication No. 2012/0050606 to Debevec et al. (“Debevec”)
1006	Japanese Unexamined Patent Application Publication No. JP2006-228529
1007	Certified English Translation of Japanese Unexamined Patent Application Publication No. JP2006-228529 (“Hiroyuki”)
1008	U.S. Patent No. 6,774,584 to Lys et al. (“Lys”)
1009	Excerpts from <u>Modern Dictionary of Electronics</u> (7th ed. 1999)
1011	Jarske et al., <u>Signal Processor Implementation of Variable Digital Filters</u> , IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, Volume 37, Issue 3 (Sept. 1988)
1012	Renfors et al., <u>Signal Processor Implementation of Digital All-Pass Filters</u> , IEEE TRANSACTIONS ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, Volume 36, Issue 5, (May 1988)
1013	Excerpts from <u>The Illustrated Dictionary of Electronics</u> (8th ed. 2001)
1014	Excerpts from <u>The American Heritage Science Dictionary</u> (2005)
1015	Excerpts from <u>The Computer Glossary: The Complete Illustrated Edition</u> (9th ed. 2001)
1016	Excerpts from <u>Modern Dictionary of Electronics</u> (7th ed. 1999)
1017	Excerpts from <u>McGraw-Hill Dictionary of Scientific and Technical Terms</u> (6th ed. 2003)

No.	Description
1018	Excerpts from <u>Dictionary of Computer Science, Engineering, and Technology</u> (2001)

I, E. Fred Schubert declare as follows:

I. INTRODUCTION

1. My full name is Eric Fred Schubert. I am the same E. Fred Schubert who provided a declaration on Oct. 16, 2023, in support of Xu Peicheng (Hong Kong) Optoelectronic Technology Co., Limited's Petition for *Inter Partes* Review in this proceeding. *See* EX1003. I maintain the opinions that were set forth in that previous declaration. I provide this reply declaration to respond to certain opinions provided by Dr. Michael Lebby in his declaration submitted in support of the Patent Owner's Response. *See* EX2001 ("Lebby Declaration").

2. My background and qualifications were set forth in paragraphs 1-15 of my original declaration in this proceeding, as well as my curriculum vitae which was attached to that declaration as Exhibit B. I incorporate that information by reference in this reply declaration. In this reply declaration, I apply the same understanding of the governing law as set forth in paragraphs 18-25 of my original declaration.

3. Like the opinions in my original declaration, the opinions herein are my own, and to the extent the Petition or Petitioner's Reply copies or mimics any language from either of my declarations, I have been advised that this is because the Patent Trial and Appeal Board does not consider arguments incorporated by reference. Therefore, my opinions should not be misconstrued as conclusory

attorney argument due to any such overlap with arguments in the Petition or Petitioner's Reply. Indeed, my opinions should not be misconstrued as repeating the reasoning of the Petition or Petitioner's Reply when the opposite is the case

 2024.

4. For ease of reference, a listing of the challenged claims is attached as Appendix A to this reply declaration in the same form as it was to my original declaration.

II. MATERIALS REVIEWED

5. In preparing this reply declaration, I have reviewed and/or considered at least the documents cited in the List of Petitioner's Exhibits above, the documents referenced in this reply declaration, and the Lebby Declaration and materials cited therein. I have also reviewed the Decision on Institution of *Inter Partes* Review provided by the U.S. Patent and Trademark Office Patent Trial and Appeal Board ("PTAB") in this proceeding. Paper 11.

III. LEVEL OF ORDINARY SKILL IN THE ART

6. In this reply declaration, I apply the same definition of a person of ordinary skill in the art ("POSITA") as set forth in paragraphs 29-31 of my original declaration. I note that Dr. Lebby used the same definition of a POSITA in providing his opinions. EX2001 ¶¶ 52-53.

IV. CLAIM CONSTRUCTION

A. “synchronous signals”

7. I understand that the PTAB has invited briefing on the interpretation of “synchronous signals,” which appears in claim 1. Paper 11 at 23.

8. In my original declaration, I stated:

In this context, a POSITA would have understood the term “synchronous signals” to mean signals that are sent to the slave nodes to control their corresponding LED strings at the same time.

EX1003, ¶ 50. The term “synchronous signals” appears in claim 1 of U.S. Patent No. 8,884,546 (the “’546 patent”) as follows: “wherein the slave control unit is controlled by the master control unit to drive the light-emitting diode light string; the transmission line is used to transit control signals and *synchronous signals*.” EX1001 at claim 1 (emphasis added).

9. In its Institution Decision, the PTAB interpreted the plain and ordinary meaning of “synchronous signals” as “transmitting signals related to an activity(ies) occurring at the same time.” Paper 11 at 44. I have no objections to this definition. In my opinion, the only material distinction between the PTAB’s construction and mine is that I construed “synchronous signals” in the broader context of the surrounding claim language.

10. On the other hand, Dr. Lebby opines that “synchronous signals” should mean “signals related to activities governed by synchronized timing.”

EX2001, ¶ 55. Dr. Lebby introduces the concept of “synchronized timing” into the

definition of “synchronous signals.” I disagree with Dr. Lebby’s proposed construction because there is no support from the ’546 patent for the concept of synchronized timing. Indeed, it is unclear what Dr. Lebby means by the wording “synchronized timing,” and defining “*synchronous* signals” with a phrase like “*synchronized* timing” merely parrots the claim language with a different form of the same word. As the PTAB points out, “the Specification of the ’546 patent does not expressly define ‘synchronous signals.’ Rather, throughout the disclosure in the Specification, the phrase ‘[t]he transmission line is used to transit control signals and synchronous signals’ is only repeatedly recited.” Paper 11 at 43. I agree with the PTAB, and therefore, believe Dr. Lebby’s proposed construction, which imports “synchronized timing” without any support in the specification or file history, should be rejected.

V. GROUND 1 AND 3

A. Kuang discloses a “curtain lamp” as claimed in 1[Pre]

11. According to Dr. Lebby, Kuang does not disclose a “curtain lamp” as recited in the preamble of claim 1. EX2001, ¶¶ 67-70. I disagree for the reasons stated in my original declaration and the additional reasons set forth below in response to Dr. Lebby’s arguments.

12. In my original opinion, I stated that a “curtain lamp” “is commonly understood to be one or more light strings.” EX1003, ¶ 37. Dr. Lebby does not

contest my interpretation, but instead argues that Kuang does not disclose “one or more light strings” under this definition of “curtain lamp.” See EX2001, ¶ 67.

13. Since Dr. Lebby agrees that the scope of “curtain lamp” can be a single light string, the ’546 patent makes clear that such a “string” may consist of only one LED:

The light-emitting diode light string 30 mentioned above includes a plurality of light-emitting diodes. However, *the light-emitting diode light string 30 could include single light-emitting diode*. It is called the driving apparatus for light-emitting diode curtain lamp with single light-emitting diode in one light-emitting diode string of the present invention.

EX1001 at 6:15-20 (emphasis added). The claimed “curtain lamp,” which Dr. Lebby does not dispute may be only one LED string, includes at least a single LED. The minimum configuration for a “curtain lamp” according to the ’546 specification is one LED. Therefore, the reverse must be true as well: one LED constitutes the claimed LED “curtain lamp.”

14. Regardless of whether the preamble is limiting, Kuang discloses a “curtain lamp” considering the ’546 patent specification’s guidance on the full scope of this term. Dr. Lebby’s argument that Kuang discloses ceiling light panels that are not curtain lamps (EX2001, ¶ 68) must be rejected because the ’546 patent specification broadly discloses the scope of a “curtain lamp” as possibly encompassing only one LED.

15. Moreover, as I pointed out in my original declaration, Kuang is not so limited in its application, since “[t]he principles described have applicability beyond transit vehicles, and may be used, for example, in connection with lighting systems in buildings, factories, and other facilities.” EX1003, ¶ 37 (quoting Kuang at [0122]). As such, a POSITA would have understood Kuang’s schematics such as that in Fig. 2B to disclose a string of LEDs (labeled 274) to satisfy the “curtain lamp” limitation:

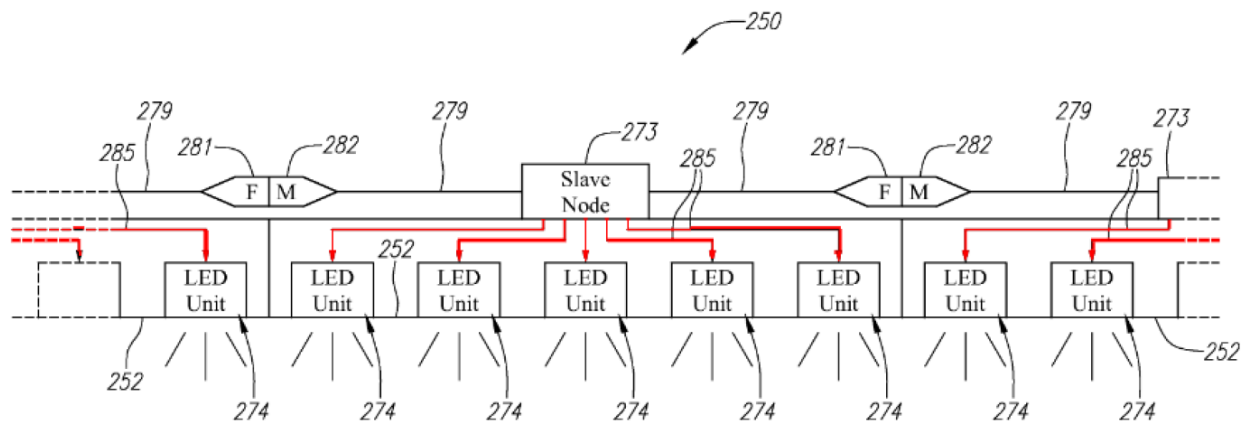


FIG. 2B

EX1003, ¶ 44 (referring to Kuang Fig. 2B (annotated in my original declaration)).

16. Like the above Figure 2B in Kuang, the “string” of LEDs disclosed in the ’546 patent is only illustrated in schematics without any description of physical aspects of “strings”:

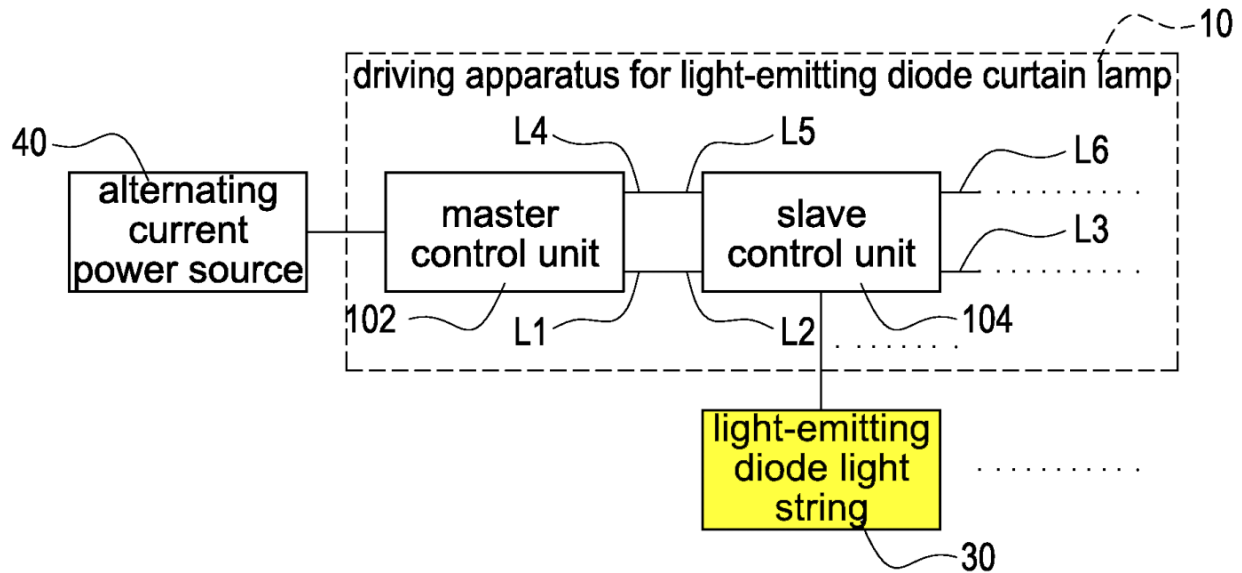


FIG.4

EX1001 at Fig. 4 (“light-emitting diode light string 30” highlighted).

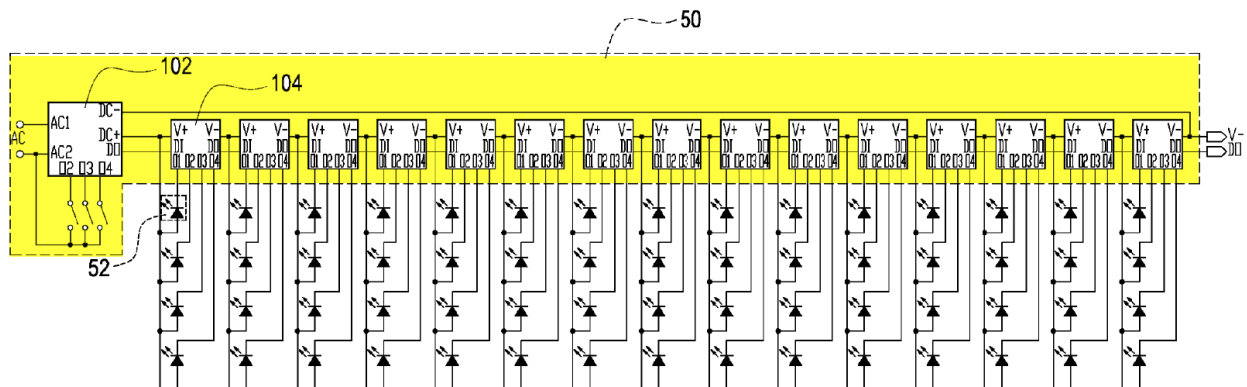


FIG.7

EX1001 at Fig. 7 (“light-emitting diode string 50” highlighted). This further demonstrates why Dr. Lebby’s critique of the application of Kuang should be rejected: there is nothing in the ’546 patent to suggest an LED “string” is limited to a certain physical configuration.

B. Lys discloses a “curtain lamp” as claimed in 1[Pre] or 8[Pre]

17. According to Dr. Lebby, Lys does not disclose a “curtain lamp” as recited in the preamble of claims 1 and 8. EX2001, ¶¶ 71-72. I disagree for the reasons stated in my original declaration and the additional reasons set forth below in response to Dr. Lebby’s arguments.

18. As explained above in Section V(A) of this reply declaration, the claimed “curtain lamp,” which Dr. Lebby does not dispute may be only one LED string, includes at least a single LED. The minimum configuration for a “curtain lamp” according to the ’546 specification is one LED. Therefore, the reverse must be true as well: one LED constitutes the claimed LED “curtain lamp.”

19. Regardless of whether the preamble is limiting, Lys discloses a “curtain lamp” considering the ’546 patent specification’s guidance on the full scope of this term. Dr. Lebby’s argument that Lys discloses pool lighting fixtures that are not curtain lamps (EX2001, ¶ 71) must be rejected because the ’546 patent specification broadly discloses the scope of a “curtain lamp” as possibly encompassing only one LED.

20. Moreover, as I pointed out in my original declaration, Lys is not so limited in its application, since “the term ‘LED’ does not restrict the package type of an LED; for example, the term ‘LED’ may refer to packaged LEDs, non-packaged LEDs, surface mount LEDs, chip-on-board LEDs, and LEDs of all other

configurations.” EX1003, ¶ 61 (quoting Lys at 33:18-36). As such, a POSITA would have understood Lys to disclose a string of LEDs (labeled 24A-24D) to satisfy the “curtain lamp” limitation:

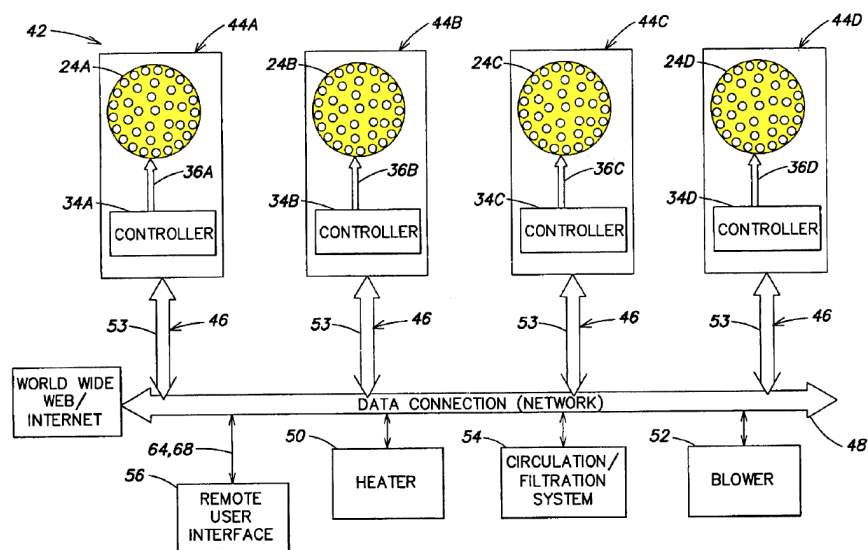


FIG. 4

Lys at Fig. 4 (“light sources 24A-24D” highlighted). I also explained in my original declaration that “light sources 24A-24D” are “coupled together to form the networked lighting system 42[.]” EX1003, ¶ 59 (quoting Lys at 15:46-56). These light sources “may include one or more LEDs 32” and may further include “two or more differently colored LEDs” 32A-32C (e.g., red, green and blue LEDs). EX1003, ¶ 59 (quoting Lys at 10:61 to 11:5; 11:6-20).

21. As shown above in Section V(A) of this reply declaration, the “string” of LEDs disclosed in the ’546 patent is only illustrated in schematics without any description of physical aspects of “strings.” This further demonstrates why Dr. Lebbey’s critique of the application of Lys should be rejected: there is nothing in

the '546 patent to suggest an LED “string” is limited to a certain physical configuration.

C. Kuang discloses “synchronous signals” as claimed in 1[D]

22. As I explain above in Section IV(A) of this reply declaration, I have no objections to the PTAB’s construction of “synchronous signals” to mean “transmitting signals related to an activity(ies) occurring at the same time.” Paper 11 at 44. The PTAB’s construction is consistent with mine, which I interpreted in the broader context of the surrounding claim language as “signals that are sent to the slave nodes to control their corresponding LED strings at the same time.” EX1003, ¶ 50.

23. Dr. Lebby argues that Kuang does not disclose “synchronous signals” because a shutoff command in Kuang would propagate from one slave controller to another subsequent slave controller. EX2001, ¶ 76. Dr. Lebby contends that the propagation would include unavoidable propagation delays that would make it impossible for the lighting units to be shut OFF “at the same time.” EX2001, ¶¶ 76-79. I disagree for the reasons stated in my original declaration and the additional reasons set forth below in response to Dr. Lebby’s arguments.

24. In the illustration below, Dr. Lebby contends that Kuang’s “shutoff command” propagates from slave controller to slave controller. EX2001, ¶ 76. Dr. Lebby also contends that the sequential propagation (from one slave controller and

associated lighting unit to the next one) would preclude the lighting units from being shut OFF “at the same time”:

Image shown in Paragraph 76 of the Lebbly Declaration:

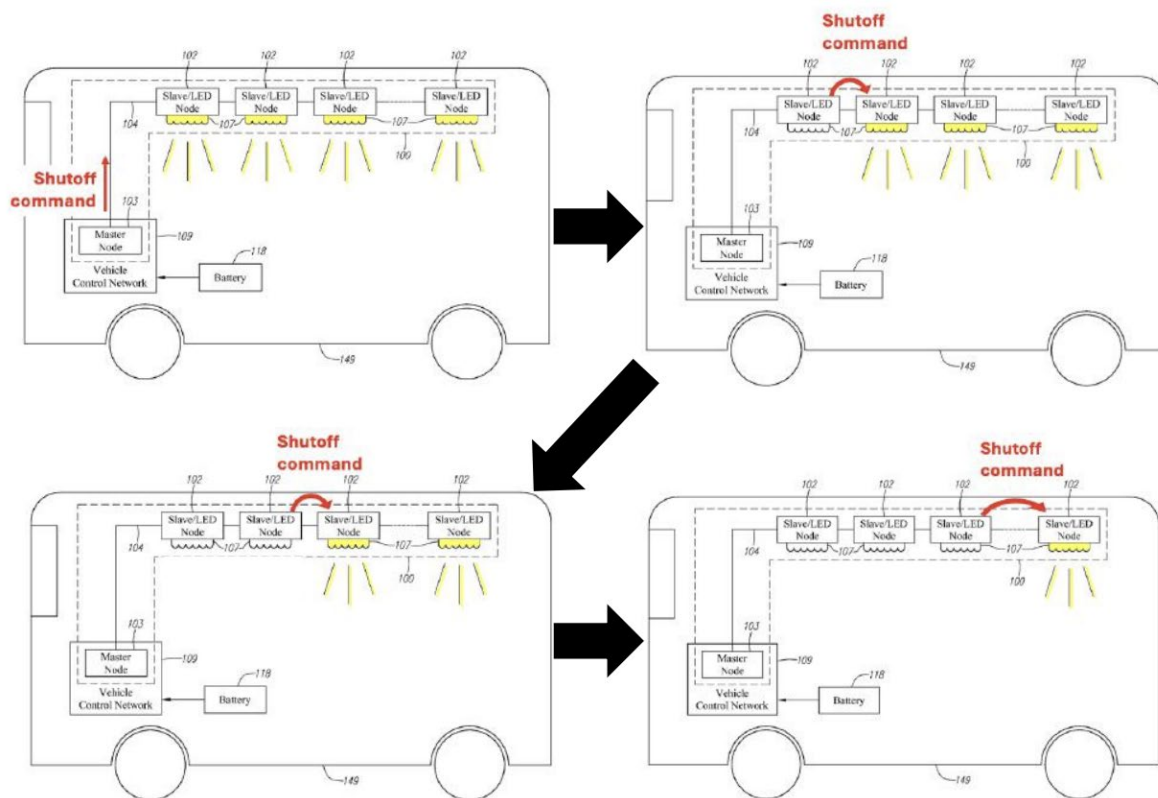


Diagram of Kuang’s signal propagation based on Kuang Fig. 1 and [0034]

EX2001, ¶ 76 (figure prepared by Dr. Lebbly).

25. As indicated by Dr. Lebbly’s annotations in the figure above, Dr. Lebbly tries to distinguish “synchronous signals” from those that propagate on transmission lines located between adjacent slave controllers. First, a POSITA would have understood that an electrical signal propagates as an electromagnetic guided wave over the transmission line. The propagation velocity of electromagnetic waves on a transmission line is related to the velocity of light, c ,

which is known to be very high (2.99×10^8 m/s). For light to propagate a distance of 10 feet takes only about 10 ns (10 nano-seconds).

26. The propagation velocity of light in vacuum is $c = 2.99 \times 10^8$ m/s. The propagation velocity of a guided electrical signal on a transmission line is given by $c / (\epsilon_r \mu_r)^{1/2}$ where ϵ_r and μ_r are the relative electric and magnetic constants of the transmission line material,¹ respectively. Because these propagation velocities are high, the propagation delays are short, certainly far below 1 ms, that is, not noticeable to a human observer. Assuming, as an example, a propagation velocity of $c / (\epsilon_r \mu_r)^{1/2} = 1.5 \times 10^8$ m/s, it would take only 20 nanoseconds (20 ns) to propagate a distance of 10 feet.² To summarize, there can be no dispute from the standpoint of a POSITA that the propagation velocity delays cited by Dr. Lebby are very small, far below 1 ms, and thus unnoticeable to the human observer.

¹ The relevant material is the material in which the electric field propagates, usually the material located between two conductors forming the transmission line.

² A common value if the electric constant (relative permittivity) for plastics and silica is about four (4.0) with an associated magnetic constant (relative permeability) of 1.0, giving a guided electromagnetic wave propagation velocity of $c / (\epsilon_r \mu_r)^{1/2} = c / 2$. The propagation velocity of light is 30 cm / ns which is about 1 foot per ns (nano-second). Consequently, the propagation delay is 1 ns / foot or 10 ns / 10 feet for light and 20 ns / 10 feet for a guided electromagnetic wave propagating in a dielectric material with an electric constant (relative permittivity) of $\epsilon_r = 4.0$ and a magnetic constant (relative permeability) of $\mu_r = 1.0$.

27. Second, the embodiments in the '546 patent *only* disclose the same propagation delays that Dr. Lebby alleges would distinguish Kuang from meeting this limitation. As indicated in the figure below, the slave control units 104 are connected by wirings that have a physical length. It is simply impossible for the propagation delay to be zero. The propagation delay is at least given by the propagation velocity of the guided electromagnetic wave propagating on the transmission line (wirings). Even if these wirings are short, such as one tenth of a foot (about 3 cm), a propagation delay of 0.20 ns would inevitably be incurred.

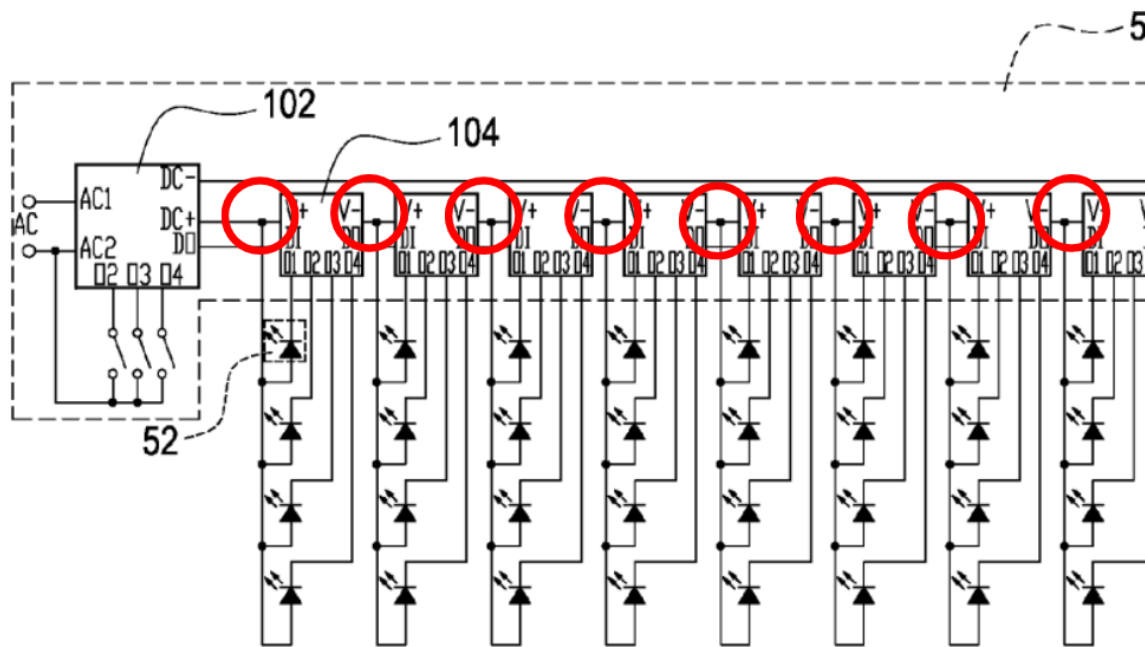


FIG.7

EX1001 at Fig. 7 (excerpt of Fig. 7, annotated, showing the locations of electromagnetic wave propagation delays between slave control units 104).

28. Accordingly, the physical limitations that Dr. Lebby argues distinguish the prior art from meeting the “synchronous signals” limitation equally affect all illustrated embodiments of the ’546 patent. Because the propagation delays are exceedingly small, below 1 ms, and certainly unnoticeable to a human observer, a POSITA, in light of these facts, would conclude that propagation delays would not prevent the lighting units in Kuang or the ’546 patent from being operated synchronously, that is, at the same time.

D. Kuang discloses “control signals” and “synchronous signals” as claimed in 1[D]

29. Claim element 1[D] recites:

wherein the slave control unit is controlled by the master control unit to drive the light-emitting diode light string; the transmission line is used to transit control signals *and* synchronous signals.

EX1001 at claim 1 (emphasis added).

30. Dr. Lebby opines that “synchronous signals are separate from control signals in 1[D], at least because there are two separate ‘signal’ claim elements.”

EX2001, ¶ 81. In support of his interpretation, Dr. Lebby cites the ’546 patent specification recitation of “[t]he transmission line [105] is used to transit control signals and synchronous signals,” which merely parrots the claim language.

EX2001, ¶ 81 (citing EX1001 at 1:50-51; 2:66-67).

31. I disagree with Dr. Lebby. First, the claim language does not read “... is used to transit control signals *or* synchronous signals,” which would indicate that

a control signal cannot also be a synchronous signal. Rather, the plain language of this claim element informs a POSITA in view of the '546 patent specification that a control signal *may* also be a synchronous signal. That is, a signal may contain control instructions (e.g. shut LEDs OFF) as well as synchronous instructions (e.g. execute the control instructions for multiple LEDs at the same time). In this case, the signals transmitted by the “master control unit” may constitute control signals and synchronous signals. I am unable to identify a basis for Dr. Lebby’s exclusion of such signals (that constitute control signals and synchronous signals) in the '546 patent.

32. This understanding is supported by the '546 patent specification, which only discloses control signals which may also be synchronous if controlling more than one slave control unit at the same time. There is nothing in the '546 patent specification to suggest that a control signal can never be synchronous, or that a synchronous signal cannot be a control signal. Indeed, the only “signals” explicitly described in the '546 patent specification are control signals. For example:

The master control unit 102 includes four terminal pins in the right side, wherein the first terminal pin viewed from top to bottom direction is used to transit 24 voltages direct current voltages, and the second terminal pin viewed from top to bottom direction ***is used to transmit signals for controlling the slave control units 104 to drive the light-emitting diode light strings 30***, and the third terminal pin viewed from top to bottom direction is used to transit 19 voltages direct current voltages outputted from the voltage regulator 108, and the fourth

terminal pin viewed from top to bottom direction is for power negative terminal.

EX1001 at 3:38-48 (emphasis added).

The slave control unit 104 includes three terminal pins in the left side, wherein the first terminal pin viewed from top to bottom direction is used to receive 24 voltages direct current voltages, and the second terminal pin viewed from top to bottom direction *is used to receive signals from the master control unit 102, to drive the light-emitting diode light string 30*, and the third terminal pin viewed from top to bottom direction is used to receive 19 voltages direct current voltages outputted from the voltage regulator 108.

EX1001 at 3:49-58 (emphasis added).

The slave control unit 104 includes four terminal pins in the right side, wherein the first terminal pin viewed from top to bottom direction is used to transit 24 voltages direct current voltages, and the second terminal pin viewed from top to bottom direction *is used to transmit signals for controlling the next slave control units 104 to drive the next light-emitting diode light strings 30*, and the third terminal pin viewed from top to bottom direction is electrically connected to the light-emitting diode light strings 30 to drive the light-emitting diode light strings 30, and the fourth terminal pin viewed from top to bottom direction is used to transit 19 voltages direct current voltages.

EX1001 at 3:59 to 4:3 (emphasis added).

The signal controlling the light-emitting diode light strings 30 is transited to the first slave control unit 104 through the second terminal pin viewed from top to bottom direction in the right side of the master control unit 102.

EX1001 at 6:7-10 (emphasis added).

33. In view of the above, it is my opinion that a POSITA would not understand the claim language to exclude a control signal that is also a

synchronous signal. Dr. Lebby's opinion to the contrary is belied by the plain language in the claims (i.e., using the conjunction "and" instead of "or"), and the '546 patent specification which only describes control signals and provides no examples of a synchronous signal that does not control the slave control units. In other words, a synchronous signal, without associated control, would not be meaningful. Dr. Lebby's citation to the specification's verbatim recitation of the claim language to support his opinion underscores the unreasonableness of his interpretation.

34. I maintain my opinions in my original declaration that Kuang discloses both control and synchronous signals in view of the above understanding of the phrase by a POSITA. EX1003, ¶¶ 48-50. In addition, and in further response to Dr. Lebby's argument, Kuang discloses: "Via commands or inquiries conveyed over the command/data bus 212, the master node 203 may control, individually *or by group*, the individual LED units 224 of each LED-based lighting fixture 202. The master node 203 may, for example, command certain LED units 224 to turn on, turn off, dim by a specified amount, intensify by a specified amount, flash (e.g., in emergency situations), or activate according to a predetermined pattern." EX1004 at [0035] (emphasis added). Based on Kuang's disclosure, a POSITA would understand that by controlling LED units *by group* as

opposed to just individually, Kuang further discloses both control signals *and* synchronous signals as claimed in element 1 [D].

35. Yet in further response to Dr. Lebby, Kuang also discloses that “[t]he master node 203 may convey commands to the slave nodes 223 *at each LED-based lighting fixture 202*, and, in response thereto, the slave nodes 223 may be responsible for locally controlling the electronics *at each LED based lighting fixture 202* in order to implement the command received from the master node 203.” EX1004 at [0035] (emphasis added). When conveying commands to “the slave nodes 223 at each LED-based lighting fixture 202,” the commands are conveyed to a group that includes “each LED-based lighting fixture 202.” That is, the group is controlled collectively at the same time (synchronously). The “convey commands” action requires control signals. The control of a group (“each LED-based lighting fixture 202”) means that the control signals include synchronous information, that is, the signals are constituted by control signals and synchronous signals.

36. In view of the above, and the arguments in my original declaration (e.g., EX1003, ¶¶ 48-50), Dr. Lebby’s contention that “control signals and synchronous signals” precludes any control signals from also being synchronous must be rejected. Dr. Lebby provides no compelling evidence from the ’546

specification aside from parroting of the claim language itself, which by its plain words does not support such a narrow and unsupported reading of this limitation.

E. Lys discloses “synchronous signals” as claimed in 1[D]

37. Dr. Lebby argues that Lys does not disclose “synchronous signals.” EX2001, ¶¶ 82-89. I disagree for the reasons stated in my original declaration (e.g., EX1003, ¶¶ 72-76) and the additional reasons set forth below in response to Dr. Lebby’s arguments.

38. As I explain above in Section IV(A) of this reply declaration, I have no objections to the PTAB’s construction of “synchronous signals” to mean “transmitting signals related to an activity(ies) occurring at the same time.” Paper 11 at 44. The PTAB’s construction is consistent with mine, which I interpreted in the broader context of the surrounding claim language as “signals that are sent to the slave nodes to control their corresponding LED strings at the same time.” EX1003, ¶ 50.

39. As I explain above in Section V(D), it is my opinion that a POSITA would not understand the claim language to preclude a control signal that is also a synchronous signal. Dr. Lebby’s opinion to the contrary is belied by the plain language in the claims (i.e., using the conjunction “and” instead of “or”), and the ’546 patent specification which only describes control signals and provides no examples of a synchronous signal that does not control the slave control units. Dr.

Lebby's citation to the specification's verbatim recitation of the claim language to support his opinion underscores the unreasonableness of his interpretation.

40. Therefore, Dr. Lebby's critique that "the Petition does not articulate precisely which signals in Lys are mapped to the 'control signals' of 1[D], and which signals in Lys are mapped to the 'synchronous signals' of 1[D]" (EX2001, ¶ 82) is irrelevant. The claimed "control signals" may be "synchronous signals" despite Dr. Lebby's erroneous interpretation of the claim language as prohibiting a "control signal" from also being a "synchronous signal" and vice versa.

41. Dr. Lebby also contends that Lys's disclosure of controlling light sources in a "coordinated fashion" does not meet the "synchronous signal" limitation because it relates to "exchanging control signals with pool devices other than light sources." EX2001, ¶ 87. I disagree with Dr. Lebby's interpretation. According to Lys, "[i]n one embodiment of the invention, one or more of the light sources 24A-24I are controlled in a *coordinated fashion* with one or more other accessories (e.g., heaters, blowers, filtration and circulation systems, etc.) in the pool or spa environment." EX1008 at 10:3-8 (emphasis added). Lys further explains:

[I]llumination conditions created by one or more of the light sources 24A-24D may particularly indicate activation of one or more of the other devices or accessories associated with the pool or Spa. Some illustrative examples of this embodiment include changing illumination conditions in the pool or spa *to a particular color when the heater 50 is activated*, or changing the illumination conditions *to one or more*

other particular colors when one or more blowers 52 comes on to agitate the liquid 22 in the pool or Spa 20. Similarly, one or more of the light sources 24A-24D can generate a particular illumination condition in the pool or spa 20 indicating any number of events associated with one or more other devices or accessories associated with the pool or spa.”

EX1008 at 16:56 to 17.2 (emphasis added). The disclosed “coordinated fashion,” therefore, is not merely coordinating with pool devices other than light sources as Dr. Lebby erroneously interprets. Rather, Lys explains that control activities, such as changing the “light sources 24A-24D” to a particular color(s) when other pool devices are turned on or activated, may occur at the same time to signify an event associated with another pool device. To control the light sources in this coordinated fashion requires “synchronous signals” as claimed.

42. Other disclosures in Lys provide additional support for my interpretation from the standpoint of a POSITA. For example, “[i]n another embodiment of the invention, two or more independently controllable light sources of the pool or spa environment shown in FIG. 1 may be synchronized without necessarily being coupled to a network[.]” EX1008 at 19:29-32. The disclosed “controllable light sources” require “control signals” to accomplish this control. And, performing control in a “synchronized” manner requires “synchronous signals” as claimed.

43. Dr. Lebby also critiques my opinion that Figure 4A in Lys discloses synchronous data paths because “nothing in ... Lys *requires* the simultaneous

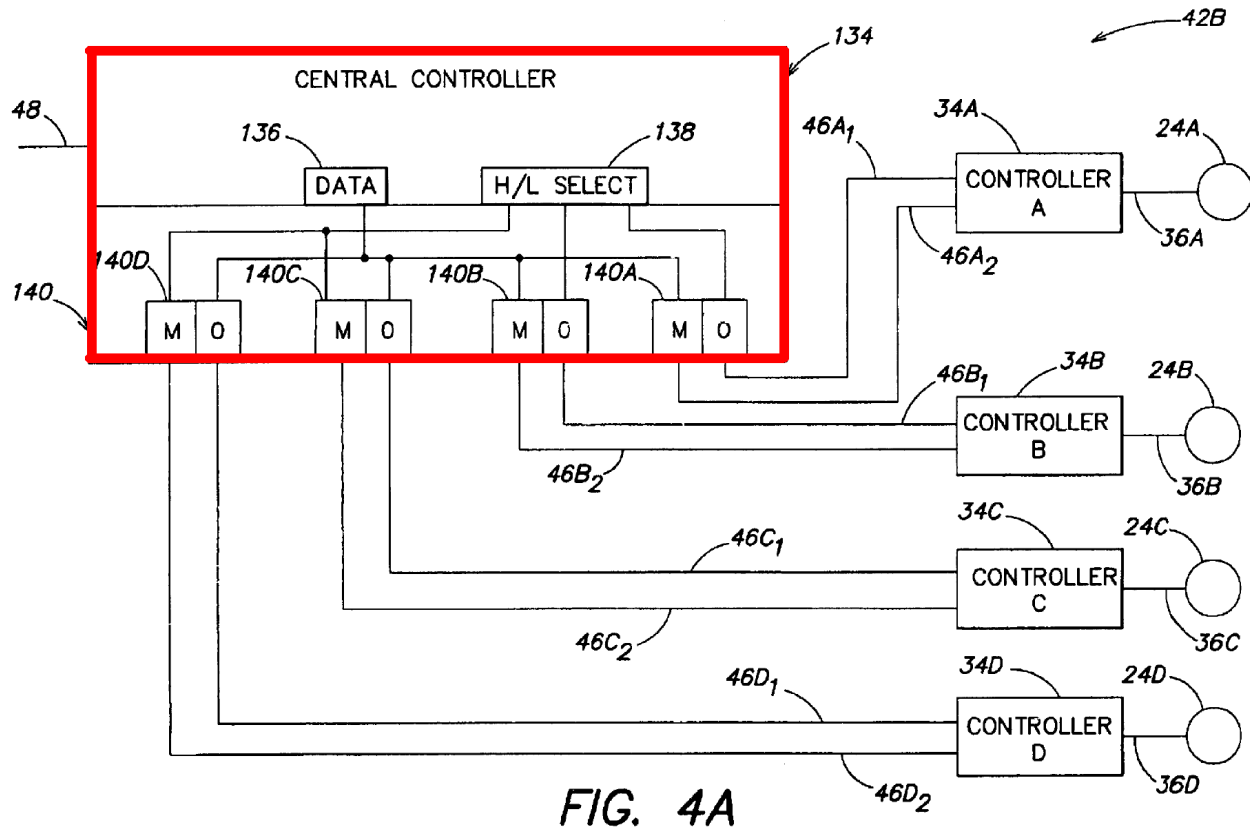
transmission of control signals” and “Lys’s controller *could have* transmitted signals to different light controllers at different times, to reduce the complexity and computing power required of the central controller.” EX2001, ¶ 88 (emphasis added). Dr. Lebby does not seem to contest my opinion that a POSITA would understand Figure 4A to “illustrate[] data signal 136 that is transmitted synchronously to each controller 34A-34D (either via ‘mode’ or ‘option’ data paths).” EX1003, ¶ 76. Whether there is some “requirement,” or a possibility that control signals may be transmitted “at different times,” is not relevant as to whether this limitation is disclosed as I have previously opined. And Dr. Lebby’s opinion that transmitting signals to different light controllers at different times has no support in Lys, and Dr. Lebby is unable to cite anything to support such a blanket statement. To the extent relevant, in my experience as a POSITA, there is no effect on complexity and/or computing power when addressing light sources individually versus collectively.

F. Lys discloses a “master control unit” as claimed in 1[A]

44. Dr. Lebby argues that Lys does not disclose a “master control unit” because the “local user interface 45” or “remote user interface 56” are only “buttons, switches, and dials.” EX2001, ¶¶ 82-89. I disagree for the reasons stated in my original declaration (e.g., EX1003, ¶¶ 62-67, 76) and the additional reasons set forth below in response to Dr. Lebby’s arguments.

45. There is no disclosure in Lys to conclude, as Dr. Lebby has, that “[a] POSITA would have understood that Lys’s button, switch, or dial on the local user interface 43 may be nothing more than those simple components.” EX2001, ¶ 91. As I cited in my original declaration, for example, “a local user interface 43 *may be associated with the controller 34* shown in FIG. 2 to facilitate user selection of one or more operating modes of the controller 34 and the light source 24.” EX1003, ¶ 63 (citing Lys at 14:17-29 (emphasis added)). I never opined that the claimed “master control unit” was merely the “buttons, switches, and dials” and nothing more.

46. Moreover, and in further response to Dr. Lebby’s arguments, a POSITA would therefore recognize that the “central controller 134” as illustrated in Figure 4A could also comprise the controller of either the local or remote user interfaces disclosed in Lys:



EX1008 at Fig. 4A (central controller 134 highlighted). As Lys explains, “[i]n the embodiment of FIG. 4A, a central controller 134 coupled to the network 48 is adapted to control four light sources 24A-24D respectively associated with four controllers 334A-34D.” EX1008 at 17:64-66. I cited Figure 4A in my original declaration and further explained the operations of central controller 134. EX1003, ¶ 76.

47. Dr. Lebby also argues that a “voltage regulator” is absent from the claimed “master control unit” because “selectors 60A-60D are simply buttons of remote user interface 56, which operates like a remote control.” EX2001, ¶ 93.

First, I disagree that I have only identified “buttons” and nothing more as the

corresponding “master control unit” as explained above and in my original declaration. Second, I maintain my original opinion that the selectors in Lys meet the “voltage regulator” limitation. EX1003, ¶ 66. To further explain in response to Dr. Lebby’s criticism, Lys is capable of changes in lighting color. Color is changed by changing the current through LEDs. Each current change is associated with a voltage change (due to Ohm’s law). Since Lys is capable of changing / regulating current, it is equally capable of changing voltage. Accordingly, Lys changes, controls, or regulates current and voltage and therefore includes a voltage regulator. I note that the ’546 patent discloses “direct current *voltages* outputted from the voltage regulator 108” (EX1001 at 3:57-58) (emphasis added). That voltages (plural) are outputted from the voltage regulator is consistent with the capability to change voltage values.

G. Lys discloses a “second curtain lamp” as claimed in 8[D]

48. Dr. Lebby argues that Lys does not disclose a “second curtain lamp.” EX2001, ¶¶ 95-97. I disagree for the reasons stated in my original declaration (e.g., EX1003, ¶¶ 89-91) and the additional reasons set forth below in response to Dr. Lebby’s arguments.

49. As explained above in Section V(A) of this reply declaration, the claimed “curtain lamp,” which Dr. Lebby does not dispute may be only one LED string, includes at least a single LED. The minimum configuration for a “curtain

lamp” according to the ’546 specification is one LED. Therefore, the reverse must be true as well: one LED constitutes the claimed LED “curtain lamp.”

50. Each one of Lys’s plurality of light sources 24A to 24D meets the claim limitation “a second curtain lamp electrically connected to the alternating current voltage transferring to direct current voltage circuit.” Each lighting module operates with DC current and, accordingly, must be connected to an “alternating current voltage transferring to direct current voltage circuit.” EX1003, ¶¶ 89-90 (explaining how each controller 34 coupled to a light source 24 in Figure 4 of Lys receives a power signal 47 that may be provided by either A.C. or D.C. power and an A.C. to D.C. converter may be utilized).

VI. GROUNDS 2 AND 4

A. Kuang and Lys already disclose a “transistor” in claim 3

51. Dr. Lebby contends that a POSITA would not have been motivated to combine Kuang with Debevec or to combine Lys with Debevec in support of the “transistor” limitation in claim 3. EX2001, ¶¶ 100-108.

52. According to Dr. Lebby, “the Petition does not identify any deficiency in Kuang warranting the addition of Debevec’s transistor. And in fact, Kuang already discloses the same functionality that Petitioner seeks to add via Debevec’s transistor.” EX2001, ¶ 101. Dr. Lebby further opines that:

Kuang discloses a feedback system in which a controller receives feedback from a temperature sensor 430 or optical sensor 432, and

adjusts LED current to adjust LED brightness. Ex. 1004 [0010], [0030], [0048], [0051], [0052]. Kuang also discloses a micro-controller that can turn LEDs on and off, and dim LEDs by pulse width modulation. Id., [0035], [0054]. In other words, *Kuang's system already has the capabilities of 'an electronic switch or valve' because it can switch power to the LEDs and dim the light output.*

EX2001, ¶ 102 (emphasis added).

53. Similarly, Dr. Lebby opines that “Lys discloses a controller 34 that changes lighting parameters without modification, such as by adjusting a PWM signal or providing variable analog signals.” EX2001, ¶ 106 (citing Lys at 11:21-52). Dr. Lebby concludes that “Lys already has a type of ‘electric switch or valve.’” EX2001, ¶ 106.

54. Although I maintain my original opinion that a POSITA would have been motivated to combine Kuang with Debevec or Lys with Debevec in satisfaction of the “transistor” limitation (e.g., EX1003, ¶¶ 54-58, 92-94), in the alternative, I agree with Dr. Lebby that “Kuang’s system already has the capabilities of ‘an electronic switch or valve’” and “Lys already has a type of ‘electric switch or valve.’” As such, Kuang and Lys each independently disclose the “transistor” limitation without combining with Debevec.

55. A transistor may be referred to as an electronic switch or electronic valve. The Illustrated Dictionary of Electronics defines “transistor” as “[a]n active (commonly three-terminal) semiconductor device capable of amplification, oscillation, and *switching action*.” EX1013 at 691 (emphasis added). Similarly,

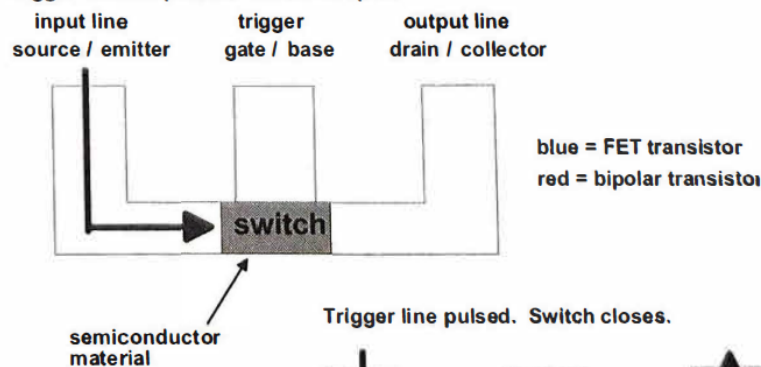
the American Heritage Science Dictionary defines “transistor” as “[a]n electronic device that controls the flow of an electric current, most often used as an amplifier or switch.” EX1014 at 637. And the Computer Glossary defines “transistor” as “[a] semiconductor device used to amplify a signal or open and close a circuit. In a computer, it functions as an electronic switch.” EX1015 at 407. The Computer Glossary further illustrates the “transistor concept” and defines “[t]he transistor as an electronic switch”:

The Transistor Concept

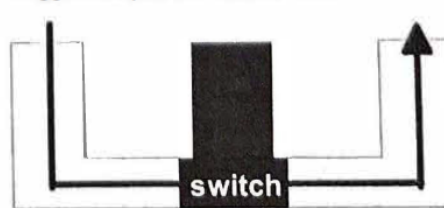
The transistor is an electronic switch. The switching element is made of semiconductor material which conducts electricity when it is pulsed.

If there is no pulse on the trigger line, the semiconductor element is in a non-conductive state. When it is pulsed, it becomes conductive and current flows from the input to the output.

Trigger line not pulsed. Switch is open.



Trigger line pulsed. Switch closes.



EX1015 at 407. As illustrated above, the current flow in an FET (field-effect transistor) between source and drain is controlled by the gate. That is, the current

flow can be switched on and off by the gate. In addition, the current flow can be continuously regulated by the gate.

56. In sum, because Dr. Lebby agrees that a transistor, including Debevec's transistor, can be characterized as an "electronic switch or valve," and a POSITA would understand a "transistor," as claimed, to be the equivalent of an electronic switch or valve as supported by the above technical resources, in the alternative I agree with Dr. Lebby and conclude that Kuang and Lys already disclose a "transistor" as claimed. A transistor is frequently described as an "electronic switch or valve." Because a transistor may be referred to as an electronic switch or valve, a POSITA would recognize that Kuang and Lys already discloses the claimed "transistor."

VII. GROUND 5

A. Hiroyuki discloses "pins" in claim 4

57. According to the PTAB, "the Schubert Declaration at paragraph 100 does not offer evidentiary support for its statements that '[t]he words "terminal" and "pin" typically imply an electrical end point at which an electrical connection is made to another unit' and that '[a] "pin" can be understood as a pointed terminal, indicating that 'terminal' encompasses a 'pin.'" Paper 11 at 52. The PTAB invited additional briefing on "issues related to claim 4" including claim

construction regarding “power negative terminal pin” and “signal output pin.”

Paper 11 at 52.

58. In response to the PTAB’s invitation and Dr. Lebby’s argument that Hiroyuki “does not disclose physical connections such as the pins of 4[A] or 4[B] (EX2001, ¶ 112), I maintain my original opinion that Hiroyuki discloses the claimed “pins” by virtue of its disclosure of corresponding terminals in schematics such as Hiroyuki Figures 1 and 7. EX1003, ¶¶ 97-106. In further support of my original opinion that “[t]he words ‘terminal’ and ‘pin’ typically imply an electrical end point at which an electrical connection is made to another unit,” the Modern Dictionary of Electronics defines “terminal” as “1. *A point of connection for two or more conductors* in an electrical circuit. 2. A device attached to a conductor to facilitate connection with another conductor.” EX1016 at 769 (emphasis added). And, the McGraw-Hill Dictionary of Scientific and Technical Terms defines “pin” as “[ELECTR] A *terminal* on an electron tube, semiconductor, integrated circuit, plug, or connector.” EX1017 at 1600 (emphasis added). Therefore, consistent with my original opinion, a POSITA (consistent with the general understanding in the art) would understand the “terminal” disclosures in Hiroyuki to reference a connection point in an electrical circuit.

59. Of note, the ’546 patent does not describe the physical structure of any claimed “pins.” The ’546 patent only provides schematics without any further

discussion or depiction of the physical nature of claimed “pins.” Therefore, consistent with my original opinion, a POSITA would understand Hiroyuki to disclose the claimed “pins” because both “terminals” and “pins” imply an electrical end point at which an electrical connection is made to another unit. And, that connection could be pointed, rounded, or flat. As shown above, not all technical definitions of “pin” are tied to a specific physical structure. Rather, they may be synonymous with “terminals” generally, and certainly nothing in Hiroyuki teaches away from “terminals” that may be pointed – to the extent such a physical distinction is relevant. The words “terminal,” “pin,” and “connection point” are frequently used interchangeably in the art, indicating that they reflect a linguistic preference rather than a substantive and non-obvious technical difference.

VIII. GROUND 6

A. Hiroyuki discloses a “signal processor” in claim 8

60. In its Institution Decision, the PTAB noted that “petitioner does not offer an interpretation of ‘signal processor.’” Paper 11 at 55. As such, the PTAB noted that “[i]t is therefore not clear, at this juncture, why, according to the Schubert Declaration at paragraph 127, ‘a POSITA would have understood the constant current circuit 72 in Hiroyuki to meet the “signal processor” limitation as claimed because it regulates the power supply to keep its output current constant in

spite of changes in load, line, or temperature.” Paper 11 at 55. The PTAB invited additional briefing on this point.

61. Consistent with the general understanding in the art, a POSITA would understand that signal processors come in two varieties: digital signal processors and analog signal processors. Signal processors are electrical circuits that, for example, process, filter, convert, modify, or decode a received electrical signal (such as command signal). The Illustrated Dictionary of Electronics defines a “signal processor” as follows: “Any device, (e.g., preamplifier, expander, amplitude limiter, delay network) inserted into or added onto a system to modify an input or output signal.” EX1013 at 628.

62. Digital signal processors work with digital signals having discrete voltage values that are associated with at least two logical states such as the “0” state and the “1” state. In contrast, analog signal processors are not limited to discrete voltage values but instead can employ a continuous range of voltage values. An electrical circuit unit (analog or digital) receiving a signal and processing the signal into another type of signal constitutes a signal processor. For example, the filtering of an electrical signal is understood as processing of the signal. This is consistent with the technical literature, for example the 1988 Jarske IEEE article, “Signal Processor Implementation of Variable Digital Filters,” and the 1988 Renfors IEEE article, “Signal Processor Implementation of Digital

Filters”, which characterize the filtering of an electronic signal as an act of signal processing. EX1011, EX1012. Such understanding is consistent with the plain and ordinary meaning of the term “signal processor” and for this reason would be shared by a POSITA. For example, an electric circuit receiving an informational signal (command signal) as well as a power signal to process the received signals into a signal that is suitable for driving an LED, constitutes a signal processor.

63. Patent owner considers the claimed signal processor to not be limited to digital signal processors. Patent owner’s response does not establish or indicate (in any way, shape or form) that the claimed signal processor should be limited to a digital signal processor. It is therefore reasonable for the claimed signal processor to include digital signal processors as well as analog signal processors. That is, the claimed signal processor should not be limited to “digital signal processor” and neither Petitioner nor Patent Owner suggests such limitation.

64. Dr. Lebby admits that the circuit of Hiroyuki processes a signal. According to Dr. Lebby, “The function performed by Hiroyuki’s constant current circuit unit 72 is essentially a filter” EX2001, ¶ 121. It is indisputable that filtering a signal constitutes the processing of a signal because the act of filtering constitutes a modification of a signal, specifically the modification of an unfiltered signal into a filtered signal. For example, the Dictionary of Computer Science and Technology defines “filter” as “an electronic device that *modifies* some

characteristic of an input signal for conditioning or other purposes.” EX1018 at 184 (emphasis added). Such modification is consistent with the dictionary definition of a signal processor, which classifies “[a]ny device ... to modify an input or output signal” as a signal processor. EX1013 at 628. Indeed, it is a common function of signal processors to filter signals as disclosed numerous times in the technical literature. In addition, the technical literature is replete with reports that identify filtering as one of the common processes performed by signal processors. Indeed, it is a common function of signal processors to filter signals. EX1011, EX1012.

65. Dr. Lebby further admits that it is sufficient for an exemplary signal processor to simply provide a signal that controls a transistor which in turn regulates the current flow to an LED. According to Dr. Lebby, “the ’546 patent discloses a signal processor 116 that outputs a signal to control transistor 118.” EX2001, ¶ 122. That is, Dr. Lebby points to an exemplary implementation of a signal processor, in which the signal processor provides an output signal that is used to drive an LED.

66. The admissions by Patent Owner and Dr. Lebby that the Hiroyuki circuit constitutes “essentially a filter” together with the facts, (i) filtering is a common process performed by signal processors, (ii) Hiroyuki’s circuit receives (as input) an informational and power signals, and (iii) Hiroyuki’s circuit provides

(as output) an output signal driving an LED (or a string of LEDs), clearly establish that Hiroyuki's circuit includes a signal processor.

B. A POSITA would have been motivated to add Debevec's microcontroller to Hiroyuki

67. The Kuang prior art reference includes a microcontroller. In contrast, the Hiroyuki prior art reference does not include a microcontroller. Dr. Lebby contends that the Petition (and my associated declaration) fails to establish that a POSITA would have been motivated to add Kuang's microcontroller to Hiroyuki. EX2001, ¶ 125.

68. In response to Dr. Lebby's arguments, adding the microcontroller of Kuang in Hiroyuki would have provided the following advantages: First, a microcontroller would have added flexibility in driving LEDs. A microcontroller can be programmed and re-programmed, whereas a hard-wired circuit cannot. The flexibility allows the circuit to be responsive to future needs. Second, a microcontroller would have enabled advanced functionalities of the system by being able to tune lighting parameters such as brightness and color. Such brightness and color tunability are desirable features that a consumer would appreciate. Third, adding a microcontroller, such as the one used by Kuang, is predictable and has a high associated probability of success. Microcontrollers are digital circuits based on logic that are widely used and have an associated low cost.

69. Moreover, the prospect of a more advanced functionality enabled by microcontrollers would motivate a POSITA to include a microcontroller (such as Kuang's microcontroller) in Hiroyuki's lighting device. A more advanced functionality would include the ability to individually and collectively address the LED strings, or the LEDs within a string, which is a functionality that would be appreciated by consumers.

70. For at least these additional reasons, a POSITA would be motivated to include Kuang's microcontroller in Hiroyuki.

IX. CONCLUSION

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on November 4, 2024

By:



E. Fred. Schubert

APPENDIX A: CHALLENGED CLAIMS

Claim	Limitation
1[Pre]	A driving apparatus for light-emitting diode curtain lamp applied to a direct current power source and at least a light-emitting diode light string, the driving apparatus for light-emitting diode curtain lamp including:
1[A]	a master control unit electrically connected to the direct current power source, including a microcontroller and a voltage regulator electrically connected to the microcontroller;
1[B]	at least a slave control unit electrically connected to the master control unit and the light-emitting diode light string; and
1[C]	a transmission line electrically connected to the master control unit and the slave control unit,
1[D]	wherein the slave control unit is controlled by the master control unit to drive the light-emitting diode light string; the transmission line is used to transit control signals and synchronous signals.
2	The driving apparatus for light-emitting diode curtain lamp in claim 1, wherein the slave control unit includes a signal processor.
3	The driving apparatus for light-emitting diode curtain lamp in claim 2, wherein the slave control unit includes a transistor electrically connected to the signal processor.
4[Pre]	A driving apparatus for light-emitting diode curtain lamp applied to an alternating current power source and at least a light-emitting diode light string, the driving apparatus for light-emitting diode curtain lamp including:

Claim	Limitation
4[A]	a master control unit including a power negative terminal pin of master control unit and a signal output pin of master control unit, the master control unit being electrically connected to the alternating current power source; and
4[B]	at least a slave control unit including a signal input pin of slave control unit, a signal output pin of slave control unit, a power positive terminal pin of slave control unit, and a power negative terminal pin of slave control unit, the slave control unit being electrically connected to the master control unit and the light-emitting diode light string,
4[C]	wherein the slave control unit is controlled by the master control unit to drive the light-emitting diode light string; the signal output pin of master control unit is electrically connected to the signal input pin of slave control unit;
4[D]	the power negative terminal pin of master control unit is electrically connected to the power positive terminal pin of slave control unit.
5	<p>The driving apparatus for light-emitting diode curtain lamp in claim 4, wherein the master control unit includes:</p> <p>a microcontroller; and</p> <p>a bridge rectifier electrically connected to the microcontroller.</p>
6	The driving apparatus for light-emitting diode curtain lamp in claim 5, wherein the master control unit includes a first Zener diode electrically connected to the bridge rectifier.
8[Pre]	A driving apparatus for light-emitting diode curtain lamp with single light-emitting diode in one light-emitting diode string applied to at least a light-emitting diode, the driving apparatus for light-emitting diode curtain lamp with single light-emitting diode in one light-emitting diode string including:

Claim	Limitation
8[A]	<p>a master control unit; and</p> <p>at least a slave control unit electrically connected to the master control unit and the light-emitting diode,</p>
8[B]	<p>wherein the master control unit includes a microcontroller; the slave control unit includes a signal processor;</p>
8[C]	<p>the driving apparatus for light-emitting diode curtain lamp with single light-emitting diode in one light-emitting diode string further including:</p> <p>an alternating current voltage transferring to direct current voltage circuit electrically connected to the slave control unit; and</p>
8[D]	<p>a second curtain lamp electrically connected to the alternating current voltage transferring to direct current voltage circuit.</p>