

United States District Court,
E.D. Michigan, Southern Division.

RELUME CORPORATION,
Plaintiff.

v.

**DIALIGHT CORPORATION, Ecolux, Inc., Precision Solar Controls, Inc., Lumileds Lighting BV,
Philips Lighting BV, and Hewlett-Packard Company,**
Defendants.

Aug. 26, 1999.

Owner of patents for light emitting diode (LED) arrays for use in traffic signals sued competitors for infringement, and competitors alleged that patents were invalid. On defendants' motions for summary judgment, the District Court, Feikens, J., held that: (1) competitors' devices did not literally infringe on patent claims for supplying LED array with regulated voltage or maintaining luminous intensity of LED array; and (2) patents were invalid as either anticipated or obvious.

Motions granted in part and denied in part.

5,661,645, 5,783,909. invalid.

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OPINION AND ORDER

FEIKENS, District Judge.

Introduction

Before me is a multi-patent infringement dispute between competitors in the light emitting diode ("LED") traffic signal industry. At issue are summary judgment motions regarding patent noninfringement and validity filed by defendants Dialight Corporation ("Dialight"), Ecolux, Inc. ("Ecolux"), Precision Solar Controls, Inc. ("Precision"), Lumileds Lighting BV ("Lumileds"), Philips Lighting BV ("Philips"), and Hewlett-Packard Company ("Hewlett-Packard").

I. Background

All parties are involved in the design, development, manufacture, assembly, and/or sales of LED traffic signals. Most traffic signals in the United States use incandescent light bulbs, which produce light by heating a filament in the bulb's vacuum chamber with electric current. The heated filament gives off light. Simple incandescence is inefficient, however, since it wastes most of the electrical energy it consumes as heat.

LEDs offer a solution to this problem because they do not use a heated filament to produce light. Instead they use a tiny piece of specially formulated semiconductor material that emits light when an electric current passes through it. LEDs have existed for decades, and so has knowledge of their energy savings advantage over incandescent bulbs, but their use in traffic signals is a relatively new application.

On June 27, 1996, Peter Hochstein, a Relume employee, filed a patent application with the U.S. Patent Office, in which he claimed a variety of power supply inventions for retrofit LED arrays, i.e., arrays that can replace incandescent bulbs in devices originally built for incandescent illumination. On August 26, 1997, the Patent Office issued that application as U.S. Patent No. 5,661,645 ("the '645 patent"). The '645 patent lists Hochstein as its inventor.

On January 10, 1997, Hochstein filed another patent application with the Patent Office, in which he claimed various inventions related to a temperature compensation circuit for LEDs. This circuit functions as a feedback loop to prevent an LED's light intensity from decreasing as temperature increases. On July 21, 1998, the Patent Office issued this second application as U.S. Patent No. 5,783,909. The '909 patent lists Hochstein as its inventor.

Relume's suit against defendants alleges infringement of its '645 and '909 patents. All defendants have argued in response that their accused products do not infringe Relume's patents. Three defendants-Lumileds, Philips, and Hewlett-Packard (collectively "Lumileds")-have also argued that Relume's patents are invalid and unenforceable in light of relevant prior art Relume did not make available to the Patent Office during the prosecution of its patents. Defendants' summary judgment motions address these issues. Relume has filed no summary judgment motions.

II. Summary Judgment Standard

Federal Rule of Civil Procedure 56(c) provides that a summary judgment shall issue "if the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." A genuine issue of material fact does not exist "[w]here the record taken as a whole could not lead a rational trier of fact to find for the nonmoving party." *Matsushita Elec. Indus. Co. v. Zenith Radio*

Corp., 475 U.S. 574, 587, 106 S.Ct. 1348, 89 L.Ed.2d 538 (1986). The movant has the initial burden of showing that no genuine issue of material fact exists. *See Celotex Corp. v. Catrett*, 477 U.S. 317, 323, 106 S.Ct. 2548, 91 L.Ed.2d 265 (1986); *see also* Fed.R.Civ.P. 56(c).

Once the movant meets this initial burden, the nonmovant "must set forth specific facts showing that there is a genuine issue for trial." Fed.R.Civ.P. 56(e). These specific facts must constitute "sufficient evidence favoring the nonmoving party." *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 249, 106 S.Ct. 2505, 91 L.Ed.2d 202 (1986). Evidence that is "merely colorable" or "not significantly probative" will not demonstrate a need for trial. *Id.* at 249-50, 106 S.Ct. 2505. Likewise, "[t]he mere existence of a scintilla of evidence in support of the [nonmovant's] position will be insufficient; there must be evidence on which the jury could *reasonably* find for the [nonmovant]." *Id.* at 252, 106 S.Ct. 2505 (emphasis added).

The essence of the summary judgment inquiry is this: "whether the evidence presents a sufficient disagreement to require submission to a jury or whether it is so one-sided that one party must prevail as a matter of law." *Id.* at 251-52, 106 S.Ct. 2505. In addressing this inquiry, I must view the evidence, and all reasonable inferences drawn from it, "in the light most favorable to the party opposing the motion." *Matsushita*, 475 U.S. at 587, 106 S.Ct. 1348.

III. Literal Infringement

In their summary judgment motions, all defendants assert literal noninfringement of claims 1, 2, 4, 5, and 6 of the '645 patent. As to the '909 patent, all defendants except Precision FN1 assert literal noninfringement of claims 1 and 10—the independent claims of that patent. Defendants also assert noninfringement of the '645 and '909 patents under the doctrine of equivalents.

FN1. Precision has not offered noninfringement arguments with respect to the '909 patent because, in a letter to the court dated January 19, 1999, Relume stated that it had chosen not to allege any of the claims of its '909 patent against Precision. There has been no change in Relume's position since.

[1] For Relume to establish literal infringement, "every limitation set forth in a claim must be found in the accused product or process exactly." *Becton Dickinson and Co. v. C.R. Bard, Inc.*, 922 F.2d 792, 796 (Fed.Cir.1990). Determining literal infringement is a "two-step process." *Id.* As a first step I must determine the meaning and scope of the claims in dispute: a step "more commonly known as claim construction." *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed.Cir.1995). The second step requires me to compare the construed claims with the product or process accused of infringement. *Id.* The first step is a question of law, *see id.* at 979, while the second step is a question of fact, *see North American Vaccine v. American Cyanamid Co.*, 7 F.3d 1571, 1574 (Fed.Cir.1993).

When construing a claim under the first step, I must consider the intrinsic evidence of record: the claim language, the specification, and, if produced, the prosecution history. *See Markman*, 52 F.3d at 979. "The appropriate starting point, however, is always with the language of the asserted claim itself." *Phonometrics, Inc. v. Northern Telecom, Inc.*, 133 F.3d 1459, 1464 (Fed.Cir.1998). This is so because "[t]he language of the claims ... defines the bounds of the patentee's exclusive rights." *Wiener v. NEC Electronics, Inc.*, 102 F.3d 534, 539 (Fed.Cir.1996).

[2] In construing the claim language at issue, I am guided by the principle that "claim language is interpreted

to ascertain the meaning that a person of ordinary skill in the art would give to the claims in dispute." *Schering Corp. v. Amgen, Inc.*, 18 F.Supp.2d 372, 380 (D.Del.1998) (citing *Wiener*, 102 F.3d at 539). Although words in a claim generally have their ordinary meaning, "a patentee may choose to be his own lexicographer and use terms in a manner other than their ordinary meaning, as long as the special definition of the term is clearly stated in the patent specification or file history." *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed.Cir.1996). Even when a patentee does not give a word a special meaning, the specification still "acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication." *Id.* As such, the specification is often "the single best guide to the meaning of a disputed term." *Id.*

If the intrinsic evidence does not resolve the ambiguities of disputed claim language, I may then consider extrinsic evidence, such as expert testimony regarding how those skilled in the art would interpret the disputed claim. *See id.* at 1583. While extrinsic evidence may be used "as an aid in arriving at the proper construction of the claim," it "may not be used to vary or contradict the otherwise unambiguous meaning of the claim." *Desper Products, Inc. v. QSound Labs., Inc.*, 157 F.3d 1325, 1333 (Fed.Cir.1998). In most cases, intrinsic evidence will suffice to resolve ambiguity, and so, in those cases, consideration of the extrinsic evidence for construction purposes would be "improper." *See Vitronics*, 90 F.3d at 1583.

Based on the record before me, I am satisfied that I can "independently assess the claims, the specification, and if necessary the prosecution history, and relevant extrinsic evidence, and declare the meaning of the claims." *Exxon Chemical Patents, Inc. v. Lubrizol Corp.*, 64 F.3d 1553, 1556 (Fed.Cir.1995). The claims I interpret are those the parties have debated with respect to their meaning and scope. I will not refer to any prosecution history because no party has placed it in issue. I emphasize that my *Markman* construction of the disputed claims serves only to determine the meaning a person of ordinary skill in the art would give to those claims. *See Wiener*, 102 F.3d at 539.

IV. Claim Construction

A. The '645 Patent

Relume's '645 patent describes an apparatus for supplying regulated voltage d.c. electrical power to an LED array. The patent has twenty-three claims, but only claims 1, 2, 4, 5, and 6 are at issue in the parties' summary judgment motions. These five claims read as follows:

1. An apparatus for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output; and

an LED array (12) having an input connected to said output of said power factor correction converter means (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12).

2. The apparatus according to claim 1 wherein said power factor correction converter means (38) is a power

factor correcting and voltage regulating buck/boost switchmode converter.

* * * * *

4. The apparatus according to claim 1 including an electromagnetic interference filter means (28) connected to said input of said rectifier means (32) for preventing conducted interference from feeding back onto a.c. power lines (22) connected to said rectifier means input.

5. The apparatus according to claim 1 including an adaptive clamp circuit means (24) connected to said input of said rectifier means (32) for eliminating leakage current problems.

6. The apparatus according to claim 5 wherein said adaptive clamp circuit means (24) has an input adapted to be connected to a pair of a.c. power lines (22), a pair of clamp circuit output lines (26) connected to said adaptive clamp circuit means input, a voltage sensing means (48) connected across said input of said adaptive clamp circuit means (24), and a controlled load means (50) connected across said clamp circuit output lines (26) and to said voltage sensing means (48), said voltage sensing means (48) being responsive to a magnitude of a.c. voltage at said adaptive clamp circuit means input lower than a predetermined magnitude for turning on said controlled load means (50) to connect a low impedance load (60) in said controlled load means (50) across said clamp circuit output lines (26) and said voltage sensing means (48) being responsive to a magnitude of the a.c. voltage at said adaptive clamp circuit means input equal to or greater than said predetermined magnitude for turning off said controlled load means (50) to disconnect said low impedance load (60) from said clamp circuit output lines (26).

'645, 13:16 to 14:18.FN2

FN2. My citations to the '645 and '909 patents will be in the form of "patent, column:lines."

1. Claim 1

a. "LED array"

The parties' dispute over claim 1's "LED array" concerns its configuration and components. Ecolux, Dialight, and Precision argue that the "LED array" requires a series-parallel configuration of strings of LEDs with a ballast resistor FN3 in each string. Lumileds supports this construction, but also argues that if I reject it, the plain meaning of "LED array" requires only a group of LEDs forming a complete unit—a broad construction that could encompass a single string of LEDs in series or a series-parallel configuration. Relume contends that the "LED array" requires a series-parallel configuration, but not ballast resistors.

FN3. A ballast resistor is a resistor that limits and spreads current across a load (here the LED array). This "ballasting" function gives the resistor its name.

The parties' proposed constructions all draw on the specification of the '645 patent for primary support.FN4 Ecolux, Dialight, and Precision find their construction of "LED array" in a specification passage that describes the array's preferred embodiment: "The LED array 12 includes a plurality of strings of series connected LEDs 14 with a ballasting resistor 16 (R1, R2, R3, R4, R5, ...) connected in each string." '645, 5:5-8. Figure 5 of the patent diagrams this preferred embodiment of the array. Numeral 12 of Figure 5 labels

the LED array as all components to the right of a vertical dash line. It also refers to the specification passage relied on by the defendants and to the phrase "LED array" in the language of claim 1.

FN4. The exception is the alternative, plain meaning construction offered by Lumileds.

Relume finds its proposed construction in a different passage of the specification than do defendants. That passage describes the preferred embodiment of the LED array as "consisting of a large number of series-parallel connected LED devices." '645, 6:24-25. Relume also relies on the patent's diagrams of three prior art LED arrays, all of which depict series-parallel configurations, but only one of which depicts ballast resistors. From these references-the preferred embodiment passage and the prior art diagrams-Relume argues that a person of ordinary skill in the art of LED array power supplies would understand the series-parallel configuration, but not the ballast resistors, to be a necessary part of the claimed "LED array".

My construction of "LED array" must begin with the language of claim 1. *See Phillips Petroleum Co. v. Huntsman Polymers Corp.*, 157 F.3d 866, 871 (Fed.Cir.1998). It does not mention series-parallel LED configurations or ballast resistors. All that claim 1 explicitly requires the "LED array" element to have as physical structure is 1) the LEDs in an array arrangement and 2) an input connected to the output of the power factor correction converter means.

In fact, claim 1 speaks broadly of its claimed invention. It states at the outset that it covers "[a]n apparatus for supplying regulated voltage d.c. electrical power to an LED array." '645, 13:16-17. It further states that this apparatus has three major elements: a rectifier means, a power factor correction converter means, and an LED array. Thus, upon reading claim 1 in its entirety, a person of ordinary skill in this art would understand that it covers a certain kind of regulated voltage power supply for an LED array, but would not necessarily conclude that the invention's application was restricted solely to traffic signals. To put it another way, the invention described by the language of claim 1 is a relatively simple one with potentially broad application: any conceivable use for regulated voltage LED illumination.

This point is important because it informs the ordinary meaning of the phrase "LED array." By itself, the word "array" connotes nothing more than a series or orderly grouping of things. *Webster's Third New International Dictionary* (1986) (hereafter "*Webster's*") defines it variously as "a regular and imposing grouping or arrangement" and "an impressive list, series, or group of things." FN5 The modifier "LED" simply tells the reader that the things arranged by the array are LEDs. Together, then, the words "LED" and "array" have a range of ordinary meaning that can cover LED configurations as simple as a string of LEDs in a series or as complicated as the series-parallel LED strings of the '645 patent's preferred embodiment. The entirety of claim 1 does not alter this range of ordinary meaning.FN6 Thus, after reading claim 1, a person of ordinary skill in the art of LED array power supplies would understand the phrase "LED array," on its face, to cover a wide scope of LED configurations, including, but not limited to, the simple series and the series-parallel.

FN5. Relume argues, without reference to a dictionary or treatise, that "array" merely means "array shaped," "having a two dimensional extent, width and height." (Pl.'s Consolidated Opp. at 12.) I reject this definition. Besides being circular and at odds with *Webster's*, it is critically incomplete. It does not speak to the ordered nature of arranged things that the word array evokes. It also fails to gain Relume what it wants for validity purposes: a construction of "LED array" that excludes from its scope a single string of LEDs in a series. That simple configuration does have a width and a height: it is one LED wide and however many LEDs

high.

A related point: In its response to Lumileds' anticipation motion, Relume raised arguments vehemently attacking the use of dictionaries in claim construction because they are extrinsic evidence. (See Pl.'s Anticipation Opp.Mot. at 9.) Throughout my opinion, I follow the rule laid down in *Vitronics*, which permits me to consult dictionaries and treatises "at any time" in my claim construction so long as the dictionary's definition does not contradict the definition supplied by the intrinsic evidence of the patent. See 90 F.3d at 1584, n. 6.

FN6. Some defendants suggest that the reference numeral attached to "LED array" limits the phrase's ordinary meaning by referring the reader to the diagram of the array's preferred embodiment, which shows ballast resistors in the array. I find this argument unpersuasive, however. A reference numeral is simply a convenient tool for directing the reader to an example of the element the patentee has claimed. Had the drafter wanted to incorporate the limitations of the preferred embodiment into the language of claim 1, he or she could have done so quite easily with words.

The parties' proposed constructions for "LED array" raise the issue whether the specification narrows the phrase's ordinary meaning. According to the United States Court of Appeals for the Federal Circuit ("Federal Circuit"), I "must presume that the terms in a claim mean what they say, and, unless otherwise compelled, give full effect to the ordinary and accustomed meaning of claim terms." *Johnson Worldwide Assocs., Inc. v. Zebco Corp.*, 175 F.3d 985, 989 (Fed.Cir.1999). The Federal Circuit has identified "two situations where a sufficient reason exists to require the entry of a definition of a claim term other than its ordinary and accustomed meaning." *Id.* at 990. "The first arises if the patentee has chosen to be his or her own lexicographer by clearly setting forth an explicit definition for a claim term." *Id.* "The second is where the term or terms chosen by the patentee so deprive the claim of clarity that there is no means by which the scope of the claim may be ascertained from the language used." *Id.* This second situation is not at issue here because, as I have explained, the phrase "LED array" is clear on its face.

The ballast resistor construction of "LED array" proposed by defendants is essentially an argument under the first situation. That is, defendants believe that the drafter of the '645 patent acted as his/her own lexicographer and clearly set forth an explicit definition of "LED array" in the specification that requires ballast resistors. At a March 22, 1999 hearing, I stated an inclination for a preliminary construction of "LED array" that was consistent with defendants' construction.

After further consideration, however, I am not persuaded that I should adopt their construction, which relies entirely on a passage and a diagram that describe the preferred embodiment of claim 1's LED array. It is a fundamental rule of claim construction that "[r]eferences to a preferred embodiment, such as those often present in a specification, are not claim limitations." *Laitram Corp. v. Cambridge Wire Cloth Co.*, 863 F.2d 855, 865 (Fed.Cir.1988); see also *Ekchian v. Home Depot, Inc.*, 104 F.3d 1299, 1302-03 (Fed.Cir.1997). Otherwise, "there would be no need for the claims." *SRI Int'l v. Matsushita Elec. Corp. of America*, 775 F.2d 1107, 1121 (Fed.Cir.1985).

Claim 1 only requires its array to incorporate one component: the LEDs. No additional components are therefore necessary. Except for its description of the preferred embodiment of the array, the specification of the '645 patent teaches nothing different. Its statement of the invention's objectives does not mention ballast resistors or claim any functional advantage related to ballast resistors. Perhaps most telling, the preferred embodiment passage relied on by defendants is itself only cursory in its reference to ballast resistors; it does

not explain what advantage is to be gained by using them in the array. From the context of the '645 patent, then, it is clear that the drafter did not intend for the preferred embodiment's use of ballast resistors to limit the full range of ordinary meaning inherent in the "LED array" phrase of claim 1.

Precision attempts to justify a ballast resistors requirement on functional grounds. As this argument goes, a person of ordinary skill in the art would understand ballast resistors to be necessary components in any voltage-regulated LED array because, without them, a voltage-regulated LED array will not illuminate well in all conditions. From an engineering standpoint, ballast resistors undoubtedly improve the performance of a voltage-regulated LED array. By limiting and spreading the current in the array, they help the LEDs maintain a more even level of illumination. Yet claim 1 recites no limitations on the array's illumination level, nor does it recite limitations for limiting and spreading current. Because their function is not essential to the claimed array, it follows that ballast resistors themselves are not essential components for that array.

Having determined that the "LED array" of claim 1 does not require ballast resistors, the question then becomes whether it also requires a certain configuration of the LEDs. Relume essentially argues that the "LED array" of claim 1 requires a series-parallel configuration of LEDs, but not necessarily the exact series-parallel example of the patent's preferred embodiment. Defendants argue that this construction improperly imports limitations from the specification into claim 1. They correctly point out the fundamental inconsistency in Relume's objection to a ballast resistors requirement, which comes from the specification, and its support for a series-parallel requirement, which also comes from the specification. Relume responds by contending that a person of ordinary skill in the art would know that a series-parallel configuration is necessary because LED string redundancy allows the array to continue to emit light in the event of a single point LED failure. FN7

FN7. A single point LED failure occurs when one LED in a string of connected LEDs fails, for whatever reason, to conduct electrical current and therefore emit light. This failure causes the entire LED string to fail as well. A series-parallel configuration of LED strings minimizes the impact of a single point LED failure because, even if one string is extinguished, the other strings will continue to emit light.

I find Relume's series-parallel construction of "LED array" unpersuasive, however, because it fails to overcome the presumption in favor of the phrase's ordinary and accustomed meaning. The language of claim 1 does not explicitly limit the "LED array" to a series-parallel configuration. Nor does it implicitly do so. As discussed above, the phrase "LED array" means on its face that the claimed element must arrange LEDs in a regular grouping. A series configuration is simply the logical minimum of this facial meaning and thus cannot be excluded from the phrase's scope. The specification supports this conclusion. It notes that both series and series-parallel configurations exist in the prior art as design choices for LED arrays. '645, 1:18-30.

If I were to determine that a person of ordinary skill in the art would read a series-parallel limitation into "LED array," I would violate the fundamental principle that the preferred embodiment not limit the meaning of the claims. *See* Laitram, 863 F.2d at 865. The specification does not indicate that the drafter acted as his own lexicographer and intended for the series-parallel definition of the preferred embodiment to override the ordinary meaning of "LED array." *See* Zebco, 175 F.3d at 990. Aside from the preferred embodiment, there are no explicit series-parallel definitions for claim 1's LED array set forth in the specification. The specification also does not mention a series-parallel configuration in its summary of the invention, nor in its statement of the invention's objectives. Finally, the specification's diagrams of the prior art tellingly attach

"series-parallel" as an adjective to "LED array"; this further reveals that the phrase "LED array" does not inherently teach a series-parallel configuration to those in the art.

Relume falls back on a functionality argument to support its narrow construction. It contends that the LED array of claim 1 requires, at minimum, a series-parallel configuration in order to gain the benefit of LED string redundancy. But just as Precision's function argument failed, so too does Relume's. Claim 1 nowhere recites a limitation on the configuration of the LED array, nor does it state a functional advantage from a series-parallel configuration. Moreover, claim 1 states no concern for how well or how safely the LED array illuminates, only that it does. All of this makes sense given that the invention described by claim 1 is not a kind of LED array or a safer LED array, but an apparatus that supplies voltage-regulated electrical power to any kind of LED array, whatever its application.

[3] I conclude that the intrinsic evidence of record would lead a person of ordinary skill in the art of LED array power supplies to understand the "LED array" of claim 1 to mean an orderly arrangement of LEDs—a meaning that encompasses both a simple series and a series-parallel configuration. I further conclude that a person of ordinary skill in this art would not understand the "LED array" of claim 1 to require ballast resistors.

b. "power factor correction converter means"

Lumileds argues that 35 U.S.C. s. 112, para. 6 governs the construction of claim 1's "power factor correction converter means" and limits it in scope to the corresponding structure disclosed in the specification: a switchmode buck/boost converter and a commercially available power factor controller. Relume argues that section 112, paragraph 6 does not apply because the language "power factor correction converter" implicitly recites sufficient structure to one of ordinary skill in the art of LED array power supplies.

Claim 1 describes the "power factor correction converter means" as

having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output.

'645, 13:22-28. By associating the word "means" with two functions—power factor correction FN8 and voltage regulation—claim 1 uses express means-plus-function language to describe the "power factor correction converter means" element. This creates a presumption that the "power factor correction converter means" is a means-plus-function element governed by section 112, paragraph 6. *See Al- Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1318 (Fed.Cir.1999) ("if the word "means" appears in a claim element in combination with a function, it is presumed to be a means-plus-function element to which s. 112, para. 6 applies").

FN8. The '645 patent explains that "power factor (p.f.) is well understood in the electrical engineering community as the ratio of real power to real power plus reactive power." '645,2:10-12. The closer a device's power factor ratio is to one, the better its efficiency. Poor power factor typically results when voltage and current are out of phase, but it can also result from harmonic distortion.

Relume contends that claim 1 overcomes this presumption by reciting sufficient structure. Relume specifically argues that a person of ordinary skill in the art would understand a "power factor correction converter" to be "a switching power supply that has some control feature to improve diode conduction time and increase power factor and reduce distortion." (Pl.'s Consolidated Opp. at 22.) Relume also notes that the claim language recites a location for the "power factor correction converter means" in the invention-between the rectifier and the LED array-and describes it as having an input and an output. (*See id.*)

[4] The Federal Circuit has determined that a presumption of section 112, paragraph 6 governance "can be rebutted if the evidence intrinsic to the patent and any relevant extrinsic evidence so warrant." *Personalized Media v. Int'l Trade Comm'n*, 161 F.3d 696, 704 (Fed.Cir.1998). Throughout the rebuttal inquiry, "the focus remains on whether the claim as properly construed recites sufficiently definite structure to avoid the ambit of s. 112, para. 6." *Id.* A claim recites sufficient structure when it elaborates the structure, material, or acts necessary to perform entirely the recited function. *See Sage Products, Inc. v. Devon Industries, Inc.*, 126 F.3d 1420, 1427-28 (Fed.Cir.1997).

Close scrutiny of the term "power factor correction converter means" reveals that it implicitly elaborates sufficient structure to a person of ordinary skill in the art of power supplies. The structural device claimed is a "converter means," and its functions are "power factor correction" and "being responsive to said rectified d.c. power ... for generating regulated voltage d.c. power." FN9 Although perhaps unremarkable to the layperson, the word "converter" is a structurally meaningful term-of-art to those of ordinary skill in the art of power supply electronics. According to Marty Brown's *Power Supply Cookbook* (1994), it connotes the generic structure of a switching power supply: that is, a switch and its controller circuit.FN10 *See id.* at 25-26. The *Power Supply Cookbook* also makes it clear that power factor correction and voltage regulation are typical functions for a switching power supply to perform. *See id.* Thus claim 1's association of "converter means" with its specified functions of power factor correction and voltage regulation would reinforce the structural connotations of "converter" to one of ordinary skill in this art.

FN9. Identification of the "power factor correction" function is less obvious than the voltage regulation function because the qualifier "power factor correction" is not phrased in the "means ... for" format that usually specifies a function in claim language. The "means ... for" formality, however, need not be present for me to interpret "power factor correction" as an additional functional constraint on the "converter means." *See Personalized*, 161 F.3d at 705 (finding that the adjective "digital" functionally constrained the word "detector" even without "means ... for" language).

FN10. The *Power Supply Cookbook* is an authoritative instructional design text for engineers in the field of power supply electronics. The background section of the '645 patent cites it as relevant prior art. Thus I consider it to be evidence intrinsic to the '645 patent and properly considered in my *Markman* construction of the claim term "converter." *See Markman*, 52 F.3d at 979.

[5] I conclude that the implicitly sufficient level of structural elaboration in the term "converter" removes the "power factor correction converter means" from its presumed statutory category as a means-plus-function element governed by section 112, paragraph 6. *See Personalized*, 161 F.3d at 705 (holding that the term "detector," even though it does not "specifically evoke a particular structure," nevertheless elaborates sufficient structure because it conveys "to one knowledgeable in the art a variety of structures known as 'detectors' "); *see also Cole v. Kimberly-Clark Corp.*, 102 F.3d 524, 531-32 (Fed.Cir.1996) (affirming a

district court's conclusion that the "perforation means" did not fall under section 112, paragraph 6 because the ordinary meaning of the term "perforation" recites sufficient structure to one of ordinary skill in the relevant art). Accordingly, I hold that a person of ordinary skill in the art of LED array power supplies would understand claim 1's "power factor correction converter means" to require the structure of a switching power supply.

c. "generating regulated voltage"

Defendants argue that the plain meaning of "generating regulated voltage" excludes from the scope of claim 1 those power supplies designed to regulate current. Relume argues that because of the basic electrical principle of Ohm's Law (voltage = current x resistance) current regulation will result in voltage regulation in a certain circumstance—specifically when resistance is constant. Relume argues that the voltage regulation performed by its invention is limited to that circumstance and, therefore, devices designed to regulate current can fall within the scope of its invention.

I begin my claim construction with the ordinary meaning of the disputed phrase. *See Phillips*, 157 F.3d at 871. The basic meaning of "generate" found in *Webster's* is that of a thing producing something else.FN11 The meaning of "regulated" is likewise straightforward; *Webster's* conveys the idea of something being ordered and controlled.FN12 Finally, *Webster's* defines "voltage" as "electric potential or potential difference expressed in volts."

FN11. *Webster's* most pertinent definitions of "generate" are 1) "to cause to be: to bring into existence," 2) "to originate (something material) by a physical or chemical process," and 3) "to be the cause of (a state of mind, an action, or something immaterial or intangible)."

FN12. *Webster's* most pertinent definitions of "regulate" are 1) "to reduce to order, method, or uniformity" and 2) "to fix the time, amount, degree, or rate of."

By combining these dictionary definitions, it is clear that "generating regulated voltage" means, on its face, the function of producing controlled electric potential. This function has a specialized understanding to those in the field of electronics. According to *The Illustrated Dictionary of Electronics* (7th ed.1997), "voltage regulation" is "[t]he stabilization of a voltage against fluctuations in source or load." FN13 Thus, upon reading the words "regulated voltage," a person of ordinary skill in the art would understand claim 1 to require the "power factor correction converter means" to stabilize the voltage it generates against fluctuations either in the input line voltage (the source) or in the LED array (the load).

FN13. Relume is correct to point out the significance of the "or" in this definition of "voltage regulation." A device need not regulate voltage against fluctuations in both source *and* load to be called voltage regulating in the art. The specification of the '645 patent makes it clear that claim 1's "converter means" is a voltage regulator concerned only with minimizing source voltage fluctuations.

Yet that is not all the language of claim 1 communicates regarding its voltage regulation function. As held above, the ordinary meaning of "converter" also implies to one of ordinary skill in the art the structure necessary to perform voltage regulation: a switching power supply. At its most basic, a switching power

supply must have some sort of switch and a controller circuit. *See Power Supply Cookbook* at 25-26. For a voltage-regulating power supply, the controller circuit's "main purpose" must be "to maintain a regulated output voltage." *Id.* at 26. It does so by acting as a voltage feedback loop. *See id.* at 73.

These structural limitations implied by the ordinary meaning of "converter" cannot be ignored. Voltage regulation calls for unique componentry—for example, the controller's output voltage feedback loop. Yet there is an even more important point: a voltage-regulating power supply is a device expressly designed to stabilize the electrical property of voltage and thus generate regulated voltage. It is built to act on voltage, not current.

Relume's tortured construction of "generating regulated voltage" turns a blind eye to these realities. Relume wants claim 1 to be nonsensically construed so that any device, regardless of its design and structure, would fall within its scope so long as that device effects source voltage regulation in the limited circumstance when resistance is constant. I have a duty, however, to give meaning to all the words in claim 1 in order to determine the scope of its claimed invention; the drafter has linked the "converter means" to the "generating regulated voltage" function. Thus I cannot ignore the implicit structural limitations in the term "converter"—structural limitations, I note, that Relume urged me to recognize in order to avoid the application of section 112, paragraph 6 to the "converter means."

There is another flaw in Relume's construction. The much trumpeted truth of Ohm's Law is ultimately immaterial to the resolution of the claim construction question before me. All it tells me is that in a certain situation, when resistance is controlled, current-regulating and voltage-regulating power supplies will have the same effect on their output voltage. It does not tell me anything about the purpose, design, and structure of current-regulating and voltage-regulating devices in the art. Thus, while interesting, the scientific fact of Ohm's Law does not address the underlying issue posed by the construction of "generating regulated voltage": What does it mean in the art when a converter regulates voltage instead of current?

The specification of the '645 patent reinforces these points. In its discussion of prior art power supplies, it recognizes the distinction drawn in the art between current regulation and voltage regulation.FN14 That distinction is based on meaningful engineering reasons. For instance, the specification notes that current regulation will result in better LED light output than voltage regulation. '645, 4:51-54. The reason: LED light output is directly related to the current flowing through the LED, not the voltage. There is of course a more obvious basis for the distinction in the art: current regulation and voltage regulation act on, and regulate, different electrical properties. Thus it is clear that treating power supplies designed for current regulation like those designed for voltage regulation—the effect of Relume's construction—would violate precepts in the art.

FN14. So too does *The Illustrated Dictionary of Electronics*. It gives distinct definitions for voltage regulation (quoted above) and for current regulation ("[t]he stabilization of current at a predetermined level or value").

There is nothing in the specification that alters my analysis of "generating regulated voltage." *See Zebco*, 175 F.3d at 990. It discloses a voltage-regulating switching power supply for the patent's invention that is structurally consistent with the ordinary meanings of "converter" and "generating regulated voltage" I discuss above:

The converter 38 includes a power factor correction (P.F.C.) integrated circuit (I.C.) controller 40, which is a commercial device available from many sources and functions by allowing current to charge a storage capacitor C (LARGE) only in phase with the rectified a.c. voltage thereby assuring a power factor close to unity. The control I.C. 40 also provides voltage regulation in the switchmode buck/boost converter by monitoring the output voltage and adjusting the high frequency on-off switching period of the pass element commensurately.

'645, 5:41-53. Not surprisingly, the specification nowhere instructs the reader on how a current-regulating power supply could be used instead of a voltage-regulating power supply to effect the aims of the invention.

[6] For all of the reasons discussed, then, I hold that a person of ordinary skill in the art of LED array power supplies would understand "generating regulated voltage" to mean that claim 1's "converter means" is designed to produce stabilized voltage at its output despite fluctuations in its input voltage. Because the intrinsic evidence of the patent provides a clear meaning for "generating regulated voltage," I decline to consider the extrinsic testimony of the '645 patent's inventor, Mr. Hochstein, which Relume offers in support of its construction. *See Southwall Tech., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1578 (Fed.Cir.1995); *see also Vitronics*, 90 F.3d at 1583.

2. Claim 2

The parties do not dispute the meaning of claim 2. As a dependent claim to claim 1, it incorporates all the limitations of claim 1, but with one exception. Instead of a generic "converter means," it teaches the use of a specific type: "a power factor correcting and voltage regulating buck/boost switchmode converter." '645, 13:33-36.

3. Claim 4

The parties do not dispute the meaning of claim 4. Like claim 2, it is a dependent claim to claim 1. It therefore incorporates all the limitations of claim 1 and adds another: the use of an "electromagnetic interference filter means." '645, 13:43. It also requires that the filter be located before the rectifier means. '645, 13:42-46.

4. Claim 5

[7] This claim recites an adaptive clamp circuit means for eliminating leakage current problems.FN15 '645, 13:47-50. Defendants contend that it is written in "means-plus-function" format and is therefore governed by 35 U.S.C. s. 112, para. 6. Relume does not appear to dispute defendants' proposed construction.

FN15. Leakage current creates problems for traffic signals because it falsely triggers the conflict monitors at an intersection. Conflict monitors exist to detect and prevent two green lights in perpendicular directions. A falsely triggered conflict monitor tells the intersection's traffic lights to go to blinking red signals when there is no need.

I agree with defendants' construction. By associating the word "means" with the function of eliminating leakage current problems, claim 5 uses express means-plus-function language to describe its "adaptive clamp circuit means" element. This creates a presumption that the "adaptive clamp circuit means" is a means-plus-function element governed by section 112, paragraph 6. *See Al- Site*, 174 F.3d at 1318. Unlike

the dispute over the "power factor correction converter means," however, Relume has not argued that claim 5 overcomes this presumption by reciting sufficient structure. Even if Relume were to argue that point, my review of the language of claim 5 does not reveal that it elaborates sufficient structure necessary to perform entirely the recited function. *See Sage Products*, 126 F.3d at 1427-28.

Thus according to section 112, paragraph 6, the "adaptive clamp circuit means" of claim 5 is to be construed "to cover the corresponding structure, material, or acts described in the specification and equivalents thereof." 35 U.S.C. s. 112, para. 6; *see also* *Lockwood v. American Airlines, Inc.*, 107 F.3d 1565, 1570-71 (Fed.Cir.1997). Accordingly, I hold that a person of ordinary skill in the art would understand the corresponding structure described in the specification of the '645 patent to be a voltage sensing means (48) comprised of a transistor (Q1) and a Zener diode (D5) and a controlled load means (50) comprised of a transistor (Q2) and a resistor (60). '645, 7:40 to 8:3. The specification explains their operation thus:

The clamping circuit 24 works by using the sensing transistor Q1 and the Zener diode D5 (the voltage sensing means 48 of FIG. 6a) to determine if the line voltage is below a certain magnitude (typically 40 volts).... If the Zener diode D5 does not conduct, the transistor Q2 is turned on to place the load resistor 60 [across] the power lines 22 causing the leakage voltage to drop below 10 volts. The transistor Q2 and the resistor 60 are the controlled load means 50 of FIG. 6a. Whenever the traffic signal controller relay "closes", the line voltage appearing at the input to the adaptive clamping circuit 24 rises to nominally 120 volts and the sensing circuit (Q1 and D5) turn off the controlling transistor Q2, removing the resistor 60 from the circuit thereby preventing unnecessary dissipation of power.

'645, 7:53 to 8:1.

5. Claim 6

Claim 6, which depends from claim 5, merely recites the specific structure presented in the specification. Accordingly, claim 6 is similar if not identical in scope to claim 5, in spite of the doctrine of claim differentiation. *See Laitram Corp. v. Rexnord, Inc.*, 939 F.2d 1533, 1538 (Fed.Cir.1991) (finding that the doctrine of "claim differentiation" cannot override section 112, paragraph 6).

B. The '909 Patent

Relume's '909 patent describes an apparatus, as well as a method, that maintains the luminous intensity of an LED. The patent has 18 claims. Claims 1-3, 6, 7, 9-12, 15, 16, and 18 are at issue in the parties' motions. They read as follows:

1. A circuit for maintaining the luminous output of a light emitting diode, said circuit comprising:

at least one light emitting diode (LED)(12) for producing a luminous output;

a sensor (22, 24) for sensing a condition proportional to said luminous output of said LED (12) and for producing a luminous output signal;

a power supply (16) electrically connected to said LED (12) for supplying ON/OFF pulses of electrical energy to produce the luminous output of said LED (12); and

said power supply (16) including a switching device responsive to said luminous output signal for adjusting

the electrical energy supplied by said pulses per unit of time to adjust the average of said current passing through said LED (12) to maintain the luminous output of said LED (12) at a predetermined level.

2. A circuit as set forth in claim 1 wherein said sensor (22) includes means for sensing changes in temperature of said LED (12).

3. A circuit as set forth in claim 2 wherein said sensor (22) includes a predetermined temperature behavior model to establish the increase in said current passing through said LED (12) as a function of the operating temperature of said LED (12) integrated with said predetermined temperature behavior model.

* * * * *

6. A circuit as set forth in claim 1 wherein said switching device includes means for adjusting the electrical energy supplied by said pulses per unit of time by adjusting the frequency of said pulses.

7. A circuit as set forth in claim 1 wherein said switching device includes means for adjusting the electrical energy supplied by said pulses per unit of time by adjusting the width of said pulses.

* * * * *

9. A circuit as set forth in claim 1 including a filter for filtering the electrical energy supplied by said pulses into substantially d.c. supplied to said LED for producing said luminous output.

10. A method of maintaining the luminous output of a light emitting diode (LED) comprising the steps of:

supplying ON/OFF pulses of electrical energy from an adjustable power supply (16) for establishing electrical current passing through the LED (12);

sensing (22, 24) a condition proportional to the luminous output of the LED (12); and

adjusting the electrical energy supplied by the ON pulses per unit of time to adjust the average of the current passing through the LED (12) to maintain the luminous output of the LED (12) at a predetermined level.

11. A method as set forth in claim 10 wherein sensing a condition is further defined as sensing changes in temperature of the LED (12).

12. A method as set forth in claim 10 further defined as establishing a predetermined temperature behavior model and increasing the current passing through the LED (12) as a function of the operating temperature of the LED (12) integrated with the predetermined temperature behavior model.

* * * * *

15. A method as set forth in claim 10 further defined as adjusting the electrical energy supplied by said pulses per unit of time by adjusting the frequency of said pulses.

16. A method as set forth in claim 10 further defined as adjusting the electrical energy supplied by said pulses per unit of time by adjusting the width of said pulses.

18. A method as set forth in claim 10 including filtering the output of the power supply for filtering the electrical energy supplied by said pulses into substantially d.c. supplied to the LED for producing said luminous output.

'909, 6:64-67, 7:all, and 8:all.

1. Claim 1

a. "condition proportional"

Ecolux construes "condition proportional" to mean directly proportional or having "the same or constant ratio." Ecolux believes this construction requires the invention's temperature sensor FN16 to be located on the LED circuit board, as opposed to somewhere else in the invention's circuitry. Relume argues that this locational requirement is an unnecessary limitation on the claimed invention. Relume believes that the scope of "condition proportional" includes temperature sensors that are sensitive to the ambient temperature surrounding the LEDs.

FN16. The '909 patent discloses two kinds of preferred embodiment sensors: a light sensor and a temperature sensor. Ecolux focuses its construction arguments on the temperature sensor because that is the kind of sensor its accused product uses.

Claim 1 does not recite a limitation on the location of its sensor. It describes the "sensor" as performing two functions: "sensing a condition proportional to said luminous output of said LED (12) and... producing a luminous output signal." '909, 7:1-3. This language limits the possible universe of conditions that could be sensed by the sensor to those that have a "proportional" relationship to the light output of the LEDs.FN17 *Webster's* most relevant definition of "proportional" is "having the same or a constant ratio;" this is, in fact, Ecolux's proposed definition.FN18 The key to understanding its scope is in the meaning of "ratio." *Webster's* defines it as "the fixed or approximate relation of one thing to another." Therefore all that claim 1 requires its sensor to do is sense a condition that has a "fixed relation" to the light emitted from the LEDs; this function does not imply a locational requirement for the invention's temperature sensor.

FN17. A related point regarding the "condition" sensed: the claim language does not limit it to the temperature of the LEDs as Ecolux has also argued. It is worth repeating that the only limit on the "condition" sensed is whether it is "proportional to the luminous output of the LEDs."

FN18. Ecolux's definition comes from its expert, Barry N. Feinberg. (*See* Ecolux's Mem. in Support of Mot. for Summ.J. of Non-Infringement at 7 & Ex. D.) He states without explanation that it is the definition given to "proportional" by those in engineering and mathematics. (*See id.*) To the extent that I accept "having the same or a constant ratio" as the definition of "proportional," I do so because it is the ordinary meaning of the word (as indicated in *Webster's*) and not because it is the opinion of Feinberg. Furthermore, in adopting this definition, I do not also adopt the alternative, "direct proportion" definition proposed by Ecolux. The claim language uses "proportional" without any qualification.

Despite the fact that the language of claim 1 neither explicitly or implicitly recites a location for the sensor, Ecolux nevertheless argues that such a requirement exists because the preferred embodiment diagram of the temperature sensor depicts it on the LED circuit board. Aside from this diagram, I find no support in the patent's specification for a locational requirement. Ecolux's argument is therefore an attempt to restrict claim language that is broader in scope than the preferred embodiment. The rules of claim construction do not permit this. *See* *Electro Med. Sys. S.A. v. Cooper Life Sciences*, 34 F.3d 1048, 1054 (Fed.Cir.1994) ("particular embodiments appearing in a specification will not be read into the claims when the claim language is broader than such embodiments").

[8] Accordingly, I hold that a person of ordinary skill in the art of LEDs would understand "condition proportional" to mean that the sensor must sense a condition that has some fixed relationship with the LEDs' light output, but would not understand the phrase to require a certain location for the sensor.

b. "ON/OFF pulses"

[9] On the basis of some of the invention's preferred embodiments, Ecolux argues that the "ON/OFF pulses" of electrical energy called for by claim 1 must have a rectangular wave form. Relume contends that the "ON/OFF pulses" limitation does not require a specific wave form but only that the invention's power supply employ a switching action to control the current delivered to the LEDs.

Ecolux's construction ignores the clear meaning of both the claim language and the specification. Claim 1 recites no limitation on the shape of the pulses' wave form. Nor does the specification. In fact, it notes that at least two types of wave forms can be utilized by the invention: rectangular and a.c. sinusoidal. Accordingly, I hold that one of ordinary skill in the art of LEDs would understand that "ON/OFF pulses" does not limit the shape of the pulses' wave form but instead requires that a switching power supply create the pulses by turning a switch on and off.

c. "said power supply (16) including a switching device"

Relume contends that this phrase requires the switch to be located in the invention's power supply. Lumileds disagrees, arguing that the word "including" does not necessarily mean "in."

The ordinary meaning of "including" supports Relume. *Webster's* defines it as "serving to enclose or cover." Reference to the definition of the verb "include" is also helpful, revealing nuances like "to shut up: CONFINE, ENCLOSE, BOUND," "to place, list, or rate as a part or component of a whole," and "to take in, enfold, or comprise as a discrete or subordinate part." These definitions clearly convey the idea that the power supply of the '909 patent embraces a switch as one of its components. The specification reflects this. By repeatedly describing the power supply as including a switch, it emphasizes to one of ordinary skill in the art that the switch is a part of the power supply.

But there is a more basic point. By having the power supply include a switch, the intrinsic evidence of the '909 patent is simply instructing a person of ordinary skill in the art that the power supply of the claimed invention must be a switching power supply. Thus the "including" limitation is less a locational requirement than a componentry requirement. So the specification of the '909 patent speaks frequently of the invention's use of "a switch mode power supply." '909, 4:66-67. And it claims a great advantage from the inherent efficiency of such a power supply. '909, 4:50-51. Yet it displays no concern for the location of the switch within the power supply. As the specification states: "It will be appreciated that such a switch mode power

supply can take many forms. Within the scope of the present invention, switch mode supplies include any power source 16 that is turned on and off at a frequency consistent with the other operating parameters of the system." '909, 4:66 to 5:3.

[10] Accordingly, I hold that a person of ordinary skill in the art would understand "said power supply (16) including a switching device" to mean that the invention of claim 1 requires a switching power supply.

d. "maintain ... at a predetermined level"

Lumileds argues that the phrase-"maintain the luminous output of said LED (12) at a predetermined level"-requires claim 1's switching power supply to adjust the current supplied to the LEDs so that their luminous output is essentially constant. Focusing solely on the meaning of the word "predetermined," Relume argues that the disputed phrase requires only that the switching power supply maintain LED light intensity at amounts that are known or modeled in advance.

The drafter's use of the word "maintain" exposes the error of Relume's construction. The idea of uniform or constant output inheres in the word's ordinary meaning. *Webster's* defines "maintain" as "to keep in a state of repair, efficiency, or validity: preserve from failure or decline." And it defines "predetermine" as "to settle beforehand: settle in advance." Taken together, these definitions establish that the phrase, "maintain the luminous output of said LED (12) at a predetermined level," simply means to keep the LEDs' luminous output at a level chosen beforehand.FN19

FN19. Here is what this construction means in practice. Suppose the desired level of LED output chosen beforehand is two units of light. The invention of claim 1 will seek to keep luminous output at this predetermined level of two units despite fluctuations in operating temperature.

The specification does not alter this construction. It states that "[t]he present invention relates to a new method of maintaining an essentially constant luminous output from an LED array, irrespective of operating temperature." '909, 4:42-44. It later observes that either of its contemplated sensors-the light sensor or the temperature sensor-"can be used to modulate the average current through the LED array to maintain essentially constant luminous output, irrespective of operating temperature." '909, 5:17-20. It also describes how the invention's preferred embodiment uses a temperature behavior model "in order to keep the luminous output of the LED array essentially constant at a predetermined level." '909, 3:66-67. Nowhere does the specification indicate that the invention of the '909 patent has the ability to produce anything other than essentially constant LED output.

In the end, the clear language of claim 1 and the equally clear specification of the '909 patent demonstrate that Relume's construction of "maintain the luminous output of said LED (12) at a predetermined level" is incomplete and at odds with the ordinary meaning of "maintain." It is not enough, as Relume did in its response brief, to offer a definition for "predetermined" and then ignore the more important and relevant meaning of "maintain." The disputed phrase must be examined in its entirety in order to comprehend its full scope.

[11] Accordingly, I hold that a person of ordinary skill in the art would understand the claim language "maintain the luminous output of the said LED (12) at a predetermined level" to charge the invention of claim 1 with the task of keeping, or preserving from decline, the luminous output of its LEDs at an amount

chosen beforehand.

2. Claims 2, 3, 6, 7, and 9

The parties do not dispute the meaning of these claims, all of which depend from claim 1. Claim 2 requires that the "sensor" recited in claim 1 "include[] means for sensing changes in temperature of said LED (12)." '909, 7:13-15. Claim 3 requires that the temperature feedback system of the '909 patent use a "predetermined temperature behavior model." '909, 7:20-21. Claim 6 specifies that the invention's switching power supply must adjust its ON/OFF pulses "by adjusting the frequency of said pulses." '909, 7:31-32. Claim 7 alternatively teaches a switching power supply that adjusts its ON/OFF pulses "by adjusting the width of said pulses." '909, 7:35-36. Finally, claim 9 requires that the invention of claim 1 include a filter for converting the ON/OFF pulses into d.c. power for the LEDs. '909, 7:41-44.

3. Claim 10

Claim 10 is an independent claim that recites a three-step method for "maintaining the luminous output of a light emitting diode (LED)." '909, 8:1-2. Dialight and Relume dispute the meaning of a phrase—"adjustable power supply"—in the claim's first step, which teaches "supplying ON/OFF pulses of electrical energy from an adjustable power supply (16) for establishing electrical current passing through the LED (12)." '909, 8:3-5. Dialight argues that the disputed phrase requires the use of a switching power supply that adjusts the frequency or pulse width of its ON/OFF current pulses in response to feedback from a sensor. Relume asserts that the "adjustable" limitation only requires a power supply that is adjustable in some broad sense, "e.g., as a voltage regulator." (Pl.'s Consolidated Opp. at 32.)

The ordinary meaning of the adjective "adjustable" provides valuable guidance, though it does not resolve the dispute. *Webster's* defines the word to mean "capable of being adjusted." Thus to label the invention's power supply as "adjustable" is to say that it is capable of being adjusted. I note that this implies that something acts *on* the power supply to adjust it.

The specification sharpens the reader's understanding of "adjustable" by detailing how the invention's power supply is capable of being adjusted. Thus in summarizing the claimed invention, the specification describes the power supply as including "a switching device responsive to the luminous intensity signal for adjusting the electrical energy supplied by the pulses per unit of time to adjust the average of the current passing through the LED to maintain the luminous intensity of the LED at a predetermined level." '909, 2:12-17. The specification also later observes that "[t]he primary purpose of the present invention is to increase the average current through the LED array with increasing temperature, by adjusting the pulse width or frequency of LED switch mode power supply." '909, 4:62-65.

These overarching statements about the invention of the '909 patent establish that the specification sets forth a specific meaning for "adjustable power supply." *See Zebco*, 175 F.3d at 990. Under that meaning, "adjustable" requires the invention's switching power supply to be responsive to a luminous intensity signal from a sensor so that the ON/OFF current pulses supplied by the power supply can be adjusted in their frequency or pulse width. In other words, the invention's power supply must be capable of being adjusted by the feedback from a sensor that measures, either directly or indirectly, the amount of light emitted by the LEDs.

[12] For these reasons, I reject Relume's construction of "adjustable power supply." Its construction gives a vague and irrelevant meaning to the phrase that conveniently ignores the specification's description of the

patent's invention. The intrinsic evidence of the '909 patent gives full support to Dialight's construction of the disputed phrase. I therefore hold that a person of ordinary skill in the art would understand the phrase "adjustable power supply" to mean that the invention's switching power supply must be capable of being adjusted by the luminous intensity signal of a sensor. FN20

FN20. In support of this construction, Dialight raised additional points regarding the meaning of the third step of claim 10: "adjusting the electrical energy supplied by the ON pulses per unit of time to adjust the average of the current passing through the LED (12) to maintain the luminous output of the LED (12) at a predetermined level." In particular, Dialight argued that 35 U.S.C. s. 112, para. 6 governed that step as a "step-plus-function" element and thus that the third step must be limited in scope to correspond to acts in the specification—specifically, the sensor's act of giving feedback to the power supply. My construction of "adjustable power supply" makes this additional argument superfluous.

4. Claims 11, 12, 15, 16, and 18

The parties do not dispute the meanings of these method claims, all of which depend from claim 10. Each parallels a dependent apparatus claim. For example, claim 11 takes the substance of claim 2 and gives it the nomenclature of a method claim. Likewise, claim 12 parallels claim 3, claim 15 parallels claim 6, claim 16 parallels claim 7, and claim 18 parallels claim 9.

V. Comparison with Accused Products

I now turn to the second step of the literal infringement analysis: comparing the properly construed claims with the product or process accused of infringement. *See* Markman, 52 F.3d at 976. Many infringement arguments are now moot in light of my claim construction. I address only those that survive.

A. The '645 Patent

1. Dialight's Accused Products

Relume has accused two Dialight products of literally infringing claim 1 of its '645 patent: Dialight's 8" and 12" LED traffic signals. Dialight argues that its products do not literally infringe claim 1 because, *inter alia*, they lack a required element—they do not generate regulated voltage.

Dialight's supporting evidence consists of a declaration by its expert, Rand Eikelberger, who is Dialight's Vice President for Engineering, and circuitry diagrams attached as exhibits to Eikelberger's declaration. Referring to these diagrams, Eikelberger states in his declaration that Dialight's accused products use "a current regulator circuit," the output of which is "regulated (i.e., constant total) current." (Eikelberger Decl. at para. 4.) He explains that the regulator uses current sense resistors to provide feedback about its output so that it can change the ON/OFF ratio of its switching and thereby alter the current flowing to the LED array. (*See id.* at para. para. 11-13.) He states that he witnessed tests of Dialight's accused products, in which some strings of the LED array were purposefully shorted, and saw that the current output of the regulator remained essentially constant despite the short circuits in the array. (*See id.* at para. para. 7-8 & Ex. 2.) And he also points out that the lack of ballast resistors in Dialight's accused products is further evidence of current regulation because ballast resistors are current controlling devices that are unnecessary, even wasteful, in arrays already supplied current regulated power by a switching power supply. (*See id.* at para. para. 15-18.)

Dialight's evidence satisfies its Rule 56(c) burden of showing that no genuine issue of material fact exists because that evidence establishes that Dialight's "converter means" is designed to generate stabilized current. *See Celotex*, 477 U.S. at 323, 106 S.Ct. 2548. In other words, Dialight has met its burden of showing that its accused products do not generate regulated voltage within the meaning of claim 1 of the '645 patent. This consequently triggers Relume's Rule 56(e) burden "to set forth specific facts showing that there is a genuine issue for trial."

Relume lists the following as evidence of Dialight's voltage regulation: 1) an advertisement and a marketing press release that state that Dialight's accused products have voltage regulation; 2) tests performed by Hochstein on Dialight's accused products that indicate they keep voltage essentially constant across the LEDs (when resistance is constant) despite input line voltage fluctuations between 80 and 135 volts a.c., (*see* Hochstein Reply Decl. at para. 4); and 3) a statement by Relume's expert, Thomas Gafford, that Dialight's current sense resistors are also ballast resistors in that they have some ballasting effect, (*see* Gafford Noninfringement Decl. at para. 6-8). Relume asserts that this meager body of evidence creates a genuine issue of material fact as to whether the "converter means" of Dialight's accused products generates regulated voltage within the meaning of claim 1.

[13] I disagree. Under the construction of claim 1 that I have adopted, Relume's evidence does not constitute proof of Dialight's literal infringement of the "generating regulated voltage" limitation because it leaves undisputed Dialight's evidence that shows its accused products have a "converter means" that is designed to regulate current. The material fact at issue here is whether Dialight's "converter means" is designed for generating regulated voltage. Even taken in a light most favorable to Relume, all that Relume's evidence demonstrates is that Dialight's marketing department thought its accused products regulated voltage, that Dialight's current-regulating "converter means" produces the same effect as a voltage-regulating "converter means" in the limited condition where Ohm's Law predicts it would, and that current sense resistors may have a mild ballasting effect because they indirectly affect voltage. None of Relume's evidence stands as direct proof that Dialight's "converter means" does not regulate current-in other words, is not designed for the purpose of generating regulated current at its output.

Indeed, Relume and its expert admit as much. Both effectively acknowledge that Dialight's "converter means" is designed to regulate current. (*See* Pl.'s Consolidated Opp. at 37 & 54.) Given my construction of "generating regulated voltage," this factual concession prevents a jury from reasonably finding in favor of Relume as a matter of law. Relume has simply failed to satisfy its Rule 56(e) burden of submitting "specific facts" sufficient to show a genuine issue for trial. I therefore hold that summary judgment of literal noninfringement in favor of Dialight is appropriate with respect to claim 1 of the '645 patent. Because dependent claims 2, 4, 5, and 6 also incorporate the "generating regulated voltage" limitation, I further hold that summary judgment of literal noninfringement in favor of Dialight is appropriate with respect to those claims as well.

2. Ecolux's Accused Product

As Dialight does, Ecolux argues that its accused product does not literally infringe claim 1 because its "converter means" generates regulated current. Ecolux had two experts testify by declaration that its power supply is designed to regulate current. The first is Mohammed Ghanem, an electrical engineer employed by Ecolux, who states in his declaration that "Ecolux uses a current regulation flyback switch mode converter and therefor [sic] does not use the same approach" as Relume's '645 patent. (Ghanem Decl. at 2.) The

second is Barry Feinberg, a retained expert, who states in his declaration that "the Ecolux power supply is a regulated current supply or acts as a constant current supply." (Feinberg Decl. at 6.) I find that these expert declarations suffice to satisfy Ecolux's Rule 56(c) burden.

Once again, however, Relume does not dispute the fact that Ecolux's "converter means" is designed to regulate current, (*see* Pl.'s Consolidated Opp. at 36 & 53), but argues instead that its tests show that when resistance is constant and line input voltage varies, the voltage across the LEDs of the accused product remains essentially constant. This is the same literal infringement theory I rejected in my claim construction and in my analysis of Dialight's accused products. Accordingly, Relume has again failed to satisfy its Rule 56(e) burden of showing a genuine issue of material fact under the construction of "generating regulated voltage" I have adopted. What evidence Relume has against Ecolux's current-regulating "converter means" only pertains to whether it incidentally keeps voltage constant in the limited circumstance where Ohm's Law predicts that it would.

I therefore hold that summary judgment of literal noninfringement in favor of Ecolux is appropriate with respect to claim 1 of the '645 patent, as well as with respect to the dependent claims, claims 2, 4, 5, and 6.

3. Precision's Accused Product

Precision also argues that its accused product does not literally infringe claim 1 of the '645 patent because its "converter means," or interface circuit, is designed to regulate current. As supporting evidence, Precision submits declarations from two experts, Bradford Perry, an electrical engineer at Precision who designed the interface circuit, and Alex Severinsky, a retained expert, both of which establish in detail that Precision's interface circuit is designed to produce regulated current at its output. (*See* Perry Decl. at para. 15-20; Severinsky Decl. at para. 12-25.) Of particular note in these declarations is the observation made by both experts that Precision's interface circuit does not have a controller that performs voltage output monitoring—in other words, it lacks an output voltage feedback loop. (*See* Perry Decl. at para. 21; Severinsky Decl. at para. 18.) Precision's expert declarations more than suffice to satisfy its Rule 56(c) burden on summary judgment.

As with Dialight and Ecolux, Relume does not dispute that Precision's "converter means" is designed to regulate current. (*See* Pl.'s Consolidated Opp. at 33 & 52.) The evidence Relume does offer against Precision is the same flawed body it offered against Ecolux. Thus under the construction I have adopted for the "generating regulated voltage" limitation, Relume has failed to satisfy its Rule 56(e) burden. I therefore hold that summary judgment of literal noninfringement in favor of Precision is appropriate with respect to claim 1 of the '645 patent, as well as with respect to the dependent claims, claims 2, 4, 5, and 6.

4. Lumileds' Accused Product

Lumileds argues that its accused product does not literally infringe claim 1 because its "converter means" is designed to regulate current, not voltage. For support, it submits a declaration by its retained expert, Professor Robert Erickson, who concludes that "[t]he power supply used in the Lumileds traffic light performs current regulation, not voltage regulation." (Fourth Erickson Decl. at para. 41.) He bases this conclusion in part on his observation that "the [Lumileds] power supply does not monitor the output voltage, but instead monitors the current through the LED array." (*Id.*) He also observes that because the Lumileds power supply regulates current, there are no ballast resistors in the array of the accused product. (*Id.* at para. 15-22.) Erickson's declaration satisfies Lumileds' Rule 56(c) burden.

In response, Relume fails to dispute Erickson's conclusion that Lumileds' "converter means" is designed to regulate current. As with the other three defendants, it acknowledges that Lumileds' "converter means" generates regulated current. (*See* Pl.'s Consolidated Opp. at 39 & 55.) The evidence it offers against Lumileds is for all purposes nearly identical to the immaterial evidence it offered against Dialight. Thus under the construction I have adopted for the "generating regulated voltage" limitation, Relume has failed to satisfy its Rule 56(e) burden. I therefore hold that summary judgment of literal noninfringement in favor of Lumileds is appropriate with respect to claim 1 of the '645 patent, as well as with respect to the dependent claims, claims 2, 4, 5, and 6.

B. The '909 Patent

1. Dialight's Accused Product

[14] Dialight utilizes two different temperature compensation devices in its LED traffic signals: the "op amp" device and the "current shunt" device. Relume has asserted that both literally infringe claims 1, 2, 3, 6, 7, 9-12, 15, 16, and 18 of its '909 patent. In its summary judgment motion, Dialight argues only that its "current shunt" device does not literally infringe Relume's asserted claims.

There is no factual dispute regarding the structure and operation of Dialight's "current shunt" device. As explained by Dialight's expert, Mr. Eikelberger, it consists of a voltage-regulating switching power supply, a variable load with a thermistor circuit, and a series-parallel LED array. (*See* Eikelberger Decl. at para. para. 5-9.) The switching power supply supplies fixed or constant d.c. pulses to the variable load and the LED array. (*See id.*) If the temperature sensed by the thermistor increases, the thermistor sends a signal to the variable load to increase its impedance of the current supplied by the power supply. (*See id.* at para. para. 9-10.) As the impedance of the variable load increases, it diverts, or "shunts," more current to the LED array. (*See id.*) The increase in current shunted to the LED array compensates for the decrease in LED illumination due to increased temperature and thus maintains the LED array's luminous intensity. (*See id.*)

Dialight argues that this "current shunt" device does not literally infringe claim 1 of the '909 patent, as well as its dependent claims 2, 3, 6, 7, and 9, because the device's switching power supply is not responsive to the luminous output signal of a sensor as required by claim 1. Dialight explains that the sensor, or thermistor, used in its device sends its luminous output signal to the variable load, not the device's switching power supply. Relume does not dispute this fact. Therefore, because Dialight's "current shunt" device lacks a power supply responsive to a luminous output signal from a sensor, I hold that a summary judgment of literal noninfringement in favor of Dialight is appropriate with respect to claims 1, 2, 3, 6, 7, and 9 of the '909 patent.

Dialight also argues that its "current shunt" process does not literally infringe method claim 10, as well as its dependent claims 11, 12, 15, 16, and 18, because the accused process does not use an "adjustable power supply" as required by the "supplying" step of claim 10. Under the construction that I have adopted for the "adjustable power supply" limitation, Relume must establish that Dialight's accused process uses a switching power supply that is responsive to a luminous output signal from a sensor so that the ON/OFF current pulses supplied by the power supply can be adjusted in their frequency or pulse width. Relume cannot establish this, however, because it is not in dispute that Dialight's accused process uses a switching power supply that is not responsive to a luminous output signal from a sensor.

Therefore, because Dialight's "current shunt" process lacks the "adjustable power supply" limitation, I hold that summary judgment of literal noninfringement in favor of Dialight is appropriate with respect to claims

10, 11, 12, 15, 16, and 18.

2. Ecolux's Accused Product

Ecolux argues that its temperature compensation device for LED traffic signals does not literally infringe claims 1-3, 6, 7, and 9 of the '909 patent because it lacks a sensor that senses a "condition proportional" to the luminous output of the LEDs. Ecolux's expert, Barry Feinberg, states in his declaration that because Ecolux's temperature sensor is mounted on the power supply circuit board, and not in with the LEDs, it is not in "a location to measure temperature of the LEDs in the device." (Feinberg Decl. at para. 9.) He also states that "[t]he Ecolux thermistor temperature sensor senses the temperature changes in the enclosure due to all energy sources, i.e. electrical and thermal in the form of conduction and radiation." (Id.)

[15] As the construction I adopted for "condition proportional" made clear, the location of the sensor is irrelevant to that claim limitation. Thus as long as a sensor senses a condition that has some fixed relation with the LEDs' light output, it qualifies as the "sensor" recited in claim 1. Ecolux's evidence does not establish that its temperature sensor does not perform the sensing function of claim 1. It is possible that the ambient temperature sensed by Ecolux's sensor bears some fixed relation to the LEDs' light output. Ecolux has therefore failed to satisfy its Rule 56(c) burden. I hold that summary judgment of literal noninfringement in favor of Ecolux is not appropriate because Ecolux has not shown that a genuine issue of material fact does not exist as to whether its sensor senses a "condition proportional."

3. Lumileds' Accused Product

Lumileds argues that its accused product does not literally infringe any of the asserted claims of the '909 patent because it does not maintain the luminous output of its LEDs at a predetermined level. As evidence, Lumileds offers a graph that shows the luminous output of its LEDs declining by 50% as the ambient temperature increases from -40 degrees Celsius to 74 degrees Celsius (the industry's specified operating range for traffic lights). (See Fourth Erickson Decl. at para. 48 & Ex. 23.)

[16] [17] Relume does not dispute the fact of the 50% decline. Rather, it argues that that decline must be considered essentially constant light output in light of the prior art loss of nearly 100% over the same operating range. (See Pl.'s Consolidated Opp. at 49.) This is of course the wrong comparison to be made. To establish literal infringement, Relume must compare the properly construed claims of the '909 patent to Lumileds' accused product, not Lumileds' accused product to the prior art. See *Becton*, 922 F.2d at 796. The construction I adopted for the "maintain ... at a predetermined level" limitation requires Relume to show that Lumileds' accused product keeps, or preserves from decline, the luminous output of its LEDs at an amount chosen beforehand. No jury could reasonably find that Lumileds' undisputed 50% decline in luminous output complies with the plain meaning of this claim limitation. See *Liberty Lobby*, 477 U.S. at 252, 106 S.Ct. 2505.

I therefore hold that summary judgment of literal noninfringement in favor of Lumileds is appropriate with respect to claims 1-3, 6, 7, 9-12, 15, 16, and 18 of the '909 patent because its accused product lacks the "maintain ... at a predetermined level" limitation that all those claims require.

VI. Validity

Lumileds has raised two validity challenges to Relume's '645 and '909 patents. With the first, Lumileds contends that certain claims of both patents are invalid because they were anticipated by prior art. With the

second, Lumileds contends that all asserted claims of both patents are invalid because they would have been obvious to one of ordinary skill in the art at the time they were invented.

[18] Federal statute requires that "[e]ach claim of a patent (whether in independent, dependent, or multiple dependent form) shall be presumed valid independently of the validity of other claims." 35 U.S.C. s. 282. "The presumption of validity under 35 U.S.C. s. 282 carries with it a presumption that the examiner did his duty and knew what claims he was allowing." *Intervet America, Inc. v. Kee-Vet Lab., Inc.*, 887 F.2d 1050, 1054 (Fed.Cir.1989). In raising its validity challenges, Lumileds has the burden of showing invalidity of each claim by clear and convincing evidence. *See North American Vaccine*, 7 F.3d at 1579.

A. Anticipation

[19] [20] "Under 35 U.S.C. s. 102, every limitation of a claim must identically appear in a single prior art reference for it to anticipate the claim." *Gechter v. Davidson*, 116 F.3d 1454, 1457 (Fed.Cir.1997). "There must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention." *Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1576 (Fed.Cir.1991). Anticipation is a question of fact. *See Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 1047 (Fed.Cir.1995). Thus "[f]or summary determination to be proper, there must be no genuine dispute whether the limitations of the claimed invention are disclosed, either explicitly or inherently, by an allegedly anticipating prior art reference." *Hazani v. U.S. Int'l Trade Comm'n*, 126 F.3d 1473, 1477 (Fed.Cir.1997).

In its response motion on the issue of obviousness, Relume alleges that I have already denied Lumileds' earlier motion for summary judgment on the issue of anticipation. This is incorrect. I reserved my ruling on Lumileds' pending anticipation motion so that, *inter alia*, I could efficiently decide all dispositive issues raised by the parties in one ruling.

1. The '645 Patent

Lumileds asserts that U.S. Patent No. 5,463,280 issued October 31, 1995 to James C. Johnson ("the Johnson patent" or "Johnson") anticipates claims 1, 2, and 4 of the '645 patent. Relume does not dispute that the Johnson patent is prior art to the '645 patent as defined by 35 U.S.C. s. 102(a) or (e). FN21 Relume did not present the prior art Johnson patent to the patent examiner when it filed its application for the '645 patent.

FN21. Section 102(a) states: "A person shall be entitled to a patent unless-(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent."

Section 102(e) states in pertinent part: "A person shall be entitled to a patent unless ... (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent."

[21] Johnson teaches using LEDs to replace incandescent bulbs in illuminated signs such as exit signs. (*See Johnson*, 1:6-10.) Johnson discloses a variety of circuitry configurations for LED arrays and their power supplies. One such configuration-the embodiment depicted in Figure 8 of Johnson-teaches a simple series LED array FN22 that is supplied electrical power by a rectifier and a switching power supply. Of all the configurations in the Johnson patent, this one comes closest to possessing all the limitations of claim 1 of the '645 patent. I find, however, that it explicitly lacks one limitation found in claim 1. Specifically, while Johnson expressly teaches a switching power supply that performs power factor correction, it does not

expressly state that the power supply also performs a "generating regulated voltage d.c. power" function-a function required by claim 1 of the '645 patent. (See Johnson, 6:67 to 7:10.) Thus the Johnson patent's switching power supply is not explicitly identical to the switching power supply of claim 1.

FN22. Relume's primary argument against the anticipation of claim 1 by the Johnson patent relied on its erroneous, series-parallel construction of "LED array." Under the construction I have adopted for that phrase, the series LED array disclosed in the Johnson patent falls within the scope of the '645 patent's "LED array" element.

The question then becomes whether Johnson inherently discloses a voltage-regulating switching power supply that is identical to that of claim 1. To show an inherently anticipating disclosure on summary judgment, Lumileds must clearly and convincingly establish that there is no genuine issue as to whether claim 1's voltage-regulating switching power supply is "necessarily present" in the Johnson patent and "that it would be so recognized by persons of ordinary skill." *Electro*, 34 F.3d at 1052. The undisputed evidence does establish this. Specifically, Professor Erickson has concluded that a person of ordinary skill in the art would have recognized that the MC 34261 Motorola power factor controller recommended by the Johnson patent for use in its switching power supply was "designed to be used in a voltage regulated power factor correction converter." (Third Erickson Decl. at para. 17.) This is so, Erickson states, because the Motorola controller "is designed with a 'voltage feedback input' ... which typically is used to monitor the output voltage for voltage regulation." (*Id.*) Relume does not contest Erickson's conclusion.

Accordingly, I hold that summary judgment of invalidity is appropriate because Lumileds has clearly and convincingly shown that no genuine issue of material fact exists as to the anticipation of claim 1 by the Johnson patent's identical device.

[22] Lumileds also argues that the Johnson patent anticipates the invention of claim 2 of the '645 patent. Claim 2 specifies that the power factor correction converter means is "a power factor correcting and voltage regulating buck/boost switchmode converter." '645, 13:33-36. Because the Johnson patent explicitly discloses a switchmode converter (or switching power supply), Lumileds argues that Johnson inherently discloses a buck/boost switchmode converter. I do not find, however, that the Johnson patent supports this conclusion as a matter of law. The evidence in this case establishes that a person of ordinary skill in the art would recognize that a switchmode converter has three forms: buck, boost, and buck/boost. Johnson does not disclose that any one of those forms must necessarily be associated with its switchmode converter. Thus the fact that three possible forms exist precludes the argument that any one form is necessarily present. *See Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1268-69 (Fed.Cir.1991) ("concluding that feature that "may result" from prior art configuration is not an "inherent" feature").

Accordingly, I hold that summary judgment on the issue of anticipation is inappropriate with respect to claim 2 of the '645 patent because Lumileds has failed to present sufficient evidence showing that a buck/boost switchmode converter would be necessarily present in the Johnson device.

Finally, Lumileds contends that the Johnson patent also anticipates claim 4 of the '645 patent. Claim 4 requires the additional element of an "electromagnetic interference filter means." '645, 13:43. The Johnson patent lacks an electromagnetic interference filter ("EMI filter"). Lumileds argues that it inherently discloses one because federal regulations now require EMI filters and the data sheet for the MC 34261 Motorola controller discloses using an EMI filter in combination with the controller. At best, Lumileds' evidence

raises a genuine issue of material fact as to whether Johnson inherently discloses an EMI filter. The Motorola data sheet only proves that an EMI filter can be used with the Johnson device, not that it necessarily results from Johnson. As for the federal regulation, it is not clear from the section referred to by Professor Erickson, 47 C.F.R. Part 15, whether it even applies to the Johnson device, whether it was in effect at the time of the Johnson device's invention, or whether it would require an EMI for compliance.

Accordingly, I hold that summary judgment on the issue of anticipation is inappropriate as to claim 4 of the '645 patent because Lumileds has not offered evidence sufficient to satisfy its Rule 56(c) burden.

2. The '909 Patent

Lumileds asserts that a Japanese patent filed by Fujitsu Co., Ltd. in January 1987 and published in July 1988 as publication No. 63-178221 ("the Fujitsu publication" or "Fujitsu") anticipates claims 1-3, 7, 10-12, and 16 of the '909 patent. Relume does not dispute that the Fujitsu publication is prior art to the '909 patent as defined by 35 U.S.C. s. 102(b). FN23 Relume did not present the prior art Fujitsu publication to the patent examiner when it filed its application for the '909 patent.

FN23. Section 102(b) states: "A person shall be entitled to a patent unless ... (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States."

The translated Fujitsu publication is entitled "Lighting Circuit for LED Array for Illumination." (Lumileds' Anticipation Mot. at Ex. 7.) It states that the object of its invention is "to provide a lighting circuit which is not affected by temperature changes and whose illumination output light is always of constant intensity and good efficiency." (*Id.*) The Fujitsu publication's sole claim reads as follows:

A lighting circuit for an LED array for illumination, comprising:

LED array (1),

temperature detection means (2) provided at this LED array (1),

lighting control circuit (3) which inputs a temperature signal from this temperature detection means (2) and outputs a pulse signal whose duty ratio is controlled in accordance with the relevant temperature signal, and

power source (4) connected to said LED array (1) via this lighting control circuit (3)

(*Id.*) Fujitsu's "lighting control circuit" regulates the electrical pulses or "signal pulses" it sends to the LED array by the use of a switch or "switching transistor T." (*Id.*) Fujitsu explains that the "[s]witching transistor T has the role of turning on and off the electricity from the power source 4, which is supplied to LED array 1." (*Id.*) These facts about the components and operation of the Fujitsu invention are undisputed. Indeed, Relume does not, and cannot, contest that Fujitsu discloses a device that has exactly the same purpose as the device of its '909 patent: to maintain the luminous output of LEDs at a predetermined level through the use of a sensor feedback loop and an adjustable power supply.

Relume's entire argument against the anticipation of claim 1 by Fujitsu is this: the Fujitsu device lacks a

power supply that includes a switch. FN24 In other words, Relume believes that the Fujitsu switch is not within the Fujitsu power supply as required by the "including" limitation of claim 1. Relume's reasoning in support of its argument: the Fujitsu "power source" is really its power supply and thus Fujitsu's switch, which is located in the lighting control circuit and not in the power source, lies outside its power supply.

FN24. This is also Relume's only argument against the anticipation of claims 2, 3, 7, 10, 11, 12, and 16 by Fujitsu.

My analysis of Relume's argument begins with the construction I adopted for the "including" limitation of claim 1. I determined that the intrinsic evidence of the '909 patent would lead a person of ordinary skill in the art to understand "said power supply (16) including a switching device" to mean that a switching power supply was required. As has been well established, a switching power supply must have at least two basic components: a converter, or switch, and its controller circuit. It is also well established by the totality of evidence in this case that a switching power supply's function is to take incoming electrical power from some existing power source and convert it (thus the label "converter") into whatever form of electrical power-voltage-regulated, current-regulated, power factor corrected, etc.-works best for the device to which it supplies power. Thus a switching power supply does not make power; rather, it transforms (modifies, regulates) already generated power according to the needs of the load it serves (in this case, an LED array).

These fundamental realities of the art make it clear that Fujitsu's lighting control circuit, not its power source, is a switching power supply in design and function. It has a switch-the "switching transistor T"-and it has circuitry that controls the turning on and off of that switch. It is also "responsive to said luminous output signal for adjusting the electrical energy supplied by said pulses per unit of time to adjust the average of said current passing through said LED." '909, 7:8-11. As Fujitsu explains:

Temperature detection means 2 detects the temperature of LED array 1 and sends a temperature signal to lighting control circuit 3. Based on this temperature signal, lighting control circuit 3 controls the duty ratio of a constant cycle lighting pulse to the desired value, and the electricity from power source 4 is turned on and off, and LED array 1 is lighted, and the amount of light is controlled to be constant.

(Lumileds' Anticipation Mot. at Ex. 7.) Thus Fujitsu's lighting control circuit functions as a switching power supply for the particular purpose of LED temperature compensation. It takes incoming power generated elsewhere and converts it into a form of electrical power-here, pulses of power that vary in their width depending on the temperature sensor's input-that better suits temperature-sensitive LEDs and therefore results in a constant level of illumination.

The only evidence Relume has that suggests the lighting control circuit of Fujitsu might not be a switching power supply is the conclusory statement of its expert, Thomas Gafford, (*see* Gafford Decl. at para. para. 17-19), and the fact that the '909 patent just once appears to use the phrases "power source" and "power supply" synonymously, *see* '909, 5:1-3. I reject Gafford's opinion on this point because his conclusory assessment is without a reliable factual foundation FN25 and because it ignores the voluminous evidence on record- the '645 patent, the '909 patent, the *Power Supply Cookbook*, etc.-that attests to the basic structure and identity of switching power supplies. *See* Union Carbide Corp. v. American Can Co., 724 F.2d 1567, 1572 (Fed.Cir.1984). As to the '909 patent's statement in question-"switch mode supplies include any power source 16 that is turned on and off"-I find that it actually works against Relume because the Fujitsu publication explicitly describes the lighting control circuit performing the exact same function.

FN25. In attempting to rebut Lumileds' evidence, Gafford does not conduct an analysis of the structure and function of Fujitsu's lighting control circuit and then explain how the circuit differs from the structure and function of switching power supplies as understood in the art. Gafford simply assumes from the outset that Fujitsu's "power source" is Fujitsu's power supply. The Supreme Court's recent decision in *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 119 S.Ct. 1167, 143 L.Ed.2d 238 (1999), requires me to perform a gatekeeping role as to all proffered expert testimony. *See id.* at 1174. Because I find Gafford's opinion on the issue of the lighting control circuit's identity to be unreliable, I reject it pursuant to *Kumho*.

Furthermore, it is revealing to contrast Gafford's opinion on this issue with the opinion of Lumileds' expert, Professor Erickson, who conducts a precise and cogent examination of the Fujitsu lighting control circuit and explains how one of ordinary skill in the art would recognize it as a switching power supply. (*See* Third Erickson Decl. at para. 40-49.) I find that this section of Professor Erickson's declaration constitutes additional clear and convincing evidence that the Fujitsu lighting control circuit is a switching power supply.

[23] Accordingly, I find that there is no genuine issue of material fact as to whether Fujitsu's lighting control circuit is a switching power supply as understood by those of ordinary skill in the art. The question then becomes whether Fujitsu's lighting control circuit is explicitly identical in every limitation to the "switching device" element recited by claim 1 of the '909 patent. *See* *Gechter*, 116 F.3d at 1457. I find that it is. It is undisputed fact that Fujitsu's lighting control circuit has a switch or switching device, that its switching device is responsive to the feedback of a sensor that senses a condition proportional to the LEDs' luminous output, and that the switching device responds to the sensor's signal by adjusting the current pulses it supplies to the LEDs (and thus the average current in the LEDs) in order to maintain the LEDs' luminous output at a predetermined level. *See* '909, 7:7-12.

It is also undisputed fact that the Fujitsu reference explicitly discloses the three other elements of claim 1. It teaches "at least one light emitting diode," its thermistor is explicitly "a sensor ... for sensing a condition proportional to said luminous output of said LED (12) and for producing a luminous output signal," and its lighting control circuit would be recognized by one of ordinary skill in the art as "a power supply (16) electrically connected to said LED (12) for supplying ON/OFF pulses of electrical energy to produce the luminous output of said LED." *See* '909, 6:66 to 7:6. Because there is "no genuine dispute" that the prior art Fujitsu publication explicitly discloses every limitation of claim 1 of the '909 patent, and thus anticipates claim 1, I hold that summary judgment of invalidity is appropriate with respect to claim 1. *Genentech*, 927 F.2d at 1576. I also hold that summary judgment of invalidity is appropriate with respect to claim 10 because the recited method of claim 10 parallels claim 1 in its elements.FN26

FN26. My claim construction of claim 10's "adjustable power supply," which determined that the phrase required a switching power supply responsive to the sensor's luminous output signal, resolves Relume's argument that Fujitsu does not disclose an "adjustable power supply." This was Relume's only argument against the anticipation of claim 10 by Fujitsu.

Dependent claim 2 and the parallel method of dependent claim 11 recite a means, or a step, for "sensing changes in the temperature of said LED (12)." It is an undisputed fact that Fujitsu explicitly discloses a thermistor that senses the temperature of the LEDs. Accordingly, summary judgment of invalidity is appropriate with respect to the anticipation of claims 2 and 11 by Fujitsu.

Dependent claim 3 and the parallel method of dependent claim 12 require the sensing means or step to include "a predetermined temperature behavior model." It is an undisputed fact that the Fujitsu publication explicitly discloses an electronic chip pre-programmed with an LED temperature behavior model that is used in conjunction with the sensor's luminous output signal. The specification of the '909 patent discloses the same type of chip with the same function. Accordingly, summary judgment of invalidity is appropriate with respect to the anticipation of claims 3 and 12 by Fujitsu.

Dependent claim 7 and the parallel method of dependent claim 16 require the switching device, or "adjusting" step, to adjust the electrical pulses by adjusting their width. It is an undisputed fact that Fujitsu explicitly discloses a switching device that adjusts its electrical pulses by adjusting their width. Accordingly, summary judgment of invalidity is appropriate with respect to the anticipation of claims 7 and 16 by Fujitsu.

B. Obviousness

[24] According to 35 U.S.C. s. 103, prior art invalidates a patent for obviousness when the "subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains." *See, e.g., Richardson-Vicks, Inc. v. Upjohn Co.*, 122 F.3d 1476 (Fed.Cir.1997) (holding patent invalid for obviousness). An obviousness inquiry under section 103 ultimately presents a question of law. *See In re Donaldson Co., Inc.*, 16 F.3d 1189, 1192 (Fed.Cir.1994) (unanimous *en banc* decision). In answering that question, I must address four underlying factual considerations:(1) what is the scope and content of the prior art; (2) what are the differences, if any, between the claims at issue and the prior art; (3) what would have been the level of ordinary skill in the prior art at the time of the invention; and (4) are there any secondary considerations of non-obviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 17, 86 S.Ct. 684, 15 L.Ed.2d 545 (1966).

Lumileds argues that resolution of these four factual inquiries clearly and convincingly establishes that the remaining asserted claims of the '645 patent-claims 2, 4, 5, and 6-and the '909 patent-claims 6, 9, 15, and 18-are invalid for obviousness in light of the relevant prior art at the time of their invention. Relume argues that genuine issues of material fact exist that preclude summary judgment on the issue of obviousness.

1. The Scope and Content of the Prior Art

[25] The Federal Circuit has repeatedly held that the scope of the relevant prior art consists of those references "reasonably pertinent to the particular problem with which the inventor was involved." *In re GPAC, Inc.*, 57 F.3d 1573, 1577 (Fed.Cir.1995). "Therefore, the prior art relevant to an obviousness determination necessarily encompasses not only the field of the inventor's endeavor but also any analogous arts." *Id.* at 1577-78. Accordingly, in determining whether a reference is from a relevant prior art, I "first must determine whether the reference is within the inventor's field of endeavor, and if it is not [I] next must determine whether the reference is reasonably pertinent to the particular problem confronting the inventor." *Id.* at 1578.

Relume believes there is a genuine dispute concerning the fields of endeavor for both of its patents. It contends that the field of the inventor's endeavor for the '645 patent is "clearly no broader than LED array traffic signals." (Pl.'s Obviousness Opp.Mot. at 7.) Relume also contends that the field of endeavor for the '909 patent is "safety-critical outdoor LED signals." (*Id.* at 8.) Relume's contentions rely on Gafford's reading of the patents. (*See* Gafford's Obviousness Decl. at para. 8-11).

Lumileds contends that the field of endeavor for the '645 patent is "power supplies, power supplies for LEDs, and circuits for preventing leakage current." (Lumileds' Obviousness Mot. at 16.) Lumileds also contends that the field of endeavor for the '909 patent is "techniques for maintaining the luminous output of an LED when temperatures rise." (Lumileds' Reply Br. at 15.) Lumileds' contentions rely on Professor Erickson's reading of the patents, (*see* Third Erickson Decl. at para. 8 & 41), and the deposition testimony of Hochstein, the patents' inventor.

I find no genuine dispute in the evidence regarding the '645 patent's field of endeavor. Lumileds' understanding of the '645's field fully reflects both the patent's own statement of its field and the inventor's own understanding of his field of endeavor. The '645 patent states at its outset that its invention "relates generally to an apparatus for generating power to a light emitting diode array and, in particular, to a power supply for operating light emitting diode array traffic signals." '645, 1:5-8. Gafford's opinion focuses exclusively on the second half of this statement-everything after the "in particular"-and so he ignores the full scope of the patent's own definition of its field. Gafford's opinion also ignores the specification's unrestricted description of its invention as "an apparatus for supplying regulated voltage d.c. electrical power to an LED array." '645, 3:18-19. Finally, Gafford's opinion clashes with Hochstein's own identification of his field of endeavor as being a.c. powered LED arrays.FN27 (*See* Hochstein Dep. at 163-64.)

FN27. Here is the pertinent section of Hochstein's deposition:

Q Now, your patent, the 645 patent, you're saying is only limited to AC LED arrays?

A No. It's limited to what the claims say it's limited to. It's an LED array driven from the AC power line with power factor controller and voltage regulation.

Q It doesn't have to be a traffic light; correct?

A No. It has to be an AC-powered device.

Q Any AC-powered device?

A An AC-powered array of LEDs. That has voltage regulation power factor control and the dependent claims.

(Hochstein Dep. at 163-64.) Reinforcing this testimony and Lumileds' understanding of the patent's field of endeavor, the specification mentions that a.c. powered LED arrays have many "common applications" beyond traffic lights—for instance, as "[s]tatus annunciators, message boards, liquid crystal display back lights." '645, 1:11-17.

For all of these reasons, then, I find that Gafford's opinion on this issue is "not significantly probative" and thus fails to create a genuine issue of material fact as to the field of the inventor's endeavor for the '645 patent. *See* Liberty Lobby, 477 U.S. at 249-50, 106 S.Ct. 2505. Accordingly, I adopt the field proposed by Lumileds. I specifically find that the inventions of claims 2 and 4 are within the field of power supplies for a.c. powered LED arrays and that the inventions of claims 5 and 6 are within the field of power supplies for a.c. powered LED arrays that use circuits to prevent leakage current.

I likewise find no genuine dispute in the evidence regarding the '909 patent's field. Lumileds' understanding of its field again enjoys the full support of the patent and its inventor. To begin with, the '909 patent states that the technical field of its "subject invention relates to light emitting diodes" and nothing else. '909, 1:4-5. It describes its invention as a "circuit for maintaining the luminous intensity of a light emitting diode." '909, 2:7-8. The preferred embodiments mention no restriction to safety critical outdoor signals and neither do the claims. Furthermore, while the specification's background section evinces a concern for LED temperature

degradation in safety-critical outdoor applications, it does not state that the invention only has significance for those applications. This makes sense given that all LEDs, regardless of whether they are used indoors or outdoors, can suffer from degradation of their luminous output due to temporarily increased operating temperatures or the passage of time. Finally, Hochstein himself was adamant that the invention of the '909 patent, and thus his field of endeavor, involved circuits for maintaining LED luminous intensity. FN28 (*See* Hochstein Dep. at 163.)

FN28. Here is the pertinent section of Hochstein's deposition:

Q What two applications?

A What shows up in the 909 patent, has nothing to do with AC power supplies.

Q Okay. What does it have to do with?

A Maintaining luminous intensity of LEDs, period.

Q Any type of LEDs?

A That's correct. This patent has to do only with AC-powered LED arrays.

Q "This" being the 645 patent?

A The 645 patent.

(Hochstein Dep. at 163.)

Because Gafford's opinion as to the '909's field ignores these undisputed facts, I find once again that his declaration fails to demonstrate a need for trial. *See* *Liberty Lobby*, 477 U.S. at 249-50, 106 S.Ct. 2505. Accordingly, I adopt the field proposed by Lumileds. I find that the inventions of claims 6, 9, 15, and 18 are within the field of circuits for maintaining the luminous intensity of an LED when temperature rises.

Having determined the field of the inventor's endeavors with respect to both patents, the question then becomes whether the prior art offered by Lumileds falls within those fields. As relevant prior art to the '645 patent, Lumileds has submitted the *Power Supply Cookbook*, the already discussed Johnson patent, the MC 34261 Motorola power factor controller that Johnson recommends in its specification, and U.S. Patent No. 5,075,601 issued December 24, 1991 to Cleve R. Hildebrand ("the Hildebrand patent" or "Hildebrand"), which teaches the use of a dynamic load circuit to prevent leakage current from triggering conflict monitors in traffic or pedestrian signals.

The Johnson patent clearly lies within the '645 patent's field; it states that some of its LED array embodiments can be used with a.c. power. Johnson, 2:42-43. Because Johnson is relevant prior art, so too is the MC 34261 Motorola controller it references. Likewise, the *Power Supply Cookbook* must also be within the '645 patent's field because it is referred to by the '645 patent. '645, 3:13-15. Finally, even though Relume disputes the exact operation and structure of the Hildebrand circuit as compared to its adaptive clamp circuit, it cannot dispute that the Hildebrand circuit functions for the purpose of eliminating leakage current problems. Hildebrand, 1:5-10. Thus Hildebrand is within the field of the inventions of claims 5 and 6.FN29

FN29. I note that even if Relume's proposed field of endeavor were to be accepted for the '645 patent, the prior art offered by Lumileds would still be analogous art because each seeks to address the same problems that Hochstein addressed in the '909 patent. *See* *In re GPAC*, 57 F.3d at 1578. For instance, claim 1 addresses the problems of poor power factor and varying LED illumination due to fluctuating input line voltage. So too do the Johnson patent, the Motorola controller, and the *Power Supply Cookbook*.

As relevant prior art to the '909 patent, Lumileds has offered the Fujitsu publication and two power supply textbooks-the *Power Supply Cookbook* and Bernard Grob's *Electronic Circuits and Applications* (1982)-both of which describe (1) various techniques for adjusting on/off pulses of energy from a switching power supply and (2) using filters to convert on/off pulses to substantially direct current ("d.c."). Fujitsu is clearly within the field of the '909 patent; as my analysis of the anticipation issue makes clear, both circuits function for the purpose of maintaining the luminous intensity of an LED when temperature rises. Because the use of a switching power supply is necessary to accomplish that function, both power supply textbooks are also within the field of the '909 patent.FN30

FN30. I note again that even if Relume's proposed field of endeavor were accepted for the '909 patent, the prior art submitted by Lumileds would still be analogous art because each seeks to address the same problems that Hochstein sought to address in the '909 patent. *See In re GPAC*, 57 F.3d at 1578.

2. The Level of Ordinary Skill in the Art

[26] I may consider a variety of factors in determining the level of ordinary skill in the art at the time of the alleged invention. *See In re GPAC*, 57 F.3d at 1579. Some of those factors include the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *Id.* The time of invention for each asserted claim of the '645 patent and the '909 patent ranges between December 25, 1994 and January 31, 1996.FN31 (*See Hochstein Dep.* at 83-84 & *Dep.Ex.* 9.)

FN31. According to Relume's evidence, Hochstein places his date of conception of each asserted claim of the '645 patent accordingly: claim 1 on December 25, 1994; claim 2 on January 31, 1996; claim 4 on April 18, 1995; and claim 5 and 6 also on January 31, 1996. (*See Hochstein Dep.* at 83-84 & *Dep.Ex.* 9.) Likewise, for the asserted claims of the '909 patent, he has placed conception at the following dates: claims 1, 9, 10, 18 on April 22, 1995; and claims 2, 3, 6, 7, 11, 12, 15, and 16 on January 31, 1996. (*See id.*) Lumileds has not disputed these dates.

Lumileds' expert, Professor Erickson, states in his declaration that he "would consider the level of ordinary skill in the art as of the mid 1990's to be at least that of a senior technician with a two year associates degree in electronics and over five years of experience in power electronics or a junior engineer with an undergraduate degree in electrical engineering and at least three years of experience in power electronics." (Third Erickson Decl. at para. 7.) He bases his conclusion on "interactions with people in the industry, consulting with companies, and attending industry conferences." (*Id.*)

Relume's expert, Mr. Gafford, believes the level of ordinary skill was lower at that time: "at most that of a bachelor's degree in electrical engineering and two to four years experience in that field [LED array traffic signals and safety critical outdoor LED signals]." (Gafford Decl. at para. 13.) Gafford bases his opinion on three pieces of evidence: 1) a Dialight patent from mid-1996 that he concludes shows only rudimentary circuitry for its LED product, 2) the fact that Bradford Perry, who is a design engineer for Precision, had no experience in LED signals when he was hired by Precision, and 3) the fact that Lumileds' 30(b)(6) technical witness, Marcel Bucks, testified that the state of LED traffic light products at the beginning of 1996 was basic. (*See id.* at para. para. 14-17.)

Relume contends that the disagreement between the experts is a genuine dispute worthy of trial. I disagree. Gafford's analysis is premised on Relume's erroneously restricted view of the relevant fields of endeavor for the two patents. (*See id.* at para. 12-13.) Moreover, his sweeping opinion relies on anecdotal evidence. The Dialight patent, Perry's level of skill, and Buck's testimony FN32 do not overcome the evident technological sophistication of the body of relevant prior art on record: that is, the *Power Supply Cookbook*, FN33 the Johnson patent, the Hildebrand patent, the Fujitsu publication, and the prior art cited in the '645 and '909 patents. *See In re GPAC*, 57 F.3d at 1579 (noting that review of prior art references provides "valuable insight" into level of skill in the art).

FN32. Bucks did not testify that the level of ordinary skill in the art was basic in 1996 but only that those products he tested at that time were basic in design because there were no industry specifications requiring anything more. (*See Bucks Dep.* at 52-54.) He also testified that Philips and Hewlett-Packard were already working on an advanced LED power supply at that time. (*See Bucks Dep.* at 54-55, 303-05.)

FN33. Notably, the *Power Supply Cookbook*, which was published in 1994, states in its introduction that switching power supplies are "complicated to design" and "unfamiliar to the typical design engineer." *Id.* at 25.

Indeed, I find the range of relevant prior art to be dispositive as to the question of ordinary skill. It shows that in the fields of both patents, a person of ordinary skill would need to understand not only the design issues associated with LEDs-their sensitivity to temperature and/or input voltage fluctuations, their degradation over time, etc.-but also the design issues associated with switching power supplies-electromagnetic interference, the pros and cons of voltage v. current regulation, power factor correction, etc. Lumileds' proposed level of skill is consistent with the breadth of knowledge required by the inventions of the '645 and the '909 patents.

Even if the lesser level of skill offered by Relume were found to have sufficient support in the evidence to create a factual dispute, Relume has not shown that this dispute would have a material bearing on the non-obviousness inquiry before me. There has been no evidence entered that suggests that Relume's lesser level of skill would preclude a person of ordinary skill in the art from recognizing that the relevant prior art submitted by Lumileds made the asserted claims obvious at the time of their invention.

Accordingly, I find that no genuine issue of material fact exists as to the ordinary level of skill at the time of the invention of the '645 and '909 patents. The evidence clearly and convincingly supports the level of skill proposed by Lumileds. Relume has offered only a "scintilla of evidence" for its position. *Liberty Lobby*, 477 U.S. at 252, 106 S.Ct. 2505.

3. Differences, If Any, Between the Invention and the Prior Art

a. Claims 2 and 4 of the '645 Patent

Lumileds contends that there is no meaningful difference for obviousness purposes between the Johnson patent and claim 2 of the '645 patent. As stated before, claim 2 requires that the '645 patent's power factor correction converter means be a buck/boost switchmode converter. The Johnson patent explicitly discloses a switchmode converter but does not specify its type, i.e. whether it is a buck., boost, or buck/boost converter. Professor Erickson has testified that it would have been obvious to one of ordinary skill to use a buck/boost

converter with the Johnson device because the *Power Supply Cookbook* explained how to implement such a circuit for switching power supplies. (See Third Erickson Decl. at para. 20.) He explains that "[e]ven a skilled technician would know to select a buck/boost converter if the input voltage could be either higher or lower than the desired output voltage." (Id. at para. 19.)

Relume has only two arguments in response. First, the Johnson patent does not disclose a device with the LED array required by claim 1 because its Figure 8 embodiment lacks a series-parallel configuration. My claim construction of "LED array" has eliminated this argument. The second argument, then, is Relume's only remaining argument against a finding of obviousness as to claim 2. That argument is this: even if left unrebutted, Professor Erickson's third declaration does not establish obviousness because 1) he "never even states that the asserted claims would have been obvious *at the time of the invention* "; and 2) he generally fails to state the motivation for combining relevant prior art. (Pl.'s Obviousness Opp.Mot. at 23-24.)

The first criticism is baseless. With respect to his third declaration, Professor Erickson states in his third supplemental declaration that "all of my opinions concerning obviousness were made from the point of view of a person of ordinary skill in the art as of the time of the inventions of the '645 and '909 patents, that is, as of the mid 1990's." (Third Suppl. Erickson Decl. at para. 61.)

The second criticism is likewise baseless. Professor Erickson is careful throughout both of his obviousness declarations to explain what motivation, suggestion, or incentive in the relevant prior art would have made a combination obvious to one of ordinary skill in the art at the time of the invention at issue. In fact, Relume's criticism reveals a flaw in its own strategy in defending against Lumileds' obviousness challenges. Relume would have me treat the obviousness test with the stringency of an anticipation test, permitting no combinations to ever invalidate an invention as obvious simply because they are combinations.

In this vein, Relume accuses Professor Erickson of repeatedly using only the level of knowledge of one of ordinary skill in the art to supply missing suggestions to combine. Relume believes his declaration offends *Al-Site, supra*, in which the Federal Circuit reaffirmed the fundamental principle that skill in the art will rarely operate to supply missing knowledge or prior art to reach an obviousness judgment. See 174 F.3d at 1324. As the court further explained, "[s]kill in the art does not act as a bridge over gaps in substantive presentation of an obviousness case, but instead supplies the primary guarantee of objectivity in the process." *Id.*

While I of course heed the warning of *Al-Site*, I nevertheless find that its concern is inapplicable to the facts of this case. First of all, nearly all of the prior art at issue in *Al-Site* had been presented to the patent examiner by the patentee; the Federal Circuit observed that this made the obviousness burden more difficult to overcome. See *id.* at 1323-24. Here, in contrast, some of the most important prior art was not before the patent examiner, as indicated by my anticipation holdings. Thus Lumileds' burden is more easily overcome. See *Para-Ordnance Mfg. Inc. v. SGS Importers Int'l Inc.*, 73 F.3d 1085, 1088-89 (Fed.Cir.1995), *cert. denied*, 519 U.S. 822, 117 S.Ct. 80, 136 L.Ed.2d 38 (1996). Second, it is important to note that *Al-Site*'s caution does not apply when the prior art references themselves provide some explicit or implicit motivation, suggestion, or incentive for combination. See *Al-Site*, 174 F.3d at 1324. As will become clear, the prior art references at issue in this case provide their own suggestions and incentives for combination. And, third, the court in *Al-Site* noted that the evidence against the asserted combination was substantial. See *id.* That is not the case here.

[27] The first good example of the inapplicability of *Al-Site* is Lumileds' obviousness challenge to claim 2

of the '645 patent. The interesting fact about the Johnson patent, and why it is so damaging to the validity of Relume's '645 patent, is that it is itself already a combination. It wed the art of power supply electronics-in particular, the art of switching power supplies (as explained in the *Power Supply Cookbook*)-to the art of retrofit LED arrays for the benefit of efficient, long-lasting illumination. This is undisputed (and also why Johnson anticipates claim 1). Also undisputed is the fact that inherent in the use of switching power supplies at that time was the knowledge that only three configurations existed: buck, boost, and buck/boost. Thus by teaching a switching power supply, the Johnson patent would have implicitly suggested to one of ordinary skill in the art the possibility of using a buck/boost switchmode converter for its power supply. This is all that Professor Erickson's opinion seeks to explain. Thus I find his unrebutted opinion regarding claim 2 to be clear and convincing evidence of the obviousness of that claim. I also find the relevant prior art references-the Johnson patent and the *Power Supply Cookbook* in particular-to be clear and convincing evidence, on their own, of the obviousness of claim 2.

[28] Lumileds also argues that there is no difference for obviousness purposes between claim 4 of the '645 patent and the Johnson patent. Claim 4 recites the additional limitation of an EMI filter. Relume again has the same two flawed arguments in response. It does not submit evidence to rebut the evidence of the prior art references or Professor Erickson's opinion. Erickson concludes that the Johnson patent would have made the invention of claim 4 obvious to one of ordinary skill in the art because, among other things, the data sheet for the MC 34261 Motorola controller recommended by Johnson describes using an EMI filter. (See Third Erickson Decl. at para. 21-25.) Erickson points out that "every power supply circuit shown in the data sheet with the MC 34261 includes an EMI filter." (Id. at para. 23.) Erickson also notes that the *Power Supply Cookbook* taught the crucial nature of EMI filters for switching power supplies; so it states that "the EMI filter is an integral part of any PFC [power factor correction] circuit." (Id. at para. 22.)

I find all of this undisputed evidence to be clear and convincing evidence of the obviousness of claim 4 in light of Johnson and the Motorola data sheet. By recommending the use of the MC 34261 Motorola controller in its switching power supply, the Johnson patent implicitly suggests to one of ordinary skill in the art that the information in the controller's data sheet is useful and suitable for the operation of its invention. That information includes a strong teaching to use EMI filters with switching power supplies. Thus I find the Johnson patent is no different than the invention of claim 4 for purposes of obviousness because it suggests a combination of its explicit teachings-the rectifier, the power factor correcting switching power supply, and the LED array-with the EMI filter teaching of the Motorola data sheet.

b. Claims 5 and 6 of the '645 Patent

[29] Lumileds argues that the prior art Hildebrand patent's dynamic load circuit is identical, or at least equivalent, to the adaptive clamp circuit of claims 5 and 6. The Hildebrand circuit is directed to "attenuating the effects of leakage currents when a particular [traffic or pedestrian crossing] signal is switched to its off state." Hildebrand, 1:8-10. It is undisputed fact that the Hildebrand circuit uses a Zener diode (CR5) in combination with a transistor (Q2) and that those components correspond to the Zener diode (D5) and the transistor (Q1) of the '645 clamp circuit's "voltage sensing means." Hildebrand, 5:57-65. It is also undisputed fact that the Hildebrand circuit uses a transistor (Q3) in combination with a resistor (R7) and that those components correspond to the transistor (Q2) and the resistor (R5) of the '645 clamp circuit's "control load means." Hildebrand, 5:66 to 6:6. Finally, it is undisputed fact that the Hildebrand circuit places resistor (R7) of its "control load means" in the circuit when the traffic light is off, thereby preventing leakage current, and that it completely removes this resistor (R7) from the circuit when the light is on. Hildebrand, 6:17-52. This operation corresponds to that of the '645 clamp circuit, which places the resistor (R5) of its

"control load means" in the circuit when the light is off and then completely removes that resistor (R5) from the circuit when the light is on. '645, 7:53 to 8:1.

This undisputed evidence suffices to show that the Hildebrand device is nearly identical in structure and function to the adaptive clamp circuit of claims 5 and 6. First of all, it shows that the Hildebrand device "clamps" within the meaning of the '645 patent.FN34 That is, when voltage falls below a certain amount-the zener voltage of Hildebrand's Zener diode (CR5)-that diode does not conduct and the leakage current is directed through resistor (R7). Hildebrand, 6:23. Likewise, when the '645's voltage falls below a certain amount-the zener voltage of its Zener diode (D5)-that diode does not conduct and leakage current is directed through resistor (R5). '645, 7:59-62. Second, the undisputed evidence also shows that the Hildebrand device is "adaptive" within the meaning of the '645 patent. When the Hildebrand light is on, its dynamic load circuit removes the resistor (R7), and when its light is off, it places the resistor (R7) in the circuit to clamp leakage. Hildebrand, 6:42-50; (Third Erickson Decl. at para. 33-34).

FN34. Relume argues that Hildebrand does not "clamp" within the meaning of the '645 patent because it does not do so at the zener voltage threshold of 40 volts-an amount the '645 specification mentions (but does not require). I do not find this to be a substantial difference for obviousness purposes, however, because the specification statements in question do not suggest that the function of clamping cannot occur at different zener voltage thresholds.

In response to this overwhelming evidence of similarity, Relume first argues that the Hildebrand dynamic load circuit substantially differs from '645's adaptive clamp circuit because the Hildebrand transistor Q3 is not a solid state switch, as required by the '645 patent, but instead is a linear amplifier. Relume's argument relies on the opinion of its expert, Mr. Gafford. I do not find that its argument precludes summary judgment, however. Hildebrand does not call the transistor Q3 a "linear amplifier." Gafford bases his opinion solely on his conclusory observation that some of the language of the Hildebrand patent is "unique to the language of amplifiers." (Gafford Decl. at para. 28.) Gafford does not explain how or why this is so.

Throwing further doubt on Gafford's reliability, Lumileds offers evidence showing that all switches, including Hildebrand's, operate in a linear amplifier mode for a period of milliseconds as they switch between on and off-yet those in the art still consider them to be switches. (See Third Suppl. Erickson Decl. at para. 63.) Thus I find that Gafford's opinion fails to set forth specific facts sufficient to raise a genuine issue of material fact. *See Lockwood v. American Airlines, Inc.*, 107 F.3d 1565, 1571 (Fed.Cir.1997) (finding that expert's conclusion that prior art patent claimed a limited structure did not preclude summary judgment when the patent's written description appeared to contradict his conclusion).

Relume's second argument in the face of Lumileds' evidence of structural and functional similarity is that the combination of Hildebrand's circuit and the Johnson device would be inefficient, thereby rebutting any motivation for combination. Relume's inefficiency argument relies on tests performed by Hochstein on a dynamic load circuit he built to match that taught in Hildebrand. Hochstein found that the circuit's power factor, harmonic distortion, and power dissipation characteristics would not pass ITE or Caltrans specifications for LED traffic signals. (See Hochstein Reply Decl. at para. 14-16.)

Even viewed in a light most favorable to Relume, Hochstein's tests do not constitute evidence that shows that the Hildebrand and Johnson devices are inefficient when operated *together*. All Hochstein's tests establish is the unsurprising fact that the Hildebrand device *alone* would not win the approval of industry

specifications that apply to an entire power factor corrected, voltage-regulated LED power supply. The relevant tests for obviousness purposes would have been to test and compare the performance of Hildebrand's circuit against that of the '645's adaptive clamp circuit or, even better, to test and compare the performance of a combined Hildebrand and Johnson device against that of the entire invention of claims 5 or 6. Relume does not submit evidence of either.

Moreover, Lumileds is correct to point out that the claims of the '645 patent do not recite any values for power factor, harmonic distortion, or power dissipation. As the Federal Circuit has stated "the name of the game is the claim." In re Hiniker Co., 150 F.3d 1362, 1369 (Fed.Cir.1998) (upholding rejection for obviousness even though prior art performed less efficiently than patent's device because it refused to read specification's operational characteristics into broader claims). Accordingly, even if the efficiency of the Hildebrand circuit were to be less than that of the '645's adaptive clamp circuit (or the efficiency of Hildebrand/Johnson were less than that of claim 5 or 6), it would be irrelevant to the obviousness question before me.

This is particularly true in this case because a person of ordinary skill in the art would have had a strong motivation to combine Hildebrand and Johnson at the time of claim 5 and 6's invention. Hildebrand teaches the crucial lesson that retrofit bulbs in safety critical traffic or pedestrian crossing signals will create leakage current problems that could interfere with the conflict monitors. Hildebrand, 1:6-41. Thus Hildebrand would have motivated a person of ordinary skill in the art to combine its dynamic load circuit with the retrofit lamp of Johnson in order to prevent these well-known leakage current problems.

Accordingly, I find that the combination of the prior art Hildebrand and Johnson patents constitutes clear and convincing evidence of the obviousness of claims 5 and 6 of the '645 patent at the time of their invention. Relume's insufficient evidence fails to demonstrate a need for trial on the factual issue of the structural and functional similarity of a combined Hildebrand/Johnson device to claims 5 and 6. *See* Liberty Lobby, 477 U.S. at 249-50, 106 S.Ct. 2505.

c. Claims 6 and 15 of the '909 Patent

[30] Lumileds argues that a prior art combination—the Fujitsu publication with one or both power supply textbooks—is identical to claims 6 and 15 of the '909 patent. Claims 6 and 15 recite the alternate technique for adjusting the energy supplied to the LEDs by frequency modulation (instead of pulse width modulation). Fujitsu discloses pulse width modulation, but not frequency modulation. Both the *Power Supply Cookbook* and the *Electronic Circuits and Applications* disclose the use of frequency modulation with switching power supplies. Based on these sources and his expertise, Professor Erickson states in his declaration that the two methods were well-known design choices within the field of switching power supplies. (*See* Third Erickson Decl. at para. 50-53.) Indeed, the '909 patent concedes this fact of the prior art when it notes that it is "widely recognized that control of power supply output voltage or output current is most efficiently accomplished by varying the pulse width or frequency of the switched waveform." '909, 5:51-54. From this evidence, then, it is clear that the Fujitsu publication would have suggested the alternate use of frequency modulation to one of ordinary skill simply because it used a switching power supply to adjust the average current to the LEDs.

Relume provides no specific facts in response. It reiterates conclusory denials that it also raised in the anticipation inquiry. Pursuant to Rule 56(e), this does not suffice to create a genuine dispute worthy of trial. I therefore find that the Fujitsu publication in combination with either power supply textbook constitutes

clear and convincing evidence of obviousness because the combinations are no different from the inventions of claims 6 and 15.

d. Claims 9 and 18 of the '909 Patent

[31] Lumileds argues that a prior art combination—the Fujitsu publication with the *Power Supply Cookbook*—is identical to the inventions of claims 9 and 18 of the '909 patent. Claims 9 and 18 relate to using a filter to provide substantially d.c. power to the LEDs. The *Power Supply Cookbook* establishes that it was well known in the art of the mid-1990's that a filter could be used to convert on/off pulses from a switching power supply to substantially d.c. power. The '909 patent acknowledges that d.c. power supplies "normally" use a filter to produce substantially d.c. power. '909, 4:54-56. And it is undisputed that the Fujitsu lighting control circuit is a d.c. power supply of the type referred to in the '909 patent. (*See* Third Suppl. Erickson Decl. at para. 68.) Thus the evidence offered by Lumileds more than satisfies its Rule 56(c) burden of showing that there is no genuine issue of material fact that a combination of the Fujitsu publication and the *Power Supply Cookbook* is clear and convincing evidence of the obviousness of claims 9 and 18 at the time of their invention.

Relume's only defense is that Fujitsu teaches away from using a filter. Specifically, Relume argues that the Fujitsu circuit would not use a filter because it is well known in the optical scanning arts that the detector circuit must receive pulsed light from the LEDs for its efficient operation—not the substantially constant light that would come from filtered, substantially d.c. power. Relume's only evidence in support of this argument comes from its inventor, Mr. Hochstein. (*See* Hochstein Reply Decl. at para. 9.)

I find that Relume's argument fails to create a genuine issue of material fact. It depends on an erroneously narrow view of the invention disclosed by the Fujitsu publication. Although Fujitsu mentions application of its invention in the field of optical scanning devices, its claim language and written description are broad in scope and reveal an invention that could have application in any setting where LEDs are exposed to increasing temperatures. Furthermore, Fujitsu nowhere discloses the use of a pulse detector with its circuit. Nor does Relume submit any prior art references that support Hochstein's assertion about the ordinary knowledge of those in the optical scanning arts.

The Fujitsu publication simply lacks any express or implied teaching away from the use of a filter to produce substantially d.c. power. In fact, the evidence offered by Lumileds establishes that the Fujitsu publication would have suggested the use of a filter to one of ordinary skill given the fact that it is a d.c. powered device. I therefore find that the combination of Fujitsu and the *Power Supply Cookbook* constitutes clear and convincing evidence of obviousness because there is no difference between the combined prior art and the inventions of claims 9 and 18.

4. Secondary Considerations

This final Graham inquiry requires me to consider relevant evidence of any secondary, non-obviousness factors such as commercial success, long-felt need, failure of others, skepticism and unexpected results. *See 3M v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 1573 (Fed.Cir.1992). These secondary considerations, however, "are but a part of the 'totality of the evidence' that is used to reach the ultimate conclusion of obviousness." *Richardson-Vicks*, 122 F.3d at 1483. The existence of such evidence does not control the obviousness determination. *Id.*; *see also Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 719 (Fed.Cir.1991) (noting that the weight of secondary considerations may be of insufficient weight to override a determination of obviousness based on primary considerations).

Relume makes various assertions and submits a smattering of anecdotal evidence as to four secondary considerations: copying, commercial success, long-felt need, and failure of others or skepticism. Each hinges on Relume's unstated assumption that all LED traffic lights which meet industry specifications must infringe the '645 and '909 patents. As defendants' successful motions for noninfringement have demonstrated, however, there are many ways to satisfy industry specifications without using literally infringing technology. Even Hochstein concedes this. (*See* Hochstein Dep. at 455-56.)

I find Relume's arguments as to the copying factor to be without evidentiary support. Except for Ecolux's temperature compensation circuit, I found that all the accused products at issue in the motions did not literally infringe the asserted claims of the '645 and '909 patents. Furthermore, Relume has no independent evidence of copying, only the assertion that because defendants at one point argued an equitable estoppel defense, they admit they copied Relume's patents. This assertion is of course insufficient to preclude summary judgment in the face of defendants' strong prima facie evidence of obviousness.

The commercial success factor is likewise unhelpful for Relume. Relume argues that evidence of defendants' commercial success, as well as its own, is evidence of the non-obviousness of its patents. This argument fails for two simple reasons. First, because Relume has failed to defeat defendants' motions for non-infringement (except with respect to Ecolux and the '909 patent), it cannot rely on the well-substantiated success of defendants' accused products to prove the commercial success of its claimed features. Second, Relume has not shown that its claimed features have enjoyed any commercial success. All it has proved to date is that one community-Murietta, California-has awarded it a bid for 400 LED traffic signals.

As to long-felt need, the only evidence Relume offers is evidence of a need for industry specifications, not necessarily for the claimed features of Relume's patents. Because defendants have demonstrated that there are several ways manufacturers can meet those specifications, Relume cannot rely on those specifications to establish that there was a long-felt need for its patents. At best, Relume's evidence suggests that the LED traffic signal industry began in the last few years to regulate itself.

The final factor Relume argues is failure of others or skepticism. Its evidence of this is slim to non-existent. It first offers the testimony of Patrick Mullins, an individual associated with McCain Traffic Supply, as evidence of failure. (*See* Mullins Dep. at 40-41, 80.) Relume claims that he testifies as to McCain's inability to make an LED traffic signal with power factor correction. A close reading of Mullins' testimony, however, reveals that he only states that McCain never successfully marketed an LED traffic signal with power factor correction, not that it could not build one. (*See id.* at 80.) Relume also offers the testimony of a Martin Wallen as evidence of skepticism as to the '909 patent. Wallen's testimony alone does not constitute sufficient evidence to overcome the strong prima facie evidence of obviousness in this case.

In the end, Relume cannot point to any convincing evidence of non-obviousness. In light of the clear and convincing prima facie evidence of obviousness in the prior art, I therefore hold that claims 2, 4, 5, and 6 of the '645 patent and claims 6, 9, 15, and 18 of the '909 patent are invalid because they would have been obvious to one of ordinary skill in the art at the time of their invention.

Conclusion

For all of the foregoing reasons, Dialight's, Precision's, and Lumileds' motions for noninfringement are **GRANTED** on the issue of literal noninfringement as to all asserted claims of the '645 and '909 patents.

Ecolux's motion for noninfringement is **GRANTED** on the issue of literal noninfringement as to all asserted claims of the '645 patent, but is **DENIED** on the same issue as to the asserted claims of the '909 patent.

I decline to consider the issue of infringement through the doctrine of equivalents at this time because of the parties' inadequate briefing on that issue. This has no bearing on the outcome of the case, however, because of my validity rulings, which find all asserted claims invalid due to prior art.

Accordingly, Lumileds' anticipation motion is **GRANTED** as to claim 1 of the '645 patent and claims 1-3, 7, 10-12, and 16 of the '909 patent, but is **DENIED** as to claims 2 and 4 of the '645 patent. Lumileds' obviousness motion is **GRANTED** as to claims 2, 4, 5, and 6 of the '645 patent and claims 6, 9, 15, and 18 of the '909 patent.

IT IS SO ORDERED.

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