

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,

Petitioner,

v.

REED SEMICONDUCTOR CORP.,

Patent Owner.

U.S. Patent No. 7,960,955

DECLARATION OF JOSEPH C. MCALEXANDER III, P.E.

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I, Joseph C. McAlexander^{III} declare as follows:

1. I have been retained as an expert consultant on behalf of Monolithic Power Systems, Inc. (“MPS” or “Petitioner”) in connection with a petition for *inter partes* review of U.S. Patent No. 7,960,955 (the ’955 Patent), which I have been told MPS is submitting to the Patent Trial and Appeal Board of the United States Patent and Trademark Office. MPS has retained me as a technical expert to study and provide my opinions on the technology covered by, and the patentability or non-patentability of, claims 1, 7, 8, and 9 of the ’955 Patent (“Challenged Claims”).

2. This declaration is directed to the Challenged Claims and sets forth certain opinions I have formed, the conclusions I have reached, and the bases for each.

3. Based on my experience, knowledge of the art at the relevant time, analysis of prior art references, and the understanding a person of ordinary skill in the art would have had regarding the claim terms in light of the specification, it is my opinion that each of the Challenged Claims of the ’955 Patent is unpatentable for at least the reasons I discuss below.

I. INTRODUCTION AND QUALIFICATIONS

4. I am an independent consultant. All opinions stated in this Declaration are based on my own personal knowledge and professional judgment. In forming

my opinions, I have relied on my knowledge and experience relating to the technology referenced in this Declaration.

5. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. A copy of my current curriculum vitae, which includes a more detailed summary of my education and professional and academic experience is provided as Exhibit 1009 to the Petition. The following provides an overview of some of my experience that is relevant to the matters set forth in this Declaration.

A. Qualifications

6. I am a Registered Professional Engineer (#79454) and the President of McAlexander Sound, Inc. I hold a Bachelor of Science degree in Electrical Engineering from North Carolina State University. I have been associated with the integrated circuit and electronics industry as a designer and consultant for the past 52 years and am a named inventor on 31 U.S. patents and a number of foreign patents.

7. I have extensive expertise in the subject matter area relevant to this matter, specifically the design, fabrication, and testing of integrated circuits, including that of power and timing control circuits embedded in integrated circuits. For example, I have over fourteen years of experience at Texas Instruments. There, I designed, developed and implemented circuits, processes, and procedures to assure

product and process reliability. More specifically, I designed and managed the processing and productization of many types of integrated circuit devices, including, among others, dynamic and static storage devices, charge coupled devices (CCD) for imaging applications, electrically programmable and erasable non-volatile devices (EPROM / EEPROM) for instruction storage and access, logic devices, and controllers. I also was responsible for the design and use of many performance boards used in testing and performance characterization of integrated circuits as well as the creation and implementation of the testing programs used to evaluate the performance characteristics of the integrated circuits. These boards required power control and signal stability for accurate assessment of device performance under various timing and power requirement conditions, adjusted according to specific, current circuit operation and load demands.

8. Additionally, while at EPI for 5 years, I managed activities which included board designs that required power and signal control. Specifically, my experience in the industry and with engineers practicing in the industry informs my opinion as to the level of skill of individuals and the general state of the art.

9. Specifically, I have:

- designed memories, including Dynamic Random Access Memories (DRAMs), Static Random Access Memories (SRAMs), Charge Coupled Devices (CCDs), Shift Registers (SRs), and functional circuits including I/O buffers for address and data, decoders, clocks, sense amplifiers, fault tolerant

(incorporating both nonvolatile EPROM and random access memory components), parallel-to-serial data paths for video applications, level shifters, converters, pumps, and logic, as well as wireless communication systems and MEMs;

- managed operations including engineering, training, and quality assurance for device fabrication, assembly, test, analysis, and reliability assessment, as well as manufacturing control, each of which involved both volatile and non-volatile memory; testing, analysis, and control involved use of mechanical calibration and measuring equipment, including optical, scanning e-beam, IR, capacitive, and laser using phase contrast and FFT for HARI applications;
- taught courses in solid-state device physics, integrated circuit design, integrated circuit fabrication, and statistical control;
- provided expert services, investigating both process and design technologies of various devices (microprocessor and controller, volatile and non-volatile memory, programmable logic, card, tag, module, mixed signal, custom, and other), systems (PC and peripheral, computer, control, laser measurement, switch, architecture, software, and other), consumer products (medical, TV, telephone, VCR, facsimile, copier, lighting, game, and other), and products related to wireless tracking and geofencing; and
- designed and managed development, testing, and evaluation of memory devices and systems incorporating such devices, including simulation of operation. I have also had experience in programming, erasing, and wearout of electrically programmable and erasable non-volatile memories.

10. I am qualified to reach the opinions and conclusions stated in this Declaration.

11. In forming my opinions, I rely on my knowledge and experience in the fields relevant to this Declaration. I further rely on documents and information referenced in this Declaration.

12. A more detailed account of my work experience and other qualifications is listed in my Curriculum Vitae, Ex. 1009.

B. Materials Reviewed

13. The opinions contained in this Declaration are based on the documents cited in this Declaration, the prior art relied on in the Petition, my professional judgment, and my education, experience, and knowledge relating to power control and related fields.

14. My opinions have also been guided by my appreciation of how a person of ordinary skill in the art (“POSITA”) would have understood the state of the art, the prior art, and the claims and the specification of the ’955 Patent at the time of the alleged invention.

15. The time of the alleged invention of the ’955 Patent encompasses the time frames near and including December 9, 2005. I understand the application for the ’955 Patent claims priority to a Japanese patent application filed on December 9, 2005. My opinions reflect how a POSITA (which I describe below) would have understood the ’955 Patent, the prior art to the ’955 Patent, and the state of the art at the time of the alleged invention.

II. UNDERSTANDING OF LEGAL PRINCIPLES AND PERSPECTIVES

16. I am not a lawyer, and I will not provide legal opinions. Although I am not a lawyer, I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims.

17. I understand that a patent claim is invalid if it is anticipated or rendered obvious over the prior art and that a claim can be unpatentable even if all requirements of the claim cannot be found in a single prior art reference. I further understand that invalidating a claim requires that the claim be anticipated or rendered obvious from the perspective of a POSITA at the time the invention was made.

18. In forming my analysis, opinions, and conclusions expressed in this Declaration, I have applied the legal principles set forth below, which were provided to me by counsel for Petitioner.

A. Types of Claims

19. I understand that there are two types of U.S. patent claims: 1) independent claims, and 2) dependent claims. I understand that independent claims only include the aspects stated in the independent claim. I further understand that dependent claims include the aspects stated in the independent claim, and any other aspects stated in any claim from which that dependent claim depends, as well as any limitations required by the dependent claim.

B. Anticipation

20. I understand that a claim in an issued patent can be invalid if it is anticipated. In this case, “anticipation” means there is a single prior art reference that discloses every element of the claim, arranged in the way required by the claim, either expressly or inherently.

21. I understand that anticipation of a claim requires that every element of a claim is disclosed expressly or inherently in the single prior art reference. I understand that “inherent” disclosure means that the claim element, although not expressly described by the prior art reference, must necessarily be present based on the disclosure. I understand that a mere probability that the element is present is not sufficient to qualify as “inherent disclosure.”

C. Obviousness

22. I understand that a claim in an issued patent can be rendered invalid if it is obvious. Unlike anticipation, obviousness does not require that every element of the claim be in a single prior art reference. Instead, it is possible for claim elements to be described in different prior art references or that a claim element in a prior art reference might be modified, so long as there is motivation or sufficient reasoning to combine the references or make the modification and a reasonable expectation of success of doing so.

23. I understand that a claim is invalid for obviousness if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious from the perspective of a person of ordinary skill in the relevant art at the time the invention was made. I also understand that, when evaluating obviousness, one must consider obviousness of the claim “as a whole.” This must be from the perspective of the person of ordinary skill in the relevant art at the time the invention was made.

24. I further understand that exemplary rationales that may support a conclusion of obviousness include:

- a) combining prior art elements according to known methods to yield predictable results;
- b) simple substitution of one known element for another to obtain predictable results;
- c) use of known technique(s) to improve similar devices (methods or products) in the same way;
- d) applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
- e) “obvious to try” - choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- f) known work in one field of endeavor may prompt variations of the work for use in either the same field or a different field based on design incentives or other market forces if the variations are predictable to a POSITA; and
- g) some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

25. In analyzing obviousness, I understand that it is important to understand the scope of the claims, the level of skill in the relevant art, the scope and content of the prior art, the differences between the prior art and the claims, and any “secondary considerations” (if available). I also understand that, if a technique has been used to improve one device, and a POSITA would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. Although I understand that it is not required, there may also be a specific “teaching, suggestion or motivation” to combine any first prior art reference with a second prior art reference. Such a “teaching, suggestion, or motivation” to combine the first prior art reference with the second prior art reference can be explicit or implicit and may provide further evidence of obviousness.

D. Claim Construction

26. I understand that, for purposes of my analysis, the terms appearing in the patent claims should be interpreted according to their “ordinary and customary meaning” at the time the alleged invention was made. In determining the ordinary and customary meaning, the words of a claim are given the plain meaning that those words would have had to a POSITA. I understand that the structure of the claims, the specification, and the file history also may be used to assist in the construction of a claim term. Additionally, treatises and dictionaries may be used, in limited

circumstances, to determine the meaning attributed by a POSITA to a claim term at the time of filing as long as such extrinsic input is consistent with the claim term as used in the claim.

27. For all claim terms considered in this Declaration, I have applied the ordinary and customary meaning of those terms as they would have been understood by a POSITA at the time the alleged invention was made. To the extent the Patent Owner or Petitioner proposes any constructions, or the Board construes any claims, I reserve the right to address such proposals or constructions. Under any reasonable construction of the claims, it is my opinion that the prior art discloses and/or renders obvious all the limitations recited in Challenged Claims of the '955 Patent.

E. Person of Ordinary Skill in the Art

28. I understand that my assessment and determination of invalidity must be undertaken from the perspective of what would have been known or understood by a POSITA at the time of the earliest patent application supporting the '955 Patent.

29. I have been informed and understand that the POSITA is not a real person, but rather a legal construct—a hypothetical person. This person is presumed to have known the relevant art at the time of the invention. I have been informed by counsel that relevant factors in determining the level of ordinary skill include (1) the educational level of the inventor, (2) the type of problems encountered in the art, (3) prior art solutions to those problems, (4) the rapidity with which innovations are

made, (5) sophistication of the technology, and (6) the educational level of active workers in the field. I further understand that the person of “ordinary skill” is not a person of extraordinary skill in the art. In other words, this person of ordinary skill is not necessarily an expert in the field.

30. As of the alleged December 9, 2005 priority date, a POSITA would have had at least a bachelor’s degree in electrical engineering or equivalent, and approximately two years of experience working in the field of power converters, circuit design, device physics, or related technologies. Lack of work experience can be remedied by additional education, and vice versa.

31. At the time of the alleged invention, I was a person of at least ordinary skill in the art, and I have applied the perspective of the POSITA in forming and expressing my opinions below.

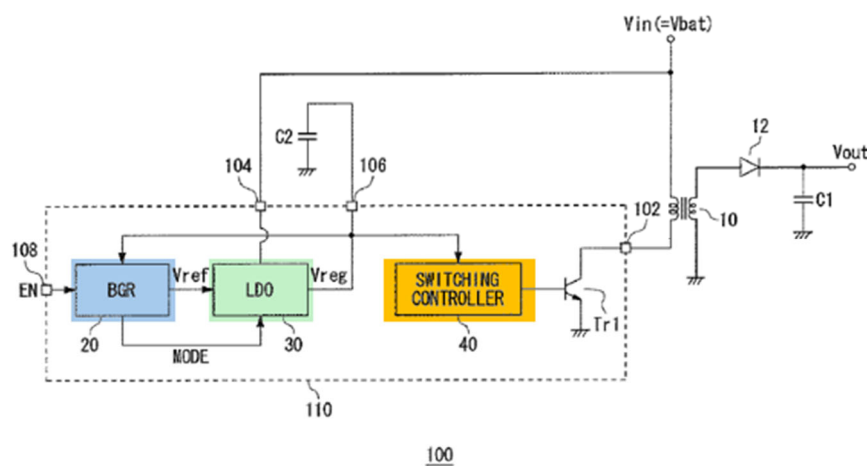
III. BACKGROUND OF THE ’955 PATENT (EX. 1001)

32. The ’955 Patent is directed to power supplies. Specifically, “switching power supplies,” which were well-known before the ’955 Patent, “supply a voltage higher or a voltage lower than a power supply voltage supplied from a battery or the like, to a load circuit.” Ex. 1001 at 1:21-26. These power supplies commonly included a “control circuit which controls ON and OFF states of a switching element” based on a “reference voltage.” *Id.* at 1:35-40. The “control circuit” of the ’955 Patent is shown as 110 in the Figure 1 block diagram, which in turn contains

a number of other components, such as a “switching controller 40.” *Id.* at Fig. 1, 4:41-43.

33. One drawback recognized by the '955 Patent with prior art power supplies is that “switching noise generated by the switching element” may impact the “reference voltage source” which results in a risk that “a stepping up or stepping down operation will be hindered.” *Id.* at 1:41-46.

34. The '955 Patent claims to have overcome that problem by disclosing a “power supply apparatus” made up of well-known components, namely, a “reference voltage source 20” (blue), “linear regulator 30” (green), and “switching controller 40” (orange) as shown below, within a “control circuit 110.” *Id.* at 4:41-43, 5:1-3, 5:9-10, 5:18-23.

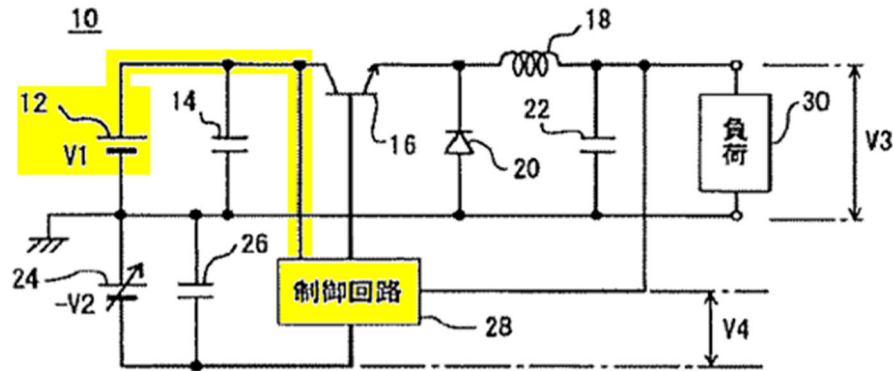


35. According to the '955 Patent, the linear regulator “stabilizes the input voltage, based on the reference voltage generated by the reference voltage source.”

Id. at 1:59-61. Then, “an output voltage of the linear regulator is supplied as a power supply voltage of a control circuit of the switching power supply and the reference voltage source.” *Id.* at 1:61-64. The ’955 Patent states that “since the reference voltage source generates the reference voltage, with the output voltage of the linear regulator as the power supply voltage, an impact of noise generated in the switching element can be reduced, and it is possible to generate the reference voltage with a small noise component.” *Id.* at 1:65-2:3.

36. During prosecution, the ’955 Patent was subject to only a single rejection. *See, e.g.*, Ex. 1002 at 252-258 (Aug. 27, 2010 Non-Final Rejection). The Examiner rejected the then-pending claim 1 and 7 (among others) as obvious in view of JP2004-32899 and JP05-35344. To overcome rejection, the Applicant amended claim 1 to include the limitation “and the input voltage is not directly supplied to the controller as a power supply voltage.” Ex. 1002 at 273 (Nov. 29, 2010 Amendment). The Applicant argued that “the output voltage of the voltage supply 12 of ‘899 (i.e., the purported input voltage) is input to a positive power supply terminal of structure 28,” which was the claimed “the controller” in the prior art. *Id.* (Nov. 29, 2010 Amendment). The claims were subsequently allowed. *Id.* at 284.

【 図 1 】



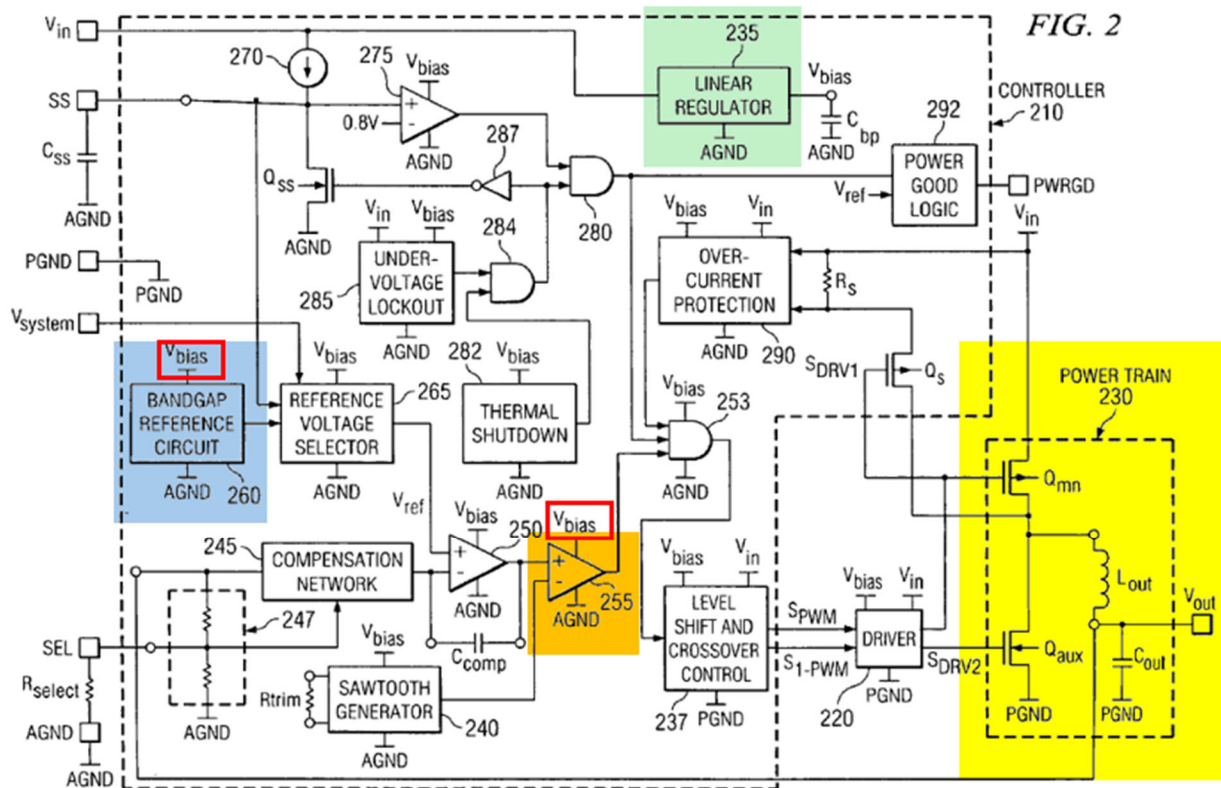
IV. REASONS FOR UNPATENTABILITY

A. Ground 1: Claims 1 And 7 Are Obvious Over Lotfi

1. Overview Of Lotfi

37. Lotfi describes a “power converter” that includes a “reference circuit 260” (blue), “linear regulator 235” (green), and a “PWM comparator 255” (orange) to control the switches of “power train 230,” which is a switching power supply (yellow). Ex. 1004 at Fig. 2; 8:37-38, 9:14-17, 10:16-25, 10:33-35.

38. Specifically, the “power train 230” is “a buck converter technology,” which is a switching power supply comprising “main and auxiliary switches Q_{mn} , Q_{aux} .” *Id.* at 8:37-44. A “buck converter” is a type of switching DC-DC converter that produces an output voltage that is less than its input by using, among other things, transistors (like Q_{mn} and Q_{aux}) that switch on and off, alternatively connecting and disconnecting the input voltage to, for example, an inductor.



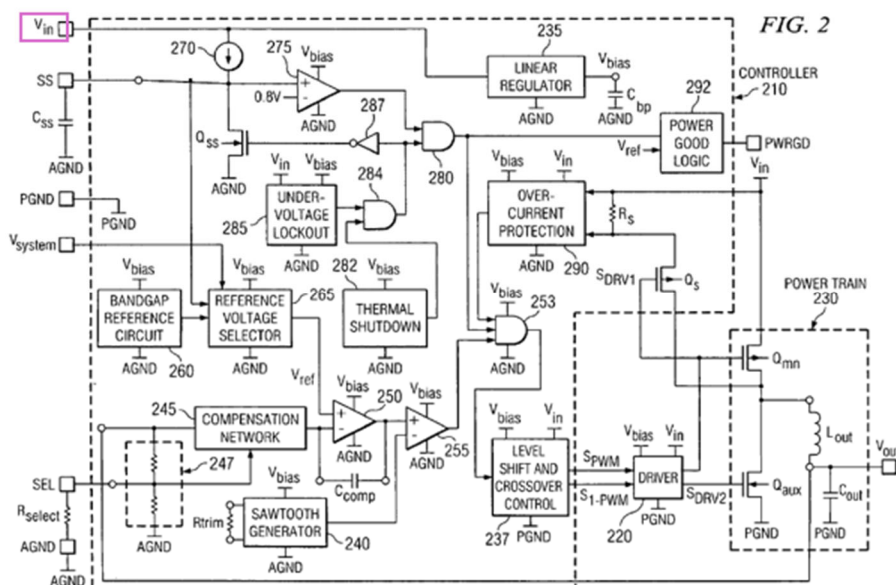
39. Lotfi discloses that a “linear regulator 235 provides a well regulated, low voltage bias voltage V_{bias} ” by “sens[ing] ... a reference voltage such as provided by the bandgap reference network circuit 260.” *Id.* at 11:32-36, 11:45-51. The output of the linear regulator V_{bias} (red) is supplied as the power supply voltage to both a “PWM comparator 255” (orange) that controls switches Q_{mn} and Q_{aux} (*id.* at 10:19-25), as well as the “reference circuit 260” (blue) as shown above in Figure 2 above. *Id.* at Fig. 2.

2. Independent Claim 1

(i) 1[PRE] “A power supply apparatus for use with an input voltage provided from outside, the power supply apparatus comprising:”

40. In my opinion, Lotfi discloses and renders obvious “[a] power supply apparatus for use with an input voltage provided from outside, the power supply apparatus.”

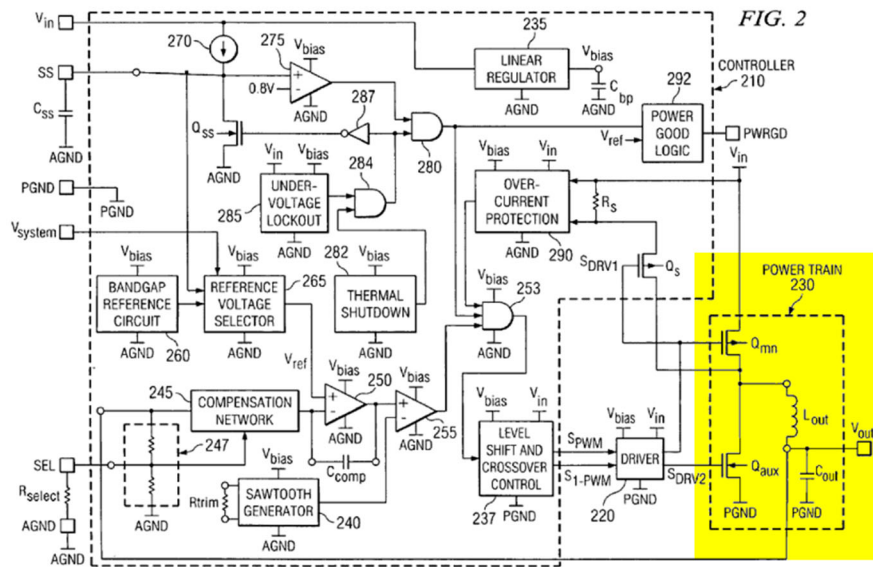
41. FIG. 2 depicts a “power converter” (which is a “power supply apparatus”) that is used with “the input voltage V_{in} ” (purple), which is “unregulated” and an “input voltage provided from the outside.” Ex. 1004 at 8:19-23, 8:64-9:1; *see also* Fig. 2. As Lotfi recognizes, V_{in} is “from a source of electrical power (represented by a battery)” and the “power train” provides a “regulated output voltage V_{out} ” (*id.* at 6:15-19).



(ii) 1[A] “a switching power supply which stabilizes the input voltage;”

42. In my opinion, Lotfi discloses and renders obvious “a switching power supply which stabilizes the input voltage.”

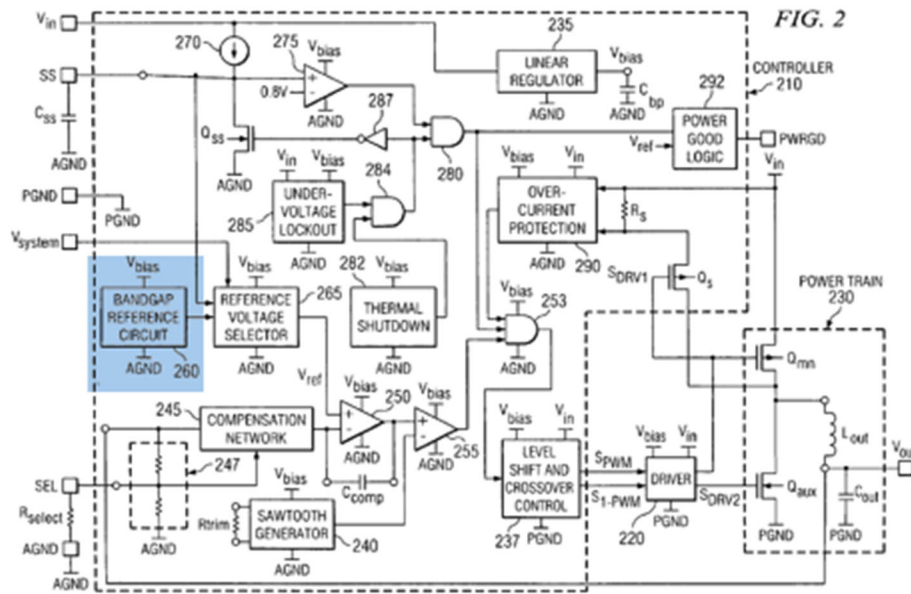
43. Figure 2 discloses a “power train” that, according to Lotfi, “receives an input voltage V_{in} from a source of electrical power (represented by a battery) at an input thereof and provides a regulated output voltage V_{out} to power, for instance, a microprocessor at the output of the power converter.” Ex. 1004 at 6:15-19. The “power train” (shown as 230 in Figure 2) is “a buck converter topology” and includes switches Q_{mn} and Q_{aux} “to regulate an output characteristic (e.g., an output voltage V_{out}) thereof.” *Id.* at 8:24-38; *see also id.* at 6:9-14. The “power train 230,” therefore, stabilizes V_{in} , which is the “input voltage,” to provide a regulated output voltage. In fact, Lotfi recognizes “a switching operation of the power converter can regulate the output voltage V_{out} .” *Id.* at 6:19-23.



(iii) 1[B] “a reference voltage source which generates a predetermined reference voltage;”

44. In my opinion, Lotfi discloses and renders obvious “a reference voltage source which generates a predetermined reference voltage.”

45. Lotfi teaches a “bandgap reference circuit 260,” which is a “reference voltage source,” in blue. Ex. 1004 at 10:33-35. Lotfi calls the output of the “bandgap reference circuit 260” a “reference voltage.” *Id.* at 11:45-51 (“...a reference voltage such as provided by the bandgap reference circuit 260...”). The “reference voltage” is “predetermined” as it provides “negative feedback to a control terminal of the series-pass, regulating switch, thereby providing voltage regulation for the bias voltage V_{bias} .” *Id.* at 11:45-51.



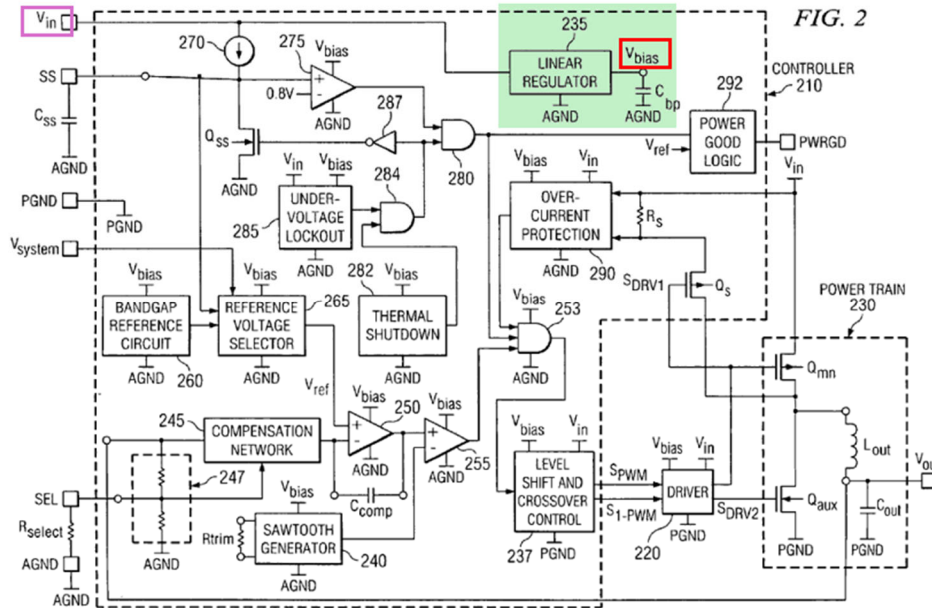
(iv) 1[C] “a linear regulator which stabilizes the input voltage, based on the reference voltage generated by the reference voltage source;”

46. In my opinion, Lotfi discloses and renders obvious “a linear regulator which stabilizes the input voltage, based on the reference voltage generated by the reference voltage source.”

47. Lotfi discloses a “linear regulator 235” (the claimed “linear regulator,” in green) that “is powered from the input voltage V_{in} ” (the claimed “input voltage,” in purple). Ex. 1004 at 11:36-37. Lotfi’s linear regulator 235 “provides a well regulated, low voltage bias voltage V_{bias} ” (a stabilized voltage, in red). *Id.* at 11:32-37. Lotfi further states that “linear regulator 235” provides “voltage regulation for the bias voltage V_{bias} ” based on “sens[ing]” a “reference voltage such as provided by the bandgap reference circuit 260 ... thereby providing voltage regulation for the

bias voltage V_{bias} .” *Id.* at 11:45-51. In other words, linear regulator 235 stabilizes V_{in} based on the reference voltage generated by the bandgap reference circuit 260.

Id.

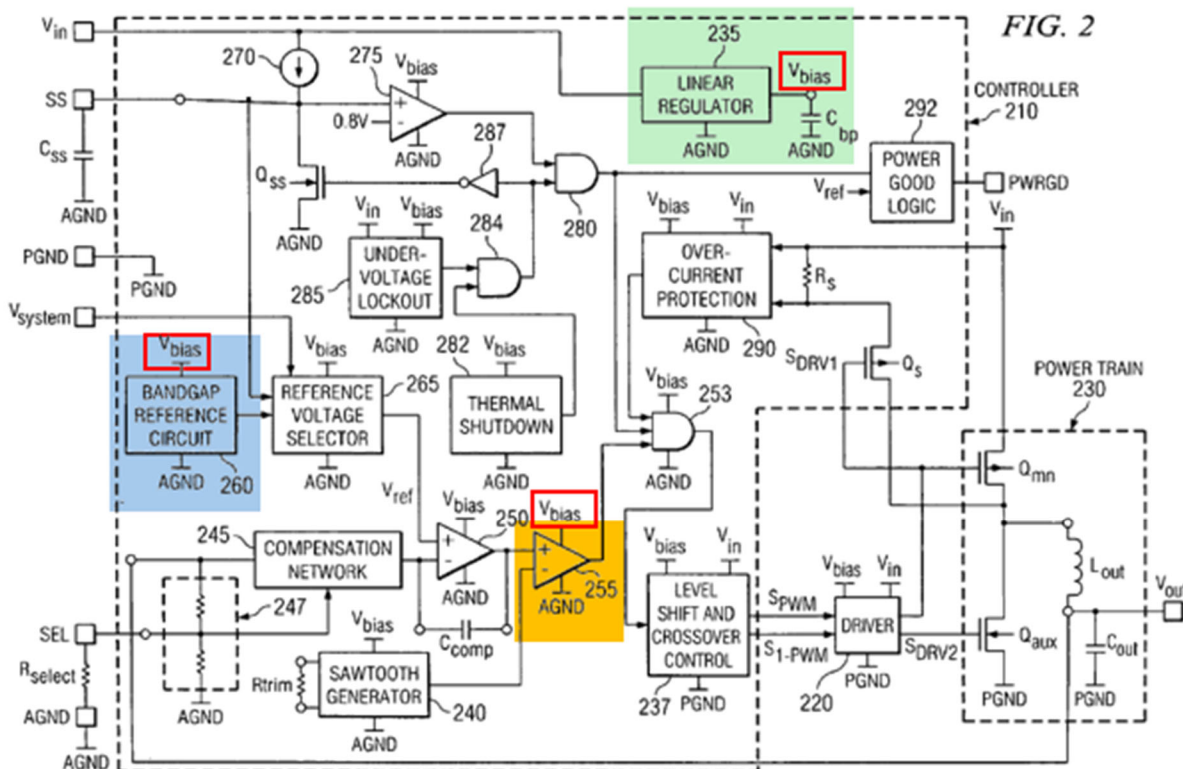


(v) 1[D1] “wherein an output voltage of the linear regulator is supplied as a power supply voltage of a controller of the switching power supply and the reference voltage source,”

48. In my opinion, Lotfi discloses and renders obvious “an output voltage of the linear regulator is supplied as a power supply voltage of a controller of the switching power supply and the reference voltage source.”

49. The output voltage of linear regulator 235 (green) is V_{bias} (red). As one can see in the schematic of Figure 2, V_{bias} is supplied as a power supply voltage to a “PWM comparator 255,” the claimed “controller of the switching power supply”

255 in orange, and “bandgap reference circuit 260,” the claimed “reference voltage source,” in blue, as shown below. Ex. 1004 at Fig. 2.



50. As I opined earlier, the “bandgap reference voltage circuit 260” is the “reference voltage source 260” and, therefore, the output of the linear regulator is supplied as a power supply voltage of “the reference voltage source,” as shown by V_{bias} .

51. The output of the linear regulator is also supplied as a power supply voltage of “a controller of the switching power supply,” which is the “PWM comparator 255.” As I opined earlier, “power train 230” is the claimed “switching power supply,” and it includes “main and auxiliary switches Q_{mn} , Q_{aux} .” Ex. 1004 at

8:37-44. According to Lotfi, “[a]n output of the PWM comparator 255 is high during a primary interval when the main switch Q_{mn} of the power train is configured to conduct” and “[t]he output of the PWM comparator 255 is low during a complementary interval when the main switch Q_{mn} of the power train is transitioned to a non-conducting state and the auxiliary switch Q_{aux} is configured to conduct.” *Id.* at 10:19-25. The PWM comparator 255 is, therefore, a controller of the switching power supply, power train 230. I note that this disclosure is consistent with the ’955 Patent’s disclosure that “switching controller 40 controls the base voltage of the switching transistor Tr1, and controls ON and OFF states thereof.” Ex. 1001 at 5:1-3.

52. If the Patent Owner contends that the claimed “controller of the switching power supply” must also include additional components such as “error amplifier 250” and/or “sawtooth generator 240,” each of those components are also powered by V_{bias} as shown in Figure 2. Ex. 1004 at Fig. 2.

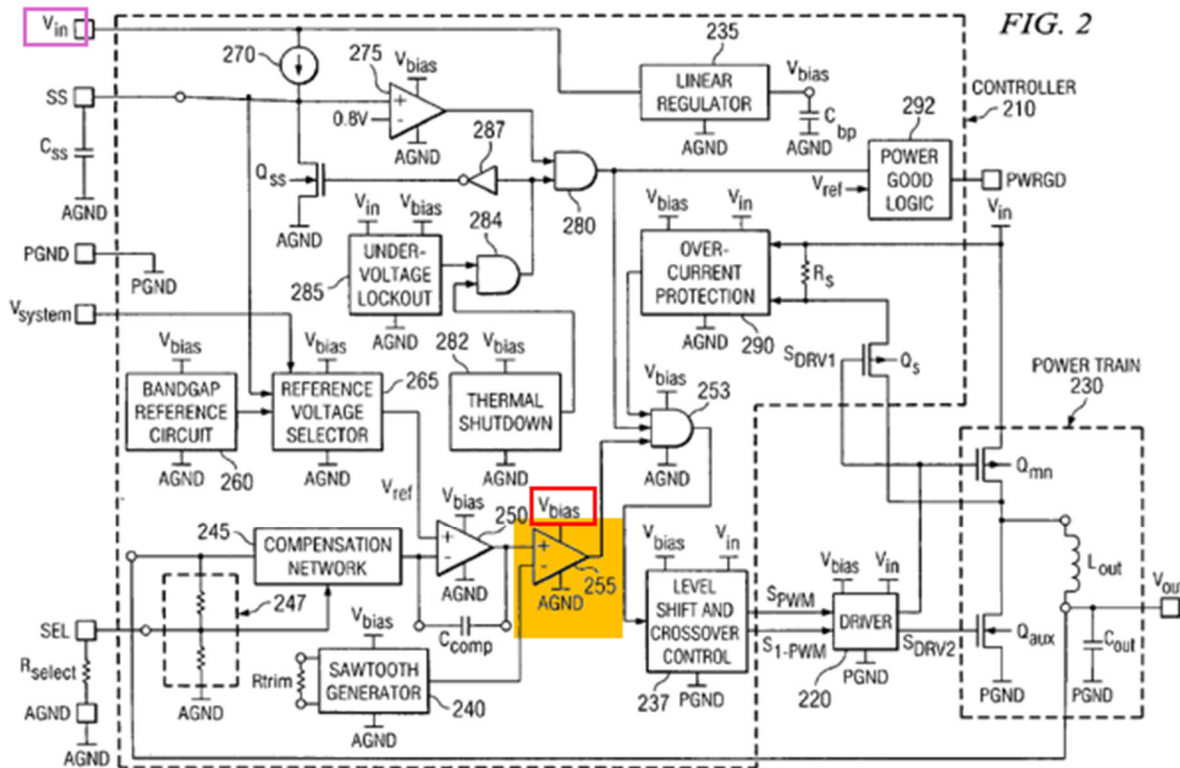
53. If the Patent Owner contends that the claimed “a controller of the switching power supply” encompasses the entirety of Lotfi’s “controller 210,” I disagree. For example, the ’955 Patent recognizes that the “switching controller 40” is just one part of an overall “control circuit 110.” Ex. 1001 at Fig. 1. That control circuit also “includes a reference voltage source 20 and a linear regulator 30,” in addition to “the switching controller 40.” Ex. 1001, 4:57-62, Fig. 1. Lotfi’s

“controller 210” is akin to the broader “control circuit 110” of the ’955 Patent, which includes “switching controller 40.” Controller 210 includes “a controller of the switching power supply,” and other components too. Ex. 1004 at Fig. 2. For example, like the “control circuit 110” of the ’955 Patent, Lotfi’s “controller 210” includes the “linear regulator 235” and “bandgap reference circuit 260,” in addition to the PWM comparator 255 that, as I discussed earlier, controls the transistors of “power train 230.” *Id.*

(vi) 1[D2] “wherein ... and the input voltage is not directly supplied to the controller as a power supply voltage.”

54. In my opinion, Lotfi discloses and renders obvious “wherein ... and the input voltage is not directly supplied to the controller as a power supply voltage.”

55. The input voltage V_{in} (purple) is not directly supplied to the “PWM comparator 255”—which I previously opined is “a controller of the switching power supply”—as a “power supply voltage” as shown in Figure 2. Ex. 1004 at Fig. 2. As I previously opined, the PWM comparator 255 is powered by V_{bias} , which is an output voltage of the linear regulator 235. V_{in} also is not directly supplied to the “error amplifier 250” and “sawtooth generator 240” as a “power supply voltage” as shown in Fig. 2 either, should the Patent Owner argue that those components also comprise the “controller.”



56. If the Patent Owner identifies components of Lotfi that are coupled to V_{in} to argue that Lotfi does not disclose or render obvious this limitation, I would disagree. That is because Lotfi states “[l]ower voltages (e.g., 2.5 volts) are employed with the *control* and signal processing devices” of its circuit 210 (shown as 120 in figure 1). Ex. 1004 at 7:35-49; *see also id.* at 1:34-37 (“More specifically, lower voltages (e.g., 2.5 volts) are employed with the control and signal processing devices”). Lotfi describes “*control* and signal processing devices” as “low voltage devices” (*id.* at 7:46-49) and explains that “the low voltage devices operate from a low voltage source which is usually well regulated such as the bias voltages V_{bias} ,” in contrast to higher voltage devices that are supplied by V_{in} (*id.* at 9:40-44). *See*

also id. at 14:37-41 (referring to V_{in} as “an unregulated input voltage at a nominal five volts”). In other words, according to Lotfi, V_{bias} —the output of the linear regulator—is the “power supply voltage” for control devices of Lotfi’s 210. Any components that Patent Owner may identify where the power supply voltage is V_{in} would, therefore, not be the claimed “a controller” based on Lotfi’s disclosures. *Id.* at 9:37-48.

57. In addition, “the controller” of this limitation refers to “a controller of the switching power supply.” Ex. 1001 at cl. 1. As discussed, it is my opinion that the “PWM comparator 255” is “a controller of the switching power supply” because Lotfi describes it as governing the ON (high) and OFF (low) states of Q_{mn} and Q_{aux} , the switches of “power train 230” (the claimed “switching power supply”). Ex. 1004 at 10:19-25 (“An output of the PWM comparator 255 is high during a primary interval when the main switch Q_{mn} , of the power train is configured to conduct. The output of the PWM comparator 255 is low during a complementary interval when the main switch Q_{mn} of the power train is transitioned to a non-conducting State and the auxiliary switch Q_{aux} is configured to conduct.”). Therefore, because the input voltage V_{in} is not directly supplied to PWM comparator 255 as a power supply voltage, Lotfi discloses this limitation, regardless of whether Patent Owner attempts to argue that *other*, additional components of 210 are coupled to V_{in} used for “higher voltage devices within the power converter” (*id.* at 9:40-42).

58. For example, should Patent Owner argue that this limitation is not met because Lotfi includes a “level shift and crossover control circuit 237,” I would disagree. In addition to the reasons I discussed above, Lotfi states that 237 “may” provide a signal to “prevent a cross conduction and enhance the switching transitions therebetween.” Ex. 1004 at 8:29-36. Thus, in my opinion, a POSITA would understand that 237 is an optional component that “may” be used to improve or enhance the “switching transitions.” It also does not change the fact that the PWM comparator 255 is “a controller of the switching power supply” to which the input voltage is not directly supplied.

3. Dependent Claim 7

- (i) “A power supply apparatus according to claim 1, wherein the reference voltage source, the linear regulator, and the controller of the switching power supply are integrated on one semiconductor substrate.”**

59. As I opined above, Lotfi discloses and renders obvious a power supply apparatus that meets the elements of claim 1. In my opinion, Lotfi further discloses and renders obvious the additional limitation of claim 7.

60. As Lotfi recognizes, a key aspect of the design of “integrated circuits” is integrating semiconductor devices “on a semiconductor substrate.” Ex. 1004 at 1:13-20, 1:22-30, 2:20-37. Lotfi teaches that “the integrated circuits as described herein should include control and signal processing devices ... on a semiconductor

substrate.” *Id.* at 2:59-64. Moreover, Lotfi contemplates that the “integrated circuit may incorporate higher voltage devices,” and a “benefit of incorporating the low voltage devices and the higher voltage devices on the semiconductor substrate” is that it is possible to “accommodate higher switching frequencies in the design of power processing circuit due to a reduction of parasitic capacitances and inductances in the integrated circuit.” *Id.* at 2:59-3:5. In other words, one aim of Lotfi is to incorporate the components of its power converter, which includes the “reference voltage source, the linear regulator, and the controller of the switching power supply (all of which I opined about above), together on one semiconductor substrate.

61. For example, Figure 2—which includes the claimed “reference voltage source,” “linear regulator,” and “controller of the switching power supply” as discussed with claim 1—is a “schematic diagram of an embodiment of a controller in an environment of a power converter embodied in, or portions thereof, an integrated circuit constructed according to the principles of the present invention.” *Id.* at 8:19-23, 13:29-39. Because Lotfi is directed to an “integrated circuit” that “incorporates higher voltage devices and low voltage devices on a semiconductor substrate,” Lotfi teaches—and a POSITA would understand—that the reference voltage source, the linear regulator, and controller of the Lotfi switching power supply are all integrated on one semiconductor substrate, such as a silicon wafer. *Id.* at 4:1-10. By the time of invention date for the ’955 Patent, forming electronic

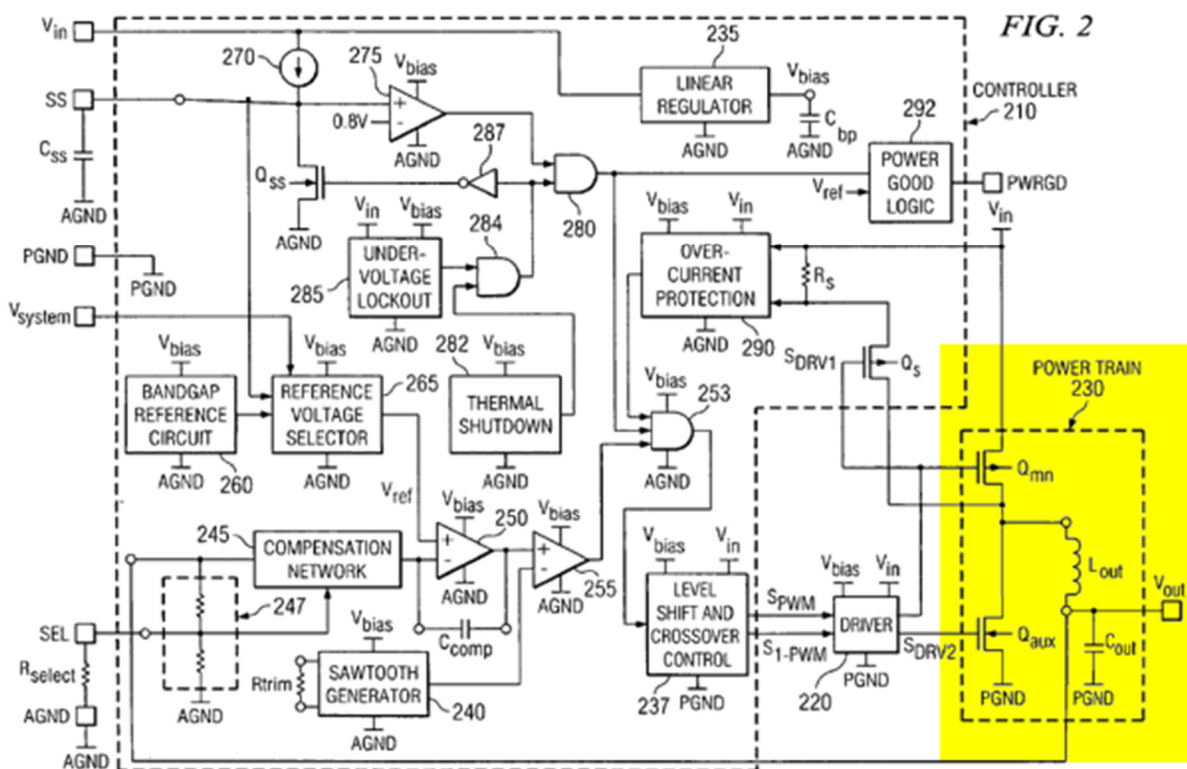
devices on a single substrate (typically, a silicon wafer) was extremely well-known in the art, as Lotfi itself recognizes. *Id.* at 1:13-20, 1:22-30, 2:20-37.

B. Ground 1B: Claims 8 and 9 Are Obvious Over Lotfi In View Of Kha

1. Dependent Claim 8

- a. “A power supply apparatus according to claim 1, wherein the switching power supply is a step-up switching regulator which steps up the input voltage.”

62. In my opinion, Lotfi alone and Lotfi in view of Kha discloses and renders obvious claim 8. Lotfi depicts a “buck converter topology” as the “power train 230” (yellow). Ex. 1004 at 8:37-38.



63. Lotfi states that “those skilled in the art should understand that other converter topologies such as a forward converter topology are well within the broad scope of the present invention.” *Id.* at 6:9-14. It was well known by 2005 to a POSITA that a “forward converter topology” could be configured as a step-up switching regulator that uses a transformer that steps up (or increases) the input voltage. For example, a patent from 1985—twenty years before the alleged invention of the ’955 Patent—discloses that a “forward converter” is capable of “voltage step-up or step-down, and voltage regulation”—a fact that was well-known to POSITAs by 2005. Ex. 1008 at 1:30-2:28.

64. In fact, by 2005, basic switching converter topologies—including buck, boost, buck-boost, and related variants—were “very well known” to POSITAs, considered “basic topologies,” and taught in introductory electrical engineering courses. Ex. 1007 at 1:12-19. It would have been routine for a POSITA to select amongst these well-known topologies in designing a device for a particular application. The choice of topology would be driven by what the intended application requires with respect to input/output voltage—e.g., whether the input voltage needs to be increased or decreased at the output. A POSITA reading Lotfi would have been motivated to consider alternative topologies for use in Lotfi rather than limiting the design to the particular buck converter topology (which steps-down, or reduces, the input voltage at the output) illustrated in Lotfi—for example,

if the output voltage were required to be larger than the input voltage. In fact, Lotfi itself motivates this, in stating that “other converter topologies” can be used. Ex. 1004 at 6:9-14.

65. In addition to the “buck” topology of Lotfi, the boost topology was a common topology that was well known before 2005. As explained in the Kha patent, filed in 1994, the “boost convertor” was already then a “very well known” and “basic topolog[y].” Ex. 1007 at 1:16-19. A POSITA would have recognized that, for applications in which the required output voltage exceeds the available input voltage, substituting a boost converter for the buck converter in the Lotfi “power train 230” would be an obvious solution.

66. Kha further confirms that using a boost converter in place of a buck converter involves only a straightforward and well-understood modification. For example, Kha recognizes that buck and boost converters both include the same basic components, namely, “an inductance L through which current is switched by means of a switch S and a diode D rectifies the output.” Ex. 1007 at 3:20-22. For a “buck convertor topology,” the “positioning of the switch S, the diode D and the inductor L differs from the arrangement in the boost convertor,” as shown in Figures 1B (buck) and 1A (boost) of Kha. *Id.* at 3:39-48. Because each topology’s behavior was predictable and extensively documented, a POSITA would have expected that replacing Lotifi’s buck converter with a boost converter, such as shown in Figure 1

of Kha, would result, predictably, in having an output voltage higher than the input voltage. Such a modification would have been well within the knowledge and ability of a POSITA by 2005.

67. A POSITA would further have understood that such a substitution would not alter the operation or configuration of the other components of Lotfi I discussed above, such as the linear regulator, the bandgap reference, and the PWM comparator circuitry. The combination of those components operate independently of whether the downstream switching power supply (or power train) employs a buck or boost topology, and their functions would continue to be performed in the same manner. Thus, selecting a boost converter in place of a buck converter represents nothing more than a routine design choice for a POSITA that would yield predictable results well understood in the art.

2. Dependent Claim 9

- a. “An electronic device comprising: a battery; a load circuit; and the power supply apparatus according to claim 8, which has voltage of the battery as an input voltage, and steps up the voltage to supply the load circuit.”**

68. It is my opinion that Lotfi alone and in view of Kha discloses and renders obvious claim 9. As discussed, Lotfi alone and in view of Kha discloses and renders obvious the apparatus of claim 8.

69. Lotfi further teaches that the input voltage V_{in} may be received from a source of electrical power “represented by a battery.” Ex. 1004 at 6:15-19. When the “power train” is a boost converter as taught by Kha, this input voltage from “a battery” is, therefore, stepped up. When that occurs, the apparatus of claim 8 provides, as Lotfi teaches, a “regulated output voltage V_{out} to power, for instance, a microprocessor at an output of the power converter.” *Id.* at 6:15-19. A POSITA would understand that a microprocessor is a “load circuit” and that this configuration would be used with the microprocessor (or other load circuit) requires a higher operating voltage than input voltage V_{in} .

C. Ground 2: Claims 1 And 7 Are Obvious Over Doluca In View of Burstein

1. Overview Of Doluca

70. Doluca discloses a DC-DC converter. Ex. 1005 at 1:31-32. As shown in Figure 1, the converter converts a “high input voltage V_{IN} ” to a “low input voltage V_{OUT} ” and includes a “linear regulator” (green), where the “linear regulator output voltage V_R ” (red) is “derived from the input power source voltage” (purple). *Id.* at 1:32-35, Fig. 1. The “linear regulator output voltage V_R ” powers a “controller” (orange) for switch S1 of a switching converter (yellow). *Id.* The “controller runs at a substantially lower voltage than the input” and V_{IN} is not directly supplied to the controller as a power supply voltage. *Id.* at 2:26-28.

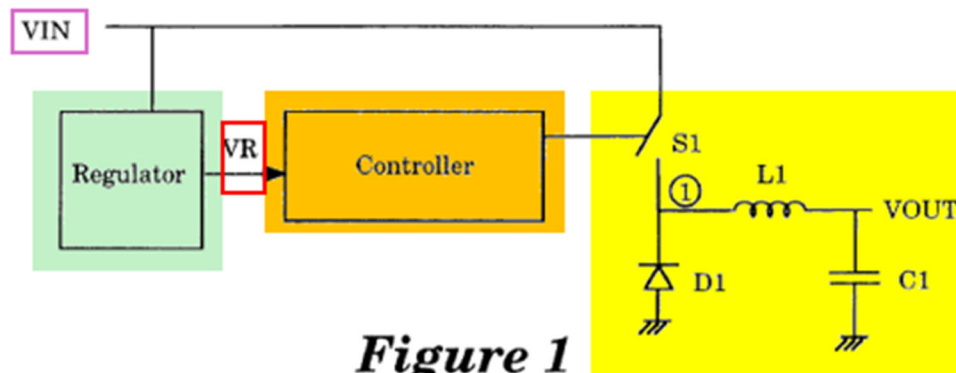


Figure 1
prior art

71. Doluca discloses all elements of claim 1 of the '955 Patent except for the linear regulator's reference voltage being from a reference voltage source. As a POSITA would recognize, however, the "regulator" of Doluca is a black-box, without any details about its implementation. Thus, a POSITA would have turned to other references for those details, such as Burstein.

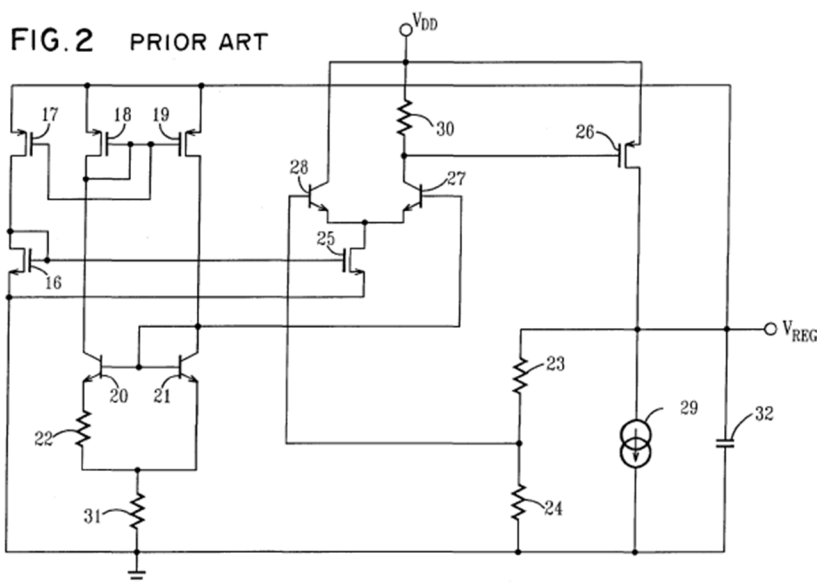
2. Overview of Burstein

72. Burstein teaches "[a] direct current (DC), voltage regulator" that "regulates the supply voltage to a preferred, accurate, and stable amplitude." Ex. 1006 at 1:12-15. Figure 1 of Burstein shows a "prior art design for a voltage regulator" that was well-known to POSITAs by Burstein's 2000 filing date. As shown in Figure 1, Burstein's "prior art" "voltage regulator" (green) converts an input V_{DD} (purple) into a regulated output voltage V_R (red). *Id.* at 1:45-47. The "voltage regulator" includes a "bandgap reference circuit 11" (blue). *Id.* at 1:45-48.

73. According to Burstein, “[t]he regulated voltage provided by this design is given by the equation: $V_R = (V_{BG} * (R1 + R2)) / R1$, where V_{BG} is the bandgap voltage.” *Id.* at 1:51-55. Thus, it would be readily apparent to a POSITA that the output of the Burstein regulator is based on the “bandgap voltage” (aqua), which POSITAs would understand to be a reference voltage generated by the bandgap reference circuit (*id.* at Fig. 1). *See also id.* at 1:36-39 (“A bandgap reference is useful in many applications because it provides a substantially invariant voltage when subjected to variations of temperatures and power supply voltage.”). The “regulated voltage” (red) is also “used as a power source for the bandgap reference circuitry” (blue). *Id.* at 1:61-64. I note that Figure 1 of Burstein may contain a minor (and common) typographical error where the inputs to the differential inputs are reversed, since a POSITA would know that the reference voltage should be applied to the non-inverting input when used with a PMOS transistor. Figure 2, the “circuit configuration for implementing the voltage regulator represented in FIG. 1” (*id.* at 1:56-57) confirms this is, at most, a typographical error.

at 3:1-4. Burstein's disclosures about the general operation of Figure 3 to convert V_{DD} to V_{reg} , therefore, are equally applicable to Figure 2.

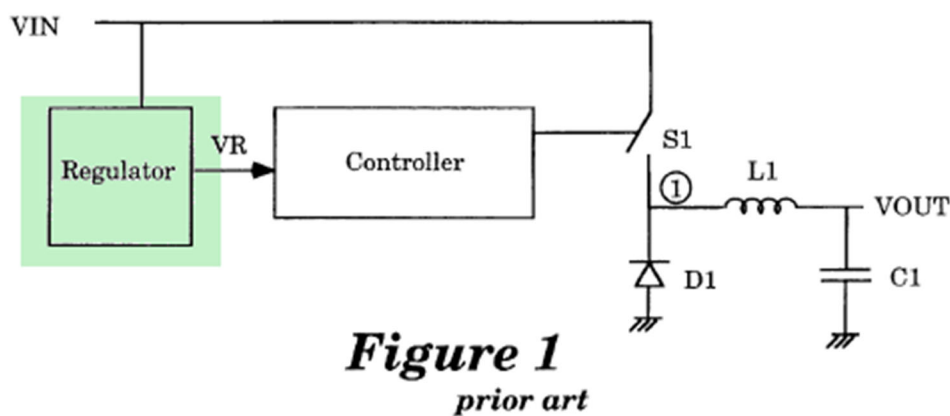
76. Burstein also explains (in connection with Figure 2, the "circuit configuration" for implementing Figure 1 (Ex. 1006 at 1:56-57)) that "[t]he regulated voltage is generated by the resistive chain of resistors 23 and 24 in conjunction with P-MOS transistor 26" (*id.* at 1:61-64) where "transistor 26" operates in "an active mode of linear operation" (*id.* at 4:19-21). A POSITA would understand that is how linear regulators operate to regulate an input voltage, further confirming that Burstein's regulator is a linear regulator.



3. Motivation to Combine Doluca With Burstein

77. In my opinion, a POSITA would have been motivated to combine Doluca and Burstein. A POSITA would have been motivated to implement

Burstein’s “prior art” linear regulator of Figure 1 with Doluca’s “very common DC-DC converter topology,” which uses such a linear regulator (green) to power a “controller” (Ex. 1005 at 1:33-36; Fig. 1).



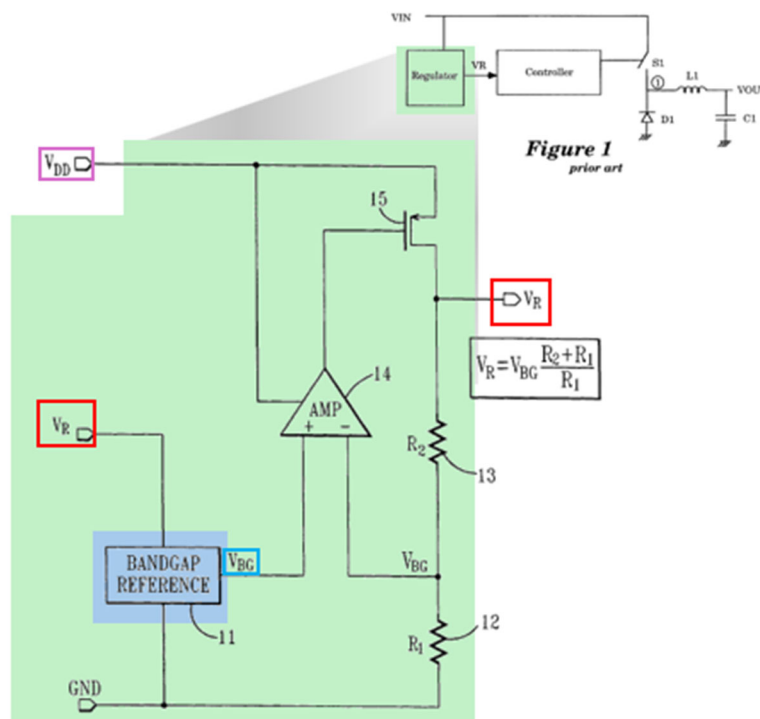
78. Doluca provides no implementation details for the regulator it identifies as powering the “controller.” The “Regulator” shown in Figure 1 is a black-box and, therefore, a POSITA would have been motivated to look to other references like Burstein for implementation details of the regulator. Burstein provides those details—i.e., a “voltage regulator” that “regulates the supply voltage to a preferred, accurate, and stable amplitude” (Ex. 1006 at 1:12-15). That is what Doluca’s black-box regulator needs to do in converting V_{IN} to V_R (Ex. 1005 at 1:32-34). Using Burstein’s regulator with Doluca’s DC-DC converter to supply power to the controller is, therefore, the very use Burstein describes for voltage regulators, that is, to provide a “highly stable and accurate” voltage “essential in many applications.” Ex. 1006 at 1:15-18.

79. Doluca and Burstein are also both used with systems where the input is supplied by a battery. Doluca discloses that its disclosed power converters are used “in battery operated systems” (Ex. 1005 at 1:15-18) and Burstein similarly recognizes that its “voltage regulator” is “essential in many applications,” in particular, systems where a “battery supplies power” (Ex. 1006 at 1:18-22). Burstein further teaches by selecting the appropriate bandgap voltage and/or resistor values for R1 and R2, a “preferred, accurate, and stable” output voltage VR can be generated from the input voltage VDD. Ex. 1006 at 1:12-15.

80. Burstein teaches that “[t]he regulated voltage provided by this design is given by the equation: $V_R = (V_{BG} * (R1 + R2)) / R1$, where V_{BG} is the bandgap voltage.” *Id.* at 1:51-55. A POSITA would understand that the Burstein regulator can be used with the Doluca converter to convert an input voltage to an appropriate voltage, using the disclosed equation, to power the controller, consistent with Doluca’s teaching that “the controller is powered from a linear regulator output voltage VR that is derived from the input voltage power source.” Ex. 1005 at 1:32-35.

81. Based on the above, in my opinion, the use of the Burstein “regulator” with the Doluca converter is a straight-forward application of a known technique (a linear regulator) to improve known devices (the “very common” power converter described by Doluca). The result is entirely predictable to a POSITA as well. The Burstein regulator will perform its known function of “regulat[ing] the supply

voltage to a preferred, accurate, and stable amplitude” (Ex. 1006 at 1:12-15) to power the controller in Doluca’s converter (Ex. 1005 at 1:12-18, 31-35). The combination I described of Doluca and Burstein is annotated below, showing how a POSITA would implement the Burstein regulator with the Doluca power converter device.



4. Independent Claim 1

- (i) 1[PRE] “A power supply apparatus for use with an input voltage provided from outside, the power supply apparatus comprising:”

82. In my opinion, Doluca in view of Burstein discloses and renders obvious “[a] power supply apparatus for use with an input voltage provided from outside, the power supply apparatus.”

83. Doluca discloses a “high frequency switching DC-DC converter.” Ex. 1005 at 1:9-11. Doluca teaches a “very common DC-DC converter topology known as the step-down, or buck, topology” (the claimed “power supply apparatus”) used with VIN, which is an “input voltage provided from outside,” in purple. *Id.* at 1:31-37.

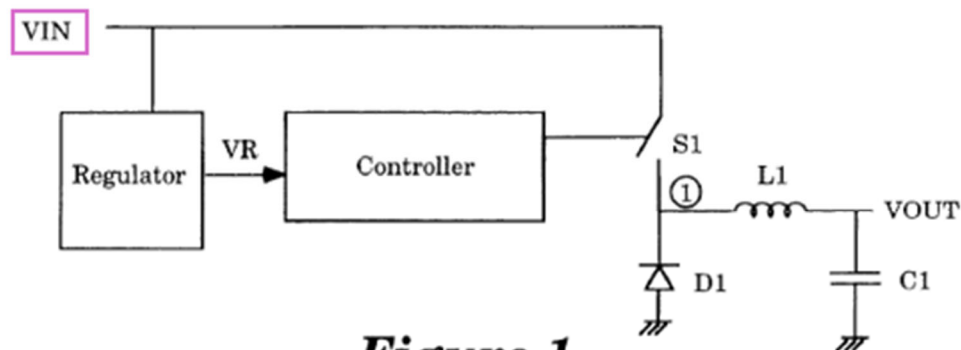


Figure 1
prior art

(ii) 1[A] “a switching power supply which stabilizes the input voltage;”

84. In my opinion, Doluca in view of Burstein discloses and renders obvious “a switching power supply which stabilizes the input voltage.”

85. Doluca teaches a “high frequency switching DC-DC converter,” which is a “switching power supply.” Ex. 1005 at 1:9-11. Figure 1 of Doluca shows “a high input voltage V_{IN} , say 20V” (purple) that “is converted to a low input voltage V_{OUT} , say 5V” by using switch S1 (yellow). *Id.* at 1:31-37.

86. A POSITA would understand that such a conversion by a switching converter as shown in Figure 1 of Doluca “stabilizes the input voltage,” as the output is a stable, regulated voltage.

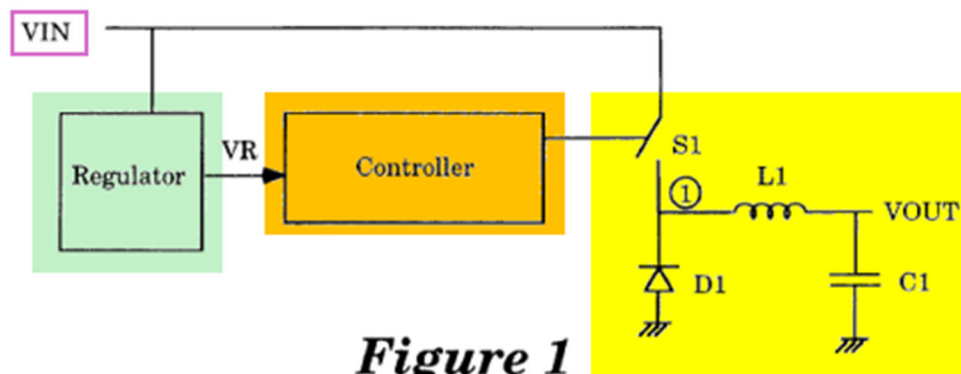


Figure 1
prior art

(iii) 1[B] “a reference voltage source which generates a predetermined reference voltage;”

87. In my opinion, Doluca in view of Burstein discloses and renders obvious “a reference voltage source which generates a predetermined reference voltage.”

88. Doluca alone does not teach 1[B] because it does not provide detail regarding the linear regulator and its reference voltage source. Burstein, however, teaches a “bandgap reference circuit 11” that generates “ V_{BG} ,” a “bandgap voltage.” Ex. 1006 at 1:46-55, Fig. 1. The “bandgap voltage” is a predetermined reference voltage because, according to Burstein, it “provides a substantially invariant voltage” and “[v]oltage regulation is typically achieved by generating a bandgap voltage and applying this voltage to a resistive chain.” *Id.* at 1:36-40; *see also id.* at 1:51-55, Fig. 1.

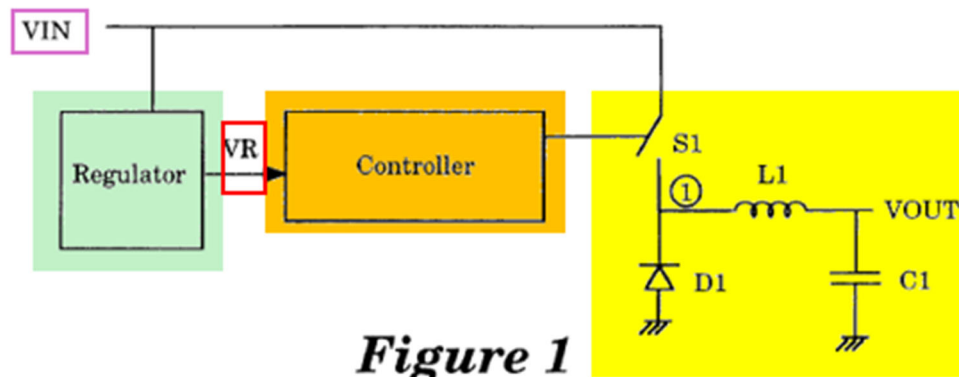
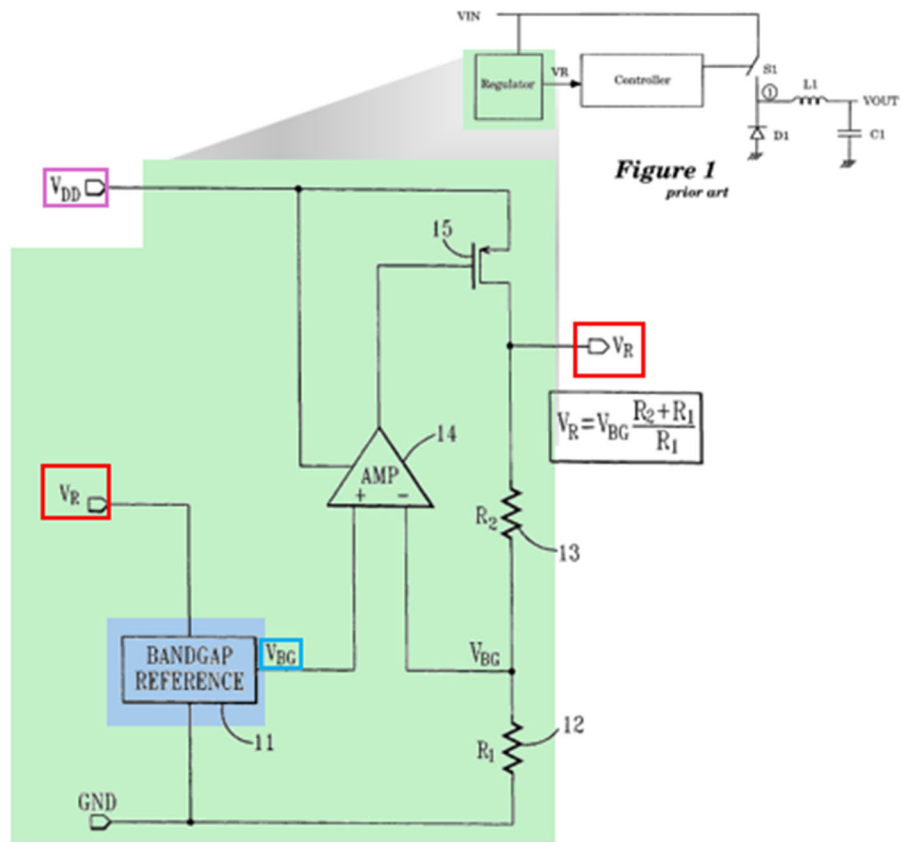
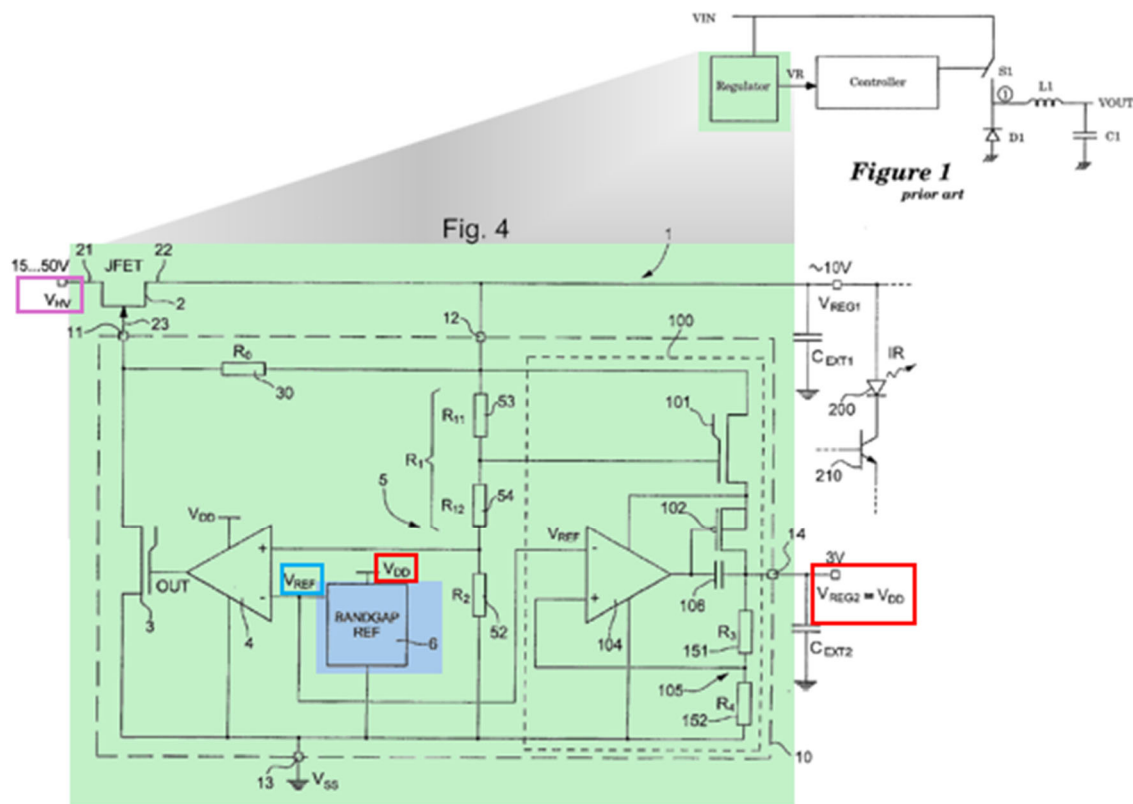


Figure 1
prior art

91. As I previously explained Doluca does not provide detail of the internal circuitry of its linear regulator. Burstein, however, teaches a “voltage regulator” (green) that “regulates the supply voltage” V_{DD} (purple) to generate a “preferred, accurate, and stable” voltage, V_R (red). Ex. 1006 at 1:12-15. A POSITA would understand that Burstein’s V_R is “based on” V_{BG} (aqua), the claimed “reference voltage generated by the reference voltage source,” bandgap reference circuit 11 (blue). *Id.* at Fig. 1, 1:51-55 (“ $V_R = (V_{BG} * (R1 + R2)) / R1$, where V_{BG} is the bandgap voltage”). Burstein recognizes this, stating that “[v]oltage regulation is typically achieved by generating a bandgap voltage and applying this voltage to a resistive chain,” further confirming that the regulated (or stabilized) input voltage is “based on” the reference voltage of the reference voltage source. *Id.* at 1:38-40.



92. Thus, in my opinion, when the Burstein linear regulator is combined with Doluca's converter, the Doluca-Burstein combination includes a linear regulator (the linear regulator of Burstein) that stabilizes the input voltage, based on the reference voltage generated by the reference voltage source, that is, V_{BG} .



- (v) 1[D1] “wherein an output voltage of the linear regulator is supplied as a power supply voltage of a controller of the switching power supply and the reference voltage source”

93. In my opinion, Doluca in view of Burstein discloses and renders obvious “an output voltage of the linear regulator is supplied as a power supply voltage of a controller of the switching power supply and the reference voltage source.”

94. Doluca teaches that “the controller is powered from a linear regulator output voltage VR” (red), as shown in Figure 1 of Doluca below. Ex. 1005 at 1:34-36.

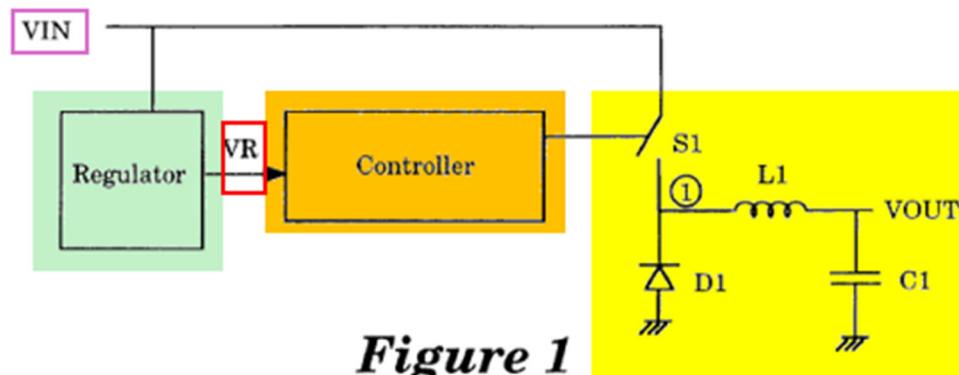
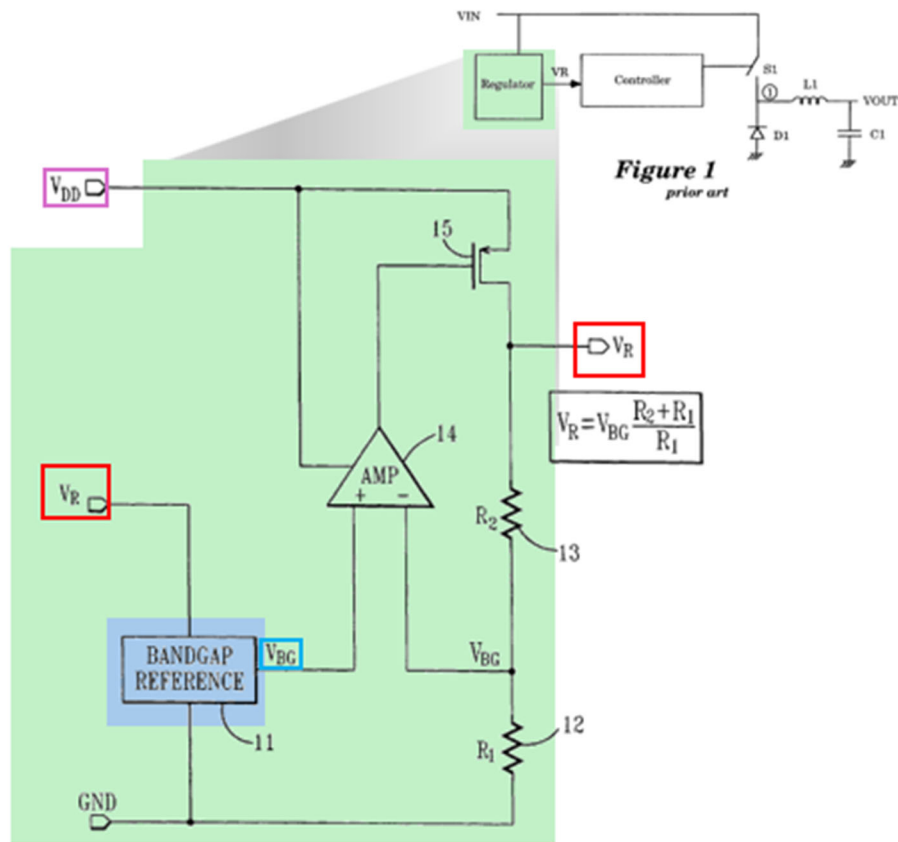


Figure 1
prior art

95. Although Doluca does not teach “wherein an output voltage of the linear regulator is supplied as a power supply voltage of ... the reference voltage source,” Burstein teaches that the “regulated voltage” or “ V_R ” (red) is “used as a power source for the bandgap reference circuitry” (blue) “as well as an external load,” which a POSITA would understand would be the “Controller” of Doluca in the Doluca-Burstein combination. Ex. 1006 at 1:61-64, Fig. 1.



96. The Doluca “controller is powered from a linear regulator output voltage VR that is derived from the input power voltage source” and “substantially lower voltage than the input.” Ex. 1005 at 1:33-35, 2:26-30. A POSITA would understand that the output of Burstein’s linear regulator VR is, therefore, appropriate for use as the VR of Doluca for powering the controller because Burstein’s VR is a voltage derived from and substantially lower than the input power voltage source.

(vi) 1[D2] “wherein ... and the input voltage is not directly supplied to the controller as a power supply voltage.”

97. In my opinion, Doluca in view of Burstein discloses and renders obvious “wherein ... and the input voltage is not directly supplied to the controller as a power supply voltage.”

98. The linear regulator of Doluca (green) has an output voltage VR (red) that is supplied to the controller (orange) as a power supply voltage, as shown below. The input voltage VIN (purple) “is not directly supplied to the controller as a power supply voltage.” Ex. 1005 at 1:31-38 and 2:27-30; *see also* Figs. 2-3 (showing that VR provides power supply to the “controller,” and not VIN). In fact, Doluca teaches that “the controller is powered from a linear regulator output voltage VR” (red) and that “the controller runs at a substantially lower voltage than the input.” *Id.* at 1:34-36, 2:26-28.

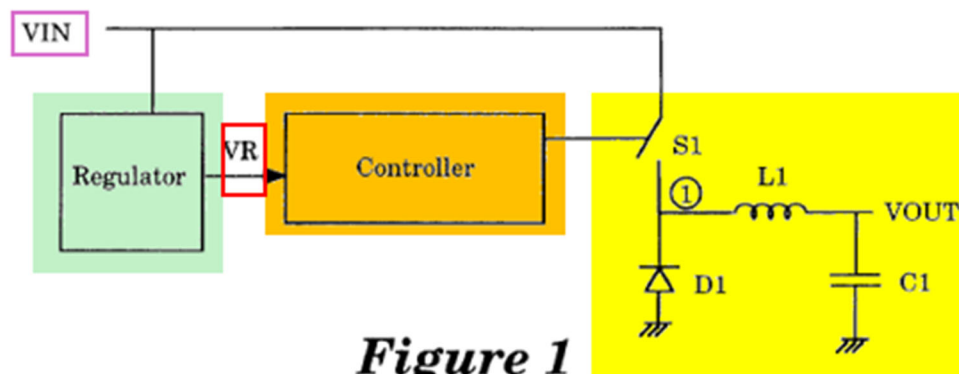


Figure 1
prior art

99. When Doluca is used in combination with Burstein, the output voltage of the Burstein regulator V_R is supplied to the controller as I explained above, rather than the unregulated input voltage V_{IN} .

5. Dependent Claim 7

- (i) “A power supply apparatus according to claim 1, wherein the reference voltage source, the linear regulator, and the controller of the switching power supply are integrated on one semiconductor substrate.”**

100. In my opinion, Doluca-Burstein combination discloses and renders obvious the additional requirements of dependent claim 7.

101. By 2005, “integrated circuits” were chips comprising semiconductor devices fabricated on a single semiconductor substrate. Doluca reinforces this understanding by explaining that power converter topologies may be implemented with “a p-channel MOSFET, though an n-channel instead of p-channel device could be used, or even a bipolar device of either conductivity type could be used.” Ex. 1005 at 3:16-26. All of these are conventional transistor structures that a POSITA in 2005 would have recognized as being formed using standard semiconductor processes on a common substrate such as silicon.

102. Burstein likewise teaches implementing its circuitry using standard and well-known transistor devices, including a “P-MOS transistor” and a “MOSFET.” Ex. 1006 at 1:45–64. The use of these standard transistor elements further confirms

that Burstein's circuitry, like Doluca's, would be implemented on a semiconductor substrate. A POSITA would, therefore, have understood that combining Doluca's and Burstein's teachings yields a system in which the reference voltage source, linear regulator, and controller of the switching power supply are integrated onto a single semiconductor substrate using routine semiconductor fabrication techniques.

D. Ground 2B: Claims 8 and 9 Are Obvious Over Doluca In View of Burstein And Kha

1. Dependent Claim 8

- a. "A power supply apparatus according to claim 1, wherein the switching power supply is a step-up switching regulator which steps up the input voltage."**

103. In my opinion, Doluca in view of Burstein and Kha disclose and renders obvious claim 8.

104. Doluca depicts a "buck" topology switching power supply in Figure 1 (yellow) that is implemented with its regulator and controller configuration. Ex. 1005 at 1:31-32. Doluca, however, recognizes that "one skilled in the art can also implement a similar scheme" of its disclosures "for other topologies, like inverting DC-DC conversion," which would replace the yellow-highlighted portion of Doluca below. Ex. 1005 at 3:16-18. A POSITA would recognize that an "inverting DC-DC conversion scheme" could step-up the input voltage as compared to the output voltage. For example, the Cuk converter, which was a common "inverting DC-DC

conversion scheme” can either increase or decrease the magnitude of the dc voltage, and it inverts the polarity.

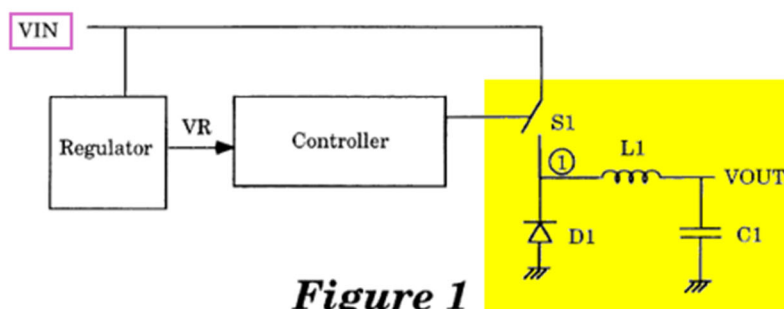


Figure 1
prior art

105. As I discussed earlier, by the 2005 priority date of the '955 Patent, switching converter topologies such as buck, boost, buck-boost, and related variants were “very well known” to POSITAs, considered “basic topologies,” and taught in introductory electrical engineering courses. Ex. 1007 at 1:12-19. It would have been routine for a POSITA to select amongst these well-known topologies in designing a device for a particular application. The choice of topology would be driven by what the intended application requires with respect to input/output voltage—e.g., whether the input voltage needs to be increased (in which case a boost topology would be used) or decreased at the output (in which case the buck topology would be used). A POSITA reading Doluca in combination with Burstein would have been motivated to consider alternative topologies for use in Doluca rather than limiting the design to the particular buck converter topology (which steps-down, or reduces, the input

voltage at the output) illustrated in Doluca, for example, if the load required a higher output voltage than input voltage. Doluca itself motivates this, in stating that “one skilled in the art can also implement a similar scheme” of its disclosures “for other topologies, like inverting DC-DC conversion.” Ex. 1005 at 3:16-18.

106. In addition to the “buck” topology of Doluca, the boost topology was a common topology that was well known before 2005. As explained in the Kha patent, filed in 1994, the “boost convertor” was already then a “very well known” and “basic topolog[y].” Ex. 1007 at 1:16-19. POSITA would have recognized that, for applications in which the required output voltage exceeds the available input voltage, substituting a boost converter for the buck converter in the Doluca-Burnstein combination would be an obvious solution.

107. Kha further recognizes that using a boost converter in place of a buck converter involves only a straightforward and well-understood modification. For example, Kha recognizes that buck and boost converters both include the same basic components, namely, “an inductance L through which current is switched by means of a switch S and a diode D rectifies the output.” Ex. 1007 at 3:20-22. For a “buck convertor topology,” the “positioning of the switch S, the diode D and the inductor L differs from the arrangement in the boost convertor,” as shown in Figures 1B (buck) and 1A (boost) of Kha. *Id.* at 3:39-48. Because each topology’s behavior was predictable and extensively documented, a POSITA would have expected that

replacing Doluca's buck converter with a boost converter, such as shown in Figure 1 of Kha, would result, predictably, in having an output voltage higher than the input voltage. Such a modification would have been well within the knowledge and ability of a POSITA by 2005.

108. A POSITA would further have understood that such a substitution would not alter the operation or configuration of the other components of the Doluca-Burnstein combination I discussed above, such as the linear regulator, the bandgap reference, and the controller. The combination of those components operate independently of whether the downstream switching power supply employs a buck or boost topology, and their functions would continue to be performed in the same manner. Thus, selecting a boost converter in place of a buck converter represents nothing more than a routine design choice for a POSITA that would yield predictable results well understood in the art.

2. Dependent Claim 9

- a. “An electronic device comprising: a battery; a load circuit; and the power supply apparatus according to claim 8, which has voltage of the battery as an input voltage, and steps up the voltage to supply the load circuit.”**

109. It is my opinion that Doluca in view of Burnstein and Kha discloses and renders obvious claim 9. As discussed, Doluca in view of Burnstein and Kha discloses and renders obvious the apparatus of claim 8.

110. Doluca states that its converter may be used “in battery operated systems” that a POSITA would understand would have the voltage of the battery as an input voltage. Ex. 1005 at 1:15-18.

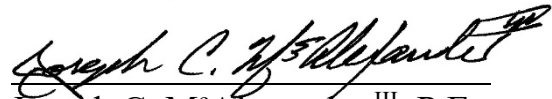
111. Doluca further recognizes that a load circuit is connected at the output of its converter. In fact, the claimed invention of Doluca is to improve “light load efficiency.” *Id.* at Abst., 3:28, 3:50 (referring to “improving the efficiency of the regulator, particularly when subject to light loads.”). That is reflected in the title of Doluca as well, which is “Method and Apparatus for Increasing Switching Regulator Light Load Efficiency.” A POSITA would, therefore, readily understand that a load circuit is to be connected to the output of Doluca.

112. When Doluca uses a boost topology for an application that requires an output voltage that is higher than the input voltage, as I discussed with respect to claim 8, the input voltage is stepped up at the output. The result is that the apparatus of claim 8 provides this increased output voltage V_{OUT} to supply a load circuit.

V. CONCLUSION

113. I hereby declare that all the statements made in this declaration are based on my own true knowledge, that all statements made on information and belief are believed to be true, and that all statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under the penalty of perjury under the laws of the United States that all statements made in this declaration are true and correct.

Dated this 1st day of December, 2025


Joseph C. McAlexander^{III}, P.E.