

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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SMA SOLAR TECHNOLOGY AMERICA LLC,

Petitioner

v.

TIGO ENERGY INC.,

Patent Owner

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Case IPR2023-01184

U.S. Patent No. 8,823,218

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**DECLARATION OF RANDY R. DUNTON IN SUPPORT OF**

**PETITION FOR *INTER PARTES* REVIEW OF**

**U.S. PATENT NO. 8,823,218**

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I, Randy R. Dunton, declare as follows:

## **I. INTRODUCTION**

1. I have been retained by Petitioner SMA Solar Technology America LLC (“SMA”) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office (“PTO”).

2. I am being compensated at a rate of \$350/hour for my services in this proceeding, which is my regular and customary rate.

3. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony or this declaration, or the outcome of this or any other proceeding. I have no other interest in this proceeding.

4. I have been asked to consider whether certain references, disclose suggest, and/or render obvious the features recited in claims 1-19 (the “challenged claims”) of U.S. Patent No. 8,823,218 (“the ’218 patent”) (Ex-1001).<sup>1</sup>

## **II. BACKGROUND AND QUALIFICATIONS**

5. I am an independent consultant. All of my 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 in solar power

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<sup>1</sup> Where appropriate, I refer to exhibits I understand will be attached to the petition for *inter partes* review of the ’218 patent (the “Petition”)

plant design, solar power plant safety system design, as well as, more generally, the field of electronics.

6. 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 details my education and professional and academic experience, is included as Ex-1003 in this proceeding. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

7. In 1980 I received a four-year Electro-Mechanical Technologist degree from Technische Berufsmittelschule in Zurich, Switzerland. As a student in the Electro-Mechanical Technologist program (a 4-year apprenticeship), I took courses in the field of high and low voltage electrical systems such as motors, transformers, electromechanical control systems and learned the skills to operate machine tools for fabrication of electromechanical components.

8. From 1981-1985, I continued my studies taking college courses in electrical engineering and computer science. While I was a student, from 1982 until 1985, I worked part time as a junior engineer designing embedded computers for test and measurement equipment for Dyntatel 3M.

9. Starting in 1985, I began working full-time as an engineer. From 1985 to 1994, I worked in several Silicon Valley companies, designing embedded

computers and semiconductors (ASICs) for personal computers, office equipment, and medical equipment.

10. From 1993 to 2009, I worked at Intel Corporation starting as a Staff Component Design Engineer and being promoted through various roles eventually holding the title of Senior System Architect and Team Leader. During my time at Intel, I worked on a number of different products, including video processors, embedded microcontrollers, digital image processors, broadband networking, and consumer electronics. My experience at Intel allowed me to expand my experience in computer electronic systems, semiconductor design, development of industry standards, system architecture, advanced research, and technical team management. During my tenure, I was also a member of the Intel patent committee which made decisions on whether to pursue patent or trade secret protection on innovations developed at Intel.

11. In 2009, I began working as a freelance solar power plant design engineer through my consulting company Helios Engineering LLC. At this time, I also co-founded another company, Helios Focus LLC, which develops intellectual property relating to safety systems for solar power plants.

12. Since 2009, I have also taught a number of courses in solar power plant design and installation at various Phoenix-based community colleges, an

international online teaching platform (Green Solutions International), and Arizona State University.

13. From 2012 to the present, my role at Hawkins Design Group is as the lead commercial and residential design engineer. My responsibilities include developing projects with customers, designing and modeling grid tied and off grid (storage based) solar PV power plants and also manage a small team of designers.

14. I am listed as a named inventor on at least 31 U.S. utility patents, including four patents in the field of photovoltaics and photovoltaic safety systems (U.S. Pat. Nos. 8,859,884; 9,369,126; 9,941,421; and 10,121,913), and three design patents.

### **III. MATERIALS REVIEWED**

15. The opinions contained in this declaration are based on the documents I reviewed, my professional judgment, as well as my education, experience, and knowledge regarding inventions, electrical engineering, solar PV power plants, computer science, consumer electronic products, and control system design.

16. In forming my opinions expressed in this declaration, I reviewed the following materials:

- U.S. Patent No. 8,823,218 (Ex-1001);
- Prosecution History of U.S. Patent No. 8,823,218 (Ex-1004);
- U.S. Patent No. 8,531,055 to Adest et al. (Ex-1005) (“*Adest*”);

- U.S. Patent No. 5,054,023 to Kronberg (Ex-1006) (“*Kronberg*”);
- U.S. Patent No. 6,650,031 to Goldack (Ex-1007) (“*Goldack*”);
- French Patent Application Publication FR2894401A1 to Moine (Ex-1008) (“*Moine*”);
- Excerpts from IEEE 100 THE AUTHORITATIVE DICTIONARY OF IEEE STANDARDS TERMS (7th Ed. 2000) (Ex-1009);
- The File History of U.S. Patent Application No. 12/254,780 (the “’780 Application);
- The File History of U.S. Patent Application No. 12/411,317 (the “’317 Application);
- The File History of U.S. Patent Application No. 12/628,977 (the “’977 Application);
- The File History of U.S. Provisional Patent Application No. 61/343,155 (the “’155 Provisional);
- The File History of U.S. Provisional Patent Application No. 61/200,601 (the “’601 Provisional);
- The File History of U.S. Provisional Patent Application No. 61/001,587 (the “’587 Provisional);
- The File History of U.S. Provisional Patent Application No. 61/275,977 (the “’977 Provisional); and

- The File History of U.S. Provisional Patent Application No. 61/276,753 (the “’753 Provisional”).

17. In forming my opinions expressed in this declaration, I have also considered the general knowledge I have, based on my experience and education, related to solar power systems, power control systems, and/or power safety systems and their design, maintenance, and development.

#### **IV. PRIORITY**

18. As the ’218 patent is a continuation from previous patents/patent applications (including provisional applications) in the same patent family, I was asked to provide my opinion on the priority date of the ’218 patent.

19. The ’218 patent issued from Application No. 13/092,783 filed April 22, 2011 (“’783 Application”). Ex-1001, Cover. The ’218 claims to be a continuation-in-part (“CIP”) of Application No. 12/254,780 (“’780 Application”), filed Oct. 20, 2008, a CIP of Application No. 12/411,317 (“’317 Application”), filed Mar. 25, 2009, and a CIP of Application No. 12/628,977, filed Dec. 1, 2009. The ’783 Application also claims priority to Provisional Application Nos. 61/343,155 (“’155 Provisional”) filed Apr. 22, 2010; 61/001,587 (“’587 Provisional”) filed Nov. 2, 2007; 61/200,601 (“’601 Provisional”) filed Dec. 2, 2008; 61/275,977 (“’977 Provisional”) filed Sep. 3, 2009, and 61/276,753 (“’753 Provisional”) filed Sep. 16, 2009.

20. I understand that the table below shows the filing date and priority claim of each priority application to the '218 patent, based on information on the cover of the patent:

| <b>Priority Claim</b> | <b>Application</b>              | <b>Date Filed</b> |
|-----------------------|---------------------------------|-------------------|
| CIP                   | 12/254,780 (“’780 Application”) | Oct. 20, 2008     |
| CIP                   | 12/411,317 (“’317 Application”) | Mar. 25, 2009     |
| CIP                   | 12/628,977 (“’977 Application”) | Dec. 1, 2009      |
| Prov.                 | 61/343,155 (“’155 Provisional”) | Apr. 22, 2010     |
| Prov.                 | 61/001,587 (“’587 Provisional”) | Nov. 2, 2007      |
| Prov.                 | 61/200,601 (“’601 Provisional”) | Dec. 2, 2008      |
| Prov.                 | 61/275,977 (“’977 Provisional”) | Sep. 3, 2009      |
| Prov.                 | 61/276,753 (“’753 Provisional”) | Sep. 16, 2009     |

21. I understand that for a claim of the '218 patent to benefit from the priority and earlier filing date of an earlier-filed application, the earlier filed application must fully describe each feature of that claim in such a way as to convey to a person of ordinary skill in the art that the patent owner was in possession of the claimed invention at the time of the earlier-filed application. I also understand that the description of each claim feature must be described in the earlier-filed

application sufficiently to enable a person of ordinary skill to make and use the claimed invention.

22. After review of the priority applications described above, it is my opinion that no claim of the '218 patent is entitled to a priority date that is earlier than the filing date of its application (U.S. Application No. 13/092, 783, or the "'783 Application") on April 22, 2011 because none of the challenged claims is sufficiently described in and supported by any priority application.

23. All challenged claims of the '218 patent depend from independent claims 1, 15, or 18. As shown in the tables below, each "priority" application fails to disclose at least the following elements for each independent claim (claims 1, 15 and 18):

**Claim 1:**

| Unsupported Limitation(s)                                                                   | Application(s)                       |
|---------------------------------------------------------------------------------------------|--------------------------------------|
| • "master management unit"                                                                  | '317 Application                     |
| • "local management unit"                                                                   | '780 Application                     |
| • "controlling one or more solar modules"                                                   | '977 Application                     |
| • "the MMU send[ing] a command to the LMU to alter the state of an associated solar module" | '977 Provisional<br>'753 Provisional |

|                                                                                                                                                                                                                                                                                                        |                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <ul style="list-style-type: none"> <li>• “wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with command”</li> </ul>                                                                                                              |                                          |
| <ul style="list-style-type: none"> <li>• “master management unit”</li> <li>• “sensor”</li> <li>• “anomaly”</li> <li>• “a command to the LMU to alter the state of an associated solar module”</li> <li>• “LMU alters the state of the one or more solar modules in accordance with command”</li> </ul> | ’601 Provisional<br><br>’587 Provisional |
| <ul style="list-style-type: none"> <li>• “anomaly”</li> <li>• “detect an anomaly”</li> </ul>                                                                                                                                                                                                           | ’155 Provisional                         |

**Claim 15:**

| Unsupported Limitation(s)                                                                                                                                         | Application(s)                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <ul style="list-style-type: none"> <li>• “monitoring a sensor for an anomaly by a master control unit (MMU)”</li> </ul>                                           | ’317 Application<br><br>’780 Application |
| <ul style="list-style-type: none"> <li>• “determining by the MMU if the sensor has detected an anomaly and, if the sensor has detected an anomaly, the</li> </ul> | ’977 Application<br><br>’977 Provisional |

|                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <p>MMU determining if the anomaly requires a control change”</p> <ul style="list-style-type: none"> <li>• “issuing a control change command to a local management unit”</li> <li>• “the control change command is selected from the group consisting of: a command to shut down one or more Solar modules; a command to disconnect one or more solar modules;.....”</li> <li>• And the subsequent list</li> </ul> | ’753 Provisional |
| <ul style="list-style-type: none"> <li>• “a command to shut down one or more solar module strings”</li> <li>• “a command to shutdown one or more LMUs; a command to disconnect one or more LMUs[;] [sic] a command to shutdown an inverter; a command to disconnect an inverter”</li> </ul>                                                                                                                       | ’601 Provisional |
| <ul style="list-style-type: none"> <li>• “monitoring a sensor for an anomaly”</li> <li>• “determining by the MMU if the sensor has detected an anomaly”</li> <li>• “determining if the anomaly requires a control change”</li> </ul>                                                                                                                                                                              | ’587 Provisional |

|                                                                                                                                                                                                                                                                                                                         |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <ul style="list-style-type: none"> <li>• “issuing a control change command”</li> <li>• “the control change command is selected from the group consisting of:” and the subsequent list</li> </ul>                                                                                                                        |                  |
| <ul style="list-style-type: none"> <li>• “a command to shut down one or more solar module strings”</li> <li>• “a command to shutdown one or more LMUs”</li> <li>• “a command to disconnect one or more LMUs”</li> <li>• “a command to shutdown an inverter”</li> <li>• “a command to disconnect an inverter”</li> </ul> | ’155 Provisional |

**Claim 18:**

| Unsupported Limitation(s)                                                                                                                                         | Application(s)                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <ul style="list-style-type: none"> <li>• “computer-implemented method”</li> </ul>                                                                                 | ’780 Application                     |
| <ul style="list-style-type: none"> <li>• “monitoring, via a computing device, a signal from a central controller remote from the computing device”</li> </ul>     | ’317 Application<br>’977 Application |
| <ul style="list-style-type: none"> <li>• “polling, via the computing device, the central controller to determine if the loss of signal is transient”</li> </ul>   | ’587 Provisional<br>’601 Provisional |
| <ul style="list-style-type: none"> <li>• “disconnecting, via the computing device, one or more solar modules from a power bus if the loss of signal is</li> </ul> | ’977 Provisional<br>’753 Provisional |

|                                                                                                                                                                                                                                                                                                                                                            |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <p>not transient, the power bus configured to connect a plurality of solar modules to an inverter”</p> <ul style="list-style-type: none"> <li>• “waiting, via the computing device, for a restart signal”</li> <li>• “connecting, via the computing device, the one or more solar modules to the power bus when the restart signal is received”</li> </ul> |                  |
| <ul style="list-style-type: none"> <li>• “polling ... the central controller to determine if the loss of signal is transient”</li> </ul>                                                                                                                                                                                                                   | ’155 Provisional |

## V. LEVEL OF ORDINARY SKILL IN THE ART

24. I have also been asked to provide my opinion concerning the level of skill that a person of ordinary skill in the art (a “POSITA”) would have with respect to the alleged invention of the ’218 patent as of the time of the invention (*i.e.*, early 2011). Based on my review of the types of problems encountered in the art, prior solutions to those problems, the rapidity with which innovations were made, the sophistication of the technology, and the educational level of active workers in the field, it is my opinion that a person of ordinary skill in the art would have had at least a bachelor’s degree or similar degree in in electrical engineering and one year of experience in designing solar power systems, power control systems, and/or power safety systems. More education can supplement practical experience and vice versa.

The POSITA could have also obtained similar knowledge and experience through other means.

25. While I understand that the time of the alleged invention is 2011 as discussed in Section IV above, because there are a number of priority applications, I have also been asked to consider—and have considered—the level of skill of a POSITA during the time period from 2007 to 2011 with respect to the alleged invention of the '218 patent and how that might impact any of my opinions. It is my opinion that the level of skill of a POSITA relative to the alleged invention of the '218 patent would be the same from 2007-2011. Additionally, my opinions expressed in this declaration remain unchanged if the time of the invention is any time during the period from 2007-2011.

26. All of my opinions in this declaration are from the perspective of a POSITA during the relevant timeframe.

## **VI. RELEVANT LEGAL STANDARDS**

27. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art.

28. For the purposes of this declaration, I have been informed by Petitioner's counsel about certain aspects of the law that are relevant to forming my opinions. My understanding of the law is as follows:

29. Petitioner's counsel has informed me that a patent claim is invalid as "anticipated" if each and every limitation of the claim is found, either expressly or inherently, in a single device or method that predates the claimed invention, or is described in a single publication or patent that predates the claimed invention. Petitioner's counsel has informed me that, in patent law, these previous devices, methods, publications, or patents are called "prior art."

30. Petitioner's counsel has informed me that claim limitations that are not expressly found in a prior art reference are inherent if the prior art necessarily functions in accordance with, or includes, the claim limitations. I understand that, for a claimed limitation to be inherently present, the prior art need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the prior art. I also understand that it is acceptable to examine evidence outside the prior art reference (extrinsic evidence) in determining whether a feature, while not expressly discussed in the reference, is necessarily present in that reference.

31. Petitioner's counsel has informed me that a patent claim can be considered to have been obvious to a person of ordinary skill in the art at the time the application was filed. I am informed that this means that, even if all of the features or limitations of a claim are not found in a single prior art reference, the claim is not patentable if the differences between the subject matter in the prior art

and the subject matter in the claim would have been obvious to a person of ordinary skill in the art at the time of the invention.

32. Petitioner's counsel has informed me that a determination of whether a claim would have been obvious should be based upon several factors, including, among others:

- the level of ordinary skill in the art at the time the application was filed;
- the scope and content of the prior art; and
- what differences, if any, existed between the claimed invention and the prior art.

33. Petitioner's counsel has informed me that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a person of ordinary skill in the art. Alternatively, I understand that the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to one having ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider, among other factors:

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;

- whether a person of ordinary skill in the art could implement a predictable variation, and would see the benefit of doing so;
- whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;
- whether a person of ordinary skill would have recognized a reason to combine known elements in the manner described in the claim;
- whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

34. Petitioner's counsel has informed me that one of ordinary skill in the art has ordinary creativity and is not an automaton. Petitioner's counsel has also informed me that in considering obviousness, obviousness may not be determined using the benefit of hindsight, including hindsight derived from the patent being considered.

35. Petitioner's counsel has also informed me that for a patent claim to benefit from the priority and earlier filing date of an earlier-filed application, the earlier filed application must fully describe each feature of that claim in such a way as to convey to a person of ordinary skill in the art that the patent owner was in

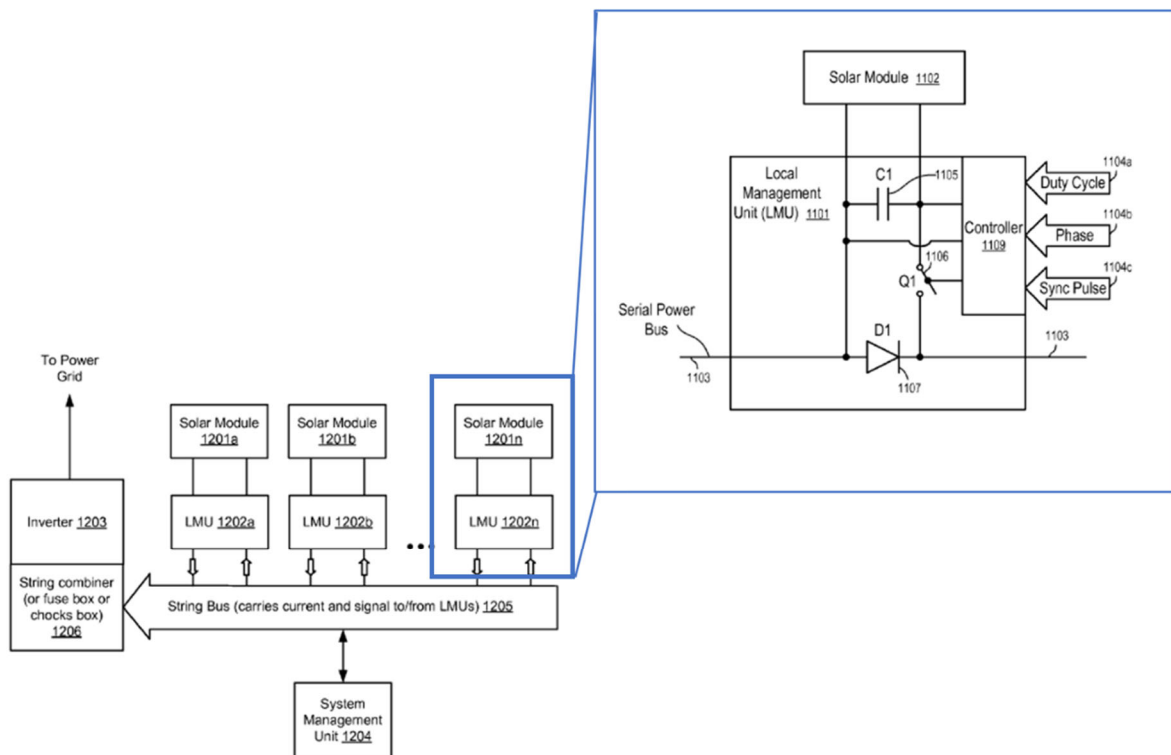
possession of the claimed invention at the time of the earlier-filed application. I also understand that the description of each claim feature must be described in the earlier-filed application sufficiently to enable a person of ordinary skill to make and use the claimed invention.

36. My opinions in this declaration have taken into account the legal standards, as they have been explained to me, including those detailed in this section.

## **VII. OVERVIEW OF THE '218 PATENT**

37. The '218 patent is generally directed to systems and methods for “automated shutdown, disconnect, or power reduction of solar panels.” Ex-1001, Abstract. The '218 patent aims to “reduce the safety risks during the shipment, installation and/or maintenance of photovoltaic systems.” *Id.*, 4:5-6, Figs. 10, 13.

38. The systems and methods described by the '218 patent “may shutdown a [*sic*] or modify the operation of all or part of the system” in the event of an anomaly in the operation of the photovoltaic system. Ex-1001, 2:51-55. For example, the systems and methods of the '218 patent “reduce the safety risks during the shipment, installation and/or maintenance of photovoltaic systems.” *Id.*, 4:5-6. Below is a representative embodiment of the '218 patent:



Ex-1001, Figs. 10, 13.<sup>2</sup>

39. The '218 patent explains that a “system” may include one or more “local management units” (“LMUs”) each coupled between a “solar module” and a “string bus (power line),” which acts as a system power bus. Ex-1001, 7:54-60. The LMU unit may receive “duty cycle,” “phase,” and synchronization pulse” inputs. Ex-1001, 9:60-64. Below is a representative figure for the system described in the '218 patent.

<sup>2</sup> All annotations and emphases, such as **bold/italics/color** emphases and annotations, in this document are added unless otherwise noted (as in the petition).

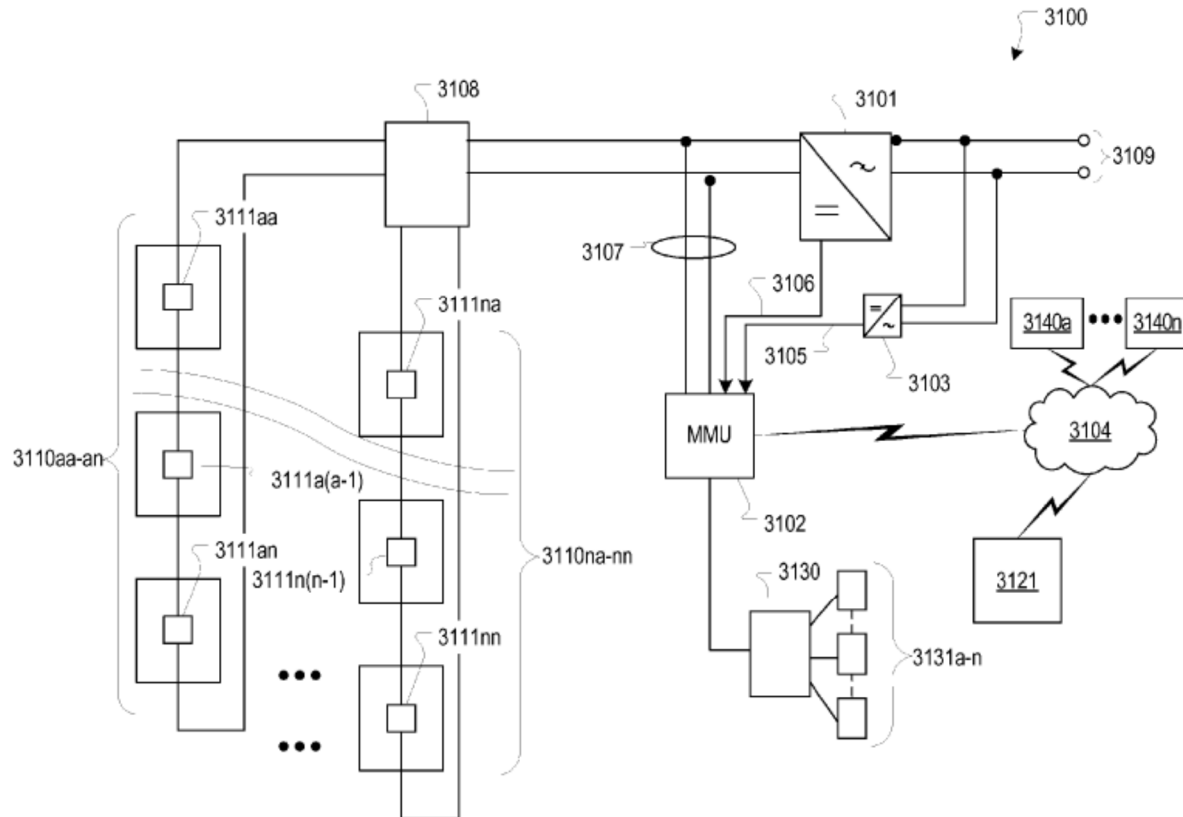


FIGURE 22

Ex-1001, Fig. 22.

40. The LMU may output signals via a wired or wireless connection. Ex-1001, 10:8-11. The LMU's controller may incorporate watch dog code to perform shutdown functions. Ex-1001, 16:61-65.

41. When detecting anomaly, (e.g., via the local sensor 3131 shown in Fig. 22), a master management unit ("MMU") may send a command to the LMU to alter the state of an associated solar module (e.g., shutting down one or more Solar modules, disconnecting one or more solar modules). Ex-1001, 7:11-16, 18:36-40, 20:60-65. The LMU's controller controls a switch to perform the shutdown function

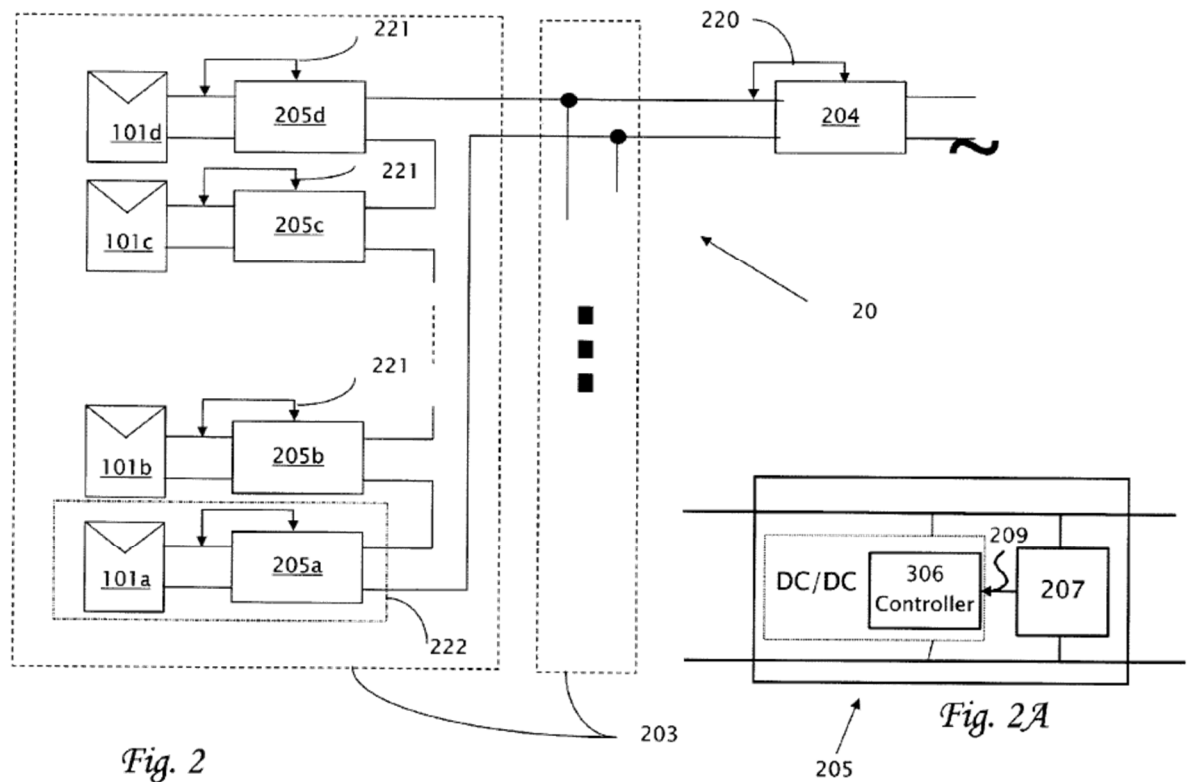
of the system in response. *Id.*, 16:63-17:3. In other words, in the event that communication with the MMUs has been cut off, the LMUs take the initiative to shut down, disconnect, or reduce the output of associated string(s) of solar panels (covered in Figure 20 (not shown) 17:24 “regular signal”). For example, the watchdog code 2308 shown in Figures 20 and 21 that can perform the shutdown operation. *Id.*, 16:60-65, 17:34-36, Figs. 20, 21.

42. The '218 patent also explains that its shutoff signals may be used to add security to the system, and recognizes that theft, accident, or vandalism may also be one of the causes of safety issues that the patent is intended to address. Ex-1001, 17:24-30, 2:36-47.

## **VIII. OVERVIEW OF THE PRIOR ART**

### **A. *Adest***

43. The *Adest* is generally directed to systems and methods relating to waking up and shutting down photovoltaic distributed power systems. Ex-1005, 1:25-27. In one embodiment, *Adest* describes power generating elements 222 that comprise a solar panel 101 and an associated power converter circuit 205, as shown in Figs. 2 and 2A, reproduced below. 5:49-50



Ex-1005, Figs. 2 and 2A

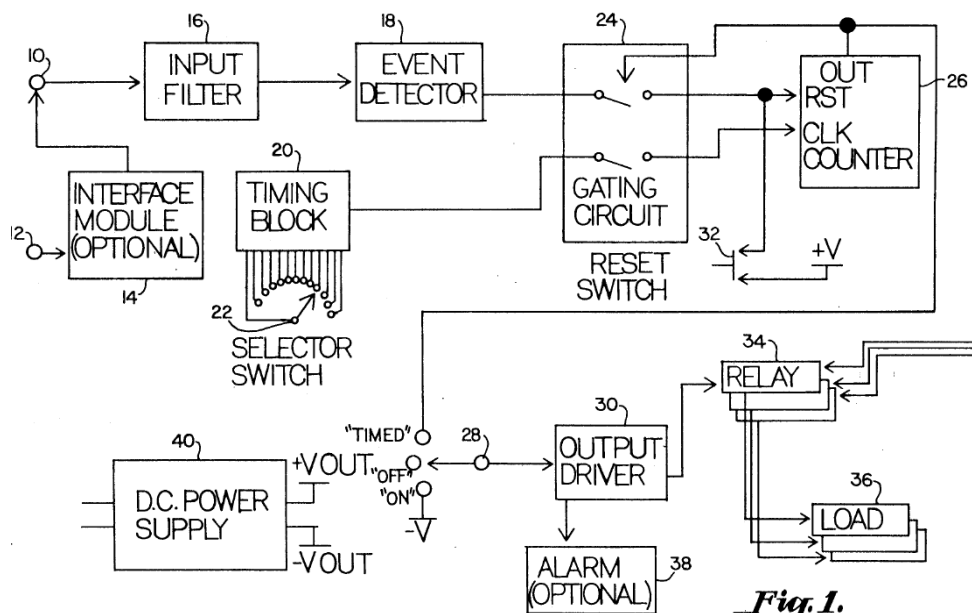
44. The power converter circuits 205 (also referred to as a power modules 205 or converters 205) “adapt optimally to the power characteristics of the connected solar panels and transfer the power from the solar panel efficiently from input to output.” Ex-1005, 5:52-55. The converter 205, includes a detector/receiver 207, that receives a signal from an inverter 204. Ex-1005, 6:54-59. According to an embodiment, the signal may be a 100/120 Hz signal, but *Adest* makes it clear that any suitable signal can be used. *See id.*, 2:65-67, 12:10-15. Normal operation of converter 205 is maintained as long as the signal continues to be received. *Id.* 10:2-

5; 12:33-39. If the communication signal is not detected, the converter 205 is typically turned off. *Id.*, 10:5-8.

45. *Adest's* system has the same general purpose as the '218 patent—to safely shutdown a solar array in case of an emergency.

### B. *Kronberg*

46. *Kronberg* is generally directed to a “smart” watchdog safety switch to “provide automatic shutdown of critical devices in case of failure,” and to ensure “process equipment is not damaged in the event of a controller failure” Ex-1006, abstract, 1:12-15, Fig. 1. *Kronberg's* “smart” watchdog safety switch also “protect[s] critical processes in the event of controller failure.” *Id.*, 2:30-32. The watchdog safety switch of *Kronberg* is shown in Figure 1, reproduced below.



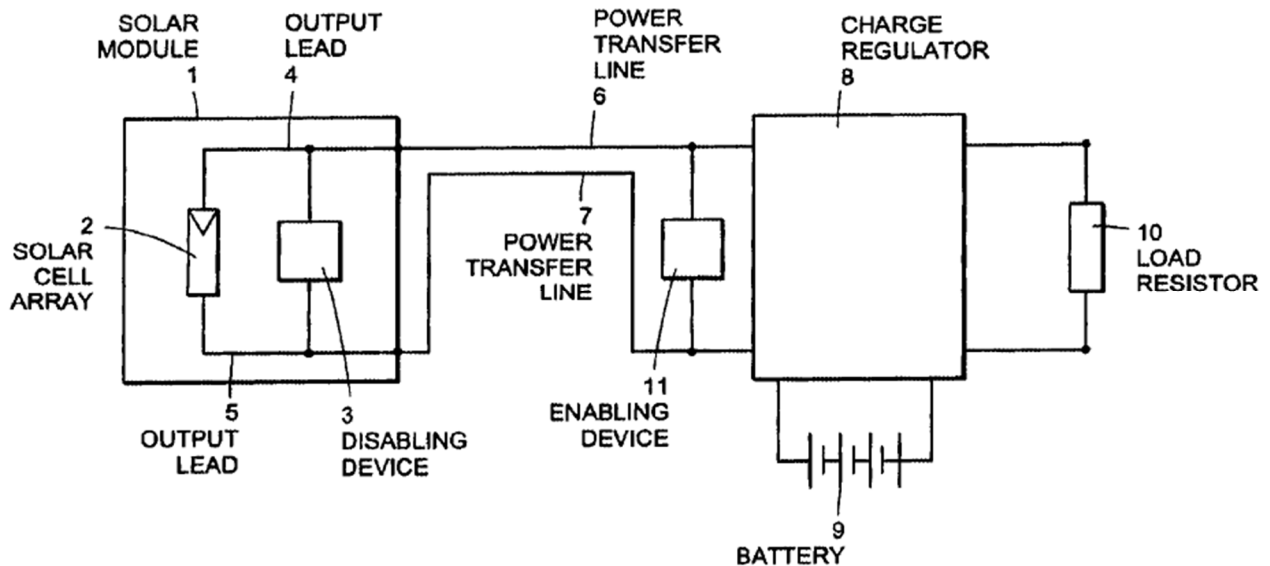
Ex-1006, Fig. 1

47. *Kronberg* monitors an event which takes place periodically during normal operation, such as an input signal that can be observed for its “transitions,” which can be detected using an event detector 18. Ex-1006, 1:45-48, 3:22-26. At the same time, a counter is counting continuously generated pulses from a timing block 20. Ex-1006, 3:27-32. The “events” of the event detector are used to reset a counter 26 to zero. Ex-1006, 3:33-37. If an event pulse is not received before a specified number of timing pulses, the counter outputs a “1”. Ex-1006, 3:38-46. This may be used to indicate a malfunction. Ex-1006, 3:59-61.

48. *Kronberg*’s watchdog also serves the same purpose as the watchdog system in the ’218 patent—to monitor communication and receive instruction to modify operation of the system components (*e.g.*, a solar module), and to shutdown equipment to protect it in case of a failure.

**C. *Goldack***

49. *Goldack* is directed to “a system for protecting a solar module against theft or unauthorized use by an authorized consumer.” Ex-1007, Abstract. The system of *Goldack* is shown below, reproduced in Fig. 1.



Ex-1007, Fig. 1

50. In particular, *Goldack* discloses a solar module-sited disabling device sends a first signal or first code during power generation. Ex-1007, 3:62-66. This first signal may be done by pulses, which can vary in “shape, length and number of the pulses.” *Id.*, 4:3-5. The consumer-sited enabling device detects the first signal and sends a second signal back. *Id.*, 4:6-8. The transmissions may be done via wire or wirelessly. *Id.*, 4:8-11. If there is no response to the first signal in “timeout of the first predetermined time period”, the system is disabled. *Id.*, 4:23-30; 39-41.

51. *Goldack*’s theft protection also serves the same purpose as the ’218 Patent—shutting down or disabling the system in the event that communication ceases from a solar panel (*e.g.*, in the case of disconnection, such as because of theft, etc.).

### D. *Moine*

52. *Moine* discloses a system including “an interruption device on the solar module” and a “release device on the consumer side.” Ex-1008 at Abstract. An embodiment of *Moine* is shown in Fig. 1:

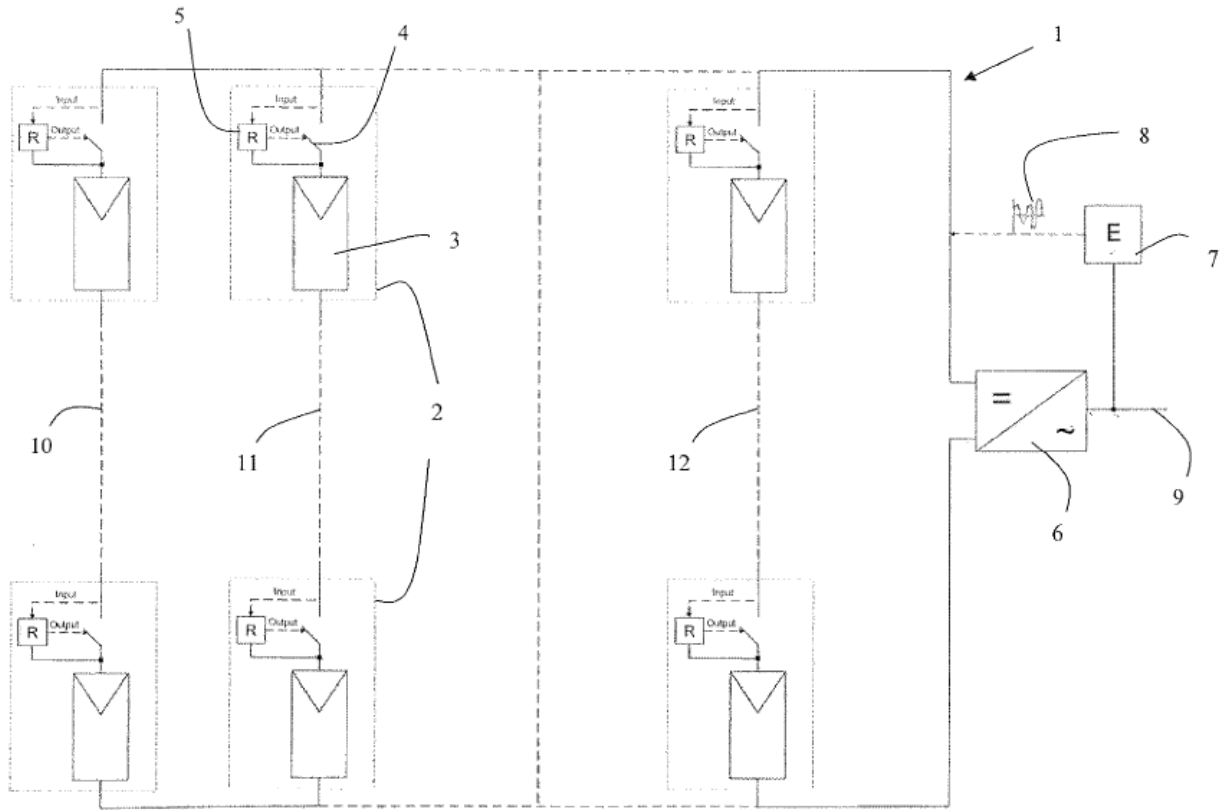


**Figure 1**

*Moine*, Ex-1008, Fig. 1

53. The “interruption device” of *Moine* comprises a receiver 5 and switch 4. The receiver 5 receives a signal from a transmitter 7. When the signal is absent, for example when the domestic power supply network lacks current, the switch shuts down the system by disconnecting the solar module 3. Ex-1008, 6:1-10. According

to *Moine*, “this makes it possible for maintenance or safety personnel to intervene with no risk of electrocution from the facility.” Ex-1008, 6:12-13.

54. In sum, *Moine* discloses a system having the same purpose as the '218 patent—to automatically shut down a solar array safely, such as in case of an emergency.

## **IX. CLAIM CONSTRUCTION**

55. I have been asked to determine if there are any particular claim terms that should be construed for the Board to understand how the prior art references read on the challenged claims. I have not identified any such claim terms.

56. Accordingly, I have given all the claim terms of the challenged claims their plain and ordinary meaning, as would have been understood by a person of ordinary skill in the art, at the time of the alleged invention, which I understand is 2007 through 2011, having taken into consideration the language of the claims, the specification, and the prosecution history of record.

## **X. THE PRIOR ART DISCLOSES OR RENDERS OBVIOUS ALL FEATURES OF THE CHALLENGED CLAIMS**

### **A. Grounds Challenging Claims 19 of the '218 patent**

57. I understand that the Petition is challenging claims 1-19 of the '218 patent on four separate grounds.

58. In **Ground 1**, I explain how the teachings of *Adest*, either alone or in combination with the teachings of *Kronberg*, render obvious claims 1-4, 6-16, 18-

19 of the '218 patent. As I discuss, although *Adest* discloses or renders obvious most features of the challenged claims, to the extent Patent Owner argues otherwise and/or the Board disagrees with my interpretation of *Adest*, regarding any of these claims, the watchdog of *Kronberg* could be combined with the system of *Adest*, as explained below. The combined teachings of *Adest* and *Kronberg* disclose or render obvious each of claims 1-4, 6-16, 18-19 of the '218 patent.

59. In **Ground 2**, I explain how the teachings of *Adest*, either alone or in combination with the teachings of *Kronberg* and/or *Goldack* render claims 1-4, 6-16, 18-19 of the '218 patent obvious. As I discuss, although the combined teachings of *Adest* and *Kronberg* disclose or render obvious most features of the challenged claims (*see* Ground 1), to the extent Patent Owner argues otherwise and/or the Board disagrees with my interpretation of the combined teachings of *Adest* and *Kronberg*, regarding any of these claims, the teachings of *Goldack* could be combined with the teachings of *Adest* and *Kronberg*, as explained below. The combined teachings of *Adest*, *Kronberg*, and/or *Goldack* disclose or render obvious each of claims 1-4, 6-16, 18-19 of the '218 patent.

60. In **Ground 3**, I explain how the teachings of *Moine*, either alone or in combination with the teachings of *Adest*, render claims 1-5, and 15-17 of the '218 patent obvious. As I discuss, although *Moine* discloses or renders obvious most features of the challenged claims (similar to *Adest*, as mentioned above), to the extent

Patent Owner argues and/or the Board disagree regarding any of these claims, the system of *Adest* could be combined with the system of *Moine*, as explained below. The combined teachings of *Moine* and *Adest* disclose or render obvious each of claims 1-5 and 15-17 of the '218 patent.

61. In **Ground 4**, I explain how *Moine*, either alone or in combination with the teachings of *Adest* and/or *Goldack* render claims 1-4, 6-14 and 18-19 of the '218 patent obvious. As I discuss, although the combined teachings of *Moine* and *Adest* disclose or render obvious most features of the challenged claims, to the extent Patent Owner argues and/or the Board disagree regarding any of these claims, the teachings of *Goldack* could be combined with the teachings of *Moine* and *Adest*, as explained below. The combined teachings of *Adest*, *Kronberg*, and/or *Goldack*. The combined teachings of disclose or render obvious each of claims 1-4, 6-14 and 18-19 of the '218 patent obvious.

62. These grounds are summarized in the table below:

| Ground | Prior Art                                                                                             | Claims Challenged    |
|--------|-------------------------------------------------------------------------------------------------------|----------------------|
| 1      | USPN 8,531,055 (" <i>Adest</i> ") (Ex-1005) in view of USPN 5,054,023 (" <i>Kronberg</i> ") (Ex-1006) | 1-4, 6-16, and 18-19 |

|   |                                                                                              |                      |
|---|----------------------------------------------------------------------------------------------|----------------------|
| 2 | <i>Adest</i> in view of <i>Kronberg</i> and/or USPN 6,650,031 (“ <i>Goldack</i> ”) (Ex-1007) | 1-4, 6-16, and 18-19 |
| 3 | FR2894401A1 (“ <i>Moine</i> ”) (Ex-1008) <sup>3</sup> in view of <i>Adest</i>                | 1-5 and 15-17        |
| 4 | <i>Moine</i> in view of <i>Adest</i> and/or <i>Goldack</i> .                                 | 1-4, 6-14 and 18-19  |

**B. Ground 1: *Adest* and/or *Kronberg* Render Obvious Claims 1-4, 6-16, and 18-19 of the ’218 Patent Obvious**

63. I have reviewed *Adest*, and it is my opinion that *Adest* and/or *Kronberg* renders claims 1-4, 6-16, 18-19 of the ’218 patent obvious.

**1. Claim 1**

**a. [1A] “A system comprising:”**

64. I understand that “A system comprising:” is the preamble to claim 1 of the ’218 patent. I have been asked to assume that the preamble is a claim limitation. Under that assumption, in my opinion *Adest* discloses/suggests this feature. For example, *Adest* discloses “wake-up and shutdown algorithms for the photovoltaic

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<sup>3</sup> Ex-1008 is a compilation of documents previously accepted into evidence in IPR2021-01286 and IPR2021-01287 (as Ex-1005 in those proceedings), comprising the English-language translation of *Moine* (1-16), its French language version (17-33), and translator declarations (34-52).

distributed power *systems*” Ex-1005, 1:26-27. *Adest* further describes “[a] distributed power *system*” including various components. *Id.*, Abstract; *see also id.*, Figs. 2, 2A.

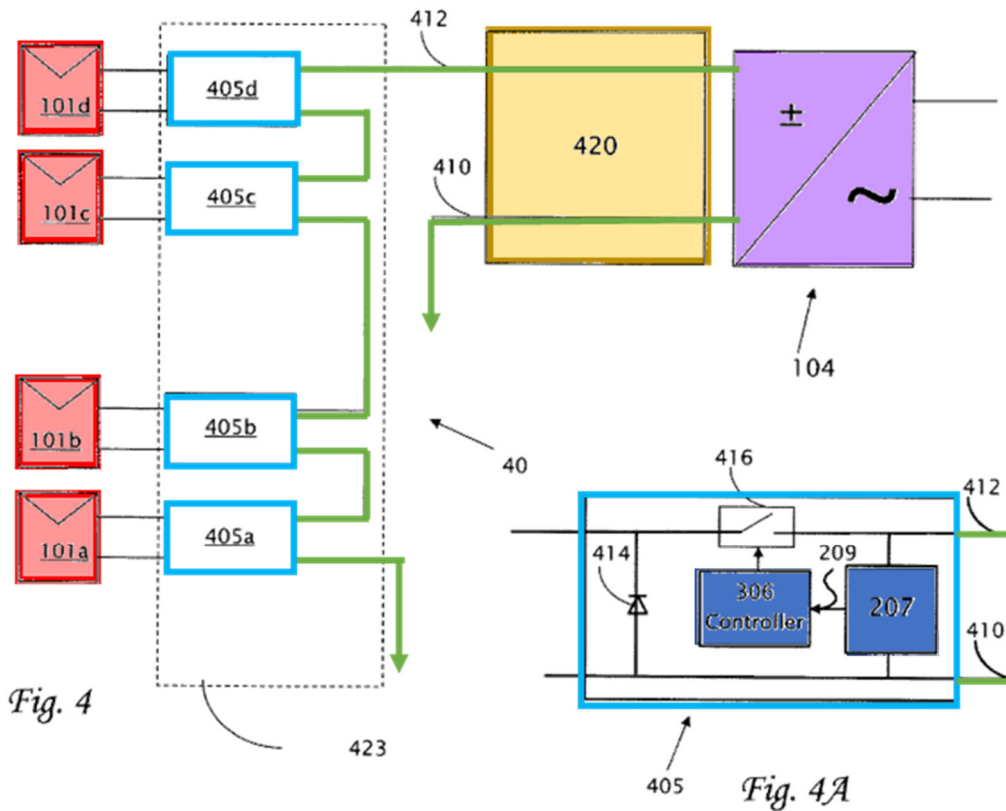
**b. [1B] “a master management unit (MMU); and”**

65. In my opinion, *Adest* discloses/suggests this feature.

66. In the '218 patent, Figure 22 shows that **MMU 3102** connected to a **string bus 3107** (or power bus) which is connected to a number of **local management units (LMUs) 3111**, each of which is connected to a **solar module 3110** and a **string bus 3107**, which is connected to a **MMU 3102**. Ex-1001, 18:6-19:29. In general, the '218 patent discusses using the DC wiring of the system. *See id.*, 18:19-26.



68. It is my opinion that a person of ordinary skill in the art would understand that *Adest* discloses a **MMU** in the same configuration as with the **MMU** of the '218 patent.



*Adest*, Ex-1005, Figs. 4 and 4A (annotated)

69. Specifically, *Adest* discloses “a **signaling mechanism 420** which superimposes a signal on serial string 423 through **wires 412 and 410** when inverter 104 is converting power to the grid.” Ex. 1005, 9:2-4, Fig. 4B. **The signaling mechanism 420** “refers to either a signal modulated on an electromagnetic carrier signal or a simple unmodulated signal such as an on/off signal “keep alive” signal or “dry contact” signal. *Id.*, 2:66-3:1. It “is adapted for controlling operation of the

power module.” *Id.*, 3:32-34. Notably, the ’218 patent discloses communications between the **MMU** and **LMU** in both directions (*i.e.*, both to and from the **MMU**). Similarly, Adest also discloses bi-directional communications in the form of polling. *See, e.g.*, Ex-1005, 9:38-41 (“Controller 306 preferably either polls signal input 209 or uses signal input 209 as an interrupt so that only when detector/receiver 207 detects the 100Hz signal, is module 405 operating in a normal operating mode.”)

70. **The signaling mechanism 420** produces a 100 Hz signal received by the detector/receiver 207 to demonstrate the system is operating in normal operating mode. Ex. 1005, 9:34-41. **The signaling mechanism 420** is an **MMU** because it is a system controller that controls operation of the power module and sends signals to determine normal operation of the system.

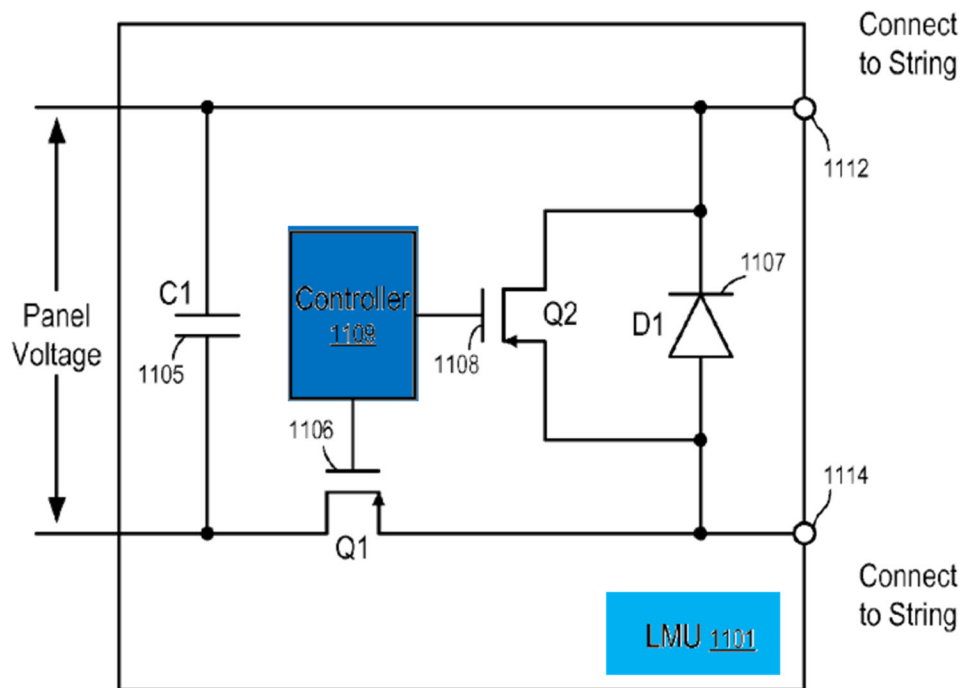
71. Accordingly, in my opinion, *Adest* discloses “a master management unit (MMU).”

**c. [1C] “a local management unit (LMU) in communication with the master management unit (MMU), the LMU controlling one or more solar modules;”**

72. In my opinion, *Adest* discloses/suggests this feature.

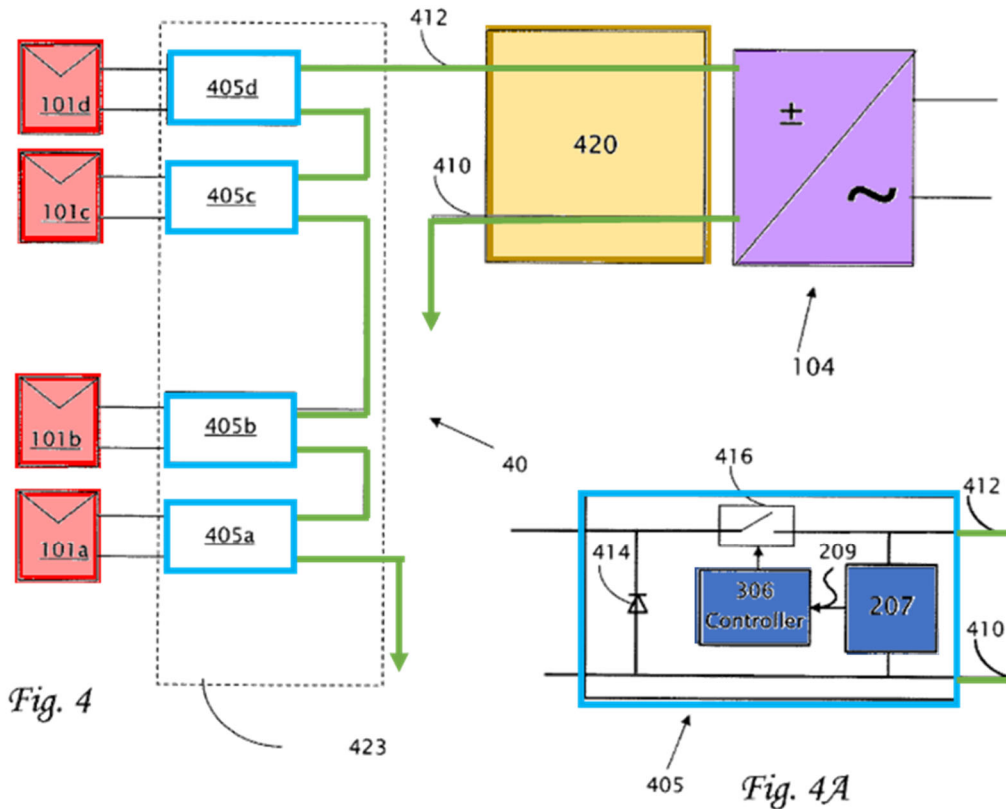
73. The ’218 patent teaches that the **LMU** “may include a solar module controller to control the operation of the solar module (1102) and/or a link module unit to provide connectivity to the serial power bus (1103) for energy delivery or data communications.” *Id.*, 7:6-10. The **MMU** may “interact with the inverter” and

“send enough current to the to wake up the **LMUs** . . . and allow them to do a quick query” of the solar panels. *Id.*, 18:29-36. The **LMU** possesses a controller that possesses watch dog code and can activate a switch to disable the system. *Id.*, 16:63-17:3.



’218 Patent, Ex-1001, Fig. 12 (annotated).

74. *Adest* discloses that each **power module 405** contains “**detector/receiver 207** which is configured to receive, optionally amplify and detect the signal, e.g. at 100 Hz, produced by **signal mechanism 420**” and “**controller 306** which functions to stop normal operation of power from the input of module 405 to the output of 405 when signal input 209 is absent indicating that inverter 104 is not transferring power to the electrical grid.” Ex-1005, 9:34-49.



Adest, Ex-1005, Figs. 4 and 4A (annotated)

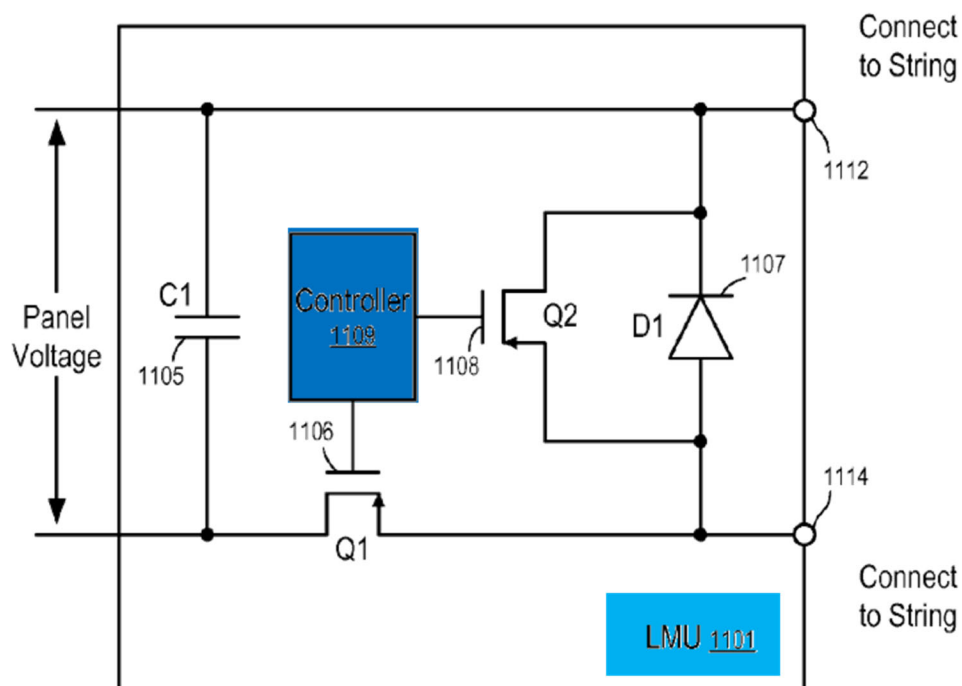
75. A person of ordinary skill in the art would have understood that **the power module** disclosed in *Adest* is the same as **an LMU** of the '218 patent. In the '218 patent, the **LMU** includes a **controller 1109**, receives input from the **MMU**, and controls the operation of the solar panels. Ex-1001, 7:6-10; 16:63-17:3; 18:29-36. Similarly, in *Adest*, **power module 405** also receives input from the **signaling mechanism 420** (e.g., in the form of a 100 Hz signal), and shuts down operations of the **solar panel, e.g. 101a-101.d.**, via a controller. Ex-1005, 9:34-49.

76. Accordingly, in my opinion, *Adest* discloses “a local management unit (LMU) in communication with the master management unit (MMU), the LMU controlling one or more solar modules.”

**d. [1D] “wherein the MMU is connected to at least one sensor, the sensor configured to detect an anomaly; and”**

77. In my opinion, *Adest* discloses/suggests this feature.

78. The '218 patent shows (e.g., in Fig. 22) **sensors 3131** connected to the **MMU 3102**. When discussing an embodiment in Fig. 12, the '218 Patent states that the “controller (1109) includes **sensors** (not shown in FIG. 12) to measure operating parameters of the **solar panel**, such as panel voltage, panel current, temperature, light intensity, etc.” Ex-1001, 9:30-33.



'218 Patent, Ex-1001, Fig. 12 (annotated).

79. In *Adest*, for example, it states that, when describing the **signaling mechanism 420** in detail, it states that “Microcontroller 422 is typically connected to one or more **sensors** in order to monitor the operation of inverter 104.” Ex. 1005, 9:13-16. One embodiment of the sensor is a “**Hall-effect sensor**.” *Id.*, 9:20. *Adest*’s **sensor** can monitor components and detect anomalies in their operation (e.g., an over-voltage condition), which can “result[] in microcontroller 422 stopping the signaling through relay 428 and/or opening one or more protective relays 424, 426 in series with the input DC voltage to inverter 104.” Ex-1005, 9:22-26.

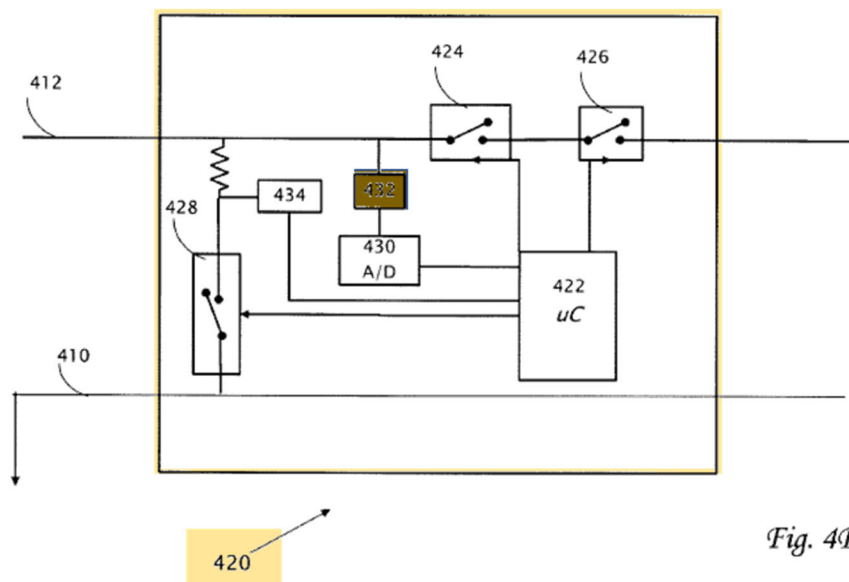


Fig. 4B

*Adest*, Ex-1005, Fig. 4B (annotated)

80. A person of ordinary skill in the art would have understood that detecting a change in operation (such as detecting an over-voltage condition, fire, smoke, other emergency conditions, etc.) would constitute detection of an anomaly by the **sensors** of *Adest*'s **signaling mechanism 420** in a similar manner using a similar **sensor** to the '218 patent detecting anomalies. Ex-1001, 18:53-55, Fig. 22. A person of ordinary skill in the art would also have understood that, to detect an anomaly in the form of a change in operation (such as an over-voltage condition), the **signaling mechanism 420** of *Adest*, like the **MMU** of the '218 patent, must be connected to a **sensor**. *Id.* 18:56-19:8.

81. Accordingly, *Adest* discloses “wherein the **MMU** is connected to at least one **sensor**, the sensor configured to detect an anomaly.”

e. [1E] “wherein upon detection of the anomaly by the sensor, the MMU sends a command to the LMU to alter the state of an associated solar module; and”

82. In my opinion, *Adest* discloses/suggests this feature.

83. *Adest* states that the **controller 306** of its **power module 405** controls the operation of switch 416 based on whether **detector/receiver 207** receives a communication. Ex-1005, 9:34-49. In addition, as shown in the Fig. 5A of *Adest*, the “**controller 306** maintains safety mode operation (step 53) until a communications signal, e.g. 100 Hz, is received by **receiver/detector 207** from inverter 204 or **signaling block 420**. When the communications signal is received

(decision block 505) indicating inverter 104 or 204 is connected and converting power, safety mode (step 53) of operation ends.” *Id.*, 10:40-46. If the signal is not detected, “the normal mode (step 57) is typically ended and power conversion of modules 405 is typically turned off.” *Id.*, 10:59-62.

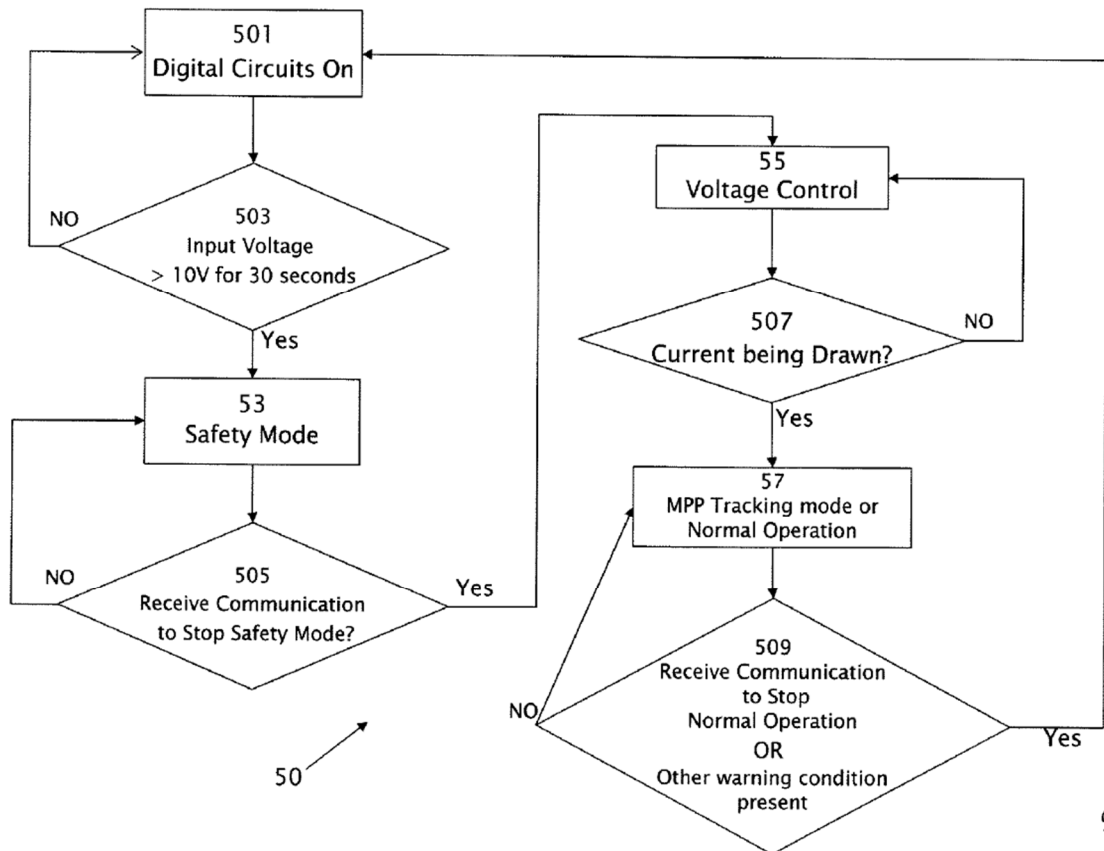


*Fig. 5A*

*Adest*, Ex-1005, Fig. 5A

84. Figure 5A of *Adest* (reproduced above) shows a flow diagram detailing normal operation and safety mode as well. When a communication has not been received to stop safety mode, safety mode continues. However, when a communication has been received, *e.g.*, receiving communication to stop normal

operation or other warning condition present in 509, the normal mode (step 57) is typically ended and power conversion of modules 405 is typically turned off (Ex-1005, 10:9-12) as altering the state of an associated solar module.

85. As discussed in Section X.B.1.c above, the **LMU** may include a **controller** that controls operation of the **solar modules**, and the **MMU** may “interact with the inverter” and “send enough current to the to wake up the LMUs . . . and allow them to do a quick query” of the solar panels or to “poll” them. Ex-1001, 7:6-10; 18:15-36. If an **LMU** does not respond, “the system would send an alarm indicating a possible security breach, such as a wire being cut or a panel being removed.” *Id.* at 18:38-40. For example, if a panel were removed for maintenance or were stolen, upon detecting a fault in the wiring, the controller “may also automatically trigger a disconnect.” Ex-1001, 17:26-29.

86. A person of ordinary skill in the art would have understood that the **controller 306** receives communications from the **signaling mechanism 420** and alters the state of the **solar module** in *Adest* in the same way that the **LMU** of the ’218 patent receives communications from the **MMU** and the **LMU** alters the state of the **module** in the ’218 patent.

87. Accordingly, *Adest* discloses “wherein upon detection of the anomaly by the **sensor**, the **MMU** sends a command to the **LMU** to alter the state of an associated **solar module**.”

- f. [1F] “wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with command.”

88. In my opinion, *Adest* discloses/suggests this feature.

89. As discussed above in Section X.B.1.e in the exemplary of *Adest*, as long as 100Hz signals are received by power module 405 from signaling mechanism 420, normal mode continues. Ex-1005, 9:34-49; 10:40-46.

90. On the other hand, if power module 405 either 1) fails to receive 100Hz signals or 2) receives communication to stop normal operation or other warning condition present, the normal mode is typically ended and power modules is then typically turned off. Ex-1005, 10:9-12; 10:59-62; Fig. 5A.

91. This operation of *Adest* is similar to the operation described in the '218 patent, as discussed in Section X.B.1.e above, where upon detecting a fault in the wiring, the MMU may send an alarm and the controller in the LMU may trigger a disconnect, changing operational state of the solar module. Ex-1001, 17:28-29; 18:36-43.

92. Accordingly, *Adest* discloses “wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with [the] command.”

## 2. Claim 2

### a. “The system of claim 1, wherein the MMU queries the sensor for the anomaly.”

93. In my opinion, *Adest* discloses/suggests this feature.

94. As shown in Section X.B.1.d, the microcontroller (part of **signaling mechanism 420** of *Adest*, similar to the **MMU** in the '218 patent) “is typically connected to one or more **sensors** in order to monitor the operation of inverter 104.” Ex-1005, 9:13-16.

95. An over-voltage condition is an example of one type of anomaly “measured by microcontroller 422” resulting in the microcontroller “stopping the signaling through relay 428 and/or operating one or more protective relays 424, 426 in series with the input DC voltage to inverter 104.” Ex-1005, 9:22-26.

96. Accordingly, *Adest* discloses “The system of claim 1, wherein the MMU queries the **sensor** for the anomaly.”

## 3. Claim 3

### a. “The system of claim 1, wherein the sensor notifies the MMU of the anomaly.”

97. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.1.d and X.B.1.e.

98. To the extent that Patent Owner or the Board disagree that *Adest* discloses the sensor notifying the **signaling mechanism 420/MMU** of the anomaly,

a person of ordinary skill in the art would have understood that the **sensor** may notify the **MMU** of the anomaly, as it is a simple logical conclusion of the function of a **sensor**. In addition, a person of ordinary skill in the art would also have understood that, in order to give effect to the use of a **sensor**, either a component must query the sensor for its results, or the sensor must provide its results to a component.

99. Accordingly, *Adest* discloses “The system of claim 1, wherein the **sensor** notifies the **MMU** of the anomaly.

#### 4. Claim 4

- a. **“The system of claim 1, wherein the command is selected from the group consisting of: a command to shutdown the module; a command to disconnect the module; and a command to alter the output of the module.”**

100. In my opinion, *Adest* discloses/suggests this feature.

101. In the '218 patent, it shows that the system may disconnect a module when it produces less power. Ex-1001, 15:15-19; 17:28-29. The system can also “implement an emergency shut down of the solar panel system when it detects a problem at the head end or in the wiring.” *Id.* at 16:29-21.

102. *Adest* discloses a similar function. *Adest* is directed to “wake-up and shutdown algorithms for the photovoltaic distributed power systems.” Ex-1005, 1:25-27. In the event of an anomaly (*e.g.*, an over-voltage condition), the microcontroller 422 stops “the signaling through relay 428 and/or opening one or more protective relays 424, 426 in series with the input DC voltage to inverter 104.”

*Id.*, 9:23-26. A switch “controlled by **controller 306**” functions “to stop normal operation of power from the input of **module 405** to the output of **405** when signal input 209 is absent,” thereby powering down the **solar panel** *Id.*, 9:45-48.

103. As discussed above in Section X.B.1.f, power conversion is turned off in the absence of a signal from **signal mechanism 420**. Ex-1005, 10:59-62. Additionally, “the **controller 306** may alternate the switches (e.g. switches 324 & 326 of buck converter) at a low duty-cycle in order to maintain a low output voltage,” altering the output of the module. *Id.*, 10:36-39.

104. Therefore, a person of ordinary skill in the art would have understood that the system in *Adest* permits the shutdown, disconnection, or alteration of output of a solar module as claimed in claim 4 of the ’218 patent.

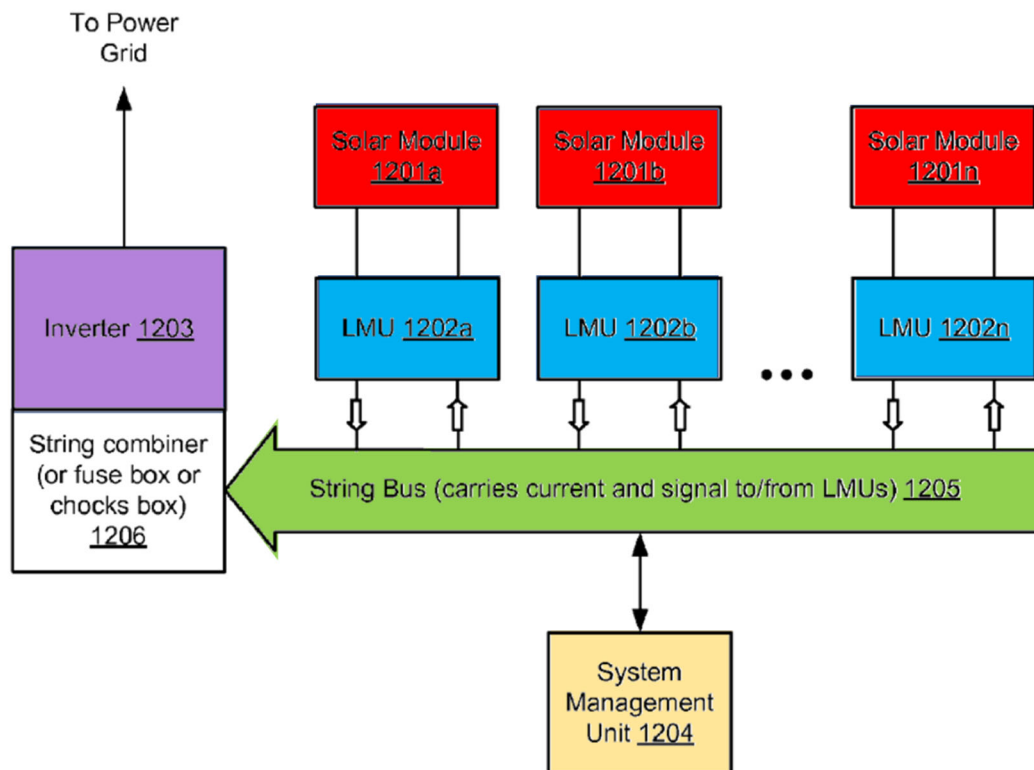
105. Accordingly, *Adest* discloses “The system of claim 1, wherein the command is selected from the group consisting of: a command to shutdown the module; a command to disconnect the module; and a command to alter the output of the module.”

## 5. Claim 6

- a. [6A] “The system of claim 1, further comprising: a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU);”

106. In my opinion, *Adest* discloses/suggests this feature.

107. As shown below in Figure 13 of the '218 patent, the '218 patent discloses **LMUs 1202** each connected between a **solar module 1201** and a **string bus 1205**. Ex-1001, 9:34-47. The **string bus** is a serial **power bus**. See, e.g. Ex-1001, 7:1-10.

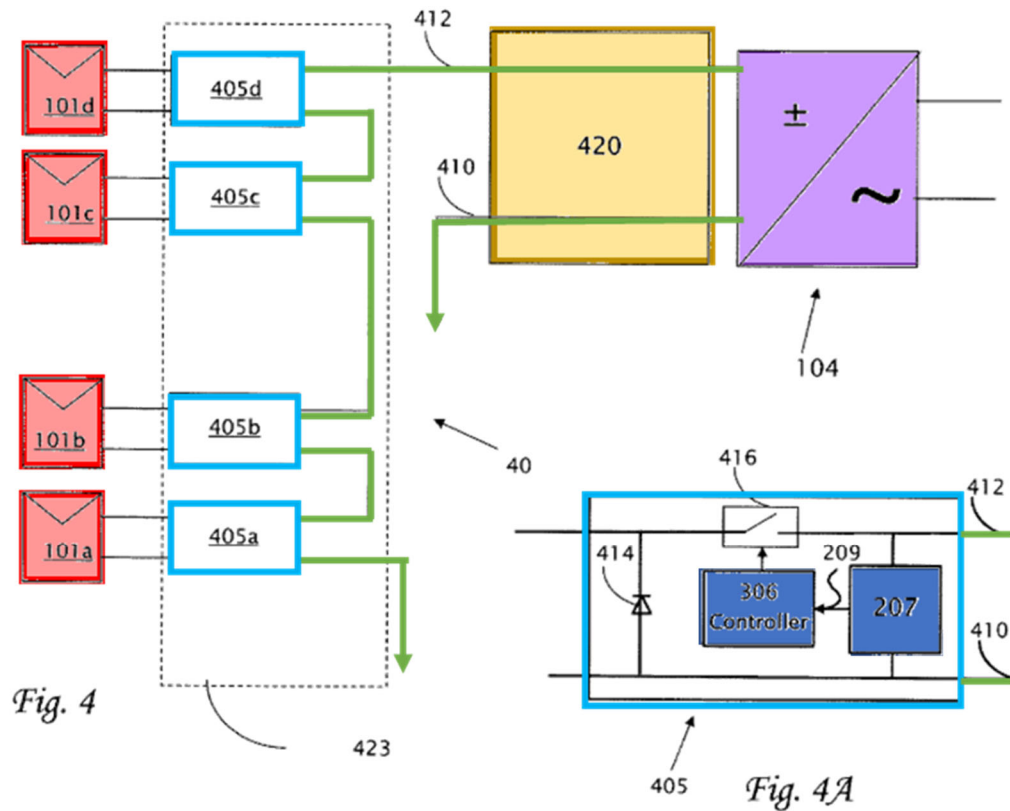


Ex-1001, Fig. 13

108. *Adest* discloses a **watchdog unit** in the same configuration as with the **watchdog unit** of the '218 patent and the understanding of a person of ordinary skill in the art.

109. In particular, **power modules 405a-405d** of *Adest* in whole or in part perform(s) as the **watchdog unit** described by the '218 patent.

110. *Adest's* Figure 4 and 4A, reproduced below, shows **power modules 405a-405d (watchdog unit)** coupled between **solar panel 101a-101d** and a **power bus**, as was the case for the '218 patent *See also*, Ex-1005, 8:61-64.



*Adest*, Ex-1005, Figs. 4 and 4A

111. Fig. 4A of *Adest* shows details of **power module 405**, which may include “**detector/receiver 207** which is configured to receive, optionally amplify and detect the signal, e.g. at 100 Hz, produced by the **signal mechanism 420**” and “stop[s] normal operation of power from the input of **module 405** to the output of **405** when signal input 209 is absent.” Ex-1005, 9:33-49.

112. Thus, a person of ordinary skill in the art would have understood that the **power module 405** in whole or in part perform(s) as a **watchdog unit** described in the '218 patent because it is configured to monitor a communication from a **signal mechanism 420** (*i.e.*, a central controller).

113. A person of ordinary skill in the art would also have understood that the **solar panels** of *Adest* are each a “**solar module**,” which was common synonym at the time of the invention. When discussing Fig. 5A, in safety mode 53, “output current and/or voltage from **module 405** is limited, for instance output voltage is limited to 2 volts and output current is limited to 10 mA so that a person can touch the wires of serial string 203,423 without any danger of electrocution. . . . Referring back to FIG. 3, safety mode may be achieved by controller 306 in module 405 *by* turning on [*sic*] FET 330 and turning off [*sic*] FETS 328, 348, and 350. Output wire 412 [*sic*] is held close to zero volts.” Ex-1005, 10:25-36. Given the context, a person of ordinary skill in the art would have recognized that the in final sentence of this passage, the words, “on” and “off” were mistakenly switched.

114. Upon the receiver/detector 207 in controller 306 receiving the 100 Hz communication signal from inverter 204 or signaling block 420, safety mode ends. Ex-1005, 9:60-66.

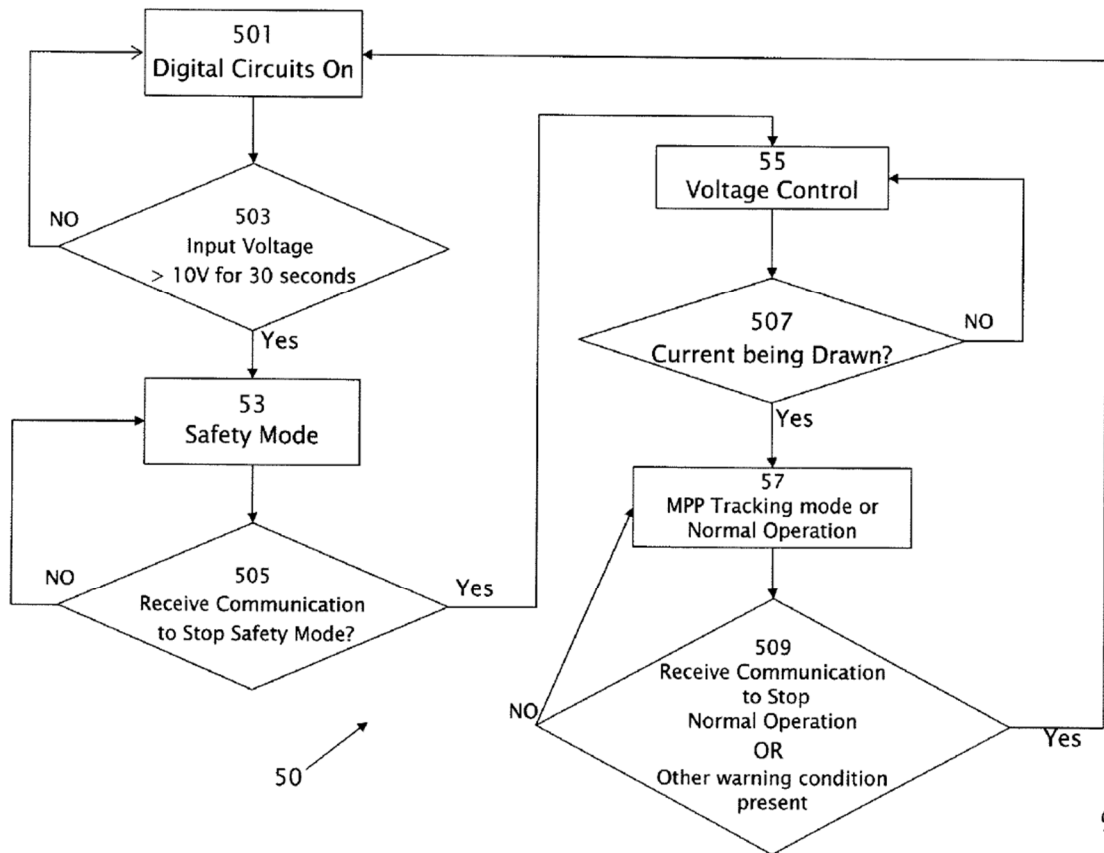


Fig. 5A

Adest, Ex-1005, Fig. 5A

115. The normal operation of the system continues “as long as the communications signal, e.g. 100 Hz is received from inverter 204 or signal mechanism 420, and no other warning condition is present. If the communications signal is not detected, or another warning condition is present, the normal mode (step 57) is typically ended and power conversion of modules 405 is typically turned off.” Ex-1005, 10:57-62. As discussed in Section IX.B.4, power conversion can be shut down and disconnected (*Id.*, 10:59-62) and the output power can be reduced (*Id.*,

10:36-39). Further, the '218 patent discloses shutdown, disconnection, and voltage reduction situations.

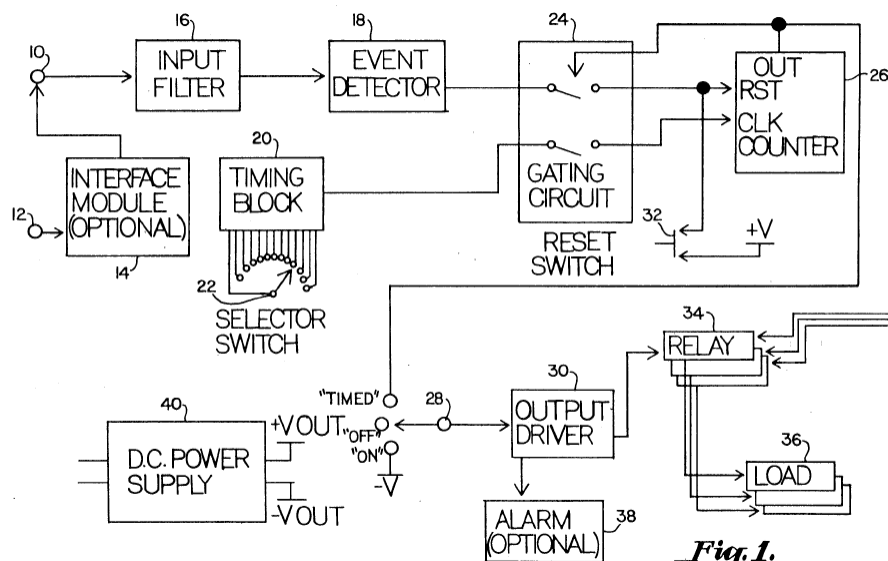
116. The detector/receiver 207 is configured to receive a 100 Hz signal produced by signal mechanism 420. Ex-1005, 9:35-37. The controller 306 possesses the capability to “polls a signal input 209 from receiver/detector 207” in order to detect the 100 Hz signal. Ex-1005, 6:60-64; *see also* 9:38-41. In the event that it does not detect the 100 Hz signal, the controller 306 “functions to stop normal operation of power.” *Id.*, 9:44-48.

117. As disclosed in Sections X.B.1.b and X.B.1.c, the LMU could include a watchdog unit. In the '218 patent, the controller 2204, which is part of the LMU as disclosed above, has watch dog code on it to perform the shutdown function of the invention. Ex-1001, 16:63. In the event that the controller does not detect the heartbeat of 100 Hz, the controller shuts down the system. *Id.*, 17:59-61.

118. Accordingly, *Adest* and the combination of *Adest* and knowledge of a person of ordinary skill in the art discloses “The system of claim 1, further comprising: a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU).”

119. To the extent that Patent Owner or the Board disagrees that *Adest* and the knowledge of a POSITA disclose a “watchdog unit,” *Kronberg* discloses this

feature. *Kronberg* discloses a “‘smart’ watchdog safety switch . . . for protecting critical processes in the event of controller failure.” Ex-1006, 2:30-32.



121. Fig. 1 of *Kronberg* is a block diagram showing this apparatus.

123. *Kronberg* further discloses that the watchdog apparatus has an internal timing block 20 that produces a train of timing pulses having a frequency determined

by a selector switch and multistage binary counter 26 that receives and counts the train of timing pulses (*i.e.*, timeout counter). Ex-1006, 3:27-32. When an event pulse is received the binary counter is reset to zero. *Id.*, 3:33-37. Thus, so long as watchdog continues to receive the input signal, the counter will continuously be reset. Ex-1006, 3:35-37.

124. However, if the watchdog receives no event pulse before a specified number of timing pulses, then the counter outputs a “1,” which indicates the “attainment of a specified binary count.” Ex-1006, 3:38-43. This binary count can be, for example, “2048 . . . or another power of 2.” *Id.*, 3:38-43. A POSITA would understand that attainment of the specified count (*i.e.*, that the periodic signal has not been detected for a certain amount of time) is the detection of irregularity in periodicity.

125. *Kronberg* also discloses that an optional alarm could be added to alert users of a “malfunction.” Ex-1006, 3:59-61. Therefore, *Kronberg* discloses this feature.

126. The watchdog of *Kronberg* could be used as part of the **receiver/detector 207** of *Adest* to detect the absence of the 100 Hz communications signal as taught therein. Rather than attach the output of the watchdog to a relay, the output of watchdog would need only be provided to the **controller 306** of *Adest*.

127. A POSITA would have been motivated to combine the watchdog unit by *Kronberg* to monitor communications between the **signal mechanism 420** (or **MMU**) and the **power modules 405** (or **LMU**) of *Adest*.

128. A POSITA would have been motivated combine the **watchdog** apparatus as taught by *Kronberg* with the solar power system taught by *Adest*. Watchdog timers, such as the watchdog apparatus taught by *Kronberg*, were a well-known technique for detecting malfunctions at the time of the invention. For example, the IEEE dictionary defines “watchdog timer” as “[a] form of interval timer that is used to detect a possible malfunction.” Ex-1009 at 1269

129. A POSITA looking to implement the **receiver/detector 207** of *Adest*, would have been motivated to look at electronic signal detection devices, such as that disclosed by *Kronberg*. It would merely be one of a number of solutions for detecting the absence of a periodic signal.

130. Moreover, *Adest* is concerned with shutting down a power generating facility when a transmitter fails to send a communication that could be “caused, for example, by a fire, or due to the theft of one or several of the photovoltaic modules comprising the facility.” Ex-1005, 7:6-12. *Kronberg* itself suggests that its watchdog apparatus is to be used to provide “automatic shutdown of critical devices in case of failure” (Ex-1006, 1:12-15), which is similar to *Adest*’s goal of shutting down a power generating facility when a transmitter fails to send a communication

that could be “caused, for example, by a fire, or due to the theft of one or several of the photovoltaic modules comprising the facility.” *See* Ex-1005, 7:6-12. A POSITA looking to implement such a safety feature would look to similar electronic safety devices available in a variety of similar fields that utilize electronic safety mechanisms for electronically controlled equipment.

131. In the final written decision of IPR2021-01287, I understand the Board agreed that a POSITA would be motivated to combine the teachings of *Adest* and *Kronberg*. Ex-1010 at 35 (IPR2021-01287, Paper No. 27 (Final Written Decision) at 35). As the same prior art is being used in combination to demonstrate obviousness of another patent in the same patent family, the motivation to combine should be applied here.

132. A POSITA could use the watchdog unit as taught by *Kronberg* to implement the watchdog unit. The watchdog unit of *Kronberg* “is a simple, versatile and direct method and apparatus for protecting critical processes in the event of controller failure” that “directly accepts all common logic, contact closure and some analog signals, and can be adapted for high level inputs by plugging in one of several industry-standard interfacing modules.” Ex-1006, 2:30-36.

133. The signal monitored by *Kronberg* is a “relatively slow, periodic waveform generated by the controller.” Ex-1006, 3:13-15. “If no further event pulses arrive before a specified number of timing pulses . . . counter 26 40 is incremented

and the output of counter 26 changes state from a logic ‘0’ to a logic ‘1’, signaling the attainment of the specified binary count.” *Id.*, 3:38-43. A logic of “0” allows a high-level current to reach critical load elements, while a logic of “1” de-energizes relays and prevents current from reaching critical load elements. *Id.*, 3:52-59.

134. Furthermore, a POSITA would have had a reasonable expectation of success using the watchdog apparatus of *Kronberg* to implement the receiver/detector 207 of *Adest*. In particular, *Kronberg* is specifically capable of detecting 100 Hz signals, like that of *Adest*. See Ex-1006, 11:34-61 (showing that the output of the timing block can be adjusted by using a properly sized resistor).

135. Additionally, *Kronberg* states that its watchdog apparatus is able to shutdown a system in a mere fraction of a second (Ex-100X, 4:9-12), which would allow the solar power system of *Adest* to quickly enter safe mode, reducing the risk of electrocution. *Adest* also discloses that the 100 Hz signal may be partially blocked by the inverter. Ex-1005, 6:44-48. A POSITA would understand that such a signal that is subject to partial blocking would be subject to noise and interference. *Kronberg* provides a “input filter” that can remove noise using clipping and filtering techniques. Ex-1006, 3:13-17. Thus, a POSITA would understand that the 100 Hz communication signal of *Adest* could successfully be detected by the watchdog of *Kronberg*.

136. It would have been obvious to a POSITA to use the watchdog apparatus as taught by *Kronberg* to implement a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU) and a POSITA would have had a reasonable expectation of success.

137. Accordingly, it would have been obvious to a POSITA at the time of the invention to use the watchdog unit of *Kronberg* with the implementation of the MMU and LMU taught by *Adest*.

**b. [6B] “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times;”**

138. In my opinion, *Adest* discloses/suggests this feature.

139. The **receiver/detector 207** is configured to receive a 100 Hz signal produced by mechanism 420. Ex-1005, 9:35-37. The **controller 306** possesses the capability to “polls a signal input 209 from **receiver/detector 207**” in order to detect the 100 Hz signal. *Id.*, 6:60-64; *see also* 9:38-41. In the event that it does not detect the 100 Hz signal, the **controller 306** “functions to stop normal operation of power.” *Id.*, 9:44-48.

140. As discussed, the **LMU** in whole or in part perform as a watchdog unit.

141. A person of ordinary skill in the art would have understood the polling performed by the controller of *Adest* to be polling of a **watchdog** unit that may poll the **MMU**.

142. In *Adest*, it already contemplated polling of the receiver/detector to detect the relevant signal, and possesses the relevant technology. It would have been obvious to a person of ordinary skill in the art to take the then-existing technology of polling of the **receiver/detector 207** for a 100 Hz signal in *Adest* and apply it to polling of the **MMU** for a 100 Hz signal.

143. Accordingly, *Adest* and the combination of *Adest* and knowledge of a POSITA discloses “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times.”

- c. **[6C] “wherein if the watchdog unit receives no response after completing the polls, receives a command to modify operation of a solar module, or receives an inappropriate response, then the watchdog unit issues an instruction to the respective LMU to modify operation of the solar module.”**

144. In my opinion, *Adest* alone or in combination with the knowledge of a POSITA discloses/suggests this feature.

145. As discussed in Sections X.B.1.f and X.B.5.a, if **power module 405** fails to receive 100Hz signals, the normal mode is typically ended and power

modules is then typically turned off as modifying operation of the **solar module**. Ex-1005, 10:8-12; 10:59-62. For more details, please refer to Section X.B.1 as discussed above.

146. As described above, it would have been obvious to a person of ordinary skill in the art to use his/her knowledge with the implementation of the **MMU** and **LMU** taught by *Adest* to disclose this limitation.

147. Accordingly, *Adest* and the combination of *Adest* and knowledge of a person of ordinary skill in the art discloses “wherein if the watchdog unit receives no response after completing the polls, receives a command to modify operation of a solar module, or receives an inappropriate response, then the watchdog unit issues an instruction to the respective **LMU** to modify operation of the solar module.”

148. To the extent that Patent Owner or the Board disagrees that *Adest* and the knowledge of a POSITA disclose a “**watchdog unit**,” *Kronberg* discloses this feature, as described above in Section X.B.5.a. It would have been obvious to a POSITA at the time of the invention to combine the teachings of *Adest* and *Kronberg* to achieve this claim element.

## **6. Claim 7**

### **a. “The system of claim 6, wherein the respective LMU comprises the watchdog unit.”**

149. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Section X.B.5.

7. **Claim 8**

- a. **“The system of claim 6, wherein the instruction is selected from the group consisting of an instruction to shut off the solar module, an instruction to disconnect the solar module from the solar array, and an instruction to reduce the output power of the solar module.”**

150. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Section X.B.5.

151. To the extent Patent Owner and/or the Board disagrees that *Adest* alone discloses a watchdog unit as required for claim 6 and 8 of the '218 patent, a person of ordinary skill in the art would have found it obvious to combine *Adest* with known watchdog units at the time. For example, *Kronberg* (Ex-1006) specifically discloses watchdog unit that would have been known at the time by a person of ordinary skill in the art.

152. *Adest* specifically teaches that “[a]ccording to a feature of the present invention, information regarding wakeup or shut-down may be conveyed from inverter 204 to converters 205. The information may be transmitted using any of the methods well known to those experienced in the art.” Ex-1005, 6:32-36. *Kronberg* also states that “prompt shutdown of critical load elements 36 is implemented whenever valid transitions fail to arrive at input 10 (or, alternatively at input 12) within the period set by timing block 20 and counter 26.”

153. Therefore, both Adest and Kronberg discloses this feature of instruction.

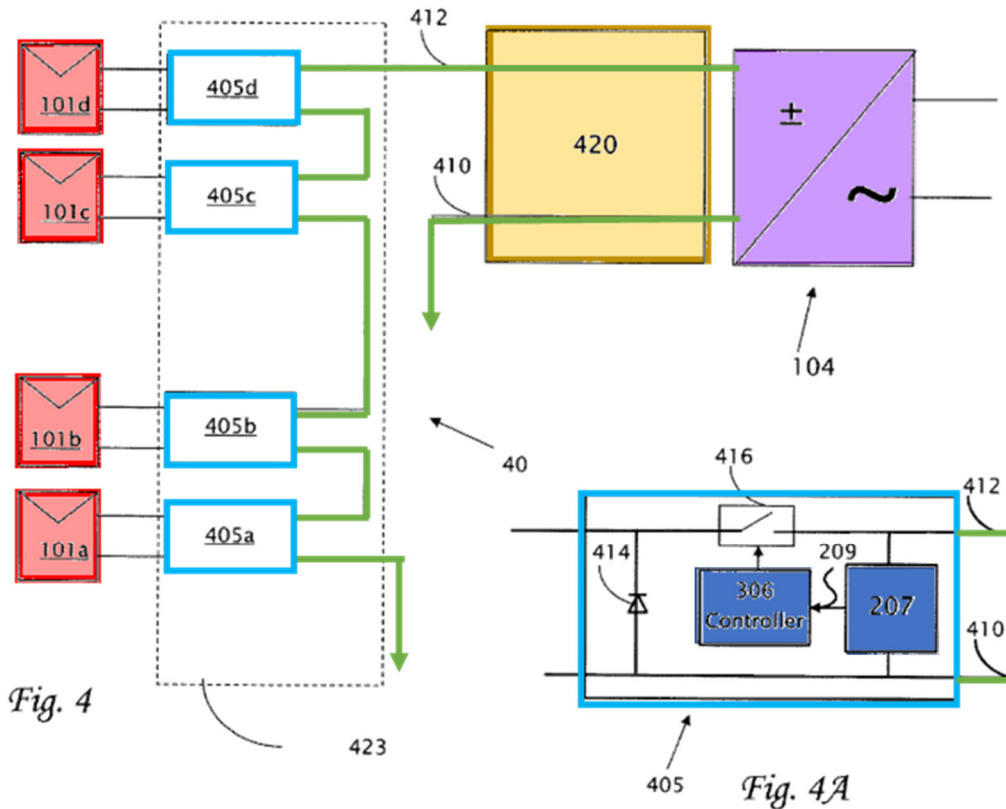
154. Accordingly, *Adest* discloses “The system of claim 6, wherein the instruction is selected from the group consisting of an instruction to shut off the solar module, an instruction to disconnect the solar module from the solar array, and an instruction to reduce the output power of the solar module.”

**8. Claim 9**

- a. [9A] “The system of claim 1, further comprising: a watchdog unit coupled between a solar module and a power bus, the power bus configured to connect a plurality of solar modules to an inverter,”

155. In my opinion, *Adest* discloses/suggests this feature as discussed in Section X.B.5.

156. As shown in Figure 4, the **power modules 405a-405d** (*i.e.*, **watchdog units**) of *Adest* are each connected between a **solar panel 101a-101d** (*i.e.*, **solar module**) and **power bus**.



*Adest*, Ex-1005, Figs. 4 and 4A.

157. In addition, a person of ordinary skill in the art would have understood that *Adest* discloses a **watchdog unit** coupled between a **solar module** and a **power bus**, as required by claim 1 of the '218 patent.

158. Accordingly, *Adest* discloses “The system of claim 1, further comprising: a watchdog unit coupled between a solar module and a power bus, the power bus configured to connect a plurality of solar modules to an inverter”

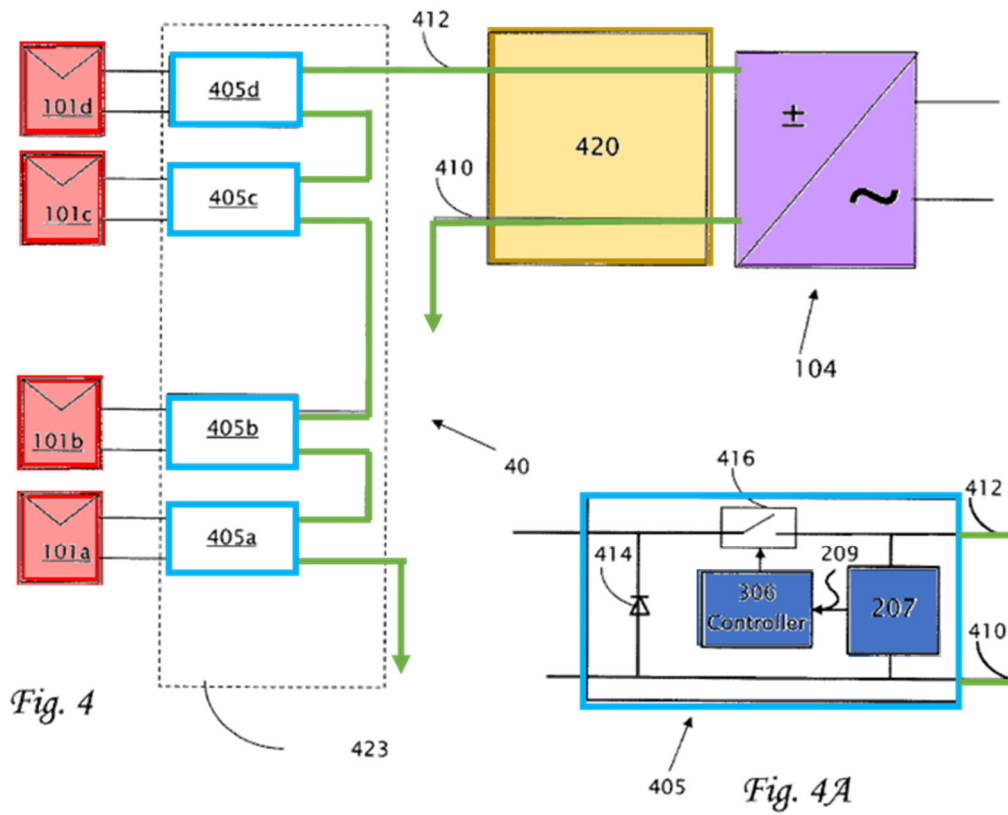
159. To the extent that Patent Owner or the Board disagrees that *Adest* and the knowledge of a POSITA disclose a “watchdog unit,” *Kronberg* discloses this feature in Section X.B.5.a.

- b. [9B] “the watchdog unit having: a local controller to monitor a communication from a central controller remote from the solar module and determine whether the communication is interrupted;”

160. In my opinion, *Adest* discloses/suggests this feature as partially discussed in Section X.B.1.c above.

161. In the '218 patent, it states that the LMU “may include a solar module controller to control the operation of the solar module (1102) and/or a link module unit to provide connectivity to the serial power bus (1103) for energy delivery and/or for data communications.” Ex-1001, 7:6-10. The controller also “controls the operation of the switch.” Ex-1001, 7:34-35.

162. In *Adest*, the **detector/receiver 207** together with **controller 306** are a “**local controller**” of a **watchdog unit** consistent with the teachings of the '218 patent. *Adest* discloses that **controller 306** controls the operation of **switch 416** based on whether **detector/receiver 207** receives a communication. Ex-1005, 9:34-49. Furthermore, *Adest* discloses that “**controller 306** maintains safety mode operation (step 53) until a communications signal, *e.g.* 100 Hz, is received by **receiver/detector 207** from **inverter 204** or **signaling block 420**. When the communications signal is received (decision block 505) indicating inverter 104 or 204 is 45 connected and converting power, safety mode (step 53) of operation ends.” *Id.*, 10:40-46.



Adest, Ex-1005, Figs. 4 and 4A.

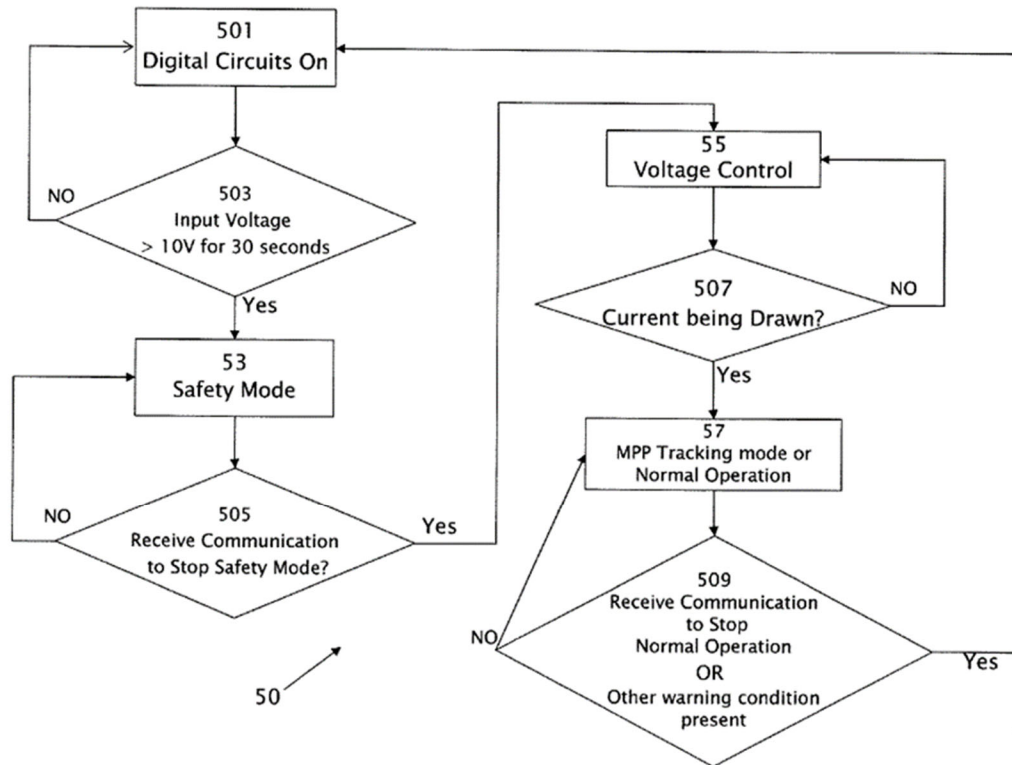


Fig. 5A

Adest, Ex-1005, Fig. 5

163. Thus, a person of ordinary skill in the art would have understood that the **detector/receiver 207** together with **controller 306** disclosed by Adest is a “**local controller.**”

164. A person of ordinary skill in the art would also have understood the **signal mechanism 420** of Adest also does perform the function of a **central controller** described in the '218 patent.

165. Even though the '218 patent does not describe the **central controller** in great detail, it provides exemplary configurations of a central controller. In particular, it states that a “controller communicates with a central controller” Ex-1001, 16:49-50.

166. Because **signal mechanism 420** of *Adest* is configured to transmit a 100 Hz periodic (*i.e.*, repeated) signal, a person of ordinary skill in the art would have understood **signal mechanism 420** of *Adest* to be a **central controller** described by the '218 patent. **Signal mechanism 420** triggers **controller 306** to have the switches close or open (*i.e.*, **controls** them) by either transmitting or not transmitting a periodic signal. *See* Ex-1005, 9:33-49.

167. Thus, a person of ordinary skill in the art would have understood **signal mechanism 420** also does perform the function of a “central controller” described in the '218 patent.

168. Accordingly, *Adest* discloses “the watchdog unit having: a local controller to monitor a communication from a central controller remote from the solar module and determine whether the communication is interrupted”

**c. [9C] “means to poll the central controller to determine if an interruption of the communication is transient;”**

169. In my opinion, *Adest* alone or in combination with the knowledge of a POSITA discloses/suggests this feature as discussed in Section X.B.5.b.

**d. [9D] “at least one switch to disconnect the solar module from the power bus if the interruption of the communication is not transient;”**

170. In my opinion, *Adest* discloses/suggests this feature as discussed in Sections X.B.5 and X.B.8.b.

- e. [9E] “wherein the watchdog unit is configured to connect the solar module to the power bus when the communication is not interrupted.”

171. In my opinion, *Adest* discloses this feature as discussed in Sections X.B.5.a, X.B.5.b, and X.B.8.b.

## 9. Claim 10

- a. “The system of claim 9, further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.”

172. In my opinion, *Adest* in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature.

173. As described in Section X.B.5.a, a person of ordinary skill in the art would have understood that the **watchdog unit** would be placed between the **solar module** and the **power bus**.

174. A person of ordinary skill in the art would also have understood that a junction box is an electrical enclosure that houses one or more wiring connections and the placement of the **watchdog unit** in a junction box would be immaterial as it would not alter the function of the **watchdog unit**.

175. In addition, the placement of the watchdog unit would not increase its effectiveness or improve its ability to act to shut down the **solar module**.

176. Accordingly, *Adest* in combination with the knowledge of a person of ordinary skill in the art discloses “The system of claim 9, further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.”

#### 10. Claim 11

- a. **“The system of claim 10, wherein the local controller is configured to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module.”**

177. In my opinion, *Adest* also discloses/suggests this claim feature of watchdog in addition to the disclosure of other watchdog features claimed in claim 6, claim 9, and claim 10 respectively as discussed in Sections X.B.5.a, X.B.8, and X.B.9.

178. In the '218 patent, it states “In some embodiments, the duty cycle of all local management units in a string or mesh can be changed, to increase or decrease the string voltage. The duty cycles may be adjusted to avoid exceeding the maximum voltage allowed.” Ex-1001, 10:47-50. Further “[i]n some embodiments, the duty cycle of one local management unit (1101) in a string can be changed to cause higher current in that local management unit (1101) and overall higher power harvesting.” *Id.*, 10:56-59.

179. In *Adest*, this feature is disclosed as it teaches that the **controller 306** may alternate the switches (e.g. switches 324 & 326 of buck converter) at a low duty-cycle in order to maintain a low output voltage. Ex-1005, 10:36-39. In addition, *Adest* further discloses “The **controller 306** may include a pulse width modulator, PWM, or a digital pulse width modulator, DPWM, to be used with the buck and boost converter circuits.” Ex-1005, 8:1-3. *Adest* also discloses that “[a]lternatively, the **controller 306** may alternate the switches (e.g. switches 324 & 326 of buck converter) at a low duty-cycle in order to maintain a low output voltage. Ex-1005, 10:36-39.

180. In terms of functionality, operation, purpose, etc., a person of ordinary skill in the art would have understood that the duty cycle disclosed in *Adest* is the same as the duty cycle shown in the '218 patent.

181. In addition, a person of ordinary skill in the art would also have understood that “the local controller is configured to operate using power from the **solar module**.” A person of ordinary skill in the art would have understood that a local controller (the **LMU**) could use some of the generated electricity from the solar panels in order to operate. Electricity would have to pass from the **solar panels** through the **LMU** in order to reach the **string bus** and the power grid. Ex-1001, Fig. 3. Therefore, the **LMU** would be able to use some of the electricity already passing through the system in order to power itself.

182. Accordingly, *Adest* discloses “The system of claim 10, wherein the local controller is configured to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module.”

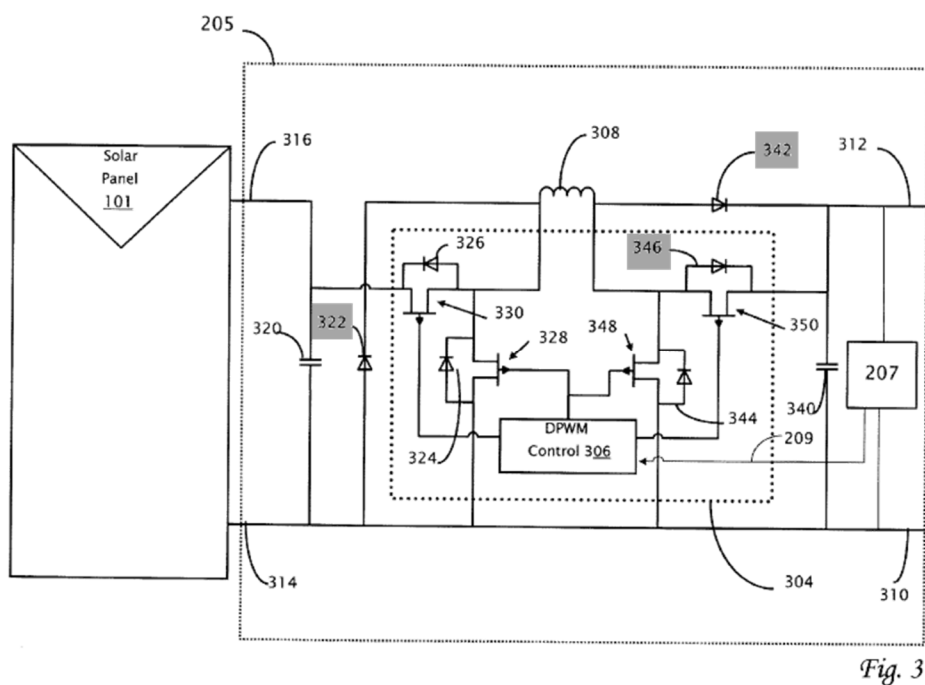
## 11. Claim 12

- a. **“The system of claim 9, further comprising a bypass circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus”**

183. In my opinion, *Adest* also discloses/suggests this claim feature.

184. For example, in addition to the disclosure of the feature claimed in claim 9 as discussed above in Section X.B.8, *Adest* further discloses “bypass circuits circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus.”

185. In Fig. 3, reproduced below, *Adest* discloses “**back-flow prevention diodes 322, 342.**” Ex-1005, 7:20-21.



*Adest*, Ex-1005, Fig. 3.

186. *Adest* discloses that electrical components “have one or more bypass routes associated with them that carry the current in case of an electrical component failing within one of converters 205.” Ex-1005, 8:48-56. The “parasitic diodes” allow for bypassing any “current from the output 312 to backflow into solar panel 101.” *Id.*, 7:23-28.

187. A person of ordinary skill in the art would understand that the presence of back-flow prevention diodes, as well as transistors that can be used to create a bypass electrical path, would create a bypass circuit to enable current to bypass the solar module.

188. Accordingly, *Adest* discloses “The system of claim 9, further comprising a bypass circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus.”

## 12. Claim 13

- a. **“The system of claim 9, wherein the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted.”**

189. In my opinion, *Adest* and/or *Kronberg* also discloses/suggests this claim feature.

190. As discussed above in Section X.B.1.c, the receiver/detector 207 detects that the 100 Hz communication is not being received. A person of ordinary skill in the art would have understood that to detect that a periodic signal, e.g. 100 Hz, is not being received, the detector would need to detect that at least one periodical signal is not received.

191. Furthermore, because the 100 Hz signal may sometimes be partially blocked by the inverter, in order to account for noise and interference, a person of ordinary skill in the art would have understood that detection of the 100 Hz signal would likely require a threshold of more than just only missing the signal for a predetermined period of time.

192. Therefore, with the knowledge and understanding of a person of ordinary skill in the art, *Adest* discloses “to determine an irregularity in periodicity of the communication to determine whether the communication is interrupted.”

**13. Claim 14**

- a. “The system of claim 9, further comprising the solar module; and a junction box coupled with the solar module to provide connectivity to the power bus, wherein the watchdog unit resides in the junction box.”**

193. In my opinion, *Adest* and/or *Kronberg* discloses/suggests this feature for the reasons provided above in Section X.B.9.

**14. Claim 15**

- a. [15A] “A method comprising:”**

194. In my opinion, *Adest* discloses/suggests this feature.

195. For example, *Adest* discloses “a method 50 for wake-up and shutdown of module 405, according to embodiments of the present invention.” Ex-1005, 10:14-15; *see also* 9:50-52; claims 13-18; Figs. 5, 5A, 6.

196. Accordingly, *Adest* discloses “A method comprising.”

- b. [15B] “monitoring a sensor for an anomaly by a master control unit (MMU);”**

197. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Section X.B.1.d.

- c. **[15C] “determining by the MMU if the sensor has detected an anomaly and, if the sensor has detected an anomaly, the MMU determining if the anomaly requires a control change; and”**

198. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Section X.B.1.e.

- d. **[15D] “issuing a control change command to a local management unit if the anomaly requires a control change, wherein the control change command is selected from the group consisting of: a command to shut down one or more solar modules; a command to disconnect one or more solar modules; a command to shut down one or more solar module strings; a command to alter the output of a solar module; a command to shutdown one or more LMUs; a command to disconnect one or more LMUs; a command to shutdown an inverter; a command to disconnect an inverter; a command to do nothing; and no command.”**

199. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.1.f and X.B.4.

## **15. Claim 16**

- a. **The method of claim 15, wherein the monitoring comprises one of: the MMU querying the sensor for the anomaly, and the sensor notifying the MMU of an anomaly.**

200. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.1.d, X.B.2, and X.B.3.

## 16. Claim 18

### a. [18A] “A computer-implemented method comprising:”

201. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Section X.B.14.a. Particularly, *Adest* discloses “a method 50 for wake-up and shutdown of module 405, according to embodiments of the present invention,” and can be implemented using “many different combinations of hardware, software, and firmware.” Ex-1005, 10:14-15, 11:55-52; *see also* 9:50-52; claims 13-18; Figs. 5, 5A, 6.

202. In addition, a person of ordinary skill in the art would have understood that this method could be implemented by a computer as a computer-based method. For example, local controller claimed in claims 9, and 11 could be run by a computer device.

203. Accordingly, *Adest* discloses “A computer-implemented method comprising.”

### b. [18B] “monitoring, via a computing device, a signal from a central controller remote from the computing device;”

204. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.1.b, X.B.1.c., X.B.8.b, and X.B.16.a.

**c. [18C] “determining, via the computing device, if there is a loss of signal;”**

205. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.1.b, X.B.1.c, X.B.8.b, X.B.16.a.

**d. [18D] “polling, via the computing device, the central controller to determine if the loss of signal is transient;”**

206. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.5.b, X.B.1.c, X.B.8.c, X.B.16.a.

**e. [18E] “disconnecting, via the computing device, one or more solar modules from a power bus if the loss of signal is not transient, the power bus configured to connect a plurality of solar modules to an inverter;”**

207. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.5, X.B.8.d, and X.B.16.a.

**f. [18F] “waiting, via the computing device, for a restart signal; and”**

208. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.5, X.B.8.b, and X.B.16.a. Particularly, *Adest* discloses that “**controller 306** maintains safety mode operation (step 53) until a communications signal, *e.g.* 100 Hz, is received by **receiver/detector 207** from **inverter 204** or **signaling block 420**. When the communications signal is received (decision block 505) indicating inverter 104 or 204 is 45 connected and converting

power, safety mode (step 53) of operation ends.” *Id.*, 10:40-46. Additionally, Figs. 5, 5A, 6 of Adest also appear to show restart checks

**g. [18G] “connecting, via the computing device, the one or more solar modules to the power bus when the restart signal is received.”**

209. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.5, X.B.8.b, X.B.16.a, and X.B.16.f.

#### **17. Claim 19**

**a. “The method of claim 18, further comprising: enabling, via the computing device, a bypass circuit when the one or more solar modules are disconnected from the power bus, so that current continues to flow in the power bus.”**

210. In my opinion, *Adest* discloses/suggests this feature for the reasons provided above in Sections in Sections X.B.11.

#### **C. Ground 2: Adest, Kronberg, and/or Goldack Renders Obvious Claims 1-4, 6-16, and 18-19**

##### **1. Claims 1-4**

211. As explained above, *Adest* discloses/suggests or renders obvious the features of claims 1-4, as discussed in Sections X.B.1–X.B.4.

2. Claim 6

- a. [6A] “The system of claim 1, further comprising: a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU);”

212. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.5.a.

- b. [6B] “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times;”

213. In my opinion, *Adest* in combination with knowledge of a POSITA, or *Adest* in combination with *Kronberg* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.5.b.

214. Further, to the extent that Patent Owner or the Board disagrees that *Adest* in combination with knowledge of a POSITA, or *Adest* in combination with *Kronberg* disclose “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times,” *Goldack* discloses this feature.

215. *Goldack* discloses the transmission of “a first signal” via power line to the release device, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract. The signals contain at least one pulse. *Id.* at 2:25-

27. The code sent by the signal “can be varied in shape, length, and number of the pulses.” *Id.* at 4:4-5. Communication can take place either via wires or wirelessly. *Id.* at 4:11.

216. A person of ordinary skill in the art could combine the polling described in *Goldack* with the MMU/LMU of *Adest* and the watchdog unit of *Kronberg* to sends polls to the MMU up to a specified number of times as the limitation in this claim. The polling of *Goldack* could be used as part of the MMU/LMU and watchdog unit system of *Adest* alone or in combination with *Kronberg* to poll the LMU.

217. A person of ordinary skill in the art would be motivated to combine *Goldack* with *Adest* and *Kronberg* as all prior art is directed to solar module handling and operational safety.

218. *Adest* is concerned with safety in distributed power installations. *See, e.g.* Ex-1005, Title; 3:47-59 (noting that “during the safety mode, the power at the output of the power module, the voltage across the output of the power module, and/or the current flowing through it, are limited so as to not endanger personnel”); 5:21-29 (noting that the present invention has “important safety benefits” for those “installing or performing maintenance on photovoltaic systems”).

219. Similarly, *Kronberg* is concerned with the same safety concerns. *See, e.g.* Ex-1006, Title; 2:5-8 (noting that “an object of the invention” is for “shutting

down process equipment in the event of control equipment failure”). *Goldack* similarly deals with disabling power transfer in the absence of a solar module, for example due to theft, like the ’218 patent. *See* Ex-1001 at 17:24-30, 2:36-47; Ex-1007 at Abstract, 2:47-50.

220. Furthermore, *Goldack* also discloses that in the event there has not been a second signal returned to it after sending the first signal “the activator means 21 activates the switching device 22 such that the power transfer is disabled.” Ex-1007, 5:41-48; *see also* 4:64-5:14. The ’218 patent also focuses on absence of a solar module due to theft, stating that “the system would send an alarm indicating a possible security breach, such as a wire being cut or a panel being removed.” Ex-1001, 18:38-40.

221. Therefore, a POSITA would have looked to *Goldack* as a solar module safety-related patent that added polling to the MMU described in *Adest*. The combination of the MMU/LMU and watchdog disclosed by *Adest* alone or in combination with *Kronberg* would be able to incorporate the security system articulated in *Goldack* to monitor the safety of the solar panel system. *Adest*, *Kronberg*, and *Goldack* contemplate that in the absence of a returning signal, the system should be shut down, deactivated, or undergo a decrease in voltage.

222. A POSITA would also have had a reasonable expectation of success with combining *Adest* and *Kronberg* with *Goldack*. For example, the addition of

*Goldack* would have permitted the system comprising *Adest* and *Kronberg* to poll the MMU in the event of an absence of signal to verify if equipment is still operational.

223. *Goldack* discloses the detection of a variety of signals, which could vary in “shape, length and number of the pulses.” Ex-100X, 4:1-5. *Goldack* would thus be able to detect the 100 Hz pulses described from *Adest*.

224. All three pieces of prior art also contemplate that in the absence of a signal, that the system should be shut down, deactivated, or undergo a decrease in voltage, demonstrating that the addition of *Goldack* would not disrupt the execution of *Adest* or *Kronberg*.

225. Accordingly, it would have been obvious to a POSITA to use the polling described in *Goldack* in combination with the watchdog unit of *Kronberg* and the implementation of the MMU/LMU taught by *Adest* to disclose “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times.”

- c. **[6C] “wherein if the watchdog unit receives no response after completing the polls, receives a command to modify operation of a solar module, or receives an inappropriate response, then the watchdog unit issues an instruction to the respective LMU to modify operation of the solar module.”**

226. In my opinion, *Adest* alone or in combination with the knowledge of a POSITA discloses/suggests this feature/limitation for the reasons provided above in Section X.B.5.c.

227. To the extent Patent Owner and/or the Board disagrees that *Adest* alone or in combination with the knowledge of a person of ordinary skill in the art suggests this limitation, *Adest* in combination with *Kronberg* discloses or suggests this feature as discussed in Section X.B.5.c.

### **3. Claim 7**

- a. **“The system of claim 6, wherein the respective LMU comprises the watchdog unit.”**

228. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.1 and X.B.2.

4. **Claim 8**

- a. **“The system of claim 6, wherein the instruction is selected from the group consisting of an instruction to shut off the solar module, an instruction to disconnect the solar module from the solar array, and an instruction to reduce the output power of the solar module.”**

229. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.4 and X.B.5.

5. **Claim 9**

- a. [9A] **“The system of claim 1, further comprising: a watchdog unit coupled between a solar module and a power bus, the power bus configured to connect a plurality of solar modules to an inverter,”**

230. In my opinion, *Adest* alone or in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.5.

231. To the extent Patent Owner and/or the Board disagrees that *Adest* alone or in combination with the knowledge of a person of ordinary skill in the art suggests this limitation, *Adest* in combination with *Kronberg* discloses or suggests this feature as discussed in Section X.B.5.

- b. [9B] “the watchdog unit having: a local controller to monitor a communication from a central controller remote from the solar module and determine whether the communication is interrupted;”**

232. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.8.b.

- c. [9C] “means to poll the central controller to determine if an interruption of the communication is transient;”**

233. In my opinion, *Adest* alone or in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.5.a.

234. To the extent that Patent Owner or the Board disagrees that *Adest* and knowledge of a POSITA disclose “means to poll the central controller to determine if an interruption of the communication is transient,” *Goldack* discloses this feature.

235. *Goldack* discloses the transmission of “a first signal” via power line to the release device, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract. The signals contain at least one pulse. *Id.*, 2:25-27. The code sent by the signal “can be varied in shape, length, and number of the pulses.” *Id.*, 4:4-5. When the code has not received a second signal in a predefined time, power output is disabled. *Id.*, 2:13-16. Communication can take place either via wires or wirelessly. *Id.*, 4:11.

236. A POSITA could use the polling described in *Goldack* with the MMU/LMU of *Adest* and the watchdog unit of *Kronberg* to poll the MMU a specified number of times.

**d. [9D] “at least one switch to disconnect the solar module from the power bus if the interruption of the communication is not transient;”**

237. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.8.b.

**e. [9E] “wherein the watchdog unit is configured to connect the solar module to the power bus when the communication is not interrupted.”**

238. In my opinion, *Adest* alone or in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.5.

239. To the extent that Patent Owner or the Board disagrees that *Adest* and knowledge of a POSITA disclose a “watchdog unit,” *Goldack* discloses this feature for the reasons provided above in Sections IX.C.5.

240. *Kronberg* discusses the situation of shutting off power versus normal operation. During “[t]he delay of an expected event opens heavy-duty relays to shut off power to process equipment.” Ex-1007, 2:17-19. However, “[d]uring normal operation these relays are closed so that the switch is transparent to main controller signals.” *Id.*, 2:19-21.

**6. Claim 10**

- a. “The system of claim 9, further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.”**

241. *Adest* in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.9.

**7. Claim 11**

- a. “The system of claim 10, wherein the local controller is configured to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module.”**

242. *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.10.

**8. Claim 12**

- a. “The system of claim 9, further comprising a bypass circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus”**

243. *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.11.

**9. Claim 13**

- a. “The system of claim 9, wherein the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted.”**

244. *Adest* discloses/suggests this feature.

245. As discussed above in Section X.B.1.c, the receiver/detector 207 detects that the 100 Hz communication is not being received.

246. A POSITA would understand that to detect that a periodic signal 100 Hz is not being received, the detector would need to detect that at least one “heartbeat” is not received (i.e., is skipped).

247. Furthermore, because the 100 Hz signal may be partially blocked by the inverter, in order to account for noise and interference, a POSITA would understand that detection of the 100 Hz signal would likely require a threshold of more than one skip.

248. Therefore, a POSITA would understand that *Adest* discloses an irregularity in periodicity of the communication.

249. To the extent that Patent Owner or the Board disagrees that *Adest* discloses “wherein the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted,” *Goldack* discloses this feature.

250. *Goldack* discloses the transmission of “a first signal” via power line to the release device, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract. The signals contain at least one pulse. *Id.* at 2:25-27. The code sent by the signal “can be varied in shape, length, and number of the pulses.” *Id.* at 4:4-5. Communication can take place either via wires or wirelessly. *Id.* at 4:11.

251. Accordingly, *Adest* in combination with the implement of *Goldack* discloses the limitation of this claim as “the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted.”

#### **10. Claim 14**

- a. “The system of claim 9, further comprising the solar module; and a junction box coupled with the solar module to provide connectivity to the power bus, wherein the watchdog unit resides in the junction box.”**

252. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.13.

#### **11. Claim 15**

- a. [15A] “A method comprising:”**

253. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.14.a.

**b. [15B] “monitoring a sensor for an anomaly by a master control unit (MMU);”**

254. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.14.b.

**c. [15C] “determining by the MMU if the sensor has detected an anomaly and, if the sensor has detected an anomaly, the MMU determining if the anomaly requires a control change; and”**

255. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.14.c.

**d. [15D] “issuing a control change command to a local management unit if the anomaly requires a control change, wherein the control change command is selected from the group consisting of: a command to shut down one or more solar modules; a command to disconnect one or more solar modules; a command to shut down one or more solar module strings; a command to alter the output of a solar module; a command to shutdown one or more LMUs; a command to disconnect one or more LMUs; a command to shutdown an inverter; a command to disconnect an inverter; a command to do nothing; and no command.”**

256. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.14.d.

**12. Claim 16**

- a. The method of claim 15, wherein the monitoring comprises one of: the MMU querying the sensor for the anomaly, and the sensor notifying the MMU of an anomaly.**

257. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Sections X.B.15.

**13. Claim 18**

- a. [18A] “A computer-implemented method comprising:”**

258. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.a.

- b. [18B] “monitoring, via a computing device, a signal from a central controller remote from the computing device;”**

259. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.b.

- c. [18C] “determining, via the computing device, if there is a loss of signal;”**

260. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.c.

- d. [18D] “polling, via the computing device, the central controller to determine if the loss of signal is transient;”**

261. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.d.

- e. **[18E] “disconnecting, via the computing device, one or more solar modules from a power bus if the loss of signal is not transient, the power bus configured to connect a plurality of solar modules to an inverter;”**

262. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.e.

- f. **[18F] “waiting, via the computing device, for a restart signal; and”**

263. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.f.

- g. **[18G] “connecting, via the computing device, the one or more solar modules to the power bus when the restart signal is received.”**

264. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.16.g.

#### **14. Claim 19**

- a. **“The method of claim 18, further comprising: enabling, via the computing device, a bypass circuit when the one or more solar modules are disconnected from the power bus, so that current continues to flow in the power bus.”**

265. In my opinion, *Adest* discloses/suggests this feature/limitation for the reasons provided above in Section X.B.17.

**D. Ground 3: Moine and Adest Render Obvious Claims 1-5, 15-17**

**1. Claim 1**

**a. [1A] “A system comprising:”**

266. I understand that “A system comprising:” is the preamble to claim 1 of the '218 patent. I have been asked to assume that the preamble is a claim limitation. Under that assumption, in my opinion *Moine* discloses/suggests this feature. Ex-1008, Abstract. For example, *Moine* discloses “a system for controlling an electric power production facility comprising a number of photovoltaic modules mounted in series and/or in parallel in order to constitute an electrical circuit for powering a storage battery or powering an electrical load” *Id.*, 3:11-14.

**b. [1B] “a master management unit (MMU); and”**

267. In my opinion, this limitation/feature is disclosed/suggested by *Moine* with the understanding of a person of ordinary skill in the art.

268. The teaching of '218 patent concerning this feature was discussed in Section X.B.1.b above.

269. *Moine* discloses a **transmitter (7)** in the same configuration as with the **MMU** of the '218 patent and the understanding of a person of ordinary skill in the art.

270. For example, *Moine*'s Figure 1, reproduced below, shows a “**receiver (5)**” controlling a “**switch (4)**,” a “**circuit (1)**,” a plurality of “**photovoltaic power**

modules (3),” and an “inverter (6).” See also, Ex-1008, 4:33-5:27. Transmitter (7) is remote from photovoltaic power modules (3).

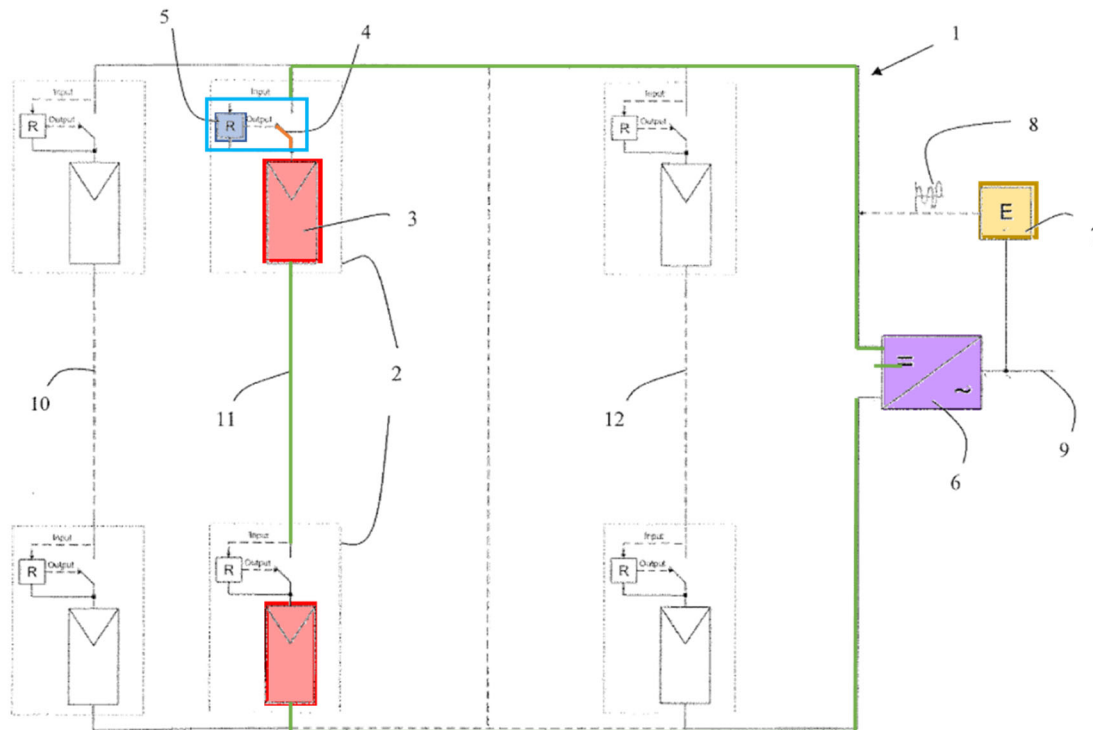


Figure 1

Moine, Ex-1008, Fig. 1 (annotated).

271. In addition, in *Moine*, this signal is coded (in particular in frequency and / or in amplitude) and detected by the receiver (5). Ex-1008, 5:34-36.

272. Further, the receiver (5) is configured to monitor a “periodic transmission of [a] *coded alternating signal*” (alternating signal 8) from a transmitter (7). Ex-1008, 6:1-5.

273. As such, if the transmitter (7) detects the absence of current at the level of the domestic electrical network (9) or a fault at this level, it stops the periodic transmission of the alternative coded signal on the circuit (1), of which the absence

identified by the receivers (5) induces the opening by the latter of the corresponding switches (4). Ex-1008, 6:1-5.

274. Because **transmitter (7)** of *Moine* is configured to transmit a periodic (i.e., repeated) signal, a POSITA would have understood **transmitter (7)** of *Moine* to be one of the configurations of the **MMU/central controller** described by the '218 patent. **Transmitter (7)** transmits the alternating signal “according to a set timing.” *Id.*, 7:1-4.

275. *Moine* gives an example of one such “set timing” as five minutes. Ex-1008, 7:1-4. If **transmitter (7)** stops transmitting the alternating signal, the **receiver (5)** is configured to identify the absence of the alternating signal. *Id.* Thus, **receiver (5)** is able to detect when communication with **transmitter (7)** has been interrupted. *Id.*, 6:1-5.

276. **Transmitter (7)** causes the switches to close or open (*i.e.*, controls them) in a number of different scenarios (*e.g.*, when fees have not been paid or when a battery is full) by either transmitting or not transmitting a periodic signal. Ex-1008, 7:1-28.

277. Thus, a person of ordinary skill in the art would have understood **transmitter (7)** to be a “**MMU**.” Accordingly, in my opinion, *Moine* discloses “a master management unit (**MMU**).”

c. [1C] “a local management unit (LMU) in communication with the master management unit (MMU), the LMU controlling one or more solar modules;”

278. In my opinion, this limitation/feature is disclosed/suggested by *Moine* with the understanding of a person of ordinary skill in the art.

279. The teaching of '218 patent concerning this feature was discussed in Section X.B.1.c above.

280. A POSITA would have understood that **receiver (5)** and **switch (4)** of *Moine* are together the claimed “**LMU (watchdog unit)**” of the '218 patent. In the '218 patent, the **LMU** receives input from the **MMU** and controls the operation of the solar panels. Ex-1001, 7:6-10; 16:63-17:3; 18:29-36.

281. Similarly, in *Moine*, the **receiver (5)** controls the operation of a transistor that opens and closes **switch (4)** based on signals that it receives from **transmitter(7)**. Ex-1008, 5:20-22, 6:1-5. (“the operation of this transistor is *controlled* by a **receiver (5)** capable of causing said **switch (4)** to open or close according to a coded signal”).

282. The **receiver (5)** of *Moine* is configured to monitor a “periodic transmission of [a] *coded alternating signal*” (**alternating signal 8**) from a **transmitter (7)**. Ex-1008, 6:1-5. Upon detecting the absence of the coded alternating signal, the **receiver (5)** causes **switch (4)** to open and thus “powers down” the circuit. *Id.*

283. When the **switch (4)** is open, the **photovoltaic power module (3)** is no longer connected to the **circuit (1)**. Ex-1008, 6:6-10. Thus, a POSITA would have understood that **receiver (5)** and **switch (4)** are together the claimed “**LMU (watchdog unit)**.”

284. As shown in the annotated Fig. 1 of *Moine*, the **LMU (watchdog unit)** of *Moine* is connected between a **photovoltaic power module (3)** and **circuit (1)**. The **photovoltaic power modules (3)** shown in Figure 1 “convert solar radiation into direct electrical current.” Ex-1008, 5:5-7. Thus, a person of ordinary skill in the art would have understood that each **photovoltaic power module (3)** is a “**solar module**.” As shown in Figure 1, **circuit (1)** is a conductive path connecting multiple **photovoltaic power modules (3)** in series to an **inverter (6)**, thus a POSITA would have understood that **circuit (1)** is the recited **power bus**.

285. As disclosed above, the transmitter sends a signal to a receiver which controls a switch. The receiver can receive signals by radio waves or wiring. Ex-1008, 3:27-30. Once the receiver opens the switch, the modules are no longer connected to the circuit. *Id.*, 6:7-10. When a receiver does not detect the periodic alternating signal either due to instruction or its own power failure, the switches open and the circuit is powered off. *Id.*, 7:6-9.

286. Accordingly, in my opinion, *Moine* discloses “a local management unit (LMU) in communication with the master management unit (MMU), the LMU controlling one or more solar modules.”

**d. [1D] “wherein the MMU is connected to at least one sensor, the sensor configured to detect an anomaly; and”**

287. In my opinion, *Moine* discloses/suggests this feature.

288. In *Moine*, it states that if the transmitter (7) **detects** the absence of current at the level of the domestic electrical network (9) or a fault at this level, it stops the periodic transmission of the alternative coded signal on the circuit (1). Ex-1008, 6:1-5.

289. It also states that the transmitter (7) “receives signals indicating the charge level of said battery and if it detects that the battery is fully charged, it then opens the switches (4) and accordingly stops recharging said battery.” *Id.*, 7:23-25.

290. A person of ordinary skill in the art would have understood that at least one sensor would be connected to the transmitter (7) for detecting the absence of current and/or battery charging.

291. Accordingly, in my opinion, *Moine* discloses ““wherein the MMU is connected to at least one sensor, the sensor configured to detect an anomaly.”

- e. [1E] “wherein upon detection of the anomaly by the sensor, the MMU sends a command to the LMU to alter the state of an associated solar module; and”

292. In my opinion, *Moine* discloses/suggests or renders obvious this feature, either alone or with Adest.

293. As discussed above in Sections X.D.1.b and X.D.1.d, *Moine* states that if the transmitter (7) **detects** the absence of current at the level of the domestic electrical network (9) or a fault at this level, it stops the periodic transmission of the alternative coded signal on the circuit (1). Ex-1008, 6:1-5.

294. The **receiver (5)** controls “**switch (4)** to open or close according to a coded signal sent as an alternating signal through the power circuit (1).” Ex-1008, 5:19-21. In particular, as discussed above, in the absence of the signal (*i.e.*, when it is interrupted), the **receiver (5)** controls the switch to disconnect the solar module from the power bus. Accordingly, *Moine* discloses a LMU (watchdog unit) “wherein upon detection of the anomaly by the sensor, the MMU sends a command to the LMU to alter the state of an associated solar module.”

295. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “detection of the anomaly by the sensor, the MMU sends a command to the LMU to alter the state of an associated solar module,” it is my opinion that the combination with *Moine* and *Adest* discloses this feature.

296. *Adest* discloses this feature in Sections X.B.1.e and X.B.8 above.

297. In Section X.B.1.e above, as the exemplary embodiment of *Adest*, as long as a signal (*e.g.*, a 100Hz signal) is received by power module 405 from signaling mechanism 420, normal mode continues. Ex-1005, 9:34-49; 10:40-46.

298. However, if power module 405 either 1) fails to receive 100Hz signals or 2) receives communication to stop normal operation or other warning condition present, the normal mode is typically ended and power modules is then typically turned off. Ex-1005, 10-9-12; 10:59-62; Fig. 5A.

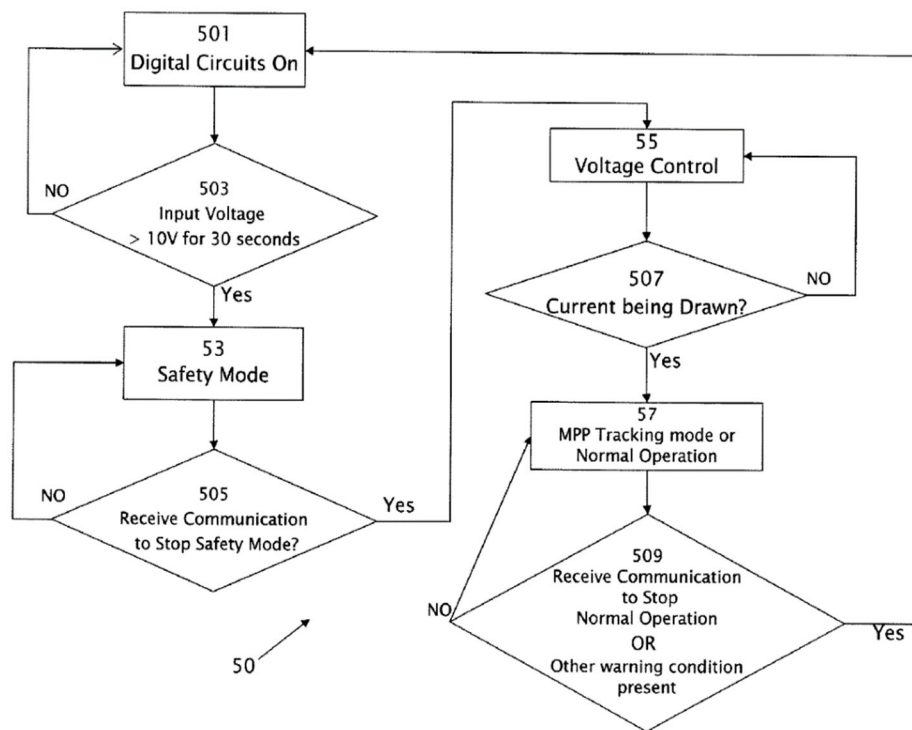


Fig. 5A

*Adest*, Ex-1005, Fig. 5A.

299. A person of ordinary skill in the art would have been motivated to combine *Moine* with *Adest* to render this limitation obvious.

300. In particular, *Moine* was known technique for improving the safety of photovoltaic power systems, which is the same as *Adest*. *Moine* recognizes safety

issues inherent to photovoltaic power systems and in particular that the voltage “produced by photovoltaic modules, can easily exceed the normative value of 120 volts, which is a safety limit, and can easily reach several hundred volts, i.e., a voltage that is largely sufficient to electrocute” firefighters who may be on a roof. Ex-1008, 2:27-33.

301. *Adest* is also directed to safety mechanisms for waking up and shutting down equipment in distributed power systems that has an operational safety mode. Ex-1005, Title, Figs. 5, 5A. A POSITA would have recognized that safety problem is equally present in *Moine* and *Adest*, would have apply some safety teachings of *Adest* to *Moine* for improvement, e.g., receiving communication to stop normal operation or other warning condition present, the normal mode is typically ended and power modules is then typically turned off.

302. A POSITA would have had a reasonable expectation of success using the system of *Adest* to establish that an MMU sends a command to the LMU to alter the state of an associated solar module. As noted above, *Moine* uses the receiver (5) to control a switch (4) to disconnect the solar panel in the event that communication signal is no longer received from the transmitter (7). *Adest* utilizes a similar system to *Moine* in that in the interruption of a signal, normal operation ends. A POSITA would have a reasonable expectation of success of utilizing a similar system with modifications.

303. In addition, to my knowledge, in another IPR petition, IPR2021-01287, the Board determined that it would be obvious to combine the teachings of *Moine* and another patent in the same *Adest* family, U.S. Patent No. 9,088,178 to Adest et al. (“*Adest* ’178”), which has a similar disclosure to *Adest*. See Ex-1010 (IPR2021-01287, Paper No. 27 (Final Written Decision)) at 46.

304. For similar reasons to those adopted by the Board in IPR2021-01287, a person of ordinary skill in the art would have been motivated to combine *Adest* and *Moine* here with the reasonable expectation of success as the IPR2021-01287 agreed by the Board.

**f. [1F] “wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with command.”**

305. In my opinion, *Moine* discloses/suggests this feature/limitation for the reasons provided above in Sections X.D.1.b and X.D.1.e.

306. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with command,” the combination with *Moine* and *Adest* discloses this feature. As discussed, *Adest* discloses this feature in Sections X.B.1.e, X.B.8 and X.D.1.e above.

## 2. Claim 2

### a. “The system of claim 1, wherein the MMU queries the sensor for the anomaly.”

307. In my opinion, *Moine* discloses/suggests this feature/limitation for the reasons provided above in Section X.D.1.

308. Particularly, in the event that “the transmitter (7) detects a lack of current in the domestic power supply network (9) or a failure thereof,” the periodic transmission of the coded signal ends, causing the switches to be opened and the circuit powers down. *Id.* at 6:1-5.

309. Accordingly, in my opinion, *Moine* discloses “[t]he system of claim 1, wherein the MMU queries the sensor for the anomaly.”

## 3. Claim 3

### a. “The system of claim 1, wherein the sensor notifies the MMU of the anomaly.”

310. In my opinion, *Moine* discloses/suggests this feature/limitation for the reasons provided above in Section X.D.1.

311. Further, to the extent that Patent Owner or the Board disagrees that *Moine* discloses the sensor notifying the MMU of the anomaly, a person of ordinary skill in the art would have understood that the sensor would notify the MMU of the anomaly, as it is a simple logical conclusion of the function of a sensor.

312. Moine has multiple different sensors. To give effect to the use of these sensors, either a component must query the sensor for its results or the sensor must provide its results to a component.

313. Accordingly, *Moine* discloses “The system of claim 1, wherein the sensor notifies the MMU of the anomaly.”

#### 4. Claim 4

- a. **“The system of claim 1, wherein the command is selected from the group consisting of: a command to shutdown the module; a command to disconnect the module; and a command to alter the output of the module.”**

314. In my opinion, *Moine/Adest* discloses/suggests this feature.

315. The receiver (5) of *Moine* controls “switch (4) to open or close according to a coded signal sent as an alternating signal through the power circuit (1).” Ex-1008, 5:19-21.

316. In particular, as discussed above, in the absence of the signal (i.e., when it is interrupted), the receiver (5) controls the switch to disconnect the solar module from the power bus. For more details, please refer to Sections X.D.1.b and X.D.1.e above.

317. Additionally, if needed, Adest discloses/suggests this feature. See Section X.B.4.a.

318. A person of ordinary skill in the art would have understood that the opening of the switch would cause a shutdown, disconnect, and alteration of the output of the module.

319. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “wherein the command is selected from the group consisting of: a command to shutdown the module; a command to disconnect the module; and a command to alter the output of the module,” the combination with *Moine* and *Adest* discloses this feature.

## **5. Claim 5**

### **a. “The system of claim 1 wherein: the MMU is connected to a network; and the sensor is connected to a network.”**

320. In my opinion, *Moine* discloses/suggests this feature.

321. *Moine* discloses in a system for controlling an electric power production facility incorporating an electric switch that a periodic signal that “control[s] the opening and closing of the circuit” “can be transmitted by radio waves.” Ex-1008, 3:11-28.

322. The signal can also be transmitted by wiring. Ex-1008, 3:30-32. In addition, *Moine* further disclosed that the transmitter of *Moine* as MMU of the '218 patent discussed above is provided with means capable of receiving remote control

signals, such as for example a radio wave receiver, or a switch of the telephone network. *Id.*, 4:13-17.

**6. Claim 15**

**a. [15A] “A method comprising:”**

323. In my opinion, *Moine* discloses/suggests this feature.

324. In *Moine*, it states that “[t]he invention relates to the general field of electric power production **by means** of photovoltaic panels or modules.” Ex-1008, 1:5-9.

325. Also, *Moine* further discloses that “[i]t relates more specifically to an electric power generation facility. Such facilities **implement** said photovoltaic modules as electric generators, and furthermore incorporate one or several devices capable of storing the electricity thus produced, in particular one or several batteries, or can even be connected to the domestic power” via an inverter. Ex-1008, 1:11-15.

326. Accordingly, *Moine* discloses “A method comprising.”

**b. [15B] “monitoring a sensor for an anomaly by a master control unit (MMU);”**

327. In my opinion, *Moine* discloses/suggests this feature for the reasons provided above in Section X.D.1.c.

- c. [15C] “determining by the MMU if the sensor has detected an anomaly and, if the sensor has detected an anomaly, the MMU determining if the anomaly requires a control change; and”

328. In my opinion, *Moine* discloses/suggests this feature for the reasons provided above in Section X.D.1.d.

- d. [15D] “issuing a control change command to a local management unit if the anomaly requires a control change, wherein the control change command is selected from the group consisting of: a command to shut down one or more solar modules; a command to disconnect one or more solar modules; a command to shut down one or more solar module strings; a command to alter the output of a solar module; a command to shutdown one or more LMUs; a command to disconnect one or more LMUs; a command to shutdown an inverter; a command to disconnect an inverter; a command to do nothing; and no command.”

329. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1.d and X.D.1.e.

330. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “issuing a control change command to a local management unit if the anomaly requires a control change, wherein the control change command is selected from the group consisting of: a command to shut down one or more solar modules; a command to disconnect one or more solar modules; a command to shut down one or more solar module strings; a command to alter the output of a solar module; a command to shutdown one or more LMUs; a command to disconnect one or more

LMUs; a command to shutdown an inverter; a command to disconnect an inverter; a command to do nothing; and no command,” the combination with *Moine* and *Adest* discloses this feature. *Adest* discloses this feature in Section X.B.1.e and X.B.4 above.

**7. Claim 16**

- a. “The method of claim 15, wherein the monitoring comprises one of: the MMU querying the sensor for the anomaly, and the sensor notifying the MMU of an anomaly.”**

331. In my opinion, *Moine* discloses/suggests this feature for the reasons provided above in Sections X.D.1 and X.D.2.

**8. Claim 17**

- a. “The method of claim 15, wherein: the MMU is connected to a network; and the sensor is connected to a network.”**

332. In my opinion, *Moine* discloses/suggests this feature for the reasons provided above in Section X.D.5.

**E. Ground 4: *Moine*, *Adest*, and/or *Goldack* Renders Obvious Claims 1-4, 6-14, 18-19**

**1. Claims 1-4**

333. *Adest* discloses/suggests or renders obvious the features of these claims, as discussed in Sections X.B.1–X.B.4.

## 2. Claim 6

- a. [6A] **“The system of claim 1, further comprising: a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU);**

334. In my opinion, *Moine* discloses/suggests this feature for the reasons provided above in Section X.D.1.

335. To the extent that Patent Owner or the Board disagrees that *Moine* and the knowledge of a person of ordinary skill in the art disclose a “watchdog unit,” *Adest* discloses this feature. *Adest* discloses this feature, as discussed in Section X.B.5. Ex-1005, 2:30-32.

- b. [6B] **“wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times;”**

336. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature. *Moine* in combination with *Adest* discloses this limitation. Particularly, *Adest* disclosed this limitation as discussed in Sections X.B.5.a and X.B.5.b.

337. Further, to the extent that Patent Owner or the Board disagrees that *Moine* in combination with *Adest* discloses “wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times,” *Goldack* discloses this feature.

338. *Goldack* discloses the transmission of “a first signal” from the interruption device as of watch dog unit in the ’218 patent via power line to the release device as of the MMU in the ’218 patent, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract.

339. The signals contain at least one pulse. Ex-1007, at 2:25-27. The code sent by the signal “can be varied in shape, length, and number of the pulses.” *Id.* at 4:4-5. Communication can take place either via wires or wirelessly. *Id.* at 4:11.

340. A person of ordinary skill in the art would be motivated to combine *Goldack* with *Moine* as all prior art is directed to solar module handling and operational safety. *Moine* is concerned with safety in voltage control for first responders. Ex-1008, 2:26-33.

341. *Goldack* similarly deals with disabling power transfer in the absence of a solar module, e.g. the solar module was stolen. Ex-1007, 1:64-44; 2:47-50.

342. Further, *Moine* discloses that it is also a theft solution. Ex-1008, 3:4-7.

343. *Goldack* discloses further that it is used as a protection against theft or unauthorized use. Ex-1007, Abstract.

344. The ’218 patent also focuses on absence of a solar module due to theft, stating that “the system would send an alarm indicating a possible security breach, such as a wire being cut or a panel being removed.” Ex-1001, 18:38-40.

345. *Goldack* discloses a first signal initiates sending of the second signal and power transfer is disabled when the second signal is not received. Ex-1007, 5:21-48, 4:64-5:14.

346. A person of ordinary skill in the art would have looked to *Moine* as a solar module safety-related patent that added sensor notification to the MMU described in *Goldack*. *Moine* and *Goldack* contemplate that a sensor notifies the MMU of the anomaly.

347. A person of ordinary skill in the art would also have a reasonable expectation of success of combining the teachings of *Moine* with the teachings of *Goldack*.

348. *Moine* possesses the requisite MMU, LMU, and watchdog unit. *Moine* and *Goldack* both monitor signals passing through a solar panel system. The receiver of *Moine* could integrate the polling feature of the solar module-sited disabling device of *Goldack* as both would be in the same location monitoring for signals. A POSITA would recognize that the inclusion of the polling into the receiver would permit for polling of the MMU as the solar module-sited disabling device polls the consumer-sited enabling device.

349. The addition of *Goldack* would have permitted the system comprising *Moine* to send polls to the MMU in the event of an absence of signal to verify if equipment is still operational.

350. The pieces of prior art also contemplate that in the absence of a signal, that the system should be shut down, deactivated, or undergo a decrease in voltage, demonstrating that the addition of *Goldack* would not disrupt the execution of *Moine*.

351. A POSITA could reasonably use signal transmission process described in *Goldack* as polling of the '218 patent with the MMU, LMU, and the watchdog unit of *Moine* as described above to poll the MMU a specified number of times.

- c. **[6C] “wherein if the watchdog unit receives no response after completing the polls, receives a command to modify operation of a solar module, or receives an inappropriate response, then the watchdog unit issues an instruction to the respective LMU to modify operation of the solar module.”**

352. In my opinion, *Moine* in combination with Adest discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.4, and Section X.B.5.

### **3. Claim 7**

- a. **“The system of claim 6, wherein the respective LMU comprises the watchdog unit.”**

353. In my opinion, *Moine* in combination with Adest discloses/suggests this feature for the reasons provided above in Sections X.D.1 and X.B.6.

4. **Claim 8**

- a. **“The system of claim 6, wherein the instruction is selected from the group consisting of an instruction to shut off the solar module, an instruction to disconnect the solar module from the solar array, and an instruction to reduce the output power of the solar module.”**

354. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.4, X.D.6, and X.B.7.

5. **Claim 9**

- a. [9A] **“The system of claim 1, further comprising: a watchdog unit coupled between a solar module and a power bus, the power bus configured to connect a plurality of solar modules to an inverter”**

355. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.B.1, and X.B.5.a.

- b. [9B] **“the watchdog unit having: a local controller to monitor a communication from a central controller remote from the solar module and determine whether the communication was interrupted;”**

356. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.B.1, and X.B.5.b.

- c. [9C] **“means to poll the central controller to determine if an interruption of the communication is transient;”**

357. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.B.1, and X.B.8.

358. Further, to the extent that Patent Owner and the Board disagrees that *Moine* in combination with *Adest* discloses a “means to poll,” *Goldack* discloses this feature.

359. *Goldack* discloses the transmission of “a first signal” via power line to the release device, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract.

360. The signals contain at least one pulse. Ex-1007, at 2:25-27. The code sent by the signal “can be varied in shape, length, and number of the pulses.” *Id.* at 4:4-5. Communication can take place either via wires or wirelessly. *Id.* at 4:11.

361. Accordingly, *Moine* in combination with *Adest* and *Goldack* discloses “means to poll the central controller to determine if an interruption of the communication is transient.”

**d. [9D] “at least one switch to disconnect the solar module from the power bus if the interruption of the communication is not transient;”**

362. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.6, and X.B.8.

- e. **[9E] “wherein the watchdog unit is configured to connect the solar module to the power bus when the communication is not interrupted.”**

363. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.6, and X.B.8.

## **6. Claim 10**

- a. **“The system of claim 9, further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.”**

364. *Moine* in combination with the knowledge of a person of ordinary skill in the art discloses/suggests this feature.

365. As disclosed in Section X.B.9, a person of ordinary skill in the art would understand that the watchdog unit has connectivity between the solar module and the power bus.

366. A POSITA would also understand that a junction box is an electrical enclosure that houses one or more wiring connections and the placement of the watchdog unit in a junction box would be immaterial as it would not alter the function of the watchdog unit.

367. The placement of the watchdog unit would not increase its effectiveness or improve its ability to act to shut down the solar module. Accordingly, *Moine* in combination with the knowledge of a POSITA discloses “The system of claim 9,

further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.”

368. To the extent that Patent Owner or the Board disagrees that *Moine* in combination with the knowledge of a person of ordinary skill in the art disclose the limitations of claim 10, it would be obvious for a person of ordinary skill in the art to combine *Moine* with *Adest* and *Goldack*.

369. *Goldack* discloses that the “disabling device may be arranged, for example, as a slim-line assembly between the positive and negative leads in the laminate of the solar module or in or under the junction box where the leads are brought out directly from the laminate.” Ex-1007, 2:56-60; *see also* 4:51-55.

370. Further, *Adest* discloses the limitation in Section X.B.9.

371. Accordingly, *Moine*, either in combination with the knowledge of a POSITA or *Adest* and *Goldack* discloses the limitations of claim 10.

## 7. Claim 11

- a. **“The system of claim 10, wherein the local controller is configured to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module.”**

372. *Moine* in combination with *Adest* and *Goldack* discloses/suggests this feature this feature of claim 10 as discussed in Section X.E.6.

373. *Adest* also further discloses “to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module” as discussed in Section X.B.10.

374. Accordingly, *Moine* in combination with *Adest* and *Goldack* discloses the limitations of claim 11.

## **8. Claim 12**

- a. “The system of claim 9, further comprising a bypass circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus”**

375. *Moine* in combination with *Adest* and *Goldack* discloses/suggests this feature of claim 9 as discussed in Section X.E.5. Also, as discussed in Sections X.B.11, Fig. 3 of *Adest* discloses that “back-flow prevention diodes 322, 342.” Ex-1005, 7:20-21.

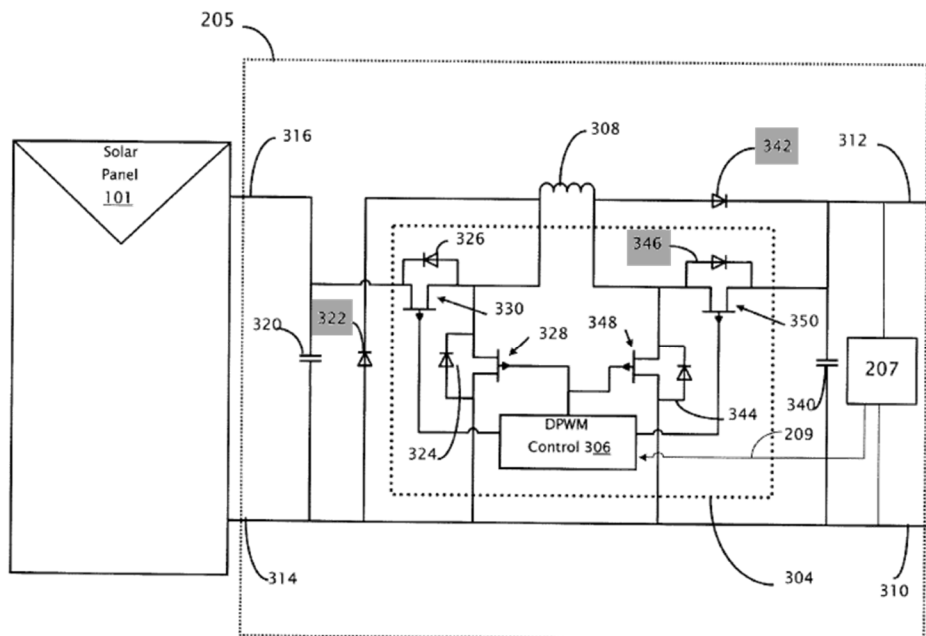


Fig. 3

*Adest*, Ex-1005, Fig. 3.

376. *Adest* discloses that electrical components “have one or more bypass routes associated with them that carry the current in case of an electrical component failing within one of converters 205.” Ex-1005, 8:48-56. The “parasitic diodes” allow for bypassing any “current from the output 312 to backflow into solar panel 101.” *Id.*, 7:23-28.

377. A person of ordinary skill in the art would understand that the presence of back-flow prevention diodes would create a bypass circuit to enable current to bypass the solar module.

378. Accordingly, *Moine* in combination with *Adest* and *Goldack* teaches “[t]he system of claim 9, further comprising a bypass circuit configured to enable

current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus.”

**9. Claim 13**

- a. “The system of claim 9, wherein the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted.”**

379. In my opinion, *Moine* discloses/suggests this feature.

380. In *Moine*, this signal is coded (in particular in frequency and / or in amplitude) and detected by the receiver (5). Ex-1008, 5:34-36. As discussed above in Sections X.D.1 and X.E.1, the **receiver (5)** is configured to monitor a “periodic transmission of [a] *coded alternating signal*” (**alternating signal 8**) from a **transmitter (7)**. Ex-1008, 6:1-5.

381. As such, if the transmitter (7) detects the absence of current at the level of the domestic electrical network (9) or a fault at this level, it stops the **periodic transmission of the alternative coded signal** on the circuit (1), of which the absence identified by the receivers (5) induces the opening by the latter of the corresponding switches (4). *Id.*

382. Accordingly, *Moine* discloses this limitation.

383. Further, to the extent that Patent Owner or the Board disagrees that *Moine* discloses “wherein the watchdog unit is configured to determine irregularity

in periodicity of the communication to determine whether the communication is interrupted,” the combination with *Moine* and *Goldack* discloses this feature.

384. *Goldack* discloses the transmission of “a first signal” via power line to the release device, which then interrupts energy transmission if the interruption device does not receive a second signal from the release device within a specified first period. Ex-1007, Abstract.

385. The signals contain at least one pulse. Ex-1007, 2:25-27.

386. The code sent by the signal “can be varied in shape, length, and number of the pulses.” Ex-1007, 4:4-5. Communication can take place either via wires or wirelessly. *Id.* at 4:11. *Goldack* states that a number of user-specified skips can take place.

387. Accordingly, the combination with *Moine* and *Goldack* discloses this feature.

## **10. Claim 14**

- a. “The system of claim 9, further comprising the solar module; and a junction box coupled with the solar module to provide connectivity to the power bus, wherein the watchdog unit resides in the junction box.”**

388. *Moine* in combination with *Adest* and *Goldack* discloses/suggests the feature of claim 9 as discussed in Sections X.E.5, X.E.6, X.B.13.

## 11. Claim 18

### a. [18A] “A computer-implemented method comprising:”

389. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Section X.D.6.a.

390. In addition, a person of ordinary skill in the art would have understood that this method could be implemented by a computer as a computer-based one.

391. For example, local controller claimed in claims 9, and 11 could be run by a computer device.

392. Accordingly, *Moine* discloses “A computer-implemented method comprising.”

393. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “[a] computer-implemented method comprising,” *Adest* discloses this feature as discussed in Section X.B.16.

### b. [18B] “monitoring, via a computing device, a signal from a central controller remote from the computing device;”

394. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1.b, X.D.1.c, and X.E.11.a.

395. To the extent that Patent Owner or the Board disagrees that *Moine* discloses “monitoring, via a computing device, a signal from a central controller

remote from the computing device” *Adest* discloses this feature as discussed in Sections X.B.1.b and X.B.1.c.

**c. [18C] “determining, via the computing device, if there is a loss of signal;”**

396. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1.c, X.D.1.d, and X.E.11.a.

**d. [18D] “polling, via the computing device, the central controller to determine if the loss of signal is transient;”**

397. In my opinion, *Moine* in combination with *Adest* and *Goldack* discloses/suggests this feature for the reasons provided above in Sections X.E.2.b, X.E.2.c, X.E.5.b, and X.E.5.c, and X.E.11.a.

**e. [18E] “disconnecting, via the computing device, one or more solar modules from a power bus if the loss of signal is not transient, the power bus configured to connect a plurality of solar modules to an inverter;”**

398. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.E.5.d, X.D.1, X.D.6, X.B.8, and X.E.11.a.

**f. [18F] “waiting, via the computing device, for a restart signal; and”**

399. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.6, X.E.1, and X.E.5, and X.E.11.a.

- g. [18G] “connecting, via the computing device, the one or more solar modules to the power bus when the restart signal is received.”**

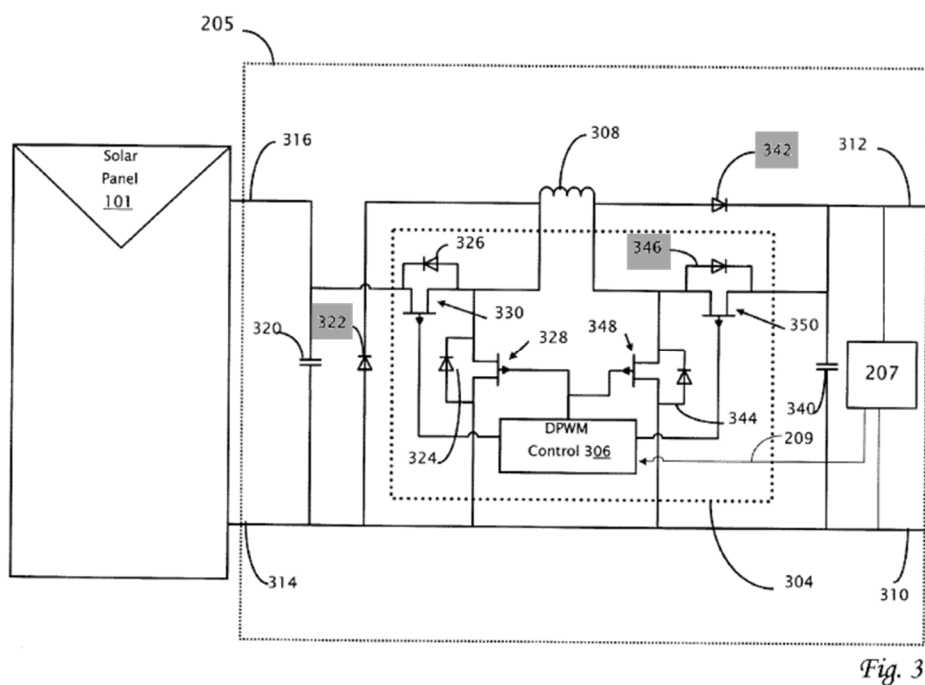
400. In my opinion, *Moine/Adest* discloses/suggests this feature for the reasons provided above in Sections X.D.1, X.D.6, X.E.1, and X.E.5, and X.E.11.a.

## **12. Claim 19**

- a. “The method of claim 18, further comprising: enabling, via the computing device, a bypass circuit when the one or more solar modules are disconnected from the power bus, so that current continues to flow in the power bus.”**

401. In my opinion, *Moine* in combination with *Adest* discloses/suggests this feature for the reasons provided above in Sections X.B.11 and X.D.1.

402. Particularly, in *Adest*, Fig. 3 discloses that “back-flow prevention diodes 322, 342.” Ex-1005, 7:20-21.



*Adest*, Ex-1005, Fig. 3.

403. *Adest* discloses that electrical components “have one or more bypass routes associated with them that carry the current in case of an electrical component failing within one of converters 205.” Ex-1005, 8:48-56. The “parasitic diodes” allow for bypassing any “current from the output 312 to backflow into solar panel 101.” *Id.*, 7:23-28.

404. A person of ordinary skill in the art would understand that the presence of back-flow prevention diodes would create a bypass circuit to enable current to bypass the solar module.

405. Accordingly, *Moine* in combination with *Adest* teaches “[t]he method of claim 18, further comprising: enabling, via the computing device, a bypass circuit

when the one or more solar modules are disconnected from the power bus, so that current continues to flow in the power bus.”

**F. CONCLUSION**

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

Date: July 10, 2023

By:   
Randy R. Dunton

## CLAIM LISTING APPENDIX

U.S. Patent No. 8,823,218 – Hadar *et al.*<sup>4</sup>

| Claim Element Designation                                                                  | Claim Element                                                                                                                                 | Corresp. Petition Section(s)                     |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| <b>Claim 1</b>                                                                             |                                                                                                                                               | VIII.A.1<br>VIII.B.1<br>VIII.C.1<br>VIII.D.1     |
| [1A]                                                                                       | A system comprising:                                                                                                                          | VIII.A.1.a<br>VIII.C.1.a                         |
| [1B]                                                                                       | a master management unit (MMU); and                                                                                                           | VIII.A.1.b<br>VIII.C.1.b                         |
| [1C]                                                                                       | a local management unit (LMU) in communication with the master management unit (MMU), the LMU controlling one or more solar modules;          | VIII.A.1.c<br>VIII.C.1.c                         |
| [1D]                                                                                       | wherein the MMU is connected to at least one sensor, the sensor configured to detect an anomaly; and                                          | VIII.A.1.d<br>VIII.C.1.d                         |
| [1E]                                                                                       | wherein upon detection of the anomaly by the sensor, the MMU sends a command to the LMU to alter the state of an associated solar module; and | VIII.A.1.e<br>VIII.C.1.e                         |
| [1F]                                                                                       | wherein upon receiving a command from the MMU, the LMU alters the state of the one or more solar modules in accordance with command           | VIII.A.1.f<br>VIII.C.1.f                         |
| <b>Claim 2:</b> The system of claim 1, wherein the MMU queries the sensor for the anomaly. |                                                                                                                                               | VIII.A.2.a<br>VIII.B.1<br>VIII.C.2.a<br>VIII.D.1 |

<sup>4</sup> The claim element designations in this Claim Listing Appendix correspond to the letters of the subsection in which each element is addressed for each section corresponding to the claim. In some cases, multiple claim elements are grouped together with the same designation in this appendix because they are addressed together in the same subsection.

| <b>Claim Element Designation</b> | <b>Claim Element</b>                                                                                                                                                                                                                                                                       | <b>Corresp. Petition Section(s)</b>              |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| <b>Claim 3:</b>                  | The system of claim 1, wherein the sensor notifies the MMU of the anomaly.                                                                                                                                                                                                                 | VIII.A.3.a<br>VIII.B.1<br>VIII.C.3.a<br>VIII.D.1 |
| <b>Claim 4:</b>                  | The system of claim 1, wherein the command is selected from the group consisting of:<br>a command to shutdown the module;<br>a command to disconnect the module; and<br>a command to alter the output of the module.                                                                       | VIII.A.4.a<br>VIII.B.1<br>VIII.C.4.a<br>VIII.D.1 |
| <b>Claim 5:</b>                  | The system of claim 1, wherein:<br>the MMU is connected to a network; and<br>the sensor is connected to the network.                                                                                                                                                                       | VIII.C.5.a                                       |
| <b>Claim 6</b>                   |                                                                                                                                                                                                                                                                                            | VIII.A.5<br>VIII.B.2<br>VIII.D.2                 |
| [6A]                             | The system of claim 1, further comprising: a watchdog unit to monitor a communication in a solar array between the master management unit (MMU) and a respective local management unit (LMU);                                                                                              | VIII.A.5.a<br>VIII.B.2.a<br>VIII.D.2.a           |
| [6B]                             | wherein if the communication is interrupted between the MMU and the respective LMU, the watchdog unit sends polls to the MMU up to a specified number of times;                                                                                                                            | VIII.A.5.b<br>VIII.B.2.b<br>VIII.D.2.b           |
| [6C]                             | wherein if the watchdog unit receives no response after completing the polls, receives a command to modify operation of a solar module, or receives an inappropriate response, then the watchdog unit issues an instruction to the respective LMU to modify operation of the solar module. | VIII.A.5.c<br>VIII.B.2.c<br>VIII.D.2.c           |
| <b>Claim 7:</b>                  | The system of claim 6, wherein the respective LMU comprises the watchdog unit.                                                                                                                                                                                                             | VIII.A.6.a<br>VIII.B.3.a<br>VIII.D.3.a           |

| <b>Claim Element Designation</b> | <b>Claim Element</b>                                                                                                                                                                                                                                                                 | <b>Corresp. Petition Section(s)</b>     |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| <b>Claim 8:</b>                  | The system of claim 6, wherein the instruction is selected from the group consisting of<br>an instruction to shut off the solar module,<br>an instruction to disconnect the solar module from the solar array, and<br>an instruction to reduce the output power of the solar module. | VIII.A.7.a<br>VIII.B.4.a<br>VIII.D.4.a  |
| <b>Claim 9</b>                   |                                                                                                                                                                                                                                                                                      | VIII.A.8<br>VIII.B.5<br>VIII.D.5        |
| [9A]                             | The system of claim 1, further comprising: a watchdog unit coupled between a solar module and a power bus, the power bus configured to connect a plurality of solar modules to an inverter,                                                                                          | VIII.A.8.a<br>VIII.B.5.a<br>VIII.D.5.a  |
| [9B]                             | the watchdog unit having: a local controller to monitor a communication from a central controller remote from the solar module and determine whether the communication is interrupted;                                                                                               | VIII.A.8.b<br>VIII.B.5.b<br>VIII.D.5.b  |
| [9C]                             | means to poll the central controller to determine if an interruption of the communication is transient;                                                                                                                                                                              | VIII.A.8.c<br>VIII.B.5.c<br>VIII.D.5.c  |
| [9D]                             | at least one switch to disconnect the solar module from the power bus if the interruption of the communication is not transient;                                                                                                                                                     | VIII.A.8.d<br>VIII.B.5.d<br>VIII.D.5.d  |
| [9E]                             | wherein the watchdog unit is configured to connect the solar module to the power bus when the communication is not interrupted.                                                                                                                                                      | VIII.A.8.e<br>VIII.B.5.e<br>VIII.D.5.e  |
| <b>Claim 10:</b>                 | The system of claim 9, further comprising a junction box housing the watchdog unit, the junction box to provide connectivity between the solar module and the power bus.                                                                                                             | VIII.A.9.a<br>VIII.B.6.a<br>VIII.D.6.a  |
| <b>Claim 11:</b>                 | The system of claim 10, wherein the local controller is configured to control a duty cycle of the switch to control an output voltage from the junction box; and the local controller is configured to operate using power from the solar module.                                    | VIII.A.10.a<br>VIII.B.7.a<br>VIII.D.7.a |

| <b>Claim Element Designation</b> | <b>Claim Element</b>                                                                                                                                                                                                           | <b>Corresp. Petition Section(s)</b>     |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|                                  | <b>Claim 12:</b> The system of claim 9, further comprising a bypass circuit configured to enable current in the power bus to bypass the solar module when the switch disconnects the solar module from the power bus.          | VIII.A.11.a<br>VIII.B.8.a<br>VIII.D.8.a |
|                                  | <b>Claim 13:</b> The system of claim 9, wherein the watchdog unit is configured to determine irregularity in periodicity of the communication to determine whether the communication is interrupted.                           | VIII.A.12.a<br>VIII.B.9.a<br>VIII.D.9.a |
|                                  | <b>Claim 14:</b> The system of claim 9, further comprising the solar module; and a junction box coupled with the solar module to provide connectivity to the power bus, wherein the watchdog unit resides in the junction box. | VIII.A.13.a<br>VIII.B.10<br>VIII.D.10.a |
|                                  | <b>Claim 15</b>                                                                                                                                                                                                                | VIII.A.14<br>VIII.B.10<br>VIII.C.6      |
| [15A]                            | A method comprising:                                                                                                                                                                                                           | VIII.A.14.a<br>VIII.C.6.a               |
| [15B]                            | monitoring a sensor for an anomaly by a master control unit (MMU);                                                                                                                                                             | VIII.A.14.b<br>VIII.C.6.b               |
| [15C]                            | determining by the MMU if the sensor has detected an anomaly and, if the sensor has detected an anomaly, the MMU determining if the anomaly requires a control change; and                                                     | VIII.A.14.c<br>VIII.C.6.c               |

| <b>Claim Element Designation</b>                                                                                                                                                     | <b>Claim Element</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Corresp. Petition Section(s)</b>    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| [15D]                                                                                                                                                                                | issuing a control change command to a local management unit if the anomaly requires a control change, wherein the control change command is selected from the group consisting of:<br>a command to shut down one or more solar modules;<br>a command to disconnect one or more solar modules;<br>a command to shut down one or more solar module strings;<br>a command to alter the output of a solar module;<br>a command to shutdown one or more LMUs;<br>a command to disconnect one or more LMUs;<br>a command to shutdown an inverter;<br>a command to disconnect an inverter;<br>a command to do nothing; and<br>no command. | VIII.A.14.d<br>VIII.C.6.d              |
| <b>Claim 16:</b> The method of claim 15, wherein the monitoring comprises one of:<br>the MMU querying the sensor for the anomaly, and<br>the sensor notifying the MMU of an anomaly. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VIII.A.15.a<br>VIII.B.10<br>VIII.C.7.a |
| <b>Claim 17:</b> The method of claim 15, wherein:<br>the MMU is connected to a network; and<br>the sensor is connected to the network.                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VIII.C.8.a                             |
| <b>Claim 18</b>                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VIII.A.16<br>VIII.B.10<br>VIII.D.11    |
| [18A]                                                                                                                                                                                | A computer-implemented method comprising:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | VIII.A.16.a<br>VIII.D.11.a             |
| [18B]                                                                                                                                                                                | monitoring, via a computing device, a signal from a central controller remote from the computing device;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | VIII.A.16.b<br>VIII.D.11.b             |
| [18C]                                                                                                                                                                                | determining, via the computing device, if there is a loss of signal;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | VIII.A.16.c<br>VIII.D.11.c             |

| <b>Claim Element Designation</b>                                                                                                                                                                                                                 | <b>Claim Element</b>                                                                                                                                                                                         | <b>Corresp. Petition Section(s)</b>     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| [18D]                                                                                                                                                                                                                                            | polling, via the computing device, the central controller to determine if the loss of signal is transient;                                                                                                   | VIII.A.16.d<br>VIII.D.11.d              |
| [18E]                                                                                                                                                                                                                                            | disconnecting, via the computing device, one or more solar modules from a power bus if the loss of signal is not transient, the power bus configured to connect a plurality of solar modules to an inverter; | VIII.A.16.e<br>VIII.D.11.e              |
| [18F]                                                                                                                                                                                                                                            | waiting, via the computing device, for a restart signal; and                                                                                                                                                 | VIII.A.16.f<br>VIII.D.11.f              |
| [18G]                                                                                                                                                                                                                                            | connecting, via the computing device, the one or more solar modules to the power bus when the restart signal is received.                                                                                    | VIII.A.16.g<br>VIII.D.11.g              |
| <b>Claim 19:</b> The method of claim 18, further comprising:<br>enabling, via the computing device, a bypass circuit when the one or more solar modules are disconnected from the power bus, so that current continues to flow in the power bus. |                                                                                                                                                                                                              | VIII.A.17.a<br>VIII.B.10<br>VIII.D.12.a |