pairs, in an effort to overcome the aforementioned obstacles and deficiencies of conventional solar cell systems.

SUMMARY

[0019] The present disclosure relates to a system for optimizing a power output of at least one photovoltaic device and methods for using and making the same. In accordance with a first aspect disclosed herein, there is set forth a method of managing one or more photovoltaic devices, the method comprising:

[0020] applying a first component of a voltage signal to a plurality of photovoltaic devices, the first component comprising a series of voltage pulses with a positive magnitude and representing an on state for generating an external electric field across a selected photovoltaic device selected from among the plurality of photovoltaic devices; and

[0021] applying a second component of the voltage signal to the selected photovoltaic device, the second component representing an off cycle between adjacent first components.

[0022] In some embodiments of the disclosed method, the method further comprises applying the first component to a second selected photovoltaic device concurrently with said applying the first component to the selected photovoltaic device; and

[0023] applying the second component to the second selected photovoltaic device concurrently with said applying the second component to the selected photovoltaic device.

[0024] In some embodiments of the disclosed method, said applying the first component comprises applying a high voltage of a time-varying voltage pulse from a voltage pulser circuit, and wherein said applying the second component comprises shutting off the voltage pulser circuit.

[0025] In some embodiments of the disclosed method, the method further comprises superimposing the first component on top of an existing voltage generated by the selected photovoltaic device, wherein said superimposing the first component optionally comprises creating a negative reference for the first component via an uplift injector circuit coupled between said voltage pulser circuit and the selected photovoltaic device.

[0026] In some embodiments of the disclosed method, said applying the first component comprises connecting a voltage source and the photovoltaic device in a first position of a

switch disposed between the voltage source and the selected photovoltaic device, and wherein said applying the second component comprises disconnecting the voltage source and the selected photovoltaic device in a second position of the switch.

[0027] In accordance with another aspect disclosed herein, there is set forth a method of managing at least one photovoltaic device, comprising:

[0028] enabling a voltage pulser to be coupled to a plurality of photovoltaic devices; and

[0029] applying a voltage signal generated by the voltage pulser to each of the photovoltaic devices, the voltage signal having a first state comprising a series of voltage pulses with a positive magnitude for generating an external electric field across a selected photovoltaic device selected from among the photovoltaic devices and a second state representing an off cycle between adjacent first states.

[0030] In some embodiments of the disclosed method, the method further comprises enabling an uplift injector circuit to be coupled between the voltage pulser and the selected photovoltaic device for providing a negative reference for the first state.

[0031] In some embodiments of the disclosed method, the method further comprises applying the voltage signal to a second selected photovoltaic device, said applying the voltage signal optionally to the second selected photovoltaic device occurs concurrently with said applying the voltage signal to the selected photovoltaic device.

[0032] In some embodiments of the disclosed method, the method further comprises enabling a second voltage pulser circuit to be coupled to the second selected photovoltaic device for concurrently providing a second time varying voltage pulse across the second selected photovoltaic device, the second time varying voltage pulse providing the first state and the second state.

[0033] In some embodiments of the disclosed method, said applying the voltage signal comprises applying an adjustable voltage to the selected photovoltaic device.

[0034] In some embodiments of the disclosed method, the method further comprises controlling at least one of a frequency and a duration of the first state and the second state via a control circuit coupled to the voltage pulser.

[0035] In accordance with another aspect disclosed herein, there is set forth a method of managing one or more photovoltaic devices, comprising:

[0036] enabling a first port of a switch to be coupled to a selected photovoltaic device selected from among the photovoltaic devices;

[0037] enabling a second port of the switch to be coupled to a load driven by the selected photovoltaic device;

[0038] enabling a third port of the switch to be coupled to a voltage source, wherein the switch can operate in a first position for providing a current path between the selected photovoltaic device and the voltage source and a second position for providing the current path between the selected photovoltaic device and the load; and

[0039] applying a voltage signal generated by the voltage source to the selected photovoltaic device, the voltage signal having a first state comprising a series of voltage pulses with a positive magnitude for generating an external electric field across the selected photovoltaic device when the switch is in the first position, and a second state between adjacent first states to provide electrical isolation between the voltage source and the load when the switch is in the second position.

[0040] In some embodiments of the disclosed method, the method further comprises enabling a first port of a second switch to be coupled to a second selected photovoltaic device;

[0041] enabling a second port of the second switch to be coupled to the load, the load driven by the selected photovoltaic device and the second selected photovoltaic device;

[0042] enabling a third port of the second switch to be coupled to the voltage source, wherein the second switch can operate in a first position for providing a current path between the second selected photovoltaic device and the voltage source and a second position for providing the current path between the second selected photovoltaic device and the load; and

[0043] applying the voltage signal generated by the voltage source concurrently to both the selected photovoltaic device and the second selected photovoltaic device, the first state for generating the external electric field across both of the selected photovoltaic device and the second selected photovoltaic device when the switch and the second switch are in the first position, and the second state to provide electrical isolation between the voltage source and the load when the switch and the second switch are in the second position.

[0044] In some embodiments of the disclosed method, said enabling the first port of the switch comprises enabling a first port of a double throw switch to be coupled to the selected photovoltaic device.

[0045] In some embodiments of the disclosed method, the method further comprises controlling at least one of a frequency and a duration of switching between the first position and the second position via a switch controller coupled to the double throw switch.

[0046] In some embodiments of the disclosed method, the method further comprises enabling a device for mitigating any voltage drop-out of the first state to be coupled between the load and the selected photovoltaic device.

[0047] In some embodiments of the disclosed method, said applying the voltage signal comprises applying an adjustable voltage to the selected photovoltaic device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0048] Fig. 1 is an exemplary top-level cross-sectional diagram illustrating an embodiment of a solar cell of the prior art.

[0049] Fig. 2A is an exemplary top-level block diagram illustrating one embodiment of a solar panel array of the prior art using the solar cells of Fig. 1.

[0050] Fig. 2B is an exemplary block diagram illustrating an alternative embodiment of a solar panel array of the prior art using the solar cells of Fig. 1, wherein each solar panel is coupled in series.

[0051] Fig. 2C is an exemplary block diagram illustrating an alternative embodiment of a solar panel array of the prior art using the solar cells of Fig. 1, wherein each solar panel is coupled both in series and in parallel.

[0052] Fig. 2D is an exemplary block diagram illustrating an alternative embodiment of a solar panel array of the prior art using the solar cells of Fig. 1, wherein each solar panel is directly coupled to a load.

[0053] Fig. 3 is an exemplary top-level block diagram illustrating an embodiment of a solar cell management system.

CLAIMS

1. A method of managing one or more photovoltaic devices, comprising:

applying a first component of a voltage signal to a plurality of photovoltaic devices, the first component comprising a series of voltage pulses with a positive magnitude and representing an on state for generating an external electric field across a selected photovoltaic device selected from among the plurality of photovoltaic devices; and

applying a second component of the voltage signal to the selected photovoltaic device, the second component representing an off cycle between adjacent first components.

2. The method of claim 1, further comprising applying the first component to a second selected photovoltaic device concurrently with said applying the first component to the selected photovoltaic device; and

applying the second component to the second selected photovoltaic device concurrently with said applying the second component to the selected photovoltaic device.

3. The method of claim 1 or claim 2, wherein said applying the first component comprises applying a high voltage of a time-varying voltage pulse from a voltage pulser circuit, and wherein said applying the second component comprises shutting off the voltage pulser circuit.

4. The method of claim 1 or 2, further comprising superimposing the first component on top of an existing voltage generated by the selected photovoltaic device, wherein said superimposing the first component optionally comprises creating a negative reference for the first component via an uplift injector circuit coupled between a voltage pulser circuit and the selected photovoltaic device.

5. The method of any one of the above claims, wherein said applying the first component comprises connecting a voltage source and the photovoltaic device in a first position of a switch disposed between the voltage source and the selected photovoltaic device, and wherein said applying the second component comprises disconnecting the voltage source and the selected photovoltaic device in a second position of the switch.

6. A method of managing at least one photovoltaic device, comprising:

enabling a voltage pulser to be coupled to a plurality of photovoltaic devices; and

applying a voltage signal generated by the voltage pulser to each of the photovoltaic devices, the voltage signal having a first state comprising a series of voltage pulses with a positive magnitude for generating an external electric field across a selected photovoltaic device selected from among the photovoltaic devices and a second state representing an off cycle between adjacent first states.

7. The method of claim 6, further comprising enabling an uplift injector circuit to be coupled between the voltage pulser and the selected photovoltaic device for providing a negative reference for the first state.

8. The method of any one of claim 6 or claim 7, further comprising applying the voltage signal to a second selected photovoltaic device, said applying the voltage signal to the second selected photovoltaic device optionally occurs concurrently with said applying the voltage signal to the selected photovoltaic device.

9. The method of claim 8, further comprising enabling a second voltage pulser circuit to be coupled to the second selected photovoltaic device for concurrently providing a second time varying voltage pulse across the second selected photovoltaic device, the second time varying voltage pulse providing the first state and the second state.

10. The method of claim 6, wherein said applying the voltage signal comprises applying an adjustable voltage to the selected photovoltaic device.

11. The method of claim 6, further comprising controlling at least one of a frequency and a duration of the first state and the second state via a control circuit coupled to the voltage pulser.

12. A method of managing one or more photovoltaic devices, comprising:

enabling a first port of a switch to be coupled to a selected photovoltaic device selected from among the photovoltaic devices;

enabling a second port of the switch to be coupled to a load driven by the selected photovoltaic device;

enabling a third port of the switch to be coupled to a voltage source, wherein the switch can operate in a first position for providing a current path between the selected photovoltaic device and the voltage source and a second position for providing the current path between the selected photovoltaic device and the load; and

applying a voltage signal generated by the voltage source to the selected photovoltaic device, the voltage signal having a first state comprising a series of voltage pulses with a positive magnitude for generating an external electric field across the selected photovoltaic device when the switch is in the first position, and a second state between adjacent first states to provide electrical isolation between the voltage source and the load when the switch is in the second position.

13. The method of claim 12, further comprising:

enabling a first port of a second switch to be coupled to a second selected photovoltaic device;

enabling a second port of the second switch to be coupled to the load, the load driven by the selected photovoltaic device and the second selected photovoltaic device;

enabling a third port of the second switch to be coupled to the voltage source, wherein the second switch can operate in a first position for providing a current path between the second selected photovoltaic device and the voltage source and a second position for providing the current path between the second selected photovoltaic device and the load; and

applying the voltage signal generated by the voltage source concurrently to both the selected photovoltaic device and the second selected photovoltaic device, the first state for generating the external electric field across both of the selected photovoltaic device and the second selected photovoltaic device when the switch and the second switch are in the first position, and the second state to provide electrical isolation between the voltage source and the load when the switch and the second switch are in the second position.

14. The method of any one of claims 12 or claim 13, wherein said enabling the first port of the switch comprises enabling a first port of a double throw switch to be coupled to the selected photovoltaic device.

15. The method of claim 14, further comprising controlling at least one of a frequency and a duration of switching between the first position and the second position via a switch controller coupled to the double throw switch.

16. The method of any one of claims 12-15, further comprising enabling a device for mitigating any voltage drop-out of the first state to be coupled between the load and the selected photovoltaic device.

17. The method of any one of claims 12-16, wherein said applying the voltage signal comprises applying an adjustable voltage to the selected photovoltaic device.

18. The method of any one of claims 1-5, wherein said applying the first component comprises applying the first component to the selected photovoltaic device among the photovoltaic devices being disposed in a series device configuration and/or a parallel device configuration.

19. The method of any one of claims 1-5 and 18, wherein said applying the first component includes generating the external electric field with a predetermined field direction across the selected photovoltaic device.

20. The method of claim 19, wherein said applying the first component includes generating the external electric field with the predetermined field direction being in the same direction as a polarity of the selected photovoltaic device to increase an output power and/or an output current of the selected photovoltaic device or generating the external electric field with the predetermined field direction being opposite the polarity of the selected photovoltaic device to decrease the output power and/or the output current of the selected photovoltaic device.

21. The method of any one of claims 1-5 and 18-20, wherein the selected photovoltaic device is configured to drive a load, and further comprising converting a direct current (DC) voltage and/or current generated by the selected photovoltaic device into an alternating current (AC) voltage and/or current via the load.

22. The method of claim 21, wherein the load is external to the selected photovoltaic device.

23. The method of claim 21 or claim 22, wherein the load comprises an inverter.

24. The method of any one of claims 21-23, further comprising electrically isolating the selected photovoltaic device from the load in the radio frequency domain.

25. The method of claim 24, wherein the electrical isolation is provided via at least one inductor, at least one capacitor, at least one battery or a combination thereof.

26. The method of any one of claims 1-5 and 18-25, wherein said applying the first component comprises applying the first component to the selected photovoltaic device without structural modification of the selected photovoltaic device.

27. The method of claim 26, wherein said applying the first component comprises applying the first component of the voltage signal to the selected photovoltaic device via existing electrodes of the selected photovoltaic device.

28. The method of any one of claims 6-11, wherein said enabling the voltage pulser comprises enabling the voltage pulser to be coupled to the selected photovoltaic device among the photovoltaic devices being disposed in a series device configuration and/or a parallel device configuration.

29. The method of any one of claims 6-11 and 28, wherein said applying the voltage signal includes generating the external electric field with a predetermined field direction across the selected photovoltaic device.

30. The method of claim 29, wherein said applying the voltage signal includes generating the external electric field with the predetermined field direction being in the same direction as a polarity of the selected photovoltaic device to increase an output power and/or an output current of the selected photovoltaic device or generating the external electric field with the predetermined field direction being opposite the polarity of the selected photovoltaic device to decrease the output power and/or the output current of the selected photovoltaic device.

31. The method of any one of claims 6-11 and 28-30, wherein the selected photovoltaic device is configured to drive a load, and further comprising converting a direct current (DC) voltage and/or current generated by the selected photovoltaic device into an alternating current (AC) voltage and/or current via the load.

32. The method of claim 31, wherein the load is external to the selected photovoltaic device.

33. The method of claim 31 or claim 32, wherein the load comprises an inverter.

34. The method of any one of claims 31-33, further comprising electrically isolating the selected photovoltaic device from the load in the radio frequency domain.

35. The method of claim 34, wherein the electrical isolation is provided via at least one inductor, at least one capacitor, at least one battery or a combination thereof.

36. The method of any one of claims 6-11 and 28-35, wherein said applying the voltage signal comprises applying the voltage signal to the selected photovoltaic device without structural modification of the selected photovoltaic device.

37. The method of claim 36, wherein said applying the voltage signal comprises applying the voltage signal to the selected photovoltaic device via existing electrodes of the selected photovoltaic device.

38. The method of any one of claims 12-17, wherein said enabling the first port comprises enabling the first port of the switch to be coupled to the selected photovoltaic device being selected from among the photovoltaic devices disposed in a series device configuration and/or a parallel device configuration.

39. The method of any one of claims 12-17 and 38, wherein said applying the voltage signal includes generating the external electric field with a predetermined field direction across the selected photovoltaic device.

40. The method of claim 39, wherein said applying the voltage signal includes generating the external electric field with the predetermined field direction being in the same direction as a polarity of the selected photovoltaic device to increase an output power and/or an output current of the selected photovoltaic device or generating the external electric field with the predetermined field direction being opposite the polarity of the selected photovoltaic device to decrease the output power and/or the output current of the selected photovoltaic device.

41. The method of any one of claims 12-17 and 38-40, further comprising converting a direct current (DC) voltage and/or current generated by the selected photovoltaic device into an alternating current (AC) voltage and/or current via the load.

42. The method of any one of claims 12-17 and 38-41, wherein the load is external to the selected photovoltaic device.

43. The method of any one of claims 12-17 and 38-42, wherein the load comprises an inverter.

44. The method of any one of claims 12-17 and 38-43, further comprising electrically isolating the selected photovoltaic device from the load in the radio frequency domain.

45. The method of claim 44, wherein the electrical isolation is provided via at least one inductor, at least one capacitor, at least one battery or a combination thereof.

46. The method of any one of claims 12-17 and 38-45, wherein said applying the voltage signal comprises applying the voltage signal to the selected photovoltaic device without structural modification of the selected photovoltaic device.

47. The method of claim 46, wherein said applying the voltage signal comprises applying the voltage signal to the selected photovoltaic device via existing electrodes of the selected photovoltaic device.

48. The method of any one of claims 1-3, 5 and 18-27, further comprising superimposing the first component on top of an existing voltage generated by the selected photovoltaic device, wherein said superimposing the first component optionally comprises creating a negative reference for the first component via an uplift injector circuit coupled between a voltage source for the first component and the selected photovoltaic device.

49. The method of claim 18, wherein said applying the first component comprises applying the first component to each of the photovoltaic devices, and wherein said applying the second component comprises applying the second component to each of the photovoltaic devices.

50. The method of any one of claims 1-5, 18-27, 48 and 49, wherein said applying the second component comprises applying the second component between adjacent series of voltage pulses.

51. The method of claim 50, wherein said applying the second component comprises applying the second component between adjacent voltage pulses.

52. The method of claim 50 or claim 51, wherein said applying the second component comprises applying the second component between selected adjacent voltage pulses.

53. The method of any one of claims 1-5, 18-27 and 48-52, further comprising determining the magnitude of the voltage pulses based upon a device configuration of the photovoltaic devices.

54. The method of claim 28, wherein said applying the voltage signal comprises applying the voltage signal to each of the photovoltaic devices.

55. The method of any one of claims 6-11, 28-37 and 54, wherein said applying the voltage signal includes applying the second state between adjacent series of voltage pulses.

56. The method of claim 55, wherein said applying the second state comprises applying the second state between adjacent voltage pulses.

57. The method of claim 55 or claim 56, wherein said applying the second state comprises applying the second state between selected adjacent voltage pulses.

58. The method of any one of claims 6-11, 28-37 and 54-57, further comprising determining the magnitude of the voltage pulses based upon a device configuration of the photovoltaic devices.

59. The method of claim 38, wherein said applying the voltage signal comprises applying the voltage signal to each of the photovoltaic devices.

60. The method of any one of claims 12-17, 38-47 and 59, wherein said applying the voltage signal includes applying the second state between adjacent series of voltage pulses.

61. The method of claim 60, wherein said applying the second state comprises applying the second state between adjacent voltage pulses.

62. The method of claim 60 or claim 61, wherein said applying the second state comprises applying the second state between selected adjacent voltage pulses.

63. The method of any one of claims 12-17, 38-47 and 59-62, further comprising determining the magnitude of the voltage pulses based upon a device configuration of the photovoltaic devices.

64. A system for managing one or more photovoltaic devices comprising means for performing the method of any one of claims 1-5, 18-27 and 48-53.

65. A system for managing at least one photovoltaic device comprising means for performing the method of any one of claims 6-11, 28-37 and 54-58.

66. A system for managing one or more photovoltaic devices comprising means for performing the method of any one of claims 12-17, 38-47 and 59-63.