[0016] The foregoing examples of the related art and limitations related thereto are intended to be illustrative and not exclusive. Other limitations of the related art will become apparent to those of skill in the art upon a reading of the specification and a study of the drawing.

Summary

[0017] In a first aspect, the present disclosure provides a bimodal near-field resonant wireless electrical power transfer system configured for simultaneous capacitive power transfer and inductive power transfer according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency, the system comprising: a transmitter subsystem comprising a transmitter antenna subsystem and a power signal tuner module, the power signal tuner module configured for adjusting the transfer mode ratio by adjusting a power signal provided by the power signal tuner module to the transmitter antenna subsystem; and a receiver subsystem comprising a receiver antenna subsystem configured for to receive electrical power from the transmitter antenna subsystem at the transfer mode ratio.

[0018] The tuner module may be configured for adjusting the power signal by adjusting a phase difference between the current and the voltage of the power signal provided to the transmitter antenna subsystem. The transmitter subsystem may further comprise a controller and at least one sensor, wherein the controller is configured for receiving sensor information from the at least one sensor and for automatically providing a tuning instruction to the tuner module based on the sensor information; and the tuner module is configured to adjust according to the tuning instruction the phase difference between the current and the voltage of the power signal provided to the transmitter antenna subsystem.

[0019] The at least one sensor may be disposed on the transmitter subsystem. In other embodiments, the at least one sensor may be disposed on the receiver subsystem and the controller may be configured for wirelessly receiving the sensor information. The at least one sensor may be one of a power load sensor; a transmission power sensor; a surrounding object detector; and a distance detector disposed for detecting a distance between the transmitter antenna and the receiver antenna.

[0020] The resonant power signal oscillation frequency may be free to vary within a predetermined frequency band. The predetermined frequency band may be an Industrial, Scientific and Medical (ISM) frequency band. The system may be detuned to a degree that allows

the resonant power signal oscillation frequency to vary within opposing limits of the predetermined frequency band.

[0020a] In a second aspect, the present disclosure provides a method for bimodally transferring power from a direct current source to a load, the method comprising: providing in electrical communication with the direct current source a transmitter subsystem comprising a transmitter antenna subsystem, and a power signal tuner module, and a controller; providing at least one sensor; providing in electrical communication with the load a receiver subsystem comprising a receiver antenna subsystem; transferring power by simultaneous capacitive power transfer and inductive power transfer at a variable resonant power signal oscillation frequency from the transmitter antenna subsystem to the receiver antenna subsystem; and adjusting the power signal module to change a transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency.

[0020b] In a third aspect, the present disclosure provides a bimodal near-field wireless power transfer system configured for simultaneous capacitive power transfer and inductive power transfer to one or more receiver resonators according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency, the system comprising: a transmission subsystem comprising: one or more transmitter resonators collectively arranged to form a transmission surface; and one or more corresponding transmitter modules in electrical communication with the one or more transmitter resonators for controlling a power signal output to the one or more transmitter resonators, each transmitter module comprising a transmitter controller and each transmitter module and its corresponding transmitter resonator forming a transmitter pair, wherein the one or more transmitter pairs are electrically decoupled from one another.

[0020c] In a fourth aspect, the present disclosure provides a method of varying a power signal of a wireless transfer system, the method comprising: providing a transmission surface comprised of one or more transmitter resonators; monitoring an input impedance of each of the one or more transmitter resonators; calibrating a baseline input impedance for the one or more transmitter resonators; and either assigning an off state to a transmitter resonator of the one or more transmitter resonators when the input impedance is less than the baseline impedance; or assigning an active state to the transmitter resonator when the input impedance is greater than the baseline impedance.

[0020d] In a fifth aspect, the present disclosure provides a near-field resonant wireless electrical power transfer system comprising: a transmission subsystem comprising a plurality of substantially mutually decoupled transmitter resonators and corresponding transmitter modules in power signal communication with each transmitter resonator, each transmitter module comprising a transmission controller and a power signal source having a power signal oscillation frequency and a power signal phase, each power signal source controlled by the corresponding transmission controller; one or more receiver subsystems each comprising a corresponding receiver resonator; a software lookup table of discrete allowed power signal oscillation frequencies for the power signal sources; and software which when loaded in a memory and executed by the controller of any of the transmitter modules performs the actions of: measuring one of an input impedance of the corresponding transmitter resonator and a test signal power draw by the corresponding transmitter resonator; and selecting for the corresponding power signal source a frequency from the lookup table based on one of the input impedance of the corresponding transmitter resonator and the test signal power draw by the corresponding transmitter resonator.

[0021] In a further embodiment, a wireless method is provided of transferring power bimodaly according to an adjustable transfer mode ratio at a resonant power signal oscillation frequency, the method comprising providing a transmitter subsystem comprising a power signal tuner module and a transmitter antenna subsystem configured for resonating at the resonant power signal oscillation frequency; providing a receiver subsystem comprising a receiver antenna subsystem configured for resonating at the resonant power signal oscillation frequency; providing a power signal from the tuner module to the transmitter antenna subsystem at the power signal oscillation resonant frequency; adjusting the transfer mode ratio by adjusting the power signal from the tuner module to the transmitter antenna subsystem; and receiving transferred power in the receiver subsystem at the power signal oscillation resonant frequency via the receiver antenna subsystem at the transfer mode ratio. The adjusting the transfer mode ratio may comprise adjusting a phase difference between the current and the voltage of the power signal provided to the transmitter antenna subsystem.

[0022] The providing a transmitter subsystem may further comprise providing a controller and at least one sensor and adjusting the phase difference between the current and the voltage may be done by the tuner module via a command of the controller based on sensor information received by the controller from the at least one sensor. The command of the controller may be automatically issued to the tuner module upon receipt by the controller of the sensor information; and the tuner

[0023] module may automatically execute the command from the controller to change the phase difference.

[0024] The method may further comprise allowing the resonant power signal oscillation frequency to vary within a predetermined frequency band. The predetermined frequency band may be an Industrial, Scientific and Medical (ISM) frequency band. Providing a transmitter subsystem may comprise providing a transmitter subsystem detuned to a degree that allows the resonant power signal oscillation frequency to vary within opposing limits of the predetermined frequency band.

[0025] In a further aspect, the present disclosure provides a near-field resonant wireless electrical power transfer system comprising: a transmission subsystem comprising a plurality of substantially mutually

decoupled transmitter resonators and corresponding transmitter modules in power signal communication with each transmitter resonator, each transmitter module comprising a transmission controller and a power signal source having a power signal oscillation frequency and a power signal phase, each power signal source controlled by the corresponding transmission controller; one or more receiver subsystems each comprising a corresponding receiver resonator; a software lookup table of discrete allowed power signal oscillation frequencies for the power signal sources; and software which when loaded in a memory and executed by the controller of any of the transmitter modules performs the actions of: measuring one of an input impedance of the corresponding transmitter resonator and a test signal power draw by the corresponding transmitter resonator; and selecting for the corresponding power signal source a frequency from the lookup table based on one of the input impedance of the corresponding transmitter resonator and the test signal power draw by the corresponding transmitter resonator. The software when executed may perform the actions of measuring a level of power transferred by the corresponding transmitter resonator while adjusting a phase of a power signal from the corresponding power signal source. The transmitter resonators may be substantially mutually decoupled by a grounded shield grid.

[0026] In a further embodiment, a wireless near-field method for transferring power at a variable resonant power signal oscillation frequency from a multi-transmitter subsystem to a single resonant receiver subsystem is provided, the method comprising: providing the multi-transmitter subsystem comprising a plurality of mutually independent transmitter resonators each driven by a corresponding transmitter module capable of being set independently to one of a plurality of preset power signal oscillation frequencies in a preset frequency band, wherein all the transmitter resonators have a common transmission surface; disposing proximate the common transmission surface a resonant receiver subsystem comprising a single receiver resonator overlapping two or more of the transmitter resonators; measuring one of an input impedance of each of the transmitter resonators and a power drawn from a test signal by of each of the transmitter resonators; setting to one of an off state and an active state a power signal to each of the plurality of mutually independent transmitter resonators based on one of the corresponding measured resonator input impedances and the power drawn from a test signal by the corresponding transmitter resonators; selecting a power signal oscillation frnequency for each active transmitter resonator from among the plurality of preset power oscillation frequencies on the basis of the measured input impedance of the active transmitter resonator; and setting the power signal of each active transmitter resonator to the corresponding selected frequency. The method may further comprise adjusting a phase of

the power signal applied to each corresponding transmitter resonator to a phase at which power transfer through the transmitter resonator is substantially maximal.

[0027] In a further embodiment, a wireless near-field method for transferring power at a variable resonant power signal oscillation frequency from a multi-transmitter subsystem to two or more receiver subsystems is provided, the method comprising: providing the multi-transmitter subsystem comprising a plurality of mutually independent transmitter resonators each driven by a corresponding transmitter module capable of being set independently to one of a plurality of preset power signal oscillation frequencies in a preset frequency band, wherein all the transmitter resonators have a common transmission surface; disposing proximate the common transmission surface the two or more resonant receiver subsystems each comprising a single receiver resonator overlapping two or more of the transmitter resonators; measuring one of an input impedance of each of the transmitter resonators and a power drawn from a test signal by of each of the transmitter resonators; setting to one of an off state and an active state a power signal to each of the plurality of mutually independent transmitter resonators based on one of the corresponding measured resonator input impedances and the power drawn from a test signal by the corresponding transmitter resonators; selecting a power signal oscillation frequency for each active transmitter resonator from among the plurality of preset power oscillation frequencies on the basis of the measured input impedance of the active transmitter resonator; and setting the power signal of each active transmitter resonator to the corresponding selected frequency. The method may further comprise adjusting a phase of the power signal applied to each corresponding transmitter resonator to a phase at which power transfer through the transmitter resonator is substantially maximal.

[0028] In a further embodiment, a near-field wireless system is provided for transferring power from a photovoltaic cell to a power load, the system comprising: a transmission module in wired electrical communication with the photovoltaic cell, the transmission module configured to convert the power from the photovoltaic cell into an oscillating electrical power signal having an oscillation frequency; a transmitter resonator in wired electrical communication with the transmission module and configured to resonate at the oscillation frequency; a receiver resonator configured to resonate at the oscillation frequency and disposed to receive power from the transmitter resonator via at least one of capacitive coupling and magnetic induction; and a receiver module in wired electrical communication with the receiver resonator, the receiver module configured to receive power from the receiver resonator and to render via wired electrical communication to the power load the received power in direct current form.

[0029] The transmission module may comprise a power amplifier configured to modulate the power received from the photovoltaic cell at the oscillation frequency. The transmission module may comprise an oscillator configured to provide the oscillation frequency to the power amplifier. The transmission module may comprise a controller and one or more sensors, the controller configured to vary the oscillation frequency based on first information from at least one of the one or more sensors. The transmission module may comprise a transmission tuning network configured to change under control of the controller at least a phase of the power provided by the transmission module to the transmitter resonator based on second information from at least one of the one or more sensors.

[0030] The system may comprise a power conditioning unit electrically connected between the photovoltaic cell and the transmission module and configured to adapt the power from the photovoltaic cell to a format compatible with the transmission module. The transmission module may comprise small signal electronic circuitry and the power conditioning unit may be further configured for providing power to the small signal electronic circuitry. The transmitter resonator may be disposed on a surface of the photovoltaic cell opposing an active solar radiation receiving surface of the cell. The transmitter resonator has a surface area that has an extent that is at least a major fraction of the extent of the active solar radiation receiving surface of the cell.

[0031] The transmitter resonator may have a planar area that is smaller than a planar area of the receiver resonator. The receiver resonator may be disposed and configured to receive power from further transmitter resonators via at least one of capacitive coupling and magnetic induction at the resonance frequency.

[0032] In a sixth aspect, the present disclosure provides a near-field wireless system for transferring power from one or more photovoltaic cells to a power load, the system comprises: one or more transmission modules in electrical communication with the one or more photovoltaic cells, each transmission module configured to convert the power from at least one of the one or more photovoltaic cells into an oscillating electrical power signal having a variable oscillation frequency; one or more transmitter resonators in electrical communication with the one or more transmission modules, each transmitter resonator configured to resonate at the variable oscillation frequency; one or more receiver resonators, each receiver resonator configured to resonate at the variable

oscillation frequency and disposed to bimodally receive power from at least one of the one or more transmitter resonators simultaneously via capacitive coupling and magnetic

induction according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at the variable oscillation frequency; and one or more receiver modules in electrical communication with the receiver resonator, each receiver module configured to receive power fromat least one of the one or more receiver resonator, render the power received from the one or more receiver resonators into a direct current voltage, and transmit the direct current voltage to the power load.

[0033] Each transmission module from among the first plurality of transmission modules may comprise a power amplifier configured to modulate the power received from the corresponding photovoltaic cell at the oscillation frequency. Each transmission module from among the first plurality of transmission modules may comprises an oscillator configured to provide the oscillation frequency to the corresponding power amplifier. Each transmission module from among the first plurality of transmission modules may further comprise a controller and one or more sensors, the controller configured to vary the oscillation frequency based on first information from at least one of the one or more sensors. Each transmission module from among the first plurality of transmission modules may comprise a transmission tuning network configured to change under control of the corresponding controller at least a phase of the power provided by the transmission module to the corresponding transmitter resonator based on second information from at least one of the one or more sensors.

[0034] The system may comprise a third plurality of power conditioning units, each power conditioning unit from among the third plurality of power conditioning units electrically connected between the corresponding photovoltaic cell and the corresponding transmission module and configured to adapt the power from the corresponding photovoltaic cell to a format compatible with the corresponding transmission module. Each transmission module from among the first plurality of transmission modules may comprise small signal electronic circuitry and the corresponding power conditioning unit may further be further configured for providing power to the small signal electronic circuitry. Each transmitter resonator from among the second plurality of transmitter resonators may be disposed on a surface of the corresponding photovoltaic cell opposing an active solar radiation receiving surface of the cell.

[0035] In a further embodiment of a near-field wireless system for transferring power from an array of photovoltaic cells to a power load, the system comprises: a first plurality of transmission modules, each transmission module in wired electrical communication with a corresponding

photovoltaic cell in the array, each transmission module configured to convert the power from the corresponding photovoltaic cell into an oscillating electrical power signal having an oscillation frequency; a second plurality of transmitter resonators, each transmission resonator in wired

electrical communication with a corresponding transmission module from the first plurality of transmission modules and configured to resonate at the oscillation frequency; a third plurality of receiver resonators configured to resonate at the oscillation frequency, each receiver resonator from among the third plurality of receiver resonators disposed to receive power from a corresponding transmitter resonator from among the second plurality of transmitter resonators via at least one of capacitive coupling and magnetic induction; and a fourth plurality of receiver modules, each receiver module in wired electrical communication with a corresponding receiver resonator from among the third plurality of receiver resonators, the receiver module configured to receive power from the corresponding receiver resonator and to render via wired electrical communication to the power load the received power in direct current form.

[0036] Each transmission module from among the first plurality of transmission modules may comprise a power amplifier configured to modulate the power received from the corresponding photovoltaic cell at the oscillation frequency. Each transmission module from among the first plurality of transmission modules may comprise an oscillator configured to provide the oscillation frequency to the corresponding power amplifier. Each transmission module from among the first plurality of transmission modules may further comprise a controller and one or more sensors, the controller configured to vary the oscillation frequency based on first information from at least one of the one or more sensors. Each transmission module from among the first plurality of transmission modules may comprise a transmission tuning network configured to change under control of the corresponding controller at least a phase of the power provided by the transmission module to the corresponding transmitter resonator based on second information from at least one of the one or more sensors.

[0037] The system may further comprise a fifth plurality of power conditioning units, each power conditioning unit from among the fifth plurality of power conditioning units electrically connected between the corresponding photovoltaic cell from among the array of solar cells and the corresponding transmission module from among the first plurality of transmission modules and configured to adapt the power from the corresponding photovoltaic cell to a format compatible with the corresponding transmission module. Each transmission module from among the first plurality of transmission modules may comprise small signal electronic circuitry and the corresponding power conditioning unit from among the fifth plurality of power conditioning units may further be configured for providing power to the small signal electronic circuitry. Each transmitter resonator from among the second plurality of transmitter resonators may be disposed

on a surface of the corresponding photovoltaic cell from among the array of photovoltaic cells opposing an active solar radiation receiving surface of the cell.

[0036a] In a seventh aspect, the present disclosure provides method for bimodally transferring power from one or more photovoltaic cells to a power load, the method comprising: providing one or more transmission modules, each transmission module being in electrical communication with a corresponding one of the one or more photovoltaic cells; providing one or more transmitter resonators configured to resonate at a variable oscillation frequency, each transmitter resonator being in electrical communication with a corresponding one of the one or more transmission modules; providing one or more receiver resonators configured to resonate at the variable oscillation frequency, each receiver resonator in electrical communication with a corresponding receiver module; converting in each transmission module power from the corresponding one of the one or more photovoltaic cells into an oscillating electrical power signal having the variable oscillation frequency; bimodally transferring power from at least one of the one or more transmitter resonators to one or more of the receiver resonators via simultaneously capacitive coupling and magnetic induction according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at the variable oscillation frequency; rendering the power received from the one or more receiver resonators into a direct current voltage; and supplying the direct current voltage to the power load.

[0036b] A method for power transfer from a direct current power source to a power load, the method comprising: providing a power transfer system in wired electrical communication with the power source, the power transfer system comprising a radio frequency power amplifier in radio frequency communication with an adjustable phase radio frequency rectifier in wired electrical contact with the power load; converting the power from the direct current source into a radio frequency oscillating power signal in the amplifier; converting the radio frequency oscillating power signal to direct current power signal in the rectifier; and adjusting an efficiency of the power transfer by adjusting a current-voltage phase characteristic of the rectifier.

[0038] In a further embodiment a near-field wireless system is presented for transferring power from an array of photovoltaic cells to a power load, the system comprising: a first plurality of transmission modules, each transmission module in wired electrical communication with a corresponding photovoltaic cell in the array, each transmission module configured to convert the power from the corresponding photovoltaic cell into an oscillating electrical power signal having an oscillation frequency; a second plurality of transmitter resonators, each transmission resonator

in wired electrical communication with a corresponding transmission module from the first plurality of transmission modules and configured to resonate at the oscillation frequency; a third plurality of receiver resonators fewer in number than the plurality of transmitter resonators and configured to resonate at the oscillation frequency, each receiver resonator from among the third plurality of receiver resonators disposed to receive power from a portion of the plurality of transmitter resonators via at least one of capacitive coupling and magnetic induction; and a fourth plurality of receiver modules, each receiver module in wired electrical communication with a corresponding receiver resonator, the receiver module configured to receive power from the corresponding receiver resonator and to render via wired electrical communication to the power load the received power in direct current form.

[0039] Each transmission module from among the first plurality of transmission modules may comprise a power amplifier configured to modulate the power received from the corresponding photovoltaic cell at the oscillation frequency. Each transmission module from among the first plurality of transmission modules may comprise an oscillator configured to provide the oscillation frequency to the corresponding power amplifier. Each transmission module from among the first plurality of transmission modules may further comprise a controller and one or more sensors, the controller configured to vary the oscillation frequency based on first information from at least one of the one or more sensors. Each transmission module from among the first plurality of transmission modules may comprise a transmission tuning network configured to change under control of the corresponding controller at least a phase of the power provided by the transmission module to the corresponding transmitter resonator based on second information from at least one of the one or more sensors.

[0040] The system may comprise fifth plurality of power conditioning units, each power conditioning unit from among the fifth plurality of power conditioning units electrically connected between the corresponding photovoltaic cell from among the array of solar cells and the corresponding transmission module from among the first plurality of transmission modules and configured to adapt the power from the corresponding photovoltaic cell to a format compatible with the corresponding transmission module.

[0041] Each transmission module from among the first plurality of transmission modules may comprise small signal electronic circuitry and the corresponding power conditioning unit from among the fifth plurality of power conditioning units may be further configured for providing power to the small signal electronic circuitry. Each transmitter resonator from among the second plurality of transmitter resonators may be disposed on a surface of the corresponding photovoltaic cell from among the array of photovoltaic cells opposing an active solar radiation receiving surface of the cell.

[0042] In a further embodiment a method is provided for transferring power from a photovoltaic cell to a power load, the method comprising: converting in a transmission module the power from the photovoltaic cell into an oscillating electrical power signal having an oscillation frequency; transferring the power to a transmitter resonator in wired electrical communication with the transmission module and configured to resonate at the oscillation frequency; receiving power in a receiver resonator configured to resonate at the oscillation frequency and disposed to receive the power from the transmitter resonator via at least one of capacitive coupling and magnetic induction; receiving the power in a receiver module in wired electrical communication with the receiver resonator; and rendering via wired electrical communication to the power load the received power in direct current form.

[0043] In a further embodiment of a method for transferring power from an array of photovoltaic cells to a power load, the method comprises: converting in each of a first plurality of corresponding transmission modules the power from each of the photovoltaic cells in the array into an oscillating electrical power signal having an oscillation frequency; transferring the power in each of the transmission modules to a corresponding transmitter resonator from among a second plurality of transmitter resonators each configured to resonate at the oscillation frequency; receiving the power in a receiver resonator configured to resonate at the oscillation frequency and disposed to receive the power from the plurality of transmitter resonators via at least one of capacitive coupling and

[0046] In a ninth aspect, the present disclosure provides an electrical power transfer system for supplying power from a direct current source to a power load, the system comprising: a radio frequency power amplifier in wired electrical communication with the direct current and configured to convert direct current voltage from the source into an alternating voltage signal having an oscillation frequency; an adjustable phase radio frequency rectifier in wired electrical contact with the power load and in radio frequency communication with the power amplifier; the rectifier configured to receive power transferred from the amplifier; and a receiver controller in communication with the rectifier, the receiver controller configured for automatically adjusting an efficiency of power transfer from the amplifier to the rectifier by adjusting a current-voltage phase characteristic of the rectifier. The rectifier may be a differential self-synchronous radio frequency rectifier.

[0047] The receiver controller may be configured for automatically adjusting the current-voltage phase characteristic of the rectifier. The power transfer system may further comprise a load management system in wired communication with the load and power signal-wise disposed between the load and the rectifier, the load management system configured for increasing an efficiency of the power transfer by adjusting an input impedance of the rectifier. The load management system may be configured for automatically adjusting the current-voltage phase characteristic of the rectifier.

[0048] The power transfer system may further comprise a transmitter controller in communication with the amplifier, the transmitter controller configured increasing an efficiency of the power transfer by adjusting a current-voltage phase characteristic of the amplifier. The transmitter controller may be configured to automatically adjust the current-voltage phase characteristic of the amplifier to increase the efficiency of the power transfer.

[0049] The power transfer system may further comprise an oscillator in communication with the amplifier and the transmitter controller. The transmitter controller may be configured for adjusting the oscillation frequency via the oscillator.

[0050] The power amplifier may be in directly wired radio frequency communication with the adjustable phase radio frequency rectifier. The power amplifier may be in wireless near-field radio frequency communication with the adjustable phase radio frequency rectifier. The power transfer system may comprise a transmitter resonator in wired radio frequency communication with the

Claims:

1. A bimodal near-field resonant wireless electrical power transfer system configured for simultaneous capacitive power transfer and inductive power transfer according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency, the system comprising:

a transmitter subsystem comprising a transmitter antenna subsystem and a power signal tuner module, the power signal tuner module configured to adjust the transfer mode ratio by adjusting a power signal provided by the power signal tuner module to the transmitter antenna subsystem; and

a receiver subsystem comprising a receiver antenna subsystem configured for to receive electrical power from the transmitter antenna at the transfer mode ratio.

2. The system of claim 1, wherein the power signal tuner module is configured to adjust the power signal by adjusting a phase difference between a current and a voltage of the power signal provided to the transmitter antenna subsystem.

3. The system of claim 2, wherein the transmitter subsystem further comprises a controller and at least one sensor, wherein the controller is configured to receive sensor information from the at least one sensor and automatically provide a tuning instruction to the power signal tuner module based on the sensor information, and wherein the tuner module is configured to adjust according to the tuning instruction the phase difference between the current and the voltage of the power signal provided to the transmitter antenna subsystem.

4. The system of claim 3, wherein the at least one sensor is disposed in the transmitter subsystem.

5. The system of claim 3, wherein the at least one sensor is disposed in the receiver subsystem and the controller is configured for wirelessly receiving the sensor information.

6. The system of any one of claims 3-5, wherein the at least one sensor comprises at least one of a power load sensor, a transmission power sensor, a surrounding object detector, and a distance detector for detecting a distance between the transmitter antenna subsystem and the receiver antenna subsystem.

7. The system of any one of claims 1-5, wherein the variable resonant power signal oscillation frequency is free to vary within a predetermined frequency band.

8. The system of claim 7, wherein the predetermined frequency band is between 1MHz and 1GHz.

9. The system of claim 7, wherein the system is detuned to a degree that allows the variable resonant power signal oscillation frequency to vary within opposing limits of the predetermined frequency band.

10. The system of any one of claims 1-9, comprising an electrical load disposed in electrical communication with an electrically conductive mechanical load-bearing structure, wherein the receiver antenna subsystem comprises at least a portion of the electrically conductive mechanical load-bearing structure.

11. A method for bimodally transferring power from a direct current source to a load, the method comprising:

providing in electrical communication with the direct current source a transmitter subsystem comprising a transmitter antenna subsystem, and a power signal tuner module, and a controller;

providing at least one sensor;

providing in electrical communication with the load a receiver subsystem comprising a receiver antenna subsystem;

transferring power by simultaneous capacitive power transfer and inductive power transfer at a variable resonant power signal oscillation frequency from the transmitter antenna subsystem to the receiver antenna subsystem; and

adjusting the power signal module to change a transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency.

12. The method of claim 11, wherein adjusting the power signal module comprises adjusting a phase difference between a current and a voltage of a power signal provided from the power signal module to the transmitter antenna subsystem.

13. The method of claim 12, wherein adjusting the phase difference between the current and the voltage of the power signal comprises,

receiving in the controller sensor information from the at least one sensor,

automatically providing a tuning instruction from the controller to the power signal tuner module based on the sensor information, and

adjusting according to the tuning instruction the phase difference between the current and the voltage of the power signal provided to the transmitter antenna subsystem.

14. The method of claim 11, wherein providing the transmitter subsystem comprises providing the at least one sensor disposed in the transmitter subsystem.

15. The method of claim 13, wherein

providing the receiver subsystem comprises providing the at least one sensor disposed in the receiver subsystem; and

the receiving in the controller the sensor information comprises wirelessly receiving the sensor information in the controller.

16. The method of any one of claims 11- 15, wherein providing the at least one sensor comprises at least one of providing a power load sensor, a transmission power sensor, a surrounding object detector, and a distance detector for detecting a distance between the transmitter antenna subsystem and the receiver antenna subsystem.

17. The method according to any one of claims 11-13, wherein the bimodally transferring power comprises allowing the variable resonant power signal oscillation frequency to vary within a predetermined frequency band contained within the range between 1MHz and 1GHz.

18. The method according to claim 17, further allowing the variable resonant power signal oscillation frequency to vary within opposing limits of the predetermined frequency band.

19. A bimodal near-field wireless power transfer system configured for simultaneous capacitive power transfer and inductive power transfer to one or more receiver resonators according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at a variable resonant power signal oscillation frequency, the system comprising:

a transmission subsystem comprising:

one or more transmitter resonators collectively arranged to form a transmission surface; and

one or more corresponding transmitter modules in electrical communication with the one or more transmitter resonators for controlling a power signal output to the one or more transmitter resonators, each transmitter module comprising a transmitter controller and each transmitter module and its corresponding transmitter resonator forming a transmitter pair,

wherein the one or more transmitter pairs are electrically decoupled from one another.

20. The system of claim 19, wherein the transmitter controller of every first one of the one or more transmitter modules is configured for adjusting the phase of the power signal transmitted by the first transmitter module to match a phase of a power signal transmitted by any second one of the one or more transmitter module.

21. The system of claim 20, wherein the one or more transmitter pairs are electrically decoupled from one another by a grounded shield grid.

22. The system of claim 19, wherein the transmission controller of each transmitter module in a transmitter pair comprises

a tuner module for varying a phase of the power signal; and

a load detector configured for measuring an input impedance of one or more coupled transmitter resonators, and wherein the load detector is configured to detect a change in the input impedance when the one or more receiver resonators are proximate to the one or more coupled transmitter resonators.

23. The system of claim 22, wherein the transmission controller is configured to vary the variable resonant power signal oscillation frequency based on a measured input impedance of the coupled transmitter.

24. The system of claim 22, wherein the load detector of the transmission controller of each transmitter module measures an input impedance of one coupled transmitter resonator.

25. The system of claim 22, wherein the load detector of the transmission controller of each transmitter module measures an input impedance of two or more coupled transmitter resonators.

26. A method of varying a power signal of a wireless transfer system, the method comprising:

providing a transmission surface comprised of one or more transmitter resonators;

monitoring an input impedance of each of the one or more transmitter resonators;

calibrating a baseline input impedance for the one or more transmitter resonators; and

either assigning an off state to a transmitter resonator of the one or more transmitter resonators when the input impedance is less than the baseline impedance; or assigning an active state to the transmitter resonator when the input impedance is greater than the baseline impedance.

27. The method of claim 26, further comprising setting a frequency of the power signal output to the one or more transmitter resonators assigned to the active state.

28. The method of claim 27, further comprising adjusting a phase of the power output signal of the one or more transmitter resonators assigned to the active state to a maximum power transfer phase, at which power transfer through the transmitter resonator is substantially maximal.

29. The method of any one of claims 26-28, further comprising providing one or more receiver resonators proximal to the transmission surface.

30. A near-field resonant wireless electrical power transfer system comprising:

a transmission subsystem comprising a plurality of substantially mutually decoupled transmitter resonators and corresponding transmitter modules in power signal communication with each transmitter resonator, each transmitter module comprising a transmission controller and a power signal source having a power signal oscillation frequency and a power signal phase, each power signal source controlled by the corresponding transmission controller;

one or more receiver subsystems each comprising a corresponding receiver resonator;

a software lookup table of discrete allowed power signal oscillation frequencies for the power signal sources; and

software which when loaded in a memory and executed by the controller of any of the transmitter modules performs the actions of:

measuring one of an input impedance of the corresponding transmitter resonator and a test signal power draw by the corresponding transmitter resonator; and

selecting for the corresponding power signal source a frequency from the lookup table based on one of the input impedance of the corresponding transmitter resonator and the test signal power draw by the corresponding transmitter resonator.

31. The system according to claim 30, wherein the software when executed performs the actions of measuring a level of power transferred by the corresponding transmitter resonator while adjusting a phase of a power signal from the corresponding power signal source.

32. The system according to claim 30 or 31, wherein transmitter resonators are substantially mutually decoupled by a grounded shield grid.

33. A bimodal near-field resonant wireless system for transferring power from one or more photovoltaic cells to a power load, the system comprising:

one or more transmission modules in electrical communication with the one or more photovoltaic cells, each transmission module configured to convert the power from at least one of the one or more photovoltaic cells into an oscillating electrical power signal having a variable oscillation frequency;

one or more transmitter resonators in electrical communication with the one or more transmission modules, each transmitter resonator configured to resonate at the variable oscillation frequency;

one or more receiver resonators, each receiver resonator configured to resonate at the variable oscillation frequency and disposed to bimodally receive power from at least one of the one or more transmitter resonators simultaneously via capacitive coupling and magnetic induction according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at the variable oscillation frequency; and

one or more receiver modules in electrical communication with the receiver resonator, each receiver module configured to receive power from at least one of the one or more receiver resonators, render the power received from the one or more receiver resonators into a direct current voltage, and transmit the direct current voltage to the power load.

34. The system according to claim 33, wherein the one or more transmission modules each comprises a power amplifier configured to modulate the power received from the one or more photovoltaic cell at the variable oscillation frequency.

35. The system according to claim 34, wherein the one or more transmission modules each comprises an oscillator configured to provide the variable oscillation frequency to the power amplifier.

36. The system according to any one of claims 33-35, wherein the one or more transmission modules each further comprises a controller and one or more sensors, the controller configured to vary the variable oscillation frequency based on first information from at least one of the one or more sensors.

37. The system according to claim 36, wherein the one or more transmission modules each comprises a transmission tuning network configured to change under control of the controller at least a phase of the power provided by the transmission module to the one or more transmitter resonators based on second information from at least one of the one or more sensors.

38. The system according to any one of claims 33-35, wherein one or more receiver resonator is disposed for receiving power from any proximate transmitter resonator.

39. The system according to any one of claims 33-35, wherein the one or more transmitter resonators are disposed on a surface of at least one of the one or more photovoltaic cells opposing an active solar radiation receiving surface of the at least one of the one or more photovoltaic cells.

40. The system according to any one of claims 33-35, wherein the variable oscillation frequency of the oscillating electrical power signal is free to vary within a predetermined frequency band contained within the range between 1MHz and 1GHz.

41. The system of claim 40, wherein the system is detuned to a degree that allows the variable oscillation frequency of the oscillating electrical power signal to vary within opposing limits of the predetermined frequency band

42. A method method for bimodally transferring power from one or more photovoltaic cells to a power load, the method comprising

providing one or more transmission modules, each transmission module being in electrical communication with a corresponding one of the one or more photovoltaic cells;

providing one or more transmitter resonators configured to resonate at a variable oscillation frequency, each transmitter resonator being in electrical communication with a corresponding one of the one or more transmission modules;

providing one or more receiver resonators configured to resonate at the variable oscillation frequency, each receiver resonator in electrical communication with a corresponding receiver module;

converting in each transmission module power from the corresponding one of the one or more photovoltaic cells into an oscillating electrical power signal having the variable oscillation frequency;

bimodally transferring power from at least one of the one or more transmitter resonators to one or more of the receiver resonators via simultaneously capacitive coupling and magnetic induction according to an adjustable transfer mode ratio of the capacitive power transfer to the inductive power transfer at the variable oscillation frequency;

rendering the power received from the one or more receiver resonators into a direct current voltage; and

supplying the direct current voltage to the power load.

43. The method of claim 42, wherein:

providing the one or more transmission modules comprises providing one or more transmission modules each comprising a power amplifier; and

modulating in at least one power amplifier the power received from the one or more photovoltaic cells at the variable oscillation frequency.

44. The method according to claim 43, wherein:

providing the one or more transmission modules comprises providing one or more transmission modules each comprising an oscillator; and

providing from the oscillator to the power amplifier the variable oscillation frequency.

45. The method according to any one of claims 42-44, wherein providing the one or more transmission modules comprises providing one or more transmission modules each having a controller and one or more sensors, and the method comprises adjusting via the controller the variable oscillation frequency based on first information from at least one of the one or more sensors.

46. The method according to claim 45, wherein providing the one or more transmission modules comprises providing one or more transmission modules each having a transmission tuning network, and the method comprises adjusting via the controller based on second

information from at least one of the one or more sensors at least a phase of the power provided by the transmission module to the one or more transmitter resonators.

47. The method of claim 42, wherein providing the one or more receiver resonator comprises providing at least one of the one more receiver resonators disposed proximate to more than one of the transmitter resonators and receiving in the at least one receiver resonator power from one or more receiver resonators proximate the at least one receiver resonator.

48. The method according to any one of claims 33-35, wherein the bimodally transferring power comprises allowing the variable oscillation frequency to vary within a predetermined frequency band contained within the range between 1MHz and 1GHz.

49. A method for power transfer from a direct current power source to a power load, the method comprising:

providing a power transfer system in wired electrical communication with the power source, the power transfer system comprising a radio frequency power amplifier in radio frequency communication with an adjustable phase radio frequency rectifier in wired electrical contact with the power load;

converting the power from the direct current source into a radio frequency oscillating power signal in the amplifier;

converting the radio frequency oscillating power signal to direct current power signal in the rectifier; and

adjusting an efficiency of the power transfer by adjusting a current-voltage phase characteristic of the rectifier.

50. The method of claim 49, wherein the direct current power source comprises at least one solar photovoltaic cell.

51. The method of claim 49, further comprising adjusting the efficiency of the power transfer by automatically adjusting a direct current equivalent input resistance of the amplifier.

52. The method of claim 49, further comprising automatically adjusting the efficiency of the power transfer by automatically adjusting a current-voltage phase characteristic of the power amplifier.

53. The method of claim 49, further comprising adjusting the efficiency of the power transfer by changing the oscillation frequency of the power amplifier.

54. The method of claim 49, wherein the providing the power transfer system comprises providing the power amplifier in directly wired radio frequency communication with the adjustable phase radio frequency rectifier.

55. The method of claim 49, wherein the providing the power transfer system comprises providing the power amplifier in wireless near-field radio frequency communication with the adjustable phase radio frequency rectifier.

56. The method of claim 49, wherein the providing the power transfer system comprises providing the power amplifier in bimodal wireless near-field wireless communication with the rectifier.

57. An electrical power transfer system for supplying power from a direct current source to a power load, the system comprising:

a radio frequency power amplifier in wired electrical communication with the direct current and configured to convert direct current voltage from the source into an alternating voltage signal having an oscillation frequency;

an adjustable phase radio frequency rectifier in wired electrical contact with the power load and in radio frequency communication with the power amplifier; the rectifier configured to receive power transferred from the amplifier; and

a receiver controller in communication with the rectifier, the receiver controller configured for automatically adjusting an efficiency of power transfer from the amplifier to the rectifier by adjusting a current-voltage phase characteristic of the rectifier.

58. The system of claim 57, further comprising a load management system in wired communication with the load and power signal-wise disposed between the load and the rectifier, the load management system configured for increasing an efficiency of the power transfer by automatically adjusting an input impedance of the rectifier.

59. The system of claim 57, further comprising a transmitter controller in communication with the amplifier, the transmitter controller configured for increasing an efficiency of the power transfer by automatically adjusting a current-voltage phase characteristic of the amplifier.

60. The system of claim 59, further comprising an oscillator in communication with the amplifier and the transmitter controller, wherein the transmitter controller is configured for adjusting the oscillation frequency via the oscillator.

61. The system of claim 57, wherein the power amplifier is in directly wired radio frequency communication with the rectifier.

62. The system of claim 57, wherein the power amplifier is in wireless near-field radio frequency communication with the rectifier.

63. The system of claim 57, wherein the power amplifier is in bimodal near-field wireless radio frequency communication with the rectifier.

64. The system of claim 57, wherein the direct current source comprises a rechargeable battery and the load comprises an electric motor.

65. The system of claim 57, wherein a resonant structure of the system comprises at least one electrically conductive mechanical load bearing structural component of the system.

66. The system of claim 57, further comprising a power conditioning unit electrically disposed between the power source and the power amplifier, the power conditioning unit configured for adjusting at least one of a current and a voltage from the power source to improve the efficiency of the power transfer.