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(54) **METHODS AND SYSTEMS FOR MAXIMUM POWER POINT TRANSFER IN RECEIVERS**

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CPC ***H02J 50/20*** (2016.02); ***H02J 50/40*** (2016.02); ***H02J 50/60*** (2016.02)

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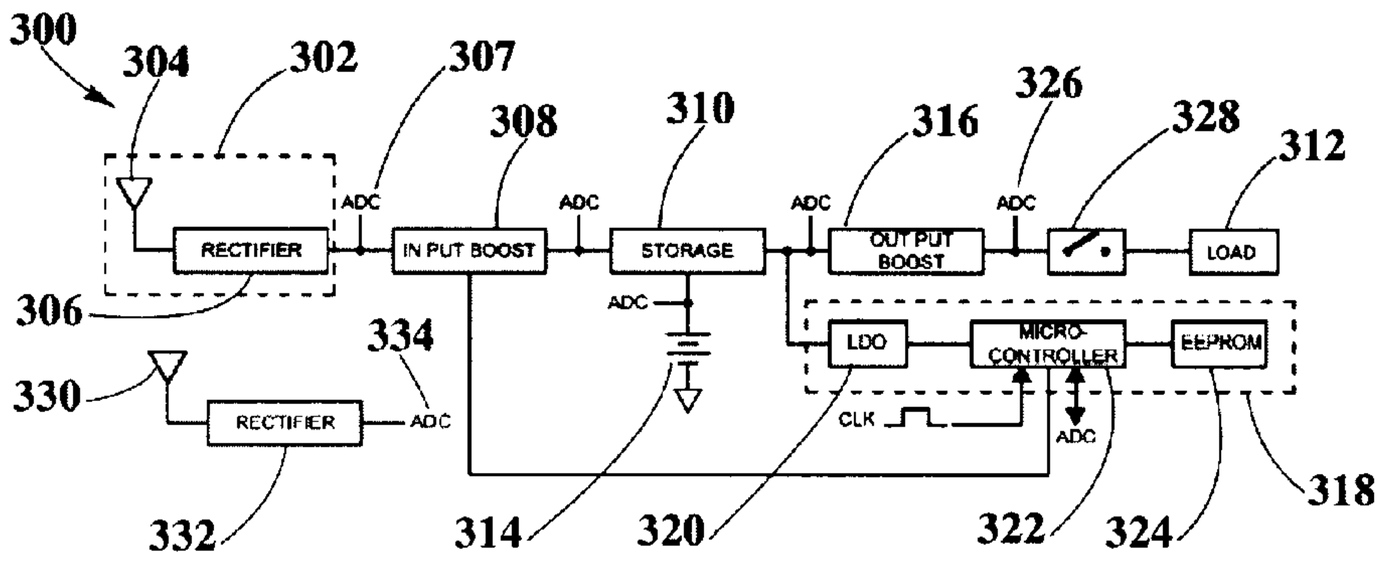
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(57) **ABSTRACT**

The embodiments described herein include a wireless power receiver. One such receiver includes: (i) a first rectifier configured to rectify a first power received at a first antenna, (ii) a second rectifier configured to rectify a second power received at a second antenna, (iii) a controller configured to transmit an operational instruction to an input boost converter to adjust the first rectified power in response to determining that the power extracted by the receiver is less than a global power maximum based upon the first rectified power and the second rectified power, and (iv) an output boost converter configured to adjust the power provided to a load associated with the receiver. The controller is configured to: (a) determine load requirements for the load and (b) transmit one or more operational instructions to at least one of the input boost converter and the output boost converter based upon the load requirements.

17 Claims, 5 Drawing Sheets



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continuation of application No. 14/584,869, filed on Dec. 29, 2014, now Pat. No. 9,438,045, which is a continuation-in-part of application No. 14/272,207, filed on May 7, 2014.

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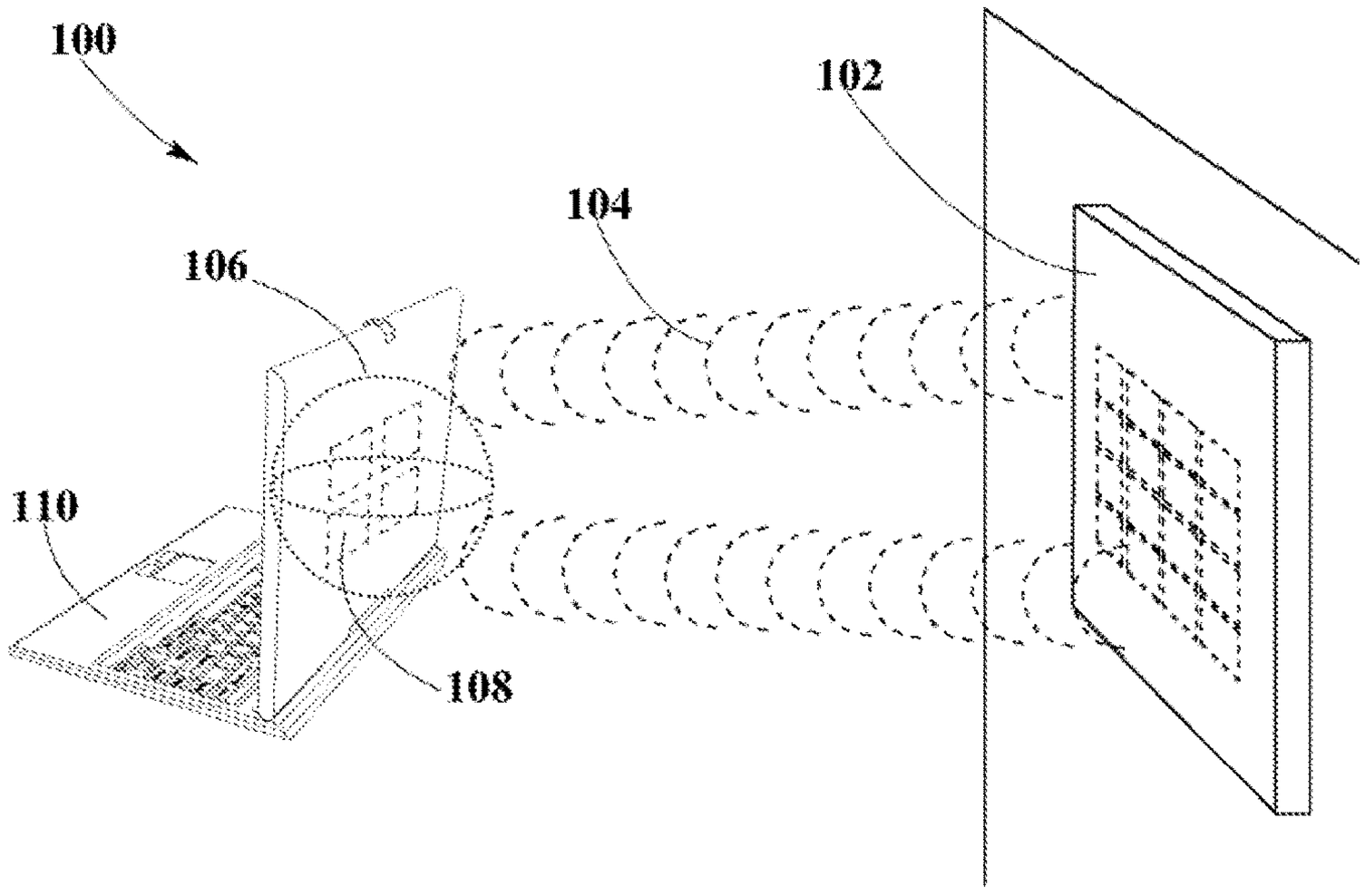


FIG. 1

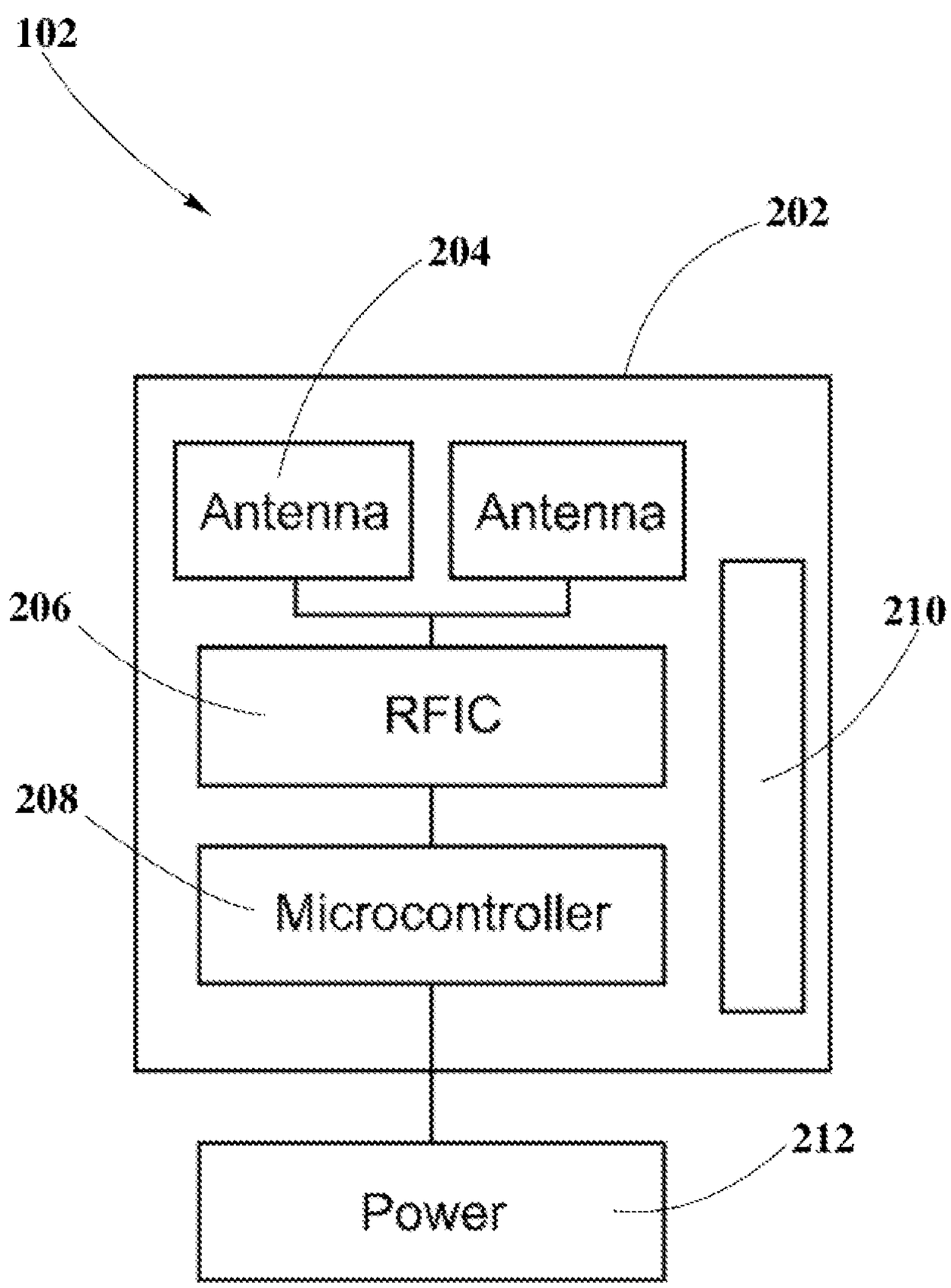

102
204
202
Antenna
Antenna
206
RFIC
210
208
Microcontroller
212
Power

FIG. 2

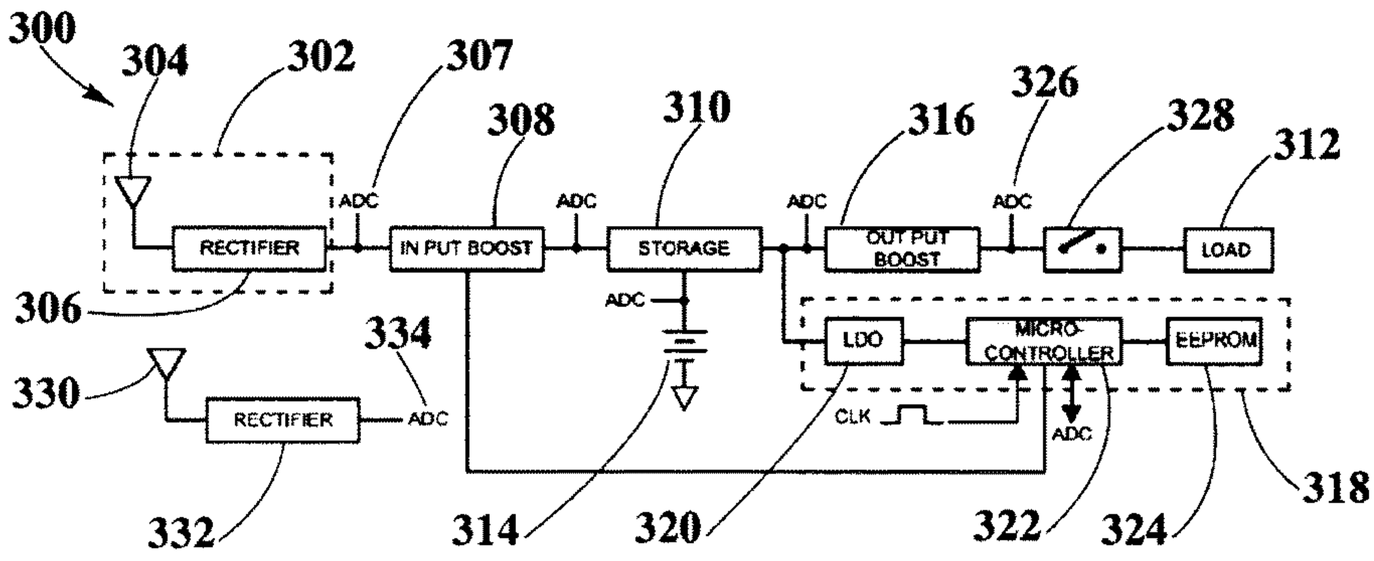

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304
302
307
308
310
316
326
328
312
ADC
RECTIFIER
IN PUT BOOST
STORAGE
OUT PUT BOOST
LOAD
306
334
330
LDO
MICRO-CONTROLLER
EEPROM
CLK
RECTIFIER
ADC
332
314
320
322
324
318

FIG. 3

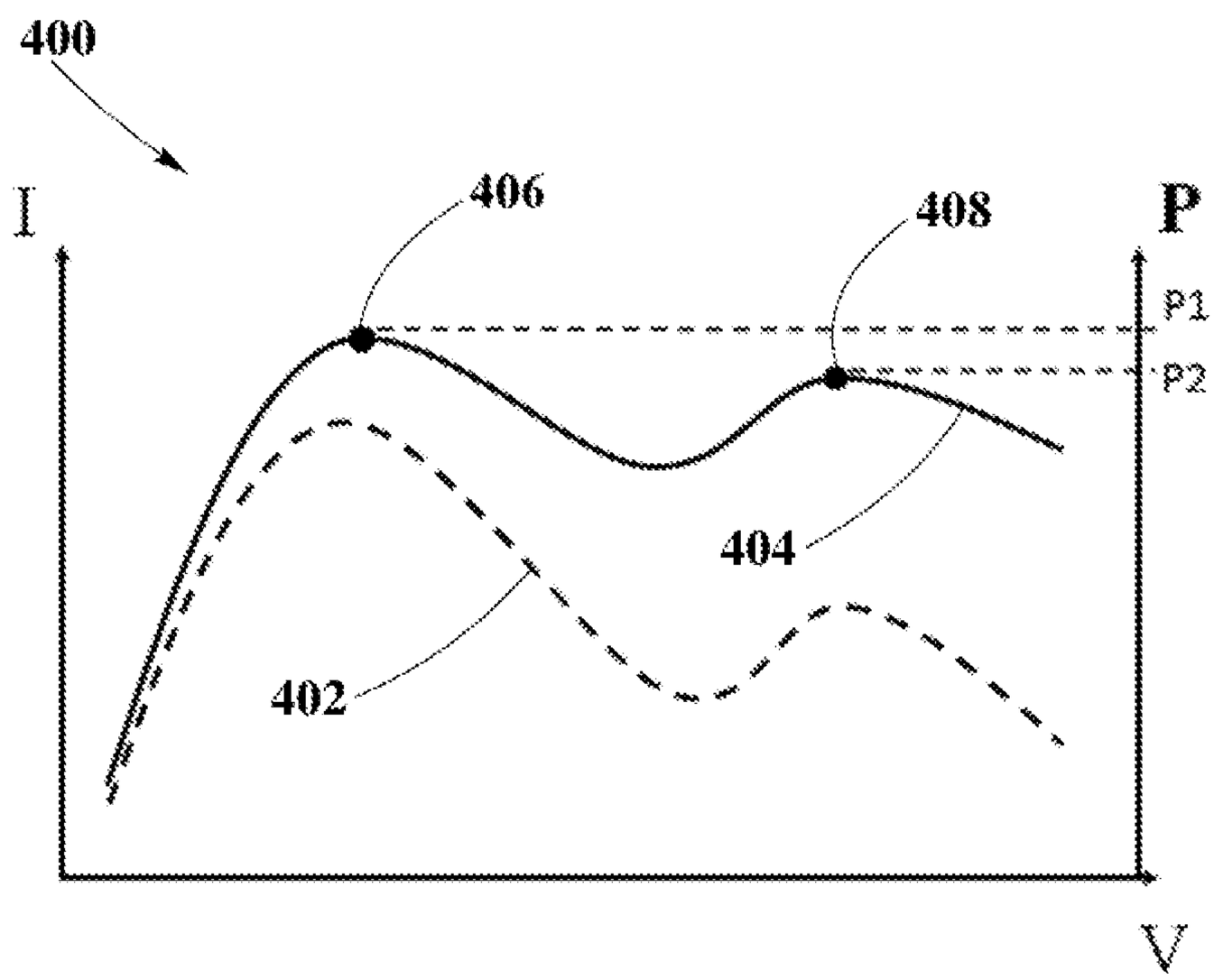


FIG. 4

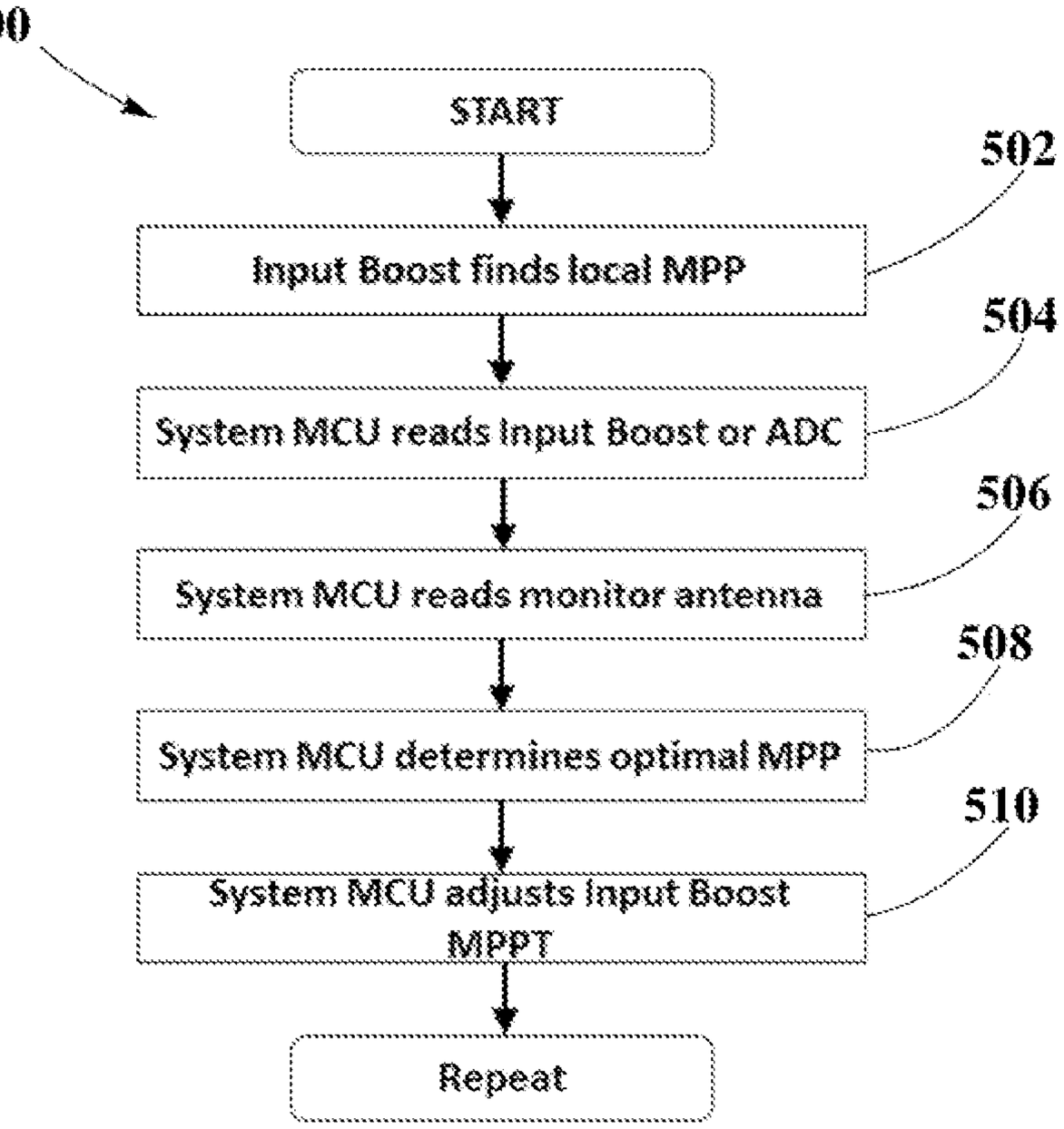

500
START
502
Input Boost finds local MPP
504
System MCU reads Input Boost or ADC
506
System MCU reads monitor antenna
508
System MCU determines optimal MPP
510
System MCU adjusts Input Boost MPPT
Repeat

FIG. 5

METHODS AND SYSTEMS FOR MAXIMUM POWER POINT TRANSFER IN RECEIVERS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/747,995 filed on Jun. 23, 2015, which is a continuation of U.S. patent application Ser. No. 14/584,869, filed on Dec. 29, 2014, which is a continuation-in-part of U.S. patent application Ser. No. 14/272,207, filed on May 7, 2014, which are herein fully incorporated by reference in their entirety.

This application is related to U.S. patent application Ser. No. 13/891,430, filed on May 10, 2013; U.S. patent application Ser. No. 13/946,082, filed on Jul. 19, 2013; U.S. patent application Ser. No. 13/891,399, filed on May 10, 2013; U.S. patent application Ser. No. 13/891,445, filed on May 10, 2013; and U.S. patent application Ser. No. 14/272,179, filed on May 7, 2014; U.S. Non-Provisional patent application Ser. No. 14/583,625, filed Dec. 27, 2014, entitled "Receivers for Wireless Power Transmission," U.S. Non-Provisional patent application Ser. No. 14/583,630, filed Dec. 27, 2014, entitled "Methodology for Pocket-Forming," U.S. Non-Provisional patent application Ser. No. 14/583,634, filed Dec. 27, 2014, entitled "Transmitters for Wireless Power Transmission," U.S. Non-Provisional patent application Ser. No. 14/583,640, filed Dec. 27, 2014, entitled "Methodology for Multiple Pocket-Forming," U.S. Non-Provisional patent application Ser. No. 14/583,641, filed Dec. 27, 2014, entitled "Wireless Power Transmission with Selective Range," U.S. Non-Provisional patent application Ser. No. 14/583,643, filed Dec. 27, 2014, entitled "Method for 3 Dimensional Pocket-Forming," all of which are incorporated herein by reference in their entirety.

FIELD OF THE DISCLOSURE

The present disclosure generally relates to wireless power transmission, and more specifically to a MPPT management method to effectively improve power extraction in receivers.

BACKGROUND

Wireless power transmission may be based on the extraction and conversion of power or energy from transmitted RF waves. One challenge that may be present during wireless power transmission is that power or energy extracted from RF waves may be variable due to inherent characteristics of the medium and environment. Moreover, the power that can be extracted from RF waves may be zero at some instances of the wireless power transmission. The variability of the power extracted from RF waves may be fueled by interference produced by electronic devices, walls, metallic objects, and electromagnetic signals, among others.

In order to extract suitable power from RF waves, it may be desirable that a receiver may work as close as possible to maximum points or peaks, despite the fact that external conditions may alter the transmission of RF waves.

According to the foregoing, there may be a need to provide a method and/or system for managing maximum power point tracking (MPPT) in a receiver capable of operating with a variable power source derived from RF waves for powering and/or charging the batteries for a plurality of electronic devices.

SUMMARY

The present disclosure provides an MPPT management method for enabling a receiver to extract maximum power from RF waves.

The receiver may include components that may be required for the efficient wireless power transmission. In one embodiment, the receiver system may include an intelligent input boost converter with a built-in micro-controller operatively coupled with a main micro-controller to deliver continuous and suitable power or voltage to a load. The receiver may also include a dedicated antenna for measuring the power received from RF waves.

According to the disclosed MPPT management method, the built-in micro-controller in the input boost converter may monitor the voltage levels received at the main antenna array. Consequently, the built-in micro-controller may detect the maximum power point by increasing or decreasing the current it is taking from the main antenna array until it has found a local power maximum. The built-in micro-controller in the intelligent input boost converter may send this MPPT data to the main system micro-controller, which may compare the measured MPPT data with MPPT tables residing in the memory of main system micro-controller or use it for further computation in algorithms located within the software of the main system micro-controller. The result from the tables or algorithms may be used for adjusting the MPPT executed in the intelligent input boost converter for maximizing power extraction from received RF waves.

Numerous other aspects, features, and benefits of the present disclosure may be made apparent from the following detailed description taken together with the drawing figures, which may illustrate the embodiments of the present disclosure, incorporated herein for reference.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure can be better understood by referring to the following figures. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the disclosure. In the figures, reference numerals designate corresponding parts throughout the different views.

FIG. **1** illustrates wireless power transmission using pocket forming, according to an embodiment.

FIG. **2** illustrates a block diagram of a wireless power transmitter, which may be used in wireless power transmission, according to an embodiment.

FIG. **3** depicts a block diagram of wireless power receiver configuration that may be used for extracting and converting power from transmitted RF waves, according to an embodiment.

FIG. **4** illustrates the MPPT of characteristic curves, which may be used to change the voltage direction and adjust the operation of the receiver, according to an embodiment.

FIG. **5** shows a flowchart for the method enabled by the proprietary MPPT algorithm controlling maximum power point transfer and operation of the input boost converter, according to an embodiment.

DETAILED DESCRIPTION

The present disclosure is here described in detail with reference to embodiments illustrated in the drawings, which form a part here. Other embodiments may be used and/or other changes may be made without departing from the spirit

or scope of the present disclosure. The illustrative embodiments described in the detailed description are not meant to be limiting of the subject matter presented here.

As used here, the following terms may have the following definitions:

"Pocket-forming" refers to generating two or more RF waves that converge in 3-d space, forming controlled constructive and destructive interference patterns.

"Pockets of energy" refers to areas or regions of space where energy or power may accumulate in the form of constructive interference patterns of RF waves.

"Transmitter" refers to a device, including a chip which may generate two or more RF signals, at least one RF signal being phase shifted and gain adjusted with respect to other RF signals, substantially all of which pass through one or more RF antenna such that focused RF signals are directed to a target.

"Receiver" refers to a device which may include at least one antenna, at least one rectifying circuit, at least one input boost converter, at least one storage element, at least one output boost converter, at least one switch, and at least one communication subsystem for powering or charging an electronic device using RF waves.

"MPPT or Maximum Power Point Tracking" refers to an algorithm included in micro-controllers of a receiver for extracting maximum available power from RF waves.

FIG. **1** illustrates a wireless power transmission **100** using pocket-forming. A transmitter **102** may transmit controlled Radio Frequency (RF) waves, which may converge in 3-d space. These RF waves **104** may be controlled through phase and/or relative amplitude adjustments to form constructive and destructive interference patterns (pocket-forming). Pockets of energy **106** may be formed at constructive interference patterns and can be 3-dimensional in shape, while null-spaces may be generated at destructive interference patterns. A receiver **108** may then utilize pockets of energy **106** produced by pocket-forming for charging or powering a cordless electronic device **110**, for example, a smartphone, a tablet, a laptop computer (as shown in FIG. **1**), a music player, an electronic toy, and the like. In some embodiments, there can be multiple transmitters **102** and/or multiple receivers **108** for powering various electronic devices **110** at the same time. In other embodiments, adaptive pocket-forming may be used to regulate the power transmitted to electronic devices **110**.

FIG. **2** illustrates the block diagram of transmitter **102**, which may be used in wireless power transmission **100**. Transmitter **102** may include a housing **202**, at least two or more antenna elements **204**, at least one RF integrated circuit (RFIC) **206**, at least one digital signal processor (DSP) or micro-controller **208**, and one communications component **210**. Housing **202** can be made of any suitable material which may allow for signal or wave transmission and/or reception, for example plastic or hard rubber. Antenna elements **204** may include suitable antenna types for operating in frequency bands such as 900 MHz, 2.5 GHz or 5.8 GHz as these frequency bands conform to Federal Communications Commission (FCC) regulations part **18** (Industrial, Scientific and Medical equipment). Antenna elements **204** may include vertical or horizontal polarization, right hand or left hand polarization, elliptical polarization, or other suitable polarizations as well as suitable polarization combinations. Suitable antenna types may include, for example, patch antennas with heights from about ⅛ inch to about 8 inches and widths from about ⅛ inch to about 6 inches. Other antenna elements **204** types that can be used include meta-materials based antennas, dipole antennas, and planar inverted-F antennas (PIFAs), among others.

RF integrated circuit (RFIC) **206** may include a proprietary chip for adjusting phases and/or relative magnitudes of RF signals, which may serve as inputs for antenna elements **204** for controlling pocket-forming. These RF signals may be produced using a power source **212** and a local oscillator chip (not shown) using a suitable piezoelectric material. Micro-controller **208** may then process information sent by receiver **108** through communications component **210** for determining optimum times and locations for pocket-forming. Communications component **210** may be based on standard wireless communication protocols, which may include Bluetooth, Wi-Fi or ZigBee. In addition, communications component **210** may be used to transfer other information such as an identifier for the device or user, battery level, location or other such information. Other communications component **210** may be possible, including radar, infrared cameras or sound devices for sonic triangulation of electronic device **110** position.

FIG. **3** shows a block diagram of receiver configuration **300** which can be used for wireless powering or charging one or more electronic devices **110** as exemplified in wireless power transmission **100**. According to some aspects of this embodiment, receiver **108** may operate with the variable power source generated from transmitted RF waves **104** to deliver constant and stable power or energy to electronic device **110**. In addition, receiver **108** may use the variable power source generated from RF waves **104** to power up electronic components within receiver **108** for proper operation.

Receiver **108** may be integrated in electronic device **110** and may include a housing (not shown in FIG. **3**) that can be made of any suitable material to allow for signal or wave transmission and/or reception, for example plastic or hard rubber. This housing may be an external hardware that may be added to different electronic equipment, for example in the form of cases, or can be embedded within electronic equipment as well.

Receiver **108** may include an antenna array **302** which may convert RF waves **104** or pockets of energy **106** into electrical power. Antenna array **302** may include one or more antenna elements **304** coupled with one or more rectifiers **306**. RF waves **104** may exhibit a sinusoidal shape within a voltage amplitude and power range that may depend on characteristics of transmitter **102** and the environment of transmission. The environment of transmission may be affected by changes to or movement of objects within the physical boundaries, or movement of the boundaries themselves. It is also affected by changes to the medium of transmission; for example, changes to air temperature or humidity. As a result, the voltage or power generated by antenna array **302** at the receiver **108** may be variable. As an illustrative embodiment, and not by way of limitation, the alternating current (AC) voltage or power generated by antenna element **304** from RF waves **104** or pocket of energy **106** may vary from about 0 volts or 0 watt to about 5 volts at 3 watts.

Antenna element **304** may include suitable antenna types for operating in frequency bands similar to the bands described for transmitter **102** from FIG. **2**. Antenna element **304** may include vertical or horizontal polarization, right hand or left hand polarization, elliptical polarization, or other suitable polarizations as well as suitable polarization combinations. Using multiple polarizations can be beneficial in devices where there may not be a preferred orientation

during usage or whose orientation may vary continuously through time, for example electronic device **110**. On the contrary, for devices with well-defined orientations, for example a two-handed video game controller, there might be a preferred polarization for antennas which may dictate a ratio for the number of antennas of a given polarization. Suitable antenna types may include patch antennas with heights from about ⅛ inch to about 6 inches and widths from about ⅛ inch to about 6 inches. Patch antennas may have the advantage that polarization may depend on connectivity, i.e. depending on which side the patch is fed, the polarization may change. This may further prove advantageous as receiver **108** may dynamically modify its antenna polarization to optimize wireless power transmission **100**.

Rectifier **306** may include diodes or resistors, inductors or capacitors to rectify the AC voltage generated by antenna element **304** to direct current (DC) voltage. Rectifier **306** may be placed as close as is technically possible to antenna element **304** to minimize losses. In one embodiment, rectifier **306** may operate in synchronous mode, in which case rectifier **306** may include switching elements that may improve the efficiency of rectification. As an illustrative embodiment and not by way of limitation input boost converter **308** may operate with input voltages of at least 0.6 volts to about 5 volts to produce an output voltage of about 5 volts. In addition, input boost converter **308** may reduce or eliminate rail-to-rail deviations and may operate as a step-up DC-to-DC converter to increase the voltage from rectifier **306** to a voltage level suitable for proper operation of receiver **108**. In one embodiment, intelligent input boost converter **308** may exhibit a synchronous topology to increase power conversion efficiency.

As the voltage or power generated from RF waves **104** may be zero at some instants of wireless power transmission **100**, receiver **108** can include a storage element **310** to store energy or electric charge from the output voltage produced by input boost converter **308**. In this way, storage element **310** may deliver a constant voltage or power to a load **312** which may represent the battery or internal circuitry of electronic device **110** requiring continuous powering or charging. For example, load **312** may be the battery of a mobile phone requiring constant delivery of 5 volts at 2.5 watts.

Storage element **310** may include a battery **314** to store power or electric charge from the voltage received from input boost converter **308**. Battery **314** may be of different types, including but not limited to, alkaline, nickel-cadmium (NiCd), nickel-metal hydride (NiHM), and lithium-ion, among others. Battery **314** may exhibit shapes and dimensions suitable for fitting receiver **108**, while charging capacity and cell design of battery **314** may depend on load **312** requirements. For example, for charging or powering a mobile phone, battery **314** may deliver a voltage from about 3 volts to about 4.2 volts.

In another embodiment, storage element **310** may include a capacitor (not shown in FIG. **3**) instead of battery **314** for storing and delivering electrical charge or power to load **312**. As a way of example, in the case of charging or power a mobile phone, receiver may include a capacitor with operational parameters matching the load device's power requirements.

Receiver **108** may also include an output boost converter **316** operatively coupled with storage element **310** and input boost converter **308**, where this output boost converter **316** may be used for matching impedance and power requirements of load **312**. As an illustrative embodiment, and not by way of limitation, output boost converter **316** may increase the output voltage of battery **314** from about 3 or 4.2 volts to about 5 volts which may be the voltage required by the battery **314** or internal circuitry of a mobile phone. Similarly to input boost converter **308**, output boost converter **316** may be based on a synchronous topology for enhancing power conversion efficiency.

Storage element **310** may provide power or voltage to a communication subsystem **318** which may include a low-dropout regulator (LDO **320**), a main system micro-controller **322**, and an electrically erasable programmable read-only memory (EEPROM **324**). LDO **320** may function as a DC linear voltage regulator to provide a steady voltage suitable for low energy applications as in main system micro-controller **322**. Main system micro-controller **322** may be operatively coupled with EEPROM **324** to store data pertaining the operation and monitoring of receiver **108**. Main system micro-controller **322** may also include a clock (CLK) input and general purpose inputs/outputs (GPIOs).

In one embodiment, intelligent input boost converter **308** may include a built-in micro-controller (not shown in FIG. **3**) operatively coupled with a main system micro-controller **322**. The main system micro-controller **322** may actively monitor the overall operation of receiver **108** by taking one or more power measurements **326** (ADC) at different nodes or sections as shown in FIG. **3**. For example, main system micro-controller **322** may measure how much voltage or power is being delivered at rectifier **306**, input boost converter **308**, battery **314**, output boost converter **316**, communication subsystem **318**, and/or load **312**. Main system micro-controller **322** may communicate these power measurements **326** to load **312** so that electronic device **110** may know how much power it can pull from receiver **108**. In another embodiment, main system micro-controller **322**, based on power measurements **326**, may control the power or voltage delivered at load **312** by adjusting the load current limits at output boost converter **316**.

Main system micro-controller **322** may monitor the voltage levels at the output of the main antenna array **302** using ADC node point **307**.

In another embodiment, main system micro-controller **322** may regulate how power or energy can be drained from storage element **310** based on the monitoring of power measurements **326**. For example, if the power or voltage at input boost converter **308** runs too low, then main system micro-controller **322** may direct output boost converter **316** to drain battery **314** for powering load **312**.

Yet in another embodiment, receiver **108** may have a dedicated antenna element **330** operatively coupled with a corresponding rectifier **332**, where these dedicated antenna element **330** and rectifier **332** may be used for continuously monitoring the surrounding pocket of energy **106**. This dedicated antenna element **330** may be separate from the main antenna array **302**. More specifically, the main system micro-controller **322** may measure power level at ADC node point **334** to compare against actual DC power levels extracted from the receiver **108** system.

Receiver **108** may include a switch **328** for resuming or interrupting power being delivered at load **312**. In one embodiment, main system micro-controller **322** may control the operation of switch **328** according to terms of services contracted by one or more users of wireless power transmission **100** or according to administrator policies.

FIG. **4** illustrates a graph **400**, depicting the intensity(I) of current available from main antenna array, (P) the power available from main antenna array, and (V) the voltage from main antenna array. FIG. **4** shows a current-to-voltage curve **402** that may be obtained from receiver **108** operation and

which may vary according to the characteristics of receiver **108**. FIG. **4** also shows a corresponding power curve **404** which may represent the power available (current×voltage) from the main antenna array **302**.

In one embodiment, voltage levels measured at ADC node point **307** may not necessarily exhibit a linear relationship with the available current from the main antenna array **302**. Thus, power curve **404** may have multiple local peaks, including a global power maximum **406** at P**1**, and a local power maximum **408** at P**2**.

The MPPT algorithm running in the input boost converter **308** may continuously track for a global power maximum **406** in graph **400**, so that input boost converter **308** may be able to extract the maximum amount of power from antenna array **302**. However, in some circumstances, the MPPT algorithm may be stuck at a local power maximum **408** which may not correspond to the global power maximum **406** in graph **400**. When operating at a local power maximum **408**, intelligent input boost converter **308** may not be able to maximize the amount of power that can be extracted from antenna array **302**.

It may be an object of embodiments described herein to adjust the MPPT algorithm to control the operation of intelligent input boost converter **308** so that it can continuously operate at global power maximum **406** to make the best use of the power that can be extracted from antenna array **302** in receiver **108** system.

FIG. **5** shows a MPPT management method **500** that may be used for maximizing the amount of power that can be extracted from antenna array **302** to deliver continuous and suitable power to receiver **108**.

At monitoring step **502**, the built-in micro-controller in the intelligent input boost converter **308** may monitor voltage from antenna array **302** and search for a global power maximum **406** or local power maximum **408**.

At step **504**, the main system micro-controller **322** may read the result from the input boost converter **308** or use ADC node point **307** to establish the input boost converter **308** current operational MPPT. Subsequently, at step **506**, the main system micro-controller **322** may read the voltage of dedicated antenna element **330** at ADC node point **334**. At step **508**, the combination of the input boost converter **308** MPP and the output value of dedicated antenna element **330** may be used to either index a predefined look-up table or be used in an algorithm. This result may or may not require an adjustment of the operational input parameters of the input boost converter **308** MPPT algorithm. Once action is determined, the main system micro-controller **322** may adjust the MPPT algorithm executed by input boost converter **308**, thus moving the operation of input boost converter **308** from local power maximum **408** P**2** to global power maximum **406** P**1**, at step **510**.

The predefined MPPT tables may include a characterization of a plurality of receivers **108** in terms of ability to extract power from a particular field. For example, the capability of receiver **108** for extracting power from RF waves **104** may vary according to the configuration of antenna array **302**. In one embodiment, these MPPT tables may be determined by laboratory measurements of different receivers **108** in a way that a particular receiver **108** may be mapped to an optimal MPPT.

In one embodiment, main system micro-controller **322** may use the information contained in MPPT tables to provide initial conditions for running an optimal MPPT at intelligent input boost converter **308** according to the specific characteristics or configuration of receiver **108**.

While various aspects and embodiments have been disclosed, other aspects and embodiments may be contemplated. The various aspects and embodiments disclosed here are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

What is claimed is:

1. A wireless power receiver comprising:

a first rectifier coupled to a first antenna, and configured to rectify a first power received at the first antenna and generate a first rectified power;

a second rectifier coupled to a second antenna, and configured to rectify a second power received at the second antenna and generate a second rectified power;

a controller configured to transmit an operational instruction to an input boost converter to adjust the first rectified power in response to determining that the power extracted by the receiver is less than a global power maximum based upon the first rectified power and the second rectified power; and

an output boost converter configured to adjust the power provided to a load associated with the receiver,

wherein the controller is configured to:

determine load requirements for the load associated with the receiver; and

transmit one or more operational instructions to at least one of the input boost converter and the output boost converter based upon the load requirements for the load associated with the receiver.

2. The receiver according to claim **1**, wherein the first power and the second power are generated by a plurality of power waves transmitted by a plurality of antennas of one or more wireless power transmitters.

3. The receiver according to claim **1**, wherein the input boost converter comprises a second controller configured to receive the one or more operational instructions from the controller.

4. The receiver according to claim **1**, wherein the operational instruction comprises an instruction for a second controller of the input boost converter to step up the first rectified power.

5. The receiver according to claim **1**, wherein the controller is configured to determine the operational instruction based upon a query to a look-up table indexed by a value of the first rectified power and a value of the second rectified power.

6. The receiver according to claim **1**, wherein the input boost converter is configured to determine at least one of the global power maximum and a local power maximum.

7. A method of receiver operation, the method comprising:

rectifying, by a first rectifier of a receiver, a first power received at a first antenna of the receiver to generate a first rectified power;

rectifying, by a second rectifier of the receiver, a second power received at a second antenna of the receiver to generate a second rectified power;

transmitting, by a controller of the receiver, an operational instruction to an input boost converter to adjust the first rectified power in response to determining that the power extracted by the receiver is less than a global power maximum based upon the first rectified power and the second rectified power;

determining, by the controller, load requirements for a load associated with the receiver; and

transmitting, by the controller, one or more operational instructions to at least one of the input boost converter

and an output boost converter based upon the load requirements for the load associated with the receiver.

8. The method of claim **7**, wherein the first power and the second power are generated by a plurality of power waves transmitted by a plurality of antennas of one or more wireless power transmitters.

9. The method of claim **7**, further comprising:

receiving, by a second controller of the input boost converter, the operational instruction from the controller.

10. The method of claim **7**, wherein the operational instruction comprises an instruction for a second controller of the input boost converter to step up the first rectified power.

11. The method of claim **7**, further comprising:

determining, by the controller, the operational instruction based upon a query to a look-up table indexed by a value of the first rectified power and a value of the second rectified power.

12. The method of claim **7**, further comprising:

determining, by the input boost converter, at least one of the global power maximum and a local power maximum.

13. A wireless power system comprising:

a first rectifier configured to rectify a first power received at a first antenna to generate a first rectified power;

a second rectifier configured to rectify a second power received at a second antenna to generate a second rectified power;

a controller configured to transmit an operational instruction to an input boost converter to adjust the first rectified power in response to determining that the power extracted by the receiver is less than a global power maximum based upon the first rectified power and the second rectified power; and

an output boost converter configured to adjust the power provided to a load associated with the receiver,

wherein the controller is configured to:

determine load requirements for the load associated with the receiver; and

transmit one or more operational instructions to at least one of the input boost converter and the output boost converter based upon the load requirements for the load associated with the receiver.

14. The wireless power system of claim **13**, wherein the input boost converter comprises a second controller configured to receive the one or more operational instructions from the controller.

15. The wireless power system of claim **13**, wherein the operational instruction comprises an instruction for a second controller of the input boost converter to step up the first rectified power.

16. The wireless power system of claim **13**, wherein the controller is configured to determine the operational instruction based upon a query to a look-up table indexed by a value of the first rectified power and a value of the second rectified power.

17. The wireless power system of claim **13**, wherein the input boost converter is configured to determine at least one of the global power maximum and a local power maximum.

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