(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 October 2016 (13.10.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/164568 A1

(51) International Patent Classification:
G05D 1/02 (2006.01) ***H02M 3/338*** (2006.01) ***G05B 11/01*** (2006.01)

(21) International Application Number:
PCT/US2016/026421

(22) International Filing Date:
7 April 2016 (07.04.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/144,070 7 April 2015 (07.04.2015) US

(71) Applicant: **EARTH STAR SOLUTIONS, LLC** [US/US]; 8774 N. Cedar Fort Circle, Eagle Mountain, Utah 84005 (US).

(72) Inventor: **MILLAR, Gary Bret**; 5032 Old Oak Lane, Highland, Utah 84003 (US).

(74) Agents: **BONNER, Anthony F.** et al.; Dinsmore & Shohl, 255 E. 5th Street, Cincinnati, Ohio 45202 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2016/164568 A1

(54) Title: SYSTEMS AND METHODS FOR CUSTOMIZED LOAD CONTROL

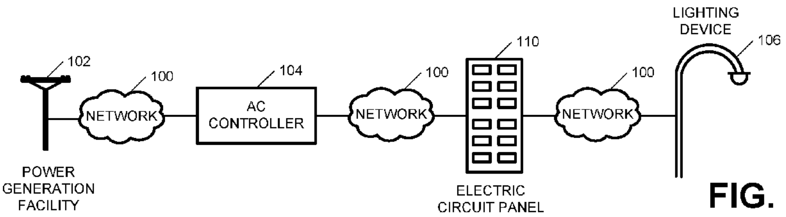


FIG. 1B

(57) Abstract: Included are embodiments for customized load control. One embodiment of a method includes receiving altered alternating current power, where the altered alternating current power is altered via inclusion of a delay to communicate a message, converting the message in the altered alternating current power into a computer-readable format, and determining an action to take related to the message. Some embodiments include utilizing the altered alternating current power for performing the action, based on the message.

SYSTEMS AND METHODS FOR CUSTOMIZED LOAD CONTROL

TECHNICAL FIELD

[0001] Embodiments described herein generally relate to systems and methods for customized lighting and communication via alternating current power and, more specifically, to providing a communication protocol and related hardware and software for customized lighting controls.

BACKGROUND

[0002] As lighting and power technologies have developed, there is now a desire to provide and/or utilize energy efficient electric and electronic devices. As an example, the lighting industry consumes a large amount of power and there is constantly pressure to reduce costs and reduce grid usage via more efficient lighting devices. Additionally, many current solutions produce a large amount of heat. It is also often difficult to adequately control lighting to provide the desired power consumption.

SUMMARY

[0003] Included are embodiments for customized load control. One embodiment of a method includes receiving altered alternating current power, where the altered alternating current power is altered via inclusion of a delay to communicate a message, converting the message in the altered alternating current power into a computer-readable format, and determining an action to take related to the message. Some embodiments include utilizing the altered alternating current power for performing the action, based on the message.

[0004] Embodiments of an electric device include an alternating current filter for filtering an altered alternating current power to create a filtered signal, a voltage current converter for utilizing the altered alternating current power to cause the load perform an action, and a load computing device that stores logic that, when executed by a processor, causes the electric device to receive the filtered signal from the alternating current filter. In some embodiments the logic causes the electric device to determine, from the filtered signal, a message included in the altered alternating current power, where the message is configured as a plurality of delays around respective zero cross points of the altered alternating current power. In some embodiments, the logic causes the electric device to determine, from the

message, the action for the load to take, and communicate an instruction related to the action to the voltage current converter, where the voltage current converter utilizes the instruction to convert the altered alternating current power to implement the action.

[0005] Also included are embodiments of a system. The system may include a voltage current converter for utilizing an altered alternating current power to cause the load perform an action and a load computing device that stores logic that, when executed by a processor, causes the electric device to receive the altered alternating current power, where the altered alternating current power includes a message that is transmitted at the same frequency as the altered alternating current power, wherein the message is configured a delay around a zero cross point of the altered alternating current power. In some embodiments, the logic further causes the system to determine, from the message, the action for the load to take and communicate an instruction related to the action to the voltage current converter, where the voltage current converter utilizes the instruction to convert the altered alternating current power for the load to implement the action.

[0006] Also included are embodiments for communication via alternating current power. As an example, a method includes receiving alternating current power at a predetermined frequency, receiving communications data for a device, and determining from the communications data a message to send to the device. Some embodiments include determining an alteration to the alternating current power to convert the communications data into the message according to a predetermined format, determining a zero cross point of the alternating current power, and altering the alternating current power around the zero cross point according to the predetermined format to send the message. Some embodiments include sending the altered alternating current power with the message according to the predetermined format to the device.

[0007] Embodiments of a system include a transistor for receiving the alternating current power at a predetermined frequency and altering the alternating current power and a zero cross detector that is coupled to the transistor for receiving the alternating current power and determining a zero cross point that indicates that the alternating current power crosses zero volts. Some embodiments include an alternating current controller computing device that is coupled to the zero cross detector. The alternating current controller computing device may include logic that when executed by a processor, causes the alternating current controller to receive a communication from a remote computing device that includes a message for including in the alternating current power, determine a predetermined format for altering the alternating current power for including the message in the alternating current power at the predetermined frequency, and receive data from the zero cross detector that indicates when the alternating current power crosses zero volts. Some embodiments may be configured to provide an instruction to the transistor for altering the alternating current power to include the message.

[0008] Similarly, some embodiments of a system may include a transistor for receiving the alternating current power at a predetermined frequency, altering the alternating current power, and outputting the altered alternating current power to an electric device. These embodiments may include a zero cross detector that is coupled to the transistor for receiving the alternating current power and determining a zero cross point that indicates that the alternating current power crosses zero volts and an alternating current controller computing device that is coupled to the zero cross detector. The alternating current controller computing device including logic that when executed by a processor, causes the alternating current controller to receive a communication from a remote computing device that includes a message for including in the alternating current power, determine a predetermined format for delaying at least a portion of the alternating current power for including the message in the alternating current power at the predetermined frequency, and receive data from the zero cross detector that indicates when the alternating current power crosses zero volts. Some embodiments may be configured to provide an instruction to the transistor for delaying at least a portion of the alternating current power to include the message.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the disclosure. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

[0010] FIGS. 1A-1B depict a power and communications network, according to embodiments described herein;

[0011] FIG. 2 depicts an alternating current (AC) controller, according to embodiments described herein;

[0012] FIGS. 3A-3B depict waveforms of AC power that may be altered by the AC controller, as described herein;

[0013] FIG. 4 depicts a lighting device, according to embodiments described herein;

[0014] FIG. 5 depicts a flowchart for sending altered AC power to a device, according to embodiments described herein;

[0015] FIG. 6 depicts a flowchart for including a delay in AC power for sending a message, according to embodiments described herein;

[0016] FIG. 7 depicts a flowchart for determining contents of a message that was sent via altered AC power, according to embodiments described herein;

[0017] FIG. 8 depicts a flowchart for altering a load, based on a determined characteristic of received AC power, according to embodiments described herein; and

[0018] FIG. 9 depicts a load computing device for determining a characteristic of AC power, according to embodiments described herein.

DETAILED DESCRIPTION

[0019] Embodiments disclosed herein include systems and methods for customized lighting and communication via alternating current. Some embodiments may be configured to facilitate communication of data from a first device to a second device via a protocol that includes creating an altered alternating current power via alteration of an AC power waveform, where the communication is made in the same frequency as a predetermined frequency of the AC power. Additionally, some embodiments may provide for LED lighting without the need for a heat sink or other heat removal devices. Specifically, some embodiments may utilize an aluminum substrate on one or more portions of the device that provides integrated heat removal. Similarly, some embodiments may be configured to provide control of a load, such as one or more lighting devices via a communications network, such as the Internet. These and other embodiments incorporating the same will be described in more detail, below.

[0020] Referring now to the drawings, FIGS. 1A-1B depict a power and communications environment, according to embodiments described herein. As illustrated in FIG. 1A, the power and communications environment may include a network 100, which is coupled to an power generation facility 102, an alternating current (AC) controller 104, a lighting device 106, and a remote computing device 108. The network 100 may include a power network, which may include alternating current power that is delivered to a plurality of devices (or loads). The network 100 may also include a communications network, such as a wide area network, (e.g., the Internet, a cellular network, a telephone network, etc.) and/or a local area network (e.g. an Ethernet network, a wireless fidelity network, a near field communications network, etc.). As will be understood, the network 100 between any two devices may include a single wire or communication link and may include a plurality of power and/or communications channels.

[0021] The power generation facility 102 is also included in the embodiments of FIGS. 1A and 1B and may include a power plant, a solar power generation network, power storage facility and/or other facility that facilitates the providing of power to one or more devices. As will be understood, the power generation facility 102 may be configured to create and/or provide alternating current (AC) power. It should be understood that while the power generation facility 102 described herein may create the AC power, some embodiments may include separate entities and/or facilities for creating, storing, and transmitting the AC power to the devices, which are all included in the power generation facility 102 for simplicity.

[0022] Also included in FIGS. 1A and 1B is the AC controller 104. The AC controller 104 may be configured to receive the AC power, as well as a communication signal. As described in more detail below, the AC controller 104 may additionally alter the AC power signal on the same frequency that the AC power was received to include a message into the AC power.

[0023] The lighting device 106 may operate in concert with or separate from the AC controller 104 and may be configured to receive AC power from the power generation facility 102 for performing a function (such as illuminating a light emitting diode (LED)). The lighting device 106 may additionally receive a message via the AC controller 104, which may alter the function of the lighting device 106, facilitate monitoring of a function of the lighting device 106, and/or perform other actions.

[0024] It should be understood that while the lighting device 106 is described herein as an LED illumination device; this is merely an example. While embodiments described herein relate to illumination, this description may extend to other electric or electronic devices. Accordingly, any load may be attached to the hardware and/or software described herein to provide the desired functionality.

[0025] Also included in FIG. 1A is a remote computing device 108. The remote computing device 108 may represent one or more computing devices that may facilitate sending messages and/or commands to be included in AC power. The remote computing device 108 may also be configured for updating software and/or firmware associated with the components, and/or provide other functionality. As an example, some embodiments may be configured to receive a command form the remote computing device 108 to activate the lighting device 106. This command may be sent via a communications network (which is part of the network 100) to the AC controller 104, which may convert the message to be communicated via an altered from of the AC power. The AC power may be received by the lighting device 106, which may also receive the message. The lighting device 106 may thus be powered by the AC power and receive communications via the AC power.

[0026] FIG. 1B depicts a different configuration than FIG. 1A in that the embodiment of FIG. 1B illustrates the AC controller 104 with an electric circuit panel 110, such as a breaker panel, which may or may not be co-located with the AC controller 104. Specifically, the embodiment of FIG. 1B depicts the power generation facility 102, which is connected to the network 100. The power generation facility 102 may provide power to a user's facility, which may be received at the electric circuit panel 110 controlling operation and/or for distribution along a local portion of the network 100 to various loads at the user's facility. However, the AC controller 104 may be included with the electric circuit panel 110 and/or provided at the user premises and coupled to the electric circuit panel 110 via a local network to provide user control of the desired functionality. Depending on the particular embodiment, the AC controller 104 may be included in series between the power generation facility 102 and the electric circuit panel 110. However, some embodiments may be configured with the electric circuit panel 110 between the power generation facility 102 and the AC controller 104. Other configurations may also be utilized, depending on the embodiment. Regardless, the lighting device 106 may be coupled to the circuit for receiving power from the power generation facility 102.

[0027] FIG. 2 depicts an AC controller 104, according to embodiments described herein. As illustrated, the AC controller 104 may include a transistor 202, an AC controller computing device 204, and a zero cross detector 206. Specifically, the AC controller 104 may receive AC power from the power generation facility 102 at the transistor 202 and the zero cross detector 206. The AC controller 104 may also receive a communication signal such as from the remote computing device 108 at the AC controller computing device 204. The AC controller computing device 204 may determine a message that was sent via the communication signal and may determine an action to take from the communication signal. As an example, the communication signal may request that the lighting device 106 be turned off. Accordingly, the AC controller computing device 204 may determine this request and then determine how to alter the AC power that is received by the transistor 202 may be altered to communicate that message over the same frequency as the AC power.

[0028] In order to communicate the communication signal over the AC power, the AC controller computing device 204 may determine a communications protocol. As an example, the communications protocol may include delaying transmission and/or inserting a standard delay time at predetermined intervals in the AC power. Depending on the timing of the plurality of delays, a recipient device may decode the communication. As another example, the AC controller computing device 204 may determine the length of delay for communicating the message. In this scenario, length of delay and timing of subsequent delays may provide the communications protocol for the recipient device to decode. Based on the determined communications protocol that is being used, the zero cross detector 206 may determine when the AC power is transmitting zero volts (e.g., when the voltage from the AC power changes from positive to negative or vice versa). At or around the zero cross point (e.g., a point where the AC power crosses zero volts, either from positive to negative or from negative to positive), the AC controller computing device 204 may insert an alteration into the AC power, such as a delay. The alteration may occur at or around one or more zero cross points of the AC power and may be configured as a binary signal, such that a delayed zero cross point indicates a binary “1” and a non-delayed zero cross point indicates a binary “0.” Other formats and protocols may be used as well, such as different lengths of delay to indicate different characters of a message. The transistor 202 may then implement the desired alteration to the AC power, which is sent along the network 100.

[0029] FIGS. 3A-3B depict waveforms of AC power that may be altered by the AC controller 104, as described herein. Specifically, FIG. 3A depicts a waveform 320a of AC power for providing power to one or more devices. The AC power may be transmitted with a peak voltage of plus/minus 120 volts, 220 volts, 440 volts, and/or other voltages. Accordingly, between the positive and negative peaks are zero cross points 322a – 322d, where the voltage is zero.

[0030] Also depicted in FIG. 3A is a square wave 324a, with a voltage range of 0 volts to 5 volts. As described in more detail with regard to FIG. 4, the square wave may be created from the AC power via an AC filter 414 (FIG. 4) such that the load computing device 412 (FIG. 4) may be adequately powered. As will be understood, the voltage range of the square wave 324a may vary, depending on the requirements and specifications of the load computing device 412.

[0031] FIG. 3B depicts a waveform 320b of AC power that has been altered to communicate a message, as described herein. Specifically, the waveform 320b may be similar to the waveform 320a, except altered to communicate the message. Accordingly, the waveform 320b may have predetermined positive and negative voltages, as well as zero cross points corresponding with the waveform 320a. Additionally, the waveform 320b may have a predetermined half period (represented as "T"), which also corresponds to the waveform 320a. Upon determining the substance of a message to be sent, the AC controller 104 may be configured to delay transmission of the AC power at or around one or more zero cross points 322 for a predetermined time period before continuing the transmission. As illustrated in FIG. 3B, the delay 326 may be implemented, such that the half period for a first portion of the waveform 230b (T^1) may be the same as (or similar to) as the normal half period (T) because the delay began at the zero cross point corresponding with the zero cross point 322a from FIG. 3A. However, because of the implemented delay, the waveform 320b may be shifted by a predetermined amount of time and thus the half period of the subsequent portion of the waveform (T^2) may be greater by that delayed amount of time.

[0032] Accordingly, a recipient device (such as the lighting device 106) may receive the AC power and may recognize the alteration to the AC power. Depending on the protocol being implemented, the recipient device may decode the message and react appropriately. In some embodiments, a delayed waveform at an expected zero cross point will be identified as a binary "1," while an unaltered zero cross point of the AC power may represent a binary "0" (or vice versa). Thus, the recipient device may decode the series of binary "ones" and "zeros" to determine a message being sent via the AC power. Other embodiments may utilize a different encoding protocol, such as varying the length of delay to indicate a "1" or "0" or other data (e.g., a first amount of delay may indicate a first signal such as a "1" and a second amount of delay may represent a second signal such as a "0" and/or other coding protocol).

[0033] It should be understood that while embodiments described herein are not required to provide a delay at or around the zero cross point, the embodiments that insert delays at, around, and/or slightly after the zero cross point may (depending on the length of delay and the load) result in a more constant output of the load, as the voltage will experience less interruption. It should also be understood that, while the above description indicates that a delay is utilized, this is also an example. As described in FIG. 3B, the AC power may actually be disconnected, creating a break in power signal. Thus, the break may actually be represented as a zero voltage event. Other alterations may also be utilized.

[0034] FIG. 3B also depicts a square wave 324b, with a corresponding delay 328. As the AC controller 104 may alter the AC power, the square wave may experience a similar delay, which may also be utilized to communicate data.

[0035] FIG. 4 depicts an electric device that takes the form of a lighting device 106, according to embodiments described herein. As illustrated, the lighting device 106 includes a device circuit 402 and a load 404. The device circuit 402 may include a voltage rectifier 406, a voltage current converter 408, a voltage regulator 410, a load computing device 412, an AC filter 414, and an interface component 418. Specifically, the AC power (or the altered AC power, depending on the embodiment) may be received by the device circuit 402 at the voltage rectifier 406. The voltage rectifier 406 may be configured to modify the AC power (waveform 320a or 320b from FIG. 3A, 3B) to rectify or remove negative portions of the waveform and/or otherwise convert the AC power into direct current (DC) power. As an example, the load 404 may be configured to only activate with positive voltage. Accordingly, if the load 404 receives AC power, the LEDs may flicker due to the negative voltage being received. This may result in a potentially undesirable output. As such, the voltage rectifier 406 may be configured to output only non-negative voltage to provide a steady output from the load 404.

[0036] The voltage rectifier 406 may send the conditioned voltage to the voltage current converter 408, as well as to the voltage regulator 410. The voltage regulator 410 may be configured to reduce the voltage of the rectified power to a level that is usable to power the load computing device 412. As an example, the voltage regulator 410 may reduce the DC voltage to about 5 volts or other voltage that is usable by the load computing device 412. This converted DC voltage may be sent to power the load computing device 412.

[0037] The load computing device 412 may also be coupled to the voltage detector 416 and may be configured to alter the manner in which voltage is delivered to the load 404. Similarly, some embodiments of the load computing device 412 may be configured to receive AC power that includes communication data; decode that communication; and perform an action, based on the decoded message.

[0038] To this end, the voltage detector 416 may receive the conditioned voltage from the voltage rectifier 406 and may determine a characteristic of the AC power. Based on the characteristic, the load computing device 412 may send a communication to the interface component 418, which acts as a barrier between high and low voltages. The interface component 418 may send a signal to the voltage current converter 408, which may alter the voltage received by various portions of the load 404, based on the message received in the AC power and decoded by the load computing device 412.

[0039] Additionally, the AC power (with the alterations described in FIG. 3B) may be received by the AC filter 414. As described above regarding FIGS. 3A and 3B, the AC filter 414 may receive the AC power and convert the AC power into a filtered signal, which may include computer-readable format, such as a square wave with a peak voltage that is compatible with the load computing device 412. If the AC controller 104 (FIGS. 1A, 1B, and 2) alters the AC power (such as including a delay), the square wave produced by the AC filter 414 may also include the alteration (or similar alteration). The load computing device 412 may receive the square wave from the AC filter 414 and may utilize logic to determine the message included in the altered square wave. Depending on the particular embodiment, the message sent via the AC power may include an instruction to activate the load 404, deactivate the load 404, reduce power to the load, etc. Some embodiments may be configured to cause the load computing device 412 to implement a test sequence for testing operation of the lighting device 106. Similarly, some embodiments may cause the load to communicate a message to another device (such as a mobile phone, television, computing device, etc.).

[0040] As an example, some embodiments may be configured such that the load is an array of light emitting diodes (LEDs). Based on the received voltage of the AC power, the load computing device 412 may cause the voltage current converter 408 to send the AC power only to those LEDs that can properly operate under the power constraints, thus changing output of the LEDs. This can provide relatively consistent output of the load 404, regardless of the AC power.

[0041] It should also be understood that embodiments of the device circuit 402 may be provided on a printed circuit board (PCB) and/or other circuit material that includes an aluminum substrate as a primary component. By utilizing an aluminum substrate for the device circuit 402, heat may be dissipated, thus removing the necessity for a heat sink or other heat removal devices.

[0042] Additionally, while the embodiment of FIG. 4 depicts a single device circuit 402 and a single load 404, this is also merely an example. Some embodiments may couple a plurality of loads 404 to a single device circuit 402 and/or a plurality of device circuits 402 together to provide the desired functionality and/or illumination. Additionally, the blocks 202 – 206 depicted in FIG. 2 and blocks 406-418 from FIG. 4 may be implemented in hardware (including programmable hardware), software, and/or firmware depending on the particular embodiment, so long as the desired functionality is provided. It should also be understood that while the lighting device 106 is depicted with both the device circuit 402 and the load 404, this is also an example. Some embodiments may include a device circuit that is separate from the lighting device 106.

[0043] FIG. 5 depicts a flowchart for sending altered AC power to a device, according to embodiments described herein. As illustrated in block 530, AC power may be received. In block 532, communication data may be received. As discussed above, the communication data may be received from a remote computing device 108 and/or via other source. Regardless, in block 534, a message for sending to a remote device may be determined from the communication data. In block 536, alterations to the AC power may be determined to convert the communications data into the message according to a predetermined format. In block 538, a zero cross point of the AC power may be determined. In block 540, the AC power may be altered to determine alterations at or around the zero cross point. In block 542, the altered AC power may be sent to an external device.

[0044] FIG. 6 depicts a flowchart for including a delay in AC power for sending a message, according to embodiments described herein. As illustrated in block 630, AC power may be received. In block 632, a communication to send may be determined. In block 634, at least one zero cross point of the AC power may be determined. In block 636, communication of the AC power may be delayed for a predetermined time at or around the at least one zero cross point, according to a predetermined format to communicate a message via the AC power.

[0045] FIG. 7 depicts a flowchart for determining contents of a message that was sent via altered AC power, according to embodiments described herein. As illustrated in block 730, altered AC power may be received with an included message. In block 732, the altered AC power may be converted into a computer-readable format. In block 734, an action may be determined from the message in the altered AC power. In block 736, the AC power may be utilized to perform the action, according to the determined message.

[0046] FIG. 8 depicts a flowchart for altering a load, based on a determined characteristic of received AC power, according to embodiments described herein. As illustrated in block 830, AC power may be received. In block 832, a characteristic of the AC power may be determined. In block 834, a command to adjust a load based on the characteristic may be determined. In block 836, the load may be adjusted, based on the characteristic.

[0047] FIG. 9 depicts a load computing device 412 for determining a characteristic of AC power, according to embodiments described herein. The load computing device 412 includes a processor 930, input/output hardware 932, network interface hardware 934, a data storage component 936 (which stores alteration data 938a, other data 936b, and/or other data), and the memory component 940. The memory component 940 may be configured as volatile and/or nonvolatile memory and as such, may include random access memory (including SRAM, DRAM, and/or other types of RAM), flash memory, electrical erasable programmed read only memory (EEPROM), secure digital (SD) memory, registers, compact discs (CD), digital versatile discs (DVD), and/or other types of non-transitory computer-readable mediums. Depending on the particular embodiment, these non-transitory computer-readable mediums may reside within the load computing device 412 and/or external to the load computing device 412.

[0048] The memory component 140 may store operating system logic 942, sensing logic 944a and altering logic 144b. The sensing logic 944a and the altering logic 944b may each include a plurality of different pieces of logic, each of which may be embodied as a computer program, firmware, and/or hardware, as an example. A local interface 946 is also included in FIG. 9 and may be implemented as a bus or other communication interface to facilitate communication among the components of the load computing device 412.

[0049] The processor 930 may include any processing component operable to receive and execute instructions (such as from a data storage component 936 and/or the memory component 140). As described above, the input/output hardware 932 may include and/or be configured to interface with the components of FIG. 9.

[0050] The network interface hardware 934 may include and/or be configured for communicating with any wired or wireless networking hardware, including an antenna, a modem, a LAN port, wireless fidelity (Wi-Fi) card, WiMax card, mobile communications hardware, and/or other hardware for communicating with other networks and/or devices. From this connection, communication may be facilitated between the load computing device 412 and other computing devices, such as those depicted in FIG. 1.

[0051] The operating system logic 942 may include an operating system and/or other software for managing components of the load computing device 412. As discussed above, the sensing logic 944a may reside in the memory component 940 and may be configured to cause the processor 930 to determine voltage values, delays in power signal waveforms, as well as perform other functions, as described above. Similarly, the altering logic 944b may be utilized to provide instructions for altering one or more functions of the lighting device 106.

[0052] It should be understood that while the components in FIG. 9 are illustrated as residing within the load computing device 412, this is merely an example. In some embodiments, one or more of the components may reside external to the load computing device 412. It should also be understood that, while the load computing device 412 is illustrated as a single device, this is also merely an example. Similarly, some embodiments may be configured with the sensing logic 944a and the altering logic 944b residing on different computing devices. Additionally, while the load computing device 412 is illustrated with the sensing logic 944a and the altering logic 944b as separate logical components, this is also an example. In some embodiments, a single piece of logic may cause the remote computing device 108 to provide the described functionality or multiple different pieces may provide this functionality.

[0053] It should also be understood that while the load computing device 412 is depicted in FIG. 9, other computing devices, such as the AC controller computing device 204 and the remote computing device 108 may also include at least a portion of the hardware described with regard to FIG. 9. The hardware and software for these devices however, may vary from those described with regard to FIG. 9 to provide the desired functionality.

[0054] As illustrated above, various embodiments for customized lighting and communication via alternating current power are disclosed. These embodiments may be configured to provide a user to with the ability to control output of a load (such as a lighting device) with a remote computing device. Embodiments also provide for circuitry that does not require heat removal devices. Some embodiments may also provide the ability to communicate over AC power using the same frequency as the AC power.

[0055] While particular embodiments and aspects of the present disclosure have been illustrated and described herein, various other changes and modifications can be made without departing from the spirit and scope of the disclosure. Moreover, although various aspects have been described herein, such aspects need not be utilized in combination. Accordingly, it is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the embodiments shown and described herein.

CLAIMS

What is claimed is:

1. A method for customized load control comprising:

receiving altered alternating current power, wherein the altered alternating current power is altered via inclusion of a delay to communicate a message;

converting the message in the altered alternating current power into a computer-readable format;

determining an action to take related to the message; and

utilizing the altered alternating current power for performing the action, based on the message.

2. The method of claim 1, wherein the delay is provided around a zero cross point of the altered alternating current power.

3. The method of claim 1, further comprising rectifying the altered alternating current power to remove negative voltage.

4. The method of claim 1, further comprising converting the altered alternating current power into a square wave, wherein the square wave includes the delay.

5. The method of claim 1, wherein performing the action includes activating a load, according to the message.

6. The method of claim 1, wherein performing the action includes causing a load to communicate with another device.

7. An electric device for customized load control comprising:

an alternating current filter for filtering an altered alternating current power to create a filtered signal;

a voltage current converter for utilizing the altered alternating current power to cause the load perform an action; and a load computing device that stores logic that, when executed by a processor, causes the electric device to perform at least the following:

receive the filtered signal from the alternating current filter;

determine, from the filtered signal, a message included in the altered alternating current power, wherein the message is configured as a plurality of delays around respective zero cross points of the altered alternating current power;

determine, from the message, the action for the load to take;

communicate an instruction related to the action to the voltage current converter, wherein the voltage current converter utilizes the instruction to convert the altered alternating current power to implement the action.

8. The electric device of claim 7, wherein the alternating current filter further transforms the altered alternating current power into a square wave, wherein the square wave includes the plurality of delays.

9. The electric device of claim 7, further comprising a voltage rectifier that receives the altered alternating current power and removes negative voltage from the altered alternating current power.

10. The electric device of claim 7, further comprising a voltage detector that receives the altered alternating current power, determines a characteristic of the altered alternating current power, and communicates data related to the characteristic to the load computing device.

11. The electric device of claim 7, further comprising an interface for formatting data communicated from the load computing device to the voltage current converter.

12. The electric device of claim 7, further comprising the load, wherein the load includes a lighting device.

13. The electric device of claim 7, wherein the action includes at least one of the following: changing output of the load, and cause the load to communicate with another device.

14. A system for customized load control that includes an electric device and the load, the electric device comprising:

a voltage current converter for utilizing an altered alternating current power to cause the load perform an action; and

a load computing device that stores logic that, when executed by a processor, causes the electric device to perform at least the following:

receive the altered alternating current power, wherein the altered alternating current power includes a message that is transmitted at the same frequency as the altered alternating current power, wherein the message is configured a delay around a zero cross point of the altered alternating current power;

determine, from the message, the action for the load to take;

communicate an instruction related to the action to the voltage current converter, wherein the voltage current converter utilizes the instruction to convert the altered alternating current power for the load to implement the action.

15. The system of claim 14, further comprising an alternating current filter, wherein the alternating current filter transforms the altered alternating current power into a square wave, wherein the square wave includes the delay.

16. The system of claim 14, further comprising a voltage rectifier that receives the altered alternating current power and removes negative voltage from the altered alternating current power.

17. The system of claim 14, further comprising a voltage detector that receives the altered alternating current power, determines a characteristic of the altered alternating current power, and communicates data related to the characteristic to the load computing device.

18. The system of claim 14, further comprising an interface for formatting data communicated from the load computing device to the voltage current converter.

19. The system of claim 14, further comprising an electric circuit panel co-located with the electric device.

20. The system of claim 14, further comprising an alternating current controller that alters alternating current power to include the message.

21. A method for providing communication via alternating current power comprising:

receiving alternating current power at a predetermined frequency;

receiving communications data for a device;

determining, from the communications data, a message to send to the device;

determining an alteration to the alternating current power to convert the communications data into the message according to a predetermined format;

determining a zero cross point of the alternating current power;

altering the alternating current power around the zero cross point according to the predetermined format to send the message; and

sending the altered alternating current power with the message according to the predetermined format to the device.

22. The method of claim 21, wherein altering the alternating current power includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point.

23. The method of claim 21, wherein the predetermined format includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point to represent a binary "1" and not delaying transmission of the alternating current power to represent a binary "0."

24. The method of claim 21, wherein the predetermined format includes delaying transmission of the alternating current power, wherein a first amount of delay represents a first signal and a second amount of delay represents a second signal.

25. The method of claim 21, further comprising sending the altered alternating current power to a lighting device, wherein the message controls output of the lighting device.

26. The method of claim 21, further comprising sending the altered alternating current power to a lighting device, wherein the lighting device utilizes the message to communicate with another device.

27. An alternating current controller for providing communication via alternating current power comprising:

a transistor for receiving the alternating current power at a predetermined frequency and altering the alternating current power;

a zero cross detector that is coupled to the transistor for receiving the alternating current power and determining a zero cross point that indicates that the alternating current power crosses zero volts; and

an alternating current controller computing device that is coupled to the zero cross detector, the alternating current controller computing device including logic that when executed by a processor, causes the alternating current controller to perform at least the following:

receive a communication from a remote computing device that includes a message for including in the alternating current power;

determine a predetermined format for altering the alternating current power for including the message in the alternating current power at the predetermined frequency;

receive data from the zero cross detector that indicates when the alternating current power crosses zero volts; and

provide an instruction to the transistor for altering the alternating current power to include the message.

28. The alternating current controller of claim 27, wherein altering the alternating current power includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point.

29. The alternating current controller of claim 27, wherein the predetermined format includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point to represent a binary “1” and not delaying transmission of the alternating current power to represent a binary “0.”

30. The alternating current controller of claim 27, wherein the predetermined format includes delaying transmission of the alternating current power, wherein a first amount of delay represents a first signal and a second amount of delay represents a second signal.

31. The alternating current controller of claim 27, wherein the transistor sends the altered alternating current power to a lighting device, wherein the message controls output of the lighting device.

32. The alternating current controller of claim 27, wherein the transistor sends the altered alternating current power to a lighting device, wherein the lighting device utilizes the message to communicate with another device.

33. The alternating current controller of claim 27, wherein the alternating current controller is coupled to an electric circuit panel at a user premises.

34. A system for providing communication via alternating current power comprising an alternating current controller comprising:

a transistor for receiving the alternating current power at a predetermined frequency, altering the alternating current power, and outputting the altered alternating current power to an electric device;

a zero cross detector that is coupled to the transistor for receiving the alternating current power and determining a zero cross point that indicates that the alternating current power crosses zero volts; and

an alternating current controller computing device that is coupled to the zero cross detector, the alternating current controller computing device including logic that when executed by a processor, causes the alternating current controller to perform at least the following:

receive a communication from a remote computing device that includes a message for including in the alternating current power;

determine a predetermined format for delaying at least a portion of the alternating current power for including the message in the alternating current power at the predetermined frequency;

receive data from the zero cross detector that indicates when the alternating current power crosses zero volts; and provide an instruction to the transistor for delaying at least a portion of the alternating current power to include the message.

35. The system of claim 34, wherein delaying at least a portion of the alternating current power includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point.

36. The system of claim 34, wherein the predetermined format includes delaying transmission of the alternating current power for a predetermined amount of time after the zero cross point to represent a binary “1” and not delaying transmission of the alternating current power to represent a binary “0.”

37. The system of claim 34, wherein the predetermined format includes delaying transmission of the alternating current power, wherein a first amount of delay represents a first signal and a second amount of delay represents a second signal.

38. The system of claim 34, further comprising the electric device that receives the message and performs a function in response to the message.

39. The system of claim 34, further comprising the electric device, wherein the electric device is configured as a lighting device, and wherein the message controls output of the lighting device.

40. The system of claim 34, further comprising an electric circuit panel located at a user premises, wherein the electric circuit panel controls operation of the electric device.

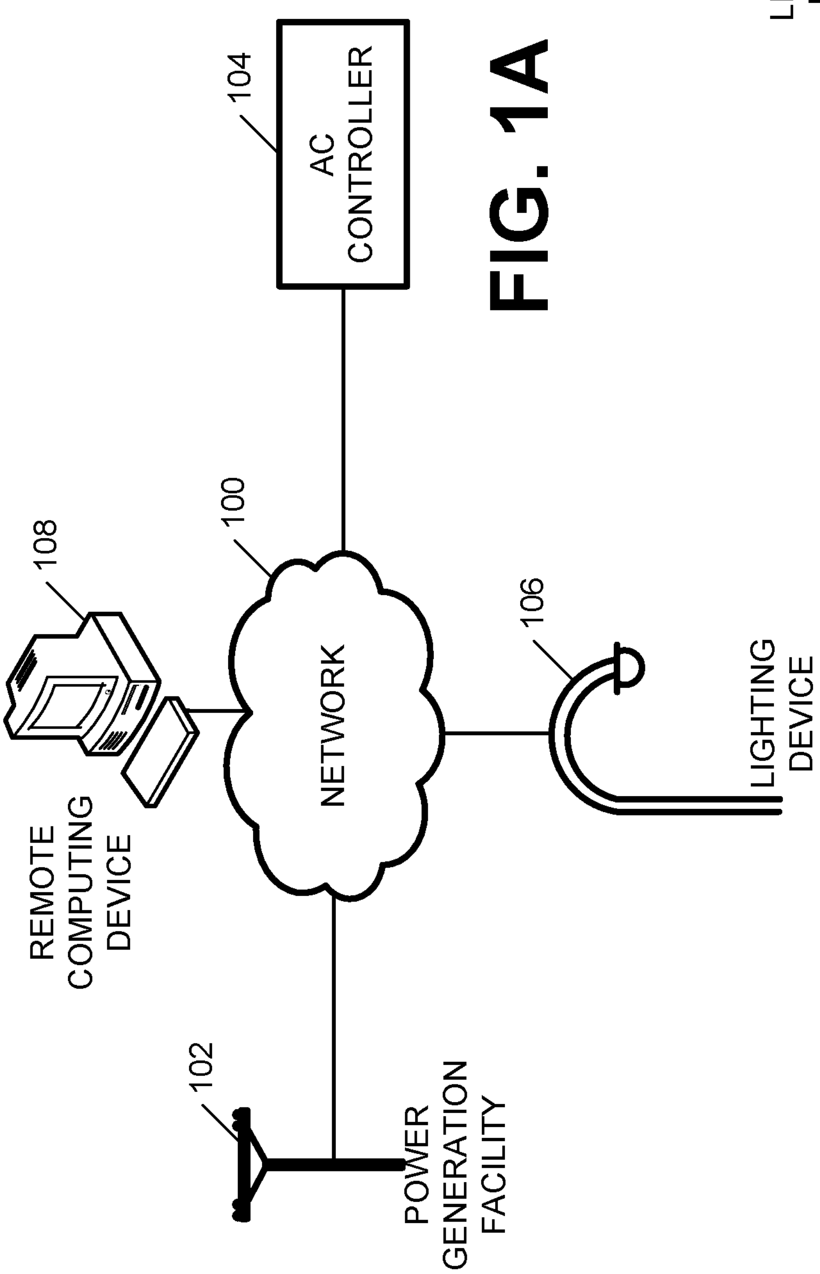

REMOTE COMPUTING DEVICE
108
NETWORK
100
104
AC CONTROLLER
106
LIGHTING DEVICE
102
POWER GENERATION FACILITY

FIG. 1A

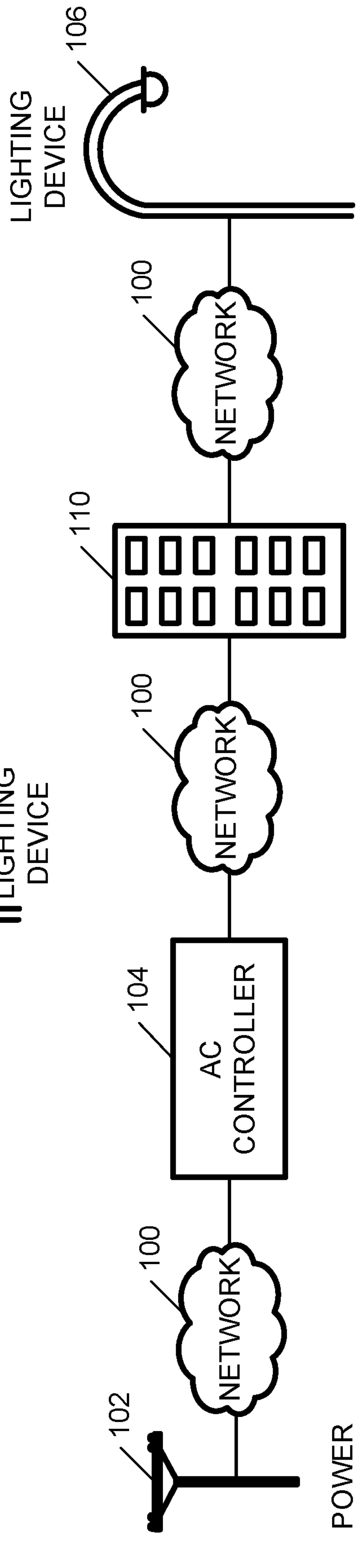

106
LIGHTING DEVICE
100
NETWORK
110
ELECTRIC CIRCUIT PANEL
100
NETWORK
104
AC CONTROLLER
100
NETWORK
102
POWER GENERATION FACILITY

FIG. 1B

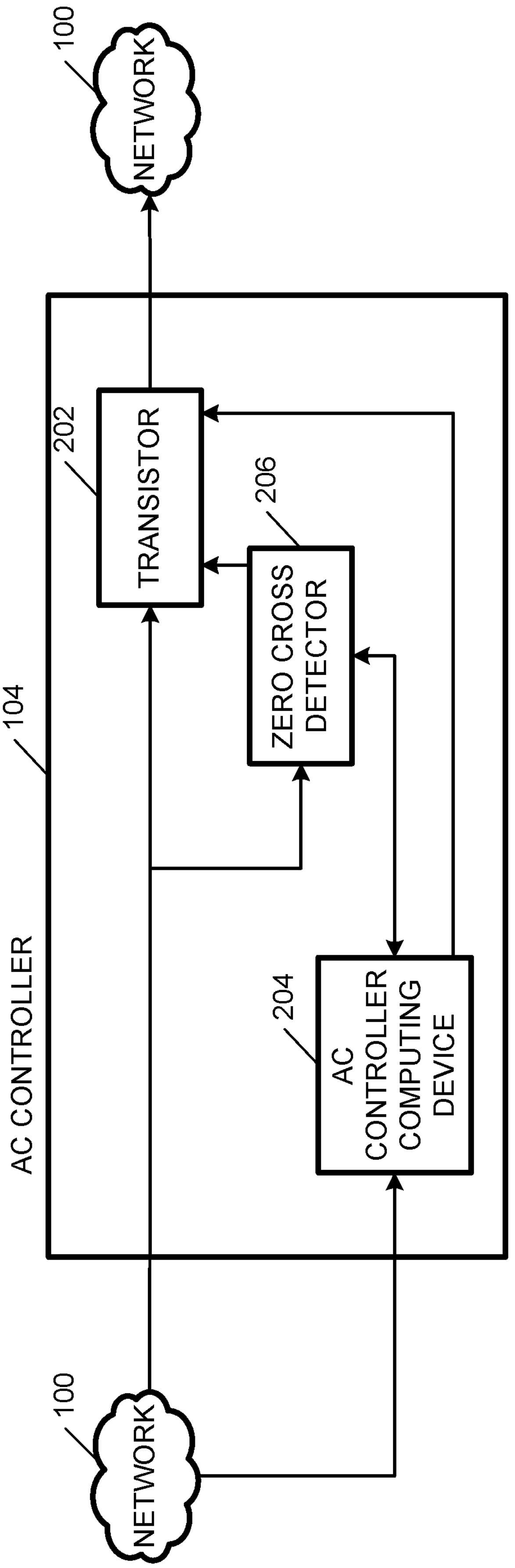

NETWORK
100
TRANSISTOR
202
ZERO CROSS DETECTOR
206
AC CONTROLLER
104
AC CONTROLLER COMPUTING DEVICE
204
NETWORK
100

FIG. 2

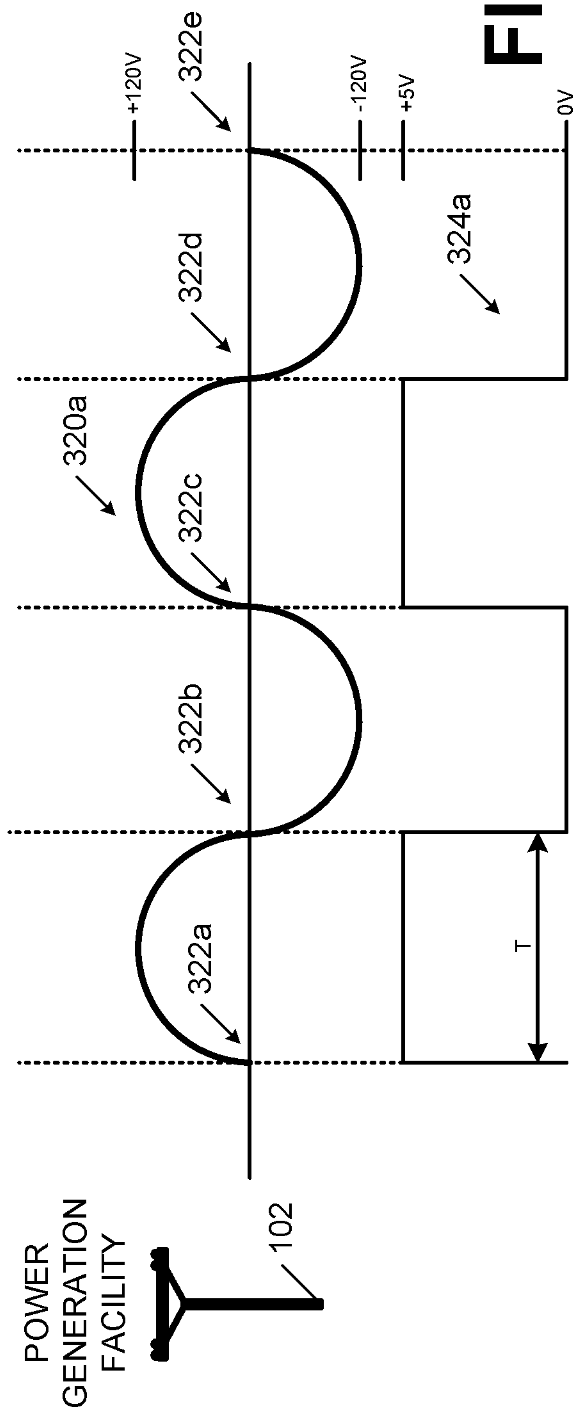

POWER GENERATION FACILITY
102
+120V
-120V
+5V
0V
322a
322b
322c
322d
322e
320a
324a
T

FIG. 3A

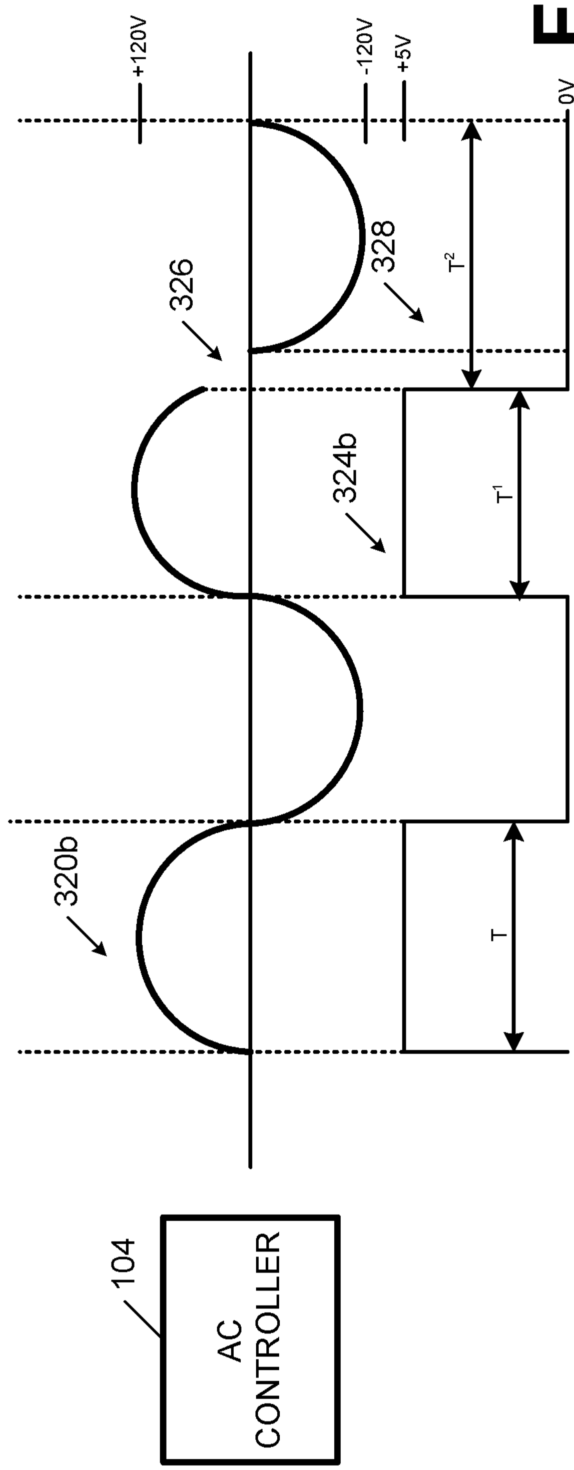
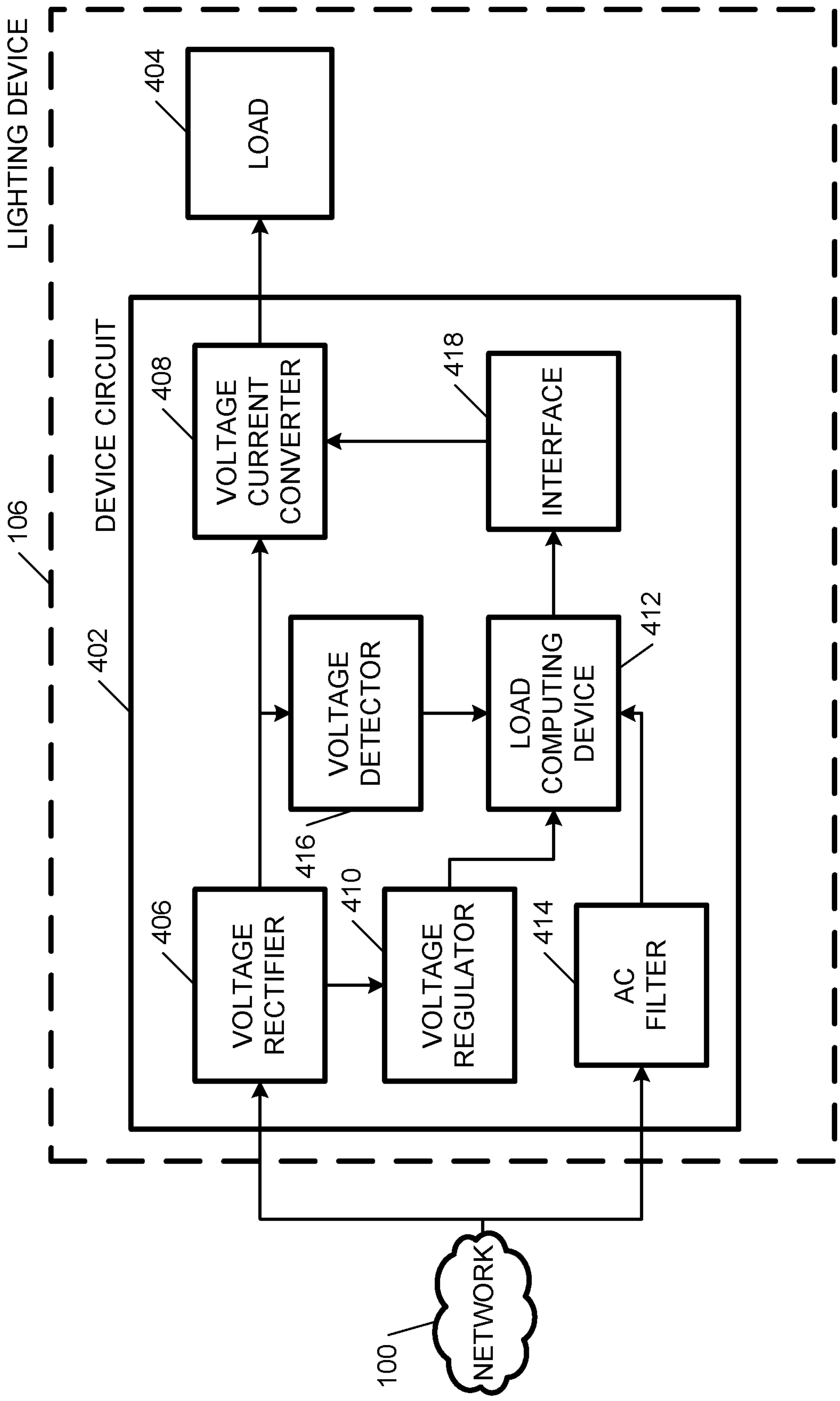

AC CONTROLLER
104
+120V
-120V
+5V
0V
320b
324b
326
328
T
T1
T2

FIG. 3B

FIG. 4


LIGHTING DEVICE
106
DEVICE CIRCUIT
402
LOAD
404
VOLTAGE CURRENT CONVERTER
408
INTERFACE
418
VOLTAGE DETECTOR
416
LOAD COMPUTING DEVICE
412
VOLTAGE RECTIFIER
406
VOLTAGE REGULATOR
410
AC FILTER
414
NETWORK
100

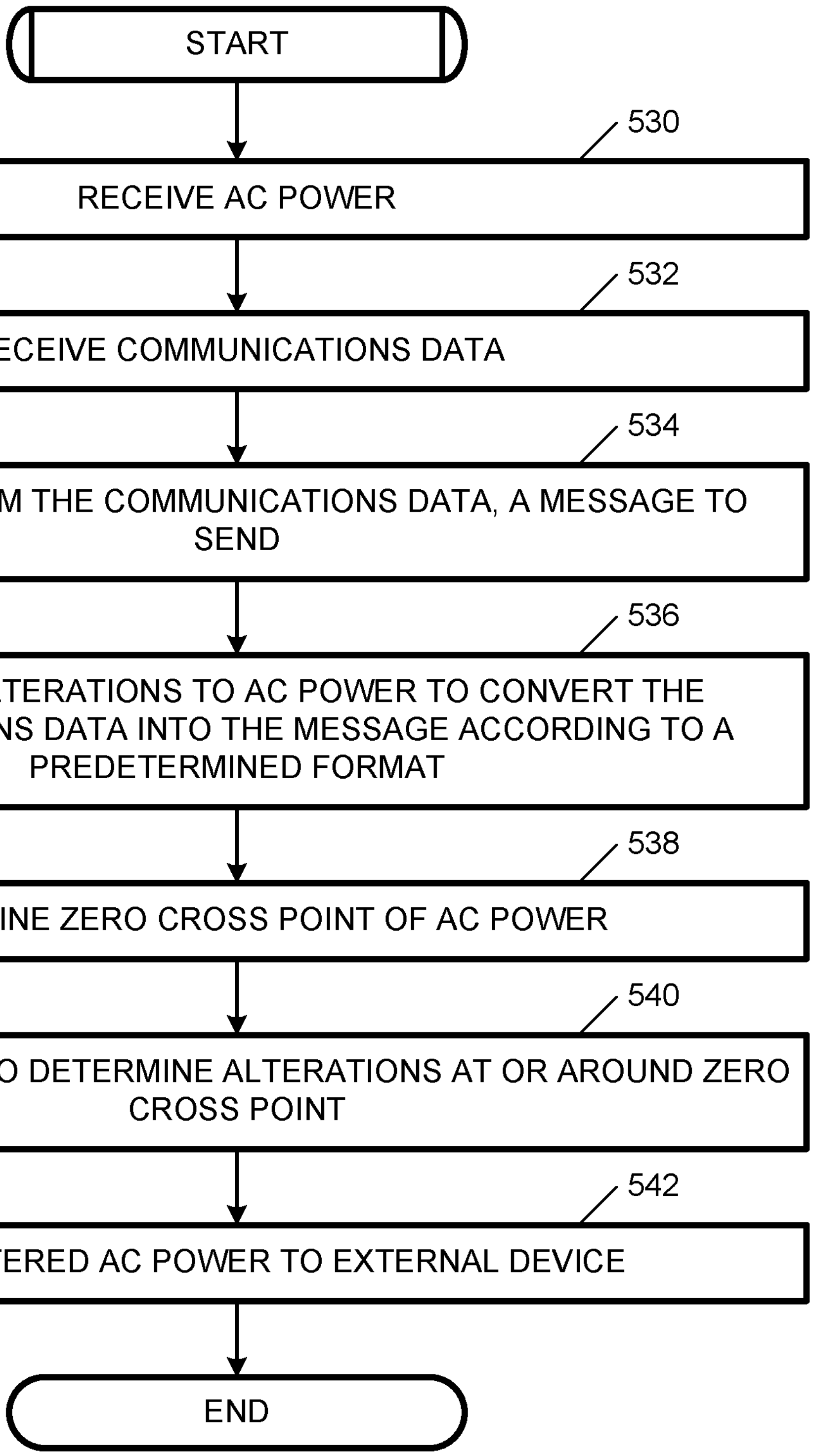

START
530
RECEIVE AC POWER
532
RECEIVE COMMUNICATIONS DATA
534
DETERMINE, FROM THE COMMUNICATIONS DATA, A MESSAGE TO SEND
536
DETERMINE ALTERATIONS TO AC POWER TO CONVERT THE COMMUNICATIONS DATA INTO THE MESSAGE ACCORDING TO A PREDETERMINED FORMAT
538
DETERMINE ZERO CROSS POINT OF AC POWER
540
ALTER AC POWER TO DETERMINE ALTERATIONS AT OR AROUND ZERO CROSS POINT
542
SEND ALTERED AC POWER TO EXTERNAL DEVICE
END

FIG. 5

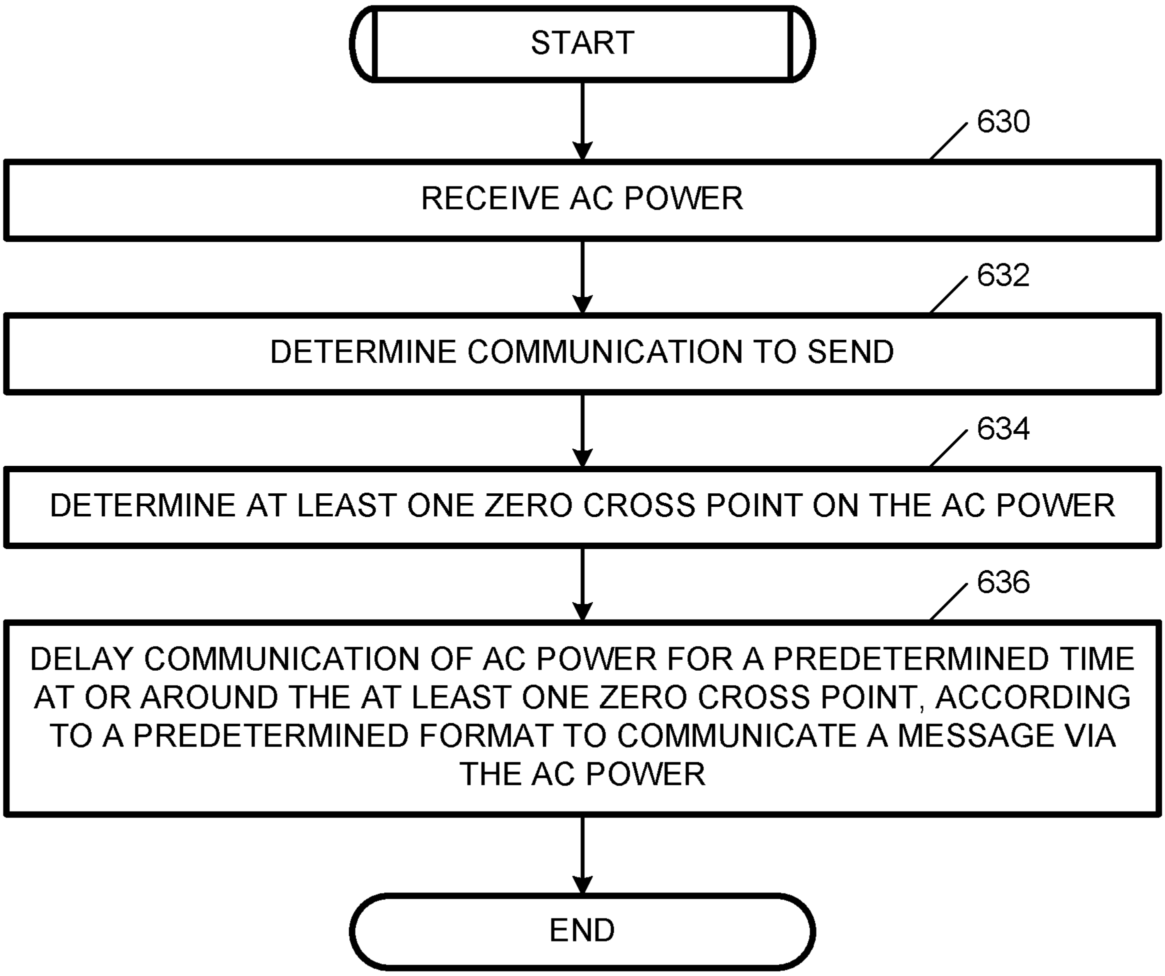

START
630
RECEIVE AC POWER
632
DETERMINE COMMUNICATION TO SEND
634
DETERMINE AT LEAST ONE ZERO CROSS POINT ON THE AC POWER
636
DELAY COMMUNICATION OF AC POWER FOR A PREDETERMINED TIME AT OR AROUND THE AT LEAST ONE ZERO CROSS POINT, ACCORDING TO A PREDETERMINED FORMAT TO COMMUNICATE A MESSAGE VIA THE AC POWER
END

FIG. 6

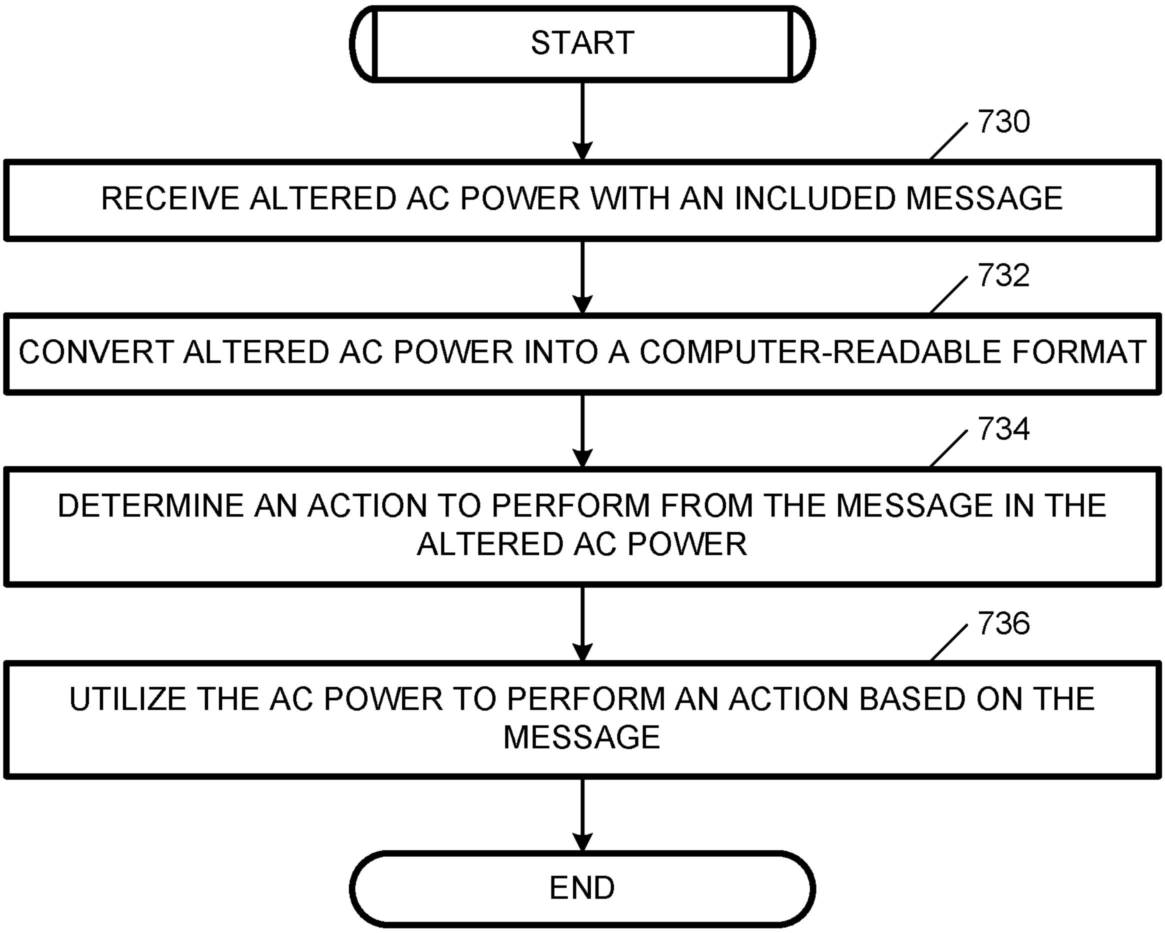

START
730
RECEIVE ALTERED AC POWER WITH AN INCLUDED MESSAGE
732
CONVERT ALTERED AC POWER INTO A COMPUTER-READABLE FORMAT
734
DETERMINE AN ACTION TO PERFORM FROM THE MESSAGE IN THE ALTERED AC POWER
736
UTILIZE THE AC POWER TO PERFORM AN ACTION BASED ON THE MESSAGE
END

FIG. 7

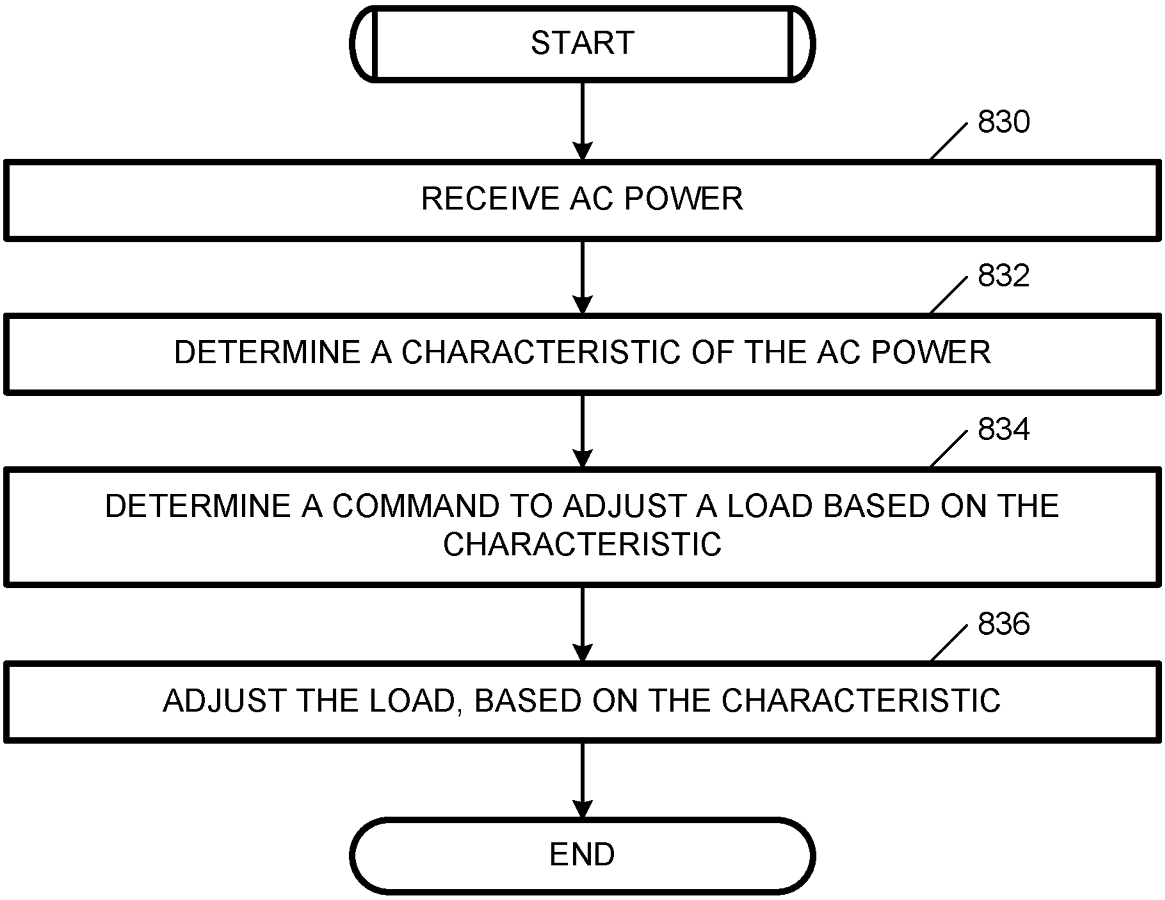

START
830
RECEIVE AC POWER
832
DETERMINE A CHARACTERISTIC OF THE AC POWER
834
DETERMINE A COMMAND TO ADJUST A LOAD BASED ON THE CHARACTERISTIC
836
ADJUST THE LOAD, BASED ON THE CHARACTERISTIC
END

FIG. 8

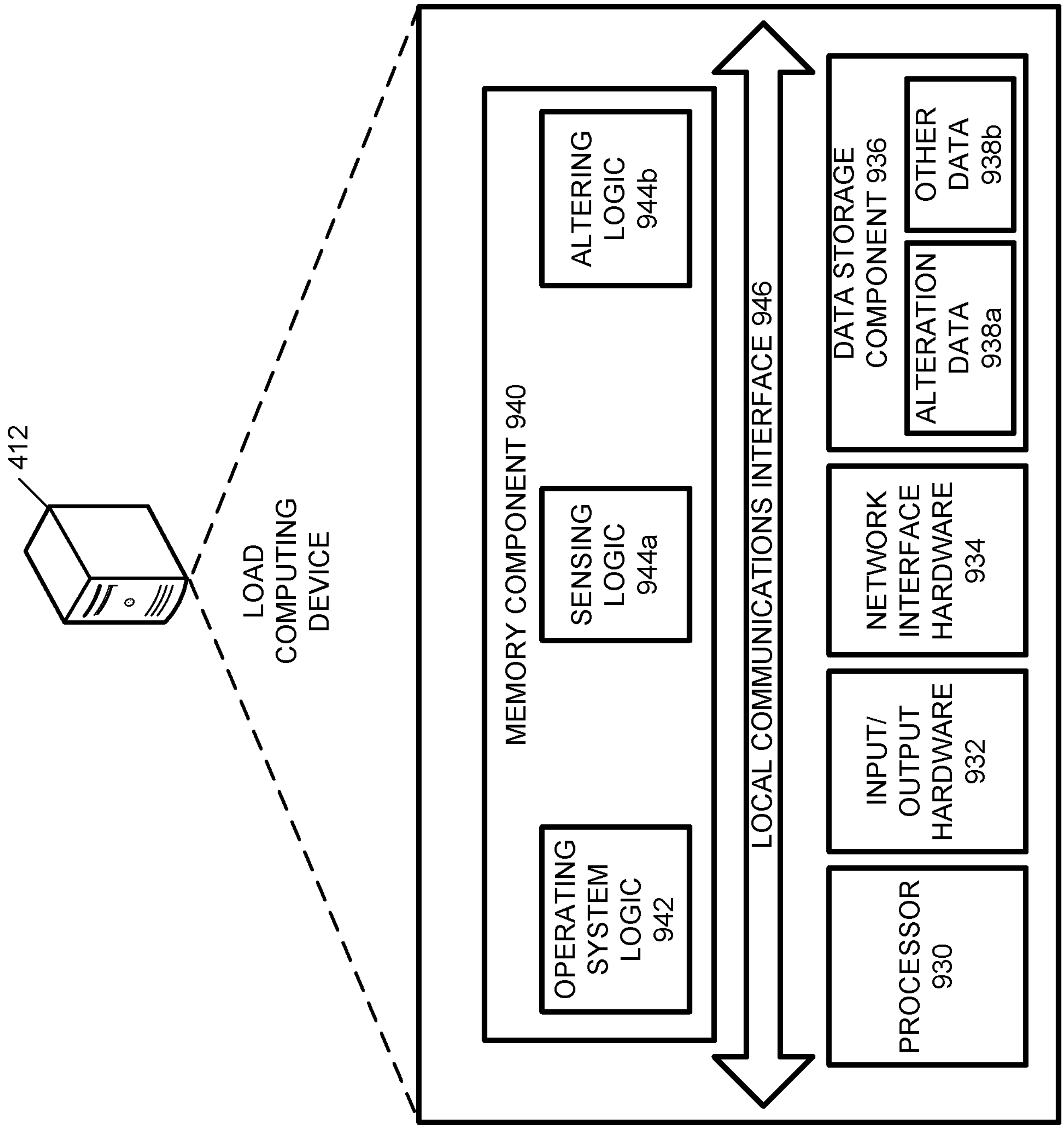

412
LOAD COMPUTING DEVICE
MEMORY COMPONENT 940
OPERATING SYSTEM LOGIC 942
SENSING LOGIC 944a
ALTERING LOGIC 944b
LOCAL COMMUNICATIONS INTERFACE 946
PROCESSOR 930
INPUT/ OUTPUT HARDWARE 932
NETWORK INTERFACE HARDWARE 934
DATA STORAGE COMPONENT 936
ALTERATION DATA 938a
OTHER DATA 938b

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/026421

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G05D 1/02; G05B 11/01; H02M 3/338 (2016.01)
CPC - G05D 1/02; G05B 11/01; H02M 3/338 (2016.02)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - G05B 11/01; G05D 1/02; H02M 3/338 (2016.01)
CPC - G05B 11/01; G05D 1/02; H02M 3/338 (2016.02)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC 340/500; 363/18; 701/19 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Orbit, Google Patents, Google Scholar, Google
Search terms used: alternating, current, power, message, delay, filter, load

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2008/0278296 A1 (NOH) 13 November 2008 (13.11.2008) entire document	1, 2, 21, 22 --- 3-20, 23-40
Y	US 2014/0254200 A1 (KUO) 11 September 2014 (11.09.2014) entire document	3, 9, 16
Y	US 2006/0187101 A1 (STADTHERR) 24 August 2006 (24.08.2006) entire document	4, 8, 15
Y	US 2008/0192512 A1 (ZHENG et al) 14 August 2008 (14.08.2008) entire document	5, 7-20, 27-40
Y	US 2014/0191574 A1 (EXPERIUM TECHNOLOGIES, LLC) 10 July 2014 (10.07.2014) entire document	6, 13, 26, 32
Y	US 2011/0082599 A1 (SHINDE et al) 07 April 2011 (07.04.2011) entire document	10, 17
Y	US 2011/0291583 A1 (SHEN) 01 December 2011 (01.12.2011) entire document	12, 19, 25, 26, 31-33, 39, 40
Y	US 2004/0004468 A1 (DEARN et al) 08 January 2004 (08.01.2004) entire document	13
Y	US 2012/0306287 A1 (KIM NAM YUN et al) 06 December 2012 (06.12.2012) entire document	14-20
Y	US 8,179,231 B1 (VARAHRAMYAN et al) 15 May 2012 (15.05.2012) entire document	23, 29, 36, 38
Y	US 2009/0282452 A1 (WEI) 12 November 2009 (12.11.2009) entire document	24, 30, 37
Y	US 5,166,549 A (DEDONCKER) 24 November 1992 (24.11.1992) entire document	27-40

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 June 2016	24 JUN 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 107710093 A
(43)申请公布日 2018.02.16

(21)申请号 201680028108.9

(22)申请日 2016.04.07

(30)优先权数据
62/144,070 2015.04.07 US

(85)PCT国际申请进入国家阶段日
2017.11.15

(86)PCT国际申请的申请数据
PCT/US2016/026421 2016.04.07

(87)PCT国际申请的公布数据
WO2016/164568 EN 2016.10.13

(71)申请人 地球之星解决方案有限责任公司
地址 美国犹他州

(72)发明人 加里·布雷·米拉

(74)专利代理机构 北京英赛嘉华知识产权代理有限责任公司 11204
代理人 王达佐　王艳春

(51)Int.Cl.
G05D 1/02(2006.01)
G05B 11/01(2006.01)
H02M 3/338(2006.01)

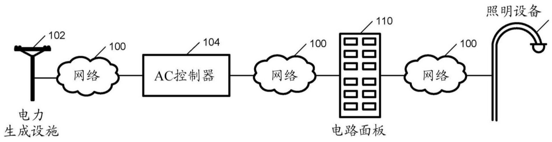
权利要求书4页　说明书7页　附图11页

(54)发明名称

用于定制化负载控制的系统和方法

(57)摘要

包括用于定制化负载控制的实施方式。方法的一个实施方式包括：接收改变的交流电力，其中改变的交流电力通过包括延迟而被改变以传送消息；将改变的交流电力中的消息转换成计算机可读格式；以及确定与消息相关的待采取的动作。一些实施方式包括基于所述消息利用改变的交流电力执行动作。



CN 107710093 A

1.用于定制化负载控制的方法,包括:

接收改变的交流电力,其中所述改变的交流电力通过包括延迟来改变,以传送消息;

将所述改变的交流电力中的消息转换成计算机可读格式;

确定与所述消息相关的待采取的动作;以及

基于所述消息,利用所述改变的交流电力来执行所述动作。

2.如权利要求1所述的方法,其中,在所述改变的交流电力的过零点周围提供所述延迟。

3.如权利要求1所述的方法,还包括对所述改变的交流电力进行整流以消除负电压。

4.如权利要求1所述的方法,还包括将所述改变的交流电力转换成方波,其中所述方波包括所述延迟。

5.如权利要求1所述的方法,其中,执行所述动作包括根据所述消息激活所述负载。

6.如权利要求1所述的方法,其中,执行所述动作包括使得负载与另一设备通信。

7.用于定制化负载控制的电子设备,包括:

交流滤波器,对改变的交流电力进行过滤以创建滤波信号;

电压-电流转换器,利用所述改变的交流电力致使所述负载执行动作;以及

负载计算设备,存储当由处理器执行时致使所述电子设备至少执行以下操作的逻辑:

从所述交流滤波器接收所述滤波信号;

从所述滤波信号确定所述改变的交流电力中所包括的消息,其中所述消息配置为在所述改变的交流电力的相应过零点周围的多个延迟;

从所述消息确定所述负载待采取的动作;

向所述电压-电流转换器传送与所述动作相关的指令,其中所述电压-电流转换器使用所述指令来转换所述改变的交流电力以执行所述动作。

8.如权利要求7所述的电子设备,其中,所述交流滤波器还将所述改变的交流电力转换成方波,其中所述方波包括所述多个延迟。

9.如权利要求7所述的电子设备,还包括电压整流器,所述电压整流器接收所述改变的交流电力,并且从所述改变的交流电力消除负电压。

10.如权利要求7所述的电子设备,还包括电压检测器,所述电压检测器接收所述改变的交流电力,确定所述改变的交流电力的特性,以及向所述负载计算设备传送与所述特性相关的数据。

11.如权利要求7所述的电子设备,还包括用于对从所述负载计算设备传送至所述电压-电流转换器的数据进行格式化的接口。

12.如权利要求7所述的电子设备,还包括所述负载,其中所述负载包括照明设备。

13.如权利要求7所述的电子设备,其中,所述动作包括以下所列中的至少一个:改变所述负载的输出;以及致使所述负载与另一设备通信。

14.用于定制化负载控制的系统,所述系统包括电子设备和所述负载,所述电子设备包括:

电压-电流转换器,利用改变的交流电力致使所述负载执行动作;以及

负载计算设备,存储当由处理器执行时致使所述电子设备至少执行以下操作的逻辑:

接收所述改变的交流电力,其中所述改变的交流电力包括以与所述改变的交流电力相

同的频率传输的消息，其中所述消息配置为在所述改变的交流电力的过零点周围的延迟；

从所述消息确定所述负载待采取的动作；

向所述电压-电流转换器传送与所述动作相关的指令，其中所述电压-电流转换器利用所述指令来转换所述改变的交流电力，以供所述负载执行所述动作。

15.如权利要求14所述的系统，还包括交流滤波器，其中所述交流滤波器将所述改变的交流电力转换成方波，其中，所述方波包括所述延迟。

16.如权利要求14所述的系统，还包括电压整流器，所述电压整流器接收所述改变的交流电力，并且从所述改变的交流电力消除负电压。

17.如权利要求14所述的系统，还包括电压检测器，所述电压检测器接收所述改变的交流电力，确定所述改变的交流电力的特性，以及向所述负载计算设备传送与所述特性相关的数据。

18.如权利要求14所述的系统，还包括用于对从所述负载计算设备传送至所述电压-电流转换器的数据进行格式化的接口。

19.如权利要求14所述的系统，还包括与所述电子设备共同定位的电路面板。

20.如权利要求14所述的系统，还包括改变交流电力以包括所述消息的交流控制器。

21.用于经由交流电力提供通信的方法，包括：

以预定频率接收交流电力；

接收用于设备的通信数据；

根据所述通信数据确定待发送至所述设备的消息；

确定对所述交流电力进行的改变，以根据预定格式将所述通信数据转换成所述消息；

确定所述交流电力的过零点；

根据所述预定格式，改变所述过零点周围的交流电力，以发送所述消息；以及

根据所述预定格式，向所述设备发送具有所述消息的改变的交流电力。

22.如权利要求21所述的方法，其中改变所述交流电力包括在所述过零点之后，将所述交流电力的传输延迟预定时间量。

23.如权利要求21所述的方法，其中所述预定格式包括：在所述过零点之后将所述交流电力的传输延迟预定时间量表示二进制“1”；以及不延迟所述交流电力的传输表示二进制“0”。

24.如权利要求21所述的方法，其中，所述预定格式包括延迟所述交流电力的传输，其中第一延迟量表示第一信号以及第二延迟量表示第二信号。

25.如权利要求21所述的方法，还包括向照明设备发送所述改变的交流电力，其中所述消息控制所述照明设备的输出。

26.如权利要求21所述的方法，还包括向照明设备发送所述改变的交流电力，其中所述照明设备利用所述消息与另一设备通信。

27.用于经由交流电力提供通信的交流控制器，包括：

晶体管，以预定频率接收所述交流电力，并且改变所述交流电力；

过零检测器，联接至所述晶体管，用于接收所述交流电力，以及确定指示所述交流电力跨过零伏的过零点；以及

交流控制器计算设备，联接至所述过零检测器，所述交流控制器计算设备包括当由处

理器执行时致使所述交流控制器至少执行以下操作的逻辑：

从远程计算设备接收包括用于包含于所述交流电力中的消息的通信；

确定用于改变所述交流电力以在所述预定频率处将所述消息包括在所述交流电力中的预定格式；

从所述过零检测器接收指示所述交流电力跨过零伏的时间的数据；以及

向所述晶体管提供用于改变所述交流电力以包括所述消息的指令。

28.如权利要求27所述的交流控制器，其中改变所述交流电力包括在所述过零点之后，将所述交流电力的传输延迟预定时间量。

29.如权利要求27所述的交流控制器，其中所述预定格式包括：在所述过零点之后将所述交流电力的传输延迟预定时间量表示二进制“1”，以及不延迟所述交流电力的传输表示二进制“0”。

30.如权利要求27所述的交流控制器，其中所述预定格式包括延迟所述交流电力的传输，其中第一延迟量表示第一信号以及第二延迟量表示第二信号。

31.如权利要求27所述的交流控制器，其中所述晶体管向照明设备发送所述改变的交流电力，其中所述消息控制所述照明设备的输出。

32.如权利要求27所述的交流控制器，其中，所述晶体管向照明设备发送所述改变的交流电力，其中所述照明设备利用所述消息与另一设备通信。

33.如权利要求27所述的交流控制器，其中所述交流控制器联接至用户住所处的电路面板。

34.用于经由交流电力提供通信的系统，包括交流控制器，所述交流控制器包括：

晶体管，以预定频率接收所述交流电力，改变所述交流电力，并且向电子设备输出所述改变的交流电力；

过零检测器，联接至所述晶体管，用于接收所述交流电力，以及确定指示所述交流电力跨过零伏的过零点；以及

交流控制器计算设备，联接至所述过零检测器，所述交流控制器计算设备包括当由处理器执行时致使所述交流控制器至少执行以下操作的逻辑：

从远程计算设备接收包括用于包含于所述交流电力中的消息的通信；

确定用于延迟所述交流电力的至少一部分以在所述预定频率处将所述消息包括在所述交流电力中的预定格式；

从所述过零检测器接收指示所述交流电力跨过零伏的时间的数据；以及

向所述晶体管提供用于延迟所述交流电力的至少一部分以包括所述消息的指令。

35.如权利要求34所述的系统，其中，延迟所述交流电力的至少一部分包括：在所述过零点之后，将所述交流电力的传输延迟预定时间量。

36.如权利要求34所述的系统，其中，所述预定格式包括：在所述过零点之后将所述交流电力的传输延迟预定时间量表示二进制“1”，以及不延迟所述交流电力的传输表示二进制“0”。

37.如权利要求34所述的系统，其中，所述预定格式包括延迟所述交流电力的传输，其中第一延迟量表示第一信号，以及第二延迟量表示第二信号。

38.如权利要求34所述的系统，还包括接收所述消息并且响应于所述消息执行功能的

电子设备。

39.如权利要求34所述的系统,还包括所述电子设备,其中,所述电子设备配置为照明设备,以及其中所述消息控制所述照明设备的输出。

40.如权利要求34所述的系统,还包括定位在用户住所处的电路面板,其中所述电路面板控制所述电子设备的操作。

用于定制化负载控制的系统和方法

技术领域

[0001] 本文描述的实施方式大体涉及经由交流电力进行定制化照明和通信的系统和方法，并且更具体地，涉及提供通信协议以及用于定制化照明控制的相关硬件和软件。

背景技术

[0002] 随着照明和电力技术得到发展，现在期望提供和/或利用高能效电气和电子设备。作为示例，照明行业消耗大量的电力，而且，对于经由更高效的照明设备来降低成本和降低电网使用存在持续的压力。另外，诸多当前的解决方案产生大量的热量。这对于适当地控制照明以提供期望的电力消耗通常也是困难的。

发明内容

[0003] 包括用于定制化负载控制的实施方式。方法的一个实施方式包括：接收改变的交流电力，其中改变的交流电力通过包括延迟来改变以传送消息；将改变的交流电力中的消息转换成计算机可读格式；以及确定与消息相关的待采取的动作。一些实施方式包括基于所述消息利用改变的交流电力执行动作。

[0004] 电子设备的实施方式包括：交流滤波器，用于过滤改变的交流电力以创建滤波信号；电压-电流转换器，利用改变的交流电力致使负载执行动作；以及负载计算设备，存储当由处理器执行时致使电子设备从交流滤波器接收滤波信号的逻辑。在某些实施方式中，所述逻辑致使电子设备根据滤波信号确定改变的交流电力中所包括的消息，其中消息配置为在改变的交流电力的相应过零点周围的多个延迟。在某些实施方式中，逻辑致使电子设备从消息确定负载待采取的动作，以及向电压-电流转换器传送与动作相关的指令，其中电压-电流转换器利用指令来转换改变的交流电力以执行所述动作。

[0005] 还包括系统的实施方式。系统可包括：利用改变的交流电力致使负载执行动作的电压-电流转换器以及存储当由处理器执行时致使电子设备接收改变的交流电力的逻辑的负载计算设备，其中改变的交流电力包括以与改变的交流电力相同的频率传输的消息，其中消息配置为在改变的交流电力的过零点周围的延迟。在某些实施方式中，逻辑还致使系统从消息确定负载待采取的动作以及向电压-电流转换器传送与动作相关的指令，其中电压-电流转换器利用指令来转换改变的交流电力以供负载执行动作。

[0006] 还包括经由交流电力进行通信的实施方式。作为示例，方法包括：以预定频率接收交流电力；接收用于设备的通信数据；以及从通信数据确定待向设备发送的消息。一些实施方式包括：确定对交流电力的改变，以根据预定格式将通信数据转换成消息；确定交流电力的过零点；以及根据预定格式改变过零点周围的交流电力以发送消息。一些实施方式包括根据预定格式向设备发送具有消息的改变的交流电力。

[0007] 系统的实施方式包括晶体管和过零检测器，其中，晶体管以预定频率接收交流电力并且改变交流电力；过零检测器联接至晶体管，用于接收交流电力并确定指示交流电力跨过零伏的过零点。一些实施方式包括联接至过零检测器的交流控制器计算设备。交流控

制器计算设备可包括当由处理器执行时致使交流控制器执行以下操作的逻辑：从远程计算设备接收包括用于包含在交流电力中的消息的通信；确定用于改变交流电力以通过预定频率将消息包括在交流电力中的预定格式；以及从过零检测器接收指示交流电力跨过零伏的时间的数据。一些实施方式可配置为向晶体管提供用于改变交流电力以包括消息的指令。

[0008] 类似地，系统的一些实施方式可包括晶体管，该晶体管以预定频率接收交流电力、改变交流电力并且向电子设备输出改变的交流电力。这些实施方式可包括过零检测器和联接至过零检测器的交流控制器计算设备，其中，过零检测器联接至晶体管，用于接收交流电力并确定指示交流电力跨过零伏的过零点。交流控制器计算设备包括当由处理器执行时致使交流控制器进行以下操作的逻辑：从远程计算设备接收包括用于包含在交流电力中的消息的通信；确定用于延迟交流电力的至少一部分以在预定频率处将消息包括在交流电力中的预定格式；以及从过零检测器接收指示交流电力跨过零伏的时间的数据。一些实施方式可配置为向晶体管提供用于延迟交流电力的至少一部分以包括消息的指令。

附图说明

[0009] 附图中描述的实施方式实际上是说明性的和示例性的，而并非旨在限制本公开。在结合以下附图进行阅读时可理解示例性实施方式的以下详细描述，在附图中相同的结构利用相同的附图标记表示，并且在附图中：

[0010] 图1A至图1B示出根据本文描述的实施方式的电力和通信网络；

[0011] 图2示出根据本文描述的实施方式的交流(AC)控制器；

[0012] 图3A至图3B示出如本文描述的那样可由AC控制器改变的AC电力的波形；

[0013] 图4示出根据本文描述的实施方式的照明设备；

[0014] 图5示出根据本文描述的实施方式的向设备发送改变的AC电力的流程图；

[0015] 图6示出根据本文描述的实施方式的将延迟包括在用于发送消息的AC电力中的流程图；

[0016] 图7示出根据本文描述的实施方式的确定经由改变的AC电力发送的消息的内容的流程图；

[0017] 图8示出根据本文描述的实施方式的基于接收的AC电力的所确定的特性来改变负载的流程图；以及

[0018] 图9示出根据本文描述的实施方式的用于确定AC电力的特性的负载计算设备。

具体实施方式

[0019] 本文公开的实施方式包括经由交流电进行定制化照明和通信的系统和方法。一些实施方式可配置为促进通过协议从第一设备到第二设备进行数据通信，所述协议包括通过改变AC电力波形来创建改变的交流电力，其中以与AC电力的预定频率相同的频率进行通信。另外，一些实施方式可在不需要散热器或其他排热设备的情况下提供LED照明。具体地，一些实施方式可在设置集成式排热装置的设备的一个或多个部分上利用铝基底。类似地，一些实施方式可配置成经由诸如互联网的通信网络提供对诸如一个或多个照明设备的负载的控制。下文中将更详细地描述这些和体现这些的其他实施方式。

[0020] 现在参照附图，图1A至图1B示出根据本文描述的实施方式的电力和通信环境。如

图1A所示，电力和通信环境可包括联接至电力生成设施102的网络100、交流(AC)控制器104、照明设备106和远程计算设备108。网络100可包括电力网络，该电力网络可包括递送至多个设备(或负载)的交流电力。网络100还可包括通信网络，诸如，广域网(例如，互联网、蜂窝网络、电话网络等)和/或局域网(例如，以太网网络、无线保真网络、近场通信网络等)。如将理解的那样，任何两个设备之间的网络100可包括单个导线或通信链路，并且可包括多个电力和/或通信信道。

[0021] 电力生成设施102也包括在图1A和图1B的实施方式中，并且可包括发电站、太阳能生成网络、电力储存设施和/或有助于向一个或多个设备提供电力的其他设施。如将理解的那样，电力生成设施102可配置为创建和/或提供交流(AC)电力。应理解，虽然本文描述的电力生成设施102可创建AC电力，但是为了简单起见，一些实施方式可包括用于创建AC电力、存储AC电力和向全部包括在电力生成设施102中的设备传输AC电力的单独的实体和/或设备。

[0022] 图1A和图1B中还包括AC控制器104。AC控制器104可配置成接收AC电力以及通信信号。如下面更详细地描述，AC控制器104还可改变AC电力信号，以与AC电力被接收的频率相同的频率上将消息包括在AC电力中。

[0023] 照明设备106可与AC控制器104协同操作或与AC控制器104独立地操作，并且可配置为接收来自电力生成设施102的AC电力以用于执行功能(诸如，照亮发光二极管(LED))。照明设备106还可经由AC控制器104接收消息、促进监测照明设备106的功能和/或执行其他动作，其中所述AC控制器104可改变照明设备106的功能。

[0024] 应理解，虽然本文将照明设备106描述为LED照明设备，但是这仅是示例。虽然本文描述的实施方式涉及照明，但是该描述可扩展至其他电气或电子设备。因此，任何负载可附接至本文描述的硬件和/或软件以提供期望的功能。

[0025] 图1A还包括远程计算设备108。远程计算设备108可表示可促进发送待包括在AC电力中的消息和/或命令的一个或多个计算设备。远程计算设备108还可配置成用于更新与组件相关的软件和/或固件，和/或提供其他功能。作为示例，一些实施方式可配置为从远程计算设备108接收命令以激活照明设备106。该命令可经由通信网络(作为网络100的一部分)发送至AC控制器104，其中所述AC控制器104可转换通过从AC电力进行改变而待被传送的消息。AC电力可由照明设备106接收，该照明设备106还可接收所述消息。照明设备106因此可由AC电力供电，并且可经由AC电力接收通信。

[0026] 图1B示出与图1A不同的配置，不同之处在于：图1B的实施方式示出具有可与或可不与AC控制器104共同定位的电路面板110(诸如，断路器面板)的AC控制器104。具体地，图1B的实施方式示出连接至网络100的电力生成设施102。电力生成设施102可向用户设施提供电力，该电力可在电路面板110处被接收从而控制操作和/或用于沿着网络100的局部部分配送至位于用户设施处的各种负载。然而，AC控制器104可包括电路面板110和/或设置在用户住所处，并且经由局域网联接至电路面板110以向用户提供对期望功能的控制。根据具体实施方式，AC控制器104可串联地包括在电力生成设施102和电路面板110之间。然而，一些实施方式可配置有处于电力生成设施102和AC控制器104之间的电路面板110。根据实施方式，还可使用其他配置。无论如何，照明设备106可联接至用于从电力生成设施102接收电力的电路。

[0027] 图2示出根据本文描述的实施方式的AC控制器104。如图所示，AC控制器104可包括晶体管202、AC控制器计算设备204和过零检测器206。具体地，AC控制器104可在晶体管202和过零检测器206处从电力生成设施102接收AC电力。AC控制器104还可在AC控制器计算设备204处例如从远程计算设备108接收通信信号。AC控制器计算设备204可确定经由通信信号发送的消息并且可确定从通信信号提取的动作。作为示例，通信信号可请求关断照明设备106。因此，AC控制器计算设备204可确定该请求然后确定如何改变通过晶体管202接收的AC电力，其中所述AC电力可被改变以与AC电力相同的频率传送该消息。

[0028] 为了在AC电力上传送通信信号，AC控制器计算设备204可确定通信协议。作为示例，通信协议可包括：延迟传输和/或在AC电力中以预定间隔插入标准延迟时间。根据多个延迟的时序，接收设备可对通信进行解码。作为另一示例，AC控制器计算设备204可确定用于传送所述消息的延迟长度。在该情况中，延迟的长度和随后的延迟的时序可向接收设备提供用于解码的通信协议。基于所确定的正在被使用的通信协议，过零检测器206可确定AC电力传输零伏的时间(例如，来自AC电力的电压从正改变到负或者反之从负改变到正的时间)。在过零点(例如，AC电力任一地从正到负或从负到正跨过零伏的点)处或过零点周围，AC控制器计算设备204可将诸如延迟的改变插入AC电力中。改变可发生在AC电力的一个或多个过零点处或所述一个或多个过零点周围，并且可配置为二进制信号，使得延迟的过零点指示二进制“1”且非延迟的过零点指示二进制“0”。还可使用其他格式和协议来指示消息的不同字符，例如不同长度的延迟。晶体管202随后可对沿着网络100发送的AC电力执行期望的改变。

[0029] 图3A至图3B示出如本文描述的那样可由AC控制器104改变的AC电力的波形。具体地，图3A示出用于向一个或多个设备提供电力的AC电力的波形320a。AC电力可以正/负120伏、220伏、440伏的峰值电压和/或其他电压进行传输。因此，在正峰值和负峰值之间是过零点322a-322d，其中在过零点322a-322d处电压为零。

[0030] 图3A还示出电压范围为0伏到5伏的方波324a。如参照如4更详细地描述，可经由AC滤波器414(图4)从AC电力创建方波，使得可充分地向负载计算设备412(图4)供电。如将理解的那样，方波324a的电压范围可根据负载计算设备412的需求和规格而变化。

[0031] 图3B示出如本文描述的那样被改变以传送消息的AC电力的波形320b。具体地，除了被改变以传送消息之外，波形320b可与波形320a相似。因此，波形320b可具有预定的正电压和负电压，以及与波形320a对应的过零点。另外，波形320b可具有同样与波形320a对应的预定半周期(表示为“T”)。在确定待发送的消息的内容之后，AC控制器104可配置为：在继续传输之前，在一个或多个过零点322处或者在所述一个或多个过零点322周围以预定时间周期延迟AC电力的传输。如图3B所示，可执行延迟326，使得用于波形230b的第一部分的半周期(T^1)可与标准半周期(T)相同(或类似)，因为延迟在与来自图3A的过零点相对应的过零点处开始。然而，因为所执行的延迟，波形320b可移位预定时间量，因此，波形的后一部分的半周期(T^2)可多出所延迟的时间量。

[0032] 因此，接收设备(诸如，照明设备106)可接收AC电力并且可识别AC电力的改变。根据正在执行的协议，接收设备可对所述消息进行解码并且恰当地做出反应。在某些实施方式中，在预期过零点处延迟的波形将标识为二进制“1”，而AC电力的未改变的过零点可表示为二进制“0”(或者反之亦然)。因此，接收设备可对二进制“1”和“0”的序列进行解码以确定

经由AC电力发送的消息。其他实施方式可利用不同的编码协议，诸如，改变延迟的长度以指示“1”或“0”或其他数据(例如，第一延迟量可指示诸如“1”的第一信号；而第二延迟量可表示诸如“0”和/或其他编码协议的第二信号)。

[0033] 应理解，虽然本文描述的实施方式不需要在过零点处或者在过零点周围提供延迟，但是在过零点处、在过零点周围和/或略微地在过零点之后插入延迟的实施方式可(根据延迟的长度和负载)导致更稳定的负载输出，因为电压将经受更少的中断。还应理解，虽然以上描述指出利用了延迟，但是这也是示例。如图3B所示，AC电力可实际上断开连接，从而在电力信号中创建中断。因此，中断实际上可表示为零电压事件。还可使用其他改变。

[0034] 图3B还示出具有对应延迟328的方波324b。由于AC控制器104可改变AC电力，所以方波可经受相似的延迟，其中该相似的延迟还可被用于传送数据。

[0035] 图4示出根据本文描述的实施方式的呈照明设备106的形式的电子设备。如图所示，照明设备106包括设备电路402和负载404。设备电路402可包括电压整流器406、电压-电流转换器408、电压调整器410、负载计算设备412、AC滤波器414和接口组件418。具体地，AC电力(或者，根据实施方式的改变的AC电力)可在电压整流器406处由设备电路402接收。电压整流器406可配置为改变AC电力(从图3A、图3B的波形320a或320b)，以调整或去除波形的负部分和/或以其他方式将AC电力转换成直流(DC)电力。作为示例，负载404可配置为仅利用正电压激活。因此，如果负载404接收AC电力，则LED可能因接收到负电压而闪烁。这可能导致潜在的不期望的输出。这样，电压整流器406可配置为仅输出非负电压以从负载404提供稳定的输出。

[0036] 电压整流器406可向电压-电流转换器408以及电压调整器410发送经调节的电压。电压调整器410可配置为将经调整的电力的电压降低至可用于为负载计算设备412供电的水平。作为示例，电压调整器410可使DC电压降低至约5伏或可由负载计算设备412使用的其他电压。转换的DC电压可被发送以为负载计算设备412供电。

[0037] 负载计算设备412还可联接至电压检测器416，并且可配置为改变电压被递送至负载404的方式。类似地，负载计算设备412的一些实施方式可配置为接收包括通信数据的AC电力、对该通信进行解码、以及基于经解码的消息执行动作。

[0038] 为此，电压检测器416可从电压整流器406接收经调节的电压，并且可确定AC电力的特性。基于所述特性，负载计算设备412可向接口组件418发送充当高电压和低电压之间的分界线的通信。接口组件418可基于在AC电力中接收到的并且通过负载计算设备412解码的消息来向电压-电流转换器408发送信号，其中所述电压-电流转换器408可改变通过负载404的各种部分接收的电压。

[0039] 另外，AC电力(具有图3B描述的改变)可由AC滤波器414接收。如上面关于图3A和图3B所述的那样，AC滤波器414可接收AC电力并将AC电力转换成滤波信号，该滤波信号可包括计算机可读格式，例如峰值电压与负载计算设备412兼容的方波。如果AC控制器104(图1A、图1B和图2)改变AC电力(诸如，包括延迟)，则通过AC滤波器414引入的方波也可包括该改变(或相似的改变)。负载计算设备412可从AC滤波器414接收方波，并且可利用逻辑来确定改变的方波中所包括的消息。根据具体实施方式，经由AC电力发送的消息可包括用于激活负载404、禁用负载404、降低通向负载的电力等的指令。一些实施方式可配置为致使负载计算设备412执行用于测试照明设备106的操作的测试序列。类似地，一些实施方式可致使负载

向另一设备(诸如,移动电话、电视、计算设备等)传送消息。

[0040] 作为示例,一些实施方式可配置成使得负载是发光二极管(LED)的阵列。基于所接收的AC电力的电压,负载计算设备412可致使电压-电流转换器408仅向可在电力限制下适当地操作的那些LED发送AC电力,从而改变LED的输出。这可为负载404提供相对一致的输出而不考虑AC电力。

[0041] 还应理解,设备电路402的实施方式可设置在印制电路板(PCB)和/或包括铝基底作为主要组件的其他电路材料上。通过将铝基底用于设备电路402,热量可被排放,因而消除对散热器或其他排热设备的需求。

[0042] 另外,虽然图4的实施方式示出单个设备电路402和单个负载404,但是这也仅是示例。一些实施方式可将多个负载404与单个设备电路402和/或多个设备电路402联接在一起,以提供期望的功能和/或照明。另外,图2所示的框202-206和来自图4的框406-418可根据具体实施方式以硬件(包括可编程硬件)、软件和/或固件来实现,只要提供期望的功能即可。还应理解,虽然照明设备106示出为具有设备电路402和负载404,但是这也是示例。一些实施方式可包括与照明设备106分离的设备电路。

[0043] 图5示出根据本文描述的实施方式的向设备发送改变的AC电力的流程图。如框530中所示,可接收AC电力。在框532中,可接收通信数据。如上所述,通信数据可从远程计算设备108接收和/或经由其他来源被接收。无论如何,在框534中,可从通信数据确定用于向远程设备发送的消息。在框536中,可确定对AC电力的改变以根据预定格式将通信数据转换成消息。在框538中,可确定AC电力的过零点。在框540中,可改变AC电力以确定在过零点处或过零点周围的改变。在框542中,可向外部设备发送改变的AC电力。

[0044] 图6示出根据本文描述的实施方式的将延迟包括在AC电力中以用于发送消息的流程图。如框630中所示的那样,可接收AC电力。在框632中,可确定待发送的通信。在框634中,可确定AC电力的至少一个过零点。在框636中,根据经由AC电力传送消息的预定格式,可在至少一个过零点处或至少一个过零点周围将AC电力的传送延迟预定时间。

[0045] 图7示出根据本文描述的实施方式的确定经由改变的AC电力发送的消息的内容的流程图。如框730中所示,可接收包括有消息的交改变的AC电力。在框732中,可将改变的AC电力转换成计算机可读格式。在框734中,可从改变的AC电力中的消息确定动作。在框736中,可根据所确定的消息利用AC电力执行所述动作。

[0046] 图8示出根据本文描述的实施方式的基于接收的AC电力的所确定的特性来改变负载的流程图。如框830所示的那样,可接收AC电力。在框832中,可确定AC电力的特性。在框834中,可确定基于所述特性调整负载的命令。在框836中,可基于所述特性调整负载。

[0047] 图9示出根据本文描述的实施方式的用于确定AC电力的特性的负载计算设备412。负载计算设备412包括处理器930、输入/输出硬件932、网络接口硬件934、数据储存组件936(存储改变数据938a、其他数据936b和/或其他数据)和存储器组件940。存储器组件940可配置为易失性和/或非易失性存储器,这样,可包括随机存取存储器(包括SRAM、DRAM和/或其他类型的RAM)、闪速存储器、电可擦可编程只读存储器(EEPROM)、安全数字(SD)存储器、寄存器、光盘(CD)、数字多媒体盘(DVD)和/或其他类型的非暂时性计算机可读介质。根据具体实施方式,这些非暂时性计算机可读介质可布置(reside)在负载计算设备412的内部和/或负载计算设备412的外部。

[0048] 存储器组件140可存储操作系统逻辑942、感测逻辑944a和改变逻辑944b。例如，感测逻辑944a和改变逻辑944b可各自包括多个不同的逻辑块，其中的每个可实现为计算机程序、固件和/或硬件。图9中还包括本地接口946，并且本地接口946可实现为促进负载计算设备412的组件之间的通信的总线或其他通信接口。

[0049] 处理器930可包括能够进行操作以(例如，从数据储存组件936和/或存储器组件140)接收指令并且执行所述指令的任何处理组件。如上所述，输入/输出硬件932可包括和/或配置为与图9的组件接合。

[0050] 网络接口硬件934可包括和/或配置成与任何有线或无线联网硬件通信，所述有线或无线联网硬件包括：天线、调制解调器、LAN端口、无线保真(Wi-Fi)卡、WiMax卡、移动通信硬件和/或用于与其他网络和/或设备通信的其他硬件。通过该连接，可促进负载计算设备412和其他计算设备(诸如，图1中所示的那些)之间的通信。

[0051] 操作系统逻辑942可包括操作系统和/或用于管理负载计算设备412的组件的其他软件。如上所述，感测逻辑944a可布置在存储器组件940中，并且如上所述，可配置为致使处理器930确定电压值、电力信号波形中的延迟以及执行其他功能。类似地，改变逻辑944b可用于提供改变照明设备106的一个或多个功能的指令。

[0052] 应理解，虽然图9中的组件示出为布置在负载计算设备412内，但是这仅是示例。在一些实施方式中，组件中的一个或多个可布置在负载计算设备412的外部。还应理解，虽然负载计算设备412示为单个设备，但是这也仅是示例。类似地，一些实施方式可配置有感测逻辑944a和布置在不同的计算设备上的改变逻辑944b。另外，虽然负载计算设备412示出为具有感测逻辑944a和改变逻辑944b作为单独的逻辑组件，但是这也是示例。在一些实施方式中，单个逻辑块可致使远程计算设备108提供所描述的功能，或者多个不同的块可提供该功能。

[0053] 还应理解，虽然负载计算设备412在图9中示出，但是其他计算设备，诸如AC控制器计算设备204和远程计算设备108也可包括参照图9描述的硬件的至少一部分。然而，用于这些设备的硬件和软件可根据参照图9进行的描述发生改变以提供期望的功能。

[0054] 如上所述，公开了经由交流电力进行的定制化照明和通信的各实施方式。这些实施方式可配置为向用户提供利用远程计算设备控制负载(诸如，照明设备)的输出的能力。实施方式还提供了不要求排热设备的电路。一些实施方式还可提供利用与AC电力相同的频率通过AC电力进行传送的能力。

[0055] 虽然本文已经示出和描述了本公开的具体实施方式和方面，但是，在不脱离本公开的精神和范围的情况下，可进行各种其他改变和修改。此外，虽然本文已经描述了各种方面，但是这样的方面不需要结合使用。相应地，因此，其意图是所附权利要求覆盖落入本文示出和描述的实施方式的范围内的所有的这样的改变和修改。

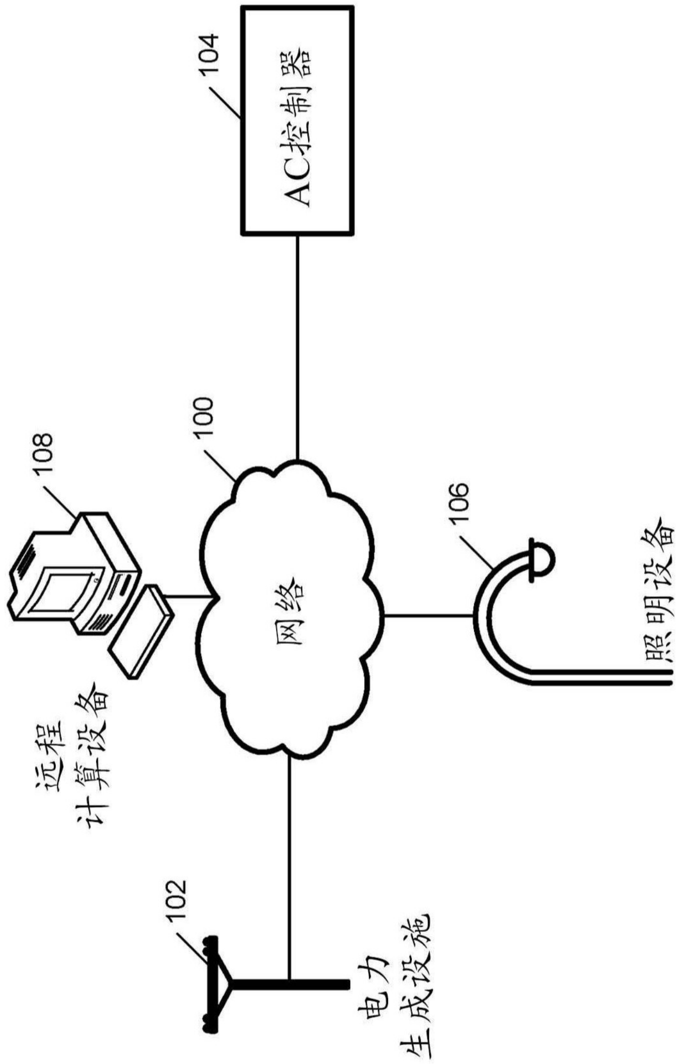


图1A

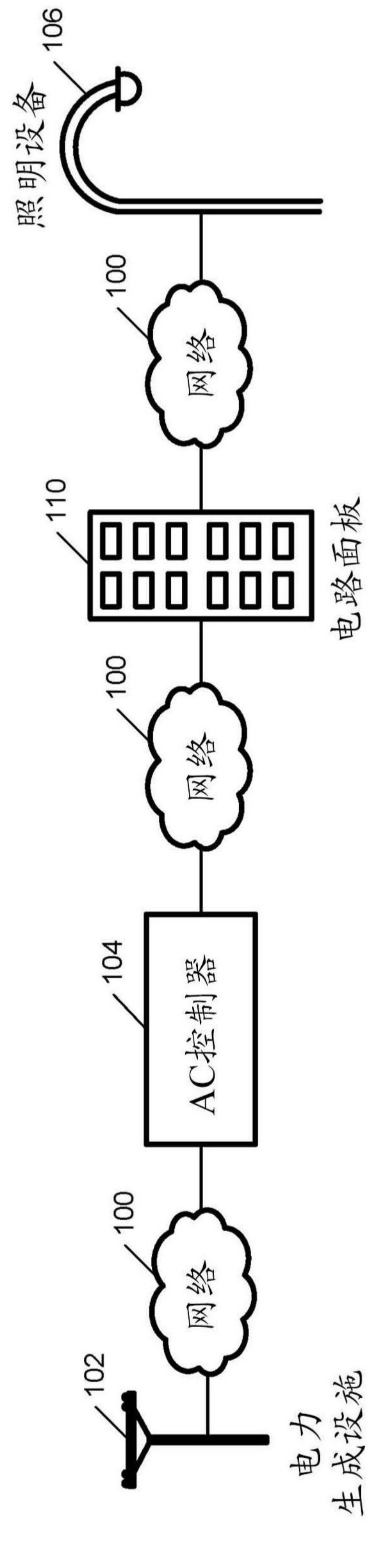


图1B

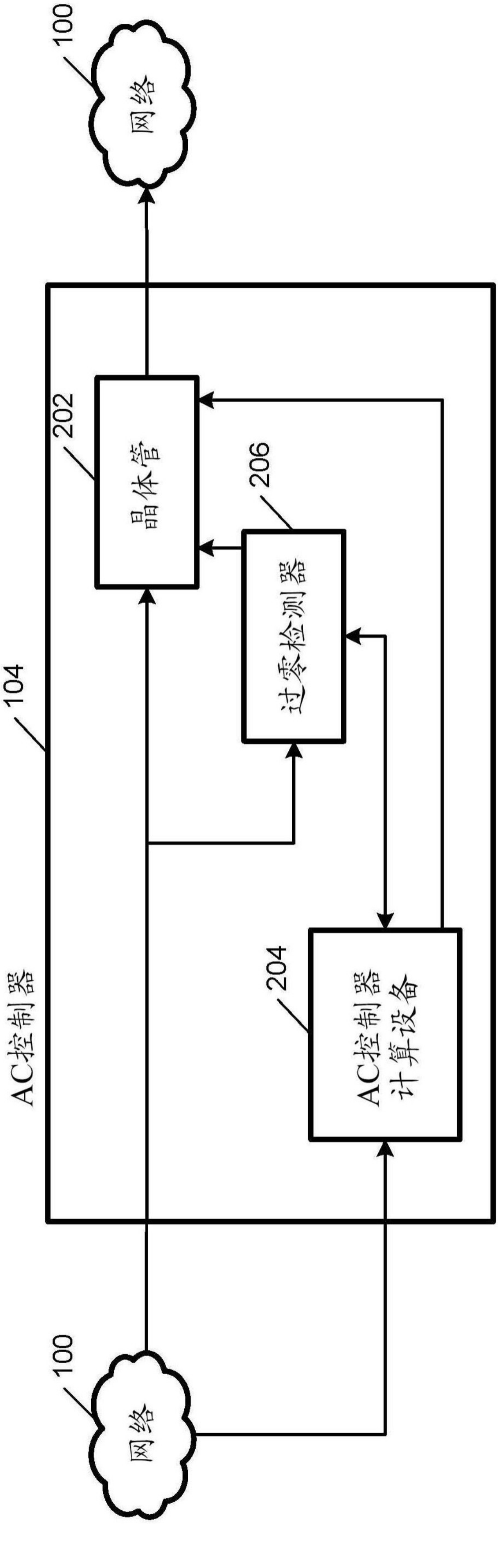


图2

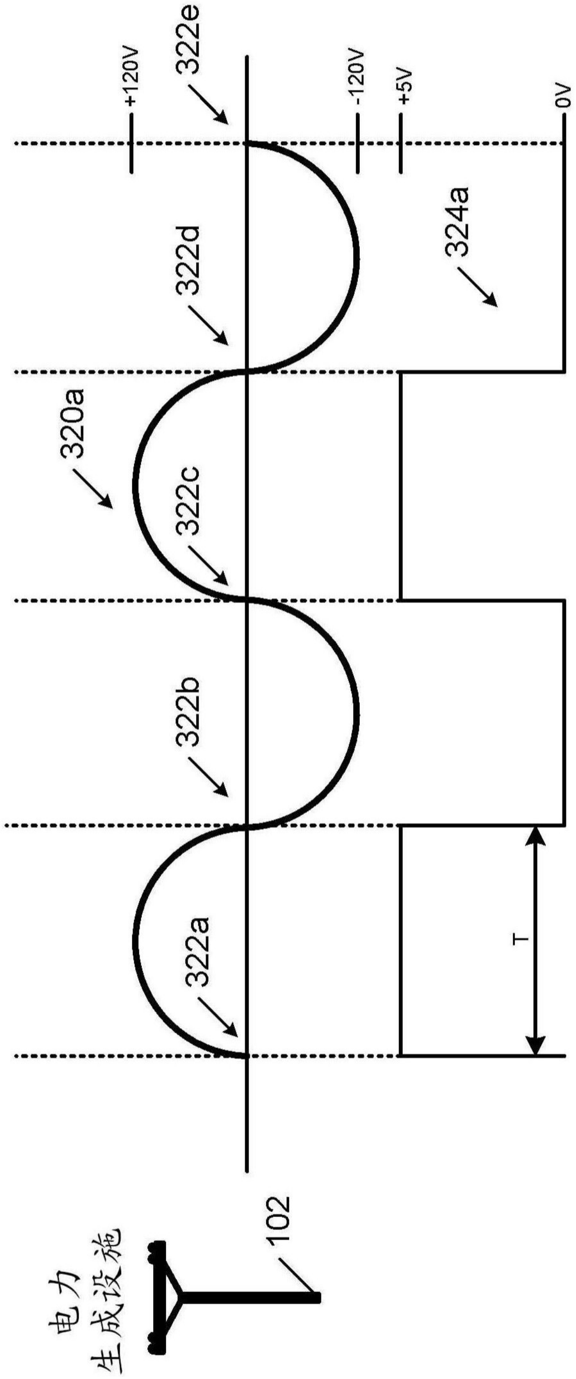

+120V
322e
-120V
+5V
0V
324a
322d
320a
322c
322b
322a
T
102
电力生成设施

图3A

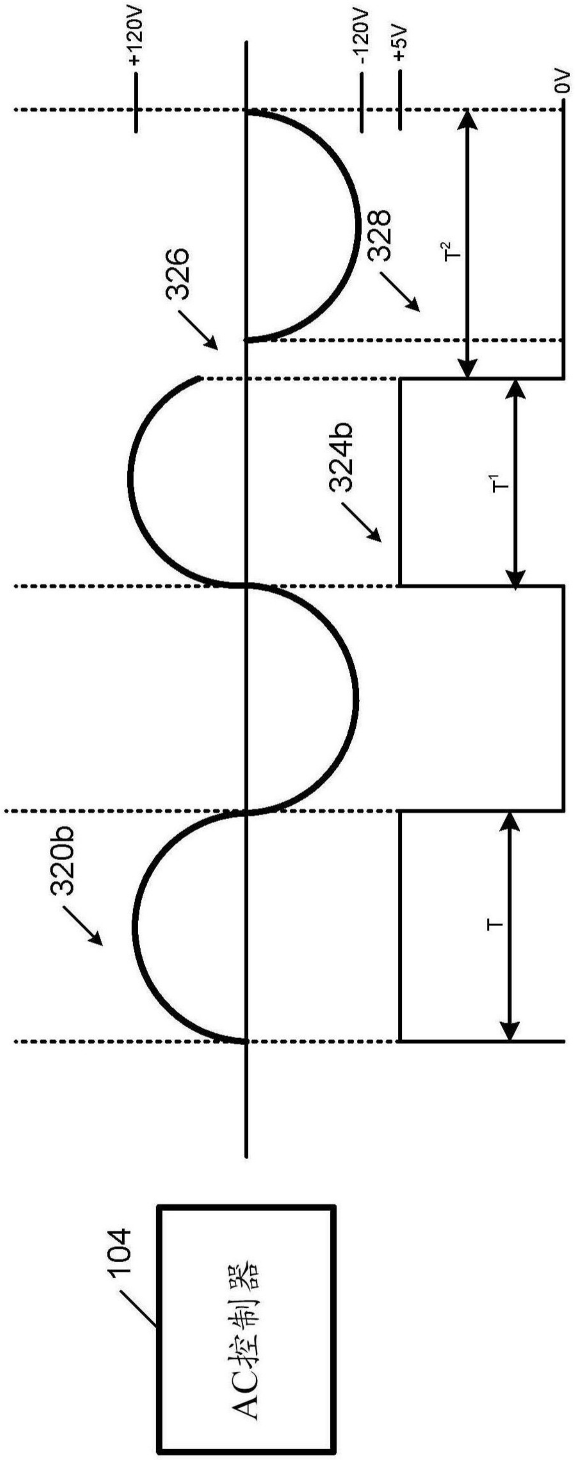


图3B

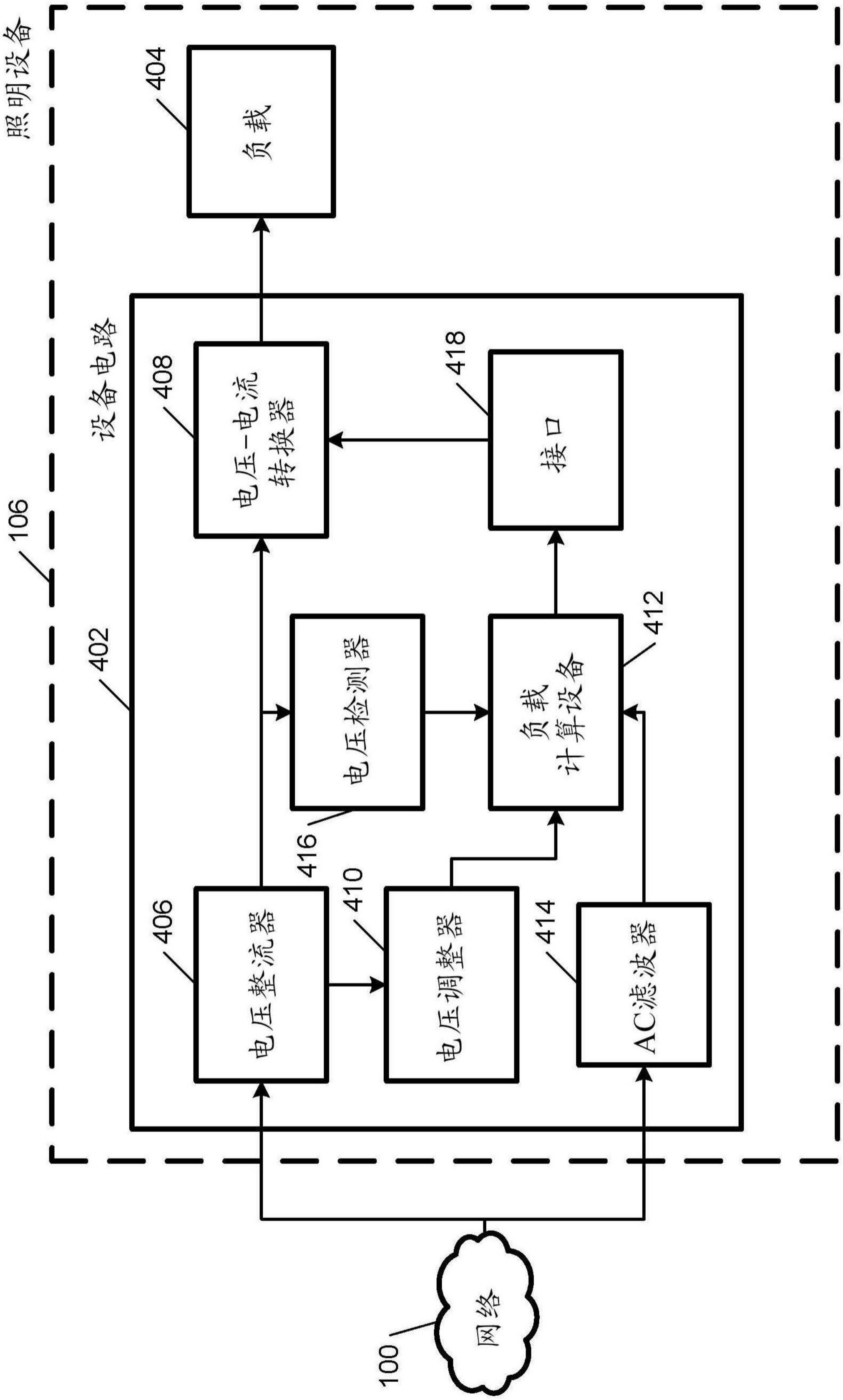

照明设备
106
404
负载
设备电路
402
408
电压-电流
转换器
418
接口
电压检测器
负载
计算设备
412
416
406
电压整流器
410
电压调整器
414
AC滤波器
100
网络

图4


开始
530
接收AC电力
532
接收通信数据
534
从通信数据确定待发送的消息
536
确定对AC电力的改变以根据预定格式将通信数据转换成消息
538
确定AC电力的过零点
540
改变AC电力以确定在过零点处或过零点周围的改变
542
向外部设备发送改变的AC电力
结束

图5

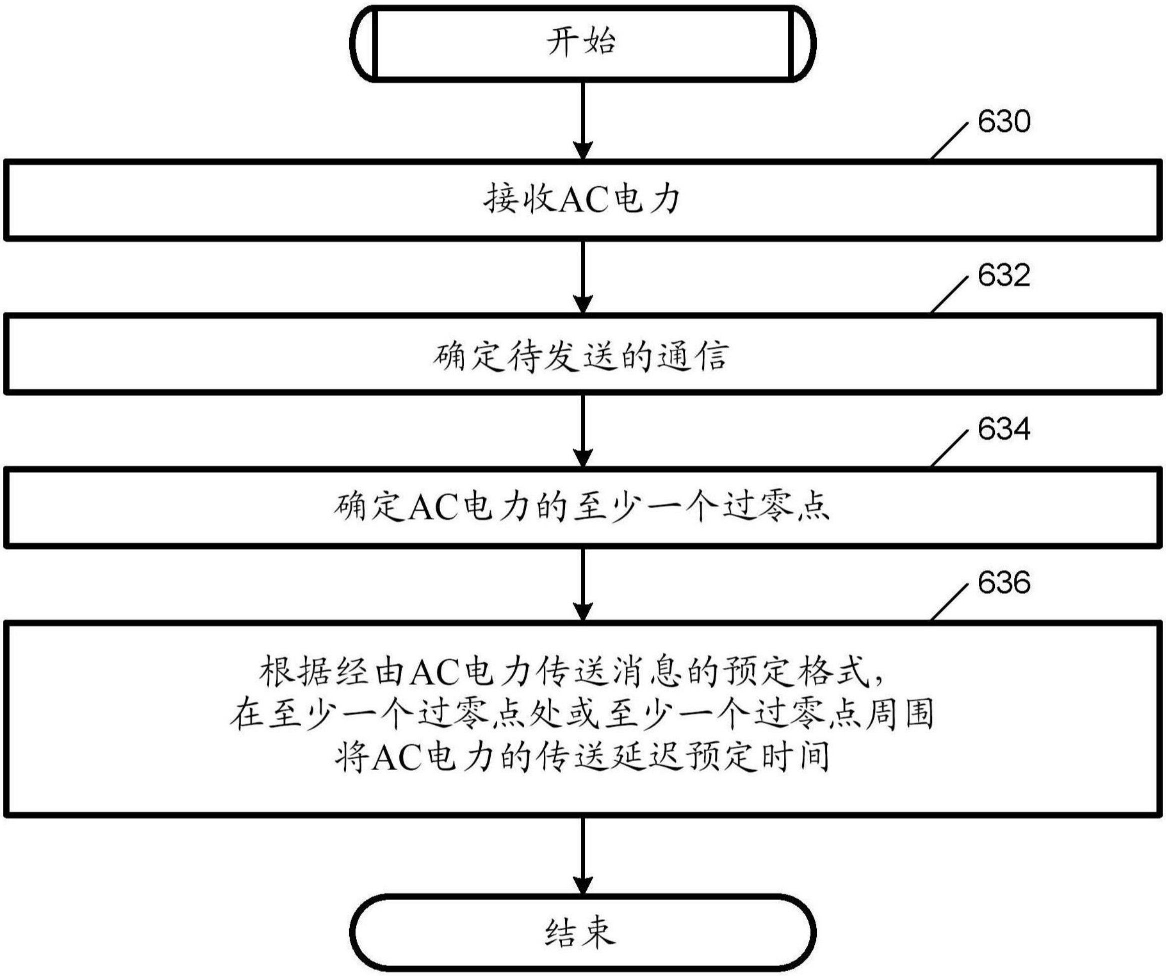

开始
630
接收AC电力
632
确定待发送的通信
634
确定AC电力的至少一个过零点
636
根据经由AC电力传送消息的预定格式，
在至少一个过零点处或至少一个过零点周围
将AC电力的传送延迟预定时间
结束

图6

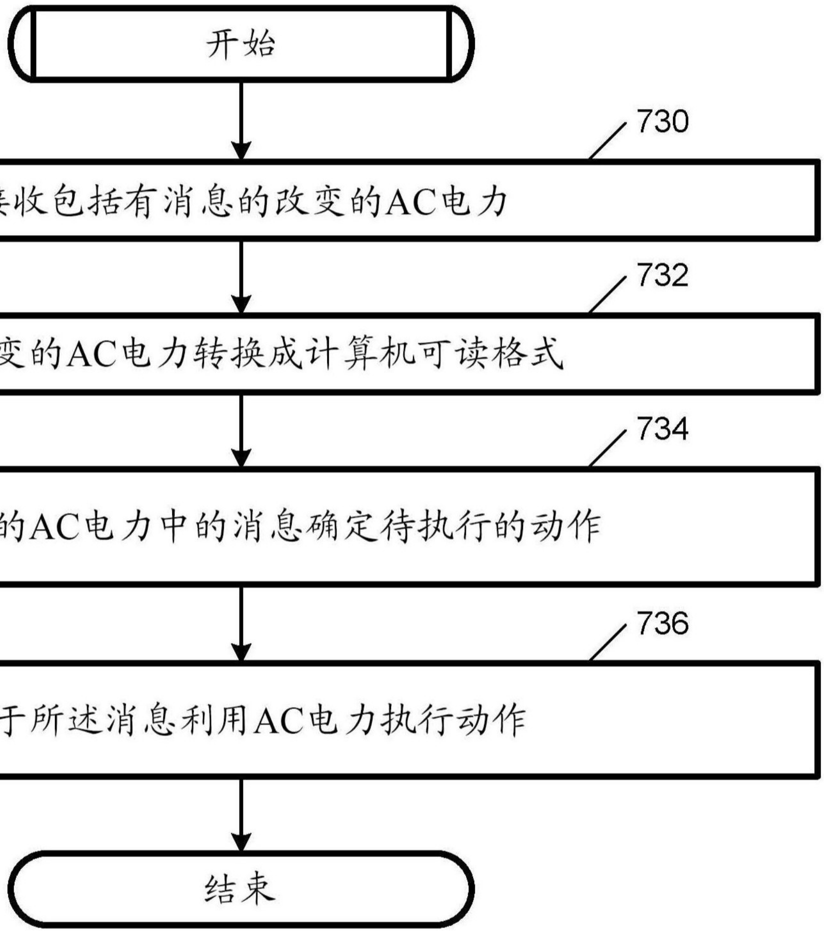

开始
730
接收包括有消息的改变的AC电力
732
将改变的AC电力转换成计算机可读格式
734
从改变的AC电力中的消息确定待执行的动作
736
基于所述消息利用AC电力执行动作
结束

图7

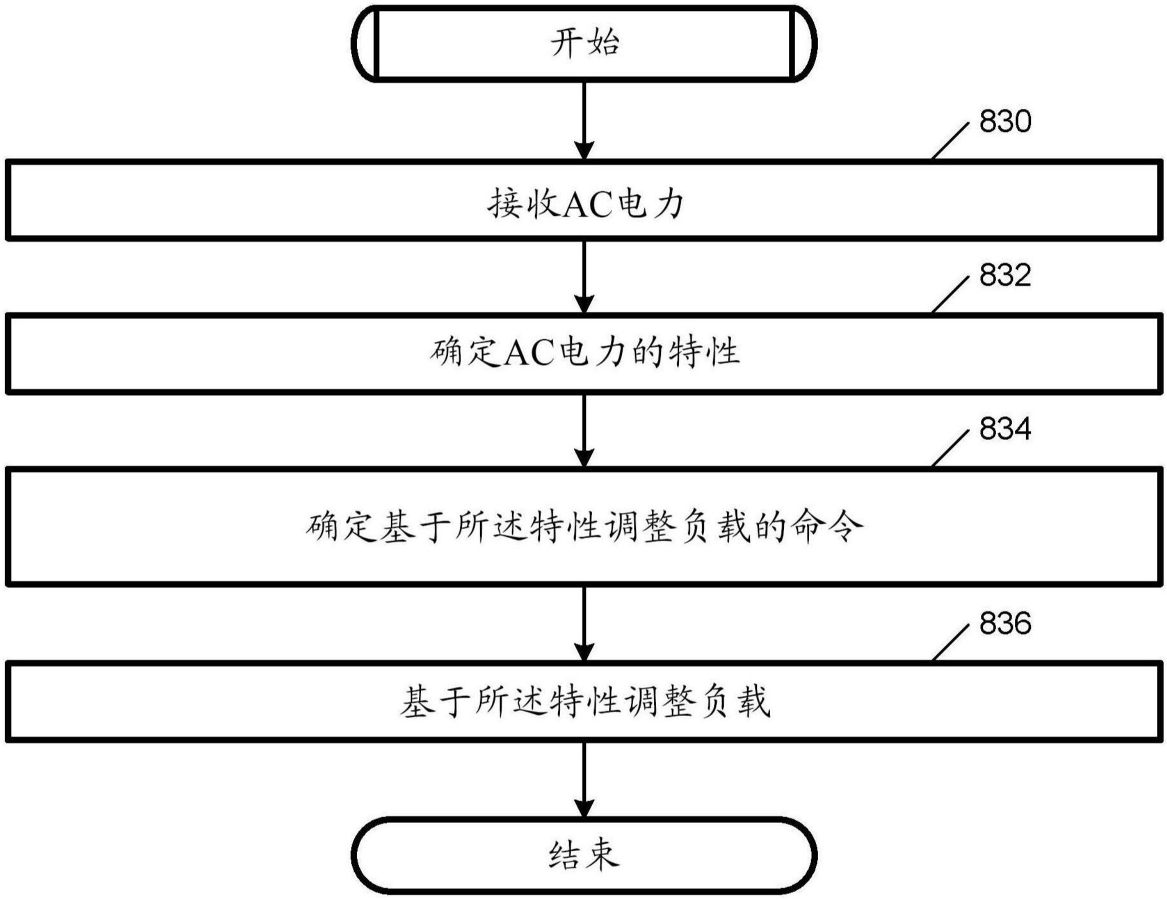

开始
830
接收AC电力
832
确定AC电力的特性
834
确定基于所述特性调整负载的命令
836
基于所述特性调整负载
结束

图8

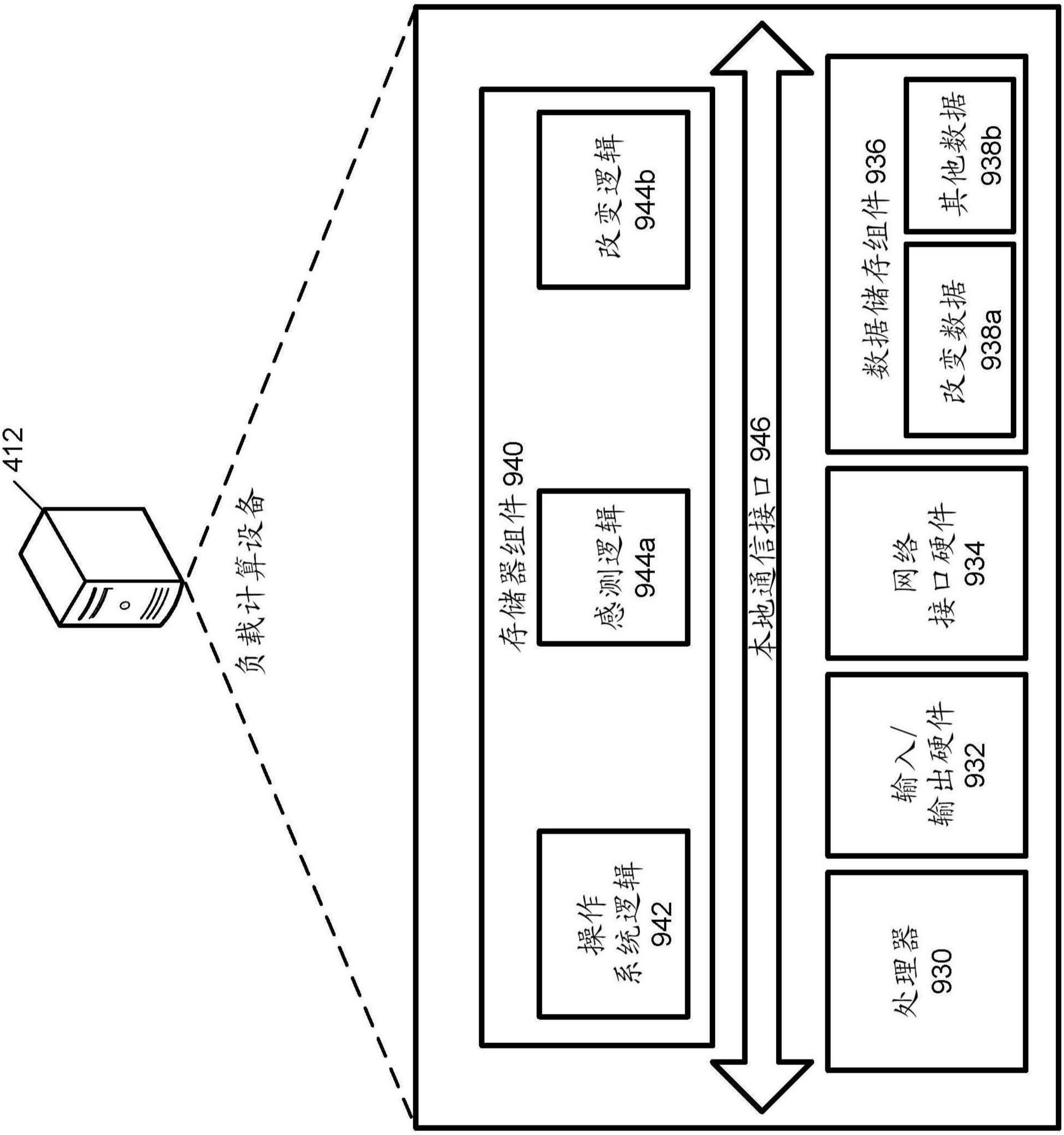

412
负载计算设备
存储器组件 940
操作系统逻辑 942
感测逻辑 944a
改变逻辑 944b
本地通信接口 946
处理器 930
输入/输出硬件 932
网络接口硬件 934
数据储存组件 936
改变数据 938a
其他数据 938b

图9