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Inventor(s)	Cahalane; David J.

Low power standby mode for luminaire

Abstract

A luminaire including a first power supply, a second power supply, a light source, a switching circuit, and a controller. The controller is in communication with the first power supply, the second power supply, and the switching circuit. The controller can control the switching circuit to remove a supply power from the first power supply, such that the second power supply provides power to the controller, in response to determining that the luminaire is operating in a standby mode, and control the switching circuit to provide the supply power to the first power supply, such that the first power supply provides power to the controller, in response to receiving a command to operate the luminaire in a normal operating mode, wherein the first power supply is capable of outputting more power than the second power supply.

Inventors: **Cahalane; David J. (Dane, WI)**

Applicant: **Electronic Theatre Controls, Inc.** (Middleton, WI)

Family ID: **1000008752237**

Assignee: **Electronic Theatre Controls, Inc. (Middleton, WI)**

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Primary Examiner: Luong; Henry

Attorney, Agent or Firm: Michael Best & Friedrich LLP

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application claims priority to U.S. Provisional Patent Application No. 63/333,855, filed on Apr. 22, 2022, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

(1) The present invention relates to luminaires and to systems for controlling a low power standby operating mode of a luminaire.

SUMMARY

(2) The invention provides, in one aspect, a system for controlling a low power standby operating mode of an entertainment luminaire. In the event the luminaire is operating in a standby operating mode, the luminaire is configured to limit current surge events from a main power supply and power on sequentially with a plurality of luminaires via a controller. The luminaire exhibits a reduction in power consumption when the luminaire is in standby operating mode when compared to traditional, switching device-controlled luminaires.

(3) The invention provides, in another aspect, a luminaire including a first power supply, a second power supply, a light source configured to receive an amount of power from the first power supply, a switching circuit, and a controller. The controller is in communication with the first power supply, the second power supply, the light source, and the switching circuit. The controller is configured to control the switching circuit to remove a supply power from the first power supply, such that the second power supply provides power to at least a portion of the controller, in response to determining that the luminaire is operating in a standby mode. The controller is further configured to control the switching circuit to provide the supply power to the first power supply, such that the first power supply provides power to the controller, in response to receiving a command to operate the luminaire in a normal operating mode, wherein the first power supply is capable of outputting more power than the second power supply.

(4) In some aspects, in response to receiving the command to operate the luminaire in a normal operating mode, the controller may provide a delay command to the switching circuit, such that the switching circuit delays providing the supply power to the first power supply by a period of time to limit an inrush current event.

(5) In some aspects, during the normal operating mode, the first power supply provides power to the light source, and the light source operates at a plurality of visual light intensities.

(6) In some aspects, during the normal operating mode, the first power supply provides power to the light source, and the light source operates at a plurality of colored light intensities.

(7) In some aspects, during the standby operating mode, the switching circuit prevents the controller and the light source from receiving supply power from the first power supply, preventing the controller and the light source from receiving supply power from the first power supply includes only supplying the supply power to the second power supply.

(8) In some aspects, the standby operating mode reduces power consumption of the controller and the luminaire. In some aspects, the power consumption during the standby operating mode is less than 0.5 W.

(9) In some aspects, during the normal operating mode, the controller provides full operational power to the luminaire. In some aspects, full operational power during the normal operating mode is greater than an amount of power supplied during the standby operating mode.

(10) In some aspects, the controller receives a user input indicative of entering a sleep mode. The controller enters the sleep mode in response to receiving the user input. The controller receives a wake-up signal and exits the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time.

(11) In some aspects, the luminaire includes a base and a lamp assembly connected to the base. In some aspects, the light source is located within the lamp assembly.

(12) In some aspects, the controller is located within the lamp assembly.

(13) In some aspects, the controller is located outside of the lamp assembly.

(14) In some aspects, the controller determines that a transition from the standby mode to the normal operating mode is necessary. The controller controls the switching circuit to apply the

transition from the standby mode to the normal operating mode.
(15) The invention provides, in another aspect, a method for operating a luminaire. The method includes supplying power to a controller via a first power supply or a second power supply and supplying, via the controller, a control signal to a switching circuit indicative of operating a luminaire in a standby mode or a normal operating mode. In response to determining that the luminaire is operating in the standby mode, the controller applies a control signal to the switching circuit to provide power to the controller via the second power supply. In response to receiving a command to operate the luminaire in the normal operating mode, the controller applies a control signal to the switching circuit to provide power to the controller via the first power supply.
(16) In some aspects, the method includes providing, in response to receiving the command to operate the luminaire in the normal operating mode, a delay command to the switching circuit, such that the switching circuit delays providing the supply power to the first power supply by a period of time to limit an inrush current event.
(17) In some aspects, the first power supply is capable of outputting more power than the second power supply.
(18) In some aspects, the method includes determining that a transition from the standby mode to the normal operating mode is necessary and controlling the switching circuit to apply the transition from the standby mode to the normal operating mode.
(19) In some aspects, the method includes providing, during the normal operating mode, power to a light source. The method includes operating, during the normal operating mode, the light source at a plurality of visual light intensities.
(20) In some aspects, the method includes providing, during the normal operating mode, power to a light source. The method includes operating, during the normal operating mode, the light source at a plurality of colored light intensities.
(21) In some aspects, the standby operating mode reduces power consumption of the controller and the luminaire. In some aspects, the power consumption during the standby operating mode is less than 0.5 W
(22) In some aspects, the method includes providing, during the normal operating mode, full operational power to the luminaire, the full operational power during the normal operating mode is greater than an amount of power supplied during the standby operating mode.
(23) In some aspects, the method includes receiving a user input indicative of entering a sleep mode. The method includes entering the sleep mode in response to receiving the user input. The method includes receiving a wake-up signal and exiting the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time
(24) In some aspects, the method includes maintaining the light source powered off in response to the wake-up time being greater than the predetermined time, and during the sleep mode, the light source of the luminaire is powered off.
(25) In some aspects, the method includes transitioning, via the controller, the sleep mode to a super-low sleep mode in response to not receiving the wake-up signal.
(26) In some aspects, the method includes receiving a user input from the control board and exiting the super-low sleep mode in response to receiving the user input. During the super-low sleep mode, all non-essential functions of the luminaire are powered off, the non-essential functions include at least one selected from the group consisting of display systems and menu systems.
(27) Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** illustrates a system including a luminaire in a venue, according to one example.

(2) FIG. **2** is a schematic view of a controller for the luminaire of FIG. **1**, according to one example.

(3) FIG. **3** is a block diagram of the luminaire of FIG. **2**, according to one example.

(4) FIG. **4** is a flow chart of a method for controlling a low power standby operating mode of a luminaire, according to one example.

(5) FIG. **5** is a block diagram of a luminaire according to another embodiment.

DETAILED DESCRIPTION OF THE DRAWINGS

(6) Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the accompanying drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

(7) FIGS. **1** and **2** illustrate a lighting system **100** capable of illuminating portions of a stage **105** in a venue **110**. The lighting system **100** includes a plurality of luminaires **115** and a control board **120** in communication with one or more of the luminaires **115** to control their operation. Each of the illustrated luminaires **115** includes a base **125** and a lamp assembly **130**. The lamp assembly **130** includes a light source **325** (e.g., an incandescent lamp, LED, LED array, arc lamp, or any other suitable light source; further described below with reference to FIG. **3**). The lamp assembly **130** also includes one or more enclosures, lenses, filters, mirrors, and the like, enabling the lamp assembly **130** to project light onto the stage **105**. In the illustrated embodiment, each of the luminaires **115** is mounted on a support bar **135** that is suspended above the stage **105**. In other embodiments, one or more of the luminaires **115** may be mounted to other suitable structures at any desired position in the venue **110**. In alternative embodiments, the lamp assembly **130** is movable relative to the base **125** (e.g., pan and tilt). In such embodiments, each of the illustrated luminaires **115** includes an electric motor in communication with the control board **120** such that the control board **120** can control the orientation of the lamp assembly **130** relative to the base **125**.

(8) With continued reference to FIG. **1**, the illustrated control board **120** is a lighting control board located within the venue **110**. Alternatively, the control board **120** may be positioned elsewhere within the venue **110**, remote from the venue **110**, or may be integrated partially or completely into one or more of the luminaires **115**. In some embodiments, the control board **120** may be electrically and/or communicatively connected to a separate controller, as further described below with reference to FIG. **2**.

(9) FIG. **2** illustrates a controller **200** for the luminaire **115**. The controller **200** is included within the luminaire **115**. In the illustrated embodiment, the controller **200** is disposed within the lamp assembly **130**. The controller **200** is electrically and/or communicatively connected to a variety of modules or components of the luminaire **115**. For example, the illustrated controller **200** may be connected to one or more indicators **202** (e.g., LEDs, a liquid crystal display [“LCD”], etc.), one or more internal sensors **203**, and a user input or user interface **204**. The controller **200** is also communicatively connected to the control board **120**. In some embodiments, the illustrated control board **120** may be connected to a communications interface **206**. The communications interface **206** is connected to a network **224** to enable the control board **120** to communicate with a server. In some embodiments, the controller **200** may communicate with the server to receive communications from the control board **120**. The controller **200** includes combinations of hardware and software that are operable to, among other things, control the operation of the system **100**, control the operation of the luminaire **115**, communicate over the network **224**, communicate with the control board **120**, receive input from a user via the user interface **204**, provide information to a user via the indicators **202**, etc. In the embodiment illustrated in FIG. **2**, each luminaire **115**

includes a controller **200**. In some embodiments, the indicators **202** and the user interface **204** are integrated together in the form of, for instance, a touch-screen. In some embodiments, the one or more internal sensors **203** includes an occupancy sensor. The occupancy sensor senses movement within a distance range of the luminaire **115**.

(10) The controller **200** includes a plurality of electrical and electronic components that provide power, operational control, and protection to the components and modules within the controller **200** and/or the luminaire **115**. For example, the controller **200** includes, among other things, a processing unit **208** (e.g., a microprocessor, a microcontroller, or another suitable programmable device), a memory **210**, input units **212**, and output units **214**. The processing unit **208** includes, among other things, a control unit **216**, an arithmetic logic unit ("ALU") **218**, and a plurality of registers **220** (shown as a group of registers in FIG. **2**), and is implemented using a known computer architecture (e.g., a modified Harvard architecture, a von Neumann architecture, etc.). The processing unit **208**, the memory **210**, the input units **212**, and the output units **214**, as well as the various modules or circuits connected to the controller **200** are connected by one or more control and/or data buses (e.g., common bus **222**). The control and/or data buses are shown generally in FIG. **2** for illustrative purposes. The use of one or more control and/or data buses for the interconnection between and communication among the various modules, circuits, and components would be known to a person skilled in the art in view of the embodiments described herein. It should further be understood that the specific modules, circuits, and components disclosed herein for controller **200** are exemplary, and are not essential for an embodiment of the invention. In some embodiments, the controller **200** is implemented partially or entirely on a semiconductor (e.g., a field-programmable gate array ["FPGA"] semiconductor, an application specific integrated circuit ["ASIC"], or other programmable semiconductor devices as appropriate for a given application).

(11) The memory **210** is a non-transitory computer readable medium and includes, for example, a program storage area and a data storage area. The program storage area and the data storage area can include combinations of different types of memory, such as a ROM, a RAM (e.g., DRAM, SDRAM, etc.), EEPROM, flash memory, a hard disk, an SD card, or other suitable magnetic, optical, physical, or electronic memory devices. The processing unit **208** is connected to the memory **210** and executes software instructions that are capable of being stored in a RAM of the memory **210** (e.g., during execution), a ROM of the memory **210** (e.g., on a generally permanent basis), or another non-transitory computer readable medium such as another memory or a disc. Software included in the implementation of the luminaire **115** and controller **200** can be stored in the memory **210** of the controller **200**. The software includes, for example, firmware, one or more applications, program data, filters, rules, one or more program modules, and other executable instructions. The controller **200** is configured to retrieve from the memory **210** and execute, among other things, instructions related to the control processes and methods described herein. In other embodiments, the controller **200** includes additional, fewer, or different components.

(12) The user interface **204** may be included to provide user control of the system **100** and the luminaire **115**. The user interface **204** is operably coupled to the controller **200** to control, for example, control or drive signals provided to the luminaire **115**. The user interface **204** can include any combination of digital and analog input devices required to achieve a desired level of control for the system **100**. For example, the user interface **204** can include a computer having a display and input devices, a touch-screen display, a plurality of knobs, dials, switches, buttons, faders, or the like. In the embodiment illustrated in FIG. **2**, the user interface **204** is separate from the control board **120**. In other embodiments, the user interface **204** is included in the control board **120**.

(13) The controller **200** is configured to work in combination with the control board **120** to provide direct control or drive signals to the luminaires **115**. As described above, in some embodiments, the controller **200** is configured to provide direct control or drive signals to the luminaire **115** without separately interacting with the control board **120**. The direct drive signals that are provided to the

luminaire **115** are provided, for example, based on a user input received by the controller **200** from the user interface **204**.

(14) FIG. **3** illustrates the luminaire **115** including a main power source **305** in electronic communication with a switching circuit **310** and a standby power supply **315**. In some embodiments, the main power source **305** is an AC power supply, such as an AC utility power supply, or any other power supply able to provide a suitable amount of output power. In some embodiments, the switching circuit **310** is located within the main power source **305**. The switching circuit **310** may encompass various types of switching circuitry. For example, the switching circuit **310** may be a relay, a silicon-controlled rectifier (SCR), an ideal diode, a transistor (e.g., a MOSFET) or any other type of suitable switching circuitry. Although the standby power supply **315** is illustrated as being in electronic communication with the main power source **305**, the standby power supply **315** may be separate from the main power source **305** entirely (e.g., in electronic communication with a separate power source). In further embodiments, the standby power supply **315** may be a battery. As will be described in more detail below, the switching circuit **310** is configured to control power from the main power source **305** to a primary power supply **320**. In some embodiments, the switching circuit **310**, the standby power supply **315**, and the primary power supply **320** are included within a single unit. In some embodiments, the switching circuit **310** controls power from the main power source **305** to the primary power supply **320** based on a signal received from the one or more internal sensors **203**. For example, the one or more internal sensors **203** sense movement within the distance range of the luminaire **115** (e.g., using the occupancy sensor) and transmits a signal indicative of the movement to the controller **200**. In response to receiving the signal indicative of movement, the controller **200** transmits a signal to turn on the main power source **305** to supply power to the primary power supply **320**.

(15) The standby power supply **315** is in electronic communication with the controller **200** of the luminaire **115**. As shown in FIG. **3**, the controller **200**, the main power source **305**, the switching circuit **310**, the standby power supply **315**, and the primary power supply **320** are located within the lamp assembly **130** of the luminaire **115**. As shown in FIG. **3**, the controller **200** is in electronic communication with the control board **120**. In one embodiment, the controller **200** may communicate with the control board **120** via a communication link or circuit. In some examples, the controller **200** may communicate with the control board **120** via a wireless communication protocol, such as Wi-Fi, cellular (e.g., 3G, 4G, 5G, LTE, CDMA, or the like), Z-Wave, Zigbee, Bluetooth, Bluetooth Low Energy, Wi-Max, Lo-Ra, NFC, and/or other wireless communication protocols as required for a given application. In other examples, the controller **200** may communicate with the external controller using a wired communication protocol, such as Ethernet, RS-232, USB, USB 2.0, Firewire, DMX-512, RDM, ACN, CANBus, or other wired communication protocol as required for a given application.

(16) As described above relative to FIG. **1**, each luminaire **115** is a lighting device including the light source **325**. As shown in FIG. **3**, the light source **325** is located within the lamp assembly **130** of the luminaire **115**. In some embodiments, the main power source **305** is in electronic communication with the luminaire **115**. In some embodiments, the controller **200** is configured to supply power to the light source **325** of the luminaire **115**. In some embodiments, the light source **325** of the luminaire **115** is configured to operate at a variety of visual light intensities and a variety of colored light intensities. Further, the light source **325** may be able to be controlled to vary in color as well as intensity. The controller **200** is further configured to control the light source **325** of the luminaire **115** to produce a variety of lighting operations and a variety of visual effects.

(17) The control board **120** may be independent of the controller **200** and may encompass various types of communication circuitry or components. For example, the communication circuit may be a digital multiplex controller (DMX-512) or any other suitable external control device. The control board **120** is configured to provide the controller **200** with a plurality of control signals to control the lighting operations and the visual effects of the LEDs **325**.

(18) The controller **200** is further configured to control the switching circuit **310** to operate in a primary operation or standby operation condition. In the standby operation condition, the switching circuit **310** is configured to prevent power from the main power source **305** from being applied to the primary power supply **320**. Accordingly, the main power source **305** supplies power to the standby power supply **315** only, which in turn is the sole provider of power to the controller **200**. In some embodiments, the standby power supply **315** supplies 5V to the controller **200**. In other embodiments, the standby power supply **315** is configured to supply the controller **200** with any suitable voltage to power the controller **200**. In some embodiments, the standby power supply **315** is a rechargeable battery source or the like. In such embodiments, the main power source **305** may receive a signal indicative of the standby power supply **315** having a low battery capacity. For example, the main power source **305** receives the signal indicative of low battery capacity from the standby power supply **315**. In other examples, the main power source **305** receives the signal indicative of low battery capacity from the controller **200**, the switching circuit **310**, or the control board **120**. In response to receiving the signal indicative of low battery capacity, the main power source **305** turns on and supplies power to the standby power supply **315** to recharge the standby power supply **315**. The standby power supply **315** may be configured as a low-power power supply. For example, the standby power supply **315** may only be capable of outputting approximately 1 W of output power. However, output power levels of more than 1 W or less than 1 W are also contemplated as required for a given application. In some embodiments, the standby power supply **315** is sized to allow the controller **200** and/or luminaire **115** to have sufficient power to perform various background operations or other functions while in standby operating mode. This allows the standby power supply **315** to provide efficient power to the controller **200** as the losses across the smaller power supply will be lower than a larger power supply, such as the primary power supply **30** described herein.
(19) The controller **200** may be configured to control the switching circuit **310** to operate in the standby operation condition where the light source **325** is off standby operating mode and the controller **200** is operating in a controller standby operating mode. When operating in the controller standby operating mode, the controller **200** may be configured to perform only basic functions, such as communication with other devices, such as the control board **120**, or perform other background operations. For example, while in the controller standby operating mode the controller **200** continues to receive and process data from the control board **120** via the plurality of control signals. In some embodiments, the power consumption of the controller **200** and/or luminaire **115** in the standby operating mode may be 0.5 W or less and may include any losses associated with the standby power supply **315**.
(20) While the controller **200** is operating in the standby operating mode, the controller **200** may determine that a mode change to a normal operating mode required. In the normal operating mode, the light source **325** of the luminaire **115** is operating and generating light based on one or more control signals from the controller **200**. In some examples, the control board **120** may provide an instruction to the controller **200** to switch to the normal operating mode. In some embodiments, the controller **200** may include one or more instructions or commands to determine when the transition to the normal operating mode needs to occur. For example, in a programmed lighting routine, it may be known when a specific luminaire, such as luminaire **115**, is needed to illuminate. Accordingly, the controller **200** may initiate the transition to the normal operating mode prior to the required transition time to prevent any latency of operation due to switching between the standby operating mode and the normal operating mode. In some embodiments, the transition time to the normal operating mode from the standby operating mode may be short enough such that the latency is unimportant. The controller **200** may initiate the transition to the normal operating mode when the transition is required, rather than in advance. For example, the reception of a DMX-512 signal instructing luminaire **115** to emit light may trigger the transition.
(21) Upon determining that a transition to the normal operating mode is required, the controller **200**

may provide a control signal to the switching circuit **310** to switch to a normal operating condition, wherein the switch is closed (e.g., power is provided from the main power source **305** to the primary power supply **320**). The primary power supply **320** may be sized to provide sufficient power for the controller **200** and the luminaire **115** to operate per a required design. For example, the primary power supply **320** may be a 200 W power supply. However, values of more than 200 W or less than 200 W are also contemplated as required for a given design. In some examples, the primary power supply may output a higher voltage to the controller **200** and/or luminaire **115**. For example, the primary power supply **320** may output a 56 VDC output. However, voltage outputs of more than 56 VDC or less than 56 VDC are also contemplated. In the normal operating mode, the controller **200** controls the light source **325** to operate at a variety of visual light intensities and a variety of colored light intensities via the plurality of control signals from the control board **120**. The controller **200** is further configured to control the light source **325** of the luminaire **115** to produce a variety of lighting operations and a variety of visual effects via the plurality of control signals from the control board **120**.

(22) In some embodiments, the controller **200** may further be configured to perform various operations to limit a surge current event associated with transitioning from the standby operating mode to the normal operating mode. For example, in a system with multiple controllers **200** and/or luminaires **115**, a large surge current may occur when multiple controller **200** and/or luminaires **115** are transitioned to the normal operating mode from the standby operating mode. In some examples, this may be due to multiple primary power supplies **320** being switched into the system (e.g., provided power from the main power source), resulting in a current inrush. This may occur where the primary power supplies **320** have various components, such as capacitors, which may cause brief surges of power when first powered up. These current surges, where sufficient current is determined to flow, may cause system issues, such as breaker tripping or fuse blowing conditions, which will require manual intervention to correct.

(23) To reduce the effects of current inrush surges from transitioning multiple controller **200** and/or luminaires **115** from a standby operating mode to a normal operating mode, the controller **200** may be configured to provide a command to the switching circuit **310** to delay providing power to the primary power supply **320** for a period of time. In some embodiments, the period of time may be a random time interval. In other embodiments, the period of time is based on a serial number of the luminaire **115** or any other unique identifier of the luminaire **115**. For example, in a large system, the controller **200** may delay controlling the switching circuit **310** to provide power to the primary power supply **320** based on the unique identifier, such that there is a sequential order in which the various primary power supplies **320** within the system are provided power from their respective switching circuits **310**. In some embodiments, the period of time can be adjusted manually by a user, such as via the control board **120**. In some examples, the period of time may be based on a general power up time for a specific primary power supply **320**.

(24) By delaying or staggering the provision of power to the primary power supplies **320** within a system, any current surges may be reduced. Spreading out surge current events over a period of time reduces likelihood of a fault being generated based on the current level exceeding a threshold value. For example, by staggering the provision of power to the primary power supplies **320**, each luminaire **115** provides power to each light source **325** at a different time to reduce current surges through a system.

(25) In some embodiments, the switching circuit **310** of the various primary power supplies **320** is controlled via a command from one or more controllers **200**. For example, while the controller **200** of FIG. **3** is shown as controlling a single switching circuit **310** and luminaire **115**, it is contemplated that in some examples a single controller **200** may control multiple switching circuits **310** and/or luminaires **115**. In some examples, the control board **120** is in communication with multiple controllers **200** and configured to control each controller **200** to control the switching circuit **310** to provide power to the respective primary power supply **320** using a sequence. The

sequence may be based on a lighting requirement for a given application, for maximizing efficiency, and/or based on other parameters. In some embodiments, the sequence is provided to the controller **200** using a remote device management (RDM) protocol of the control board **120**. In some embodiments, the control board **120** provides commands to power on the plurality of primary power supplies **320** (and therefore the corresponding luminaires **115**) in a certain order and is controlled automatically based on one or more factors, such as an address of the controller **200**, a luminaire **115** identifier, random time delay intervals, or manual user inputs to the controller **200**. In some embodiments, the sequence is changed for each luminaire **115** of the plurality of luminaires to account for different peak surge times. For example, different groups of luminaires may be powered on at different times in a predefined light show or presentation.

(26) In some embodiments, the primary power supply **320** may receive power from the main power source **305** even when the luminaire **115** is not illuminating (e.g., in a standby mode). This may be appropriate where the luminaire **115** is switched off for short periods of time. This can reduce the effects of unnecessarily switching the primary power supply **320** on and off and lead to an extension of the operation life of various components typically used in power supplies, such as the primary power supply **320**, which may otherwise see a reduction in operational life due to over switching. Example components may include electrolytic capacitors. However, other components are also contemplated.

(27) In some embodiments, the controller **200** and/or luminaire **115** may be manually set to operate in a very low power sleep mode. In the very low power sleep mode, main power source **305** may be continuously energized. Continuous main power reduces the need for separate switch or relay circuit outputs controlling the main power source **305**, such as remotely controlled relays or breakers. When in very low power deep sleep mode the power consumption of the system may be comparable with, or lower than, the power consumption of external remotely controlled relays or breakers thus maintaining or reducing the quiescent power load of the entire system.

(28) FIG. **4** illustrates a flow chart of a control method **400** for controlling a low power standby operating mode of the luminaire **115**. The control method **400** begins at step **405** in which the main power source **305** is powered on and the controller **200** receives power from the main power source **305** via either the standby power supply **315** or the primary power supply **320**, the control method **400** then proceeds to step **410**. At step **410**, the switching circuit **310** receives a control signal from the controller **200** to operate in the standby operating mode or the normal operating mode, the control method **400** then proceeds to step **415**. As described above, the controller **200** may determine whether to operate in the standby operating mode or the normal operating mode based on a command received from the control board **120**.

(29) At step **415**, where the control signal indicates whether the switching circuit **310** will operate in the standby operating mode, in response to the control signal indicating that the switching circuit **310** will operate in the standby operating mode, the control method **400** proceeds to step **420**. At step **420**, the controller **200** operates in the standby operating mode (e.g., instructs the switching circuitry to remove power from primary power supply). In response to the control signal indicating that the relay will operate in the normal operating mode, the control method **400** proceeds to step **425**. At step **425**, the controller **200** controls the switching circuit **310** to provide power to the primary power supply **320**, which then supplies a control voltage to the controller **200** to provide full operational power to the controller **200** and luminaire **115**. The light source **325** of the luminaire **115** may then be controlled via a plurality of control signals from the control board **120**. In some examples, the controller **200** may delay controlling the switching circuit **310** to provide power to the primary power supply by a period of time to limit surge current events and reduce the power consumption of the luminaire **115**, as described above. The delay duration of the luminaire **115** may be chosen to differ from the delay duration of other luminaires such that, when a plurality of luminaires each receive simultaneous commands to return to normal operating mode, each luminaire **115** will preferably delay their switching of their associated first power supplies by

differing amounts of time. The delay duration may be a random delay, or a delay that is preset during luminaire manufacture, or addressing, or any other method as known in the art.
(30) In some embodiments, the achieved reduction in power consumption is low enough to meet EnergyStar requirements. In one specific example, power consumption of the controller **200**, luminaire **115**, and the standby power supply **315** may be 0.265 W when operating in the standby mode. The controller **200** further comprises a sleep mode in which the LEDs are off. In some embodiments, the controller **200** receives a user input from the control board **120** or from the user interface **204** indicative of entering the sleep mode. In some embodiments, during the sleep mode, the controller **200** continues to receive and process data of the luminaire **115**. The control board **120** is further configured to provide a wake-up signal to the controller **200**. In some embodiments, where a wake-up time of the controller **200** in response to the received wake-up signal is less than a predetermined time, the system **300** is considered a live system (e.g., the controller **200** exits the sleep mode). Where the wake-up time is greater than a predetermined time, the light source **325** remains in the sleep mode until receiving a wake-up signal. In some embodiments, the sleep mode is extended to a super-low sleep mode. In the super-low sleep mode, all non-essential functions of the luminaire **115** are turned off (e.g., display systems and menu systems). The controller **200** wakes up from the super-low sleep mode based on a received input. For example, the input may include a user input received from the control board **120**, a control signal received from the control board **120**, or any valid data received by the controller **200**. In some embodiments, during the super-low sleep mode, the controller **200** automatically wakes up after a predetermined time period (e.g., every 30 seconds). When the controller **200** automatically wakes up, the controller **200** determines whether the light source **325** should be turned on. When the controller **200** determines that the light source **325** should be turned on, the controller **200** returns to normal operation and the light source **325** is turned on. When the controller **200** determines that the light source **325** should remain off, the controller **200** remains in the super-low sleep mode.
(31) FIG. **5** illustrates the luminaire **115** including the main power source **305** in electronic communication with the switching circuit **310** and the standby power supply **315**. The embodiment shown in FIG. **5** is an alternative embodiment to the embodiment of FIG. **3**. The luminaire **115** of FIG. **5** is operable to perform similar functions as other embodiments described herein. As shown in FIG. **5**, the light source **325** is located within the lamp assembly **130** of the luminaire **115**. In such embodiments, the controller **200**, the main power source **305**, the switching circuit **310**, the standby power supply **315**, and the primary power supply **320** are located separately or outside from the lamp assembly **130** in a different location than the lamp assembly **130**. For example, some or all of the controller **200**, the main power source **305**, the switching circuit **310**, the standby power supply **315**, and the primary power supply **320** may be adjacent to or in the control board **120**. The controller **200** is further configured to control the switching circuit **310** to operate in a primary operation or standby operation condition, as described above. In some embodiments, the controller **200** is configured to supply power to the light source **325** of the luminaire **115**, as described above. In other embodiments, the controller **200** may be included within the control board **120**, and, for example, the controller **200** can provide control signals directly to the luminaire **115**. In other embodiments, the controller **200** may be associated with the server and communicates through the network **224** to provide control signals to the control board **120** and the luminaires **115**. In some embodiments, the controller **200** is separate from the luminaire **115**.
(32) Although the invention has been described with reference to certain preferred embodiments, variations and modifications exist within the scope and spirit of one or more independent aspects of the invention as described.

Claims

1. A luminaire, comprising: a first power supply, a second power supply, a light source configured to receive an amount of power from the first power supply, a switching circuit, and a controller in communication with the first power supply, the second power supply, the light source, and the switching circuit, wherein the controller is configured to: control the switching circuit to remove a supply power from the first power supply, such that the second power supply provides power to the controller in response to determining that the luminaire is operating in a standby mode, and control the switching circuit to provide the supply power to the first power supply, such that the first power supply provides power to the controller in response to receiving a command to operate the luminaire in a normal operating mode, wherein the first power supply is capable of outputting more power than the second power supply; and wherein the controller is further configured to provide a delay command to the switching circuit, such that the switching circuit delays providing the supply power to the first power supply by a period of time to limit an inrush current event, in response to receiving the command to operate the luminaire in the normal operating mode.
2. The luminaire of claim 1, wherein during the normal operating mode, the first power supply provides power to the light source, and the light source is configured to operate at a plurality of visual light intensities.
3. The luminaire of claim 1, wherein during the normal operating mode, the first power supply provides power to the light source, and the light source is configured to operate at a plurality of colored light intensities.
4. The luminaire of claim 1, wherein during the standby operating mode, the switching circuit prevents the controller from receiving supply power from the first power supply, and wherein preventing the controller from receiving supply power from the first power supply includes only supplying the supply power to the second power supply.
5. The luminaire of claim 4, wherein the standby operating mode reduces power consumption of the controller and the luminaire, and wherein the power consumption during the standby operating mode is less than 0.5 W.
6. The luminaire of claim 5, wherein during the normal operating mode, the controller provides full operational power to the luminaire, and wherein full operational power during the normal operating mode is greater than an amount of power supplied during the standby operating mode.
7. The luminaire of claim 1, wherein the controller is further configured to: receive a user input indicative of entering a sleep mode; enter the sleep mode in response to receiving the user input; receive a wake-up signal; and exit the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time.
8. The luminaire of claim 1, further comprising: a base; and a lamp assembly connected to the base, wherein the light source is located within the lamp assembly.
9. The luminaire of claim 8, wherein the controller is located within the lamp assembly.
10. The luminaire of claim 8, wherein the controller is located outside of the lamp assembly.
11. The method of claim 10, the method further comprising: providing, during the normal operating mode, power to a light source; and operating, during the normal operating mode, the light source at a plurality of visual light intensities.
12. The method of claim 10, the method further comprising: providing, during the normal operating mode, power to a light source; and operating, during the normal operating mode, the light source at a plurality of colored light intensities.
13. The luminaire of claim 1, the controller further configured to: determine that a transition from the standby mode to the normal operating mode is necessary; and control the switching circuit to apply the transition from the standby mode to the normal operating mode.
14. A method for operating a luminaire, the method comprising: supplying power to a controller via a first power supply or a second power supply; supplying, via the controller, a control signal to a switching circuit indicative of operating the luminaire in a standby mode or a normal operating

mode; controlling, in response to determining that the luminaire is operating in the standby mode, the switching circuit provide power to the controller via the second power supply; and controlling, in response to receiving a command to operate the luminaire in the normal operating mode, the switching circuit to provide power to the controller via the first power supply; and providing, in response to receiving the command to operate the luminaire in a normal operating mode, a delay command to the switching circuit, such that the switching circuit delays providing the supply power to the first power supply by a period of time to limit an inrush current event.

15. The method of claim 14, wherein the first power supply is capable of outputting more power than the second power supply.

16. The method of claim 14, the method further comprising: determining that a transition from the standby mode to the normal operating mode is necessary; and controlling the switching circuit to apply the transition from the standby mode to the normal operating mode.

17. The method of claim 14, wherein the standby operating mode reduces power consumption of the controller and the luminaire, and wherein the power consumption during the standby operating mode is less than 0.5 W.

18. The method of claim 17, the method further comprising: providing, during the normal operating mode, full operational power to the luminaire, wherein full operational power during the normal operating mode is greater than an amount of power supplied during the standby operating mode.

19. The method of claim 14, the method further comprising: receiving a user input indicative of entering a sleep mode; entering the sleep mode in response to receiving the user input; receiving a wake-up signal; and exiting the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time.

20. The method of claim 19, the method further comprising: maintain a light source powered off in response to the wake-up time being greater than the predetermined time, wherein during the sleep mode, the light source of the luminaire is powered off.

21. The method of claim 19, the method further comprising: transitioning, via the controller, the sleep mode to a super-low sleep mode in response to not receiving the wake-up signal.

22. The method of claim 21, the method further comprising: receiving a user input from the control board; and exiting the super-low sleep mode in response to receiving the user input, wherein during the super-low sleep mode, all non-essential functions of the luminaire are powered off, wherein the non-essential functions include at least one selected from the group consisting of display systems and menu systems.

23. A method for operating a luminaire, the method comprising: supplying power to a controller via a first power supply or a second power supply; supplying, via the controller, a control signal to a switching circuit indicative of operating the luminaire in a standby mode or a normal operating mode; controlling, in response to determining that the luminaire is operating in the standby mode, the switching circuit provide power to the controller via the second power supply; and controlling, in response to receiving a command to operate the luminaire in the normal operating mode, the switching circuit to provide power to the controller via the first power supply; receiving a user input indicative of entering a sleep mode; entering the sleep mode in response to receiving the user input; receiving a wake-up signal; exiting the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time; and transitioning, via the controller, the sleep mode to a super-low sleep mode in response to not receiving the wake-up signal.

24. The method of claim 23, the method further comprising: receiving a user input from the control board; and exiting the super-low sleep mode in response to receiving the user input, wherein during the super-low sleep mode, all non-essential functions of the luminaire are powered off, wherein the non-essential functions include at least one selected from the group consisting of display systems and menu systems.

25. A method for operating a luminaire, the method comprising: supplying power to a controller via a first power supply or a second power supply; supplying, via the controller, a control signal to a

switching circuit indicative of operating the luminaire in a standby mode or a normal operating mode; controlling, in response to determining that the luminaire is operating in the standby mode, the switching circuit provide power to the controller via the second power supply; and controlling, in response to receiving a command to operate the luminaire in the normal operating mode, the switching circuit to provide power to the controller via the first power supply; receiving a user input indicative of entering a sleep mode; entering the sleep mode in response to receiving the user input; receiving a wake-up signal; exiting the sleep mode based on a wake-up time in response to the wake-up signal being less than a predetermined time; and maintain a light source powered off in response to the wake-up time being greater than the predetermined time, wherein during the sleep mode, the light source of the luminaire is powered off.