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(54) EMERGENCY LIGHTING SYSTEM

(57) The invention relates to an emergency lighting system (100, 200), comprising a DC bus (101), at least one emergency lighting means (101a, 101b) connected to the DC bus (101), a central unit (103, 201) connected to the DC bus (101), wherein the central unit (103, 201) is configured to supply the emergency lighting means (101a, 101b) with a bus voltage via the DC bus (101), and an operating device (105) for communicating with the central unit (103, 201), wherein the operating device (105) is configured to display a graphical user interface (107), wherein the operating device (105) is configured to receive a user input on the graphical interface (107), and wherein the central unit (103, 201) is configured to commission and/or to configure the emergency lighting means (101a, 101b) based on the user input.

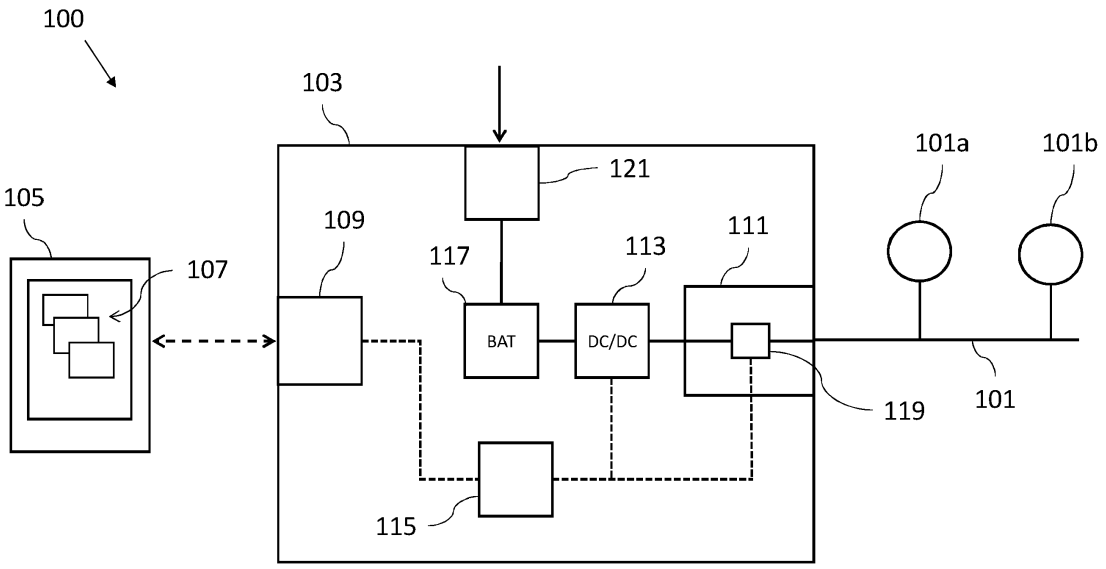

Fig. 1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to an emergency lighting system and a method for operating an emergency lighting system.

BACKGROUND OF THE INVENTION

[0002] Emergency lighting systems enable a quick and safe evacuation of buildings in an emergency situation, for instance during a fire alarm.

[0003] The emergency lighting system can comprise a central unit, which supplies emergency luminaires and other devices, e.g. sensors, with energy via a DC-BUS. The central unit can comprise a battery, which provides an energy supply in an emergency situation, for instance in case of a failure of the mains voltage.

[0004] However, it is a complex task to set up and commission such a central unit and the connected emergency luminaires. Typically, a proprietary commissioning hardware, e.g. a laptop running specialized software, is connected to the central unit or the luminaires for commissioning the system. Often many settings need to be adjusted manually, e.g. Amp hours, amount of battery cells or wattage. Entering these settings manually can be time consuming.

[0005] Thus, it is an objective to provide an improved emergency lighting system and an improved method for operating an emergency lighting system, which avoid the above-mentioned disadvantages. In particular, it is an object to provide a an emergency lighting system that can be commissioned and configured in a fast and simple way.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is achieved by the solution provided in the enclosed independent claims. Advantageous implementations of the present invention are further defined in the dependent claims.

[0007] According to a first aspect, the invention relates to an emergency lighting system, comprising a DC bus, at least one emergency lighting means connected to the DC bus, and a central unit connected to the DC bus, wherein the central unit is configured to supply the emergency lighting means with a bus voltage via the DC bus, and an operating device for communicating with the central unit, wherein the operating device is configured to display a graphical user interface, wherein the operating device is configured to receive a user input on the graphical interface, and wherein the central unit is configured to commission and/or to configure the emergency lighting means based on the user input. This achieves the advantage that the emergency lighting system can be commissioned and/or configured in a fast and simple way.

[0008] The emergency lighting means can comprise an emergency luminaire, such as an emergency light or illuminated escape sign, or another lighting technology device, e.g. a sensor. The emergency lighting means can comprise an LED track.

[0009] The emergency lighting means can further comprise a LED-driver and/or a converter. In particular, the converter is integrated into the LED-driver.

[0010] The emergency lighting means can further comprise lighting equipment of the emergency lighting system such as a bus phase monitor, a switching input module and/or a remote display for displaying a system status. The emergency lighting means can further comprise a sub-unit of the central unit.

[0011] The DC bus can be a supply line for supplying the emergency lighting means with the DC bus voltage. The DC bus voltage can serve as a supply voltage for the emergency lighting means. The DC bus voltage can be powerline (PLC) modulated. The DC bus can further be a system bus of the emergency lighting system.

[0012] The central unit can comprise an electrical energy storage, in particular a chargeable battery, for providing an energy supply in an emergency situation.

[0013] The central unit can further comprise a charging circuit for charging the electrical energy storage. The charging circuit can comprise an AC input for receiving an AC supply voltage, in particular the mains voltage, and a AC/DC converter for converting the AC supply voltage to a DC supply voltage.

[0014] The central unit can further comprise a DC/DC converter configured to convert a DC output signal of the electrical energy storage into a DC bus voltage, wherein the central unit can be configured to forward the DC bus voltage to the lighting means on the DC bus via an output circuit.

[0015] The output circuit can be configured to modulate the DC bus voltage, in particular with a powerline modulation. The output circuit can be configured to filter the DC bus voltage, in particular to filter out unwanted interferences or surges from the DC bus voltage.

[0016] The output circuit of the central unit can be arranged on a modular card, wherein the modular card is detachably connectable to a base body of the central unit.

[0017] The operating device can be a smartphone, a tablet or a notebook. In particular, the operating device is a handheld device.

[0018] The operating device can comprise a display, in particular a touch display, for displaying the graphical user interface.

[0019] In an embodiment, the central unit comprises a communication interface for communicating with the operating device, in particular for receiving commissioning and/or configuration commands from the operating device. This achieves the advantage that commands can be forwarded from the operating device to the central unit efficiently.

[0020] In an embodiment, the communication interface comprises a wireless communication interface, in particular a RFID, a NFC, a Bluetooth and/or WiFi interface.

[0021] In an embodiment, the operating device is configured to transmit address data and/or operating parameters to the central unit based on the user input, wherein the central unit is configured to commission the emergency lighting means by assigning the address data to the emergency lighting means and/or to configure the emergency lighting means according to the operating parameters. This achieves the advantage that the emergency lighting means can be commissioned and/or parametrized efficiently.

[0022] Preferably, during addressing a deviceID is assigned to each emergency lighting means. The deviceID can be assigned via NFC. During commissioning, the system can read and/or correct the deviceID, which can serve as identification of the lighting means.

[0023] In an embodiment, the operating device is configured to transmit update data and/or configuration commands to the central unit based on the user input, for updating and/or configuration of the central unit. This achieves the advantage that the central unit, in particular its components, can be updated and/or configured in a fast and simple way.

[0024] Preferably, some components of the central unit are configurable, while others are not configurable. For instance, an output circuit of the central unit that connects the central unit to the DC bus can be a not configurable component.

[0025] In an embodiment, the central unit comprises components, for instance a charging circuit, an electrical energy storage, a control unit and/or a phase monitor, wherein the central unit is configured to update at least one of its components based on the update data. This achieves the advantage that the components of the central unit can be updated efficiently via the operating device.

[0026] In an embodiment, the operating device is configured to display a graphical and/or parametric representation of the emergency lighting means and/or of the central unit in the graphical user interface. This achieves the advantage that the graphical user interface is easy and intuitive to use for commissioning or configuring components of the emergency lighting system.

[0027] The operating device can be configured to display components of the emergency lighting means and/or of the central unit in a hierarchic order on the graphical user interface. The operating device can be configured to also display the DC bus on the graphical user interface.

[0028] In an embodiment, the central unit is configured to establish an initial connection to the operating device via Bluetooth, wherein the central unit is configured to subsequently establish a WiFi connection to the operating device for exchanging communication data, in particular for receiving commissioning and/or configuration commands from the operating device. This achieves the advantage that the system is protected from manipulation from foreign devices.

[0029] Preferably, the central unit comprises a physical pairing button, wherein the central unit is configured to establish the initial Bluetooth connection to the operating device if the user pushes the pairing button. This achieves the advantage that the user of the operating device needs to be in physical contact with the central unit to establish the initial connection, which makes the system more secure.

[0030] The initial connection between the operating device and the central unit can refer to the first communication connected between the two devices. Subsequent connections between both devices, in particular for exchanging communication data, can be established via WiFi.

[0031] In an embodiment, the central unit comprises a powerline modulation unit for modulating the bus voltage, wherein the central unit is configured to commission and/or configure the emergency lighting means via powerline modulation of the bus voltage. This provides the advantage that signals can be forwarded to the emergency lighting means efficiently via PLC.

[0032] The powerline modulation unit can be arrange on the output circuit of the central unit.

[0033] In an embodiment, the central unit is configured to receive an update, in particular a firmware update, via a powerline modulation of the bus voltage, wherein the powerline modulation unit is configured to extract the update from the bus voltage. This provides the advantage that the central unit can be updated efficiently without establishing an additional connection to an external device.

[0034] In particular, an emergency lighting system comprises a DC bus, at least one emergency lighting means and a central unit, wherein the central unit is connected to the emergency lighting means via a DC bus, wherein the central unit provides a bus voltage, wherein the central unit is configured to receive an update, in particular a firmware update, via a powerline modulation of the bus voltage, wherein the powerline modulation unit is configured to extract the update from the bus voltage.

[0035] The update can be provided by an update source that is connected to the DC bus.

[0036] In an embodiment, the central unit in a non-emergency mode is configured to periodically transmit a status signal to the emergency lighting means on the DC bus, in particular by means of a powerline modulation of the bus voltage. This achieves the advantage that a current non-emergency situation can be indicated efficiently.

[0037] In particular, an emergency lighting system comprises a DC bus, at least one emergency lighting means and a central unit, wherein the central unit is connected to the emergency lighting means via a DC bus, wherein the central unit provides a bus voltage, wherein the central unit in a non-emergency mode is configured to periodically transmit a status signal to the emergency lighting means on the DC bus, in particular by means of a powerline modulation of the bus voltage.

[0038] In an embodiment, the emergency lighting means, in particular an LED-driver or a converter, is configured to receive the status signal, wherein the emer-

gency lighting means is configured to detect an emergency situation if the status signal is not received within a certain reference time span. This achieves the advantage that an emergency situation can be detected quickly.

[0039] The status signal can be a periodic "heartbeat signal". During operation, this signal can be broadcast to the converter via powerline modulation. If the central unit is faulty, no signal is sent and the central unit switches to an emergency mode (DC-level)

[0040] According to a second aspect, the invention relates to a method for operating, in particular commissioning or servicing, an emergency lighting system, wherein the emergency lighting system comprises at least one emergency lighting means connected to a DC bus and a central unit, the method comprising the steps of connecting an operating device to the central unit via a communication link, displaying a graphical user interface on the operating device, receiving a user input on the graphical interface, and commissioning and/or configuring the emergency lighting means based on the user input. This achieves the advantage that the emergency lighting system can be commissioned and/or configured in a fast and simple way.

[0041] In particular, the central unit is connected to the DC bus and is configured to supply a DC bus voltage to the emergency lighting means via the DC bus.

[0042] In an embodiment, the method further comprises the step of transmitting commissioning and/or configuration commands based on the user input from the operating device to the central unit via the communication link. This achieves the advantage that commands can be forwarded from the operating device to the central unit efficiently.

[0043] In an embodiment, the step of commissioning and/or configuring the emergency lighting means comprises transmitting address data and/or operating parameters from the operating device to the central unit, and assigning the address data to the emergency lighting means and/or configuring the emergency lighting means according to the operating parameters. This achieves the advantage that an efficient addressing and/or parametrization of the emergency lighting means can be performed.

[0044] In an embodiment, the method further comprises the step of displaying a graphical and/or parametric representation of the emergency lighting means and/or of the central unit in the graphical user interface.

[0045] The method can further comprise the step of configuring, commissioning and/or updating, the central unit, in particular components of the central unit, based on the user input on the graphical user interface.

[0046] Preferably, the method further comprises the steps of establishing an initial connection between the central unit and the operating device via Bluetooth, and subsequently establishing a WiFi connection between the central unit and the operating device for exchanging communication data, in particular for forwarding commissioning and/or configuration commands from the operating device to the central unit.

[0047] The method can be performed with the emergency lighting system according to the first aspect of the invention.

[0048] A computer program product, in particular an app, can comprise program code for performing the steps of the above described method, when the computer program product runs on a processor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] The invention will be explained in the followings together with the figures.

Fig. 1 shows a schematic diagram of an emergency lighting system according to an embodiment;

Fig. 2 shows a schematic diagram of an emergency lighting system according to an embodiment;

Fig. 3 shows a schematic diagram of the parameterizability of an emergency lighting system according to an embodiment;

Fig. 4 shows a schematic diagram of a graphical user interface according to an embodiment;

Fig. 5 shows a schematic diagram of a monitoring concept for detecting an emergency situation according to an embodiment;

Fig. 6 shows a schematic diagram of a method for operating an emergency lighting system according to an embodiment;

Fig. 7 shows a schematic diagram of a method for charging an electrical energy storage according to an embodiment; and

Fig. 8 shows a schematic diagram of a method for providing a deep discharge protection of an electrical energy storage according to an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0050] The present invention is described more fully hereinafter with reference to the accompanying drawings, in which various aspects of the present invention are shown. This invention however may be embodied in many different forms and should not be construed as limited to the various aspects of the present invention presented through this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. The various aspects of the present invention illustrated in the drawings may

not be drawn to scale. Rather, the dimensions of the various features may be expanded or reduced for clarity. In addition, some of the drawings may be simplified for clarity. Thus, the drawings may not depict all of the components of a given apparatus.

[0051] The term "LED luminaire" shall mean a luminaire with a light source comprising one or more LEDs. LEDs are well-known in the art, and therefore, will only briefly be discussed to provide a complete description of the invention.

[0052] It is further understood that the aspect of the present invention might contain integrated circuits that are readily manufacturable using conventional semiconductor technologies, such as complementary metal-oxide semiconductor technology, short "CMOS". In addition, the aspects of the present invention may be implemented with other manufacturing processes for making optical as well as electrical devices. Reference will now be made in detail to implementations of the exemplary aspects as illustrated in the accompanying drawings.

[0053] The same references signs will be used throughout the drawings and the following detailed descriptions to refer to the same or like parts.

[0054] Fig. 1 shows a schematic diagram of an emergency lighting system 100 according to an embodiment.

[0055] The emergency lighting system 100, comprising a DC bus 101, at least one emergency lighting means 101a, 101b connected to the DC bus 101, a central unit 103 connected to the DC bus 101, wherein the central unit 103 is configured to supply the emergency lighting means 101a, 101b with a bus voltage via the DC bus 101.

[0056] The emergency lighting system 100 can further comprise an operating device 105 for communicating with the central unit 103, wherein the operating device 105 is configured to display a graphical user interface 107, wherein the operating device 105 is configured to receive a user input on the graphical interface 107, and wherein the central unit 103 is configured to commission and/or to configure the emergency lighting means 101a, 101b based on the user input.

[0057] The operating device 105 can be a smartphone, a tablet or a notebook. The operating device 105 can be handheld device.

[0058] The operating device 105 can comprise a display for displaying the graphical user interface. Preferably, the display is a touch display. The user can enter the user input directly on the touch display.

[0059] The emergency lighting means 101a, 101b can comprise an emergency luminaire, such as an emergency light or an illuminated escape sign, or another lighting technology device, e.g. a sensor. The emergency lighting means 101a, 101b can comprise an LED track.

[0060] The emergency lighting means 101a, 101b can further comprise a LED-driver and/or a converter, in particular for a LED. The emergency lighting means 101a, 101b can further comprise a sub-unit of the central unit 103.

[0061] The central unit 103 can comprises a communication interface 109 for communicating with the operating device 105. The central unit 103 can receive commissioning and/or configuration commands from the operating device 105 via the communication interface 109.

[0062] The communication interface 109 can be a wireless communication interface. Preferably, the communication interface 109 comprises a RFID, a NFC, a Bluetooth and/or WiFi interface.

[0063] The operating device 105 can comprise a complementary communication interface, in particular a RFID, a NFC, a Bluetooth and/or WiFi interface, to transmit the commissioning and/or configuration commands to the central unit 103.

[0064] The operating device 105 can be configured to transmit address data, for instance a deviceID, to the central unit 103 based on the user input. The central unit 103 can be configured to assign the address data to the emergency lighting means 101a, 101b. In particular, the central unit 103 can read and/or correct the deviceID, which can serve as identification of the lighting means 101a, 101b.

[0065] The operating device 105 can further be configured to transmit operating parameters to the central unit 103, in particular operating parameters of the emergency lighting means 101a, 101b of the central unit 103 based on the user input. The central unit 103 can be adapted to configure the emergency lighting means 101a, 101b according to the operating parameters.

[0066] In Fig. 1, the central unit 103 comprises several components, including an electrical energy storage 117, e.g. a chargeable battery, a charging circuit 121 for charging the electrical energy storage 117, a DC/DC converter 113 for converting a DC output signal of the electrical energy storage 117 into a DC bus voltage and an output circuit 111 for forwarding the DC bus voltage to the DC bus 101 and the connected emergency lighting means 101a, 101b.

[0067] The output circuit 111 in Fig. 1 can comprise a powerline modulation unit 119 for modulating the DC bus voltage and/or for extracting signals from the DC bus voltage via demodulation.

[0068] Preferably, the output circuit 111 is configured to filter the DC bus voltage, in particular to filter out unwanted interferences or surges from the DC bus voltage.

[0069] The output circuit 111 can be arranged on a modular card, wherein the modular card is detachably connectable to a base body of the central unit 103. In particular, the modular card can be connected to the base body of the central unit 103 by plugging the modular card in a slot of the central unit.

[0070] The output circuit 111 can comprise further components that are not depicted in Fig. 1, such as filters, a current or voltage measurement unit and/or a phase monitor.

[0071] The central unit 103 can comprise a plurality of output circuits 111, wherein each output circuit 111 connects the central unit 103 to a DC bus 101. For instance, one output circuits 111 connects the central unit 103 to

a system bus and another output circuits 111 connects the central unit 103 a powerline modulated bus.

[0072] The central unit 103 can further comprise a control unit 115, in particular an ASIC or a microcontroller. The control unit 115 can be configured for processing any commands received from the operating device 105. The control unit 115 can further comprise a memory.

[0073] Preferably, the control unit 115 is configured to control the output circuit 111, in particular the powerline modulation unit 119.

[0074] The control unit 115 can be configured to receive the communication data, in particular the address data and/or the operating parameters, from the operating device 105 via the communication interface 109. The control unit can further be configured to control the powerline modulation unit 119 in order to modulate the DC bus voltage according to the communication data, in particular for commissioning and/or parametrization of the emergency lighting means 101a, 101b.

[0075] Preferably, the operating device 105 can also be used for commissioning and/or configuration of the components of the central unit. For this purpose, the operating device 105 can be configured to transmit commissioning and/or configuration data to the central unit 103.

[0076] The central unit 103, in particular the control unit 115, can be configured to commission, configure and/or update its components based on the received data.

[0077] Preferably, in order to initiate an initial communication connection between the operating device 105 and the central unit 103, a user has to push a pairing button on the central unit 103 to pair the operating device 105 to the central unit 103 via a Bluetooth connection. The pairing button can be arranged on a housing of the central unit 103.

[0078] Subsequent to the first Bluetooth pairing a WiFi connection between operating device 105 and central unit 103 can be established, wherein the configuration and/or commissioning takes place via the WiFi channel.

[0079] Thus, to initiate the initial communication connection the user needs physical access to the central unit 103. Since the central unit 103 is often arranged at a place where only qualified users have access, this guarantees that only these qualified users can commission and/or configure the emergency lighting system 100 with their devices 105.

[0080] According to another embodiment, the central unit is configured to receive an update, in particular a firmware update, via a powerline modulation of the bus voltage.

[0081] The update can be a firmware update. Via the update either the central unit 103 or components of the central unit 103 can be updated.

[0082] The powerline modulation unit 119 can be configured to extract the update from the bus voltage signal. The control unit 115 can receive the update from the powerline modulation unit 119, and initiate an update process.

[0083] The update can be provided by an update source that is connected to the DC bus 101, for instance another central unit or a subunit on the DC bus 101.

[0084] Fig. 2 shows a schematic diagram of an emergency lighting system 200 according to an embodiment.

[0085] The emergency lighting system 200 comprises a central unit 201. The central unit 201 can be an nBox device. In particular, the central unit 201 in Fig. 2 corresponds to the central unit 103 in Fig. 1.

[0086] The central unit 201 in Fig. 2 is connected to a system bus line 202, in particular a DC bus.

[0087] Several emergency lighting means are connected to the system bus line 202: A bus phase monitor 203 for detecting undervoltage, phase failure and/or interruption of the neutral conductor, a switching input module 205 and a remote display 207 for displaying a system status. The bus phase monitor can further be configured to monitor a heartbeat signal on the DC bus.

[0088] The central unit 201 in Fig. 2 is further connected to powerline (PLC) lines 209, 210 via a powerline output 208. The PLC lines 209, 210 can be additional DC bus lines with a PLC modulated bus voltage.

[0089] Further emergency lighting means in the form of luminaires 209a-c can be connected to the PLC lines 209, 210.

[0090] During commissioning, the central unit 201 and the systembus 202 can be registered automatically. The powerline output 208 and the PLC lines 209, 210 can be detected by the central unit 201 during startup and can be registered automatically.

[0091] The emergency lighting means 203, 205, 207 on the system bus line 202 and the emergency lighting means 209a-c on the PLC line 209 can be registered by the central unit 201 during commissioning via the operating device 105.

[0092] Fig. 3 shows a schematic diagram of the parameterizability of the emergency lighting system 100, 200 according to an embodiment.

[0093] In particular, Fig. 3 shows which categories of the emergency lighting system 100, 200 can be configured and/or commissioned by the operating device 105 via the central unit 301.

[0094] The central unit 301 can be an nBox device. In particular, the central unit 301 in Fig. 3 corresponds to the central unit 103 in Fig. 1 and/or the central unit 201 in Fig. 2.

[0095] In an embodiment, these categories can be displayed on the graphical user interface, in particular in form of a graphical and/or parametric representation. Upon selecting these parameters by the user, the user can change parameters of these categories.

[0096] In a parametrizable category 303 details on the parameterization of other categories can be specified; in the emergency lighting system category 305 parameters of the emergency lighting means can be configured, e.g. service intervals; in the emergency battery manager category 307, the charging and/or discharging voltage and

other parameters of the battery can be set. In the emergency lighting manager category 309 an emergency recovery mode and/or a phase monitoring can be configured.

[0097] Fig. 3 further shows several categories for measurement data, for instance a voltage measurement category 313, a temperature measurement category 315 and a current measurement category 317. In these categories, the corresponding sensors can be configured. Further a general sensor category 311 is shown.

[0098] Furthermore, an address service category 319 for controlling the commissioning and addressing, e.g. the setting of timeouts or scan intervals, and a device updater category 321 for controlling the updating of the emergency lighting system 100, 200 are shown.

[0099] In a phase monitoring category 323 a phase monitor can be configured, e.g. a time interval of a heartbeat signal can be set.

[0100] Moreover, in a master device category 325 and subsequent line device category 327 the devices on the DC bus 101, in particular the PLC lines 207, 208 of Fig. 2, can be configured.

[0101] Fig. 4 shows a schematic diagram of a graphical user interface 107 according to an embodiment.

[0102] The graphical user interface 107 can display a graphical and/or parametric representation of the emergency lighting means 101a, 101b and/or of the central unit 103, 201, 301, in particular of components of the central unit 103, 201, 301.

[0103] In particular, the graphical user interface 107 can display a graphical and/or parametric representation of the categories of the emergency lighting system 100, 200 that are shown in Fig. 3.

[0104] The graphical user interface 107 can comprise animated segments, in particular icons or tiles. Each segment can correspond to an element or category of the emergency lighting system 100, 200.

[0105] The animated segments can change their color depending on a current property of the corresponding element or category. For instance, one segment shows the current battery status and another segment shows current system errors. The segments can change their color from green or gray to red if the charging level of the battery is too low or if an error is detected, respectively.

[0106] The operating device 105 can be configured to receive the user input on the graphical user interface 107 as a touch input.

[0107] The graphical user interface 107 can switch to another screen with additional information or adjustment options if the user selects a segment or icon of the graphical user interface 107.

[0108] The user can navigate through the graphical user interface 107 by using common gestures, such as swipe gestures. In particular, the user does not have to type in text in order to change a setting.

[0109] The graphical user interface 107 can be implemented in the operating device 105 via an app. The app can use system resources of the operating device 105 or existing apps, such as the native photo app of the device.

[0110] The operating device 105 can be a common smartphone. Therefore, no proprietary commissioning hardware is required to commission and/or configure the system. In particular, the system can be commissioned and/or configured quickly by only one person.

[0111] Fig. 5 shows a schematic diagram of a monitoring concept for detecting an emergency situation according to an embodiment.

[0112] In Fig. 5 a controller 501 periodically broadcasts a "heartbeat" signal to emergency lighting means on the DC bus.

[0113] The controller 501 in Fig. 5 can be a component of the central unit 103, 201, 301. In particular, the controller 501 corresponds to the control unit 115 of the central unit 103 in Fig. 1.

[0114] The controller 501 can be configured to broadcast the heartbeat signal via powerline modulation of the DC voltage to the emergency lighting means on each connected DC bus line. The emergency lighting means can comprise a converter 503-1,...,n on each line.

[0115] The converter 503-1,...,n on each line can be configured to receive the periodic status signal, wherein the converter 503-1,...,n is configured to detect an emergency situation if the status signal is not received within a certain reference time span.

[0116] For instance the heartbeat signal is broadcast every 4s and the converters 503-1,...,n are configured to detect the emergency situation if the signal is not received within 6s after receipt of a previous signal, or if 5 consecutive heartbeat timers expire.

[0117] Each converter 503-1,...,n can be configured to switch the LEDs of the respective line to a DC-level if the converter 503-1,...,n detects an emergency situation. In the DC-level, the power supply to the LEDs is provided by a battery, e.g. the central electrical energy storage 117 of the central unit 103.

[0118] Each converter 503-1,...,n can be integrated in a driver of an emergency luminaire. The driver can be configured to switch on the emergency luminaire if the converter 503-1,...,n detects the emergency situation.

[0119] The controller 501 can be configured to cease broadcasting the heartbeat signal if an AC supply, in particular the AC mains, fails or if an emergency situation is signaled to the controller 501.

[0120] Preferably, the controller 501 comprises two independent CPUs (FEC and host) communicating via UART. The FEC is configured to check if a UART communication is working properly. If the communication is not working for at least 60s, all emergency luminaires on the DC bus should can be set to DC-level. If the communication is working again, the emergency luminaires can be set to their previously set level. In particular, each CPU has a watchdog function to make sure that the CPU is restarted in case of a failure.

[0121] In an embodiment, the system 100, 200 can detect an AC outage and switch on emergency luminaires

if the AC outage is detected. This can be achieved by measuring the AC voltage with an analogue input on the controller 115, in particular the FEC CPU.

[0122] If an AC outage is detected, a command is sent to activate the DC level of the emergency luminaires. In particular, the command "Activate DC level" can be sent periodically (every 1s) as broadcast to all luminaires.

[0123] Fig. 6 shows a schematic diagram of a method 600 for operating the emergency lighting system 100, 200 according to an embodiment.

[0124] The emergency lighting system 100, 200 comprises at least one emergency lighting means 101a, 101b connected to the DC bus 101 and the central unit 103, 201.

[0125] The method 600 comprising the steps of connecting 601 the operating device 105 to the central unit 103, 201 via a communication link, displaying 603 the graphical user interface 107 on the operating device 105, receiving 605 the user input on the graphical interface 107, and commissioning and/or configuring 607 the emergency lighting means 101a, 101b based on the user input.

[0126] The step of commissioning and/or configuring 607 the emergency lighting means 101a, 101b can comprise transmitting address data and/or operating parameters from the operating device 105 to the central unit 103, 201, and assigning the address data to the emergency lighting means 101a, 101b and/or configuring the emergency lighting means 101a, 101b according to the operating parameters.

[0127] The method 600 can further comprise the step of transmitting commissioning and/or configuration commands based on the user input from the operating device 105 to the central unit 103, 201 via the communication link, in particular after the step of receiving 605 the user input.

[0128] Preferably, the method 600 comprises the step of displaying a graphical and/or parametric representation of the emergency lighting means 101a, 101b and/or of the central unit 103, 201 in the graphical user interface 107.

[0129] The method 600 can further comprise the step of configuring, commissioning and/or updating, the central unit 103, 201, in particular components of the central unit 103, 201, based on the user input on the graphical user interface 107.

[0130] Fig. 7 shows a schematic diagram of a method 700 for charging the electrical energy storage 117 according to an embodiment.

[0131] The method 700 comprises the steps of unsetting a disable charging mode 701 to start the charging process, starting a 12 hour timer 703, detecting if the battery current is smaller or equal a fixed end of charge current 705. If the current it is not smaller or equal, it is checked if the 12 hour timer is expired 707; if the timer is not expired the charging is continued, if the timer is not expired an error message is generated 709. If the current is not smaller or equal, charging is disabled 711 since the battery is fully charged.

[0132] After the step of disabling charging 711, the method 700 comprises checking if the battery voltage is smaller than a end of charging voltage 713, wherein the end of charging voltage is a set or preset reference value. If it is smaller, another error message is generated 715; if it is larger or equal it is checked in two steps 717, 719 if the battery voltage is smaller or larger than a fixed trickle charging voltage, which is another set or preset reference value. If it is larger, the charging stays disabled unit the battery voltage is again smaller than the trickle charge voltage 721.

[0133] As soon as the battery voltage is smaller than the trickle charge voltage, or if an error message was generated, the method 700 is restarted.

[0134] The battery charging can be controlled by the control unit 115. In particular, the charging is controlled by a combination of a battery charger board and a software module running on the FEC CPU.

[0135] During the commissioning process, a battery pack is selected which defines necessary charging parameters. The parameters can be derived based on a nominal capacity and a capacity buffer of the battery pack.

[0136] Fig. 8 shows a schematic diagram of a method 800 for providing a deep discharge protection of the electrical energy storage 117 according to an embodiment.

[0137] The method 800 comprises the steps of reading the battery voltage 801 and detecting if the battery voltage is smaller or equal a deep discharge voltage 803, wherein the deep discharge voltage is a set or preset reference value. If the battery voltage is smaller or equal to the deep discharge voltage a deep discharge state is activated 805. The deep discharge state can be for example signaled to the user via the control unit 115.

[0138] The method 800 can be repeated every n seconds, e.g. every 2 seconds, to periodically check if the battery is in a deep discharge state.

[0139] The methods 700 and 800 can be performed by the central unit 103, 201, in particular by the control unit 115.

[0140] All features of all embodiments described, shown and/or claimed herein can be combined with each other.

[0141] While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only and not limitation. Numerous changes to the disclosed embodiments can be made in accordance with the disclosure herein without departing from the spirit of scope of the invention. Thus, the breadth and scope of the present invention should not be limited by any of the above-described embodiments. Rather, the scope of the invention should be defined in accordance with the following claims and their equivalence.

[0142] Although the invention has been illustrated and described with respect to one or more implementations, equivalent alternations and modifications will occur to

those skilled in the art upon the reading of the understanding of the specification and the annexed drawings. In addition, while a particular feature of the invention may have been disclosed with respect to only of the several implementations, such features may be combined with one or more other features of the other implementations as may be desired and advantage for any given or particular application.

Claims

1. An emergency lighting system (100, 200), comprising:

   a DC bus (101),
   at least one emergency lighting means (101a, 101b) connected to the DC bus (101),
   a central unit (103, 201) connected to the DC bus (101), wherein the central unit (103, 201) is configured to supply the emergency lighting means (101a, 101b) with a bus voltage via the DC bus (101), and
   an operating device (105) for communicating with the central unit (103, 201), wherein the operating device (105) is configured to display a graphical user interface (107),
   wherein the operating device (105) is configured to receive a user input on the graphical interface (107), and
   wherein the central unit (103, 201) is configured to commission and/or to configure the emergency lighting means (101a, 101b) based on the user input.

2. The emergency lighting system (100, 200) according to claim 1, wherein the central unit (103, 201) comprises a communication interface (109) for communicating with the operating device (105), in particular for receiving commissioning and/or configuration commands from the operating device (105).

3. The emergency lighting system (100, 200) according to claim 2, wherein the communication interface (109) comprises a wireless communication interface, in particular a RFID, a NFC, a Bluetooth and/or a WiFi interface.

4. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the operating device (105) is configured to transmit address data and/or operating parameters to the central unit (103, 201) based on the user input, wherein the central unit (103, 201) is configured to commission the emergency lighting means (101a, 101b) by assigning the address data to the emergency lighting means (101a, 101b) and/or to configure the emergency lighting means (101a, 101b) according to the operating parameters.

5. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the operating device (105) is configured to transmit update data and/or configuration commands to the central unit (103, 201) based on the user input, for updating and/or configuration of the central unit (103, 201).

6. The emergency lighting system (100, 200) according to claim 5, wherein the central unit (103, 201) comprises components, for instance a charging circuit (121), an electrical energy storage (117), a control unit (115) and/or a phase monitor, wherein the central unit (103, 201) is configured to update at least one of its components based on the update data.

7. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the operating device (105) is configured to display a graphical and/or parametric representation of the emergency lighting means (101a, 101b) and/or the central unit (103, 201) in the graphical user interface (107).

8. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the central unit (103, 201) is configured to establish an initial connection to the operating device (105) via Bluetooth, wherein the central unit (103, 201) is configured to subsequently establish a WiFi connection to the operating device (105) for exchanging communication data, in particular for receiving commissioning and/or configuration commands from the operating device (105).

9. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the central unit (103, 201) comprises a powerline modulation unit (119) for modulating the bus voltage, wherein the central unit (103, 201) is configured to commission and/or configure the emergency lighting means (101a, 101b) via powerline modulation of the bus voltage.

10. The emergency lighting system (100, 200) according to claim 9, wherein the central unit (103, 201) is configured to receive an update, in particular a firmware update, via a powerline modulation of the bus voltage, wherein the powerline modulation unit (119) is configured to extract the update from the bus voltage.

11. The emergency lighting system (100, 200) according to any one of the preceding claims, wherein the central unit (103, 201) in a non-emergency mode is configured to periodically transmit a status signal to the emergency lighting means (101a, 101b) on the DC bus, in particular by means of a powerline modulation

of the bus voltage.

12. The emergency lighting system (100, 200) according to claim 11, wherein the emergency lighting means (101a, 101b), in particular a LED-driver or converter (503-1...n), is configured to receive the status signal, wherein the emergency lighting means (101a, 101b) is configured to detect an emergency situation if the status signal is not received within a certain reference time span.

13. A Method (600) for operating, in particular commissioning or servicing, an emergency lighting system (100, 200), wherein the emergency lighting system (100, 200) comprises at least one emergency lighting means (101a, 101b) connected to a DC bus (101) and a central unit (103, 201), the method comprising the steps of:

connecting (601) an operating device (105) to the central unit via a communication link,
displaying (603) a graphical user interface (107) on the operating device (105),
receiving (605) a user input on the graphical interface (107), and
commissioning and/or configuring (607) the emergency lighting means (101a, 101b) based on the user input.

14. The method (600) according to claim 13, further comprising the step of: transmitting commissioning and/or configuration commands based on the user input from the operating device (105) to the central unit (103, 201) via the communication link.

15. The method (600) according to claim 13 or 14, wherein the step of commissioning and/or configuring the emergency lighting means (101a, 101b) comprises transmitting address data and/or operating parameters from the operating device (105) to the central unit (103, 201), and assigning the address data to the emergency lighting means (101a, 101b) and/or configuring the emergency lighting means (101a, 101b) according to the operating parameters.

16. The method (600) according to any one of claims 13 to 15, further comprising the steps of: displaying a graphical and/or parametric representation of the emergency lighting means (101a, 101b) and/or the central unit (103, 201) in the graphical user interface (107).

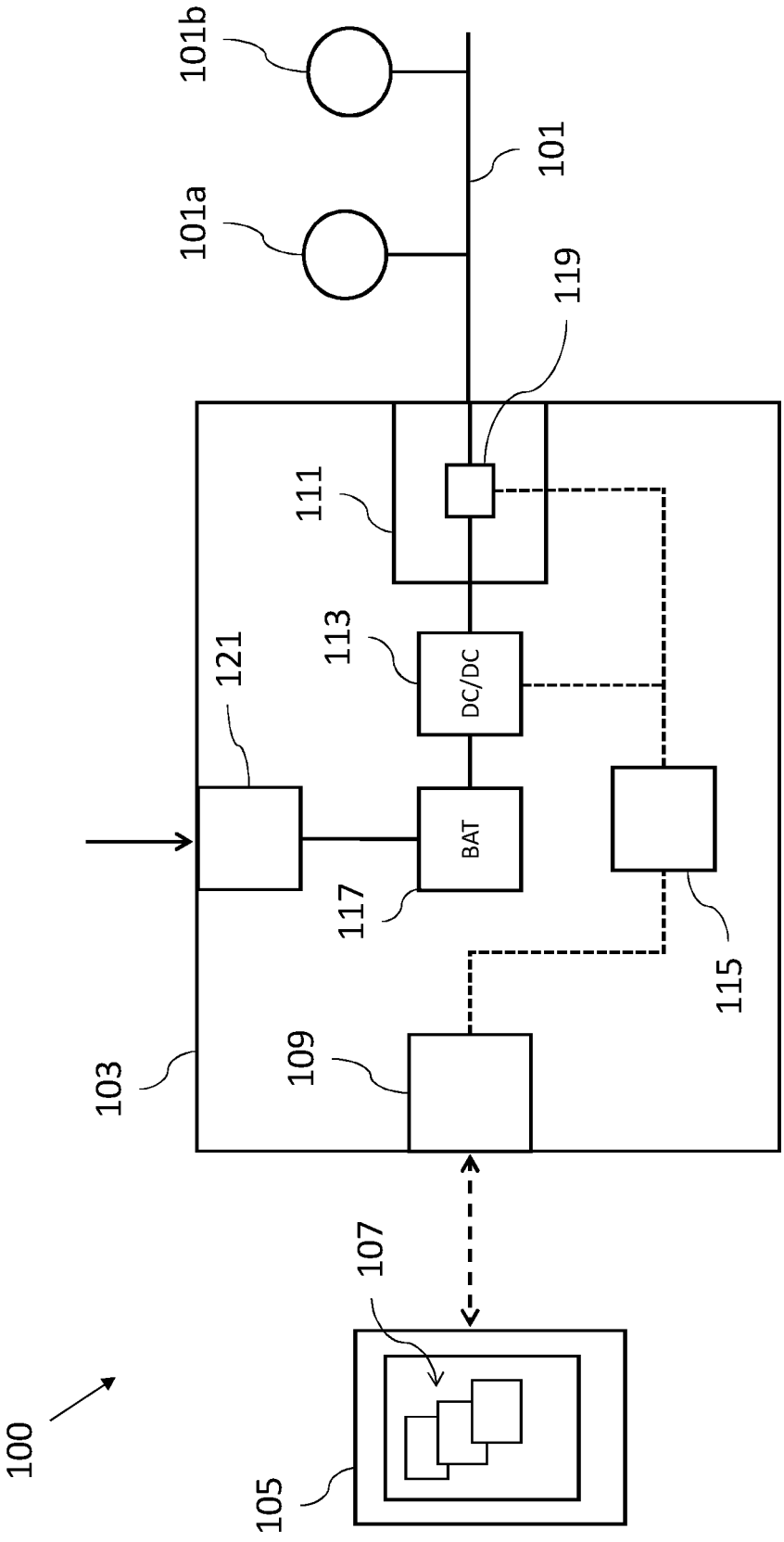
101b
101a
101
119
111
113
DC/DC
121
BAT
117
115
103
109
107
105
100

Fig. 1

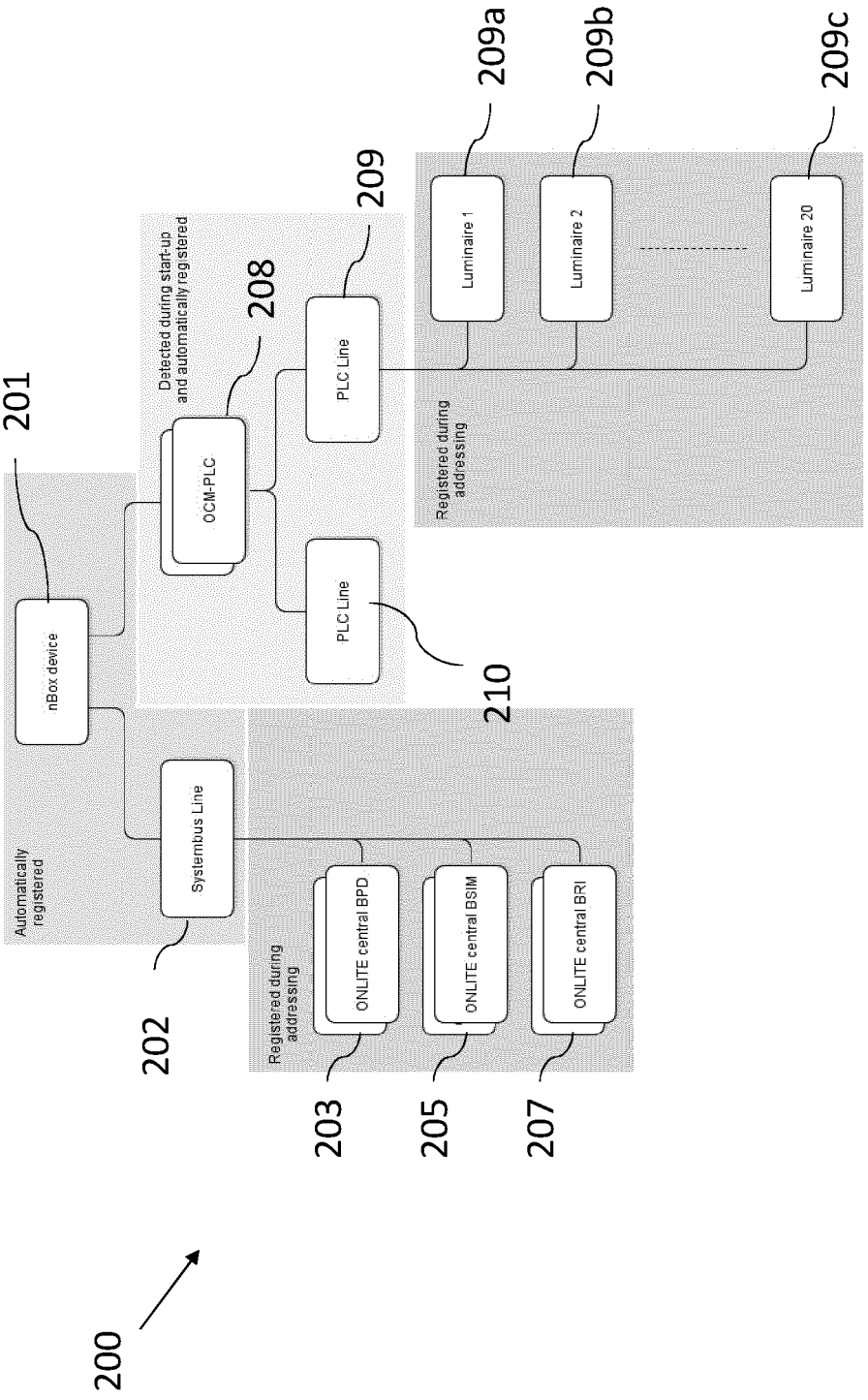
200
201
202
203
205
207
208
209
209a
209b
209c
210
nBox device
Systembus Line
OCM-PLC
PLC Line
PLC Line
ONLITE central BPD
ONLITE central BSIM
ONLITE central BRI
Luminaire 1
Luminaire 2
Luminaire 20
Automatically registered
Detected during start-up and automatically registered
Registered during addressing
Registered during addressing

Fig. 2

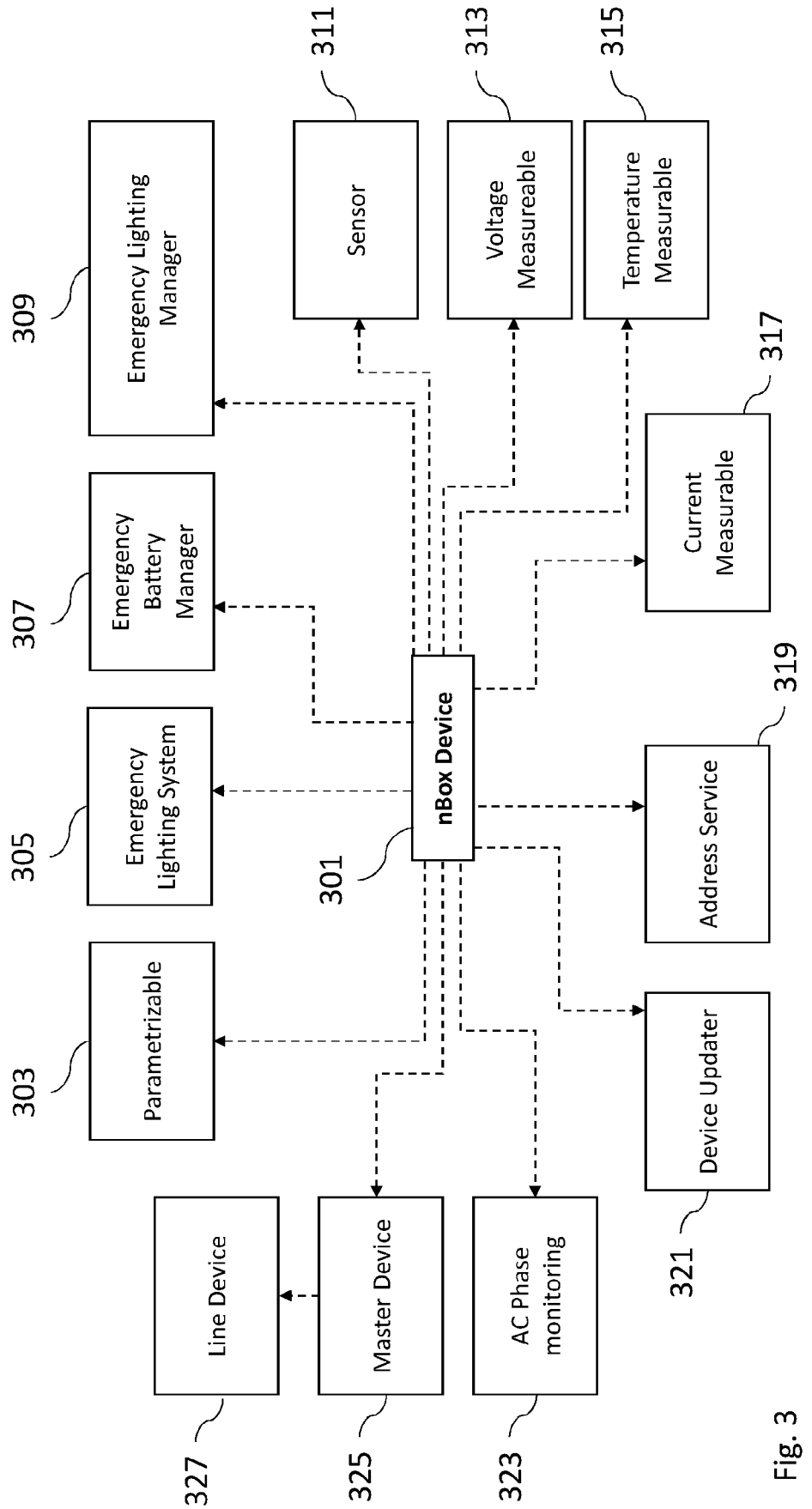
311
313
315
Sensor
Voltage Measureable
Temperature Measurable
309
Emergency Lighting Manager
317
Current Measurable
307
Emergency Battery Manager
319
Address Service
305
Emergency Lighting System
nBox Device
301
303
Parametrizable
Device Updater
321
Line Device
Master Device
AC Phase monitoring
327
325
323

Fig. 3

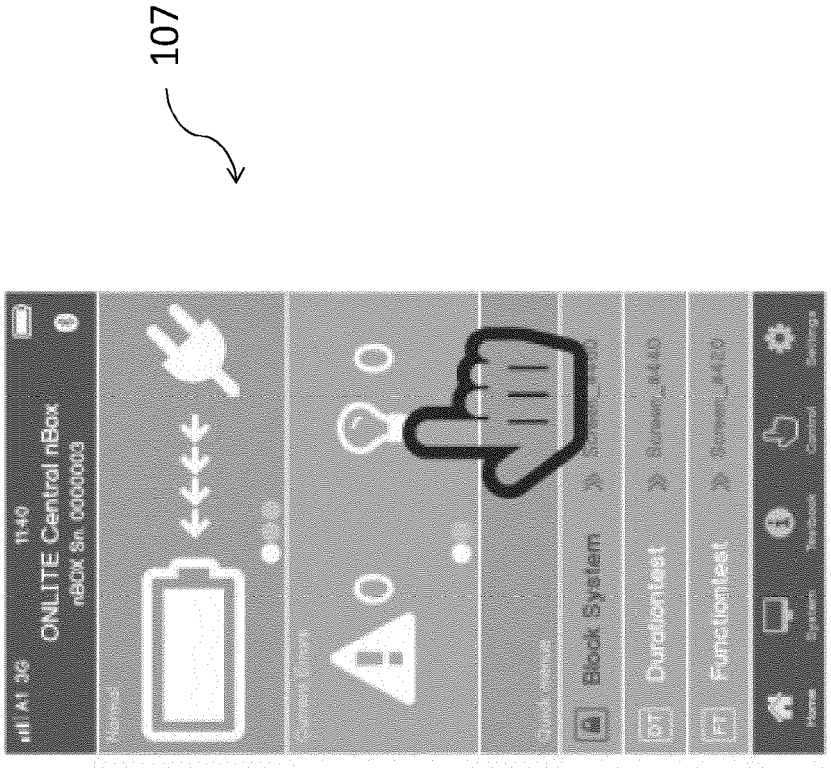
107
11:40
ONLITE Central nBox
nBOX Sn. 04000003
Block System
Durationtest
Functiontest

Fig. 4

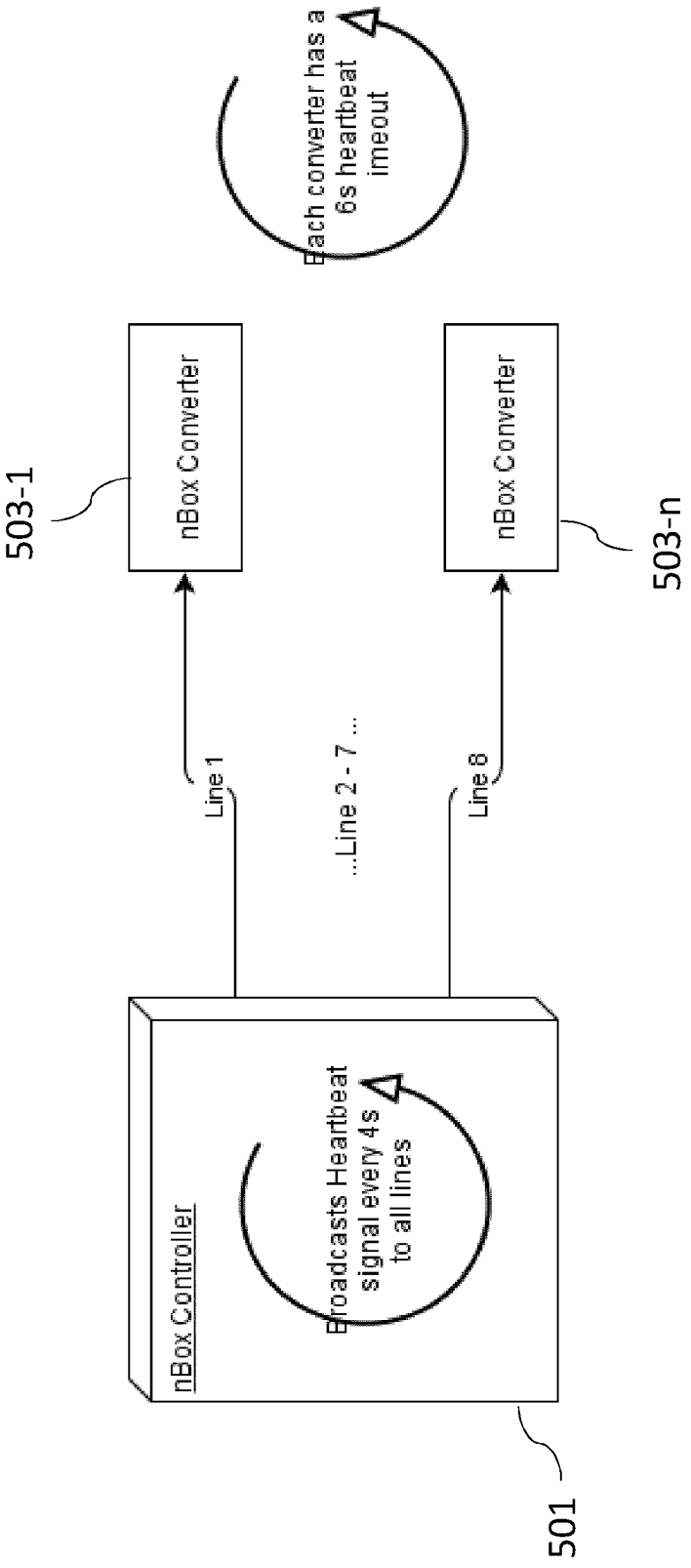
Each converter has a 6s heartbeat imeout
503-1
nBox Converter
nBox Converter
503-n
Line 1
...Line 2 - 7 ...
Line 8
nBox Controller
Broadcasts Heartbeat signal every 4s to all lines
501

Fig. 5

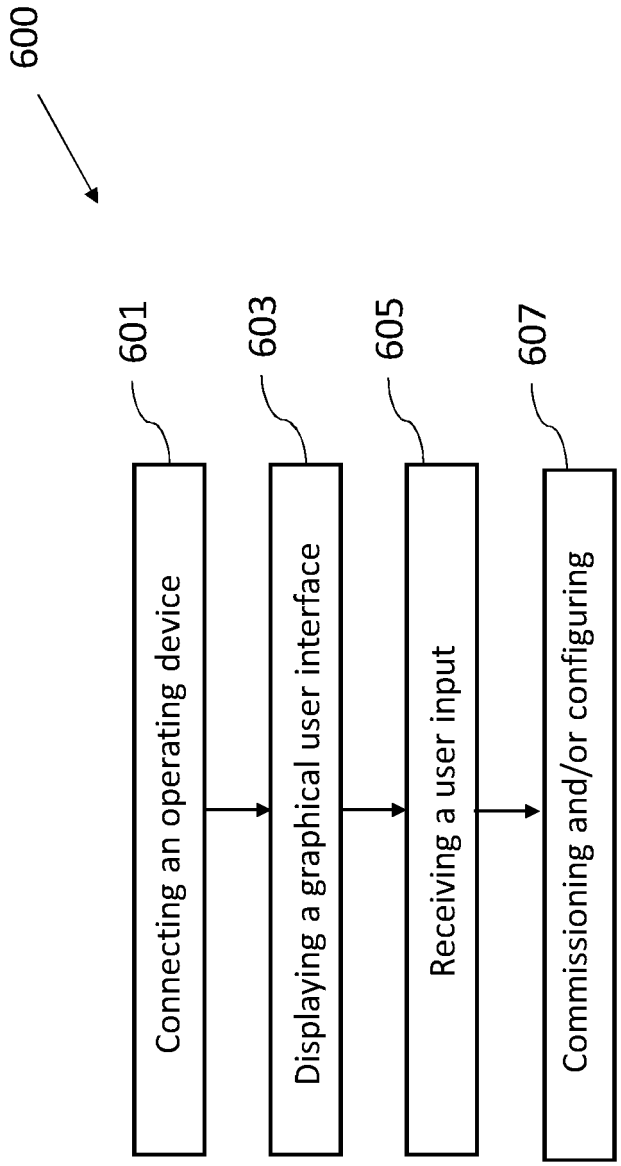
600
601
603
605
607
Connecting an operating device
Displaying a graphical user interface
Receiving a user input
Commissioning and/or configuring

Fig. 6

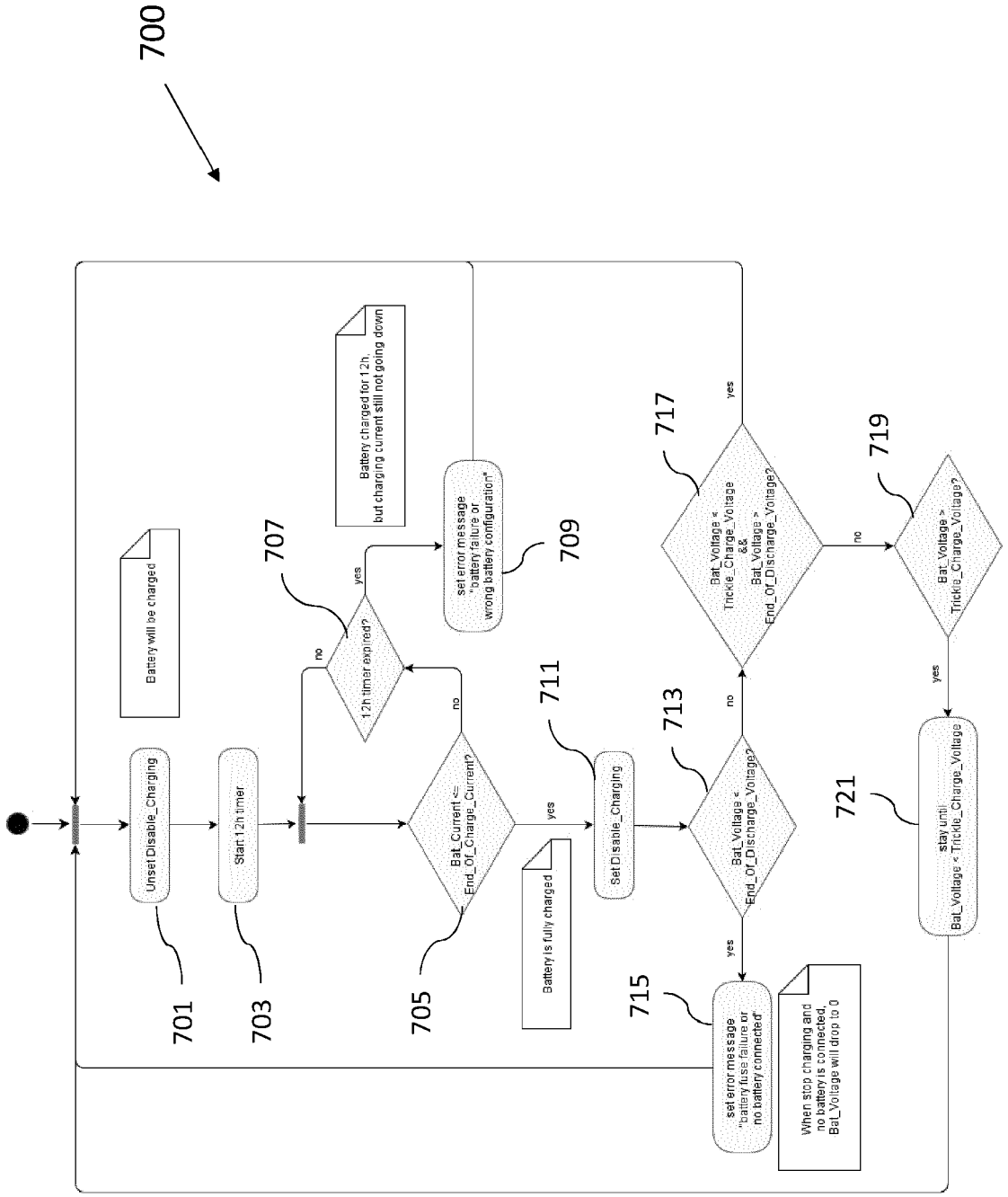
700
Battery will be charged
Unset Disable_Charging
Start 12h timer
12h timer expired?
Battery charged for 12h
but charging current still not going down
set error message
"battery failure or
wrong battery configuration"
Bat_Current <=
End_Of_Charge_Current?
Battery is fully charged
Set Disable_Charging
Bat_Voltage <
End_Of_Discharge_Voltage?
Bat_Voltage <
Trickle_Charge_Voltage
&&
Bat_Voltage >
End_Of_Discharge_Voltage?
Bat_Voltage >
Trickle_Charge_Voltage?
stay until
Bat_Voltage < Trickle_Charge_Voltage
set error message
"battery fuse failure or
no battery connected"
When stop charging and
no battery is connected,
Bat_Voltage will drop to 0
yes
no
701
703
705
707
709
711
713
715
717
719
721

Fig. 7

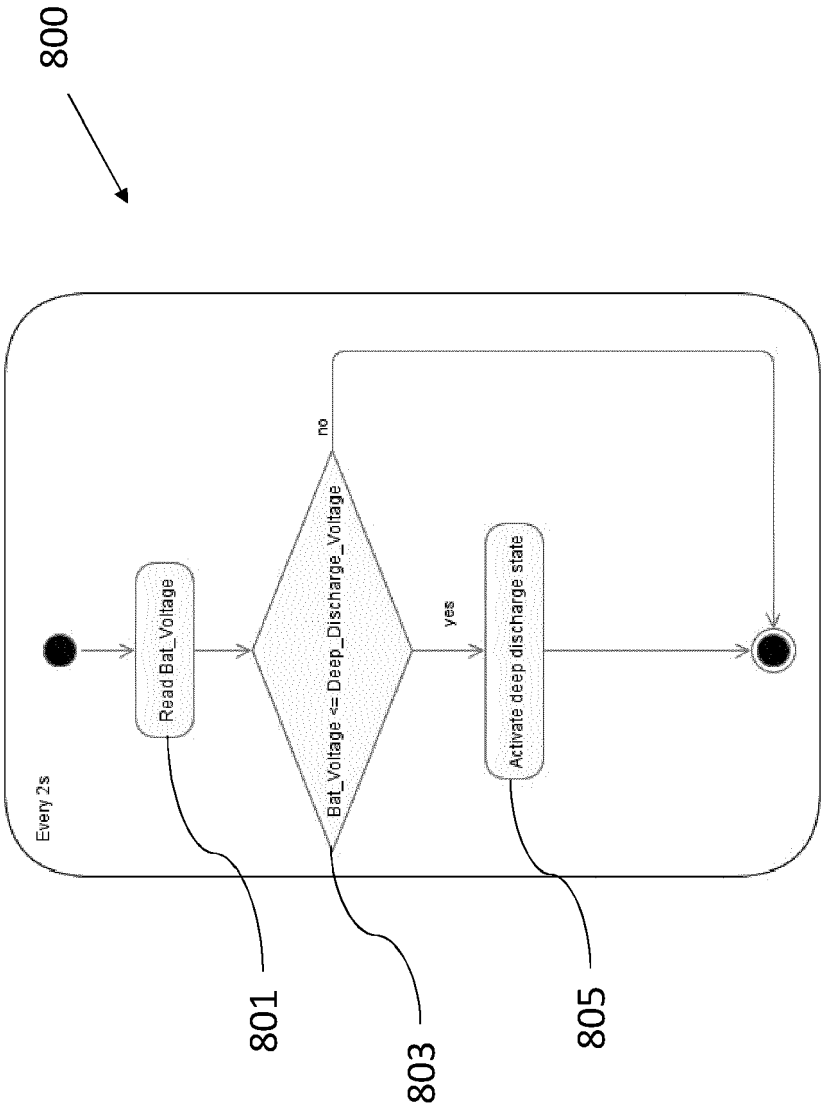
800
Every 2s
Read Bat_Voltage
Bat_Voltage <= Deep_Discharge_Voltage
no
yes
Activate deep discharge state
801
803
805

Fig. 8

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 9188

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			H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 April 2020	Maicas, Jesús

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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28-04-2020

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