**Title:** METHOD FOR CONFIGURING AN ELECTRONIC ELEMENT IN A LIGHTING SYSTEM, ELECTRONIC ELEMENT AND CONFIGURING SYSTEM

**Abstract:** The invention relates to a method for configuring an electronic element in a lighting system wherein the method comprises the steps of retrieving configuration information from a machine-readable medium by means of a configuring device; sending the retrieved configuration information from the configuring device to the electronic element in the lighting system; and storing the configuration information into a information storage means of the electronic element in the lighting system.

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The invention relates to a method for configuring an electronic element in a lighting system. The invention further relates to an electronic element. The invention further relates to a configuring system for a lighting system. The invention further relates to a housing for an electronic element. The invention further relates to a method for sending configuration information. The invention further relates to a computer program product for a configuring device of a configuring system.

Nowadays lighting systems for buildings do not only comprise a lighting system that is switched by a wall switch. Nowadays lighting systems comprises intelligent electronic elements. Furthermore control units are used, which are configured to control, and/or to monitor and/or to maintain the electronic elements and the lighting means. This allows a high functionality of the lighting system, for instance different dimming scenarios, different coloring, different light fading and also an emergency function.

The drawback of such an intelligent lighting system is the increasing effort to commission and to maintain such a lighting system, which inherently leads to an increase of time that is needed for the commissioning of such lighting systems.

Another drawback is that each specific electronic element in the lighting system needs to be configured manually, which due to the number of such electronic elements is time-consuming and error prone.

Another drawback of the existing lighting systems is the need that the lighting system has to be powered in order to configure the electronic element. Thus, the commissioning cannot start before the installation phase of the lighting system is finished. Therefore, the installation state of the lighting system has to be finished first and it is impossible to install and commission a lighting system in parallel.
There is a need to decrease the effort and the time that is used for commissioning of a lighting system. Especially, an easier way to configure the electronic elements in a lighting system has to be found.

The above identified problems are solved by the technical features of the independent patent claims. Advantageous embodiments are described in the respective dependent patent claims.

The above identified problems are solved by a method for configuring an electronic element, such as a ballast, in a lighting system. The method comprises the steps of: retrieving configuration information from a machine-readable medium by means of a configuring device; sending the retrieved configuration information from the configuring device to the electronic element in the lighting system; and storing the configuration information into an information storage means of the electronic element in the lighting system.

Advantageously, the configuring of the said electronic element is done electronically instead of manually configuring the electronic element. This leads to an easy handling without a time consuming commissioning.

Preferably, in the sending step a bidirectional channel of a wireless communication interface, especially based on a near field communication or a radio frequency identification communication between the configuring device and the electronic element is established. The near-field communication, short: NFC, is standardized by ISO 14443, ISO 18092, ISO 21481, ECMA-340, ECMA-352, ECMA-356, ECMA-362 or ETSI TS 102 190. The radio-frequency identification, short: RFID, is especially standardized in ISO/IEC 18000-X.

It is also possible to use alternative types of wireless communication interfaces, e.g. mobile device like a smartphone or tablet PC may use a wireless booster system where a signal coming from the the audio jack output or USB connector is transmitted to a wireless communication.
If the configuration information is sent wirelessly, it is unnecessary to plug and to unplug the configuring device to an input terminal of the electronic element. Furthermore, the electronic element does not have to be physically contacted, which especially is helpful in areas where the electronic element is difficult to access, for instance on a ceiling or behind a cover panel or an intermediate partition in a wall of the building.

Preferably the configuration information is retrieved from a lighting system map, where a building plan or an installation plan or the like in combination with the at least one electronic element is drawn. Such building plans are printed and comprise the machine-readable medium, such as a QR-code or NFC-tag or the like, which can easily be read by the configuring device. Preferably, the lighting system map is digitized and displayed on a screen of a portable computer device, such as a tablet-PC or the like.

Preferably the method is applied in an unpowered state of the electronic element, preferably in an unpowered state of the lighting system. Therefore, the configuring device comprises an autarkic power supply and is configured to store the configuration information into the information storage means without an additional voltage supply derived from the lighting system. Thus, the installation phase of the lighting system does not have to be finished and a configuration of parts of the lighting system is possible in parallel to the installation of the lighting system. An offline commissioning method is therefore achieved.

In a preferred embodiment, the lighting system or at least the electronic element is powered after the storing step and the configuration information are read from the information storage means of the electronic element to configure the electronic element. This is mainly achieved after finishing the installation of the lighting system, so that the lighting system is ready to be powered-up. During the first powering of the lighting system, the configuration information is detected in the information storage unit and is read out of the information storage means of the specific electronic element. After read-out, those configuring information is installed and/or used in the individual electronic elements. This embodiment has the further advantage that an archive function is obtained.
Whenever the electronic element fails to operate, a simple restart and reconfiguring of the electronic element is possible using the information storage means of the electronic elements in which the configuration information are stored into.

In a preferred embodiment, a lighting system failure is determined and upon determination of the system failure, the configuration information is again read from the information storage means of each electronic element to reconfigure the electronic element.

In a preferred embodiment, the configuration information is operational parameters for the electronic element, such as voltage information, at which the electronic element should be operated, temperature information, on which the electronic element is to switch, running cycle information, on which the electronic element is to be maintained or updated, dimming parameter information and/or fade parameter information.

In another preferred embodiment, the configuration information is system-relevant information, such as address information, needed to contact the electronic element or a lighting group information, to define, which lighting mean is specifically controlled by which electronic element.

Additionally the configuration information may comprise service information such as lighting means type, load type or battery type.

Additionally positioning values of each electronic element can also be stored into the electronic elements storage means in order to mark the device on an electronic lighting system map to allow an easier locating of the electronic element.

Advantageously, the electronic element can be installed without configuration information. The configuration information are read from a machine readable medium in an easy manner and are provided to the electronic elements storage unit subsequent or in parallel to the installation procedure. An easy installation and commissioning of the lighting system is therefore achieved.
The above identified problems are further solved by an electronic element in a lighting system comprising a communication interface for receiving configuration information from an external configuration device. The electronic element further comprises an information storage means for storing the received configuration information. The electronic element at least comprises a controlling unit for generating control signals for at least a light source. The communication interface of the electronic element comprises a wireless communication interface for receiving the configuration information via an over-the-air communication technique, such as NFC and/or RFID.

The communication interface is configured to receive information from an external configuration device and a information storage means is used for storing the received configuration information. Thus, a commissioning of the electronic element and the configuration of the electronic element can be achieved in an unpowered mode of the electronic element.

The configuring device is able to write and read information stored in the information storage means in an unpowered mode of the electronic element. The configuring device may power the electronic element through wireless transmission of energy, e.g. by radio-frequency or inductive coupling. Therefore a commissioning of a lighting system in parallel to the installation of the lighting system is possible, which saves time and reduces effort.

Preferably, the received configuration information are provided to a control unit of the electronic element via a wired communication channel. This wired communication channel might be an Inter-Integrated communication, short: I²C, which is a multi-master, multi-slave, single-ended, serial computer bus used for attaching low-speed peripherals to electronic systems. It can be used for a communication between the wireless interface and the control unit of the electronic element. Using this wired communication channel, a configuration of the electronic element can be achieved in a powered state after completion of the installation phase of the lighting system by reading the stored configuration information.
Thus, the provisioning of configuration information to each electronic element can be obtained in a depowered mode of the lighting system, wherein the finalization of the configuration is automatically achieved after powering the lighting system.

In a preferred embodiment, the electronic element is an active electronic element for supplying voltage to the light source and for controlling at least one light source. Thus, the electronic element is for instance a driver or ballast of a lighting means or a driving circuit or the like. The active electronic element comprises a driving unit configured to drive the at least one lighting means. Such an active electronic element might comprise a fly-back converter technology to efficiently drive the specific lighting means. Such active electronic elements might be an emergency converter module further comprising or being connected to an energy storage means for supplying energy to a lighting means or an emergency lighting means in an emergency case.

In another embodiment the electronic element further comprises another information interface for obtaining control commands. Such another information interface might be a digital addressing lighting interface, short DALI, to monitor and maintain each specific active electronic element. Via the control commands the status of each electronic element can be read out and further adjustments to the configuration information can be achieved.

In an alternative embodiment the electronic element is a passive electronic element, especially a sensing means, such as a photocell or infrared detection means or a switching means such as an electronic wall switch or a dimming unit or the like. These passive electronic elements are equipped with a communication interface to access an information storage means for storing configuration information sent by a configuring device of the lighting system. Therefore, each electronic element is commissioned in an unpowered mode of the lighting system.

The above identified problems are further solved by a configuring system of a lighting system which comprises an electronic element as previously stated for controlling a lighting means.
The configuring system further comprises a configuring device configured to retrieve configuration information for the electronic element from a machine-readable medium. The machine-readable medium is for instance a quick response code, short QR-code, especially a one-dimensional bar code or a two-dimensional bar code. Those machine-readable media are easily printed on paper or can be provided via electronic lighting maps, e.g. provided on a screen of a handheld tablet device. Those machine-readable media contain the configuration information which can easily be retrieved from the configuring device.

In a preferred embodiment, the machine-readable media is an electronic token, such as a NFC tag or an RFID tag or a USB token. Since the configuring device might be equipped with a wireless communication interface a NFC or RFID interface is already contained into the configuring device. This NFC or RFID interface can advantageously be used to retrieve the configuration information.

In a preferred embodiment, the machine-readable medium is a part of a digitized lighting system map, which incorporates the configuration information of each electronic element and the position information of this specific electronic element. Such a digitized lighting system map can be obtained from a server station and downloaded via specific interfaces to an electronic device, such as a portable computer. This lighting system map is then displayed and the configuration information can be retrieved thereof. An electronic overview of the lighting system is therefore obtained, which is easily updateable and can be used to navigate through the building to the specific electronic element in order to send the configuration information thereto.

Preferably, the configuring device is a commissioning tool, which is used to configure the at least one electronic element during a commissioning state of the lighting system. Such a commissioning tool might be used by a commissioner or an installer of the lighting system and comprises a wireless communication interface to send the configuration information to the electronic element.
In a more preferred embodiment, the configuring device is a handheld device, especially a configured smart phone or a configured tablet PC or a configured portable computer. Nowadays smart phones and tablet PCs comprise a variety of communication interfaces, such as NFC, WLAN, USB or the like. Those smart phones and tablet PCs can be configured with a computer program, such as a commissioning application to allow a commissioning of the lighting system in a depowered state of the lighting system.

In case the commissioning device is originally not equipped with a wireless communication interface, e.g. NFC or RFID, it is upgraded with an additional wireless communication module. Such modules comprise wired communication interfaces to connect the module with the configuring device. Those wired communication interfaces are audio phone connectors or USB or the like. Thus, a wireless communication can be established between the configuring device and the electronic element also in case the configuring device is not equipped with an internal wireless communication interface.

In a more preferred embodiment, the configuring device obtains the configuration information from the machine-readable medium by operating an optical interface, especially a camera or a scanning element.

Alternatively, the configuration device retrieves the configuration information from the machine-readable medium by operating an electronic interface, especially a wireless communication interface.

The light source configuring system is capable of configuring a plurality of lighting means. Especially the plurality of lighting means can be grouped into at least two different groups of luminaries. Those light groups can be organized per room, per floor and/or per booth. The grouping information is a part of the configuration information.

The housing for an electronic element may comprise a metallic case configured to shield the electronic element. The shielding prevents an external electromagnetic radiation to
electronically disturb the electronic element. Additionally, the shielding prevents other
electronic devices to get disturbed by electromagnetic radiation, generated by the electronic
element.

The housing may further comprise a wireless electronic interface configured to retrieve
configuration information from the configuring device, wherein an antenna is used to receive
over-the-air signals coded with the configuration information, wherein the antenna is
arranged horizontally or vertically to the metallic case.

Preferably the above identified problems are solved by a method for sending configuration
information in a lighting system using a configuring device. The method comprises the steps of:
retrieving configuration information from a machine-readable medium; and sending the
retrieved configuration information from the configuring device to an information storage
means of an electronic element via a communication interface of the configuring device.

The retrieved configuration information is displayed on a display screen of the configuring
device to be validated.

The electronic element is selected by the configuring device if the configuring device is in
communication vicinity of the electronic element. In case more than one electronic element
is in close vicinity to the configuring device, the user manually selects one specific electronic
element, which should be configured. Alternatively, the electronic element identifies itself
with identification information, which is verified by the configuring device for an automatic
selection of the desired electronic element.

In a preferred embodiment, the configuring device checks the information integrity during
the retrieving method step, wherein the configuring device displays an error message in case
the information integrity check fails.

An automatic resending of the configuration information is used in case a sending failure
occurs.
The configuring device receives an error code in case the sent configuration information is not stored correctly in the electronic element.

In a preferred embodiment the configuring device displays a success message in case the sent configuration information is stored correctly in the electronic element.

The above identified problems are further solved by a computer program product for a configuring device of a lighting system, the configuring device comprises means for subsequently executing the previously stated configuring method steps in a computer program.

Preferably a graphical user interface, short GUI, is used to display a digitized lighting system map. Such a GUI allows an easy handling and a convenient commissioning of the lighting system.

Preferably the lighting system map is obtained from a server station or a quick response code or a downloaded file.

The lighting system map incorporates positioning information of each electronic element. Therefore the electronic element is bundled with a specific coordinate in the map.

The sent configuration information to each specific electronic element is displayed in the lighting system map. This allows an easy way to find the configuration information without manually walking to the specific electronic element.

The positioning information of the electronic element is sent to the electronic element. This is mainly done during commissioning of the lighting system, wherein the electronic element is programmed with positioning to be found later.
The computer program product comprises an operating system of the configuring device which is an Android operating system or Apple iOS operating system etc.

The information which can be written into the information storage means can be updated system information when a modified commissioning is running.

Following exemplary embodiments of the invention are described with reference to the drawings. Those exemplary embodiments do not limit the scope of the invention. The same reference signs in different drawings indicate same elements or at least same functions unless otherwise stated.

Fig. 1 shows a first exemplary embodiment of a method for configuring an electronic element in a lighting system according to the invention.

Fig. 2 shows a second exemplary embodiment of a method for configuring an electronic element in a lighting system according to the invention.

Fig. 3 shows an exemplary embodiment of a configuring system for a lighting system according to the invention.

Fig. 4 shows an exemplary embodiment of a machine-readable medium according to the invention.

Fig. 5 shows an exemplary embodiment of digitized lighting system map according to the invention.

Fig. 6 shows an exemplary embodiment of a method for sending configuration information using a configuring device according to the invention.

Fig. 7a-7g show exemplary embodiments of a graphical user interface based on a computer program product executed in a configuring device according to
Fig. 8 shows an exemplary embodiment of the configuration of a lighting system map according to the invention.

Tab. 1 shows an overview of configuration information according to the invention.

Tab. 2 shows an exemplary embodiment of configuration information retrieved from a machine-readable medium.

Tab. 3 shows a second exemplary embodiment of configuration information retrieved from a machine-readable medium.

Fig. 1 shows a first exemplary embodiment of a method for configuring an electronic element 11 in a lighting system 9. Therein a retrieving step 1 is used to retrieve configuration information from a machine-readable medium 13. Such configuration information are for instance contained in a machine-readable optical label such as quick response code, short QR code according to Fig. 4 or an alternative type of barcode.

Upon retrieving 1 the configuration information, those information are sent in a sending step 2 to the information storage means 120 of an electronic element 11. In the information storage means 120 those configuration information are stored according to the storing step 3. Subsequently, the lighting system 9 is powered in a powering step 4. Upon powering the lighting system 9, the configuration information are read from the information storage means 120 in reading step 5. Subsequently, the configuring of the electronic element 11 occurs in the configuring step 6.

QR codes 13 are used to store the configuration information. A configured smart phone or similar commissioning device is used as a configuring device 12 to retrieve 1 the configuration information and send those configuration information to the electronic
element 11, especially to an information storage means 120, which is reached a communication interface 110.

Additionally, that configuration information can be digitally stored to a digitized lighting system map 14. The specific electronic element 11 is shown as an icon in the digitized lighting map 14, which denotes the specific lighting means 10 and the configuration information which have to be used to configure the electronic element 11. It is beneficial that the complete configuration information for each lighting means 10 can be sent even before the system 9 is powered. Therefore a fast and efficient commissioning is possible without an extra commissioning engineer who commissions the lighting system 9 in an inconvenient manner. The configuring of the lighting system can be done by the installer of the lighting system 9 before finishing the installation procedure of the whole lighting system 9.

According to Fig. 2, a second exemplary embodiment of the method for configuring an electronic element 11 in a lighting system 9 is shown. Therein, a determining step 7 is shown which incorporates the determination of a lighting system failure. Whenever the determination step 7 occurs, the configuration information are read in reading step 5 and a reconfiguring 8 of the electronic element 11 can be done easily.

Thus, another benefit is included, since now the ability to easily read the configuration information from a failed electronic element 11 in order to reconfigure the electronic element 11 in an identical manner is obtained. This is achieved by using the information storage means 120 of the electronic element 11 as an archive for configuration information. Whenever the electronic element 11 fails to operate, the electronic element 11 is reset and the configuration information stored in the information storage means 120 are read again.

In Fig. 3 a first exemplary embodiment of a lighting system 9 is shown. The lighting system 9 is able to supply at least one lighting means 10 by an active electronic element 11, which is a ballast of the lighting means 10. Thus, the ballast comprises a driving circuit 140, which is controlled via a controlling unit 130. To control the driving circuit 140, an information storage
120 is used to store configuration information. For commissioning such a lighting system 9, the configuration information has to be stored in the storage 120.

According to the invention, this configuration information is retrieved from a machine-readable medium 13 in a retrieving step 1. Therefore a configuring device 12 is used. This configuring device 12 might be a configured smart phone, which uses its camera as a means for optically obtaining the configuration information contained in the machine-readable medium 13. The configuring device 12 may also be a dedicated handheld programmer device with a display and means for retrieval of configuration information from a machine-readable medium 13 and transmission to the ballast 11 and vice versa.

Alternatively and not shown in Fig. 3 the machine-readable medium 13 can be a device using electromagnetic fields to wirelessly transfer data, e.g. a NFC tag or RFID tag. The configuring device 12 therefore may comprise a communication interface for wireless electromagnetic communication such as an NFC or RFID communication interface for retrieving the configuration information from the machine-readable medium 13. The machine-readable medium 13 may comprise a memory, e.g. EEPROM or FLASH memory, where various lists of parameters and configuration variants are stored as configuration information. The configuring device 12 sends the configuration information to the ballast 11. Therefore a bidirectional channel is established in a wireless communication technique in step 2.

Therefore the electronic element 11 comprises a communication interface 110. According to Fig. 3 the electronic interface 110 comprises a wireless communication interface 1110, which is used to receive the configuration data sent from the configuring device 12. This wireless communication interface 1110 might comprise a storage unit, e.g. EEPROM or FLASH memory, to store the received configuration information.

The machine-readable medium 13 can be a NFC-tag or RFID-tag combined with an optical label such as QR-code where the QR-code may be used for optical information retrieval and the NFC-tag or RFID-tag which comprises a memory may store information which can be altered by the user, e.g. by the configuring device 12.
The configuring device 12 may send and receive configuration information from the ballast 11 via electronic interface 110 in a mode where the ballast 11 is not powered. The configuring device 12 may power the electronic interface 110 through wireless transmission of energy, e.g. by electro-magnetic or inductive coupling. The ballast 11 with the driving circuit 140 may be switched off during such transmission. As the electronic interface 110 with the wireless communication interface 1110 may comprise a storage unit it may store the received configuration information in the storage unit.

The electronic interface 110 further comprises a wired communication channel 1120, which might be an I²C-interface or SPI-interface. This wired communication channel 1120 is used to provide the received configuration information to the information storage means 120 of the electronic element 11. This wired communication channel 1120 is preferably used to provide the received configuration information to a control unit 130 of the electronic element 11 in an operation mode of the electronic element 11. Preferably the electronic interface 110 may read out the configuration information stored in the storage unit of the wireless communication interface 1110 through the wired communication channel 1120 when the ballast 11 is powered. Therefore the configuration information may be read out by the ballast 11 at a later time than commissioning and programming by the configuring device 12 is done. This provides also the option that the configuration information may be read out again at a later time, e.g. after a power failure.

The ballast 11 may control selectively whether electronic interface 110 is supplied during normal operation or not. The ballast 11 may power the electronic interface 110 only at start-up or at repeated intervals and check whether any configuration information has to be read out. If no configuration has to be read out the ballast may stop powering the electronic interface 110 and thereby deactivate the electronic interface 110. Thus the electronic interface 110 may be better protected against failure or influences from outside, e.g. overvoltage. Such deactivation of the electronic interface 110 provides the opportunity that in case that the ballast 11, especially the driving circuit 140 and also the information storage means 120 may be damaged during a failure under operation whereas the electronic
interface 110 has a higher change to remain without damage and could be read out at a later time although the ballast 11 itself is damaged. Thus a replacement would be easier as the configuration information could be read out from the electronic interface 110 and transferred to another ballast which shall replace the damaged ballast.

The configuring device 12 might originally not be equipped with a wireless communication interface. In such a case, a wireless communication module is connected to the configuring device 12 in order to obtain wireless communication functionality with the electronic element 11.

Thus, the configuring device 12 can be a smart phone which is customized with a mobile wireless reading device to read and write to NFC-tags or RFID-tags. Therefore, the wireless interface 1110 features integrated wireless, storage and an I2C-interface capability in a single chip. The RFID-interface 1110 complies with EPC global class 1 GEN2 specification. An information storage means 120 such as an EEPROM is capable of storing the configuration information. It is worth noting that the EEPROM 120 can be programmed without an external supply when accessed via the wireless interface 1110. Therefore it is possible to commission the electronic element 11 without having a powered lighting system 9.

The electronic element 11 according to Fig. 3 contains the electronic interface 110. Alternatively (not shown), the electronic element 11 can comprise an external wireless communication module, which is directly connected to a wired communication channel 1120 of the ballast, e.g. at input terminals of an I2C communication channel. The wireless communication interface 1110 is placed on a housing of the electronic element 11 and provides the configuration information to the control unit 130 via its modules memory or via the information storage means 120.

In Fig. 3 another electronic element 11 is also shown, which is a passive electronic element 11 and also comprises an electronic interface 110 incorporating a wireless interface 1110 and a memory 120. A control unit 130 is used in the passive electronic element 11 to control the
lighting means 10. Such a passive electronic element can be an electronic wall switch or a photocell or an infrared sensing means. This passive element 11 is used to generate a control signal to the control unit 130 of an active electronic element 11 for a respective driving of the light source 10 by driving circuit 140. The ballast 11 may comprise as well a wired interface circuit with terminals for connection to a wired interface like a wired lighting control bus, e.g. to a DALI bus. The ballast 11 may receive dimming commands by the wired interface circuit.

In Fig. 4 a machine-readable medium 13 is shown. Here, the machine-readable medium 13 is a QR-code. This QR-code can feature at least 20 bytes of configuration information relevant to the electronic element 11.

In Tab. 1 the included information are listed with their appropriate size. Such information can easily be read via the configuring device 12 by using its camera or an appropriate QR-code scanning device. Such configuration information can for instance be the group of lighting means 10, the scene in which the lighting means 10 should operate the power-on level, the system failure level, a maximum and a minimum voltage level as well as fading time and fading rate. Especially the address information of the specific electronic element 11 and a location in X and Y coordinates according to the digitized lighting system map is shown. According to Tab. 1, a total of 43 bytes are included in a machine-readable medium according to Fig. 4.

In Tab. 2 exemplary embodiments of a validation string and a scene memory is shown. The specific configuration information are hexadecimal coded. This Tab. 2 is completed with bytes as shown in Tab. 3.

A computer program product can be used to retrieve the configuration information read from the QR-code 13. The wireless communication interface 1110 of the electronic element 11 can be obtained by a smart phone and tablet PC standard 3.5 mm audio-connector, which can be reconfigured as a NFC- or RFID-interface. Therefore the configuring device 12 can easily be equipped with the wireless communication module and can easily communicate with the electronic element 11.
In an alternative or extended embodiment the configuring device 12 may comprise an equipment to perform 3D location position retrieval such as a camera and linked recognition software where the position of an object like a luminaire or lighting unit in a building can be located. The 3D location position retrieval may be also performed with the aid of a positioning system of the configuring device 12 which may be a GPS system or indoor location system, e.g. a system transmitting universally unique identifiers using radio frequency signals or modulated light signals for retrieving a location position. Such location information of luminaires or lighting units may be stored in a database whereby each electronic element is registered as well, e.g. each electronic element is part of a luminaire whereby all positions of the luminaires are stored in the database as well as all positions of the electronic elements. Thus the configuring device 12 may detect which luminaire and thus which electronic element 11 inside this luminaire is currently selected, e.g. by aid of the camera. Based on the selection the configuration information relevant to the electronic element 11 may be retrieved by the configuring device 12 and send to the electronic element 11 according to the invention.

In Fig. 5 an exemplary embodiment of a lighting system map 14 is shown.

The ultimate goal of the invention is to use digitized machine readable media 13 as a basis to obtain the configuration information. So the installer does not have to scan any QR-codes 13 from a physical map, such as a printed paper. Instead, all the configuration information would be generated as a layer of a digitized lighting system map 14. A set of digital files are downloaded to a configuring device 12 before the installer begins. This is shown in Fig. 8 wherein the process is made even more intuitive, since the user would select a lighting means 10 by tapping on a screen of the configuring device 12, e.g. a portable computer device, such as a tablet PC or a smart phone. After tapping, the configuration information is sent to the electronic element 11 using the configuring device.

The digitized lighting system map 14 of Fig. 5 comprises five groups 15 of lighting means 10, which are shown with different textures. Each specific group 15 is controlled via at least one
electronic element 11. Therefore it is important that each electronic element 11 obtains configuration information in which the specific grouping ID is set.

In Fig. 5 the specific lighting means 10 and the appropriate electronic elements 11 are shown on the digitized lighting system map 14. The electronic element 11 can be an active electronic element 11, such as a ballast or driver or a passive electronic element 11, such as a sensing means or a switching means. According to Fig. 5 the sensing means are shown as circular symbols. Each specific lighting means 10 comprises an electronic element 11 which needs to be configured using the digitized machine-readable medium 13 which is placed next to the electronic element 11 in the map 14. Each electronic element 11 according to the lighting system map 14 comprises positioning information which mainly refer to X and Y coordinates of the map 14. The positioning information of the digitized lighting system map 14 are also sent as configuration information to the specific electronic element 11.

In Fig. 6 an exemplary embodiment of a method for sending configuration information using a configuring device 12 is shown. Therein also the retrieving step 1 is used. After retrieving 1 of the configuration information, a validation step 16 is used to validate the configuration information of the machine-readable medium 13. The validation step 16 is used for security reasons and to avoid configuration information which is inoperable with the chosen electronic element 11. After validating 16 of the configuration information the user selects an electronic element 11 in the selecting step 17. Therefore the user or installer needs to place a configuring device 12 in communication vicinity to the electronic element 11 in order to allow an establishing of a bidirectional channel to wirelessly communicate with the configuring device 12. If an electronic element 11 is selected, the configuration information is sent via sending step 2 and is stored according to storing step 3.

In case a failure occurs, the configuring device 12 obtains an error code. The error code generates an error message on the screen of the configuring device 12 in displaying message step 18 to warn the user that the configuring method was not successful.
In case no failure occurs, the configuring device 12 obtains a confirmation code. The confirmation code generates a display message on the screen of the configuring device 12 in displaying message step 18 to inform the user that the storing step 3 was successful.

In case more than one electronic element 11 is in communication vicinity to the configuring device 12, more than one electronic element 11 might respond to the configuring device 12. Thus, the user needs to select a specific electronic element 11. Normally the device with the highest number of responses is likely to be chosen. Alternatively, an ID of the electronic element 11 is transmitted, which is used to verify the correct electronic element 11 automatically.

According to Fig. 7a to 7g, different smart phone display information of a graphical user interface is shown. Therefore the smart phone as configuring device 12 comprises a display to display the stage of the configuring method.

According to Fig. 7a, the configuring method is started by starting a lighting system configuring application stored as a computer program in a storage means of the configuring device 12. Upon starting of the application, a respective display information informs the user that the application has been started.

After starting the application, the user is asked in Fig. 7b to scan a specific machine-readable medium 13 to retrieve the configuration information in the retrieving step 1. In dependence on the used machine-readable medium 13, either an optical retrieving or an electronic retrieving of the configuration information is made by respective means of the configuring device 12.

The information retrieved from the machine-readable medium 13 are displayed on the screen of the configuring device 12 according to Fig. 7c. Therefore the application is configured to convert the retrieved configuration information user into user readable configuration information. For instance the address information, the positioning information,
the tag-ID, the date/time of retrieving is displayed on the screen. The information is displayed for validation purposes.

Referring to Fig. 7d, the user has to select a specific electronic element 11 in order to update the retrieved configuration information to the electronic element 11. Therefore the user needs to approach the communication vicinity of the electronic element 11. In case the communication vicinity is reached, the user is asked to upload the information to the electronic element 11. The upload step implies that the configuration information is sent via the wireless interface 1110 to the wireless interface 1110 of the electronic element 11.

During the sending step 2, the user is informed that the sending is in progress, see Fig. 7e.

Referring to Fig. 7f, a display message is generated according to displaying message step 18 to inform the user that the storing of information was successful or in case a failure occurs that the configuration information are not stored successfully, see Fig. 7g. Upon receiving a failure message, the user can try to resend the retrieved configuration information or cancel the configuring method.

Since the configuration information are stored in a information storage unit 120 without powering the electronic element 11, no supply voltage is required to read and write to the storage unit 120. Thus, an offline commissioning method is obtained. A contactless uploading via a wireless interface 1110 is possible and coordinates in parameters inside the electronic element 11 can be stored. This allows the easy replacement of an electronic element 11 and using the storage unit 120 as an archive to reconfigure the electronic element 11 in case of a failure.

The configuring device 12 may be used to read out the stored configuration information and optionally additional information like operation, service and maintenance information stored in a information storage unit 120 of a first electronic element 11 and store the read out information inside the configuration device or may forwarded it to a central light management
device or central light management server or central light management database which may be e.g. a cloud service. The configuring device 12 may also be used to read out the stored configuration information and optionally additional information like operation, service and maintenance information stored in a information storage unit 120 of a first Electronic element 11 which shall be replaced and may write this information to another second Electronic element 11 which shall replace the first Electronic element.

To allow an easy communication with the wireless electronic interface 1110, a specific wiring should be used for providing an antenna in order to reach the electronic element 11 in a convenient manner. For instance an antenna in horizontal extracts the vicinity for communication to 10 to 20 centimeters. In case the wired antenna is placed vertically on the metallic case, a communication vicinity of 20 to 30 centimeters can be obtained. The housing for the electronic element 11 may comprise a metallic case configured to shield the electronic element. The shielding prevents an external electromagnetic radiation to electronically disturb the electronic element. Additionally, the shielding prevents other electronic devices to get disturbed by electromagnetic radiation, generated by the electronic element. Thus metallic housings are common for electronic elements in lighting systems. If the wired antenna is placed close to an opening of the metallic case the performance of the communication may be improved. As a part of the electronic element like the end of the printed circuit board and/or the terminals may protrude out the metallic housing the antenna may be placed close to the terminals or at an end of the printed circuit board. Such placement of the wired antenna on the printed circuit board would be preferably a vertical placement close on the metallic housing or nearby outside.

As already stated the communication between electronic interface 110 and configuring device 12 may be a bidirectional communication where both Communication interface 110 and Configuring device 12 are able to receive and send information from each other. Thus the configuring device 12 can also receive information from the electronic interface 110 and thus may read out the stored configuration information as well as additional information like operation, service and maintenance information, e.g. number of switching cycles, time of
operation, nominal operation parameters like nominal lamp current, maximum operation parameters like maximum operating temperature, battery cycles, power consumption, last dimming level, error messages, device failures, abnormal supply voltages etc.

The access of the configuring device 12 to the electronic interface 110 may be performed with different levels of access rights. As one example the manufacturer may have full access to the Information storage means 120 and may read and write the whole Information storage means 120. In difference to the manufacturer other users may have only limited rights to access the Information storage means 120. The access for the manufacturer to the Information storage means 120 may be locked with a specific manufacturer code which is only available to the manufacturer of the Electronic element 11 or its authorized personal.

For other users there may be only restricted access to the Information storage means 120 possible. For instance a luminaire producer may have access only to certain parts of the Information storage means 120 and thereby may only read out and write certain parts of the configuration information (e.g. addressing) and operational information (e.g. lifetime or lamp current setting). Such access to certain parts of the Information storage means 120 may be only locked with a user code which might be only available to certain users which may receive the user code from the manufacturer of the Electronic element 11. The access to certain parts of the Information storage means 120 may be based on the data written by the manufacturer of the Electronic element 11 to the Information storage means 120. For instance the programming of the Information storage means 120 by the manufacturer of the Electronic element 11 may comprise predefined variables for configuration information (e.g. addressing) and operational information which can be modified by the luminaire producer.

There may be also a third level of access possibility to the limited parts of the Information storage means 120 which may be accessible for a user without any user or manufacturer code. For instance a change of the address may be performed by unrestricted access to the relevant part of Information storage means 120 which is necessary for addressing. An access to restricted areas of the Information storage means 120 may be only possible if a
manufacturer code or user code is being transmitted first from the configuring device 12 to the electronic interface 110. The electronic interface 110 may check the transmitted manufacturer code or user code and may only enable access to the Information storage means 120 when the manufacturer code or user code has been confirmed to be correct.

In one embodiment an access to the complete Information storage means 120 may be only be possible by transmission of the manufacturer code and when the Electronic element 11 is powered. For example the programming and writing to the complete Information storage means 120 may be only be possible by transmission of the manufacturer code and when the Electronic element 11 is powered by a defined supply voltage having a specific supply frequency and/or amplitude which is different to the nominal supply for the Electronic element 11 (e.g. 160V AC at 60 Hz instead of normal 230V AC at 50 Hz).

In Fig. 8 a digitized lighting system map 14 is shown, wherein the lighting map 14 is displayed on a screen of a portable computer, such as a tablet-PC comprising a touch screen as input means. The QR-codes 13 are thus digitized on the screen and can be chosen easily. The portable computer can furthermore be used as the configuring device 12, wherein for retrieving the configuration information in retrieving step 1, the digitized QR-code 13 is chosen by touching on the screen.

All embodiments described, shown and/or claimed herein can be combined with each.
Reference signs

1   Retrieving step
2   Sending step
3   Storing step
4   Powering step
5   Reading step
6   Configuring step
7   Determining step
8   Reconfiguring step
9   Lighting system
10  Lighting means
    100  Emergency light source
11  Electronic element
    110  Electronic interface
        1110  Wireless communication interface
        1120  Wired communication channel
120  Information storage means
130  Control unit
1301 Another information interface
140  Driving unit
12  Configuring device
13  Machine readable medium
14  Lighting source system map
15  Lighting group
16  Validating step
17  Selecting step
18  Displaying step
We claim

1. A method for configuring an electronic element (11), especially a ballast, in a lighting system (9), the method comprises the following steps:

- Retrieving (1) configuration information from a machine readable medium (13), especially a QR-code, by means of a configuring device (12);
- Sending (2) the retrieved configuration information from the configuring device (12) to the electronic element (11) in the lighting system (9); and
- Storing (3) the configuration information into an information storage means (120) of the electronic element (11).

2. The method according to claim 1,

wherein in the sending step (2) a bidirectional channel of a wireless interface (1110), especially based on a near field communication or a radio frequency identification communication between the configuring device (12) and the electronic element (11) is established.

3. The method according to claim 1 or 2,

wherein the configuration information are retrieved from a lighting system map (14).

4. The method according to one of the preceding claims, wherein the method is applied to the lighting system (9) in an unpowered state of the electronic element (11), preferably in an unpowered state of the lighting system (9).

5. The method according to one of the preceding claims,

wherein after the storing step (3) the lighting system (9) or at least the electronic element (11) is powered up and the configuration information are read from the information storage means (120) of the electronic element (11) to configure the electronic element (11).
6. The method according to one of the preceding claims, wherein a failure of the lighting system (9) is determined (7) and upon determination (7) of the failure of the lighting system (9), the configuration information are read (5) from the information storage means (120) of the electronic element (11) to reconfigure (8) the electronic element (11).

7. The method according to one of the preceding claims, wherein the configuration information are at least voltage information, temperature information, running cycle information, address information, positioning information, lighting group information, dimming parameter information and/or fade parameter information.

8. An electronic element (11) in a lighting system (9), the electronic element (11) comprises:
   - a communication interface (110) for receiving configuration information from an external configuring device (12);
   - an information storage means (120) for storing (3) the received configuration information; and
   - a control unit (130) for generating control signals for at least a lighting means (10), wherein the communication interface (110) is a wireless communication interface (1110) for receiving the configuration information via an over-the-air communication technique.

9. The electronic element (11) according to claim 8, wherein the received configuration information are provided to a control unit (130) of the electronic element (11) via a wired communication channel (1120) in an operation mode of the electronic element (11).

10. The electronic element (11) according to claims 8 or 9, wherein the electronic element (11) is an active electronic element for supplying and controlling at least a lighting means (10), wherein the electronic element (11) further comprises a driving unit (140) configured to drive the at least one lighting means (10).
11. The electronic element (11) according to claim 10, wherein the electronic element (11) further comprises another communication interface (1301) for obtaining control commands.

12. The electronic element according to one of the claims 8 to 11, wherein the electronic element (11) is a passive electronic element, especially a photocell or a switching means or a sensing means.

13. A configuring system for a lighting system comprising:

- an electronic element (11) according to one of the claims 8 to 12 to control the operation of a lighting means (10); and

- a configuring device (12) configured to retrieve configuration information for the electronic element (11) from a machine readable medium (13).

14. The configuring system according to claim 13,

wherein the machine readable medium (13) is a quick response code, especially a one-dimensional bar code or a two-dimensional bar code.

15. The configuring system according to claim 13,

wherein the machine readable medium (13) is an electronic token, especially an NFC-tag or an RFID-tag or a USB-device.

16. The configuring system according to claim 13,

wherein the machine readable medium (13) is a part of a digitized lighting system map, incorporating each electronic element and a position information of the electronic element (11).

17. The configuring system according to one of the claims 13 to 16, wherein the configuring device (12) is a commissioning tool, used to configure the electronic element (11) in a commissioning state of the lighting system (9).
18. The configuring system according to one of the claims 13 to 17, where in the configuring device (12) is a handheld device, especially a configured smartphone or a configured portable computer or configured tablet PC.

19. The configuring system according to one of the claims 13 to 18, where in the configuring device (12) retrieves the configuration information from the machine readable medium (13) by operating an optical interface, especially a camera or a scanning element.

20. The configuring system according to one of the claims 13 to 19, where in the configuring device (12) retrieves the configuration information from the machine readable medium (13) by operating an electronic interface, especially a wireless communication interface.

21. The configuring system according to one of the claims 13 to 20 capable of configuring a plurality of lighting means (10).

22. The configuring system according to claim 21, where in the plurality of lighting means (10) is grouped into at least two different groups (15) of light sources (10).

23. A housing for an electronic element (11) according to one of the claims 8 to 12 comprising:
   - a metallic case configured to shield the electronic element (11);
   - a wireless electronic interface (1110) configured to retrieve configuration information from the configuring device (12); and
   - an antenna to receive over-the-air signals coded with the configuration information, where in the antenna is arranged horizontally or vertically to the metallic case.
A method for sending configuration information in a lighting system using a configuring device (12), the method comprises the following steps:

- Retrieving (1) configuration information from a machine readable medium (13), especially a QR-code; and
- Sending (2) the retrieved configuration information from the configuring device (12) to an information storage means (120) of an electronic element (11), especially a ballast, via a communication interface of the configuring device (12).

The method according to claim 24,

wherein the retrieved configuration information are displayed on a display screen of the configuring device (12) for validation.

The method according to claims 24 or 25,

wherein the electronic element (11) is selected by the configuring device (12) if the configuring device is in communication vicinity of the electronic element (11).

The method according to one of the preceding claims 24 to 26,

wherein the configuring device (12) checks the information integrity in at least the retrieving step, wherein the configuring device (12) displays (18) an error message in case the information integrity check fails.

The method according to one of the preceding claims 24 to 27,

wherein an automatic resending of the configuration information is used in case a sending failure occurs.

The method according to one of the preceding claims 24 to 28,

wherein the configuring device (12) receives an error code in case the sent configuration information are not stored correctly in the electronic element.
30. The method according to one of the preceding claims 24 to 29, wherein the configuring device (12) displays (18) a success-message in case, the sent configuration information are stored correctly in the electronic element (11).

31. A computer program product for a configuring device (12) of a lighting system, the configuring device (12) comprises means for subsequently executing the method steps according to claims 24 to 30 in a computer program.

32. The computer program product according to claim 31, wherein a graphical user interface is used to display a digitized lighting system map (14).

33. The computer program product according to claim 32, wherein the lighting system map (14) is obtained from a remote server station or a local quick response code.

34. The computer program product according to one of the claims 31 to 33, wherein the lighting system map (14) incorporates positioning information of each electronic element (11).

35. The computer program product according to one of the claims 31 to 34, wherein the sent configuration information to each specific electronic element (11) are displayed in the lighting system map (14).

36. The computer program product according to one of the claims 31 to 35, wherein positioning information of the electronic element (11) are sent to the electronic element (11).

37. The computer program product according to one of the claims 31 to 36, wherein an operating system of the configuring device (12) is an Android operating system.
Fig. 1
Fig. 2

Start

Determining light source system failure

Reading configuration data

Reconfiguring electronic element

End

Fig. 3

Config Device

NFC

MEM

Control

Driving circuit

MEM

Control

NFC

I^2C

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Fig. 5

Luminaire grouping
- Group 00
- Group 01
- Group 02
- Group 03
- Group 04
- Group 05

○ Emergency operation capability
○ Sensor
Start

Retrieve configuration data

Validate configuration data

Selecting electronic element

Sending configuration data

Storing configuration data

Displaying message

End

Fig. 6
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**INV. H05B37/02**

According to International Patent Classification (IPC) or both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[ ] Further documents are listed in the continuation of Box C.  [X] See patent family annex.

* Special categories of cited documents:
  * "A" document defining the general state of the art which is not considered to be of particular relevance
  * "B" earlier application or patent but published on or after the international filing date
  * "L" document which may throw doubts on priority claim(s) one of which is cited to establish the publication date of another citation or other special reason (as specified)
  * "O" document referring to an oral disclosure, use, exhibition or other means
  * "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a skilled person in the art

"A" document member of the same patent family

Date of the actual completion of the international search: 13 June 2016

Date of mailing of the international search report: 12/08/2016

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax. (+31-70) 340-3016

Authorized officer:
Henderson, Richard

Form PCT/ISA/210 (second sheet) (April 2005)
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This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-22, 24-37

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

   Configuring an electronic element
   ---

2. Claim: 23
   Housing
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