

LIGHTING SYSTEM WITH A LIGHT SENSOR FOR BALLAST CONTROL

Technical field

The present invention relates to electronic ballasts controlled by light receivers for lamps. In this case, the term "lighting system" is used for the electronic ballast together with the light receiver for the control thereof, with it being possible for the appropriate lamp to be included, but not necessarily. The term "lamp" in this case applies to luminous means in the most general sense including LEDs and LED modules.

Prior art

It is known to control electronic ballasts and therefore the operation of the lamps supplied by said ballasts via light receivers. The light receivers can be used in the case of dimmable ballasts and lamps for brightness control or generally for switch-on and switch-off operations depending on certain brightness threshold values or on the dimming of certain points (for example in the case of light barriers) or for similar purposes. For this purpose, light-sensitive photodiodes are electrically connected to a ballast.

Description of the invention

The invention is based on the technical problem of specifying an improved lighting system of this type which provides improved use possibilities as a result of a favorable compromise between reliability and technical complexity.

The invention relates to a lighting system with an electronic ballast and a light receiver, which is connected in terms of signal technology to the ballast, for receiving ambient light and for controlling the ballast in response to the ambient light, characterized by an optocoupler, which is electrically connected to the ballast, and an optical waveguide, which

optically connects the light receiver to the optocoupler, and to a method for operating a lamp with such a lighting system, in which method ambient light is detected via a light receiver, is transported to an optocoupler via an optical waveguide, which is connected to the light receiver, and is converted by the optocoupler into an electrical signal, which is supplied to an electronic ballast and is used to control said ballast in response to the detected ambient light, the ballast operating the lamp in response to the control.

Preferred configurations are specified in the dependent claims and will be explained below. The entire disclosure is in this case to be understood both in terms of the apparatus aspect and in terms of the method aspect of the invention, without an explicit distinction being drawn specifically between said aspects.

The basic concept of the invention consists in the use of an optical waveguide between the light receiver and the ballast. The optical waveguide is intended to connect the light receiver optically to an optocoupler, which for its part is electrically connected to the ballast. On the part of the light receiver, however, no optoelectronic conversion is intended to be provided; the light receiver should in this case only denote the device for light entry, i.e. can in the simplest case be an end surface of the optical waveguide. The light to be detected is therefore transported as far as the optocoupler by the optical waveguide without being converted into electrical signals, which optocoupler for its part may be arranged, if required, also in the direct vicinity of the ballast or preferably even integrated structurally in the ballast.

The light receiver therefore corresponds to the light sensor from the prior art only insofar as it absorbs light and the line to the ballast feeds in a corresponding signal, which in this case itself is a light signal, however. Owing to the fact

that there is no electrical light sensor, the light receiver, i.e. the top of the optical waveguide or an optical apparatus fitted there, can be designed to be very small and unnoticeable and can also be matched well to specific structural conditions. That is to say that solutions which are improved in terms of the esthetic appearance and matching to a predetermined design can be found by virtue of the light receiver being capable of being integrated in a very unnoticeable and adaptable manner. Conventional light receivers, on the other hand, are comparatively large and are often very disruptive visually. Depending on the structural implementation, for example integrated in luminaires or fitted to ceilings, they can have a disadvantageous influence on the design of other devices.

In addition, owing to the omission of the electrical transition between the light receiver and the optocoupler, further advantages can also result, for example the avoidance of electromagnetic interference, the lack of problems associated with dielectric strength, voltage protection and the like. Specifically, the light entry opening at the top of the optical waveguide or the optical apparatus fitted there as light receiver are voltage-insulated and therefore inherently safe. Necessary openings for fitting purposes can be reduced to very small diameters in the millimeters range. There is no longer any risk of short circuits.

The ambient light can originate from the physical environment which is to be illuminated by the lamp operated by the ballast. Then, the brightness can be detected by the light receiver by means of the lamp lighting or by means of otherwise artificial lighting or else daylight or mixed lighting in order to match, for example, a dimming state of the ballast and of the lamp. It is also possible for a presence recognition of moving objects in the environment to be involved, as will be explained in more detail further below, to be precise including light barriers, in which ambient light is masked by moving objects.

The optical waveguide between the light receiver and the optocoupler does not necessarily need to be continuous. In individual cases it may be of interest to interpose an electrical device, for example for signal amplification in the case of long transmission paths or for signal distribution, mixing or injection in the case of relatively complex lighting systems. However, it is preferred for the optical waveguide to be designed to be continuous, i.e. for there to be purely optical transmission via optical conductors between the light receiver and the optocoupler. Furthermore, this optical waveguide is preferably also integral, i.e. does not comprise a plurality of structurally separate parts, in order to minimize the structural complexity and losses.

It is further preferable to utilize optical plug-type connection elements known per se for the invention, i.e. to fit the optical waveguide at least to the optocoupler and/or to the light receiver by means of an optical plug-type connection element. Since in the preferred cases the end of the optical waveguide itself is in the form of a light receiver, this relates in particular to an optical plug-type connection element on the optocoupler. Since the optocoupler is preferably integrated in the ballast, in this case there is naturally an optical plug-type connection element on the ballast itself.

A further possible configuration provides for an imaging light receiver and optical waveguide, i.e. for example an optical waveguide with a large number of parallel fibers. Such imaging systems are particularly suitable for applications for presence checking, since movements can be detected by them without any marked changes in the detected brightness (mean) value.

Some of the mentioned advantages of the use of optical waveguides are also true for additional connections in terms of signal technology in a lighting system or a relatively large lighting assembly. It is therefore preferred for the ballast to

have an optical output and/or input for data communication via a further or the same optical waveguide. For example, an external device could be optically connected to the optical waveguide in order to read or write data, for example by virtue of it being fitted with an optical interface in the vicinity of the light receiver.

Preferred applications are also more complex lighting systems or lighting assemblies in which a plurality of ballasts occur and are preferably connected to a common light receiver via a common optical waveguide. In this case, the optical waveguide can be split in such a way that it delivers the light signal injected via the light receiver to the optocoupler of the various ballasts. In a further preferred configuration, the ballasts also split the optocoupler and are electrically connected to a common optocoupler.

Preferred are in particular applications in the sector of digital lighting assemblies, i.e. those lighting assemblies in which control devices communicate via digital communication protocol with connected ballasts. This relates in particular to lighting assemblies which function on the basis of the so-called DALI (digital addressable lighting interface) protocol.

The invention will be explained in more detail below with reference to an exemplary embodiment, with the individual features disclosed also being capable of being essential to the invention in other combinations and the description above and below relating to both the apparatus category and the method category of the invention.

Brief description of the drawing

Figure 1 shows a simplified block circuit diagram of a lighting system according to the invention.

Figure 2 shows a block circuit diagram corresponding to figure 1 relating to a variant of the lighting system according to the invention as a second exemplary embodiment.

Preferred embodiment of the invention

Figure 1 shows a lighting system according to the invention with three low-pressure discharge lamps LA1, LA2 and LA3, which are each supplied via supply terminals 1-4 by a respective electronic ballast "EVG QT DALI" 1-3. The lamps LA1-LA3 are conventional. The ballasts, in terms of their electrical and electronic construction, are likewise conventional and well known to a person skilled in the art apart from the particular features explained below. The ballasts in question here are specifically ballasts from the manufacturer OSRAM with the type designation Quicktronic DALI, which are designed for digital control on the basis of the DALI protocol. For this purpose, the ballasts have digital control terminals DA, via which they can be controlled in a bus circuit by a common light control device LSG, which is likewise designed for the DALI protocol.

In addition, the ballasts are connected via a supply circuit with three phases L1, L2 and L3, which are each associated with one of the ballasts, and a neutral conductor N and a protective earth conductor PE to a power supply.

The light control device LSG also has a digital control terminal with a digital control line DSL connected thereto, via which digital control line it can be controlled externally via a pushbutton switch, a PC or in another manner or else can be programmed.

Finally, the light control device has an optical waveguide LWL, which is plugged in via a plug-type connection element SV, which is not illustrated specifically here, for connection to

an optocoupler OK, which optical waveguide comprises optical fibers and leads to a top K, which is emphasized by a box in the drawing, of the optical waveguide. This top K represents a fitting sleeve, with which the end of the optical waveguide LWL is held in the outer housing of a luminaire, which comprises the three lamps LA1-LA3, the associated ballasts and the light control device LSG, in integrated fashion. When viewed from the outside, the light-absorbing surface is only a small one which is a few millimeters in size, is coupled optically to the optical waveguide LWL and focuses the light received via its surface in the optical waveguide.

The optical waveguide LWL is moreover integral and in this case has a length of approximately 10-15 m, with markedly smaller lengths, for example up to 1 m, and markedly larger lengths up to 100 m or more also being possible in principle.

In addition, the light control device LSG has an optical output and an optical input, which are connected to the optocoupler OK. Thus, an optical link can be picked up with a mobile handheld device and an optical interface, i.e. a light entry face and light exit face, in the vicinity of the optical waveguide top K, and data can be read from and written to the light control device or, via said light control device, the ballasts.

The optical waveguide LWL may in particular be a fiber bundle and can thus input an image, even if this has a coarse grid pattern, into an optocoupler OK which likewise detects an image. The light control device LSG can therefore also detect movements independently of the change in a brightness mean value and, in response to this, switch the light on or switch it to a higher brightness level, for example.

Figure 2 shows a second exemplary embodiment with a variant of the lighting system shown in figure 1. The difference consists in the fact that the light control device LSG1-LSG3 with the

optocoupler OK1-OK3 and the plug-type connection element SV1-SV3 is provided a plurality of times, to be precise once per ballast, and the optical waveguide is split in such a way that in each case one branch LWL1-LWL3 leads to another optocoupler OK1-OK3. In this case, the splitting is therefore provided optically between the optocouplers OK1-OK3 in the light control devices LSG1-LSG3 and the integral optical waveguide top K, and not electrically as in the variant in figure 1 between the light control device LSG therein and the ballasts. Combinations of electrical and optical splitting are naturally possible. The common light receiver K can also be formed by directly adjacent optical waveguide tops of separate optical waveguides LWL.

CLAIMS

1. A lighting system with an electronic ballast (EVG QT DALI 1-3) and a light receiver (K), which is connected in terms of signal technology to the ballast (EVG QT DALI 1-3), for receiving ambient light and for controlling the ballast (EVG QT DALI 1-3) in response to the ambient light, characterized by an optocoupler (OK, OK1-OK3), which is electrically connected to the ballast (EVG QT DALI 1-3), and an optical waveguide (LWL, LWL1-LWL3), which optically connects the light receiver (K) to the optocoupler (OK, OK1-OK3).
2. The lighting system as claimed in claim 1, in which the optocoupler (OK, OK1-OK3) is integrated structurally in the ballast (EVG QT DALI 1-3).
3. The lighting system as claimed in claim 1 or 2, in which the optical waveguide (LWL, LWL1-LWL3) is present continuously or preferably integrally between the light receiver (K) and the optocoupler (OK, OK1-OK3).
4. The lighting system as claimed in one of the preceding claims, in which the optical waveguide (LWL, LWL1-LWL3) can be fitted on the optocoupler (OK, OK1-OK3) and/or on the light receiver (K) by means of an optical plug-type connection element (SV, SV1-SV3).
5. The lighting system as claimed in one of the preceding claims, in which the light receiver (K) and the optical waveguide (LWL, LWL1-LWL3) are imaging.
6. The lighting system as claimed in one of the preceding claims, in which the ballast has at least one optical input or output for data communication via an optical waveguide (LWL, LWL1-LWL3).

7. The lighting system as claimed in one of the preceding claims with a plurality of ballasts (EVG QT DALI 1-3) with a common light receiver (K), which is optically connected to the individual ballasts (EVG QT DALI 1-3) via at least one optical waveguide (LWL1-LWL3).

8. The lighting system as claimed in one of the preceding claims with a plurality of ballasts, which are electrically connected to a common optocoupler (OK), the common optocoupler (OK) being connected to a common light receiver (K) via a common optical waveguide (LWL).

9. A lighting assembly with a digital control device (LSG, LSG1-LSG3) and a plurality of digitally drivable ballasts (EVG QT DALI 1-3) and with a lighting system as claimed in one of the preceding claims.

10. A method for operating a lamp using a lighting system or a lighting assembly as claimed in one of claims 1-9, in which method ambient light is detected via a light receiver (K), is transported to an optocoupler (OK, OK1-OK3) via an optical waveguide (LWL, LWL1-LWL3), which is connected to the light receiver (K), and is converted by the optocoupler (OK, OK1-OK3) into an electrical signal, which is supplied to an electronic ballast (EVG QT DALI 1-3) and is used to control said ballast (EVG QT DALI 1-3) in response to the detected ambient light, the ballast (EVG QT DALI 1-3) operating the lamp (LA 1-3) in response to the control.