(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 855 871 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.07.2021 Bulletin 2021/30

(51) Int Cl.:
H05B 47/18 *(2020.01)*

(21) Application number: **20153305.6**

(22) Date of filing: **23.01.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **METHOD FOR PERFORMING A FIRMWARE UPDATE OF A LIGHTING TECHNOLOGY DEVICE**

(57) The invention relates to a method (100) for performing a firmware update of a lighting technology device (300), comprising the steps of: supplying (101) firmware update data according to a firmware update protocol; transmitting (103) said firmware update data via a DALI bus (303) using the physical layer of a DALI signal; and receiving (105) said firmware update data at a DALI interface (305) of said lighting technology device (300); wherein the firmware update data is obtained directly by translating changes of the physical states, in particular phase changes of a square wave carrier signal, of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol.

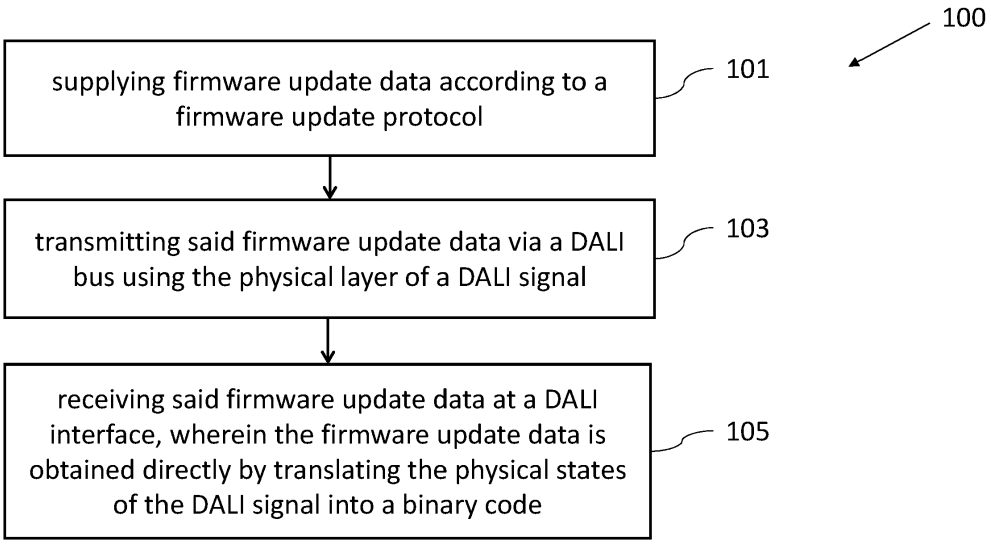

Fig. 1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates a method for performing a firmware update of a lighting technology device, in particular via a DALI bus. The invention further relates to a lighting technology device capable of receiving such a firmware update, and a system for performing a firmware update via a DALI bus.

BACKGROUND OF THE INVENTION

[0002] Lighting systems for buildings often comprise a number of lighting technology devices, such as drivers for luminaires, sensors or user interfaces, which can be connected to a central unit via a bus. The bus can be a DALI bus, which allows controlling the lighting technology devices.

[0003] Such lighting technology devices are often controlled and/or operated by a software called firmware, which is embedded in the device. To provide new features or to eliminate errors, the firmware can be updated to a newer version (firmware update).

[0004] It is known to provide firmware updates to lighting technology devices via a bus to which the device is connected. For instance, the document WO 2006/066884 A1 discloses a method for programming a driver of a luminaire in which the firmware of the driver is updated via a bus interface, in particular a PLC interface, of the driver.

[0005] The document WO 2012/028541 discloses a method for programming multiple lighting bus subscribers by a central unit, which is connected to the lighting bus subscribers via a bus.

[0006] However, if a firmware update is provided to a device via a bus interface using the known techniques, the data received at the interface first needs to be decoded and converted to a suitable firmware update protocol by the device. For this purpose, the device typically uses dedicated software that is stored in a memory of the device.

[0007] However, this conversion and decoding use up resources of the device, in particular memory space and programming power. For instance, a separate flash region of the device is required to store the software. Thus, the device complexity and cost are increased.

[0008] Thus, it is an objective to provide an improved method for performing a firmware update of a lighting technology device, an improved lighting technology device, and an improved system for performing a firmware update via a DALI bus. In, particular it is an object to provide a resource-saving method for performing a firmware update of a device via a DALI bus, especially without the need to decode a bus signal after receipt at the device.

SUMMARY OF THE INVENTION

[0009] 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.

[0010] According to a first aspect the invention relates to a method for performing a firmware update of a lighting technology device, comprising the steps of: supplying firmware update data according to a firmware update protocol; transmitting said firmware update data via a DALI bus using the physical layer of a DALI signal; and receiving said firmware update data at a DALI interface of said lighting technology device; wherein the firmware update data is obtained directly by translating changes of the physical states, in particular dedicated phase changes of a square wave carrier signal, of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol. This achieves the advantage that the firmware of the lighting technology device can be updated efficiently and by using fewer resources of the device.

[0011] In particular, no decoding and/or conversion of the DALI signal to data according to the firmware update protocol is required at the lighting technology device.

[0012] Furthermore, updating the firmware via the DALI interface of the device is time and cost saving, since the update can be performed on site, e.g. in a warehouse, without disassembling the device or opening a housing of the device.

[0013] The lighting technology device can be a driver for a luminaire, such as a gas discharge lamp, a LED, an OLED or a halogen lamp. The driver can comprise a DALI interface and a microprocessor. The driver can be a 0-10 V driver.

[0014] Furthermore, the lighting technology device can comprise a sensor, e.g. a motion, a smoke or light sensor, a control unit or a user interface, e.g. a dimmer or a touchscreen.

[0015] The firmware update can be supplied by a central unit connected to the DALI bus via a DALI interface of the central unit. The central unit can comprise a data processing apparatus, such as a computer.

[0016] The firmware can be embedded software of the lighting technology device for controlling and/or operating the device. In particular, the firmware provides low-level control of specific device features and/or acts as the device's operating system. The firmware can be stored in a memory of the lighting technology device.

[0017] The firmware update data can be data that replaces at least a part of a current device firmware after performing the firmware update.

[0018] The physical layer of the DALI signal can refer to the physical properties of the signal. In particular, the physical layer comprises the physical states of the signal, e.g. the modulation of the signal level and the corresponding phase change or the signal strength of the DALI signal over time.

[0019] In an embodiment, the firmware update protocol is one of the following protocols: UART (Universal Asynchronous Receiver Transmitter), USART (Universal Synchronous/Asynchronous Receiver Transmitter), I2C (Inter Integrated Circuit), SPI (Serial Peripheral Interface), or USB (Universal Serial Bus).

[0020] In particular, the firmware update protocol is a synchronous and/or an asynchronous serial protocol.

[0021] In an embodiment, the method comprises the further step of: setting the lighting technology device in a firmware update mode, in particular by forwarding an initiation command to the lighting technology device. This provides the advantage that the lighting technology device can be adjusted efficiently to receive the firmware update data via the DALI bus.

[0022] Preferably, the lighting technology device in the firmware update mode does not decode signals received at the DALI interface as DALI signals. Instead, it directly translates the physical states or the changes of the physical states, in particular phase changes, of the received DALI signal into a binary code.

[0023] The lighting technology device can be configured to exit the firmware update mode after performing a firmware update, such that subsequent data received at the DALI interface will be decoded as DALI signals.

[0024] In an embodiment, the step of supplying the firmware update data according to the firmware update protocol comprises the steps of: providing a USB signal representing the firmware update data; and converting the USB signal to the firmware update data according to the firmware update protocol via an adapter unit, in particular via a USB to RS232 adapter. This provides the advantage that the firmware update data can be provided efficiently.

[0025] The USB signal can be transferred to the central unit connected to the DALI bus via a USB interface of the central unit. The central unit can comprise the adapter unit, in particular the USB to RS232 adapter, to transfer the USB signal to data according to the firmware update protocol.

[0026] In an embodiment, the step of transmitting said firmware update data via the DALI bus comprises: generating the DALI signal which's physical states, in particular phase changes of the physical states, represent the firmware update data, and transmitting said DALI signal over the DALI bus. This achieves the advantage that the firmware update data can be transferred efficiently to the lighting technology device.

[0027] The DALI signal can be generated based on the firmware update data by the central unit connected to the DALI bus. The central unit can comprise a processing unit for generating the DALI signal and a DALI interface for transmitting the DALI signal via the DALI bus.

[0028] In an embodiment, the physical states of the DALI signal comprise a sequence of modulations of the signal level.

[0029] Translating the physical states of the DALI signal into the binary code can refer to detecting the modulations of the DALI signal, and assigning binary code to these modulations, in particular to the phase changes of a modulated square wave carrier signal. In particular, the modulations are detected at the DALI interface of the lighting technology device.

[0030] For instance, during translation of changes of the physical states, a 1 is assigned to a change from a first to a second signal level and a 0 is assigned to a change from the second back to the first signal level, such that a binary code is generated; this binary code can correspond to the firmware update data according to the firmware update data protocol. In particular, the DALI signal is a Manchester coded signal.

In an embodiment, the method comprises the further step of updating the firmware of the lighting technology device based on the received firmware update data. This provides the advantage that the firmware of the lighting technology device can be updated efficiently.

[0031] In an embodiment, the update is performed by a processing unit of the lighting technology device, in particular an ASIC or a microcontroller of the processing unit. This provides the advantage that the update can be performed efficiently.

[0032] The processing unit can perform the update based on the binary code representing the firmware update data, which is forwarded to the processing unit by the DALI interface.

[0033] The lighting technology device can comprise a boot loader for performing the firmware update based on the firmware update data.

[0034] The boot loader can be a software of the lighting technology device that is executed by the processing unit of the device. Alternatively, the boot loader can be a part of the processing unit of the device.

[0035] In an embodiment, the lighting technology device comprises a memory, in particular a flash memory. The firmware and/or the boot loader of the device can be stored in the memory.

[0036] According to a second aspect, the invention relates to a lighting technology device, comprising a DALI interface, wherein the lighting technology device is settable to a firmware update mode, wherein the lighting technology device in the firmware update mode is configured to translate signals received at the DALI interface directly to a binary code representing firmware update data according to a firmware update protocol. This achieves the advantage that the firmware of the lighting technology device can be updated efficiently and by using fewer resources of the device.

[0037] Preferably, the lighting technology device in the firmware update mode does not decode signals received at the DALI interface as DALI signals. Instead, it directly translates the changes of the physical states of the DALI signal into a binary code.

[0038] The lighting technology device can be configured to exit the firmware update mode after performing a firmware update, such that subsequent data received at the DALI interface will be decoded as DALI signals.

[0039] In an embodiment, the lighting technology device is set to the firmware update mode upon receiving an initiation command.

[0040] In an embodiment, the lighting technology device is configured to receive the initiation command at the DALI interface, in particular in form of a DALI signal. This achieves the advantage that the lighting technology device can be set to the firmware update mode efficiently via DALI.

[0041] Alternatively, the initiation command can be a RS232 command.

[0042] In an embodiment, the lighting technology device comprises a communication interface, in particular a pin, wherein the lighting technology device is configured to receive the initiation command at the communication interface. This achieves the advantage that the lighting technology device can be set to the firmware update mode efficiently.

[0043] In an embodiment, the lighting technology device comprises a processing unit, in particular a microcontroller or an ASIC, configured to perform a firmware update based on the received firmware update data. This provides the advantage that the update can be performed efficiently.

[0044] The processing unit can perform the update based on the binary code representing the firmware update data. Preferably, the processing unit executes a boot loader.

[0045] In an embodiment, the lighting technology device comprises a memory, in particular a flash memory, for storing the firmware and/or the boot loader.

[0046] In an embodiment, at least a section of the data stored in the memory is overwritten during the firmware update.

[0047] In an embodiment, lighting technology device comprises an echo cancellation circuit configured to suppress signal echoes, in particular signal echoes back to a sender of the DALI signals. This achieves the advantage that the signal is not fed back to the sender, in particular to Rx pins of the sender.

[0048] In an embodiment, the lighting technology device is a driver for a luminaire, a DALI-enabled sensor or a DALI-enabled control unit.

[0049] The luminaire can be a gas discharge lamp, a LED, an OLED or a halogen lamp. The sensor can be a motion, smoke or light sensor. The control unit can comprise a user interface, e.g. a dimmer or a touchscreen.

[0050] According to a third aspect, the invention relates to a system for performing a firmware update via a DALI bus, comprising a central unit, and a lighting technology device, in particular the lighting technology device according to the second aspect of the invention, wherein the central unit is connected to the lighting technology device via the DALI bus, wherein the central unit is configured to transmit firmware update data according to a firmware update protocol to the lighting technology device via the DALI bus using the physical layer of a DALI signal, and wherein the lighting technology device comprises a DALI interface, which is configured to receive the firmware update data, wherein the lighting technology device is configured to obtain the firmware update data directly by translating changes of the physical states, in particular dedicated phase changes of a square wave carrier signal, of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol.

[0051] The central unit can comprise a data processing apparatus, such as a computer. The central unit can be connected to the DALI bus via a DALI interface.

[0052] Preferably, the central unit is configured to supply the firmware update data according to the firmware update protocol.

[0053] In an embodiment, the central unit is configured to provide a USB signal representing the firmware update data, and to convert the USB signal to the firmware update data according to the firmware update protocol via an adapter unit, in particular via a USB to RS232 adapter.

[0054] In an embodiment, the central unit is configured to set the lighting technology device in a firmware update mode, in particular by forwarding an initiation command to the lighting technology device.

[0055] Preferably, the central unit is configured to forward the initiation command as a DALI signal via the DALI interface to the lighting technology device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] The invention will be explained in the followings together with the figures.

Fig. 1 shows a schematic diagram of a method for performing a firmware update of a lighting technology device according to an embodiment;

Fig. 2 shows a schematic diagram of a method for performing a firmware update of a lighting technology device according to an embodiment;

Fig. 3 shows a schematic diagram of a lighting technology device according to an embodiment;

Fig. 4 shows a schematic diagram of a system for performing a firmware update via a DALI bus according to an embodiment;

Fig. 5 shows a schematic diagram of a system for performing a firmware update via a DALI bus according to an embodiment; and

Fig. 6 shows a schematic diagram of an echo cancellation circuit according to an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0057] 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.

[0058] 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.

[0059] 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. The same references signs will be used throughout the drawings and the following detailed descriptions to refer to the same or like parts.

[0060] Fig. 1 shows a schematic diagram of a method 100 for performing a firmware update of a lighting technology device according to an embodiment.

[0061] The method 100 comprises the steps of:

- supplying 101 firmware update data according to a firmware update protocol;
- transmitting 103 said firmware update data via a DALI bus using the physical layer definition of a DALI signal; and
- receiving 105 said firmware update data at a DALI interface of said lighting technology device;

wherein the firmware update data can be obtained directly by translating changes of the physical states of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol.

[0062] The changes of the physical states of the DALI signal can correspond to dedicated phase changes of a square wave carrier whose frequency is the data rate of the firmware update data.

[0063] The firmware update data can be data that replaces at least a part of a current device firmware after performing the firmware update.

[0064] Since the firmware update data is received 105 according to the firmware update protocol at the lighting technology device, no separate step of decoding the DALI signal at the device is required. Hence, no dedicated software for this purpose needs to be stored in a separate flash region of the device memory.

[0065] The firmware update protocol can be one of the following protocols: UART, USART, I2C, SPI, or USB. In particular, the firmware update protocol is a synchronous and/or an asynchronous serial protocol.

[0066] Preferably, the physical states of the DALI signal comprise a sequence of modulations of the signal level. In particular, the sequence of modulations, in particular phase changes, of the DALI signal represents the binary code, which corresponds to the firmware update data according to the firmware update protocol, in particular UART.

[0067] Fig. 2 shows a schematic diagram of the method 100 for performing a firmware update of a lighting technology device according to an embodiment.

[0068] The method 100, as shown in Fig. 2, comprises the additional step of: setting 201 the lighting technology device in a firmware update mode. In particular, this step 201 is performed before the step of transmitting 103 the firmware update data via the DALI bus using the physical layer of the DALI signal.

[0069] The lighting technology device can be set 201 in the firmware update mode, by forwarding an initiation command to the lighting technology device, for instance by the same central unit that also forwards the firmware update data.

[0070] The lighting technology device can be configured not to decode signals received at the DALI interface as DALI signals if it is in the firmware update mode. Instead, it directly translates changes of the physical states of the DALI signal into a binary code.

[0071] After performing a firmware update, the firmware update mode can be quit and the lighting technology device can return to a default mode, where it decodes signals received at the DALI interface as DALI signals again.

[0072] Preferably, the step of supplying 101 firmware update data according to an update protocol, as shown in Fig. 1, comprises the two sub-steps:

- providing 203 a USB signal representing the firmware update data; and
- converting 205 the USB signal to the firmware update data according to the firmware update protocol via an adapter unit.

[0073] Preferably, the adapter is configured to convert the USB signal to firmware update data according to the UART protocol. The adapter unit can be an USB to RS232 adapter, in particular a FTDI serial adapter.

[0074] Preferably, the step of transmitting 103 the firmware update data via the DALI bus using the physical layer of a DALI signal, as shown in Fig. 1, comprises the two sub-steps:

- generating 207 the DALI signal which's physical states, in particular phase changes of the physical states, represent the firmware update data, and
- transmitting 209 said DALI signal over the DALI bus.

[0075] The DALI signal can be generated 207 based on the firmware update data by a central unit connected to the DALI bus.

[0076] The central unit can comprise a processing unit for generating the DALI signal and a DALI interface for transmitting 209 the DALI signal via the DALI bus.

[0077] The method 100, as shown in Fig. 2, further comprises the step of: updating 211 the firmware of the lighting technology device based on the received firmware update data.

[0078] Preferably, the firmware update is performed by a processing unit of the lighting technology device, for instance a microcontroller or an ASIC. The processing unit can perform the update based on the binary code representing the firmware update data.

[0079] The firmware update can be performed by a boot loader. The boot loader can be a software of the lighting technology device that is executed by the processing unit to perform the firmware update based on the provided firmware update data.

[0080] Fig. 3 shows a schematic diagram of a lighting technology device 300 according to an embodiment.

[0081] The lighting technology device 300 comprises a DALI interface 305, wherein the lighting technology device 300 is settable to a firmware update mode, wherein the lighting technology device 300 in the firmware update mode is configured to translate signals received at the DALI interface 305 directly to the binary code representing firmware update data according to the firmware update protocol.

[0082] The lighting technology device 300 can be connected to a DALI bus 303 via its DALI interface 305. The DALI interface 305 can be configured to receive the firmware update data from the DALI bus 303.

[0083] The lighting technology device 300 can be a driver for a luminaire 301, for instance a LED, an OLED, a gas discharge lamp or a halogen lamp.

[0084] Alternatively, the lighting technology device 300 can be a sensor, for instance a motion, smoke or light sensor, or a control unit, e.g. a dimmer or a touchscreen, in particular for controlling a luminaire.

[0085] The lighting technology device 300 can be arranged in a building, e.g. an office or a warehouse, or outdoors. The lighting technology device 300 can be connected to an energy supply, e.g. the AC mains, of the building.

[0086] The lighting technology device, shown in Fig. 3, comprises a processing unit 307, for instance a microcontroller and/or an ASIC.

[0087] The DALI interface 305 can be configured to forward received signals to the processing unit 307, for translating the signals to the binary code representing the firmware update data if the device 300 is in the firmware update mode. Alternatively, the DALI interface 305 itself can be configured to directly translate the signal to the binary code, and forward this binary code to the processing unit 307.

[0088] The processing unit 307 can further be configured to perform the firmware update based on the data received at the DALI interface 305. Preferably, the processing unit 307 performs the firmware update based on the binary code representing the firmware update data.

[0089] Preferably, the firmware update is performed by a boot loader. The boot loader can be a software of the lighting technology device that is executed by the processing unit to perform the firmware update based on the provided firmware update data.

[0090] The lighting technology device 300 can further comprise a memory 309, in particular a flash memory.

[0091] The firmware of the lighting technology device 300 can be stored in the memory 309. During the firmware update, at least a section of the data stored in the memory can be overwritten to provide an updated firmware version.

[0092] In particular, only a portion of the device firmware is updated by the firmware update, e.g. only ASIC settings or device specific settings. The ASIC setting can be parameters used by the ASIC for control.

[0093] The boot loader can be an embedded boot loader that is stored in the memory 309 of the device 300. The boot loader can be configured to reprogram the memory 309 using one of the following interfaces: USART on pins, I2C on pins or USB DFU (USB Device Firmware Update) interface.

[0094] The lighting technology device 300 can be configured to set itself to the firmware update mode upon receiving an initiation command. In particular, the processing unit 307 can be configured to set the lighting technology device 300 in the firmware update mode.

[0095] The initiation command can be a DALI signal and/or a RS232 command.

[0096] The lighting technology device 300 can be configured to receive the initiation command at the DALI interface 305.

[0097] The lighting technology device 300 can comprise a communication interface 311. The communication interface 311 can be a pin, in particular a pin of the processing unit 307.

[0098] The lighting technology device 300 can be configured to receive the initiation command at the communication interface 311.

[0099] The initiation command can be issued to a selected lighting technology device 300 on the DALI bus 303, for instance as a DALI signal that only addresses the selected device, such that only this device is put into the update mode. In this way, firmware updates can be issued to selected devices on the DALI bus 303, while other devices connected to the same bus are not updated.

[0100] Preferably, the lighting technology device 300

is configured not to decode signals received at the DALI interface 305 as DALI signals if the device 300 is in the firmware update mode.

[0101] Preferably, the lighting technology device 300 is configured to exit the firmware update mode after performing a firmware update, and to decode subsequent data received at the DALI interface 305 as DALI signals.

[0102] Furthermore, the lighting technology device 300 can comprise an echo cancellation circuit 313 configured to suppress signal echoes.

[0103] The echo cancellation circuit 313 can be configured to suppress signal echoes between the DALI interface and the processing unit, in particular echoes from the DALI interface 305 that can be received at the processing unit 307, or signal echoes on the DALI bus 303.

[0104] Fig. 4 shows a schematic diagram of a system 400 for performing a firmware update via the DALI bus 303 according to an embodiment.

[0105] The system 400 comprises a central unit 401, and a lighting technology device 300, wherein the central unit 401 is connected to the lighting technology device 300 via the DALI bus 303, wherein the central unit 401 is configured to transmit the firmware update data according to the firmware update protocol to the lighting technology device 300 via the DALI bus 303 using the physical layer of the DALI signal.

[0106] The lighting technology device 300 can comprise a DALI interface 305, which is configured to receive the firmware update data, wherein the lighting technology device 300 is configured to obtain the firmware update data directly by translating the changes of the physical states of the DALI signal into the binary code representing the firmware update data according to the firmware update protocol.

[0107] Translating the changes physical states of the DALI signal into the binary code can refer to detecting modulations of the DALI signal, and assigning binary code to these modulations, in particular to the phase changes of the modulated signal. In particular, the modulations are detected at the DALI interface of the lighting technology device.

[0108] For instance, during translation of changes of the physical states, a 1 is assigned to a change from a first to a second signal level and a 0 is assigned to a change from the second back to the first signal level, such that a binary code is generated; this binary code can correspond to the firmware update data according to the firmware update data protocol.

[0109] The lighting technology device 300 in the system 400 shown in Fig. 4 can correspond to the lighting technology device 300 from Fig. 3.

[0110] The central unit 401 can be data processing apparatus, such as a computer. The central unit can be connected to the DALI bus via a DALI interface 403. The central unit 401 can comprise a processor.

[0111] The DALI interface 403 can be a component of the central unit 401, or can be a separate device of the system 400 connected to the central unit 401.

[0112] The central unit 401 can be configured to supply the firmware update data according to the firmware update protocol, in particular the UART protocol.

[0113] Preferably, the central unit 401 provides a USB signal representing the firmware update data and converts this USB signal to the USB signal to the firmware update data.

[0114] This conversion can be performed by an adapter unit 405, e.g. a USB UART converter. In Fig. 4, the adapter unit 405 is shown as a separate component of the system 400. Alternatively, the adapter unit can be a component of the central unit 401.

[0115] Preferably, the adapter unit 415 is a USB to RS232 adapter.

[0116] After this conversion, the central unit 401 can be configured to transmit the firmware update data in the UART protocol to the lighting technology device 300 via the DALI bus 303. Therefore, the central unit 401 transmits a DALI signal, which's physical layer comprises the firmware update according to the UART protocol (UART on DALI).

[0117] The lighting technology device 300 can subsequently receive the DALI signal via its DALI interface 305. The DALI interface 305 can further translate the changes of the physical states of the DALI signal into the binary code representing the firmware update data according to the firmware update protocol.

[0118] The processing unit 307 of the device 300 can then perform the firmware update based on the firmware update data.

[0119] The firmware update data can have a baud rate, which corresponds to a data transfer rate of the signal.

[0120] Preferably, a maximum deviation from an internal initialized baud rate and a real baud rate is below a threshold value, e.g. 2.5%. This ensures a correct data transfer from the host, e.g. the DALI interface 305 of the device 300, to the processing unit 307. In particular, the baud rate of the firmware update data according to the USART protocol is between 1.200 and 115.200. These values for the baud rate represent an advantageous embodiment, other values are also conceivable.

[0121] The system 400 in Fig. 4 further comprises a bus power supply unit 407 connected to the DALI bus 303.

[0122] The central unit 401 can further be configured to forward an initiation command to the lighting technology device 300, in particular before sending the firmware update data, in order to set the lighting technology device 300 in a firmware update mode.

[0123] The central unit 401 can forward the initiation command as a DALI signal via its DALI interface 403 and the DALI bus 303 to the device 300.

[0124] Fig. 5 shows a schematic diagram of the system 400 for performing a firmware update via the DALI bus 303 according to another embodiment. Thereby, the system 400 shown in Fig. 5 represents an improved version of the system 400 shown in Fig. 4 that mitigates the effect

of signal echoes.

[0125] The system 400 in Fig. 5 comprises two echo cancellation circuits 501, 313. The first echo cancelation circuit 405 is arranged between the adapter unit 405 and the DALI interface 403 on the central unit 401 side of the DALI bus 303, and the second echo cancelation circuit 313 is arranged in the lighting technology device 300 between the DALI interface 305 and the processing unit 307.

[0126] The echo cancellation circuits can be adapted to suppress echoes from the DALI interfaces 403, 305 to the adapter unit 405 and the processing unit 307, respectively. In particular, the echo cancellation circuits 405, 313 prevent that the hardware bootloader of the lighting technology device 300 and the firmware update software of the central unit 401 get confused due to receiving the signal they are sending as echoes.

[0127] The system 400 in Fig. 5 further comprises a USB-DALI adapter 505 that connects the central unit 401 to the DALI bus 303.

[0128] Furthermore, the lighting technology device 300 in Fig. 5 is connected to the mains supply for providing a power supply.

[0129] Fig. 6 shows a schematic diagram of an echo cancellation circuit 600 according to an embodiment.

[0130] The echo cancellation circuits 313, 501 from Figs. 3 and 5 can correspond to the echo cancellation circuit 600 shown in Fig. 6.

[0131] The echo cancellation circuit 600 comprises a first pair of pins 601a, 601b that are connected to the DALI interface 305, 403 and a second pair of pins 603a, 603b that are connected to the processing unit of the lighting technology device 300 or the central unit 401, respectively.

[0132] Preferably, the pins 601a, 603a are configured for forwarding data received at the DALI interface 305, 403 to the processing unit of the respective device via a first line, and pins 603b, 601b are configured to forward data in the other direction, from the processing unit to the respective DALI interface 305, 403 via a second line.

[0133] In the circuit 600 shown in Fig. 6, a number of gates A1, A2, A3, in particular NAND gates, are connected between both lines. The gates A1, A2, A3 can be configured to keep the signal at pin 603a at a high level while data is transmitted via pin 603b to the DALI interface 305, 403. Alternatively, the gates A1, A2, A3 can be replaced by transistors to allow for a higher baud rate and reduce the overall cost of the circuit 600.

[0134] Furthermore, the echo cancellation circuit 600 can be configured to invert the signals in order to be compatible with the UART high IDLE and the standard DALI interfaces.

[0135] Preferably, the echo cancellation circuit 600 is configured to eliminate negative pulses caused by propagation delay. The duration of these pulses can be 70ps. The echo cancellation circuit 600 can prevent that these pulses are interpreted as bits of the firmware update data by the processing unit 307, in particular at high baud rates.

[0136] All features of all embodiments described, shown and/or claimed herein can be combined with each other.

[0137] 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.

[0138] 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 one 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. A method (100) for performing a firmware update of a lighting technology device (300), comprising the steps of:

   - supplying (101) firmware update data according to a firmware update protocol;
   - transmitting (103) said firmware update data via a DALI bus (303) using the physical layer of a DALI signal; and
   - receiving (105) said firmware update data at a DALI interface (305) of said lighting technology device (300);

   wherein the firmware update data is obtained directly by translating changes of the physical states, in particular dedicated phase changes of a square wave carrier signal, of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol.

2. The method (100) according to claim 1, wherein the firmware update protocol is one of the following protocols: UART, USART, I2C, SPI or USB.

3. The method (100) according to any one of the preceding claims, comprising the further step of:

   - setting (201) the lighting technology device

(300) in a firmware update mode, in particular by forwarding an initiation command to the lighting technology device (300).

4. The method (100) according to any one of the preceding claims, wherein the step of supplying (101) the firmware update data according to the firmware update protocol comprises the steps of:

- providing (203) a USB signal representing the firmware update data; and
- converting (205) the USB signal to the firmware update data according to the firmware update protocol via an adapter unit (405), in particular via a USB to RS232 adapter.

5. The method (100) according to any one of the preceding claims, wherein the step of transmitting (103) said firmware update data via the DALI bus (303) comprises:

- generating (207) the DALI signal which's physical states, in particular phase changes of the physical states, represent the firmware update data; and
- transmitting (209) said DALI signal over the DALI bus (303) .

6. The method (100) according to any one of the preceding claims, wherein the physical states of the DALI signal comprise a sequence of modulations of the signal level.

7. The method (100) according to any one of the preceding claims, wherein the method (100) comprises the further step of:

- updating (211) the firmware of the lighting technology device (300) based on the received firmware update data.

8. The method (100) according to claim 7, wherein the update is performed by a processing unit (307) of the lighting technology device (300), in particular an ASIC or a microcontroller.

9. A lighting technology device (300), comprising:

a DALI interface (305),
wherein the lighting technology device (300) is settable to a firmware update mode,
wherein the lighting technology device (300) in the firmware update mode is configured to translate signals received at the DALI interface (305) directly to a binary code representing firmware update data according to a firmware update protocol.

10. The lighting technology device (300) of claim 9, wherein the lighting technology device (300) is set to the firmware update mode upon receiving an initiation command.

11. The lighting technology device (300) of claim 10, wherein the lighting technology device (300) is configured to receive the initiation command at the DALI interface (305), in particular in form of a DALI signal.

12. The lighting technology device (300) of any one of claims 10 to 11, wherein the lighting technology device (300) comprises a communication interface (311), in particular a pin, wherein the lighting technology device (300) is configured to receive the initiation command at the communication interface (311).

13. The lighting technology device (300) of any one of claims 9 to 12, wherein the lighting technology device comprises a processing unit (307), in particular a microcontroller or an ASIC, configured to perform a firmware update based on the received firmware update data.

14. The lighting technology device (300) of any one of claims 9 to 13, wherein the lighting technology device (300) comprises a memory (309), in particular a flash memory, for storing the firmware.

15. The lighting technology device (300) of any one of claims 9 to 14, comprising an echo cancellation circuit (313, 600) configured to suppress signal echoes, in particular signal echoes back to a sender of the DALI signal.

16. The lighting technology device (300) of any one of claims 9 to 15, wherein the lighting technology devices (300) is a driver for a luminaire, a DALI-enabled sensor or a DALI-enabled control unit.

17. A system (400) for performing a firmware update via a DALI bus (303), comprising:

a central unit (401), and
a lighting technology device (300), in particular the lighting technology device (300) of any one of claims 9 to 16,
wherein the central unit (401) is connected to the lighting technology device (300) via the DALI bus (303),
wherein the central unit (401) is configured to transmit firmware update data according to a firmware update protocol to the lighting technology device (300) via the DALI bus (303) using the physical layer of a DALI signal,
wherein the lighting technology device (300) comprises a DALI interface (305), which is con-

figured to receive the firmware update data, and wherein the lighting technology device (300) is configured to obtain the firmware update data directly by translating changes of the physical states, in particular dedicated phase changes of a square wave carrier signal, of the DALI signal into a binary code representing the firmware update data according to the firmware update protocol.

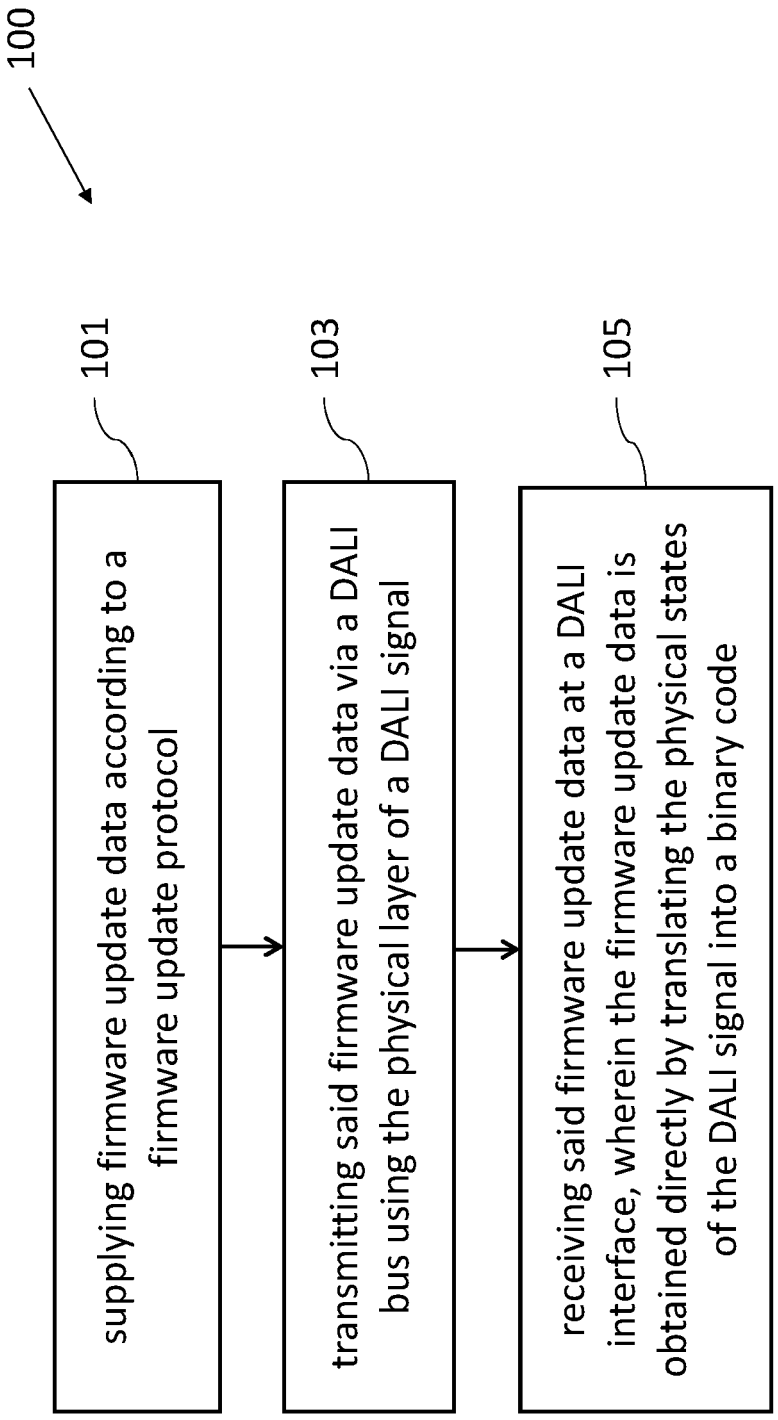
100
101
supplying firmware update data according to a firmware update protocol
103
transmitting said firmware update data via a DALI bus using the physical layer of a DALI signal
105
receiving said firmware update data at a DALI interface, wherein the firmware update data is obtained directly by translating the physical states of the DALI signal into a binary code

Fig. 1

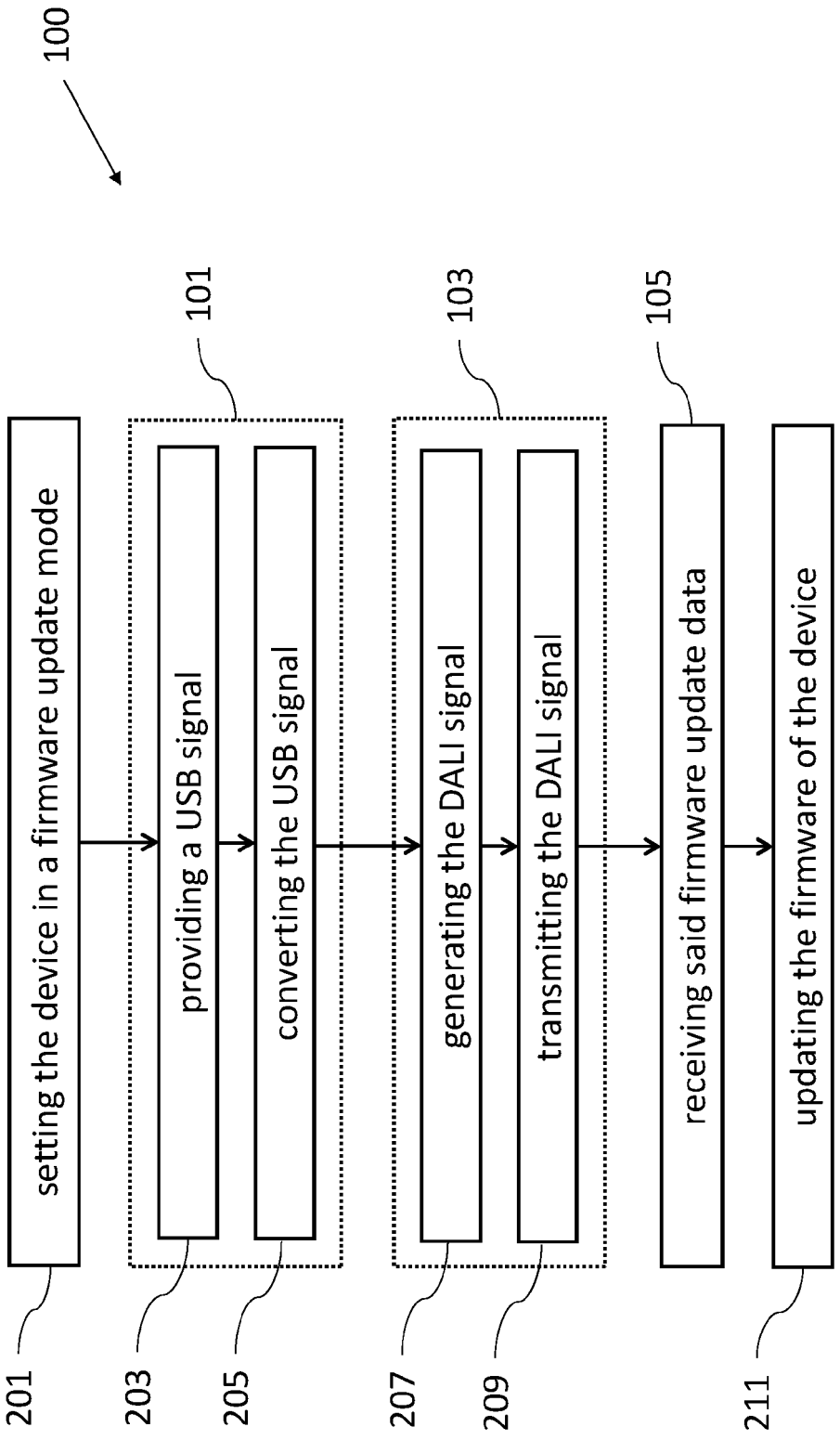
100
101
103
105
setting the device in a firmware update mode
providing a USB signal
converting the USB signal
generating the DALI signal
transmitting the DALI signal
receiving said firmware update data
updating the firmware of the device
201
203
205
207
209
211

Fig. 2

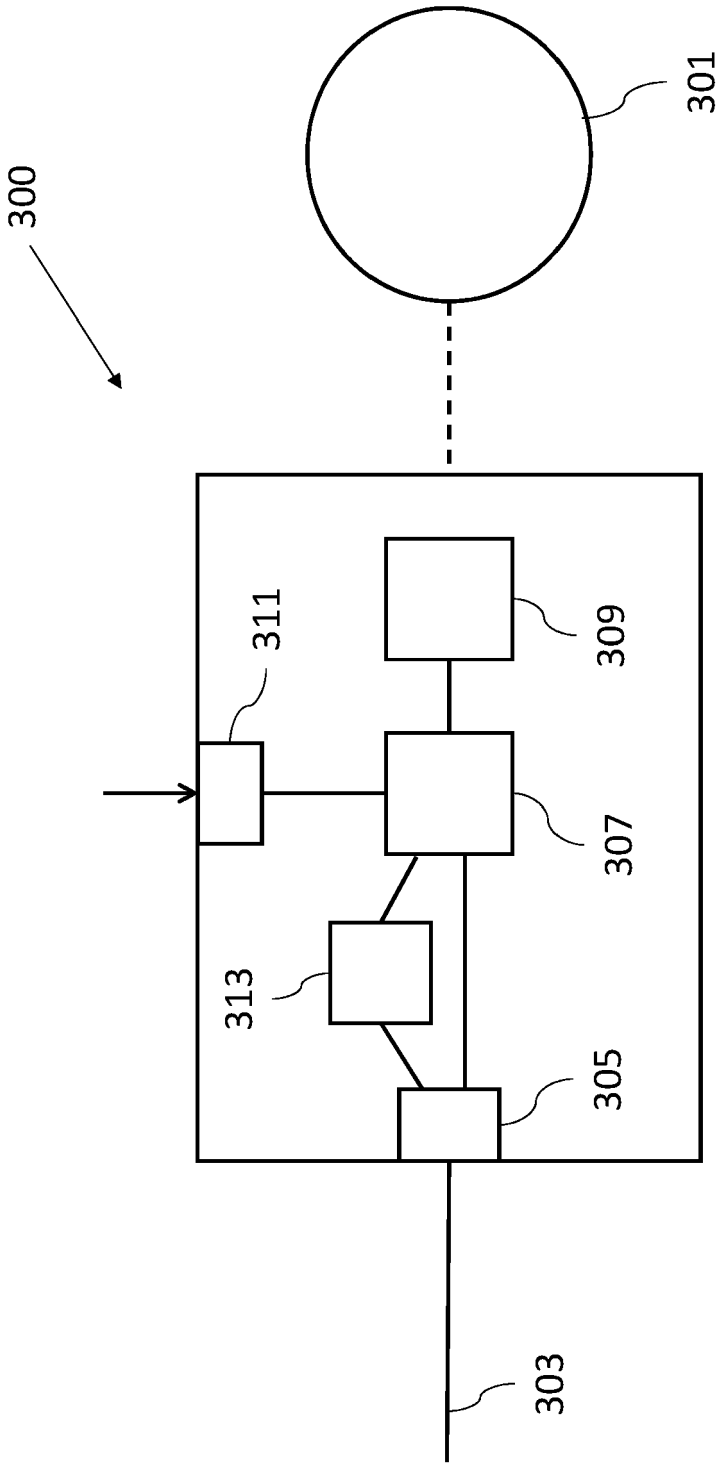

Fig. 3

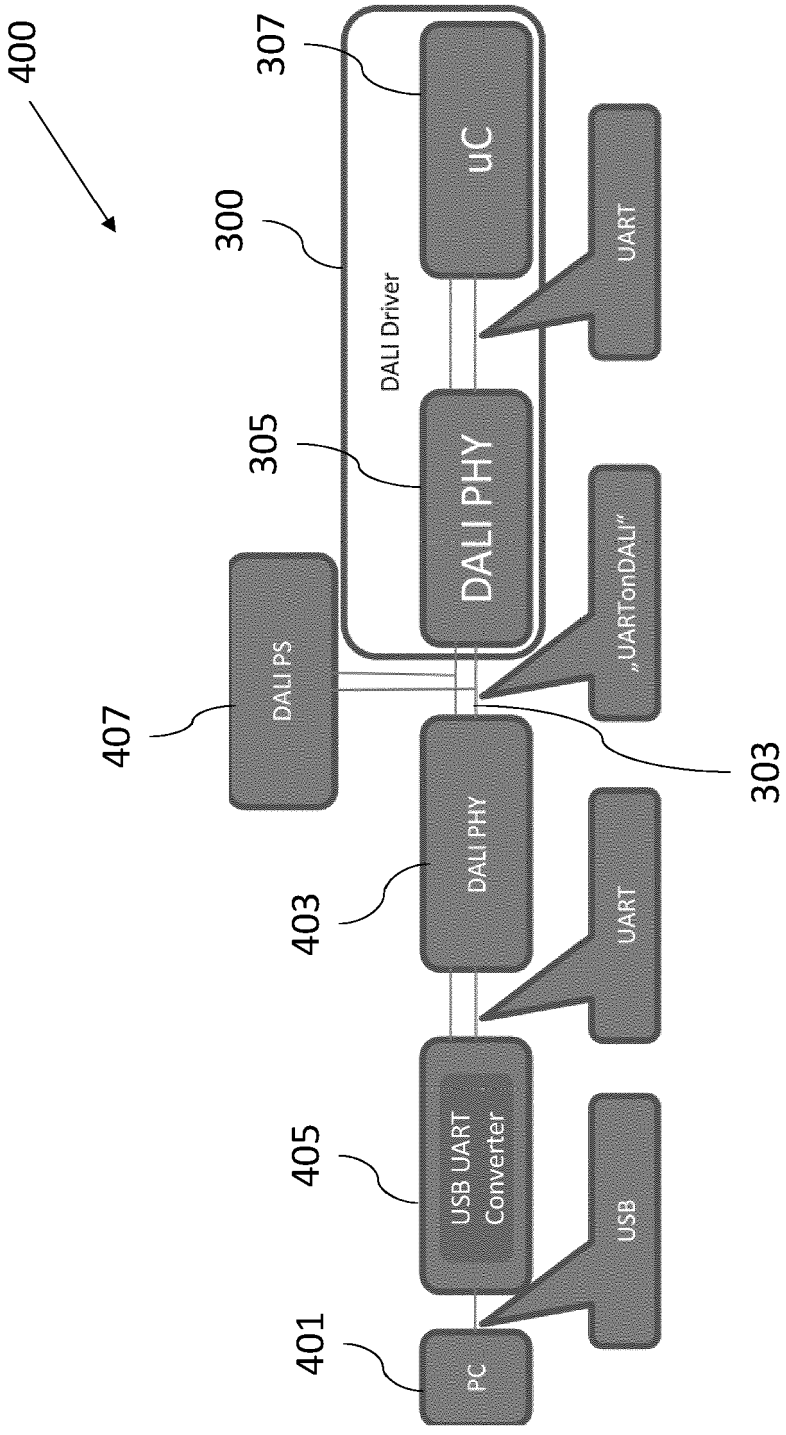
400
307
300
305
407
303
403
405
401
uC
UART
DALI Driver
DALI PHY
„UARTonDALI"
DALI PS
DALI PHY
UART
USB UART Converter
USB
PC

Fig. 4

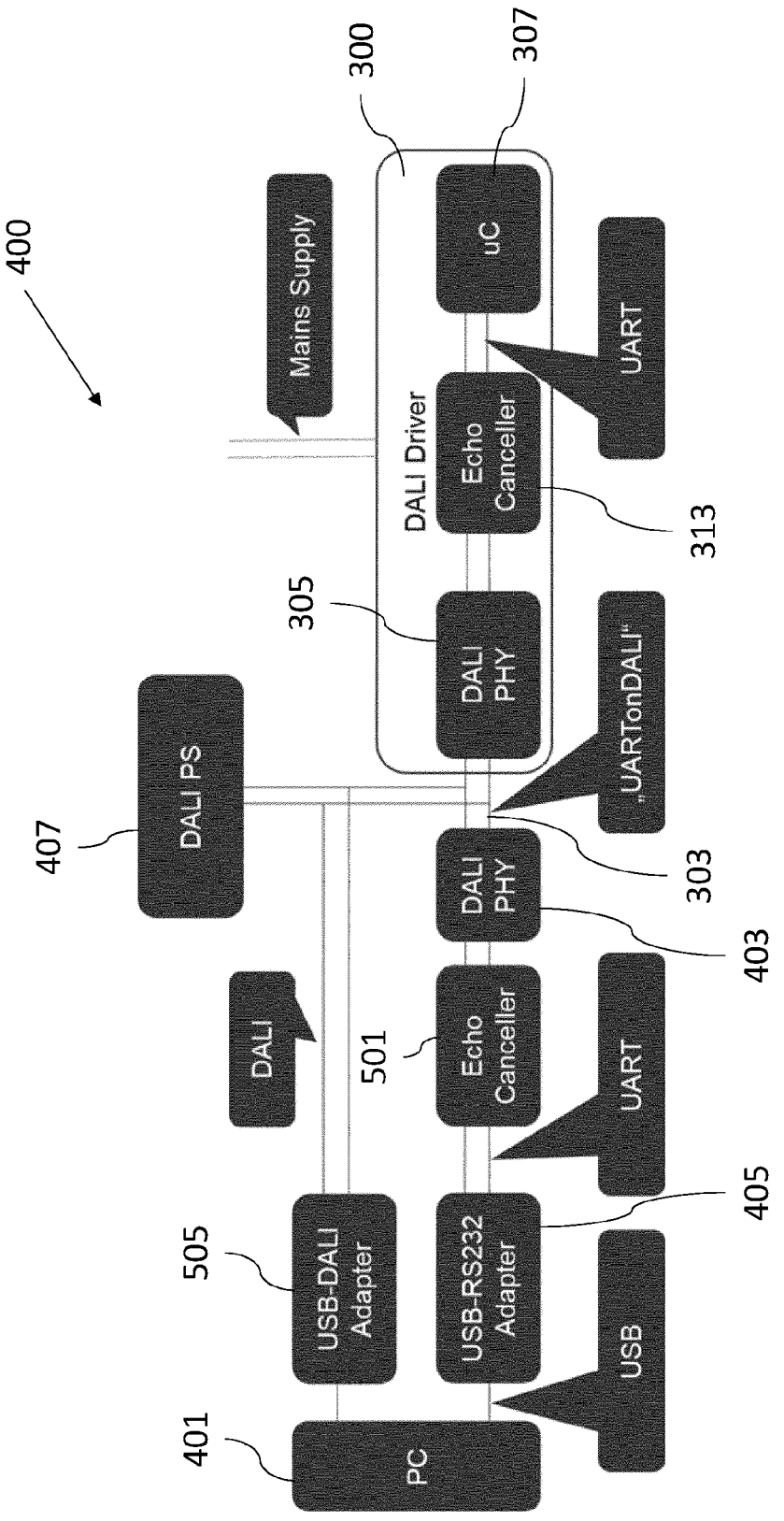
400
Mains Supply
300
307
uC
UART
DALI Driver
Echo Canceller
313
305
DALI PHY
„UARTonDALI"
DALI PS
407
303
DALI PHY
403
DALI
501
Echo Canceller
UART
405
505
USB-DALI Adapter
USB-RS232 Adapter
USB
401
PC

Fig. 5

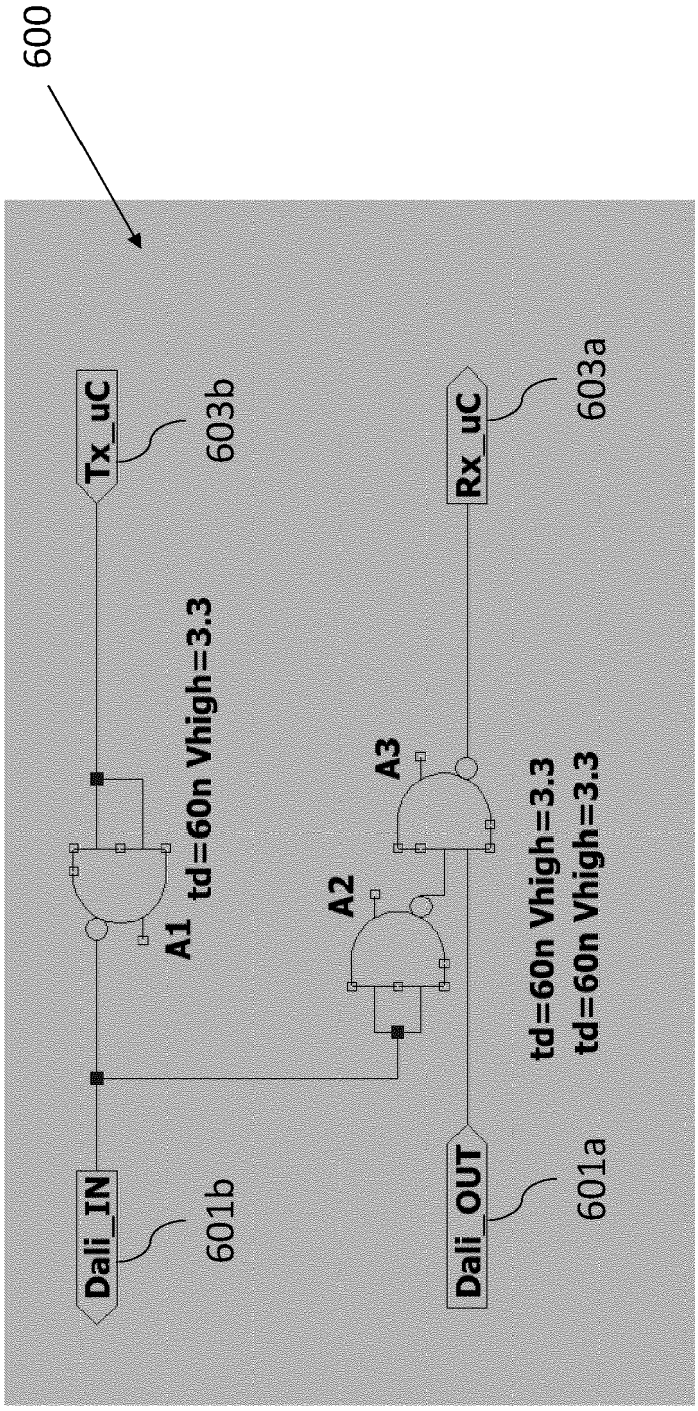
600
Tx_uC
603b
Rx_uC
603a
A1
td=60n Vhigh=3.3
A2
A3
td=60n Vhigh=3.3
td=60n Vhigh=3.3
Dali_IN
601b
Dali_OUT
601a

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 3305

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 166 038 A1 (HELVAR OY AB [FI]) 10 May 2017 (2017-05-10)	1-3,5-17	INV. H05B47/18
Y	* paragraphs [0013] - [0025]; figure 1 *	4	
Y	TW 201 123 975 A (UNIV ISHOU [TW]) 1 July 2011 (2011-07-01) * paragraph [0014]; figure 1 *	4	
A	US 2013/249442 A1 (PIPER MARTIN JOHN [GB]) 26 September 2013 (2013-09-26) * paragraph [0036]; figure 3 *	1-17	

TECHNICAL FIELDS SEARCHED (IPC)

H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 June 2020	Morrish, Ian

CATEGORY OF CITED DOCUMENTS

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02-06-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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