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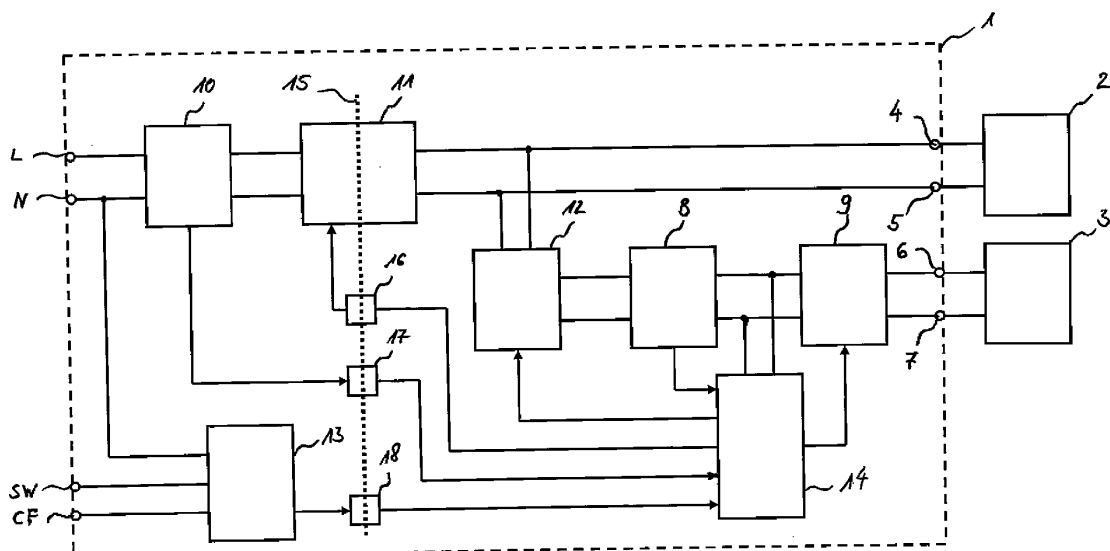
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KH MA MD TN(72) Inventor: **Stevens, Frederick****6850 Dornbirn (AT)**(74) Representative: **Beder, Jens****Mitscherlich PartmbB****Patent- und Rechtsanwälte****Karlstraße 7****80333 München (DE)**(71) Applicant: **Tridonic GmbH & Co. KG****6851 Dornbirn (AT)****(54) CONVERTER DEVICE CONTROLLED BY COMBINED CONTROL SIGNALS**

(57) The present invention relates to a converter device for providing a supply voltage and/or current to a lighting means. The converter device (1) comprises a first input terminal (SW), a second input terminal (CF), a combining circuit (13) and a control circuit (14). The first input terminal (SW) is configured to receive a first control signal, which is a switched AC signal, and the second input terminal (CF) is configured to receive a second control signal, which is a switched DC signal or a switched

AC signal. The combining circuit (13) comprises a rectifying circuit (D71, D73, D74, D75) configured to generate a combined signal from the first control signal and the second control signal, wherein the combining circuit (13) controls the rectifying circuit (D71, D73, D74, D75) based on the second control signal to selectively fully rectify the first control signal or half rectify the first control signal. The control circuit (14) controls the converter device (1) based on the combined signal.

**Fig. 1****EP 4 475 631 A1**

Description

[0001] The invention relates to an operating device for an illuminant. The invention further relates to an operating device for emergency lighting means.

[0002] In lighting systems, operating devices (converters, ballasts, driver devices) are used to drive lighting means such as gaseous-discharge lamps, halogen bulbs, light-emitting diodes (LED), wherein the operating device can be further configured to monitor operations of lighting means, to control dimming and/or to switch to battery operation in the event of an emergency (fire alarm or mains voltage failure).

[0003] Many operating devices comprise screw or spring terminals, to which sensor, mains power and/or control cables can be connected and which are internally connected to a control circuit, such as a microcontroller or other components of the device.

[0004] GB 2537692 A discloses an operating device that comprises a combining circuit for combining signals received at different terminals in order to reduce the number of internal transmission channels and/or the number of input pins of the microcontroller. The combining circuit includes a rectifying circuit configured to generate a combined signal from a first input AC signal and a second input AC signal, wherein the AC signals are fed to the rectifier circuit such that the first signal is fully rectified whereas the second signal is only half rectified. The second signal is mains voltage and used by the operating device to detect mains voltage loss. A light switch by switching the mains voltage generates the first signal.

[0005] However, both control signals must be AC signals. Further, if the first signal is present, the presence of the second signal cannot be determined from the combined signal because the combined signal in this case is always a rectified full-wave signal. In particular, if the second signal controls switching on and off of the light and the first signal activates a corridor function where the switched-on light is dimmed to 10% when no person is present, the dimmed light cannot be switched off by the second signal.

[0006] It is an object of the present invention to provide an apparatus and a method, which reduce the above problems. In particular, it is an object of the present invention to provide an operating device with which internal transmission channels and/or controller pins can be reduced even with different types of input signals.

[0007] This object is achieved by the operating device according to the enclosed claim 1. Advantageous features of the present invention are defined in the corresponding subclaims.

[0008] According to the present invention, a converter device for providing a supply voltage and/or current to a lighting means comprises a first input terminal, a second input terminal, a combining circuit and a control circuit. The first input terminal is configured to receive a first control signal, which is a switched AC signal and the second input terminal is configured to receive a second control signal, which is a switched DC signal or a switched AC signal.

[0009] The combining circuit comprises a rectifying circuit configured to generate a combined signal based on the first control signal and the second control signal, wherein the combining circuit controls the rectifying circuit based on the second control signal to selectively fully rectify the first control signal or half rectify the first control signal and the converter device is controlled by the control circuit based on the combined signal.

[0010] Since the second control signal controls the rectifier circuit and is not rectified, the second control signal does not have to be an AC signal. Further, even if the first signal is present (signal on), the presence of the second signal (signal on) and the absence of the second signal (signal off) can be determined from the combined signal.

[0011] The first and/or second control signal can indicate two switching states (on/off) and/or can include information/data added by modulating the frequency or pulse width of the first and/or second control signal.

[0012] The rectifying circuit can be a single full-wave rectifier, such as a diode bridge.

[0013] The combining circuit can comprise a switch, such as a transistor, connected in series or in parallel with a diode of the rectifying circuit, wherein the switch is controlled based on the second control signal to selectively set the rectifying circuit in full-wave rectification mode or a half-wave rectification mode. The rectifier circuit can include two input terminals for inputting the first signal and two output terminals for outputting the combined/rectified signal, with the switch connecting one of the input terminals and one of the output terminals in its conductive state. In this way, a prefabricated diode bridge with a housing can be used.

[0014] First and second control signal can be detected/extracted from the combined signal by the control circuit or a detecting circuit which outputs detecting result to the control circuit.

[0015] The control circuit or the detecting circuit can be configured to detect the first control signal and the second control signal by detecting frequency of the combined signal, effective voltage of the combined signal and/or peak voltage of the combined signal.

[0016] In addition, the control circuit or the detecting circuit can be configured to detect a presence of the first control signal by comparing the detected peak voltage and a certain peak voltage (threshold) and/or to detect a presence of the second control signal by comparing the detected frequency and a certain frequency and/or by comparing the detected effective voltage and a certain effective voltage (threshold).

[0017] Alternatively or in addition, the converter device can comprise an isolation barrier between the control circuit

and the rectifying circuit and can comprise an optocoupler, relay or transformer configured to transfer the combined signal across the isolation barrier.

[0018] In addition, a flyback converter can provide the isolation barrier. The flyback converter can generate the supply voltage and/or current for the lighting means and/or the control circuit can control the flyback converter based on the first control signal and the second control signal.

[0019] Alternatively or in addition, the converter device can be an emergency converter comprising an energy storage device and/or an energy storage interface configured to connect the energy storage device to the converter device, and a first converter circuit configured to provide a supply voltage and/or current to an emergency lighting means using energy stored in the energy storage device.

[0020] In addition, the emergency converter can comprise a charging circuit configured to charge the energy storage device and a second converter circuit configured to provide a supply voltage and/or current to the charging circuit using mains supply.

[0021] The lighting means can be the emergency lighting means or no emergency lighting means.

[0022] First control signal can be mains voltage or can indicate presence of mains voltage, wherein the control circuit is configured to control the first converter circuit based on the first control signal.

[0023] Second control signal can be a test request signal, wherein the control circuit is configured to detect a presence of the test request signal and to start a function test or an operation duration test when the presence of a test request signal is detected.

[0024] An emergency lighting system is need to be tested at predefined intervals by performing function and/or operation duration (endurance) tests. During the function test, which typically takes about five seconds, the function of the energy storage device, the illuminant and the emergency converter are tested. A function test is initiated for example by operating a test switch arranged at or externally to the emergency converter. In addition to the functions tested in the function test, the capacity of the battery is tested in the operation endurance test (duration test) by operating the illuminant or the emergency lamp with the battery for 2/3 of its rated operating time of, e.g., one or three hours. Once the time elapses, the test is ended. The time interval (e.g., weekly/monthly) between two successive functional tests is longer than the time interval (e.g., annually) between two successive operation endurance tests.

[0025] Alternatively, the first control signal can be a signal for requesting a function test and the second control signal can be a signal for requesting an operation duration test or vice-versa, and the control circuit is configured to detect a presence of the first control signal and a presence of the second control signal, to start the function test when only the presence of the first control signal is detected and to start the operation duration test when the presence of the first control signal and the presence of the second control signal are detected.

[0026] Alternatively, the first control signal can be a signal for requesting a maintained lighting mode and the second control signal can be a signal for requesting non-maintained lighting mode or vice-versa. The emergency light is used for a conventional lighting as well as for the emergency lighting in the maintained lighting mode, wherein the voltage supply for the converter device is maintained in case of a mains supply failure for a rated service time using energy stored in an energy storage device such as a rechargeable battery. In the non-maintained lighting mode, except for test purposes, the emergency light is only used for the emergency lighting, i.e., the emergency light is only switched on if the mains supply fails and the main lighting drivers are not supplied with power.

[0027] Alternatively, the control circuit can be configured to control the flyback converter or the first converter circuit based on the first control signal to turn the lighting means on and off and can be configured to set a first light level (e.g., 100%) or a second light level (e.g., 10% corridor function) for the lighting means based on the second control signal when the lighting means is turned on.

[0028] Embodiments of the invention are discussed in detail with reference to the enclosed figures, in which

Fig. 1 shows a simplified block diagram of parts of an emergency light system with an emergency lighting means and an emergency converter according to an embodiment of the present invention,

Fig. 2 shows the combining circuit of the emergency converter shown in Fig. 2 according to a first embodiment of the present invention,

Fig. 3 shows the combining circuit of the emergency converter shown in Fig. 2 according to a second embodiment of the present invention, and

Fig. 4 to Fig. 6 show diagrams with the course of the combined signal with different states of the input signals.

[0029] In the figures, same reference numbers denote same or equivalent structures. The explanation of structures with same reference numbers in different figures is avoided where deemed possible for sake of conciseness.

[0030] Fig. 1 shows an emergency lighting system with an emergency converter 1 detachably connected to a first LED

lighting device 2 and a second LED lighting device 3. The parts shown in Fig. 1 can be housed in an emergency luminaire. The emergency converter 1 comprises a first light device terminal 4, 5 (connectors) for connecting the first LED lighting device 2 to the emergency converter 1, a second light device terminal 6, 7 (connectors) for connecting the second LED lighting device 3 to the emergency converter 1, mains terminal L, N (connectors) for connecting the emergency converter 1 to the mains supply, an energy storage device 8 and a LED driver 9 for generating a LED drive current using energy stored in the energy storage device 8. The LED drive current generated by the LED driver 9 is output via the light device terminal 6, 7 to the LED lighting device 4, which is an emergency lighting means, and the LED lighting device 3 fed with the LED light current emits light from one or more LEDs (not shown).

[0031] The emergency converter 1 shown in Fig. 1 further comprises a rectifier and grid monitoring unit 10 connected to the mains terminal L, N, a power supply unit 11 supplied with DC voltage from the rectifier and grid monitoring unit 10, a charging circuitry 12 for the energy storage device 8, a first control terminal SW (connector) for connecting a light switch (not shown) to the emergency converter 1, a second control terminal CF (connector) for connecting a motion detector (not shown) to the emergency converter 1, a combining circuit 13 and a control circuit 14, which is advantageously a microcontroller circuit or a dedicated application specific integrated circuit (ASIC).

[0032] The control circuit 14 determines continuously or at certain times whether the energy storage device 8 is to be charged or not, wherein the control circuit 12 obtains information on the energy storage device 8 (e.g., type, open circuit voltage, temperature), determines the state of charge based on the information, compares the determined state of charge with a first threshold (e.g., 80%) and starts a charging process of the energy storage device 8 by activating the charging circuitry 12 if the state of charge is below the first threshold. The charging circuitry 12 or the control circuit 14 can terminate the charging process after a certain time or when the state of charge exceeds a second threshold. During charging, the charging circuit 12 is supplied with power by the power supply unit 11, which includes at least one DC-to-CD converter for generating a constant operating voltage for the charging circuit 12 using the DC voltage generated by the rectifier and grid-monitoring unit 10. In addition, an active Power-factor correction (PFC) circuit can be a part of the rectifier and grid-monitoring unit 10 or the power supply unit 11 and/or the rectifier and grid-monitoring unit 10 can include filters to control electromagnetic interference (EMI) and ensure electromagnetic compatibility (EMC).

[0033] The emergency lighting system shown in Fig. 1 is configured to operate the second LED lighting device 3 at least in the non-maintained lighting mode, in which the LED driver 9 is switched off (deactivated) if no mains failure is detected by the rectifier and mains monitoring unit 10. When the rectifier and mains monitoring unit 10 detects mains failure and reports it to the control circuit 14, the control circuit 12 activates the LED driver 9 to generate the LED drive current, as described above. Since the energy storage 8 also supplies power to the control circuit 12, the power supply to the control circuit 12 is maintained even if the mains supply fails.

[0034] The emergency lighting system shown in Fig. 1 is further configured to operate the first LED lighting device 2 based on a first signal received from the light switch via the first control terminal SW and a second signal received from the motion detector via the second control terminal CF, wherein the control circuit 12 controls the power supply unit 11 so that light level of the first LED lighting device 3 is 100% when first signal received (i.e., the light switch is on), the light level is 0% when first signal is not received (i.e., the light switch is off) and the light level is 10% or another preset level between 0% and 100% when second signal is not received (i.e., the motion detector has not detected a person). To charge the energy storage device 8 even at the light level of 0%, the power supply unit 11 generates such a low current for the charging circuit 12 that the first LED lighting device 2 does not light up. Alternatively, the power supply unit 11 can comprise a DC-to-CD converter for the charging circuit 12 and a DC-to-CD converter for the first LED lighting device 2.

[0035] The energy storage device 8 shown in Fig. 1 is a part of the emergency converter 1. Alternatively, the emergency converter 1 can comprise an energy storage interface for connecting the energy storage device 8 to the emergency converter 1 and/or can comprise an internal energy storage that supplies energy to the control circuit 14. The internal energy storage can be a capacitor or rechargeable/non-rechargeable battery, wherein the power supply unit 11, the charging circuitry 12 or the energy storage device 8 charges the capacitor or the rechargeable battery. In this way, power can be supplied to the control circuit 14 even when the energy storage device 8 is not connected or operational.

[0036] The control circuit 12 activates the LED driver 8 to generate the LED drive current when the rectifier and mains monitoring unit 9 detects mains failure. In addition or alternatively, the emergency converter 1 can comprise a wired or wireless interface configured to receive at least one of a signal indicating mains failure, a signal indicating the maintained lighting mode, a signal indicating the non-maintained lighting mode, a signal indicating a function test and a signal indicating an operation endurance test.

[0037] The power supply unit 11 can comprise a flyback converter (not shown) providing an isolation barrier 15 between high voltages on mains supply side and low voltages on low voltage side (SELV). The rectifier and mains monitoring unit 10 and the combining circuit 13 are located on mains supply side and the charging circuitry 12, the energy storage device 8, the LED driver 9 and the control circuit 14 are located on the low voltage side. The control circuit 14 receives and transmits signals from/to the mains supply side via optocoupler 16..18.

[0038] According to the present invention, the combining circuit 13 combines the first signal received from the light switch via the first control terminal SW and the second signal received from the motion detector via the second control

terminal CF and outputs the combined signal to the control circuit 14 via the optocoupler 18 so that only one optocoupler 18 and one input connector of the control circuit 14 are required for both signals.

[0039] Fig. 2 shows the combining circuit 13 according to a first embodiment of the present invention. The combining circuit 13 comprises a rectifier circuit formed by four diodes D73, D74, D71, D75 in a bridge configuration (bridge rectifier). The rectifier circuit, which can be prefabricated device with a housing, includes two input connectors 20, 21 and two output connectors 22, 23. The first input connector 20 is connected to the first control terminal SW via an optional resistor R70, the second input connector 21 is connected to the connector N of the mains terminal L, N, the first output connector 22 is connected to an input connector of the optocoupler 18 via an optional resistor R1 and the second output connector 23 is connected to the other input connector of the optocoupler 18.

[0040] When the light switch is switched on, an AC mains voltage is present between the first control terminal SW and the connector N (neutral), and the rectifier circuit converts the AC current, which periodically changes direction, into direct current (DC), which flows in one direction only.

[0041] The combining circuit 13 shown in Fig. 2 further comprise a transistor M1 (MOSFET) as a switch that connects the first input connector 20 and the second output connector 23 in its conductive state, so that the transistor M1 bypasses the diode D71. In this case, only half-wave rectification is performed, wherein the current flows from the first control terminal SW to the connector N via resistor R70, transistor M1 and diode D75, and flows from the connector N to the first control terminal SW via diode D74, resistor R1, optocoupler 18, transistor M1 and resistor R70.

[0042] The transistor M1 is controlled by the second signal received from the motion detector via the second control terminal CF when the motion detector detects a person. Because the second signal is the AC mains voltage, i.e., an AC signal, the second signal is fed to transistor M1 via a diode D70 and an optional resistor R70. Alternatively, a DC signal can be used to control the transistor M1 so that diode D70 is not required. Resistor R76, optional capacitor C72 and optional Zener diode Z70 are connected in parallel with the Gate of the transistor M1 and the second output connector 23.

[0043] Both the light switch and the switch of the motion detector could be sensitive to leakage currents (e.g. from a neon tube via an external switch or multiple parallel wiring of the inputs) which can cause false ON triggers of the switches. Optional capacitor C8 connected in parallel with the first control terminal SW and the connector N and optional capacitor C20 connected in parallel with the second control terminal CF and the connector N provide a capacitive path to neutral N for such leakage currents, providing some immunity to them.

[0044] Half-wave rectification of the AC mains voltage switched-on by the light switch is performed when the second signal is present and full-wave rectification of the AC mains voltage switched-on by the light switch is performed when the second signal is not present. The rectified signal (combined signal) is output to the control circuit 14 via the optocoupler 18. The control circuit 14 sets the light level to 0% when no rectified signal is detected, to 100% when a half-rectified signal is detected and to 10% when a full-rectified signal is detected. The detection can be performed by determining frequency, effective voltage and/or peak voltage of the signal.

[0045] Fig. 3 shows the combining circuit 13 according to a second embodiment of the present invention, in which the AC mains voltage is nearly a square-wave signal with 50Hz and a supply circuit 24 connected in parallel with the optocoupler 18 provides a voltage of 3.3V at the output of the optocoupler 18.

[0046] Fig. 4 shows a diagram with the course of the signal CF_in that is output to the control circuit 14 when no signal is rectified, i.e., the light switch is switched-off. In the diagram shown in Fig. 4, the signal is constant with 3.3V and the control circuit 14 determines that the light switch is off when the average voltage is above 2.5V and controls the power supply unit 11 so that light level of the first LED lighting device 3 is 0%.

[0047] Fig. 5 shows a diagram with the course of the signal CF_in for the case when the first signal is present/rectified and the second signal is not present, i.e., the light switch is switched-on and the motion detector has not detected a person. In the diagram shown in Fig. 5, the frequency of the signal CF_in is 100Hz and the average voltage is below 0.5V. The control circuit 14 activates the corridor function when the frequency of the signal CF_in is 100 Hz and/or the average voltage is below 0.5V.

[0048] Fig. 6 shows a diagram with the course of the signal CF_in for the case when the first signal is present/rectified and the second signal is present, i.e., the light switch is switched-on and a person is detected. In the diagram shown in Fig. 6, the frequency of the signal CF_in is 50Hz and the average voltage is below 3.3V and above 0.5V. The control circuit 14 controls the power supply unit 11 so that light level of the first LED lighting device 3 is 100% when the frequency of the signal CF_in is 50Hz and the average voltage is below 3.3V and above 0.5V.

[0049] The following table shows the combinations of the states of the first and second signal, the characteristic of the signal CF_in and the corresponding state of the first LED lighting device 3.

Light switch	Corridor Function	CF_in	Lighting device
OFF	OFF	3.3V	OFF
OFF	ON	3.3V	OFF

(continued)

Light switch	Corridor Function	CF_in	Lighting device
ON	OFF	100Hz	100% light output
ON	ON	50Hz	10% light output

Claims

1. A converter device for providing a supply voltage and/or current to a lighting means, wherein

the converter device (1) comprises a first input terminal (SW), a second input terminal (CF), a combining circuit (13) and a control circuit (14);

the first input terminal (SW) is configured to receive a first control signal, which is a switched AC signal;

the second input terminal (CF) is configured to receive a second control signal, which is a switched DC signal or a switched AC signal;

the combining circuit (13) comprises a rectifying circuit (D71, D73, D74, D75) configured to generate a combined signal based on the first control signal and the second control signal; and

the control circuit (14) is configured to control the converter device (1) based on the combined signal,

characterized in that

the combining circuit (13) is configured to control the rectifying circuit (D71, D73, D74, D75) based on the second control signal to selectively fully rectify the first control signal or half rectify the first control signal.

2. The converter device according to claim 1, wherein

the combining circuit further comprises a switch (M1) connected in series or in parallel with a diode (D71) of the rectifying circuit (D71, D73, D74, D75); and

the switch (M1) is controlled based on the second control signal.

3. The converter device according to claim 1 or 2, wherein

the control circuit (14) is configured to detect, in the combined signal, the first control signal and the second control signal; or

the converter device (1) further comprises a detecting circuit configured to detect, in the combined signal, the first control signal and the second control signal and to output detecting result to the control circuit.

4. The converter device according to claim 3, wherein

the control circuit (14) or the detecting circuit is configured to detect the first control signal and the second control signal by detecting frequency of the combined signal, effective voltage of the combined signal and/or peak voltage of the combined signal.

5. The converter device according to claim 4, wherein

the control circuit (14) or the detecting circuit is configured to detect a presence of the first control signal by comparing the detected peak voltage and a certain peak voltage, and/or is configured to detect a presence of the second control signal by comparing the detected frequency and a certain frequency and/or by comparing the detected effective voltage and a certain effective voltage.

6. The converter device according to any one of the preceding claims, wherein

the converter device (1) further comprises an isolation barrier (15) between the control circuit (12) and the rectifying circuit (D71, D73, D74, D75) and comprises an optocoupler (18), relay or transformer configured to transfer the combined signal across the isolation barrier (15).

7. The converter device according to claim 6, wherein

the converter device (1) comprises a flyback converter (11) providing the isolation barrier (15).

8. The converter device according to any one of the preceding claims, wherein

the converter device (1) is an emergency converter;
the converter device (1) further comprises an energy storage device (8) and/or an energy storage interface configured to connect the energy storage device (8) to the converter device (1), and a first converter circuit (9) configured to provide a supply voltage and/or current to an emergency lighting means (3) using energy stored in the energy storage device (8).

9. The converter device according to claim 8, wherein
the converter device (1) further comprises a charging circuit (12) configured to charge the energy storage device (8), and a second converter circuit configured to provide a supply voltage and/or current to the charging circuit (12) using mains supply.

10. The converter device according to claim 8 or 9, wherein
the lighting means is the emergency lighting means (3) or no emergency lighting means (2).

11. The converter device according to any one of claims 8 to 10, wherein

the first control signal is mains voltage or indicates mains voltage; and
the control circuit (14) is configured to control the first converter circuit (9) based on the first control signal.

12. The converter device according to any one of claims 8 to 11, wherein

the second control signal is a test request signal; and
the control circuit (14) is configured to detect a presence of the test request signal and to start a function test or an operation duration test when the presence of a test request signal is detected.

13. The converter device according to any one of claims 8 to 10, wherein

the first control signal is a signal for requesting a function test; and
the second control signal is a signal for requesting an operation duration test; and
the control circuit (14) is configured to detect a presence of the first control signal and a presence of the second control signal, to start the function test when only the presence of the first control signal is detected and to start the operation duration test when the presence of the first control signal and the presence of the second control signal are detected.

14. The converter device according to any one of claims 8 to 10, wherein
the control circuit (14) is configured to control the converter device (1) based on the first control signal to turn the lighting means on and off and is configured to set a first light level or a second light level for the lighting means based on the second control signal when the lighting means is turned on.

15. The converter device according to claim 7 and 14, wherein
the control circuit (14) is configured to control the flyback converter (11) based on the first control signal and the second control signal.

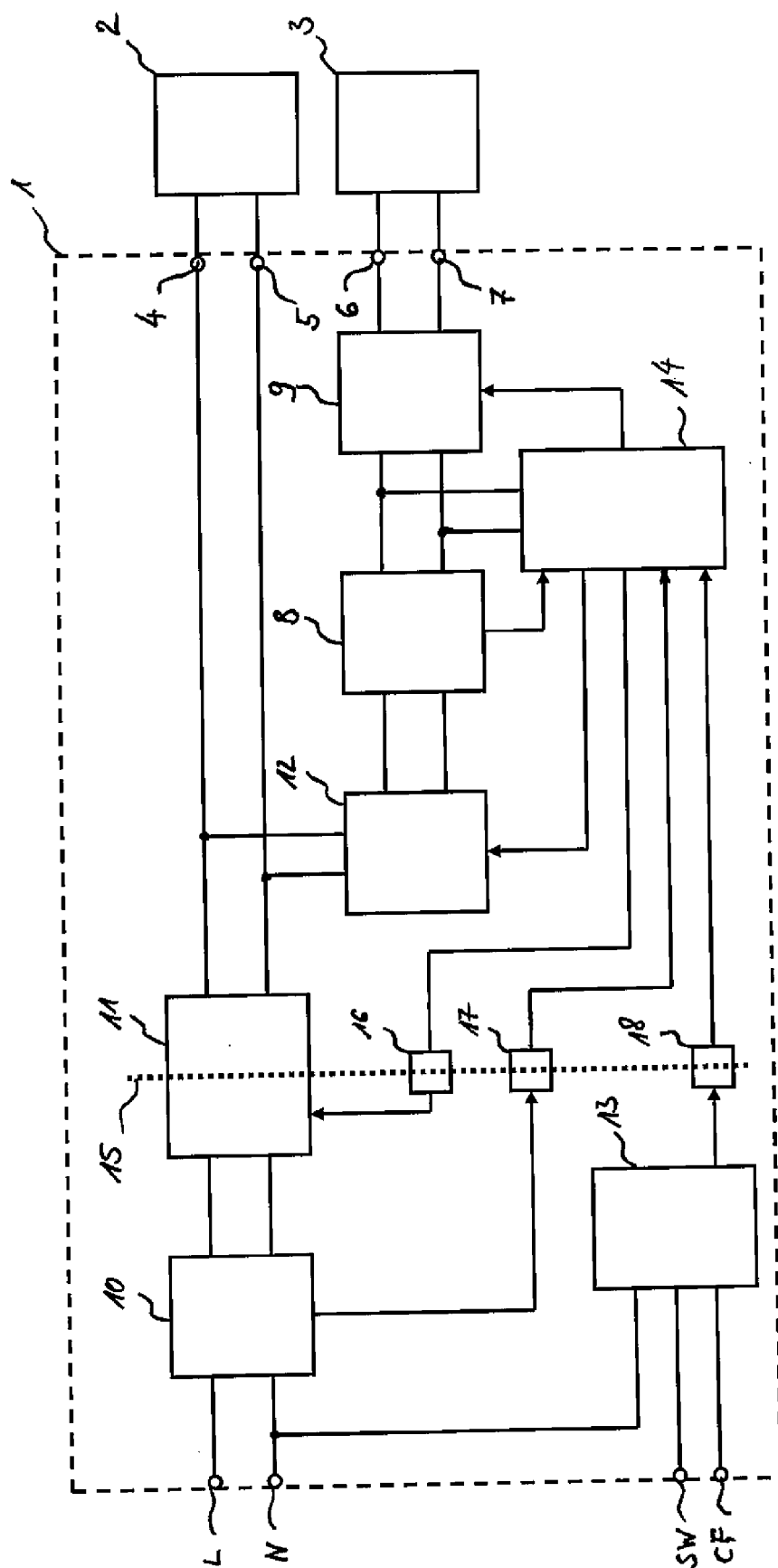


Fig. 1

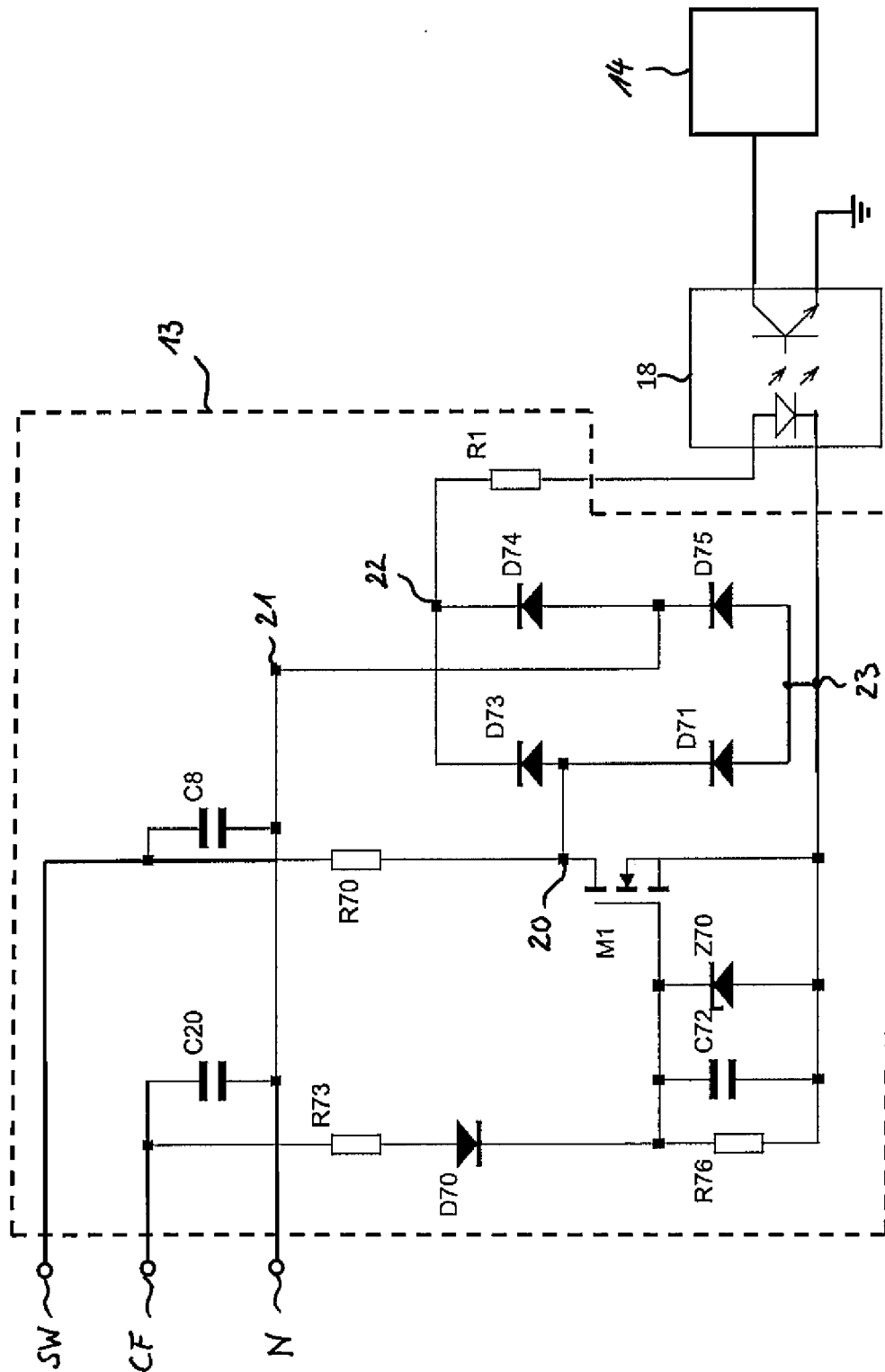


Fig. 2

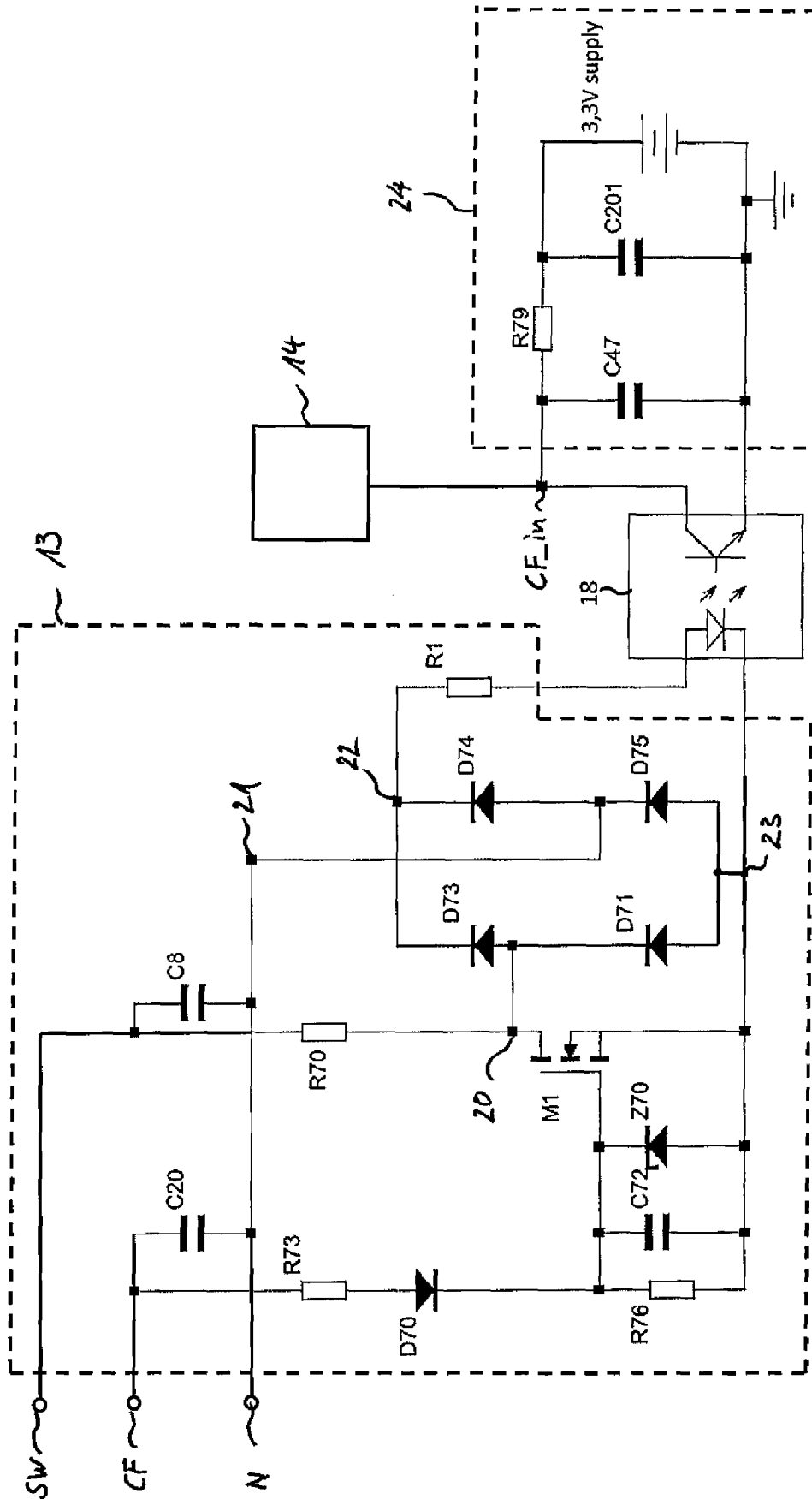


Fig. 3

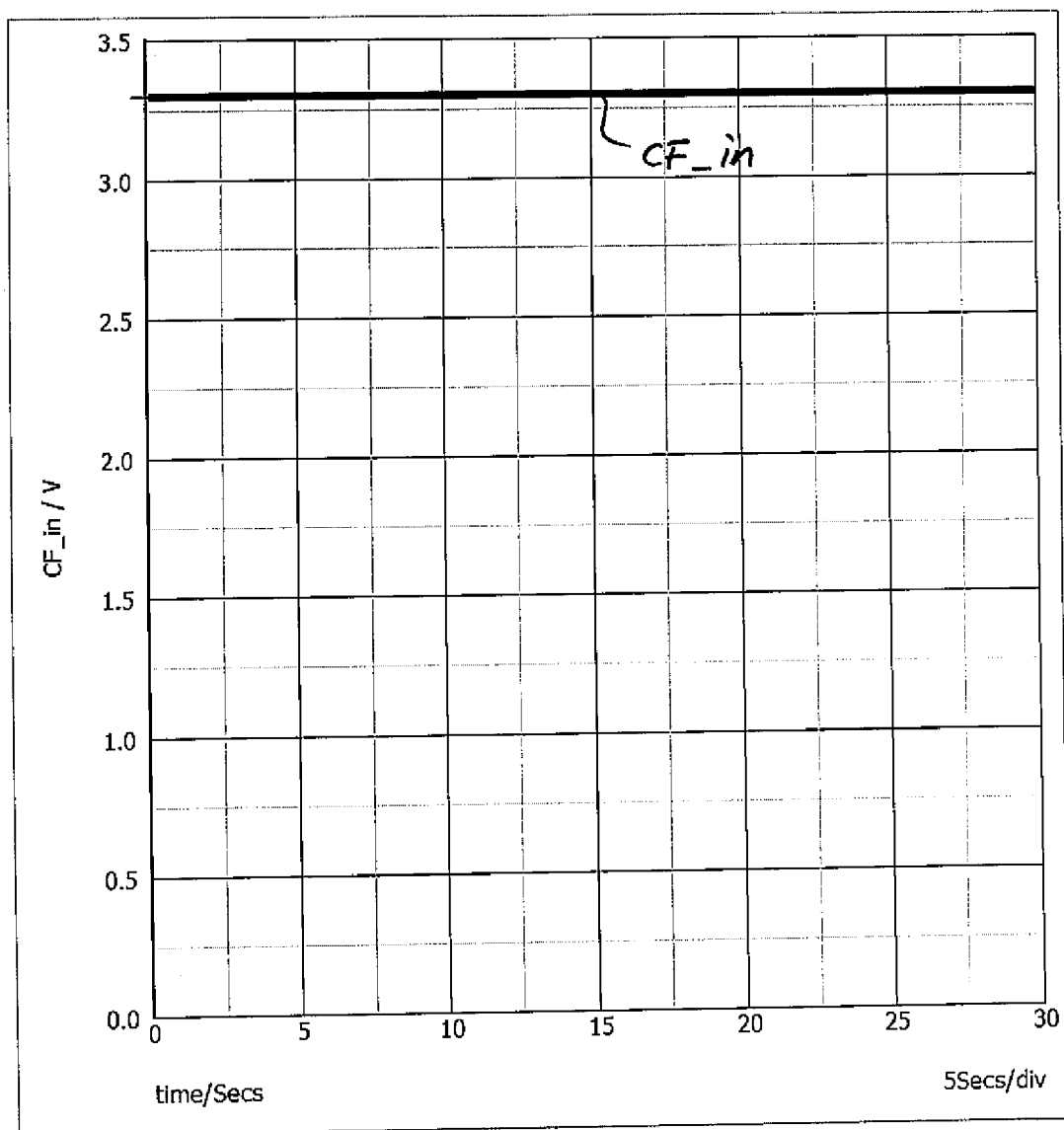


Fig. 4

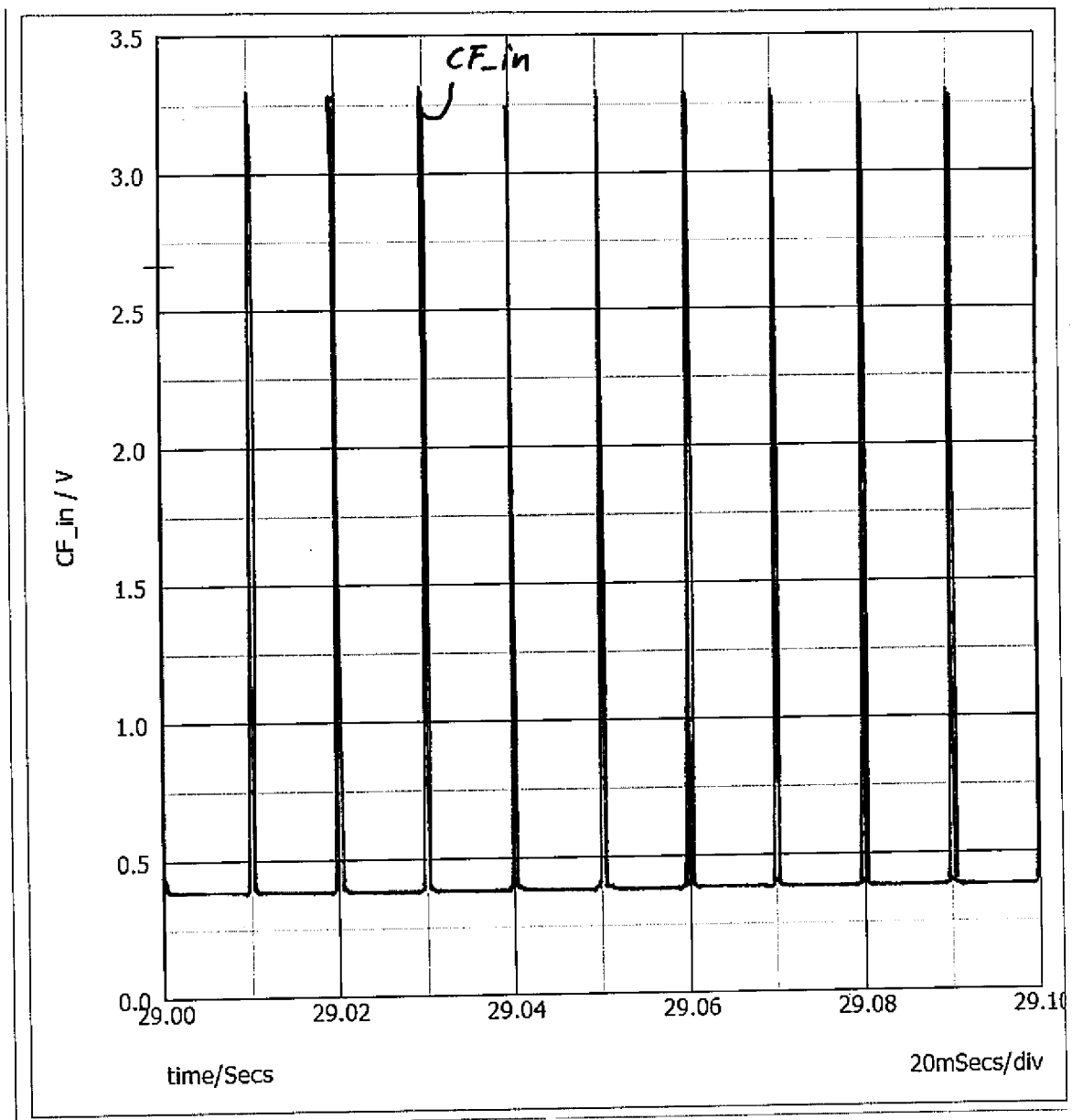


Fig. 5

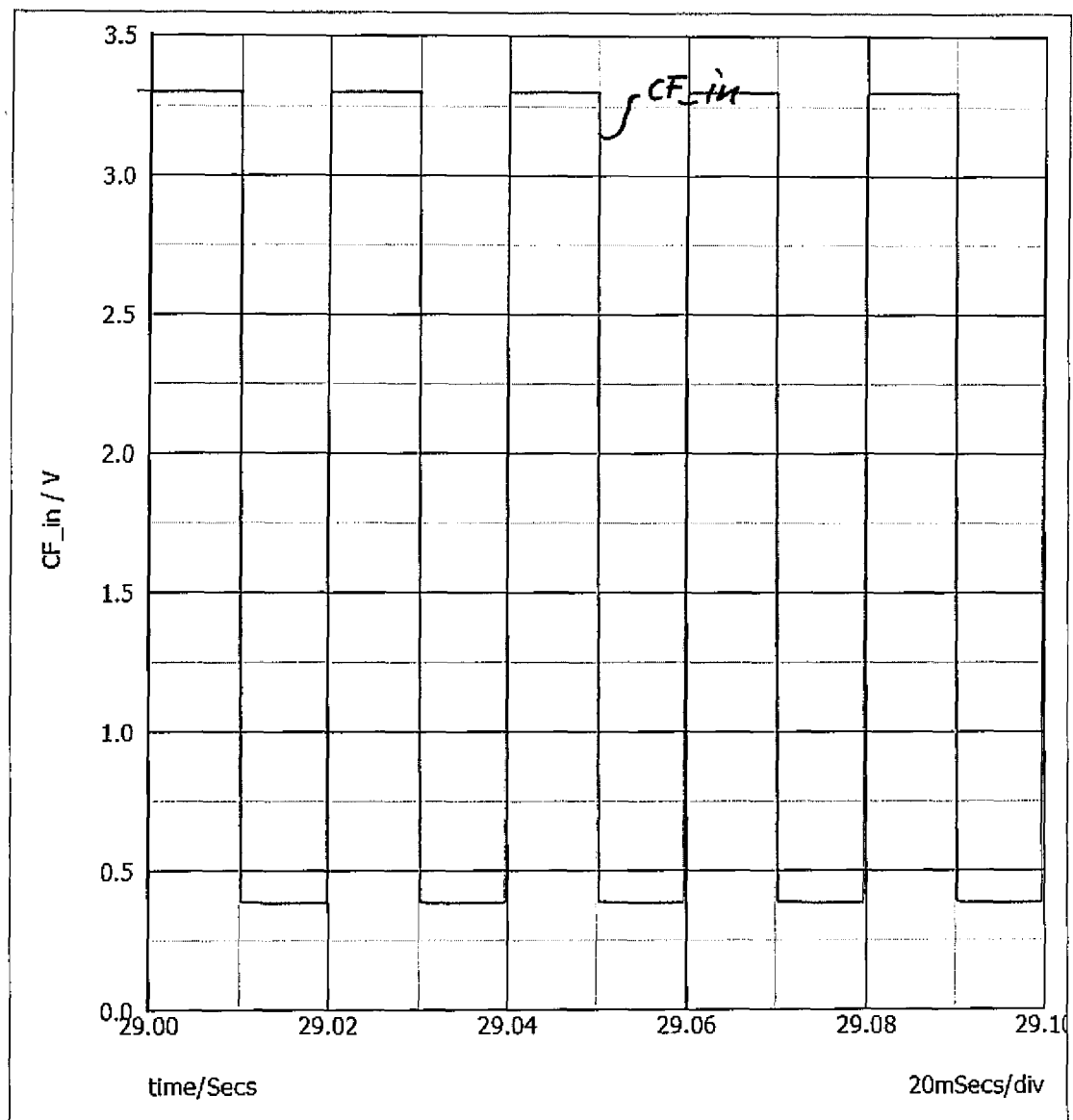


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

EP 23 17 7846

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	GB 2 537 692 A (TRIDONIC GMBH & CO KG [AT]) 26 October 2016 (2016-10-26) * the whole document *	1-15	INV. H05B45/30
A	WO 2020/007171 A1 (SHENZHEN WENOVA LIGHTING & ELECTRICAL CO LTD [CN]) 9 January 2020 (2020-01-09) * paragraph [0054]; figure 1 *	1-15	
A	WO 2019/027580 A1 (KLEVERNESS INCORPORATED [US]) 7 February 2019 (2019-02-07) * page 20, line 21 - page 22, line 27; figures 8, 9 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

H05B
H02M

The present search report has been drawn up for all claims

1

Place of search

Munich

Date of completion of the search

26 October 2023

Examiner

Morrish, Ian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
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D : document cited in the application
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 17 7846

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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26-10-2023

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REFERENCES CITED IN THE DESCRIPTION

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