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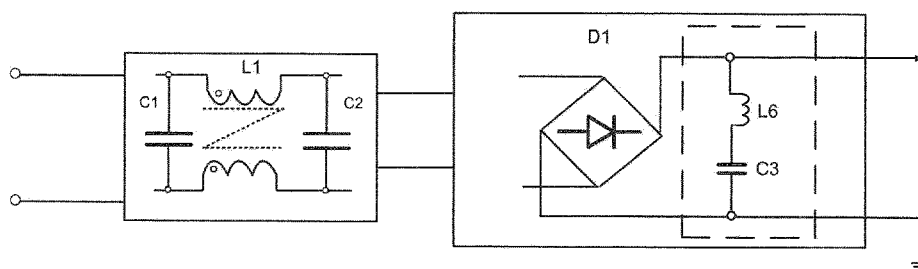


Figure 4

(57) Abstract: A power supply device and an LED driving device are provided. The power supply device includes: a filter configured to filter an AC input power; a rectifier configured to rectify the filtered AC input power. The filter includes an LC resonant circuit connected across two output terminals of the rectifier and includes an inductor L and a capacitor C connected in series, where a resonant frequency of the LC resonant circuit is close to a frequency of a noise to be filtered. An LC resonant circuit including an inductor L and a capacitor C connected in series is provided in the power supply device according to the embodiment of the disclosure. The LC resonant circuit provides a low impedance path to absorb noises in a designed frequency range. The power supply device according to the embodiment of the disclosure has advantages of a low cost, a high electric efficiency and a small volume.



POWER SUPPLY DEVICE AND LED DRIVING DEVICE

FIELD

[0001] The present disclosure relates to the technical field of power supply devices, and in particular to an LED power supply device.

BACKGROUND

[0002] The background part provides background information related to the present disclosure, which is not necessarily the conventional technology.

[0003] In general, a filter can effectively filter out a specific frequency or frequencies other than the specific frequency in a power supply line to obtain a power supply signal with the specific frequency or a power supply signal in which the specific frequency is filtered out.

[0004] For example, an electromagnetic interference (EMI) filter is generally a low-pass filter circuit including series inductors and parallel capacitors, and functions to allow a frequency signal generated when an equipment operates normally into the equipment, and to greatly block high-frequency interference signals.

[0005] However, any product has specific performance indicators expected by a customer or specified by certain standards.

[0006] LED products are widely used because of its high photoelectric conversion efficiency and environmental characteristic. Therefore, an LED power supply (that is, an LED driving device) meeting the following conditions (1) to (3) is desired. (1) An output current of a dimmable driver can be changed according to actual needs, where an LED driver may be dimmed, for example with a dimming degree of 100%, 50%, 30% or 10%, to output different currents based on different application environments or different time of a day, which provides more energy saving. (2) The LED driving device has a wide input voltage range, and the LED driver is designed to fit an input voltage in a wide range (for example, 100V to 277V), so that requirements on product model numbers and stocks are reduced. (3) The LED driver is compliant with international standards and fulfills an application requirement of a customer.

SUMMARY

[0007] This summary part provides a general summary of the present disclosure, rather than a full disclosure for a full scope or all features of the present disclosure.

[0008] An object of the present disclosure is to provide a power supply device and an LED power supply device.

[0009] According to an aspect of the present disclosure, it is provided a power supply device, which includes: a filter configured to filter an AC input power; a rectifier configured to rectify the filtered AC input power. The filter may include an LC resonant circuit which may be connected across two output terminals of the rectifier and may include an inductor L and a capacitor C connected in series, where a resonant frequency of the LC resonant circuit may be close to a frequency of a noise to be filtered.

[0010] Preferably, the inductor L may be an I-type inductor.

[0011] Preferably, the filter may be an electromagnetic interference EMI filter.

[0012] Preferably, the rectifier may be a diode bridge rectifier.

[0013] According to another aspect of the present disclosure, it is provided a power supply device, which includes: a filter configured to filter an AC input power; a rectifier configured to rectify the filtered AC input power to obtain a DC power; and a power factor corrector configured to perform power factor correction on the DC power. The filter may include an LC resonant circuit which may be arranged between the rectifier and the power factor corrector. The LC resonant circuit may be connected across two output terminals of the rectifier and may include an inductor L and a capacitor C connected in series, where a resonant frequency of the LC resonant circuit may be close to a switching frequency of the power factor corrector.

[0014] Preferably, the power factor corrector may be a boost power factor corrector.

[0015] Preferably, the inductor L may be an I-type inductor.

[0016] Preferably, the filter may be an electromagnetic interference EMI filter.

[0017] Preferably, the rectifier may be a diode bridge rectifier.

[0018] According to still another aspect of the present disclosure, it is provided an LED driving device, which includes: the power supply device according to the present disclosure; and an LED driver configured to be powered by the power supply device to drive an LED.

[0019] Preferably, an output voltage of the power supply device is controlled based on a control signal, to obtain a constant voltage for the LED.

[0020] Preferably, the control signal may include a control signal for a dimmer, a control signal for limiting a maximum voltage, and a control signal for voltage stabilization.

5 [0021] An LC resonant circuit including an inductor L and a capacitor C connected in series is provided in the power supply device according to the embodiment of the present disclosure. The LC resonant circuit provides a low impedance path to absorb noises in a designed frequency range. The power supply device according to the embodiment of the present disclosure has advantages of a low cost, a high electric efficiency and a small volume.

10 [0022] In particular, a low cost I-type inductor is used in the power supply device according to the embodiment of the present disclosure instead of an expensive ring inductor used in the conventional technology, thereby saving a cost. In addition, the I-type inductor has a smaller volume compared to the ring inductor. In addition, an expensive film capacitor used in the conventional technology is omitted in the power supply device according to the embodiment
15 of the present disclosure.

[0023] In addition, the power supply device according to the embodiment of the present disclosure has a high electric efficiency and a low temperature rise. This is because that: a power consumption of the inductor L according to the embodiment of the present disclosure is small, where only a small portion of an input high-frequency current is passed through the
20 inductor L according to the embodiment of the present disclosure; and an equivalent series resistance (ESR) of the inductor L according to the embodiment of the present disclosure is small.

[0024] Therefore, the power supply device according to the embodiment of the present disclosure has a compact size since a volume required for a small inductance (for example,
25 5uH to 10uH) of the inductor L is small and a film capacitor is omitted.

[0025] The description and specific examples in the summary are only illustrative and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

30 [0026] The drawings described herein are used for illustrating the selected embodiments,

rather than all of the possible embodiments, and are not intended to limit the scope of the present disclosure. In the drawings:

[0027] Fig. 1 shows a topology structure of a common LED power supply;

[0028] Fig. 2 is an exemplary circuit diagram of a power supply device according to a
5 solution of the present disclosure;

[0029] Fig. 3 is a block diagram of a power supply device 300 according to an embodiment of the present disclosure;

[0030] Fig. 4 is an exemplary circuit diagram of a power supply device according to an embodiment of the present disclosure;

10 [0031] Fig. 5 is a block diagram of a power supply device 500 according to another embodiment of the present disclosure;

[0032] Fig. 6 is an equivalent circuit diagram of a series resonant circuit including an inductor L6 and a capacitor C3 according to an embodiment of the present disclosure;

[0033] Fig. 7 shows an impedance curve of a series resonant circuit including an inductor
15 and a capacitor according to an embodiment of the present disclosure; and

[0034] Fig. 8 is a block diagram of an LED driving device 800 according to an embodiment of the present disclosure.

[0035] Although the present disclosure is susceptible to various modifications and substitutions, specific embodiments thereof are shown in the drawings as an example and are
20 described in detail herein. It should be understood that the description for specific embodiments herein is not intended to limit the present disclosure into a disclosed particular form, but rather, the present disclosure aims to cover all modifications, equivalents and substitutions within the spirit and scope of the present disclosure. It should be noted that, throughout the drawings, corresponding numerals indicate corresponding components.

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DETAILED DESCRIPTION OF EMBODIMENTS

[0036] Examples of the present disclosure are described more fully with reference to the drawings. The following description is merely exemplary and is not intended to limit the present disclosure and an application or use thereof.

[0037] Exemplary embodiments are provided below to make the present disclosure thorough and to convey a scope of the present disclosure to those skilled in the art. Examples of various specific details, such as specific elements, devices, and methods, are set forth to provide thorough understanding for the embodiments of the present disclosure. It is apparent to those skilled in the art that the exemplary embodiments may be embodied in multiple different forms without using specific details, and should not be construed as limiting the scope of the present disclosure. In some exemplary embodiments, well-known processes, well-known structures, and well-known technology are not described in detail.

[0038] Taking an LED product as an example, as described above, an LED driving device meeting the following conditions (1) to (3) is desired. (1) An output current of a dimmable driver can be changed according to actual needs, where an LED driver may be dimmed, for example with a dimming degree of 100%, 50%, 30% or 10%, to output different currents based on different application environments or different time of a day, which provides more energy saving. (2) The LED driving device has a wide input voltage range, and the LED driving device is designed to fit an input voltage in a wide range (100V to 277V), so that requirements on product model numbers and stocks are reduced. (3) The LED driving device is compliant with international standards and fulfills an application requirement of a customer.

[0039] In addition to international safety regulations, the LED driving device has to meet requirements on an electromagnetic compatibility (EMC), a total harmonic distortion (THD) and a power factor (PF). For some users, it is required $PF > 0.9$ and $THD < 20\%$ in a case of a maximum input voltage $V_{in} = 277V$ and a minimum load (for example, an output power is 30%).

[0040] However, an problem on the EMI in the existing solution is that: it is difficult to compromise between EMI performance (especially in a case of a low frequency range of a boost PFC, such as 65kHz) and a power factor PF under a high input voltage and a low load (for example, in a case of an input voltage $V_{in} = 277V$ and an output power of a load of 30%, $PF > 0.9$).

[0041] Fig. 1 shows a topology structure of a common LED power supply (that is, an LED driving device), where a typical LED power supply includes an EMI filter 101, a bridge rectifier 102, a boost power factor corrector (PFC) 103, and an LED driver 104.

[0042] In particular, as shown in Fig. 1, the EMI filter 101 may include an inductor L1, a

capacitor C1, a capacitor C2, and a capacitor C3 which is connected across two output terminals of the bridge rectifier 102 including a diode D1. An output terminal of the EMI filter 101 is connected to the boost PFC 103. The boost PFC 103 may further include a PFC controller 1030, a PFC power circuit, a capacitor C4, and a voltage dividing circuit including a resistor R2 and a resistor R3. The PFC controller 1030 may include an amplifier which outputs a control signal based on comparison between an output voltage of the PFC and a reference voltage (for example, 2.5V). The PFC power circuit may include an inductor L3, a diode D2, and a transistor switch M1, where the transistor switch M1 is connected in parallel with the capacitor C4, and the transistor switch M1 may control an output of the inductor L3 and an output of the diode D2 based on a control signal of the PFC controller 1030 to obtain an output voltage V_{o_PFC} . The LED driver 104 may control the obtained output voltage V_{o_PFC} based on a control signal such as a control signal of a dimmer, a control signal for limiting a maximum output voltage and a control signal for voltage stabilization, to obtain a constant output voltage V_o for driving an LED.

[0043] For example, in order to obtain a high power factor PF, according to the embodiment of the present disclosure, a capacitance of the capacitor C1 and a capacitance of the capacitor C2 may be the same, for example, the capacitance of the capacitors C1 and C2 may range from 0.47 μ F to 0.22 μ F, a capacitance of the capacitor C3 may range from 1 μ F to 0.47 μ F.

[0044] However, a capacitance in the present disclosure should not be too high, this is because that: a large capacitance may result in a large phase shift between an input voltage and an input current, which means a small power factor PF; and a small input capacitance may result in poor EMI performance, especially in a low frequency range (which is close to a switching frequency of the boost PFC). That is, good EMI performance is contradictory with a high power factor PF, and it is difficult to compromise between the EMI performance and the power factor PF.

[0045] Table 1 and Table 2 show test data for the EMI and the PF based on different settings in the conventional technology.

[0046] Table 1 Increased capacitances of the capacitor C1/C2/C3 (an output power of the load is 30%)

V _{in} (V)	P _o (output power, W)	Capacitance C1=C2 (uF)	Capacitance C3 (nF)	Power factor PF	EMI_margin	Result	Annotation
120V	75.2	0.47uF	1000nF	0.98	+5dB, f=65kHz	passed	
230V	75.1	0.47uF	1000nF	0.91	+5dB, f=65kHz	passed	
277V	75.3	0.47uF	1000nF	0.825	+8dB, f=65kHz	not passed	PF=0.825<0.9

[0047] It can be seen from the data in Table 1 that: in a case of the increased capacitances of capacitors C1=C2=0.47uF and C3=1000nF, the power factor PF is greater than 0.9 when the input voltage V_{in} is 120 V or 230 V, and the EMI margin is +5dB at the frequency f=65kHz, that is, only in this case the LED driving device can meet the requirements on both the EMI and the PF; however, the power factor PF is less than 0.9 when the input voltage V_{in} is 277V, the EMI margin is +8dB at the frequency f=65kHz, although requirement on the EMI is met, PF=0.825<0.9 does not meet the requirement on the PF. That is, the LED driving device cannot meet the requirements on both the EMI and the PF at the same time in a case of a high input voltage.

[0048] Table 2 Reduced capacitances of the capacitor C1/C2/C3 (an output power of the load is 30%)

Vin (V)	Po (output power, W)	Capacitance C1=C2 (uF)	Capacitance C3 (nF)	Power factor PF	EMI_margin	Result	Annotation
120V	75.3	0.22uF	680nF	0.98	-10.5dB	not passed	
230V	75.3	0.22uF	680nF	0.93	+0.6dB	no margin	
277V	75.5	0.22uF	680nF	0.902	+5dB, f=65kHz	passed	

[0049] As can be seen from the data in Table 2 that: in a case of the reduced capacitances of the capacitors C1=C2=0.22uF and C3=680nF, the power factor PF is greater than 0.9 when the input voltage Vin is 120V, 230V or 277V, and the EMI margin is -10.5dB (too large) when the input voltage Vin is 120V, that is, the requirement on the PF is met, while the requirement on the EMI is not met; the EMI margin is +0.6dB when the input voltage Vin is 230V, which is equivalent to that there is no margin; and only when the input voltage Vin is 277V, the EMI margin is +5dB at the frequency f=65kHz, that is, requirements on both the power factor PF and the EMI are met only when the input voltage Vin is 277V.

[0050] In summary, it can be seen from Table 1 and Table 2 that the LED driving device cannot meet the requirements on both the EMI and the PF at the same time with the same setting.

[0051] Accordingly, in order to overcome the drawbacks described in the present disclosure, the following solutions 1 to 3 are proposed.

[0052] Solution 1: for an EMI filter including the inductor L1, the capacitor C1, the capacitor C2, and the capacitor C3 which is connected across two output terminals of the diode bridge D1, an LC filter is generally provided following the diode bridge D1, to form a π -shaped filter circuit, thereby absorbing noises in a low frequency range. As shown in Fig. 2, for the EMI filter, an inductor (such as a ring inductor) L5 and a capacitor (such as a film

capacitor) C5 are provided following the diode bridge D1, therefore, a π -shaped filter circuit is formed by the inductor L5 as well as the capacitor C5 and the capacitor C3.

[0053] However, such a design has the following disadvantages.

[0054] 1. Since all input currents are passed through the inductor L5, the inductor L5 may consume additional powers, resulting in a reduced electric efficiency and an increase in a temperature of an element; and

[0055] 2. A cost of a bill of materials (BOM) is increased due to a high cost of a ring inductor and a film capacitor, and a volume of a ring inductor is large.

[0056] Solution 2: two capacitors, that is, the capacitor C2 and the capacitor C3 (the capacitances of which are in a range of 0.22 μ F to 0.47 μ F), are provided on the basis of the original capacitor C1.

[0057] However, such a design has the following disadvantages.

[0058] A low power factor PF under a high input voltage and a low load output power (for example, the power factor PF=0.75<0.9 in a case where the input voltage V_{in} =277V and an output power of the load is 30%) may not meet a requirement of a user.

[0059] Solution 3: an input current and an input voltage are monitored by using a specific integrated circuit (IC) or a micro control unit (MCU), and then PFC control logic is adjusted accordingly to achieve a high power factor PF.

[0060] The solution may complicate the circuit, thereby increasing a cost of the BOM.

[0061] Accordingly, a novel solution is proposed hereinafter in the present disclosure to overcome the drawbacks of above-described technical solutions.

[0062] Those skilled in the art should appreciate that the power supply device according to the present disclosure is applicable to any switch-type power supply, the LED power supply is merely an example of the present disclosure, and the present disclosure is not limited thereto.

[0063] According to an embodiment of the present disclosure, it is provided a power supply device, which includes a filter configured to filter an AC input power and a rectifier configured to rectify the filtered AC input power. The filter may include an LC resonant circuit which may be connected across two output terminals of the rectifier and may include an inductor L and a capacitor C connected in series, where a resonant frequency of the LC

resonant circuit may be close to a frequency of a noise to be filtered.

[0064] In particular, as shown in Fig. 3 and Fig. 4, the power supply device 300 according to the present disclosure may include a filter 301, the filter 301 includes an inductor L1, a capacitor C1, and a capacitor C2 as shown in Fig. 4 and is configured to filter an AC input power. According to a preferred embodiment of the present disclosure, the filter 301 may be an electromagnetic interference EMI filter.

[0065] Continuing with reference to Fig. 3 and Fig. 4, the power supply device 300 according to the present disclosure may further include a rectifier 302 configured to rectify the filtered AC input power. According to a preferred embodiment of the present disclosure, the rectifier 302 may be a diode bridge rectifier D1.

[0066] According to an embodiment of the present disclosure, the filter 301 may further include an LC resonant circuit including an inductor L and a capacitor C connected in series, the LC resonant circuit may be connected across two output terminals of the rectifier 302. Continuing with reference to Fig. 4, the LC resonant circuit may include an inductor L6 and a capacitor C3 connected in series and may be connected across two output terminals of the rectifier D1, where a resonant frequency of the LC resonant circuit may be close to a frequency of a noise to be filtered.

[0067] With the power supply device 300 according to the embodiment of the present disclosure, the resonant frequency of the LC resonant circuit including the inductor L and the capacitor C connected in series is close to the frequency of the noise by adjusting the inductance of the inductor L and the capacitance of the capacitor C, thereby filtering out the frequency of the noise.

[0068] According to a preferred embodiment of the present disclosure, the inductor L6 may be an I-type inductor.

[0069] A low cost I-type inductor is used in the power supply device 300 according to the embodiment of the present disclosure instead of an expensive ring inductor used in the conventional technology, thereby saving the cost. In addition, the I-type inductor has a smaller volume compared to the ring inductor. In addition, an expensive film capacitor used in the conventional technology is omitted in the power supply device 300 according to the embodiment of the present disclosure.

[0070] In addition, the power supply device 300 according to the embodiment of the present disclosure has a high electric efficiency and a low temperature rise. This is because that: a power consumption of the inductor L6 according to the embodiment of the present disclosure is small, where only a small portion of an input high-frequency current is passed through the inductor L6 according to the embodiment of the present disclosure; and an equivalent series resistance (ESR) of the inductor L6 according to the embodiment of the present disclosure is small.

[0071] Therefore, the power supply device 300 according to the embodiment of the present disclosure has a compact size since a volume required for a small inductance (for example, 5uH to 10uH) of the inductor L6 is small and a film capacitor is omitted.

[0072] According to another embodiment of the present disclosure, it is provided a power supply device, which includes: a filter configured to filter an AC input power; a rectifier configured to rectify the filtered AC input power, to obtain a DC power; and a power factor corrector configured to perform power factor correction on the DC power. The filter may include an LC resonant circuit which may be arranged between the rectifier and the power factor corrector and may be connected across the two output terminals of the rectifier. The LC resonant circuit may include an inductor L and a capacitor C connected in series, and a resonant frequency of the LC resonant circuit may be close to a switching frequency of the power factor corrector.

[0073] As shown in Fig. 5, the power supply device 500 according to the present disclosure may include a filter 501. The filter 501 may include an inductor L1, a capacitor C1, and a capacitor C2 and is configured to filter an AC input power. According to a preferred embodiment of the present disclosure, the filter 501 may be an electromagnetic interference EMI filter.

[0074] Continuing with reference to Fig. 5, the power supply device 500 according to the present disclosure may further include a rectifier 502 configured to rectify the filtered AC input power to obtain a DC power. According to a preferred embodiment of the present disclosure, the rectifier 502 may be a diode bridge rectifier.

[0075] Continuing with reference to Fig. 5, the power supply device 500 according to the present disclosure may further include a power factor corrector 503 configured to perform power factor correction on the rectified DC power. According to a preferred embodiment of

the present disclosure, the power factor corrector 503 may be a boost power factor corrector (PFC).

[0076] For example, referring back to Fig. 1, the boost PFC may further include a PFC controller 1030, a PFC power circuit, a capacitor C4, and a voltage dividing circuit including a resistor R2 and a resistor R3.

[0077] The PFC controller 1030 may include an amplifier configured to output a control signal based on comparison between an output voltage of the PFC and a reference voltage (for example, 2.5V).

[0078] The PFC power circuit may include an inductor L3, a diode D2, and a transistor switch M1, the transistor switch M1 is connected in parallel with the capacitor C4 and controls an output of the amplifier L3 and an output of the diode D2 based on a control signal of the PFC controller 1030 to obtain an output voltage V_{o_PFC} .

[0079] According to an embodiment of the present disclosure, the filter 501 may further include an LC resonant circuit including an inductor L and a capacitor C connected in series. The LC resonant circuit may be connected across two output terminals of the rectifier 502. According to a preferred embodiment of the present disclosure, the inductor L may be an I-type inductor.

[0080] The LC resonant circuit may include an inductor L6 and a capacitor C3 connected in series and may be connected across the two output terminals of the rectifier 502. Fig. 6 is an equivalent circuit diagram of a series resonant circuit including an inductor L6 and a capacitor C3 according to an embodiment of the present disclosure; and Fig. 7 shows an impedance curve of a series resonant circuit including an inductor L6 and a capacitor C3 according to an embodiment of the present disclosure.

[0081] As can be seen from Fig. 6 and Fig. 7, the LC series resonant circuit has a minimum impedance at a resonant frequency f_0 of the LC series resonant circuit in a case of $Z_{\min}=R$. That is, the impedance of the LC resonant circuit is minimized at the resonant frequency f_0 . According to an embodiment of the present disclosure, $f_0=1/(2*3.14*(L*C)^{0.5})$. In other words, according to an embodiment of the present disclosure, the resonant frequency f_0 is designed to be close to a switching frequency of the boost PFC, and the L6/C3 circuit can provide a low impedance path to filter out noises in a switching frequency range of the boost

PFC, thereby improving EMI performance.

[0082] An LC resonant circuit including an inductor L6 and a capacitor C3 connected in series is provided in the power supply device 500 according to an embodiment of the present disclosure, the LC resonant circuit provides a low impedance path to absorb noises in the switching frequency range of the boost PFC.

[0083] A low cost I-type inductor is used in the power supply device 500 according to the embodiment of the present disclosure instead of an expensive ring inductor used in the conventional technology, thereby saving a cost. In addition, the I-type inductor has a smaller volume compared to the ring inductor. In addition, an expensive film capacitor used in the conventional technology is omitted in the power supply device according to the embodiment of the present disclosure.

[0084] In addition, the power supply device 500 according to the embodiment of the present disclosure has a high electric efficiency and a low temperature rise. This is because that: a power consumption of the inductor L6 according to the embodiment of the present disclosure is small, where only a small portion of an input high-frequency current is passed through the inductor L6 according to the embodiment of the present disclosure; and an equivalent series resistance (ESR) of the inductor L6 according to the embodiment of the present disclosure is small.

[0085] Therefore, the power supply device 500 according to the embodiment of the present disclosure has a compact size since a volume required for a small inductance (for example, 5uH to 10uH) of the inductor L6 is small and a film capacitor is omitted.

[0086] Similarly, it is apparent to those skilled in the art that the power supply device according to the present disclosure is applicable to any switch-type power supply, the LED power supply is merely an example of the present disclosure, and the present disclosure is not limited thereto.

[0087] According to an embodiment of the present disclosure, it is provided an LED driving device 800. As shown in Fig. 8, the LED driving device 800 may include the power supply device 500 as described above according to the present disclosure. The power supply device 500 may include the filter 501, the rectifier 502, and the power factor corrector 503 as described above according to the present disclosure. In addition, the LED driving device 800

according to the present disclosure may further include an LED driver 801 which is powered by the power supply device 500 to drive an LED.

[0088] The power supply device 500 according to the embodiment of the present disclosure is described above in detail with reference to Fig. 5 to Fig. 7, and the power supply device 500 is not described here.

[0089] According to an embodiment of the present disclosure, the LED driver 801 may control an output voltage of the power supply device 500 based on a control signal such as a control signal of a dimmer, a control signal for limiting a maximum voltage, and a control signal for voltage stabilization to obtain a constant voltage for the LED.

[0090] An LC resonant circuit including an inductor L and a capacitor C connected in series is provided in the LED driving device according to the embodiment of the present disclosure. The LC resonant circuit provides a low impedance path to absorb noises in a designed frequency range. The LED driving device according to the embodiment of the present disclosure has advantages of a low cost, a high electric efficiency and a small volume.

[0091] In particular, a low cost I-type inductor is used in the LED driving device according to the embodiment of the present disclosure instead of an expensive ring inductor used in the conventional technology, thereby saving the cost. In addition, the I-type inductor has a smaller volume compared to the ring inductor. In addition, an expensive film capacitor used in the conventional technology is omitted in the LED driving device according to an embodiment of the present disclosure.

[0092] In addition, the LED driving device according to the embodiment of the present disclosure has a high electric efficiency and a low temperature rise. This is because that: a power consumption of the inductor L according to the embodiment of the present disclosure is small, where only a small portion of an input high-frequency current is passed through the inductor L according to the embodiment of the present disclosure; and an equivalent series resistance (ESR) of the inductor L according to the embodiment of the present disclosure is small.

[0093] Therefore, the LED driving device according to the embodiment of the present disclosure has a compact size since a volume required for a small inductance (for example, 5uH to 10uH) of the inductor L is small and a film capacitor is omitted.

[0094] Table 3 shows test data for the EMI and the PF according to the solution of the embodiments of the present disclosure.

[0095] Table 3 lower capacitances of the capacitor C1/C2/C3 (an output power of the load is 30%)

Vin (V)	Po (output power, W)	Capacitance C1=C2 (uF)	Capacitance C3 (nF)	Power factor PF	EMI_margin	Result	Annotation
120V	75.3	0.22uF	680nF	0.98	+10dB,f=65kHz	passed	Both the EMI and the PF are passed
230V	75.3	0.22uF	680nF	0.925	+5dB,f=65kHz	passed	
277V	75.5	0.22uF	680nF	0.901	+5dB,f=65kHz	passed	

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[0096] As can be seen from the data in Table 3, the power supply device or the LED driving device according to the embodiment of the present disclosure can pass tests on the EMI and the PF. In a case where the capacitances of the capacitors are lower, C1=C2=0.22uF, C3=680nF, the input voltage Vin is 120V, 230V and 277V respectively and an output power of the load is 30%, the power factor PF is greater than 0.9 and the EMI margin meets the requirement on the EMI.

10

[0097] In the device according to the present disclosure, it is apparent that each unit or step can be decomposed and/or recombined. These decomposition and/or recombination shall be considered as equivalents of the present disclosure. Also, above-described series of steps may be naturally performed in chronological order in the order described, but are not necessarily performed in chronological order. Some steps may be performed in parallel or independently from each other.

15

[0098] Although the embodiments of the present disclosure have been described above in detail with reference to the drawings, it should be understood that the above-described embodiments are merely used for illustrating the present disclosure and are not intended to limit the present disclosure. Those skilled in the art can make various modifications and variations to the above-described embodiments without departing from the substance and

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scope of the present disclosure. Accordingly, the scope of the present disclosure is defined only by the appended claims and their equivalents.

LIST OF REFERENCE SIGNS

	101	EMI filter
	102	bridge rectifier
	103	boost power factor corrector (PFC)
5	104	LED driver
	1030	PFC controller
	300	power supply device
	301	filter
	302	rectifier
10	500	power supply device
	501	filter
	502	rectifier
	503	power factor corrector
	800	LED driving device
15	801	LED driver

CLAIMS

1. A power supply device comprising:

a filter configured to filter an AC input power; and

5 a rectifier configured to rectify the filtered AC input power,

wherein the filter comprises an LC resonant circuit which is connected across two output terminals of the rectifier and comprises an inductor L and a capacitor C connected in series, wherein a resonant frequency of the LC resonant circuit is close to a frequency of a noise to be filtered.

10 2. The power supply device according to claim 1, wherein the inductor L is an I-type inductor.

3. The power supply device according to claim 1, wherein the filter is an electromagnetic interference EMI filter.

15 4. The power supply device according to claim 1, wherein the rectifier is a diode bridge rectifier.

5. A power supply device comprising:

a filter configured to filter an AC input power;

a rectifier configured to rectify the filtered AC input power to obtain a DC power; and

a power factor corrector configured to perform power factor correction on the DC power,

20 wherein the filter comprises an LC resonant circuit arranged between the rectifier and the power factor corrector, the LC resonant circuit is connected across two output terminals of the rectifier and comprises an inductor L and a capacitor C connected in series, and a resonant frequency of the LC resonant circuit is close to a switching frequency of the power factor corrector.

25 6. The power supply device according to claim 5, wherein the power factor corrector is a boost power factor corrector.

7. The power supply device according to claim 5, wherein the inductor L is an I-type inductor.

8. The power supply device according to claim 5, wherein the filter is an electromagnetic interference EMI filter.

9. The power supply device according to claim 5, wherein the rectifier is a diode bridge rectifier.

5 10. An LED driving device comprising:

the power supply device according to any one of claims 5 to 9; and

an LED driver configured to be powered by the power supply device to drive an LED.

10 11. The LED driving device according to claim 10, wherein an output voltage of the power supply device is controlled based on a control signal to obtain a constant voltage for the LED.

12. The LED driving device according to claim 11, wherein the control signal comprises a control signal for a dimmer, a control signal for limiting a maximum voltage, and a control signal for voltage stabilization.

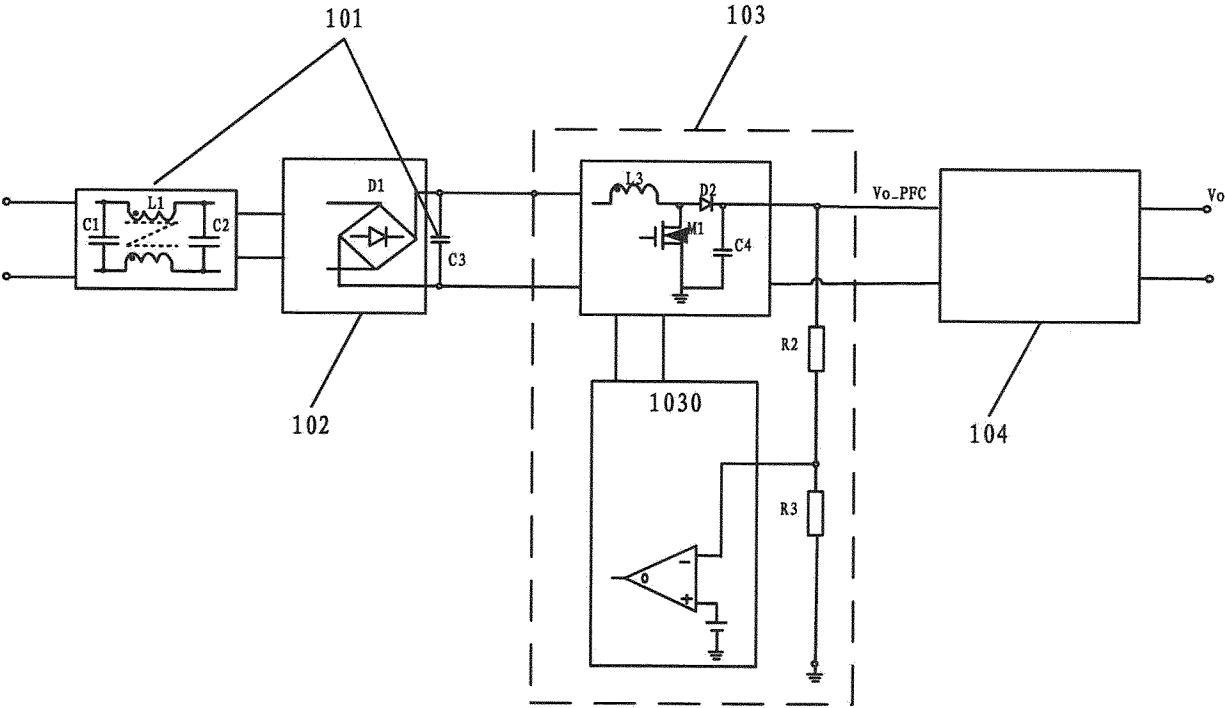


Figure 1

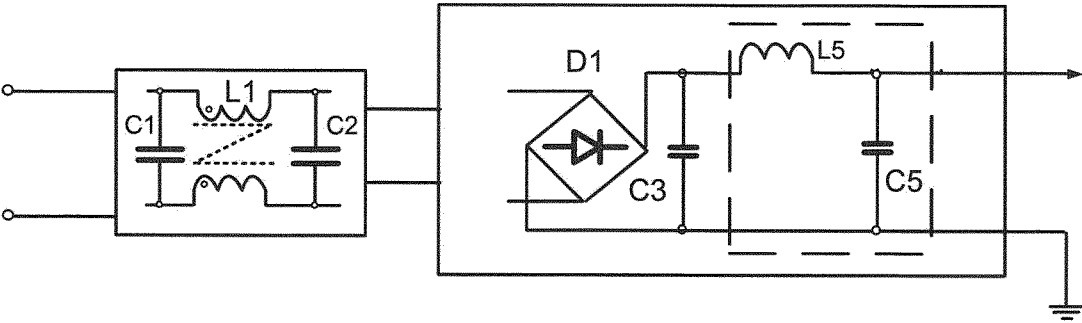


Figure 2

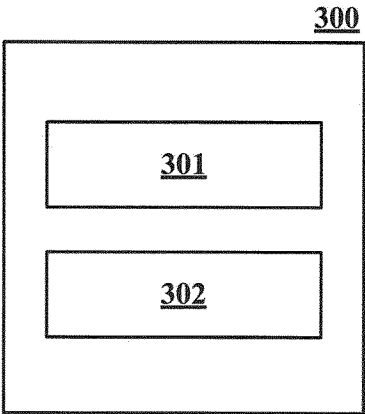


Figure 3

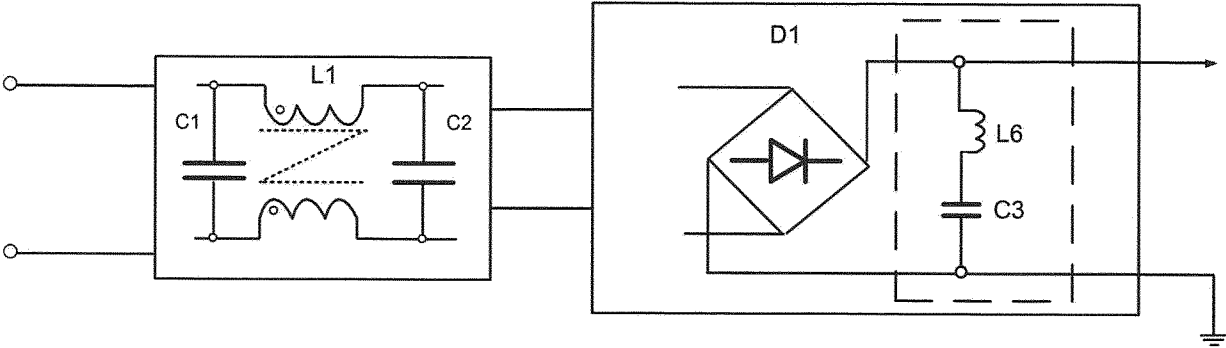


Figure 4

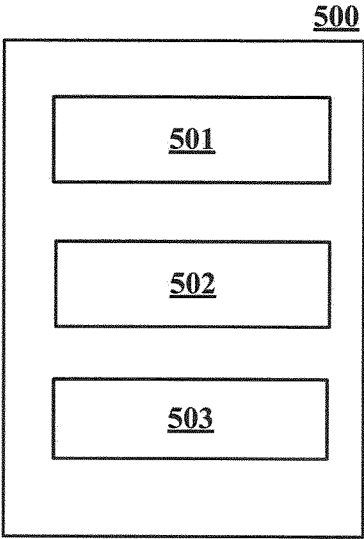


Figure 5

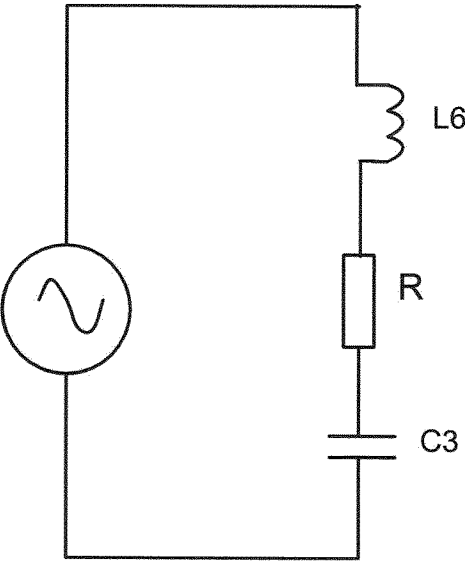


Figure 6

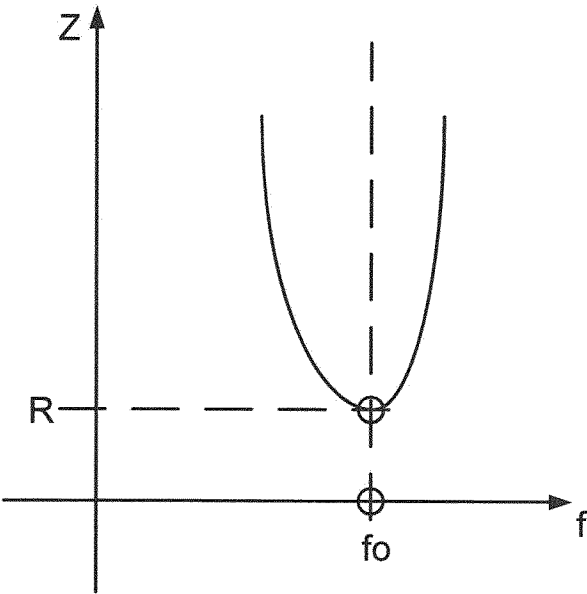


Figure 7

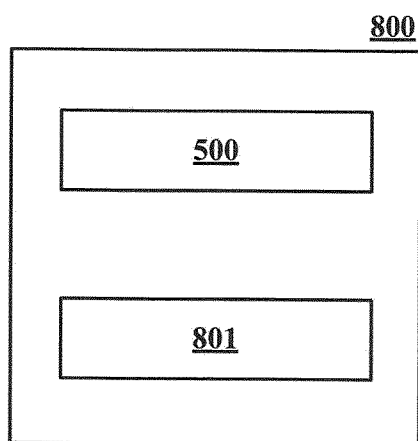


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/080914

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B33/08 H02M1/12 H02M1/42
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05B H02M

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016/315552 A1 (NISHIMOTO TAIKI [JP] ET AL) 27 October 2016 (2016-10-27) paragraph [0036]; figures 1,4 paragraph [0086] paragraph [0134] - paragraph [0139] -----	1-12
X	US 2014/346965 A1 (MOOSMANN FLORIAN [AT] ET AL) 27 November 2014 (2014-11-27) figures 1-2 paragraph [0014] - paragraph [0018] -----	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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

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

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

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Date of the actual completion of the international search

23 January 2019

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/080914

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