CONTROL OF A DC-DC CONVERTER TO SUPPLY A CONSTANT CURRENT TO A PULSED LOAD

TECHNOLOGICAL FIELD

The invention is in the field of control of a power supply coupled to a pulsed load.

BACKGROUND

A pulsed load or switched load is a load which requires a large supply of power intermittently.

A power supply (such as a DC-DC converter) provides energy to the pulsed load. In order to mitigate the impact of the pulsating requirement of the pulsed load on the power supply, some prior art solutions use a plurality of intermediate converters (multi-stage converters) and heavy filters. These solutions are costly and not optimal in terms of efficiency.

References considered to be relevant as background to the presently disclosed subject matter are listed below (acknowledgement of the references herein is not to be inferred as meaning that these are in any way relevant to the patentability of the presently disclosed subject matter):

- US10218264;
- US8878505;
- US10298122; and
- US10056830.

There is therefore a need to propose new systems and methods to control a power supply coupled to a pulsed load.

GENERAL DESCRIPTION

In accordance with certain aspects of the presently disclosed subject matter, there is provided a method comprising, for a power supply which has an output electrically coupled to at least one pulsed load: generating a signal V_{OV} informative of a voltage V_{OUT}

at the output of the power supply, generating a signal $V_{I_{load}}$ informative of a current I_{load} required by the at least one pulsed load, wherein, for at least one given period of time, the current I_{load} comprises a series of pulses, generating a signal $V_{I_{in}}$ informative of a current I_{in} at an input of the power supply, feeding the signal V_{OV}, the signal $V_{I_{load}}$ and the signal $V_{I_{in}}$ to a controller of the power supply, and controlling, by the controller, the current I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$.

In addition to the above features, the method according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (i) to (xviii) below, in any technically possible combination or permutation:

i. the amplitude of I_{in} is constant according to a stability criterion over at least part of the given period of time;

ii. said controlling of the current I_{in} by the controller according to the predefined relationship induces the power supply to generate, at its output, a current I_{out} which matches an average of I_{load} according to a matching criterion over at least part of the given period of time;

iii. the current I_{out} is constant according to a stability criterion over at least part of the given period of time;

iv. the voltage V_{OUT} is associated with an acceptable voltage range comprising a minimal acceptable value $V_{OUT,min}$ and a maximal acceptable value $V_{OUT,max}$, wherein the signal V_{OV} is informative of whether the voltage V_{OUT} is within the acceptable voltage range;

v. the voltage V_{OUT} is within the acceptable voltage range, the signal V_{OV} remains within a different voltage range between a first value $V_{OV,1}$ and a second value $V_{OV,2}$;

vi. the second value $V_{OV,2}$ is determined for a maximal average current I_{load} required by the pulsed load during given conditions of operation, such that, according to said predefined relationship, $V_{I_{in}} = V_{I_{load}}$;

vii. when the voltage V_{OUT} is above the maximal acceptable value $V_{OUT,max}$, the signal V_{OV} is set equal to a first maximal value $V_{OV,max}$, larger than $V_{OV,2}$;

viii. the output of the power supply is electrically coupled to an output capacitor, wherein when an average value of the current I_{load} is increased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is increased, and the signal V_{OV} is decreased;

ix. the output of the power supply is electrically coupled to an output capacitor, wherein when an average value of the current I_{load} is decreased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is decreased, and the signal V_{OV} is increased;

x. the output of the power supply is electrically coupled to an output capacitor, wherein during periods of the given period of time in which I_{load} does not comprise pulses, I_{out} enables charging of the output capacitor;

xi. the current I_{out} which is used to charge the output capacitor, is constant according to a stability criterion over at least part of the given period of time;

xii. the output of the power supply is electrically coupled to an output capacitor, wherein, during at least one period of the given period of time in which a pulse of current I_{load} is required by the pulsed load, the power supply generates a current I_{out} and the output capacitor generates a current $I_{capacitor}$, wherein the sum of I_{out} and $I_{capacitor}$ matches an amplitude of the pulse of current I_{load} required by the pulsed load according to a matching criterion;

xiii. an input voltage provided to the power supply is down-converted only once before it is fed, at the output of the power supply, to the pulsed load;

xiv. the controller induces a decrease of an amplitude of I_{in} when an amplitude of V_{OV} increases;

xv. the controller induces an increase of an amplitude of I_{in} when an amplitude of V_{OV} decreases;

xvi. the controller induces an increase of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ increases;

xvii. the controller induces a decrease of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ decreases; and

xviii. the controller controls I_{in} using the predefined relationship $k_1 V_{I_{in}} + k_2 V_{OV} - k_3 V_{I_{load}} = V_{ref}$, wherein k_1, k_2, and k_3 are positive parameters, and V_{ref} is a reference voltage of the controller.

In accordance with certain aspects of the presently disclosed subject matter, there is provided a system comprising a controller operative to control a power supply which has an output electrically coupled to at least one pulsed load, wherein the controller is operative to obtain a signal V_{OV} informative of a voltage V_{OUT} at the output of the power supply, obtain a signal $V_{I_{load}}$ informative of a current I_{load} required by the at least one pulsed load, wherein, for at least one given period of time, the current I_{load} comprises a series of pulses, obtain a signal $V_{I_{in}}$ informative of a current I_{in} at an input of the power supply, and control the current I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$.

In addition to the above features, the system according to this aspect of the presently disclosed subject matter can optionally comprise one or more of features (xix) to (xxxviii) below, in any technically possible combination or permutation:

xix. the amplitude of I_{in} is constant according to a stability criterion over at least part of the given period of time;

xx. said control of the current I_{in} by the controller according to said predefined relationship induces the power supply to generate, at its output, a current I_{out} which matches an average of I_{load} according to a matching criterion over at least part of the given period of time;

xxi. the current I_{out} is constant according to a stability criterion over at least part of the given period of time.

xxii. the voltage V_{OUT} is associated with an acceptable voltage range comprising a minimal acceptable value $V_{OUT,min}$ and a maximal acceptable value $V_{OUT,max}$, wherein the signal V_{OV} is informative of whether the voltage V_{OUT} is within the acceptable voltage range;

xxiii. the voltage V_{OUT} is within the acceptable voltage range, the signal V_{OV} remains within a different voltage range between a first value $V_{OV,1}$ and a second value $V_{OV,2}$.

xxiv. the second value $V_{OV,2}$ is determined for a maximal average current I_{load} required by the pulsed load during given conditions of operation, such that, according to said predefined relationship, $V_{I_{in}} = V_{I_{load}}$;

xxv. when the voltage V_{OUT} is above the maximal acceptable value $V_{OUT,max}$, the signal V_{OV} is set equal to a first maximal value $V_{OV,max}$, larger than $V_{OV,2}$;

xxvi. the system comprises an output capacitor electrically coupled to the output of the power supply, wherein when an average value of the current I_{load} is increased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is increased, and the signal V_{OV} is decreased;

xxvii. the system comprises an output capacitor electrically coupled to the output of the power supply, wherein when an average value of the current I_{load} is decreased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is decreased, and the signal V_{OV} is increased;

xxviii. the system comprises an output capacitor electrically coupled to the output of the power supply, wherein during periods of the given period of time in which I_{load} does not comprise pulses, I_{out} enables charging of the output capacitor;

xxix. the current I_{out} which is used to charge the output capacitor, is constant according to a stability criterion over at least part of the given period of time;

xxx. the system comprises an output capacitor electrically coupled to the output of the power supply, wherein, during at least one period of the given period of time in which a pulse of current I_{load} is required by the pulsed load, the power supply is operative to generate a current I_{out} and the output capacitor is operative to generate a current $I_{capacitor}$, wherein the sum of I_{out} and $I_{capacitor}$ matches an amplitude of the pulse of current I_{load} required by the pulsed load according to a matching criterion;

xxxi. an input voltage provided to the power supply is down-converted only once before it is fed, at the output of the power supply, to the pulsed load;

xxxii. the controller is operative to induce a decrease of an amplitude of I_{in} when an amplitude of V_{OV} increases;

xxxiii. the controller is operative to induce an increase of an amplitude of I_{in} when an amplitude of V_{OV} decreases;

xxxiv. the controller is operative to induce an increase of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ increases;

xxxv. the controller is operative to induce a decrease of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ decreases.

xxxvi. the controller is operative to control I_{in} using the predefined relationship $k_1 V_{I_{in}} + k_2 V_{OV} - k_3 V_{I_{load}} = V_{ref}$, wherein k_1, k_2, and k_3 are positive parameters, and V_{ref} is a reference voltage of the controller;

xxxvii. the system comprises the power supply; and

xxxviii. the system comprises the pulsed load.

According to some embodiments, the proposed solution provides control and architecture of a power supply connected to a pulsed load which enables high efficiency operation of the power supply.

According to some embodiments, the proposed solution provides a highly efficient power supply together with a reduction of the manufacturing costs.

According to some embodiments, the proposed solution prevents the pulsating requirement of a pulsed load from significantly impacting operation of the power supply.

According to some embodiments, the proposed solution enables usage of a single stage DC-DC converter to provide energy to a pulsed load.

According to some embodiments, the proposed solution does not require the use of heavy filters.

According to some embodiments, the proposed solution induces smooth behavior of the power supply, notwithstanding the pulsating requirement of the pulsed load.

According to some embodiments, the proposed solution provides efficient control of the power supply, even in the presence of high-frequency pulsed load(s).

According to some embodiments, the proposed solution provides control of the power supply which adapts quickly to changes in the load required by the pulsed load(s).

According to some embodiments, the proposed solution reduces the need for cooling of the system.

According to some embodiments, the proposed solution reduces the weight of the system.

According to some embodiments, the proposed solution proposes a system which is more reliable.

According to some embodiments, the proposed solution increases the MTBF ("Mean Time Between Failures") of the system.

According to some embodiments, the proposed solution is operative even with high-voltage pulsed load.

According to some embodiments, the proposed solution provides a power supply with a low RMS current at its output (I_{out}).

According to some embodiments, the proposed solution does not require usage of a filter at the input of the power supply.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

- **Fig. 1A** illustrates an architecture of a system operative to provide energy to a pulsed load;
- **Fig. 1B** illustrates a non-limitative example of a current required by a pulsed load, which includes pulses of current;
- **Fig. 1C** illustrates an embodiment of the architecture of the system of **Fig. 1A**;
- **Fig. 2** illustrates an embodiment of a method of controlling a power supply to provide energy to a pulsed load;
- **Fig. 3A** illustrates an embodiment of a conversion of the current required by the pulsed load into a voltage signal informative thereof;
- **Fig. 3B** illustrates an embodiment of an architecture enabling conversion of the current required by the pulsed load into a voltage signal informative thereof;
- **Fig. 3C** illustrates a non-limitative example of the voltage signal informative of the current required by the pulsed load;
- **Fig. 3D** illustrates another non-limitative example of the voltage signal informative of the current required by the pulsed load;

- **Fig. 4** illustrates a non-limitative example of a voltage at the output of the power supply coupled to the pulsed load, and of a current required by the pulsed load;
- **Fig. 5** illustrates a non-limitative example of a voltage signal informative of the voltage at the output of the power supply;
- **Fig. 6** illustrates an embodiment of a conversion of the voltage at the output of the power supply into a voltage signal informative thereof;
- **Fig. 7** illustrates a non-limitative example of a voltage signal informative of the current at the input of the power supply;
- **Fig. 8** illustrates a non-limitative example of the current required by the pulsed load, of the DC current generated by the power supply and of the current generated by the output capacitor;
- **Fig. 9** illustrates an embodiment of a conversion of the current at the input of the power supply into a voltage signal informative thereof;
- **Fig. 10** illustrates an embodiment of a combination of various signals before their feeding to the controller of the power supply; and
- **Fig. 11** illustrates a non-limitative example of the current required by the pulsed load, of the DC current generated by the power supply, of the DC current at the input of the power supply, and of the current generated by the output capacitor.

DETAILED DESCRIPTION OF EMBODIMENTS

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the presently disclosed subject matter may be practiced without these specific details. In other instances, well-known methods have not been described in detail so as not to obscure the presently disclosed subject matter.

Attention is drawn to **Fig. 1A**, which illustrates a controlled power supply **100** electrically coupled to a pulsed load **101**.

The power supply **100** is typically a DC/DC converter. For example, it can be a Buck Converter or a Boost Converter. According to some embodiments, the architecture as described in **Fig. 1A** (or in the other embodiments described hereinafter) enables to feed energy to the pulsed load **101** using a single power supply **100** (e.g., single DC/DC converter, or single Buck Converter, or single Boost converter). This corresponds to a

"single stage" converter. In a single stage converter, the input voltage (see V_{source} in **Fig. 1**) provided to the power supply is down-converted only once (it is reduced to a lower voltage only once) before it is fed, at the output of the power supply (see V_{OUT}), to the pulsed load **101**. The down-conversion is performed by the power supply **100**.

The pulsed load **101** can include a single pulsed load, or a plurality of pulsed loads (in some embodiments, the plurality of pulsed loads can operate synchronously in time). Non-limitative examples of pulsed loads include e.g., a phased-array antenna (including a plurality of tiles), a radar, or other pulsed load applications.

The output **105** of the controlled power supply **100** is electrically coupled (connected) to the pulsed load **101** and to an output capacitor **110**. The output capacitor **110** is itself electrically coupled to the pulsed load **101**.

The power supply **100** receives energy from a power source (voltage source) **120**. In some embodiments, the power source **120** includes a rectified phase of a 3-phase power line having a rectified line voltage. In some embodiments, the power source **120** includes an electrically connected bank of batteries configured to provide a required line voltage. This is however not limitative. The voltage provided by the power source **120** to the power supply **100** is noted V_{source}. V_{source} - which is generally a constant voltage (e.g., 320 V – this is however not limitative), and is a given input imposed by the electrical network.

Fig. 1A further illustrates a controller **103**, which controls operation of the power supply **100**. The controller **103** can be a Pulse Width Modulation (PWM) controller. This is however not limitative. Various signals are generated and fed to the input of the controller **103**, which will be discussed hereinafter.

Attention is now drawn to **Fig. 1B**.

Fig. 1B depicts a non-limitative example of the current I_{load}, which is required by the pulsed load **101** for its operation over a given period of time (between 10ms and 22ms – the period of time between 0ms and 10ms can correspond e.g., to a transition period).

As visible in **Fig. 1B**, current I_{load} includes a series of pulses (also called bursts). Note that the representation of **Fig. 1B**, in which a perfect square signal is depicted, is schematic, and the pulses of the current I_{load} may include a slope (caused by a non-zero rise time). The profile of I_{load} in the period of time represented in **Fig. 1B** corresponds to an alternance over time between:

- pulses **111** of current intensity, and
- periods of time which are free of pulses, in which the current intensity **112** is equal to zero (or nearly equal to zero).

According to some embodiments, the different pulses of the current intensity I_{load} are, at least during a given time frame, of the same amplitude (or substantially of the same amplitude). In the non-limitative example depicted in **Fig. 1B**, the amplitude of each of the pulses is equal to 170A in a time frame between 10ms and 22ms.

In the non-limitative example of **Fig. 1B**, the duty cycle of the current intensity I_{load} is equal to 20% (this value is not limitative). The duty cycle corresponds to the ratio between the duration of the pulses and the total period of the waveform.

In the non-limitative example of **Fig. 1B**, the current intensity I_{load} has a frequency of 400Hz (each pulse having a duration/width of 500 µs).

Attention is now drawn to **Fig. 1C**, which depicts an embodiment of the system of **Fig. 1A**.

In **Fig. 1C**, typical components of the power supply **100** are depicted. Note that the components of the power supply depicted in **Fig. 1C** are only examples. These components include an array **180** of one or more field-effect transistors (FET(s)), a transformer **181** and an inductor **182**. Other components and/or additional components can be used as part of the power supply **100**. In particular, components typically used in a Buck Converter or in a Boost Converter can be used.

The controller **130** is fed with a plurality of signals. As shown in **Fig. 1C**, a combiner **150** can perform operations on the plurality of signals. The output of the combiner **150** is fed to an input of the controller **130**. Note that the combiner **150** can be part of the controller **130** or external to it.

Attention is now drawn to **Fig. 2**.

A signal (e.g., voltage signal), noted $V_{I_{load}}$, is generated (operation **200**). $V_{I_{load}}$ is informative of the current I_{load} required by the at least one pulsed load **101**. In particular, $V_{I_{load}}$ can be computed such that its amplitude is representative of the average current required by the at least one pulsed load **101** (in other words, $V_{I_{load}}$ is informative of an average of I_{load}). The average current can be computed over a predetermined period of time, for example over one or more (repetitive) cycles, each cycle comprising a period of time including a peak of current intensity and a period of time in which the current intensity is substantially equal to zero (until the next peak of current intensity is reached).

Figs. 3A and **3B** depict a method which can be used to generate $V_{I_{load}}$. The method includes sampling I_{load} to obtain a voltage signal V_1. A sampler **329** can be used. The sampler **329** can include e.g., a current transformer, a resistance, etc. (this is not limitative).

The method further includes determining (operation **310**) an average $\overline{V_1}$ of the voltage signal V_1 over a predetermined period of time T. In some embodiments, the predetermined period of time T can be set as corresponding to the highest PRI (Pulse Repetition Interval) of the pulsed load **101**. Indeed, according to some embodiments, the operator of the pulsed load **101** can provide the highest PRI under which the pulsed load **101** is expected to operate. As a consequence, T can be selected as equal to this value, or can be selected as higher than this value by a factor of e.g. 10% (this value is not limitative).

The average $\overline{V_1}$ of V_1 can be determined using a standard module **331**, which can include electrical components such as a resistor and a capacitor.

At the end of each period of time T, the average $\overline{V_1}$ is provided (operation **320**) to a sample and hold circuit **333**. The sample and hold circuit **333** acts as a "memory". The output of the sample and hold circuitry **333** can correspond to the signal $V_{I_{load}}$ (operation **330**).

The module **331** repetitively calculates the average of the signal V_1 over the period of time T, which is then transmitted to the sample and hold circuit **333**.

In the most demanding operating conditions of the pulsed load **101**, the amplitude of each peak of current I_{load} is maximal, the duration in time of each peak of current I_{load} is maximal, and the duty cycle of I_{load} is maximal. The most demanding operating conditions can correspond e.g., to a configuration in which the average current I_{load} required by this pulsed load **101** is maximal. Note that the data defining the most demanding operating conditions of the pulsed load **101** constitute a known input and are generally provided by the operator of the pulsed load **101**.

Assume for example that the most demanding operating conditions of operation (worst case scenario) of the pulsed load **101** correspond to the parameters provided hereinafter: each peak of current intensity I_{load} is equal to 170A, with a duration of 500 µs, the duty cycle is equal to 20%, and the PRI is equal to 2.5 msec (frequency of 400 Hz).

In this non-limitative example, under the most demanding operating conditions of operation, the voltage signal $V_{I_{load}}$ which is obtained is a constant voltage equal to 6.8V, as visible in **Fig. 3C**. This value is not limitative and depends on the parameters chosen for the components used in the module **331** and in the sample and hold circuity **333**. Note that the representation of **Fig. 3C** (and **Fig. 3D**) is schematic and does not depict the time response that can be required to compute the signal $V_{I_{load}}$. Note that the conversion of I_{load} under the most demanding operations into a constant voltage $V_{I_{load}}$ equal to 6.8V is arbitrary, and another value can be selected.

Assume that the pulsed load **101** currently operates under given conditions of operations for I_{load} (for example, the most demanding conditions of operation). As long as the pulsed load **101** does not deviate from these given conditions of operation, the value of $V_{I_{load}}$ remains the same.

When the pulsed load **101** deviates from the given conditions of operation, the voltage signal $V_{I_{load}}$ has a different value. For example, assume that the duty cycle of I_{load} is reduced by a factor of 2, from 20% to 10%. As a consequence, the voltage signal $V_{I_{load}}$ is reduced by the same factor. For example (note that this example is not limitative), the voltage signal $V_{I_{load}}$ is now a constant voltage equal to 3.4V (see **Fig. 3D**). Similarly, if the amplitude of the peaks of I_{load} is reduced from 170A to 56A (division by three) then the voltage signal $V_{I_{load}}$ is a constant voltage equal e.g. to 2.26V (division by three). In other words, a linear relationship can be generated between the signal $V_{I_{load}}$ and the current I_{load}.

Any change in the parameters defining I_{load} will therefore induce a change in $V_{I_{load}}$.

Reverting to **Fig. 2**, the method includes operation **210**, in which a signal V_{OV} is generated. V_{OV} is an electrical signal (e.g., a voltage signal) informative of the voltage V_{OUT} at the output of the power supply **100** (that is to say, the voltage of the output capacitor **110** – this is also the voltage at the input of the pulsed load **101**).

According to some embodiments, it is desired to obtain a voltage V_{OUT} which remains within an acceptable voltage range. Indeed, the pulsed load **101** generally requires a constant voltage value. The acceptable voltage range is provided e.g., by the operator of the pulsed load **101**, and is a given input. The acceptable voltage range includes a minimal acceptable value $V_{OUT,min}$ and a maximal acceptable value $V_{OUT,max}$.

For example, it is desired to have a voltage V_{OUT} which varies around a main value (e.g., 50V) with a predefined tolerance of variation around this main value (e.g., ± 2V). In this case, the acceptable voltage range for V_{OUT} is [48V;52V]. These values are not limitative.

The output capacitor **110** can be selected to meet the requirements of the pulsed load **101** under its most demanding operating conditions (which are, as mentioned above, known in advance): maximal allowed variation of the voltage V_{OUT} (e.g. ± 2V), under maximal pulse width of I_{load}, maximal amplitude of load current I_{load} and maximal duty cycle.

For example, assume that the maximal amplitude of each peak of current I_{load} is equal to 170A, the maximal duration in time of each peak of current I_{load} is 500 µs, and the maximal duty cycle of I_{load} is 20%. This implies that the maximal average value of the current I_{load} is 34A.

As explained hereinafter, the power supply **100** is controlled to provide a DC current I_{out} (I_{out} is substantially constant according to a stability criterion) corresponding to the average of I_{load}, which, together with the current $I_{capacitor}$ generated by the output capacitor **110**, enable to feed to the pulsed load **101** the required current I_{load}.

In order to provide a current which matches the maximal peak of current (in this non limitative example, 170A) periodically requested by the pulsed load **101**, the output capacitor **110** (previously charged using a current I_{load} of 34A) must provide a current $I_{capacitor}$ of 170A-34A=136A. As known in the art, $I_{capacitor} = C\frac{dV}{dt}$, with C the capacitance of the capacitor and dV the voltage variation. We therefore obtain: $C = \frac{I_{capacitor}dt}{dV} = \frac{(136A)(500\mu s)}{2V} = 34mF$. These values are not limitative. This corresponds to the minimal capacitance required for the output capacitor **110**, determined in the most demanding operating conditions of the pulsed load **101**. Note that this is not limitative, and a larger capacitance can be used for the output capacitor **110**.

As visible in **Fig. 4**, the signal V_{OUT} includes a repetitive sequence of two main temporal phases.

In a first phase **400** corresponding to a time period in which there is a peak in the current I_{load}, there is a drop in the amplitude of V_{OUT} (in the non-limitative example of **Fig. 4**, a drop of around 2V is present). This is due to the fact that during a peak of current I_{load}, the output capacitor **110** generates a current $I_{capacitor}$ which induces a drop in the voltage V_{OUT} of the output capacitor **110**.

In a second phase **410** corresponding to a time period in which there is no peak in the signal I_{load} (in this time period the current I_{load} is substantially equal to zero), the signal V_{OUT} increases (until a new peak appears in the current I_{load}, and at that time there is again a drop in V_{OUT}). In the example of **Fig. 4**, an increase of 2V is present.

In the example of **Fig. 4**, the signal V_{OUT} remains in the acceptable voltage range ([48V;52V] as defined e.g., by the operator of the pulsed load **101**).

In order to ensure that the signal V_{OUT} remains in the acceptable voltage range, the signal V_{OV} can be used. As explained hereinafter, the signal V_{OV} is also used to enable the controller **103** to command the power supply **100** to request/generate a substantially constant current I_{in}, in order to obtain a substantially constant output current I_{out}, which is substantially equal to the average of the current I_{load} demanded by the pulsed load **101**. This will be further described hereinafter.

As long as the signal V_{OUT} remains in the acceptable voltage range, it is converted into a signal V_{OV} which remains within a predefined voltage range $[V_{OV,1}; V_{OV,2}]$. $V_{OV,1}$ is generally selected as a small value, for example 0.5V. Note that this value is not limitative, and another value can be used.

In order to determine $V_{OV,2}$, the following computation can be performed.

As explained hereinafter, the controller **103** controls the power supply **100** using a predefined relationship (see Equation 2). Assume for example that the predefined relationship is (note that Equation 1 is an example of Equation 2):

$$V_{I_{in}} + V_{OV} - V_{I_{load}} = 2 * V_{ref}$$

Equation 1

V_{ref} is a reference voltage of the controller **130**. Assume for example that $V_{ref} = 1.25$. As explained hereinafter, $V_{I_{in}}$ is an electrical signal (e.g., voltage signal) informative of the current I_{in} at the input of the power supply **100**.

$V_{OV,2}$ can be selected such that, for $V_{OUT} = V_{OUT,max}$ (for example 52V), $V_{I_{in}} = V_{I_{load}}$.

According to the relationship above, this implies that $V_{OV,2} = 2 * V_{ref} = 2.5V$.

Once $V_{OV,1}$ and $V_{OV,2}$ have been selected, it can set that, for a value of V_{OUT} which is equal to 50V (corresponding to the middle of the acceptable voltage range), the value of V_{OV} is also located at the middle of the interval $[V_{OV,1}; V_{OV,2}]$. In the example provided

above, a value of V_{OUT} equal to 50V corresponds therefore to a value of V_{OV} equal to 1.5V.

The conversion of V_{OUT} from the interval $[V_{OUT,min}; V_{OUT,max}]$ (e.g. [48V;52V]) to the interval $[V_{OV,1}; V_{OV,2}]$ (e.g. [0.5V;2.5V]) can be performed using different methods. In some embodiments, a FPGA can be used. In some embodiments, this conversion can be performed using e.g., a differential amplifier and a resistance.

In some embodiments, in order to prevent the signal V_{OV} from having ripples as the signal V_{OUT} (when it varies by ±2V), a capacitor can be used to determine an average of the signal V_{OV}.

Note that in some embodiments, the signal V_{OV} is informative of an average of the value of V_{OUT}. When the average of V_{OUT} is equal to $V_{OUT,max}$, then V_{OV} is set equal to $V_{OV,2}$, when the average of V_{OUT} is equal to $V_{OUT,min}$, then V_{OV} is set equal to $V_{OV,1}$, and when the average of V_{OUT} is equal to $\frac{V_{OUT,min}+V_{OUT,max}}{2}$ then V_{OV} is set equal to $\frac{V_{OV,1}+V_{OV,2}}{2}$.

According to some embodiments, when the signal V_{OUT} is higher than the maximal acceptable value $V_{OUT,max}$ (for example the signal V_{OUT} is larger 52V), the signal V_{OV} is set (see operation **610**) as equal to a new value $V_{OV,max}$, which is (much) larger than $V_{OV,2}$.

As explained hereinafter with reference to Equation 3 (which describes the operation performed by the controller **130** in coordination with the combiner **150**), this enables the controller to reduce I_{in}, and in turn, to bring back V_{OUT} to the acceptable voltage range.

This can be performed by using e.g., a diode. As long as the signal V_{OUT} is within the acceptable voltage range, the diode does not operate. When the signal V_{OUT} is higher than 52V, this diode starts to operate (and can induce charging of a capacitor, and therefore, induces an increase of V_{OV}). This induces the signal V_{OV} to reach the value of $V_{OV,max}$. Note that $V_{OV,max}$ can be selected using Equation 3, such that, even under the highest load required by the pulsed load **101** (in which $V_{I_{load}} = 6.8V$), the voltage $V_{I_{in}}$ (and therefore the current I_{in}) is set to zero. Intuitively, this means that the power supply **100** should stop providing current to the pulsed load **101** in case the signal V_{OUT} is very high.

In the example of Equation 1, this yields the following equation (for $V_{I_{in}} = 0$ and $V_{I_{load}} = 6.8V$):

$$V_{OV,max} = 2.5 + 6.8 = 9.3V$$

In some embodiments, when the signal V_{OUT} is lower than 48V (meaning that the signal V_{OUT} is smaller than the minimal acceptable value $V_{OUT,min}$), the signal V_{OV} can be set equal to a new smaller value $V_{OV,min}$ (see operation **620**), which is smaller than $V_{OV,1}$. For example, $V_{OV,min}$ is equal to 0V. This can be performed by using e.g., a comparator. Intuitively, this means that the power supply **100** should provide maximal current to the pulsed load **101** in case the signal V_{OUT} is very small.

In the example of **Fig. 4**, since the average of the signal V_{OUT} is in the middle of the acceptable voltage range (50V), the signal V_{OV} depicted in **Fig. 5** is substantially equal to 1.5V.

As shown in **Fig. 2**, another signal, hereinafter noted $V_{I_{in}}$ (operation **220**), is generated. $V_{I_{in}}$ is an electrical signal (e.g. voltage signal) informative of the current I_{in} at the input of the power supply **100**.

Fig. 7 illustrates an example of the signal $V_{I_{in}}$.

A possible embodiment of a conversion of the current I_{in} into the signal $V_{I_{in}}$ is described with reference to **Fig. 9**.

The method of **Fig. 2** further comprises feeding (operation **230**) the signal V_{OV}, the signal $V_{I_{load}}$ and the signal $V_{I_{in}}$ to the controller **130** of the power supply **100**.

Based on these signals, the controller **130** controls the current I_{in} fed to the power supply **100**. In particular, the controller **130** can control opening of one or more field-effect transistors (FET) of the power supply **100** to control the value of I_{in} . Note that this is not limitative and, in some embodiments, a phase shift controller or another adapted topology can be used.

The controller **130** controls the current I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$ (see e.g., Equation 3 recited hereinafter). As shown in **Figs. 1A** and **1C**, a closed loop control is implemented, in which the controller **130** receives as an input the signal $V_{I_{in}}$ informative of the current I_{in}, and controls the current I_{in}.

Assume that the pulsed load **101** requests a series of current peaks with the same amplitude over a given period of time. After a transition time enabling the current I_{in} to reach the required value, the controller **130** enables the power supply **100** to request a current I_{in} for which the predefined relationship is met. Once the predefined relationship

is met, the current I_{in} is a DC current. Since the power supply **100** receives a DC current I_{in}, it generates at its output a current I_{out}which is a DC current. Note that due to various factors (noise, etc.), even after a period of stabilization, the amplitude of I_{in} can vary slightly. According to some embodiments, the amplitude of I_{in} is constant according to a stability criterion over at least part of the given period of time. The stability criterion can define the maximal peak-to-peak variation which is acceptable for I_{in}. In some embodiments, the stability criterion defines that the variations in the amplitude of I_{in} are smaller than or equal to 5% or 10% of the average of I_{in}, when the system is not in a transition period. For example, the peak-to-peak variation is smaller than 400 mA (this is not limitative).

Similarly, even after a period of stabilization, the amplitude of I_{out} can vary slightly. According to some embodiments, the amplitude of I_{out} is constant according to a stability criterion over at least part of the given period of time. The stability criterion can define the maximal peak-to-peak variation which is acceptable for I_{out}. According to some embodiments, the stability criterion defines that the variations in the amplitude of I_{out} are smaller than or equal to $0.2.\overline{I_{out}}$, when the system is not in a transition period ($\overline{I_{out}}$ is the average value of I_{out}). For example, the peak-to-peak variation is smaller than 400 mA (this is not limitative).

The predefined relationship is calibrated to ensure that the DC current I_{in} has a value which induces generation of a current I_{out} at the output of the power supply **100** which matches an average of I_{load} according to a matching criterion over at least part of the given period of time.

The matching criterion can define the maximal acceptable error between I_{out} and the average of I_{load} (e.g., 5% - this is not limitative).

For example, assume that current I_{load} includes peaks of 170A with a duty cycle of 20% over a given period of time. The average value of the current I_{load} is equal to 34A (the most demanding conditions of operation of the pulsed load **101**, as explained above). Therefore, the controller **103** needs to control the power supply **100** to request a current I_{in}, which induces generation of an output current I_{out} equal to 34A. The relationship between I_{in} and I_{out} can be defined as follows (this is not limitative):

$$V_{out}I_{out} = \varepsilon V_{source}I_{in}$$

ε is the efficiency of the power supply **100** which is known or can be estimated.

During a period of time (see reference **410** in **Fig. 4**) in which the pulsed load **101** does not require a peak of current (I_{load} is equal to zero, or close to zero), the output current I_{out} charges the output capacitor **110** (this occurs automatically since the pulsed load **101** does not require current in this period of time **410**).

During a period of time (see reference **400** in **Fig. 4**) in which the pulsed load **101** requires a peak of current (I_{load} is equal to its maximal value), the output current I_{out} is fed to the pulsed load **101**. In addition, since the output capacitor **110** has been previously charged (as explained above), the output capacitor **110** generates an output current $I_{capacitor}$. The sum of I_{out} and $I_{capacitor}$ matches an amplitude of the pulse of current required by the pulsed load during a peak (according to a matching criterion defining the maximal acceptable error, e.g., 5%, this value being not limitative). In the example mentioned above, in which peaks of 170A are required by the pulsed load **101** with a duty cycle of 20%, the value of $I_{capacitor}$ is 136A. This is illustrated in **Fig. 8**, in which peaks of the current of 136A are depicted for $I_{capacitor}$. Note that **Fig. 8** is schematic and does not represent noise or delays which can be caused by the time response of the system.

Attention is drawn to **Fig. 9**.

As explained above, the controller **130** controls I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$. Assume that in this example, the predefined relationship is $V_{I_{in}} + V_{OV} - V_{I_{load}} = 2.V_{ref}$.

When the pulsed load **101** operates in its most demanding operating conditions for the current I_{load} (in the non-limitative example used above, this corresponds to a configuration in which each peak of current intensity I_{load} is equal to 170A with a duration of 500µs, the duty cycle is 20%, and the voltage V_{OUT} varies between 48V and 52V), we have $V_{OV} = 1.5V$ and $V_{I_{load}} = 6.8V$. As explained hereinafter, V_{ref} is a given parameter of the controller **130** (reference voltage) equal e.g., to 1.25V. As a consequence, in order to meet the predefined relationship when the pulsed load **101** operates in its most demanding operating conditions, the signal $V_{I_{in}}$ must be equal to 7.8V ($V_{I_{in}} = 2.5 + 6.8 - 1.5 = 7.8V$).

The relationship between I_{in} and I_{out} can be defined as follows (this is not limitative):

$$V_{out}I_{out} = \varepsilon V_{source}I_{in}$$

ε is the efficiency of the power supply **100** which is known or can be estimated (for example, $\varepsilon = 0.94$).

In the most demanding operating conditions for the current of the pulsed load, we therefore obtain:

$$I_{in} = \frac{V_{out} I_{out}}{\varepsilon V_{source}} = \frac{50 * 34}{0.94 * 320} = 5.65A$$

Equation 2

Therefore, in the most demanding operating conditions for the current of the pulsed load, the value of $V_{I_{in}}$ (7.8V) must represent a current I_{in} of 5.65A.

In the architecture of **Fig. 9**, the current I_{in} is fed to a current sensor **900**. The parameters of the current sensor **900** are selected to ensure that for an input current I_{in} of 5.65A, a voltage $V_{I_{in}}$ of 7.8V is generated.

In some embodiments, the current I_{in} is fed to a current sensor which divides the current by a known constant factor, and the output is multiplied by a fixed gain G (to be determined), in order to obtain $V_{I_{in}}$. The gain G is therefore determined such that, for an input current I_{in} of 5.65A, the value of $V_{I_{in}}$ is equal to 7.8V.

Note that there is a linear relationship between I_{in} and $V_{I_{in}}$.

Attention is now drawn to **Fig. 10**.

As mentioned above, the controller **130** controls I_{in}, in order to ensure that a predefined relationship is met between $V_{I_{in}}$, V_{OV} and $V_{I_{load}}$.

According to some embodiments, the predefined relationship is defined as follows:

$$k_1 V_{I_{in}} + k_2 V_{OV} - k_3 V_{I_{load}} = V_{ref}$$

Equation 3

In this relationship, k_1, k_2, and k_3 are positive parameters. In a non-limitative example, $k_1 = k_2 = k_2 = 1/2$. V_{ref} is a reference voltage of the controller **130** (this is a given parameter of the parameter – each controller **130** having his own reference voltage).

The relationship provided above is not limitative.

The controller **130** tries to modify $V_{I_{in}}$ (by modifying I_{in} taken by the power supply **100** from the power source **120**) in order to have the relationship which is met. Note that V_{OV} and $V_{I_{load}}$ are measured, and V_{ref} is a predefined constant of the controller **130**. The generation of the signals V_{OV}, $V_{I_{load}}$ and $V_{I_{in}}$ has been described above.

Assume that the predefined relationship is met, and that the load (current) taken by the pulsed load **101** is decreased. For example, the amplitude of the pulses of I_{load} is decreased, and/or the duty cycle of the pulses of I_{load} is decreased and/or the width of each pulse of the current I_{load} is decreased, etc.

As a consequence, the output capacitor **110** will be less discharged during a pulse of current taken by the pulsed load **101** (since there is a linear relationship between the current and the voltage in a capacitor). For example, if the output capacitor **110** formerly discharged from 52V to 48V during a pulse of I_{load}, it is now discharged from 52V to 50V.

Therefore, the variations in the voltage V_{OUT} at the output capacitor **110** will have a smaller amplitude (e.g., with an amplitude smaller than 2V). The average of the voltage V_{OUT} is increased. The value of the signal V_{OV} will therefore increase. In some cases, the value of V_{OUT} may reach a value which is above the maximal acceptable value $V_{OUT,max}$.

Since V_{ref} is fixed, in order to maintain the relationship of Equation 3 as true, the controller **130** needs to decrease also the amplitude $V_{I_{in}}$, by decreasing I_{in}. Since I_{in} is decreased, I_{out} at the output of the power supply **100** is decreased, thereby complying with the decrease in I_{load}. When the predefined relationship is met, the power supply **100** generates, at its output, a current I_{out} which is equal (or substantially equal) to the new average value of I_{load}. Indeed, the predefined relationship has been defined for the most demanding conditions of operation, and, in view of its linearity, adapts to other conditions of operation of the pulsed load **101**.

Similarly, assume that the predefined relationship is met, and that the load (current) taken by the pulsed load **101** is increased. For example, the amplitude of the pulses of I_{load} is increased, and/or the duty cycle of the pulses of I_{load} is increased, and/or the width of each pulse of the current I_{load} is decreased, etc.

As a consequence, the output capacitor **110** will be more discharged during a pulse of current taken by the pulsed load **101** (since there is a linear relationship between the current and the voltage in a capacitor). For example, if the output capacitor **110** used to be discharged from 52V to 48V during a pulse of I_{load}, it is now discharged from 52V to 46V.

Therefore, the average value of the voltage V_{OUT} at the output capacitor **110** is decreased. In some cases, the value of V_{OUT} may reach a value which is below the minimal

acceptable value $V_{OUT,min}$. The value of the signal V_{OV} will therefore decrease. Since V_{ref} is fixed, in order to maintain the relationship of Equation 3 as true, the controller **130** needs to increase also the amplitude $V_{I_{in}}$, by increasing I_{in}. Since I_{in} is increased, I_{out} at the output of the power supply **100** is increased, thereby complying with the increase in I_{load}. When the predefined relationship is met, the power supply **100** generates, at its output, a current I_{out} which is equal (or substantially equal) to the new average value of I_{load}.

A non-limitative example is provided with reference to **Fig. 11**.

Assume that the current I_{load} previously included peaks of 170A, which have now been reduced to 85A. The duty cycle remains equal to 20%. This corresponds to an average current I_{load} of 17A. The other parameters of the pulsed load **101** remain the same. As a consequence, $V_{I_{load}}$ decreases from 6.8V to 3.4V. The output capacitor **110** is less discharged, and its average voltage V_{OUT} increases to around 51V (with variations of ±1V around the average value 51V). Therefore, the signal V_{OV} also increases. According to Equation 3, this induces the controller **130** to decrease I_{in} until the relationship is met (the process is iterative until the relationship is met). In particular, the value of $V_{I_{in}}$ decreases from its original value 7.8V to a new value 3.9V. This corresponds to a value of $I_{in} = 2.82A$, which enables to generate an output current $I_{out} = \frac{\varepsilon V_{source} I_{in}}{V_{out}} = \frac{0.94*320*2.82}{51} = 16.63A$, which matches substantially the average value (17A) of the current I_{load}, as requested.

I_{out} charges the output capacitor **110** during the periods of time in which there is no peak of current. When the pulsed load **101** requires a peak of current, the output capacitor **110** provides peaks of current of around $I_{capacitor} = 68A$ (since the output capacitor **110** is charged with a current which is divided by two with respect to the most demanding operating conditions of the pulsed load **101**, in which $I_{out} = 34A$ and $I_{capacitor} = 136A$).

Assume now that the current I_{load} previously included peaks of 85A, which have now been increased to 100A (average of I_{load} is therefore 20A). The other parameters of the pulsed load **101** remain the same. As a consequence, $V_{I_{load}}$ increases from 3.4V to around 4V. The output capacitor **110** is more discharged, and its average voltage V_{OUT}

decreases to around 50V (with variations of ±2V around the average value 50V). The signal V_{OV} decreases such that $V_{I_{in}}$ reaches its new value.

The controller **130** increases I_{in} until the relationship is met, which means that value of $V_{I_{in}}$ increases from its previous value 3.9V to a new value 4.56V.

This corresponds to a value of $I_{in} = 3.30A$, which generates an output current $I_{out} = \frac{\varepsilon V_{source} I_{in}}{V_{out}} = \frac{0.94*320*3.30}{50} = 19.8A$, which matches substantially the average value (20A) of the current I_{load}, as requested.

I_{out} charges the output capacitor **110** during the periods of time in which there is no peak of current. When the pulsed load **101** requires a peak of current, the output capacitor **110** provides peaks of current of around $I_{capacitor} = 80A$.

It is to be noted that the various features described in the various embodiments may be combined according to all possible technical combinations.

It is to be understood that the invention is not limited in its application to the details set forth in the description contained herein or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Hence, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting. As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for designing other structures, methods, and systems for carrying out the several purposes of the presently disclosed subject matter.

Those skilled in the art will readily appreciate that various modifications and changes can be applied to the embodiments of the invention as hereinbefore described without departing from its scope, defined in and by the appended claims.

CLAIMS:

1. A method comprising, for a power supply which has an output electrically coupled to at least one pulsed load:

generating a signal V_{OV} informative of a voltage V_{OUT} at the output of the power supply,

generating a signal $V_{I_{load}}$ informative of a current I_{load} required by the at least one pulsed load, wherein, for at least one given period of time, the current I_{load} comprises a series of pulses,

generating a signal $V_{I_{in}}$ informative of a current I_{in} at an input of the power supply,

feeding the signal V_{OV}, the signal $V_{I_{load}}$ and the signal $V_{I_{in}}$ to a controller of the power supply, and

controlling, by the controller, the current I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$.

2. The method of claim 1, wherein the amplitude of I_{in} is constant according to a stability criterion over at least part of the given period of time.

3. The method of claim 1 or of claim 2, wherein said controlling of the current I_{in} by the controller according to the predefined relationship induces the power supply to generate, at its output, a current I_{out} which matches an average of I_{load} according to a matching criterion over at least part of the given period of time.

4. The method of claim 3, wherein the current I_{out} is constant according to a stability criterion over at least part of the given period of time.

5. The method of any one of claims 1 to 4, wherein the voltage V_{OUT} is associated with an acceptable voltage range comprising a minimal acceptable value $V_{OUT,min}$ and a maximal acceptable value $V_{OUT,max}$, wherein the signal V_{OV} is informative of whether the voltage V_{OUT} is within the acceptable voltage range.

6. The method of claim 5, wherein, when the voltage V_{OUT} is within the acceptable voltage range, the signal V_{OV} remains within a different voltage range between a first value $V_{OV,1}$ and a second value $V_{OV,2}$.

7. The method of claim 5 or of claim 6, wherein the second value $V_{OV,2}$ is determined for a maximal average current I_{load} required by the pulsed load during given conditions of operation, such that, according to said predefined relationship, $V_{I_{in}} = V_{I_{load}}$.

8. The method of any one of claims 5 to 7, wherein, when the voltage V_{OUT} is above the maximal acceptable value $V_{OUT,max}$, the signal V_{OV} is set equal to a first maximal value $V_{OV,max}$, larger than $V_{OV,2}$.

9. The method of any one of claims 1 to 8, wherein the output of the power supply is electrically coupled to an output capacitor, wherein when an average value of the current I_{load} is increased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is increased, and the signal V_{OV} is decreased.

10. The method of any one of claims 1 to 9, wherein the output of the power supply is electrically coupled to an output capacitor, wherein when an average value of the current I_{load} is decreased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is decreased, and the signal V_{OV} is increased.

11. The method of any one of claims 1 to 10, wherein the output of the power supply is electrically coupled to an output capacitor, wherein during periods of the given period of time in which I_{load} does not comprise pulses, I_{out} enables charging of the output capacitor.

12. The method of claim 11, wherein the current I_{out} which is used to charge the output capacitor, is constant according to a stability criterion over at least part of the given period of time.

13. The method of any one of claims 1 to 12, wherein the output of the power supply is electrically coupled to an output capacitor, wherein, during at least one period of the given period of time in which a pulse of current I_{load} is required by the pulsed load, the power supply generates a current I_{out} and the output capacitor generates a current $I_{capacitor}$, wherein the sum of I_{out} and $I_{capacitor}$ matches an amplitude of the pulse of current I_{load} required by the pulsed load according to a matching criterion.

14. The method of any one of claims 1 to 13, wherein an input voltage provided to the power supply is down-converted only once before it is fed, at the output of the power supply, to the pulsed load.

15. The method of claim 1, wherein, according to the predefined relationship, at least one of (i), (ii), (iii) or (iv) is met:

(i) the controller induces a decrease of an amplitude of I_{in} when an amplitude of V_{OV} increases;

(ii) the controller induces an increase of an amplitude of I_{in} when an amplitude of V_{OV} decreases;

(iii) the controller induces an increase of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ increases; or

(iv) the controller induces a decrease of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ decreases.

16. The method of any one of claims 1 to 15, wherein the controller controls I_{in} using the predefined relationship:

$$k_1 V_{I_{in}} + k_2 V_{OV} - k_3 V_{I_{load}} = V_{ref}$$

wherein k_1, k_2, and k_3 are positive parameters, and V_{ref} is a reference voltage of the controller.

17. A system comprising a controller operative to control a power supply which has an output electrically coupled to at least one pulsed load, wherein the controller is operative to:

obtain a signal V_{OV} informative of a voltage V_{OUT} at the output of the power supply,

obtain a signal $V_{I_{load}}$informative of a current I_{load} required by the at least one pulsed load, wherein, for at least one given period of time, the current I_{load} comprises a series of pulses,

obtain a signal $V_{I_{in}}$ informative of a current I_{in} at an input of the power supply, and

control the current I_{in} such that the signal $V_{I_{in}}$ which is informative thereof, meets a predefined relationship with the signals V_{OV} and $V_{I_{load}}$.

18. The system of claim 17, wherein the amplitude of I_{in} is constant according to a stability criterion over at least part of the given period of time.

19. The system of claim 17 or of claim 18, wherein said control of the current I_{in} by the controller according to said predefined relationship induces the power supply to generate, at its output, a current I_{out} which matches an average of I_{load} according to a matching criterion over at least part of the given period of time.

20. The system of claim 19, wherein the current I_{out} is constant according to a stability criterion over at least part of the given period of time.

21. The system of any one of claims 17 to 20, wherein the voltage V_{OUT} is associated with an acceptable voltage range comprising a minimal acceptable value $V_{OUT,min}$ and a maximal acceptable value $V_{OUT,max}$, wherein the signal V_{OV} is informative of whether the voltage V_{OUT} is within the acceptable voltage range.

22. The system of claim 21, wherein, when the voltage V_{OUT} is within the acceptable voltage range, the signal V_{OV} remains within a different voltage range between a first value $V_{OV,1}$ and a second value $V_{OV,2}$.

23. The system of claim 21 or of claim 22, wherein the second value $V_{OV,2}$ is determined for a maximal average current I_{load} required by the pulsed load during given conditions of operation, such that, according to said predefined relationship, $V_{I_{in}} = V_{I_{load}}$.

24. The system of any one of claims 21 to 23, wherein, when the voltage V_{OUT} is above the maximal acceptable value $V_{OUT,max}$, the signal V_{OV} is set equal to a first maximal value $V_{OV,max}$, larger than $V_{OV,2}$.

25. The system of any one of claims 17 to 24, comprising an output capacitor electrically coupled to the output of the power supply, wherein when an average value of the current I_{load} is increased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is increased, and the signal V_{OV} is decreased.

26. The system of any one of claims 17 to 25, comprising an output capacitor electrically coupled to the output of the power supply, wherein when an average value of the current I_{load} is decreased, an amplitude of discharge of the output capacitor during a pulse of I_{load} is decreased, and the signal V_{OV} is increased.

27. The system of any one of claims 17 to 26, comprising an output capacitor electrically coupled to the output of the power supply, wherein during periods of the given period of time in which I_{load} does not comprise pulses, I_{out} enables charging of the output capacitor.

28. The system of claim 27, wherein the current I_{out} which is used to charge the output capacitor, is constant according to a stability criterion over at least part of the given period of time.

29. The system of any one of claims 17 to 28, comprising an output capacitor electrically coupled to the output of the power supply, wherein, during at least one period of the given period of time in which a pulse of current I_{load} is required by the pulsed load, the power supply is operative to generate a current I_{out} and the output capacitor is operative to generate a current $I_{capacitor}$, wherein the sum of I_{out} and $I_{capacitor}$ matches

an amplitude of the pulse of current I_{load} required by the pulsed load according to a matching criterion.

30. The system of any one of claims 17 to 29, wherein an input voltage provided to the power supply is down-converted only once before it is fed, at the output of the power supply, to the pulsed load.

31. The system of any one of claims 17 to 30, wherein, according to the predefined relationship, at least one of (i), (ii), (iii) or (iv) is met:

(i) the controller is operative to induce a decrease of an amplitude of I_{in} when an amplitude of V_{OV} increases;

(ii) the controller is operative to induce an increase of an amplitude of I_{in} when an amplitude of V_{OV} decreases;

(iii) the controller is operative to induce an increase of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ increases; or

(iv) the controller is operative to induce a decrease of an amplitude of I_{in} when an amplitude of $V_{I_{load}}$ decreases.

32. The system of any one of claims 17 to 31, wherein the controller is operative to control I_{in} using the predefined relationship:

$$k_1 V_{I_{in}} + k_2 V_{OV} - k_3 V_{I_{load}} = V_{ref}$$

wherein k_1, k_2, and k_3 are positive parameters, and V_{ref} is a reference voltage of the controller.

33. The system of any one of claims 17 to 32, further comprising the power supply.

34. The system of any one of claims 17 to 33, further comprising the pulsed load.