

DEVICE AND METHOD FOR CONTROLLABLY DIMMING OUTPUT OF LOAD**Technical Field**

[0001] The present invention relates to a device and method for controlling operation of the output of a load. In particular the present invention relates to dimmer circuits for use in controlling the output of electric devices such as the light intensity of light emitting devices, as well as the speed of fans, heat intensity of space heaters and the like.

Background of the Invention

[0002] Dimmer circuits are commonly used to control the output light intensity of light emitting devices by selectably varying the conduction angle of an input AC supply voltage applied to the light emitting device. Typically the conduction angle of the voltage is varied by chopping or blocking a portion of the positive and negative cycles of the input AC supply voltage applied to the light emitting device. The amount of dimming which is achieved is variable depending upon the extent to which the conduction angle is chopped or blocked.

[0003] Dimmer circuits are generally designed for linear operation and are therefore relatively easily interfaced with and functionally operable with traditional light emitting devices such as incandescent lamps and iron core transformer low voltage halogen lamps which happen to be linear in nature.

[0004] However, as existing dimmer circuits tend to exhibit generally poor compatibility with non-linear light emitting devices such as compact fluorescent lamps (CFLs), fluorescent tube lamps and Light Emitting Diodes (LEDs) various problems such as flickering, service cycle reduction, and light emission failure tend to arise. Moreover, in order for an existing dimmer circuit to be rendered suitably compatible with a dimmable non-linear light emitting device, adaptations of the existing dimmer circuit have to be made and each individual adaptation for one type or brand of non-linear light emitting device may not be applicable to another type or brand of non-linear light emitting device.

[0005] As it is perceived that the market for energy-saving light emitting devices (which are generally non-linear in nature) is rapidly growing, the problems associated with poor compatibility of existing dimmers with such devices is commercially undesirable.

Summary of the invention

[0006] The present invention seeks to alleviate at least one of the problems discussed above in relation to the prior art.

[0007] The present invention may involve several broad forms. Embodiments of the present invention may include one or any combination of the different broad forms herein described.

[0008] In a first broad form, the present invention provides a device configured for electrical connection with a load to control an output of the load, the device including:

- circuitry for varying a conduction angle of an input AC supply voltage applied to the load;

- a current scanner for scanning at least one current form flowing through the load in response to the varying conduction angle of the input AC supply voltage applied to the load;

- a digital signal processing unit electrically coupled to the current scanner and the circuitry, the digital signal processing unit being configured for identifying an operational load type of the load by reference to a pattern indicative of a relationship between the scanned at least one current form and the varying conduction angle of the input AC supply voltage;

- wherein the digital signal processing unit is configured for applying at least one of a plurality of predetermined operational modes to control the output of the load based upon the identified operational load type of the load.

[0009] Typically, the load may include at least one of a light emitting device, a fan and a space heater.

[0010] Typically, the circuitry for varying the conduction angle of the input AC supply voltage may be configured to vary the conduction angle by at least one of gradually increasing the conduction angle within a first predetermined conduction angle range, and, gradually decreasing the conduction angle within a second predetermined conduction angle range.

[0011] Preferably, the current scanner may be configured to scan at least one of the following current forms:

- (a) an absolute current average;
- (b) a half-cycle current average;
- (c) a root mean square current; and
- (d) a current integration.

[0012] Preferably, the digital signal processing unit may be configured for identifying the operational load type of the load by reference to at least one feature of the pattern. Typically, the feature may include at least one of:

- (a) a turning point in the pattern;
- (b) a maximum slope in the pattern;
- (c) a minimum slope in the pattern;
- (d) a monotonic decrease in the pattern;
- (e) a monotonic increase in the pattern;
- (f) a local valley in the pattern; and
- (g) a peak in the pattern.

[0013] Preferably, by reference to the at least one feature of the pattern, the digital signal processing unit may be further configured for identifying at least one of:

- (a) a minimum kick-start conduction angle for enabling suitable start-up output of the load; and
- (b) a minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards a relatively lower end output.

[0014] Preferably, the operational load type of the load may include at least one of a linear load, a dimmable non-linear load, and a non-dimmable non-linear load.

[0015] Preferably, the digital signal processing unit may be configured to execute a pattern recognition algorithm for recognising the operational load type of the load.

[0016] Preferably, the digital signal processing unit may be configured for digitising the at least one scanned current form.

[0017] Preferably, the digital signal processing unit may be configured for normalising the at least one scanned current form.

[0018] Preferably, the digital signal processing unit may be configured for filtering noise from the at least one scanned current form.

[0019] Preferably, the predetermined operational modes may include at least one of:

(a) a linear operational mode for controlling operation of the output of the load of a linear load type;

(b) a dimmable non-linear operational mode for controlling operation of the output of the load of a dimmable non-linear load type, said dimmable non-linear operational mode being configured for applying at least one of the minimum kick-start angle for enabling suitable start-up output of the load, and, the minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards the relatively lower end output; and

(c) a non-dimmable non-linear operational mode for controlling operation of the output of the load of a non-dimmable non-linear load type.

[0020] Preferably, at least one of the predetermined operational modes may be configured for providing trailing-edge phase cut dimming of the input AC supply voltage in response to the load being resistive or capacitive, and, leading-edge phase cut dimming of the input AC supply voltage in response to the load being inductive.

[0021] Preferably, the non-dimmable non-linear operational mode may be configured to provide switching on/off of the input AC supply voltage to the non-dimmable non-linear load.

[0022] Preferably, a dimming range may be able to be set for the conduction angle between 0-180° for trailing-edge or leading edge phase cut dimming.

[0023] In a second broad form, the present invention provides a method for controlling an output of a load including the steps of:

(i) scanning at least one current form flowing through the load in response to a varying conduction angle of an input AC supply voltage being applied to the load;

(ii) identifying an operational load type of the load by reference to a pattern indicative of a relationship between the at least one scanned current form and the varied conduction angle of the input AC supply voltage; and

(iii) applying at least one of a plurality of predetermined operational modes to control the output of the load based upon the identified operational load type of the load.

[0024] Typically, the load may include at least one of a light emitting device, a fan and a space heater.

[0025] Typically, the conduction angle of the input AC supply voltage may be varied by at least one of gradually increasing the conduction angle within a first predetermined conduction angle range, and, gradually decreasing the conduction angle within a second predetermined conduction angle range.

[0026] Preferably, at least one of the following current forms may be scanned:

- (a) an absolute current average;
- (b) a half-cycle current average;
- (c) a root mean square current; and

(d) a current integration.

[0027] Preferably, the operational load type of the load may be identified by reference to at least one feature of the pattern. Typically, the feature may include at least one of:

- (a) a turning point in the pattern;
- (b) a maximum slope in the pattern;
- (c) a minimum slope in the pattern;
- (d) a monotonic decrease in the pattern;
- (e) a monotonic increase in the pattern;
- (f) a local valley in the pattern; and
- (g) a peak in the pattern.

[0028] Preferably, by reference to the at least one feature of the pattern, at least one of following may be identified:

- (a) a minimum kick-start conduction angle for enabling suitable start-up output of the load; and
- (b) a minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards a relatively lower end output.

[0029] Preferably, the operational load type of the load may include at least one of a linear load, a dimmable non-linear load, and a non-dimmable non-linear load.

[0030] Preferably, the operational load type of the load may be identified by applying a pattern recognition algorithm.

[0031] Preferably, the at least one scanned current form may be digitised.

[0032] Preferably, the at least one scanned current form may be normalised.

[0033] Preferably, the at least one scanned current form may be filtered to remove noise.

[0034] Preferably, the predetermined operational modes may include at least one of:

- (a) a linear operational mode for controlling operation of the output of the load of a linear load type;
- (b) a dimmable non-linear operational mode for controlling operation of the output of the load of a dimmable non-linear load type, the dimmable non-linear operational mode being configured for providing at least one of the minimum kick-start conduction angle for enabling suitable start-up output of the load, and, the minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards the relatively lower end output; and
- (c) a non-dimmable non-linear operational mode for controlling operation of the output of the load of a non-dimmable non-linear load type.

[0035] Preferably, at least one of the predetermined operational modes may be configured for providing trailing-edge phase cut dimming of the input AC supply voltage in response to the load being resistive or capacitive, and, leading-edge phase cut dimming of the input AC supply voltage in response to the load being inductive.

[0036] Preferably, the non-dimmable non-linear operational mode may be configured to provide switching on/off of the input AC supply voltage to the non-dimmable non-linear load.

[0037] Preferably, a dimming range may be able to be set for the conduction angle between 0-180° for trailing-edge or leading edge phase cut dimming.

[0038] Advantageously, due to its load recognition capability and automatic operational control mode selection, the present invention may be able to operate with both traditional linear loads such as incandescent and iron core transformer low voltage halogen lamps, as well as non-linear loads including dimmable/non-

dimnable compact fluorescent lamps, fluorescent tube lamps with electronic ballast, and dimmable/non dimmable LEDs.

[0039] Also advantageously, the present invention does not require any manual configuration and/or programming in order to function properly and is able to operate simply upon installation in series with a light emitting device.

[0040] It would be further appreciated that as the present invention is compatible with a wider range of light emitting device operational load types including both linear and non-linear devices, the invention exhibits considerable commercial attractiveness.

Brief Description of the Drawings

[0041] The present invention will become more fully understood from the following detailed description of a preferred but non-limiting embodiment thereof, described in connection with the accompanying drawings, wherein:

Figure 1 shows a block diagram of a first embodiment dimmer device;

Figures 2A shows the first embodiment dimmer device connected to a light emitting device and an AC mains power supply in an exemplary two-wire series configuration;

Figures 2B shows the first embodiment dimmer device connected to a light emitting device and an AC mains power supply in an exemplary three-wire configuration;

Figure 3 shows a flow diagram of method steps in accordance with a second embodiment of the present invention; and

Figures 4A-4D shows exemplary graphed patterns of scanned averaged

current form data against increasing and decreasing input voltage conduction angle for an incandescent lamp, a lamp with an electronic transformer, a dimmable compact fluorescent lamp, and, a non-dimmable compact fluorescent lamp respectively.

Detailed Description of Preferred Embodiments

[0042] Preferred embodiments of the present invention will now be described with reference to Figs. 1-4. The embodiments are described herein only in relation to controllable dimming of a light emitting device (8) for exemplary purposes. However, it would be understood by a person skilled in the art that alternative embodiments not explicitly described herein are able to be applicable for controllably dimming the output of other types of devices such as the speed of fans, the heat output of space heaters and the like.

[0043] A first embodiment dimming device (1) is shown in Figs. 1, 2A and 2B which may be configured for two or three-wire electrical connection. In Fig. 2A conductive terminals (6) of the dimming device (1) are connected to a 50/60 Hz AC mains voltage supply (7) and a (linear or non-linear) light emitting device (8) in a two-wire series configuration. Alternatively, Fig. 2B depicts the dimming device, AC mains voltage supply (7) and the light emitting device (8) connected in a three-wire configuration. In the three-wire configuration, the dimmer device (1) includes additional conductive terminal (6') for connection with AC mains voltage supply (7) and the light emitting device (8).

[0044] The dimming device (1) also includes circuitry (not shown) for varying a conduction angle of the voltage applied to the light emitting device (8), a current scanner (4), and, a digital signal processing unit (2) which is electrically coupled to both the current scanner and circuitry. The digital signal processing unit (2) could for instance be a microcomputer and includes an analogue to digital converter (2a) and a memory store (2b). A computer program is embedded in the memory store (2b) which is executable on the digital signal processing unit (2) to configure the digital signal processing unit (2) to perform one or more of the functions described herein.

[0045] When the dimming device (1) is initially connected in series with the light emitting device (8) and the AC mains power supply (7) as indicated in the Figs. 2A and 2B, the digital signal processing unit (2) and current scanner (4) are configured to automatically perform a scan of the current forms flowing through the dimming device (1) in response to the conduction angle of the voltage applied to the light emitting device (8) being varied. By way of example, in this embodiment, the conduction angle is varied by gradually increasing the conduction angle of the voltage from a relative minimum conduction angle to a relative maximum conduction angle (referred to as "current-up scanning"), as well as gradually decreasing the conduction angle from the relative maximum to the relative minimum conduction angle (referred to as "current-down scanning"). The step of current-up scanning and current-down scanning is represented by block 100 in the flow chart of Fig. 3. The digital signal processing unit (2) in combination with suitable switching circuitry is configured to automatically perform variation of the conduction angle during scanning of the current forms. Such circuitry is known and understood by persons skilled in the art and will not be discussed in further detail herein.

[0046] The current forms which are scanned by the digital signal processing unit (2) and the current scanner (4) in response to varying voltage could include:

- (a) an absolute current average;
- (b) a half-cycle current average;
- (c) root mean square current; and/or
- (d) current integration.

[0047] As would be understood by a person skilled in the art, the conduction angle of the voltage is the portion of the duty cycle (e.g. 360° of a sinusoid voltage) which is utilised to power the light emitting device (8). In this embodiment, as only a half duty cycle is considered during dimming, the relative minimum conduction angle is 0° whilst the relative maximum conduction angle is 180° for the half duty cycle. The range of the conduction angles scanned may of course be varied in alternative embodiments if desired. By way of example, in the present embodiments, for the positive half cycle, the minimum conduction angle may be 0° or larger than 0° , and the maximum conduction angle may be 180° or smaller than 180° . For the negative

half cycle, the minimum conduction may be 180° or larger than 180° , and the maximum conduction angle may be 360° or smaller than 360° .

[0048] After each current form is scanned in response to a conduction angle of the voltage applied to the light emitting device (8) being gradually increased and decreased, data representing the scanned current forms is fed from the current scanner (4) to the current processing unit (3) and then to the digital signal processing unit (2) which uses the analogue-to-digital converter (2a) to digitise the data. The digitised data is then recorded in the digital signal processing unit memory store (2b) for further processing and analysis. The step of digitising the scanned current form data is represented by block 110 in the flow chart of Fig. 3.

[0049] The digital signal processing unit (2) is configured to pre-process the scanned current form data by normalising the data, and, also provides noise filtering for smoothening out relatively sharp distortions in the scanned current form data. The steps of normalising and noise filtering the scanned current form data is represented by block 120 in the flow chart of Fig. 3.

[0050] The relationship between the scanned current form data both as a function of increasing conduction angle, and, as a function of decreasing conduction angle are able to be visually represented in two-dimensional graphical format. By way of example, the graphed pattern shown Figs 4A, 4B, 4C and 4D are indicative of the relationship between certain exemplary scanned average line current form data and increasing/decreasing voltage conduction angle for an incandescent lamp, a linear-operating lamp with a capacitive load characteristic (e.g. with an electronic transformer), a dimmable compact fluorescent lamp, and, a non-dimmable compact fluorescent lamp respectively. The line X shown in each of Figs. 4A-4D represents the pattern of current-down scanned average line current form data against decreasing conduction angle whilst the line Y in each of the Figs. 4A-4D represents the pattern of current-up scanned average line current form data against increasing conduction angle. It would be understood by a person skilled in the art that where current forms different to that of the average line current are graphed against the increasing/decreasing conduction angle of the voltage, different graphed patterns may be produced. As will be apparent further below, by scanning several different current forms (e.g. absolute current average, half-cycle current average, root mean

square current, current integration etc) as a function of varying conduction angle of the voltage, a greater number of unique identifying features can be extracted from each graphed pattern and used to assist in recognition of the particular operational load type of the light emitting device (8).

[0051] The digital signal processing unit (2) is configured to identify whether the operational load type of the light emitting device (8) appears to be a linear device, a dimmable non-linear device, a non-dimmable non-linear device, and/or whether it exhibits a resistive, capacitive and/or inductive load characteristics. In particular, the operational load type identification is performed by reference to key features extracted from the scanned patterns, representing scanned current form data in relation to varying conduction angle of the voltage. The extracted key features of the scanned patterns are uniquely indicative of known operational load types. Such features used in the comparison could for instance include turning points, maximum and minimum slope, monotonic decreasing and increasing, local valleys and peaks typically present in a graphed pattern of any given operational load type. A library of such known features could be stored in the digital signal processing unit memory store (2b) as a reference for performing such a comparison and identification. The step of extracting key features of the pattern representing the relationship between scanned current form data and increasing/decreasing conduction angle is represented by block 130 in the flow chart of Fig. 3.

[0052] Based on the extracted features of the pattern, the digital signal processing unit (2) is also configured to identify a minimum kick-start conduction angle to be applied to the load for enabling suitable start-up illumination of the light emitting device (8), and, a minimum portion of the conduction angle to be blocked in order to enable dimming of the output of the load towards a relatively lower end output.

[0053] In this embodiment, the feature extraction and comparison function is performed by a program running on the digital signal processing unit (2) to apply a suitable pattern recognition algorithm. This step is represented by block 140 in the flow chart of Fig. 3.

[0054] Once the operational load type is identified, the digital signal processing unit (2) is configured to automatically implement at least one of a selection of operational modes which is suitable for controlling dimming of the light emitting device (8) illumination based upon the identified operational load type of the light emitting device (8).

[0055] In the embodiments of the present invention, the step of automatically applying at least one of a plurality of predetermined operational modes to control the light emitting device (8) is performed by the digital signal processing unit (2). By way of example, in the embodiments of the present invention described herein, three possible operational modes are available to be automatically applied to the controllably dim the light emitting device (8) based on the recognised operational load type including:

- (a) a linear operational mode for controlling operation of the output of a linear light emitting device;
- (b) a dimmable non-linear operational mode for controlling operation of the output of a dimmable non-linear light emitting device; and
- (c) a non-dimmable non-linear operational mode for controlling operation of the output of a non-dimmable non-linear light emitting device.

[0056] Where linear and dimmable non-linear operational modes are applied by the digital signal processing unit (2), trailing-edge phase cut dimming of the voltage is used in response to the light emitting device (8) having resistive or capacitive load characteristics, and, leading-edge phase cut dimming of the voltage is used in response to the light emitting device (8) having inductive load characteristics. The dimming range in either case can be at any conduction angle between 0-180° for positive and negative cycles of the voltage.

[0057] By way of example, a dimmable non-linear operational mode would be automatically applied by the digital signal processing unit (2) to a lamp with an electronic transformer having operational characteristics exemplified by the graphed pattern of Fig. 4B. The lamp with the electronic transformer is capacitive in nature and trailing-edge phase cut dimming would be applied in dimming this particular load. The dimmable non-linear operational mode applied by the digital signal processing

unit (2) is also configured to automatically apply the kick-start conduction angle for suitable start-up illumination of the light emitting device (8), and/or, the minimum portion of the conduction angle to be blocked in order to enable dimming of the output of the load towards a relatively lower end output, by reference to the extracted features of the pattern so as to automatically compensate for non-linearity in the operational characteristics of the device. By way of example, in this embodiment, the kick-start conduction angle could be set such that no less than 20% of each of the voltage positive and negative half-cycles are applied to the load at start-up, whilst the portion of the conduction angle to be blocked in order to enable dimming of the output of the load towards a relatively lower end output could be set at no less than 20% of the voltage positive and negative half-cycles. Additionally, as the operational load type is recognisable by the pattern recognition program as having a capacitive load characteristic, the digital signal processing unit (2) would automatically apply trailing-edge phase cut dimming in this instance.

[0058] The dimming range in respect of either leading-edge or trailing edge phase cut dimming can again be at any conduction angle between 0-180°.

[0059] Where the light emitting device (8) is recognised as exhibiting a non-dimmable non-linear characteristic, the non-dimmable non-linear operational mode is applied which provides for switching on/off of the voltage to the light emitting device (8).

[0060] Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described without departing from the scope of the invention. All such variations and modification which become apparent to persons skilled in the art, should be considered to fall within the spirit and scope of the invention as broadly hereinbefore described. It is to be understood that the invention includes all such variations and modifications. The invention also includes all of the steps and features, referred or indicated in the specification, individually or collectively, and any and all combinations of any two or more of said steps or features.

[0061] The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge.

What is claimed is:

1. A device configured for electrical connection with a load to control an output of the load, the device including:

 circuitry for varying a conduction angle of an input AC supply voltage applied to the load;

 a current scanner for scanning at least one current form flowing through the load in response to the varying conduction angle of the input AC supply voltage applied to the load;

 a digital signal processing unit electrically coupled to the current scanner and the circuitry, the digital signal processing unit being configured for identifying an operational load type of the load by reference to a pattern indicative of a relationship between the scanned at least one current form and the varying conduction angle of the input AC supply voltage;

 wherein the digital signal processing unit is configured for applying at least one of a plurality of predetermined operational modes to control the output of the load based upon the identified operational load type of the load.

2. A device as claimed in claim 1 wherein the load includes at least one of a light emitting device, a fan and a space heater.

3. A device as claimed in claims 1 or 2 wherein the circuitry for varying the conduction angle of the input AC supply voltage is configured to vary the conduction angle by at least one of gradually increasing the conduction angle within a first predetermined conduction angle range, and, gradually decreasing the conduction angle within a second predetermined conduction angle range.

4. A device as claimed in claim 1 wherein the current scanner is configured to scan at least one of the following current forms:

- (a) an absolute current average;
- (b) a half-cycle current average;
- (c) a root mean square current; and

(d) a current integration.

5. A device as claimed in claim 1 wherein the digital signal processing unit is configured for identifying the operational load type of the load by reference to at least one feature of the pattern.

6. A device as claimed in claim 5 wherein the feature includes at least one of:

- (a) a turning point in the pattern;
- (b) a maximum slope in the pattern;
- (c) a minimum slope in the pattern;
- (d) a monotonic decrease in the pattern;
- (e) a monotonic increase in the pattern;
- (f) a local valley in the pattern; and
- (g) a peak in the pattern.

7. A device as claimed in claim 6 wherein, by reference to the at least one feature of the pattern, the digital signal processing unit is further configured for identifying at least one of:

- (a) a minimum kick-start conduction angle for enabling suitable start-up output of the load; and
- (b) a minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards a relatively lower end output.

8. A device as claimed in claim 1 wherein the operational load type of the load includes at least one of a linear load, a dimmable non-linear load, and a non-dimmable non-linear load.

9. A device as claimed in claim 1 wherein the digital signal processing unit is configured to execute a pattern recognition algorithm for recognising the operational load type of the load.

10. A device as claimed in claim 1 wherein the digital signal processing unit is configured for digitising the at least one scanned current form.

11. A device as claimed in claim 1 wherein the digital signal processing unit is configured for normalising the at least one scanned current form.

12. A device as claimed in claim 1 wherein the digital signal processing unit is configured for filtering noise from the at least one scanned current form.

13. A device as claimed in claim 7 wherein the predetermined operational modes include at least one of:

(a) a linear operational mode for controlling operation of the load of a linear load type;

(b) a dimmable non-linear operational mode for controlling operation of the load of a dimmable non-linear load type, said dimmable non-linear operational mode being configured for applying at least one of the minimum kick-start angle for enabling suitable start-up output of the load, and, the minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards the relatively lower end output; and

(c) a non-dimmable non-linear operational mode for controlling operation of the load of a non-dimmable non-linear load type.

14. A device as claimed in claim 1 wherein at least one of the predetermined operational modes is configured for providing trailing-edge phase cut dimming of the input AC supply voltage in response to the load being resistive or capacitive, and, leading-edge phase cut dimming of the input AC supply voltage in response to the load being inductive.

15. A device as claimed in claim 13 wherein the non-dimmable non-linear operational mode is configured to provide switching on/off of the input AC supply voltage to the non-dimmable non-linear load.

16. A device as claimed in claim 14 wherein a dimming range is able to be set for the conduction angle between 0-180° for trailing-edge or leading edge phase cut dimming.

17. A method for controlling an output of a load including the steps of:

(i) scanning at least one current form flowing through the load in response to a varying conduction angle of an input AC supply voltage being applied to the load;

(ii) identifying an operational load type of the load by reference to a pattern indicative of a relationship between the at least one scanned current form and the varied conduction angle of the input AC supply voltage; and

(iii) applying at least one of a plurality of predetermined operational modes to control the output of the load based upon the identified operational load type of the load.

18. A method as claimed in claim 17 wherein the load includes at least one of a light emitting device, a fan and a space heater.

19. A method as claimed in claims 17 or 18 wherein the conduction angle of the input AC supply voltage is varied by at least one of gradually increasing the conduction angle within a first predetermined conduction angle range, and, gradually decreasing the conduction angle within a second predetermined conduction angle range.

20. A method as claimed in claim 17 wherein at least one of the following current forms is scanned:

- (a) an absolute current average;
- (b) a half-cycle current average;
- (c) a root mean square current; and
- (d) a current integration.

21. A method as claimed in claim 17 wherein the operational load type of the load is identified by reference to at least one feature of the pattern.

22. A method as claimed in claim 21 wherein the feature includes at least one of:

- (a) a turning point in the pattern;
- (b) a maximum slope in the pattern;
- (c) a minimum slope in the pattern;
- (d) a monotonic decrease in the pattern;
- (e) a monotonic increase in the pattern;
- (f) a local valley in the pattern; and
- (g) a peak in the pattern.

23. A method as claimed in claim 22 wherein, by reference to the at least one feature of the pattern, at least one of following is identified:

- (a) a minimum kick-start conduction angle for enabling suitable start-up output of the load; and
- (b) a minimum portion of the conduction angle to be blocked in order to enable dimming of the output of the load towards a relatively lower end output.

24. A method as claimed in claim 17 wherein the operational load type of the load includes at least one of a linear load, a dimmable non-linear load, and a non-dimmable non-linear load.

25. A method as claimed in claim 17 wherein the operational load type of the load is identified by applying a pattern recognition algorithm.

26. A method as claimed in claim 17 wherein the at least one scanned current form is digitised.

27. A method as claimed in claim 17 wherein the at least one scanned current form is normalised.

28. A method as claimed in claim 17 wherein the at least one scanned current form is filtered to remove noise.

29. A method as claimed in claim 23 wherein the predetermined operational modes include at least one of:

(a) a linear operational mode for controlling operation of the output of the load of a linear load type;

(b) a dimmable non-linear operational mode for controlling operation of the output of the load of a dimmable non-linear load type, the dimmable non-linear operational mode being configured for providing at least one of the minimum kick-start conduction angle for enabling suitable start-up output of the load, and, the minimum portion of the conduction angle to be blocked in order to enable varying of the output of the load towards the relatively lower end output; and

(c) a non-dimmable non-linear operational mode for controlling operation of the output of the load of a non-dimmable non-linear load type.

30. A method as claimed in claim 17 wherein at least one of the predetermined operational modes is configured for providing trailing-edge phase cut dimming of the input AC supply voltage in response to the load being resistive or capacitive, and, leading-edge phase cut dimming of the input AC supply voltage in response to the load being inductive.

31. A method as claimed in claim 29 wherein the non-dimmable non-linear operational mode is configured to provide switching on/off of the input AC supply voltage to the non-dimmable non-linear load.

32. A method as claimed in claim 30 wherein a dimming range is able to be set for the conduction angle between 0-180° for trailing-edge or leading edge phase cut dimming.