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Abstract

A voltage regulator for an electric device is proposed, which, in the event of a given output voltage being exceeded, is turned off and in the event of the voltage at the voltage output
5 falling below it is switched on again. With an outlet voltage in a given interval the operation duration and thus the power input of the voltage regulator, in particular in a rest mode of the electric device, can be decreased.

10 (Figure 2)

-3-

Voltage Regulator and Electrical Device

5 The invention relates to a voltage regulator.

Electrical devices are known, in which an input voltage is converted to an operating voltage, which is provided for the electric or electronic components in the electric device. Here the value of the operating voltage can be both increased and decreased with respect to
10 the input voltage. In addition, alternating between direct current and alternating current can take place and vice versa. In electronic components such as microprocessors or semiconductors eg. direct voltages of 3.3 volts or 5 volts are generally required. For a reliable operation the direct voltages are to be stabilised and alternating voltage components are to be decoupled from the direct voltage. In devices, which must only be
15 provided with operating voltage when a user needs the device, the device can be completely separated from the voltage supply after use so that in its rest phase the device takes up no power. Devices are also known, however, in which following switching off a rest condition occurs, in which only the main functions are turned off, while a limited operation is relayed with a limited performance range. For example, a power input takes
20 place for the operation of a clock switch or for storing an operational status before switching off in order to ensure a quick start-up after the restart. In the rest phase the power input of the components, which must operate during the rest phase, is sharply reduced in comparison to normal operation. The power dissipation of the component, which serves to convert the voltage is, however, only slightly lower compared with the
25 normal operation so that in the rest operation the power input of the voltage conversion unit constitutes a large part compared to the required effective power or can even be greater than the required effective power. This is problematic especially in devices, which have no access to a power supply system but which are dependent on an automotive battery or batteries.
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This is especially the case in motor vehicles, some of which are turned off for long periods of time while, eg. a vehicle clock must still be supplied with voltage.

2003204307 27 Jul 2007

Summary of the Invention

According to the present invention there is provided a voltage regulator with a voltage regulation unit and with a measuring unit for measuring voltage, whereby a voltage output
5 is connected to the measuring unit, whereby the voltage regulation unit is switched off with the exceeding of a first voltage at the voltage output and when falling below a second voltage, which is smaller than the first, is turned on, said voltage regulator further including a switch input arranged for switching the voltage regulation unit on and off, and
10 a signal can be sent to the switch input from a further signal source in such a way that a switching off of the voltage regulation unit is suppressed.

Advantages of the invention

The voltage regulator of the invention has the advantage over prior art, that the voltage
15 regulation unit is switched off at the voltage output when a first voltage is exceeded and if a second voltage is fallen below, which is smaller than the first voltage, is restarted, so that a pulse operation of the voltage regulator exists. Power dissipation of the voltage regulator occurs only for the period, in which the voltage regulator is switched on. In the remainder of the time, the components which are to be supplied with a voltage can be supplied by the
20 capacity or the inductance of the system. If in this event the voltage at the voltage output sinks to below a given amount, the voltage regulator is automatically reactivated, so that no interruption of the power supply of the unit to be supplied with power occurs. By this means the power input of the voltage regulator can be decreased over the entire operating time. Moreover, the waste heat of the voltage regulator is decreased. In addition, the load
25 of an automotive battery is decreased, particularly for times in which no charging of the automotive battery takes place. This is of particular advantage for devices in a vehicle, which are dependent on a motor vehicle automotive battery, which should not be too strongly charged for a subsequent start of the vehicle. In addition, an unnecessary heating of the circuit in the vehicle is prevented, as less heat dissipation need be eliminated.
30 Above all, the rest current of an electrical device, which has that type of voltage regulator at its disposal or is connected to it at its input, can be decreased.

It is possible to arrange an electric storage unit on the voltage output. By this means, the dropping of the voltage is not determined by means of the capacities and inductances of all

27 Jul 2007

2003204307

- 4 -

the connected components, but mainly by means of the additionally arranged storage unit. It is particularly advantageous to design the storage unit in the form of at least one coil and/or at least one capacitor, as these are usual components and can be adapted to the required storage space of charge carriers.

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If the voltage regulator is switched on, power is consumed from the voltage source and the output voltage is generated and applied by the voltage regulator. If the voltage regulator is turned off, either the voltage regulator is separated from the voltage supply or an electronic separation device is provided in the voltage regulator itself to break the power input, so that the voltage regulator itself takes up no or only minimal power. In particular the components are no longer flowed through by a current, which serve to convert the voltage or the other processing of the input voltage, eg. the smoothing of the input voltage, resulting in the power input of the voltage regulator being considerably reduced.

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A circuit can be easily realised in that a voltage signal is directed from the measurement unit to the voltage regulation unit which, when receiving a first voltage value, turns the voltage regulation unit off and when a second voltage value is received, turns the voltage regulation unit on.

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When the further signal to the voltage regulation unit, by means of which a switching off is suppressed, this has an advantage for a normal or full operation of the electric device of the voltage regulator, as here in general a large load is applied to the outlet of the voltage regulator, so that a switching off would lead very quickly to a voltage drop. In a normal operation of the electric device the switching off can take place simply.

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It is also advantageous to provide a clock switch in the electric device, which serves eg. to provide a display of the time or to activate the device at a given point in time. This is particularly advantageous in an electric device for driver information, which outputs optical and/or acoustic information for the driver. By means of the voltage regulator of the invention, the start of such an invention can be accelerated by means of a starting of the vehicle, and basic information can be made available even in the event of the vehicle being turned off. In particular, eg. making available the current time is possible without a heavy load being placed on the automotive battery.

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Drawing

Embodiments of the invention are represented in the drawing and are described in the following description. In the drawing:

- 5 Figure 1 shows an electric device of the invention with an electric voltage converter, which is designed as a display device in a vehicle;
Figure 2 shows a circuit diagram of a voltage converter of the invention; and
Figure 3 shows a voltage course at a voltage output of a voltage converter of the invention.

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Description of the preferred embodiment

- The voltage regulator of the invention can be used for any electric device. It is advantageous for devices in which data is to be stored in the switched off state or for
15 procedures such as, eg. the measurement of time which are to be continued while other functions rest, which the electric device carries out. This is the case with household devices, eg. electric stoves with time switches or in devices of entertainment technology, such as, eg. televisions, radios, video recorders or portable computers. The voltage regulator of the invention can lower the power input of these devices in rest mode. In
20 particular, however, the power input in rest mode is important in devices in which only a limited energy reserve is available as it has no access to mains power as they are battery operated, eg. portable radios. The same applies for devices in motor vehicles, in which in general very short trip times and relatively long rest times can exist without a charging of the automotive battery and in which also in the event of the start-up the vehicle systems are
25 available to a user without long stop or start phases. The voltage regulator of the invention can therefore be used for storing configurations of electric devices in the vehicle or for continuing processes in these electric devices. In the following the voltage converter of the invention is described on the basis of the use in a display device in a vehicle.
- 30 A display device 1 in a vehicle, which is arranged in front of a driver in the vehicle is represented in Figure 1. The display device 1 is connected to an automotive battery 3 via a voltage input 2, the automotive battery 3 supplying the display device 1 with an operating voltage. The electric circuit is closed via a frame earth terminal 4 of the display device 1. The voltage provided by the motor vehicle battery 3 is supplied to a voltage regulator 5,

which is represented in the detail in Figure 2. An output voltage of the voltage regulator 5, which supplies the components of the display device 1 with an operating voltage, is provided on a voltage supply line 7. The display device 1 has at its disposal a liquid crystal display 8, a pointer display 9 and a light source 10. Other, in general similar
5 display elements can also be provided. The display elements 8, 9, 10 are arranged, visible for the driver, on the display device 1. A control device 12 and a storage unit 11 are also supplied with an operating voltage. A data line 13 leads from the control device 12 to the liquid crystal display 8 in which the time is displayed. In an operating mode of the vehicle an ignition lock is closed so that the operating voltage is then directed to a switch input 15
10 of the display device and thus on to the voltage regulator 5. In an operating mode the display units 8, 9, 10 are supplied with an operating voltage, whereby corresponding switches 16 are closed preferably by the control device 12. If the vehicle is turned off and the ignition lock is released, the operating voltage is turned off at the switch input 15 by means of the ignition lock 14. Likewise the display units 8, 9, 10 are turned off via the
15 switches 16. In the idle state however, the storage unit 11 and the control device 12 for controlling a clock switch is supplied with the operating voltage by the voltage regulator 5 via the voltage supply line 7. The control device 1 can feature other units not represented in Figure 1, eg. an audio output unit, a radio tuner, a telephone unit or a navigation unit. In another embodiment not represented in Figure 1, the voltage regulator 5 can be arranged
20 outside the display device 1, so that its output voltage is directed to the display device 1. This is particularly advantageous, when several devices arranged in the vehicle should be supplied by an operating voltage from the outlet of the voltage regulator 5.

An example of a design of the voltage regulator 5 is represented in Figure 2. A first input
25 20 is connected to the voltage input 2 of the display device 1. A second input 21 is connected to the switch input 15 of the display device 1. An output 22 is connected to the voltage supply line 7. Also, the voltage regulator 5 is connected to earth, whereby on various positions of the switch a connection to the earth connection 4 of the display device 1 takes place via components. The input voltage is directed from the first input 20 via a
30 first diode 23 and a first coil 24 to a voltage input 25 of a voltage regulation unit 26. A first condenser 44 for decoupling against earth is connected between the first diode 23 and the first coil 24. The first diode serves to smooth the input voltage and the decoupling of alternating voltage just as the first coil 24 and the first condenser 44.

The inlet voltage taken up via the voltage inlet 25 is converted through the voltage regulator unit 26 to a predetermined output voltage, the voltage being stabilised and smoothed by means of corresponding electronic circuits. The output voltage amounts, in a preferred embodiment, to 5V or 3.3V direct current. The conversion takes place, eg. by means of a semiconductor device or an integrated circuit by means of Zener diodes or of a transformer unit in the case of alternating current. The output voltage is output at an outlet 27 of the voltage regulating unit 26.

In a preferred embodiment, a direct voltage entering the voltage input 25 is converted to a direct voltage of another and additionally stabilised voltage on the outlet 27. However an alternating voltage can also be taken up or an alternating voltage can be output, provided the construction of the voltage regulation unit 26 is correspondingly adapted. The outlet voltage is directed from the outlet 27 to the outlet 22, which is connected to the voltage supply line 7 and onto which the loads, which are supplied via the voltage controller 5 are to be connected. The second coil 28 features, in a preferred embodiment, an inductance of 33 μ H. In contrast, the first coil 24 has preferably an inductance of 10 μ H. The voltage applied to the outlet 22 is directed to a measuring unit 30, which measures the voltage on the outlet 22, via a first resistor 29. In a preferred embodiment, by means of the choice of the size of the first resistance 29, the input voltage to the measuring device 30 can be set to a permanently uniform switching threshold in the measurement unit. It is possible by this means to always use the same measurement unit at various output voltages. A reference voltage source for the measurement, which is compared by a comparator with the outlet voltage directed to the first resistor 29, is provided in the measurement unit 30.

A switching device 31 is controlled by the measurement unit 30 dependent on the measured voltage value. The switching device 31 is constructed in a preferred embodiment as a transistor, eg. as a field effect transistor. The switching device 31 can switch over between a first voltage value (high) and a second voltage value (low). The output of the switching device 31 is directed to a switching unit 32, which is preferably constructed with the voltage regulation unit 26 in one unit. The switching device 32 features a switching input 33 for controlling the voltage regulation unit 26 and for receiving the output signal of the switching device 31. In a preferred embodiment the voltage regulation unit 26 is designed together with the switching unit 32 and the measuring unit 30 with the switching device 31 each as integrated electronic components.

If the first voltage value (high) is applied at the switching input 33, then the switching unit 32 switches the voltage regulating unit 26 off, so that no power is taken up from the voltage regulation unit via the voltage input 25. If, however, the second voltage value (earth, low) is applied, then the operating voltage, applied via the voltage input 25, is taken up by the voltage regulation unit 26 and correspondingly output at the output 27.

If the voltage regulation unit 26 is turned off, no more voltage is made available via the output 27. In order, however, to prevent an immediate voltage drop at the output 22, the second coil 28 is connected between the output 27 of the voltage regulation unit 26 and the output 22. Moreover a second capacitor 34 is connected to earth between the output 22 and the second coil 28. The second capacitor 34 forms, together with the second coil 28 an electric storage unit, whereby on the one hand through the inductance of the second coil 28 on the one hand and through the capacity of the second capacitor 34 on the other, the voltage is initially maintained at the output 22. The load of the second capacitor 34 and the energy stored in the inductance of the second coil 28 is subsequently discharged via the load connected to the output 22, which results in the voltage at the output 22 sinking. In a rest operation of the display device 1, only the storage unit and the control device 12 with the clock switch are to be supplied. By this means the resistance of the load is very high and only little current flows over the voltage supply line 7 to the control device 12 and the storage unit 11. The data stored in the storage unit 11 is secured by means of the current flow made available.

The second diode 35, which is directed against the flow direction between the output 27 and the second coil 28 to earth, serves to collect voltage overshoots which arise from the second coil 28 or the second capacitor 34.

The voltage at the output 22 is measured by the measuring unit 30. If a voltage value stored in the measuring unit is reached or exceeded the switching device 31 is so controlled by the measuring unit 30 that the output signal of the switching device 31 is increased to the first voltage value, so that the voltage regulation unit 26 is switched off. As a result of the discharging of the second capacitor 34 and the breakdown of the magnetic field in the second coil 28 as a result of the discharging via the load connected to the output 22 the voltage drops gradually at the output 22. If the voltage drops below a value set in the measurement unit 30, a signal is emitted to the switching device 31, that the output signal

of the switching device 3 is set again to the second voltage value (earth, low). By this means the output voltage is applied again to the output 27, so that the second capacitor 34 is charged again, a magnetic field is activated and the voltage at the output 22 is increased again. If the given voltage value is reached again and detected by the measuring unit, the
5 process is repeated again.

A temporal course of the output voltage on the output 22 is shown in Figure 3. The voltage U is shown with respect to the time t in Figure 3. The voltage increases in a first time interval 36 on the output 22. In this time interval the voltage regulation unit 26 is
10 operated. In a second, longer time interval 37 the voltage on the output 22 drops. The process is then repeated in time intervals 36', 37'. The operational duration of the voltage regulation unit can accordingly be severely decreased with respect to a constant operation.

The voltage at the output 22 is also directed, correspondingly reduced, over a voltage
15 divider made from a second resistor 38 and a third resistor 39, which is connected to earth into the voltage regulation unit 26 through a tap between the two resistors 38, 39. A monitoring of the outlet voltage and thus a feedback voltage regulation for stabilising the output voltage is possible through the voltage regulation unit 26. Also the voltage regulation unit 26 has at its disposal a frame earth terminal.

20 If the ignition lock 14 is activated, that is if the vehicle is operating, a multiplicity of devices are connected to the output 22, so that a continuous operation of the voltage regulation unit 26 is desired. Thus in the event of the ignition lock 14 being closed, an applied voltage, which is connected via a fifth resistor 45 to earth, generally the output
25 voltage of the motor vehicle battery 3, is led over the second input 21 and a fourth resistor 40 to the base of the transistor 41. By this means the transistor 41 is energised. The emitter of the transistor 41 is connected to a switch input 33 of the switching unit 32 and the collector of the transistor 41 is connected to earth, so that in the event of a closed ignition lock earth always connects the switch input 33 of the switching unit 32, so that the
30 voltage regulation unit 26 is always operating independent of the output of the switching device 31. In order to ensure a defined switching state of the switching unit 32, the base of the transistor 41 is also connected to the voltage connected to the voltage input 25 via a third capacitor 46. The third capacitor 46 sees to it that in the event of a sudden voltage drop at the second input 21 due to the discharging of the capacitor a defined state exists at

the switching input 33 and the conversion procedure explained elsewhere on the basis of Figure 3 begins between the switching on and switching off of the voltage regulation unit 26.

- 5 Where the terms “comprise”, “comprises”, “comprised” or “comprising” are used in this specification, they are to be interpreted as specifying the presence of the stated features, integers, steps or components referred to, but not to preclude the presence or addition of one or more other feature, integer, step, component or group thereof.

EDITORIAL NOTE

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THE NEXT TWO PAGES ARE CLAIMS PAGES

[CLAIMS 1 – 11]

The claims defining the invention are as follows:

1. A voltage regulator with a voltage regulation unit and with a measuring unit for measuring voltage, whereby a voltage output is connected to the measuring unit,
5 whereby the voltage regulation unit is switched off with the exceeding of a first voltage at the voltage output and when falling below a second voltage, which is smaller than the first, is turned on, said voltage regulator further including a switch input arranged for switching the voltage regulation unit on and off, and a signal can be sent to the switch input from a further signal source in such a way that a switching off of the voltage regulation unit is
10 suppressed.
2. The voltage regulator according to Claim 1, wherein an electric storage unit is arranged on the voltage output.
- 15 3. The voltage regulator according to Claim 2, wherein the electric storage unit includes a coil and/or a capacitor.
4. The voltage regulator according to any one of the preceding claims, wherein when the first voltage is exceeded, a first signal can be transmitted from the
20 measuring unit to the switch input of the voltage regulation unit for switching off the voltage regulation unit and that when the second voltage is fallen below, a second signal can be transmitted from the measuring unit to the switch input to switch on the measuring unit of the voltage regulation unit.
- 25 5. The voltage regulator according to Claim 4, wherein a switching device is arranged on the measuring unit and that the first and the second signal can be sent from the switching device.
6. The voltage regulator according to any one of the preceding claims,
30 wherein an input voltage direct voltage can be converted to an output direct voltage.
7. The voltage regulator according to Claim 6, wherein means are provided for smoothing the energy voltage and/or the output direct voltage.

2003204307 27 Jul 2007

8. An electric device, in particular in a vehicle, with a voltage regulator according to any one of the preceding claims, wherein the electric device can be operated in an operating mode and in a rest mode.

5 9. The electric device according to Claim 8, wherein a clock switch is arranged in the electric device and that the clock switch is operated during the rest mode.

10 10. The electric device according to any one of Claims 8 to 9, characterised in that the electric device is a driver information device for the optical and/or acoustic information of a driver.

11. A voltage regulator substantially as hereinbefore described with reference to the accompanying drawings.

