

The invention relates to a switched power supply for the production of various operating voltages from the mains voltage, especially for television receivers, video recorders, personal computers and the like.

A switched power supply generally contains a switching transistor which is connected to an operating voltage obtained from the mains voltage via the working winding of a transformer serving for the voltage transformation and the mains isolation. The switching transistor is periodically controlled to be conducting and blocked by means of a control voltage. The control voltage comes for example, from an oscillator provided on the primary side or is conveyed to the primary side from the secondary side via a coupling transformer separate from the transformer. The control voltage is preferably modulated in the sense of a pulse width modulation (PWM) in dependence on the amplitude of the operating voltage generated at the secondary side such that the duration of the current flow through the switching transistor is altered and the operating voltages are stabilised.

In a switched power supply of this type, impermissibly high currents and voltages, which would endanger the components, especially the switching transistor and the transformer, can arise on the switching transistor and on the transformer in the event of a disturbance, e.g. of too great a load on the rectifier circuits on the secondary side, of a short circuit, of failure of components or of an interruption in the regulating circuit.

Energy in the form of the current passing through is stored in the transformer during the period of the current flow through the working winding and the switching transistor. After the blocking of the switching transistor, this energy is transferred by an induced pulse in the secondary windings and a corresponding charging current into the charging capacitors of the secondary side rectifying circuits. The transformer is thus "discharged" during this time until the current in the transformer has decayed to zero. Thereafter, the switching transistor is made conducting once more and the transformer is "charged" anew with energy in the form of the current through the working winding. Thus, when operating in a trouble free manner, the transformer is fully discharged each time it is newly charged by the switching on of the switching transistor. In the event of a disturbance, it can happen that the discharge current of the transformer flows for a relatively long time and does not fall to zero during the desired time span. The case then arises that, at the time point of the switching on of the

switching transistor, the transformer is charged anew even though it is not yet fully discharged. This condition is not wanted and is dangerous because too high currents and voltages can then arise on the transformer. Also, due to other disturbances of the kind described, too high currents and voltages can occur in the transformer which cause the described endangering of the components.

The object of the invention is to develop the switched power supply using simple circuit means such that a more certain protection of the components such as especially the transformer and the switching transistor is achieved in the case of a disturbance.

This object is achieved by the invention defined in the independent claim.

A switched power supply is also known (Patent Abstract of Japan, Vol. 12, No 246), in which a current measuring resistor is located in the emitter path of the switching transistor whose voltage drop then, when the current through the switching transistor oversteps a certain value, reduces the frequency of the oscillator producing the switching voltage for the switching transistor in order to then reduce the power transmitted from the primary side to the secondary side of the transformer.

Furthermore, a switched power supply is known (Electronic Engineering, June 88, No 738, page 25) in which the voltage on a current measuring resistor in the emitter path of the switching transistor is differentiated and rectified and the regulating voltage thus obtained is utilised for a shortening of the time for which the switching transistor is switched on.

A switched power supply is also known (EP-A-0 144 754), in which a regulating voltage, that activates an additional oscillator upon detection of a fault, is obtained from a pulse voltage in the secondary winding of the switched power supply by rectification.

The invention is based on the following consideration. The regulating voltage obtained from the pulse voltage in the transformer will be smaller in the event of a disturbance because of the falling pulse amplitude in the transformer. Consequently, this regulating voltage, which serves for the stabilisation of the generated operating voltages, is additionally utilised to reduce the frequency of the control voltage for turning on and blocking the switching transistor i.e. the working frequency of the switched power supply. A lower

frequency means a longer periodic time and thus a greater spacing between the time points at which the switching transistor is newly switched on. The fact that the discharge of the transformer lasts longer in the event of a disturbance is thus taken into account in an advantageous manner by means of a longer periodic time for the controlling of the switching transistor. It can thereby be prevented that the switching transistor is switched on again in an unwanted manner before the transformer is discharged. Preferably, a regulating voltage that is in any case already available and which influences the duration for which the switching transistor is turned on e.g. by means of a pulse width modulation of the control voltage for the stabilisation of the generated operating voltages, is utilised for the alteration of the working frequency. The increased expenditure on circuitry is therefore small and in essence, only consists in that the point of the circuit carrying the regulating voltage is additionally connected to a frequency control terminal of the oscillator generating the control voltage.

The invention will be explained hereinafter in detail with the help of the drawing. The Fig. shows the primary side of a switched power supply in simplified form.

In the Fig., the operating voltage U_B , which is applied via the working winding 2 of the transformer Tr to the switching transistor T_1 , is obtained between the points a and b from the mains voltage U_N , that can alter between 90 V and 260 V, using the mains rectifier 1. The emitter of the switching transistor T_1 is connected to the primary side earth via the low resistance resistor 3. The switching transistor T_1 is controlled by the driver circuit having the transistors T_2 , T_3 via the network 4. The control circuit 5 is provided on the primary side with an oscillator 0. The latter receives an operating voltage at the terminal c, which is obtained by rectification of the pulse voltage occurring on the winding 6 with the rectifier 7 and the capacitor 8. The control circuit 5 delivers the control voltage 9 which controls the transistors T_2 , T_3 via the network 10 and thereby makes the switching transistor T_1 periodically conducting and blocked. Thereby, voltage pulses are generated in the transformer Tr from which operating voltages of different magnitudes and polarities are produced by one or more secondary windings 11 and rectifying circuits connected thereto.

By rectification of the pulse voltage occurring on the winding 6 with the rectifying circuit 12, a regulating voltage U_r , which is a measure for the magnitude of the pulse voltage on the transformer Tr , is obtained at the point d. This regulating

voltage reaches the terminal e of the control circuit 5 and causes there a pulse width modulation of the control voltage 9 for the stabilisation of the operating voltages generated on the secondary side. The circuit described thusfar is known.

The regulating voltage U_r is additionally applied via the resistor 13 to the terminal f of the control circuit 5. The voltage on the terminal f causes a change of the frequency of the oscillator 0 within the control circuit 5 and thus of the control voltage 9, in the sense that, the frequency of the control voltage 9 reduces with reducing regulating voltage U_r . In the event of a disturbance of the kind described, e.g. a short circuit in the secondary side rectifying circuits, a too great a load on these circuits, breakdown of a component, interruption of a winding of the transformer Tr and the like, the amplitude of the pulse voltage effective on the transformer Tr sinks. Thereby, the regulating voltage U_r becomes smaller i.e. less positive. The periodic time of the control voltage 9 is thus increased accordingly so that the switching transistor T1 is only switched on again, in the desired manner, after a longer time of 0.4 ms, whereas the periodic time amounts to about 20 μ s for trouble-free operation of the circuit. Due to this increased periodic time of the control voltage 9 which is matched to the disturbance and the extended discharge time of the transformer Tr, the renewed switching on of the switching transistor T1 before the complete discharge of the transformer Tr and an endangering of the components such as especially Tr and T1, is avoided. The alteration of the frequency of the control voltage 9 preferably takes place continuously by means of the regulating voltage U_r and can take on any of the intermediate values between the minimum periodic time of 20 μ s corresponding to 50kHz and the maximum periodic time of 0.4 ms corresponding to 2.5kHz occurring in the case of a disturbance.



Claims

1. Switched power supply in accordance with the blocking converter principle having a transformer (Tr) and, connected in series with its primary winding (2), a switching transistor (T1) which is controlled to be periodically conducting and blocked by means of a control voltage (9) from a control circuit (5) containing an oscillator (0); wherein a regulating voltage (Ur), which is applied to a control terminal (e) of the control circuit (5) for the production of the control voltage (9) pulse width modulated by the regulating voltage (Ur), is obtained from the pulse voltage on a secondary winding (6) of the transformer (Tr) via a rectifier (12), characterised in that, the regulating voltage (Ur) is additionally applied to a frequency control terminal (f) of the control circuit (5) influencing the frequency of the oscillator (0) in such a way that the frequency of the control voltage (9) decreases with a falling regulating voltage (Ur) in the case of a disturbance due to overloading.