

In equipment of the communications art, such as a television receiver for example, it is known to produce the operating voltages necessary for the individual stages from the mains voltage by a switched-mode power supply. A switched-mode power supply renders possible the electrical isolation of the receiver circuit from the mains, which is an advantage for the connection of external equipment and for the measures for insulation. Since a switched-mode power supply works at a high frequency in comparison with the mains frequency, the switched-mode power supply transformer serving for the electrical isolation can be made considerably smaller and lighter in comparison with a mains transformer for 50 Hz. Operating voltages of different magnitude and polarity can be produced at the secondary side of the switched-mode power supply transformer by means of a plurality of windings or winding taps and rectifiers connected up.

Switched-mode power supplies synchronized with the line frequency are known for television receivers, wherein the switching transistor is controlled by pulse-width modulation depending on the load by an integrated circuit (TEA 2029) disposed at the secondary side, via an electrical isolation. Such a power supply is described in the Application DE-P 34 36 555.9. When a supply voltage is applied, the integrated circuit starts in that the pulse-width modulator begins at first with pulses of narrow width and so causes a gentle switching-on.

A large part of the television receiver can be remote-controlled and is therefore equipped with a supply independent of the switched-mode power supply for the remote-control receiver, for "standby" operation. Some of these work with a 50 Hz auxiliary power supply or the whole switched-mode power supply is operated in

an "economy mode", for example with reduced or disconnected voltages at the secondary side.

A switched-mode power supply without stand-by operation is known from the Patent Specification DE-P 32 27 152 wherein an oscillator, which oscillates freely in the absence of a voltage control signal at horizontal frequency during a starting phase after the switching-on, is provided at the side connected to the mains. The switching transistor is driven so that voltages which are sufficient for the starting of the horizontal deflection section result at the side of the switched-mode power supply transformer isolated from the mains. In a later phase, the starting oscillator is synchronized by the voltage control signal at horizontal frequency produced at the secondary side, and after that it is switched off.

Furthermore, it is known from the European Patent Application EP-A-223 131, which is not a prior publication, for a switched-mode power supply with starting oscillator without stand-by operation, to allow the starting oscillator disposed at the side connected to the mains to start at first with pulses of narrow width and low frequency for the drive of the switching transistor after the switching-on. During the starting operation, these pulses are continuously widened by the starting circuit as a result of which the secondary voltages rise in the switched-mode power supply and the pulse-width modulator (TEA 2029) disposed at the secondary side takes up its function. Like the starting oscillator, this pulse-width modulator at first delivers pulses of narrow width but a relatively high frequency, namely at line frequency. As a result, the starting oscillator is put out of operation and the pulse-width modulator takes over the further control of the switching transistor.

These known switched-mode power supplies with a starting oscillator have the disadvantage that they

cannot be used for equipment with remote control without additional expenditure.

It is the object of the invention to indicate a switched-mode power supply for a device which can be remote-controlled and has a starting oscillator and which manages without additional expenditure such as a mains-isolating 50 Hz additional power supply for the receiving section which can be remote-controlled.

This problem is solved in a switched-mode power supply according to the preamble to Claim 1 by the features described in the characterising part of Claim 1. Further developments of the invention are described in the sub-claims.

In principle, the remotely controllable receiving section of the television receiver, like the starting oscillator and an evaluation circuit following the remote-control receiver, is disposed at the side of the switched-mode power supply connected to the mains. The voltage supply for these parts is effected directly from the mains by rectification and filtering.

The on and off functions are evaluated and carried out at the side connected to the mains while the other operating functions such as transmitter selection, luminance and contrast control etc. are transmitted via a mains isolator, for example an optical coupler at the secondary side, to a microprocessor controlling these functions. These instructions can only be carried out when the switched-mode power supply has come into operation and the microprocessor is being supplied with voltage from the switched-mode power supply.

Both the off and the on function are controlled via the evaluation circuit, a monostable trigger stage, for example, being triggered and also acting as an electronic protection at the same time. In the event

of an excess current for example, this circuit switches the switched-mode power supply and hence the television receiver out of operation.

The invention will be explained in more detail with reference to a Figure.

This shows in an exemplary form of embodiment a circuit diagram for a switched-mode power supply of a remotely controllable device with starting oscillator and stand-by operation. The remote-control receiver 1 controls the on and off function via its output line B while the other instructions such as transmitter selection, luminance or contrast control etc. are transmitted over the line A to a microprocessor disposed at the secondary side of the switched-mode power supply transformer 21 but not illustrated, via a mains isolator 11 with output E. The mains isolator 11 may be constructed in the form of an optical coupler or a transformer.

The starting circuit with starting oscillator is formed from the transistors 3 and 4. For the switching-on operation, these transistors are supplied directly with direct voltage via diode 2 and via the resistors 5 and 6, without isolation from the mains. The centre of the series connection of the resistors 5 and 6 is connected to the emitter of transistor 8 which, together with the transistor 9, causes the execution of the on and off functions given by the remote-control receiver. In the off function, transistor 8 is conductive and, as a result, connects the centre of the resistors 5 and 6 to earth so that the transistors 3 and 4, which form the starting circuit with starting oscillator, are inoperative. Transistor 8 and transistor 9 are connected as a monostable trigger stage which, on the one hand is triggered by the remote-control transmitter

via the line B and, on the other hand, in the event of an excess current in the switching transistor 13, by a voltage drop at the precision resistor 12. It acts as a protective circuit for the switched-mode power supply in that, when transistor 9 becomes conductive, the monostable trigger stage connects the diode 10 to earth and as a result causes an interruption in the drive of the switching transistor 13.

The device is switched on by a negative pulse on line B in that the transistors 8 and 9 are controlled so as to be without current. As a result, the d.c. voltage from diode 2 can charge the capacitor 7 via resistor 6. When there are about +3 V at the capacitor 7, the starting oscillator begins to oscillate. As a result of the wiring, a frequency of about 13 kHz results. The voltage supply for the transistors 14 and 15 which are connected in push-pull and drive the switching transistor 13, as well as for the pre-driver transistor 16, is effected during the starting phase via the diode 17 constructed in the form of a light-emitting diode. This serves as an indication of stand-by operation at the beginning of the starting phase and also during the stand-by operation. After the voltages in the switched-mode power supply have risen and the voltage at the capacitor 18 exceeds a specific value, the diode 17 becomes currentless.

As the voltage at the capacitor 7 rises, the pulse duty factor in the starting oscillator is reduced. As a result, the cut-off angle of current flow in the switching transistor 13 varies in direct proportion to the voltage applied to capacitor 7. Voltages are induced in the windings 27 - 31 at the secondary side by the working winding 26 of the switched-mode power supply transformer 21, which is connected in

series with the switching transistor 13; a rise in the supply voltages is effected. At a certain magnitude of these supply voltages, the pulse-width modulator 22 in the integrated circuit TEA 2029 comes into operation and, via the mains isolator 19, delivers pulses at line frequency, at first with a high pulse duty factor, to the base of transistor 16. On the arrival of the first pulses, the starting oscillator oscillating at a lower frequency is put out of operation and the control for the switching transistor 13 is taken over at line frequency by the pulse-width modulator 22. The final switching off of the starting oscillator occurs as a consequence of the rise in the voltage at the capacitor 18. It is applied via diode 20, Zener diode 23 and resistor 24 to the base of transistor 3 which becomes current conductive as a result.

The two mains isolators 11 and 19 may also be combined to form one component, for example in that two optical couplers are disposed in one housing.



CLAIMS

1. A switched-mode power supply for a device which can be remote-controlled, particularly for a television set, having a starting circuit for the switching transistor (13), which circuit is disposed at the side of the switched-mode power supply transformer (21) connected to the mains, and a protective circuit or the switching transistor (13), likewise disposed at the side connected to the mains, comprising the following features:

- a) The remote-control receiving section (1) is disposed at the side connected to the mains and is supplied with an operating voltage produced directly from the mains,
- b) the remotely controllable on and off instructions are fed to an evaluation circuit which is connected to the mains and releases the switching instructions at the side connected to the mains,
- c) all other remotely controllable instructions are fed via a mains isolator (11) to a processing circuit (uP),
- d) during the starting operation when the secondary voltages are rising in the switched-mode power supply transformer (21), the starting circuit is separated by a pulse width modulator (22) disposed at the secondary side and delivering control signals via a mains isolator (19).

2. A switched-mode power supply according to Claim 1, characterised in that the remotely controllable off instructions are carried out by the protective circuit for the switching transistor (13).



3. A switched-mode power supply according to claim 1 or claim 2, characterised in that the protective circuit is a monostable flip-flop.

4. A switched-mode power supply according to one of claims 1 to 3, characterised in that the mains isolators (11,19) are optical couplers.

5. A switched-mode power supply according to claim 4, characterised in that the mains isolators (11,19) are arranged in a common housing.

6. A switched-mode power supply according to one of claims 1 to 3, characterised in that the mains isolators (11,19) are formed by a transformer.

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7. A switched-mode power supply according to claim 1, characterised in that the starting circuit, the ~~switching~~^{driving} circuit and the protective circuit for the switching transistor (13), and also the evaluation circuit for the on and off instructions, are combined in an integrated circuit.

8. A switched-mode power supply according to claim 1, characterised in that the control signals supplied by the pulse-width modulator are at line frequency.