

POWER SUPPLY FOR TELEVISION APPARATUS

The invention relates to an arrangement for regulating a supply voltage of a television apparatus.

In, for example, a television receiver, a pulse-width modulator, for a voltage regulator, may generate a pulse-width modulated control signal, at a horizontal deflection related frequency. The control signal may be coupled to a power supply switching stage that supplies a regulated B+ supply voltage to a horizontal output stage. The voltage regulator circuitry may be combined with horizontal deflection circuitry and incorporated in an integrated circuit (IC) that is referred to herein as the deflection IC. The deflection IC may be required to operate, selectively, in a power-up mode and in a standby mode, in accordance with an on/off control signal provided by a remote receiver. Such pulse-width voltage regulator may be required to supply, in the power-up mode, the pulse-width modulated control signal for controlling the power supply that generates the regulated B+ supply voltage used for operating the horizontal output stage of the receiver. When operation in the standby mode is required, such control signal may be required to prevent the power supply from energizing the deflection output stage until such time as a user initiates a power-up command that is provided via the remote receiver.

The deflection IC that includes, for example, the voltage regulator, may include other circuitry that is required to be energized during both the power-up and the standby modes. A second voltage regulator such as a shunt regulator internal to the IC, for example, may be coupled between a supply voltage receiving terminal of the deflection IC and ground for regulating the supply voltage of the deflection IC during both the power-up and standby modes. Similarly, the remote receiver may also be required to be energized during both the power-up mode and the standby mode.

A standby power supply for the deflection IC may include a standby transformer having a primary winding that

is coupled to an alternating current (AC) mains supply source. A voltage that is developed at a secondary winding of the transformer may be rectified to produce a DC, standby energizing voltage. The standby energizing voltage may be applied to the supply voltage receiving terminal of the deflection IC to energize, for example, that portion of the deflection IC that is required to be energized by the standby power supply during the standby mode. During the power-up mode, the run-mode power supply provides the energizing voltage to such terminal. The shunt regulator may regulate the energizing voltage at such terminal during both the power-up and standby modes.

The regulated energizing voltage, developed at the supply voltage receiving terminal during the power-up mode, may be at, for example, the same level that is required by other integrated circuits of the television receiver. Therefore, it may be desirable to utilize such regulated energizing voltage to regulate a second supply voltage that is coupled to various other circuits of the television receiver and that provides a corresponding supply current during operation in the power-up mode.

It may be desirable to obtain such regulation of the second supply voltage with as few circuit components as possible. Furthermore, it may be desirable that, during operation in the standby mode, the second supply voltage generating and regulating circuitry will not load the standby power supply that is coupled to the supply voltage receiving terminal of the deflection IC. Reduction of the supply current that is required from the standby transformer during the standby mode is desirable so as to reduce the cost of such transformer.

In accordance with an aspect of the invention, a television apparatus power supply generates a first supply voltage during a normal operation power-up mode of the power supply. A second supply voltage is coupled to a first terminal of a first load circuit to develop a first terminal supply voltage prior to operation in the power-up mode. A switching arrangement is coupled between the first

supply voltage and the first terminal for coupling, during the power-up mode, the first supply voltage to the first terminal to develop, during the power-up mode, the first terminal supply voltage at the first terminal. A voltage regulator coupled to the first terminal regulates the first terminal supply voltage such that the regulated first terminal supply voltage is coupled through the switching arrangement, during the power-up mode, to a second terminal of the switching arrangement to regulate at the second terminal a third supply voltage that, prior to the operation in the power-up mode, is isolated by the switching arrangement from the first terminal.

In the Drawing:

The sole FIGURE illustrates a television power supply including a supply regulator embodying the invention.

The sole FIGURE illustrates a portion of a television receiver incorporating a deflection IC 100. The television receiver includes a bridge rectifier 101 that rectifies a mains supply voltage V_{AC} to produce a DC, unregulated voltage V_{UR} . A conventional source such as switching regulator 102, that may include a silicon controlled rectifier (SCR), produces, in a power-up mode, a regulated voltage B+ that is coupled to a flyback transformer T1. An input terminal 102c of regulator 102 is coupled to unregulated voltage V_{UR} . Regulated voltage B+ is developed at an output terminal 102d of switching regulator 102. Transformer T1 is coupled to a collector electrode of a deflection switching transistor Q1 of a horizontal circuit output stage 99 operating at a horizontal rate f_H . A control signal H_r , at the horizontal rate f_H , that is produced in a corresponding portion of deflection IC 100, referred to herein as a horizontal processor 100a, is coupled via a horizontal driver 666 to the base electrode of transistor Q1. Signal H_r controls the switching of transistor Q1 to generate a deflection current i_y in a deflection winding L_y of output stage 99. A retrace voltage V_{w2} is produced in a conventional manner

across a winding W2 of transformer T1 during each retrace interval of each horizontal period H. Each retrace interval occurs immediately after transistor Q1 becomes nonconductive. A DC run-mode supply voltage V+, that is
5 illustratively +16 volts, is produced by rectifying voltage V_{w2} in a rectifier arrangement 104 that is coupled to winding W2. Voltage V+ is also coupled to various circuits of the receiver to provide them with energy during a power-up mode of the television receiver. Such circuits
10 are depicted as a load 900.

Voltage V+ is also coupled to a corresponding portion of deflection IC 100, that is referred to herein as switch mode regulator and pre-driver 100b, to provide a feedback signal V_{IN} . Regulator and pre-driver 100b
15 generates a pulse width modulated signal S_c that controls the duration, in each horizontal interval H, in which switching regulator 102 is conductive. The duty cycle of signal S_c varies, in accordance with changes in feedback signal V_{IN} . Signal S_c causes regulated voltage B+ to be at
20 a predetermined DC voltage level such as, illustratively, +125 volts. Signal S_c , voltage B+ and voltage V+ that may be produced in a conventionally known manner are produced, illustratively, when deflection IC 100 operates in the power-up mode, but are not produced during television
25 receiver standby-mode operation.

A standby transformer T0 steps down voltage V_{AC} . The stepped down voltage is rectified in a rectifier arrangement 106 to produce a standby voltage V_{SB} . Standby voltage V_{SB} is coupled to an energizing voltage receiving
30 terminal 120 of deflection IC 100 through a resistor R1 that charges a capacitor 66 to produce in capacitor 66 an energizing voltage V_{CC} . Voltage V_{CC} is coupled to terminal 120 of deflection IC 100. Regulated voltage V+ is coupled to terminal 120 via a resistor R11, that is coupled in
35 series with a diode D2, to supply voltage V_{CC} from voltage V+ only when deflection IC 100 operates in the power-up mode. Diode D2 is nonconductive during the standby mode,

and prevents current drain via load 900 from standby transformer T0.

Standby voltage V_{SB} is coupled to a remote receiver 107 to provide the operating voltage of remote receiver 107. Remote receiver 107 causes MOS transistor 108, when transistor 108 is conductive, to form a low impedance at a terminal 109 of deflection IC 100. The low impedance occurs after, for example, a user initiates a power-on command via an infra-red communication link that causes a start-up interval to occur. When transistor 108 becomes conductive, it causes an on/off control circuit 555 to generate a control signal 555a that applies voltage V_{CC} to horizontal processor 100a; consequently, a horizontal oscillator, not shown in the FIGURES, of processor 100a begins operating and signal H_r is generated. Similarly, a control signal 555b of circuit 555 applies voltage V_{CC} to pre-driver 100b that causes pre-driver 100b to generate signal S_c .

At the beginning of the start-up interval, horizontal driver 666 is energized by unregulated voltage V_{UR} through resistor 110. Voltage V_{CC} is then obtained from the charge previously stored by arrangement 106 in capacitor 66. During the start-up interval, voltage $V+$ increases from zero. At the end of the start-up interval, when voltage $V+$ is sufficiently large, diode D2 turns-on for supplying voltage V_{CC} in the power-up mode from voltage $V+$.

In the power-up mode, the television receiver is fully operative. Conversely, after a power-off command is initiated by the user, transistor 108 becomes nonconductive and forms a high impedance circuit at terminal 109 that causes a standby mode to occur. In the standby mode, deflection current i_y and the raster on a display device of the television receiver are turned-off.

An input supply current i_{ps} is coupled through terminal 120 to deflection IC 100 for providing the energizing current of deflection IC 100. During operation in the power-up mode, current i_{ps} is supplied mainly by

rectifier arrangement 104 through diode D2; whereas, during operation in the standby mode, current i_{ps} is supplied from standby transformer 106 via rectifier arrangement 106 and resistor R1.

5 Voltage V_{cc} is regulated in deflection IC 100 by a shunt regulator 131 that is required to regulate voltage V_{cc} during operations in both the standby mode and the power-up mode. Regulation of voltage V_{cc} during the standby mode may be desirable for protecting deflection IC
10 100 from an over-voltage condition at terminal 120 that may occur should voltage V_{cc} exceed the voltage rating of deflection IC 100. If permitted to occur, such over voltage condition may damage deflection IC 100. Voltage V_{cc} may also be required to be regulated during the standby
15 mode for operating, for example, on/off control circuit 555 of deflection IC 100. Shunt regulator 131 regulates voltage V_{cc} in accordance with a reference voltage V_{BG2} , that is generated during both the power-up and standby modes. Voltage V_{BG2} is generated in, for example, a bandgap type
20 voltage source 105 that is, therefore, required to operate during both the standby and the power-up modes.

Various circuits in the receiver such as, for example, a second IC of the television receiver, that are depicted as a load 999 in the FIGURE, may require, only
25 during the power-up mode, a regulated supply voltage, that is depicted as a voltage V_{RUN} in the FIGURE. Voltage V_{RUN} may be required to be at a level that is equal to that of, for example, voltage V_{cc} . It may be desirable to utilize voltage V_{cc} that is regulated by shunt regulator 131 to
30 also provide regulation of voltage V_{RUN} .

In a preferred aspect of the invention, a transistor Q2 having a collector electrode that is coupled to voltage $V+$ at a terminal 104a produces regulated voltage V_{RUN} at an emitter electrode of transistor Q2. The base
35 electrode of transistor Q2 is coupled to the anode of diode D2. The base current of transistor Q2 is provided by resistor R11. The forward voltage drop across diode D2 is summed with voltage V_{cc} to produce at the base of

transistor Q2 a voltage that is higher than voltage by diode D2 voltage drop of approximately, 0.7 volts (in a silicon diode). Consequently, voltage V_{RUN} , that is smaller than the base voltage of transistor Q2 by approximately the same voltage drop that is developed across diode D2, is equal to voltage V_{CC} . A current i_{RUN} that is supplied via transistor Q2 to load 999 is outside the current path of current i_{PS} that is coupled to deflection IC 100 via terminal 120.

10 In another preferred aspect of the invention, temperature related changes of the voltage across the base-emitter junction of transistor Q2, are temperature compensated by diode D2 to render voltage V_{RUN} regulated and temperature compensated. Furthermore, using
15 a bandgap type voltage source 105 for regulating voltage V_{RUN} provides, advantageously, temperature compensation with tighter tolerances than obtained by using a zener diode that is used in some prior art circuits. Also, unlike a zener diode, the bandgap type voltage source can
20 be designed to provide any selected voltage within a given range of voltages. Using resistor R111, diode D2 and shunt regulator 131, that are used for operating deflection IC 100, also for controlling transistor Q2 to obtain regulation of voltage V_{RUN} , advantageously, eliminates the
25 need for separate resistor, diode and regulator that would have otherwise been required for providing the base voltage of transistor Q2.

During operation in the power-up mode, voltage $V+$, that is coupled via resistor R111, causes diode D2 to
30 be conductive. Resistor R111 is required for developing a voltage drop that is equal to the difference between voltage $V+$ and a sum voltage of voltage V_{CC} and the forward voltage drop across diode D2.

During the standby mode it is undesirable to load
35 transformer T0 and capacitor 66 by any of load 900, load 999, resistor R111 and transistor Q2, because the cost of transformer T0 is directly related to the standby current requirement from, or loading of, transformer T0. Diode D2,

(advantageously, prevents the loading of transformer T0 during the start-up interval, as long as voltage V+ is not sufficiently large to turn on diode D2. Similarly, during the standby mode, each of load 900, load 999, resistor R111 and transistor Q2 is, advantageously, isolated from standby transformer T0 by diode D2 that is switched off.

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CLAIMS:

1. A television apparatus power supply, comprising:

a source of an input supply voltage;

5 a source of an on/off control signal that selectively generates power-on and power-off control information that is indicative of a requirement for normal operation of said power supply in a power-up mode and of a requirement for a standby mode, respectively;

means responsive to said on/off control signal
10 and coupled to said input supply voltage for generating therefrom a first supply voltage during normal operation power-up mode of said power supply;

means coupled to said input supply voltage for generating therefrom a second supply voltage that is
15 coupled to a first terminal of a first load circuit to develop thereat a first terminal supply voltage during said standby mode;

switching means coupled between said first supply voltage and said first terminal for coupling during said
20 power-up mode said first supply voltage to said first terminal to develop during said power-up mode said first terminal supply voltage at said first terminal; and

a voltage regulator coupled to said first terminal for regulating said first terminal supply voltage
25 such that said regulated first terminal supply voltage is coupled through said switching means during said power-up mode to a second terminal of said switching means to regulate thereat a third supply voltage that during said standby mode is isolated by said switching means from said
30 first terminal.

2. An apparatus according to Claim 1 wherein said switching means comprises a diode.



3. An apparatus according to Claim 1 further comprising, a transistor having a control electrode that is coupled to said second terminal, wherein a second load circuit is coupled to a main current conducting electrode of said transistor and wherein said switching means comprises a diode that is interposed between said control electrode of said transistor and said first terminal supply voltage and a resistor coupled between said diode and said first supply voltage that causes said diode to be conductive only when said first supply voltage is generated.

4. An apparatus according to Claim 3 wherein said diode isolates said first supply voltage generating means from said second supply voltage during said standby mode.

5. An apparatus according to Claim 4 wherein said diode isolates said first supply voltage generating means from said second load during said standby mode when said first supply voltage is turned-off.

6. An apparatus according to Claim 3 wherein said diode provides temperature compensation for variations of a base-emitter junction voltage in said transistor to produce a temperature compensated output supply voltage at an emitter electrode of said transistor.



7. An apparatus according to Claim 1 wherein said first supply voltage generating means comprises a deflection circuit, responsive to a control signal at a frequency that is related to a deflection frequency, that includes a flyback transformer for producing, when said signal at said deflection related frequency is generated, said first supply voltage from a voltage that is developed at said flyback transformer and wherein said regulated first terminal supply voltage is coupled to a control circuit that generates said control signal at said deflection related frequency for energizing said control circuit.

8. An apparatus according to Claim 7 wherein said control circuit generates said control signal that is a pulse-width modulated control signal.

9. An apparatus according to Claim 1 wherein said second supply voltage generating means comprises a step-down transformer coupled to said input supply voltage, and a rectifier having an input terminal that is coupled to said step-down transformer for generating said second supply voltage by rectifying a voltage that is developed at said step-down transformer.

10. An apparatus according to Claim 1 wherein said first supply voltage generating means comprises a deflection circuit having a flyback transformer for generating in a winding of said flyback transformer a voltage at a frequency that is related to a deflection frequency and a rectifier coupled to said winding of said flyback transformer for generating from a voltage that is generated in said winding said first supply voltage.

11. An apparatus according to Claim 1 wherein said source of said on/off control signal comprises a remote receiver.



12. An apparatus according to Claim 1 further comprising a third load circuit coupled to said first supply voltage generating means wherein said switching means isolates said first terminal from said third load circuit during said standby mode.

13. A television apparatus power supply, comprising:

- a source of a start-up supply voltage;

- a run-mode power supply for developing in a run-mode a run-supply voltage, said run-mode power supply having a first terminal that is coupled to said start-up supply voltage for developing a first terminal supply voltage at said first terminal during a start-up interval;

- switching means coupled to said first terminal and to said source of run-supply voltage for applying said run supply voltage to said first terminal to develop said first terminal supply voltage at said first terminal during operation in said run-mode; and

- an emitter follower stage having an input terminal that is coupled to said first terminal via said switching means during said run-mode and having an output terminal coupled to a load and a third terminal that is coupled to said source of run supply voltage for supplying current from said output terminal to said load during operation in said run-mode at an applied voltage level that is regulated in accordance with said first terminal supply voltage.



14. A television apparatus power supply, comprising:

a source of an input supply voltage;

means coupled to said input supply voltage for generating therefrom a first supply voltage during a normal operation power-up mode of said power supply;

means coupled to said input supply voltage for generating therefrom a second supply voltage that is coupled to a first terminal of a first load circuit to develop thereat a first terminal supply voltage prior to the operation in said power-up mode;

switching means coupled between said first supply voltage and said first terminal for coupling during said power-up mode said first supply voltage to said first terminal to develop during said power-up mode said first terminal supply voltage at said first terminal; and

a voltage regulator coupled to said first terminal for regulating said first terminal supply voltage such that said regulated first terminal supply voltage is coupled through said switching means during said power-up mode to a second terminal of said switching means to regulate thereat a third supply voltage that prior to the operation in said power-up mode is isolated by said switching means from said first terminal.

15. An apparatus according to Claim 1 wherein said switching means comprises a diode.



16. An apparatus according to Claim 14 further comprising, a transistor having a control electrode that is coupled to said third supply voltage at said second terminal, wherein a second load circuit is coupled to a main current conducting electrode of said transistor and wherein said switching means comprises a diode that is interposed between said control electrode of said transistor and said first terminal supply voltage and a resistor coupled between said diode and said first supply voltage that causes said diode to be conductive only when said first supply voltage is generated.

17. An apparatus according to Claim 16 wherein said diode isolates said first supply voltage generating means from said second supply voltage during a standby mode of operation.

18. An apparatus according to Claim 17 wherein said diode isolates said first supply voltage generating means from said second load during said standby mode when said first supply voltage is turned-off.

19. An apparatus according to Claim 16 wherein said diode provides temperature compensation for variations of a base-emitter junction voltage in said transistor to produce a temperature compensated output supply voltage at an emitter electrode of said transistor.



20. An apparatus according to Claim 14 wherein
said first supply voltage generating means comprises a
deflection circuit, responsive to a control signal at a
frequency that is related to a deflection frequency, that
5 includes a flyback transformer for producing, when said
signal at said deflection related frequency is generated,
said first supply voltage from a voltage that is developed
at said flyback transformer and wherein said regulated
first terminal supply voltage is coupled to a control
10 circuit that generates said control signal at said
deflection related frequency for energizing said control
circuit.

21. A television apparatus power supply
15 substantially as herein described with reference to the
accompanying drawings.