

SOURCE VOLTAGE CONTROL SWITCHING CIRCUIT

1 BACKGROUND OF THE INVENTION

This invention relates to a source voltage control switching circuit for maintaining the source voltages to be stable at the light-load powering time of
5 BS (Direct Broadcasting Satellite) timer recording mode and at the maximum load powering time of television mode.

Recently, most television receivers are of the BS-tuner-built-in type. Thus, a converter switching
10 power source for the BS built-in type has been developed so far.

The source voltage control switching circuit used in the above switching power source will be described with reference to the accompanying drawings.

15 Fig. 5 shows a conventional source voltage control switching circuit.

Referring to Fig. 5, there are shown an AC rectifying circuit 1, a power control integrated circuit (hereinafter, referred to as the power control IC) 2, a
20 rectifying capacitor 3, a power output MOSFET 4, a power transformer 5, a voltage control feedback photocoupler 6, a start resistor 7, a rectifying diode 8, a rectifying capacitor 9, a 18-V control constant voltage diode 10, rectifying diodes 11, 12, a relay 13 for
25 turning a television source voltage 140 V on and off,

1 rectifying capacitors 14, 15, an error amplifying shunt
regulator 16, a relay drive transistor 17, a switching
transistor 18 for turning the 18-V control constant
voltage diode on and off, a switching transistor 19 for
5 turning the 140-V control error amplifying shunt
regulator on and off, and diodes 20, 21 and resistors
22, 23, 24, 25, 26, 27.

The operation of this conventional source
voltage control switching circuit will be mentioned
10 below.

When the AC power supply is turned on, the
control switching circuit is started through the start
resistor 7 so that voltages are induced in the secondary
windings of the transformer 5. At the same time, a
15 high-level signal in the television mode is supplied to
the bases of the transistors 17 and 19 so that the
transistor 17 becomes conductive to make the relay 13 be
energized. Thus, upon television reception, the
television source voltage 140 V and the BS source
20 voltage 18V are supplied to the load side. At this
time, the transistor 19 is also conductive, making the
3-pin of the error amplifying shunt regulator 16 be
grounded. Thus, the secondary output voltages are
controlled by use of the television source voltage 140
25 V. In other words, the voltage change fed from the 140-
V line through the resistor 27 is converted by the error
amplifying shunt regulator 16 into a current change,
which is then fed back to the power control IC 2 through

1 the photocoupler 6 so that the source voltages can be stabilized.

In the BS timer recording mode, the voltage to the bases of the transistors 19, 17 becomes low, and
5 thus the transistors 19, 17 are nonconductive. "BS timer recording mode" is a mode in which connection of a relay circuit is cut, television receiver circuit does not operate and only BS broadcasting signal is receiving condition. Therefore, the relay 13 is deenergized so
10 that the television source voltage is not supplied to the load side, and thus only the BS source voltage is supplied to the load side. At this time, since the transistor 19 is nonconductive, the error amplifying shunt regulator 16 is inoperative. Thus, the secondary
15 output voltages are controlled through the BS source voltage 18 V, the resistor 22, the transistor 18 and the constant voltage diode 10. In other words, the voltage change on the 18-V line is converted into a current change, which is then fed back to the power control IC 2
20 through the photocoupler 6 so that the source voltages can be stabilized. At this time, the BS source voltage value depends on the voltage value of the constant voltage diode.

Another conventional example will be described
25 below.

Fig. 6 is a circuit diagram of the converter switching power source for the BS tuner built-in television receiver. Referring to Fig. 6, the output

1 end of an AC rectifying circuit 31 is connected to one
end of a primary winding 32a of a power transformer 32,
to one end of a start register 33, and to one end of a
rectifying capacitor 34 of which the other end is
5 grounded. The other end of the start resistor 33 is
connected to the input terminal of a power control
integrated circuit(hereinafter, referred to as the power
control IC) 35, to the collector of the phototransistor
of a photocoupler 36, to one end of a rectifying
10 capacitor 37 with the other end grounded, and to the
cathode of a rectifying diode 38. The emitter of the
phototransistor of the photocoupler 36 is connected to
the control terminal of the power control IC 35. The
anode of the rectifying diode 38 is grounded through the
15 secondary winding, 32b of the power transformer 32. The
output terminal of the power control IC 35 is connected
to the base of a power output MOS transistor
(hereinafter, referred to as MOSFET) 39. The drain of
the MOSFET 39 is connected to the other end of the
20 primary winding 32a of the power transformer 32, and the
source of the MOSFET 39 is grounded.

One end of a secondary winding 32c of the
power transformer 32 of which the other end is grounded
is connected to the anode of a rectifying diode 40. The
25 cathode of the rectifying diode 40 is connected to one
end of a rectifying capacitor 41 of which the other end
is grounded, and to the BS circuit, supplying + 18 V to
the BS circuit. In addition, one end of a secondary

1 winding 32d of the power transformer 32 of which the
other end is grounded is connected to the anode of a
rectifying diode 42. The cathode of the rectifying
diode 42 is connected to one end of a rectifying
5 capacitor 43 of which the other end is grounded, and to
the television circuit through relay contacts 44a of a
relay 44, thus supplying + 130 V to the television
circuit. Also, the collector of a switching transistor
46, of which the emitter is grounded and of which the
10 base is supplied with a low level signal (hereinafter,
abbreviated as the L-signal) through a resistor 45 in
the television receiving mode and with a high level
signal (hereinafter, abbreviated the H-signal) through
the resistor 45 in the BS timer recording mode, is
15 connected to the cathode of the rectifying diode 42
through a dummy load resistor 47. An error amplifying
shunt regulator 48 has a terminal 48a connected to the
cathode of the rectifying diode 42 through a volume
control 49, a terminal 48b connected to the cathode of
20 the photodiode of the photocoupler 36 of which the anode
is connected to + B power source, and a terminal 48c
grounded. Moreover, a relay drive transistor 51 has its
emitter grounded, its base supplied with the H-signal
through a resistor 50 in the television receiving mode
25 and with the L-signal through the resistor 50 in the BS
timer recording mode, and its collector connected
through a relay winding 44b of the relay 44 to + 12 V
source voltage.

1 The operation of the above construction will
be mentioned. First, when the AC power supply is turned
on, a source voltage is supplied from the AC rectifying
circuit 31 to the input terminal of the power control IC
5 35 through the start resistor 33. The power control IC
35 produces a signal at its output terminal, causing the
MOSFET 39 to make switching operation. Thus, the power
source is actuated so that voltages are induced in the
secondary windings 32b, 32c and 32d of the power
10 transformer 32.

 In the television receiving mode in which a
picture is displayed on the cathode ray tube, as soon as
the voltages are induced in the secondary windings 32b,
32c and 32d of the power transformer 2, the H-signal is
15 supplied to the base of the transistor 51, making the
transistor 51 conductive so that the relay 44 is
energized. Thus, the relay contacts 44a are closed,
allowing the television circuit to be supplied with
+ 130 V from the secondary winding 32d so that a picture
20 can be displayed on the cathode ray tube. In addition,
the BS source voltage + 18 V is supplied from the
secondary winding 32c to the BS receiving circuit and so
on. At this time, the error amplifying shunt regulator
48 converts the voltage change of the television source
25 voltage + 130 V line into a current change, and feeds it
through the photocoupler 36 back to the control terminal
of the power control IC 35 so that the source voltage of
the television power source + 130 V line can be

1 stabilized. The base of the transistor 46, in the television receiving mode, is supplied with the L-signal so that the transistor 46 is not conductive.

Then, in the BS timer recording mode in which
5 a BS program is received by only operating the BS receiving circuit and recorded on a VTR, the base of the transistor 51 is supplied with the L-signal so that the transistor 51 is nonconductive. Thus, the relay 44 is not energized so that the relay contacts 44a are opened.
10 Therefore, the television source voltage is not supplied to the load side, or the television circuit, but only the BS source voltage is supplied to the BS receiving circuit. At this time, the base of the transistor 46 is supplied with the H-signal in the BS timer recording
15 mode so that the transistor 46 is conductive, thus connecting the dummy resistor 47 between the television power source + 130 V line and ground. The current (several tens of mA) flowing in the dummy load resistor 47, preventing the no-load state. Thus, the source
20 voltage stabilization at the light-load powering time can be achieved by use of the error amplifying shunt regulator 48.

SUMMARY OF THE INVENTION

In the above constructions, however, when
25 switching is made from the BS timer recording mode to the television mode, the voltage control current is easily stopped in a period (discontinuous period) by the

chattering of the relay, switching time difference and so on. Thus, the output voltage may be abnormally increased, breaking the load-side circuits. In addition, in the BS timer recording mode of the light-load powering time, the dummy load resistor 47 is inserted for the power source stabilization, thus increasing the power loss with the result that the power efficiency is deteriorated.

Accordingly, it is an object of the invention to provide a power supply having no above-mentioned problem and a high power efficiency for use in the television receiver.

According to a first aspect of the present invention there is provided a source voltage control switching circuit for adjusting a control voltage in order to stabilize an output voltage of a switch-mode power supply by performing output voltage control using a television source voltage as the control voltage in a television receiving mode and using a BS source voltage which is switched to during a BS timer recording mode requiring light-load power, wherein:

a constant voltage diode is inserted in a primary side of a transformer provided in a control circuit of a power supply so as to effect voltage control at said light-load powering time.

According to a second aspect of the present invention there is provided a source voltage control

switching circuit for adjusting a control voltage in order to stabilize an output voltage of a switch-mode power supply by performing output voltage control using a television source voltage as the control

5 voltage in a television receiving mode and using a BS source voltage which is switched to during a BS timer recording mode requiring light-load power, wherein:

a constant voltage diode is inserted in a secondary side of a transformer provided in a control
10 circuit of a power supply so as to effect voltage control at said light-load powering time.

According to a third aspect of the present invention there is provided a source voltage control switching circuit for adjusting a control voltage in
15 order to stabilize an output voltage of a switch-mode power supply by performing output voltage control using a television source voltage as the control voltage in a television receiving mode and using a BS source which is switched to during a BS timer
20 recording mode requiring light-load power, wherein:

a constant voltage diode is inserted in a secondary side of a transformer provided in a control circuit of a power supply, and there are provided a switching circuit for turning said constant voltage
25 diode on and off and a delay circuit for decreasing the switching speed of said switching circuit.

One embodiment of the invention provides a power

supply for a television receiving having a television
source voltage detection means for detecting the
television source voltage, BS power source voltage
detection means for detecting the BS power source
5 voltage, power control means to which the amount of
detection is fed back from the television source
voltage detection means so that the television source
voltage can be controlled to be stable or to which the
amount of detection is fed back from the BS source
10 voltage means so that the BS source voltage can be
controlled to be stable, and switching means for
switching to the stabilization control using the
television source voltage detection means in the
television receiving mode in which the television
15 circuit and the BS circuit as powered and to the

1 stabilization control using the BS source voltage
detection means in the BS timer recording mode in which
the television circuit is not powered but the BS circuit
is powered.

5 Moreover, the constant voltage diode is
inserted in the primary side control circuit of the
power supply so as to make voltage control at the time
of light load, the constant voltage diode is inserted in
the secondary side control circuit so as to make voltage
10 control at the time of light load, or the constant
voltage diode is inserted in the secondary side control
circuit and a switching circuit for turning the constant
voltage diode on and off and a delay circuit for
decreasing the switching speed of the switching circuit
15 are provided.

According to the construction of this
invention, since there is no discontinuous period in
which the control current is not flowed when switching
is made from the BS timer recording mode to the
20 television mode, the secondary side output voltage can
be prevented from being abnormally increased. In
addition, since in the television receiving mode the
television source voltage detection means is switched to
by switching means so that the television source voltage
25 can be controlled to be stable through the television
source voltage detection means or in the BS timer
recording mode the BS source voltage detection means is
switched to by switching means so that the BS source

1 voltage is controlled to be stable through the BS source
voltage detection means without using the television
source voltage detection means as in the prior art, the
stable voltage can be obtained in the BS timer recording
5 mode of light-load powering time and in the television
receiving mode of high-load powering time, and in the BS
timer recording mode in which the BS circuit is powered
but the television circuit is not powered, the dummy
load resistor is not necessary which is used for
10 avoiding the no-load state in the stabilization control
using the television source voltage detection means as
in the prior art, so that the power efficiency can be
improved since the dummy load resistor which consumes
some power is not used.

The invention will be described now by way of example only,
15 with particular reference to the accompanying drawings. In the drawings:

Fig. 1 shows a source voltage control
switching circuit in the first embodiment of the
invention;

Fig. 2 shows a source voltage control
20 switching circuit in the second embodiment of the
invention;

Fig. 3 shows a source voltage control
switching circuit in the third embodiment of the
invention;

25 Fig. 4 shows a source voltage control
switching circuit in the fourth embodiment of the
invention;

1 Fig. 5 shows a conventional source voltage control switching circuit; and

 Fig. 6 shows another conventional source voltage switching circuit.

5 Fig. 7 shows a power supply system block diagram toward a television receiver circuit and BS receiver circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

 Some embodiments of the source voltage control
10 switching circuit of the invention will be described with reference to Figs. 1 to 4.

 Fig. 1 shows the first embodiment of the invention. Referring to Fig. 1, there are shown an AC rectifying circuit 1, a power control IC 2, a rectifying
15 capacitor 3, a power source output MOSFET 4, a power transistor 5, a voltage control feedback photocoupler 6, a start register 7, a rectifying diode 8, a rectifying capacitor 9, a 18-V controlling constant voltage diode 10, rectifying diodes 11, 12, a relay 13 for turning a
20 140-V voltage source (television source voltage) on and off, rectifying capacitors 14, 15, a 140-V control error amplifying shunt regulator 16, a relay drive transistor 17, and resistors 18, 19. The operation of the first embodiment constructed above will be described below.

25 When the AC power supply is turned on, the power supply is actuated through the start resistor 7 so that voltages are induced in the secondary windings of

1 the transformer 5. At the same time, a high-level
signal in the television mode is supplied to the base of
the transistor 17, making the transistor 17 conductive
so that the relay 13 is energized. Therefore, in the
5 television receiving mode, the television source voltage
140 V and the BS source voltage 18 V are supplied to the
load side. At this time, the secondary output voltages
are controlled by use of the television source voltage
140 V. In other words, the voltage change from the 140-
10 V line through the resistor 19 is converted into a
current change by the error amplifying shunt regulator
16 and fed back to the power control IC 2 through the
photocoupler 6 so that the source voltage can be
stabilized.

15 In the BS timer recording mode, the base
voltage of the transistor 17 becomes low so that the
transistor 17 is nonconductive. Thus, the relay 13 is
deenergized. At this time, the error amplifying shunt
regulator 16 is disconnected from the 140-V line, and
20 thus no control current is flowed so that the secondary
output voltages are increased. When the secondary
voltages are increased, the primary drive voltage (the
voltage across the smoothing capacitor 9) is increased.
Thus, the constant voltage diode 10 becomes conductive
25 so that a current is flowed in the constant voltage
diode 10 (a diode which becomes conductive by about 5 %
increase is selected). The anode of this constant
voltage diode 10 is connected to the control terminal of

1 the power control IC 2. The secondary side voltages are controlled by this current.

When switching is made from the BS timer recording mode to the television mode, the transistor 17
5 is turned on to energize the relay 13 so that 140 V is supplied to the load side. At this time, since the anode voltage of the constant voltage diode 10 is decreased, it is suddenly turned off. The secondary side voltages are controlled by the 140-V error
10 amplifying regulator 16. In other words, when switching is made from the BS timer recording mode to the television mode, even though the discontinuous period in which the 140-V control current is not flowed is caused by chattering of relay or the like, the control current
15 is flowed in the constant voltage diode 10 so as to restrict the increase of the secondary side output voltage to within 5 %.

The second embodiment of the invention will be described with reference to Fig. 2.

20 In the second embodiment, the 18-V control voltage diode 10 in the first embodiment is inserted between the ②-pin and ground of the 140-V control error amplifying shunt regulator 16, so that the same effect as in the first embodiment can be achieved. The
25 detailed description is omitted.

The third embodiment of the invention will be described with reference to Fig. 3.

1 Referring to Fig. 3, in the television mode,
the low-level signal is supplied to the base of the
transistor 19, so that the transistor 19 is non-
conductive and that the transistor 18 is conductive.
5 Thus, the relay 13 is energized, permitting 140 V to be
supplied to the load side. At this time, since the
transistor 17 is nonconductive, the secondary side
voltages are controlled by use of the 140-V error
amplifying shunt regulator 16.

10 In the BS timer recording mode, the high-level
signal is supplied to the base of the transistor 19,
turning the transistor 19 on, but turning the transistor
18 off so that the relay 13 is deenergized. At this
time, since the transistor 17 is nonconductive, the
15 secondary side voltages are controlled by the constant
voltage diode 10.

When switching is made from the BS timer
recording mode to the television mode, the relay 13 is
energized, but the transistor 17 is nonconductive, so
20 that the secondary voltages are controlled by the 140-V
control error amplifying shunt regulator 16. At this
time, a delay circuit 20 is inserted at the base of the
transistor 17. This delay circuit absorbs the time lag
due to chattering time of relay 13 and switching time
25 difference, thus removing the control current dis-
continuous period, or preventing the secondary side
voltages from being abnormally increased upon switching.

1 The fourth embodiment of the invention will be
described with reference to Fig. 4. In Fig. 4, like
elements corresponding to those in Fig. 6 are identified
by the same reference numerals and will not be
5 described.

Fig. 4 is a circuit diagram of the converter
switching power supply for the BS tuner built-in
television receiver as the fourth embodiment of the
invention. Referring to Fig. 4, one end of the
10 secondary winding 32d of the power transformer 2 of
which the other end is grounded is connected through the
rectifying diode 42 and through the relay contacts 44a
to one end of the rectifying capacitor 43 with the other
end grounded, to one end of the volume control 49, and
15 to the television circuit, thus supplying source voltage
+ 130 V to the television circuit. The terminal 48a of
the error amplifying shunt regulator 48 is connected to
the other end of the volume control 49, and the terminal
48b thereof is connected to the cathode of a rectifying
20 diode 71. The anode of the rectifying diode 71 is
connected to the cathode of the photodiode of the
photocoupler 36 and to the collector of a shunt
regulator transistor 62. The terminal 48c of the error
amplifying shunt regulator 48 is connected to the
25 cathode of a rectifying diode 63 and to the collector of
a switching transistor 64. The anode of the rectifying
diode 63 is connected through a resistor 65 to the
cathode of a rectifying diode 40 and to the base of the

1 transistor 62. The emitter of the transistor 62 is grounded through a diode 66 and a constant voltage diode 67. The base of the transistor 64 is connected through a resistor 68 and a resistor 50 to the base of a relay drive transistor 51. The bases of the transistors 51 and 64 are supplied with the H-signal of the control signal in the television receiving mode and with the L-signal of the control signal in the BS timer recording mode.

10 The television source voltage detection means is formed of the error amplifying shunt regulator 48 and the volume control 49, and detects the error of the television source voltage. The BS source voltage detection means is formed of the transistor 62, the diode 66 and the constant voltage diode 67, and detects the error of the BS source voltage. The transistor 64 as the switching means is responsive to the control signal supplied to its base to switch to the stabilization control using the error of the television source voltage in the television receiving mode in which the television circuit and BS circuit are powered and to the stabilization control using the detection error of the BS source voltage in the BS timer recording mode in which the television circuit is not powered but the BS circuit is powered.

25 The operation of the converter switching power supply constructed above for the BS tuner built-in television receiver will be described below. When the

1 AC power supply is turned on, the MOSFET 39 is actuated
through the start resistor 33 and the power control IC
35 as power control means so as to make switching
operation. Thus, voltages are induced in the secondary
5 windings of the power transformer 32, and at the same
time the bases of the transistors 51 and 64 are supplied
with the H-signal of the control signal in the
television mode. The transistor 51 becomes conductive,
permitting the relay 44 be energized so that the
10 television source voltage + 130 V can be supplied
through the relay contacts 44a to the television
circuit. Therefore, in the television receiving mode,
the television source voltage + 130 V and the BS source
voltage + 18 V are supplied to the load side. At this
15 time, since the transistor 64 is also turned on, the
terminal 48c of the error amplifying shunt regulator 48
is grounded through the transistor 64. Thus, the
secondary output voltages are controlled by use of the
television source voltage + 130 V. In other words, the
20 voltage change supplied from the television source
voltage + 130 V through the volume control 49 to the
error amplifying shunt regulator 48 is converted into a
current change by the regulator and this current change
is fed through the photocoupler 36 back to the control
25 terminal of the power control IC 35, thus stabilizing
the secondary source voltages.

In the BS timer recording mode, the bases of
the transistors 51 and 64 are supplied with the L-signal

1 of the control signal and thus the transistors 51 and 64
are turned off. Therefore, the relay contacts 44a are
opened, disconnecting the television source voltage
+ 130 V from the television circuit on the load side.
5 As a result, only the BS source voltage + 18 V is
supplied to the BS circuit on the load side. At this
time, since the transistor 64 is nonconductive, the
error amplifying shunt regulator 48 is inoperative.
Thus, the secondary output voltages are controlled by
10 supplying the voltage change from the BS source voltage
+18 V line through the resistor 65 to the base of the
transistor 62. When the voltage change is supplied to
the base of the transistor 62, a current is flowed from
the transistor 62 through the diode 66 and the constant
15 voltage diode 67. In other words, the voltage change on
the BS source voltage + 18 V is converted into a current
change by the transistor 62, and the current change is
fed through the photocoupler 36 back to the control
terminal of the power control IC 35, thus stabilizing
20 the source voltage. Therefore, the stabilization
characteristic of the source voltage in the BS timer
recording mode can be greatly improved. Also, since the
television voltage source + 130 V line is disconnected
from the secondary winding by the relay contacts 44a
25 between the rectifying diode 42 and the rectifying
capacitor 43, the voltage across the rectifying
capacitor 43 becomes 0 V. Thus, the voltage on the
television source voltage + 130 V line can be prevented

- 1 from being increased.

According to the source voltage control switching circuit of the invention, when switching is made from the BS timer recording mode to the television mode, the discontinuous period of control current can be avoided from occurring, and the secondary output voltages can be prevented from being abnormally increased upon switching.

- Moreover, the stabilization characteristic of the source voltages can be maintained to be satisfactory and the power efficiency can be increased, both in the BS timer recording mode and in the television receiving mode.

CLAIMS:

1. A source voltage control switching circuit for
adjusting a control voltage in order to stabilize an
5 output voltage of a switch-mode power supply by
performing output voltage control using a television
source voltage as the control voltage in a television
receiving mode and using a BS source voltage which is
switched to during a BS timer recording mode requiring
10 light-load power, wherein:

a constant voltage diode is inserted in a primary
side of a transformer provided in a control circuit of
a power supply so as to effect voltage control at said
light-load powering time.

15

2. A source voltage control switching circuit for
adjusting a control voltage in order to stabilize an
output voltage of a switch-mode power supply by
performing output voltage control using a television
20 source voltage as the control voltage in a television
receiving mode and using a BS source voltage which is
switched to during a BS timer recording mode requiring
light-load power, wherein:

a constant voltage diode is inserted in a
25 secondary side of a transformer provided in a control
circuit of a power supply so as to effect voltage
control at said light-load powering time.



3. A source voltage control switching circuit for adjusting a control voltage in order to stabilize an output voltage of a switch-mode power supply by performing output voltage control using a television
5 source voltage as the control voltage in a television receiving mode and using a BS source which is switched to during a BS timer recording mode requiring light-load power, wherein:

a constant voltage diode is inserted in a
10 secondary side of a transformer provided in a control circuit of a power supply, and there are provided a switching circuit for turning said constant voltage diode on and off and a delay circuit for decreasing the switching speed of said switching circuit.

15

4. A source voltage control switching circuit for stabilising output voltages substantially as hereinbefore described with reference to and as shown in any one of Figs. 1 to 4 of the accompanying
20 drawings.