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U1S S2106 S2206

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GB 2257338 A **GB 2105929 A** **WO 92/17934 A2**

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INT CL^{5} **H02M 3/325 3/335 3/337 , H04N 3/18 5/63**

(54) **Switch mode power supply circuit**

(57) To ensure that a sufficient base current is provided for the power transistor TP10 of a switch mode power supply, circuit means are provided ensuring that, after switching the supply from OFF mode or from Standby mode to normal ON mode, a charging capacitor CP05 is fully charged before the switching voltage Us appears at the base of the power transistor. The charging capacitor CP05 is continuously charged during Standby mode. The circuit is switchable between OFF mode, Standby mode and normal ON mode by a microcontroller IR01. A circuit (Fig 2) prevents operation of the power transistor of an undervoltage across a capacitor CP41 is determined by a zener diode (DR04) and transistor circuit (TR05, TR04). Alternatively, a delay circuit (Fig 3) is provided for introducing a delay time between switching ON the circuit and the occurrence of the switching voltage US at the base of said power transistor TP10. A circuit (Fig 4) is described which provides proper power up of the microcontroller IR01. The power supply can be used for a TV receiver or video recorder.

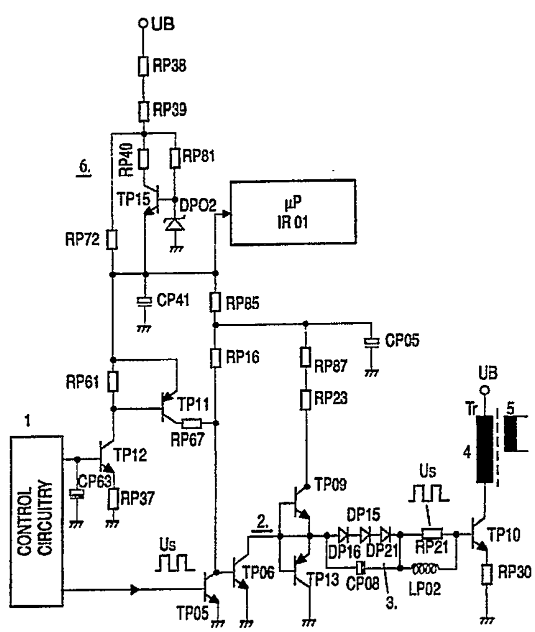

Fig.1

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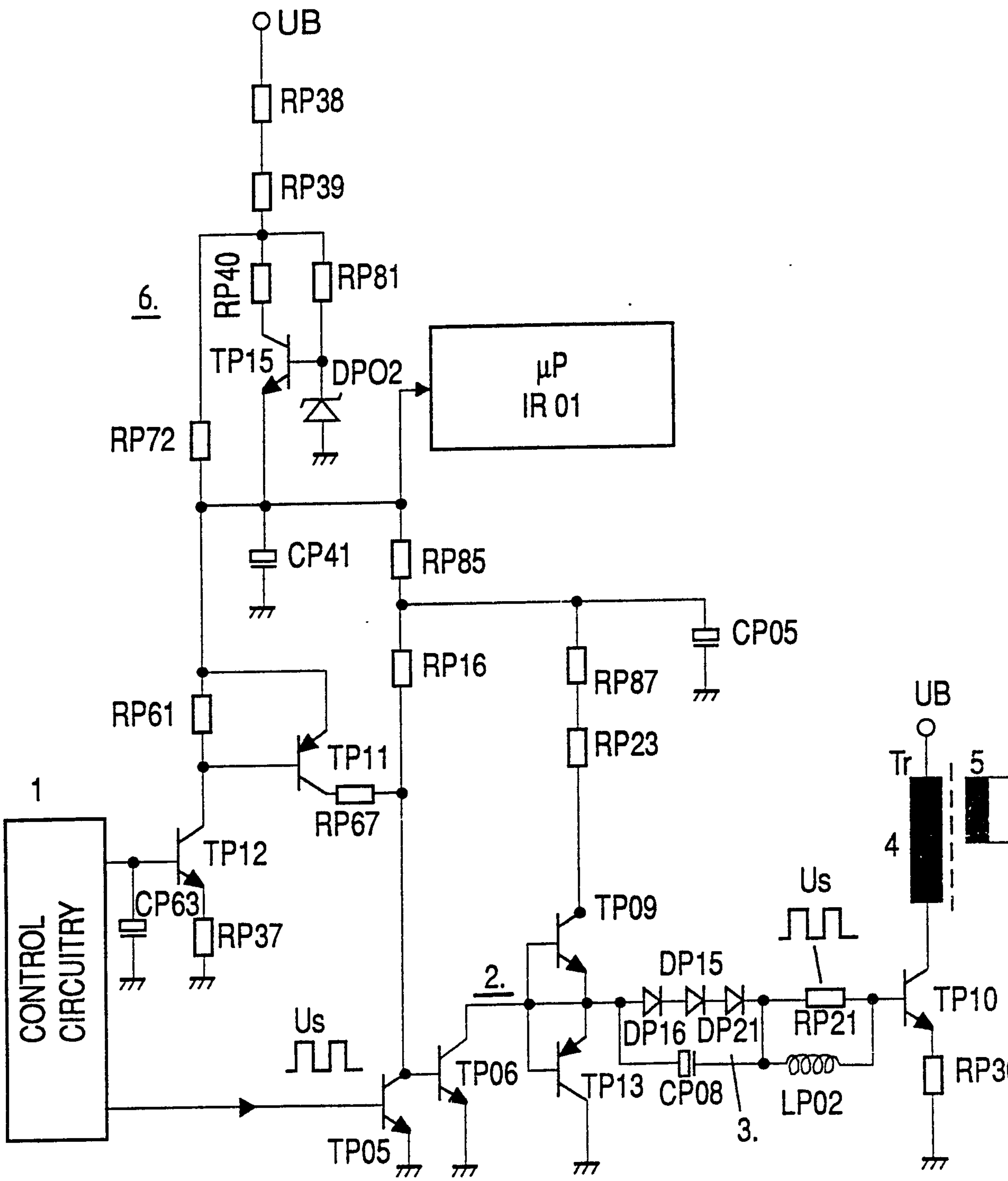
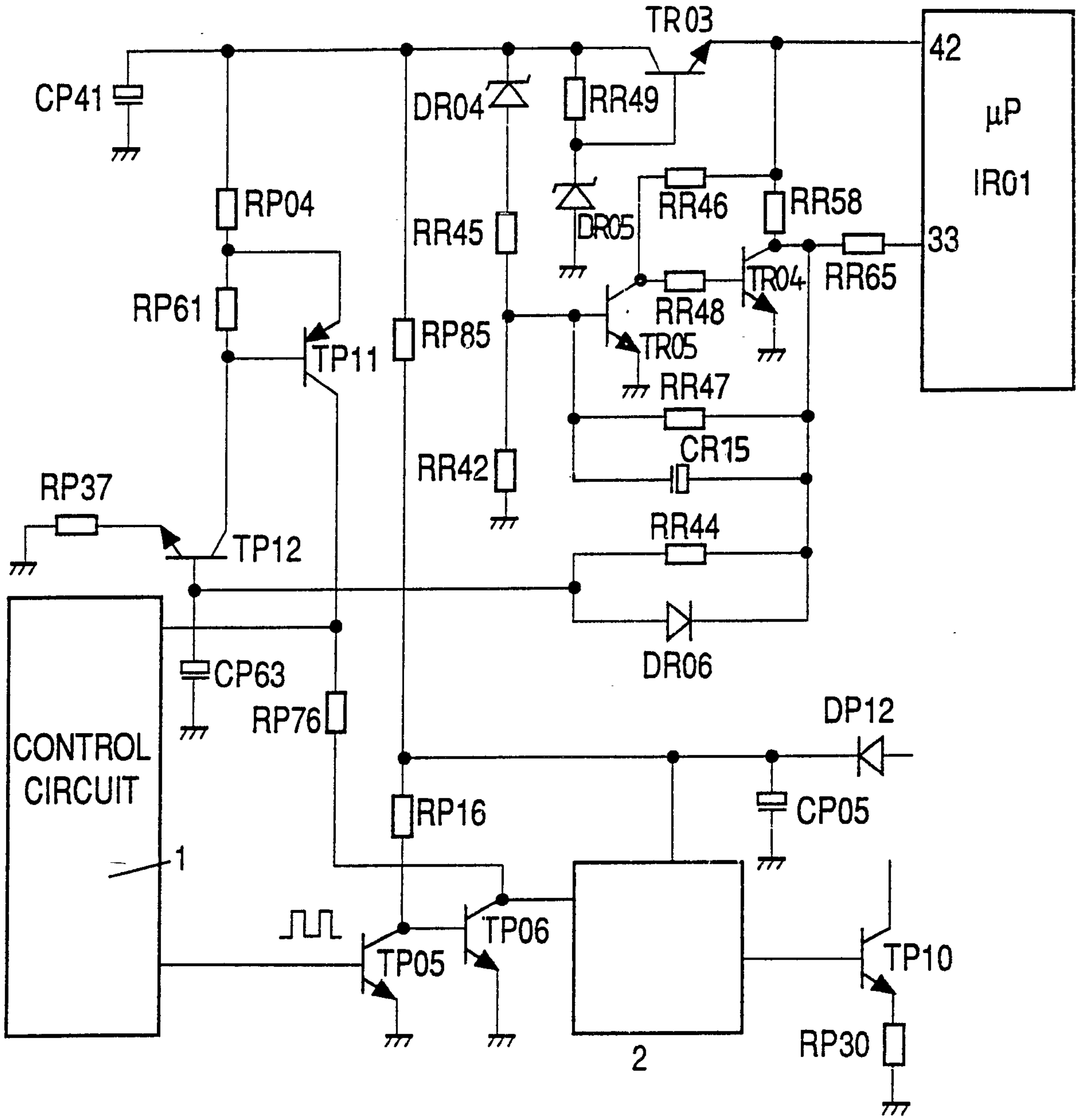

UB
RP38
RP39
RP40
RP81
6.
TP15
DPO2
μP
IR 01
RP72
CP41
RP85
CP05
RP16
RP87
UB
RP61
TP11
RP23
Tr
5
1
RP67
4
TP12
Us
CONTROL
CIRCUITRY
CP63
RP37
TP09
DP15
2.
TP10
Us
DP16
DP21
RP21
TP06
TP13
CP08
RP30
LP02
TP05
3.

Fig.1



TR03
42
µP
IR01
33
CP41
RP04
RP61
TP11
DR04
RR49
DR05
RR46
RR58
RR45
TR04
RR65
RP85
RR48
TR05
RR47
CR15
RR42
RP37
TP12
RR44
DR06
CP63
RP76
CONTROL
CIRCUIT
1
DP12
RP16
CP05
TP06
TP05
TP10
RP30
2

Fig.2

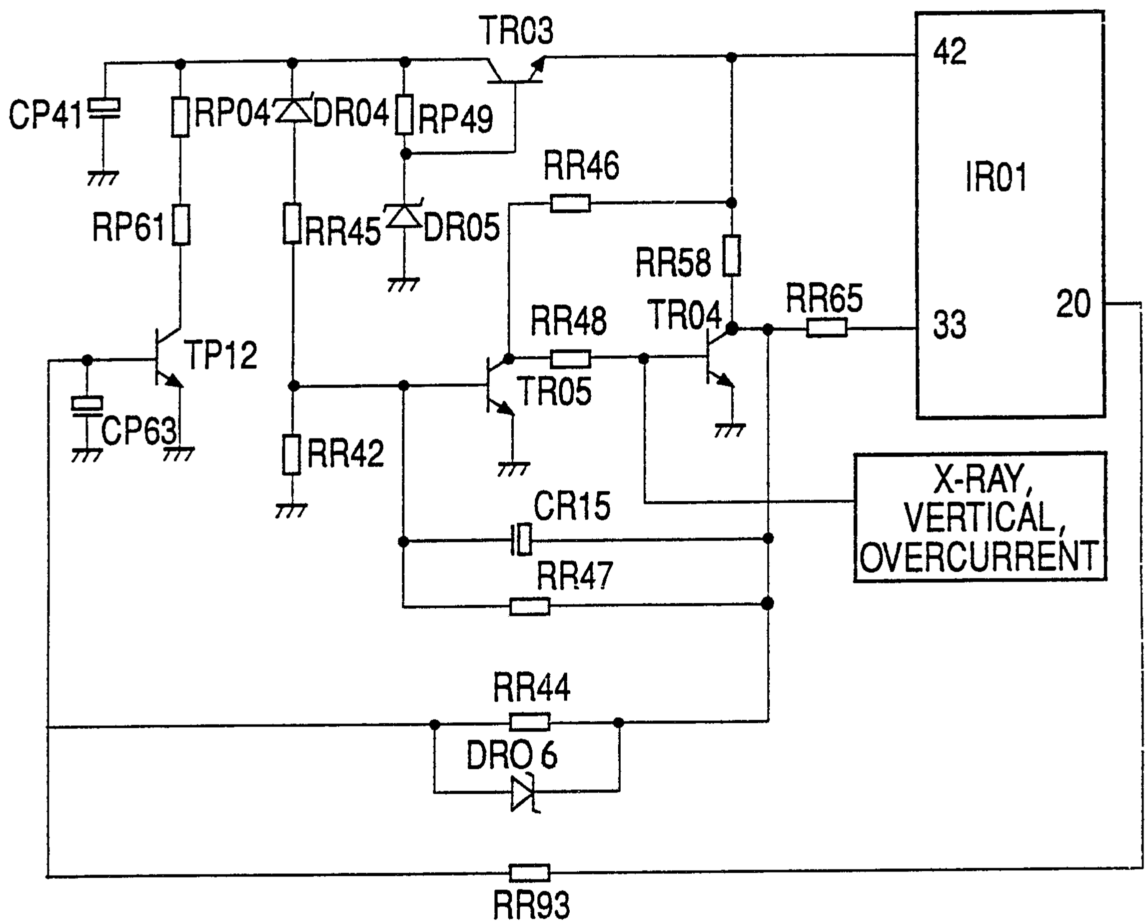

TR03
42
CP41
RP04
DR04
RP49
RR46
IR01
RP61
RR45
DR05
RR58
RR65
20
RR48
TR04
33
TP12
TR05
CP63
RR42
X-RAY,
VERTICAL,
OVERCURRENT
CR15
RR47
RR44
DRO 6
RR93

Fig.3

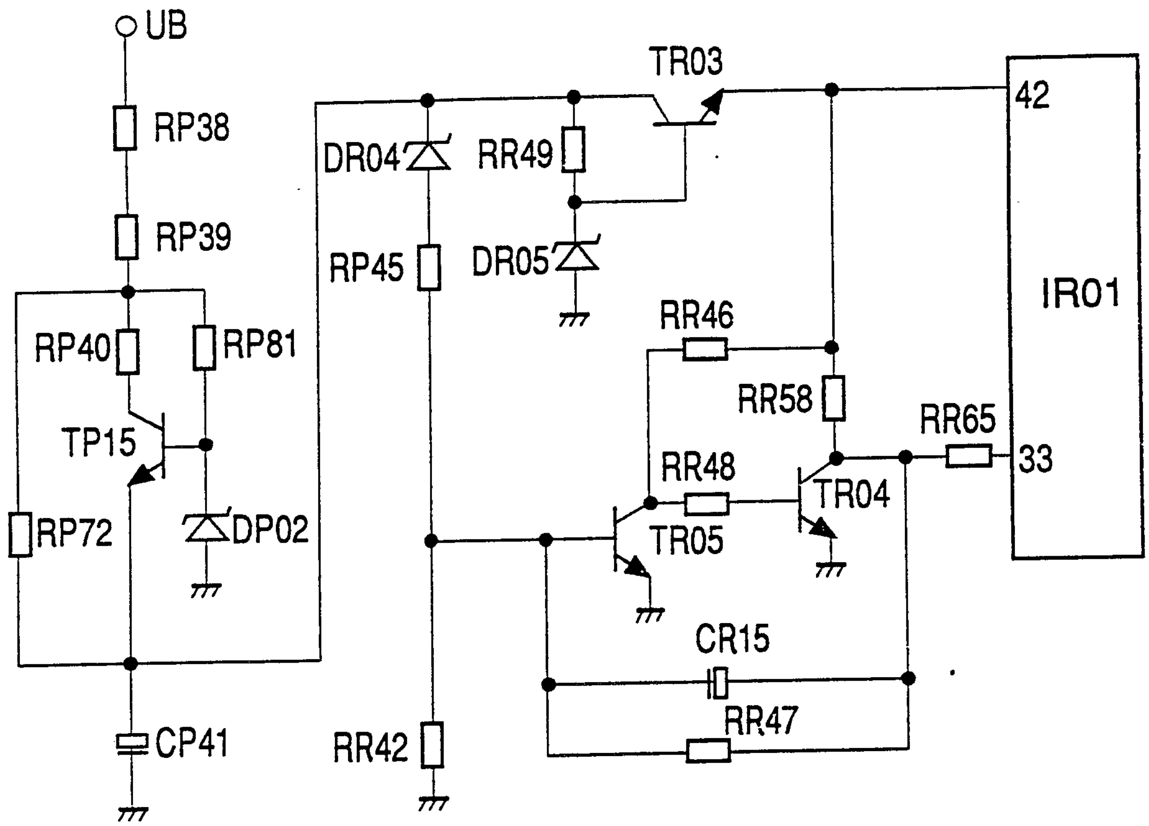

UB
RP38
RP39
RP40
RP81
TP15
RP72
DP02
CP41
TR03
DR04
RR49
DR05
RP45
RR46
RR58
RR65
RR48
TR04
TR05
CR15
RR47
RR42
IR01
42
33

Fig.4

Switch mode power supply circuit

The invention relates to a switch mode power supply circuit according to the introductory part of claim 1. Such circuits generally are used in TV receivers and video recorders.

Within circuits of this art the following requirement does exist. To ensure that said power transistor is fully turned on, the current flowing into the base must be sufficiently large. Said charging capacitor acts as a reservoir of charges to supply the necessary base current. That means most current for the control of said power transistor is sourced from said charging capacitor. Hence, the charges stored in this charging capacitor are vital for the reliability of the power supply. Insufficient charge will result in insufficient turning ON of said power transistor. With insufficient base current, said power transistor will not be in the saturation region resulting in reduced reliability and at times immediate destruction. With respect to said requirement circuits according to prior art used up to now suffer from the following disadvantages:

1) Before the capacitor is fully charged up, the pulse train appears at the collector of the power transistor and starts to toggle said transistor ON. The base current depends heavily on the stored charges on said charging capacitor as the current from the collector of driving transistor will not be able to react and provide sufficient base current. Moreover, during start up, there is no current feeding back from the secondary winding of the transformer via a diode to provide the necessary base current. The base current depends largely on the stored charges in the capacitor.
2) When the set is switched from STAND-BY to ON, current from the collector of the driving transistor is supplied to many paths. This includes :
   - the oscillator circuit for generating the sawtooth waveform
   - the micro-controller
   - further transistors and resistors of the circuit.

This reduces the amount of current required to charge up said charging capacitor.

3) If the set is safely turned ON, the base current is largely supplied by a current feedback through a diode. However, in the event that the protection circuit is activated, there is no current feedback via said diode to charge up said charging capacitor. This again poses a problem. When the protection circuit is activated and the power supply shuts down, the fault signal disappears. In the absence of the fault signal, the power supply attempts a restart. Once restarted, the fault signal appears again and the power supply shuts down once more. This process, known as "hiccuping", induces great "stress" to the power supply and goes on forever until the set is switched OFF or some major components (especially the power transistor) are damaged. This invention ensures that the latter does not happen and even if it does, it is extremely rare.
In the previous circuit, during the hiccuping process, said charging capacitor will not be fully charged up. In the absence of the feedback current via said diode, the only current source is via a further resistor. However, as mentioned above, due to the many current paths common to the charging path of the charging capacitor, this capacitor will not be sufficiently charged before the fault signal disappears and the pulse train appearing at the collector of the driving transistor to attempt a restart i.e. turning the power transistor ON. As the "hiccuping" goes on, the amount of charge accumulated across said charging capacitor depends on the capacitance of said capacitor and a resistor and the interval of "hiccuping". Of course, if the capacitance of the charging capacitor is reduced, said capacitor can be fully charged up but then the stored charges will be less and the capacitor will not be able to provide the base current for a sufficient duration to turn on said power transistor.

It is an object of the present invention to modify said switch mode power supply circuit in such a way that said disadvantages are avoided ensuring that under all conditions like switching from OFF to STAND-BY or from STAND-BY to ON or during repeatedly turning OFF and ON the receiver as well as during operation of the protection circuit proper controlling of the power transistor is achieved.

According to the invention circuit means are provided ensuring that after switching the supply from OFF mode or from STAND-BY mode to normal ON mode said charging capacitor is fully charged before said switching voltage appears at the base of said power transistor.

By using the invention the following major advantages are achieved.

1) The invention on the power up circuit allows the micro-controller to be properly powerup at the "STAND-BY" mode.
2) The invention on the power up circuit creates a delay to allow a further capacitor whose role is similar to said charging capacitor to charge up fully before the set can be switched from STAND-BY to ON.
3) The invention allows charging capacitor to be fully charged up in the STAND-BY mode instead of beginning to charge up when the TV is switched ON. This ensures said capacitor to be fully charged up before the pulse train appears at the collector of said driver transistor and attempts to switch the power transistor ON.
4) The invention allows a larger charging capacitor (470μF) by limiting the number of current paths when said capacitor is charged without any feedback current via said mentioned diode. This allows more stored charges and hence ensures sufficient base drive at all times.

In addition to the above advantages, the interaction between the power up circuit and the start-up circuit creates further gains :

1) Acts as an under voltage protection. This is useful as it prevents any attempt to turn the power supply on when the voltage across the charging capacitor is too low. A low voltage across said capacitor signifies insufficient stored charges and hence will not be able to maintain the base current to drive the power transistor ON for sufficient turn on duration.
2) Provides a delay when the TV is continuously switched from STAND-BY to ON.
3) Provides a delay when the hiccuping process is in order. This delay allows the charging capacitor to be fully charged and enhances the reliability of the power supply.

According to one embodiment of the invention the charging capacitor is continuously charged during STAND-BY mode. In this embodiment current supplied to the driver circuit remains cut off during STAND-BY mode. According to another embodiment of the invention a delay circuit is provided for introducing a delay time between switching ON the circuit and the occurrence of the switching voltage at the base of said power transistor. Delay means may be associated to a micro-controller controlling switching of the power transistor in such a way that said charging capacitor is fully charged up before said micro-controller is powered up and ready to accept command from the user.

In order that the invention may more clearly be understood, several embodiments of the invention are more fully described, reference being made to the drawing. Within the drawing:

Fig. 1 shows a switch mode power supply circuit including the invention,

Fig. 2 shows a proper interrupt of the micro-controller operation and undervoltage protection,

Fig. 3 shows a delayed start up when the power supply is switched from STAND-BY to ON and

Fig. 4 shows a proper power up of the micro-controller.

Fig. 1 shows a switch mode power supply circuit including control circuit 1 providing switching voltage Us which is fed via driver circuit 2 and base network 3 to the base of power transistor TP 10 which is connected via primary winding 4 of transformer Tr to operating voltage UB. Secondary winding 5 of transformer Tr provides via a rectifier an operating voltage. Generally several secondary windings 5 are provided for generating operating voltages of different amplitudes and polarities.

Main current source for driver circuit 2 is constituted by charging capacitor CP05 connected via circuit 6 to operating potential UC. In the following the operation of the circuit shown is described.

When the television set is plugged into the mains, the charging capacitor CP05 will charge up via resistor RP38, RP39, RP40, RP72, transistor TP15 and resistor RP85. During this time, other than supplying current to the micro-controller IR01 and charging up the capacitor CP05, the only other current path is via the resistor RP16 to turn on the transistor TP06. Since the set is at STAND-BY mode, the transistor TP12 is OFF and no current will flow through the resistor RP61. Hence the transistor TP11 is OFF. It is necessary to turn on the transistor TP06 to switch off the transistor TP09 and turn on the transistor TP13. The transistor TP09 and TP13 form the push-pull drive circuit of the power transistor TP10. When the transistors TP09 and TP13 are at these states, there is no base current to turn on the transistor TP10, which means power supply is off. Current is unable to flow via the resistors RP87, RP23, transistors TP09, diodes DP15, DP16, DP21 and the inductor LP02 to turn on the transistor TP10. This current path which forms the base drive current for the transistor TP10 consumes a large current. By curtailing this current path at this stage, most of the current that flows through the resistor RP38, RP39, RP40, RP72 and TP15 is used in charging up the capacitor CP41 to supply the micro-controller IR01 associated circuitries and to charge up the capacitor CP05 through the resistor RP85 (as the current flowing through the resistors RP85 and RP16 to turn on the transistor TP06 is relatively small). Since the major current load (the base drive of the transistor TP10) is removed, the capacitor CP05 can be made large to store high amount of energy and yet be fully charged up before the micro-controller IR01 completes its power up as mentioned in Part a) above. It is necessary to charge up the capacitor CP05 with large amount of energy well before the micro-controller is properly powered up and ready to accept command from the user. This is because when the user switches the set from STAND-BY to ON, the transistors TP12 and TP11 are turned ON and a train of pulses will appear at the base of the transistor TP05. This train of pulses will toggle the transistor TP05 ON and OFF. When the transistor TP05 turns on, the transistor TP06 will be turned off and vice versa. The turning off of the transistor TP06 will cause current to flow via the transistor TP11 and resistor RP76 to turn on the transistor TP09 and turn off the transistor TP13. Current then flows through the resistor RP87, RP23 and the transistor TP09 to turn on the transistor TP10. During the first few cycles of the pulse train appearing at the base of the transistor TP05, the major energy source that forms the base drive current of the transistor TP10 comes from the stored energy in the capacitor CP05. It is, therefore, important that the capacitor CP05 is fully charged up and has stored sufficient energy before the pulse train appears at the base of the transistor TP05. In other words, the capacitor CP05 must be fully charged with large amount of energy before the power supply turns on. In case the capacitor CP05 is not fully charged or has not stored sufficient energy when the power supply is turned on, there will be insufficient energy to provide the base drive current which flows via the resistors RP87, RP23, diodes DP16, DP15, DP21 and the inductor LP02 to turn on the power transistor TP10. The transistor TP10 is then not operating in saturation mode for the duration that the transistor TP09 is in the ON state and transistor TP10 can be damaged.

In summary, this invention overcomes the problem of insufficient base drive current during power supply start-up by:

i) Providing sufficient time delay between the mains on and the power supply operation. This allows the capacitor CP05 to be fully charged before it is made to supply the base current for the transistor TP10.

ii) Charging the capacitor CP05 continuously during TV STAND-BY mode and with the input socket plugged into the mains. Hence, the capacitor CP05 can react immediately to supply the energy necessary to start-up the power supply.

iii) Providing sufficient current to charge up the capacitor CP05 by limiting the number of loads to the input. This is mainly achieved by cutting off the current supplied to the base drive of the transistor TP10 during STAND-BY mode

iv) Using a large capacitance (470µF) for the capacitor CP05 to store sufficient energy.

Fig. 2 shows a circuit according to Fig. 1 with additional circuit means for proper interrupt of the micro-controller IR01.

At STAND-BY or normal operation, if the voltage across the capacitor CP41 drops due to some faults, the voltage at the emitter of the transistor TR03 will also drop when the voltage across the capacitor CP41 falls below the voltage necessary to maintain the breakdown voltage of the zener diode DR05. The voltage at the output of the emitter is tied to pin 42 of the micro-controller IR01. This voltage should be maintained between 4.5 volts to 5.5 volts for proper operation of the micro-controller IR01. The micro-controller, IR01 should cease all program executions before the supply voltage at pin 42 of the micro-controller IR01 drops below 4.5 volts. This can be done by pulling the reset pin 33 of the micro-controller IR01 from the initial high to low level. This feature is incorporated into the invention. When the voltage across the capacitor CP41 falls to about 6.0 volt, the voltage at pin 42 of the micro-controller IR01 is still 5 volt but the transistor TR05 will be turned off. This is due to insufficient current flowing through the zener diode, DR04 and the resistor RR45 and insufficient feedback current via the resistors RR58 and RR47 to turn the transistor TR05 ON. When the transistor TR05 turns OFF, current will flow via the resistors RR46 and RR48 to turn the transistor TR04 ON. This, in turn, pulls the reset pin 33 of the micro-controller IR01 low as it is tied to the collector of the transistor TR04 via the resistor RR65. When the rest pin 33 of the micro-controller IR01 is pulled low, the micro-controller IR01 will stop all command executions, i.e. the micro-controller goes into RESET.

With the above feature, this invention can be used as an under voltage protection. When the transistor TR04 is turned on, the capacitor CP63 will discharge immediately via the diode DR06 and the transistor TR04 to ground. When this occurs, the transistor TP12 will be turned OFF. The turning OFF of the transistor TP12 prevents the train of pulses from appearing at the base of the transistor TP05 causing the transistor TP05 to be in the OFF state. The transistor TP06 will then be turned ON by the current flowing via the resistors, RP85 and RP16. When the transistor TP06 is ON, there will be no base drive current supplied to the transistor TP10. This effectively shuts off the power supply. This under voltage protection is useful to detect faults that cause the voltage across the capacitor CP41 to fall. It is especially useful when a fault occurs while the power supply is on. A fault will greatly reduce the current flowing through the diode DP12 and so the capacitor CP05 is unable to be charged up through this path. However, a current which is larger than normal will flow via the resistor RP85 to charge up the capacitor CP05 and provide the base drive current of the transistor TP10. This will cause the voltage across the capacitor CP41 to fall. When the voltage falls to 6 volt, the power supply will shut OFF as described above. This shutdown is necessary to ensure that the capacitor CP05 is not devoid of the amount of energy necessary to provide the base drive of the transistor TP10. If this is not prevented, insufficient base drive will occur and the transistor TP10 will be damaged.

Fig. 3 shows a circuit with delayed start up when the power supply is switched from STAND-BY to ON. The operation of this circuit is the following:

When the TV set is turned from ON to STAND-BY, pin 20 of the micro-controller IR01 switches from high to low. The capacitor CP63 will then discharge via the resistor RR93. As such, the transistor TP12 will turn OFF. With the transistor TP12 in the OFF state, there will be no train of pulses at the base of the transistor TP05 causing the transistor TP05 to be permanently OFF. With the transistor TP05 in the OFF state, the transistor TP06 is turned on and there is no base drive current to the transistor TP10. The power supply is, therefore, OFF. When the set is turned from STAND-BY to ON, pin 20 of the micro-controller IR01 will be high. However, the train of pulses will not appear immediately at the base of the transistor TP05 to turn on the power supply until the capacitor CP63 is charged to the voltage level sufficient to turn on the transistor TP12. The capacitor CP63 will charge up via the resistors RR58 and RR44 according to the time constant which is equal to the sum of the resistance of the resistor RR58 and RR44 times the capacitance of the capacitor CP63. This slow charging of the capacitor CP63 and hence the delay in turning the transistor TP12 ON which subsequently delays the starting up of the power supply provides the necessary time for the capacitor CP05 to regain its full energy through the process. This feature is especially critical when the user presses the ON/OFF key continuously. If this function is absent, the power supply will turn-on too quickly without having sufficient time for the capacitor CP05 to charge up. This results in insufficient base drive to the transistor TP10 and may result in catastrophic failure of the power supply.

Fig. 3 partly incorporates protections relating to sufficient delay time when X-ray, vertical or over-current protection is activated. When any of the protection is activated, the transistor TR04 is turned on. The reset pin 33 of the micro-controller IR01 will be pulled from high to low state immediately as this pin is tied to the collector of the transistor TR04 via the resistor RR65. This instantaneous change from high to low will result in the micro-controller IR01 to suspend any further execution of instructions immediately. At the same time, the positive terminal of the capacitor CR15 is tied to ground. The negative terminal of the capacitor CR15 is then negative (-5 volts) with respect to the ground potential. This -5 volts reverse biases the transistor TR05 and switches it OFF. Current then flows via the resistors RR46 and RR48 to further turn ON the transistor TR04. At the same time, the capacitor CP63 will discharge immediately via the diode DR06 and the transistor TR04 to ground. The transistor TP12 then switches OFF and the train of pulses disappears from the base of the transistor TP05. This shuts OFF the power supply. As such, the power supply will shut OFF immediately when a fault (X-ray, vertical or over current) occurs. When the power supply is OFF, the fault condition will disappear. However, the transistor TR04 will remain ON for a while because of the current flowing via the resistors RR46 and RR48. Also, the transistor TR05 remains in the OFF state until the negative terminal of the capacitor CR15 is charged up from -5 volt to about 0.6 volt (via the diode DR04 and resistor RR45) to turn the transistor TR05 on again. Once the transistor TR05 is turned on, the transistor TR04 will be turned-OFF. Current will then flow to charge up the capacitor CP63 via the resistors RR58 and RR44. When the capacitor is charged up sufficiently, the transistor TP12 will turn ON and a pulse train will reappear at the base of the transistor TP05. This turns the power supply ON. When the power supply is restarted, a fault condition will again be detected (if the fault has not been removed yet) and the whole cycle of shutdown and restart occurs again. However, as mentioned above, the shutdown is immediate but the restart is slow. This continuous "hiccup" of the power supply with quick shutdown and long delay before restart is necessary for the overall reliability of the set and safety of the consumer. For example, if :

i) The X-radiation protection is activated.
This circuit will allow the set to shutdown immediately to prevent the consumer from being exposed to excessive radiation. A long delay before start-up allows the capacitor CP05 to charge up sufficiently to ensure the reliability of the power supply as well as to reduce the amount of radiation. Once the power supply is restarted without isolating the fault, it will again be shutdown immediately. During this "hiccuping" sequence, no raster will appear on the television screen. Hence the radiation is greatly reduced.

ii) The vertical protection is activated.
This circuit allows the immediate shutdown of the television set and prevents greater damage to the television set. During the "hiccuping" process (before the fault is removed), the capacitor CP05 is fully charged which prevents further damages to the set.

iii) The over current protection is activated.
This circuit allows the immediate shutdown of the power supply and hence limits any damages to the television set. During the "hiccuping" process before the isolation of the fault, the long turn off time before the power supply attempts a restart allows the capacitor CP05 to be sufficiently charged up and reduces the stress on the transistor TP10.

Fig. 4 shows a circuit with proper power up of the micro-controller IR01. Operation is the following:

When the television set is plugged into the mains, the capacitor CP41 will charge-up via the resistor RP38, RP39, RP40, RP72 and the transistor TP15. While charging up, current will flow via the resistor RR49 and diode DR05 to ground. This turns the transistor TR03 ON and the voltage at the emitter of the transistor TR03 rises to 5 volt. During this time, current will also flow through the resistor RR46 and RR48 to turn on the transistor TR04. The reset pin (pin 33 of the micro-controller IR01) is then low as it is tied to the collector of the transistor, TR04 via the resistor, RR65. When the voltage across the capacitor CP41 is 7.6 volts, the voltage at pin 42 of the micro-controller IR01 (which is tied to the emitter of the transistor TR03) has stabilised to 5 volt. This is required as the micro-controller is designed to operate with the voltage at pin 42 of 4.5 volt to 5.5 volt. When the voltage at CP41 reaches 7.6 volt, sufficient current will flow via the diode DR04 and the resistor RR45 to charge up the capacitor CR15. This capacitor CR15 with its positive terminal tied to the collector of the transistor TR04 (which is at the ON state) will have its negative terminal charged to about 0.6 volt and turns on the transistor TR05. Once the transistor TR05 turns on, the current flowing through the resistor RR48 is shunted to ground via the transistor TR05. This cut OFF the base current through the transistor TR04 and turns the transistor TR04 OFF. Current then flows through RR58 to charge up the positive terminal of the capacitor CR15 with time constant equal to the resistance of the resistor RR58 times the capacitance of the capacitor CR15. Since the reset pin 33 of the micro-controller IR01 is tied to the positive terminal of the capacitor CR15 via the resistor RR65, the reset voltage will also rise smoothly to and maintained at 5 volt. This smooth rise time is necessary for the proper power-up of the micro-controller IR01. After this, the micro-controller will start to function and accept command from the user.

In one practical embodiment of the invention the components shown in the figures 1-4 have the following values:

DP16 - Diode type, 1N4001	RR49 - Resistor, 1.2 kohms
DP21 - Diode type, 1N4001	RR46 - Resistor, 10 kohms
DR06 - Diode type, 1N4148	RR58 - Resistor, 3.3 kohms
DP15 - Diode type, 1N4001	RR48 - Resistor, 10 kohms

DP12 - Diode type, BA157
DR04 - Zener diode, ZPD6V8
DR05 - Zener diode, ZPD5V6
CP05 - Capacitor, 470μF
CP63 - Capacitor, 47μF
CP41 - Capacitor, 1000μF
CR15 - Capacitor, 4.7μF
RP38 - Resistor, 680 ohms
RP39 - Resistor, 220 ohms
RP40 - Resistor, 680 ohms
RP72 - Resistor, 12 kohms
RR45 - Resistor, 3.3 kohms
RP76 - Resistor, 1.2 kohms
RR93 - Resistor, 680 ohms
RP87 - Resistor, 4.7 ohm
RP23 - Resistor, 5.6 ohms
P85 - Resistor, 220 ohms
RRP16 - Resistor, 10 kohms
RR65 - Resistor, 10 kohms
RR47 - Resistor, 33 kohms
RP61 - Resistor, 3.3kohms
RR44 - Resistor, 8.2 kohms
TP15 - Transistor, S1836
TP11 - Transistor, BC558C
TP12 - Transistor, BC548C
TP05 - Transistor, BC548C
TP06 - Transistor, BC548C
TP09 - Transistor, BC337
TP13 - Transistor, BD4340
TP10 - Transistor, S2000A3
TR03 - Transistor, BC548B
TR04 - Transistor, BC548C
TR05 - Transistor, BC548C
LP02 - Inductor, 6μH
IR01 - Micro controller ST6497

Claims

1. Switch mode power supply circuit including a power transistor (TP10) which during ON mode periodically is switched ON and OFF by a switching voltage fed via a driver circuit (2) to the base of said transistor (TP10), further including a charging capacitor (CP05) connected to a charging path and providing operating voltage for said driver circuit, said circuit being switchable between OFF mode, STAND-BY mode and normal ON mode by a micro-controller (IR01), **characterized in that** circuit means are provided ensuring that after switching the supply from OFF mode or from STAND-BY mode to normal ON mode, said capacitor (CP05) is fully charged before said switching voltage appears at the base of said power transistor (TP10).

2. Circuit according to claim 1, **characterized in that** the charging capacitor (CP05) is continuously charged during STAND-BY mode.

3. Circuit according to claim 2, **characterized in that** during STAND-BY mode current supplied to the driver circuit remains cut OFF.

4. Circuit according to claim 1, **characterized in that** a delay circuit is provided for introducing a delay time between switching ON the circuit and the occurrence of the switching voltage (Us) at the base of said power transistor (TP10).

5. Circuit according to claim 1, **characterized in that** delay means are associated to a micro-controller (IR01) controlling switching of the power transistor (TP10) in such a way that said charging capacitor (CP05) is fully charged up before said micro-controller (IR01) is powered up and ready to accept command from the user.

6. Circuit according to claim 1, **characterized in that** the value of said charging capacitor (CP05) lies in the order of 500µF.

7. A switch mode power supply circuit substantially as herein described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 -16-
(The Search report)

Application number
GB 9321583.8

Relevant Technical Fields

(i) UK Cl (Ed.M) H2F (FCTV, FMDRS, FMDRT, FMDRX, FMDXS, FMDXT, FMDXX, FPC)

(ii) Int Cl (Ed.5) H02M (3/325, 3/335, 3/337) H04N (3/18, 5/63)

Search Examiner
B J EDE

Date of completion of Search
7 JANUARY 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-7

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2257338 A	(THOMSON) see C5, 60, Q1, Figure 1	1
A	GB 2105929 A	(RCA) see page 2, lines 82-88, page 3, lines 72-74	1
A	WO 92/17934 A2	(DEUTSCHE THOMSON) see Figure 5	1

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