



Tianfeng Science & Technology

# YinXin Electronic.,Ltd

## Data Sheet

**TFC718 Switching Power Supply Controller**

**TFC Micro-Elec.**



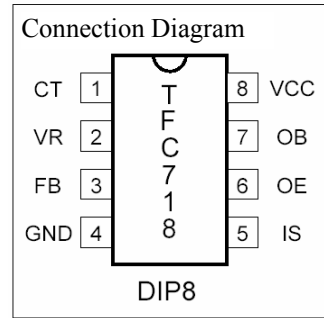
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### Brief Introduction

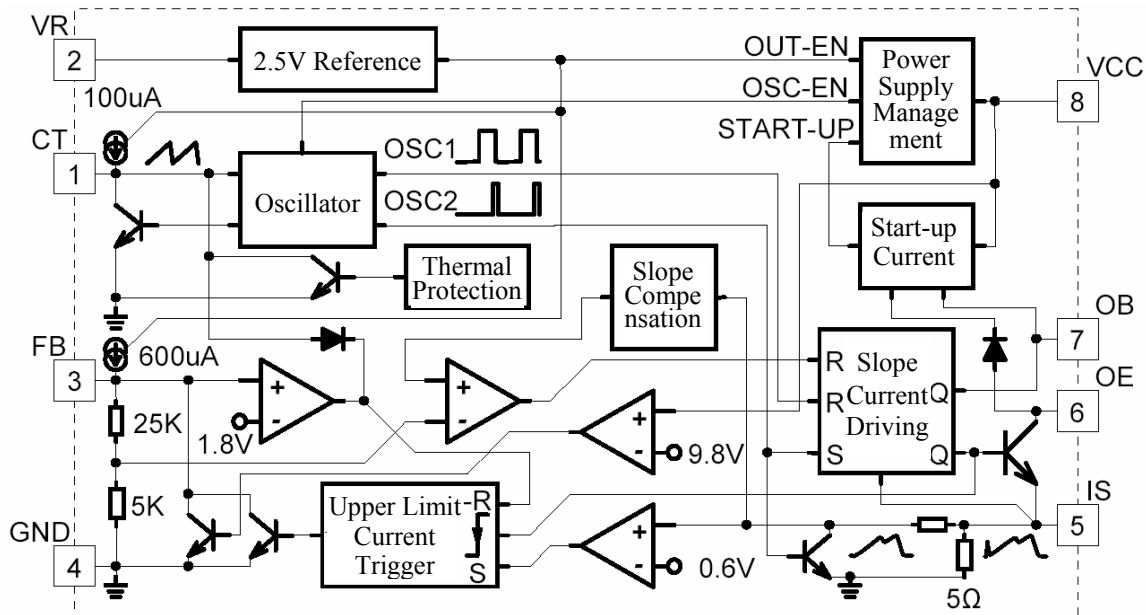
Being manufactured with bi-polar process, and by using advanced anti-overload and anti-saturation technology, and being a switching power supply controller capable of satisfying higher standard for environment protection, TFC718 is applicable for economic type of switching power supply devices such as DVD player, set-top box, fax machine, printer, LCD display, and etc.



### Features

- Being designed with advanced anti-overload and anti-saturation technology, capable of timely preventing failures such as overload, saturation of the switching transformer, output short circuit and etc.;
- Using built-in power triode as the switching tube, and at the same time completing the start-up by using its amplifying capability to reduce the power consumption of the start-up resistor more than ten times;
- Built-in slope compensation circuit, thermal protection circuit and slope current driving circuit;
- Standby power consumption is below 0.3W, when inputs with 220V AC the standby consumption may be below 0.2W.

### Block Diagram



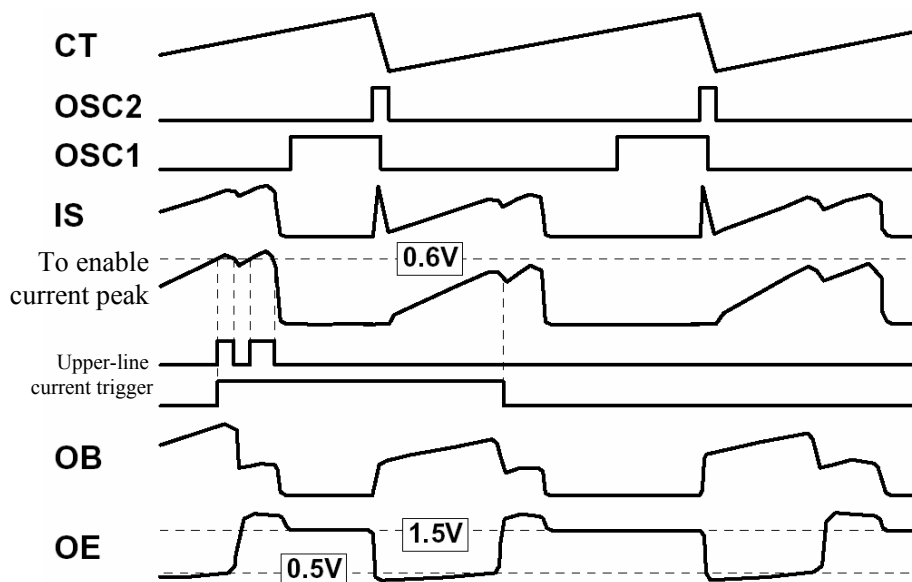
### Description of Connection Pins

Pin	Symbol	Pin Description
1	CT	Oscillator C input pin.
2	VR	2.5V reference output pin
3	FB	Feedback input pin
4	GND	Ground pin
5	IS	Current input pin of the power tube
6	OE	Emitter driving output pin of the power tube, and enabling current input pin
7	OB	Base driving output pin of the power tube, and enabling current control pin
8	VCC	Positive power supply pin



## Description of the Operating Principle

- In the enabling stage, when power is on, VR has no output, the pull-up current source FB is closed; the power tube inputs enabling current from OE to VCC, OB controls the base current of the power tube, limits the collector current of the power tube (i.e. TFC718 enabling reception current), so as to ensure the safety of the power tube; when VCC voltage raises up to 8.8 V, the enabling stage ends and it goes into the normal stage.
- In the normal stage, VCC voltage should be maintained at 4.75V to 9.8V, VR outputs 2.5V reference; FB pull-up current source is opened; the oscillator output OSC1 decides the maximum duty ratio, output OSC2 tries to trigger the power into open period, and the screened power tube turns on the current peak; if FB is below 1.8V (approximately between 1.2V and 1.8V), the oscillator period will then get wider until the stop of the oscillator (this feature will lower the stand-by power consumption of the switch power source); if the external feedback intends to make VCC higher than 9.8V, the internal circuit feedback to FB will stabilize VCC at 9.8V (with this feature, the internal circuit rather than the external feedback circuit will be used to stabilize the output voltage, but the stabilizing accuracy may be low); in the open period, OB provides base current to the power tube, OE pulls down the emitter of the power tube to IS, and OB uses the slope current driving (i.e. OB open current is the function of IS, when IS = 0V, OB open current is approximately 40mA, then OB open current will increase along with IS linearly, when IS raises to 0.6V, OB open current is approximately 120mA, this feature will effectively utilize the OB open current and lower the power consumption of TFC718), if IS detects the specified current of FB, it goes into close period; in the close period, OB pulls down, the power tube may not be turned off immediately, but OE clamps on 1.5V (after the power tube turns off, the base will be reverse bias and the voltage withstanding capacity is increased); in the open or close period, if it detects the power tube exceeding upper limit current, then the upper limit current trigger will be put at the preferential position, forcing FB to decrease and the duty ratio will turn smaller, so that the power tube and transformer will be protected; at the beginning of next close period edge or if FB is below 1.8V, the upper limit current trigger will reset. Besides, the built-in thermal protection of TFC718 will widen the oscillator period when the internal temperature is above 140°C to ensure the temperature of TFC718 will not exceed 150°C; the built-in slope compensation will stabilize the open/close period when TFC718 is at high duty ratio or in continuous current mode.
- When VCC lowers to about 4.4V, the oscillator will be closed, OSC1 and OSC2 will be at low level, and the power source will be maintained at close period; when VCC goes on lowering to about 3.8V, TH718 will enter the enabling stage again.

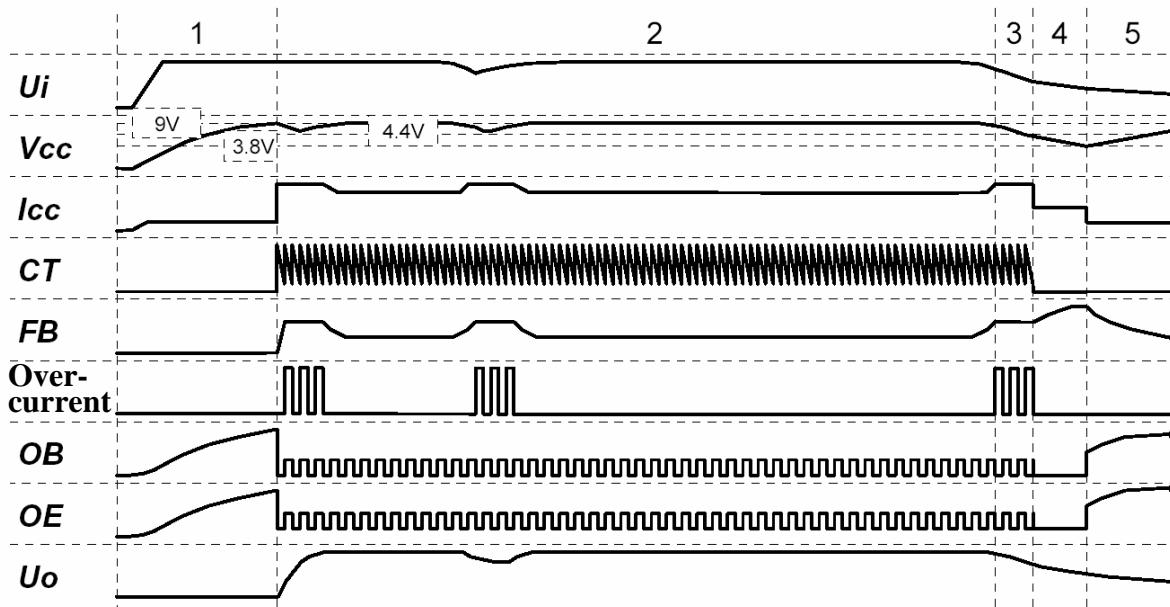


Normal Stage Switching Cycle Oscillogram (Figure 1)



### Definitions of Electrical Characteristics

- Enabling reception current: The current on OE point when OB starts to have a 0.1mA pull-down current in the enabling stage.
- Enabling static current: The minimum power supply current when VCC connects to filter capacitor and adjustable power supply, CT connects to 680PF and other pins unconnected to enable the oscillation of VCC (i.e. enable the start-up of TFC718)
- Enabling Voltage: The maximum VCC value of the above-mentioned VCC oscillation.
- Re-enabling voltage: The minimum VCC value of the above mentioned VCC oscillation.
- Oscillator turn-off voltage: The VCC value causing the stop of oscillator when the above-mentioned oscillation falls to the edge.
- Static current: VCC power supply current when FB connects to ground through 1.8K resistor in normal stage.
- Oscillator pull-up/pull-down current: The pull-up/pull-down current at CT when FB = 2.5V, CT = 1.25V in normal stage.



Global Oscillogram (Figure 2)

- FB pull-up current: In normal stage, when FB = 2.5V, IS = 0V, FB will be pull-up current.
- FB anti-upper limit current: In normal stage, when FB = 2.5V, IS = 0.8V, FB will be pull-down current.
- Internal feedback power supply voltage: No-external standby feedback circuit of the power source TFC718. In normal stage, it is the VCC value.
- IS upper limit voltage: When FB = 2.5V, add from outside the adjustable power supply to IS, the minimum IS voltage of the pull-down current at FB.
- Slope current driving: Referring to that OB open current of the power tube is the function of IS, when IS = 0V, OB open current is approximately 40mA, then OB open current will increase along with IS linearly, when IS raises to 0.6V, OB open current is approximately 120mA.
- Oscillator Cycle: The function of CT's external capacitor CT, about CT \* 24000 seconds.

### Electrical Characteristics

Symbol	Item	Test Condition	Min	Typ	Max	Unit
ics	Enabling Reception Current		1.6	2.0	2.4	mA
	Enabling Static Current			55	80	uA
	Enabling voltage		8.6	8.8	9.0	V
	Oscillator Turn-off Voltage		4.1	4.28	4.45	V
	Re-enabling voltage			3.7		V



	Internal Feedback Power Supply Voltage		9.2	9.6	10	V
I <sub>cc</sub>	Static Current	VCC = 8V		3		mA
VR	VR Reference Voltage		2.4	2.5	2.6	V
	Oscillator Cycle	CT * 24000	0.9	1	1.1	Multiple
	Oscillator Pull-up Current	CT = 1.25V		100		uA
	Oscillator Pull-down Current	CT = 1.25V		1.9		mA
	Maximum Duty Ratio	CT = 680PF	53	57	61	%
	FB Feedback Voltage	IS = 0.5V, CT = 0.6V		3.3		V
	FB Pull-up Current	FB = 2.5V, IS = 0V		580		uA
	FB Anti-upper Limit Current	FB = 2.5V, IS = 0.8V		300		uA
	IS Upper Limit Voltage	R <sub>IS-GND</sub> = 0.75Ω	0.54	0.58	0.62	V
	OE Clamp Voltage	OE = 0.001 ~ 1.2A		1.6		V
	OB Open Current	IS = 0.5V	102	120	140	mA
	OB Open Current	IS = 0.0V	32	44	60	mA
	OB Close Current	OB – IS = 1V	-145	-210	-230	mA
	OB Close Current	OB – IS = 0.25V		-10	-6	mA
	OE Output Current	OE – IS = 0.6V		-1.2	-1	A

## Key Points to the Power Supply Design (Refer to Application Cases)

- Designed in flyback current control type of switching power supply, and in non-continuous current operating mode (or shallow continuation at low voltage);
- The power supply enabling current is selected to 0.5 ~ 3mA, the amplification of the power tube can be calculated based on 10, then the selection of start-up resistor (such as R1 in Figure 3 and Figure 4) should ensure that the base current of the power tube to be 0.05 ~ 0.3mA at the time when the power supply starts. Therefore, it could reduce the power consumption of the start-up resistor by ten times and reduce the standby power consumption;
- In Figure 3 and Figure 4, C5 = 680pF, the maximum operating frequency is about 60KHz;
- Switching transformer (T1 in Figure 3 and Figure 4): The rectified output of the reference winding is 4.8 ~ 9V (the preferred value is 6V) providing working power supply to TFC718;
- If the maximum primary peak current of the switching transformer is 0.8A, in 220V AC, 140V demagnetized voltage, by considering factors such as power supply efficiency, the maximum available output power will be 22W; in case of broad voltage or 110V AC, 90V demagnetized voltage, when using shallow continuation current mode at below 90V AC power supply, the maximum output power may reach 18W;
- Selection of the power tube: When the maximum peak current is 0.8A, by considering OB open current, the β value of the power tube should be 10@5V<sub>ce</sub>@0.8A, the corresponding testing resistor (R3 in Figure 3 and Figure 4) should be 0.75ohm; in any current condition, the power tube should work in the saturation area and its testing resistor should be 0.6V/max. peak current;
- Although TFC718 has been provided with thermal protection, in case of requirement for higher output power, if not considering enlarging heat sinking area on PCB board of TFC718, it may decrease the output power and output voltage. Similarly, it should also consider the heat sinking issue of the power tube during high output power.

## Application Cases

- Application Case 1 (Figure 3): A 18 W switching power supply with its output voltage determined by the voltage ratio of R6 and R7, but the transformation ratio of switching transformer T1 should be considered.

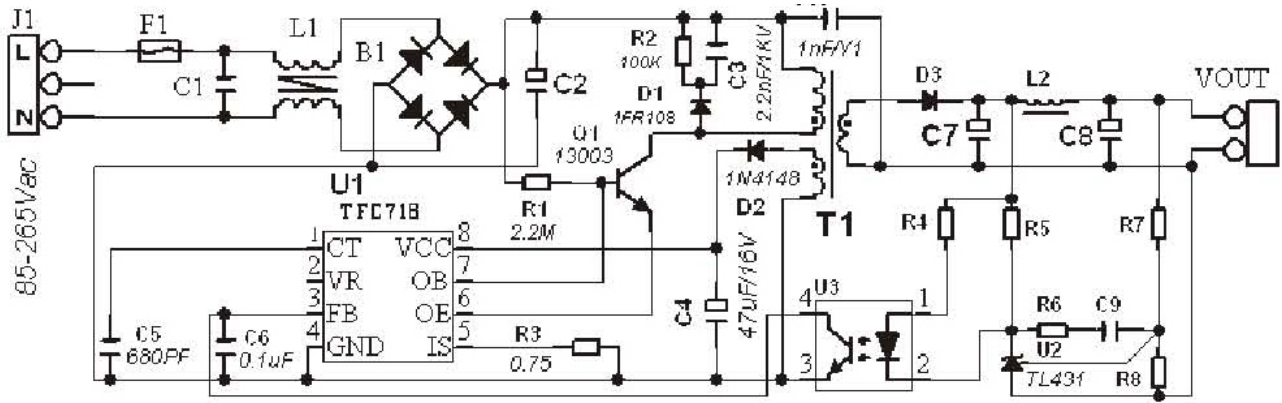


Figure 3: 18W Switching Power Supply

- Application Case 2 (Figure 4): A DVD power supply with broad voltage and peak value capable of reaching 18W. The reason why it is said “peak value capable of reaching 18W” is that DVD needs a very short period of high power during its waiting for start-up and needs probably below 10W in all other times. So, it is possible to consider reducing the heat-sinking requirement for the power tube Q1, or even without using the heat sinking.

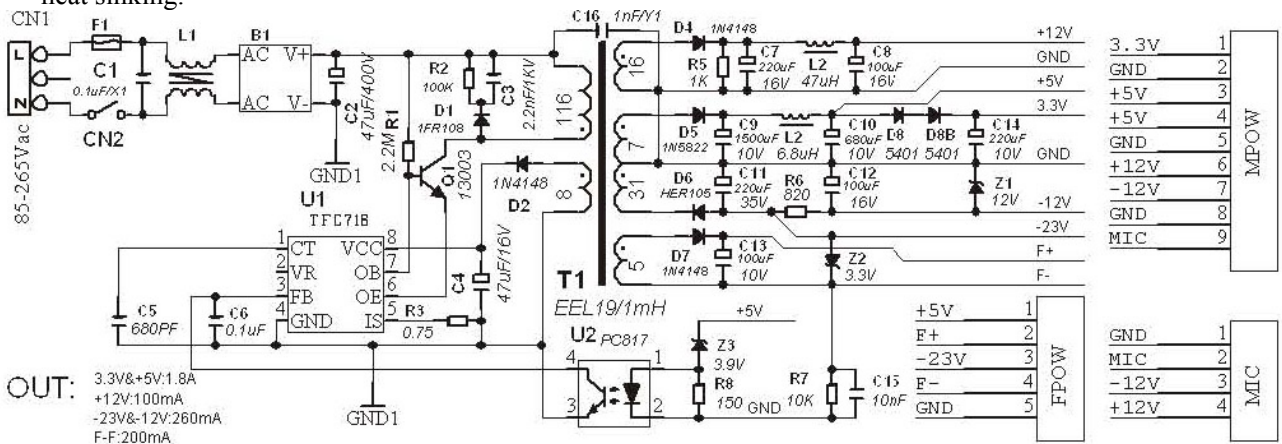


Figure 4: DVD Power Supply with Broad Voltage and Peak Value capable of reaching 18W

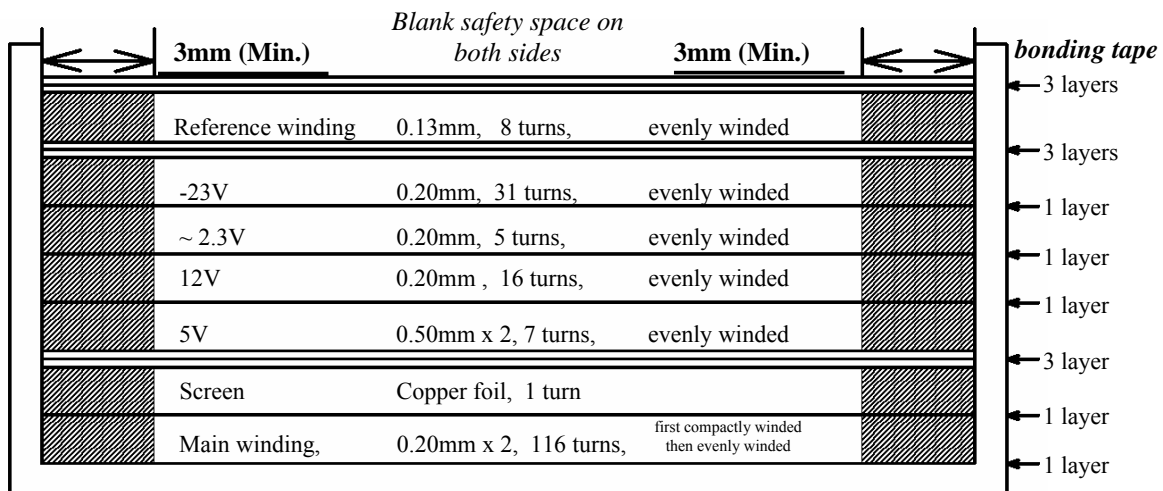


Figure 5: Application Case 2, T1, EEL19, 1mH transformer structure



Application Case 3 (Figure 6): Power supply for DVD or set-top box with separate stand-by function. It uses TFC719 as the stand-by power supply and TFC718 as the main power supply. When in stand-by condition, POWER is at low level, the saturation of the optical couple U3 enables U1.FB, U1.TC and U1.OB to be at low level, the main power is closed, but U1 will be provided with power current by R4, U1 is in the holding status; when the main power operates, POWER is at high level, the power current provided by R4 is low, all protective functions of U1.TFC718 remain effective. Since the stand-by power supply requires low output current, the +5Vsb could meet the requirement, no need to use optical coupling circuit.

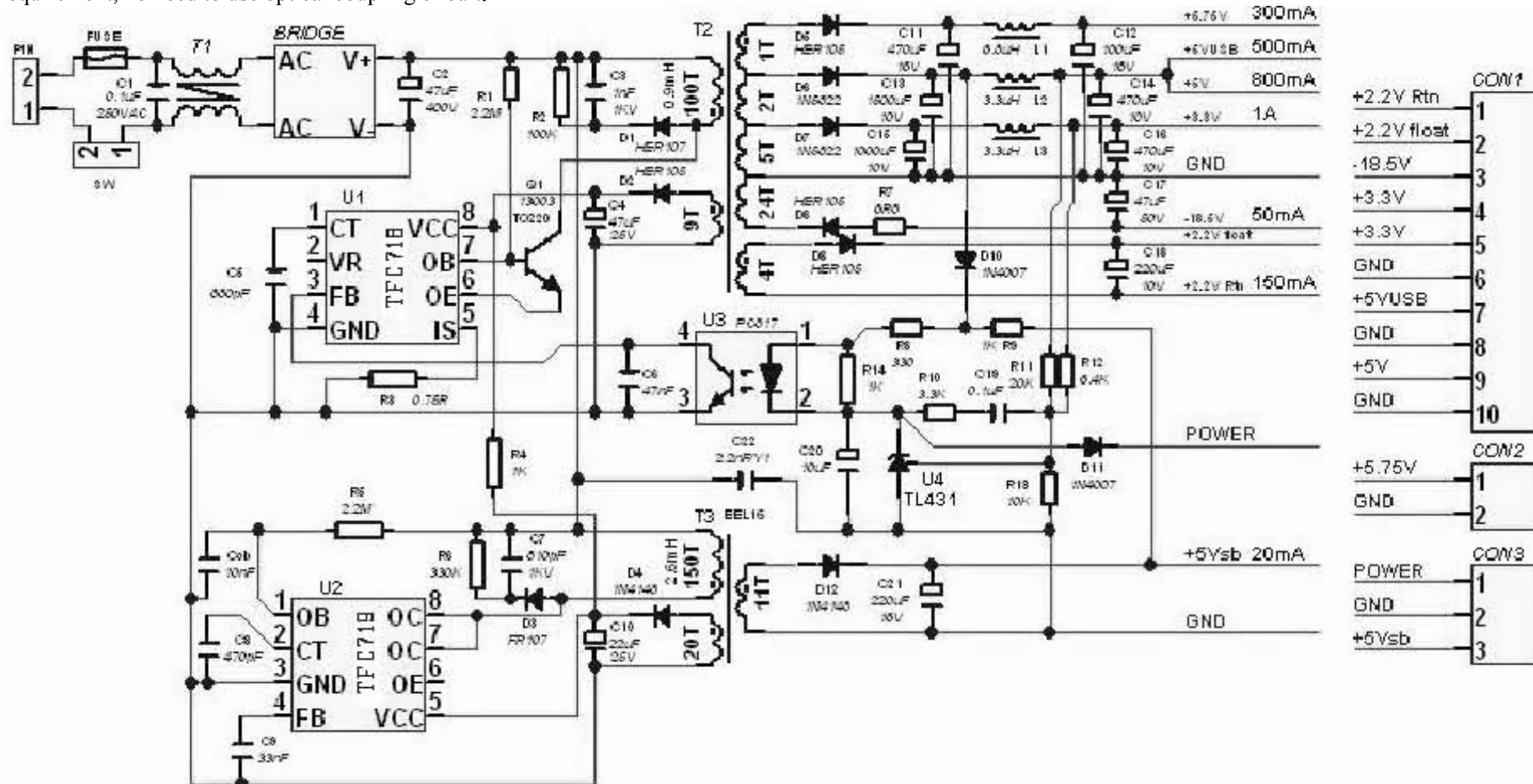


Figure 6: Power Supply for DVD or Set-Top Box with Separate Stand-by Function





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