

# DI-41 参考设计 TOPSwitch-GX

## 43 W、100/115 VAC多输出机顶盒电源

应用	器件	输出功率	输入电压	输出电压	拓扑结构
机顶盒	TOP247YN	43 W cont, 57 W pk	90 – 132 VAC	3.3 V, 5 V, 12 V, 18 V, 33 V	反激式

### 设计特色

- 低成本，元件数量少
- 出色的输出电压跟踪和交叉调整率—不需要线性调整器
- 高效率，90 VAC输入时效率>71%
- 线电压欠压检测(UV)和电源系统浪涌保护(OV)
- 满足CISPR22B/EN55022B传导EMI限制
- 通过4 kV差模和共模浪涌测试(EN61000-4-5)
- 通过4 kV/100 kHz震铃波测试(IEEE C62.41)

### 工作方式

图1的设计使用了TOP247YN并应用了TOPSwitch-GX的很多特性。用一个2 MΩ的电阻(R1)实现线电压UV和OV（各为100 V和450 V）

功能。欠压消除了开/关机时的输出抖动，过压在输入电压瞬态和长时间浪涌时提供保护。R4将U1的内部限流点设置为标称值的80%，限制了过载功率。

所示电路的关键特性是具有出色的输出电压跟踪和交叉调整率。使用了两种技术使输出电压恰好位于中心值。超快整流管D10（用来代替肖特基）的额外电压降使5 V输出正好是5 V的同时，使用直流叠加来改善12 V、18 V和30 V的输出。磁珠L7和12 V、18 V、30 V输出绕组串联来改进这些输出的设置精度和交叉调整率。

频率抖动可以在简单的滤波情况下提供大的EMI裕量。初级软启动在启动时使元件应力最小，软启动电容(C20)消除了输出启动过冲。

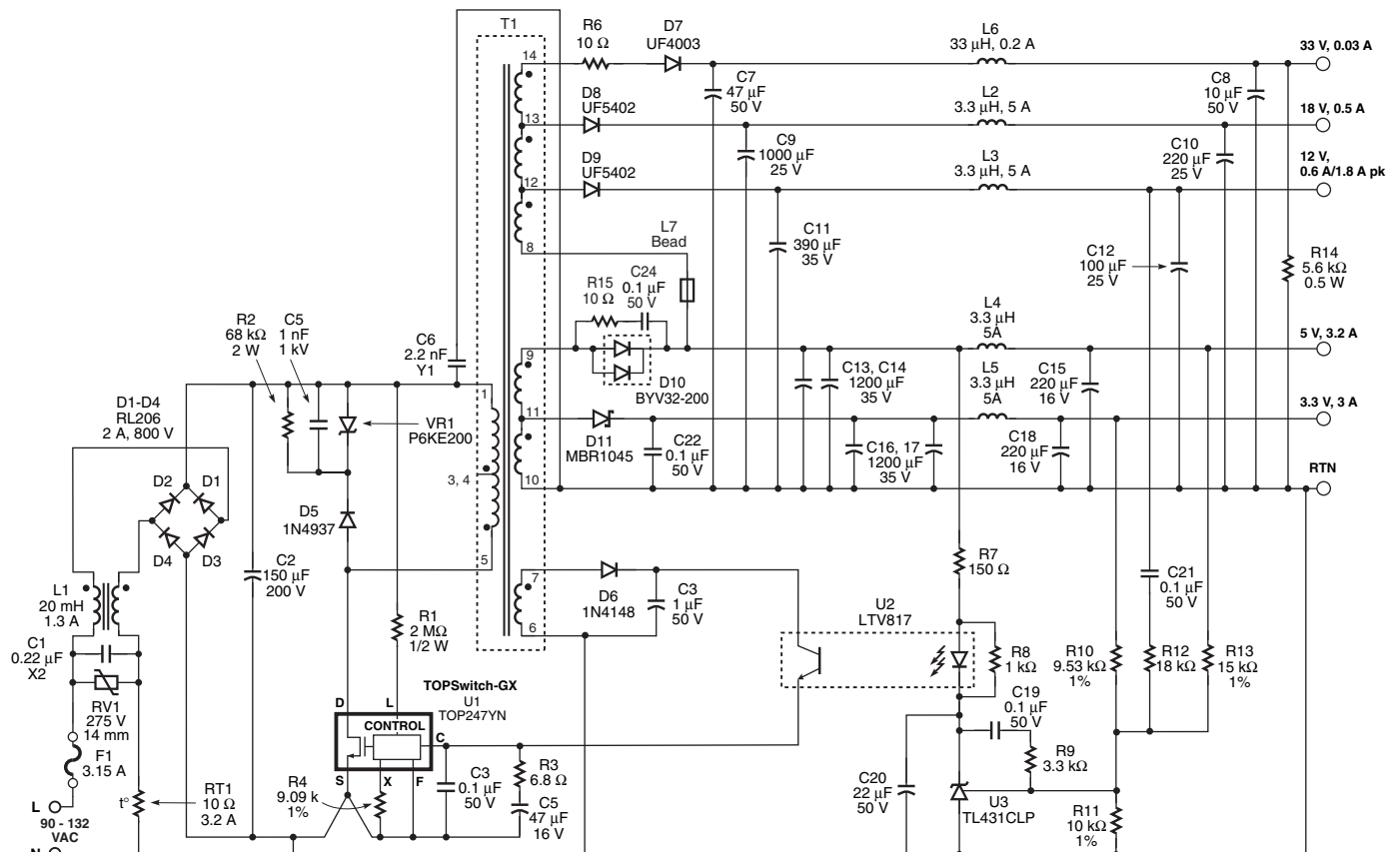


图1. 使用TOPSwitch-GX的43 W连续、57 W峰值的机顶盒电源

PI-3389-101408

## 设计要点

- 使 $K_{RP}$ （纹波对峰值的电流比）在0.4-0.6之间，可得到较高的效率和交叉调整率。 $V_{OR}$ （反射输出电压）在90 V到110 V之间以使性能优化。
- 走大开关电流的PCB走线应该短且宽从而减少EMI。
- 使每一个绕线层充满整个骨架的宽度，减小漏感、改善交叉调整率。
- 电阻R14在33 V输出上提供了一个小的假负载，阻止了由漏感尖峰形成的峰值充电效应。
- R5和C5减少了VR1的功率损耗。

电压 (V)	负载范围 (%)	调整率(%)											
		-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3
3.3	1-3												
5	1-3.2												
12	0.3-0.6												
30	0.01-0.03												

表2. 在最差情况下输出调整率—输出从最小到最大负载，线电压从85 VAC到132 VAC

## 变压器参数

磁芯材料	ERL28, Nippon Ceramic NC-2H material or equivalent, gapped for $A_{LG}$ of 128 nH/t <sup>2</sup>
骨架	ERL28 14 pin, Vertical, Jinbo Industrial JB-0039 or equivalent
绕组细节	Primary: 30T + 23T, 25 AWG Shield: 1T, 0.6" × 0.001" Cu foil Bias: 7T, 2 × 27 AWG 3.3 V: 2T, 0.6" × 0.005" Cu foil 5 V: 1T, 0.6" × 0.005" Cu foil 12 V: 4T, 2 × 27 AWG 18 V: 3T, 2 × 27 AWG 33 V: 6T, 27 AWG (2 × 27 AWG = Bifilar 27 AWG)
绕组顺序 (引脚号)	Apply 3.2 mm tape margin to both sides of bobbin. Primary (4-3), tape, Shield (1-NC), tape, Bias (6-7), 3 × tape, 5 V (9-11), 3.3 V (11-10), tape, 12 V (12-8), 18 V (13-12), 33 V (14-13), 3 × tape, Primary (3-1), 3 × tape
电感	Primary: 356 $\mu$ H Leakage: 11 $\mu$ H (maximum)
初级共振频率	650 kHz (minimum)

表1. 变压器结构信息 (AWG = 美国线规, NC = 无连接)

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