Design Idea DI-55
TOPSwitch®-GX
20 W (25 W peak) DVD Supply

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DVD	TOP245P	20 W (25 W pk)	85-265 VAC	3.3 V / 5 V / 12 V / -24 V	Flyback

Design Highlights

- Simple, low cost, low part count solution
- No heatsinks required
- Low EMI-frequency jitter allows EN55022B/FCC B compliance with simple EMI filter
- High efficiency, >75% at 90 VAC
- Low zero load power consumption, <100 mW at 230 VAC
- Low standby power consumption, <1 W input at 0.5 W output, 230 VAC
- Excellent cross-regulation
- Differential and common mode surge immunity to 3 kV (EN 61000-4-5)

Operation

The TOP245P selected for the design in Figure 1 is ideal for DVD and set-top box applications. The P package removes the need for a heatsink while still delivering 20 W/25 W peak at an ambient temperature of 50 °C.

The external current limit programming and remote ON/OFF (inhibit) functions of the M pin allow current mode control and reduced switching frequency at light and no-load conditions. Current mode control is implemented by R2, Q3, R3, C16, R4 and R6.

Feedback current above ~2 mA (U1 supply current) forward biases Q3 and pulls up R6. This adjusts the sink current out of the M pin, thereby allowing the output voltage feedback loop to control the primary switch current.

Resistor R6 sets the maximum current limit, while R2 and C16 provide slope compensation. The value of R4 is chosen to ensure that current does not flow into the M pin, enabling the line sensing features of the pin. The current out of the M pin falls as the load is reduced until the M pin inhibit threshold is reached. The supply then operates with a fixed 25% current limit, lowering the switching frequency to maintain regulation. This greatly reduces switching losses, maintaining high standby efficiency and low no-load power consumption.

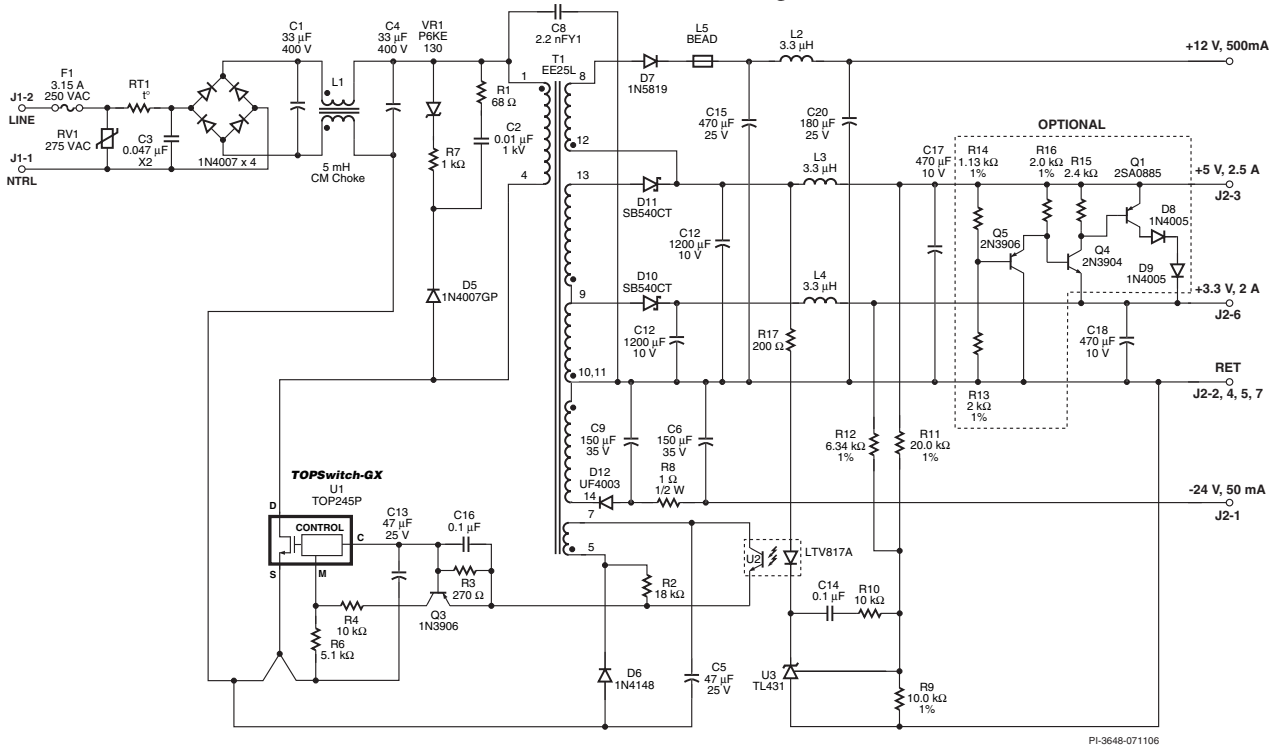

Figure 1. 20 W Multiple Output DVD Supply.

Key Design Points

- For good cross-regulation, minimize transformer leakage - use foil for 3.3 V and 5 V outputs; minimize peak primary currents by designing transformer for continuous conduction mode.
- Shunt regulator (temperature compensated) between 5 V and 3.3 V outputs in dotted box on schematic is optional. It is only necessary where min and max load conditions do not occur simultaneously on both outputs.
- Feedback is taken from both the 3.3 V and 5 V outputs to the reference (U3) via R9, R11 and R12. The 12 V output is DC stacked on the 5 V output for enhanced regulation and voltage centering.
- Primary clamp components VR1, D5, R7, R1 and C2 limit the leakage inductance induced peak drain voltage spike.
- D5 is a slow recovery diode to recover some of the clamp energy. It must be a glass passivated type to guarantee a defined t_{rr}.
- Use a Zener clamp for lowest zero load input power consumption.

TRANSFORMER PARAMETERS	
Core Material	EEL25, N67 or equivalent, gap for A_{LG} of 202 nH/T²
Bobbin	7 pin + 7 pin
Winding Details	Shield 1: 32T, 2 x 32 AWG Primary: 63T, 2 x 32 AWG Bias: 6T, 4 x 32 AWG Shield 2: 4T, 4 x 32 AWG 3.3 V/5 V foil: 2T + 1T, 0.12 mm foil -24 V: 13T, 2 x 32 AWG +12 V: 4T, 4 x 32 AWG
Winding Order (pin numbers)	Shield (NC-1), tape, primary (1-4), tape, bias (5-7), tape, shield 2 (13-NC), foil (10,11-9-13), -24 V (14-10,11), 12 V (12-8).
Inductance	Primary: 800 µH ±10% Leakage: 80 µH (max.)
Primary Resonant Frequency	300 kHz (minimum)

Table 1. Transformer Design Parameters.

Voltage (V)	Load Range (A)	Regulation (%)												
		-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7
3.3	0.3-0.6													
5	0.3-1.2													
12	0.1-0.2													
-24	0.03-0.05													

Table 2. Worst Case Output Cross-Regulation - all Outputs Taken from Minimum to Maximum Loads.

Power Integrations **5245 Hellyer Avenue** **San Jose, California 95138**

MAIN PHONE NUMBER
+1 408-414-9200

APPLICATIONS HOTLINE
+1 408-414-9660

APPLICATIONS FAX
+1 408-414-9760

For a complete listing of worldwide sales offices, please visit ***www.powerint.com***