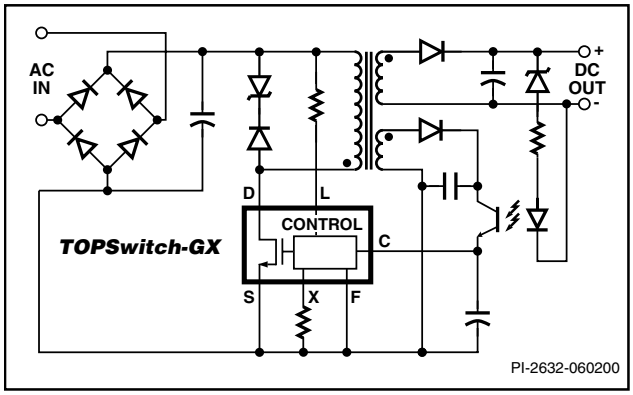
TOPSwitch®-GX Family

Extended Power, Design Flexible, EcoSmart®, Integrated Off-line Switcher IC

APRIL 2004 UPDATE

NEW! TOP246P Extends Power Rating With No Heatsink Required.

Typical Flyback Application



Product Highlights

- Extended power range for higher power applications
- No heatsink required up to 34 W using P package
- Tight temperature and absolute tolerance on critical parameters
- Integrates high-voltage power MOSFET, PWM control, fault protection, and other control circuitry on **ONE CMOS CHIP**
- TO-220/262/263, DIP-8 & SMD-8 packages

Features & Benefits

Low System Cost, High Design Flexibility

- Fully integrated soft-start for minimum stress/overshoot
- Externally programmable accurate current limit
- Wider duty cycle for more power, smaller input capacitor
- Separate line sense & current limit pins on Y/R/F packages
- Line under-voltage (UV) detection for no turn-off glitches
- Line overvoltage (OV) shutdown extends line surge limit
- Line feed-forward with maximum duty cycle (DC_{MAX}) reduction rejects ripple and limits DC_{MAX} at high line
- 132 kHz frequency reduces transformer/power supply size

EcoSmart® - Energy Efficiency

- Extremely low consumption in remote OFF mode (80 mW @ 110 VAC, 160 mW @ 230 VAC)
- Frequency lowered with load for high standby efficiency
- Allows shutdown/wake-up via LAN/input port

EcoSmart®

Product Family

PRODUCT	230 VAC ±15%		85-265 VAC	
	Adapter	Open Frame	Adapter	Open Frame
TOP242 P or G	9 W	15 W	6.5 W	10 W
TOP242 R	21 W	22 W	11 W	14 W
TOP242 Y or F	10 W	22 W	7 W	14 W
TOP243 P or G	13 W	25 W	9 W	15 W
TOP243 R	29 W	45 W	17 W	23 W
TOP243 Y or F	20 W	45 W	15 W	30 W
TOP244 P or G	16 W	28 W	11 W	20 W
TOP244 R	34 W	50 W	20 W	28 W
TOP244 Y or F	30 W	65 W	20 W	45 W
TOP245 P	19 W	30 W	13 W	22 W
TOP245 R	37 W	57 W	23 W	33 W
TOP245 Y or F	40 W	85 W	26 W	60 W
TOP246 P	21 W	34 W	15 W	26 W
TOP246 R	40 W	64 W	26 W	38 W
TOP246 Y or F	60 W	125 W	40 W	90 W
TOP247 R	42 W	70 W	28 W	43 W
TOP247 Y or F	85 W	165 W	55 W	125 W
TOP248 R	43 W	75 W	30 W	48 W
TOP248 Y or F	105 W	205 W	70 W	155 W
TOP249 R	44 W	79 W	31 W	53 W
TOP249 Y or F	120 W	250 W	80 W	180 W
TOP250 R	45 W	82 W	32 W	55 W
TOP250 Y or F	135 W	290 W	90 W	210 W

See Data Sheet for Additional Notes and Conditions

Package Options

Y	P	G	R	F
				
TO-220	DIP-8	SMD-8	TO-263	TO-262

TOPSwitch-GX® Family Design Tools

Power Supply Design Software

With ***PI Expert***™, you're only "mouse-clicks" away from determining the key components in your next switching power supply design, including the best Power Integrations power IC and design details for the transformer! It's fast & easy...and best of all, **FREE!**

Design Accelerator Kits

DAKs include a working prototype power supply, sample devices, unpopulated pcb, data sheet, comprehensive engineering report & other related documentation.

DAK-12	145 W, PC Main Power Supply
DAK-31	180 W, PC Main Power Supply
DAK-32	20 W, Universal Input, DVD Supply, No Heatsink
DAK-33	45 W, 12 V LCD Power Supply
DAK-34	30 W, 12 V Universal Input Power Supply

TOPSwitch-GX Product & Design Collateral*

Data Sheet	**TOP242-250**	***TOPSwitch-GX*** Family Data Sheet
Application Notes	**AN-29**	***TOPSwitch-GX*** Flyback Quick Selection Curves
	AN-30	***TOPSwitch-GX*** Forward Design Methodology
	AN-32	***TOPSwitch-GX*** Flyback Design Methodology
Design Ideas	**DI-12**	Application: Lead Acid Battery Charger Design (16 W, Universal Input)
	DI-16	Application: Set-top Box (57 W, 230 VAC Input)
	DI-17	Application: PC Standby (17 W)
	DI-20	Application: PC Main ATX (145 W)
	DI-21	Application: LCD Monitor Adapter (45 W, Universal Input)
	DI-22	Application: Laptop Adapter (70 W, 19 V, Universal Input)
	DI-23	Application: High Speed Modem (10 W, Universal Input)
	DI-26	Application: DVB-T (7 W, 230 VAC Input)
	DI-30	Application: PC Main SFX (180 W)
	DI-35	Application: Audio Amplifier w/ No Heatsink (16 W - 35 W Peak, Universal Input)
	DI-39	Application: DVD (13 W, Universal Input)
	DI-41	Application: Set-top Box (43 W, 100/115 VAC Input)
	DI-43	Application: Medium Power AC-DC Power Supply (30 W, Universal Input)
	DI-55	Application: DVD w/ No Heatsink (20 W, Universal Input)
	DI-66	Application: LCD Monitor (45 W, 90 - 265 VAC Input)
	DI-67	Application: LED Arrays (17.6 W, 108 - 132 VAC, 60 Hz Input)

* Downloadable from ***www.powerint.com***

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 heatsink 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 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,

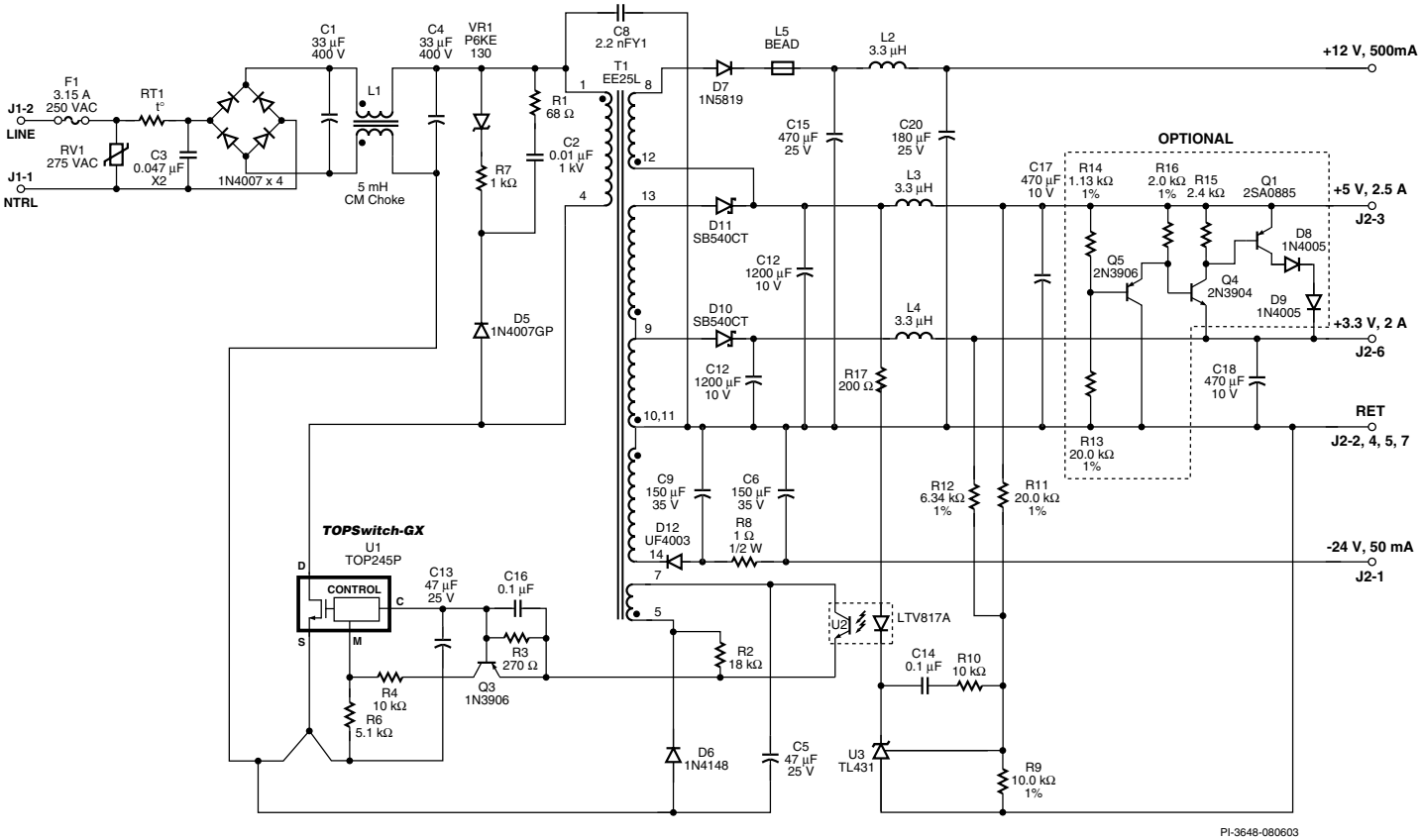


Figure 1. 20 W Multiple Output DVD Supply.

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.

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/T^2
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 Construction Information.

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.

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