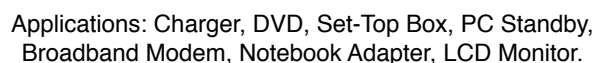


## FEBRUARY 2006 UPDATE



- 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 onto a monolithic IC
- TO-220/262/263, DIP-8 & SMD-8 packages

- 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



| PRODUCT                                    | 230 VAC ±15%         |                       | 85-265 VAC           |                      |
|--------------------------------------------|----------------------|-----------------------|----------------------|----------------------|
|                                            | Adapter              | Open Frame            | Adapter              | Open Frame           |
| TOP242 P or G<br>TOP242 R<br>TOP242 Y or F | 9 W<br>21 W<br>10 W  | 15 W<br>22 W<br>22 W  | 6,5 W<br>11 W<br>7 W | 10 W<br>14 W<br>14 W |
| TOP243 P or G<br>TOP243 R<br>TOP243 Y or F | 13 W<br>29 W<br>20 W | 25 W<br>45 W<br>45 W  | 9 W<br>17 W<br>15 W  | 15 W<br>23 W<br>30 W |
| TOP244 P or G<br>TOP244 R<br>TOP244 Y or F | 16 W<br>34 W<br>30 W | 28 W<br>50 W<br>65 W  | 11 W<br>20 W<br>20 W | 20 W<br>28 W<br>45 W |
| TOP245 P or G<br>TOP245 R<br>TOP245 Y or F | 19 W<br>37 W<br>40 W | 30 W<br>57 W<br>85 W  | 13 W<br>23 W<br>26 W | 22 W<br>33 W<br>60 W |
| TOP246 P or G<br>TOP246 R<br>TOP246 Y or F | 21 W<br>40 W<br>60 W | 34 W<br>64 W<br>125 W | 15 W<br>26 W<br>40 W | 26 W<br>38 W<br>90 W |
| TOP247 R<br>TOP247 Y or F                  | 42 W<br>85 W         | 70 W<br>165 W         | 28 W<br>55 W         | 43 W<br>125 W        |
| TOP248 R<br>TOP248 Y or F                  | 43 W<br>105 W        | 75 W<br>205 W         | 30 W<br>70 W         | 48 W<br>155 W        |
| TOP249 R<br>TOP249 Y or F                  | 44 W<br>120 W        | 79 W<br>250 W         | 31 W<br>80 W         | 53 W<br>180 W        |
| TOP250 R<br>TOP250 Y or F                  | 45 W<br>135 W        | 82 W<br>290 W         | 32 W<br>90 W         | 55 W<br>210 W        |

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

# TOPSwitch-GX<sup>®</sup> Family Design Tools



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## DESIGN ACCELERATOR KITS

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

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



## TOPSwitch-GX PRODUCT & DESIGN COLLATERAL\*

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

\* Downloadable from [www.powerint.com](http://www.powerint.com)

# Design Idea DI-55

## TOPSwitch-GX<sup>®</sup> 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

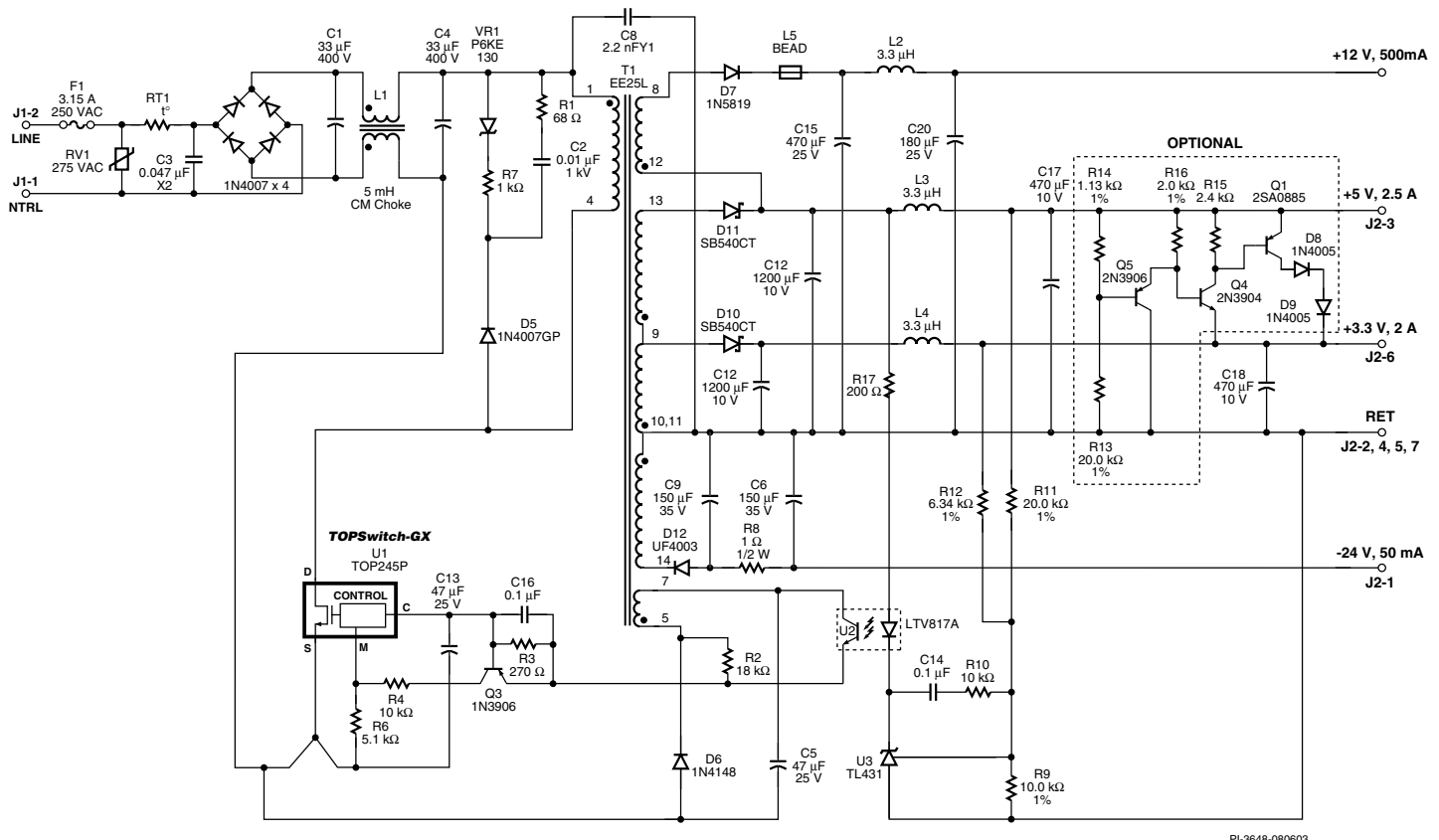
- Simple, low cost, low part count solution
- No heatsink required
- Low EMI-frequency jitter allows EN55022B/FCC B compliance with simple EMI filter
- High efficiency, >75% at 90 VAC
- Low zero load power consumption, <100 mW at 230 VAC
- Low standby power consumption, <1 W input at 0.5 W output, 230 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,



PI-3648-080603

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 <sup>2</sup>                                                                                                                                   |
| Bobbin                      | 7 pin + 7 pin                                                                                                                                                                                         |
| Winding Details             | Shield 1: 32T, 2 x 32 AWG<br>Primary: 63T, 2 x 32 AWG<br>Bias: 6T, 4 x 32 AWG<br>Shield 2: 4T, 4 x 32 AWG<br>3.3 V/5 V foil: 2T + 1T, 0.12 mm foil<br>-24 V: 13T, 2 x 32 AWG<br>+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 $\mu$ H $\pm$ 10%<br>Leakage: 80 $\mu$ H (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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