DI-17 Design Idea
TOPSwitch®-GX

17 W, PC Standby

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
PC Standby	TOP242YN	17 W	200 – 375 VAC	3.3 V / 5 V	Flyback

Design Highlights

- Meets Blue Angel efficiency requirements providing output power of 3.9 W with 5 W input power
- Input undervoltage (UV) detect eliminates power-up/down output glitches
- 132 kHz switching frequency allows small, low cost EEL19 based transformer to deliver 17 W
- Regulation derived from 3.3 V and 5 V outputs ensuring ±5% regulation on both outputs
- 15 V output for primary side circuitry
- Primary soft-start minimizes start-up component stresses

Operation

The design in Figure 1 utilizes the TOP242YN and takes advantage of many of the device's features. Input UV is set at 195 VDC using a single 3.9 MΩ resistor (R1). On increasing input voltage, the supply is disabled until 195 VDC is reached (this threshold is typically the lowest operating DC input voltage for a PC main power supply with a doubler input configuration). On decreasing input voltage the supply continues to operate until regulation is lost, even if this is below the UV threshold. Once regulation is lost the input voltage has to exceed the UV threshold again before the supply is enabled.

During the first 10 ms of operation internal soft-start is enabled. The duty cycle is linearly increased from 0% to 78% and the current limit from 70% to 100%, lowering stresses on the internal power MOSFET, clamp and output rectifier. Diode D1 and Zener VR1 are used to clamp the leading-edge drain-voltage spikes caused by transformer leakage inductance. At light load, a Zener clamp provides higher efficiency than an RCD clamp, maximizing available output power for the Blue Angel 5 W input power limit.

A secondary shunt regulator (U3) together with R6, R7, R9, R10 and R11 are used to sense both the 3.3 V and 5 V outputs. Control loop compensation is accomplished with capacitor C7, R5 and C5. Resistor R6 sets the DC gain while R7 provides bias to the TL431 (U3). The values shown provided satisfactory phase margin and bandwidth.

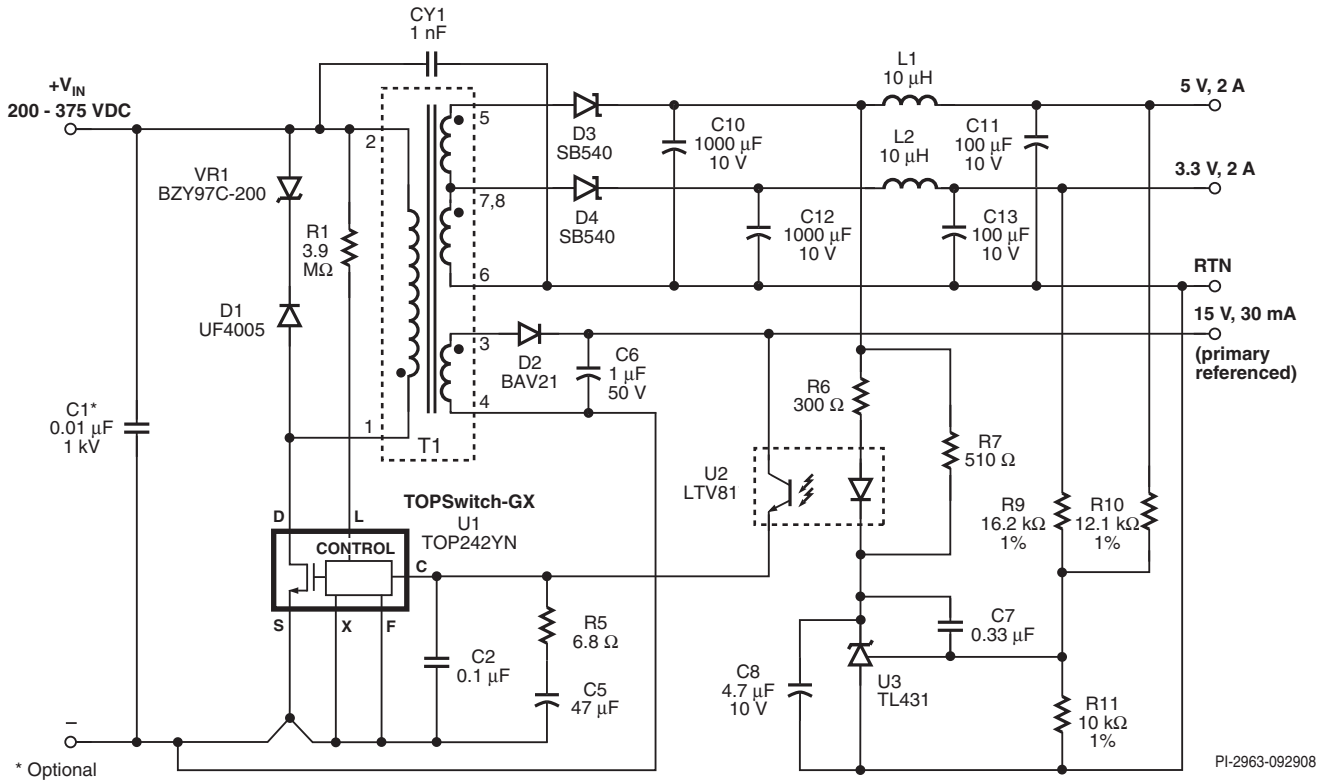

Figure 1. TOPSwitch-GX 17 W PC Standby.

Key Design Points

- Decoupling capacitor (C1) should be used if the standby supply is far from the main input bulk capacitor.
- The value of R1 is set according to the equation: $R1 = (V_{UV} - 2.5)/50\ \mu A$.
- Minimize secondary trace leakage inductance to improve output cross regulation.
- Y1 capacitor (CY1) should be connected between secondary return and primary positive DC rail to minimize potential coupling into the TOPSwitch-GX SOURCE pin during common mode line surge events.
- Connect bias winding return past SOURCE pin to route common mode surge currents away from TOPSwitch-GX.
- A soft-finish capacitor (C8) eliminates output start-up overshoot.
- Capacitor C2 should be located close to U1.

Transformer Parameters	
Core Material	EEL19 (Nippon Ceramic NC-2h) ALG = 720 nH/t²
Bobbin	EEL19 8 pin (TDK BD-9-118CPH or equivalent)
Winding Details	Primary: 147T × 34 AWG Bias: 17T × 34 AWG 3.3 V: 4T × 3 × 27 AWG T.I.W. 5.0 V: 2T × 3 × 27 AWG T.I.W.
Winding Order (pin numbers)	Primary (1–2), tape, 3.3 V (7, 8–6), 5 V (5–7, 8), tape Bias (3–4), tape
Inductance	Primary: 2.3 mH, 10% Leakage: 75 μH (maximum)
Primary Resonant Frequency	650 kHz (minimum)

Table 1. Transformer Parameters. (AWG = American Wire Gauge, T.I.W. = Triple Insulated Wire)

Power Integrations
5245 Hellyer Avenue
San Jose, CA 95138, USA.
Main: +1 408-414-9200
Customer Service
Phone: +1-408-414-9665
Fax: +1-408-414-9765
Email: usasales@powerint.com

On the Web
www.powerint.com

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