DI-22 Design Idea
TOPSwitch®-GX

70 W, 19 V External Laptop Adapter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Laptop Adapter	TOP249YN	70 W	85 – 265 VAC	19 V	Flyback

Design Highlights

- High efficiency: 84% at 85 VAC (with 50 °C external ambient temperature)
- Low component count and high power density, 7 W/in.^{3}
- Very compact design (4.1 in. × 2.225 in. × 1.06 in.)
- No surface mount components required
- Low zero load power consumption, <370 mW at 115 VAC
- Approximately constant overload power with line voltage
- Line undervoltage detection (UV) and overvoltage (OV) shut-down
- Low EMI - switching frequency jitter helps meet CISPR22B/ EN55022B limits
- Fully protected for overload, short circuit and thermal faults

Operation

The design utilizes a TOP249YN in a flyback converter providing a 70 W output in a sealed enclosure at an external ambient of 50 °C. Line UV and OV (100 V and 450 V, respectively) are implemented using a single 2 MΩ resistor (R1). Undervoltage eliminates power-up/down glitches and overvoltage provides line transient and long duration power system surge protection. Resistor R10 programs the internal current limit to 75% of nominal at the UV threshold. As a function of input voltage the current limit is further reduced by R9 to provide approximately constant overload power. The larger TOPSwitch-GX selection reduces conduction losses, raising efficiency (without circuit changes or increased overload power) and permits a higher inductance design for reduced primary RMS currents, further increasing efficiency.

To reduce winding and diode dissipation the secondary is split into two windings and diode OR'ed into the output capacitors (C2, 3). Regulation is provided by a secondary side reference (U3), the output voltage sensed by R4, R13 and R6.

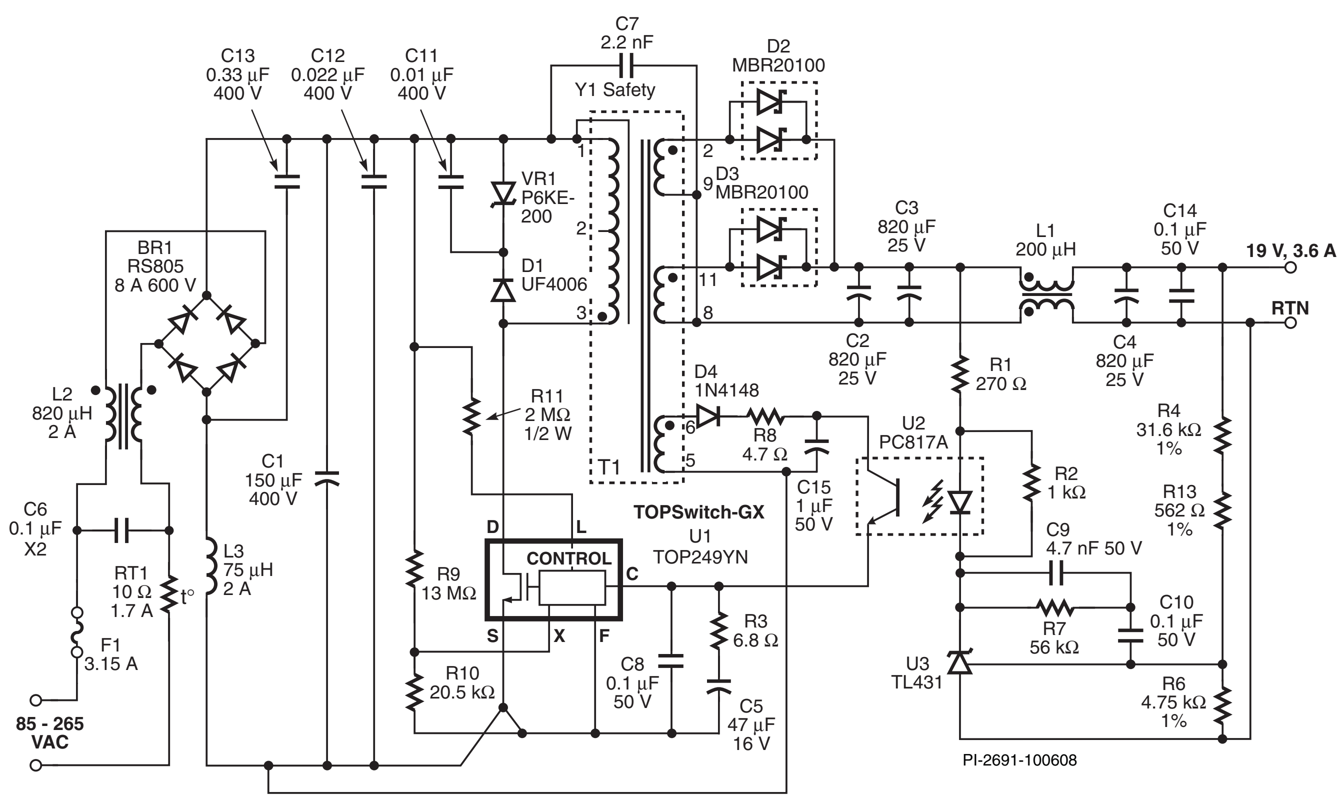

Figure 1. TOPSwitch-GX 70 W Laptop Adapter Schematic.

Key Design Points

- D1 and VR1 clamp leakage inductance spikes. A Zener clamp provides lower zero load consumption than an RCD clamp and higher efficiency below full load.
- C11 reduces VR1 dissipation, raising efficiency.
- Additional differential filtering is provided by C13 and L3.
- C12 provides high frequency bypass, reducing high frequency EMI.
- Use foil windings to reduce dissipation and reduce leakage inductance.
- Sandwich secondary winding between two halves of primary to reduce leakage inductance.
- High core temperature reduces saturation flux density. Keep flux density below 3000 gauss (0.3 T) to prevent saturation.
- Use 100 V Schottky diodes for highest efficiency.
- Good layout practices should be followed:
  - Locate C8, R3, C5, R9, R10 and R11 close to U1.
  - Power and signal source currents should be separated, joined using a Kelvin connection at the SOURCE pin.
  - Minimize the primary and secondary loop areas to reduce parasitic leakage and EMI.
- Consult DAK-11 and EPR-11 for more information.

Transformer Parameters

Core Material	FPQ26/20-A TDK PC40, gapped for ALG of 843 nH/t²
Bobbin	TDK BPQ26/20-1112CP
Winding Details	Primary: 9T + 9T, 2 × 26 AWG Shield: 1T, 8 mm × 0.015 mm Cu foil Secondary 1: 3T, 3 × 26 AWG T.I.W. Secondary 2: 3T, 3 × 26 AWG T.I.W. Bias: 2T, 8 mm × 0.015 mm Cu foil
Winding Order (pin numbers)	Primary (2–1), Shield (1–NC), Tape, Secondary 1 (12–9), Secondary 2 (11–8), Bias (6–5), Tape, Primary (3–2), Tape
Inductance	Primary: 273 μH, 10% Leakage: 3 μH (maximum)
Primary Resonant Frequency	1.5 MHz (minimum)

Table 1. Transformer Parameters. (AWG = American Wire Gauge, T.I.W. = Triple Insulated Wire, NC = No Connection)

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