Design Idea DI-22

TOPSwitch®-GX 70 W, 19 V External Laptop Adapter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Laptop Adapter	TOP249Y	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) shutdown
- Low EMI - switching frequency jitter helps meet CISPR22B/ EN55022B limits
- Fully protected for overload, short circuit and thermal faults

Operation

The design utilizes a TOP249Y 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.

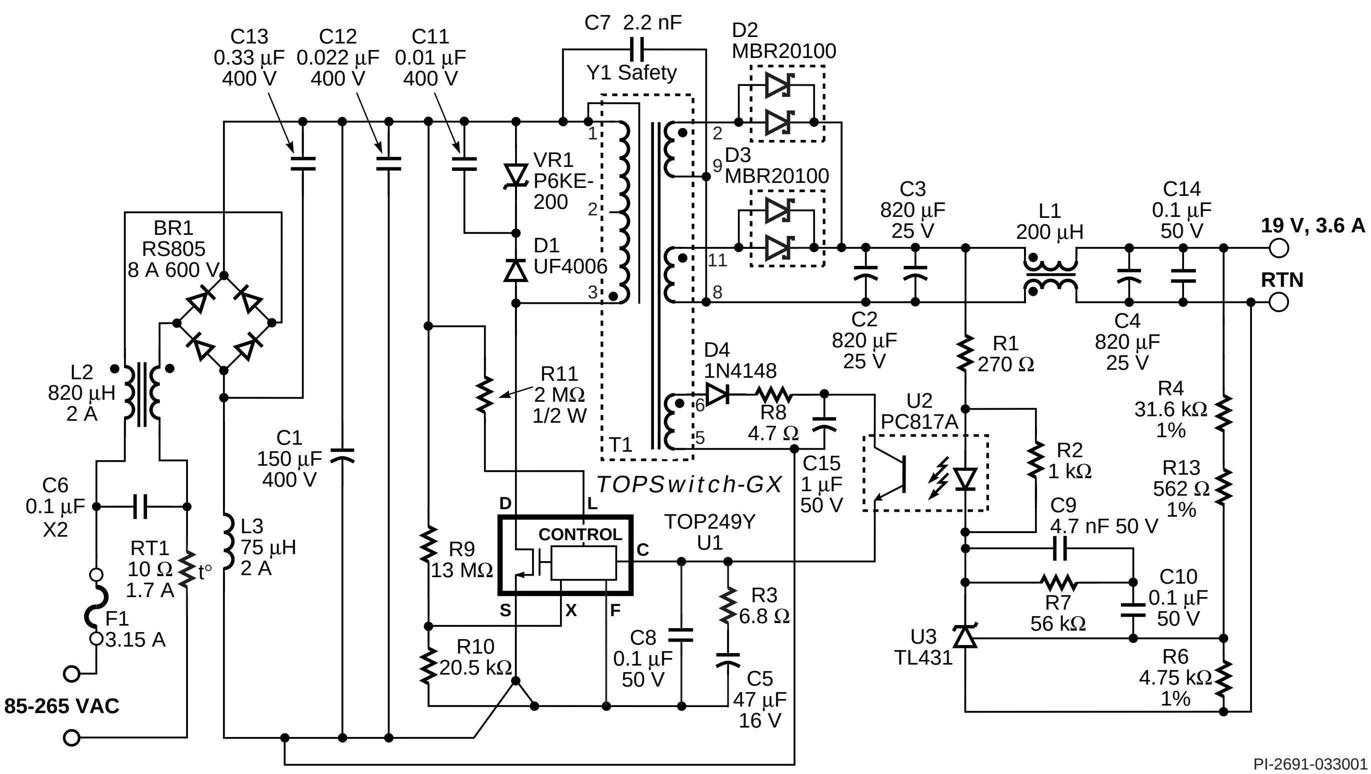

Figure 1. TOPSwitch-GX 70 W Laptop Adapter Schematic.

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.

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 gappped for A_{LG} = 843 nH/T^2
Bobbin	TDK BPQ26/20-1112CP
Winding Details	Primary: 9T + 9T, 2 x 26 AWG Shield: 1T, 8 mm x 0.015 mm Cu foil Secondary 1: 3T, 3 x 26 AWG T.I.W. Secondary 2: 3T, 3 x 26 AWG T.I.W. Bias: 2T, 8 mm x 0.015 mm Cu foil (T.I.W. = Triple Insulated Wire)
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%, Leakge: 3 μH (maximum)
Primary Resonant Frequency	1.5 MHz (minimum)

Table 1. Transformer Construction Information.

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