DI-43 Design Idea
TOPSwitch®-GX

30 W, Universal Input, 12 V Supply with <250 mW No-load

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Adapter	TOP244Y	30 W	85-265 VAC	12 V	Flyback

Design Highlights

- High efficiency (79% minimum)
- Low component count
- Excellent no-load consumption <200 mW at 115 VAC and <250 mW at 230 VAC input
- Rugged supply includes UV/OV shutdown, thermal and short circuit protection with auto-recovery
- Comfortably meets EN55022B and CISPR22B conducted EMI standards
- Overload power delivery at 265 VAC limited to 160% of rated load

Operation

The TOPSwitch-GX integrates many features to implement low cost, switched mode power supplies.

A single resistor (R1) implements input UV/OV protection using the L pin (UV typ. 100 VDC; OV typ. 450 VDC). Resistor R4 programs the U1 current limit to 85% of nominal, and resistor R2 reduces this current limit as input voltage increases, limiting maximum overload power. The reduced current limit allows continuous conduction mode operation with a small transformer, reducing primary and secondary peak currents, optimizing efficiency, and reducing component stress.

Diode D1 and VR1 form a clamp circuit that absorbs leakage inductance energy during normal operation, with Zener VR1 clamping the voltage to a safe level. Capacitor C2 diverts some of the leakage energy from VR1, reducing its temperature and increasing overall efficiency. After clamping, reverse current flows through D1, recovering some of the clamp energy. R3 limits the reverse current in D1 and improves EMI by limiting drain voltage ringing.

Resistors R9 and R10 set the output voltage. Components C10 and R8 provide compensation with R6 setting DC loop gain. Using a TL431 error amplifier gives better regulation and output voltage tolerance than a Zener reference and also provides better no-load performance due to lower (1 mA) bias current.

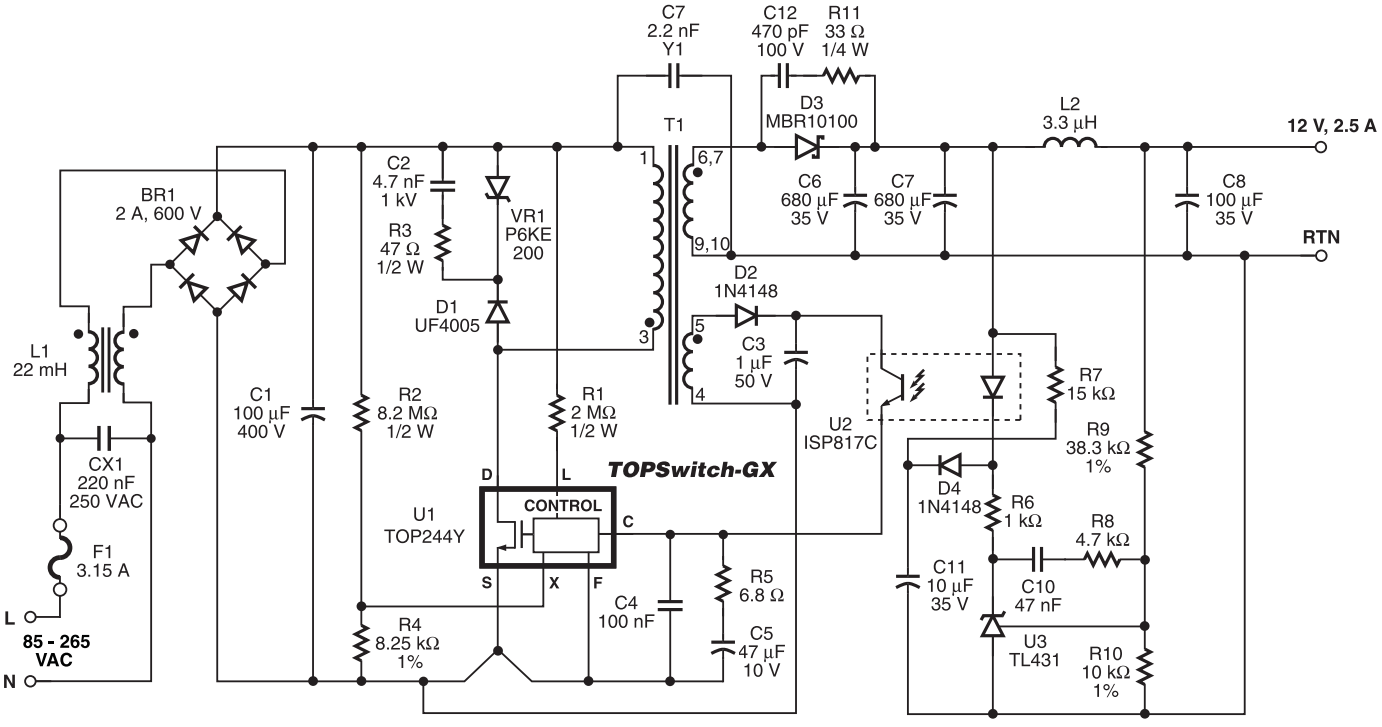

Figure 1. TOPSwitch-GX 12 V, 30 W Universal Power Supply.

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Optional components D4, C11, and R7 implement soft finish to limit startup overshoot. Resistor R7 discharges this soft-finish capacitor at power down.

Key Design Points

- Use reflected voltage from 90 V to 120 V.
- Compact layout for components D3, C6 and C7 will improve efficiency. Make sure both capacitors C6 and C7 have equal secondary loop areas to balance the ripple currents in each.
- Clamp: for lowest cost use an RCD clamp replacing Zener VR1 with a power resistor. For best no-load performance, use the Zener clamp as shown.
- Reference voltage: Use low current Zener secondary reference with 5 mA bias current for lowest cost. Use TL431 as shown for both better regulation accuracy and no-load consumption (due to lower bias current 1 mA).

Transformer Parameters	
Core Material	EF25 Nippon Ceramic NC-2H A_{LG} of 264 nH/t^2
Bobbin	EF25 10 pin (Miles Platts FE0100 with TBS-601)
Winding Details	Primary: 58T × 26 AWG Bias: 5T 2 × 26 AWG 12 V: 6T, 4 × 25 AWG T.I.W.
Winding Order (Pin Numbers)	1/2 Primary, tape, 1/2 primary (1-3), tape, bias (5-4), tape, 12 V (9-10, 6-7), tape
Inductance	Primary: 876 µH, ±10% at 132 kHz Leakage: 28 µH (maximum)
Primary Resonant Frequency	570 kHz (minimum)

Table 1. Transformer Parameters. (TIW = Triple Insulated Wire).

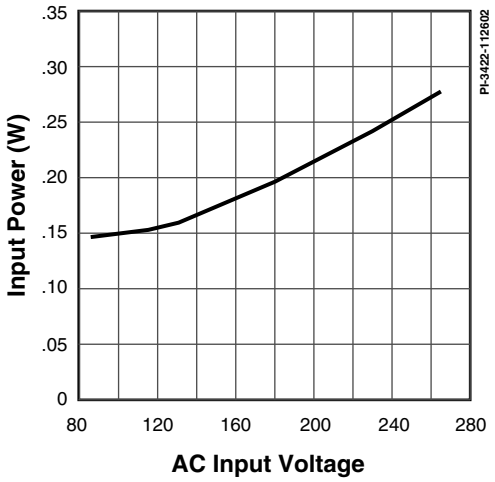

Figure 2. P_{IN} vs V_{IN} Curve.

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