

Design Idea DI-21

TOPSwitch-GX[®] 45 W, Universal Input, LCD Monitor External Adapter



Application	Device	Power Output	Input Voltage	Output Voltage	Topology
LCD Monitor	TOP247Y	45 W	90-265 VAC	12 V	Flyback

Design Highlights

- High efficiency, >82% at 90 VAC
- Low part count solution
- Extremely low EMI – frequency jitter helps meet EN55022B and FCC B limits with output return grounded
- Low zero load power consumption, <250 mW at 115 VAC
- Line undervoltage detection (UV) and overvoltage (OV) power system protection
- Differential and common mode surge immunity to 4 kV (EN61000-4-5)
- 100 kHz ring wave immunity to 4 kV (IEEE C62.41)

Operation

The design in Figure 1 utilizes the TOP247Y and takes advantage of many of the device's features. Line UV and OV (100 V and 450 V, respectively) are implemented using a single 2 MΩ resistor (R1). Undervoltage eliminates power-up/down output glitches and overvoltage provides protection for both short duration transients and long duration power system surges, removing the need for an input MOV. Resistor R8 programs the internal current limit of the TOP247Y to 50% of nominal. The

current limit is further reduced as a function of line voltage by R4-R6 to provide approximately constant overload power vs. line. The larger TOPSwitch-GX selection reduces conduction losses, raising efficiency (without circuit changes or increased overload power), and permits a high inductance design with a small EE30 core for higher efficiency.

Key Design Points

- Nominal UV and OV set points are calculated according to the equations:

$$V_{UV} = (50 \mu A \times R1) + 2.5 V, \quad V_{OV} = (R1 \times 225 \mu A) + 2.9 V$$
- C2 provides high frequency bypass for high voltage DC bus, reducing high frequency EMI.
- C3 reduces clamp Zener temperature and increases efficiency. R18 in series with C3 damps drain ringing.
- Ferrite beads, instead of RC snubbers are used on output rectifier D7 to reduce zero load power consumption.
- L5 and L6 reduce common mode conducted interference at high frequencies (>10 MHz).
- T1 shield winding (pins 2-3) reduces EMI. R7 damps ringing caused by shield capacitive currents.

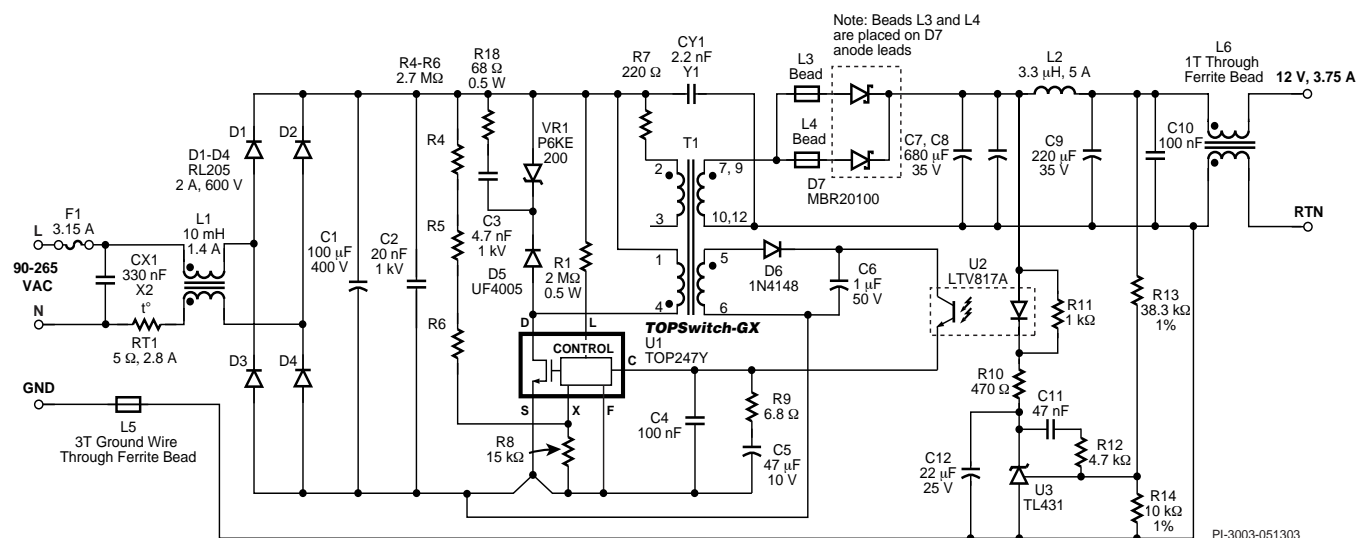


Figure 1. TOPSwitch-GX 45 W LCD Monitor Adapter.

- Capacitor C12 is added to eliminate output start-up overshoot.
- Feedback compensation is accomplished with C11 and R12 across TL431 reference amplifier U3 and correct choice of optocoupler series resistor R10.

TRANSFORMER PARAMETERS	
Core Material	EE30 TDK PC40EE30-Z or equivalent, Gap for A_{LG} of 1045 nH/T ²
Bobbin	E130 12 pin (Yih Hwa YW-016 or equivalent)
Winding Details	Shield: 10T, 2 x 28 AWG Primary: 22T, 25 AWG Bias: 3T, 4 x 28 AWG Secondary: 3T, 5 x 25 AWG T.I.W. (T.I.W. = Triple Insulated Wire)
Winding Order (Pin Numbers)	Tape, Shield (2-3), Tape, Primary (4-1), Tape, Bias (6-5), Tape, Secondary (7,8,9-10,11,12), Tape
Inductance	Primary: 490 μ H \pm 10%, Leakage: 6 μ H (maximum)
Primary Resonant Frequency	2 MHz (minimum)

Table 1. Transformer Construction Information.

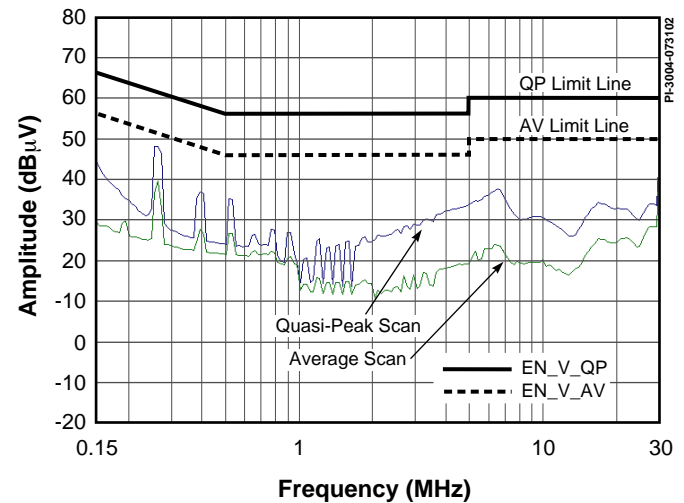


Figure 2. 115 V Conducted EMI for LCD Monitor Supply. Meets FCC Part 15 Class B.

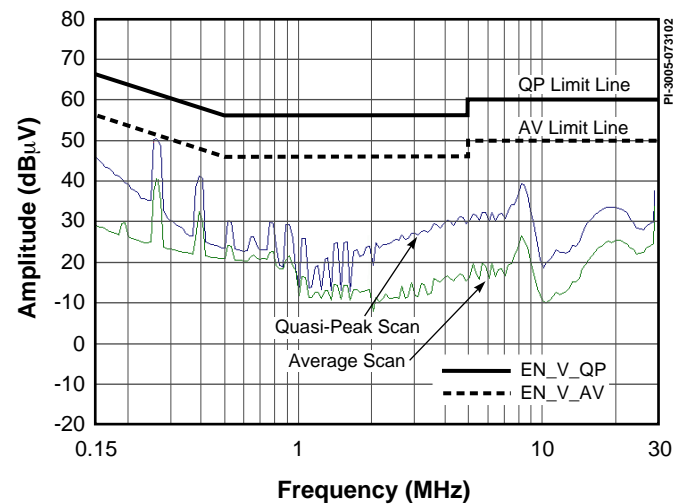


Figure 3. 230 V Conducted EMI for LCD Monitor Supply. Meets EN55022 EMI spec.

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