Design Idea DI-33

TinySwitch®-II Wide Range DVD Supply: <50 mW No-load Consumption

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DVD Player	TNY268P	11 W cont. 17 W pk.	85-265 VAC	+3.3 V, +5.0 V, +12.0 V, -12 V	Flyback

Design Highlights

- No-load input power <50 mW
- 700 mW of output power with 1 W input
- Built-in frequency jitter allows low cost π filter
- 132 kHz operation minimizes transformer size and turns, providing good cross-regulation
- High efficiency – >77% minimum
- Meets CISPR22B/EN55022B and FCC B with >10 dB margin

Key Design Points

- An optional low voltage bias circuit, D9 and C10, powers U1 via R6, reducing light and zero load power consumption. This provides bias current that would otherwise be provided from the DRAIN by the internal high voltage current source. The current source is disabled when the BP pin is fed externally, an internal clamp limiting the voltage to 6.3 V. The bias supply is designed to produce 7.5 V at no-load. Resistor R6 is chosen to provide approximately 500 µA into the BP pin, the maximum consumption at no-load.
- Good cross-regulation on 5 V and 3.3 V outputs is achieved by minimizing secondary leakage through the use of foil windings and dual sense feedback via R15 and R16.
- To minimize potential noise coupling to the SOURCE pin during common mode surges, the Y1 capacitor C8 is connected between secondary return and the HV DC rail.
- Resistors R5 and R7 damp ringing to improve EMI.
- Optional soft-finish capacitor C7 eliminates output startup overshoot.
- Optional under-voltage resistor R1 provides clean startup and prevents output glitches on power down. R1 = (V_{UV}-2.5 V)/50 µA.
- Small loop areas in the secondary layout around D10, C12, D9, C11, D7, C15, D8 and C9 together with post-filters L2/C20, L3/C17 and L4/C18 provide low output ripple, below 50 mV p-p.

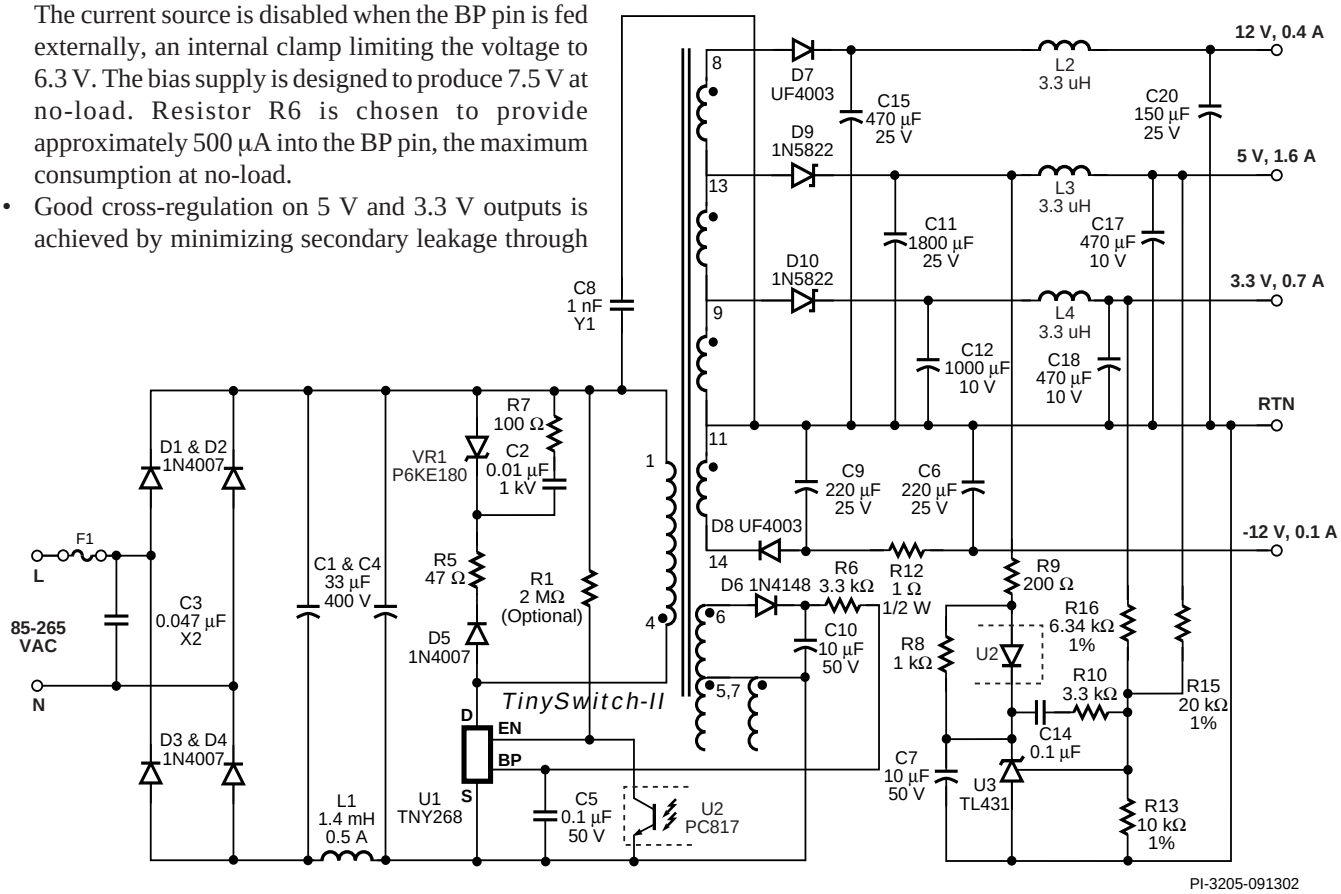

Figure 1. TinySwitch-II DVD Player Schematic.

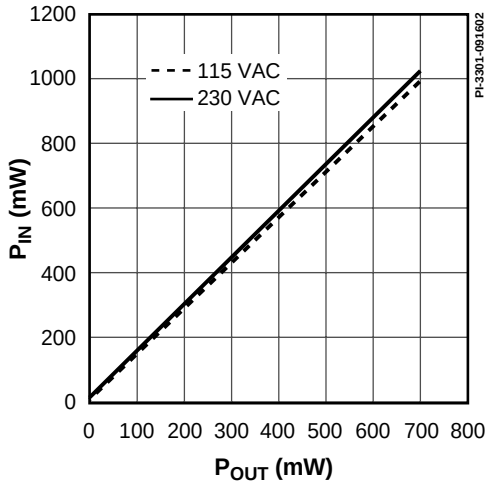

Figure 2. P_{IN} vs. P_{OUT} Curve.

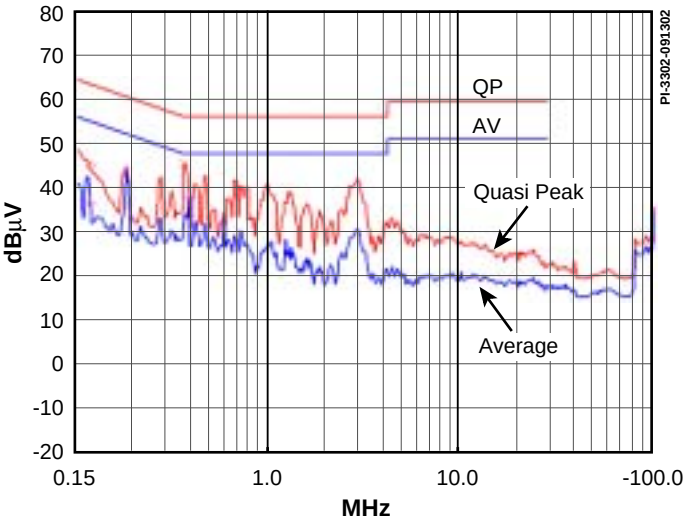

Figure 3. Conducted EMI with Artificial Hand Connected to Output Return.

TRANSFORMER PARAMETERS	
Core Material	Himag MZ4 EEL25.4, or equivalent, Gap for A_L of 344 nH/T^2
Bobbin	EEL25 Vertical 14 Pins
Winding Details	Shield: 32T, 2 x 32 AWG Primary: 64T, 2 x 32 AWG Bias: 6T, 4 x 32 AWG Shield 2: 4T, 4 x 32 AWG +12 V: 4T, 4 x 32 AWG +5 V: 1T, 14 mm Cu Foil +3.3 V: 2T, 14 mm Cu Foil -12 V: 7T, 4 x 32 AWG
Winding Order (Pin Numbers)	3 mm margin tape on both sides of bobbin. Shield (NC-5), tape, Primary (1-4), tape, Bias (7-6), tape, Shield (NC-7), tape, 12 V (13-8), 3.3 V (11-9), 5 V (9-13), tape, -12 V (14-11), tape (NC - no connect)
Inductance	1420 µH ±25%
Primary Resonant Frequency (Pins 1-4, all other open)	500 kHz (minimum)

Table 1. Transformer Construction Information.

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