DI-147 Design Idea
PeakSwitch®

Multiple Output Power Supply for Audio Amplifiers

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Audio	PKS607YN	60 W, 200 W pk	195 – 265 VAC	±26 V, -15 V, 10 V, 5 V	Flyback

Design Highlights

- Effectively replaces linear transformer-based power supplies in home audio applications
- Low component count, compact and lightweight
- Energy efficiency
  - >75% efficiency at full load (60 W)
  - <300 mW no-load power consumption at 265 VAC
  - Reduces heat sink requirements and eliminates need for separate standby supply
- Excellent transient response improves audio quality
- Duel converter approach gives excellent cross-regulation between outputs
- Integrated frequency jittering, together with a low cost EMI filter, allows for CISPR-22/EN55022B conducted EMI compliance (see Figure 2)
- Integrated safety/reliability features:
  - Accurate auto-recovering, thermal shutdown function maintains safe PCB temperatures under all conditions
  - Latching shutdown protects against output short circuits and open feedback loops

Operation

The universal input power supply shown in Figure 1 has two main output supplies, +26 VDC and –26 VDC, and consists of two parallel converters, which are each 30 W (continuous) and up to 100 W (peak). Each converter uses a PeakSwitch device (PKS607YN) and shares a common input stage. The ±26 V outputs can each deliver an output current of 3.8 A peak and 1.15 A continuous. The combined power of both converters is thus 60 W (continuous) and 200 W (peak). Applications include audio amplifiers, where high peak power requirements exist for short time durations. Amplitude and duration of peak current is determined by duty cycle, thermal environment and heat-sinking.

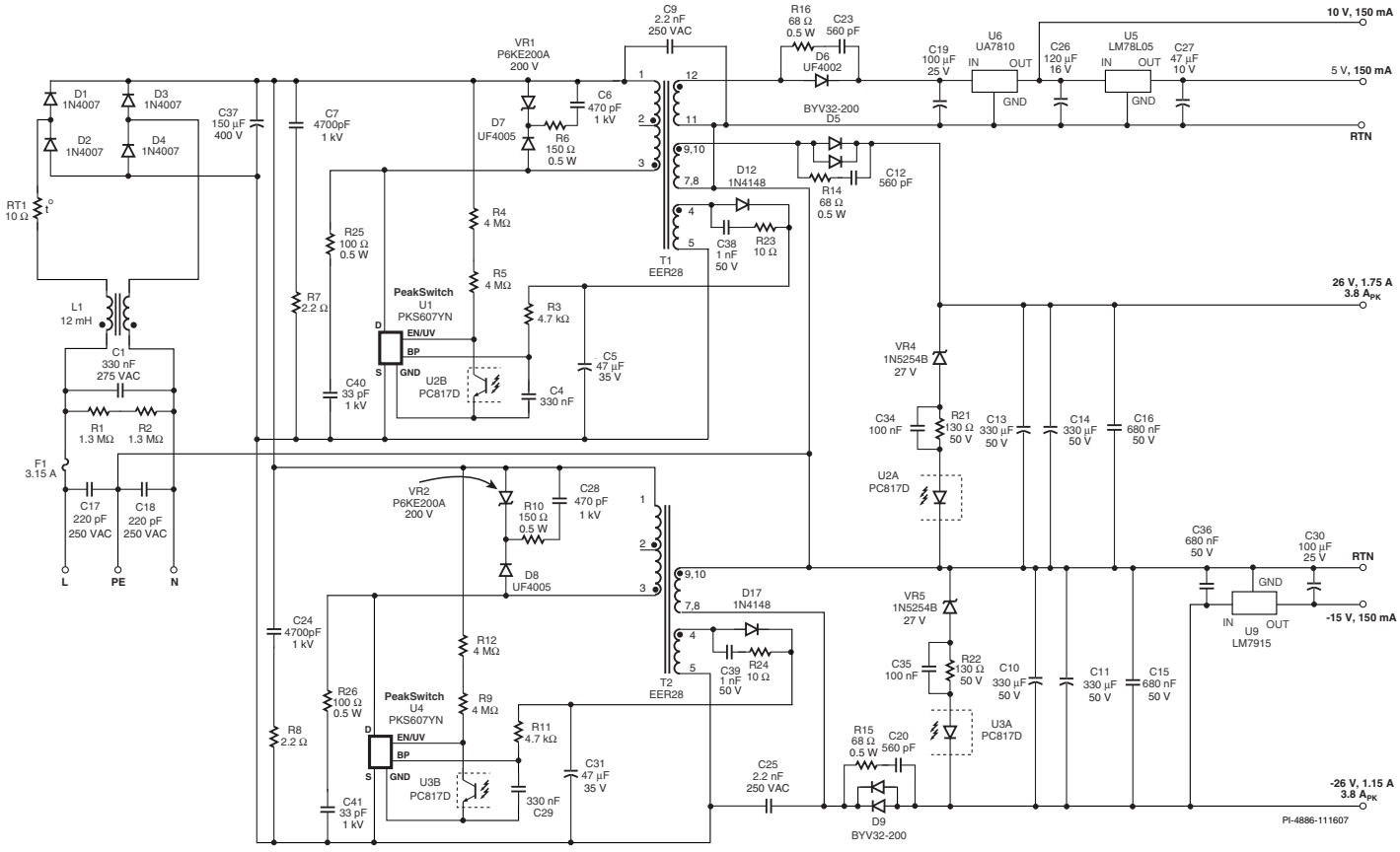

Figure 1. Schematic of a 60 W continuous and 200 W Peak Audio Amplifier Power Supply.

Common mode choke, L1, and the four Y-capacitors, C9, C17, C18 and C25, form the common mode EMI filter. Common mode choke L1 also works in conjunction with X-capacitor C1 to provide differential mode EMI filtering.

The controller in U1 (U4) skips switching cycles to regulate the output voltage based on feedback to its EN/UV pin. When the current pulled out of this pin exceeds 240 µA, a low logic level (disable) is generated. At the beginning of each cycle, the EN/UV pin state is sampled, and if high, the power MOSFET is turned on for that cycle (enabled); otherwise the power MOSFET remains off (disabled).

During start-up, switching is inhibited until the input voltage is above the undervoltage threshold, which is determined when a current >25 µA flows into the EN/UV pin.

Two independent feedback loops are used to control the voltages on the ±26 V outputs. This ensures that both outputs are tightly regulated and also ensures better cross-regulation between all outputs over line and load.

Key Design Points

- The high crest factor of the music source allows for smaller heatsinks.
- The auxiliary -15 V, 5 V and 10 V outputs are obtained from a linear regulator. To limit the power dissipation in the (5 V and 10 V) linear regulators, a second 17 V output was added to T1.
- As the value of X capacitor C1 is above 0.1 µF, safety agency requirements specify that R1 and R2 should be used to discharge C1 such that C1 × (R1 + R2) ≤ 1_S.
- To reduce group pulsing of switching cycles, a high gain optocoupler U2 (U3) was used. Capacitor C34 (C35) adds high frequency gain to the feedback signal.
- In a three wire system, placing Y capacitors (C17, C18) between line/neutral and earth helps reduce common mode EMI.
- The core size and the winding wire diameter sizes (see Table 1) were chosen based on the average of the peak and the continuous output power.
- A drain to source snubber (R25, C40 and R26, C41) was added to reduce radiated EMI.

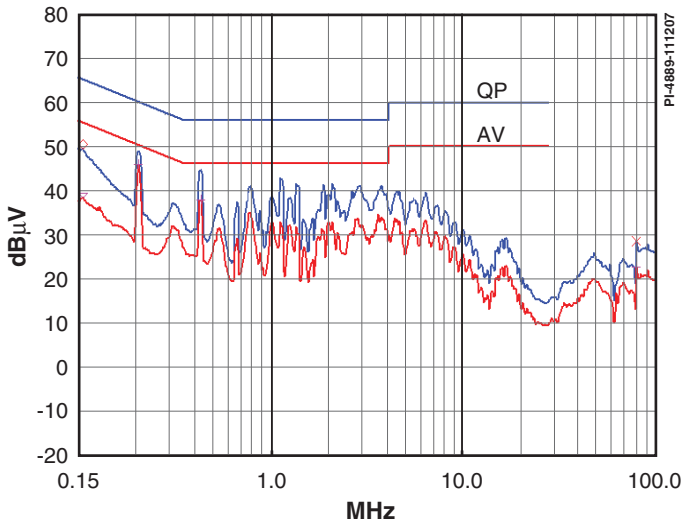

Figure 2. Conducted EMI at 230 VAC With Output Grounded (CISPR-22 Limit Lines Shown).

Transformer Parameters

Core Material	EER28 NC-2H or equivalent, gapped for ALG of 100 nH/t²
Bobbin	EER28, 12 pin, Vertical
Winding Details	Add 3 mm margins on both sides of bobbin Primary: 18T × 2, AWG31, tape Shield: 1T × 1, Foil 2 mils thickness, 3 layers tape 17 V: 6T × 2, AWG26, tape 26 V: 8T × 4, AWG23, 3 layers tape Bias: 5T × 2, AWG28, tape Primary: 18T x 2, AWG31, 2 layers tape
Winding Order	Primary (3-2), Shield (NC-1),17 V (12-11), 26 V (9,10-7,8), Bias(4-5), Primary (2-1)
Primary Inductance	129 µH, ±12%
Primary Resonant Frequency	2 MHz (minimum)
Leakage Inductance	5 µH (maximum)

Table 1. Transformer Parameters. (NC = No Connection)

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