

DI-129 Design Idea PeakSwitch®

33 W (60 W Peak) PVR Power Supply

| Application | Device | Power Output | Input Voltage | Output Voltage | Topology |
|-------------|----------|------------------|---------------|--------------------------|----------|
| PVR | PKS606PN | 33 W (60 W Peak) | 195 - 265 VAC | 3.3 V, 5 V, 17.5 V, 22 V | Flyback |

Design Highlights

- Small, low-cost EF25 core size delivers 60 W peak
- Low component count: only 47 parts
- High efficiency: $\geq 76\%$ at 33 W
- Meets EN55022 B conducted EMI limits

Operation

The flyback converter shown in Figure 1 uses a member of the PeakSwitch family (U6, a PKS606PN) to supply 33 W continuously and peak power pulses of up to 60 W.

The controller in U6 receives feedback from the secondary through U5, and based on that feedback, enables or disables the switching of its integrated MOSFET to maintain regulation. A portion of both the 3.3 V and the 5 V outputs are fed into the TL431 (U2), which controls the current through the LED in U5. As the 3.3 V or the 5 V output voltages rise above their set-point thresholds, U2 pulls additional current through the LED in U5. This in turn increases the base drive to Q1, increasing the current pulled out of the EN/UV pin of U6. Switching cycles are skipped once the EN/UV disable threshold current is exceeded. When the current out of the EN/UV pin falls below the disable threshold, switching cycles are re-enabled.

A bias winding (T1, pins 4 and 5) on the transformer is rectified and filtered by D15 and C21, and supplies operating current to U6, through R14. The frequency jitter function within U6 and a Y-type capacitor (C10) across T1 reduce the generation of conducted EMI so that a single common mode choke (L5) and a small X-capacitor (C13) allow the supply meet EN55022B limits with 6 dB μ V or more of margin. A combination RCD-Zener clamp (R2, R15 C9, D10 and VR2) limits the peak drain-node voltage to below the 700 V rating of the MOSFET integrated within U6. Resistor R16 provides the bias current for U2. Resistor R10 sets the gain. Capacitor C22 improves transient responsiveness. Capacitor C11 and resistor R9 roll off the high frequency gain of U2. Capacitor C2 performs a soft-finish function that prevents the 3.3 V and the 5 V output voltages from overshooting their regulation set points during the initial power up of the converter. All output windings are AC stacked and exhibit good cross regulation, due to the tight coupling within transformer T1. The -5 V output uses Zener diode VR1 as a post regulator.

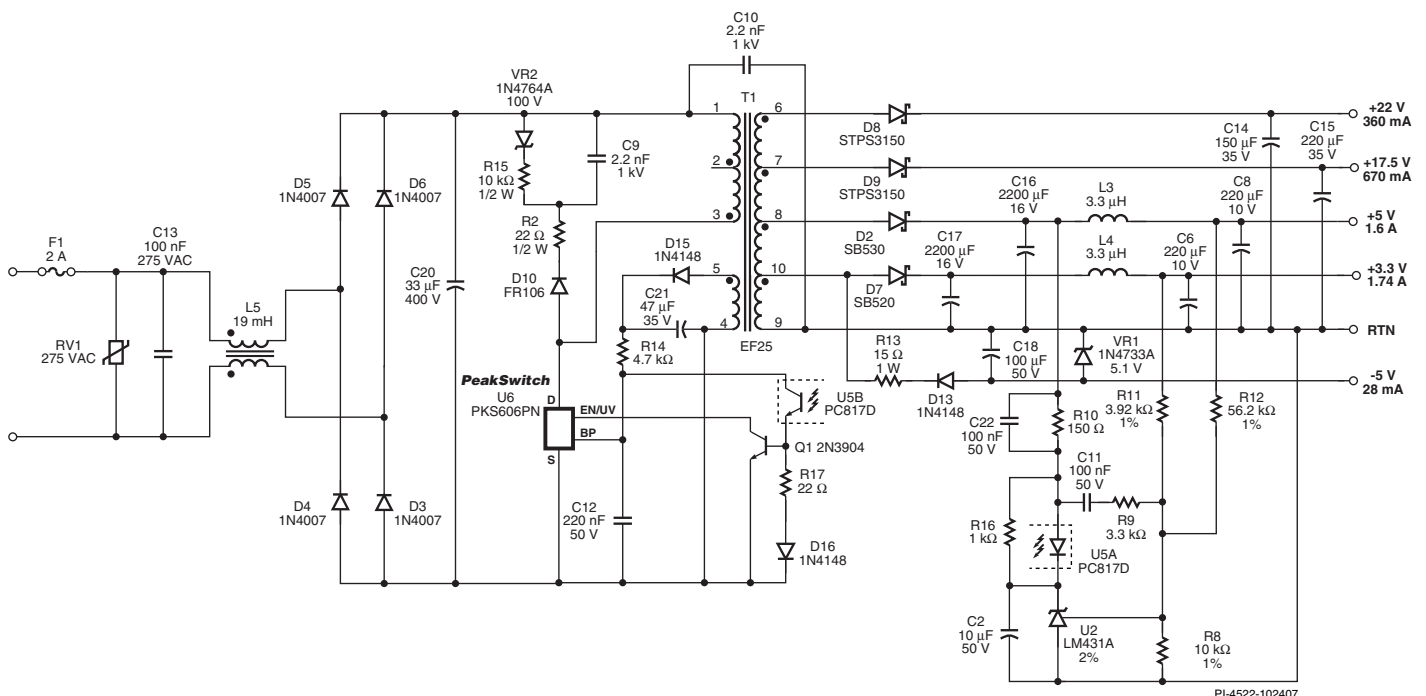


Figure 1. Circuit Diagram of a 33 W Continuous, 60 W Peak, PVR Power Supply.

Key Design Points

- All secondary winding should be wound in layers right next to each other, in order to assure the best cross regulation.
- Use foil for 3.3 V and 5 V secondary windings for the best cross regulation.
- The reflected output voltage (V_{OR}) was set at 126 V to ensure good output voltages cross regulation. If tighter cross regulation is needed, a lower value of V_{OR} could be used at the expense of reduced peak power delivery.
- The configuration of U5, Q1, R17 and D6 increases the speed of U5 and reduces pulse grouping.

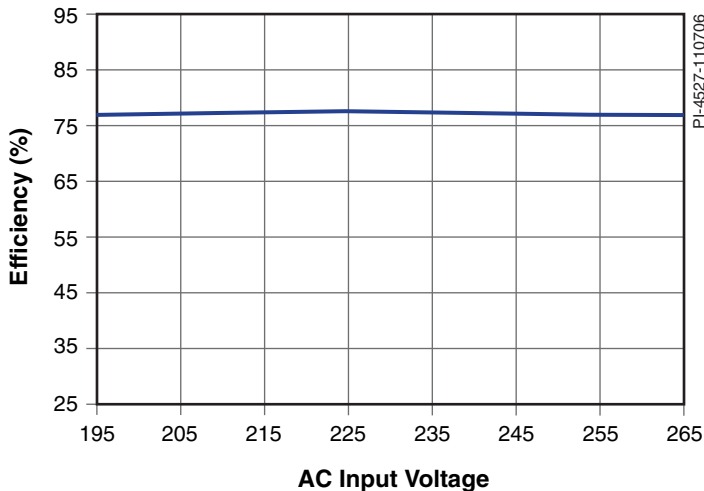


Figure 2. Efficiency vs Input Line Voltage at Full Load, Room Temperature, 50 Hz Line.

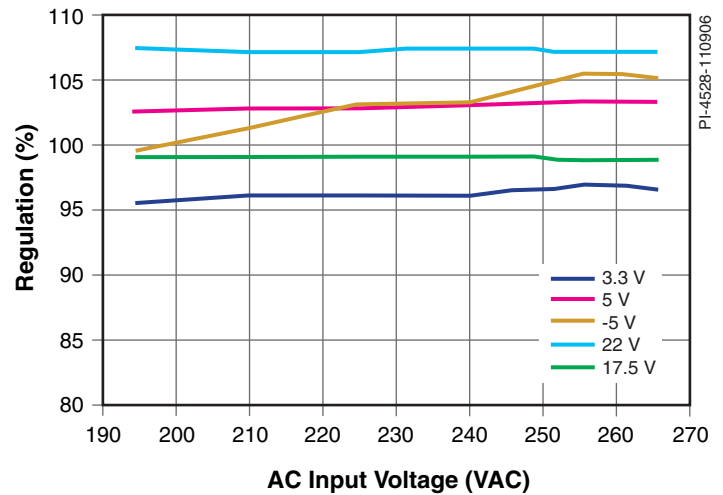


Figure 3. Output Regulation vs Input Line Voltage, Room Temperature, Full Load.

Transformer Parameters

| | |
|---------------------------|--|
| Core Material | PC40EF25-Z or equivalent |
| Bobbin | EF25 Horizontal |
| Winding Details | 1/2 Primary: 32T, 31 AWG Bias: 9T, 0.45 mm Secondary: Foil 2T, Foil 1T, 6T, 0.45 mm x 2 & 3T 0.25mm 1/2 Primary: 32T, 31 AWG |
| Winding Order | Primary (3-2), Bias (5-4) Secondary (9-10, 10-8, 7-8, 6-7), Primary (2-1) |
| Primary Inductance | 342 μ H, \pm 10% |

Table 1. Transformer Parameters. (TIW = Triple Insulated Wire, NC = No Connection, FL = Flying Lead).

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