

# DI-198 Design Idea

## LinkSwitch-CV

### Wide Range DVD Player Multiple Output Power Supply Without Need for Optocoupler

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
DVD Player	LNK626PG	7 W cont, 10 W pk	85 – 265 VAC	5 V, 12 V, -22 V	Flyback

#### Design Highlights

- Primary side control eliminates optocoupler and reduces part count
- Provides  $\pm 5\%$  tolerance on 5 V output voltage across load and line variations
- Multiple output power supply
  - Excellent cross regulation across all outputs
- Highly energy efficient
  - 0.6 W output power available for 1 W input
  - Low no-load power consumption (<130 mW at 230 VAC)
- Meets CISPR-22/EN55022B conducted EMI limits >10dB margin
- Green package: halogen free and RoHS compliant

#### Operation

The LinkSwitch-CV based multiple output power supply shown in Figure 1 provides 7 W of continuous output power and 10 W of peak power. Typical applications include DVD players or set-top boxes where a multiple output Flyback supply is required.

Diodes D1, D2, D3 and D4 and capacitors C1 and C2 rectify and smooth the AC input. Differential EMI filtering is provided by C1, C2, L1 and L2. The integrated frequency jitter feature of the LNK626PG (U1) along with transformer E-Shield™ techniques

allow such simple EMI filtering techniques to meet compliance with EN55022B, without the need for a Y-capacitor across the primary to secondary isolation barrier with floating output (see Figure 3).

Device U1 is completely self-powered from the bypass (BP) pin and decoupling capacitor C4. The controller in U1 regulates the output using On/Off control. The ratio of R3 and R6 defines the output voltage set-point.

The output voltage is sensed by monitoring the voltage at the bias winding. The feedback pin voltage is sampled 2.5  $\mu$ s after the turn-off of the high voltage switch within U1. If the sensed voltage is higher than the threshold of 1.8 V, the following switching cycle is disabled. In this manner, the controller maintains output regulation by adjusting the ratio of enabled cycles to disabled cycles. This also optimizes the efficiency of the converter over the entire load range feedback pin voltage to remain at its threshold voltage of 1.8 V using an On/Off state-machine.

Diode D6, C6 and R4 form an optional bias circuit which provides external bias to U1, reducing the no load power consumption.

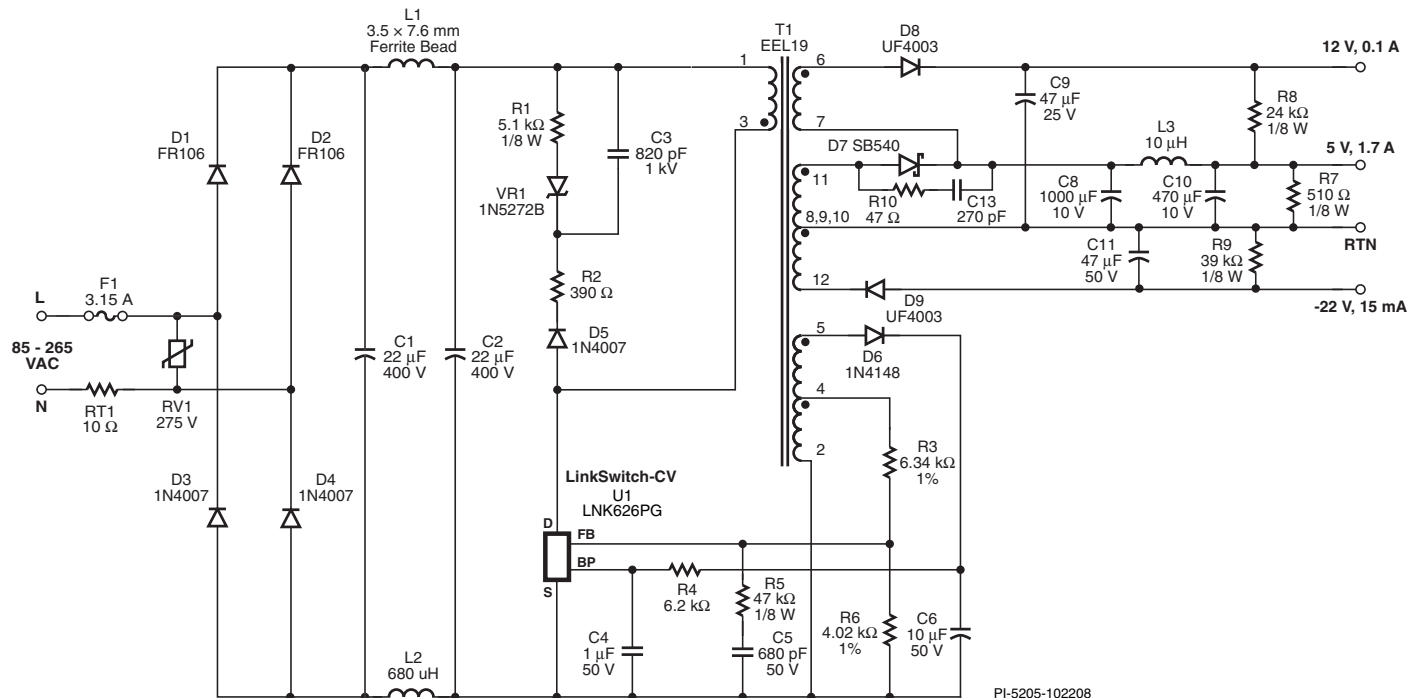


Figure 1. Schematic of a Universal Input, a Multiple Output DVD Player Power Supply Using LNK626PG.

The 5 V winding is placed next to the feedback winding for better coupling. The 12 V winding is DC stacked on top of the 5 V winding for better cross regulation. Since the 12 V winding is DC stacked the -22 V winding is physically placed in between the 5 V and 12 V outputs for better coupling to the 5 V winding.

### Key Design Points

- Diodes D1 and D2 were selected as fast rectifier diodes for better EMI performance.
- Components D5, R1, R2, VR1 and C3 form the clamping circuit. This series arrangement of VR1 and R1 reduces clamp losses at no-load and standby. Resistor R2 damps excessive ringing, thereby improving output regulation as well as EMI margin
- Long cores can cause audible noise. To minimize audible noise the flux density in the core was limited to 1500 Gauss (150 mT).
- Resistor R10 and C13 form a snubber network across D7 and reduce high frequency conducted and radiated EMI.
- Preload resistor R7, R8 and R9 limit the output voltage to within specification limits when no load is present on the respective outputs.

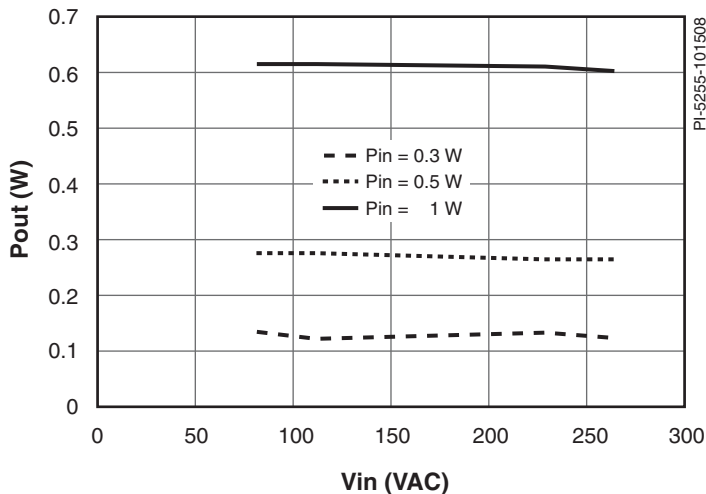


Figure 2. Available Stand-by Power at 0.3 W, 0.5 W and 1 W Input Power.

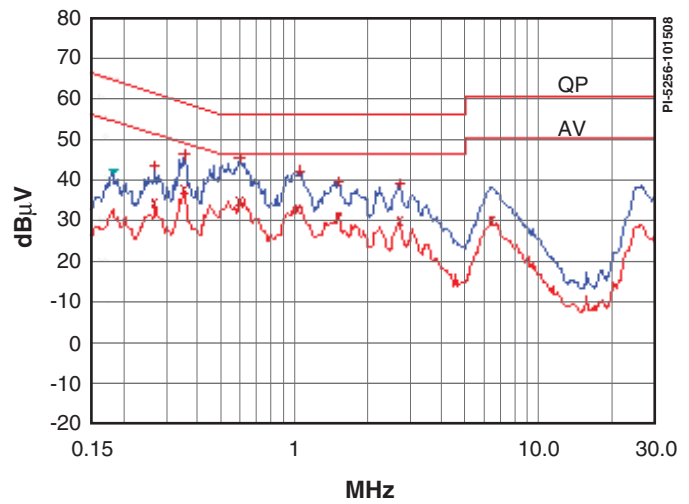


Figure 3. Conducted EMI at 230 VAC With Output Floating (CISPR-22 / EN55022B Limit Lines Shown).

### Transformer Parameters

<b>Core Material</b>	EEL19 NC-2H or equivalent, gapped for ALG of 40.5 nH/t <sup>2</sup>
<b>Bobbin</b>	EEL19, 12 pin, Horizontal
<b>Winding Details</b>	3 mm margin on Primary side and 6 mm margin on Secondary side of the bobbin to meet safety Shield: 33T × 1, 31 AWG, tape Primary: 200T × 1, 37 AWG, tape Bias: 10T × 1, 32 AWG, tape Feedback: 9T × 3, 28 AWG, 3 layers, tape 5 V: 10T × 3, 29 AWG, tape 12 V: 13T × 3, 32 AWG, tape -22 V: 40T × 1, 33 AWG, tape
<b>Winding Order</b>	Shield (2-NC), Primary (3-1), Bias (5-4), Feedback (4-2), 5 V (11-9), 12 V (6-7), -22 V (10-12)
<b>Primary Inductance</b>	1.62 mH, ±10%
<b>Primary Resonant Frequency</b>	375 kHz (minimum)
<b>Leakage Inductance</b>	210 µH (maximum)

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

Power Integrations  
5245 Hellyer Avenue  
San Jose, CA 95138, USA.  
Main: +1 408-414-9200  
Customer Service  
Phone: +1-408-414-9665  
Fax: +1-408-414-9765  
Email: usasales@powerint.com

On the Web  
www.powerint.com

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