DI-201 Design Idea
LinkSwitch®-CV

6 W, High Efficiency, Adapter Power Supply

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Adapter	LNK625PG	6 W	90 – 265 VAC	5 V	Flyback

Design Highlights

- Eliminates optocoupler and all secondary side control circuitry
- EcoSmart® – Easily meets all existing and proposed international energy efficiency standards – CoC / China (CECP) / EISA / DoE / European Commission
  - ON/OFF control provides constant efficiency to very light loads
    - No-load consumption <80 mW at 230 VAC
    - Meets ENERGY STAR 2.0 active mode efficiency (77% vs 70% requirement)
    - Ultra-low leakage current: <5 µA at 265 VAC input (no Y capacitor required)
- Over-temperature protection – tight tolerance (±5%) with hysteretic recovery for safe PCB temperatures under all conditions
- Auto-restart output short circuit and open-loop protection
- Easy compliance to EN550022 and CISPR-22 Class B EMI standards
- Green package: halogen free and RoHS compliant

Operation

The Flyback power supply shown in Figure 1 generates a single isolated 5 V, 1.2 A (6 W) output voltage from a, 90 VAC to 264 VAC input voltage range. The output regulation is within ±5% across load, line and temperature without the need for an optocoupler.

Diodes D1, D2, D3 and D4 together with capacitors C1 and C2 rectify and smooth the AC input voltage. Differential EMI filtering is provided by C1, C2, and L1. The integrated frequency jitter feature of the LNK625PG (U1) along with transformer E-Shield™ techniques allow such simple EMI filtering to meet compliance with EN55022B, even without a Y-capacitor across the primary to secondary isolation barrier (see Figure 2).

The primary clamp (D5, R1, R2, and C3) limits the maximum peak drain voltage to less than the 700 V B_{VDSS} rating of the internal MOSFET of U1. Resistor R2 damps out the high-frequency leakage inductance ringing and thereby reducing EMI and ensuring that the voltage at the FB pin more accurately represents the output voltage. Fusible, flameproof resistor RF1 limits inrush current at start-up, provides differential EMI filtering and catastrophic failure protection.

Device U1 is completely self-powered from the bypass (BP) pin and decoupling capacitor C4. The controller in U1 regulates the output by maintaining the feedback pin at its threshold voltage of 1.86 V using an On/Off state-machine. The ratio of R3 and R4 defines the output voltage set-point.

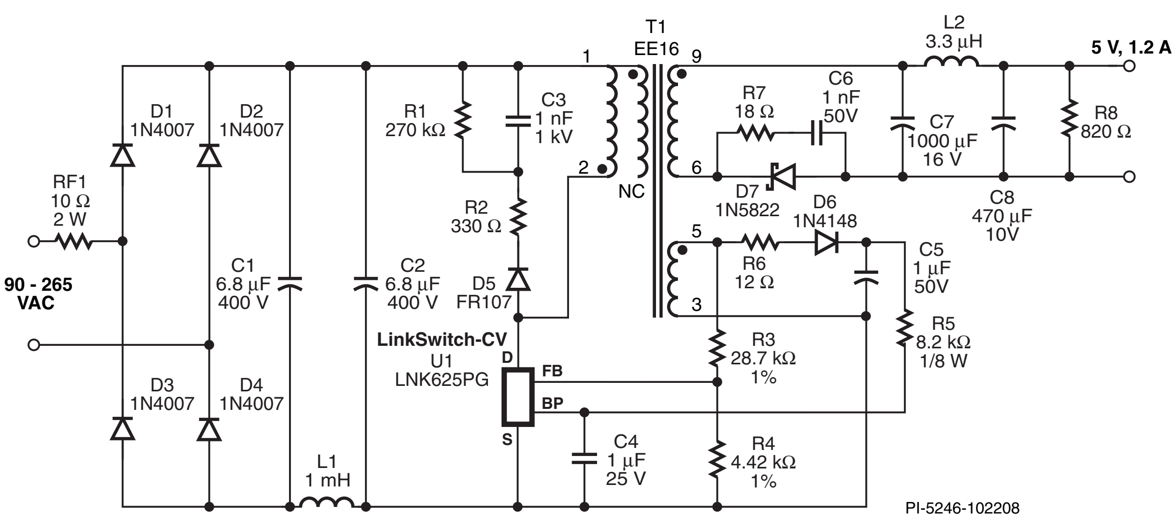

Figure 1. Schematic of a 5 V, 1.2 A Adapter Power Supply Using the LinkSwitch-CV, LNK625PG.

The output voltage is sensed by monitoring the "AC" voltage at the bias winding (anode side of D6). This voltage is divided down by R3 and R4 and sensed at the FB pin. The feedback pin voltage is sampled 2.5 μs after the turn-off of the high voltage switch. If the sensed voltage is higher than the threshold of 1.86 V the following switching cycle is disabled. Conversely, if the sensed voltage is lower than the threshold of 1.86 V the following switching cycle is enabled. 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.

At light loads the internal current limit of U1 is reduced to decrease the transformer flux density, which also reduces audible noise and switching losses.

The feedback winding voltage is above the BP pin voltage allowing it to be used as the bias supply for U1. Diode D6 and C5 rectify the voltage at the feedback winding. Resistor R5 provides external bias current to U1 via the BP pin. This results in lower no-load input power consumption.

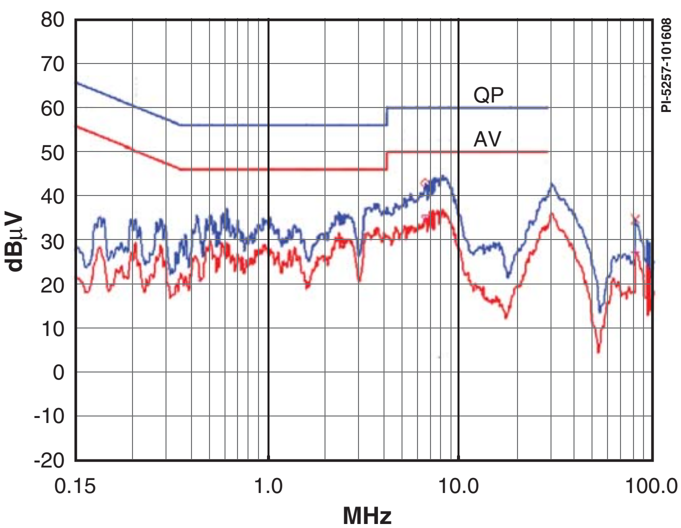

Figure 2. Conducted EMI Scan to EN55022 B Limits. Measurements Made at 230 VAC With Output RTN Connected to Artificial Hand Connection Representing Worst Case Conditions.

Key Design Points

- The voltage that appears on the feedback winding should be a very close reflection of the secondary winding voltage while the internal MOSFET is off. Therefore any leakage inductance induced ringing can affect output regulation.
- Diode D7 is placed on the return leg of the secondary. This is to ensure that shielding techniques used in T1 are repeatable and effective at reducing conducted EMI
- A fast blocking diode (FR107) was selected for D5, with a 330 Ω series resistor. This damps out the leakage ringing which can affect output regulation.
- Feedback resistors R3 and R4 have 1% tolerance values to allow precise centering of the nominal output voltage.

Transformer Parameters

Core Material	EE16 NC-2H or equivalent, gapped for ALG of 126 nH/t²
Bobbin	EE16, 10 pin, Horizontal
Winding Details	Feedback: 19T × 2, 34 AWG, 4 layers tape Primary: 115T × 1, 34 AWG, tape Shield: 16T × 3, 36 AWG, 2 layers tape Secondary: 7T × 2, 27 AWG, TIW, tape
Winding Order	Feedback (5–3), Primary (2–1), Shield (1–NC), Secondary (9–6)
Primary Inductance	1670 μH, ±10%
Primary Resonant Frequency	500 kHz (minimum)
Leakage Inductance	100 μH (maximum)

Table 1. Transformer Parameters. (TIW = Triple Insulated Wire, 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