Design Idea DI-76
LinkSwitch®
3.1 W Low Parts Count Power Supply

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Appliance/Industrial Control	LNK520P	3.1 W	100-375 VDC	12 V	Flyback

Design Highlights

- Replaces a linear transformer based power supply at the same or lower cost, but with much better performance
- High Efficiency: >75% at >100 mA of load current
- Primary side regulated: requires no optocoupler
- <300 mW no-load power consumption at 375 VDC
- Very low parts count: only 9 components!
- 12 V output: ideal for driving motors, relays, or SCRs

Operation

The very low parts count *LinkSwitch* flyback circuit shown below can be used as a general-purpose power supply or linear adapter replacement.

The design provides regulated output voltage during normal loads as well as a soft output-current limit during overload conditions (such as a stalled motor or defective relay). Adding to this, the other *LinkSwitch* self-protection features of auto-restart (for hard short circuits) and thermal shutdown effectively produce a very rugged design.

LinkSwitch derives all feedback information from the primary side, thus no optocoupler is required. During output diode (D4) conduction, the output voltage is reflected through the transformer turns ratio, providing a primary feedback voltage (V_{OR}), which is rectified by diode D3 and held by capacitor C4. Resistor R3 limits the effects of transformer leakage on the feedback voltage. Resistor R2 feeds the V_{OR} signal as a current to the CONTROL pin of the *LinkSwitch*, controlling duty cycle (and primary current limit during overload conditions). When there is little or no feedback signal (such as a short circuit) the *LinkSwitch* goes into auto-restart, limiting output current to approximately 40 mA.

Capacitor C3 provides device decoupling. The extra winding on pin 3 of T1 is a shield that reduces EMI.

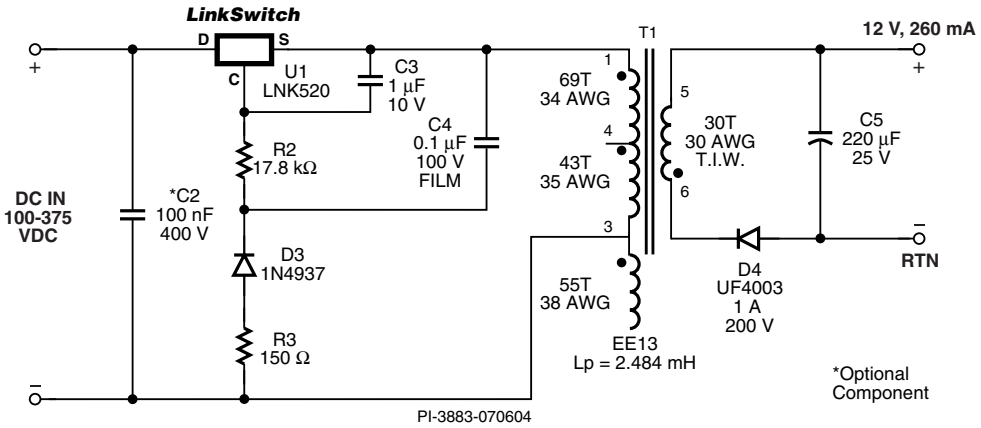

Figure 1. DC-Input, Isolated LinkSwitch 3.12 W Flyback Converter.

Key Design Points

- The value of C3 (1 µF) allows time for the output voltage to develop at startup.
- A larger R3 value will provide flatter voltage regulation if a higher no-load voltage can be tolerated.
- A lower R2 value will reduce the output voltage while proportionally increasing the maximum output current.
- Output diode D4 needs a sufficient peak inverse voltage (PIV) rating for high line withstand, requiring an ultra-fast 200 V type (UF4003). For lower output voltages (PIV <100 V), Schottky diodes work well and enable improved efficiency.
- The *LinkSwitch* PIXls spreadsheet tool included in *PI Expert*™ Design Software can be used to redesign the transformer for different output voltages.

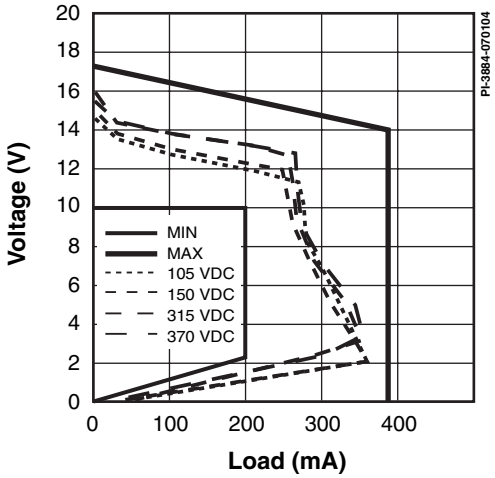

Figure 2. Output Regulation vs. Load Current Curves.

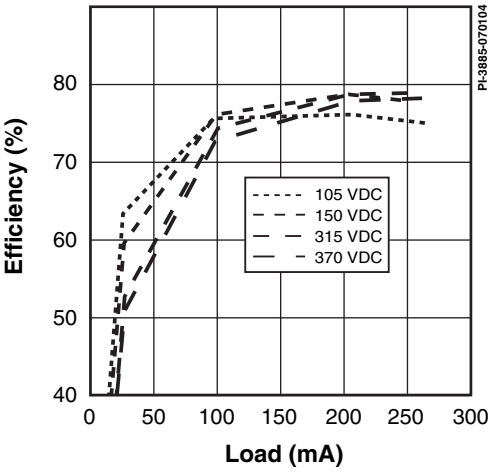

Figure 3. Efficiency vs. Output Current Curves.

TRANSFORMER PARAMETERS	
Core Material	TDK PC40 EE13, A_{LG} = 199 nH/T²
Bobbin	EE13 Horizontal 8-pin
Winding Details	Shield 1: 55 T, #38 AWG, 1 Layer Primary-1: 69 T, #34 AWG, 2 Layers Primary-2: 43 T, #35 AWG, 1 Layer Secondary: 30 T, #30 T.I.W., 2 Layers
Winding Order (pin numbers)	Shield 1: (3-Float), Primary-1 (1-4), Primary-2 (4-3), Secondary (6-5)
Primary Inductance	2484 µH ±10%
Primary Resonant Frequency	500 kHz (minimum)
Leakage Inductance	70 µH (maximum)

Table 1. Transformer Design Parameters.

Power Integrations **5245 Hellyer Avenue** **San Jose, California 95138**

MAIN PHONE NUMBER
+1 408-414-9200

APPLICATIONS HOTLINE
+1 408-414-9660

APPLICATIONS FAX
+1 408-414-9760

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