

DI-37 Design Idea

DPA-Switch®

16.5 W DC-DC Converter

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Telecom	DPA424RN	16.5 W	36 – 75 VAC	3.3 V	Forward Sync. Rec.

Design Highlights

- Low cost
- 400 kHz synchronous rectification design
- Low component count
- Efficiency – 87% at 48 VDC
- No current sense resistor or current transformer required
- Output overload, open loop and thermal protection
- Integrated UV meets ETSI standard

Operation

DPA-Switch greatly simplifies the design compared to a discrete implementation. Resistor R1 programs the under/over voltages and linearly reduces the maximum duty cycle with input voltage to

prevent core saturation during load transients. Resistor R3 programs the DPA-Switch current limit to 60% of nominal to limit fault and overload power. Drain voltage clamping is provided by Zener diode VR1. Transformer core reset is controlled by the gate capacitance of Q1.

Resistor R15 charges the gate of Q2, the forward synchronous rectifier MOSFET. The catch synchronous rectifier MOSFET (Q1) is directly driven by the transformer (T1) reset voltage and operates only when Q2 is off. Diode D2 provides a conduction path for the output inductor (L2) current when the transformer reset is complete.

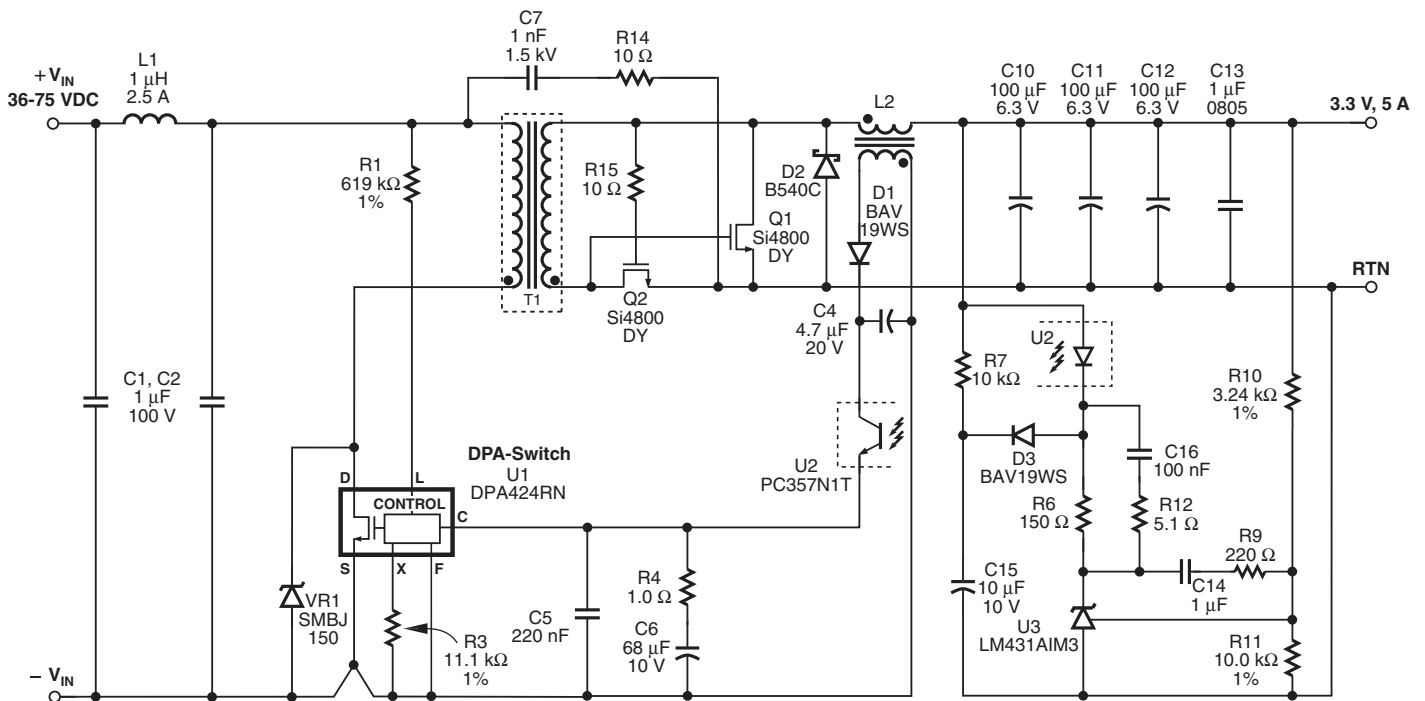


Figure 1. DPA424RN – 16.5 W, 3.3 V, 5 A DC-DC Converter.

PI-3650-022008

Key Design Points

- Transformer core reset is critical in this design. MOSFET gate loading will affect the transformer reset waveform. Capacitor C_{Q1gs} will load transformer reset. Choose Q1 MOSFET such that C_{Q1gs} provides sufficient reset at low line and safe maximum drain voltage at high line.
- Choose synchronous rectifier MOSFETs which have both low $R_{DS(ON)}$ and also low Q_g (combination of gate charge Q_{gs} and Miller capacitance Q_{gd}).

Transformer Parameters

Core Material	Epcos P/N: P 14 × 8 N87, ungapped
Bobbin	8-pin P 14 × 8 surface mount bobbin
Winding Details	Primary: 10T + 10T, 1 × 26 AWG 3.3 V: 4 × 26 AWG
Winding Order (pin numbers)	Primary-1 (4-NC), 3.3 V (5-6) Primary-2 (NC-1)
Primary Inductance	600 μH, ±25% at 400 kHz
Primary Resonant Frequency	3.8 MHz (minimum)
Leakage Inductance	1 μH (maximum)

Table 1. Transformer Parameters. (AWG = American Wire Gauge, NC = No Connection)

- Reduce transformer leakage inductance by filling each winding layer across the entire width of the bobbin.
- Choose a low-drop Schottky diode (such as Vishay SL44 – $V_f = 0.42$ V), to increase high line efficiency.
- Choose a larger DPA-Switch to increase efficiency at low and medium input voltages.

Inductor Parameters

Core Material	EPCOS P/N: P 14 × 8 N87, gap for inductor
Bobbin	8-pin P 14 × 8 surface mount bobbin
Winding Details	Main: 10T, 2 × 24 AWG Bias: 30T, 1 × 32 AWG
Winding Order (pin numbers)	Main: (7,8–5,6) Bias: (1–2)
Inductance	Pin (7,8–5,6): 16 μH, ±10% at 400 kHz

Table 2. Inductor Design Parameters.

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

Power Integrations reserves the right to make changes to its products at any time to improve reliability or manufacturability. Power Integrations does not assume any liability arising from the use of any device or circuit described herein. POWER INTEGRATIONS MAKES NO WARRANTY HEREIN AND SPECIFICALLY DISCLAIMS ALL WARRANTIES INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF THIRD PARTY RIGHTS. The products and applications illustrated herein (transformer construction and circuits external to the products) may be covered by one or more U.S. and foreign patents or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com. Power Integrations grants its customers a license under certain patent rights as set forth at <http://www.powerint.com/ip.htm>.

The PI logo, TOPSwitch, TinySwitch, LinkSwitch, DPA-Switch, PeakSwitch, EcoSmart, Clampless, E-Shield, Filterfuse, StackFET, PI Expert and PI FACTS are trademarks of Power Integrations, Inc. Other trademarks are property of their respective companies. ©2004, Power Integrations, Inc.