Design Idea DI-3
TOPSwitch®
Burst Mode Flyback

Application	Device	Power Output	Input Voltage	Output Voltage	Topology
Industrial Bias	TOP221P	100 mW	85 - 265 VAC	5.1 V	Burst Mode Flyback

Design Highlights

- Low cost isolated converter (competitive with capacitive dropper)
- DC/DC or AC/DC markets
- Wide range AC input applications
- No inductive components required in EMI filter
- Extremely low average EMI
- Surge protection without MOV
- Small physical size (1.2 in/30.5 mm × 2.2 in/55.8 mm)

Operation

The *TOPSwitch* burst mode flyback supply generates a single isolated output voltage from an AC or DC input. It is optimized for use with the TOP221 for outputs of 0-100 mW. The basic design can be scaled up to a maximum power of 200 mW with a different transformer design. Typical applications are industrial bias supplies, utility meters, and other applications requiring extremely low system cost and low output power. The circuit is designed to replace conventional linear supplies and capacitor droppers, offering universal input range and higher output power than a conventional capacitor dropper supply.

The example shown below delivers 5.1 V at 20 mA. Input voltage range is 85-265 VAC. Incoming AC is half-wave rectified and averaged by R1, R2, D1, D2, and C1, providing a DC voltage to one end of the primary winding of T1. The other end of the transformer primary is driven by the integrated high voltage MOSFET inside the TOP221.

C2 is charged by the *TOPSwitch* internal current source to initiate operation and provide enough charge to sustain the *TOPSwitch* for 8-9 switching cycles per autorestart period.

VR1 clamps the primary leakage spike at the *TOPSwitch*

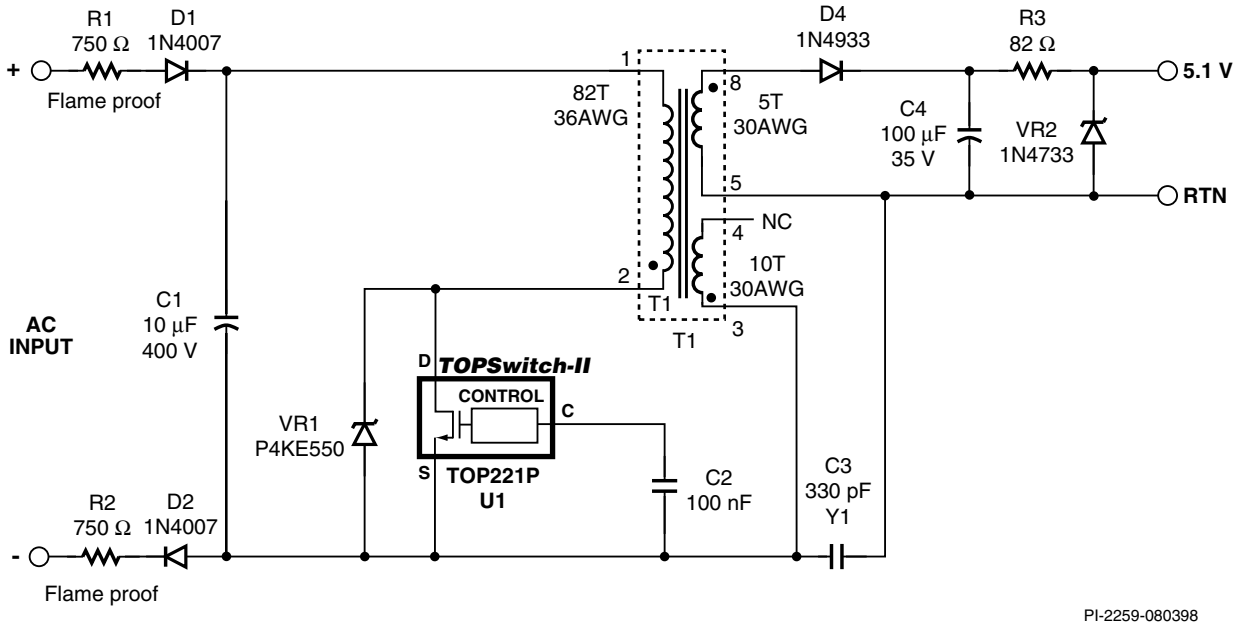

Figure 1. TOPSwitch Burst Mode Flyback.

DRAIN to a safe level. The power secondary winding of T1 is rectified and filtered by D4 and C4 to provide 7.5-8 V. R3 and VR2 step down this voltage to provide a regulated 5.1 V output. R3 is sized to provide 20 mA of output load current and 10 mA of bias current for Zener VR2 in order to maintain output regulation. A shunt regulator is used in this circuit to provide a constant load to the converter since the *TOPSwitch* runs open loop.

R1, R2, C1 and C3 provide EMI filtering for the power supply. R1, R2 and C1 also protect the rest of the circuit against input line transients. The T1 bias winding (Pins 3 and 4) does not provide power for *TOPSwitch*, but acts as a shield to reduce EMI.

In this circuit, the TOP221 runs repetitively in autorestart. The amount of power delivered in this mode is determined by the *TOPSwitch* auto restart duty cycle, which sets the ratio of switching time to idle time during autorestart, as well as the transformer primary inductance and the *TOPSwitch* current limit. With a 0.1 µF CONTROL pin capacitor, the TOP221 delivers a single burst of 8-9 pulses at 100 kHz, during each autorestart period, with approximately 1.2 ms between bursts.

To stabilize output power over extremes of line voltage, T1 is designed for discontinuous mode, with each switching pulse terminated by the *TOPSwitch* current limit. Transformer parameters are shown in following table.

Transformer Parameters	
Core Material	TDK PC40EI12.5-Z or equiv. Gap for A_L of 208 nH/T^2
Bobbin	TDK BE-12.5-1110CP or equiv.
Winding Order	Primary (2-1), Tape, Bias (3-4), Tape, Secondary (8-5)
Primary Inductance (Pins 1-2, all others open)	1.4 mH ± 10% @ 100 kHz
Primary Resonant Frequency (Pins 1-2, all others open)	700 kHz minimum
Leakage Inductance (Pins 1-2, with Pins 5-8 shorted)	70 µH maximum

Key Design Points

- Design transformer for discontinuous mode operation, with *TOPSwitch* reaching current limit each cycle.
- Size R1, R2, and C1 to provide at least 70 VDC bus voltage at minimum AC line voltage and maximum load.
- VR1 can be sourced by General Semiconductor (P4KE550). It can be replaced by a fast recovery diode (600V PIV) and series Zener clamp (BZY97-C200 or P6KE200) from DRAIN to Pin 1 of the transformer, as in conventional *TOPSwitch* designs.

For the latest updates, visit our Web site: *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, nor does it convey any license under its patent rights or the rights of others.

WORLD HEADQUARTERS AMERICAS
Power Integrations, Inc.
San Jose, CA 95138 USA
Customer Service:
Phone: +1 408-414-9665
Fax: +1 408-414-9765
e-mail: usasales@powerint.com

EUROPE & AFRICA
Power Integrations (Europe) Ltd.
United Kingdom
Phone: +44-1344-462-300
Fax: +44-1344-311-732
e-mail: eurosales@powerint.com

TAIWAN
Power Integrations
International Holdings, Inc.
Taipei, Taiwan
Phone: +886-2-2727-1221
Fax: +886-2-2727-1223
e-mail: taiwansales@powerint.com

CHINA
Power Integrations
International Holdings, Inc.
China
Phone: +86-755-367-5143
Fax: +86-755-377-9610
e-mail: chinasales@powerint.com

KOREA
Power Integrations
International Holdings, Inc.
Seoul, Korea
Phone: +82-2-568-7520
Fax: +82-2-568-7474
e-mail: koreasales@powerint.com

JAPAN
Power Integrations, K.K.
Keihin-Tatemono 1st Bldg.
Japan
Phone: +81-45-471-1021
Fax: +81-45-471-3717
e-mail: japansales@powerint.com

INDIA (Technical Support)
Innovatech
Bangalore, India
Phone: +91-80-226-6023
Fax: +91-80-228-9727
e-mail: indiasales@powerint.com

APPLICATIONS HOTLINE
World Wide +1-408-414-9660

APPLICATIONS FAX
World Wide +1-408-414-9760