New current-mode PWM controllers support boost, flyback, SEPIC and LED-driver applications

By Jürgen Schneider, *Systems Engineer Power Solutions*

Introduction

With their wide input voltage range, the TPS40210 and TPS40211 PWM controllers are targeted for isolated and non-isolated power converters used in industrial, automotive, and battery-powered applications. The full freedom in selecting the power stage and its compensation—as well as the advanced features, such as programmable soft start, adjustable/synchronizable oscillator frequency and internal slope compensation—supports the use of the devices in many applications. The basic converter architecture can provide different power levels by simply changing the power stage. While the TPS40210 is designed for general-purpose applications, the TPS40211 is tailored for driving high-brightness LEDs.

Features

- Input voltage: 4.5 to 52 V
- Current-mode architecture
- Switching frequency: 35-kHz to 1-MHz (programmable and synchronizable)
- Programmable soft start (closed loop)
- Reference voltage: 700 mV for TPS40210 and 260 mV for TPS40211
- Internal slope compensation
- Threshold for overcurrent detection: 150 mV
- Internal 8-V regulator and N-channel MOSFET driver
- Quiescent current when disabled: 10 µA
- MSOP10 PowerPAD™ and 3-mm x 3-mm SON package

Boost converter application

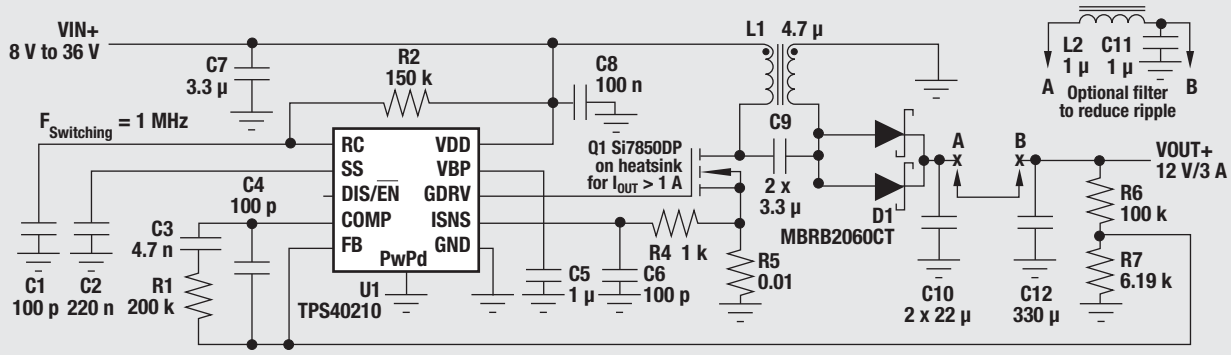
The devices and their basic configuration are described in detail in Reference 1.

SEPIC converter application

The SEPIC-converter shown in Figure 1 allows the input voltage to be smaller, larger, or equal to the targeted output voltage. The topology requires two single inductors or one coupled inductor, L1, and a capacitor C9, which is responsible for the energy transfer. The filter formed by L2 and C11 is optional. It reduces the output ripple voltage to 50 mV_{p-p} in the example shown. When operating the converter at 1 MHz, the size of the power stage (inductors/capacitors) can be minimized. However, due to the increased switching loss at this high frequency, a greater than 1-A continuous output current requires Q1 to be mounted on a heat sink. Operation without a heat sink is possible at a reduced switching frequency and/or reduced maximum input voltage.

With a 2-A current output and a 1-MHz switching frequency, converter efficiency was measured as follows: 90% with a 12-V source, 88% with a 24-V source, and 85% with a 36-V source.

Figure 1. SEPIC 1-MHz converter with 8- to 36-V input and 12-V/3-A output



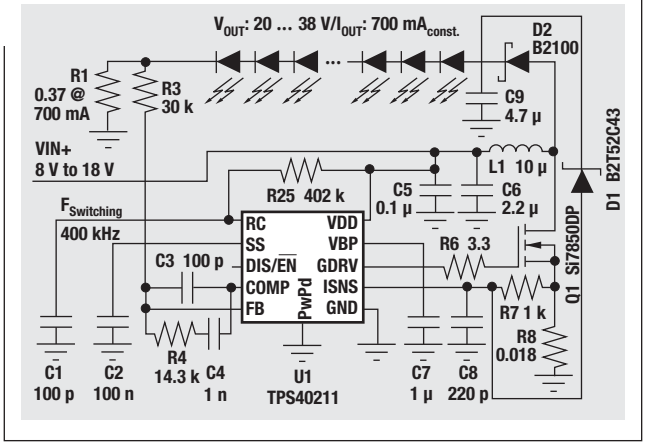
Flyback converter application

Figure 2 shows the TPS40210 controller configured in a flyback-converter topology for a dual-output isolated supply. Key components include the transformer (T1), the snubbers (R5, C7, D1, R8, C9, R10, R11, C12 and C13), the optocoupler (U2), the secondary-side reference and error amplifier (U3), the bias resistor (R15) belonging to U3, the loop compensation (C19, C20 and R16), the output-voltage divider (R17 and R18), and the secondary-side soft-start and overshoot control (D5, R14 and C18). The circuit shown directly controls the positive output rail (V_{OUT}+) only. Negative-rail regulation is based on the cross regulation between the two secondary windings of T1. When the negative output does not have a load, R12 and D4 provide a basic load.

High-brightness LED-driver application

DC/DC regulators are usually designed to provide a constant-voltage output; however, LED applications require a constant-current output. In Figure 3, R1 is used to sense the LED current. The losses in R1 are minimized with the TPS40211 because of its low 250-mV reference voltage. D1 protects against output overvoltage in the event of an LED-string open circuit. The brightness can be programmed by altering R1, current injection into the FB pin, or by PWM dimming. See Reference 1 for more information.

Figure 3. 700-mA high-brightness LED driver



References

For more information related to this article, you can download an Acrobat Reader file at www-s.ti.com/sc/techlit/*litnumber* and replace *"litnumber"* with the **TI Lit. #** for the materials listed below.

Document Title	**TI Lit. #**
1. "TPS40210/211" data sheet	slus772

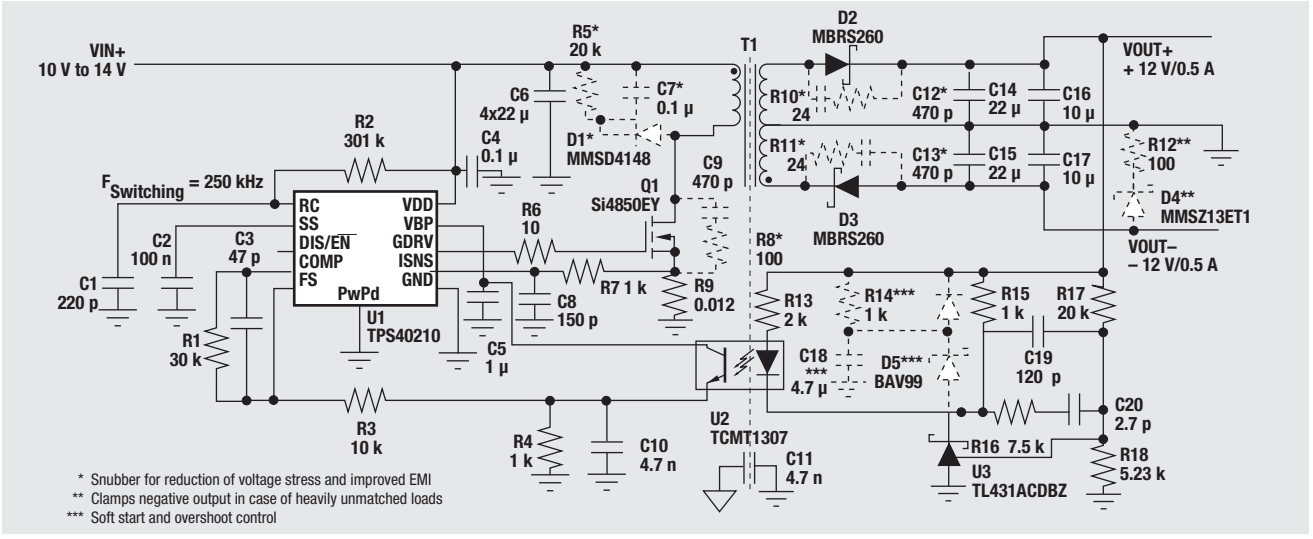
Related device

TPS40200—4.5- to 52-V wide input range step-down converter
www.ti.com/sc/device/TPS40200

Related Web sites

power.ti.com
www.ti.com/sc/device/TPS40210

Figure 2. Isolated flyback converter with a 10- to 14-V input and ±12-V/0.5-A output



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products	
Amplifiers	**amplifier.ti.com**
Data Converters	**dataconverter.ti.com**
DSP	**dsp.ti.com**
Interface	**interface.ti.com**
Logic	**logic.ti.com**
Power Management	**power.ti.com**
Microcontrollers	**microcontroller.ti.com**
Applications	
Audio	**www.ti.com/audio**
Automotive	**www.ti.com/automotive**
Broadband	**www.ti.com/broadband**
Digital control	**www.ti.com/digitalcontrol**
Military	**www.ti.com/military**
Optical Networking	**www.ti.com/opticalnetwork**
Security	**www.ti.com/security**
Telephony	**www.ti.com/telephony**
Video & Imaging	**www.ti.com/video**
Wireless	**www.ti.com/wireless**

TI Worldwide Technical Support

Internet

TI Semiconductor Product Information Center Home Page
support.ti.com

TI Semiconductor KnowledgeBase Home Page
support.ti.com/sc/knowledgebase

Product Information Centers

Americas

Phone	+1(972) 644-5580	Fax	+1(972) 927-6377
Internet/Email	support.ti.com/sc/pic/americas.htm		

Europe, Middle East, and Africa

Phone

European Free Call	00800-ASK-TEXAS (00800 275 83927)
International	+49 (0) 8161 80 2121
Russian Support	+7 (4) 95 98 10 701

Note: The European Free Call (Toll Free) number is not active in all countries. If you have technical difficulty calling the free call number, please use the international number above.

Fax	+(49) (0) 8161 80 2045
Internet	support.ti.com/sc/pic/euro.htm

Japan

Fax			
International	+81-3-3344-5317	Domestic	0120-81-0036
Internet/Email			
International	support.ti.com/sc/pic/japan.htm		
Domestic	www.tij.co.jp/pic		

Asia

Phone			
International	+886-2-23786800		
Domestic	Toll-Free Number		Toll-Free Number
Australia	1-800-999-084	Malaysia	1-800-80-3973
China	800-820-8682	New Zealand	0800-446-934
Hong Kong	800-96-5941	Philippines	1-800-765-7404
India	+91-80-41381665 (Toll)	Singapore	800-886-1028
Indonesia	001-803-8861-1006	Taiwan	0800-006800
Korea	080-551-2804	Thailand	001-800-886-0010
Fax	+886-2-2378-6808	Email	tiasia@ti.com
Internet	support.ti.com/sc/pic/asia.htm		ti-china@ti.com

C010208

Safe Harbor Statement: This publication may contain forward-looking statements that involve a number of risks and uncertainties. These "forward-looking statements" are intended to qualify for the safe harbor from liability established by the Private Securities Litigation Reform Act of 1995. These forward-looking statements generally can be identified by phrases such as TI or its management "believes," "expects," "anticipates," "foresees," "forecasts," "estimates" or other words or phrases of similar import. Similarly, such statements herein that describe the company's products, business strategy, outlook, objectives, plans, intentions or goals also are forward-looking statements. All such forward-looking statements are subject to certain risks and uncertainties that could cause actual results to differ materially from those in forward-looking statements. Please refer to TI's most recent Form 10-K for more information on the risks and uncertainties that could materially affect future results of operations. We disclaim any intention or obligation to update any forward-looking statements as a result of developments occurring after the date of this publication.

Trademarks: All trademarks are the property of their respective owners.

Mailing Address: Texas Instruments
Post Office Box 655303
Dallas, Texas 75265