AN-1390 LM3203 Evaluation Board

1   Introduction

The LM3203 evaluation board is a working demonstration of a buck converter. This document contains information about the board. For further information on buck converter topology and component selection, see the device-specific data sheet.

2   General Description

The LM3203 converts high input voltages to lower output voltages with high efficiency. It does this through a inductor based switching topology, applying the input voltage to the inductor for a certain portion of the cycle. The duty cycle in pulse width modulation (PWM) mode will be V_{OUT} / V_{IN}, which can be seen on the SW pin.

There are three modes of operation. These are fixed frequency PWM, forced bypass, and shutdown mode. Setting the BYP pin low (<0.4 V) or leaving floating places the device in PWM mode. Setting the BYP pin high (>1.2 V) places the device in forced bypass mode. Setting the EN pin low (<0.4 V) places the device in shutdown mode. Setting the EN pin high (>1.2 V) enables normal operation.

At the PWM mode, the output voltage is setting by the voltage of the V_{CON} pin, as in Equation 1:

$$V_{OUT} = ((R1 + R2) / R2) \times V_{CON}$$

(1)

3   Operating Conditions

The board will operate under the following conditions:

$2.7\ V \le V_{IN} \le 5.5\ V$

$0.267\ V \le V_{CON} \le 1.2\ V$

$0.8\ V \le V_{OUT} \le 3.6\ V$
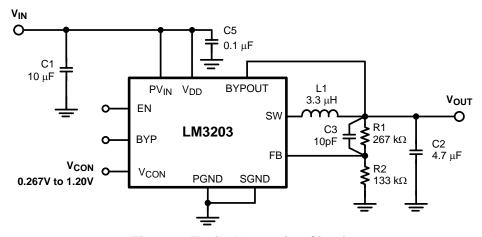
$0\ mA \le I_{OUT} \le 500\ mA$

4   Schematic

Figure 1. Typical Operating Circuit

All trademarks are the property of their respective owners.

5   Board Layout

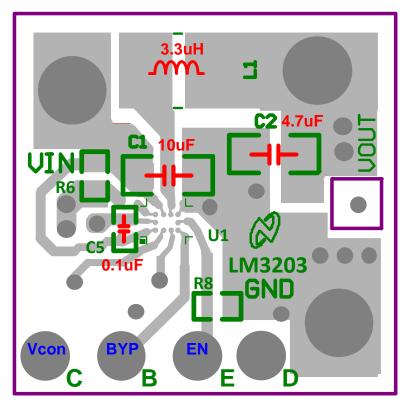**Figure 2. Top Layer**

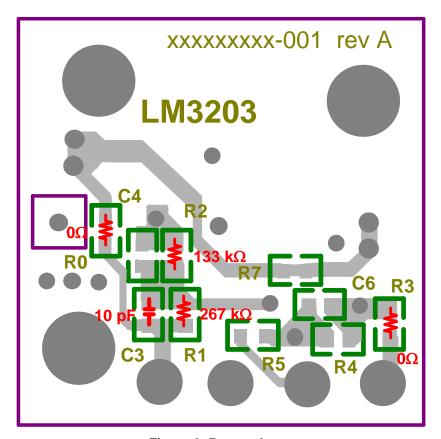**Figure 3. Bottom Layer**
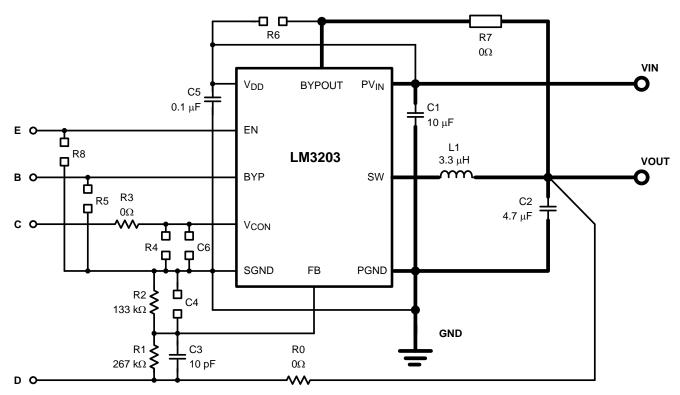
6   Board Schematic

Figure 4. Complete Evaluation Board Schematic

7   PCB Guidelines

For your application circuit, proper layout for the buck regulator should be implemented by following a few simple guidelines. (Also, see the *Board Layout Considerations* section in the device-specific data sheet.)

- Place C1 right next to the device between PV_{IN} and PGND pin.
- Place C5 right next to the device between V_{DD} and SGND pin.
- Make the traces drawn with heavy lines, which are Power lines, as short and as wide as possible.
- Making the traces drawn with heavy lines on the same layer should be good. However, place as many vias as possible if traces are on multiple layers.
- Leave R7 unconnected, and short R6 and R5 when BYPASS mode is NOT required.

8 Bill of Materials (BOM)

Table 1. Bill of Materials

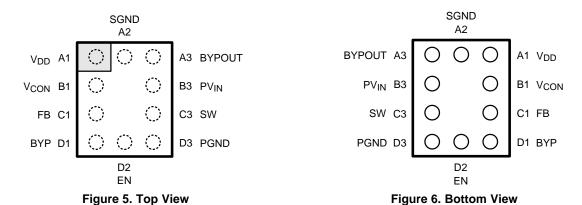| Designator	Footprint	Manufacture	Manufacture No	Description
C1 (input C)	1206 (3216)	TDK	C3216JB1A106K	10 µF, 10 V, 20%
C2 (output C)	1206 (3216)	TDK	C2012JB0J475K	4.7 µF, 6.3 V, 20%
C3	0603 (1608)			10 pF
C4	0603 (1608)			optional
C5 (input C)	0402 (1005)			0.1 µF, 10 V, 20%
C6	0603 (1608)			optional
L1 (inductor)		Coilcraft	DO3314-332	3.3 µH inductor, 1.4A Isat, 0.26 Ωmax.
R0	0603 (1608)			0 Ω
R1	0603 (1608)			267 kΩ
R2	0603 (1608)			133 kΩ
R3	0603 (1608)			0 Ω
R4	0603 (1608)			optional
R5	0603 (1608)			optional
R6	0603 (1608)			optional
R7	0603 (1608)			0 Ω
R8	0603 (1608)			optional
COMMON TO ALL				
V_{IN} banana jack - red		Johnson Components	108-0902-001	conn jack banana insul nylon red
V_{OUT} banana jack - yellow		Johnson Components	108-0907-001	conn jack banana insul nylon yellow
GND banana jack - black		Johnson Components	108-0903-001	conn jack banana insul nylon black

9 Connection Diagrams

Figure 5. Top View

Figure 6. Bottom View

Figure 7. 10–Bump Thin DSBGA Package, Large Bump

Table 2. Pin Descriptions

Pin No	Name	Description
A1	V_{DD}	Analog Supply Input. A 0.1 µF ceramic capacitor is recommended to be placed as close to this pin as possible.
B1	V_{CON}	Voltage Control Analog input. V_{CON} controls V_{OUT} in PWM mode. Do not leave floating.
C1	FB	Feedback Analog Input. Connect to the external resistor divider.
D1	BYP	Bypass. Use this digital input to command operation in Bypass mode. Set the BYP pin high (> 1.2 V) for Bypass mode. Set BYP low (< 0.4 V) for PWM operation.
D2	EN	Enable Input. Set this digital input high (> 1.2 V) after Vin > 2.7 V for normal operation. For shutdown, set low (< 0.4 V).
D3	PGND	Power Ground
C3	SW	Switching Node connection to the internal PFET switch and NFET synchronous rectifier. Connect to an inductor with a saturation current rating that exceeds the maximum Switch Peak Current Limit specification of the LM3203.
B3	PV_{IN}	Power Supply Voltage Input to the internal PFET switch and Bypass FET.
A3	BYPOUT	Bypass FET Drain. Connect to the output capacitor. Connect this pin to V_{DD} when Bypass mode is NOT required. Do not leave floating.
A2	SGND	Analog and Control Ground

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have *not* been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

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