One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluation Board for the 800 mA, 3 MHz Buck Regulator

FEATURES

- **Full-featured evaluation board for the ADP2138/ADP2139**
- **Standalone capability**
- **Simple device measurements, including line and load regulation, demonstrable with**
  - **A single voltage supply**
  - **A voltage meter**
  - **A current meter**
  - **Load resistors**
- **Easy access to external components**

GENERAL DESCRIPTION

The ADP2138 and ADP2139 are high efficiency, low quiescent current, synchronous step-down dc-to-dc converters. The ADP2139 has the additional feature of an internal discharge switch. The total solution requires only three tiny external components.

When the MODE pin is set high, the buck regulator operates in forced PWM mode, which provides low peak-to-peak ripple for power supply noise sensitive loads at the expense of light load efficiency. When the MODE pin is set low, the buck regulator automatically switches operating modes, depending on the load current level. At higher output loads, the buck regulator operates in PWM mode. When the load current falls below a predefined threshold, the regulator operates in power save mode (PSM), improving light load efficiency.

The 3 MHz switching frequency minimizes the size of external components. Full details on the ADP2138/ADP2139 are provided in the ADP2138/ADP2139 data sheet available from Analog Devices, Inc., which should be consulted in conjunction with this data sheet.

DIGITAL PICTURE OF THE EVALUATION BOARD



Figure 1.

TABLE OF CONTENTS

Features 1
General Description 1
Digital Picture of the Evaluation Board 1
Revision History 2
Using the Evaluation Board 3
Powering Up the Evaluation Board 3
Measuring Evaluation Board Performance 3
Evaluation Board Schematics and Artwork 4
Evaluation Board Layout 4
Ordering Information 5
Bill of Materials 5

REVISION HISTORY

3/11—Revision 0: Initial Version

USING THE EVALUATION BOARD

POWERING UP THE EVALUATION BOARD

The ADP2138/ADP2139 evaluation board is supplied fully assembled and tested. Before applying power to the evaluation board, follow the procedures in this section.

Jumper TB2 (Enable)

Jumper TB2 (EN) enables/disables the ADP2138/ADP213. Connect a jumper between TB2 and TB1 (VIN) to enable the ADP2138/ADP2139. Connecting TB2 (EN) to TB4 (GND) disables the ADP2138/ADP2139 and brings the current to < 1 µA.

Input Power Source

If the input power source includes a current meter, use that meter to monitor the input current. Connect the positive terminal of the power source to TB1 (V_{IN}) on the evaluation board, and the negative terminal of the power source to TB4 (GND OUT) of the evaluation board.

If the power source does not include a current meter, connect a current meter in series with the input source voltage. Connect the positive lead (+) of the power source to the ammeter positive (+) connection, the negative lead (−) of the power source to TB4 (GND OUT) on the evaluation board, and the negative lead (−) of the ammeter to TB1 (V_{IN}) on the board.

Output Load

Connect an electronic load or resistor to set the load current. If the load includes an ammeter, or if the current is not measured, connect the load directly to the evaluation board, with the positive (+) load connection to TB3 (V_{OUT}) and the negative (−) load connection to TB4 (GND).

If an ammeter is used, connect it in series with the load. Connect the positive (+) ammeter terminal to the evaluation board TB3 (VOUT), the negative (−) ammeter terminal to the positive (+) load terminal, and the negative (−) load terminal to the evaluation board TB4 (GND OUT).

Input and Output Voltmeters

Measure the input and output voltages with voltmeters. Make sure that the voltmeters are connected to the appropriate evaluation board terminals and not to the load or power source themselves. If the voltmeters are not connected directly to the evaluation board, the measured voltages are incorrect due to the voltage drop across the leads and/or connections between the evaluation board, the power source, and/or the load.

Connect the input voltage measuring voltmeter positive terminal (+) to the evaluation board TB1 (VIN), and the negative (−) terminal to the evaluation board TB4 (GND OUT). Connect the output voltage measuring voltmeter positive (+) terminal to the evaluation board TB3 (VOUT) and the negative (−) terminal to the evaluation board TB4 (GND OUT).

Turning On the Evaluation Board

Once the power source and load are connected to the ADP2138/ADP2139 evaluation board, the board can be powered for operation. Perform the following steps:

1. Ensure that the power source voltage is > 2.3 V and < 5.5 V.
2. Ensure that TB2 (EN) is high and monitor the output voltage.

If the load is not already enabled, enable the load, check that it is drawing the proper current, and that the output voltage maintains voltage regulation.

Changing the Mode of the Device

Each ADP2138/ADP2139 has a MODE pin, which determines the operation of the buck regulator in either PWM mode (when the MODE pin is set high by connecting TB6 to TB1) or power save mode (when the mode pin is set low by connecting TB6 to TB4).

MEASURING EVALUATION BOARD PERFORMANCE

Measuring Output Voltage Ripple

To observe the output voltage ripple, place an oscilloscope probe across the output capacitor (C_{OUT}) with the probe ground lead at the negative (−) capacitor terminal and the probe tip at the positive (+) capacitor terminal. Set the oscilloscope to ac, 20 mV/division, and 2 µs/division time base.

Measuring the Switching Waveform

To observe the switching waveform with an oscilloscope, place the oscilloscope probe tip at the end of the inductor with the probe ground at GND OUT. Set the oscilloscope to dc, 2 V/division, and 2 µs/division time base.

Measuring Load Regulation

The load regulation must be tested by increasing the load at the output and looking at the change in output voltage. To minimize voltage drop, use short low resistance wires, especially for loads approaching maximum current.

Measuring Line Regulation

Vary the input voltage and examine the change in the output voltage.

Measuring Efficiency

Measure the efficiency, η, by comparing the input power with the output power.

$$\eta = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times I_{IN}}$$

Measure the input and output voltages as close as possible to the input and output capacitors to reduce the effect of IR drops.

Measuring Inductor Current

The inductor current can be measured by removing one end of the inductor from its pad and connecting a current loop in series. A current probe can be connected onto this wire.

EVALUATION BOARD SCHEMATICS AND ARTWORK

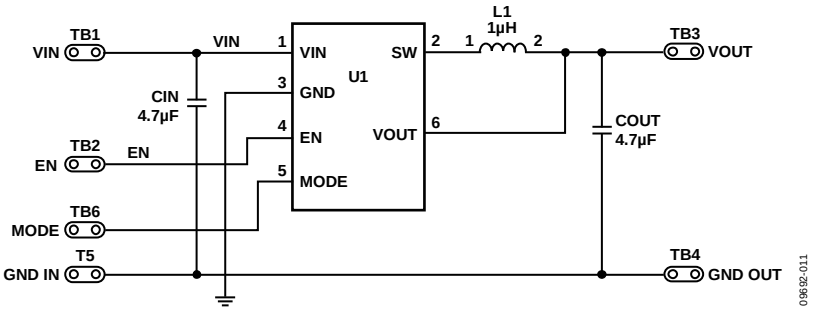


Figure 2. Evaluation Board Schematic

EVALUATION BOARD LAYOUT

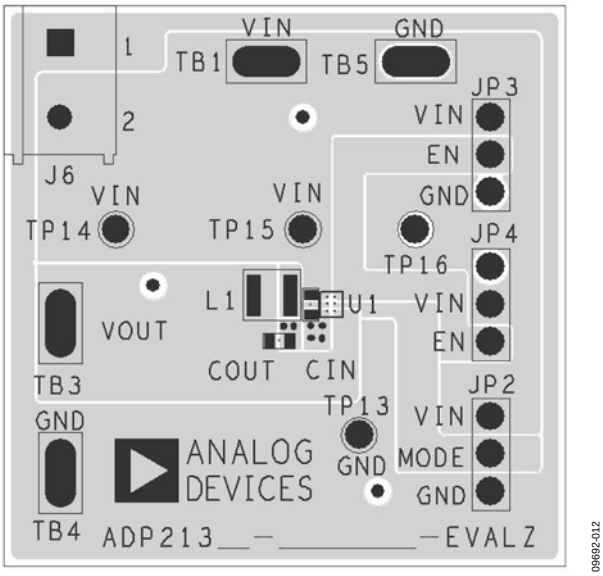


Figure 3. Top Layer

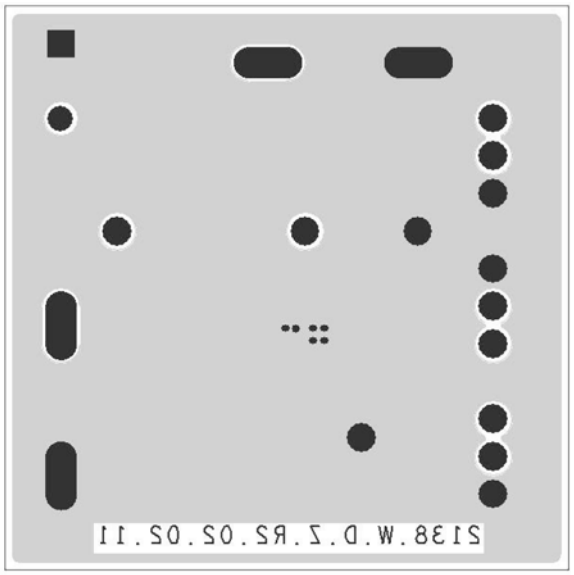


Figure 4. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 1.

Qty.	Reference Designator	Description	Manufacturer	Part Number
1	U1	ADP2138/ADP2139 buck regulator	Analog Devices, Inc.	ADP2138/ADP2139
1	C_{IN}	Capacitor, MLCC, 4.7 µF, 6.3 V, 0603, X5R	Murata Manufacturing Co., Ltd	GRM188R60J475
1	C_{OUT}	Capacitor, MLCC, 4.7 µF, 6.3 V, 0603, X5R	Murata Manufacturing Co., Ltd	GRM188R60J475
1	L1	Inductor, 1.0 µH, 1.4 A, 85 mΩ	Murata Manufacturing Co., Ltd	LQM2MPN1R0NG0B

NOTES

NOTES

NOTES



ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS ($100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

©2011 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.

UG09692-0-3/11(0)



www.analog.com