User's Guide

LM26400Y Step-Down Converter Evaluation Module User's Guide

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1 Introduction

The LM26400Y demonstration board was designed to provide two 2A outputs at 1.2V and 2.5V respectively. It uses the HTSSOP package option of the LM26400Y for easier probing. The design emphasizes on the compactness of the LM26400Y PCB layout and is thermally optimized. The total solution size is about 20mm by 30mm. The board supports the conversion from an input voltage ranging from 5V to 20V down to output voltages of 1.2V and 2.5V. With the availability of a separate 5V rail and a couple of small bootstrap diodes, the board also supports an input voltage down to 3.3V with 2A output currents. The EN pins are pulled up to VIN by default for easy evaluation but can also be easily controlled by external logic.

The board also has two small C_{FF} capacitors (C12 and C13) installed for improved load step response and elimination of output voltage overshoot after a short-circuit release.

The board's specifications are:

- Input Voltage: 5V to 20V
- Output Voltages: 1.2V and 2.5V
- Maximum load current: 2A/output
- Minimum load current: 0A
- Peak Current Limit: ≅ 3A at 25°C
- Measured Efficiency: 83% (V_{IN} = 5V, I_{OUT2} = 2A)
- Nominal Switching Frequency: 520 kHz
- Size: 2 in. x 2 in.

2 Powering Up The Board

Since the EN pins are directly tied to the input voltage, starting up the board is a single-step procedure. Simply connect a voltage rail between 5V and 20V to the VIN and GND terminals and there should be 1.2V and 2.5V output at the corresponding terminals. Certain bench-top power supplies upon powering up may shoot up to their maximum output voltages momentarily before settling to the programmed value. If their maximum voltage is above 22V, it can damage the LM26400Y demonstration board. In this case, either connect the board after the input power supply is powered up, or use the current limit knob of the power supply to bring up the input voltage.

The linear soft-start ramps for the two output voltages should last about 1ms and 2ms. Load can be applied prior to power-up. If no load is applied, the two channels will operate in pulse skipping mode or discontinuous conduction mode. If an output is shorted either before or after start-up, removal of the short-circuit condition should bring the corresponding output back to normal voltage.

If additional output capacitors are desired, C8 and C9 on the back of the board are reserved for that purpose.

If it is desired to control the start-up and shutdown timing, connect the logic signals to the EN1 and/or EN2 pads on the back of the board. Make sure the voltages on the EN pads are never higher than VIN. If only a soft-start slope needs to be adjusted, simply change the corresponding SS capacitor (C5 or C6).

To operate between 3.3V and 5V of input voltage, populate D3 and D4 (on the back of the board) each with a SOT-23 Schottky diode such as the BAT54 and apply a 5V supply to the "5V_Bias" pad on the back. Do not exceed 6V on the 5V bias. The LM26400Y device itself can work with an input voltage as low as 3V. The demonstration board when using an external bootstrap bias can operate down to 3.3V under room temperature. This extra 0.3V requirement is due to the large duty cycle in the 2.5V channel being too close to the maximum allowed.

3 Board Schematic

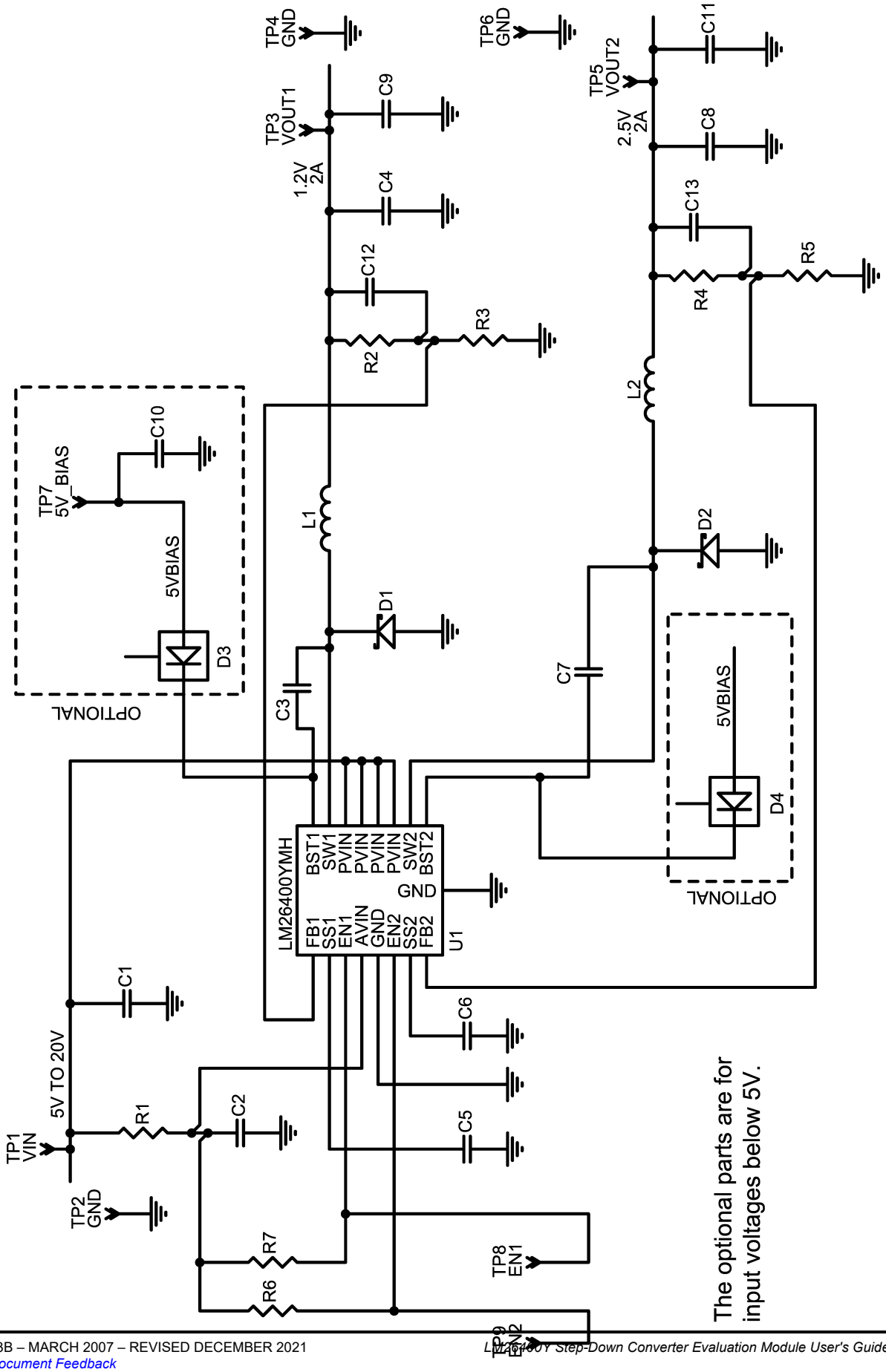

Table 3-1. Bill of Materials

Item	Designator	Description	Manufacturer	Part No.	Qty.
1	C5, C6, C12, C13	0.022µF, 6.3V, X5R, 10%, 0402	Kemet	C0402C223K9PACTU	4
2	C2, C3, C7	0.1µF, 25V, X5R, 10%, 0402	Taiyo Yuden	TMK105BJ104KV-F	3
3	C1	10µF, 25V, X5R, 20%, 1210	Taiyo Yuden	TMK325BJ106MM-T	1
4	C11	47µF, 6.3V, X5R, 20%, 1210	Taiyo Yuden	JMK325BJ476MM-T	1
5	C4	100µF, 6.3V, X5R, 20%, 1210	Taiyo Yuden	JMK325BJ107MM-T	1
6	D1, D2	2A, 30V, SMB	IR	20BQ030TRPBF	2
7	L1	5µH, 2.2A, 23mΩ, 7x7x2.8mm^3	Sumida	CDRH6D26NP-5R0NC	1
8	L2	8.7µH, 2.2A, 25mΩ, 7x7x4mm^3	Sumida	CDRH6D38NP-8R7NC	1
9	R1	4.7Ω, 1%, 0402	Vishay	CRCW04024R70FNED	1
10	R2, R3, R5	5.9kΩ, 1%, 0402	Vishay	CRCW040259R0FKED	3
11	R4, R6, R7	18.7kΩ, 1%, 0402	Vishay	CRCW0402187RFKED	3
12	TP1-TP6	0.094" Diameter Solder Terminal	Cambion	160-1026-02-01-00	6
13	U1	Dual 2A, 20V, 500kHz PWM Switcher, HTSSOP-16	TI	LM26400	1

4 PCB Layout

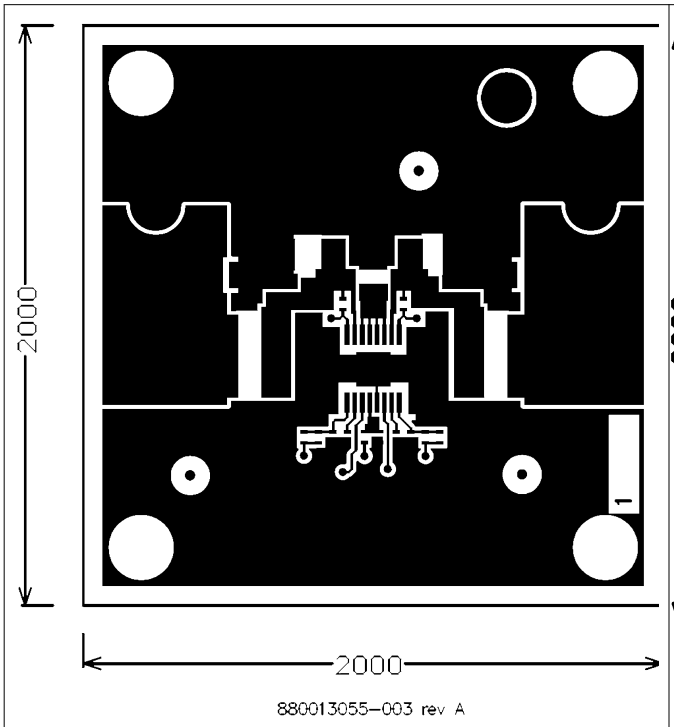

Figure 4-1. Top Copper

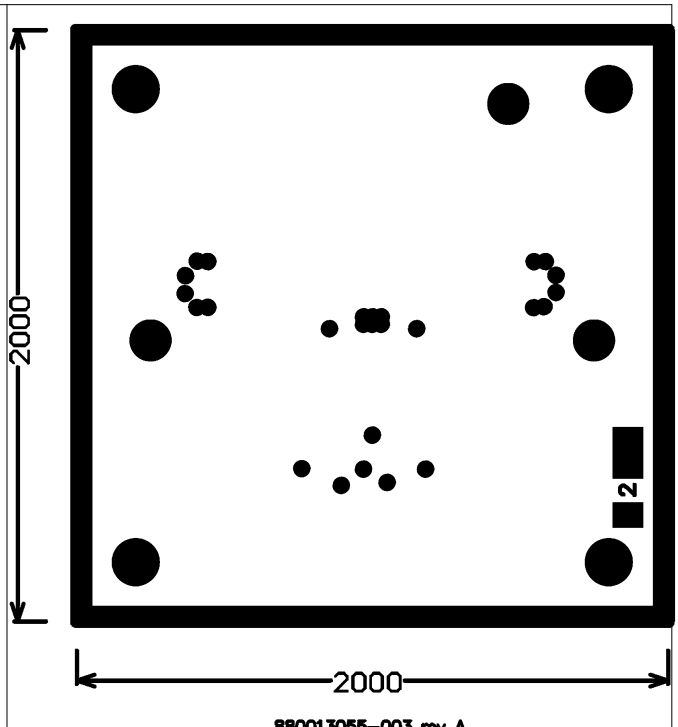

Figure 4-2. Ground Plane

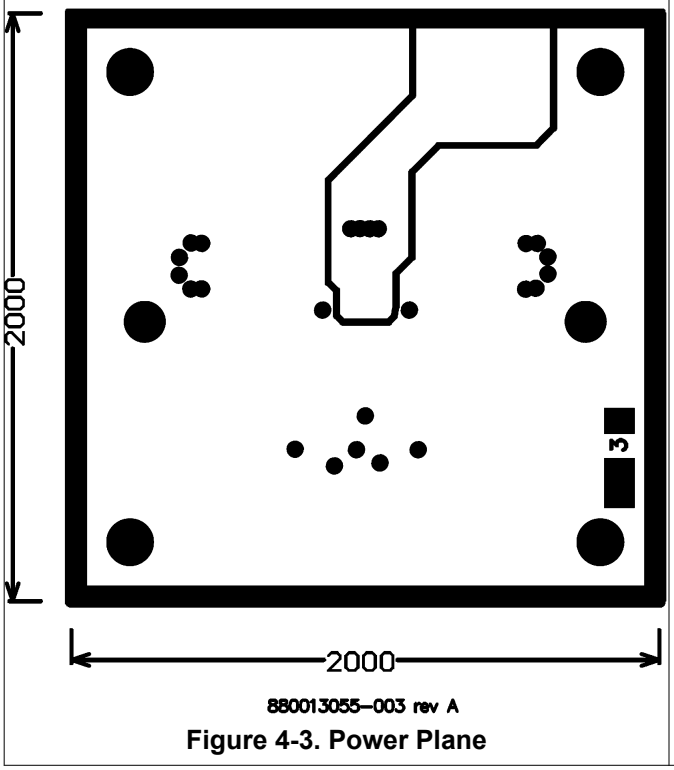

Figure 4-3. Power Plane

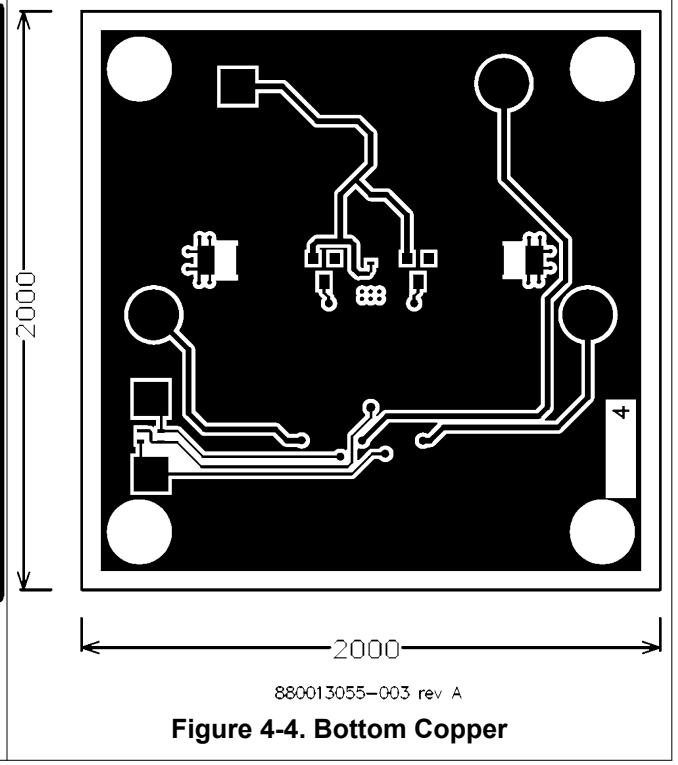

Figure 4-4. Bottom Copper

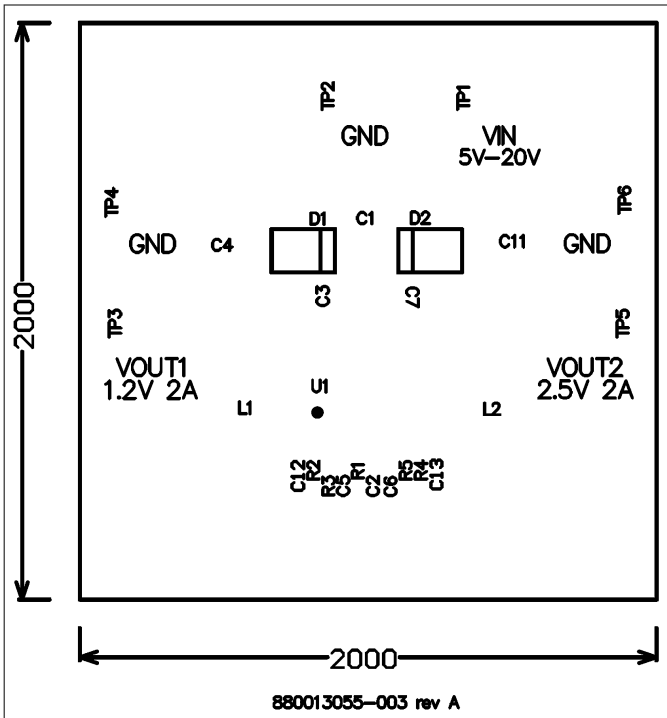

Figure 4-5. Top Silkscreen

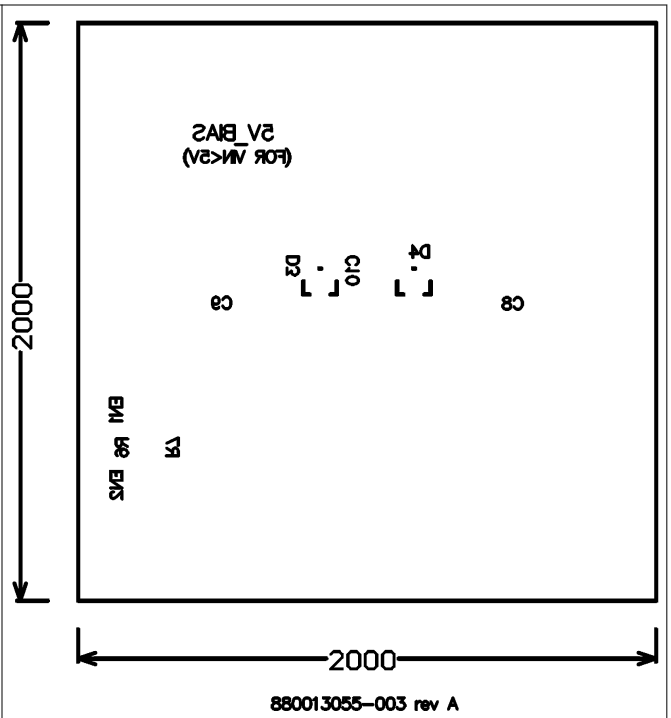

Figure 4-6. Bottom Silkscreen

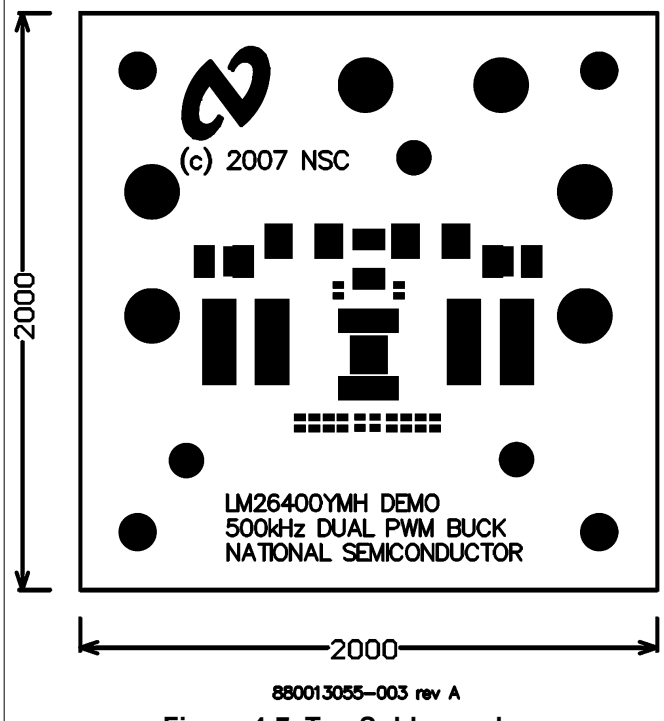

Figure 4-7. Top Soldermask

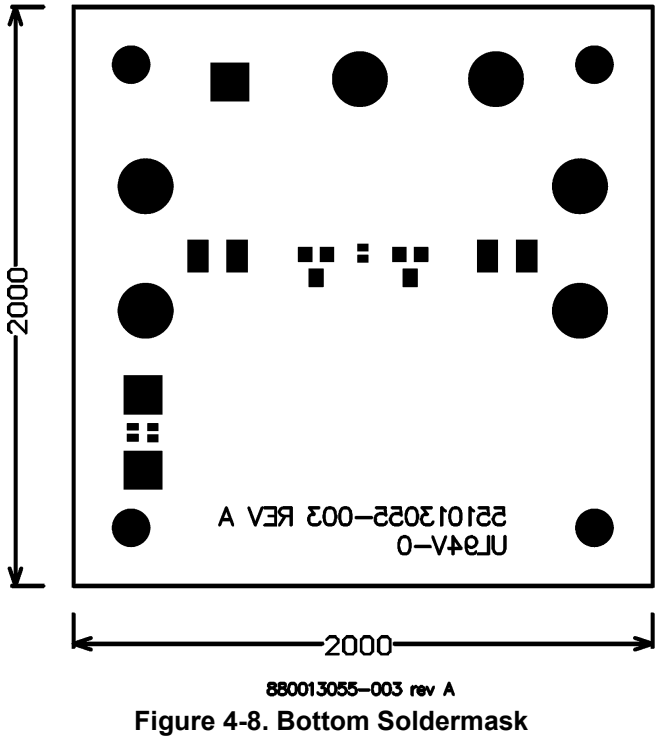

Figure 4-8. Bottom Soldermask

5 Typical Performance Characteristics

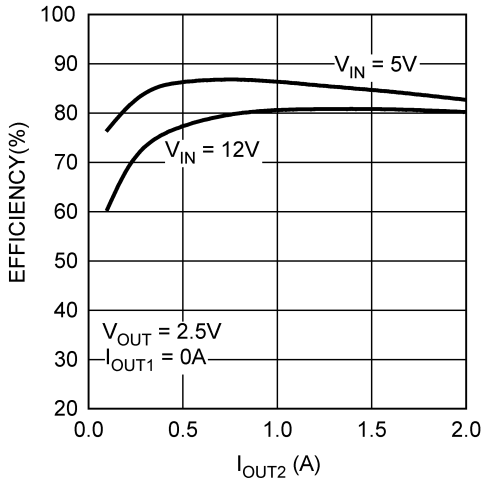

Figure 5-1. Efficiency

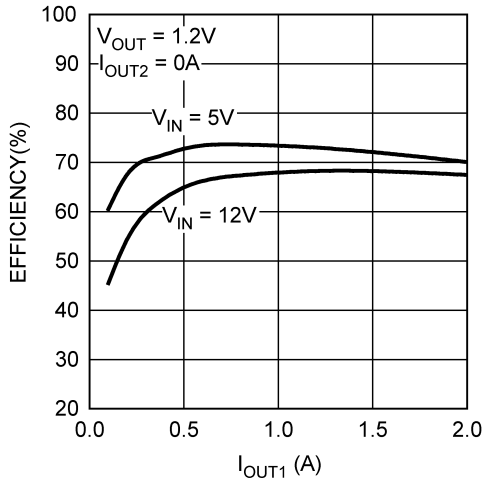

Figure 5-2. Efficiency

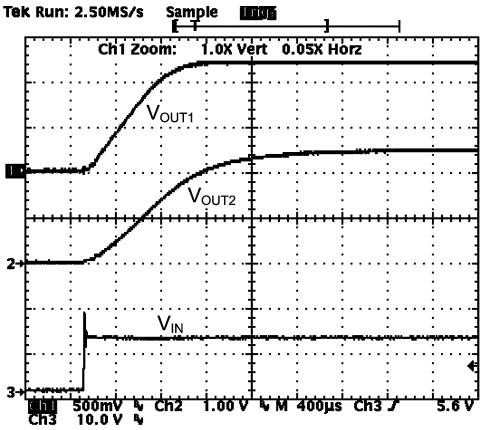

Figure 5-3. Start-up

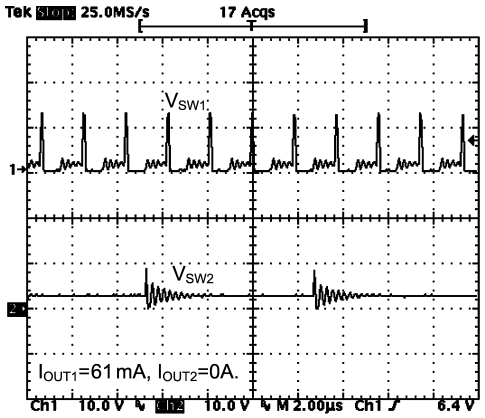

Figure 5-4. Steady State (Ch1 = DCM, Ch2 = Pulse Skipping)

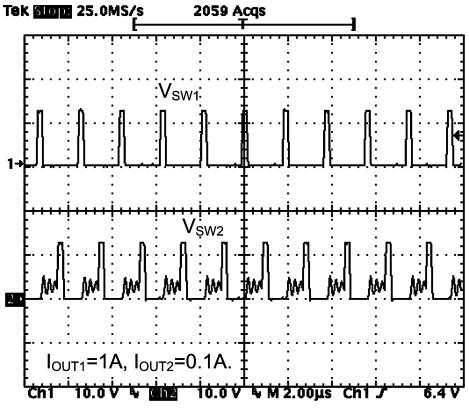

Figure 5-5. Steady State (Ch1 = CCM, Ch2 = DCM)

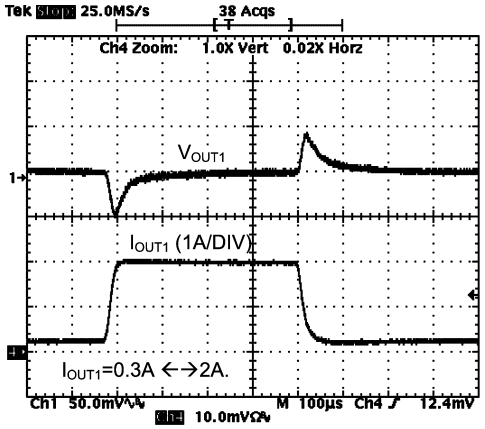

Figure 5-6. Load Step Response (Slew Rate = 0.25A/µs)

6 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (April 2013) to Revision B (December 2021)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document.	2
• Updated the user's guide title.	2

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CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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