NCV97310MW50GEVB

NCV97310評価ボード・ユーザーズ・マニュアル

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EVAL BOARD USER'S MANUAL

説明

NCV97310は、バッテリが接続された1個の低Iqの3 A 2 MHz非同期スイッチャと2個の低電圧1.5 A 2 MHz同期スッチャで構成される3出力レギュレータです。すべて内蔵のパワー・トランジスタを使用しています。

高電圧スイッチャは4.1〜18 Vのバッテリ入力を2 MHzの定スイッチング周波数で5 Vまたは3.3 V出力に変換し、最大3 Aを供給できます。36 Vまでの過電圧状態では、スイッチング周波数は1 MHzにフォールドバックし、45 Vまでの負荷ダンプ状態ではレギュレータがシャットダウンします。

バッテリが接続された降圧レギュレータの出力は、2個の同期スイッチャの低電圧入力になります。各ダウンストリーム出力は1.2〜3.3 Vの範囲で調整でき、1.5 Aの電流制限と2 MHzの定スイッチング周波数を備えています。各スイッチャには独立したイネーブル・ピンとリセット・ピンがあり、柔軟に電源管理を行うことができます。

低Iq動作モードの場合、低電圧スイッチャはディセーブルされ、スタンバイ・レールには30 μAの低Iq LDO (最大150 mA)によって標準Iqが給電されます。LDOレギュレータは高電圧スイッチャと並列になっており、スイッチャがスタンバイ・モードに強制されるとアクティブになります。

3つのSMPS出力はすべて内部スロープ補償、内部設定ソフトスタート、バッテリ低電圧ロックアウト、バッテリ過電圧保護、サイクル単位の電流制限、ヒカップ・モード短絡保護、およびサーマル・シャットダウンを備えたピーク電流モード制御を使用しています。診断にエラー・フラグを使用できます。

主な特長

- 低消費電流のスタンバイ・モード
- マイクロコントローラでイネーブルされる2個の低電圧同期式降圧コンバータ
- 18〜3.3 Vの高変換比のバッテリ接続スイッチャ
- 低電圧ロックアウト(UVLO)付きの4.1〜45 Vの広い入力電圧範囲
- 2.0〜2.6 MHzの範囲で調整可能な固定周波数動作
- 内部1.5 msソフトスタート
- サイクル単位の電流制限保護
- ヒカップ過電流保護(OCP)
- 調整可能な遅延付き個別リセット・ピン
- これらのデバイスはPbフリー、ハロゲン・フリー/BFRフリーで、RoHSに適合

代表的アプリケーション

- インフォテイメント、車体エレクトロニクス、テレマティクス、ECU

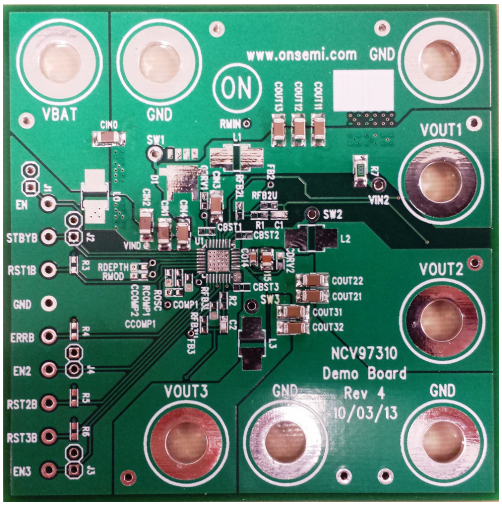

Figure 1. Evaluation Board Photo

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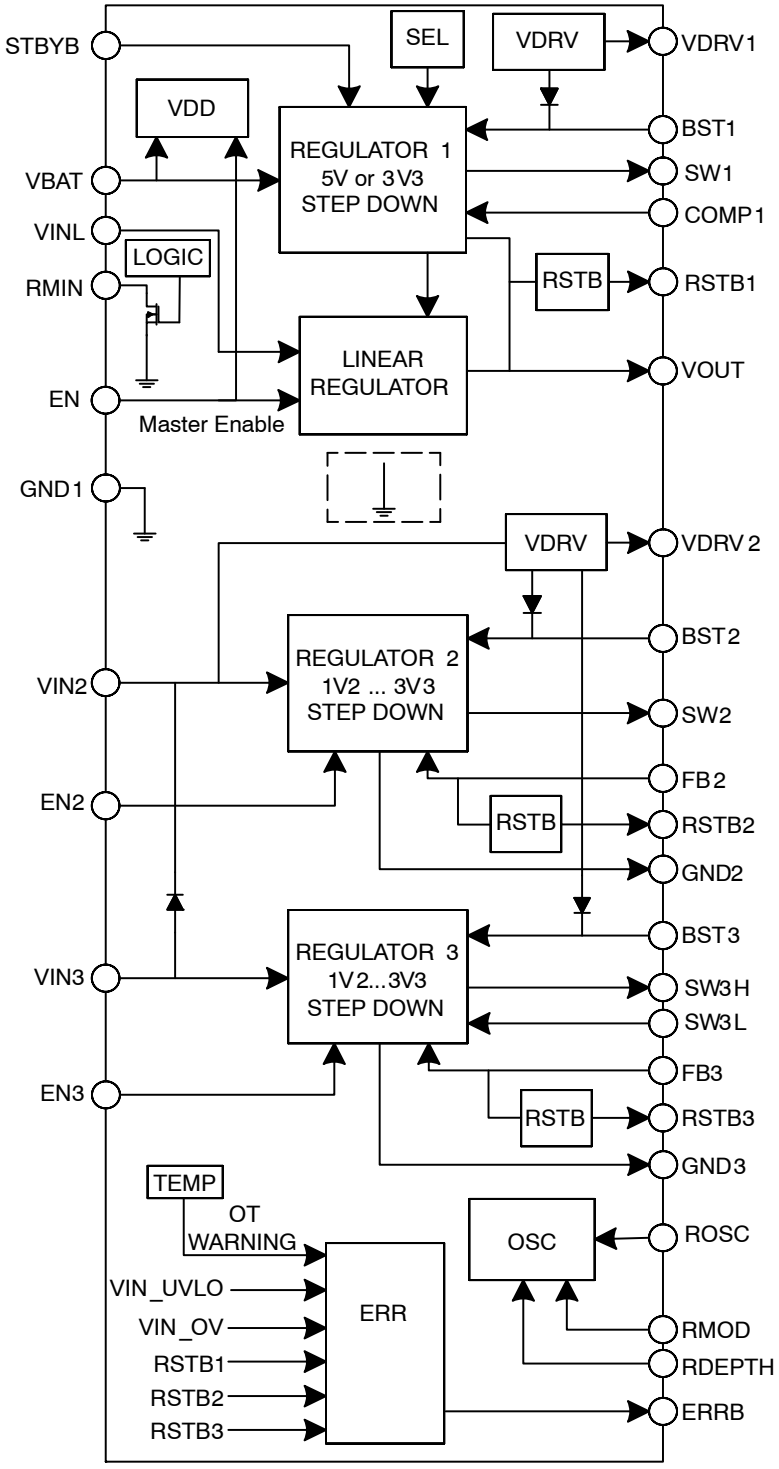


Figure 2. NCV97310 Block Diagram

代表的アプリケーション

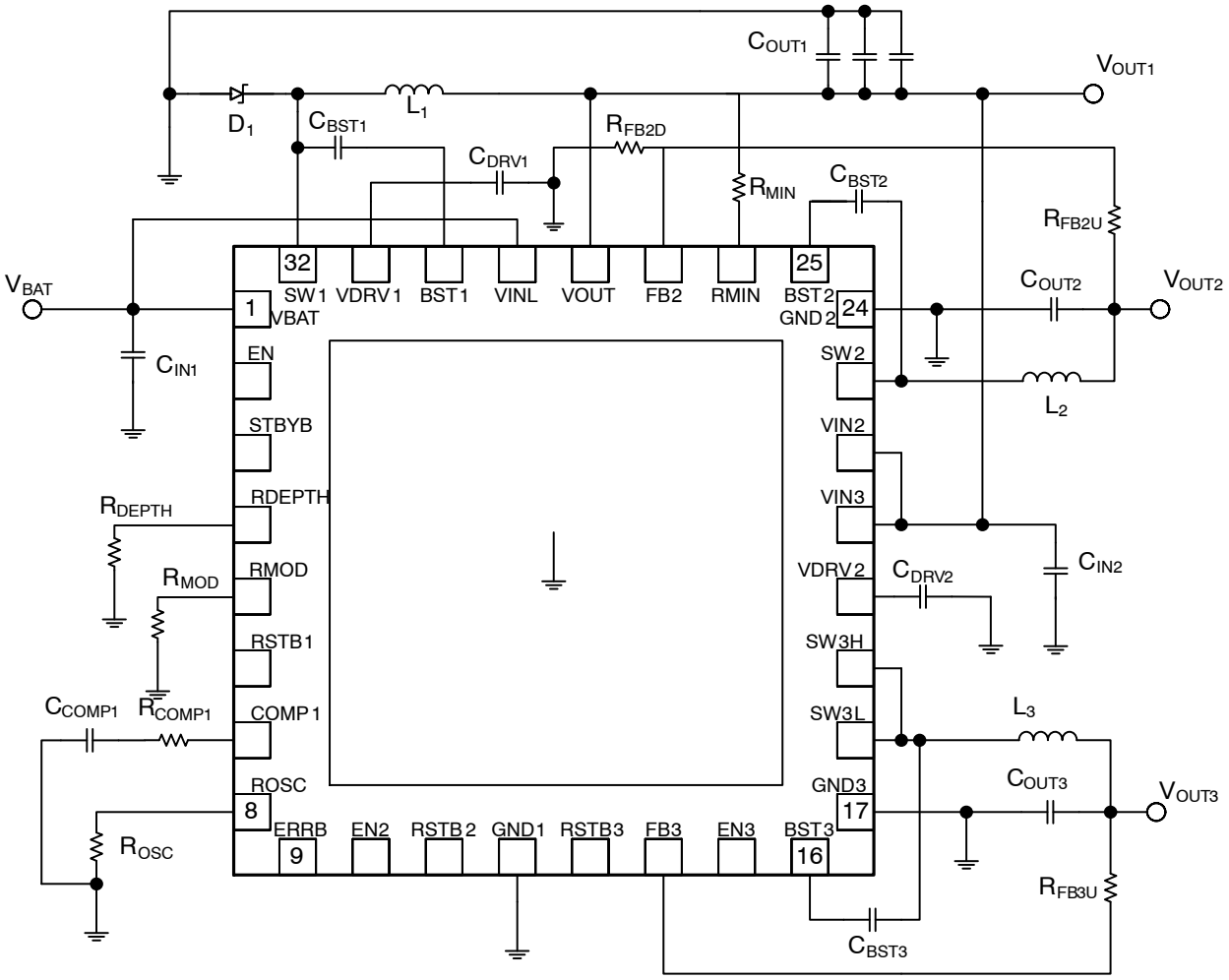


Figure 3. Typical Application

Table 1. EVALUATION BOARD TERMINALS

Pin Name	Function
VBAT	Positive dc input voltage
GND	Common dc return
VOUT1	Positive 5.0 V dc output voltage (LDO / switcher 1)
VOUT2	Positive DC output voltage (switcher 2)
VOUT3	Positive DC output voltage (switcher 3)
EN	Master enable input. Includes jumper J3 to connect to VBAT.
STBYB	Standby enable input. Includes jumper J4 to connect to VBAT.
EN2	Switcher 2 enable input. Includes jumper J6 to connect to VOUT1.
EN3	Switcher 3 enable input. Includes jumper J5 to connect to VOUT1.
ERRB	Error flag combining temperature and input and output voltage sensing.
RST1B	Reset with adjustable delay. Goes low when the VOUT1 is out of regulation.
RST2B	Reset with adjustable delay. Goes low when the VOUT2 is out of regulation.
RST3B	Reset with adjustable delay. Goes low when the VOUT3 is out of regulation.

Table 2. ABSOLUTE MAXIMUM RATINGS (Voltages are with respect to GND)

Rating	Value	Unit
Dc Supply Voltage (VBAT, EN, STBYB)	−0.3 to 36	V
Dc Supply Voltage (VIN2, VIN3)	−0.3 to 12	V
Dc Supply Voltage (RSTB1, RSTB2, RSTB3, ERRB, EN2, EN3)	−0.3 to 6	V
Storage Temperature Range	−55 to 150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
(参考訳)
最大定格を超えるストレスは、デバイスにダメージを与える危険性があります。これらの定格値を超えた場合は、デバイスの機能性を損ない、ダメージが生じたり、信頼性に影響を及ぼす危険性があります。

Table 3. ELECTRICAL CHARACTERSITICS (T_A = 25°C, 4.5 ≤ VIN ≤ 18 V, IOUT ≤ 2 A, unless otherwise specified)

Characteristic	Conditions	Typical Value	Unit
REGULATION			
Output Voltage (VOUT1)		5.0	V
Output Voltage (VOUT2)		3.3	V
Output Voltage (VOUT3)		1.2	V
Line Regulation (VOUT1)	I_{OUT1} = 1.0 A	0.03	%
Line Regulation (VOUT2)	I_{OUT2} = 1.0 A	0.01	%
Line Regulation (VOUT3)	I_{OUT3} = 1.0 A	0.001	%
Load Regulation (VOUT1)	V_{BAT} = 13.2 V	0.3	%
Load Regulation (VOUT2)	V_{BAT} = 13.2 V	0.02	%
Load Regulation (VOUT3)	V_{BAT} = 13.2 V	0.03	%
SWITCHING			
Switching Frequency		2.0	MHz
Soft−start Time		1.4	ms
R_{OSC} Frequency Range	50 kΩ ≥ R_{OSC} ≥ 10 kΩ	2.0 to 2.6	MHz
CURRENT LIMIT			
Peak Current Limit (VOUT1)	STBYB = 0 V	0.2	A
Peak Current Limit (VOUT1)	STBYB = 5 V	4.4	A
Peak Current Limit (VOUT2)		2.9	A
Peak Current Limit (VOUT3)		2.9	A
PROTECTION			
Input Undervoltage Lockout (UVLO)	V_{BAT} Decreasing	3.9	V
Input Overvoltage Protection	V_{BAT} Increasing	36	V
Thermal Warning	T_J Rising	150	°C
Thermal Shutdown	T_J Rising	170	°C

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
(参考訳)
製品パラメータは、特別な記述が無い限り、記載されたテスト条件に対する電気的特性で示しています。異なる条件下で製品動作を行った時には、電気的特性で示している特性を得られない場合があります。

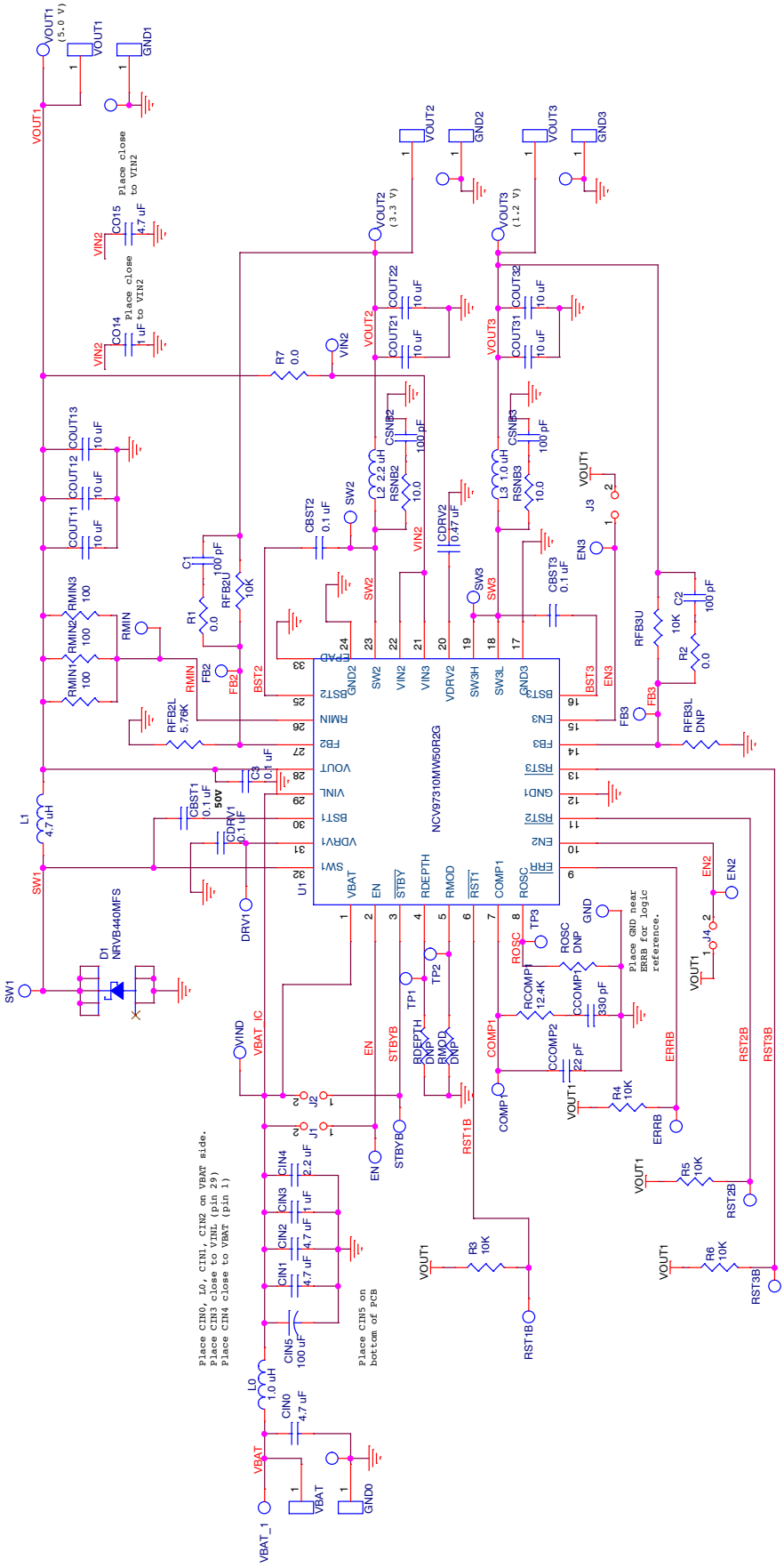


Figure 4. NCV97310GEVB 5.0 V Board Schematic

操作ガイドライン

1. VBATとGNDの間に6.0～36 Vの範囲のdc入力電圧を接続します。
2. VOUT1とGNDの間に負荷(<150 mA)を接続します。
3. ENとGNDの間に2.0～36 Vの範囲のdcイネーブル電圧を接続します。これによって、内部LDOが低Iqモードになります。ジャンパJ1を使用してENを直接VBATに接続することもできます。
   a. VOUT1信号は5.0 Vとします。
   b. VOUT2信号は(EN2の状態に関係なく)ディセーブルされ、読取値は0 Vでなければなりません。
   c. VOUT3信号は(EN3の状態に関係なく)ディセーブルされ、読取値は0 Vでなければなりません。
4. STBYBとGNDの間に2.0～36 Vの範囲のdcイネーブル電圧を接続します。これによって、低Iqモードが終了し、スイッチャ1が起動します。ジャンパJ2を使用してSTBYBを直接VBATに接続することもできます。
   VOUT1信号は5.0 Vのままでなければなりません。ここで、VOUT1に高い負荷を追加することもできます。
5. EN2とGNDの間に2.0～6 Vの範囲のdcイネーブル電圧を接続します。これによってスイッチャ2が起動します。ジャンパJ4を使用してEN2を直接VOUT1に接続することもできます。
   VOUT2信号は3.3 Vでなければなりません。
6. EN3とGNDの間に2.0～6 Vの範囲のdcイネーブル電圧を接続します。これによってスイッチャ3が起動します。ジャンパJ3を使用してEN3を直接VOUT1に接続することもできます。
   VOUT3信号は1.2 Vでなければなりません。

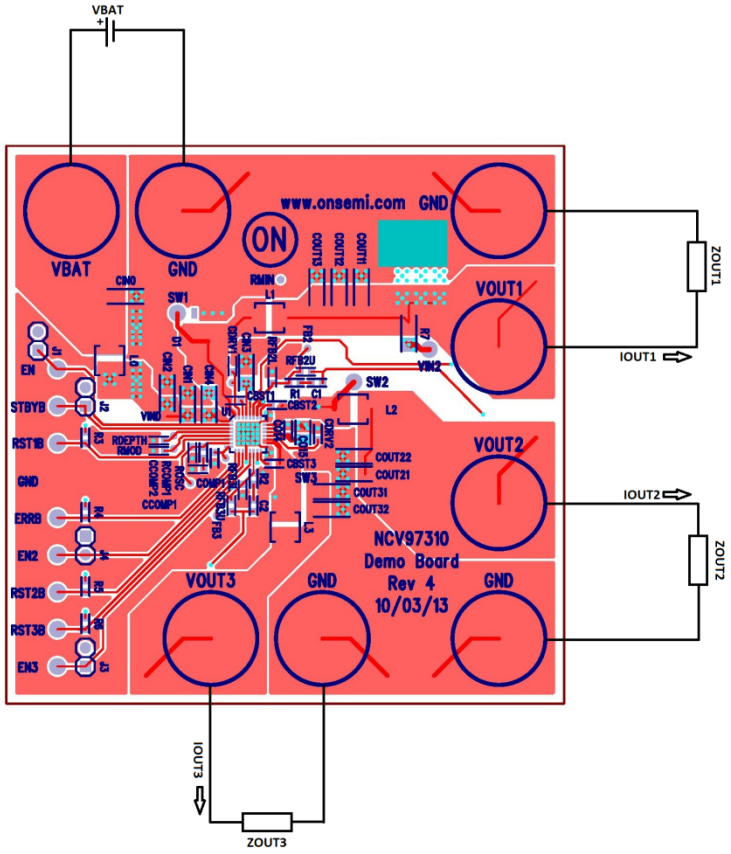
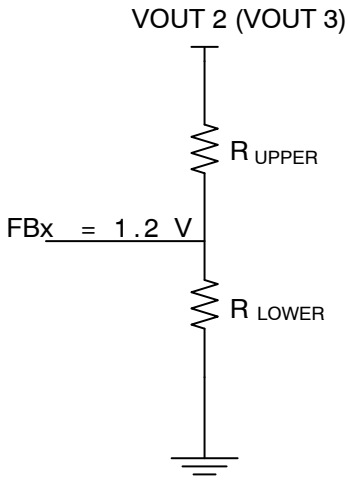


Figure 5. NCV97310 Board Connections

アプリケーション情報

出力電圧の選択

スイッチャ2とスイッチャ3の電圧出力は調整可能であり、抵抗分割回路で設定できます。両方のスイッチャのFBリファレンスは1.2 Vです。



上側抵抗は10 kΩに設定され、帰還ループの一部を構成しています。あらゆる状態で安定性を維持するために、下側の帰還抵抗のみを変更して出力電圧を設定することが推奨されます。次の等式を使用してください。

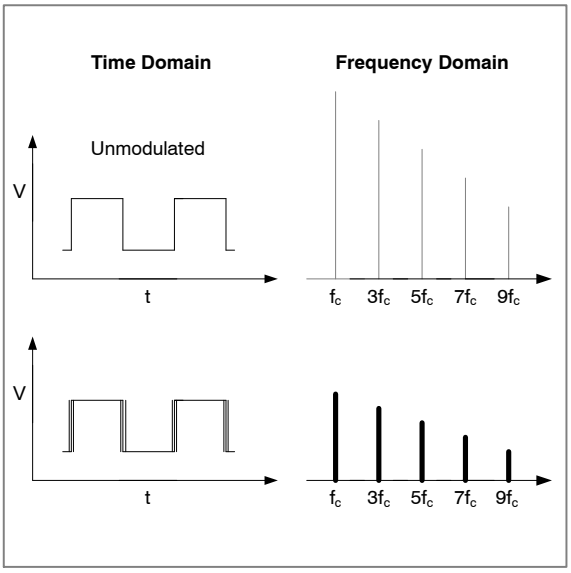
$$R_{LOWER} = R_{UPPER} \frac{V_{FB}}{V_{OUT} - V_{FB}}$$

一般的なセットアップを以下に示します。

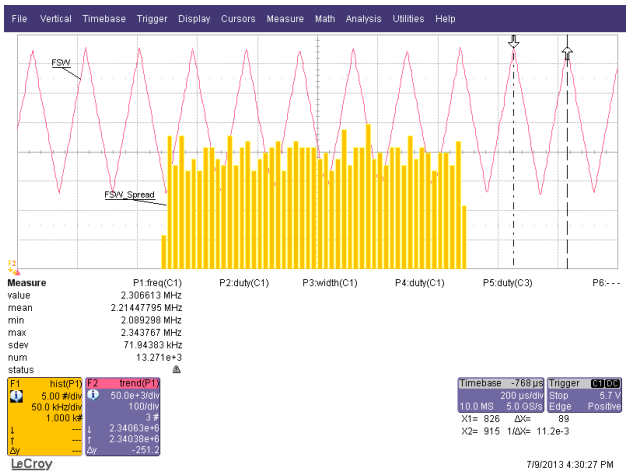
Desired Output (V)	VREF (V)	R_{UPPER} (kΩ, 1%)	R_{LOWER} (kΩ, 1%)
1.2	1.2	10.0	NP
1.5	1.2	10.0	40.0
1.8	1.2	10.0	20.0
2.5	1.2	10.0	9.31
3.3	1.2	10.0	5.76

スペクトラム拡散

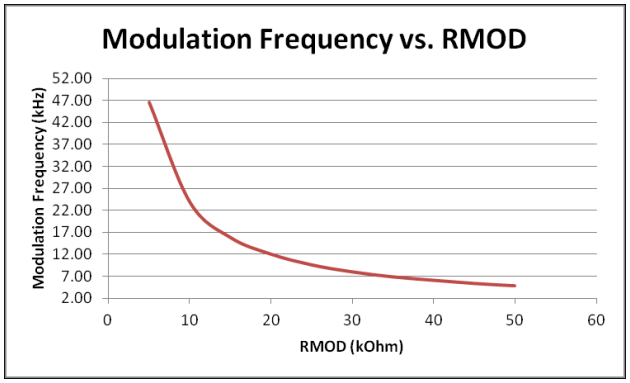
SMPSデバイスでは、スイッチングは高効率につながります。残念ながら、スイッチングによりEMIプロフィールのノイズが増加します。スペクトラム拡散技術で一部の放射を大幅に低減することができます。スペクトラム拡散は、スイッチング・レギュレータのピーク電磁放射を低減するために使用されます。

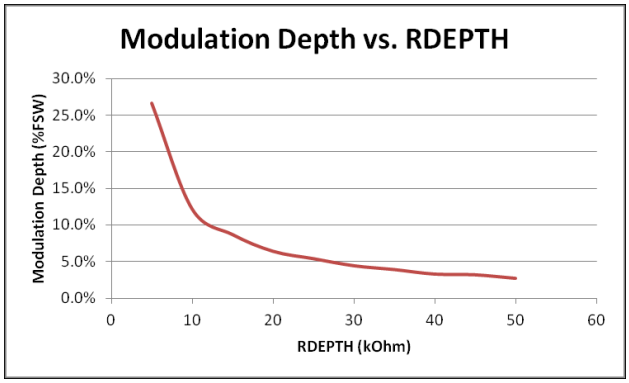


NCV97310では「アップスプレッド」手法によるスペクトラム拡散が使用されています。すなわち、スイッチング周波数は2.0 MHzの基底周波数から上方に拡散されます。例えば、5%拡散の場合はスイッチング周波数が2.0 MHzから最高2.1 MHzまで直線的に掃引(拡散)されます。この比率を変調度と呼びます。この拡散が起こるレートを変調周波数と呼びます。例えば、10 kHzの変調周波数の場合、周波数は2.0 MHzから2.1 MHzまで50 μsで掃引され、ついで2.1 MHzから2.0 MHzまで50 μsでスィープバックされます。



変調度と変調周波数はそれぞれ2本の外付け抵抗をGNDに接続して設定されます。変調周波数は、RMODピンからGNDに接続される抵抗を使用して、5 kHzから50 kHzまでの範囲で設定できます。変調度は、RDEPTHピンからGNDに接続される抵抗を使用して、公称スイッチング周波数の3%から30%までの範囲で設定できます。標準値については、以下の曲線を参照してください。





スペクトラム拡散は、RMODピンまたはRDEPTHピンでGNDへの短絡またはオープン回路が発生すると自動的にオフになります。スペクトル拡散を使用したときに、ROSCピンがオープン回路になることを確認してください。

代表的な性能

Efficiency

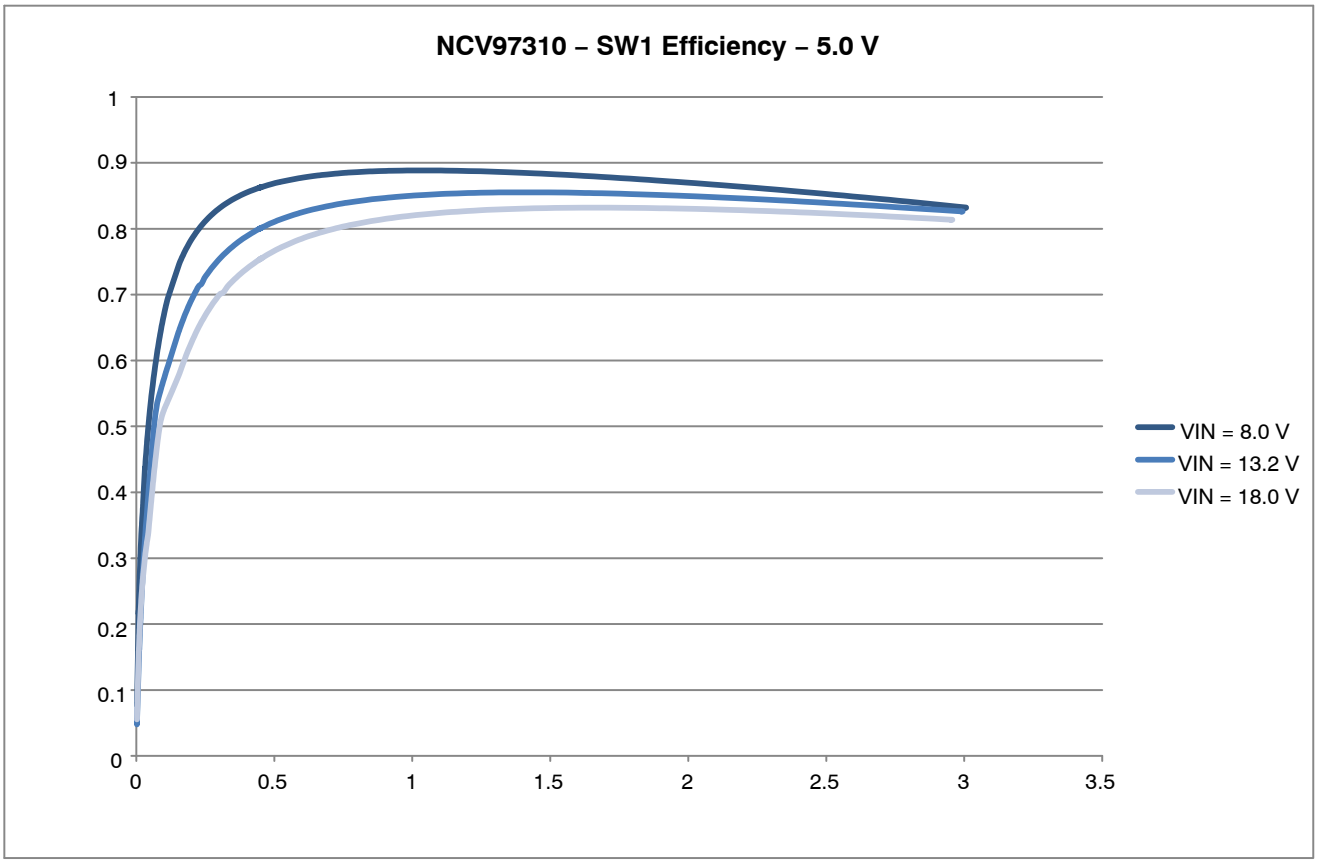


Figure 6. Efficiency for SW1 with a 5.0 V Output

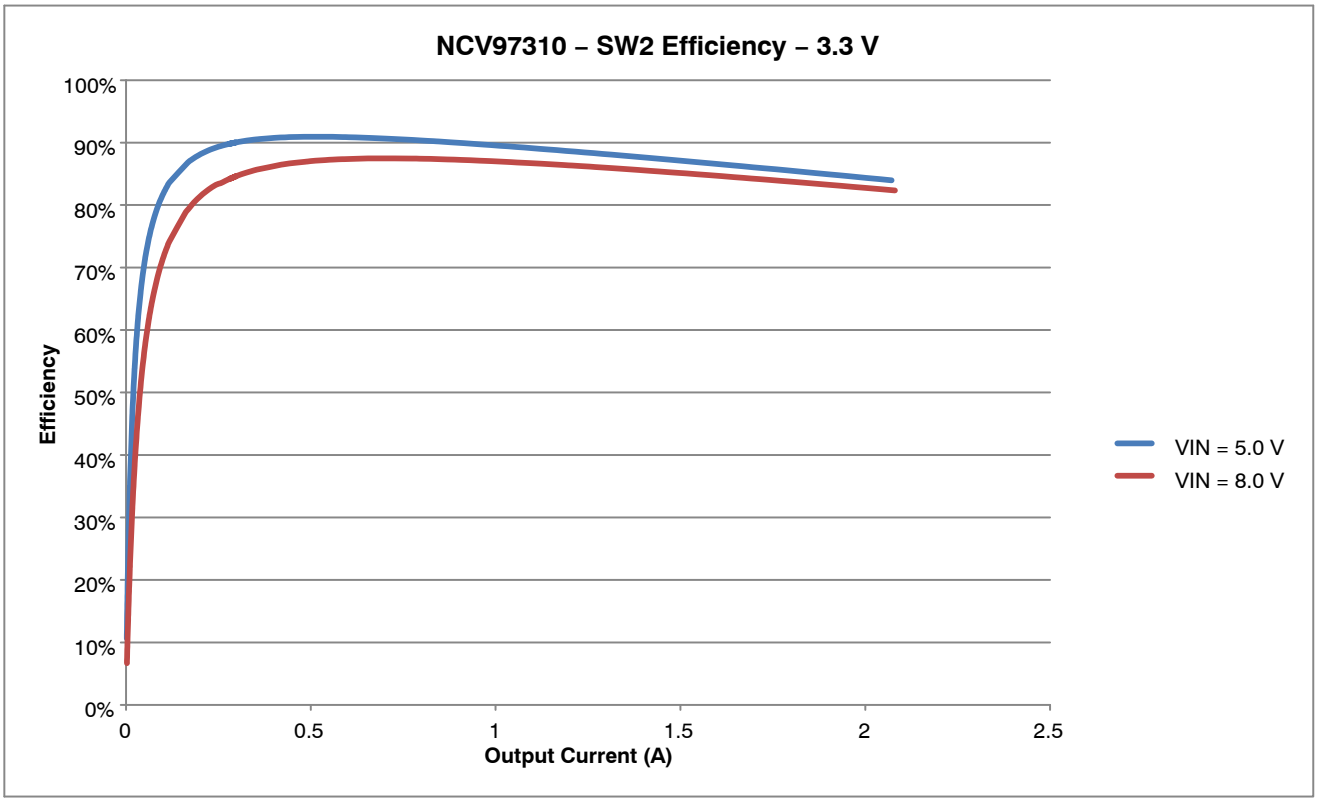


Figure 7. Efficiency for SW2 with a 3.3 V Output

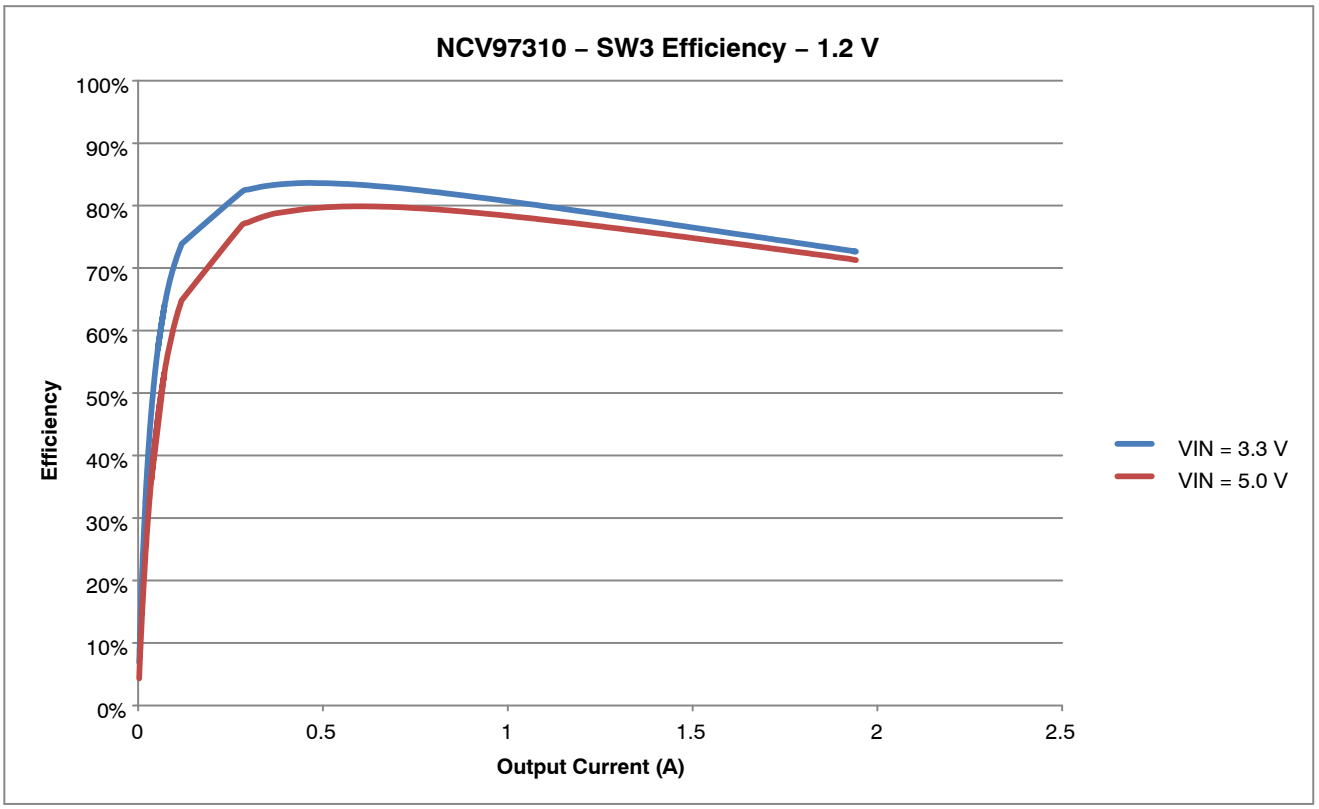


Figure 8. Efficiency for SW3 with a 1.2 V Output

Line Regulation

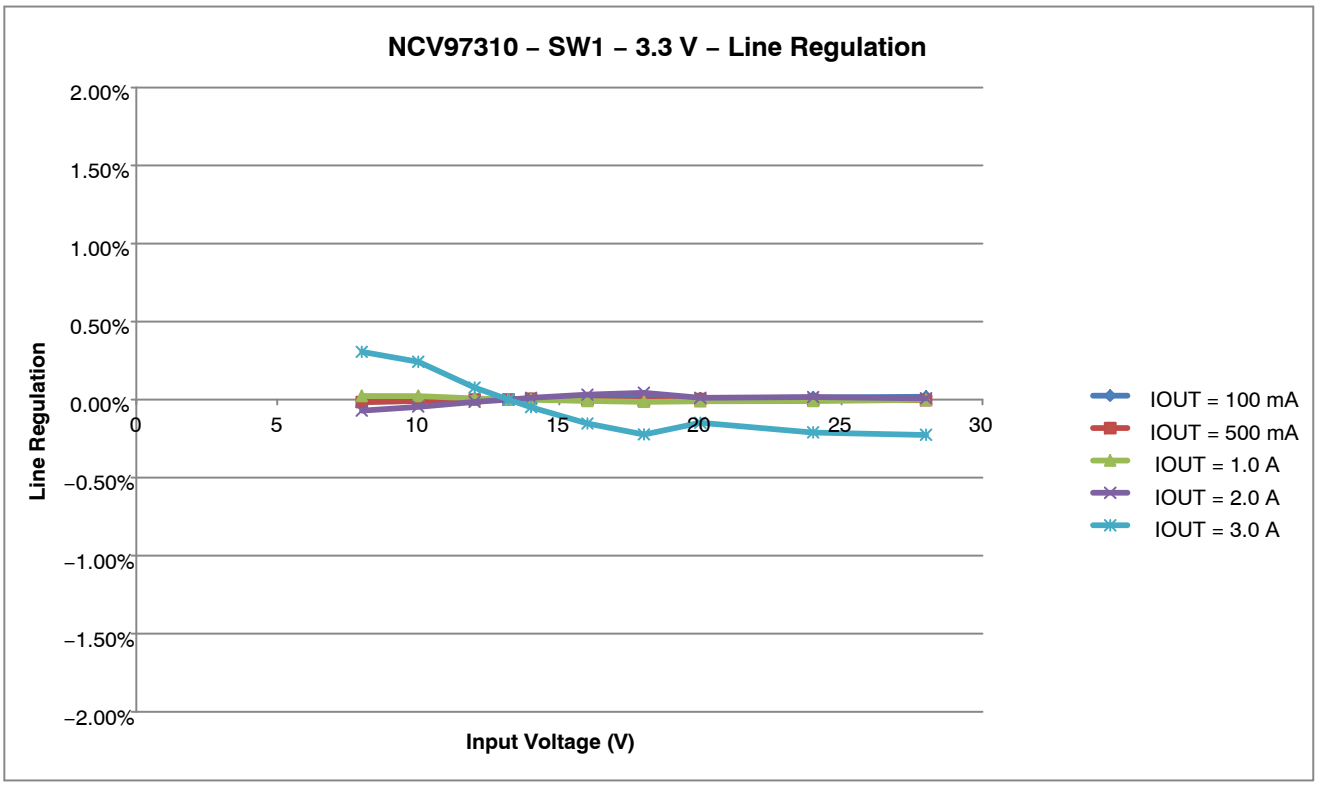


Figure 9. Line Regulation for SW1 with a 3.3 V Output

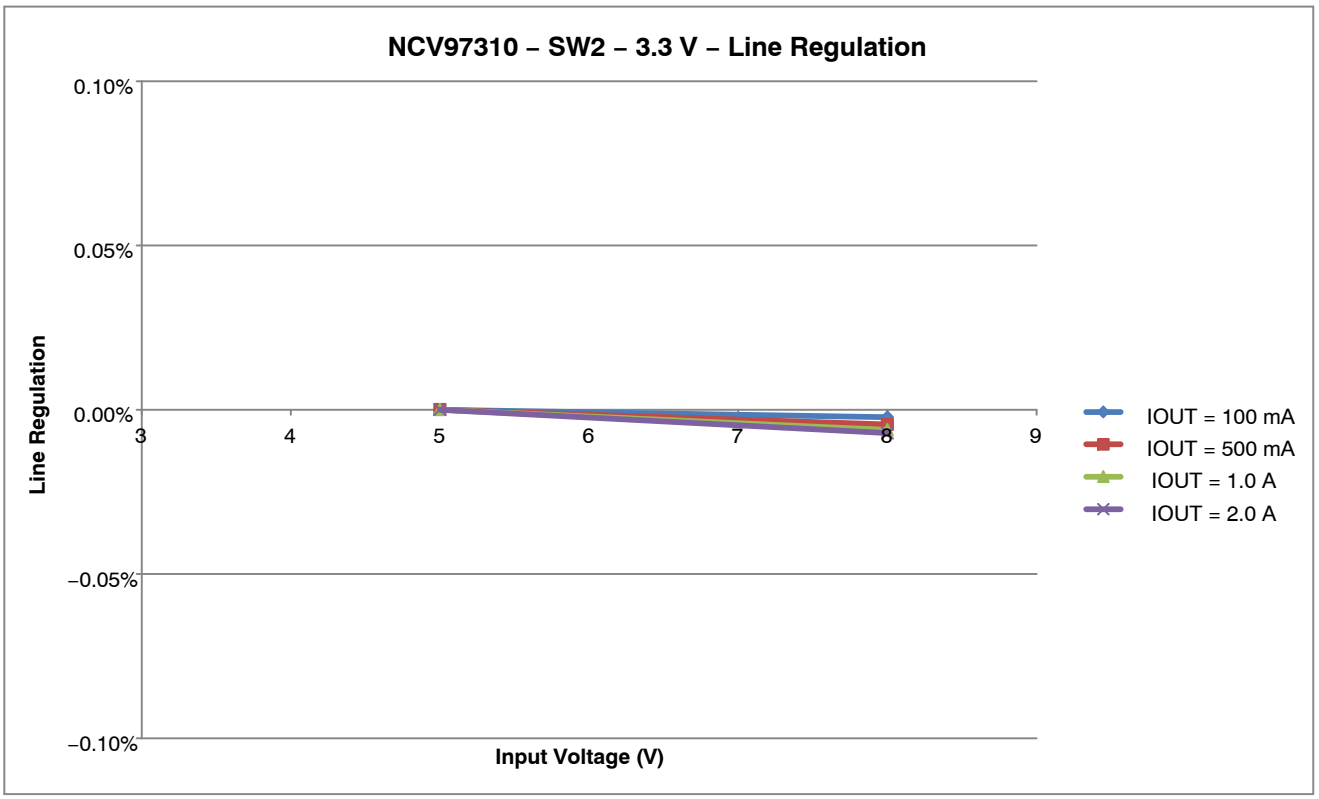


Figure 10. Line Regulation for SW2 with a 3.3 V Output

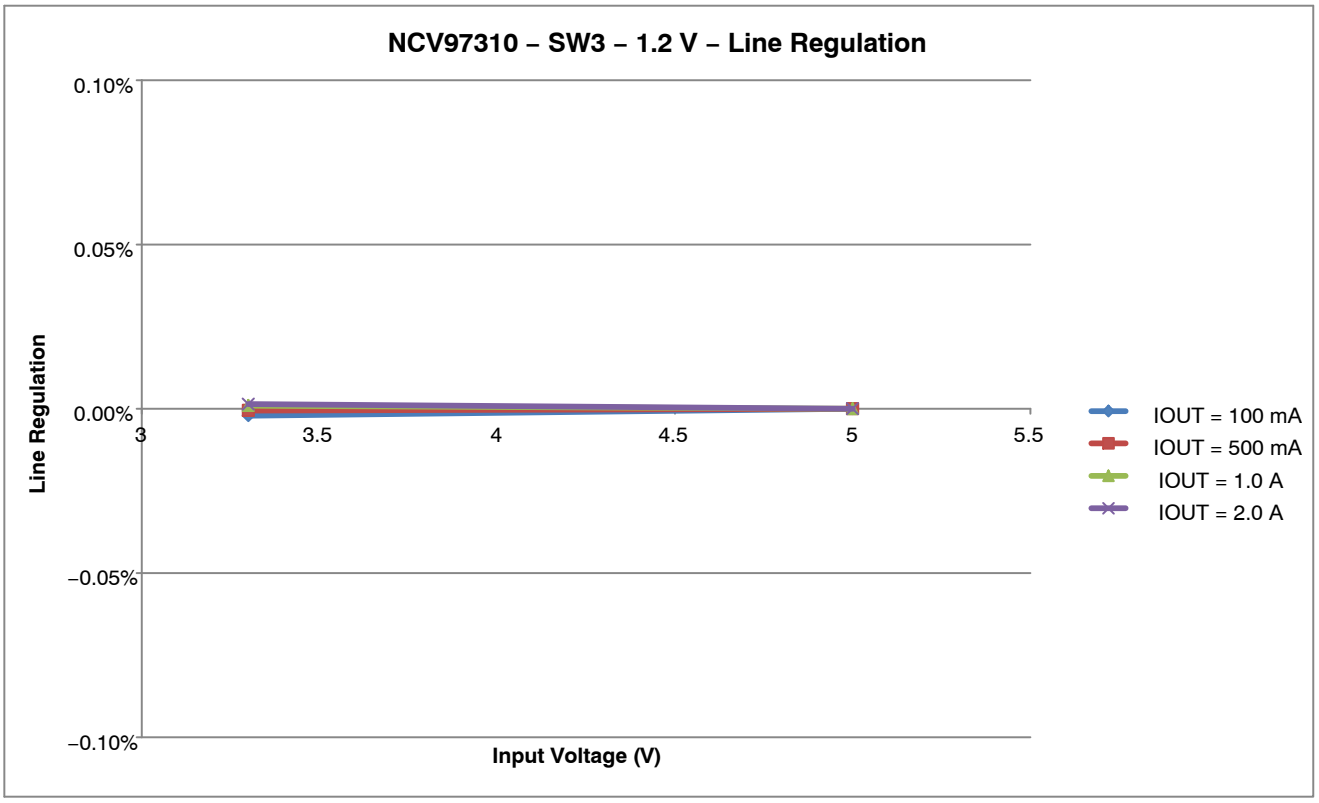


Figure 11. Line Regulation for SW3 with a 1.2 V Output

Load Regulation

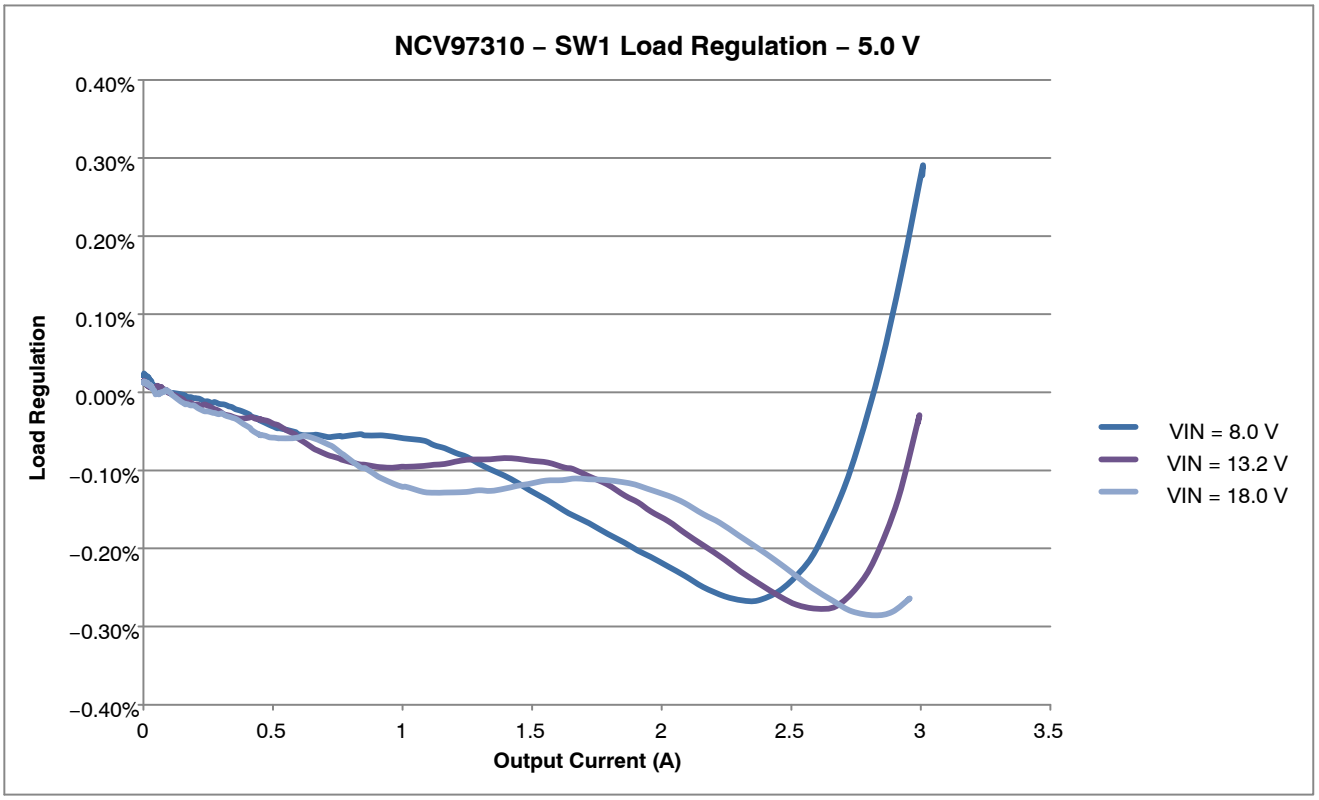


Figure 12. Load Regulation for SW1 with a 5.0 V Output

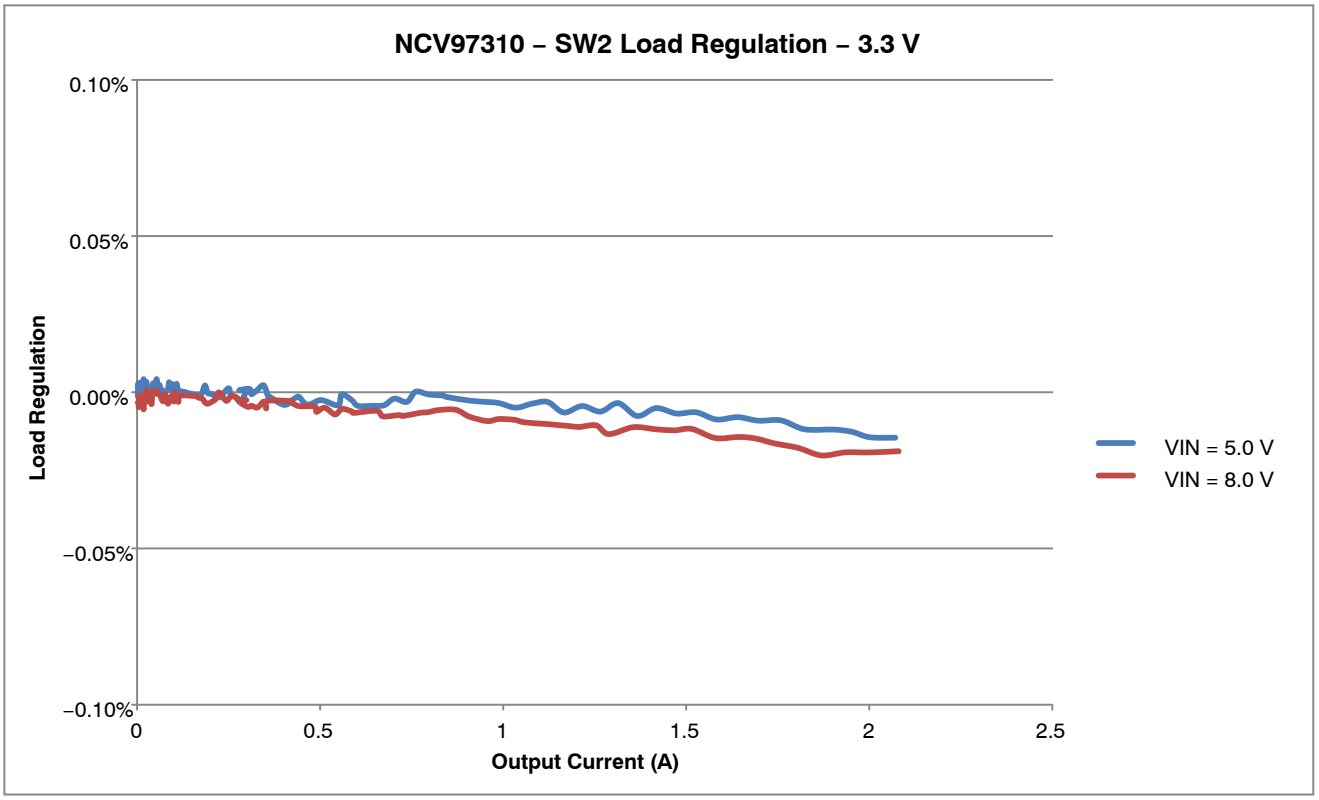


Figure 13. Load Regulation for SW2 with a 3.3 V Output

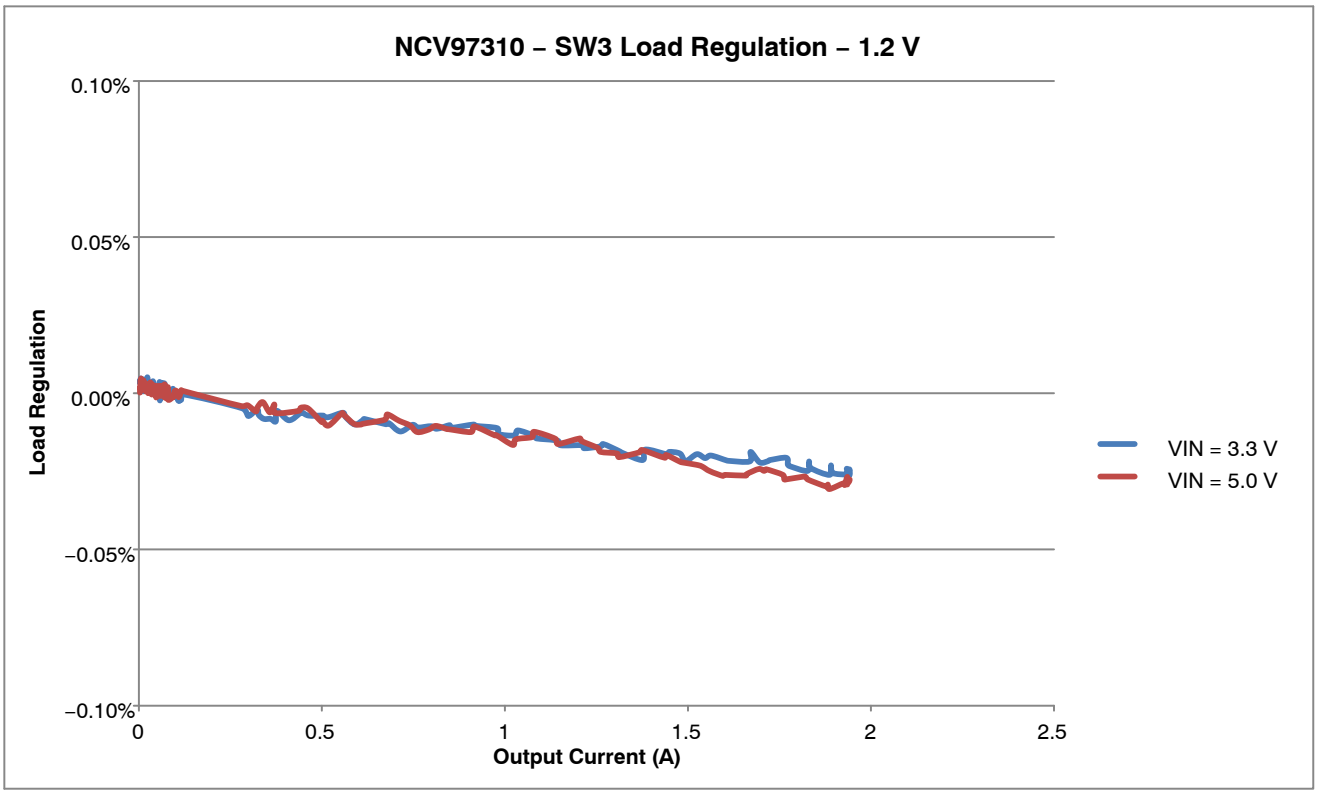
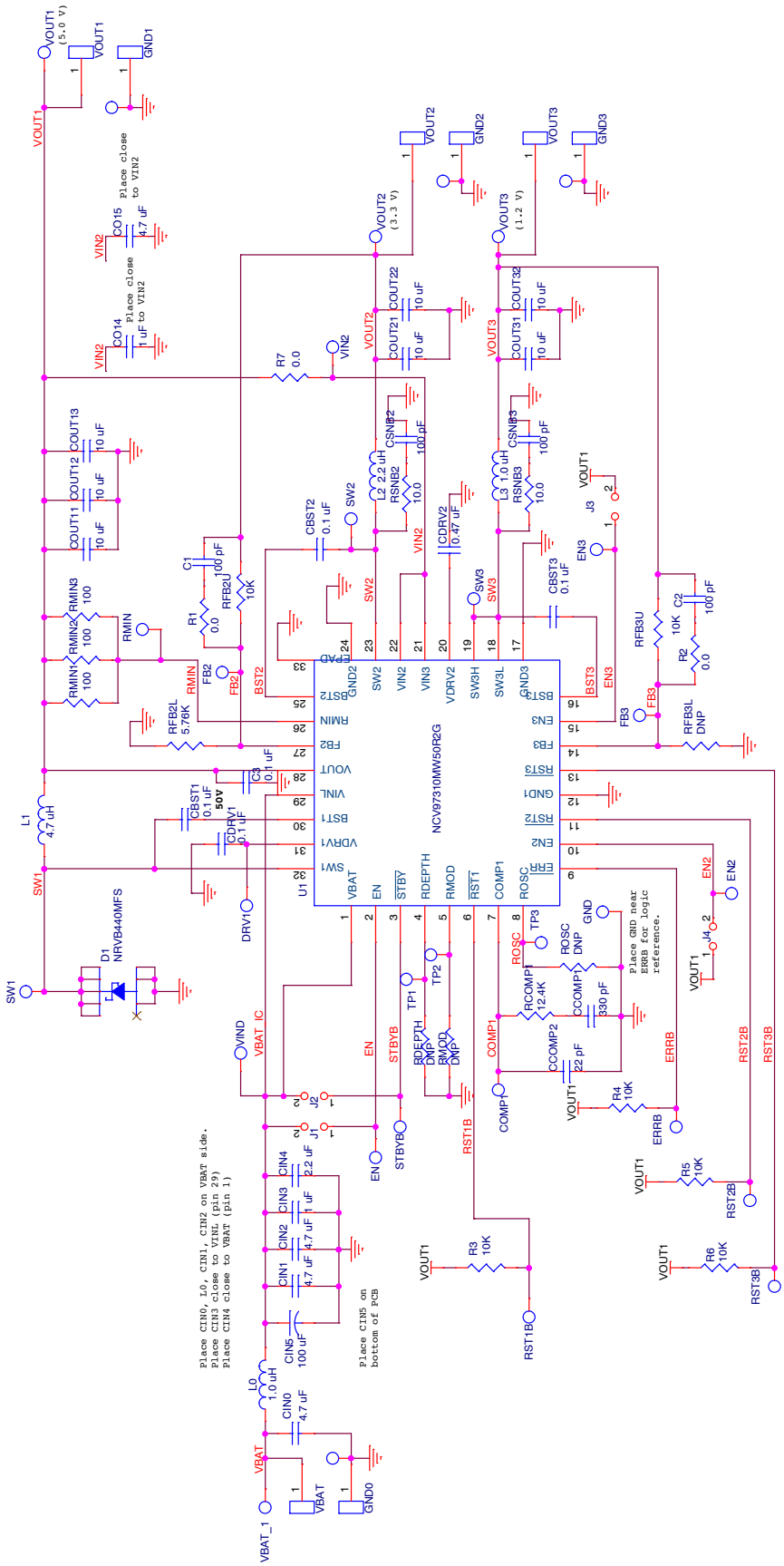


Figure 14. Load Regulation for SW3 with a 1.2 V Output

回路図


NCV97310MW50R2G
U1
VBAT
EN
STBY
RDEPTH
RMOD
RST1
COMP1
ROSC
ERR
SW1
VDRV1
BST1
VINL
VOUT
FB2
RMIN
BST2
GND2
SW2
VIN2
VIN3
VDRV2
SW3H
SW3L
GND3
BST3
EN3
FB3
RST3
GND1
RST2
EN2
EPAD
VOUT1
VOUT2
VOUT3
VIN2
VBAT_IC
VBAT_1
GND0
GND1
GND2
GND3
VOUT1 (5.0 V)
VOUT2 (3.3 V)
VOUT3 (1.2 V)
D1 NRVB440MFS
L1 4.7 uH
L0 1.0 uH
L2 2.2 uH
L3 1.0 uH
R1 0.0
R2 0.0
R3 10K
R4 10K
R5 10K
R6 10K
R7 0.0
RFB2L 5.76K
RFB2U 10K
RFB3U 10K
RFB3L DNP
RCOMP1 12.4K
CCOMP1 330 pF
CCOMP2 22 pF
ROSC DNP
CBST1 0.1 uF 50V
CBST2 0.1 uF
CBST3 0.1 uF
CDRV1 0.1 uF
CDRV2 0.47 uF
CSNB2 100 pF
CSNB3 100 pF
RSNB2 10.0
RSNB3 10.0
CIN0 4.7 uF
CIN1 4.7 uF
CIN2 4.7 uF
CIN3 1 uF
CIN4 2.2 uF
CIN5 100 uF
Place CIN0, L0, CIN1, CIN2 on VBAT side.
Place CIN3 close to VINL (pin 29)
Place CIN4 close to VBAT (pin 1)
Place CIN5 on bottom of PCB
Place GND near ERRB for logic reference.
Place close to VIN2

PCBのレイアウト

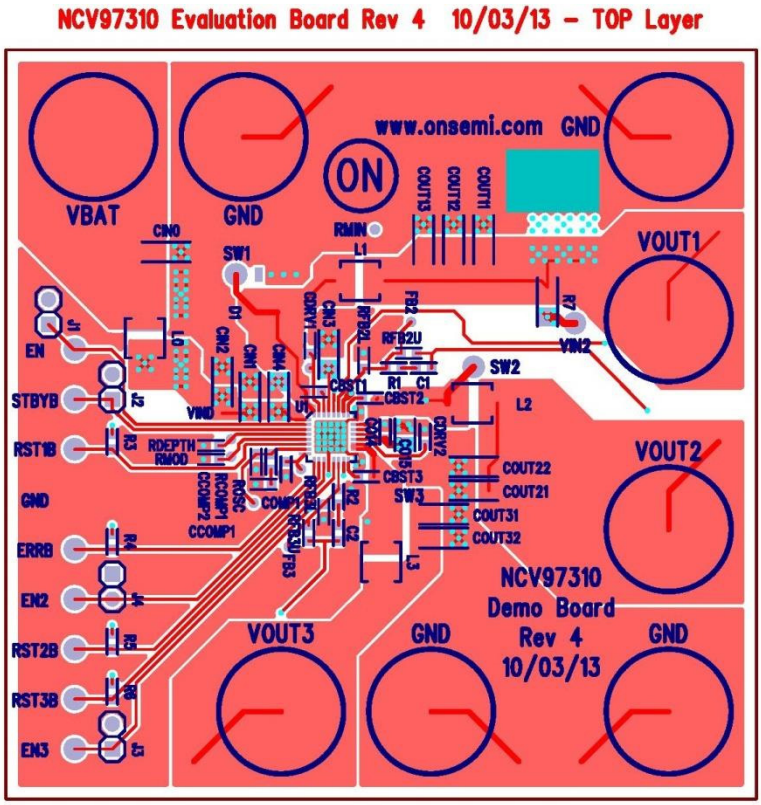


Figure 15. Top View

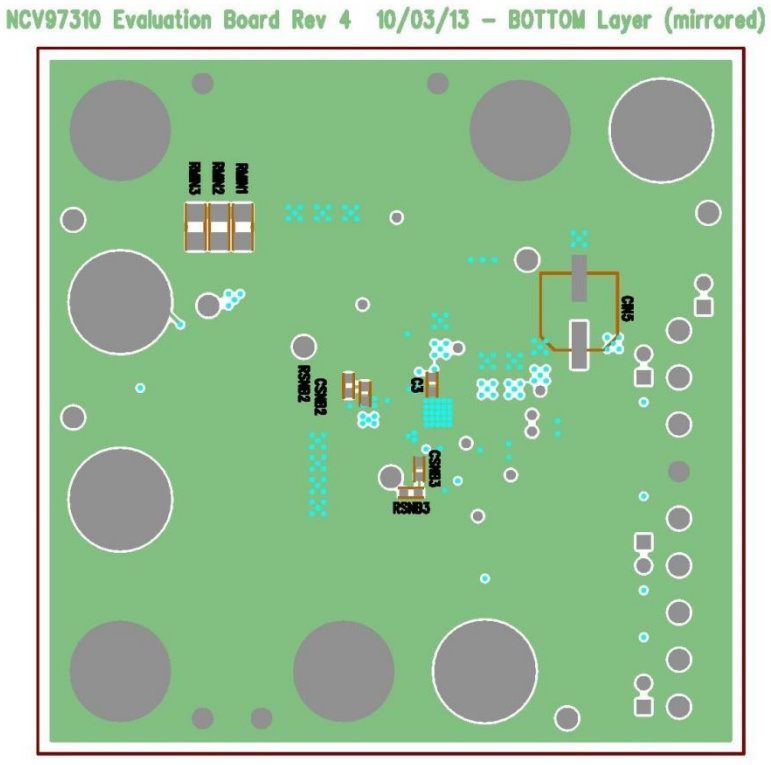


Figure 16. Bottom View

部品表(BOM)

Table 4. BILL OF MATERIALS

Reference Designator(s)	Qty.	Description	Value	Tolerance	Footprint	Manufacturer	Manufacturer's Part Number	Substitution Allowed
C1, C2, CSNB2, CSNB3	4	CAP CER 100 pF 50 V 5% NP0 0603	100 pF	5%	603	Murata Electronics North America	GCM1885C1H101JA16D	Yes
C3, CBST1, CBST2, CBST3, CDRV1	5	CAP CER 0.1 μF 50 V 10% X7R 0603	0.1 μF	10%	603	Murata Electronics North America	GCM188R71H104KA57D	Yes
CCOMP1	1	CAP CER 330 pF 50 V 5% NP0 0603	330 pF	5%	603	Murata Electronics North America	GCM1885C1H331JA16D	Yes
CCOMP2	1	CAP CER 22 pF 50 V 5% NP0 0603	22 pF	5%	603	Murata Electronics North America	GCM1885C1H220JA16D	Yes
CDRV2	1	CAP CER 0.47 μF 16 V 10% X7R 0603	0.47 μF	10%	603	Murata Electronics North America	GCM188R71C474KA55D	Yes
CIN0, CIN1, CIN2	3	CAP CER 4.7 μF 50 V 10% X7R 1206	4.7 μF	10%	1206	TDK Corporation	C3216X7R1H475K160AC	Yes
CIN3	1	CAP CER 1.0 μF 50 V 10% X7R 1206	1.0 μF	10%	1206	Murata Electronics North America	GCM31MR71H105KA55L	Yes
CIN4	1	CAP CER 2.2 μF 50 V 10% X7R 1206	2.2 μF	10%	1206	Murata Electronics North America	GCM31CR71H225KA55L	Yes
CIN5	1	CAP ALUM 100 μF 50 V 20% SMD	100 μF	20%	FK_V_E	Chemi-Con	EMZA500ADA101MHA0G	Yes
CO14	1	CAP CER 1 μF 16 V 10% X7R 0603	1.0 μF	10%	603	Murata Electronics North America	GCM188R71C105KA64D	Yes
CO15	1	CAP CER 4.7 μF 16 V 10% X7R 0805	4.7 μF	10%	805	TDK Corporation	CGA4J3X7R1C475K125AB	Yes
COUT11, COUT12, COUT13, COUT21, COUT22, COUT31, COUT32	7	CAP CER 10 μF 10 V 10% X7R 1206	10 μF	10%	1206	Murata Electronics North America	GCM31CR71A106KA64L	Yes
R1, R2	2	RES 0.0 OHM 1/10 W 0603 SMD	0 Ω	Jumper	603	Vishay/Dale	CRCW06030000Z0EA	Yes
R3, R4, R5, R6, RFB2U, RFB3U	6	RES 10.0K OHM 1/10 W 1% 0603 SMD	10.0 kΩ	1%	603	Vishay/Dale	CRCW060310K0FKEA	Yes
R7	1	RES 0.0 OHM 1/4 W 1206 SMD	0 Ω	Jumper	1206	Vishay/Dale	CRCW12060000Z0EA	Yes
RCOMP1	1	RES 12.4K OHM 1/10 W 1% 0603 SMD	12.4 kΩ	1%	603	Vishay/Dale	CRCW060312K4FKEA	Yes
RFB2L	1	RES 20.0K OHM 1/10 W 1% 0603 SMD	20.0 kΩ	1%	603	Vishay/Dale	CRCW060320K0FKEA	Yes
RMIN1, RMIN2, RMIN3	3	RES 100 OHM 1/4 W 1% 1206 SMD	100 Ω	1%	1206	Vishay/Dale	CRCW1206100RFKEA	Yes
RSNB2, RSNB3	2	RES 10.0 OHM 1/10 W 1% 0603 SMD	10.0 Ω	1%	603	Vishay/Dale	CRCW060310R0FKEA	Yes
D1	1	DIODE SCHOTTKY 4.0 A 40 V SMB	40 V/4.0 A	N/A	SMB_DIODE	ON Semiconductor	NRVB440MFST1G	No

Table 4. BILL OF MATERIALS (continued)

Reference Designator(s)	Qty.	Description	Value	Tolerance	Footprint	Manufacturer	Manufacturer's Part Number	Substitution Allowed
L0, L3	2	High Current Shielded Inductor 1.0 μH, 8.7 A SAT	1.0 μH	20%	XAL4020-102ME	Coilcraft	XAL4020-102ME	No
L1	1	High Current Shielded Inductor 4.7 μH, 4.5 A SAT	4.7 μH	20%	XAL4030-472ME	Coilcraft	XAL4030-472ME	No
L2	1	High Current Shielded Inductor 2.2 μH, 5.6 A SAT	2.2 μH	20%	XAL4020-222ME	Coilcraft	XAL4020-222ME	No
EN, EN2, EN3, ERRB, GNDL, PGND1_1, PGND1_2, PGND2_1, PGND3_1, RST1B, RST2B, RST3B, STBYB, SW1, SW2, SW3, VIN2, VBAT, VOUT1_1, VOUT2_1, VOUT3_1	21	PIN INBOARD .042″ HOLE 1000/PKG	N/A	N/A	TP	Vector Electronics	K24C/M	Yes
GND0, GND1, GND2, GND3, VBAT, VOUT1, VOUT2, VOUT3	8	CONN JACK BANANA UNINS PANEL MOU	N/A	N/A	BANANA	Emerson Network Power Connectivity Johnson	108-0740-001	No
J1, J2, J3, J4	4	CONN HEADER 2POS .100 VERT GOLD	N/A	N/A	JMP	Molex Connector Corporation	22-28-4023	Yes
	4	CONN JUMPER SHORTING GOLD	N/A	N/A	JMP	Sullins Connector Solutions	SSC02SYAN	Yes
COMP1, DRV1, FB2, FB3, RMIN, TP1, TP2, TP3, VIND	9	CIRCUIT PIN PRNTD .020″D .425″L	Do Not Populate	N/A	SMALLTP	Mill-Max Manufacturing Corp.	3128-2-00-15-00-00-08-0	Yes
RDEPTH, RFB3L, RMOD, ROSC	4		Do Not Populate		603			Yes
U1	1	Automotive Battery-Connected Low IQ Multi-Output PMU	N/A	N/A	QFN32	ON Semiconductor	NCV97310MW50R2G	No

NOTE: All devices are RoHS Compliant.

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