Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

NCV8851BDBGEVB

NCV8851B Automotive Grade Synchronous Buck Controller Evaluation Board User's Manual

ON Semiconductor®

http://onsemi.com

EVAL BOARD USER'S MANUAL

Description

The NCV8851B Evaluation Board provides a convenient way to evaluate and integrate a complete high-efficiency synchronous buck converter design. No additional components are required, other than dc supplies for the input voltage and enable pin. The board also can be connected to an external clock source to synchronize the switching frequency or for spread spectrum operation. The board is configured for a 5.0 V output with a 170 kHz switching frequency and a 4 A current limit, intended for applications requiring over 3 A of current.

Additionally, modifying the NCV8851B Evaluation Board for different output voltage, switching frequency or current limit is straightforward, requiring minimal component changes.

Key Features

- 5.0 V Output Voltage
- 91% Efficiency at 3 A
- 4 A Average Current Limit (ACL)
- 170 kHz Switching Frequency
- Average Current Mode Control
- Automotive Grade for up to T_A = 105°C
- Wide Input Voltage Range of 4.5 V to 40 V
- Regulates through Load Dump Conditions
- 1.0 μA Maximum Quiescent Current in Sleep Mode
- Programmable Fixed Frequency – 170 kHz to 500 kHz
- External Clock Synchronization up to 600 kHz
- Easy to Modify for Other Applications

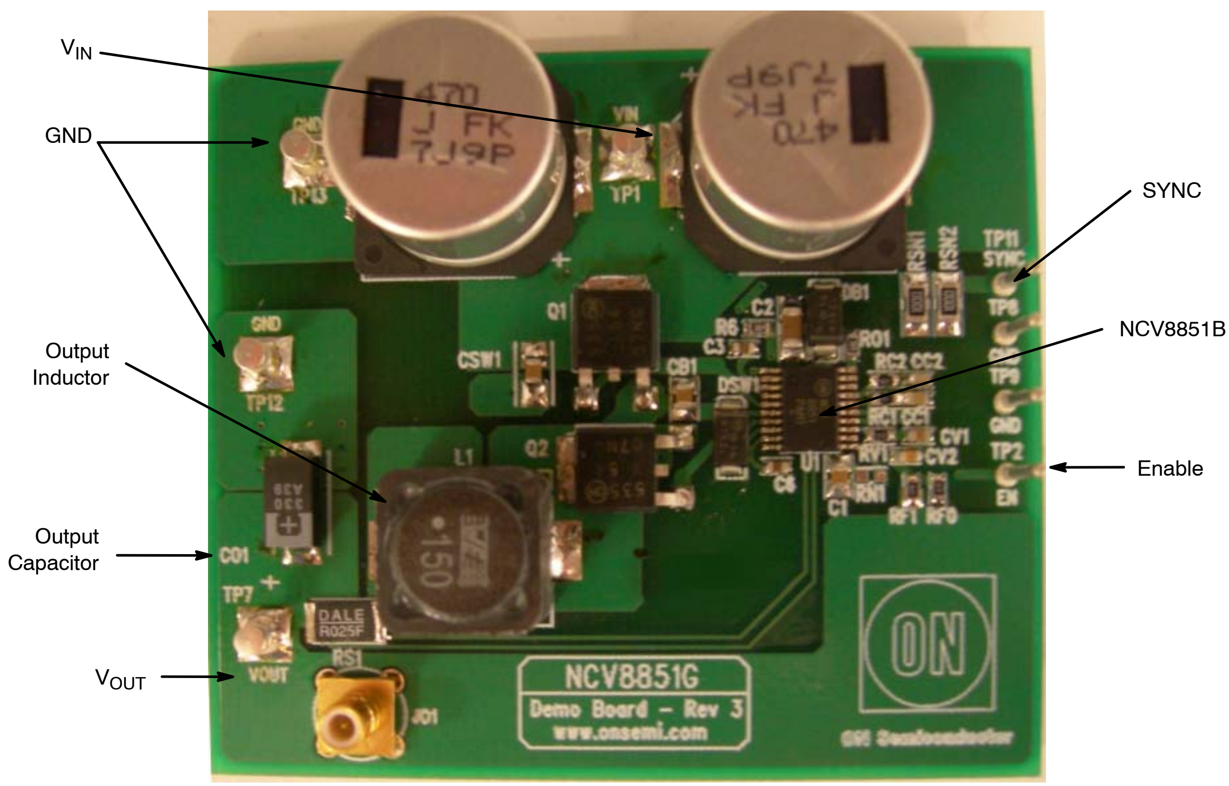

Figure 1. NCV8851B Evaluation Board

May, 2012 – Rev. 1

Publication Order Number:
EVBUM2119/D

Table 1. EVALUATION BOARD TERMINAL DESCRIPTIONS

Terminal	Function
V_{IN}	Positive dc input voltage.
GND	Common dc return.
V_{OUT}	Regulated dc output voltage.
SYNC	Input for external clock synchronization.
EN	Enable input. When disabled, the part enters sleep mode.

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

Rating	Value	Unit
Dc Supply Voltage (VIN, EN) Peak Transient Voltage (Load Dump)	−0.3 to 40 45	V
Dc Supply Voltage (SYNC)	−0.3 to 7	V
Junction Temperature (NCV8851B)	−40 to 150	°C
Ambient Temperature (Demo board)	−40 to 105	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 3. ELECTRICAL CHARACTERISTICS (T_A = 25°C, 4.5 V ≤ V_{IN} ≤ 40 V, I_{OUT} ≤ 4 A, unless otherwise specified)

Characteristic	Conditions	Typical Value	Unit
OUTPUT VOLTAGE			
Output Voltage	-	5.00	V
Voltage Accuracy	-	4	%
Line Regulation	I_{OUT} = 0 A	0.02	%
Load Regulation	V_{IN} = 13.2 V	0.04	%
SWITCHING REGULATOR			
Switching Frequency	V_{IN} = 13.2 V, I_{OUT} = 0 A	170	kHz
Soft-start Time	V_{IN} = 13.2 V, I_{OUT} = 100 mA, 10-90%	14	ms
SYNC Frequency	-	170 to 600	kHz
Duty Cycle Range	-	5 to 95	%
CURRENT LIMIT			
Average Current Limit	-	4	A
Cycle-by-cycle Overcurrent Protection	-	6.4	A
GENERAL			
Input Undervoltage Lockout (UVLO)	V_{IN} increasing	4.3	V
Efficiency	V_{IN} = 13.2 V, I_{OUT} = 100 mA V_{IN} = 13.2 V, I_{OUT} = 1 A V_{IN} = 13.2 V, I_{OUT} = 4 A	70.7 93.2 90.9	%
Maximum Shutdown Current	-	1.0	μA
Thermal Shutdown	-	180	°C

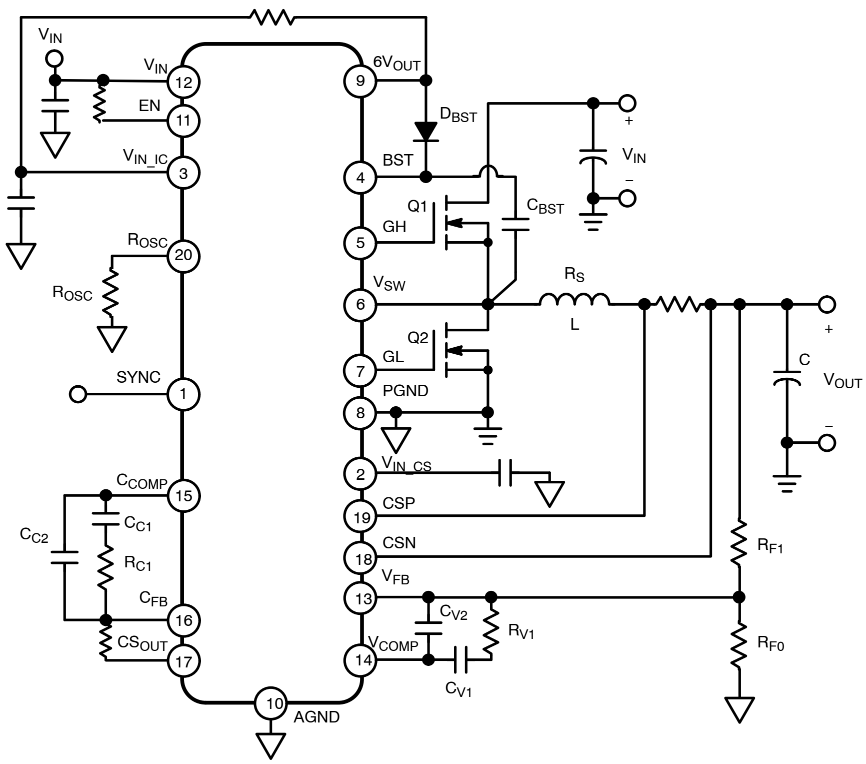

Figure 2. NCV8851B Application Diagram

Operational Guidelines

1. Connect a dc input voltage, 4.5 V ≤ V_{BATT} ≤ 40 V, between "V_{IN}" and "GND".
2. Connect a load impedance between "V_{OUT}" and "GND".
3. Connect a dc enable voltage, 4.5 V ≤ EN ≤ V_{BATT} ≤ 20 V, between "EN" and "GND". If EN must be tied to a higher voltage, a current limiting resistor is required (see below).
4. Optionally, for external clock synchronization, connect a pulse source, SYNC, between "SYNC" and "GND". The positive amplitude should be 1.0 V ≤ SYNC ≤ 7.0 V and negative amplitude should be -0.3 V ≤ GND ≤ 0.8 V. SYNC pulse duty cycle may range from 10% to 90%, and frequency may range from the programmed frequency (170 kHz by default) to 600 kHz.

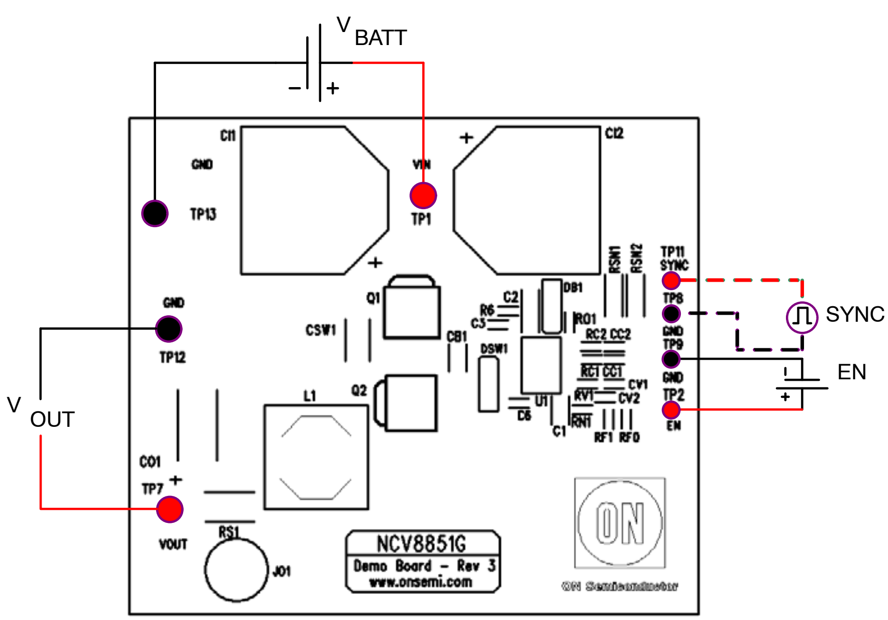

Figure 3. Evaluation Board Connections

TYPICAL WAVEFORMS

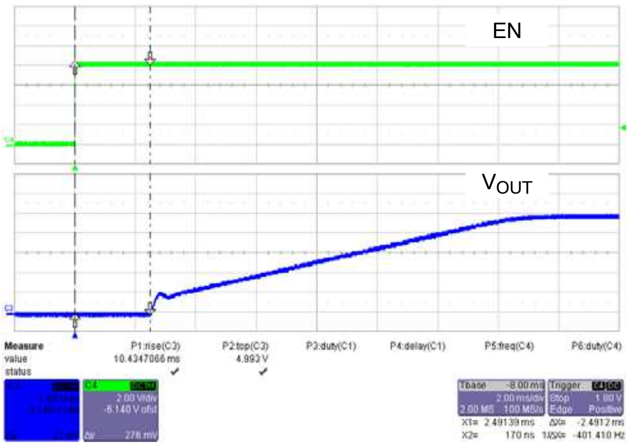

Figure 4. Startup at 170 kHz, 13.2 V to 5 V Output

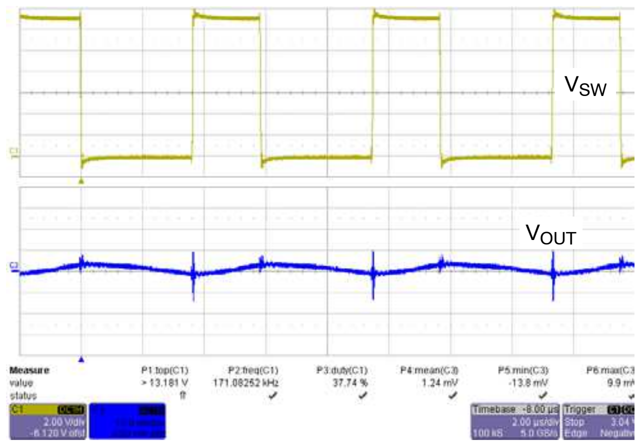

Figure 5. SWN, V_{OUT} at 170 kHz, 13.2 V to 5 V Output

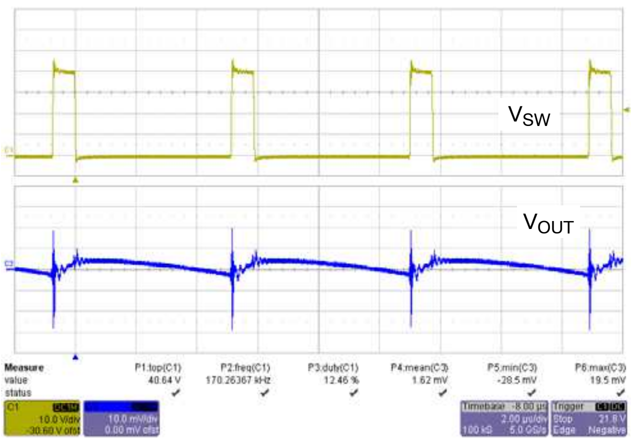

Figure 6. Minimum Duty Cycle at 170 kHz, 5 V Output

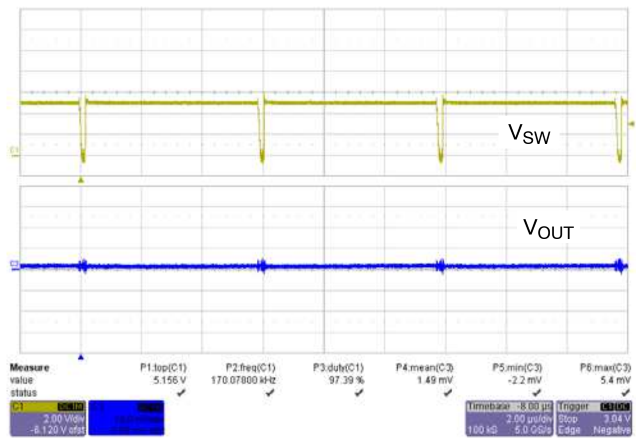

Figure 7. Maximum Duty Cycle at 170 kHz, 5 V Output

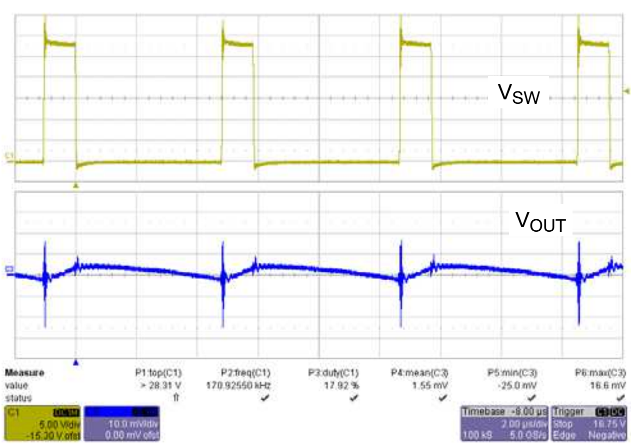

Figure 8. SWN, V_{OUT} at 170 kHz, 28 V to 5 V Output

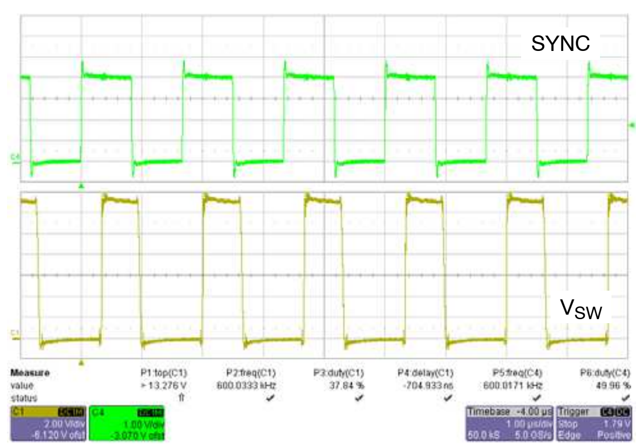

Figure 9. SYNC from 170 to 600 kHz, 13.2 V to 5 V Output

TYPICAL PERFORMANCE

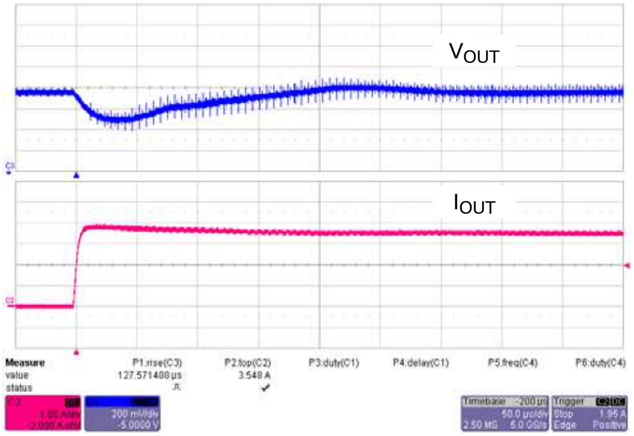

Figure 10. 100 mA to 3.6 A Load Step, 170 kHz, 5 V Output

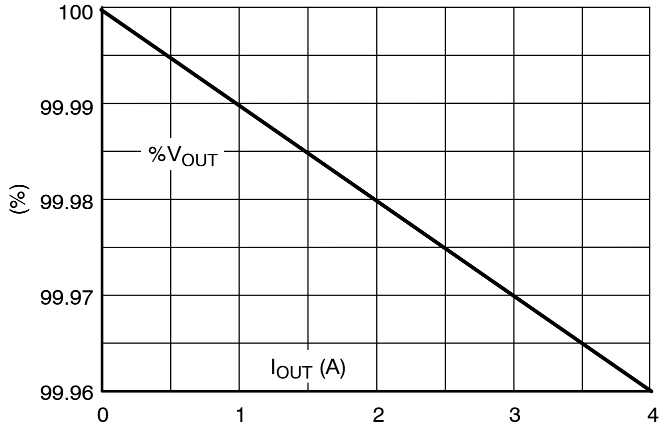

Figure 11. 100 mA to 3.6 A Load Step, 170 kHz, 5 V Output

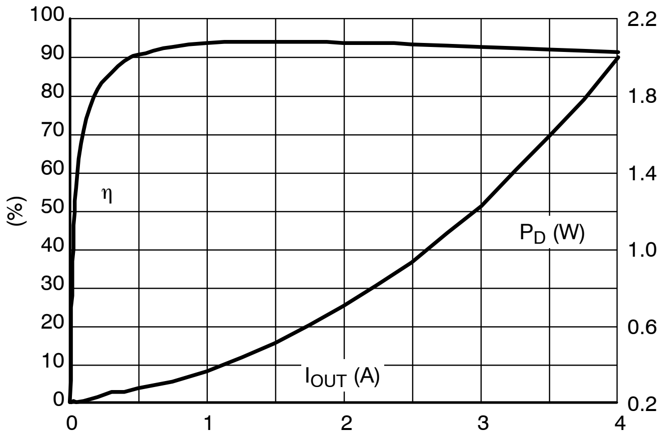

Figure 12. Efficiency at 170 kHz, 13.2 V to 5 V Output

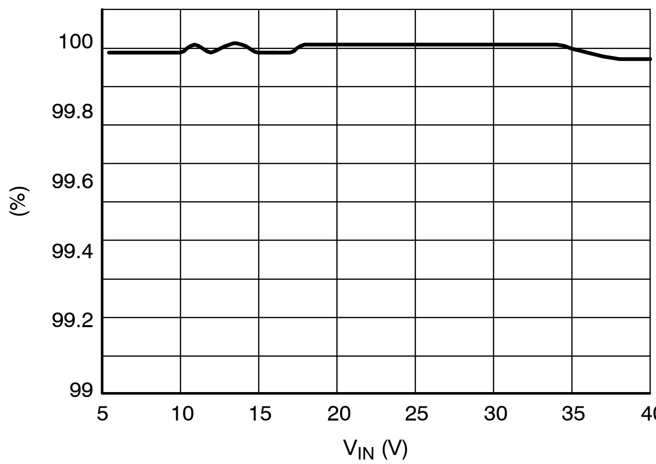

Figure 13. Line Regulation at 170 kHz, 13.2 V to 5 V Output

NCV8851BDBGEVB

SCHEMATIC

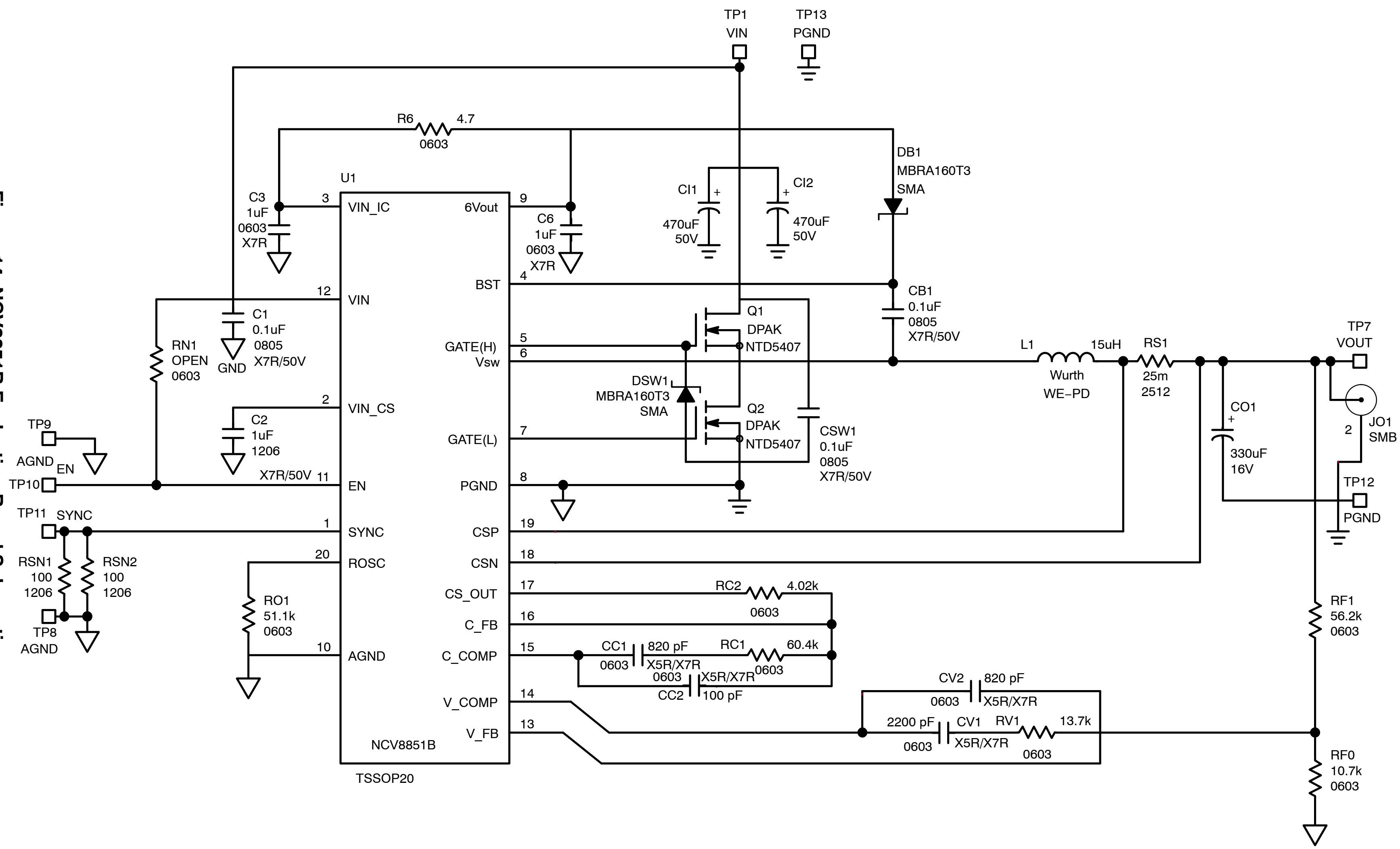

Figure 14. NCV8851B Evaluation Board Schematic

Table 4. BILL OF MATERIALS

Qty	Ref	Part	Part Description	Manufacturer	Part Number
3	CSW1	0.1μF	0.1μF 50V 10% 0805 X7R ceramic SMD capacitor	Kemet	C0805C104K5RACTU
	CB1	0.1μF	0.1μF 50V 10% 0805 X7R ceramic SMD capacitor	Kemet	C0805C104K5RACTU
	C1	0.1μF	0.1μF 50V 10% 0805 X7R ceramic SMD capacitor	Kemet	C0805C104K5RACTU
2	CC1	820pF	820pF 10% 0603 X7R ceramic SMD capacitor	Murata Electronics North America	GRM188R71H821KA01D
	CV2	820pF	820pF 10% 0603 X7R ceramic SMD capacitor	Murata Electronics North America	GRM188R71H821KA01D
1	CC2	100pF	820pF 10% 0603 X7R ceramic SMD capacitor	Murata Electronics North America	GCM1885C1H101JA16D
2	CI1	470μF	470μF 63V FK electrolytic SMD capacitor	Panasonic - ECG	EEVFK1J471M
	CI2	470μF	470μF 63V FK electrolytic SMD capacitor	Panasonic - ECG	EEVFK1J471M
1	CO1	330μF	330μF 10V 20% polymer electrolytic SMD capacitor	Sanyo Electronic Components Co.	10TPE330M
1	CV1	2200pF	2200pF 10% 0603 X7R ceramic SMD capacitor	Panasonic - ECG	ECJ-1VB1H222K
1	C2	1μF	1μF 50V 10% 1206 X7R ceramic SMD capacitor	Murata Electronics North America	GCM31MR71H105KA55L
2	C3	1μF	1μF 16V 10% 0603 X7R ceramic SMD capacitor	Taiyo Yuden	EMK107BJ105KA-TR
	C6	1μF	1μF 16V 10% 0603 X7R ceramic SMD capacitor	Taiyo Yuden	EMK107BJ105KA-TR
2	DSW1	MBRA160T3	1A, 60 V Schottky SMD rectifier	ON Semiconductor	MBRA160T3G
	DB1	MBRA160T3	1A, 60 V Schottky SMD rectifier	ON Semiconductor	MBRA160T3G
1	JO1	SMB	Vertical PCB mount gold RF connector jack	Emerson Network Power Connectivity Solutions	131-3701-261
1	L1	15μH	15μH SMD power inductor	Wurth	7447709150
2	Q1	NTD5407	40V, 38A N-channel power MOSFET	ON Semiconductor	NTD5407NG
	Q2	NTD5407	40V, 38A N-channel power MOSFET	ON Semiconductor	NTD5407NG
1	RC1	60.4k	60.4kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-0760K4L
1	RC2	4.02k	4.02kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-074K02L
1	RF0	10.7k	10.7kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-0710K7L
1	RF1	56.2k	56.2kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-0756K2L
1	RN1	OPEN	1% 0.1W 0603 Thick-film SMD resistor		
1	RO1	51.1k	51.1kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-0751K1L
2	RSN1	100	100Ω 1% 0.25W 1206 Thick-film SMD resistor	Yageo Corporation	RC1206FR-07100RL
	RSN2	100	100Ω 1% 0.25W 1206 Thick-film SMD resistor	Yageo Corporation	RC1206FR-07100RL

Table 4. BILL OF MATERIALS

Qty	Ref	Part	Part Description	Manufacturer	Part Number
1	RS1	25m	25mΩ 1% 2512 Thick-film SMD current sense resistor	Vishay/Dale	WSL2512R0250FEA
1	RV1	13.7k	13.7kΩ 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-0713K7L
1	R6	4.7	4.75Ω 1% 0.1W 0603 Thick-film SMD resistor	Yageo Corporation	RC0603FR-074R75L
4	TP1	VCC	0.291” X 0.109” Solder terminal turret Ag over Cu	Mill-Max Manufacturing Corporation	2501-2-00-44-00-00-07-0
	TP7	VOUT	0.291” X 0.109” Solder terminal turret Ag over Cu	Mill-Max Manufacturing Corporation	2501-2-00-44-00-00-07-0
	TP12	PGND	0.291” X 0.109” Solder terminal turret Ag over Cu	Mill-Max Manufacturing Corporation	2501-2-00-44-00-00-07-0
	TP13	PGND	0.291” X 0.109” Solder terminal turret Ag over Cu	Mill-Max Manufacturing Corporation	2501-2-00-44-00-00-07-0
4	TP8	AGND	0.042” Inboard pin	Vector Electronics	K24C
	TP9	AGND	0.042” Inboard pin	Vector Electronics	K24C
	TP10	EN	0.042” Inboard pin	Vector Electronics	K24C
	TP11	SYNC	0.042” Inboard pin	Vector Electronics	K24C
1	U1	NCV8851B	Automotive synchronous buck controller	ON Semiconductor	NCV8851BG

EVALUATION BOARD MODIFICATIONS

Connecting EN to a Higher Voltage or V_{BATT}

Typically, EN is tied to a logic output or low-voltage supply. However, EN can be tied to a higher voltage or to V_{BATT}. In either case, if the supply that EN is tied to is expected to go above 20 V, a current limiting resistor is required.

For convenience, RN1 is unpopulated, disconnecting EN from V_{BATT} (via V_{IN}) by default. To connect EN to V_{BATT}, populate RN1 with a current limiting resistor. To connect EN to a separate higher voltage supply from V_{BATT}, place a current limiting resistor in series with the supply. Consult the data sheet, NCV8851B/D, for selecting a current limiting resistor.

Programming the Switching Frequency to a Different Value

The switching frequency is programmed with a resistor, RO1, from the R_{OSC} pin to GND. By default, the switching frequency is set to 170 kHz with a 51.1 kΩ resistor used for RO1. The frequency can be programmed to a different value by replacing RO1. Consult the data sheet, NCV8851B/D, for selecting a different frequency program resistor.

Changing the switching frequency may impact dynamic characteristics. Typically, increasing the switching frequency allows the dynamic response to improve by further optimization of the compensators; however, it is advised to analyze dynamic response results of simulation whenever the switching frequency is modified.

Synchronizing to a Higher Frequency

When connecting the SYNC input to a significantly higher frequency than that set by the program resistor, dynamic performance could be impaired. Based on empirical results, it is advised to analyze dynamic response results of simulation whenever SYNC is more than 33% higher than the programmed switching frequency.

Adjusting the Current Limit

The current limit can be adjusted by using a different sense resistor for RS1. Consult the data sheet, NCV8851B/D, for selecting a different current limit.

Changing the sense resistor may impact dynamic characteristics. It is advised to analyze dynamic response results of simulation whenever the sense resistor is modified.

Table 5. BOM VARIATIONS

The following list of BOM variations on output voltage and switching frequency have been tested.

Part	3.3 V, 4 A			5 V, 4 A			8 V, 4 A			Unit
	170kHz	360 kHz	500 kHz	170kHz	360 kHz	500 kHz	170 kHz	360 kHz	500 kHz	
RO1	51.1	23.2	16.2	51.1	23.2	16.2	51.1	23.2	16.2	kΩ
L1	15	10	10	15	15	10	22	15	15	μH
CO1	330	330	330	330	330	330	330	330	330	μF
RS1	25	25	25	25	25	25	25	25	25	mΩ
RC1	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	kΩ
RC2	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	kΩ
CC1	820	820	820	820	820	820	820	820	820	pF
CC2	100	100	100	100	100	100	100	100	100	pF
RV1	13.7	27.4	27.4	13.7	27.4	27.4	13.7	13.7	13.7	kΩ
RF0	17.4	17.4	8.66	10.7	5.36	3.57	10.0	4.99	3.32	kΩ
RF1	54.9	54.9	27.4	56.2	28	18.7	90.9	45.3	30.1	kΩ
CV1	2200	2200	2200	2200	2200	2200	2200	2200	2200	pF
CV2	820	820	820	820	820	820	820	820	820	pF

Selection of components for different operational configurations than those listed above is beyond the scope of this document and the data sheet, NCV8851B/D, should be consulted. Additionally, it is advised to analyze dynamic response results of simulation whenever variant components are used.

LAYOUT PLOTS

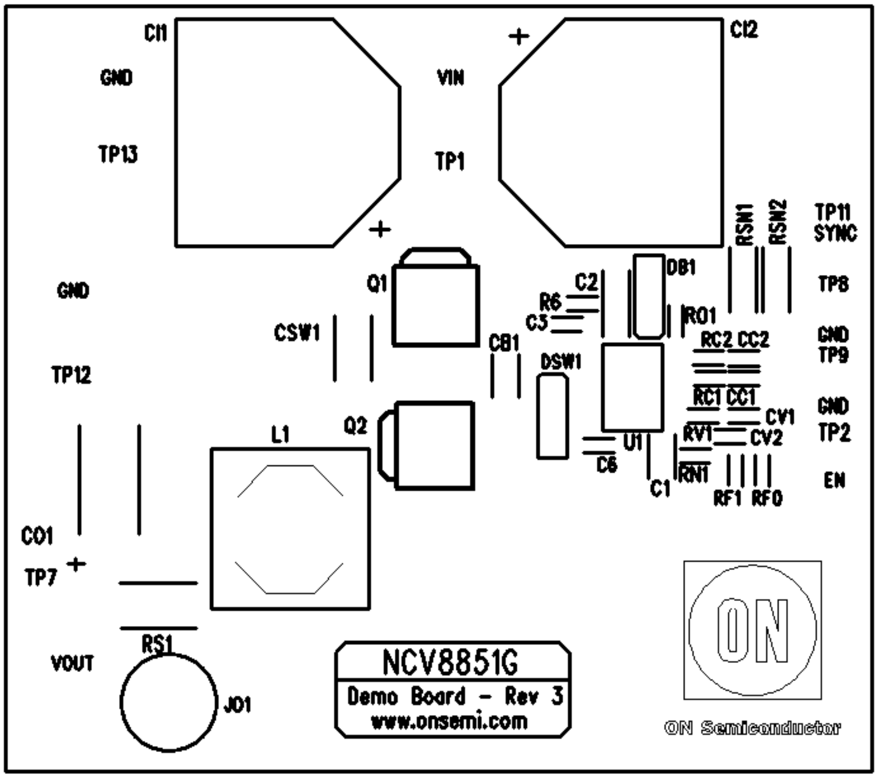

Figure 15. Top Silk Screen

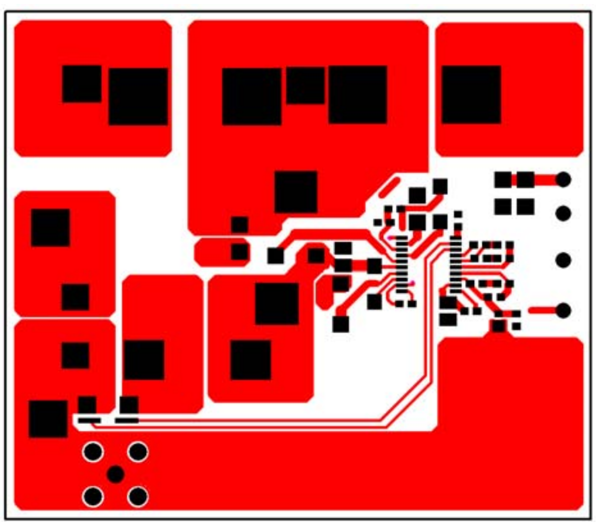

Figure 16. Top Copper

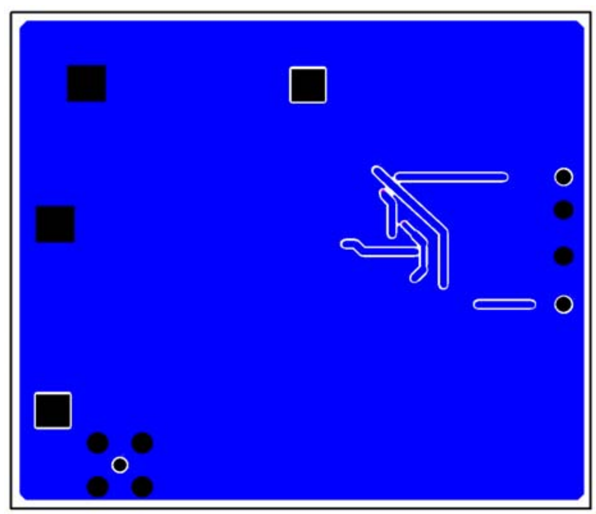

Figure 17. Bottom Copper

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81−3−5817−1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative