Secondary Buck DC/DC Converter

Single Synchronous Buck DC/DC Converter For Automotive BD9S201NUX-C Evaluation Board

BD9S201NUX-TSB-001 (2.7V to 5.5V Input, 2A)

Introduction

This user's guide will provide the necessary steps to operate the Evaluation Board of ROHM's BD9S201NUX-C Buck DC/DC converter. This includes the external parts, operating procedures and application data.

Description

This Evaluation Board was developed for ROHM's single Synchronous buck DC/DC converter BD9S201NUX-C. BD9S201NUX-C is a synchronous buck DC/DC converter with built-in low On Resistance power MOSFETs. The BD9S201NUX-C accepts a power supply input range of 2.7V to 5.5V and generates a maximum output current of 2A. BD9S201NUX-C generates an output voltage range of 0.8V to VIN using external resistors. BD9S201NUX-C is a current mode control DC/DC Converter and features high-speed transient response.

Application

Automotive Equipment

Other Electronic Equipment

Recommended Operating Conditions

Table 1. Recommended Operating Conditions

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage	2.7	-	5.5	V	
Output Voltage for BD9S201NUX-C (Note1)	0.8	-	VIN	V	
Output Current Range	-	-	2.0	A	
Switching Frequency	-	2.2	-	MHz	
Maximum Efficiency (Vo=3.3V)	-	92.12	-	%	VIN=5.0V, Vo=3.3V, Io=1.0A, Ta=25°C
Maximum Efficiency (Vo=1.8V))		91.88		%	VIN=3.3V, Vo=1.8V, Io=0.34A, Ta=25°C

(Note 1) Although the minimum output voltage is configurable up to 0.8 V, it may be limited by the SW min ON pulse width. SW Minimum ON Time that BD9S201NUX-C can output stably in the entire load range is 80ns.Use the value to calculate the input and output conditions that satisfy the equation of $80[\text{ns}] \leqq \frac{Vout}{VIN \times fsw}$.

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Evaluation Board

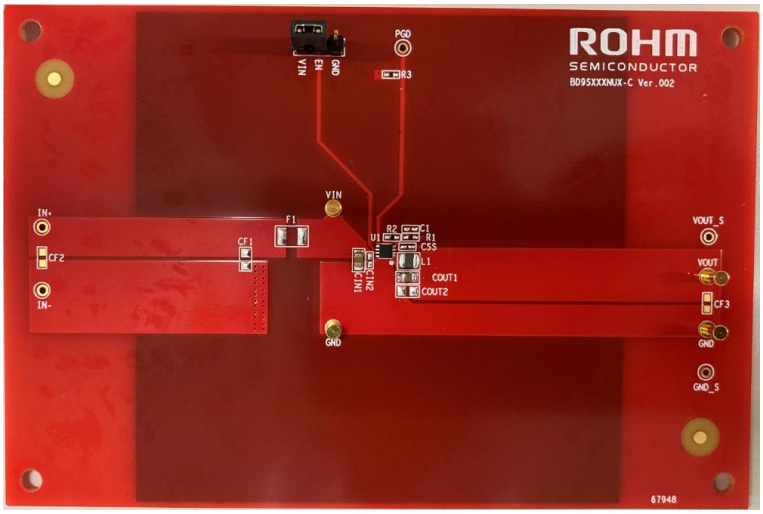

Figure 1. Evaluation Board Top View

Evaluation Board Schematic

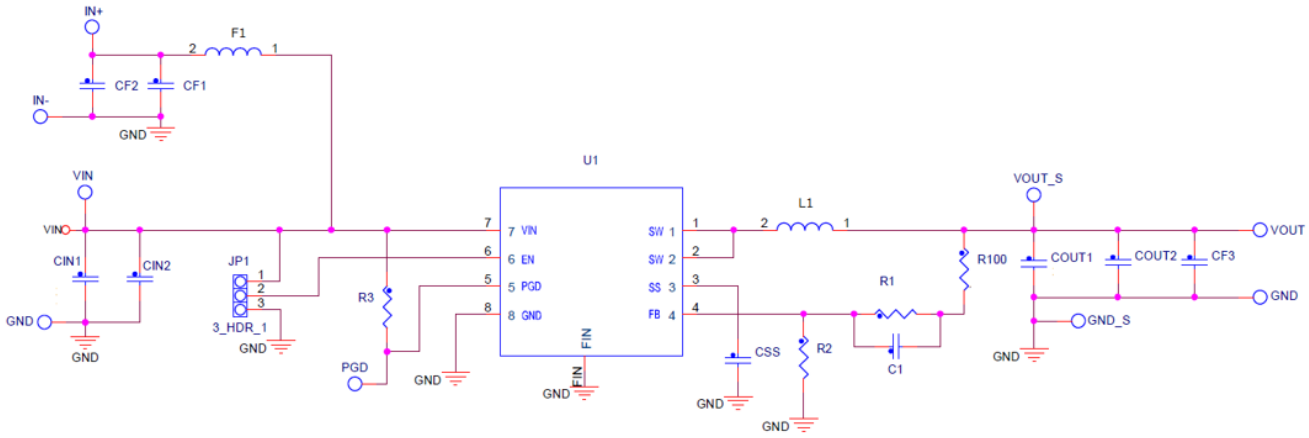

Figure 2. Circuit Diagram

Operating Procedure

1. Turn off EN and connect the GND terminal of the power supply to the GND terminal of Evaluation Board.
2. Connect power supply to the VIN pin of the Evaluation Board.
3. Connect the load to the Evaluation Board's VOUT and GND terminals. When using an electronic load, connect with the load turned off.
4. Connect a voltmeter to the Evaluation Board's VOUT_S and GND_S terminals.
5. Turn on the Power supply of VIN. Turn ON the switch of EN terminal.
6. Make sure that the voltmeter is set to measure voltage.
7. Turn on the electronic load.

(Caution) This Evaluation Board does not support hot plug. Do not perform hot plug test.

(Note) If EN=High (EN short to VIN) before Power ON, the turn ON and turn OFF is controlled by VIN only.

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Pin Configuration

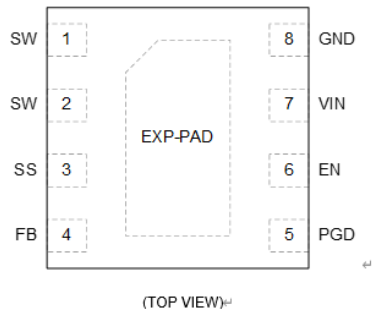

Figure 3. Pin Configuration

Pin Description

Table 2. VIN and EN Terminal Description

VIN PIN	EN PIN	SW Discharge	VOUT
VIN ≧ 2.55V(TYP)	EN ≧ 1.0V	OFF	Start up with Soft Start
VIN ≧ 2.55V(TYP)	EN ≦ 0.4V	ON	Discharge
VIN ≦ 2.45V(TYP)	-	ON	Discharge

(Note) SW is discharged with the resistor of 1100 Ω (TYP). When SW discharge on, VOUT is discharged through the SW pin.

Table 3. FB and PGD Terminal Description

FB PIN	PGD
In the range of 0.8V(TYP) ±7%	HIGH
Out the range of 0.8V(TYP) ±10%	LOW

(Note)PGD pin is an output of open drain MOSFET, and the PGD pin is pulled down with impedance of 60Ω (TYP). It is recommended to use a pull-up resistor of 2kΩ to 100kΩ for the power source.

Table 4. FB and SW Terminal Description

FB PIN	SW Discharge	Protection
FB ≧ 0.6V(TYP)	OFF	-
FB ≦ 0.56V and remains 1ms(TYP)	ON	SCP
FB ≧ 0.88V(TYP)	ON	OVP

(Note) When the FB pin voltage has fallen to 0.56 V (TYP) or less and remained there for 1ms (TYP), SCP stops the operation for 14ms (TYP) and subsequently initiates a restart. When the FB pin voltage becomes over or equal to 0.88 V (TYP), which is Output Over Voltage Protection Detection Voltage, the MOSFETs on the output stage are turned OFF to prevent the increase in the output voltage.

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Parts list

Table 5. Parts List (VOUT=1.0V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	7.5 kΩ, 1 %, 1/16 W	MCR01MZPF7501	Chip Resistor	ROHM
R2	1005	30 kΩ, 1 %, 1/16 W	MCR01MZPF3002	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 6. Parts List (VOUT=1.2V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	10 kΩ, 1 %, 1/16 W	MCR01MZPF1002	Chip Resistor	ROHM
R2	1005	20 kΩ, 1 %, 1/16 W	MCR01MZPF2002	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 7. Parts List (VOUT=1.5V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT 1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	16 kΩ, 1 %, 1/16 W	MCR01MZPF1602	Chip Resistor	ROHM
R2	1005	18 kΩ, 1 %, 1/16 W	MCR01MZPF1802	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT 2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

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Table 8. Parts List (VOUT=1.8V, VIN=5.0V,3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	30 kΩ, 1 %, 1/16 W	MCR01MZPF3002	Chip Resistor	ROHM
R2	1005	24 kΩ, 1 %, 1/16 W	MCR01MZPF2402	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

Table 9. Parts List (VOUT=3.3V, VIN=5.0V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1	2520	1.0 µH	TFM252012ALMA1R0M	Inductor	TDK
COUT1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN1	2012	10 µF, X7R, 10 V	GCM21BR71A106K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	75 kΩ, 1 %, 1/16 W	MCR01MZPF7502	Chip Resistor	ROHM
R2	1005	24 kΩ, 1 %, 1/16 W	MCR01MZPF2402	Chip Resistor	ROHM
R3	1005	100 kΩ, 1 %, 1/16 W	MCR01MZPF1003	Chip Resistor	ROHM
CSS	-	-	-	-	-
C1	-	-	-	-	-
COUT2	-	-	-	-	-
CIN2	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
F1	-	-	-	-	-
CF3	-	-	-	-	-

(Note) CSS, C1, COUT2, CIN2, CF1, CF2, F1, CF3 patterns are only optional. They can be utilized for adjusting the characteristics constants.

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Board Layout

Evaluation Board PCB information

Number of Layers	Material	Board Size	Copper Thickness
4	FR4	114.3mm x 76.2mm x 0.1mm	2oz(70µm) / 1oz (35µm) / 1oz (35µm) / 2oz(70µm)

The layout of BD9S201NUX-C is shown below.

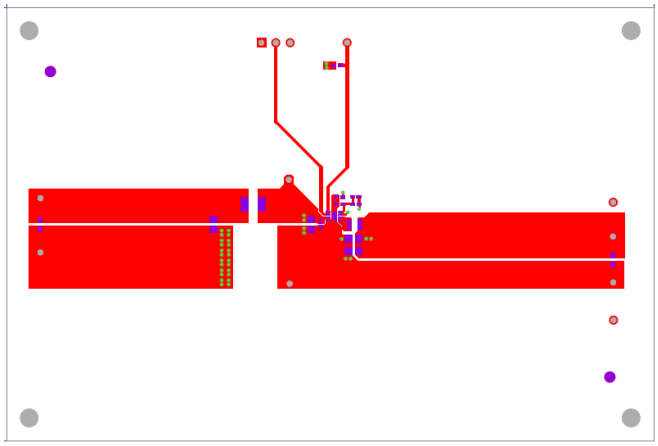

Figure 4. Top Layer Layout
(Top View)

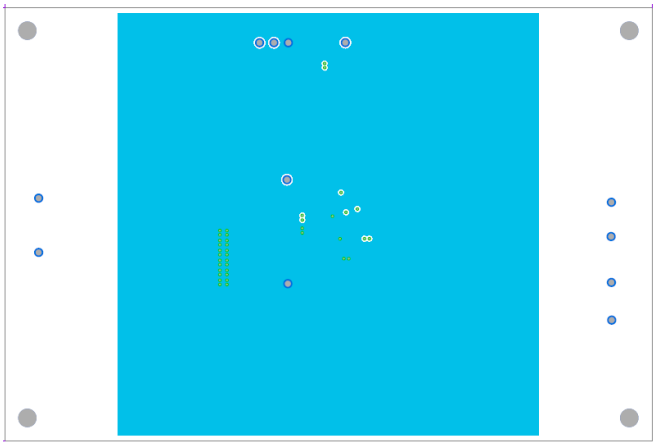

Figure 5. Middle1 Layer Layout
(Top View)

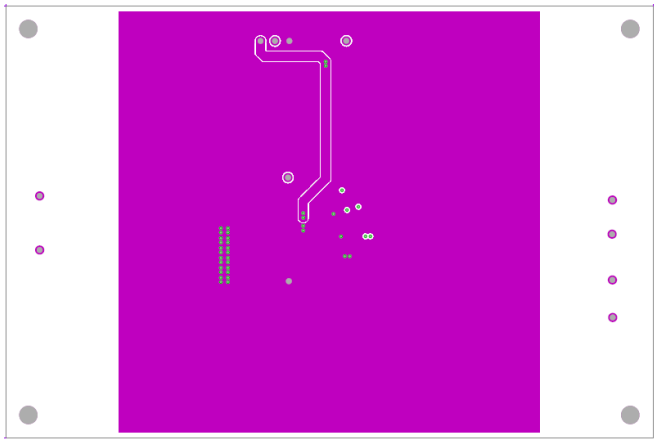

Figure 6. Middle2 Layer Layout
(Top View)

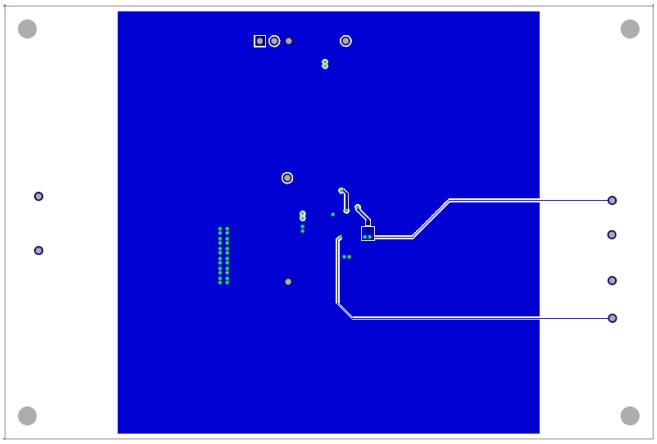

Figure 7. Bottom Layer Layout
(Top View)

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Reference application data

(V_{IN}=V_{EN}, V_{OUT}=1.8V, Ta=25°C)

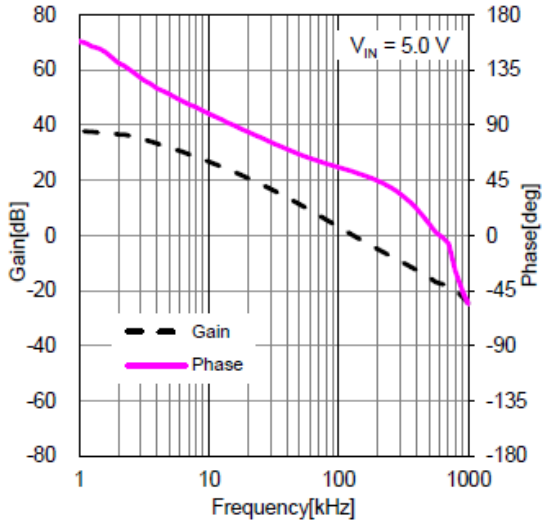

Figure 8. Frequency Characteristics

(I_{OUT} = 2 A)

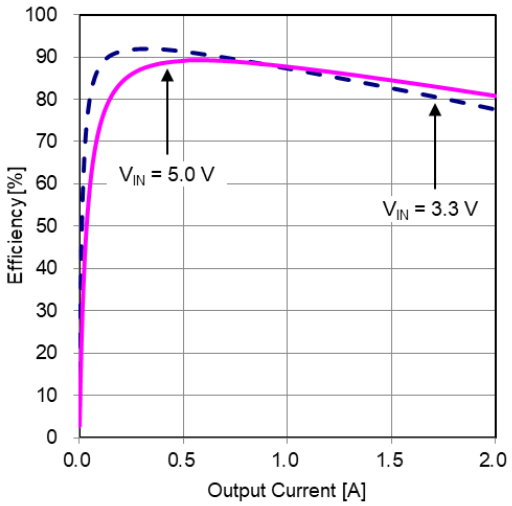

Figure 9. Efficiency vs Output Current

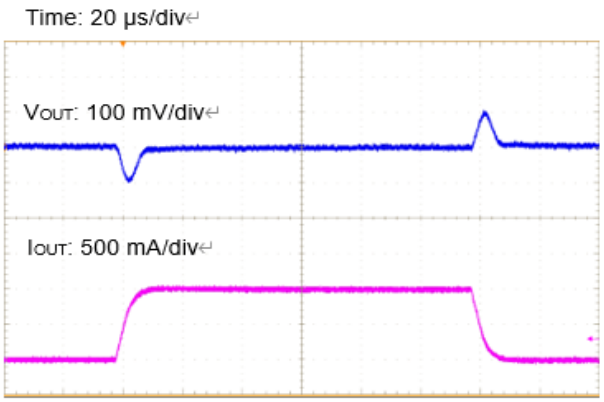

Figure 10. Load Transient Response

(I_{OUT} = 0 A ↔ 1 A)

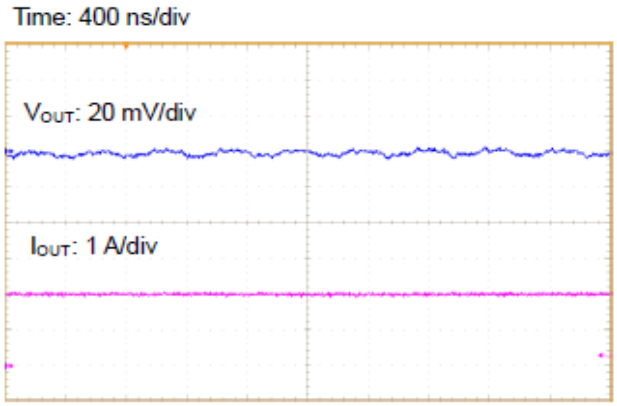

Figure 11. Output Ripple Voltage

(I_{OUT} = 2 A)

Other series application data please refer to datasheet.

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Revision History

Date	Revision Number	Description
27. Jan. 2021	01	Initial release

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