Secondary Buck DC/DC Converter

Single Synchronous Buck DC/DC Converter For Automotive BD9S300MUF-C Evaluation Board

BD9S300MUF-TSB-001 (2.7V to 5.5V Input, 1.2V, 3A Output)

Introduction

This user's guide will provide the necessary steps to operate the Evaluation Board of ROHM's BD9S300MUF-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 BD9S300MUF-C. It is a synchronous buck DC/DC converter with built-in low On Resistance power MOSFETs. The BD9S300MUF-C accepts a power supply input range of 2.7V to 5.5V and generates a maximum output current of 3A. The SLLM™ control provides excellent efficiency characteristics in light-load conditions which make the product ideal for reducing standby power consumption of equipment. BD9S300MUF-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 BD9S300MUF-C (Note1)	0.8	-	PVIN×0.8	V	
Output Current Range	-	-	3.0	A	
Switching Frequency	-	2.2	-	MHz	
Maximum Efficiency (Vo=3.3V)	-	92.1	-	%	VIN=5.0V, Io=1.0A, Ta=25°C
Maximum Efficiency (Vo=1.0V)		82.1		%	VIN=3.3V, Io=0.65A, 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 BD9S300MUF-C can output stably in the entire load range is 95ns.Use the value to calculate the input and output conditions that satisfy the equation of 95[ns] $\leqq \frac{Vout}{VIN \times fsw}$

Evaluation Board

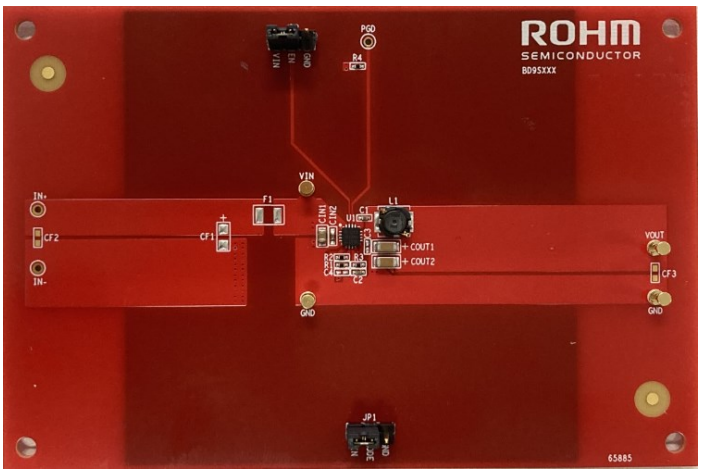

Figure 3. Evaluation Board Top View

Evaluation Board Schematic

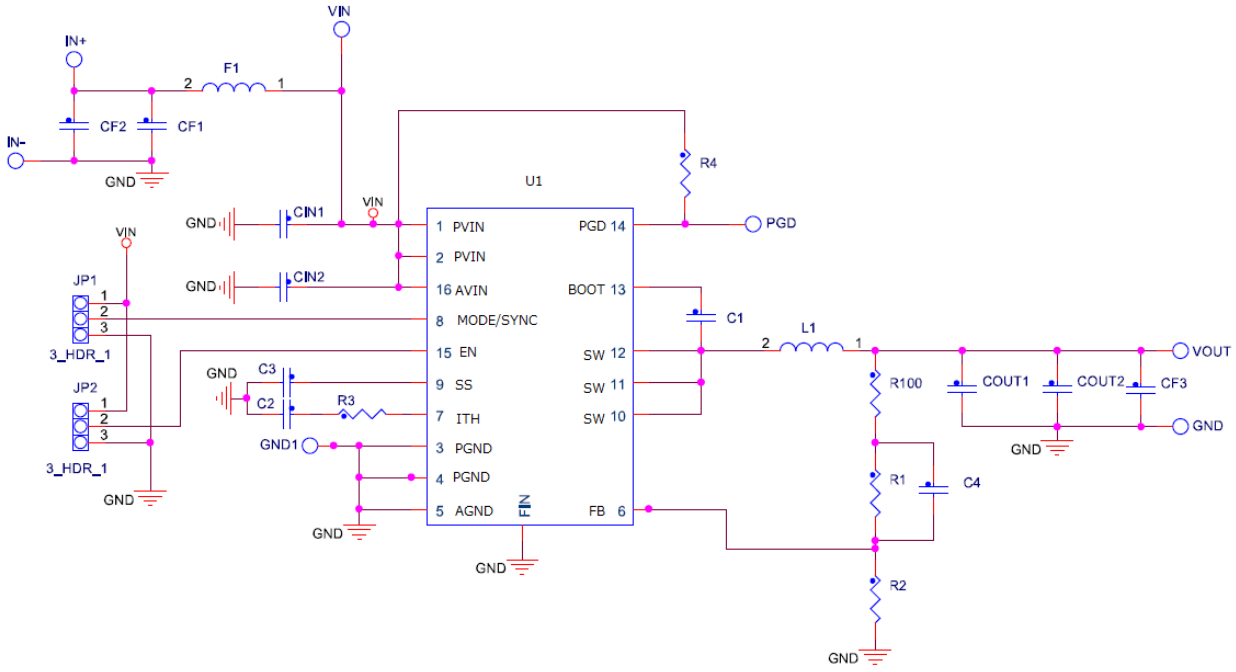

Figure 4. Circuit Diagram

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 terminal 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 and GND 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.

Pin Configuration

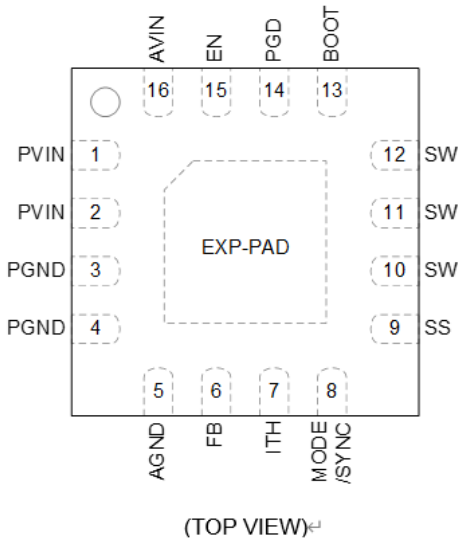

Figure 5. Pin Configuration

Pin Description

Table 2. Mode Terminal Description

Terminal	Setting	Operation Mode	Function
MODE / SYNC	HIGH	SLLM™ control	Automatically switched between SLLM™ control and PWM mode.
	LOW or OPEN	Forced PWM	Forced PWM mode
	Pulse signal (Note)	SYNC	External synchronization mode

(Note) When pulse signal is applied at a frequency of 1.8MHz or higher, the external synchronization operation is started after the falls of the synchronous pulse are detected 7 times. Input the signal with the synchronization frequency range between 1.8MHz and 2.4MHz and the duty range between 25% and 75%

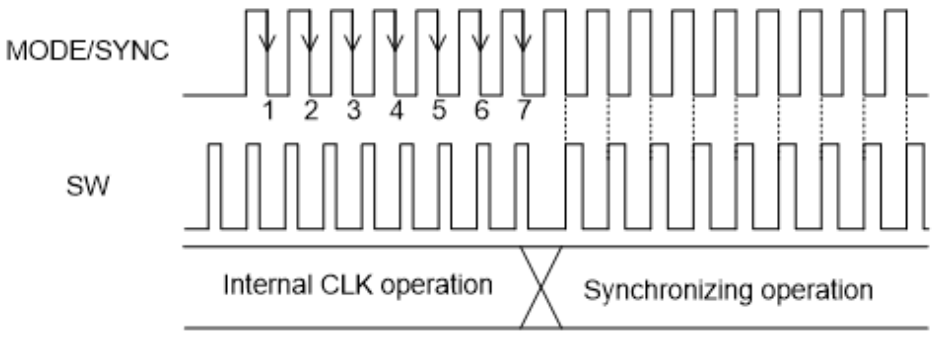

Figure 6. External Synchronization Function Timing Chart

Table 3. VIN and EN Terminal Description

VIN PIN	EN PIN	VOUT
VIN ≧ 2.55V(TYP)	EN ≧ 2.0V	Start up with Soft Start
VIN ≧ 2.55V(TYP)	EN ≦ 0.8V	Shutdown
VIN ≦ 2.45V(TYP)	-	Shutdown

Table 4. FB and PGD Terminal Description

FB PIN	Power Good Output
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 30Ω (TYP). It is recommended to use a pull-up resistor of 10kΩ to 100kΩ for the power source.

Table 5. EN and FB Terminal Description

EN Pin	**FB PIN**	**Protection**	**Protection item**
EN ≧ 2.0V	0.88V(TYP) > FB ≧ 0.6V(TYP)	Enabled	No detection
	FB ≦ 0.56V and remains 1ms(TYP)		SCP
	FB ≧ 0.88V(TYP)		OVP
EN ≦ 0.8V	-	Disabled	-

(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.

Parts list

Table 6. Parts list (VOUT=1.0V, VIN=3.3V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1		1.0μH	CLF5030NIT-1R0N-D	Inductor	TDK
COUT1	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10μF, X7R, 10V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN2	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	7.5kΩ, 1%, 1/16W	MCR01MZPF7501	Chip Resistor	ROHM
R2	1005	30kΩ, 1%, 1/16W	MCR01MZPF3002	Chip Resistor	ROHM
R3	1005	8.2kΩ, 1%, 1/16W	MCR01MZPF8201	Chip Resistor	ROHM
R4	1005	100kΩ, 1%, 1/16W	MCR01MZPF1003	Chip Resistor	ROHM
C1	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
C2	1005	4700pF, X7R, 50V	GCM155R71H472K	Ceramic Capacitor	Murata
C3	-	-	-	-	-
C4	-	-	-	-	-
F1	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
CF3	-	-	-	-	-

Table 7. Parts list (VOUT=1.2V, VIN=5.0V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1		1.0μH	CLF5030NIT-1R0N-D	Inductor	TDK
COUT1	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10μF, X7R, 10V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN2	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	10kΩ, 1%, 1/16W	MCR01MZPF1002	Chip Resistor	ROHM
R2	1005	20kΩ, 1%, 1/16W	MCR01MZPF2002	Chip Resistor	ROHM
R3	1005	8.2kΩ, 1%, 1/16W	MCR01MZPF8201	Chip Resistor	ROHM
R4	1005	100kΩ, 1%, 1/16W	MCR01MZPF1003	Chip Resistor	ROHM
C1	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
C2	1005	4700pF, X7R, 50V	GCM155R71H472K	Ceramic Capacitor	Murata
C3	-	-	-	-	-
C4	-	-	-	-	-
F1	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
CF3	-	-	-	-	-

Table 8. Parts list (VOUT=1.5V, VIN=5.0V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1		1.0μH	CLF5030NIT-1R0N-D	Inductor	TDK
COUT1	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10μF, X7R, 10V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN2	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	16kΩ, 1%, 1/16W	MCR01MZPF1602	Chip Resistor	ROHM
R2	1005	18kΩ, 1%, 1/16W	MCR01MZPF1802	Chip Resistor	ROHM
R3	1005	12kΩ, 1%, 1/16W	MCR01MZPF1202	Chip Resistor	ROHM
R4	1005	100kΩ, 1%, 1/16W	MCR01MZPF1003	Chip Resistor	ROHM
C1	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
C2	1005	3300pF, X7R, 50V	GCM155R71H332K	Ceramic Capacitor	Murata
C3	-	-	-	-	-
C4	-	-	-	-	-
F1	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
CF3	-	-	-	-	-

Table 9. Parts list (VOUT=1.8V, VIN=5.0V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1		1.0μH	CLF5030NIT-1R0N-D	Inductor	TDK
COUT1	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10μF, X7R, 10V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN2	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	30kΩ, 1%, 1/16W	MCR01MZPF3002	Chip Resistor	ROHM
R2	1005	24kΩ, 1%, 1/16W	MCR01MZPF2402	Chip Resistor	ROHM
R3	1005	13kΩ, 1%, 1/16W	MCR01MZPF1302	Chip Resistor	ROHM
R4	1005	100kΩ, 1%, 1/16W	MCR01MZPF1003	Chip Resistor	ROHM
C1	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
C2	1005	3300pF, X7R, 50V	GCM155R71H332K	Ceramic Capacitor	Murata
C3	-	-	-	-	-
C4	-	-	-	-	-
F1	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
CF3	-	-	-	-	-

Table 10. Parts list (VOUT=3.3V, VIN=5.0V)

No	Package	Parameters	Part Name (Series)	Type	Manufacturer
L1		1.0μH	CLF5030NIT-1R0N-D	Inductor	TDK
COUT1	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
COUT2	3216	22μF, X7R, 6.3V	GCM31CR70J226K	Ceramic Capacitor	Murata
CIN1	2012	10μF, X7R, 10V	GCM21BR71A106K	Ceramic Capacitor	Murata
CIN2	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
R100	-	SHORT	-	-	-
R1	1005	75kΩ, 1%, 1/16W	MCR01MZPF7502	Chip Resistor	ROHM
R2	1005	24kΩ, 1%, 1/16W	MCR01MZPF2402	Chip Resistor	ROHM
R3	1005	20kΩ, 1%, 1/16W	MCR01MZPF2002	Chip Resistor	ROHM
R4	1005	100kΩ, 1%, 1/16W	MCR01MZPF1003	Chip Resistor	ROHM
C1	1005	0.1μF, X7R, 16V	GCM155R71C104K	Ceramic Capacitor	Murata
C2	1005	2200pF, X7R, 50V	GCM155R71H222K	Ceramic Capacitor	Murata
C3	-	-	-	-	-
C4	-	-	-	-	-
F1	-	-	-	-	-
CF1	-	-	-	-	-
CF2	-	-	-	-	-
CF3	-	-	-	-	-

(Note1) VOUT= $\frac{R1+R2}{R2} \times 0.8$ [V]

(Note) C3, C4, F1, CF1, CF2, CF3 patterns are only optional. They can be utilized for adjusting the characteristics constants.

Board Layout

Evaluation Board PCB information

Number of Layers	Material	Board Size	Copper Thickness
4	FR4	114.3mm x 76.2mm x 1.6mm	2oz(70µm) / 1oz (35µm) / 1oz (35µm) / 2oz(70µm)

The layout of BD9S300MUF-C is shown below.

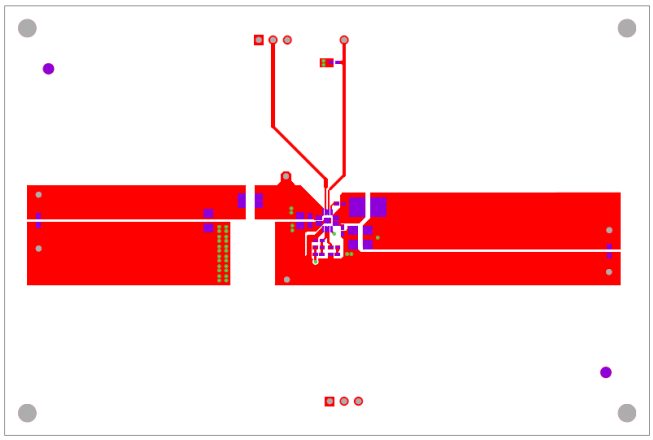

Figure 7. Top Layer Layout

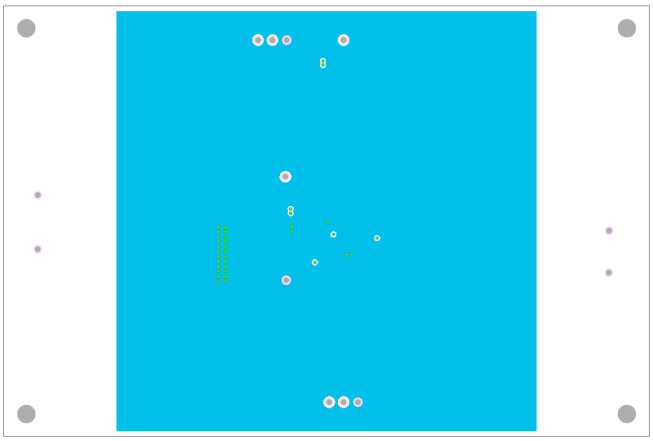

Figure 8. Middle1 Layer Layout

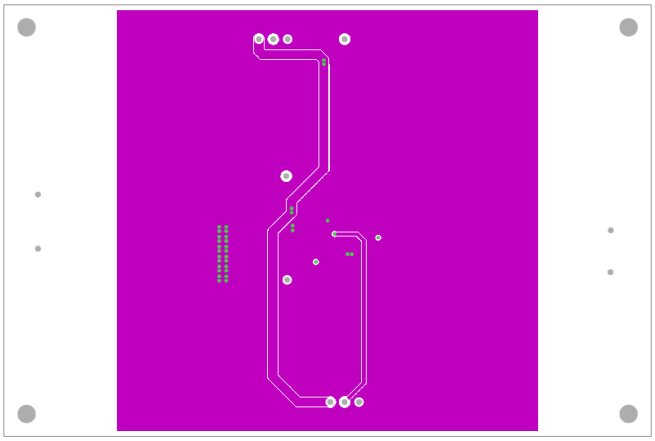

Figure 9. Middle2 Layer Layout

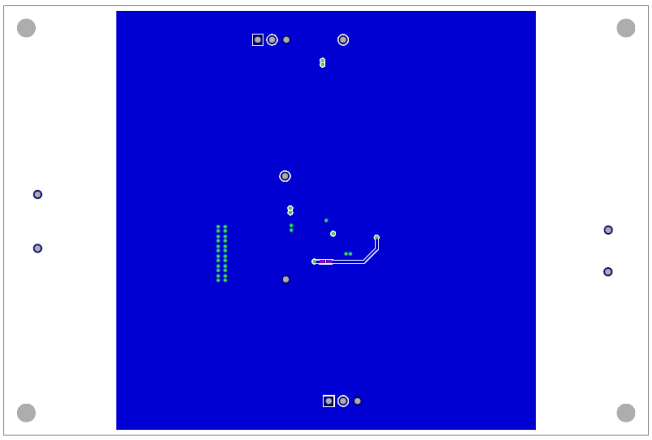

Figure 10. Bottom Layer Layout

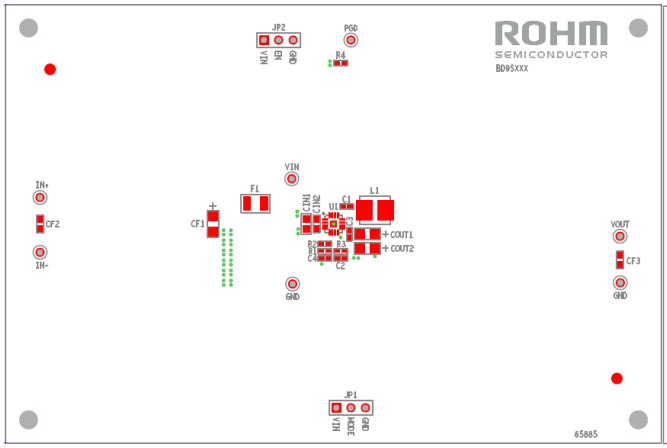

Figure 11. Top Parts Placement

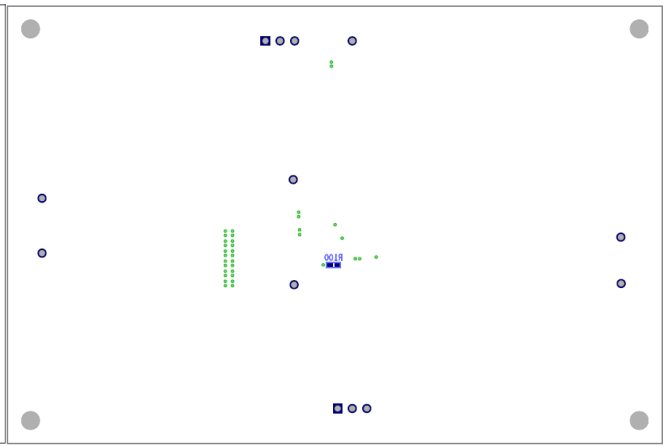

Figure 12. Bottom Parts Placement

Reference application data (BD9S300MUF-C)

(V_{IN}=V_{EN}=5.0V, V_{OUT}=3.3V, Ta=25°C)

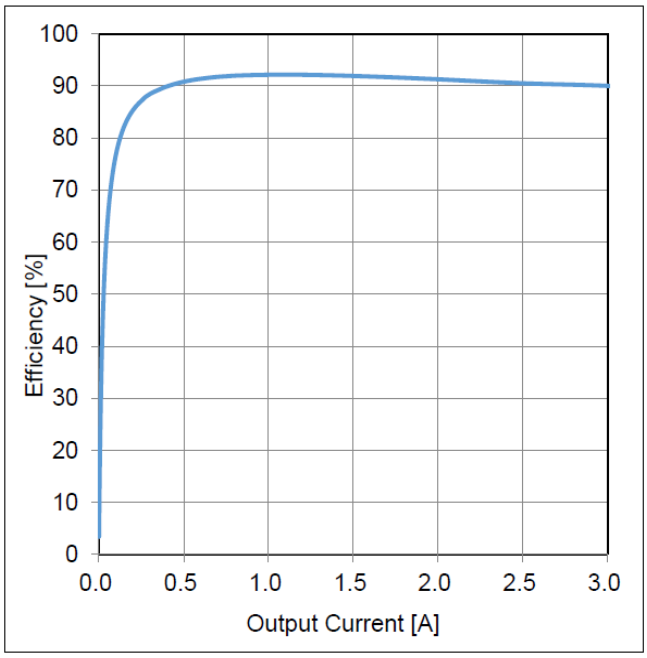

Figure 13. Efficiency vs Output Current

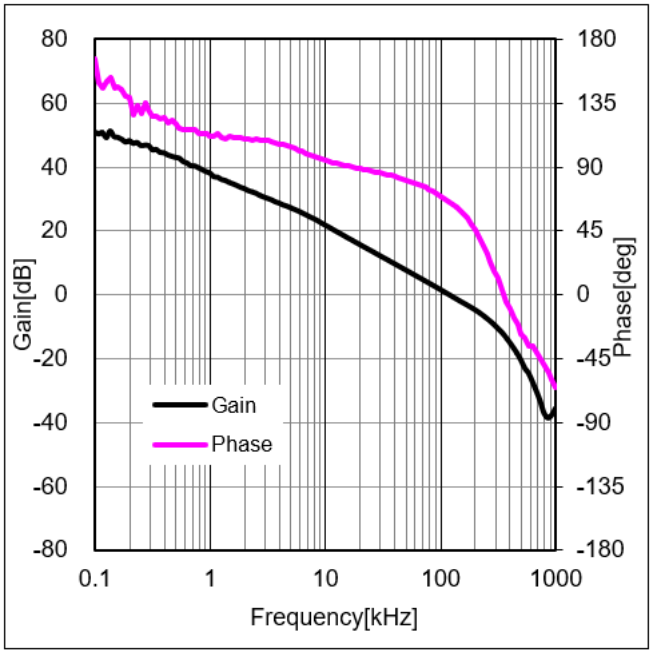

Figure 14. Frequency Characteristics (I_{OUT}=2 A)

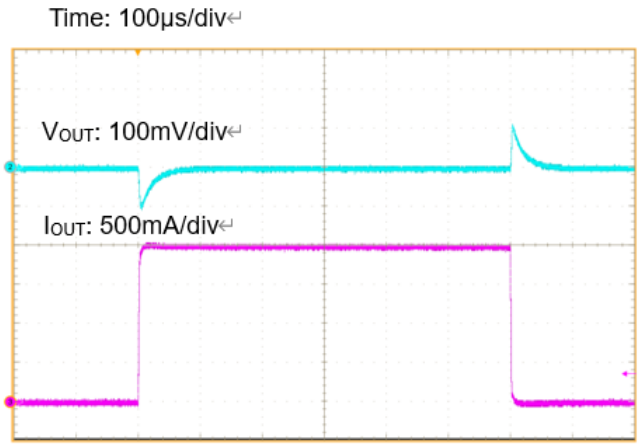

Figure 15. Load Transient Response (I_{OUT} = 0 A ↔ 1 A)

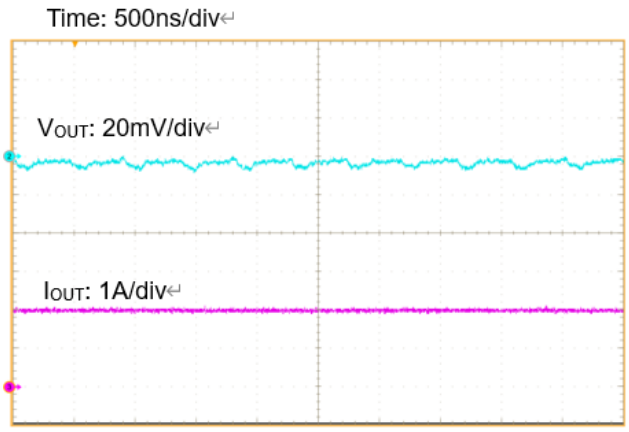

Figure 16. Output Ripple Voltage (I_{OUT} = 2 A)

Other series application data please refer to datasheet.

Revision History

Date	Revision Number	Description
Oct. 2021	001	Initial release
6. Jan. 2025	002	Add the VOUT setting value of Test Board to sub tittle

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