

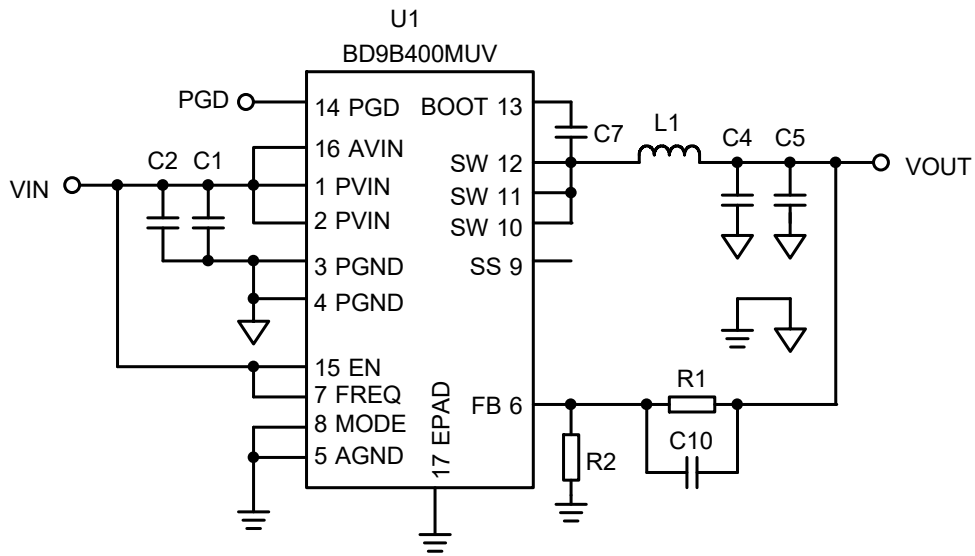
DC/DC Converter

Application Information

IC Product Name	BD9B400MUV
Topology	Buck (Step-Down) Switching Regulator
Type	Non-Isolation

	Input	Output	Switching Frequency
1	2.7V to 5.5V	1.0V, 4A	1MHz
2	2.7V to 5.5V	1.2V, 4A	1MHz
3	2.7V to 5.5V	1.5V, 4A	1MHz
4	2.7V to 5.5V	1.8V, 4A	1MHz
5	4.13V to 5.5V	3.3V, 4A	1MHz
6	2.7V to 5.5V	1.0V, 4A	2MHz
7	2.7V to 5.5V	1.2V, 4A	2MHz
8	2.7V to 5.5V	1.5V, 4A	2MHz
9	2.7V to 5.5V	1.8V, 4A	2MHz
10	4.5V to 5.5V	3.3V, 4A	2MHz

■ Typical Application Circuit



■ FREQ terminal setting (7-pin)

Terminal state	IC operation
High	Operated with 1 MHz
Low	Operated with 2 MHz

■ MODE terminal setting (8-pin)

Terminal state	IC operation
High	PWM fixing operation
Low	Automatic switching operation between PWM and light load mode

■ SS terminal setting (9-pin)

Terminal state	Soft start time
Open	$T_{SS} = 1[ms]$
Capacitor connection	$T_{SS} = \frac{C \times 0.8}{1 \times 10^{-6}}[s]$

■ EN terminal setting (15-pin)

Terminal state	IC operation
$\geq 2.0V$	Normal operation
$\leq 0.8V$	Power down

■ Output voltage setting

$$V_{OUT} = \frac{R_1 + R_2}{R_2} \times 0.8 [V]$$

Input/output voltage conditions are required to satisfy the following equations:

$$V_{OUT} = 0.8V \sim (V_{IN} \times 0.8)V$$

■ Bill of Materials

1. $V_O=1.0V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=1MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, \pm 20%	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, \pm 10%	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, \pm 20%	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	120pF	25V, CH, \pm 5%	GRM1552C1E121JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	75k Ω	0.063W, 50V, 1%	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	300k Ω	0.063W, 50V, 1%	MCR01MZPF3003	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

2. $V_O=1.2V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=1MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, \pm 20%	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, \pm 10%	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, \pm 20%	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	150pF	25V, CH, \pm 5%	GRM1552C1E151JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	75k Ω	0.063W, 50V, 1%	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	150k Ω	0.063W, 50V, 1%	MCR01MZPF1503	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

3. $V_O=1.5V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=1MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, \pm 20%	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, \pm 10%	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, \pm 20%	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	180pF	25V, CH, \pm 5%	GRM1552C1E181JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	150k Ω	0.063W, 50V, 1%, R1=157.5k Ω	MCR01MZPF1503	ROHM	1005
1		Resistor	7.5k Ω	0.063W, 50V, 1%, R1=157.5k Ω	MCR01MZPF7501	ROHM	1005
1	R2	Resistor	180k Ω	0.063W, 50V, 1%	MCR01MZPF1803	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

4. $V_O=1.8V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=1MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, \pm 20%	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, \pm 10%	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, \pm 20%	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	180pF	25V, CH, \pm 5%	GRM1552C1E181JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	150k Ω	0.063W, 50V, 1%	MCR01MZPF1503	ROHM	1005
1	R2	Resistor	120k Ω	0.063W, 50V, 1%	MCR01MZPF1203	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

■ Bill of Materials (continued)

5. $V_O=3.3V$ ($V_{IN}=4.13V$ to $5.5V$), $f_{SW}=1MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM31CB30J226ME18	MURATA	3216
1	C10	Ceramic Capacitor	180pF	25V, CH, $\pm 5\%$	GRM1552C1E181JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	100k Ω	0.063W, 50V, 1%, R1=175k Ω	MCR01MZPF1003	ROHM	1005
1		Resistor	75k Ω	0.063W, 50V, 1%, R1=175k Ω	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	56k Ω	0.063W, 50V, 1%	MCR01MZPF5602	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

6. $V_O=1.0V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=2MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	82pF	50V, CH, $\pm 5\%$	GRM1552C1H820JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	75k Ω	0.063W, 50V, 1%	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	300k Ω	0.063W, 50V, 1%	MCR01MZPF3003	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

7. $V_O=1.2V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=2MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	82pF	50V, CH, $\pm 5\%$	GRM1552C1H820JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	75k Ω	0.063W, 50V, 1%	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	150k Ω	0.063W, 50V, 1%	MCR01MZPF1503	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

8. $V_O=1.5V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=2MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	82pF	50V, CH, $\pm 5\%$	GRM1552C1H820JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	150k Ω	0.063W, 50V, 1%, R1=157.5k Ω	MCR01MZPF1503	ROHM	1005
1		Resistor	7.5k Ω	0.063W, 50V, 1%, R1=157.5k Ω	MCR01MZPF7501	ROHM	1005
1	R2	Resistor	180k Ω	0.063W, 50V, 1%	MCR01MZPF1803	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

■ Bill of Materials (continued)

9. $V_O=1.8V$ ($V_{IN}=2.7V$ to $5.5V$), $f_{SW}=2MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM21BB30J226ME38	MURATA	2012
1	C10	Ceramic Capacitor	82pF	50V, CH, $\pm 5\%$	GRM1552C1H820JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	150k Ω	0.063W, 50V, 1%	MCR01MZPF1503	ROHM	1005
1	R2	Resistor	120k Ω	0.063W, 50V, 1%	MCR01MZPF1203	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

10. $V_O=3.3V$ ($V_{IN}=4.5V$ to $5.5V$), $f_{SW}=2MHz$

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1 μ F	25V, B, $\pm 20\%$	GRM155B31E104MA87	MURATA	1005
1	C2	Ceramic Capacitor	22 μ F	10V, B, $\pm 10\%$	GRM31CB31A226KE19	MURATA	3216
2	C4, C5	Ceramic Capacitor	22 μ F	6.3V, B, $\pm 20\%$	GRM31CB30J226ME18	MURATA	3216
1	C10	Ceramic Capacitor	100pF	25V, CH, $\pm 5\%$	GRM1552C1E101JA01	MURATA	1005
1	L1	Inductor	1.0 μ H	See the recommended inductor list of separate volume.			
1	R1	Resistor	100k Ω	0.063W, 50V, 1%, R1=175k Ω	MCR01MZPF1003	ROHM	1005
1		Resistor	75k Ω	0.063W, 50V, 1%, R1=175k Ω	MCR01MZPF7502	ROHM	1005
1	R2	Resistor	56k Ω	0.063W, 50V, 1%	MCR01MZPF5602	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9B400MUV	ROHM	VQFN016V3030

■ Precautions for use

- (1) This document provides the BOM for evaluation boards. Small parts can also be selected for resistor, capacitor, and coil.
- (2) When miniaturizing a resistor, consider decrease in rated power and withstand voltage.
- (3) When miniaturizing a ceramic capacitor, consider decrease in withstand voltage. In addition, the capacity may be decreased by DC bias characteristics, and the desired characteristics may not be obtained.
- (4) If ceramic capacitor models differ even when they have the same capacity and withstand voltage, the capacity may be decreased by DC bias characteristics depending on the model, and desired characteristics may not be obtained. Be sure to check the DC bias characteristics.
- (5) When miniaturizing a coil, consider increase in direct current resistance and decrease in rated current. An increase in DC resistance can cause a deterioration of power conversion efficiency. A decrease in rated current can saturate the coil when outputting a large current, which may deteriorate efficiency or make it impossible to obtain the desired output current.
- (6) If there is a possibility that the output will short-circuit, use a coil with a rated current that is larger than the maximum IC output current. For example, even when up to 100 mA is actually used for an IC that can output 1 A, select a coil whose rated current is larger than 1 A. If a coil with a small rated current is used, it will be saturated by a large current in the event of output short-circuiting, resulting in a steep increase in output voltage. The IC may be broken down because the processing speed of the overcurrent protecting function of the IC cannot keep up with the increase in voltage.
- (7) This circuit constant is the value for our evaluation board. It may be necessary to adjust the constant for the actual board. Carry out suitable evaluations.

Notice

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- Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment ^(Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

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 - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc. prior to use, must be necessary:
 - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
 - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
 - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
 - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
 - Sealing or coating our Products with resin or other coating materials
 - Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
 - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
 - [a] the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [b] the temperature or humidity exceeds those recommended by ROHM
 - [c] the Products are exposed to direct sunshine or condensation
 - [d] the Products are exposed to high Electrostatic
2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

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Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

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