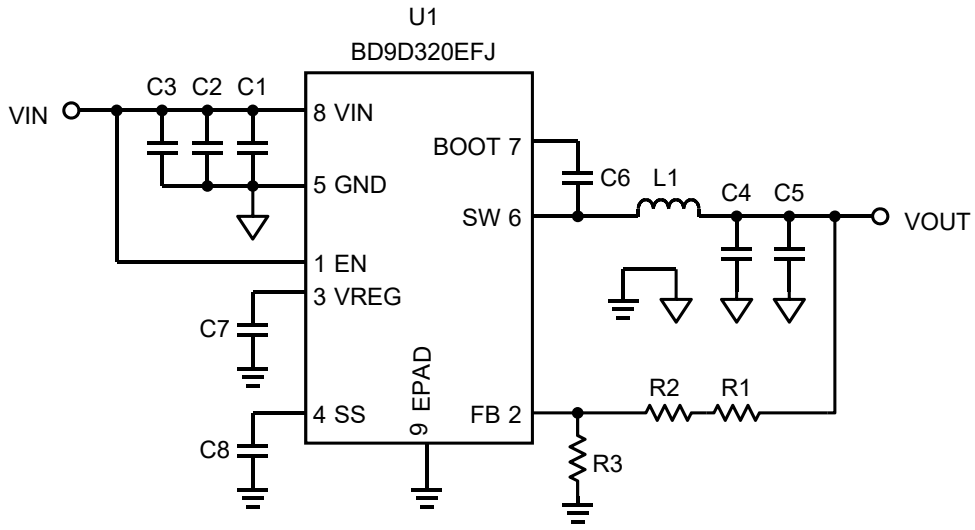
DC/DC Converter Application Information

IC Product Name	BD9D320EFJ
Topology	Buck (Step-Down) Switching Regulator
Type	Non-Isolation

	Input	Output
1	4.5V to 14.2V	1.0V, 3A
2	4.5V to 15V	1.05V, 3A
3	4.5V to 15.7V	1.1V, 3A
4	4.5V to 17.1V	1.2V, 3A
5	4.5V to 18V	1.5V, 3A
6	4.5V to 18V	1.8V, 3A
7	5.08V to 18V	3.3V, 3A
8	7.7V to 18V	5.0V, 3A
9	10.8V to 18V	7.0V, 3A

■ Typical Application Circuit



■ EN terminal setting (1-pin)

Terminal state	IC operation
≥ 2.2V	Normal operation
≤ 0.3V	Power down

■ SS terminal setting (4-pin)

Terminal state	Soft start time	
Capacitor connection	$T_d = \frac{C_8 \times 0.7}{2 \times 10^{-6}}\ [s]$	Soft start delay time
	$T_{SS} = \frac{C_8 \times 0.88}{2 \times 10^{-6}}[s]$	Soft start time

■ Output voltage setting

$$V_{OUT} = \frac{R_1 + R_2 + R_3}{R_3} \times 0.765\ [V]$$

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

$$V_{OUT} = 0.765V \sim 7.0V$$

$$0.07 \leq \frac{V_{OUT}}{V_{IN}} \leq 0.65$$

Bill of Materials

1. V_O=1.0V (V_{IN}=4.5V to 14.2V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	4V, B, ±20%	GRM188B30G226MEA0	MURATA	1608
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	1.5µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	12kΩ	0.063W, 50V, 1%	MCR01MZPF1202	ROHM	1005
1	R2	Resistor	0Ω	Jumper	MCR01MZPJ000	ROHM	1005
1	R3	Resistor	39kΩ	0.063W, 50V, 1%	MCR01MZPF3902	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

2. V_O=1.05V (V_{IN}=4.5V to 15V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	4V, B, ±20%	GRM188B30G226MEA0	MURATA	1608
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	1.5µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	8.2kΩ	0.063W, 50V, 1%	MCR01MZPF8201	ROHM	1005
1	R2	Resistor	0Ω	Jumper	MCR01MZPJ000	ROHM	1005
1	R3	Resistor	22kΩ	0.063W, 50V, 1%	MCR01MZPF2202	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

3. V_O=1.1V (V_{IN}=4.5V to 15.7V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	4V, B, ±20%	GRM219B30G226ME66	MURATA	2012
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	1.5µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	10kΩ	0.063W, 50V, 1%	MCR01MZPF1002	ROHM	1005
1	R2	Resistor	510Ω	0.063W, 50V, 1%	MCR01MZPF5100	ROHM	1005
1	R3	Resistor	24kΩ	0.063W, 50V, 1%	MCR01MZPF2402	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

■ Bill of Materials (continued)

4. V_O=1.2V (V_{IN}=4.5V to 17.1V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	4V, B, ±20%	GRM219B30G226ME66	MURATA	2012
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	1.5µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	9.1kΩ	0.063W, 50V, 1%	MCR01MZPF9101	ROHM	1005
1	R2	Resistor	0Ω	Jumper	MCR01MZPJ000	ROHM	1005
1	R3	Resistor	16kΩ	0.063W, 50V, 1%	MCR01MZPF1602	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

5. V_O=1.5V (V_{IN}=4.5V to 18V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	6.3V, B, ±20%	GRM31CB30J226ME18	MURATA	3216
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	2.2µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	16kΩ	0.063W, 50V, 1%	MCR01MZPF1602	ROHM	1005
1	R2	Resistor	1.3kΩ	0.063W, 50V, 1%	MCR01MZPF1301	ROHM	1005
1	R3	Resistor	18kΩ	0.063W, 50V, 1%	MCR01MZPF1802	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

6. V_O=1.8V (V_{IN}=4.5V to 18V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10µF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22µF	6.3V, B, ±20%	GRM31CB30J226ME18	MURATA	3216
1	C6	Ceramic Capacitor	0.1µF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1µF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	2.2µH	See the recommended inductor list of separate volume.			
1	R1	Resistor	24kΩ	0.063W, 50V, 1%	MCR01MZPF2402	ROHM	1005
1	R2	Resistor	360Ω	0.063W, 50V, 1%	MCR01MZPF3600	ROHM	1005
1	R3	Resistor	18kΩ	0.063W, 50V, 1%	MCR01MZPF1802	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

■ Bill of Materials (continued)

7. V_O=3.3V (V_{IN}=5.08V to 18V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1μF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10μF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22μF	10V, B, ±10%	GRM31CB31A226KE19	MURATA	3216
1	C6	Ceramic Capacitor	0.1μF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1μF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	2.2μH	See the recommended inductor list of separate volume.			
1	R1	Resistor	47kΩ	0.063W, 50V, 1%	MCR01MZPF4702	ROHM	1005
1	R2	Resistor	2.7kΩ	0.063W, 50V, 1%	MCR01MZPF2701	ROHM	1005
1	R3	Resistor	15kΩ	0.063W, 50V, 1%	MCR01MZPF1502	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

8. V_O=5.0V (V_{IN}=7.7V to 18V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1μF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10μF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22μF	16V, B, ±20%	GRM32EB31C226ME16	MURATA	3225
1	C6	Ceramic Capacitor	0.1μF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1μF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	3.3μH	See the recommended inductor list of separate volume.			
1	R1	Resistor	120kΩ	0.063W, 50V, 1%	MCR01MZPF1203	ROHM	1005
1	R2	Resistor	1.8kΩ	0.063W, 50V, 1%	MCR01MZPF1801	ROHM	1005
1	R3	Resistor	22kΩ	0.063W, 50V, 1%	MCR01MZPF2202	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

9. V_O=7.0V (V_{IN}=10.8V to 18V)

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
1	C1	Ceramic Capacitor	0.1μF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
2	C2, C3	Ceramic Capacitor	10μF	35V, B, ±10%	GRM32EB3YA106KA12	MURATA	3225
2	C4, C5	Ceramic Capacitor	22μF	16V, B, ±20%	GRM32EB31C226ME16	MURATA	3225
1	C6	Ceramic Capacitor	0.1μF	25V, B, ±20%	GRM155B31E104MA87	MURATA	1005
1	C7	Ceramic Capacitor	1μF	10V, B, ±10%	GRM188B11A105KA61	MURATA	1608
1	C8	Ceramic Capacitor	3300pF	50V, B, ±10%	GRM155B11H332KA01	MURATA	1005
1	L1	Inductor	3.3μH	See the recommended inductor list of separate volume.			
1	R1	Resistor	120kΩ	0.063W, 50V, 1%	MCR01MZPF1203	ROHM	1005
1	R2	Resistor	43kΩ	0.063W, 50V, 1%	MCR01MZPF4302	ROHM	1005
1	R3	Resistor	20kΩ	0.063W, 50V, 1%	MCR01MZPF2002	ROHM	1005
1	U1	IC	-	Buck DC/DC Converter	BD9D320EFJ	ROHM	HTSOP-J8

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

Precaution on using ROHM Products

1. 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
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. 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:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] 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
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. 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.

7. 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.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. 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

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. 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.

Precaution for Foreign Exchange and Foreign Trade act

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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