

# 1.75V to 4.5V, 10mA 1ch Synchronous Boost DC/DC Converter

## BU33DV5G

### ●General Description

The BU33DV5G devices provide a power supply solution for products powered by either two-cell alkaline, NiCd or NiMH, or one-cell Li-ion or Li-polymer battery.

Output currents can go as high as 10mA while using two alkaline, and discharge it down to 1.8 V.

The boost converter is based on a fixed frequency, Pulse-width-modulation (PWM) controller using a synchronous rectifier to obtain maximum efficiency. The maximum peak current in the boost switch is typically limited to a value of 10 mA.

BU33DV5G output voltage is fixed by an internal resistor divider.

The device is packaged in a 5-pin small SSOP5 package.

### ●Key Specifications

■ Input voltage range:	1.75V to 4.5V
■ Output voltage range:	3.23V to 3.37V
■ Average output Current:	10mA(Max.)
■ Switching frequency:	100KHz(Typ.)
■ Standby current:	250μA (Typ.)
■ Power-OFF Circuit Current	1.0μA (max)
■ Operating temperature range:	-25°C to +85°C

### ●Features

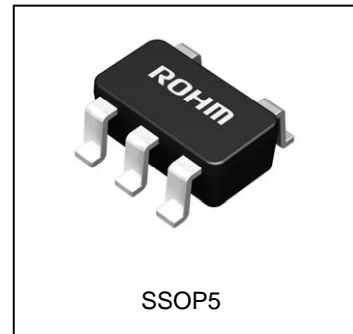
- Synchronous Boost DC/DC Converter(PWM)  
10mA @Vout=3.3V, Vin=1.8V
- UVLO-detect Voltage:1.65V(Typ.)
- UVLO-release Voltage:1.75V(Typ.)
- Thermal Shutdown

### ●Package(s)

W(Typ.) x D(Typ.) x H(Max.)  
SSOP5 2.90mm x 2.80mm x 1.25mm

### ●Applications

- Two-Cell Alkaline, NiCd or NiMH or Single-CellLi Battery-Powered Products
- Portable Audio Players
- PDA
- Cellular Phones
- Personal Medical Products



### ●Typical Application Circuit(s)

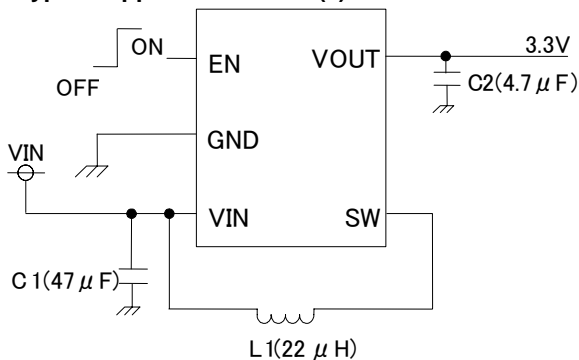


Figure 1. Application Circuit

### ●Typical Performance characteristics

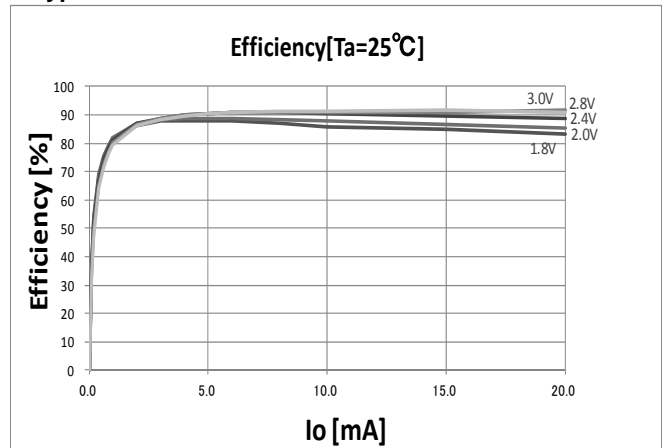


Figure 2. Efficiency

● Block diagram

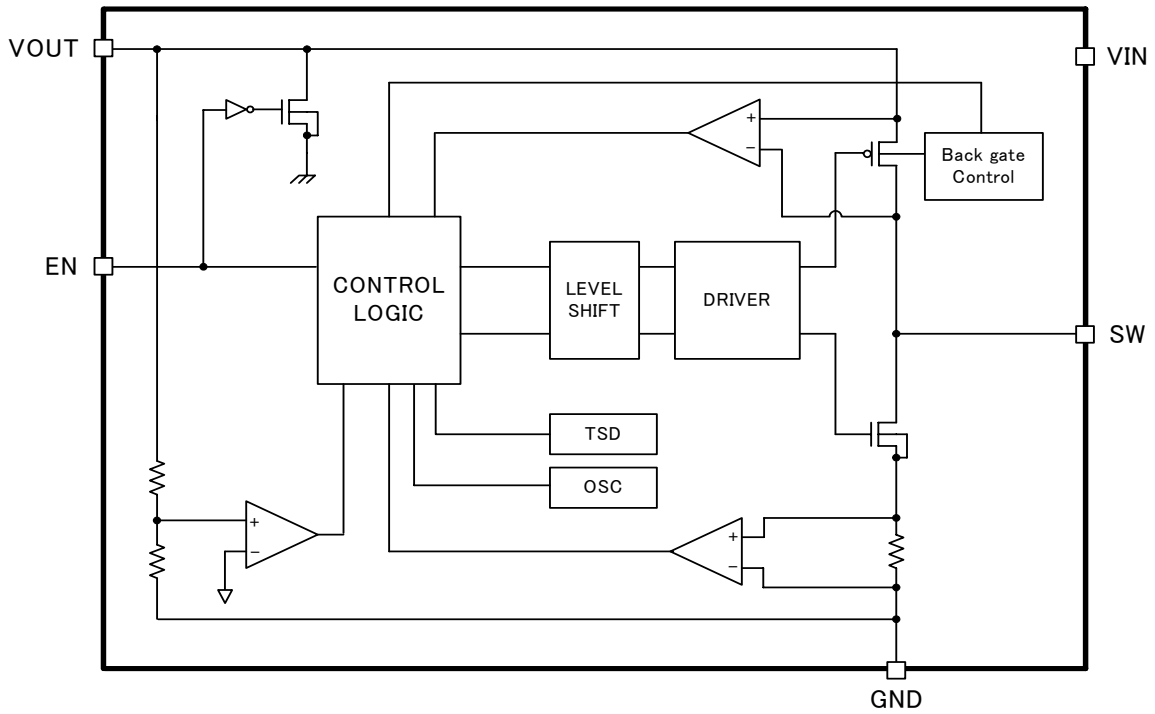


Figure 3. Circuit Block

● Pin Configuration

Symbol	Pin No.	Function	Terminal circuit
EN	1	EN=VIN: Power-ON EN=GND: Power-OFF	B
GND	2	GND	A
VIN	3	Power supply input	B
SW	4	Inductor connection terminal	-
VOUT	5	Boost voltage output	B

※ Don't use EN PIN at OPEN.

SSOP5

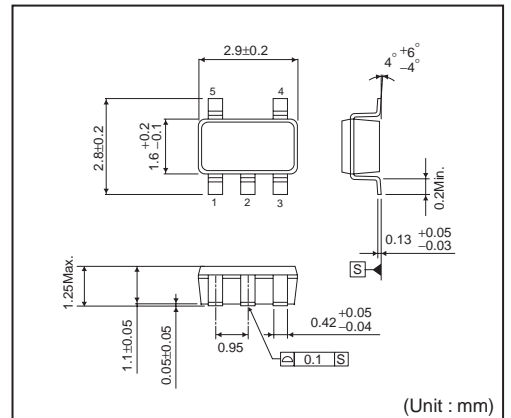
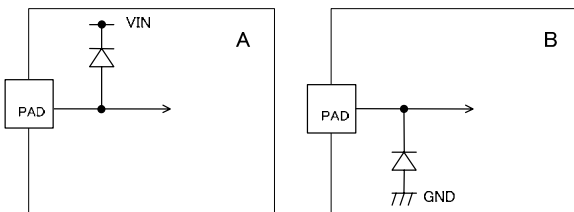


Figure 4. Package

● Input-Output Equivalent Circuit

I/O equivalent circuit diagram is as follows.



● Absolute maximum ratings(Ta=25°C)

Parameter	Symbol	Ratings	Unit	Condition
Maximum applied voltage	Vmax	6.0	V	
Power dissipation	Pd	674.9 (Note1)	mW	1 layer board (70mm x 70mm x 1.6mm)
Operating temperature range	Topr	-40 to +85	°C	
Storage temperature range	Tstr	-55 to +125	°C	

\*1 When it is used by more than Ta=25°C, it is reduced by 6.749mW/°C.

● Operating conditions

Parameter	Symbol	Ratings	Unit	Condition
Power supply voltage range	VCC	1.75 to 4.5	V	VIN terminal voltage

● Electrical characteristics

(Unless otherwise specified Ta=25°C, VIN=2.8V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Circuit current1	ICC1	-	0.01	1.0	μA	EN=0V
Circuit current2	ICC2	-	250	350	μA	EN=VIN, Io=0mA
Oscillation frequency	fsw	80	100	120	kHz	
Output voltage range	Vout	3.23	3.3	3.37	V	Io=1mA
Current limit	Ilim	-	240	-	mA	
EN Input High	VIH	1.6	-	-	V	
EN Input Low	VIL	-	-	0.35	V	
UVLO Release Threshold	VuvloR	1.7	1.75	1.8	V	VIN rising
UVLO Detect Threshold	VuvloD	-	1.65	-	V	VIN falling
UVLO Hysteresis	Vuvlohys	0.05	0.1	0.15	V	

Note1: Load disconnect during shutdown.

● Typical Performance Curve(s)

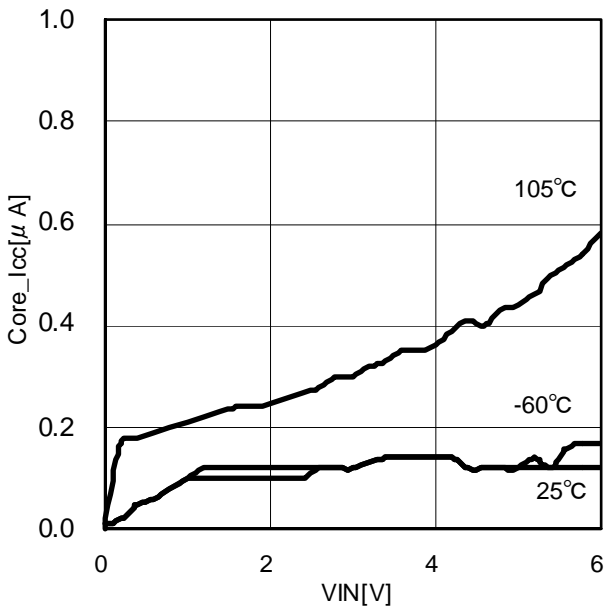


Figure 5. Quiescent Current

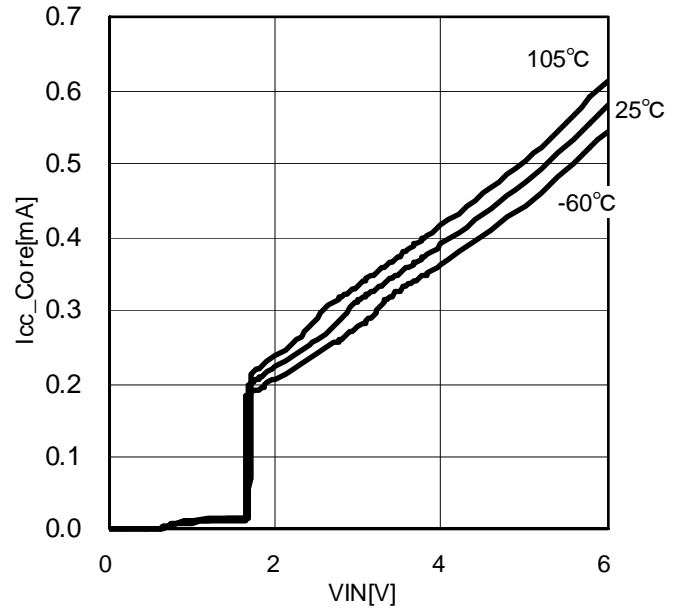


Figure 6. Core Current  
(This is only VIN current. Not include SW current)

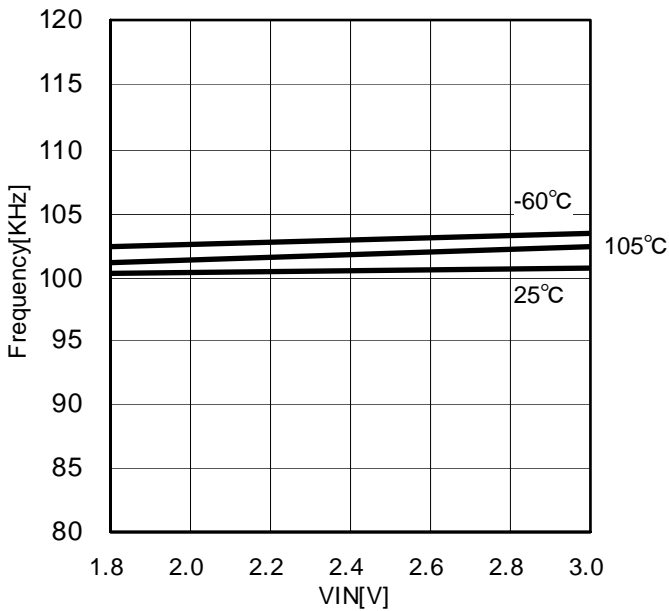


Figure 7. Frequency

●Electrical characteristic curves (Reference data) – Continued

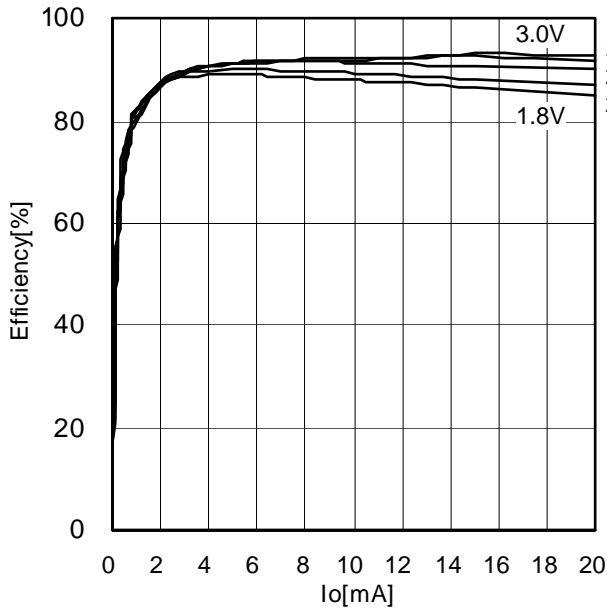


Figure 8. Efficiency[Ta=-30°C]

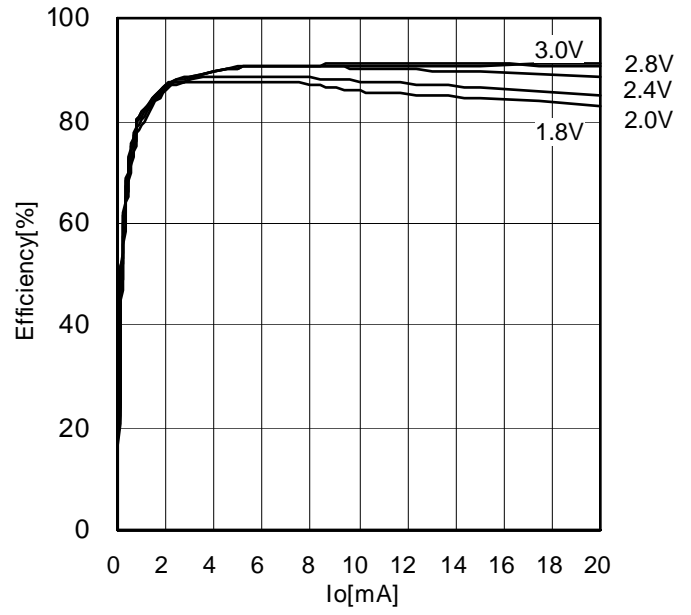


Figure 9. Efficiency[Ta=25°C]

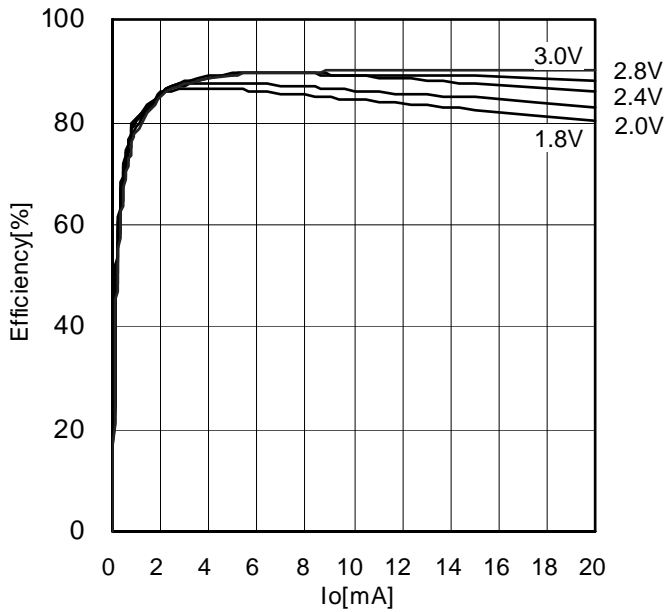


Figure 10. Efficiency[Ta=-85°C]

●Electrical characteristic curves (Reference data) – Continued

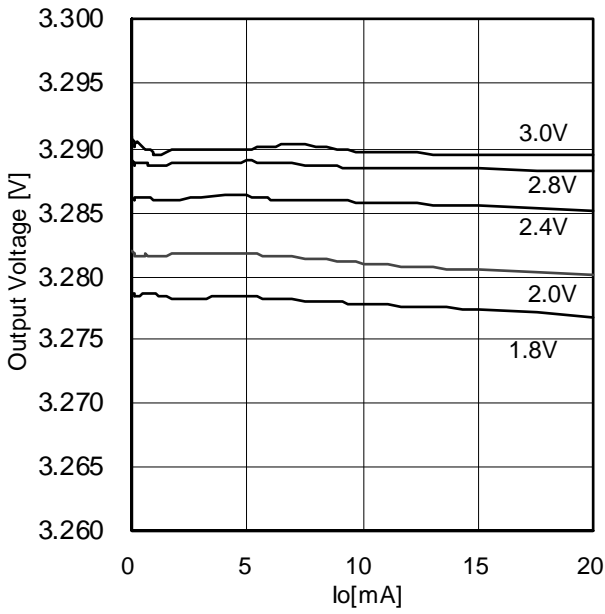


Figure 11. Load-Regulation[Ta=-30°C]

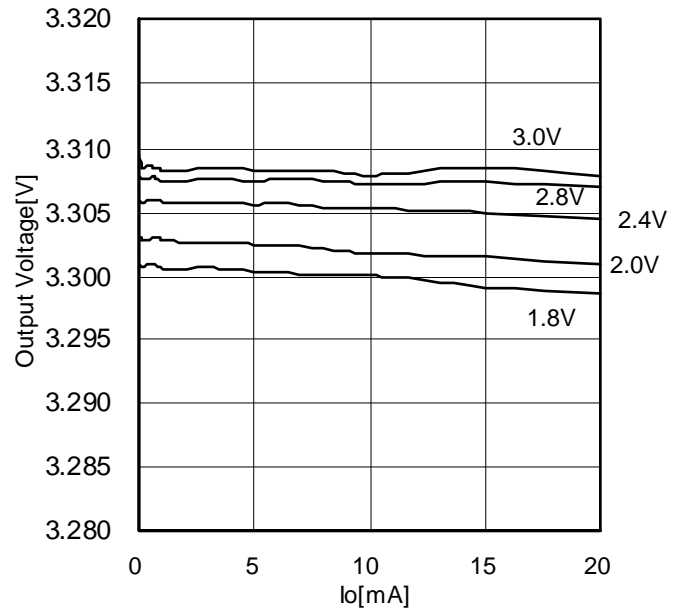


Figure 12. Load-Regulation [Ta=25°C]

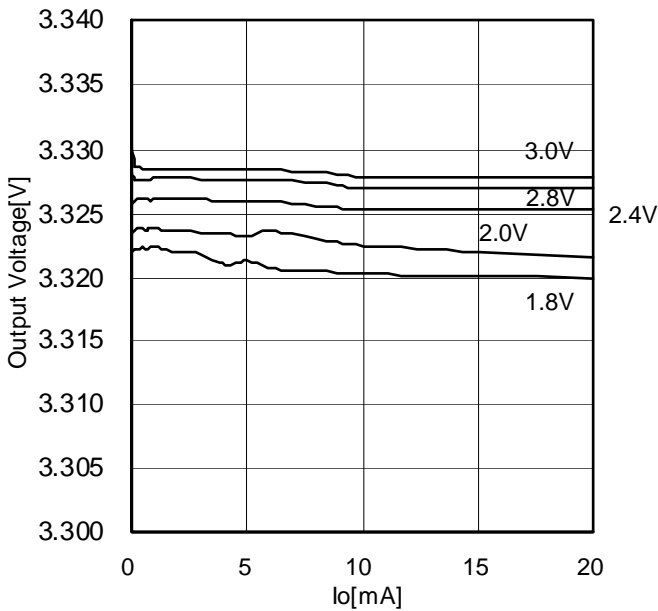


Figure 13. Load-Regulation[Ta=-85°C]

●Electrical characteristic curves (Reference data) – Continued

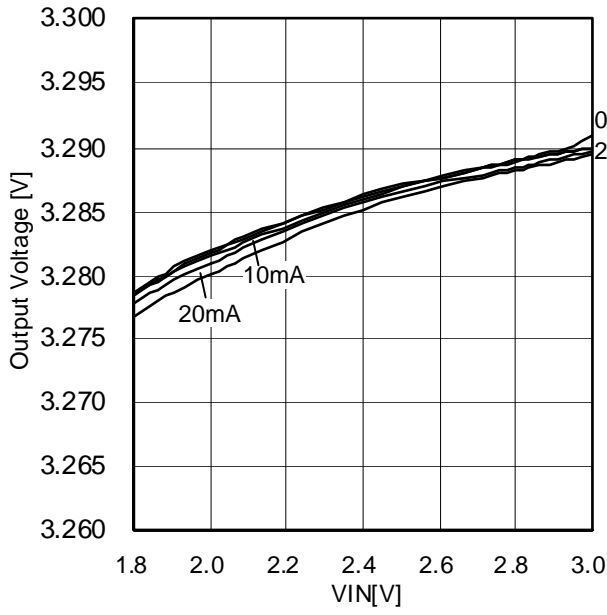


Figure 14. Line-Regulation[Ta=-30°C]

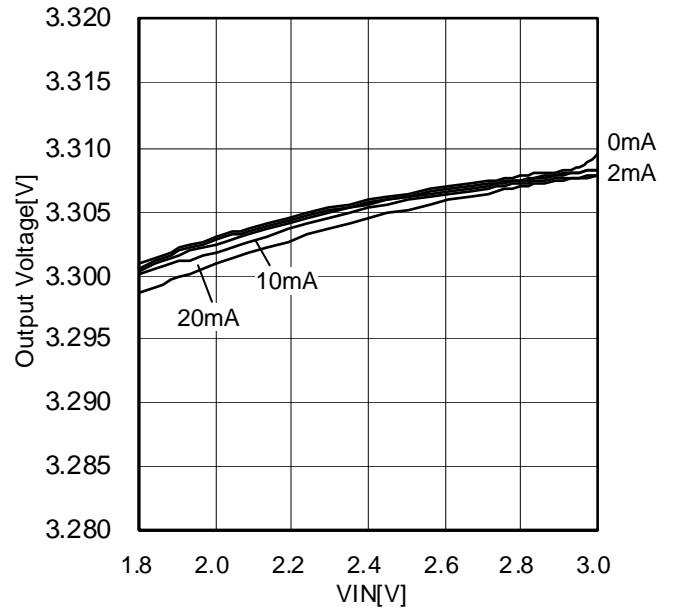


Figure 15. Line-Regulation [Ta=25°C]

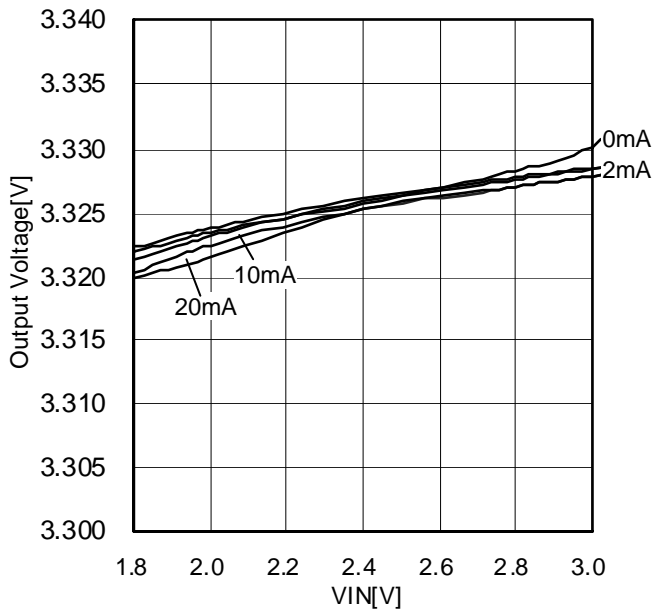


Figure 16. Line-Regulation[Ta=-85°C]

●Electrical characteristic curves (Reference data) – Continued

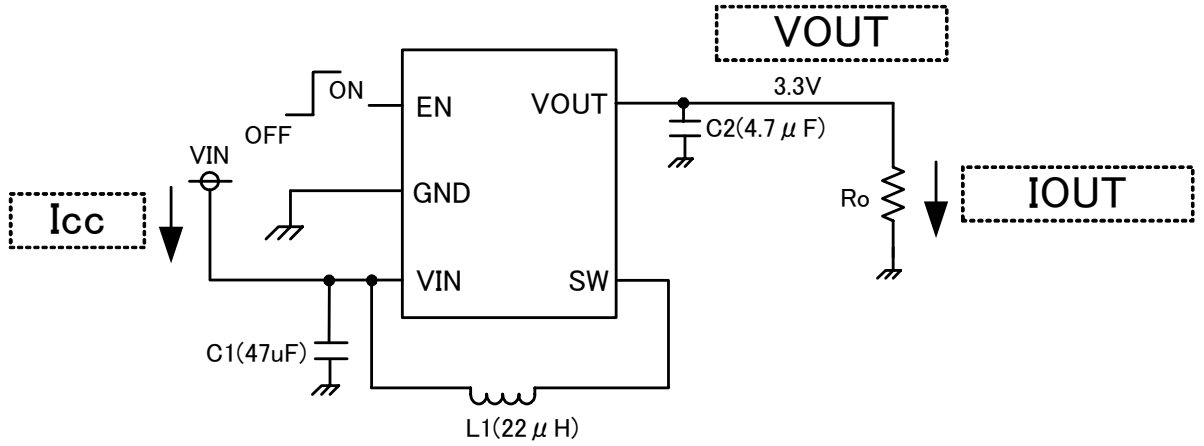


Figure 17. Measure circuit

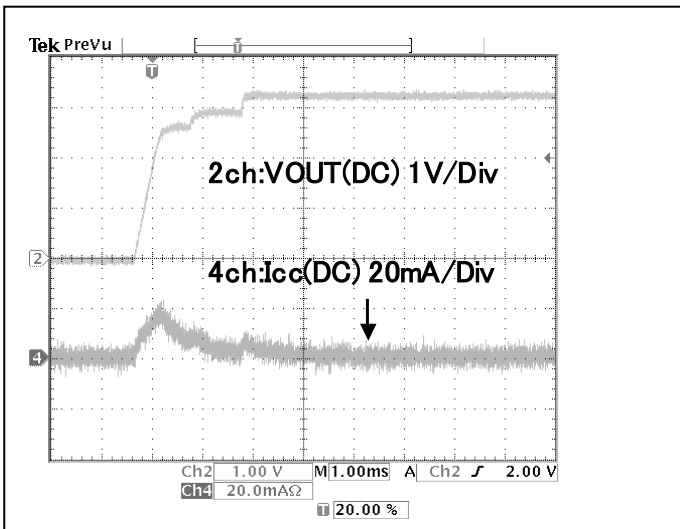


Figure 18. Rise VIN=2.8V[CR2032],Io=0mA

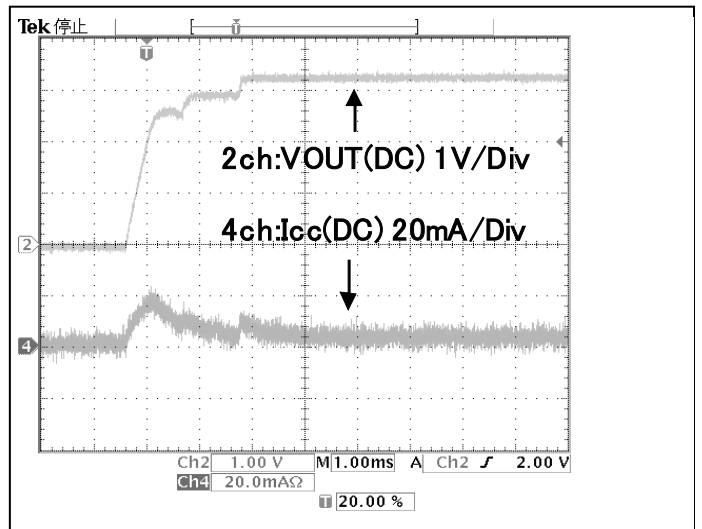


Figure 19. Rise VIN=2.8V[CR2032], Ro=1.65kΩ

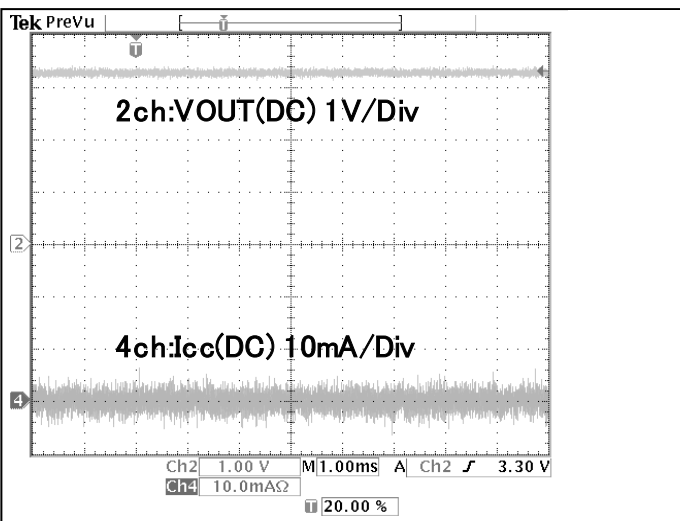


Figure 20. VIN=2.8V[CR2032],Io=0mA

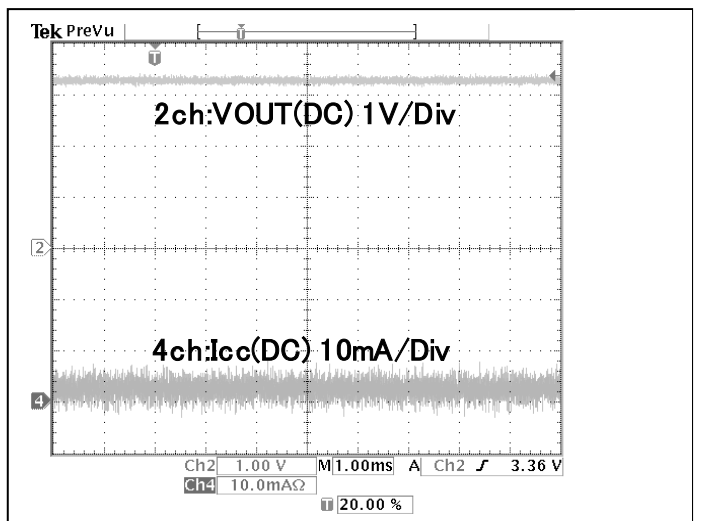


Figure 21. VIN=2.8V[CR2032], Ro=1.65kΩ



●Electrical characteristic curves (Reference data) – Continued

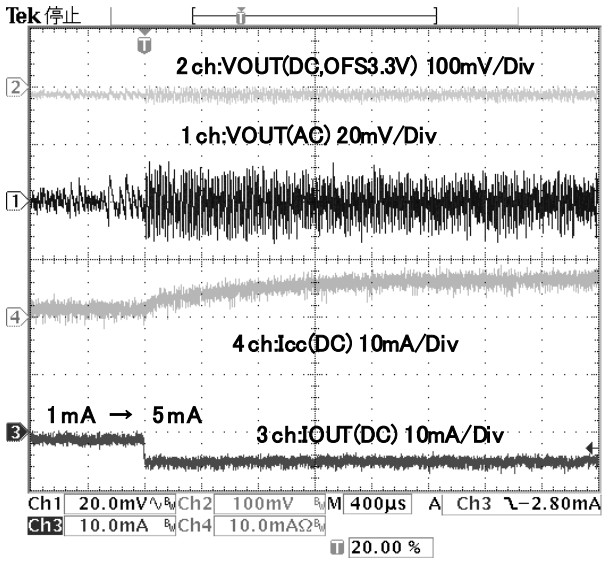


Figure 22. I<sub>o</sub> change 1mA=>5mA, VIN=2.8V[CR2032]

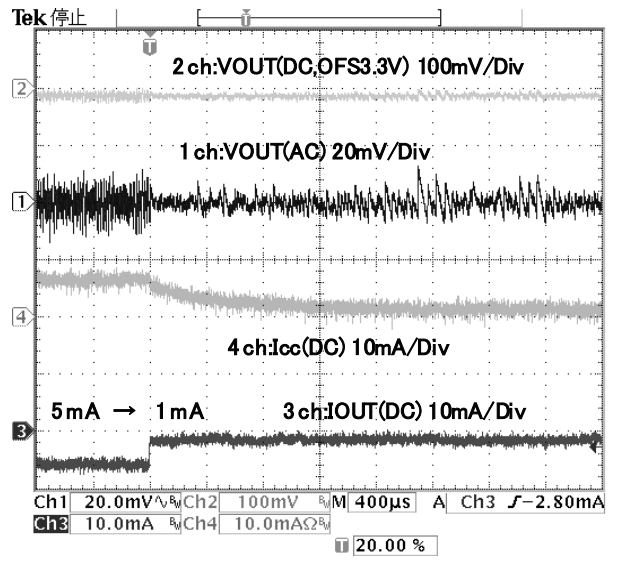


Figure 23. I<sub>o</sub> change 5mA=>1mA, VIN=2.8V[CR2032]

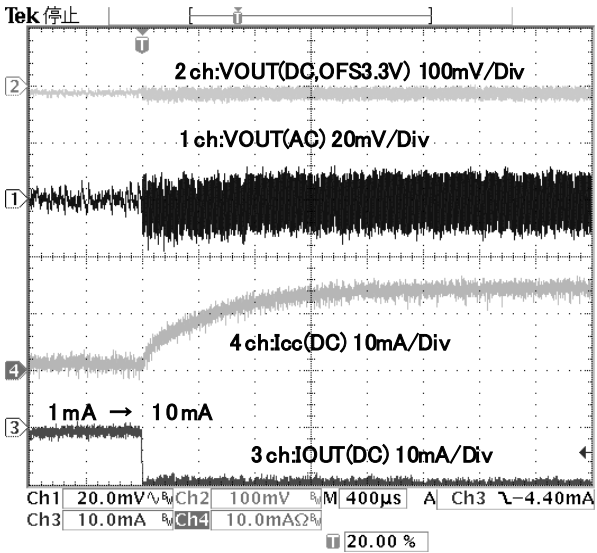


Figure 24. I<sub>o</sub> change 1mA=>10mA, VIN=2.8V[CR2032]

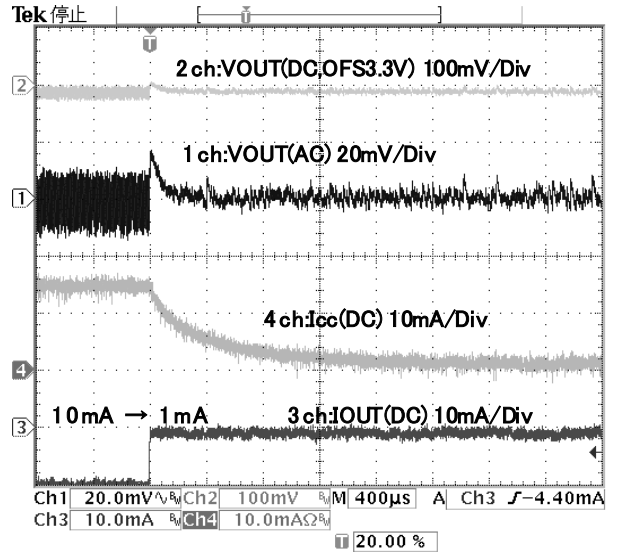


Figure 25. I<sub>o</sub> change 10mA=>1mA, VIN=2.8V[CR2032]

●Functional descriptions

1) Under voltage Lockout (UVLO)

DCDC converter stops the boost action when power-supply voltage drops to detect voltage. UVLO release automatically when power-supply voltage rises, Release voltage is 1.75V (Typ.). Detect voltage is 1.65V (Typ.)

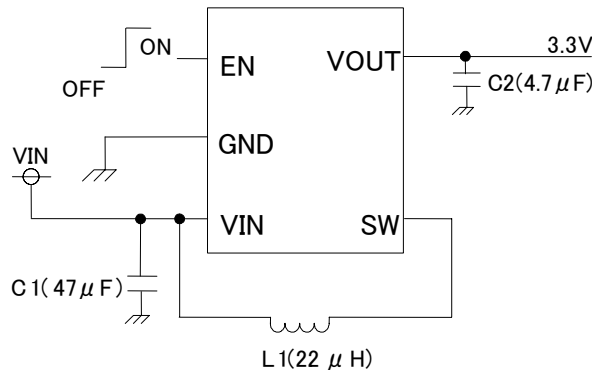
2) Over Current Protection 1

Over current protection circuit work when over current run to POWNMOS. 240mA(Typ.)

3) Over Current Protection 2

Over current protection circuit work when over current run to POWPMOS. 30mA(Typ.) This protection work at soft start.

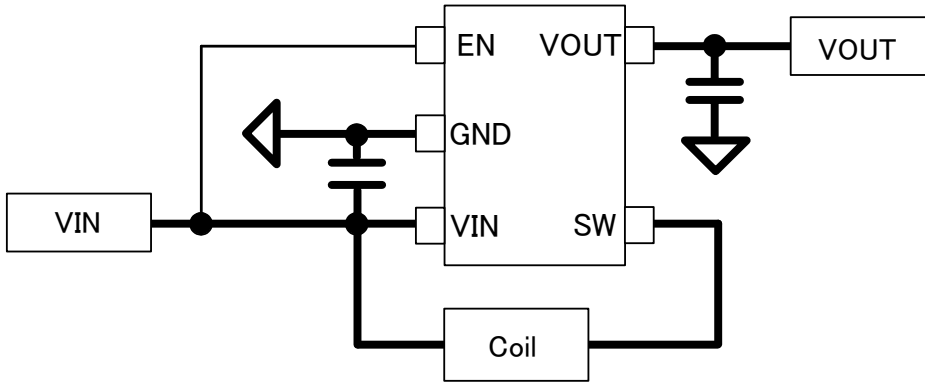
●How to select parts of application



Parts No.	Name	Value	STYLE(VENDOR)
L1	Inductance	22 $\mu$ H	VLF3010ST-220MR34 (TDK)
C1	Capacitor	47 $\mu$ F	X7R, X5R Ceramic
C2	Capacitor	4.7 $\mu$ F	X7R, X5R Ceramic

●Notes of board layout

BU33DV5G is switching DCDC converter, so characteristics of noise and etc changing by board layout. Please note the following respect besides a general board layout matter when you make PCB.



Please shorten power supply-coil GND loop.

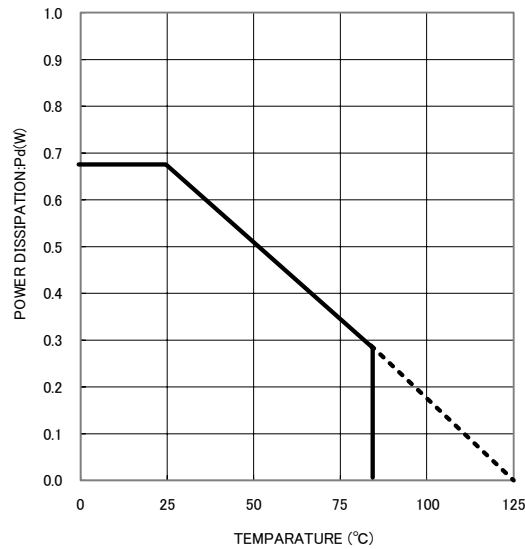
●About heat loss

In the heat design, please operate it in the following condition.

(Please consider the margin etc. because the following temperature is a guarantee temperature.)

1. Surrounding temperature  $T_a$  must be 85°C or less.
2. Loss of IC must be permissible loss  $P_d$  or less.

The allowable dissipation ( $P_d$ ) characteristics are described below.



70mm × 70mm × 1.6mm (ROHM standard 1 layer board mounting)

**●Operational Notes****(1) Absolute Maximum Ratings**

An excess in the absolute maximum rating, such as supply voltage, temperature range of operating conditions, etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

**(2) The power supply and the GND lines**

Design PCB pattern to provide low impedance for the wiring between the power supply and the GND lines. Please take care about interference by common impedance of the wiring pattern when there are two or more power supply and GND line. For the GND line, please note the separation of the large current route and the small signal route including the external circuit. Furthermore, for all power supply terminals to ICs, mount a capacitor between the power supply and the GND terminal. At the same time, in order to use an electrolytic capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.

**(3) GND voltage**

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state.

**(4) Short circuit between terminals and erroneous mounting**

In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

**(5) Operation in strong electromagnetic field**

Be noted that using ICs in the strong electromagnetic field can malfunction them.

**(6) Input terminals**

In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals, such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input terminals a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

**(7) External capacitor**

In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.

**(8) Thermal design**

Perform thermal design in which there are adequate margins by taking into account the permissible dissipation (Pd) in actual states of use. Moreover, please use it within the range where output Tr doesn't exceed the rated voltage and ASO.

**(9) Rush current**

In CMOS IC, when the power supply is turned on rush current might flow momentarily in logical internal irregular state. Therefore, note drawing the capacity of the power supply coupling, the power supply, and width and drawing the GND pattern wiring, please.

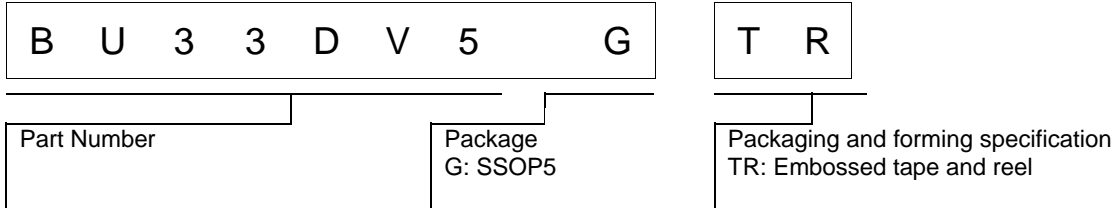
**(10) Test terminal and unused terminal processing**

Please process a test terminal and unused terminal according to explanations of the function manual and the application note, etc. to be unquestionable while real used. Moreover, please inquire of the person in charge of our company about the terminal without the explanation especially.

**(11) Content of material**

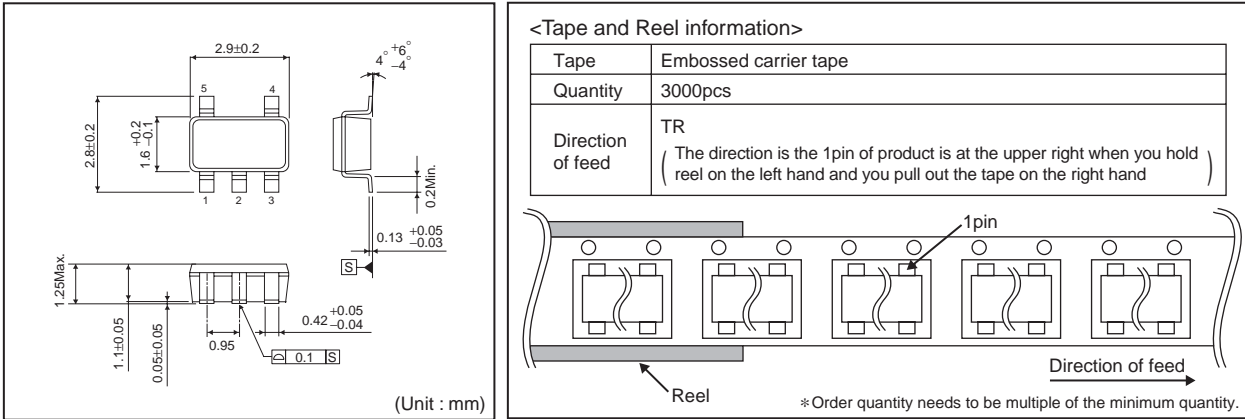
The application notes etc. are the design material to design the application, and no one of the content securing it. Please decide the application after it examines enough and it evaluates it including external parts.

●Ordering Information

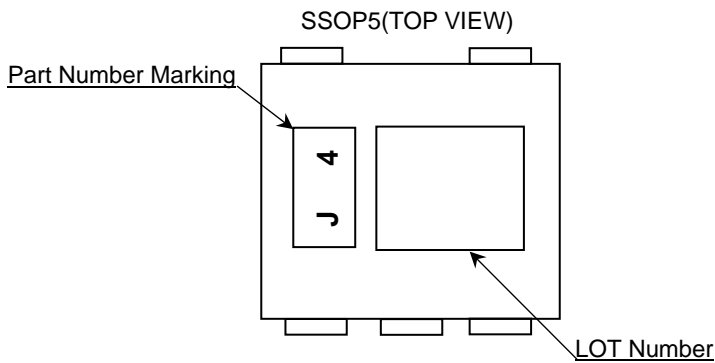


●Physical Dimension Tape and Reel Information

SSOP5



●Marking Diagram(s)



## ●Revision History

Date	Revision	Changes
14.Feb.2013	001	New Release

# Notice

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

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  - 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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - 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 (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient 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; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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.

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