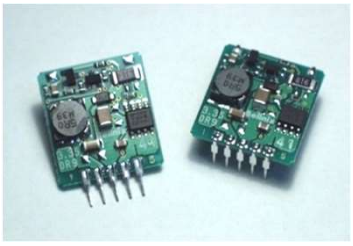
High Efficiency of 86%
Non-isolated Step-up DC-DC Converter
Bellnix® 3 Watt BUP Series

BUP-3W series products are step-up DC-DC converters workable with very low input voltage from 1.3V.
By adopting a synchro-nous rectification method, small size and high efficiency have been achieved. A new circuit was adopted to be a compact size. The internal circuit configuration is made simple yet highly efficient. Due to the addition of ON/OFF control function, the product has come easy to use in more variety of applications.

<Features>

- Efficiency: 86%（At 0.7A load）
- Efficiency: 90%（At 0.5A load）
- Synchronous rectification circuit (New
- Non-isolated converter
- Wide input voltage range
- Heat Sink not required
- Very Small
- ON/OFF control function
- Output voltage adjustable
- High reliablity, High performance
- Operation temperature: -20°C～+70°C (Temperature derating required)



<Part Number, Ratings> **Table 1**

Part Number	Vin Vdc	Vin Range Vdc	Vout Vdc	Iout A	Ripple Noise mVpp (typ)	Efficiency % (typ)	Package
BUP-3.3S0R9	2.5	+1.3 to (+4.2)	+3.3(3.3 to 5)	0 to 0.9 (Note 1)	10	82 (86)	SIP
BUP-3.3S0R9D							DIP

Note 1: The maximum output current is limited depending on the input voltage. See page 7, Figure 11.

Note 2: This converter will not properly work unless the output voltage is higher than the input voltage. See page 6, Figure 10.
Input voltage range at 3.3V output: 1.3V to 2.8V
Input voltage range at 5V output: 1.3V to 4.2V

Note 3: The efficiency shown in the parentheses in above table is the efficiency at 0.7A load.

〈Specifications〉 **Table 2**

Input voltage rating / range, etc.	See page 6, Figure 10. When turning on the input with a load connected without using ON/OFF control, Input voltage start-up time should be in 50ms.
Output Voltage Rating	Output voltage is set to +3.3V whern V.ADJ pin is open. (Vout setting precision: +/-4.5% max.)
Output Voltage Adjustable Range	Output voltage is adjustable in the range shown above.
Line Regulation	0.3% typ. / 1% max.（For input voltage fluctuations of 1.3 to 2.8V / load current of 0.2A)
Load Regulation	0.2% typ. / 0.8% max. (For load fluctuations of 0 to 0.9A)
Temerature Regulation	+/-0.02%/°C typ. (For the load current of 0.7 A, temperature change between -20°C and +50°C)
Ripple Noise	$10mV_{p-p}$ typ. / $50mV_{p-p}$ max.（BW = 20MHz）
Efficiency	82% typ. (Nominal input/output conditions, at room temperature. See Table 1)
Over Current Protection Circuit	None
Stand-by Current	15mA max.(When output is controlled to OFF by ON/OFF control and Vout has been set to 3.3V.)
Remote ON/OFF	Pin 1 (ON/OFF) - Pin 3 (GND) [Open: Output ON / Short: Output OFF] (See "ON/OFF Control in Page 4.)
Operation Temperature Range	-20°C to +70°C (See temperature derating plots in pages 7 and 8.)
Storage Temperature Range	-20°C to +85°C
Humidity Range	20% to 95% RH（Maximum wet bulb temperature: 35°C / No condensation)
Cooling Condition	See temperature derating plots in pages 7 and 8.
Vibration	5 to 10 Hz , Total amplitude: 10 mm (1 hour each in 3 directions) / 10 to 55 Hz acceleration: 2G (1 hour each in 3 directions)
Shock	Acceleration: 20G (3 times each in 3 directions), Shock time: 11+/-5 ms
Weight	3g typ.
Outline Dimensions	See page 2 for outline dimensions.

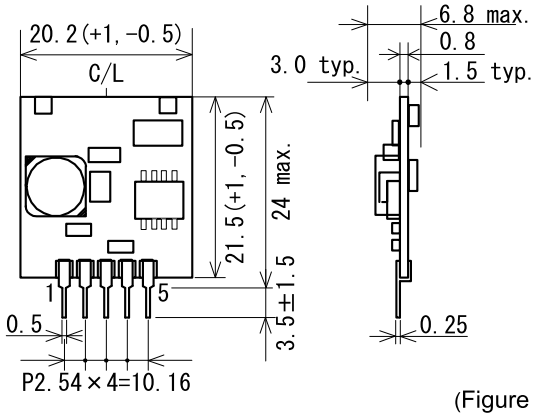
*Above specifications are specified for nominal values unless any specified conditions are stated.

Note 1: The output may shut down when it is overloaded or shorted. In that case, it will recover by using ON/OFF control or turning on the power again.

Note 2: If a nonlinear load such as a motor or a constant current load is connected, the output voltage may not go up at startup. If there is such a possibility, please check in actual application.

<Outline Dimensions>

BUP-3.3S0R9 (SIP)

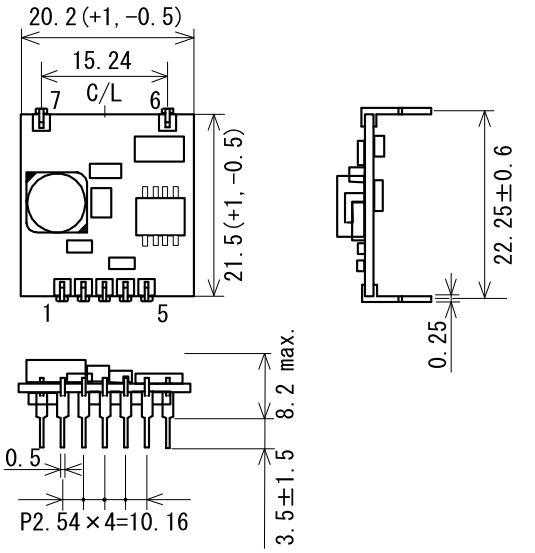


Pin	Function
1	on/off
2	Vin
3	GND
4	Vout
5	V.ADJ

Unit: mm
Dimensional tolerance unless noted: +/-0.5

(Figure 1)

BUP-3.3S0R9D (DIP)



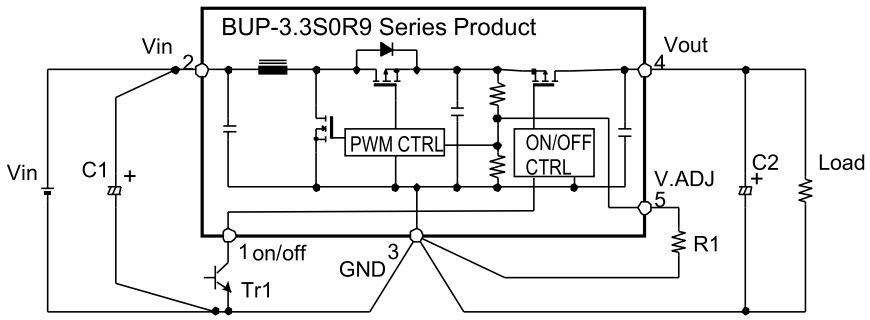
Pin	Function
1	on/off
2	Vin
3	GND
4	Vout
5	V.ADJ
6	Test pin *1
7	NC

Unit: mm
Dimensional tolerance unless noted: +/-0.5
*1: This pin is for our shipping test. Do not connect anywhere.

(Figure 2)

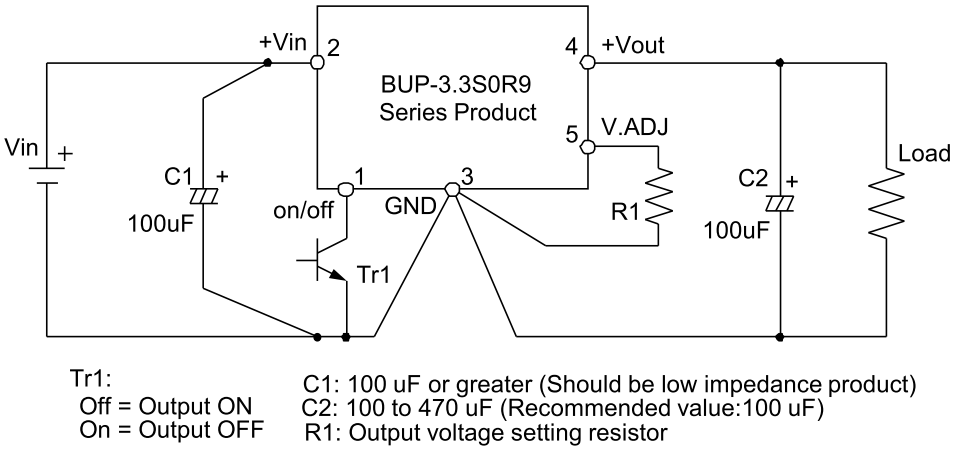
BUP-3.3S0R9(D)

<Block Diagram>



(Figure 3)

<Standard Circuit>



Tr1:
Off = Output ON
On = Output OFF

C1: 100 uF or greater (Should be low impedance product)
C2: 100 to 470 uF (Recommended value:100 uF)
R1: Output voltage setting resistor

(Figure 4)

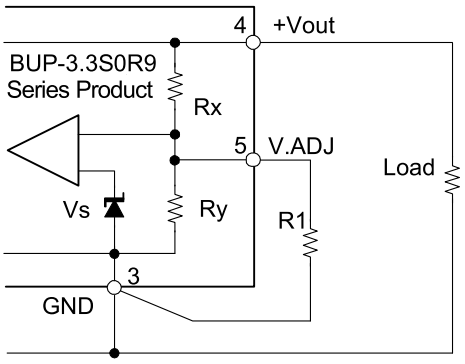
Note 1: Leave ON/OFF control pin open if it is not used.

Note 2: Leave V.ADJ pin open if Vout is not adjusted.

Note 3: Be sure to add the input capacitor (C1), place it as close as possible to (Pin 2 and Pin 3) and connect it by a bold pattern.

<How To Adjust Output Voltage>

- When using at 3.3V with no change on the output voltage, leave the V.ADJ pin (Pin 5) open.
- By connecting a resistor between GND pin (Pin 3) and V.ADJ pin (Pin 5), the output voltage can be varied up to 5.0V.
- Place R1 close to Pin 3 and Pin 5, and connect it as short as possible.
- To calculate the external resistance value, refer to the following calculation formula. After calculating the required external resistance, check the output voltage and (re-)adjust the resistance.



(Figure 5)

Output voltage adjustable range: 3.3 to 5.0 V

$$R1 = \frac{Vs \cdot Rx \cdot Ry}{Ry \cdot Vo - Vs(Rx + Ry)}$$

Vo: Output voltage to set
Vs = 1.25 (V)
Rx: 24.82 (K ohm)
Ry: 15 (K ohm)

[Example] R1 = 18.43 K-ohm for the output voltage of 5 V.

Note: The maximum output voltage is 5V.
Do not connect a resistor smaller than 18.43 K-ohm.

<ON/OFF Control>

- ON/OFF Control Function

By using the ON/OFF control function, the output can be controlled ON/OFF without interrupting the input.
This function is effective to configure the sequence of the power supply system.

- If not using the ON/OFF function:

In the cases of not using the ON/OFF function, leave the ON/OFF pin open.

- How To Use ON/OFF Control Function

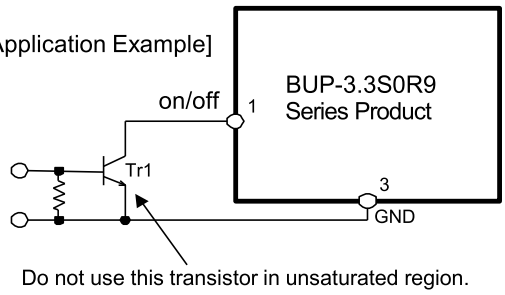
Between ON/OFF pin (Pin 1) and GND pin (Pin 3):

Tr1 OFF: Output = ON
Voltage between Pin 1 and Pin 3: 3V max.

Tr1 ON: Output = OFF
Between Pin 1 and Pin 3: -0.3 to +0.4V, 2.7mA max.
(When Vout = 5V)

Note: Do not use mechanical switches.
*The internal circuit may wrongly work due to chattering.

[Application Example]

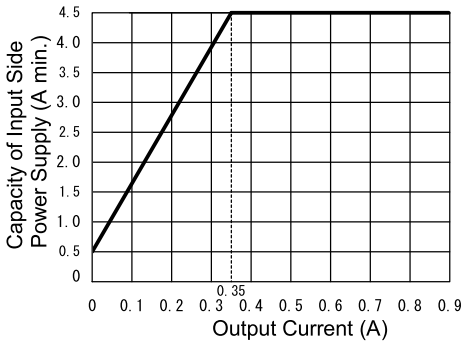


(Figure 6)

<Precautions for the power supply on the input side>

- When the configuration is the standard circuit:

As this converter starts working from a low input voltage (approx. 0.8V), a large current flows at the start-up of the input voltage. Therefore, use a power supply having a current capacity greater than that shown in the graph below for the power supply at the input side. If the current capacity is insufficient, the output voltage cannot start-up.



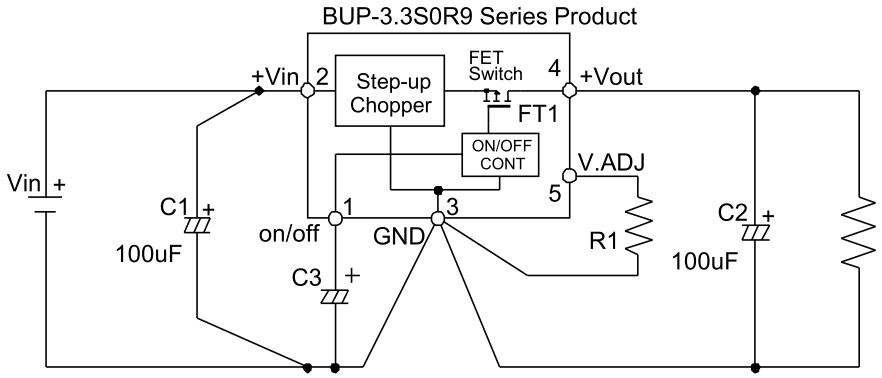
- The current capacity required for the power supply at the input side does not so much depend on the output voltage but is determined by the output current.

(Figure 7)

If an input power supply having a relatively large capacity as described above cannot be prepared, use the ON/OFF control, or turn on the output after the input voltage rises in accordance with page 5 "Start-up with a delay time".

- In the case of starting up with a delay time

If the conditions in Figure 7 on page 4 cannot be met, connect C3 between the ON/OFF pin and GND pin as shown below to delay the timing that the FET switch "FT1" turns ON. By delaying the turn-on timing of FT1, the output will be able to turn on after the start-up of the input.



C1: 100 uF or greater (Should be low impedance product)
C2: 100 to 470 uF (Recommended value:100 uF)
C3: 0 to 470 uF (Maximum value:100 uF)
R1: Output voltage setting resistor (Figure 8)

C1, C2 and R1 are the same as the standard circuit.

Please refer to the table below for setting the delay time by adding C3.

C3	Delay Time	
	Vout = 3.3 V	Vout = 5.0 V
47 uF	Approx. 75 ms	Approx. 45 ms
100 uF	Approx. 170ms	Approx. 100 ms
220 uF	Approx. 350 ms	Approx. 210 ms

Delay time: Time from the start-up of input voltage until FT1 turns ON.

Maximum capacitance of C3: 470 uF

Set a sufficient delay time comparing to the start-up time of input voltage with referring to the table above.
Input voltage, load current, and capacitance of C2 do not so much affect the delay time. The required delay time is determined by the output voltage. If it is required to re-start, please wait for the discharge (several seconds) of C3.

[Example]

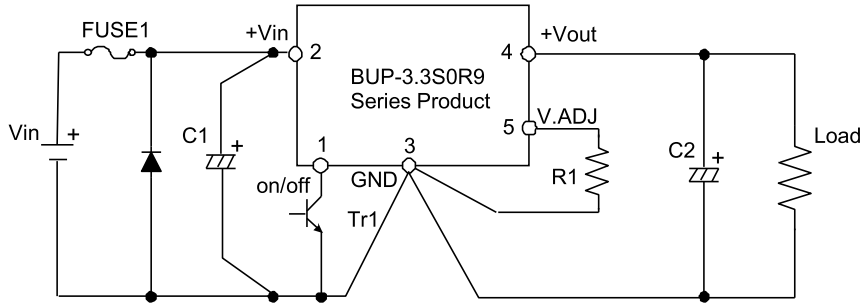
- In the case of starting up with a delay time or turning ON after the start-up of input voltage by using ON/OFF control function:
  Regarding the current capacity required for the power supply at the input side, refer to the following two examples.

Input voltage: 2.5V / Output: 3.3V / 0.9A - - - - - - 2.5A (Required current capacity)
Input voltage: 3.3V / Output: 5.0V / 0.72A - - - - - 3A (Required current capacity)

Note: Even if the method explained above is used, the effect of reducing the current capacity required for the power supply cannot be expected when the input voltage is low.

<Reverse Connection Prevention Method Of Input Power Supply (Example)>

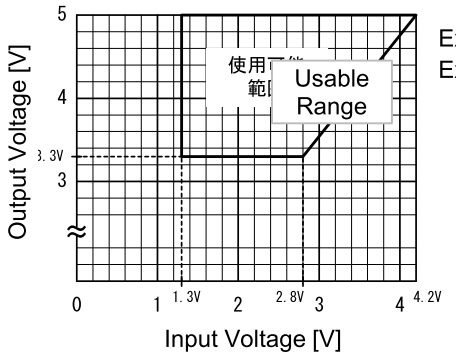
This converter will be damaged if the input polarity is reversed by mistake. If there is a risk of reverse connection, add a protection circuit as shown below. It is an example using a fuse and a diode. The power supply at the supply side should have enough capacitance to melt the fuse.



(Figure 9)

<Input Voltage Range>

As this converter is a step-up chopper type, it will not properly work unless the output voltage is higher than the input voltage. The shaded area in the plots below indicates the usable range.

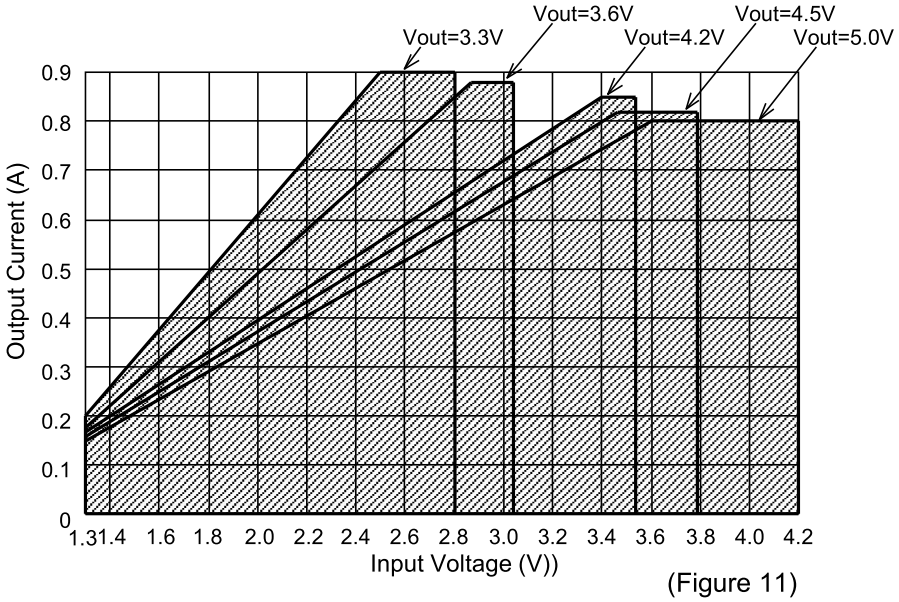


Example 1: The input voltage range is 1.3 to 2.8 V when the output is 3.3 V.
Example 2: The input voltage range is 1.3 to 4.2 V when the output is 5 V.

(Figure 10)

<Voltage Derating>

The maximum output current of this product is limited by the input voltage. The graph below shows the relationship between input voltage and output current at Vout = 3.3V, 3.6V, 4.2V, 4.5V and 5V. The shaded area indicates the usable region.



(Figure 11)

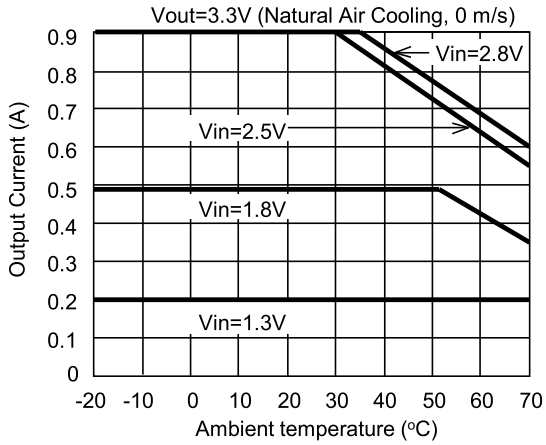
Conditions At Start-up:

- The value reduced by 10% relative to the maximum output curThe value reduced by 10% relative to the maximum output current value read from the above plots is the maximum current that can be started up when the input power source comes in.

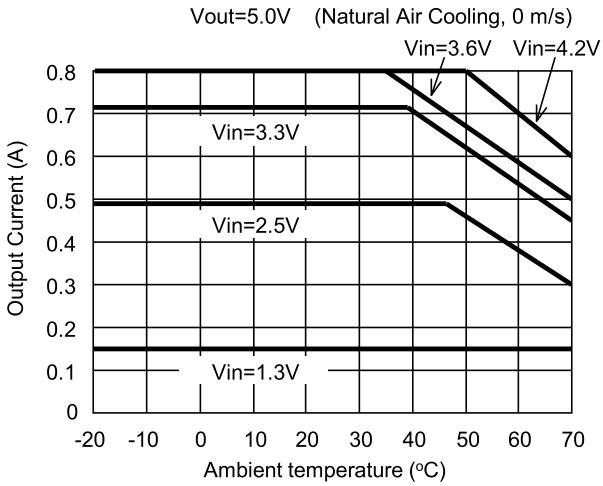
  (The same also applies to the output current value when the output is turned on by ON/OFF control.)
- If the input voltage does not atart-up under the above conditions due to the start-up curve of the input voltage, etc., turn on the output by ON/OFF control after the start-up of the input voltage or along with " In the case of starting up with a delay time" in Page 5.

<Temperature Derating (Natural Air Cooling)>

This product should be placed in a location with good air flow. Further, when using this product in an environment with an ambient temperature of 30°C or higher, implement the following temperature derating.



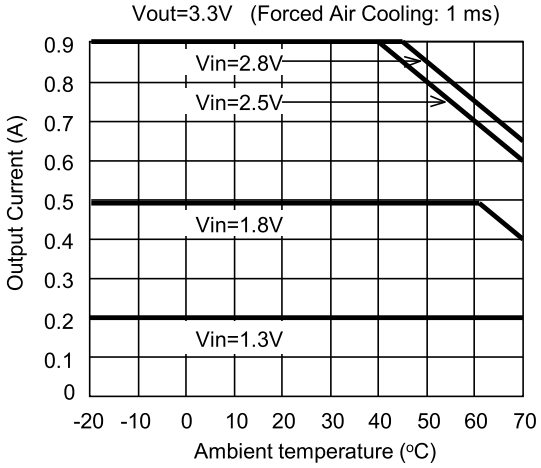
(Figure 12)



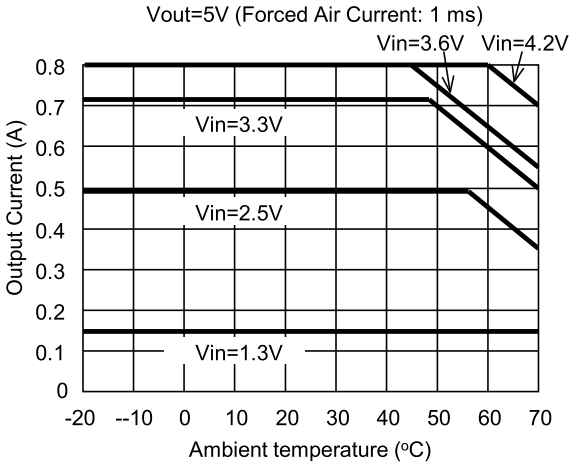
(Figure 13)

<Temperature Derating (Forced Air Cooling)>

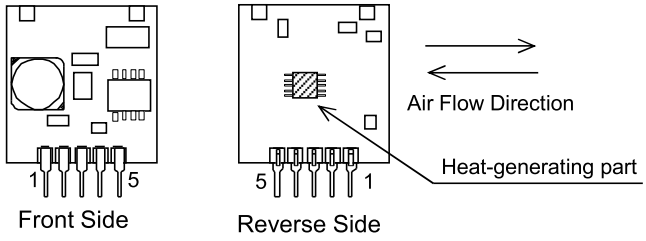
The temperature derating curve at the use of this product (SIP type) with forced air cooling is as shown below.



(Figure 14)



(Figure 15)



(Figure 16)

*In the case of the DIP type, the effect of forced air cooling is not expected so much.

<Pre-cautions For Washing>

This product cannot be washed as a whole. The use of no-clean flux is recommended for this product.
If washing is unavoidable, wash only the solder surface with a hand-washing brush using isopropyl alcohol (IPA).
After washing, please thoroughly dry before the use..

<Soldering Conditions>

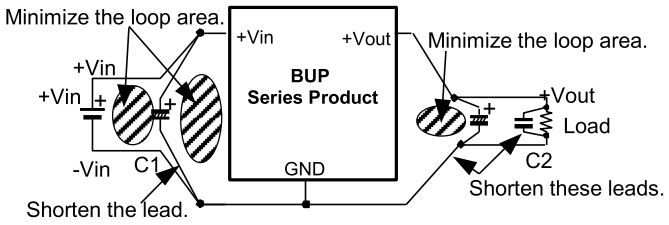
Soldering should be conducted under the following conditions.

Soldering iron:	Max. 350°C, 3 seconds
Dipping in solder bath:	Max. 260°C, 10 seconds

<Noise Reduction Meathod (Example)>

The BUP series is used by adding capacitors at the input and output. To take advantage of the converter's performance and to achieve lower noise, design the printed circuit board taking into account the following items.

1. Use a low impedance capacitor having good high frequency characteristics.
2. Shorten the lead of each capacitor as much as possible to reduce the lead inductance.
3. At both sides of the input and output, minimize the witing loop between the positive and negative pins. The effect of leakage inductance can be reduced.
4. The printed pattern of the main circuit should be designed to be as bold and short as possible.



(Figure 15)

<Pre-cautions For Use>

- This product is designed with the intention to be used in general electronics equipment (office equipment, communication equipment, measurement equipment). Do not use the product for medical equipment, nuclear equipment, trains, etc., whereby human life or property may directly be affected by a damaged on this product. Consult to us for any use other than for such general electronics equipment.
- This product should not work in parallel and/or in series.
- This product has no built-in overcurrent or short-circuit protection circuit and may be damaged at the event of an overload or output short circuit.Do not use in overloaded conditions.
- Do not use a connector or a socket for mounting this product. The performance may not be satisfied due to contact resistance. Mounting on PCB should be done by soldering.
- This product may be damaged if used out of specified electrical conditions or environmental conditions such as temperature range. Be sure to use the product within the specifications.
- Static electricity may cause damage to the product. Work in an environment where static electricity charged in the worker is discharged to the ground or otherwise protected against ESD.
- This product does not have a built-in fuse. Connect a fuse to the "+"input line to protect against excessive input current at the occurrence of anomalous conditions. The power supply should have enough capacity to blow the fuse.
- No test report is attached to this product.

<Warranty>

- The warranty period for this product is one year. If a defect occurs during the warranty period due to our design or manufacturing factors, the product will be repaired free of charge or replaced with a good quality product. However, it cannot be guaranteed in the cases such that the internal parts are modified. The scope of warranty for this product is the scope of the product as it is.

<Others>

If you have any doubts about this datasheet, please contact us.

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