

# Small Type High-Speed Response POL DC-DC Converter

## BSV-nano Series



BSV-nano Series is a small type (11x11x3.5mm), light (1.0g), 4A output step-down DC-DC converter. It has low output voltage from 0.8V and an accuracy of  $\pm 1\%$  typ. It can support the latest DSP, ASIC applications. High efficiency and high-speed response with synchronous rectification and space-saving packaging has been achieved. This product will exceed your expectations.



### ■ Features

- Ultra Small 11×11mm
- Ultra Thin 3.5mm
- High-Speed Load Response
- Output Accuracy  $\pm 1\%$
- High Efficiency
- Over Current Protection
- Under Voltage Lock Out
- Remote ON/OFF Control
- Adjustable Output Voltage
- Surface Mount Package (LGA)
- Heat Sink Not Required
- Non-Isolated Type converter
- Operating Temp Range -40°C to +85°C
- RoHS Compliance

### ■ Model/Rating

Models	Input V Vdc	Output V Vdc	Output I A	Output ADJ Vdc	Noise mVpp(typ)	Efficiency %(typ)
BSV-nano Series						
<b>BSV-1.8S4R0N</b>	3.0 - 5.5	1.8	0 - 4.0	0.8 - 1.8	10	85

Note 1: Ripple noise, efficiency value is when input voltage is 5V and load is rated.

Note 2: Ripple noise is measured at 20MHz bandwidth, with a multi layered ceramic capacitor with 47 $\mu$ F at input and 22 $\mu$ F at output.

Note 3: Depending on conditions, cooling airflow may be required.

### ■ Specification

Input voltage range	Refer to Table 1
Rated output voltage	1.8V $\pm 1\%$ typ ( Trim pin OPEN )
Output voltage adjustable Range	0.8-1.8V
Line regulation	0.5%typ (Rated output, input voltage varying from 3.0 to 5.5 )
Load regulation	0.5%typ (Rated input/output voltage, load varying from 0 to 100% )
Temp regulation	0.02%/°C (Rated input/output, Operating temp varying from -40°C - +70°C)
Ripple noise	Refer to Table 1 (Rated input/output, Common temp, measurement frequency bandwidth 20MHz )
Efficiency	90%typ ( Output current 2A ) 85% typ ( Output current 4A, Refer to Table 1 )
Start up time	2.8ms typ ( Resistance load )
Max output load capacity	2200 $\mu$ F max
Over current protection	Operate at 105% or above of rated load current, Auto restart type
Over voltage protection	None
Under Voltage Lock Out	Yes
Input over current protection	None
Remote ON/OFF control	Between 2pin( ON/OFF )- 4pin( GND ):Output is ON when open, output is OFF when short.(Please refer to pg8 )
Standby current	0.2mA typ
P-Good signal	Normal output :HIGH Abnormal output : LOW (Open drain)
Remote sensing	Yes
Operating temp range	-40°C - +100°C (Refer to pg5 for derating)
Storage temp range	-40°C - +100°C
Humidity range	20 ~ 95%R.H. (Max wet bulb temp 35°C with no condensation )
Storage condition	Below 30°C/60% R.H. before mounting the converter
Cooling condition	(Refer to pg5 for derating)
Vibration	5-10Hz total altitude 10mm, 10 to 55Hz acceleration 2G (1H for each of three directions)
Impact	Acceleration 20G, (3 times for each of three directions), Impact time: 11 $\pm$ 5ms
Weight	1.0g typ
Dimensions	W=11.0 L=11.0 H=3.5 typ ( mm )

\*The above specification is provided with rated value, unless otherwise specified.

\*The content provided in this page may be changed at any time without notice.

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## 1. Usage range

This specification is for the direct input, non-isolated type DC-DC converter BSV-1.8S4R0N.

## 2. Model Name/Rating

Model Type	Rated input voltage	Rated output	Package	Memo
BSV-1.8S4R0N	DC5.0V	1.8V, 4.0A	SMD	

The input/output will be rated and the ambient temp is at 25°C±5°C unless otherwise specified.

## 3. Environmental conditions

### 3-1. Temp Range

Active	-40°C - +100°C
Storage	-40°C - +100°C

### 3-2. Humidity Range

Active	20 - 95%RH (The max wet bulb temp is 35°C with no condensation)
Storage	20 - 95%RH (The max wet bulb temp is 35°C with no condensation)

Note: The storing conditions before mounting should be less than 30°C/60%RH.

## 4. Specification/Rating

The product is lead-free.

### 4-1. Input characteristics

Item	Specification/Rating	Conditions
Input voltage	+3.0 - 5.5V (Rating at 5.0V)	
Input current	1.7A typ	During rated input/output
Standby current	0.2mA typ	V <sub>in</sub> =5.0V, SHORT between on/off pin - GND pin

4-2. Output characteristics/Attached functions

\*1, \*2

Item	Specification/Rating	Conditions
Output voltage	1.8V	
Output voltage accuracy	1.8V±1.5%(±0.027V)	
Adjustable output voltage	0.8V - 1.8V	By external resistor
Output current	0 - 4.0A	
Line Regulation	0.5% typ (1.0% max)	Input varying from 3.0 to 5.5V
Load Regulation	0.5% typ (1.0% max)	Load varying from 0 to 4.0A
Temp Regulation	±0.02%/°C typ	Temp varying from -40°C to +70°C
Efficiency	90% typ (I <sub>o</sub> =2A), 85% typ (I <sub>o</sub> =4.0A)	
Ripple noise	10mVp-p typ 50mVp-p max.	Bw=20MHz, Measured at both sides of an external capacitor
Over current protection	Operate at 105% or above, Auto restart type	
Over voltage protection	No	
Under voltage lock out	Yes Start-up voltage: 2.85 typ Stop voltage: 2.75 typ	
ON/OFF control	Between ON/OFF pin and GND pin Open ----- Output ON Short(0 - 0.9V 0.2mA max) -----Output OFF	
P-Good low level voltage	0.3V max	Sink current 4mA max
Max output load capacity	2200µF max	

\*1 Referring to measurement circuit, section 4-3.

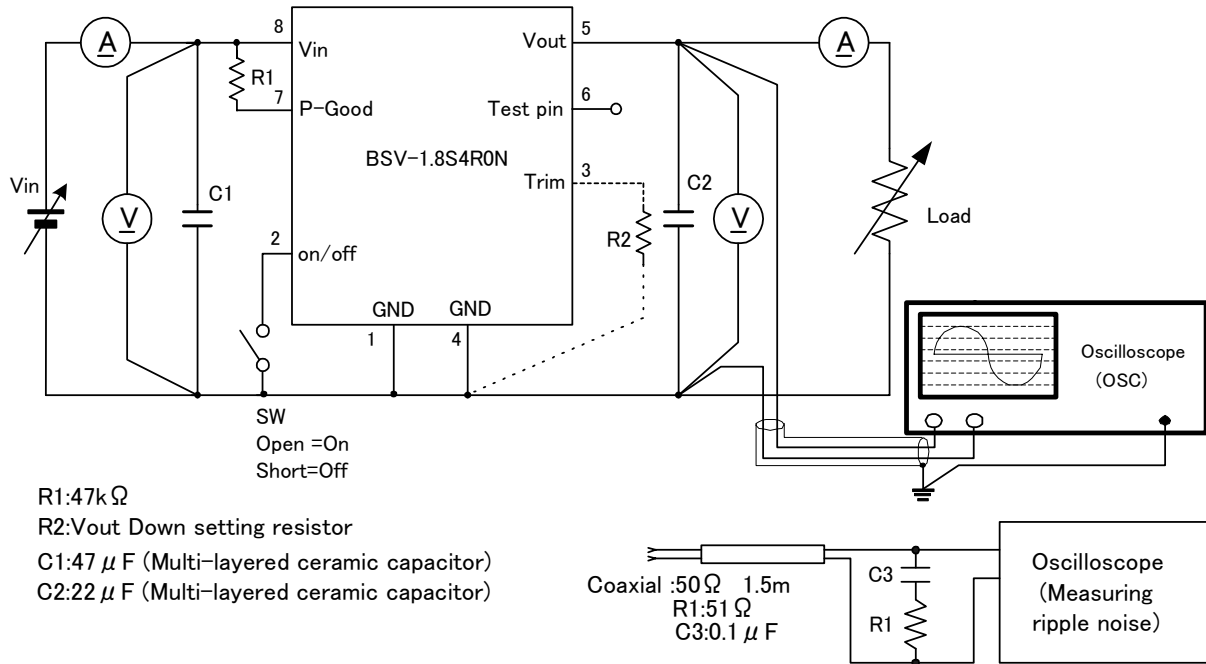
\*2 The above items are measured with input voltage at 5.0V, output voltage 1.8V, output current 4.0A (resistance load) and the ambient temp at 25°C±5°C unless otherwise noted.

# Small Type High-Speed Response POL DC-DC Converter

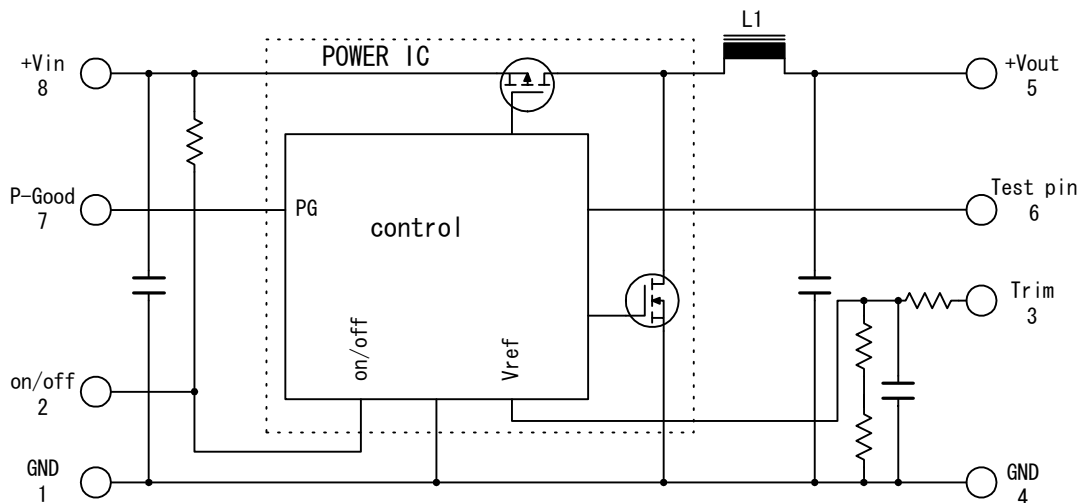
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## 4-3. Measurement Circuit



## 5. Internal Block Diagram



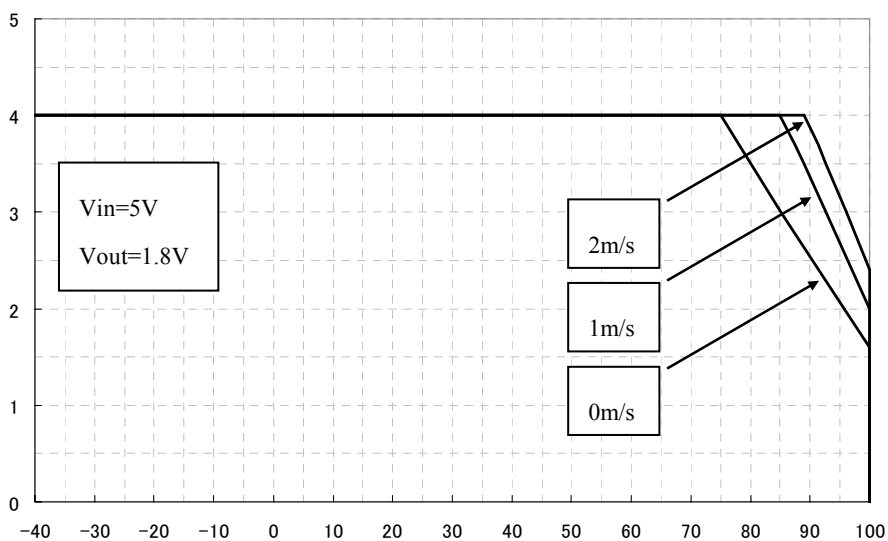
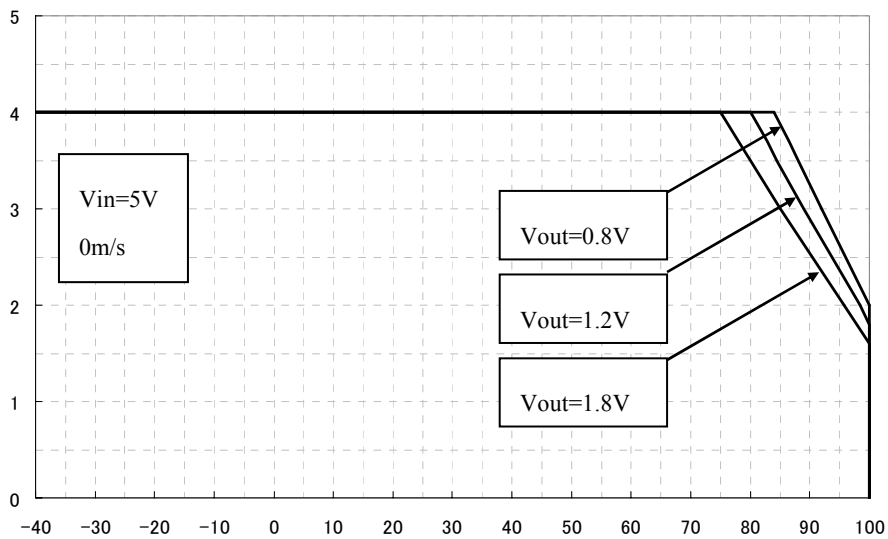
6. Temperature Derating

Place the product where there is good air flow. Since the product was made to radiate heat using PCB, make sure to place the product onto the PCB. Patterns to converters should be taken thick and wide, especially lines to GND pin. Since it has a larger heat release, the line needs to be wide enough.

The derating curve below is when BSV-1.8S4R0N is mounted onto the evaluation board (BSV-1.8S4R0NEVM-01: Double-sided board of Copper coating thickness 35µm, Copper coating dimension 80 x 75mm, PCB thickness 1.6mm). The heat release characteristics may change depending on wiring.

The temp characteristics are largely affected by PCB and the ambient temp. Therefore, make sure that IC surface temp of the converter does not exceed 120°C when operated at the max ambient temp while mounted onto an actual device.

Derating curve when BSV-1.8S4R0N is mounted on an evaluation board



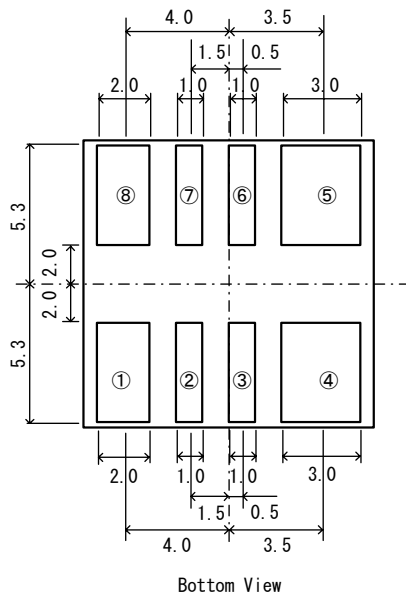
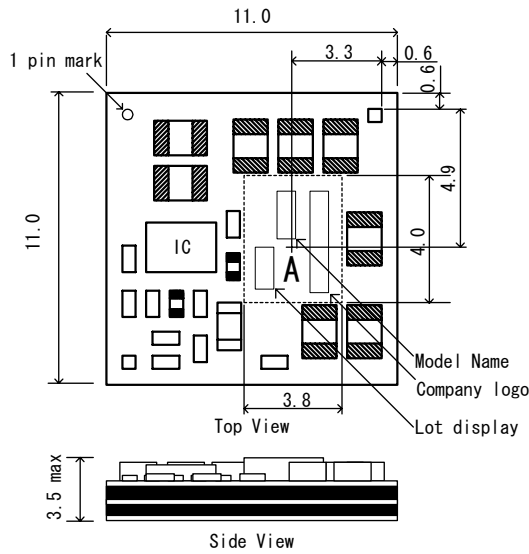
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## 7. Outer dimensions and pin information

### 7-1. Configurations/Dimensions (SMD type)



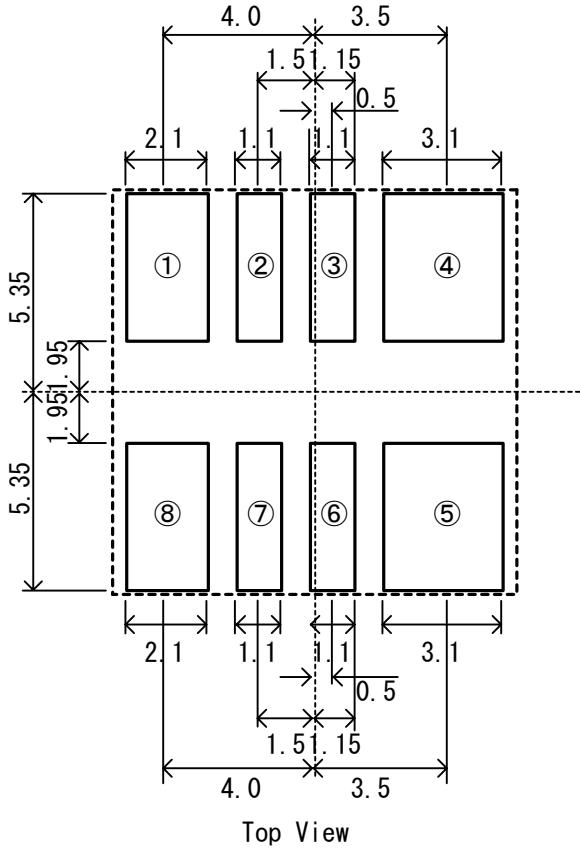
- Unit mm
- Tolerance unless otherwise specified  $\pm 0.2$
- Weight = 1.0g typ
- Pick up point: A
- Lot No is placed on 1 pin side.
- DISPLAY: ①②③
  - ① Last digit is the YEAR
  - ② Manufacturing month (e.g., 10, 11, 12 are for O, N, D respectively)
  - ③ Lot No for the month (No number for the first lot)
- Pin's variation is 0.1 mm max (when placed on the level).

#### Note)

When the product is mounted by machine, make sure to pick up at A point (Dimension: 4.0x3.8mm). Please refrain from picking up IC.

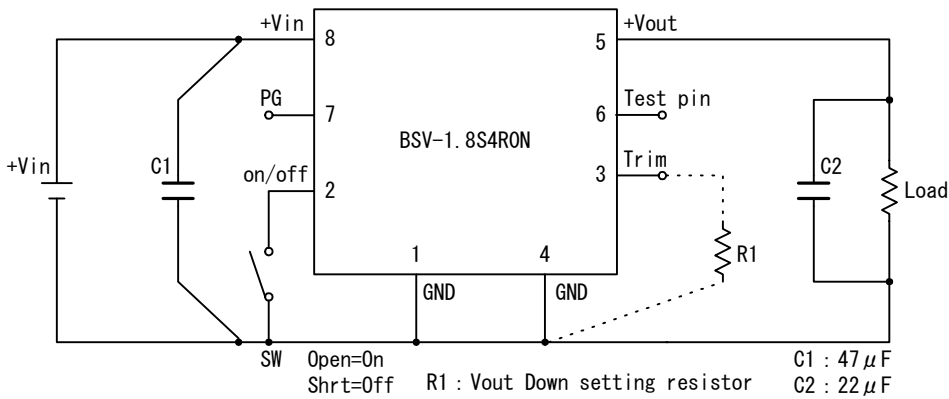
Pin	Function
①	GND
②	ON/OFF
③	Trim
④	GND
⑤	Vout
⑥	Test pin
⑦	P-Good
⑧	Vin

7-2. Recommended footprint



8. Usage information

8-1. Standard connection diagram



- Note1: The product is mounted on the PCB. Most of the heat is released mainly through GND pins (1, 4pin) and the rest through +Vin pin and +Vout pin. The pattern should be taken wide enough to release heat when designing. Make sure that surface temp of IC does not exceed 120°C.
- Note2: Over heat protection will shut down when IC junction temp exceeds 150°C. It will return to normal by switching on or resetting the ON/OFF feature when the heat problem is resolved.
- Note3: Keep ON/OFF pin open when not using the ON/OFF control.
- Note4: P-Good pin is an open drain output. Use P-Good feature with input voltage pulled up by resistance.

Note5: Keep Trim pin open when not using adjustable output.

Note6: GND pins (1, 4pin) are connected internally. These two pins should be connected to GND line to make the best use of the product.

Recommended capacitor

C1=47μF

C2=22μF - 200μF

C1: It is not necessary when impedance is very low on the input side and the line is connected short between power supply and the converter with ample width. A product with low ESR such as an organic semiconductor solid capacitor or a multi layered ceramic capacitor is recommended.

C2: Since output capacitor is placed internally, C2 is not required. However, it may be necessary to satisfy the electric characteristics such as ripple noise. When C2 is connected to the load side, noise will be reduced. A multi layered ceramic capacitor is recommended.

### 8-2. ON/OFF control

By using ON/OFF control feature, the output voltage can be turned on and off without disconnecting the input. The ON/OFF pin is connected to +Vin pin with 30kΩ resistor internally. Keep the ON/OFF pin OPEN when not using the ON/OFF feature.

At 3.3V input

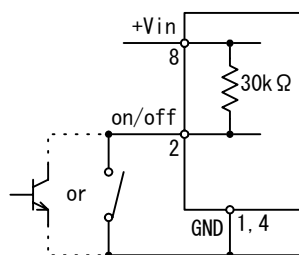
ON        OPEN between ON/OFF pin (2pin) and GND pin (4pin) or HIGH (2.6V or above)

OFF       SHORT between ON/OFF pin (2pin) and GND pin (4pin) or LOW (0.65V or below)

At 5.0V input

ON        OPEN between ON/OFF pin (2pin) and GND pin (4pin) or HIGH (3.75V or above)

OFF       SHORT between ON/OFF pin (2pin) and GND pin (4pin) or LOW (0.9V or below)



8-3. Adjustable method for output voltage

Keep Trim pin (3pin) OPEN, when using output voltage at 1.8V without adjusting. Output voltage may be adjusted between 0.8 and 1.8V by connecting a resistor between Trim pin (3pin) and GND pin (4pin).

Wiring for Trim pin should be short and straight preferably when using adjustable output voltage feature. If noise appears on the pin, it causes mal-function.

The below formula for external resistance should be referred.

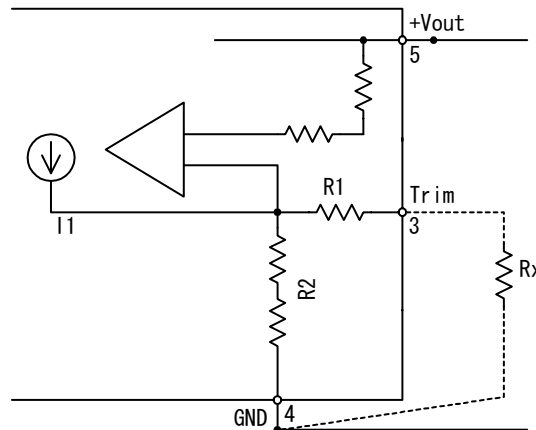
When setting between 0.8V and 1.8V

$$R_x = \frac{R_2 \times V_{out}}{R_2 \times I_1 - V_{out}} - R_1 \quad (\Omega)$$

R1=47000 (Ω) , R2=63800 (Ω) , I1=0.000028186 (A) , Vout=Desired output voltage (V)

e.g.

Output voltage (V)	Rx calculated value (kΩ)
1.8	OPEN
1.5	273.85
1.2	80.97
1.0	32.92
0.8	4.13



8-4 P-Good pin

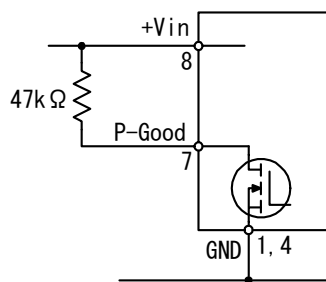
Output state of the converter may be obtained by using P-Good pin (7pin). The pin is an open drain output. When using the P-Good features, the pin needs to be pulled up by input voltage with external resistor. (5.5Vmax)

When output voltage (+Sense pin voltage) goes out of the converter's pre-set range, P-Good pin becomes SHORT (LOW).

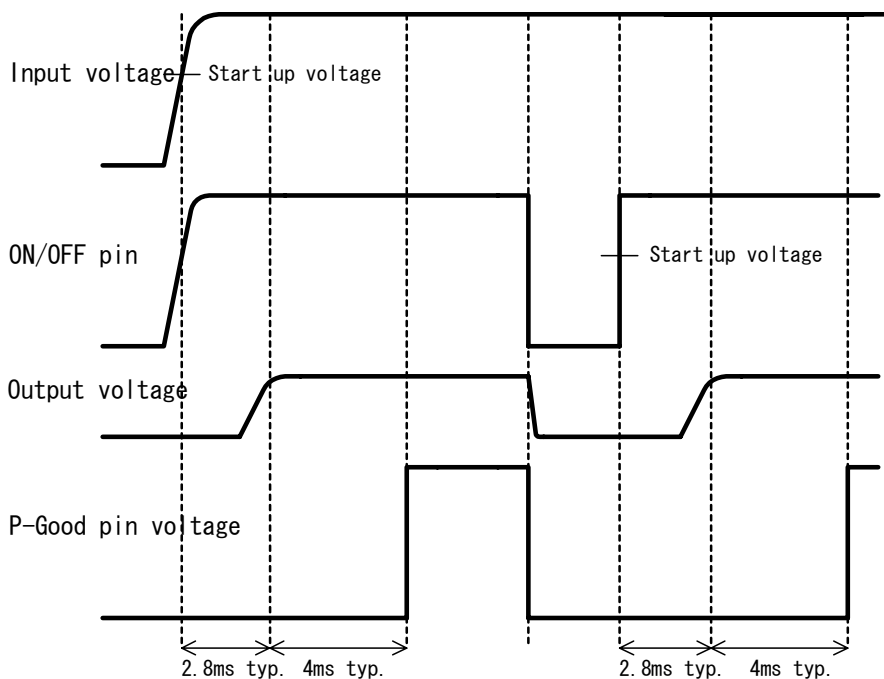
$$|\text{Output voltage} - \text{Set voltage}| \leq 0.2\text{V typ} \rightarrow \text{OPEN (HIGH)}$$

However, even if the above conditions are fulfilled, the P-Good pin may decrease to low under the following circumstances.

- At start-up (4ms typ)
- Input voltage is less than 3V
- Output current is in the state of over current
- IC junction temp exceeds 150°C



Amount of time required for output voltage and P-Good pin to output after they fulfill the start-up conditions

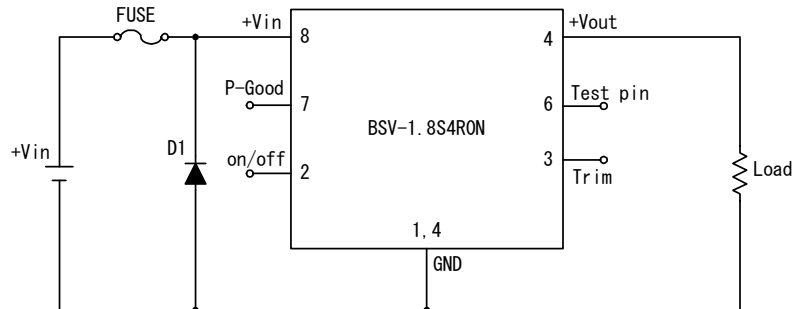


9. Protection against reverse connection method for input power supply (e.g.)

The product is non-isolated between input and output and steps down from (+) to (+).

The product will break if the input polarity is connected in reverse. Therefore, adding protection circuit is recommended as shown below.

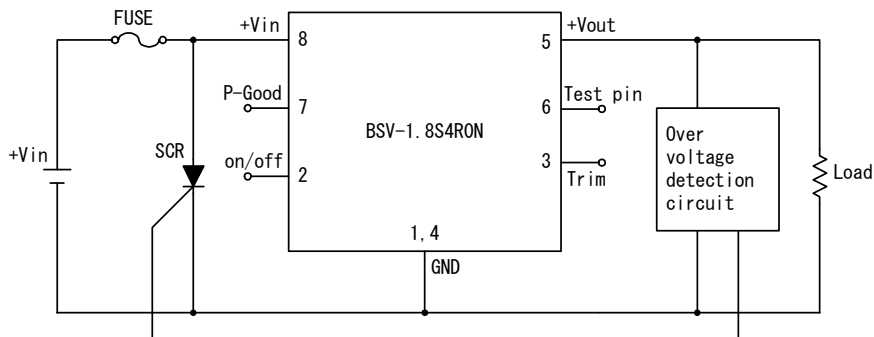
Below is a diagram using a fuse and a diode.



10. Over voltage protection circuit (e.g.)

The product does not have over voltage protection feature.

When switch element inside the product breaks in short mode, DC input voltage will be affected directly to the output. Therefore the input shut-off circuit below is recommended in case of breakage in over voltage mode.



Note1: ON/OFF control will not work when the converter breaks in over voltage mode.

Note2: If there is ON/OFF control feature on the electrical supply source side, it can also be used.

Note3: DC power supply should have enough capacity to melt a fuse.

11. Mounting conditions

The conditions stated below are required to follow such as soldering temp, time and storage before mounting. The converter can not be mounted by flow soldering.

11-1. Re-flow method

Pre-heat temp: 150 - 180°C, 60sec max. (Refer to the below chart)  
 Peak temp: 250°C max.  
 220°C or above, 60sec max.

Number of re-flows: twice

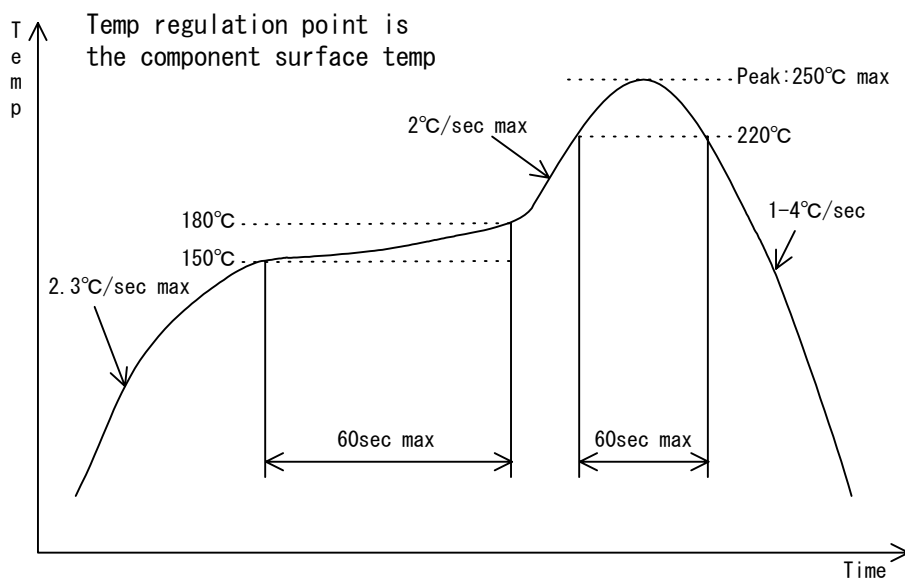
Note1) Make sure not to vibrate during the re-flow or components making up the converter may be dislocated.

Note2) After mounting the converter to PCB, re-flow can not be repeated with the PCB upside down.

11-2. Storage before mounting

This is MSL 3 product. Storage conditions before mounting should be at 30°C/60% RH or below after opening the dry pack. Furthermore, baking (125°C ±5°C, 12H) is required before the re-flow when exceeding one year period in a dry pack condition and 168 hours at 30°C/60% RH in an open dry pack condition.

After mounting, it depends on the storing condition.



12. Vibration and shock test

Vibration 5-10Hz All amplitudes 10mm, 10-55Hz Acceleration 2G (3 direction for 1H each)

Shock Acceleration 20G (3 direction, 3 times each)  
 Shock time 11±5ms

13. Cleaning conditions

The product can not be washed as a whole. Non-scrub flux is recommended.

14. Precautions

For the safety of our customer, please follow all warnings and specifications stated below.

- This product is intended for use in general electronic appliances (office work machines, telecommunication equipment and measurement equipment). Do not use for medical equipment, nuclear power equipment and trains, etc. where the malfunction and damage of this product may directly cause harm to human life and/or property. Confirmation is recommended when using in other than general electronic equipment.
- Parallel and serial operations are not possible.
- Refrain from using connectors and sockets when mounting the product. The performance may not be fulfilled by the effect of contacting resistors. Make sure to mount onto the PCB by soldering.
- Though over current and short circuit protections are built in, long time use in short circuit should be avoided since it may cause failure to the product.
- The product may be damaged if used in environments where the electric and temp characteristics are out of specification.
- Do not store this product where corrodible gases and dusts may generate.
- There is a possibility that the product may be damaged from static electricity. The workers should discharge all static electricity before handling the product and the work atmosphere should also have a static countermeasure.
- This product does not have a fuse built in. When the converter is in an abnormal state, please connect a fuse into +input line as a protection of over current. The electrical supply source should have enough capacity to be able to shut down a fuse.
- The product does not have an over voltage protection circuit built in. When large amount of voltage occur inside the module, there is a mode in which it is directly released from the output and may cause smoke or fire. Therefore, an over voltage protection circuit should always be added.
- No test certificate is attached to the product.

15. Warranty

The period of warranty for this product is 1 year. During this time, if any defects occur in which our company's design or production is to blame we will either fix the product or trade with a new one free of charge. However, this warranty is voided if the product has been internally modified or adjusted. The warranty covers only the stated products in this datasheet.

16. If you have any further technical questions for this product,

Please contact us:

E-mail: [info@bellnix.com](mailto:info@bellnix.com)

<http://www.bellnix.com>