

High-Speed Response, Output Set Accuracy±1%

POL DC-DC Converter

Bellnix[®]

BSV-H Series

BSV-H series is a small size (27.0x16.5x4.2mm size) and light weight (3.1g) step-down DC-DC converter, which has achieved 12A. Since it can correspond from ultra low output voltage of 0.6V, and set accuracy of output voltage is under $\pm 1\%$, it can be used for the latest DSP, ASIC and FPGA applications. Due to high efficiency and high-speed response by synchronous rectification circuit technology, saving space by no external components, and with SMD package etc. an excellent performance beyond our common sense has been achieved.

<Features>

- Ultra Small Size 27x16.5mm
- Low Profile 4.2mm
- High-Speed Load Response
- Output Voltage Accuracy $\pm 1\%$
- Ultra High Efficiency
- Built in Over-Current Protection
- Under Voltage Lock Out
- External Capacitors not required
- Heat Sink not required
- RoHS Compliance
- Non-Isolated Type
- Remote ON/ OFF Control
- Adjustable Output Voltage
- Surface Mount Package (SMD)
- Operating Temp. Range -40°C to +85°C (Temp. Derating required)



<Model/ Rating>

Table 1

Model	Rating Input Voltage	Input Voltage Range	Rating Output Voltage	Output Current	Output Voltage Adjustable Range	Ripple/ Noise	Efficiency	Package
	Vdc	Vdc	Vdc	A	Vdc	mVpp (typ)	% (typ)	type
BSV-1.5S12R0H	5.0	3.0-5.5	1.5	0-12	0.6-1.5	30	87	SMD

Note 1: The value of ripple and noise and efficiency is the one at input voltage (5V) and rating load.

Note 2: Measurements of ripple noise is performed at BW=20MHz, with an additional multilayer ceramic capacitor of 47 μ F to the input and 4.7 μ F to the output.

Note 3: Depending on the ambient air temperature conditions, air flow is required.

<Specification>

Table 2

Rating Input Voltage/ Range	Refer to Table 1
Rating Output Voltage	+1.5V $\pm 1\%$ (Trim Pin at open)
Adjustable Output Voltage Range	0.6~1.5V
Line Regulation	0.5% typ. (Rating output, for the regulation of input voltage range on table 1)
Load Regulation	0.5% typ. (Rating input/ output voltage, for the regulation of load 0-100%)
Temperature Coefficient	$\pm 0.02\%/^{\circ}\text{C}$ typ. (Input/ output rating, for the regulation of operating temp. range -40°C to +50°C)
Ripple & Noise	Refer to table 1 (Input/ output rating, normal temperature and Bw=20MHz)
Efficiency	87%typ. (Input/ output rating, normal temperature. Refer to table 1)
Turn-On Transient	0.4ms typ. (Resistance load)
Max. Output Capacitance	2200 μ F max.
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type. Avoid long time short-circuit condition.
Over-Voltage Protection	None
Under Voltage Lock Out	Available
Remote On/ Off Control	Between 9pin (ON/ OFF) and -5, 8pin (GND): output goes ON when in open, output goes OFF when in short
Standby Current	0.1mA typ.
P-Good Signal	At normal output: high, at output decrease: low, (This terminal is open-drain.)
Remote Sensing	Available
Operating Temp. Range	-40°C to +85°C (Refer to thermal derating graph)
Storage Temp. Range	-40°C to +85°C
Humidity Range	20%-95% R.H. max. (Max. wet-bulb temp. 35°C, non-condensing)
Storage Condition	For the converter before being mounted, store at 30°C/60% R.H. or below
Cooling Condition	Refer to thermal derating graph
Vibration	5-10Hz All amplitude 10mm, 10-55Hz acceleration 2G (1 hour in each of 3 orthogonal axes)
Shock	Acceleration 20G (3 directions, 3 times each, total : 18 times), Shocking time 11 \pm 5ms
Weight	3.1g typ.
Outline	SMD type L=27.0 W=16.5 H=4.2 typ. (mm) (For detail dimensions refer to the outline on page 5)

* The above specification is provided with rating value, unless otherwise specified

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1. Application range

This specifications is applied to the direct current input and non-isolated type DC/DC converter, [BSV-1.5S12R0H](#).

2. Models and ratings

Models	rated input voltage	rated output	Package type	note
BSV-1.5S12R0H	DC5.0V	1.5V, 12.0A	SMD	

When the condition is not decribed in this specifications, it will be that the input is the rated input and the output is the rated output and the ambient temperature is 25 ± 5 .

3. Environmental condition

3-1. Temperature range

At operating -40 ~+85 (Load derating from 55 is required, only when mounting on a both sided PCB of 100 X 100mm and thickness 1.6mm.)
 At storage -40 ~+85

3-2. Humidity range

At operating 20 ~ 95%RH (Maximum wet-bulb temperature is 35 , and not dew condensation.)
 At storage The same as above

Note). Before mounting, please keep the product under 30 /60% RH.

4. Specification and Standard

This product is a lead free products.

4-1. Input characteristic

Item	Specification and standard	terms
Input voltage	+3.0 ~ 5.5V (Ratings : 5.0V)	
Input current	4.14A typ.	At rated input and rated output
Stanby current	0.1mA typ.	Vin=5.0V, Short between On/Off Pin - GND Pin

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4-2. Output characteristic and attached function

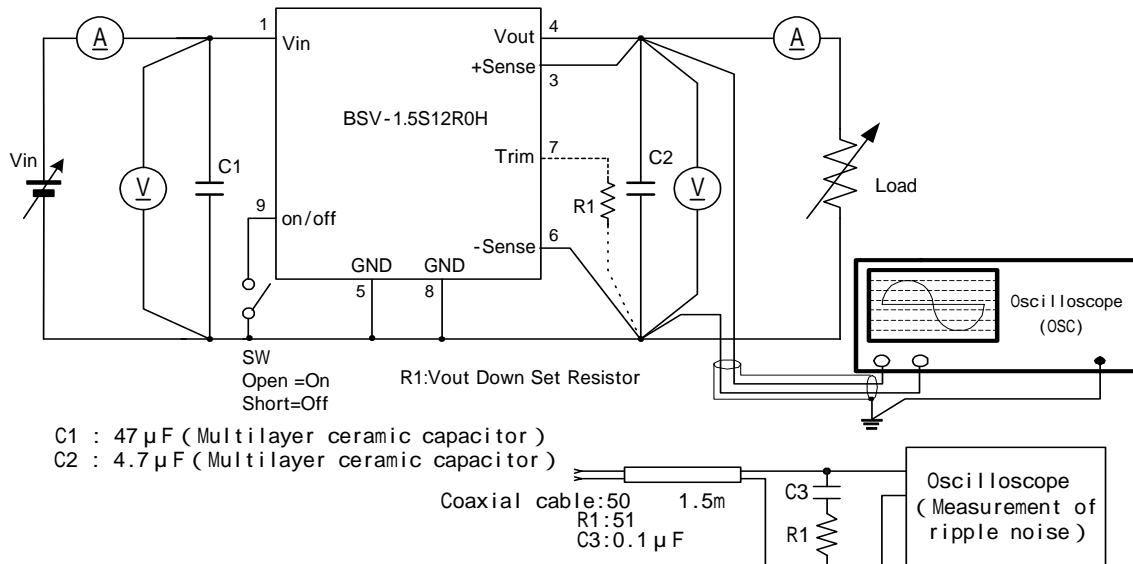
Item	Specification and standard	terms
Output voltage	1.5V	
Output voltage set accuracy	1.5V \pm 1.0% (\pm 0.015V)	
Adjustable Output Voltage Range	0.6V ~ 1.5V	Depending on external resistance
Output current	0 ~ 12A	Derating required
Line Regulation	0.5% typ. (1.0% max)	For regulation of 3.0 - 5.5V input
Load Regulation	0.5% typ. (1.0% max)	For regulation of 0 - 12A load
Temperature Coefficient	\pm 0.02%/ typ.	For coefficient of -40 to +50
Efficiency	87% typ.	
Ripple & Noise	30mVp-p typ. 100mVp-p max.	Bw=20MHz
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type.	Avoid long time short-circuit condition.
Over-voltage Protection	None	
Under Voltage Lock Out	Available Start up voltage : 2.8V \pm 0.2V Shut down voltage : 2.7V \pm 0.2V	Starting up at 3V or more
ON/OFF control	Open or High (2V or more) - ON. Short or Low (0.8V or less) - OFF	
P-Good low level voltage	0.4V max	Sink current : 14mA max
Turn-On Transient	0.4ms typ.	Resistance load
Max. Output Capacitance	2200 μ F max	

Note 1) With the measurement circuit of 4-3.

Note 2) Measured by the following conditions without any notice;

Input voltage : 5V, Output voltage : 1.5V, Output Current : 12A, (Resistance load), Ambient temperature : 25 \pm 5 .

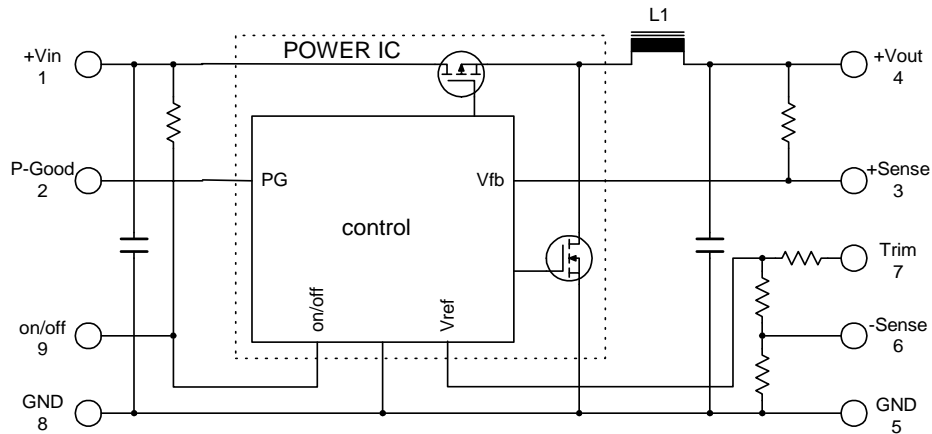
4-3. Measurement circuit



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5. Block Diagram



6. Thermal Derating

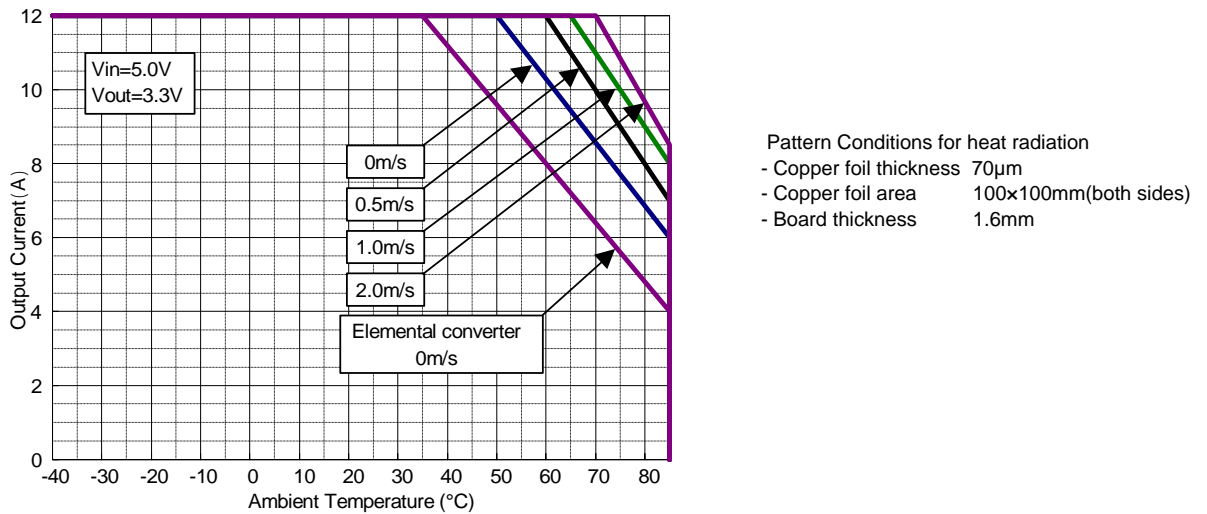
Set this product in a place where good convection is ensured. And also be sure to mount on a board, when using.

This product has been designed to radiate by utilizing the mounted board. So make the line to connect to the converter as wide as possible.

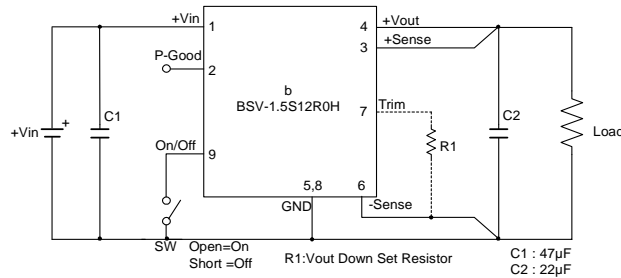
The radiation from GND is especially big, so make the GND line wide.

The derating curve below is a data when mounted on a double-side board of copper foil thickness 70 μ m, copper foil area 100 \times 100mm (both sides) and thickness of the board 1.6mm. The radiation characteristics will change depending on the wiring, so please refer to the data.

The thermal characteristics for this converter will be largely influenced by the mounted board and the ambient condition. For this reason, finally mount the converter into the device that will be actually mounted. And when it is operated at the maximum ambient temperature of the equipment, be sure that the temperature of the board surface does not exceed 100 $^{\circ}$ C.



8. Standard Connection Circuit Diagram



Note 1) It is a prerequisite for this product to be mounted onto a board, thereby heat radiation is done.

70% or more of the heat radiation is done from the GND pin (5, 8pin) and the rest is done from the +Vin pin and +Vout pin.

Take space of the pattern as much as possible and design the board to make radiation easy. (Please use that surface temperature of converter's PCB will not exceed 100 °C.)

Note 2) When not using the ON/ OFF control, keep the On/ Off pin open.

Note 3) P-Good pin is an open drain output. When using the P-Good function, pull up the P-Good to the input voltage using the resistance.

Note 4) When not adjusting the output, keep the trim pin open.

Note 5) GND pin (5, 8pin) is connect inside, however to secure the performance, use it with the 2 pins connected to the GND line.

Note 6) Be sure to connect the sense pin and output pin on the board. Unless the sense pin is connected, there is a possibility that a higher voltage than the rating voltage may be output.

Note 7) Do not wire a pattern right under the converter (first layer). For other layers wiring a pattern will be no problem.

Recommended Capacitor

C1=47µF

C2=2.2µF~200µF

C1: It is unnecessary if impedance of the power supply on the input side is low enough and the power supply on input side is connected by the enough thick and short line, however, it is necessary if the impedance is high.

Use ones with low ESR such as organic semiconductor solid capacitor, multilayer ceramic capacitor.

C2: The converter will operate without C2 because the output capacitor has built in, however, it is necessary to satisfy with the electric characteristic (Ripple Noise). The connecting to the load side will make noise decrease.

Use a multilayer ceramic capacitor.

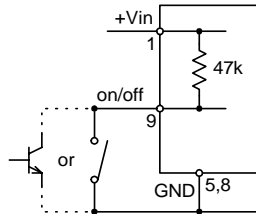
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8-2. ON/ OFF Control

By using the ON/ OFF control function, ON/ OFF of the output without connecting and disconnecting the input can be controlled. ON/OFF Pin (9pin) has been connected with +Vin terminal internally by the resistance of 47k. When not using the ON/ OFF control, keep the ON/ OFF pin open.

Between ON/ OFF pin (9pin) and GND (8pin)
 Open : Output=ON
 Short (0-0.8V 0.2mA max.) : Output=OFF



8-3. Adjusting Output Voltage

When using at 1.5V without adjusting output voltage, keep Trim pin (7pin) open. By connecting a resistor between Trim pin (7pin) and -Sense pin, the output voltage can be adjusted within the range of 0.6-1.5V. Connect -Sense pin to GND (5pin)

When adjusting the output voltage, place the Rx close to the converter and make the wiring of Rx as short as possible. If the Trim pin catches noise, malfunction may occur.

To calculate the external resistance, please refer to the equation below. After calculating the external resistance, please check the output voltage and adjust the resistance value.

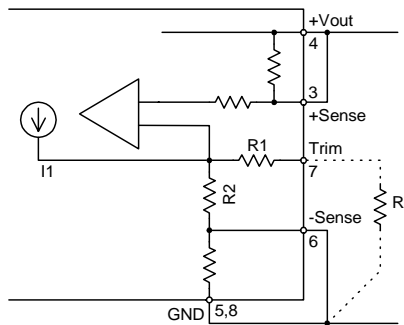
To set within the range of 0.6V-1.5V

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

R1=24k ohm, R2=52.6k ohm, I1=0.0286mA, Vout=Requested output voltage (V)

Ex.)

Desired Output Voltage Vout(V)	Rx Calculated value (k ohm)
1.5	Open
1.2	183.39
1.0	80.29
0.8	35.74
0.6	10.90



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8-4. Sensing function

An excellent load regulation characteristic can be obtained by using the sensing function on the load side. Enough attention is required for wiring because the sensing line is a part of the feedback loop, and it is very sensitive. Please wire +Sense and -Sense close together to the load.

Please connect the +Vout Pin and +Sense Pin, -Vout Pin and -Sense Pin respectively on the PCB when not using the sensing function.

8-5. P-Good Function

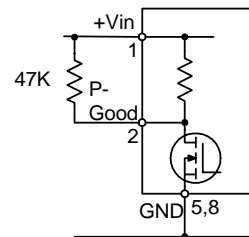
By utilizing this P-Good pin, the output condition of the converter can be obtained. This terminal is open-drain. If using P-Good function, please use P-Good terminal connecting the resistor outside and pulling-up to the input voltage.

It will be open by

$|\text{Output voltage} - \text{Set voltage}| \geq 0.2\text{V typ.}$

However, under the conditions written below, even if the output voltage is within this range, it may become low.

- When the input voltage is below 3V
- When the output current is at over-current state.
- When the IC temperature is above 100°C



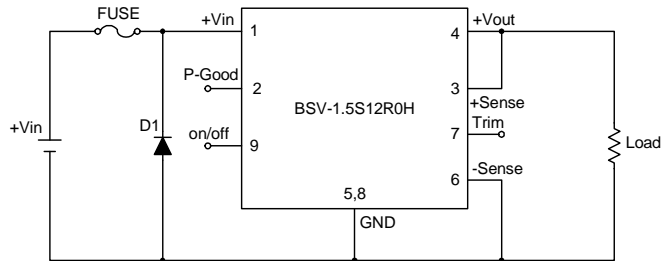
High-Speed Response, Output Set Accuracy $\pm 1\%$ POL DC-DC Converter **BSV-H Series**

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9. To prevent reverse input voltage protection (Ex.)

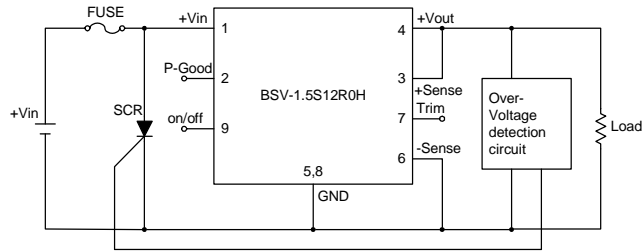
This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).
If the input voltage reversed is connected by mistake, it will be damaged.

If there is a possibility of reverse connection, please add a protection as shown in the right figure. The right figure is an example using fuse and diode.



10. Over-Voltage Protection Diagram (Ex.)

This product does not have a built-in over-voltage protection. If the switching element in this converter is damaged in short mode, DC input voltage will go out as output. To avoid damage at over-voltage mode, in advance, please add the input interrupting circuit as the right figure.



- Note 1. When it is damaged at over-voltage mode, ON/ OFF control will not operate.
- Note 2. When having ON/ OFF function on the supplying power side, this circuit can be used.
- Note 3. Be sure that the DC power supply on the supplying side has the capacity to cut the fuse.

11. Soldering Conditions

Please conduct by the condition as below regarding the soldering temperature and time and storage before mounting,

11-1. Reflow method

Pre-heating temp.: 150-180°C, within 60 sec max. (Refer to the figure below)

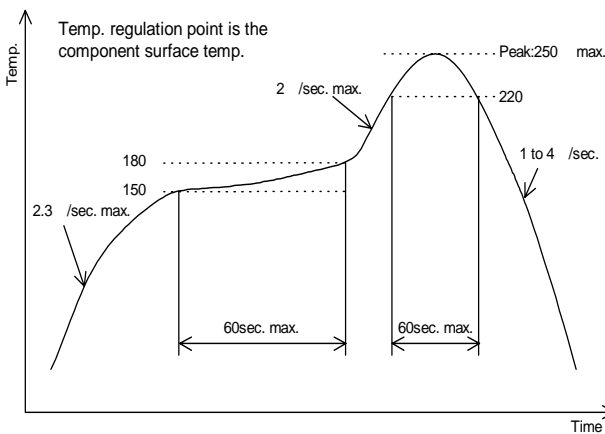
Peak heating temp.: 250°C max.

220°C or more, within 60 sec max.

Reflow: twice

Note 1. Do not give shock at reflow because components which compose the converter may move.

Note 2. After mounting the converter on PCB, please do not reflow again turning the PCB over.



11-2. About storage before being mounted

Storage conditions before being mounted should be 30°C/ 60% RH or below.

After mounting, it depends on the environmental condition.

12. Vibration and shock test

Vibration : 5~10 Hz All amplitudes 10mm, 10~55Hz Acceleration 2G (Three direction, for one hour each)

Shock : Acceleration 20G (Three direction, three times each)

Shocking time 11 \pm 5ms

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13. Cleaning Conditions

This product can not be washed whole. No-clean solder paste is recommended for this product.

14. Precautions

For customer's safety, when using this product, please refer to the specification and please use keeping the following precautions surely.

- This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipments). Can not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product. Be sure to contact our sales when using in besides general use.
- For this product parallel and series operation are not possible.
- For mounting this product, please do not use connector of socket. The performance may not be fulfilled due to the effect of contacting resistor. Mount to print board by soldering.
- This product has a built-in over-current, short protection, but long time short circuit will cause failure, so please avoid it.
- There is possibility of damage when used under electric conditions and environmental conditions such as temperature that are out of the standards. Be sure to be use within the standards.
- There is possibility of damage by static. When the worker has electrified static, electrical discharge should be done and the working on the table so grounded may be recommended.
- Do not store in a place where corrodible gas may be generated or a dusty place.
- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to fuse the fuse.
- This product does not have a built-in over-voltage protection. When over-voltage occurs due to the abnormality in the module, there is a mode that input voltage comes out at it is, and may cause smoke and ignition. To preven this, be sure to add over-voltage protection.
- No test result certificate attached to this product.

15. Guarantee

The guaranteed term of this product is one year. When occuring any failure mode by the cause of our design and production in this guarabteed term, we will repair the failure product or replace to the good product by free of charge.

However, when being remodeled inside etc., we shall not guarantee it.

The range of the guarantee for this product is the one of this products concerned.

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Bellnix Co., Ltd.

5-7-8 Negishi Minami-ku Saitama-shi, Saitama Japan 336-0024

Tel: +81-48-864-7733 Fax: +81-48-861-6402

E-mail: info@bellnix.co.jp

URL <http://www.bellnix.co.jp/>

All specifications are subject to change without notice.

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The Fifth Generation, Ultra Small Size, Isolated DC-DC Converter

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BSV-H22A Series

BSV-H series is a small size(23.0x27.0x4mm size) and light weight(4.0g) step-down DC-DC converter, which has achieved 22A. Since it can correspond from ultra low output voltage of 0.6V, and set accuracy of output voltage is under $\pm 1\%$, it can be used for the latest DSP, ASIC and FPGA applications. Due to high efficiency and high-speed response by synchronous rectification circuit technology, saving space by no external components, and with SMD package etc. an excellent performance beyond our common sense has been achieved.

<Features>

- | | |
|---|---|
| <ul style="list-style-type: none"> -Ultra Small Size 23x27mm -Low Profile 4.0mm -High-Speed Load Response -Output Voltage Accuracy $\pm 1\%$ -Ultra High Efficiency -Built in Over-Current Protection -Under Voltage Lock Out -Remote ON/OFF Control | <ul style="list-style-type: none"> -Adjustable Output Voltage -Surface Mount Package (SMD) -External Capacitors not required -Heat Sink not required -Non-Isolated Type -Operating Temp. Range -40°C to $+85^{\circ}\text{C}$
(Temp. Derating required) -RoHS Compliance |
|---|---|



<Model / Rating>

Table 1

Model	Input V Vdc	Output V Vdc	Output I A	Output ADJ Vdc	Noise mVpp(typ.)	Efficiency %(typ.)
BSV-1.5S22R0H	3.0 to 5.5	1.5	0 to 22	0.6 to 1.5	30	87

Note1 : The value of ripple and noise and efficiency is the one at input voltage (5V) and rating load.

Note2 : Measurements of ripple noise is performed at BW=20MHz, with an additional multilayer ceramic capacitor of 47 μF to the input and 22 μF to the output.

Note3 : Depending on the ambient air temperature conditions, air flow is required.

<Specification>

Table2

Rating Input Voltage/ Range	Refer to Table 1
Rating Output Voltage	+1.5V $\pm 1\%$ (Trim Pin at open)
Adjustable Output Voltage Range	0.6~1.5V
Line Regulation	0.5% typ. (Rating output, for the regulation of input voltage range on table 1)
Load Regulation	0.5% typ. (Rating input/output voltage, for the regulation of load 0-100%)
Temperature Coefficient	$\pm 0.02\%/^{\circ}\text{C}$ typ. (Input/output rating, for the regulation of operating temp. range -40°C to $+50^{\circ}\text{C}$)
Ripple Noise	Refer to Table 1 (Input/output rating, normal temperature and Bw=20MHz)
Efficiency	87% typ. (Input/output rating, normal temperature. Refer to table 1)
Turn-On Transient	0.5ms typ. (Resistance load)
Max. Output Capacitance	4700 μF max.
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type. Avoid long time short-circuit condition.
Over-Voltage Protection	None
Under Voltage Lock Out	Available
Remote On/Off Control	Between 10pin (ON/OFF) and -6, 9pin (GND): output goes ON when in open, output goes OFF when in short
Standby Current	0.2mA typ.
P-Good Signal	At normal output: high, at output decrease: low, (This terminal is open-drain.)
Remote Sensing	Available
Operating Temp. Range	-40°C to $+85^{\circ}\text{C}$ (Refer to thermal derating graph)
Storage Temp. Range	-40°C to $+85^{\circ}\text{C}$
Humidity Range	20%-95%R.H. max. (Max. wet bulb 35°C , non-condensing)
Storage Condition	For the converter before being mounted, store at $30^{\circ}\text{C}/60\%$ R.H. or below
Cooling Condition	Refer to thermal derating graph
Vibration	5-10Hz All amplitude 10mm, 10-55Hz acceleration 2G (1 hour in each of 3 orthogonal axes)
Shock	Acceleration 20G (3 directions, 3 times each, total : 18 times), Shocking time $11\pm 5\text{ms}$
Weight	4.0g typ.
Outline	SMD type W=23.0 L=27.0 H=4.0 typ. (mm) (For detail dimensions refer to the outline)

*The above specification is provided with rating value, unless otherwise specified

The Fifth Generation, Ultra Small Size, Isolated DC-DC Converter

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BSV-H22A Series

1- Application Range

This specifications is applied to the direct current input and non-isolated type DC/DC converter, BSV-1.5S22R0H.

2- Model and rating

Model	Rating Input Voltage	Rating Output	Package type	Note
BSV-1.5S22R0H	DC5.0V	1.5V, 22.0A	SMD	

When the condition is not described in this specifications, it will be that the input is the rated input and the rated output and the ambient temperature is 25°C±5°C

3- Environmental Condition

3-1 Temperature range

At Operating : -40°C to +85°C (Load derating from 55°C is required, only when mounting on a both sided PCB of 100 X 100mm and thickness 1.6mm.)

At Storage : -40°C to 85°C

3-2 Humidity Range

At Operating : 20~95%RH (Maximum wet bulb temperature is 35°C, and not dew condensation.)

At Storage : The same as above

Note). Before mounting, it is different from the above mentioned condition.

Please refer to the section of "Mounting condition" for details.

4. Specification and Standard

This product is a lead free products.

4-1. Input characteristic

Item	Specification and Standard	Terms
Input voltage	+3.0 to 5.5V (Ratings : 5.0V)	
Input current	7.60A typ.	At rating input and rating output
Stanby current	0.2mA typ.	Vin=5.0V, Short between On/Off Pin – GND Pin

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BSV-H22A Series

4-2 Output characteristic and attached function

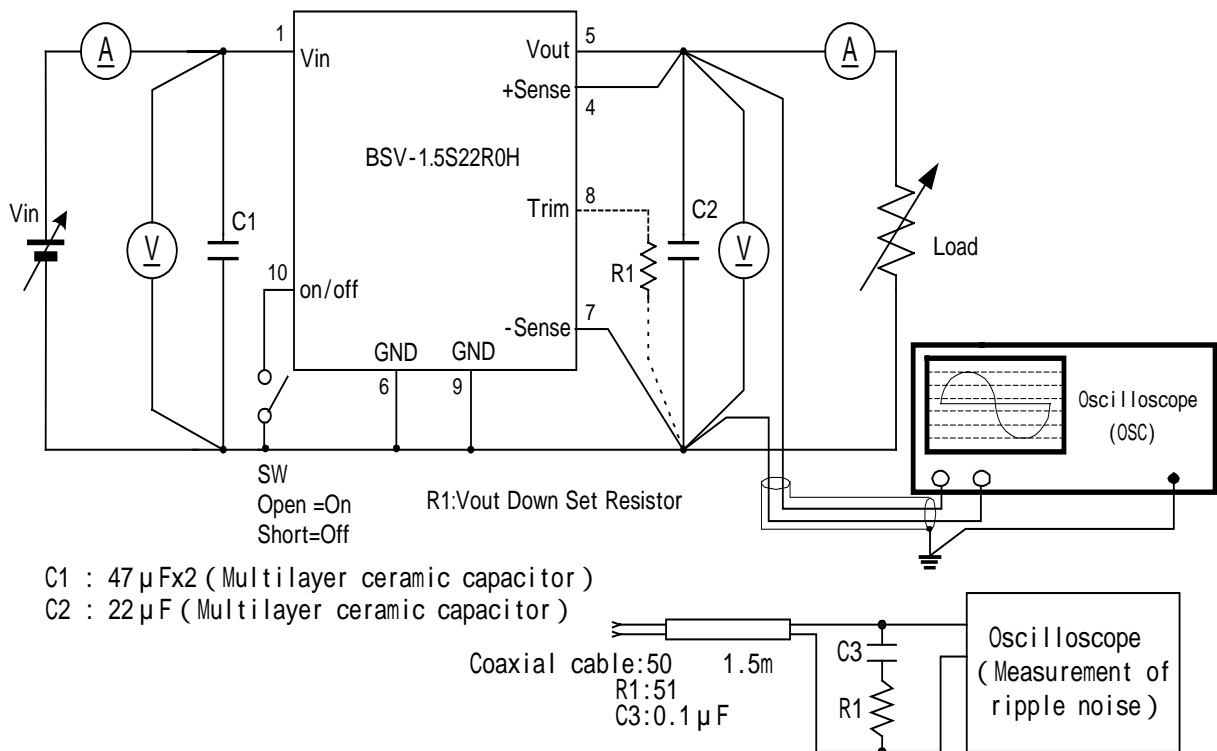
Item	Specification and standard	Terms
Output voltage	1.5V	
Output voltage set accuracy	1.5V±1.0% (±0.015V)	
Adjustable Output Voltage Range	0.6V to 1.5V	Depending on external resistance
Output current	0 to 22A	Derating required
Line Regulation	0.5% typ. (1.0% max)	For regulation of 3.0 to 5.5V input
Load Regulation	0.5% typ. (1.0% max)	For regulation of 0 to 22A load
Temperature Coefficient	±0.02%/°C typ.	For coefficient of -40 to +35°C
Efficiency	87% typ.	
Ripple Noise	30mVp-p typ. 100mVp-p max.	Bw=20MHz
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type.	Starts and it returns by 50% of ratings the load when the start and O.C. are released.
Over-Voltage Protection	None	
Under Voltage Lock Out	Available Start up voltage : 2.8V±0.2V Shut down voltage : 2.7V±0.2V	Starting up at 3V or more
ON/OFF Control	Open or High (2V or more) – ON Short or Low (0.8V or less) – Off	
P-Good low level voltage	0.4V max	Sink current : 14mA max
Turn-On Transient	0.5ms typ.	Resistance load
Max. Output Capacitance	4700 μF max	

Note 1) With the measurement circuit of 4-3.

Note 2) Measured by the following conditions without any notice ;

Input voltage : 5V, Output voltage : 1.5V, Output Current : 22A, (Resistance load), Ambient temperature : 25°C±5°C

4-3 Measurement Circuit

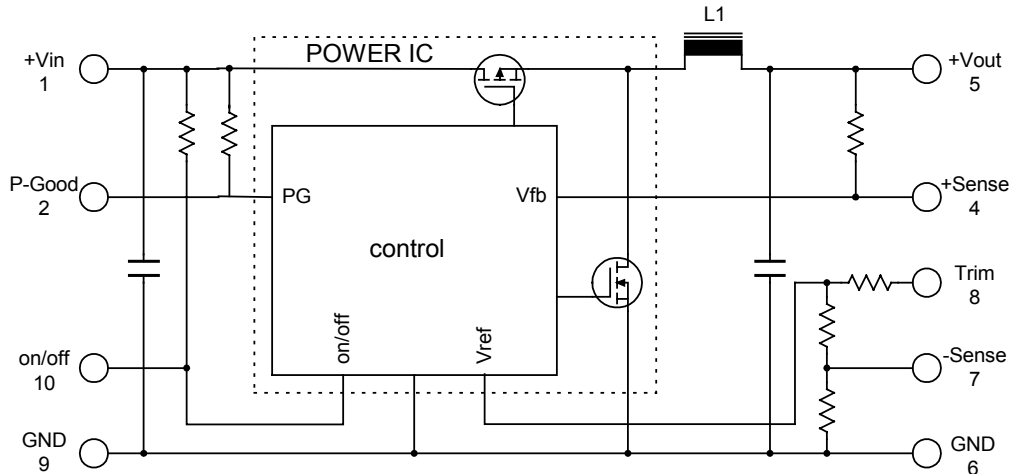


The Fifth Generation, Ultra Small Size, Isolated DC-DC Converter

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BSV-H22A Series

5. Block Diagram

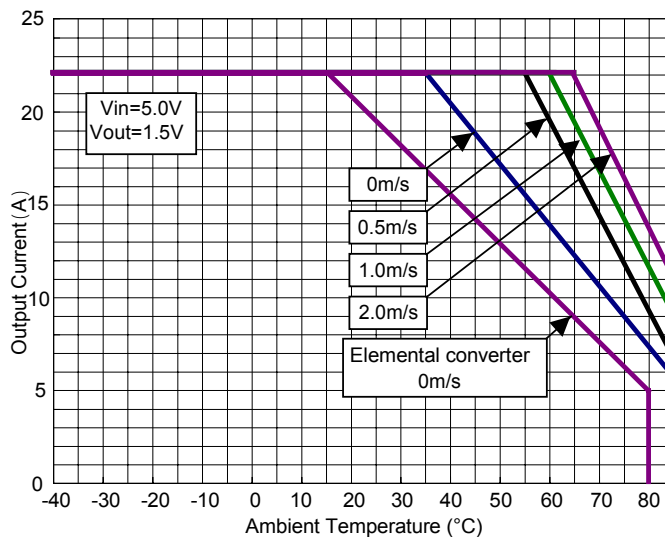


6. Thermal Derating

Set this products in a place where good convection is ensured. And also be sure to mount on a board, when using. This product has been designed to radiate by utilizing the mounted board. So make the line to connect to the converter as wide as possible. The radiation from GND is especially big, so make the GND line wide.

The derating curve below is a data when mounted on a double-side board of copper foil thickness 35 μm , copper foil area 100x100mm (both sides) and thickness of the board 1.6mm. The radiation characteristics will change depending on the wiring, so please refer to the data.

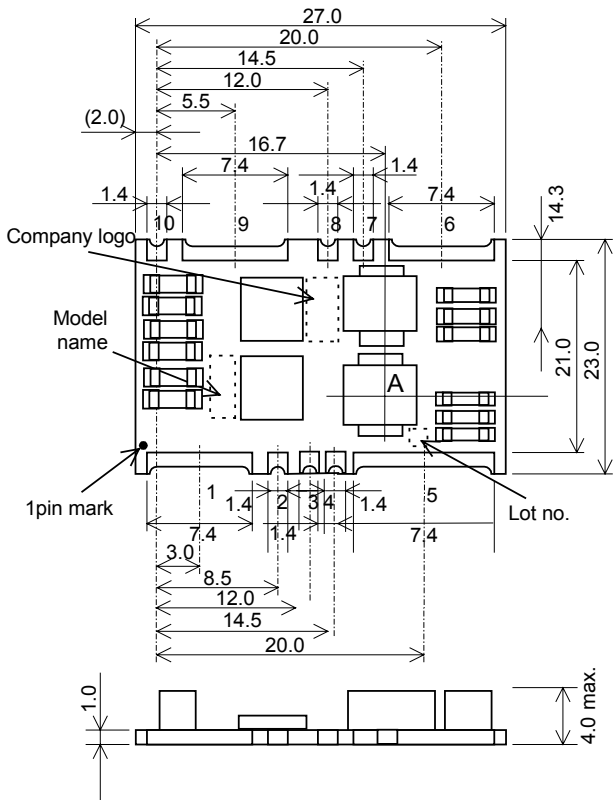
The thermal characteristics for this converter will be largely influenced by the mounted board and the ambient condition. For this reason, finally mount the converter into the device that will be actually mounted. And when it is operated at the maximum ambient temperature of the equipment, be sure that the temperature of the board surface does not exceed 100°C.



Copper foil area 100 x 100mm The derating curve of substrate is mounted

7. Outline and Pin Function

7-1. Shape, Outline and Package (SMD type)



Pi	Function
1	+Vin
2	P-Good
3	NC
4	+Sense
5	+Vout
6	GND
7	-Sense
8	Trim
9	GND
10	On/Off

- Dimensions : mm
- Tolerances unless otherwise specified : ± 0.5
- Weight = 4.0G typ
- The adsorption position uses left chart A point
- It displays "V1.5S22" to the model display to the product
- Lot No. is filled in on 5 pin side.

Mark :

End of A.D.

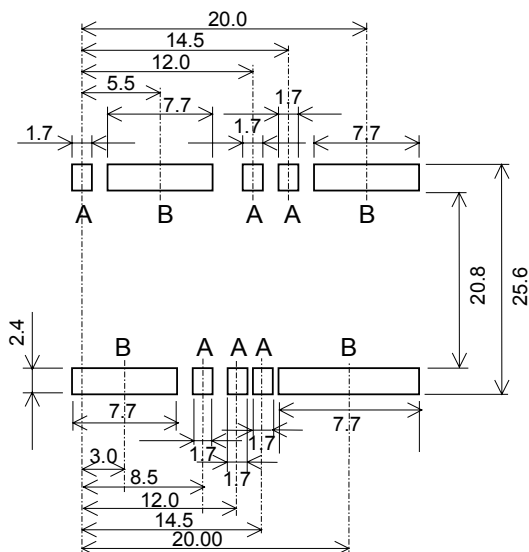
The manufacturing months (10,11,12,months is O, N, D)

Lot of the months (The first lot is filled in nothing.)

- Flapping of pin 0.2mm max (Floatage of pin when putting it on a horizontal plane)

Note) Be sure to pick up at point A shown in the outline when mounting by an automated machine. Avoid pick up at the component(IC) placed in the center of the board.

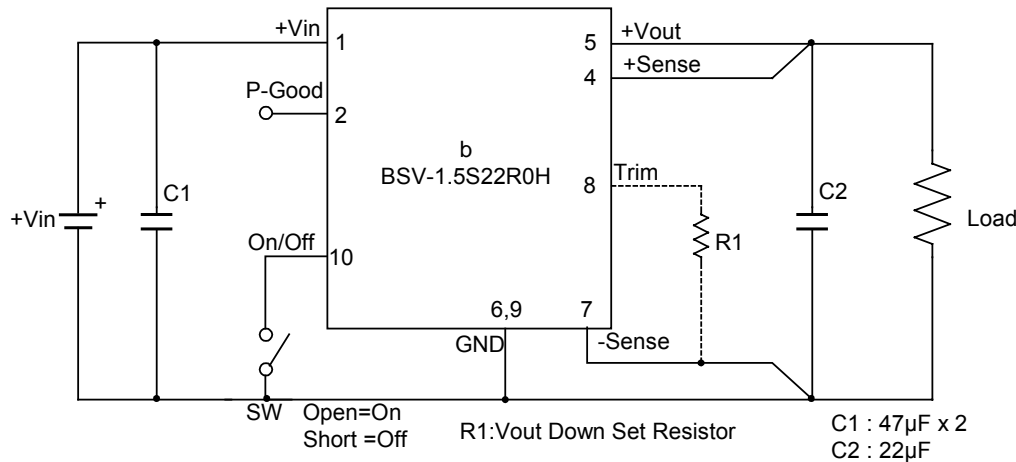
7-2. Recommended Pad Layout



Note) Do not wire a pattern right under the converter (first layer). Since this converter has adopted a normal through-hole board, if there is a pinhole in the resist, it may become a problem.

8. Standard Connection Circuit Diagram

8-1. Standard connection circuit



- Note 1) It is a prerequisite for this product to be mounted onto a board, thereby heat relation is done. 70% or more of the heat radiation is done from the GND pin(6, 9pin) and the rest is done from the +Vin pin and +Vout pin. Take space of the pattern as much as possible and design the board to make radiation easy. (Please use that surface temperature of converter's PCB will not exceed 100°C.)
- Note 2) The third pin is check pin when it manufactures. Please install land for the converter fixation and fix on the board. Please do not connect this land with the GND line or +Vin line, etc.
- Note 3) When not using the On/Off control, keep the On/Off pin open.
- Note 4) When not adjusting the output, keep the trim pin open.
- Note 5) GND pin (6, 9pin) is connect inside, however to secure the performance, use it with the 2 pins connected to the GND line.
- Note 6) Be sure to connect the sense pin and output pin on the board. Unless the sense pin is connected, there is a possibility that a higher voltage than the rating voltage may be output.
- Note 7) Do not wire a pattern right under the converter (first layer). For other layers wiring a pattern will be no problem.

Recommended Capacitor

C1=47 µ F x 2

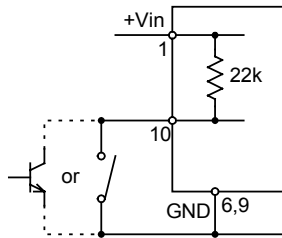
C2=2.2 µ F ~200 µ F

- C1 : It is unnecessary if impedance of the power supply on the input side is low enough and the power supply on input side is connected by the enough thick and short line, however, it is necessary if the impedance is high. Use ones with low ESR such as organic semiconductor solid capacitor, multilayer ceramic capacitor.
- C2 : The converter will operate without C2 because the output capacitor has built in, however, it is necessary to satisfy with the electric characteristic (Ripple Noise). The connecting to the load side will make noise decrease. Use a multilayer ceramic capacitor.

8-2. ON/OFF Control

By using the ON/OFF control function, ON/OFF of the output without connecting and disconnecting the input can be controlled. ON/OFF Pin (9pin) has been connected with +Vin terminal internally by the resistance of 22k . When not using the ON/OFF control, keep the ON/OFF pin open.

Between ON/OFF pin (10pin) and GND (9pin)
 Open : Output=ON
 Short (0 to 0.8V 0.3mA max.) : Output=OFF



8-3. Adjusting Output Voltage

When using at 1.5V without adjusting output voltage, keep Trim pin (8pin) open. By connecting a resistor between Trim (8pin) and -Sense pin (7pin), the output voltage can be adjusted within the range of 0.6-1.5V. Connect -Sense pin to GND (6pin). When adjusting the output voltage, place the Rx close to the converter and make the wiring of Rx as short as possible. If the Trim pin catches noise, malfunction may occur. To calculate the external resistance, please refer to the equation below. After calculating the external resistance, please check the output voltage and adjust the resistance value.

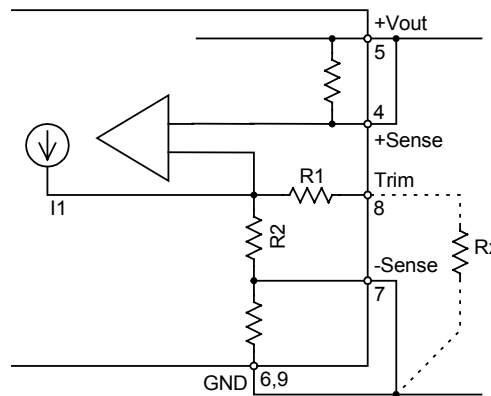
To set within the range of 0.6V-1.5V

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

R1=24k ohm, R2=52.6k ohm, I1=0.0286mA, Vout=Requested output voltage (V)

Ex.)

Desired Output Voltage Vout (V)	Rx Calculated Value (k ohm)
1.5	Open
1.2	183.39
1.0	80.29
0.8	35.74
0.6	10.90



8-4. Sensing function

An excellent load regulation characteristic can be obtained by using the sensing function on the load side. Enough attention is required for wiring because the sensing line is a part of the feedback loop, and it is very sensitive. Please wire +Sense and –Sense close together to the load.

Please connect the +Vout Pin and +Sense Pin, -Vout Pin and –Sense Pin respectively on the PCB when not using the sensing function.

8-5. P-Good Function

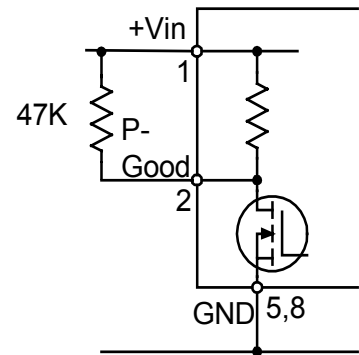
By utilizing this P-Good pin, the output condition of the converter can be obtained. This terminal is open-drain. If using P-Good function, please use P-Good terminal connecting the resistor outside and pulling-up to the input voltage.

It will be open by

|Output voltage-Set voltage| 0.2V typ.

However, under the conditions written below, even if the output voltage is within this range, it may become low.

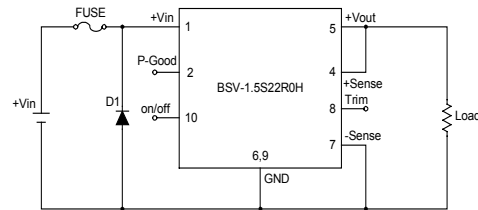
- When the input voltage is below 3V
- When the output current is at over-current state.
- When the IC temperature is above 100°C



9. To prevent reverse input voltage protection(Ex.)

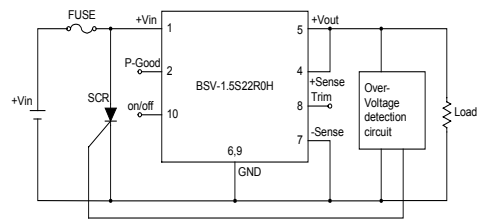
This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).
If the input voltage reversed is connected by mistake, it will be damaged.

If there is a possibility of reverse connection, please add a protection as shown in the right figure. The right figure is an example using fuse and diode.



10. Over-Voltage Protection Diagram (Ex.)

This product does not have a built-in over-voltage protection. If the switching element in this converter is damaged in short mode, DC input voltage will go out as output. To avoid damage at over-voltage mode, in advance, please add the input interrupting circuit as the right figure.



- Note 1. When it is damaged at over-voltage mode, ON/OFF control will not operate.
- Note 2. When having ON/OFF function on the supplying power side, this circuit can be used.
- Note 3. Be sure that the DC power supply on the supplying side has the capacity to cut the fuse.

11. Soldering Conditions

Please conduct by the condition as below regarding the soldering temperature and time and storage before mounting.

11-1. Reflow method

Pre-heating temp.: 150-180°C, within 60 sec max. (Refer to the figure below)

Peak heading temp.: 250°C max.

220°C or more, within 60 sec max.

Reflow: twice

Note 1. Do not give shock at reflow because components which compose the converter may move.

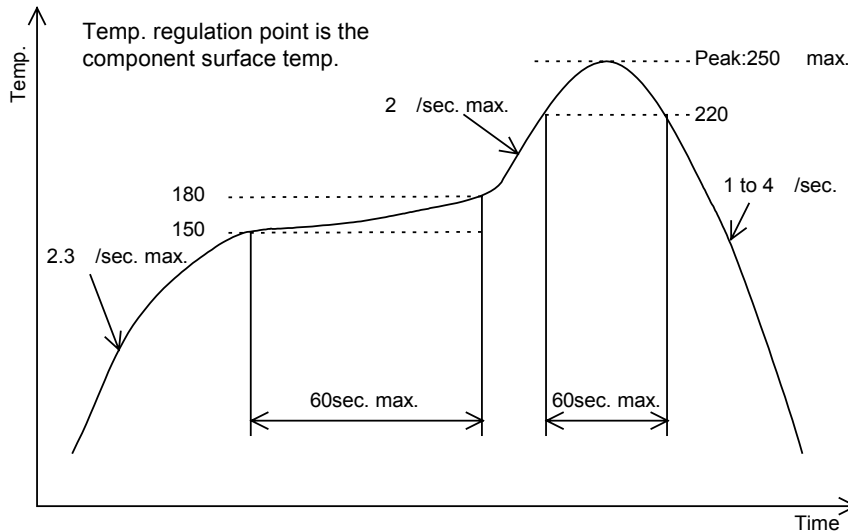
Note 2. After mounting the converter on PCB, please do not reflow again turning the PCB over.

Note 3. This converter cannot be soldered by flow.

11-2. About storage before being mounted

When you open dry packing, storage conditions before being mounted should be 30°C/60% RH or below. Moreover, baking (125°C±5°C, 12H) is needed before the reflow when it is one year while dry packed and dry packing is opened with 30°C/60% RH above 168 hours.

After mounting, it depends on the environmental condition.



12. Vibration and shock test

Vibration : 5~10 Hz All amplitudes 10mm, 10~55Hz Acceleration 2G (Three direction, for one hour each)

Shock : Acceleration 20G (Three direction, three times each)

Shocking time 11±5ms

13. Cleaning Conditions

This product can not be washed whole. No-clean solder paste is recommended for this product.

14. Precautions

For customer's safety, when using this product, please refer to the specification and please use keeping the following precautions surely.

- This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipment).
Can not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product.
Be sure to contact our sales when using in besides general use.
- For this product parallel and series operation are not possible.
- For mounting this product, please do not use connector of socket. The performance may not be fulfilled due to the effect of contacting resistor.
Mount to print board by soldering.
- This product has a built-in over-current, short protection, but long time short circuit will cause failure, so please avoid it.
- There is possibility of damage when used under electric conditions and environmental conditions such as temperature that are out of the standards.
Be sure to be use within the standards.
- Do not store in a place where corrodible gas may be generated or a dusty place.
- There is possibility of damage by static. When the worker has electrified static, electrical discharge should be done and the working on the table so grounded may be recommended.
- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to fuse the fuse.
- This product does not have a built-in over-voltage protection. When over-voltage occurs due to the abnormality in the module, there is a mode that input voltage comes out at it is, and may cause smoke and ignition. To prevent this, be sure to add over-voltage protection.
- No test result certificate attached to this product.

15. Guarantee

The guaranteed term of this product is one year. When occurring any failure mode by the cause of our design and production in this guaranteed term, we will repair the failure product or replace to the good product by free of charge.

However, when being remodeled inside etc., we shall not guarantee it.

The range of the guarantee for this product is the one of this products concerned.

Ultra High Efficiency 93%

High-Speed Response, Step-Down DC-DC Converter

Bellnix[®] BSV-H Series

BSV-H series is a small size (27.0x16.5x4.2mm size) and light weight (3.1g) step-down converter, which has achieved 39.6W. Since it can correspond from ultra low output voltage of 0.8V, it can be used for the latest DSP, ASIC applications. Due to high efficiency and high-speed response by synchronous rectification circuit technology, saving space by no external components, and with SMD package etc. an excellent performance beyond our common sense has been achieved.

<Features>

- Ultra Small Size 16.5x27mm
- Low Profile 4.2mm
- High-Speed Load Response
- Ultra High Efficiency
- Over-Current Protection
- External Capacitors not required
- Heat Sink not required
- RoHS Compliance
- Non-Isolated Type
- Under Voltage Lock Out
- Remote ON/ OFF Control
- Adjustable Output Voltage
- Surface Mount Package (SMD)
- Operating Temp. Range -40°C to +85°C (Temp. Derating required)



<Model/ Rating>

Table 1

Model	Rating Input Voltage	Input Voltage Range	Rating Output Voltage	Output Current	Output Voltage Adjustable Range	Ripple/ Noise	Efficiency	Package
	Vdc	Vdc	Vdc	A	Vdc	mVpp (typ)	% (typ)	type
BSV-3.3S12R0H	5.0	3.0-5.5	3.3	0-12	0.8-3.3	30	93	SMD

Note 1: The input and output voltage difference needs to be 0.5V or more. $V_{in}(V)-V_{o}(V) \geq 0.5V$

Note 2: Measurements of ripple noise is performed at BW=20MHz, with an additional multilayer ceramic capacitor of 47μF to the input and 4.7μF to the output.

Note 3: Depending on the ambient air temperature conditions, air flow is required.

<Specification>

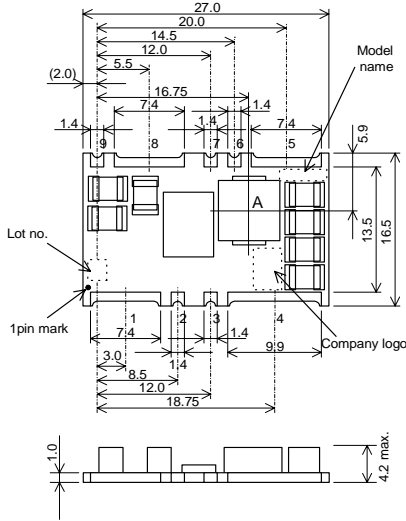
Table 2

Rating Input Voltage/ Range	Refer to Table 1
Rating Output Voltage	+3.3V (Trim Pin at open)
Output Voltage Setting Accuracy	3.3V±3% (±0.099V)
Adjustable Output Voltage Range	Refer to Table 1
Line Regulation	0.5% typ. (Rating output, for the regulation of input voltage range 3.8-5.5V)
Load Regulation	1.0% typ. (Rating input/ output voltage, for the regulation of load 0-12A)
Temperature Coefficient	±0.02%/°C typ. (Input/ output rating, for the regulation of operating temp. range -40°C to +55°C)
Ripple & Noise	30mVp-p typ. (Input/ output rating, Bw=20MHz)
Efficiency	93% (Input/ output rating, ambient temp. 25°C ±5°C. Refer to table 1)
Turn-On Transient	0.3ms typ. (Resistance load)
Max. Output Capacitance	2200μF max.
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type. Avoid long time short-circuit condition.
Over-Voltage Protection	None
Standby Current	1mA typ. (Vin=5V, short between ON/ OFF pin and GND pin.)
Remote On/ Off Control	Between 9pin (ON/ OFF) and 8pin (GND): output goes ON when in open, output goes OFF when in short (Refer to the ON/ OFF control paragraph)
P-Good Signal	At normal output: high, at output decrease: low, (Pull up to +Vin with a 10k ohm resistor inside)
Remote Sensing	Available
Operating Temp. Range	Operating temp. -40°C to +85°C (Refer to thermal derating graph)
Storage Temp. Range	Storage temp. -40°C to +85°C
Humidity Range	20%-95% R.H. max. (Max. wet-bulb temp. 35°C, non-condensing)
Storage Condition	For the converter before being mounted, store at 30°C/60% R.H. or below
Cooling Condition	Refer to thermal derating graph
Vibration	5-10Hz All amplitude 10mm, 10-55Hz acceleration 2G (1 hour in each of 3 orthogonal axes)
Shock	Acceleration 20G (3 directions, 3 times each), Shocking time 11±5ms
Weight	3.1g typ.
Outline	SMD type W=27.0 L=16.5 H=4.2 typ. (mm) (For detail dimensions refer to the outline on page 2)

* The above specification is provided with rating value, unless otherwise specified

<Outline>

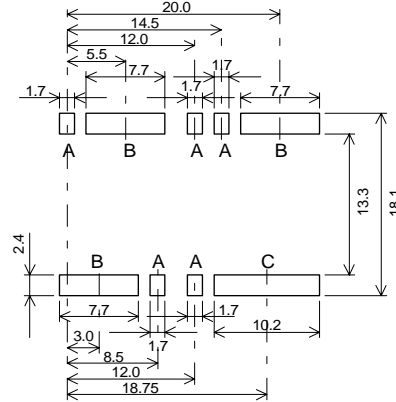
BSV-3.3S12R0H



Pin	Function
1	+Vin
2	P- Good
3	+Sense
4	+Vout
5	GND
6	-Sense
7	Trim
8	GND
9	On/Off

- Dimensions: mm
- Tolerances unless otherwise specified: ±0.5

<Recommended Pad Layout>

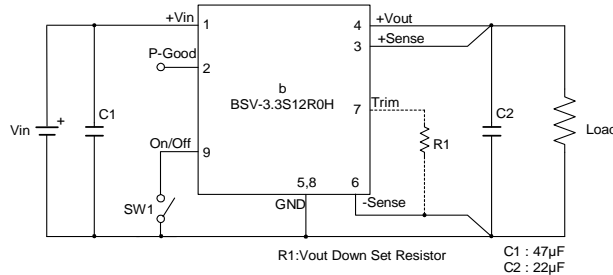


Note) Be sure to pickup at point A shown in the outline when mounting by an automated machine.

Avoid pickup at the component(IC) placed in the center of the board.

Note) Do not wire a pattern right under the converter (first layer). Since this converter has adopted a normal through-hole board, if there is a pinhole in the resist, it may become a problem.

<Standard Connection Circuit Diagram>



- It is a prerequisite for this product to be mounted onto a board, thereby heat radiation is done. 70% or more of the heat radiation is done from the GND pin (5, 8pin) and the rest is done from the +Vin pin and +Vout pin. Take space of the pattern as much as possible and design the board to make radiation easy.
- When not using the ON/ OFF control, keep the On/ Off pin open.
- When not adjusting the output, keep the trim pin open.
- An input capacitor is not required, however, when it includes inductance in input line or switching element is connected to the input side or the wire is long, C1 shall be required to fulfill its performance. Also we recommend a pattern with an additional C1 to lower the input impedance, and to verify it by an actual equipment. Place the C1 to connect it with a line as thick and short as possible to the converter. There is a built-in output capacitor, so it will operate without C2, however, required to fulfill the electrical characteristics. Place C2 as close as possible to the load. By adding C2, the output ripple can be lowered.
- GND pin (5, 8pin) is connect inside, however to secure the performance, use it with the 2 pins connected to the GND line.
- Be sure to connect the sense pin and output pin on the board. Unless the sense pin is connected, there is a possibility that a higher voltage than the rating voltage may be output.
- Do not wire a pattern right under the converter (first layer). For other layers wiring a pattern will be no problem.

Recommended Capacitor

C1=47µF

C2=2.2µF to 200µF

C1: Use ones with low ESR such as organic semiconductor solid capacitor, multilayer ceramic capacitor.

C2: Use a multilayer ceramic capacitor.

<Adjusting Output Voltage>

When using at 3.3V without adjusting output voltage, keep Trim pin (7pin) open. By connecting a resistor between Trim pin (7pin) and -Sense pin, the output voltage can be adjusted within the range of 0.8-3.3V. (Connect -Sense pin to GND)

When adjusting the output voltage, place the Rx close to the converter and make the wiring of Rx as short as possible. If the Trim pin catches noise, malfunction may occur.

To calculate the external resistance, please refer to the equation below. After calculating the external resistance, please check the output voltage and adjust the resistance value.

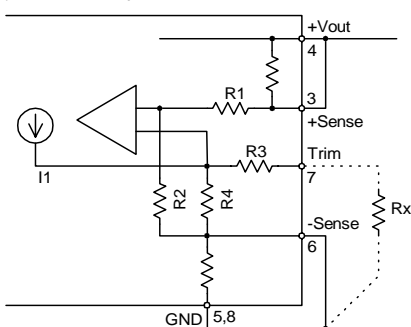
To set within the range of 0.8V-3.3V

$$V_{out} = \frac{R1 + R2}{R2} \times \frac{R4 \times (R3 + Rx)}{R4 + (R3 + Rx)} \times I1$$

$$Rx = \frac{R2 \times R4 \times V_{out}}{(R1 + R2) \times R4 \times I1 - R2 \times V_{out}} - R3(\text{ohm})$$

R1=100 ohm, R2=300 ohm, R3=22k ohm, R4=86.7k ohm, I1=0.0286mA, Vout=Requested output voltage (V)

(Be sure to adjust the units of resistor to ohm and current to A, when calculating.)



Ex.)

Desired Output Voltage Vout(V)	Rx (k ohm)
3.3	Open
2.5	246.7
2.0	110.7
1.8	81.6
1.5	50
1.2	27.4
1.0	15.6
0.8	5.7

<ON/ OFF Control>

- ON/ OFF Function

By using the ON/ OFF control function, ON/ OFF of the output without intermitting the input can be controlled.

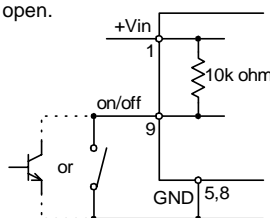
When not using the ON/ OFF function, keep the ON/ OFF pin open.

- Method of On/ OFF Control

Between ON/ OFF pin (9pin) and GND (8pin)

Open : Output=ON

Short (0-0.7V 1mA max.): Output=OFF



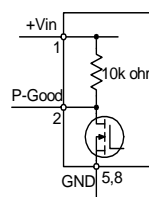
<P-Good Function>

By utilizing this P-Good pin, the output condition of the converter can be obtained. This pin is internally pulled up by the 10k ohm resistor connected to the +Vin pin.

It will be high at |Output voltage-Set voltage| 0.3V typ.

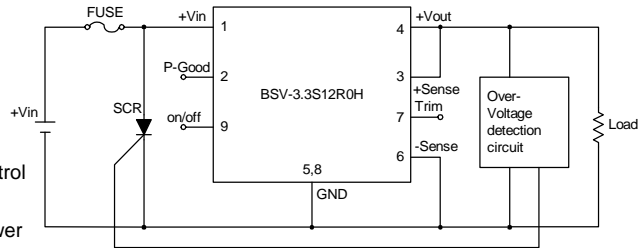
However, under the conditions written below, even if the output voltage is within this range, it may become low.

- When the input and output difference is Vin-Vout<0.5
- When the input voltage is below 3V
- When the output current is at over-current state.
- When the IC temperature is above 100°C



<Over-Voltage Protection Diagram (Ex.)>

This product does not have a built-in over-voltage protection. If the switching element in this converter is damaged in short mode, input voltage (+Vin) will go out as output. However, to avoid damage at over-voltage mode, in advance, adding a circuit to intercept the supplying power circuit can be recommended.



Note 1. When it is damaged at over-voltage mode, ON/ OFF control do not operate.

Note 2. When there is an ON/ OFF function on the supplying power side, this may be used.

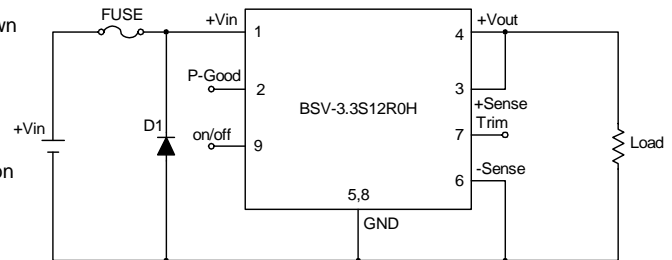
Note 3. Be sure that the DC power supply on the supplying side has the capacity to fuse the fuse.

<To prevent reverse input voltage protection>

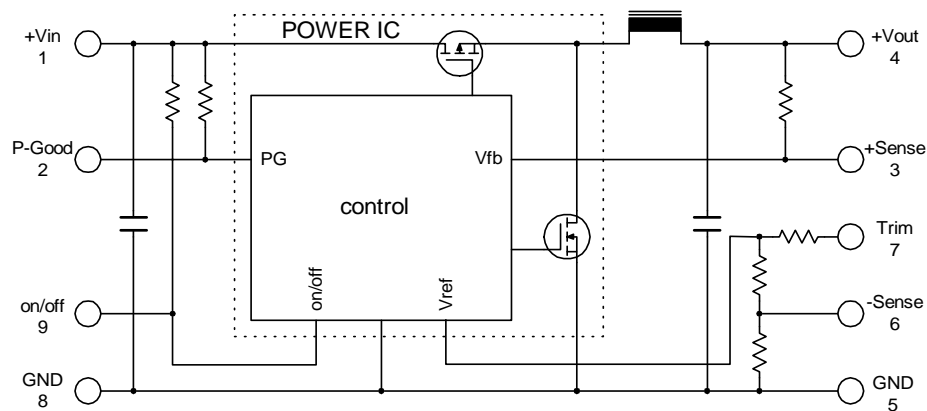
This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).

If the input voltage reversed is connected by mistake, it will be damaged.

If there is a possibility of reverse connection, please add a protection as shown in the right figure. The right figure is an example using fuse and diode.



<Block Diagram>



Ultra High Efficiency 93% High-Speed Response, Step-Down DC-DC Converter

Bellnix®

BSV-H Series

<Thermal Derating>

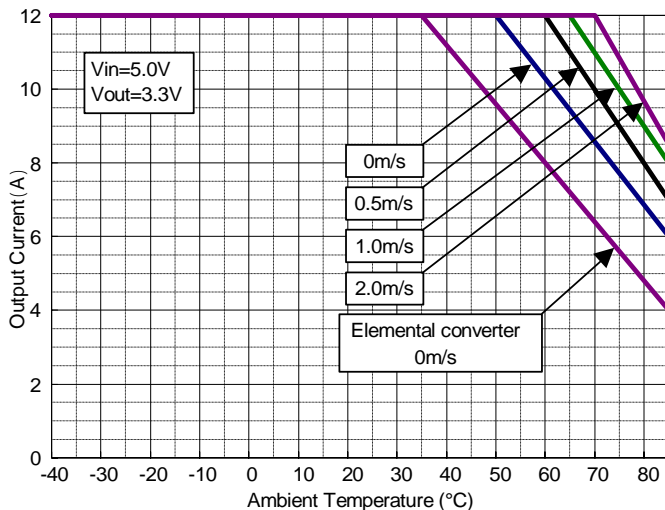
Set this product in a place where good convection is ensured. And also be sure to mount on a board, when using.

This product has been designed to radiate by utilizing the mounted board. So make the line to connect to the converter as wide as possible.

The radiation from GND is especially big, so make the GND line wide.

The derating curve below is a data when mounted on a double-side board of copper foil thickness 70µm, copper foil area 100x100mm (both sides) and thickness of the board 1.6mm. The radiation characteristics will change depending on the wiring, so please refer to the data.

The thermal characteristics for this converter will be largely influenced by the mounted board and the ambient condition. For this reason, finally mount the converter into the device that will be actually mounted. And when it is operated at the maximum ambient temperature of the equipment, be sure that the temperature of the board surface does not exceed 100°C.



Pattern Conditions for heat radiator

- Copper foil thickness 70µm
- Copper foil area 100x100mm(both sides)
- Board thickness 1.6mm

<Cleaning Conditions>

This product can not be washed whole. No-clean solder paste is recommended for this product.

<Soldering Conditions>

- Soldering Conditions

Solder under the following conditions.

Pre-heating temp.: 150-180°C, within 1min.

Peak heating temp.: 250°C max.

220°C or more, within 1min.

Reflow: twice

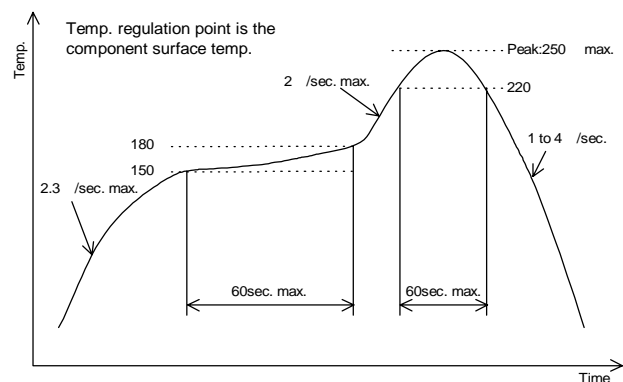
Note 1. Do not give shock at reflow.

Note 2. This converter can not be mounted by flow.

Note 3. This converter can not be reflowed with the component side faced down.

- About storage before being mounted

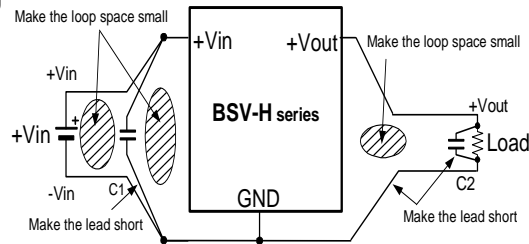
Storage conditions before being mounted should be 30°C/ 60% RH or below.



<Method to lower the noise (ex.)>

Usually BSV-H series is used, adding an input/ output capacitor, please make sure to design the printed board with special attention to the following items in order to obtain lower noise level by taking advantage of the performance of the converter.

1. Use low impedance capacitor with good high frequency characteristic.
2. Shorten the lead of each capacitor as much as possible, and make it low lead inductance.
3. Make the wiring loop space between the (+) and (-) of both input and output pin side as small as possible. You can decrease the possibilities of leakage inductance.
4. Design the printed pattern of the main circuit as thick and short as possible.



<Precautions>

- This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipments). Can not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product. Be sure to contact our sales when using in besides general use.
- For this product parallel and series operation are not possible.
- For mounting this product, please do not use connector of socket. The performance may not be fulfilled due to the effect of contacting resistor. Mount to print board by soldering.
- This product has a built-in over-current, short protection, but long time short circuit will cause failure, so please avoid it.
- There is possibility of damage when used under electric conditions and environmental conditions such as temperature that are out of the standards. Be sure to be use within the standards.
- There is possibility of damage by static. When the worker has electrified static, electrical discharge should be done and the working on the table so grounded may be recommended.
- Do not store in a place where corridible gas may be generated or a dusty place.
- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to fuse the fuse.
- This product does not have a built-in over-voltage protection. When over-voltage occurs due to the abnormality in the module, there is a mode that input voltage comes out at it is, and may cause smoke and ignition. To preven this, be sure to add over-voltage protection.
- No test result certificate attached to this product.

■Information

The BSV-HE series is a small type (16.5 x 27 x 4mm) light weight (2.2g) step down DC-DC converter which has achieved 9.5A. Since it can corresponds to low output voltage from 0.8V and output voltage setting accuracy is less than ±1%, it is suitable with the latest DSP, ASIC applications. Furthermore, high efficiency, very high speed response and SMD package which requires non-external parts have been achieved with a synchronous rectification system. This product breaks all the barriers of a normal product.



■Features

- Ultra small type (16.5 x 27mm)
- Ultra thin type 4.0mm
- Very high-speed load response
- Output setting accuracy ±1%
- Very high efficiency
- Over current protection
- Under Voltage Lock Out
- Remote ON/OFF control
- Adjustable output voltage
- SMD package
- External capacitor not required
- Heatsink not required
- Non-Isolated type converter
- Operating temp -40°C to +85°C (Temp derating required)
- RoHS compliance

■Model/Rating

Model BSV-H Series	Input V Vdc	Output V Vdc	Output I A	Output ADJ Vdc	Ripple Noise mVpp(typ.)	Efficiency % (typ.)
BSV-1.8S9R5HE	3.0-5.5	1.8	0-9.5	0.8-1.8	10	87

Figure 1

Note 1 : Ripple noise and efficiency are when input voltage is 5V and load is rated
 Note 2 : Ripple noise is measured by 20MHz bandwidth, with a multi-layered ceramic capacitor with 47µF at input and 4.7µF at output.
 Note 3 : Depending on ambient temp conditions, cooling air flow may be required.

■Specifications

Input voltage range	Refer to Figure 1
Rated output voltage	1.8V±1% (Trim pin when open)
Adjustable output voltage range	0.8 to 1.8V
Line Regulation	0.5% typ. (Rated output, refer to Figure 1 for input voltage range)
Load Regulation	0.5% typ. (Rated input/output voltage, load varying from 0 to 100%)
Temp Regulation	0.02%/°C (Rated input/output, temp change from -40°C to +85°C)
Ripple noise	Refer to Figure 1 (Rated input/output, common temp, measurement frequency bandwidth 20 MHz)
Efficiency	87% typ. (Rated input/output, common temp, refer to figure 1)
Start up time	2ms typ. (Resistance load)
Maximum output load capacity	2200 µ F max
Over current protection	Rated load current operates at 105%+. Auto recovery type.
Over voltage protection	None
Under Voltage Lock Out	Yes
Over input current protection	None
Remote ON/OFF control	Between 9pin (ON/OFF) and 8pin (GND) : Output switches on when open, output switches off when short. *Refer to Page 7
Standby current	0.2mA typ.
P-Good signal	At normal output : HIGH, at decreased output : LOW (This terminal is open-drain)
Remote sensing	Yes
Operating temp range	-40°C to +85°C (Refer to the thermal derating graph on Page 5)
Storage temp range	-40°C to +85°C
Humidity range	20 to 95%R.H. (While the max wet bulb temp is 35°C, no dewing)
Storage condition	Store the product at 30°C/60% R.H. or lower before mounting
Cooling condition	Refer to the thermal derating graph on Page 5
Vibration	5-10Hz, all amplitude 10mm, 10-55Hz acceleration 2G (1 hour in each of 3 orthogonal axes)
Shock	Acceleration 20G (3 directions, 3 times each), Shocking time 11±5 m s
Weight	2.2g typ.
Dimensions	W=16.5 L=27.0 H=4.0 typ. (mm) *For detail dimensions refer to the outline

Figure 2

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

Application Range

This specification is applied to the direct current input and non-isolated type DC/DC converter, BSV-1.8S9R5HE.

1. Model and Rating

Model	Rating Input Voltage	Rating Output	Package type	Note
BSV-1.8S9R5HE	DC5.0V	1.8V, 9.5A	SMD	

When the condition is not described in this specifications, the input/output is rated and the ambient temperature is 25°C±5°C.

2. Environmental Condition

3-1. Temperature range

When operating : -40°C to +85°C (Load derating from 50°C is required, only when mounting on both sided PCB of 100 X 100mm and thickness 1.6mm.)

When storing : -40°C to +85°C

3-2. Humidity range

When operating : 20-95%RH (Maximum wet bulb temperature is 35°C, and no dew condensation)

When storing : same as above

Note) Before mounting, store the product at 30°C/60% RH or lower.

3. Specification and Standard

This product is a lead free product.

4-1. Input characteristic

Article	Specification and Standard	Terms
Input voltage	+3.0 to 5.5V (Rating 5.0V)	
Input current	3.93A typ.	When input/output is rated
Standby current	0.20mA typ.	Vin=5.0V, Short Between ON/OFF Pin and GND Pin

4-2. Output characteristics and attached functions

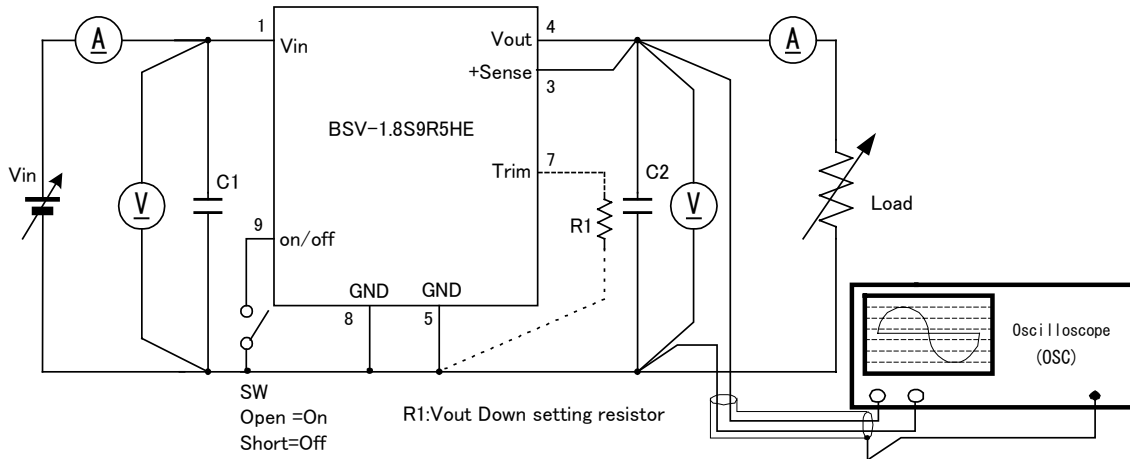
Article	Specification and Standard	Terms
Output voltage	1.8V	
Output voltage setting accuracy	1.8V±1.0% (±0.018V)	
Adjustable output voltage range	0.8V to 1.8V	Depending on external resistance
Output current	0 to 9.5A	Derating required
Line Regulation	0.5% typ. (1.0% max)	Input varying from 3.0 to 5.5V
Load Regulation	0.5% typ. (1.0% max)	Load varying from 0 to 9.5A
Temp Regulation	±0.02%/°C typ.	Varying from -40 to +50°C
Efficiency	91% typ. (I _o =5A), 87% typ. (I _o =9.5A)	
Ripple Noise	10mVp-p typ. 50mVp-p max.	Bw=20MHz, with external capacitor attached on both load sides
Over current protection	Operates at 105%+, Auto recovery type	
Over voltage protection	None	
Under Voltage Lock Out	Yes. Start up voltage : 2.85 typ. Shut down voltage : 2.75 typ.	
ON/OFF control	Between the ON/OFF pin (9) and the GND pin (8) OPEN → Output ON SHORT (0-0.6V, 0.2mA max) → Output OFF	
P-Good low level voltage	0.3V max	Sink current : 4mA max
Max. output load capacitance	2200 μ F max	

Note 1) About the measurement circuit of 4-3

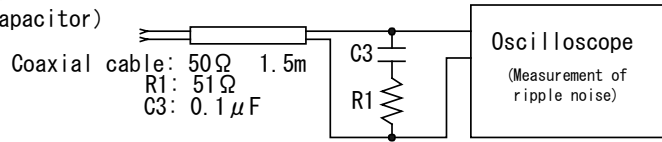
Note 2) Measured by the following conditions unless otherwise specified :

Input voltage 5.0V, Output voltage 1.8V, Output current 9.5A (Resistance load), Ambient temperature 25°C±5°C.

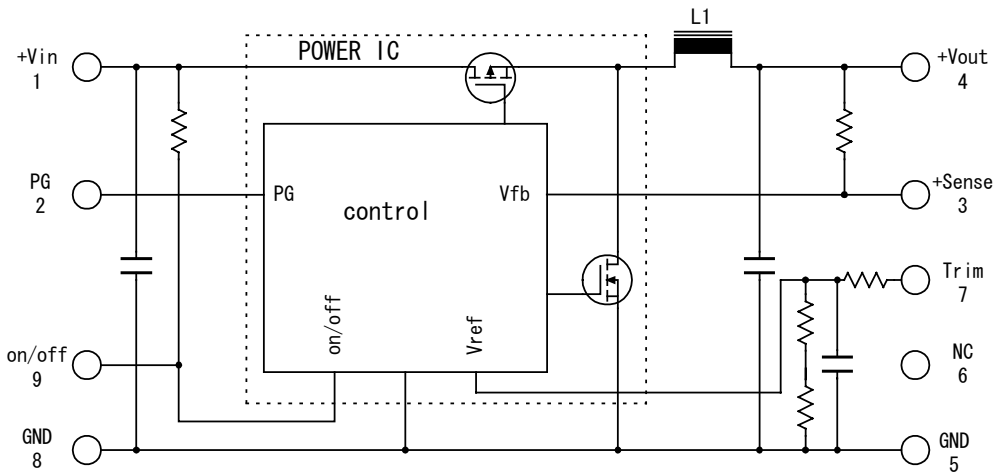
4-3. Measurement Circuit



C1 : 47 μ F (Multilayer ceramic capacitor)
 C2 : 4.7 μ F (Multilayer ceramic capacitor)



4. Block Diagram



5. Temperature Derating

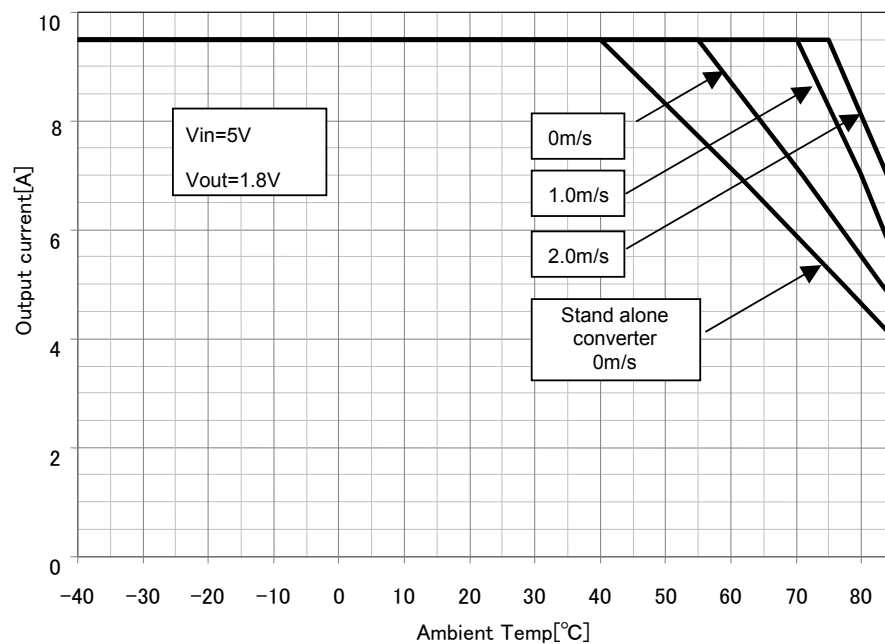
Place this product in a position with good airflow. The product must be mounted on a board during use. This product has been designed to radiate heat utilizing the mounted board. Since the GND pin radiates a larger amount of heat making the GND line wider.

The derating curve below shows the product data when mounted on a double-sided board of copper foil (thickness $70\ \mu\text{m}$), copper foil area ($100\times 100\text{mm}$) and thickness of the board (1.6mm). Since the heat radiation characteristics will vary depending on the wiring, please use the data as a reference.

The thermal characteristics of this converter will be largely influenced by the mounted board and the ambient condition.

For this reason, ultimately mount the converter inside the device and operate at the max ambient temperature of the device.

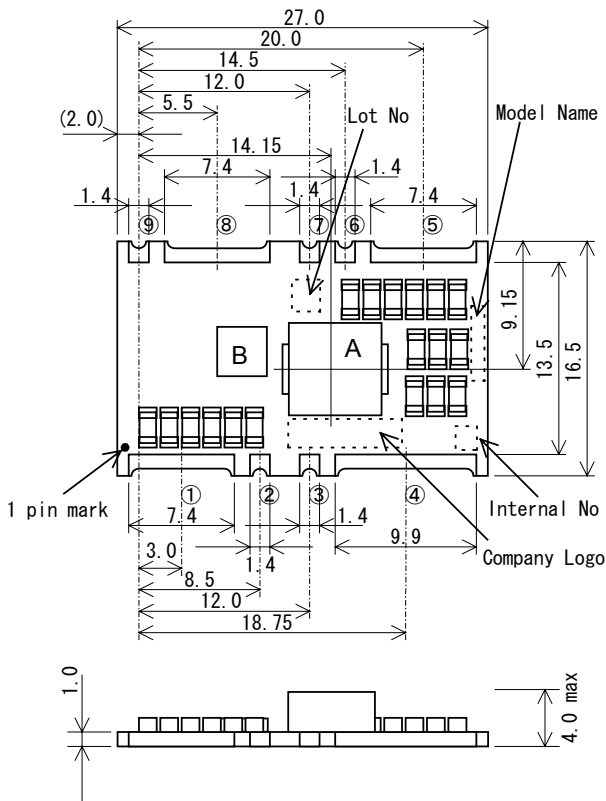
Make sure that the surface temperature of the board does not exceed 100°C .



The derating curve shows the product data when mounted on a double-sided board of copper foil $100\times 100\text{mm}$

7. Outer dimensions and pin information

7-1. Configurations/Dimensions



Pin	Function
①	+Vin
②	P-Good
③	+Sense
④	+Vout
⑤	GND
⑥	NC
⑦	Trim
⑧	GND
⑨	On/Off

Units : mm

Tolerances unless otherwise specified : ±0.5

Weight : 2.2g typ.

Adsorption position : Use A point on the left diagram

Display 'BSV-1.8S9R5HE' for the model name

Lot No.is inscribed on the 1 pin side

① Suffix = year of manufacture

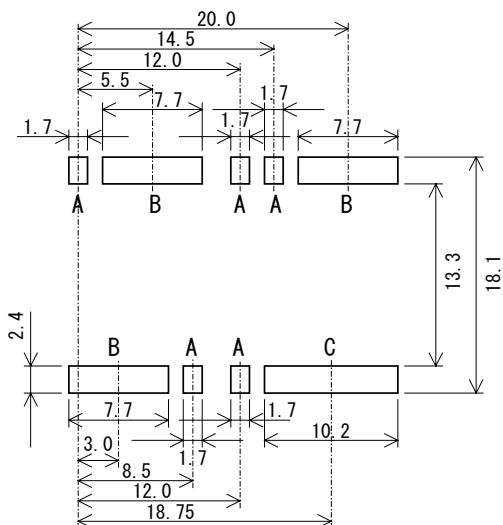
② Manufacturing month(O, N, D for Oct, Nov, Dec respectively)

③ Lot of the month (None is inscribed for the first month)

Floppy pin : 0.2mm max (when placed horizontally)

Note) Be sure to pick up at A point in the outline when mounting by an automated machine. Avoid pick up at the component (IC) placed in the center of the board.

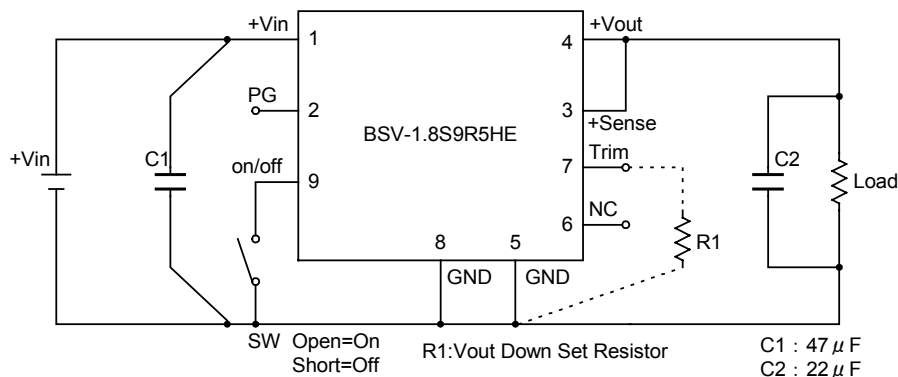
7-2. Recommended Pad Layout



Note) Do not wire a pattern below the converter (The first layer). The converter adopts an ordinary through hole board. If there is a pin hole on the resist film, it could be a problem.

8. Usage

8-1. Standard connection circuit



Note 1) It is a prerequisite for this product to be mounted onto a board, thereby heat relation is done. 70% or more of the heat radiation is done from the GND pin(5, 8pin) and the rest is done from the +Vin pin and +Vout pin. Take space of the pattern as much as possible and design the board to make radiation easy. (Please use that surface temperature of converter's PCB will not exceed 100°C.)

Note 2) When not using the On/Off control, keep the On/Off pin open.

Note 3) P-Good pin is open-drain. If using P-Good function, please pull up to the input voltage at the resistor.

Note 4) When not adjusting the output, keep the trim pin open.

Note 5) GND pin (5, 8pin) is connect inside, however to secure the performance, use it with the 2 pins connected to the GND line.

Note 6) Be sure to connect the sense pin and output pin on the board. Unless the sense pin is connected, there is a possibility that a higher voltage than the rating voltage may be output.

Note 7) Do not wire a pattern right under the converter (first layer). For other layers wiring a pattern will be no problem.

Recommended Capacitor

C1=47 μF

C2=2.2 μF -200 μF

C1 : It is unnecessary if impedance of the power supply on the input side is low enough and the power supply on input side is connected by the enough thick and short line, however, it is necessary if the impedance is high.

Use ones with low ESR such as organic semiconductor solid capacitor, multilayer ceramic capacitor

C2 : The converter will operate without C2 because the output capacitor has built in, however, it is necessary to satisfy with the electric characteristic (Ripple Noise). The connecting to the load side will make noise decrease. Use a multilayer ceramic capacitor.

8-2. ON/OFF Control

By using the ON/OFF control function, ON/OFF of the output without connecting and disconnecting the input can be controlled. ON/OFF Pin has been connected with +Vin terminal internally by the resistance of 30kΩ.

When not using the ON/OFF control, keep the ON/OFF pin open.

3.3V Input

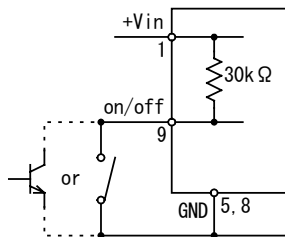
ON/OFF Pin(9pin)-GND Pin(8pin) Open or High (Above 2.6V) ON

ON/OFF Pin(9pin)-GND Pin(8pin) Short or Low (Below 0.65V) OFF

5.0V Input

ON/OFF Pin(9pin)-GND Pin(8pin) Open or High (Above 3.75V) ON

ON/OFF Pin(9pin)-GND Pin(8pin) Short or Low (Below 0.9V) OFF



8-3. Adjusting Output Voltage

When using at 1.8V without adjusting output voltage, keep Trim pin (7pin) open. By connecting a resistor between Trim pin (7pin) and GND pin (5pin), the output voltage can be adjusted within the range of 0.8-1.8V.

When adjusting the output voltage, please be careful not to draw around the wire of Trim pin. If the Trim pin catches noise, malfunction may occur.

To calculate the external resistance, please refer to the equation below. After calculating the external resistance, please check the output voltage and adjust the resistance value.

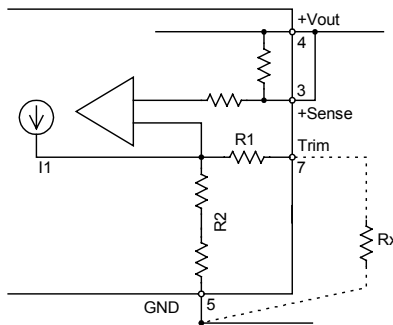
To set within the range of 0.8V-1.8V

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

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

Ex.)

Desired Output Voltage Vout (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. Sensing function

An excellent load regulation characteristic can be obtained by using the sensing function on the load side. Make sure to connect the +Vout pin (4 pin) and +Sense pin (3 pin) as close to each other as possible.

8-5. P-Good Function

By utilizing this P-Good pin (2 pin), the output condition of the converter can be obtained.

This terminal is open-drain. If using P-Good function, please use P-Good terminal connecting the resistor outside and pulling-up to the input voltage. (5.5V max.)

It may become low when output voltage (+Sense voltage) is very different from the voltage set by the converter.

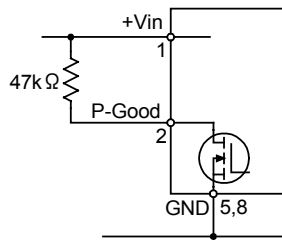
It will be open by

Vout<1.2V : |Output voltage-Set voltage| ≤ 0.076V typ.

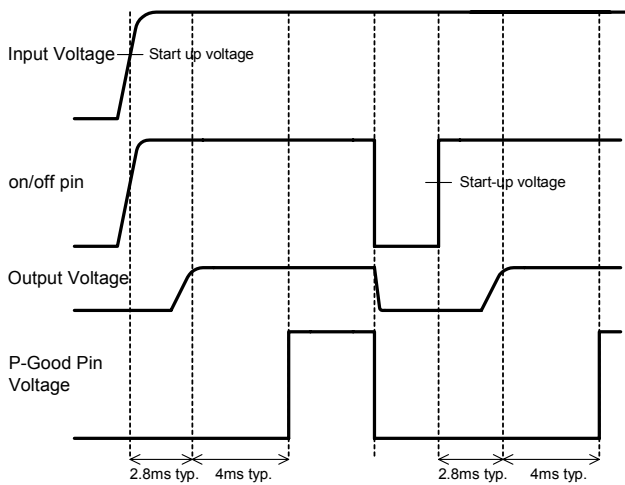
Vout ≥ 1.2V : |Output voltage-Set voltage| ≤ 6.25%typ. of set voltage.

However, under the conditions written below, even if the output voltage is within this range, it may become low.

- At standing up. (4ms typ.)
- When the input voltage is below 3V
- When the output current is at over-current state.
- When the IC temperature is above 100°C



Output of output voltage and P-Good after reaching the start-up condition is as shown below:



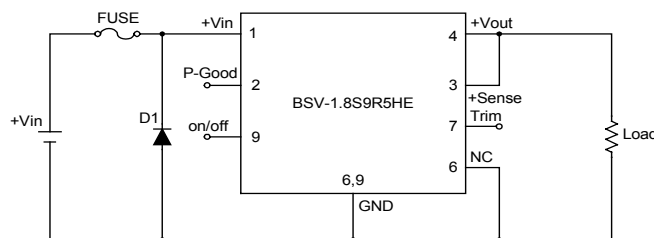
9. To prevent reverse input voltage protection(Ex.)

This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).

If the input voltage reversed is connected by mistake, it will be damaged.

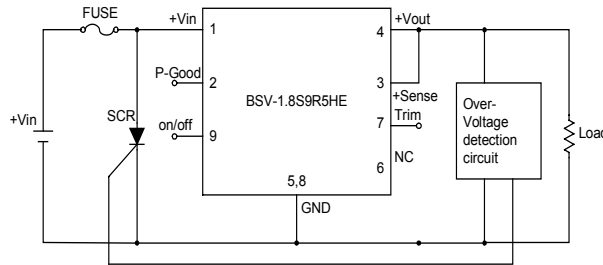
If there is a possibility of reverse connection, please add a protection as shown in the below figure.

The below figure is an example using fuse and diode.



10. Over-Voltage Protection Diagram (Ex.)

This product does not have a built-in over-voltage protection.
 If the switching element in this converter is damaged in short mode, DC input voltage will go out as output.
 To avoid damage at over-voltage mode, in advance, please add the input interrupting circuit as below.



- Note 1. When it is damaged at over-voltage mode, ON/OFF control will not operate.
- Note 2. When having ON/OFF function on the supplying power side, this circuit can be used.
- Note 3. Be sure that the DC power supply on the supplying side has the capacity to cut the fuse.

11. Soldering Conditions

Please conduct by the condition as below regarding the soldering temperature and time and storage before mounting.

11-1. Reflow method

Pre-heating temp.: 150-180°C, within 60 sec max. (Refer to the figure below)

Peak heading temp.: 250°C max.

220°C or more, within 60 sec max.

Reflow: twice

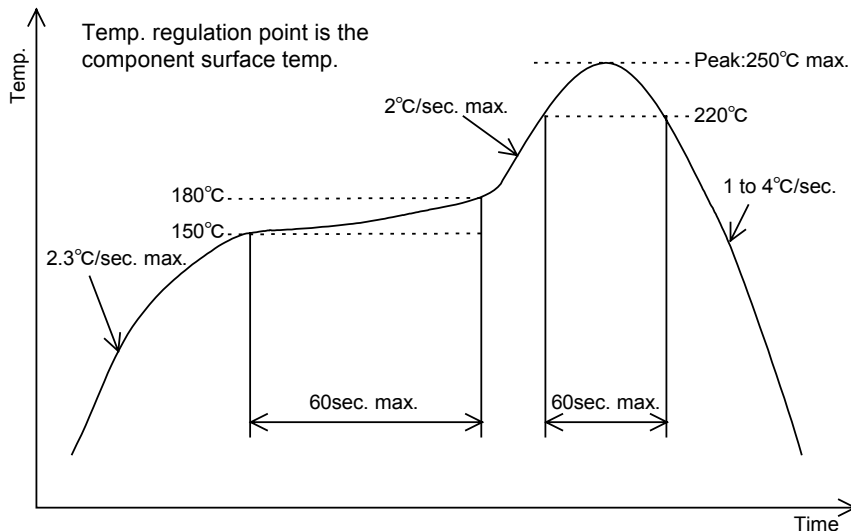
Note 1. Do not give shock at reflow because components which compose the converter may move.

Note 2. After mounting the converter on PCB, please do not reflow again turning the PCB over.

11-2. About storage before being mounted

When you open dry packing, storage conditions before being mounted should be 30°C/60% RH or below. Moreover, baking (125°C±5°C, 12H) is needed before the reflow when exceeding one year in a dry pack and 168 hours at 30°C/60% RH in an open dry pack conditions.

After mounting, it depends on the environmental condition.



12. Vibration and shock test

Vibration : 5-10 Hz All amplitudes 10mm, 10-55Hz Acceleration 2G (Three direction, for one hour each)

Shock : Acceleration 20G (Three direction, three times each)

Shocking time 11±5ms

13. Cleaning Conditions

This product can not be washed whole. No-clean solder paste is recommended for this product.

14. Precautions

For customer's safety, when using this product, please refer to the specification and please use keeping the following precautions surely.

-This product is for being used in general electric equipments (business equipments, telecommunication equipments and measurement equipment).

Can not be used in medical equipments, nuclear equipments and trains which would affect lives or properties directly by the failure of this product.

Be sure to contact our sales when using in besides general use.

- For this product parallel and series operation are not possible.

- For mounting this product, please do not use connector of socket. The performance may not be fulfilled due to the effect of contacting resistor.

Mount to print board by soldering.

- This product has a built-in over-current, short protection, but long time short circuit will cause failure, so please avoid it.

- There is possibility of damage when used under electric conditions and environmental conditions such as temperature that are out of the standards.

Be sure to be use within the standards.

- Do not store in a place where corrodible gas may be generated or a dusty place.

- There is possibility of damage by static. When the worker has electrified static, electrical discharge should be done and the working on the table so grounded may be recommended.

- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to fuse the fuse.

- This product does not have a built-in over-voltage protection. When over-voltage occurs due to the abnormality in the module, there is a mode that input voltage comes out at it is, and may cause smoke and ignition. To prevent this, be sure to add over-voltage protection.

- No test result certificate attached to this product.

15. Guarantee

The guaranteed term of this product is one year. When occurring any failure mode by the cause of our design and production in this guaranteed term, we will repair the failure product or replace to the good product by free of charge.

However, when being remodeled inside etc., we shall not guarantee it.

The range of the guarantee for this product is the one of this products concerned.

16. Miscellaneous

Any doubtful point arising in connection with the interpretation of any provision hereof shall be decided on by mutual agreement between the parties hereto.

17. If you have any further technical questions for this product, please contact us.

E-mail : info@bellnix.com

URL : <http://www.bellnix.com>

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

						Table 1	
Models BSV-nano Series	Input V Vdc	Output V Vdc	Output I A	Output ADJ Vdc	Noise mVpp(typ)	Efficiency %(typ)	
BSV-1.8S4R0N	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 μ F at input and 22 μ F at output.

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

■ Specification

		Table 2
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 μ 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.

Small Type High-Speed Response POL DC-DC Converter

Bellnix®

BSV-nano Series

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	Vin=5.0V, SHORT between on/off pin - GND pin

Small Type High-Speed Response POL DC-DC Converter

Bellnix®

BSV-nano Series

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 _o =2A), 85% typ (I _o =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.

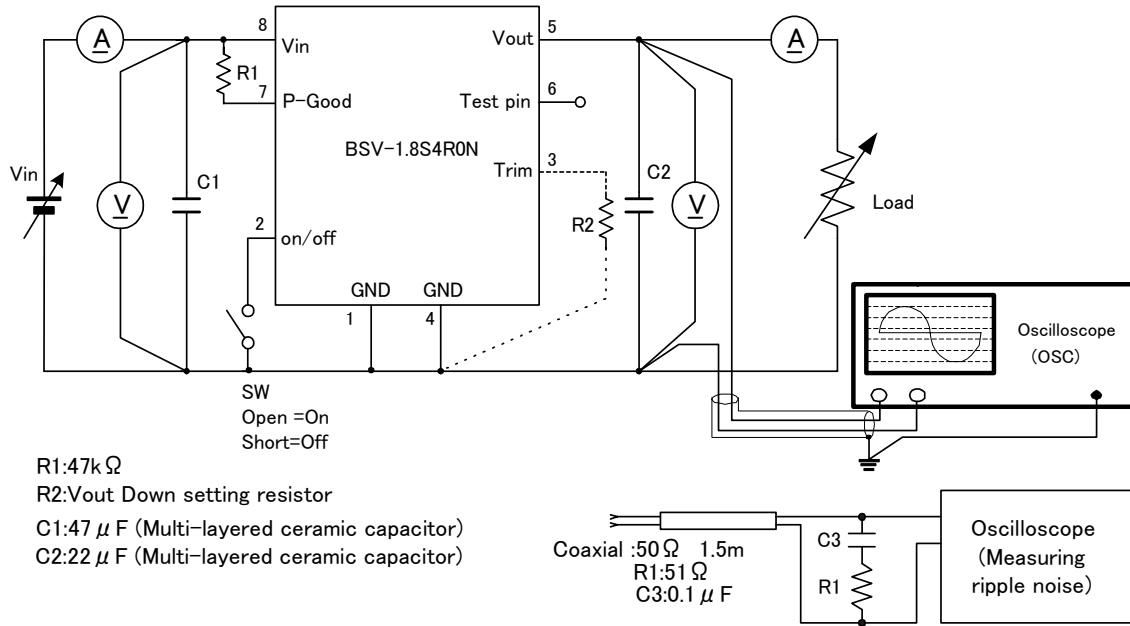
*2 The above items are measured with input voltage at 5.0V, output voltage 1.8V, output current 4.0A (resistance load) and the ambient temp at 25°C±5°C unless otherwise noted.

Small Type High-Speed Response POL DC-DC Converter

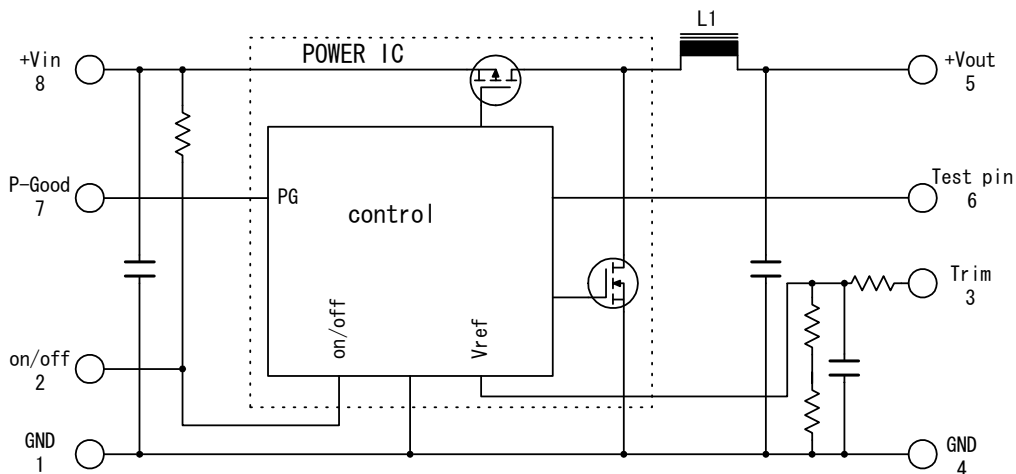
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4-3. Measurement Circuit



5. Internal Block Diagram



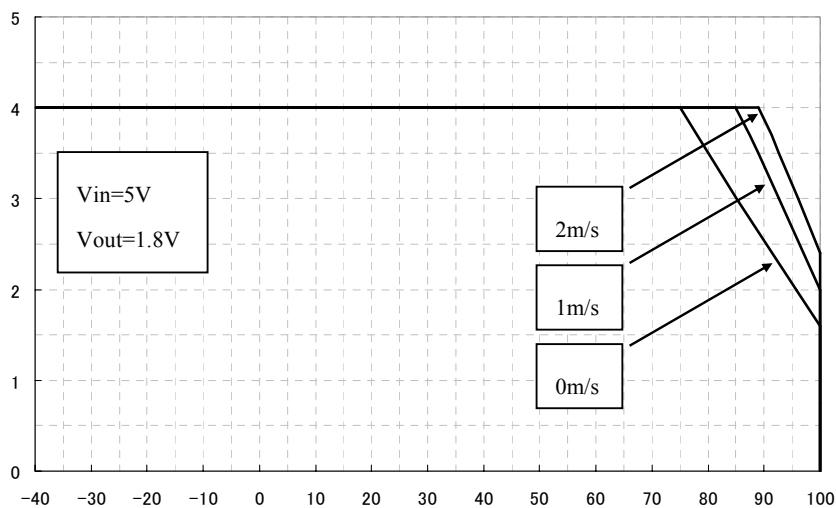
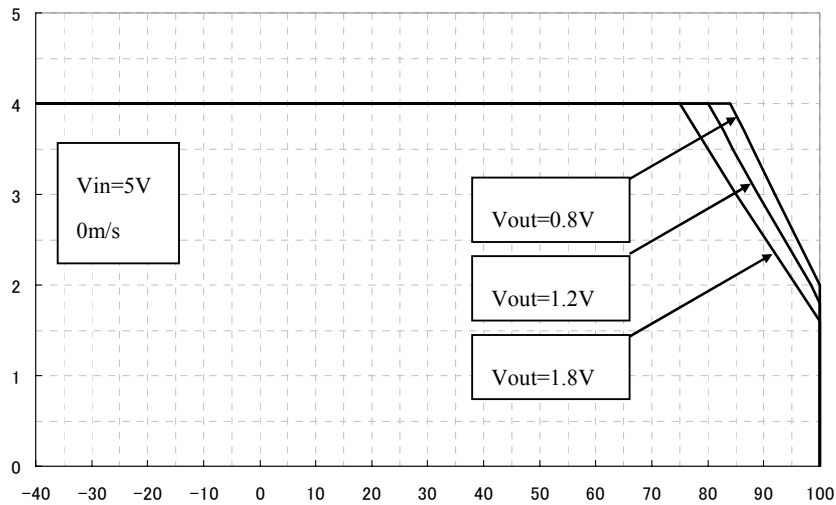
6. Temperature Derating

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



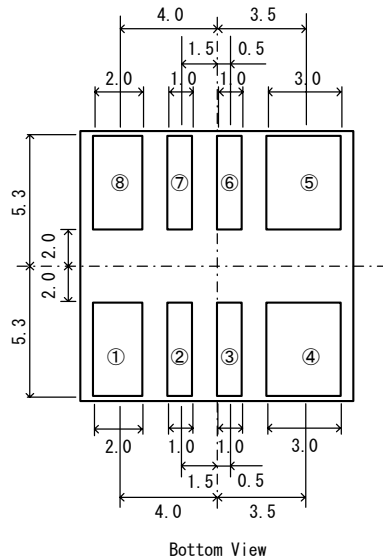
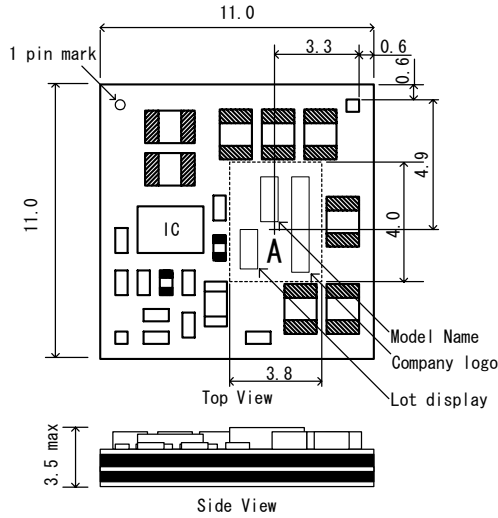
Small Type High-Speed Response POL DC-DC Converter

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7. Outer dimensions and pin information

7-1. Configurations/Dimensions (SMD type)



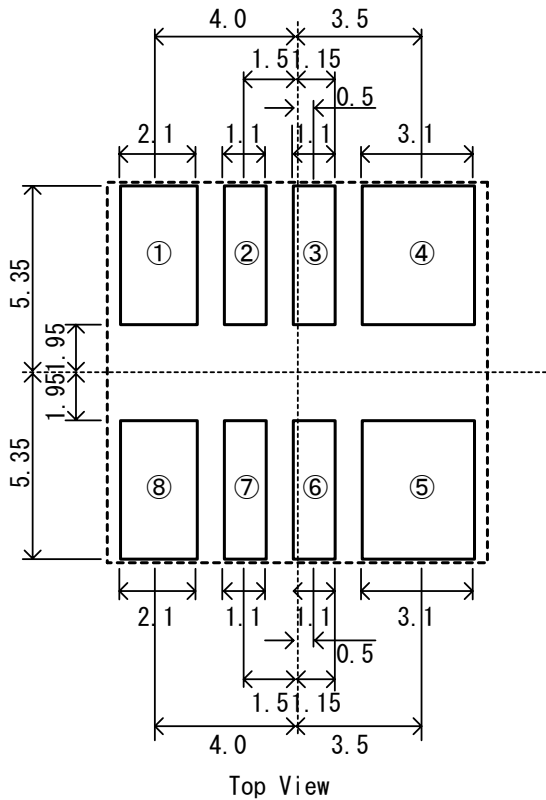
- Unit mm
- Tolerance unless otherwise specified ± 0.2
- Weight = 1.0g typ
- Pick up point: A
- Lot No is placed on 1 pin side.
- DISPLAY: ①②③
 - ① Last digit is the YEAR
 - ② Manufacturing month
(e.g., 10, 11, 12 are for O, N, D respectively)
 - ③ Lot No for the month
(No number for the first lot)
-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

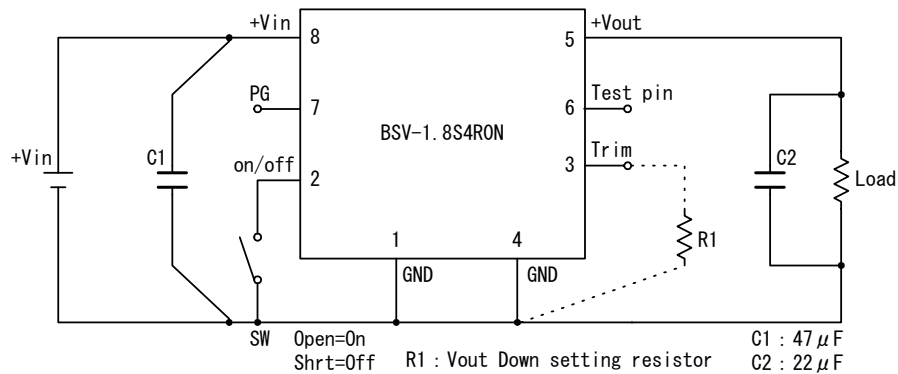
Pin	Function
①	GND
②	ON/OFF
③	Trim
④	GND
⑤	Vout
⑥	Test pin
⑦	P-Good
⑧	Vin

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 = 47 μ F

C2 = 22 μ F - 200 μ F

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 30k Ω resistor internally. Keep the ON/OFF pin OPEN when not using the ON/OFF feature.

At 3.3V input

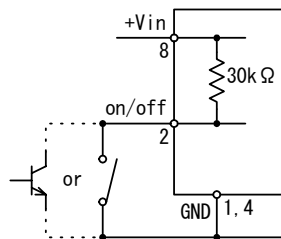
ON OPEN between ON/OFF pin (2pin) and GND pin (4pin) or HIGH (2.6V or above)

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.

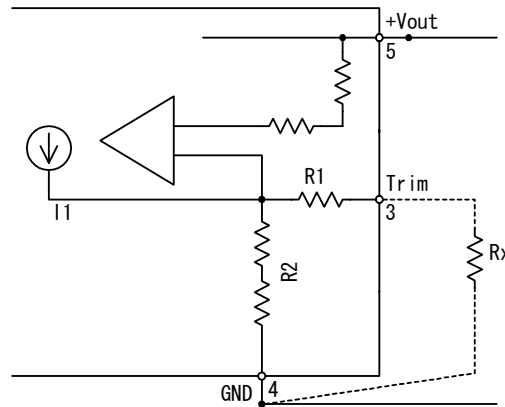
When setting between 0.8V and 1.8V

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

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

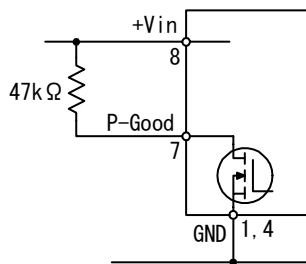
Output state of the converter may be obtained by using P-Good pin (7pin). The pin is an open drain output. When using the P-Good features, the pin needs to be pulled up by input voltage with external resistor. (5.5Vmax)

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

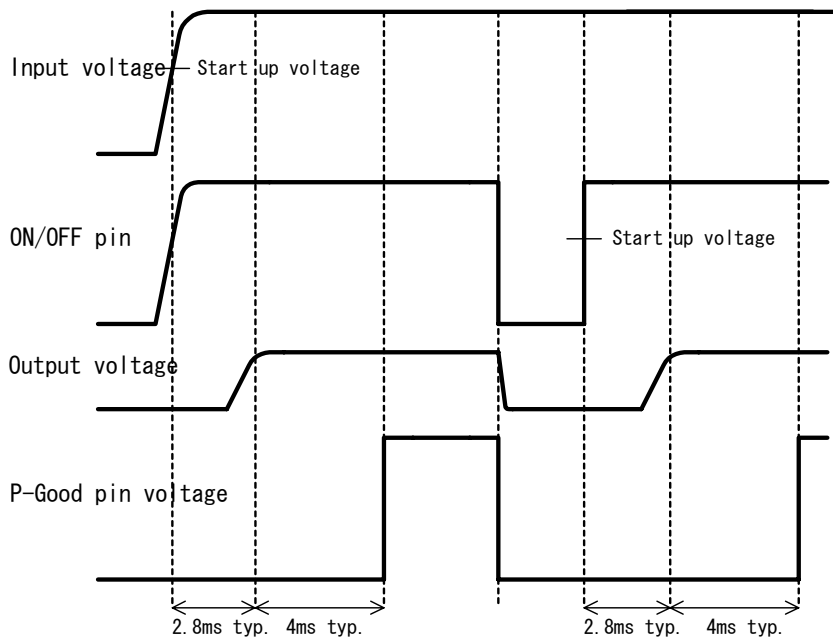
$$| \text{Output voltage} - \text{Set voltage} | \leq 0.2\text{V typ} \rightarrow \text{OPEN (HIGH)}$$

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



Small Type High-Speed Response POL DC-DC Converter

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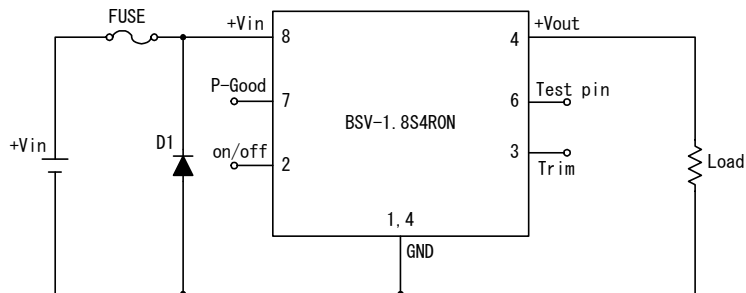
BSV-nano Series

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.

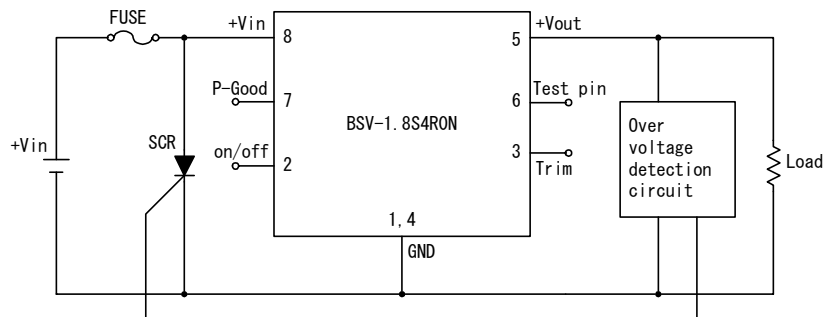
Below is a diagram using a fuse and a diode.



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

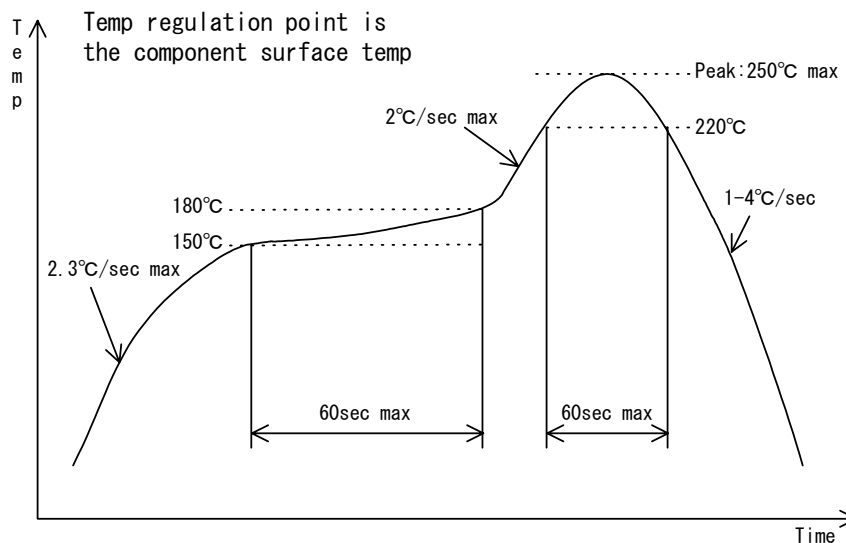
Note1) Make sure not to vibrate during the re-flow or components making up the converter may be dislocated.

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

<http://www.bellnix.com>

Ultra High Efficiency 93%

High-speed Response, Step-Down DC-DC Converter

20 Watt BSV-A Series

Bellnix®

BSV series is a small size (33x21.5x6mm size) and light weight (4g) step-down DC-DC converter, which has achieved 20W. Since it can correspond from ultra low output voltage of 0.8V, it can be used for the latest DSP, ASIC applications. High efficiency by synchronous rectification system, ultra high-speed responding, saving space by no external components, and by having SIP, DIP, SMD packages etc. this has achieved a product that has exceeded our conventional common sense.

<Features>

- High-speed responding
- Efficiency 93%
- ON/OFF Control
- Adjustable Output
- The Latest Power-IC adopted
- The Latest Technology, Synchronous Rectification Circuit
- Additional external capacitor not required
- Short-Circuit, Over-Current Protection
- Non-Isolated Type Converter
- Amazing Minimum Size
- Operating Temp. -40°C to +85°C
- Heat Sink not required
- High Reliability, High Performance
- RoHS Compliance



<Model, Rating>

Table 1

Model	Rating Input Voltage Vdc	Input Voltage Range Vdc-Vdc	Output Voltage Vdc	Output Current A	Non-Load Current mA(typ.)	Ripple & Noise mVpp(typ.)	Efficiency %(typ.)	Package type
BSV-3.3S6R0A	5.0	3.0-5.5 (*1)	3.3(0.8-3.6)	6	65	40	93	SIP
BSV-3.3S6R0DA								DIP
BSV-3.3S6R0SA								SMD

(*1) Input Voltage should be 0.5V or more higher than output voltage.

<Specification>

Table 2

Rating Input V/ Range	Refer to Table 1
Rating Output V	When Vadj pin is open, output voltage will be set at 3.3V. (The accuracy of output V setting is ±3% max.)
Adjustable Output V Range	Output Voltage is adjustable according to the range above.
Line Regulation	1.5%typ. 3.0%max. (For the regulation of input voltage range 3.8-5.5V)
Load Regulation	2.0%typ. 4.0%max. (For 0-6A of load regulation, at rating input.)
Temp. Regulation	±0.02%/°C typ. (For the change of operating temp. -10°C to +50°C)
Ripple & Noise	100mVpp max. (Rating input, rating output, room temp.) (20MHz bandwidth)
Efficiency	93% (Rating input/ output, room temp., refer to Table 1)
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type. Avoid long time short-circuit condition.
Over-Voltage Protection	None
Standby Current	1mA typ.
Remote ON/OFF	Between ON/OFF (1pin) - S.GND (5-8pin) Open: Output ON, Short: Output OFF (Refer to application)
Remote Sensing	The voltage between converter's output pin [9-11pin] -GND pin [5-8pin] and sensing voltage [voltage between 14-15pin] difference is 10% (0.1V-0.3V) or below of the sensing voltage.
P-Good Signal	At normal output: Open (H), at output drop: Short (L), open drain output 5mA max. * No P-Good function for BSV-3.3S6R0A (SIP type)
Operating Temp. Range	-40°C to +85°C (Refer to the thermal derating graph.)
Storage Temp. Range	-40°C to +85°C
Humidity Range	20%-95%R.Hmax. (Max. Wet-bulb Temp. 35°C, non-condensing)
Storage Condition	For the converter before being mounted, store at 30°C/ 60% R.H. or below.
Cooling Condition	Refer to the thermal derating graph
Vibration	5-10Hz All amplitude 10mm, 10-55Hz acceleration 2G (1hour in each of 3 orthogonal axes)
Shock	Acceleration 20G (3times in each of 3 orthogonal axes), Shocking time 11±5ms
Weight	4g typ.
Outline	SIP type W=24 L=33 H=5.0 typ. (mm) (For dimensions refer to outline.) DIP type W=22.25 L=33 H=6.0 typ. (mm) (For dimensions refer to outline.) SMD type W=23.9 L=33 H=6.0 typ. (mm) (For dimensions refer to outline.)

* The above specification will be provided with rating value, unless specified condition is described.

Bellnix DC-DC CONVERTERS

BDD20080825

<Outline>

1. BSV-3.3S6R0A (SIP type)

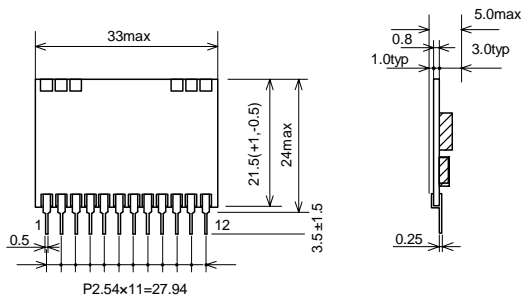


Figure 1

- Dimensions: mm
 - Tolerance when nothing specified ± 0.5

Table 3

Pin	Function
1	on/off
2	Vin
3	Vin
4	Vin
5	GND
6	GND
7	GND
8	GND
9	Vout
10	Vout
11	Vout
12	V.ADJ

2. BSV-3.3S6R0DA (DIP type)

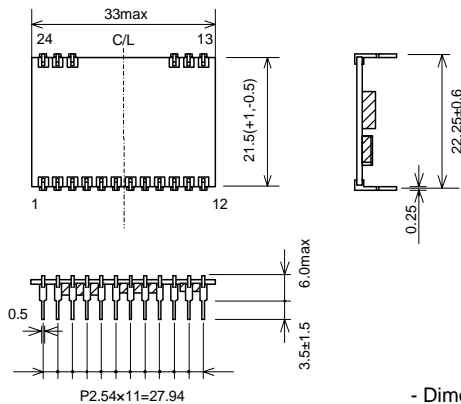


Figure 2

- Dimensions: mm
 - Tolerance when nothing specified ± 0.5

Table 4

Pin	Function	Pin	Function
1	on/off	11	Vout
2	Vin	12	V.ADJ
3	Vin	13	NC
4	Vin	14	+S
5	GND	15	-S
6	GND	22	NC
7	GND	23	P-Good
8	GND	24	NC
9	Vout		
10	Vout		

3. BSV-3.3S6R0SA (SMD type)

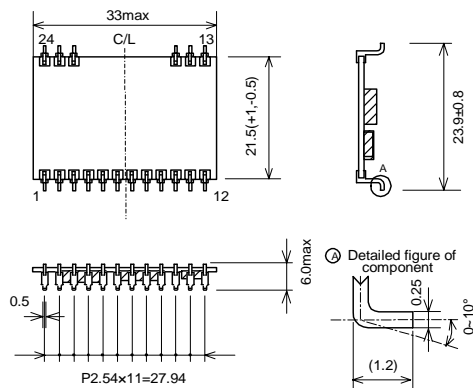


Figure 3

- Dimensions: mm
 - Tolerance when nothing specified ± 0.5

Table 5

Pin	Function	Pin	Function
1	on/off	11	Vout
2	Vin	12	V.ADJ
3	Vin	13	NC
4	Vin	14	+S
5	GND	15	-S
6	GND	22	NC
7	GND	23	P-Good
8	GND	24	NC
8	GND		
9	Vout		
10	Vout		

Ultra High Efficiency 93%
High-speed Response, Step-Down DC-DC Converter

Bellnix[®]

20 Watt BSV-A Series

<Block Diagram>

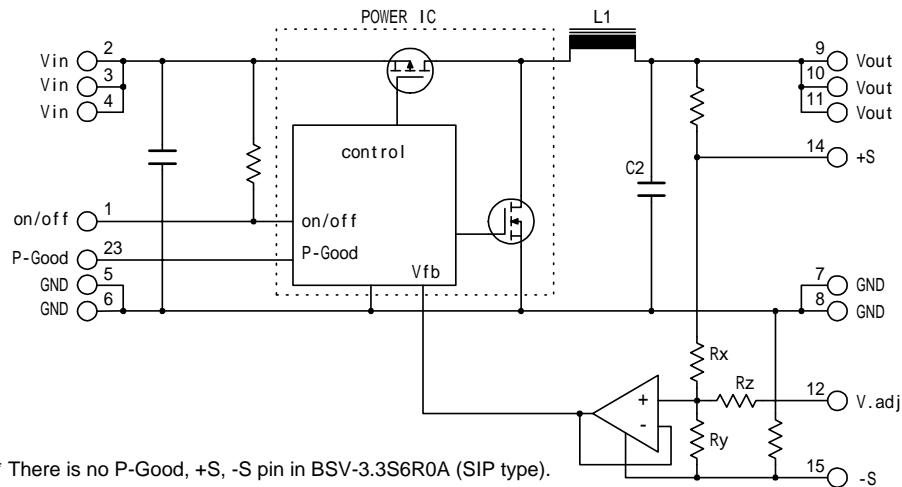


Figure 4

<Thermal Derating>

Please set this product in the place where good convection is ensured.

And when using this product in the environment that ambient temp. is 40°C or more, please refer to the thermal derating below.

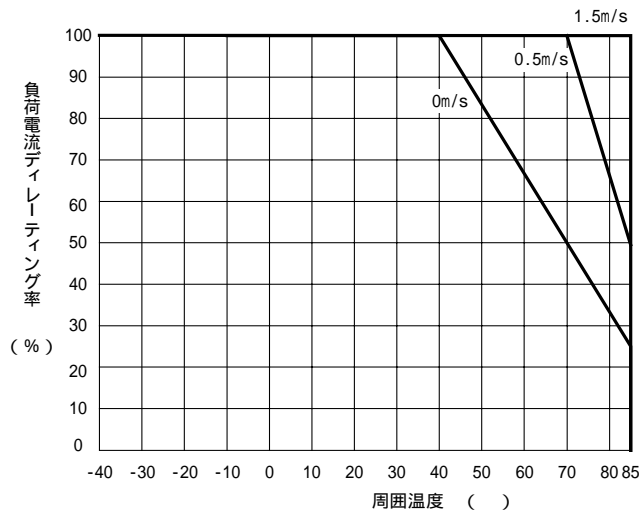


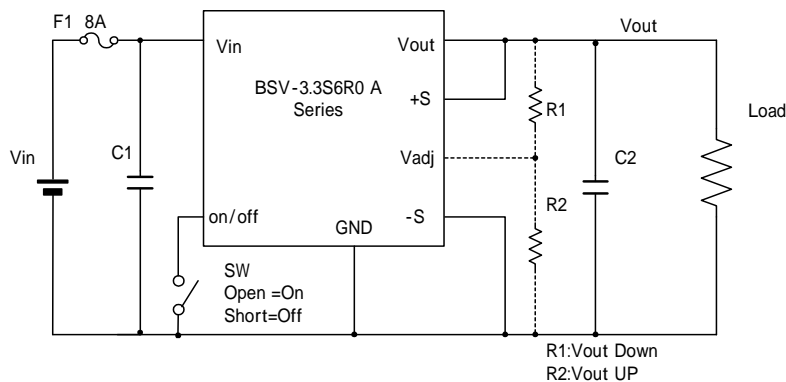
Figure 5

Ultra High Efficiency 93% High-speed Response, Step-Down DC-DC Converter

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20 Watt BSV-A Series

<Standard Connection Circuit Diagram>



* There is no P-Good, +S, -S pin in BSV-3.3S6R0A (SIP type).

Figure 6

Note 1: When not using the ON/OFF control, keep ON/OFF pin open.

Note 2: When not adjusting output, keep V.ADJ pin open.

Note 3: When it includes inductance in input line or switching element is connected to the input side or the wire is long, fulfilling the performance C1 will be required. Also we recommend a pattern with an additional C1 to lower the input impedance, and to verify on a actual equipment. Or, by adding C2 you can lower the output ripple more.

Recommended Capacitor

C1=33μF10WV

C2=2.2μF-22μF

C2: An output capacitor is built-in, so it is not required. However, by connecting 2.2μF-22μF, you can lower the noise more.

Note 4: There is no +S, -Spin in BSV-3.3S6R0A (SIP type).

<Method of Adjusting Output Voltage>

When using at 3.3V without adjusting output voltage, keep V.ADJ pin (12Pin) open.

By connecting a resistor between +Vout pin (9-11Pin) and V.ADJ pin (12Pin), you can adjust the output voltage within the range of 0.8-3.3V. (Vout Down Control)

By connecting a resistor between Vadj pin (12Pin) and GND pin (5-8Pin), you can adjust the output voltage within the range of 3.3V-3.6V. (Vout Up Control)

To calculate the external resistance, please refer to the equation below. After calculating the external resistance, please check the output voltage and adjust the resistance value.

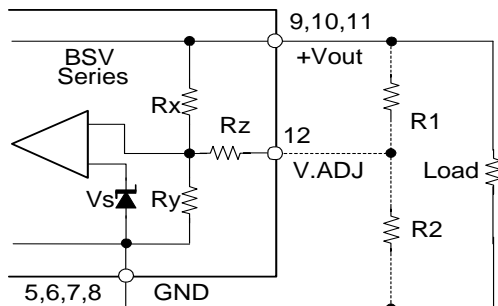


Figure 7

To set within the range of 0.8V-3.3V

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

To set within the range of 3.3V-3.6V

$$R2 = \frac{Rx \cdot Ry \cdot Vs}{Ry (Vo - Vs) - Rx \cdot Vs} - Rz$$

Vo= Required output V (Adjustable voltage range=0.8-3.6V)

Rx=10.2k ohm

Ry=2.7k ohm

Rz=0.1K ohm

Vs=0.703V

Bellnix DC-DC CONVERTERS

BDD20080825

<ON/OFF Control>

- ON/OFF Function

By using this ON/OFF control function, ON/OFF control can be secured in the output without intermitting input.
 This is an effective function when composing a power supply system sequence.
 And this can also be used as a power standby function for saving power control.

- Not using ON/OFF Function

Do not use the ON/OFF function, keep ON/OFF pin open.

- Method of ON/OFF Control

Between ON/OFF pin (1Pin) and S.GND (5-8Pin)
 Open ---- Output=ON
 Short ---- Output=OFF (0-0.7V 0.5mA typ.)

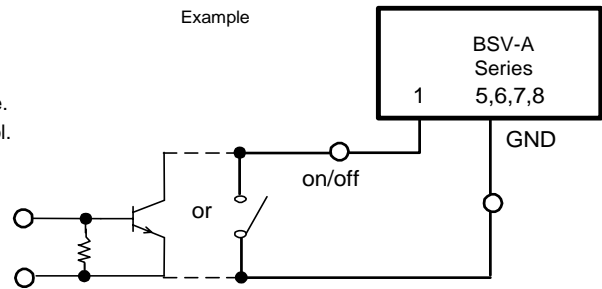


Figure 8

<To prevent reverse connection of Input Power Supply (ex.)>

This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).
 If you connect the input voltage reversed by mistake, it will be damaged.
 If there is a possibility of reverse connection, please add a protection as shown in the right figure.
 The right figure is an example using fuse and diode.

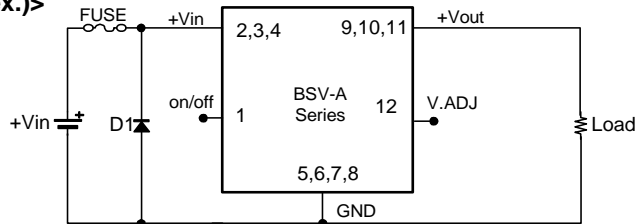


Figure 9

<Over-Voltage Protection (ex.)>

This product does not have a built-in over-voltage protection.
 If the switching element in this converter is damaged in short mode input voltage (+Vin) will be as it is.
 However, to prepare for damage at over-voltage mode, we recommend to add a circuit to intercept the supplying power circuit.

- Note1: When it is damaged at over-voltage mode, ON/OFF control does not operate.
- Note2: When there is a ON/OFF function on the supplying power side, this may be used.
- Note 3: Be sure that the DC power supply on the supplying side has the capacity to fuse the fuse.

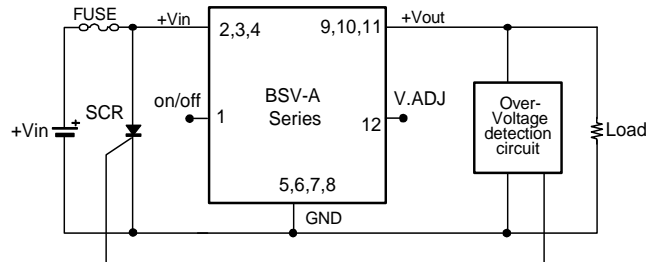


Figure 10

<Cleaning Conditions>

This product can not be washed whole. No-clean solder paste is recommend for this product.
 Only for SIP type and DIP type, if cleaning is necessary, use IPA and handwash the soldered surface by brush cleaning.
 And after cleaning, dry sufficiently before using this product.

<Soldering Conditions>

Solder under the following conditions.

1. With soldering iron 340°C to 360°C within 3sec.
2. With soldering dip 240°C to 260°C within 10sec.
3. Reflow method (only for SMD type)
 Preheating Temp.: 150-180°C, within 1min.
 Peak heating temp.: 250°Cmax.
 Reflowing frequency: once

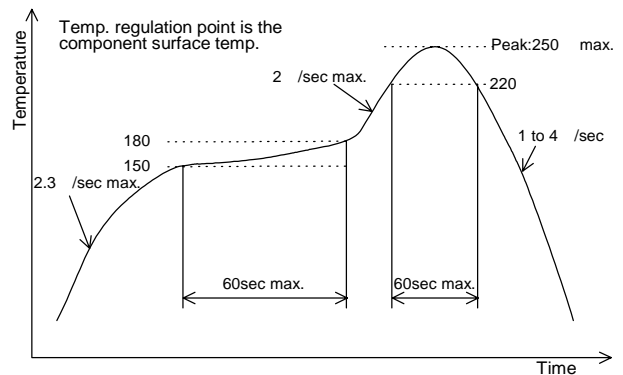


Figure 11

<Method to decrease the noise (ex.)>

Usually BSV-A series is used by adding an input/output capacitor, and to make the most of the converter's performance, and to lower the noise level further more, consider the following items when in designing the printed circuit board.

1. Use low impedance capacitor with good high frequency characteristic.
2. Shorten lead of each capacitor as much as possible, and make it low lead inductance.
3. Make the wiring loop space between the (+) and (-) of both input and output pin side as small as possible. The influence of leakage inductance can be decreased.
4. Design the print pattern of the main circuit as thick and short as possible.

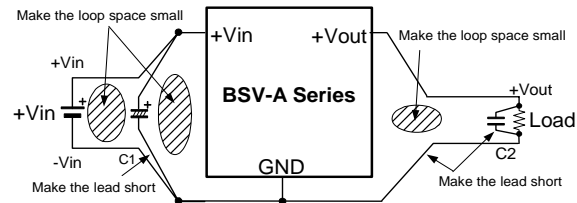


Figure 21

<Precautions>

- For this product parallel/ series operation is not possible.
- For mounting this product, please do not use connector or socket. The performance may not be fulfilled by the effect of contacting resistor. Mount to print board by soldering.
- This product has a built-in over-current and short protection circuit, but long time short circuit will cause failure, so please avoid it.
- May not be used for what would affect lives or properties directly by the failure of this product. Please confirm before adopting.
- Product can not be used under oscillation, strike or temp. condition that are out of the specification. Contact for any questions.
- There is possibility of damage from static. When the worker has electrified static, please earth discharge and working on an earthed worktable will be recommended.
- This product does not have a built-in fuse. When it is abnormal, please connect the fuse with +input line as a protection for excessive current flowing into the input. Please give capacity, so that the fuse can be cut to from the power supply.
- This product does not have a built-in over-voltage protection. When over-voltage is abnormally generated in the module, there is such a mode that the input voltage appears to the output straight, and which may cause smoke and ignition. Please make sure to add the over-voltage protection circuit to prevent it.
- No test certificate is attached to this product.