

■ Information

BSS-A Series is a low cost, thin type and high efficiency non-isolated DC-DC converter. It has got a more efficient and simpler circuit structure than the existing product. Furthermore, the synchronous feature has been added as a new feature.



■ Features

- Heat sink and Cooling Air Flow not required
- High Efficiency 85 to 94%
- Adjustable Output Voltage
- Non-Isolated Type Converter
- Small-footprint SIP Type
- Over Current Protection
- No Tantalum Capacitor
- Wide Input Voltage Range
- Wide Output Voltage Range
- ON/OFF control
- Synchronous Function
- High Reliability and High Performance
- Operating temp -10°C to +80°C (Temp derating required)
- RoHS compliance

■ Model/Rating

Table 1

Models BSS-A Series	Input V Vdc	Output V Vdc	Output I A	Line Reg. % (typ.)	Load Reg. % (typ.)	Noise mVpp (typ.)	Efficiency % (typ.)
BSS-12S2R5A	15 – 36	9.5 – 15	0 – 2.5	0.1	0.2	50	94

Note 1:An external capacitor is required.

Note 2:Voltage difference between input and output is required.

Note 3:Derating may be required depending on the input/output use conditions.

Note 4:Value of ripple noise is when an external electrolytic capacitor is added. (BW=20MHz)

Note 5:Efficiency is when input/output is rated.

■ Specifications

Table 2

Input Voltage Range	Refer to Table 1 ($V_{in} \geq (V_{out} + 0.8) / 0.78$)
Rated Output Voltage	12V ± 4% (Vadj pin when open)
Adjustable Output Voltage	Refer to Table 1
Line Regulation	Refer to Table 1 (Rated output, input voltage varying from 15 to 36V)
Load Regulation	Refer to Table 1 (Rated input/output voltage, load varying from 0 to 100%)
Temp Regulation	±0.01%/°C typ. (Rated input/output, operating temp varying from -10°C to +50°C)
Ripple Noise	Refer to Table 1 (Rated input/output, Common temp, measurement frequency bandwidth 20MHz)
Efficiency	94% typ. (Rated input/output, Common temp, Refer to Table 1)
Over Current Protection	Operate at 105%+ of rated load current, Auto recovery type, Pls refrain from long hours of over load and short circuit conditions.
Over Voltage Protection	No
Remote ON/OFF Control	Between 1 pin (RC pin) and 4, 5 pin (GND pin) : Output switches on when short, Output switches off when open. (Refer to section 9 for more details)
Input Current at No Load	19mA typ. (Rated input/output voltage at no load)
Stand-by Current	1.0mA typ. (Rated input voltage, Between 1 pin (RC pin) and 4, 5 pin (GND pin) when open)
Synchronous Feature	Yes. (Refer to section 11 for more details)
Operating Temp Range	-10°C to +80°C (Temp derating required depending on the input/output condition), (Refer to section 12 for more details)
Storage Temp Range	-20°C to +85°C
Humidity Range	95%R.H. max. (While the max wet bulb temp. is 35°C with no condensation)
Cooling Conditions	Natural air flow (Place this product where air convection is well)
Vibration	5-10Hz all amplitude 10mm, 10-55Hz acceleration 2G (3 directions for one hour each with no power on)
Impact	Acceleration 20G (3 directions, 3 times each, total of 18 times), Shock time 11 ± 5ms
Weight	10.0g type.
Dimension	SIP type, W=38 L=35 h=10 typ. (mm) (Refer to section 6 for details)

*The above specifications are when input/output is rated and the ambient temp is 25°C ± 5°C unless otherwise specified.

1. Applicable Range

The specifications are applied to the direct current input and non-isolated type DC/DC converter, BSS-12S2R5A.

2. Model/Rating

Model	Rated Input Voltage	Rated Output Voltage	Rated Output Current	Package
BSS-12S2R5A	DC24V	12V	2.5A	SIP

3. Specifications and Standards

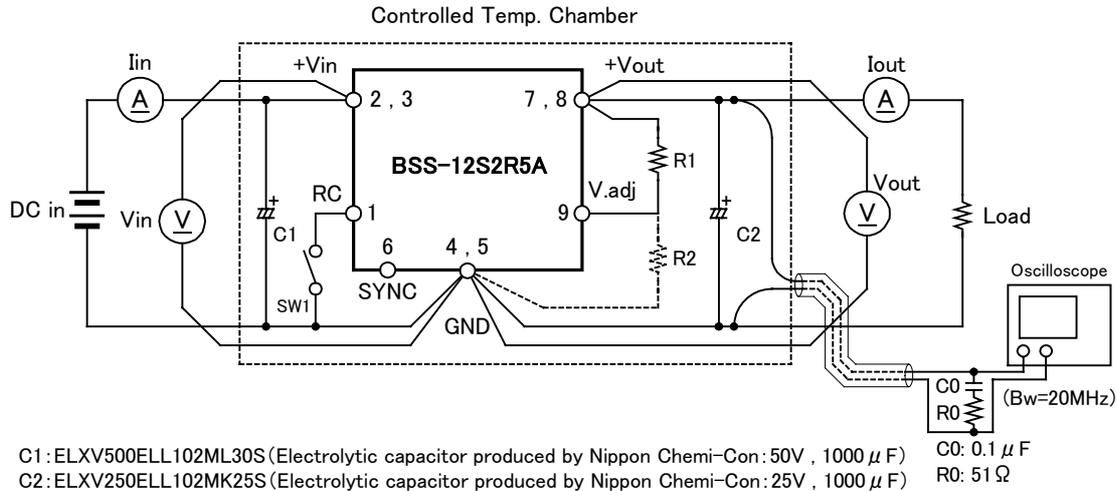
This product complies with RoHS.

The specifications are when input/output is rated and the ambient temp is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ unless otherwise specified. *1

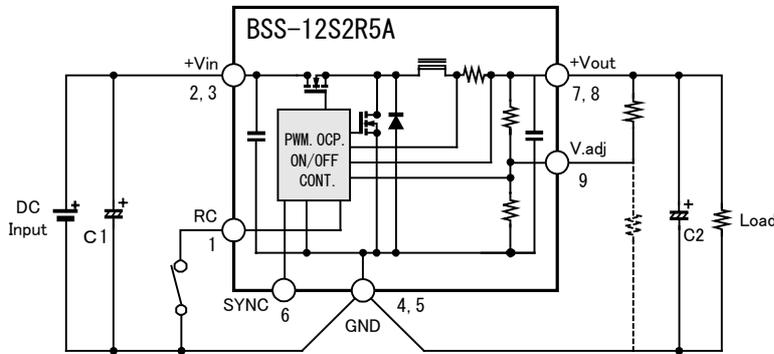
Item	Specifications and Standards	Conditions
Input Characteristics		
Input Voltage Range	+16.4V to +36V	Output voltage $V_o=12\text{V}$
	+15 to +36V	$V_{in} \geq (V_{out}+0.8)/0.78$ When output voltage is adjusted.
Input Current	1.3A typ.	When input/output is rated.
Output Characteristics		
Output Voltage Accuracy	$12\text{V} \pm 4\%$ ($12\text{V} \pm 0.48\text{V}$)	Voltage setting deviation, Line regulation and Load regulation are included.
Output Current	2.5A	
Line Regulation	0.1% typ., 0.5% max.	Input varying from 16.4 to 36V (When output is rated)
Load Regulation	0.2% typ., 1.0% max.	Output varying from 0 to 2.5A
Temp Regulation	$\pm 0.01\%$ / C typ.	Temp regulation varying from -10°C to $+50^{\circ}\text{C}$ (When input/output is rated)
Ripple Noise	50mVp-p typ., 150mVp-p max.	Rated input/output, BW = 20MHz
Adjustable Output Voltage Range	9.5V to 15V (Adjusted using an external resistor)	-Conditions added that there is a difference in voltages between input and output. -The default output voltage is 12V.
Other characteristics		
Oscillation Frequency	300kHz typ.	
Efficiency	94% typ.	When input/output is rated.
Extra Features		
Over Current Protection	Operate at 105%+, Auto Recovery	Current should be at 1.5A or lower when recovered.
Over Voltage Protection	No	
ON/OFF Control	Yes	Refer to section 9 of ON/OFF control
External Synchronous Feature	Yes	Refer to section 11 of External synchronous feature
General Conditions		
Operating Temp Range	-10°C to $+80^{\circ}\text{C}$ (Temp derating required)	Refer to section 12 of Temp derating
Storage Temp Range	-20°C to $+85^{\circ}\text{C}$	
Operating Ambient Humidity	20 to 95% R.H	The max web bulb is $+35^{\circ}\text{C}$ with no condensation.
Storage Ambient Humidity	20 to 95% R.H	The max web bulb is $+35^{\circ}\text{C}$ with no condensation.
Cooling Conditions	Natural convection	Place the product where air convection is well.
Dimensions/Weight		
Dimensions	W=38, L=35, H=10(mm) typ.	Refer to section 6 of Outer dimensions
Weight	10.0g typ.	

*1: In regards to the measurement circuit of section 4.

4. Measurement Circuit

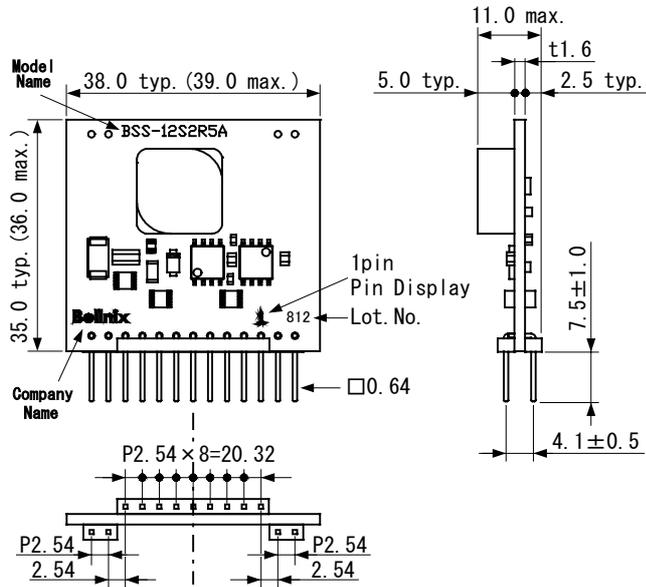


5. Block Diagram



6. Outer dimensions and pin information

6-1. Configurations/Dimensions



Pin	Name	Feature
1	RC	ON/OFF pin
2	+Vin	Input pin
3	+Vin	Input pin
4	GND	GND pin
5	GND	GND pin
6	SYNC	Synchronous signal input pin
7	+Vout	Output pin
8	+Vout	Output pin
9	V.adj	Adjustable output voltage pin

Units : mm

Tolerances unless otherwise specified : ±0.5

Pin

Material : Brass

Treatment : Nickel base tin plate

6-2) Lot Display

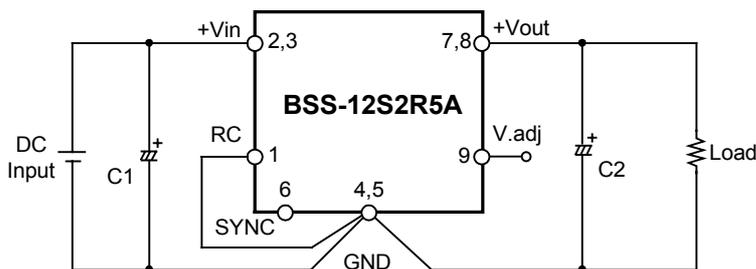
85 (2008/May manufacturing)

8 D 2 (2008/Dec manufacturing)

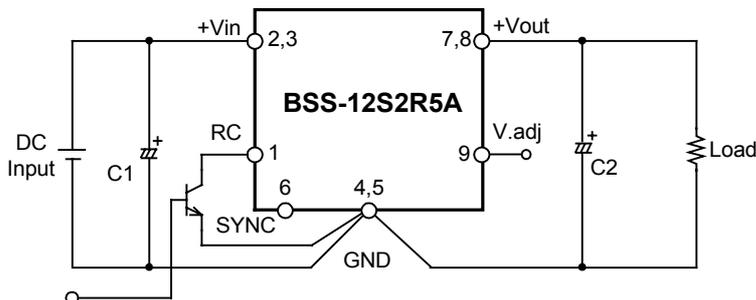
- └─ Internal manufacturing number (No number may be displayed)
- └─ Manufacturing month (Jan to Sep = 1 to 9, Oct = 0, Nov = N, Dec = D)
- └─ Manufacturing year (Last number of the year)

7. Pin Connection Diagram

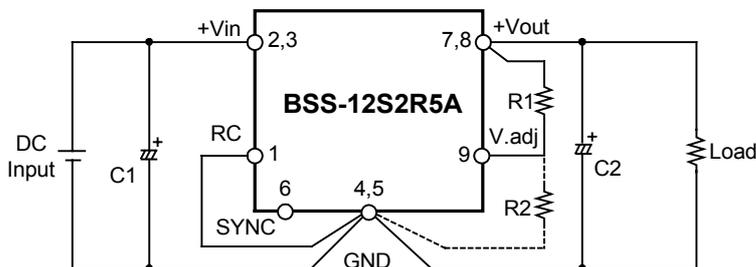
7-1) Standard Connection Diagram



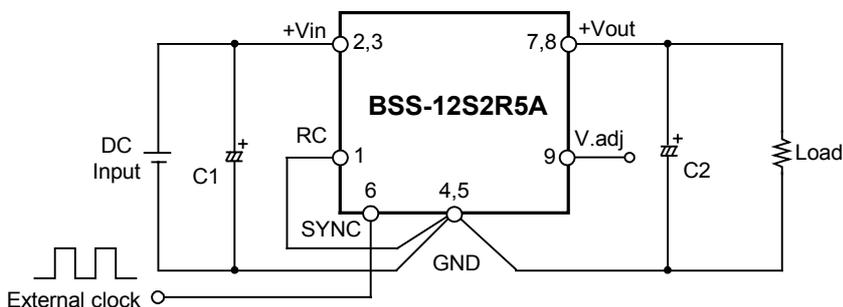
7-2) Connection when using the ON/OFF control



7-3) Connection when using the adjustable output voltage



7-4) Connection when using the synchronous feature



Note 1. When not using the ON/OFF control, connect RC pin to GND pin.

Note 2. When not using the adjustable output, keep V.adj pin open.

When open, the output voltage is 12V.

Note 3. SYNC pin is a synchronous signal input pin. When not using the synchronous feature, keep this pin open.

Note 4. Make sure to add input/output capacitor, C1 and C2.

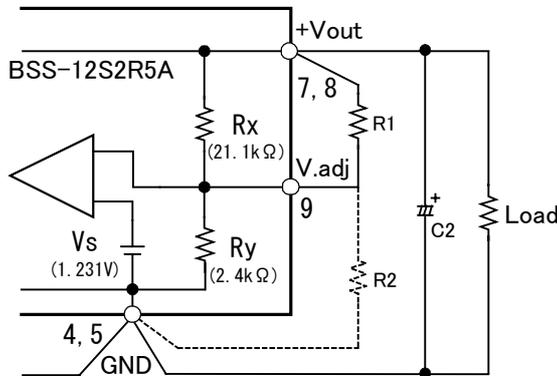
Place input/output capacitor, C1 and C2 near to the converter with wide pattern wiring.

Recommended capacitors C1 : 50V, 1000 μ F ELXV500ELL102ML30S (Nippon Chemi-Con) or equivalent

C2 : 25V, 1000 μ F ELXV250ELL102ML25S (Nippon Chemi-Con) or equivalent

8. Adjustable Output Voltage

When using output voltage other than 12V (from 9.5V to 15V), the output voltage may be adjusted to Vout Down (9.5V to 12V) or Vout Up (12V to 15V) by connecting an external resistor R1 or R2.



Vs	1.231V
Rx	21.1kΩ
Ry	2.4kΩ
Vo	Desired output voltage

8-1) Setting method for Vout Down (9.5V to 12V)

- Keep R2 open.
- Connect R1 calculated in the below formula between +Vout to V.adj pins.

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

(e.g.) Adjustable output voltage resistance fixed value

Desired output voltage Vo[V]	Vout Down R1[kΩ]	Vout Up R2[kΩ]
9.5V	68.33	Open
12V	Open	Open
14V	Open	13.34
15V	Open	8.815

8-2) Setting method for Vout Up (12V to 15V)

- Keep R1 open.
- Connect R2 calculated in the below formula between V.adj to GND pins.

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

When desired output voltage can not be set with one resistor, set 2 resistors in series.
e.g.) 68.33kΩ (68kΩ + 330Ω)

- Note 1 : When using the converter at output voltage of 12V without adjustment, keep V.adj pin open.
- Note 2 : After calculating an external resistance value, check the output voltage and adjust the resistance value.
- Note 3 : The converter should have a higher input voltage than output voltage. The minimum required input voltage varies depending on the output voltage, use the below formula to calculate the minimum required input voltage.

$$Vin \text{ min.} = (Vo + K) / D$$

e.g.) Vo = 15V

$$Vin \text{ min.} = (15 + 0.8) / 0.78 = 20.26[V]$$

Vin min.	Minimum required input voltage [V]
Vo	9.5 - 15 (Desired output voltage[V])
K	0.8 (Coefficient)
D	0.78 (Duty)

During synchronous operation
 : $D = 0.96 - f_{sync} \times 624 \times 10^{-9}$
 (f_{sync}: Synchronizing frequency[Hz])

- Note 4 : Since V.adj pin has a high impedance, the wiring might pick up some noise in a bad environment and this might have a negative impact. Please refrain from changing output voltage drastically during the power-on by opening, closing and switching external resistors (R1, R2). Choose R1 and R2 resistors with good accuracy and temp characteristics and place them as near to the converter as possible. Make sure to mount R1 and R2 by soldering without using connectors and sockets.

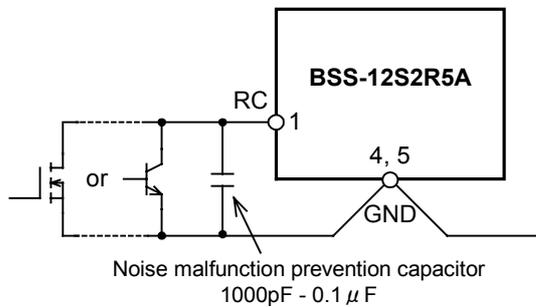
9. ON/OFF feature

Output voltage may be controlled by ON/OFF feature without switching on and off the input that is to short or open the circuit between RC pin and GND pin. It is an efficient feature to configure a sequence of the power supply system. It also conserves power during the stand by.

9-1) When not using the ON/OFF control
Please connect the RC pin to the GND pin.

9-2) When using the ON/OFF control
Please see below.

Output Voltage	Between RC-GND pins	Pin leak current	Pin open voltage
ON	Short (0 - +0.4V)	2.0mA max.	—
OFF	Open	—	8.0V max.



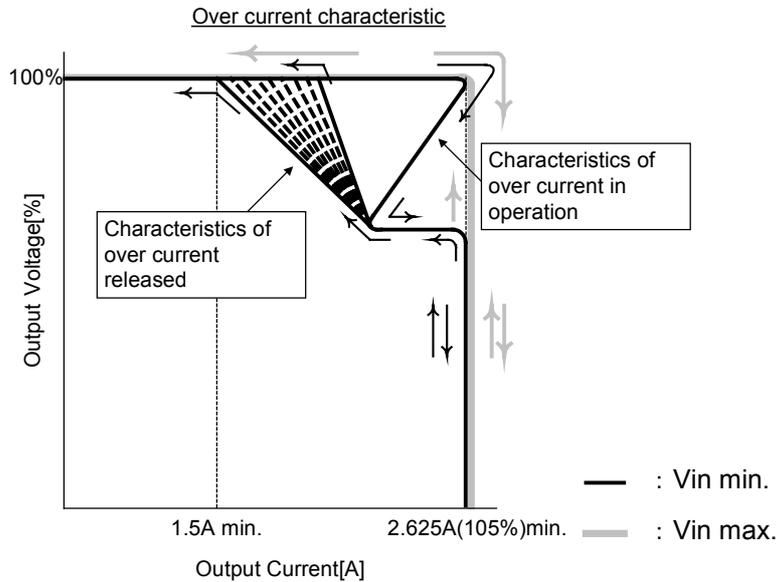
Note1) Switching element for the ON/OFF control may be used by an open collector (or drain).
Note2) Please place the switching element near to the converter and connect with a short loop.

10. Over current protection feature and Load current restriction during start-up

10-1) Over current protection features

Features of over current protection during the operation and release are as indicated in the below diagram. A trace line of the over current protection features changes depending on the input voltage.

The same line of over current protection is depicted during the operation and release in the area of the max input voltage. As the input voltage decreases, the trace line will form inward (toward smaller current side) during the release, compared to the operation.



10-2) Load current restriction during the start-up

Converters that have the over current feature like this product may not start up when it is connected to nonlinear loading or constant current loading such as a lamp and a motor load.

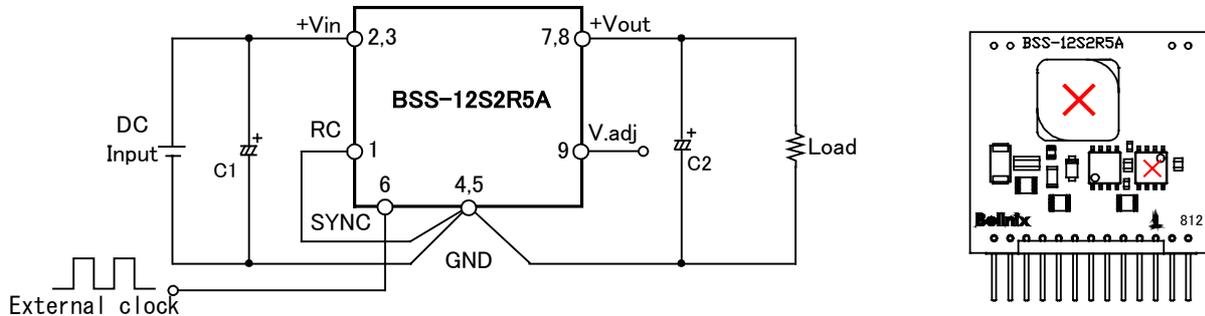
Please use the product with the load current less than the value mentioned below during the start-up.

Output current restriction value during the start-up : 1.5A or smaller

11. External synchronous features

11-1) Synchronous feature

Since the converter operates at 300kHz (typ.) of oscillating frequency, frequency may be synchronized with feeding an external clock into SYNC pin.



Note1. If not using synchronous feature, keep SYNC pin open.

Note2. If oscillating frequency becomes high by synchronous feature, switching loss inside the converter will increase and generate heat. Therefore, output current has to be kept low (not exceeding 100°C) at the two X spots of on the converter's diagram above.

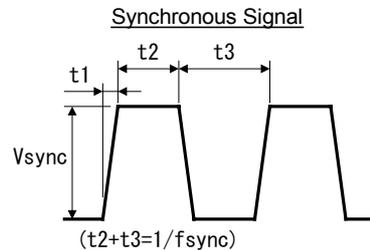
Note3: If the synchronous feature changes oscillating frequency, the minimum required voltage difference between the input and output will change. Apply the below formula about Note 3 on P8.

$$D = 0.96 - f_{sync} \times 624 \times 10^{-9} \quad (f_{sync} : \text{Synchronizing frequency [Hz]})$$

11-2) Synchronous signal (external clock)

Synchronous signal feeding into the SYNC pin is required to satisfy the below conditions.

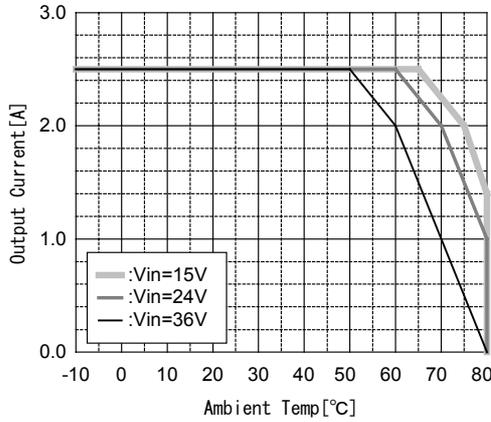
- f_{sync} : 360 – 440kHz
- V_{sync} : 2.5 – 4.5V
- t₁ : 500ns or lower
- t₂ : 1μs or higher



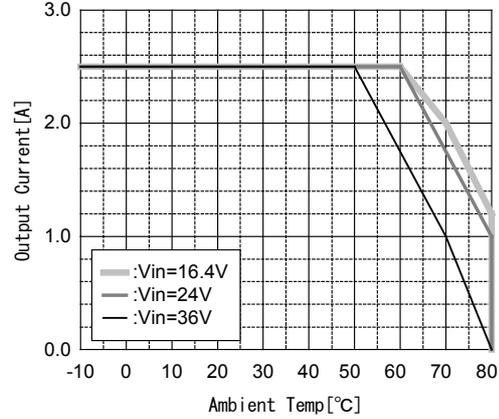
12. Output Derating

Place this product where air convection is well. The derating needs to be adjusted depending on the environment. The derating varies depending on the ambient temperature and the input voltage.

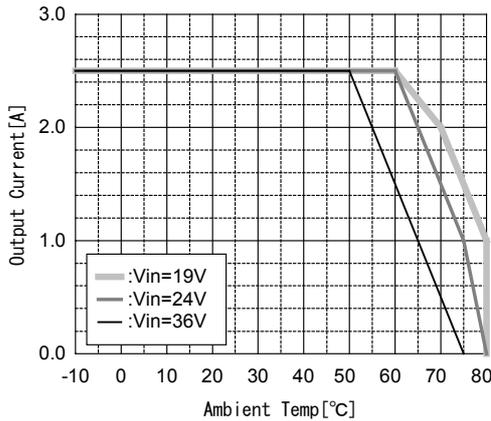
12-1) Vout=9.5V



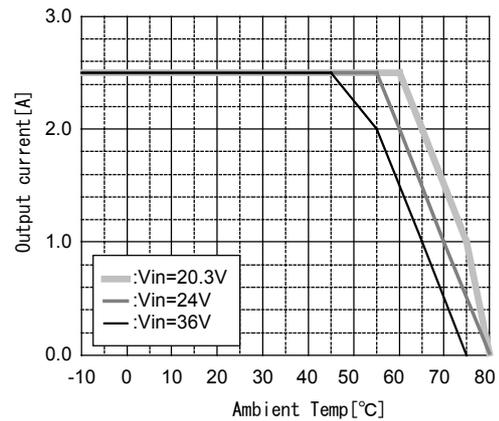
12-2) Vout=12V



12-3) Vout=14V



12-4) Vout=15V



13. External Capacitor

Make sure to add input/output capacitors, C1, C2. (Refer to connection diagram in section 7)

Recommended capacitors for input/output capacitors, C1, C2 are as follow.

C1: 50V, 1000 μ F ELXV500ELL102ML30S (Nippon Chemi-Con) or equivalent.

C2: 25V, 1000 μ F ELXV250ELL102MK25S (Nippon Chemi-Con) or equivalent

When using capacitors other than the recommended one, please choose one which fits the below conditions.

	Dielectric pressure	Capacitance	ESR(Impedance) 20°C/-10°C
Input capacitor : C1	Max input voltage or more	330 μ F or more	29m Ω / 73m Ω or lower for 100kHz Permissible ripple current 2.1A rms. (100kHz) or more
Output capacitor : C2	Max output voltage or more	330 μ F or more	34m Ω / 85m Ω or lower for 100kHz

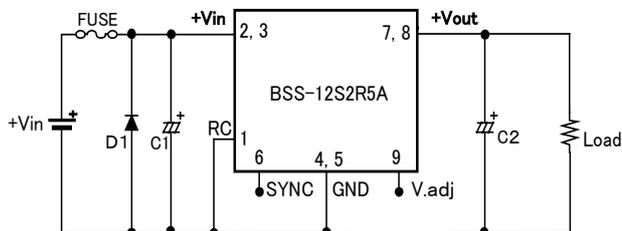
Note: Ample evaluation should be given with a real machine when choosing a capacitor.

14. Reverse polarity protection for input power supply

The product is a step down DC-DC converter from straight polarity to straight polarity and is non-isolated between input and output.

It will be damaged if the input polarity is reversed.

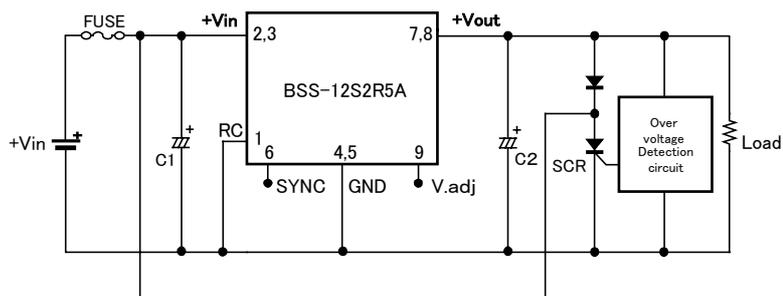
Please add a protection circuit as indicated in the below diagram when there is a possible reverse connection. Fuse and diode have been used in the below diagram.



15. Over voltage protection circuit (i.e.)

The product does not have an over voltage protection circuit built in.

When a switch element inside the product is damaged in a short mode, DC input voltage will appear in output. In case over voltage mode may be damaged, add the shut off circuit as indicated in the below diagram.



Note1: The ON/OFF control will not operate when the product is damaged in the over voltage mode.

Note2: Make sure that DC power supply has enough capacitance to meltdown a fuse on the supply side.

16. Mounting conditions

Please follow the below conditions in regards to temp and time for soldering.

16-1) Soldering Iron

340°C - 360°C within 5 seconds

16-2) Dip solder bath

240°C - 260°C within 10 seconds

17. Storing conditions before mounting

Please follow the below precautions.

- Store the product where there are no noxious fumes (chlorine, sulfur).
- Do not store the product in a corrosive environment
- Keep the product away from dirt and dust
- Keep the product out of direct sunlight.
- Do not place heavy objects on the product.

18. Vibration/Impact test

Vibration	5 – 10Hz	Total amplitude 10mm (one hour each for three directions)
	10 – 55Hz	Acceleration 2G (one hour each for three directions)
Impact	Acceleration 20G (3 times each in three directions, total 18 times)	
	Impact time	11±5ms

19. Washing

If washing is required, use a hand brush with IPA (Insolvency Practitioner Association) on the solder side only. A non-scrub flux is recommended. Completely dry the product after washing before use.

20. Precautions

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

-This product is intended for use in general electronic appliances (office work machines, telecommunication equipment, and measurement equipments). Do not use for medical equipments, nuclear power equipments, and trains, etc. where the malfunction and damage of this product may directly cause harm to human life and or property. Please confirm when using except in general electronic equipment.

-For this product, parallel and serial operations are not possible.

-For mounting this product, please do not use connectors or sockets. The performance may not be fulfilled by the effect of contacting resistors. Mount onto the PCB by soldering.

-The product could be damaged when the GND pin gets OPEN when applying current. If a module is taken out for the purpose of the inspection, make sure that input pin voltage and output pin voltage of the module is 0V.

-This product has a built-in over-current, short circuit protection, however long time usage in short circuit should be avoided since this may cause failure to the product.

-This product may be damaged if used under nonstandard electric and environmental conditions such as the temperature. Please be sure to always use within the standard conditions.

-Do not store this product where corrodible gases and dusts may generate.

- This product does not have a fuse built in. When abnormal, 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.

-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 have a built-in over voltage protection, however when the module malfunctions and over voltage occurs, the over voltage protection installed will not activate. Therefore, an over voltage protection circuit should always be connected.

-The product does not have over voltage protection built in. If over voltage happens due to an abnormality inside the module, input voltage will appear in output as it is which could lead to smoke or fire. Make sure to add an over voltage protection circuit in order to prevent this from happening.

-No test certificate is attached to this product.

21. 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.

This warranty covers only the stated products in this datasheet.

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

Please contact us.

E-mail: info@bellnix.com

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

23. If the specifications are unclear, both parties should consult with each other..