

# Output Voltage 3V-5V Ultra High Efficiency 95%

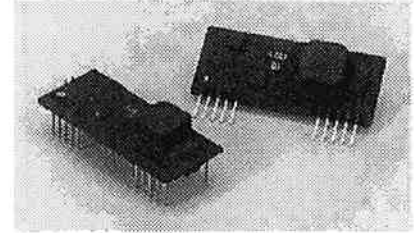
## Ultra Small Size, Step-Down Non-Isolated Type DC-DC Converter

# 15Watt BSI A Series

15W BSI A Series is an ultra small size, light weight, and non-isolated type step-down DC-DC converters, which has achieved ultra high efficiency (95%) by the latest synchronous rectification circuit technology. BSI A series with the size of 20×50×10mm and 15W is capable to be used without heat sink, and it is capable to choose between the two types, vertical or horizontal (F type) depending on the usage. This product has been accomplished as a high reliability, long life product by adopting the latest integrated circuit, low loss diode etc. and a simple circuit composition.

### <Features>

- Low height, ultra small type
- Convert with high efficiency 12V → 5V
- Ultra high efficiency 95%
- Low standby input current 100μA max.
- Wide operating temperature range -10°C to +70°C
- MTBF 1,000,000Hrs, All products received aging
- High reliability, long life, high performance
- High reliability from latest surface mounting structure
- Remote ON/ OFF control
- Wide input voltage range
- Over-current protection
- Non-isolated type
- Adjustable output
- Low cost
- High reliability, long life, high performance
- Ultra high efficiency 95%



### <Model, Rating>

Table 1

Model	Rating Input Voltage Vdc	Input Voltage Range Vdc	Rating Output Voltage Vdc	Output Voltage Trim Range Vdc	Output Current A	Ripple & Noise mVpp(typ)	Efficiency %(typ)	Package
<b>BSI A (15W) Series</b>	12	6.0 - 16.5	5	3.0 - 5.0	0 - 3	50	95	SIP
BSI-5.0S3R0A								DIP
BSI-5.0S3R0FA								

### <Specification>

Table 2

Rating Input Voltage/ range	12V/ 6.0-16.5V
Rating Output Voltage	5.0V±5% (When 14pin is open.)
Output Voltage Trim Range	3.0-5.0V
Line Regulation	0.2% typ. (For the Input voltage range of 6.0-16.5V, at rating load)
Load Regulation	0.2% typ. (At rating input voltage, when load regulation is 0% - 100%)
Temperature Coefficient	±0.01%/ °C typ. (When operating temperature changes between -10°C to +50°C)
Ripple & Noise	50mVp-p typ. (Rating input/ output, Room Temperature.) (20MHz bandwidth)
Efficiency	95% (Rating input/ output, Room Temperature, refer to table 1)
Over-Current Protection	Operates at more than 105% of rating load current, auto recovery type. Avoid more than 30sec. of short-circuit condition.
Over-Voltage Protection	None
No Load Input Current	2mA max. at No load and Output ON
Standby Input Current	100μA max. at No load and Output OFF (0V)
Remote ON/ OFF Control	Between 5pin (ON/ OFF pin) and 3, 4pin (-Vin): Open= Output ON, Short= Output OFF (Refer to application)
MTBF	1,000,000Hr min. (EIAJ RCR-9102)
Switching Frequency	190kHz typ. (20% - 100% load current range, When the load is 0% - 20% the switching frequency will go down.)
Operating Temperature Range	Operating Temperature -10°C to +70°C (Derating above +50°C required)
Storage Temperature Range	Storage Temperature -20°C to +85°C
Humidity range	95%R.H max.
Cooling Condition	Natural air cooling (Set in a place with good air circulation.)
Vibration	5 - 10Hz All amplitude 10mm (1 hour in each of 3 orthogonal axes), 10 - 55Hz acceleration 2G (1 hour, in each of 3 orthogonal axes)
Shock	Acceleration 20G (3 times in each of 3 orthogonal axes), Shocking time 11±5ms
Weight	10g typ.
Outline (1)	W=20.5 L=50 H=9.8 (mm) (For more detailed dimensions refer to the outline on page 2.)
Outline (2) F type	W=20.5 L=50 H=10.3 (mm) (For more detailed dimensions refer to the outline on page 2.)

\* The above specification will be provided at rating value, when there is no specified condition described.

### <Outline>

[1] SIP type  
BSI-5.0S3R0A

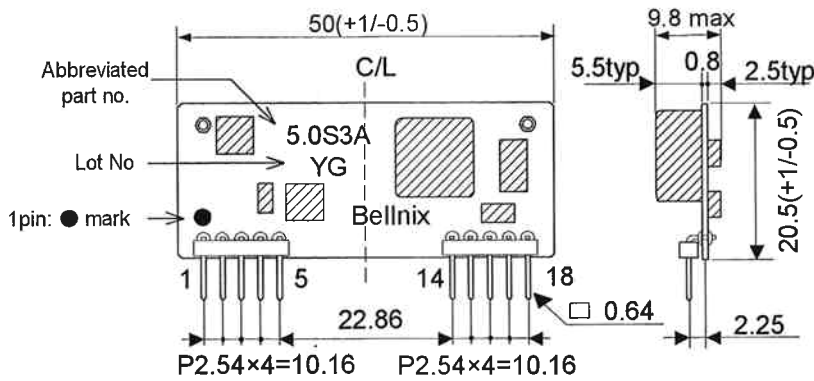


Figure 1 Outline (SIP type)

pin	Function
1	+Vin
2	+Vin
3	-Vin
4	-Vin
5	on/off
14	V.ADJ
15	-Vout
16	-Vout
17	+Vout
18	+Vout

Dimensions: mm  
Tolerances unless otherwise specified :±0.5  
External resinous coating

[2] DIP type  
BSI-5.0S3R0FA  
(F type size)

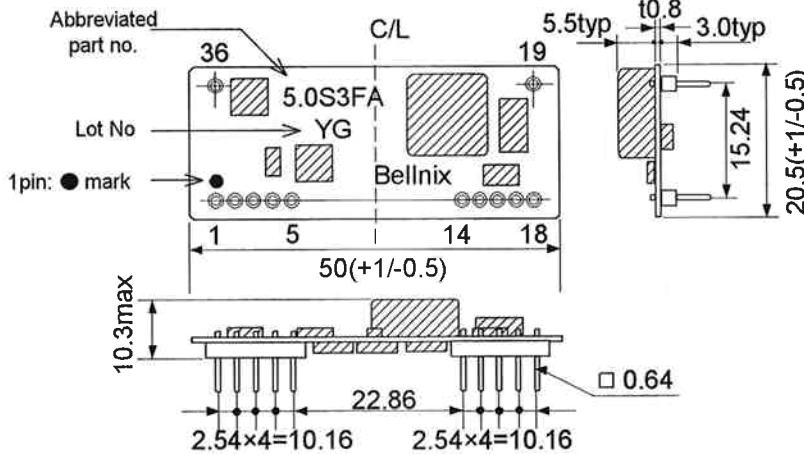


Figure 2 Outline (DIP type)

pin	Function
1	+Vin
2	+Vin
3	-Vin
4	-Vin
5	on/off
14	V.ADJ
15	-Vout
16	-Vout
17	+Vout
18	+Vout
19	NC
36	NC

Dimensions: mm  
Tolerances unless otherwise specified :±0.5  
External resinous coating

### <Block Diagram>

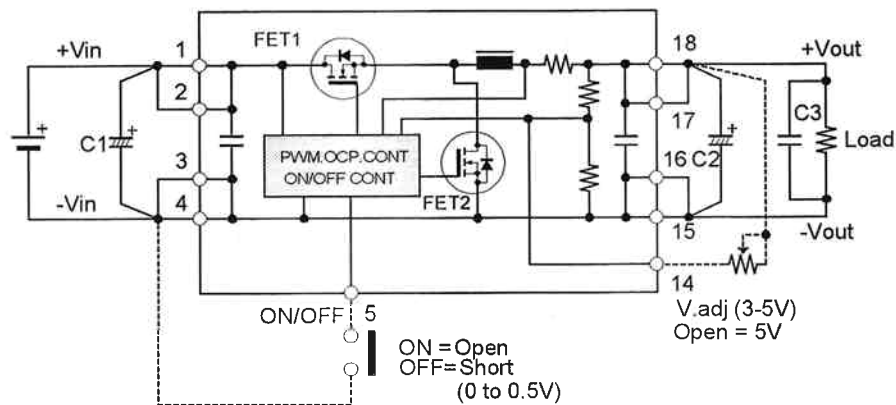


Figure 3 Regarding external components, refer to the application.

# Output Voltage 3V-5V Ultra High Efficiency 95%

## Ultra Small Size, Step-Down Non-Isolated Type DC-DC Converter

# 15Watt BSI A Series

**<Usage>**

**(A) Standard Connection**

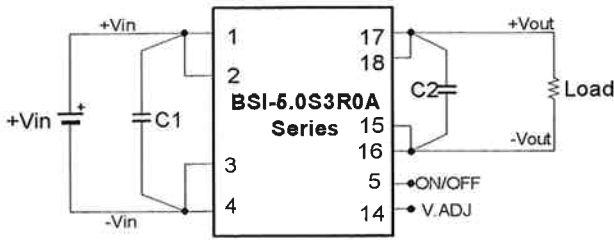


Figure 4 Standard Connection

**(B) ON/ OFF Control Connection**

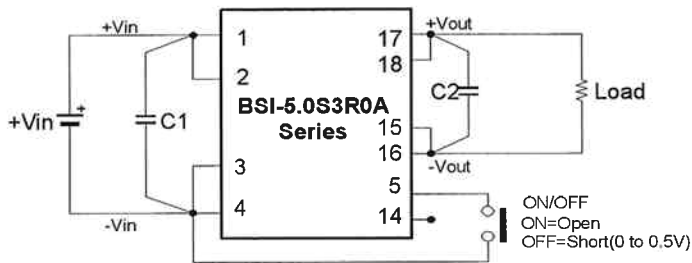


Figure 5 Remote ON/OFF Connection

**(C) Output Voltage Adjustment Connection**

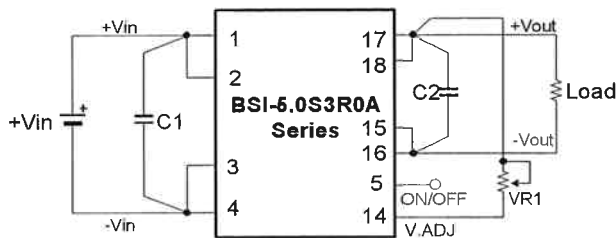


Figure 6 Output Voltage Adjustment Connection

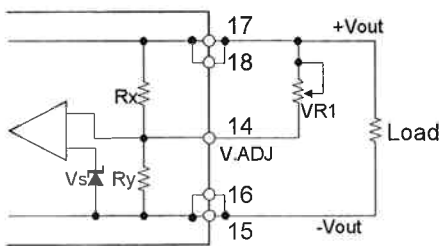


Figure 7 Internal Circuit

Be sure to add an external capacitor (C1, C2)

Choice of external capacitors:

C1=100µF20WV × 2pcs or more OS-CON

C2=220µF10WV × 1pce or more OS-CON

SH series (SANYO) or equivalent capacitors

Rating Output Voltage: +5V ±5%

ON/ OFF is controlled by opening or shortening 5pin (ON/ OFF) and 3, 4pin (-Vin).

A transistor (open collector) is recommended for the open and short control parts.

Output V: ON

Between (5pin) and (3pin, 4pin) : OPEN

Output V: OFF

Between (5pin) and (3pin, 4pin) : SHORT

Off state Voltage 0 - 0.5Vdc (0.1mA max.)

Output voltage decreases by connecting a resistor between 14pin (V.ADJ) and 17, 18pin (+Vout).

The output voltage trim range is as in table 1.

The output voltage trimming resistor can be calculated by the following equation.

To reduce the output voltage

$$VR1 = \frac{Rx \times Ry \times (Vo - Vs)}{Rx \times Vs - Ry \times (Vo - Vs)}$$

<b>BSI-5.0V</b> type calculated value
Vo= Requested Output Voltage (Vout trim range:3.0V-5.0V)
VR1=Vout trimming resistor (down)
Vs=0.8V
Ry=20k ohm
Rx=106k ohm

Table 3

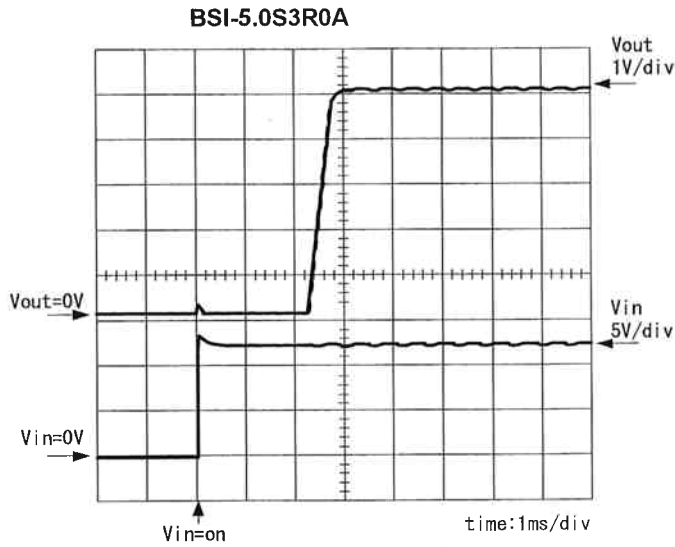
Note 1: When 14pin V.ADJ is open, the output will be the rating value.

Note 2: When using a trimmer potentiometer, be careful of the position of the adjustable lug. It is recommended to confirm the resistor value in advance, or to start the initial energizing after turning the lug in the direction of low voltage. And for mass production using a fixed resistor is recommended.

Note 3: Checking the output voltage value using a converter after calculating the resistor value is also recommended.

<Turn-On transient>

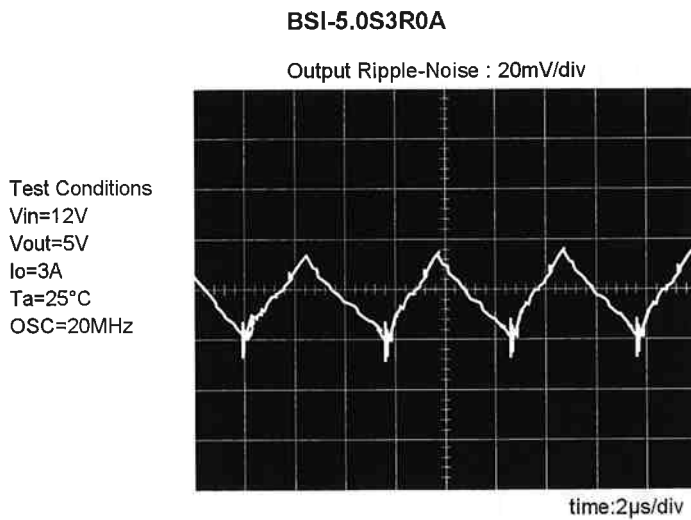
Note: These test data do not represent all products.



Test conditions: At rating input, rating load and room temp.

Figure 8

<Output Voltage Ripple Noise>



Test conditions: At rating input, rating load and room temp.  
 Test circuit is indicated in figure 12.

Figure 9

# Output Voltage 3V-5V Ultra High Efficiency 95% Ultra Small Size, Step-Down Non-Isolated Type DC-DC Converter **15Watt BSI A Series**

**<Test Data>**

Note: These test data do not represent all products.

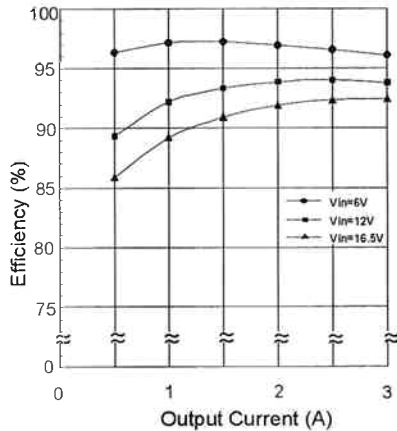
Model: BSI-5.0S3R0A

Temp. Condition: +25°C

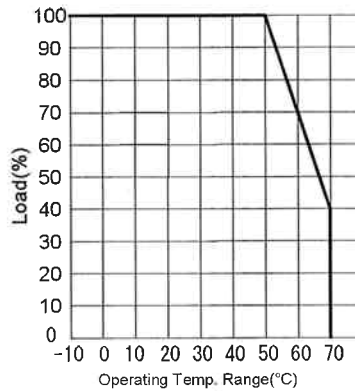
Input			Output				Efficiency (%)
Voltage (V)	Current (A)	Power (W)	Voltage (V)	Current (A)	Ripple/Noise (mVp-p)	Power (W)	
5.997	0.0005	0.003	5.026	0	12	0	-
6.001	0.437	2.622	5.023	0.503	12/20	2.527	96.38
6.002	0.869	5.216	5.023	1.009	12/20	5.068	97.16
5.997	1.292	7.748	5.022	1.500	12/20	7.533	97.23
6.005	1.721	10.335	5.022	1.995	12/20	10.019	96.94
5.990	2.170	12.998	5.021	2.500	12/20	12.553	96.58
5.996	2.613	15.668	5.018	3.000	12/28	15.054	96.08
11.992	0.0004	0.005	5.028	0	12	0	-
12.008	0.236	2.834	5.024	0.504	24/32	2.532	89.34
11.995	0.456	5.470	5.023	1.004	32/36	5.043	92.19
11.993	0.676	8.107	5.023	1.506	32/40	7.565	93.31
11.994	0.895	10.735	5.023	2.005	32/44	10.071	93.81
11.993	1.113	13.348	5.022	2.498	32/44	12.545	93.98
11.994	1.337	16.036	5.021	2.995	36/48	15.038	93.78
16.492	0.0004	0.007	5.028	0	12	0	-
16.497	0.178	2.936	5.024	0.502	28/32	2.522	85.90
16.509	0.343	5.663	5.023	1.006	36/44	5.053	89.23
16.503	0.502	8.285	5.023	1.500	44/52	7.535	90.95
16.507	0.665	10.977	5.022	2.009	44/52	10.089	91.91
16.504	0.823	13.583	5.022	2.497	44/56	12.540	92.32
16.504	0.988	16.306	5.017	3.003	44/56	15.066	92.40

Table 5

Efficiency Characteristics (Figure 10)

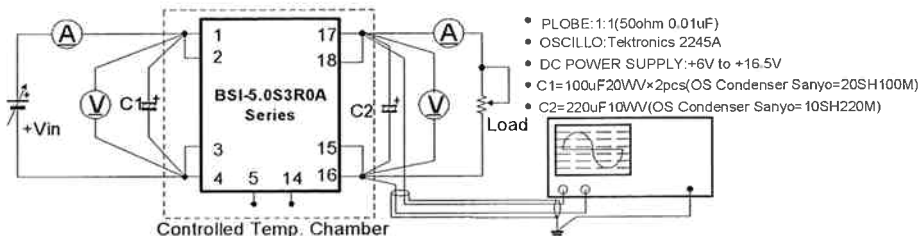


Temp. Derating (Figure 11)



**<Test Circuit>**

Figure 12



### <Soldering Conditions>

Solder to be executed under the following conditions.

1. Soldering iron 340°C to 360°C, 5sec.
2. Soldering dip 230°C to 260°C, 10sec.

### <Cleaning Conditions>

This product can not be washed whole. No-clean solder paste is recommended for this product. When and if cleaning should be necessary, use IPA and hand-wash the soldered surface by brush cleaning.

After cleaning be sure to dry up before using.

### <To prevent reverse input voltage protection (ex.)>

The input/ output of 15W BSI A series is a non-isolated type and a step-down DC-DC converter from (+) polarity to (+) polarity. If the input polarity is connected reverse by mistake, it will be eventually damaged.

If there is a possibility of reverse connection, please add a protection circuit as indicated in the following figure. The figure below is an example using diode and capacitor.

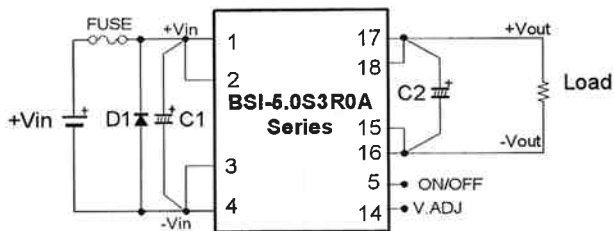


Figure 13

### <Over-Voltage Protection>

15W BSI A series do not have a built-in over-voltage protection.

When the switching element of this converter gets damaged by short mode, input voltage (+Vin) will go out as output.

For emergency if it gets damaged at over-voltage mode, please add a circuit as below to intercept the supplying power circuit.

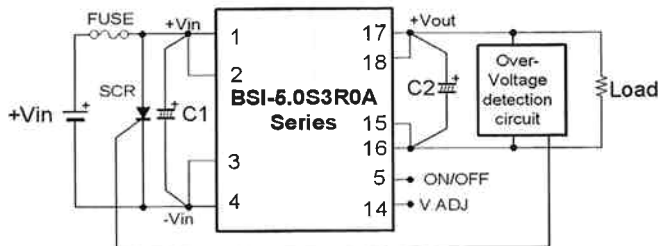


Figure 14

### Notes:

- 1 When it is damaged at over-voltage mode, ON/ OFF control does not operate.
- 2 When there is a ON/ OFF function on the supplying power side, this is also usable.
- 3 Make sure that the DC power supply of the supplying side has the capacity to fuse the fuse.

### <Method to decrease the noise level (ex.)>

Usually 15W BSI A series is used by adding input/ output capacitor, please make sure to design the print board with special care for the following items in order to obtain lower noise level by taking advantage of the performance of a 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. The influence of leakage inductance can be decreased.
4. Design the print pattern of the main circuit as thick and short as possible.

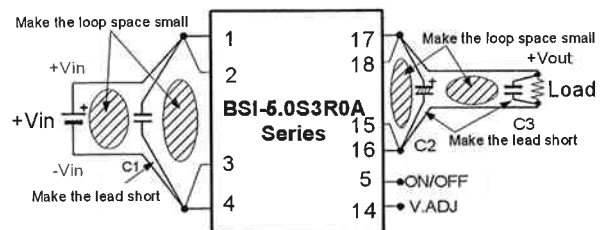


Figure 15

### <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 due to the effect of contacting resistor. Mount to printed circuit 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.
- Can not be used in case that it would affect lives or properties directly by failure of this product. Please confirm us before adopting it.
- 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 by static. When the worker has electrified static, please earth discharge and working on a earthed worktable will be recommended.
- No test result certificate is attached to this product.

