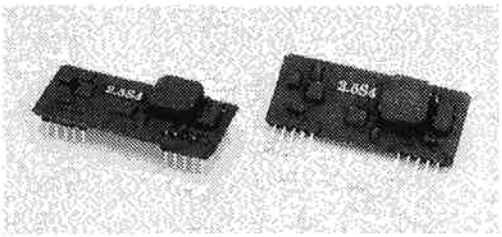
Output Voltage 1.5V-2.5V Ultra High Efficiency 90%

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

10Watt BSI A Series

10W BSI A Series is an ultra small size and light non-isolated type step-down DC-DC converter, which has achieved ultra high efficiency (90%) by the latest synchronous rectification circuit technology. This 10W BSI A Series possible to be used without heat sink at 10W with the size of 20×50×11mm has a choice of vertical and horizontal (F type) as to the usage. And this product has been accomplished as a high reliability, long-life product by adopting new type IC, low loss FET and simple circuit composition.



<Features>

- Low Profile, Ultra Small Size
- Convertible with high efficiency 3.3V to 2.5V
- Ultra High Efficiency 90%
- Wide Operating Temperature Range -10°C to +70°C
- MTBF 1,000,000Hrs, All aging
- High Reliability with Latest Surface Mount Structure
- ON/ OFF Control
- Wide Input Voltage Range
- Over-Current Protection
- Input/ Output Non-Isolated Type
- Adjustable Output Voltage
- Low Cost
- Long Life, High Performance

<Model, Rating>

Table 1

Model 10W BSI A Series	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 Type
BSI-2.5S4R0A	3.3	2.5-5.25	2.5	1.5-2.5	0-4	40	90	SIP
BSI-2.5S4R0FA								DIP

With the method adopted to this converter (step-down type chopper), potential difference between input voltage and output voltage is required. When using with the input voltage at rating value or below, the minimum input voltage is required to be Vout 0.6V.

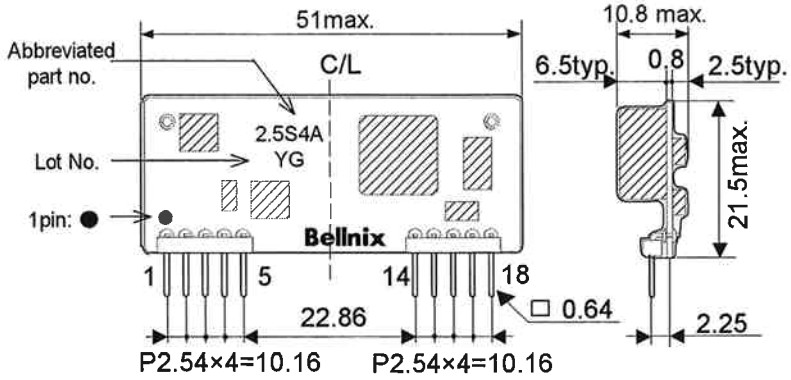
<Specification>

Rating Input Voltage/ Range	3.3V/ 2.5V-5.25V (At input voltage range of 2.5-3.1V, the max. output voltage will be input voltage -0.6V.)
Rating Output Voltage	2.5V±5% (When 14pin is open)
Adjustable Output Range	1.5V-2.5V
Line Regulation	0.2% typ. (For the regulation of input voltage range 3.1-5.25V, at rating load)
Load Regulation	0.2% typ. (For the load regulation of 0-100%, at rating input voltage)
Temperature Coefficienct	±0.01%/°C typ. (When operating temperature changed between -10°C to +50°C)
Ripple & Noise	40mVp-p typ. (Rating input/ output, room temperature) (20MHz bandwidth)
Efficiency	90% (Rating input/ output, room temperature)
Over-Current Protection	Operates at 105% or more rating load current, auto recovery type. Fall back characteristic. Avoid long time short-circuit condition of 30 sec. or more.
Over-Voltage Protection	None
Input Current at No Load	40mA max. at no load and output ON (2.5V)
Remote ON/ OFF	Between 5pin (ON/ OFF pin)-3, 4pin (-Vin): Open=Output ON, Short=Output OFF
MTBF	1,000,000Hrmin. (EIAJ RCR-9102)
Operating Temperature Range	-10°C to +70°C (Temperature derating required from +50°C)
Storage Temperature Range	-20°C to +85°C
Humidity Range	95%R.Hmax.
Cooling Conditions	Air convection (Set in a place where good convection is ensured.)
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±5
Weight	10g typ.
Outline (1)	SIP type W=20.5 L=50 H=10.8 (mm) (For detail dimensions, refer to the attached outline drawing.)
Outline (2) F type	DIP type W=20.5 L=50 H=11.3 (mm) (For detail dimensions, refer to the attached outline drawing.)

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

<Outline>

[1] SIP type BSI-2.5S4R0A

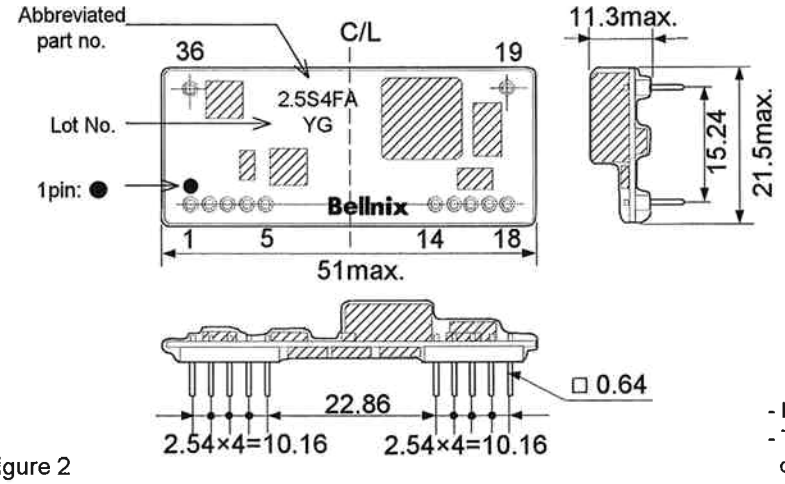


pin	Function
1	+Vin
2	+Vin
3	-Vin
4	-Vin
5	on/off
14	V.ADJ
15	-Vout
16	-Vout
17	+Vout
18	+Vout

- Dimensions: mm
- Tolerance unless otherwise specified: ±0.5
- External resinous coating

Figure 1

[2] DIP type BSI-2.5S4R0FA (F type size)



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
- Tolerance unless otherwise specified: ±0.5
- External resinous coating

Figure 2

<Block Diagram>

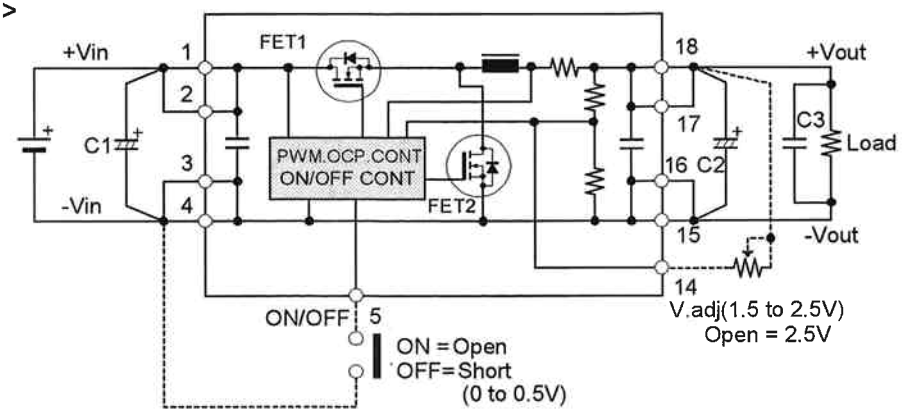
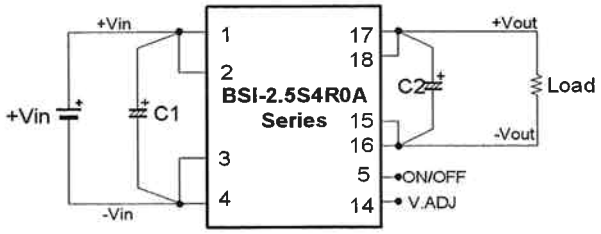


Figure 3 * For external components, refer to the application separately.

<Standard Usage>

(A) Standard Usage (Figure 4)



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

Choice of external capacitors:

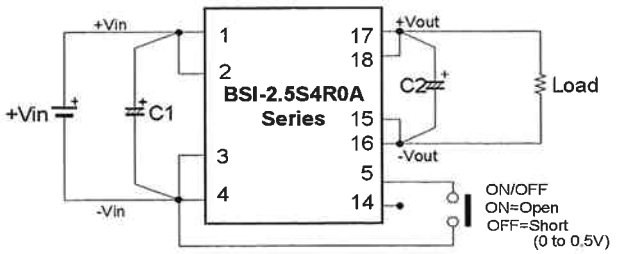
C1=220μF10WV×2pcs or more OS-CON

C2=330μF6.3WV×2pcs or more OS-CON

SH type (Sanyo) or equivalent

Rating Output Voltage: +2.5V±5%

(B) ON/ OFF Control (Figure 5)



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

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

Output voltage: ON

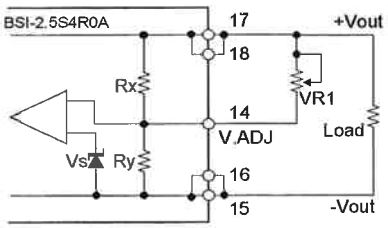
Between (5pin) and (3pin, 4pin) : OPEN

Output voltage : OFF

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

0 - 0.5Vdc

(C) Adjustable Output Voltage (Figure 6)



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

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

Table 3

BSI-2.5S4R0A calculated value
Vo=Desired output voltage
(Vout trim range: 1.5V-2.5V)
VR1=Vout trimming resistor (down)
Vs=0.8V
Ry=20k ohm
Rx=42.6k ohm

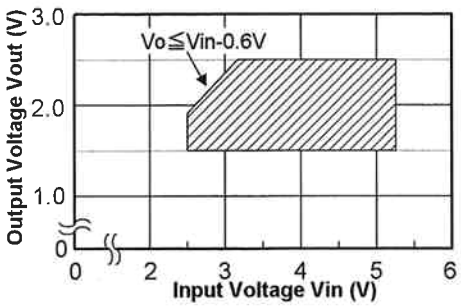
Note 1: When adjusting the output voltage, please add OS-CON of C2=330μF 6.3WV 3pcs or more.

Note 2: When 14pin V.ADJ is open, the output will be the rating value.

Note 3: When using a trimmer potentiometer, be careful of the posiotion 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, a fixed resistor is recommended.

Note 4: Checking the output voltage value using a converter after calculating the resistor value is also recommended.

(D) Output Voltage Adjustable Range (Figure 7)



For this converter's circuit method (step-down type), difference between input and output voltage is required. And for this converter, input and output voltage difference of 0.6V is required. When the input voltage is 3.1V or below, the max. output voltage is as shown in figure 7.

<Turn-On Transient>

Note: These test data do not represent all products.

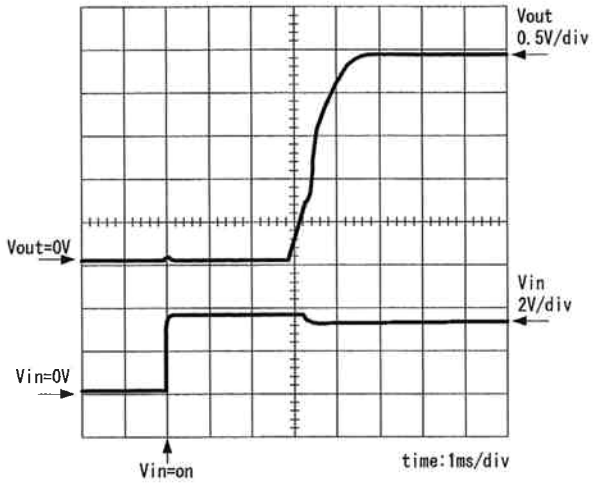


Figure 8 Test conditions: At rating input, rating load and room temp.

<Output Voltage Ripple Noise>

Test Conditions
Vin=3.3V
Vout=2.5V
Io=4A
Ta=25°C
OSC=20MHz

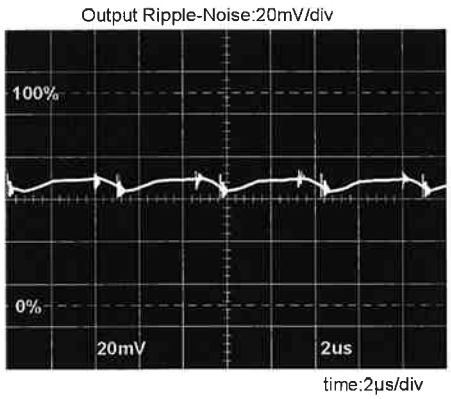


Figure 9 Test conditions: At rating input, rating load and room temp.
Test circuit is indicated in figure 12.

Note: These test data do not represent all products.

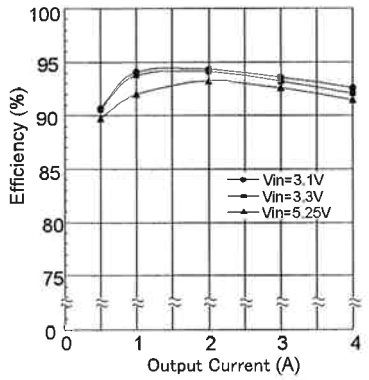
<Test Data>

Model: BSI-2.5S4R0A

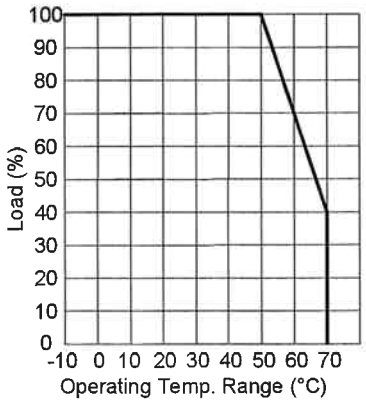
Table 5 Temp. Condition: +25°C

Input			Output				Efficiency
Voltage (V)	Current (A)	Power (W)	Voltage (V)	Current (A)	Ripple/Noise (mVp-p)	Power (W)	(%)
3.112	0.0090	0.028	2.507	0	8/10	0	-
3.116	0.450	1.403	2.505	0.508	8/10	1.273	90.73
3.123	0.866	2.704	2.505	1.015	6/10	2.543	94.05
3.106	1.748	5.430	2.505	2.044	6/16	5.119	94.27
3.104	2.595	8.054	2.504	3.010	6/20	7.537	93.58
3.110	3.487	10.844	2.504	4.009	6/21	10.035	92.54
3.308	0.0090	0.030	2.507	0	8/12	0	-
3.317	0.424	1.407	2.506	0.509	14/20	1.274	90.55
3.320	0.815	2.707	2.505	1.014	8/12	2.539	93.79
3.302	1.647	5.440	2.505	2.043	8/14	5.118	94.08
3.309	2.443	8.085	2.504	3.009	8/20	7.535	93.20
3.305	3.301	10.909	2.504	4.009	6/22	10.039	92.02
5.249	0.0090	0.047	2.508	0	8/12	0	-
5.252	0.271	1.422	2.506	0.509	25/32	1.276	89.73
5.254	0.526	2.765	2.506	1.015	24/32	2.544	92.01
5.250	1.041	5.466	2.505	2.034	14/30	5.096	93.23
5.252	1.551	8.144	2.505	3.010	14/32	7.538	92.56
5.250	2.091	10.979	2.505	4.010	16/36	10.044	91.48

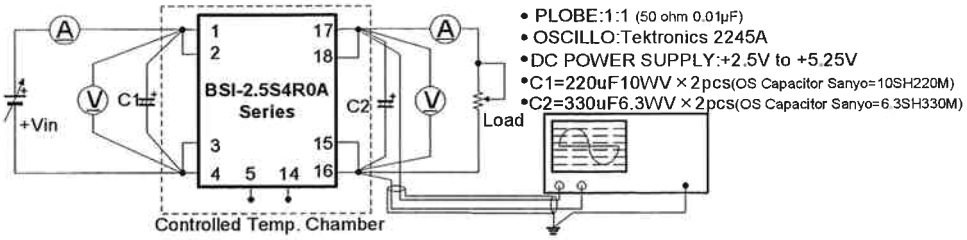
<Efficiency Characteristics> (Figure 10)



<Temperature Derating> (Figure 11)



<Test Circuit> (Figure 12)



- PLOBE:1:1 (50 ohm 0.01μF)
- OSCILLO:Tektronics 2245A
- DC POWER SUPPLY:+2.5V to +5.25V
- C1=220uF10WV × 2pcs(OS Capacitor Sanyo=10SH220M)
- C2=330uF6.3WV × 2pcs(OS Capacitor Sanyo=6.3SH330M)

<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 only 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 10W 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 hues and diode.

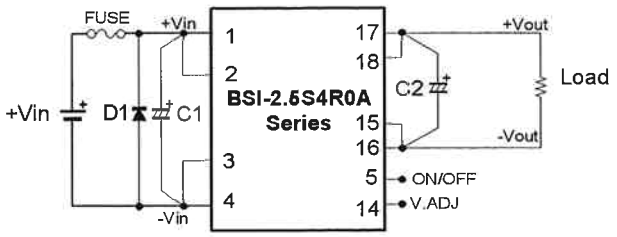


Figure 13

<Over-Voltage Protection>

10W 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, add a circuit as below to intercept the supplying power circuit.

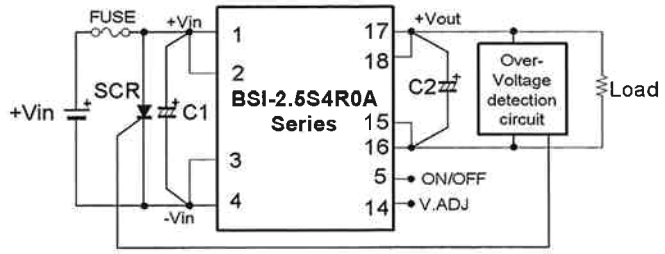


Figure 14

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 usuable.
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 10W BSI A series is used by adding input/ output capacitor, 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.

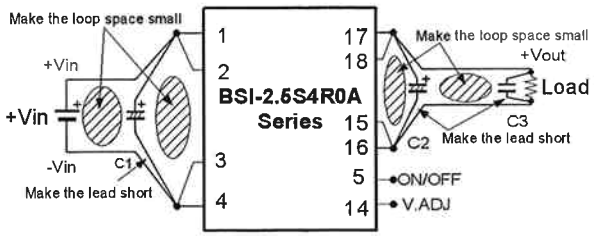


Figure 15

<Precautions>

- For this product parallel/ series operation is not possible.
- For mounting this product, 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 avoid it.
- Can not be used in case that it would affect lives or properties directly by failure of this product. Make sure to confirm us before adopting it.
- Product can not be used under oscillation, strike or temp. conditions that are out of the specification. Contact for any questions.
- There is possibility of damage by static. When the worker has electrified static, earth discharge and working on a earthed worktable will be recommended.
- No test result certificate is attached to this product.

Output Voltage 1.5V-2.5V Ultra High Efficiency 90%

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

10Watt BSI A Series

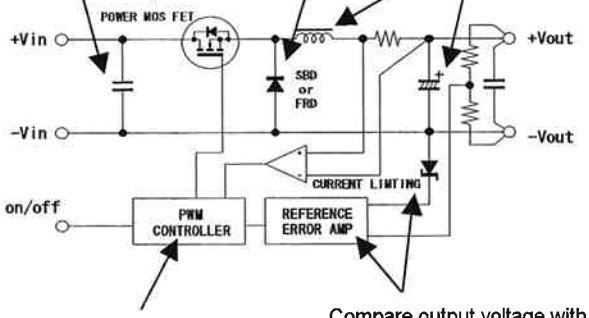
<Non-Isolated Type Step-Down DC-DC Converter> (Diode Commutating Method)

Line Filter
Remove and decrease noise

Commutating smooth diode
Commutate the energy accumulated in the inductor with this diode

Switching the inductor with the POWER MOS FET

Inductor (choke coil)
When FET is ON, put a smooth LC filter to save energy here.
Decrease the output ripple noise

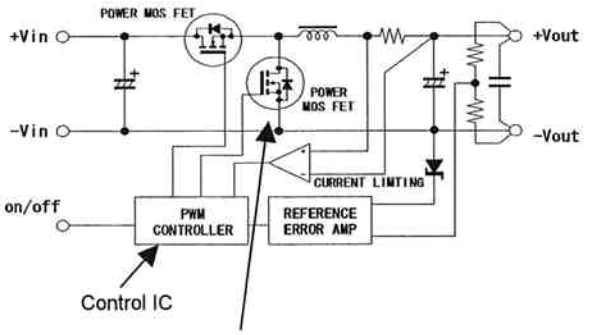


ON/OFF ratio changes by modulating the pulse width.
Transformed to digital signal

Compare output voltage with the standard voltage (zener diode).
Detect this imperceptible change and amplify the OP amp.

<Non-Isolated Type Step-Down DC-DC Converter> (Synchronous Rectification Commutating Bellnix Method)

Operation principle is exactly same as above.



POWER MOS FET for Synchronous Rectification
Efficiency is improved by dropping to 13m ohm in this direction.

[Loss Comparison] (At 5V 10A)

- Commutating method with schottky diode
  Vf=0.55V
  10×0.55V=5.5W
- Commutating method with Synchronous Rectification
  =Bellnix Latest Technology
  Rf=13m ohm
  10A×10A×13m ohm=1.3W (Loss will be largely improved.)

<Memo>

<Confirmation of Usage>

This product is delivered after executing our sufficienct design evaluation tests. It can not be used in case that it would affect lives or properties directly by the failure of this product. Make sure to confirm us before adopting it.
We shall not take any responsibilities for any other cases except for the above.

<Guarantee>

This product shall be guaranteed for one year. During this period, if there should be any failure definitely due to our designing or manufacturing workmanship, we will repair or replace it with new one at our own expense.
But in case that it should be modified and/ or made internal remodeling by buyer itself whatsoever, we cannot guarantee it.
This guarantee shall cover only 15Watt BSI A series.

Bellnix®

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