

Output Voltage 3V-5V Ultra High Efficiency 93%

TO-3PL Size, Step-Down Non-Isolated Type DC-DC Converter

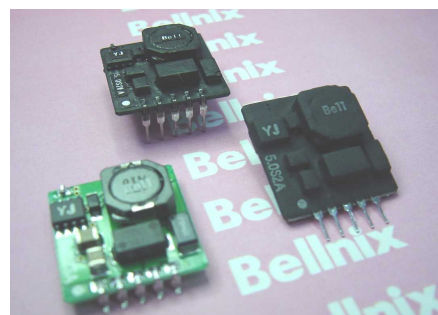
10 Watt BSI-mini A Series



BSI-mini A Series is an ultra small, TO-3PL packaged type, and non-isolated type step-down DC-DC converter which has achieved ultra high efficiency by the latest synchronous rectification circuit technology. BSI-mini A Series with the size of 20.2x21.5x8.3mm and 10W can be used without heat sink and external capacitor. BSI-mini A Series is the next generation three terminal regulator which has fundamentally changed dropper regulator with big heat.

<Features>

- Synchronous Rectification Control IC equipped.
- Solid Electrolytic Chip Capacitor equipped.
- Convert +12V into +5V with high efficiency
- High efficiency 93%
- Low standby input current 100 μ A max
- Wide operating temperature range -10~+70 $^{\circ}$ C
- MTBF 1,000,000 Hrs, All aging
- Output capacitor installed
- Heat Sink not required
- Ultra low profile, Ultra small type
- Remote on/off control
- Wide input voltage range
- Over current protection Circuit
- Non-Isolated type
- Adjustable output voltage
- High reliability, long life, high performance



SIP&DIP: External resinous coating
SMD : Without resinous coating

<Model>

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
BSI-mini A Series	12	+6.0~+16.5	+5.0	3.0~5.0	0~2	30	93	SIP
BSI-5.0S2R0FMA								DIP
BSI-5.0S2R0SMA								SMD

SMD type : Order received product

<Specification>

Table 2

Rating input voltage/range	+12V / +6.0~+16.5V
Rating output voltage	5.0V \pm 5% (When 1pin is open)
Adjustable output range	+3.0~+5.0V
Line regulation	0.2% typ. (For the input voltage range of +6~+16.5V, at rating load.)
Load regulation	0.4% typ. (At rating input voltage, when load changes 0%~100%)
Temperature coefficient	\pm 0.01%/ $^{\circ}$ C typ. (When operating temperature changes between -10 $^{\circ}$ C~+50 $^{\circ}$ C)
Ripple & Noise	30mVp-p typ. (Rating input / output , room temperature) (20MHz bandwidth)
Efficiency	93% (Rating input / output, room temperature)
Over-Current Protection	Operates at more than 105% of rating load current, auto recovery type, foldback recovers. Avoid more than 30seconds of short-circuit condition
Over-Voltage Protection	None
No Load Input Current	3mA max. At no load and output o
Standby Input Current	100 μ A max. At no load and output off (0V)
Remote on/off control	Between 1pin(on/off pin) and 3pin(GND); Open=output ON, short=output off
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	-10 $^{\circ}$ C~+70 $^{\circ}$ C (Derating to be required from +50 $^{\circ}$ C)
Storage temperature range	-20 $^{\circ}$ C~+85 $^{\circ}$ C
Humidity range	20%~95%R.H. (non condensing)
Cooling condition	Natural air cooling
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 \pm 5ms
Weight	3.8g typ.
Outline	Refer to page 2. (There are stock on SIP&DIP type, SMD type is order received production.)

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

<Outline>
[SIP type]
BSI-5.0S2R0MA

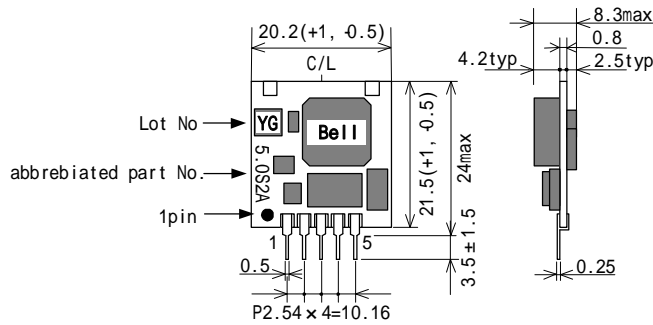


Figure1

pin	Function
1	ON/OFF CONT
2	+Vin
3	GND
4	+Vout
5	+Vout.ADJ

Dimensions: mm
 Tolerance when nothing specified ±0.5
 External resinous coating

[DIP type]
BSI-5.0S2R0FMA

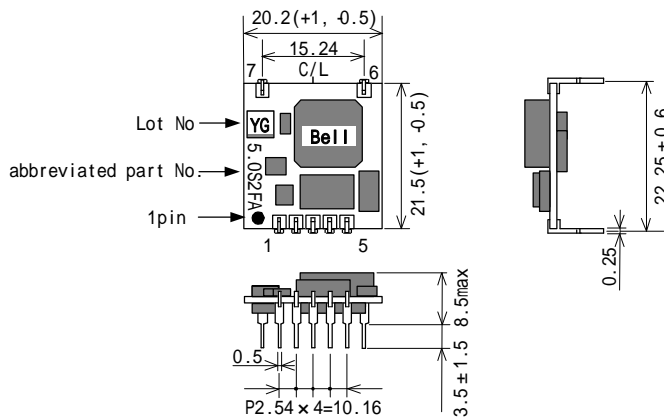


Figure2

pin	Function
1	ON/OFF CONT
2	+Vin
3	GND
4	+Vout
5	+Vout.ADJ
6	NC
7	NC

Dimensions: mm
 Tolerance when nothing specified ±0.5
 External resinous coating

[SMD type]
BSI-5.0S2R0SMA
 (for order received product)

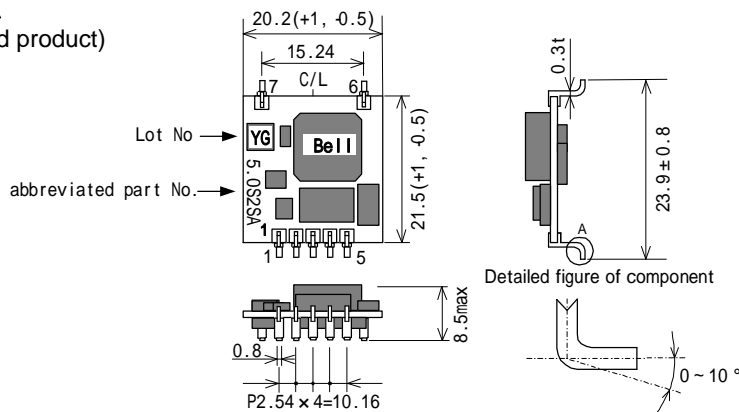


Figure3

pin	Function
1	ON/OFF CONT
2	+Vin
3	GND
4	+Vout
5	+Vout.ADJ
6	NC
7	NC

Dimensions : mm
 Tolerance when nothing specified ±0.5
 Without coating.
 (for adsorption mounter air)

<Block Diagram>

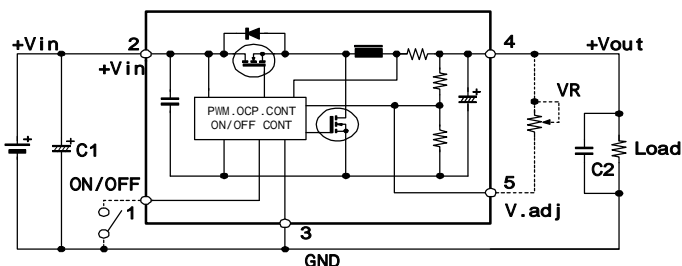


Figure4

- Use this model according to a usual three terminal regulator.
- Output Voltage
 5pin Open= +5V (rating output voltage)
- C1 : More than 100µF (In order to reduce the line impedance)
- C2 : Output capacitor built-in.
 In case that the wiring is long to the load, output noise may be further reduced with the 2.2µF~4.7µF added.
- Refer to figure 6~8 about :
 adjustment output voltage, on/off control.
- Refer to page 6 about :
 over-current protection, soldering conditions, and cleaning conditions.

Output Voltage 3V-5V Ultra High Efficiency 93% TO-3PL Size, Step-Down Non-Isolated Type DC-DC Converter 10 Watt BSI-mini A Series

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<Technical Notes>

(A) Standard Connection

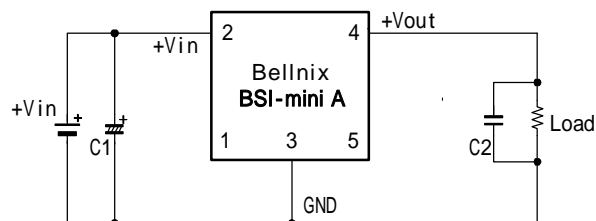


Figure5

Choice of external capacitors

C1=100µF20WV

C2=2.2µF~4.7µF

C2: No need to add the output capacitor, because it is built in.

In case that the wiring is long to the load, output noise may be further reduced with the C2 added.

Rating Output Voltage : +5V ±5%

(B) ON/OFF Control connection

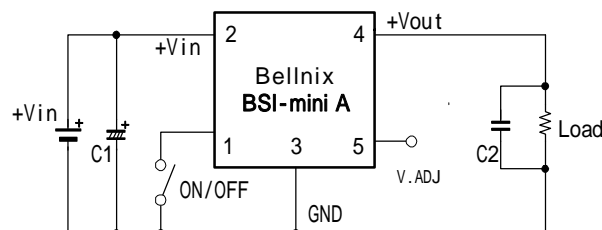


Figure6

ON/OFF can be controlled by opening or shortening 1pin and 3pin. Transistor(open collector) is recommended for the open and short control parts.

Output ON mode

Between 1pin and 3 pin : OPEN

Output OFF mode

Between 1pin and 3 pin : SHORT

Off state voltage 0~0.5Vdc (100µA max.)

(C) Output Voltage Adjustment Connection

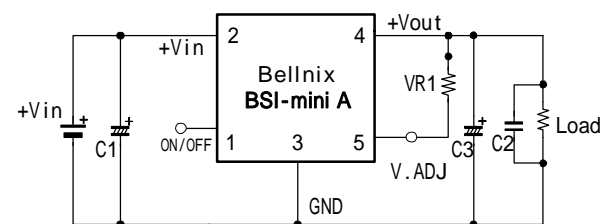


Figure7

It is possible to adjust output voltage by connecting a resistor between 5pin (V.ADJ)and 4pin (+Vout).

The output voltage trim range is as in 3.0V~5.0V.

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

Output voltage adjustable equation

$$VR1 = \frac{R_x \times R_y \times (V_o - V_s)}{R_x \times V_s - R_y (V_o - V_s)}$$

To adjust output voltage : C3=100µF~220µF

Table 3

BSI-5.0V type calculated value
V _o : Desired Output Voltage (V _{out} trim range: 3.0V~5.0V)
VR1: V _{out} variable resistor(down)
V _s =0.8V
R _y =20k ohm
R _x =106k ohm

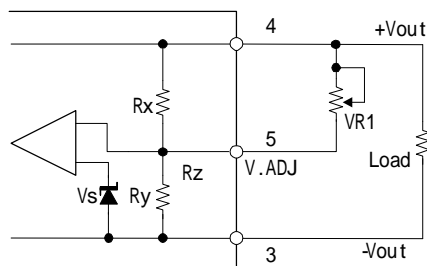


Figure8

Note1: When 5pin V.ADJ is open, the output will be the rating value.

Note2: When using a trimmer potentiometer, be careful of the position of the adjustable lug. We recommend you 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 we recommend to use a fixed resistor.

Note3: We recommend checking the output voltage value, using converter after calculating the resistor value.

Note4: When changing output voltage, add C3=100µF~220µF.

<Turn on transient>

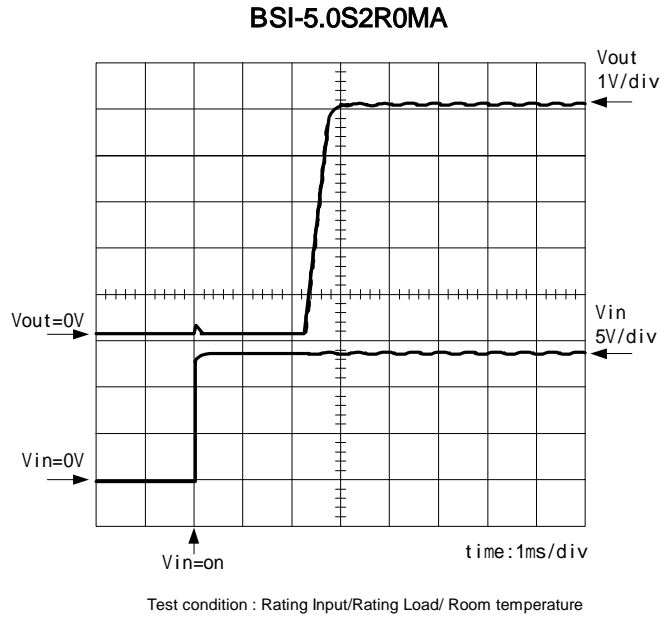


Figure9

<Output Ripple & Noise>

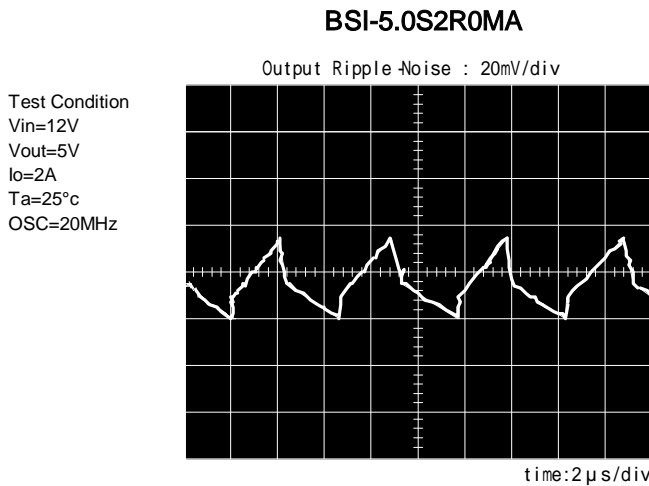


Figure10

Test condition : Rating Input/Rating Load/ Room temperature
 Test circuit is indicated in figure 13.

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Note: These test data do not represent all product.

<Test Data>

Model: BSI-5.0S2R0MA

Temp. : 25°C

Input			Output				Efficiency (%)
Voltage (V)	Current (A)	Power (W)	Voltage (V)	Current (A)	Ripple/Noise (mVp-p)	Power (W)	
5.994	0.0005	0.003	5.014	0	12/12	0	-
6.005	0.436	2.618	5.013	0.503	8/12	2.522	96.33
6.007	0.866	5.202	5.009	1.003	12/16	5.024	96.58
6.003	1.303	7.822	5.006	1.501	16/20	7.514	96.06
6.004	1.754	10.531	5.005	2.006	16/20	10.04	95.34
12.002	0.0004	0.005	5.023	0	24/24	0	-
12.005	0.231	2.773	5.012	0.503	20/28	2.521	90.91
12.004	0.447	5.366	5.009	1.002	24/28	5.019	93.53
12.002	0.667	8.005	5.004	1.500	24/28	7.506	93.77
12.003	0.897	10.767	5.004	2.003	28/32	10.023	93.09
16.492	0.0004	0.007	5.023	0	20/20	0	-
16.500	0.175	2.888	5.010	0.502	28/32	2.515	87.08
16.507	0.333	5.497	5.008	1.002	28/32	5.018	91.29
16.503	0.493	8.136	5.005	1.499	32/36	7.502	92.21
16.506	0.659	10.877	5.001	2.002	32/36	10.012	92.05

Figure 11

Efficiency vs. output current for input voltage

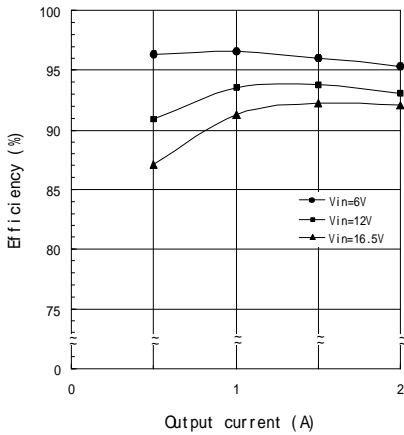
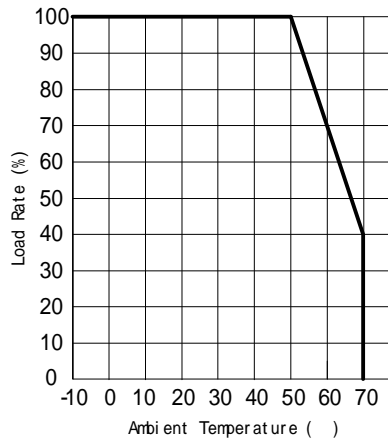
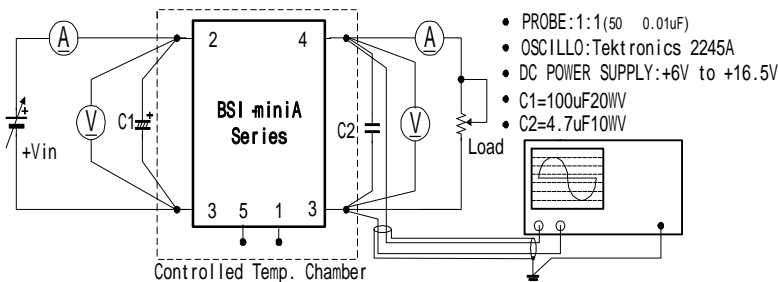


Figure 12



<Test Circuit>

Figure 13



BDD20060518V2

<Soldering Conditions>

Solder to be executed under the following conditions.

1. Soldering iron 340°C ~ 360°C within 5sec.
2. Soldering dip 230°C ~ 260°C within 10sec.

<Cleaning Condition>

This product can not be cleaned bodily. Non-cleaned flax is recommended. When and if cleaning only for SIP and DIP type should be necessary, use IPA and hand-wash the soldered surface by brush cleaning. After cleaning, please dry enough to use it.

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

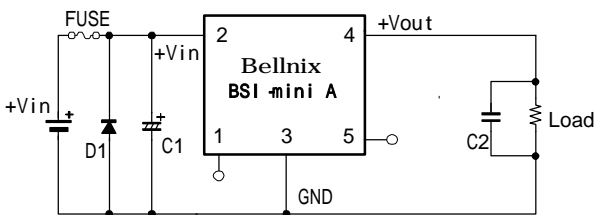
The input/ output of BSI-mini A series is a non-isolated type and a step-down DC-DC converter from (+) polarity to (+) polarity.

If you connect the input polarity reversed of this product by mistake it will be eventually damaged.

If there is a possibility of reverse connection, please add a protection circuit as indicated in Figure14. The figure below is an example using fuse and diode.

Fuse is not built-in, so connecting fuse into input line is recommended to protect from abnormal condition.

Figure 14



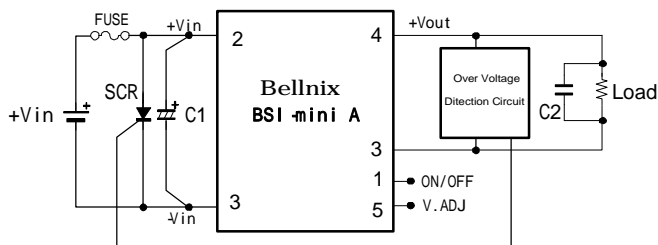
<Over Voltage protection>

BSI-mini A series does 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 damages at over-voltage mode, please add a circuit as below to intercept the supplying power circuit.

Figure 15



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, it can be used, too. For further inquiries, please contact us.
- 3 When there is a DC Power Supply on the supplying power side, please make sure to have the capacity the fuse can be cut.

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

Usually BSI-mini A series is used by adding input/output capacitor, please make sure to design the print board with special attention to 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 (+) and (-) of both input and output pin side small as possible.
You can decrease the influence of leakage inductance.
4. Design the print pattern of the main circuit thick and short as much as possible.

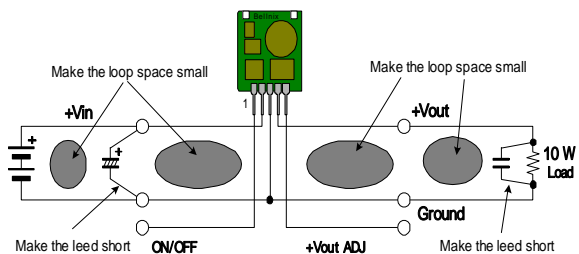


Figure 16

<Precautions>

1. For this product parallel/series operation is not possible.
2. 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.
3. This product has a built-in over current and short protection circuit, but long time short circuit will cause failure, so please avoid that.
4. This product can not be used in case that it would effect lives or properties directly by the failure of this product. Please confirm us before adopting it.
5. Product can not be used under vibration, shock or tmp.conditions that are out of the specification.
Contact us, if any question.
6. There is possibility of damage from static. When the worker has electrified static, electrical discharge by grounding should be done and the working on the table may be recommended.
7. No test certificate is attached to this product.

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