

Ultra High Efficiency 93-95%
Ultra Small Size, Step-Down Non-Isolated Type DC-DC Converter

Bellnix

40 Watt BSI-POWER Series

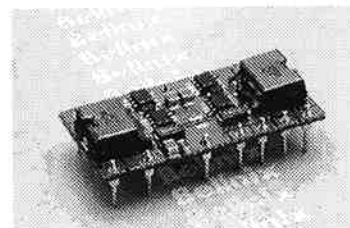
BSI-40W Series is an ultra small size, light, and large capacity non-isolated type step-down DC-DC converter, which has achieved ultra high efficiency (93-95%) by the latest synchronous rectification circuit technology. It has also achieved the surprising 40W output with the size of 25×50×10mm without heat sink. 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.

Input: 5V, 12V Output: 3.3V 12A (1.0V-3.3V)

Input : 12V Output: 5.0V 8A (5.0V-6.0V)

<Features>

- Thin, Ultra Small Size, Large Capacity 40W
- Output Voltage 1.0-3.3V/ 5V-6V
- Output Current 0-12A/ 0-8A
- Ultra High Efficiency 93%-95%
- Wide Operating Temperature Range -10°C to +70°C
- MTBF 900,000Hrs, All aging
- Heat Sink not required
- High Reliability (Surface Mounting Structure) , Long Life, High Performance
- ON/OFF Control
- Remote Sensing
- Over-Current Protection
- Input/Output Non-Isolated Type
- Adjustable Output Voltage
- Wide Input Voltage Range



<Model, Rating>

Table 1

Model	Rating Input Voltage Vdc	Input Voltage Range Vdc-Vdc	Rating Output Voltage Vdc	Output Voltage Trim Range Vdc-Vdc	Output Current A	No-Load Input Current mA(typ)	Ripple & Noise mVpp(typ)	Efficiency % (typ)
BSI (40W) Series								
BSI-3.3S12R0F	7.5	4.5-13.6	3.3	1.0-3.3	0-12 (*1)	90	40	93
BSI-5.0S8R0F	12	8.0-13.6 (*2)	5.0	5.0-6.0	0-8 (*1)	60	60	95

(*1) The max. output will change according to the input voltage and air cooling method (air flow or air convection). Please refer to thermal derating graph.
(*2) When the voltage between the converter's output pins are 5.3V or below, operating is possible from input 7V but only at input between 7-8V and max output current at 7A.

<Specification>

Table 2

Rating Input Voltage/ Range	Refer to Table 1
Rating Output Voltage	When it is open between 11pin - 12pin, output voltage will be set at +3.3V or +5V. (The accuracy of output voltage setting is ±4% max.)
Adjustable Output Range	Refer to Table 1
Line Regulation	10mVtyp. (For the input voltage range of Table 1, at rating load)
Load Regulation	8mVtyp. (When load changes 0-100%, at rating input)
Temperature Coefficient	±0.01%/°C typ. (When operating temperature changes between -10°C to +50°C)
Ripple & Noise	Refer to Table 1 (Rating input/ output, room temperature)(20MHz bandwidth)
Efficiency	93%-95% (Rating input/output, room temperature, 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 Input Current	BSI-3.3S12R0F 3mAmax. (Vin=5.5V), 6mAmax. (Vin=13.6V) BSI-5.0S8R0F 100µAmax.
Remote ON/OFF	Between 1pin(ON/OFF) - 2pin(S.GND)[Open: Output ON, Short: Output OFF (Refer to application)]
Remote Sensing	BSI-3.3S12R0F The voltage between the converter's output pins [voltage between 7-8pin] and sensing voltage [voltage between 6-9pin] difference is 10% of sensing voltage (0.1V-0.3V) or below. (*1) BSI-5.0S8R0F The voltage between the converter's output pins [voltage between 7-8pin] and sensing voltage [voltage between 6-9pin] difference is 0.3V or below. (*2)
MTBF	900,000Hrmin. (EIAJ RCR-9102)
Switching Frequency	220kHz typ. (BSI-3.3S12R0F), 270kHz typ. (BSI-5.0S8R0F)
Operating Temperature Range	-10°C to +70°C (Refer to the thermal derating graph.)
Storage Temperature Range	-20°C to +85°C
Humidity Range	95%R.Hmax.
Cooling Condition	Air cooling condition will change depending on the output current and input voltage. Refer to the thermal derating graph.
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	14g typ.
Outline	W=24.9 L=50.0 H=10.0 typ (mm) (For detail dimensions, refer to the outline.)

(*1) When input is +5.5V or below and voltage between output pins are 3.40V-3.63V, max. output current will be 11A.

(*2) When the voltage between converter's output pins are 5.3V or more, max output current will be 7A.

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

<Outline > (BSI-3.3S12R0F)

Figure 1

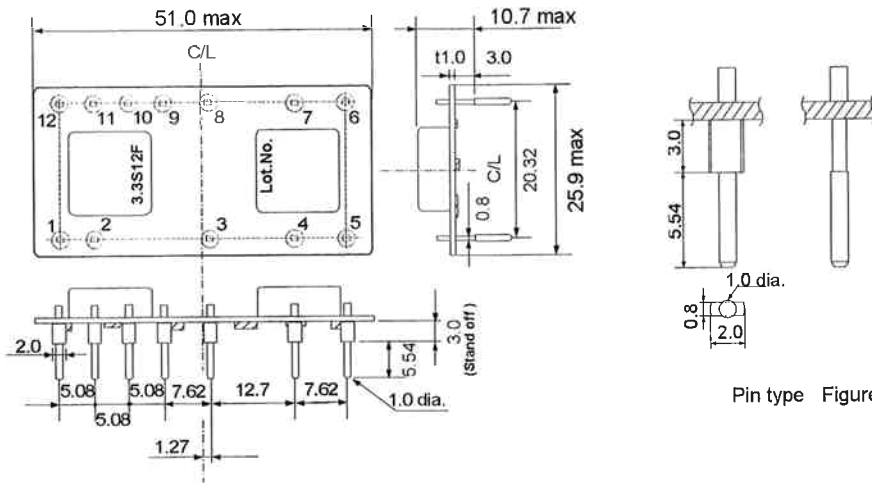


Table 3

pin	Function
1	ON/OFF
2	S.GND
3	+Vin
4	-Vin
5	NC
6	-Vs
7	-Vout
8	+Vout
9	+Vs
10	NC
11	V.ADJ 1
12	V.ADJ 2

Dimensions: mm
Tolerance when nothing specified ± 0.5
Without coating
weight: 14g typ

Pin type Figure 2

<Block Diagram > (BSI-3.3S12R0F)

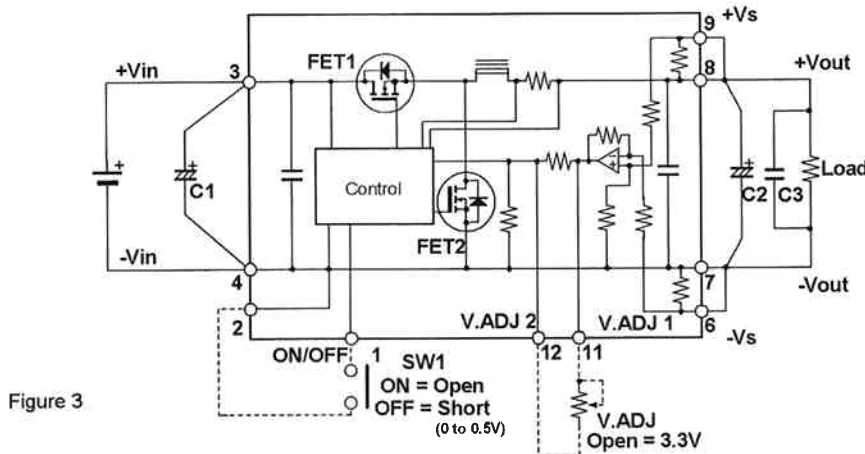


Figure 3

<Thermal Derating > (BSI-3.3S12R0F)

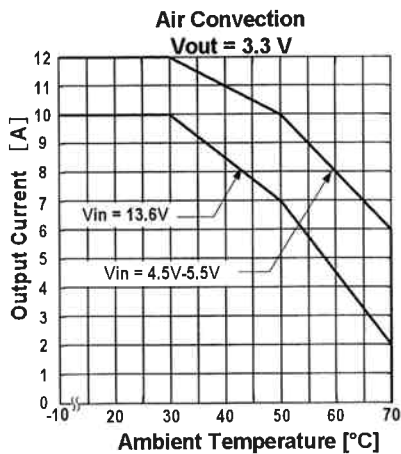


Figure 4

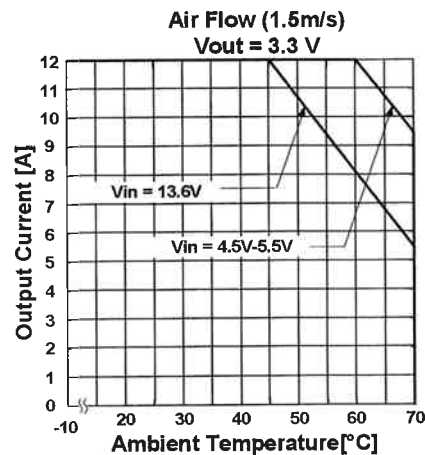


Figure 5

Vout: Voltage between output pins (voltage between 7-8pin)

Note: Please refer to the above thermal derating graph when designing, and contact us if there should be any questions.

BDD20040921

<Standard Connection Circuit Diagram> (BSI-3.3S12R0F)

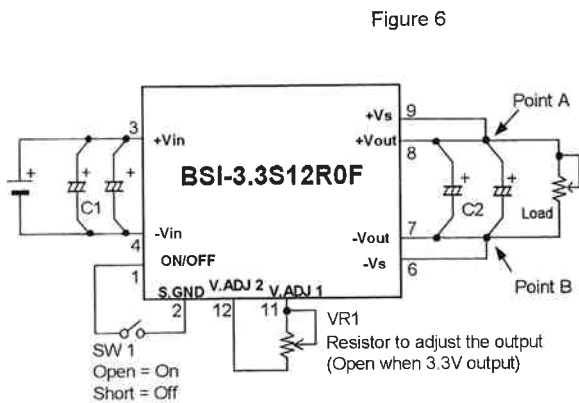


Figure 6

[Additional Capacitor]

- C1 selection
Add 2 or more C1=68μF or more, ESR=34m ohm or below in parallel.
Recommended Capacitor: 20SP68M (Sanyo)×2pcs,
or 20SH100M (Sanyo)×2pcs
- C2 selection
{When Output Voltage is 1.7V or more}
Add 2 or more C2=220μF or more, ESR=28m ohm or below in parallel.
Recommended Capacitor: 6SP220M (Sanyo)×2pcs,
or 10SH220M (Sanyo)×2pcs

{When Output Voltage is below 1.7V}
Add 3 or more C2=330μF or more, ESR=25m ohm or below in parallel.
Recommended Capacitor: 4SP330M (Sanyo)×3pcs,
or 6SH330M (Sanyo)×3pcs

ESR Frequency of the above additional capacitor: 100kHz-300kHz

Note 1. This product can be effected by contact resistance, so do not use a connector and solder directly to the printed circuit board.

Note 2. C1 and C2 should be fitted to the converter terminal as closely as possible, thereby the influence by the lead inductance and impedance can be reduced. Further, please make sure not to make the loop big by means of approaching plus(+) and minus(-) line.

Note 3. Connect +Vs pin and -Vs pin to the capacitor closer to the load side.

These pins are remote sensing pins, so do not keep it open.

<Remote Sensing> (BSI-3.3S12R0F)

+Vs pin and -Vs pin are remote sensing pins.

The connecting point of sensing line and output line will be the output setting voltage. (Between A-B of figure 6)

By this function, the voltage drop at the output line can be corrected.

As much as point A and point B gets closer to the load side, Vout (voltage between 7-8pin) will become higher than the output setting voltage.

<Method of Adjusting Output Voltage> (BSI-3.3S12R0F)

Output voltage is adjustable within the range of 1.0-3.3V by connecting a resistor between V.ADJ1pin (11Pin) and V.ADJ2 pin (12Pin).

Resistance is as per in the equation.

Resistance when adjusting output voltage (Equation 1)

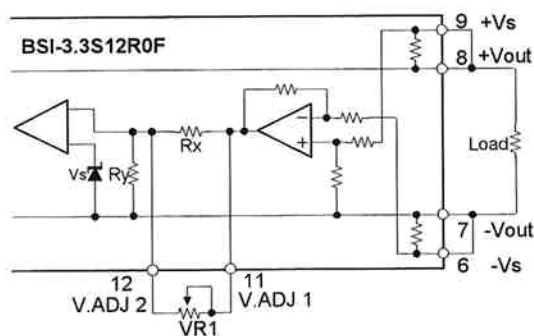


Figure 7

$$VR1 = \frac{Rx \times Ry \left(\frac{Vo}{1.1} - 0.8 \right)}{Rx \times Vs - Ry \left(\frac{Vo}{1.1} - 0.8 \right)}$$

Vo= Desired output voltage

Rx=22.56k ohm

Ry=8.2k ohm

Vs=0.8V

Note 1. When adjusting output voltage

Start initial energizing after checking that the adjustable resistor's lug is in the direction of low voltage.

Note 2. Recommend fixed resistor when in mass production.

Note 3. Wire between V.ADJ1-V.ADJ2 pin as short as possible.

Note 4. Without a resistor between V.ADJ1-V.ADJ2 pin, rating output voltage will be +3.3V.

<ON/OFF Control> (BSI-3.3S12R0F)

- 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 configuring a power supply system sequence. And this can also be used as a power standby function for power saving control.

- Not using ON/OFF Function

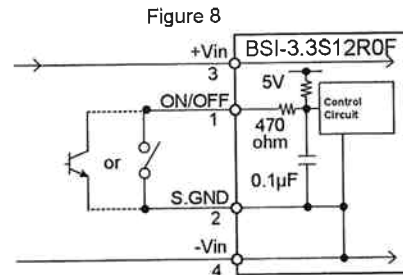
Do not use the ON/OFF function. Keep ON/OFF pin open.

- Method of ON/OFF Control

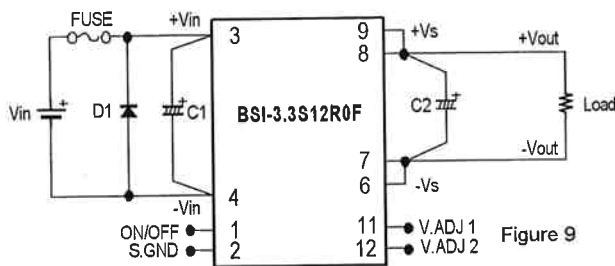
Between ON/OFF pin (1Pin) and S.GND (2Pin)

Open (Max. 6V will be generated) Output=ON
Short (0-0.5V 500 μ A max.) Output=OFF

Max. Rating Voltage of ON/OFF pin (1Pin): -0.3V to +6V



<To prevent reverse connection of Input Power Supply (ex.)> (BSI-3.3S12R0F)



This product is a non-isolated type DC-DC converter. If you connect the input voltage reversed by mistake, it will be eventually damaged.

If there is a possibility of reverse connection, please add a protection circuit as shown in figure 9.

The left figure is an example using fuse and diode.

<Over-Voltage Protection (ex.)>

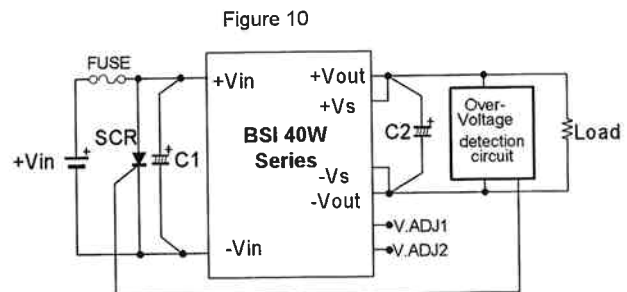
BSI-40W series does not have a built-in over-voltage protection.

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 damaged at over-voltage mode, please add a circuit as the right to intercept the supplying power circuit.

Note:

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



<Cleaning Conditions>

This product can not be cleaned bodily. When and if cleaning should be necessary, use IPA and hand-wash the soldered surface by brush cleaning. For further queries, please contact us.

<Soldering Conditions>

Solder to be executed under the following conditions.

1. Soldering iron 340°C to 360°C within 5sec.
2. Soldering dip 240°C to 260°C within 10sec.

<Outline> (BSI-5.0S8R0F)

Figure 11

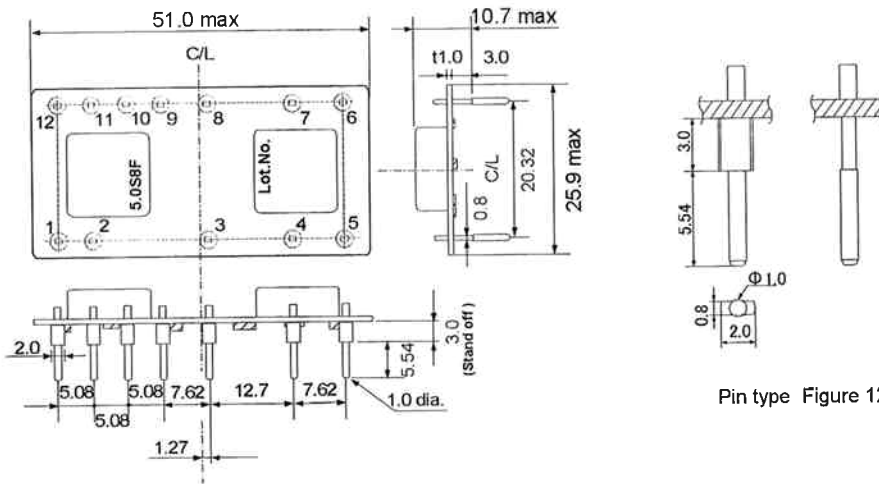


Table 4

pin	Function
1	ON/OFF
2	S.GND
3	+Vin
4	-Vin
5	NC
6	-Vs
7	-Vout
8	+Vout
9	+Vs
10	NC
11	V.ADJ 1
12	V.ADJ 2

Dimensions: mm
Tolerance when nothing specified ± 0.5
Without coating
weight: 14g typ

<Block Diagram> (BSI-5.0S8R0F)

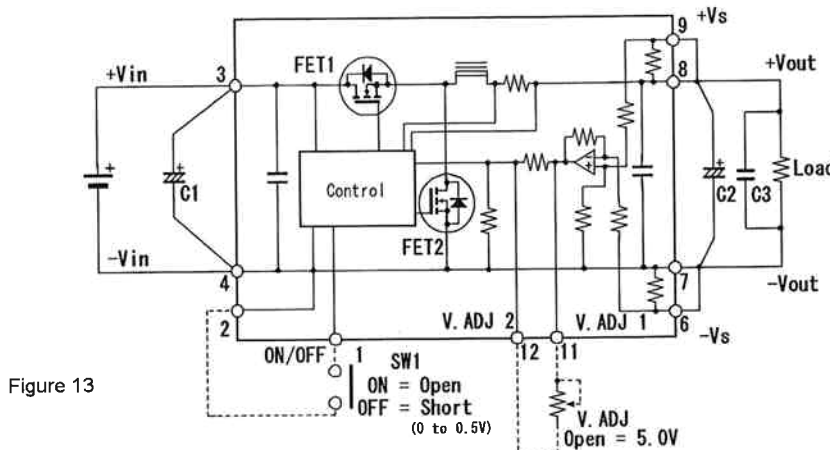


Figure 13

<Thermal Derating> (BSI-5.0S8R0F)

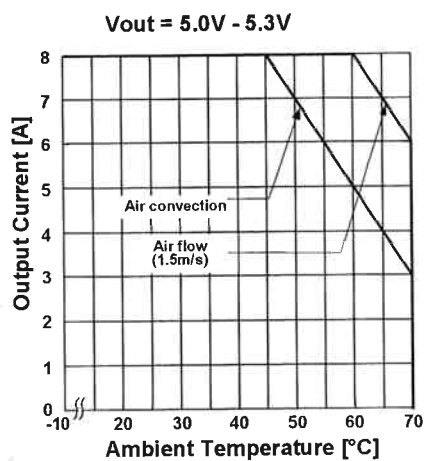


Figure 14

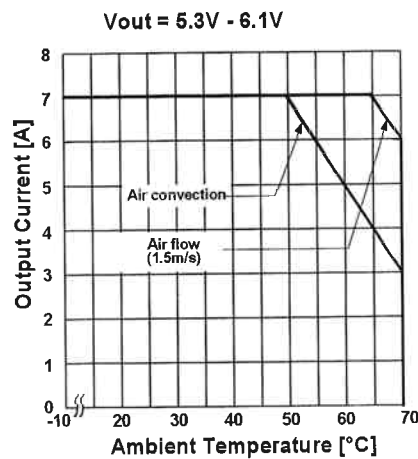


Figure 15

Vout: Voltage between output pin (voltage between 7-8pin)

<Standard Connection Circuit Diagram> (BSI-5.0S8R0F)

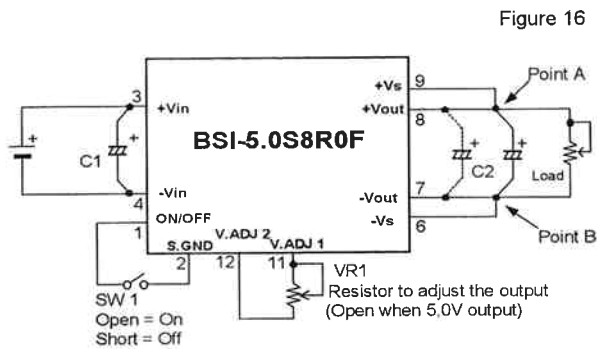


Figure 16

[Additional Capacitor]

Add 1 or more C1=68μF or more, ESR=34m ohm or below.
Recommended Capacitor: 20SP68M (Sanyo)×1pce,
or 20SH100M (Sanyo)×1pce

Add 1 or more C2=150μF or more, ESR=30m ohm or below.
Recommended Capacitor: 10SP180M (Sanyo)×1pce,
or 10SH220M (Sanyo)×1pce

ESR Frequency of the additional capacitor: 100kHz-300kHz

- Note 1. This product can be effected by contacting resistor, so do not use a connector and solder directly to the printed circuit board.
- Note 2. C1 and C2 should be fitted to the converter terminal as closely as possible, thereby the influence by the lead inductance and impedance can be reduced. Further, please make sure not to make the loop big by means of approaching plus(+) and minus(-) line.
- Note 3. Connect +Vs pin and -Vs pin to the capacitor closer to the load side.
This pin is a remote sensing pin, so do not keep it open.

<Remote Sensing> (BSI-5.0S8R0F)

+Vs pin and -Vs pin are remote sensing pins.

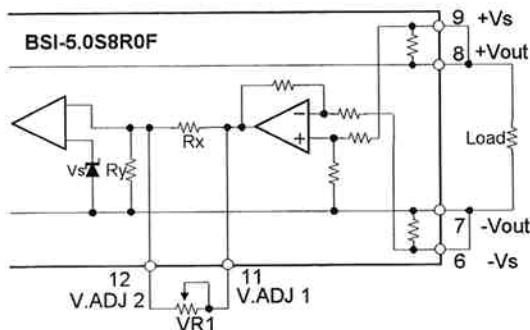
The connecting point of sensing line and output line will be the output setting voltage. (Between A-B of figure 16)

By this function, the voltage drop at the output line can be corrected.

As much as point A and point B gets closer to the load side, Vout (voltage between 7-8pin) will become higher than the output setting voltage.

<Method of Adjusting Output Voltage> (BSI-5.0S8R0F)

Output voltage is adjustable within the range of 5.0-6.0V by connecting a resistor between V.ADJ1pin (11Pin) and V.ADJ2 pin (12Pin). Resistance value is as per in the equation.



Resistance when adjusting output voltage (Equation 2)

Figure 17

$$VR1 = \frac{0.8 \times Rx \times Ry}{\frac{13}{22} \times Vo \times Ry - 0.8(Rx + Ry)}$$

Vo=Desired output voltage
Rx=22.1k ohm
Ry=8.2k ohm
Vs=0.8V

- Note 1. Be sure not to make the Vout (voltage between 7-8pin) over 6.1V.
- Note 2. When adjusting output voltage
Start initial energizing after checking that the adjustable resistor's lug is in the direction of low voltage.
- Note 3. Recommend fixed resistor when in mass production.
- Note 4. Wire between V.ADJ1-V.ADJ2 pin as short as possible.
- Note 5. Without a resistor between V.ADJ1-V.ADJ2 pin, rating output voltage will be +5.0V.

<ON/OFF Control> (BSI-5.0S8R0F)

- 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.

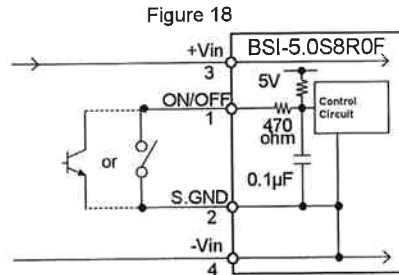
- Method of ON/OFF Control

Between ON/OFF pin (1Pin) and S.GND (2Pin)

Open (Max. 6V will be generated) Output=ON

Short (0-0.5V 500μA max) Output=OFF

Max. Rating Voltage of ON/OFF pin (1Pin): -0.3V to +6V



<To prevent reverse connection of Input Power Supply (ex.)> (BSI-5.0S8R0F)

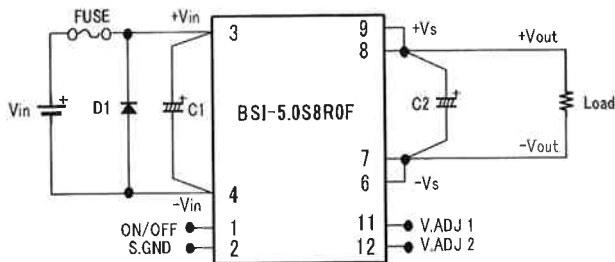


Figure 19

This product is a non-isolated type DC-DC converter. If you connect the input voltage reversed by mistake, it will be eventually damaged.

If there is a possibility of reverse connection, please add a protection circuit as shown in figure 19.

The left figure is an example using fuse and diode.

<Over-Voltage Protection (ex.)>

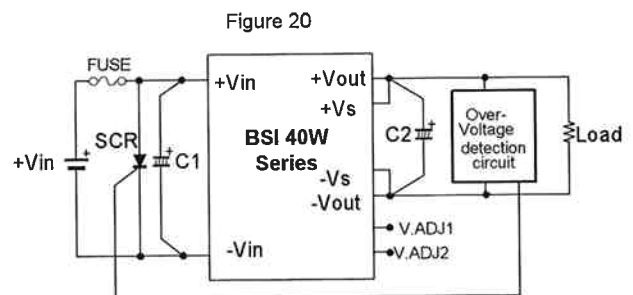
BSI-40W series does not have a built-in over-voltage protection.

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 damaged at over-voltage mode, please add a circuit as the right to intercept the supplying power circuit.

Note:

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



<Cleaning Conditions>

This product can not be cleaned bodily. When and if cleaning should be necessary, use IPA and hand-wash the soldered surface by brush cleaning. For further queries, please contact us.

<Soldering Conditions>

Solder to be executed under the following conditions.

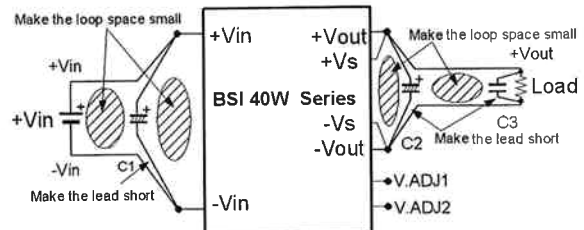
1. Soldering iron 340°C to 360°C within 5sec.
2. Soldering dip 240°C to 260°C within 10sec.

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

Usually BSI 40W 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 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 (+) and (-) of both input and output pins side small as much as possible. You can decrease the influence of parasitic inductance.
4. Design the print pattern of the main circuit as thick and short as much as possible.

Figure 21



<Precautions>

- Depending on output current and input voltage, air flow is required. Please refer to application note.
- For this product parallel and series operation are not possible.
- For mounting this product, please do not use connector or socket. The performance may not be fulfilled by the effect of contact resistance. Mount to printed circuit 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 in for what would affect lives or properties directly by the failure of this product. Please confirm before adopting.
- This product can not be used under vibration, shock or temperature condition that are out of the specification. Contact us, if any questions.
- 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 so grounded may be recommended.
- No test certificate is attached to this product.

<Reliability Test>

Table 5

Test Items	Test Conditions
Low-temp. storage	-40°C 1000hrs. Without energizing
High-temp. storage	+85°C 1000hrs. Without energizing
Thermal Shock	-40°C to +125°C 30min. each 100cycles
High-temp. Aging	+70°C 1000hrs. Rated input, output 3.3V (10A) 5V (7A)
Humidity	+40°C 90 to 95%RH 1000hrs. At rated input/ output
Resistance to Solvent	In IPA for 5min.
Soldering Heatproof	260°C±5°C 10sec. And 350°C±10°C for 3sec.
Vibration	5-10Hz All amplitude 10mm, 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
Evaluation Should be standard in the electrical characteristics and appearance before or after the test.	

Bellnix®

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* All specification are subject to change without notice.

PRINTED IN JAPAN BDD20040921