

## Step-Down Non-Isolated Type DC-DC Converter

# 13Watt BSV-Light A Series

**Bellnix®**

13W BSV-Light A Series is an ultra small size, light weight, and non-isolated type step-down DC-DC converters, which has achieved ultra high efficiency by the latest synchronous rectification circuit technology. BSV-Light A series can be used without heat sink, and it can be chosen among the three types SIP, DIP, and SMD 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 simple circuit composition.

### <Features>

- Synchronous rectification circuit
- Ultra small size, lightweight
- Few external capacitors
- Heat sink not required
- Over-current protection/Short-circuit protection
- Adjustable output
- Non-isolated type
- Operating temperature range  
-40 to +85°C Temp.  
(derating required)
- ON/OFF control
- MTBF1,000,000Hrs
- High reliability
- High performance



### <Model, Rating>

Table 1

Model BSV-LA Series	Rating Input Voltage Vdc	Rating Output Voltage Vdc	Output Current A	Line Regulation %(typ.)	Load Regulation %(typ.)	Ripple & Noise mVpp(typ.)	Efficiency %(typ.)	Package
BSV-1.8S5R0LA	4.5	1.8	3.0 (5.0)	1.0	1.0	30	84 (81)	SIP
BSV-1.8S5R0DLA								DIP
BSV-1.8S5R0SLA								SMD

Note1: Numbers of output I in ( ) is under air flow condition.

### <Specification>

Table 2

Rating Input V/ range	3.0-5.5V. (Derating required)
Input Current	1.45A typ.
Output voltage accuracy	1.8V±4%
Output Voltage Trim Range	1.0V-3.3V (By the external resistance) Tolerance between I/O depends on conditions. Rating output voltage is Vo=1.8V.
Output Current	Rating: 3.0A Max.: 5.0A Air flow is required at 3A or more. Current limited at start-up (2.5A-3A) (Derating required)
Line Regulation	1.0% typ. , 2.0% max. For the line regulation 3.2-5.5V.
Load Regulation	1.0% typ. , 2.0% max. For the load regulation 0-3A.
Temperature Coefficient	±0.01%/typ. (When operating temperature changes between -40°C to +40°C)
Ripple & Noise	30mVp-p typ. 100mVp-p max., (20MHz bandwidth)
Over-Current Protection	Operates at more than 105% of rating load current, auto recovery type. Fold-back type limiting.
Over-Voltage Protection	None
Remote ON/ OFF Control	Installed.
Operating Temperature Range	-40°C to +85°C (Derating required)
Storage Temperature Range	-40°C to +85°C
Operating Ambient Humidity	20-95%R.H max (Max. wet-bulb temp. 35°C, non condensing)
Storage Humidity range	20-95%R.H max (Max. wet-bulb temp. 35°C, non condensing, For storage conditions before mounting refer to soldering conditions on page 9.)
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
Cooling Condition	0-3A: Natural convection 3-5A: Air 1m /sec. or more (refer to the thermal derating )
Outline	Refer to the outline drawings on page 2.
Weight	SIP, DIP: 4.5g typ. SMD: 5.0g typ.

## <Outline>

### [1] BSV-1.8S5R0LA (SIP type)

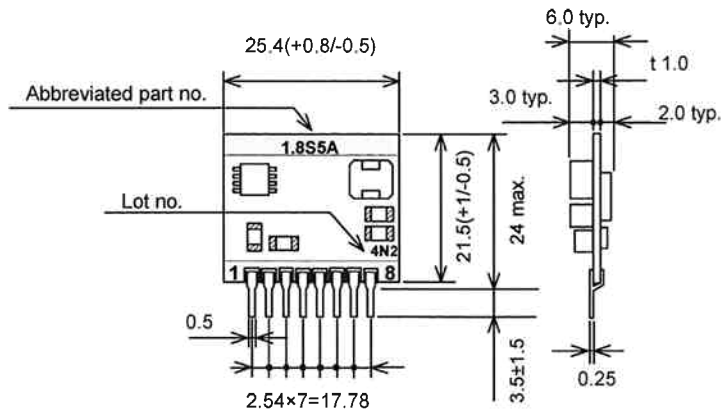


Figure 1

pin	Function
1	on/off
2	+Vin
3	+Vin
4	GND
5	GND
6	+Vout
7	+Vout
8	V.adj

Dimensions: mm  
Tolerances without  
otherwise specified: ±0.5

#### Terminal

Substance: Phosphor bronze (Plating: Sn)  
Treatment: Soldering (Sn-3.0Ag-0.5Cu)  
dip treatment

### [2] BSV-1.8S5R0DLA (DIP type)

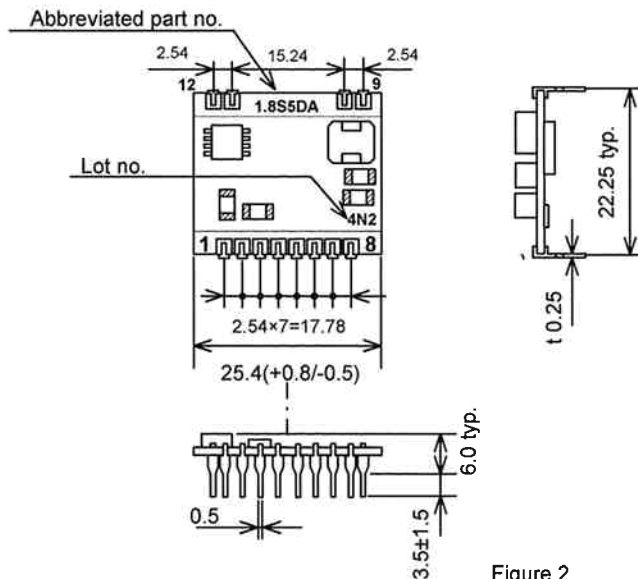


Figure 2

pin	Function
1	on/off
2	+Vin
3	+Vin
4	GND
5	GND
6	+Vout
7	+Vout
8	V.adj
9-12	No Connection

Dimensions: mm  
Tolerances without  
otherwise specified: ±0.5

#### Terminal

Substance: Phosphor bronze (Plating: Sn)  
Treatment: Soldering (Sn-3.0Ag-0.5Cu)  
dip treatment

### [3] BSV-1.8S5R0SLA (SMD type)

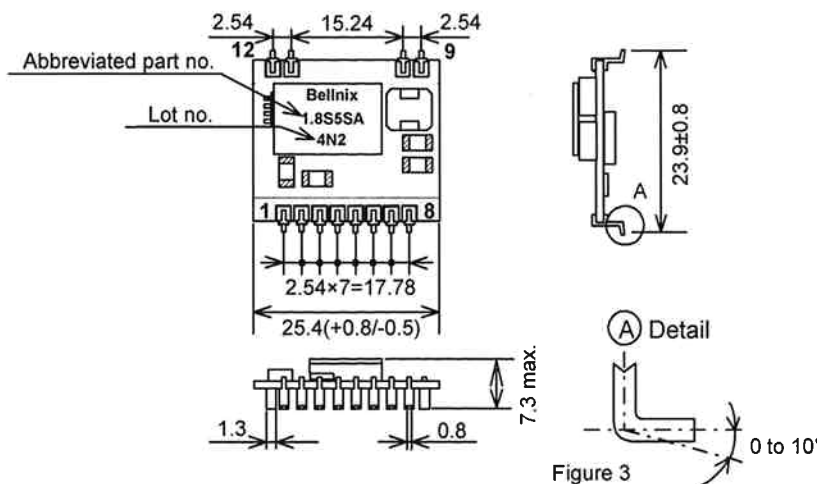


Figure 3

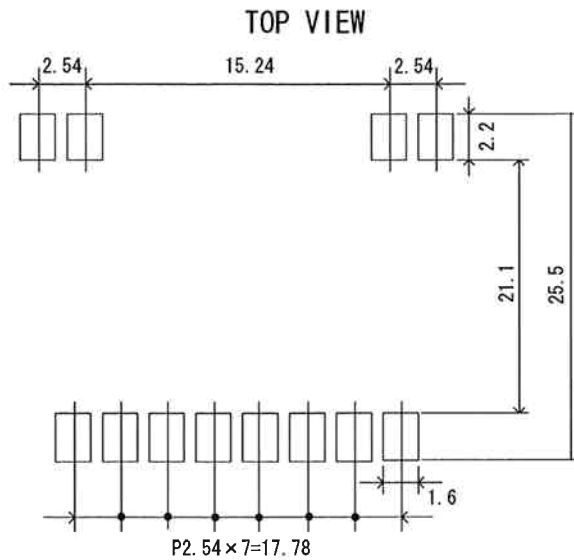
pin	Function
1	on/off
2	+Vin
3	+Vin
4	GND
5	GND
6	+Vout
7	+Vout
8	V.adj
9-12	No Connection

Dimensions: mm  
Tolerances without  
otherwise specified: ±0.5

#### Terminal

Substance: Phosphor bronze (Plating: Sn)  
Treatment: Soldering (Sn-3.0Ag-0.5Cu)  
dip treatment

<Recommended Pad Dimensions (Only for SMD)>



Dimensions: mm

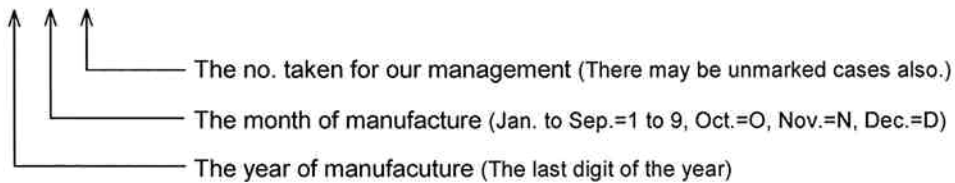
Figure 4

Note 1: The above dimensions are recommended values. Be sure to take your own designing standard into consideration, when designing.

<Lot Indication>

Ex.)

- 5 3 (In case of manufacture in March, 2005)
- 4 N 2 (In case of manufacture in November, 2004)



<Measurement Circuit>

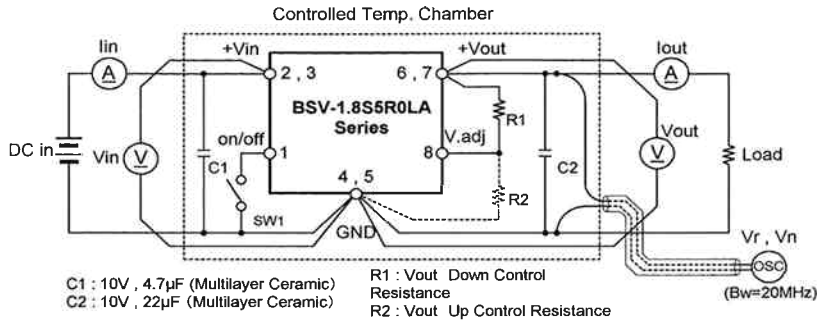


Figure 5

<Standard Connection>

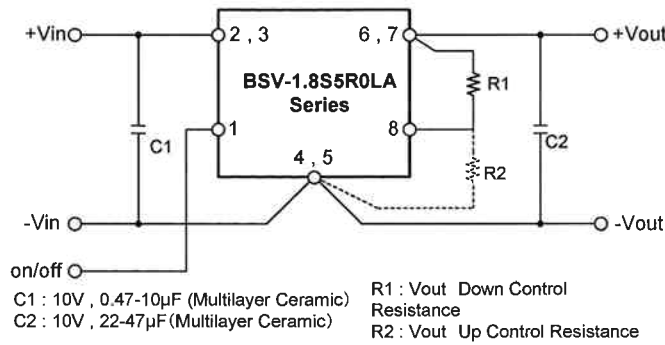


Figure 6

Note 1: Be sure to connect the additional capacitors (C1,C2) without fail.

Note 2: Keep ON/OFF pin (1pin) open when ON/OFF control is not being used.

Note 3: Keep V. adj pin (8pin) open when output trim is not being used.

Note 4: Vout-Down and Vout-Up control can not be done at the same time.

Keep Vout-Up control resistance (R2) open when Vout-Down is being controlled (R1 connected).

Keep Vout-Down control resistance (R1) open when Vout-Up is being controlled (R2 connected).

<Block Diagram>

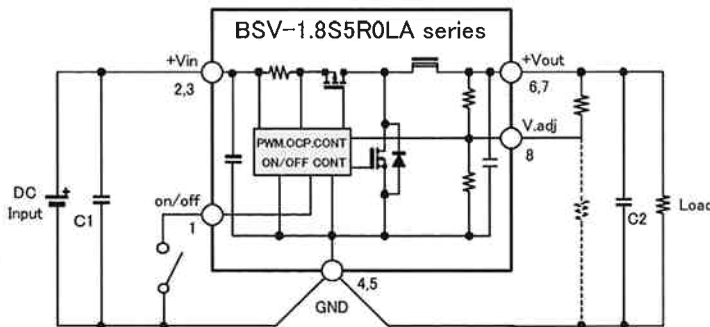
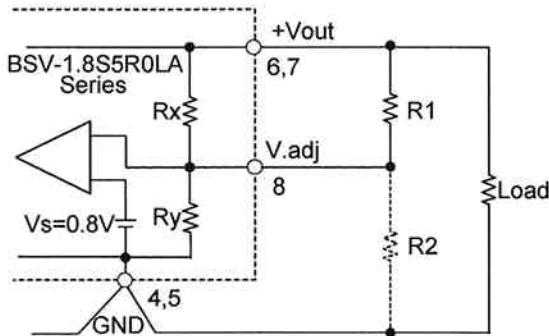


Figure 7

## <Output Voltage Trim Function>

Please see the following, concerning internal equivalent circuit.

By connecting the external resistance R1 or R2, it is possible to adjust Vout-Down control (1.0-1.8V) or Vout-Up control (1.8-3.3V).



Vs	0.8V
Rx	102.7K ohm
Ry	82K ohm
Vo	Desired output voltage

Figure 8

### 1. Vout-Down control (1.0-1.8V)

- Keep R2 open.
- Calculate according to the below equation, and connect the resistor (R1) between 8-6,7.

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

ex.) Reference Fixed Value At 1.0V  
R1=25.6k ( 24k+1.6k )

### 2. Vout-Up control (1.8-3.3V)

- Keep R1 open.
- Calculate according to the below equation, and connect the resistor (R2) between 8-4,5.

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

ex.) Reference Fixed Value At 3.3V  
R1=54.9k ( 51k+3.9k )

Please confirm the value of Vout and adjust the resistance after calculating the external resistance.

3. Keep 8pin(V.adj pin) open in case this unit at 1.8V is used without trimming the Vout.

4. The minimum required input voltage

Regarding this circuit method (step-down), this converter requires input/ output voltage difference. When using with the voltage adjusted, the minimum required voltage difference will change according to the input/ output conditions. So please use the equation to calculate.

Minimum required input voltage  $\geq$  Vout (Desired output voltage)+1V (Also Vin=3V or more)

Ex.) Desired output voltage 2.5V

Minimum required input voltage  $\geq$  2.5V +1V  
 $\geq$  3.5V or more

Note 1. Since 8pin (V.adj pin) is at high impedance, under bad environment this wiring will pick up noise and there is concern of causing bad influence. Please avoid switching the output voltage sharply by opening and shortening or switching the adjustable output voltage's fixed resistor (R1, R2). Also choose a R1, R2 with quality precision and quality temperature characteristics, and mount it by soldering the converter as closer as possible without using connectors or sockets.

Note 2. Low output voltage, low current operation

When this converter is operated with low duty cycle as high input voltage, low output voltage and low output current, the control IC will start skip operation. At this point, the output voltage will be stable continuously, but the output ripple voltage will be increased. By adding a capacitor to the output side, the output ripple can be reduced under skip operation. Also by reducing the operation input voltage skip operation can be avoided.

**<ON/OFF Control>**

Note: These test data do not represent all products.

ON/ OFF is controlled by opening or shortening between the On/OFF pin (1pin) and GND (4, 5pin).

- 1) Not using On/Off control  
Keep 1pin (On/Off pin) open.
- 2) Using On/Off control  
Vout ON condition : Between 1pin-4.5pin Open  
Vout OFF condition : Between 1pin-4.5pin short (0.4Vmax 2.5μA max.)

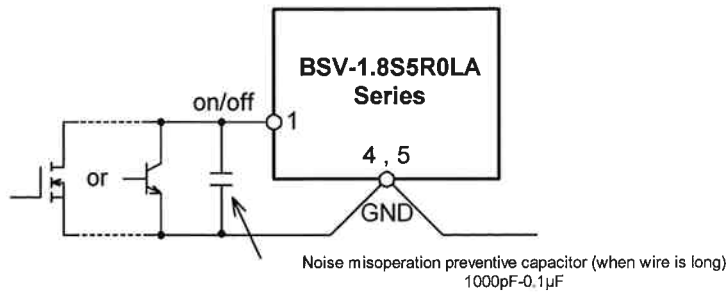


Figure 9

- Note 1: Please use the open collector (or drain) for switch element which is for On/Off control.
- Note 2: Set the switch element of On/Off control near to the converter and wire with the loop short.
- Note 3: If noise misoperation preventive capacitor is connected, it takes long time.

**<Derating>**

Please set this product in the place where good convection is ensured.  
 And also refer to the temperature and input voltage derating to correspond to the environment.

1)Temperature derating

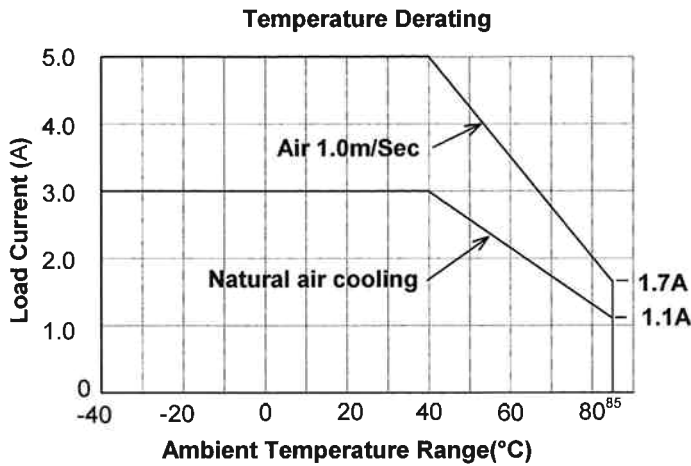


Figure 10

2)Input voltage derating

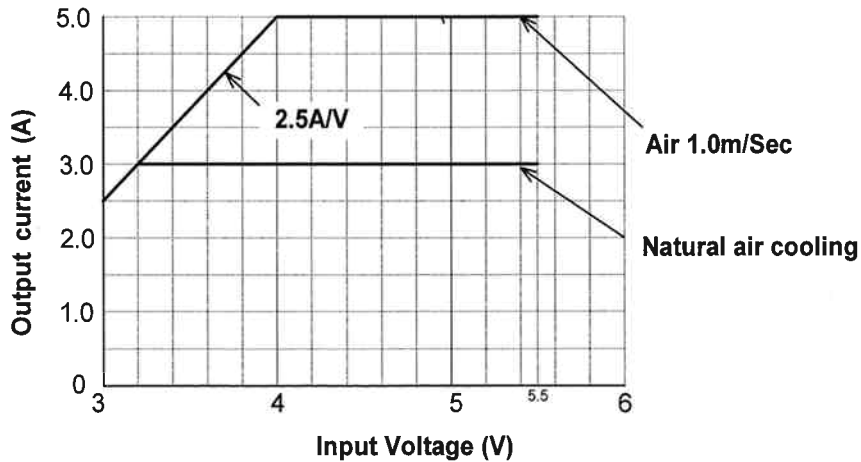


Figure 11

Be sure to use at  $V_{in(min.)} \geq V_{out} + 1V$ . (And also needs to be  $V_{in} = 3V$  or more.)

**<Over current protection and Load current control at start-up>**

This converter has a built-in over current protection circuit (which operates at rating 105% or more), and it is a protection against over current output. By releasing the over current situation, it will be automatically recovered.

**1) Over Current Protection Circuit**

The characteristics for over current protection circuit operating and releasing will be shown as the figure below.

Over current protection circuit for this converter has combined current limiting with fold-back protection. In case of recovering output voltage, it is necessary to decrease the load once.

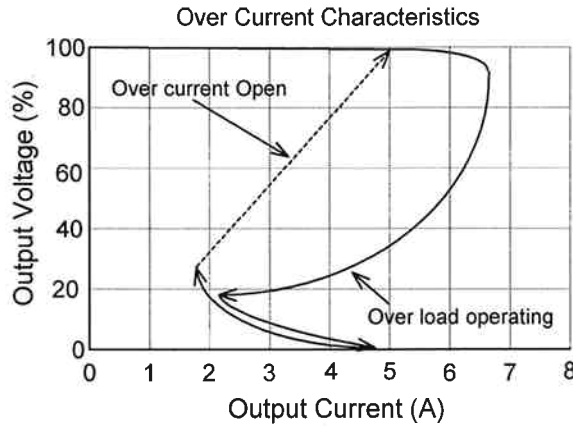


Figure 12

**2) Load current control at start-up**

If this converter with fold-back protection is connected, to non linear loads such as ramps or motors, and rating current loads, there is a possibility to cause start-up failure.

Please control the load current at the start-up time. Control current depends on the output voltage as shown in the table below.

Vout trim range	Output current control
1-2.5V	3A
>2.5V	2.5A



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

Between the input/ output of BSV-Light series is a non-isolated type DC-DC converter that steps down 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 shown in Figure11. The figure below is an example using fuse and diode.

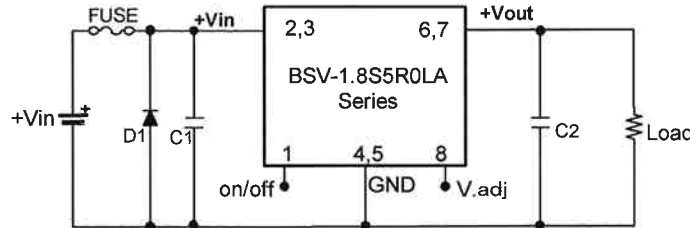


Figure 13

**<Over Voltage protection>**

BSV-Light series does not have a built-in over voltage protection.

When the switching element of this converter gets damaged in short mode, input voltage (+Vin) will be output as it is.

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

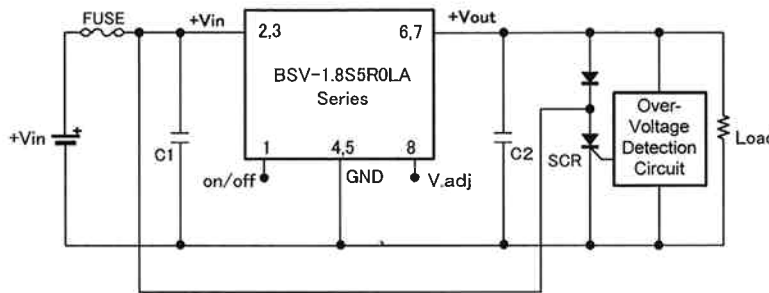


Figure 14

Notes:

1. When it is damaged at over-voltage mode, On/Off control will not operate.
2. Make sure that the DC Power Supply on the supplying power side has the capacity the fuse can be cut.

**<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.
3. Reflow method (only for SMD type)  
Preheating Temp. : 150-180°C, 120-180 sec.  
Main heating temp.: 220°C or more, 60sec max.  
Peak temperature : 250°C max.  
Reflowing frequency: once

\* When reflowing, be sure not to vibrate this product.

4. Storage before mounting

Please storage this unit in the ambient temperature under 30°C and humidity condition under 60%RH. And please obey the following notice.

- Keep it in a place where the unit will not be influenced by poisonous gas.
- Keep it in a place where the unit will not be exposed in a atmosphere of corrosion.
- Please avoid the dust.
- Keep it in a place where direct sunlight will not effect it.
- Keep it under the condition that the unit will not take be loaded.

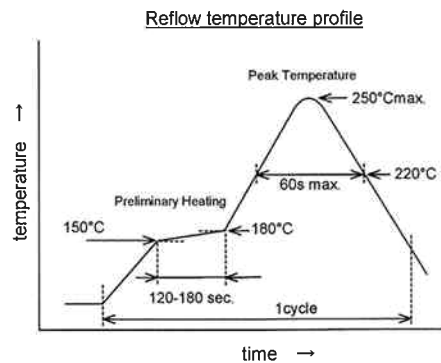


Figure 15

**<Precautions>**

For customer's safety, please see the specification and observe the undermentioned notes definitely when using this product.

- This product intends to be used for general electronic equipments (Clerical work machines, Telecommunications equipments, and Measurement equipments). Therefore, do not use for medical equipments, nuclear power equipments, and trains, etc. the malfunction and damage of which may influence directly to human life and property. Please confirm when using it in the case except general electronic equipment.
- 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 by the effect of contacting resistor.
- This product has a built-in over current and short protection circuit, but long time short circuit will cause failure, so please avoid it.
- The product may be damaged if it is used under electric conditions and environmental conditions such as temperature out of the standard. So please be sure to keep the standards.
- There is a possibility of damage from static. When the worker has electrified static, please earth discharge and working on an earthed worktable will be recommended.
- This product does not have a built in fuse. When it is abnormal, please connect the fuse with + input line as a protection for excessive current flowing into the input. Please give capacity, so that the fuse can be cut to from power supply.
- This product does not have a built in over voltage protection. When over voltage is abnormally generated in the module, there is such a mode that the input voltage appears to the output straight, and which may cause smoke and ignition. Please make sure to add the overvoltage protection circuit to prevent it.
- No test certificate is attached to this product.

**<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 with new one at our own expense.

But in case that you should modify and/ or make internal remodeling by itself whatsoever, we cannot guarantee it. This guarantee shall cover only 13Watt BSV-Light series.

**<Contact Bellnix>**

For further information of this product, please contact to the number below.

**TEL: 81-48-864-7733**

**FAX: 81-48-861-6402**

