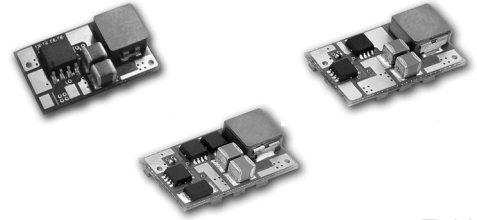


Information

The BST12M series is a small, thin, highly efficient and low noise non-isolated type step down DC-DC converter with 12V input that has been developed for distributed feeding. Output voltage is adjustable from 0.7525V to 5.5V and it can operate up to 85°C of the ambient temp with a minimal derating.



Features

- Small and thin type
W=20.3 L=11.4 H=5.35mm
- Non-Isolated type
- SMD
- High efficiency
94.0%, 94.0%, 92.5%
- Wide input voltage range
- Adjustable output voltage
- ON/OFF control
- Under voltage lockout
- Over current protection
- No electrolytic capacitor
- Long life, high-performance low price
- Operating temp -40°C to +85°C
(Temp derating required)
- Heatsink not required
- RoHS compliance

Model/Rating

Model BST12M Series	Input V Vdc	Output V Vdc	Output I A	Line Reg. % (typ.)	Load Reg. % (typ.)	Noise mVpp (typ.)	Efficiency % (typ.)
BST12M-0.7S03PDM	6.0-14.0	0.7525-5.5	3.0	0.2	0.6	20	94.0
BST12M-0.7S06PDM			6.0		0.6	40	94.0
BST12M-0.7S10PDM			10.0		0.8	55	92.5

Note1: Ripple noise and efficiency are when input voltage is 12V, output voltage 5V and output current is rated.

Note2: Ripple noise is measured by 20MHz bandwidth with a multi layered ceramic capacitor, 47μF×2 at input, 47μF×2+1μF at output

Note3: Depending on ambient temp conditions, cooling air flow may be required.

Specifications

Table 2

Models	BST12M-0.7S03PDM	BST12M-0.7S06PDM	BST12M-0.7S10PDM	Conditions
Input voltage range	6.0 to 14.0V (Vout ≤ 3.8Vdc) 8.0 to 14.0V (Vout > 3.8Vdc)			
Rated input voltage	12.0V			
Output voltage anomaly	± 1.5% (Output voltage : 0.7525V)			Trim pin Open , Output current 0A
Adjustable output voltage range	0.7525 to 5.5V			0.7525V for the default setting
Line regulation	0.2% typ.			Input voltage varying from 6.0 to 14.0V
Load regulation	0.6% typ.	0.6% typ.	0.8% typ.	Load varying from 0 to 100%
Total regulation	± 2.5% max.			Inclusive of output voltage anomaly, line, load and temp regulations
Ripple noise	20mVp-p typ.	40mVp-p typ.	55mVp-p typ.	Output voltage 5V, Measurement frequency bandwidth 20MHz
Efficiency	94.0% typ.	94.0% typ.	92.5% typ.	When input is rated, output voltage is 5V and output current is rated.
	81.5% typ.	80.5% typ.	76.0% typ.	When input is rated, output voltage is 1V and output current is rated.
Over current protection	Activated at 6A typ. A hick-up mode, Auto-recovery	Activated at 10A typ. A hick-up mode, Auto-recovery	Activated at 17A typ. A hick-up mode, Auto-recovery	Vout=3.3V
Over voltage protection	No			
Under voltage lockout	Yes			
Over current protection	No			
Remote ON/OFF control	Between 5 pin (On/Off) and 2 pin (GND) : Output ON when in Open, Output OFF when in Short (Refer to P.8)			
Standby Current	2.9mA typ.	2.7mA typ.	2.5mA typ.	
Remote sensing	No			
Max output load capacity	2000μF max (ESR>10mΩ), 1000μF max (ESR>1mΩ)			
Operating temp range	-40°C to +85°C (Refer to the separate temp derating chart)			
Humidity range	20 to 85% R.H. (No condensation)			
Storing temp range	-55°C to +125°C			
Storing conditions	Before mounting a converter : 30°C/60% R.H. or lower with less than 1 year (After opening moisture-proof packaging)			
Cooling conditions	A cooling air flow may be required depending on the ambient temp. Refer to the separate derating chart.			
Vibrations	5-10Hz, all amplitude 10mm p-p, 5-55Hz acceleration 4m/s ² (2 hours in each of 3 orthogonal axes)			
Shock	Acceleration 50m/s ² , 11m/s, Half sine Wave (3 directions, 3 times each)			
Weight	2.2g typ.	2.4g typ.	2.4g typ.	
Dimensions	W=20.3 L=11.4 H=5.35 typ. (mm) *For further details, please refer to Page 6.			

*The above information is stated with rated value at normal temp, unless otherwise specified.

1. Usage range

The datasheet applies to a direct input, non-isolated type DC-DC converter, BST12M Series.

2. Model name/Rating

Table 3

Models	Rated input voltage	Output voltage	Rated output current	Shapes	Note
BST12M-0.7S03PDM	DC 12.0V	0.7525V to 5.5V	3A	SMD	
BST12M-0.7S06PDM			6A		
BST12M-0.7S10PDM			10A		

The default setting of output voltage is $0.7525V \pm 1.5\%$.

Input/output is rated with ambient temp $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, unless otherwise specified in the datasheet.

3. Environmental conditions

3-1. Temp range

Active -40°C to $+85^{\circ}\text{C}$ (Refer to temp derating section)

Storage -55°C to $+125^{\circ}\text{C}$

3-2. Humidity range

Active 20 to 85%RH (No condensation)

Storage 5 to 85%RH (No condensation)

4. Specification/Rating

The product complies with RoHS.

4-1 Absolute maximum rating

Absolute maximum rating is the rating when the product is overworked. Excessive stress to the product can cause permanent damage. If the product is used under the absolute maximum rating for a long period of time, the credibility of the product could be damaged. Therefore, please use the product under the conditions specified in the electrical characteristics chart [4-2].

Table 4

Items	code	min.	max.	Units
Input voltage	Vin	-0.3	15	V
Output voltage	Vout	0.7525	5.5	V
Operating temp range	Ta	-40	85	$^{\circ}\text{C}$
Storing temp	Tstg	-55	125	$^{\circ}\text{C}$

4-2. Electrical characteristics

4-2-1. Electrical characteristics BST12M-0.7S03PDM

(Ta=25°C, Airflow=200LFM(1.0m/s), Vin=12.0V, Vout=0.7525-5.5V, Io=Rated, unless otherwise specified in the conditions)

Table 5

Item	Code	Conditions	Min.	Typ.	Max.	Units
Input characteristics						
Input voltage range	Vin	Vout = 3.8V (3.3V+15%)	6.0	12.0	14.0	V
		Vout > 3.8V (3.3V+15%)	8.0	12.0	14.0	V
UVLO turn-on voltage				5.5	6.0	V
UVLO turn-off voltage			4.0	4.4		V
Max input current	Iin	Vin = 8.0V Vout = 5.0V Io = 3A			2.0	A
Input current at no-load	Iin	Vout = 5.0V Io = 0A		31		mA
Standby current	Iin			2.9		mA
Recommended input capacity	Cin		100		1200	μF
Output characteristics						
Output voltage setting	Vout	Vin = 12.0V Io = 0A	-1.5	Vout	+1.5	%Vout
Adjustable output voltage range	Vout		0.7525		5.5	V
Output variation						
Line regulation		Vin = 8.0V ~ 14.0V Io = 3A		0.2		%Vout
Load regulation		Io = 0A ~ 3A		0.6		%Vout
Total regulation		Inclusive of line, load and temp regulations	-2.5		+2.5	%Vout
Output current (Temp derating required)	Io		0		3.0	A
Over current protection	Io	Vout = 3.3V		6		A
Output overshoot at turn-on		Remote ON / Input ON			2	%
Recommended output capacity	Co	47μF × 2 min.	94			μF
Max output load capacity	Co	Min ESR > 1mΩ Min ESR > 10mΩ			1000 2000	μF
Output ripple noise Peak to Peak						
Vout = 5.0V Vout = 1.0V		Bandwidth = 20MHz Cin = 47μF×2, Cout = 47μF×2+ 1μF		20 10	40 30	mVp-p
Efficiency						
Vo = 5.0V Vo = 1.8V Vo = 1.0V	η	Vin=12.0V Io=3A		94.0 88.0 81.5		%
Others, features and characteristics						
Switching frequency				320		kHz
Remote ON/OFF control Logic High Voltage Logic Low Voltage		Module On, Von/off Module Off, Von/off	Vin-1.0 -5.0		Vin Vin-2.7	V V
Overheat protection				120		°C
Weight				2.2		g

4-2-2. Electrical characteristics BST12M-0.7S06PDM

(Ta=25°C, Airflow=200LFM(1.0m/s), Vin=12.0V, Vout=0.7525-5.5V, Io=Rated, unless otherwise specified in the conditions)

Table 6

Item	Code	Conditions	Min.	Typ.	Max.	Units
Input characteristics						
Input voltage range	Vin	Vout = 3.8V (3.3V+15%)	6.0	12.0	14.0	V
		Vout > 3.8V (3.3V+15%)	8.0	12.0	14.0	V
UVLO turn-on voltage				5.5	6.0	V
UVLO turn-off voltage			4.0	4.4		V
Max input current	Iin	Vin = 8.0V Vout = 5.0V Io = 6A			4.0	A
Input current at no-load	Iin	Vout = 5.0V Io = 0A		65		mA
Standby current	Iin			2.7		mA
Recommended input capacity	Cin		100		1200	μF
Output characteristics						
Output voltage setting	Vout	Vin = 12.0V Io = 0A	-1.5	Vout	+1.5	%Vout
Adjustable output voltage range	Vout		0.7525		5.5	V
Output variation						
Line regulation		Vin = 8.0V ~ 14.0V Io = 6A		0.2		%Vout
Load regulation		Io = 0A ~ 6A		0.6		%Vout
Total regulation		Inclusive of line, load and temp regulations	-2.5		+2.5	%Vout
Output current (Temp derating required)	Io		0		6.0	A
Over current protection	Io	Vout = 3.3V		10		A
Output overshoot at turn-on		Remote ON / Input ON			2	%
Recommended output capacity	Co	47μF × 2 min.	94			μF
Max output load capacity	Co	Min ESR > 1mΩ Min ESR > 10mΩ			1000 2000	μF
Output ripple noise Peak to Peak						
Vout = 5.0V		Bandwidth = 20MHz Cin = 47μF×2, Cout = 47μF×2+1μF		40	80	mVp-p
Efficiency						
Vo = 5.0V Vo = 1.8V Vo = 1.0V	η	Vin=12.0V Io=6A		94.0 87.5 80.5		%
Others, features and characteristics						
Switching frequency				320		kHz
Remote ON/OFF control Logic High Voltage Logic Low Voltage		Module On, Von/off Module Off, Von/off	Vin-1.0 -5.0		Vin Vin-2.7	V V
Overheat protection				120		°C
Weight				2.4		g

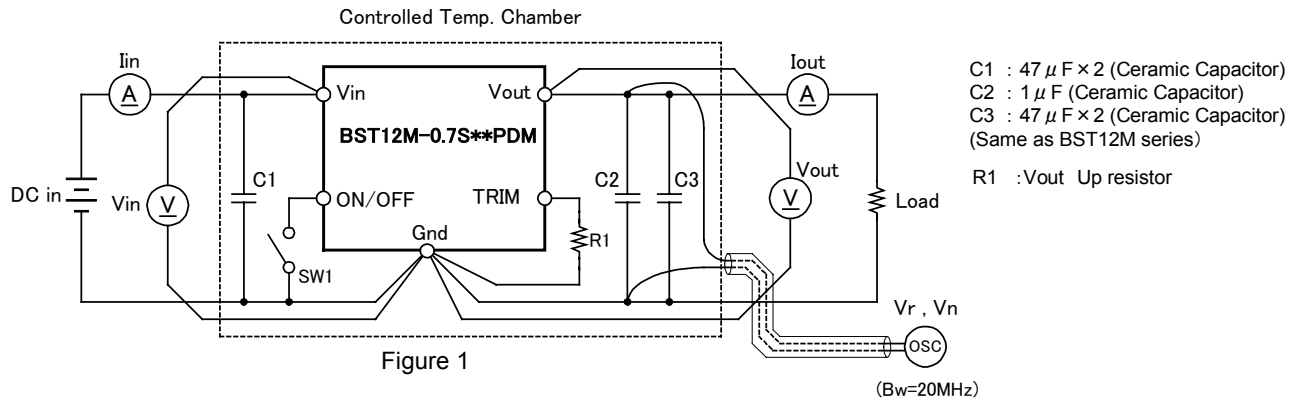
4-2-3. Electrical characteristics BST12M-0.7S10PDM

(Ta=25°C, Airflow=200LFM(1.0m/s), Vin=12.0V, Vout=0.7525-5.5V, Io=Rated, unless otherwise specified in the conditions)

Table 7

Item	Code	Conditions	Min.	Typ.	Max.	Units
Input characteristics						
Input voltage range	Vin	Vout = 3.8V (3.3V+15%)	6.0	12.0	14.0	V
		Vout > 3.8V (3.3V+15%)	8.0	12.0	14.0	V
UVLO turn-on voltage				5.5	6.0	V
UVLO turn-off voltage			4.0	4.4		V
Max input current	Iin	Vin = 8.0V Vout = 5.0V Io = 10A			6.8	A
Input current at no-load	Iin	Vout = 5.0V Io = 0A		65		mA
Standby current	Iin			2.5		mA
Recommended input capacity	Cin		100		1200	μF
Output characteristics						
Output voltage setting	Vout	Vin = 12.0V Io = 0A	-1.5	Vout	+1.5	%Vout
Adjustable output voltage range	Vout		0.7525		5.5	V
Output variation						
Line regulation		Vin = 8.0V ~ 14.0V Io = 10A		0.2		%Vout
Load regulation		Io = 0A ~ 10A		0.8		%Vout
Total regulation		Inclusive of line, load and temp regulations	-2.5		+2.5	%Vout
Output current (Temp derating required)	Io		0		10.0	A
Over current protection	Io	Vout = 3.3V		17		A
Output overshoot at turn-on		Remote ON / Input ON			2	%
Recommended output capacity	Co	47μF × 2 min.	94			μF
Max output load capacity	Co	Min ESR > 1mΩ Min ESR > 10mΩ			1000 2000	μF
Output ripple noise Peak to Peak						
Vout = 5.0V Vout = 1.0V		Bandwidth = 20MHz Cin = 47μF×2, Cout = 47μF×2+1μF		55	100	mVp-p
				45	80	
Efficiency						
Vo = 5.0V Vo = 1.8V Vo = 1.0V	η	Vin=12.0V Io=10A		92.5 84.0 76.0		%
Others, features and characteristics						
Switching frequency				320		kHz
Remote ON/OFF control Logic High Voltage Logic Low Voltage		Module On, Von/off Module Off, Von/off	Vin-1.0 -5.0		Vin Vin-2.7	V V
Overheat protection				120		°C
Weight				2.4		g

4-3. Measurement circuits



5. Outer dimensions and pin information
 5-1. Configurations/Dimensions

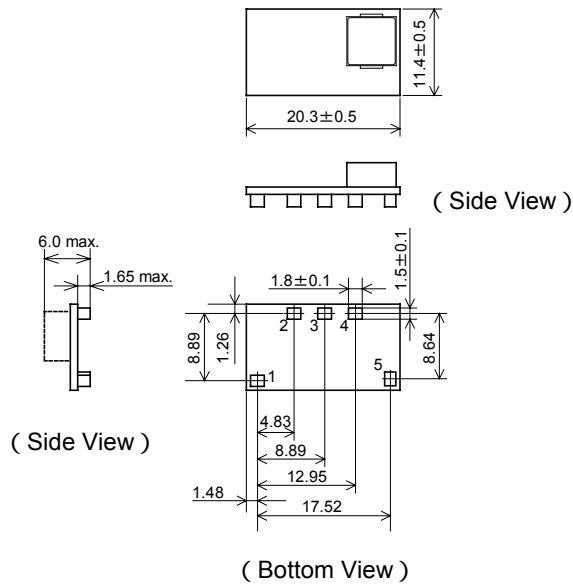


Figure 2

Table 8

Pin	Name	Function
1	Vin	+ Input pin
2	GND	Input/output GND pin
3	TRIM	Adjustable output voltage pin
4	Vout	+ Output pin
5	ON/OFF	Remote ON/OFF control pin

Pin numbers are not indicated on the product.

Pin material : Copper
 Coat on the pins : Gold plate after plated with Nickel

- Units mm
- Tolerances unless otherwise specified \pm 0.25
- Weight = 2.2g typ.
 (BST12M-0.7S03PDM)
 = 2.4g typ.
 (BST12M-0.7S06PDM, BST12M-0.7S10PDM)

5-2. Recommended pad dimension diagram

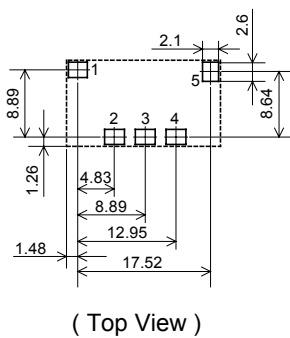


Figure 3

5-3. Model name/Year and Month of manufacturing display

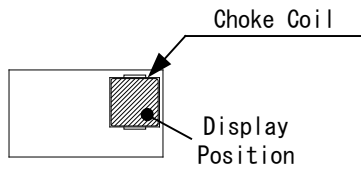


Figure 4

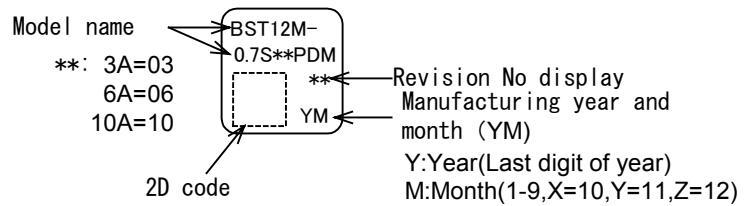


Figure 5

6. Usage

6-1. Standard connection circuit

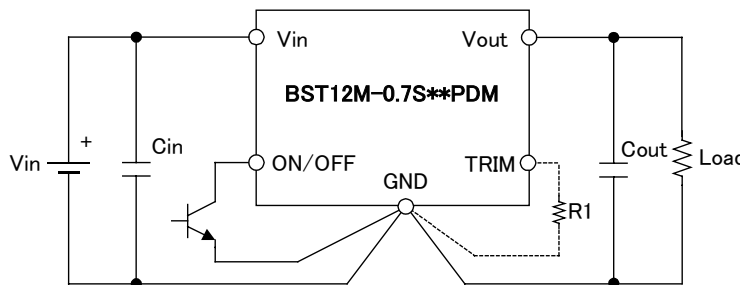


Figure 6

Cin : 47 μ F \times 2 (Ceramic Capacitor)
 Cout : 47 μ F \times 2 + 1 μ F (Ceramic Capacitor)
 (Common with BST12M series)

R1 :Vout Up resistor

6-2. Input filter

Input power supply to the BST12M series should be provided with low impedance.

High impedance on the input side may cause some stability issues to the module. Therefore, a low ESR capacitor is recommended for an added capacitor (Cin). When impedance on the input side is especially high, such as long wiring, capacitors other than the recommended capacitors are required to be added. The capacitor (Cin) should be connected near to the module.

When several converters with the switching method operate with the same electrical power source or by a cascade connection, they interact with each other and will have an effect of beat frequency that could appear in output voltage or a beat sound. When using these connections, L-C filters need to be made.

6-3. Remote ON/OFF control

Output voltage may be controlled by ON/OFF feature without switching on and off the input. The ON/OFF pin is pulled-up by Vin inside the module. When not using the ON/OFF control, leave the ON/OFF pin open or connect to Vin.

Between ON/OFF (5pin) and GND (2pin)

OPEN : Output ON

SHORT : Output OFF

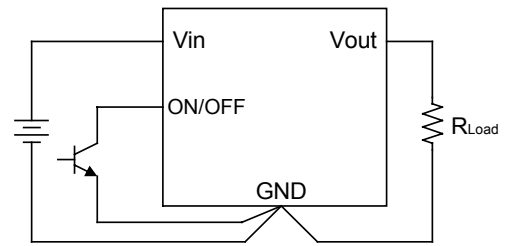


Figure 7

A device used for the ON/OFF control should have a sink capability of around 0.3mA in the Low level.

6-4. Output voltage programming

The BST12M series may adjust to any output voltage within the range of 0.7525V to 3.63V.

Please note that the input voltage range may vary depending on the output voltage. Please refer to the electrical characteristics [Section 4-2].

When the TRIM pin is open, the output voltage is $0.7525V \pm 1.5\%$.

There are two methods to adjust output voltage. One is by an external voltage and the other is by an external resistive connection.

6-4-1. Adjustable methods by an external voltage

Output voltage, Vout may be adjusted by applying an external voltage between the TRIM and GND pins as in Figure 8.

The output voltage, Vout may vary to slight change of VCTRL voltage with only external power supply of VCTRL (REXT=0Ω).

Connecting a resistor, REXT between the TRIM pin and the external power supply in series should be recommended to prevent this.

The formula for the adjustable external voltage VCTRL of the BST12M series is as follows.

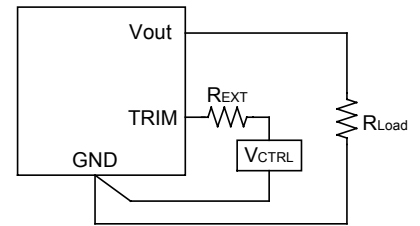


Figure 8

$$V_{CTRL} = 0.7 - \frac{(1 + R_{EXT} \dots \dots \dots)(V_{out} - 0.7525)}{15} \text{ [V]}$$

e.g.) The formula of VCTRL for setting Vout to 3.3V (REXT=15KΩ) is as follows.

$$V_{CTRL} = 0.7 - \frac{(1 + 15)(3.3 - 0.7525)}{15} = -2.017V$$

E.g. for voltage control Table 9

Vout (V)	VCTRL (V)	
	REXT=0Ω	REXT=15kΩ
0.7525	OPEN or 0.700	OPEN or 0.700
1.0	0.684	0.436
1.2	0.670	0.223
1.5	0.650	-0.097
1.8	0.630	-0.417
2.0	0.617	-0.631
2.5	0.584	-1.164
3.3	0.530	-2.017
5.0	0.417	-3.831
5.5	0.384	-4.364

6-4-2. Adjustable methods by an external resistor

Output voltage, Vout may be adjusted by connecting a resistor between the TRIM and GND pins as in Figure 9.

The formula for the adjustable resistor, RTRIM of the BST12M series is as follows.

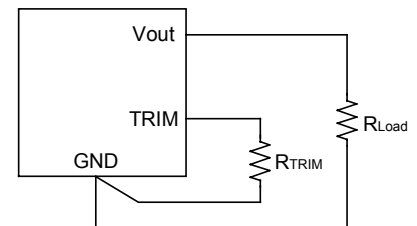


Figure 9

$$R_{TRIM} = \frac{10.5}{(V_{out} - 0.7525)} - 1 \text{ [k}\Omega\text{]}$$

e.g.) The formula of RTRIM for setting Vout to 3.3V is as follows.

$$R_{TRIM} = \frac{10.5}{(3.3 - 0.7525)} - 1 = 3.12k\Omega$$

E.g. for adjustable resistance control Table 10

Vout (V)	RTRIM [kΩ]	Approximate value of RTRIM when using the resistor in THE E96 line [kΩ]*
0.7525	OPEN	—
1.0	41.42	41.2
1.2	22.46	22.6
1.5	13.05	13.0
1.8	9.02	9.09
2.0	7.42	7.50
2.5	5.01	4.99
3.3	3.12	3.09
5.0	1.47	1.47
5.5	1.21	1.21

*There may be a slight difference in Vout value because of the approximate values.

After working out the external resistance, make sure to check the output voltage and adjust the resistance value. The tolerances of RTRIM will affect to the tolerances of the output voltage.

7. Overheat protection

When the BST12M series is used under adverse condition, it will go into the overheat state and stop operating automatically. When the temperature goes back to normal, it will recover itself. (Auto-reset).

8. Over current protection

The converter protects itself against over current and short circuits. When it goes into the over heat state, it will go into the pulse-by-pulse and hick-up modes. When the over current state is released, the output voltage will go back to normal. (Auto-reset). Please refrain from using the product for a long period of time under the over current or load circuit conditions that could result in damaging the converter.

9. Temperature derating

Although the converter will operate in a wide range of temperatures, a cooling airflow will be required to release heat when the ambient temp is high.

Please refer to Page 11 in regards to the temp. derating curve that will support the thermal design to use the converter properly.

Measuring in the actual usage environment will be recommended for certain cooling. Especially, when the load in the actual use is close to maximum value of the temp derating, the measurement is required. Make sure that the parts temperatures do not exceed 120°C when used. Figure 10 shows the appropriate parts when measuring temperatures.

Figure 12 to 20 show the max output current under the conditions of the designated environmental temperature and air-cooling. The product is placed horizontally and the wind direction is as in Figure 11.

The air-cooling condition is 100LFM 0.5m/sec.

[Maximum output current]

The value of maximum output current under given conditions will be either 1) or 2), whichever the current value is smaller.

- 1) Output current when the temperature of any parts reaches to 120°C
- 2) The official rated current value of the converter

[Measurement condition]

The temp. derating curve will be defined under the following conditions.

Board : Size 110 x 100mm, t1.6, 4 layers (Copper foil inner layer 70μF, outer layer 70μF)

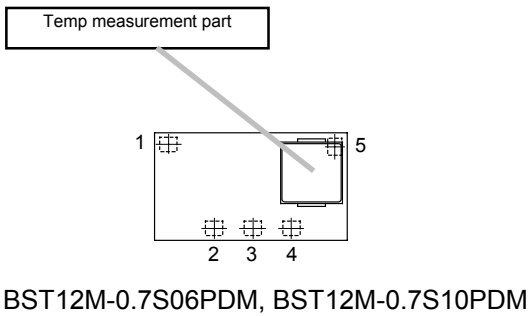
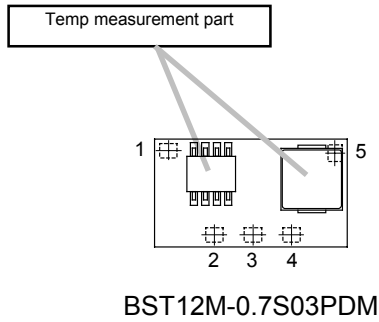


Figure 10. Temp measurement point

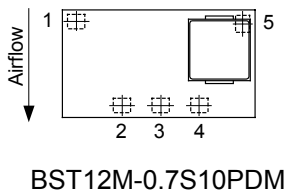
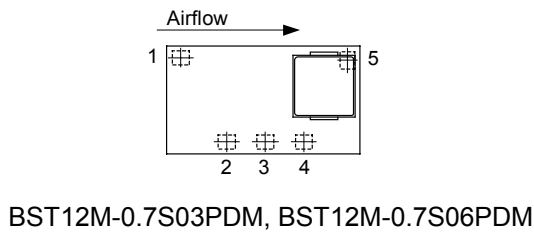


Figure 11. Temp derating air-cooling direction

9.1 BST12M-0.7S03PDM Temp derating curve

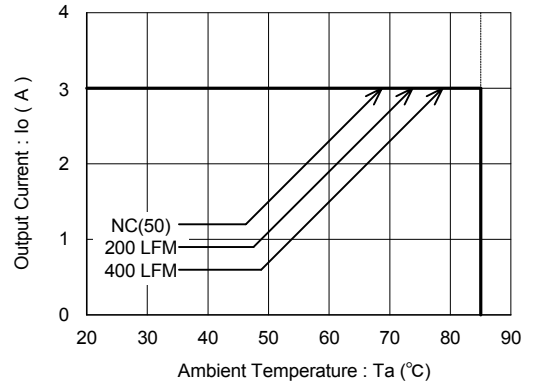


Figure 12. BST12M-0.7S03PDM ($V_{in}=12.0V$, $V_o=5.0V$)

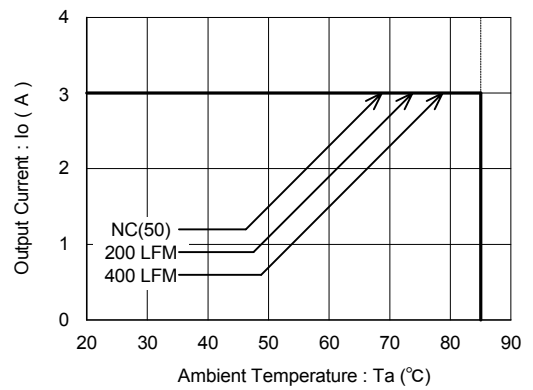


Figure 13. BST12M-0.7S03PDM ($V_{in}=12.0V$, $V_o=3.3V$)

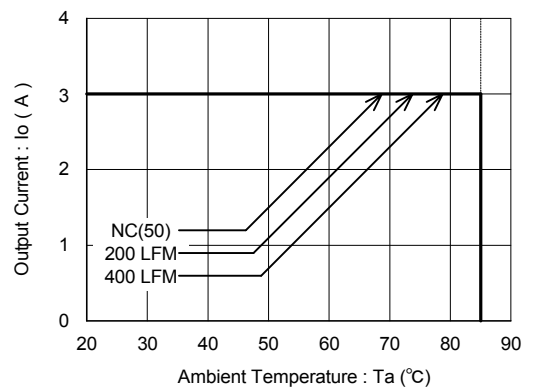


Figure 14. BST12M-0.7S03PDM ($V_{in}=12.0V$, $V_o=1.0V$)

100LFM 0.5m/sec

9.2. BST12M-0.7S06PDM Temp derating curve

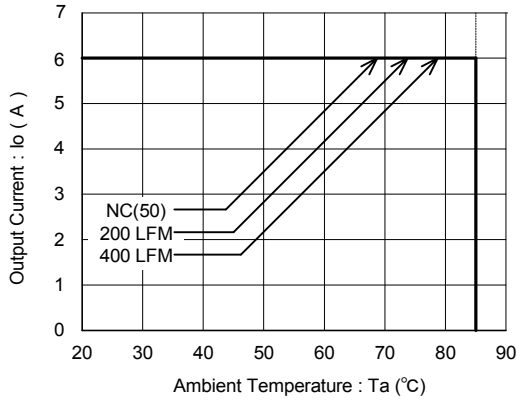


Figure 15. BST12M-0.7S06PDM (Vin=12.0V, Vo=5.0V)

9.3. BST12M-0.7S10PDM Temp derating curve

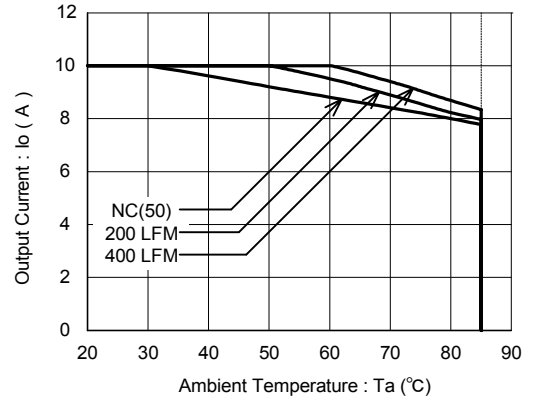


Figure 18. BST12M-0.7S10PDM (Vin=12.0V, Vo=5.0V)

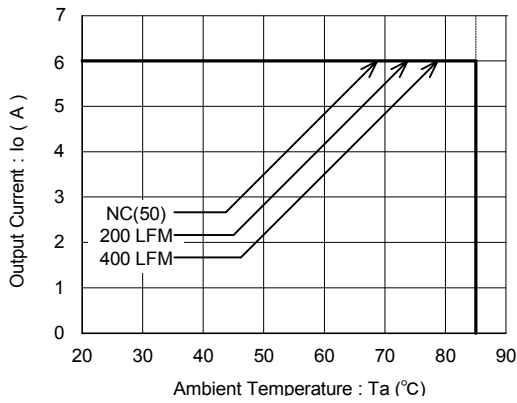


Figure 16. BST12M-0.7S06PDM (Vin=12.0V, Vo=3.3V)

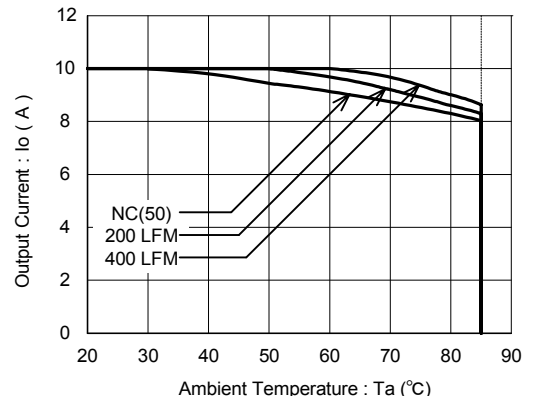


Figure 19. BST12M-0.7S10PDM (Vin=12.0V, Vo=3.3V)

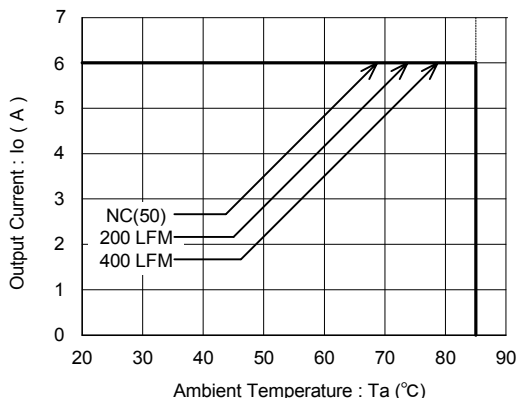


Figure 17. BST12M-0.7S06PDM (Vin=12.0V, Vo=1.0V)

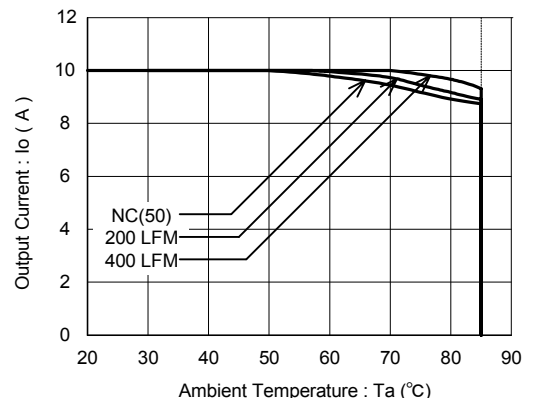


Figure 20. BST12M-0.7S10PDM (Vin=12.0V, Vo=1.0V)

*100LFM 0.5m/sec

10. Protection method of input power supply against reverse connection

The product is a non-isolated type between input and output and step down converter from a straight polarity to a straight polarity. It will be damaged if input polarity is connected in reverse. When there is a possibility of reverse connection, please add a protection circuit as in the below figure.

The below figure is an example of using fuse and diode. The power supply on the supply side should have enough capacity to meltdown a fuse.

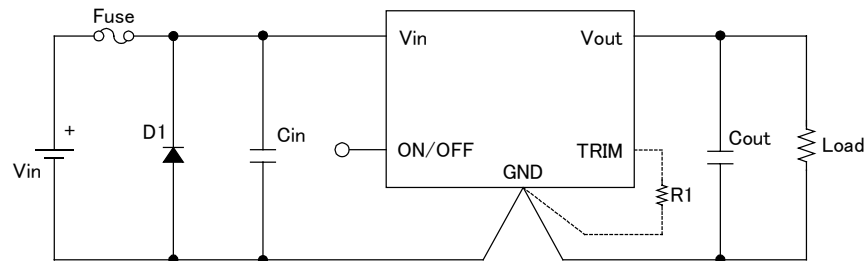


Figure 21

11. Over voltage protection (Example)

The product does not have over voltage protection built in.

When the product is damaged due to the short mode in the internal switch element, the DC input voltage will appear in output as is. Therefore, just in case the over voltage mode will be damaged, please add the input shutoff circuit as in the below figure.

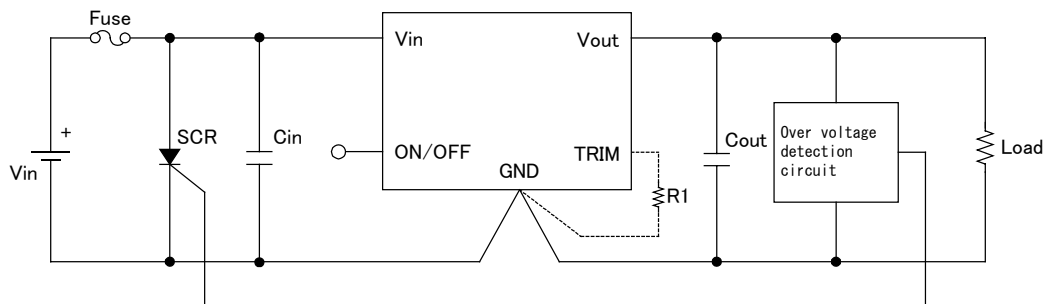


Figure 22

*1 When the product is damaged due to the over voltage mode, the ON/OFF control will not function.

*2 When there is ON/OFF control on the electrical supply side, over voltage protection circuit will be used.

*3 The DC power supply on the electrical supply side should have enough capacity to meltdown a fuse.

12. Mounting conditions

The product may be soldered by the re-flow method. Make sure not to cause the product to vibrate during the re-flow.

This product can not be soldered on by flow. The number of re-flows is twice.

The re-flow temp profile is as follows (Figure 23).

The number of re-flow will be limited to twice.

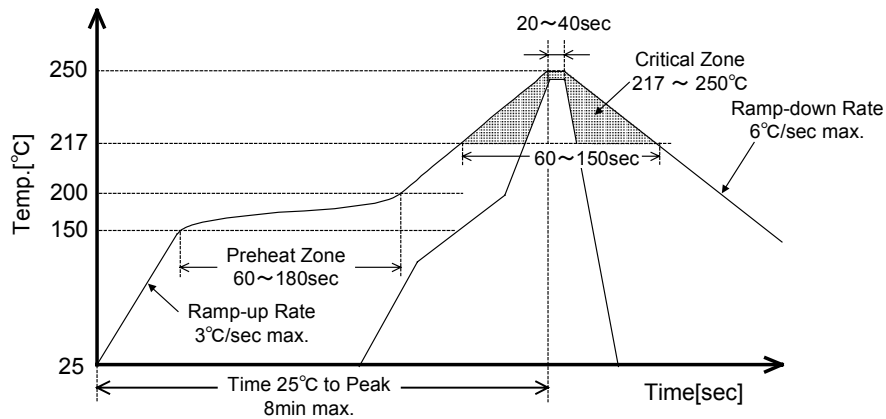


Figure 23. Re-flow temp profile (lead-free product)

13. About washing

The product can not be washed as a whole, although a non scrub flux is recommended.

14. Precautions

For the safety of our customer, please follow all warnings and specifications which are stated below.

- This product is intended for use in general electronic appliances (office work machines, telecommunication equipment, and measurement equipments). Do not use for medical equipments, nuclear power equipments, and trains, etc. where the malfunction and damage of this product may directly cause harm to human life and/or property. Please confirm when using except in general electronic equipment.
- For this product, serial and parallel operations are not possible.
- For mounting this product, please do not use connectors or sockets. The performance may not be fulfilled by the effect of contacting resistors. Mount onto the PCB by soldering.
- This product has a built-in over current, short circuit protection, however long time usage in short circuit should be avoided since this may cause failure to the product.
- This product may be damaged if used under nonstandard electric and environmental conditions such as the temperature. Please be sure to always use within the standard conditions.
- Please refrain from using and storing the product where corrosive gas may be generated. Dust may cause problems so store in a dust free environment.
- There is a possibility that the product may be damaged from static electricity. The workers should discharge all static electricity before handling the product, and the work atmosphere should also have a static countermeasure.
- This product does not have a fuse built in. When abnormal, please connect a fuse into +input line as a protection of over current. The electrical supply source should have enough capacity to be able to shut down a fuse.
- This product does have a built-in over voltage protection, however when the module malfunctions and over voltage occur, the over voltage protection installed will not activate. Therefore, an over voltage protection circuit should always be connected.
- No test certificate is attached to this product.

15. Warranty

The warranty period for this product is one year. If any defects occur in which our company's design or production is to blame during the period, we will either fix the product or trade with a new one, free of charge.

However, the warranty is voided if the product has been internally modified or adjusted.

The warranty covers only the stated products in this datasheet.

16. If you have any further technical questions for this product, please contact us.

E-mail: info@bellnix.com

<http://www.bellnix.com>