The Fifth Generation, Ultra Small Size, Isolated DC-DC Converter

Bellnix® 6Watt BTC Series

BTC series is a thin, high efficiency, low noise isolated DC-DC converter.
Contrived to adopt new circuit to achieve miniaturization. Circuit construction is high-efficiency and simple.
Adjustable output voltage and remote ON/OFF control has been added as a new function.



<Features>

-Adjustable Output Voltage
-Remote ON/OFF Control
-Dual Power Supply usable as Single Power Supply
-Isolation Voltage AC500V
-Built-in Over-Current Protection Circuit
-Built-in Low Input Voltage Protection Function
-Built-in Over Input Current Protection Element
-No Electrolytic Capacitor, No Tantalum Capacitor
-MTTF 1,500,000 Hrs
-Metallic Shield Cover
-Halogen-Free PCB Used
-Between Primary and Secondary Combination Capacitance approx. 30 to 110pF
-Operating Temp. Range -40°C to 85°C (Temp. Derating required)
-RoHS Compliance

<Model, Rating>

Table 1

Model	Input V Vdc	Output V Vdc	Output I mA	Line Reg. mV(max.)	Load Reg. mV(max.)	Noise mVpp(typ.)	Efficiency %(typ.)
BTC05-03S120X	4.5 to 9	3.3	0 to 1200	20	40	40	76
BTC05-05S100X		5	0 to 1000				79
BTC05-12S50X		12(15)	0 to 500 (400)	40	100	30	82
BTC05-12W25X		±12(±15)	0 to 250 (200)	80	600		82
BTC12-03S120X	9 to 18	3.3	0 to 1200	20	40	40	78
BTC12-05S120X		5	0 to 1200				82
BTC12-12S50X		12(15)	0 to 500 (400)	40	100	30	85
BTC12-12W25X		±12(±15)	0 to 250 (200)	80	600		85
BTC24-03S120X	18 to 36	3.3	0 to 1200	20	40	40	77
BTC24-05S120X		5	0 to 1200				81
BTC24-12S50X		12(15)	0 to 500 (400)	40	100	30	87
BTC24-12W25X		±12(±15)	0 to 250 (200)	80	600		86
BTC48-03S120X	36 to 76	3.3	0 to 1200	20	40	40	77
BTC48-05S120X		5	0 to 1200				81
BTC48-12S50X		12(15)	0 to 500 (400)	40	100	30	86
BTC48-12W25X		±12(±15)	0 to 250 (200)	80	600		86

Note1 : Specify the type in the "X" model name. D:DIP type, S:SMD type
Ex.) DIP type: BTC05-03S120D, SMD type: BTC05-03S120S
Note2 : The Output voltage inside () is when it is short between Vadj and –Vout.
Note3 : The output current inside () is when adjusted to the max. output voltage.

<Specification> Table2

Input Voltage Range	Refer to Table 1
Rating Output Voltage	3.3V±3%, 5V±3%, 12V±3%, ±12V±5% (Vadj pin at open)
Adjustable Output Voltage Range	3.15 to 3.6V (For 3.3V), 4.75 to 6.0V (For 5V), 11.4 to 15V (For 12V), ±11.4 to ±15V (For 12V)
Line Regulation	Refer to Table1 (Rting Output, for the regulation of Input Voltage Range of Table1)
Load Regulation	Refer to table1 (Rating Input/Output Voltage, for the regulation of load 0 to 100% (±Output is when load is at balance))
Temp. Regulation	80mV max. (For 3.3V, 5V), 200mV max. (For 12V), 300mV max. (For ±12V) (Input/Output rating, For operating temp. -40°C to 50°C)
Ripple/Noise	Refer to Table 1 (Rating Input/Output, At room temp, 20MHz bandwidth)
Efficiency	76% to 87% typ. (Rating Input/Output, At room temp., Refer to table 1)
Over Current Protection Circuit	Operates at 105% or more rating load current, auto recovery type. Avoid 30 second or more long time over current Condition.
Over Voltage Protection Circuit	None
Low Input Voltage Protection	Available (Refer to p.11)
Over Input Current Protection	Built-in fuse in the input (refer to p.12)
Remote ON/OFF	Between 2pin (ON/OFF) and 3pin (−Vin) : Output goes OFF at open, Output goes ON when in short. (Refer to p.9)
Stand by Current	0.8 to 3.3mA typ. (Depend on the model)
Isolation Voltage	Input – Output, Input – Case, Output – Case AC500V 1min.
Isolation resistance	Input – Output, Input – Case, Output – Case Over 50MΩ at DC500V
Primary-Secondary capacitance	Approx. 30 to 110pF (Depend on the model)
Operating Temp. Range	Operating Temp. -40°C to 85°C (Need temp. derating from 50°C)
Storage Temp. Range	Storage Temp.-40°C to 85°C
Humidity Range	Humidity range 95%R.H. max. (Max. wet bulb temperature 38°C, non-condensing)
Cooling Condition	Air Convection (Set in a place where good convection is ensured)
Vibration	10 to 55Hz All amplitude 1.52mmp-p (2 hours in each orthogonal axes), Scanning time 15min.
Shock	Acceleration 100G (3directions, 3times each, 18times in total), Persistent time 6ms
Weight	5.8g typ.
Outline	DIP type W=21.1 L=23.2 H=8.4 typ. (mm) (For detail dimensions, refer to the outline on p.7)
	SMD type W=21.1 L=26.2 H=8.5 typ.(mm) (For detail dimensions, refer to the outline on p.8)

NOTE : Unless condition is specified, above specification is regulated as rating value.

1- Application Range

This datasheet applies to the isolated DC/DC converter, BTC series.

2- Model/Rating

Model	Rating Input Voltage	Rating Output	Package
BTC05-03S120D	DC5V	3.3V, 1200mA	DIP
BTC05-03S120S			SMD
BTC05-05S100D		5.0V, 1000mA	DIP
BTC05-05S100S			SMD
BTC05-12S50D		12V, 500mA	DIP
BTC05-12S50S			SMD
BTC05-12W25D		±12V, each250mA	DIP
BTC05-12W25S			SMD
BTC12-03S120D	DC12V	3.3V, 1200mA	DIP
BTC12-03S120S			SMD
BTC12-05S120D		5.0V, 1200mA	DIP
BTC12-05S120S			SMD
BTC12-12S50D		12V, 500mA	DIP
BTC12-12S50S			SMD
BTC12-12W25D		±12V, each250mA	DIP
BTC12-12W25S			SMD
BTC24-03S120D	DC24V	3.3V, 1200mA	DIP
BTC24-03S120S			SMD
BTC24-05S120D		5.0V, 1200mA	DIP
BTC24-05S120S			SMD
BTC24-12S50D		12V, 500mA	DIP
BTC24-12S50S			SMD
BTC24-12W25D		±12V, each250mA	DIP
BTC24-12W25S			SMD
BTC48-03S120D	DC48V	3.3V, 1200mA	DIP
BTC48-03S120S			SMD
BTC48-05S120D		5.0V, 1200mA	DIP
BTC48-05S120S			SMD
BTC48-12S50D		12V, 500mA	DIP
BTC48-12S50S			SMD
BTC48-12W25D		±12V, each250mA	DIP
BTC48-12W25S			SMD

3- Environmental Condition

3-1 Temp. range

When Operating : -40°C to 85°C (Derating required from 50°C)

When Storage : −40°C to 85°C

3-2 Humidity Range

When Operating : 95%R.H. max. (Max. wet-bulb temp. 38°C, non-condensing)

When storage : 95%R.H. max. (Max. wet-bulb temp. 38°C, non-condensing)

4-Specification

4-1 Input Condition, Output Characteristics

When condition is not mentioned in this data sheet, input is rating input, output is rating output, ambient temp. is 25°C±5°C.

Model *1	Input Voltage (V)	Output Voltage (V) *2	Output Current (mA)	Max. Output Voltage Constancy.			Output Ripple/Noise *4 (mVp-p)typ./ max.	Efficiency (%)typ. *5
				Input (mV)	Load (mV)	Temp. *3 (mV)		
BTC05-03S120X	4.5 to 9	3.3±3%	0 to 1200	20	40	80	40 / 120	76
BTC05-05S100X		5.0±3%	0 to 1000	20	40	80	40 / 120	79
BTC05-12S50X		12±3%	0 to 500	40	100	200	30 / 120	82
		15±3%	0 to 400	40	100	200	30 / 120	82
BTC05-12W25X		±12±5%	0 to 250 × 2	80	600	300	30 / 120	82
		±15±5%	0 to 200 × 2	80	600	300	30 / 120	82
BTC12-03S120X	9 to 18	3.3±3%	0 to 1200	20	40	80	40 / 120	78
BTC12-05S120X		5.0±3%	0 to 1200	20	40	80	40 / 120	82
BTC12-12S50X		12±3%	0 to 500	40	100	200	30 / 120	85
		15±3%	0 to 400	40	100	200	30 / 120	85
BTC12-12W25X		±12±5%	0 to 250 × 2	80	600	300	30 / 120	85
		±15±5%	0 to 200 × 2	80	600	300	30 / 120	85
BTC24-03S120X	18 to 36	3.3±3%	0 to 1200	20	40	80	40 / 120	77
BTC24-05S120X		5.0±3%	0 to 1200	20	40	80	40 / 120	81
BTC24-12S50X		12±3%	0 to 500	40	100	200	30 / 120	87
		15±3%	0 to 400	40	100	200	30 / 120	87
BTC24-12W25X		±12±5%	0 to 250 × 2	80	600	300	30 / 120	86
		±15±5%	0 to 200 × 2	80	600	300	30 / 120	86
BTC48-03S120X	36 to 76	3.3±3%	0 to 1200	20	40	80	40 / 120	77
BTC48-05S120X		5.0±3%	0 to 1200	20	40	80	40 / 120	81
BTC48-12S50X		12±3%	0 to 500	40	100	200	30 / 120	86
		15±3%	0 to 400	40	100	200	30 / 120	86
BTC48-12W25X		±12±5%	0 to 250 × 2	80	600	300	30 / 120	86
		±15±5%	0 to 200 × 2	80	600	300	30 / 120	86

*1 Specify the package in the "X". D:DIP type(Flow) S:SMD type(Reflow)
*2 Output Voltage includes line regulation, load regulation(Balance Load), temp. regulation.
*3 For temp. regulation –40 to 50°C.
*4 Bandwidth 20MHz
*5 When Rating Input Voltage, max. Output Current.

4-2 Capacity of External Capacitor

This product has limit to the capacity of external output capacitor. Please refer to the below table.

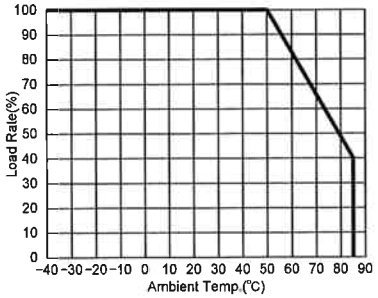
External Output Capacitor

Model	Capacity	
	+output side	-output side
BTCXX-03SXXX	0 to 470μF *1	—
BTCXX-05SXXX	0 to 470μF *1	—
BTCXX-12SXXX	0 to 220μF *1	—
BTCXX-12WXXX	0 to 100μF *2	0 to 100μF *3

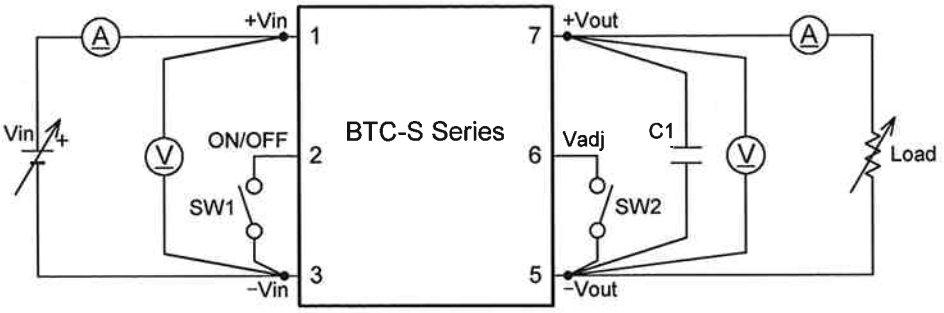
*1 Sum of C2 and C3 in standard connecting circuit in section 6,(1)
*2 Sum of C2 and C4 in standard connecting circuit in section 6,(2)
*3 Sum of C3 and C5 in standard connecting circuit in section 6,(2)

4-3 Temp. Derating

Air Convection



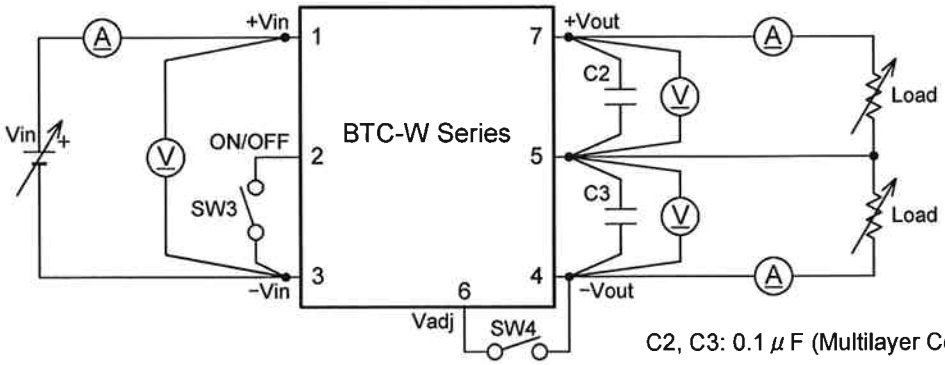
4-4 Measurement Circuit



SW1
Open = Output OFF
Short = Output ON

SW2
Open: Vout = 3.3V, 5V, 12V
Short: Vout = 3.3V→3.6V
= 5V→6V
= 12V→15V

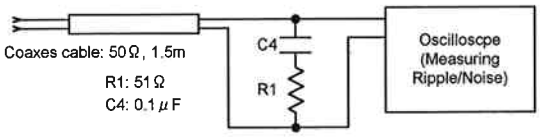
C1: 0.1 μ F (Multilayer Ceramic Capacitor)



SW3
Open = Output OFF
Short = Output ON

SW4
Open: Vout = ±12V
Short: Vout = ±15V

C2, C3: 0.1 μ F (Multilayer Ceramic Capacitor)



4-5 Additional Function

Article	Specification / Standarization	Condition
Over Current Protection Circuit	Operates above 105%, Auto-recovery type	
Over Voltage Protection Circuit	None	
Low Input Voltage Protection Function	Available	
Output Voltage Adjustable Range	3.15 to 3.6V(BTCXX-03SXXX) 4.75 to 6.0V(BTCXX-05SXXX) 11.4 to 15V(BTCXX-12SXXX) ±11.4 to ±15V(BTCXX-12WXXX)	By External Resistor. Refer to 7-2
ON/OFF Control	Output ON at Low(0 to 0.4V) Output OFF at open	Refer to 7-1

4-6 Isolation Voltage, Isolation Resistance

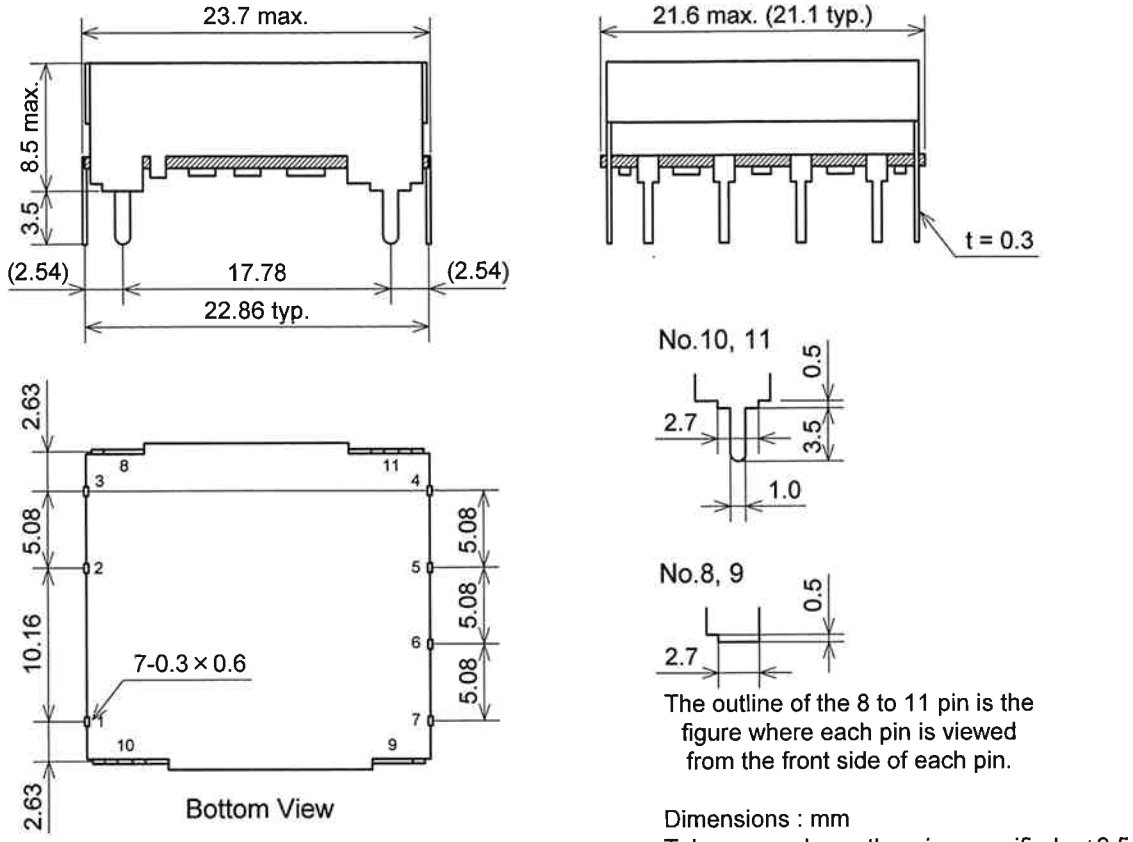
1- Isolation Voltage

Input - Output, Input - Case, Output - Case : AC500V, 1min.

2- Isolation Resistance

Input - Output, Input - Case, Output - Case : Over 50MΩ(at DC500V)

5. Outline and Pin
5-1 DIP type
1- Outline

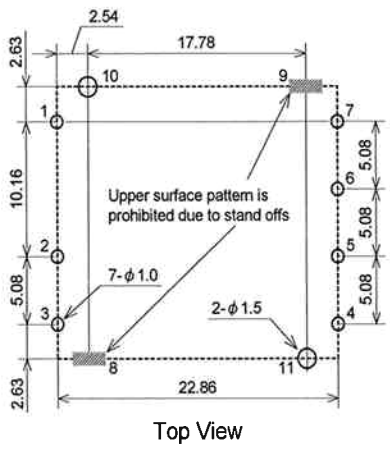


The outline of the 8 to 11 pin is the figure where each pin is viewed from the front side of each pin.

Dimensions : mm
Tolerance unless otherwise specified : ±0.5

Model name and Manufacturing lot No. is indicated on upper side.

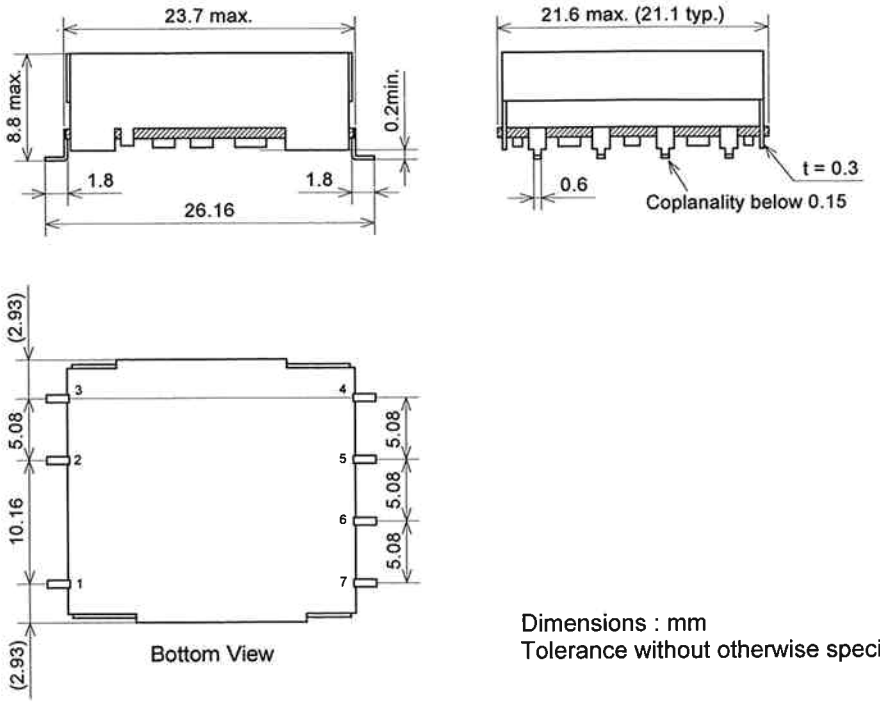
2- Recommended dimension of the board, Pin function



Dimensions : mm

Pin	Function	
	BTC-S	BTC-W
1	+Vin	+Vin
2	ON/OFF	ON/OFF
3	−Vin	−Vin
4	NC	−Vout
5	−Vout	Common
6	Vadj	Vadj
7	+Vout	+Vout
8, 9	Stand off	Stand off
10, 11	Connected to Case	Connected to Case

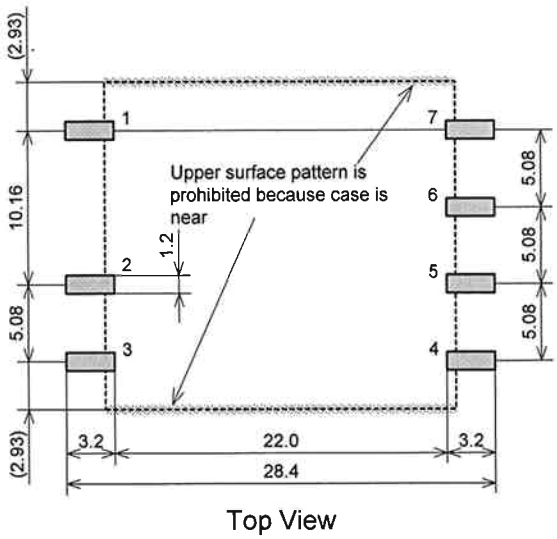
5-2 SMD type
1-Outline



Dimensions : mm
Tolerance without otherwise specified : ±0.5

Model name and Manufacturing lot No. is indicated on upper side.

2- Recommended dimension of the board, Pin function

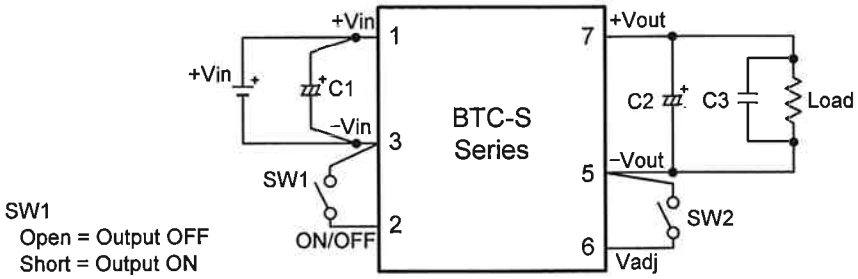


Pin	Function	
	BTC-S	BTC-W
1	+Vin	+Vin
2	ON/OFF	ON/OFF
3	−Vin	−Vin
4	NC	−Vout
5	−Vout	Common
6	Vadj	Vadj
7	+Vout	+Vout

Dimensions : mm

6. Standard Connecting Circuit

(1) BTC-S Series

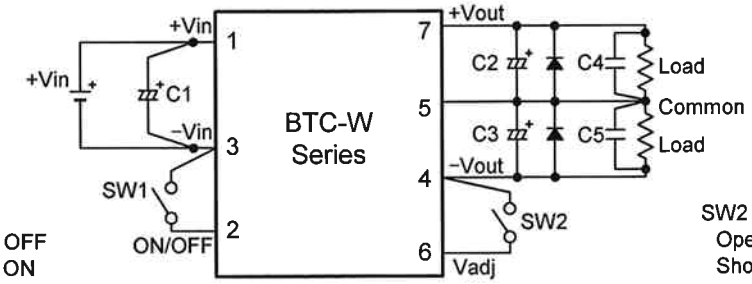


SW1
Open = Output OFF
Short = Output ON

SW2
Open: Vout = 3.3V, 5V, 12V
Short: Vout = 3.3V→3.6V
= 5V→6V
= 12V→15V

C1: 22 μ F
C2: 22 μ F
C3: 0.47 μ F

(2) BTC-W Series



SW1
Open = Output OFF
Short = Output ON

SW2
Open: Vout = ±12V
Short: Vout = ±15V

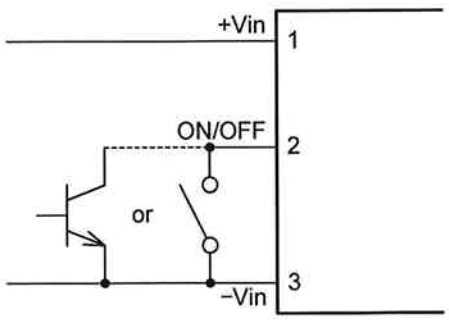
C1: 22 μ F
C2, C3: 22 μ F
C4, C5: 0.47 μ F

7. Function

7-1 ON/OFF Control

By using ON/OFF control function, ON/OFF of the output without connecting and disconnecting the input can be controlled.

Between −Vin pin (Pin3) and ON/OFF pin (Pin2)
Low (0 to 0.4V 1mA max.) : Output ON
Open (Open voltage : +Vin max.) : Output OFF



7-2 Adjustable Output Voltage

Output voltage can be set as follow when Vadj pin and −Vout pin is short.
Please open this pin when not adjusting the output voltage.

Output voltage to connection of Vadj pin

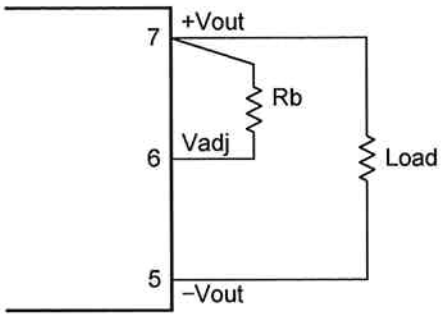
Model	Open	Short to -Vout
BTCXX-03SXXX	3.3V	3.6V
BTCXX-05SXXX	5.0V	6.0V
BTCXX-12SXXX	12V	15V
BTCXX-12WXXX	±12V	±15V

Output voltage is adjustable by connecting resistor between Vadj pin and +Vout pin. (Or between Vadj pin and −Vout pin)
Note : When adjusting the output voltage, please operate below max. power

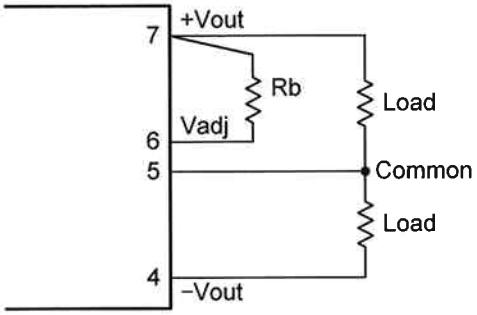
7-2-1 To lower the output voltage

Output voltage can be lowered by connecting resistor Rb between Adjustable Output Pin (Vadj) and Plus Output Pin (+Vout). Calculation is as below. (Unit of Rb is [kΩ]).

BTC-S Series



BTC-W Series



Output Voltage : Vo[V], Connecting resistor : Rb[kΩ]

BTCXX-03SXXX

Vo = 1.26 × (91.5 + 2.62 Rb) / (39.6 + Rb)
Rb = (39.6 Vo − 115.3) / (3.30 − Vo)
Adjustable range is below to 3.15V (Rb≧62)

BTCXX-05SXXX

Vo = 1.26 × (84.8 + 3.98 Rb) / (31.8 + Rb)
Rb = (31.8 Vo − 106.85) / (5.01 − Vo)
Adjustable range is below to 4.75V (Rb≧160)

BTCXX-12SXXX

Vo = 1.26 × (201 + 9.53 Rb) / (57 + Rb)
Rb = (57 Vo − 253.26) / (12.01 − Vo)
Adjustable range is below to 11.4V (Rb≧620)

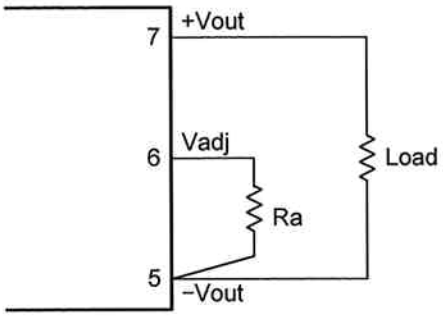
BTCXX-12WXXX

Vo = {1.26 × (429 + 19.1 Rb) / (103 + Rb)} / 2
Rb = (206 Vo − 540.54) / (24.07 − 2 Vo)
Adjustable range is below to 11.4V (Rb≧1500)

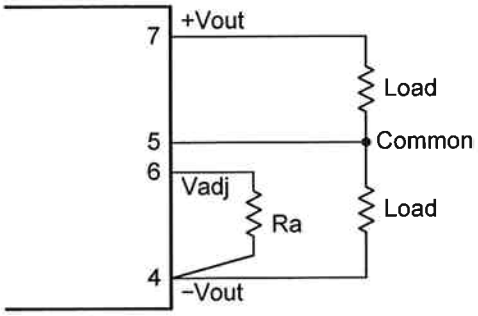
7-2-2 To raise the output voltage

Output voltage can be raised by connecting resistor Ra between Adjustable Output Pin (Vadj) and Minus Output Pin (−Vout). Calculation is as below. (Unit of Ra is[kΩ])

BTC-S Series



BTC-W Seires



Output Voltage : Vo[V], Connecting resistor : Ra[kΩ]

BTCXX-03SXXX

Vo = 1.26 × (91.5 + 2.62 Ra) / (32 + Ra)

Ra = (115.3 − 32 Vo) / (Vo − 3.30)

BTCXX-05SXXX

Vo = 1.26 × (84.8 + 3.98 Ra) / (17.8 + Ra)

Ra = (106.85 − 17.8 Vo) / (Vo − 5.01)

BTCXX-12SXXX

Vo = 1.26 × (201 + 9.53 Ra) / (16.9 + Ra)

Ra = (253.26 − 16.9 Vo) / (Vo − 12.01)

BTCXX-12WXXX

Vo = {1.26 × (429 + 19.1 Ra) / (18 + Ra)} / 2

Ra = (540.54 − 36 Vo) / (2 Vo − 24.07)

7-3 Output Over Current Protection Function

Output voltage will be lowered when output current is in state of over current and start operating over current protection circuit. (Over current protection set point : 105 to 250% of rating current value)

It will automatically recover when over current state is released. In order to avoid from damage, please do not hold the over current state for more than 30sec.

If by any reason does not auto recover after releasing, please off the output at ON/OFF control or switch off to reactivate.

7-4 Low Input Voltage Protection Function

This product built-in the low input voltage protection function to avoid malfunction at low input voltage. Start-up operation and termination voltage range is within the below table.

Model	Commencing operation Termination Voltage
BTC05	3.0 to 4.5V
BTC12	6.0 to 9.0V
BTC24	13 to 18V
BTC48	27 to 36V

7-5 Input Circuit Protection Function

Fuse is built in at input in order to protect circuit at secondary side when overcurrent flows to input by some abnormalities.

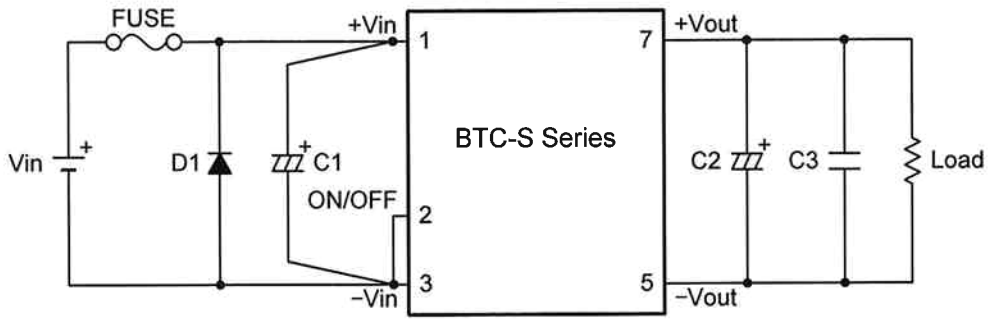
Rating current and fusing current of the Built-in fuse is as below table. To assure fusing at abnormality, current capacity of power supply should be more than fusing current which is stated in below table.

Model	Rating Current	Fusing Current
BTC05	5.0A	Above 10A
BTC12	2.5A	Above 5.0A
BTC24	1.25A	Above 2.5A
BTC48	0.75A	Above 1.5A

8. An example method to prevent inverse connection of input power supply.

This product will be damaged when input polarity is connected reversely. Please add protection circuit when connection may be reversed.

Below diagram is an example of using fuse and diode.



9. Soldering Conditions

Soldering is to be executed under the following conditions.

1- Soldering Iron (DIP Type, SMD Type)

380°C 3sec. max

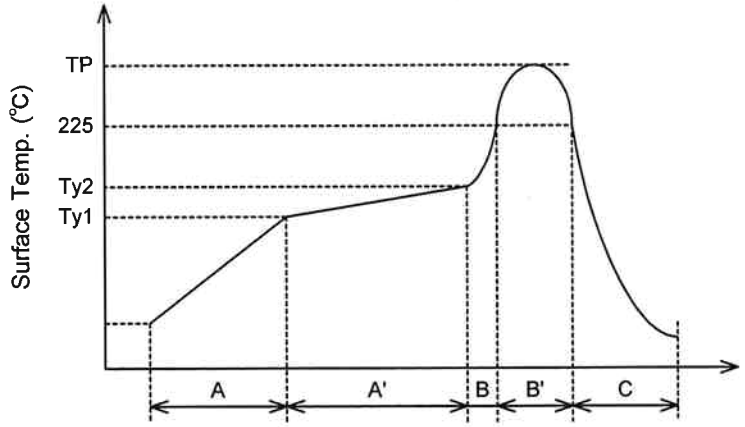
2- Soldering Dip (DIP type)

260°C 10sec. max

3- Reflow (SMD type)

Reflow Temp. Profile

Solder Sn-3Ag-0.5Cu



A	1.0 to 3.0°C/s	
A'	Ty1:	150±10°C
	Ty2:	170±10°C
	Ty1 to Ty2:	40 to 100s
B	1.0 to 4.0°C/s	
B'	TP:	245°Cmax.
	Above 225°C:	20 to 40s
C	1.0 to 5.0°C/s	

Do not vibrate the product during reflow.
Reflow can be done only once. (Please do not mount backside.)
NOTE: Eutectic solder can be used within condition as above.

10. Material of Pin and case

Pin : Phosphor bronze (Ni Foundation Sn Plating)
Case : SPCC (Ni Plating)

11. Vibration / Shock Test

Vibration : 10 to 55Hz All Amplitude 1.52mmp-p (2 hours in each of 3 orthogonal axes)
Scanning time 15min.
Shock : Acceleration 100G (3 times in each of 3 orthogonal axes, Total 18 times)
Duration 6ms

12. Cleaning Condition

This product can not be washed whole. No clean solder paste is recommended for this product. If cleaning should be necessary only for DIP type, use IPA and hand-wash only soldered surface by brush cleaning.
After cleaning be sure to dry up before using.

13. Environmental Compliance
This product is RoHS compliance.
Halogen free material is used for PCB.
{Note} RoHS Compliance : Based on EU Directive 2002/95/EC.

14. Precautions
-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 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. Please mount to PCB by soldering.
-This product has a built-in over-current, short protection, but long time short circuit will cause failure, so avoid it.
-The product may be damaged if it is used under nonstandard electric and environmental conditions such as temperature. Please be sure to keep the standards.
-Do not store in a place where corridible gas may be generated or at a dusty place.
-The soldering may degrade, so be careful when safekeeping in a place with high-temperature, humidity and rapid temperature change for more than 1 year.
-There is a possibility of damage by 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 over voltage protection.
-No test certificate is attached to this product.

15. Guarantee
This product shall be guaranteed for 5 years. 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 can not guarantee it.
This guarantee shall cover only this products.