

TSI-15N Series are step down converters with a very high efficiency. By adopting a custom multi chip module IC, it was possible to reduce the number of components drastically. Herewith two goals, high reliability and low cost could be realized.

### Features

- Ultra Small
- High efficiency (84 ~ 94 %)
- Operating Temp. -10°C ~ +70°C
- MTBF 1,000,000Hrs.
- Over-Current Protection
- Over-Temp. Protection
- Easy to use ; SIP / DIP type
- Adjustable output range
- No Heat Sink required
- Long life, High reliability



Table 1

Model	Input Voltage Vdc	Output Voltage Vdc	Output Current A	Input Regulation %(typ)	Load Regulation %(typ)	Ripple & Noise mVpp(typ)	Efficiency %(typ)	Package Type
TSI 15N-0509	5.0 (+4.75 ~ 6)	+2.5 (+1.5 ~ 3.3)	0 ~ 3	1.5	1	50	91	SIP
DIP								
TSI 15N-2410	+9 ~ 36	+3.3 (+3 ~ 5)	0 ~ 1.8 (0 ~ 2.2)	1.5	1	50	84	SIP
TSI 15N-2410D								DIP
TSI 15N-2412	+18 ~ 36	+12 (+9 ~ 12)	0 ~ 0.75 (0 ~ 1)	1.5	1	100	94	SIP
TSI 15N-2412D								DIP

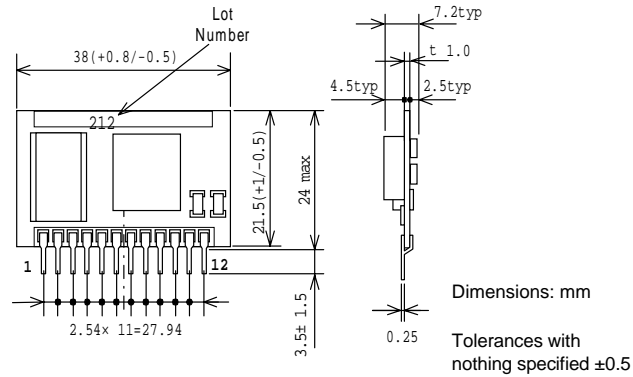
Note 1: Rating input voltage ( ) value indicates Input voltage range. Note 2: Output Current ( ) with forced air cooling.

Note 3: Rating output voltage ( ) value indicates adjustable, possible range.

### Specification

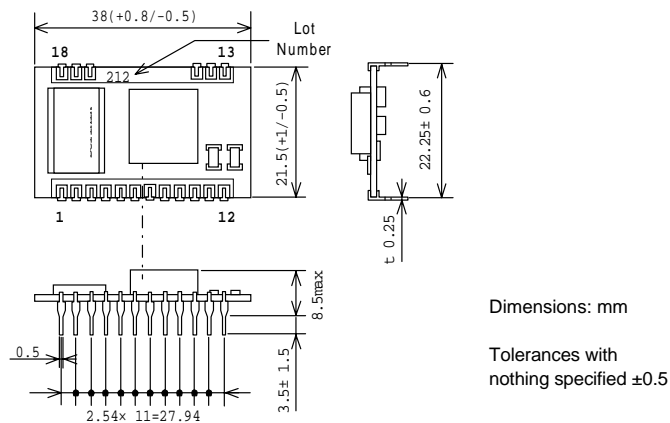
Rating Input Voltage	Refer to Table 1
Rating Output Voltage	Refer to Table 1
Adjustable Output range	Output voltage is adjustable within the above range in Table 1. (By the external resistance)
Input regulation	1.5% typ., 3.0% max. (For the input voltage regulation in Table 1)
Load regulation	1.0% typ., 2.0% max. (For 0 ~ 100% regulation )
Temperature regulation	±0.01%/ °C typ. (For the regulation of operating temperature -10°C ~ +50°C)
Ripple & Noise	50/100mVp-p typ., 150mVp-p max. (20 MHz Band Width)
Efficiency	84% ~ 94% typ. (Rating I/O, in room temp., refer to Table 1)
Over-Current Protection	Operation at 105% or more of rating load current, auto recovery type.
Over-Voltage Protection	None
ON/OFF Control	Between 1 pin (ON/OFF) - 5 ~ 8 pin (GND) [Open: Output OFF, Short: Output ON]
Non- load Input current	TSI 15N-0509 Models: t.b.a, TSI 15N-2410 Models: 15mA typ., TSI 15N-2412 Models: 25mA typ.(No load)
Stand-by current	1mA typ. ( OFF Control )
MTBF	1,000,000Hr min ( EIAJ RCR-9102 )
Switching frequency	250 kHz typ.
Operating Temp. range	-10 °C ~ +70°C ( Refer to Page 6, Thermal derating )
Storage Temp. range	-20 °C ~ +85°C
Humidity range	20% ~ 95% R.H ( Max temperature 35 °C, only non - condensing )
Cooling Condition	Natural air - cooling at rated output current as in
Vibration	5 ~ 10 Hz All amplitude 10 mm, 10 ~ 55 Hz acceleration 2G ( 1 hr. in each of 3 axes )
Shock	Acceleration 20G ( 3 times in each of 3 axes), Shocking time 11±5ms
Weight	7.5g typ.
Dimension	see page 2

### Outline SIP Type ( Figure 1 )



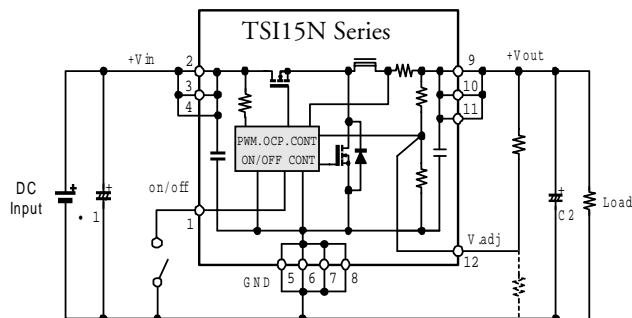
pin	Function
1	On/Off
2	+Vin
3	+Vin
4	+Vin
5	GND
6	GND
7	GND
8	GND
9	+Vout
10	+Vout
11	+Vout
12	V.adj

### DIP Type ( Figure 2 )



pin	Function
1	On/Off
2	+Vin
3	+Vin
4	+Vin
5	GND
6	GND
7	GND
8	GND
9	+Vout
10	+Vout
11	+Vout
12	V.adj
13, 18	No Connection

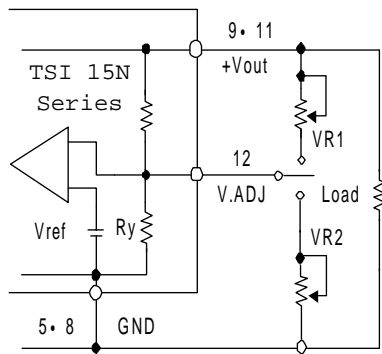
### Block Diagram



Output ON=Short  
Output OF=Ope ( Figure 4 )

#### Application notes

(C) Output voltage changeable direction ( Figure 7 )



Please open the terminal V.ADJ when you use the output voltage with rating, without changing. By connecting resistance between the terminal +Vout (9~11Pin) and V.ADJ (12 Pin), or between the terminal V.ADJ (12 pin) and GND (5~8 pin) you can change output voltage within the range of voltage in Table 1. Please refer to the undermentioned equation for the calculation of external resistance. Please confirm the output voltage and adjust resistance value after calculating external resistance.

you can change output voltage within the range of voltage in Table 1.

#### To reduce the output voltage

$$VR1 = \frac{Rx \times Ry \times (Vo - Vref)}{Rx \times 2.45 - Ry \times (Vo - Vref)}$$

VR2 = OPEN

0509	2410	2412
	Vo=Req. Vout	Vo=Req. Vout
	(3~3.3V)	(9~12V)
	Rx=765ohm	Rx=8.6Kohm
	Ry=2.2Kohm	Ry=2.2Kohm
	Vref=2.45V	Vref=2.45V

#### To add the output voltage

$$VR2 = \frac{Vref \times Rx \times Ry}{Ry \times (Vo - Vref) - Vref \times Rx}$$

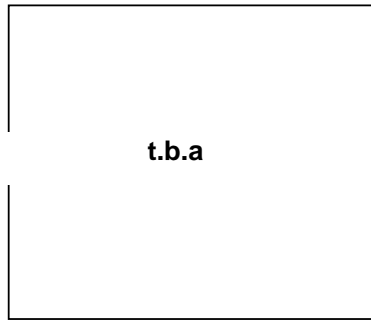
VR1 = OPEN

0509	2410
	Vo=Req. Vout
	(3.3~5V)
	Rx=765ohm
	Ry=2.2Kohm
	Vref=2.45V

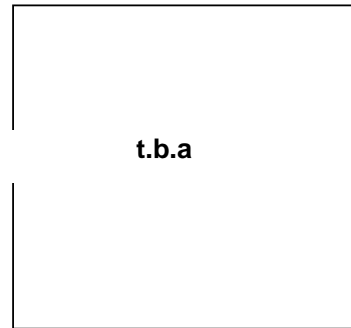
### Turn-On Transient Time

### Output Voltage Ripple & Noise

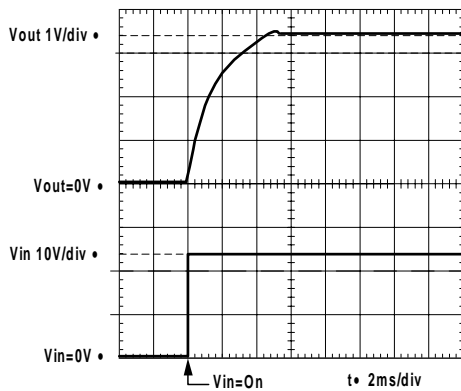
**TSI 15N-0509**



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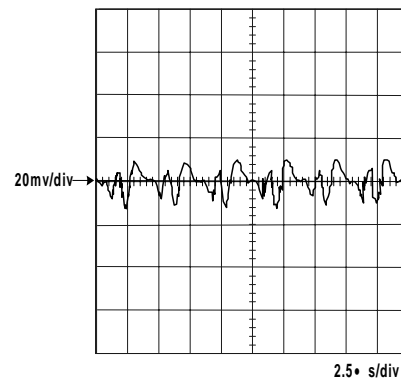


**TSI 15N-2410**



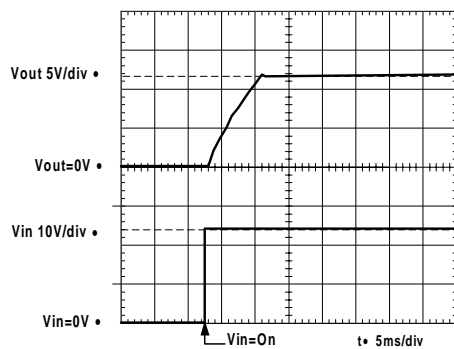
Test conditions: At rating input, rating load and room temp.

**TSI 15N-2410**



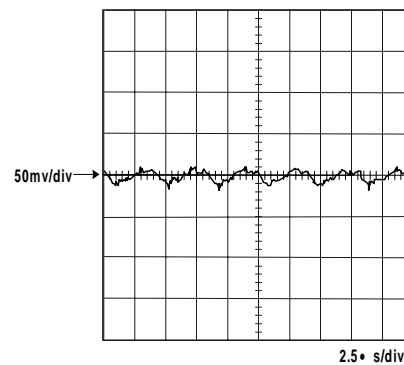
Test conditions: At rating input, rating load and room temp.

**TSI 15N-2412**



Test conditions: At rating input, rating load and room temp.

**TSI 15N-2412**

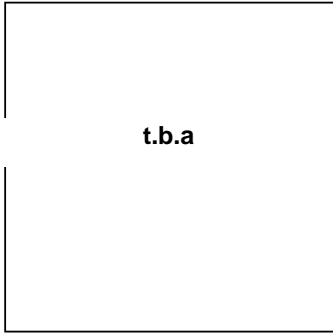


Test conditions: At rating input, rating load and room temp.

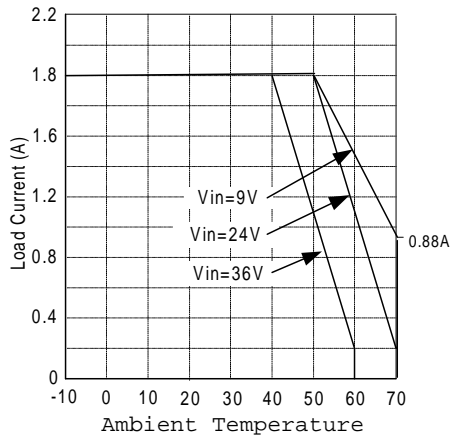
### Temperature derating

Convection Cooling

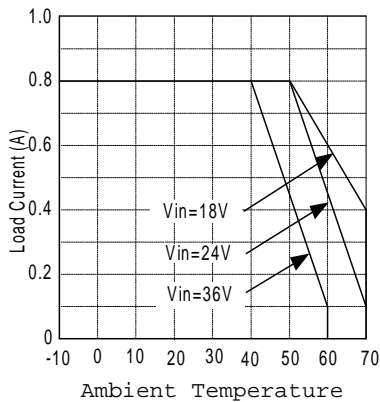
**TSI 15N-0509**



**TSI 15N-2410**

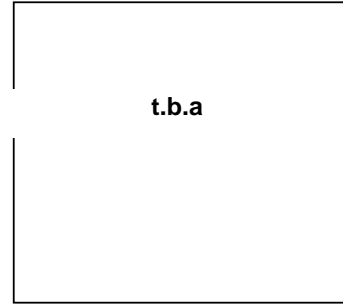


**TSI 15N-2412**

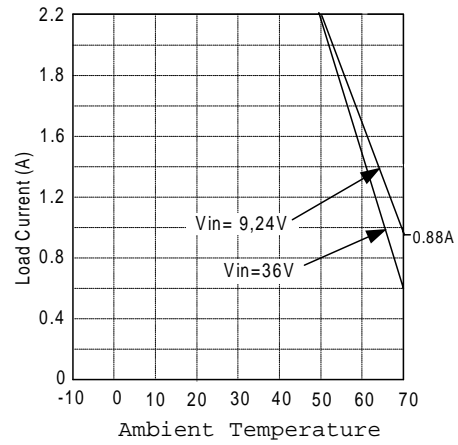


Forced Air Cooling

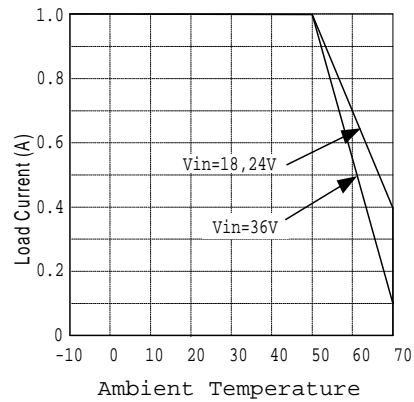
**TSI 15N-0509**



**TSI 15N-2410**



**TSI 15N-2412**



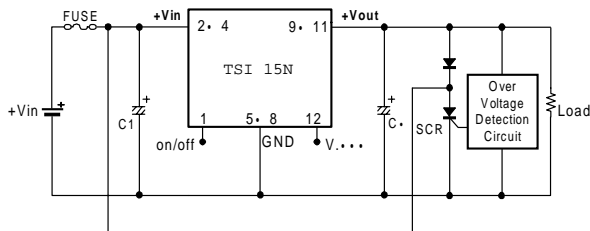
### Soldering Conditions

Solder to be executed under the following conditions.

1. Hand soldering                    340°C ~ 360°C, 5sec.max
2. Flow soldering                    230°C ~ 260°C, 10sec.max.

### Reverse Input Voltage Protection

The input/output of this products 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 the following figure. The figure below is an example using fuse and diode.



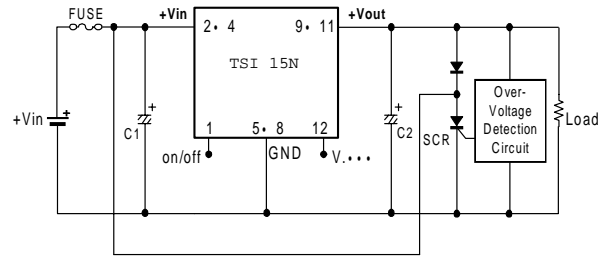
(Figure 14)

### Over-Voltage Protection

This product 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 on the output.

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



(Figure 15)