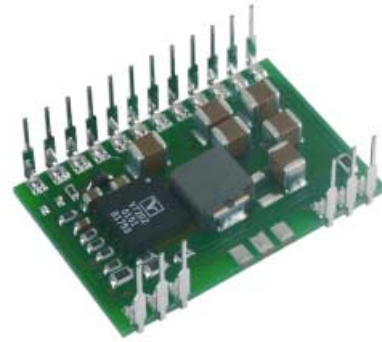


TSI-20N series is a small size (33x21.5x6mm size) and light weight (.g) step-down DC-DC converter with 20W. Since it can operate from ultra low output voltage of 0.8V, it can be used for latest DSP, ASIC applications. High efficiency, ultra high-speed response by synchronous rectification topology. No external components required.

Input: +3.3V/+5.0V Output: +1.8V, +2.0V, +2.5V, +3.3V (+0.8V ~ +3.6V)

Features

- High-speed response
- Ultra high Efficiency 93%
- ON/OFF Control
- Adjustable Output
- Latest Power-IC adopted
- Synchronous Rectification Circuit
- Additional external capacitor not required
- Short-Circuit, Over-Current Protection
- Non-Isolated Type Converter
- Amazing Minimum Size
- Operating Temp. -40°C~+85°C
- No Heat Sink required
- High Reliability, High Performance



Model	Standard Input Voltage Vdc	Input Voltage Range Vdc~Vdc	Output Voltage Vdc	Output Current A	Non-Load Current mA(typ)	Ripple & Noise mVpp(typ)	Efficiency %(typ)	Package type
TSI 20N-0510V	5.0	+3.0~5.5 (*1)	+3.3(0.8~3.6)	6	3	40	93	SIP
TSI 20N-0510D								DIP
TSI 20N-0510S								SMD

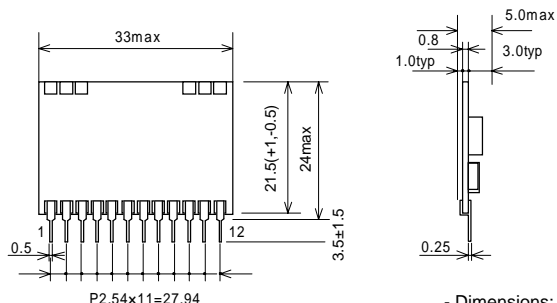
(*1) Input Voltage should be 0.5V or more higher than output voltage.

Specification

Standard Output Voltage	When Vadj pin is open, output voltage will be set at +3.3V. (The accuracy of output V setting is ±3% max.)
Adjustable Output V Rang	Output Voltage is adjustable according to the range above.
Line Reg.	0.7%typ. 1.5%max. (For the regulation of Input Voltage Range 3.8~5.5V)
Load Reg.	2.0%typ. 4.0%max. (For 0~6A of Load Reg., at Rating Input..)
Temp. Coefficient	±0.02%/°C typ. (For the change of Operating Temp. -10°C~+50°C)
Ripple & Noise	120mVpp max. (Rating Input, Rating Output, Room Temp.) (Measurements Frequency Band Width 20MHz)
Efficiency	93% (Rating Input/ Output, Room Temp., Refer Table 1)
Over-Current Protection	Operates at 105% or more Rating Load Current, auto recovery type. Avoid long time of short-circuit condition.
Over-Voltage Protection	None
Standby Current	2.4mA typ.
Remote ON/OFF	Between 1pin(ON/OFF) 5~8pin(S.GND) [Open: Output ON, Short: Output OFF(Refer to application)]
Remote Sensing	The voltage between converter's output pin .voltage between 7-8pin. and sensing voltage difference [voltage between 6-9pin] is 10% of sensing voltage (0.1V~0.3V) or below.
Operating Temp. Range	Operating Temp. -40°C~+85°C (Refer to the thermal derating graph.)
Storage Temp. Range	Storage Temp. -40°C~+85°C
Humidity Range	20% ~ 95%R.Hmax. (Max. Wet-bulb Temp. 35°C, non-condensing)
Cooling Condition	Refer to the thermal derating graph
Vibration	5~10Hz Every amplitude 10mm (3directions, each for 1hour), 10~55Hz acceleration 2G (3directions, each for 1hour)
Weight	4g typ.
External Dimensions	SIP type.W=24 L=33 H=5.0 typ. (mm) (For dimensions refer to outline.) DIP type.W=22.25 L=33 H=6.0 typ. (mm) (For dimensions refer to outline.) SMD type.W=23.9 L=33 H=6.0 typ. (mm) (For dimensions refer to outline.)

* The above specification will be provided at rating value, when there is no specified condition described.

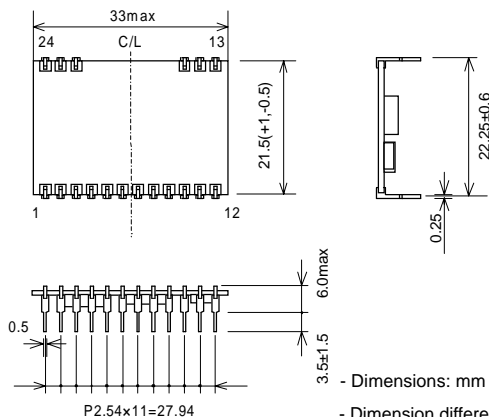
1. TSI 20N-0510V (SIP type)



- Dimensions: mm
- Dimension difference with nothing specified ± 0.5

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

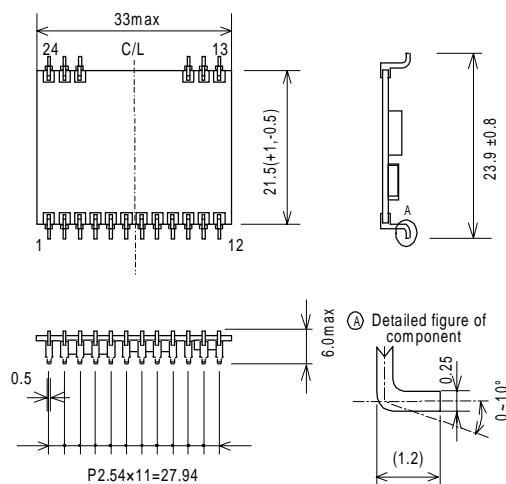
2. TSI 20N-0510D (DIP type)



- Dimensions: mm
- Dimension difference with nothing specified ± 0.5

Pin	Function	Pin	Function
1	on/off	11	Vout
2	Vin	12	V.ADJ
3	Vin	13	NC
4	Vin	14	+S
5	GND	15	-S
6	GND	22	NC
7	GND	23	P-Good
8	GND	24	NC
9	Vout		
10	Vout		

3. TSI 20N-0510S (SMD type)



- Dimensions: mm
- Dimension difference with nothing specified ± 0.5

Pin	Function	Pin	Function
1	on/off	11	Vout
2	Vin	12	V.ADJ
3	Vin	13	NC
4	Vin	14	+S
4	Vin	15	-S
5	GND	22	NC
6	GND	23	P-Good
7	GND	24	NC
8	GND	24	NC
9	Vout		
10	Vout		

Standard Connection Circuit Diagram

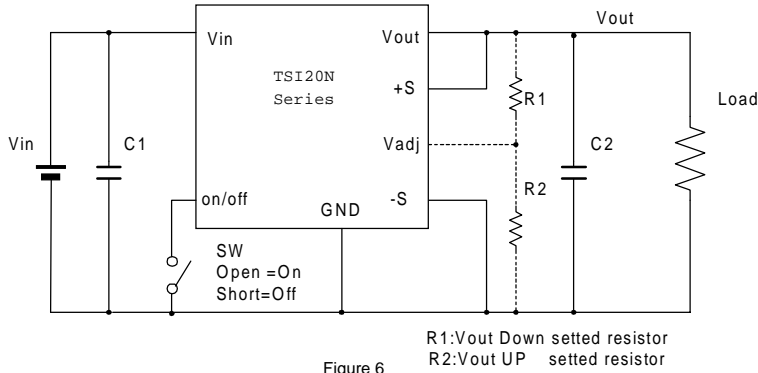


Figure 6

Note 1: When not using the ON/OFF control, keep ON/OFF pin open.

Note 2: When not adjusting output, keep V.ADJ pin open.

Note 3: When it includes inductance in input line or switching element is connected to the input side or the wire is long, ...to fulfill the performance C1 will be required. Also to lower the input impedance we recommend a pattern that has an ...additional C1, and to verify on a actual equipment. Or, by adding C2 you can lower the output ripple more.

Recommended Capacitor

C1=33 μ F10WV

C2=2.2 μ F~22 μ F

C2: An output capacitor is built-in so it is not required, however by connecting 2.2 μ F~22 μ F you can lower the noise more

Note 4: There is no +S, Pin in TSI 20N-0510V .SIP type.

Method of Adjusting Output Voltage

When using at 3.3V without adjusting output voltage, keep V.ADJ pin (12Pin) open.

By connecting a resistor between +Vout pin (9~11Pin)~V.ADJ pin (12Pin), you can adjust the output voltage in the range of 0.8~3.3V. (Vout,Down Control)

By connecting a resistor between Vadj pin (12Pin)~GND pin (5~8Pin), you can adjust the output voltage in the range of 3.3V~3.6V. (Vout,Up Control)

To calculate external resistance, please refer to the equation below. After calculating external resistance, please check output voltage and adjust resistance value.

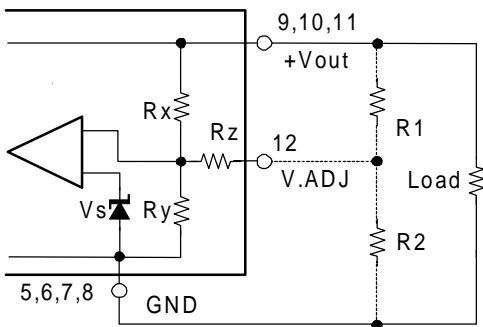


Figure 7

To set in the range of 0.8V~3.3V

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

To set in the range of 3.3V~3.6V

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

Vo= Requested output V .Adjustable voltage range=0.8~3.6V.

Rx=10.2k ohm

Ry=2.7k ohm

Rz=0.1K ohm

Vs=0.703V

Remote ON/OFF Control

- ON/OFF Function

By using this ON/OFF control function, the output can be ON/OFF controlled 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

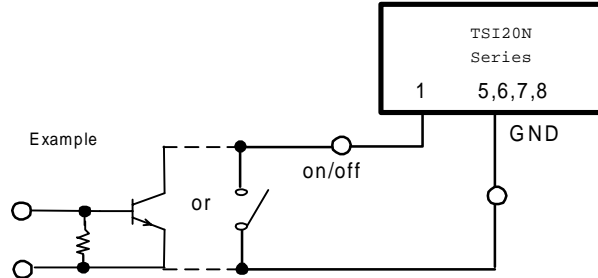
To not use the ON/OFF function, keep ON/OFF pin open.

- Method of ON/OFF Control

Between ON/OFF pin (1Pin) and S.GND (5-8Pin)

Open ---- Output=ON

Short ---- Output=OFF (0~0.7V 1*A max.)



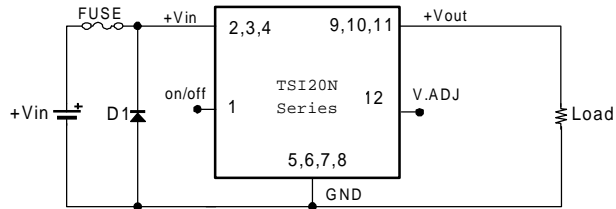
To prevent reverse connection of Input Power Supply (ex.)

This product is a non-isolated type DC-DC converter that steps-down from (+) to (+).

If you connect the input voltage reversed by mistake, it will be damaged.

If there is a possibility of reverse connection, please add a protection as the right figure.

The right figure is an example using fuse and diode.



Over-Voltage Protection (ex.)

This product does not have a built-in over-voltage protection.

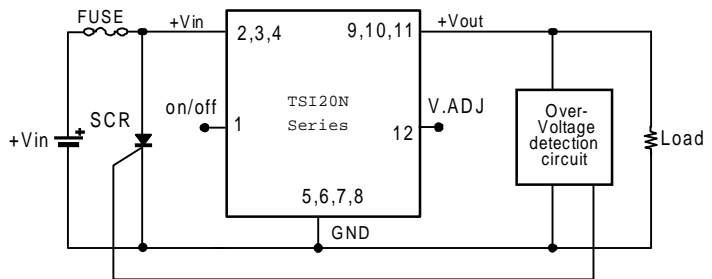
If the switching element in this converter is damaged in short mode input voltage, +Vin, will be output as is.

However, to prepare for damage at over-voltage mode, we recommend to add a circuit to intercept the supplying power circuit.

Note1: When it is damaged at over-voltage mode, ON/OFF control does not operate.

Note2: When there is a ON/OFF function on the supplying power side, this may be used.

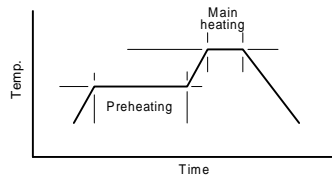
Note 3: Be sure that the DC power supply on the supplying side has the capacity to fuse the fuse.



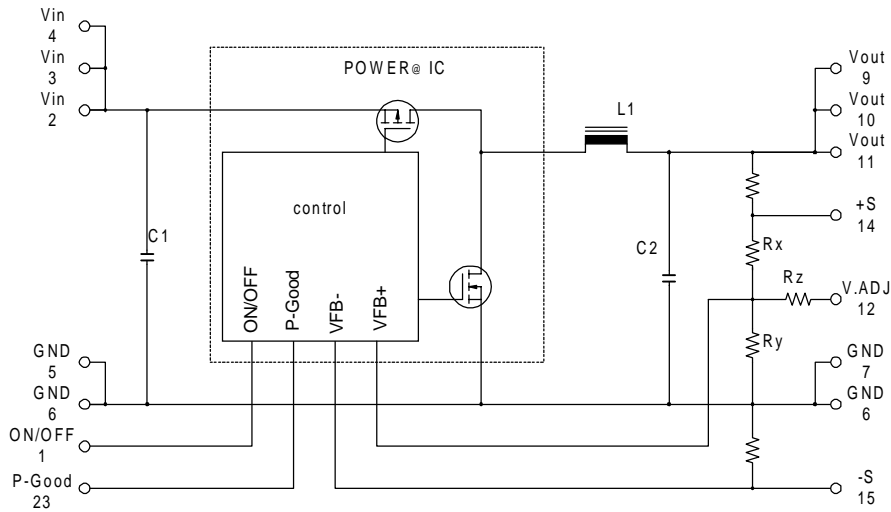
Soldering Conditions

Solder under the following conditions.

1. With soldering iron 340°C~360°C within 3sec.
2. With soldering dip 240°C~260°C within 10sec.
3. Reflow method (only for SMD type)
 - Preheating Temp.: 150±10°C, within 1min.
 - Main heating temp.: 235°Cmax. 10sec max.
 - Reflowing frequency: once



Block Diagram

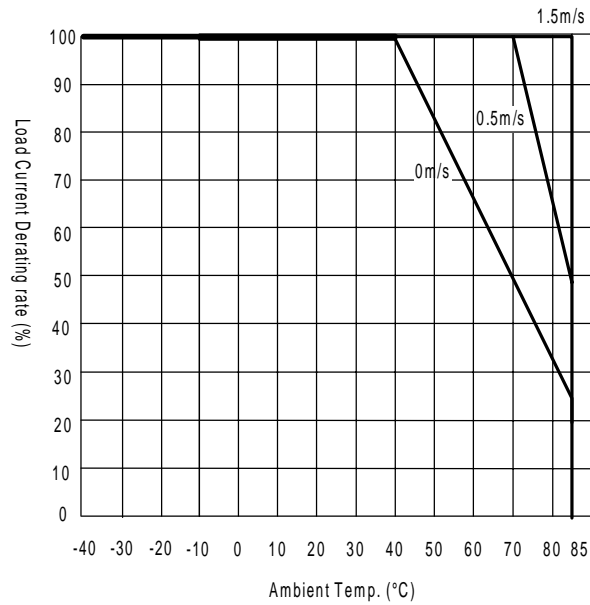


* There is no P-Good, +S, -S pin in TSI 20-0510S (SIP type).

Thermal Derating

Please set this product in a place with good circulation.

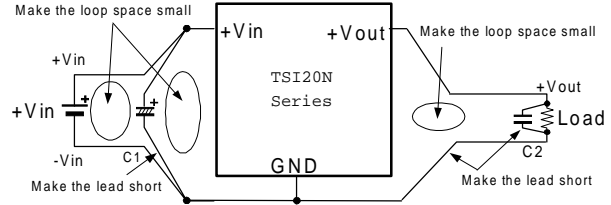
And when using this product in an environment that ambient temp. is 40°C or more, please refer to the thermal derating below.



Method to decrease noise

Usually TSI 20N series is used adding an input/output capacitor, and making the most of the converter's performance and to decrease the noise more, consider the following items when designing the print board.

1. Use low impedance capacitor which has good high frequency characteristic.
2. Shorten lead of each capacitor as much as possible, and make it low lead inductance.
3. Make the wiring loop space small between the (+) and (-) of both input and output pin side as much as possible. You can decrease the effect of leakage inductance.
4. Design the print pattern of the main circuit thick and short as much as possible.



Precautions

- 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. Mount to print board by soldering.
- This product has a built-in over-current, short protection, but long time of short circuit will cause failure, so please avoid that.
- May not be used in a use of that would affect lives or properties directly by the failure of this product. Please confirm before adopting.
- Product can not be used under oscillation, strike or temp. condition that are out of the specification. Contact for any questions.
- There is possibility of damage from static. When the worker has electrified static, electrical discharge by grounding, and recommend working on a table grounded.
- This product does not have a built-in fuse. Connect a fuse to the +input line for protection when over-current flows into input at abnormal. Please be sure that the supplying power has the capacity to cut the fuse.
- This product does not have a built-in over-voltage protection. When over-voltage occurs by the abnormality in the module there is a mode that input voltage comes out at output as it is, and this may cause smoke and ignition. To prevent this, be sure to add over-voltage protection.
- There is no test result report attached for this product.

Reliability Test

Test Items	Test Conditions
Low-temp. storage	-40°C 1000hrs. Leave without energizing
High-temp. storage	+85°C 1000hrs. Leave without energizing
Heat shock	-40°C~+125°C 30min. Each 100cycle
High-temp. Load	+85°C 1000hrs. Rating input, output 3.3V (3A)
Withstand humidity load	+40°C 90~9%RH 1000hrs. Leave at rating input/ output
Withstand flux	Leave in IPA for 5min.
Solder withstand heat	260°C±5°C 10sec. And 350°C±10°C for 3sec.
Oscillation	5~10Hz Every amplitude 10mm, 10^55Hz Acceleration 2G (3directions, each for 1 hour)
Striking	Acceleration 20G (3directions, 3times each), Striking time 11±6ms
Evaluation	Should be nothing extraordinary in electrical characteristics and appearance before or after the test.