

# Application Notes

Output Voltage 1.8V-3.3V Ultra High Efficiency 92%  
 TO-3PL Size, Step-Down Non-Isolated Type DC-DC Converter  
**10 Watt VSI-mini A Series**

## <Technical Notes>

### (A) Standard Connection

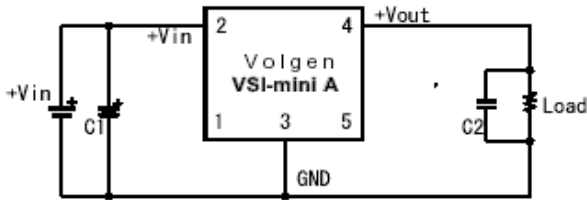


Figure5

Choice of external capacitors

C1=100µF20WV

C2=2.2µF~4.7µF

C2: No need to add the output capacitor, because it is built in.

In case that the wiring is long to the load, output noise may be further reduced with the C2 added.

Rating Output Voltage : 3.3V ±5%

### (B) ON/OFF Control connection

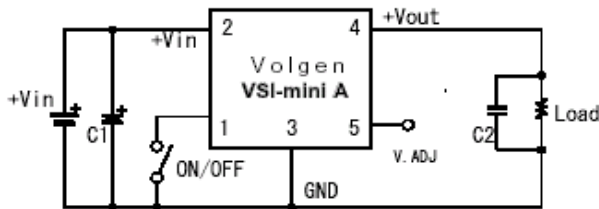


Figure6

ON/OFF can be controlled by opening or shortening 1pin and 3pin. Transistor(open collector) is recommended for the open and short control parts.

Output ON mode

Between 1pin and 3 pin : OPEN

Output OFF mode

Between 1pin and 3 pin : SHORT

Off state voltage 0~0.5Vdc (100µA max.)

### (C) Output Voltage Adjustment Connection

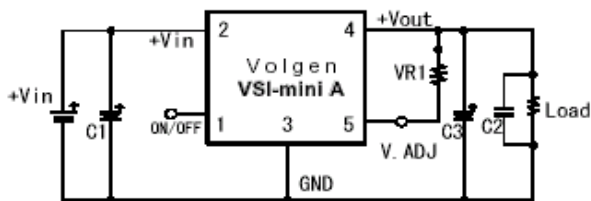


Figure7

It is possible to adjust output voltage by connecting a resistor between 5pin (V.ADJ)and 4pin (+Vout).

The output voltage trim range is as in 3.0~5.0V.

The output voltage adjustable resistor can be calculated by the following equation.

Output voltage adjustable equation

$$VR1 = \frac{R_x \times R_y \times (V_o - V_s)}{R_x \times V_s - R_y (V_o - V_s)}$$

To adjust output voltage : C3=100µF~220µF

Table 3

| VSI-3.3V type calculated value  |
|---|
| V <sub>o</sub> : Desired Output Voltage<br>(V <sub>out</sub> trim range: 1.8V-3.3V) |
| VR1: V <sub>out</sub> variable resistor(down)                                       |
| V <sub>s</sub> =0.8V  |
| R <sub>y</sub> =20k ohm   |
| R <sub>x</sub> =62.51k ohm  |

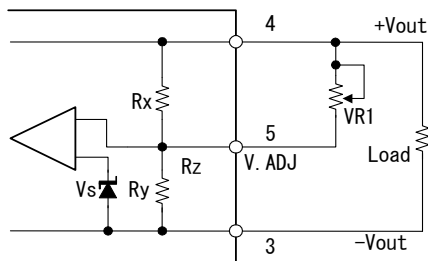


Figure8

Note1: When 5pin V.ADJ is open, the output will be the rating value.

Note2: When using a trimmer potentiometer, be careful of the position of the adjustable lug. We recommend you to confirm the resistor value in advance, or to start the initial energizing after turning the lug in the direction of low voltage. And for mass production we recommend to use a fixed resistor.

Note3: We recommend checking the output voltage value, using converter after calculating the resistor value.

Note4: When changing output voltage, add C3=100µF~220µF.



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These test data do not represent all product.

<Turn on transient>

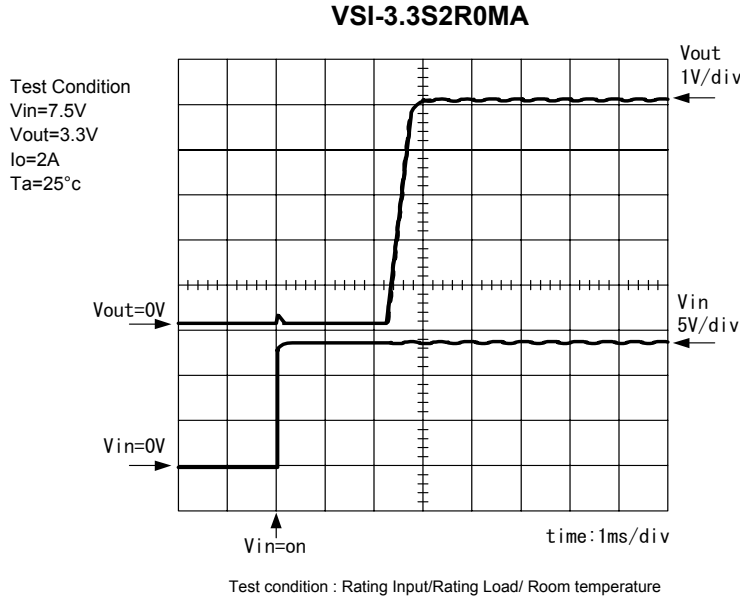


Figure9

<Output Ripple & Noise>

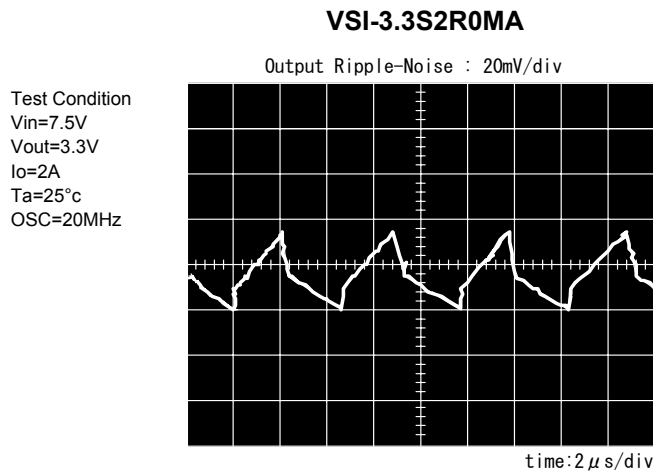


Figure10

Test condition : Rating Input/Rating Load/ Room temperature  
Test circuit is indicated in figure 13.



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<Test Data>

Model: VSI-5.0S2R0MA

Temp. : 25°C

| Input       |             |           | Output      |             |                      |           | Efficiency (%) |
|-------------|-------------|-----------|-------------|-------------|----------------------|-----------|----------------|
| Voltage (V) | Current (A) | Power (W) | Voltage (V) | Current (A) | Ripple/Noise (mVp-p) | Power (W) |                |
| 4.750       | 0.0005      | 0.002     | 3.316       | 0           | 24/24                | 0         | -              |
| 4.751       | 0.366       | 1.739     | 3.304       | 0.501       | 12/20                | 1.655     | 95.17          |
| 4.743       | 0.733       | 3.477     | 3.302       | 1.005       | 12/20                | 3.319     | 95.46          |
| 4.753       | 1.105       | 5.252     | 3.300       | 1.505       | 16/20                | 4.967     | 94.57          |
| 4.754       | 1.486       | 7.064     | 3.298       | 2.006       | 16/24                | 6.616     | 93.66          |
|             |             |           |             |             |                      |           |                |
| 7.499       | 0.0005      | 0.004     | 3.315       | 0           | 24/24                | 0         | -              |
| 7.501       | 0.239       | 1.793     | 3.304       | 0.501       | 60/60                | 1.655     | 92.3           |
| 7.502       | 0.472       | 3.541     | 3.302       | 1.004       | 20/28                | 3.315     | 93.62          |
| 7.501       | 0.710       | 5.326     | 3.299       | 1.504       | 24/28                | 4.962     | 93.17          |
| 7.500       | 0.953       | 7.148     | 3.298       | 2.004       | 24/32                | 6.609     | 92.46          |
|             |             |           |             |             |                      |           |                |
| 13.600      | 0.0004      | 0.005     | 3.315       | 0           | 20/20                | 0         | -              |
| 13.595      | 0.141       | 1.917     | 3.303       | 0.501       | 48/48                | 1.655     | 86.33          |
| 13.594      | 0.270       | 3.67      | 3.301       | 1.004       | 32/36                | 3.314     | 90.3           |
| 13.593      | 0.401       | 5.451     | 3.298       | 1.503       | 32/40                | 4.957     | 90.94          |
| 13.606      | 0.534       | 7.266     | 3.295       | 2.000       | 32/40                | 6.590     | 90.7           |

Figure 11

Efficiency vs. output current for input voltage

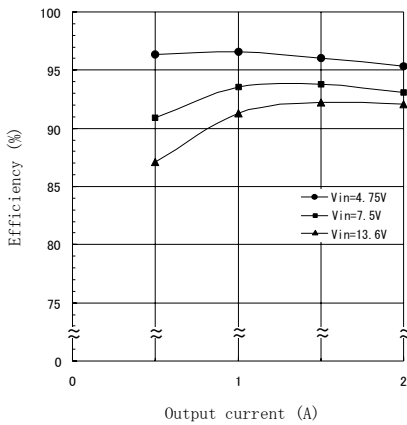
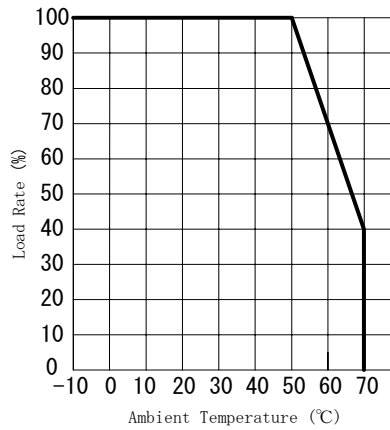
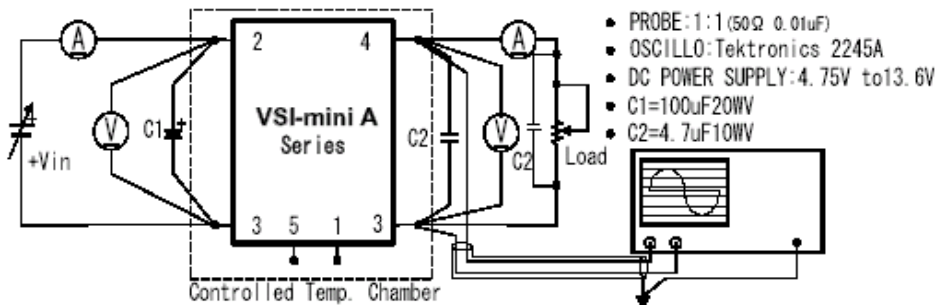


Figure 12



<Test Circuit>

Figure 13

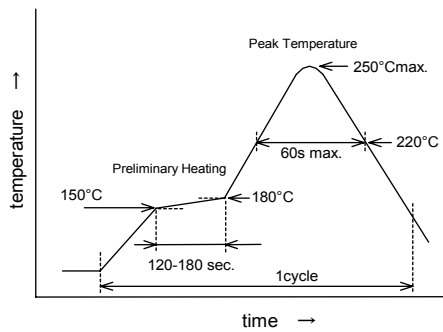


### <Soldering Conditions>

Solder to be executed under the following conditions.

1. Soldering iron 340°C - 360°C within 5sec.
2. Soldering dip 230°C - 260°C within 10sec.
3. Reflow method (only for SMD type)

#### Reflow temperature profile



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

- Keep it in a place where the unit will not be influenced by poisonous gas.
- Please avoid the dust.
- Keep it in a place where direct sunlight will not effect it.

\*1,2 apply to SIP and DIP, 3 applies to SMD.

### <Cleaning Condition>

This product can not be cleaned bodily. Non-cleaned flux is recommended. When and if cleaning only for SIP and DIP type should be necessary, use IPA and hand-wash the soldered surface by brush cleaning. After cleaning, please dry enough to use it.

### <Over Voltage protection>

VSI-mini A series 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 as output. For emergency if it gets damages at over-voltage mode, please add a circuit as below to intercept the supplying power circuit.

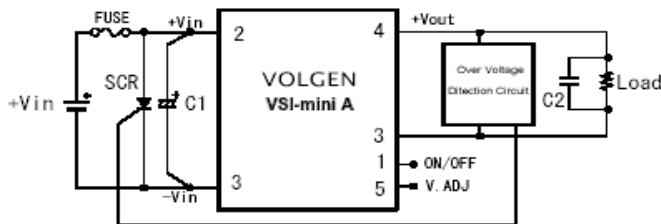


Figure 15

Notes:

- 1 When it is damaged at over-voltage mode, On/Off control does not operate.
- 2 When there is a On/Off function on the supplying power side, it can be used, too. For further inquiries, please contact us.
- 3 When there is a DC Power Supply on the supplying power side, please make sure to have the capacity the fuse can be cut.

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

The input/ output of VSI-mini A series 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 Figure 14. The figure below is an example using fuse and diode.

Fuse is not built-in, so connecting fuse into input line is recommended to protect from abnormal condition.

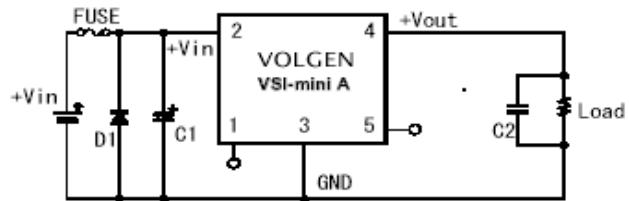


Figure 14

### <Method to decrease the noise level (ex.)>

Usually VSI-mini A series is used by adding input/output capacitor, please make sure to design the print board with special attention to the following items in order to obtain lower noise level by taking advantage of the performance of a converter.

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

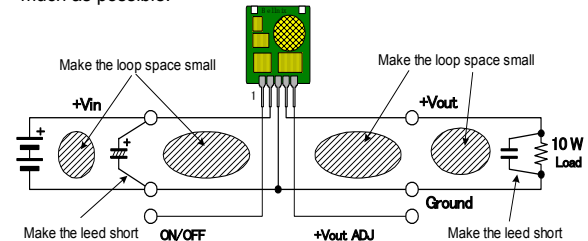


Figure 16

### <Precautions>

1. For this product parallel/series operation is not possible.
2. 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.
3. This product has a built-in over current and short protection circuit, but long time short circuit will cause failure, so please avoid that.
4. This product can not be used in case that it would effect lives or properties directly by the failure of this product. Please confirm us before adopting it.
5. Product can not be used under vibration, shock or tmp.conditions that are out of the specification. Contact us, if any question.
6. There is possibility of damage from static. When the worker has electrified static, electrical discharge by grounding should be done and the working on the table may be recommended.
7. No test certificate is attached to this product.