

## VS7800B Series Three Terminal Voltage Regulator

### 1 Introduction

The VS7800B series is a group of three terminal positive voltage linear regulators with multiple fixed output voltages. Under the condition of good heat dissipation, it can provide output current up to 1A, and has the functions of internal current limit, short circuit protection, thermal shutdown protection and output transistor SOA protection, which make it relatively difficult to damage. Although designed as fixed voltage regulators without external components, these devices can be used with external components to obtain adjustable voltage and current. Therefore, the VS7800B series is widely used as fixed voltage regulators, including local (on card) regulators, to eliminate noise and power distribution problems associated with single point regulation.

### 2 Available Packages

| PART NUMBER    | PACKAGE   |
|----------------|-----------|
| VS7800B Series | TO-220-3L |
|                | TO-220F   |
|                | TO-252-2L |
|                | TO-263-2L |

**Note:** For all available packages, please refer to the part *Orderable Information*.

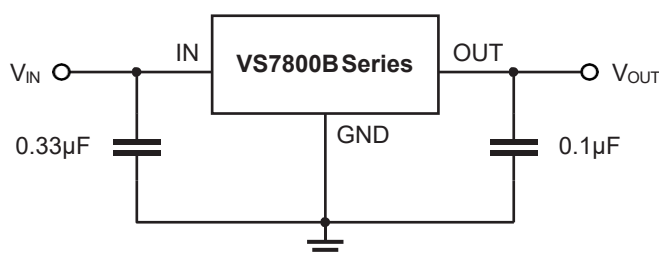


Figure 2-1. Typical Application Circuit

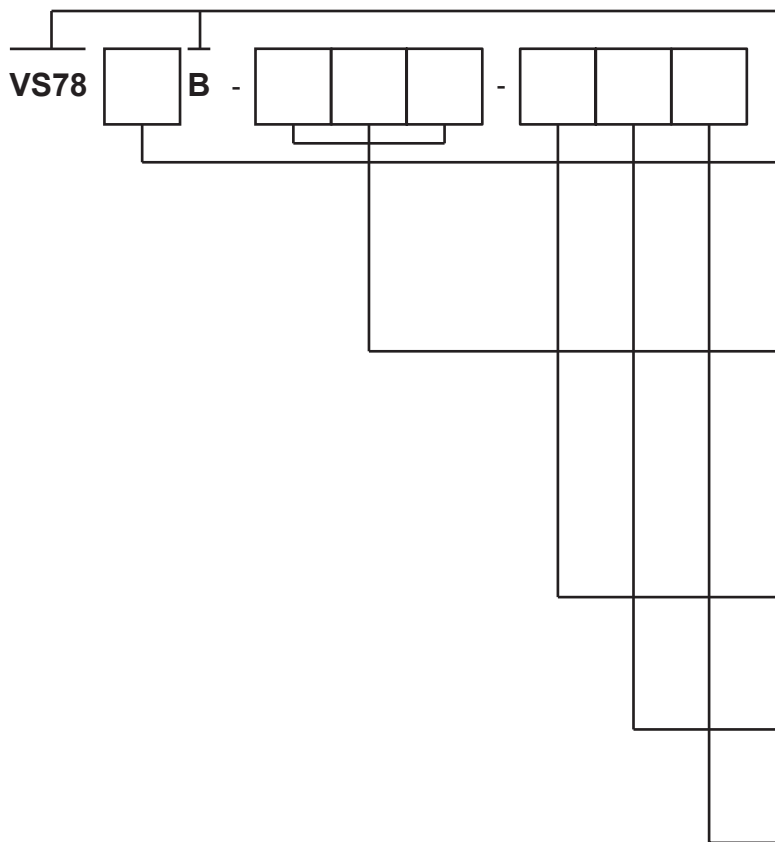
### 3 Features

- Available Fixed Output Voltage:
  - 5.0V: VS7805B
  - 6.0V: VS7806B
  - 8.0V: VS7808B
  - 9.0V: VS7809B
  - 12V : VS7812B
  - 15V : VS7815B
- Output Current:
  - up to 1A at  $T_J = 25^\circ\text{C}$
- Output Voltage Tolerance at  $T_J = 25^\circ\text{C}$ :
  - $\pm 2\%$  for Conventional Device
  - $\pm 1\%$  can be Customized
- Operating Junction Temperature:
  - $-40 \sim 125^\circ\text{C}$
- Output Voltage Tolerances of  $\pm 4\%$  over the Temperature Range
- Dropout Voltage:  $2\text{V}@1\text{A}$
- Power Supply Rejection Ratio:
  - $70\text{dB}@120\text{Hz}$  ( $V_{\text{OUT}} = 5.0\text{V}$ )
- Output Transistor SOA Protection
- Internal Current Limit
- Short Circuit Protection
- Thermal Shutdown Protection

### 4 Applications

- AC Inventors
- DC Motor Drivers
- Household Electric Appliances
- HVAC Systems
- Industrial Power Supplies
- SMPS Post Regulation
- Solar Energy String Inventors
- Test and Measurement Equipment

## 5 Orderable Information



**Device serial number.**

**Output voltage.**

05: Fixed output 5.0V  
06: Fixed output 6.0V  
08: Fixed output 8.0V  
09: Fixed output 9.0V  
12: Fixed output 12V  
15: Fixed output 15V  
18: Fixed output 18V

**Package type.**

TBN: TO-220-3L  
TCN: TO-220F  
TDN: TO-251-3L  
TEN: TO-251S  
TFN: TO-252-2L  
TGN: TO-263-2L

**Output voltage tolerances.**

A:  $\pm 2\%$  grade  
B:  $\pm 1\%$  grade

**Outer package option.**

R: Tape and reel  
T: Tube

**Eco-label.**

G: Green device, halogen free and lead free

**Figure 5-1. VS7800B Series Naming Conventions**

| MODEL                      | DEVICE          | PACKAGE   | OP T <sub>J</sub> | ECO PLAN     | MSL               | PACKING OPTION          | SORT   |
|----------------------------|-----------------|-----------|-------------------|--------------|-------------------|-------------------------|--------|
| <b>Conventional Device</b> |                 |           |                   |              |                   |                         |        |
| VS7800B-5.0                | VS7805B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |
| VS7800B-6.0                | VS7806B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |
| VS7800B-8.0                | VS7808B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |
| VS7800B-9.0                | VS7809B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |
| VS7800B-12                 | VS7812B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |
| VS7800B-15                 | VS7815B-TBN-ATG | TO-220-3L | -40 ~ 125°C       | RoHS & Green | Level 3<br>168 HR | Tube<br>50 Units / Rail | Active |

## 5 Orderable Information

**Note:**

**ECO PLAN:** For the RoHS and Green certification standards of this product, please refer to the official report provided by JSVS.

**MSL:** Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

**SORT:** Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued.

## 7 Specifications

### 7.1 Absolute Maximum Ratings

(over operating free-air temperature range, unless otherwise specified)

| CHARACTERISTIC                             |                |           | SYMBOL               | VALUE                             | UNIT |
|--------------------------------------------|----------------|-----------|----------------------|-----------------------------------|------|
| Maximum input voltage range <sup>(2)</sup> |                |           | V <sub>IN</sub> MAX  | 36                                | V    |
| Maximum output current                     |                |           | I <sub>OUT</sub> MAX | 1.0                               | A    |
| Maximum power dissipation                  | VS7800B Series | TO-220-3L | P <sub>D</sub> Max   | Internally Limited <sup>(3)</sup> | W    |
|                                            |                | TO-220F   |                      |                                   |      |
|                                            |                | TO-251-3L |                      |                                   |      |
|                                            |                | TO-251S   |                      |                                   |      |
|                                            |                | TO-252-2L |                      |                                   |      |
|                                            |                | TO-263-2L |                      |                                   |      |
| Maximum junction temperature               |                |           | T <sub>J</sub> Max   | 150                               | °C   |
| Storage temperature                        |                |           | T <sub>stg</sub>     | -65 ~ 150                         | °C   |
| Soldering temperature & time               |                |           | T <sub>solder</sub>  | 260°C, 10s                        | -    |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) Refer to *Thermal Information* for details.

### 7.2 Recommend Operating Conditions

| PARAMETER                      |         | SYMBOL   | MIN. | NOM. | MAX. | UNIT |
|--------------------------------|---------|----------|------|------|------|------|
| Input voltage range            | VS7805B | $V_{IN}$ | -    | -    | 25   | V    |
|                                | VS7806B |          | -    | -    | 26   |      |
|                                | VS7808B |          | -    | -    | 28   |      |
|                                | VS7809B |          | -    | -    | 29   |      |
|                                | VS7812B |          | -    | -    | 32   |      |
|                                | VS7815B |          | -    | -    | 32   |      |
|                                | VS7818B |          | -    | -    | 32   |      |
| Operating junction temperature |         | $T_J$    | -40  | -    | 125  | °C   |
| Operating ambient temperature  |         | $T_A$    | -    | -(4) | -    | °C   |

(4) It is necessary to ensure that the operating junction temperature of the device does not exceed the rated value of the recommended operating conditions when using the device for design.

## 7 Specifications

### 7.3 ESD Ratings

| ESD RATINGS                            |                  | SYMBOL               | VALUE | UNIT |
|----------------------------------------|------------------|----------------------|-------|------|
| Electrostatic discharge <sup>(5)</sup> | Human body model | V <sub>ESD-HBM</sub> | 6000  | V    |
|                                        | Machine model    | V <sub>ESD-MM</sub>  | 500   |      |

(5) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body model (HBM) electrostatic discharge test is based on the JESD22-114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ. The electrostatic discharge test in mechanical model (MM) is based on the JESD22-115-A test standard and uses a 200pF capacitor to discharge directly to each pin of the device.

### 7.4 Thermal Information

| THERMAL METRIC <sup>(6)</sup>                                | SYMBOL             | VS7800B Series |           |           | UNIT |
|--------------------------------------------------------------|--------------------|----------------|-----------|-----------|------|
| Junction-to-ambient thermal resistance                       | R <sub>θJA</sub>   | TO-220-3L      | TO-220F   | TO-251-3L | °C/W |
|                                                              |                    | 65.1           | 66.4      | 80.4      |      |
|                                                              |                    | TO-251S        | TO-252-2L | TO-263-2L |      |
|                                                              |                    | 81.8           | 78.9      | 62.3      |      |
| Junction-to-case thermal resistance                          | R <sub>θJC</sub>   | TO-220-3L      | TO-220F   | TO-251-3L | °C/W |
|                                                              |                    | 5.4            | 6.2       | 9.1       |      |
|                                                              |                    | TO-251S        | TO-252-2L | TO-263-2L |      |
|                                                              |                    | 9.7            | 5.8       | 5.3       |      |
| Reference maximum power dissipation for continuous operation | P <sub>D Ref</sub> | TO-220-3L      | TO-220F   | TO-251-3L | W    |
|                                                              |                    | 1.53           | 1.51      | 1.25      |      |
|                                                              |                    | TO-251S        | TO-252-2L | TO-263-2L |      |
|                                                              |                    | 1.23           | 1.25      | 1.60      |      |

(6) T<sub>A</sub> = 25°C, all numbers are typical, and apply for packages soldered directly onto a PCB board in still air without extra heat dissipation pads.

## 7 Specifications

### 7.5 Electrical Characteristics

**VS7805B ( $V_{IN} = 10V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                    |                                | MIN. | TYP. | MAX. | UNIT            |
|----------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------|------|------|------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                | $\pm 2\%$ grade <sup>(8)</sup> | 4.90 | 5.00 | 5.10 | V               |
|                                        |                                              |                                                                                                   | $\pm 1\%$ grade <sup>(8)</sup> | 4.95 |      | 5.05 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 7.5$ to $20V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 4.80 | 5.00 | 5.20 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 7.5$ to $20V$ , $I_{OUT} = 500mA$                                                       |                                | -    | 25   | 50   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 10V$ , $I_{OUT} = 5mA$ to $1A$                                                          |                                | -    | 20   | 50   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 10V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                   |                                | -    | 3.2  | 6.0  | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 10V$ , $I_{OUT} = 5mA$ to $1A$                                                          |                                | -    | 0.1  | 0.8  | mA              |
|                                        |                                              | $V_{IN} = 8$ to $25V$ , $I_{OUT} = 500mA$                                                         |                                | -    | 0.3  | 0.8  |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                 |                                | -    | 0.4  | -    | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                   |                                | -    | 80   | -    | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                         |                                | -    | 10   | -    | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 8$ to $18V$ , $I_{OUT} = 500mA$                                           |                                | -    | 70   | -    | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                    |                                | -    | 2.0  | -    | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                        |                                | -    | 10   | -    | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                               |                                |      | 50   | -    | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 10V$                                                                                    |                                | -    | 2.2  | -    | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7806B ( $V_{IN} = 11V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                    |                                | MIN. | TYP. | MAX. | UNIT            |
|----------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------|------|------|------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                | $\pm 2\%$ grade <sup>(8)</sup> | 5.88 | 6.00 | 6.12 | V               |
|                                        |                                              |                                                                                                   | $\pm 1\%$ grade <sup>(8)</sup> | 5.94 |      | 6.06 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 8.6$ to $21V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 5.76 | 6.00 | 6.24 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 8.6$ to $21V$ , $I_{OUT} = 500mA$                                                       |                                | -    | 25   | 60   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 11V$ , $I_{OUT} = 5mA$ to $1A$                                                          |                                | -    | 20   | 60   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 11V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                   |                                | -    | 3.2  | 6.0  | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 11V$ , $I_{OUT} = 5mA$ to $1A$                                                          |                                | -    | 0.1  | 0.8  | mA              |
|                                        |                                              | $V_{IN} = 8.6$ to $21V$ , $I_{OUT} = 500mA$                                                       |                                | -    | 0.3  | 0.8  |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                 |                                | -    | 0.5  | -    | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                   |                                | -    | 80   | -    | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                         |                                | -    | 10   | -    | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 9.5$ to $19.5V$ , $I_{OUT} = 500mA$                                       |                                | -    | 65   | -    | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                    |                                | -    | 2.0  | -    | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                        |                                | -    | 10   | -    | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                               |                                |      | 200  | -    | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 11V$                                                                                    |                                | -    | 2.2  | -    | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7808B ( $V_{IN} = 14V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                      |                                | MIN. | TYP. | MAX. | UNIT            |
|----------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------|------|------|------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                  | $\pm 2\%$ grade <sup>(8)</sup> | 7.84 | 8.00 | 8.16 | V               |
|                                        |                                              |                                                                                                     | $\pm 1\%$ grade <sup>(8)</sup> | 7.92 | 8.00 | 8.08 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 10.6V$ to $23V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 7.70 | 8.00 | 8.30 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 10.6$ to $23V$ , $I_{OUT} = 500mA$                                                        |                                | -    | 25   | 75   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 14V$ , $I_{OUT} = 5mA$ to $1A$                                                            |                                | -    | 25   | 75   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 14V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                     |                                | -    | 3.2  | 6.0  | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 14V$ , $I_{OUT} = 5mA$ to $1A$                                                            |                                | -    | 0.1  | 0.8  | mA              |
|                                        |                                              | $V_{IN} = 10.6$ to $23V$ , $I_{OUT} = 500mA$                                                        |                                | -    | 0.3  | 0.8  |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                   |                                | -    | 0.64 | -    | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                     |                                | -    | 80   | -    | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                           |                                | -    | 10   | -    | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 11.5$ to $21.5V$ , $I_{OUT} = 500mA$                                        |                                | -    | 62   | -    | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                      |                                | -    | 2.0  | -    | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                          |                                | -    | 10   | -    | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                                 |                                |      | 200  | -    | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 14V$                                                                                      |                                | -    | 2.2  | -    | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .



## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7809B ( $V_{IN} = 15V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                     |                                | MIN. | TYP. | MAX. | UNIT            |
|----------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------|------|------|------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                 | $\pm 2\%$ grade <sup>(8)</sup> | 8.82 | 9.00 | 9.18 | V               |
|                                        |                                              |                                                                                                    | $\pm 1\%$ grade <sup>(8)</sup> | 8.91 | 9.00 | 9.09 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 11.5$ to $23V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 8.65 | 9.00 | 9.35 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 11.5$ to $23V$ , $I_{OUT} = 500mA$                                                       |                                | -    | 25   | 90   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 15V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -    | 25   | 100  | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 15V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                    |                                | -    | 3.2  | 6.0  | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 15V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -    | 0.1  | 0.8  | mA              |
|                                        |                                              | $V_{IN} = 11.5$ to $23V$ , $I_{OUT} = 500mA$                                                       |                                | -    | 0.3  | 0.8  |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                  |                                | -    | 0.72 | -    | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                    |                                | -    | 80   | -    | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                          |                                | -    | 10   | -    | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 11.5$ to $21.5V$ , $I_{OUT} = 500mA$                                       |                                | -    | 61   | -    | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                     |                                | -    | 2.0  | -    | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                         |                                | -    | 10   | -    | $m\Omega$       |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                                |                                |      | 200  | -    | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 15V$                                                                                     |                                | -    | 2.2  | -    | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7812B ( $V_{IN} = 19V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                     |                                | MIN.  | TYP.  | MAX.  | UNIT            |
|----------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------|-------|-------|-------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                 | $\pm 2\%$ grade <sup>(8)</sup> | 11.76 | 12.00 | 12.24 | V               |
|                                        |                                              |                                                                                                    | $\pm 1\%$ grade <sup>(8)</sup> | 11.88 | 12.00 | 12.12 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 14.8$ to $27V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 11.50 | 12.00 | 12.50 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 14.8$ to $27V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 25    | 120   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 19V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -     | 40    | 120   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 19V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                    |                                | -     | 3.4   | 6.0   | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 19V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -     | 0.1   | 0.8   | mA              |
|                                        |                                              | $V_{IN} = 14.8$ to $30V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 0.3   | 0.8   |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                  |                                | -     | 0.96  | -     | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                    |                                | -     | 80    | -     | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                          |                                | -     | 10    | -     | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 15$ to $25V$ , $I_{OUT} = 500mA$                                           |                                | -     | 60    | -     | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                     |                                | -     | 2.0   | -     | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                         |                                | -     | 11    | -     | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                                |                                |       | 200   | -     | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 18V$                                                                                     |                                | -     | 2.2   | -     | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7815B ( $V_{IN} = 23V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                     |                                | MIN.  | TYP.  | MAX.  | UNIT            |
|----------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------|-------|-------|-------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                                 | $\pm 2\%$ grade <sup>(8)</sup> | 14.70 | 15.00 | 15.30 | V               |
|                                        |                                              |                                                                                                    | $\pm 1\%$ grade <sup>(8)</sup> | 14.85 | 15.00 | 15.15 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 17.9$ to $30V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 14.40 | 15.00 | 15.60 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 17.9$ to $30V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 35    | 150   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 23V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -     | 70    | 150   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 23V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                    |                                | -     | 3.4   | 6.0   | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 23V$ , $I_{OUT} = 5mA$ to $1A$                                                           |                                | -     | 0.1   | 0.8   | mA              |
|                                        |                                              | $V_{IN} = 17.9$ to $30V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 0.3   | 0.8   |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                  |                                | -     | 1.2   | -     | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                    |                                | -     | 80    | -     | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                          |                                | -     | 10    | -     | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 18.5$ to $28.5V$ , $I_{OUT} = 500mA$                                       |                                | -     | 58    | -     | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                     |                                | -     | 2.0   | -     | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                         |                                | -     | 10    | -     | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                                |                                |       | 200   | -     | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 21V$                                                                                     |                                | -     | 2.2   | -     | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

### 7.5 Electrical Characteristics (continued)

**VS7818B ( $V_{IN} = 27V$ ,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified)**

| CHARACTERISTIC                         | SYMBOL                                       | TEST CONDITIONS <sup>(7)</sup>                                                                   |                                | MIN.  | TYP.  | MAX.  | UNIT            |
|----------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------|-------|-------|-------|-----------------|
| Output voltage                         | $V_{OUT}$                                    | $T_J = 25^\circ C$                                                                               | $\pm 2\%$ grade <sup>(8)</sup> | 17.64 | 18.00 | 18.36 | V               |
|                                        |                                              |                                                                                                  | $\pm 1\%$ grade <sup>(8)</sup> | 17.82 | 18.00 | 18.18 |                 |
|                                        |                                              | $I_{OUT} = 5mA$ to $1A$ , $V_{IN} = 21$ to $33V$ , $T_J = -40$ to $125^\circ C$ , $P_D \leq 15W$ |                                | 17.30 | 18.00 | 18.70 |                 |
| Line regulation                        | $\Delta V_{RLINE}$                           | $V_{IN} = 21$ to $33V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 45    | 180   | mV              |
| Load regulation                        | $\Delta V_{RLOAD}$                           | $V_{IN} = 27V$ , $I_{OUT} = 5mA$ to $1A$                                                         |                                | -     | 85    | 180   | mV              |
| Quiescent current                      | $I_Q$                                        | $V_{IN} = 27V$ , $T_J = -40$ to $125^\circ C$ , $I_{OUT} = 0mA$                                  |                                | -     | 3.6   | 6.0   | mA              |
| Quiescent current change               | $\Delta I_Q$                                 | $V_{IN} = 27V$ , $I_{OUT} = 5mA$ to $1A$                                                         |                                | -     | 0.1   | 0.8   | mA              |
|                                        |                                              | $V_{IN} = 21$ to $33V$ , $I_{OUT} = 500mA$                                                       |                                | -     | 0.3   | 0.8   |                 |
| Output voltage temperature coefficient | $\Delta V_{OUT} / \Delta T$                  | -                                                                                                |                                | -     | 1.44  | -     | mV/ $^\circ C$  |
|                                        | $\Delta V_{OUT} / (V_{OUT} \times \Delta T)$ |                                                                                                  |                                | -     | 80    | -     | ppm/ $^\circ C$ |
| Output noise voltage                   | $V_N$                                        | $f = 10$ to $100k$ Hz, $T_A = 25^\circ C$                                                        |                                | -     | 10    | -     | $\mu V / V_O$   |
| Ripple rejection                       | RR                                           | $f = 120Hz$ , $V_{IN} = 22$ to $32V$ , $I_{OUT} = 500mA$                                         |                                | -     | 57    | -     | dB              |
| Dropout voltage <sup>(9)</sup>         | $V_D$                                        | $I_{OUT} = 1A$                                                                                   |                                | -     | 2.0   | -     | V               |
| Output resistance                      | $R_{OUT}$                                    | $f = 1kHz$                                                                                       |                                | -     | 10    | -     | m $\Omega$      |
| Short circuit current                  | $I_{SC}$                                     | $V_{IN} = 35V$ , $T_A = 25^\circ C$                                                              |                                |       | 200   | -     | mA              |
| Peak current                           | $I_{PK}$                                     | $V_{IN} = 24V$                                                                                   |                                | -     | 2.2   | -     | A               |

**Note:**

(7) Pulse test technology is used to make  $T_J$  as close to  $T_A$  as possible. Thermal effects must be considered separately.

(8)  $\pm 2\%$  for conventional device,  $\pm 1\%$  can be customized.

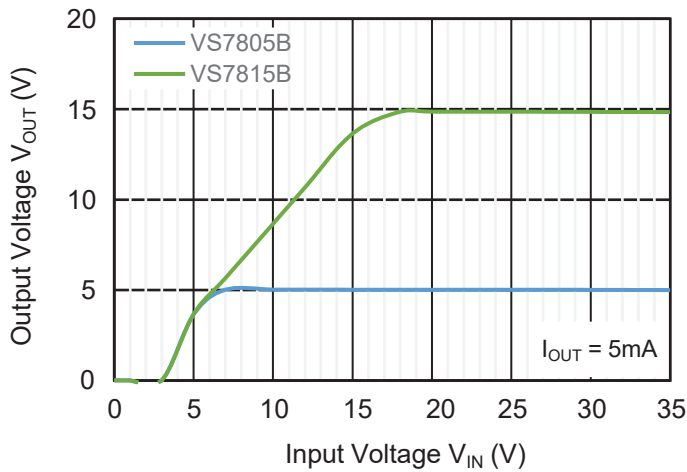
(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of  $V_{OUT}$ .

## 7 Specifications

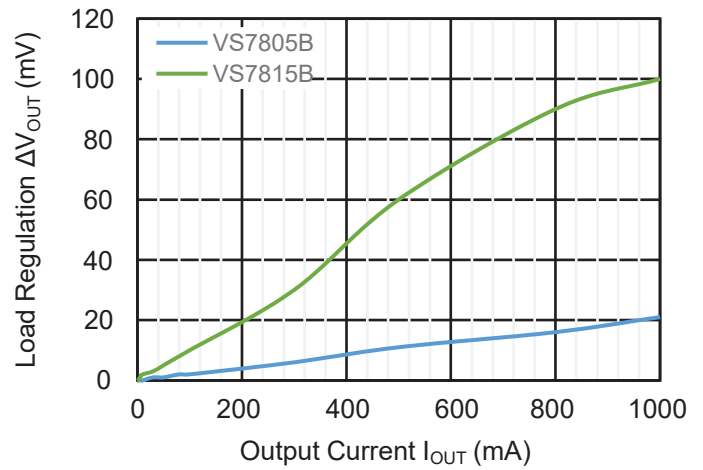
### 7.6 Typical Characteristics

**VS7800B Series** ( $V_{IN} = 10V$  for VS7805B,  $V_{IN} = 23V$  for VS7815B,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_A = 25^\circ C$ , unless otherwise specified)

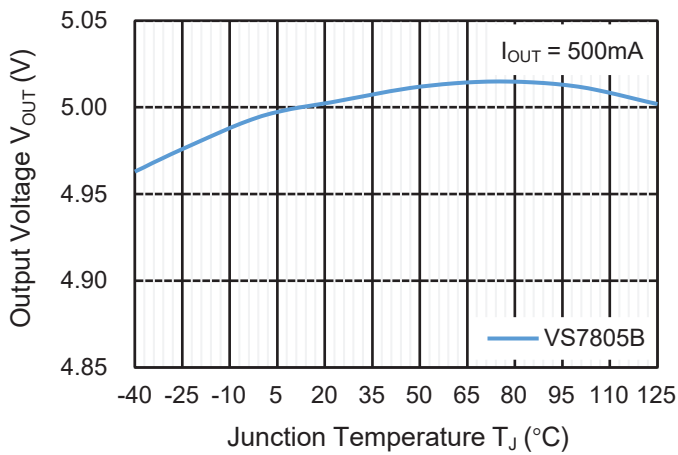
Line Regulation



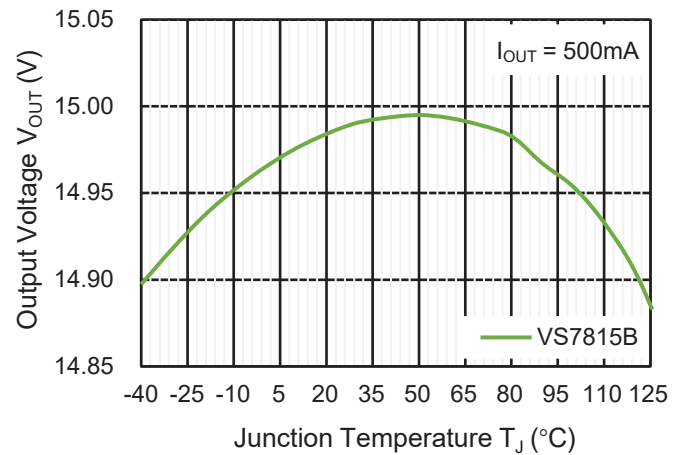
Load Regulation



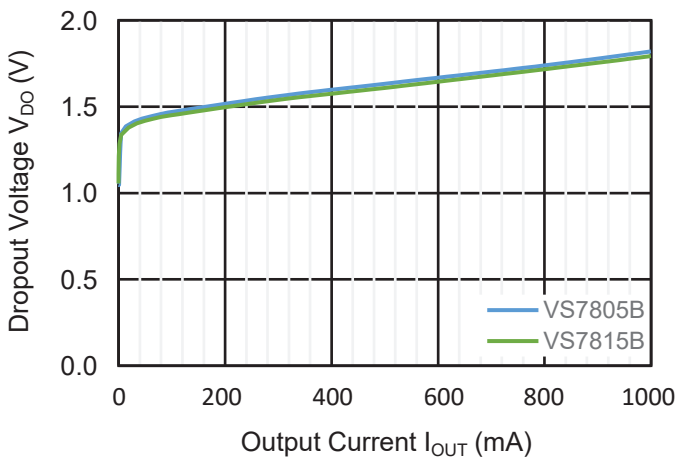
Temperature Characteristics



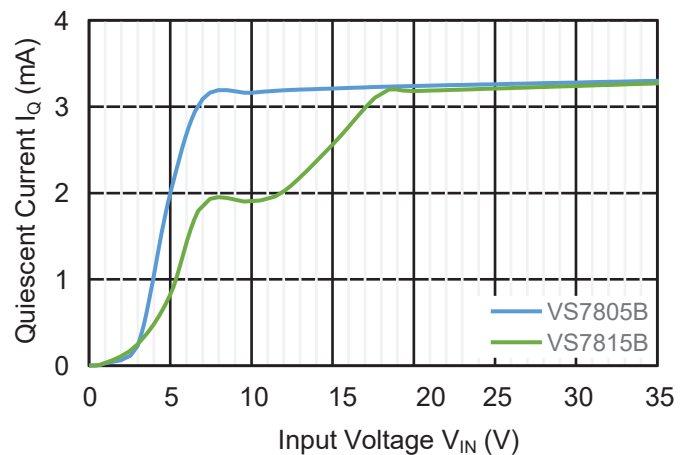
Temperature Characteristics



Dropout Voltage



Quiescent Current

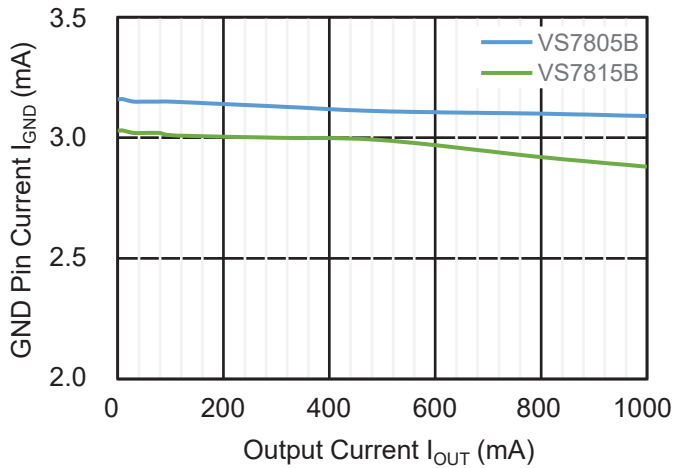


## 7 Specifications

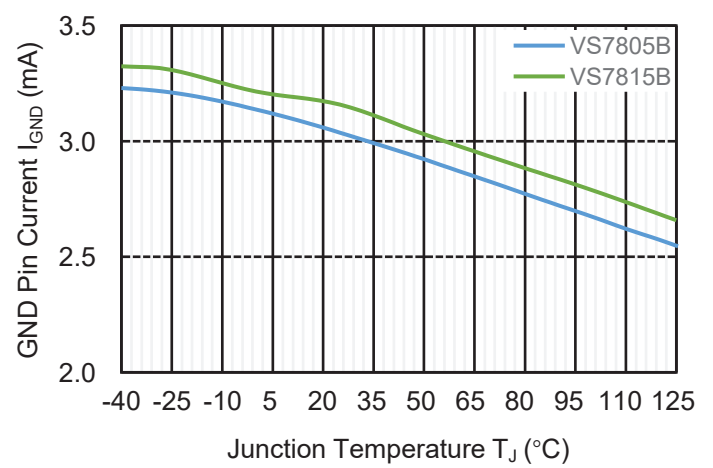
### 7.6 Typical Characteristics (continued)

**VS7800B Series** ( $V_{IN} = 10V$  for VS7805B,  $V_{IN} = 23V$  for VS7815B,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_A = 25^\circ C$ , unless otherwise specified)

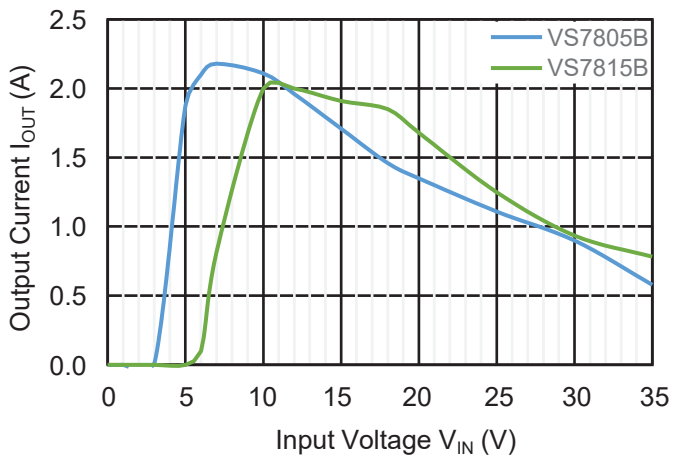
GND Pin Current



GND Pin Current

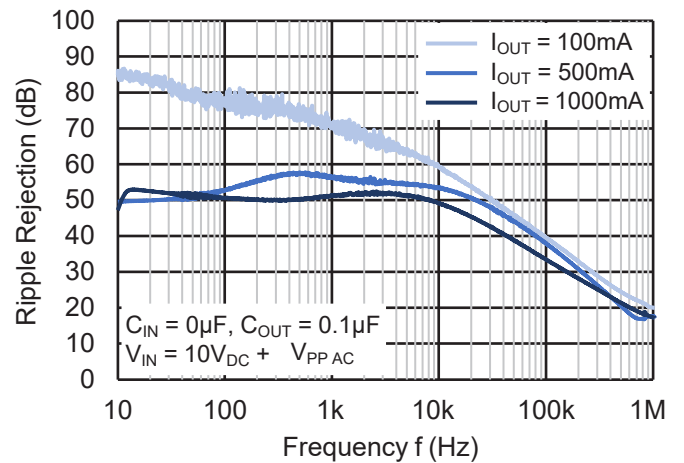


Output Current Limit



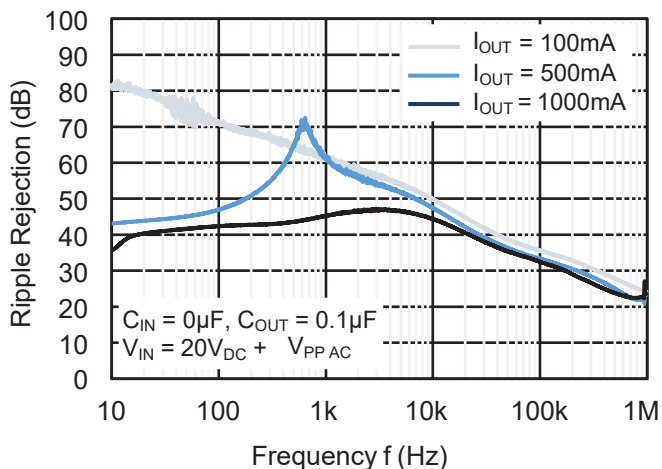
Ripple Rejection

VS7805B

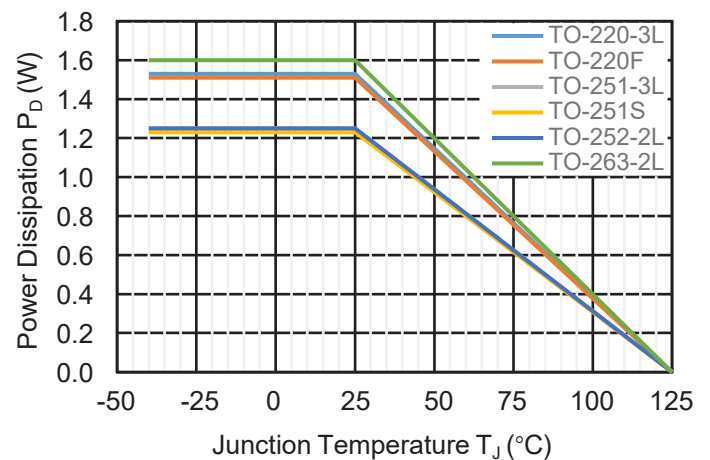


Ripple Rejection

VS7815B



Power Dissipation



## 7 Specifications

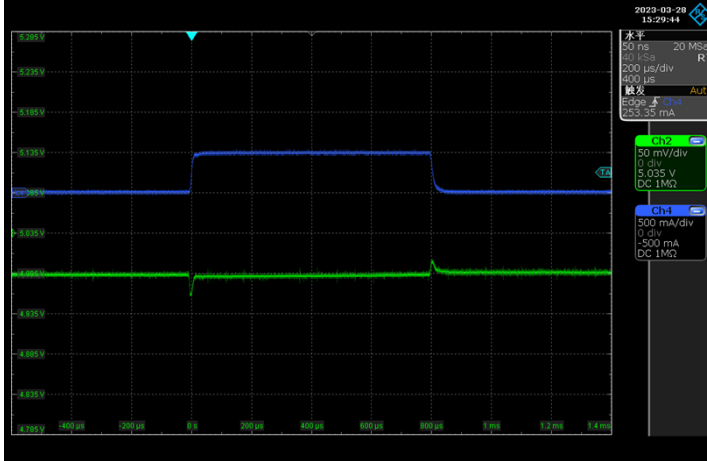
### 7.6 Typical Characteristics (continued)

VS7800B Series ( $V_{IN} = 10V$  for VS7805B,  $V_{IN} = 23V$  for VS7815B,  $I_{OUT} = 500mA$ ,  $C_{IN} = 0.33\mu F$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_A = 25^\circ C$ , unless otherwise specified)

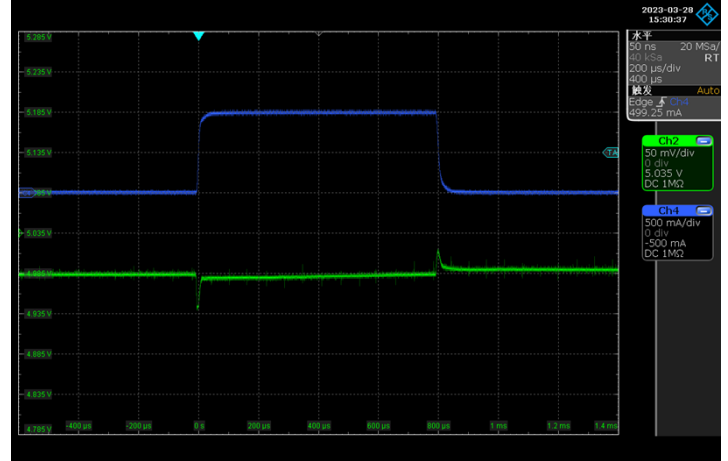
#### Load Transient

VS7805B,  $V_{IN} = 10V$ , CH<sub>2</sub>:  $V_{OUT}$ , CH<sub>4</sub>:  $I_{OUT}$

$I_{OUT} = 10$  to  $500mA$



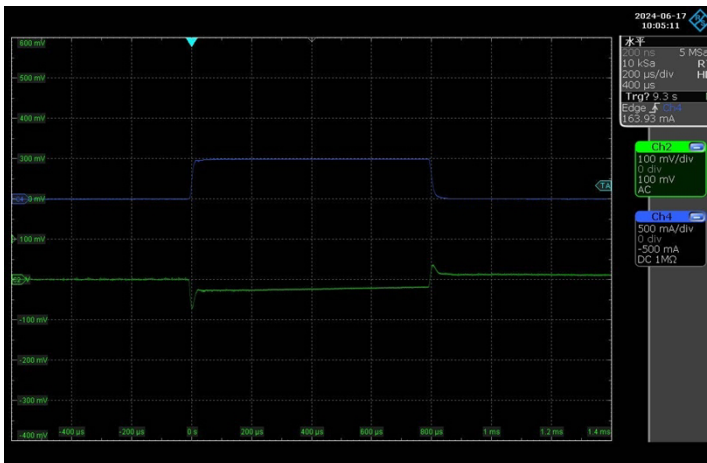
$I_{OUT} = 10$  to  $1000mA$



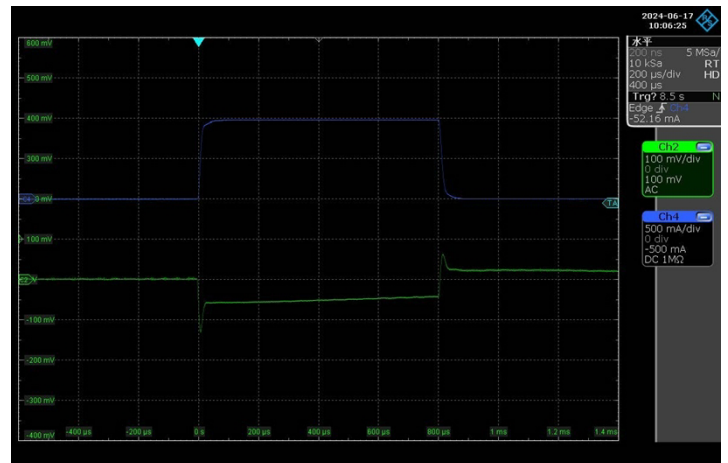
#### Load Transient

VS7815B,  $V_{IN} = 20V$ , CH<sub>2</sub>:  $V_{OUT}$ , CH<sub>4</sub>:  $I_{OUT}$

$I_{OUT} = 10$  to  $500mA$



$I_{OUT} = 10$  to  $1000mA$

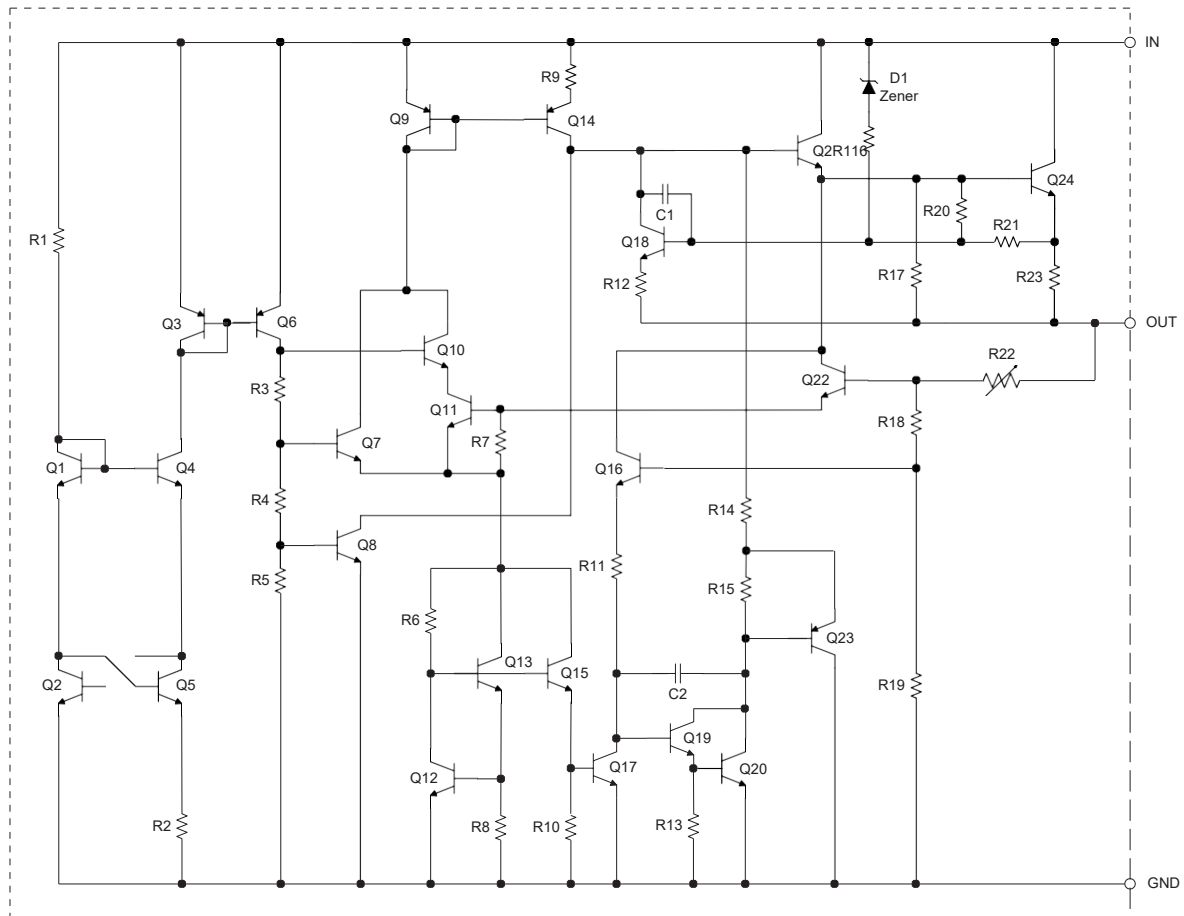


## 8 Detailed Description

### 8.1 Description

The VS7800B series is a group of fixed output positive voltage regulators. It integrates built-in current limit, short-circuit protection, thermal overload protection and safe operating area protection of output transistor, which makes it relatively difficult to be damaged. By setting the resistance value of peripheral resistance, the VS7800B series can also be used as adjustable voltage output regulator.

### 8.2 Representative Schematic Diagram



### 8.3 Feature Description

#### Input Voltage

When the input voltage is lower than the rated range of the data sheet, the device will lose the regulation function of stabilizing the output voltage, that is, it is unable to maintain the output voltage within the rated range. When the input voltage is higher than the rated range of the data sheet, the device may cause irreversible damage or failure due to exceeding the maximum rated range of electrical stress.

#### Built-in Current Limit & Short Circuit Protection

The VS7800B series has built-in current limit and short circuit protection. When the output current of the device is too high, the output of the device will be shut down. When the output of the device is short circuited to ground, the output of the device will also be shut down and the output current will be maintained within a certain range.

The typical current limits for the VS7800B series is 2.2A.



## 8 Detailed Description

### 8.3 Feature Description (continued)

#### Thermal Shutdown Protection

The VS7800B series has thermal shutdown protection. When the junction temperature exceeds the rated temperature range for normal operation in the data sheet, the device will enter the thermal shutdown state. At this time, the output voltage of the device will be reduced to prevent catastrophic damage to the chip due to accidental heat. When the junction temperature decreases and no longer remains too high, the device will release the thermal shutdown and output normally. To ensure reliable operation, please limit the junction temperature to the specified range of recommended operating conditions in the data sheet. Applications that exceed the recommended temperature range may cause the device to exceed its operating specifications.

Although the internal protection circuitry of the device is designed to protect against thermal overall conditions, this circuitry is not intended to replace proper heat sinking. Continuously running the device into thermal shutdown or above the maximum recommended junction temperature reduces long-term reliability.

#### Output Current

Due to the internal integration of thermal shutdown protection, in the case of large output current, the device may enter the thermal shutdown state because the junction temperature is higher than the rated value in the data sheet. Therefore, the appropriate package should be selected for circuit design according to the heat dissipation power consumption of the package and the effective connection thermal resistance with the environment, so as to make the device emit more heat energy, so as to ensure the maximum load current capacity of the device. If the circuit design is appropriate and the device has good heat dissipation conditions, the VS7800B series can output a current of up to 1A.

## 9 Application and Implementation

### 9.1 Risk Alert and Precautions

The VS7800B series is designed with thermal protection, output short circuit protection and output transistor SOA protection. However, like any IC regulator, precautions are necessary to reduce the possibility of accidental damage to the regulator. The following describes the possible causes of unit damage or failure:

#### Electrostatic Discharge (ESD) and Instantaneous Electrical Surge

Electrostatic discharge (ESD) is a common near-field hazard source. It comes from many sources, such as human body, mechanical equipment and electronic components themselves. ESD can cause phenomena such as high voltage and instantaneous high current in a very short time, resulting in damage or failure of the device due to electric shock.

In some applications, a short duration but high energy spike may occur in the circuit, including peak voltage and surge current. They may cause unstable operation of the regulator, accelerated aging and potential hazards, and even damage or malfunction of the regulator. These peaks are usually more likely to occur in hot-plug, switch inductance, heavy-load, and other types of circuits.

#### Precautions for ESD and Electrical Surge

In the practical application of the circuit, adopting the following suggestions can reduce the possibility of device failure due to the above reasons to a certain extent.

Using TVS:

Place a TVS between the IN and GND of the voltage regulator to absorb the peak voltage that may be generated due to ESD or other reasons. As shown in Figure 9-4;

Using Input Resistor:

Place a resistor with appropriate resistance in series before the IN of the voltage regulator, which can help the voltage regulator share part of the energy in case of surge. The resistance value of the resistance should not be too large. The specific resistance value depends on the application of the circuit. Generally, the resistance value of this resistance does not exceed 20Ω. As shown in Figure 9-5;

Using Electrolytic Capacitor:

For the application circuit using the low ESR multilayer ceramic capacitor (MLCC) type input capacitor, the LC resonant voltage spike caused by hot plugging or power transmission line inductance can be suppressed by using RC suppression circuit for parallel connection of the input capacitor. A very simple method is to parallel a suitable electrolytic capacitor to the input capacitor. As shown in Figure 9-6. For most 100μF/25V electrolytic capacitor has an ESR of about 0.2Ω at 100kHz. This can completely suppress the overshoot phenomenon of the input and minimize the possibility of IC damage due to input voltage spikes.

Figure 9-1 and Figure 9-2 show the impact of not using electrolytic capacitor [Test circuit is shown in Figure 9-3 ] and using 100μF/25V electrolytic capacitor parallel to the input capacitor [Test circuit is shown in Figure 9-6 ] on suppressing surge voltage. As shown in Figure 9-1., when the input is powered on from 0 to 10V, a peak voltage of up to 20V (shown in the RED part) is generated in front of the input terminal of the device. When the electrolytic capacitor is used, as shown in Figure 9-2., the peak voltage generated by power on is effectively suppressed (shown in the GREEN part).

## 9 Application and Implementation

### 9.1 Risk Alert and Precautions (continued)

Test Condition: VS7805B,  $C_{IN} = 10\mu\text{F}$  (MLCC),  $C_{OUT} = 100\mu\text{F}$ ,  $V_{IN} = 0 \sim 10\text{V}$ ,  $I_{OUT} = 100\text{mA}$ , CH<sub>1</sub>:  $V_{IN}$ , CH<sub>2</sub>:  $V_{OUT}$ .

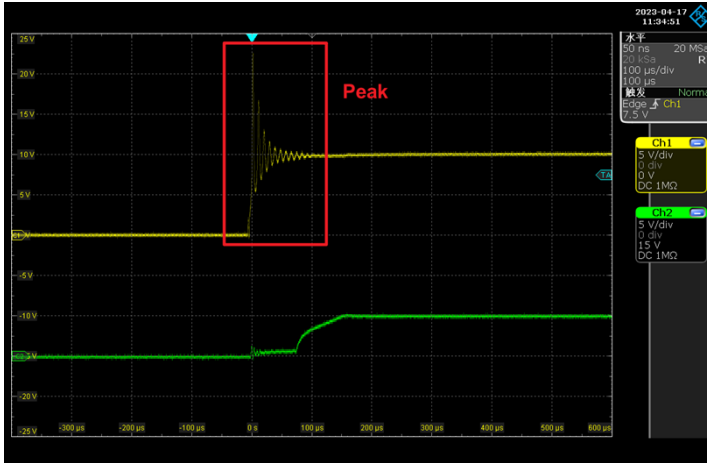


Figure 9-1. Test with the conventional circuit

[Test Circuit is shown in Figure 9-3]

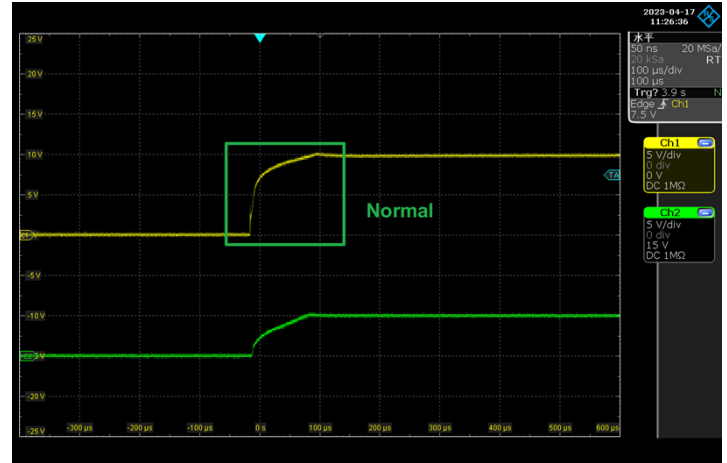


Figure 9-2. Test with the circuit that

a  $100\mu\text{F}/25\text{V}$  electrolytic capacitor parallel to the  $C_{IN}$

[Test Circuit is shown in Figure 9-6]

For the VS7800B series, it is recommended that the input peak voltage should not exceed 36V. When the input voltage of the operating circuit may not meet the application conditions described above, it is recommended to adopt the circuit layout shown in Figure 9-5 in the circuit design.

### Large Output Capacitance

The VS7800B series can obtain better transient response with the help of output capacitance. However, if the output capacitor is relatively large, the surge current generated by the charging of the output capacitor will also be large at the moment of power on of the regulator, and the large surge current passing through the regulator may damage the internal circuit. When the output capacitance is large, adopting the circuit design shown in Figure 9-5 will reduce the possibility of damage to the device due to large surge current to a certain extent. It is recommended that the selection of output capacitor should not exceed  $20\mu\text{F}$ . **If the selection of output capacitor exceeds  $20\mu\text{F}$ , it is recommended to adopt the circuit design in Figure 9-5 to reduce the possibility of accidental failure of the device due to large surge current during power on.**

### 9.2 Typical Application Circuits

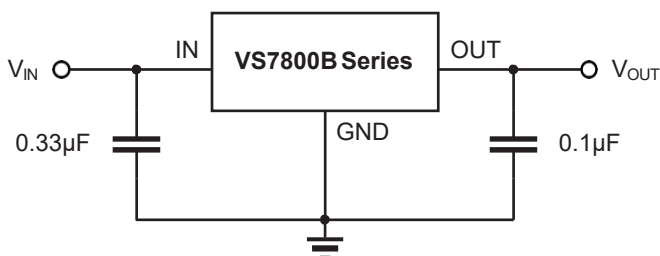


Figure 9-3. Conventional Circuit

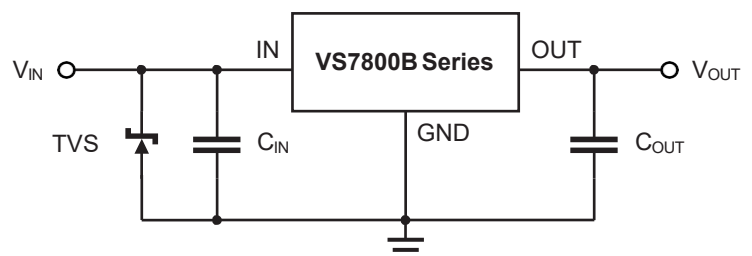


Figure 9-4. TVS is used at IN