

## SG2011

## 300mA , Low Power, Low Dropout, Linear Regulators

### GENERAL DESCRIPTION

The SG2011 low-power, low-dropout, CMOS linear voltage regulators operate from a 2.5V to 5.5V input and deliver up to 300mA. They are perfect choice for low voltage, low power applications. An ultra low ground current (110 $\mu$ A at 300mA output) makes them attractive for battery operated power systems. The SG2011 series also offer ultra low dropout voltage (210mV at 300mA output) to prolong battery life in portable electronics.

The output voltage is preset to voltages in the range of 1.5V to 5.0V. Other features include foldback current limit and thermal shut-down protection.

SG2011 comes in 3-pin SOT23 and 3-pin SOT89 packages.

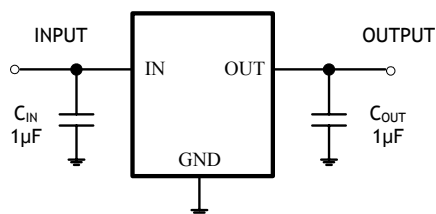
### FEATURES

- Ultra-Low Dropout Voltage:  
210mV at 300mA output
- Low 80 $\mu$ A No-Load Supply Current
- Low 110 $\mu$ A Operating Supply Current  
at 300mA Output
- Thermal-Overload Protection
- Output Current Limit
- Preset Output Voltages ( $\pm 1.8\%$  Accuracy)
- Output Voltage:  
Available in Fixed Outputs of 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, and 3.6V

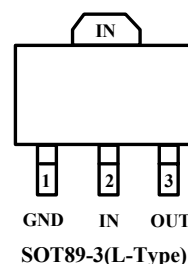
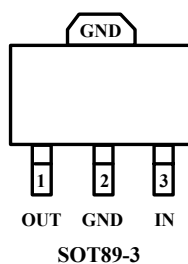
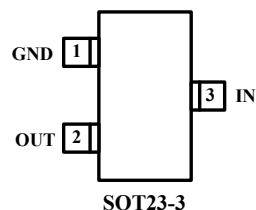
### APPLICATIONS

Cellular Telephones  
Digital Cameras  
MP3、MP4  
USB 2.0  
Modems  
PC Cameras  
Hand-Held Instruments  
Electronic Dictionarys  
Portable/Battery-Powered Equipment

### TYPICAL OPERATION CIRCUIT



### PIN CONFIGURATIONS (TOP VIEW)



## ORDERING INFORMATION

| MODEL      | V <sub>OUT</sub><br>(V) | PIN-<br>PACKAGE | SPECIFIED<br>TEMPERATURE<br>RANGE | ORDERING<br>NUMBER | PACKAGE<br>MARKING | PACKAGE<br>OPTION   |
|------------|-------------------------|-----------------|-----------------------------------|--------------------|--------------------|---------------------|
| SG2011-1.5 | 1.5V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-1.5XN3/TR   | XB15               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-1.5XK3/TR   | SG2011-1.5XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-1.5XK3L/TR  | SG2011-1.5XK3L     | Tape and Reel, 1000 |
| SG2011-1.8 | 1.8V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-1.8XN3/TR   | XB18               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-1.8XK3/TR   | SG2011-1.8XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-1.8XK3L/TR  | SG2011-1.8XK3L     | Tape and Reel, 1000 |
| SG2011-2.5 | 2.5V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-2.5XN3/TR   | XB25               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-2.5XK3/TR   | SG2011-2.5XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-2.5XK3L/TR  | SG2011-2.5XK3L     | Tape and Reel, 1000 |
| SG2011-2.8 | 2.8V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-2.8XN3/TR   | XB28               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-2.8XK3/TR   | SG2011-2.8XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-2.8XK3L/TR  | SG2011-2.8XK3L     | Tape and Reel, 1000 |
| SG2011-3.0 | 3.0V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-3.0XN3/TR   | XB30               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-3.0XK3/TR   | SG2011-3.0XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-3.0XK3L/TR  | SG2011-3.0XK3L     | Tape and Reel, 1000 |
| SG2011-3.3 | 3.3V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-3.3XN3/TR   | XB33               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-3.3XK3/TR   | SG2011-3.3XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-3.3XK3L/TR  | SG2011-3.3XK3L     | Tape and Reel, 1000 |
| SG2011-3.6 | 3.6V                    | SOT23-3         | - 40°C to +125°C                  | SG2011-3.6XN3/TR   | XB36               | Tape and Reel, 3000 |
|            |                         | SOT89-3         |                                   | SG2011-3.6XK3/TR   | SG2011-3.6XK3      | Tape and Reel, 1000 |
|            |                         | SOT89-3(L-Type) |                                   | SG2011-3.6XK3L/TR  | SG2011-3.6XK3L     | Tape and Reel, 1000 |

## ABSOLUTE MAXIMUM RATINGS

IN to GND.....- 0.3V to +6V  
Output Short-Circuit Duration.....Infinite  
OUT to GND.....- 0.3V to (V<sub>IN</sub> + 0.3V)  
Power Dissipation, P<sub>D</sub> @ T<sub>A</sub> = 25°C  
SOT23-3 .....0.4W  
SOT89-3 .....0.571W  
Package Thermal Resistance  
SOT23-3, θ<sub>JA</sub>..... 250°C/W

SOT89-3, θ<sub>JA</sub>.....175°C/W  
Operating Temperature Range.....- 40°C to +125°C  
Junction Temperature.....+150°C  
Storage Temperature.....- 65°C to +150°C  
Lead Temperature (soldering, 10s).....260°C  
ESD Susceptibility  
HBM.....7000V  
MM.....400V

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## PIN DESCRIPTION

| NAME | FUNCTION                                                        |
|------|-----------------------------------------------------------------|
| IN   | Regulator Input.<br>Supply voltage can range from 2.5V to 5.5V. |
| GND  | Ground.                                                         |
| OUT  | Regulator Output.                                               |

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = V_{OUT (NOMINAL)} + 0.5V$  or  $2.5V$  (whichever is greater),  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .)

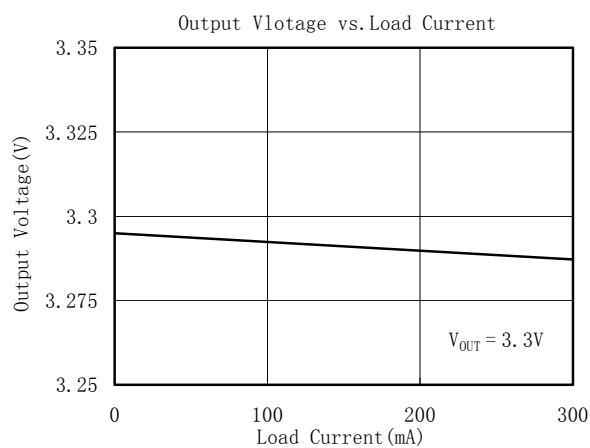
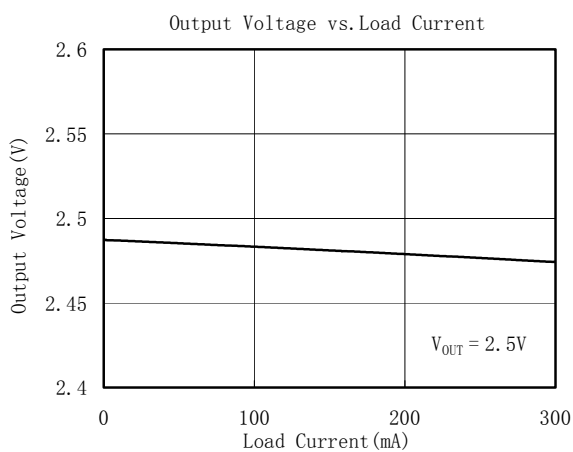
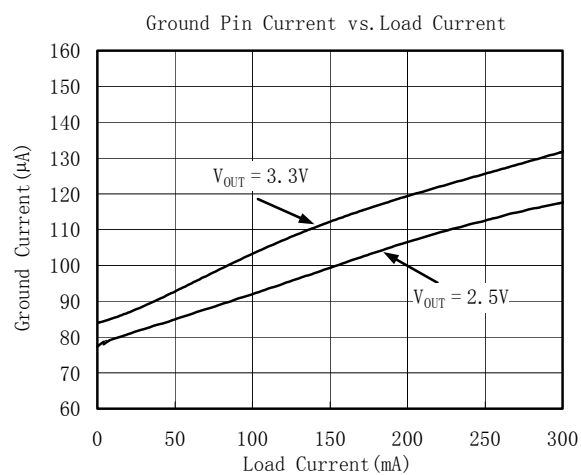
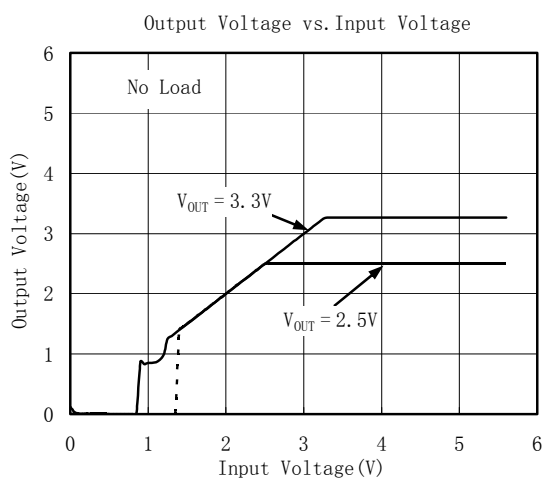
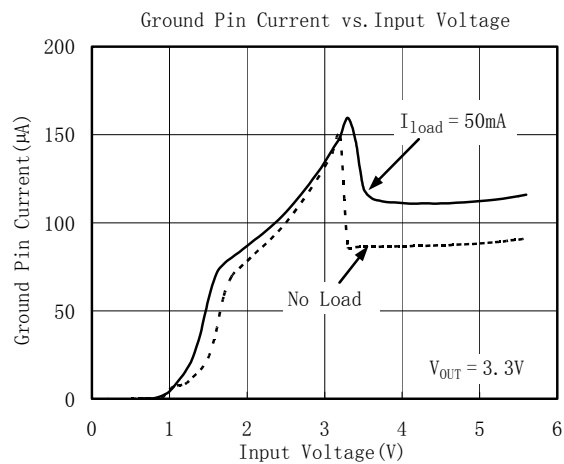
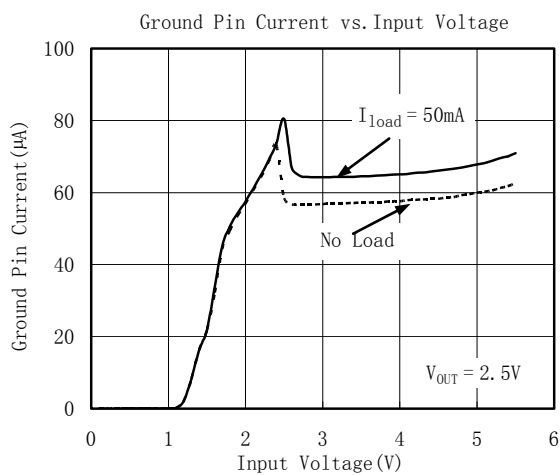
| PARAMETER                    | SYMBOL             | CONDITIONS                                                                             |            | MIN  | TYP    | MAX   | UNITS |
|------------------------------|--------------------|----------------------------------------------------------------------------------------|------------|------|--------|-------|-------|
| Input Voltage                | V <sub>IN</sub>    |                                                                                        |            | 2.5  |        | 5.5   | V     |
| Output Voltage Accuracy      |                    | I <sub>OUT</sub> = 0.1mA, T <sub>A</sub> = +25°C                                       |            | -1.8 |        | 1.8   | %     |
|                              |                    | I <sub>OUT</sub> = 0.1mA to 300mA,<br>T <sub>A</sub> = 0°C to +70°C                    |            |      |        | 2.5   |       |
|                              |                    | I <sub>OUT</sub> = 0.1mA to 300mA,<br>T <sub>A</sub> = - 40°C to +125°C                |            |      |        | 2.9   |       |
| Output Current               |                    |                                                                                        |            | 300  |        |       | mA    |
| Current Limit                | I <sub>LIM</sub>   |                                                                                        |            | 310  | 750    |       | mA    |
| Ground Pin Current           | I <sub>Q</sub>     | No load                                                                                |            |      | 80     | 140   | μA    |
|                              |                    | I <sub>OUT</sub> = 300mA                                                               |            |      | 110    |       |       |
| Dropout Voltage(Note1)       |                    | I <sub>OUT</sub> = 1mA                                                                 |            |      | 0.8    |       | mV    |
|                              |                    | I <sub>OUT</sub> = 300mA                                                               |            |      | 210    | 340   |       |
| Line Regulation              | ΔV <sub>LNR</sub>  | V <sub>IN</sub> = 2.5V or (V <sub>OUT</sub> + 0.1V) to 5.5V,<br>I <sub>OUT</sub> = 1mA |            |      | 0.004  | 0.15  | %/V   |
| Load Regulation              | ΔV <sub>LDR</sub>  | I <sub>OUT</sub> = 0.1mA to 300mA, C <sub>OUT</sub> = 1μF                              |            |      | 0.0005 | 0.002 | %/mA  |
| Output Voltage Noise         | e <sub>n</sub>     | f = 10Hz to 100KHz, C <sub>OUT</sub> = 10μF                                            |            |      | 120    |       | μVRMS |
| Power Supply Rejection Rate  | PSRR               | I <sub>LOAD</sub> = 50mA, C <sub>OUT</sub> = 1μF                                       | f = 100Hz, |      | 74     |       | dB    |
|                              |                    |                                                                                        | f = 1KHz,  |      | 54     |       | dB    |
| THERMAL PROTECTION           |                    |                                                                                        |            |      |        |       |       |
| Thermal Shutdown Temperature | T <sub>SHDN</sub>  |                                                                                        |            |      | 160    |       | °C    |
| Thermal Shutdown Hysteresis  | ΔT <sub>SHDN</sub> |                                                                                        |            |      | 15     |       | °C    |

Specifications subject to change without notice.

**Note 1:** The dropout voltage is defined as  $V_{IN} - V_{OUT}$ , when  $V_{OUT}$  is 100mV below the value of  $V_{OUT}$  for  $V_{IN} = V_{OUT} + 0.5V$ . (Only applicable for  $V_{OUT} = +2.5V$  to  $+5.0V$ )

## TYPICAL OPERATING CHARACTERISTICS

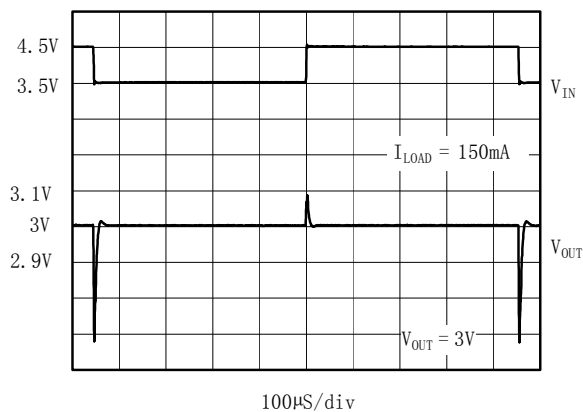
$V_{IN} = V_{OUT(NOMINAL)} + 0.5V$  or  $2.5V$  (whichever is greater),  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.



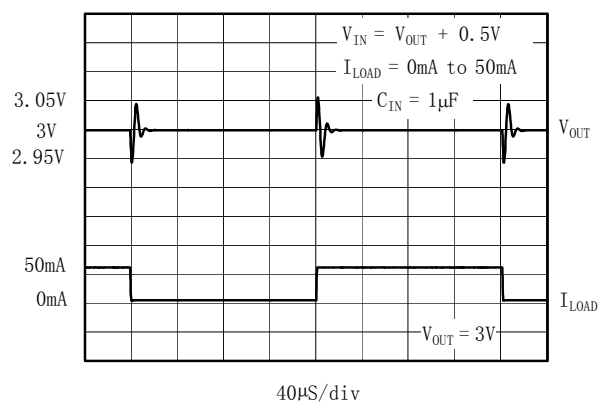
## TYPICAL OPERATING CHARACTERISTICS

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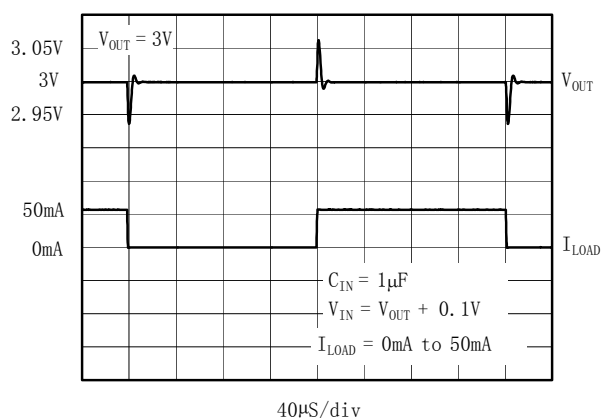
Line-Transient Response



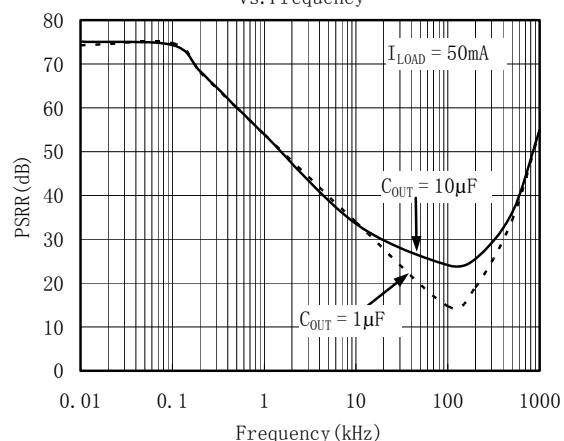
Load-Transient Response



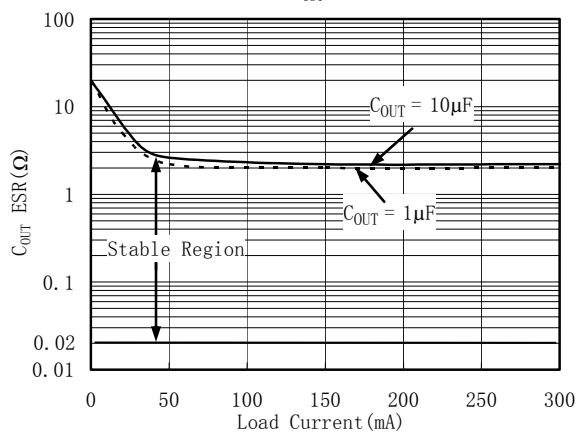
Load-Transient Response Near Dropout



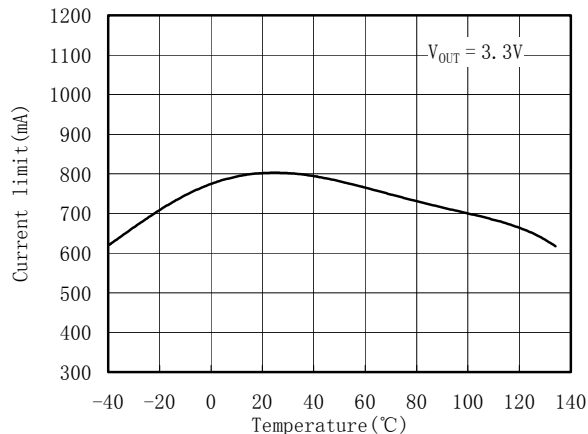
Power-Supply Rejection Ratio vs. Frequency



Region of Stable  $C_{OUT}$  ESR vs. Load Current

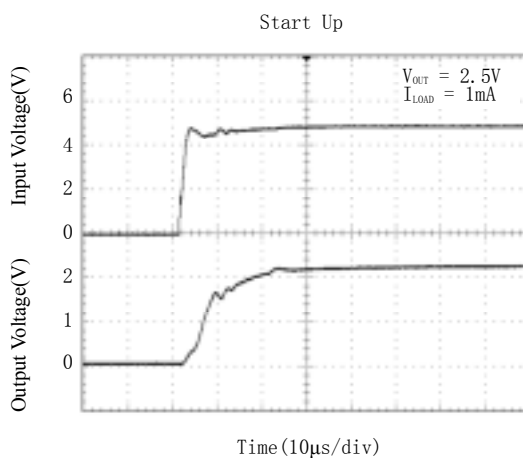
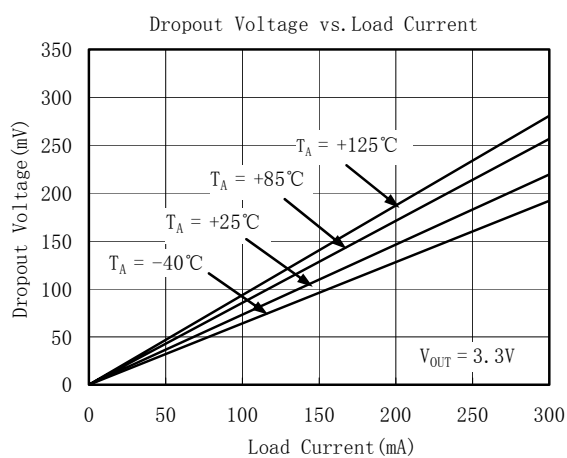
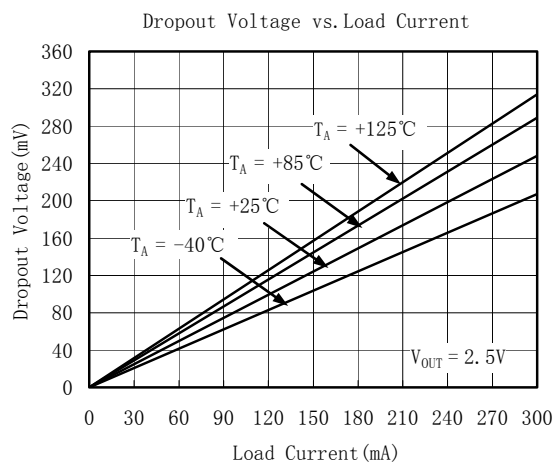
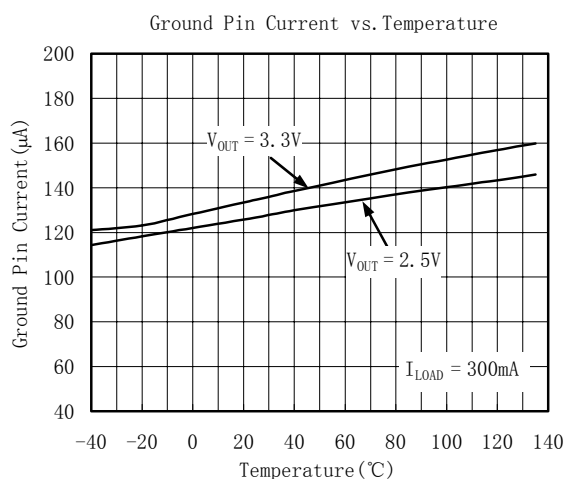
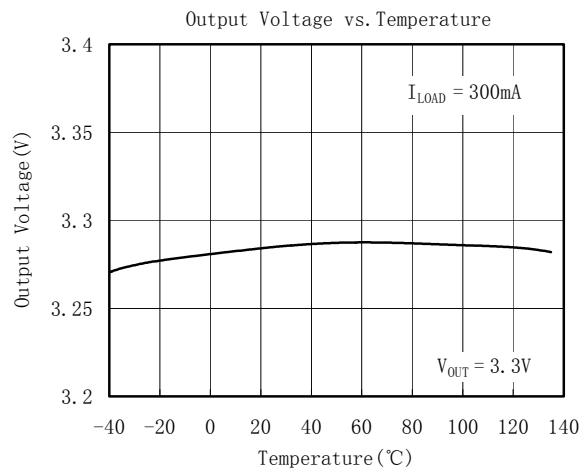
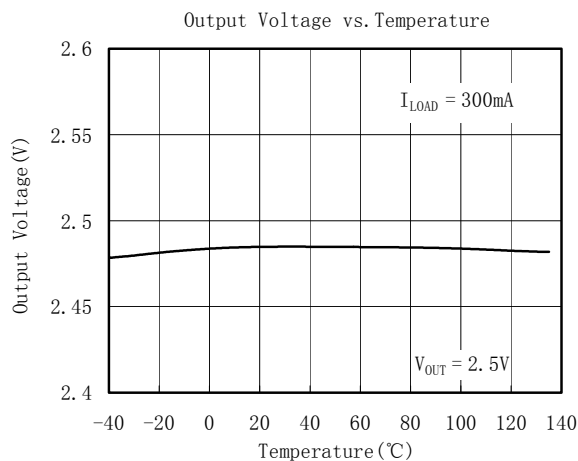


Current limit vs. Temperature



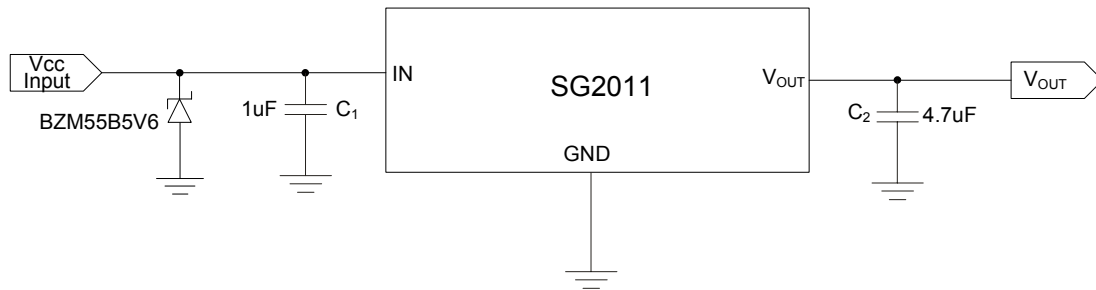
## TYPICAL OPERATING CHARACTERISTICS

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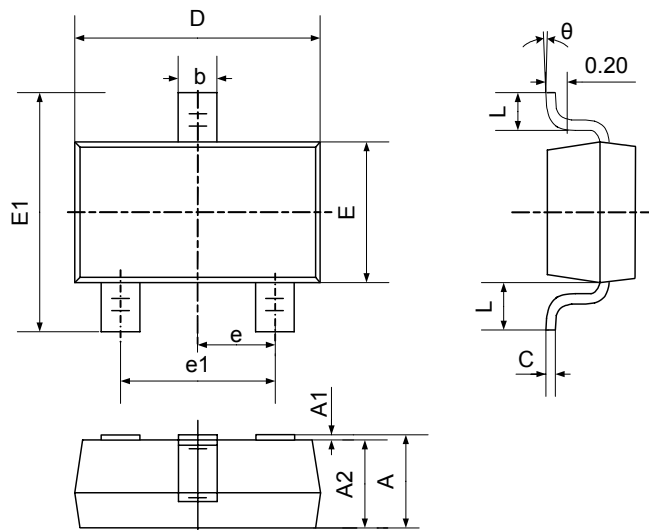
## Application Notes

When LDO is used in handheld products, Attention must be paid to voltage spike which would damage SG2011. In such applications, voltage spike will be generated at charger interface and  $V_{BUS}$  pin of USB interface when charger adapters and USB equipments are hot-inserted. Besides this, handheld products will be tested on the production line on the condition of no battery. Test Engineer will apply power from the connector pin which connects with positive pole of the battery. When external power supply is turned on suddenly, the voltage spike will be generated at the battery connector. The voltage spike will be very high, it always exceeds the absolute maximum input voltage (6.0V) of LDO. In order to get robust design. Design Engineer needs to clear up this voltage spike. Zener diode is a cheap and effective solution to eliminate such voltage spike. For example, BZM55B5V6 is a 5.6V small package Zener diode which can be used to remove voltage spike in cell phone design. The schematic is shown in below:



## PACKAGE OUTLINE DIMENSIONS

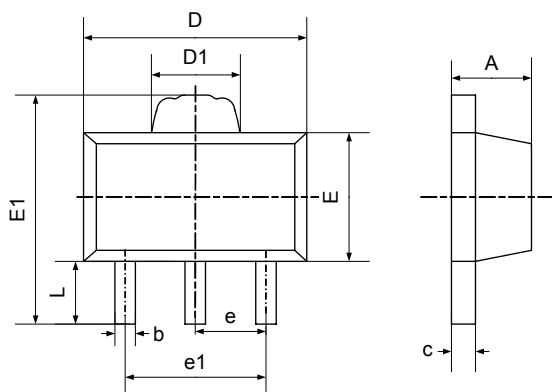
### SOT23-3



| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | Min                          | Max   | Min                     | Max   |
| A      | 1.050                        | 1.250 | 0.041                   | 0.049 |
| A1     | 0.000                        | 0.100 | 0.000                   | 0.004 |
| A2     | 1.050                        | 1.150 | 0.041                   | 0.045 |
| b      | 0.300                        | 0.400 | 0.012                   | 0.016 |
| c      | 0.100                        | 0.200 | 0.004                   | 0.008 |
| D      | 2.820                        | 3.020 | 0.111                   | 0.119 |
| E      | 1.500                        | 1.700 | 0.059                   | 0.067 |
| E1     | 2.650                        | 2.950 | 0.104                   | 0.116 |
| e      | 0.950TYP                     |       | 0.037TYP                |       |
| e1     | 1.800                        | 2.000 | 0.071                   | 0.079 |
| L      | 0.700REF                     |       | 0.028REF                |       |
| L1     | 0.300                        | 0.600 | 0.012                   | 0.024 |
| θ      | 0°                           | 8°    | 0°                      | 8°    |

## PACKAGE OUTLINE DIMENSIONS

### SOT89-3



| Symbol | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|--------|------------------------------|-------|-------------------------|-------|
|        | Min                          | Max   | Min                     | Max   |
| A      | 1.400                        | 1.600 | 0.055                   | 0.063 |
| b      | 0.320                        | 0.520 | 0.013                   | 0.020 |
| b1     | 0.360                        | 0.560 | 0.014                   | 0.022 |
| c      | 0.350                        | 0.440 | 0.014                   | 0.017 |
| D      | 4.400                        | 4.600 | 0.173                   | 0.181 |
| D1     | 1.400                        | 1.800 | 0.055                   | 0.071 |
| E      | 2.300                        | 2.600 | 0.091                   | 0.102 |
| E1     | 3.940                        | 4.250 | 0.155                   | 0.167 |
| e      | 1.500TYP                     |       | 0.060TYP                |       |
| e1     | 2.900                        | 3.100 | 0.114                   | 0.122 |
| L      | 0.900                        | 1.100 | 0.035                   | 0.043 |

## REVISION HISTORY

| Location                                            | Page |
|-----------------------------------------------------|------|
| 9/05— Data Sheet changed from preliminary to REV. A |      |
| 12/06— Data Sheet changed from REV. A to REV. B     |      |
| Changed to ABSOLUTE MAXIMUM RATINGS .....           | 2    |
| Added Application Notes .....                       | 7    |

### Shengbang Microelectronics Co, Ltd

Unit 3, ChuangYe Plaza  
No.5, TaiHu Northern Street, YingBin Road Centralized Industrial Park  
Harbin Development Zone  
Harbin, HeiLongJiang 150078  
P.R. China  
Tel.: 86-451-84348461  
Fax: 86-451-84308461  
[www.sg-micro.com](http://www.sg-micro.com)