# SGM2013
# 300mA, Low Power, Low Dropout, 3-Terminal, Linear Regulators

## GENERAL DESCRIPTION

The SGM2013 series low power, low noise, low dropout, CMOS linear voltage regulators operate from a 2.5V to 5.5V input voltage. They are the perfect choice for low voltage, low power applications. A low ground current makes this part attractive for battery operated power systems. The SGM2013 series also offer low dropout voltage to prolong battery life in portable electronics.

The SGM2013 features include output current limit and thermal shutdown protection.

SGM2013 operates over an ambient temperature range of -40℃ to +125℃. It comes in a Green SOT-89-3 package.

## FEATURES

- **Low Output Noise**
- **Low Dropout Voltage**
- **Maximum Output Current: 300mA**
- **Thermal-Overload Protection**
- **Output Current Limit**
- **Available Fixed Output Voltages: 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V and 3.3V**
- **Available in a Green SOT-89-3 Package**

## APPLICATIONS

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

## TYPICAL APPLICATION

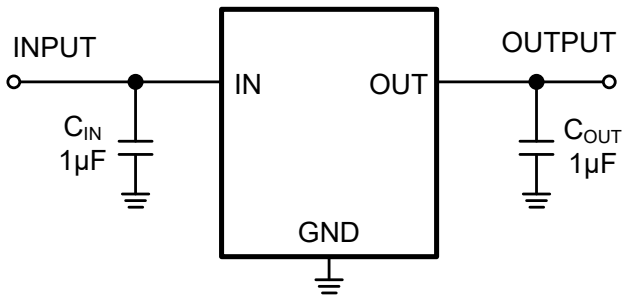



**Figure 1. Typical Application Circuit**

# PACKAGE/ORDERING INFORMATION

| MODEL | $V_{OUT}$ (V) | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|---|
| SGM2013-1.2 | 1.2V | SOT-89-3 | -40℃ to +125℃ | SGM2013-1.2XK3/TR | SGM2013-1.2XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-1.2XK3L/TR | SGM2013-1.2XK3L | Tape and Reel, 1000 |
| SGM2013-1.5 | 1.5V | SOT-89-3 | -40℃ to +125℃ | SGM2013-1.5XK3/TR | SGM2013-1.5XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-1.5XK3L/TR | SGM2013-1.5XK3L | Tape and Reel, 1000 |
| SGM2013-1.8 | 1.8V | SOT-89-3 | -40℃ to +125℃ | SGM2013-1.8XK3/TR | SGM2013-1.8XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-1.8XK3L/TR | SGM2013-1.8XK3L | Tape and Reel, 1000 |
| SGM2013-2.5 | 2.5V | SOT-89-3 | -40℃ to +125℃ | SGM2013-2.5XK3/TR | SGM2013-2.5XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-2.5XK3L/TR | SGM2013-2.5XK3L | Tape and Reel, 1000 |
| SGM2013-2.8 | 2.8V | SOT-89-3 | -40℃ to +125℃ | SGM2013-2.8XK3/TR | SGM2013-2.8XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-2.8XK3L/TR | SGM2013-2.8XK3L | Tape and Reel, 1000 |
| SGM2013-3.0 | 3.0V | SOT-89-3 | -40℃ to +125℃ | SGM2013-3.0XK3/TR | SGM2013-3.0XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-3.0XK3L/TR | SGM2013-3.0XK3L | Tape and Reel, 1000 |
| SGM2013-3.3 | 3.3V | SOT-89-3 | -40℃ to +125℃ | SGM2013-3.3XK3/TR | SGM2013-3.3XK3 | Tape and Reel, 1000 |
| | | SOT-89-3 (L-Type) | -40℃ to +125℃ | SGM2013-3.3XK3L/TR | SGM2013-3.3XK3L | Tape and Reel, 1000 |

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

IN to GND ..... 0.3V to 6V
Output Short-Circuit Duration ..... Infinite
OUT to GND ..... -0.3V to ($V_{IN}$ + 0.3V)
Power Dissipation, $P_D$ @ $T_A$ = +25℃
SOT-89-3 ..... 0.571W
Package Thermal Resistance
SOT-89-3, $\theta_{JA}$ ..... 175℃/W
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM ..... 4000V
MM ..... 400V

## RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +125℃

## OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

## ESD SENSITIVITY CAUTION

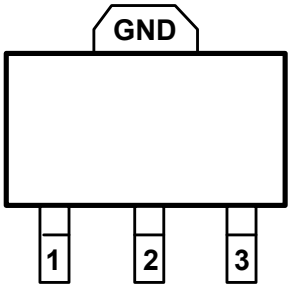
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

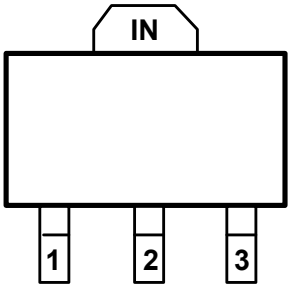
## PIN CONFIGURATIONS

(TOP VIEW)




SOT-89-3

(TOP VIEW)




SOT-89-3 (L-Type)

## PIN DESCRIPTION

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| SOT-89-3 | SOT-89-3 (L-Type) | | |
| 1 | 3 | OUT | Regulator Output. |
| 2 | 1 | GND | Ground. |
| 3 | 2 | IN | Regulator Input. Supply voltage can range from 2.5V to 5.5V. |

## ELECTRICAL CHARACTERISTICS

($V_{IN}$ = $V_{OUT\ (NOMINAL)}$ + 0.5V or 2.5V, whichever is greater, $T_A$ = +25℃, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | | 2.5 | | 5.5 | V |
| Output Voltage Accuracy | | $I_{OUT}$ = 0.1mA | | -2.5 | | 2.5 | % |
| Maximum Output Current | | | | 300 | | | mA |
| Current Limit | $I_{LIM}$ | | | 310 | 500 | | mA |
| Ground Pin Current | $I_Q$ | No load, EN = 2V | | | 100 | 200 | μA |
| Dropout Voltage (1) | | $I_{OUT}$ = 1mA | | | 0.9 | | mV |
| | | $I_{OUT}$ = 300mA | | | 270 | 400 | |
| Line Regulation | $\Delta V_{LNR}$ | $V_{IN}$ = 2.5V or ($V_{OUT}$ + 0.5V) to 5.5V, $I_{OUT}$ = 1mA | | | 0.02 | 0.05 | %/V |
| Load Regulation | $\Delta V_{LDR}$ | $I_{OUT}$ = 0.1mA to 300mA, $C_{OUT}$ = 1μF, $V_{OUT}$ > 2V | | | 0.002 | 0.005 | %/mA |
| | | $I_{OUT}$ = 0.1mA to 300mA, $C_{OUT}$ = 1μF, $V_{OUT}$ ≤ 2V | | | 0.004 | 0.008 | |
| Output Voltage Noise | $e_n$ | f = 10Hz to 100kHz, $C_{OUT}$ = 10μF | | | 140 | | $\mu V_{RMS}$ |
| Power Supply Rejection Ratio | PSRR | $I_{OUT}$ = 50mA, $C_{OUT}$ = 1μF, $V_{IN}$ = $V_{OUT}$ + 1V | f = 217Hz | | 72 | | dB |
| | | | f = 1kHz | | 72 | | dB |
| **THERMAL PROTECTION** | | | | | | | |
| Thermal Shutdown Temperature | $T_{SHDN}$ | | | | 150 | | ℃ |
| Thermal Shutdown Hysteresis | $\Delta T_{SHDN}$ | | | | 15 | | ℃ |

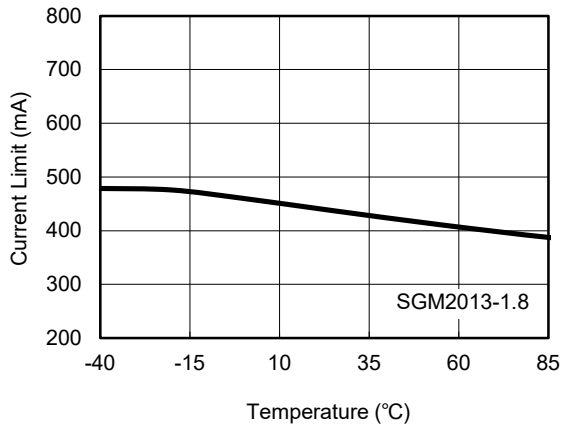
NOTE:

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).

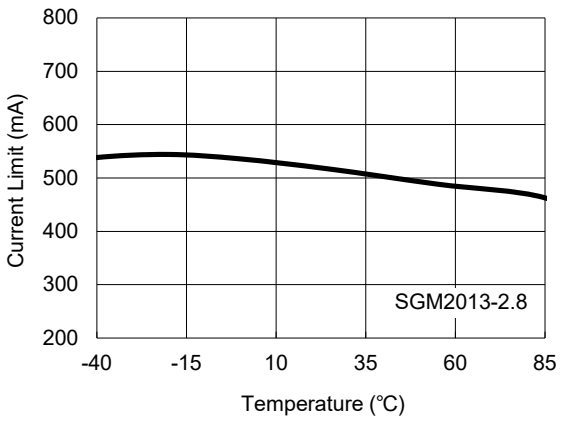
## TYPICAL PERFORMANCE CHARACTERISTICS

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

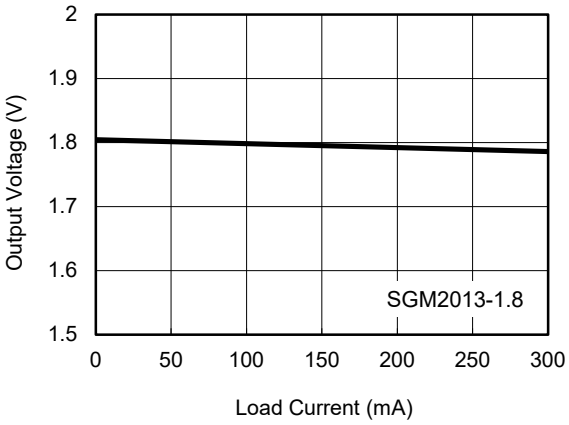
Current Limit vs. Temperature



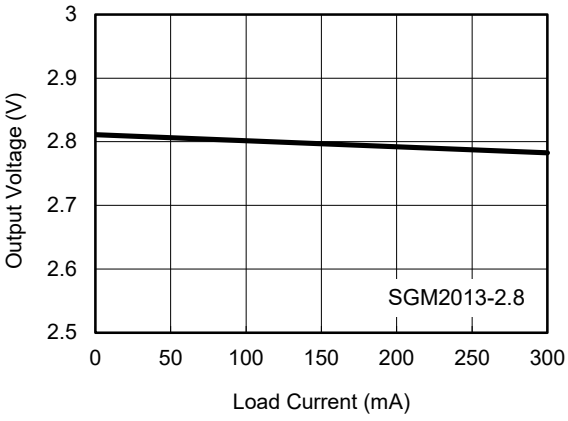

Current Limit vs. Temperature



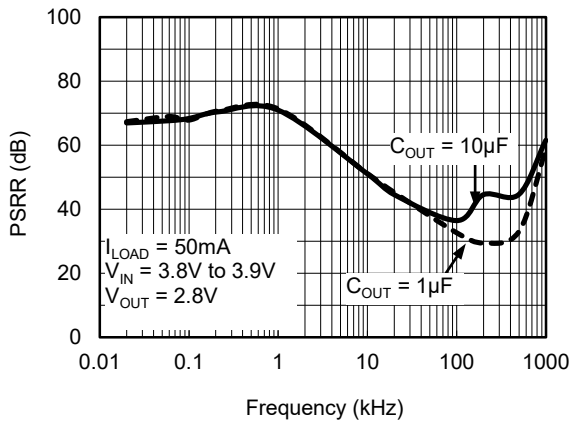

Output Voltage vs. Load Current



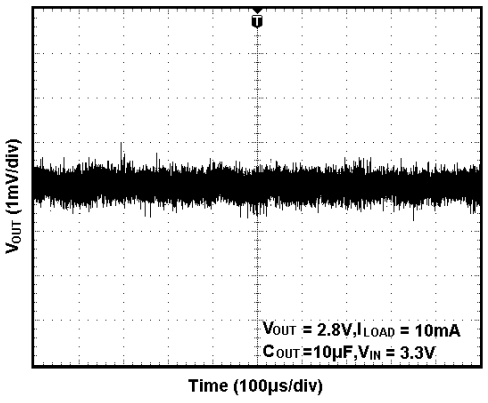

Output Voltage vs. Load Current




Power Supply Rejection Ratio vs. Frequency



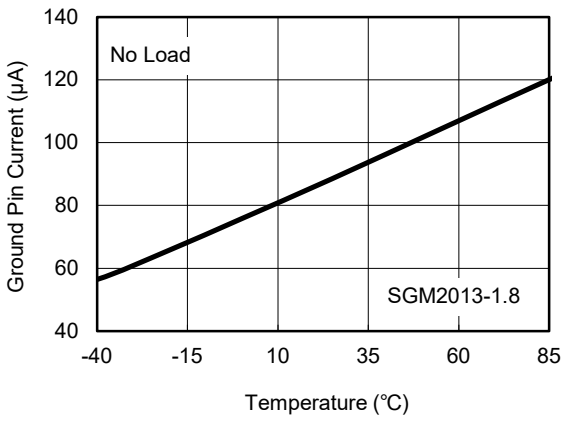

Output Noise 10Hz to 100kHz



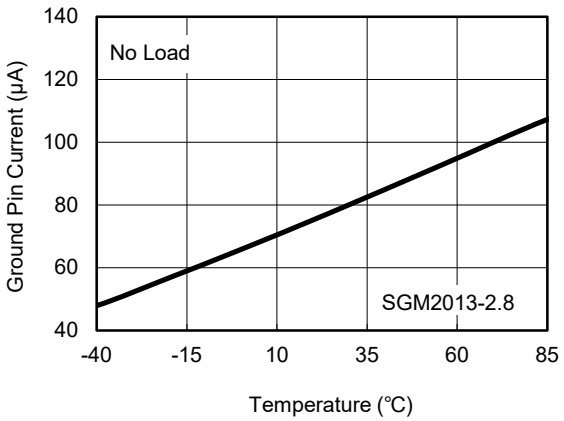
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

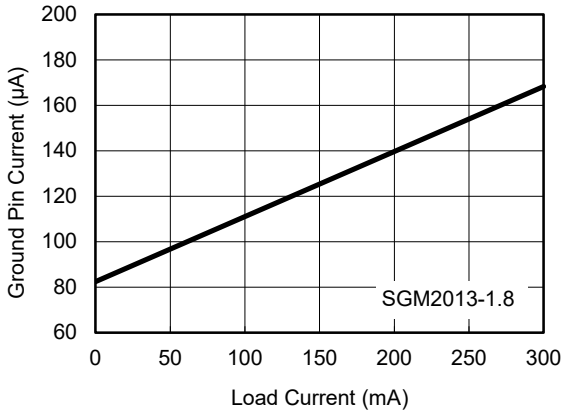
Ground Pin Current vs. Temperature




Ground Pin Current vs. Temperature




Ground Pin Current vs. Load Current

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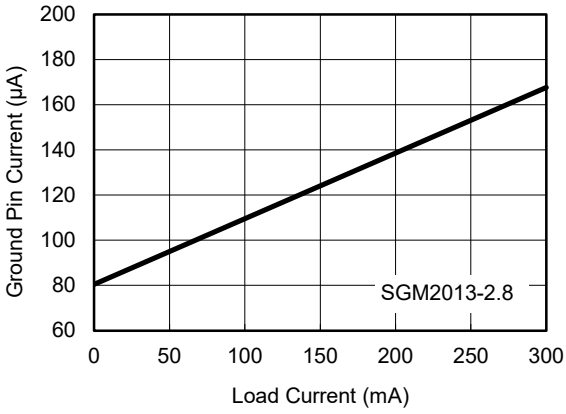
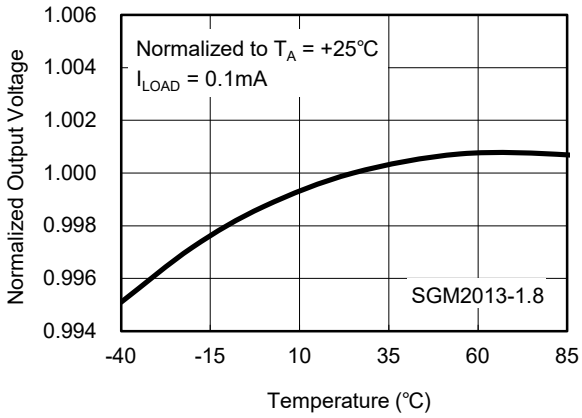
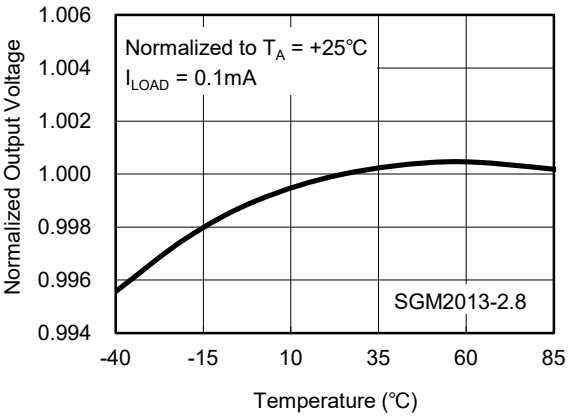



Normalized Output Voltage vs. Temperature




Normalized Output Voltage vs. Temperature



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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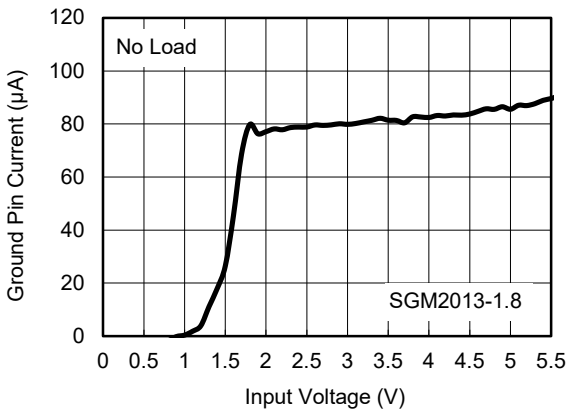
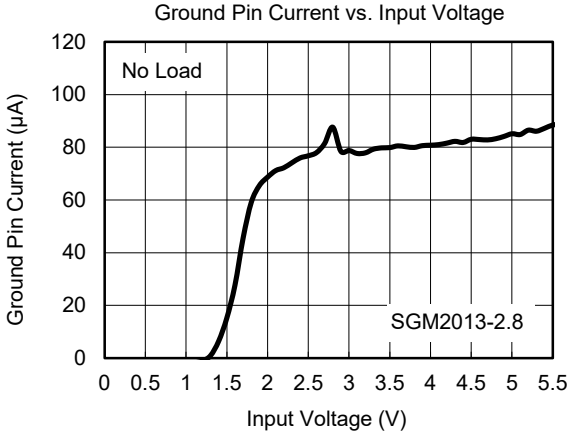
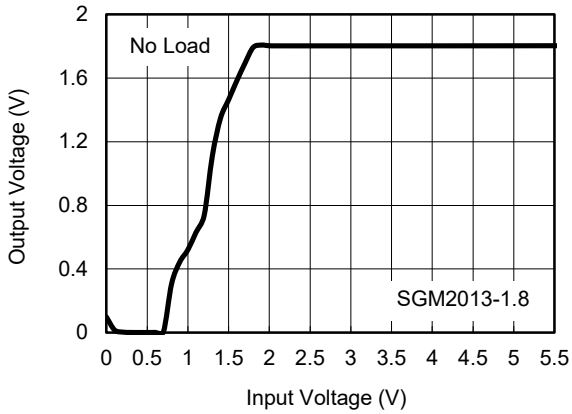
Ground Pin Current vs. Input Voltage



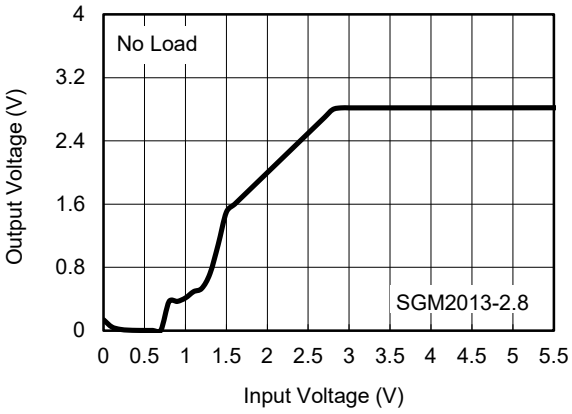

Ground Pin Current vs. Input Voltage



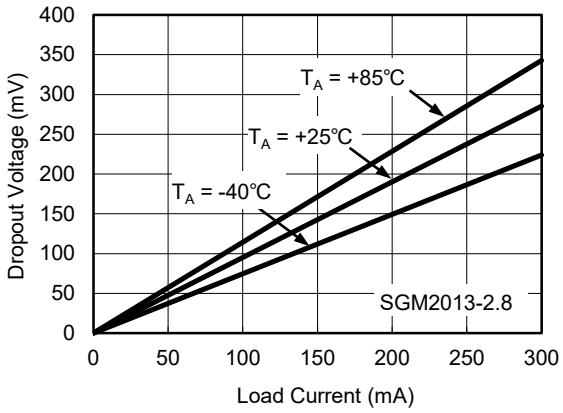

Output Voltage vs. Input Voltage



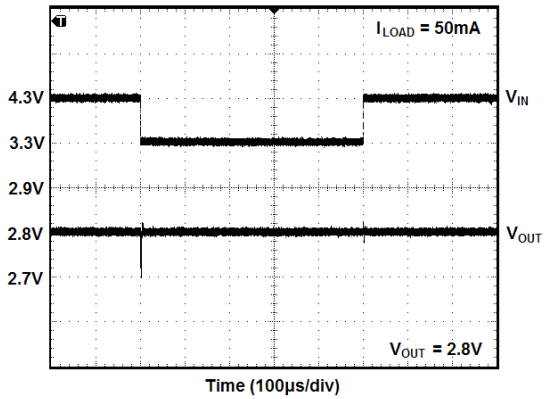

Output Voltage vs. Input Voltage




Dropout Voltage vs. Load Current



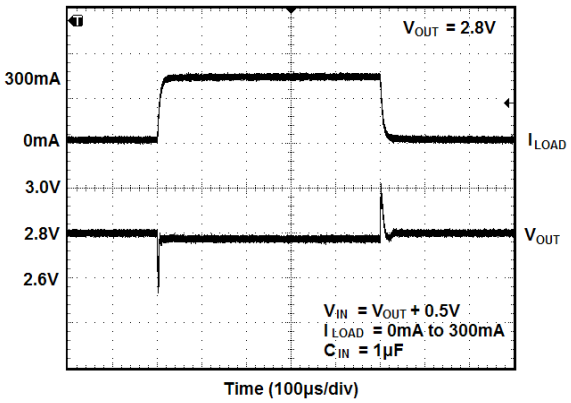

Line-Transient Response



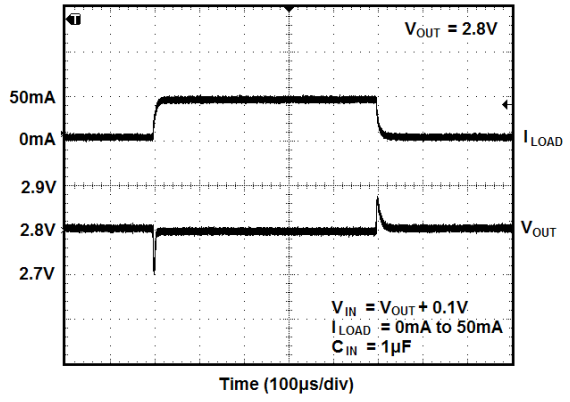
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

Load-Transient Response

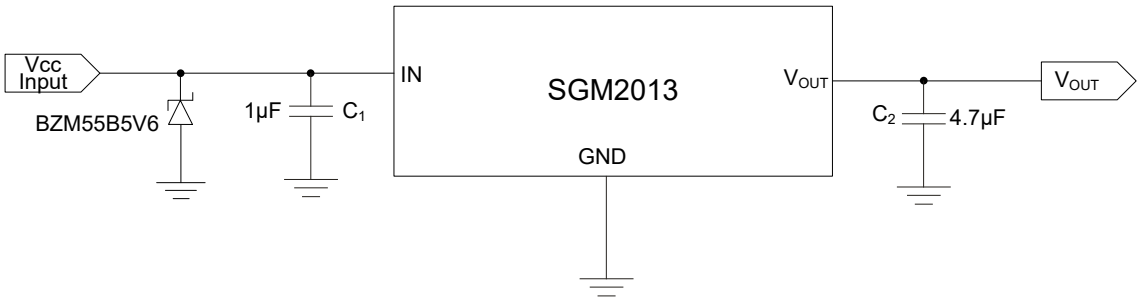



Load-Transient Response Near Dropout



## APPLICATION NOTE

When LDO is used in handheld products, attention must be paid to voltage spikes which could damage SGM2013. In such applications, voltage spikes will be generated at charger interface and $V_{BUS}$ pin of USB interface when charger adapters and USB equipments are hot-plugged. Besides this, handheld products will be tested on the production line without 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 spikes will be generated at the battery connector. The voltage spikes will be very high, and 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 spikes in cell phone designs. The schematic is shown below.




## REVISION HISTORY

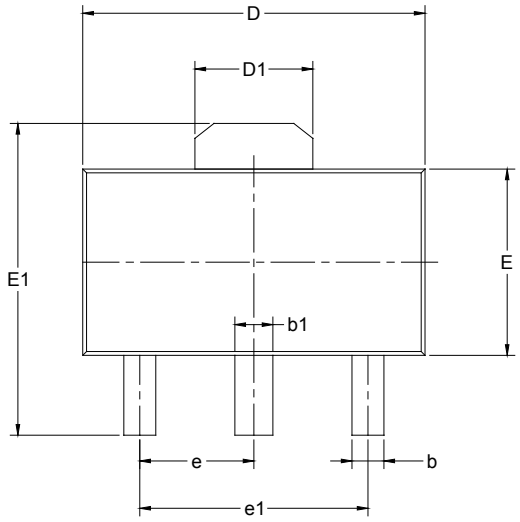
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

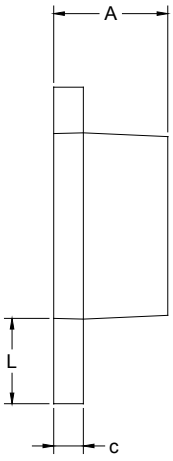
**APRIL 2016 – REV.C.4 to REV.D**

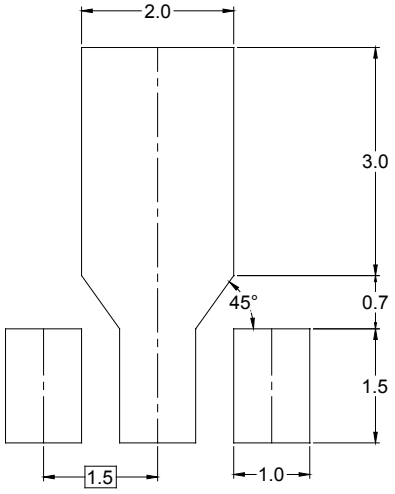
Changed the Normalized Output Voltage vs. Temperature curves ..... 7

# PACKAGE OUTLINE DIMENSIONS

## SOT-89-3



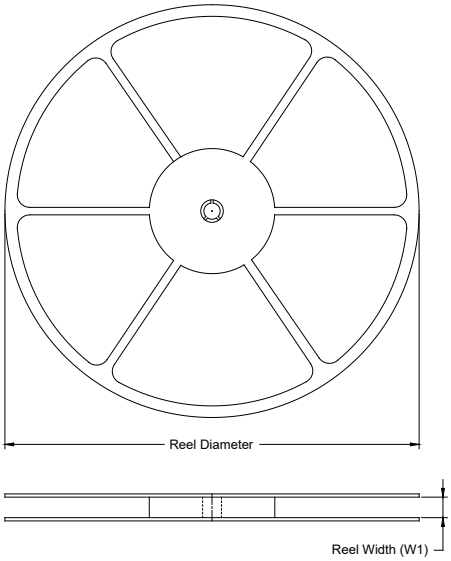




**RECOMMENDED LAND PATTERN** (Unit: mm)

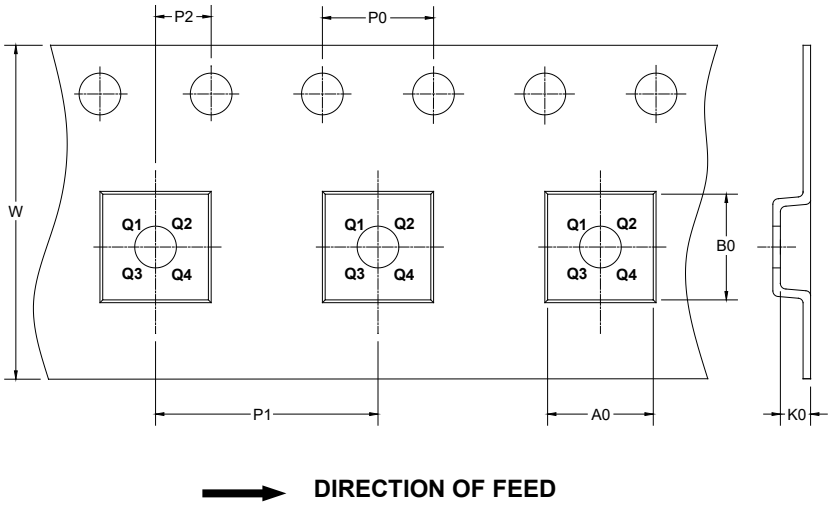
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.400 | 1.600 | 0.055 | 0.063 |
| b | 0.320 | 0.520 | 0.013 | 0.020 |
| b1 | 0.400 | 0.580 | 0.016 | 0.023 |
| c | 0.350 | 0.440 | 0.014 | 0.017 |
| D | 4.400 | 4.600 | 0.173 | 0.181 |
| D1 | 1.550 REF | | 0.061 REF | |
| E | 2.300 | 2.600 | 0.091 | 0.102 |
| E1 | 3.940 | 4.250 | 0.155 | 0.167 |
| e | 1.500 TYP | | 0.060 TYP | |
| e1 | 3.000 TYP | | 0.118 TYP | |
| L | 0.900 | 1.200 | 0.035 | 0.047 |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS



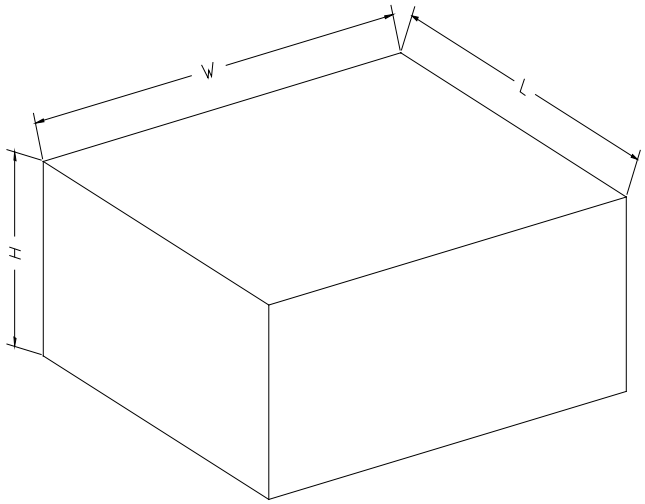

NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|
| SOT-89-3 | 7″ | 13.2 | 4.85 | 4.45 | 1.85 | 4.0 | 8.0 | 2.0 | 12.0 | Q3 |

DD0001

## CARTON BOX DIMENSIONS




NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|---|---|---|---|---|
| 7″ (Option) | 368 | 227 | 224 | 8 |
| 7″ | 442 | 410 | 224 | 18 |

DD0002