



# SGM2028

## 500mA, Ultra Low Dropout, Low Power, RF Linear Regulators

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### GENERAL DESCRIPTION

The SGM2028 is a low-power, low-noise, low-dropout, CMOS linear voltage regulator that operates from a 2.5V to 5.5V input voltage. It is the perfect choice for low voltage, low power applications. A low ground current makes this part attractive for battery operated power systems. The SGM2028 also offers ultra low dropout voltage to prolong battery life in portable electronics. Systems requiring a quiet voltage source, such as RF applications, will benefit from the SGM2028's ultra low output noise ( $30\mu\text{V}_{\text{RMS}}$ ) and high PSRR. An external noise bypass capacitor connected to the device's BP pin can further reduce the noise level.

Other features include output current limit and thermal shutdown protection.

The SGM2028 is available in Green SOT-23-5 package. It operates over an ambient temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

### FEATURES

- **500mA Guaranteed Output Current**
- **Ultra Low Dropout Voltage**
- **Low Output Noise**
- **Thermal-Overload Protection**
- **Output Current Limit**
- **High PSRR (73dB at 1kHz)**
- **SGM2028-2.8, SGM2028-3.0 and SGM2028-ADJ: 110k $\Omega$  Pull Down Resistor at EN Pin**
- **SGM2028-3.3: No Pull Down Resistor at EN Pin**
- **Available Fixed Output Voltages: 2.8V, 3.0V and 3.3V**
- **Adjustable Output from 1.2V to 5.0V**
- **$-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  Operating Temperature Range**
- **Available in Green SOT-23-5 Package**

### APPLICATIONS

Cellular Telephones  
Cordless Telephones  
PCMCIA Cards  
Modems  
MP3 Player  
Hand-Held Instruments  
Palmtop Computers  
Electronic Planners  
Portable/Battery-Powered Equipment

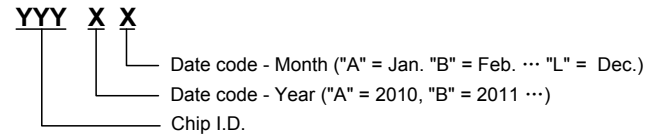
**PACKAGE/ORDERING INFORMATION**

| MODEL       | V <sub>OUT</sub> (V) | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER    | PACKAGE MARKING | PACKING OPTION      |
|-------------|----------------------|---------------------|-----------------------------|--------------------|-----------------|---------------------|
| SGM2028-2.8 | 2.8                  | SOT-23-5            | -40°C to +85°C              | SGM2028-2.8YN5G/TR | S58XX           | Tape and Reel, 3000 |
| SGM2028-3.0 | 3.0                  | SOT-23-5            | -40°C to +85°C              | SGM2028-3.0YN5G/TR | G68XX           | Tape and Reel, 3000 |
| SGM2028-3.3 | 3.3                  | SOT-23-5            | -40°C to +85°C              | SGM2028-3.3YN5G/TR | S55XX           | Tape and Reel, 3000 |
| SGM2028-ADJ | ADJ                  | SOT-23-5            | -40°C to +85°C              | SGM2028-ADJYN5G/TR | S4BXX           | Tape and Reel, 3000 |

NOTE: XX = Date Code.

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.

**MARKING INFORMATION**



For example: S55GJ (2016, October)

**ABSOLUTE MAXIMUM RATINGS**

|  |                                   |
|--|-----------------------------------|
| IN to GND .....  | -0.3V to 6V                       |
| Output Short-Circuit Duration.....                         | Infinite                          |
| EN to GND.....   | -0.3V to (V <sub>IN</sub> + 0.3V) |
| OUT, BP/FB to GND .....                                    | -0.3V to (V <sub>IN</sub> + 0.3V) |
| Power Dissipation, P <sub>D</sub> @ T <sub>A</sub> = +25°C |                                   |
| SOT-23-5.....  | 0.34W                             |
| Package Thermal Resistance                                 |                                   |
| SOT-23-5, θ <sub>JA</sub> .....                            | 367°C/W                           |
| Junction Temperature.....                                  | +150°C                            |
| Storage Temperature Range .....                            | -65°C to +150°C                   |
| Lead Temperature (Soldering, 10s).....                     | +260°C                            |
| ESD Susceptibility   |                                   |
| HBM.....   | 4000V                             |
| MM.....  | 400V                              |

**RECOMMENDED OPERATING CONDITIONS**

|                                   |                |
|-----------------------------------|----------------|
| Input Voltage Range .....         | 2.5V to 5.5V   |
| Operating Temperature Range ..... | -40°C to +85°C |

**OVERSTRESS CAUTION**

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

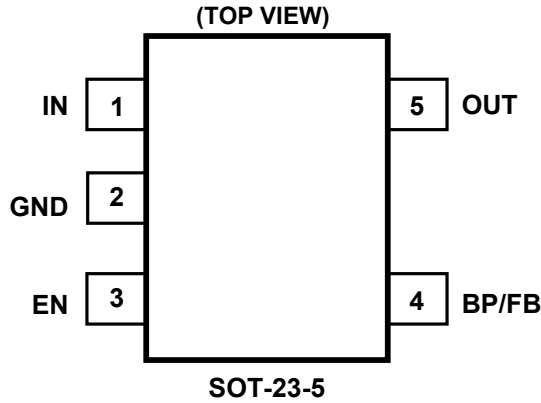
**ESD SENSITIVITY CAUTION**

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, specification or other related things if necessary without notice at any time.

**PIN CONFIGURATION**



**PIN DESCRIPTION**

| PIN | NAME | FUNCTION   |
|-----|------|--|
| 1   | IN   | Regulator Input. Supply voltage can range from 2.5V to 5.5V. Bypass with a 1µF capacitor to GND.   |
| 2   | GND  | Ground.  |
| 3   | EN   | Shutdown Input. A logic low reduces the supply current to 10nA. Connect to IN for normal operation.                                      |
| 4   | BP   | Reference-Noise Bypass (fixed voltage version only). Bypass with a low-leakage 0.01µF ceramic capacitor for reduced noise at the output. |
|     | FB   | Feedback Pin (adjustable voltage version only). This is used to set the output voltage of the device.                                    |
| 5   | OUT  | Regulator Output.  |

## ELECTRICAL CHARACTERISTICS

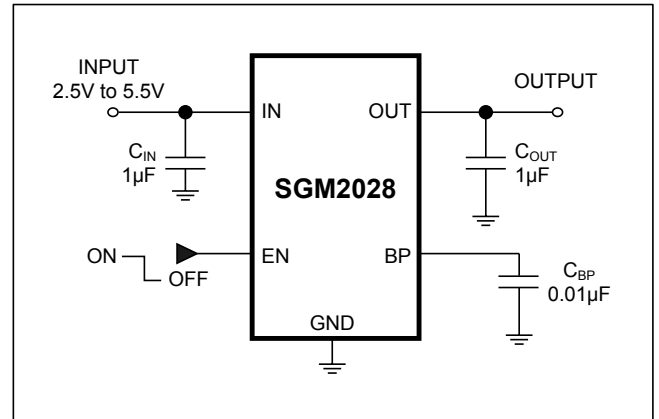
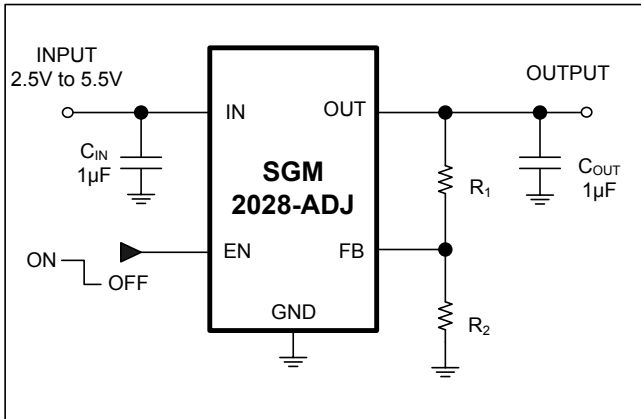
( $V_{IN} = V_{OUT (NOMINAL)} + 0.5V$  or  $2.5V$ , whichever is greater, Full =  $-40^{\circ}C$  to  $+85^{\circ}C$ . For SGM2028-ADJ,  $V_{OUT} = 3.3V$ , unless otherwise noted.)

| PARAMETER                             | SYMBOL            | CONDITIONS   | TEMP           | MIN            | TYP    | MAX    | UNITS         |    |
|---------------------------------------|-------------------|--|----------------|----------------|--------|--------|---------------|----|
| Input Voltage                         | $V_{IN}$          |  | $+25^{\circ}C$ | 2.5            |        | 5.5    | V             |    |
| Output Voltage Accuracy               |                   | $I_{OUT} = 0.1mA$  | $+25^{\circ}C$ | -3             |        | +3     | %             |    |
| Maximum Output Current <sup>(1)</sup> |                   |  | $+25^{\circ}C$ | 500            |        |        | mA            |    |
| Current Limit                         | $I_{LIM}$         |  | $+25^{\circ}C$ | 510            |        |        | mA            |    |
| Ground Pin Current                    | $I_Q$             | No Load, $V_{EN} = 2V$   | $+25^{\circ}C$ |                | 115    | 220    | $\mu A$       |    |
| Dropout Voltage <sup>(2)</sup>        |                   | $I_{OUT} = 100mA$  | $+25^{\circ}C$ |                | 54     | 90     | mV            |    |
|                                       |                   | $I_{OUT} = 300mA$  |                |                | 162    | 270    |               |    |
|                                       |                   | $I_{OUT} = 500mA$  |                |                | 270    | 420    |               |    |
| Line Regulation                       | $\Delta V_{LNR}$  | $V_{IN} = V_{OUT} + 0.5V$ to $5.5V$ , $I_{OUT} = 1mA$                                    | $+25^{\circ}C$ |                | 0.02   | 0.095  | %/V           |    |
| Load Regulation                       | $\Delta V_{LDR}$  | $I_{OUT} = 0.1mA$ to $500mA$ , $C_{OUT} = 1\mu F$  | $+25^{\circ}C$ |                | 0.0025 | 0.0075 | %/mA          |    |
| Output Voltage Noise                  | $e_n$             | $f = 10Hz$ to $100kHz$ , $C_{BP} = 0.01\mu F$ ,<br>$C_{OUT} = 10\mu F$                   | $+25^{\circ}C$ |                | 30     |        | $\mu V_{RMS}$ |    |
| Power Supply Rejection Ratio          | PSRR              | $C_{BP} = 0.1\mu F$ , $I_{OUT} = 50mA$ ,<br>$C_{OUT} = 1\mu F$ , $V_{IN} = V_{OUT} + 1V$ | $f = 217Hz$    | $+25^{\circ}C$ |        | 77     |               | dB |
|                                       |                   |  | $f = 1kHz$     | $+25^{\circ}C$ |        | 73     |               | dB |
| <b>SHUTDOWN</b>                       |                   |  |                |                |        |        |               |    |
| EN Input Threshold                    | $V_{IH}$          | $V_{IN} = 2.5V$ to $5.5V$  | Full           |                | 1.5    |        | V             |    |
|                                       | $V_{IL}$          |  | Full           |                |        | 0.3    |               |    |
| Shutdown Supply Current               | $I_{Q(SHDN)}$     | $V_{EN} = 0.3V$  | $+25^{\circ}C$ |                | 0.01   |        | $\mu A$       |    |
| Shutdown Exit Delay <sup>(3)</sup>    |                   | $C_{BP} = 0.01\mu F$ , $C_{OUT} = 1\mu F$ , No Load                                      | $+25^{\circ}C$ |                | 30     |        | $\mu s$       |    |
| <b>THERMAL PROTECTION</b>             |                   |  |                |                |        |        |               |    |
| Thermal Shutdown Temperature          | $T_{SHDN}$        |  |                |                | 150    |        | $^{\circ}C$   |    |
| Thermal Shutdown Hysteresis           | $\Delta T_{SHDN}$ |  |                |                | 15     |        | $^{\circ}C$   |    |

## NOTES:

- Maximum output current is affected by PCB layout, size of metal trace, the thermal conduction path between metal layers and the environment of the system.
- 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  $+5.0V$ .)
- Time needed for  $V_{OUT}$  to reach 90% of final value.

TYPICAL APPLICATION CIRCUITS

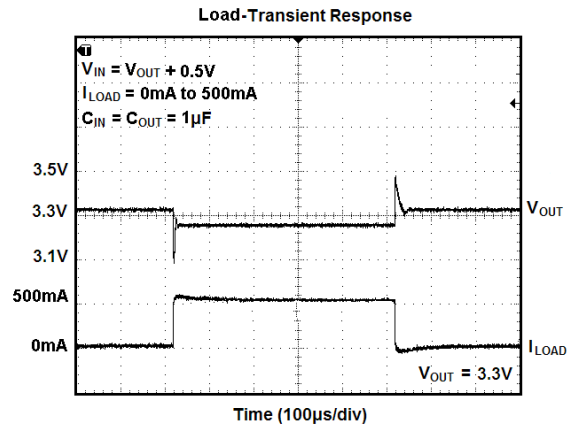
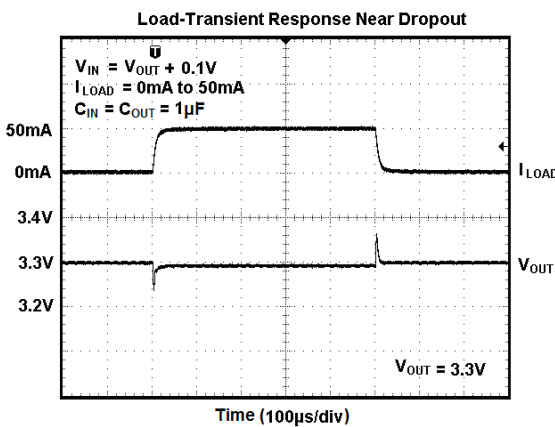
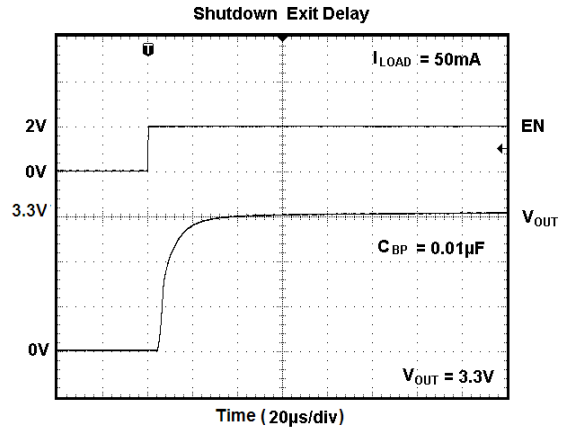
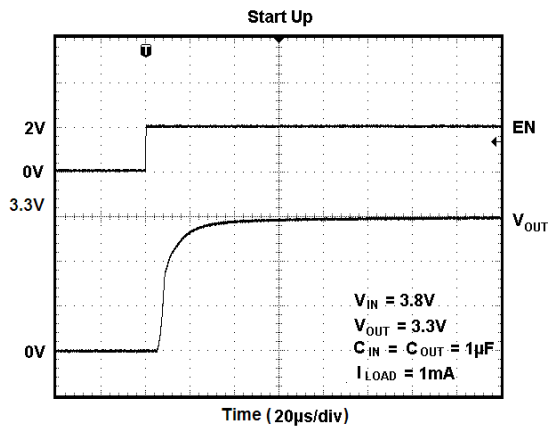
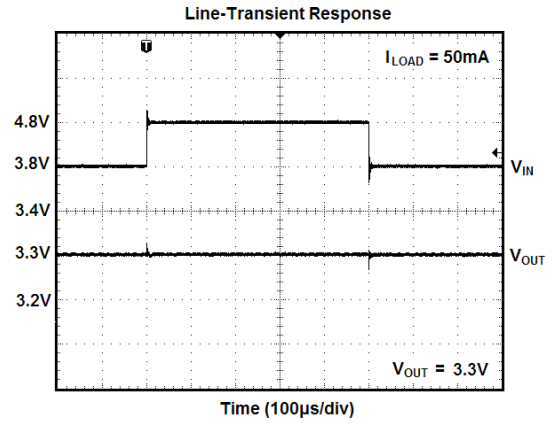
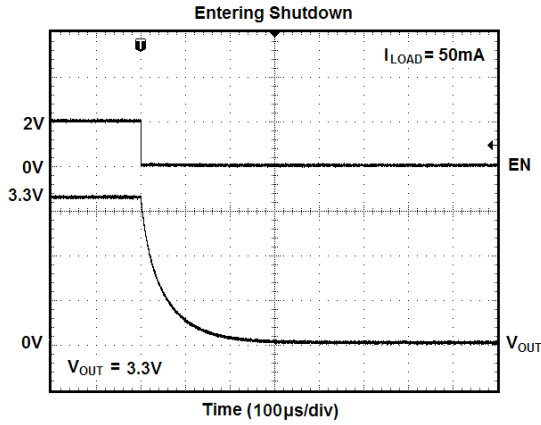


NOTE: Choose  $R_2 = 47k\Omega$  to maintain a  $26\mu A$  minimum load. Calculate the value for  $R_1$  using the following equation:

$$R_1 = R_2 \times \left( \frac{V_{OUT}}{1.206V} - 1 \right)$$

TYPICAL PERFORMANCE CHARACTERISTICS

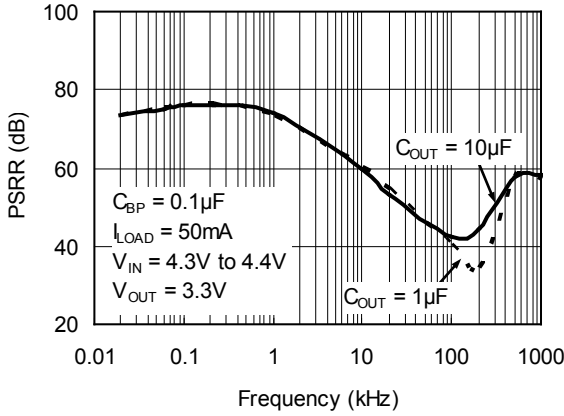
$V_{IN} = V_{OUT (NOMINAL)} + 0.5V$  or  $2.5V$ , whichever is greater,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $C_{BP} = 0.01\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.



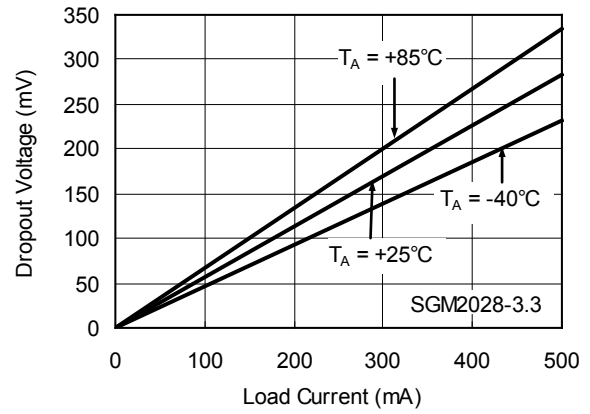
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = V_{OUT (NOMINAL)} + 0.5V$  or  $2.5V$ , whichever is greater,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $C_{BP} = 0.01\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

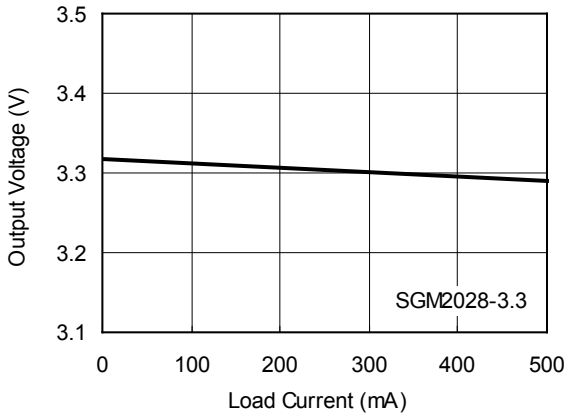
Power Supply Rejection Ratio vs. Frequency



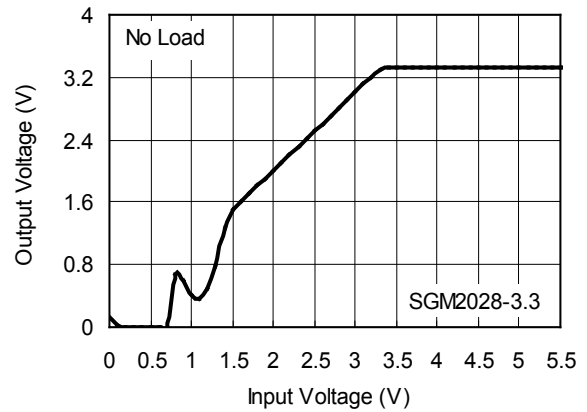
Dropout Voltage vs. Load Current



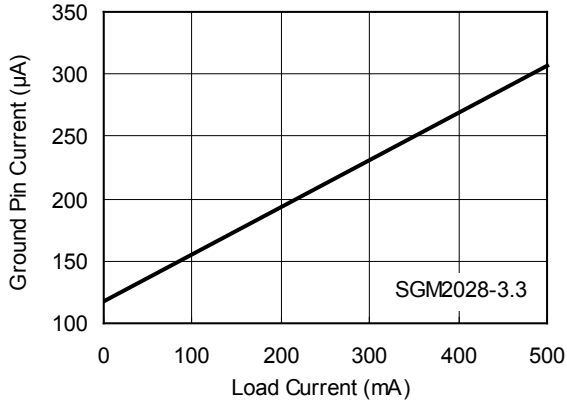
Output Voltage vs. Load Current



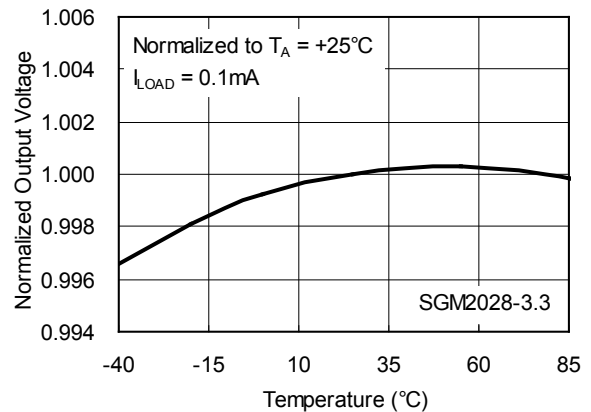
Output Voltage vs. Input Voltage



Ground Pin Current vs. Load Current

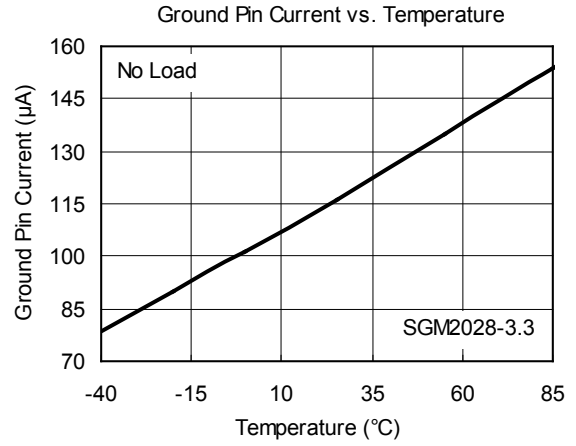
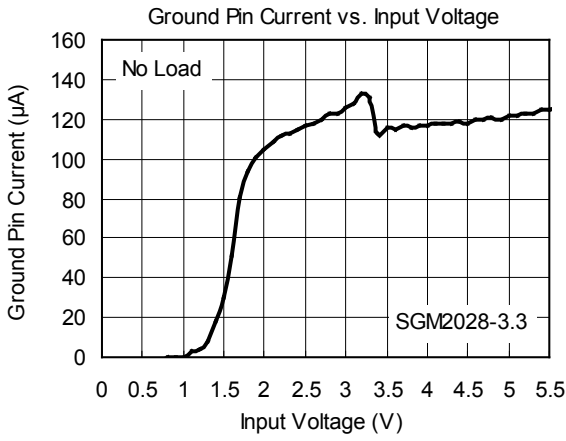


Normalized Output Voltage vs. Temperature



**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

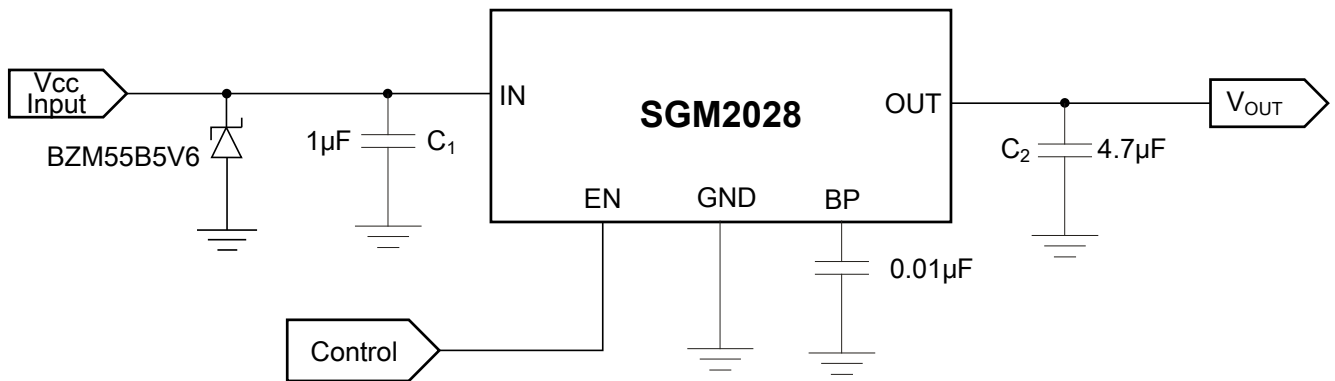
$V_{IN} = V_{OUT (NOMINAL)} + 0.5V$  or  $2.5V$ , whichever is greater,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $C_{BP} = 0.01\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.





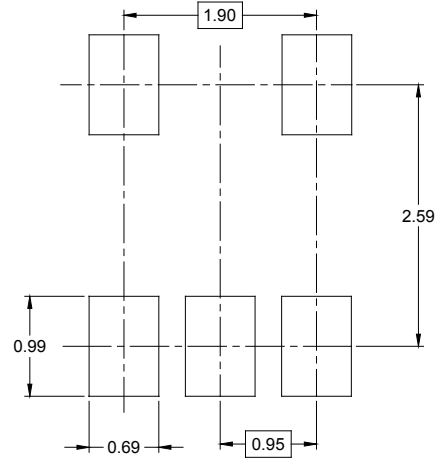
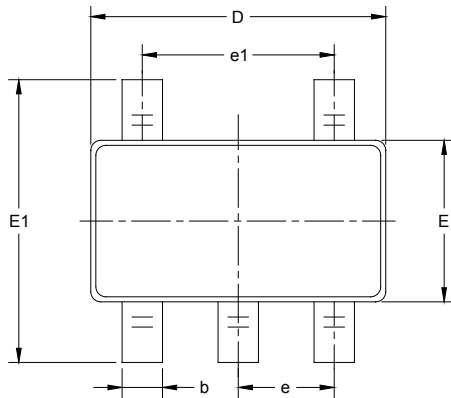
**APPLICATION NOTE**

When LDO is used in handheld products, attention must be paid to voltage spikes which could damage SGM2028. 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.

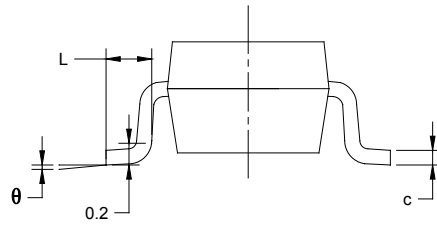
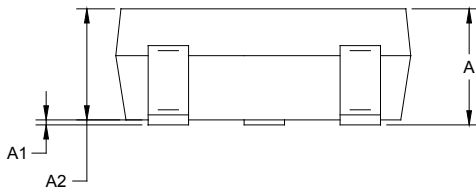


PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

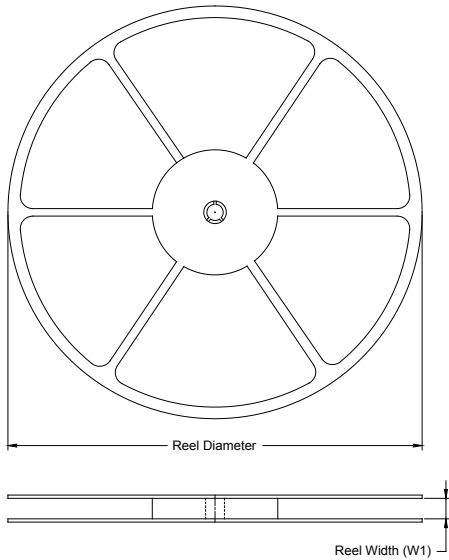


| Symbol   | Dimensions<br>In Millimeters |       | Dimensions<br>In Inches |       |
|----------|------------------------------|-------|-------------------------|-------|
|          | MIN                          | MAX   | MIN                     | MAX   |
| A        | 1.050                        | 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                        | 0.500 | 0.012                   | 0.020 |
| 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        | 0.950 BSC                    |       | 0.037 BSC               |       |
| e1       | 1.900 BSC                    |       | 0.075 BSC               |       |
| L        | 0.300                        | 0.600 | 0.012                   | 0.024 |
| $\theta$ | 0°                           | 8°    | 0°                      | 8°    |

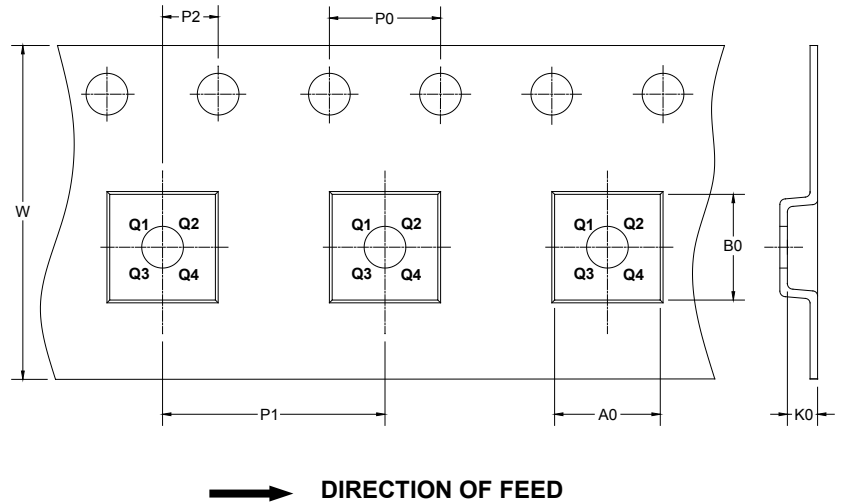
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



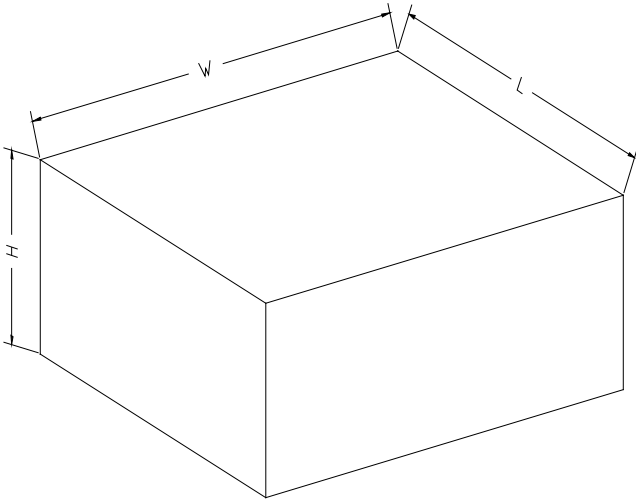
NOTE: The picture is only for reference. Please make the object as the standard.

### 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-23-5     | 7"            | 9.5                | 3.20    | 3.20    | 1.40    | 4.0     | 4.0     | 2.0     | 8.0    | Q3            |

000001

## 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           |

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[NCP715MX30TBG](#) [NCV8702MX25TCG](#) [NCV8170BXV120T2G](#) [MIC5317-1.2YD5-T5](#) [NCV8170AMX150TCG](#) [NCV8170BMX150TCG](#)  
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