



# SGM2225

## 800mA, High Voltage, Low Noise LDO Regulator

### GENERAL DESCRIPTION

The SGM2225 is a high voltage efficient linear voltage regulator with very low dropout voltage, typically 480mV at full load.

Designed especially for hand-held, battery-powered devices, the SGM2225 features low ground current to help prolong battery life. An enable/shutdown pin on SOIC-8, TDFN-3×3-8L and TO-263-5B versions can further improve battery life with near-zero shutdown current.

Key features include high PSRR, low ground current, fast load transient, output shorted to GND protection, reversed-battery protection, current limiting, over-temperature shutdown and availability in thermally efficient packaging. The SGM2225 is available in adjustable or fixed output voltage versions.

The SGM2225 is available in Green SOT-89-3, SOT-223-3, SOIC-8, TDFN-3×3-8L and TO-263-5B packages. It operates over an operating temperature range of -40°C to +125°C.

### FEATURES

- 3.6V to 36V Wide Input Voltage Range
- Output Voltage Range: 1.8V to 12V
- Guaranteed 800mA Output over the Full Operating Temperature Range
- Low 480mV (TYP) Dropout Voltage at Full Load
- Extremely Tight Load and Line Regulation
- Fast Load Transient
- Low Temperature Coefficient
- Output Shorted to GND Protection
- Current and Thermal Limiting
- No-Load Stability
- Output Voltage Accuracy:  $\pm 2\%$
- -40°C to +125°C Operating Temperature Range
- Thermally-Efficient Surface-Mount Package
- Available in Green SOT-89-3, SOT-223-3, SOIC-8, TDFN-3×3-8L and TO-263-5B Packages

### APPLICATIONS

Laptop, Notebook and Palmtop Computers  
Cellular Telephones  
Consumer and Personal Electronics  
SMPS Post-Regulator/DC-to-DC Modules  
High-Efficiency Linear Power Supplies

### TYPICAL APPLICATIONS

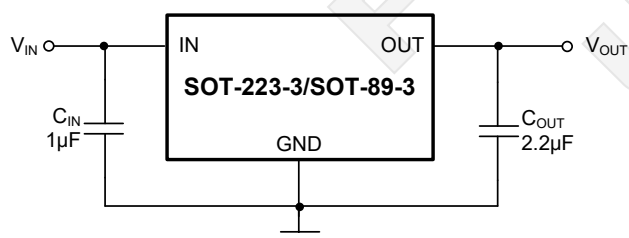


Figure 1. Fixed Voltage Typical Application Circuit

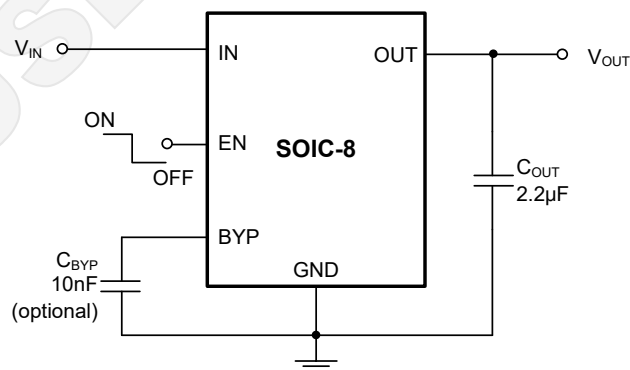


Figure 2. Low Noise Regulator



**ABSOLUTE MAXIMUM RATINGS**

Supply Voltage Range ( $V_{IN}$ )	-40V to +40V
EN to GND	-0.3V to $ V_{IN}  + 0.3V$
Package Thermal Resistance	
SOT-89-3, $\theta_{JA}$	75°C/W
SOT-89-3, $\theta_{JC}$	84°C/W
SOT-223-3, $\theta_{JA}$	95°C/W
SOT-223-3, $\theta_{JC}$	50°C/W
SOIC-8, $\theta_{JA}$	95°C/W
SOIC-8, $\theta_{JC}$	41°C/W
TDFN-3x3-8L, $\theta_{JA}$	92°C/W
TDFN-3x3-8L, $\theta_{JC}$	46°C/W
TO-263-5B, $\theta_{JA}$	45°C/W
TO-263-5B, $\theta_{JC}$	42°C/W
Junction Temperature	+150°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10s)	+260°C

**RECOMMENDED OPERATING CONDITIONS**

Supply Voltage Range ( $V_{IN}$ )	3.6V to 36V
Adjustable Output Voltage Range	1.8V to 12V
Operating Temperature Range	-40°C to +125°C

**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.

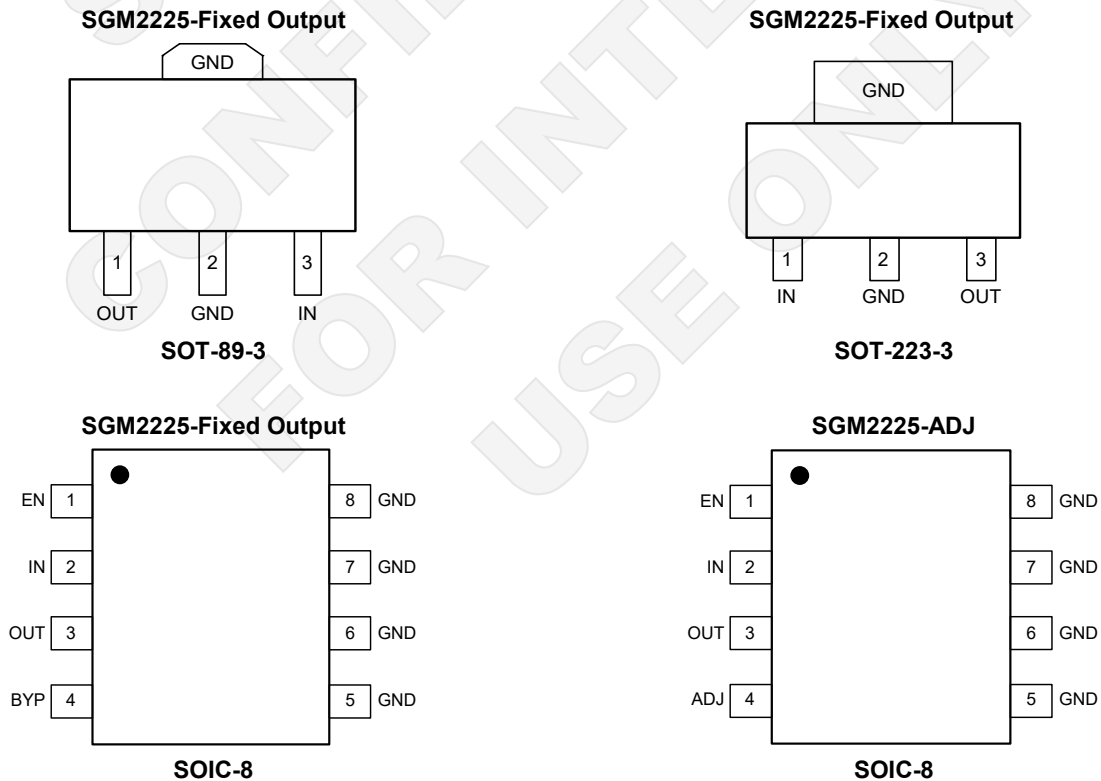
**ESD SENSITIVITY CAUTION**

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.

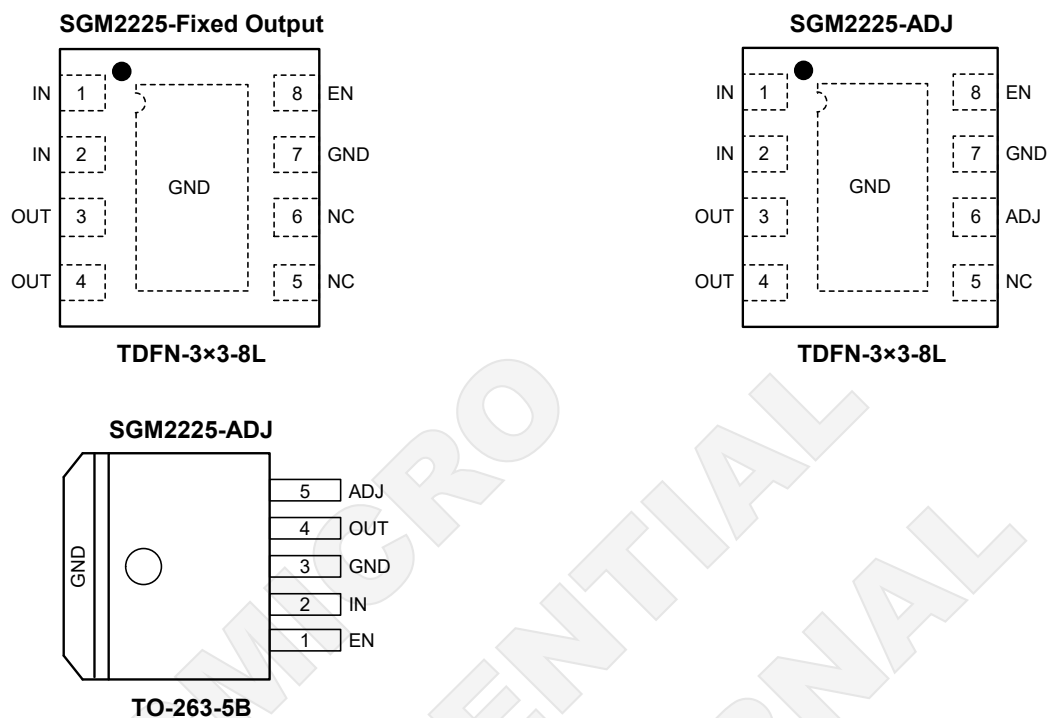
**DISCLAIMER**

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

**PIN CONFIGURATIONS**



PIN CONFIGURATIONS (continued)



PIN DESCRIPTION

PIN					NAME	FUNCTION
SOT-89-3	SOT-223-3	SOIC-8	TDFN-3x3-8L	TO-263-5B		
1	3	3	3, 4	4	OUT	Regulator Output Pin. It is recommended to use output capacitor with effective capacitance in the range of 1µF to 10µF. TDFN-3x3-8L pins 3 and 4 must be tied together.
2	2	5-8	7	3	GND	Ground Pin. SOIC-8 pins 5 through 8 are internally connected.
3	1	2	1, 2	2	IN	Supply Input Pin.
-	-	1	8	1	EN	Enable Pin: CMOS-Compatible Control Input. Logic High = Enable; Logic Low = Shutdown.
-	-	4	-	-	BYP	Reference Bypass (fixed voltage version only). Connect external 10nF capacitor to GND to reduce output noise.
-	-		6	5	ADJ	Adjustable Pin: Feedback Input (adjustable voltage version only). Connect to resistive voltage-divider network.
-	-	-	6	-	NC	Not Connected (fixed voltage version only).
-	-	-	5	-	NC	Not Connected.
-	-	-	Exposed Pad	-	GND	Exposed Thermal Pad. Connect to GND for best thermal performance.

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = V_{OUT(NOM)} + 1.0V$ ,  $C_{OUT} = 2.2\mu F$ ,  $I_{OUT} = 100\mu A$ ,  $T_J = -40^\circ C$  to  $+125^\circ C$ , typical values are at  $T_J = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Voltage Range	$V_{IN}$		$+25^\circ C$	3.6		36	V
Output Voltage Accuracy	$V_{OUT}$	Variation from nominal $V_{OUT}$	$+25^\circ C$	-2		2	%
Ground Pin Current <sup>(1, 2)</sup>	$I_Q$	$V_{EN} \geq 1.6V$ , no load	$+25^\circ C$		75		$\mu A$
		$V_{EN} \geq 1.6V$ , $I_{OUT} = 100\mu A$	$+25^\circ C$		75		
		$V_{EN} \geq 1.6V$ , $I_{OUT} = 50mA$	$+25^\circ C$		220		
		$V_{EN} \geq 1.6V$ , $I_{OUT} = 500mA$	$+25^\circ C$		1320		
		$V_{EN} \geq 1.6V$ , $I_{OUT} = 800mA$	$+25^\circ C$		1950		
Ground Pin Quiescent Current <sup>(2)</sup>	$I_{Q(GND)}$	$V_{EN} \leq 0.4V$ (Shutdown)	$+25^\circ C$		3		$\mu A$
Current Limit	$I_{LIM}$	$V_{OUT} = 90\%V_{OUT(NOM)}$	$+25^\circ C$		1100		mA
Dropout Voltage <sup>(3)</sup>	$V_{DROPO}$	$I_{OUT} = 50mA$	$+25^\circ C$		30		mV
		$I_{OUT} = 200mA$	$+25^\circ C$		120		
		$I_{OUT} = 500mA$	$+25^\circ C$		300		
		$I_{OUT} = 800mA$	$+25^\circ C$		480		
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	$V_{IN} = V_{OUT(NOM)} + 1.0V$ to 36V	$+25^\circ C$		0.009		%/V
Load Regulation	$\Delta V_{OUT}$	$I_{OUT} = 100\mu A$ to 800mA	$+25^\circ C$		0.08		%
Power Supply Rejection Ratio	PSRR	$f = 1kHz$ , $V_{OUT} = 2.5V$ , $I_{OUT} = 50mA$	$+25^\circ C$		75		dB
Output Voltage Noise <sup>(4)</sup>	$e_n$	$V_{OUT} = 2.5V$ , $I_{OUT} = 50mA$ , $C_{OUT} = 2.2\mu F$ , $C_{BYP} = 0\mu F$	$+25^\circ C$		500		nV/ $\sqrt{Hz}$
Output Voltage Temperature Coefficient <sup>(5)</sup>	$\frac{\Delta V_{OUT}}{\Delta T_A \times V_{OUT}}$		$-40^\circ C$ to $+125^\circ C$		40		ppm/ $^\circ C$
Enable Input Logic-Low Voltage	$V_{ENL}$	$V_{EN} = \text{Logic Low (Regulator Shutdown)}$	$+25^\circ C$			0.4	V
		$V_{EN} = \text{Logic High (Regulator Enabled)}$	$+25^\circ C$	1.6			
Enable Input Current	$I_{ENL}$	$V_{ENL} \leq 0.4V$	$+25^\circ C$		1		$\mu A$
	$I_{ENH}$	$V_{ENH} \geq 1.6V$	$+25^\circ C$		1		
Voltage Reference	$V_{REF}$		$+25^\circ C$		1.2		V

## NOTES:

- Ground pin current is the regulator quiescent current plus pass transistor base current. The total current drawn from the supply is the sum of the load current plus the ground pin current.
- $V_{EN}$  is the voltage externally applied to devices with the EN (enable) input pin (SOIC-8, TDFN-3x3-8L and TO-263-5B packages only).
- Dropout voltage is characterized when  $V_{OUT}$  falls 5% below  $V_{OUT(NOM)}$ .
- $C_{BYP}$  is an optional, external bypass capacitor connected to devices with a BYP (bypass) pin (SOIC-8 package only).
- Output voltage temperature coefficient is defined as the worst-case voltage change divided by the total temperature range.

FUNCTIONAL BLOCK DIAGRAMS

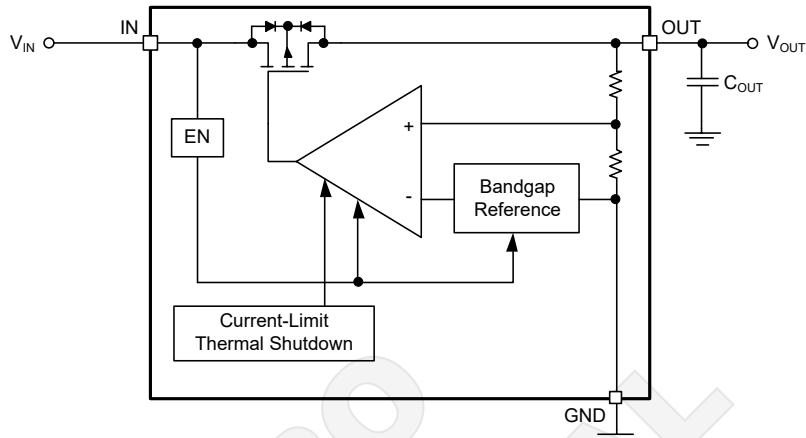


Figure 3. Low Noise Fixed Regulator (SOT-89-3 and SOT-223-3 Versions)

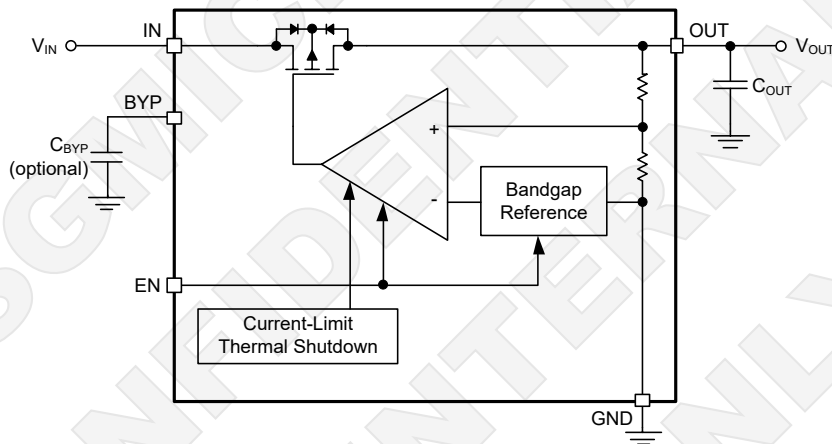


Figure 4. Low Noise Fixed Regulator (SOIC-8 Version)

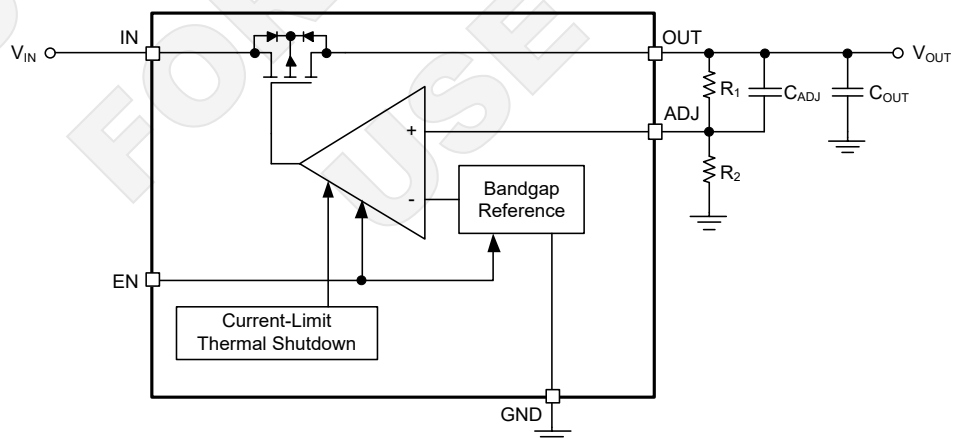


Figure 5. Low Noise Adjustable Regulator (SOIC-8, TDFN-3x3-8L and TO-263-5B Versions)

## APPLICATION INFORMATION

### Enable Shutdown

Enable is not available on devices in the SOT-89-3 and SOT-223-3 packages.

Forcing EN (enable/shutdown) high ( $> 1.6\text{V}$ ) enables the regulator. EN is compatible with CMOS logic. If the enable/shutdown feature is not required, connect EN to IN (supply input).

### Input Capacitor ( $C_{IN}$ )

A  $1\mu\text{F}$  capacitor should be placed from IN to GND if there is more than 10 inches of wire between the input and the AC filter capacitor or if a battery is used as the input.

### Output Capacitor ( $C_{OUT}$ )

An output capacitor is required between OUT and GND to prevent oscillation. The minimum size of the output capacitor is  $1\mu\text{F}$ . Larger values improve the regulator's transient response.

Most tantalum or aluminum electrolytic capacitors are adequate; film types will work, but are more expensive. Since many aluminum electrolytics have electrolytes that freeze at about  $-30\text{ }^{\circ}\text{C}$ , solid tantalums are recommended for operation below  $-25\text{ }^{\circ}\text{C}$ .

### No-Load Stability

The SGM2225 will remain stable and in regulation with no load (other than the internal voltage divider) unlike many other voltage regulators. This is especially important in CMOS RAM keep-alive applications.

### Reference Bypass Capacitor ( $C_{BYP}$ )

BYP (reference bypass) is available only on devices in SOIC-8 package.

BYP is connected to the internal voltage reference. A  $10\text{nF}$  capacitor connected from BYP to GND quiets this reference, providing a significant reduction in output noise (low noise performance).

The start-up speed of the SGM2225 is inversely proportional to the size of the reference bypass capacitor.

Applications requiring a slow ramp-up of output voltage

should consider larger values of  $C_{BYP}$ . Likewise, if rapid turn-on is necessary, consider omitting  $C_{BYP}$ .

If output noise is not critical, omit  $C_{BYP}$  and leave BYP open.

### Low Voltage Operation

During regulator power-up, the pass transistor is fully saturated for a short time, while the error amplifier and voltage reference are being powered up more slowly from the output (see Functional Block Diagrams).

Selecting larger output and bypass capacitors allows additional time for the error amplifier and reference to turn-on and prevent overshoot.

To ensure that no overshoot is present when starting up into a light load ( $100\mu\text{A}$ ), use a  $4.7\mu\text{F}$  output capacitance and  $10\text{nF}$  bypass capacitance. This slows the turn-on enough to allow the regulator to react and keep the output voltage from exceeding its nominal value. At heavier loads, use a  $10\mu\text{F}$  output capacitance and  $10\text{nF}$  bypass capacitance. Lower values of output and bypass capacitance can be used, depending on the sensitivity of the system.

Applications that can withstand some overshoot on the output of the regulator can reduce the output capacitor and/or reduce or eliminate the bypass capacitor. Applications those are not sensitive to overshoot due to power-on reset delays can use normal output and bypass capacitor configurations.

### Fixed Regulator Circuits

Figure 6 (a) shows a basic SOIC-8 fixed output voltage regulator circuit. A  $1\mu\text{F}$  minimum output capacitor is required for basic fixed output voltage applications.

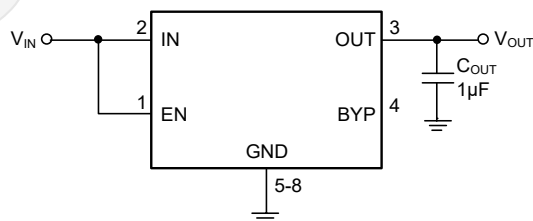


Figure 6 (a). Low Noise Fixed Voltage Regulator

APPLICATION INFORMATION (continued)

Figure 6 (b) includes the optional 10nF noise bypass capacitor between BYP and GND to reduce output noise.

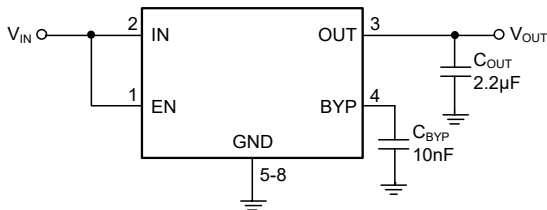


Figure 6 (b). Low Noise Fixed Voltage Regulator

Although ADJ pin is a high-impedance input, but for best performance, R<sub>1</sub> should not exceed 470kΩ. The capacitor C<sub>ADJ</sub> = 4.7pF improves the stability.

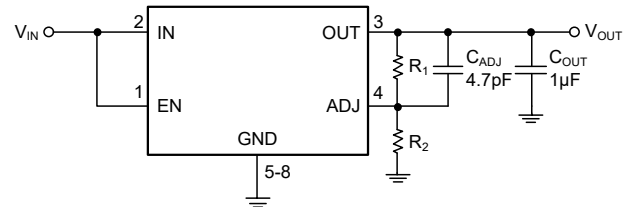


Figure 7. Low Noise Adjustable Voltage Regulator

Adjustable Regulator Circuits

The SGM2225-ADJ can be adjusted to a specific output voltage by using two external resistors as shown in Figure 7. The resistors set the output voltage based on the equation:

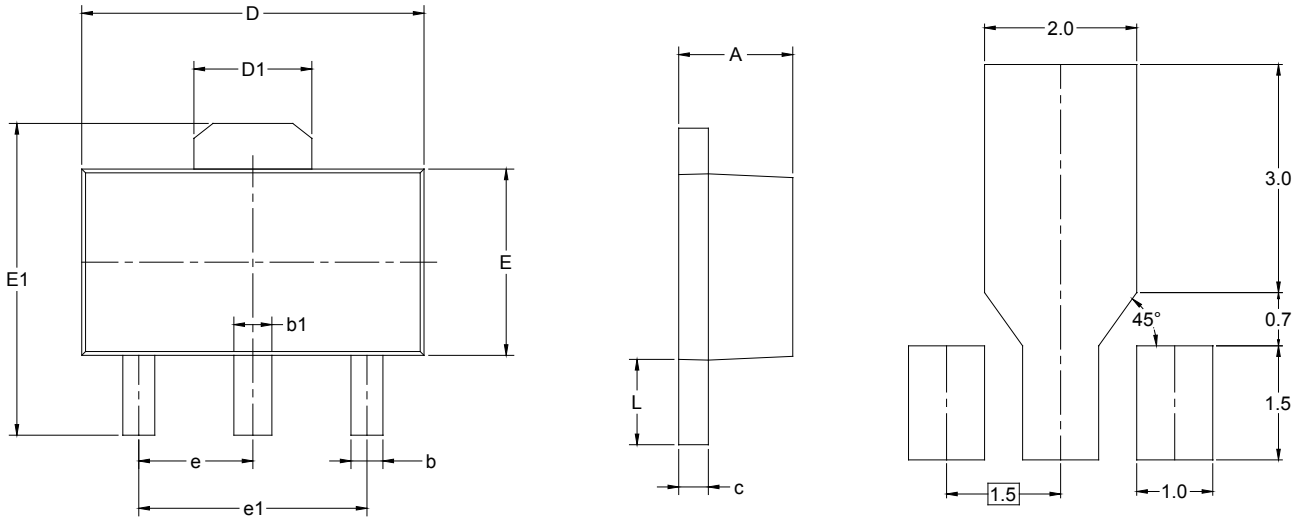
$$V_{OUT} = 1.2V \left( 1 + \frac{R_1}{R_2} \right) \quad (1)$$

SGMICRO  
CONFIDENTIAL  
FOR INTERNAL  
USE ONLY



PACKAGE OUTLINE DIMENSIONS

SOT-89-3

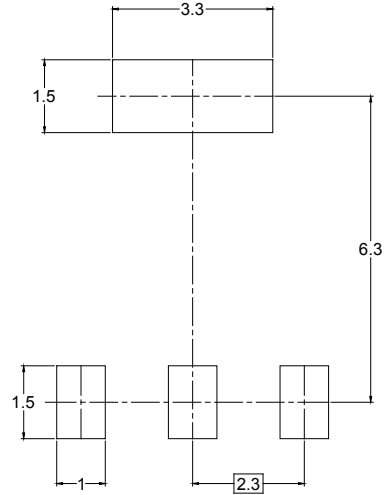
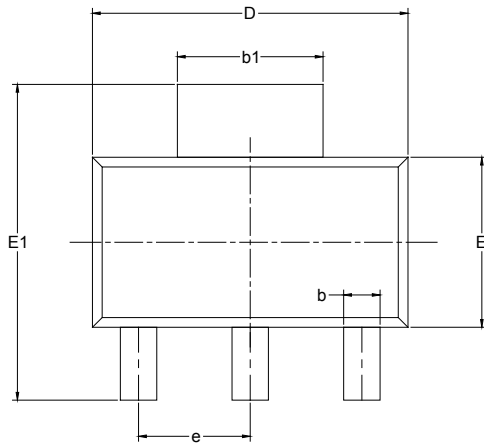


RECOMMENDED LAND PATTERN (Unit: mm)

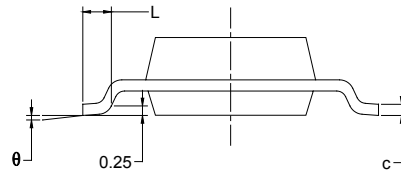
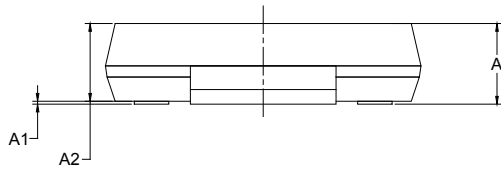
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF		0.061 REF	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060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

PACKAGE OUTLINE DIMENSIONS

SOT-223-3



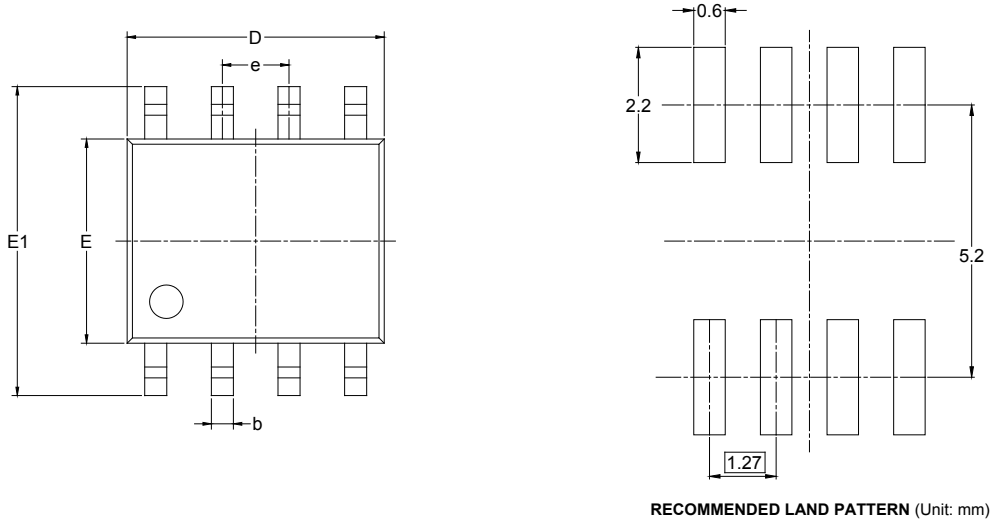
RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A		1.800		0.071
A1	0.020	0.100	0.001	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.840	0.026	0.033
b1	2.900	3.100	0.114	0.122
c	0.230	0.350	0.009	0.014
D	6.300	6.700	0.248	0.264
E	3.300	3.700	0.130	0.146
E1	6.700	7.300	0.264	0.287
e	2.300 BSC		0.091 BSC	
L	0.750		0.030	
$\theta$	0°	10°	0°	10°

PACKAGE OUTLINE DIMENSIONS

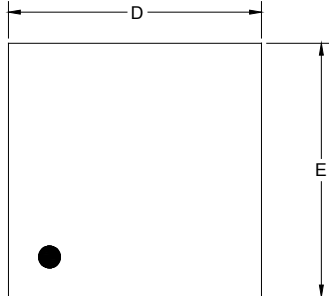
SOIC-8



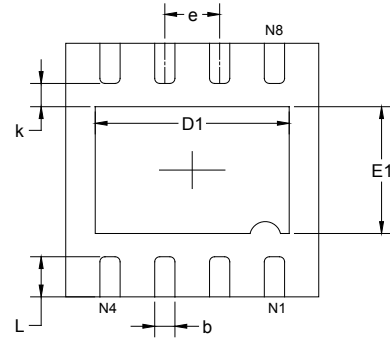
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

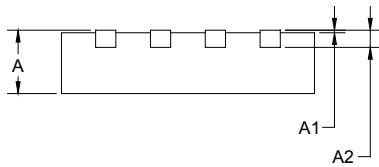
TDFN-3x3-8L



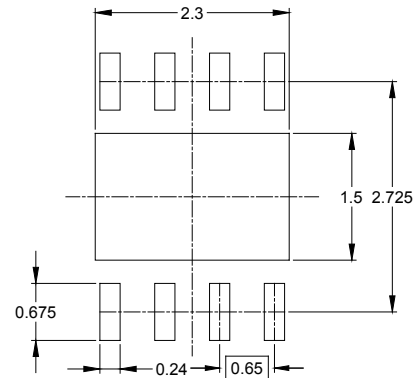
TOP VIEW



BOTTOM VIEW



SIDE VIEW

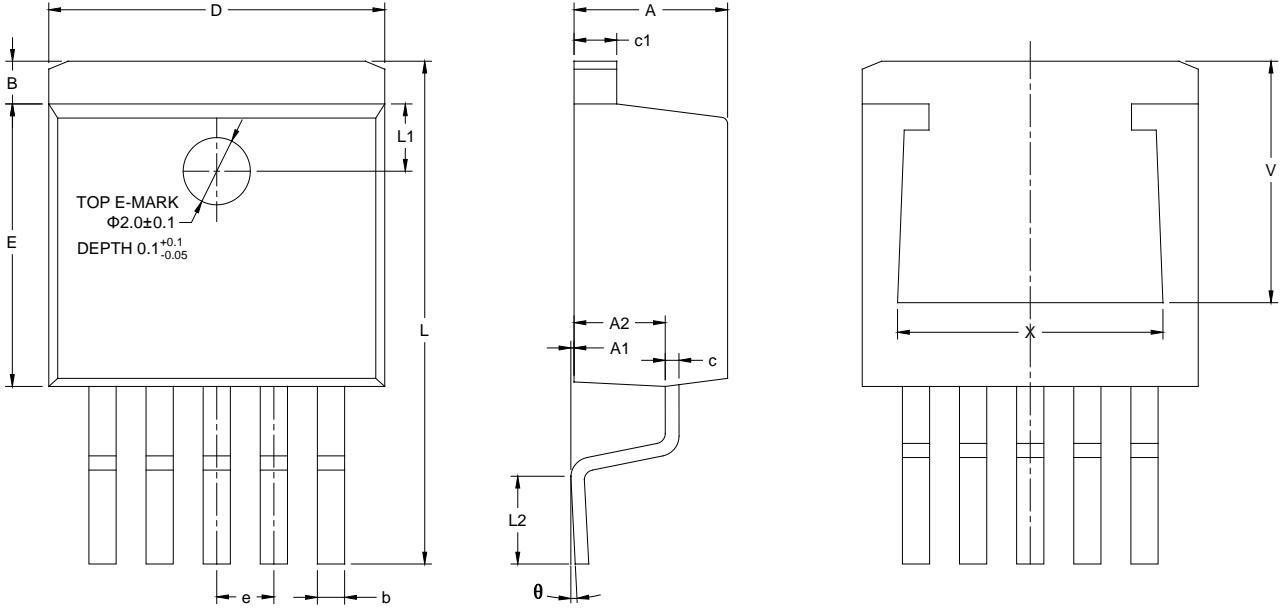


RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	2.200	2.400	0.087	0.094
E	2.900	3.100	0.114	0.122
E1	1.400	1.600	0.055	0.063
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.650 TYP		0.026 TYP	
L	0.375	0.575	0.015	0.023

PACKAGE OUTLINE DIMENSIONS

TO-263-5B



Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	4.40	4.57	4.70
A1	0	0.10	0.25
A2	2.59	2.69	2.79
b	0.77	-	0.90
c	0.34	-	0.47
c1	1.22	-	1.32
e	1.70 BSC		
D	10.06	10.16	10.26
E	9.05	9.15	9.25
B	1.17	1.27	1.40
V	6.86	-	7.50
X	7.50	-	8.30
L	14.70	15.10	15.50
L1	2.00 REF		
L2	2.00	2.30	2.60
$\theta$	0°	-	8°

## 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
SOT-223-3	13"	12.4	6.55	7.25	1.90	4.0	8.0	2.0	12.0	Q3
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
TDFN-3×3-8L	13"	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q1
TO-263-5B	13"	24.4	10.80	16.30	5.11	4.0	16.0	2.0	24.0	

# PACKAGE INFORMATION

## 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
13"	386	280	370	5

DD0002