



SGM2028

500mA, Ultra-Low Dropout, Low Power, RF Linear Regulator

GENERAL DESCRIPTION

The SGM2028 is a low dropout voltage, low power and low noise RF linear regulator. It is capable of supplying 500mA output current with typical dropout voltage of only 270mV. The operating input voltage range is from 2.5V to 5.5V.

Other features include logic-controlled shutdown mode, short-circuit current limit and thermal shutdown protection.

The SGM2028 is available in a Green SOT-23-5 package. It operates over an operating temperature range of -40°C to +85°C.

FEATURES

- **Operating Input Voltage Range: 2.5V to 5.5V**
- **Fixed Output Voltages: 2.8V, 3.0V, 3.3V**
- **Adjustable Output Voltage Range: 1.2V to 5.0V**
- **500mA Guaranteed Output Current**
- **Output Voltage Accuracy: $\pm 3\%$ at +25°C**
- **High PSRR: 73dB (TYP) at 1kHz**
- **Ultra-Low Dropout Voltage:
270mV (TYP) at 500mA**
- **Low Output Noise: 30 μ V_{RMS} (TYP)**
- **Thermal Shutdown Protection**
- **Output Current Limit**
- **SGM2028-2.8, SGM2028-3.0 and SGM2028-ADJ:
110k Ω Pull Down Resistor at EN Pin**
- **SGM2028-3.3: No Pull Down Resistor at EN Pin**
- **-40°C to +85°C Operating Temperature Range**
- **Available in a Green SOT-23-5 Package**

APPLICATIONS

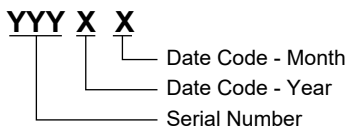
Modems
MP3 Players
Cellular Telephones
PCMCIA Cards
Palmtop Computers
Portable Electronics

PACKAGE/ORDERING INFORMATION

MODEL	V _{OUT} (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

MARKING INFORMATION

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.

ABSOLUTE MAXIMUM RATINGS

IN to GND	-0.3V to 6V
Output Short-Circuit Duration.....	Infinite
EN to GND.....	-0.3V to (V _{IN} +0.3V)
OUT, BP/FB to GND.....	-0.3V to (V _{IN} + 0.3V)
Power Dissipation, P _D @ T _A = +25°C	
SOT-23-5.....	0.53W
Package Thermal Resistance	
SOT-23-5, θ _{JA}	235°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 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.

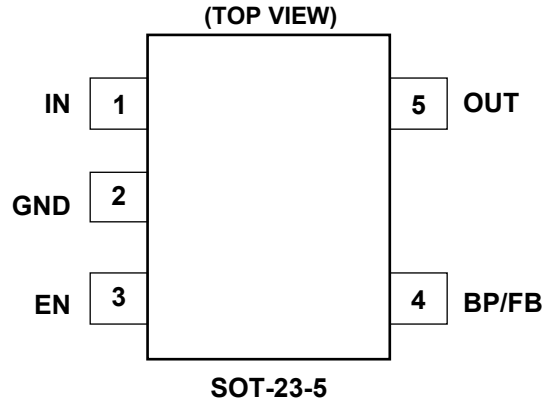
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. 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 even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

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

PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	IN	Input Supply Voltage Pin. It is recommended to use a 1μF or larger ceramic capacitor from IN pin to ground.
2	GND	Ground.
3	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. This pin must be connected to IN pin if enable functionality is not used.
4	BP	Reference-Noise Bypass Pin (fixed voltage version only). Bypass with an external capacitor C _{BP} can reduce output noise to very low level.
	FB	Feedback Voltage Input Pin (adjustable voltage version only). Connect this pin to the midpoint of an external resistor divider to adjust the output voltage. Place the resistors as close as possible to this pin.
5	OUT	Regulator Output Pin. It is recommended to use 1μF or larger ceramic output capacitor from OUT pin to ground. The capacitor should be located very close to this pin.

ELECTRICAL CHARACTERISTICS

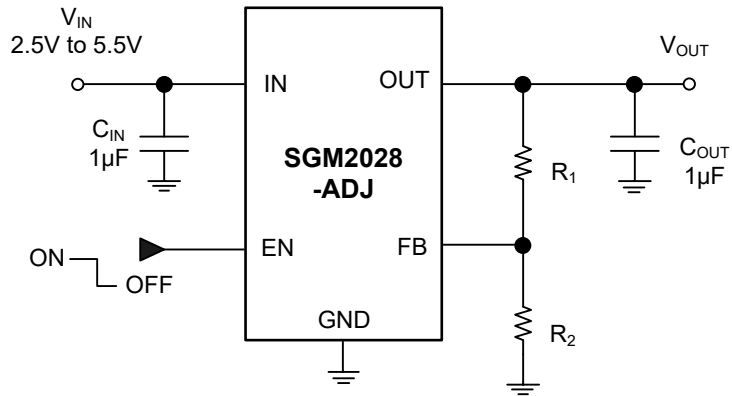
($V_{IN} = V_{OUT (NOMINAL)} + 0.5V$ or $2.5V$, whichever is greater, Full = $-40^{\circ}C$ to $+85^{\circ}C$. For SGM2028-ADJ, $V_{OUT} = 3.3V$, unless otherwise noted.)

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			$+25^{\circ}C$	500			mA	
Output Current Limit	I_{LIMIT}		$+25^{\circ}C$	510			mA	
Ground Pin Current	I_Q	No load, $V_{EN} = 2V$	$+25^{\circ}C$		115	220	μA	
Dropout Voltage ⁽¹⁾		$I_{OUT} = 100mA$	$+25^{\circ}C$		54	90	mV	
		$I_{OUT} = 300mA$			162	270		
		$I_{OUT} = 500mA$			270	420		
Line Regulation	ΔV_{LNR}	$V_{IN} = V_{OUT} + 0.5V$ to $5.5V$, $I_{OUT} = 1mA$	$+25^{\circ}C$		0.02	0.095	%/V	
Load Regulation	ΔV_{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 $100kHz$, $C_{BP} = 0.01\mu F$, $C_{OUT} = 10\mu F$	$+25^{\circ}C$		30		μV_{RMS}	
Power Supply Rejection Ratio	PSRR	$C_{BP} = 0.1\mu F$, $I_{OUT} = 50mA$, $C_{OUT} = 1\mu F$, $V_{IN} = V_{OUT} + 1V$	$f = 217Hz$	$+25^{\circ}C$		77		dB
			$f = 1kHz$	$+25^{\circ}C$		73		dB
Shutdown								
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		μA	
Shutdown Exit Delay ⁽²⁾		$C_{BP} = 0.01\mu F$, $C_{OUT} = 1\mu F$, no load	$+25^{\circ}C$		30		μs	
Thermal Protection								
Thermal Shutdown Temperature	T_{SHDN}				150		$^{\circ}C$	
Thermal Shutdown Hysteresis	ΔT_{SHDN}				15		$^{\circ}C$	

NOTES:

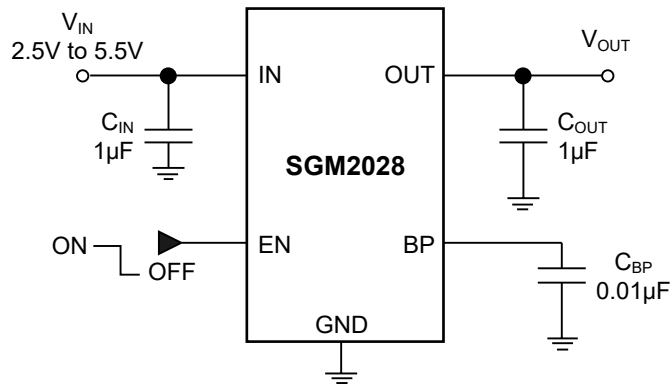
- The dropout voltage is defined as $V_{IN} - V_{OUT}$, when V_{OUT} is 100mV below the value of V_{OUT} for $V_{IN} = V_{OUT} + 0.5V$.
(Only applicable for $V_{OUT} = +2.5V$ to $+5.0V$.)
- Time needed for V_{OUT} to reach 90% of final value.

TYPICAL APPLICATION CIRCUITS



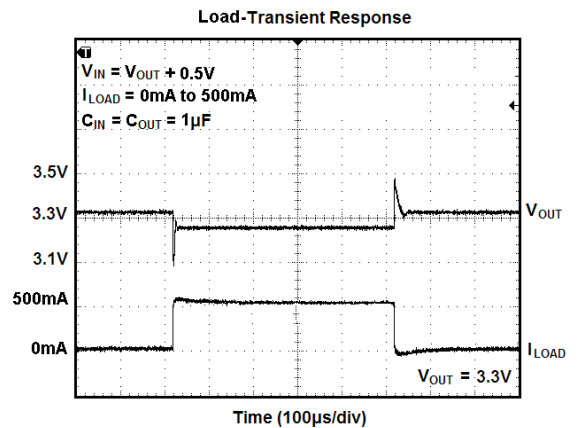
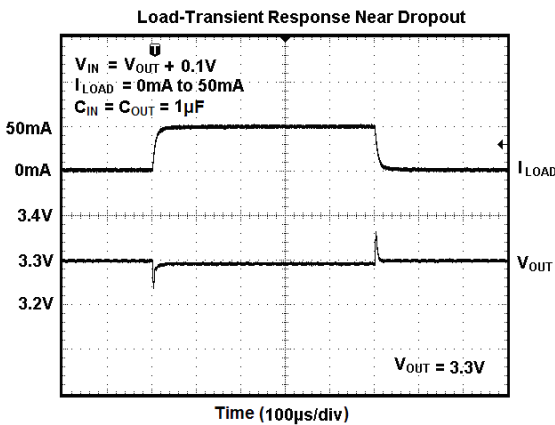
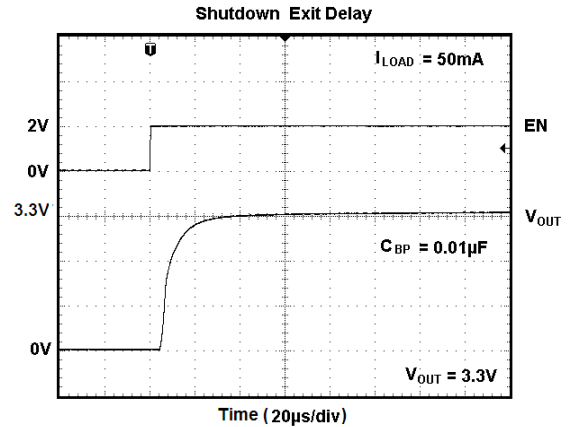
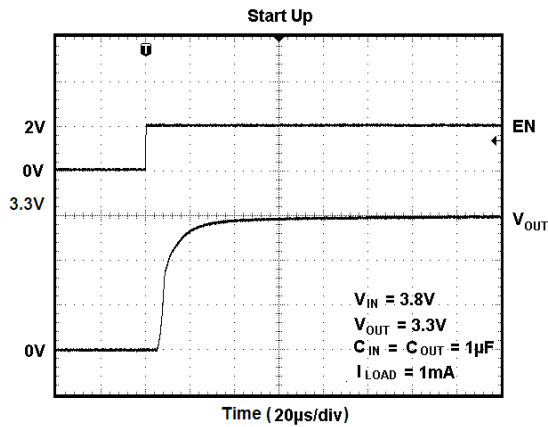
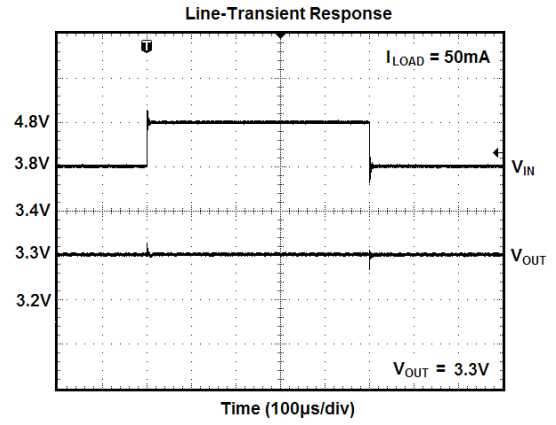
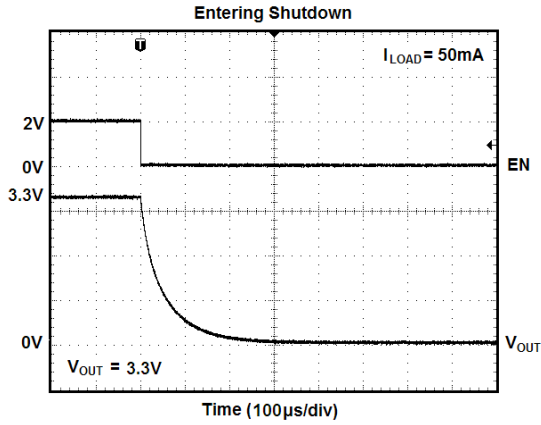
NOTE: Choose $R_2 = 47k\Omega$ to maintain a $26\mu A$ minimum load. Calculate the value for R_1 using the following equation:

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



TYPICAL PERFORMANCE CHARACTERISTICS

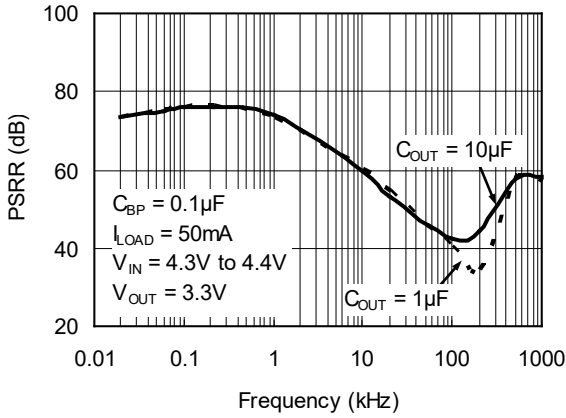
$V_{IN} = V_{OUT(NOMINAL)} + 0.5V$ or $2.5V$, whichever is greater, $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0.01\mu F$, $T_A = +25^\circ C$, unless otherwise noted.



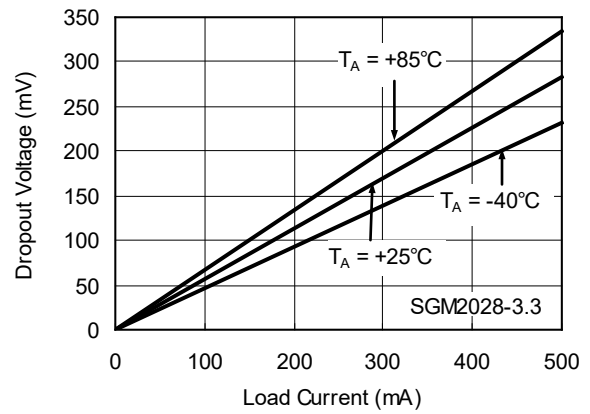
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = V_{OUT (NOMINAL)} + 0.5V$ 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.

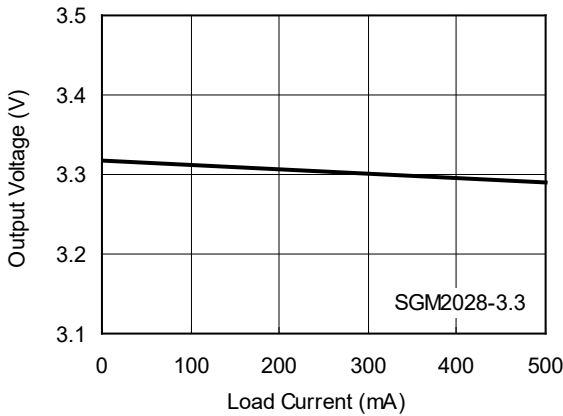
Power Supply Rejection Ratio vs. Frequency



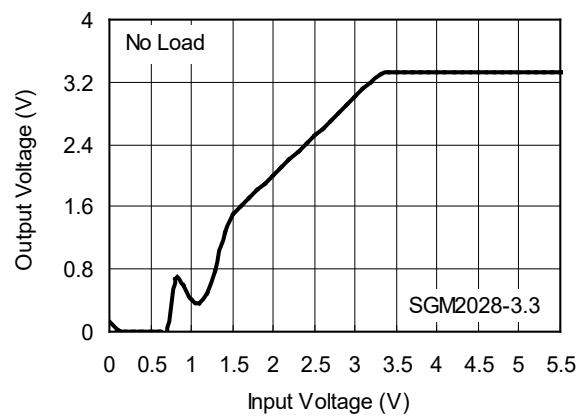
Dropout Voltage vs. Load Current



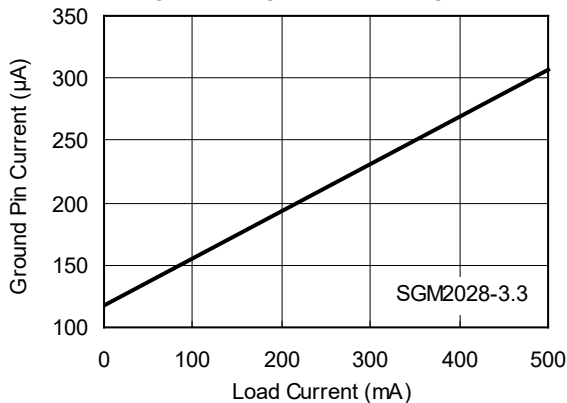
Output Voltage vs. Load Current



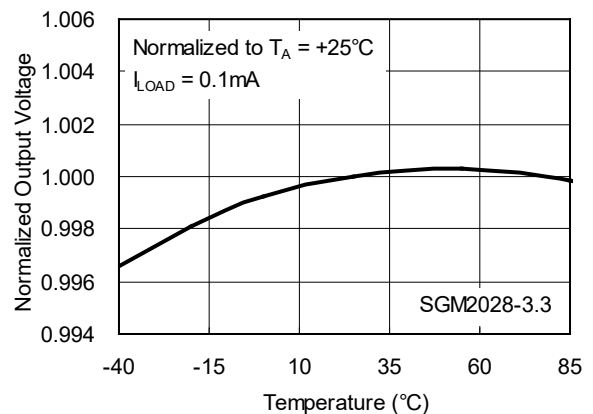
Output Voltage vs. Input Voltage



Ground Pin Current vs. Load Current

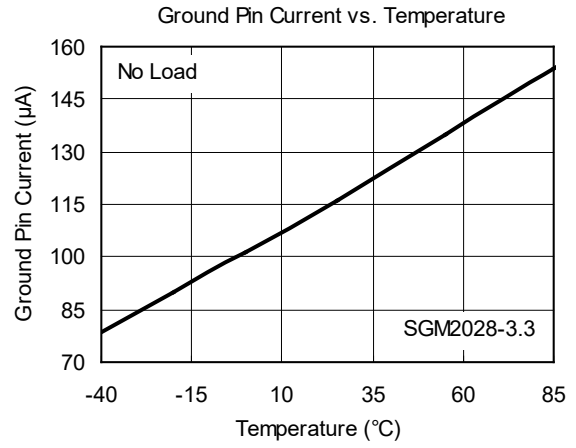
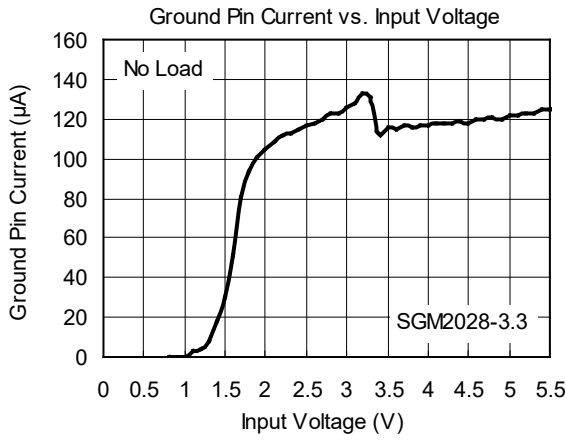


Normalized Output Voltage vs. Temperature



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 INFORMATION

The SGM2028 is a low power and low dropout LDO and provides 500mA output current. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply. The high performance also makes the SGM2028 useful in a variety of applications. The SGM2028 provides protection functions for output overload, output short-circuit condition and overheating.

Input Capacitor Selection (C_{IN})

The input decoupling capacitor is necessary to be connected as close as possible to the IN pin for ensuring the device stability. 1 μ F or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance.

When V_{IN} is required to provide large current instantaneously, a large effective input capacitor is required. Multiple input capacitors can limit the input tracking inductance. Adding more input capacitors is available to restrict the ringing and to keep it below the device absolute maximum ratings.

Output Capacitor Selection (C_{OUT})

The output decoupling capacitor should be located as close as possible to the OUT pin. 1 μ F or larger X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SGM2028 can remain stable is 0.5 μ F. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, so enough margin of C_{OUT} must be considered in design. Larger capacitance and lower ESR C_{OUT} will help improve the load transient response and increase the high frequency PSRR.

Enable Control

The SGM2028 uses the EN pin to enable/disable its device.

When the EN pin voltage is lower than 0.3V, the device is in shutdown state. There is no current flowing from IN pin to OUT pin.

When the EN pin voltage is higher than 1.5V, the device is in active state. The output voltage is regulated to expected value

Output Current Limit and Short-Circuit Protection

When overload events happen, the output current is internally limited to 510mA (MIN). When the OUT pin is shorted to ground, the short-circuit protection will limit the output current.

Thermal Shutdown

The SGM2028 can detect the temperature of die. When the die temperature exceeds the threshold value of thermal shutdown, the SGM2028 will be in shutdown state and it will remain in this state until the die temperature decreases to +135°C.

Layout Guidelines

To get good PSRR, low output noise and high transient response performance, the input and output bypass capacitors must be placed as close as possible to the IN pin and OUT pin separately. V_{IN} and V_{OUT} had better use separate ground planes and these ground planes are single point connected to the GND pin.

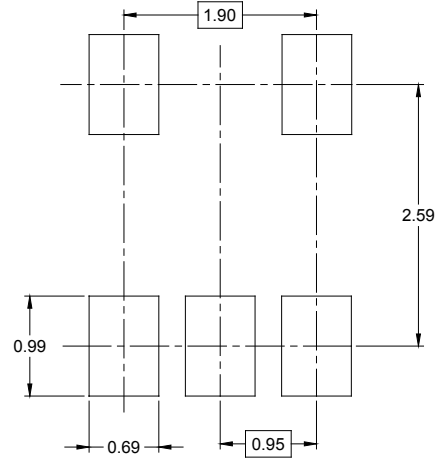
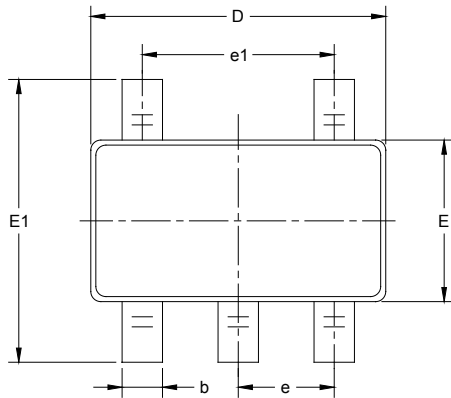
REVISION HISTORY

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

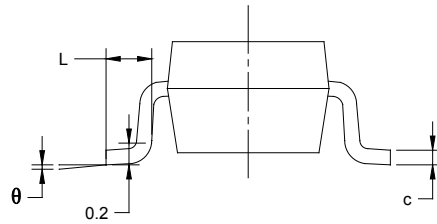
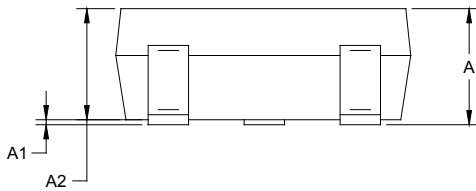
JUNE 2020 – REV.B.3 to REV.B.4	Page
Updated Absolute Maximum Ratings section	2
OCTOBER 2016 – REV.B.2 to REV.B.3	Page
Added SGM2028-3.0 version (110kΩ Pull Down Resistor at EN Pin).....	All
MAY 2016 – REV.B.1 to REV.B.2	Page
Changed Normalized Output Voltage vs. Temperature	7
DECEMBER 2013 – REV.B to REV.B.1	Page
Added 2.8V Output Voltage and ADJ	All
Changed Electrical Characteristics section	4
Changed Typical Application Circuits section.....	5
Changed Typical Performance Characteristics section.....	7, 8
JUNE 2013 – REV.A.4 to REV.B	Page
Deleted 2.8V Output Voltage.....	All

PACKAGE OUTLINE DIMENSIONS

SOT-23-5



RECOMMENDED LAND PATTERN (Unit: mm)

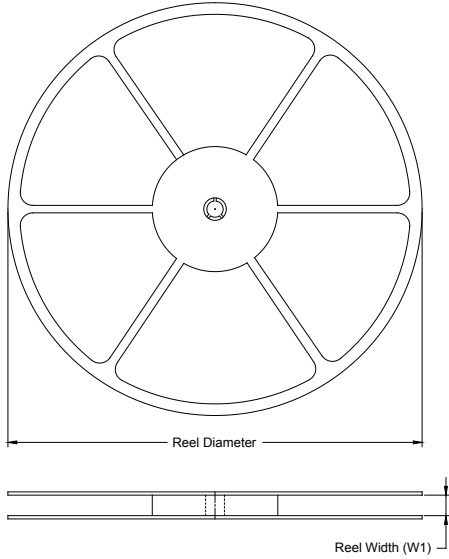


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

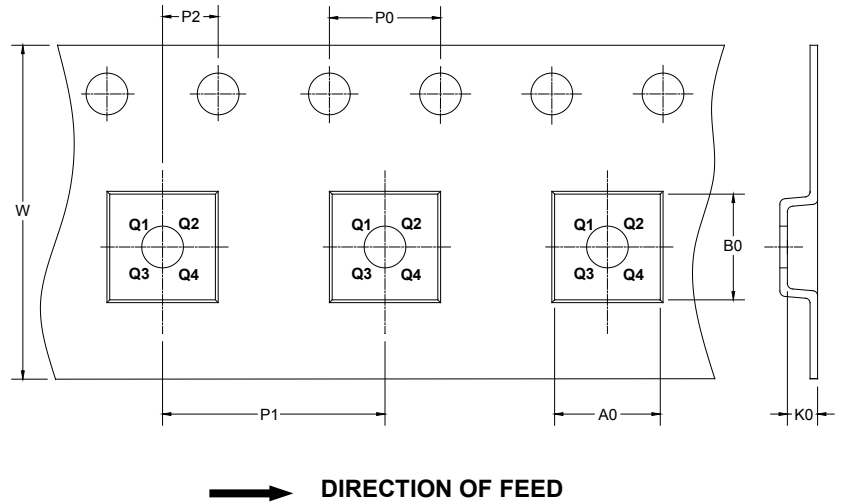
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

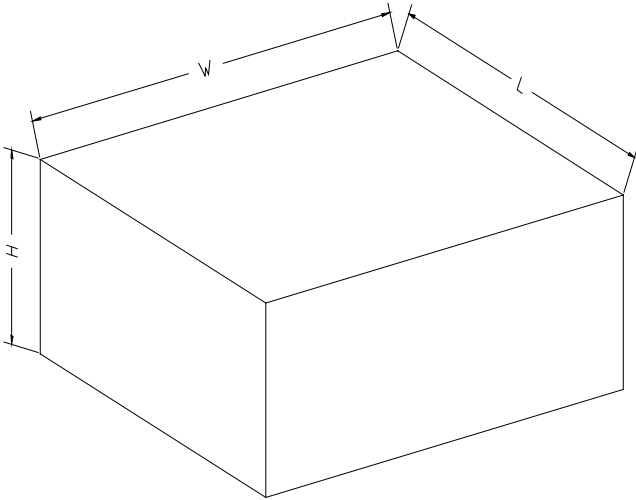
KEY PARAMETER LIST OF TAPE AND REEL

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

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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

DD0002