

GENERAL DESCRIPTION

The SGM2028 is a low power and low dropout voltage 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. The fixed output voltages are 1.8V, 2.8V, 3.0V and 3.3V.

Other features include logic-controlled shutdown mode, 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.

APPLICATIONS

- Modems
- MP3 Players
- Cellular Telephones
- PCMCIA Cards
- Palmtop Computers
- Portable Electronics

FEATURES

- **Operating Input Voltage Range: 2.5V to 5.5V**
- **Fixed Outputs of 1.8V, 2.8V, 3.0V, 3.3V**
- **Adjustable Output from 1.2V to 5.0V**
- **500mA Output Current**
- **High PSRR: 73dB (TYP) at 1kHz**
- **Low Dropout Voltage: 270mV (TYP) at 500mA**
- **Low Output Noise: 30μV_{RMS} (TYP)**
- **Current Limiting and Thermal Protection**
- **SGM2028-1.8, SGM2028-2.8, SGM2028-3.0 and SGM2028-ADJ: 110kΩ 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**

TYPICAL APPLICATION CIRCUITS

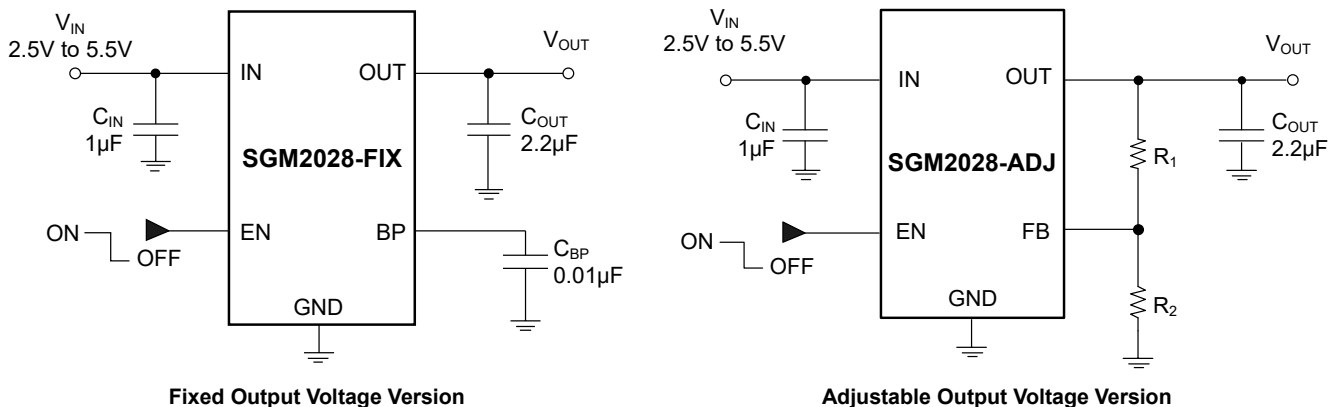


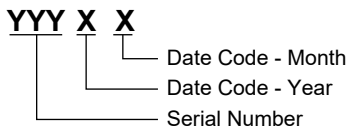
Figure 1. Typical Application Circuits

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM2028-1.8	SOT-23-5	-40°C to +85°C	SGM2028-1.8YN5G/TR	09HXX	Tape and Reel, 3000
SGM2028-2.8	SOT-23-5	-40°C to +85°C	SGM2028-2.8YN5G/TR	S58XX	Tape and Reel, 3000
SGM2028-3.0	SOT-23-5	-40°C to +85°C	SGM2028-3.0YN5G/TR	G68XX	Tape and Reel, 3000
SGM2028-3.3	SOT-23-5	-40°C to +85°C	SGM2028-3.3YN5G/TR	S55XX	Tape and Reel, 3000
SGM2028-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.

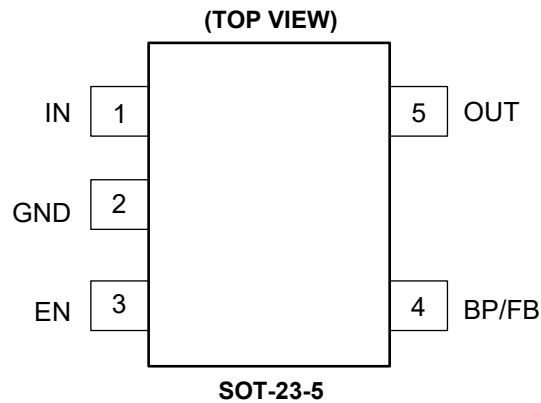
ESD SENSITIVITY CAUTION

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 1 μ F or larger ceramic capacitor from IN pin to ground to get good power supply decoupling. This ceramic capacitor should be placed as close as possible to IN pin.
2	GND	Ground.
3	EN	Enable Pin. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator.
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 1 μ F or larger ceramic capacitor from OUT pin to ground to ensure stability. This ceramic capacitor should be placed as close as possible to OUT 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.)

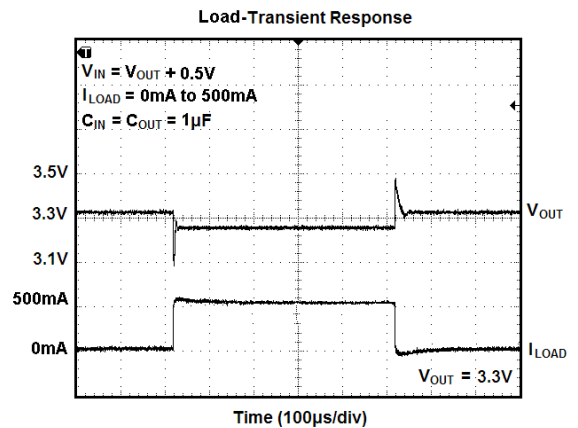
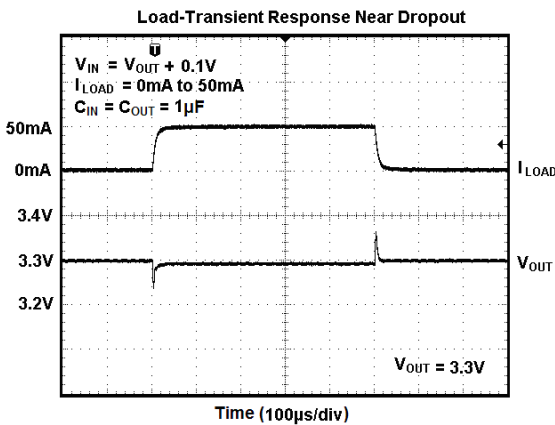
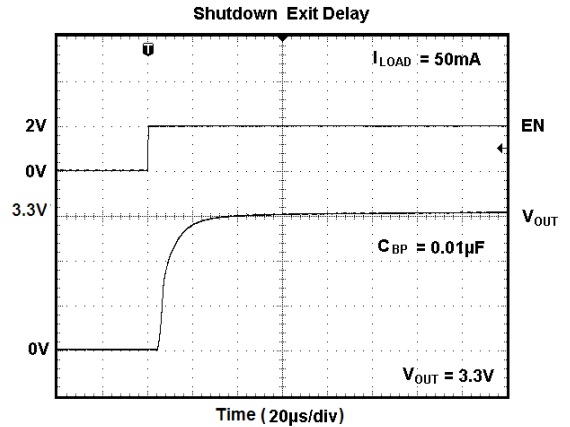
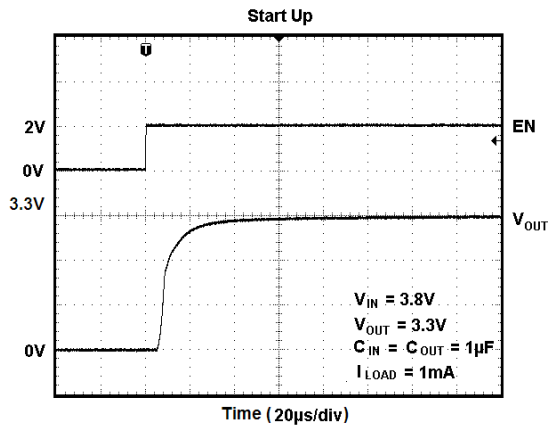
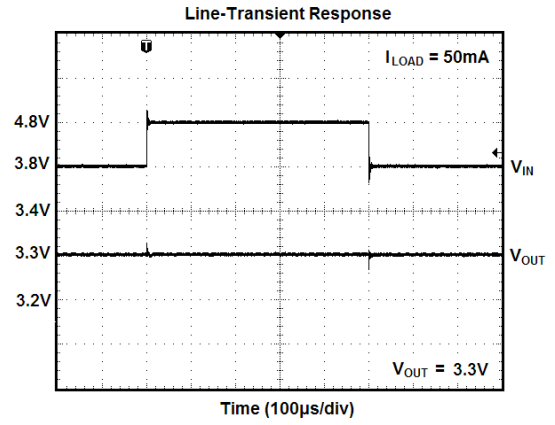
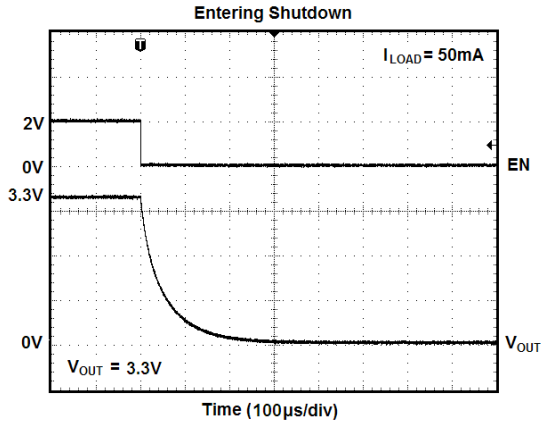
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		$+25^{\circ}C$	2.5		5.5	V
Output Voltage Accuracy		$I_{OUT} = 0.1mA$	$+25^{\circ}C$	-3		+3	%
Maximum Output Current			$+25^{\circ}C$	500			mA
Output Current Limit	I_{LIMIT}		$+25^{\circ}C$	510			mA
Ground Pin Current	I_Q	No 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	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	$V_{IN} = V_{OUT} + 0.5V$ to $5.5V$, $I_{OUT} = 1mA$	$+25^{\circ}C$		0.02	0.095	%/V
Load Regulation	$\frac{\Delta V_{OUT}}{\Delta I_{LOAD} \times V_{OUT}}$	$I_{OUT} = 0.1mA$ 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 the difference between V_{IN} and V_{OUT} when V_{OUT} falls to $(V_{OUT(NOM)} - 100mV)$ 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.

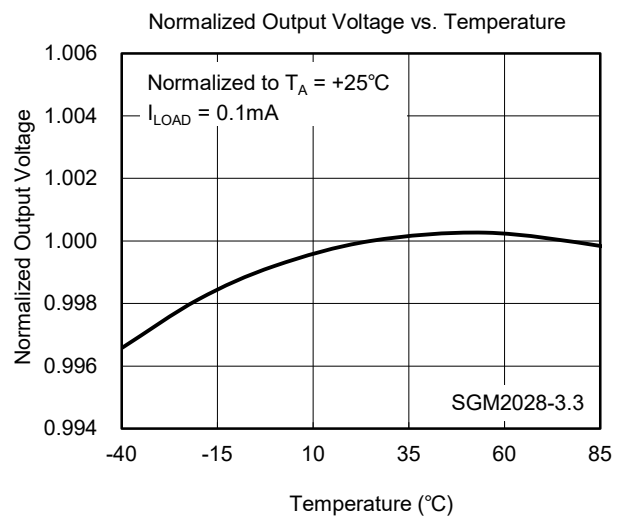
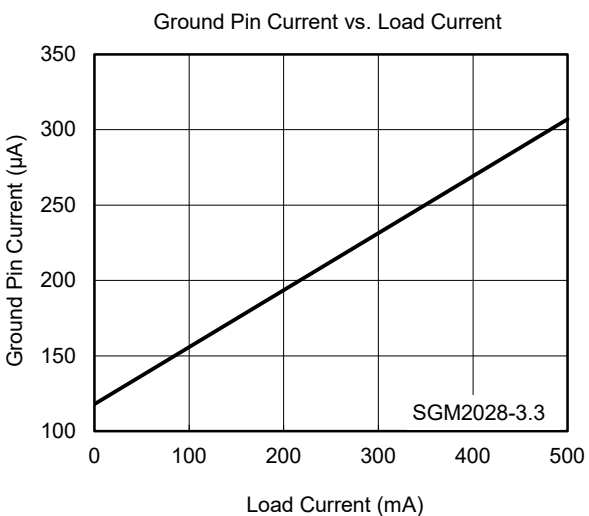
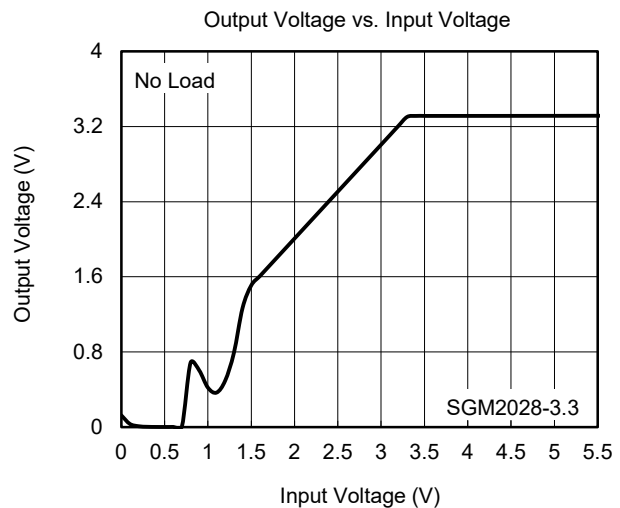
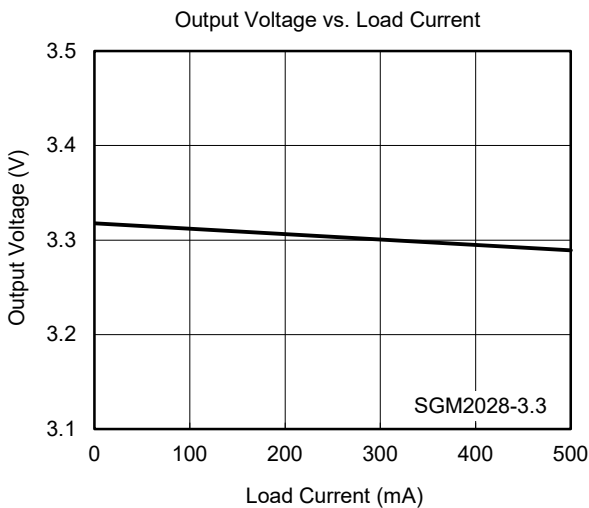
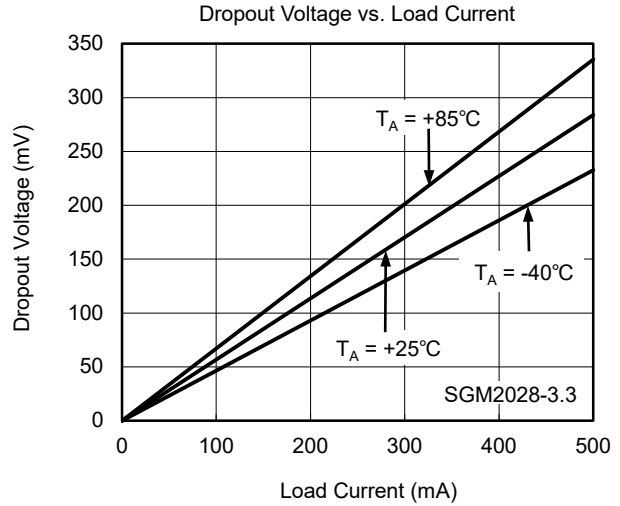
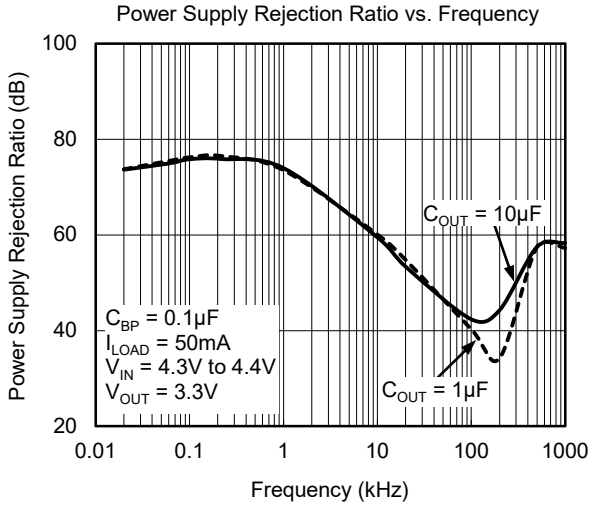
TYPICAL PERFORMANCE CHARACTERISTICS

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



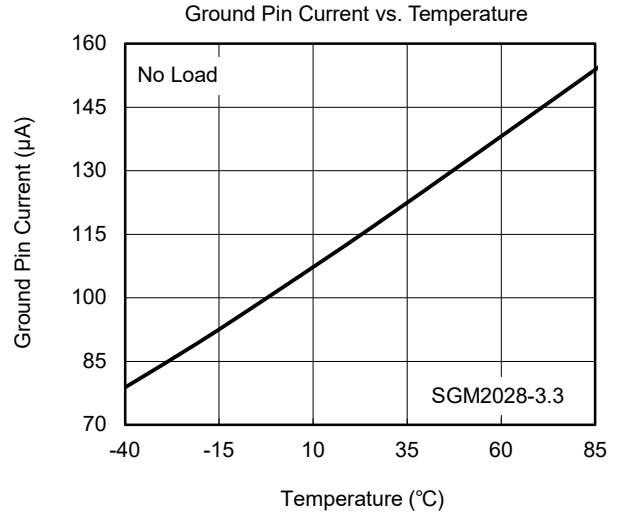
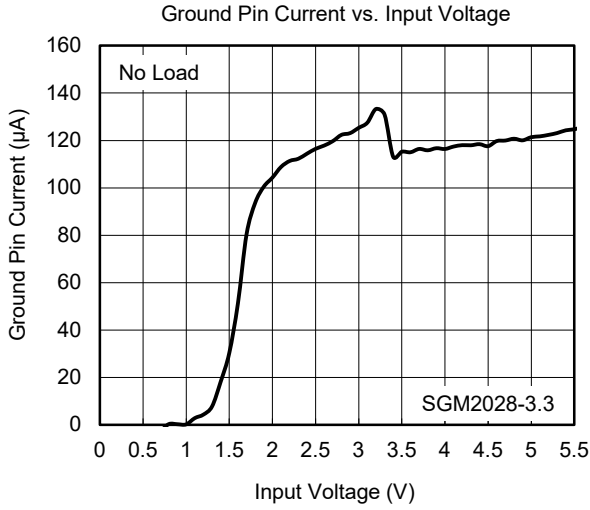
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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

Input Capacitor Selection (C_{IN})

The input decoupling capacitor should be placed 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 capacitor should be placed 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. 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. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Adjustable Regulator

The output voltage of the SGM2028-ADJ can be adjusted from 1.2V to 5.0V. The FB pin will be connected to two external resistors as shown in Figure 2. Choose $R_2 = 47k\Omega$ to maintain a 26 μ A minimum load. Calculate the value for R_1 using the following equation:

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

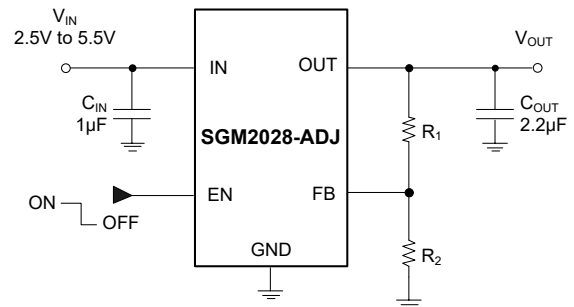


Figure 2. Adjustable Output Voltage Application

Enable Operation

The EN pin of the SGM2028 is used 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 the expected value.

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.

Power Dissipation (P_D)

Power dissipation (P_D) of the SGM2028 can be calculated by the equation $P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$. The maximum allowable power dissipation ($P_{D(MAX)}$) of the SGM2028 is affected by many factors, including the difference between junction temperature and ambient temperature ($T_{J(MAX)} - T_A$), package thermal resistance from the junction to the ambient environment (θ_{JA}), the rate of ambient airflow and PCB layout. $P_{D(MAX)}$ can be approximated by the following equation:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA} \quad (2)$$

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.

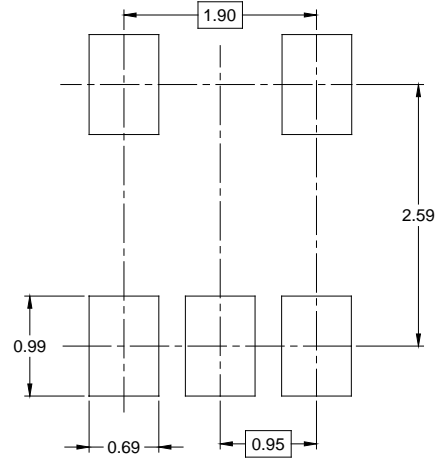
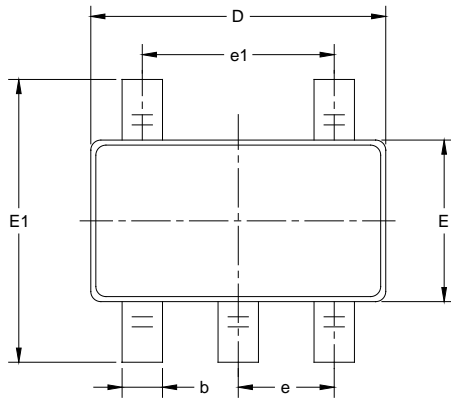
REVISION HISTORY

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

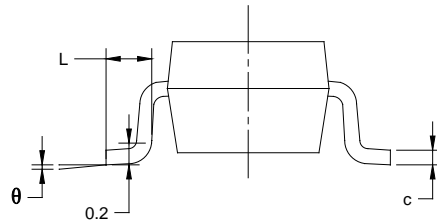
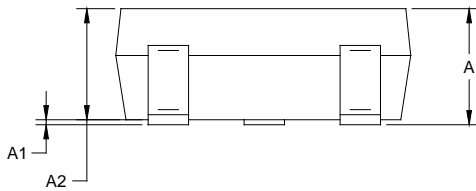
	Page
MAY 2023 – REV.B.4 to REV.C	
Added SGM2028-1.8YN5G/TR.....	2
JUNE 2020 – REV.B.3 to REV.B.4	
Updated Absolute Maximum Ratings section.....	2
OCTOBER 2016 – REV.B.2 to REV.B.3	
Added SGM2028-3.0 version (110kΩ Pull Down Resistor at EN Pin).....	All
MAY 2016 – REV.B.1 to REV.B.2	
Changed Normalized Output Voltage vs. Temperature.....	7
DECEMBER 2013 – REV.B to REV.B.1	
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	
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°

NOTES:

1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

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

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