

SGM66051 Efficient Synchronous Boost Converter with a 2.7A Switch

GENERAL DESCRIPTION

The SGM66051 is an internally compensated, 1.1MHz switching frequency, current mode, synchronous Boost switching regulator, which is capable of generating 5V output at 1A load current from a 3.3V rail. This device also has the 5.1V and 5.4V fixed output version.

This device turns into power-saving mode to maintain high efficiency by lowering switching frequency. With its anti-ringing circuitry damping the charge in parasitic capacitor, it reduces EMI interference significantly. Its output is disconnected by the rectifier circuit during shutdown, with no input to output leakage.

The SGM66051-5.1 and SGM66051-5.4 are preset for outputting 5.1V and 5.4V, while the SGM66051-ADJ is output voltage programmable with an external resistor divider.

The device is available in a Green TSOT-23-6 package and operates over an ambient temperature range of -40°C to +85°C.

FEATURES

- 2.2V to 5.5V Input Voltage Range
- 5.1V and 5.4V Fixed Output Voltages
- Adjustable Output Voltage up to 5.5V
- Up to 90% Efficiency
- 20µA (TYP) Quiescent Current
- 1µA (MAX) Shutdown Current
- 6V Output Voltage Clamping
- Improved Light Load Efficiency with Power-Save Mode (PSM)
- Load Disconnect during Shutdown
- Low Reverse Leakage Current when V_{OUT} > V_{IN}
- Over-Temperature Protection
- Available in a Green TSOT-23-6 Package
- -40°C to +85°C Operating Temperature Range

APPLICATIONS

Single-Cell Li-Ion Powered Products Portable Audio Players Mobile Phones Personal Medical Devices

TYPICAL APPLICATION

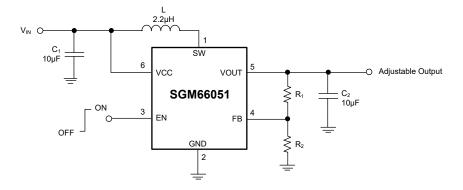


Figure 1. Typical Application Circuit



PACKAGE/ORDERING INFORMATION

MODEL	V оит (V)	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
	5.1	TSOT-23-6	-40°C to +85°C	SGM66051-5.1YTN6G/TR	G43XX	Tape and Reel, 3000
SGM66051	5.4	TSOT-23-6	-40°C to +85°C	SGM66051-5.4YTN6G/TR	G44XX	Tape and Reel, 3000
	Adjustable	TSOT-23-6	-40°C to +85°C	SGM66051-ADJYTN6G/TR	G45XX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XX = Date Code.

YYY X X

Date Code - Month
Date Code - Year
Serial Number

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

Input Voltage Range on SW, VOUT, VCC, FB, EN	
0.3V to 6V	
Package Thermal Resistance	
TSOT-23-6, θ_{JA} 50°C/W	
Junction Temperature+150°C	
Storage Temperature Range65°C to +150°C	
Lead Temperature (Soldering, 10s)+260°C	
ESD Susceptibility	
HBM4000V	
MM400V	
CDM 1000V	

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range	2.2V to 5.5V
Operating Temperature Range	40°C to +85°C
Operating Junction 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.

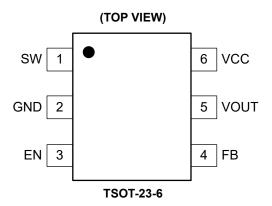
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged 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	SW	Boost Switch Node. Connect this node to one terminal of power inductor.
2	GND	Ground.
3	EN	Enable Input. Input logic high to enable this circuit and logic low to shut down. Do not leave this pin unconnected.
4	FB	Output Voltage Feedback Input or Internally Connected Pin. Connect to tap of external resister divider for SGM66051-ADJ; leave it floating for SGM66051-5.1 and SGM66051-5.4.
5	VOUT	Boost Converter Output. Place a storage capacitor close to this pin.
6	VCC	Supply Input.

ELECTRICAL CHARACTERISTICS

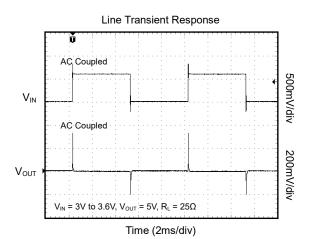
 $(V_{IN} = 3.6V. \text{ Full} = -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}, \text{ typical values are at } T_{A} = +25^{\circ}\text{C}, \text{ unless otherwise noted.})$

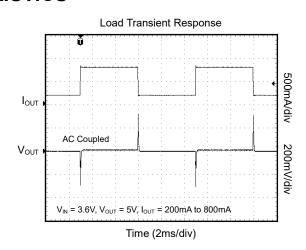
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS	
DC/DC Stage	•		<u> </u>				•	
Output Voltage Range	V _{OUT}	V _{IN} < 0.9V _{OUT}	Full	3.0		5.5	V	
Input Voltage Range	V _{IN}		+25°C	2.2		5.5	V	
Feedback Voltage	V_{FB}	SGM66051-ADJ	Full	478	495	510	mV	
Switching Frequency	f		Full	850	1100	1300	kHz	
Switch Current Limit	ΙL		+25°C	2.15	2.7	3.25	Α	
Start-Up Current Limit			+25°C		500		mA	
Boost Switch On-Resistance		V _{OUT} = 5.1V	+25°C		100		mΩ	
Rectifying Switch On-Resistance		V _{OUT} = 5.1V	+25°C		110		mΩ	
Outual Vallana		SGM66051-5.1	Full	4.86	5.05	5.18	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	
Output Voltage		SGM66051-5.4	Full	5.19	5.35	5.48	V	
Line Regulation		$V_{CC} = 2.7V \text{ to } V_{OUT} - 0.5V$	+25°C		0.5		%	
Load Regulation			+25°C		0.5		%	
Quiescent Current	ΙQ	$V_{EN} = V_{CC} = 3.6V$, not switching	+25°C		20	35	μA	
Shutdown Current		V _{EN} = 0V, V _{CC} = 3.6V	+25°C			1	μA	
Control Stage								
EN Input Low Voltage	V _{IL}		Full			0.4	V	
EN Input High Voltage	V _{IH}		Full	1.6			V	
EN Input Current		Clamped on GND or VCC	Full			1	μA	
Over-Temperature Protection			•		150		°C	
Over-Temperature Hysteresis					20		°C	

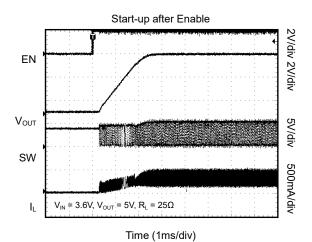
RECOMMENDED COMPONENTS OF TEST CIRCUITS

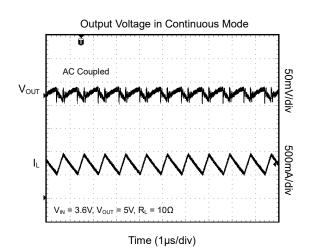
	Component		Component
Inductor	2.2uH/CDRH5D28RHPNP-2R2NC	Capacitor	10μF/08055C106KAT2A
inductor	2.2µH/CDRH3D28RHPNP-2R2NC	Capacitor	22μF/08055C226KAT2A

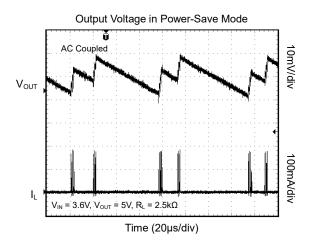
TYPICAL PERFORMANCE CHARACTERISTICS



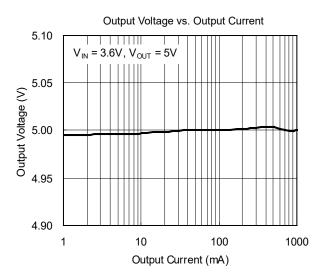


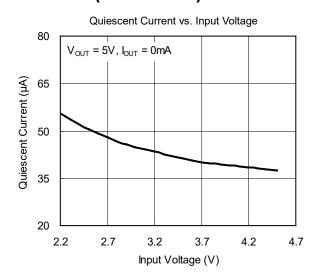


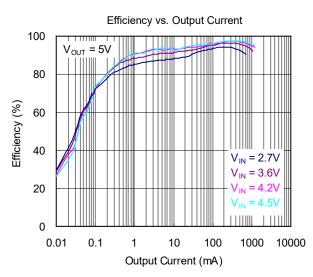


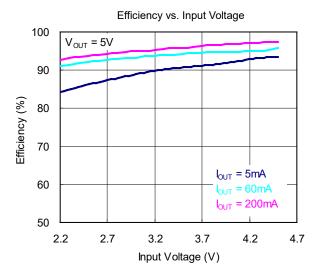


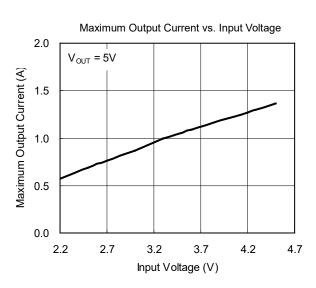
TYPICAL PERFORMANCE CHARACTERISTICS (continued)











TYPICAL APPLICATION CIRCUITS

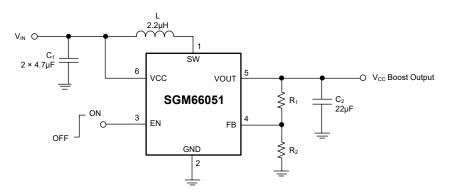


Figure 2. Power Supply Solution Having Small Total Solution Size

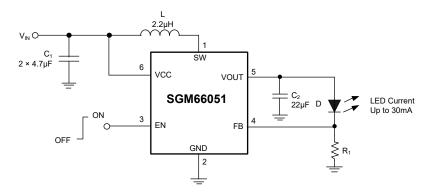


Figure 3. Circuit of Powering White LEDs in Lighting Applications

FUNCTIONAL BLOCK DIAGRAM

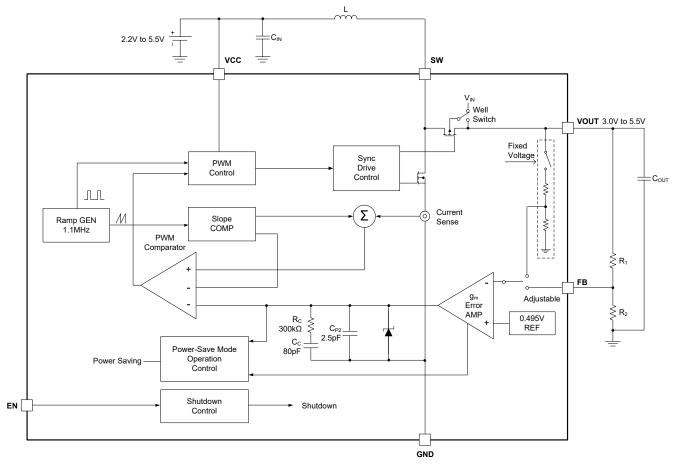


Figure 4. Block Diagram

APPLICATION INFORMATION

Design

The SGM66051 is a synchronous Boost converter capable of starting up from 2.2V input, which is suitable for majority of readily available input sources. The device is capable of providing up to 5.5V output, and the integrated power MOSFET has 2.7A (TYP) switch current limit.

Output Voltage Configuration

The SGM66051 supports output voltage up to 5.5V, and a resistor divider connected at FB pin is used to configure the output voltage. The resistive divider value is calculated via Equation 1.

$$\frac{V_{OUT} - V_{FB}}{R_1} = \frac{V_{FB}}{R_2} \tag{1}$$

For simplicity, $110k\Omega$ is recommended for R_2 . A $1M\Omega$ resistor for R_1 configures the output voltage to 5V.

Inductor Selection

Inductor is an essential element for today's DC/DC switch mode power supplies regardless of topology. Inductor serves as the energy storage element for power conversion. Inductance and inductor's saturation current are two most important criterions for inductor selection. For general rule of thumb, the selected inductance should provide a peak to peak ripple current that is around 30% of the average inductor current at full load and nominal input voltage. The average inductor current for a Boost converter is the input current. Equation 2 shows the calculation of inductance selection, where f is the switching frequency, $\Delta I_{\rm L}$ is the inductor ripple current.

$$L = \frac{V_{CC}}{\Delta I_{L} \times f_{SW}} \times \left(1 - \frac{V_{IN}}{V_{O}}\right)$$
 (2)

The selected inductor should have a saturation current rating higher than the 2.7A current limit of SGM66051.

Lastly, the inductor affects the close loop response of the DC/DC converter. The SGM66051 is an internally compensated device with the loop response optimized for inductor in the range of $2.2\mu H$ to $10\mu H$.

Input Capacitor

Boost converter's input capacitor sees continuous current throughout the entire switching cycle. A $10\mu F$ ceramic capacitor is recommended to place as close as possible

between the VCC pin and GND pin of SGM66051. For the applications where the SGM66051 is located far away from the input source, a $47\mu F$ or higher capacitance capacitor is recommended to damp the wiring harness's inductance.

Output Capacitor

The output capacitors of Boost converter dictate the output voltage ripple and load transient response. Equation 3 is used to estimate the necessary capacitance to achieve desired output voltage ripple. Where ΔV is the maximum allowed ripple.

$$C_{MIN} = \frac{I_{O} \times (V_{OUT} - V_{CC})}{f \times \Delta V \times V_{OUT}}$$
(3)

Again, the SGM66051 is an internally compensated device. The loop response is optimized for capacitor in the range of $4.7\mu F$ to $22\mu F$. Due to the DC bias nature of ceramic capacitors, care should be taken by verifying manufacture's datasheet to ensure enough effective capacitance at desired output voltage.

Layout Guidelines

In addition to component selection, layout is a critical step to ensure the performance of any switch mode power supplies. Poor layout could result in system instability, EMI failure, and device damage. Thus, place the inductor, input and output capacitors as close to the IC as possible, and use wide and short traces for current carrying traces to minimize PCB inductance.

For Boost converter, the output capacitor's current loop from VOUT pin back to the GND pin of the device should be as small as possible.

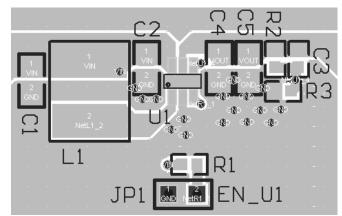


Figure 5. Layout Example

SGM66051

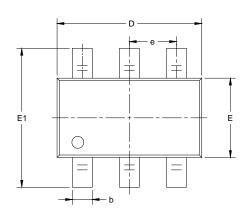
REVISION HISTORY

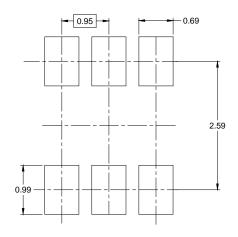
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

MAY 2022 – REV.A.3 to REV.A.4	Page
Updated Application Information section	9
DECEMBER 2021 – REV.A.2 to REV.A.3	Page
Updated the Figure 2 Block Diagram and Programming Output Voltage sections	8, 9
NOVEMBER 2021 – REV.A.1 to REV.A.2	Page
Added the Figure 1 Block Diagram and Figure 5. Layout Example sections	8, 9
FEBRUARY 2021 – REV.A to REV.A.1	Page
Updated FEATURES and RECOMMENDED OPERATING CONDITIONS	1, 2
Changes from Original (MARCH 2016) to REV.A	Page
Changed from product preview to production data	All

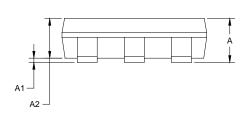


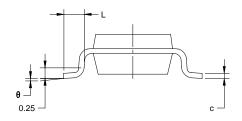
PACKAGE OUTLINE DIMENSIONS TSOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dir	Dimensions In Millimeters					
Symbol	MIN	MOD	MAX				
А	-	-	1.100				
A1	0.000	-	0.100				
A2	0.700	-	1.000				
b	0.300	-	0.500				
С	0.080	-	0.200				
D	2.820	-	3.050				
Е	1.550	-	1.700				
E1	2.650	-	2.950				
е	0.950 BSC						
L	0.300	-	0.600				
θ	0°	-	8°				

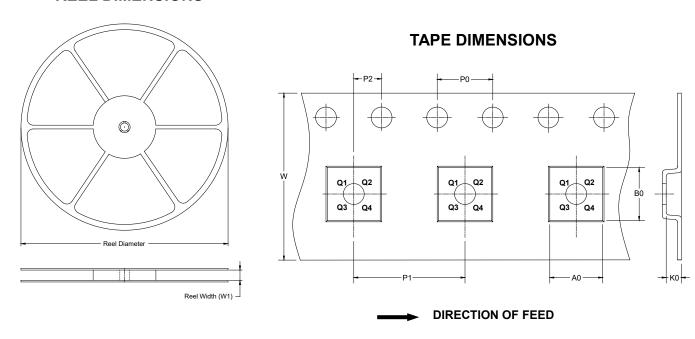
NOTES

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



TAPE AND REEL INFORMATION

REEL DIMENSIONS

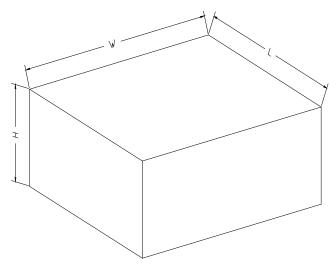


NOTE: The picture is only for reference. Please make the object as the standard.

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
TSOT-23-6	7"	9.5	3.20	3.10	1.10	4.0	4.0	2.0	8.0	Q3

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