



# SGM3727

## High Efficiency, 38V Step-Up WLED Driver

### GENERAL DESCRIPTION

The SGM3727 is a step-up DC/DC converter designed for driving the white LEDs with an externally programmable constant current. This device features integrated, 38V power MOSFET that is capable of driving up to 10 white LEDs in series, providing inherent current matching for uniform brightness. WLED brightness adjustment is easily achieved via a single wire interface, totally 32 brightness levels of LED Dimming.

The SGM3727 features a variety of protection circuits, including integrated over-voltage protection (OVP), soft-start, cycle-by-cycle current limiting, and thermal shutdown protection circuitry.

The SGM3727 has 1A current limit. It is available in Green TDFN-2x2-8L package. It operates over an ambient temperature range of -40°C to +85°C.

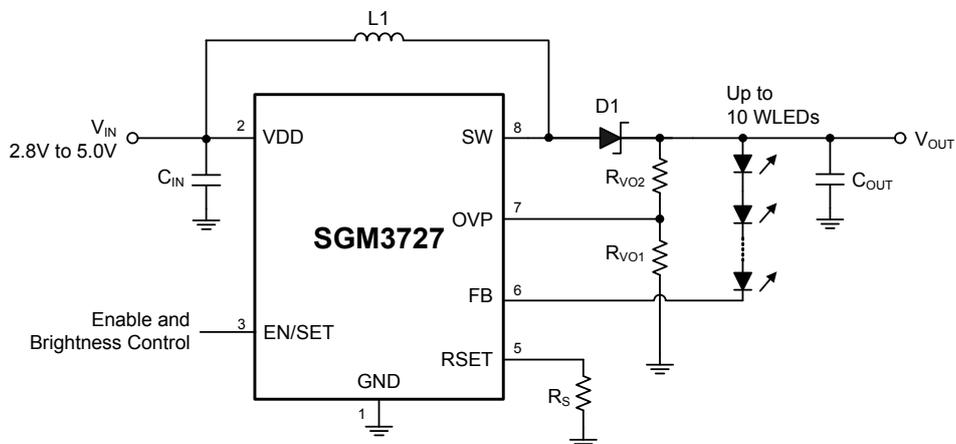
### FEATURES

- High-Efficiency Boost DC/DC WLED Bias Supply
- Internal 38V, 0.5Ω Power MOSFET
- Up to 10 Serial White LEDs per String
- Switch Current Limit: 1A
- Single Wire Interface 32 Brightness Levels for LED Dimming
- Programmable OVP Voltage
- Soft-Start Function
- No Leakage from  $V_{IN}$  to GND through LED String
- Thermal Shutdown
- Cycle-by-Cycle Over-Current Protection
- -40°C to +85°C Operating Temperature Range
- Available in Green TDFN-2x2-8L Package

### APPLICATIONS

- TFT LCD Displays
- Smart Phones
- Portable Media Players
- GPS/Personal Navigation Devices

### TYPICAL APPLICATION



**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDER NUMBER	MARKING INFORMATION	PACKAGE OPTION
SGM3727	TDFN-2x2-8L	-40°C to +85°C	SGM3727YDE8G/TR	3727 XXXX	Tape and Reel, 3000

NOTE: XXXX = Date Code.

**ABSOLUTE MAXIMUM RATINGS**

SW, FB to GND.....-0.3V to 40V  
 VDD, EN/SET to GND.....-0.3V to 6V  
 RSET, OVP to GND.....-0.3V to 6V  
 Continuous SW Current.....Internally limited to 1A  
 Package Thermal Resistance  
 TDFN-2x2-8L,  $\theta_{JA}$ .....75°C/W  
 Storage Temperature Range..... -65°C to +150°C  
 Junction Temperature.....150°C  
 Operating Temperature Range..... -40°C to +85°C  
 Lead Temperature (Soldering 10 sec).....260°C  
 ESD Susceptibility  
 HBM.....4000V  
 MM.....200V

NOTE:

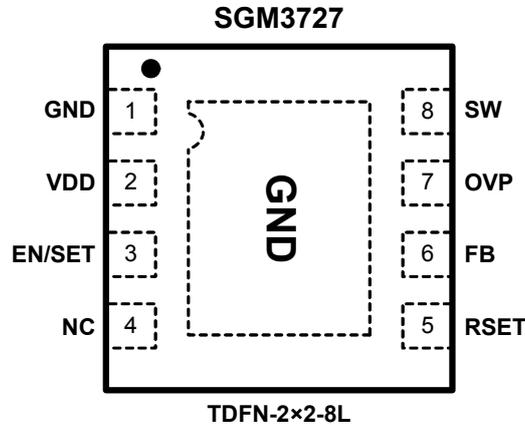
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**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.

SGMICRO reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SGMICRO sales office to get the latest datasheet.

**PIN CONFIGURATION (TOP VIEW)**



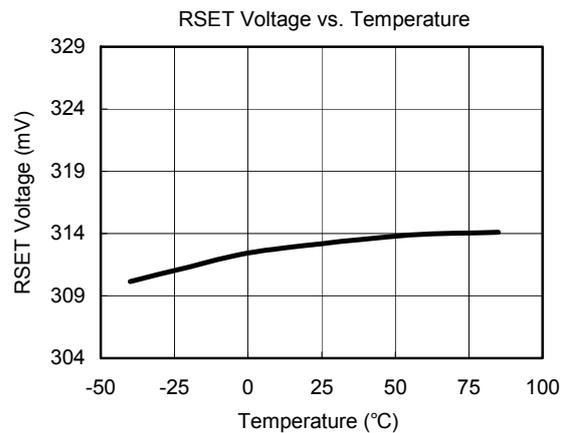
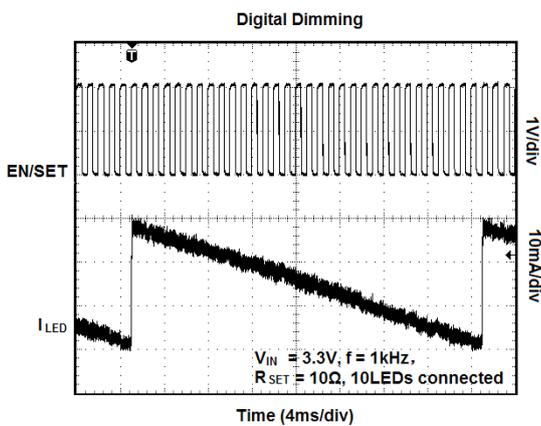
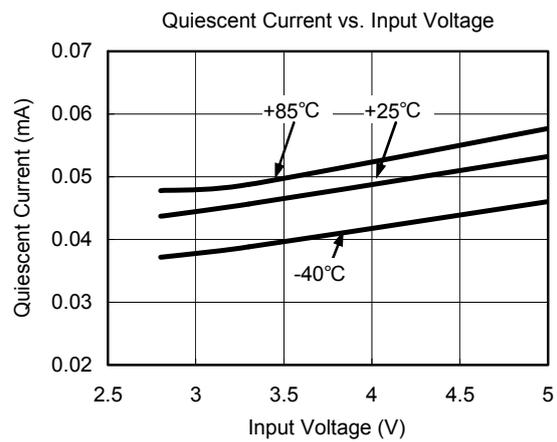
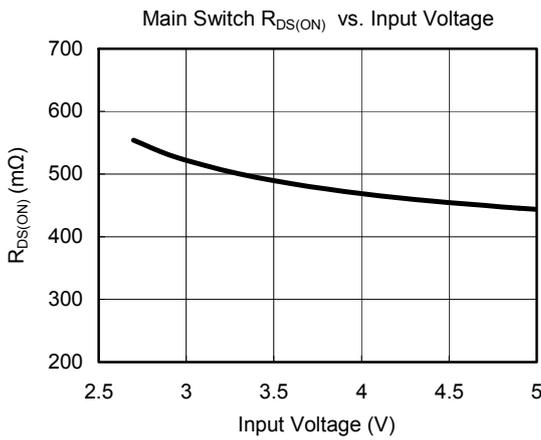
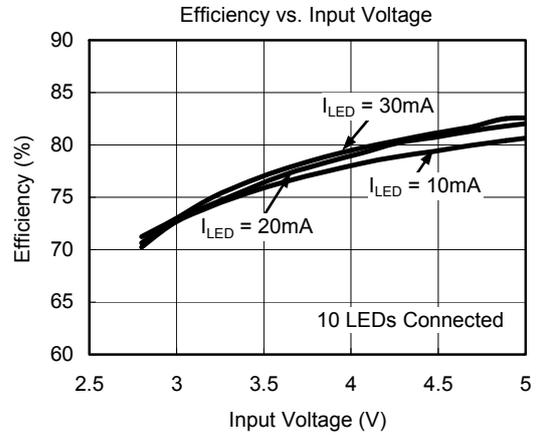
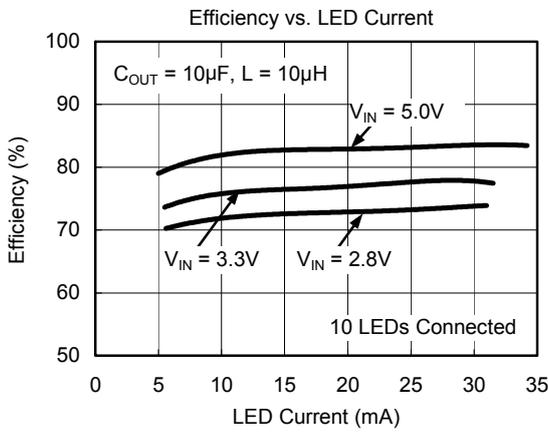
**PIN DESCRIPTION**

PIN	NAME	FUNCTION
1	GND	Ground.
2	VDD	Supply Input.
3	EN/SET	Enable Control and Single Wire Dimming Interface. Drive to a logic high to enable the device. Use pulse to dim LED brightness. Keep EN/SET pin in "Low" status for 3ms to shut down chip.
4	NC	No Connection.
5	RSET	RSET Pin. Connect one resistor from RSET to GND to program the maximum white LED current.
6	FB	Feedback Input. Connect this pin to the cathode of the white LED.
7	OVP	Over-Voltage Protection Input. The IC is automatically disabled when the voltage at this pin exceeds 1.24V. Connect OVP pin to the center point of a resistive voltage divider connected across the LED string.
8	SW	Switch Output. Connect this pin to the inductor and the Schottky diode.
Exposed Pad	GND	Exposed pad should be soldered to PCB board and connected to GND.

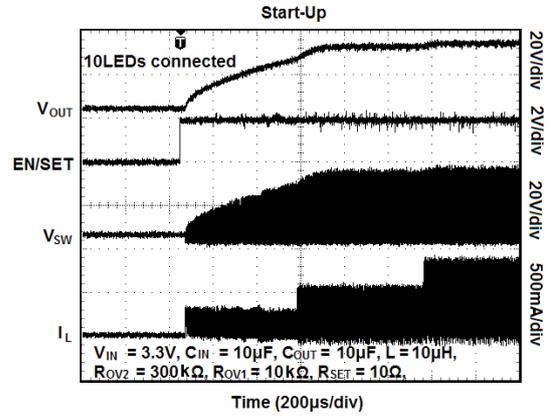
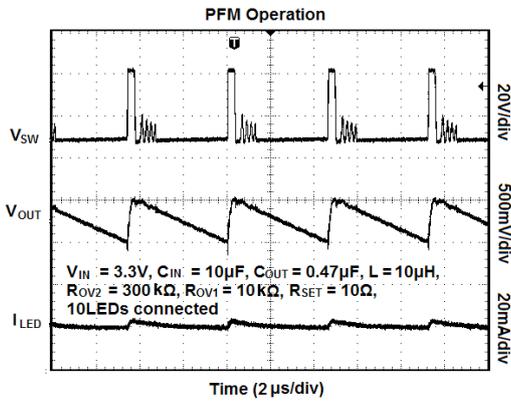
**ELECTRICAL CHARACTERISTICS**(V<sub>IN</sub> = 3.3V, V<sub>EN</sub> = 2.8V, T<sub>A</sub> = 25°C, unless otherwise specified.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage	V <sub>IN</sub>		2.8		5.0	V
Power Switch Voltage Rating					38	V
Under-Voltage Lockout Threshold	V <sub>UVLO</sub>	V <sub>IN</sub> Rising	2.1	2.2	2.45	V
Under-Voltage Lockout Hysteresis				70		mV
Supply Current		Not Switching		0.045	0.08	mA
		Switching		0.12	0.16	mA
Supply Current in Shutdown	I <sub>SHDN</sub>	EN/SET = GND		0.2	1	μA
Maximum On Time	t <sub>ON</sub>	V <sub>IN</sub> = 3.5V	5	6.2	7.5	μs
Minimum Off Time	t <sub>OFF</sub>		300	420	550	ns
RSET Voltage	V <sub>RSET</sub>		300	314	330	mV
Switch Current Limit	I <sub>LIM</sub>		750	1000	1250	mA
Switch On Resistance	R <sub>DS(ON)</sub>	V <sub>IN</sub> = 3.3V		0.5	1	Ω
LED Switch On Resistance		V <sub>IN</sub> = 3.3V (from FB to RSET)		2.2		Ω
Switch Leakage Current		V <sub>SW</sub> = 38V, EN/SET = GND		0.1		μA
Over-Voltage Protection Threshold		V <sub>OVP</sub> Rising	1.1	1.24	1.31	V
OVP Input Current		V <sub>OVP</sub> = 1.5V		1	300	nA
EN/SET Input Current		V <sub>EN</sub> = 0V or 2.8V		0.1	1	μA
Thermal Shutdown Temperature				155		°C
Thermal Shutdown Hysteresis				25		°C
<b>EN/SET LOGIC</b>						
EN Low Time for Shutdown	T <sub>SHDN</sub>		3			ms
EN Low Time for Dimming	T <sub>IL</sub>		0.5		500	μs
EN High Time for Dimming	T <sub>IH</sub>		0.5			μs
EN Threshold	Logic-High Voltage	V <sub>IH</sub>	1.5			V
	Logic-Low Voltage	V <sub>IL</sub>			0.5	V

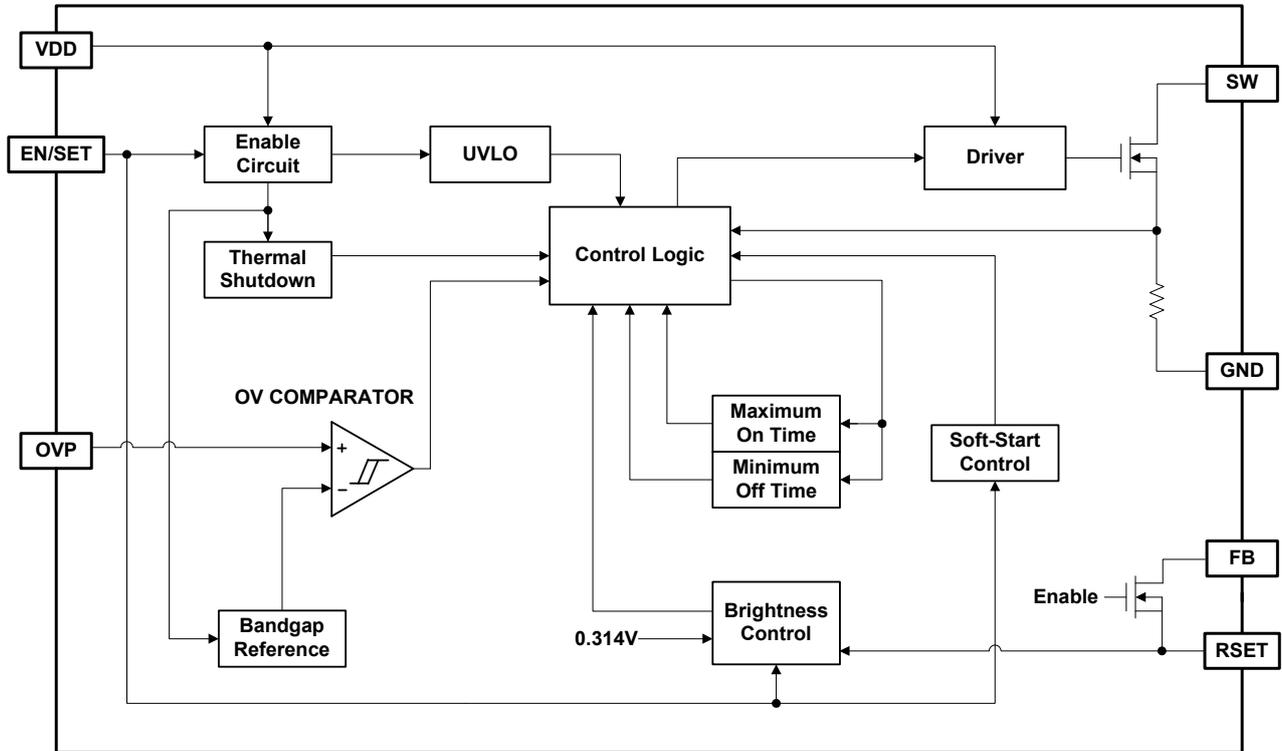
TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



FUNCTIONAL BLOCK DIAGRAM



**OPERATION**

**Control Scheme**

The SGM3727 uses a minimum off-time, peak current control scheme to achieve excellent performance under high duty-cycle operating conditions. This control scheme initiates a switching cycle only when needed to maintain output voltage regulation, resulting in very high efficiency operation.

During each switching cycle, the N-Channel power MOSFET turns on, increasing the inductor current. The switching cycle terminates when either the inductor current reaches the current limit of 1A or when the cycle lasts longer than the maximum on-time of 6.2µs. Once the MOSFET turns off, it remains off for at least the minimum off-time of 420ns, then another switching begins when the error comparator detects that the output is falling out of regulation again.

**Soft-Start**

The SGM3727 limits the in-rush current during start-up by increasing the current limit in two steps starting from  $I_{LIM}/3$  for 256 switch cycles to  $I_{LIM} \times 2/3$  for the next 256 switch cycles and then full current limit. See the Typical Performance Characteristics for typical start-up behavior.

**Single Wire Pulse Dimming Control**

The SGM3727 implements a pulse dimming method to control the brightness of white LEDs. Users can easily configure the LED current from 1.25mA to 30mA by a serial pulse. The dimming of white LEDs' current can be achieved by applying a pulse signal to the EN/SET pin. There are totally 32 current steps could be set by users. The detail operation of brightness dimming is shown in Figure 1.

**Shutdown**

The SGM3727 features low-current shutdown mode. In shutdown mode, the control circuitry is disabled, the LEDs are disconnected and the quiescent supply current drops to less than 1µA. To disable the SGM3727, simply drive EN/SET to a logic low for more than 3ms. To enable the ICs, drive EN/SET to a logic high or connect it to the input supply.

**Over-Voltage Protection**

The SGM3727 includes internal over-voltage protection circuitry that monitors the OVP pin voltage. Over-voltage protection is critical when one of the LEDs in the LED string fails as an open circuit. When this happens, the feedback voltage drops to zero, and the control switches at maximum on time causing the output voltage to keep rising until it exceeds the maximum voltage rating of the power MOSFET. The SGM3727's over-voltage protection detects this condition and switching ceases if the voltage at the OVP pin reaches 1.24V and stays for about 10µs. To set the maximum output voltage, connect a resistor divider from the output node to GND, with center tap at OVP, and select the two resistors with the following equation:

$$R_{OV2} = R_{OV1} \times \left[ \left( \frac{V_{OVP}}{1.24V} \right) - 1 \right]$$

where  $V_{OVP}$  is the over-voltage detection threshold,  $R_{OV1}$  is the resistor between OVP pin and GND, and  $R_{OV2}$  is the resistor from the output to the OVP pin. As a first estimate, the OVP threshold can often be set to 3.8V times the number of LEDs in the string. The  $C_{OUT}$  has an effect on the final  $V_{OVP}$ . Considering the OVP comparator has some delay, the final measured  $V_{OVP}$  could be higher than the set  $V_{OVP}$  if  $C_{OUT}$  is small.

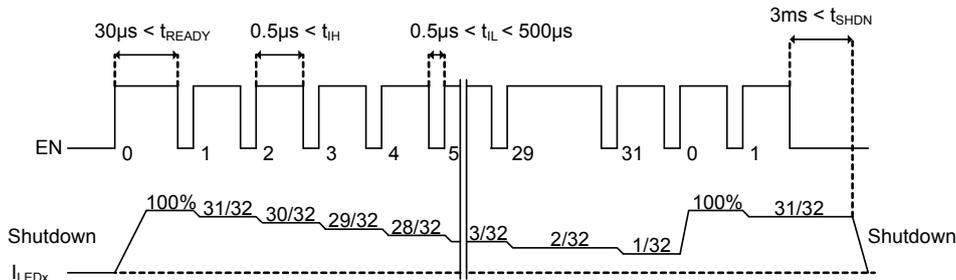


Figure 1. Brightness Control by Pulse Dimming

## APPLICATION INFORMATION

### Setting the Maximum LED Current

The maximum LED current is programmed by appropriate selection of the resistor  $R_S$  connected between RSET pin and GND. To set the full LED current, choose the resistor according to the equation:

$$R_S = \frac{V_{RSET}}{I_{LED}} = \frac{0.314}{I_{LED}}$$

where  $V_{RSET}$  is the voltage reference and  $I_{LED}$  is the desired maximum LED current, such as 30mA. The current in white LED can be adjusted via the EN/SET single wire interface to provide a simple means of LED dimming.

### Inductor Selection

The SGM3727 was designed for operation with inductors in the 2.2 $\mu$ H to 22 $\mu$ H range. Keep in mind that larger-valued inductors (usually requiring higher  $V_{IN}$ ) generally yield higher efficiency due to lower switching frequency, while smaller inductors typically yield a smaller footprint but at the cost of lower efficiency. For best results, choose an inductor with a low DC-Resistance (DCR) and be sure to choose an inductor with a saturation current that exceeds the 1A current limit.

### Diode Selection

The SGM3727 requires a Schottky diode as the rectifier. Select a low forward voltage drop Schottky diode with forward current ( $I_F$ ) rating that exceeds the peak current limit of 1A and a peak repetitive reverse voltage ( $V_{RRM}$ ) rating that exceeds the maximum output voltage, typically set by the OVP threshold.

### Capacitor Selection

The SGM3727 only requires a tiny 0.47 $\mu$ F output capacitor for most applications. For better output voltage filtering, a low ESR output capacitor is recommended. The selection of the output capacitor value directly influences the output voltage ripple of the converter which also influences line regulation. The ripple can be improved by adding a small feed-forward capacitor from OUT to FB. 3000pF is a good starting point for most applications.

For circuits driving 6 or fewer LEDs, a 4.7 $\mu$ F input capacitor is generally suitable. For circuits driving more than 6 LEDs, a 10 $\mu$ F input capacitor may be required.

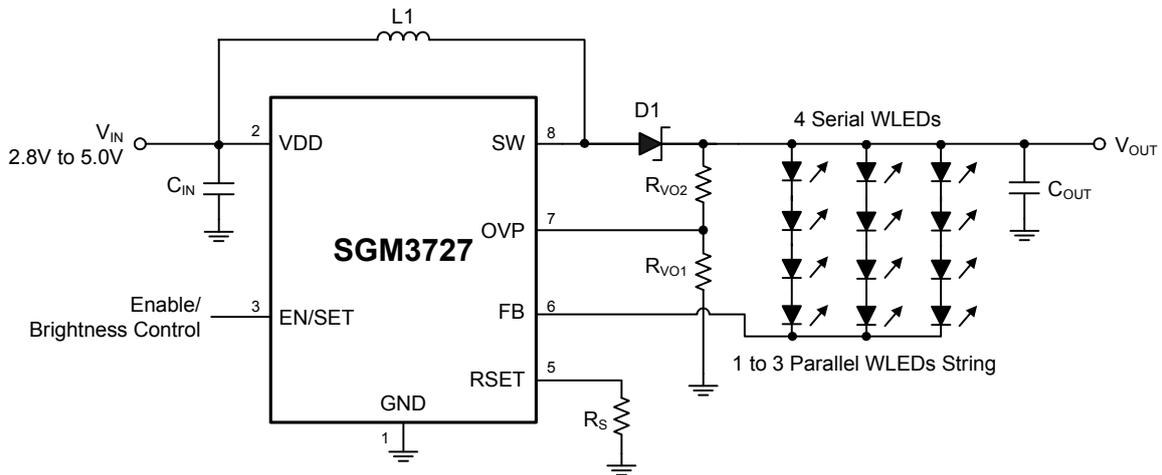
Ceramic capacitors are recommended for most applications. For best performance, use X5R and X7R type ceramic capacitors, which possess less degradation in capacitance over voltage and temperature.

### Low Input Voltage Application

In applications that have low input voltage range, such as those powered from 2~3 AA cells, the SGM3727 may still be used if there is a suitable system supply (such as 3.3V) available to power the controller. In such an application, the inductor may be connected directly to the battery, while the IC power is supplied by the system supply.

**TYPICAL APPLICATION**

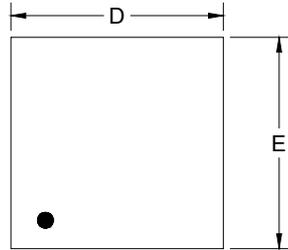
The SGM3727 can drive different WLEDs topologies. For example, Figure 2 shows the 3 × 4 WLEDs configuration. The total WLEDs current can be set by the  $R_S$  which is equal to following equation:  $I_{TOTAL} = \frac{V_{RSET}}{R_S}$



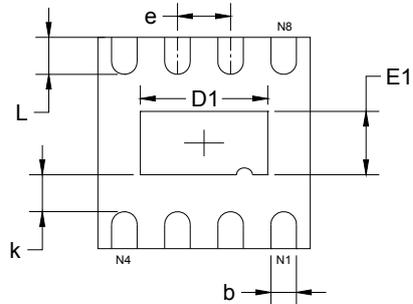
**Figure 2. Application for Driving 3 × 4 WLEDs**

PACKAGE OUTLINE DIMENSIONS

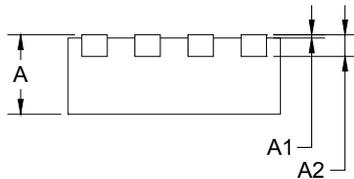
TDFN-2x2-8L



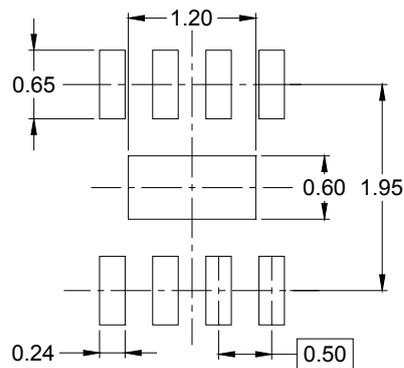
TOP VIEW



BOTTOM VIEW



SIDE VIEW

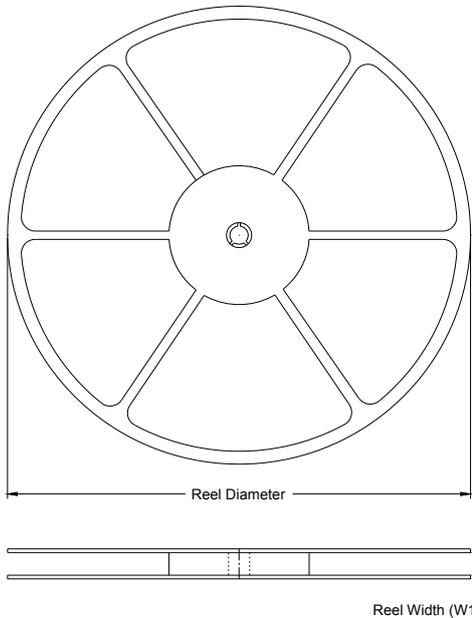


RECOMMENDED LAND PATTERN (Unit: mm)

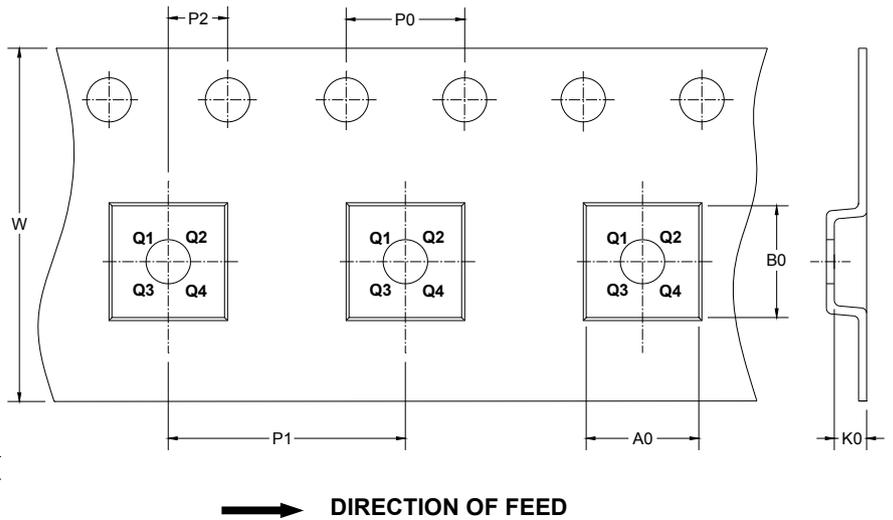
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.500	0.700	0.020	0.028
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.250	0.450	0.010	0.018

**TAPE AND REEL INFORMATION**

**REEL DIMENSIONS**



**TAPE DIMENSIONS**



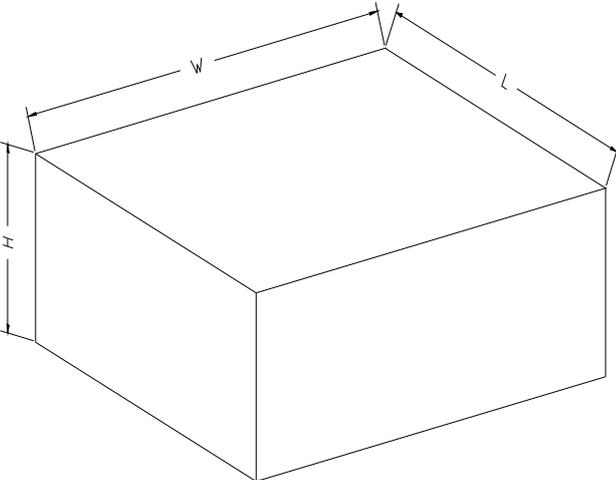
NOTE: The picture is only for reference. Please make the object as the standard.

**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
TDFN-2x2-8L	7"	9.50	2.30	2.30	1.10	4.00	4.00	2.00	8.00	Q1

**SGM3727**

**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