PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3735	TDFN-2×2-8L	-40℃ to +85℃	SGM3735YTDE8G/TR	3735 XXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXX = Date Code.

XXXX

- Date Code - Week
- Date Code - Year

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, V_{IN} .... -0.3V to 6V
High Voltage Nodes, SW, VOUT .... -0.3V to 40V
Other Pins, FB, EN/SET ....-0.3V to V_{IN} + 0.3V
Package Thermal Resistance
TDFN-2×2-8L, θ_{JA} .... 75℃/W
Junction Temperature ....+150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility
HBM 3000V
MM 200V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range .... -40℃ to +85℃

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.

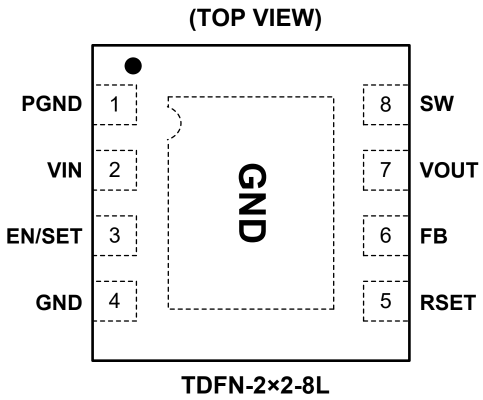
ESD SENSITIVITY CAUTION

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.

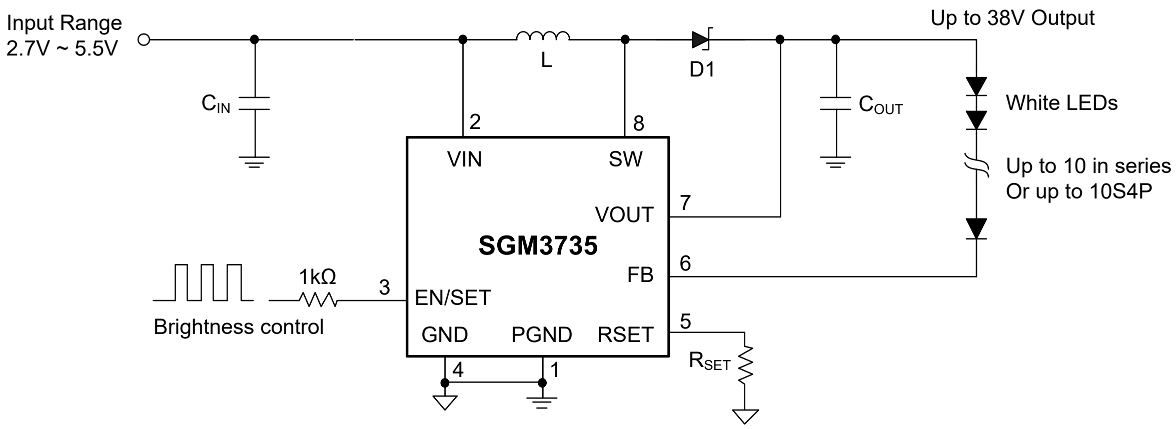
PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	PGND	Power Ground.
2	VIN	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	GND	Ground.
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	VOUT	Output and Over-Voltage Protection Pin.
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.

TYPICAL APPLICATION



ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, L = 10μH, C_{IN} = 10μF, C_{OUT} = 0.47μF, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

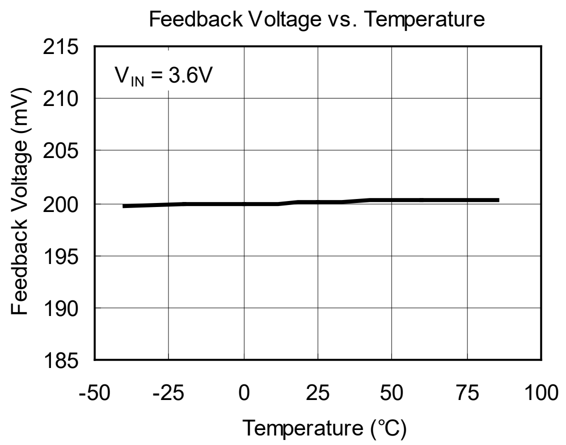
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
IC Supply							
Input Voltage Range	V_{IN}		Full	2.7		5.5	V
Input Under-Voltage Lockout	UVLO	Rising edge	+25℃		2.5	2.6	V
UVLO Hysteresis	V_{HYS}		+25℃		0.15		V
Quiescent Current (Non Switching)	I_Q	V_{FB} = 0.4V	+25℃		0.20	0.35	mA
Operating Current (Switching)	I_Q	V_{FB} = 0V	+25℃		0.72	1.20	mA
VIN Pin Shutdown Current	I_{SHDN}	V_{EN} = 0V	+25℃		0.1	1	μA
Step-Up Converter							
Voltage Feedback Regulation Voltage	V_{REF}		Full	192	200	212.5	mV
NMOS On-Resistance	$R_{DS(ON)}$		+25℃		0.36	0.55	Ω
SW Pin Leakage Current	I_{SW}		+25℃		0.01	1	μA
Peak NMOS Current Limit	I_{LIM}		+25℃	1.0	1.35	1.7	A
Oscillator Frequency	f_S		Full	0.8	1.0	1.22	MHz
Maximum Duty Cycle	D_{MAX}		+25℃	92	95		%
Over-Voltage Threshold	V_{OVP}	Measured at VOUT pin	Full	35.5	38	40.5	V
Start-Up Time	t_S		+25℃		800		μs
Control							
Logic Low Threshold	V_{IL}		Full			0.35	V
Logic High Threshold	V_{IH}		Full	1.5			V
Minimum Logic High Pulse Width Timing	t_{HIGH_MIN}		+25℃	0.4			μs
Logic Low Pulse Width Timing	t_{LOW}		+25℃	0.4		750	μs
Minimum Shutdown Pulse Width Timing	t_{OFF}		+25℃	3			ms
Junction Thermal Shutdown Threshold					150		℃
Junction Thermal Shutdown Hysteresis					15		℃

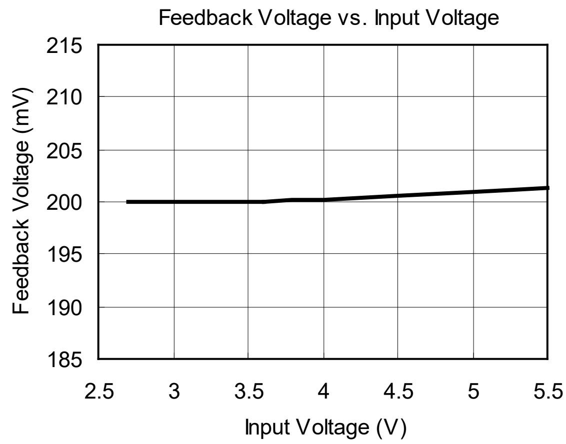
NOTE:

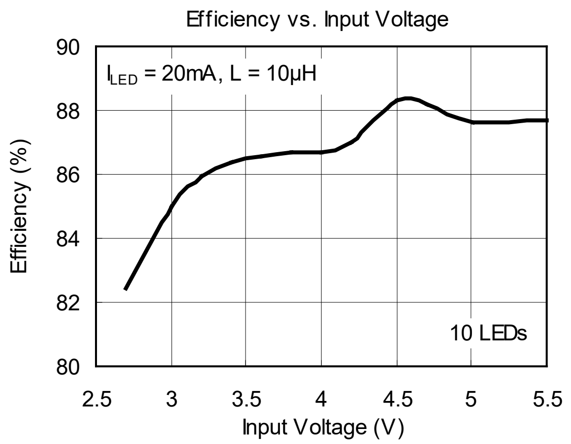
1. The SGM3735 is guaranteed to meet performance specifications over the -40℃ to +85℃ operating temperature range by design, characterization and correlation with statistical process controls.

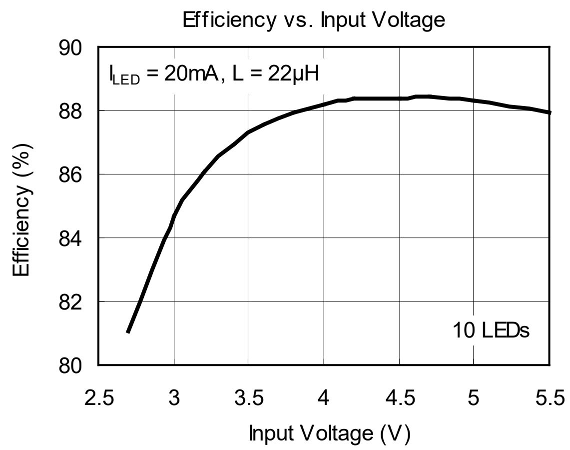
TYPICAL PERFORMANCE CHARACTERISTICS

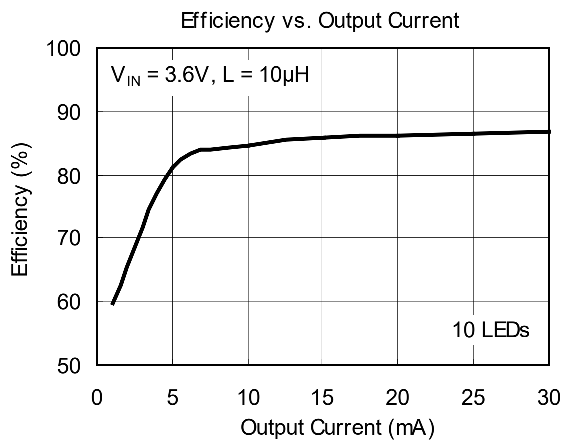
T_A = +25℃, L = 10μH, C_{IN} = 10μF, C_{OUT} = 0.47μF, unless otherwise noted.

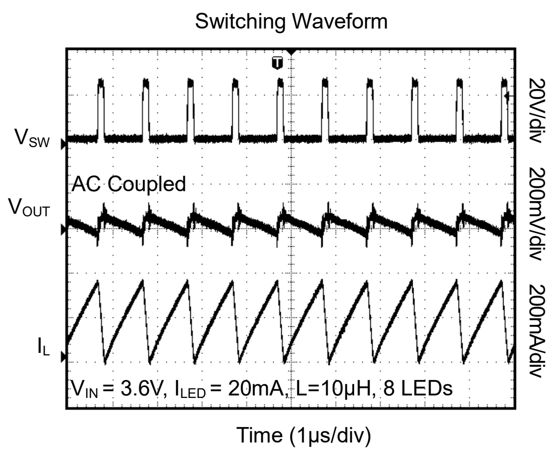








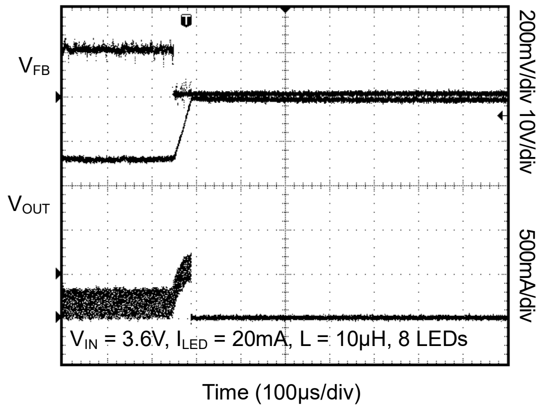




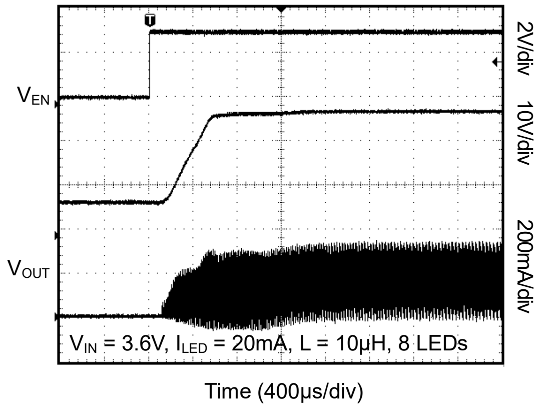
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, L = 10μH, C_{IN} = 10μF, C_{OUT} = 0.47μF, unless otherwise noted.

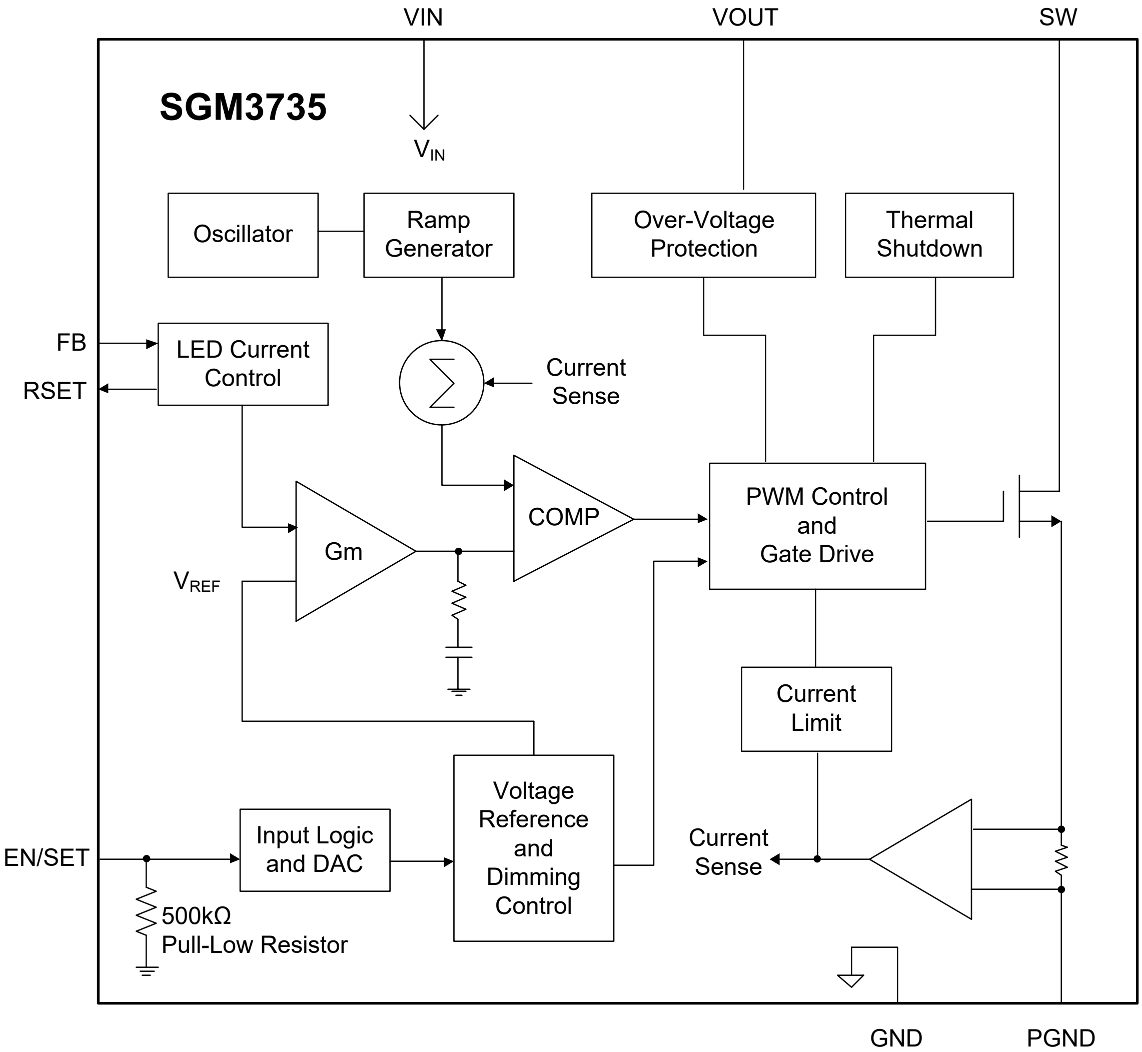
Open LED Protection



Start-Up



FUNCTIONAL BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The SGM3735 uses a constant-frequency current-mode boost converter architecture to control the LED current by regulating the feedback voltage. Please refer to the Functional Block Diagram above for an explanation of SGM3735 operation. The beginning of each cycle turns on the Power MOSFET. A slope compensation ramp is added to the output of the current sense amplifier and the result is fed into the positive input of the comparator (COMP). When this voltage goes above the output voltage of the error amplifier (Gm), the Power MOSFET is turned off. The voltage at the output of the Gm block amplifies the difference between the reference voltage and the feedback voltage (FB), so that FB voltage can be regulated to the reference voltage.

The SGM3735 has built-in soft-start to limit the inrush current during start-up and to limit the amount of overshoot on the output. Protection features in the SGM3735 include over-voltage protection (OVP), cycle-by-cycle current limit protection and thermal shutdown. OVP protects in the event where an LED fails open, which forces the feedback voltage to zero. This causes the boost converter to operate in maximum duty cycle mode, ramping up the output voltage. Switching will stop when the output reaches the OVP threshold. The OVP feature protects the IC from damaging itself by exceeding the voltage rating on SW/VOUT pins.

The single wire control interface accepts a series of pulses into the EN/SET pin to program the reference voltage. The number of rising edges is detected internally and decoded as illustrated in Table 1. The register contains 5 bits, yielding 32 different current levels. Using the simplest control method, output current can be toggled on and off between I_{MAX} and 0mA, by pulling the EN/SET pin high or low. I_{MAX} is programmed by the resistor connected between FB and GND. Please see LED Maximum Current Setting section in this document to determine the proper resistor value. The next level of control is achieved by injecting a series of pulses into the EN/SET pin to program the reference voltage at 32 levels. The number of rising edges is detected internally and decoded to the current level as illustrated in Table 1. The reference voltage levels are evenly spaced among these 32 steps.

The first rising edge on the EN/SET pin takes the current level to maximum of 100% of I_{MAX}. Then the current will be changed with each additional qualified pulse. The current stays unchanged as long as the EN/SET pin stays High.

Table 1. Current Setting

DATA	LED Current Ratio	DATA	LED Current Ratio	DATA	LED Current Ratio	DATA	LED Current Ratio
1	32/32	**9**	24/32	**17**	16/32	**25**	8/32
2	31/32	**10**	23/32	**18**	15/32	**26**	7/32
3	30/32	**11**	22/32	**19**	14/32	**27**	6/32
4	29/32	**12**	21/32	**20**	13/32	**28**	5/32
5	28/32	**13**	20/32	**21**	12/32	**29**	4/32
6	27/32	**14**	19/32	**22**	11/32	**30**	3/32
7	26/32	**15**	18/32	**23**	10/32	**31**	2/32
8	25/32	**16**	17/32	**24**	9/32	**32**	1/32

APPLICATION INFORMATION

Inductor Selection

A 6.8μH to 22μH inductor is recommended for 10/8/6 series LED applications and 10S4P LED applications. If high efficiency is a critical requirement, a low DCR inductor should be selected. The inductor's saturation current rating should also exceed the peak input current, especially for high load current application (like 10S4P).

Capacitor Selection

Small size ceramic capacitors are ideal for SGM3735 application. An input capacitor in the range of 1μF to 22μF and a 0.47μF output capacitor are suggested for 10/8/6 series LED applications. For higher output current applications like 10S4P, larger value output capacitors like 2.2μF are recommended to minimize output ripple.

Diode Selection

The current rating of the Schottky diode should exceed the peak current of the boost converter. The voltage rating should also exceed the target output voltage.

LED Maximum Current Setting

LED maximum current setting, I_{MAX}, is determined by the feedback resistor (R_{SET} in Figure 1). The feedback voltage is internally set at 200mV when the DATA = 1. The LED current is programmed according to the formula I_{MAX} = 200mV/R_{SET}. For accurate LED current settings, precision 1% resistors are recommended. The formula and table for R_{SET} selection are shown below.

$$R_{SET} = 200mV/I_{MAX}$$

Table 2. Current Setting Resistor (1% Values)

R_{SET} (Ω) 1% Values	I_{MAX} Current (mA)
200	1
40.2	5
20.0	10
13.3	15
10.0	20
6.65	30
2.00	100

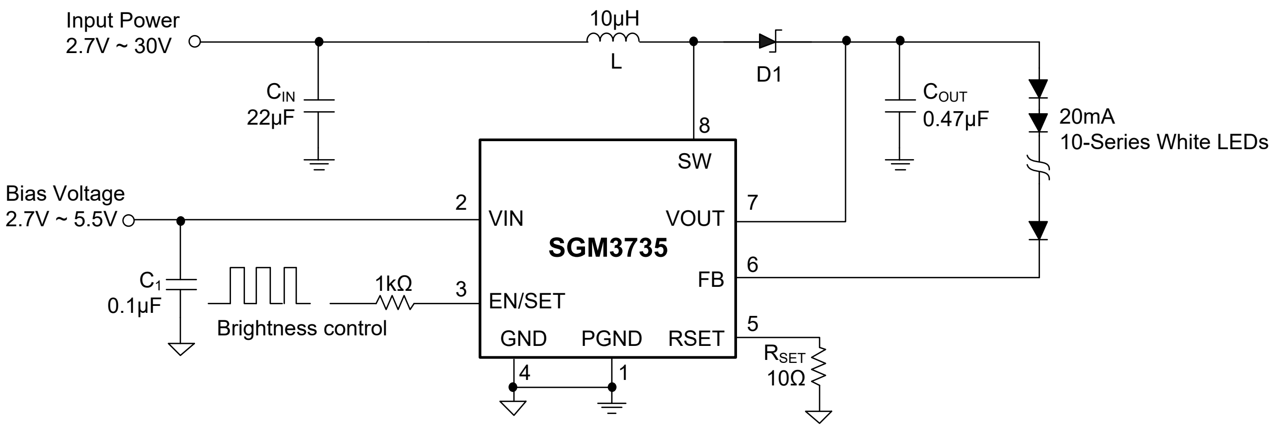


Figure 1. Application Circuit for 10 LEDs in Series with 20mA Current (VIN can be tied to input power rail if less than 5.5V)

APPLICATION INFORMATION (continued)

Current Setting at EN/SET Pin

Current control can be as simple as a bi-level signal at the EN/SET pin, resulting in LEDs ON at 100% I_{MAX} or LED OFF state. However, more sophisticated control techniques can be achieved by pulsing the EN/SET pin. Active logic low or high is required since there is no internal pull-up or pull-down at the EN/SET pin. An example for programming the output current is shown in Figure 2.

There are two ways to adjust the channels' ON/OFF state or current level. The first way is by simply adding the number of pulses according to Table 2. For example, we will use R_{SET} = 10Ω to program 20mA I_{MAX}. In this example, the user can add 12 more pulses when changing from 14/32 (8.75mA when I_{MAX} = 20mA) to 2/32 (1.25mA when I_{MAX} = 20mA). However, increasing the current level can be accomplished by two ways, allowing for more flexible programming.

Since the data in Table 1 automatically circles around after 32 pulses, adding 32 - 8 = 24 pulses changes from 6/32 (DATA 27) to 14/32 (DATA 19). The second way is to reset the IC by pulling EN/SET pin low for 3ms (guaranteed shutdown), and then inputting the desired number of pulses.

Example: going from 6/32 (DATA 27) to 14/32 (DATA 19)

Option 1: send in 24 pulses (19 + 32 - 27 = 24);
Option 2: pull low for 3ms and then send in 19 pulses.

Layout Considerations

PCB layout is very important for high frequency switching regulators in order to keep the loop stable and minimize noise. The input capacitor should be very close to the IC to get the best decoupling. The path of the inductor and output capacitor should be kept as short as possible to minimize noise and ringing. Please see the SGM3735 evaluation document for detailed PCB layout guidelines.

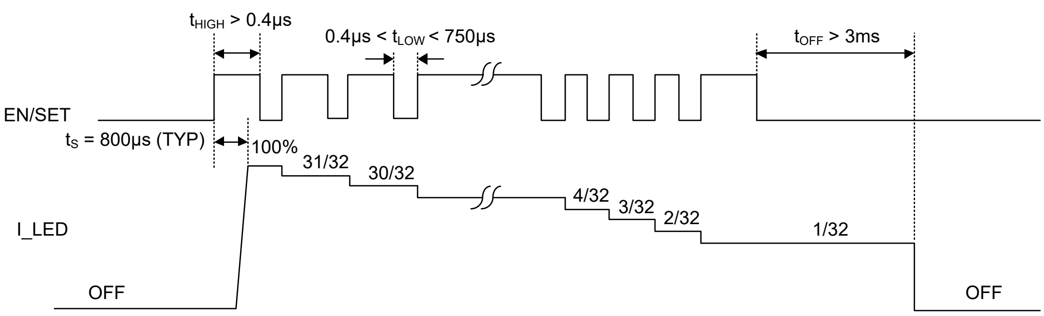


Figure 2. Output Current Programming via EN/SET Pin

REVISION HISTORY

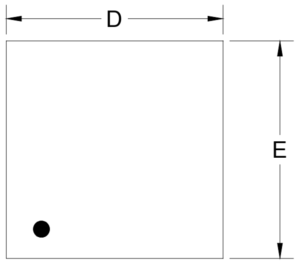
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

JULY 2014 – REV.A to REV.A.1	Page
Changed GENERAL DESCRIPTION section	1
Changed Figure 1	9

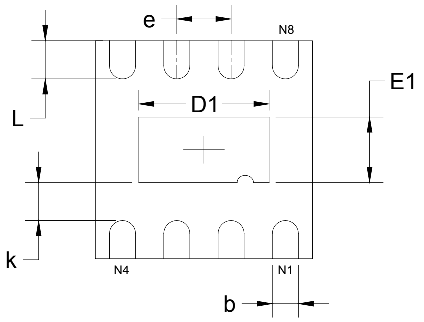
Changes from Original (MARCH 2014) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

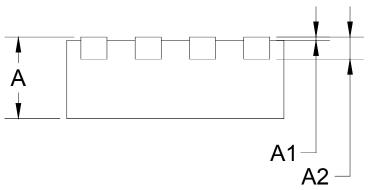
TDFN-2×2-8L



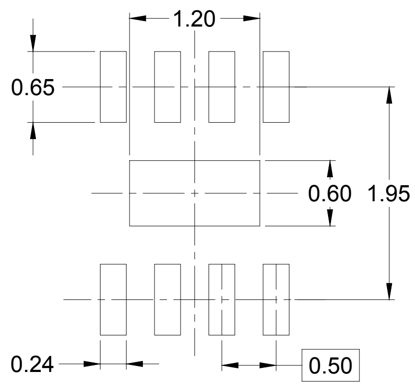
TOP VIEW



BOTTOM VIEW



SIDE VIEW

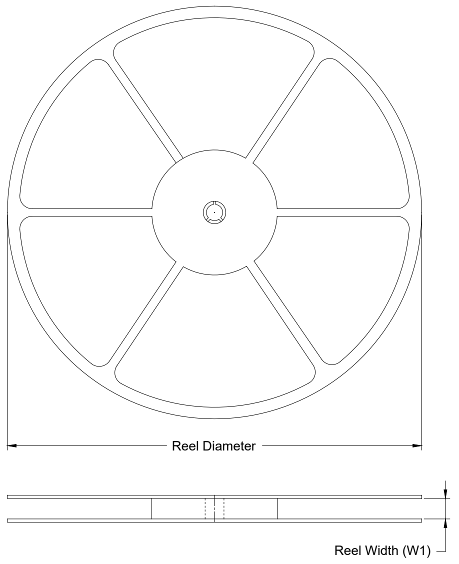


RECOMMENDED LAND PATTERN (Unit: mm)

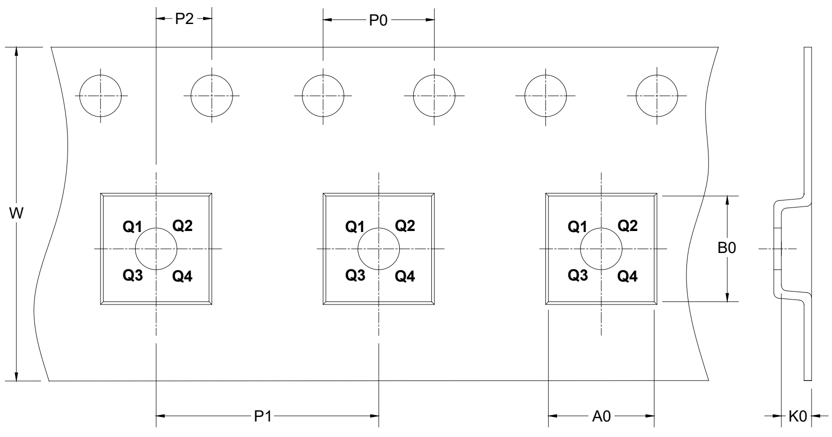
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	1.900	2.100	0.075	0.083
D1	1.100	1.300	0.043	0.051
E	1.900	2.100	0.075	0.083
E1	0.500	0.700	0.020	0.028
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007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



DIRECTION OF FEED

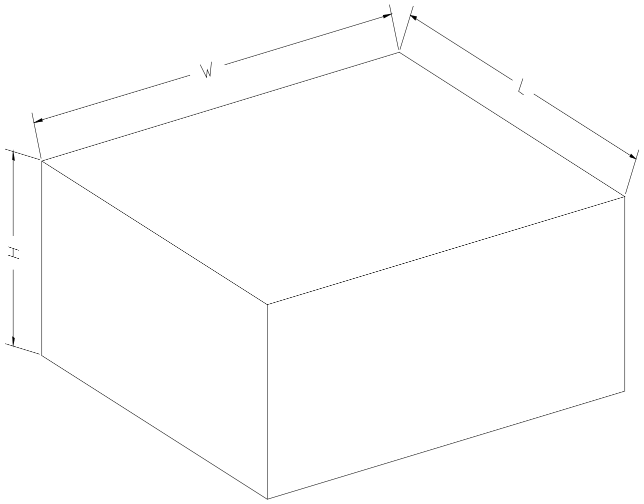
NOTE: The picture is only for reference. Please make the object as the standard.

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-2×2-8L	7″	9.5	2.30	2.30	1.10	4.0	4.0	2.0	8.0	Q1

DD0001

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