SGM3743

2-Channel White LED Driver for Smart Phone

GENERAL DESCRIPTION

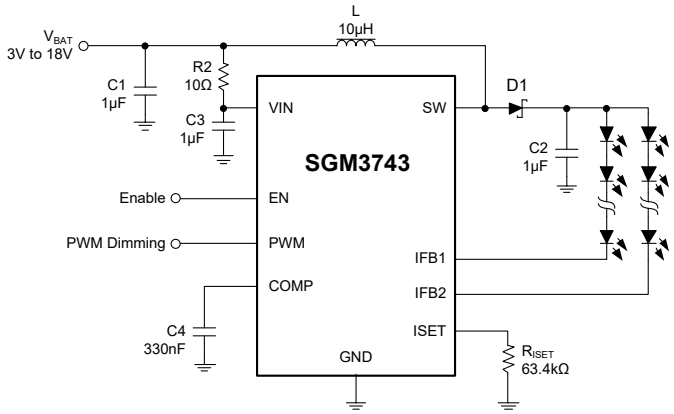
The SGM3743 is a 2-channel white LED driver with high efficiency boost regulator. With an internal 40V/1.5A power MOSFET, it is well suited for smart phone backlight applications powered by 1-cell Li-Ion battery. The supply voltage operates from 3V to 18V.

The boost output has an adaptive voltage regulation with enough low headroom voltage. The SGM3743 is capable of driving up to 10S2P white LEDs while achieving high efficiency. It supports both PWM dimming control and one-wire digital dimming control. A programmable 9-bit brightness code allows for LED brightness control.

The SGM3743 includes a comprehensive set of protection features such as 38.5V over-voltage protection, over-current protection and thermal shutdown. Built-in soft-start circuitry avoids excessive inrush current during startup.

The SGM3743 is available in a Green WLCSP -1.32×1.32-9B package. It operates over an ambient temperature range of -40℃ to +85℃.

TYPICAL APPLICATION CIRCUIT



FEATURES

- **Input Voltage Range: 3V to 18V**
- **Support up to 30mA Current per String**
- **Integrated 40V/1.5A MOSFET**
- **Up to 90% Efficiency**
- **Adaptive Boost Regulator**
- **Switching Frequency: 1.2MHz**
- **Optimized Rise Time and Fall Time to Reduce EMI on SW Pin**
- **1% Regulated LED Current Matching and Accuracy**
- **Very Low Headroom Voltage: 90mV**
- **Independent Digital and PWM Dimming Control**
- **One-Wire Digital Dimming Interface**
- **PWM Dimming Interface**
- **Up to 9-Bit Resolution for LED Brightness**
- **Automatic Soft-Start for Reducing Inrush Current**
- **Dimming Stable in More than 1:500 PWM Range**
- **PFM Mode at Light Load**
- **Support 4.7μH Inductor**
- **Protection Features**
  - **Over-Voltage Protection**
  - **LED Open or Short Protection**
  - **Thermal Shutdown**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in a Green WLCSP-1.32×1.32-9B Package**

APPLICATIONS

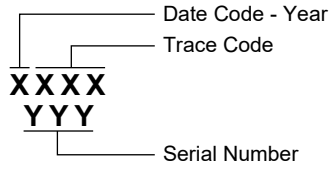
Smart Phones
GPS Receivers
Handheld Devices
Backlight for Media Form Factor
LCD Displays with 1-Cell Battery

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3743	WLCSP-1.32×1.32-9B	-40℃ to +85℃	SGM3743YG/TR	XXXX G06	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXX = Date Code and Trace 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

VIN ..... 0.3V to 20V
EN, PWM to GND ..... .-0.3V to 6V
COMP, ISET to GND ..... -0.3V to 3V
SW, IFB1, IFB2 to GND ..... -0.3V to 40V
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering 10s) ..... +260℃
ESD Susceptibility
HBM 4000V
MM 200V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range ..... 3V to 18V
Operating Temperature Range ..... -40℃ to +85℃
Operating Junction Temperature Range, T_J
..... -40℃ to +125℃

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

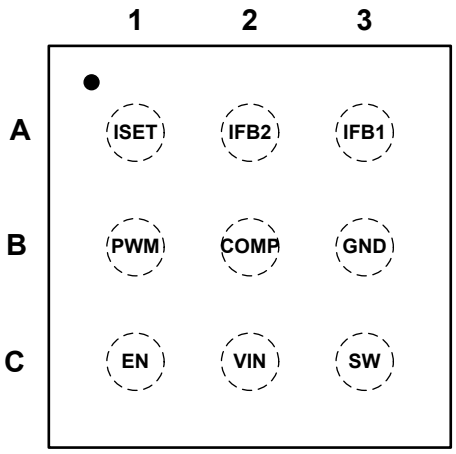
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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

SGM3743 (TOP VIEW)



WLCSP-1.32×1.32-9B

PIN DESCRIPTION

PIN	NAME	I/O	FUNCTION
A1	ISET	I	Current Setting Pin. Connect an external resistor from this pin to ground to set the maximum LED current.
A2	IFB2	I	Regulated Current Sink 2.
A3	IFB1	I	Regulated Current Sink 1.
B1	PWM	I	PWM Dimming Input.
B2	COMP	O	Transconductance Error Amplifier Output. Connect an external capacitor from COMP to ground to compensate the converter.
B3	GND	O	Ground Pin.
C1	EN	I	Enable Control and One-Wire Digital Dimming Input.
C2	VIN	I	Input Supply Pin.
C3	SW	I	Drain Connection for Internal Low-side N-Channel MOSFET.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, EN = high, PWM = high, I_{FB} = 20mA, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise specified.)

PARAMETER		SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Power Supply								
Input Voltage Range		V_{IN}		+25℃	3		18	V
Operating Quiescent Current into VIN		I_Q	Device enable, switching 1.2MHz and no load, V_{IN} = 3.6V	+25℃		1.2	1.7	mA
Shutdown Current		I_{SD}	EN = low	+25℃		0.4	1	μA
Under-Voltage Lockout Threshold		UVLO	V_{IN} falling	+25℃		2.25	2.45	V
			V_{IN} rising	+25℃		2.35		
Under-Voltage Lockout Hysterisis		V_{HYS}		+25℃		100		mV
EN and PWM								
EN/PWM Threshold	Logic High Voltage	V_{IH}		Full	1.6			V
	Logic Low Voltage	V_{IL}		Full			0.3	V
EN Pin and PWM Pin Internal Pull-Down Resistor		R_{PD}		+25℃		800		kΩ
PWM Logic Low Width to Shutdown		t_{PWM_SD}	PWM high to low	+25℃	40			ms
EN Logic Low Width to Shutdown		t_{EN_SD}	EN high to low	+25℃	5			ms
PWM Dimming Signal Frequency		f_{PWM}		+25℃	10		100	kHz
Minimum PWM On-Time		$t_{PWM_ON(MIN)}$		+25℃	30			ns
Regulation								
ISET Pin Voltage		V_{ISET_FULL}	Full brightness	Full	1.18	1.213	1.24	V
Current Multiplier		K_{ISET_FULL}	Full brightness	+25℃		1050		
Current Accuracy		I_{FB_AVG}	I_{ISET} = 20μA, D = 100%	+25℃	-3.5	1	3.5	%
$(I_{MAX} – I_{AVG}) / I_{AVG}$		K_M	D = 100%	+25℃		1	2	%
Current Sink Max Output Current		I_{IFB_MAX}	I_{ISET} = 35μA, each IFBx pin	+25℃	30			mA
Power Switch								
Switch MOSFET On-Resistance		$R_{DS(ON)}$	V_{IN} = 3.6V	+25℃		0.35		Ω
			V_{IN} = 3V	+25℃		0.38		
Switch MOSFET Leakage Current		I_{LEAK_SW}	V_{SW} = 35V, T_A = 25℃	+25℃		0.1	1	μA
Oscillator								
Oscillator Frequency		f_S		Full	1000	1200	1350	kHz
Maximum Duty Cycle		D_{MAX}	Measured on the drive signal of switch MOSFET	+25℃		95		%
Boost Voltage Control								
IFBx Feedback Regulation Voltage		V_{IFB_REG}	I_{IFBx} = 20mA, measured on IFBx pin which has a lower voltage	+25℃		90		mV
COMP Pin Sink Current		I_{SINK}		+25℃		12		μA
COMP Pin Source Current		I_{SOURCE}		+25℃		5		μA
Error Amplifier Transconductance		G_{EA}		+25℃		55		μmho
Error Amplifier Output Resistance		R_{EA}		+25℃		100		MΩ
Error Amplifier Crossover Frequency		f_{EA}	5pF connected to COMP pin	+25℃		1.2		MHz

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = 3.6V, EN = high, PWM = high, I_{FB} = 20mA, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise specified.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Protection							
Switch MOSFET Current Limit	I_{LIM}	D = D_{MAX}	+25℃	1.15	1.5	1.75	A
Switch MOSFET Start Up Current Limit	I_{LIM_START}	D = D_{MAX}	+25℃		0.6		A
Time Window for Half Current Limit	t_{HALF_LIM}		+25℃		6		ms
SW Pin Over-Voltage Threshold	V_{OVP_SW}		Full	37.5	38.5	39.7	V
IFBx Pin Over-Voltage Threshold	V_{OVP_IFB}	Measured on IFBx pin	+25℃		4.5		V
Digital One-Wire Interface							
One-Wire Detection Delay	t_{OW_DELAY}	Measured from EN low to high	+25℃	100			μs
One-Wire Detection Time	t_{OW_DET}	EN pin low time	+25℃	260			μs
One-Wire Detection Window (1)	t_{OW_WIN}	Measured from EN low to high	+25℃	1			ms
Start Time of Program Stream	t_{START}		+25℃	6			μs
End Time of Program Stream	t_{EOS}		+25℃	6		360	μs
High Time of Low Bit	t_{H_LB}	Logic 0	+25℃	6		180	μs
Low Time of Low Bit	t_{L_LB}	Logic 0	+25℃	2 × t_{H_LB}		360	μs
High Time of High Bit	t_{H_HB}	Logic 1	+25℃	2 × t_{L_HB}		360	μs
Low Time High Bit	t_{L_HB}	Logic 1	+25℃	6		180	μs
Acknowledge Valid Time	$t_{valACKN}$		+25℃			4	μs
Duration of Acknowledge Condition	t_{ACKN}		+25℃			512	μs
Acknowledge Output Voltage Low (2)	V_{ACKNL}	Open drain, $R_{PULL-UP}$ = 15kΩ to V_{IN}	+25℃			0.4	V
Thermal Shutdown							
Thermal shutdown threshold	T_{SHDN}				150		℃
Thermal shutdown hysteresis	T_{HYS}				15		℃

NOTES:

1. Drive the EN pin low for longer than t_{OW_DET} after t_{OW_DELAY} delay and before t_{OW_WIN} expires, in order to select one-wire digital interface.

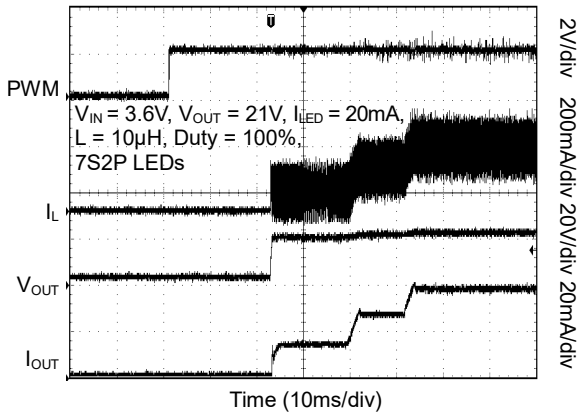
2. This condition is only applied when RFA = 1. Use this feature only when the master has an open-drain output and the data line is required to pull high by the master through a pull-up resistor.

RECOMMENDED COMPONENTS OF TEST CIRCUITS

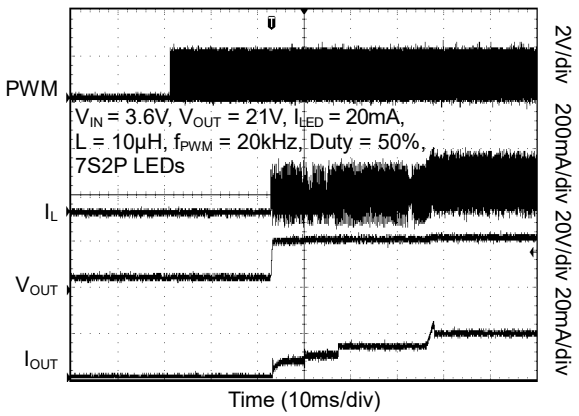
	Component		Component
Inductor	10μH/CD75NP-100KC	**Capacitor**	1μF/C2012X7R1H105KT
Diode	MBR0540		

TYPICAL PERFORMANCE CHARACTERISTICS

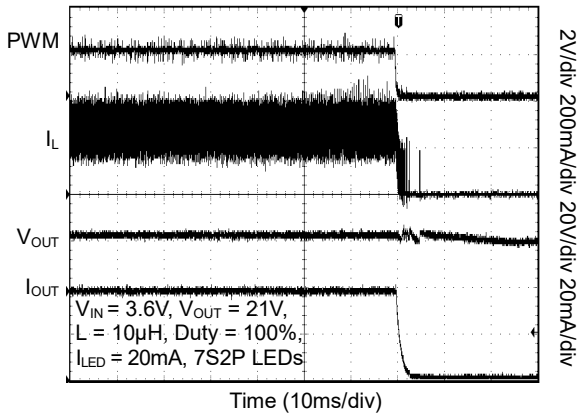
Start-Up



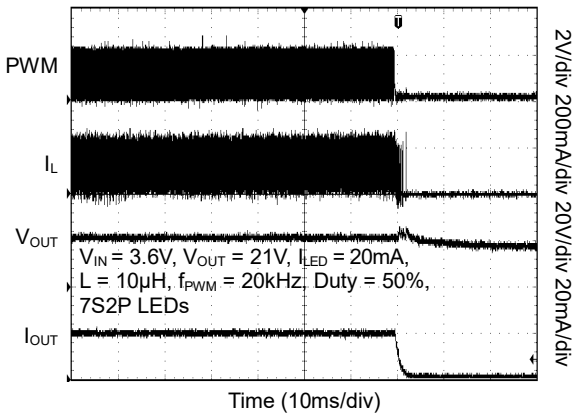
Start-Up



Shutdown

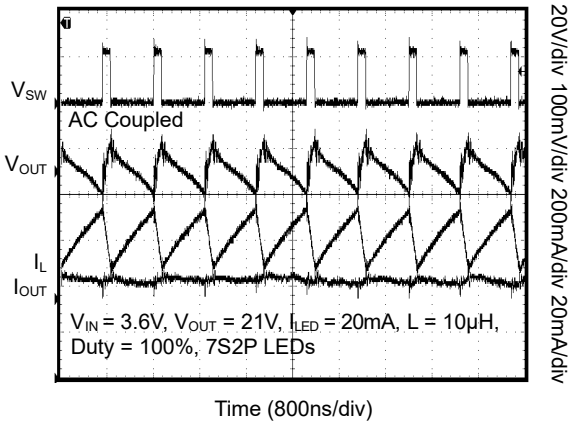


Shutdown

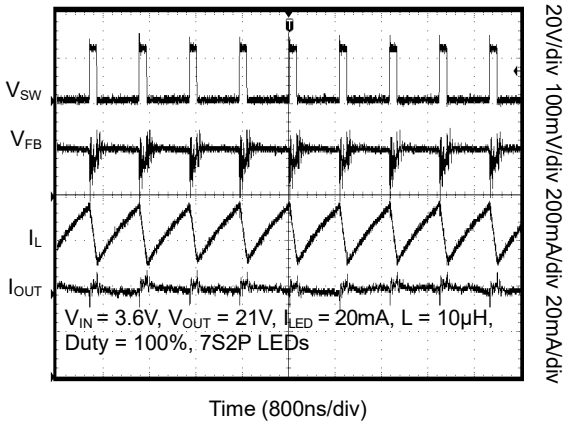


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

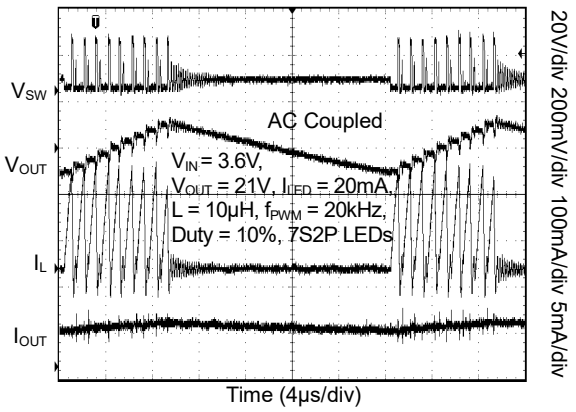
Switching Waveform



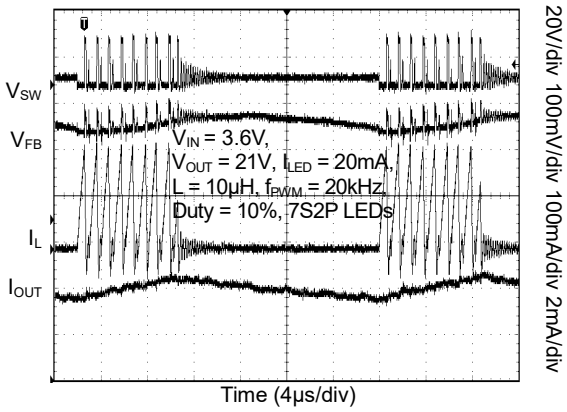
Switching Waveform



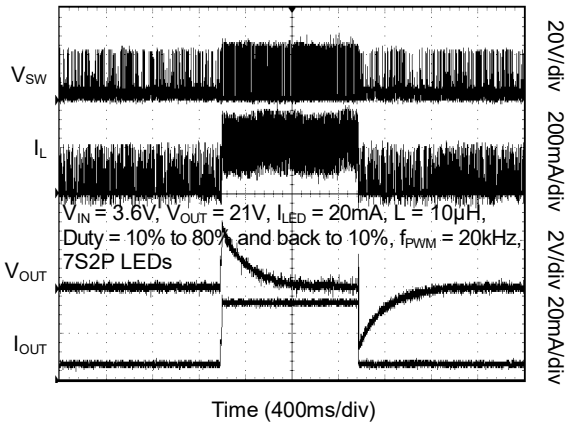
Switching Waveform



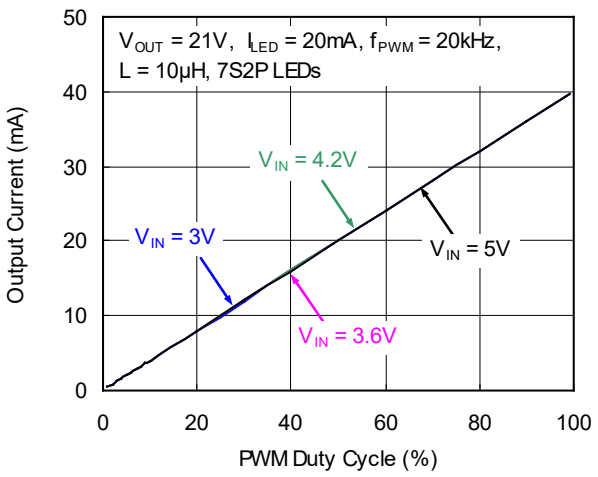
Switching Waveform



Dimming Transient Waveform

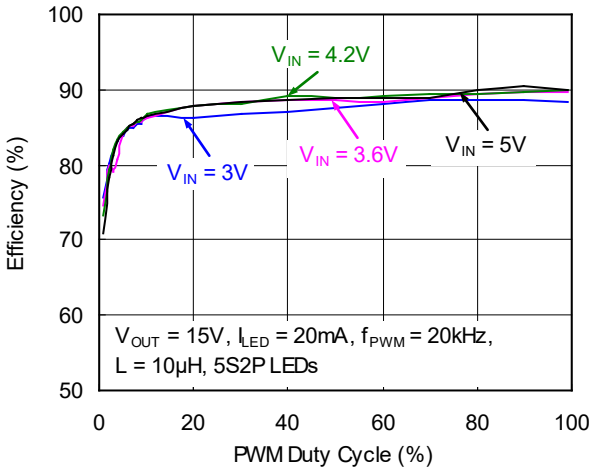


Dimming Linearity

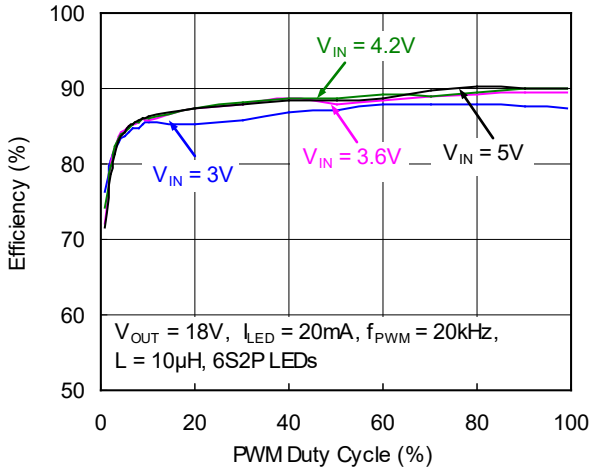


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Efficiency vs. PWM Duty Cycle



Efficiency vs. PWM Duty Cycle



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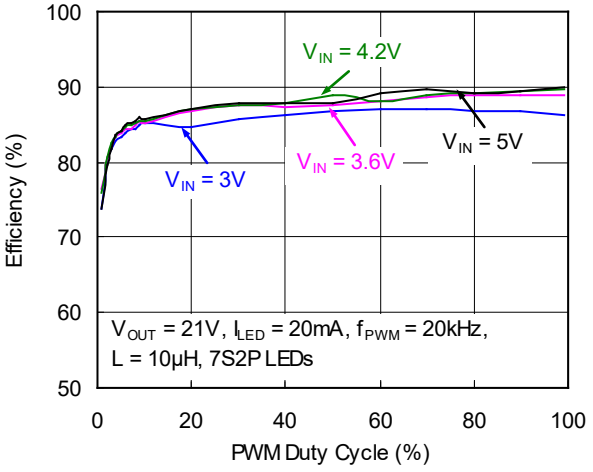
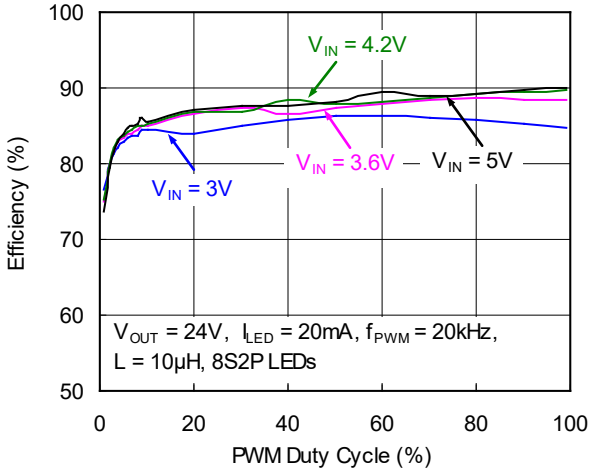
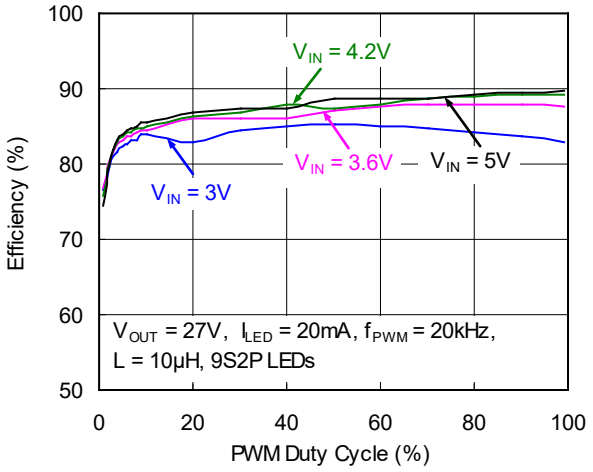


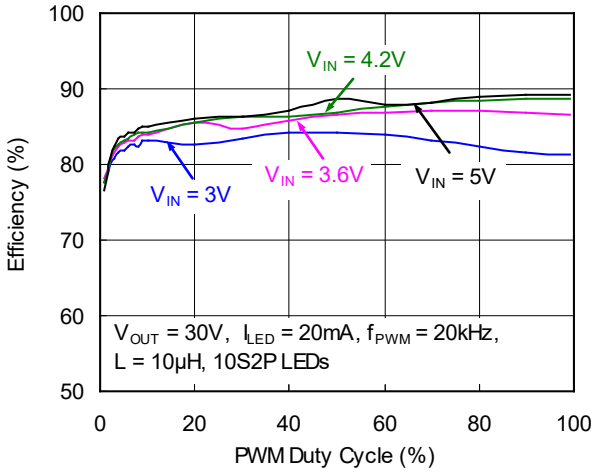
Efficiency vs. PWM Duty Cycle



Efficiency vs. PWM Duty Cycle



Efficiency vs. PWM Duty Cycle



DETAILED DESCRIPTION (continued)

Table 1. One-Wire Digital Interface Bit Description

BIT NUMBER	NAME	DESCRIPTION	TRANSMISSION DIRECTION
23 (MSB)	A7	Device Address: 0x8F	IN
22	A6		
21	A5		
20	A4		
19	A3		
18	A2		
17	A1		
16	A0		
15	Bit 15	Reserved. Write 0 to this bit.	IN
14	Bit 14		
13	Bit 13		
12	Bit 12		
11	Bit 11		
10	RFA	Request for acknowledge. If RFA = 1, the data line is pulled low when the device receives the command well. It is only used when the master has an open-drain output and the data line is required to pull high by the master through a pull-up resistor. Otherwise, do not set RFA to 1.	
9	Bit 9	Reserved. Write 0 to this bit.	
8	D8	9-bit Brightness Code	
7	D7		
6	D6		
5	D5		
4	D4		
3	D3		
2	D2		
1	D1		
0 (LSB)	D0		

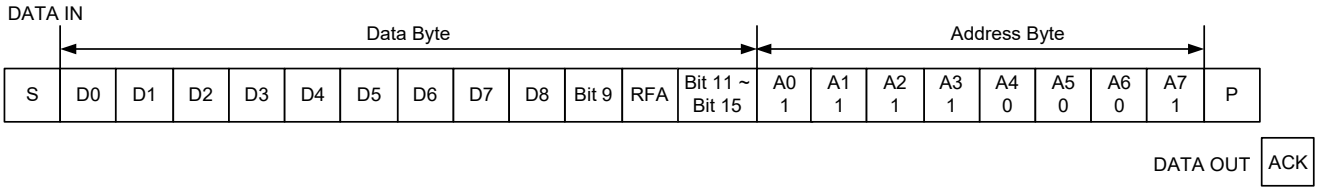


Figure 1. One-Wire Digital Interface Protocol Overview

ADDITIONAL APPLICATION CIRCUITS

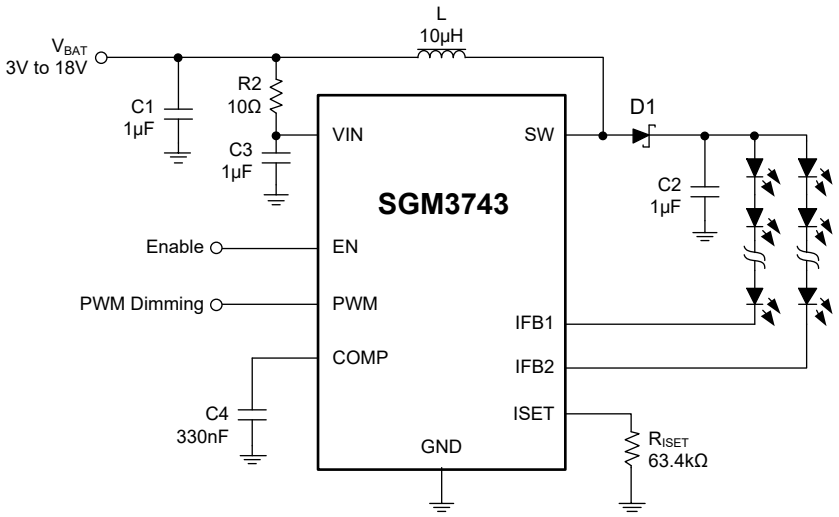


Figure 2. SGM3743 Typical Application (PWM interface enabled, EN pin can be used to enable or disable the IC)

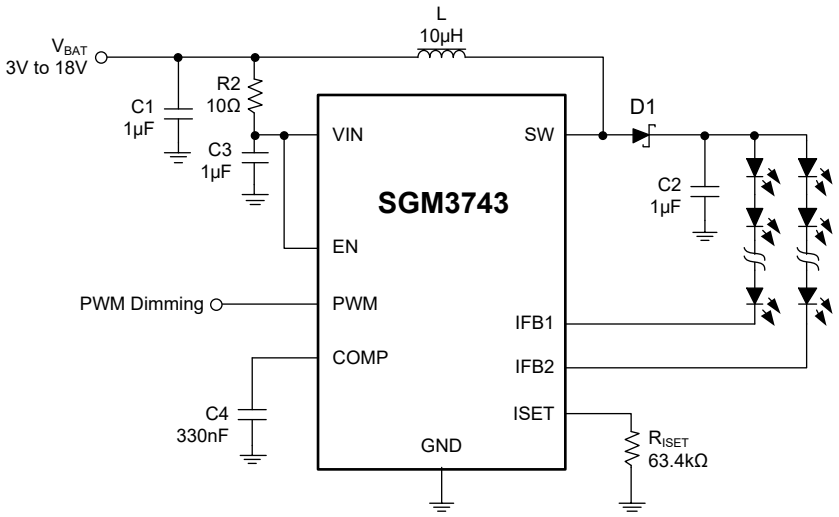


Figure 3. SGM3743 Typical Application
(PWM interface enabled, EN pin connected to VIN, only PWM signal is used to enable or disable the IC)

ADDITIONAL APPLICATION CIRCUITS (continued)

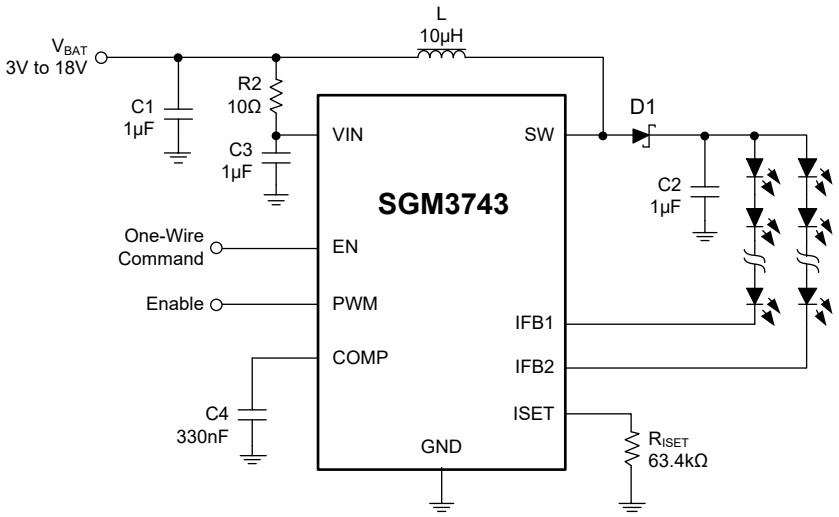


Figure 4. SGM3743 Typical Application
(One-Wire digital interface enabled, PWM pin can be used to enable or disable the IC)

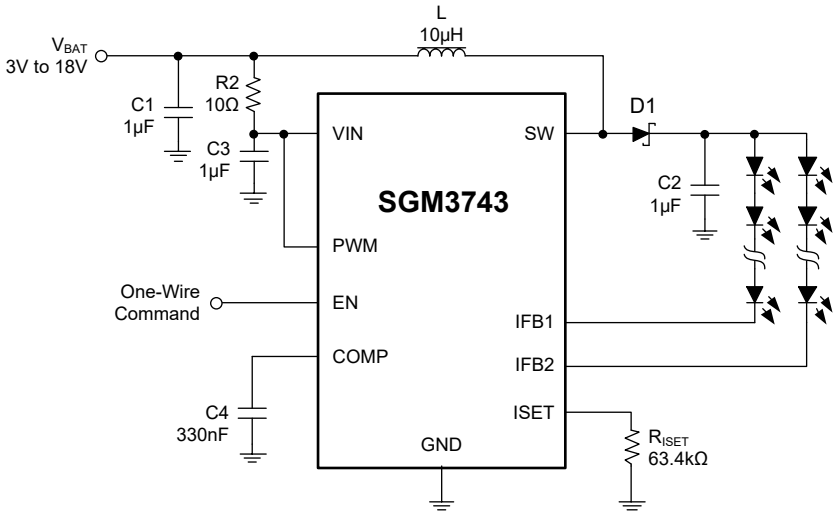


Figure 5. SGM3743 Typical Application
(One-Wire digital interface enabled, PWM pin connected to VIN, only EN signal is used to enable or disable the IC)

REVISION HISTORY

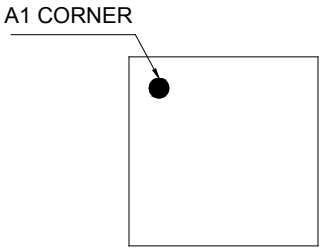
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

FEBRUARY 2021 – REV.A to REV.A.1	Page
Updated Marking Information section	2

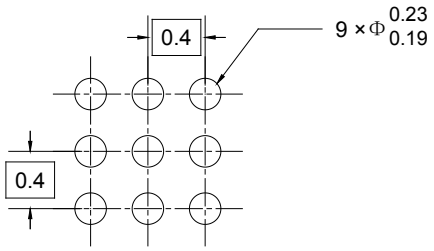
Changes from Original (JUNE 2016) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

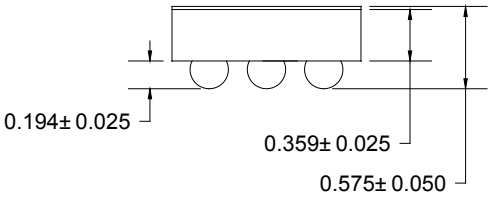
WLCSP-1.32×1.32-9B



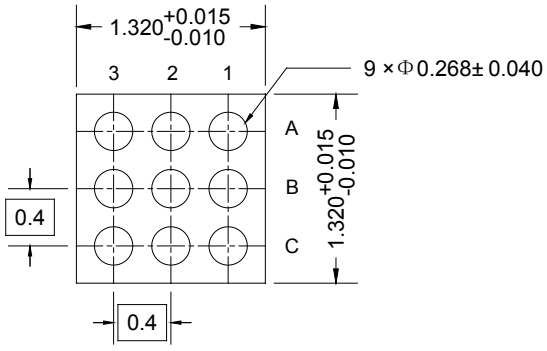
TOP VIEW



RECOMMENDED LAND PATTERN



SIDE VIEW

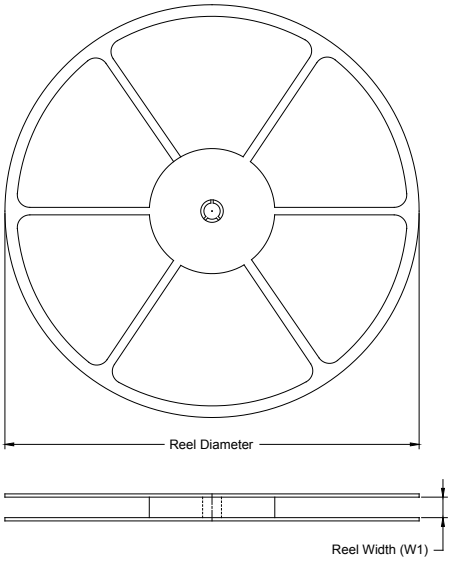


BOTTOM VIEW

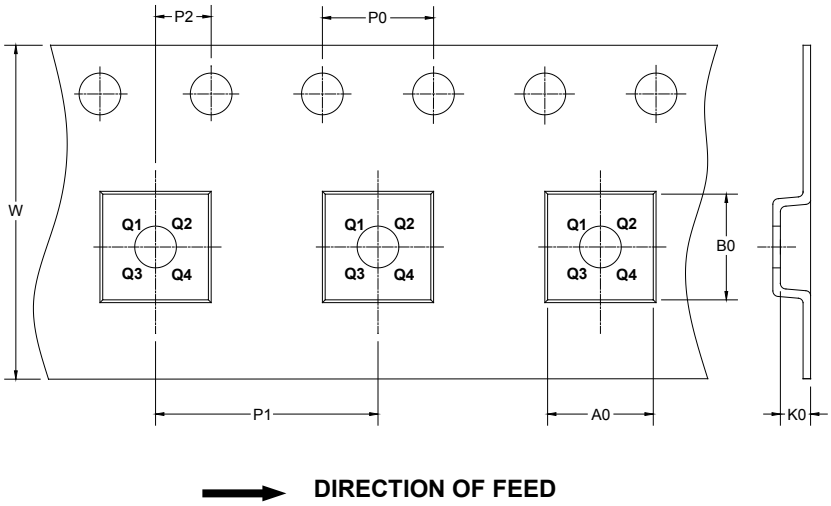
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



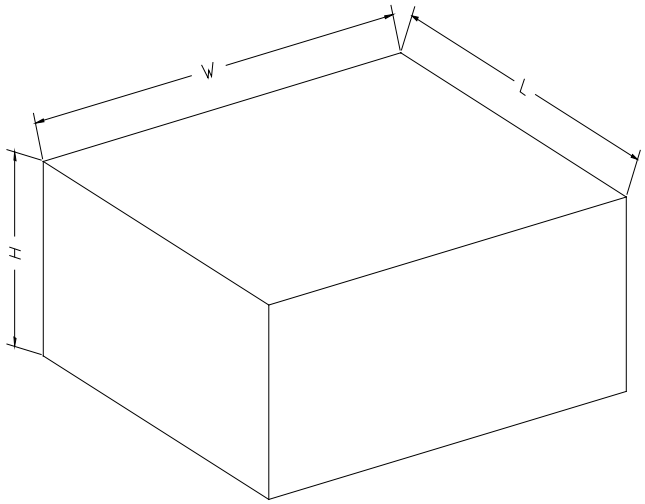
NOTE: The picture is only for reference. Please make the object as the standard.

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
WLCSP-1.32×1.32-9B	7″	9.5	1.38	1.38	0.70	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