

## PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3146	TQFN-3×3-20L	-40°C to +85°C	SGM3146YTQG20G/TR	SGM 3146QG XXXXX	Tape and Reel, 3000

## MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

XXXXX

Vendor Code  
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

$V_{IN}$  to GND.....-0.3V to 6V  
 The Other Pins to GND .....-0.3V to  $V_{IN}$   
 Power Dissipation,  $P_D$  @  $T_A = +25^\circ\text{C}$   
 TQFN-3×3-20L ..... 1.48W  
 Junction Temperature ..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature Range (Soldering 10s) ..... +260°C  
 ESD Susceptibility  
 HBM..... 2000V  
 MM..... 200V

## RECOMMENDED OPERATING CONDITIONS

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.

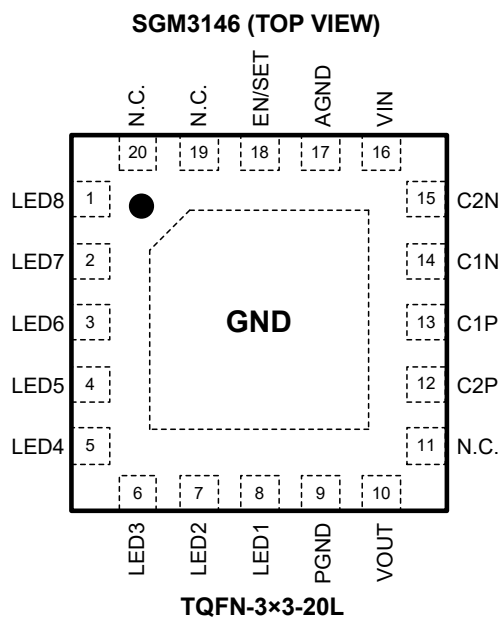
## ESD SENSITIVITY CAUTION

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

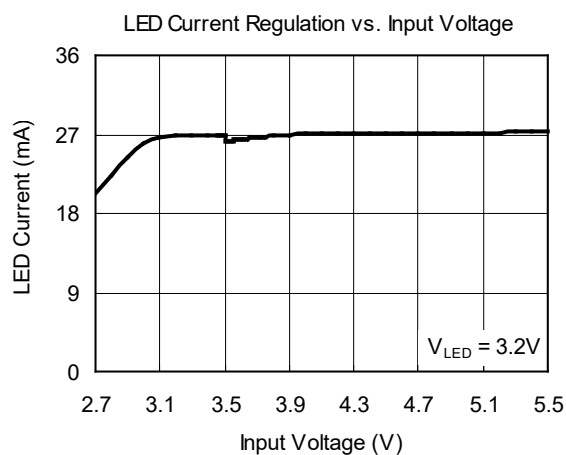
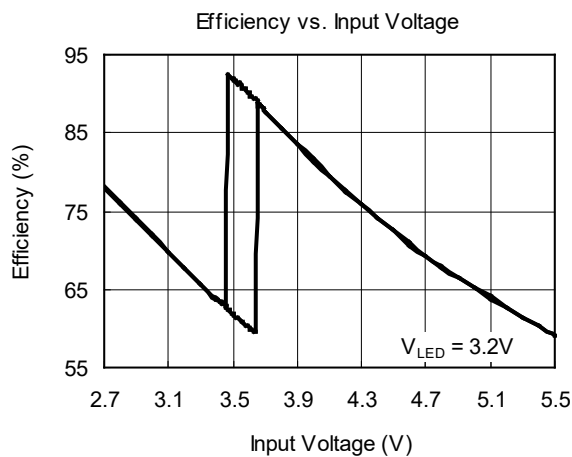
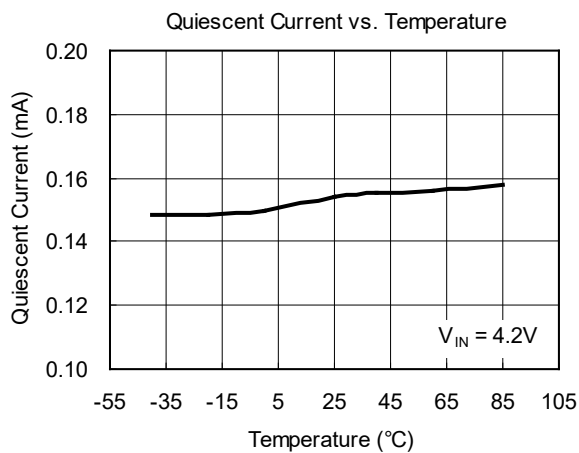
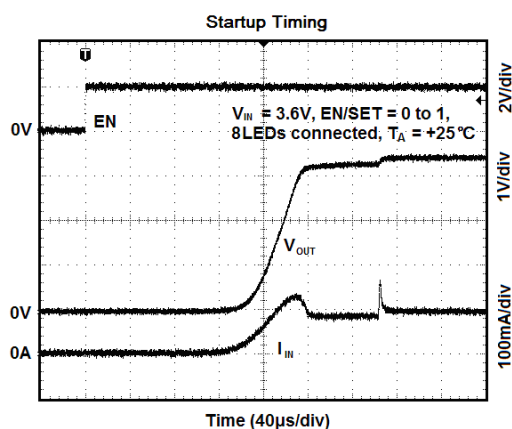
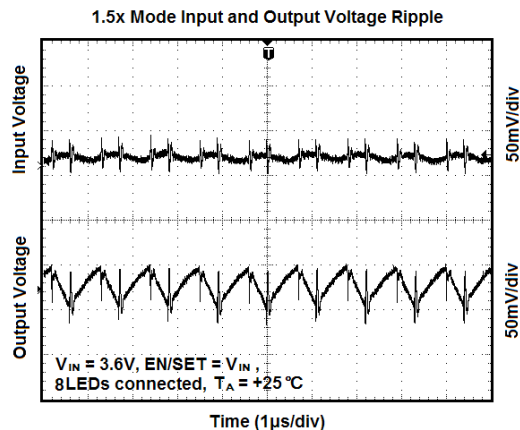
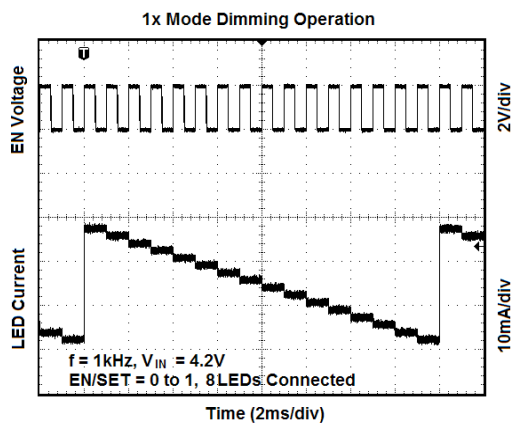
PIN	NAME	I/O	FUNCTION
1, 2, 3, 4 5, 6, 7, 8	LED8 - LED1	I	Current Sink Input. Connect the cathode of the white LEDs to these inputs.
9	PGND	-	Power Ground.
10	VOUT	O	Output Voltage Source. Connect the output capacitor and the anode of the LEDs to this pin.
11, 19, 20	N.C.	-	No Internal Connection.
12	C2P	-	Positive Terminal of Bucket Capacitor 2.
13	C1P	-	Positive Terminal of Bucket Capacitor 1.
14	C1N	-	Negative Terminal of Bucket Capacitor 1.
15	C2N	-	Negative Terminal of Bucket Capacitor 2.
16	VIN	I	Supply Voltage Input.
17	AGND	-	Analog Ground.
18	EN/SET	I	LED1 to LED8 Enable (Active High) and Dimming Control. Connects to GPIO pin of MCU. For normal operation, suggest connecting to VIN only after the VIN has settled if the VIN ramping up is slow.
Exposed Pad	GND	-	Exposed pad should be soldered to PCB board and connected to GND.

## ELECTRICAL CHARACTERISTICS

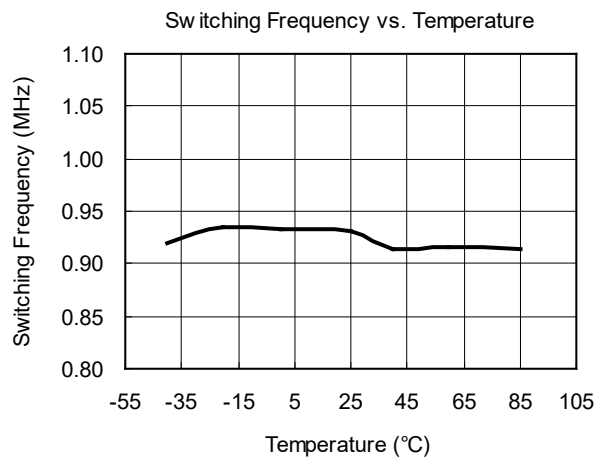
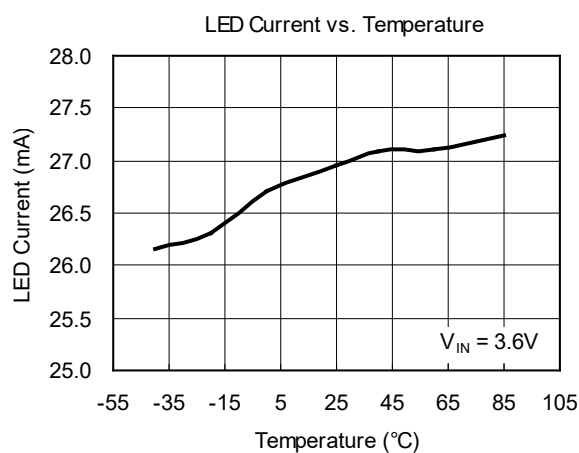
(V<sub>IN</sub> = 3.6V, EN/SET = V<sub>IN</sub>, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Supply Voltage and Current</b>						
Input Voltage Range	V <sub>IN</sub>		2.7		5.5	V
Quiescent Power Supply Current	I <sub>Q</sub>	V <sub>IN</sub> = 4.2V, 1× Mode, I <sub>LEDx</sub> = 0mA		155	240	μA
		1.5× Mode, I <sub>LEDx</sub> = 0mA		1.35		mA
Shutdown Supply Current	I <sub>SHDN</sub>	EN/SET = GND, V <sub>IN</sub> = 4.2V		0.01	2.5	μA
<b>Charge Pump Stage</b>						
Over-Voltage Limit	V <sub>OUT</sub>			5.4		V
Start-Up Time		C <sub>OUT</sub> = 1μF, I <sub>LEDx</sub> ≥ 0.9 × I <sub>LEDx-set</sub>		280		μs
Soft-Start Duration				150		μs
Switching Frequency	f		0.7	0.93	1.25	MHz
Efficiency	η	At 1× Mode before switching to 1.5× Mode		90		%
Shutdown Temperature		Temperature rising		140		°C
Shutdown Temperature Hysteresis				10		°C
Input Current Limit				300		mA
<b>Current Sinks</b>						
Recommended Maximum Current per Current Sink	I <sub>LEDx</sub>	3.2V ≤ V <sub>IN</sub> ≤ 5.5V	24	27	30	mA
Current Matching between Any Two Outputs		V <sub>LEDx</sub> = 3.2V, I <sub>LEDx</sub> = 27mA	-4.8	1	4.8	%
Line Regulation		3.3V < V <sub>IN</sub> < 5.5V, V <sub>LEDx</sub> = 3.2V		1.4		%
Voltage at LED <sub>x</sub> to GND	V <sub>SOURCE</sub>	V <sub>IN</sub> = 4.2V		550		mV
<b>EN/SET Logic</b>						
Low Time for Shutdown	T <sub>SHDN</sub>		3			ms
Low Time for Dimming	T <sub>LO</sub>		0.5		500	μs
High Time for Dimming	T <sub>HI</sub>		0.5			μs
Threshold	Logic-High Voltage	V <sub>IH</sub>	1.2			V
	Logic-Low Voltage	V <sub>IL</sub>			0.4	V
<b>Threshold of Switching between 1× and 1.5× Mode</b>						
1× Mode to 1.5× Mode		V <sub>LEDx</sub> = 3.2V		3.48		V
1.5× Mode to 1× Mode		V <sub>LEDx</sub> = 3.2V		3.65		V

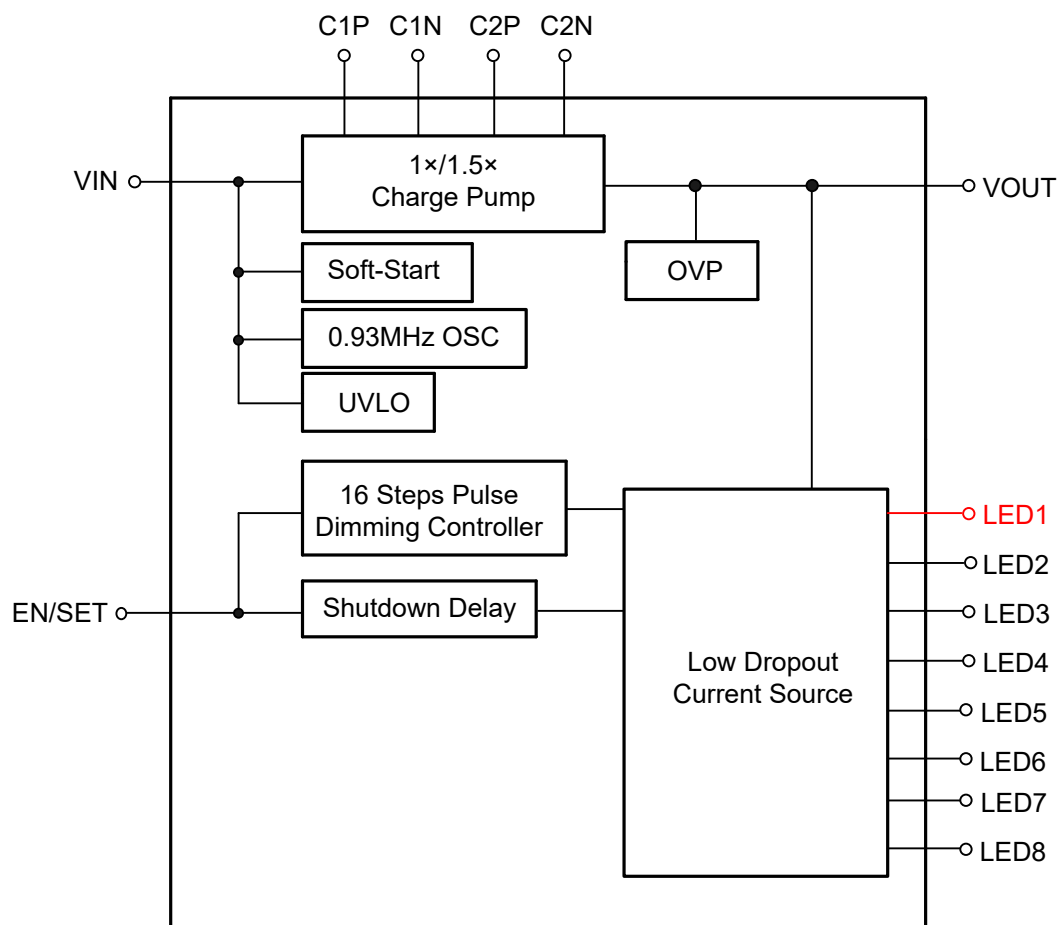
## TYPICAL PERFORMANCE CHARACTERISTICS



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



## FUNCTIONAL BLOCK DIAGRAM



## TYPICAL APPLICATION

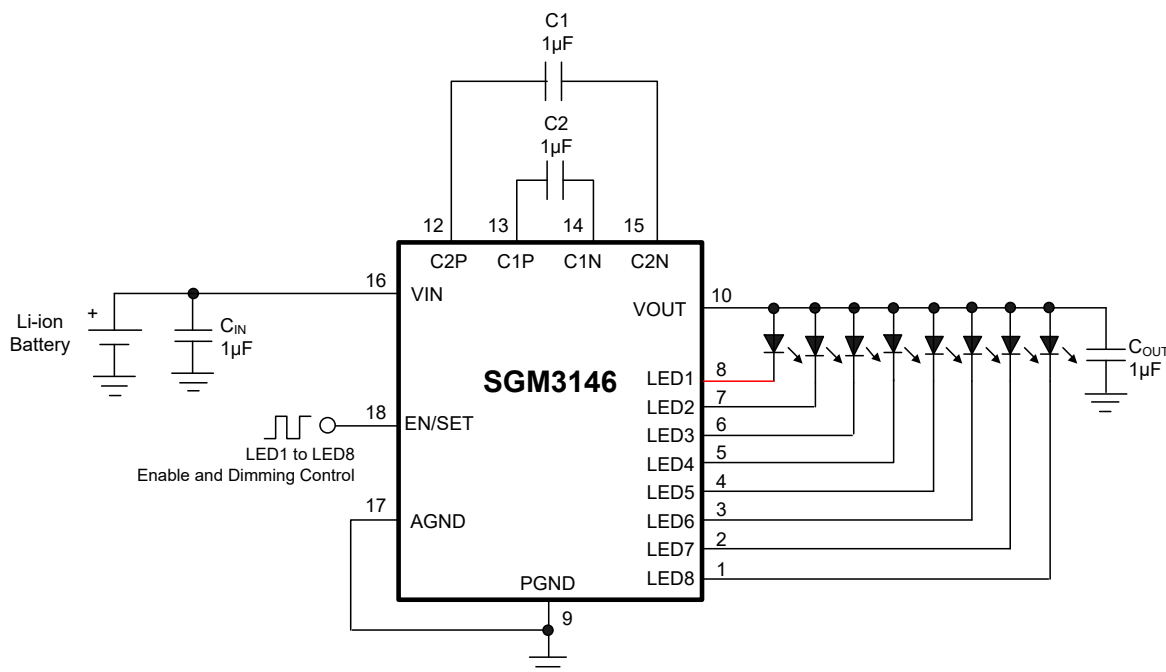


Figure 1. For 8-WLEDs Application Circuit

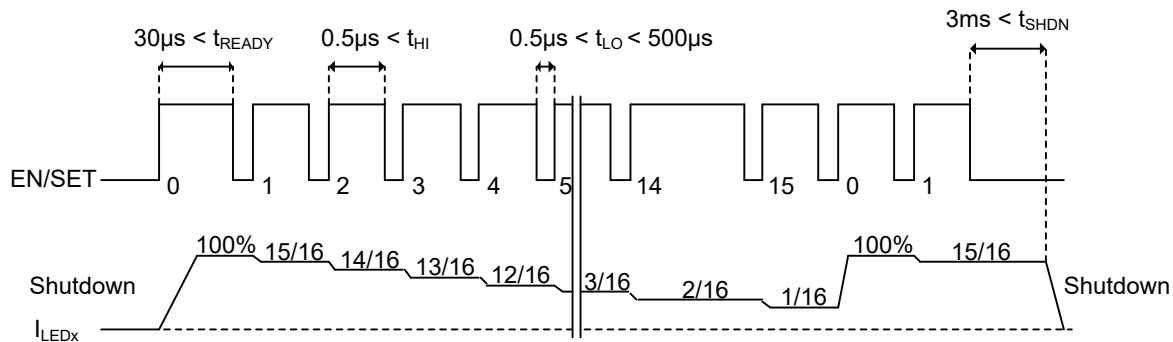


Figure 2. Brightness Control by Pulse Dimming

## APPLICATION INFORMATION

The SGM3146 uses a fractional switched capacitor charge pump to power up to 8 white LEDs with a programmable current for uniform intensity. The part integrates current sources and automatic mode selection charge pump. It maintains the high efficiency by utilizing a  $1\times/1.5\times$  fractional charge pump and current sources. The small equivalent  $1\times$  mode open loop resistance and ultra-low dropout voltage of current source extend the operating time of  $1\times$  mode and optimize the efficiency in white LED applications.

### Input UVLO

The input operating voltage range of the SGM3146 is 2.7V to 5.5V. An input capacitor at the VIN pin could reduce ripple voltage. It is recommended to use a ceramic  $1\mu\text{F}$  or larger capacitance as the input capacitor. This IC provides an under-voltage lockout (UVLO) function to prevent it from unstable issue when startup. The UVLO threshold of input rising voltage is set at 2.15V typically with a hysteresis 30mV.

### Soft-Start

The SGM3146 employs a soft-start feature to limit the inrush current. The soft-start circuit prevents the excessive inrush current and input voltage droop. The soft-start clamps the input current over a typical period of 150 $\mu\text{s}$ .

### Mode Decision

The SGM3146 uses a smart mode selection method to decide the working mode for optimizing the efficiency. Mode decision circuit senses the output and LED voltage for up/down selection. The SGM3146 automatically switches to  $1.5\times$  mode whenever the dropout condition is detected from the current source and returns to  $1\times$  mode whenever the dropout condition releases.

### Chip Enable and Shutdown

When EN/SET is in "High" status, SGM3146 will enter into active status. When EN/SET is in "Low" status for 3ms, and SGM3146 will enter into shutdown status.

### Over-Voltage Protection

The SGM3146 equips over-voltage protection function. When LED1 is open, the output voltage will be clamped to 5.4V.

### LED Brightness Control

The SGM3146 implements a pulse dimming method to control the brightness of white LEDs. Users can easily configure the LED current from 1.65mA to 27mA 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 16 steps of current could be set by users. The detail operation of brightness dimming is showed in the Figure 2.

### LED Connection

The SGM3146 supports up to 8 white LEDs. The 8 LEDs are connected from VOUT to pin 1, 2, 3, 4, 5, 6, 7 and 8 respectively. Figure 1 shows the connection for 8-WLEDs application. LED1 to LED8 are controlled by EN/SET pin. The SGM3146 internal current source reference circuit bases feedback from current sensed on the LED1 output. For best operation, the only requirement for this type of application is the output LED1 should always be connected to the load circuit. The other LED pins (LED2, 3, 4, 5, 6, 7 & 8) can be left floating if those white LEDs are not used.

### Selecting Capacitors

To get the better performance of SGM3146, the selection of peripherally appropriate capacitor and value is very important. These capacitors determine some parameters such as input/output ripple voltage, power efficiency, and maximum supply current by charge pump. To reduce the input and output ripple effectively, the low ESR ceramic capacitors are recommended. For LED driver applications, the input voltage ripple is more important than output ripple. Input ripple is controlled by input capacitor CIN, increasing the value of input capacitance can further reduce the ripple. Practically, the input voltage ripple depends on the power supply impedance. The flying capacitor C1 and C2 determine the supply current capability of the charge pump and to influence the overall efficiency of system. The lower value will improve efficiency, but it will limit the LED's current at low input voltage. For  $8 \times 27\text{mA}$  load over the entire input range of 2.7V to 5.5V, it is recommended to use a  $1\mu\text{F}$  ceramic capacitor on the flying capacitor C1 and C2.



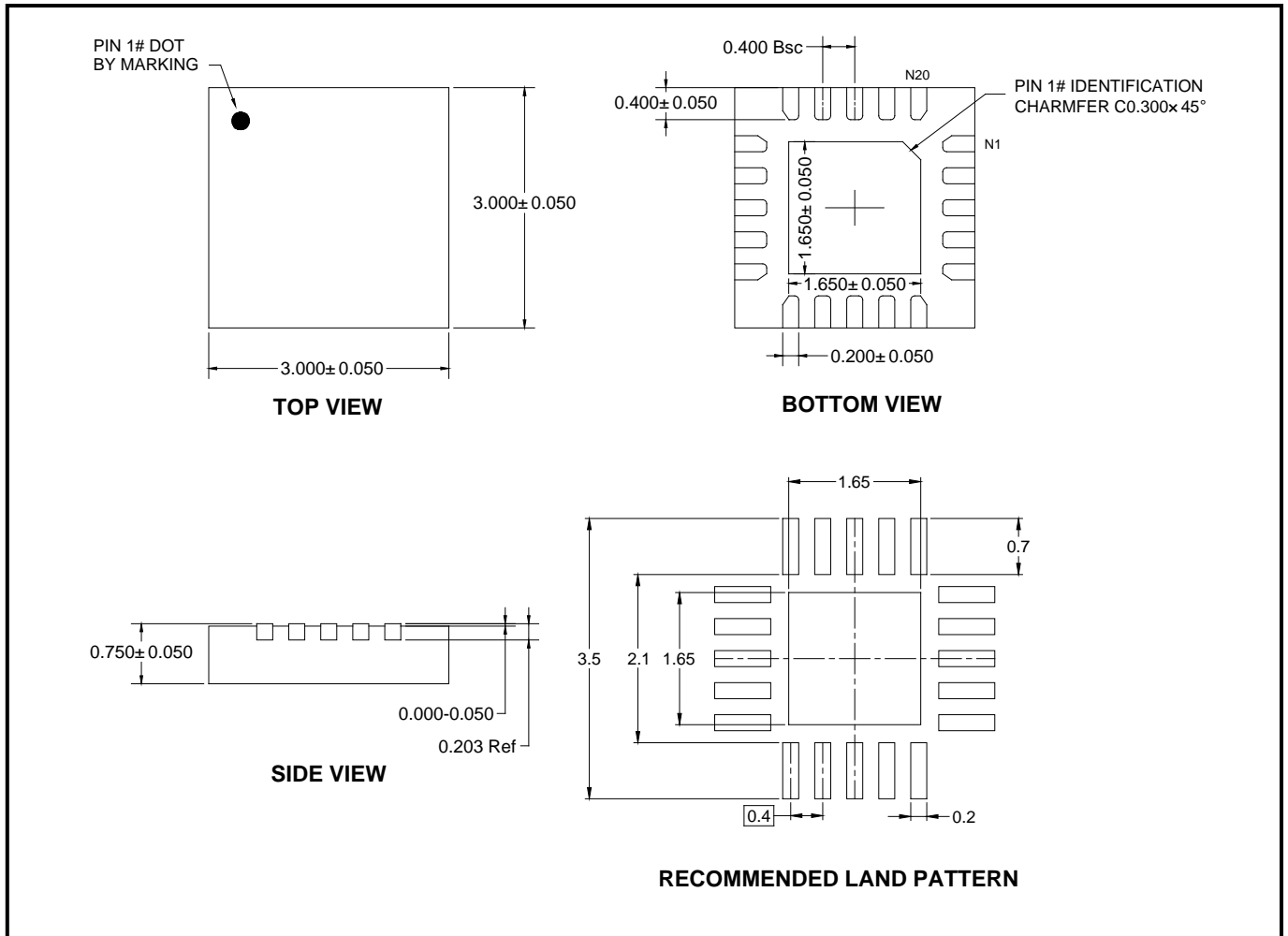
## REVISION HISTORY

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

JANUARY 2013 – REV.A to REV.A.1		Page
Added Tape and Reel Information section .....		12, 13
Changes from Original (MAY 2012) to REV.A		Page
Changed from product preview to production data.....		All

## PACKAGE OUTLINE DIMENSIONS

### TQFN-3x3-20L

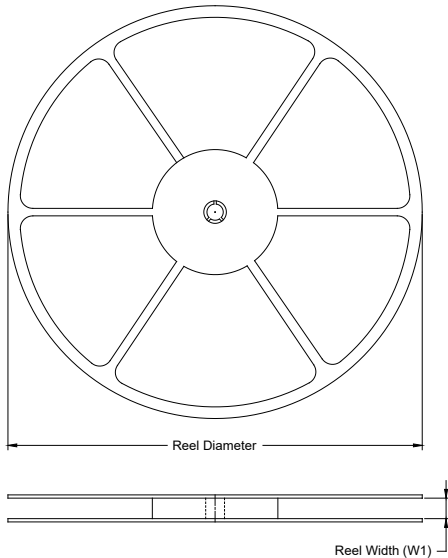


NOTE: All linear dimensions are in millimeters.

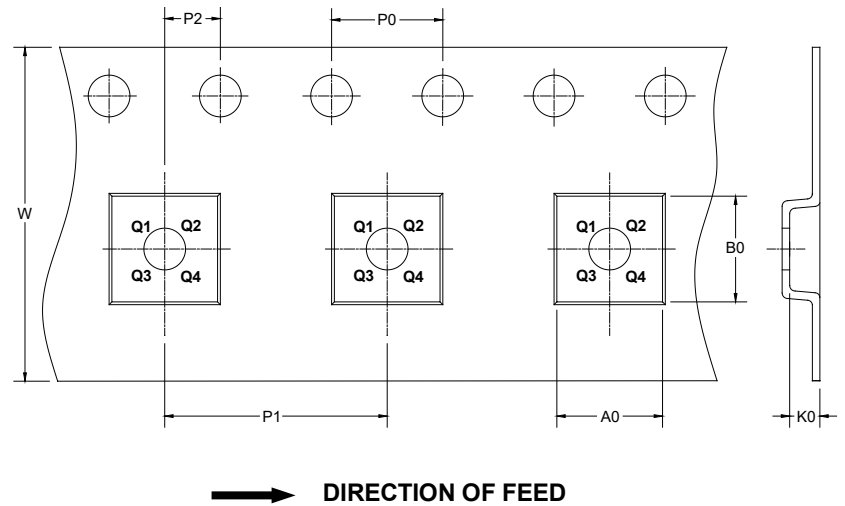
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



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

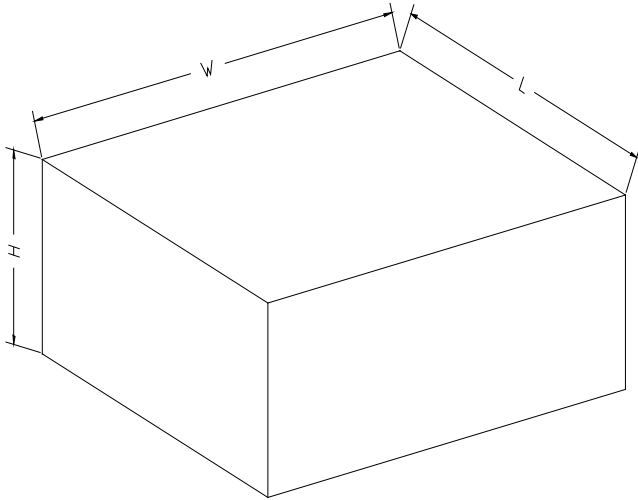
### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-3×3-20L	13"	12.4	3.30	3.30	1.10	4.0	8.0	2.0	12.0	Q1

DD0001

## 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
13"	386	280	370	5

DD0002