



SGM3124 PWM Dimming, Charge Pump White LED Driver with Low Dropout Current Source

GENERAL DESCRIPTION

The SGM3124 is a current-regulated white LED driver with integrated low dropout current sources and a high efficiency charge pump. The charge pump has 1×/1.5× fractional operation mode. The SGM3124 is designed for LCD display backlight applications.

The supply voltage operates from 2.7V to 5.5V and is well suited for various applications powered by a 1-cell Li-Ion battery, as well as 3-cell or 4-cell NiCd, NiMH or Alkaline batteries.

The ISET reference current is set through an external resistor on the ISET pin. The SGM3124 supports up to 3 LED strings for total maximum 120mA current. In addition, the charge pump with current control reduces input current ripple and ensures low EMI. Low capacitance makes the SGM3124 ideal for small battery-powered applications.

The SGM3124 is available in a Green TQFN-3×3-16L package. It operates over an ambient temperature range of -40°C to +85°C.

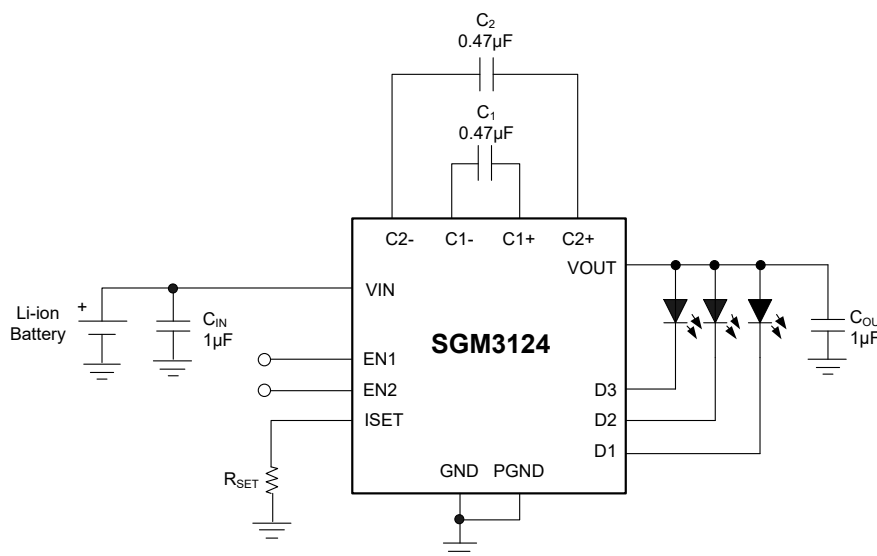
FEATURES

- Input Voltage Range: 2.7V to 5.5V
- Support up to 3 LEDs at 30mA Each
- LED Brightness Control through PWM Signal
- 1× and 1.5× Charge Pump for High Conversion Efficiency
- Switching Frequency: 1MHz
- 0.5% Regulated Output Current Matching
- Built-in Soft-Start for Reducing Inrush Current
- Low Input Ripple and Low EMI
- Protection Features
 - ♦ Over-Current Protection
 - ♦ Under-Voltage Lockout
 - ♦ Thermal Shutdown
- Available in a Green TQFN-3×3-16L Package

APPLICATIONS

Cellular Phones, Smart Phones
Digital Cameras, Camcorders, PDAs
Handheld PCs
Keypad Backlight

TYPICAL APPLICATION



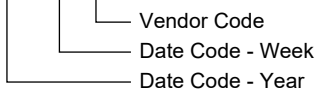
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3124	TQFN-3x3-16L	-40°C to +85°C	SGM3124YTQ16G/TR	3124TQ XXXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code and Vendor Code.

XXXXX



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

- Supply Voltage Range -0.3V to 6V
- Voltage at EN1, EN2, VOUT, ISET -0.3V to V_{IN}
- Output Current at VOUT 300mA
- Operating Temperature Range -40°C to +85°C
- Maximum Junction Temperature +160°C
- Storage Temperature Range -65°C to +150°C
- Lead Temperature (Soldering 10s) +260°C
- ESD Susceptibility
- HBM 4000V
- MM 400V

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.

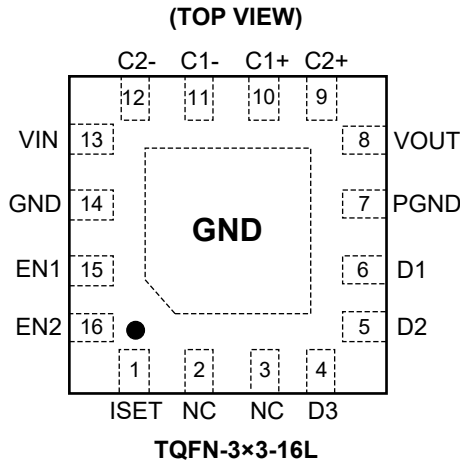
ESD SENSITIVITY CAUTION

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	ISET	I	Current Setting Pin. Connect an external resistor from this pin to ground to set the maximum LED current.
2, 3	NC	-	No Connection.
4, 5, 6	D3, D2, D1	I	Current Sink Input. Connect to the cathode of the corresponding LED.
7	PGND	-	Power Ground Pin.
8	VOUT	O	Connect to the output capacitor and the anodes of the LEDs.
9	C2+	-	Positive Terminal of the Flying Capacitor 2.
10	C1+	-	Positive Terminal of the Flying Capacitor 1.
11	C1-	-	Negative Terminal of the Flying Capacitor 1.
12	C2-	-	Negative Terminal of the Flying Capacitor 2.
13	VIN	I	Input Supply Pin.
14	GND	-	Analog Ground Pin.
15	EN1	I	Enable Pin and PWM Dimming Control. Pull it high to enable the device, and pull it low to disable the device. The shutdown current is less than 1µA if both EN1 and EN2 pins are tied to GND.
16	EN2	I	Enable Pin and PWM Dimming Control. Apply a PWM signal to EN1 and/or EN2 pins to program the LED current. Both enable pins can be tied together for PWM dimming and used for 4-step digital dimming control.
Exposed Pad	GND	-	Exposed pad. It should be soldered to PCB board and connected to PGND and GND.

ELECTRICAL CHARACTERISTICS

(V_{IN} = 3.6V, EN1 = EN2 = V_{IN}, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage and Current						
Input Voltage Range	V _{IN}	I _{LED} = 25mA	2.7		5.5	V
Quiescent Power Supply Current	I _Q	V _{IN} = 4.2V, 1× mode, EN1 = EN2 = 1, I _{SET} = 0μA		100		μA
		V _{IN} = 4.2V, 1× mode, EN1 = EN2 = 1, I _{SET} = 20μA		200		μA
		I _{OUT} = 0mA, 1.5× mode		2		mA
Shutdown Supply Current	I _{SD}	EN1 = EN2 = GND		0.1	1	μA
Charge Pump Stage						
Over-Voltage Limit	V _{OUT}	LED1 unconnected, V _{IN} = 4.2V		5.3		V
Start-Up Time		C _{OUT} = 1μF, I _{DX} ≥ 0.9 × I _{DX_SET}		150		μs
Soft-Start Duration				130		μs
Switching Frequency	f		0.6	1	1.4	MHz
Efficiency	η	V _{IN} = 3.7V, I _{LED} = 15mA each, V _{DX} = 3.1V		83		%
Shutdown Temperature		Temperature rising		160		°C
Shutdown Temperature Hysteresis				20		°C
Input Current Limit		EN1 = EN2 = 1, I _{SET} = 100μA		300		mA
Current Sinks						
Recommended Maximum Current per Current Sink	I _{DX}	3.2V ≤ V _{IN} ≤ 5.5V		30		mA
Current into Each Current Sink when ISET is Shorted to GND	I _{DX}	3V ≤ V _{IN} ≤ 5.5V, ISET shorted to GND		45		mA
Current Matching between Any Two Outputs		V _{DX} = 3.1V, T _A = +25°C	-3	0.5	3	%
Line Regulation		3V < V _{IN} < 5.5V, V _{LED} = 3.1V, EN1 = EN2 = 1, I _{SET} = 80μA		0.8		%
Reference Voltage for Current Set	V _{ISET}	EN2 = 0, EN1 = 1		200		mV
		EN2 = 1, EN1 = 0		400		
		EN2 = 1, EN1 = 1	580	600	620	
Recommended ISET Pin Current Range	I _{SET}		2		130	μA
I _{DX} to ISET Current Ratio	K	EN1 = EN2 = 1, I _{SET} = 80μA	230	255	280	
Voltage at D _x to GND	V _{SOURCE}	EN2 = 0, EN1 = 1		200		mV
		EN2 = 1, EN1 = 0		300		
		EN2 = 1, EN1 = 1		400		
EN1, EN2						
EN1, EN2 High Level Input Voltage	V _{IH}		1.3			V
EN1, EN2 Low Level Input Voltage	V _{IL}				0.3	V
EN1, EN2 Trip Point Hysteresis				75		mV
EN2 Input Leakage Current	I _{IKG}	EN1, EN2 = GND or EN1, EN2 = V _{IN} = 5.5V		0.1	1	μA
EN1 Input Leakage Current	I _{IKG}	EN1, EN2 = GND or EN1, EN2 = V _{IN} = 5.5V		0.1	1	μA
Under-Voltage Lockout Threshold	V _(UVLO)	Input voltage falling		2.1		V
Under-Voltage Lockout Hysteresis				20		mV
Frequency Range at PWM			0		50	kHz
Recommended ON-Time for PWM Signal				2.5		μs
Shutdown Delay Time				0.85		ms

LOGIC TABLE

Table 1. Enable Logic

EN2	EN1	V _{ISET}	LED Current
0	0	0	0
0	1	200mV	1/3
1	0	400mV	2/3
1	1	600mV	Full

TYPICAL PERFORMANCE CHARACTERISTICS

Table of Graphs

FIGURE		
1	Efficiency (η)	vs. Input Voltage ($I_{LED} = 25mA, 20mA, 15mA, 10mA, 5mA$ per LED), EN2 = EN1 = 1. The curve with higher efficiency is for Input voltage from high to low.
2	LED Current, I_{LED}	vs. Duty Cycle on PWM (I_{LED_MAX} set to 20mA) For $f = 32kHz$, and $f = 1kHz$, DC = 1% to 100%, $V_{IN} = 3.6V$.
3	Switching Frequency (f)	vs. Operating Temperature ($T_A = -40^\circ C$ to $+85^\circ C$, $V_{IN} = 3.6V$)
4	Quiescent Current (I_Q)	vs. Input Voltage ($T_A = +25^\circ C$) (measured with $I_{D1} = 5mA$)
5	LED Current Regulation	vs. Input Voltage $3 \times 20mA$
6	Maximum Output Current from Charge Pump Stage	vs. Input Voltage ($T_A = +25^\circ C$)
7, 8	Dimming Response	PWM Signal and Current at D1 vs. Time-On Scope $f = 32kHz$ and $f = 1kHz$, $V_{IN} = 3.6V$, duty cycle = 50%, EN1 = EN2 = PWM
9, 10	Start-Up Timing	$V_{IN} = 3.6V$, $3 \times 20mA$, EN1 = EN2 = 00 changed to EN2 = EN1 = 11
11	Input and Output Ripple	$V_{IN} = 3.6V$, $3 \times 20mA$, EN1 = EN2 = 1
12	Line Transient Response	V_{IN} and I_{D1} vs. Time-On Scope, LED current at D1 with $V_{IN} = 4.2V$ to $3.6V$ to $4.2V$ with EN2 = EN1 = 11, $3 \times 20mA$

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

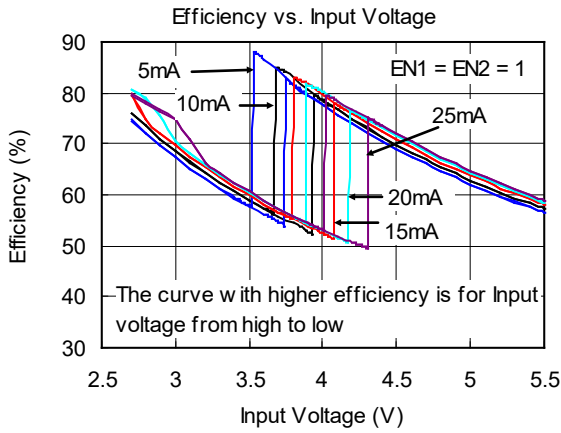


Figure 1

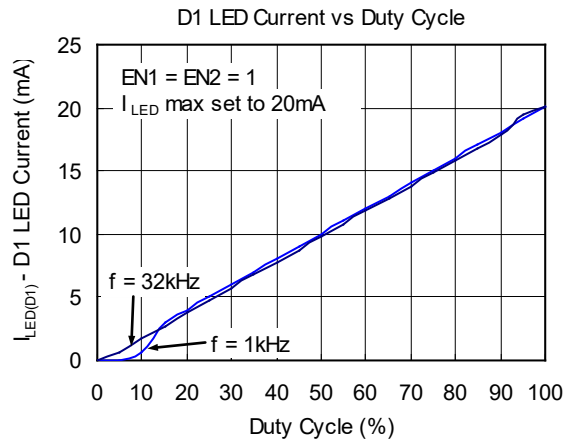


Figure 2

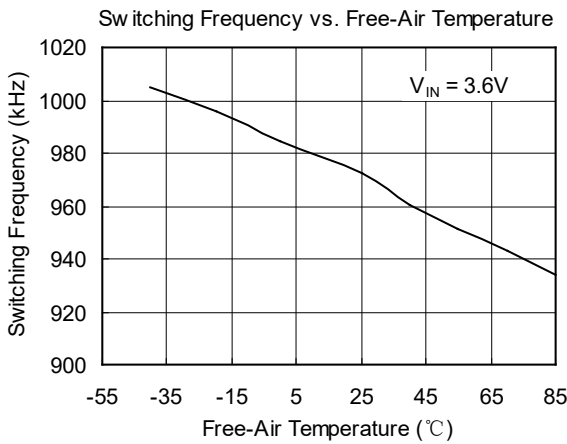


Figure 3

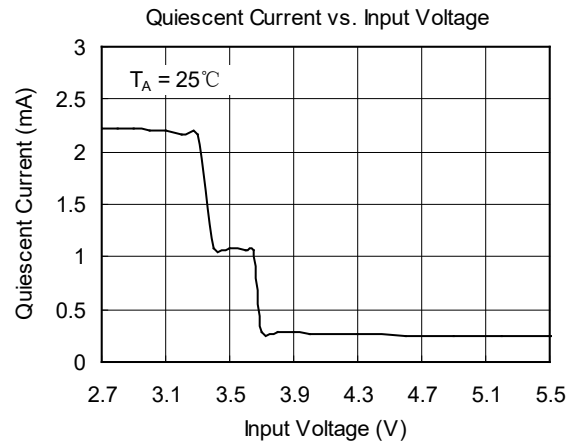


Figure 4

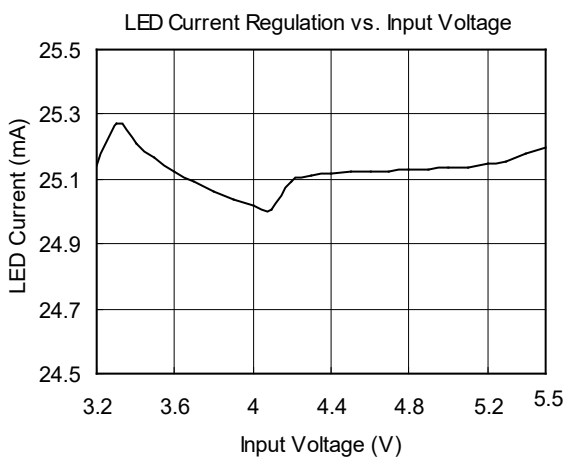


Figure 5

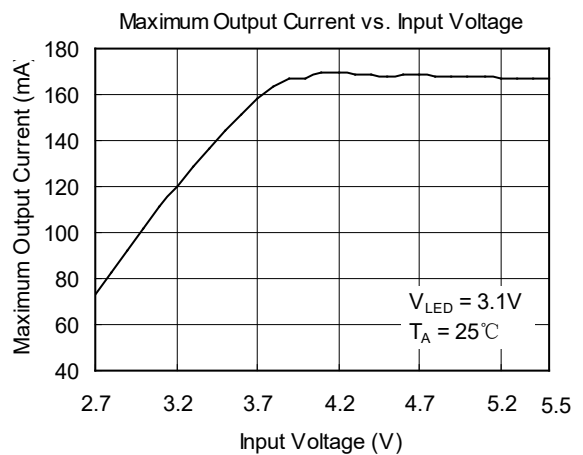
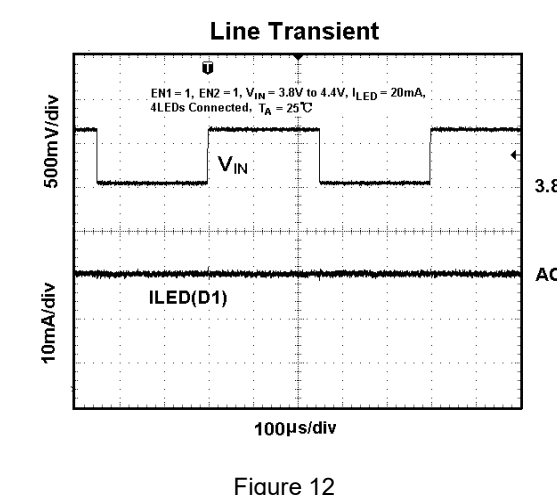
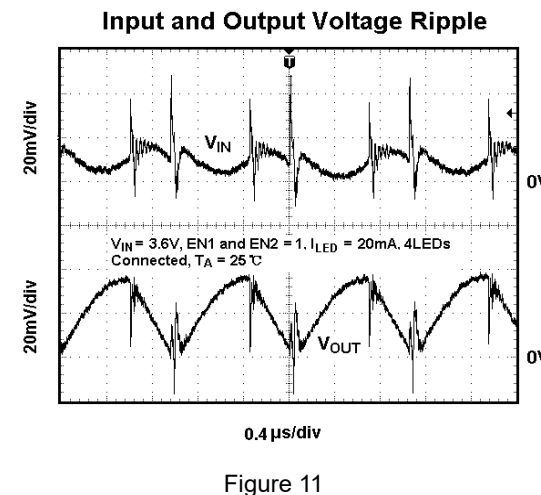
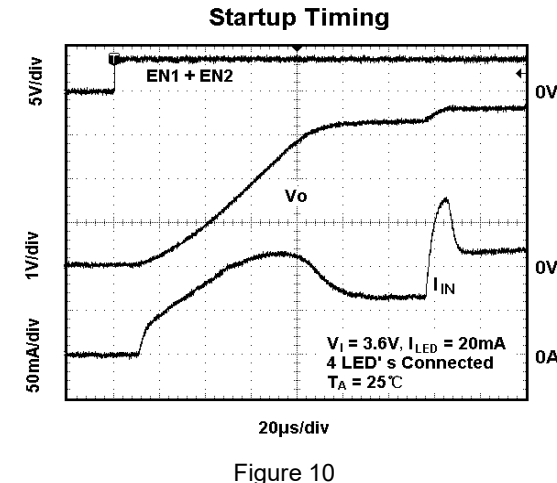
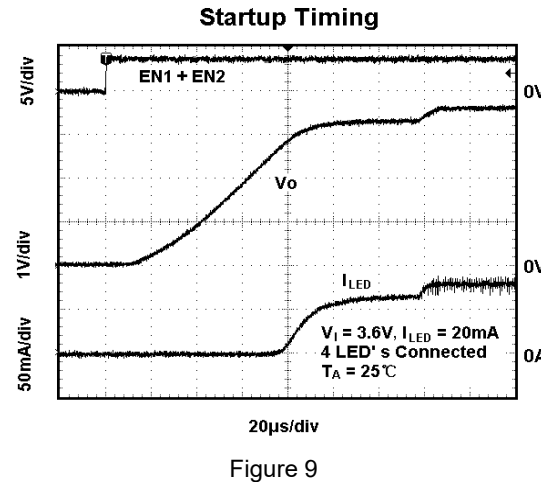
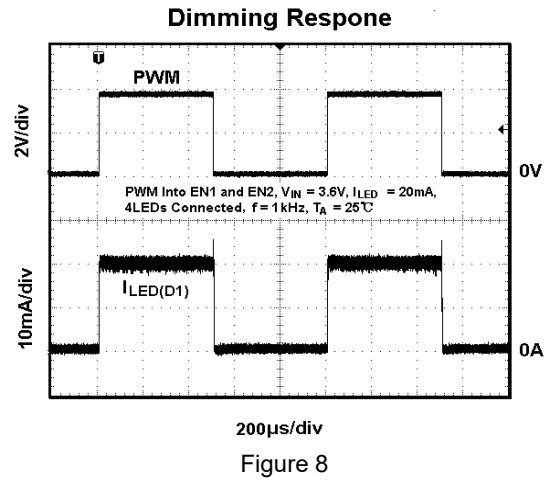
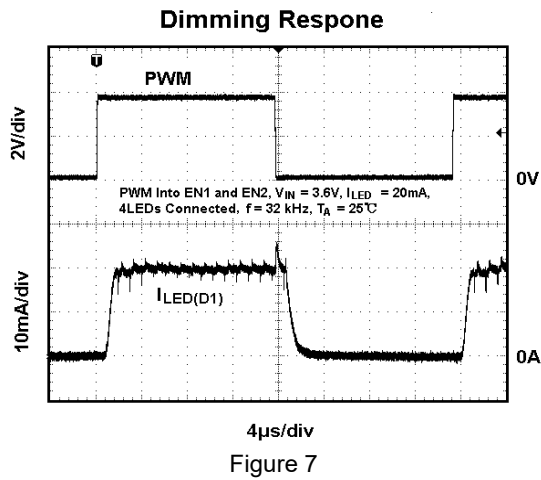


Figure 6

TYPICAL PERFORMANCE CHARACTERISTICS (continued)



REVISION HISTORY

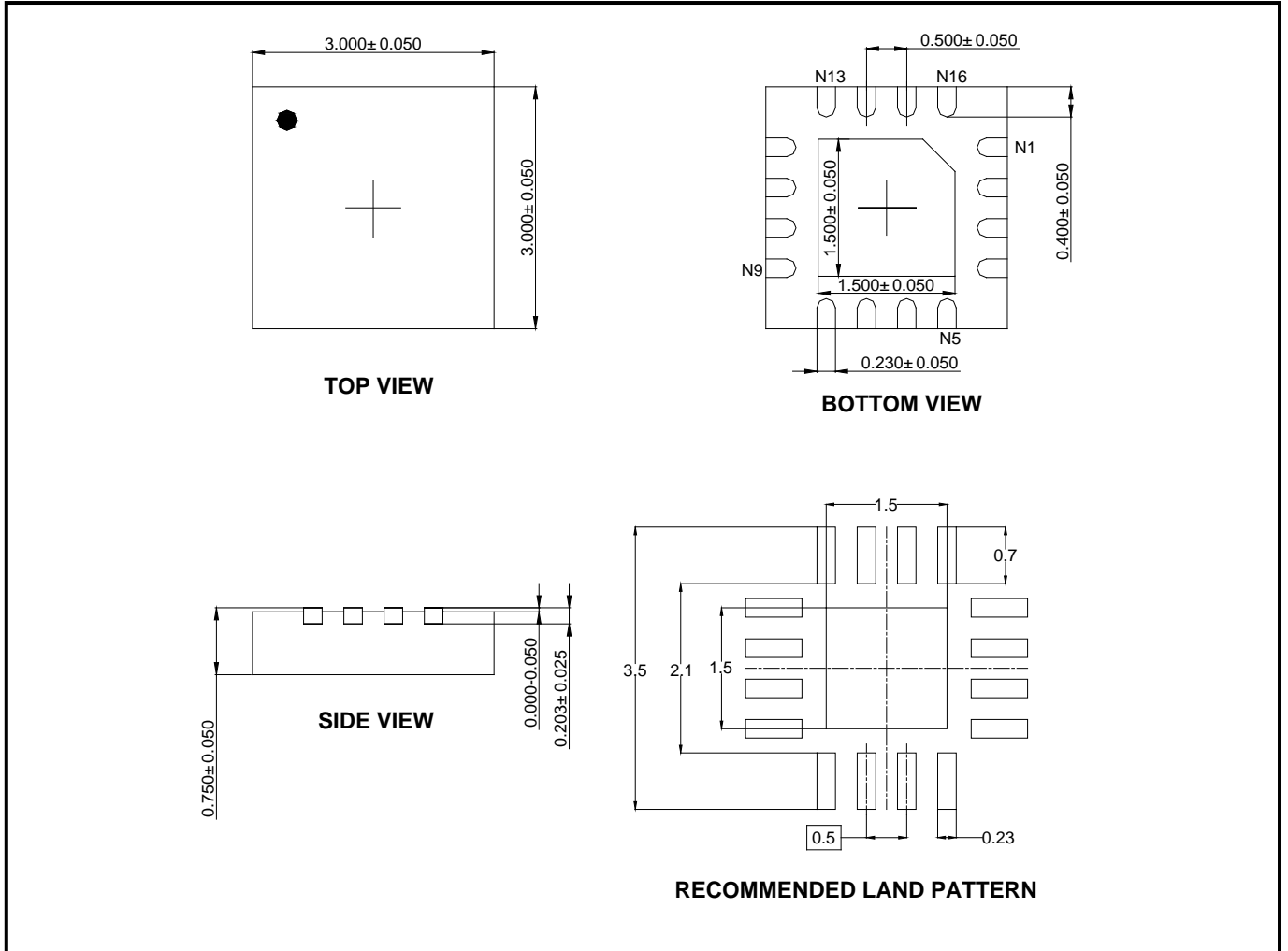
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

JANUARY 2013 – REV.A to REV.A.1	Page
Added Recommended Land Pattern section.....	13
Added Tape and Reel Information section.....	14, 15

Changes from Original (OCTOBER 2010) to REV.A	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

TQFN-3x3-16L

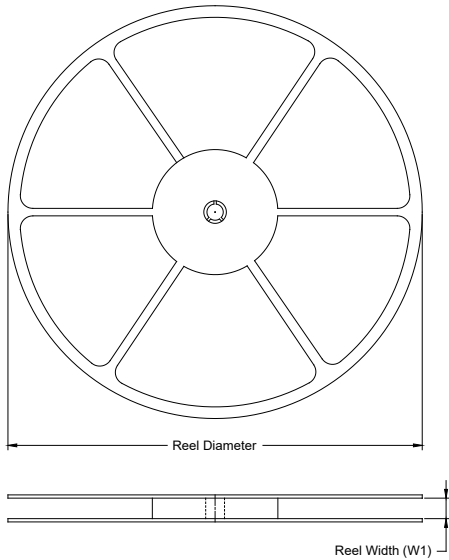


NOTE: All linear dimensions are in millimeters.

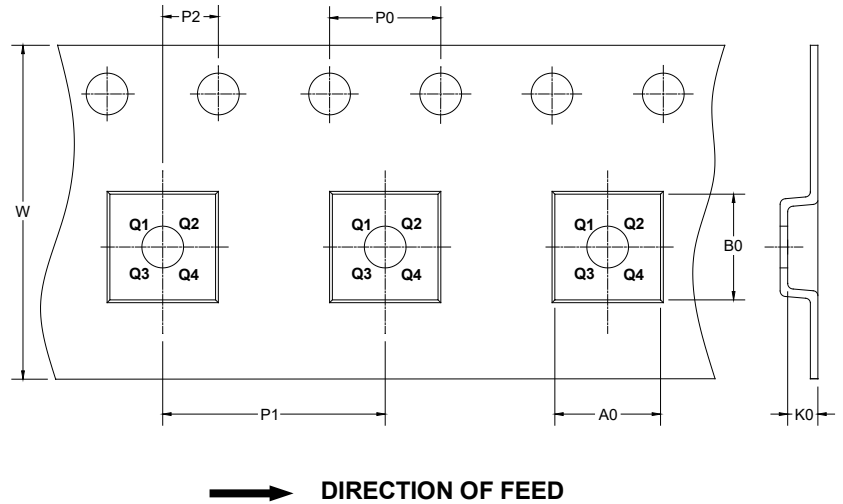
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

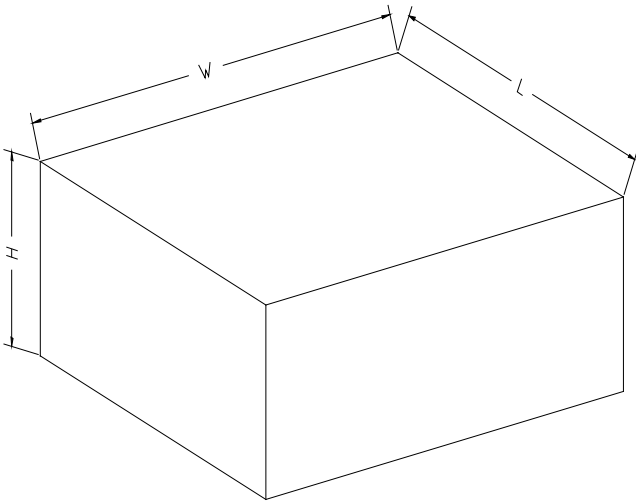
KEY PARAMETER LIST OF TAPE AND REEL

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-3×3-16L	13"	12.4	3.35	3.35	1.13	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