



SGM3803

90% Efficient Synchronous Step-Up Converter with 200mA Negative Charge Pump Inverter

GENERAL DESCRIPTION

The SGM3803 is a constant frequency, current mode, synchronous step-up switching regulator with 200mA negative charge pump inverter which generates an unregulated negative output voltage from an input voltage range of 1.4V to 5.5V. The device is typically used to generate +5V and -5V from battery.

High switching frequency minimizes the sizes of inductor and capacitor. The device requires only three external capacitors for a complete DC/DC charge pump inverter. Integrated power MOSFETs and internal compensation of boost DC/DC make the SGM3803 simple to use and optimized for compact solutions.

The negative charge pump inverter of the SGM3803 is capable of providing 200mA output current. The typical conversion efficiency exceeds 80% over a wide output current range.

The SGM3803 boost DC/DC enters the power-save mode at light loads to maintain high efficiency. Anti-ringing control circuitry reduces EMI concerns by damping the inductor in discontinuous mode. The SGM3803 boost DC/DC provides true output disconnect, thus allowing V_{OUT1} to go to zero volt during shutdown without drawing any current from the input source. The SGM3803 supports 1.8V logic for control.

The output voltage of the boost DC/DC can be programmed by an external resistor divider. Boost DC/DC and negative charge pump inverter have independent enable control.

The device is available in a TDFN-3×3-12L package. It operates over an ambient temperature range of -40°C to +85°C.

FEATURES

Boost DC/DC

- Input Voltage Range: 2.7V to 5.5V
- Up to 5.2V Adjustable Output Voltage
- Output Voltage Clamping: 6V
- 90% Efficient Synchronous Boost Converter
- Quiescent Current: 30μA (TYP)
- Less than 1μA Shutdown Current
- Improved Light Load Efficiency with Power-Save Mode (PSM)
- Load Disconnect during Shutdown
- Low Reverse Leakage Current when $V_{OUT1} > V_{CC}$
- 1.8V Logic on EN1 Pin for Control
- Over-Temperature Protection

Negative Charge Pump Inverter

- Input Voltage Range: 1.4V to 5.5V
- 200mA Output Current Capability
- Only Three Small 2.2μF to 4.7μF Ceramic Capacitors are Required
- Low Quiescent Current in Active Status: 1.5mA (TYP)
- Switching Frequency: 950kHz (TYP)
- 1.8V Logic on EN2 Pin for Control
- Integrated Active Schottky Diode for Startup into Load

APPLICATIONS

Single-Cell Li Battery Powered Products

Portable Audio Players

Cellular Phones

Personal Medical Products

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3803	TDFN-3x3-12L	-40°C to +85°C	SGM3803YTDF12G/TR	SGM 3803DF 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

Input Voltage Range on SW, OUT1, VCC, FB, EN1, EN2, IN
..... -0.3V to 6V
OUT2 -6V to 0.3V
C_{FLY-} 0.3V to V_{OUT2} - 0.3V
C_{FLY+} -0.3V to V_{IN} + 0.3V
Junction Temperature +150°C
Storage Temperature Range -65°C to +150°C
Lead Temperature (Soldering, 10s) +260°C
ESD Susceptibility
HBM 4000V
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.

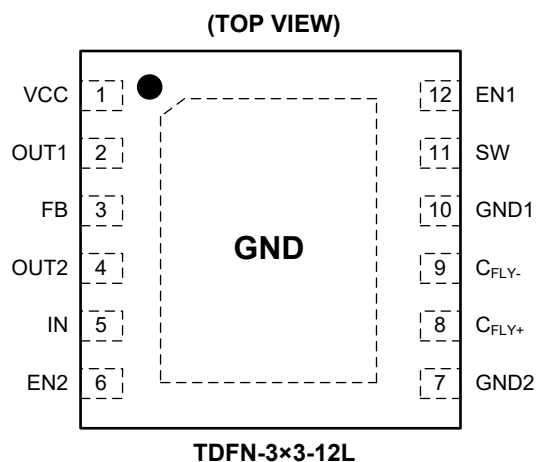
ESD SENSITIVITY CAUTION

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	FUNCTION
1	VCC	Boost Converter Supply Voltage.
2	OUT1	Boost Converter Output.
3	FB	Boost Converter Output Voltage Feedback Pin. An external resistor divider programs the output voltage.
4	OUT2	Charge Pump Inverter Power Output with $V_{OUT2} = -V_{IN}$.
5	IN	Charge Pump Inverter Supply Input. Connect to an input supply in the range of 1.4V to 5.5V.
6	EN2	Charge Pump Inverter Enable Control. When EN2 is biased high, charge pump is in active mode. When EN2 is biased low, charge pump is in shutdown mode.
7	GND2	Ground of Charge Pump Inverter.
8	C _{FLY+}	Charge Pump Inverter Positive Terminal of the Flying Capacitor.
9	C _{FLY-}	Charge Pump Inverter Negative Terminal of the Flying Capacitor.
10	GND1	Ground of Boost DC/DC.
11	SW	Boost and Rectifying Switch Input.
12	EN1	Boost Converter Enable Input. When EN1 is biased high, boost converter is in active mode. When EN1 is biased low, boost converter is in shutdown mode.

ELECTRICAL CHARACTERISTICS

Boost DC/DC

(Full = -40°C to +85°C, typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER		SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
DC/DC Stage								
Output Voltage Range		V_{OUT1}		Full	3		5.2	V
Input Voltage Range		V_{CC}		+25°C	2.7		5.5	V
Feedback Voltage		V_{FB}		Full	487	500	516	mV
Oscillator Frequency		f_1		Full	940	1200	1460	kHz
Switch Current Limit		I_{SW}		Full	0.85	1.1	1.35	A
Start-Up Current Limit				+25°C		300		mA
Boost Switch-On Resistance			$V_{OUT1} = 5V$	+25°C		400		mΩ
Rectifying Switch-On Resistance			$V_{OUT1} = 5V$	+25°C		530		mΩ
Line Regulation			$V_{CC} = 2.7V$ to $V_{OUT1} - 0.5V$, $I_{OUT1} = 0mA$	Full		0.5	1	%
Load Regulation				+25°C		0.5		%
Quiescent Current	V_{CC}		$V_{EN1} = V_{CC} = 2.7V$, $I_{OUT1} = 0mA$	Full		0.1	1	μA
	V_{OUT}		$V_{EN1} = V_{CC} = 2.7V$, $I_{OUT1} = 0mA$, $V_{OUT1} = 5V$	+25°C		30	65	
Shutdown Current			$V_{EN1} = 0V$, $V_{CC} = 2.7V$	+25°C			1	μA
Control Stage								
EN1 Input Low Voltage		V_{IL1}		Full			0.4	V
EN1 Input High Voltage		V_{IH1}		Full	1.6			V
EN1 Input Current			Clamped on GND or VCC	Full			1	μA
Over-Temperature Protection						150		°C
Over-Temperature Hysteresis						20		°C

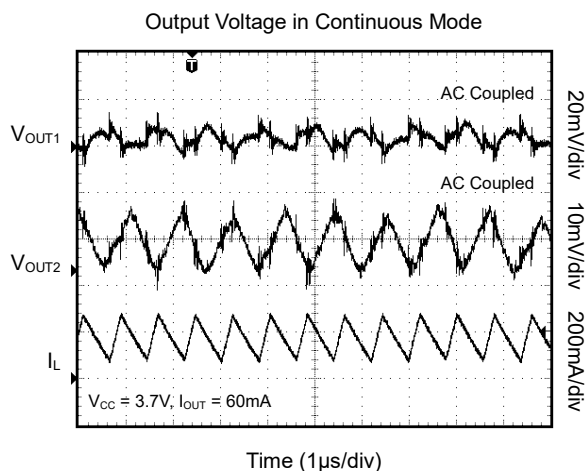
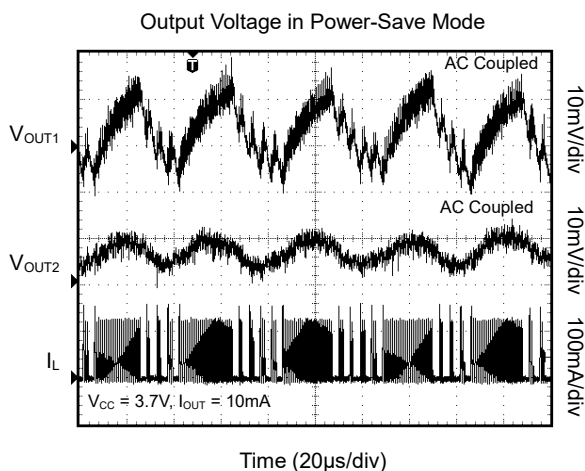
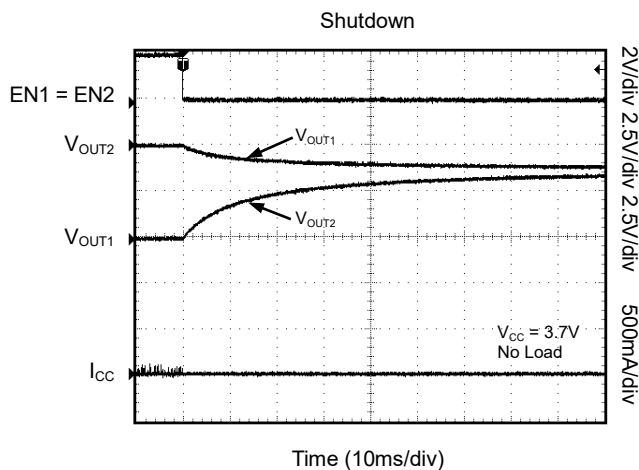
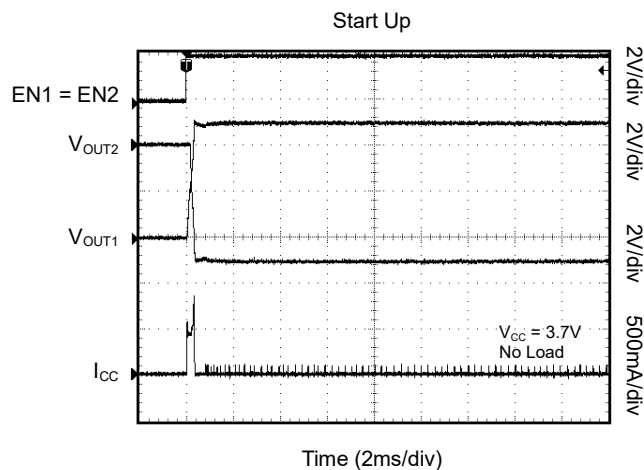
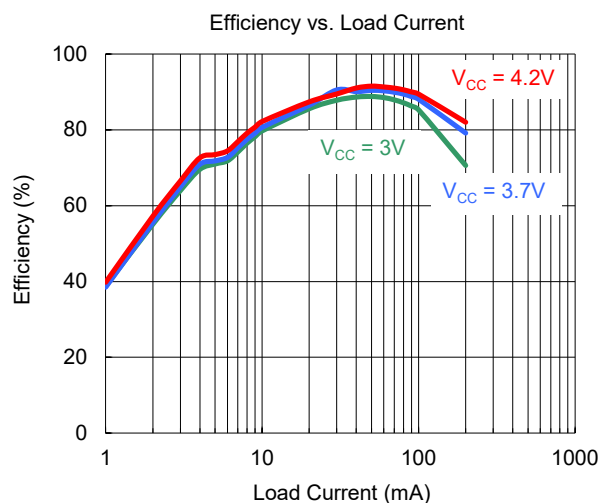
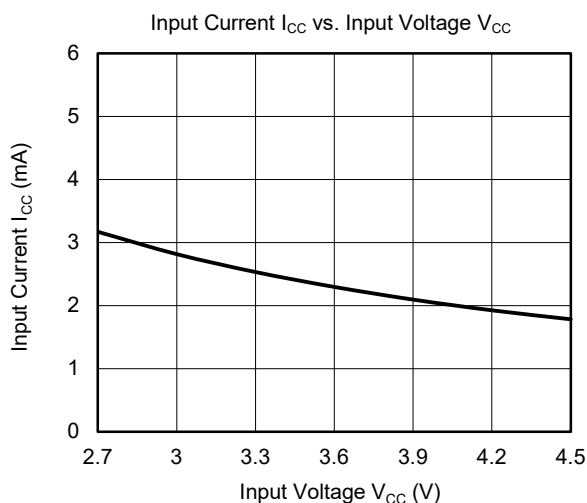
Negative Charge Pump Inverter

(C_{IN2} = C_{FLY} = C_{OUT2} = 3.3μF, V_{IN} = 5V, Full = -40°C to +85°C. Typical values are at $T_A = +25^\circ\text{C}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Charge Pump Stage							
Input Voltage Range	V _{IN}	R _L = 5kΩ	Full	1.4		5.5	V
Maximum Output Current Range at OUT2	I _{OUT2}		Full	200			mA
Output Voltage	V _{OUT2}		+25°C		-V _{IN}		V
Output Voltage Ripple	V _{PP}	I _{OUT2} = 100mA, C _{FLY} = C _{OUT2} = 3.3μF	+25°C		20		mV _{P-P}
Quiescent Current (No Load Input Current)	I _Q		+25°C		1.5	1.85	mA
			Full			1.9	
		Shutdown mode	+25°C		0.4	1	μA
			Full			2	
Oscillator Frequency	f ₂		+25°C	800	950	1100	kHz
			Full	750		1150	
Impedance		I _{OUT2} = 30mA	+25°C		4.2	7.5	Ω
			Full			8	
Control Stage							
EN2 Input High Voltage	V _{IH2}		Full	1.5			V
EN2 Input Low Voltage	V _{IL2}		Full			0.4	V

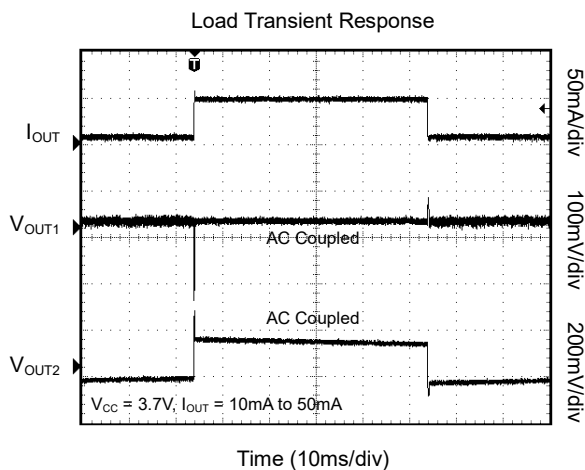
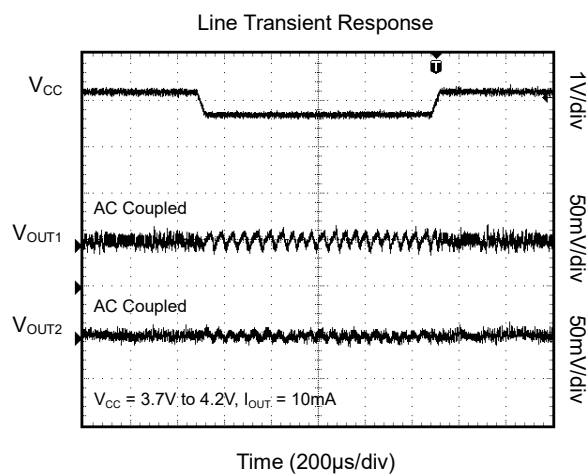
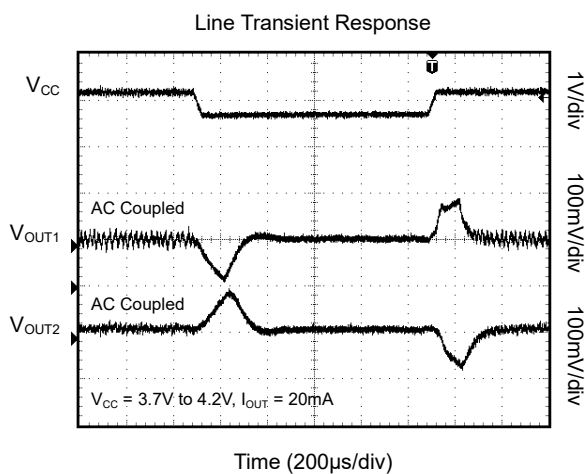
TYPICAL PERFORMANCE CHARACTERISTICS

All the curves are measured with typical application, and load current I_{OUT} is between V_{OUT1} and V_{OUT2} , unless otherwise noted.

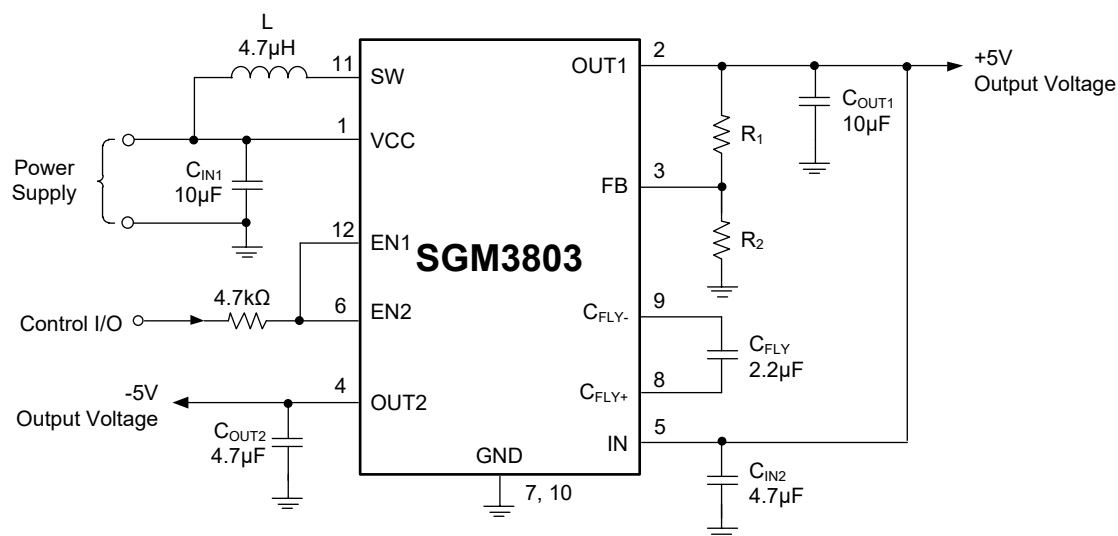


TYPICAL PERFORMANCE CHARACTERISTICS (continued)

All the curves are measured with typical application, and load current I_{OUT} is between V_{OUT1} and V_{OUT2} , unless otherwise noted.



TYPICAL APPLICATION



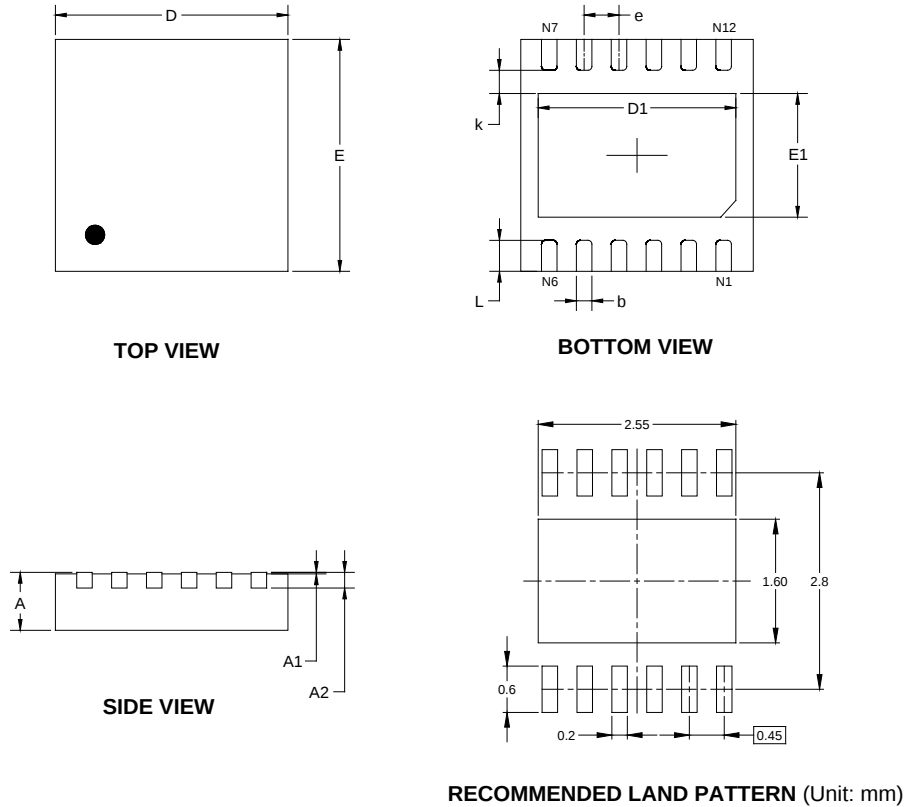
REVISION HISTORY

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

JUNE 2017 – REV.A.1 to REV.A.2		Page
Changed Maximum Output Voltage	1, 4, 9	
JUNE 2014 – REV.A to REV.A.1		Page
Changed 3.3µF Capacitors to 2.2µF ~ 4.7µF	All	
Changes from Original (APRIL 2014) to REV.A		Page
Changed from product preview to production data.....	All	

PACKAGE OUTLINE DIMENSIONS

TDFN-3×3-12L



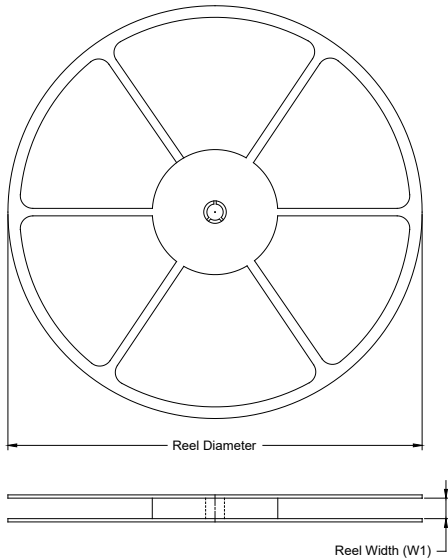
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.924	3.076	0.115	0.121
D1	2.450	2.650	0.096	0.104
E	2.924	3.076	0.115	0.121
E1	1.500	1.700	0.059	0.067
k	0.200 MIN		0.008 MIN	
b	0.150	0.250	0.006	0.010
e	0.450 TYP		0.018 TYP	
L	0.324	0.476	0.013	0.019

NOTE: This drawing is subject to change without notice.

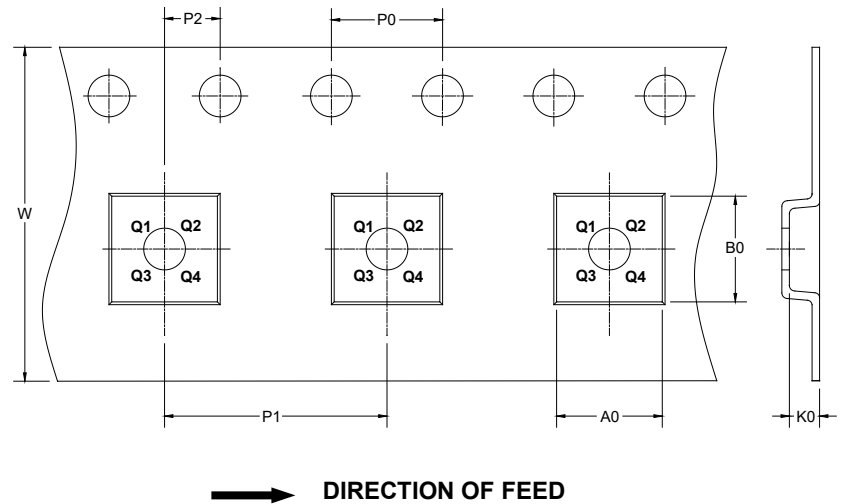
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

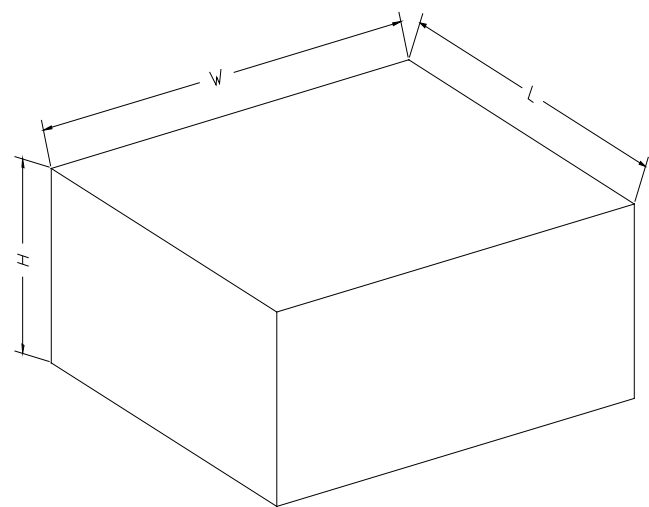
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TDFN-3×3-12L	13"	12.4	3.30	3.30	1.10	4.0	8.0	2.0	12.0	Q1

DD00001

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