SGM6627
650kHz/1.2MHz, 4.2A, 18.5V Boost Converter

GENERAL DESCRIPTION

SGM6627 is a high-efficient Boost converter with high frequency. The device integrates a 0.13Ω power switch with 4.2A (TYP) current limit and supports an output voltage up to 18.5V. A pin selectable 650kHz or 1.2MHz switching frequency provides the device with fast transient response. This device also includes the built-in functions of soft-start, under-voltage lockout (UVLO) and thermal shutdown.

The SGM6627 is available in a Green TDFN-3×3-10AL package.

FEATURES

- **2.5V to 5.5V Input Voltage Range**
- **Up to 18.5V Output Voltage**
- **4.2A (TYP) Current Limit**
- **650kHz/1.2MHz Selectable Switching Frequency**
- **Programmable Soft-Start**
- **Under-Voltage Lockout (UVLO)**
- **Thermal Shutdown**
- **Available in a Green TDFN-3×3-10AL Package**

APPLICATIONS

Body Electronics
Infotainment Clusters
Telemetry and Calling

SIMPLIFIED SCHEMATIC

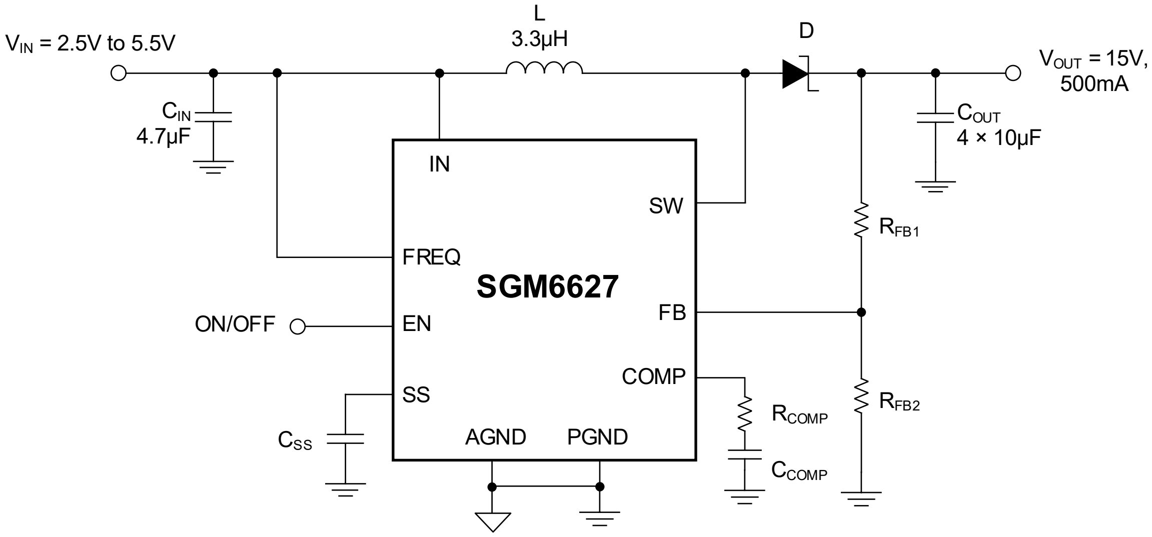


Figure 1. Simplified Schematic

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM6627	TDFN-3×3-10AL	-40℃ to +125℃	SGM6627XTGZ10G/TR	SGM 6627GZ XXXXX	Tape and Reel, 4000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.

XXXXX
- Vendor Code
- Trace Code
- 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 .... -0.3V to 6V
EN, FB, SS, FREQ, COMP .... -0.3V to 6V
SW .... -0.3V to 20V
Package Thermal Resistance
TDFN-3×3-10AL, θ_{JA} .... 44.4℃/W
TDFN-3×3-10AL, θ_{JB} .... 19.3℃/W
TDFN-3×3-10AL, $\theta_{JC (TOP)}$ .... 44.4℃/W
TDFN-3×3-10AL, $\theta_{JC (BOT)}$ .... 8.3℃/W
Junction Temperature ....+150℃
Storage Temperature Range .... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility [(1) (2)]
HBM .... ±3000V
CDM .... ±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.

2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range, V_{IN} ....2.5V to 5.5V
Boost Output Voltage Range, V_{OUT} .... V_{IN} +0.5V to 18.5V
Operating Junction Temperature Range...... -40℃ to +150℃

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

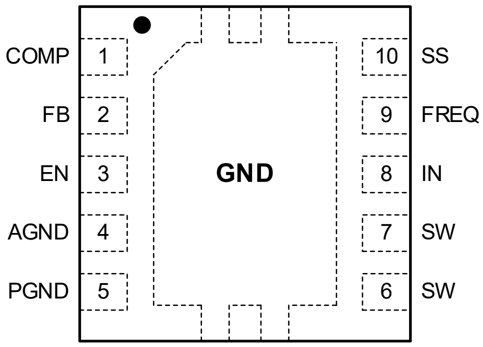
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

(TOP VIEW)



TDFN-3×3-10AL

PIN DESCRIPTION

PIN	NAME	TYPE	FUNCTION
1	COMP	I/O	Compensation Pin. Connect a capacitor and resistor in series.
2	FB	I	Feedback Input Pin. Feedback input to the error amplifier for regulated output.
3	EN	I	Enable Pin of the Boost Regulator. Logic low disables the chip and logic high enables it.
4	AGND	G	Analog Ground.
5	PGND	G	Power Ground.
6	SW	I	Switching Node of the Device.
7	SW	I	Switching Node of the Device.
8	IN	I	Supply Power Input Pin.
9	FREQ	I	Frequency Selection Pin. When FREQ is connected to GND, the device operates at 650kHz. When FREQ is connected to IN pin, the device operates at 1.2MHz.
10	SS	O	Soft-Start Control Pin. Connect a capacitor to this pin to set soft-start time. Open = no soft-start.
Exposed Pad	GND	G	Ground.

NOTE: I = input, O = output, I/O = input/output, G = ground.

ELECTRICAL CHARACTERISTICS

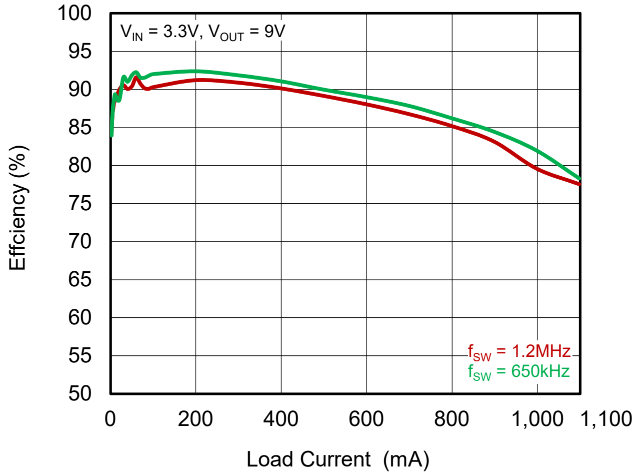
(V_{IN} = 5V, V_{EN} = V_{IN}, V_{OUT} = 15V, T_J = -40℃ to +125℃, all typical values are measured at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply						
Input Voltage Range	V_{IN}		2.5		5.5	V
Operating Quiescent Current into IN Pin	I_Q	Device not switching, V_{FB} = 1.3V		70	110	μA
Shutdown Current into IN Pin	I_{SD_IN}	EN = GND			1	μA
Under-Voltage Lockout Threshold	V_{UVLO}	V_{IN} falling			2.4	V
		V_{IN} rising			2.5	V
Thermal Shutdown	T_{SD}	Temperature rising		153		℃
Thermal Shutdown Hysteresis	T_{SD_HYS}			12		℃
Logic Signals of EN, FREQ						
High-Level Input Voltage	V_{IH}	V_{IN} = 2.5V to 5.5V	1.2			V
Low-Level Input Voltage	V_{IL}	V_{IN} = 2.5V to 5.5V			0.4	V
Input Leakage Current	I_{IN_LEAK}	EN = FREQ = GND			0.1	μA
Boost Converter						
Boost Output Voltage	V_{OUT}		V_{IN} + 0.5		18.5	V
Feedback Regulation Voltage	V_{FB}		1.226	1.238	1.250	V
Transconductance Error Amplifier	gmEA			110		μA/V
Feedback Input Bias Current	I_{FB}	V_{FB} = 1.238V			0.1	μA
N-Channel MOSFET On-Resistance	R_{DSON}	V_{IN} = V_{GS} = 5V, I_{SW} = current limit		0.11	0.21	Ω
		V_{IN} = V_{GS} = 3V, I_{SW} = current limit		0.14	0.24	
SW Leakage Current	I_{SW_LEAK}	EN = GND, V_{SW} = 6V			2	μA
N-Channel MOSFET Current Limit	I_{LIM}		3.3	4.2	5.1	A
Soft-Start Current	I_{SS}	V_{SS} = 1.238V	9	11	13	μA
Switching Frequency	f_{SW}	FREQ = V_{IN} = 5V, V_{OUT} = 15V, I_{OUT} = 500mA	0.9	1.2	1.5	MHz
		FREQ = GND, V_{IN} = 5V, V_{OUT} = 15V, I_{OUT} = 500mA	505	650	795	kHz
Line Regulation		V_{IN} = 2.5V to 5.5V, I_{OUT} = 10mA		0.0005		%/V
Load Regulation		V_{IN} = 5V to 6V, I_{OUT} = 1mA to 1A		0.25		%/A

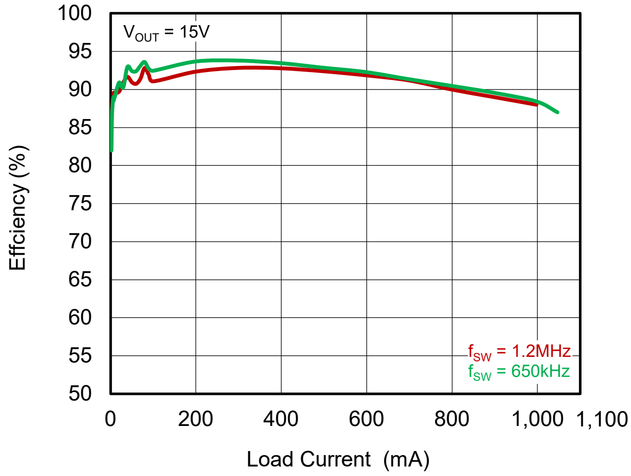
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +25℃, V_{IN} = 5V, unless otherwise noted.

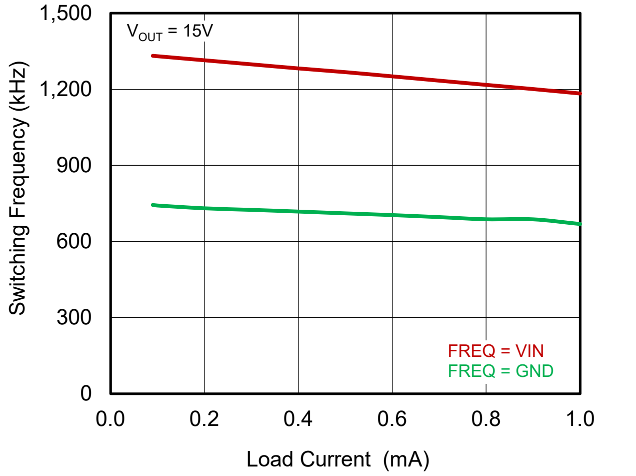
Efficiency vs. Load Current



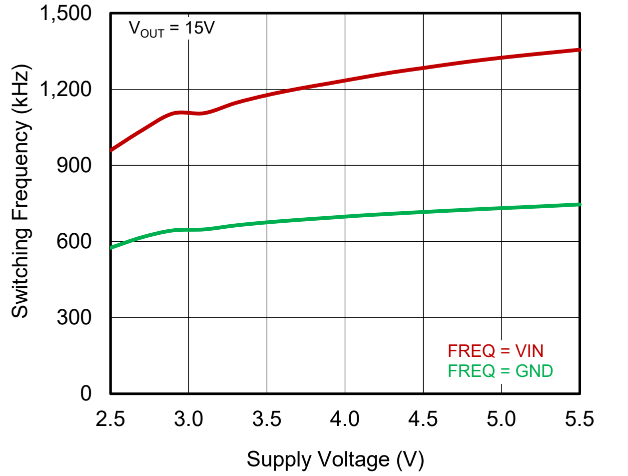
Efficiency vs. Load Current



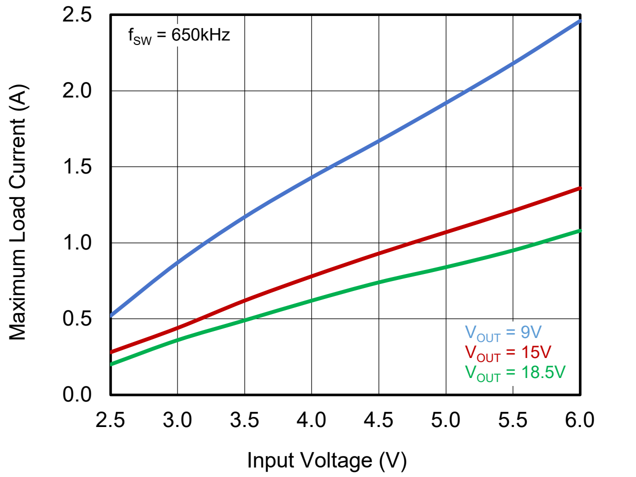
Switching Frequency vs. Load Current



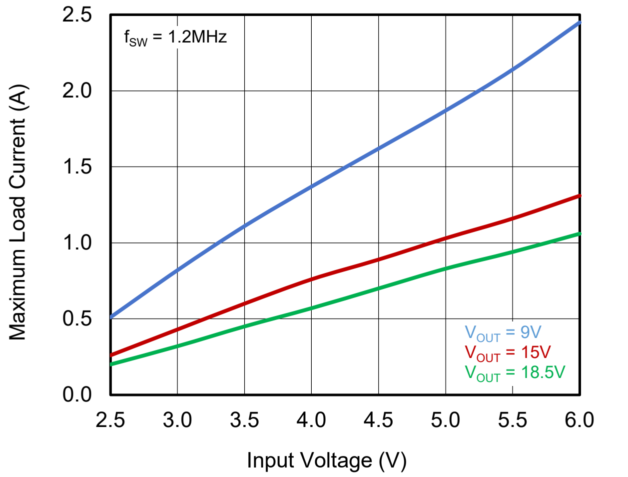
Switching Frequency vs. Supply Voltage



Maximum Load Current vs. Input Voltage



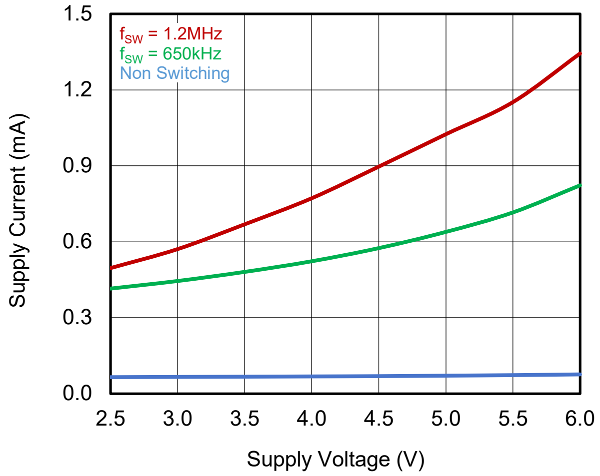
Maximum Load Current vs. Input Voltage



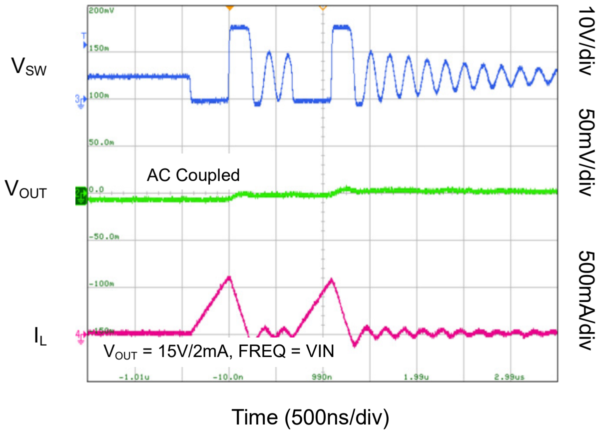
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, V_{IN} = 5V, V_{OUT} = 15V, unless otherwise noted.

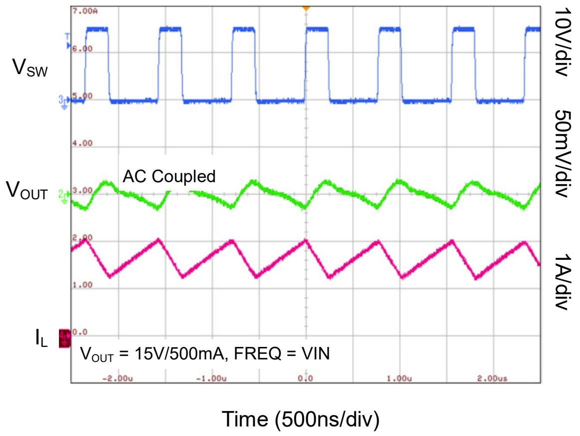
Supply Current vs. Supply Voltage



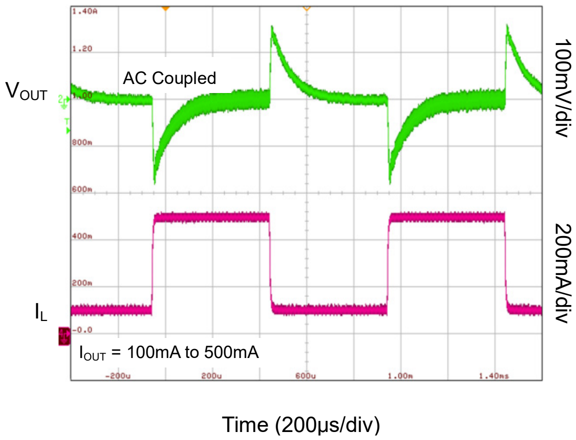
PWM Switching Discontinuous Conduction Mode



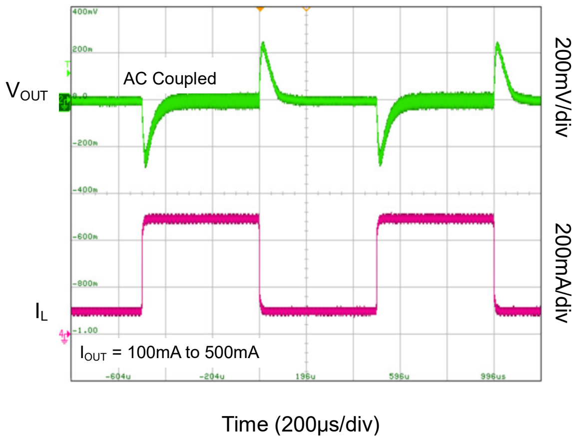
PWM Switching (CCM)



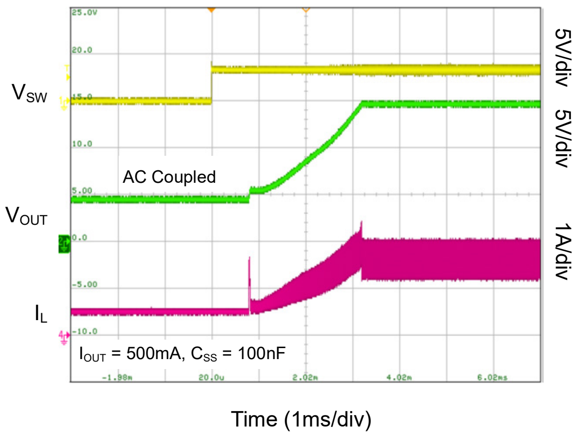
Load Transient High Frequency (1.2MHz)



Load Transient Low Frequency (650kHz)



Soft-Start



FUNCTIONAL BLOCK DIAGRAM

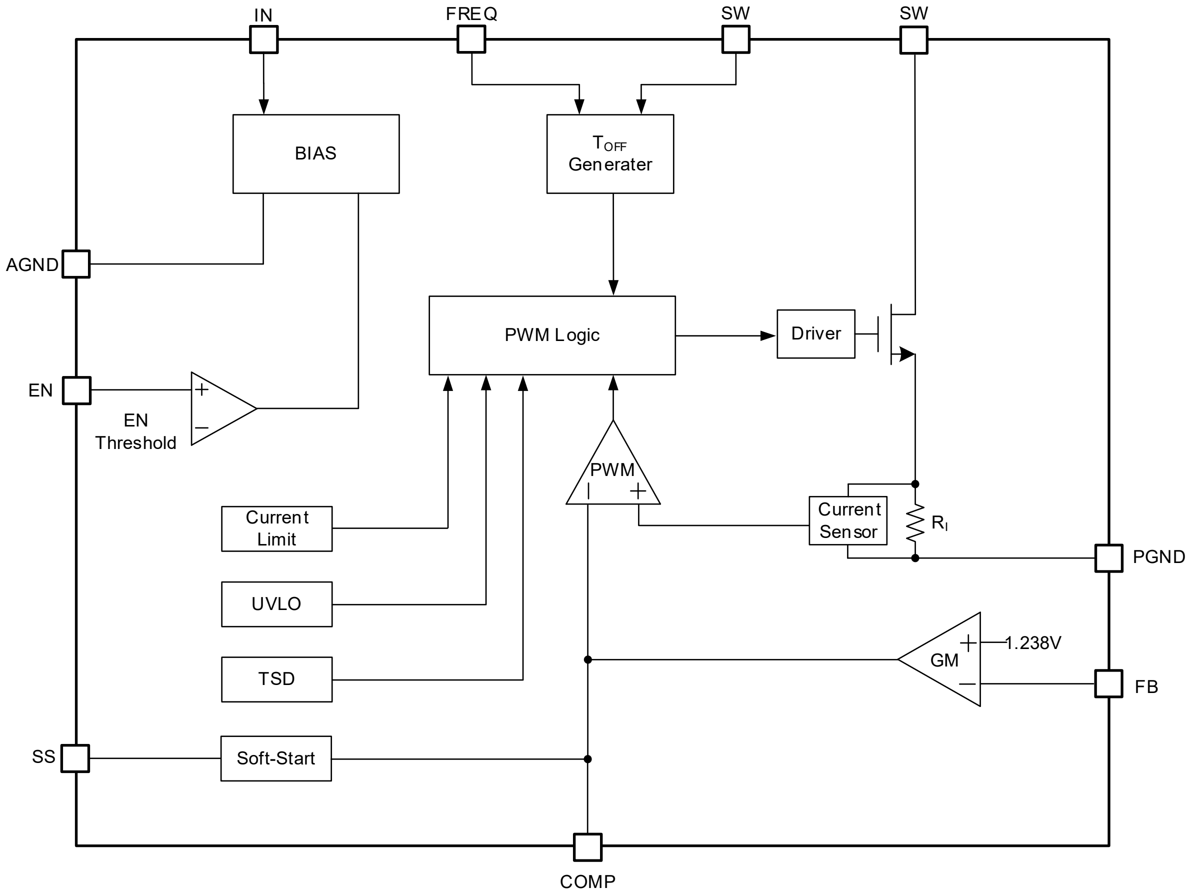


Figure 2. Block Diagram

DETAILED DESCRIPTION

The SGM6627 is a Boost DC/DC converter featuring an integrated low-side MOSFET switch and an adaptive constant off-time control scheme with quasi-constant frequency operation to regulate output voltages up to 18.5V. Designed for wide adaptability, it supports input voltages as low as 2.5V and delivers a peak current limit of 4.2A (TYP). The switching frequency is selectable between 650kHz and 1.2MHz via FREQ pin. Its CFT control architecture ensures enhanced transient response to line and load variations, outperforming conventional control methods in dynamic scenarios.

The device operates in multiple modes to optimize efficiency under varying loads: continuous conduction mode (CCM) under heavy loads for high efficiency, discontinuous conduction mode (DCM) during light loads to minimize losses, and pulse-skip mode when the output load is extremely low to maintain output precision. A built-in soft-start mechanism suppresses inrush current during startup, ensuring reliable power-up sequences. These multi-mode operations, combined with rapid transient recovery, make the SGM6627 suitable for applications demanding fast dynamic performance.

By integrating advanced control strategies and robust protection features, the SGM6627 achieves broader application compatibility compared to traditional converters. Its ability to seamlessly transit between operational modes while maintaining voltage precision and efficiency underscores its versatility in both power-sensitive and high-performance environments.

Soft-Start

The Boost converter employs an adjustable soft-start mechanism to mitigate inrush current during startup. This is achieved by connecting an external capacitor to the SS pin, which controls the gradual ramp up of the internal current limit. When the EN pin is activated (pulled high), the soft-start capacitor (C_{SS}) is pre-charged to 0.6V and then charged with a constant 10μA current. During this phase, the COMP voltage follows the SS voltage, linearly adjusting the peak inductor current to ensure a gradual increase in the output voltage. Once the FB voltage reaches 98% of its nominal value, the COMP pin initiates closed-loop regulation, while the SS voltage continues to rise until it stabilizes at the VIN level.

The soft-start duration scales with C_{SS} capacitance (larger values prolong the ramp time) though 100nF typically suffices for most applications. Upon disabling the EN pin (pulled low), C_{SS} is actively discharged to ground, resetting the startup sequence. This design balances controlled current limiting with minimal external component requirements.

Frequency Select Pin (FREQ)

The switching frequency of the SGM6627 is user configurable through its FREQ pin, which supports binary selection between two preset values: connecting the FREQ pin directly to VIN sets the operating frequency to 1.2MHz, while grounding the FREQ pin (GND) reduces the frequency to 650kHz.

A higher switching frequency can enhance the load transient response capability. This means the converter can better adapt to sudden changes in the load. However, it will cause a slight decrease in conversion efficiency. Additionally, operating in a high-frequency mode can reduce the output ripple voltage, which helps in providing a more stable output voltage.

Under-Voltage Lockout (UVLO)

Under-voltage lockout protection (UVLO) monitors the VIN power input. When the voltage is lower than UVLO threshold voltage, the device is shut down. This is a non-latched protection.

Thermal Shutdown

The internal thermal shutdown protection turns off the device when the junction temperature exceeds +153℃ (TYP). The chip will resume operation when the junction temperature drops by at least 12℃ (TYP).

Over-Voltage Prevention

The device incorporates an over-voltage protection mechanism that triggers when the FB pin voltage exceeds its threshold (typically 3% above the 1.238V). Once the OVP is triggered, the device stops switching immediately, preventing further voltage escalation to the output. This mechanism protects the device from potential damage caused by sudden load shedding or other factors from the downstream circuit.

Device Functional Modes

The converter automatically adjusts its operating modes based on load conditions: it remains in continuous conduction mode (CCM) when the input current exceeds half the inductor ripple current. As the load current decreases, it transits to discontinuous conduction mode (DCM). Under extremely light loads, pulse skipping is activated to regulate the output voltage, ensuring efficient energy management across varying operational demands.

APPLICATION INFORMATION

The SGM6627 supports output voltages up to 18.5V with a 4.2A peak current limit, utilizing current-mode control and quasi-fixed frequency for stable operation. Its switching frequency is adjustable between 650kHz and 1.2MHz, with an input range of 2.5V to 5.5V, while external compensation ensures adaptability and stability. A dedicated soft-start pin controls inrush current during startup, and the subsequent guide outlines a simplified process to configure the IC as a Boost converter for voltage regulation.

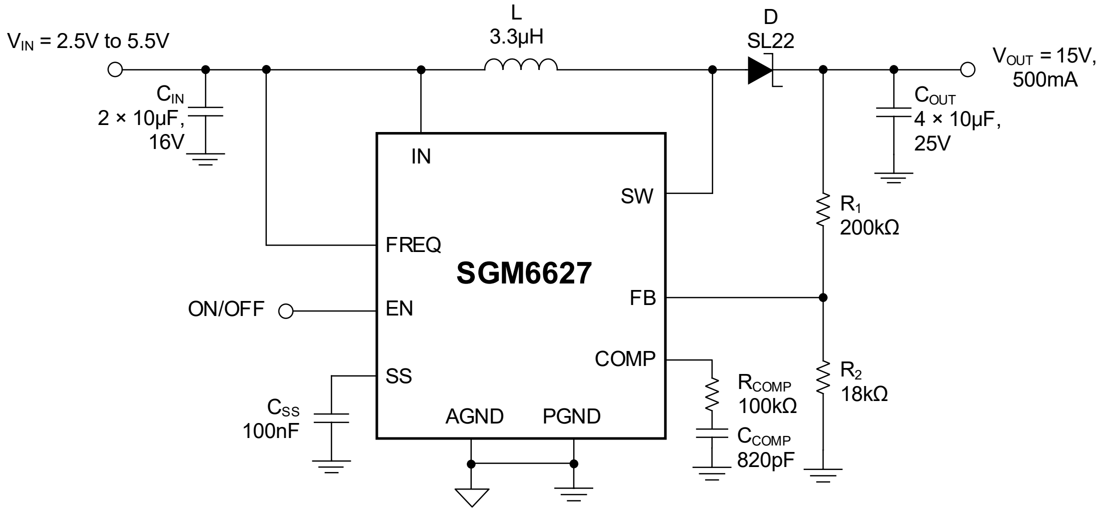


Figure 3. f_{SW} = 1.2MHz, Application Circuit

Design Requirements

For this design example, use the parameters shown in Table 1.

Table 1. Design Parameters

PARAMETER	EXAMPLE VALUE
Input Voltage	2.5V to 5.5V
Output Voltage	15V
Output Current	500mA
Switching Frequency	1.2MHz

Detailed Design Procedure

The design procedure begins by confirming the Boost converter's peak output current capability aligns with system requirements. This validation can be performed through provided efficiency curve for preliminary calculations.

Duty cycle (D) is calculated with Equation 1.

$$D = 1 - \frac{V_{IN} \times \eta}{V_{OUT}} \quad (1)$$

Maximum output current (I_{OUT_MAX}) is calculated with Equation 2.

$$I_{OUT\_MAX} = \left(I_{LIM\_MIN} - \frac{\Delta I_L}{2}\right) \times (1 - D) \quad (2)$$

Peak switch current in application (I_{SW_PEAK}) is calculated with Equation 3.

$$I_{SW\_PEAK} = \frac{\Delta I_L}{2} + \frac{I_{OUT}}{1 - D} \quad (3)$$

The inductor peak-to-peak ripple current (ΔI_L) is calculated with Equation 4.

$$\Delta I_L = \frac{V_{IN} \times D}{f_S \times L} \quad (4)$$

where, V_{IN} is the minimum input voltage. V_{OUT} is the output voltage. I_{LIM_MIN} is the converter switch current limit (minimum switch current limit = 3.3A). f_{SW} is the converter switching frequency (typically 1.2MHz or 650kHz). L is the selected inductor value. η is the estimated converter efficiency (use the number from the efficiency plots or 90% as an estimation).

APPLICATION INFORMATION (continued)

Inductor Selection

The SGM6627 is available with a wide range of inductors, prioritizing two key criteria: saturation current and DC resistance. The inductor's saturation current must exceed the calculated peak switch current (Equation 3) with sufficient margin for load spikes, or alternatively match/exceed the 5.1A maximum switch current limit for conservative designs. Lower DC resistance typically enhances efficiency, though core material, type, and high-frequency losses (core losses, skin/proximity effects at 1.2MHz) also significantly impact the performance. Larger inductors generally yield higher efficiency, with variations of 2% to 10% between models. Recommended values are 3μH to 6μH (3.3μH typical) at 1.2MHz, or 6μH to 13μH (6.8μH typical) for 650kHz operation. Engineers must verify inductor selections against their specific application requirements using Table 2 to ensure optimal performance.

It is recommended that the inductor current ripple is below 35% of the average inductor current. Equation 5 can be used to calculate the inductor value (L).

$$L = \left(\frac{V_{IN}}{V_{OUT}}\right)^2 \times \left(\frac{V_{OUT} - V_{IN}}{I_{OUT} \times f_S}\right) \times \left(\frac{\eta}{0.35}\right) \quad (5)$$

where, I_{OUT} is the maximum output current in the application.

Rectifier Diode Selection

To achieve high efficiency, a Schottky diode is strongly recommended for rectification purposes. The reverse voltage rating of the Schottky should exceed the maximum output voltage of the Boost converter, while its average forward current rating must match the converter's output current (I_{OUT}). These parameters ensure reliable operation under both voltage and load conditions.

$$I_{AVG} = I_{OUT} \quad (6)$$

A Schottky diode rated for 2A average forward current is typically adequate for general use. Lower current diodes may be viable if aligned with the output current, provided their power dissipation capacity meets operational requirements. Typically the power dissipation on the diode must be around 500mW. The power dissipation of the Schottky diode is calculated by following equation:

$$P_D = I_{AVG} \times V_{FORWARD} \quad (7)$$

Table 3 lists the recommended Schottky diode for most application.

Table 2. Inductor Selection

INDUCTOR VALUE	TYPICAL DCR	I_{SAT}	SUPPLIER	SIZE (L × W × H mm^3)	COMPONENT CODE
1.2MHz					
4.7μH	7.9mΩ	15.5A	Wurth Elektronik	12.1 × 11.4 × 9.5	7443320470
3.3μH	5.7mΩ	22.4A	Wurth Elektronik	12.1 × 11.4 × 9.5	7443320330
650kHz					
6.8μH	11mΩ	12.9A	Wurth Elektronik	12.1 × 11.4 × 9.5	7443320680

Table 3. Rectifier Diode Selection

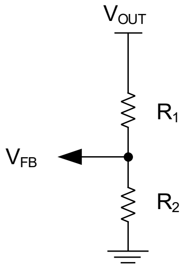
I_{AVG}	V_R	$V_{FORWARD}$	SUPPLIER	COMPONENT CODE
2A	20V	0.44V	Vishay Semiconductor	SL22
2A	20V	0.5V	Fairchild Semiconductor	SS22

APPLICATION INFORMATION (continued)

Setting the Output Voltage

The output voltage is configured via an external resistive divider. To ensure precision and noise immunity, a feedback divider current ≥ 50μA is typically recommended. For typical application, an 18kΩ resistor is used as a bottom resistor.

The resistors are then calculated as shown in Equation 8:



$$R_2 = \frac{V_{FB}}{70\mu A} \approx 18k\Omega$$
$$R_1 = R_2 \times \left(\frac{V_S}{V_{FB}} - 1\right)$$
$$V_{FB} = 1.238V \quad (8)$$

Compensation (COMP)

The regulator loop compensation can be optimized by modifying the external components connected to the COMP pin, which functions as the output terminal of the internal transconductance error amplifier.

Equation 9 can be used to calculate R_{COMP} and C_{COMP}.

$$R_{COMP} = \frac{110 \times V_{IN} \times V_{OUT} \times C_{OUT}}{L \times I_{OUT}}$$
$$C_{COMP} = \frac{V_{OUT} \times C_{OUT}}{7.5 \times I_{OUT} \times R_{COMP}} \quad (9)$$

where, C_{OUT} is the output capacitance.

Make sure that R_{COMP} < 120kΩ and C_{COMP} > 820pF, independent of the results of the above formulas.

Table 4 lists the specialized compensation networks that can improve the load transient response for different application conditions.

Standard values of R_{COMP} = 16kΩ and C_{COMP} = 2.7nF works for the majority of the applications.

Table 4. Recommended Compensation Network Values at High and Low Frequency

FREQUENCY	L (μH)	V_{OUT} (V)	V_{IN} ± 20% (V)	R_{COMP} (kΩ)	C_{COMP}
High (1.2MHz)	3.3	15	5	100	820pF
			3.3	91	1.2nF
		12	5	68	820pF
			3.3	68	1.2nF
		9	5	39	820pF
			3.3	39	1.2nF
Low (650kHz)	6.8	15	5	51	1.5nF
			3.3	47	2.7nF
		12	5	33	1.5nF
			3.3	33	2.7nF
		9	5	18	1.5nF
			3.3	18	2.7nF

APPLICATION INFORMATION (continued)

Input Capacitor Selection

For optimal performance, low ESR ceramic capacitors are recommended for effective input voltage filtering. The SGM6627's analog input (IN) requires a 1μF bypass capacitor between IN and GND positioned as close to the IC as practical. Most applications benefit from two parallel 10μF ceramic input capacitors (or a single 22μF ceramic capacitor), with larger values enhancing filtering effect.

Output Capacitor Selection

For optimal output voltage regulation, low ESR ceramic capacitors are recommended. A total output capacitance of 40μF (achieved via 4 × 10μF or 2 × 22μF configurations) typically satisfies typical application requirements. Increased capacitance values may enhance transient performance. The DC bias derating effects of the ceramic capacitors should be considered when selecting capacitors. Final component validation remains mandatory to verify compatibility under target operating conditions

To calculate the output voltage ripple, use Equation 10.

$$\Delta V_C = \frac{V_{OUT} - V_{IN}}{V_{OUT} \times f_S} \times \frac{I_{OUT}}{C_{OUT}}$$

$$\Delta V_{C\_ESR} = I_{L\_PEAK} \times R_{C\_ESR} \qquad (10)$$

where, ΔV_C is the output voltage ripple dependent on output capacitance, output current, and switching frequency. ΔV_{C_ESR} is the output voltage ripple due to output capacitors ESR (equivalent series resistance). I_{SW_PEAK} is the inductor peak switch current in the application. R_{C_ESR} is the output capacitors equivalent series resistance (ESR). ΔV_{C_ESR} can be neglected in many cases because ceramic capacitors provide low ESR.

Layout Guidelines

For most switching power supplies, especially with high frequency and high current, a good layout is required to prevent EMI failure and device damage as well as good stability of the device.

- Use wide and short traces for main power traces.
- Place the input capacitor to the IN and GND pins as close as possible. If possible, choose high capacitance value for C_{IN} for a stable input.
- Since the SW pin carries high current with fast rising and falling edges, all connections to the SW pin should be kept as short and wide as possible.
- The output capacitor (C_{OUT}) should be placed close to V_{OUT}. It is also beneficial to have the ground of C_{OUT} close to the GND pin since there is large ground return current flowing between them.
- Sensitive signals like FB and COMP must be placed away from SW trace to prevent noise coupling through parasitic capacitance. Components should be positioned in close proximity to the corresponding pins to cut down on parasitic inductance and capacitance.

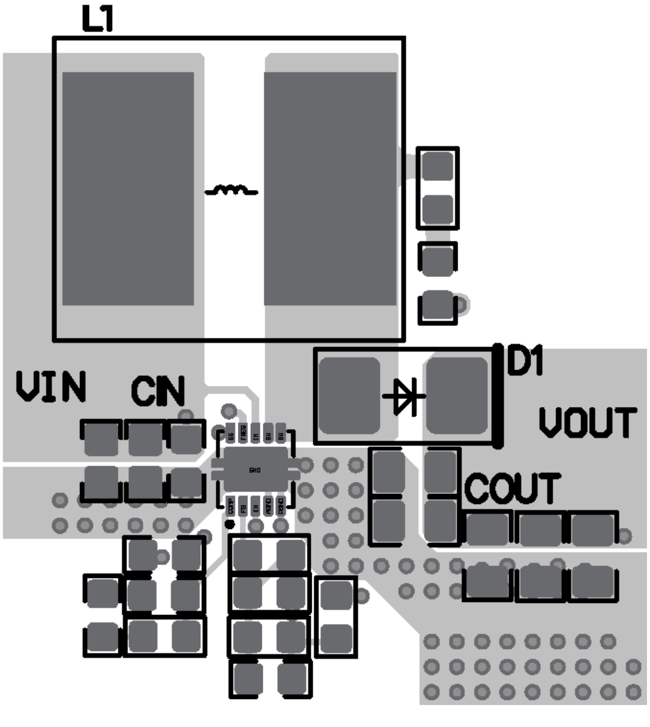


Figure 4. PCB Layout

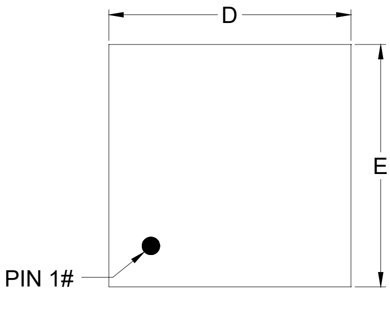
REVISION HISTORY

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

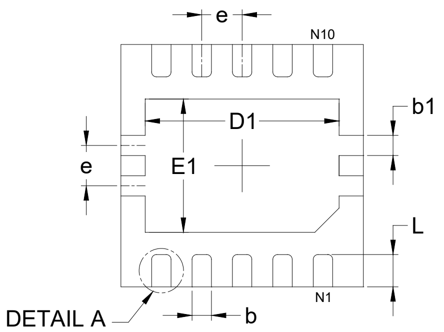
Changes from Original to REV.A (DECEMBER 2025)	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

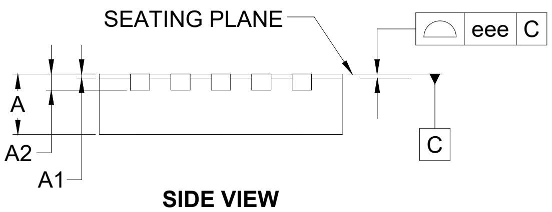
TDFN-3×3-10AL



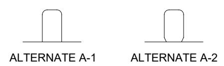
TOP VIEW



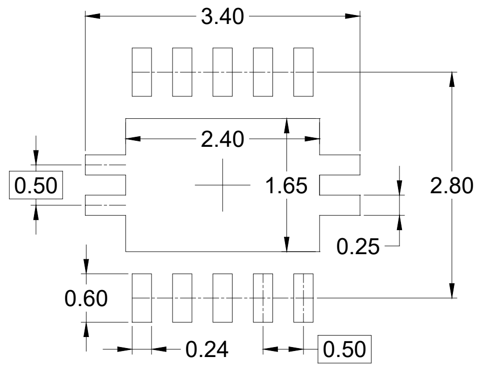
BOTTOM VIEW



SIDE VIEW



DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



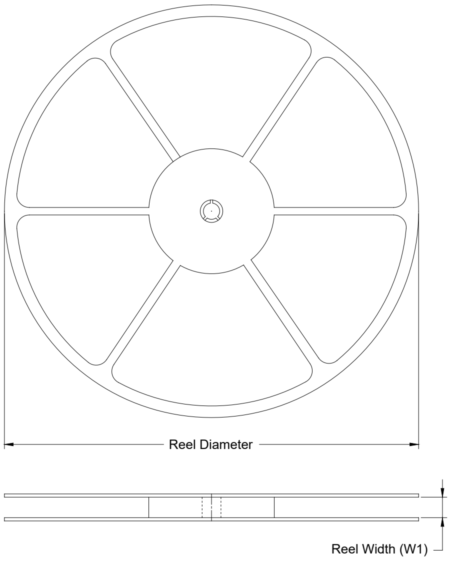
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	**NOM**	**MAX**
A	0.700	-	0.800
A1	0.000	-	0.050
A2	0.203 REF		
b	0.180	-	0.300
b1	0.250 REF		
D	2.900	-	3.100
E	2.900	-	3.100
D1	2.300	-	2.500
E1	1.550	-	1.750
e	0.500 BSC		
L	0.300	-	0.500
eee	0.080		

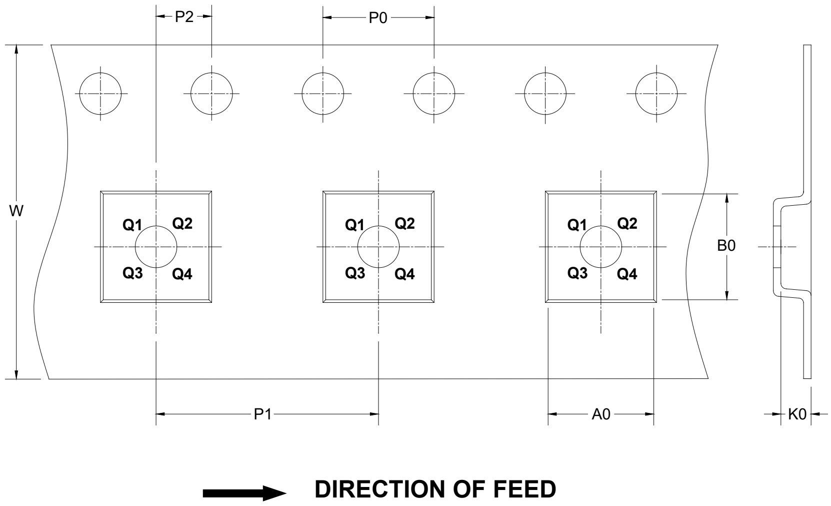
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



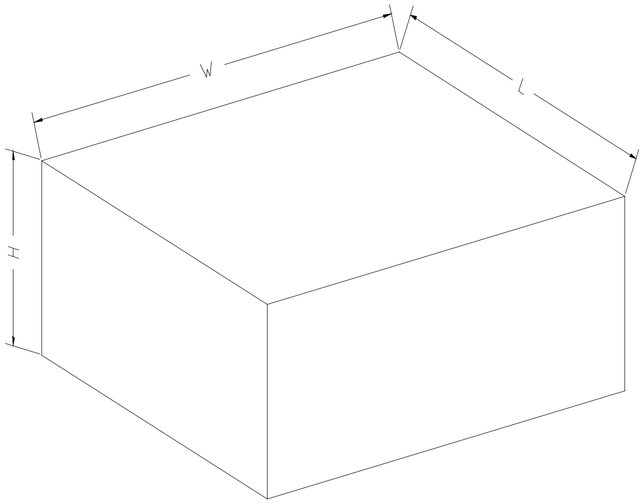
NOTE: The picture is only for reference. Please make the object as the standard.

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-3×3-10AL	13"	12.4	3.30	3.30	1.10	4.0	8.0	2.0	12.0	Q2

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
13″	386	280	370	5

DD0002