SGMICRO

SGM66022
8A Valley Current, 0.5V Ultra-Low Input, Synchronous Boost Converter

GENERAL DESCRIPTION

The SGM66022 is a high power density synchronous Boost converter with 8A (TYP) valley current limit. The device supports wide input voltage range from 0.5V to 5.5V which is suitable for various input source type, such as Li-Ion battery, multiple Alkaline batteries in series, and super capacitors. The device is capable of operating down to 0.5V input voltage after startup which is beneficial for maximizing the input source utilization.

The SGM66022 operates with 1.2MHz switching frequency at input voltage above 1.5V to allow the use of small inductor. The switching frequency folds back gradually to 0.6MHz as the input voltage drops from 1.5V to 1V. The device implements a MODE pin to configure forced PWM mode or auto PFM mode at light load condition. The 30μA (TYP) quiescent current into VOUT pin maximizes the light load efficiency.

The SGM66022 provides input disconnect feature during shutdown. In addition, various protection features such as over-voltage protection, short-circuit protection and thermal shutdown protection.

The SGM66022 is available in a Green TDFN-2×2-7AL package.

FEATURES

- **0.5V to 5.5V Input Voltage Range**
- **2.2V to 5.5V Output Voltage Range**
- **1.8V Minimal Startup V_{IN}**
    - **0.5V after Startup**
- **15mΩ Low-side/20mΩ High-side MOSFETs**
- **8A (TYP) Valley Switching Current Limit**
- **Up to 94.7% Efficiency**
- **1.2MHz and 0.6MHz Switching Frequency**
- **Excellent Load Regulation**
- **Configurable Auto PFM Operation Mode or Forced PWM Operation Mode at Light Loads**
- **Pass-Through Mode when $V_{IN} > V_{OUT}$**
- **True Disconnection during Shutdown**
- **Output Over-Voltage and Thermal Shutdown Protections**
- **Output Short-Circuit Protection**
- **Available in a Green TDFN-2×2-7AL Package**

APPLICATIONS

Audio Power Supply
Super Capacitor Backup
4G, GPRS Power Supply

TYPICAL APPLICATION

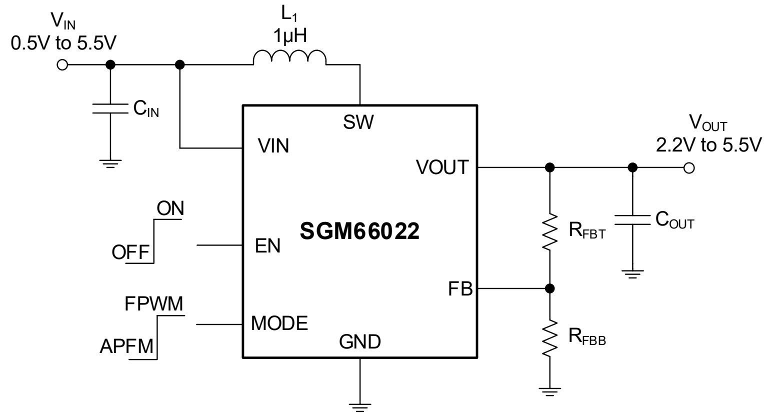


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM66022	TDFN-2×2-7AL	-40℃ to +125℃	SGM66022XTHD7G/TR	0GS XXXX	Tape and Reel, 3000

MARKING INFORMATION

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

Y Y Y — Serial Number
X X X X
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

Voltage Range
VIN, EN, FB, MODE, SW, VOUT .... -0.3V to 6V
Package Thermal Resistance
TDFN-2×2-7AL, θ_{JA} .... 92.5℃/W
TDFN-2×2-7AL, θ_{JB} .... 13.8℃/W
TDFN-2×2-7AL, θ_{JC} .... 50.8℃/W
Junction Temperature ....+150℃
Storage Temperature Range ....-65℃ to +150℃
Lead Temperature (Soldering, 10s) ....+260℃
ESD Susceptibility
HBM..4000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range, V_{IN} ....0.5V to 5.5V
Output Voltage Setting Range, V_{OUT}...................2.2V to 5.5V
Effective Inductance Range, L .... 1.0μH (TYP)
Effective Input Capacitance Range, C_{IN}
....4.7μF (MIN), 10μF (TYP)
Effective Output Capacitance Range, C_{OUT}
$I_{OUT} \geq 3A$ .... 30μF to 1000μF, 30μF (TYP)
$1.5A < I_{OUT} < 3A$ .... 20μF to 1000μF, 30μF (TYP)
$I_{OUT} \leq 1.5A$ .... 10μF to 1000μF, 30μF (TYP)
Operating Junction Temperature Range.......-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.

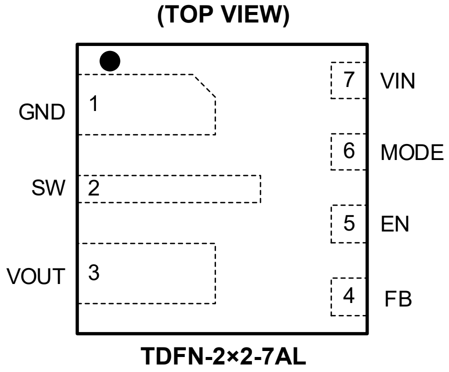
ESD SENSITIVITY CAUTION

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



PIN DESCRIPTION

PIN	NAME	I/O	FUNCTION
1	GND	G	Ground. All signals are referenced to this pin.
2	SW	P	Switch Node. Drain connection of low-side power FET.
3	VOUT	O	Output Pin of the Boost Converter.
4	FB	I	Boost Converter Output Feedback Pin.
5	EN	I	Enable Pin. Logic high turns the converter on. Logic low turns the converter off.
6	MODE	I	Forced PWM Mode or Auto PFM Mode at Light Load Condition Program Pin.
7	VIN	I	Input Pin of the Boost Converter.

NOTE: I: input, O: output, P: power, G: ground.

ELECTRICAL CHARACTERISTICS

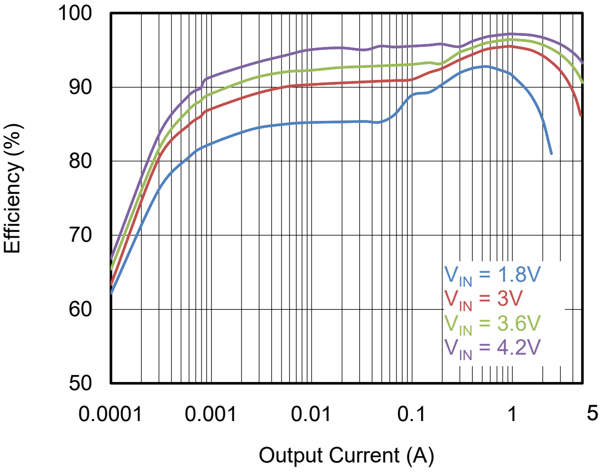
(T_J = -40℃ to +125℃, V_{IN} = 3.6V and V_{OUT} = 5.0V. Typical values are measured at T_J = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Power Supply						
Input Voltage Range	V_{IN}		0.5		5.5	V
Input Voltage Under-Voltage Lockout (UVLO) Threshold	V_{IN_UVLO}	V_{IN} rising, T_J = +25℃		1.65	1.85	V
		V_{IN} rising		1.65	2.1	
		V_{IN} falling		0.4	0.5	
Quiescent Current into VIN Pin	I_Q	EN = high, no load, no switching V_{IN} = 2.1V to 5.5V, V_{FB} = V_{REF} + 0.1V, T_J = -40℃ to +85℃		0.7	5	μA
Quiescent Current into VOUT Pin		EN = high, no load, no switching V_{OUT} = 2.2V to 5.5V, V_{FB} = V_{REF} + 0.1V, T_J = -40℃ to +85℃		30	70	μA
Shutdown Current into VIN and SW Pins	I_{SD}	EN = low, V_{IN} = 2.1V to 5.5V, T_J = +25℃		0.29	1	μA
		EN = low, V_{IN} = 2.1V to 5.5V, T_J = -40℃ to +85℃		0.29	3.5	
Output						
Output Voltage Range	V_{OUT}		2.2		5.5	V
Feedback Reference Voltage	V_{REF}	Forced PWM mode	568	593	615	mV
		Auto PFM mode	568	593	615	
Over-Voltage Protection Threshold	V_{OVP}	V_{OUT} rising	5.5	5.7	6	V
Over-Voltage Protection Hysteresis	V_{OVP_HYS}			150		mV
Leakage Current at FB Pin	I_{FB_LKG}				50	nA
Leakage Current into VOUT Pin	I_{VOUT_LKG}	EN = low, V_{IN} = 0V, V_{SW} = 0V, V_{OUT} = 5.5V, T_J = -40℃ to +85℃		5	30	μA
Soft Startup Time	t_{SS}	From active EN to VOUT regulation. V_{IN} = 2.5V, V_{OUT} = 5.0V, C_{OUT_EFF} = 30μF, I_{OUT} = 0A		670		μs
Power Switch						
High-side MOSFET On-Resistance	R_{DSON}	V_{OUT} = 5V		20		mΩ
Low-side MOSFET On-Resistance		V_{OUT} = 5V		15		mΩ
Switching Frequency	f_{SW}	V_{IN} = 3.6V, V_{OUT} = 5V, PWM mode		1.2		MHz
		V_{IN} = 1.0V, V_{OUT} = 5V, PWM mode		0.6		
Minimum Off Time	t_{OFF_MIN}			150	300	ns
Valley Current Limit	I_{LIM_SW}	V_{IN} = 3.6V, V_{OUT} = 5V	5.5	8	11	A
Pre-charge Current	I_{LIM_CHG}	V_{IN} = 2.1V to 4.8V, V_{OUT} < 0.4V		2000		mA
Maximum Pre-charge Current	$I_{LIM\_CHG\_MAX}$	V_{IN} = 2.4V, V_{OUT} > 0.4V		2		A
Logic Interface						
EN Logic High Threshold	V_{EN_H}	V_{IN} > 2.1V or V_{OUT} > 2.2V			1.2	V
EN Logic Low Threshold	V_{EN_L}	V_{IN} > 2.1V or V_{OUT} > 2.2V	0.35	0.4	0.45	V
MODE Logic High Threshold	V_{MODE_H}	V_{IN} > 2.1V or V_{OUT} > 2.2V			1.2	V
MODE Logic Low Threshold	V_{MODE_L}	V_{IN} > 2.1V or V_{OUT} > 2.2V	0.4			V
Protection						
Thermal Shutdown Threshold	T_{SD}	T_J rising		150		℃
Thermal Shutdown Hysteresis	T_{SD_HYS}	T_J falling below T_{SD}		20		℃

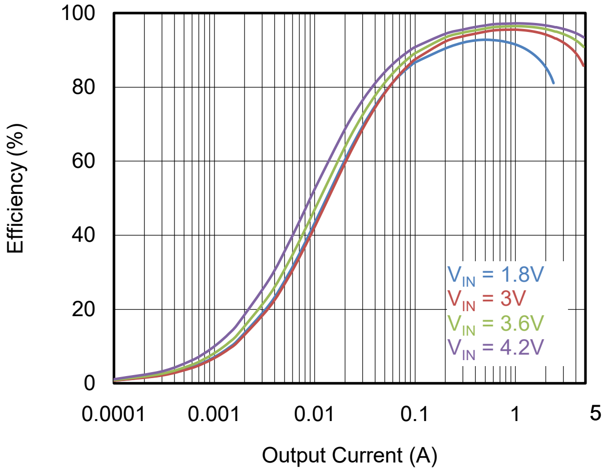
TYPICAL PERFORMANCE CHARACTERISTICS

At T_J = +25℃, V_{IN} = 3.6V and V_{OUT} = 5V, unless otherwise noted.

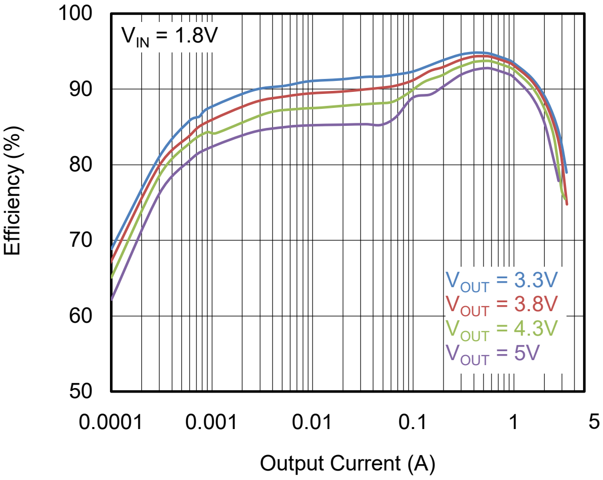
Load Efficiency with Different Input in Auto PFM



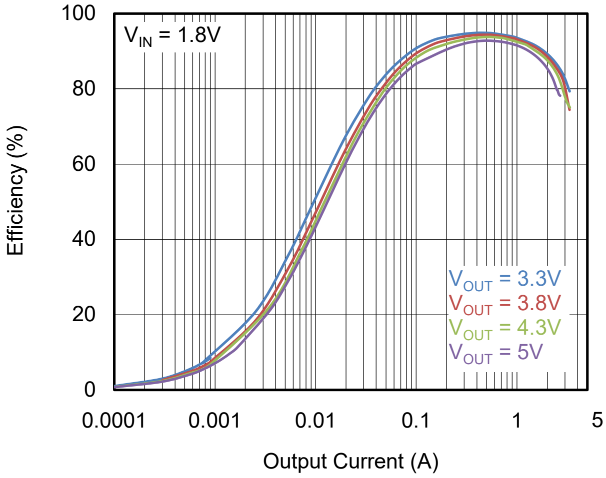
Load Efficiency with Different Input in Forced PWM



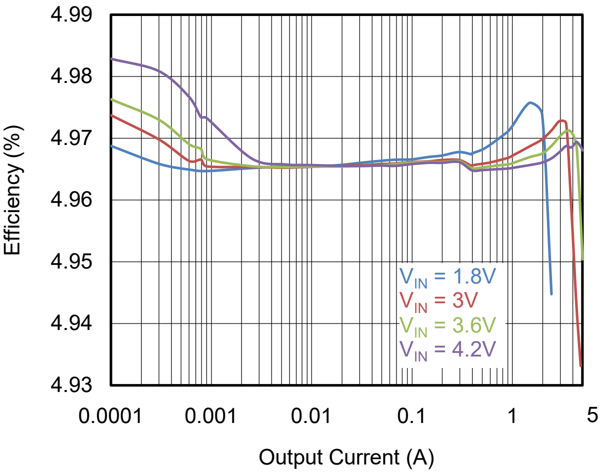
Load Efficiency with Different Output in Auto PFM



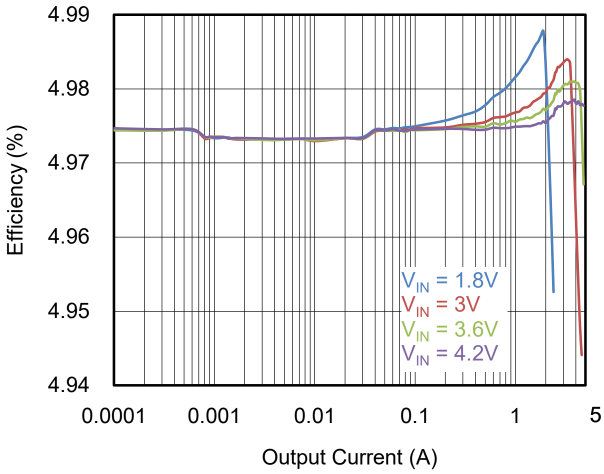
Load Efficiency with Different Output in Forced PWM



Load Regulation in Auto PFM



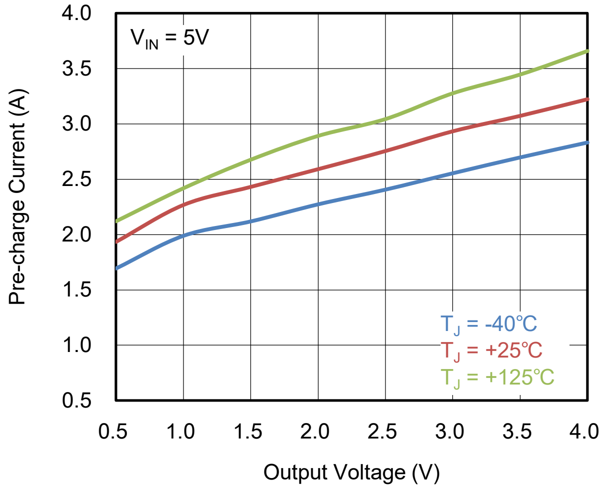
Load Regulation in Forced PWM



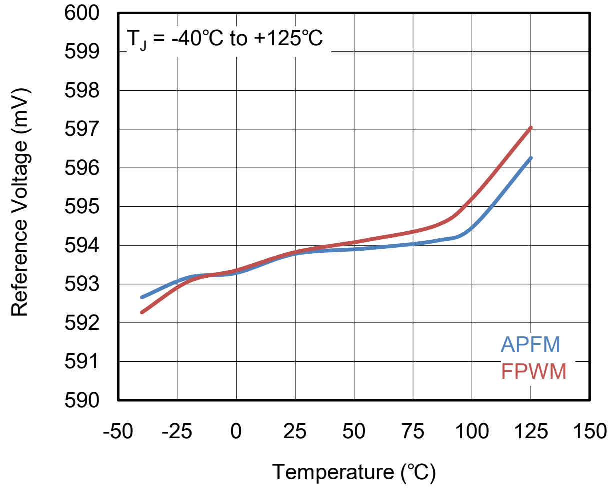
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_J = +25℃, V_{IN} = 3.6V and V_{OUT} = 5V, unless otherwise noted.

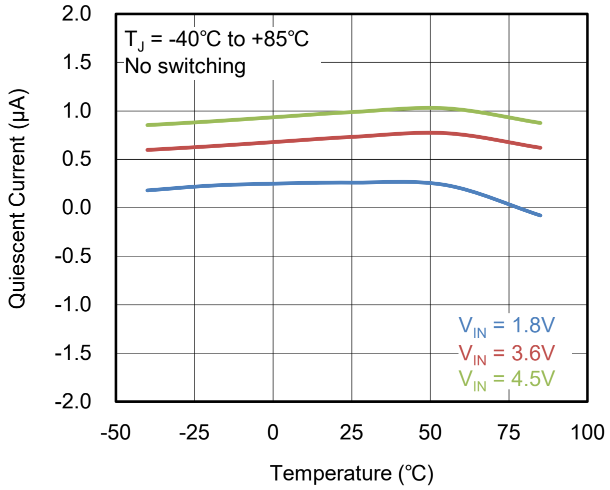
Pre-charge Current vs. Output Voltage



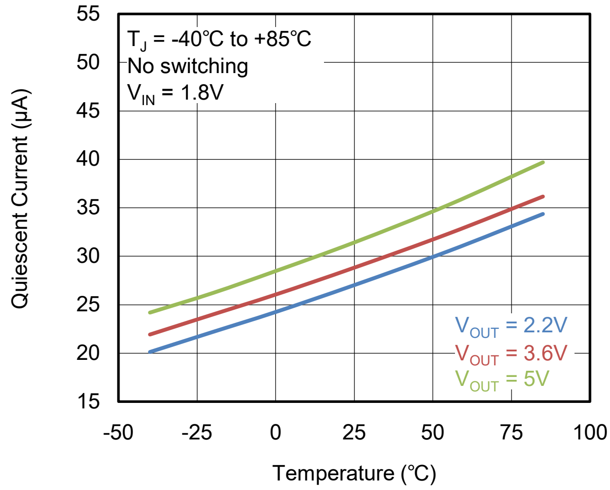
Reference Voltage vs. Temperature



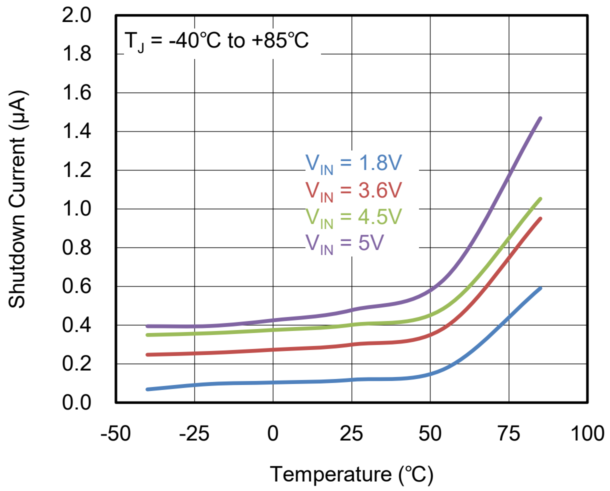
Quiescent Current into VIN vs. Temperature



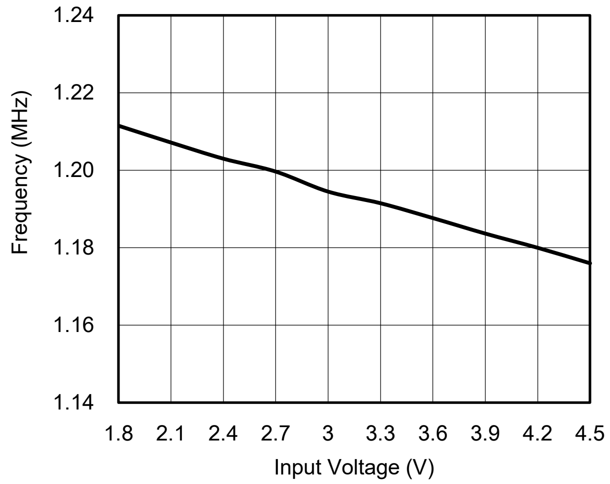
Quiescent Current into VOUT vs. Temperature



Shutdown Current vs. Temperature

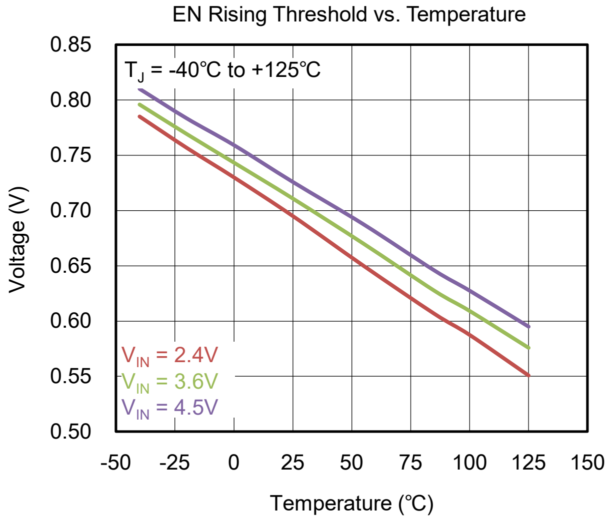


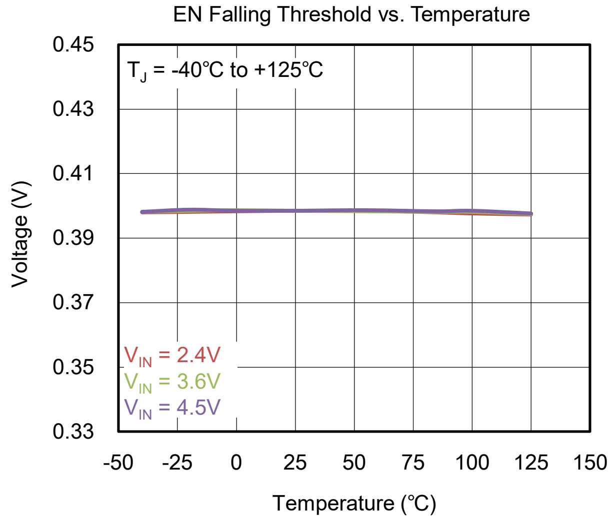
Switching Frequency vs. Input Voltage



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_J = +25℃, V_{IN} = 3.6V and V_{OUT} = 5V, unless otherwise noted.

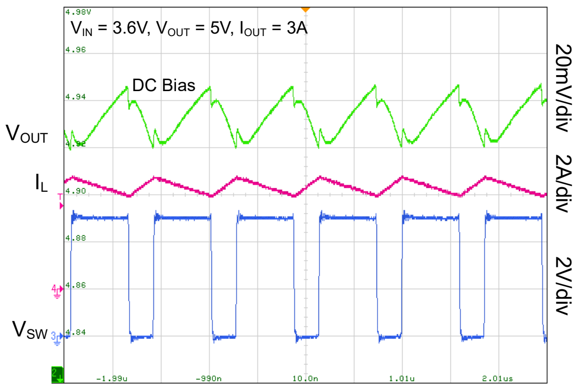




TYPICAL PERFORMANCE CHARACTERISTICS (continued)

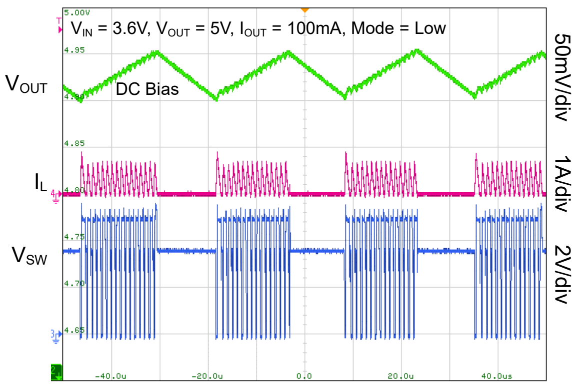
At T_J = +25℃, V_{IN} = 3.6V and V_{OUT} = 5V, unless otherwise noted.

Ripple Heavy Load



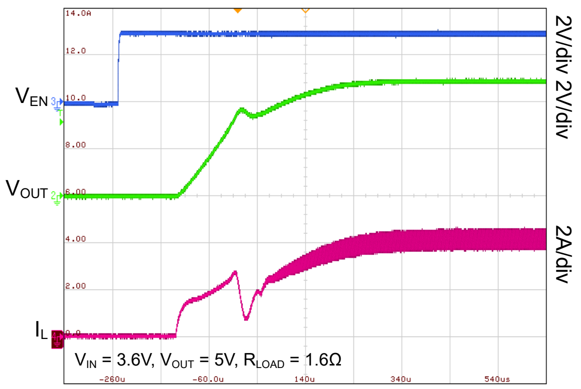
Time (500ns/div)

Ripple Light Load



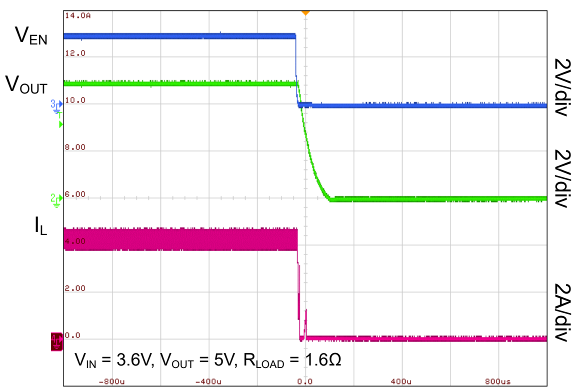
Time (10μs/div)

EN Startup Waveform



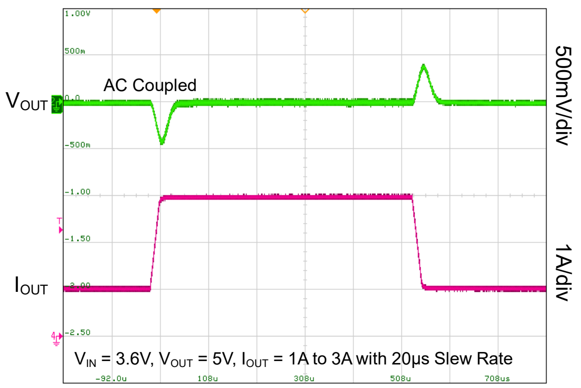
Time (100μs/div)

EN Shutdown Waveform



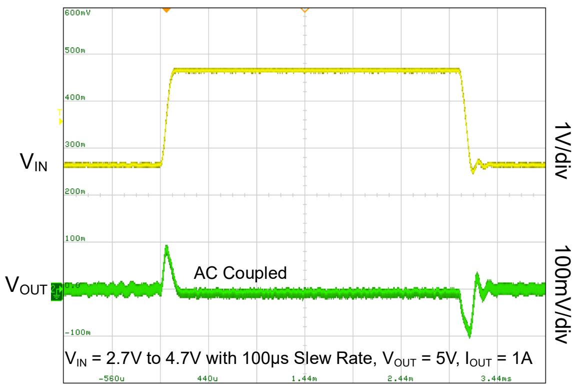
Time (200μs/div)

Load Transient



Time (100μs/div)

Line Transient

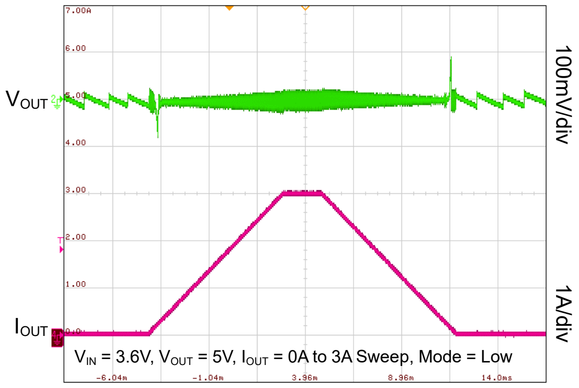


Time (500μs/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

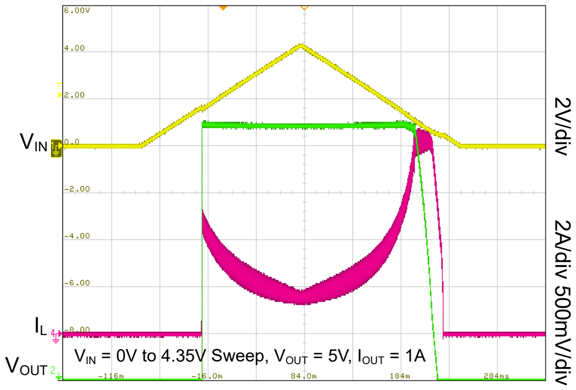
At T_J = +25℃, V_{IN} = 3.6V and V_{OUT} = 5V, unless otherwise noted.

Load Sweep



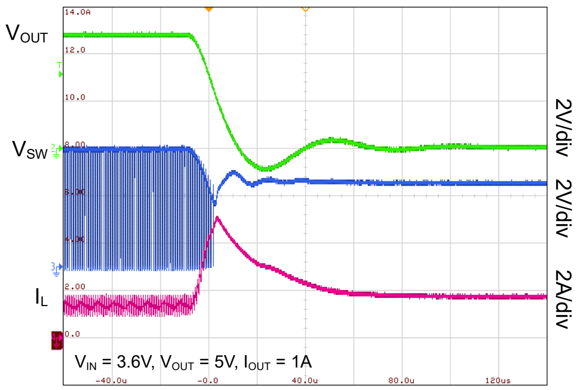
Time (2.5ms/div)

Line Sweep



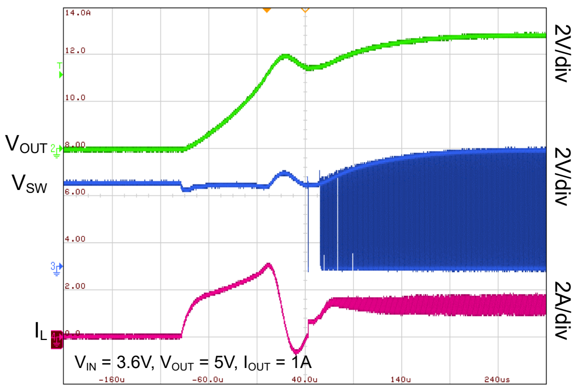
Time (50ms/div)

Short-Circuit Protection Entry



Time (20μs/div)

Short-Circuit Protection Recovery



Time (50μs/div)

FUNCTIONAL BLOCK DIAGRAM

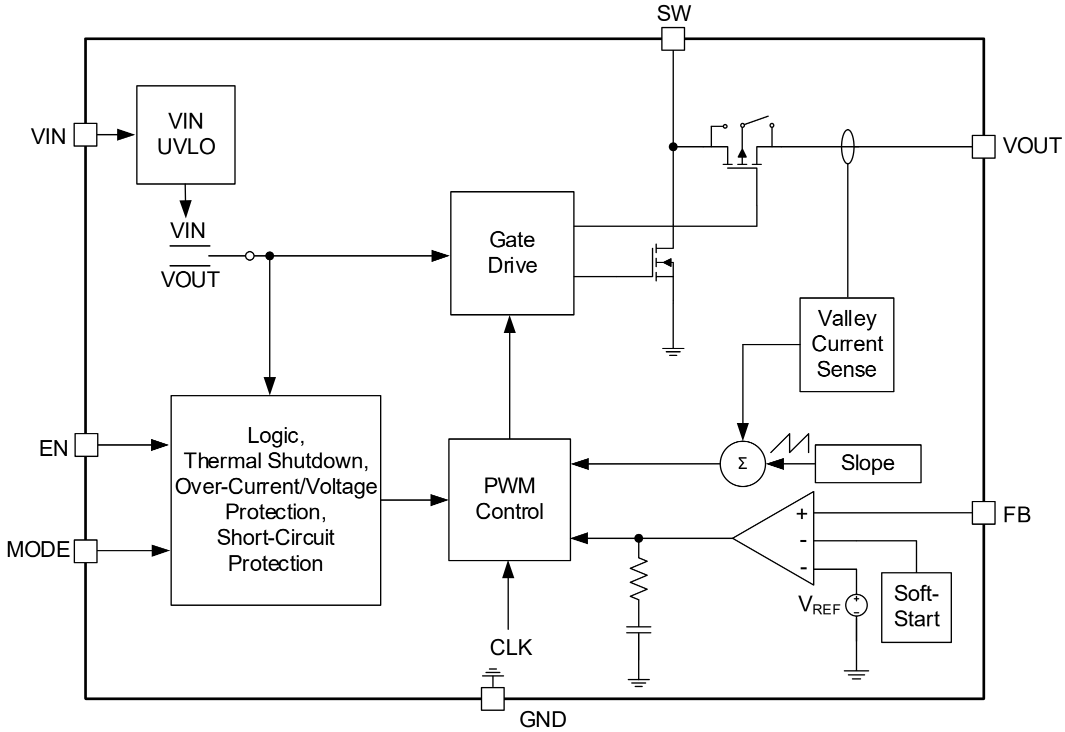


Figure 2. Block Diagram

DETAILED DESCRIPTION

Overview

The SGM66022 is a high power density synchronous Boost converter with 8A (TYP) valley current limit. The device supports wide input voltage range from 0.5V to 5.5V. The SGM66022 operates with 1.2MHz switching frequency at input voltage above 1.5V to allow the use of small inductance. The switching frequency folds back gradually to 0.6MHz as the input voltage drops from 1.5V to 1V. The device implements a MODE pin to configure forced PWM mode or auto PFM mode at light load condition. The 30μA (TYP) quiescent current into VOUT pin maximizes the light load efficiency. The SGM66022 provides input disconnect feature during shutdown. In addition, the SGM66022 provides various protection features such as over-voltage protection, short-circuit protection and thermal shutdown protection.

Under-Voltage Lockout

The SGM66022 integrates input voltage under-voltage lockout (UVLO) feature to protect the device from malfunctioning. The UVLO rising threshold is 1.65V (TYP), and after boosting the output voltage, the SGM66022 can operate with input voltage higher than 0.5V.

Enable and Soft-Start

When the input voltage is valid, pulling the EN input to logic high will enable the device and the output reaches target voltage after about 670μs delay (for 2.5V input voltage, 5V output voltage, 30μF output effective capacitance and 0A load).

When output voltage is less than 0.4V, the pre-charge current is I_{LIM_CHG}. When output voltage is higher than 0.4V but less than input voltage, the pre-charge current is slightly increasing with the grow of output voltage. When output voltage is higher than input voltage, SGM66022 starts switching and boosts up the output voltage to the target voltage.

Pulling EN to logic low will shut down SGM66022. In shutdown mode, the switches and all control circuits are turned off to reduce the device current to 0.29μA (TYP).

Switching Frequency

The SGM66022 operates with 1.2MHz switching frequency at input voltage above 1.5V. The switching frequency folds back gradually to 0.6MHz as the input voltage drops from 1.5V to 1V. The switching frequency is fixed to 0.6MHz when input voltage is below 1V.

Current Limit Operation

The SGM66022 implements an inductor current limit operation if there is an over-current event, the high-side P-MOSFET is turned on to reduce the inductor current until the inductor current decreases to the valley limit value.

Due to the limitation of the inductor valley current, the output current has the maximum continuous value $I_{OUT(CL)}$, and can be defined as Equation 1.

$$I_{OUT(CL)} = (1-D)\times(I_{LIM} + \frac{1}{2}\Delta I_{L(P-P)}) \tag{1}$$

where:

• D is the duty cycle.
• $\Delta I_{L(P-P)}$ is the inductor ripple current.

The duty cycle considering efficiency is defined by Equation 2.

$$D = 1 - \frac{V_{IN}\times\eta}{V_{OUT}} \tag{2}$$

where:

• V_{OUT} is the output voltage of the Boost converter.
• V_{IN} is the input voltage of the Boost converter.
• η is the efficiency of the converter, use 90% for most applications.

The peak-to-peak inductor ripple current is defined by Equation 3.

$$\Delta I_{L(P-P)} = \frac{V_{IN}\times D}{L\times f_{SW}} \tag{3}$$

where:

• L is the inductance value of the inductor.
• f_{SW} is the switching frequency.
• D is the duty cycle.
• V_{IN} is the input voltage of the Boost converter.

Pass-Through Operation

When the input voltage is higher than output voltage, and FB pin voltage is higher than the 101% of V_{REF}, the high-side P-MOSFET of SGM66022 is fully turned on as the gate of P-MOSFET connected to the ground, which means that the SGM66022 enters pass-through mode, and when V_{IN} is lower than output voltage or FB pin voltage is less than 96% of V_{REF}, the SGM66022 exits pass-through mode and regulates the output voltage again.

DETAILED DESCRIPTION (continued)

Over-Voltage Protection

SGM66022 integrates over-voltage protection (OVP) to protect the device in the event of feedback resistor short-to-ground or incorrect feedback resistor value being populated. The SGM66022 stops switching when the OVP threshold of 5.7V (TYP) is reached. When the output voltage is 150mV lower than the OVP threshold, the device resumes switching.

Thermal Shutdown

If the junction temperature exceeds the +150℃ (TYP), the device will go into thermal shutdown mode. When the junction temperature drops below the threshold minus 20℃, the switching will resume automatically.

Device Functional Modes

The SGM66022 operates at valley current control. When the sampling value of the inductor current plus the internal slope compensation value equals to the internal comp voltage, the low-side N-MOSFET will be turned on, the high-side P-MOSFET turns off, the input voltage charges the inductor, the inductor current rises, and the output capacitor provides energy to the load. The CLK triggers the high-side P-MOSFET to turn on, while the low-side N-MOSFET will be turned off. Due to the higher output voltage than the input voltage, the inductor current releases energy to the output.

When the load is light, configure the MODE pin to select FPWM (forced PWM mode) or APFM (auto PFM mode). When MODE pin is logic high, the SGM66022 will operate at FPWM, and when MODE pin is logic low, the SGM66022 will operate at APFM.

Forced PWM Mode

In the FPWM mode, the SGM66022 runs at fixed frequency whether heavy or light loads. The high-side P-MOSFET is still turned on when the inductor current drops below zero based on the duty ratio. This will be beneficial for audio. However, FPWM mode can cause poor efficiency at light loads because energy is transferred from output to input.

Power-Save Mode

To reduce light load loss and increase the efficiency, power-save mode (PSM) feature is included in the SGM66022 when configure the MODE pin to logic low. The SGM66022 determines whether entering PSM based on internal compensation voltage. When the inductor current is maintained at the minimum level, the output voltage rises, thereby affecting the comp voltage. Once the comp voltage reaches the set threshold, SGM66022 enters PSM and stops switching. When the output voltage drops causing SGM66022 to exit PSM, the device switches again.

APPLICATION INFORMATION

Typical Application

The SGM66022 can be used as a power solution for portable devices and super-capacitor backups. For portable devices using single-cell Li-Ion battery application, the SGM66022 can output 5V and 3A.

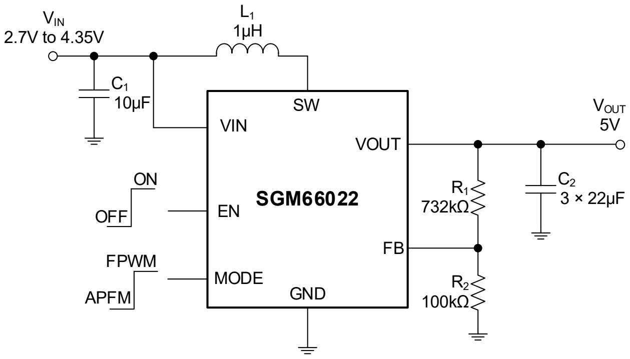


Figure 3. Li-Ion Battery to 5V Boost Converter

Design Requirements

The design parameters are listed in Table 1.

Table 1. Design Parameters

Parameters	Values
Input Voltage	2.7V to 4.35V
Output Voltage	5V
Output Current	3A
Output Voltage Ripple	±50mV

Detailed Design Procedure

Setting the Output Voltage

The SGM66022 supports output voltage up to 5.5V, and a resistor divider connected at FB pin is used to configure the output voltage. The resistive divider value is calculated via Equation 1.

$$\frac{V_{OUT} - V_{REF}}{R_1} = \frac{V_{REF}}{R_2} \quad (1)$$

For simplicity, 100kΩ is recommended for R_2. A 732kΩ resistor for R_1 configures the output voltage to 5V. A lower value of R_1 and R_2 increases the noise immunity. A higher value of R_1 and R_2 reduces the quiescent current which can benefit the light load efficiency.

Inductor Selection

Inductor is an essential element for current DC/DC switch mode power supplies regardless of topology. Inductor serves as the energy storage element for power conversion. Inductance and saturation current of inductor are two most important criterions for inductor selection. For general design guidance, the selected inductance should provide a peak-to-peak ripple current that is around 30% of the average inductor current at full load and nominal input voltage. The average inductor current for a Boost converter is the input current. Equation 2 shows the calculation of inductance selection, where f_{SW} is the switching frequency and ΔI_L is the inductor ripple current.

$$L = \frac{V_{IN} \times (V_{OUT} - V_{IN})}{\Delta I_L \times f_{SW} \times V_{OUT}} \quad (2)$$

The 8A (TYP) valley current limit and the inductor current ripple should be considered when selecting the saturation current of the inductor.

The inductor also affects the close loop response of the DC/DC converter. The SGM66022 is an internally compensated device, and the loop response is optimized for inductor in the range of 0.33μH to 1.3μH.

Input Capacitor Selection

Boost converter's input capacitor has continuous current throughout the entire switching cycle and a 10μF ceramic capacitor is recommended to place as close as possible between the VIN pin and GND pin. For applications where the SGM66022 is located far away from the input source, a 47μF or higher capacitance capacitor is recommended to damp the wiring harness inductance.

Output Capacitor Selection

The output capacitors of Boost converter dictate the output voltage ripple and load transient response. Equation 3 is used to estimate the necessary capacitance to achieve desired output voltage ripple, where ΔV is the maximum allowed ripple.

$$C_{MIN} = \frac{I_{OUT} \times (V_{OUT} - V_{IN})}{f_{SW} \times \Delta V \times V_{OUT}} \quad (3)$$

Since SGM66022 is an internally compensated device, the loop response is optimized by using the ceramic output capacitor with effective capacitance around 10μF to 50μF. Due to the DC bias nature of ceramic capacitors, care should be taken by verifying manufacturer's datasheet to ensure enough effective capacitance at desired output voltage. An effective output capacitance of 30μF is recommended for typical application. When using tantalum or aluminum electrolytic capacitors, the ESR must be considered.

APPLICATION INFORMATION (continued)

Loop Stability, Feedforward Capacitor Selection

When SGM66022 works at heavy-load or low-input, some phenomena may be observed, such as the duty cycle jitter, output voltage oscillation or inductor current oscillation. These indicate that the loop is unstable.

The margin of loop stability can also be estimated by transient responses, such as ringing or settling time of output voltage. No ringing is a general loop design requirement, and such loops have sufficient phase margin (more than 45°).

The use of a feedforward capacitor (C_3 in the Figure 4) in parallel with R_1 can form a zero and pole. And the zero can provide additional phase increase and the zero frequency can be calculated by Equation 4. The pole can be calculated by Equation 5. To improve the response speed of the loop, it is recommended to place the crossover frequency of the loop without feedforward capacitor at the geometric center of zero and pole points of feedforward capacitors as show in Equation 6. To increase the phase margin for lower input (less than 2V) application when the effective output capacitance is less than 40μF, it is recommended to place the zero frequency at around 20kHz.

$$f_{FFZ} = \frac{1}{2\pi \times R_1 \times C_3} \quad (4)$$

$$f_{FFP} = \frac{R_1 + R_2}{2\pi \times R_1 \times R_2 \times C_3} \quad (5)$$

$$f_{C\_NFF} = \sqrt{f_{FFZ} \times f_{FFP}} \quad (6)$$

where:

- R_1 is the resistor between the VOUT pin and FB pin.
- R_2 is the resistor between the FB pin and GND.
- f_{FFZ} is the zero frequency created by the feedforward capacitor.
- f_{FFP} is the pole frequency created by the feedforward capacitor.
- f_{C_NFF} is the crossover frequency of the loop without feedforward capacitor.

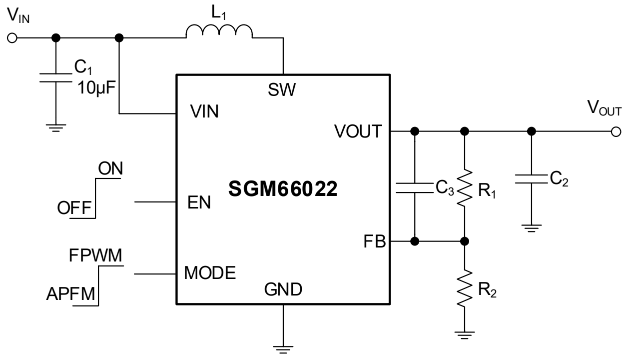


Figure 4. SGM66022 Circuit with Feedforward Capacitor

Layout Guidelines

Layout is a critical step to ensure the performance of any switch mode power supplies, especially for high switching frequency and high current converters. Poor layout could result in system instability, EMI failure, and device damage. Thus, place the inductor, input capacitors and output capacitors as close to the IC as possible, and use wide and short traces for current carrying traces to minimize PCB parasitic inductance. The length and area connected to the SW pin should be minimized because the SW pin is a source of interference.

For Boost converter, the current loop of the output capacitor from VOUT pin back to the GND pin of the device should be as small as possible to optimize the overshoot at SW pin and VOUT pin.

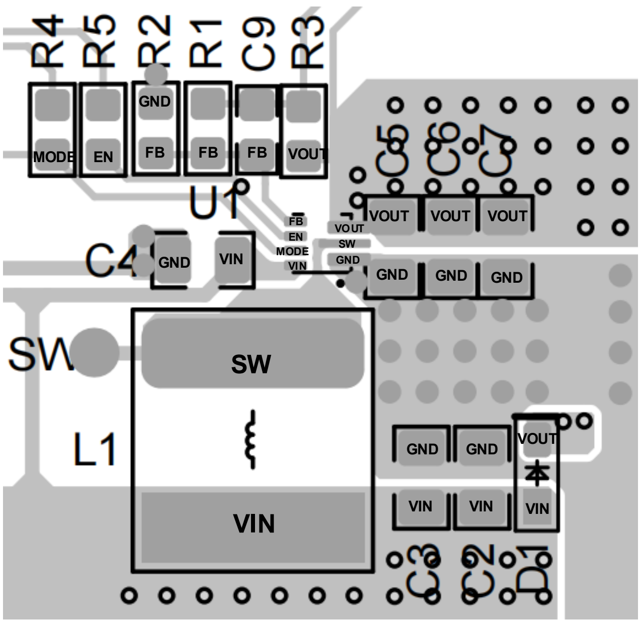


Figure 5. Layout Example

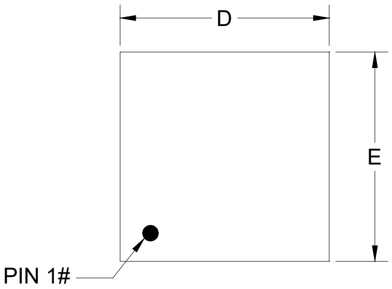
REVISION HISTORY

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

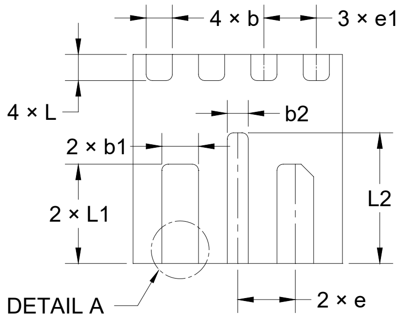
Changes from Original (APRIL 2024) to REV.A	Page
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

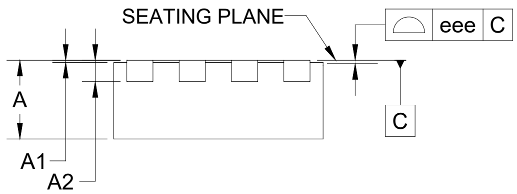
TDFN-2×2-7AL



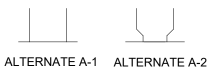
TOP VIEW



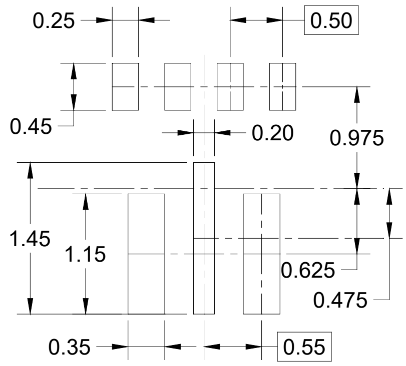
BOTTOM VIEW



SIDE VIEW



DETAIL A
ALTERNATE TERMINAL CONSTRUCTION



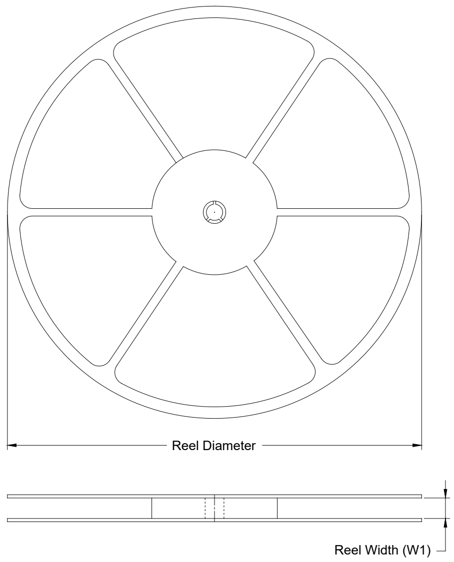
RECOMMENDED LAND PATTERN (Unit: mm)

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.700	-	0.800
A1	0.000	-	0.050
A2	0.203 REF		
b	0.200	-	0.300
b1	0.300	-	0.400
b2	0.150	-	0.250
D	1.900	-	2.100
E	1.900	-	2.100
e	0.550 BSC		
e1	0.500 BSC		
L	0.150	-	0.350
L1	0.850	-	1.050
L2	1.150	-	1.350
eee	0.080		

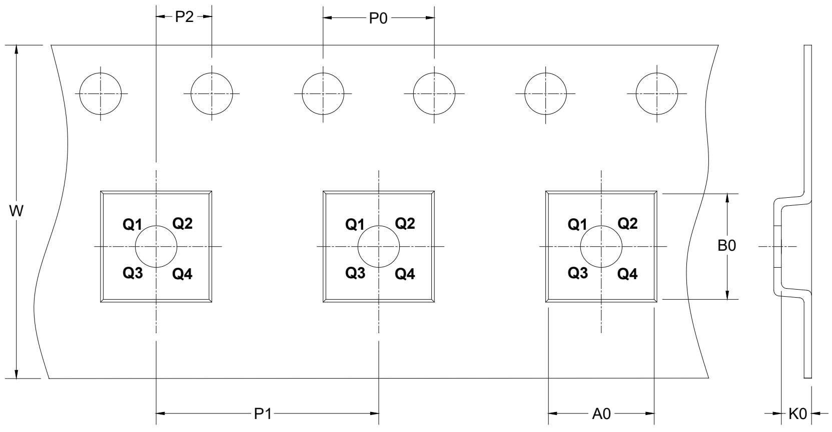
NOTE: This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

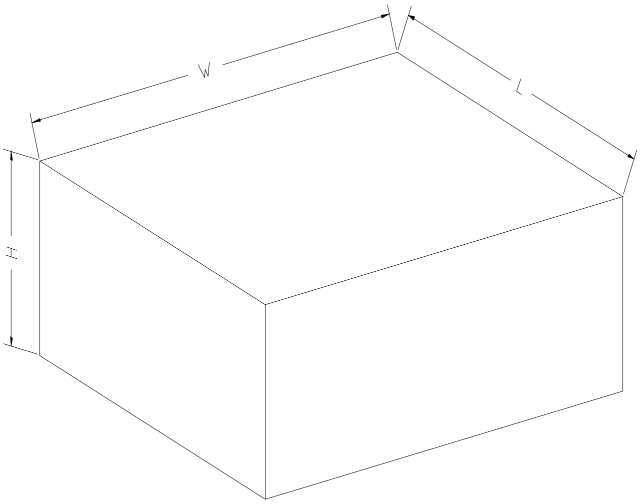
NOTE: The picture is only for reference. Please make the object as the standard.

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-2×2-7AL	7"	9.5	2.30	2.30	1.00	4.0	4.0	2.0	8.0	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
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002