SGM6626
700kHz/1.35MHz, 2A, Non-Synchronous Boost Converter

GENERAL DESCRIPTION

The SGM6626 is a high-voltage non-synchronous Boost converter. The device integrates a 24V power MOSFET and supports an input voltage down to 2.5V. A pin selectable 700kHz or 1.35MHz fixed switching frequency provides the device with easy filtering and low noise. The COMP pin provides flexibility in setting loop dynamics for the device with small capacitors. This device also includes the built-in functions of over-current limit, SW over-voltage protection, soft-start, under-voltage lockout (UVLO) and thermal shutdown.

The SGM6626 is available in a Green MSOP-8 package.

FEATURES

- **Down to 2.5V Low Input Voltage**
- **Up to 24V High Output Voltage**
- **Pin Selectable 700kHz or 1.35MHz Fixed Switching Frequency**
- **At 5V Input (TYP): 12V at 500mA**
- **Integrated Low-side Power MOSFET**
- **Small Capacitors and Inductors**
- **Programmable Soft-Start Function**
- **Under-Voltage Lockout (UVLO)**
- **Thermal Shutdown**
- **Available in a Green MSOP-8 Package**

APPLICATIONS

Portable Applications
Small LCD Displays
Handheld Computers and PDAs
Digital Cameras and Video Cameras

TYPICAL APPLICATION

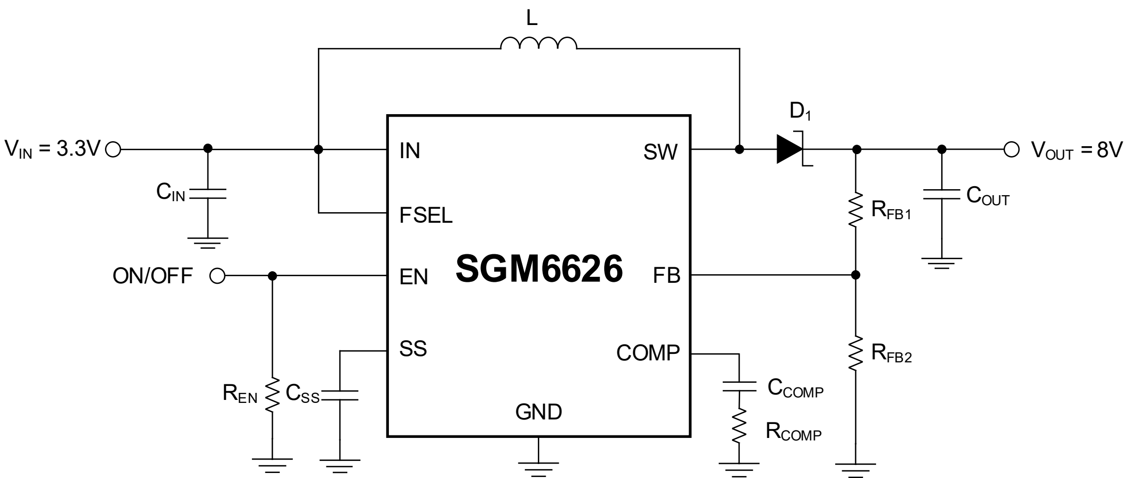


Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM6626	MSOP-8	-40℃ to +125℃	SGM6626XMS8G/TR	SGM6626 XMS8 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

SW Pin.................................. -0.5V (-1V for < 50ns) to +25V
IN Pin.. -0.5V to +25V
All Other Pins... -0.3V to +6.0V
Continuous Power Dissipation [1], T_A = +25°C 0.83W
Package Thermal Resistance
MSOP-8, θ_{JA}.. 131.3℃/W
MSOP-8, θ_{JB}.. 69.1℃/W
MSOP-8, θ_{JC} .... 48.1℃/W
Junction Temperature...+150℃
Storage Temperature Range ....-65℃ to +150℃
Lead Temperature (Soldering, 10s)............................+260℃
ESD Susceptibility [2] [3]
HBM...±3000V
CDM ....±2000V

NOTES:

1. The maximum allowable power dissipation $P_{D(MAX)}$ can be calculated from the following formula: $P_{D(MAX)} = (T_{J(MAX)} - T_A)/ J_A$. $T_{J(MAX)}$ is the maximum junction temperature, J_A is the junction-to-ambient thermal resistance and T_A is the ambient temperature. Excessive die temperature and the thermal shutdown will happen if exceeds the maximum allowable power dissipation.

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

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

RECOMMENDED OPERATING CONDITIONS

Supply Voltage, V_{IN} ....2.5V to 22V
Output Voltage, V_{OUT} ....3V to 24V
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

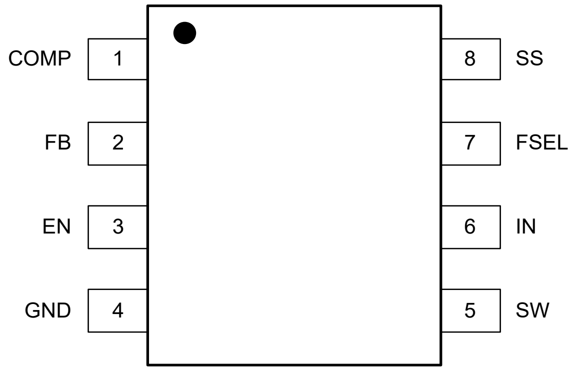
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance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

(TOP VIEW)



MSOP-8

PIN DESCRIPTION

PIN	NAME	TYPE	FUNCTION
1	COMP	O	Compensation Pin. Connect a capacitor and resistor in series to set loop dynamics.
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. It needs to be pulled up to enable the device, connect EN to the input source (through a 100kΩ pull-up resistor if the voltage of IN is larger than 6V) when EN is not used.
4	GND	G	Ground.
5	SW	P	Switching Node of the Device. Connect to the input source through the Boost inductor.
6	IN	I	Supply Power Input for Internal Circuit.
7	FSEL	I	Frequency Selection Pin. It needs to be pulled up for 1.35MHz operation (connected to the input source through a 100kΩ resistor if the voltage of IN is larger than 6V) or pulled down for 700kHz operation.
8	SS	I	Soft-Start Control Pin. Connect a capacitor to this pin to set soft-start time.

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

ELECTRICAL CHARACTERISTICS

(V_{IN} = 5V, V_{EN} = 5V, T_J = -40℃ to +125℃, unless otherwise noted.)

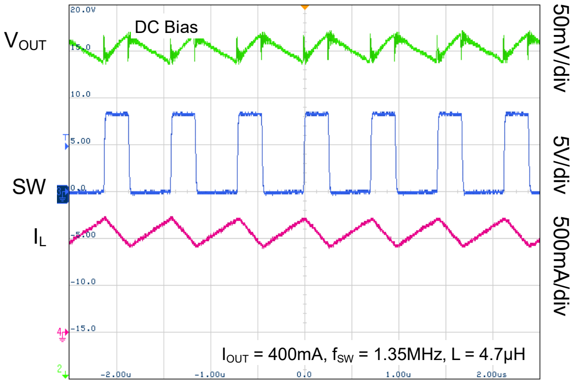
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Input Voltage	V_{IN}			2.5		22	V
Under-Voltage Lockout	V_{UVLO}	V_{IN} rising		2.15		2.45	V
Under-Voltage Lockout Hysteresis					100		mV
Shutdown Supply Current	I_{SD}	V_{EN} = 0V			0.1	1	μA
Quiescent Supply Current	I_Q	V_{FB} = 1.35V			400	610	μA
Switching Frequency	f_{SW}	V_{FSEL} = V_{IN}		0.92	1.35	1.77	MHz
		V_{FSEL} = GND		430	700	1060	kHz
FSEL High Threshold		V_{FSEL} rising				1.2	V
FSEL Low Threshold				0.6			V
Maximum Duty Cycle	D_{MAX}	T_J = +25℃	V_{FB} = 0V, V_{FSEL} = V_{IN}	82	90		%
			V_{FB} = 0V, V_{FSEL} = GND	87	94		
		T_J = -40℃ to +125℃	V_{FB} = 0V, V_{FSEL} = V_{IN}	80	90		
			V_{FB} = 0V, V_{FSEL} = GND	86	94		
EN High Threshold	V_{EN_H}	V_{EN} rising				1.2	V
EN Low Threshold	V_{EN_L}			0.4			V
EN Input Bias Current		V_{EN} = 0V, 5V				3.5	μA
Soft-Start Current	I_{SS}				16		μA
FB Voltage	V_{FB}			1.2	1.25	1.3	V
FB Input Bias Current				-150	-0.2		nA
Error Amplifier Voltage Gain	A_{VEA}				40000		V/V
Error Amplifier Transconductance	G_{EA}				360		μA/V
Error Amplifier Output Current					32		μA
SW On-Resistance	R_{DSON}				0.2		Ω
SW Current Limit	I_{SW_LIM}				2		A
SW Leakage Current	I_{SW_LKG}	V_{SW} = 20V				1	μA
Thermal Shutdown (1)	T_{SD}				156		℃

NOTE:
1. Specified by design and characterization, not production tested.

TYPICAL PERFORMANCE CHARACTERISTICS

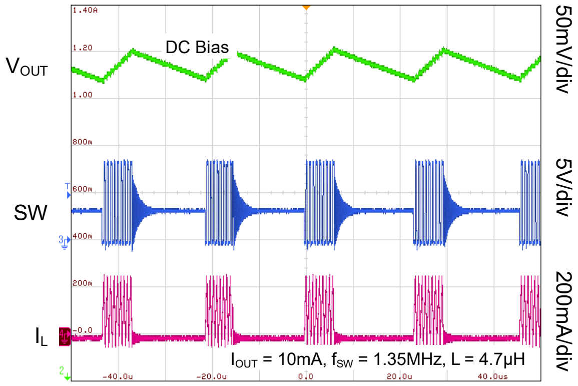
T_A = +25℃, V_{IN} = 3.3V, V_{OUT} = 8V, unless otherwise noted.

Heavy Load Ripple



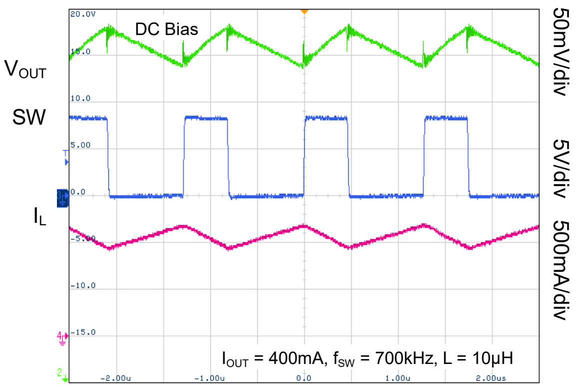
Time (500ns/div)

Light Load Ripple



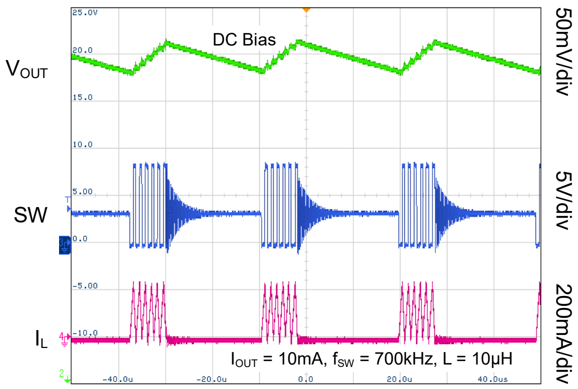
Time (10μs/div)

Heavy Load Ripple



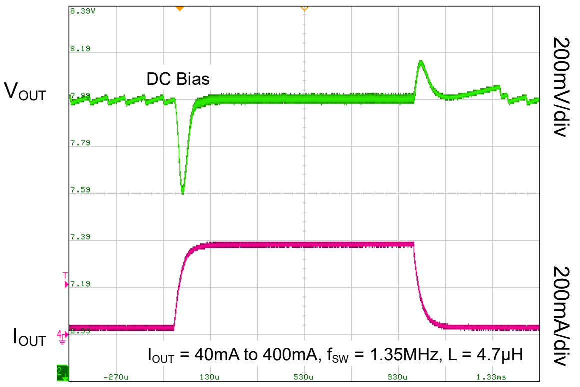
Time (500ns/div)

Light Load Ripple



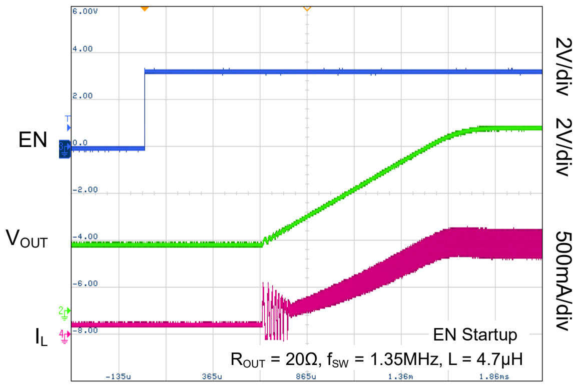
Time (10μs/div)

Load Transient



Time (200μs/div)

Startup Waveform

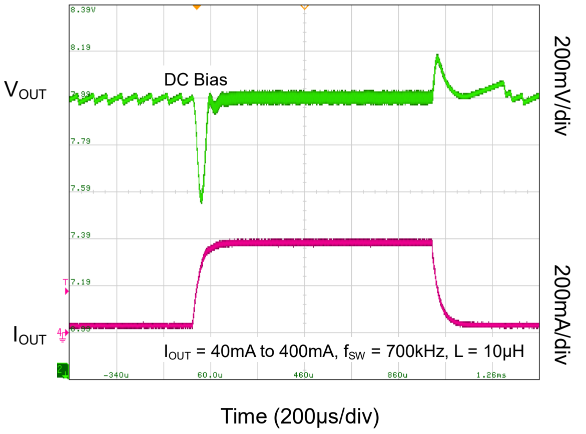


Time (250μs/div)

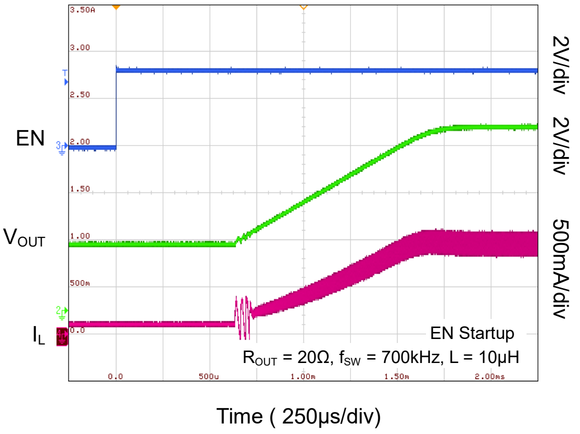
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, V_{IN} = 3.3V, V_{OUT} = 8V, unless otherwise noted.

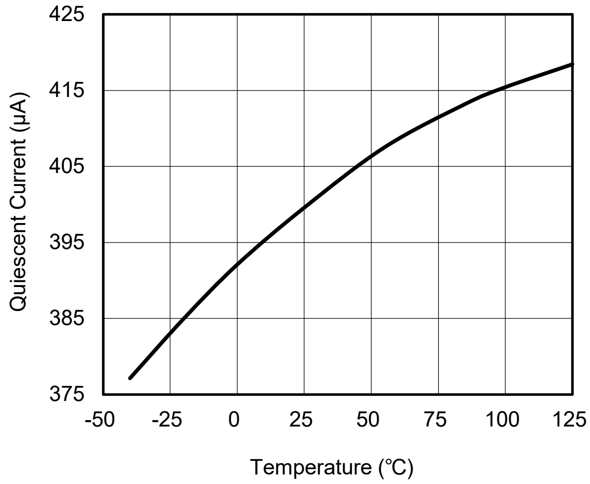
Load Transient



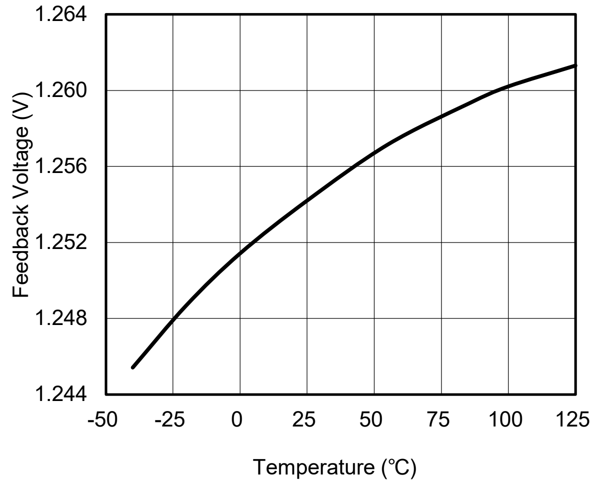
Startup Waveform



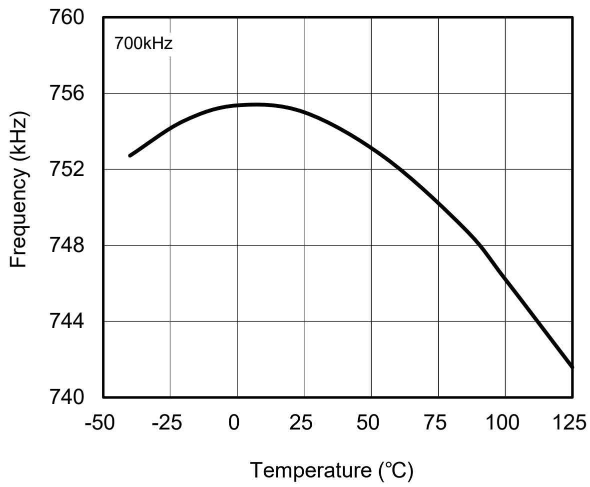
Quiescent Current vs. Temperature



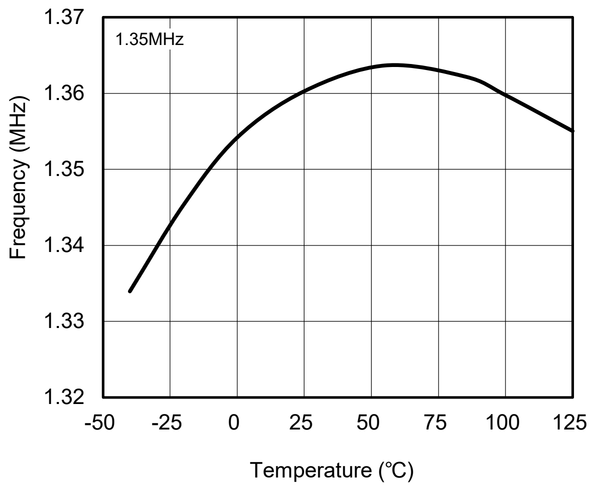
Feedback Voltage vs. Temperature



Frequency vs. Temperature



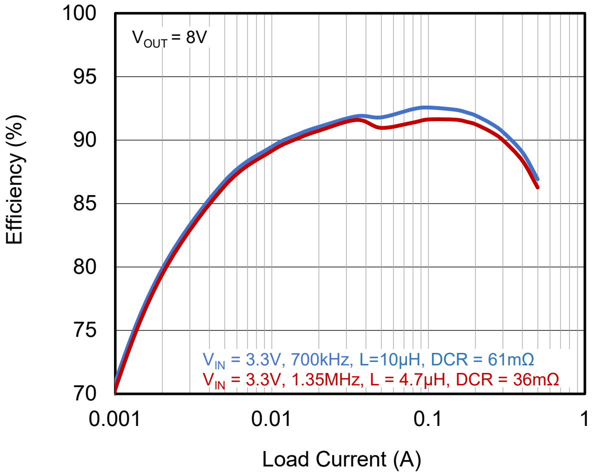
Frequency vs. Temperature



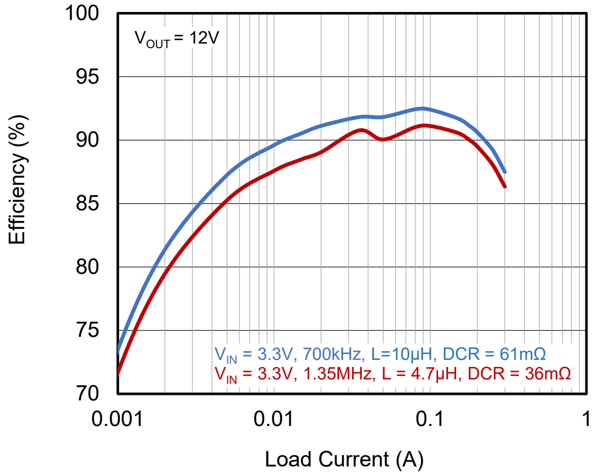
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T_A = +25℃, V_{IN} = 3.3V, V_{OUT} = 8V, unless otherwise noted.

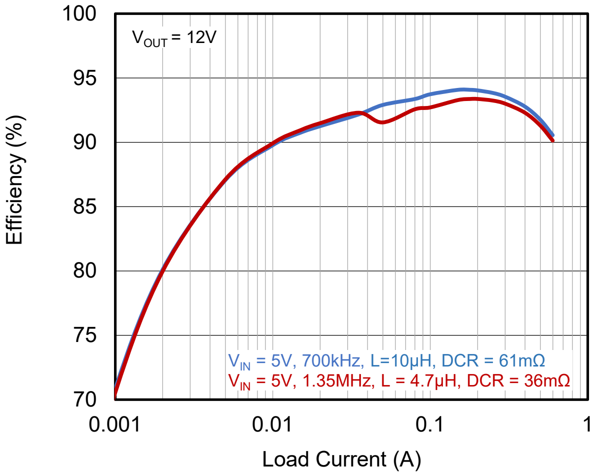
Efficiency vs. Load Current



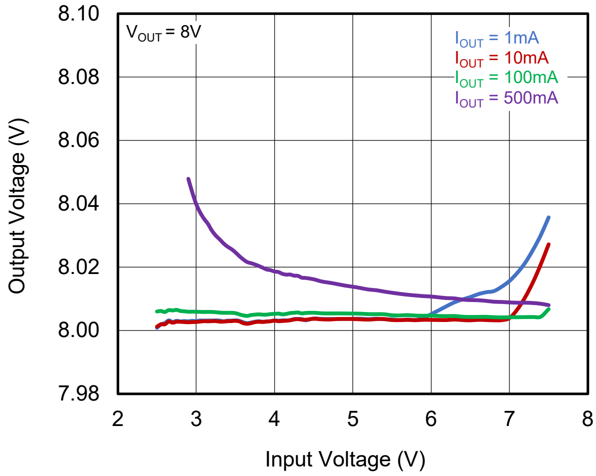
Efficiency vs. Load Current



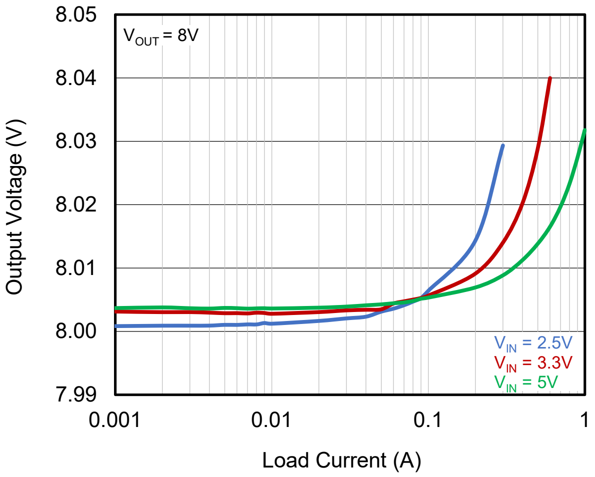
Efficiency vs. Load Current



Output Voltage vs. Input Voltage



Output Voltage vs. Load Current



FUNCTIONAL BLOCK DIAGRAM

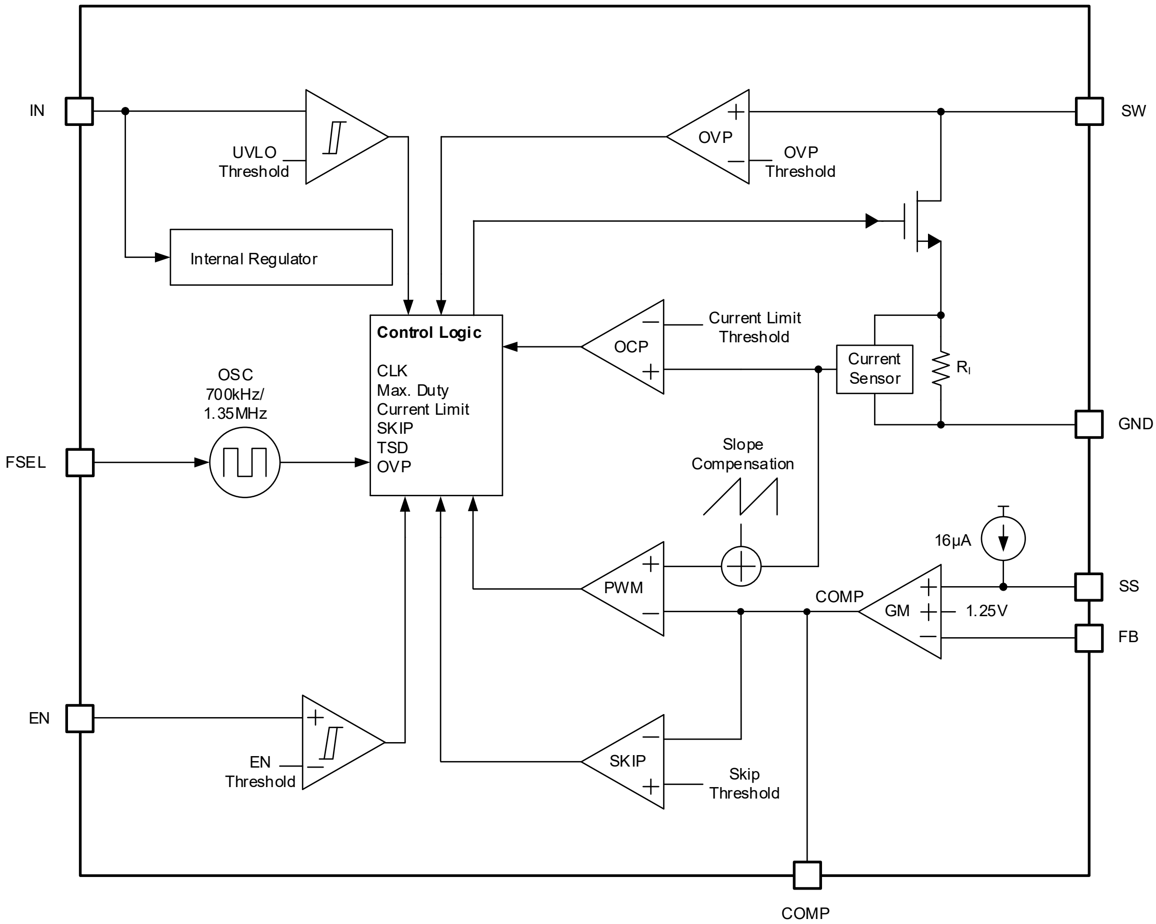


Figure 2. Block Diagram

DETAILED DESCRIPTION

Overview

The SGM6626 is a Boost converter with integrated low-side MOSFET switch, which is capable of delivering up to 24V output voltages. Peak current mode PWM control is used to regulate the output voltage as shown in Figure 2. The device has FSEL pin selectable 700KHz (TYP) or 1.35MHz (TYP) fixed switching frequency. The error amplifier compares the FB pin voltage with an internal reference signal to provide an error signal for the PWM comparator to adjust the duty cycle which ultimately regulates the output voltage to the desired voltage. An external compensation pin gives user flexibility in setting loop stability and dynamics. Soft-start results in small inrush current and can be programmed with an external capacitor. At the beginning of each clock cycle, the PWM comparator turns on the low-side MOSFET to ramp up the inductor current. As the inductor current reaches the level set by output of the error amplifier, the low-side MOSFET turns off, which causes the external Schottky diode to be forward biased to ramp down the inductor current that delivers the energy to the load as well as replenishes the output capacitor.

Under-Voltage Lockout

The SGM6626 integrates VIN under-voltage lockout (UVLO) feature to protect the device from malfunction. An under-voltage lockout circuit prevents operation at the input voltage below 2.15V with a hysteresis of 100mV. Therefore, if the input voltage rises and exceeds 2.45V, the device restarts.

Enable and Soft-Start

When the input voltage is valid, pulling EN input to logic high will enable the device and the device starts operation and ramps up the reference voltage to 1.25V (TYP). The SGM6626 implements a soft-start timer to reduce the inrush current drawn during startup. The soft-start time can be programmed with an external capacitor.

Pulling EN to logic low will shut down the SGM6626. In shutdown mode, the switches and all control circuits are turned off to reduce the device current to 0.1μA (TYP).

Switching Frequency

The switching frequency of the device is set using the frequency selection pin (FSEL) to 700kHz (FSEL = low) or 1.35MHz (FSEL = high). Higher switching frequency improves load transient response but slightly reduces the efficiency. Another benefit of higher switching frequency is a lower output ripple voltage. On the contrary, lower switching frequency can enhance the efficiency especially in light load.

Over-Voltage Protection

Over-voltage protection circuitry prevents IC damage as the result of output resistor divider disconnection. The SGM6626 monitors the voltage of SW pin in each switching cycle. When SW pin voltage exceeds V_{OVP} threshold (25.3V, TYP) for 8 consecutive cycles, the device turns the switch FET off, and shuts down the device. After a waiting time of 5.5ms, the device will attempt a soft restart.

Over-Current Protection

The SGM6626 provides inherent over-current protection. The low-side MOSFET is turned off when the peak current reaches the current limit threshold of 2A (TYP), and the low-side MOSFET is not turned on again until the next clock cycle.

Thermal Shutdown

The internal thermal shutdown protection turns off the device when the junction temperature exceeds 156℃. The device will resume operation when the junction temperature drops by at least 20℃ (TYP).

Pulse-Skipping Mode

The SGM6626 integrates a pulse-skipping mode at the light load. When a light load condition occurs, the COMP voltage naturally decreases and reduces the peak current. When the COMP voltage further goes down with the load lowered and reaches the pre-set low threshold, the output of the error amplifier is clamped at this threshold and does not go down any more. If the load is further lowered, the output voltage of SGM6626 exceeds the nominal voltage and the device skips the switching cycles. The pulse-skipping mode reduces the switching losses and improves efficiency at the light load condition by reducing the average switching frequency.

APPLICATION INFORMATION

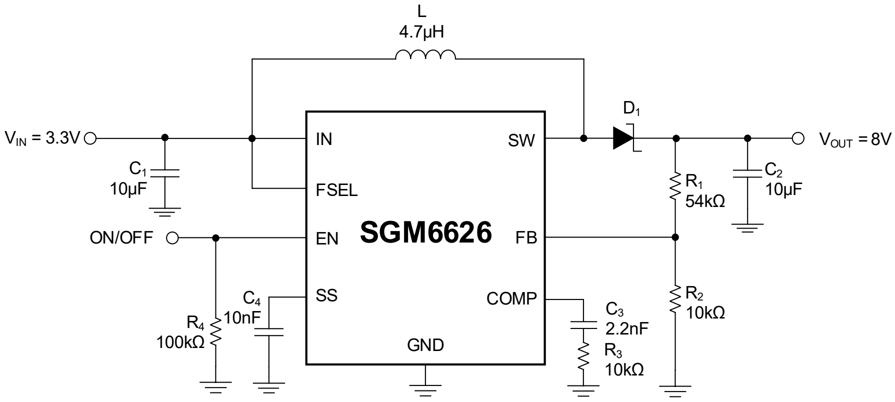


Figure 3. Typical Application Circuit

Output Voltage Setting

The SGM6626 supports an output voltage up to 24V, and a resistor divider connected to FB pin is used to configure the output voltage. The resistive divider value is calculated via Equation 1.

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

where, V_{OUT} is the output voltage. For simplicity, 10kΩ is recommended for R_2. A 54kΩ resistor for R_1 configures the output voltage to 8V. Lower values of R_1 and R_2 increase the noise immunity. Higher values of R_1 and R_2 reduce the quiescent current, which can benefit the light load efficiency.

Soft-Start Capacitor Selection

The SGM6626 includes a soft-start timer to prevent excessive current at the input. To minimize the inrush current during startup, an external capacitor connected to the SS pin and charged with a constant current, is used to slowly ramp up the internal current limit of the Boost converter. When the EN pin is pulled high, the capacitor is then charged at a constant current of 16µA (TYP) when SS rises. The soft-start period is determined by the Equation 2:

$$t_{SS} = 75 \times C_4 \quad (2)$$

where, C_4 (in nF) is the soft-start capacitor from SS to GND, and t_{SS} (in µs) is the soft-start period. Determine the capacitor required for a given soft-start period by the Equation 3:

$$C_4 = 0.0133 \times t_{SS} \quad (3)$$

Input Capacitor Selection

Low-ESR ceramic capacitors are recommended for good input voltage filtering and noise limit at the input source. The SGM6626 has an analog input (IN). Therefore, customers should place at least one 0.1µF bypass capacitor as close as possible to the IC from IN to GND. One 10µF ceramic input capacitor is sufficient for most of the applications. For applications where the SGM6626 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 4 is used to estimate the necessary capacitance to achieve desired output voltage ripple, where V_{RIPPLE} is the maximum allowed ripple, V_{IN} and V_{OUT} are the DC input and output voltages respectively, I_{LOAD} is the load current, f_{SW} is the switching frequency, and C_2 is the capacitance of the output capacitor.

$$C_2 \approx \frac{(1-\frac{V_{IN}}{V_{OUT}}) \times I_{LOAD}}{V_{RIPPLE} \times f_{SW}} \quad (4)$$

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. A 4.7µF to 22µF capacitor is recommended for most applications. When using tantalum or aluminum electrolytic capacitors, the ESR must be considered and so the output ripple is calculated as:

$$V_{RIPPLE} \approx \frac{(1-\frac{V_{IN}}{V_{OUT}}) \times I_{LOAD}}{C_2 \times f_{SW}} + \frac{I_{LOAD} \times R_{ESR} \times V_{OUT}}{V_{IN}} \quad (5)$$

where, R_{ESR} is the equivalent series resistance of the output capacitors.

APPLICATION INFORMATION (continued)

Inductor Selection

Inductor is the most critical component in the design of a Boost converter with SGM6626, because it affects the steady state operation, transient behavior and loop stability. A 4.7μH inductor is recommended for most 1.35MHz applications and a 10μH inductor is recommended for most 700kHz applications. Four parameters of the inductor must be considered in the design: nominal inductance value, DC resistance (DCR), saturation current (or 20% ~ 30% inductance drop currents) and maximum RMS current (DC plus AC) for a certain temperature rise.

$$\Delta I_L = \frac{V_{IN} \times (V_{OUT} + V_F - V_{IN})}{L \times (V_{OUT} + V_F) \times f_{SW}} \tag{6}$$

where,

ΔI_L = Inductor peak-to-peak ripple current.

L = Inductor value.

V_F = Schottky diode forward voltage.

f_{sw} = Switching frequency.

Inductance and saturation current of an inductor are the two most important criterions for the inductor selection. It is recommended to choose a peak-to-peak ripple current (given by Equation 6) that is in the 30% ~ 40% range of the maximum DC current of the inductor in the application. Such ripple factor usually gives a good compromise between inductor core and converter conduction losses (due to the AC ripple) and the inductor size. Inductor DC current can be calculated based on the input-output power balance as given in Equation 7:

$$\Delta I_{IN\_DC} = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times \eta} \tag{7}$$

where, η is the efficiency of the converter.

Using an inductor with smaller inductance in a Boost converter will result in discontinuous conduction mode (DCM) range extending to the higher load currents due to larger ripple. Small inductance can also result in reduced maximum output current, increased input voltage ripple and reduced efficiency. Large inductors with low DCR values can offer better output current and higher conversion efficiency. However, smaller inductance usually provides better load transient response. SGM6626 implements built-in slope compensation to prevent sub-harmonic oscillation. Too small inductance might result in insufficient slope compensation, which ultimately results in unstable operation. Therefore, the designer must verify the selected inductor for the application with the maximum and minimum margins of the input and output voltages if it is not chosen based on the recommended values. See Table 2 for inductor selection. Customers must verify and validate selected components for suitability with their application.

Schottky Diode Selection

The external rectification diode selection is critical to ensure device performance. A high speed and low forward voltage drop diode is recommended to improve efficiency. The average current rating of the diode should be higher than the peak load. The breakdown voltage of the selected diode should be higher than the maximum output voltage (24V) with margin. To achieve smaller size and less cost, Schottky diodes with lower rated voltages can be used. See Table 1 for diode selection. Customers must verify and validate selected components for suitability with their application.

Table 1. Rectifier Diode Selection

Part Number	V_R	Forward Voltage Drop	I_{AVG}	Vendor
PMEG4020ER	40V	0.43V	2A	Nexperia
B240/A	40V	0.5V	2A	DIODES

Table 2. Inductor Selection

Part Number	L (μH)	DCR (mΩ)	Saturation Current (A)	Size (L × W × H, mm^3)	Vendor
1.35MHz					
VLS5045EX-4R7M	4.7	36	4.4	5.0 × 5.0 × 4.5	TDK
74438357047	4.7	40	6.4	4.1 × 4.1 × 3.1	Wurth Elecktronik
DFE252012F-4R7M	4.7	160	2.4	2.5 × 2.0 × 1.2	muRata
700kHz					
VLS5045EX-100M	10	61	3.1	5.0 × 5.0 × 4.5	TDK
74438357100	10	100	4.6	4.1 × 4.1 × 3.1	Wurth Elecktronik
CKSTTH0412N-10μH/M	10	190	3	4.0 × 4.0 ×1.2	Cenker

APPLICATION INFORMATION (continued)

Loop Compensation

The SGM6626 uses a trans-conductance error amplifier (COMP) to compensate the feedback loop. Frequency compensation is provided by an external resistor and capacitor. Since the LC-filter resonance is eliminated with the current feedback, there is much less phase delay in the power stage transfer function, and compensation is much easier. A Type II compensator is needed to design the loop for current-mode Boost converter, and the use of the Type II compensator greatly simplifies the design process. Type II (an origin pole, plus a pole/zero pair) gives us one pole-at-zero, one pole and one zero. We always need a pole-at-zero in the compensation for achieving high DC gain, good DC regulation, and low frequency line injection. Note that four components (R_{LOAD}, R_3, C_2 and C_3) are involved in determining the poles and zero. Output capacitor (C_2) and load resistance (R_{LOAD}) set the f_{P1}. The compensation capacitor (C_3) and the compensation resistor (R_3) set the f_{Z1} and f_{P2}.

$$f_{P1} = \frac{1}{\pi \times C_2 \times R_{LOAD}} \quad (8)$$

$$f_{P2} = \frac{G_{EA}}{2\pi \times C_3 \times A_{VEA}} \quad (9)$$

$$f_{Z1} = \frac{1}{2\pi \times C_3 \times R_3} \quad (10)$$

where, R_{LOAD} is the load resistance, G_{EA} is the error amplifier transconductance, and A_{VEA} is the error amplifier voltage gain.

The DC loop gain is:

$$A_{VDC} = \frac{1.85 \times A_{VEA} \times V_{IN} \times R_{LOAD} \times V_{FB}}{V_{OUT}^2} \quad (11)$$

where, V_{FB} is the feedback regulation threshold. Regardless of which model is used, the right-half-plane zero (f_{RHPZ}), created by lack of continuous current flow to the output, is still present. Equation 12 shows the frequency of the right half plane zero:

$$f_{RHPZ} = \frac{V_{IN}^2 \times R_{LOAD}}{2\pi \times L \times V_{OUT}^2} \quad (12)$$

See Table 3 for dedicated compensation networks, giving an improved load transient response. These conservative R_3 and C_3 values for certain inductors, input, and output voltages provide a very stable system. For a faster response time, a higher R_3 value can be used to enlarge the bandwidth, as well as a slightly lower value of C_3 to keep enough phase margin. These adjustments must be performed in parallel with the load transient response monitoring of SGM6626. The second compensation capacitor (from COMP to GND) is optional due to the low ESR ceramic capacitors.

Finally, customers must verify and validate selected compensation parameters for suitability with their application. Designing the loop for greater than 45° of phase margin and greater than 10dB gain margin could provide good loop stability and avoid output voltage ringing during load and line transient.

Table 3. Component Selection

V_{IN} (V)	V_{OUT} (V)	C_2 (μF)	R_3 (kΩ)	C_3 (nF)
3.3	8	4.7	10	2.2
3.3	8	10	10	2.2
3.3	8	22	10	2.2
3.3	12	4.7	15	1
3.3	12	10	15	1
3.3	12	22	15	2.2
3.3	18	4.7	20	1
3.3	18	10	20	1
3.3	18	22	30	2.2
5	8	4.7	10	4.7
5	8	10	10	4.7
5	8	22	15	1
5	12	4.7	15	2.2
5	12	10	15	2.2
5	12	22	20	1
5	18	4.7	20	1
5	18	10	20	1
5	18	22	30	1
12	15	4.7	10	2.2
12	15	10	10	2.2
12	15	22	15	1
12	18	4.7	5.1	2.2
12	18	10	5.1	2.2
12	18	22	15	1

APPLICATION INFORMATION (continued)

AMLCD Application

An application diagram for active matrix LCD power supply is shown in Figure 4. Two voltage rails (positive and negative) are generated by the adaptive × 3 charge pump converter and an inverting charge pump inverter. These circuits must be fully validated about the stability and transient performance, and tested by customers before using these circuits in their designs.

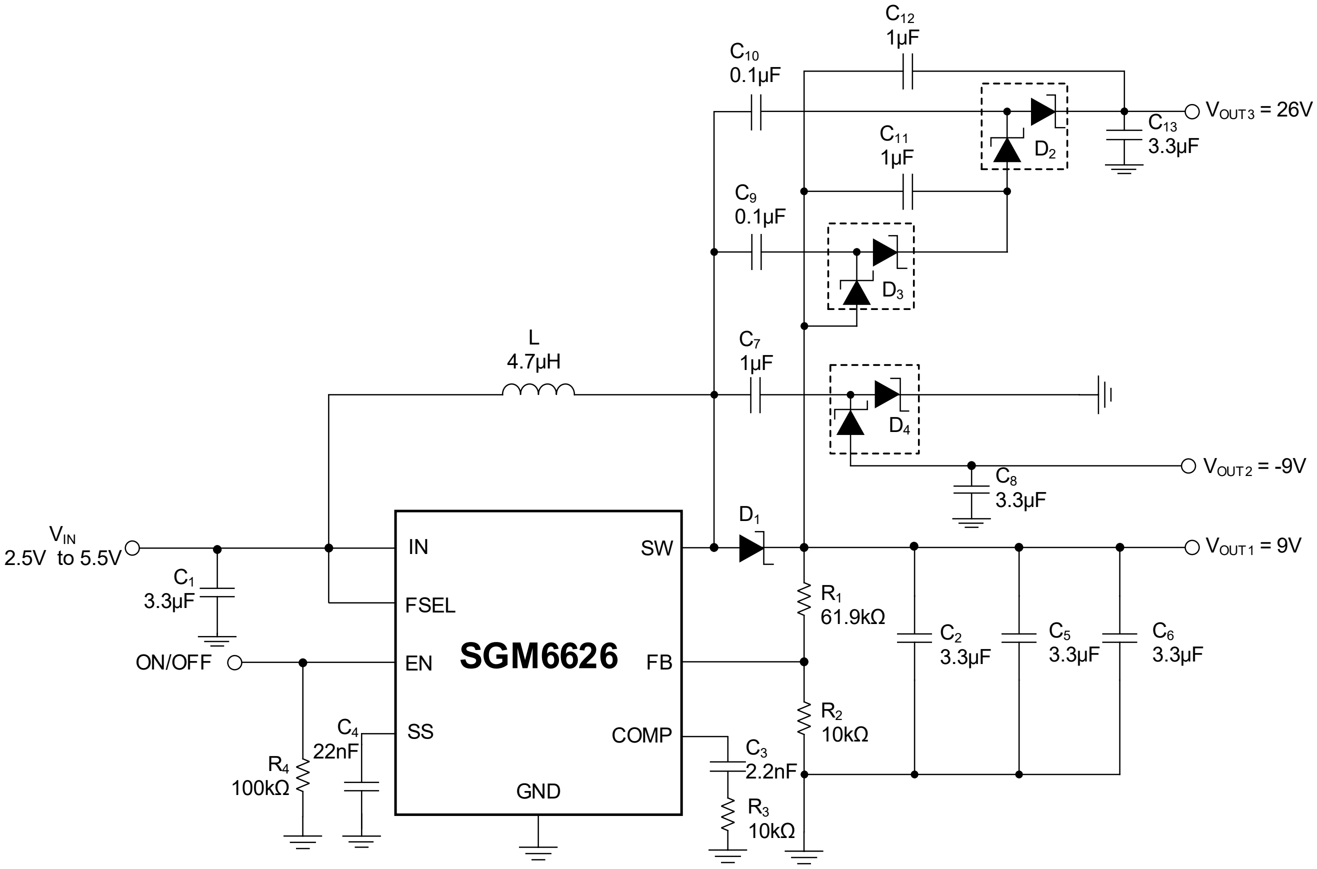


Figure 4. Multiple Outputs, Low Profile (1.2mm MAX) TFT LCD Power Supply

APPLICATION INFORMATION (continued)

PCB Layout Considerations

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. All feedback components must be kept close to the FB pin to prevent noise injection on the FB pin trace. 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.

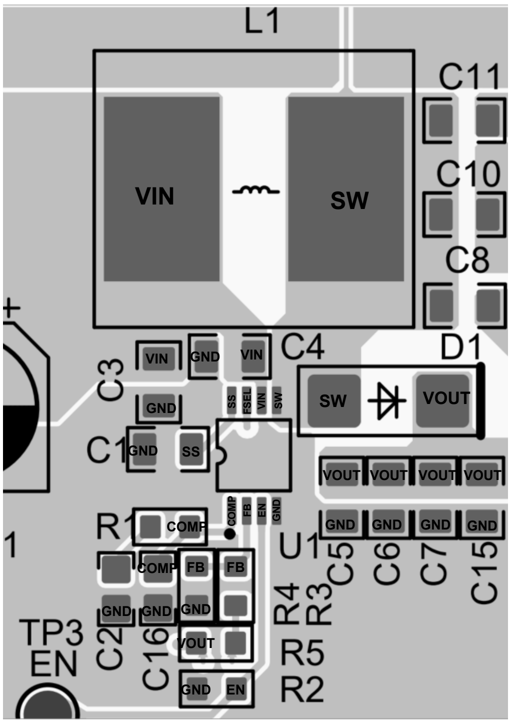


Figure 5. Layout Example

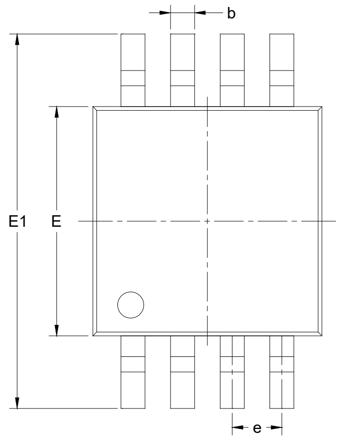
REVISION HISTORY

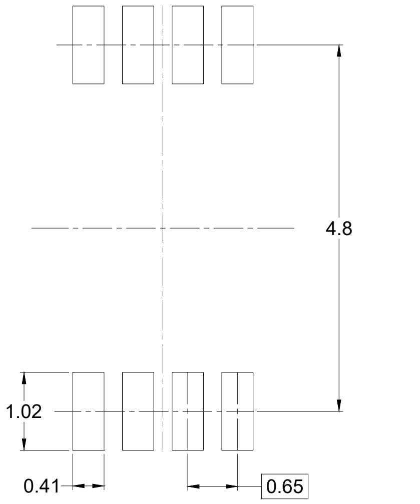
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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

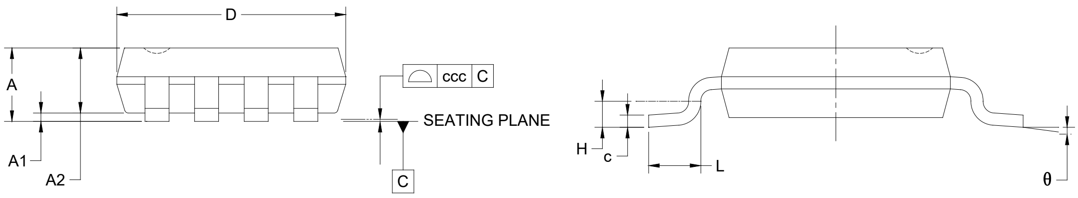
PACKAGE OUTLINE DIMENSIONS

MSOP-8





RECOMMENDED LAND PATTERN (Unit: mm)

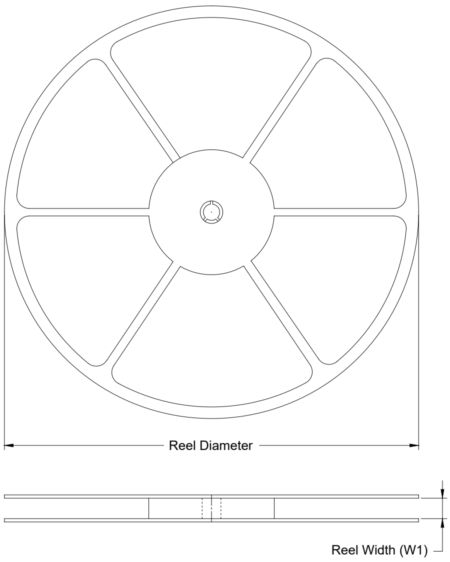


Symbol	Dimensions In Millimeters		
	MIN	**NOM**	**MAX**
A	-	-	1.100
A1	0.000	-	0.150
A2	0.750	-	0.950
b	0.220	-	0.380
c	0.080	-	0.230
D	2.800	-	3.200
E	2.800	-	3.200
E1	4.650	-	5.150
e	0.650 BSC		
L	0.400	-	0.800
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

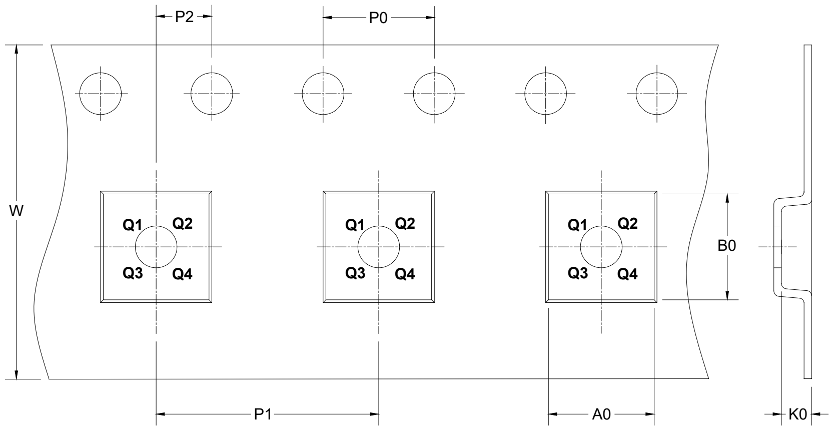
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-187.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

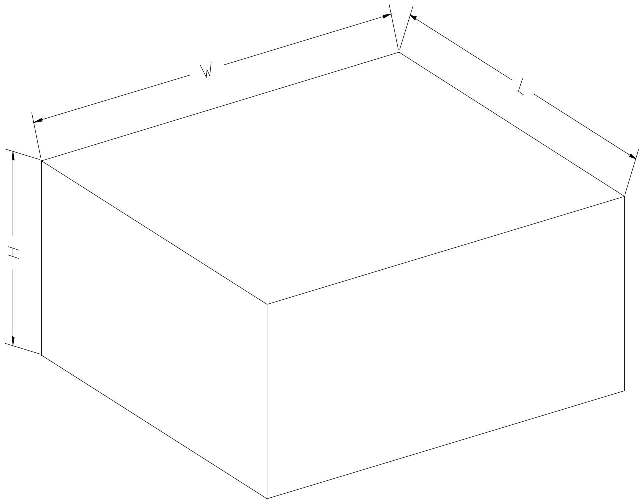
NOTE: The picture is only for reference. Please make the object as the standard.

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
MSOP-8	13"	12.4	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

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