

9V, 6A PWM STEP-UP DC-DC CONVERTER

GENERAL DESCRIPTION

The SLM6160 device is a high-performance, fixed frequency, current-mode PWM step-up DC/DC converters that incorporate internal power MOSFETs. The SLM6160 includes an integrated 50-mΩ power switch that supports peak currents of up to 6A. The device is capable of providing an output voltage up to 9V.

The SLM6160 uses peak current control topology to regulate the output voltage. In moderate to heavy load condition, the SLM6160 works in the pulse width modulation (PWM) mode. In light load condition, the device works in the pulse frequency modulation (PFM) mode to improve the efficiency.

The SLM6160 utilizes simple external loop compensation allowing optimization between component size, cost and AC performance across a wide range of applications. Additional functions include an externally programmable soft-start function for easy inrush current control, internal over-voltage protection (OVP), cycle-by-cycle current limit protection, under voltage lock-out and thermal shutdown.

The SLM6160 is available in the small SOP8-EP package.

FEATURES

- Input Voltage Range: 2.7 to 5.5V
- Adjustable Output Voltage Up to 9V
- 6A Switch Current
- Up to 85% Efficiency at $V_{IN} = 4.2V$, $V_{OUT} = 9V$, and $I_{OUT} = 1.0A$
- Internal 9V 50-mΩ Power MOSFET
- 0.1μA Current into VIN Pin during Shutdown
- 800kHz Frequency
- Built-in Over-Voltage Protection (OVP)
- Open Protection
- Programmable Soft-Start Function
- Thermal Shutdowns
- Under-Voltage-Lockout
- Cycle-by-Cycle Overcurrent Protection
- SOP8-EP Package

APPLICATIONS

- Battery-Powered Equipment (Bluetooth™ Speaker; E-Cigarette; Quick Charge Power Bank)
- Portable POS Terminal
- TFT LCD Monitors
- Set-Top Boxes
- DSL and Cable Modems and Routers

TYPICAL APPLICATION CIRCUIT

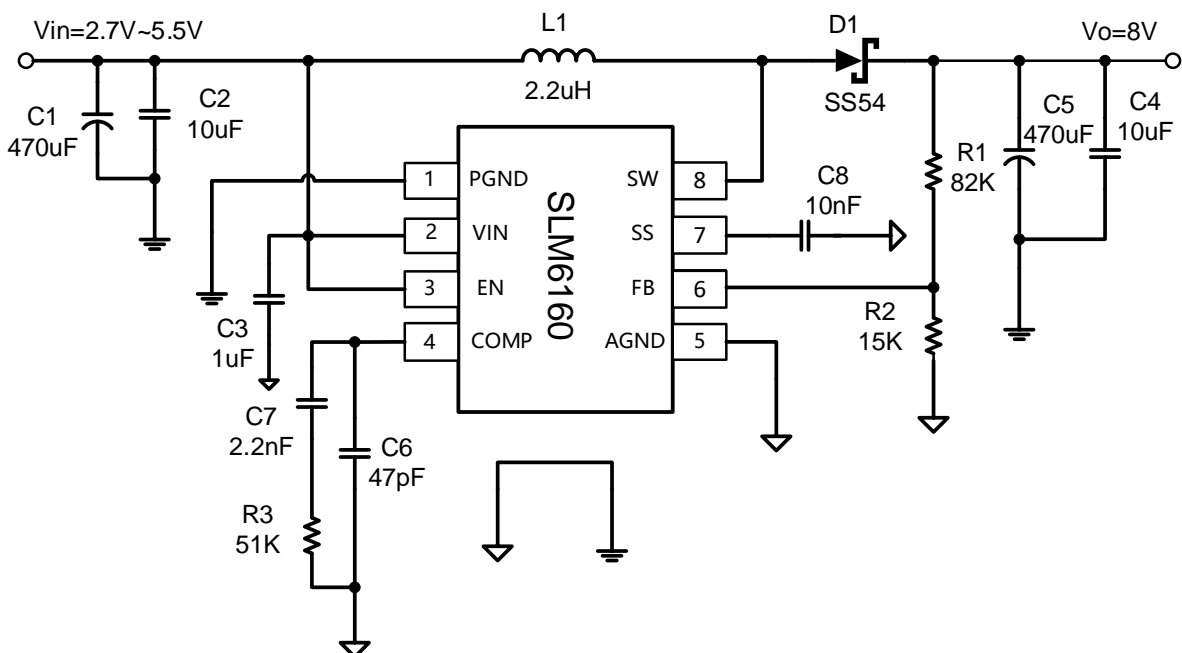
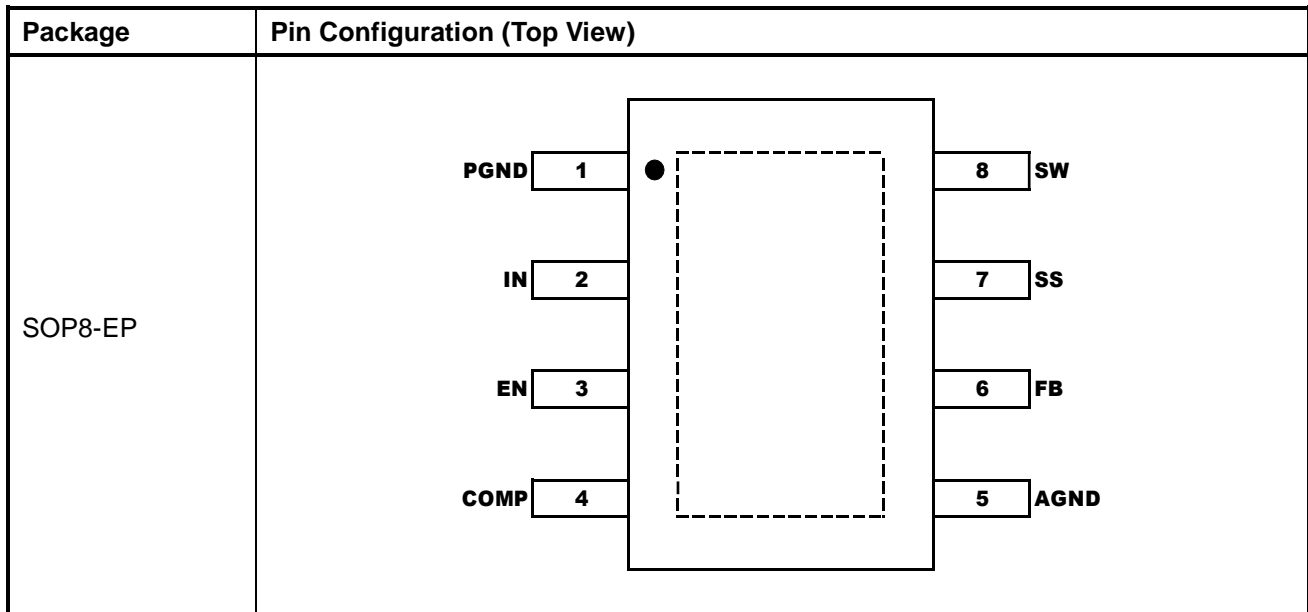


Figure 1. Typical Application Circuit

Table of Contents

General Description	1
Features	1
Applications.....	1
Typical Application Circuit	1
PIN Configuration	3
PIN Function Descriptions	3
Ordering Information	4
Functional Block Diagram	5
Absolute Maximum Ratings.....	6
Electrical Characteristics.....	7
Typical Performance Characteristics	8
Application Information	10
Soft-Start.....	10
Setting the Output Voltage	10
Rectifier Selection.....	10
Open Voltage Protection	10
Overcurrent Protection	10
Open Circuit Protection	10
Shutdown.....	10
Package Case Outlines	11
Revision History	12

PIN CONFIGURATION

PIN FUNCTION DESCRIPTIONS

No.	Pin Name	Function Description
1	PGND	Power Ground
2	IN	Supply Input
3	EN	Enable Control. Connect to a logic high level to enable the IC. Connect to a logic low level to disable the IC. When unused, connect EN pin to IN (do not leave pin floating).
4	COMP	Error Amplifier Compensation Node
5	AGND	Analog Ground
6	FB	Feedback Input. Connect this pin a resistor divider from the output to set the output voltage. FB is regulated to 1.262V.
7	SS	Soft Start Control Input. Connect a capacitor from this pin to Ground to set soft-start timing duration. SS is discharged to ground in shutdown. SS may be left unconnected if soft start is not desired.
8	SW	Switch Output. Connect this pin to the inductor and the schottky diode. To minimize EMI, minimize the PCB trace path between this pin and the input bypass capacitor.
	Exposed Pad	Connected to Ground

ORDERING INFORMATION

Industrial Range: -40°C to +125°C

Order Part No.	Package	QTY
SLM6160CB-13GTR	SOP8-EP	2500/Reel

FUNCTIONAL BLOCK DIAGRAM

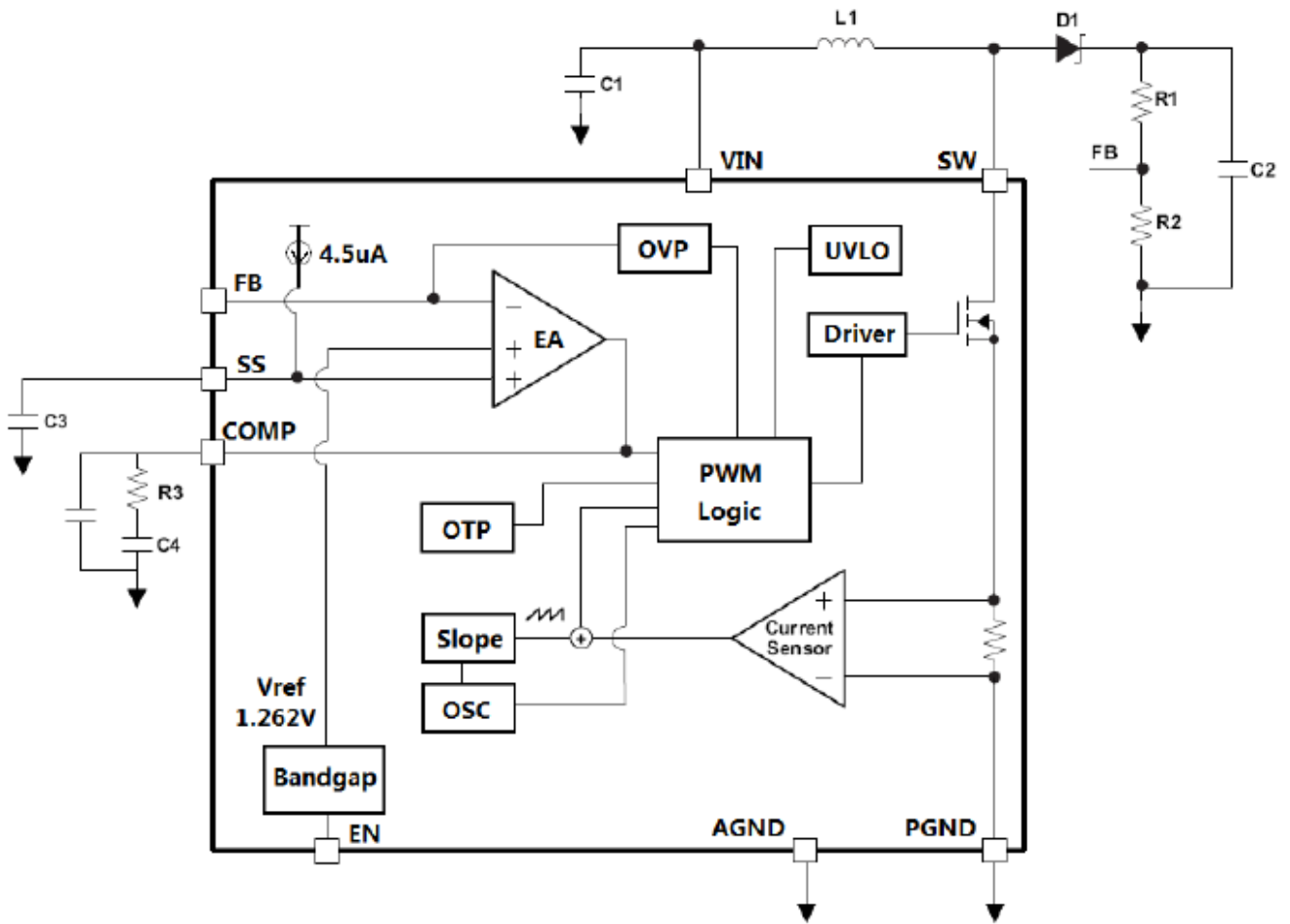


Figure 2. Functional Block Diagram

ABSOLUTE MAXIMUM RATINGS

Parameter		Rating
SW to Ground		-0.3V to 12V
V _{IN} , EN, FB, SS, COMP to Ground		-0.3V to 6.5V
Continuous SW Current		Internally Limited
Total power dissipation, P _{TOT}		1.5W (T _s ≤ 100°C)
Maximum junction temperature, T _{JMAX}		150°C
Storage temperature range, T _{STG}		-65° to +150°C
Operating temperature range, T _A		-40°C to +125°C
Package Thermal Resistance	Junction to Ambient, R _{th-JA}	60 °C/W
	Junction to Case, R _{th-JC}	15 °C/W
ESD (HBM)		2000 V
ESD (CDM)		200 V
ESD (FICDM)		1500 V
Latch-up		+/- 100mA

Note:

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

 Test condition is $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$. Typical values are at $T_A = 25^{\circ}\text{C}$, unless otherwise specified.

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{IN}	Input voltage operation range		2.7		5.5	V
UVLO	Under voltage lockout threshold	V_{IN} Rising		2.5		V
	Under voltage lockout hysteresis			200		mV
I_Q	Chip quiescent current	$V_{IN}=3.6\text{V}$, $V_{FB}=1.4\text{V}$, Non-switching		0.30	0.35	mA
		$V_{IN}=3.6\text{V}$, $V_{FB}=1.0\text{V}$, Switching		3	5	
I_{SHDN}	Supply current in shutdown	EN=GND		0.1	1.0	uA
f_{REQ}	Switching frequency			800		kHz
DC	Maximum duty cycle		90			%
V_{FB}	Feedback voltage		1.23	1.26	1.29	V
I_{FB}	Feedback input current			0	80	nA
LNR	Feedback voltage line regulation	V_{FB} from 2.7V to 5.5V		0.05	0.15	%/V
I_{CL}	Switching Current Limit	$V_{IN}=3.6\text{V}$, Duty cycle = 70%	5.5	6.0		A
R_{DSON}	Switching ON resistance	$V_{IN}=3.6\text{V}$, $V_{SW}=9\text{V}$, Duty cycle = 70%		50		m Ω
I_{SW}	Switch leakage current	$V_{SW}=9\text{V}$, EN=GND			15	uA
I_{SS}	Soft start pin bias current	$V_{SS}=1.2\text{V}$	2.0	4.5	7.0	uA
V_{IH}	EN pin logic high		1.4			V
V_{IL}	EN pin logic low				0.4	V
R_{EN}	EN pull down resistor			1		M Ω
T_{SD}	Thermal shutdown temperature			150		$^{\circ}\text{C}$
T_{SD_HYS}	Thermal shutdown hysteresis			15		$^{\circ}\text{C}$

TYPICAL PERFORMANCE CHARACTERISTICS

Test condition is $T_A = 25^\circ\text{C}$, $V_{IN} = V_{EN} = 5.0\text{V}$, $V_{FREQ} = 0\text{V}$, unless otherwise specified.

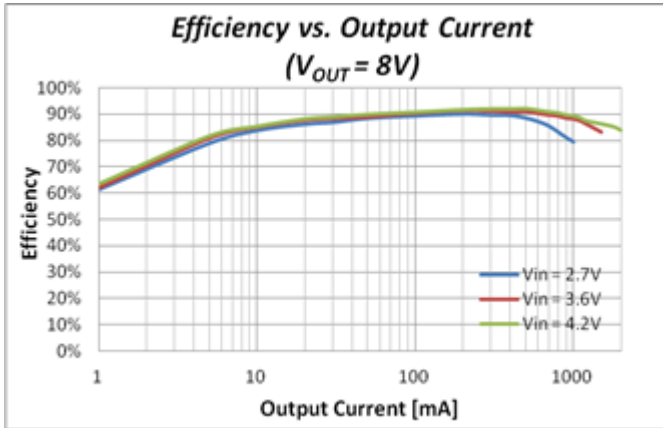


Figure 3. Efficiency vs. Output Current

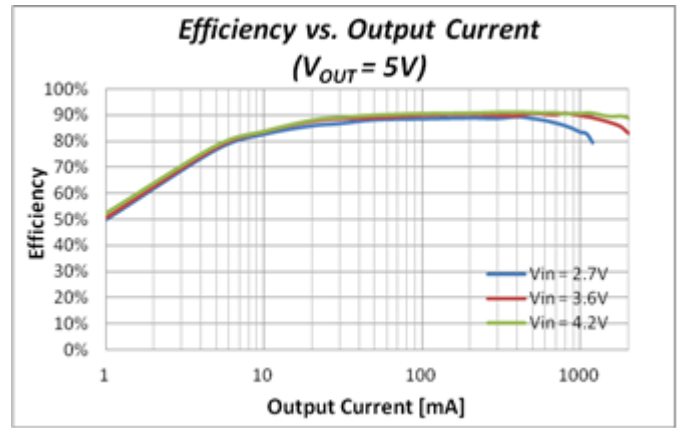


Figure 4. Efficiency vs. Output Current

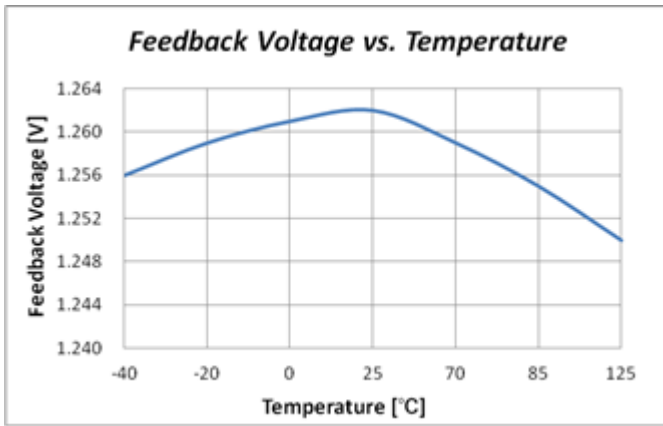


Figure 5. Feedback Voltage vs. Temperature

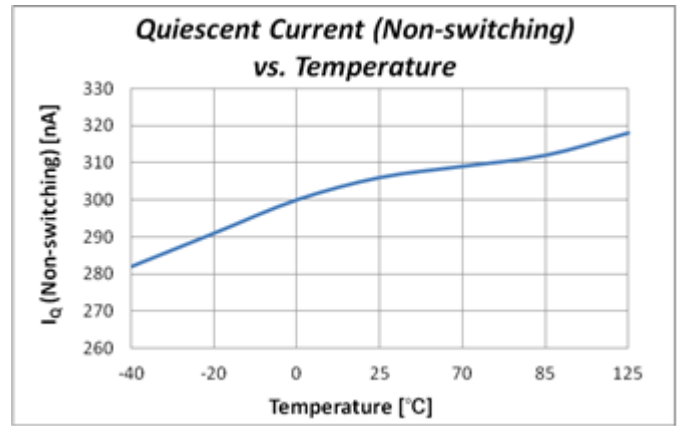


Figure 6. Quiescent Current (Non-Switching) vs. Temperature

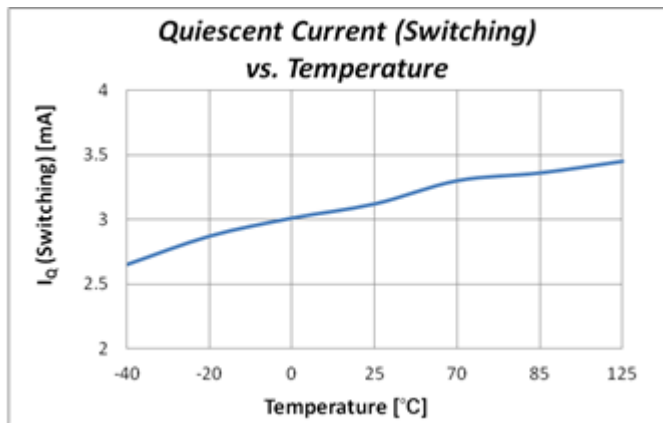


Figure 7. Quiescent Current (Switching) vs. Temperature

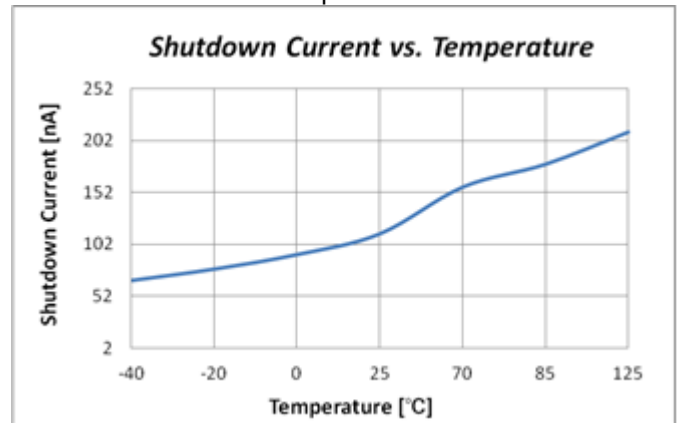


Figure 8. Shutdown Current vs. Temperature

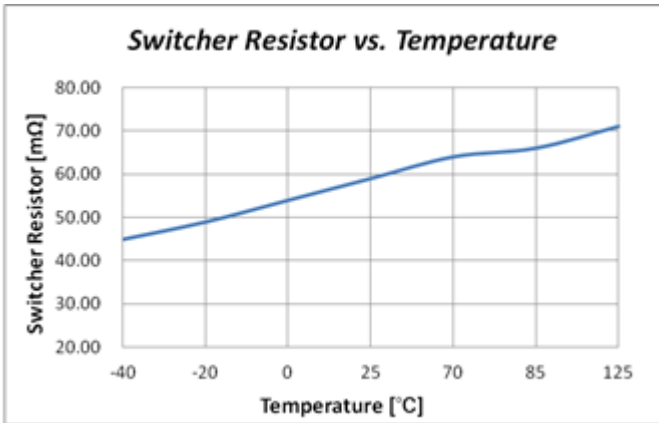


Figure 9. Switcher Resistor vs. Temperature

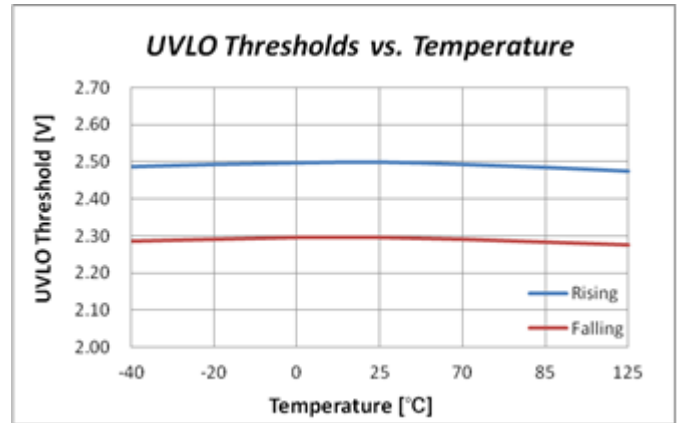


Figure 10. UVLO Threshold vs. Temperature

APPLICATION INFORMATION

The SLM6160 is a highly efficient step-up DC/DC converter that employs a current mode, fixed frequency pulse-width modulation (PWM) architecture with excellent line and load regulation. The SLM6160 operates at constant switching frequency under medium to high load current conditions. At light loads, the device operates in a pulse-skipping mode in order to improve light-load efficiency.

Soft-Start

The SLM6160 offers a programmable soft-start function which minimizes inrush current during startup. The soft-start period is programmed by connecting a 10nF capacitor between SS and Ground. Operation of the soft-start function is as follows: when the IC is disabled, SS is actively discharged to Ground. Upon enabling the IC, C_{SS} is charged with a 4.5μA current so that the voltage at SS increases in a controlled manner. The peak inductor current is limited by the voltage at SS, so that the input current is limited until the soft-start period expires, and the regulator can achieve its full output current rating.

Setting the Output Voltage

The device features external adjustable output voltages of up to 9V. To program the output voltage, simply connect a resistive voltage divider between the output, FB, and GND, with resistors set according to the following equation:

$$R_1 = R_2 \times \left[\left(\frac{V_{OUT}}{V_{FB}} \right) - 1 \right]$$

where $V_{FB}=1.26V$

Rectifier Selection

For optimal performance, the rectifier should be a Schottky rectifier that is rated to handle both the output voltage as well as the peak switch current.

Open Voltage Protection

The device features internal automatic over-voltage protection, when feedback voltage is higher than 115%.

Overcurrent Protection

The SLM6160 has a cycle-by-cycle overcurrent limit protection that turns off the power switch once the inductor current reaches the overcurrent limit threshold. The PWM circuitry resets itself at the beginning of the next switch cycle. During an overcurrent event, the output voltage begins to droop as a function of the load on the output.

$$V_{OUT} = \frac{V_{IN} \times \left(I_{CL} - \frac{I_{RIPPLE}}{2} \right) \times \eta}{I_{OUT}}$$

where

- V_{OUT} is the output voltage of the boost regulator.
- I_{OUT} is the output current of the boost regulator.
- V_{IN} is the input voltage of the boost regulator.
- I_{CL} is the input switching peak current limit of the boost regulator.
- I_{RIPPLE} is the inductor ripple current of the boost regulator.
- η is the power conversion efficiency.

Open Circuit Protection

Once the outputs achieve regulation, if the voltage at FB falls below 0.2V the controller will automatically disable, preventing the controller from running open-loop and potentially damaging the IC and load.

Shutdown

Drive EN low to disable the IC and reduce the supply current to just 0.1μA. As with all non-synchronous step-up DC/DC converters, the external Schottky diode provides a DC path from the input to the output in shutdown. As a result, the output drops to one diode voltage drop below the input in shutdown.

The SLM6160 features integrated thermal overload protection. The device is automatically disabled when the junction temperatures exceed +150°C, and automatically re-enable when the die temperature decreases by 15°C.

PACKAGE CASE OUTLINES

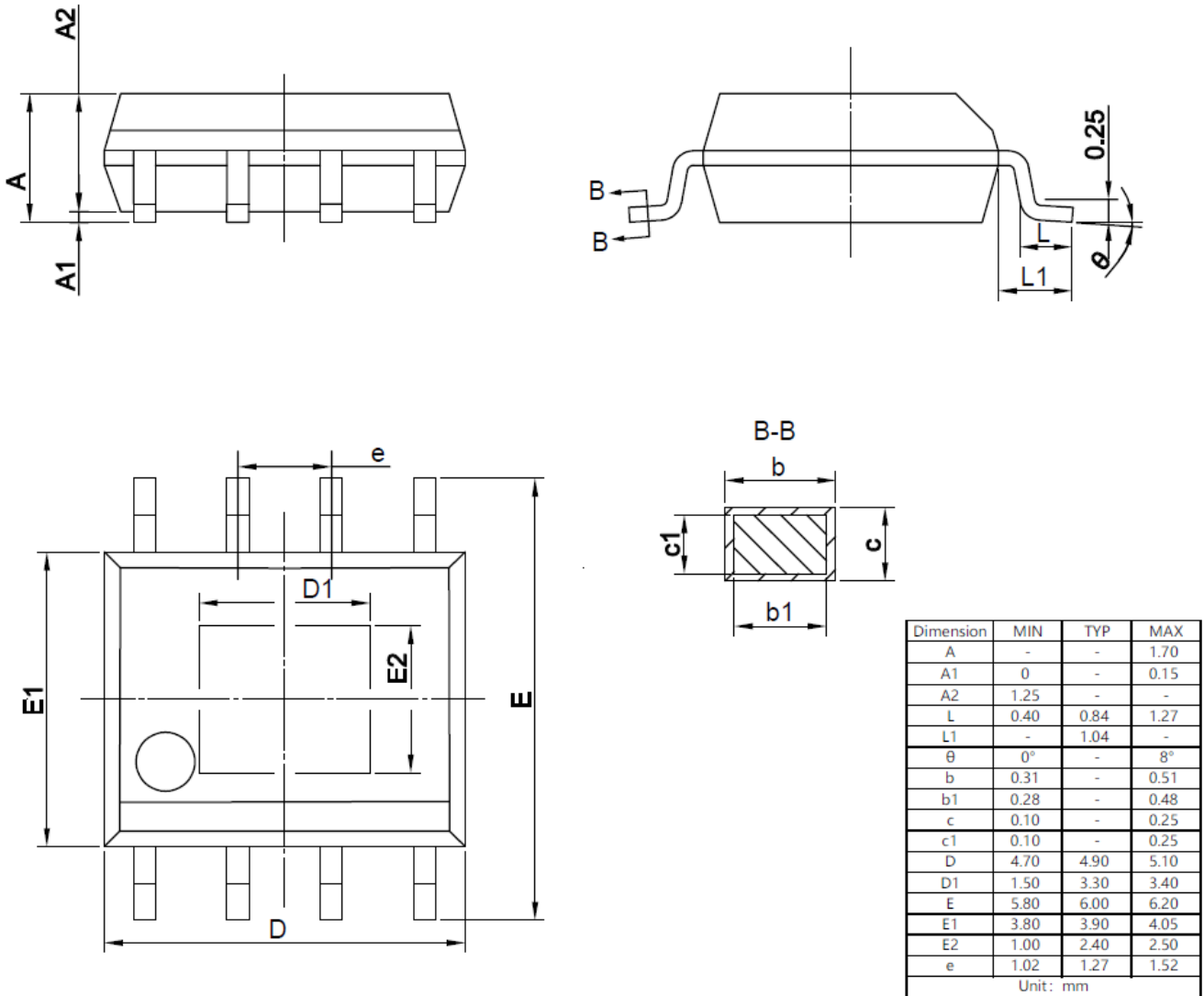


Figure 11. SOP8-EP Outline Dimensions

REVISION HISTORY

Note: page numbers for previous revisions may differ from page numbers in current version

Page or Item	Subjects (major changes since previous revision)
Rev 1.0 datasheet, 2019-9-2	
Whole document	New company logo released
Page 1	Change typical application circuit
Rev1.1 datasheet, 2023-10-23	
Whole document	Datasheet format change
Page 11	Change the package name from SOIC8-EP to SOP8-EP and update the POD