SE3510

SEAWARD ELECTRONICS

1MHz, 3A, Boost PWM Converter with QC2.0 interface(Preliminary)

General Description

The SE3510 is a current mode boost DC-DC converter with built-in handshake interface circuitry to QC2.0 compatible cellphones and other similar devices. If the interface is successful, SE3510 will automatically increase the voltage to 9V and 1.5A to provide fast charging. If the plugged device is not QC2.0 compatible, SE3510 will provide up to 5V/2A for fast charging.

SE3510 integrates an super efficient MOSFET with Rds(ON) ~ 40mΩ. This makes power conversions very efficient. The internal compensation network are fined turned to provide the best compensation for both 5V and 9V operations. This allows SE3510 to use only 8 components to provide either 9V/1.5A or 5V/2A operations. The soft-start function is also onboard..

The SE3510 is available in the SOP8 package and provides space-saving PCB for the application fields.

Features

- Built-in D-/D+ interface with QC2.0 devices
- Automatic Output Selection between 5V and 9V
- Internal Fixed PWM frequency: 1.0MHz
- Precision Feedback Reference Voltage:
  1.275V@Vout=5V; 2.275V@Vout=9V (±2%)
- Internal 40mΩ, 6A, 20V Power MOSFET
- Shutdown Current: 0.1μA
- Over Temperature Protection
- Over Current Protection: 2.4A@Vout=5V;
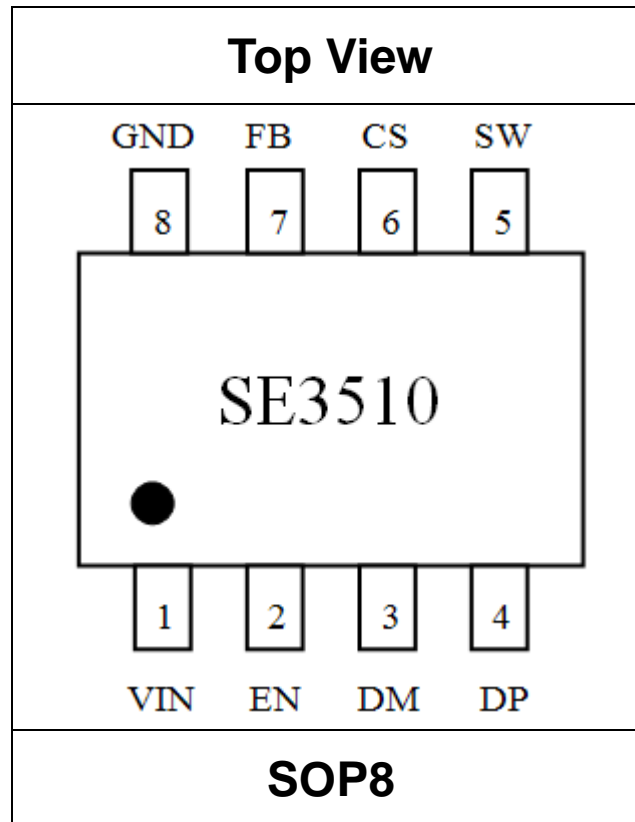 1.8A@ Vout=9V
- Package: SOP8

Application

- Portable Chargers compatible with QC2.0
- LCD Displays
- Digital Cameras
- Handheld Devices
- Portable Products

Typical   Application

Pin Configuration

Top View

GND   FB   CS   SW

8   7   6   5

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1   2   3   4

VIN   EN   DM   DP

SOP8
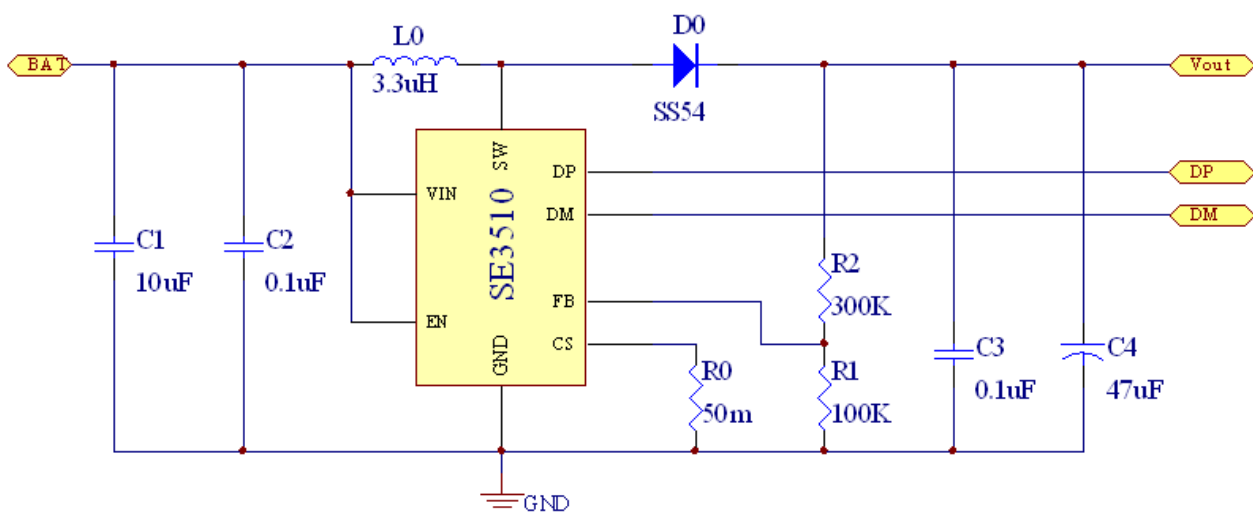
Pin Description

Number	Pin	Pin Function Description
1	VIN	Input power supply pin
2	EN	Shutdown control input, Connect this pin to logic high level to enable the device
3	DM	USB D- Data Line Input
4	DP	USB D+ Data Line Input
5	SW	Switch pin
6	CS	Current Sense PIN
7	FB	Feedback pin
8	GND	Power ground

Ordering Information

Part Number	Marking Information	Package	Remarks
SE3510-LF	SE3510-HF 1535	SOP8	Starting with 5, a bar on top of 5 is for production year 2011, and underlined 5 is for year 2012. The next character is marked on top for 2013, and underlined for 2014. The naming pattern continues with consecutive characters for later years. The character "x" is the week code. (A-Z: 1-26, a-z: 27-52) The last character "L" is for lead-free process. A dot on bottom left corner is Pin 1.

Functional Block Diagram
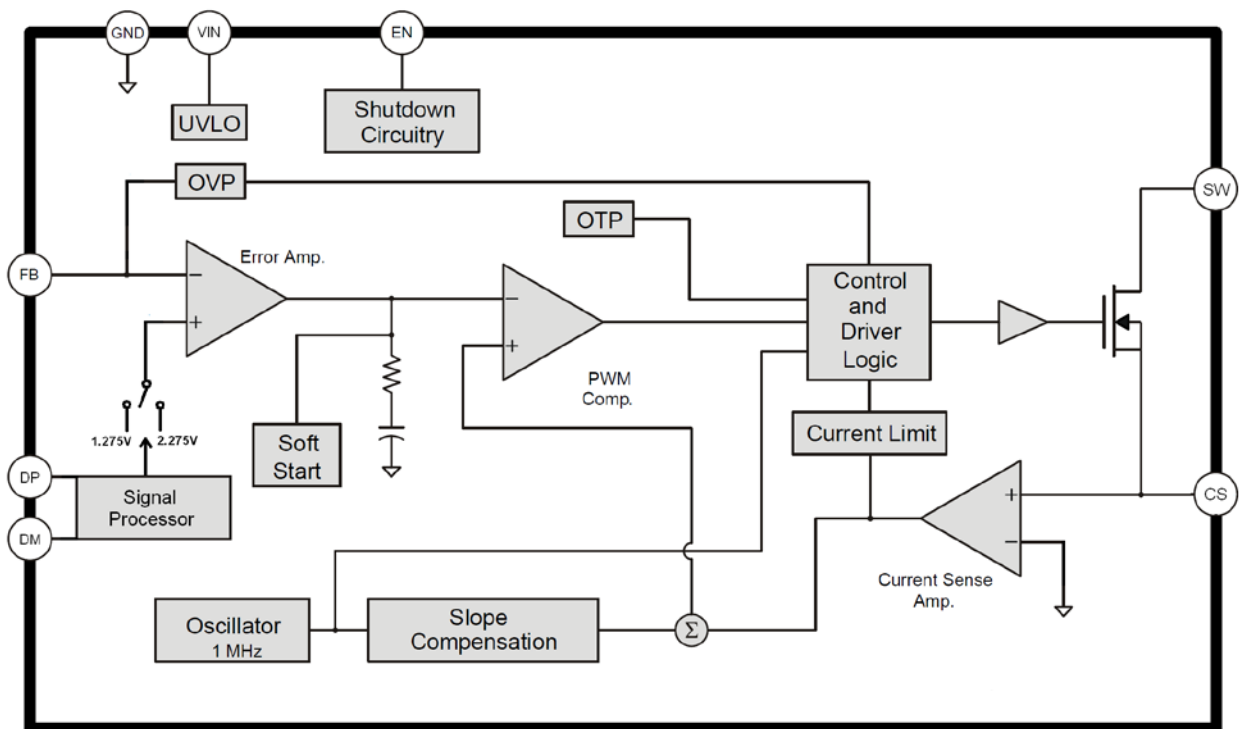
Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
Supply Voltage VIN	VIN	6	V
SW Voltage	V_{SW}	20	V
EN, DM, DP, CS, FB Voltage		6	V
Power Dissipation	P_D	455	mW
Thermal Resistance	θ_{JA}	+220	°C/W
Junction Temperature	T_J	+150	°C
Operating Temperature	T_{OP}	-40 to +85	°C
Storage Temperature	T_{ST}	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)		+260	°C

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	VIN	2.8		5.5	V
Operating Temperature Range	T_A	-40		+85	℃

Electrical Characteristics

VIN = 3.3V, T_A= 25℃; unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
System Supply Input						
VIN	Input Supply Range		2.8		5.5	V
V_{UVLO}	Under Voltage Lockout			2.8		V
	UVLO Hysteresis			0.17		V
Iq	Quiescent Current	V_{FB}=90% *Vref, No switching		0.19		mA
Iq	Average Supply Current	V_{FB}=110%*Vref, Switching		2		mA
Iq	Shutdown Supply Current	V_{EN}=GND		0.1		µA
Oscillator						
F_{OSC}	Operation Frequency	V_{FB}=90% *Vref	0.8	1.0	1.2	MHz
$\triangle f / \triangle V$	Frequency Change with Voltage	VIN=2.8V to 5.5V		5		**%**
T_{DUTY}	Maximum Duty Cycle			90		**%**
Reference Voltage						
V_{REF}	Reference Voltage	Vout=5V	1.25	1.275	1.3	V

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		Vout=9V	2.23	2.275	2.32	
	Line Regulation	VIN=2.7V to 5.5V		0.05		%/V
Enable Control						
V_{EN}	Enable Voltage		0.9			V
V_{EN}	Shutdown Voltage				0.7	V
MOSFET						
$R_{DS(ON)}$	On Resistance of Driver	I_{sw}=4.5A		40		mΩ
Protection						
I_{OCP}	OCP Current	Vout=5V		2.4		A
		Vout=9V		1.8		A
T_{OTP}	OTP Temperature			+150		℃

Functional Description

Operation

The SE3510 is a current mode boost converter. The constant switching frequency is 1MHz and operates with pulse width modulation (PWM). Build-in 20V / 6A MOSFET provides a strong enough power output to provide either 5V/2A or 9V/1.5A. The control loop architecture is current mode control; The slope compensation circuit is internally added to the current signal to allow stable operation for duty cycles larger than 50%.

Internal QC2.0 Interface

The QC 2.0 interface circuitry is internally built-in for SE3510. When the Device to be charged is first connected to charger, SE3510 will attempt to broadcast the QC2.0 interface signal to the Device. If the devices is QC2.0 compatible and responses back with standard QC2.0 information, and completes the interface protocol, SE3510 will automatically deliver 9V and up to 1.5A to the device. On the other hand, if the connected Device is not QC2.0 compatible, the SE3510 will automatically deliver 5V and up to 2 A.

Soft Start Function

Soft start circuitry is integrated into SE3510 to avoid inrush current during power on. After the IC is enabled, the output of error amplifier is clamped by the internal soft-start function, which causes PWM pulse widthto increase in a controlled fashion and thus reducing input input surge current.

Over Temperature Protection (OTP)

SE3510 will turn off the power MOSFET automatically when the internal junction temperature is over 150°C. The power MOSFET wakes up when the junction temperature drops 20°C under the OTP threshold temperature.

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Application Information

Inductor Selection

Inductance value is decided based on different condition. 3.3uH to 4.7µH inductor value is recommended for general application circuit. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance has better power efficiency. Also, it avoids inductor saturation which will cause circuit system unstable and lower core loss at 1 MHz.

Capacitor Selection

The output capacitor is required to maintain the DC voltage. Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider operation temperature range.

Diode Selection

Schottky diodes with fast recovery times and low forward voltages are recommended. Ensure the diode average and peak current ratings exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the output voltage.

Layout Considerations

1. The power traces, consisting of the GND trace, the SW trace and the VIN trace should be kept short, direct and wide.
2. SW、L and D switching node, wide and short trace to reduce EMI.
3. Place C_{IN} near VIN pin as closely as possible to maintain input voltage steady and filter out the pulsing input current.
4. The resistive divider R1 and R2 must be connected to FB pin directly as closely as possible.
5. FB is a sensitive node. Please keep it away from switching node, SW.
6. The GND of the IC, C_{IN} and C_{OUT} should be connected close together directly to a ground plane.

Outline Drawing For SOP8
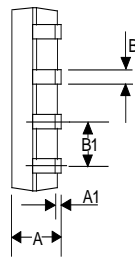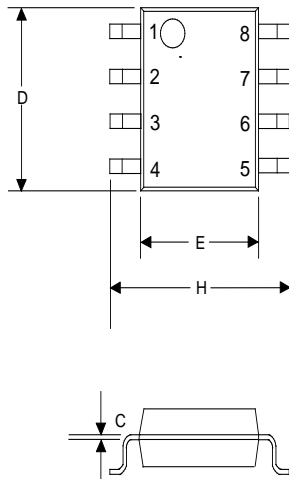
DIMENSIONS				
DIM^N	INCHES		MM	
	MIN	MAX	MIN	MAX
A	0.0532	0.0688	1.35	1.75
A1	0.0040	0.0098	0.10	0.25
B	0.0130	0.0200	0.33	0.51
B1	0.050 BSC		1.27 BSC	
C	0.0075	0.0098	0.19	0.25
D	0.1890	0.1968	4.80	5.00
H	0.2284	0.2440	5.80	6.20
E	0.1497	0.1574	3.80	4.00

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