■ DESCRIPTION

SP3313 has an optimum input voltage, step-down converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. The maximum input voltage is up to 36V and the operation input voltage from 7.5V to 32V.

MOSFET, what build in 35mΩ High-Side and 25mΩ Low-Side, could deliver up to 3.5A of continuous output current and the output current accurate to within ±7%.

No external compensation component requirement. The line compensation and the constant current can be set by an external resistance.

Independent output voltage protection suits for BC1.2 and QC2.0/3.0 dual channel output voltage.

In conclusion, SP3313 is a full function and high performance, high reliability buck DC-DC converter.

■ FEATURES

- 100% Duty Cycle Car Charge Scheme
- Build in High-Side and Low-Side MOSFET
- Max Output Current: 3.5A
- Adjustable Output Voltage, V_{FB}=1.0V
- Excellent Constant Current Accuracy: ±7%
- Constant Voltage Accuracy: ±2%
- Jitter Function
- Efficiency: Up to 95%
- Adjustable Line Compensation
- Short Circuit Protection
- Over Voltage Protection
- Thermal shutdown Protection
- Under Voltage Lock Output
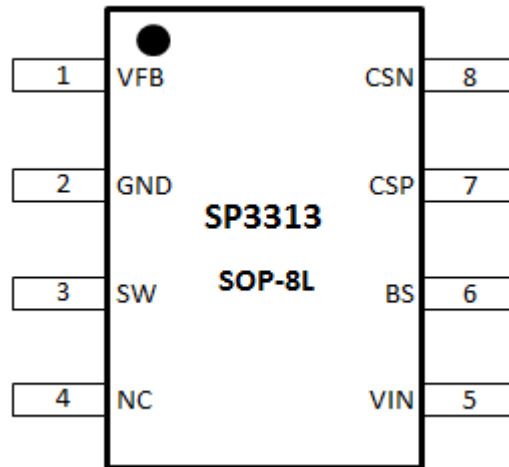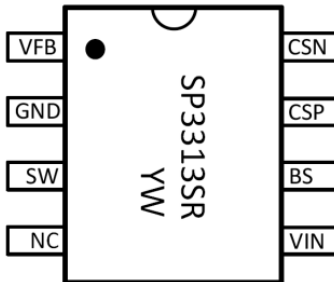- Available in SOP-8L Package
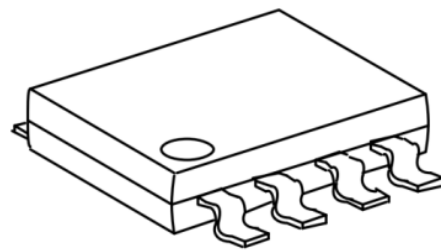
SOP-8L

■ APPLICATIONS

- Car Charger
- Wall Charger
- Power Strip/Hub
- Portable charger device
- Car DVD
- Black Box
- Industry Application
- Other

■ TYPICAL APPLICATION

PIN	NAME	DESCRIPTION
1	VFB	Feed Back Of Output Voltage
2	GND	Ground
3	SW	Positive Of Current Sense Power Switching Output to External Inductor
4	NC	NC
5	VIN	Power Supply Input. Bypass this pin with a 2.2µF ceramic capacitor to GND, placed as close to the IC as possible.
6	BS	Power to the internal high-side MOSFET gate driver. Connect a 22~100nF capacitor from BS pin to VIN pin
7	CSP	Positive Of Current Sense
8	CSN	Negative Of Current Sense

■ ORDER/MARKING INFORMATION

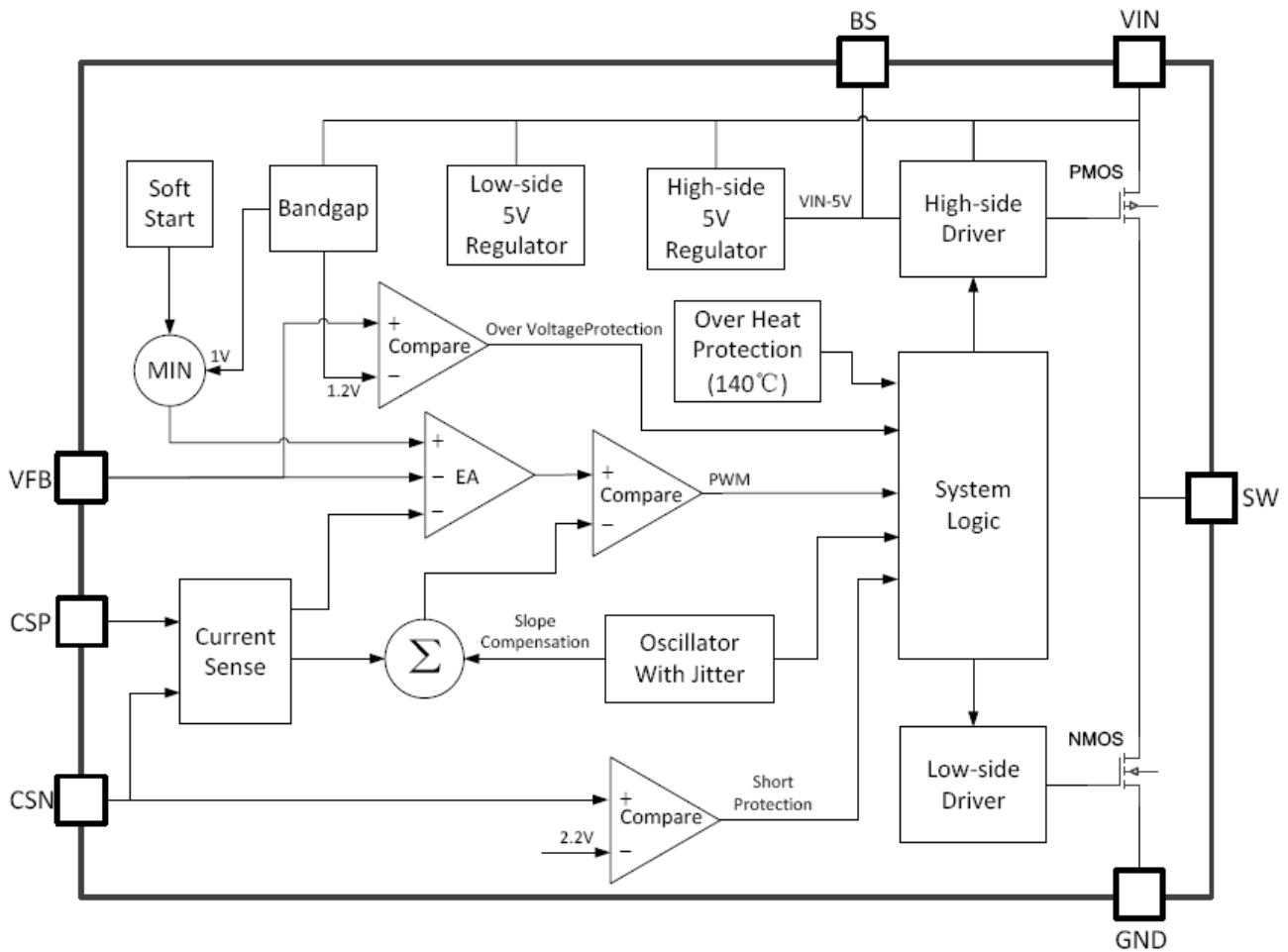| Order Information	Top Marking
SP3313 - X - X Packing R: Tape Reel Package S: SOP-8L Product Number	 Y: Year (15=2015,16=2016,…) W: Weekly (01-54)

■ ABSOLUTE MAXIMUM RATINGS (at T_A = 25°C)

Parameter	Symbol	Rating	Units
V_{IN} to GND		-0.3 to 36	V
SW to GND		-0.3 to 32	V
BS to GND		-0.3 to 36	V
CSP, CSN to GND		-0.3 to 25	V
V_{FB} to GND		-0.3 to 6	V
Junction to Ambient Thermal Resistance		105	°C/W
Operating Junction Temperature		-40 to 150	°C
Storage Junction Temperature		-55 to 150	°C
Lead Temperature (Soldering 10 sec.)		300	°C
Thermal Resistance from Junction to case	θ_{JC}	15	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	40	°C/W
ESD (HBM)		>2000	V

Note: *Exceed these limits to damage to the device. Exposure absolute maximum rating conditions may affect device reliability.*
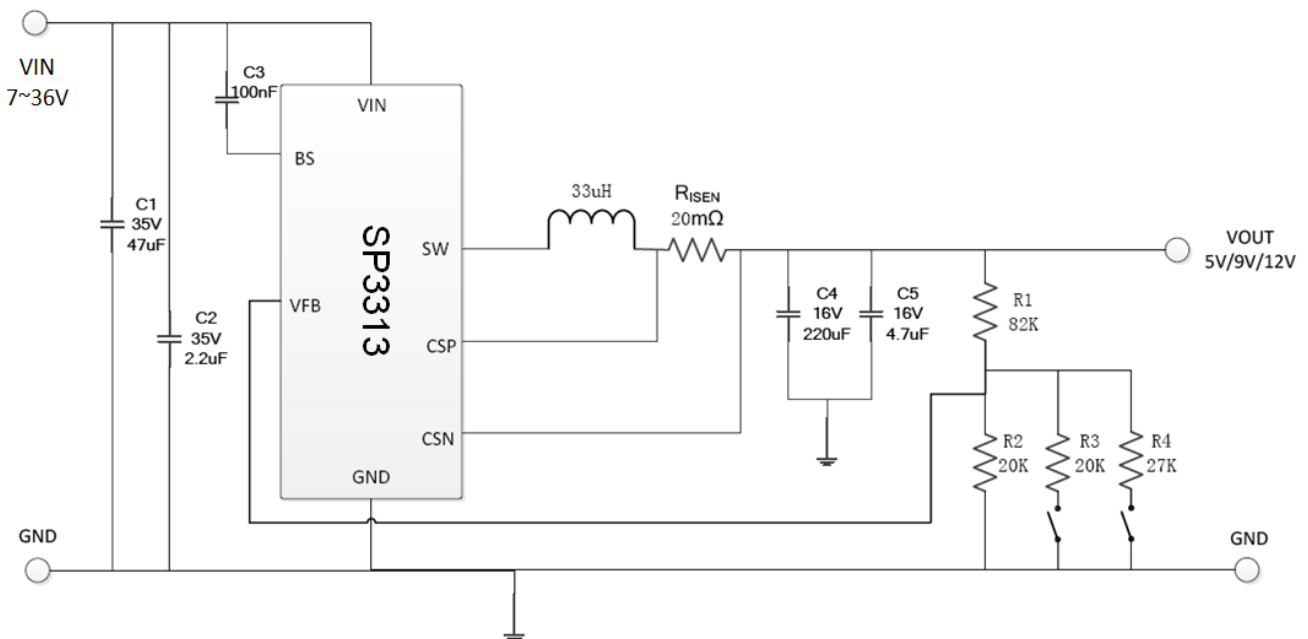
■ ELECTRICAL CHARACTERISTICS(V_{IN}=12V, T_A = 25°C,unless otherwise stated)

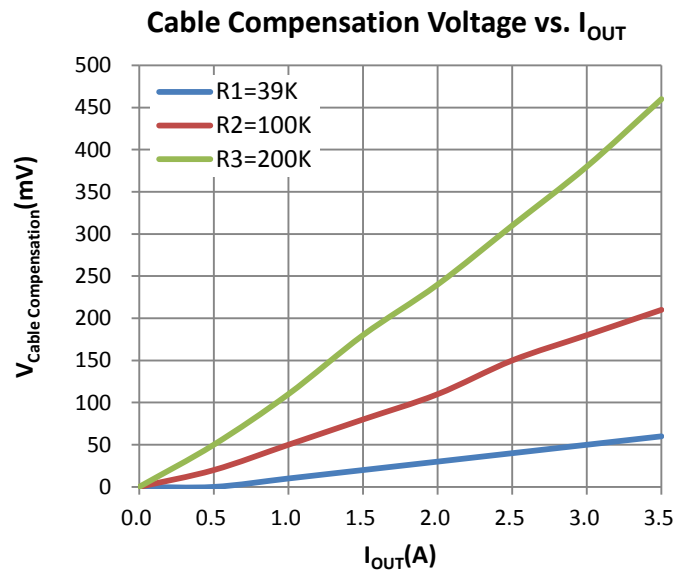| Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage	V_{IN}		7	-	36	V
Input OVP Threshold	$V_{OVP\text{-}VIN}$		31	32	33	V
UVLO Voltage	V_{UVLO}		7	7.5	8	V
UVLO Hysteresis			0.3	0.5	0.8	V
Quiescent Current	I_{CCQ}	V_{FB}=1.5V, force driver off.	-	1.5	-	mA
Standby Current	I_{SB}	No Load	-	1.6	2	mA
Reference Voltage Of VFB	V_{FB}		0.98	1	1.02	V
Output OVP detect Voltage	V_{OVP}	Internal define	-	1.2	-	V
Switching Frequency	F_{SW}	I_{OUT}=1A	120	135	155	KHz
Maximum Duty Cycle	D_{MAX}			100	-	%
Minimum On-Time			-	250	-	ns
Reference Voltage Of Constant Current	Reference Of CSP-CSN	0.4V<VFB<0.95V	46.5	50	53.5	mV
$V_{OUT\text{-}Short}$	V_{CSN}		2.2	2.4	2.6	V
RDS$_{ON}$ Of Power MOS	High side	I_{OUT}=1A	30	35	40	mΩ
	Low side	I_{OUT}=1A	22	25	30	mΩ
Thermal shutdown Temp	T_{SD}		-	140	-	°C
Thermal Shutdown Hysteresis	T_{SH}		-	30	-	°C

Segma Power

■ BLOCK DIAGRAM

■ TYPICAL APPLICATION CIRCUIT

■ TYPICAL PERFORMANCE CHARACTERISTICS

Efficiency vs. I_{OUT} (V_{OUT}=5V)

Efficiency vs. I_{OUT} (V_{OUT}=9V)

Efficiency vs. I_{OUT} (V_{OUT}=12V)

Cable Compensation Voltage vs. I_{OUT}

Switch Frequency vs. Input Voltage

Standby Current vs. Input Voltage
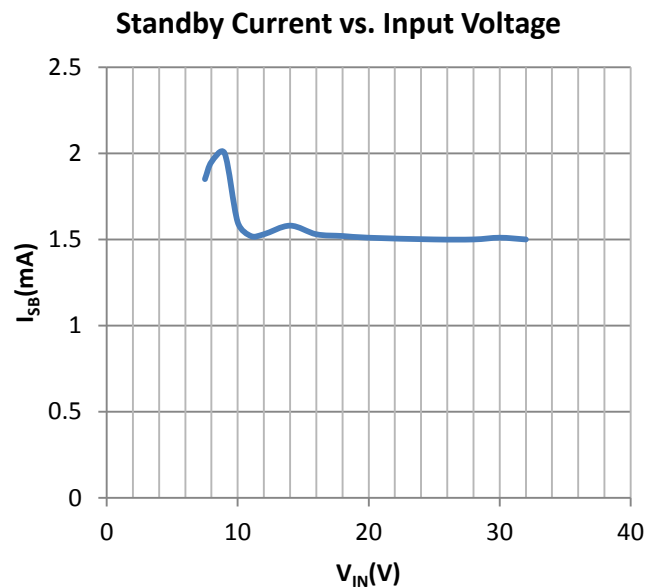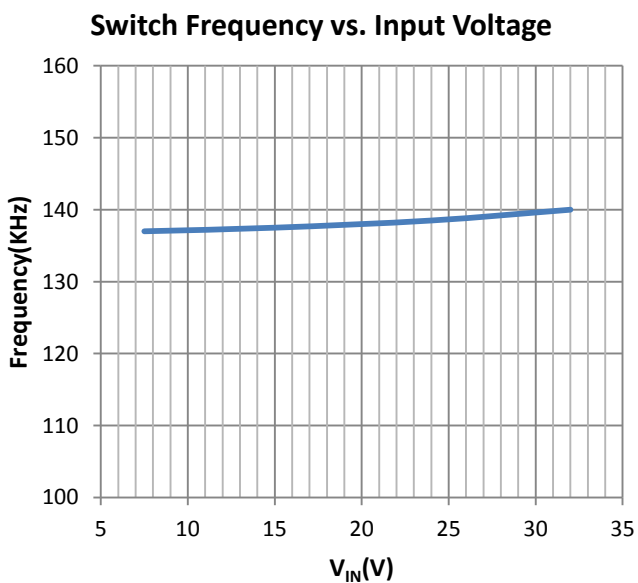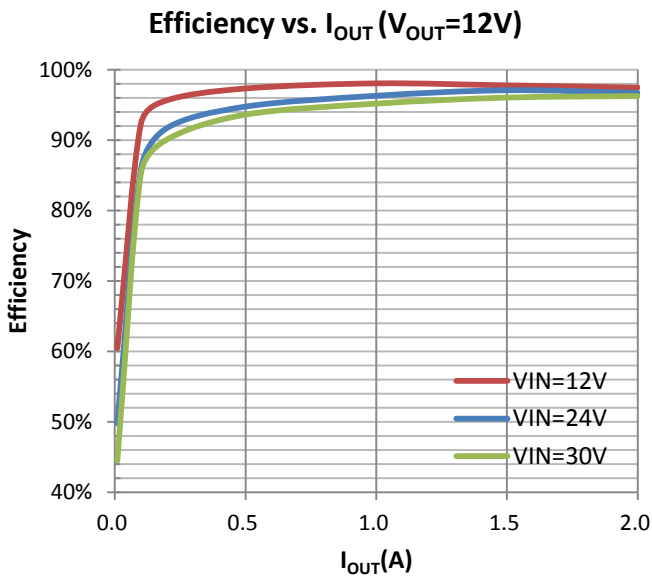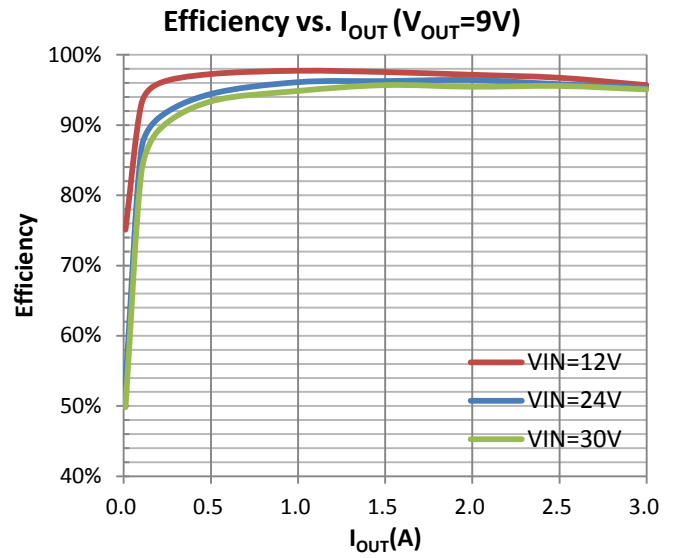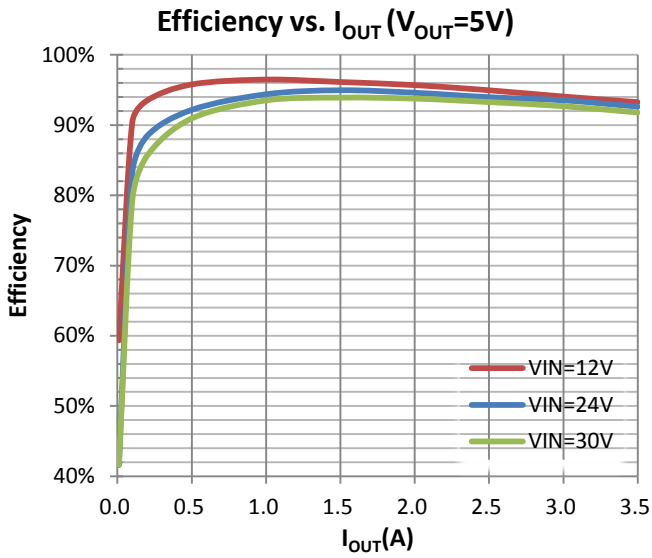
■ FUNCTIONAL DESCRIPTION

Input Under Voltage Protection

SP3313 provides an input voltage up to 36V and operates from an input voltage range of 7.5V to 32V. If V_{IN} drops below 7V, the UVLO circuit inhibits switching. Once V_{IN} rises above 7.5V, the UVLO clears, and the soft-start sequence activates.
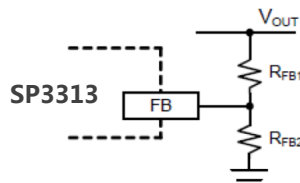
Input Over Voltage Protection

If V_{IN} rises above 32V, the UVLO circuit inhibits switching. SP3313 will not be damaged until the voltage exceeds 36V. Once V_{IN} drops below 30V, the UVLO clears, and the soft-start sequence activates.

Soft-start

SP3313 has an internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal-overload event, the soft-start circuitry slowly ramps up current available after 300us.

Constant Voltage Output

SP3313 presets the V_{FB} voltage to 1V. The Output Voltage can be set by extra resistance.

$$V_{OUT} = V_{FB} \times (\frac{R_{FB1}}{R_{FB2}} + 1)$$

Output Over Voltage Protection

Once V_{FB} rises above 1.2V, SP3313 shuts down to avoid damage caused by abnormal use of electrical equipment.

Constant Current Output

SP3313 senses the current by sampling the voltage difference between the CSP and the CSN, and adjusts the output current to the default value by the loop.

$$I_{OUTPUT} = \frac{50mV}{R_{ISEN}}$$

Constant current operates normally when CSN is higher than 2.4V. When CSN is below 2.2V causing by overload, SP3313 will enter short circuit protection mode.

Short Circuit Protection

When CSN drops below 2.2V since too heavy load, SP3313 will enter short circuit protection function, and the system will enter hit-cup mode, and frequency drop to 40KHz per cycle and stop switching for 300mS.

Line Compensation

When users use different cables, it will produce different voltage drop, the users can set their own

cable compensation voltage according to the need:

$$V_{Cable\ Compensation} = 3.7\mu A \times R1 \times \frac{V_{CSP} - V_{CSN}}{50mV}$$

Thermal Shutdown

Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds T_J= +150°C, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 25°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

■ APPLICATION GUIDELINES

Input capacitance selection

Input capacitance selection pressure 50V, the total capacity of 40 μF ceramic capacitor, of course, if considering the cost factor, can also choose a more than 50V voltage, capacity of more than 100 μF electrolytic capacitor, parallel a 50V voltage, capacity of 2.2μF ceramic capacitors.

The location of the input capacitance, try to close to the chip VIN PIN position, if it is electrolytic capacitors and ceramic capacitors in parallel, ceramic capacitor is more close to the chip.

Inductance selection

SP3313 selection are amount at 22μH~51μH inductance, if the demand is higher, the output ripple is advised to choose a larger inductance sense of values, such as 33μH or 47μH.

Require inductor saturation current must be not less than 1.5 times of the preset constant current value.

Output capacitance selection

Generally recommended to use a 220 μF electrolytic capacitor and a 4.7 μF ceramic capacitors in parallel as the output capacitance, the demand is higher, if the output ripple is proposed to 4.7 μF ceramic capacitor replacement for one or two ESR lower 22 μF ceramic capacitors, ceramic capacitors capacitance value, the greater the output ripple is smaller.

BS capacitance selection

BS and select let VIN proposal in 22nF~100nF ceramic capacitor, withstand voltage value of not less than 50V.

EMI/EMC

SW reserved RC circuit, resistance to choose 4.7R, 2.2nF capacitance advice; If the application version enough volume, can be reserved at input end type π circuit. SW pin reserved RC circuit of R2 4.7Ω and C4 1nF; BS pin reserved R1 5.1Ω string C3 100nF; Being enough, if the PCB can be reserved in the input circuit π type.(The following figure)
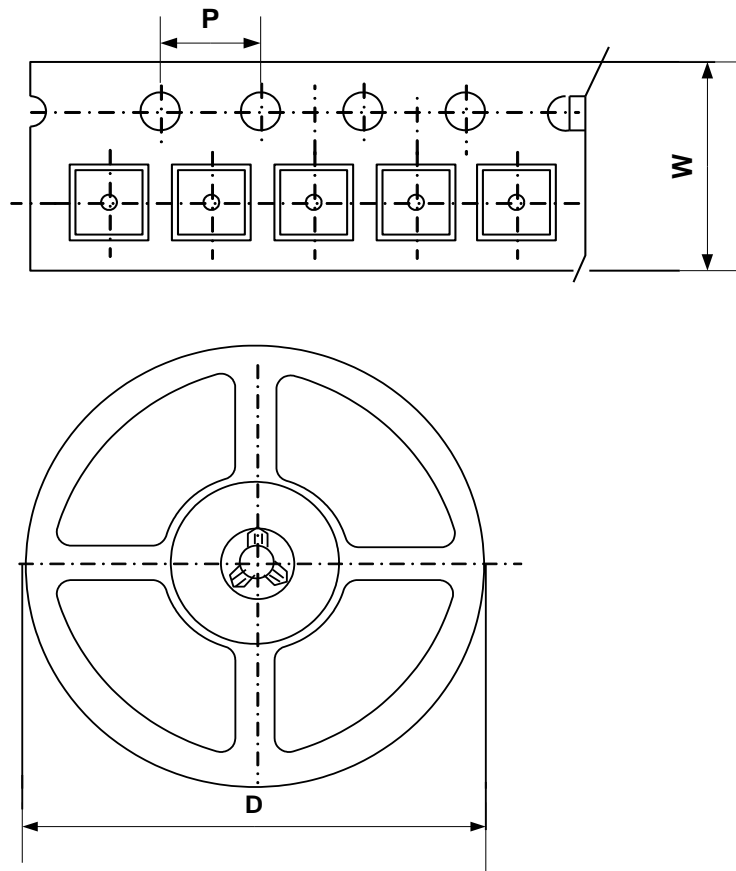
Layout design reference
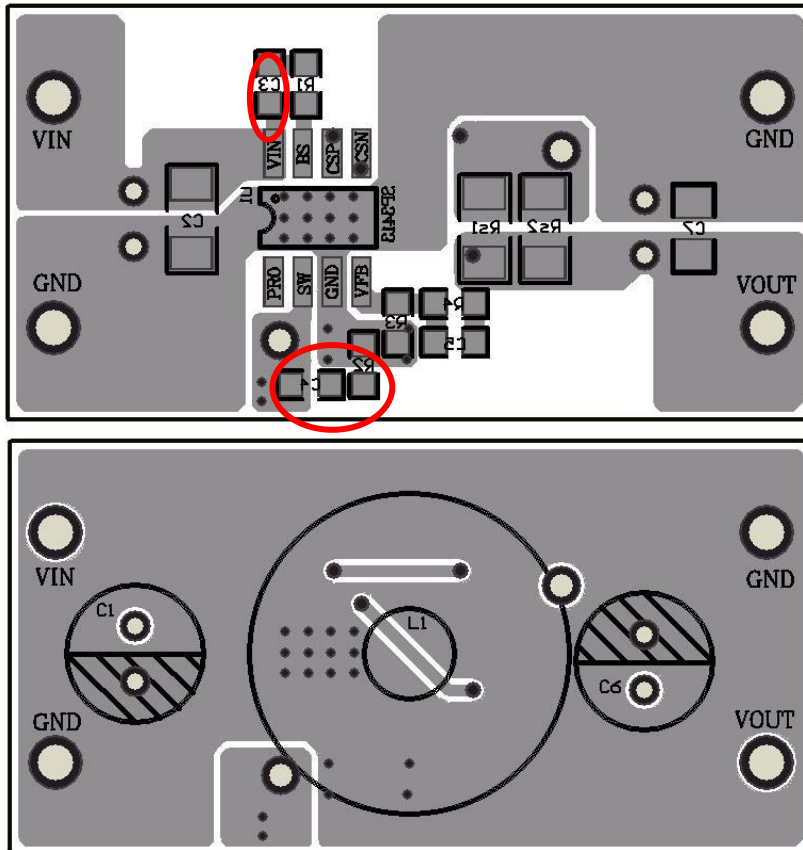
■ PACKAGE INFORMATION
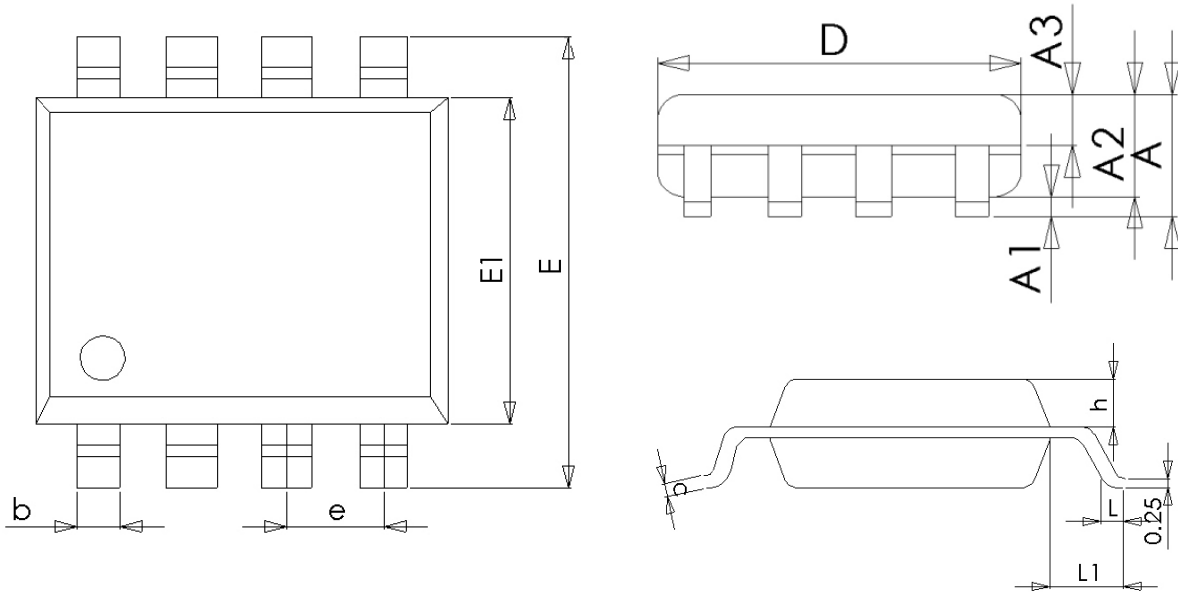
Symbol	Dimensions In Millimeters		
	Min	**NOM**	**Max**
A	--	--	1.65
A1	0.05	--	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	--	0.50
L	0.50	0.60	0.80
L1	1.05BSC		

■ TAPE AND REEL INFORMATION

Package Type	Carrier Width (W)	Pitch (P)	Reel Size(D)	Packing Minimum
SOP-8L	12.0±0.1 mm	8.0±0.1 mm	330±1 mm	4000pcs

Note: Carrier Tape Dimension, Reel Size and Packing Minimum