Description

The SE8324 is a one switch, multi-topology LED controller that regulates LED current from input voltage above, below or equal to the output voltage. With 4.5V to 60V input, 0V to 60V output, and seamless low noise transitions between operation regions, the SE8324 is ideal for LED driver and battery charger applications in automotive, industrial and battery-powered systems.

The 60V capability coupled with the high-side current sense enables SE8324 to be used in a wide range of applications and drive in excess of 15 LEDs in series.

The special control scheme enables SE8324 to be dimming by both linear and PWM control signal.

Additional features include thermal shutdown, cycle-by-cycle current limit, output over voltage protection and over-current protection, soft start, smart thermal gradual protection, Internal Spread Spectrum Frequency Modulation for Low EMI.

The SE8324 is available in the DFN10 package.

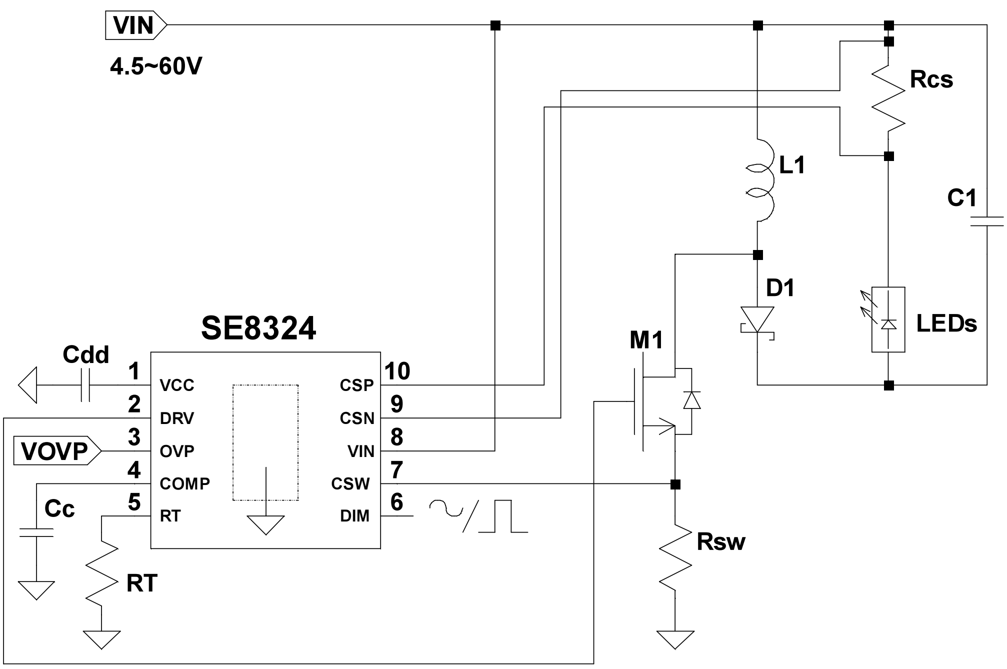
Features

- Wide Operating Voltage Range: 4.5V～60V
- Buck, Boost, and Buck-Boost Configurations
- Linear/PWM Combined Dimming
- High-side Current Cense Mode
- Internal Spread Spectrum Frequency Modulation for Low EMI
- Average control for high accuracy
- 0-100% duty control, smooth current control
- Over-current Protection (OCP)
- Over-Voltage Protection (OVP)
- Over-Temperature Protection (OTP)
- Smart Thermal Gradual Protection

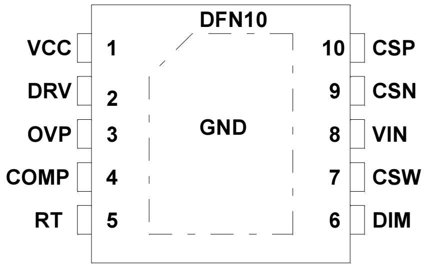
Applications

- luminaries, RGB lamp
- Automotive Lighting
- LED Flashlights

Typical Application Circuit (Buck-Boost)



Pin Configuration



Pin Functions

PIN No.	Name	DESCRIPTION
1	VCC	Chip Supply, Connect 1uF to GND
2	DRV	Drive External MOSFET
3	OVP	Output Over Voltage Protection
4	COMP	Loop Compensation
5	RT	Frequency Setting Resistor
6	DIM	Linear/PWM Diming Input
7	CSW	Over Current Sense
8	VIN	4.5~60V Input Voltage
9	CSN	LED Current Cense -
10	CSP	LED Current Cense +
11	GND	Ground

Order Information

Device	Package	Temp	Ship Info	Logo
SE8324	DFN10	-40℃～105℃	Tape 4KPCS/Reel	SE8324

Absolute Maximum Ratings

Unless otherwise specified, $T_J = T_A = 25°C$

Description	Rating	UNIT
VIN	-0.3~70	V
CSP,CSN,CSW,OVP,COMP,DIM,RT,VCC	-0.3~7	V
DRV	-0.3~VCC	V
Storage Temperature Range	-40~150	℃
Junction temperature	-40~125	℃
ESD HBM Mode	2000	V

Note: 1 Absolute Maximum Ratings are limits beyond which damage to the device may occur.

Note: 2 HBM Mode，100pF, 1.5kΩ discharge.

Recommended Operating Conditions

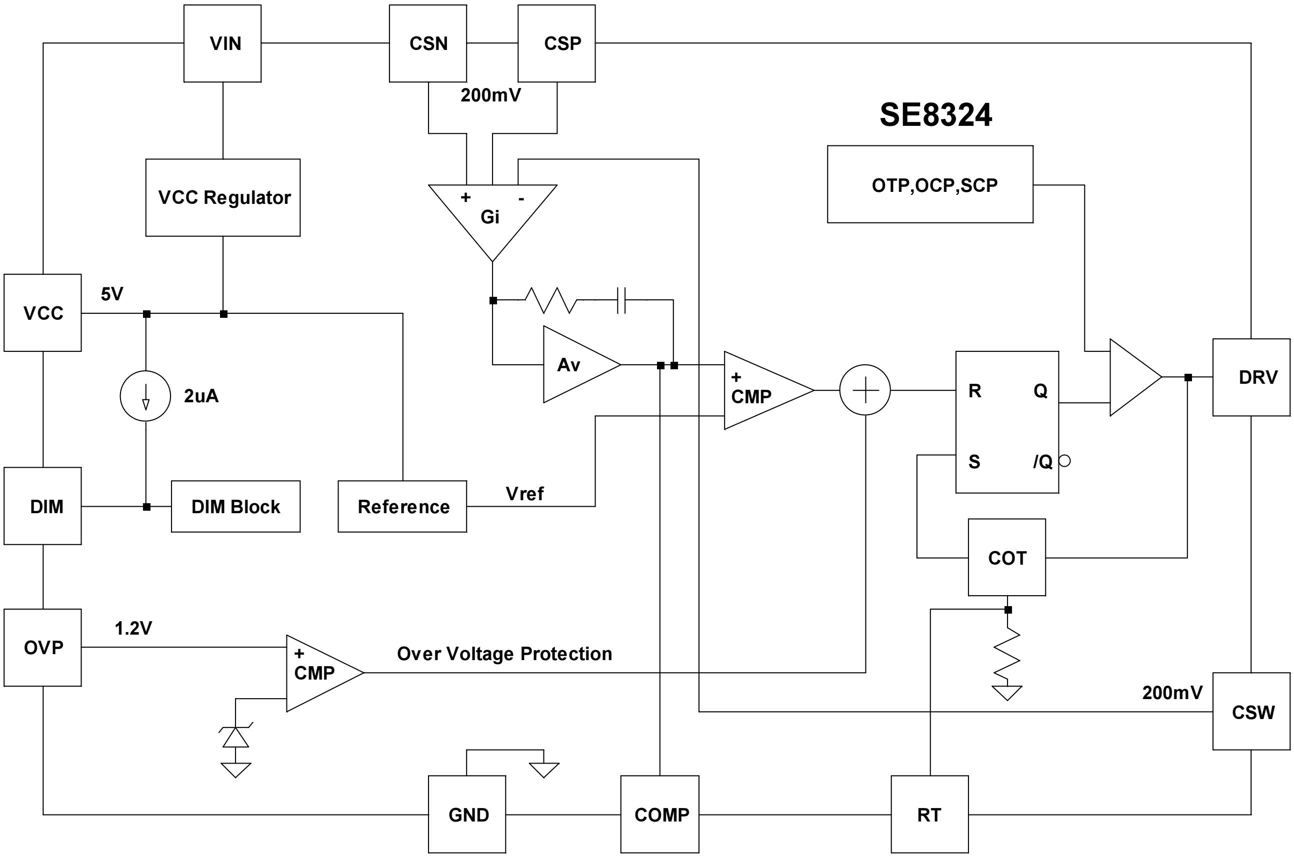
	MIN	MAX	UNIT
Input voltage, V_{IN}	4.5	60	V
Junction temperature, T_J	-40	125	℃

Electrical Characteristics

Unless otherwise specified, -40℃ ≤ $T_J = T_A$ ≤ 125℃, V_{IN} =12 V

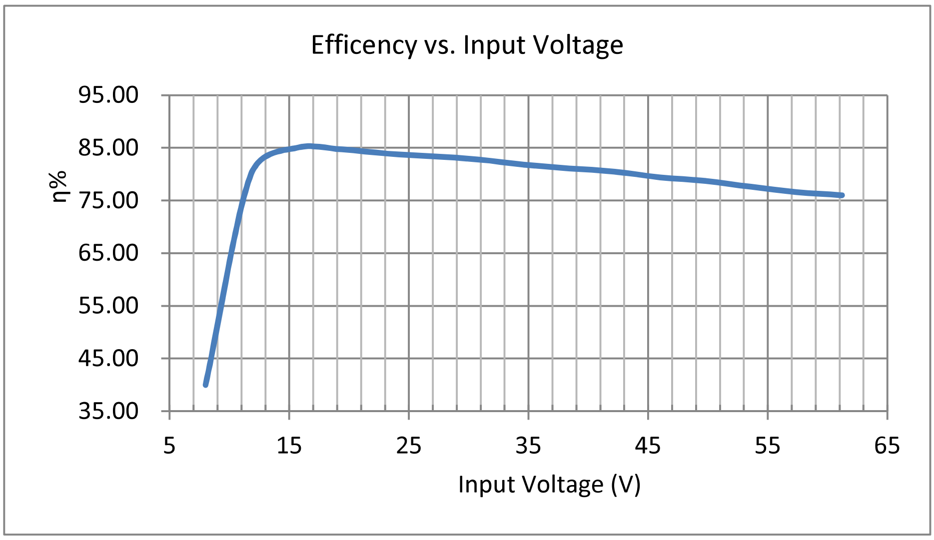
Parameter	Symbol	Conditions	Min	Typical	Max	Unit
Power Supply						
Input Voltage	V_{IN}		4.5		60	V
Chip Supply	V_{CC}		4.5	5.0	5.5	V
VCC Start up	V_{UVLO}			4.5		V
UVLO Hys	△UVLO			300		mV
Switch Frequency	F_{SW}				1	MHz
Current Sense						
LED Current Sense	V_{CSP}	VIN-CSP	194	200	206	mV
CSP Bias Current	I_{CSN}	VIN -CSP =50mV		8		uA
Power MOSFET Protection						
Over Current	V_{CSW}			200		mV
Chip Current						
Standby Current	I_{SD}	V_{DIM} <0.3V		60	100	uA
Quiescent Current	I_{OFF}	No Switch		0.16	0.3	mA
DIM Voltage						
DIM Floating Voltage	V_{DIM}	DIM Floating		4.2		V
Linear High Voltage	V_{DIM_H}			0.3	0.35	V
Linear Hysteresis Voltage	V_{DIM_HYS}		20	50	80	mV
Min PWM Frequency	F_{DIM_MIN}			0.1		KHz
Max PWM Frequency	F_{DIM_MAX}			20		KHz
DIM Bias Current	I_{DIM}			2		uA
MOSFET Driver						
High Side Resistance	R_source	V_{GS} = 5.0V		6		Ω
Low Side Resistance	R_sink			2		Ω
DRV High Voltage	V_{OH}	I_{DRV} =10mA	4.5		5.5	V
DRV Low Voltage	V_{OL}	I_{DRV} =10mA			0.3	V
Switch Time						
Min On Time	T_{ON_MIN}			100		ns
Min Off Time	T_{OFF_MIN}			100		ns
Temperature						
OTP shutdown	T_{END}			170		℃
OTP start	T_{START}			120		℃

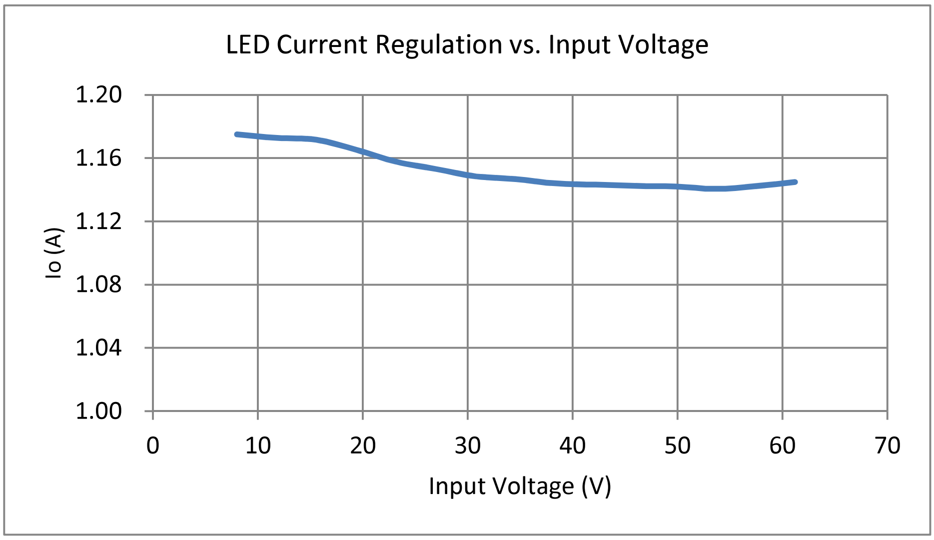
Functional Block Diagram



TYPICAL OPERATION CHARACTERISTICS

（V_{IN}=5V～60V,V_{OUT}=9.8V,I_{OUT}=1.15A,C_{IN}=10uF,L=22uH.）

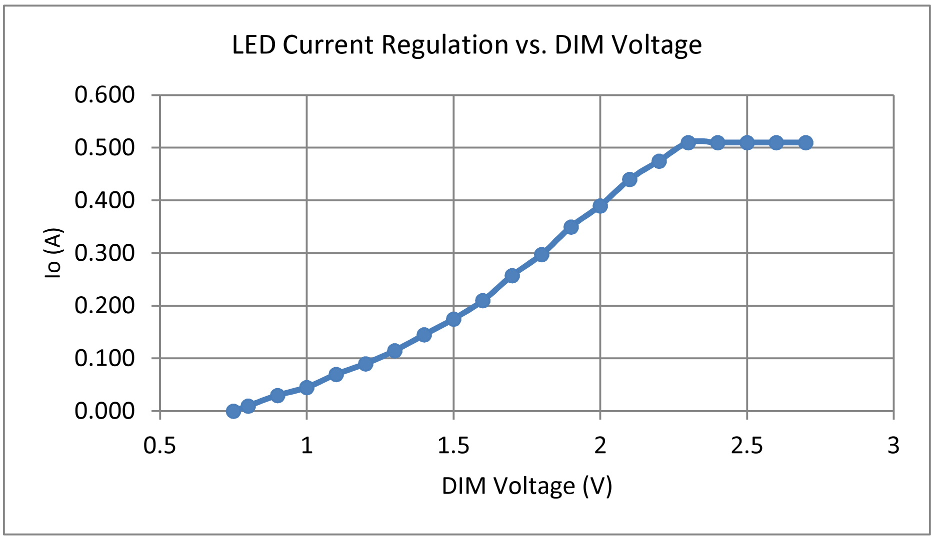




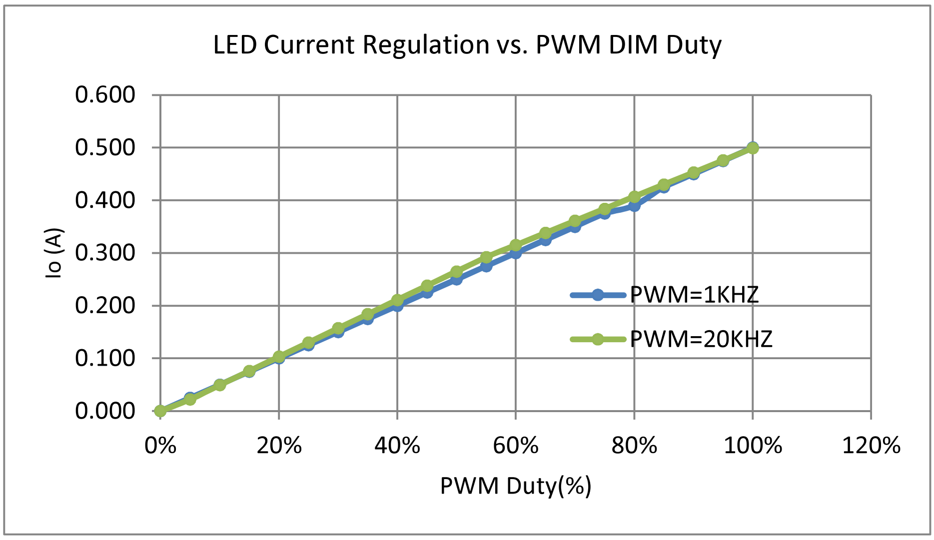
Dimming plots

（V_{IN}=8V,V_{OUT}=9.8V,I_{OUT}=0.5A,C_{IN}=10uF,L=22uH.）

Linear Dimming



PWM Dimming



Detailed Description

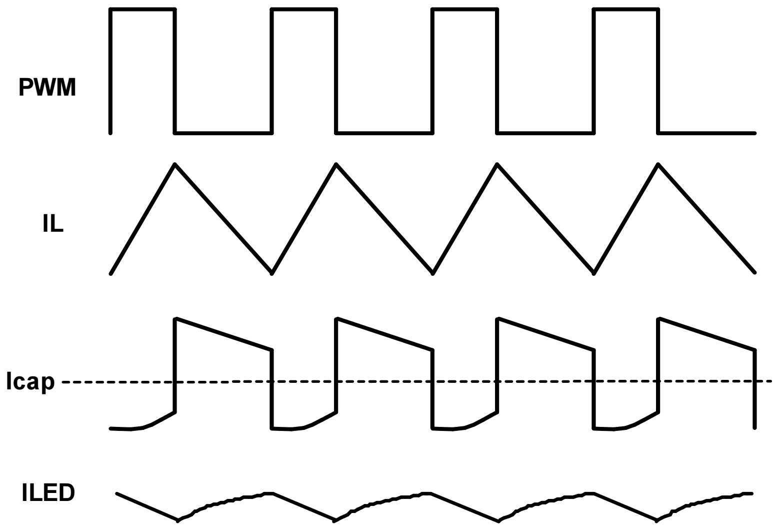
SE8324 is a high accuracy average current mode multi-topology controller designed to be used with one external NMOS switch for current-driving single or multiple series-connected LEDs.

The 60V capability coupled with the high-side current sense enables SE8324 to be used in a wide range of applications and drive in excess of 15 LEDs in series.

The SE8324 is a constant off time (COT) current mode controller. The inductor current is sensed through the inductor sense resistor between the CSW and GND pins. The current sense voltage is gained up by amplifier Gi. The signal is then fed into the positive terminals of the LED current comparator. The negative terminals of comparator are controlled by the voltage on the COMP pin, which is the output of error amplifiers Av. A capacitor connected at pin COMP is used to compensate the loop to improve stability.

During the first switching phase, an external high voltage power MOSFET allows the inductor current to charge linearly until the peak maximum level is reached, at which point the MOSFET is switched off and the second phase commences, allowing the inductor current to then flow through the Schottky diode circuit and discharge linearly during one constant off time set by internal component. During the first phase, the LED current is supplied by the output capacitor.

The switching architecture will always operate at COT mode. This average current sense and COT operating mode results in an average LED current which is controlled well by the sense resistor.

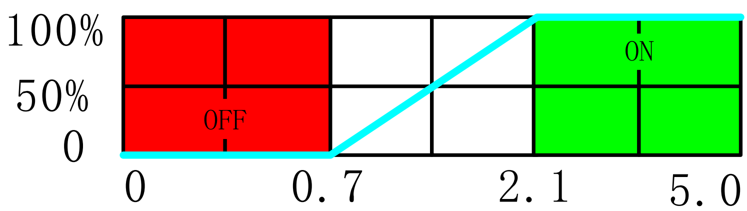


LED Analog/PWM Dimming

Applying a DC voltage from 0.7V to 2.1V on the DIM Pin can adjust output current from 0 to 100% of I_{OUTNOM}.

Applying a PWM on the DIM Pin can adjust output current from 0 to 100% of I_{OUTNOM}.

The detailed dimming feature is showed in the below figure:

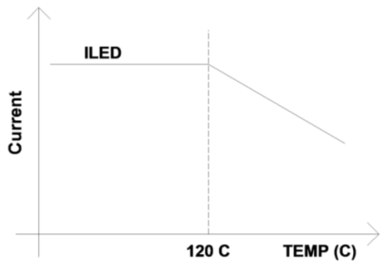


Spread Spectrum Frequency Modulation

Switching regulators can be particularly troublesome for applications where electromagnetic interference (EMI) is a concern. To improve the EMI performance, the SE8324 includes a spread spectrum frequency feature. Simple digital circuits were used to fed a quasi-triangle wave into the internal oscillator to modulate the switching frequency between about ±90% of the base frequency. The Spread Spectrum modulation introduces an insignificant amount of jitter to the clock.

Thermal Gradual Protection

SE8324 use a smart thermal gradual protection method to reduce the average current of the LEDs continuously in a slope dimming characteristic, not abruptly shutdown chip.



Setting LED Current

The LED current I_{LED} of the SE8324is programmable by a sense resistor R_{CS}.

$$R_{CS} = \frac{0.20}{I_{LED}}$$

Setting MOSFET Cycle by Cycle Current

The MOSFET maximum current I_{OCP} of the SE8324 is programmable by a sense resistor R_{CSW}.

$$R_{CSW} = \frac{0.20}{I_{OCP}}$$

Setting MOSFET Short Current

The MOSFET maximum current I_{SCP} of the SE8324 is programmable by a sense resistor R_{CSW}.

$$R_{CSW} = \frac{0.60}{I_{OCP}}$$

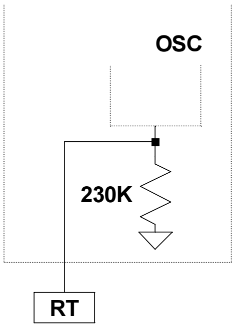
Setting Output over Voltage

The OVP fault will be triggered if the voltage at Pin OVP is larger than 1.20V.

Vovp=1.20V

Setting Switching Frequency

Pin RT may be floated as one 230K resistor is connected at Pin RT in IC internal.



$R_{OSC}=R_T//230K$

The switching frequency of the SE8324 should be programmed in a proper range.

The following equation shows the relationship between F_{SW} and V_{IN}, V_{LED}, R_{OSC}

Application Type	Switching Frequency
Buck-Boost	$F_{OSC} = 160K \times \frac{V_{IN}}{R_{OSC}(V_{IN} + V_{LED})}$ (KHz)
Boost	$F_{OSC} = 160K \times \frac{V_{IN}}{R_{OSC} \times V_{LED}}$ (KHz)
Buck	$F_{OSC} = 160K \times \frac{(V_{IN} - V_{LED})}{R_{OSC} \times V_{IN}}$ (KHz)
V_{LED}: LED output voltage V_{IN}: Input voltage R_{OSC}: Resistance at Pin RT, $R_{OSC}=R_T//230K$	

For example, when Buck-Boost:

V_{IN}=12V, V_{OUT}=40V, R_T=230K (R_{OSC}=200K//230K=107K):

$$F_{OSC} = 160K \times \frac{12}{107 \times (12 + 40)} \text{ (KHz)} = 345KHz$$

Drive LEDs Application (Buck-Boost)

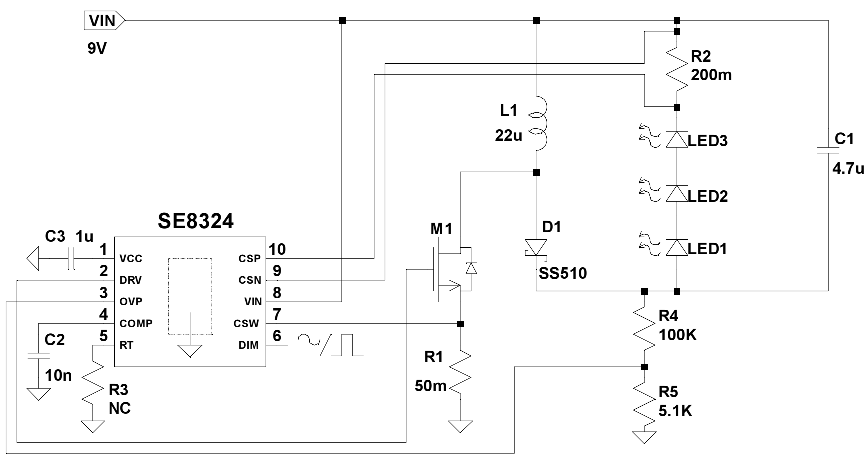


Fig 1 V_{IN}=9V, I_{LED}=1.0A, Vout=9V

Drive LEDs Application (Buck)

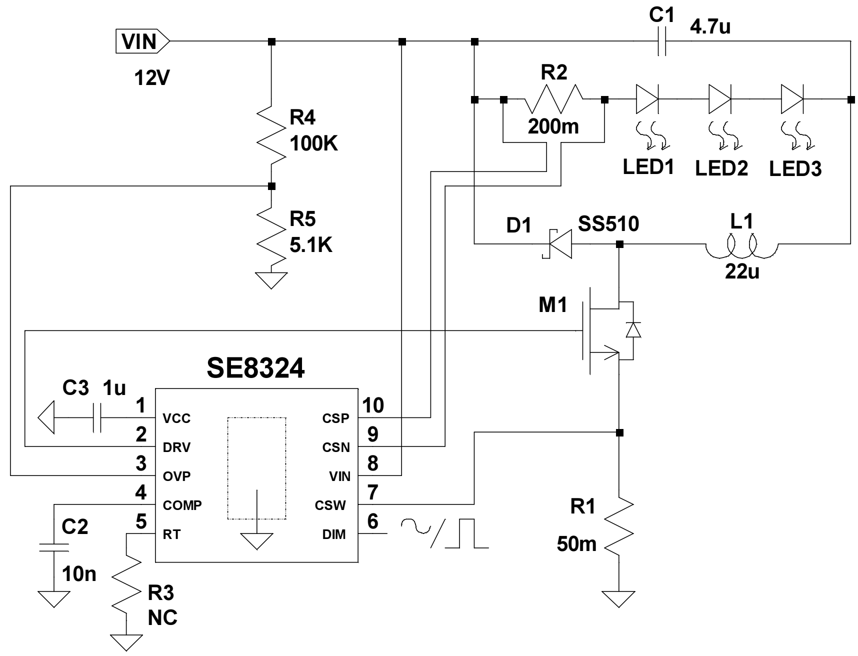


Fig 2 Buck V_{IN}=12V, I_{LED}=1.0A, Vout=9V

Drive LEDs Application (Boost)

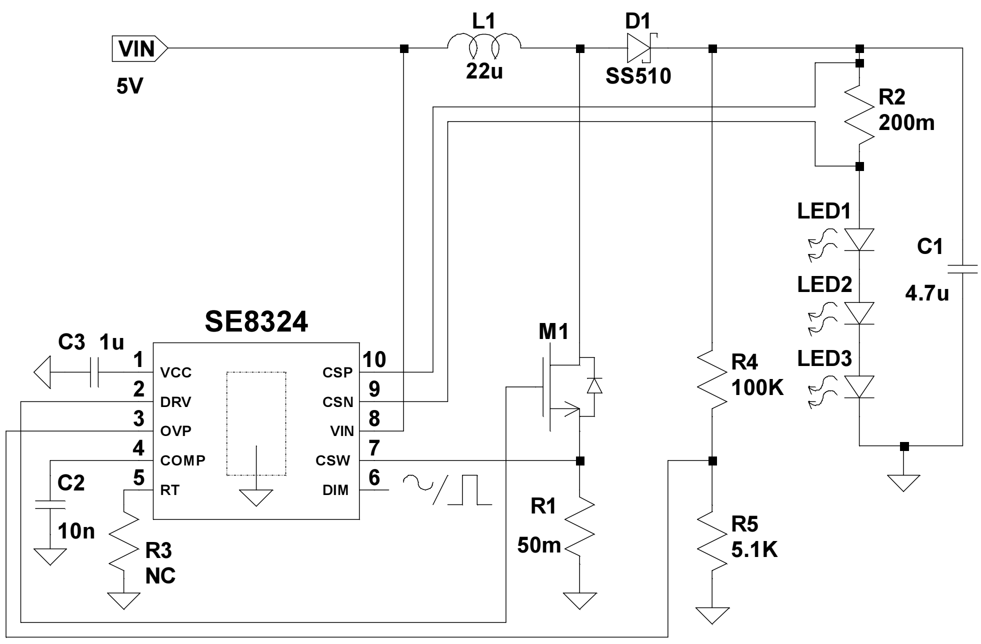
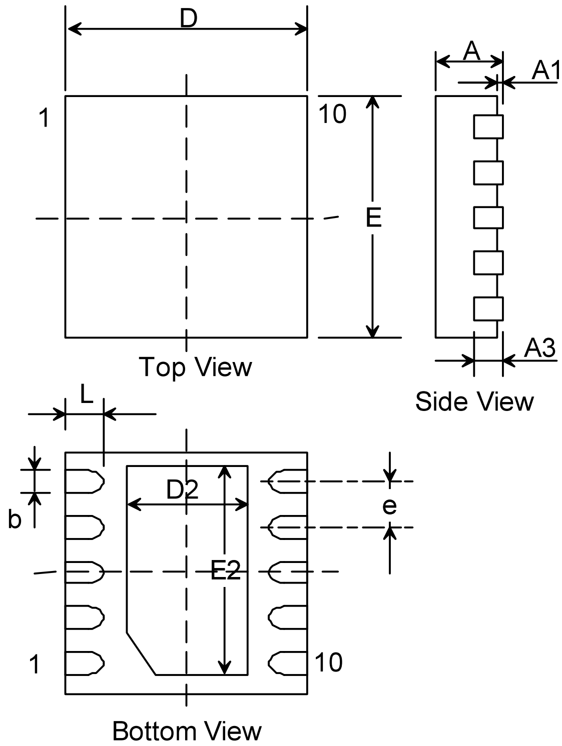


Fig 3 Boost V_{IN}=5V, I_{LED}=1.0A, Vout=9V

PACKAGING INFORMATION (DFN10)

Package Dimensions



Mechanical Data

Size / Signal	Min	Typ	Max	Size / Signal	Min	Typ	Max
A	0.70	0.75	0.80	E	2.90	3.00	3.10
A1	-	-	0.05	D2	1.60	1.70	1.80
A3	0.203 REF			E2	2.30	2.40	2.50
b	0.18	0.23	0.28	e	0.50 TYP		
D	2.90	3.00	3.10	L	0.35	0.40	0.45
* Unit=mm							