

350mA、LED照明驱动器

UM1350 SOT23-5

描述

UM1350能够高效驱动单个或多个串联LED，适用于输入电压高于LED电压的场景。该器件输入电压范围为6V至30V，外部输出电流可调，最高可达350mA。根据电源电压和外部元件的不同，它的输出功率可达8W。UM1350内置输出开关，采用高压侧输出电流检测电路，该电路通过外部电阻设定额定平均输出电流。通过向VSET引脚施加外部控制信号，可将输出电流调节至设定值以下。VSET引脚可接受直流电压或PWM波形，从而提供连续或受控输出电流。该芯片内部集成PWM滤波器，可通过控制输入/输出电流的上升速度来实现软启动功能。可通过在VSET引脚与地之间连接外部电容来延长软启动时间。向VSET引脚施加小于或等于0.2V的电压时，功率开关关断，器件切换至低电流待机状态。

UM1350采用扁平SOT23-5封装。

应用

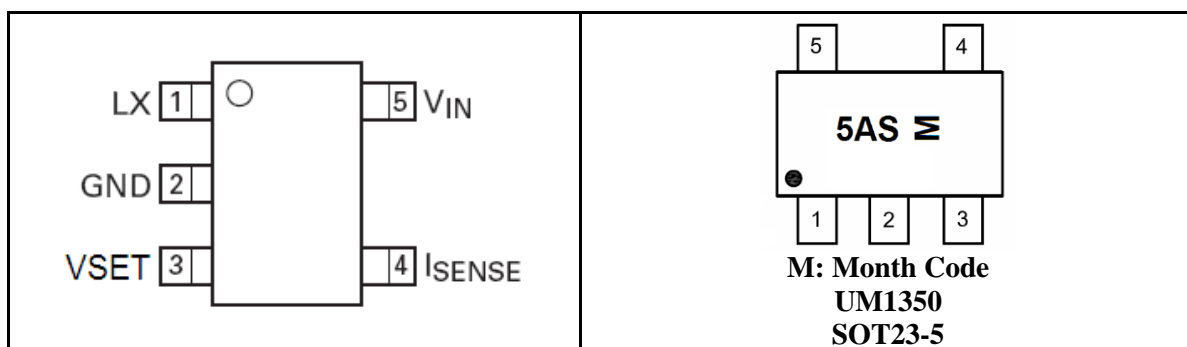
- MR16 和普通照明
- 汽车照明
- 低压工业照明
- LED 背光照明
- LED 信号灯

特性

- 内置过热和过流保护电路
- 内置 40V NDMOS 开关
- 350mA 输出电流
- 通过 VSET 引脚的直流电压或 PWM 信号实现单引脚开/关及调光控制
- 内置 PWM 滤波器
- 软启动
- 效率高达 95%
- 宽输入电压范围：6V 至 30V
- 40V 瞬间耐压能力
- 可关断输出
- 开关频率高达 1MHz
- LED 开路保护
- 5% 输出电流精度

引脚配置

顶部视图



Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM1350	SOT23-5	5AS	3000pcs/7Inch Tape & Reel

Pin Description

Pin Number	Symbol	Function
1	LX	Drain of NDMOS switch.
2	GND	Ground (0V).
3	VSET	Multi-function On/Off and brightness control pin: <ul style="list-style-type: none"> • Leave floating for normal operation. ($V_{VSET}=2V_{REF}$ giving nominal average output current $I_{OUTnom}=100mV/R_S$) • Drive to voltage below 0.2V to turn off output current. • Drive with DC voltage ($0.3V < V_{VSET} < 2.5V$) to adjust output current from 12% to 100% of I_{OUTnom}. • Drive with PWM signal from open-collector or open-drain transistor, to adjust output current. Adjustment range 1% to 100% of I_{OUTnom} for $f < 500Hz$. <ul style="list-style-type: none"> • Connect a capacitor from this pin to ground to increase soft-start time. (Default soft-start time=20μs. Additional soft-start time is approx.0.6ms/nF)
4	I_{SENSE}	Connect resistor R_S from this pin to V_{IN} to define nominal average output current ($I_{OUTnom}=100mV/R_S$).
5	V_{IN}	Input Voltage

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V_{IN}	Input Voltage	-0.3 to +40	V
V_{SENSE}	I_{SENSE} Voltage	+0.3 to -5 (Note 2)	V
V_{LX}	LX Output Voltage	-0.3 to +40	V
V_{VSET}	Adjust Pin Input Voltage	-0.3 to +6	V
I_{LX}	Switch Output Current	500	mA
P_D	Continuous Power Dissipation at $T_A=25^{\circ}C$	0.89	W
T_J	Operating Junction Temperature	-40 to +120	$^{\circ}C$
T_{STG}	Storage Temperature Range	-55 to +150	$^{\circ}C$

Note 1: These are stress ratings only. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Note 2: This voltage is measured with respect to V_{IN} .

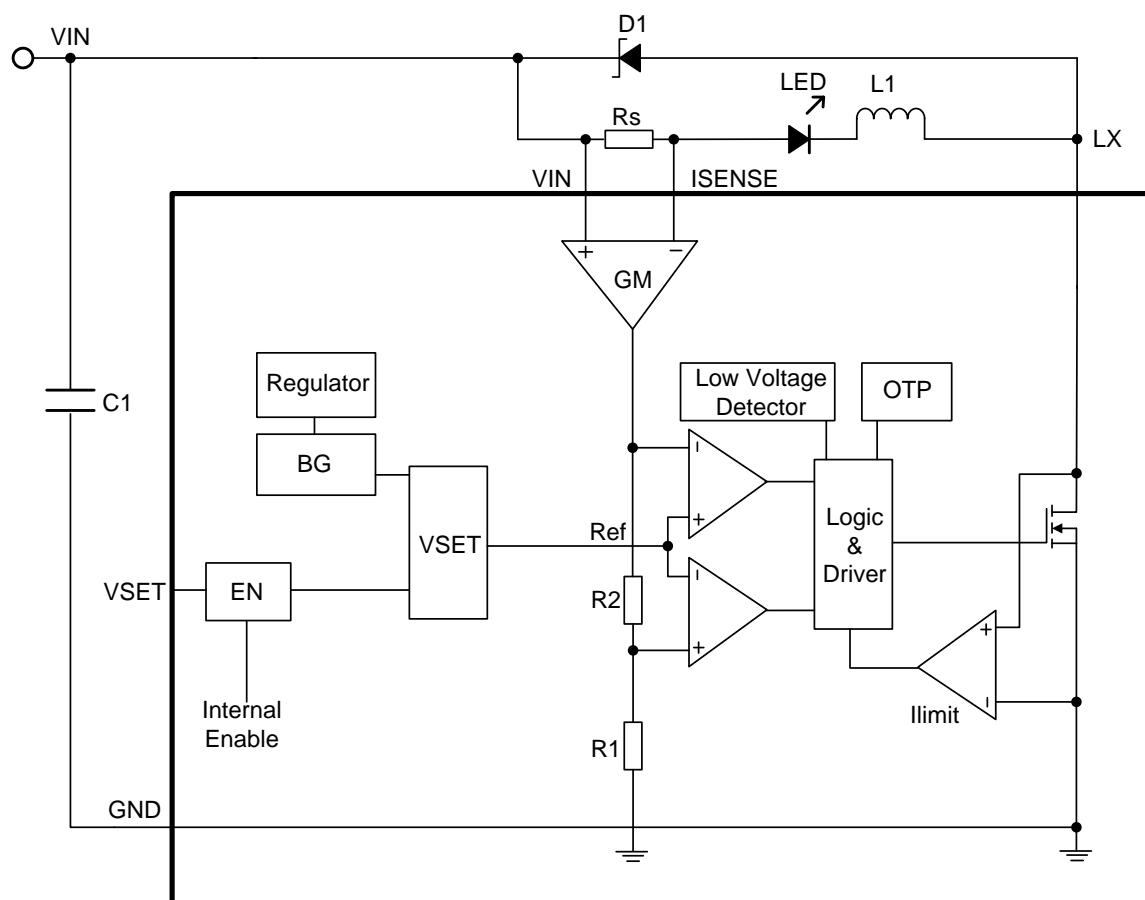
Electrical Characteristics

($V_{IN}=12V$, $T_A=25\text{ }^{\circ}C$, unless otherwise noted.)

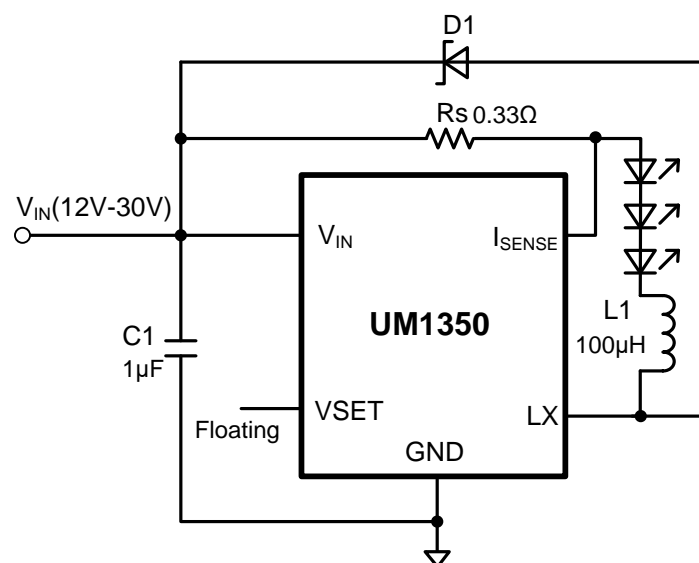
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		6		30	V
V_{SU}	Internal Regulator Start-up Threshold	V_{IN} Rising		4.5		V
I_{INQoff}	Quiescent Supply Current with Output Off	VSET Pin Grounded		40		μA
I_{INQon}	Quiescent Supply Current with Output Switching	VSET Pin Floating $f=250kHz$		220		μA
V_{SENSE}	Mean Current Sense Threshold Voltage (Define LED Current Setting Accuracy)	Measured on I_{SENSE} Pin with Respect to V_{IN} $V_{VSET}=1.25V$	95	100	105	mV
$V_{SENSEHYS}$	Sense Threshold Hysteresis			$\pm 15\%$		
I_{SENSE}	I_{SENSE} Pin Input Current	$V_{SENSE}=V_{IN}-0.1$		16	20	μA
V_{REF}	Internal Reference Voltage	Measured on VSET Pin with Pin Floating	1.20	1.25	1.30	V
V_{VSET}	External Control Voltage Range on VSET Pin for DC Brightness Control (Note 3)		0.3		2.5	V
$V_{VSEToff}$	DC Voltage on VSET Pin to Switch Device from Active (On) State to Quiescent (Off) State	V_{VSET} Falling	0.15	0.20	0.25	V
V_{VSETon}	DC Voltage on VSET Pin to Switch Device from Quiescent (Off) State to Active (On) State	V_{VSET} Rising	0.20	0.25	0.30	V
I_{LXmean}	Continuous LX Switch Current				0.37	A
R_{LX}	LX Switch 'On' Resistance			0.95	1.8	Ω
$I_{LX(leak)}$	LX Switch Leakage Current				1	μA

Note 3: 100% brightness corresponds to $V_{VSET}=2.5V$. Driving the VSET pin above 2.5V will not increase the output current proportionally.

Block Diagram



Typical Application Circuit



Device Description

The device, in conjunction with the coil (L1) and current sense resistor (R_s), forms a self-oscillating continuous-mode buck converter.

Device Operation (Refer to block diagram (page 4) and Figure 1 (page 6)-Operating Waveforms)

Operation can be best understood by assuming that the VSET pin of the device is unconnected and the voltage on this pin (V_{VSET}) appears directly at the (+) input of the comparator.

When input voltage V_{IN} is first applied, the initial current in L1 and R_s is zero and there is no output from the current sense circuit. Under this condition, the (-) input to the comparator is at ground and its output is high. This turns MN on and switches the LX pin low, causing current to flow from V_{IN} to ground, via R_s , L1 and the LED(s). The current rises at a rate determined by V_{IN} and L1 to produce a voltage ramp (V_{SENSE}) across R_s . The supply referred voltage V_{SENSE} is forced across internal resistor R1 by the current sense circuit and produces a proportional current in internal resistors R2 and R3. This produces a ground referred rising voltage at the (-) input of the comparator. When this reaches the threshold voltage (V_{VSET}), the comparator output switches low and MN turns off. The comparator output also drives another NMOS switch, which bypasses internal resistor R3 to provide a controlled amount of hysteresis. The hysteresis is set by R3 to be nominally 15% of V_{VSET} .

When MN is off, the current in L1 continues to flow via D1 and the LED(s) back to V_{IN} . The current decays at a rate determined by the LED and diode forward voltages to produce a falling voltage at the input of the comparator. When this voltage returns to V_{VSET} , the comparator output switches high again. This cycle of events repeats, with the comparator input ramping between limits of $V_{VSET} \pm 15\%$.

Switching Thresholds

With $V_{VSET} = V_{REF}$, the ratios of R1, R2 and R3, define an average V_{SENSE} switching threshold of 100mV (measured on the I_{SENSE} pin with respect to V_{IN}). The average output current I_{OUTnom} is then defined by this voltage and R_s according to:

$$I_{OUTnom} = 100\text{mV}/R_s$$

Nominal ripple current is $\pm 22\text{mV}/R_s$

Adjusting Output Current

The VSET pin can be overdriven with either DC or pulse signals to change the V_{SENSE} switching threshold and adjust the output current.

Details of the different modes of adjusting output current are given in the applications section.

Output Shutdown

The output of the low pass filter drives the shutdown circuit. When the input voltage to this circuit falls below the threshold (0.2V nom), the internal regulator and the output switch are turned off. The voltage reference remains powered during shutdown to provide the bias current for the shutdown circuit. Quiescent supply current during shutdown is nominally 40 μ A and switch leakage is below 1 μ A.

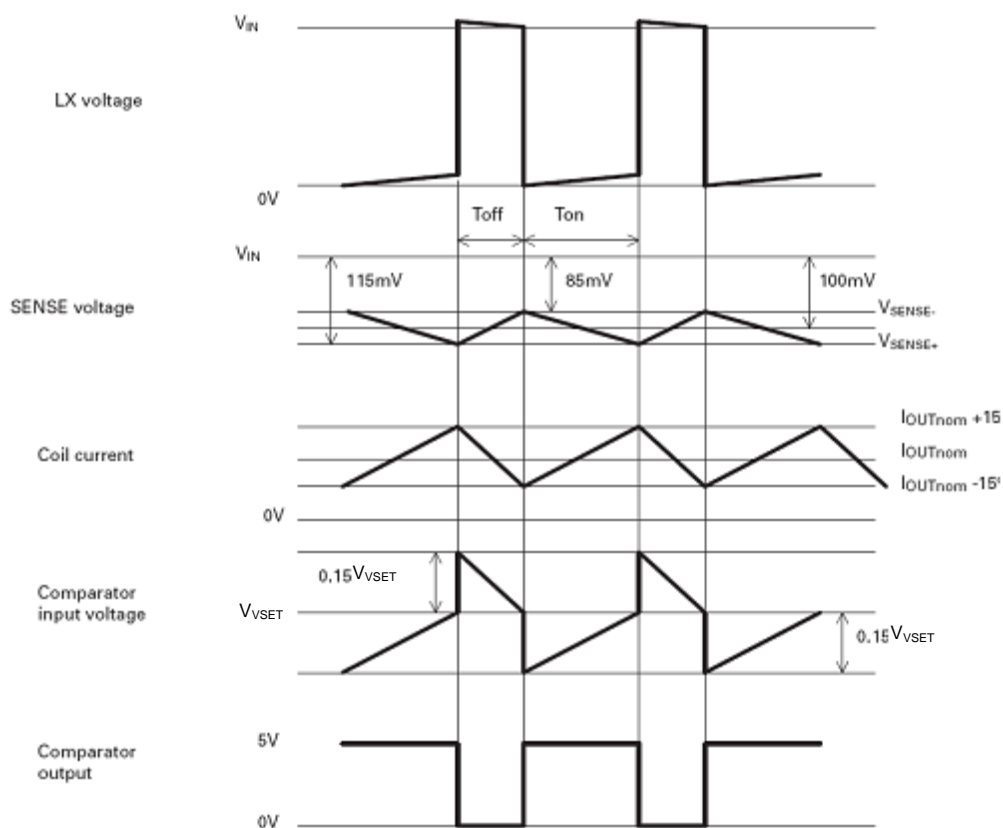
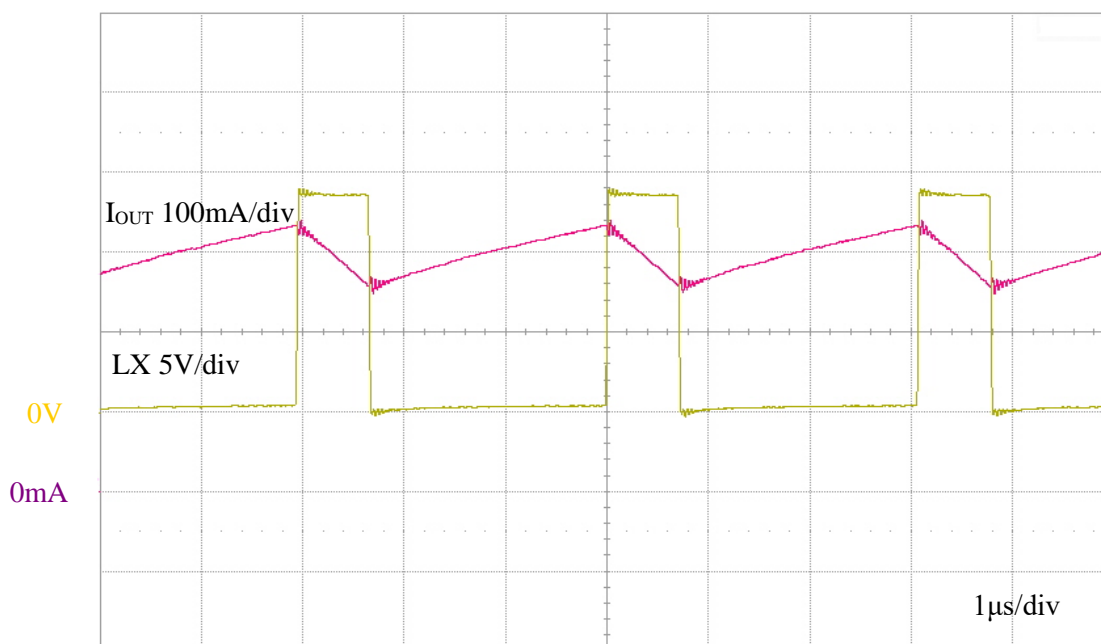


Figure 1. Operating Waveforms

Typical Operating Waveforms

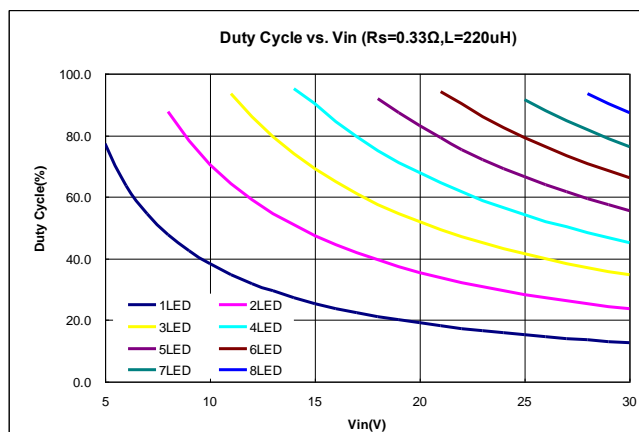
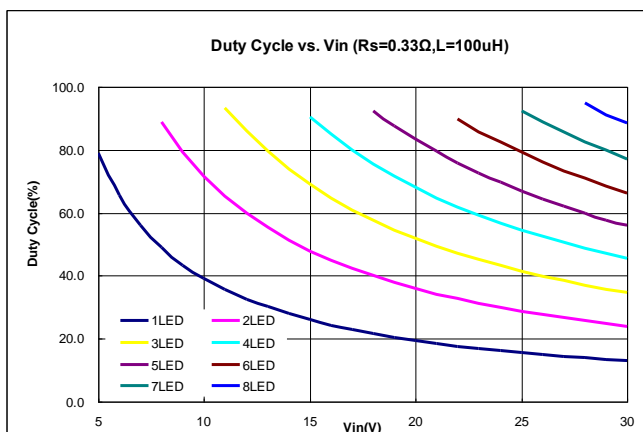
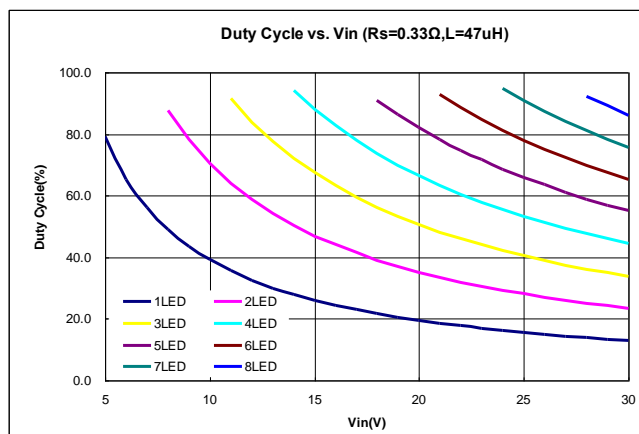
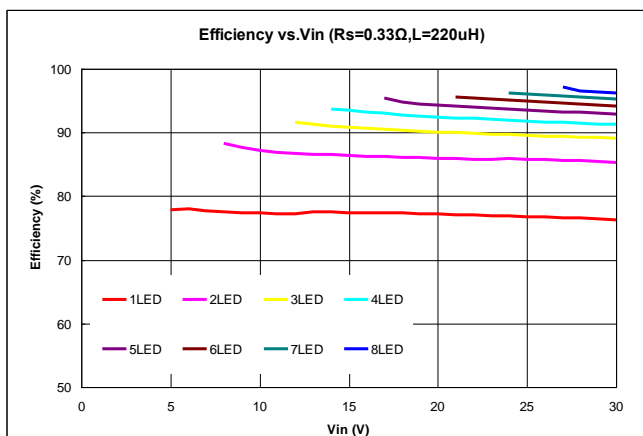
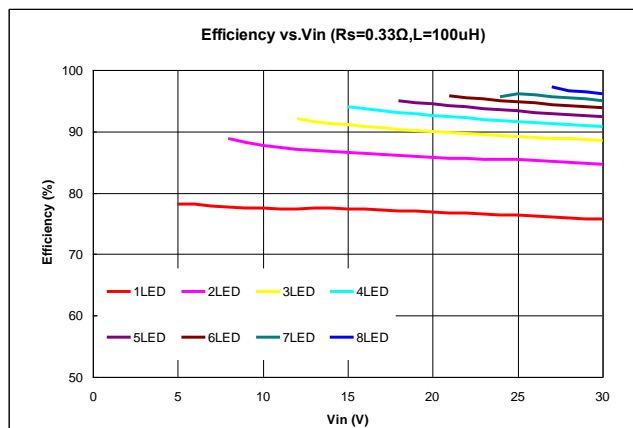
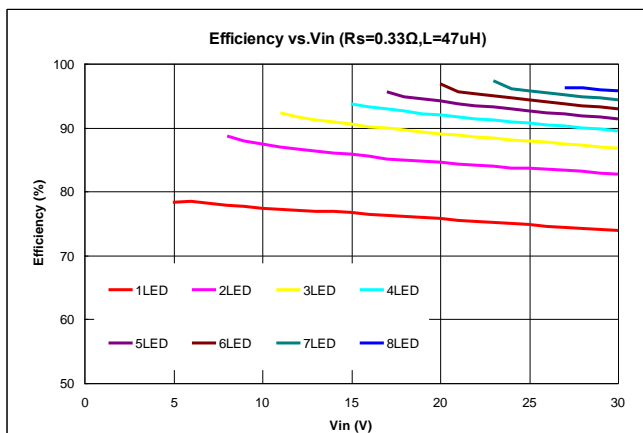
($V_{IN}=12V$, $L=100\mu H$, $R_S=0.33\Omega$, 3LED)

Normal Operation: Output Current and LX Voltage



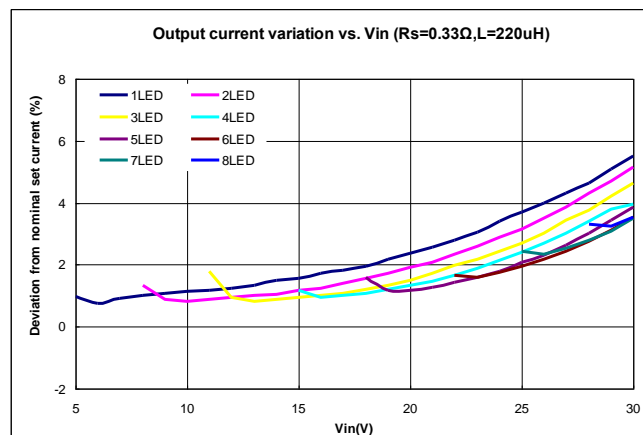
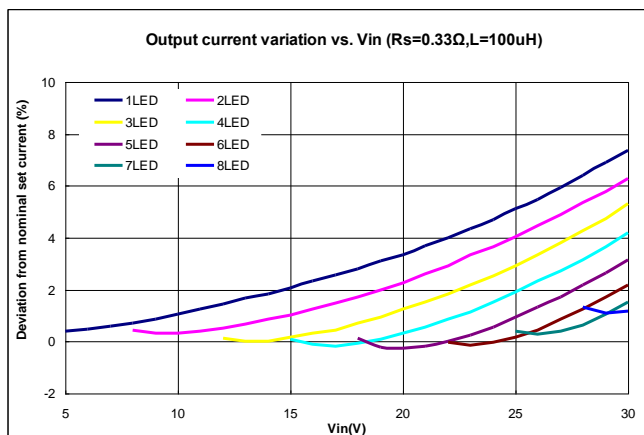
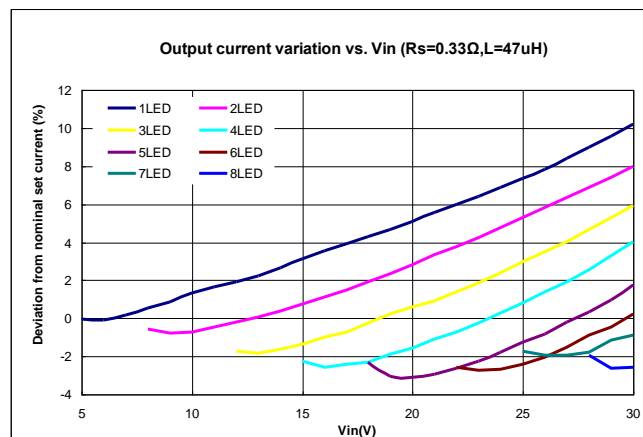
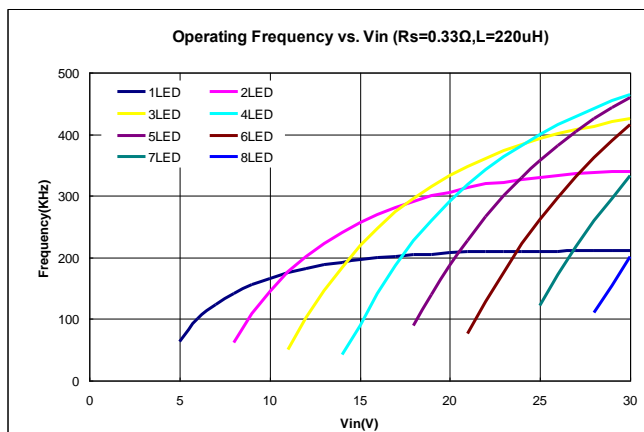
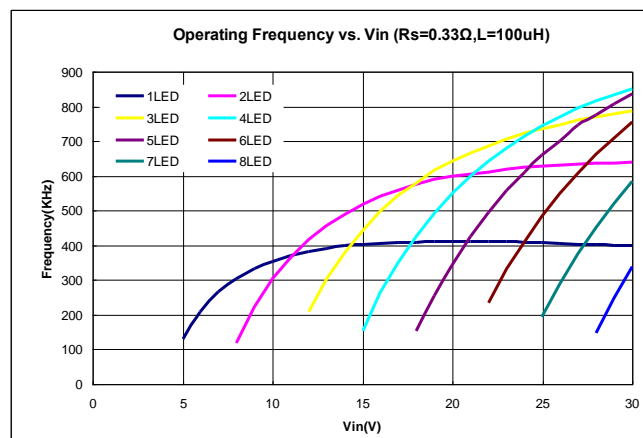
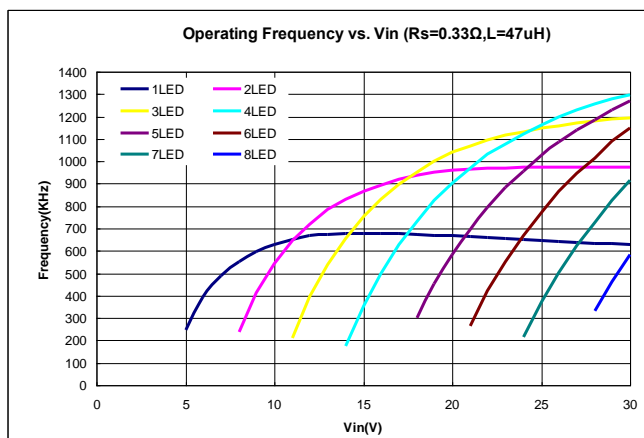
Typical Operating Characteristics

($V_{IN}=12V$, $T_A=25^\circ C$, unless otherwise noted)



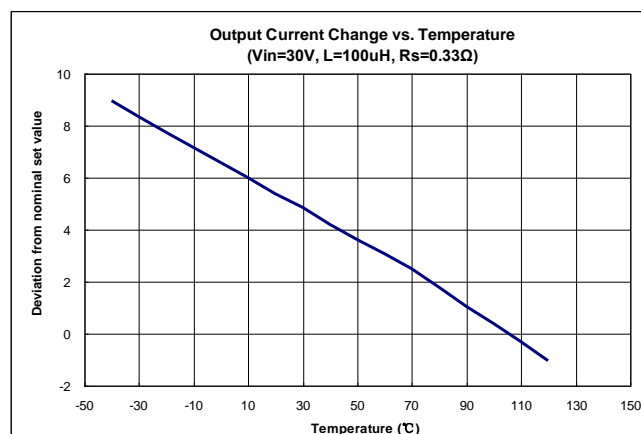
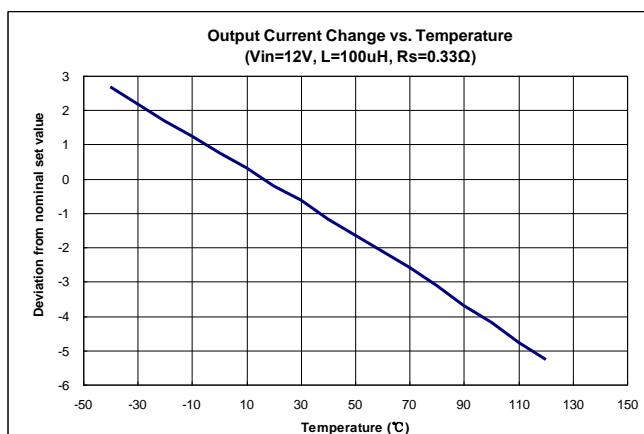
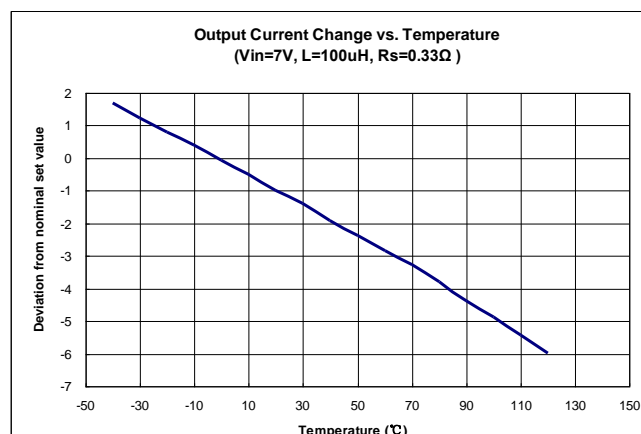
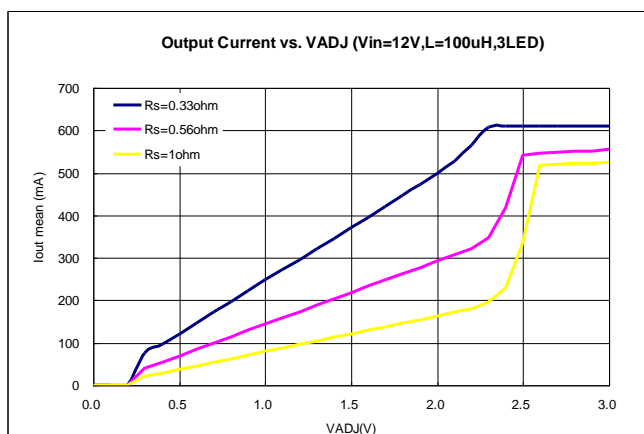
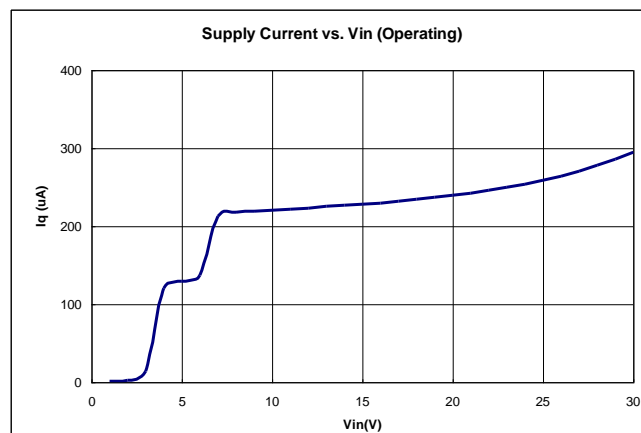
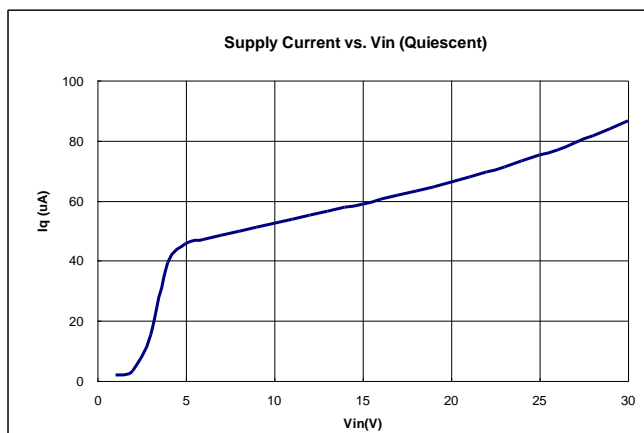
Typical Operating Characteristics (Continued)

($V_{IN}=12V$, $T_A=25^\circ C$, unless otherwise noted)



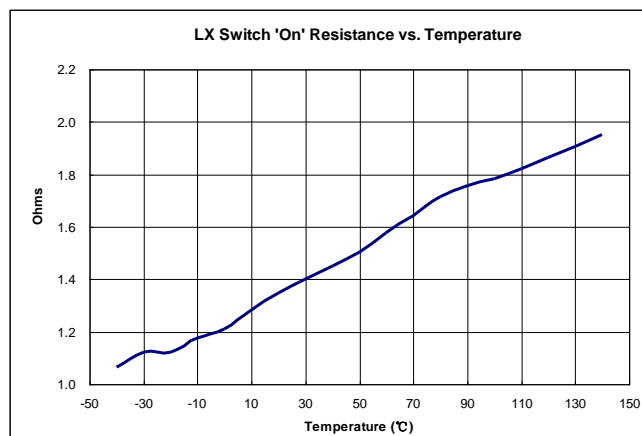
Typical Operating Characteristics (Continued)

($V_{IN}=12V$, $T_A=25\text{ }^{\circ}\text{C}$, unless otherwise noted)



Typical Operating Characteristics (Continued)

($V_{IN}=12V$, $T_A=25\text{ }^{\circ}C$, unless otherwise noted)



Applications Information

Setting Nominal Average Output Current with External Resistor R_S

The nominal average output current in the LED(s) is determined by the value of the external current sense resistor (R_S) connected between V_{IN} and I_{SENSE} and is given by:

$$I_{OUTnom} = 0.1 / R_S \quad (R_S \geq 0.27\Omega)$$

The table below gives values of nominal average output current for several preferred values of current setting resistor (R_S) in the typical application circuit shown on page 5:

R_S (Ω)	Nominal Average Output Current (mA)
0.27	370
0.3	333
0.33	300
0.39	256

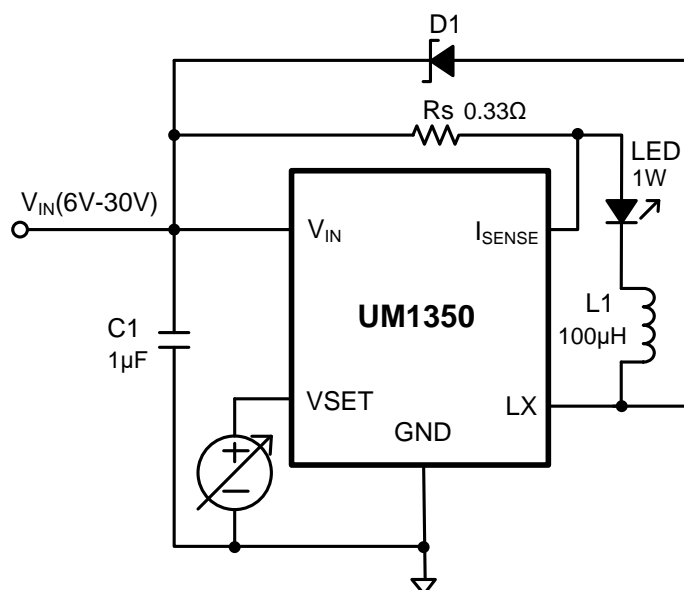
The above values assume that the VSET pin is floating and at a nominal voltage of V_{REF} . Note that $R_S=0.27\Omega$ is the minimum allowed value of sense resistor under these conditions to maintain switch current below the specified maximum value.

Output Current Adjustment by External DC Control Voltage

The VSET pin can be driven by an external dc voltage, as shown, to adjust the output current to a value below the nominal average value defined by R_S .

The average output current is given by:

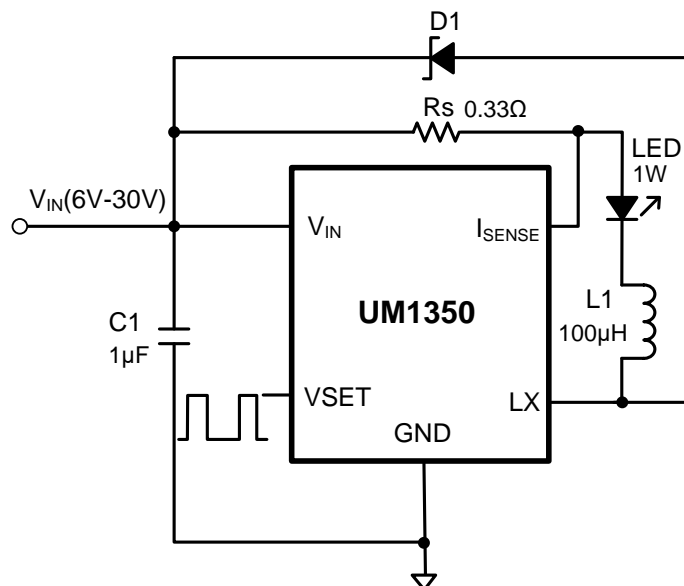
$$I_{OUT} = (0.1 * V_{VSET} / 2.5) / R_S \quad [\text{for } 0.3V < V_{VSET} < 2.5V]$$



Output Current Adjustment by PWM Control

A Pulse Width Modulated (PWM) signal with duty cycle PWM can be applied to the VSET pin, as shown below, to adjust the output current to a value below the nominal average value set by resistor R_S :

$$I_{OUT} = (V_{pulse} * 0.1 * D) / (2.5 * R_S) \quad (0 \leq D \leq 100\%, 0.3V < V_{pulse} < 2.5V)$$



PWM dimming provides reduced brightness by modulating the LED's forward current between 0% and 100%. The LED brightness is controlled by adjusting the relative ratios of the on time to the off time. A 25% brightness level of $(V_{pulse} * 0.1 / R_S)$ is achieved by turning the LED on at full current for 25% of one cycle. To ensure this switching process between on and off state is invisible by human eyes, the switching frequency must be greater than 100Hz. Above 100Hz, the human eyes average the on and off times, seeing only an effective brightness that is proportional to the LED's on-time duty cycle. The advantage of PWM

dimming is that the forward current is always constant, therefore the LED color does not vary with brightness as it does with analog dimming. Pulsing the current provides precise brightness control while preserving the color purity.

Capacitor Selection

A low ESR capacitor should be used for input decoupling, as the ESR of this capacitor appears in series with the supply source impedance and lowers overall efficiency. This capacitor has to supply the relatively high peak current to the coil and smooth the current ripple on the input supply. A minimum value of 1μF is acceptable if the input source is close to the device, but higher values will improve performance at lower input voltages, especially when the source impedance is high. The input capacitor should be placed as close as possible to the IC.

For maximum stability over temperature and voltage, capacitors with X7R, X5R, or better dielectric are recommended. Capacitors with Y5V dielectric are not suitable for decoupling in this application and should NOT be used.

Inductor Selection

Recommended inductor values for the UM1350 are in the range 47μH to 220μH. Higher values of inductance are recommended at lower output current in order to minimize errors due to switching delays, which result in increased ripple and lower efficiency. Higher values of inductance also result in a smaller change in output current over the supply voltage range.

The inductor should be mounted as close to the device as possible with low resistance connections to the LX and V_{IN} pins. The chosen coil should have a saturation current higher than the peak output current and a continuous current rating above the required mean output current.

The inductor value should be chosen to maintain operating duty cycle and switch 'on'/'off' times within the specified limits over the supply voltage and load current range. The following equations can be used as a guide.

SW Switch 'On' time

$$T_{ON} = (L * \Delta I) / (V_{IN} - V_{LED} - I_{LED} * (R_S + R_L + R_{LX}))$$

SW Switch 'Off' time

$$T_{OFF} = (L * \Delta I) / (V_{LED} + V_D + I_{LED} * (R_S + R_L))$$

Where:

L is the coil inductance (H)

R_L is the coil resistance (Ω)

R_S is the current sense resistance (Ω)

I_{LED} is the required LED current (A)

ΔI is the coil peak-peak ripple current (A) {Internally set to 0.3 × I_{LED}}

V_{IN} is the supply voltage (V)

V_{LED} is the total LED forward voltage (V)

R_{LX} is the switch resistance (Ω)

V_D is the diode forward voltage at the required load current (V)

Diode Selection

For maximum efficiency and performance, the rectifier (D1) should be a fast low capacitance Schottky diode with low reverse leakage at the maximum operating voltage and temperature.

They also provide better efficiency than silicon diodes, due to a combination of lower forward voltage and reduced recovery time.

It is important to select parts with a peak current rating above the peak coil current and a continuous current rating higher than the maximum output load current. It is very important to

consider the reverse leakage of the diode when operating above 85 °C. Excess leakage will increase the power dissipation in the device and if close to the load may create a thermal runaway condition.

The higher forward voltage and overshoot due to reverse recovery time in silicon diodes will increase the peak voltage on the LX output. If a silicon diode is used, care should be taken to ensure that the total voltage appearing on the LX pin including supply ripple, does not exceed the specified maximum value.

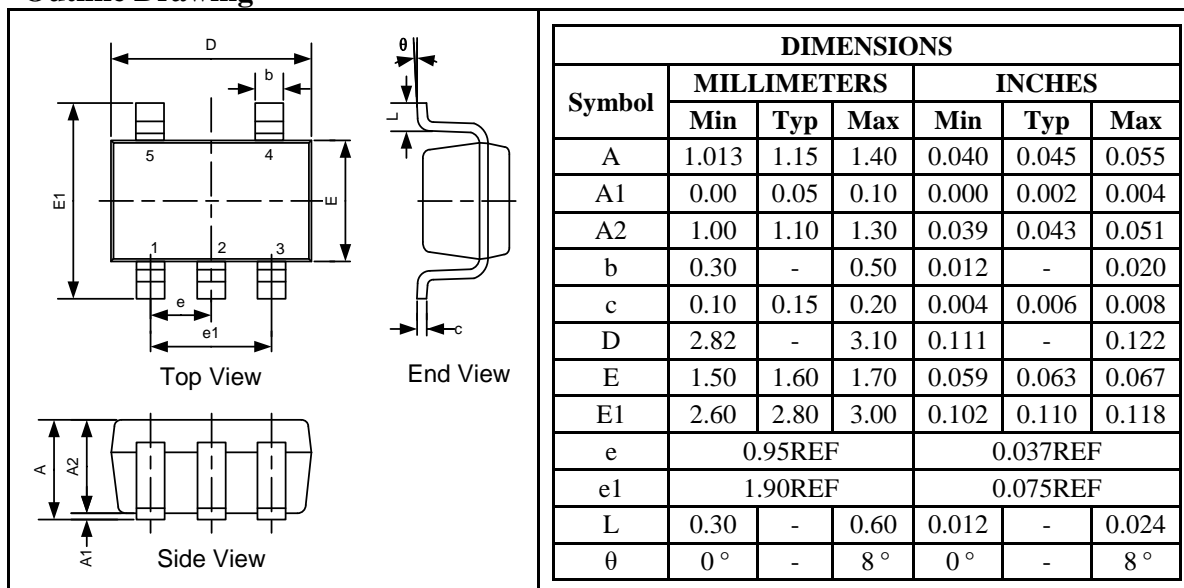
PCB Layout Guidelines

Careful PCB layout is critical to achieve low switching losses and stable operation. Minimize ground noise by connecting high current ground returns, the input bypass capacitor ground lead, and the output filter ground lead to a single point. Place R_s as close as possible to the I_{sense} and V_{IN} . For better noise immunity, a Kelvin connection is strongly recommended between I_{sense} and R_s .

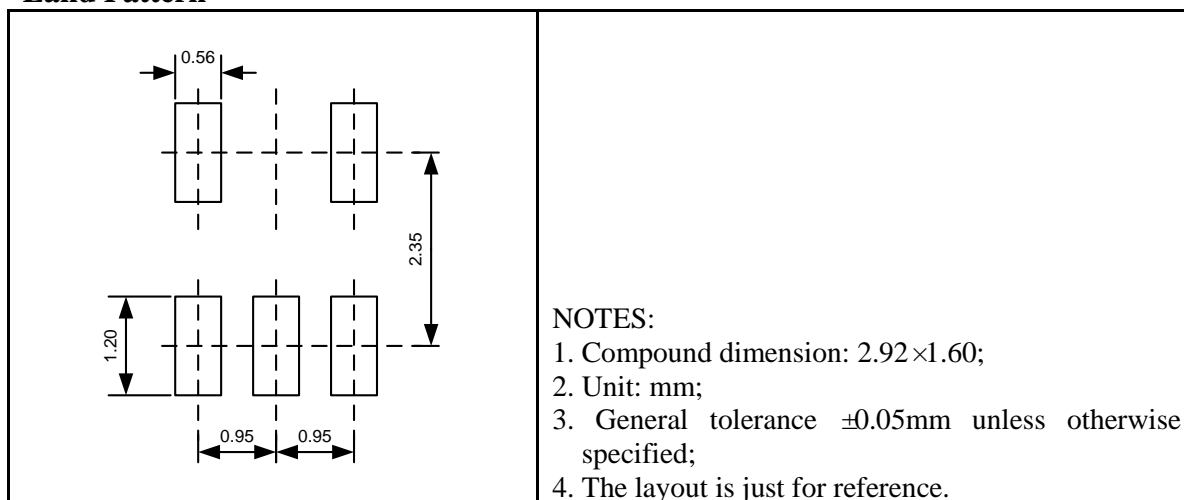
Package Information

UM1350 SOT23-5

Outline Drawing



Land Pattern



Tape and Reel Orientation



GREEN COMPLIANCE

Union Semiconductor is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

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