



DW8521

2A Peak, 44V
Multi-Topology LED Driver

Preliminary

Ver. 0.2

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1. General Description

DW8521 is a current mode monolithic LED driver. The LED current can be controlled with an analog input voltage. With high-side LED current sensing, the DW8521 can be configured as buck, boost or buck-boost topology to serve different LED driver need. The integrated 44V/2A N-Channel MOSFETs ensures high efficiency operation. At light loads, DW8521 operates in low frequency to maintain high efficiency and low output ripple. The overvoltage lockout protection on SW pin protects DW8521 from open LED fault. DW8521 also has thermal protection at 140°C. The DW8521 is available in a 6-pin SOT23-6 and a 8-pin ESOP8 package, which provides a compact solution with minimal external components.

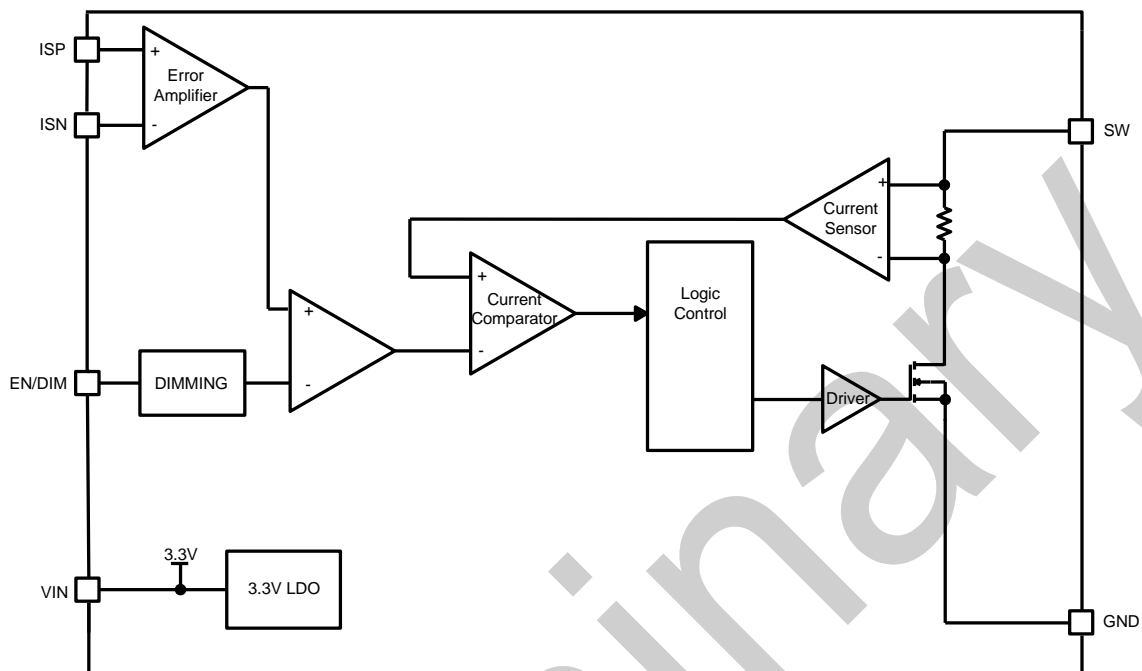
■ Features

- 4.6V to 44V operating input range
- 2A peak switch current
- Analog dimming and PWM dimming
- Constant off-time operation
- SW over voltage lockout
- Thermal protection
- Available in SOT23-6 and ESOP8 package

■ Applications

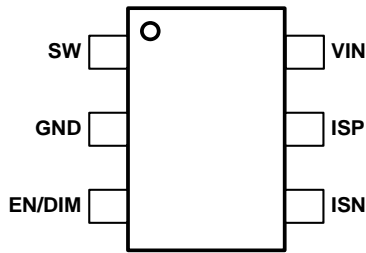
- LED Driver

2. Block Diagram

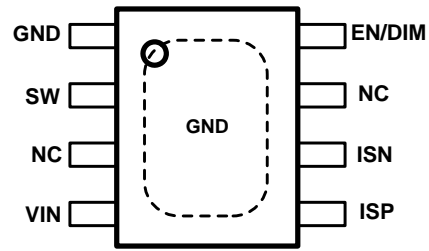


3. Pin Information

■ Pin Placement and IC dimension



SOT23-6L



ESOP-8L

■ Pin Description

SOT23-6L Pin No..	Pin Name	Description	Note
1	SW	SW is the switching node. Connect inductor to this pin.	
2	GND	Ground pin.	
3	EN/DIM	Drive EN/DIM pin above 1.1V to enable the LED driver. To achieve dimming, drive the EN/DIM pin with a PWM pulse or an analog voltage between 1.2V and 2.4V.	
4	ISN	LED current negative sensing pin. Connect a resistor between ISP and ISN to set full LED current.	
5	ISP	LED current positive sensing pin.	
6	VIN	Input voltage pin. VIN supplies power to the IC.	

4. Absolute Maximum Ratings⁽¹⁾

Symbol	Parameter	Ratings
VIN, EN/DIM, SW	VIN, EN/DIM, SW Pin Voltage	-0.3V ~ 48V
ISP, ISN	ISP, ISN Pin Voltage	-0.3V ~ 48V
ISP-ISN	ISP to ISN Pin Voltage	-0.3V to 6V
θ_{JA}	Package Thermal Resistance ⁽²⁾	220 °C/W
θ_{JC}	Package Thermal Resistance ⁽²⁾	130 °C/W
T _{JOPR}	Junction Operating temperature	40~+125°C
T _{STG}	Storage Temperature	-65 ~ 150 °C
T _J	Junction temperature ^{(3),(4)}	150°C

Note (1) Stresses above the max. Values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

(2) θ_{JA} is measured in the convection at Ta=30°C on a high effective thermal conductivity test board(4 Layers, 2S2P) of JEDEC 51-7 thermal measurement standard. PCB dimension is 100x100x1.6mm and 4 layers.

5. Recommended Operating Condition

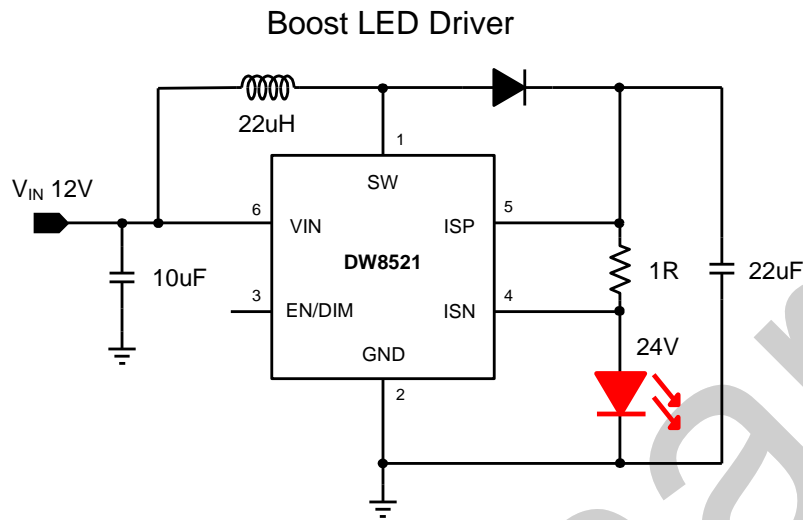
Symbol	Parameter	Min.	Typ.	Max.	Unit
SW-GND	SW-GND voltage	3.3		44	V

6. Electrical Specification

($V_{IN}=12V$, typical values are at $T_A=+25^{\circ}C$, unless otherwise specified.)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
V_{IN} under-Voltage Lockout Threshold	V_{IN_MIN}	V_{IN} Rising		3.9	4.25	V
Shutdown Supply Current	I_{SD}	$V_{EN/DIM}=0V$			3	μA
Supply Current	I_Q	$V_{EN/DIM}=5V, V_{FB}=2V$		70	100	μA
LED Current Voltage (ISP-ISN)	I_{LED}	$V_{EN/DIM}=3V$	191	200	209	mV
Bottom Switch Resistance	$R_{DS(ON)B}$			200		m Ω
EN/DIM Shut Down Threshold Voltage	V_{EN/DIM_TH}	$V_{EN/DIM}$ Rising			1.2	V
EN Shut Down Hysteresis	V_{EN/DIM_HYST}		100			mV
EN/DIM Input Low Voltage	V_{EN/DIM_PLOW}	PWM Dimming		0.3		V
EN/DIM Input High Voltage	V_{EN/DIM_PHIGH}	PWM Dimming		3		V
EN/DIM Analog Dimming Low Threshold	V_{EN/DIM_ALOW}	Analog Dimming		1.2		V
EN/DIM Analog Dimming High Threshold	V_{EN/DIM_AHIGH}	Analog Dimming		2.4		V
SW Over Voltage Lockout Threshold	V_{SW_TH}			44		V
Current Limit	I_{LIMIT}			2.3		A
Constant Off-Time	T_{OFF}			2		μs
Thermal Shutdown	T_{TSD}			140		$^{\circ}C$
Thermal Shutdown Hysteresis	T_{TSD_HYST}			15		$^{\circ}C$

7. Typical Application Circuit



8. Detailed Descriptions

The DW8521 is a current-mode LED driver that can be configured as boost, buck or buck-boost topology.

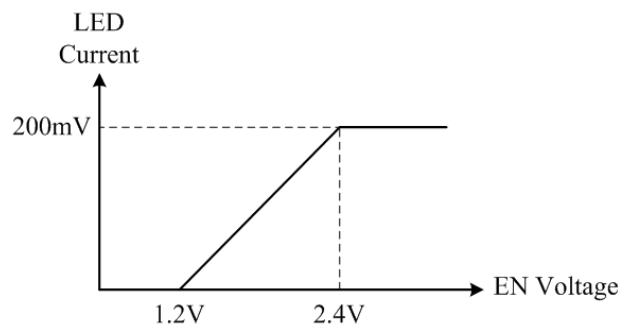
■ Current-Mode Control

The DW8521 operates in constant off-time in heavy load. At light load DW8521 extends the off time to minimize power consumption in the IC.

■ Dimming

The DW8521 EN/DIM pin serves as analog dimming input. And can also be used for a PWM dimming, where the output current is proportional to the duty cycle of the PWM square pulses.

The analog dimming range is 1.2V ~ 2.4V corresponding to the LED current sensing voltage of 0~200mV. Refer to the dimming curve.



■ Thermal Protection

DW8521 has thermal protection that shuts down the part at 140°C, and resumes operation after the temperature drops to below 130°C.

8.1. Detailed Descriptions (Continued)

■ LED Current Setting

The output current is determined by the resistor R_{SENSE} connected between ISP and ISN, and the output current can be calculated by:

$$R_{SENSE} = \frac{200mV}{I_{LED}}$$

For example, for $I_{LED}=1A$, $R_{FB}=200m\ \Omega$.

■ Analog Dimming

Apply a 1.2V~2.4V DC voltage to the EN/DIM pin to control the output current, and the DIM voltage is proportional to the output current.

■ PWM Dimming

A PWM pulse can also be applied to the EN/ DIM pin to achieve dimming. When PWM dimming, the LED current is proportional to the duty cycle of the PWM square pulse.

■ Input Capacitor

The input capacitor is used to reduce the surge current from the input supply and maintaining the DC input voltage. It can be electrolytic, tantalum or ceramic. To minimizing the switching noise, a small X5R or X7R ceramic capacitor, i.e. 0.1uF, should be placed as close to the IC as possible when using electrolytic capacitors. A 10uF ceramic capacitor is sufficient for most application.

■ Output Capacitor

The output capacitor is required to maintain the DC output voltage, and the capacitance value determines the output ripple voltage. It can be low ESR electrolytic, tantalum or ceramic, which lower ESR capacitors get lower output ripple voltage. The output capacitors also affect the system stability and transient response, and a 22uF ceramic capacitor is recommended in typical application.

■ Inductor

The inductor is used to supply constant current to the output load, and the value determines the ripple current which affect the efficiency and the output voltage ripple. The ripple current is typically allowed to be 30% of the maximum switch current limit. DW8521 operates in constant off-time in heavy load, and the inductance can be determined by:

$$L = \frac{(V_{OUT} - V_{IN}) \cdot t_{off}}{\Delta I}$$

Which t_{off} is the off-time of the MOSFET, ΔI is the inductor ripple current.

After the inductance is determined, the on-time can be calculated by:

$$t_{on} = L \cdot \frac{\Delta I}{V_{IN}}$$

Then the frequency also can be calculated by:

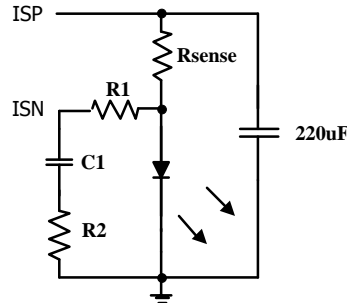
$$f = \frac{V_{IN}}{t_{off} \cdot V_{OUT}}$$

Lower DC resistance of the inductor is preferred for higher efficiency.

8.2. Detailed Descriptions

■ Start-up Current limit

When using in MR16 application, the output capacitance should be very large to maintain the continuous output current, which causes the failure of the internal soft-start. The following circuit is designed to limit the start-up current.



The ISN voltage is always following the ISP voltage before the output voltage build up, which causes a low feedback voltage and a large start-up current. The resistor R1, R2 and the capacitor C1 are used to slowing down the ISN voltage rising, and the RC time constant should be larger than the startup time.

$$(R_1 + R_2) \cdot C_1 > t_r$$

Where t_r is the startup time, and the startup time is about 400us.

Because the ISN pin sink current, and to keep the output current sense accuracy, the R1 can be determined by :

$$R_1 \cdot I_{\text{sink}} = 3\text{mV}$$

At steady state, R1 and R2 divide the output voltage, and then, R2 should be larger than R1. In most typical application, R2 can be set to 5 times of R1.

Take all the conditions into consideration, the parameters can be calculated. For example, R1= 300R, R2=2K, and C1=0.1uF.

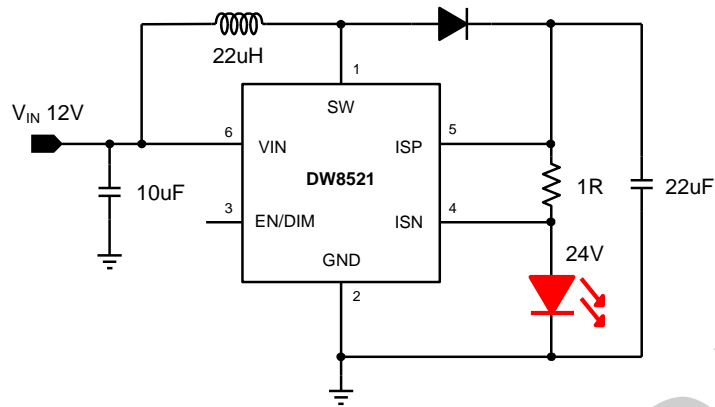
■ PCB Layout Precaution

The PCB layout of DW8521 must be carefully designed. Different PCB layout optimization is required for different topology application of DW8521.

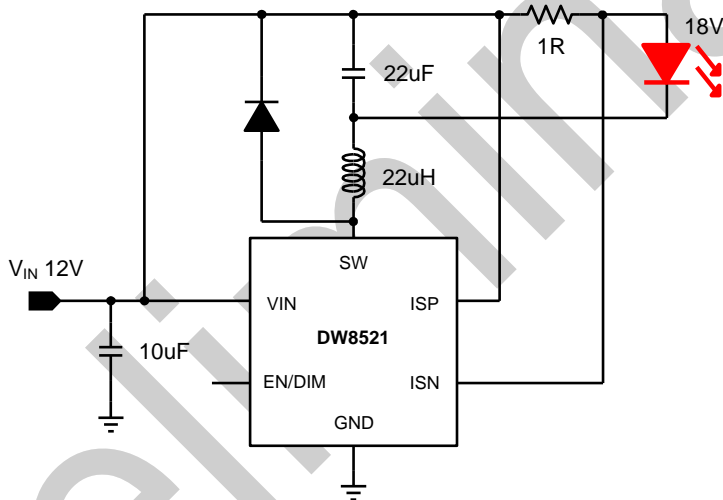
1. Place the input decoupling capacitor as close to DW8521 (VIN pin and PGND) as possible to eliminate noise at the input pin. The loop area formed by input capacitor and GND must be minimized.
2. Put the feedback trace as far away from the inductor and noisy power traces as possible.
3. The ground plan on the PCB should be as large as possible for better heat dissipation.

9. Typical Application Circuit

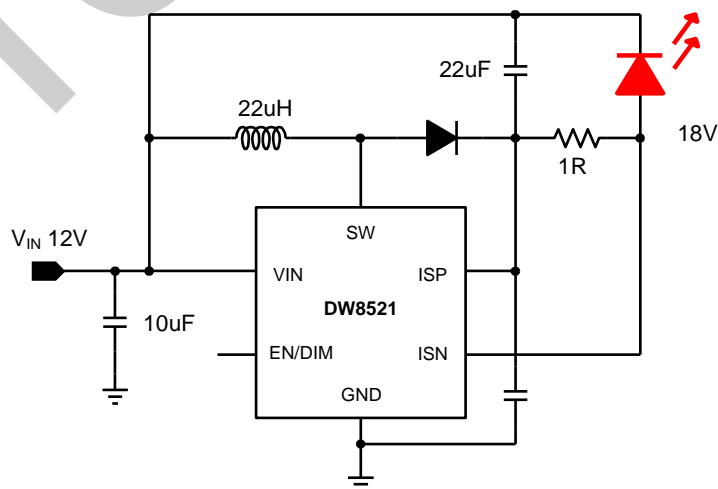
■ Step-up LED Driver Application :



■ Step-down LED Driver Application :

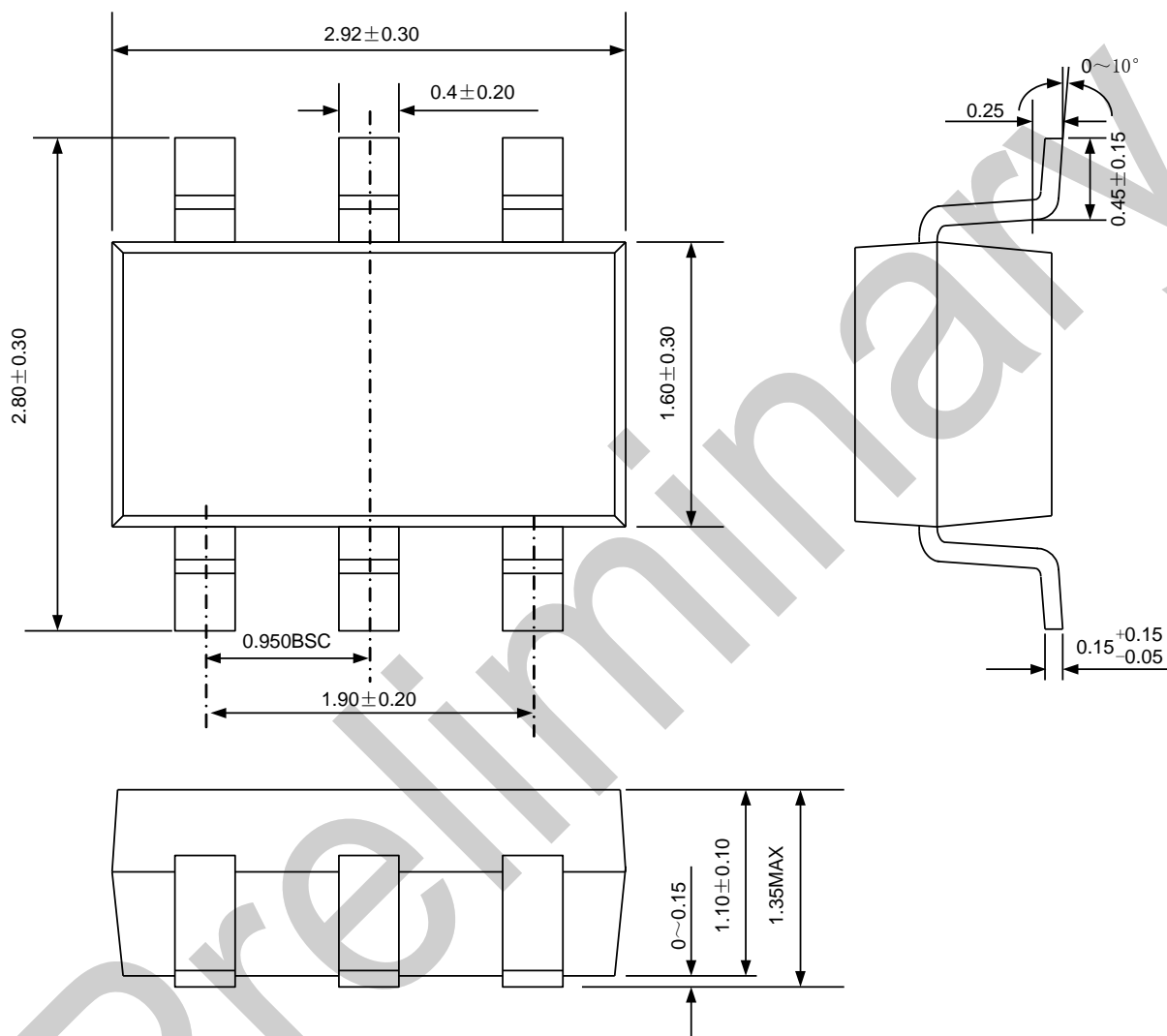


■ Step-up/down LED Driver Application :



10. Package Dimension

Package Name : SOT23-6L
Package Size : 2.92mm * 2.8mm, Thickness : 1.35mm
Pin Pitch : 0.95mm



10.1. Package Dimension

Package Name : ESOP-8L
 Package Size : 5.0mm * 6.0mm, Thickness : 1.75mm
 Pin Pitch : 1.27mm

