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High Voltage High Current LED Driver Controller for Buck, Boost or Buck-Boost Topology

General Description

The RT8496 is a current-mode PWM controller designed to drive an external MOSFET for high current LED applications. With a current sense amplifier threshold of 315mV, the LED current is adjustable with one external current sense resistor. With the maximum operating input voltage of 36V and output voltage up to 150V, the RT8496 is ideal for Buck, Boost or Buck-Boost operation.

With the switching frequency programmable over 100kHz to 1MHz, the external inductor and capacitors can be small while maintaining high efficiency.

Dimming can be done by either analog or digital. The built-in clamping comparator and filter allow easy low noise analog dimming conversion from digital signal with only one external capacitor.

The RT8496 is available in the SOP-14 package.

Applications

- General Industrial High Power LED Lighting
- Desk Lights and Room Lighting
- Building and Street Lighting
- Industrial Display Backlight

Features

- **High Voltage Capability : V_{IN} Up to 36V, LED Sensing Threshold Common Mode Voltage Up to 150V**
- **Buck, Boost or Buck-Boost Operation**
- **Adjustable Switching Frequency**
- **Easy Dimming Control : Analog or Digital Converting to Analog with One External Capacitor**
- **Adjustable Soft-Start to Avoid Inrush Current**
- **Adjustable Over-Voltage Protection**
- **V_{IN} Under-Voltage Lockout and Thermal Shutdown**

Ordering Information

RT8496□□

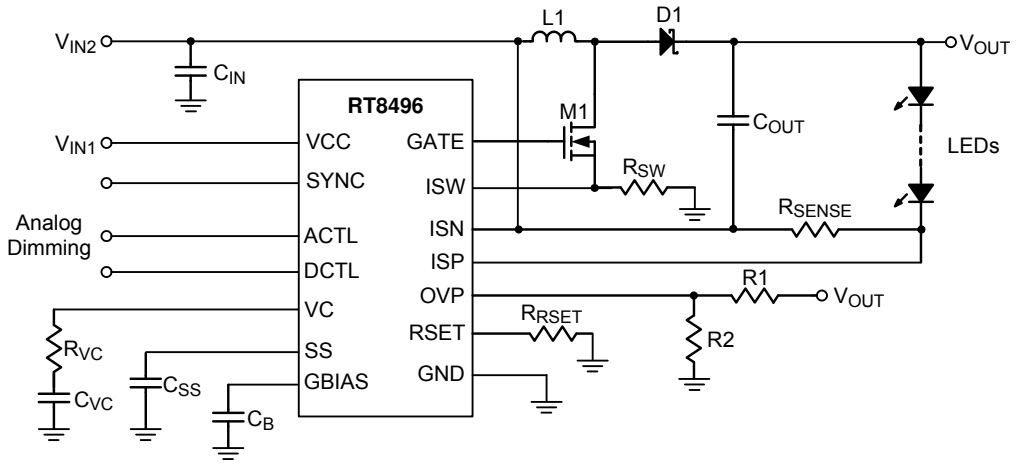
- Package Type
  S : SOP-14
- Lead Plating System
  G : Green (Halogen Free and Pb Free)

Note :

Richtek products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Simplified Application Circuit



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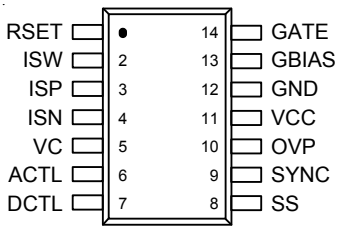
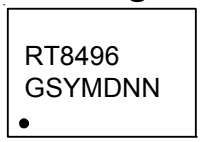
Pin Configurations

(TOP VIEW)



SOP-14

Marking Information



RT8496GS : Product Number

YMDNN : Date Code

Functional Pin Description

Pin No.	Pin Name	Pin Function
1	RSET	Switching Frequency Setting. Connect a resistor from RSET to GND. R_{RSET} = 30kΩ will set f_{SW} = 360kHz.
2	ISW	Current Sense for External MOSFET Switch. Connect the current sense resistor between external N-MOSFET switch and the ground.
3	ISP	LED Current Sense Amplifier Positive Input with Common Mode Up to 150V.
4	ISN	LED Current Sense Amplifier Negative Input. Voltage threshold between ISP and ISN is 315mV with common mode voltage up to 150V.
5	VC	Compensation Node for PWM Control Loop.
6	ACTL	Analog Dimming Control. The effective programming voltage range of the pin is between 0.2V and 1.2V.
7	DCTL	Digital Dimming Control by adding a 0.47μF filtering capacitor on ACTL pin, the PWM dimming signal on DCTL pin can be averaged and converted into analog dimming signal on the ACTL pin.
8	SS	Soft-Start Time Setting. A capacitor of at least 10nF is required for proper soft-start.
9	SYNC	Switching Frequency Synchronization Pin. In order to synchronize RT8496 switching frequency to external frequency, the SYNC pin must be fed with square wave with frequency higher than the set switching frequency of RT8496. The high level voltage of the square wave must be higher than1.4V. The SW pin will be pulled low (turned off) on the rising edge (from low to high) of the SYNC pin signal to achieve frequency synchronization. Keep the SYNC pin floating if the switching frequency synchronization function is not used.
10	OVP	Over-Voltage Protection Sense Input. The PWM converter turns off when the voltage of the pin goes higher than 1.18V.
11	VCC	Power Supply of the Chip. For good bypass, a low ESR capacitor is required.
12	GND	Ground. The Exposed Pad must be Soldered to a Large PCB and Connected to GND for Maximum Power Dissipation.
13	GBIAS	Internal Gate Driver Bias. A good bypass capacitor is required.
14	GATE	External MOSFET Switch Gate Driver Output.

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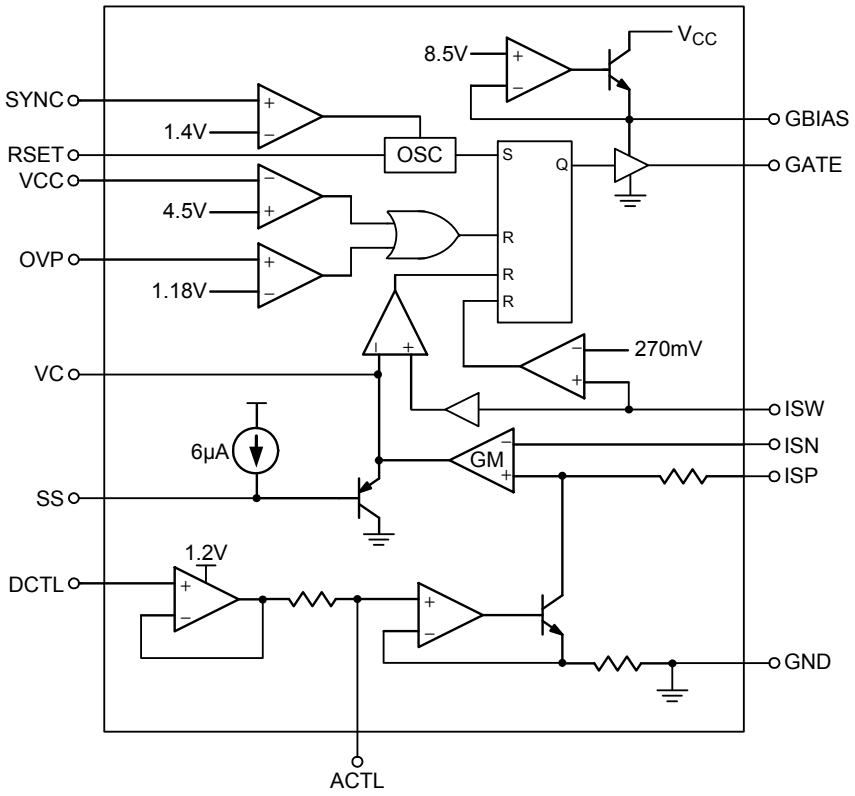
Function Block Diagram



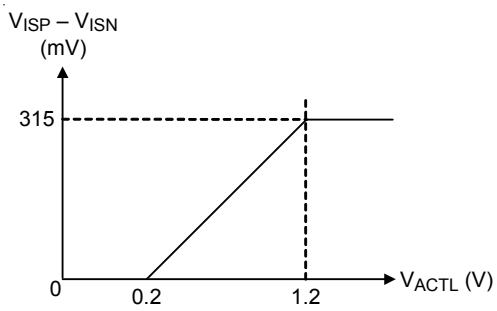


Figure 4

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Operation

The start up voltage of the RT8496 is around 4.5V. When VCC voltage is greater than 4.5V, the RT8496 starts operation and a regulated GBIAS supply voltage is generated by an internal LDO circuit. With VCC greater than 10V, the GBIAS supply will be regulated around 8.5V to supply the power for the internal GATE pin driver circuit.

The RT8496 is a constant switching frequency PWM controller. The OSC block generates an adjustable switching frequency set by an external resistor at RSET pin. The RT8496 is also equipped with switching frequency synchronization function. The switching frequency can be synchronized to the frequency of the signal feeding into the SYNC pin. On the rising edge of the SYNC pin signal toggled from low to high (the high level voltage must be higher than 1.4V), the switch will be turned off. In order to make the switching frequency synchronization function to work, the frequency of the signal feeding into the SYNC pin must be greater than the nominal switching frequency set by the resistor at the RSET pin.

As the system starts, the capacitor at the soft-start pin is slowly charged by an internal current source around 6μA. During soft-start period, the VC pin voltage follows the soft-start pin voltage up by one VBE and gradually ramps up. The slowly rising VC pin voltage allows the PWM duty to increase gradually to achieve soft-start function.

In normal operation, the GATE turns high when the oscillator (OSC) turns high. The ISW pin voltage is the triangular feedback signal of the sensed switch current (which equals inductor current ramp). The PWM comparator compares the ISW pin voltage to the VC pin voltage. When the ISW pin voltage exceeds the VC pin voltage, the PWM comparator resets the latch and turns off GATE. If the ISW pin voltage does not exceed the VC pin voltage by the end of the switching cycle, the GATE will be turned off by the OSC circuit for a minimum off time. The cycle repeats when the GATE is turned on at the beginning of the next OSC cycle.

The RT8496 features high voltage LED driver control. The common mode operation voltage of the ISP and ISN pins can be high up to 150V. The regulated ($V_{ISP} – V_{ISN}$) sense threshold voltage is around 315mV. If the sensed ($V_{ISP} – V_{ISN}$) voltage is lower than 315mV, the VC pin will be charged higher by the internal OP AMP in the PWM control loop and vice versa. By the PWM closed loop control, the ($V_{ISP} – V_{ISN}$) voltage is regulated to 315mV. The actual LED output current can be adjusted by the sense resistor between the ISP and ISN pins.

The dimming can be done by varying the ACTL/DCTL pin voltage signal. The internal sense threshold reference for ($V_{ISP} – V_{ISN}$) regulation follows the ACTL/DCTL signal to achieve dimming control.

The fault protection features of the RT8496 include (1) VCC Under-Voltage Lockout (UVLO) (2) VOUT Over - Voltage Protection (OVP) (3) switch Over-Current Protection (OCP) (4) Over-Temperature Protection (OTP).

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Absolute Maximum Ratings (Note 1)

- Supply Input Voltage, VCC ---------- –0.3V to 38V
- GBIAS, GATE ---------- –0.3V to 10V
- ISW ---------- –0.3V to 1V
- ISP, ISN ---------- –0.3V to 180V
- DCTL, ACTL, OVP (Note 2) ---------- –0.3V to 8V
- SYNC ---------- –0.3V to 20V
- SS, RSET, VC ---------- –0.3V to 5V
- Power Dissipation, P_D @ T_A = 25°C
  SOP-14 ---------- 0.87W
- Package Thermal Resistance (Note 3)
  SOP-14, θ_{JA} ---------- 113.9°C/W
- Junction Temperature ---------- 150°C
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 4)
  HBM (Human Body Model), except the HV pins ISP (500V) and ISN (500V) ---------- 2kV
  MM (Machine Model) ---------- 200V

Recommended Operating Conditions (Note 5)

- Supply Input Voltage Range, VCC ---------- 4.5V to 36V
- ISP, ISN ---------- 150V
- Junction Temperature Range ---------- –40°C to 125°C

Electrical Characteristics

(V_{CC} = 24V, No Load on any Output, T_A = 25°C, unless otherwise specified)

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Overall							
Supply Current		I_{VCC}	$V_{VC} \leq 0.4V$ (Switching Off)	--	6	7.2	mA
SYNC Input Voltage	Logic-High	V_{SYNCH}		2	--	--	V
	Logic-Low	V_{SYNCL}		--	--	0.8	
SYNC Input Current			SYNC > 2V	--	--	1.2	μA
Current Sense Amplifier							
Input Threshold ($V_{ISP} - V_{ISN}$)			V_{ACTL} = 1.4V, 12V ≤ Common Mode ≤ 150V	302	315	328	mV
ISP Input Current		I_{ISP}	4.5V ≤ V_{ISP} ≤ 150V	--	140	--	μA
ISN Input Current		I_{ISN}	4.5V ≤ V_{ISN} ≤ 150V	--	60	--	
VC Output Current		I_{VC}	$V_{ISP} - V_{ISN}$ = 315mV, 0.5V ≤ V_C ≤ 2.4V	--	±20	--	μA
VC Threshold for PWM Switch Off				--	0.7	--	V

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Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
LED Dimming						
Analog Dimming ACTL Pin Input Current	I_{ACTL}	V_{ACTL} = 1.2V	--	1	--	μA
		V_{ACTL} = 0.2V	--	10	--	
Maximum LED Current On Threshold at ACTL	V_{ACTL_On}		--	1.2	1.5	V
LED Current Off Threshold at ACTL	V_{ACTL_Off}		0.15	0.2	--	V
DCTL Input Current	I_{DCTL}	0.3V ≤ V_{DCTL} ≤ 6V	--	--	0.5	μA
DCTL Input Voltage	V_{DCTL_H}	(Note 6)	2	--	--	V
	V_{DCTL_L}	(Note 6)	--	--	0.3	
PWM Control						
Switching Frequency	f_{SW}	R_{RSET} = 30kΩ	280	360	420	kHz
Minimum Off-Time		R_{RSET} = 30kΩ	--	250	--	ns
Switch Gate Driver						
GBIAS Voltage	V_{GBIAS}	I_{GBIAS} = 20mA	7.8	8.5	9.2	V
GATE Voltage High	V_{GATE_H}	I_{GATE} = −50mA	--	7.2	--	V
		I_{GATE} = −100μA	--	7.8	--	
GATE Voltage Low	V_{GATE_L}	I_{GATE} = 50mA	--	0.25	--	V
		I_{GATE} = 100μA	--	0.1	--	
GATE Drive Rise and Fall Time		1nF Load at GATE	2	15	300	ns
PWM Switch Current Limit Threshold	I_{SW_LIM}	V_C = 1V	235	270	305	mV
OVP and Soft-Start						
OVP Threshold	V_{OVP_th}		--	1.18	--	V
OVP Input Current	I_{OVP}	0.9V ≤ V_{OVP} ≤ 1.5V	--	--	0.5	μA
Soft-Start Current	I_{SS}	V_{SS} ≤ 2V	--	6	--	μA
Thermal Shutdown Threshold	T_{SD}		--	145	--	°C
Thermal Shutdown Hysteresis	ΔT_{SD}		--	10	--	

Note 1. Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

Note 2. If connected with a 20kΩ serial resistor, ACTL and DCTL can go up to 36V.

Note 3. θ_{JA} is measured at T_A = 25°C on a high effective thermal conductivity four-layer test board per JEDEC 51-7. θ_{JC} is measured at the exposed pad of the package.

Note 4. Devices are ESD sensitive. Handling precaution is recommended.

Note 5. The device is not guaranteed to function outside its operating conditions.

Note 6. Guaranteed by design, not subjected to production test.

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Typical Application Circuit

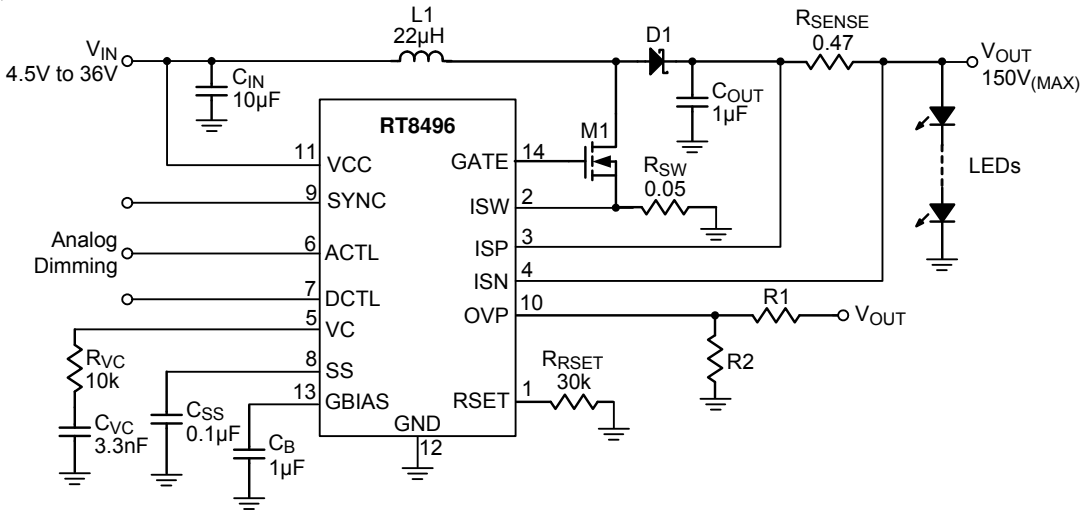

Figure 1. Analog Dimming in Boost Configuration

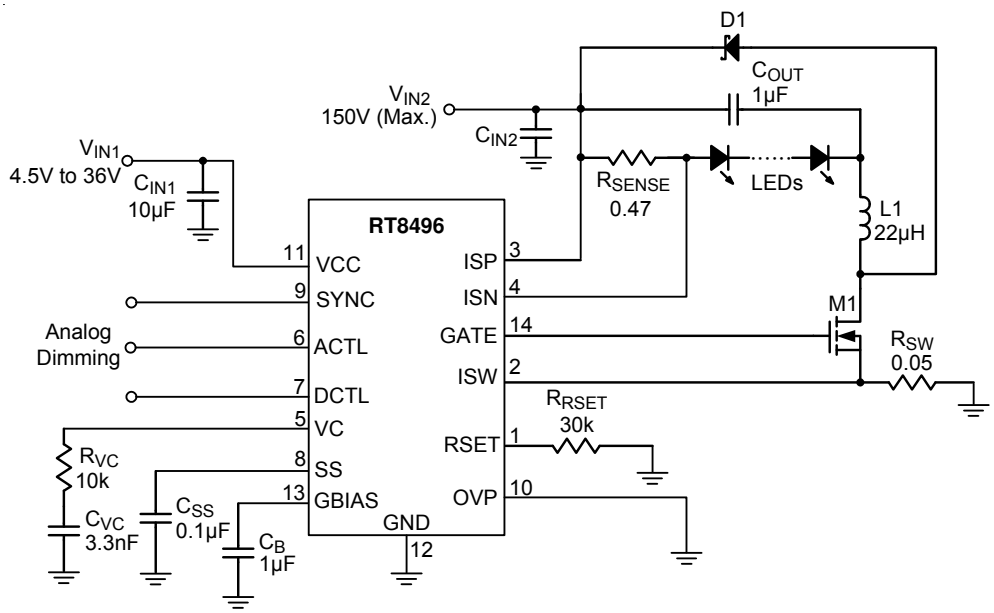

Figure 2. Analog Dimming in Buck Configuration

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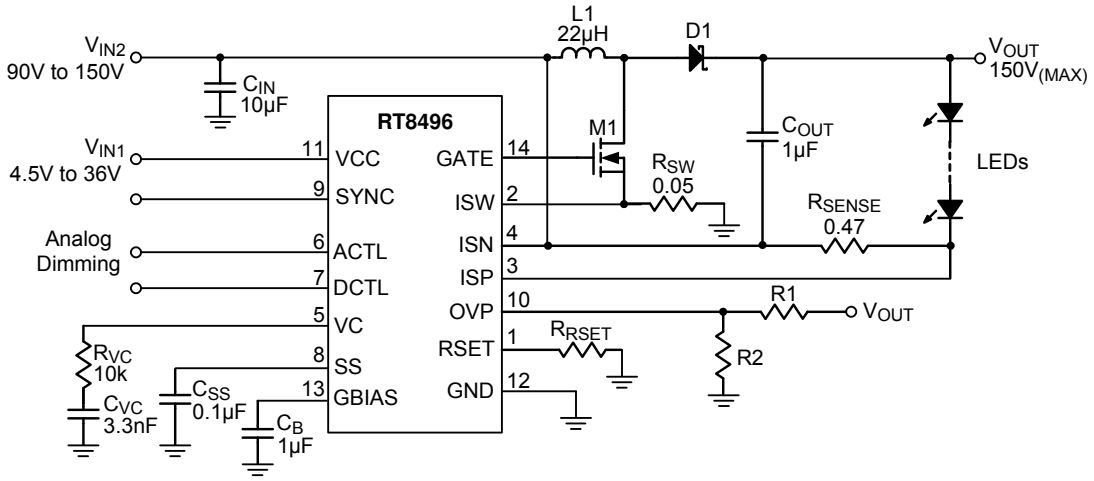

Figure 3. Analog Dimming in Buck-Boost Configuration

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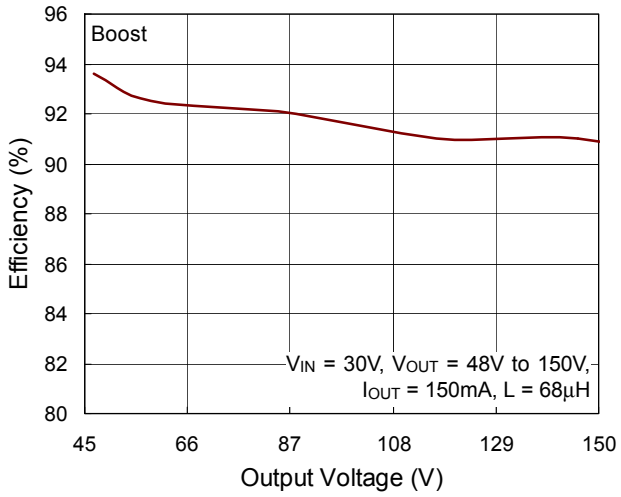
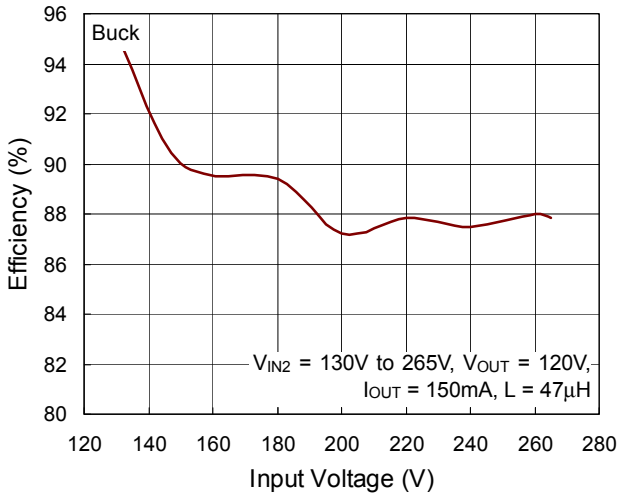
Typical Operating Characteristics

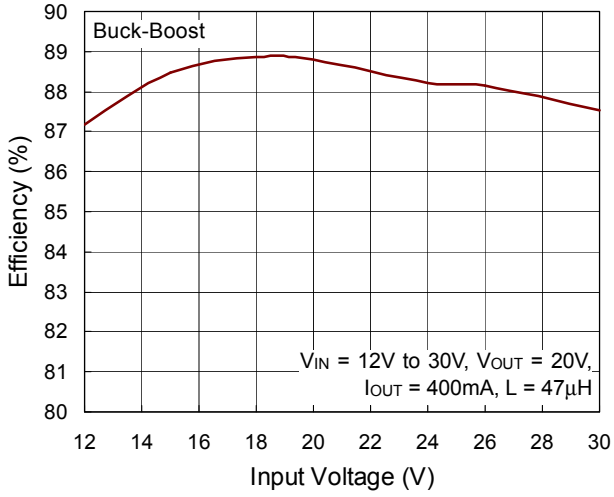
Efficiency vs. Output Voltage



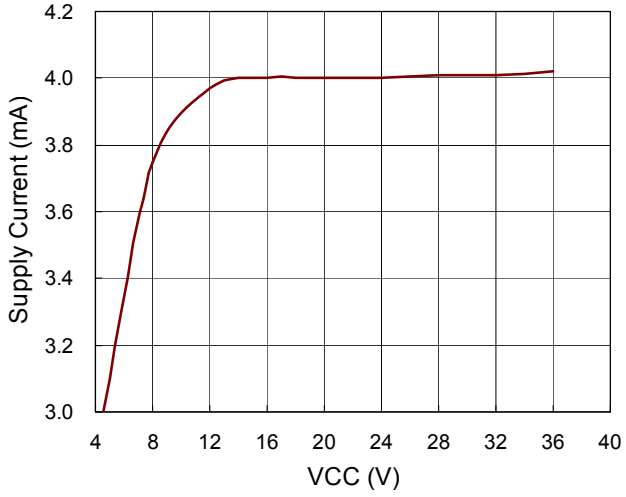
Efficiency vs. Input Voltage



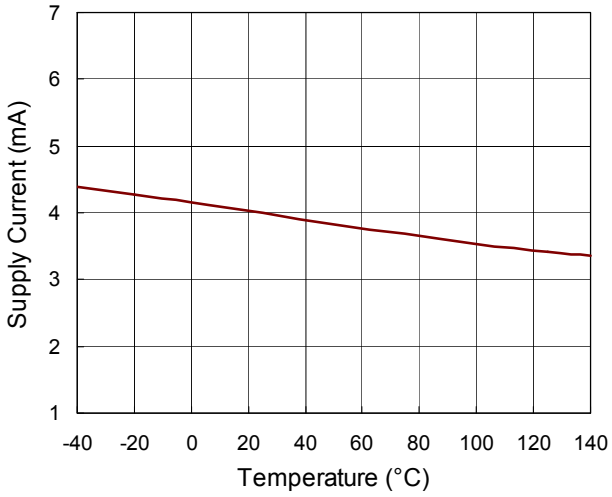
Efficiency vs. Input Voltage



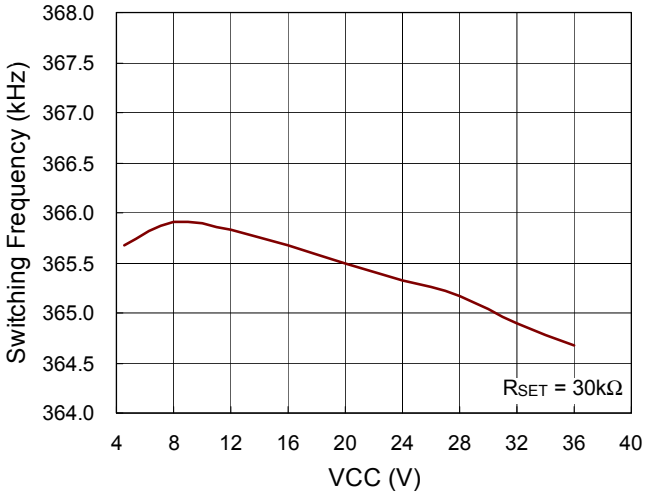
Supply Current vs. VCC



Supply Current vs. Temperature



Switching Frequency vs. VCC



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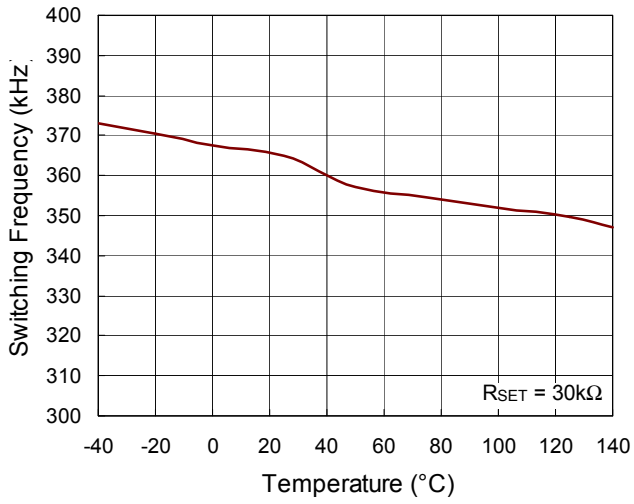
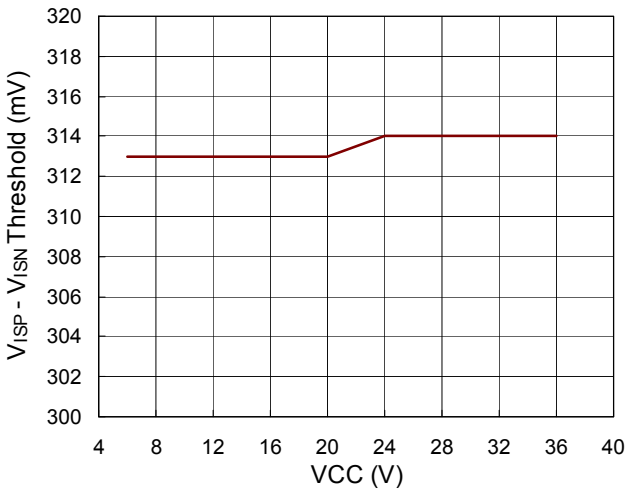
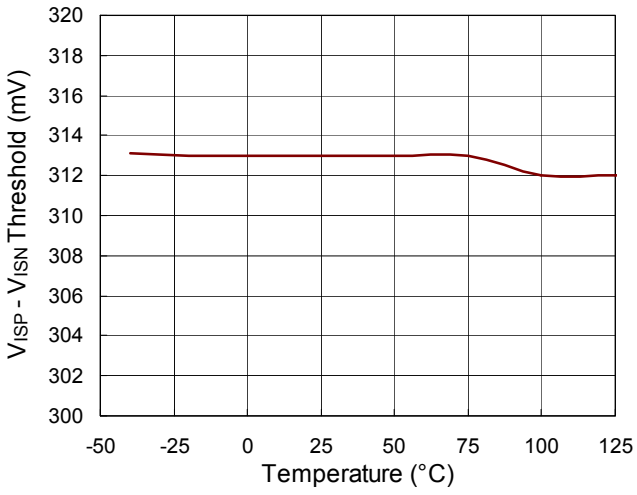
Switching Frequency vs. Temperature



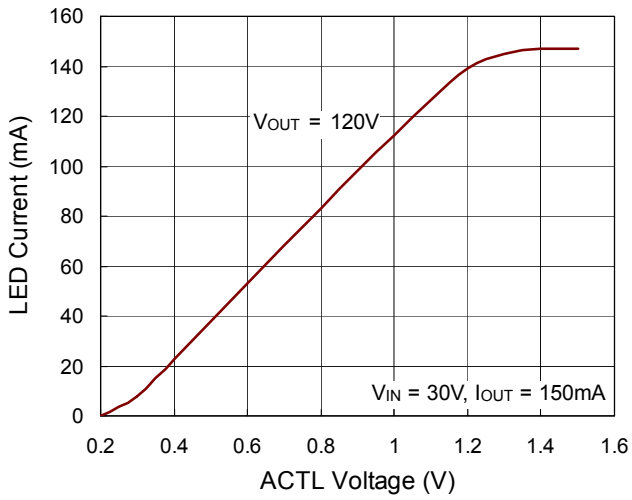
V_{ISP} - V_{ISN} Threshold vs. VCC



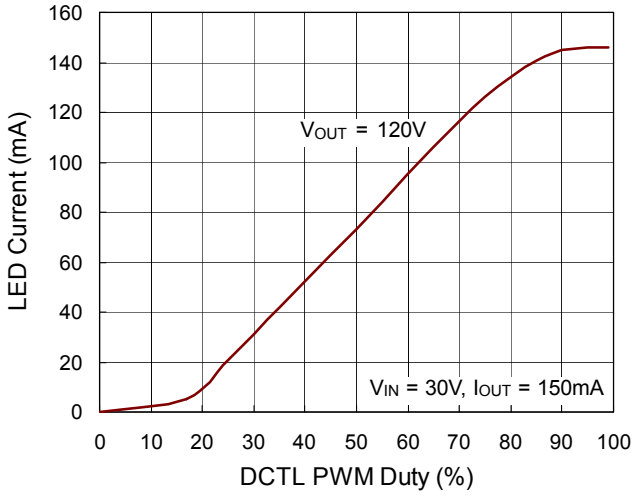
V_{ISP} - V_{ISN} Threshold vs. Temperature



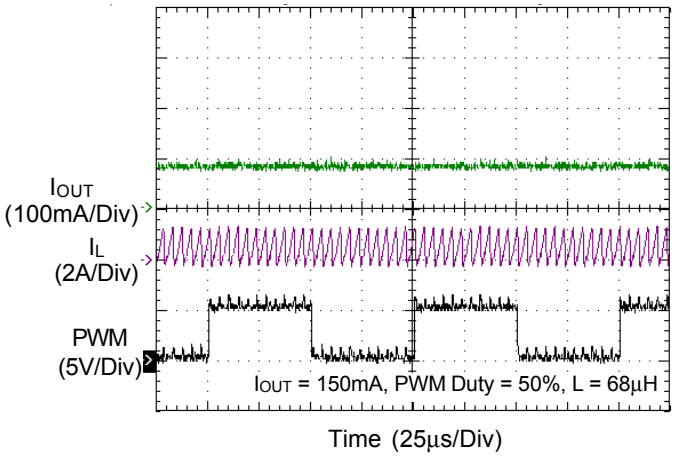
LED Current vs. ACTL Voltage



LED Current vs. DCTL PWM Duty



DCTL Dimming on PWM Duty 50%



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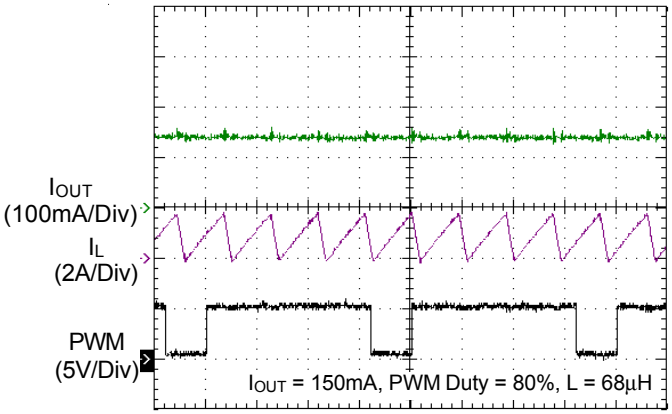
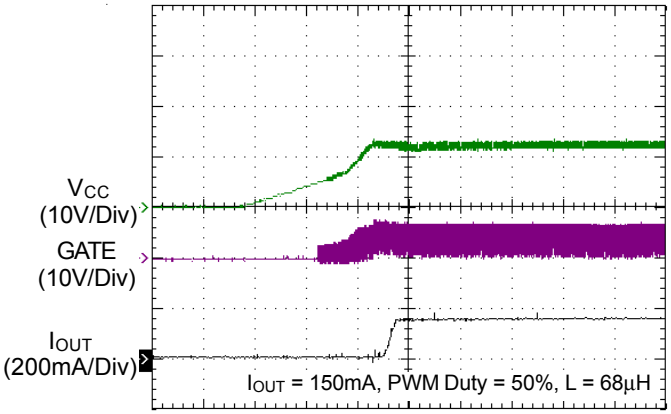
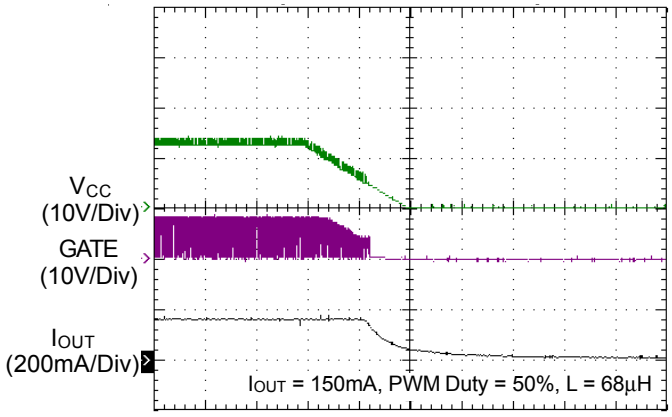
DCTL Dimming on PWM Duty 80%



Power On form VCC Voltage



Power Off form VCC Voltage



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Applications Information

The RT8496 is a current mode PWM controller designed to drive an external MOSFET for high current LED applications. The LED current can be programmed by an external resistor. The input voltage range of the RT8496 can be up to 36V and the output voltage can be up to 150V. The RT8496 provides analog and PWM dimming to achieve LED current control.

GBIAS Regulator and Bypass Capacitor

The GBIAS pin requires a capacitor for stable operation and to store the charge for the large GATE switching currents. Choose a 25V rated low ESR, X7R or X5R ceramic capacitor for best performance. The value of a 1μF capacitor will be adequate for many applications.

Place the capacitor close to the IC to minimize the trace length to the GBIAS pin and also to the IC ground. An internal current limit on the GBIAS output protects the RT8496 from excessive on-chip power dissipation.

The GBIAS pin has its own under-voltage disable (UVLO) set to 4.3V(typical) to protect the external FETs from excessive power dissipation caused by not being fully enhanced. If the input voltage, VIN, will not exceed 8V, then the GBIAS pin should be connected to the input supply. Be aware if GBIAS supply is used to drive extra circuits besides RT8496, typically the extra GBIAS load should be limited to less than 10mA.

Loop Compensation

An external resistor in series with a capacitor is connected from the VC pin to GND to provide a pole and a zero for proper loop compensation. The external inductor, output capacitor and the compensation resistor and capacitor determine the loop stability. The inductor and output capacitor are chosen based on performance, size and cost. The compensation resistor and capacitor at VC are selected to optimize control loop response and stability. For typical LED applications, a 3.3nF compensation capacitor at VC is adequate, and a series resistor should always be used to increase the slew rate on the VC pin to maintain good regulation of LED current during fast transients on the input supply to the converter The typical compensation for the RT8496 is 10kΩ and 3.3nF.

Soft-Start

The soft-start of the RT8496 can be achieved by connecting a capacitor from SS pin to GND. The built-in soft-start circuit reduces the start-up current spike and output voltage overshoot. The soft-start time is determined by the external capacitor charged by an internal 6μA constant charging current. The SS pin directly limits the rate of voltage rise on the VC pin, which in turn limits the peak switch current.

The soft-start interval is set by the soft-start capacitor selection according to the equation :

$$t_{SS} = C_{SS} \times \frac{2.4V}{6\mu A}$$

A typical value for the soft-start capacitor is 0.1μF. The soft-start capacitor is discharged when VCC falls below its UVLO threshold, during an over temperature event or during an GBIAS under voltage event.

LED Current Setting

The LED current is adjustable by placing an appropriate value current sense resistor between the ISP and ISN pins. Typically, sensing of the current should be done at the top of the LED string. The ACTL pin should be tied to a voltage higher than 1.2V to get the full-scale 315mV (typical) threshold across the sense resistor. The ACTL pin can also be used to dim the LED current to zero, although relative accuracy decreases with the decreasing voltage sense threshold. When the ACTL pin voltage is less than 1.2V, the LED current is :

$$I_{LED} = \frac{(V_{ACTL} - 0.2) \times 0.315}{R_{SENSE}}$$

Where,

R_{SENSE} is the resistor between ISP and ISN.

When the voltage of ACTL is higher than 1.2V, the LED current is regulated to :

$$I_{LED(MAX)} = \frac{315mV}{R_{SENSE}}$$

The ACTL pin can also be used in conjunction with a thermistor to provide over-temperature protection for the LED load, or with a voltage divider to V_{IN} to reduce output

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power and switching current when V_{IN} is low. The presence of a time varying differential voltage signal (ripple) across ISP and ISN at the switching frequency is expected.

The amplitude of this signal is increased by high LED load current, low switching frequency and/or a smaller value output filter capacitor. The compensation capacitor on the VC pin filters the signal so the average difference between ISP and ISN is regulated on the user-programmed value.

Switching Frequency Setting

The RSET frequency adjust pin allows the user to adjust the switching frequency from 100kHz to 1MHz for optimized efficiency and performance or external component size. Higher frequency operation allows smaller component size but increases switching losses and gate driving current, and may not allow sufficient high or low duty cycle operation. Lower frequency operation gives better performance but with larger external component size. For an appropriate R_{RSET} resistor value see Table 1 or Figure 4. An external resistor from the RSET pin to GND is required and do not leave this pin open.

Table 1. Switching Frequency vs. R_{REST} Value (1% Resistor)

f_{OSC} (kHz)	R_{RSET} (kΩ)
1000	8
800	10
600	15
500	19
300	35
200	55
100	120

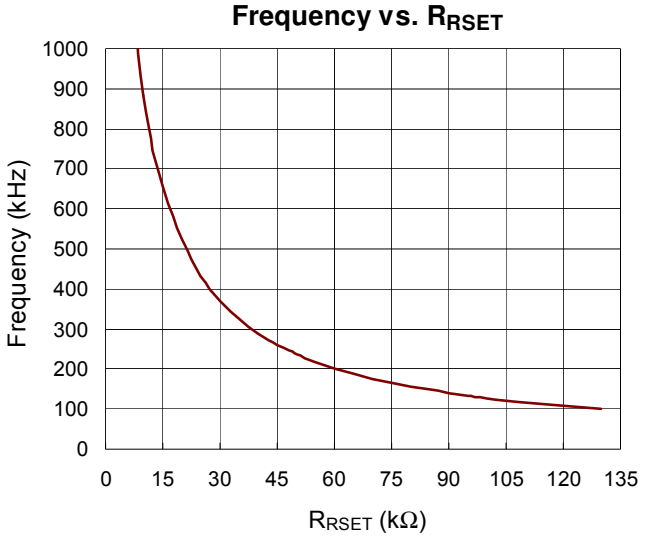

Figure 4. Switching Frequency vs. R_{RSET}

Output Over Voltage Setting

The RT8496 is equipped with Over-Voltage Protection (OVP) function. When the voltage at OVP pin exceeds a threshold of approximately1.18V, the power switch is turned off. The power switch can be turned on again once the voltage at OVP pin drops below 1.18V. For the Boost and Buck-Boost application, the output voltage could be clamped at a certain voltage level. The OVP voltage can be set by the following equation :

$$V_{OUT,\,OVP} = 1.18 \times \left(1 + \frac{R1}{R2}\right)$$

Where,

R1 and R2 are the voltage dividers from V_{OUT} to GND with the divider center node connected to OVP pin.

Over-Temperature Protection

The RT8496 has Over-Temperature Protection (OTP) function to prevent the excessive power dissipation from overheating. The OTP function will shut down switching operation when the die junction temperature exceeds 145°C. The chip will automatically start to switch again when the die junction temperature cools off.

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Inductor Selection

The converter operates in discontinuous conduction mode when the inductance value is less than the value L_{BCM}. With an inductance greater than L_{BCM}, the converter operates in Continuous Conduction Mode (CCM). The inductance L_{BCM} is determined by the following equations.

For Buck application :

$$L_{BCM} = \frac{V_{OUT}}{2 \times I_{OUT} \times f} \times \left(\frac{V_{IN} - V_{OUT}}{V_{IN}} \right)$$

For Boost application :

$$L_{BCM} = \frac{V_{IN}^2}{2 \times I_{OUT} \times f} \times \left(\frac{V_{OUT} - V_{IN}}{V_{OUT}^2} \right)$$

For Buck-Boost application :

$$L_{BCM} = \frac{V_{IN}^2}{2 \times I_{OUT} \times f} \times \frac{V_{OUT}}{(V_{IN} + V_{OUT})^2}$$

where

VOUT = output voltage.

VIN = input voltage.

f = operating frequency.

I_{OUT} = LED current.

Choose an inductance based on the operating frequency, input voltage and output voltage to provide a current mode ramp signal during the MOSFET on period for PWM control loop regulation. The inductance also determines the inductor ripple current. Operating the converter in CCM is recommended, which will have the smaller inductor ripple current and hence the less conduction losses from all converter components.

As a design example, to design the peak to peak inductor ripple to be ±30% of the output current, the following equations can be used to estimate the size of the needed inductance :

For Buck application :

$$L = \frac{V_{OUT}}{2 \times 0.3 \times I_{OUT} \times f} \times \left(\frac{V_{IN} - V_{OUT}}{V_{IN}} \right)$$

For Boost application :

$$L = \frac{V_{IN}^2}{2 \times 0.3 \times I_{OUT} \times f} \times \left(\frac{V_{OUT} - V_{IN}}{V_{OUT}^2} \right)$$

For Buck-Boost application :

$$L = \frac{V_{IN}^2}{2 \times 0.3 \times I_{OUT} \times f} \times \frac{V_{OUT}}{(V_{IN} + V_{OUT})^2}$$

The inductor must also be selected with a saturation current rating greater than the maximum inductor current during normal operation. The maximum inductor current can be calculated by the following equations.

For Buck application :

$$I_{PEAK} = I_{OUT} + \frac{V_{OUT}}{2 \times L \times f} \times \left(\frac{V_{IN} - V_{OUT}}{V_{IN}} \right)$$

For Boost application :

$$I_{PEAK} = \frac{V_{OUT} \times I_{OUT}}{\eta \times V_{IN}} + \frac{V_{IN}}{2 \times L \times f} \times \left(\frac{V_{OUT} - V_{IN}}{V_{OUT}} \right)$$

For Buck-Boost application :

$$I_{PEAK} = \frac{(V_{IN} \times V_{OUT}) \times I_{OUT}}{\eta \times V_{IN}} + \frac{V_{IN}}{2 \times L \times f} \times \left(\frac{V_{OUT}}{V_{IN} + V_{OUT}} \right)$$

where

η is the efficiency of the power converter.

Power MOSFET Selection

For applications operating at high input or output voltages, the power N-MOSFET switch is typically chosen for drain voltage VDS rating and low gate charge. Consideration of switch on-resistance, $R_{DS(ON)}$, is usually secondary because switching losses dominate power loss. The GBIAS regulator on the RT8496 has a fixed current limit to protect the IC from excessive power dissipation at high VIN, so the N-MOSFET should be chosen so that the product of Qg at 5V and switching frequency does not exceed the GBIAS current limit.

ISW Sense Resistor Selection

The resistor, R_{SW}, between the Source of the external N-MOSFET and GND should be selected to provide adequate switch current to drive the application without exceeding the current limit threshold set by the ISW pin sense threshold of RT8496. The ISW sense resistor value can be calculated according to the formula below :

$$R_{SW} = \frac{\text{Current Limlit Threshold Minimum Value}}{I_{OCP}}$$

where I_{OCP} is about 1.33 to 1.5 times of inductor peak current I_{PEAK}.

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The placement of RSW should be close to the source of the N-MOSFET and the IC GND of the RT8496. The ISW pin input to RT8496 should be a Kelvin sense connection to the positive terminal of R_{SW}.

Schottky Diode Selection

The Schottky diode, with their low forward voltage drop and fast switching speed, is necessary for the RT8496 applications. In addition, power dissipation, reverse voltage rating and pulsating peak current are the important parameters for the Schottky diode selection. Choose a suitable Schottky diode whose reverse voltage rating is greater than maximum output voltage. The diode's average current rating must exceed the average output current. The diode conducts current only when the power switch is turned off (typically less than 50% duty cycle). If using the PWM feature for dimming, it is important to consider diode leakage, which increases with the temperature, from the output during the PWM low interval. Therefore, choose the Schottky diode with sufficiently low leakage current.

Capacitor Selection

The input capacitor reduces current spikes from the input supply and minimizes noise injection to the converter. For most of the RT8496 applications, a 10μF ceramic capacitor is sufficient. A value higher or lower may be used depending on the noise level from the input supply and the input current to the converter.

In Boost application, the output capacitor is typically a ceramic capacitor and is selected based on the output voltage ripple requirements. The minimum value of the output capacitor C_{OUT} is approximately given by the following equation :

$$C_{OUT} = \frac{I_{OUT} \times V_{OUT}}{V_{IN} \times V_{RIPPLE} \times f_{SW}}$$

For LED applications, the equivalent resistance of the LED is typically low and the output filter capacitor should be sized to attenuate the current ripple. Use of X7R type ceramic capacitors is recommended. Lower operating frequencies will require proportionately higher capacitor values.

Thermal Considerations

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula :

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance.

For recommended operating condition specifications, the maximum junction temperature is 125°C. The junction to ambient thermal resistance, θ_{JA}, is layout dependent. For SOP-14 package, the thermal resistance, θ_{JA}, is 113.9°C/W on a standard JEDEC 51-7 four-layer thermal test board. The maximum power dissipation at T_A = 25°C can be calculated by the following formula :

$P_{D(MAX)}$ = (125°C – 25°C) / (113.9°C/W) = 0.87W for SOP-14 package

The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance, θ_{JA}. The derating curves in Figure 5 allow the designer to see the effect of rising ambient temperature on the maximum power dissipation.

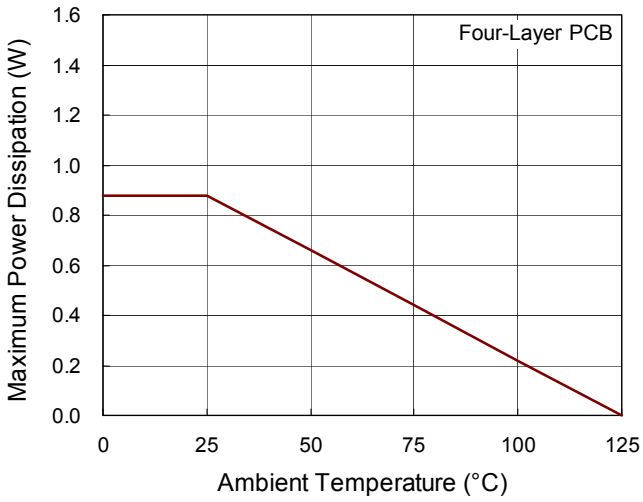

Figure 5. Derating Curve of Maximum Power Dissipation

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Layout Consideration

PCB layout is very important to design power switching converter circuits. The layout guidelines are suggested as follows :

- The power components L1, D1, C_{IN}, M1 and C_{OUT} must be placed as close to each other as possible to reduce the ac current loop area. The PCB trace between power components must be as short and wide as possible due to large current flow through these traces during operation.
- The input capacitor C_{VCC} must be placed as close to VCC pin as possible.
- Place the compensation components to VC pin as close as possible to avoid noise pick up.
- Connect GND pin and Exposed Pad to a large ground plane for maximum power dissipation and noise reduction.

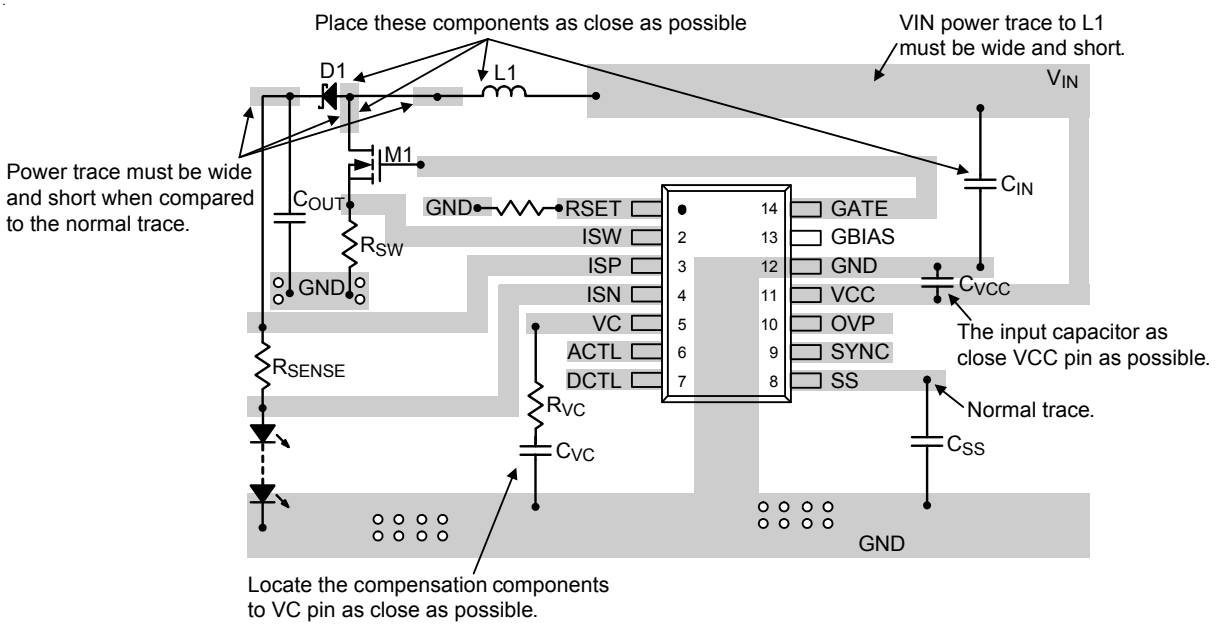

Figure 6. PCB Layout Guide

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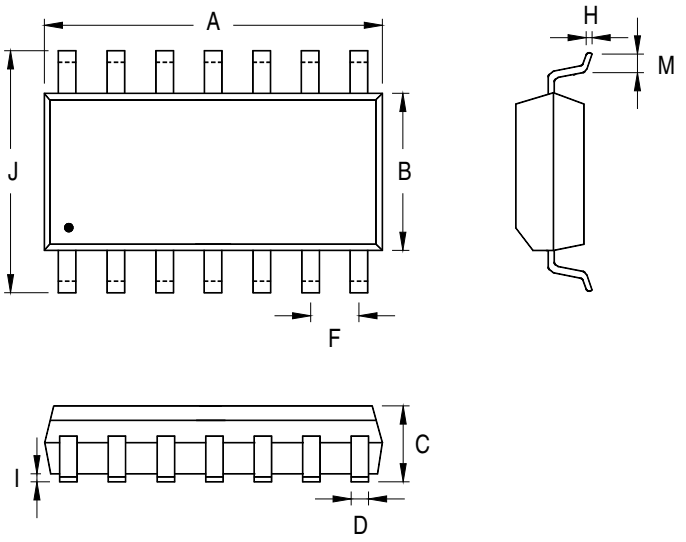
Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	8.534	8.738	0.336	0.344
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.178	0.254	0.007	0.010
I	0.102	0.254	0.004	0.010
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050

14–Lead SOP Plastic Package

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