

High Voltage High Current LED Driver Controller for Boost Topology

General Description

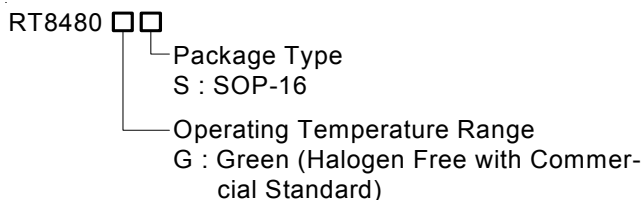
The RT8480 is a current mode PWM controller designed to drive an external MOSFET for high current LED applications. With a low side current sense amplifier threshold of 190mV, the LED current is programmable with one external current sense resistor.

With programmable operating frequency up to 700kHz, the external inductor and capacitors can be small while maintaining high efficiency.

Dimming can be done by either analog or digital. A built-in clamping comparator and filter allow easy low noise analog dimming conversion from digital signal with only one external capacitor. An unique True PWM dimming control is made easy with MOSFET under LED string. A very high dimming ratio can be achieved by adopting both analog/digital dimming and True PWM dimming together.

The RT8480 is available in SOP-16 package.

Ordering Information



Note :

Richtek Green 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.

Marking Information

For marking information, contact our sales representative directly or through a Richtek distributor located in your area, otherwise visit our website for detail.

Features

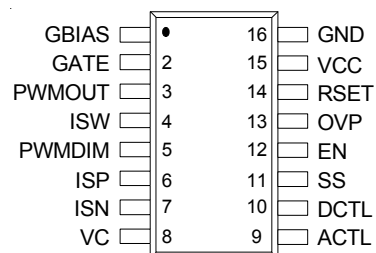
- **High Voltage Capability** : V_{IN} Up to 36V, V_{OUT} is limited by external MOSFET switch
- **Boost Operation**
- **Current Mode PWM with Programmable Switching Frequency**
- **Easy Dimming Control** : Analog or Digital Converting to Analog with One External Capacitor
- **True PWM Dimming** : External FET Driver is Build-in
- **Programmable Soft Start to Avoid Inrush Current**
- **Programmable Over Voltage Protection**
- **V_{IN} Undervoltage Lockout and Thermal Shutdown**
- **16-Lead SOP Package**
- **RoHS Compliant and Halogen Free**

Applications

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

Pin Configurations

(TOP VIEW)



SOP-16

Typical Application Circuit

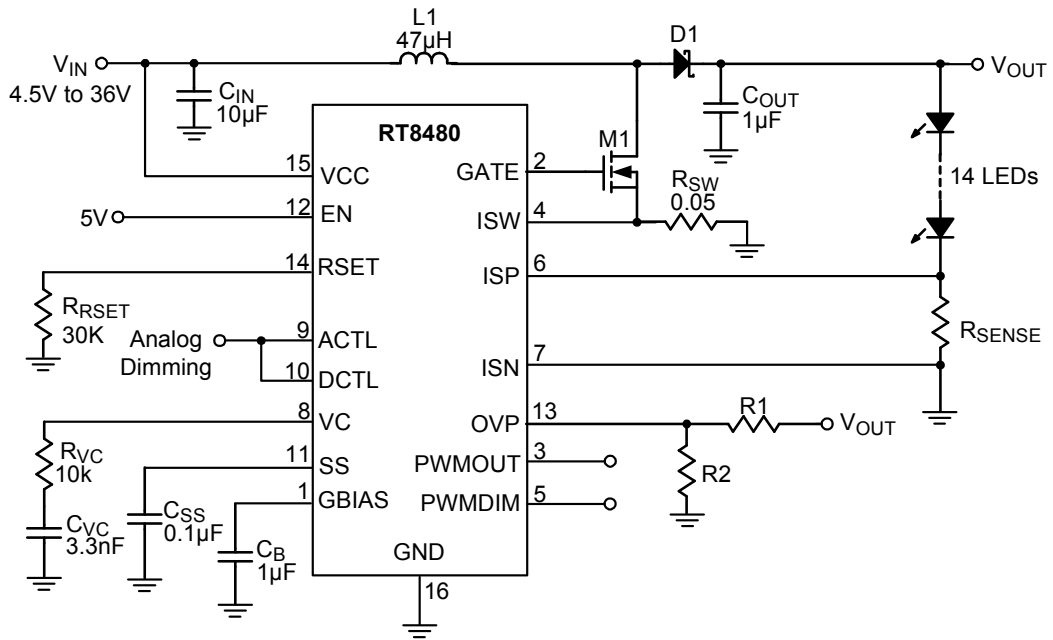


Figure 1. Analog Dimming in Boost Configuration

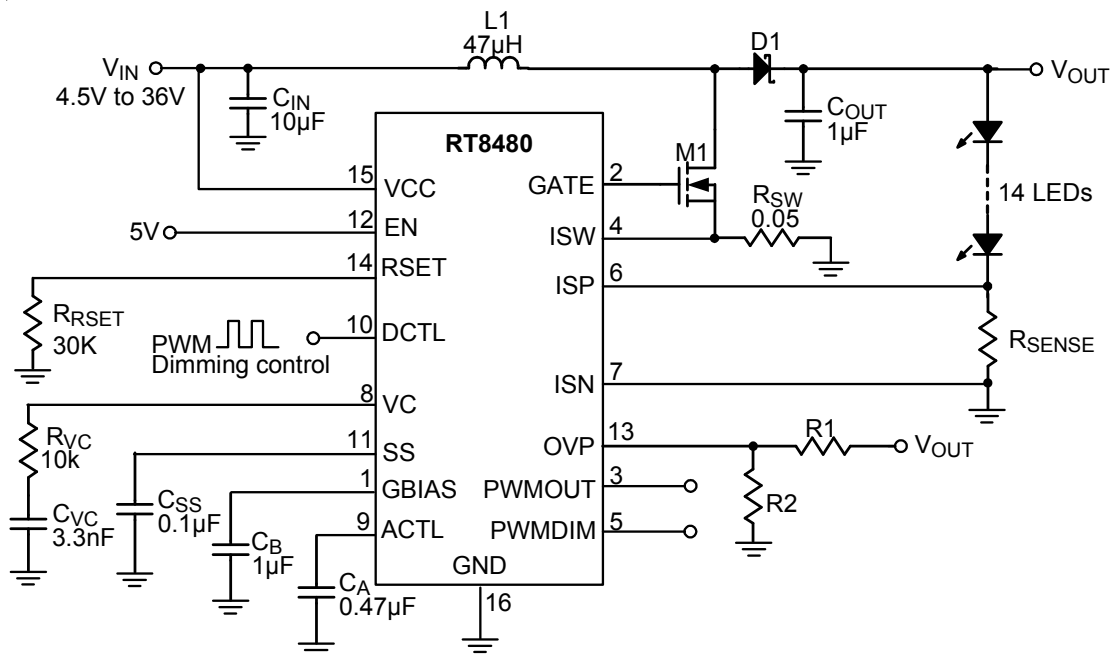


Figure 2. PWM to Analog Dimming in Boost Configuration

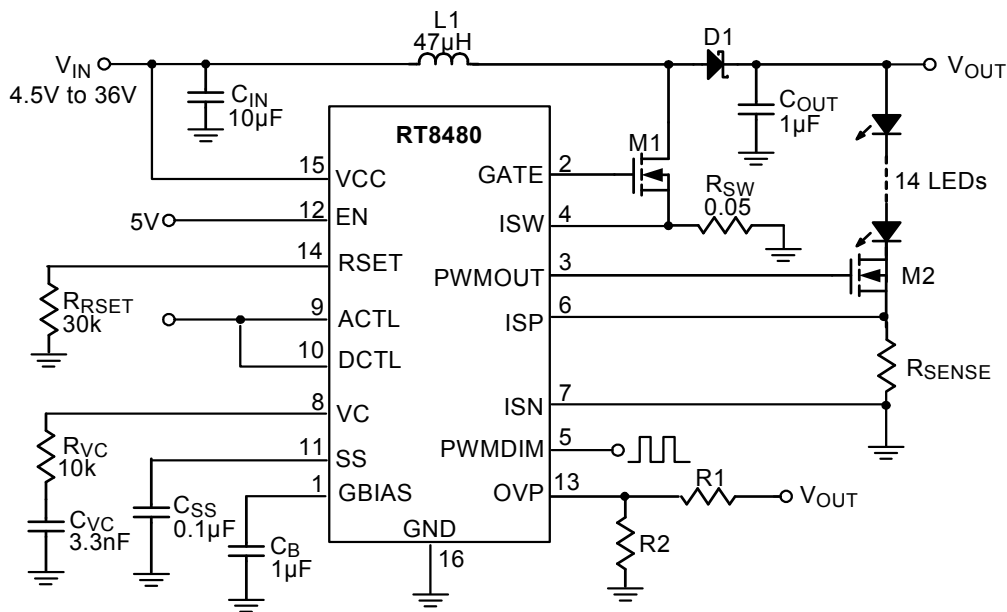


Figure 3. True PWM Dimming in Boost Configuration

Functional Pin Description

SOP-16	Pin Name	Pin Function
1	GBIAS	The Internal Gate Driver Bias Pin. A good bypass capacitor is required.
2	GATE	The External MOSFET Switch Gate Driver Output Pin.
3	PWMOUT	The Output Pin for the PWM Dimming FET Driver.
4	ISW	The External MOSFET Switch Current Sense Pin. Connect the current sense resistor between external N-MOSFET switch and the ground.
5	PWMDIM	The Control Input Pin for the PWM Dimming FET Driver.
6	ISP	The LED Current Sense Amplifier Positive Input.
7	ISN	The LED Current Sense Amplifier Negative Input. Voltage threshold between ISP and ISN is 190mV.
8	VC	The PWM Control Loop Compensation Pin.
9	ACTL	The Analog Dimming Control Pin. The effective programming voltage range of the pin is between 0.3V and 1.2V.
10	DCTL	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 following the formula below. $V_{ACTL} = 1.2V \times \text{PWM Dimming Duty Cycle}$.
11	SS	The Soft-Start Pin. A capacitor of at least 10nF is required for proper soft start.
12	EN	The Chip Enable (Active High) Pin. When this pin voltage is low, the chip is in shutdown mode.
13	OVP	The Over Voltage Protection Pin. The PWM converter turns off when The voltage of the pin goes to higher than 1.2V.
14	RSET	Set switching frequency with a resistor from RSET to GND. $R_{RSET} = 30k\Omega$ will set $F_{SW} = 370kHz$.
15	VCC	The Power Supply Pin of the Chip. For good bypass, a low ESR Capacitor is required.
16	GND	The Ground Pin. The exposed pad must be soldered to a large PCB. And connected to GND for maximum power dissipation.

Function Block Diagram

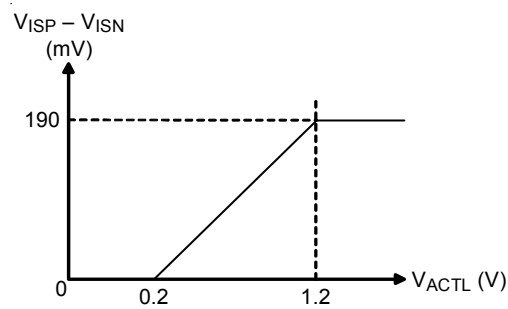
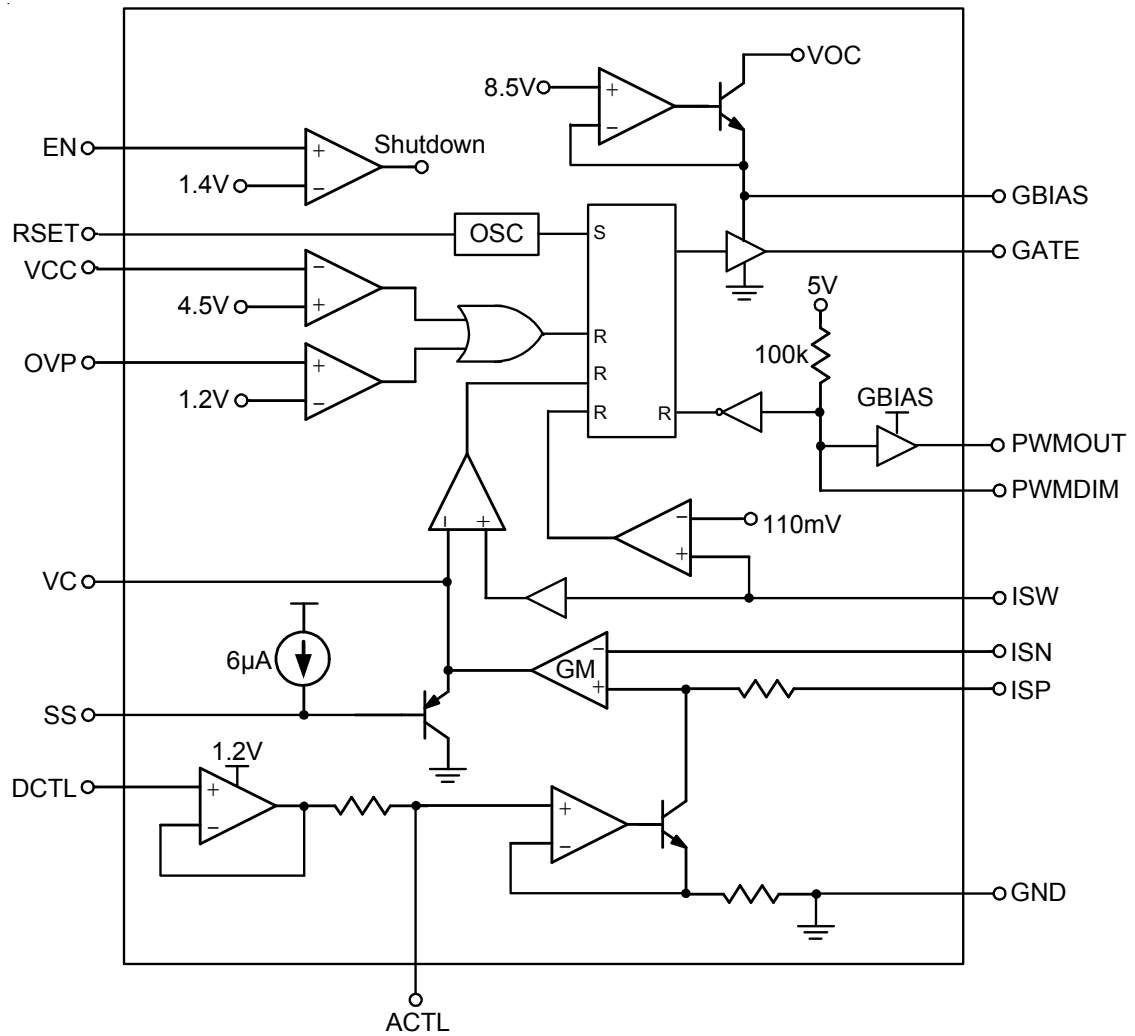


Figure 6

Absolute Maximum Ratings (Note 1)

- Supply Input Voltage, V_{CC} ----- 38V
- GBIAS, GATE, PWMDIM, PWMOUT ----- 10V
- ISW ----- 1V
- ISP, ISN ----- 2V
- DCTL, ACTL, OVP Pin Voltage ----- 8V (Note 6)
- EN Pin Voltage ----- 20V
- Power Dissipation, $P_D @ T_A = 25^\circ\text{C}$
- SOP-16 ----- 1.0W
- Package Thermal Resistance (Note 4)
- SOP-16, θ_{JA} ----- 95°C/W
- Junction Temperature ----- 150°C
- Lead Temperature (Soldering, 10 sec.) ----- 260°C
- Storage Temperature Range ----- -65°C to 150°C
- ESD Susceptibility (Note 2)
- HBM (Human Body Mode) ----- 2kV
- MM (Machine Mode) ----- 200V

Recommended Operating Conditions (Note 3)

- Supply Input Voltage Range, V_{CC} ----- 4.5V to 36V
- Junction Temperature Range ----- -40°C to 125°C
- Ambient Temperature Range ----- -40°C to 85°C

Electrical Characteristics

($V_{CC} = 24\text{V}$, No Load on any Output, $T_A = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Overall						
Supply Current	I_{VCC}	$V_C \leq 0.4\text{V}$ (Switching off)	--	6	7.2	mA
Shutdown Current	I_{SHDN}	$V_{EN} \leq 0.7\text{V}$	--	12	--	μA
EN Threshold Voltage	V_{EN}		--	1.4	--	V
EN Input Current		$V_{EN} \leq 3\text{V}$	--	--	1.2	μA
Current Sense Amplifier						
Input Threshold ($V_{ISP} - V_{ISN}$)		$12\text{V} \leq \text{common mode} \leq 36\text{V}$	170	190	210	mV
ISP / ISN Input Current	I_{ISP} / I_{ISN}	$4.5\text{V} \leq V_{ISP} = V_{ISN} \leq 52\text{V}$	--	140	--	μA
ISP / ISN Common Mode Voltage			--	--	1	V
VC Output Current	I_{VC}	$V_{ISP} - V_{ISN} = 190\text{mV}$, $0.5\text{V} \leq V_C \leq 2.4\text{V}$	--	± 20	--	μA
VC Threshold for PWM Switch Off			--	0.7	--	V
LED Dimming						
Analog Dimming ACTL Pin Input Current	I_{ACTL}	$V_{ACTL} = 1.2\text{V}$	--	1	--	μA
		$V_{ACTL} = 0.3\text{V}$	--	10	--	

To be continued

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
LED Current Off Threshold at ACTL	V _{ACTL_Off}		–	0.3	--	V
DCTL Input Current	I _{DCTL}	0.3V ≤ V _{DCTL} ≤ 6V	–	--	0.5	μA
PWM Control						
Switching Frequency	f _{SW}	R _{RSET} = 30kΩ	300	370	440	kHz
Maximum Duty Cycle (Note 5)			–	93	--	%
Switch Gate Driver						
GBIAS Voltage	V _{GBIAS}	I _{GBIAS} = 20mA	–	8.5	--	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	–	15	--	ns
PWM Switch Current Limit Threshold	I _{SW_LIM}		–	110	--	mV
PWM Dimming Gate Driver						
PWMDIM Threshold (Low to High)			–	1.5	--	V
PWMDIM Threshold Hysteresis			–	0.5	--	V
PWMOUT Drive Rise and Fall Time		1nF Load at PWMOUT	–	40	--	ns
OVP and Soft Start						
OVP Threshold	V _{OVP_th}		–	1.2	--	V
OVP Input Current	I _{OVP}	0.7V ≤ V _{OVP} ≤ 1.5V	–	--	0.1	μA
Soft Start Pin Current	I _{SS}	V _{SS} ≤ 2V	–	6	--	μA

Note 1. Stresses beyond those listed under “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 for extended periods may affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution is recommended.

Note 3. The device is not guaranteed to function outside its operating conditions.

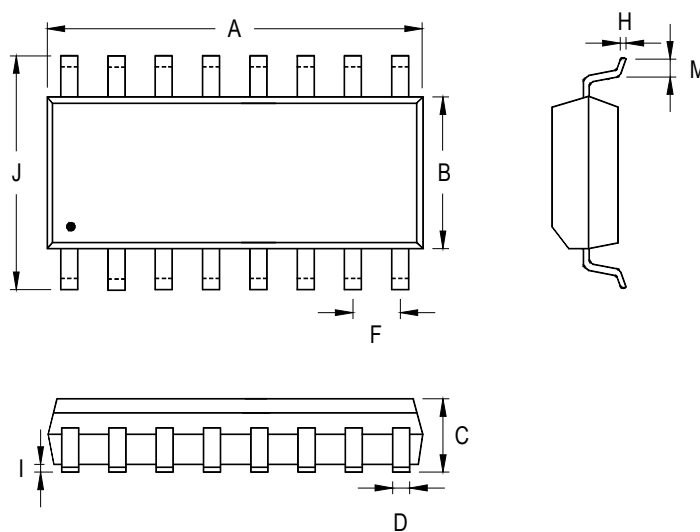
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective four layers thermal conductivity test board of JEDEC 51-7 thermal measurement standard.

Note 5. When the natural maximum duty cycle of the switching frequency is reached, the switching cycle will be skipped (not reset) as the operating condition requires to effectively stretch and achieve higher on cycle than the natural maximum duty cycle set by the switching frequency.

Note 6. If connected with a 20kΩ serial resistor, ACTL and DCTL can go up to 36V.

Datasheet Revision History

Version	Date	Page No.	Item	Description
P00	2009/7/30			First edition
P01	2009/8/3		Features Absolute Maximum Ratings Typical Application Circuit (Figure 3) Electrical Characteristics	Modify
P02	2009/8/12		General Description Features Typical Application Circuit Electrical Characteristics	Modify



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	9.804	10.008	0.386	0.394
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

16-Lead SOP Plastic Package