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

General Description

The RT8452 is a current mode PWM controller designed to drive an external MOSFET for high current LED applications. With a current sense amplifier threshold of 180mV, the LED current is programmable with one external current sense resistor and the power loss is minimized. With the maximum operating input voltage of 40V and output voltage up to 60V, the RT8452 is ideal for boost or buck-boost operation. (See RT8450 and RT8451 for buck mode LED driver application.)

With 1MHz operating frequency, the external inductor and capacitors can be small while mainteining high efficiency.

Dimming can be either analog or PWM digital. The unique built-in clampping comparator and filter allow easy low noise analog dimming conversion from PWM signal with only one external capacitor. PWM dimming control is made easy with a build in FET driver dedicated for the extermal dimming MOSFET.

The RT8452 is available in WQFN-16L 3x3 and SOP-16 packages.

Ordering Information

RT8452 □□

- Package Type
  - S : SOP-16
  - QW : WDFN-16L 3x3 (W-Type)
- Operating Temperature Range
  - G : Green (Halogen Free with Commercial Standard)

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.
- }100% matte tin (Sn) plating.

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

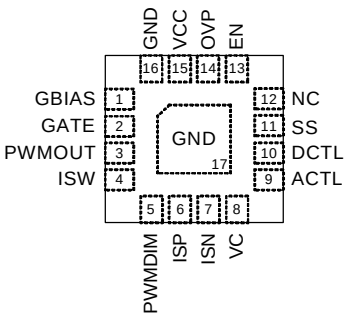
- **High Voltage Capability : V_{IN} Up to 40V, V_{OUT} Up to 60V**
- **Boost or Buck-Boost Operation**
- **Current Mode PWM with 1MHz Switching Frenquency**
- **Easy Dimming : Analog, PWM Digital or PWM Converting to Analog with One External Capacitor**
- **Programmable Soft Start to Avoid Inrush Current**
- **Programmable Over Voltage Protection to Limit Output Voltage**
- **V_{IN} Undervoltage Lockout and Thermal Shutdown**
- **16-Lead WDFN and SOP Packages.**
- **RoHS Compliant and 100% Lead (Pb)-Free**

Applications

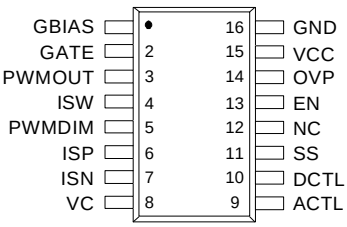
- General Industrial High Power LED Lighting
- Desk Lights and Room Lighting
- Building and Street Lighting
- Industrial Display Backlight

Pin Configurations

(TOP VIEW)



WQFN-16L 3x3



SOP-16

Typical Application Circuit

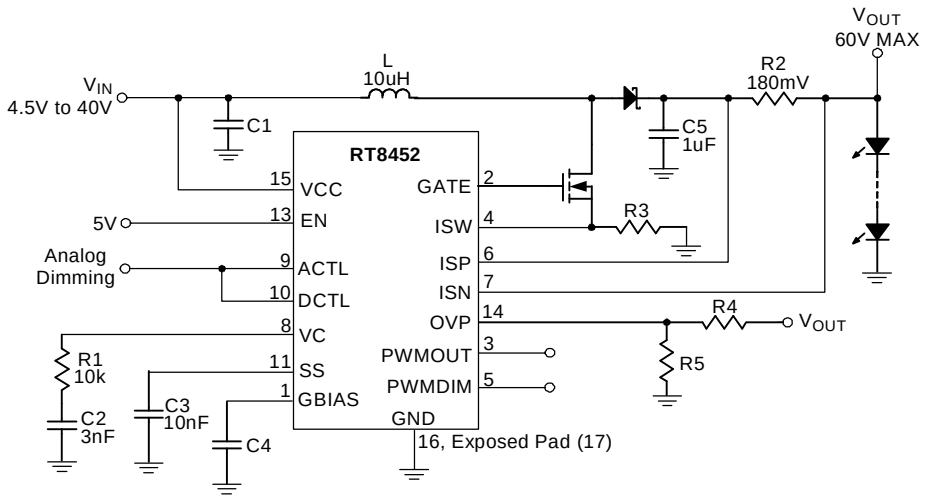


Figure 1. Analog Dimming in Boost Configuration

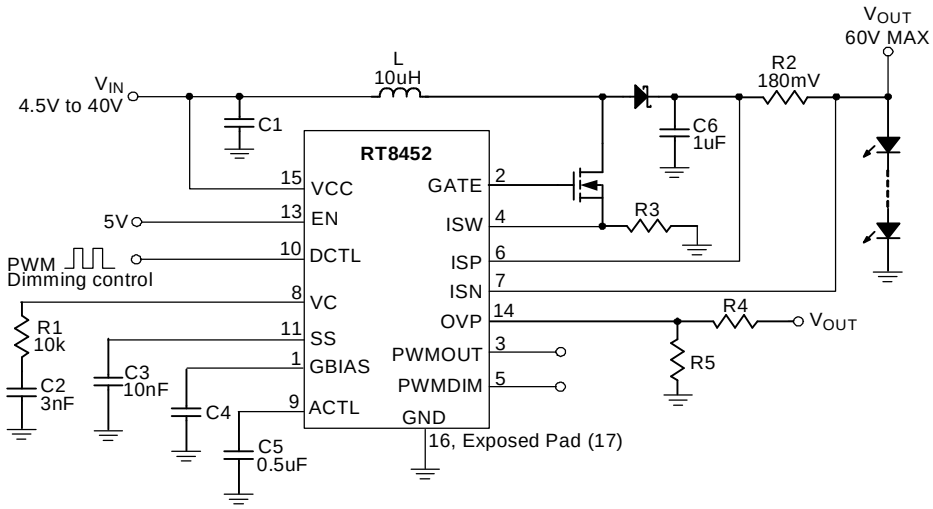


Figure 2. PWM to Analog Dimming in Boost Configuration

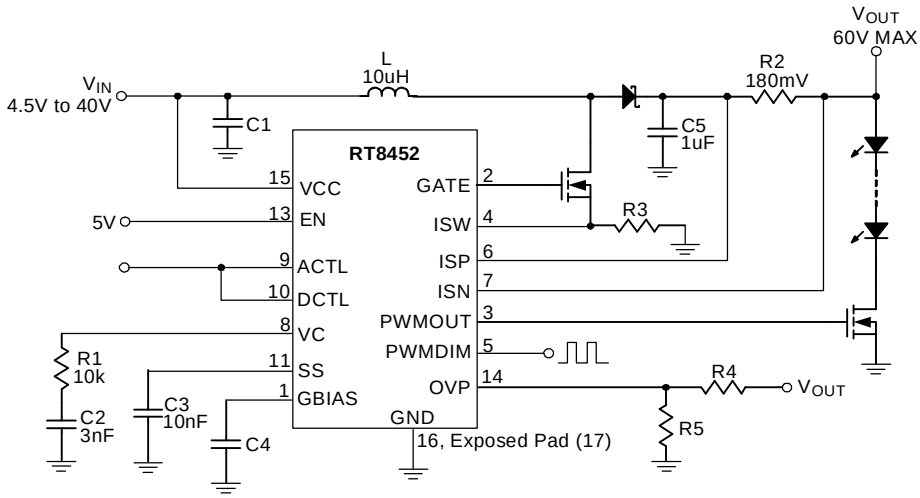


Figure 3. True PWM Dimming in Boost Configuration

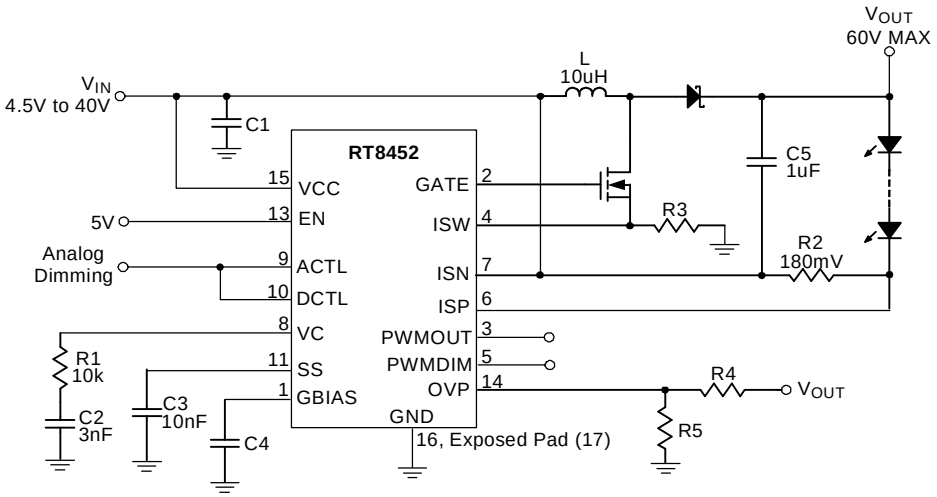
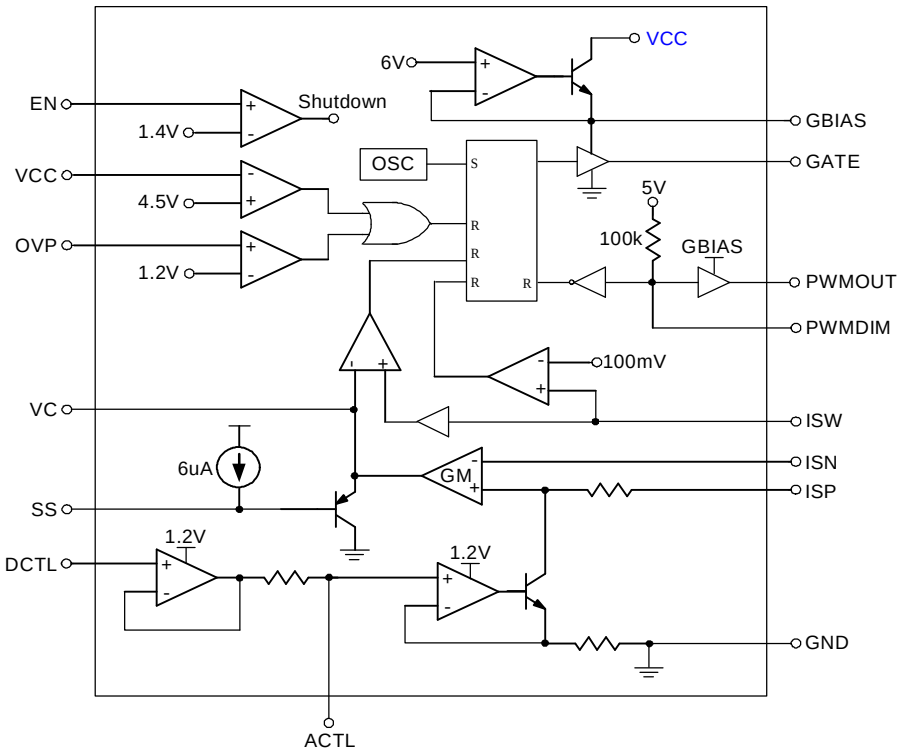


Figure 4. Analog Dimming in Buck-Boost Configuration

Functional Pin Description

SOP-16	QFN3X3-16	Pin Name	Pin Function
1	1	GBIAS	The Internal Gate Driver Bias Pin.A good bypass capacitor is required.
2	2	GATE	The External MOSFET Switch Gate Driver Output Pin.
3	3	PWMOUT	The Output Pin for the PWM Dimming FET Driver.
4	4	ISW	The External MOSFET Switch Current Sense Pin. Connect the current sense resistor between external N-MOSFET switch and the ground.
5	5	PWMDIM	The Control Input Pin for the PWM Dimming FET Driver.
6	6	ISP	The LED Current Sense Amplifier Positive Input.
7	7	ISN	The LED Current Sense Amplifier Negative Input. Voltage threshold between ISP and ISN is 180mV.
8	8	VC	The PWM Control Loop Compensation Pin.
9	9	ACTL	The Analog Dimming Control Pin. The effective programming voltage range of the pin is between 0.3V and 1.2V.
10	10	DCTL	By adding a 0.1uF 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 x PWM Dimming Duty Cycle.
11	11	SS	The Soft-Start Pin. A capacitor of at least 10nF is required for proper soft start.
12	12	NC	No Internal Connection.
13	13	EN	The Chip Enable (Active High) Pin. When this pin voltage is low, the chip is in shutdown mode.
14	14	OVP	The Over Voltage Protection Pin. The PWM converter turns off when The voltage of the pin goes higher than 1.2V.
15	15	VCC	The Power Supply Pin of the Chip. For good bypass, a low ESR Capacitor is required.
16	16 Exposed Pad (17)	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



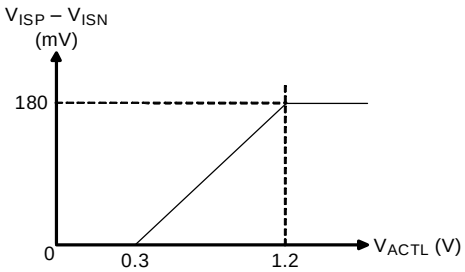


Figure 5

Absolute Maximum Ratings (Note 1)

- Supply Input Voltage, V_{CC} ---- 45V
- GBIAS, GATE, PWMDIM, PWMOUT, ISW ---- 10V
- ISP, ISN ---- 65V
- DCTL, ACTL, OVP, EN ---- 20V
- Power Dissipation, P_D @ T_A = 25°C
  - SOP-16 ---- 1.053W
  - WQFN-16L 3x3 ---- 1.471W
- Package Thermal Resistance (Note 4)
  - SOP-16, θ_{JC} ---- 95°C/W
  - SOP-16, θ_{JC} ---- 45°C/W
  - WQFN-16L 3x3, θ_{JA} ---- 68°C/W
  - WQFN-16L 3x3, θ_{JC} ---- 7.5°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)

- Junction Temperature Range ---- –40°C to 125°C
- Ambient Temperature Range ---- –40°C to 85°C

Electrical Characteristics

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Overall						
Supply Voltage	V_{CC}		4.5	--	40	V
Supply Current	I_{VCC}	VC ≤ 0.4V (Switching off)	--	4	6	mA
Shutdown Current	I_{SHDN}	V_{EN} ≤ 0.7V	--	12	--	uA
Shutdown Threshold	V_{EN}		--	1.4	--	V
EN Input Current		V_{EN} ≤ 5V	--	--	0.5	uA
Current Sense Amplifier						
Input Threshold (V_{ISP} – V_{ISN})		4.5V ≤ common mode ≤ 40V	170	180	190	mV
ISP / ISN Input Current	I_{ISP} / I_{ISN}	4.5V ≤ V_{ISP} = V_{ISN} ≤ 60V	--	140	--	uA
VC Output Current	I_{VC}	V_{ISP} – V_{ISN} = 120mV, 0.5V ≤ V_C ≤ 2.4V	--	±20	--	uA
VC Threshold for PWM Switch Off			--	0.7	--	V
LED Dimming						
Analog Dimming ACTL Pin Input Current	I_{ACTL}	0.3V ≤ V_{ACTL} ≤ 1.3V	--	--	1	uA

To be continued

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
LED Current Off Threshold at ACTL	V_{ACTL_Off}		--	0.2	--	V
DCTL Input Current	I_{DCTL}	$0.3V \le V_{DCTL} \le 6V$	--	--	0.5	uA
PWM Control						
Switching Frequency	f_{SW}		800k	1M	1.2M	Hz
Maximum Duty Cycle (Note 5)			--	86	--	%
Minimum on Time			--	200	--	ns
Switch Gate Driver						
GBIAS Voltage	V_{GBIAS}	I_{GBIAS} = 20mA	--	5.7	--	V
Gate Voltage High	V_{Gate_H}	I_{Gate} = –50mA	--	4.2	--	V
		I_{Gate} = –100uA	--	5	--	
Gate Voltage Low	V_{Gate_L}	I_{Gate} = 50mA	--	0.25	--	V
		I_{Gate} = 100uA	--	0.1	--	
GATE Drive Rise and Fall Time		1nF Load	--	15	--	ns
PWM Switch Current Limit Threshold	I_{SW_LIM}		--	100	--	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	--	40	--	ns
OVP and Soft Start						
OVP Threshold	V_{OVP_th}		--	1.2	--	V
OVP Input Current	I_{OVP}	$0.7V \le V_{OVP} \le 1.5V$	--	--	0.1	uA
Soft Start Pin Current	I_{SS}	$V_{SS} \le 2V$	--	6	--	uA

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 recommended. The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

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

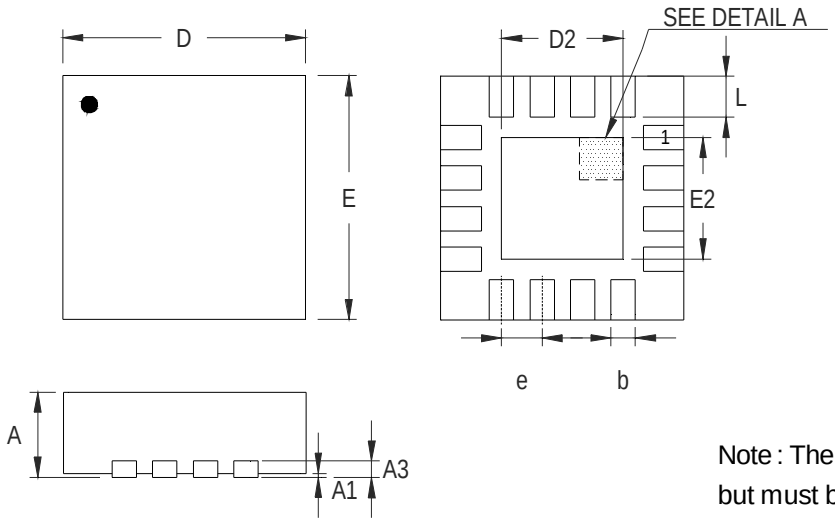
Note 4. θ_{JA} is measured in the natural convection at T_A = 25°C on a high effective four layers thermal conductivity test board of JEDEC 51-7 thermal measurement standard.

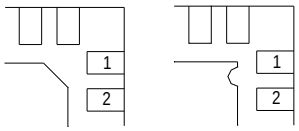
Note 5. When the natural maximum duty cycle of 1MHz switching frequency is reached, the switching cycle will be skipped (not reset) as the operating condition requires to effectively stretch and achieve higher on cycle than the natural maximum duty cycle set by the 1MHz switching frequency.

Datasheet Revision History

Version	Data	Page No.	Item	Description
00C	2008/2/22			first edition
01C	2008/2/27		Features Typical Application Circuit Functional Pin Description Function Block Diagram Electrical Characteristics	Modify
02C	2008/3/18		Ordering Information	Modify

Outline Dimension





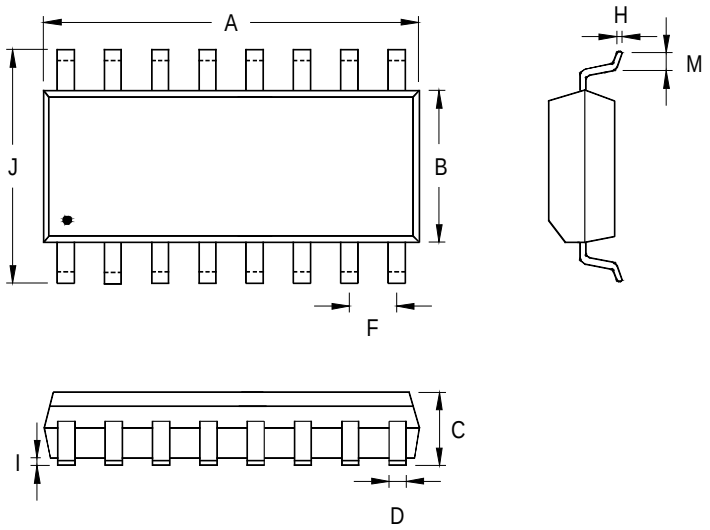
DETAIL A

Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.175	0.250	0.007	0.010
b	0.180	0.300	0.007	0.012
D	2.950	3.050	0.116	0.120
D2	1.300	1.750	0.051	0.069
E	2.950	3.050	0.116	0.120
E2	1.300	1.750	0.051	0.069
e	0.500		0.020	
L	0.350	0.450	0.014	0.018

W-Type 16L QFN 3x3 Package



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

Richtek Technology Corporation

Headquarter
5F, No. 20, Taiyuen Street, Chupei City
Hsinchu, Taiwan, R.O.C.
Tel: (8863)5526789 Fax: (8863)5526611

Richtek Technology Corporation

Taipei Office (Marketing)
8F, No. 137, Lane 235, Paochiao Road, Hsintien City
Taipei County, Taiwan, R.O.C.
Tel: (8862)89191466 Fax: (8862)89191465
Email: marketing@richtek.com

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