

60mA 3-Channel Pulse Dimming Current Source LED Driver

General Description

The RT9302 is a high performance constant current driver for white LED. It supports up to 3 white LEDs and regulates a constant current for uniform intensity. Each channel supports up to 20mA output current with 1% typical current accuracy and 0.7% typical current matching. The RT9302 provides a 16-step brightness dimming control. The LED current can be easily configured from 1.25mA to 20mA. The dimming of white LEDs' current can be achieved by applying a pulse signal to the EN pin. The LED current can be turned off by EN pin with pull low for 20 μ s or longer. The typical leakage current is 4 μ A while shutdown condition.

RT9302 is available in a TSOT-23-8 package (1.0mm maximum height).

Ordering Information

RT9302	□□
	Package Type J8 : TSOT-23-8
	Operating Temperature Range P : Pb Free with Commercial Standard G : Green (Halogen Free with Commercial Standard)

Note :

RichTek Pb-free and 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.

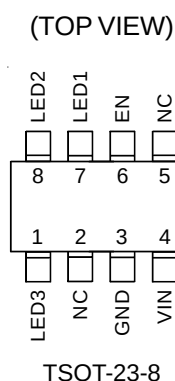
Features

- Support Up to 3 White LEDs
- Output Current up to 20mA Each Channel
- Support Pulse and PWM Dimming
- 40mV Typical Current Source Dropout
- 1% Typical LED Current Accuracy
- 0.7% Typical LED Current Matching
- 16-Step Brightness Control
- Low Noise and EMI
- Low Shutdown Current 4 μ A Typical
- RoHS Compliant and 100% Lead (Pb)-Free

Applications

- Mobile Phone, DSC, MP3
- White LED Backlighting
- LCD Display Supply

Pin Configurations



Note : There is no pin1 indicator on top mark for TSOT-23-8 type, and pin 1 will be lower left pin when reading top mark from left to right.

Typical Application Circuit

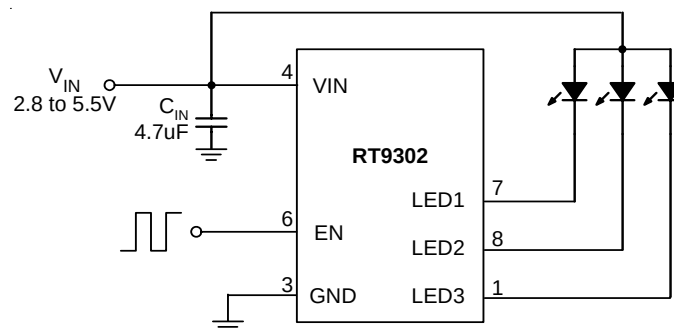


Figure 1. For 3-WLEDs Application Circuit

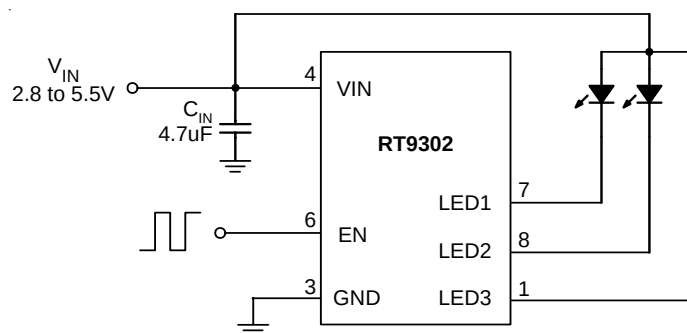


Figure 2. For 2-WLEDs Application Circuit

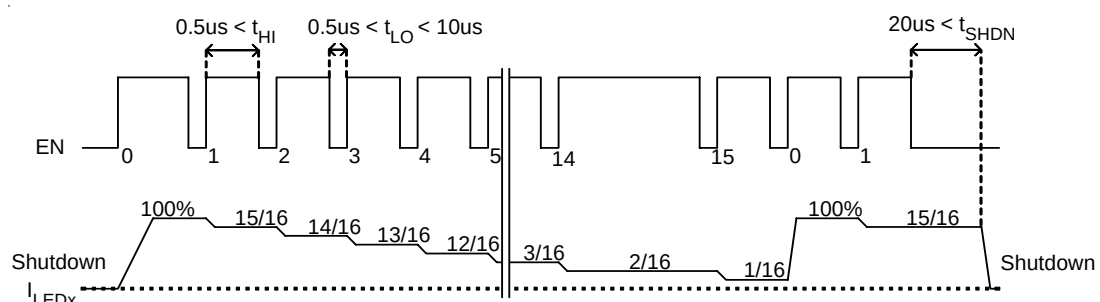
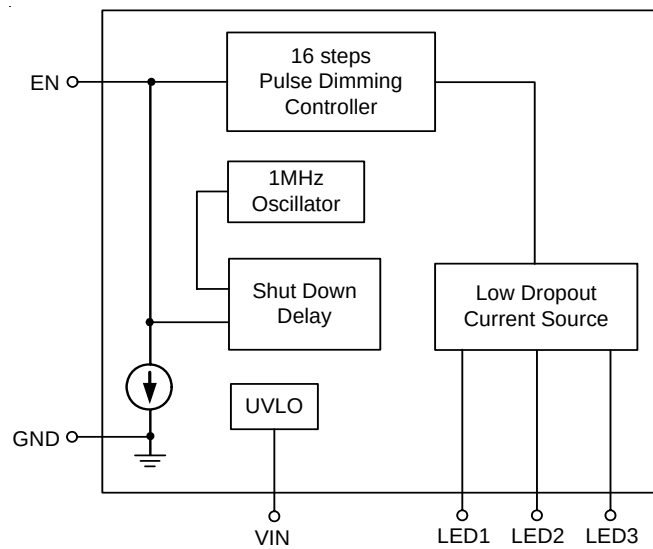


Figure 3. Brightness control by pulse dimming. RT9302 implements 16 steps brightness control

Functional Pin Description

Pin Number	Pin Name	Pin Function
1	LED3	Current Sink for LED3. (If not in use, this pin must be connected to VIN)
2, 5	NC	No Internal Connection.
3	GND	Power Ground.
4	VIN	Input Voltage.
6	EN	Chip Enable.
7	LED1	Current Sink for LED1. (If not in use, this pin must be connected to VIN)
8	LED2	Current Sink for LED2. (If not in use, this pin must be connected to VIN)

Function Block Diagram



Absolute Maximum Ratings (Note 1)

- Supply Input Voltage ----- -0.3V to 6V
- Other I/O Pin Voltages ----- -0.3V to 6V
- VIN, EN to GND ----- 6V
- Power Dissipation, P_D @ $T_A = 25^\circ\text{C}$
 TSOT-23-8 ----- 0.455W
- Package Thermal Resistance (Note 4)
 TSOT-23-8, θ_{JA} ----- 220°C/W
- Lead Temperature (Soldering, 10 sec.) ----- 260°C
- Junction Temperature ----- 150°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

($V_{IN} = 3.6\text{V}$, $C_{IN} = 1\mu\text{F}$, $\text{ESR} = 0.03\Omega$, $V_F = 3.4\text{V}$, $I_{LED1} = I_{LED2} = I_{LED3} = 20\text{mA}$, $T_A = 25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Input						
Input Supply Voltage	V_{IN}		2.8	--	5.5	V
Under Voltage Lockout Threshold		V_{IN} falling	--	2.0	--	V
Under Voltage Lockout Hysteresis			--	200	--	mV
Shutdown Current	I_{SHDN}	$V_{EN} = 0\text{V}$	--	4	10	μA
Quiescent Current	I_Q	$V_{EN} = \text{High}$, $I_{OUT} = 0$	--	0.4	--	mA
Output						
Output Current	I_{LED}	100% setting, $V_{LED} = 1\text{V}$	18.4	20	21.6	mA
Current Matching	$I_{LED-LED}$	100% setting, $V_{LED} = 1\text{V}$	-5	0	+5	%
Dropout Voltage	V_{LED}	90% of full output current	--	40	150	mV
Enable						
EN Threshold Voltage	Logic-High	V_{IH}	1.5	--	--	V
	Logic-Low	V_{IL}	--	--	0.4	V
Time of EN Logic	Logic-High	T_{HI}	Duration of EN Logic High for pulse dimming	0.5	--	μs
	Logic-Low	T_{LO}	Duration of EN Logic Low for pulse dimming	0.5	--	10 μs
Shutdown Delay	T_{SHDN}	From EN Low to Shutdown	10	16	20	μs
EN Input Current	I_{EN}	$V_{EN} = 1.8\text{V}$	--	1	--	μA

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

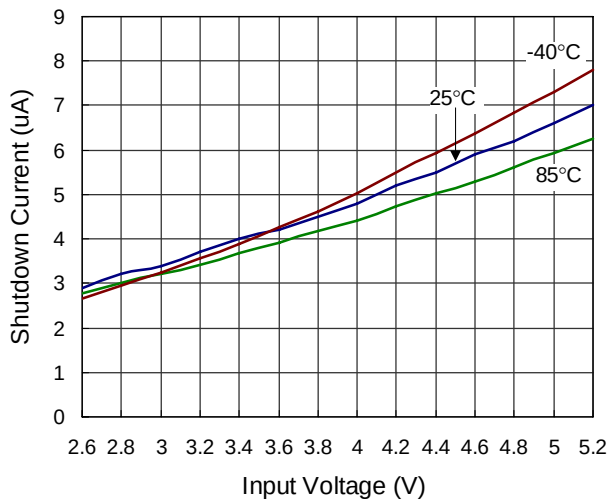
Note 2. Devices are ESD sensitive. Handling precaution recommended.

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

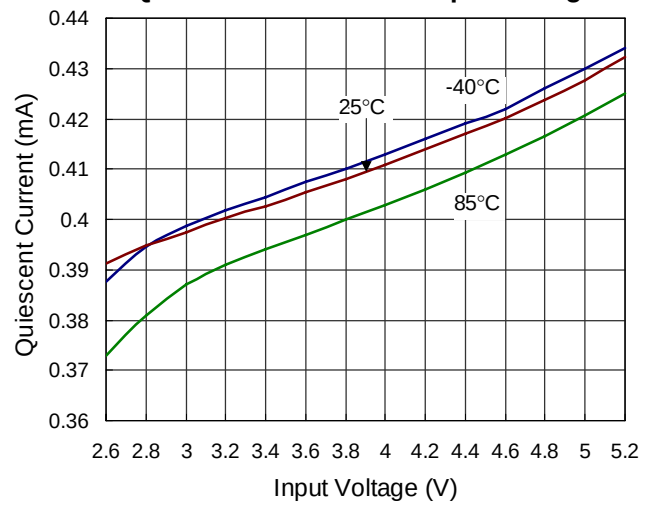
Note 4. θ_{JA} is measured in the natural convection at $T_A = 25^\circ\text{C}$ on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Typical Operating Characteristics

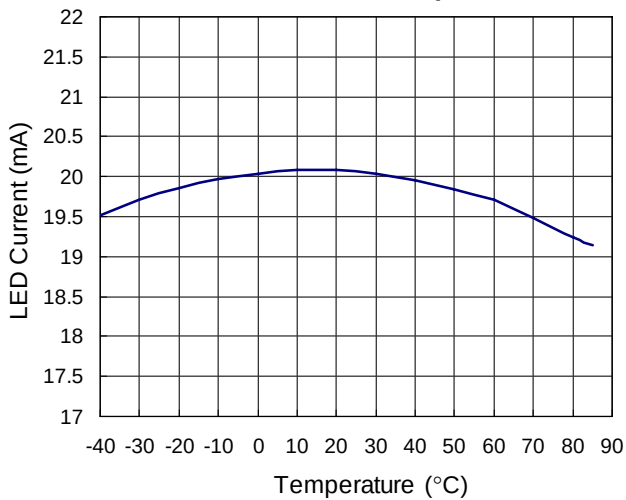
Shutdown Current vs. Input Voltage



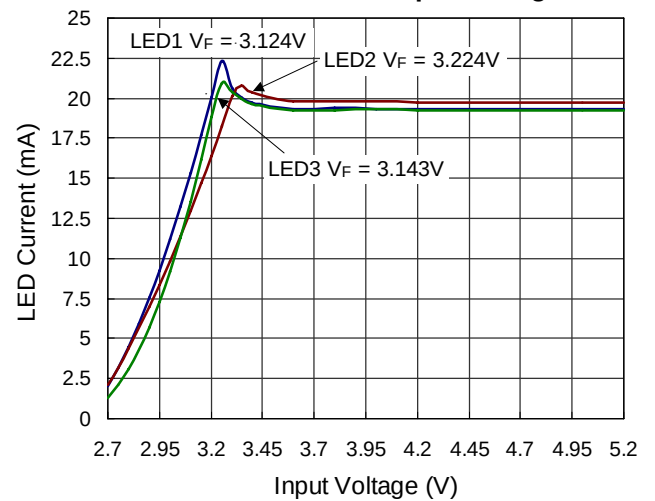
Quiescent Current vs. Input Voltage



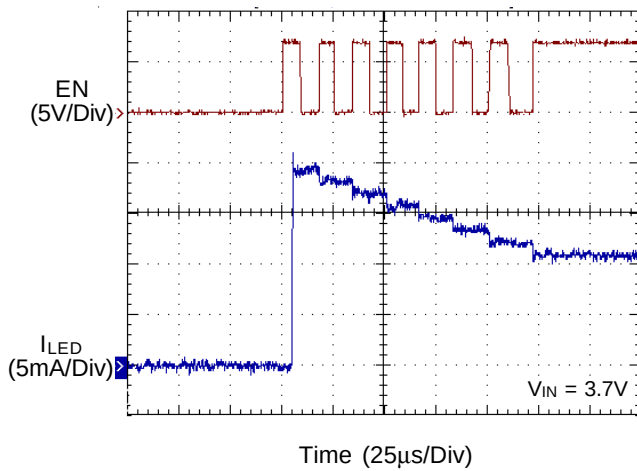
LED Current vs. Temperature



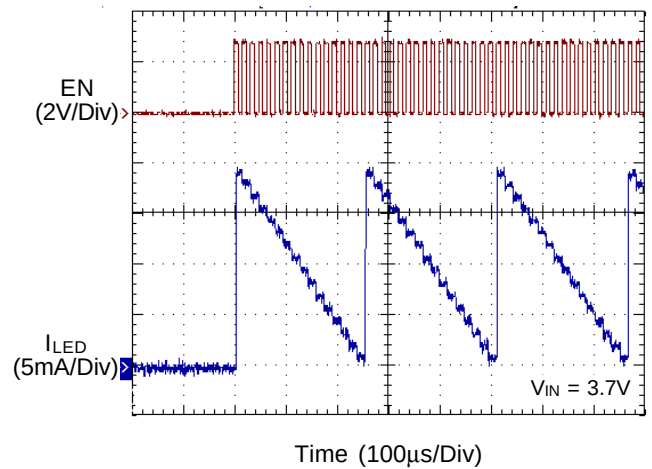
LED Current vs. Input Voltage



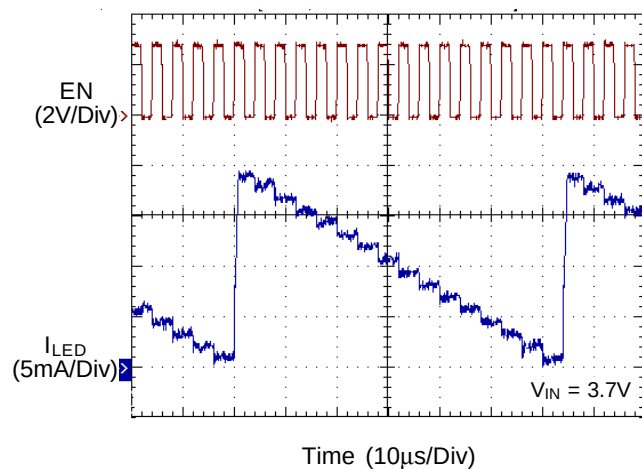
Dimming Operation



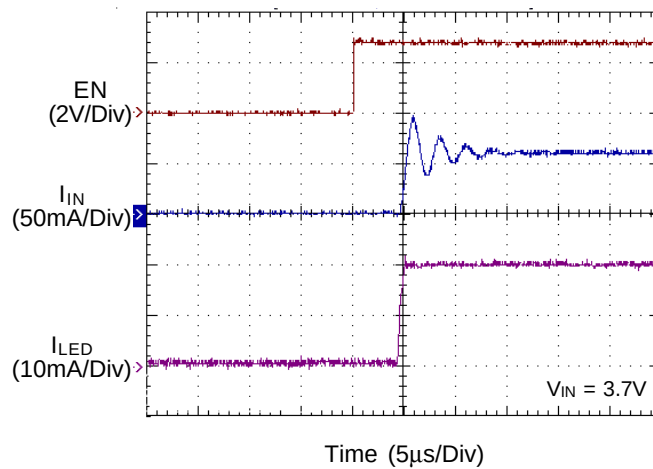
Dimming Operation



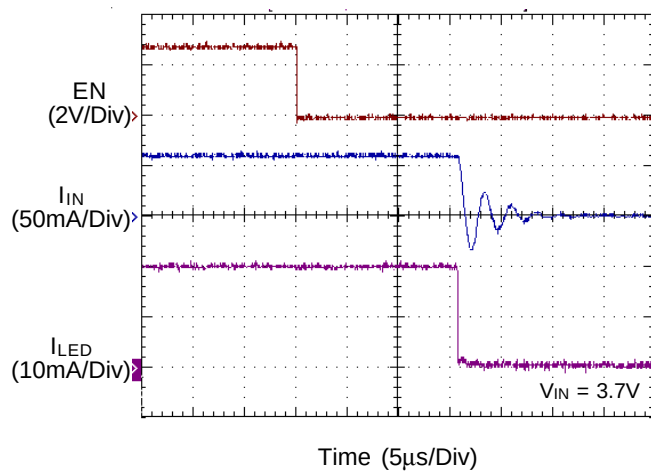
Dimming Operation



Turn-On



Turn-Off



Application Information

Input UVLO

The input operating voltage range of the RT9302 is 2.8V to 5.5V. An input capacitor at the VIN pin could reduce ripple voltage. It is recommended to use a ceramic 1 μ F or larger capacitance as the input capacitor. This IC provides an under voltage lockout (UVLO) function to prevent it from unstable issue when startup. The UVLO threshold of input falling voltage is set at 2V typically with a hysteresis 0.2V.

Output Current

RT9302 provides a constant output current for white LED. Figure 1 shows a typical application circuit for 3 white LEDs. Each channel supports up to 20mA output current and regulates a constant current for uniform intensity. For two or one LED application, the non-used channel must be connected to V_{IN} as shown in Figure 2.

Brightness Dimming Control

The RT9302 provides a 16-step brightness dimming control. The LED current can be easily configured from 1.25mA to 20mA. The dimming of white LEDs' current can be achieved by applying a pulse signal to the EN pin. Figure 3 shows the configuration of the 16-step pulse dimming control operation. The output current is set at 100% of 20mA typical output current when EN pin pull high initially from shutdown condition. The step change of pulse dimming can be implemented by EN pin changing with a logic Low pulse. Each step change 1/16 of full output current setting. The output current change of pulse dimming is designed in decreasing sequence in terms of (16/16, 15/16,, 1/16) and then (16/16, 15/16,) cycle by cycle. The duration of logic Low pulse is between 0.5 μ s and 10 μ s. The duration of EN logic High pulse should be longer than 0.5 μ s.

The LED current can be turned off by EN pin with pulling low for 20 μ s or longer. The typical leakage current is 4 μ A while shutdown condition.

Layout Consideration

For best performance, careful PCB layout is necessary. All peripheral components should be placed as close to

the IC as possible. A short connection is highly recommended. The following guidelines should be strictly followed when designing a PCB layout for the RT9302.

1. All the traces of LED and V_{IN} running from chip to LEDs should be wide and short to reduce the parasitic connection resistance.
2. Input capacitor (C_{IN}) should be placed close to VIN and connected to ground plane. The anodes of LEDs must be connected to C_{IN}, not battery directly.
3. The GND should be connected to a strong ground plane for heat sinking and noise protection.

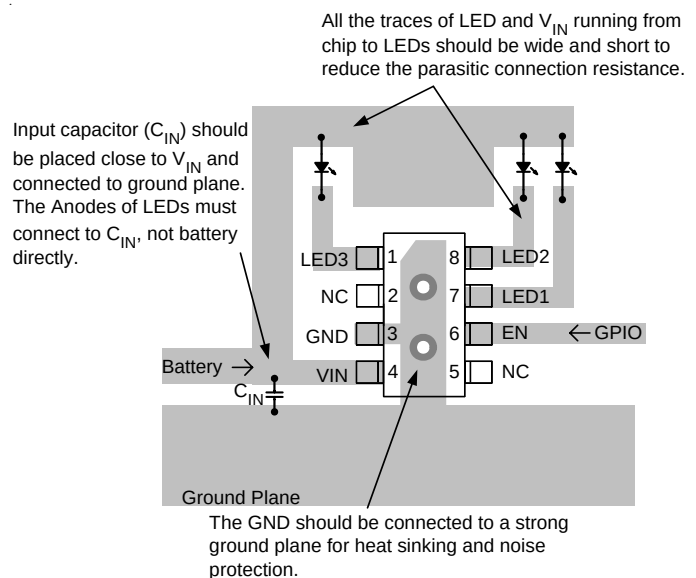
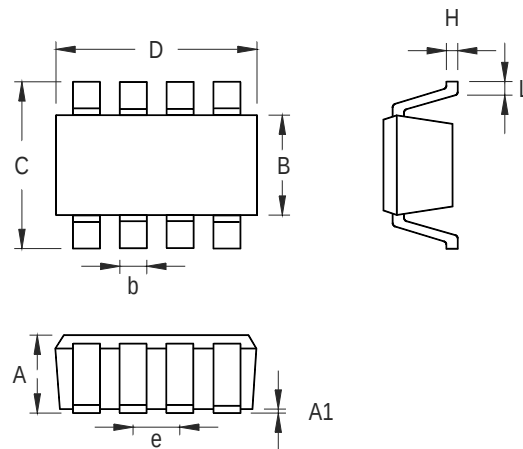


Figure 4. PCB Layout Guide

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	1.000	0.028	0.039
A1	0.000	0.100	0.000	0.004
B	1.397	1.803	0.055	0.071
b	0.220	0.380	0.009	0.015
C	2.591	3.000	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.585	0.715	0.023	0.028
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

TSOT-23-8 Surface Mount Package

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