60V, 800mA 3-Channel Constant Current LED Driver

Features

- 3-channel total output current: 800mA
  - Channel OUTA: 200mA
  - Channel OUTB: 200mA
  - Channel OUTC: 400mA
- ±4.5% LED current accuracy
- 7V to 40V wide power input voltage range
- 60V breakdown voltage
- Thermal protection: Current ramp down
- RoHS Compliant and Halogen Free

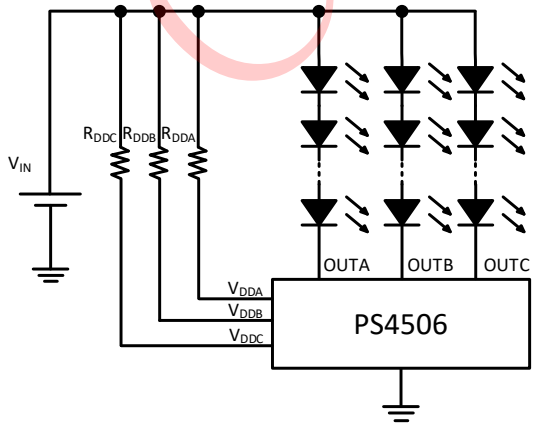
General Description

PS4506 is a 3-channel LED driver with constant current regulator. PS4506 offers excellent temperature stability and output current accuracy with a wide input voltage from 7V to 40V and temperature range. PS4506 implements various fixed output current versions without external current setting resistors and thus creates a simple solution for constant current LED driver. Besides, for the thermal management in LED, PS4506 is featured a current ramp down function from 125°C to 145°C of junction temperature. Moreover, taking reliability into consideration, the maximum voltage rating on VDDA/B/C and OUTA/B/C is designed as 60V ability to handle high voltage pulse suddenly. 3-channel functions are integrated in PSOP-8 package.

Applications

- DC general lighting
- Constant current COB light engine

Application Circuit



Recommended component table

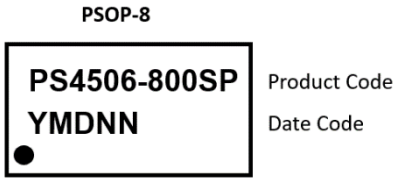
V_{IN}	$R_{DD(A/B)}$	R_{DDC}	LEDs (EA)
12V	20kΩ	10kΩ	3
24V	100kΩ	51kΩ	7
36V	180kΩ	87kΩ	11
48V	260kΩ	130kΩ	15

Contents

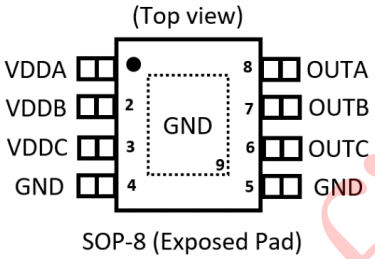
1 Ordering Information

Part no.	Package	Description	Product code
PS4506-800SP	SP: PSOP-8 (Exposed Pad)	60V, 800mA Single Channel High Power Linear LED Driver	PS4506-800SP

2 Marking Information



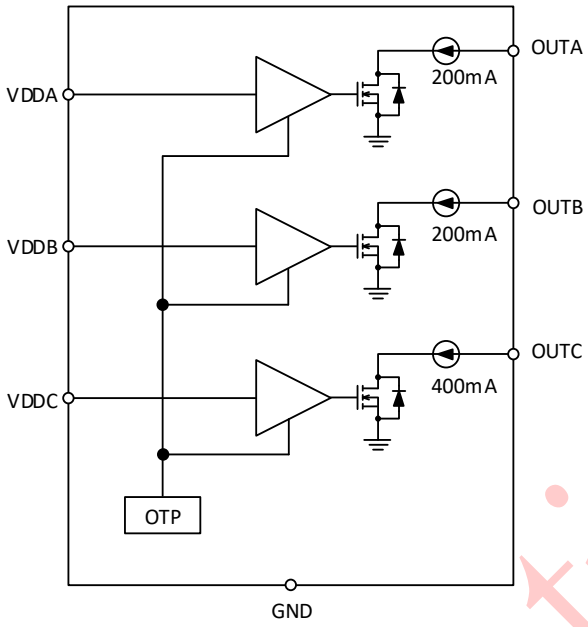
3 Pinout and Functions



Pin	Name	I/O(1)	Description
1	VDDA	I	Supply voltage to OUTA
2	VDDB	I	Supply voltage to OUTB
3	VDDC	I	Supply voltage to OUTC
4	GND	--	Connect to power ground
5	GND	--	Connect to power ground
6	OUTC	O	Output current regulated pin. Output current flows through this pin and regulated.
7	OUTB	O	Output current regulated pin. Output current flows through this pin and regulated.
8	OUTA	O	Output current regulated pin. Output current flows through this pin and regulated.
9	GND	--	Connect to power ground

(1) I= Input, O= Output, --= Other

4 Functional Block Diagram



5 Absolute Maximum Ratings (Note 1)

- Supply Input Voltage: VDDA, VDDB, VDDC .....-0.3V to 60V
- Other Pin Voltage: OUTA, OUTB, OUTC .....-0.3V to 60V
- Package Thermal Resistance (Note 2)
  - PSOP-8, θ_{JA} .....150°C/W
  - PSOP-8, θ_{JC} .....10°C/W
- Lead Temperature (Soldering, 10sec.).....260°C
- Junction Temperature .....150°C
- Storage Temperature ..... -65°C to 150°C

6 Recommended Operating Conditions (Note 3)

- Supply Input Voltage: VDDA, VDDB, VDDC .....7V~40V
- Junction Temperature Range..... -40°C to 125°C

Note 1: Stresses above the ones listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θ_{JA} is measured under natural convection (still air) at T_A= 25°C with the component mounted on a high effective-thermal-conductivity four-layer test board on a JEDEC 51-7 thermal measurement standard. θ_{JC} is measured at the exposed pad of the package

Note 3: Device function is not guaranteed if it is operated out of this range.

7 Electrical Characteristic

(V_{DD}= 7V, T_A= 25°C unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply voltage	V_{DDA}/V_{DDB}	$I_{OUTA/OUTB}$ = 200mA	7	--	40	V
	V_{DDC}	I_{OUTC} = 400mA				
Supply current	I_{DDA}/I_{DDB}	7V ≦ V_{DD} ≦ 40V	0.06	0.16	0.22	mA
	I_{DDC}		0.12	0.32	0.44	
Output current	I_{OUTA}/ I_{OUTB}		--	200	--	mA
	I_{OUTC}		--	400	--	
Minimum dropout voltage	$V_{DROPOUT}$	V_{DD} > 7V, I_{OUT}= 90%I_S	--	--	1	V
Output current accuracy	I_{Skew}		-4.5	--	4.5	%
Output current accuracy vs temperature	$I_{Skew,T}$	T_J= -40°C~120°C	-3	--	3	%
Current ramp down temperature	T_{J_down}	I_{OUT} ≧ 90%I_S	--	125	--	°C
Shutdown temperature	T_{J_shtdn}	I_{OUT} ≦ 10%I_S	--	145	--	°C
Output current accuracy vs V_{DD}	$I_{Skew,VDD}$	V_{DD}= 7V to 40V, V_{OUT}= 1V	-1.5	--	1.5	%
Output current accuracy vs V_{OUT}	$I_{Skew,VOUT}$	V_{OUT}= 0.3V to 40V, V_{DD}= 7V	-1.5	--	1.5	%

8 Application information

8.1 Output current combinations

PS4506 is a versatile LED driver with three output channels to support various output combinations. Excepts the original 200+200+400mA output, the output combination can also be 200+600mA, 400+400mA, 800mA. Figure 1/2/3 show the circuits of output channel combinations.

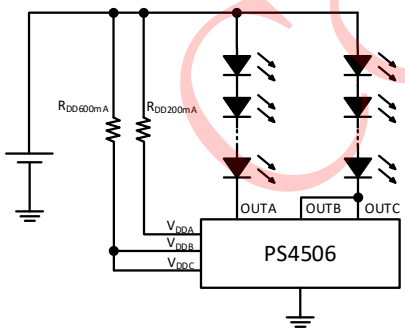


Figure 1. 200+600mA combo output

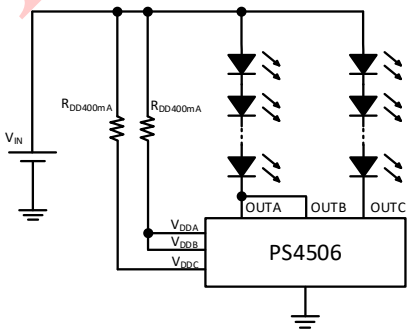


Figure 2. 400+400mA combo output

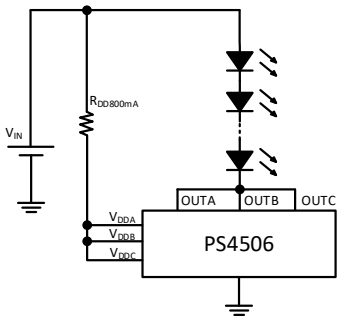


Figure 3. 800mA combo output

When the outputs are different, the resistor connected to the VDD pin should give different resistance as shown in the table on the right.

Recommended component table

V_{IN}	R_{DD} (200mA)	R_{DD} (400mA)	R_{DD} (800mA)	LEDs (EA)
12V	20kΩ	10kΩ	5.1kΩ	3
24V	100kΩ	51kΩ	27kΩ	7
36V	180kΩ	87kΩ	59kΩ	11
48V	260kΩ	130kΩ	68kΩ	15

8.2 PWM Dimming

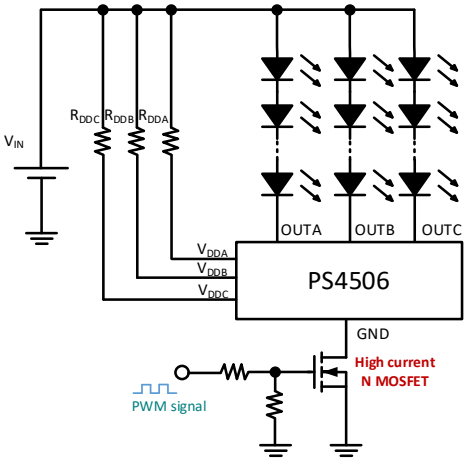


Figure 4. Synchronized dimming control

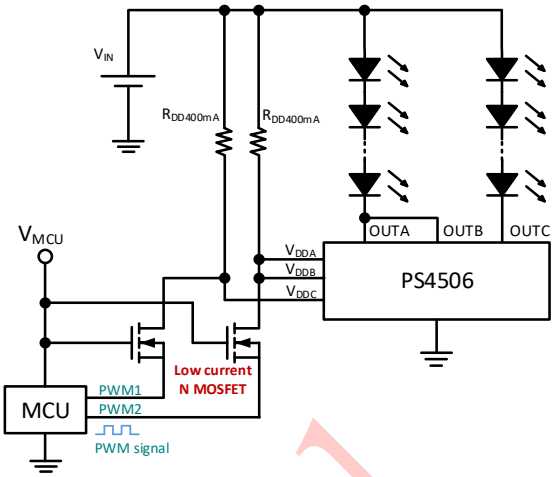


Figure 5. Non-synchronized dimming control

There are two ways to control dimming on PS4506. Figure 4 shows the first synchronized dimming way to control all the LEDs on or off. By this way, a high current MOSFET is used for switching the total current of PS4506. Figure 5 shows the way to control each channel individually. Each channel is controlled by a low current MOSFET. This small MOSFET switch the voltage on V_{DD} pin high or low to achieve the dimming function. Additionally, the recommended Pulse Width Modulation (PWM) dimming frequency for both methods is below 1 kHz, which helps in preventing visible flickering in the LEDs.

The duty cycle of the PWM signal is defined as the ratio of the LED on time (T_{ON}) to the entire cycle time (T). The duty cycle of the PWM signal is shown in figure 6. Figure 7 shows the current accuracy with different duty cycle.

$$Duty = \frac{T_{ON}}{T_{ON}+T_{OFF}} = \frac{T_{ON}}{T} \quad \text{.....(1)}$$

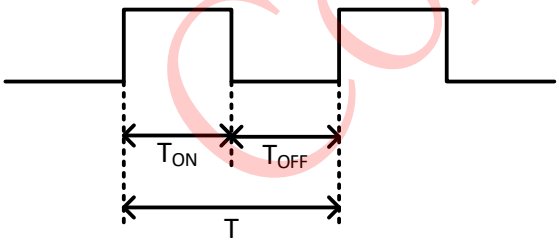


Figure 6. PWM dimming signal

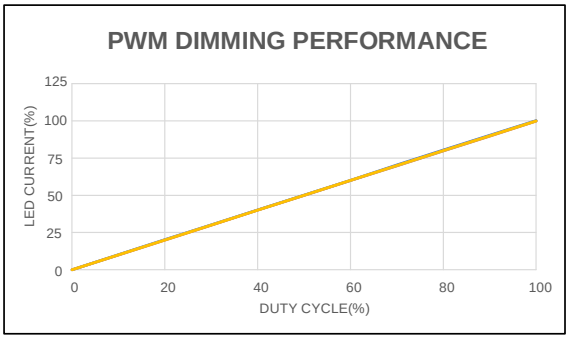


Figure 7. Output current vs. PWM duty cycle

8.3 Thermal Protection

For protecting LED under high temperature application, LED current is decreased automatically while PS4506's junction temperature is over 125°C. If PS4506's junction temperature approaches 145°C, LED current remains below 10%. As the temperature decreases, the LED current will recover when the junction temperature is below 125°C.

8.4 Power Dissipation

PS4506 is indeed a 3-channel linear constant current driver, and managing the heat it generates is important for ensuring its reliability and performance. The power consumption of PS4506 can be calculated using the formula:

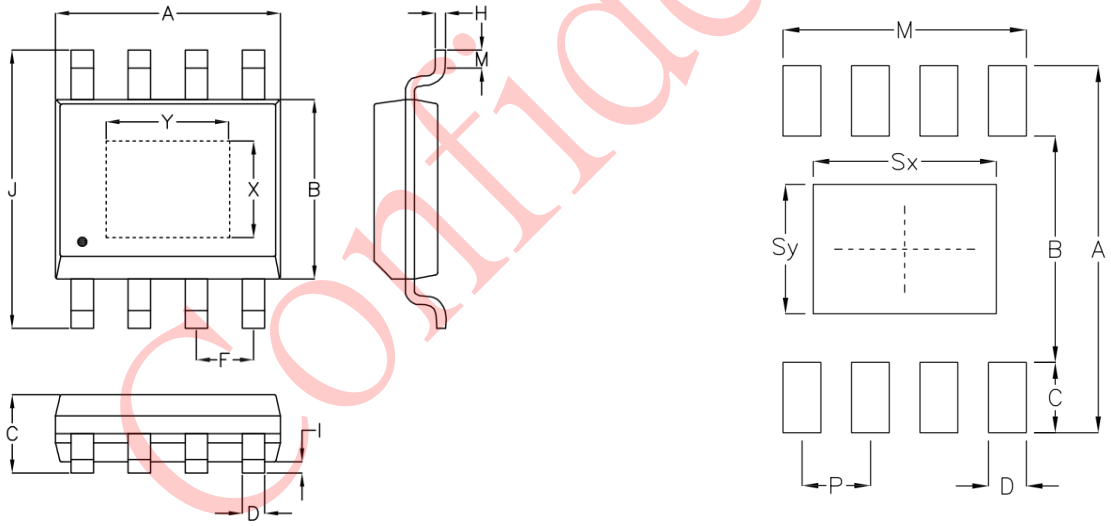
$$V_{OUT\_CHn} = V_{IN} - V_{LED\_CHn} \quad \text{.....(2)}$$

$$P_{D\_CHn} = I_{OUT\_CHn} \times V_{OUT\_CHn} \quad \text{.....(3)}$$

$$P_{D\_Total} = P_{D\_CH1} + P_{D\_CH2} + P_{D\_CH3} \quad \text{.....(4)}$$

Where I_{OUT_CHn} is the regulated current of channel n, V_{OUT_CHn} is the voltage of output channel n. From circuit design perspective, first, optimizing the voltage across the device is crucial for improving system efficiency and reducing heat generation. Such as selecting LEDs with a forward voltage that best matches supply voltage, or carefully selecting or designing the power supply to provide a voltage that matches the LED string's needs without excessive headroom. Secondly, for higher current applications, using multiple low current drivers in parallel can spread the heat generation and avoid OTP protection. Third, implement proper thermal management, such as heat sinks or improved airflow. All of these issues should be handled carefully to void output current ramping down.

9 Outline Dimension and Footprint



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.801	5.004	0.189	0.197
B	3.810	4.000	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.510	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.170	0.254	0.007	0.010
I	0.000	0.152	0.000	0.006
J	5.791	6.200	0.228	0.244
M	0.406	1.270	0.016	0.050
X	2.100	2.500	0.083	0.098
Y	3.000	3.500	0.118	0.138

SOP8 surface mount package

Package	Number of Pin	Footprint Dimension (mm)								Tolerance
		P	A	B	C	D	Sx	Sy	M	
PSOP-8	8	1.27	6.80	4.20	1.30	0.70	3.40	2.40	4.51	±0.10

10 Restrictions on product use

- PowerX Semiconductor reserves the right to update these specifications in the future.
- The information contained herein is subject to change without notice.
- PowerX Semiconductor will continually be working to improve the quality and reliability of its products. Nevertheless, semiconductor device in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress.

  It is the responsibility of the buyer, when utilizing PowerX Semiconductor products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such PowerX Semiconductor products could cause loss of human life, bodily injury or damage to property.

  In developing your designs, please ensure that PowerX Semiconductor products are used within specified operating ranges as set forth in the most recent PowerX Semiconductor products specifications.
- The PowerX Semiconductor products listed in this document are intended for usage in general electronics applications (lighting system, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).

  These PowerX Semiconductor products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”).

  Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc..

  Unintended Usage of PowerX Semiconductor products listed in this document shall be made at the customer’s own risk.