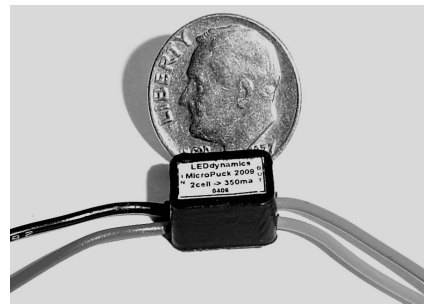


# LuxDrive

LEDdynamics, Inc. 2009 Micro Puck  
Application Note COM-DRV-2009-APP  
"Additional Applications of the 2009"



## Additional Applications of the 2009 "MicroPuck"

The LEDdynamics 2009 One Watt LED Driver Module is a inexpensive device originally designed to efficiently and safely drive a one Watt Luxeon<sup>\*1</sup> emitter from one or two batteries. However, the 2009's elegantly simple design allows a great deal of flexibility in application. This document will illustrate a number of possible alternate configurations, including the ability to drive newly released high-power emitters such as Nichia's Jupiter\* and the "Golden Dragon"\* from Osram, in addition to a review of the standard one Watt Luxeon connection.

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Paralleling 2009s, Buck/Boost . . . . .	Page 6

#### • LED

1 Watt	
Luxeon™	
Osram Golden Dragon®	
ISP "High Power" . . . . .	Pages 2-5
2,3 Watt	
Luxeon III™	
Nichia Jupiter™ and Sirius™ . . . . .	Pages 4,5
5 Watt	
Luxeon V™ . . . . .	Page 4

#### • Battery

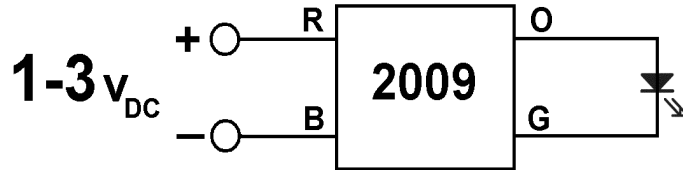
Alkaline . . . . . Page 2-6 . . . . .	1v - 3v one or two cells . . . . .	Pages 2,5
Rechargeable . . . . . Page 3	4v - 8v three to five cells . . . . .	Pages 3,4,6
Lithium . . . . . Page 2-6	1v - 7v one to four cells . . . . .	Pages 4,6

#### • Drive type

Boost . . . . .	Pages 2,5
Buck . . . . .	Page 3
Buck/Boost . . . . .	Pages 4,6

\* Luxeon is a registered trademark of LumiLEDs Corp. Sirius and Jupiter are registered trademarks of Nichia Corp. "Golden Dragon" is a registered tradesymbol of OSRAM Opto Semiconductors GmbH.

# 2009 as a Boost Driver



**Figure 1.** 2009 in its standard boost configuration driving a single junction InGaN(P) LED, one Watt or greater

**NOTE:**  
LED(s) must *always* be connected whenever power is applied!

• **Applicable LED configurations**

- 15 Parallel 5mm LEDs @ 20mA ea.
- 1 1W Luxeon™ LED
- 1 1W ISP High-Power LED

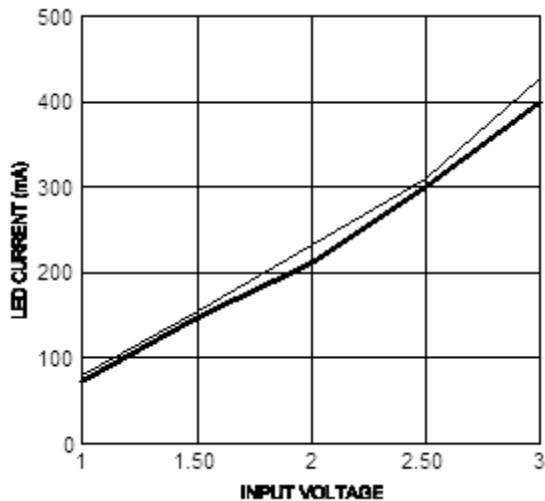
• **Suggested battery configurations**

- 2 Alkaline cell(s)
- 1 Lithium 3V cell

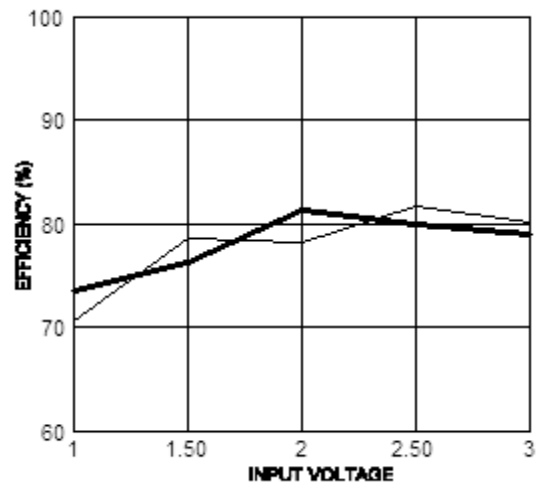
• **Application examples**

- 1 or 2 cell flashlights/other portable lighting
- Point of load conversion

Specification	Min	Max
Input Voltage	1	3
Output Voltage	-	8
LED Current	-	500mA
Efficiency	70% @1v	85% @2.5v



**Figure 2.** The 2009 driving 1W (thin line) and 3W (thick line) Luxeon emitters.



**Figure 3.** The 2009 driving 1W (thin line) and 3W (thick line) Luxeon emitters.

# 2009 as a Buck Driver

• **Applicable LED configuration:**

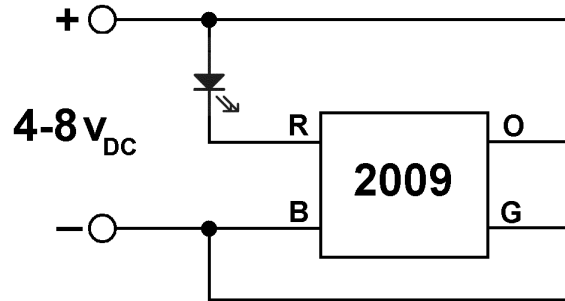
- 15 Parallel 5mm LEDs @ 20mA ea.
- 24 Series/Parallel 2V LEDs @ 30mA ea
- 1 1W Luxeon™ LED
- 1 1W ISP High-Power LED

• **Suggested battery configurations**

- 4 or 5 Alkaline cells
- 4 NiHM, or NiCad cell(s)
- 2 Lithium 3V or 3.6V cell
- 1 6V Lantern Battery

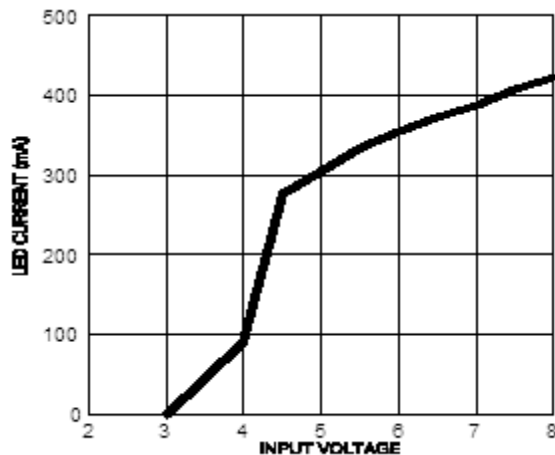
• **Application examples**

- 3 to 5 cell flashlights
- 4 to 8 volt embedded bulb drivers
- portable lighting
- low voltage accent lighting
- PC accent lighting (5v)

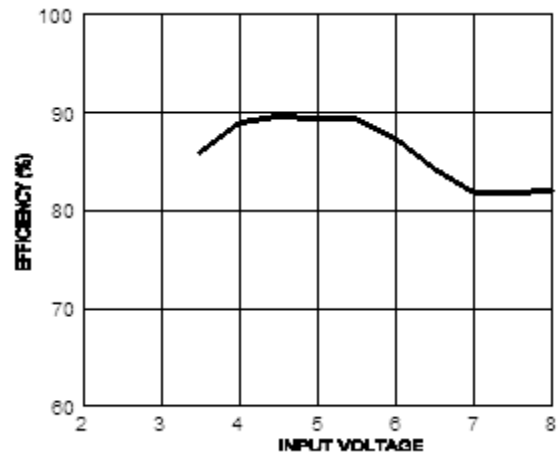


**Figure 4.** The 2009 configured as a buck converter. The load must be floating for this buck topology. The 2009 will not function with less than ~3.7 volts (LED  $V_f + 0.7$ ) in this configuration.

<u>Specification</u>	<u>Min</u>	<u>Max</u>
Input Voltage	3.7	8
LED Current	-	500mA
Efficiency	82% @7v	90% @4v

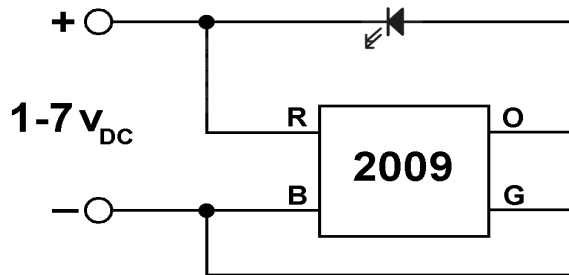


**Figure 5.** Operation is possible all the way up to 8 volts but the current quickly rises. Ideal 1W operation is at 6V, perfect for a four cell flashlight.



**Figure 6.** This figure demonstrates the inherent efficiency of a driver in buck mode. This topology is 12% more efficient than the standard boost mode.

# 2009 as a Buck/Boost Driver



- **Applicable LED configurations**
  - 15 Parallel 5mm LEDs @ 20mA
  - 1 1W Luxeon™ LED
  - 1 2W Nichia Jupiter™
  - 1 1W ISP High-Power LED

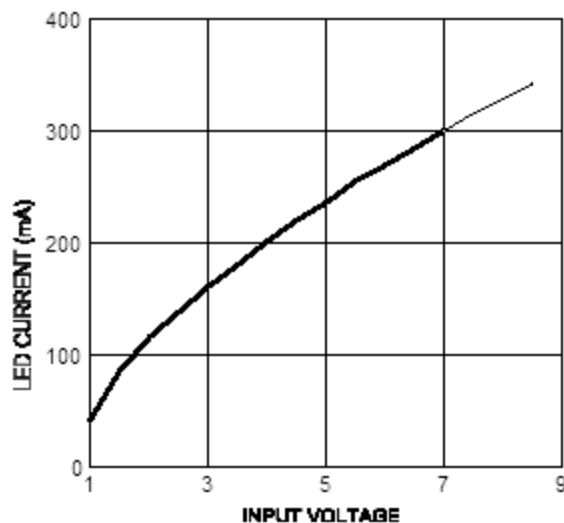
- **Suggested battery configurations**
  - 1 to 4 Alkaline cells
  - 2 Lithium 3V or 3.6V cell
  - 1 6V Lantern Battery

**Figure 7.** 2009 configured in a novel buck/boost configuration. This topology boasts an extremely wide input voltage range that will continue to supply effective power as batteries become exhausted, but is 15% less efficient than boost.

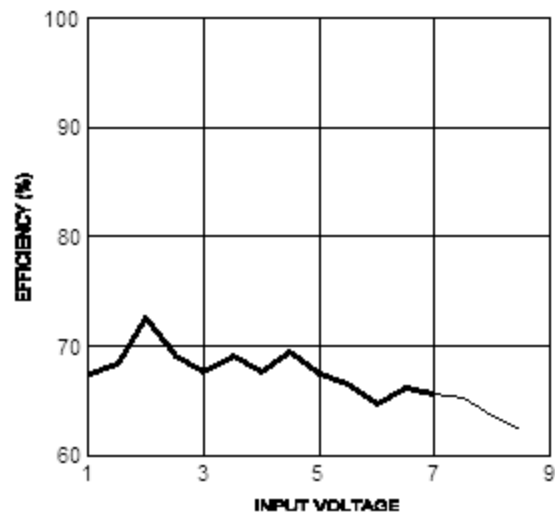
- **Application examples**
  - 1 to 5 cell flashlights
  - 6 volt embedded bulb drivers
  - low voltage accent lighting
  - portable lighting where completely exhausting batteries is desired

**NOTE:**  
LED(s) must *always* be connected whenever power is applied!

Specification	Min	Max	Specification	Min	Max
Input Voltage	1	7	LED Current	-	300mA
Output Voltage	-	10	Efficiency	65% @6v	72% @2v



**Figure 8.** This circuit delivers substantial LED current from the maximum input of 7 volts all the way down to 1.5 volts!



**Figure 9.** Efficiency is lower with this configuration than with buck or boost alone.

# Two 2009s in Parallel, Boost

• **Applicable LED configurations**

- 1 5W Luxeon V™
- 1 3W Luxeon III™
- 1 3W Nichia Sirius™
- 2 2W Nichia Jupiter™
- 2-4 1W Luxeon™
- 2-4 1W ISP High-Power LED
- 30 5mm LEDs @ 20mA ea (parallel)

• **Suggested battery configurations**

- | 1-3W | 5W  |                         |
|------|-----|-------------------------|
| 1-2  | 2-4 | Alkaline standard cells |
| 1    | 2   | Lithium 3V cell(s)      |

• **Application examples**

- Dual CR123 cell flashlight with Lux V emitter
- Single CR123 cell flashlight with Lux III LED
- 1-4 cell flashlights

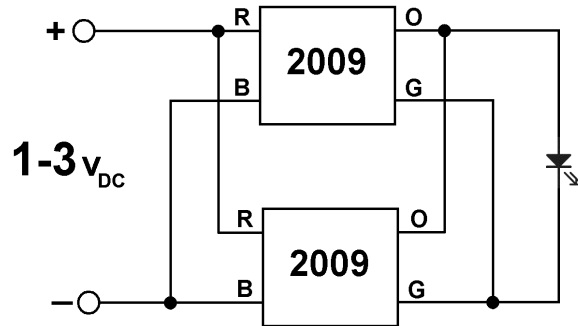


Figure 10. Two 2009s can be paralleled to nearly double LED current for a high-power emitter such as Luxeon III or V.

**NOTE:**  
LED(s) must always be connected whenever power is applied!

Specification	Min	Max
Input Voltage	1	3
Output Voltage	-	8
LED Current	-	800mA
Efficiency	72% 3W@1v	78% 3W@3v

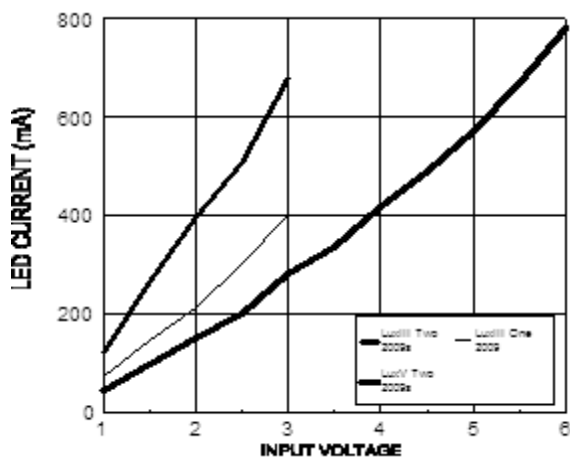


Figure 11. Two 2009s driving a LuxIII and LuxV. A single 2009 driving a LuxIII is included for reference.

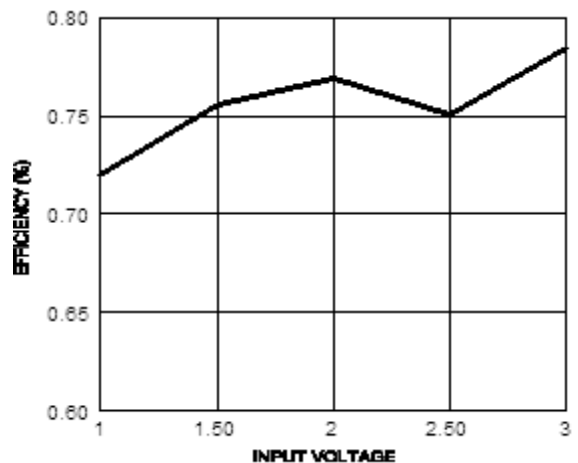
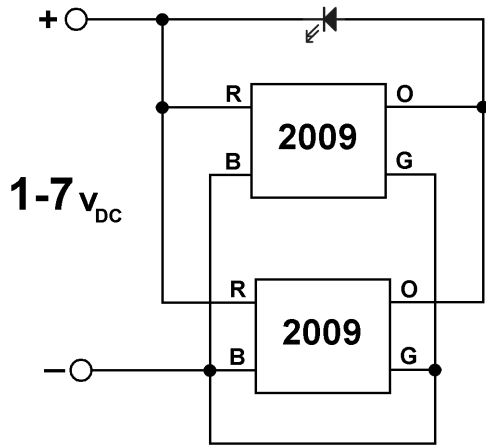


Figure 12. Two 2009s driving a Luxeon III emitter.

## Two 2009s in Parallel, Buck/Boost



- **Applicable LED configurations**
  - 1 3W Luxeon III™
  - 2 Nichia Jupiter™
  - 1 Nichia Sirius™
  - 2 1W Luxeon™
  - 2 1W ISP High-Power LED
  - 30 Parallel 5mm LEDs @ 20mA

- **Suggested battery configurations**
  - 1 to 4 Alkaline cells
  - 2 Lithium 3V or 3.6V cell
  - 1 6V Lantern Battery

- **Application examples**
  - 1 to 5 cell flashlights
  - 6 volt embedded bulb drivers
  - low voltage accent lighting
  - high power portable lighting

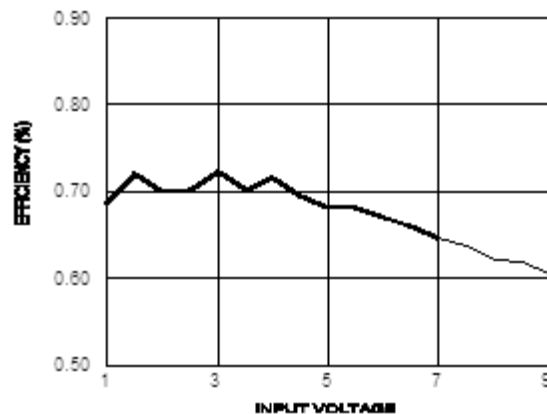
**Figure 13.** Two 2009s running buck/boost can be paralleled to nearly double LED current for a high-power emitter such as Luxeon III or Nichia Jupiter emitters. The second 2009 can be connected by switch to provide extra power only when necessary.

Specification	Min	Max	Specification	Min	Max
Input Voltage	1	7	LED Current	-	700mA
Output Voltage	-	10	Efficiency	65% @7v	72% @2v

**NOTE:**  
LED(s) must always be connected whenever power is applied!



**Figure 14.** Two 2009s in parallel buck/boost running a LuxIII.



**Figure 15.** Two 2009's in parallel buck/boost running a LuxIII.