



Comparison of White Light LED Technology vs. Incandescent Sources

	White Light LED	Standard Flashlight Bulb	NightStar Illumination System	Standard Flashlight Beam	Standard Household Bulb
I (amps)	0.02	0.28	0.02	0.28	0.83
V (volts)	3.60	3.00	3.60	3.00	120
P(e) (watts)	0.07	0.84	0.07	0.84	100
P(o) / P(e)	30%	5%	30%	5%	5%
P(o) (watts)	0.02	0.04	0.02	0.04	5.0
Lumens	7	14	7	14	1710
Solid Angle	1.75	11	0.1	0.1	12
Candelas	4.0	1.3	70	140	142.5

Legend

Violet [published values]

Blue [experimentally measured values]

Teal [calculated values using published and measured values]

Basic Definitions

I = Drive Current measured in amps

V = Drive Voltage measured in volts

P(e) = I x V = Electrical Power Consumption measured in watts

P(o) / P(e) = Conversion Efficiency from Electrical Power to Optical Power (visible light)

P(o) = Visible Light Power measured in watts

Lumen = luminous flux (For an LED there is approximately 100 lumens of luminous flux per watt of electrical power consumed. For incandescent bulbs there is approximately 17 lumens of luminous flux per watt of electrical power consumed.

Solid Angle = Illumination angle in steradians (there are $4 * \pi$ steradians in a complete sphere)

Candela = Lumen / Solid Angle (luminous intensity)

Note: When light emitted by a source is collected and projected into a beam the candela value increases. From these rough calculations it can be seen that a standard flashlight with fully charged batteries is approximately twice as bright as NightStar (light gathering inefficiencies in the optical imaging systems of both types of flashlights were not considered for these calculations). Also, for these calculations the volts and drive currents used for the LED and for NightStar correspond to a capacitor charge after 5 minutes of run time. Initially, and on a full capacitor charge, NightStar produces nearly 0.04 watts of visible light with a corresponding luminous flux and intensity of 14 lumens and 140 candelas, respectfully. Due to the discharge characteristics of the capacitor this drops off quickly and reaches a relatively stable state after 4 to 5 minutes.