

## **REPLACING INCANDESCENT SUBMINIATURE LAMPS WITH LED EQUIVALENTS**

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Based LEDs are suitable for new designs but are especially fitting for replacing lamps in existing designs without having to change sockets or mounting schemes. LEDs are being built into a variety of bases with control circuits to limit current over wide variations in input voltage, along with allowing the LEDs to be used with AC as well as DC systems. JKL Components Corporation, with 40 years of experience in the lighting industry, has developed a list of several popular incandescent subminiature lamps and their LED based lamp equivalents. Care should be taken in choosing the correct LED based lamp to make sure that the LED will illuminate the area the same as the incandescent lamp by having equal viewing angle of the light and intensity.

As LEDs generate light differently from incandescent lamps, care should be taken with applications that are sensitive in terms of color, viewing angle, and brightness.

Incandescent lamps generate light by passing current through a thin wire, (A filament) heating the wire until it glows. An LED generates light by energizing electrons from one orbital shell to another and then allowing the electrons to release photons as they drop back into their original orbital shell. The material the electrons are embedded in is one of the determining factors for the color of the photons. A variety of LEDs are available that operate on DC voltage however; JKL also offers based LED designs that operate from AC voltage. JKL's series of Flatwedge LED replacement lamps consist of a constant current source, surface mount type LEDs populated on two sides of a printed circuit board and on the top of the board. This configuration gives almost 360 degrees of illumination coupled with the warm white color of the LEDs making these lamps

good candidates for use as replacements for Glass Wedge Based Incandescent Lamps. The Flatwedge LED lamps are listed as 12 volt lamps but because of the constant current sources built into the lamps they will maintain the same light output when run on voltages from 10 Volts to 16 Volts. The LEFW-F12 is a DC voltage only device, but will fit wherever a T-1 3/4 glass wedge based lamp is used, and will fit into some sockets for the T-1 1/2 size lamps. The LEFW-M12 will operate in both AC and DC systems and fits where a T-3 1/4 wedge base lamp will fit. The Flatwedge LED replacement lamps offer a significant cost and power savings over comparable wedge based incandescent lamps. Two examples of this cost and power savings compares the FWG 103 lamp to the LEFW-F12 LED Flatwedge lamp and the 193 lamp to the LEFW-M12 LED Flatwedge lamp. While the LEFW-F12 costs just over 1.5 times the cost of the FWG103 lamp it will last 33 times longer, saving lamp cost and service charges to replace the lamp. Each LEFW-F12 lamp used saves 2.72 watts of power. This represents a savings of 2 Kw-Hr per month for each lamp replaced. The total cost of ownership for the two lamps would be \$34.59 for the FWG103 and \$2.52 for the LEFW-F12 for the 50,000 hours life time and the cost of electricity at \$0.08 per Kw-Hr, not including the maintenance costs to replace the burned out lamps.

The LEFW-M12 lamp costs 5.5 times more than the 193 lamp but will outlast it 6.7 times longer. Each LEFW-M12 uses 2.16 watts less than the 193 lamp. This represents a savings of just over 1.5 Kw-Hr per month for each lamp replaced. The total cost of ownership for the two lamps would be \$20.98 for the 193 lamps and \$5.54 for the LEFW-M12 for the 50,000 hours life time and the cost of electricity at \$0.08 per Kw-Hr not including the maintenance cost to replace the burned out lamps.

The LE series offers several different operating voltages in both AC and DC, and colors available in bases that allow for narrow viewing angles for switch lighting and focused lighting. The LE series are available in wedge base for T-1 3/4 and T-3 1/4 with one and three LEDs and standard miniature bayonet base for T-3 1/4. Chart 1 compares the LED based lamps with the popular incandescent subminiature lamps comparing important

parameters such as voltage, current usage, life hours, and lumens output. Although the cost per piece of the LED may be higher than the incandescent lamp, these higher costs are actually paid back in terms of reduced expenses associated with maintenance and replacement. Additional benefits are also realized for areas that may be difficult to access and for specifiers that aim to reduce energy consumption.

Life hours have different meanings for each of the types of lamps. For subminiature incandescent lamps, life hours indicate when 50% of a test group will fail during an operation. Additional service conditions such as DC voltage, shock, vibration, voltage fluctuations, and temperature will shorten the lamp life further. It is also important to note that the life hours for lamps are usually specified based upon operating the lamp with AC voltage. If the lamp is operating on DC voltage, the life hours will be reduced by 50%. Conversely, if an LED is designed for AC or DC operation, the life hours do not differ. For the LED lamp, life hours typically indicates when the LED will reach a light output that is 70% of the original lumens output. This value is significant in that it is the first point when the eye can see a difference in the light output of a lamp.

Part Number	Typ. Voltage	Rated current	Rated wattage	Brightness in Lumens	Average life hours
T-1 ¾ Wedge Based Lamp					
84	6	.040	.252	.38	20000
LE-0504-06W	6	.020	.12	2	50000
T-3 ¼ Standard Miniature Bayonet Based Lamp					
1850	5	.090	.45	3.14	1500
755	6.3	.150	.945	4.15	20000
LE-BA9S-6W	6	.020	.12	3.45	50000
T-1 ¾ Wedge Based Lamp					
74	14	.100	1.4	8.8	500
FWG-103	14	.220	3.08	21.37	1500
LEFW-F12	12	.030	0.36	21	50000
T-3 ¼ Standard Miniature Bayonet Based Lamp					
756	13-14	.080	1.12	3.9	15000
LE-BA9S-12W	12-14	.020	.24	3.18	50000
T-3 ¼ Wedge Based Lamp					
193	14	.330	4.62	25	7500
194	14	.270	3.78	25.14	2500
158	14	.240	3.36	25.14	500
168	14	.350	4.9	37.71	1500
LE-0903-02W	12	.0135	0.16	12	50000
LEFW-M12	12	0.060	0.72	25	50000

Part Number	Typ. Voltage	Rated current	Rated wattage	Brightness in Lumens	Average life hours
T-3 ¼ Standard Miniature Bayonet Based Lamp					
1818	24	.170	4.08	41.48	250
LE-BA9S-24W	24	.014	.336	2.75	50000
T-1 ¾ Standard Midget Groove Based Lamp					
386	14	.300	4.2	3.77	50000
7354	12	.040	.48	1.51	10000
LE-MG-12W	12	.015	.18	2.00	50000
T-1 ¾ Standard Midget Groove Based Lamp					
457	22	.040	.88	3.77	2000
LE-MG-24W	24	.015	.36	2.00	50000
T-1 ¾ Standard Midget Flange Based Lamp					
382	14	.080	1.12	3.77	50000
394	12	.040	.48	1.51	10000
LE-MF-12W	12	.015	.18	3.50	50000
T-1 ¾ Standard Midget Flange Based Lamp					
459	22	.040	.88	1.89	2000
LE-MR-24W	24	.015	.36	3.50	50000
T-1 ¾ Standard Midget Screw Based Lamp					
342	6	.040	.24	.38	10000
7320	6.3	.040	.252	.38	20000
1775	6.3	.075	.472	2.89	1000
LE-MS-6W	6	.009	.054	3.00	50000
T-1 ¾ Standard Midget Screw Based Lamp					
7326	12	.040	.48	1.51	10000
8362	14	.080	1.12	3.77	50000
383	14	.080	1.12	6.29	2500
373	14	.080	1.12	6.29	2500
8162	14	.100	1.4	6.29	50000
LE-MS-12W	12	.030	.36	9.00	50000

Chart 1

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