Replacement of TSN by AlInGaP Chip Technology

(Replacement of Lx xxx0, Lx xxx1, Lx xxx9 by Lx xxxK)

Application Note

Introduction

This application note illustrates, how one can replace LEDs with old TSN chip technology (transparent substrate, n-doped) by state of the art AlInGaP (Aluminum Indium Gallium Phospide) low current (= LC) LEDs in existing designs.

Ongoing development in LED semiconductor technology has yielded impressive results: increased brightness, improved efficiency and a greatly expanded range of color, culminating with the advent of Color On Demand (COD), the ability to replicate almost any color of the spectrum with a LED.

These technology advances have been realized through an iterative development process, so accordingly there exists in Osram's product portfolio both emerging and mature LED technologies. And being a forward looking company, Osram Opto Semiconductors is highly motivated to offer these latest technology advancements, along with their attendant advantages, to its customers.

AlInGaP (Aluminum Indium Gallium Phosphide) represents one of the newest and efficient chip technologies being used in Osram's LEDs. All things being equal, LEDs utilizing AlInGaP technology are anywhere from 200% - 500% brighter than previous generations utilizing TSN chip technology (transparent substrate, n-doped). As such, significant advantages can be realized by the adoption of this LED technology in new and existing designs.

Accordingly, this application note will discuss the replacement of TSN LEDs with AlInGaP LEDs in existing lighting designs.

AlInGaP Low Current Replacement Types

When the lighting design is new or if the design is existing and does not require a specific brightness, the selection of an AlInGaP LED is a simple: select the most appropriate Osram LED and proceed. When updating an existing TSN lighting design to AlInGaP, and the design must meet a particular luminous target, the current driven through the AlInGaP LED must be reduced appropriately to arrive at a like brightness to that of the TSN LED.

To this end, Osram offers numerous low current TSN replacement types that can be recognized by the letter "K" at the end of the designation code. They replace LEDs with the letters "0" (= standard), "1" (= foreign die) or "9" (= previous low current technology) at the end (I.e. LS T67K versus LS T670). Please refer also to table 1.
These low current AlInGaP LEDs share the exact same packaging as their TSN predecessors, so changes to the layout of the circuit board are unnecessary.

A comprehensive cross-reference replacement table (Table 2) is located on the last page of this application note to address further, specific, references.

new type		**old type**
Lx xxxK	*replaces*	Lx xxx0
Lx xxxK	*replaces*	Lx xxx1
Lx xxxK	*replaces*	Lx xxx9

Table 1: LED replacement overview

LS T670, LO T670, LY T670, LG T670, LP T670

Typ Type	Emissions-farbe Color of Emission	Farbe der Lichtaustritts-fläche Color of the Light Emitting Area	Lichtstärke Luminous Intensity I_F = 10 mA I_V (mcd)	Lichtstrom Luminous Flux I_F = 10 mA Φ_V (mlm)	Bestellnummer Ordering Code
LS T670-H2J2-1	super-red	colorless clear	3.55 ... 7.10	15 (typ.)	Q62703-Q5094
LS T670-J2L1-1			5.60 ... 14.00	28 (typ.)	Q62703-Q5095

Figure 1: Excerpt from LS T670 data sheet (available brightness groups)

The proceeding sections will expound on the replacement of TSN chip technology by AlInGaP chip technology by discussing two examples:

Example 1: Replacement of LS T670 with LS T67K

Example 2: Replacement of LY A679 with LY A76K

Example 1: Replacement of LS T670 with LS T67K

According to the latest data sheet (Figure 1), the LS T670 is offered in brightness groups (bins) of H2-J2 and J2-L1. (For the purpose of this example, only the H2-J2 group will be discussed.) The brightness group H2-J2 is comprised of three half groups: H2, J1 and J2. The brightness grouping (in mcd) is done at 10mA.

In accordance with Figure 2, the LS T67K is offered in two brightness configurations: H1-J1 and J1-K2 (which for the purpose of this example will be ignored). Like all of Osram's LEDs, the LS T67K is comprised of three half groups, in this case: H1, H2 and J1. Because of the increased efficiency offered by the AlInGaP chip technology, the LS T67K is grouped at 2mA.

The LS T670 and the LS T67K differ in brightness by one half group. If the LS T67K is driven at a current higher than 2mA (allowing for the maximum permissible current), this can be compensated. The brightness factor between two adjacent half groups is approximately 1.26. Therefore, if the brightness of the LS T67K is increased by this factor, its brightness is shifted up one half group (H1 becomes H2, H2 becomes J1 and J1 becomes J2). By looking at the diagram of the relative luminous intensity (Figure 3), one can see that the brightness of the LED increases almost linearly with the current (this is valid for currents of approximately 2mA). If the LED is driven at 1.26 x 2mA ≈ 2.5mA, the desired brightness can be achieved with the caveat that the power consumption is reduced by approximately one quarter.

LS T67K, LO T67K, LY T67K

Typ Type	Emissions-farbe Color of Emission	Farbe der Lichtaustritts-fläche Color of the Light Emitting Area	Lichtstärke Luminous Intensity I_F = 2 mA I_V (mcd)	Lichtstrom Luminous Flux I_F = 2 mA Φ_V (mlm)	Bestellnummer Ordering Code
LS T67K-H1J1-1 LS T67K-J1K2-1	super-red	colorless clear	2.80 … 5.60 4.50 … 11.20	13 (typ.) 25 (typ.	Q62703-Q6434 Q62703-Q6435

Figure 2: Excerpt from the data sheet of LS T67K (available brightness groups)

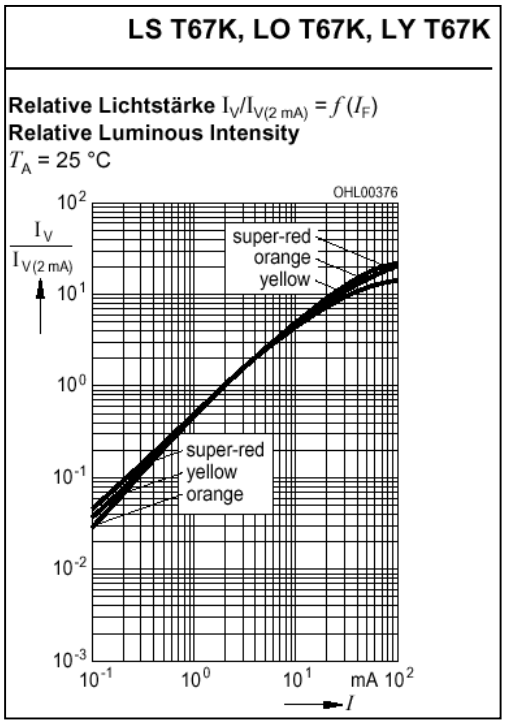

Figure 3: Excerpt from LS T67K data sheet (relative luminous intensity)

Example 2: Replacement of LY A679 with LY A67K

As referenced in Figure 4, the LY A679 is offered in two brightness groups: D2-E2 and E2-G1 (which, as in the previous example, will be ignored). The LY A679 D2-E2 is comprised of the following half groups: D2, E1 and E2. The brightness grouping (in mcd) is done at 10mA.

As shown in Figure 5, the LY A67K is available in two brightness groups: H2-J2 and J2-L1 (which, as in the previous example will be ignored). Because of the increased efficiency offered by the AlInGaP chip technology, the LY A67K is grouped at 2mA.

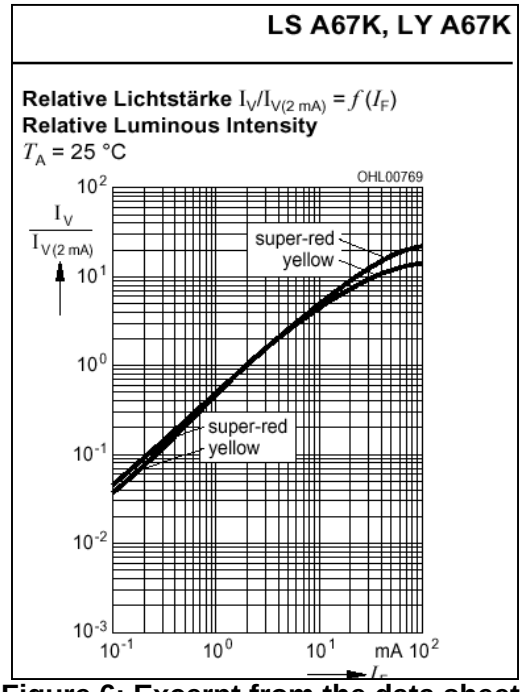

Figure 6: Excerpt from the data sheet of LS A67K (relative luminous intensity)

LS A679, LY A679, LG A679

Typ Type	Emissionsfarbe Color of Emission	Farbe der Lichtaustrittsfläche Color of the Light Emitting Area	Lichtstärke Luminous Intensity I_F = 2 mA I_V (mcd)	Lichtstrom Luminous Flux I_F = 2 mA Φ_V (mlm)	Bestellnummer Ordering Code
LS A679-D2E2-1	super-red	colorless clear	0.56 ... 1.12	2.5 (typ.)	Q62703-Q5076
LS A679-E2F2-1			0.90 ... 1.80	3.9 (typ.)	Q62703-Q5077
LS A679-F2G2-1			1.40 ... 2.80	6.1 (typ.)	Q62703-Q5078
LY A679-D2E2-1	yellow	colorless clear	0.56 ... 1.12	2.5 (typ.)	Q62703-Q5113
LY A679-E2G1-1			0.90 ... 2.24	4.4 (typ.)	Q62703-Q5114

Figure 4: Excerpt from the data sheet of LY A679 (available brightness groups)

LS A67K, LY A67K

Typ Type	Emissionsfarbe Color of Emission	Farbe der Lichtaustrittsfläche Color of the Light Emitting Area	Lichtstärke Luminous Intensity I_F = 2 mA I_V (mcd)	Lichtstrom Luminous Flux I_F = 2 mA Φ_V (mlm)	Bestellnummer Ordering Code
LS A67K-H1J1-1	super-red	colorless clear	2.80 ... 5.60	13 (typ.)	Q65110-A0330
LS A67K-J1K2-1			4.50 ... 11.20	25 (typ.	Q65110-A0331
LY A67K-H2J2-26	yellow	colorless clear	3.55 ... 7.10	15 (typ.)	Q65110-A0337
LY A67K-J2L1-26			5.60 ... 14.00	30 (typ.)	Q65110-A0338

Figure 5: Excerpt from the data sheet of LY A67K (available brightness groups)

The LY A67K has a brightness that is eight (!) groups higher than the LY A679 and therefore is simply too bright by a factor of $1.26^8 \approx 6.35$.
Again, if we assume a linear correlation between the luminous intensity and the current (Figure 6), the current through the LY A67K should be reduced from a value of 2mA down to 2mA : 6.35 ≈ 0.31mA.
Side effect: the power consumption drops down to a tenth. The reduction to such low currents by a resistor might not be exact enough in most of the cases.
Here one should preferably use pulse width modulation (PWM). In our case one could achieve the desired brightness by applying a pulse current with a peak value of 2mA and a duty cycle equalling D = 0.16.

Conclusion

All things being equal, LEDs utilizing AlInGaP chip technology are anywhere from 200% - 500% brighter than previous generations (TSN) depending on wavelength.

When updating an existing TSN lighting design to AlInGaP, and the design must meet a particular luminous target, the current driven through the AlInGaP LED must be reduced appropriately to arrive at a like brightness to that of the TSN LED.

NEW low current		***standard technology***	***old low current***
LS 336K	replaces	LS 3360,	LS 3369
LY 336K	replaces	LY 3360,	LY 3369
LG M67K	replaces	LG M670	
LP M67K	replaces	LP M670	
LO M67K	replaces	LO M670	
LS M67K	replaces	LS M670	
LYM67K	replaces	LY M670	
LG M47K	replaces	LG M470, LG M770	
LS M47K	replaces	LS M770	
LOG T77K	new		
LS A67K	replaces	LS A670,	LS A679
LY A67K	replaces	LY A670,	LY A679
LO L89K	new		
LS L89K	new		
LY L89K	new		
LG T67K	replaces	LG T670, LG T671, LG T672	LG T679
LP T67K	replaces	LP T670, LP T672	
LO T67K	replaces	LO T670	
LS T67K	replaces	LS T670	LS T679
LY T67K	replaces	LY T670	LY T679
LO T77K	replaces	LO T770	

Table 2: Reference for LED replacement

Author: Josef Hüttner

About Osram Opto Semiconductors

Osram Opto Semiconductors GmbH, Regensburg, is a wholly owned subsidiary of Osram GmbH, one of the world's three largest lamp manufacturers, and offers its customers a range of solutions based on semiconductor technology for lighting, sensor and visualisation applications. The company operates facilities in Regensburg (Germany), San José (USA) and Penang (Malaysia). Further information is available at www.osram-os.com