

Philips Lumileds Lighting Company

370 W. Trimble Road, San Jose, California 95131 USA

Subject: New Luxeon White Binning Structure

Notification Date: May 1, 2006

Dear Customer,

In an ongoing program to further enhance the ease of use of Philips Lumileds white Luxeon products, Philips Lumileds is pleased to announce the introduction of a new white binning structure for white Luxeon, Luxeon III, Luxeon V and Luxeon K2 emitters and L2 arrays. The introduction of this new binning structure does not affect Lumileds existing flux and forward voltage binning structures.

There are no physical changes to the Luxeon Emitter or Luxeon Level 2 (Star, Line, Ring, Flood) products. Form, fit and function remain unchanged, as defined in Product Datasheets. These binning changes will be reflected in an updated AB21, Luxeon Product Binning and Labeling, which will be posted May 5, 2006.

Part Numbers Affected:

The part numbers listed in Chart 1 will be tested and binned to the new Lumileds white binning and labeling structure beginning on April 24, 2006. Additional information on the migration to the new binning structure is detailed on page 9 of this document.

White Luxeon I Emitter	
Lambertian	LXHL-PW01, LXHL-PW01-00F, LXHL-PW01-00J, LXHL-PW01-00M
Batwing	LXHL-BW02, LXHL-BW02-00F, LXHL-BW02-00J, LXHL-BW02-00M
Side Emitter	LXHL-DW01, LXHL-DW01-00F, LXHL-DW01-00J, LXHL-DW01-00M
White Luxeon III Emitter	
Lambertian	LXHL-PW09
Side Emitter	LXHL-DW09
White Luxeon V Portable Emitter	
Lambertian	LXHL-PW03
Side Emitter	LXHL-DW03
White Luxeon I Star	
Lambertian	LXHL-MW1B, LXHL-MW1D, LXHL-MW1D-00F, LXHL-MW1D-00J, LXHL-MW1D-00M
Batwing	LXHL-MWEA, LXHL-MWEC, LXHL-MWEC-00F, LXHL-MWEC-00J, LXHL-MWEC-00M, LXHL-NWE8
Side Emitter	LXHL-FW1C, LXHL-FW1C-00F, LXHL-FW1C-00J, LXHL-FW1C-00M
White Luxeon III Star	
Lambertian	LXHL-LW3C
Side Emitter	LXHL-FW3C
White Luxeon V Star Portable	
Lambertian	LXHL-LW6C
Side Emitter	LXHL-FW6C
White Luxeon Arrays	
Luxeon Line	LXHL-NWE9
Luxeon Flood 12-up	LXHL-MWCE
Luxeon Flood 18-up	LXHL-MWJE
Luxeon Ring 6-up	LXHL-NWE7
Luxeon Ring 12-up	LXHL-NWE6
White Luxeon K2	LXK2-PW12-R00, LXK2-PW12-S00, LXK2-PW14-U00, LXK2-PW14-V00

Chart 1: White Luxeon part numbers affected by new white binning and labelling structure



Development of the New Luxeon White Binning Structure:

Investigation into prior art in the field of color science was conducted to determine whether an existing framework could be used to create an improved white binning structure. MacAdam ellipses are typically used in color science to define areas in color space in which there exists no perceptible difference in color to the average human observer. Typically these ellipses are created using focus group studies, where the color of the test device is varied until a difference is observed, compared to the control source.

Based on previous perception studies, a new graphical framework has been defined to account not only for variations in color temperature, but also offset above and below the Planckian curve. This framework is a refinement of the previous Lumileds bin structure, in which the larger bins have been broken into smaller bins. Based on previous focus group studies, this new bin structure aligns well with customer feedback, and results in a solution that will be suitable for lighting, signal and signage applications.

Comparison of Existing and New Luxeon White Binning Structures

The existing binning structure consists of eight bins of various sizes, aligned around the Planckian curve. The existing binning structure may be graphically portrayed in x,y color space as below seen in figure 1.

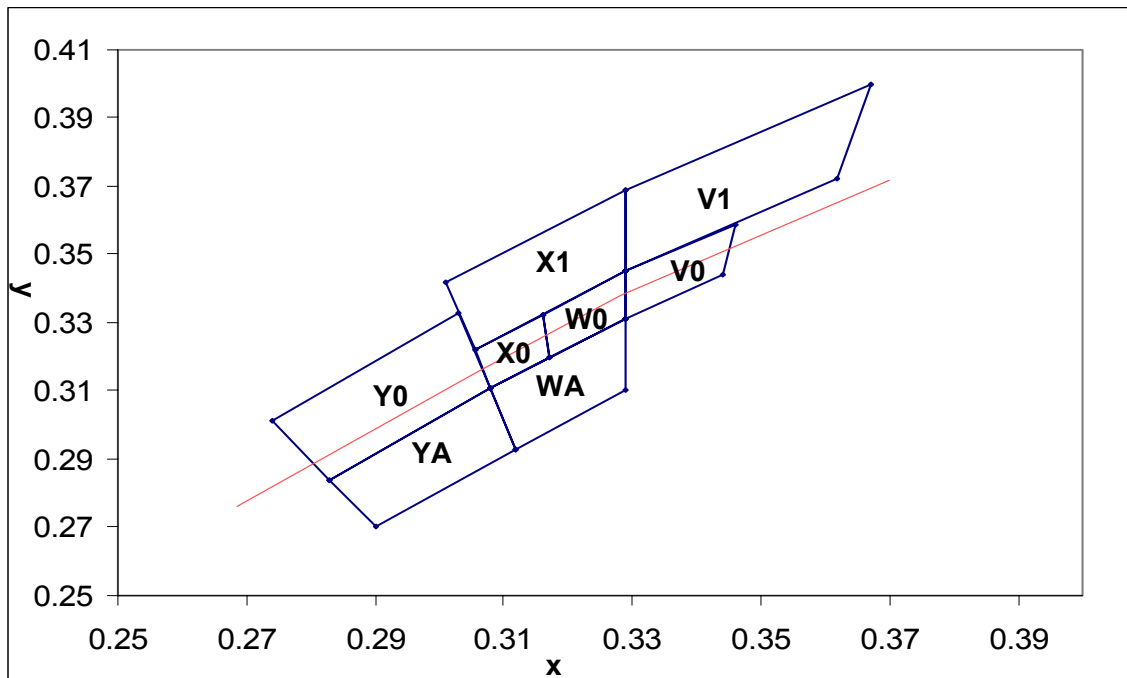


Figure 1: Graphical representation of existing white Luxeon binning structure

Table 1 lists the x,y coordinates and typical CCT values for the existing white Luxeon binning structure.

Bin	x	y	Typical CCT
V0	0.346	0.359	5300
	0.344	0.344	
	0.329	0.331	
	0.329	0.345	
V1	0.367	0.400	5000K
	0.362	0.372	
	0.329	0.345	
	0.329	0.369	
W0	0.329	0.345	6000K
	0.329	0.331	
	0.317	0.320	
	0.316	0.333	
WA	0.329	0.331	6300K
	0.330	0.310	
	0.311	0.293	
	0.308	0.311	
X0	0.316	0.333	6700K
	0.317	0.320	
	0.308	0.311	
	0.305	0.322	
X1	0.329	0.369	6300K
	0.329	0.345	
	0.305	0.322	
	0.301	0.342	
YA	0.308	0.311	8000K
	0.311	0.293	
	0.290	0.270	
	0.283	0.284	
Y0	0.303	0.333	8000K
	0.308	0.311	
	0.283	0.284	
	0.274	0.301	

Table 1: Coordinates of existing Luxeon white binning structure



Although the binning structure defined in figure 1 constrains bins along the blackbody curve, thus reducing perceptible white point “tints”, feedback from focus groups indicated that the overall size of the larger bins resulted in detectable differences of white.

Figure 2 is a graphical representation of the new white Luxeon binning structure. Consult Table 2 below for exact coordinates.

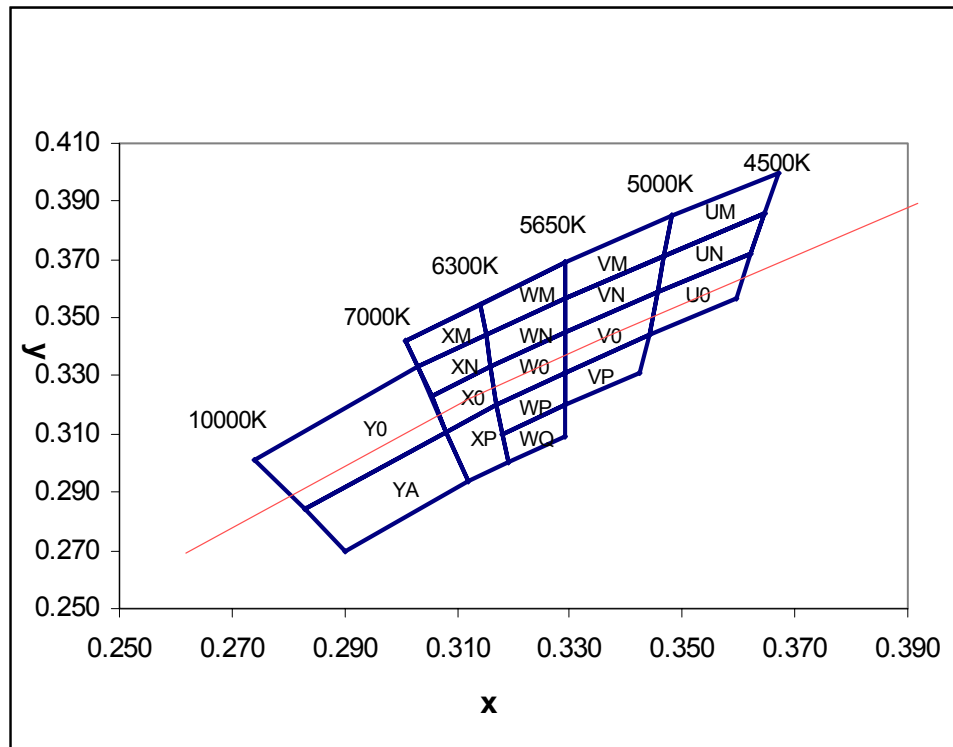


Figure 2: New white Luxeon binning and labeling structure



Table 2 lists the x,y coordinates and typical CCT values for the new white Luxeon binning structure.

Bin	x	y	Typical CCT
U0	0.362	0.372	4750K
	0.360	0.357	
	0.344	0.344	
	0.346	0.359	
UN	0.364	0.383	4750K
	0.362	0.372	
	0.346	0.359	
	0.347	0.372	
UM	0.364	0.383	4750K
	0.367	0.400	
	0.348	0.385	
	0.347	0.372	
VP	0.329	0.331	5300K
	0.344	0.344	
	0.343	0.331	
	0.329	0.320	
V0	0.329	0.331	5300K
	0.329	0.345	
	0.346	0.359	
	0.344	0.344	
VN	0.329	0.345	5300K
	0.329	0.357	
	0.347	0.372	
	0.346	0.359	
VM	0.329	0.357	5300K
	0.329	0.369	
	0.348	0.385	
	0.347	0.372	
WQ	0.329	0.321	6000K
	0.329	0.310	
	0.319	0.300	
	0.318	0.310	
WP	0.329	0.331	6000K
	0.329	0.320	
	0.318	0.310	
	0.317	0.320	
W0	0.329	0.345	6000K
	0.329	0.331	
	0.317	0.320	
	0.316	0.333	
WN	0.329	0.345	6000K
	0.316	0.333	
	0.315	0.344	
	0.329	0.357	
WM	0.329	0.369	6000K
	0.329	0.357	
	0.315	0.344	
	0.314	0.355	
XP	0.308	0.311	6700K
	0.317	0.320	
	0.319	0.300	
	0.311	0.293	
X0	0.308	0.311	6700K
	0.305	0.322	
	0.316	0.333	
	0.317	0.320	
XN	0.305	0.322	6700K
	0.303	0.333	
	0.315	0.344	
	0.316	0.333	
XM	0.301	0.342	6700K
	0.314	0.355	
	0.315	0.344	
	0.303	0.333	
Y0	0.308	0.311	8000K
	0.283	0.284	
	0.274	0.301	
	0.303	0.333	
YA	0.308	0.311	8000K
	0.311	0.293	
	0.290	0.270	
	0.283	0.284	

Table 2: Coordinates of new Luxeon white binning structure



From figure 2, additional delineations parallel to the Planckian curve may be observed. The combination of these new parallel lines and additional lines of constant color temperature (perpendicular to the Planckian curve) offer additional resolution in the color space covered by white Luxeon LEDs. The new Luxeon white color binning structure results in improved color homogeneity within a color bin. The newer, finer binning structure nearly eliminates perceptible “tint” and white point variation, significantly increasing the ease of use in a wider range of applications. Products within an individual color bin will appear nearly identical in color to the human observer.

Figure 3 shows an overlay of the new white binning structure over the existing white binning structure. The lines of constant color temperature and the lines parallel to the Planckian curve align between the two binning structures. Noticeably, bins parallel to the Planckian curve are reduced in size, which will enable critical applications sensitive to “tint” variation. Additionally, warmer color temperatures are now accommodated in the “U” bins. Focus group studies determined the acceptability of extending the product color range and the desirability of smaller bins in the warmer color temperature ranges.

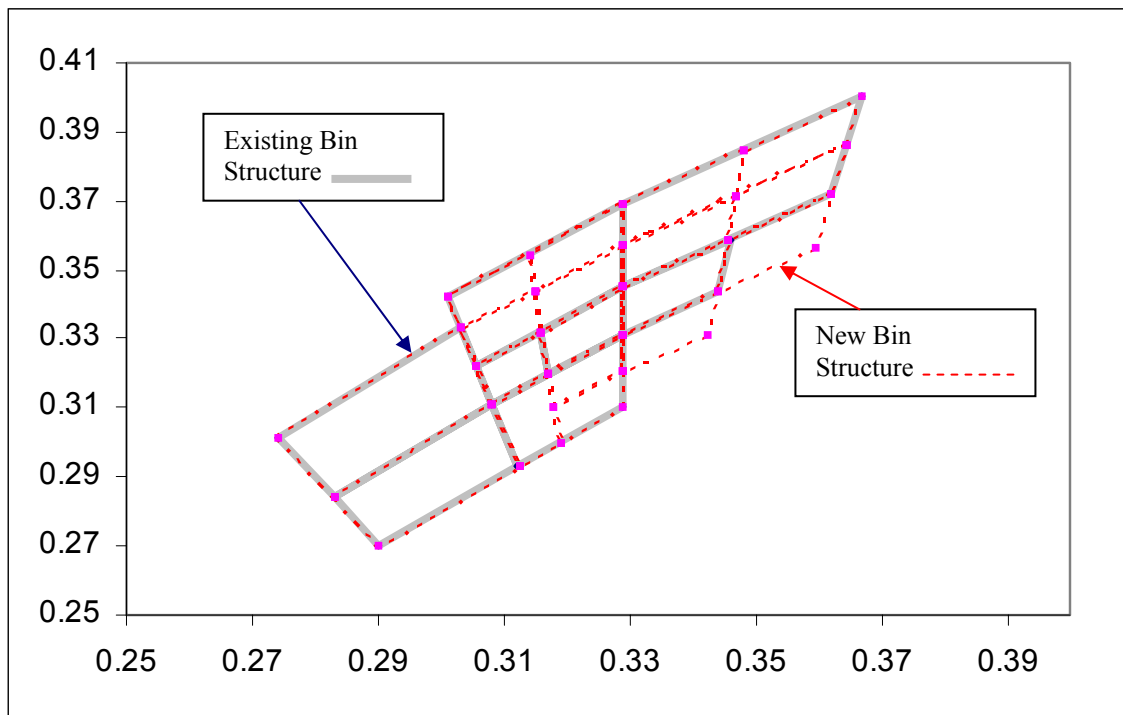


Figure 3: Overlay of new binning structure onto existing binning structure

Packaging label correlating existing and new binning

For ease of transition, Philips Lumileds will incorporate a label on white Luxeon packaging to correlate existing and new bins. Figure 4 exhibits this new label.

Philips Lumileds will also continue to offer options for white bin selections. The three existing standard white selections will be shifted to the new bin structure as detailed below in table 3.

Figures 5 and 6 depict an example of existing and new labels for reels of Luxeon emitters.

New Bin	Old Bin
Y0	Y0
YA	YA
X0	X0
W0	W0
V0	V0
XM	X1
XN	
WM	
WN	
XP	WA
WP	
WQ	
VM	V1
VN	
UM	
UN	
VP	new
U0	new

Figure 4: New “Tag” correlating new and existing bins

Part Number	Existing Color Bins	New Color Bins
-00M	X1, W0, X0, WA	XM, XN, WM, WN, XP, WP, WQ, X0, W0
-00F	V1, V0, X1, W0, X0	VM, VN, UM, UN, XM, XN, WM, WN, V0, X0, W0
-00J	WA, W0, X0, Y0, YA	W0, WP, WQ, XP, XQ, Y0, YA

Table 3: Transition from existing to new white bins for three standard white option codes.





Figure 5: existing Luxeon emitter label



Figure 6: New Luxeon emitter label with temporary correlating "tag"



Implementation Plan for New White Binning Structure

Beginning April 24, 2006 affected products will be tested and binned to the new binning structure. Philips Lumileds will implement the schedule below for transitioning from old to new binning structures.

Start of Shipment to New Structure:

- Luxeon Emitters, Luxeon Stars, Rings, Lines, Floods – April 24, 2006

Period of Shipments with Mixed “old” and “new” Labels:

- Luxeon Emitters, Luxeon Stars, Rings, Lines, Floods – April 24, 2006 to July 31, 2006

Completion Date for Conversion to New Binning Structure:

- Luxeon Emitters – July 31, 2006

Shipments during the transition period may contain new and old bin structure labels; however, single reels within an SPI will not be mixed. The label correlating existing and new bins placed on the white Luxeon packaging will continue for 6 months (work week 42). SPI will remain unchanged.

Customers purchasing affected part numbers (see Chart 1), will see the number of white color bins rise from 8 to 18, from existing to new bin structures, respectively. Luxeon white products will still be tested to existing flux and forward voltage binning structures.

We believe that this new binning structure will increase the ease of use of Luxeon white products by delivering a product with minimal perceptible white point differences within a white color bin. While the resolution we have chosen may be overly fine for some applications, the new binning structure should further enable applications currently hindered by the lack of granularity of our existing bin structure. Customers should find that the adoption of this new binning structure will dramatically improve their ability to mix and match products for various application requirements. To better serve our customers, Philips Lumileds will be releasing new standard selections based on this binning structure in May 2006.

Thank you for attention to these changes. Please consult your Philips Lumileds authorized distributor or Philips Lumileds sales representative for further information.

Sincerely,

Keith Scott

Keith Scott
Luxeon Lighting Product Manager
Lumileds Lighting LLC

