March 2nd, 2010
Citizen Electronics Co., Ltd

A chromaticity control standard “3-Step MacAdam ellipses” is implemented in mass production of white LEDs for lighting – Mass production with 1/9th of the conventional chromaticity range

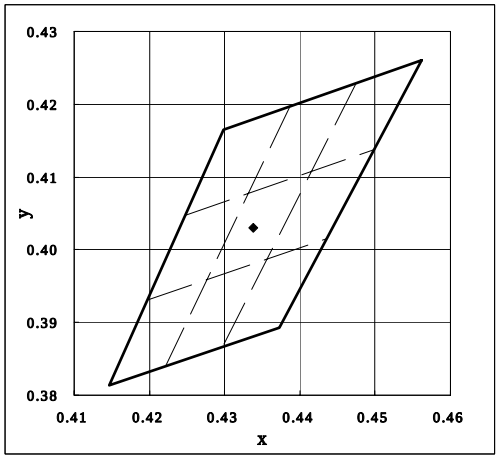
Citizen Electronics Co., Ltd (Head Office: Fujiyoshida City, Yamanashi Prefecture. President: Katsuhiko Noguchi. Paid-in capital: 1,988.55 million yen), a precision electronics manufacturer, achieves mass production of white LEDs for lighting with about one-ninth the conventional chromaticity range. Through use of “3-Step MacAdam ellipses” as a chromaticity control standard the necessary reduction in the variation in chromaticity is accomplished.

White LEDs are well-known in various fields such as for LCD TV’s backlights or lighting and they require strict color control of the chromaticity range, especially in white LEDs for general lighting. Usually, the products need to be ranked and sorted according to the requirements before shipment, as the color always varies even if the products are produced in the same lot.

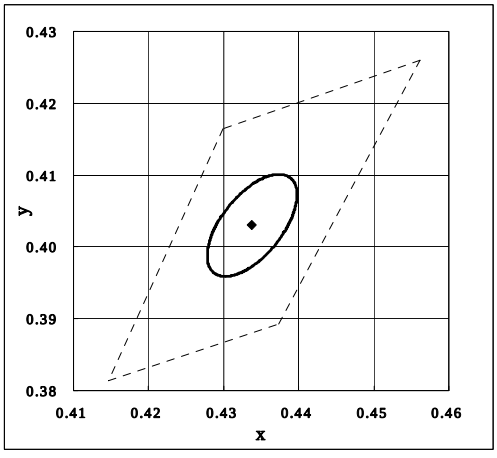
Since the chromaticity of a white LED is determined by a combination of many elements configuring the product such as a light-emitting device, phosphor, and encapsulation resin, a complicated process control is also needed to control those elements. We developed Surface Mount LED chips in 1983, and since then we have brought out a wide variety of products as a leading manufacturer of LED packages. Using basic studies and innovations of our accumulated high-precision processing technology and manufacturing technology has allowed us to finally achieve mass production with the chromaticity standard of about a ninth of the conventional chromaticity range (“3-Step MacAdam ellipses”) by controlling the deviation from specific chromaticity coordinates and “elaborating” the products.

This will enable us to stably produce and offer a white LED that has the least variation in chromaticity while keeping the production cost low by discontinuing the “sorting” process before shipment. We believe that at the destination sites it will be possible to use separate LED colors with high accuracy and that will help to produce quality lighting equipment. Citizen Electronics Co., Ltd will start color control using “3-Step MacAdam ellipses” at the mass production level, taking the initiative in the lighting industry.

Example of existing range reduction by “Sorting”



Example of new range reduction by “Elaborating”



Nowadays the use of white LEDs in general lighting is rapidly progressing. There is always a possibility that a great deal of interest will be focused on the LED's energy-saving performance based on its high luminous efficacy. However, we consider that it is very important to offer quality products stably with no variation in color as well as improving the luminous efficacy. Citizen Electronics Co., Ltd will continue to utilize the "CITIZEN" tradition of "Precision Engineering Technology", and advance the development of high-quality LED products as light sources for general lighting.

*1 "ANSI C78.377" is a chromaticity control standard provided by American Standards Institute (ANSI).

*2 "MacAdam ellipses" is a standard derived by *David Lewis MacAdam* from visual color-matching experiments and shows the standard deviation of the color discrimination variations from a specific center color on the xy chromaticity diagram.
The standard deviation shown with the "MacAdam ellipses" does not indicate a color difference distinguishable by the average human eye, but in another experiment *MacAdam* found that the color discrimination threshold is about three times (3-Step) the standard deviation.
[Reference] Ohta Noboru: Color Engineering(The 2nd edition), Tokyo Denki University Press

■LED packages and the color temperature incorporating "3-Step MacAdam ellipses"
- CL-L103 Series: 4000K, 3500K, 3000K, 2700K
- CL-L251 Series: 4000K, 3500K, 3000K, 2700K
- CL-L233 Series: 4000K, 3500K, 3000K, 2700K

*The corresponding LED packages and color temperatures will be improved sequentially.
*Sample availability: April, 2010
*Start of mass production: June, 2010

A product demonstration will be held during "Light+Building 2010" in Frankfurt am Main from April 11 to 16, 2010 and "LightFair International 2010" at Las Vegas Convention Center LVCC from May 12 to 14, 2010.

Press Contact:

North America area ---------- Dave Lomas, +1-847-619-6700
Europe area ---------- Atsuro Ijichi, +49-69-2992-4810
Asia area ---------- Eric Au-Yeung, +852-2793-0613
Dale Zhu, +86-21-6295-5510
South East Asia / India area ---- Irving Wong, +65-6334-9326
Other areas ---------- inquiry@ce.citizen.co.jp