

Benchmarking High-Power LEDs: A Life Test



For any fixture and lamp, life is an issue. How long will a lamp continue to shine? At what point is its quality and quantity of light output no longer acceptable? Although high-power LEDs generally perform better than previous types, each type and color of LED may perform differently. The LRC is learning more about how LED characteristics change over time.

Experiment

LRC researchers conducted life tests of high-power LEDs to investigate their change in light output and color over time. Five types—red, green, blue, single-chip white, and multi-chip white—were mounted in specially designed life-test chambers and operated for 10,000 hours at combinations of two drive currents and two ambient temperatures. Researchers estimated the LED junction temperature, a known predictor of LED life.

Results

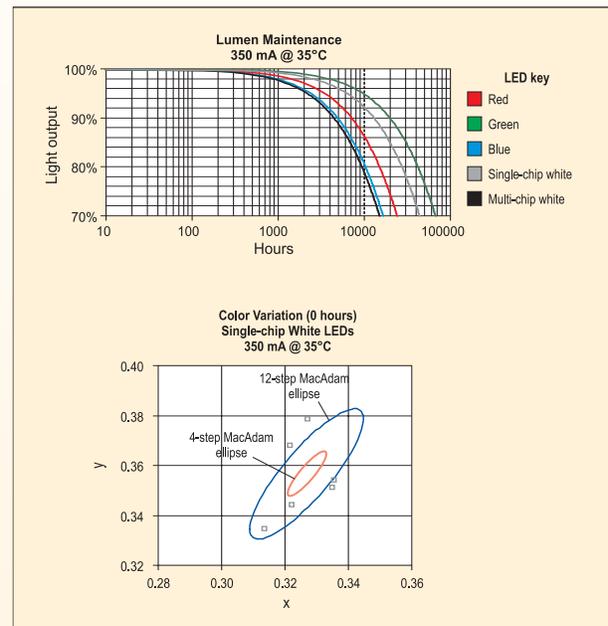
The LEDs degraded at different rates under similar operating conditions.

- Green and single-chip white LEDs degraded slowly, even under increased drive current and ambient temperature.
- The blue and multi-chip white LEDs showed the highest rates of degradation.
- Data extrapolation indicates that the single-chip white LED will maintain 70% of its initial light output at 45,000 hours.
- The individual white LEDs on each array exhibited large color variations from the beginning. However, their color shift over time was quite small.

In general, the degradation rate increases with higher junction temperatures. However, the relationship between junction temperature and degradation rate is still unknown.

Ongoing studies

LRC researchers are testing additional high-flux LEDs from several manufacturers. Preliminary results indicate significant performance variations among the different manufacturers' products. Researchers are also developing alternate life prediction methods to avoid long-term life testing.



Top: Actual (to 10,000 hours) and estimated (beyond 10,000 hours) light output change over time. The trend lines indicate approximately when each LED will reach 70% of initial light output. Bottom: Initial color variation between each white LED in one single-chip LED array.

Sponsors

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