

Intisari

Pada awal bulan Januari 2016, di ruang kelas E6 dilakukan penggantian lampu TL konvensional menjadi lampu LED T8 18W Opble. Meskipun lampu LED tabung dapat beroperasi tanpa *ballast*, penggantian dilakukan tanpa melepas *ballast* elektromagnetik (EM) yang sudah ada untuk mempermudah pemasangan. Selain lampu LED T8 18W Opble, terdapat pilihan lain yaitu lampu LED T8 18W Fokus. Untuk itu, penelitian ini bertujuan untuk mengetahui perbedaan lampu LED dengan dan tanpa *ballast* EM, perbandingan lampu LED T8 Opble dan lampu LED T8 Fokus, serta kinerja lampu LED T8 Opble sebagai pengganti lampu *fluorescent* T8 di ruang E6 DTETI FT UGM.

Prosedur-prosedur penelitian meliputi pengukuran dengan osiloskop dan penyimpanan datanya, pengukuran dengan Nanovip Plus dan penyimpanan datanya, serta pengukuran dengan luxmeter dan pencatatan datanya. Pengukuran dilakukan di Laboratorium Elektronika Dasar, *lighting panel* lantai 3 sayap selatan, dan ruang kelas E6 DTETI FT UGM. Hasil-hasil pengukuran akan dibandingkan dengan pengukuran-pengukuran terdahulu.

Hasil pengukuran dan perhitungan menunjukkan bahwa penggunaan lampu LED T8 18W Opble dengan *ballast* EM menarik arus 15% lebih kecil dan memiliki faktor daya 16% lebih tinggi dibandingkan dengan lampu LED T8 18W Opble yang dipasang tanpa *ballast* EM. Selain itu, lampu LED T8 Opble yang dipasang dengan *ballast* EM memiliki kandungan harmonik 71,85% lebih rendah.

Meskipun selisih daya aktif keduanya sangat kecil, faktor daya LED T8 Opble lebih rendah 24,3% dibandingkan faktor daya LED T8 Fokus. Selain itu, LED T8 Opble memiliki persentase arus harmonik ke-3 terhadap fundamental yang lebih tinggi 53,7% dari yang dimiliki LED T8 Fokus.

Penggantian lampu *fluorescent* menjadi lampu LED di ruang E6 memangkas konsumsi daya aktif sebesar 447 W atau sekitar 20% dari keadaan sebelumnya pada fase R LP lantai 3 sayap selatan untuk kegiatan perkuliahan sehari-hari. Selain pengurangan daya aktif, terjadi peningkatan faktor daya sebesar 21,8%, tetapi diikuti dengan kenaikan distorsi harmonik arus sebesar 15%. Meskipun demikian, peningkatan faktor daya tersebut dirasa jauh lebih patut diapresiasi dibandingkan kenaikan distorsi harmonik arus yang terjadi.

Langkah untuk pengurangan harmonik beban penerangan tidak diperlukan karena THD_v pada panel penerangan masih jauh di bawah 8%. Percobaan untuk mengurangi injeksi harmonik arus dari beban penerangan E6 yang dilakukan menggunakan trafo *grounding zigzag* belum memberikan hasil yang diharapkan atau dalam kata lain distorsi harmonik arus belum berhasil dikendalikan, sedangkan filter pasif tidak realistis untuk diwujudkan.

Kata kunci : LED, *fluorescent*, *ballast*, daya, harmonik

Abstract

At the beginning of January 2016, E6 classroom's fluorescent tube lamps were replaced by LED T8 18W Opple. Although an LED tube lamp can be switched on without a ballast, the replacement was done without removing the electromagnetic (EM) ballasts which are already there to make the installation easier. Another option was the LED T8 18W Fokus lamp. Therefore, this research investigated the difference between an LED tube lamp operated with and without an EM ballast, the comparison of LED T8 Opple and LED T8 Fokus, and the performance of LED T8 Opple lamps as the replacement of fluorescent T8 lamps in E6 classroom of DTETI FT UGM.

Research procedures included measurements using oscilloscope and its data storage, measurements using Nanovip Plus and its data storage, and measurements using luxmeter and its data recording. Measurements were conducted in the Basic Electronic Laboratorium, the south wing 3rd floor lighting panel, and the E6 classroom of DTETI FT UGM. The measurement results are compared with the previous measurement results.

Measurement and calculation results showed that an LED T8 18W Opple lamp operated with an EM ballast drew 15% less current and had 16% higher power factor compared to those of an LED T8 18W Opple lamp operated without an EM ballast. Additionally, an LED T8 18W Opple lamp operated with an EM ballast have 71,85% less harmonic content.

Despite a slight difference in their watt consumption, LED T8 Opple power factor was 24,3% lower than that of LED T8 Fokus. The LED T8 Opple also had third harmonic percentage of fundamental current that was 53,7% higher than that of LED T8 Fokus.

The replacement of fluorescent lamps by LED lamps in E6 classroom cut the south wing 3rd floor lighting panel's R phase's watt consumption by 447 W, about 20% of the previous consumption, in lecture period. In addition to the watt reduction were the improvement of power factor by 21,8% and the increase in current harmonic distortion by 15%. Nevertheless, that improvement in power factor deserves much more appreciation than the increase in harmonic distortion.

Mitigation of lighting load's harmonic content are unnecessary because the current distortion of the lighting panel are still far below 8%. Experiments intended to mitigate harmonic current injection of E6 classroom's lighting loads using a zigzag grounding transformer didn't give the expected result or in other words the current harmonic hasn't been successfully controlled, whereas passive filter implementation is unrealistic.

Keywords : LED, fluorescent, ballast, power, harmonic