ANALISIS DAN IMPLEMENTASI PEMODELAN HARMONISA DENGAN METODE SUMBER ARUS HARMONIK DALAM PERANCANGAN FILTER PASIF LC LAMPU LED 21 WATT

TUGAS AKHIR

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Judul	Analisis dan Implementasi Pemodelan Harmonisa dengan Metode Sumber Arus Harmonik dalam Perancangan Filter Pasif LC Lampu LED 21 Watt	Restu Purwanto Wahyudi
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Abstrak

Lampu LED dipercaya dapat menghemat penggunaan energi listrik pada sektor penerangan. Berdasarkan survei dirjen EBTKE kementerian ESDM, Di Kota Medan Lampu LED paling banyak digunakan pada rentang 21-25 watt. Karena lampu LED tersusun atas komponen non-linear, maka penggunaan lampu LED dapat menyebabkan terbangkitnya harmonisa. Melalui pengukuran harmonisa lampu LED 21 watt dengan UNI-T UT283A, hasil menunjukkan bahwa lampu LED 21 watt membangkitkan harmonisa arus dengan jenis harmonisa ganjil dan nilai THD_I 163,21 %. Harmonisa dapat dikurangi dengan menggunakan filter. Jadi, untuk mereduksi harmonisa lampu tersebut dirancang filter pasif LC dengan prinsip *low-pass* filter. Perancangan filter dimulai dengan menghitung perkiraan nilai awal C dan L menggunakan serangkaian persamaan sehingga diperoleh nilai awal 0,3 µF dan 4,2 H. Selanjutnya filter dengan nilai L dan C tersebut diuji secara simulasi. Rangkaian simulasi dibuat melalui pemodelan harmonisa dengan metode sumber arus harmonik berdasarkan hasil pengukuran harmonisa lampu LED 21 watt pada aplikasi MATLAB *Simulink*. Rangkaian simulasi yang tersebut berfungsi dengan baik karena hasil simulasi menyerupai hasil pengukuran. Rangkaian simulasi dipasang filter pasif LC dengan nilai perkiraan awal C 0,3 µF dan L 4,8 H. Namun THD_I yang diperoleh masih tinggi yaitu 49,31 %. Untuk mendapatkan THD_I kecil dari 15%, maka dilakukan pergeseran nilai L dan C serta diuji kembali terhadap rangkaian simulasi. Hal berulang dilakukan sampai diperoleh THDI sesuai nilai yang ditetapkan. Setelah beberapa pergeseran didapatkan nilai C 1 µF dan nilai L 4,8 H dengan THD_I 11,16%. Nilai tersebut diujikan kepada lampu LED 21 watt dan diperoleh THD_I sebesar 6,9%. Penggunaan rangkaian pemodelan dalam merancang filter pasif LC ini sangat membatu karena dapat memperkirakan hasil pemfilteran serta menghemat biaya jika rancangan filter belum bekerja dengan baik. Secara simulasi, THD_I berubah dari 163,7% menjadi 11,16% dengan reduksi rata-rata orde ganjil sebesar 99,032%. Untuk pengujian secara praktik, nilai THD_I diturunkan dari 163,21% menjadi 6,9% serta nilai rata-rata reduksi orde ganjil sebesar 99,584%.

Kata kunci: harmonisa, pemodelan, filter pasif LC, reduksi.

Title	*Analysis and Implementation of Harmonic Modeling with the Harmonic Current Source Method in the Design of Passive Filters for 21 Watt LED Lamp*	Restu Purwanto Wahyudi
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Abstract

LED lamp are believed to save electricity usage in the lighting sector. Based on a survey by the Director General of EBTKE at the Ministry of Energy and Mineral Resource, in Medan City LED lamp are most widely used in the range of 21-25 watts. Because LED lamps are composed of non-linear components, the use of LED lamps can cause harmonic to arise. By measuring the harmonic of a 21 watt LED lamp with the UNI-T UT283A, the results show that the 21 watt LED lamp generates current harmonics with odd harmonic types and a THD_I value of 163,21%. Harmonics can be reduced by using filters. So, to reduce the harmonic of the lamp, a passive LC filter with a low-pass filter principle was designed. Filter design begins by calculating the initial values of C and L using a series of equations to obtain initial values of 0,3uF and 4,2H. Then the filters with L and C values are tested by simulation circuit was made through harmonic modeling using the harmonic current source method based on the harmonic measurement of a 21 watt LED lamp in the MATLAB Simulink application. This series of simulations works well because the simulation results resemble the measurement results. The simulation circuit was installed with a passive LC filter with an initial estimated value of C 0,3 μF and L 4,8 H. However, the THD_I obtained was still high, namely 49,31%. To get a THD_I of less than 15%, the C and L values ware shifted and tested again against the simulation circuit. This until the THD_I is obtained according to the set values. After several shift, the C value was 1uF and the L value was 4,8 H with a THD_I of 11,16%. This value was tested on a 21 watt LED lamp and a THD_I of 6,9% was obtained. The use of modeling series in designing passive LC filters is very helpful because it can predict filtering result and save costs if the filter design is not working properly. By simulation, THD_I changed from 163,7% to 11,16% with and average odd-order reduction of 99,032%. For practical testing, the THDI value was reduced from 163,21% to 6,88% and the average odd order reduction value was 99,584%.

Keywords:harmonics, modeling, LC Passive filter, reduction.