RANCANG BANGUN KOMPOR INDUKSI 48V DC *HALF-BRIDGE SERIES-RESONANT INVERTER* DENGAN *FREQUENCY-TRACKING* MENGGUNAKAN *FAST FOURIER TRANSFORM* BERBASIS ESP32

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ABSTRAK

Perubahan material dan diameter panci pada kompor induksi menyebabkan pergeseran parameter ekuivalen tangki resonansi. Pengoperasian inverter pada frekuensi tetap dalam kondisi tersebut dapat menurunkan efisiensi dan kinerja sistem pemanasan. Penelitian ini bertujuan untuk merancang kompor induksi 48V DC berbasis *Half-Bridge Series-Resonant Inverter* (HB-SRI) serta mengevaluasi penerapan metode *frequency-tracking* menggunakan algoritma *Fast Fourier Transform* (FFT) pada mikrokontroler ESP32. Estimasi frekuensi resonansi dilakukan secara *one-shot* dengan menganalisis komponen harmonisa pertama dan ketiga dari arus resonansi. Pengujian kinerja dilakukan dengan membandingkan mode *non-tracking* pada frekuensi tetap 20,55 kHz dengan mode *FFT tracking*. Beban yang digunakan meliputi panci berbahan *stainless steel* dan *carbon steel* dengan variasi diameter 16 cm dan 18 cm. Hasil pengujian menunjukkan bahwa sistem mampu mengestimasi frekuensi pada rentang 22,93–26,34 kHz dengan penyebaran data yang kecil, ditunjukkan oleh standar deviasi sebesar 0,13–0,71 kHz dan *Relative Standard Deviation* 0,51–2,82%. Efisiensi pemanasan air tertinggi tercapai pada panci *stainless steel* 16 cm sebesar 77,05%. Kesimpulannya, penerapan *frequency-tracking one-shot* berbasis FFT terbukti efektif menyesuaikan frekuensi operasi terhadap karakteristik beban, sehingga mampu meningkatkan efisiensi dan kinerja pemanasan dibandingkan operasi frekuensi tetap.

Kata Kunci: Kompor Induksi, *Half-Bridge Series-Resonant Inverter*, *Fast Fourier Transform*, *frequency tracking.*

DESIGN AND DEVELOPMENT OF A 48V DC HALF-BRIDGE SERIES-RESONANT INVERTER INDUCTION STOVE WITH FREQUENCY-TRACKING USING A FAST FOURIER TRANSFORM BASED ON ESP32

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ABSTRACT

Variations in cookware material and diameter cause shifts in the equivalent parameters of the resonant tank in induction cookers. Operating the inverter at a fixed frequency under these conditions can reduce heating efficiency and overall system performance. This study aims to design a 48V DC induction cooker based on a Half-Bridge Series-Resonant Inverter (HB-SRI) and evaluate the application of a frequency-tracking method using the Fast Fourier Transform (FFT) algorithm on an ESP32 microcontroller. Resonant frequency estimation was performed via a one-shot procedure by analyzing the first and third harmonic components of the resonant current. Performance testing compared a non-tracking mode at a fixed frequency of 20.55 kHz with the FFT-tracking mode. The applied loads included stainless-steel and carbon-steel pans with diameters of 16 cm and 18 cm. The experimental results showed that the estimated frequencies ranged from 22.93 to 26.34 kHz with a low data spread, indicated by standard deviations of 0.13–0.71 kHz and Relative Standard Deviation values of 0.51–2.82%. The highest water-heating efficiency reached 77.05% using the 16 cm stainless-steel pan. In conclusion, the implementation of FFT-based one-shot frequency-tracking effectively adjusts the operating frequency to match load characteristics, thereby significantly improving heating efficiency and performance compared to fixed-frequency operation.

Keywords: Induction Cooker, Half-Bridge Series-Resonant Inverter, Fast Fourier Transform, frequency tracking.