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PROGRAM STUDI	:	Teknik Elektro
JUDUL ARTIKEL	:	**Standalone Single Phase DC-AC Inverter with FPGA-based Pulse Modulated Generator Unit. International Seminar on Intelligent Technology and Its Applications (ISITIA) 2020**
No. HP	:	**081342117772**

2020 International Seminar on Intelligent Technology and Its Applications (ISITIA)

Standalone Single Phase DC-AC Inverter with FPGA-based Pulse Modulated Generator Unit

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***Abstract*— This paper presents the design of a pulse modulation signal generator using a Field Programmable Gate Array (FPGA) to control the power switch devices used in an inverter that are arranged in full bridge configuration. A single-phase inverter is designed for stand-alone operation mode in renewable energy-based power supply system. FPGA is an electronic device that works digitally and has the advantage of being able to work at high frequency and high concurrent computing capability. The modulated pulse signal is generated by comparing a sinusoidal wave and triangular wave generated digitally using the Look-Up Table (LUT) method to retrieve an amount of voltage data at some points of sampling. The data obtained is then stored in the FPGA internal memory. To test the hardware, an LC filters are used to reduce harmonic caused by the switching process and produce pure sinusoidal output quality. System validation is made using two methods, i.e. SPICE simulation and testing on the real inverter unit. Total harmonic distortion (THD) of the inverter hardware is measured and analyzed.**

Keywords—Power Electronic, Single Phase Inverter, FPGA, LC Filter, SPWM, Look Up Table (LUT).

Some research works have been done to improve the inverter performance including reducing design cost by miniaturizing the inverter's components and module size. Increasing switching frequency can reduce the module and component sizes including the power filter components and can improve also the efficiency [2, 3, 4, 5]. However, switching frequency increase must comply with the specification of the power semiconductor devices. This should be made to avoid switching loses and to improve the aging condition of the power devices.

There are many techniques to generate AC inverting output signal of the inverter. One of them is a sinusoidal-based pulse width modulation (SPWM) technique, which is applied to power switching device, mostly a MOSFET device. The SPWM control signal is generated by comparing two periodic signals, i.e. a saw tooth signal having fixed frequency called modulating or carrier frequency and a sinusoidal having fixed frequency equal to grid frequency. In general, the modulating frequency is set higher or much higher than the grid frequency. The SPWM control signal can also generated using other techniques such as a pre-sampling time for the on-time (T_{on}) and off-time (T_{off}) of the SPWM