# UNIVERSITY OF CENTRAL FLORIDA

## *PV Energy Conversion and System Integration*


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**Description:** The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package.
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**Budget:** $1,267,000

**Universities:** UCF

## Progress Summary

- **Advanced Digital Control Algorithms**

*a. Pulse skipping control strategy development*

To verify the performance of the previously developed pulse skipping techniques, an experimental setup was built and the performance of the 200W micro-inverter was measured using the maximum efficiency criteria developed earlier. The experimental results (Fig. 1) match the predicted calculation fairly accurately, where the inverter efficiency is greatly improved to above 90% even at light loads resulting in an overall CEC (weighted) efficiency improvement of 0.5%.

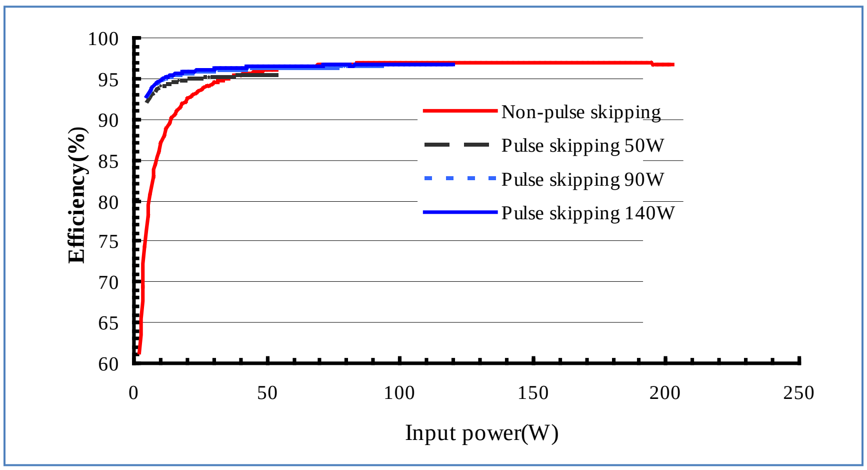


**Fig. 1: Efficiency improvement using pulse skipping**

*2) Adaptive PV Sun Tracking System*

An experimental setup is being built to verify the mathematical model that has been developed. The experimental setup utilizes a dsPICDEM MCSM development board, 12V 85W solar panel, and a 6V 2A 361 oz-in stepper motor. Over the peats few months, the effort was focused on spent pn testing the developed sun tracking algorithm on the 16 bit dsPIC33FJ32MC204 Digital Signal Controller, constructing the frame and mounts for the solar panel, and developing motor control code for the 6V 2A 361 oz-in stepper motor. Presently, the team is involved in designing the power measurement sensor board containing the voltage and current sensors.

- **SmartTie Interface with the Utility Grid**

A novel control strategy that enables PV inverters to absorb little active power from the grid when the renewable source (e.g. the sun) is not available to compensate for the inverters' internal losses, regulate the DC bus voltage to keep it within limits, and operate the inverters in VAR mode wa s developed. This will extend the utilization of PV inverters beyond active power generation and will help improving grid stability and voltage regulation. Detailed simulation and experimental measurements were conducted to verify the proposed scheme (experimenntal results during VAR mode operation are shown in Fig. 2).

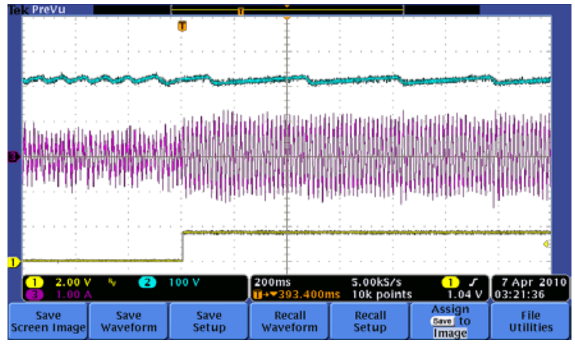

Fig. 2: VAR mode operation (No Sun)

- **Ultra Compact PV Inverter Packaging**

*Thermal Design and Optimization*

An optimal heat sink design, based on the optimization design process developed earlier, was built and tested. A micro inverter power board was assembled using the optimized heatsink and the thermal performance of the inverter and the heat sink was measured. The measurements show that the averaged temperature of current design is merely 2.3 $^{o}$C higher than the previous design (Fig. 3). Note that the heat sink of the optimal design is more than 55% lighter and smaller than the original design.

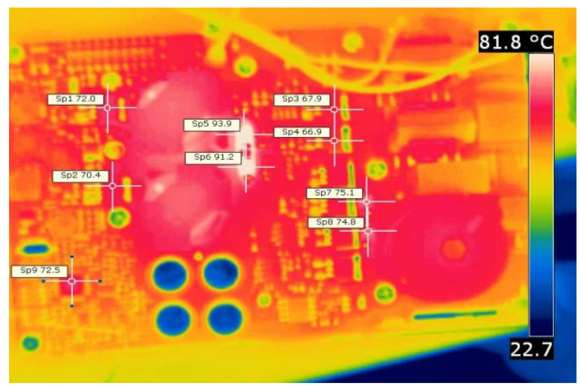

Fig. 3: Thermal performance with optimal heat sink design