



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

Name(s) Weston D. Braun	Project Number S0904
Project Title FPGA-Based Digital Controller for High Frequency Induction Heating	
Abstract Objectives/Goals The goal of this project was to design a prototype induction heating system utilizing a digital control loop implemented on a FPGA. This would replace the analog phase-locked loop conventionally used to control induction heaters, which must be reconfigured when the induction heating work coil or load is changed and require retuning for each specific system. Methods/Materials Signal acquisition hardware and power electronics were built to work in conjunction with a Nexys-2 FPGA development board running Verilog code. The primary components of the induction heater developed were the power electronics, which perform the actual duty of induction heating, the digital control loop, which generates drive signals and regulates the power output, and the data acquisition system, which is responsible for converting analog signals from the induction heater into a digital representation. Results The digital control loop developed for this project was tested and demonstrated to be capable of tracking the maximum power point of the induction heater while adapting to variations in loading of the work coil. The functionality of the overcurrent protection system was verified and the heating efficiency of the all-digital controlled induction heater averaged 72%, which is comparable to current analog-based controlled induction heaters. Conclusions/Discussion This project has successfully demonstrated the feasibility of an all-digital FPGA-based controller for high frequency induction heaters. The digital controller developed presents a promising alternative to the analog controllers currently used for induction heating.	
Summary Statement An induction heating system under the control of an all-digital control loop which was implemented on a FPGA was designed, constructed, and evaluated.	
Help Received Used equipment in high school metal shop to construct parts for project.	