

Michigan State University
ECE 480 – Senior Design
Design Team 6
3 February 2011

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**MSP430-F1612, MSP430-F5437 AND THE STELLARIS-
LM3S9B95 BRUSHED-DC-MOTOR CONTROL CARDS FOR THE
DRV8824 MOTOR DRIVER**

EXECUTIVE SUMMARY

Texas Instruments has developed an evaluation module for their newest motor driver the DRV8824. This evaluation module comes with a MSP430F1612 on board to control the motor driver. The MSP430 uses two pulse-width modulation (PWM) signals to control the motors speed.

The problem that faces Texas Instruments here is that the customers can only use this brand new motor driver with code written for just the microcontroller that is on the DRV8824 evaluation module. Texas Instruments would Ideally like to have an evaluation module that could drive motors with many different microcontrollers.

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1. Introduction

The electric motor has been around since the early 1800's, and it is still a very important piece of equipment today. Electric motors are used in many devices today, including cars, air conditioners and microwaves. There are also many types of electric motors, including brushed, brushless and stepper DC motors. Each type of motor can be used in many different applications, and each motor must be controlled in some way.

Texas Instruments (TI) is a company that offers many ways to control electric motors. The DRV8824 is one such control device. The DRV8824 is a pulse width modulation (PWM) micro-stepping motor driver. TI wants to make this card modular, by allowing different microcontrollers to be connected to DRV8824 with minimal effort. This will allow TI's customers to use their preferred microcontroller, and also TI will not have to create a separate DRV for each microcontroller. TI plans to have each type of microcontroller on a dual in-line memory module (DIMM) card, and then the DIMM card will interface to the DRV board.

Last semester's design team integrated a MSP430 on to a DIMM card. A MSP430 is a 16-bit microcontroller. They also programmed and created an interface it to control the electric motor. Design Team 6 (DT6) will expand on this project. DT6 is tasked with both software and hardware designs. On the hardware side DT6 must remove the MSP430 from the DRV8824 and integrate it on a DIMM card. They must also attach a DIMM card slot to the board. On the software side, DT6 must write code for controlling the stepper motor. TI has also provided a DIMM card with a Cortex M3 already in place, so DT6 must port the code from the MSP430 DIMM card to the M3. On top of this, last semester's MSP430 DIMM card should work with the DRV8824.

On completion of these tasks TI will have 3 DIMM cards. One will be the MSP430 DIMM that was created last semester, one will be the MSP430 created this semester, and the Cortex M3 DIMM. These cards will all be able to control the electric stepper motor by interfacing with the DRV8824 through the DIMM card slot.

2. Design Specifications

Texas Instruments has provided several design specifications for a modular approach to control of a stepper motor evaluation module. The modularity of the design will originate from the ability to interchangeably use multiple microcontrollers, the MSP430 and the Stellaris M3 Cortex, to control a stepper motor. The final design will contain the following:

- An analog based DRV8824 EVM with a dual in-line memory module, DIMM, socket
- A DIMM card supplied by fall semester 2010 containing the MSP430 F5437 microcontroller and USB interface.
- A DIMM card redesigned with the MSP430 F1612 microcontroller and USB interface.
- A DIMM card supplied by Texas Instruments containing the Stellaris M3 Cortex microcontroller.
- The same software running on the MSP430 microcontroller will run on the M3 Cortex after being ported to support the different architecture.
- A windows application containing sections to control each of the available microcontroller DIMM cards.

3. Proposed Design

The proposed solution encompasses the hardware redesign of the DRV8824 evaluation board, testing and verification of the last semesters MSP430F5437 DIMM control card, and the design of this semesters MSP430F1612 DIMM control card. In addition, software to control the motor will need to be ported to the MSP430F5437 and Stellaris M3 DIMM cards. The hardware redesign consists of removing the digital section of the DRV8824EVM and replacing it with a DIMM slot. To achieve this, the pin outs of the MSP430F5347 control card and M3 Cortex card will be carefully studied in order to design a functional MSP430F1612 control card. There are three major steps for accomplishing our project.

- Removal of the MSP430F1612 and definition of DIMM ports

The DRV8824EVM has a MSP430 microcontroller on board that will be removed. There will then be input and output wires that need to be connected to a DIMM slot. The DIMM ports will be ported based on the pins that the MSP430F5437 and Stellaris control cards can both control the motor driver.

- Design of MSP430F1612 Control Card

Once the definition of the DIMM ports is selected then the design of the MSP430F1612 control card can take place. The code will be the same that the DRV8824EVM comes stock with, but the control card will be a removable extension of the DRV8824EVM.

- Coding of the Stellaris Control Card

Since the Stellaris has never been programmed to work with the DRV8824 motor driver before, the code from the MSP430F1612 will be ported to the Stellaris control card.

4. Project Management

Our team is tasked with designing a DIMM100 card using the MSP430-F1612, redesigning the DRV8824EVM, coding the Stellaris-LM3S9B95, and connecting last year's DIMM to our evaluation module. Our team consists of Leslie Thomas, Patrick O'Hara, Thomas Volinski, and Kole Reece. The following tables break down both the technical and non-technical roles performed by each team member:

Team Member	Technical Role	Focus
Leslie Thomas	Software/hardware development	Stellaris
Patrick O'Hara	Software/hardware development	DRV8824EVM
Thomas Volinski	Software/hardware development	MSP430-F1612
Kole Reece	Software/hardware development	MSP430-F5437

Team Member	Non-technical Role
Leslie Thomas	Manager
Patrick O'Hara	Document Prep
Thomas Volinski	Presentation Prep
Kole Reece	Website